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SUMMARY REPORT

THE LOS ANGELES TO LONG BEACH LIGHT RAIL PROJECT AND
EVALUATION OF OTHER RAPID TRANSIT OPPORTUNITIES STUDY

FEBRUARY 1982

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LIGHT RAIL PROJECT
AND
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EXECUTIVE OVERVIEW

This study served to advance the planning for a light rail transit (LRT) in the Los Angeles - Long Beach Corridor and to carry out a comparative evaluation of the possible use of other transit mode technologies — automated guideway transit (AGT) and cable-suspended transit (CST) — and/or five other possible transportation corridors in Los Angeles County (No. 4: Exposition Blvd; No. 5: Santa Monica Blvd.; No. 8: San Fernando Valley; No. 11: Union Station - LAX; and No. 13: Firestone Blvd.).

The investigation carried out within the time and resources available for this study indicate that no insurmountable engineering/construction problems exist with respect to any of the three transit modes or six corridors under consideration. The problem areas which were identified are of the kinds normally associated with projects of this type and should be amenable to conventional engineering solutions. Suitable provisions have been included in the study's cost estimates and reflected in other elements of this report.

It is estimated that LRT in the Los Angeles - Long Beach Corridor would attract almost 6.5 million riders a year (21,000 on a typical weekday; 2,600 in the peak direction during the peak hour). The AGT and CST modes, being fully grade separated, would attract even more riders; 7.2 million and 7.1 million annually, respectively. Ridership in the other corridors would range from a low of 5.3 million for No. 5 Santa Monica Blvd. to a high of 6.8 million in No. 11: Union Station - LAX.

LRT fleet size requirements would range from 8 vehicles for Corridor No. 5: Santa Monica Blvd. to 33 cars for No. 1: Los Angeles - Long Beach. AGT operation in Corridor 1 would require 48 vehicles and CST operation 42 vehicles. Operating speeds for at-grade LRT service were estimated to vary between 20.1 mph and 29.1, while speeds of 27.0 for AGT and 26.6 for CST are anticipated. Trains would run as frequently as every 5-6 minutes for AGT and CST and about every 15 minutes for LRT during peak periods.

The annual operating costs range from about \$3.5 million for LRT in Corridor No. 5: Santa Monica Blvd. to almost \$7.5 million for CST in No. 1: Los Angeles - Long Beach. Depending upon what fare policies are selected, required annual operating subsidies could extend from \$0.21 per passenger (LRT in Corridor No. 4: Exposition Blvd.) to \$0.59 (LRT in Corridor No. 8: San Fernando Valley).

A varying amount of interference with railroad and traffic operations can be expected; least with long-span CST and most with at-grade LRT. The exact nature and amount of interference — as well as the best means for dealing with it — can only be determined after more detailed railroad operating and traffic volume data is obtained and further analysis carried out. Based on currently available information, suitable physical, traffic engineering and transit operating provisions have been incorporated into this study which should permit safe and reasonably efficient transit, railroad and vehicular operations in each corridor.

The environmental impact analysis found a number of areas requiring sensitive design treatments and the use of mitigating measures (such as noise barriers, for example), but there do not appear to be any insurmountable environmental problems (or unique opportunities) associated with any of the travel corridors. It was also found that in general, the CST system was preferable from the environmental viewpoint except for drawbacks associated with stations on aerial structures.

Six possible route alternatives were examined in the central area of Los Angeles and three in downtown Long Beach. Although more detailed studies would be required before a final selection can be made, a one-way couplet along Broadway and Main/Spring Streets in Los Angeles and along Atlantic Avenue and Long Beach Blvd. in Long Beach was selected for

the purposes of this study. These routings are believed to be acceptable in terms of transit service, impact on vehicular circulation, environmental considerations and cost considerations.

Capital cost estimates for the various alternatives are shown in Table S-1 below:

TABLE S-1
CAPITAL COST ESTIMATES

| Corridor | Total Capital Costs (Millions of Dollars) | |
|---|---|-------------------------|
| | January 1982 Cost | Range of Escalated Cost |
| 1. Los Angeles - Long Beach (LRT) | 194 | 254 - 280 |
| 1. Los Angeles - Long Beach (AGT) | 591 | 804 - 897 |
| 1. Los Angeles - Long Beach (CST) | 466 | 644 - 722 |
| 4. Exposition Boulevard | 130 | 170 - 187 |
| 5. Santa Monica Blvd. | 182* | 238 - 262 |
| 8. San Fernando Valley - Los Angeles | 385 | 504 - 584 |
| 11. Union Station - LAX | 399 | 551 - 618 |
| 13. Firestone Boulevard | 195 | 255 - 281 |

* Includes an allowance of \$69 million for right-of-way, which may be high. Also includes connection to Metro rail line and an estimated \$20 million for a street couplet in Santa Monica.

Two tables in the body of this report (Table 7: COST-EFFECTIVENESS ANALYSIS and Table 8: EVALUATION MATRIX TRADE-OFF ANALYSIS) summarize the major results needed for each decision-maker to weigh the advantages and disadvantages of the alternative corridors and transit mode technologies under consideration. These tables include both quantitative and qualitative assessments of how well each alternative helps meet LACTC's transit-related goals and objectives.

An overview of the information contained in Tables 7 and 8 indicates that none of the other corridors considered demonstrates a clear superiority overall in comparison to Corridor No. 1: Los Angeles - Long Beach. At most, it might be said that Corridors No. 4: Exposition Blvd. and Corridor 13: Firestone Blvd. have combinations of advantages and disadvantages which are about equal to those found for Corridor No. 1.

With respect to transit technology, at-grade LRT was found to offer major cost advantages vis-a-vis AGT and CST; not only in terms of total capital and operating costs, but also in terms of annualized cost per passenger carried and annual subsidy required per passenger. Selection of AGT or CST rather than LRT in the face of these cost differences would be warranted only if very great importance was attached to those areas shown in Table 8 where AGT or CST are shown as performing better than LRT and if relatively little importance were assigned to those areas in Table 8 where (in addition to cost) LRT was ranked higher than CST or AGT.

INTRODUCTION AND BACKGROUND

The Los Angeles to Long Beach Light Rail Project and Evaluation of Other Rapid Transit Opportunities Study was carried out for the Los Angeles County Transportation Commission (LACTC) by the consulting engineering, architectural and planning firm of Parsons Brinckerhoff Quade & Douglas, Inc. in association with Kaiser Engineers. The two basic reasons for undertaking this four-month project were:

- o to refine and further develop the findings of the Long Beach to Los Angeles Light Rail Transit Feasibility Study prepared by the California Department of Transportation (Caltrans) District 07 - Public Transportation Branch in October 1981; and
- o to investigate transit opportunities throughout Los Angeles County and evaluate the potential of other modes of public transportation and/or other transit corridors vis-a-vis light rail transit in the Los Angeles- Long Beach Corridor.

In carrying out the study, extensive use was made of existing information and results from earlier preliminary work in Los Angeles to supplement the limited resources available for this project. Information, assistance and reviews were provided by a number of agencies and individuals and the major participants in this cooperative effort are listed in the Appendix of this report. In addition to the use of already available data, reasonable assumptions based on experience with similar projects elsewhere and the application of professional judgement were also utilized to round out the analytical work that was possible within the study's budgeting and time constraints.

It is believed the the resultant findings and conclusions presented here, while not the products of a rigorous fully-developed physical, operational and financial feasibility study, do constitute a structured, unbiased and comprehensive analysis and evaluation. As such, they provide a sound basis for informed decision-making consistent with the LACTC needs at this point in time.

METHODOLOGY AND APPROACH

Los Angeles - Long Beach Corridor

The refinement and development of the previous proposal for light rail transit in the Los Angeles - Long Beach corridor involved: seeking additional data on railroad facilities and operations from the Southern Pacific Transportation Company (SPTC) and by field inspections; collection of other data from a variety of sources; field investigations along the entire route carried out by a multi-disciplinary team of engineers, planners and environmental specialists; defining and assessing not only a "baseline" light rail project but a number of possible variations and options as well; and definition of possible transit routes in the Los Angeles and Long Beach Central Business Districts.

In order to provide a basis for selecting a preferred transit system configuration, the study developed additional information on potential patronage, possible railroad and traffic operational conflicts, environmental problems and opportunities, and total estimated capital and operating costs. These current cost estimates include areas (such as agency administrative costs and the expected effect on costs of inflation over the duration of the construction period, for example) which were not explicitly dealt with in the previous Caltrans study. Further, this study developed cost-effectiveness indicators to assist in deciding which light rail transit system options and alternatives, if any, should be selected.

Other Transit Opportunities

In addition to consideration of light rail transit in the Los Angeles - Long Beach Corridor, this study also assessed the potential for early implementation of fixed guideway transit in a number of other corridors throughout Los Angeles County. Further, it also assessed the relative advantages and disadvantages of two other transit technologies — automated guideway transit (AGT) and cable-suspended transit (CST) — in addition to the light rail mode.

Experience with urban transportation facilities in Los Angeles and other regions have clearly shown that a broad rather than narrow viewpoint must be adopted in evaluating and assessing potential projects. Intangible qualitative factors (such as aesthetics) as well as tangible quantitative items (such as construction costs) are important. Not only the needs of transit system users and operators must be considered, but those of travellers on adjacent facilities, the local neighborhoods directly adjacent to any proposed improvement and the needs of the community at large must enter into project evaluation and decision-making. Consequently, the work program for this study featured a comprehensive approach involving such areas as: potential ridership; impacts on the existing bus system, railroad operations and street traffic; neighborhood disruptions; influence on land use and regional development patterns; impacts on noise levels, air quality and petroleum-based energy consumption; capital and operating costs; and operating subsidy requirements. The breadth of the study's scope can be seen by the variety of Technical Working Papers produced. These are listed in the Appendix to this report.

Comparative Evaluation

Since a number of alternatives exist both with respect to light rail transit characteristics within the Los Angeles - Long Beach Corridor and with respect to other transit modes and/or other corridors within Los Angeles County, a procedure was developed for carrying out a systematic and internally consistent comparative evaluation of alternative transit options.

In brief, the procedure involved establishing agreed-upon goals and objectives and then using selected criteria to assess how well each option or alternative helps achieve these goals and objectives. Since it is seldom, if ever, that one option always performs best for all criteria, a means was established for making trade-off decisions based on comparing

the advantages and disadvantages of each alternative and selecting the one to be preferred on balance when all relevant factors are considered.

It was recognized from the outset that each decision-maker may believe different aspects of evaluation to be more important. One might feel that attracting the most riders is paramount while another thinks that protecting the environment is most important and a third may consider that a minimum cost solution is essential. Consequently, it was agreed with LACTC staff that the study's Consultant Team would not produce specific recommendations. Rather, a summary of the results of this study are presented subsequently in this report which displays how each of the alternatives performed both quantitatively and qualitatively.

Using these summary tables (or the more extensive material to be found in this study's Technical Working Papers), members of the Los Angeles County Transportation Commission and other decision-makers can exercise their individual value judgements in trading off these performance results and select what they believe to be the preferred alternative overall.

LOS ANGELES - LONG BEACH CORRIDOR

Engineering/Construction Considerations

An important study work element dealt with an evaluation of the constructability of three transit modes — light rail transit (LRT), automated guideway transit (AGT) and cable-suspended transit (CST) — in Study Corridor No. 1: Los Angeles - Long Beach. The line was subdivided into 7 analysis segments; 2 in the Los Angeles Central Area, 1 in Long Beach and 4 within the trunk segment between those two cities. Segments were defined either on the basis of uniformity of construction conditions or to provide flexible "building blocks" permitting subsequent aggregation of cost estimates in a variety of ways.

The investigation carried out within the scope of this study indicates that no insurmountable construction problems exist with respect to any of the three transit modes under consideration. Where problems exist, these were noted and allowances for overcoming them included in the segment's associated construction cost estimates. The problems found are believed to be of the types normally encountered in projects of this kind and should be amenable to conventional engineering solutions.

In order to provide a complete basis for cost estimating and other subsequent study tasks, the engineering study element also developed assumptions reflecting local characteristics and needs concerning all major transit system components. These included: transit vehicles; storage and maintenance facilities; electrification/propulsion systems; signals, train control and communications systems; passenger stations (at grade or on aerial structures when appropriate); fare collection system; automobile parking and bus transfer facilities; security/crime prevention; landscaping, noise barriers and miscellaneous.

Potential Ridership

It was not possible within the study's constraints to develop transit patronage estimates using a conventional travel forecasting and computer-oriented modelling process. Instead, an alternative approach was adopted which features the judicious use of available existing data, experience from comparable transit operations elsewhere, and the study team's professional judgement and knowledge of the project corridor.

In brief, the procedure featured: a review of previous forecasts developed by Caltrans, SCRTD, SCAG and others; inspection of field conditions, demographic and land use characteristics along the corridor; corridor highway capacity deficiencies as estimated by SCAG; current ridership on existing parallel or nearby bus routes; and other circumstances. The major results are summarized in Table 1 below for LRT.

Table 1
LRT TRANSIT RIDERSHIP: LOS ANGELES - LONG BEACH

| <u>Item</u> | <u>Current Estimate</u> | <u>Caltrans 1981 Estimate</u> |
|---------------------------|-------------------------|-------------------------------|
| Total Annual Patronage | 6,426,000 | 4,700,000 |
| Typical Workday | | |
| Daily Total | 21,000 | 15,000 |
| Peak Hour, Peak Direction | 2,600 | 2,500 |

The LRT ridership potential was then projected to the year 2,000 level based on two different growth rates; 2% and 5% annual growth (compounded). This resulted in an estimated range of 30,600 to 53,000 for that future year.

For comparative purposes, it might be noted that the daily passengers projected for the San Diego - San Ysidro LRT line in 1981 are 11,500 and the expected range for 1995 is 28,000 - 30,000 daily passengers. Comparisons were also made with ridership estimates for other cities. It was concluded that the results for the Los Angeles - Long Beach Corridor appear to be reasonably consistent with other cities, given their different circumstances.

With respect to the patronage likely to be attracted to AGT or CST systems in the Los Angeles - Long Beach Corridor, estimates were prepared which reflect the higher operating speeds expected to be associated with both of these fully grade-separated modes. It should be noted, in passing, that if the LRT mode were also to be implemented on a wholly dedicated, independent right-of-way, it too would operate at a higher speed and attract more users. This study concluded that about 23,500 daily riders (7.191 million annually) would use an AGT line in the corridor. The CST system, expected to operate at

a slightly lower speed, would attract approximately 23,100 patrons on a typical workday, for an annual ridership of 7.069 million.

Possible Railroad Interference

This portion of the study was limited by a lack of current, detailed information on railroad operations in the corridor. The operating data requested on several occasions from the Southern Pacific Transportation Company (SPTC) has not been received to date. Consequently, it was necessary to rely on the material contained in the 1981 Caltrans report and on inferences derived from field observations.

It will be recalled that the proposal contained in the 1981 Caltrans report anticipates joint use of some track segments by both railroad freight trains and light rail transit vehicles. No firm assurances have been given that the consultant team is aware of that joint usage of track would be acceptable to the railroad. A review of current and proposed LRT lines in railroad corridors throughout the United States was made and led to the conclusions that — with the apparent number and kinds of railroad operations which can be anticipated here — it may be extremely difficult to arrive at a mutually acceptable joint operating agreement with the railroad and its users except for some limited sections such as the Los Angeles River Crossing. Consequently, alternative approaches have been developed as a part of this study which would reduce the amount of potential interference implied in the 1981 Caltrans proposal.

This study's LRT "Baseline" system consists of a single track with passing sidings provided at a spacing of about 1.5 miles and generally located at passenger stations. The LRT track would not be jointly used with SPTC trains except on the existing single-track railroad bridge across the Los Angeles River. This would help minimize, but not eliminate, railroad interference.

Short-term railroad conflicts can be expected from such construction activities as railroad track relocations needed to provide space for the Baseline LRT track and implementation of LRT/railroad grade crossings and turnouts. Long-term railroad conflicts resulting from operation of the Baseline LRT system would involve the following railroad companies and facilities:

- o SPTC Railroad Lines and Spur Tracks
- o SPTC Sidings
- o Union Pacific Railroad Tracks to Long Beach Harbor at Cota Crossing
- o Atchison Topeka & Santa Fe Harbor District Railroad Track at Slason Junction.

It was concluded that the potential exists for varying amounts of interference between railroad and LRT operations in the Los Angeles - Long Beach Corridor. The exact nature and amount of interference — as well as the best means for dealing with it — can only be determined after more detailed railroad operating data is obtained and discussions are

held with railroad officials and customers. Possible ways of eliminating or minimizing such interference include: grade separations; agreements restricting freight movements to specific time periods; abandonment of railroad service on some segments where this is appropriate; and interlocking signal protection systems with negotiated agreements as to priority use.

For the purpose of this study, the cost of protective signal systems are included in the capital cost estimate, railroad grade separations are costed as optional additions to the baseline system, and the estimated cost of right-of-way includes an allowance for negotiated compensation for the curtailment or elimination of service to shippers in the corridor. It is believed that these measures are sufficient to permit the use of the Los Angeles - Long Beach Corridor for safe and reasonably efficient transit and railroad operations.

Possible Vehicular Traffic Interference

This study also found a number of operational problems which are expected to arise where transit vehicles share street rights-of-way with vehicular traffic and where the transit alignment crosses truck, automobile and bus traffic streams at-grade. The exact nature and amount of interference, as well as the most appropriate means of dealing with it, can only be determined after detailed traffic volume data and site characteristics are known.

For the purpose of this study, it was concluded that at-grade LRT operations should generally proceed at a maximum speed consistent with that of adjacent vehicular traffic, with no special provisions except for LRT turn signal phases and selective pre-emption at a few appropriate locations. The cost of protective signals, gates, turn indicators, interconnections and similar items are included in the capital cost estimate. Complete transit/street grade separations have been estimated as optional treatments for ten major intersections of arterial streets and the trunk line segment of the corridor. It was further concluded that the traffic/transit operational disturbances to be expected in the Los Angeles - Long Beach Corridor are of the types normally associated with projects of this kind and can be satisfactorily dealt with using a combination of physical improvements, transit operating and traffic engineering techniques designed to mitigate adverse impacts on traffic circulation.

The operational impact of other transit technologies (i.e., AGT and CST) will be much less than that associated with at-grade LRT. Both of the other modes feature fully grade separated guideways whose supports can usually be sited to avoid undue interference with railroad operations and traffic flows. Any interruptions are likely to be short-term ones during construction. Even these effects can be minimized through such actions as scheduling sensitive major construction activities for weekends or other light traffic periods, the use of "shoeflys" and temporary traffic bypasses, and so on.

Transit Operating Characteristics

The overall terminal-to-terminal travel characteristics for each of the modes being considered in the Los Angeles - Long Beach Corridor were found to be as shown below in

Table 2. For comparative purposes, Table 2 also includes similar data taken from the 1981 Caltrans report and current SCRTD Freeway Express Bus service schedule.

Table 2
SPEED AND TRAVEL TIME COMPARISON
Los Angeles - Long Beach

| Mode | Route Length (Miles) | Average Speed (MPH) | One-Way Trip Time (Min.) |
|--------------------------------|----------------------|---------------------|--------------------------|
| Baseline LRT (Single Track) | 22.5 | 20.1 | 67.0 |
| AGT | 22.5 | 27.0 | 48.3 |
| CSTS | 22.5 | 26.3 | 51.3 |
| SCRTD Express Bus Route 456 | 25.4 | 23.8 | 64.0 |

The higher average speed reported for the LRT line in the Caltrans 1981 report is attributable to a variety of factors. These include assumptions made in that study with respect to LRT speeds to be achieved on city streets, vehicle acceleration characteristics, and so on which are significantly more optimistic than those made in the current analysis. It is believed that an end-to-end estimated travel time of about 60 minutes rather than 50 minutes could realistically be achieved with a double-track line without disruptive pre-emption of traffic signals in central areas. Thus, double-track LRT running time would be somewhat faster than current express bus service despite the more numerous stops on the LRT line but not as fast as indicated in the Caltrans 1981 Report.

The estimated travel time, patronage and other assumptions were used to develop operating plans for each mode. It was found that fleet sizes, including spares, of 33 LRT vehicles, 48 AGT vehicles and 42 CSTS cars would be required. Peak period LRT operations could feature 3 car trains at about 13 minute headways (or 2 car trains more frequently in order to reduce at-grade traffic interference, but this would result in a higher operating cost). Corresponding values are 3 car AGT trains at about 6½ minute headways and 2 car CST trains at 5½ minute headways.

Annual operating and maintenance costs were estimated for each mode based on staffing plans and various policy and other assumptions. These are: \$5,615,300 per year for the baseline LRT; \$7,029,300 for AGT; and \$7,481,600 per year for CST.

Environmental Aspects

The environmental investigations were grouped into two major areas: Social Issues (visual intrusion, noise impacts, relocation, community disruption and socioeconomic aspects) and

Environmental Issues (geologic considerations, air quality, energy, vegetation and water quality). It was found that while sensitive areas exist which require careful design and use of impact mitigation measures (such as noise barriers, for example), there do not appear to be any insurmountable environmental problems associated with guideway transit development in the Los Angeles - Long Beach Corridor.

It was also found that in general the Cable Suspended Transit System was preferable from the environmental standpoint except for drawbacks associated with stations on aerial structures.

Downtown Los Angeles and Long Beach

Alternative means of bringing the light rail project (or other guideway transit mode) into the central areas of Los Angeles and Long Beach were studied jointly with the staffs of those two cities.

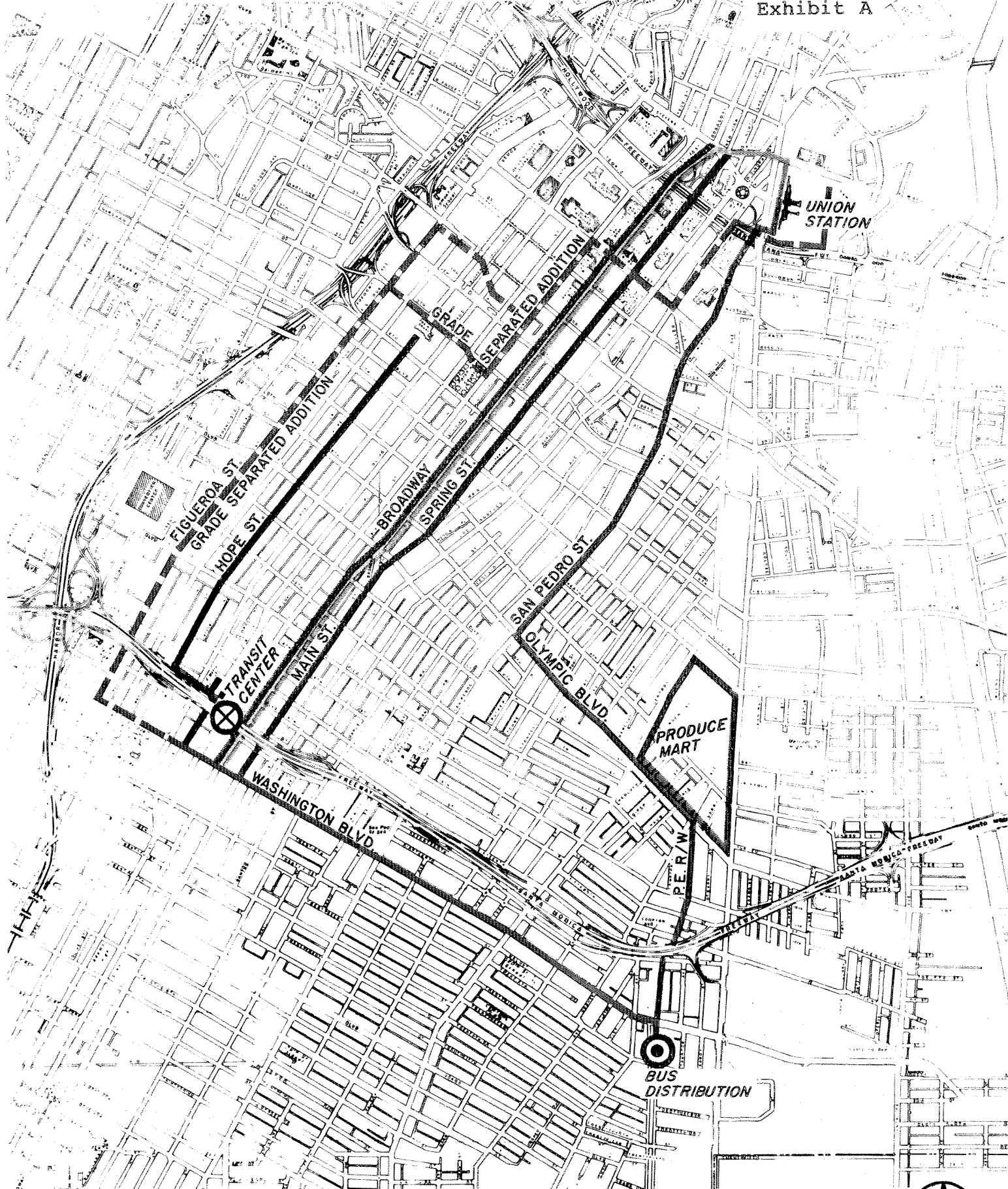
Six possible alternatives were examined in Los Angeles and these are shown in the figure on the following page which was prepared by the City of Los Angeles Department of Transportation. These were examined from the points of view of capital cost, patronage, traffic interference and environmental considerations. Cost differences with respect to a one-way couplet along Broadway and Spring Streets were found to range from a possible reduction of about \$18 million if a bus distribution system was to be substituted to a cost increase of about \$157 million for a fully grade-separated addition along the LADPM alignment.

Similar ranges exist with respect to patronage potential. The bus distribution alternative requiring virtually all central area riders to transfer and the San Pedro Street - Olympic Boulevard alternatives were judged least attractive. The westerly alignments more directly serve the trip end concentrations in the downtown area and would be expected to attract the most riders.

A one-way couplet would have less impact on vehicular circulation than implementation of a two-way guideway within a single downtown street.

It was concluded that for the purpose of this study the Baseline LRT route would incorporate the Broadway-Spring Street one-way couplet. It is emphasized, however, that not enough information is available at this time on items such as costs, patronage, trip origins and destinations, traffic impacts and business community support to definitively choose a single most appropriate central city alternative. Detailed studies normally conducted during preliminary engineering and environmental impact documentation would have to be completed before a final selection of a transit guideway route in the central business district can be made.

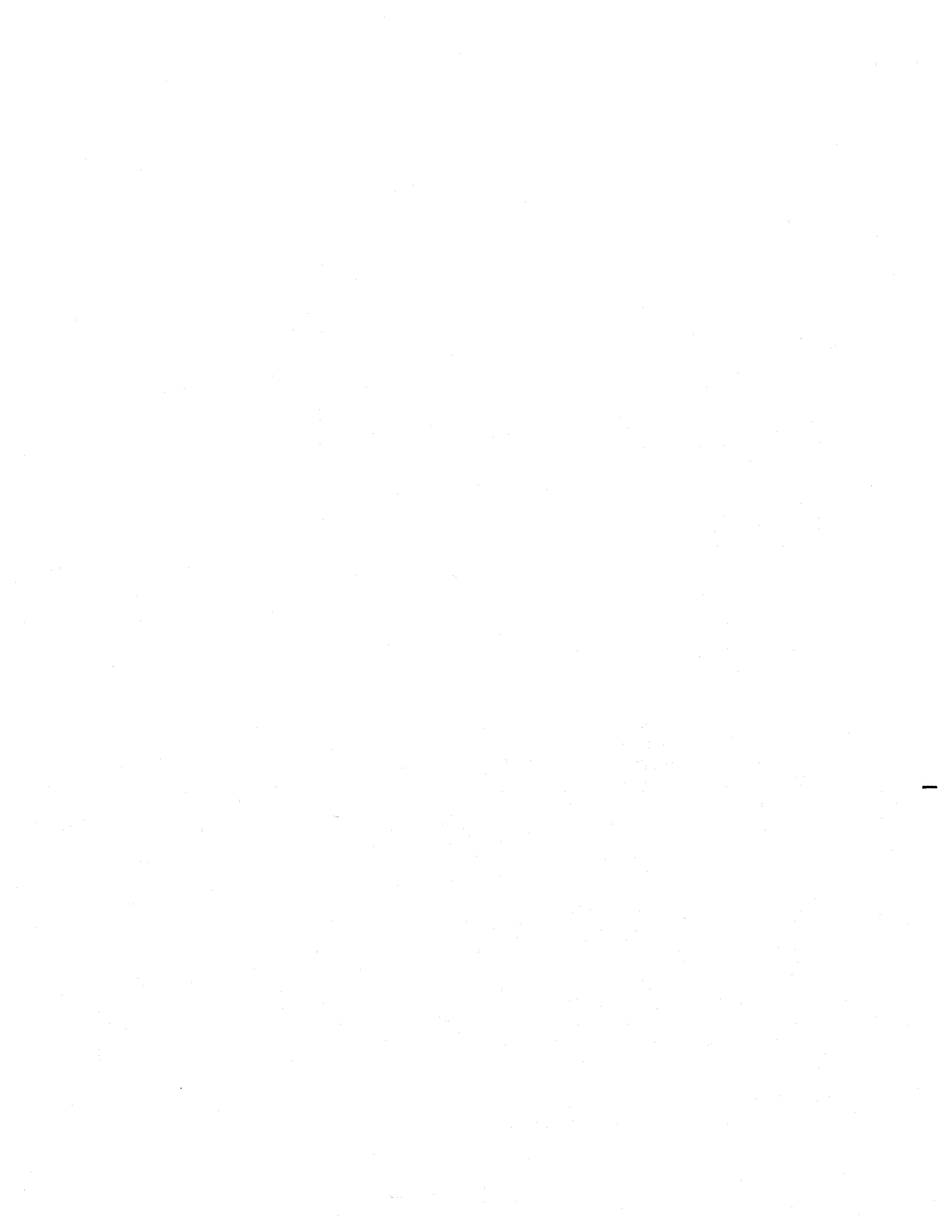
Alternatives examined in downtown Long Beach were an alignment adjacent to the Los Angeles River (subsequently rejected because of poor patronage potential), double track in Long Beach Boulevard, double track in Atlantic Avenue and a one-way couplet using Long Beach Boulevard and Atlantic Avenue. For reasons similar to these discussed above in Los Angeles, the one-way couplet was chosen to be a part of the baseline project for this



**LOS ANGELES - TO - LONG BEACH
 LIGHT RAIL TRANSIT PROPOSAL
 LOS ANGELES CENTRAL BUSINESS
 DISTRICT DISTRIBUTION ALTERNATIVES**



scale 1" = 2000'



study. Again, however, more detailed evaluation studies are required before a final selection of the downtown transit route can be made.

Capital Cost Estimates

Order-of-magnitude capital cost estimates were prepared for the Baseline LRT, AGT and CST systems for the Los Angeles - Long Beach Corridor. Also estimated were the costs for route alternatives in the central areas of the two cities and optional system features which could be added to, or deleted from, the Baseline Alternative. Included in the capital cost derivation were: site preparation; guideways; stations; trackwork; propulsion power; control and communications; noise barriers; landscaping; storage yards and maintenance shops; systems pre-operations testing; right-of-way; vehicles; engineering, management and agency costs; and a contingency allowance to reflect the uncertainties which exist at the present time. Costs were initially estimated using January 1982 prices. Escalated cost ranges were then calculated using an inflation rate of 8% (optimistic) and 11% (pessimistic) and the mid-point of cash flow requirements assuming an early implementation decision is made. Results are summarized in Table 3 below.

Table 3
CAPITAL COST ESTIMATES: LOS ANGELES - LONG BEACH

| | Total Capital Costs (Millions of Dollars) | |
|--|---|-------------------------|
| | January 1982 Cost | Range of Escalated Cost |
| Baseline LRT Project | 194 | 254 - 280 |
| Baseline LRT upgraded to double track | 223 | 292 - 321 |
| Baseline LRT plus railroad grade separations | 197 | 258 - 284 |
| Baseline LRT plus roadway grade separations | 253 | 331 - 365 |
| "Caltrans" Configuration | 202 | 264 - 291 |
| AGT System | 591 | 804 - 897 |
| CST System | 466 | 644 - 722 |

OTHER TRANSIT OPPORTUNITIES COUNTYWIDE

Corridor Selection

Initially, 15 countywide transit corridors were defined as having potential for helping to achieve the goals and objectives of the LACTC. Screening criteria were developed (potential for implementation within five years; identified in Proposition A or low cost; likely land use commitment and identified reasonable need) and applied. This screening

process resulted in six corridors being selected for further consideration and evaluation during this study. The six corridors are:

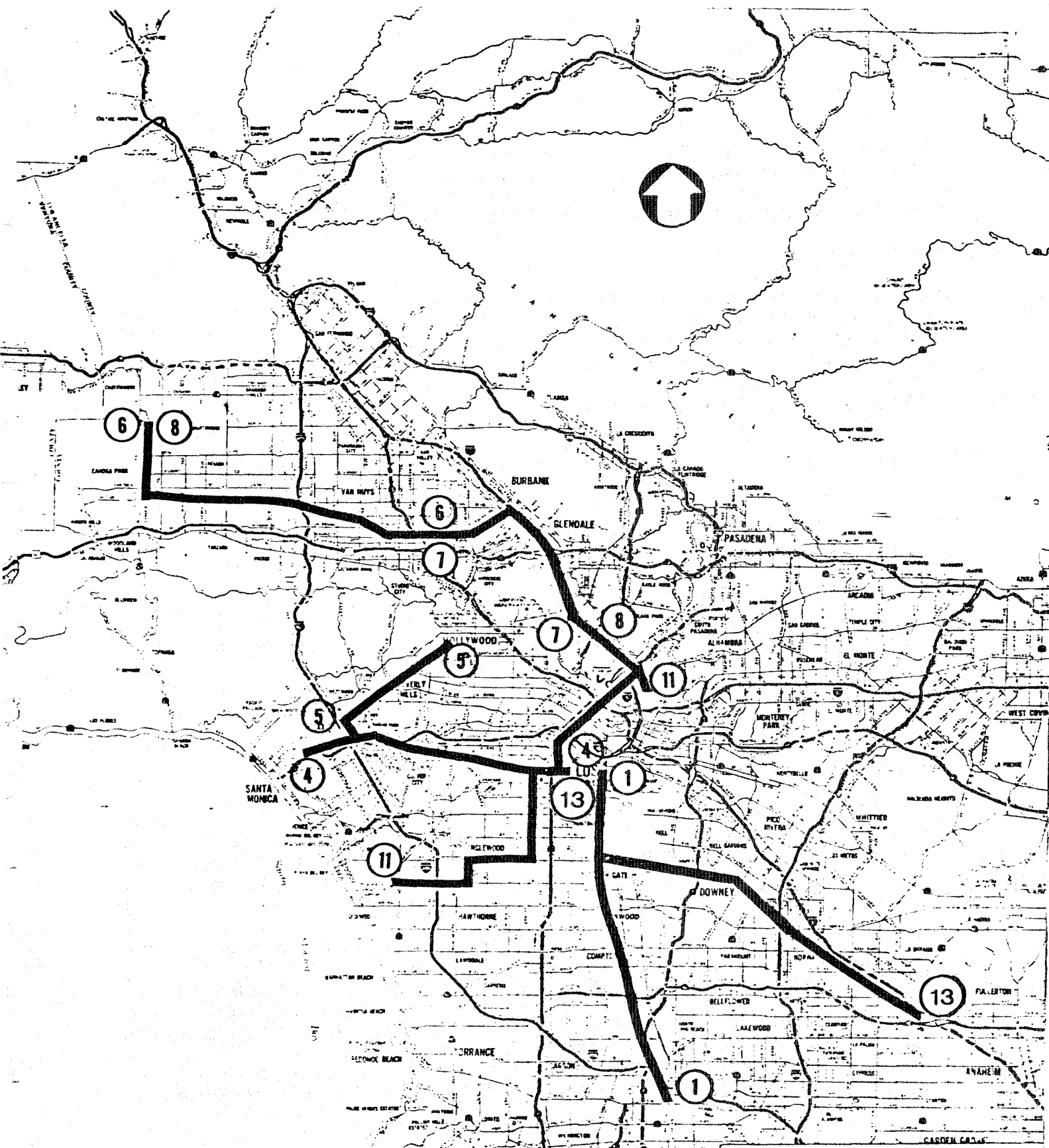
- 1 Los Angeles - Long Beach
4. Exposition Boulevard
5. Santa Monica Boulevard
8. San Fernando Valley - Los Angeles
11. Union Station to Los Angeles Airport (LAX)
13. Firestone Boulevard

The methodology employed in the countywide analysis paralleled that used for the Los Angeles - Long Beach Corridor. As noted earlier, this involved: engineering and construction aspects; patronage potential; railroad and traffic operational interference; transit operating characteristics; environmental considerations; and capital and operating cost estimates. The major findings in these areas are briefly discussed below.

Engineering/Construction Considerations

The corridor investigations carried out within the limitations of this study indicate that no insurmountable construction problems exist with respect to any of those under consideration. Where problems do exist, they are believed to be of the types normally encountered in projects of this kind and should be amenable to conventional engineering solutions. Some of these problems are fairly major and will impact construction costs and other items involved in corridor evaluation in a significant manner, such as:

- o In order to provide a functional eastern terminus for Corridor 5: Santa Monica Boulevard, it is likely that a subway section will have to be constructed to connect this line to the SCRTD Starter Line station on Fairfax Avenue.
- o Difficult and expensive aerial structures or tunnels would be required at the eastern end of Corridor 8: San Fernando Valley - Los Angeles. Another segment of this line also presents difficulties, requiring right-of-way acquisition and relocation of SPTC mainline track to overcome.
- o Corridor 11: Union Station to LAX contains a relatively narrow segment (Vermont Avenue between Exposition Boulevard and Gage Avenue) which will require careful siting of the CST system supports and stations in order to avoid or at least minimize adverse traffic impacts.
- o The west end of Corridor 13: Firestone Boulevard may require right-of-way acquisition and/or the use of areial structures to make the connection to the Los Angeles - Long Beach Corridor.



OTHER TRANSIT OPPORTUNITIES
ROUTE PLAN

STUDY CORRIDOR ②

For comparative purposes, the transit system assumed for Corridors 4,5,8, and 13 is the Baseline LRT system defined earlier for Corridor 1. To provide data for mode evaluation, Corridor 1 was also analyzed for both AGT and CST transit technologies. Corridor 11 was selected for evaluation considering only the CST transit mode.

Potential Ridership

The procedure followed in estimating possible patronage for each of the countywide corridors was similar to that described earlier for Corridor 1: Los Angeles - Long Beach and the results can be summarized as shown below in Table 4.

Table 4
PATRONAGE POTENTIAL: COUNTYWIDE CORRIDORS

| | County-wide Transit Corridors | | | | | |
|---------------------|-------------------------------|--------|--------|--------|--------|--------|
| | No. 1 | No. 4 | No. 5 | No. 8 | No. 11 | No. 13 |
| System Technology | LRT | LRT | LRT | LRT | CSTS | LRT |
| Weekday: | | | | | | |
| Daily Ridership | 21,000 | 18,500 | 17,200 | 20,000 | 22,300 | 19,400 |
| Peak-hour peak-dir. | 2,600 | 2,200 | 1,120 | 2,400 | 2,680 | 2,330 |
| Peak link volume | 2,200 | 1,900 | 800 | 2,040 | 2,360 | 1,980 |
| Saturday, daily | 12,600 | 11,100 | 10,300 | 12,000 | 13,380 | 11,640 |
| Sunday, daily | 8,400 | 7,400 | 6,900 | 8,000 | 8,920 | 7,760 |

Possible Railroad Interference

Again, this aspect of the study was handicapped by a lack of information on current railroad operations. Based on field observations, it appears that there should be relatively few problems in Corridor 4; very few (if any) in Corridor 5; considerably more possible interference in Corridor 8; none of any significance in Corridor 11; and possibly substantial conflicts in Corridor 13.

As was the case in Corridor 1, both short-term (during construction) and long-term railroad interference must be considered. Techniques are available for minimizing problems (i.e. use of "Shoeflys" as required; conflict-causing construction activity limited to light traffic hours; construction of grade separations; negotiated agreements on railroad operating hours, etc.). Most of the comments made in the corresponding section for the Los Angeles - Long Beach corridor are also applicable here. Capital cost estimates for each corridor suitably reflect necessary provisions to permit safe and reasonably efficient railroad/transit operations within the same general right-of-way.

Possible Vehicular Traffic Interference

Based on the study team's observations during a field inspection and a review of available data from several sources, it can be concluded that a basically at-grade LRT system is feasible from the perspective of cross-traffic in all the county-wide transit corridors except for the Los Angeles - LAX Corridor where only a CSTS technology is being considered. Although the proposed LRT operations would cause additional delays to cross street traffic at the crossings with moderate to heavy traffic, there do not seem to exist insurmountable traffic problem areas in any of the LRT corridors which would make such a system infeasible. Among the LRT corridors, Corridor No. 5 (Santa Monica Boulevard) is most sensitive to traffic impact because of its high density development nature and existing traffic congestion at several major intersections. But even there, the potential impact of LRT can be minimized through proper coordination between train movements and the existing signal phasing.

Given the limited scope of this investigation, the following ranking of preference has been developed based on the total number of grade crossings in the corridor, the order-of-magnitude traffic volume on cross streets, and the anticipated degree of ease in mitigating potential adverse impacts.

Corridor No. 1: Los Angeles - Long Beach

Corridor No. 8: Los Angeles - San Fernando Valley

Corridor No. 13: Firestone Boulevard

Corridor No. 4: Exposition Boulevard

Corridor No. 5: Santa Monica Boulevard

Transit Operating Characteristics

A transit operating plan was developed for each corridor on the assumption that it would be implemented on a "stand alone" basis independent of any other alternative. These were then used to prepare staffing plans and arrive at estimated operating and maintenance costs. The results are summarized in Table 5.

Environmental Aspects

As was the case with the Los Angeles - Long Beach Corridor, each of the five other countywide corridors was evaluated with respect to potential adverse impacts or opportunities to enhance the environment considering the following areas: visual intrusion, noise, relocation, community disruption, socioeconomic factors, geologic considerations, air quality, energy consumption/conservation, vegetation and air quality. It was again found for the other corridors that while there are potential problem areas which will require sensitive design treatments and the application of mitigating measures (such as noise barriers), there do not appear to be any insurmountable environmental

Table 5
 OPERATING CHARACTERISTICS: COUNTYWIDE CORRIDORS

| Corridor ⁽¹⁾ | Route Length (Miles) | Average Speed (MPH) | 1-Way Trip Time (Min.) | Total Fleet Size | Peak Period Headway (Min.) | No. of Cars/Train | Annual ⁽²⁾ O&M Cost (\$ Millions) |
|---------------------------|----------------------|---------------------|------------------------|------------------|----------------------------|-------------------|--|
| 4. Exposition Boulevard | 17.8 | 21.9 | 48.7 | 20 | 15 | 3 | 4.532 |
| 5. Santa Monica Boulevard | 11.1 | 24.2 | 27.6 | 8 | 13 | 2+1 (3) | 3.471 |
| 8. San Fernando Valley | 33.2 | 29.1 | 68.5 | 30 | 15 | 3 | 6.849 |
| 11. Union Station - LAX | 17.4 | 26.6 | 39.2 | 34 | 5 | 2 | 6.754 |
| 13. Firestone Boulevard | 25.3 | 27.9 | 54.4 | 23 | 16 | 3 | 5.104 |

Note:

- (1) All corridors operate LRT Baseline system except No. 11 which operates Cable-Suspended Transit (CST) service.
- (2) A contingency allowance of 20% - 25% should be added to the annual operating and maintenance costs shown.
- (3) Alternating 2 car and 1 car trains.

problems (or unique improvement opportunities) associated with guideway transit development in any of the corridors.

Again similarly to Corridor 1, CST is generally preferable from the environmental point of view with exception of the drawbacks associated with stations on aerial structures (in particular, on the narrow segment of Vermont Avenue in Corridor 11).

Central Los Angeles

The discussion presented earlier with respect to transit route alternatives in central Los Angeles are generally also applicable to the similar issues associated with several other countywide corridors. The exceptions are Corridor 8: San Fernando Valley - Los Angeles which does not require traversing the central business district and Corridor 5: Santa Monica Boulevard which does not serve central Los Angeles directly but only via a connection to the SCRTD Starter Line.

Capital Cost Estimates

Order-of-magnitude capital cost estimates were prepared for each countywide corridor in a similar manner to that described for Corridor 1: Los Angeles - Long Beach. Results are summarized in Table 6 below:

Table 6
CAPITAL COST ESTIMATES: COUNTYWIDE CORRIDORS

| Corridor | Total Capital Costs (Millions of Dollars) | |
|---|---|-------------------------|
| | January 1982 Cost | Range of Escalated Cost |
| 4. Exposition Boulevard | 130 | 170 - 187 |
| 5. Santa Monica Boulevard | 182* | 238 - 262 |
| 8. San Fernando Valley - Los Angeles | 385 | 504 - 584 |
| 11. Union Station - LAX | 399 | 551 - 618 |
| 13. Firestone Boulevard | 195 | 255 - 281 |

* Includes an allowance of \$69 million for right-of-way, which may be high. Also includes connection to Metro rail line and an estimated \$20 million for street couplet in Santa Monica.

COMPARATIVE EVALUATION

As discussed earlier in the section on Methodology and Approach, results of the Los Angeles - Long Beach Corridor refinement and the investigation of other transit

TABLE 7
COST - EFFECTIVENESS ANALYSIS

| CORRIDOR | MODE | APPROX. MILES LONG | CONST. COST (\$ MILLIONS) | CONST. COST/MILE (\$ MILLIONS) | TOTAL ⁽¹⁾ CAPITAL COST (\$ MILLIONS) | TOTAL CAPITAL COST/MILE (\$ MILLIONS) | ANNUALIZED ⁽²⁾ CAPITAL COST (\$ MILLIONS) |
|---------------------------|------|--------------------------|---------------------------------|--------------------------------------|--|--|---|
| 1. Los Angeles-Long Beach | LRT | 22.5 | 91.823 | 4.081 | 194.0 | 8.62 | 20.373 |
| 1. Los Angeles-Long Beach | ACT | 22.5 | 364.796 | 16.213 | 591.0 | 26.27 | 61.598 |
| 1. Los Angeles-Long Beach | CSTS | 22.5 | 268.733 | 11.944 | 466.0 | 20.71 | 48.614 |
| 4. Exposition Blvd. | LRT | 17.8 ⁽⁵⁾ | 59.287 | 3.331 | 130.0 | 7.30 | 13.635 |
| 5. Santa Monica Blvd. | LRT | 11.1 | 52.184 | 4.689 | 182.0 ⁽⁶⁾ | 16.40 | 18.934 |
| 8. San Fernando Valley | LRT | 33.2 | 198.172 | 5.969 | 385.0 | 11.60 | 40.154 |
| 11. Union Station - LAX | CSTS | 17.4 | 236.549 | 13.595 | 399.0 | 22.93 | 41.610 |
| 13. Firestone Blvd. | LRT | 25.2 | 90.060 | 3.560 | 195.0 | 7.71 | 20.398 |

TABLE (continued)

| CORRIDOR | MODE | ANNUAL OPERATING COST ⁽³⁾ (\$ MILLIONS) | TOTAL ANNUALIZED CAP. & OP. COST (\$ MILLIONS) | ANNUAL PASSENGERS (MILLIONS) | ANNUALIZED COST/PASSENGER (\$) | ANNUALIZED REVENUE ⁽⁴⁾ (\$ MILLIONS) | ANNUAL OPERATING SUBSIDY (\$/PASSENGER) |
|---------------------------|------|---|---|------------------------------------|--------------------------------------|---|--|
| 1. Los Angeles-Long Beach | LRT | 6.738 | 27.111 | 6.426 | 4.22 | 4.820 | 0.30 |
| 1. Los Angeles-Long Beach | ACT | 8.435 | 70.033 | 7.191 | 9.74 | 5.393 | 0.42 |
| 1. Los Angeles-Long Beach | CSTS | 8.978 | 57.592 | 7.069 | 8.15 | 5.301 | 0.52 |
| 4. Exposition Blvd. | LRT | 5.438 | 19.073 | 5.661 | 3.37 | 4.246 | 0.21 |
| 5. Santa Monica Blvd. | LRT | 4.165 | 23.099 | 5.294 | 4.36 | 2.647 | 0.29 |
| 8. San Fernando Valley | LRT | 8.216 | 48.370 | 6.120 | 7.90 | 4.590 | 0.59 |
| 11. Union Station - LAX | CSTS | 8.105 | 49.715 | 6.824 | 7.29 | 5.118 | 0.44 |
| 13. Firestone Blvd. | LRT | 6.125 | 26.523 | 5.936 | 4.47 | 4.452 | 0.28 |

NOTES:

- (1) INCLUDES CONSTRUCTION COST PLUS RIGHT-OF-WAY, VEHICLES, ENGINEERING AND MANAGEMENT, AND CONTINGENCY ALLOWANCE. ALL COSTS SHOWN IN THIS TABLE ARE AS OF JANUARY 1982.
- (2) ASSUMES A DISCOUNT RATE OF 10%, 25 YEAR ECONOMIC LIFE FOR VEHICLES, AND 35 YEARS FOR FIXED FACILITIES.
- (3) OPERATING COST ESTIMATES SHOWN IN WORKING PAPERS 9 AND 18 INCREASED BY A CONTINGENCY FACTOR OF 20%.
- (4) ASSUMED AVERAGE FARE OF \$0.75 PER PASSENGER (POLICY ISSUE - NEEDS FURTHER STUDY) EXCEPT \$0.50 ASSUMED ON SHORT SANTA MONICA CORRIDOR.
- (5) INCLUDES AN ON-STREET COLLECTION/DISTRIBUTION COUPLET IN SANTA MONICA.
- (6) INCLUDES AN ALLOWANCE OF \$69 MILLION FOR R.O.W. BASED ON ADJACENT LAND VALUES; MAY BE HIGH. ALSO INCLUDES CONNECTION TO METRO RAIL LINE AND AN ESTIMATED \$20 MILLION TO REACH INTO SANTA MONICA.

TABLE 8
EVALUATION MATRIX TRADE-OFF ANALYSIS

| OBJECTIVES AND CRITERIA (MEASURES) ⁽¹⁾ (NOT IN ANY PARTICULAR ORDER) | CORRIDOR NO. 1 LOS ANGELES - LONG BEACH | | | | | | NO. 4 EXPOSITION BLVD. LRT | NO. 5 SANTA MONICA BLVD. LRT | NO. 8 SAN FERNANDO VALLEY LRT | NO. 11 UNION STATION - LAX CSTS | NO. 13 FIRE- STONE BLVD. LRT | |
|--|---|----------------------------------|-------------------|--------------------------------|--------------------------------|---------|-------------------------------------|--|---|---|--|---------|
| | L R T | | | | | AGT | | | | | | CSTS |
| | BASELINE | "CALTRANS" CONFIGURA- TION | TWO NEW TRACKS | RAILWAY GRADE SEPARATION | ROADWAY GRADE SEPARATION | | | | | | | |
| 1. Low-cost construction. | + | + | 0 | + | 0 | -- | -- | ++ | + | -- | -- | + |
| 1.0 Escalated cost range (Millions of dollars). | 254-280 | 264-291 | 292-321 | 258-284 | 331-365 | 804-897 | 644-722 | 170-187 | 238-262 | 504-584 | 551-618 | 255-281 |
| 1a. Total capital cost. (Jan. 1982 dollars). | 194 | 202 | 223 | 197 | 253 | 591 | 466 | 130 | 182 | 385 | 399 | 195 |
| 1b. Total capital cost per mile (Jan. 1982 dollars). | 8.6 | 9.0 | 9.9 | 8.8 | 11.2 | 26.3 | 20.7 | 7.3 | 16.4 | 11.6 | 22.9 | 7.7 |
| 1c. Not applicable. | | | | | | | | | | | | |
| 2. Speed competitive with automobile. | | | | | | | | | | | | |
| 2a. Estimated round trip running time. | - | - | - | - | - | 0 | 0 | - | - | 0 | 0 | 0 |
| 2b. Accessibility of the line haul trunk segment. | + | + | + | + | + | 0 | 0 | + | ++ | 0 | + | ++ |
| 3. Serve area in need of transit improvement (e.g., low auto ownership). | | | | | | | | | | | | |
| 3a. Socioeconomic characteristics of the neighborhoods served. Also see 4c below. | ++ LF 43 | ++ | ++ | ++ | ++ | ++ | ++ | 0 LF 15 | 0 LF 32 | + | + | + |
| 4. Acceptable environmental impacts; and where possible, a positive enhancement of the natural and man-made environment. | | | | | | | | | | | | |
| 4a. Urban land use patterns. | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | + | + | ++ | ++ |
| 4b. Reducing Traffic congestion, air pollution and petroleum consumption | + | + | + | + | + | ++ | ++ | + | ++ | 0 | ++ | + |
| 4c. Improving mobility and access to employment and urban services. | ++ | ++ | ++ | ++ | ++ | ++ | ++ | 0 | + | 0 | + | ++ |
| 4d. Minimizing displacement, disruption, disturbance, visual impact and noise exposure. | 0 | 0 | 0 | 0 | - | -- | - | + | + | - | + | 0 |
| 4e. Potential for joint development. | 0 | 0 | 0 | 0 | 0 | + | + | 0 | 0 | 0 | 0 | 0 |
| 4f. Potential for benefit assessment financing. | - | - | - | - | - | - | - | 0 | 0 | 0 | 0 | 0 |
| 4g. Potential for influencing land use in a desirable manner. | + | + | + | + | + | + | + | + | 0 | + | + | 0 |

FOOTNOTES:

(1) See Working Paper No. 3: Methodology, Goals, Objectives, and Criteria for expanded descriptions of these items.

LEGEND: More attractive performances are indicated by the symbol ++, 0 for neutral and -- for less attractive. Intermediate levels of performance are shown by a single + or - symbol.

Continued...

TABLE 8 (Continued)

EVALUATION MATRIX TRADE-OFF ANALYSIS

| OBJECTIVES AND CRITERIA (MEASURES) ⁽¹⁾ (NOT IN ANY PARTICULAR ORDER) | CORRIDOR NO. 1 LOS ANGELES - LONG BEACH | | | | | | NO. 4 EXPOSITION BLVD. LRT | NO. 5 SANTA MONICA BLVD. LRT | NO. 8 SAN FERNANDO VALLEY LRT | NO. 11 UNION STATION - LAX CSTS | NO. 13 FIRE- STONE BLVD. LRT | |
|---|---|----------------------------------|-------------------|--------------------------------|--------------------------------|-------|-------------------------------------|--|---|---|--|-------|
| | L R T | | | | | AGT | | | | | | CSTS |
| | BASELINE | "CALTRANS" CONFIGURA- TION | TWO NEW TRACKS | RAILWAY GRADE SEPARATION | ROADWAY GRADE SEPARATION | | | | | | | |
| 4h. Potential for land-use related increased patronage. | 5 + | + | + | + | + | + | + | 3 0 | 3 0 | 3 0 | N.A. 0 | 0-7 + |
| 5. Patronage potential sufficient for cost-effective operation. | | | | | | | | | | | | |
| 5a. Potential patronage (Annual patronage in million passengers). | 6.43 | 6.43 | 6.76 | 6.43 | 6.43 | 7.14 | 7.07 | 5.66 | 5.29 | 6.12 | 6.82 | 5.94 |
| 5b. Capital, operating and life-cycle cost-effectiveness in terms of the following performance indicators, over a foreseeable range of passenger volumes and relative to current performance indicators for the Los Angeles-Long Beach express bus service and SCRTP overall total bus system performance indicators: | | | | | | | | | | | | |
| - Passengers; (See 5a above). | | | | | | | | | | | | |
| - Passenger-miles | NA ⁽²⁾ | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| - Operating and life-cycle costs per passenger (Analyzed \$/Passenger). | 4.22 | NA | NA | NA | NA | 9.74 | 8.15 | 3.37 | 4.36 | 7.90 | 7.29 | 4.47 |
| - Subsidy per passenger (\$). | 0.30 | NA | NA | NA | NA | 0.42 | 0.52 | 0.21 | 0.29 | 0.59 | 0.44 | 0.28 |
| - Daily trips diverted from other modes. | 3,150 | NA | NA | NA | NA | 3,500 | 3,500 | 3,700 | 5,200 | 4,000 | 4,960 | 6,400 |
| - Annual operating subsidy per corridor (in millions of 1982 dollars). | 1.93 | NA | NA | NA | NA | 3.00 | 3.68 | 1.19 | 1.53 | 3.61 | 3.00 | 1.66 |
| 6. Use of existing right-of-way will be emphasized, shared with existing users (railroad, automobiles) wherever feasible. | | | | | | | | | | | | |
| 6a. Types of right-of-way used; length of each type. | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | + | ++ | + |
| 6b. Assessment of the number, kind and magnitude of conflicts with railroad and automobile operations. | - | -- | - | - | 0 | + | ++ | - | - | - | ++ | - |

FOOTNOTES:

(1) See Working Paper No. 3: Methodology, Goals, Objectives, and Criteria for expanded descriptions of these items.

NA: Not applicable/Not available at this time.

Continued...

TABLE 8 (Continued)

EVALUATION MATRIX TRADE-OFF ANALYSIS

| OBJECTIVES AND CRITERIA (MEASURES) ⁽¹⁾ (NOT IN ANY PARTICULAR ORDER) | CORRIDOR NO. 1 LOS ANGELES - LONG BEACH | | | | | | NO. 4 EXPOSITION BLVD. LRT | NO. 5 SANTA MONICA BLVD. LRT | NO. 8 SAN FERNANDO VALLEY LRT | NO. 11 UNION STATION - LAX CSTS | NO. 13 FIRE- STONE BLVD. LRT | |
|--|---|----------------------------------|-------------------|--------------------------------|--------------------------------|------|-------------------------------------|--|---|---|--|------|
| | L R T | | | | | ACT | | | | | | CSTS |
| | BASELINE | "CALTRANS" CONFIGURA- TION | TWO NEW TRACKS | RAILWAY GRADE SEPARATION | ROADWAY GRADE SEPARATION | | | | | | | |
| 7. Minimum capital and operating cost, consistent with attainment of other objectives. 7a. Estimated capital, operating and life-cycle costs. Also see 5b above. (Annualized 1982 \$ Millions) | 27.1 | NA | NA | NA | NA | 70.0 | 57.5 | 19.1 | 23.1 | 48.4 | 49.7 | 26.5 |
| 8. Attractive level of service which equals or exceeds that provided by buses (frequency, speed, comfort, convenience, safety, security and dependability). 8a. Review of experiences with similar facilities elsewhere. | 0 | 0 | 0 | 0 | 0 | + | + | 0 | 0 | 0 | + | 0 |
| 9. Proven, reliable, mature technology featuring off-the-shelf hardware with minimum developmental requirements. 9a. Operating history in revenue service. 9b. Current development status of new technology systems. | + | + | ++ | ++ | ++ | 0 | - | + | + | + | - | + |
| 10. Adequate capacity to meet present and anticipated future needs. 10a. Initial and ultimate capacity potential relative to anticipated patronage. | ++ | ++ | ++ | ++ | ++ | 0 | - | ++ | ++ | ++ | - | ++ |
| 11. Suitable for staged construction; i.e., capable of being expanded and upgraded in the future with respect to coverage area, capacity and service level. 11a. Potential for early implementation; current conditions or right-of-way (physical and operational). 11b. No longer applicable. 11c. Relative ease of adding additional capacity and/or improving the service level. 11d. Opportunities, constraints on extending service to new areas. | 0 | - | + | 0 | 0 | ++ | -- | - | 0 | - | -- | 0 |
| | 0 | 0 | 0 | + | 0 | - | -- | + | 0 | 0 | -- | 0 |
| | + | + | 0 | 0 | 0 | - | - | 0 | 0 | 0 | - | 0 |
| | + | + | + | + | + | 0 | -- | + | 0 | + | -- | + |

FOOTNOTES:

(1) See Working Paper No. 3: Methodology, Goals, Objectives, and Criteria for expanded descriptions of these items.

Continued...

TABLE 8 (Continued)

EVALUATION MATRIX TRADE-OFF ANALYSIS

| OBJECTIVES AND CRITERIA (MEASURES) ⁽¹⁾ (NOT IN ANY PARTICULAR ORDER) | CORRIDOR NO. 1 LOS ANGELES - LONG BEACH | | | | | | NO. 4 EXPOSITION BLVD. LRT | NO. 5 SANTA MONICA BLVD. LRT | NO. 8 SAN FERNANDO VALLEY LRT | NO. 11 UNION STATION - LAX CSTS | NO. 13 FIRE- STONE BLVD. LRT | |
|--|---|----------------------------------|-------------------|--------------------------------|--------------------------------|-----|-------------------------------------|--|---|---|--|------|
| | L R T | | | | | ACT | | | | | | CSTS |
| | BASELINE | "CALTRANS" CONFIGURA- TION | TWO NEW TRACKS | RAILWAY GRADE SEPARATION | ROADWAY GRADE SEPARATION | | | | | | | |
| 12. Minimal implementation difficulties for an initial segment. | | | | | | | | | | | | |
| 12a. Potential for early implementation (identification of environmental, legal and fiscal constraints). | + | + | + | + | 0 | -- | -- | + | 0 | - | -- | 0 |
| 12b. Potential for qualifying under existing State and/or Federal programs for construction funds. | 0 | 0 | 0 | 0 | 0 | - | -- | 0 | 0 | 0 | -- | 0 |
| 12c. Potential for early completion of Federal and State required alternatives analyses and environmental impact studies. | + | + | + | 0 | 0 | - | - | + | + | - | - | + |
| 12d. Viability as "stand alone" project (vs. necessity of having to be connected to a larger system). | ++ | ++ | ++ | NA | NA | ++ | ++ | + | -- | ++ | ++ | + |
| 13. Compatible with other existing and anticipated transportation system elements. | | | | | | | | | | | | |
| 13a. Physical and operations relationship to existing Regional Transportation Plan, Wilshire Starter Line and ongoing transit corridor development projects. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | + | - | - | + |
| 13b. Financial and operations impacts on background bus system. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | + | 0 | + | 0 |

FOOTNOTES:

(1) See Working Paper No. 3: Methodolgy, Goals, Objectives, and Criteria for expanded descriptions of these items.

NA: Not applicable/Not available at this time.

opportunities countywide were expressed both quantitatively and qualitatively and summary tables prepared to facilitate trade-off comparisons.

Table 7 below displays the results of the cost-effectiveness analysis and Table 8 (which contains over four pages) summarizes the performance of the various options and alternatives (both within the Los Angeles - Long Beach Corridor and countywide) with respect to the previously-defined evaluation objectives and criteria.

The entries in Table 8 are mainly symbols indicating non-quantifiable evaluations. These range from ++ to indicate more attractive performance through 0 for neutral and - for less attractive results. Intermediate levels of performance within this range are indicated by a single + or - symbol. These ratings were assigned by the study team using the material contained in the project's Working Papers. A discussion of how these ratings were arrived at can be found in Working Paper No. 20: Strengths and Weaknesses of Various Modes and Corridors.

The corridor alternatives discussion below assumes Baseline LRT transit technology in each corridor for purposes of comparability. This is followed by a comparison of LRT, AGT, and CST technology options in Corridor 1: Los Angeles - Long Beach and CST in Corridor 11: Union Station - LAX.

Corridor Alternatives

Cost-Effectiveness Analysis

It can be seen in Table 7 that the estimated total capital costs for Baseline LRT systems in the corridors under consideration range from a low of \$130 million (in January 1982 dollars) for Corridor 4: Exposition Boulevard to a high of \$385 million for Corridor 8: San Fernando Valley. The other three LRT Corridors are closely grouped in the area of \$182 - \$195 million.

With respect to total annual LRT operating cost requirements, these range from just over \$4 million (Corridor 5) to over \$8 million (Corridor 8). Capital and operating cost indicators were combined by annualizing estimated capital costs over the expected economic life of transit vehicles and facilities. This results in figures ranging from about \$19 million a year for Corridor 4 to over \$48 million for Corridor 8.

While the above figures provide an indication of the order-of-magnitude of the amount of money needed to implement and operate transit improvements in each corridor, they do not reflect the productivity of such investments. Consequently, annualized costs per passenger carried were calculated. These show that for this measure, Corridor 4: Exposition Boulevard ranks best with \$3.37. It is followed by Corridor 1: Los Angeles - Long Beach at \$4.22, Corridor 5: Santa Monica Boulevard at \$4.36, and Corridor 13: Firestone Boulevard at \$4.47. The San Fernando Valley - Los Angeles line (Corridor 8) performs worst with respect to this measure; requiring an annualized cost of \$7.90 for each passenger carried.

The data in Table 7 also shows that annual operating subsidies per passenger in the range of \$0.21 (Corridor 4) to \$0.59 (Corridor 8) can be expected if the average fare were to be \$0.75 per passenger. Since fare revenue (and hence subsidy requirements) depend directly on fare policies which will require more study and discussion to establish, this indicator should be looked at for relative indications of how the corridors perform rather than as estimates of total annual subsidy funds required. Thus Table 7 shows that Corridor 4 would require the lowest annual operating subsidy, Corridors 13, 5 and 1 are next and are all about the same, followed by Corridor 8 which is significantly higher than any of the others.

Evaluation Matrix

The LRT data in Table 8 with respect to the objective of achieving low-cost construction indicates that Corridors 4: Exposition Boulevard and 13: Firestone Boulevard rank best with respect to total capital cost per mile. Corridor 1: Los Angeles - Long Beach is not far behind, but all other corridors are significantly higher. This segment of Table 8 also shows the impact inflation is expected to have on total capital cost requirements.

Transit speed competitive with the automobile are generally not achievable except for fully grade-separated service in congested corridors. Consequently, only two of the corridors are believed to even come close to this objective: Corridor 8: San Fernando Valley and Corridor 13: Firestone Boulevard (adjacent to the I-5 Santa Ana Freeway). The most directly accessible line haul segments would be on No. 5: Santa Monica Boulevard and No. 13: Firestone Boulevard, although all corridors except No. 8: San Fernando Valley rank well with respect to this particular criteria.

Corridor No. 1: Los Angeles - Long Beach ranks best with respect to serving areas in need of transit improvement and has the highest current bus load factor (43) for all of the corridors evaluated. Corridors 4 and 5 (Exposition and Santa Monica Boulevard) were ranked neutral for this measure, while 8 and 13 were ranked positively.

Corridors 1, 4 and 13 offer good prospects for positive effects on land use patterns. All corridors except No. 8 should have a positive effect on reducing traffic congestion, air pollution and petroleum consumption (No. 8: San Fernando Valley was rated neutral to indicate an expected relatively lower diversion of choice riders but still should be a positive enhancement overall). Corridors 1 and 13 are expected to perform best with respect to mobility improvement. All corridors will perform about the same with respect to minimizing displacement, except No. 8: San Fernando Valley which has a segment requiring acquisition of private right-of-way. The corridors rank about the same with respect to joint development potential but Corridor 1 is believed to have a somewhat lower potential for benefit assessment financing in view of its relatively depressed socioeconomic condition. Similarly, there is little to distinguish the corridors with respect to potential ability to intensify land use and generate additional transit patronage.

The cost-effective patronage potential of the various corridors was discussed earlier in the Cost-Effectiveness Analysis section.

All of the corridors were assessed as performing well with respect to right-of-way usage and all involve a varying amount of conflicts with railroad and automobile operations. As noted elsewhere, these conflicts are believed to be manageable and within acceptable limits.

Performance with respect to minimum capital and operating costs requirements is expressed in terms of annualized cost. This shows Corridor 4: Exposition Boulevard as performing best, followed by No. 5: Santa Monica Boulevard, No. 13: Firestone Boulevard, and No. 1: Los Angeles - Long Beach. Corridor 8: San Fernando Valley ranked significantly lower in this regard.

Corridor 4: Exposition Boulevard has some constraints on its ultimate capacity to accommodate anticipated patronage because of potentially extensive vehicular conflicts. Similarly, capacity of Corridor 8: San Fernando Valley is somewhat constrained by railroad operations. All other corridors were ranked as neutral with respect to ultimate transit capacity relative to anticipated demand.

Review of the series of measures dealing with suitability for staged construction and potential for extensions indicate that all corridors were evaluated to be about the same in this regard, with a slight advantage to Corridor 1: Los Angeles - Long Beach and a slight disadvantage to Corridor 5: Santa Monica Boulevard.

Similarly, Corridor 1 performs best with respect to minimal implementation difficulties for an initial segment and Corridor 5 was assessed to be the worst in this regard (most notably, it is seriously deficient in ability to function independently as a viable "stand-alone" project). On the other hand, since Corridor 5 ties directly to the SCRTD Starter Line, it was rated positively with respect to physical and operational relationship to the regional transportation plan and other projects. Similarly, Corridor 13 ranks positively in this regard because it promises relief to the badly over-loaded I-5 Santa Ana Freeway. The San Fernando Valley Corridor 8 was ranked negatively with respect to this last criteria in Table 8 since it is in partial competition with the Metro Rail Starter Line.

Conclusion re: Corridor Analysis

It was stated earlier that each decision-maker should apply his or her individual value system in comparing the performance evaluations presented in Tables 7 and 8. Conceivably, one favorable ranking could be valued highly enough to overcome numerous negative assessments, and vice-versa. A simple adding up of plus and minus ratings would only be appropriate if each and every criteria and measure are considered of equal importance; a highly unlikely possibility. On the other hand, some conclusions do suggest themselves based on a general overview of Tables 7 and 8. If one examines the frequency distribution of ratings (including both the presence of positive evaluations and the absence of negative one) it can be seen that:

- o Corridor 1: Los Angeles - Long Beach, Corridor 4: Exposition Boulevard and Corridor 13: Firestone Boulevard rank about the same considering the net difference in positive/negative indicators.

- o The net difference in positive/negative indicators for Corridor 5: Santa Monica is at about 60% of the level for Corridors 1, 4 and 13.
- o The net difference in positive/negative indicators for Corridor 8: San Fernando Valley is at about 25% of the level for Corridors 1, 4 and 13.
- o The evaluation of Corridor 11: Union Station to LAX directly reflects to a great degree the characteristics of the CST mode assumed to operate in that corridor. Consequently, discussion of this corridor has been deferred to the following section of this Summary Report.

Transit Mode Technology Alternative

Cost-Effectiveness Analysis

Implementation of CST or AGT rather than the Baseline LRT in Corridor 1: Los Angeles-Long Beach would require approximately \$272-\$397 million more in capital costs at January 1982 price levels, but would attract from 643,000 to 765,000 more riders annually. Both the CST and AGT modes would cost more to operate than the Baseline LRT: \$2.24 million more for CST and \$1.7 million more for AGT. The annualized cost per passenger is estimated to be \$9.74 for AGT and \$8.15 for CST versus \$4.22 for the Baseline LRT. The marginal annualized cost per marginal passenger added (comparing CST to Baseline LRT) is \$42.92. Operating subsidy requirements would be \$0.42 per AGT passenger, \$0.52 per CST passenger and \$0.30 per Baseline LRT passenger.

The cost-effectiveness performance of CST in Corridor 11: Union Station - LAX is somewhat different than in Corridor 1. The capital cost requirements for CST in Corridor 11 is about \$205 million more than Baseline LRT in Corridor 1 (over 100% higher). Operating cost for CST in Corridor 11 exceeds that for Baseline LRT in Corridor 1 by about \$1.4 million annually, but it would serve almost 400,000 more passengers a year. The marginal annualized cost per marginal passenger added (comparing CST in Corridor 11 to Baseline LRT in Corridor 1) is \$53.36. The annualized cost per passenger is \$7.29 for CST in Corridor 11 versus \$4.22 for Baseline LRT in Corridor 1. Corresponding annual operating subsidies are \$0.44 for CST and \$0.30 for Baseline LRT.

The CST system in Corridor 11: Union Station - LAX has a higher total cost and higher annualized capital cost than any of the LRT corridors. Corridor 11 CST has higher operating costs, higher annualized cost per passenger and higher operating subsidy requirements per passenger than any of the LRT corridors except No. 8: San Fernando Valley.

Evaluation Matrix

For Corridor 1: Los Angeles-Long Beach, AGT and CST generally were assessed as performing better than the LRT mode in the same corridor in such areas as: speed more competitive with the automobile (attributable to fully grade-separated guideway rather than any modal characteristic); anticipated reductions in traffic congestion, air pollution

and petroleum consumptions; potential for joint development; potential patronage; conflicts with railroad and automobile operations; and level of service relative to buses.

The AGT and CST modes are assessed as inferior to Baseline LRT in Corridor 1: Los Angeles-Long Beach with respect to the following evaluation areas: total capital cost and cost per mile; visual impact, displacement/disruption (at station areas); operating and life-cycle costs per passenger; operating subsidy required; annualized capital and operating cost; operating history in revenue service; current development status; suitability for staged construction/flexibility for upgrading and expansion; and potential for early implementation.

Other Technology Considerations

In addition to the material presented in Tables 7 and 8, the transit mode technology assessment work done during this study (as part of Task 14 and subsequently) identified several particular areas of concern associated with implementation of the CST mode as part of an urban public transportation network. These are:

- o Restrictions in operating flexibility
 - Requirement to standardize train length due to the tensioning requirements of the support cable system.
 - Restriction of one train per span due to ride quality impact.
 - Need to transition to a slow speed at stations, switches and sharp horizontal curves.
 - Need to slow operations in moderate to high winds.
- o Legal ambiguities and potential patent right conflicts regarding proprietary aspects of the system.
- o Limited procurement options ranging from 3 or 4 potential suppliers to possibly only one; with consequent risks and disadvantages associated with a sole-source procurement.
- o Time requirements for development work still outstanding. (Implementation of the AGT and CST modes is estimated to require about 6-7 years after a decision to proceed, versus about 5 years for LRT.)
- o Emergency Evacuation/Safety treatments and risk of non-certification by California PUC or other regulatory agency.

Conclusions Regarding Technology Analysis

At-grade LRT has major cost advantages vis-a-vis AGT and CST, not only in terms of total capital and operating costs, but also in terms of annualized cost per passenger

carried and annual subsidy requirements per passenger. Selection of AGT or CST rather than LRT in spite of these cost differences would be warranted only if very great importance were attached to those areas described earlier where these two modes were assessed as performing better than LRT, and relatively little importance were assigned to those other non-cost areas in which LRT also ranked higher than CST or AGT.

Optional LRT Additions

The cost of upgrading the Baseline LRT concept to a double track system is about \$29 million (January 1982 dollars), and would reduce one-way travel time by about seven minutes. It would also help improve system reliability and operating flexibility. The "Caltrans" configuration would achieve somewhat the same benefits at a lower cost of only \$8 million more if satisfactory joint use of track with railroad freight trains can be assured. Sharing the track without such assurances might actually result in degraded service levels and reliability compared to the Baseline LRT system. Provision of railway grade separations would add about \$3 million to the cost of the Baseline LRT system and would effectively eliminate three major points of potential interference. The cost of ten roadway grade separations with stations on aerial structure would add about \$59 million to the Baseline LRT. Without stations on the structure, the cost of ten overpasses would be \$19 million. The benefit achieved by such an expenditure would be decreased impact on traffic circulation and improved reliability/performance/safety of the transit line.

THE NEXT STEPS

After review of the material contained in this Summary Report, the associated LACTC staff recommendations and any other relevant considerations, it is expected that the Los Angeles County Transportation Commission will formally decide which, if any, transit corridor improvements warrant further development. Depending upon the nature of that decision, the following actions would be undertaken:

- o Detailed discussions with railroad facility operators and users need to be held so as to determine under what conditions railroad and transit activities can or should co-exist in the corridor. Specific and mutually acceptable operating agreements need to be worked out and documented.
- o Preliminary engineering and advanced planning activities need to be undertaken to further define specific right-of-way requirements and for a variety of other purposes; including selection of routes and station locations in City streets and preparation of refined estimates of capital and operating costs.
- o Necessary environmental studies and impact statements and reports need to be prepared, grant applications for funding submitted and other actions carried out to satisfy the requirements of regulatory agencies and others involved with the project.

APPENDIX



TECHNICAL WORKING PAPERS

- | <u>No.</u> | <u>Subject Area</u> |
|------------|--|
| 1. | Outline description of the work program |
| 2. | Available data/information used as the basis for conducting the technical evaluation |
| 3. | Criteria, goals and objectives |
| 4. | Baseline Los Angeles - Long Beach light rail project |
| 5. | Alternative means of bringing the project into the central areas of Los Angeles and Long Beach |
| 6. | Engineering feasibility of the baseline project |
| 7. | Range of potential ridership for the baseline project |
| 8. | Possible operational problems due to railroad traffic in the corridor and automobile traffic crossing the corridor |
| 9. | Operating plan and operating costs for the baseline project |
| 10. | Possible environmental issues (problems and opportunities) associated with the baseline project |
| 11. | Capital costs of the baseline project and optional system additions and deletions |
| 12. | Cost and efficiency measures for baseline project |
| 14. | Feasibility of alternative modes of public transit |
| 15. | The routes/rights-of-way evaluated countywide |
| 16. | Engineering feasibility of various modes on each route/right-of-way |
| 17. | Potential patronage on each route/right-of-way |
| 18. | Costs and efficiency measures for each route/right-of-way and mode |
| 19. | Potential for early implementation of each route (or route segment) |
| 20. | Strengths and weaknesses of various modes on each route/right-of-way |

STUDY PARTICIPANTS

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- *Pat Russell, Vice Chairwoman, Councilwoman-City of Los Angeles
Peter Schabarum, Supervisor-Los Angeles County
- *Kenneth Hahn, Supervisor-Los Angeles County
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- City of Long Beach
- Caltrans
- Southern California Rapid Transit District
- Southern California Association of Governments
- Municipal Bus Operators' Representative
- Paratransit Operations Subcommittee Representative
- City of Compton
- City of Carson
- Port of Long Beach
- Port of Los Angeles
- City of Downey