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SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT

FINAL REPORT

MAY 1968

A FINAL REPORT

to the people of the Los Angeles Metropolitan Area regarding a first-stage system of Rapid Transit, prepared in accordance with the provisions of the Southern California Rapid Transit District Law (Statutes of 1964, as amended) by the Directors and staff of:

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT

DIRECTORS: Don C. McMillan, District President, retired Pasadena City Manager, Business Administrator, Pasadena Museum; **Herbert H. Krauch,** District Vice President, Editor (retired), Los Angeles Herald-Examiner; **Kermit M. Bill,** Mayor, Huntington Park, Realtor, Conway-Pinnell; **Charles E. Compton,** Mayor, Burbank, Realtor, Paul White Carnahan Realty Co.; **A. J. Eyraud, Jr.,** President, Asbury Transportation Company; **Gordon R. Hahn,** Businessman, former California State Assemblyman and Los Angeles City Councilman; **H. Lee Hale,** Mayor, Walnut, General Manager, First Thrift of America; **David K. Hayward,** Councilman, Redondo Beach, Owner, David K. Hayward Insurance Agency; **Michael E. Macke,** Realtor, Macke Realty; **Douglas A. Newcomb,** Superintendent (retired), Long Beach Unified School District; **Dr. Norman Topping,** President, University of Southern California. Former Directors include: Howard P. Allen, Mark Boyar, Dr. Robert F. Brandon, Allan F. Daily, Jr. (Deceased), Harry A. Faull, Leonard Horwin, and Martin Pollard.

DISTRICT STAFF: Dale W. Barratt, General Manager; Jack R. Gilstrap, Assistant General Manager—Rapid Transit Development; Raymond W. Gareau, Manager of Operations; Richard Gallagher, Chief Engineer; John Curtis, Director of Rapid Transit Planning; George W. Heinle, Principal Design Engineer; Reed O. Christiansen, Director of Public Information; Milton McKay, General Counsel; Virginia L. Rees, Secretary; H. L. Black, Auditor and Treasurer.

CONSULTANTS: Kaiser Engineers/Daniel, Mann, Johnson & Mendenhall, a Joint Venture, overall system general engineering and architectural consultants; M. A. Nishkian & Company, engineering consultants; Day & Zimmermann, Inc., airport express study; Coverdale & Colpitts, traffic, revenue and operating expense estimates; Stone & Youngberg, financing consultants; Stanford Research Institute, economic impact analysis; Simpson & Curtin, transit systems application; O'Melveny and Myers, bond counsel.

Acknowledgement is made of an appropriation of tidelands oil revenue from the California State Legislature under Chapter 155, Statutes 1966 (1st Extraordinary Session).

The preparation of this report has been financed in part through a mass transportation technical study grant from the U. S. Department of Housing and Urban Development under the provisions of Section 9 of the Urban Mass Transportation Act of 1964 as amended by Public Law 89-562, 89th Congress, 1966.

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
1060 South Broadway, Los Angeles, California 90015

PREFACE

This is the Final Report on a rapid transit rail-bus system from the Southern California Rapid Transit District to the cities of the District, to the County of Los Angeles and to the citizens of the District for whose benefit the proposed system has been planned and designed.

The Board of Directors of the District has been guided in all of its endeavors by policies and objectives directed toward determining and meeting the unfilled rapid transit and public transportation needs in the Los Angeles Metropolitan Area.

Under its legislative mandate, the District has proceeded to develop a Master Plan Concept for public transportation; to identify and accomplish preliminary design engineering on the five corridors where the greatest need exists; and to operate a surface transit system which provides more than three-quarters of the bus service within the District as well as bus service in Orange, Riverside, and San Bernardino Counties.

The District, in all of its efforts, has worked in close cooperation with local, state and federal governmental agencies to insure the development of the best possible public transportation system for the metropolitan area.

THE RAPID TRANSIT DISTRICT

The Southern California Rapid Transit District was created in 1964 by an act of the California State Legislature. It is the public agency charged with the responsibility of providing most of the existing public transportation in Los Angeles County and planning, constructing and operating a mass rapid transit system for the community.

District boundaries coincide with those of Los Angeles County, except for the exclusion of the Antelope Valley, much of Angeles National Forest and the offshore islands.

All bus operating expenses, equipment replacement and debt service on outstanding revenue bonds are met solely from operating revenues. The District has no power to levy taxes for such purposes.

The Legislature has empowered the District to levy a property tax for rapid transit construction after approval by 60 percent of the electorate voting on the ballot proposition. Additional legislation will be required to provide the public with any alternate method of financing rapid transit construction, such as a general sales tax.

Funds with which to plan and engineer the initial stage of a rapid transit system and to develop the Master Plan Concept as presented in this report were provided by the California State Legislature from state tidelands oil and dry gas revenue and by the United States Department of Housing and Urban Development through a mass transportation technical study grant.

DISTRICT BOARD OF DIRECTORS

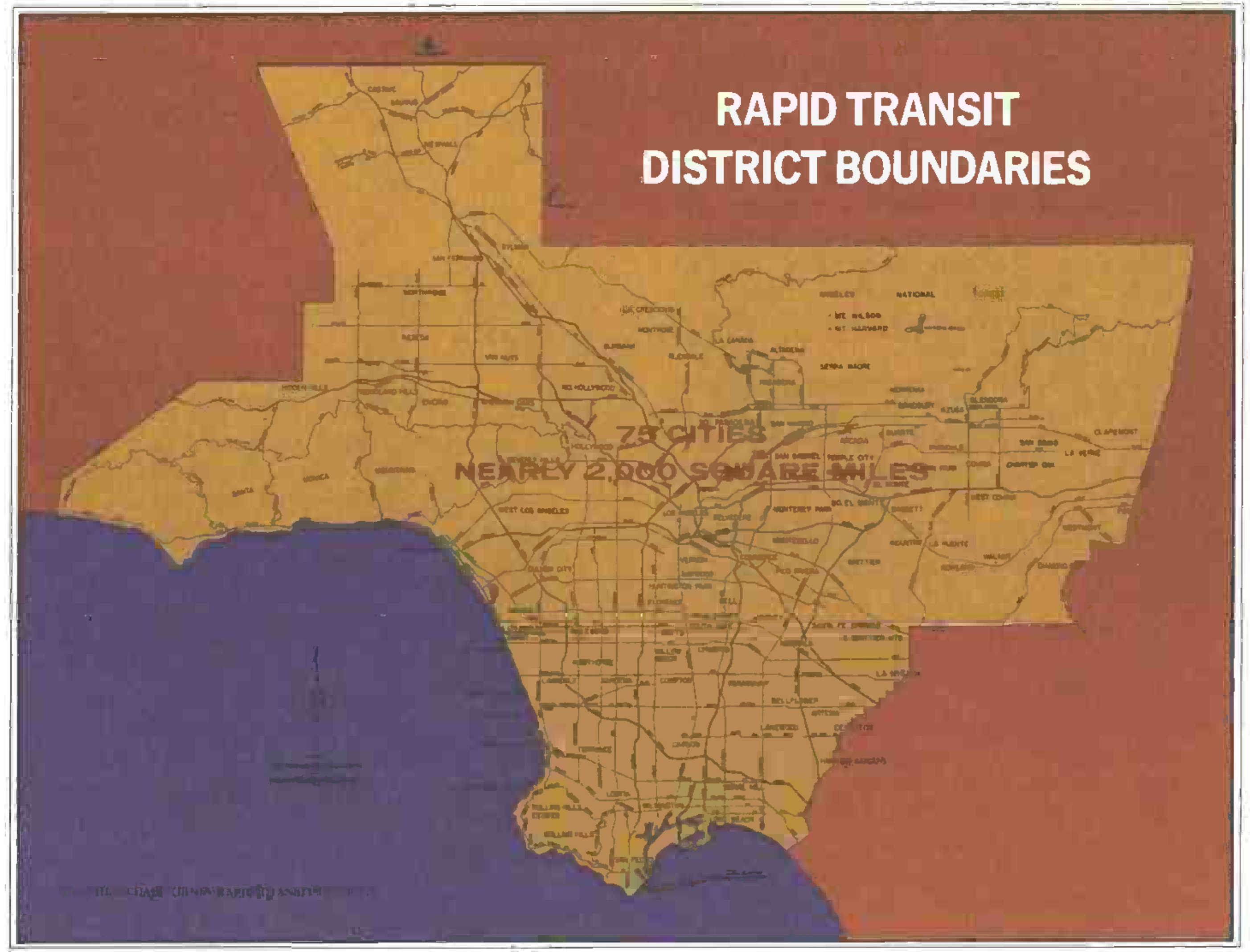
One of the principal aims in the creation of the District was to make its governing board responsive to local community needs and desires. To accomplish this purpose, the Legislature provided for the appointment of an eleven-member Board of Directors in which is vested all executive and administrative authority over District operations.

APPOINTMENT OF SCRTD DIRECTORS

The Directors are appointed as follows: five by the Board of Supervisors of Los Angeles County, of whom one must reside in each supervisorial district; two by the Mayor of the City of Los Angeles subject to confirmation by the City Council, both of whom must reside in the City of Los Angeles; and four by a City Selection Committee representing all cities in the District except Los Angeles, each of whom must reside in a different city and none of whom may reside in the City of Los Angeles

RAPID TRANSIT DISTRICT LAW

In establishing the District, the Legislature provided that the District proceed at once with rapid transit planning and preliminary engineering and that the results of this program be submitted to the community in a Preliminary Report, and that a Final Report be submitted after community views and desires were received and considered. Both reports are required by law to include the estimated construction and equipment costs of the system, the sources and estimated amounts of income from the system, the estimated cost of maintenance and operation, the proposed method or methods of financing and other ancillary information pertinent to the project.



PRELIMINARY REPORT

In the latter half of 1967, planning and preliminary design engineering had reached the level at which the District could report recommendations to the people. Accordingly, the Preliminary Report was issued at a public meeting in The Los Angeles County Hall of Administration on October 30.

Official notice of this meeting was sent to every city in the District and to the County of Los Angeles. Invitations to attend were mailed to 1,812 public officials, State officers, legislators, civic leaders, community groups and business and labor organizations. Extensive coverage of this meeting by the newspaper, radio and television media was of great value to the District in informing its citizens.

INTERIM ACTIVITIES

Technical studies continued during and after publication of the Preliminary Report. Preliminary engineering and cost estimates were refined in the process leading to publication of this Final Report.

Immediately following the October 30 meeting a series of special community meetings was held throughout the District to acquaint the people with the project and to obtain their desires, comments and criticisms. Advance notice of these meetings was given to the communities through city councils, the local news media, chambers of commerce and civic organizations.

At the meetings a presentation was made which included a film strip with recorded narrative summarizing the material contained in the Preliminary Report. A team of District staff personnel answered questions from the public.

Those who attended the meetings were given comment sheets to be completed and returned to the District for evaluation.

Similar presentations were made in the interim period to many interested citizen groups including civic organizations, service clubs and technical societies.

The Preliminary Report, in addition to being officially transmitted to the cities of the District and the County of Los Angeles, was widely distributed to chambers of commerce, labor organizations, major businesses, legislators, state officials, planning agencies and groups, public and special purpose libraries, civic organizations and to individuals requesting copies.

In response to these informational activities, formal letters and resolutions commenting on the Preliminary Report were received from the cities and the County, civic organizations, and individuals throughout the District.

On January 15, 1968 the Board of Directors called a special meeting to receive public testimony on the Preliminary Report. Again invitations were sent to the cities of the District and to the County, and public notices placed in newspapers with circulation within the District.

In this public meeting numerous cities, organizations and individuals offered comment on the proposed rapid transit system.

COMMUNITY ATTITUDES

The District is grateful to the hundreds of elected officials, administrators, planners, engineers, organizations, civic leaders and citizens for their significant contributions to this project.

The analysis of community response since the Preliminary Report reveals several general conclusions reached by the public:

- First, the people recognize the urgent need for a rapid transit system and desire it to be built without delay.
- Second, there is broad demand for more first-stage system than was proposed in the Preliminary Report and for an early development and implementation of the Master Plan Concept second-stage.
- Third, the people insist that means of financing construction other than property tax be available to them.
- Fourth, there is strong public support for improved and expanded bus service in areas not immediately served by first-stage rapid transit lines.

There were many comments on route alignments, station sites and other matters of a technical nature. All of these were considered in the process leading to preparation of this Final Report.

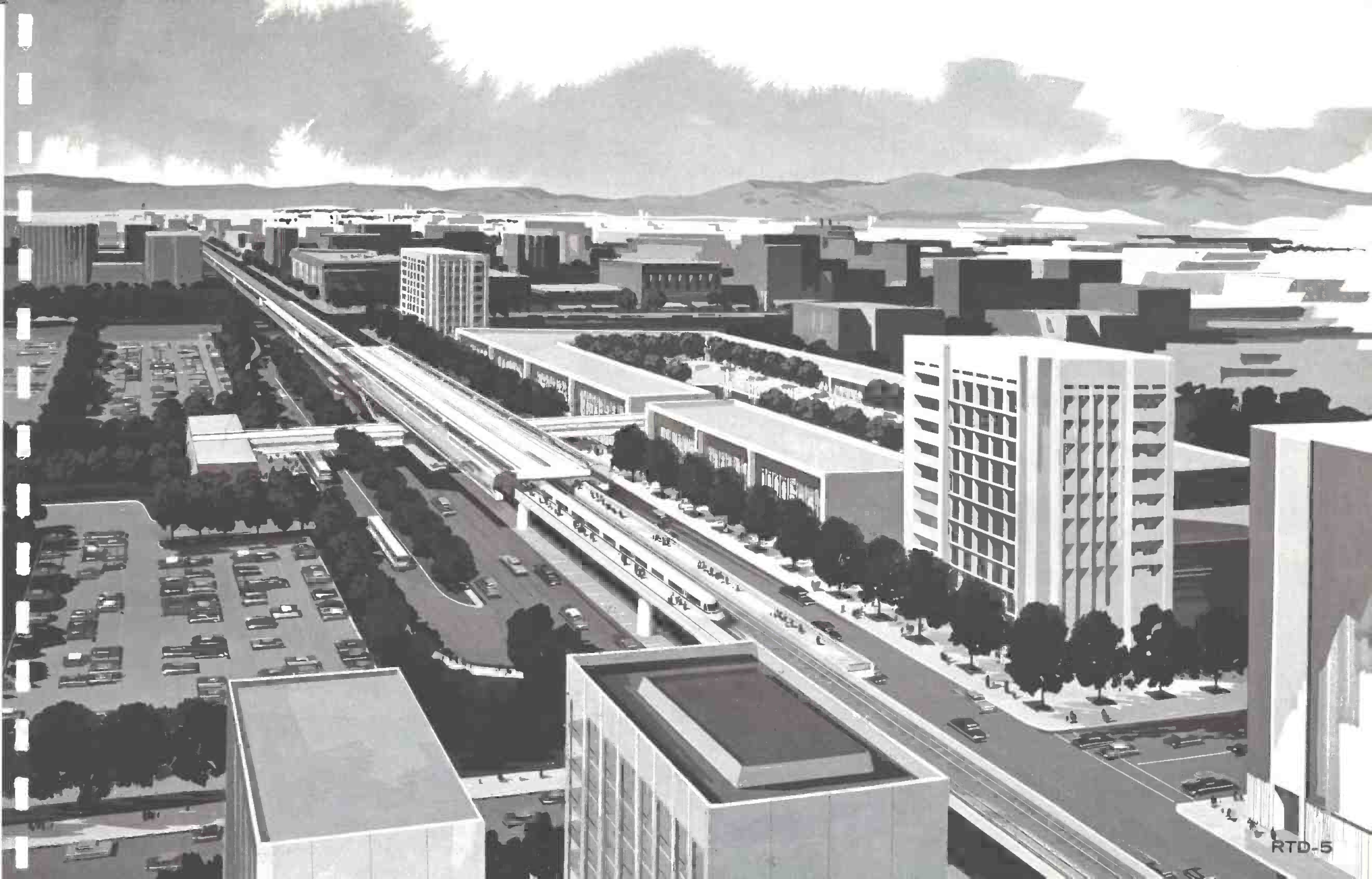
ACTIVITIES AFTER FINAL REPORT

The District will fulfill its obligation to inform the community concerning the total public transportation program described in this Final Report.

As called for by law, public hearings will be held to obtain response to the Final Report.

Information and comment from the community will be evaluated in the process leading to adoption of the program which will be placed before the electorate when an acceptable method of financing construction of the system has been made available to the people by the Legislature.

PRELIMINARY DESIGN—SEPULVEDA STATION
Rapid Transit stations blend into surrounding and integrate modes of travel.



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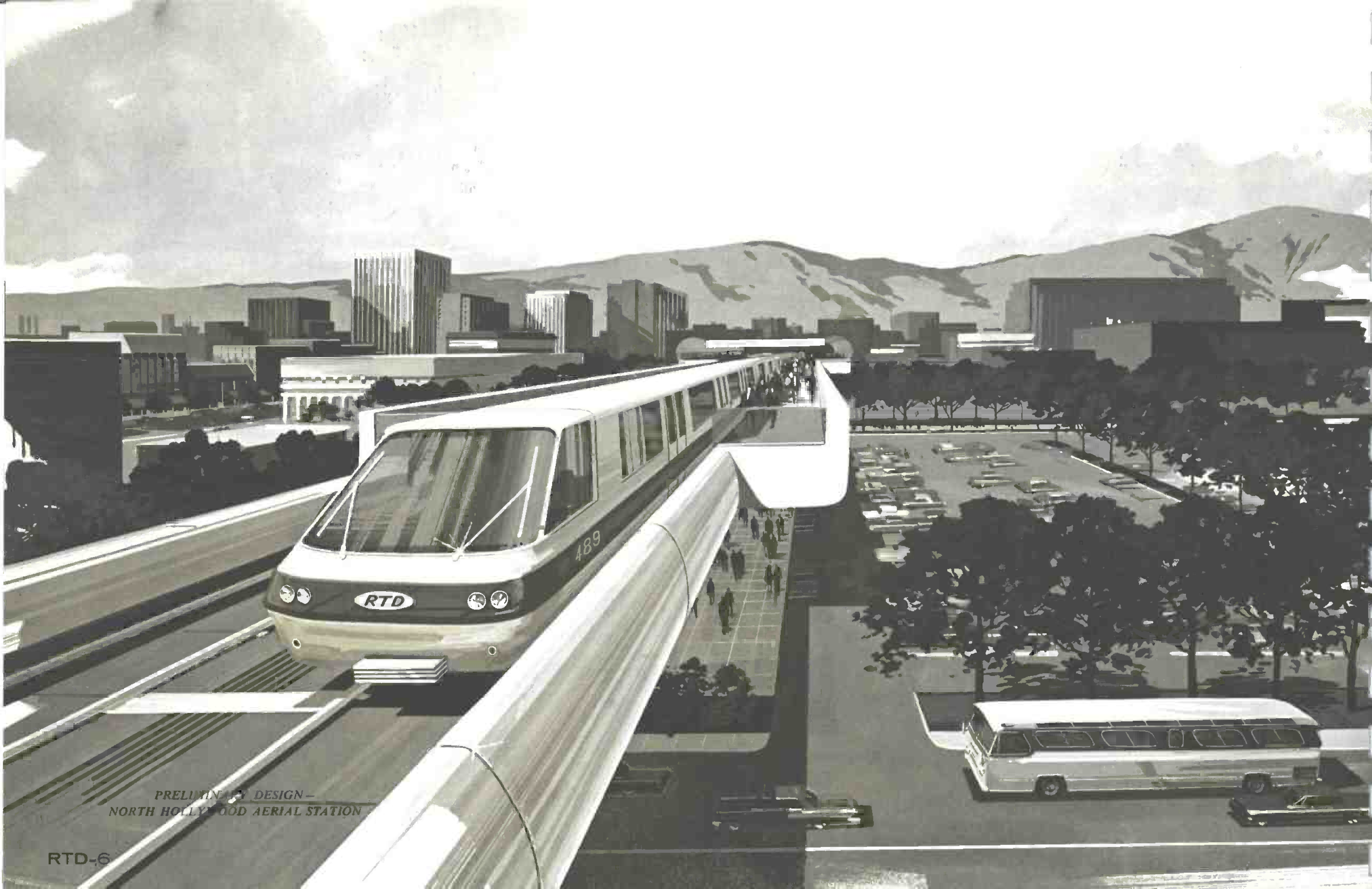

PRELIMINARY DESIGN –
NORTH HOLLYWOOD AERIAL STATION

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT

FINAL REPORT

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Appendices A through D comprise technical material.

STATEMENT OF POLICY

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT

1060 SOUTH BROADWAY • LOS ANGELES, CALIFORNIA 90015 • TELEPHONE (213) 749-6977

May 1, 1968

The Honorable Governor of the
State of California

The Honorable Members of the
California State Legislature

The Honorable Board of Supervisors of
Los Angeles County

The Honorable Mayors and City Councils
of the District

The Citizens of the District

Gentlemen:

The Southern California Rapid Transit District was created by the State of California as the public agency responsible for the development of adequate and effective public transportation in the Los Angeles Metropolitan Area.

As a central objective in meeting this responsibility, the District has, since its inception, sought to formulate a Master Plan Concept -- combining a surface transportation network with a coordinated system of rapid transit -- together designed to meet the public transportation needs of the people of the communities in this dynamic urban area.

The Master Plan Concept adopted by the District and contained in this report is designed to meet current public transportation requirements as well as those yet to come. This concept, in addition to the first-stage rail-and-bus system detailed in this Report, also encompasses -- as an integral element -- second-stage rapid transit development.

To make this Master Plan Concept a reality, funds for second-stage rapid transit preliminary design engineering and route alignment are included in the financing program recommended in this Report for construction of the first-stage system.

A five-corridor rapid transit system, combined with a substantially increased bus service, is recommended as the first stage of a public transportation network to be developed for and financed by the citizens of the District. Community response to the four-corridor system presented in the District's Preliminary Report of October 1967, has resulted in significant modifications in route alignments, corridor extensions, and the addition of the Airport-Southwest Corridor route.

Reflecting the unmistakable voice of the entire community, the District has taken the position that means other than the property tax must be made available to the electorate for the financing of rapid transit construction. In this regard, the District recommends that the Legislature consider authorizing a general sales tax of up to one-half of one percent -- either as the sole financing means or in combination with a sales tax on gasoline or an in lieu tax on motor vehicles.

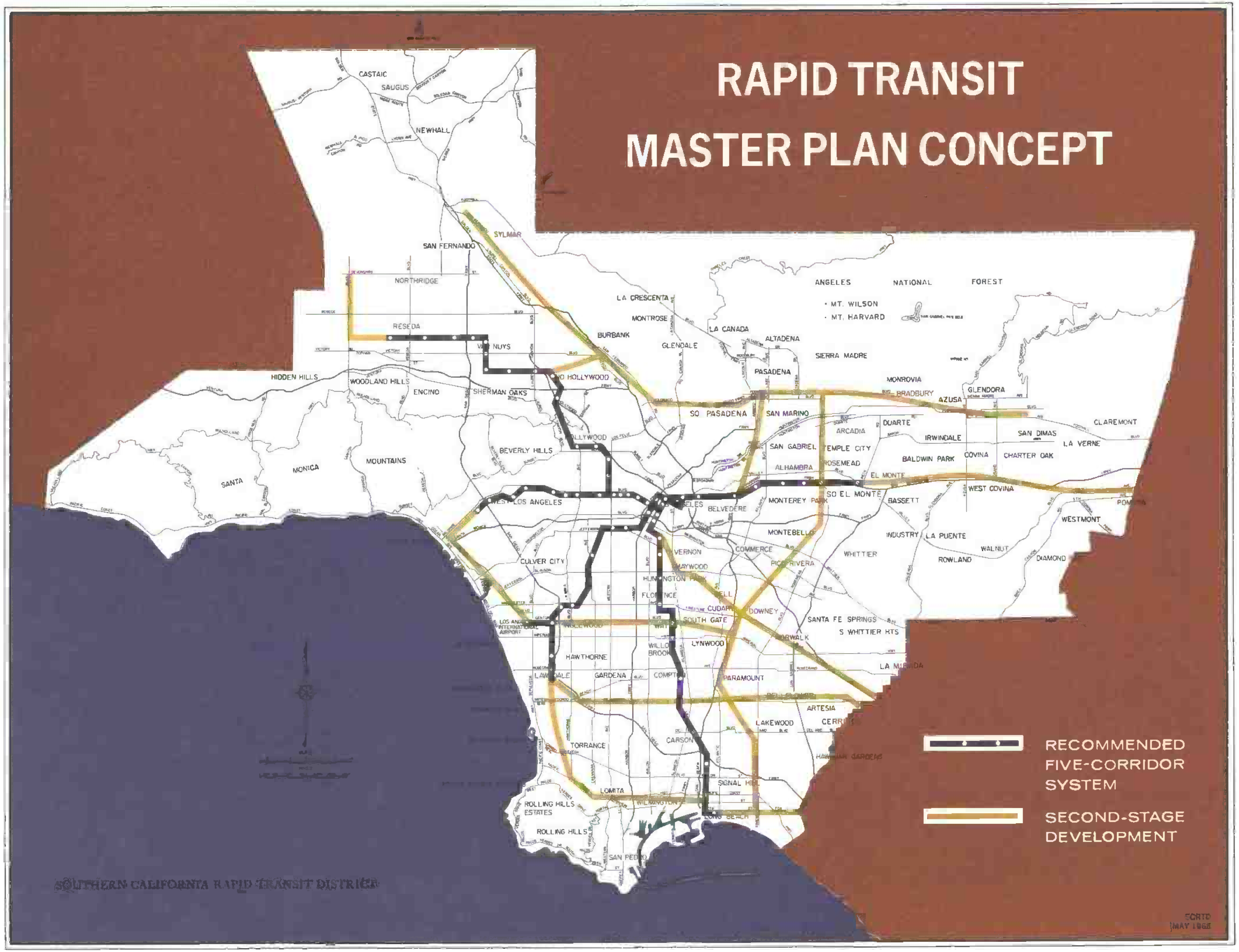
The District urges that the financing made available be sufficient for the construction of the first-stage, five-corridor, rail-and-bus public transportation system as described in this Final Report.

A more limited four-corridor system is described in the Report as an alternate initial first-stage program in the event that financing for the full recommended five-corridor system is not made available.

SOUTHERN CALIFORNIA RAPID
TRANSIT DISTRICT, by order of
the Board of Directors

Don C. McMillan
President

Dale W. Barratt
General Manager


RAPID TRANSIT
MASTER PLAN CONCEPT
RECOMMENDED FIVE-CORRIDOR SYSTEM
SECOND-STAGE DEVELOPMENT
SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
SCRTD
MAY 1968
CASTAIC
SAUGUS
NEWHALL
SYLMAR
SAN FERNANDO
NORTHRIDGE
RESEDA
VAN NUYS
NO HOLLYWOOD
HIDDEN HILLS
WOODLAND HILLS
ENCINO
SHERMAN OAKS
BURBANK
GLENDALE
LA CRESCENTA
MONTROSE
LA CANADA
ALTADENA
PASADENA
SIERRA MADRE
ANGELES NATIONAL FOREST
MT. WILSON
MT. HARVARD
MONROVIA
BRADBURY
AZUSA
GLENDORA
CLAREMONT
SAN DIMAS
LA VERNE
CHARTER OAK
COVINA
IRWINDALE
DUARTE
ARCADIA
SO PASADENA
SAN MARINO
SAN GABRIEL
TEMPLE CITY
ROSEMEAD
ALHAMBRA
EL MONTE
BALDWIN PARK
WEST COVINA
POMONA
WESTMONT
SO EL MONTE
BASSETT
MONTEREY PARK
BELVEDERE
MONTEBELLO
INDUSTRY
LA PUENTE
WALNUT
ROWLAND
DIAMOND
WHITTIER
COMMERCE
PICO RIVERA
SANTA FE SPRINGS
S WHITTIER HTS
BEVERLY HILLS
WEST LOS ANGELES
SANTA MONICA MOUNTAINS
CULVER CITY
VERNON
HUNTINGTON PARK
FLORENCE
DOWNEY
SOUTH GATE
LYNWOOD
HAWTHORNE
GARDENA
PARAMOUNT
LA MIRADA
ARTESIA
LAKEWOOD
CARSON
TORRANCE
LOMITA
SIGNAL HILL
ROLLING HILLS ESTATES
ROLLING HILLS
SAN PEDRO
HAWAIIAN GARDENS

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SUMMARY AND FINDINGS

THIS FINAL REPORT to the people by the Southern California Rapid Transit District is the culmination of a continuing engineering program and an analysis of community needs and desires expressed since the issuance of the Preliminary Report in October 1967. It carries out the legal responsibility of the District to develop a comprehensive plan for improved public transportation designed to meet the needs of this great urban complex for many years to come.

THE MASTER PLAN CONCEPT proposes a network of some 300 miles of high capacity rapid transit service to every sector of the District, combined with expanded feeder and local bus service forming a comprehensive public transportation system projected to provide constant mobility in this metropolitan area.

THE RECOMMENDED FIVE-CORRIDOR SYSTEM, *the first stage of the total plan*, is an 89-mile double track network on which people will ride safely at high speeds in comfort on dependable, computer-controlled, smog-free electric cars; operating on grade-separated, exclusive rights-of-way in subway, skyway and at ground level . . . augmented by 850 additional buses operating over 300 miles of new bus routes providing local and express feeder bus service throughout the District.

THE ROUTES enable people to travel quickly between home, work, the airport and other desired locations. Communities in the San Gabriel Valley, the San Fernando Valley, the Long Beach area, the South Central Region, the Westwood-UCLA complex and the Airport-Southwest area are connected to each other and to areas of concentrated employment and population including the Wilshire area, Hollywood, the Central Business District and the Civic Center.

- More than *two-thirds* of the entire population of Los Angeles County live within ten minutes travel time of the recommended rail routes.
- 42% of the estimated 1980 total employment in Los Angeles County will be employed within *one mile* of the Rapid Transit System.
- Kiss and ride facilities, expansive station parking areas and the new feeder bus system coupled with the District's existing bus fleet will make public transportation readily accessible to virtually all residents of the District.
- More than 1,400,000 passengers will ride public transportation daily in 1980, 477,000 on the rail system alone.
- Special express passenger service will provide the key transportation link to air passengers at Los Angeles International Airport where arrivals and departures are projected to increase from 18,125,000 in 1967 to as much as 57,500,000 by 1975, *a 217 percent increase.*

CONSTRUCTION COST of the recommended five-corridor system including its 66 stations is $1,209,477,000 at 1968 prices. The 756 rapid transit cars will cost $161,387,000; rights-of-way, $160,291,000; retirement of MTA Revenue Bonds, $31,500,000; new feeder buses, $34,750,000; preliminary engineering for second-stage routes under the Master Plan Concept, $8,000,000; provision for contingencies, $222,343,000.

PROVISION FOR ESCALATION of costs over the 8½-year construction period increases the cost by $687,113,000 – bringing the total project cost to $2,514,861,000.

MAINTENANCE AND OPERATING EXPENSES will be met from system revenues.

THE NEED for rapid transit stems from the fact that mobility is vital to a prosperous and viable urban core.

- One of every six households in Los Angeles County has no auto . . . more than one-half the households have *only one* car.
- The Division of Highways estimates that by 1980 during peak hours thousands of commuters will not be able to enter the freeways serving the job-intensive urban core.
- Every trip made by rapid transit instead of auto is a contribution to the reduction of smog – at least 85 percent of which comes from automobile exhaust.

DOLLAR BENEFITS of rapid transit far exceed its costs . . . by as much as 87 percent.

- *Traveler benefits* in time saved, reduced auto operating and parking costs, etc. will be $85 million net yearly.
- Another $109 million annually will accrue to the people in *community benefits* through reduced unemployment, increased business and governmental productivity, real estate appreciation, etc.

FINANCING METHODS available under present law offer only the property tax to the people for rapid transit construction financing. However, virtually every segment of the community has rejected property tax for paying bond service costs. Thus, the District recommends to the Legislature that it provide the people the opportunity to vote on a ½ of 1% general sales tax to finance the 5-corridor system without the levy of a property tax.

A MORE LIMITED 62-mile, four-corridor Rapid Transit System is also described in this report in the event that financing alternatives to the property tax producing sufficient revenue to finance the Recommended Five-Corridor System cannot be made available. The Four-Corridor System would cost $1,666,926,000.

PUBLIC HEARINGS at which citizens, public officials and interested groups may offer comments will be held after issuance of this Final Report, and prior to final adoption of a ballot proposition to place before the electorate.

PUBLIC TRANSPORTATION

HISTORY OF THE LOS ANGELES URBAN AREA

Nationwide, the trend is toward bigger and bigger cities. Southern California's phenomenal growth provides a notable example: the trend has continued unabated for many years. From less than one million in 1920, the population of Los Angeles County grew to nearly three million by 1940, to more than six million by 1960. Today it exceeds seven million. The Regional Planning Commission estimates a further two million growth over the next 13 years. From a predominantly agricultural region, Los Angeles County has evolved into a metropolitan giant second in population only to New York. Topography and transportation have been powerful stimuli.

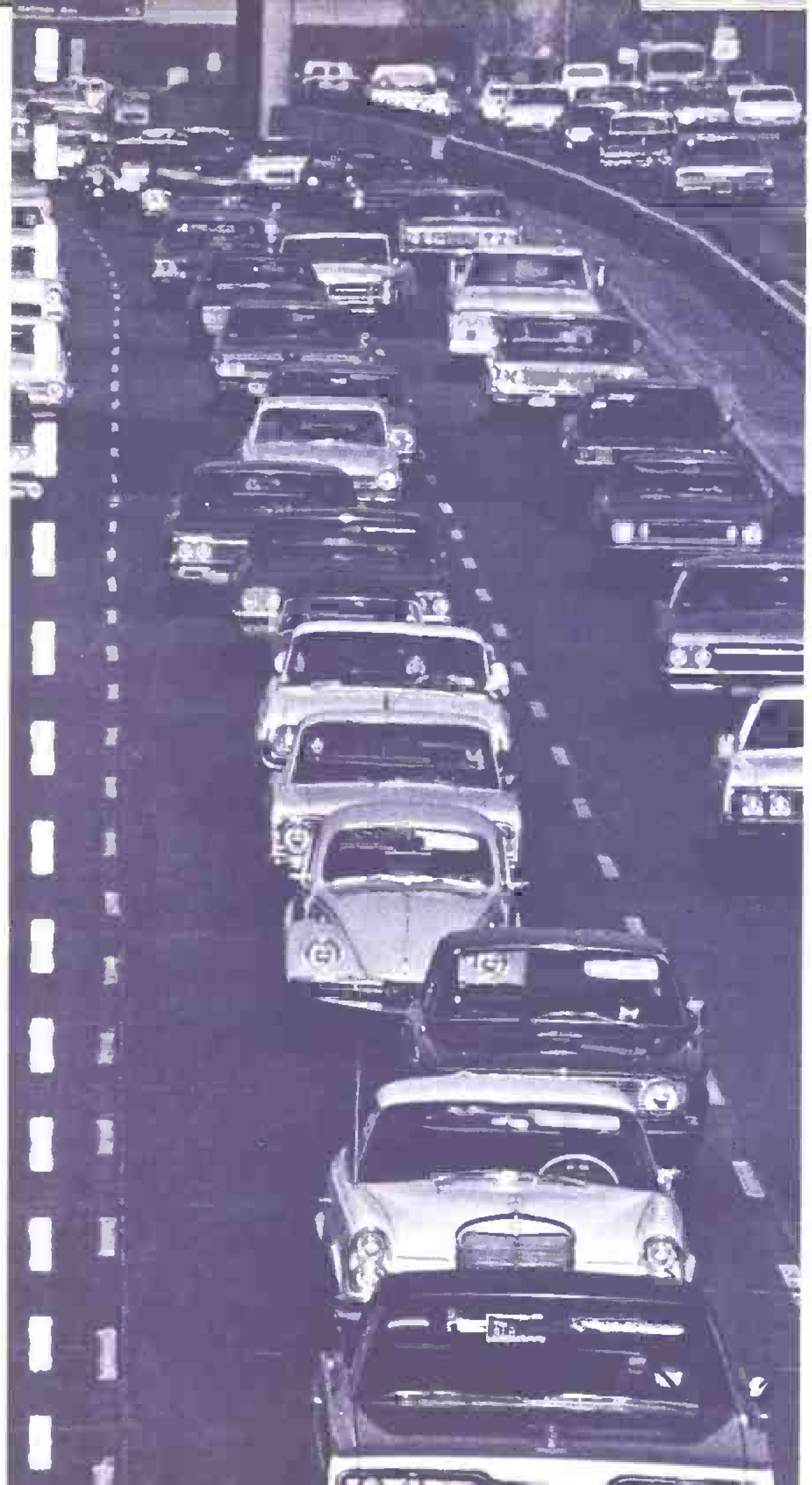
Principal geographic regions within the District are: the broad coastal plains; the San Fernando Valley to the northwest between the San Gabriel and Santa Monica Mountains; and the San Gabriel Valley between the San Gabriel range and the Puente Hills.

Boundaries of the Southern California Rapid Transit District cover approximately one-half of the 4,083 square mile area of Los Angeles County (the portion south of the San Gabriel Mountains). But it includes some 98% of the County's population and business activity.

THE BIG RED CARS

Seldom if ever in history has an area been so crisscrossed with speedy transportation prior to the advent of populated cities as was the Southland. Early in the 1900's – long before Los Angeles County claimed its first million residents – two major electric railway systems were already fully developed.

The Pacific Electric Railway penetrated the two major Valleys and fanned out across the coastal plain to the ocean at Santa Monica and the South Bay cities, San Pedro and Long Beach. Inland it extended to Whittier... Fullerton . . . Bellflower . . . Santa Ana . . . Torrance . . .



Gardena. One result was the formation of a number of independent communities – in a pattern of dispersed development that was to be characteristic of early Southland growth.

Although based in the central city, Los Angeles Railway Company's streetcar system also ventured far afield – to such neighboring communities as Highland Park . . . Eagle Rock . . . Vernon . . . Huntington Park . . . Inglewood. Well before 1920, this transportation facility made a pattern of low-density development feasible, with streetcars traversing miles of undeveloped land on their way to serve population clusters.

Then came the automobile – glamorous solution to California mobility. In a climate far superior to most of the rest of the country and with a well-designed system of arterial highways, it was inevitable that the private car should become a way of life. The low-density development created by the electric railway nurtured the assumption that, almost by itself, the automobile could meet the region's transportation needs.

As indeed it could – in the twenties and thirties. But with World War II, the Los Angeles urban area almost overnight became an important center of aircraft construction, shipbuilding and other defense industry. Industrial workers were recruited in tremendous numbers from all over the nation. The area's population spurted. Responsible governmental agencies, aware that continued growth depended on maintaining a free flow of traffic, gave the transit problem serious study. But even Los Angeles could not accurately forecast the growth that was to come.

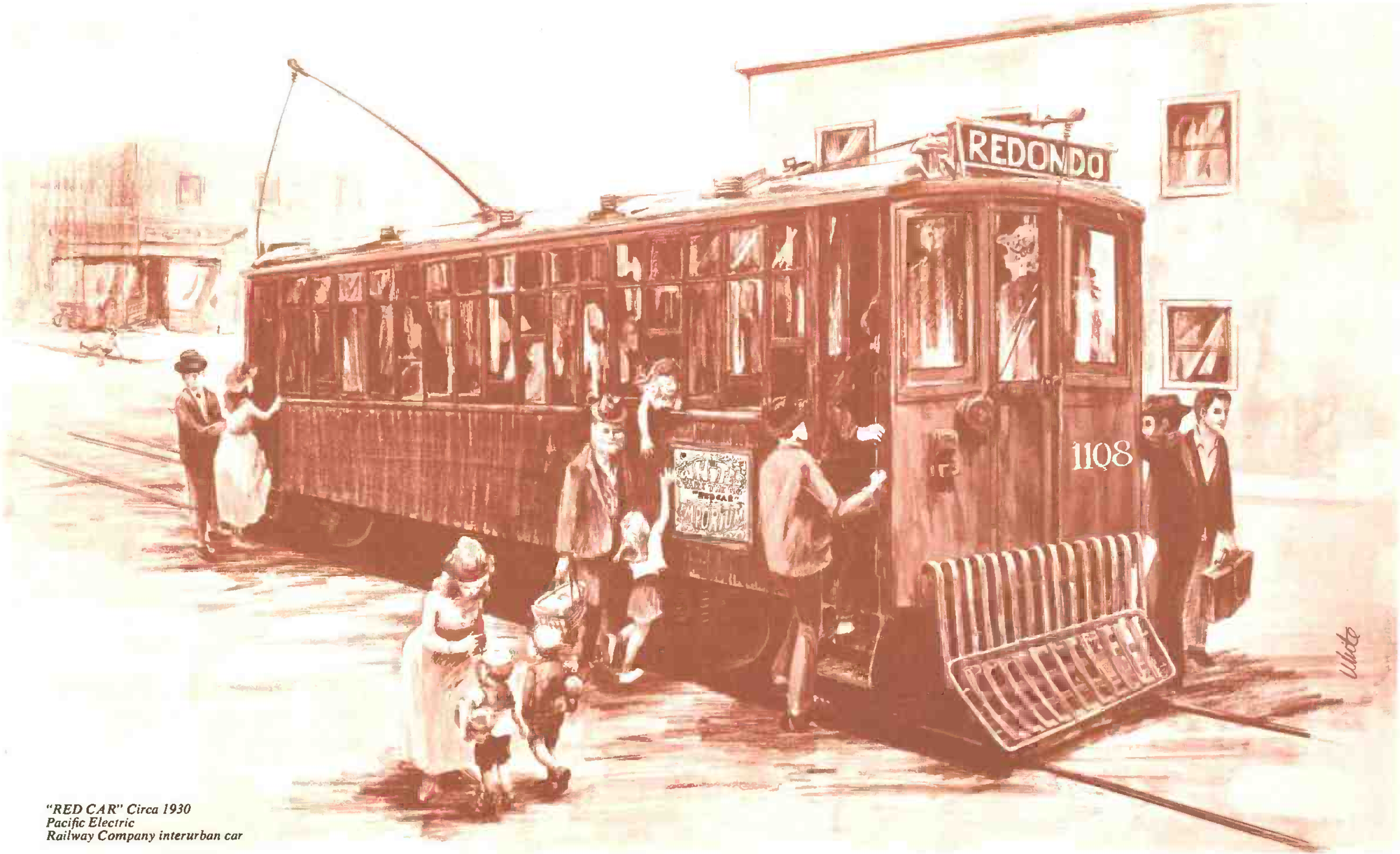
GROWING TRAFFIC PROBLEMS

In 1945 the City of Los Angeles published a report: "Recommended Program for Improvement of Transportation and Traffic Facilities in the Metropolitan Area." But the nationally-reputed consulting firm engaged to conduct the study peered into a clouded crystal ball when it assumed an "ultimate" Los Angeles County population of only six million persons. It made further assumptions: that a "total" freeway system (quite similar to the present master freeway plan) would have been already complete by the time the six-million population was reached; that the total cost of the entire freeway system would be $582 million; and that rail rapid transit might profitably be incorporated in the median of several of the projected freeways. The "ultimate" six-million population estimate fell far short of predicting actual growth, but it was a daring guess for its time. (In a like manner on the state level, the Kennedy Report, submitted to the State Legislature in 1945 as a basis for the State's freeway-financing program, projected a California population of only 14 million in 1980. Recent estimates have upped the probable figures to **double** that number – **28** million in 1980).

The 1945 report, although it greatly understated the problem, did alert the community to action. Under the sponsorship of the Los Angeles Chamber of Commerce, a group of interested civic leaders joined together in 1948 to propose a Rapid Transit Action Program, aimed at meeting projected public transportation needs by providing rapid transit routes within the framework of the intricate freeway system then being designed. Existing interurban rail lines and rights-of-way, it was felt, could also be utilized and converted to rapid transit use. The group invested time, energy, diligence, dedication – but to no avail. So complete was the enthusiasm for, and reliance upon, the freeway's ability to solve all mobility problems alone and unaided, that the Rapid Transit Action Program was not adopted. It was not until 1951 that the California Legislature, with the freeway program well under way, took the first significant steps to move forward on **public** transportation. In that year, the lawmakers created both MTA – the Los Angeles Metropolitan Transit Authority – and BART – the San Francisco Bay Area Rapid Transit Commission.

EARLY PUBLIC AGENCY PLANNING

MTA's assignment was deceptively simple and geographically restricted. It was authorized solely to construct – and operate – a monorail line between the San Fernando Valley and Long Beach. There were, moreover, strict conditions attached. The line must be financed entirely from its own revenues. Although a public agency, it was



"RED CAR" Circa 1930
Pacific Electric
Railway Company interurban car

made subject, like any **private** utility, to the State Public Utilities Commission. And it was required to pay the same taxes as privately-owned transit companies. The legislation also neglected to provide MTA with any financial support whatever, either for the basic expenses of a nominal staff or for underwriting the cost of a competent technical evaluation of the authorized project. The BART Commission, on the other hand, was given far different treatment. Not only was it empowered to develop a plan for an overall rapid transit system to serve its entire area, but the legislation provided a reserve of State fund advances to match local funds allocated to finance the necessary studies.

It was the Los Angeles County Board of Supervisors that finally granted the MTA funds to determine the feasibility of establishing the limited monorail operation. Investigation proved conclusively the project was **not** feasible under the terms imposed. It would **not** pay for itself, either in construction or operation. Thus MTA could do little until 1957, when the Legislature empowered it to acquire most of the existing private transit facilities, financing the acquisition through the issuance of revenue bonds. It was then to operate the consolidated public transportation system—and proceed with transit planning on a County-wide basis.

The conversion to public ownership and operation under MTA took place in March 1958.

Upstate, a year earlier, the San Francisco Bay Area Rapid Transit Commission had already completed its area-wide transit planning studies. The 1957 session of the Legislature created the San Francisco Bay Area Transit **District**—with taxing powers to finance the engineering and final development of the Commission's plan.

In the decade preceding the 1958 conversion to public agency operation, the path of the two major private transit systems in the Los Angeles area had been far from smooth. Part of the once vast networks of the private rights-of-way remained, but their effectiveness had been reduced by the creation of numerous grade crossings. The private car and the public transportation vehicle had literally clashed head-on at the crossroads; and every grade crossing became, if not an impasse, a snail-pace slowdown for the interurban cars. Auto victims of grade crossing entanglements began dubbing the electric cars "Grim Red Reapers." Congestion caused interurban service to wither and slowed street cars to a crawl. Patronage declined.

The owners of the system did not make capital expenditures that might have improved and preserved the lines: grade-separations; improved access to urban terminals; updated interurban equipment. Both major companies had initiated programs—interrupted by World War II and the Korean War—aimed at abandonment of all rail passenger operations and conversion to motor bus. Between 1945 and 1958, these conversions were substantially achieved. Pacific Electric's passenger operations ceased in 1953 when a new company, Metropolitan Coach Lines, acquired its passenger service franchises and motor coach equipment. The new company acquired no track or right-of-way but only the right to continue operating the remaining rail lines over Pacific Electric tracks and rights-of-way for a limited time. The other major system, Los Angeles Transit Lines, converted all except five of its remaining trolley lines to bus operation in 1955.

When the systems came into public ownership under MTA in 1958, only five of the narrow-gauge Los Angeles Transit Lines local streetcar lines remained in operation, and the four remaining standard-gauge lines were mere short-term temporary operating privileges on Pacific Electric's tracks.

The legislation which in 1957 established the MTA as a Countywide public transit agency expressed its charge to the Authority in Section 1.1 of the Act as follows:

> *"It is hereby declared to be the policy of the State of California to develop mass rapid transit systems in the various metropolitan areas within the State for the benefit of the people. A necessity exists within Los Angeles County (hereinafter sometimes called "metropolitan area") for such a system. Because of the numerous separate municipal corporations and unincorporated populated areas in the metropolitan area hereinbefore described, only a specially created authority can operate effectively in said metropolitan area. Because of the unique problem presented by that metropolitan area and the facts and circumstances relative to the establishment of a mass rapid transit system therein, the adoption of a special act and the creation of a special authority is required."*

MTA BECOMES AN OPERATING AGENCY

Los Angeles Metropolitan Transportation Authority (MTA) completed acquisition of the properties of the two principal privately-owned mass transit agencies in Los Angeles County, Los Angeles Transit Lines and Metropolitan Coach Lines, on March 3, 1958. The purchase of the properties was financed through the sale of a revenue bond issue totaling $40,000,000. During the months which followed, the acquired personnel and operations were consolidated to accomplish the efficiencies and economies inherent in a unified mass transit system.

In the years since 1958, the MTA (and its successor, Southern California Rapid Transit District) developed new freeway express bus service and extended services —both on existing lines and through acquisition of smaller private operations which have been incorporated into the publicly-owned system.

Present operations comprise 116 lines over 2,392 miles of route, on which 1,492 buses operate 54 million miles annually and transport nearly 200 million passengers. Almost unique among publicly-operated transit systems, the agency has from its inception had **no public subsidy support.** All of its obligations for operating expenses, purchase of new equipment, and interest and principal payments on its outstanding bonds have come solely from operating revenues. This obligation has been fully met at all times.

RAPID TRANSIT PLANNING

In discharge of its responsibility to develop a feasible rapid transit plan, the MTA in 1958 commissioned expert studies of the needs for rapid transit service within its jurisdiction, the most effective means of meeting the defined demand, and the feasibility of providing the necessary system and facilities under its granted financing powers. In rapid transit, as in surface transit, the MTA was limited to fares alone to meet not only cost of operating the service but also the entire cost of constructing the system.

As a first step, MTA engaged the firm of Coverdale & Colpitts to survey the need for rapid transit service. The resulting "Study of Public Transportation Needs for the Determination of Potential Rapid Transit Routes" was completed May 5, 1959. The study was based upon extensive surveys of actual trip origins and destinations in the Los Angeles County area by all modes of travel. In addition to trip volumes, analysis of this data considered trip purposes, trip lengths, street and highway capacities existing and planned, projected patterns of population growth, and trends of employment and economic development.

Twelve "corridors" or major streams of travel were thus identified. Further detailed study selected four of these corridors as the basis for an initial priority system. These four corridors extended through the Wilshire District and Beverly Hills to the west, through Hollywood into the San Fernando Valley to the north, through the San Gabriel Valley and El Monte to the east, and to the south to Long Beach.

COMPARATIVE ANALYSIS OF RAPID TRANSIT SYSTEMS

To evaluate all existing and proposed types of rapid transit systems in terms of capacity, performance, passenger comfort and convenience, and economics, the MTA hired the architectural and engineering firm of Daniel, Mann, Johnson & Mendenhall. These consulting engineers were also instructed to study feasible route alignments within the four corridors and to develop preliminary planning estimates of construction and maintenance costs. The report on these studies, submitted August 26, 1960, furnished data on alternate vehicle systems and alternate alignments in each corridor.

FINANCIAL FEASIBILITY ANALYSIS

The system selected for the financial feasibility study was chosen on the basis of minimum construction cost. It was substantially all on overhead structure, much of it in public streets. The more costly alignments studied, involving subway construction and the acquisition of exclusive rights-of-way, were recognized as being clearly beyond the means of the agency.

The preliminary planning cost estimate to construct the four-corridor system on this basis indicated that a bond issue of $625 million would be required. This estimate was based on 1960 cost levels and included no provisions for price escalation. An estimate of revenues, cost of operation and debt service requirements for the study system was submitted to the MTA by the firm of Coverdale & Colpitts on December 6, 1960.

Analysis of financial results of operation, however, indicated that although the projected system would meet all operating and maintenance costs and equipment replacement expense, it could not produce sufficient net revenue to service a construction bond issue. Public reaction to the minimum-cost system concept also clearly revealed that any local rapid transit system must be designed to integrate properly with the urban form of the communities served and meet high aesthetic standards.

BACKBONE ROUTE PROPOSAL

Faced with the inescapable conclusion that even a minimum-cost four-corridor system was not feasible under then-existing financing capabilities, in 1962 MTA made a final effort to develop an initial rapid transit line within its limited financing capabilities. The Wilshire Corridor was an area of high-destination potential for rapid transit and the concentration of job opportunity was centered closely on Wilshire Boulevard, conditions suited to convenient transit delivery. The highest residential densities in the Los Angeles area likewise existed in the service area of that route. The San Gabriel Valley, on the other hand, was a residential area with a relatively low employment-to-population ratio. Located between the two, the Los Angeles Central Business District was the largest single concentration of specialized employment in the region. Linking these areas, therefore, afforded the highest potential for effective rapid transit development in the region.

A line spanning this area between the City of Beverly Hills on the west and the City of El Monte on the east was selected for evaluation as the single portion of the four priority routes which would have the greatest potential for farebox-based financing. This line came to be known as the "Backbone Route"—since it was apparent, from all the data assembled in the studies and the projections of future growth, that this line would always be an essential element in any system of rapid transit which might later evolve.

The public evaluation of the minimum-cost design discussed in 1960 led to the conclusion that while it was essential to provide service direct to destinations along Wilshire Boulevard and in the Central Business District, street width and growing traffic demand would not permit accommodation of the transit structure in the existing street space. No feasible alternative alignment providing effective service to the centers of commercial activity could be found which could be developed at lower cost than subway construction. In the San Gabriel Valley, the median of the San Bernardino Freeway, the route favored by the communities in the area, was selected. Here overhead structures and surface construction were feasible.

Traffic, revenue and financial projections for this Backbone Route were made by Coverdale & Colpitts. Substantial new data was developed, including the most thorough home-to-work traffic studies ever made in the area to that date. Origin-destination studies of automobile trips moving in the corridor were made by new and efficient methods involving photo identification of vehicles.

The firm of Kaiser Engineers was engaged to perform planning engineering sufficient to determine exact recommended route alignments and station locations, preliminary design of facilities and a planning estimate of construction cost for the lines.

The Backbone Route was found to produce a significantly better ratio of net earnings to capital cost than the full four-corridor system – in spite of the more costly design in the CBD-Wilshire Corridor. The earnings, however, were not sufficient to permit unsecured revenue bond financing – the only method available to MTA.

Efforts were made on behalf of the MTA to secure loans or other assistance from the Federal Government, and legislation was introduced to accomplish this purpose. This bill, as well as an administration proposal for capital grants to aid transit construction, was considered by the 87th Congress in 1962, but no legislation was then adopted. Subsequently, Congress passed the Urban Mass Transit Act of 1964 which provides for capital grants of up to two-thirds of net project cost for transit capital improvements, matching a one-third share net from local tax funds. But, since no matching funds from local tax sources have been provided, neither the MTA nor the Rapid Transit District has been able to obtain aid for the Los Angeles area from this capital grants program, either for surface transit facilities or for rapid transit. The level of appropriations under the act has not, in any event, been sufficient to this time to afford a significant measure of aid in rapid transit construction financing, particularly in view of the limitation that not more than 12½ per cent of the available funds may be allocated to any one State.

CREATION OF SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT

While MTA was seeking a financially feasible initial construction program between 1958 and 1963, traffic congestion continued to increase. It became apparent that private transportation could not solve urban mobility needs singlehanded, despite the fact that the freeway construction program was accelerated by the 90 per cent financing contribution of the Federal government for the Interstate System.

The strong trend of urban growth and increasing commercial development caused responsible officials to have serious concern for the threats to mobility and continued economic health posed by future demands on the street systems, particularly in areas of employment opportunity. The Los Angeles City Department of Planning in its "Centropolis" study, for example, estimated that traffic demand in the 6.4-square mile Central City would require increased traffic capacity equivalent to 32 additional freeway lanes and 38 lanes of additional arterial streets. The final Centropolis Report recommended inclusion of the basic four corridors of rapid transit in its plan for the area.

However, when construction of the Backbone Route was found to be not financially possible, and when the 1962 session of Congress failed to provide essential financing aid, it was evident that the MTA could not establish fast, high-capacity rapid transit using the unsecured revenue financing available under the Authority Act.

This conclusion was reported by the MTA to the State Legislature in 1963 in testimony before the Assembly Interim Committee on Transportation and Commerce. The MTA proposed that the Legislature make available one or more of a number of suggested tax resources sufficient to permit financing of a basic rapid transit system. The Committee devoted several days of searching public hearings to the matter with the objective of drafting legislation which would break the impasse and clear the way for early construction of adequate public transportation facilities in the Los Angeles region.

Action on the issue came in the 1964 session of the State Legislature with the passage of the Southern California Rapid Transit District Act. This Act created the Rapid Transit District (RTD) as successor to the MTA and authorized the District to propose to the electorate a rapid transit program to be financed by general obligation bonds. The seven-member MTA governing board, appointed by the Governor, was superseded by an eleven-member board appointed by locally elected officials in Los Angeles County. The Act also set forth the specific processes through which a rapid transit proposal was to be developed in harmony with the master plans of concerned local jurisdictions.

On November 5, 1964, the District succeeded the MTA as operator of the surface transit system and as the agency responsible for rapid transit development.

RTD PLANNING PROCESS

In its charge to the Southern California Rapid Transit District in the 1964 Act, the Legislature reflected the concern for a solution to the increasingly evident problem of mobility in the Los Angeles region:

> *Sec. 30001.*
>
> *"(a) There is an imperative need for a comprehensive mass transit system in the Southern California area, and particularly in Los Angeles County. Diminution of congestion on the streets and highways in Los Angeles will facilitate passage of all Californians motoring through the most populous area of this state and will especially benefit domiciliaries of that county who reside both within and without the rapid transit district.*
>
> *"(b) In view of the limited powers of the Los Angeles Metropolitan Transit Authority (herein sometimes referred to as 'authority') it has become apparent that the authority is unable to solve the transit problems of the Southern California area and provide the needed comprehensive mass rapid transit system.*
>
> *"(c) It is, therefore, necessary to provide a successor corporation to the authority, to wit: a transit district, and to establish such transit district governed by representatives of the governmental agencies in the Southern California area so that there will be sufficient power and authority to solve the transportation problems in the Southern California area and to provide the needed comprehensive mass rapid transit system."*

RAPID TRANSIT PROGRAM DEVELOPMENT

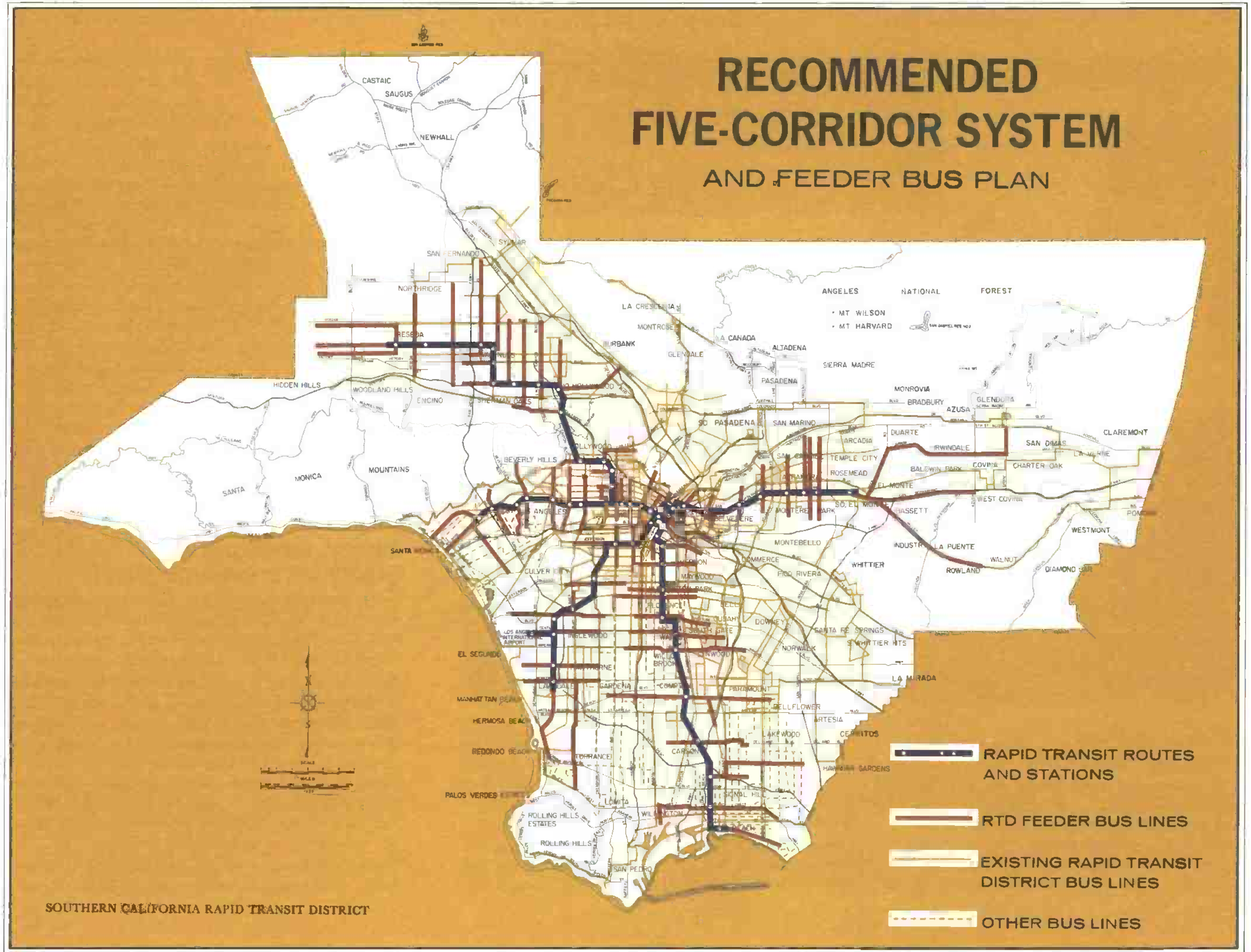
Upon its creation, the District immediately initiated a review of the current status of rapid transit planning and program development, as well as an evaluation of trends of population, employment and economic activity in the region as they relate to transportation requirements.

Objective analysis revealed that a number of factors were influencing the evolution of regional development that was taking place. For example, vast new subdivisions were springing up on formerly agricultural land in the outlying suburban areas. At the same time, building permit figures showed that construction of multiple-family housing exceeded construction of new single-family housing in Los Angeles County in every year from 1958 to 1963 rising to a ratio of 3 to 1 in the latter year.

New large shopping centers and industrial plants were being established in scattered suburban areas. In the urban center of the region, however, strong growth in commercial development was apparent as the majority of all large new office buildings were concentrated in the central area.

To form a sound basis for evaluation, the District authorized professional research of the population, economic and land-use developments occurring in the area as they affect transportation requirements. The economic, planning and traffic engineering specialists on the staff of Daniel, Mann, Johnson & Mendenhall were assigned to provide the expert services required for the investigations. This research revealed trends which supported in strongest terms the necessity for complementing the private-vehicle transportation systems with public transportation services with the capability of meeting the growing demand for fast, dependable and efficient movement of people.

The most striking fact revealed by the analysis is the centralizing trend of employment opportunity—in the face of the continuing growth in residential population in suburban areas. This pointed to the fact that the local trend of residential development is not decentralization in the sense of absolute loss of residential population in the core of the region, as some older cities initially overpopulated are experiencing. Instead it is a general spread of population growth tending to actually increase density in the core even while converting vacant land to single-family residential densities in other areas. The population growth in the core area is being accommodated by an orderly second-generation improvement of land in multiple residence use.


RECOMMENDED
FIVE-CORRIDOR SYSTEM
AND FEEDER BUS PLAN
RAPID TRANSIT ROUTES AND STATIONS
RTD FEEDER BUS LINES
EXISTING RAPID TRANSIT DISTRICT BUS LINES
OTHER BUS LINES
SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
CASTAIC
SAUGUS
NEWHALL
SAN FERNANDO
NORTHRIDGE
RESEDA
HIDDEN HILLS
WOODLAND HILLS
ENCINO
SHERMAN OAKS
BURBANK
MONTROSE
LA CRESCENTA
GLENDALE
LA CANADA
ALTADENA
PASADENA
SIERRA MADRE
ANGELES
NATIONAL
FOREST
MT WILSON
MT HARVARD
MONROVIA
BRADBURY
AZUSA
GLENDORA
DUARTE
ARCADIA
IRWINDALE
SAN DIMAS
CLAREMONT
LA VERNE
CHARTER OAK
COVINA
BALDWIN PARK
TEMPLE CITY
ROSEMEAD
SAN MARINO
SO PASADENA
EL MONTE
SO. EL MONTE
BASSETT
WEST COVINA
POMONA
WESTMONT
INDUSTRY
LA PUENTE
WALNUT
ROWLAND
DIAMOND BAR
WHITTIER
MONTEBELLO
MONTEREY PARK
PICO RIVERA
COMMERCE
DOWNEY
SANTA FE SPRINGS
WHITTIER HTS
NORWALK
LA MIRADA
BELLFLOWER
ARTESIA
CERRITOS
LAKEWOOD
HAWAIIAN GARDENS
PARAMOUNT
MAYWOOD
BEVERLY HILLS
SANTA
MONICA
MOUNTAINS
SANTA MONICA
CULVER CITY
INGLEWOOD
EL SEGUNDO
MANHATTAN BEACH
HERMOSA BEACH
REDONDO BEACH
TORRANCE
GARDENA
CARSON
PALOS VERDES ESTATES
ROLLING HILLS ESTATES
ROLLING HILLS
LOMITA
WILMINGTON
SAN PEDRO

RTD-19

The present and projected patterns of residential densities are shown on maps on page RTD-22 & 23.

In contrast to the spread of population growth, there has been an intensification of employment opportunity within the center of the region, within a five-mile radius of Los Angeles City Hall. In 1960, a net total of 432,000 persons commuted daily to this regional center of employment. This is estimated to increase to 714,000 commuters by 1980. Access to the great number and variety of job opportunities which the regional core provides is essential. The priority system of rapid transit – together with the District's extensive surface lines in the core area – will help to assure that access.

The map on page RTD-23 shows the areas of job opportunity in the Los Angeles area as estimated for the year 1980 by the Los Angeles Regional Transportation Study. LARTS is the staff arm of the Transportation Association of Southern California, the joint powers agency of the counties and cities in Southern California responsible for comprehensive transportation planning.

There are validly divergent opinions regarding desired patterns of urban development into which the evident future growth should be directed. Complete dispersion of residential and all other development uniformly throughout the region would, of course, require an arbitrary reversal of present patterns of community growth and organization. Either the desirability or the accomplishment of such an objective is highly improbable.

All forms of development except complete dispersion will require rapid transit to provide an adequate and balanced transportation system. The basic corridor system developed in the transit planning studies between 1958 and 1965 meets the requirements for initial rapid transit by providing services which are essential in dealing with today's problems of congestion on streets and highways. In addition, this basic system is equally vital to the long-range development of the region on any of the realizable concepts which have been discussed – and an essential element in the Master Plan Concept for public transportation in this area.

DEVELOPMENT OF MASTER PLAN CONCEPT

An effective total transportation system in a metropolitan community requires a properly balanced provision for both private vehicle and public transit modes. Within the public transit mode, a balance is also necessary.

Fast, high capacity rapid transit services meet the need for the dependable transportation of a substantial share of the rush-hour traffic which congests the highways serving major employment centers. As an example, the proposed San Gabriel Valley rapid transit line will carry, during the peak hour, as many home-bound commuters as are now traveling on both the San Bernardino and Pomona Freeways – with the actual total capacity of the line substantially in excess of that volume.

These trunk line services are complemented by surface feeder bus lines which provide quick and frequent access

The Los Angeles Urbanized Area, a metropolitan area including Los Angeles and Orange Counties and extending into Riverside, San Bernardino and Ventura Counties, will have 23 million residents by the year 2000, according to forecasts by the Urban Land Institute. This will be the second largest urban concentration in the nation, and only 1 million less than that of the New York – New Jersey area.

SCRTD's responsibility for planning and constructing a rapid transit system ends at the District boundaries. The travel needs of people in the metropolitan area do not recognize these limitations. In the next planning step – developing the second stage lines of the Master Plan Concept – planning must increasingly involve travel which crosses boundary lines as indicated on the map on the following page. The District's design for its complete system will consider these needs and will be carried out in close coordination with the responsible agencies outside its area of system construction responsibility.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SCRTD · MAY, 1968

to the rapid transit stations from the residential neighborhoods. The same feeder lines provide service to community centers for work or shopping, and their flexibility will permit route and schedule changes to meet the evolving needs of the individual communities.

Future freeways can make special provision for fast express bus service between communities and to and from rapid transit terminals and stations, increasing the availability of quick access to the rail system and providing expedited public transportation, pending development of future stages of rail rapid transit.

From a review of the trend of transportation demand patterns and the projections of population, employment and land use in the District area, a Master Plan concept of public transportation services was prepared. The Master Plan projects the continuing development of trunk line rapid transit in a system which will provide for the meeting of major travel demands. The combination of radial routes gives access to major employment centers, and the lateral routes provide high speed links for major inter-community travel throughout the system. The high-speed routes will be supplemented by additional new and extended surface transit routes to meet public transportation needs where volumes of use may not warrant exclusive facilities and to provide wide access to the high-speed trunk lines.

The District proposes to begin final planning and preliminary engineering of the Master Plan rapid transit routes in the second-stage program immediately upon approval of financing of construction of the first-stage lines. Provision for financing second-stage preliminary engineering work is included in the bond issue for the first-stage system.

REGIONAL TRANSPORTATION PLANNING

The Urban Land Institute has forecast a year 2000 population of more than 23 million in the Los Angeles Urbanized Area. This area includes the contiguous urbanized land in Los Angeles, Orange, Ventura, Riverside and San Bernardino Counties, and is predicted to become the second most populous urban area in the nation, only one million less than the New York-New Jersey area and twice the population of the Chicago urban area. Although the District's responsibilities for rapid transit development are technically limited to the basin area of Los Angeles County, its bus services extend into the neighboring counties to the south and east. The inevitable spread of complete urbanization requires that the impact of growth beyond the District's borders be considered in our planning and that rapid transit and surface public transportation planning consistent with regional objectives be carried forward in coordination with appropriate agencies in adjacent counties.

SIMPSON & CURTIN CONSULTING TRANSPORTATION ENGINEERS

SUMMARY OF CONCLUSIONS, STUDY OF ALTERNATE MODES OF RAPID TRANSIT

Technological developments in aerospace industries provide an impetus for new concepts in ground transportation, particularly in Los Angeles which has been at the forefront of air transport technology for two decades. Forty rapid transit concepts were initially reviewed including rail rapid transit, several rubber-tired applications and alternate modes of monorails. These were measured for significant criteria: capacity, speed, convenience, proven performance, riding comfort, environment, and, finally, costs. From these analyses, two likely alternatives emerged – (1) high-performance rail transit, and (2) rapid busway operation.

'Steel wheels on steel rail' is the prevailing standard for rapid transit performance universally, with 31 of the world's largest cities operating rail rapid transit systems. No 'rapid busway' installations have yet been made, although several are proposed. The nearest approach is express buses on freeways, which SCRTD now operates extensively.

The possibility of single vehicle, door-to-door convenience is the outstanding characteristic of bus rapid transit service. Four *rapid busway* concepts were analyzed: (1) skip-stop operation on exclusive roadway; (2) local pickup with express delivery to downtown terminal; (3) local delivery as well as local pickup; and (4) local pickup with expressway station stops. The desirability of two elements – local bus collection, followed by non-stop operation on grade-separated roadways – is clearly established. Only one-sixth of potential riders are within walking distance of the proposed routes, so that local bus pickup is a significant travel convenience item.

It is at the delivery end of journeys that the rapid busway concept bogs down in Los Angeles. Of all passengers originating in the four corridors, 31% are CBD-bound, with the balance distributed among numerous points. The most serious objection is that rapid busways would require multi-lane, and in some instances multi-level, stations to accommodate passenger delivery. These would approach highway interchanges in overall scale, create serious construction and environmental problems and raise capital costs close to rail rapid transit.

Another serious handicap is the problem of noxious gases and fumes in long tunnels. Forced ventilation would add significantly to operating expenses. The fumes and pollutants could also be a blighting influence at ventilation discharge points.

Restricted capacity, large multi-level elevated stations, air pollution control, high capital costs and lack of surplus capacity to accommodate travel growth, eliminate rapid busways as a reasonable alternative to rail rapid transit. In the present state of the art, there appears to be no rapid bus alternative capable of meeting the diverse travel needs projected for the Los Angeles metropolitan area.

FINANCING PRELIMINARY ENGINEERING

Review of the plan for the basic four-corridor system confirmed the validity of the priorities which had been established. The District, therefore, proceeded with the program of route planning, preliminary engineering and cost determination required by the District Act. The State Legislature was requested to provide funds to assist in defraying the cost of this rapid transit planning and engineering. In the 1966 session, the Legislature made available to the District approximately $3,600,000. The District subsequently applied to the United States Department of Housing and Urban Development for a technical studies grant of matching funds. That Department made an initial allocation of $975,600; an allocation of additional funds is currently pending.

CONSULTANTS ENGAGED

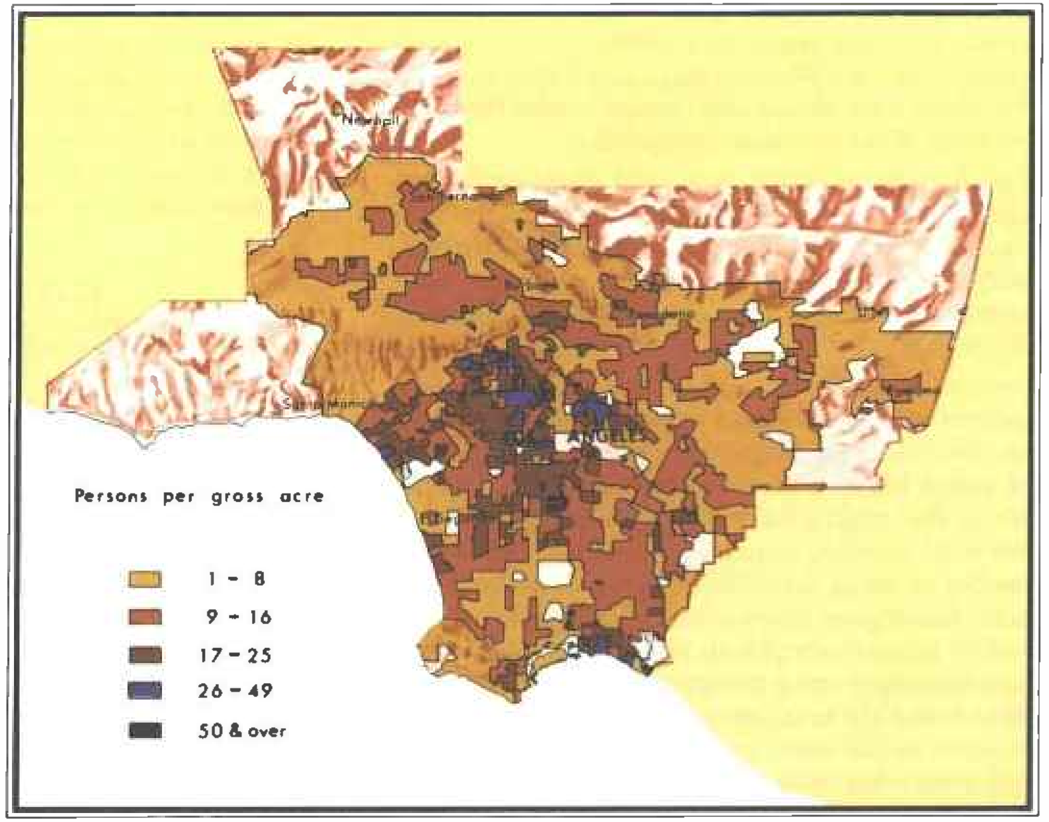
To complete the rapid transit planning and engineering, the District continued to utilize the experience and technical talents of the consultants who had done the previous preliminary work.

Coverdale & Colpitts, consulting engineers on passenger traffic, revenue and financial operating results, were retained to develop passenger traffic projections for the various alternative route alignments and station locations considered in the course of line location studies in the corridors, and to prepare the estimates of traffic, revenues and financial results of operation for the District's total system – incorporating the rapid transit routes recommended in the planning and engineering studies.

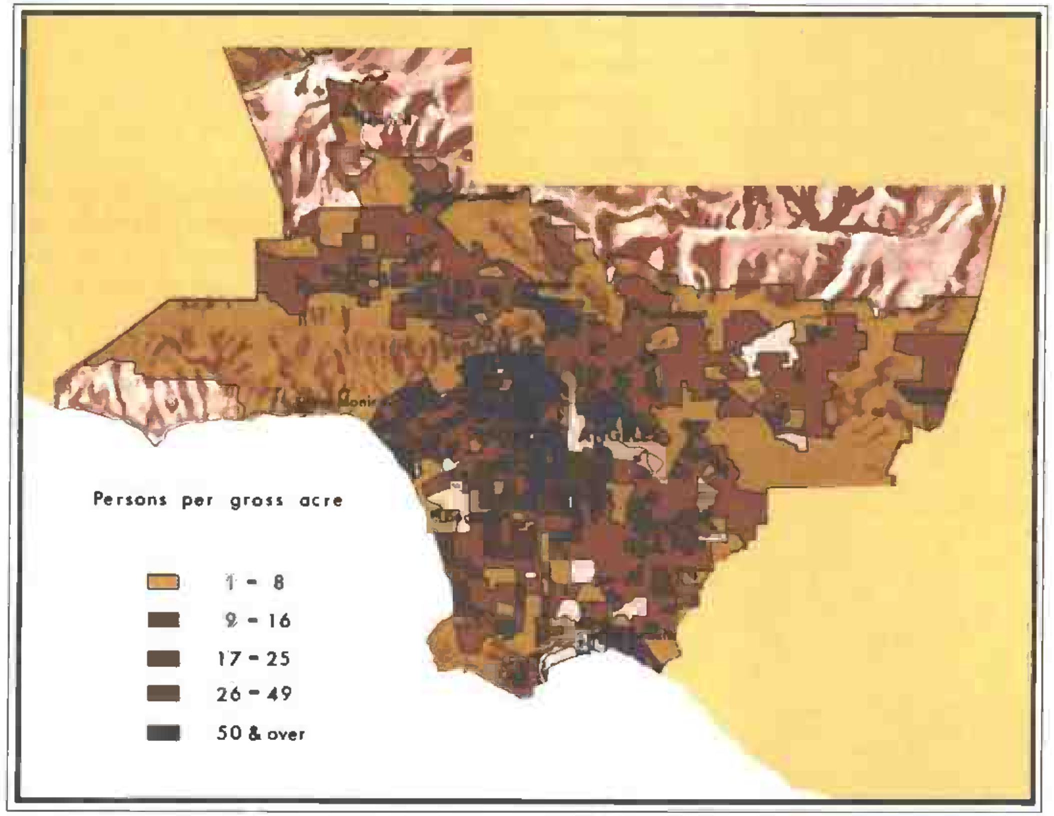
Kaiser Engineers and Daniel, Mann, Johnson & Mendenhall in a Joint Venture provided the planning, engineering and architectural studies, and determination of preliminary estimates of construction costs for the lines in the four initial-priority corridors.

DEVELOPMENT OF PRELIMINARY REPORT

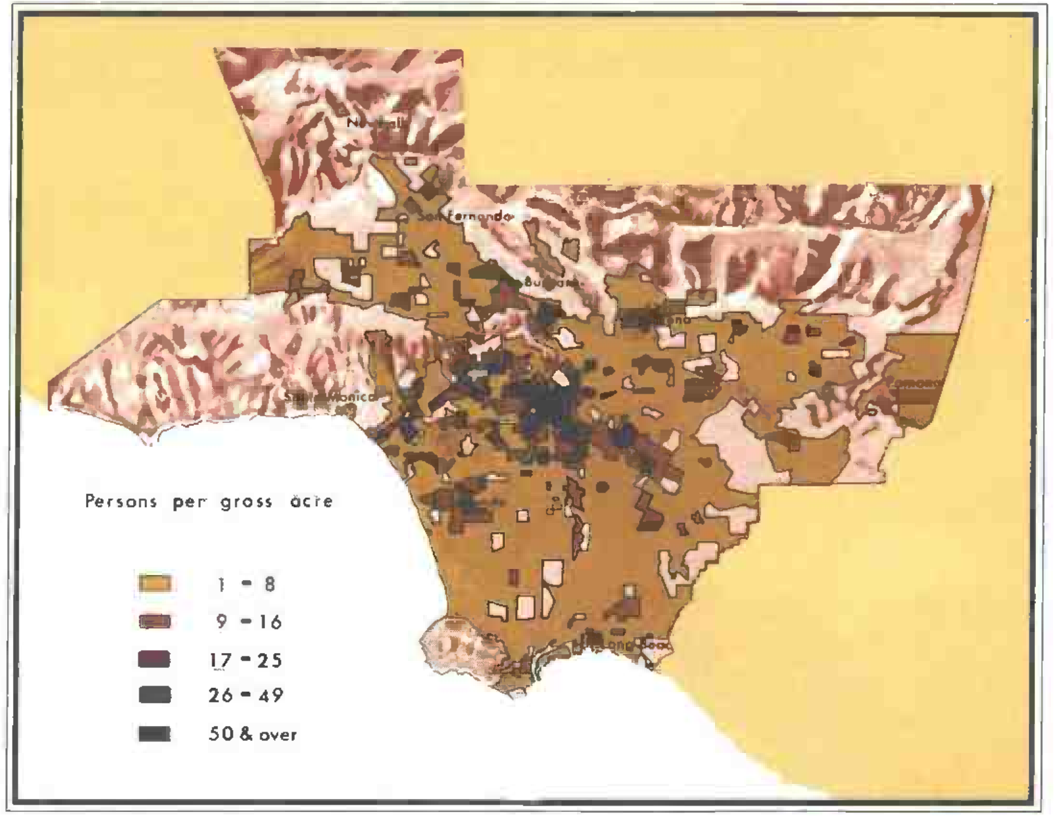
Details of the program for the planning and preliminary engineering of lines in the four initial-priority corridors



1960 POPULATION DENSITY

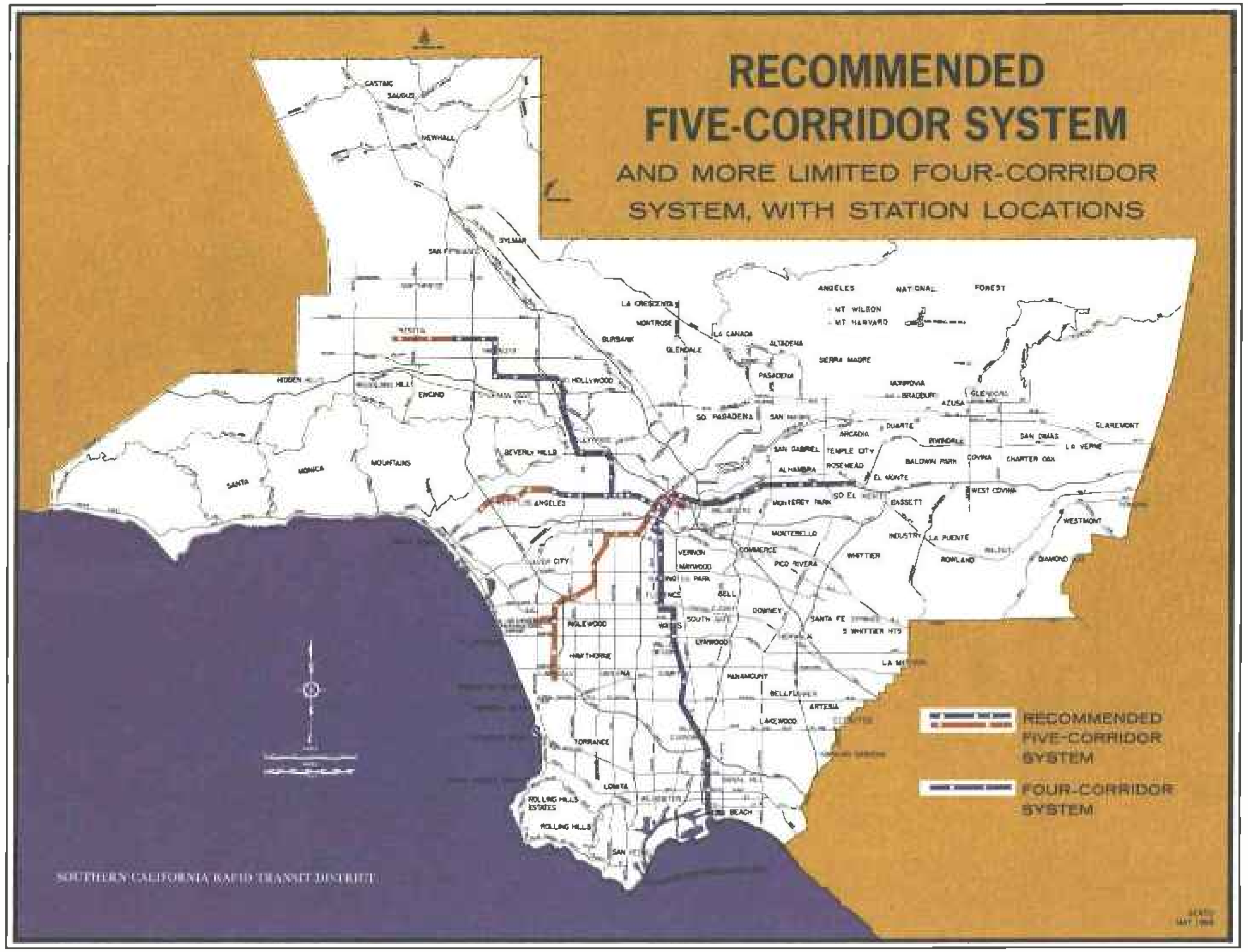


1980 POPULATION DENSITY



1980 EMPLOYMENT DENSITY

These three maps were prepared as part of the Los Angeles Regional Transportation Study, conducted by the State Division of Highways and participated in by the cities, counties and transportation agencies of the Southern California area.



were announced by the District at a meeting on December 12, 1966 to which the governing officials of the County of Los Angeles and all cities in the county were invited. The active participation of all concerned governmental agencies was asked. Throughout the course of the engineering work the District staff maintained close liaison with each affected municipality, securing from their planning and public works staffs an intimate understanding of local factors, desires and needs.

Work of the engineering consultants started in November 1966. Surveys were made of feasible alignments and design concepts in each corridor. Practical alternates were identified — after consideration of passenger service convenience in residential and destination areas, master plans, land use plans, community development objectives, topography, right-of-way availability, physical and economic impact of line and stations, and other pertinent factors. Meetings were then held in each of the corridor areas, at which various alternatives were detailed and discussed. Community comment was solicited, and the inter-relationship of adjacent community interests and desires explored. Based on data obtained at all these meetings and conferences, specific route alignments and station locations for presentation in a Preliminary Report were selected. Work on the preliminary design and engineering and cost estimating was carried forward on the selected route alignments.

AIRPORT-SOUTHWEST CORRIDOR

The community-wide discussion of transportation needs developed by the planning studies for the four-corridor system also revealed an intense public concern for improved access to Los Angeles International Airport. In addition to airport parking, actual physical access to the Airport has become a critical problem with the tremendous growth in air passenger travel. The Department of Airports has discussed creation of a city passenger terminal at Union Station in downtown Los Angeles to provide extensive parking and high speed transportation to International Airport. Responding to this need, the RTD Board authorized inclusion of an Airport-Southwest Corridor route in the preliminary engineering studies. The engineers were instructed to design a line which would provide a rapid transit service operationally integrated with the basic four corridors as well as a high-speed service for airline passengers and baggage between the projected downtown terminal and the Airport. Since the Terminal Annex Post Office is immediately adjacent to the Union Station site of the Airport Department's proposed metroport, consideration was also directed to the handling of mail. The Joint Venture was authorized to subcontract to M. A. Nishkian and Co., of Long Beach, the alignment and facilities design work on the added Airport-Southwest Corridor to expedite completion for the Final Report on the same schedule as the

four-corridor system engineering then in progress. The firm of Day and Zimmermann, Inc. was retained to study airport express passenger and mail service.

PRELIMINARY REPORT

The Preliminary Report required by Section 30636 of the District Act was adopted and officially transmitted to all municipalities and the County of Los Angeles on October 30, 1967. The Report included the detailed engineering description of 62 miles of route proposed for construction in the four basic corridors, plus the projected alignment and advance estimate of construction cost of the Airport-Southwest Corridor line.

The four-corridor system extended to Fairfax Avenue in the Wilshire Corridor, to Balboa Avenue in the San Fernando Valley, to Peck Road in El Monte and to Ocean Boulevard in Long Beach. The system proposed 21 miles on skyway structure, two miles in open cut, 18 miles in subway and 21 miles at grade.

Projected revenues were estimated as sufficient to cover all operation, maintenance and replacement of equipment together with some possible contribution to bond retirement. The capital cost of the system, financed by bonds authorized by a vote of the people, would be met principally by tax funds. While the property tax is the only form which the Act presently authorizes the District to submit to the voters for capital financing, alternative sources of tax support which had been considered by the State Legislature were examined in the Report.

COMMUNITY RESPONSE TO PRELIMINARY REPORT

In releasing the Preliminary Report, the District requested comment and suggestions from all concerned municipalities. District staff personnel conferred with local agencies to provide information and assistance in review of the Report. Nine well-publicized community meetings were held in various sections of the District, with official and personal comments requested. Subsequent to a 60-day review period, the District advertised and held a public hearing on January 15, 1968 on the plan presented in the Preliminary Report. Representatives of municipalities, citizen organizations and private individuals appeared and offered recommendations and comment.

No city disapproved proposed alignments within its borders as being inconsistent with its master or general plan.

The County of Los Angeles found the proposed system, including the Airport-Southwest Corridor line, and subject to certain recommendations, to be a "desirable and necessary adjunct to the overall transportation needs within the Los Angeles Metropolitan Area and that the proposed system falls within the guidelines of the Policy on Transportation Planning as recommended by the Regional Planning Commission on November 29, 1966 and endorsed by the Board of Supervisors on January 31, 1967."

RECOMMENDATIONS TO THE DISTRICT—

MODIFICATION OF ROUTES

The City of Huntington Park, the County of Los Angeles and the City of Los Angeles proposed relocation of that portion of the Long Beach Corridor between the Los Angeles Central Business District and the point at which the Preliminary Report alignment entered the right-of-way of the projected Industrial Freeway north of 103rd Street.

The City of Huntington Park objected to the alignment on skyway structure in the median of Pacific Boulevard and suggested an alternate location in the vicinity of Santa Fe Avenue.

The County recommended inclusion of the rapid transit line in the Industrial Freeway north of 103rd Street.

The City of Los Angeles recommended modification to an alignment in the Central Business District to serve the southeasterly portion of the District in which the garment industry is concentrated, and thence southerly along Central Avenue.

The alignment proposed by the City of Los Angeles seemed to accommodate the intent of the other suggestions and, at the same time, afforded improved access to the residential areas of south central Los Angeles. The rapid transit line plus a substantial enlargement and augmentation of surface bus services would also provide a major improvement in public transportation in an area of recognized need. Industrial employment opportunity exists along and within the service area of the proposed new routing. With cooperation of other public agencies, final design of the transit facility could stimulate many desirable improvements in the area.

In this Final Report, the District proposes an alignment generally as recommended by the City of Los Angeles. It starts south from 7th Street via Broadway, proceeds easterly in private right-of-way just north of 25th Street, and then south adjacent to Central Avenue to the vicinity of 91st Street. Thence it goes east in private right-of-way to join the Industrial Freeway routing proposed in the Preliminary Report.

For the San Gabriel route, the City of Los Angeles recommended construction through the East Los Angeles area in the vicinity of Brooklyn Avenue, instead of the proposed alignment near the District's Macy Street Yard property and in railroad private right-of-way along the San Bernardino Freeway.

The County, however, recommended that service needs at General Hospital be given major consideration. The Preliminary Report routing serves the hospital, and nearby residential areas will have convenient access to the rapid transit line at the County Hospital stop by bus. This augmented feeder service will improve access to the Hospital by surface transportation as well.

The alignment via Brooklyn Avenue would have made the route 1.49 miles longer, adding significantly to the travel time of most users of the line. It also substantially increases cost of construction and prevents access to Macy Yard, a strategic storage and maintenance facility difficult to replace in the central area. The Final Report, therefore, retains the alignment proposed in the Preliminary Report in this area.

The City of Los Angeles recommended subway or other alternative to aerial structure in the San Fernando Valley and objected specifically to the proposed use of aerial structure on Van Nuys Boulevard between Chandler Boulevard and Sherman Way. All alignments which were proposed for aerial structure in the San Fernando Valley with the exception of the Van Nuys Boulevard section were in untraveled medians of wide boulevards completely unused and largely unimproved, in railroad rights-of-way, or in private rights-of-way to be acquired.

The Final Report recommends that the proposed Van Nuys Boulevard alignment be relocated to private right-of-way one block west of Van Nuys Boulevard.

SYSTEM EXTENSIONS

The City of Los Angeles, the County of Los Angeles and many residents of the area recommended extension of the Wilshire Boulevard line to the West Los Angeles area. The City of Beverly Hills, through which the extended line would pass, did not take an official stand on the matter.

Residents of the San Fernando Valley requested extension of the San Fernando Valley line westerly from the proposed first-stage terminus at Balboa Boulevard.

The City of Los Angeles and the County of Los Angeles urged the inclusion of the Airport-Southwest Corridor line in the first-stage system.

The District recognized the desirability of these extensions and has included them in the proposed first-stage of construction. Preliminary engineering has been carried forward on these extensions, and construction and operating cost estimates which include them have been developed for this Final Report.

FINANCING

Construction of rapid transit will require support in the form of tax funds sufficient to meet debt service on bonds authorized by the electorate and issued to finance the capital cost of the facilities. The District Act now provides only that such funds be secured by annual tax levy upon property in the District. In the many meetings and conferences on the Preliminary Report which have been held throughout the area, the District has been repeatedly advised by public officials, civic organizations and the general public that general property taxes should not be used as a primary source of funds for rapid transit capital financing. The unanimity of opinion cannot be disregarded. The District, therefore, concludes that:

1. Some form or forms of tax resource other than the general property tax must be made available to the public to finance rapid transit construction. It must, of course, be in the amount sufficient to meet debt service – with only security back-up from general property tax necessary to obtain a favorable interest rate.
2. The extent of system which can be undertaken as a first phase of rapid transit development will depend upon the amount of such tax resources available.

PROPOSED SYSTEM FINANCING

In response to the strong recommendations of both official government agencies and the general public, the District proposes a first-stage system which includes the 62-mile system presented in the Preliminary Report, modified as described above, plus extensions to Barrington Avenue in the Wilshire Corridor and to Tampa Avenue in the San Fernando Corridor, and the inclusion of the Airport-Southwest Corridor line. The resulting first-stage system, therefore, includes 89 miles of rapid transit routes plus approximately 300 miles of new and augmented feeder bus lines. The capital cost of the system, including feeder buses and the retirement of the District's existing revenue bonds, is $2,514,861,000.

Consulting Engineers, Coverdale & Colpitts, find that the estimated passenger revenues of this basic five-corridor rapid transit system and the local and feeder bus system will meet costs of operation and maintenance and provision for the replacement of equipment. No revenues are projected for the payment of debt service.

In view of the substantially universal public opposition to the use of property tax funds to finance the capital cost of the system, the District proposes that provision be made by the State Legislature for financing support from some alternative form or forms of tax. The firm of Stone & Youngberg, engaged by the District to advise on the development of a financing program, sets forth in the Financing Section of this Report the projected annual debt service requirements for the financing of the system, and the finding that the entire 89-mile, five-corridor system could be financed by a ½ of 1 percent general sales tax. Other forms of tax support which have been suggested, including the sales tax on gasoline or the 1 percent in lieu tax on motor vehicles, would not alone permit financing of either the five-corridor system demanded by community consensus, or the four-corridor system described in the Preliminary Report. If the Legislature authorizes a tax-support program (other than property tax) sufficient to finance the basic 89-mile, five-corridor system, the District will – after hearing on the Final Report as provided for by law – submit to the electorate a proposal for the financing and construction of the five-corridor system.

If the level of tax support available is insufficient to finance the 89-mile system – but would provide for debt service on the 62-mile, four-corridor system proposed in the Preliminary Report with modifications in alignment adopted as the result of community response to the Report – the 62-mile system and supporting tax proposal for its capital cost of $1,666,926,000 will be submitted for approval of the electorate.

INTRODUCTION TO THE RECOMMENDED SYSTEM

The District is much aware that the development of an adequate system of public transportation will have a pronounced effect on all facets of community activity and development. Accordingly, the District has retained an inter-disciplinary team of architects, engineers, economists, scientists and experts in such specialized fields as acoustics and soil structure to accomplish the preliminary study and design work for the system proposed herein – with the District professional staff exercising management supervision and policy control.

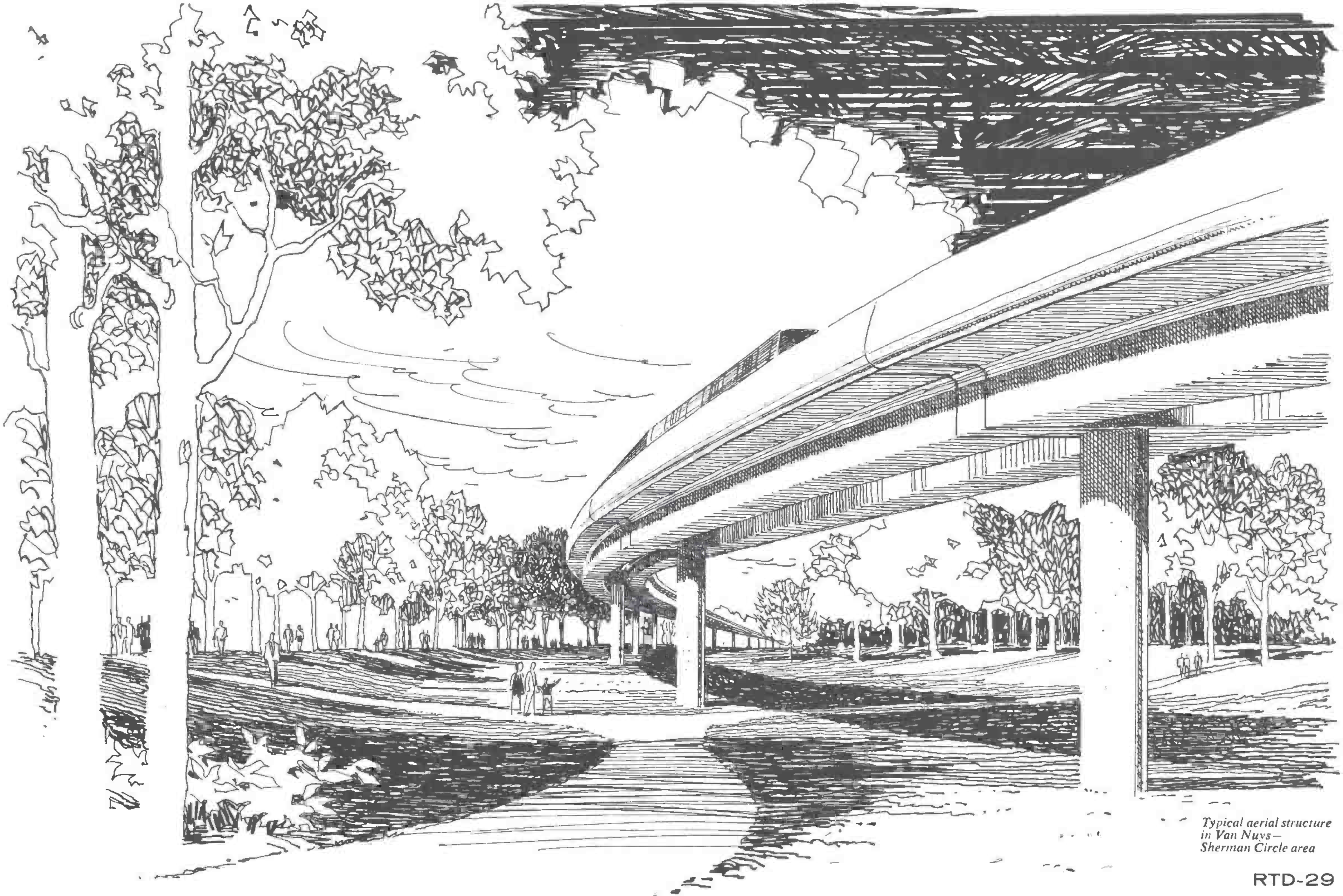
The dynamic nature of the Southern California area demands a multi-moded, balanced transportation system. The assigned objective to all consultants, therefore, was to develop a system which would fit this concept.

THE PRELIMINARY DESIGN PROGRAM

This project is perhaps unique in that the public has been a continuing and integral part of the design team. In drafting the District Law, the State Legislature insured that any mass rapid transit program for Southern California would be one of the most thoroughly reviewed and discussed proposals ever to be submitted to any electorate.

In addition to the public review programs of the two reports required by District Law, the District has carried on an extensive meeting and conference program to acquaint the planning and engineering staffs of every online community and affected public agency with the details of the system as they have been developed. The comments, criticisms and suggestions resulting from this series of conferences and hearings were carefully considered during each succeeding step of the program.

The engineering and planning has been carried out to the depth necessary to assure that design is logical and feasible and that construction can be accomplished within the estimated costs and contingency allowances. When



Typical aerial structure in Van Nuys—Sherman Circle area construction of the project is funded, the District will complete the detailed field surveys, research, design calculations, and the preparation of right-of-way acquisition, construction plans and specifications necessary for bid requests and actual construction.

PROFESSIONAL COOPERATION

Many professional engineering organizations have cooperated and helped in this effort.

An outstanding case of inter-agency cooperation is evidenced by tremendous amounts of valuable information readily made available to the District by the San Francisco Bay Area Rapid Transit District and Washington (D.C.) Metropolitan Area Transportation Authority. The American Institute of Architects and the Structural Engineers Association of Southern California, and especially the technical staffs of planners and engineers from all of the on-line cities and agencies, have provided invaluable assistance and comment. Various sections of the American Society of Civil Engineers and the National Society of Professional Engineers have shown keen interest in the program and have been kept fully informed.

COMMUNITY AND PATRON FACTORS VITAL IN DESIGN AND ROUTE SELECTION

Architectural and aesthetic considerations have been given paramount attention to insure a system which maintains a compatible relationship with the communities and areas through which it passes. In determining route alignments, maximum use was made of public streets, freeways and/or railroad rights-of-way in order to minimize use of private property and to avoid separation of portions of communities beyond that already due to existing railroads, major streets or freeways.

Stations have been designed and planned to be functional and aesthetically pleasing, and in harmony with the environmental goals of each community. Particular attention has been given to capitalize on every opportunity to bring natural light into the subway stations. Off-street facilities have been provided for ease of bus and automobile access to rapid transit stations, as well as ease of pedestrian access through ground floor levels of buildings, rather than exclusively from sidewalk areas.

Comfort, convenience and safety of transit patrons have been of major importance in the design of the transit vehicle. Sleek, modern trains will have interiors which offer wide, cushioned seats, air conditioning, soundproofing, soft but reading-level lighting and attractive color combinations. Car propulsion and control systems will provide smooth acceleration and braking which are rapid, yet comfortable for the passenger.

Maximum use is made of automated devices which will provide punctual, safe train operation. Automatic, computer operated train control will provide the system with more frequent and reliable performance than would otherwise be possible. Automatic fare collection equipment will simplify and speed collection of fares. Station and train attendants will also be on hand to assist patrons as needed.

DESIGN ALTERNATIVES

During the development of the recommended plan, several design features with possible alternatives were recognized as worthy of more detailed study and analysis. Thus, the individual design of each station and of the aerial structure may be further refined. Subway ventilation and station environmental control will receive additional study to determine the optimum system. Basic, proven systems have been used for the purpose of estimating system costs; any future changes will be those which represent technological advances to the selected systems and make them more efficient and/or less costly than those used as the basis for this report. Such an approach avoids expenditure of additional funds for preliminary engineering, yet leaves the way open for selection of the best arrangement during the process of the final, detailed system engineering which will follow system financing.

During the process of final design preparation, the latest developments in systems, materials and equipment technology will be carefully examined so that improvements can be incorporated into the project. Stations and structures on their fully grade-separated rights-of-way will retain their unique character as protected, traffic-free alignments for adaptation to any substantially improved high-capacity passenger transit system for urban and suburban service which may evolve from future technology.

RIGHT-OF-WAY

Acquisition of private property for way structures and station facilities has been kept to a minimum consistent with the necessity to locate lines and stations where they will provide optimum service to the community.

The recommended plan includes rail lines placed in subways, in open cut, above ground level on fill, at grade and on aerial structure, with the specific configuration selected which is most economical and most compatible with adjacent land use and existing major utilities.

Subway construction has been proposed in those areas where high property values preclude above-ground construction in private right-of-way. This includes portions of Hollywood and Long Beach, the Wilshire Corridor, and in downtown Los Angeles.

The economy of constructing rail lines on the surface is offset if there are frequent cross streets which must be carried over or under the transit line. Within the urban area, at-grade configurations are best utilized in freeways with adequate medians which are already grade-separated, such as in the San Bernardino Freeway or in the proposed Industrial Freeway.

Aerial structures provide an economical and feasible trackway, especially where routes follow railroad rights-of-way or the medians of wide public streets. Generally, open cut and elevated embankment configurations are used as economical adjuncts to subway or aerial construction. They are limited in application because of possible conflict with adjacent land use or with major utilities, and where the cost of right-of-way is high. Air rights over open cut sections may, however, provide desirable locations for building development.

It has been possible to route the proposed five-corridor system with a relatively small amount of private property acquisition. Of the total 89 miles of line: 28 miles will be in subway or tunnel, 17 will be in freeway or street medians, four will be in other public rights-of-way, 14 miles will be in easements allowing joint use of existing railroad property, 11 miles will require acquisition of railroad property that is now receiving only minor use. Only 15 miles, or 17 percent of the proposed system will require private residential, commercial or industrial property for trackage.

In residential areas where private rights-of-way are used for aerial track structures, the ground areas will be landscaped and thus be available for parks, playgrounds and other appropriate uses. In commercial or industrial districts, ground space can be used for parking. The combined utilization of the right-of-way will thus be economical in use of land and meet community needs.

Wherever possible, the District has proposed joint use of rights-of-way now used for existing railroad operation. This assures most economical use of the land and avoids unnecessary partitioning of the community.

AIRPORT EXPRESS SERVICE

One pressing requirement for the Los Angeles area is access to the Los Angeles International Airport. The existing problem of traffic congestion will become much more critical. In 1967, there were 17 million air passengers. The estimates of growth vary from airport consultants Landrum and Brown's estimate of 40 million airline passengers by 1975 to The Department of Airports' estimate of 57.5 million in 1975.

A special study was initiated to determine how the requirement for quick, reliable, and efficient means of movement to and from the airport could be met under the Master Plan Concept. This study has indicated that it is feasible to operate a special Airport Express service in addition to regular rapid transit on the Southwest Corridor line. The Airport Express will provide high speed travel between the proposed City Airline Passenger Terminal or Metroport at Union Station and the Los Angeles International Airport with only one intermediate stop at Seventh and Flower Streets. It is proposed that the Department of Airports provide the facilities beyond the limits of local service lines at the Metroport and the Airport. The study also found that it will be feasible to provide for the transportation of containerized mail for the United States Post Office on the Airport Express service between the Terminal Annex Post Office, adjacent to the Metroport, and the Airport. The District will need permissive action from the State Legislature in order to provide this mail service.

PROPOSED SYSTEM AND THE MASTER PLAN CONCEPT

The Master Plan Concept contemplates prompt construction of the first-stage, five-corridor system. The high capacity, grade-separated, reliable trunk lines proposed in this report are an essential part of a balanced transportation system in the Los Angeles urban area. They provide for a need which is clearly evident now and, at the same time, allow for a necessary degree of flexibility to meet future growth patterns.

The advantages of high-speed rapid transit can be extended to virtually every part of the metropolitan area by coordinating the trunk line system with existing bus lines and the additional feeder bus lines which will be established specifically to bring the commuter from his home to the nearest rapid transit station.

Feeder bus lines will provide two types of service: local bus service within two or three miles of the rapid transit stations and express buses providing connecting service with the rapid transit lines.

Many communities beyond the convenient limits of local feeder bus service will be able to link into the system through the high-speed express buses, pending extension into their areas of further stages of the fully grade-separated rapid transit lines.

The area of influence of the rail rapid transit lines can be extended substantially. Examples of typical travel times for combined express bus-rail service are shown in the accompanying table.

**TYPICAL RUSH HOUR TRAVEL TIMES
EXAMPLES OF COMBINATION EXPRESS FEEDER
BUS-RAIL RAPID TRANSIT TRIPS**

Origin		Destination	Rush Hour Travel Time in Minutes
Burbank	to	7th & Flower	35
San Pedro	to	Central & Gage	37
Lakewood	to	Olympic & Broadway	37
Northridge	to	Wilshire & Western	42
Norwalk	to	Central & Vernon	28
Pasadena	to	6th & Broadway	24
Pomona	to	Beverly Hills	66
Santa Monica	to	Wilshire & Normandie	31
Whittier	to	Los Angeles Civic Center	42

Some of the express bus links may be provided with exclusive lanes in future freeways, thus extending a form of grade-separated rapid transit in advance of the time when the greater capacity of rail service is required.

Simultaneous with the development and inauguration of rapid transit and local and express feeder bus services will be the expansion of the District's existing bus system into areas not now serviced, providing even greater benefits from the effective coordination of both rail and bus.

CAPITAL COST OF THE RECOMMENDED SYSTEM

The costs of construction of the Recommended Five-Corridor System and four-corridor system have been estimated by the Joint Venture engineers. The estimates assume construction of the system during the period 1969-1977 and include allowance for price escalation during the construction period. Provision is made for acquisition of required rights-of-way and the purchase of bus equipment for the expanded feeder services. The financing of the rapid transit system will require retirement of the outstanding portion of the revenue bond issue under which the Los Angeles Metropolitan Transit Authority acquired the existing properties. The proposed system financing also includes the estimated cost of planning and preliminary engineering on the second-stage rapid transit lines in the Master Plan, which the District will initiate as soon as the funds become available. The total required financing is set forth in the following tables.

RECOMMENDED FIVE-CORRIDOR 89-MILE SYSTEM
ESTIMATED CAPITAL FINANCING REQUIREMENTS
SCHEDULE OF CASH FLOW — FIGURES IN THOUSANDS OF DOLLARS

	1/1/69 to 6/30/69	7/1/69 to 6/30/70	7/1/70 to 6/30/71	7/1/71 to 6/30/72	7/1/72 to 6/30/73	7/1/73 to 6/30/74	7/1/74 to 6/30/75	7/1/75 to 6/30/76	7/1/76 to 6/30/77	Total
System Construction*	8,606	52,542	156,006	329,341	461,810	481,058	340,279	149,137	34,861	2,013,640
Rapid Transit Vehicles			8,107	4,134	35,874	70,513	45,173	44,595	5,055	213,451
Rights-of-Way**	1,000	20,000	50,000	60,000	55,000	10,000	5,000	2,000	1,000	204,000
Retirement of LAMTA Revenue Bonds	31,500									31,500
Feeder Buses				1,600	3,000	6,500	15,000	15,000	3,170	44,270
Second Stage Preliminary Engineering***	8,000									8,000
Yearly Total	49,106	72,542	214,113	395,075	555,684	568,071	405,452	210,732	44,086	2,514,861

*These figures include final design costs and provision for contingencies and price escalation.

**Does not include $42,000,000 which would be added to right-of-way and construction costs in the event railroad rights-of-way are not available.

***This program will continue throughout and beyond the construction period.

FOUR-CORRIDOR 62-MILE SYSTEM
ESTIMATED CAPITAL FINANCING REQUIREMENTS
SCHEDULE OF CASH FLOW — FIGURES IN THOUSANDS OF DOLLARS

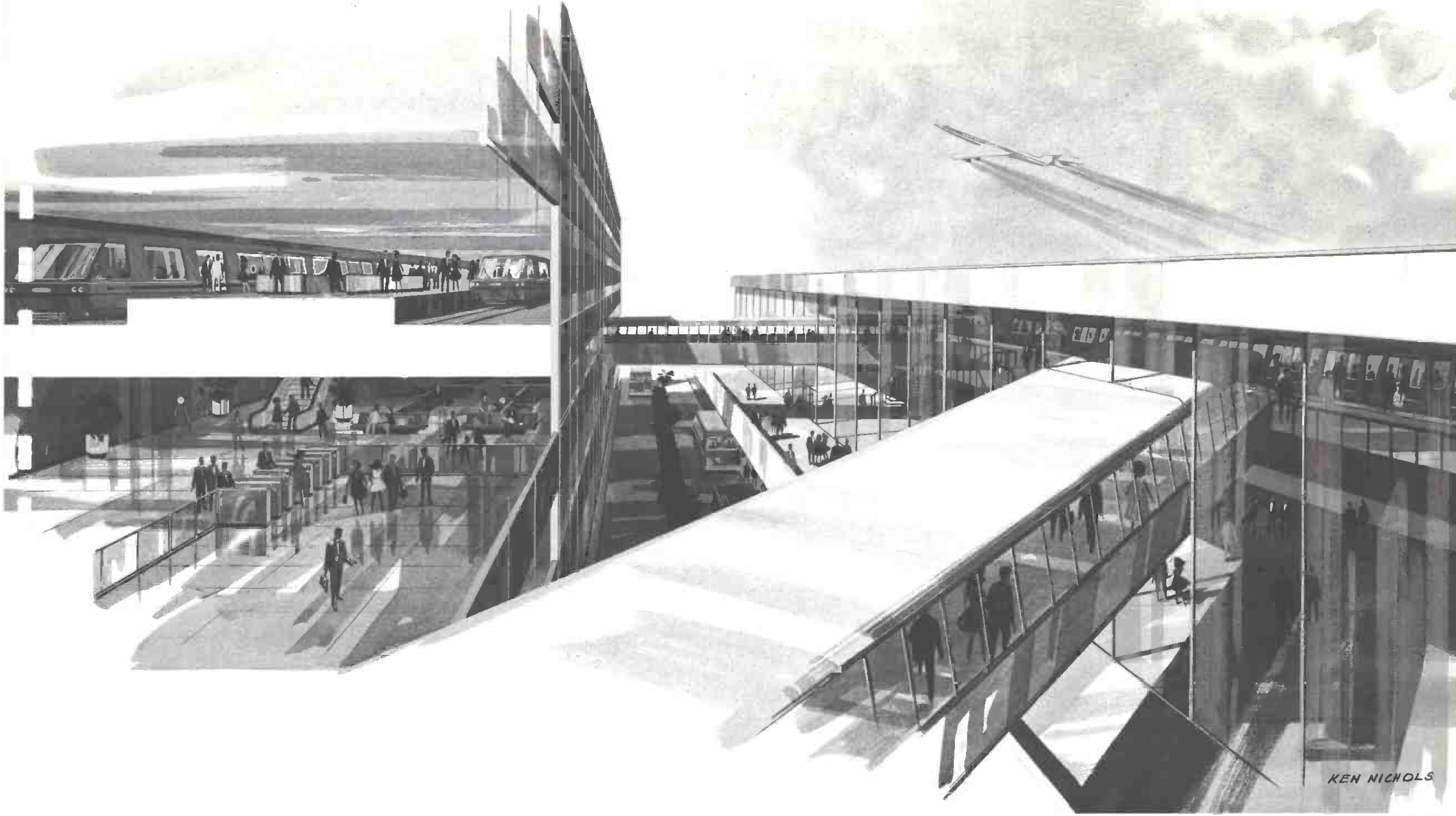
	1/1/69 to 6/30/69	7/1/69 to 6/30/70	7/1/70 to 6/30/71	7/1/71 to 6/30/72	7/1/72 to 6/30/73	7/1/73 to 6/30/74	7/1/74 to 6/30/75	7/1/75 to 6/30/76	Total
System Construction*	4,507	26,415	101,719	255,617	370,036	324,997	173,517	37,310	1,294,118
Rapid Transit Vehicles			7,056	3,598	33,939	69,301	31,658	3,726	149,278
Rights-of-Way**	1,000	20,000	50,000	50,000	20,000	5,000	2,000	1,000	149,000
Retirement of LAMTA Revenue Bonds	31,500								31,500
Feeder Buses				1,600	3,000	6,000	13,430	11,000	35,030
Second Stage Preliminary Engineering***	8,000								8,000
Yearly Total	45,007	46,415	158,775	310,815	426,975	405,298	220,605	53,036	1,666,926

*These figures include final design costs and provision for contingencies and price escalation.

**Does not include $42,000,000 which would be added to right-of-way and construction costs in the event railroad rights-of-way are not available.

***This program will continue throughout and beyond the construction period.

LOS ANGELES INTERNATIONAL AIRPORT STATION


KEN NICHOLS

PLANNING AND PRELIMINARY ENGINEERING

KAISER ENGINEERS / **DMJM**
DIVISION OF KAISER INDUSTRIES CORPORATION — DANIEL, MANN, JOHNSON, & MENDENHALL
A JOINT VENTURE

April 1, 1968

Southern California Rapid Transit District
1060 South Broadway
Los Angeles, California 90015

Gentlemen:

We are pleased to submit our Final Report on the planning and preliminary engineering for a rapid transit system for the Los Angeles Metropolitan Area. The technical effort required to produce the report has been accomplished in accordance with contract terms which called for the development of the Recommended Five-Corridor 89-mile system and the Four-Corridor 62-mile system.

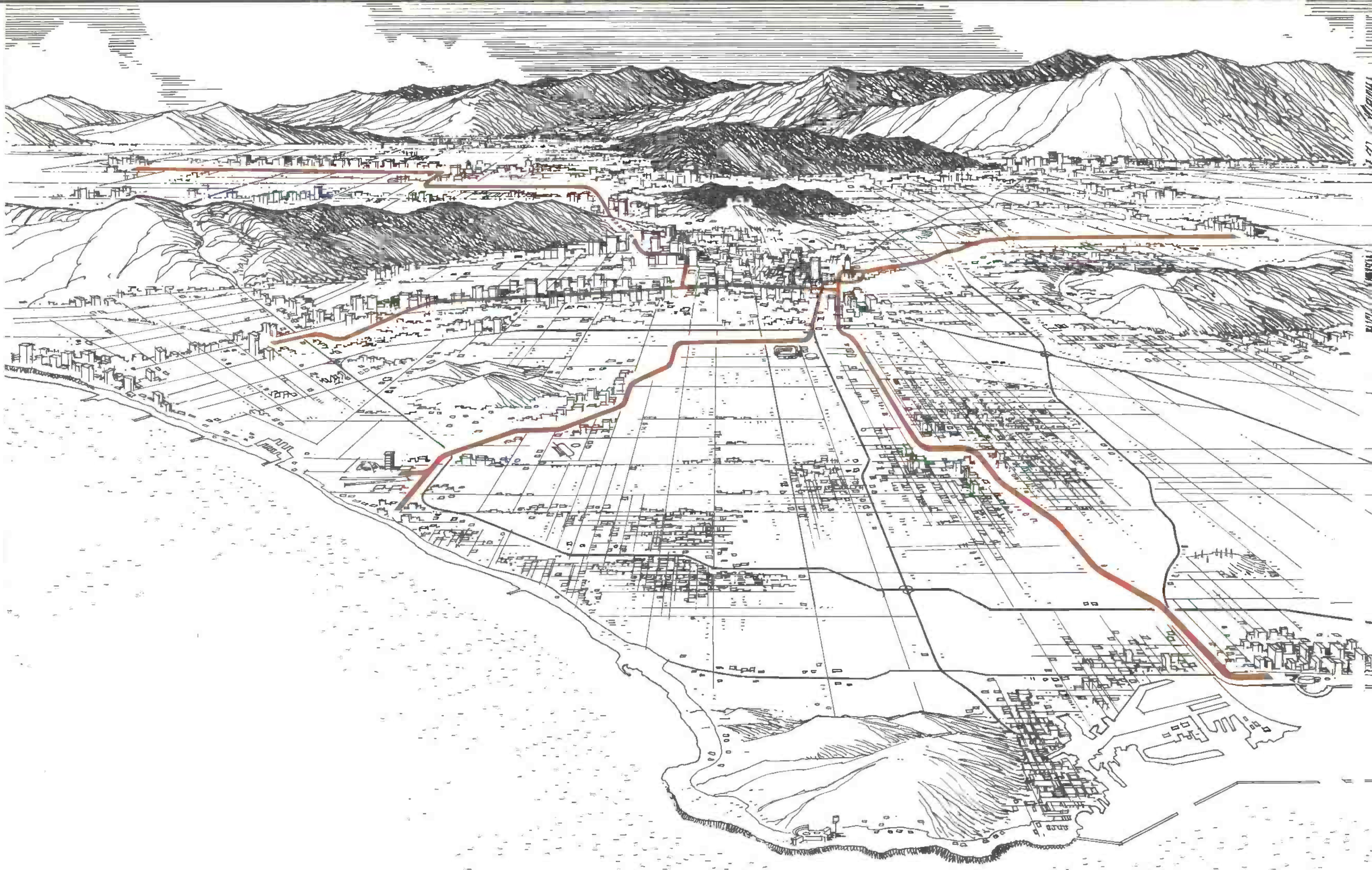
This report is a summary of major findings including route and alignment, facilities and systems design and estimates of capital cost. Reflected in this report is a careful review with the District of the community response to the Preliminary Report issued in October 1967. The system developed as a result of this review represents the first stage of a comprehensive public transportation system including rail rapid transit and feeder bus network. Additional data including preliminary drawings and specifications, design calculations and other technical backup material to the report are being submitted separately.

The scope and complexity of this most challenging program demanded and received the full extent of our combined planning, engineering and architectural capabilities, working closely with the professional staff of the Southern California Rapid Transit District whose cooperation and assistance we gratefully acknowledge. This acknowledgement also extends to numerous representatives of the various affected communities and public agencies who willingly contributed valuable data and comment essential to the conduct of this study.

Very truly yours,

KAISER ENGINEERS
Louis H. Oppenheim
Vice President and General Manager

DANIEL, MANN, JOHNSON, & MENDENHALL
Irvan F. Mendenhall
President



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INTRODUCTION

The preliminary planning and engineering required for the development of a modern and efficient rapid transit system for the Los Angeles Metropolitan Area is presented in this report. It is the second of a two-part program. The first part, or Preliminary Report presented in October, 1967, defined selected routes and station locations, described facilities and system concepts, and set forth the preliminary estimate of construction cost. This Final Report represents the continuation of these studies and presents the findings of the Joint Venture for the Recommended Five-Corridor System comprised of the Wilshire, San Fernando Valley, San Gabriel Valley, Long Beach, and Airport-Southwest Corridors; and the Four-Corridor System comprised of the first four corridors listed above and similar to that presented in the Preliminary Report.

The purpose of this current planning and preliminary engineering program has been to develop sufficient detail to accurately define the primary facilities and systems, and to permit the preparation of reliable estimates of construction cost. The first part of this program, described in the earlier Preliminary Report, was the route planning study which lead to the selection of the most favorable route alignment in each corridor. The selected routes were further analysed in light of the expressed desires of affected communities, necessary route modifications and changes were made, and the system routes were then finalized for preliminary engineering.

The second part of this program consisted of preliminary engineering of facilities and systems for the proposed rapid transit system. The scope of this effort encompassed research, investigation, comparative analyses, criteria development, design studies and calculations, and preparation of preliminary drawings and outline specifications. Detail route alignment investigations, plan and profile drawings, and right-of-way maps were developed for the entire system. Investigations were conducted of geological and soil conditions, sound and vibration control, and landscape treatment. The preliminary design of facilities, including stations, way structures and storage and maintenance facilities, was the culmination of comprehensive design studies and analyses which took into consideration functional, aesthetic and economic factors to best meet system design objectives. The vehicle, traction power, and control and communications systems design incorporates the most modern and technologically advanced concepts. Members of the Joint Venture staff have visited and studied all of the newer rapid transit systems in the world. In addition, an extensive review has been made of new concepts currently under research, or in testing and development phases. The end product of the preliminary engineering was the preparation of final estimates of construction, maintenance, and operation costs for the system's facilities and its equipment.

The development of the proposed rapid transit program was based upon the trunk line and feeder system concept. This report covers the trunk line elements of the overall system, and includes all facilities required for the rapid and convenient transfer of feeder system passengers to and from the trunk line rapid transit system. Major features of the trunk line rapid transit system presented in this report are route alignment, stations, way structures, yards and shops, subway ventilation, fare collection, transit vehicles, traction power, and control and communications. These are presented in the form of technical discussions and conclusions, plus graphics including maps, drawings and renderings, and summary tables of construction cost estimates and cash flow.

The planning and preliminary engineering work was performed by the staff of Kaiser Engineers and Daniel, Mann, Johnson, & Mendenhall, a Joint Venture. All engineering and planning was reviewed by a Technical Advisory Board composed of executives of the Joint Venture parent firms. The Technical Board and Key Staff members included:

- *Technical Advisory Board*

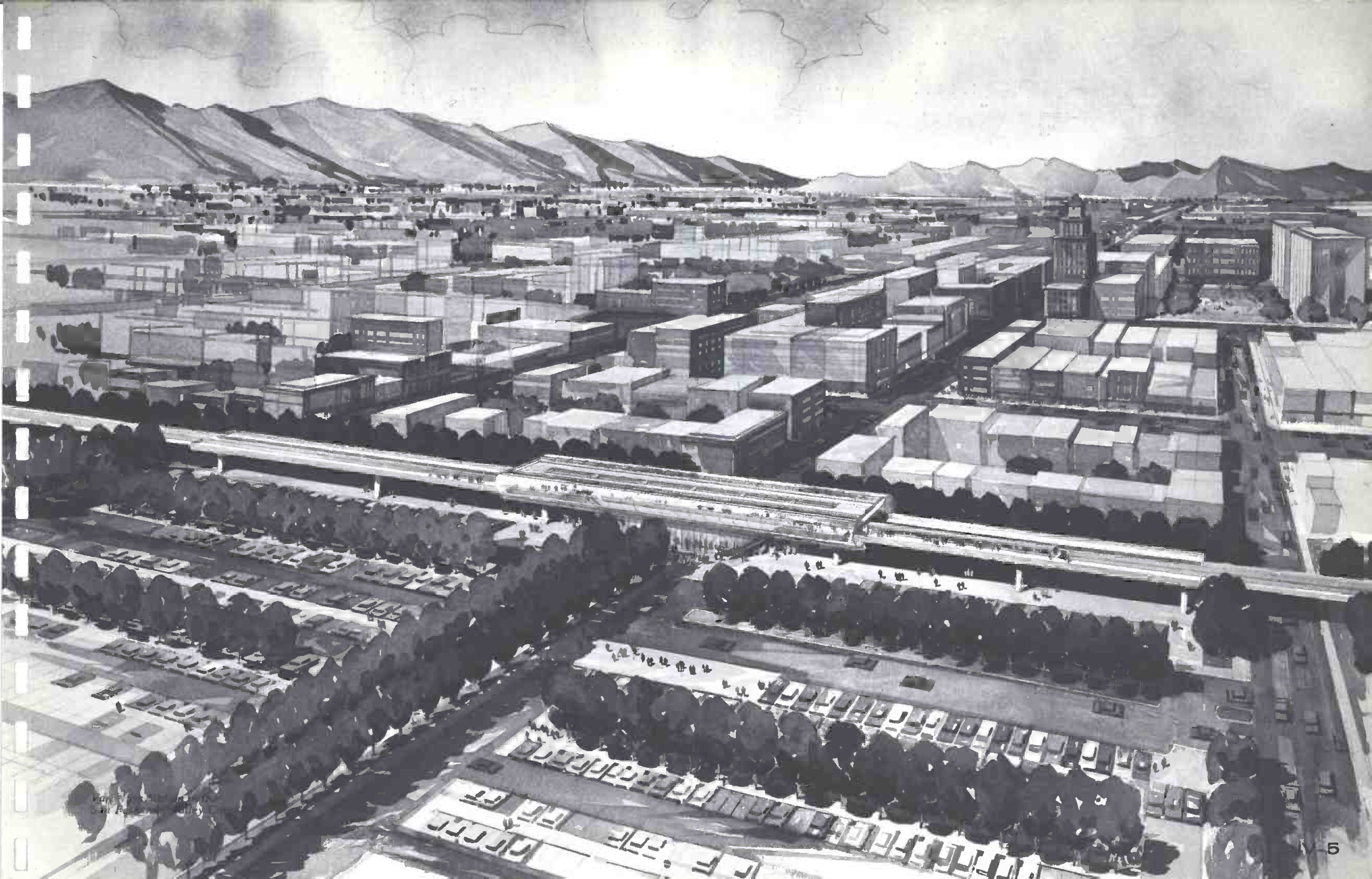
  V. E. Cole, Vice President, Kaiser Engineers
  T. K. Kutay, Executive Vice President, DMJM
  F. B. Tobias, Vice President, Kaiser Engineers
  D. R. Miller, Vice President, DMJM
  S. B. Svendsen, Vice President, DMJM
  H. A. Thomas, Manager, Transportation Projects, Kaiser Engineers

- *Joint Venture Staff*

  P. J. Iovin, Project Manager
  S. Magota, Deputy Project Manager
  R. C. Hammersmith, Office Engineer
  A. J. Lumsden, Project Architect
  W. A. Dela Barre, Project Planning Engineer
  C. C. Coppin, Project Electrical Engineer
  J. V. Ellis, Project Civil Engineer
  J. P. Cassidy, Project Structural Engineer

The following subcontractors and special consultants participated in the planning and preliminary engineering program and their work has been made a part of the Final Report:

- M. A. Nishkian and Company, Consulting Engineers, Long Beach, conducted design studies for the Airport-Southwest Corridor route including preliminary design of route alignment, way structures, stations, station site plans, electrification systems, storage and maintenance facilities, and prepared estimated construction, operating and maintenance costs.
- Dr. George Paul Wilson of Wilson, Ihrig & Associates, Inc., Acoustical Consultants, Berkeley, California, was retained as a Special Consultant for acoustical and vibration studies.
- LeRoy Crandall and Associates, Consulting Foundation Engineers, Los Angeles, California, conducted soils investigation studies.
- Eckbo, Dean, Austin, & Williams, Consultants in Landscape Architecture, Los Angeles and San Francisco, were retained as Special Consultants to prepare landscape development recommendations.
- Day & Zimmermann of Philadelphia, Pennsylvania, were Special Consultants to the District in the study of the needs and special arrangements for handling air travel passengers and their baggage, and for handling U. S. Mail on the Airport Express service.
- Sundberg & Ferar, Industrial Designers of Detroit, Michigan, conducted preliminary styling studies of the rapid transit vehicle.



PROPOSED RAPID TRANSIT SYSTEM

The character of the Los Angeles region, with its vast residential areas surrounding a high density, high employment urban core area, creates well-defined high volume travel corridors. These corridors are already seriously congested during peak hours and every indication clearly points to increasing volume demands. Therefore, any supplemental transportation element incorporated to satisfy this demand must have the highest practical capacity to meet both existing and future requirements. The grade separated trunk line and feeder concept has been selected because it best serves this region's public transportation needs as the first phase of a total public transportation plan. The bimodal feeder element provides service flexibility and wide coverage through buses and automobiles, and other systems which may be developed in the future, by linking these elements to a safe, fast and dependable trunk line operation through conveniently located stations. This system is specifically designed to provide optimum transit facilities which will economically meet and efficiently serve all existing and future patterns of regional development.

The trunk line element provides the primary transportation operation of the total system, and its vehicle system must have proven capabilities to meet long range, stringent requirements of safety, reliability, capacity, efficiency, speed and comfort.

A thorough investigation was made of all possible vehicle concepts. This included systems currently developed and in operation, as well as those in experimental and conceptual stages. Many of these systems are not applicable to a trunk line rapid transit system because they cannot meet the established requirements. Some of these systems have not been engineered sufficiently to permit proper evaluation, and they cannot be seriously considered at this time.

Based on the requirements of this system and today's knowledge and probable technological developments within the project schedule, the modern and thoroughly proved dual-rail, flanged-wheel vehicle is the most efficient, safe, comfortable, and reliable of all applicable systems. It is the most widely accepted vehicle concept for rapid transit systems because of its superior operational characteristics in switching, speed, and lower capital and operating costs. In addition, the bottom-supported dual-rail system is the one most adaptable for modification to accommodate future technological advancements such as the air cushion concept.

DESIGN OBJECTIVES

The following design objectives were established to provide the Los Angeles Metropolitan Area with the safest, most attractive, and modern system yet designed:

- The rapid transit system must provide the highest practical speed consistent with required station spacing.
- The rapid transit vehicle must provide maximum rider comfort, have a climate-controlled interior, and produce the lowest possible operational sound levels, both inside and outside.
- Train headways must be as close as possible to reduce waiting and transfer time to a minimum during peak hours.
- The system must provide maximum automation to insure safety and reliability.
- Structural systems, stations, and vehicles must be safe, maintenance free, and aesthetically pleasing.
- Stations and station areas must be well-lighted and provided with climate control in subway stations to create a pleasant environment for the passenger.
- Suburban stations must provide convenient parking areas consistent with land use and anticipated patronage.
- Interface with buses and automobiles at stations must be convenient.
- Maximum practical use must be made of existing transportation rights-of-way, including railroads, city streets, and freeways.

DESIGN REQUIREMENTS

The design parameters established for the proposed transit system impose stringent requirements on the design of various elements of the system. Some of these parameters are based upon passenger safety, comfort, and convenience; others are based upon operational requirements of capacity, headways, speed, and economy. The most significant design parameters are the following:

DESIGN CAPACITY

Headways, number of cars in a train, and maximum propulsion power demand are based upon estimated 1980 passenger volume.

SYSTEM OPERATION

Minimum operating headways	90 sec. under fully automated train control
Schedules – peak	90 sec. minimum
– off peak (daytime)	10 minute maximum
– off peak (evening)	15 minute maximum
Train makeup	8-car maximum 2-car minimum
Station dwell time	20 seconds

VEHICLE

Maximum speed	75 mph
Acceleration – maximum	3.5 mph/sec
Acceleration – service	3.0 mph/sec
Braking – emergency	3.0 mph/sec
Braking – service	2.6 mph/sec
Capacity – design	1000 passengers/train

FACILITIES

Stations	
Platform length	600 ft.
Platform width (min.)	22 ft. center platform 11 ft. side platform
Vertical circulation	Escalators
Fare collection	Fully automatic

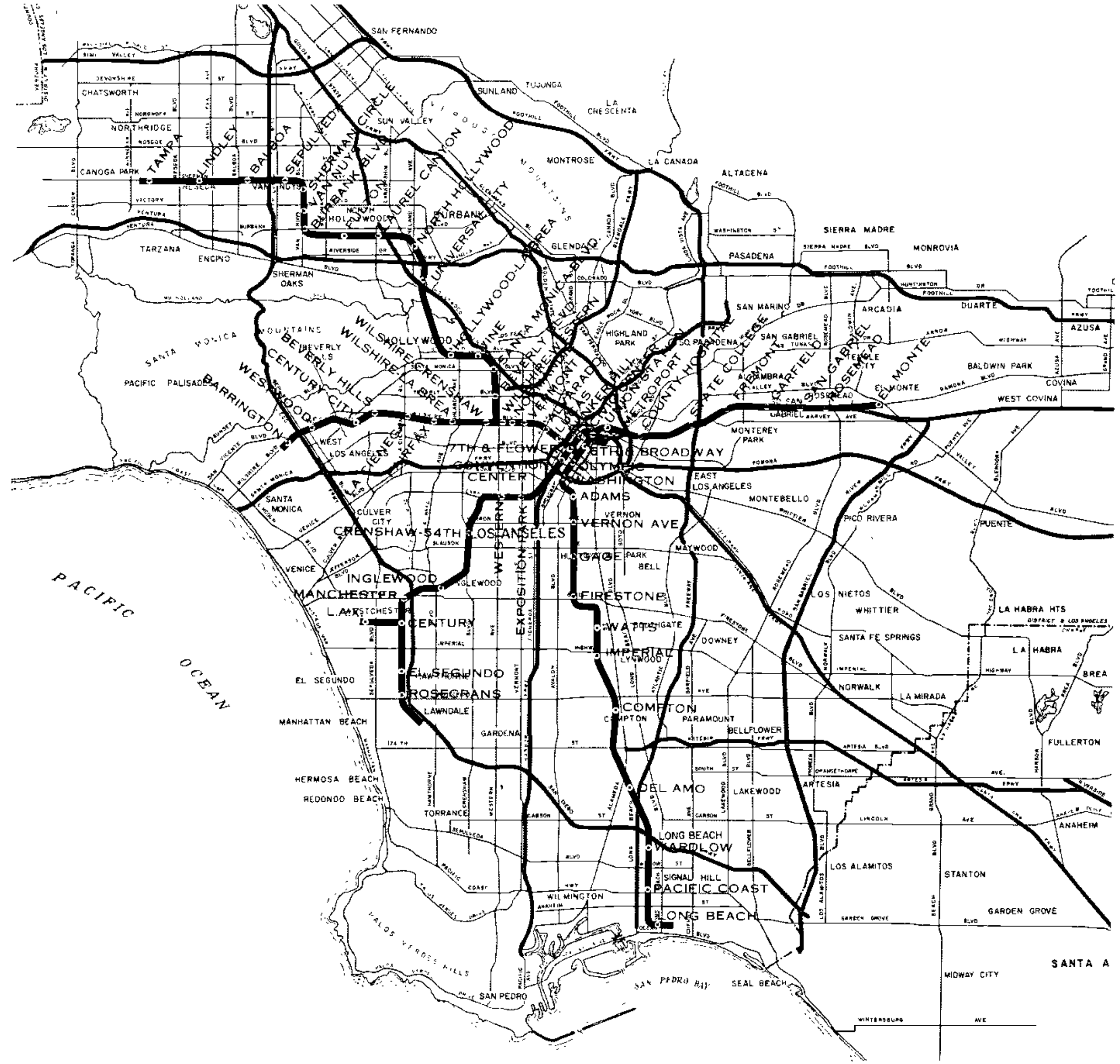
WAY AND STRUCTURE

Vertical clearance	16 ft. minimum over streets and highways, and 23 ft. minimum over railroads
Minimum curve radius	500 ft. minimum in main line and 275 ft. in yards and terminals
Maximum grade	3% for main line sustained and 4% for short distance

SYSTEM DESCRIPTION

Either the Recommended Five-Corridor or the Four-Corridor System will provide the highest possible quality of service. The system will incorporate the most modern and advanced technology in vehicle and operational systems. Passenger comfort and convenience will be primary in both vehicle and station design. Station interiors will be modern, attractive and will provide the passenger with a pleasing and comfortable climatically controlled environment throughout the year.

From the community standpoint, aesthetics were a paramount consideration in the design of way structures,



THE RECOMMENDED FIVE-CORRIDOR SYSTEM

stations, and vehicles. The latest techniques are incorporated to reduce noise to a minimum, both inside the vehicle and along the routes. Station areas and rights-of-way will be landscaped to provide pleasant surroundings.

The transit vehicle is a key element in the overall system because a substantial portion of the patrons' in-system time is spent within the transit car. To attract riders, the vehicle must provide a maximum of comfort and convenience, and include such features as air-conditioning, spacious seating, adequate lighting, quiet ride, and large window areas. The vehicle itself will be 75 ft. long with seats for 80 passengers, and it will be propelled by electric motors powering each axle. The vehicles will be connected into trains of two to eight cars to meet varying service requirements. The trains will have adequate power for a top speed of 75 mph with a design load of 1000 passengers in an eight-car train. Recently developed, precise and consistent automatic train controls will permit safe operation at these speeds with headways as close as 90 seconds. These operational capabilities will provide a capacity with normal loading conditions of 40,000 passengers per track per hour.

In this system, automatic train control will be accomplished by on-board digital computers to electronically start and stop the train, open and close the doors, and maintain safe train separation. A computer in the system control center will manage the overall train operation, maintain a check on each train position against its schedule, and make adjustments for changing conditions.

Vehicle storage yards will be located at or near the terminal in each corridor with the exception of the Wilshire Corridor. Car storage for that corridor will be in a yard located near Macy Street in East Los Angeles on land presently owned by the District. All yards will provide storage areas for the transit vehicles and for minor servicing and cleaning operations. Major service and repair work will be carried out at the Long Beach Corridor storage yard located in the Dominguez industrial area. Changes in train make-up to meet service requirements, as well as dispatching and withdrawing trains in service, will also be accomplished at each yard.

THE RECOMMENDED FIVE-CORRIDOR SYSTEM

The Recommended Five-Corridor System consists of 89 route miles in five corridors: Wilshire terminating at Barrington Avenue, San Fernando Valley terminating at Tampa Avenue in Reseda, San Gabriel Valley terminating near Tyler Avenue in El Monte, Long Beach terminating at Ocean Avenue and Pine Street in Long Beach, and the Airport-Southwest terminating at Rosecrans Avenue and Aviation Blvd. This system will contain 66 stations, 26 in subway, with a total parking capacity of 28,000 spaces at 30 stations. Off-street kiss-and-ride facilities will be provided at 37 stations and bus interface will be available at all station locations.

With the top speed of 75 miles per hour, the average speed in the suburban corridors will approximate 40 mph including station stops. Due to the close station spacing dictated by service to destination areas along Wilshire Blvd. and in the central business district, the Wilshire Corridor average speed is 34 miles per hour.

The Recommended Five-Corridor System operationally forms an "X" pattern including four of the corridors with the Airport-Southwest route operationally independent. Trains from the San Fernando Valley will normally continue into the Long Beach Corridor, while Wilshire trains continue eastward through the San Gabriel Valley. A full "Y" interchange is provided at 7th and Broadway to permit operational flexibility in balancing peak load requirements between corridors. A track connection is provided between the Airport-Southwest and the Long Beach routes to permit equipment servicing at the major shop facility in the Dominguez Yard.

Major transfer points in this system occur at the Western Avenue station where the San Fernando Valley route joins the Wilshire line, and at the 7th and Flower station where the Long Beach route joins the Wilshire line. In non-typical train routing, transfers may be made at 6th and Broadway or at Olympic and Broadway. In addition, transfers may be made at any station in the common section along Wilshire Boulevard. The Airport-Southwest Corridor provides additional intercorridor transfer at the 7th and Flower station and the Civic Center station.

An important operational feature of the Recommended Five-Corridor System is the introduction of an Airport Express service. This service will provide premium fare express service between the Los Angeles Department of Airports' proposed Metroport at Union Station and the Los Angeles International Airport with only one stop enroute at the 7th and Flower station. The Airport Express service will operate over the same trackage as Airport-Southwest local service, and will provide an over-all travel time between the Metroport and the Los Angeles International Airport (LAX) of 18.5 minutes. Transit cars will be slightly modified to provide a different seating arrangement and space for hand baggage. Each express train will include a special car for transporting containerized baggage and mail.

THE FOUR-CORRIDOR SYSTEM

The Four-Corridor System consists of 62 route miles in four corridors: Wilshire, San Fernando Valley, San Gabriel Valley, and Long Beach. In this system, the San Fernando Valley Terminal will be located at Balboa Blvd., and the Wilshire Terminal at La Cienega Blvd. in Beverly Hills. This system is essentially that shown in the Preliminary Report with some alignment modifications reflecting community desires.

The Four-Corridor System will contain 46 stations, and 18 of these will be below ground level. Parking for a total of nearly 21,000 automobiles will be provided at 23 stations, primarily in the suburban areas. Off-street kiss-and-ride facilities will also be provided at 28 stations, with provisions for short-term parking while awaiting passenger arrivals. Interface with local bus distribution and feeder bus operation will be provided at all stations.

Operationally, the Four-Corridor System will be similar to the "X" pattern of the equivalent corridors in the Recommended Five-Corridor System, and average speeds will be in the same range.

SYSTEM DATA SUMMARY
RECOMMENDED FIVE-CORRIDOR SYSTEM

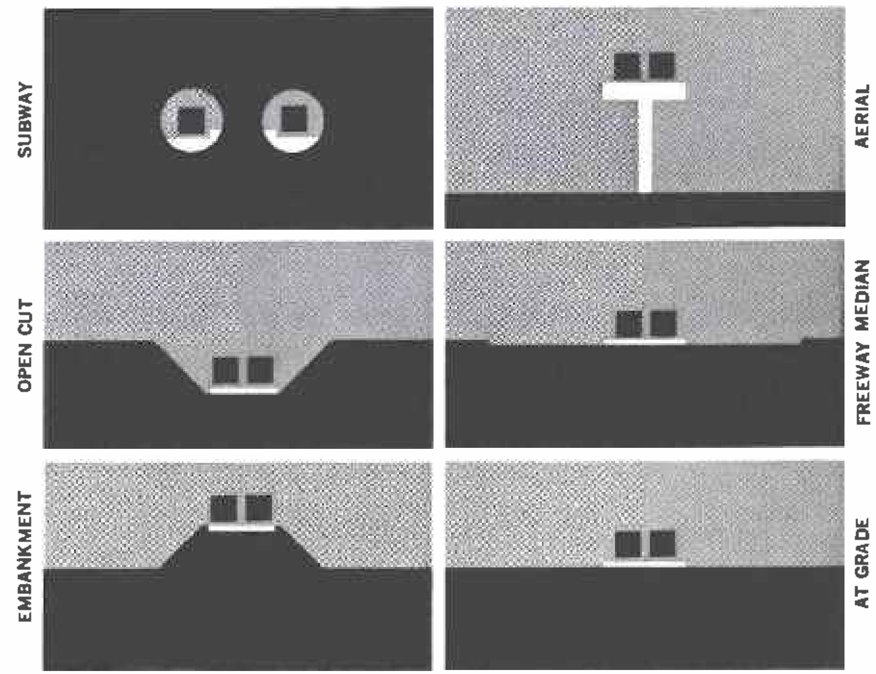
WAY STRUCTURE TYPE	WILSHIRE		SAN FERNANDO VALLEY		SAN GABRIEL VALLEY		LONG BEACH		AIRPORT SOUTHWEST		TOTALS	
	LENGTH (Miles)	STA-TIONS	LENGTH (Miles)	STA-TIONS	LENGTH (Miles)	STA-TIONS	LENGTH (Miles)	STA-TIONS	LENGTH (Miles)	STA-TIONS	LENGTH (Miles)	STA-TIONS
SUBWAY	14.94	17	5.84	2	0.81	—	2.32	3	4.78	4	28.69	26
OPEN CUT	—	—	1.93	2	0.59	—	0.68	—	0.49	—	3.69	—
EMBANK-MENT	—	—	0.40	—	0.14	—	4.81	—	0.22	—	5.57	—
AERIAL	—	—	13.54	11	0.46	1	9.65	5	13.18	9	36.83	26
FREEWAY MEDIAN	—	—	—	—	6.12	4	4.23	3	—	—	10.35	7
AT GRADE	—	—	—	—	3.59	2	—	2	0.38	1	3.97	6
TOTALS	14.94	17	21.71	15	11.71	7	21.69	13	19.05	14	89.10	67

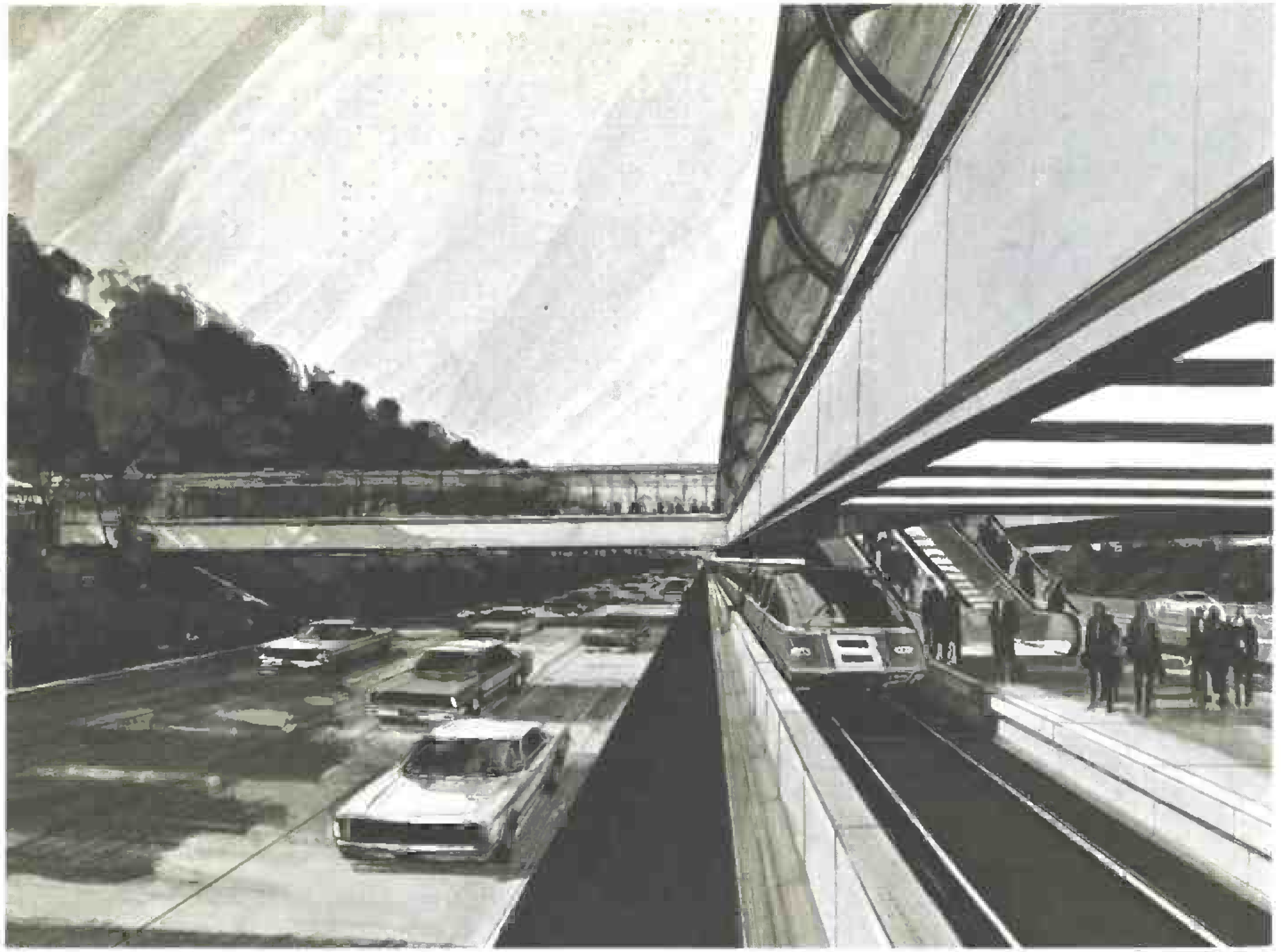
SYSTEM DATA SUMMARY
FOUR-CORRIDOR SYSTEM

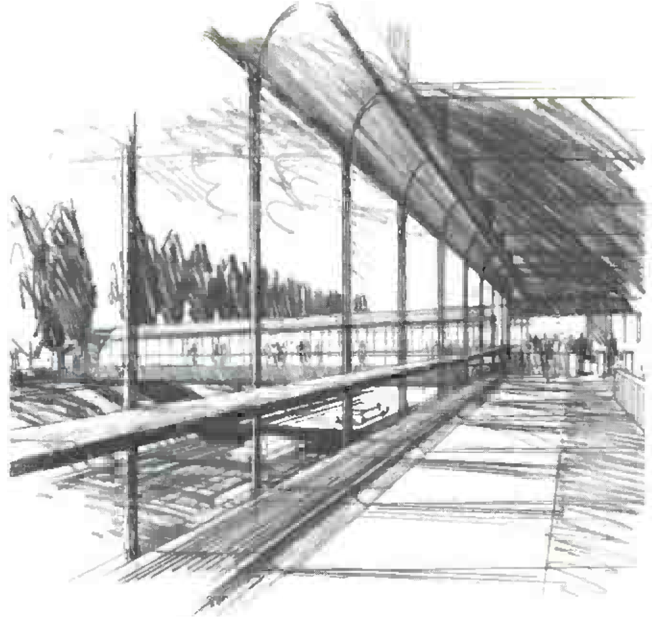
WAY STRUCTURE TYPE	WILSHIRE		SAN FERNANDO VALLEY		SAN GABRIEL VALLEY		LONG BEACH		TOTALS	
	LENGTH (Miles)	STA-TIONS	LENGTH (Miles)	STA-TIONS	LENGTH (Miles)	STA-TIONS	LENGTH (Miles)	STA-TIONS	LENGTH (Miles)	STA-TIONS
SUBWAY	9.79	13	5.84	2	0.81	—	2.32	3	18.76	18
OPEN CUT	—	—	1.93	2	0.59	—	0.68	—	3.20	2
EMBANK-MENT	—	—	0.40	—	0.14	—	4.81	—	5.35	—
AERIAL	—	—	10.37	9	0.46	1	9.65	5	20.48	15
FREEWAY MEDIAN	—	—	—	—	6.12	4	4.23	3	10.35	7
AT GRADE	—	—	—	—	3.59	2	—	2	3.59	4
TOTALS	9.79	13	18.54	13	11.71	7	21.69	13	61.73	46

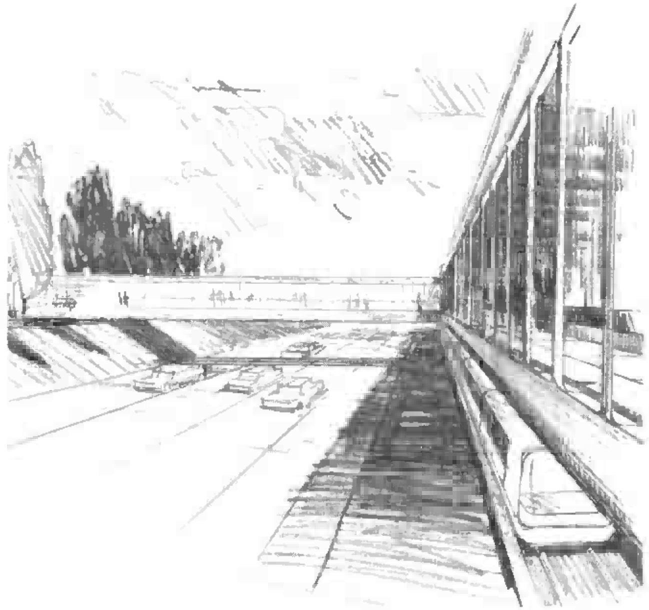
TRAVEL TIME IN MINUTES AND SECONDS BETWEEN SELECTED STATIONS

	7TH & FLOWER	VERMONT	FAIRFAX	CENTURY CITY	WESTWOOD	STATE COLLEGE	SAN GABRIEL	EL MONTE	VINE	UNIVERSAL CITY	VAN NUYS	TAMPA	GAGE	COMPTON	WARDLOW	LONG BEACH	EXPOSITION PARK	INGLEWOOD
7TH & FLOWER	—																	
VERMONT	4:23	—																
FAIRFAX	12:16	7:53	—															
CENTURY CITY	17:56	13:33	5:40	—														
WESTWOOD	20:24	16:01	8:08	2:28	—													
STATE COLLEGE	10:10	14:33	22:26	28:06	30:34	—												
SAN GABRIEL	16:31	20:54	28:47	34:27	36:55	6:21	—											
EL MONTE	20:50	25:13	33:06	38:46	41:14	10:40	4:19	—										
VINE	13:27	9:04	11:53	17:33	20:01	23:37	29:58	34:17	—									
UNIVERSAL CITY	19:02	14:39	17:28	23:08	25:36	29:12	35:33	39:52	5:35	—								
VAN NUYS	30:06	25:43	28:32	34:12	36:40	40:16	46:37	50:56	16:39	11:04	—							
TAMPA	40:16	35:53	38:42	44:22	46:50	50:26	56:46	61:06	26:49	21:14	10:10	—						
GAGE	9:45	14:08	22:01	27:41	30:09	19:55	26:16	30:35	23:12	28:47	39:51	50:01	—					
COMPTON	19:44	24:07	32:00	37:40	40:08	29:54	36:15	30:34	33:11	38:46	49:50	60:00	9:59	—				
WARDLOW	26:28	30:53	38:46	44:24	46:52	36:38	42:59	47:18	39:55	45:30	56:34	66:44	16:43	6:44	—			
LONG BEACH	31:46	36:09	44:02	49:42	52:10	41:56	48:17	52:36	45:13	50:48	61:52	72:02	22:01	12:02	5:18	—		
EXPOSITION	4:33	8:56	16:49	22:29	24:57	14:43	21:04	25:23	18:00	23:35	34:39	44:49	14:18	24:17	31:01	36:19	—	
INGLEWOOD	13:44	18:07	26:00	31:40	34:08	23:54	30:15	34:34	27:11	32:46	43:50	54:00	23:29	33:28	40:12	45:30	9:11	—
ROSECRANS	21:56	26:19	34:12	39:52	42:20	32:06	38:27	42:46	35:23	40:58	52:02	62:12	31:41	41:40	48:24	53:42	17:23	8:12









Compton Station in the Industrial Freeway portion of the Long Beach Corridor

TRANSIT FACILITIES

TRANSIT FACILITIES

STATIONS

Transit station design is based upon the concept of providing both the passengers and the community with functional and environmental amenities which provide the highest level of convenience, comfort and visual attractiveness. Stations are the focal points of the system, and every passenger must pass through at least two stations to complete his trip. They are also the interchange points for various travel modes serving the transit system. Therefore, functional, efficient station design which creates a pleasant environment is essential to make rapid transit a preferred mode of transportation in the Los Angeles Metropolitan Area.

As a result of extensive analysis of passenger loading and movement at each station location, a number of basic station types have been developed. All reflect a certain degree of standardization related to specific way configuration, i.e. subway, open cut, on-grade and aerial. Preliminary station design determined basic functional requirements and physical arrangement of stations, ancillary equipment and passenger circulation patterns. Architectural concepts of station exteriors have been developed and basic interior treatment has been established to assure adequate lighting and aesthetic coordination. Final station design will be based upon uniform functional criteria as well as definitive architectural specifications which will permit design freedom and produce stations best suited to each particular site.

Stations are designed to accommodate projected passenger volumes without congestion and provide adequate capacity to meet anticipated patronage increases in the years to come. The minimum passenger volume used in station design provides for 900 passengers alighting during a peak period of 20 minutes. Station entrances will be fitted with closures which will effectively prevent access to station areas during the early morning hours when the transit system is not operating.

CLOSED CIRCUIT TELEVISION STATION SURVEILLANCE

The character of mass transit facilities is such that visual observation from a single central point is limited. Therefore, effective supervision of the areas involved could require a large number of people to effect proper security measures or render passenger assistance. However, in the recommended system local closed circuit television is provided to accomplish surveillance of the large station areas with minimum personnel. The cameras would be mounted for visual observation of the train platform and other remote areas. A monitor screen will be placed in the attendant's booth, and the attendant can select remote points for observation. The provision of closed circuit television and an effective communication link between the station and the central control center for the entire system enables safe and efficient operation of public areas.

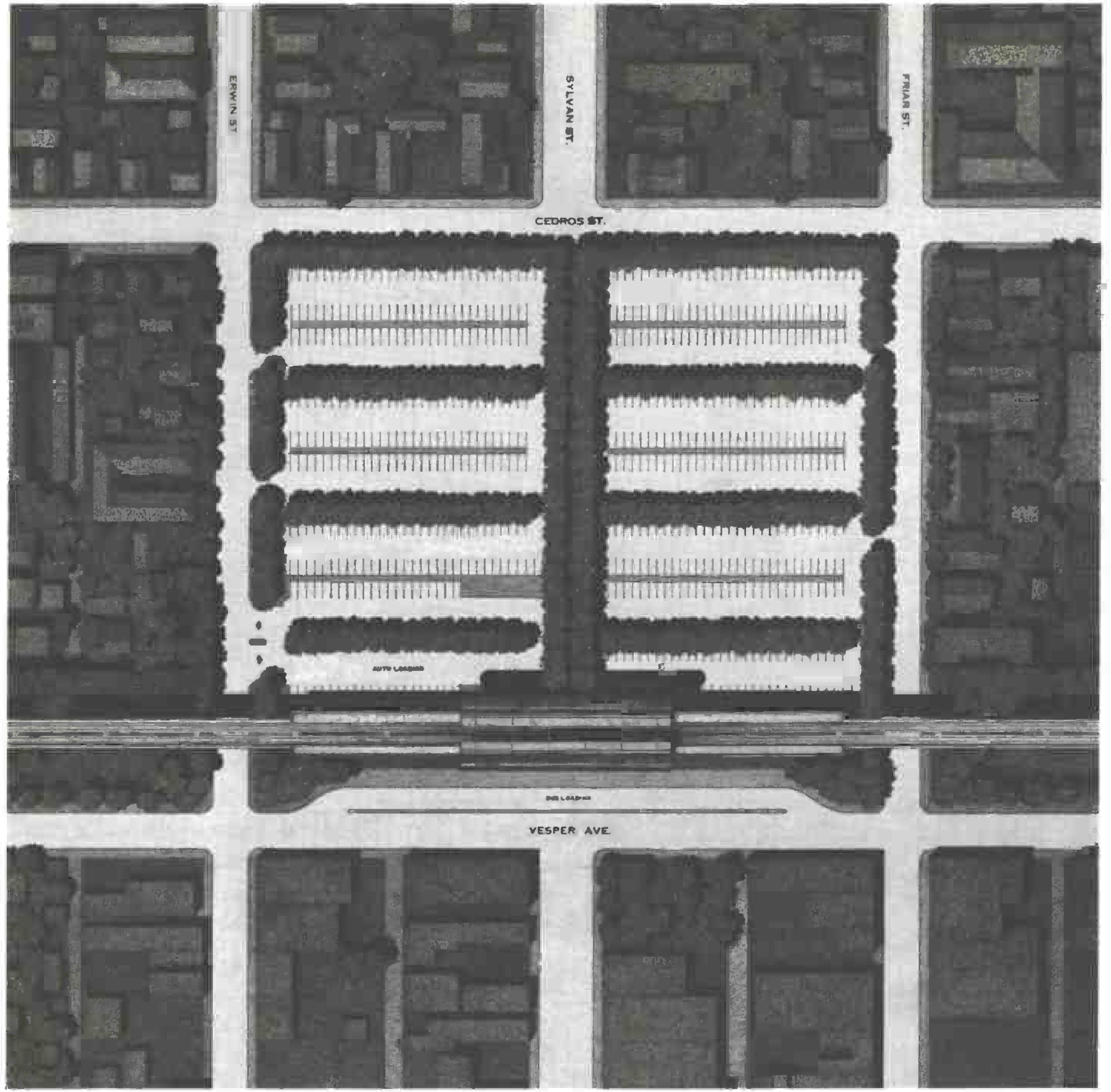
STATION ELEMENTS

There are major functional elements common to all stations regardless of configuration or passenger volume. Two major areas common to each station consist of the "free area," which is open to the general public, and the "paid area," which is reached only after passing through the turnstiles. Relating to one or both of these areas are the following common elements:

- STATION ACCESS areas have been located and designed for the convenience of the passengers. Distinctive treatment of the points of entry permit easy recognition, and easy passenger in-and-out flow avoids congestion. Stairs and escalators extending to or through public sidewalks from subway stations will occur only where there is adequate width to prevent congestion of pedestrian traffic. Where desirable, provisions will be made to obtain easements or purchase private property for transit access facilities.
- THE CONCOURSE area is designed to receive patrons into the free area of the station and to control admission into the paid areas of the system through turnstiles which allow the entering passenger to proceed to the head of the escalator bank for transport to the loading platform. The same space serves the exiting patron, and also provides access to the attendants office where assistance may be obtained. Where appropriate, other available spaces in the concourse area, conveniently located, will be designated for certain select concessions.
- THE PLATFORM provides for the transfer of passengers between the station and vehicle. During the normal 20-second dwell time of the train, up to 20 passengers can board and alight through each of the vehicle doors. The platform length is determined by the maximum train length, and adequate width is provided to facilitate uniform distribution and circulation of patrons.
- VERTICAL CIRCULATION up or down within the station will be accomplished by heavy duty reversible escalators in addition to stairs where floor to floor distance exceeds 12 feet. All escalators will have an operating speed of 90 feet per minute with provisions to increase speed to 120 feet per minute.
- SUPPORT FACILITIES required to operate the system are located in non-public spaces in all stations. These include the substation, mechanical, control and communications, storage and maintenance rooms, attendant's offices, toilet facilities, and vault for the fare vending equipment.

SITE DEVELOPMENT

Station locations which are primarily origin points will have adequate automobile parking, and off-street bus



loading and unloading areas. The location of the station's structure and parking facility has been carefully selected. All due consideration has been given to existing and future land use, street patterns and capacity, and existing land and improvement values. In developing station sites, care has been exercised to assure proper integration with the community's desires and its master plan. The sites will also be pleasantly landscaped and properly and aesthetically screened where required.

Station sites have been selected to provide adequate ground level parking for transit patrons. If additional parking is required in the future, multi-decked parking structures can be built on the existing station sites without acquiring additional property. Separate from the long term parking areas, there will be a special area located close to the station for "kiss-and-ride" short-term parking. Careful attention has been given to provisions which will facilitate transfer from surface transportation to the rapid transit. Feeder buses will have conveniently located access to the station for pick up and discharge of transit patrons.

TYPICAL STATION DESIGN

The four basic types of stations are aerial, on-grade, open cut, and subway. These terms refer to the vertical location of the tracks and platform in relation to the ground level at the station. The preliminary designs discussed in the following pages for each station type are based on the most typical conditions. Some variations are required due to projected passenger volumes, individual site conditions, and operational requirements.

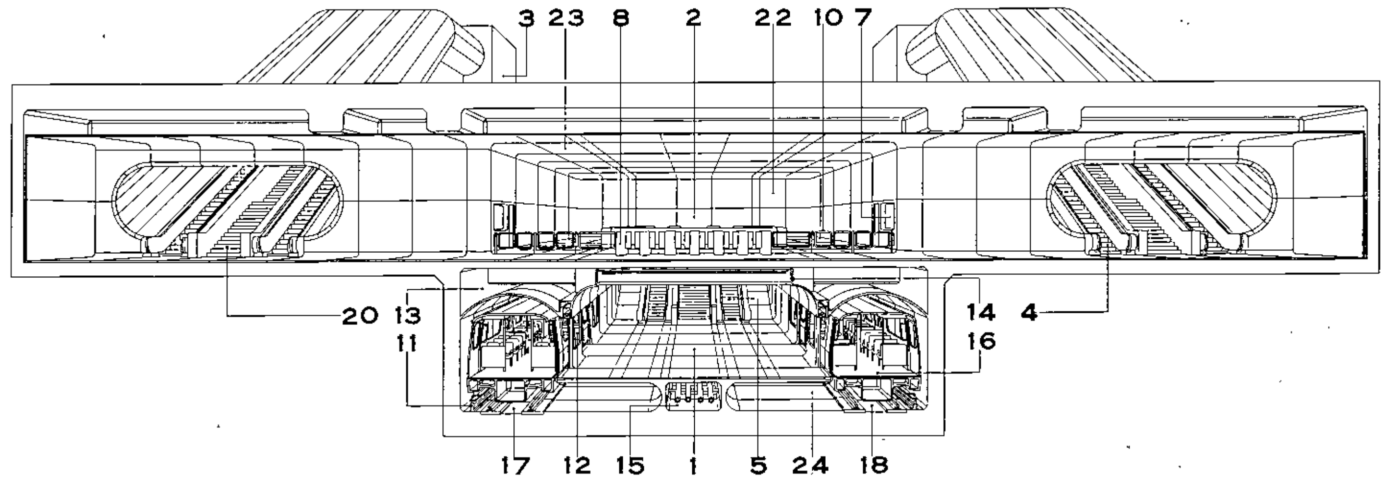
Two basic platform locations have been employed. Side platforms have been used where it is necessary to maintain minimum center to center distance between tracks. This configuration is most applicable to the aerial and open cut stations. Center platforms are most appropriate in subways with twin tube tunnels. Center platforms are more efficient because common escalators can serve both boarding and alighting passengers. Passengers may transfer from one line to another without delay by crossing the center platform.

SUBWAY

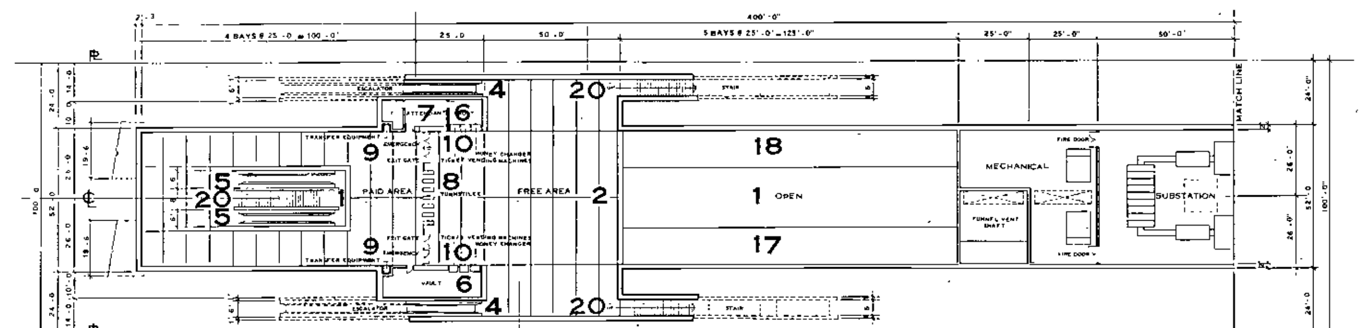
The task of creating an aesthetic and comfortable subway environment is most demanding because of the underground location and construction restraints. Additional restraints imposed by right-of-way widths, underground utilities, entrance requirements, and operational requirements combine to influence the most suitable arrangement for each station location.

As at all stations, the projected passenger loadings provide a design basis that governs the extent of fare collection and escalator installations as well as all space requirements. The minimum station requirements of one escalator each for up and down travel between the concourse and the platform is best met by having the pair of escalators centered on the length of platform. A single ticketing area is then sufficient with two sets of turnstiles. The remainder of the space over the platform and track area is assigned to mechanical, electrical, train control and substation installations. Access to the street level is by escalators and stairs opening into sidewalk area. Special consideration will be given to the purchase or acquisition of easements in private properties to locate entrances off-street where possible.

Subway stations which must accommodate in excess of 1000 passengers in the peak twenty-minute period have been designed with end-loaded platforms. Separate banks of escalators and stairs serve each end of the boarding and alighting area and, in most cases, these open into separate ticketing concourses beyond the ends of the platform. Excellent flow of patrons on the platform and superior distribution of entering and exiting passengers at street level permit these stations to handle the larger volume with ease. Each individual station site selected requires unique arrangements for street access. However, the primary distinction in station design is the location of non-public support facilities.

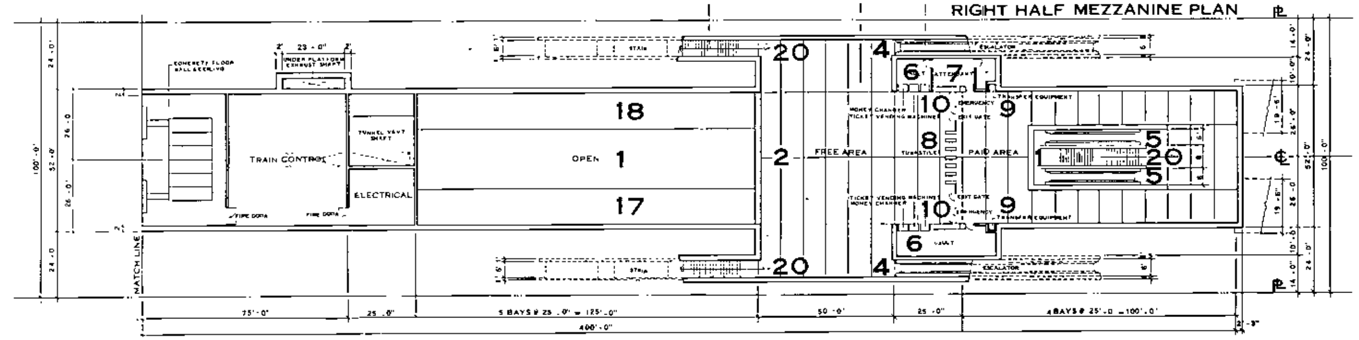


1 PASSENGER PLATFORM
2 CONCOURSE LEVEL
3 STREET LEVEL
4 ESCALATOR TO STREET
5 ESCALATOR TO PLATFORM
6 TICKET VENDING EQUIPMENT
7 ATTENDANTS BOOTH
8 TURNSTILES
9 TRANSFER EQUIPMENT
10 EMERGENCY EXIT GATES
11 ELECTRIFIED THIRD RAIL
12 GLASS TRAIN SCREEN
13 AIR SUPPLY PLENUM
14 AIR SUPPLY LOUVER
15 UTILITY CHASE
16 TRAIN
17 INBOUND TRACK
18 OUTBOUND TRACK
19 TERRAZZO FLOOR AND WALL
20 TERRAZZO STAIR
21 TRASH SCREEN
22 ANODIZED ALUMINUM PANELS
23 ANODIZED ALUMINUM CEILING
24 UNDER PLATFORM EXHAUST



LEFT HALF MEZZANINE PLAN

RIGHT HALF MEZZANINE PLAN



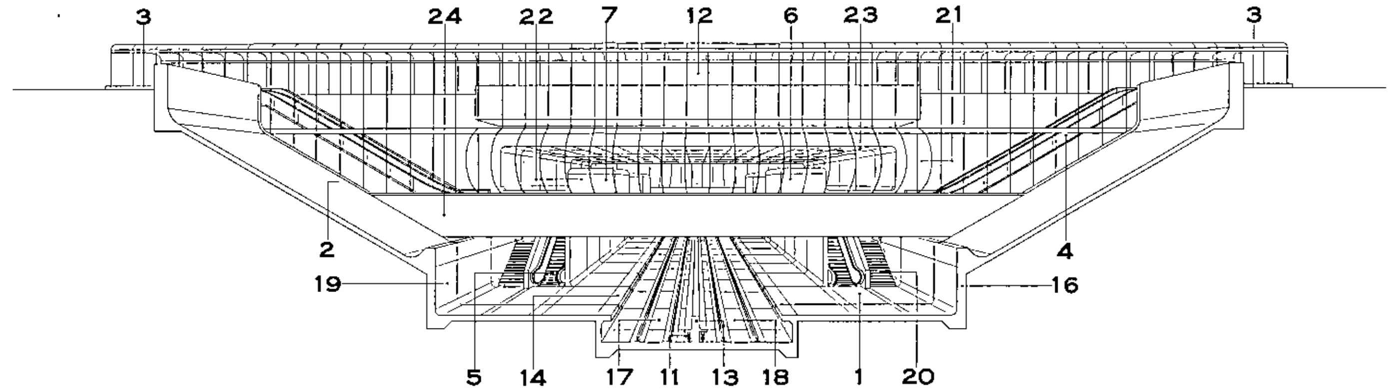
OPEN CUT

The open cut configuration is primarily used to connect two sections of subway where the relationship between alignment and topography and major utilities permits development of an attractive, below ground level right-of-way.

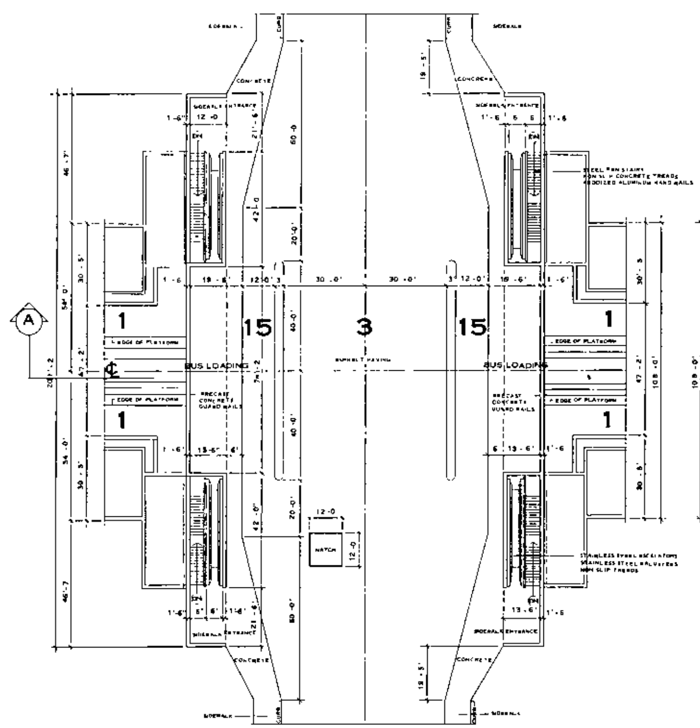
For this configuration, the tracks and station platforms are constructed on-grade in a landscaped open cut. The ticket concourses are located over the platforms as integral parts of the understructure of arterial overcrossings. Side platforms permit a minimum center to center track separation of 14 feet, and minimize the width of right-of-way acquisition at street level while permitting the use of air-rights over the tracks for future developments.

The additional width required for the platforms and in-line escalators from the concourse to the platforms is absorbed in the sloped walls of the open cut and in the public space under the cross street. This arrangement permits direct access to the concourse from bus and kiss-and-ride unloading zones on both sides of the vehicular overpasses.

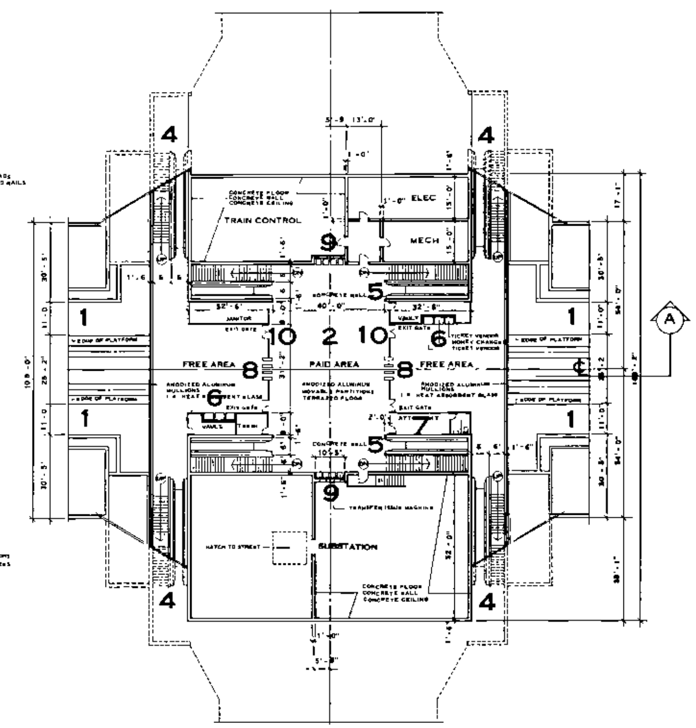
Two escalators for up and down travel connect each of these zones with the free areas of the concourse. The concourse contains the fare vending equipment and overlooks the platform and track area. A bank of turnstiles in each of the two free areas controls access to the paid area, and escalators move patrons between the concourse and the inbound and outbound loading platforms. Flanking the concourse under the street are the rooms housing the mechanical, electrical, train control, and propulsion power equipment.



1 PASSENGER PLATFORM
2 CONCOURSE LEVEL
3 STREET LEVEL
4 ESCALATOR TO STREET
5 ESCALATOR TO PLATFORM
6 TICKET VENDING EQUIPMENT
7 ATTENDANTS BOOTH
8 TURNSTILES
9 TRANSFER EQUIPMENT
10 EMERGENCY EXIT GATES
11 ELECTRIFIED THIRD RAIL
12 COVERED WAITING AREA
13 CENTER BARRIER
14 SAFETY STRIP
15 BUS LOADING
16 RETAINING WALL
17 INBOUND TRACK
18 OUTBOUND TRACK
19 TERRAZZO FLOOR AND WALL
20 TERRAZZO STAIR
21 HEAT REFLECTIVE GLASS
22 ANODIZED ALUMINUM PANELS
23 ANODIZED ALUMINUM CEILING
24 ANODIZED ALUMINUM SPANDREL



STREET LEVEL PLAN



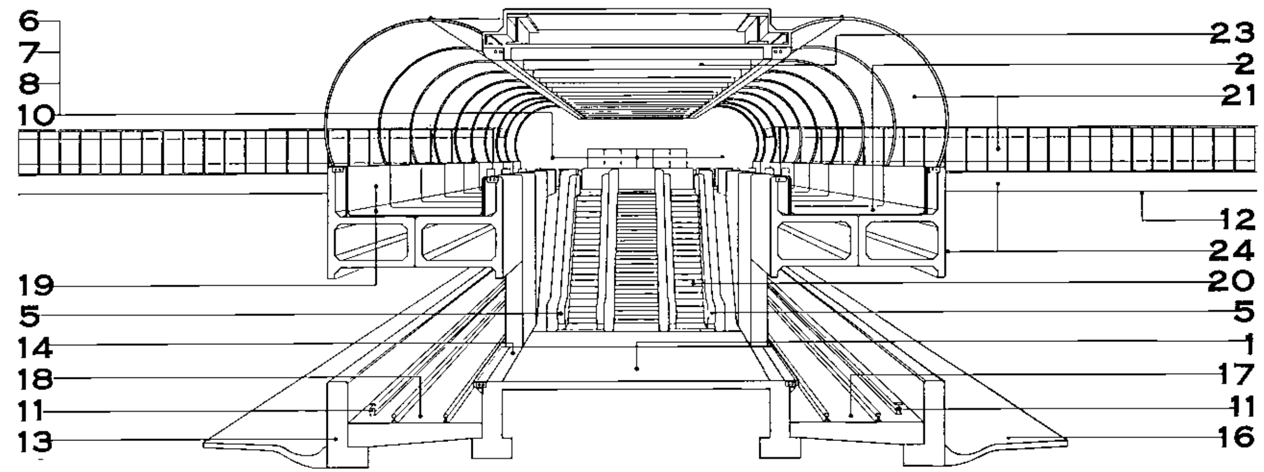
CONCOURSE LEVEL PLAN

ON-GRADE

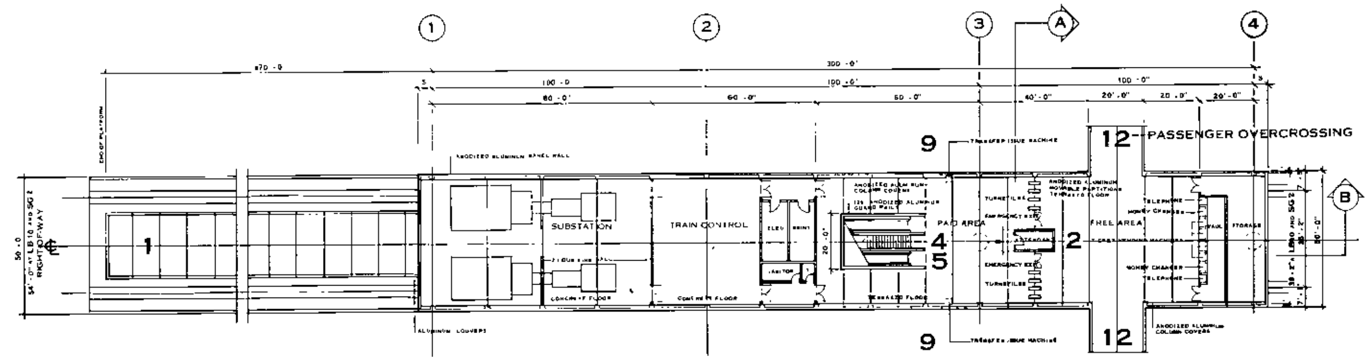
The use of the on-grade way configuration is most efficient and economical where grade separation from surface traffic already exists. One condition which permits this configuration occurs when the transit line is within the right-of-way of a freeway. Access to the on-grade platform is accomplished by a pedestrian overcrossing 16 feet above the traffic lanes. Two versions of this type of station are used in the system. Both employ the center platform concept because the horizontal separation of tracks built on-grade entails no additional expense, and the center platform avoids an otherwise costly duplication of escalators.

An alternative version is utilized where access is required from only one side of the thoroughfare. The detached ticketing concourse is located on-grade adjacent to the freeway and is connected to an elevated mezzanine above the platform level by a single pedestrian overcrossing. The escalators descend in line and terminate in the center of the platform. The mezzanine structure provides a protective cover for the center 200 feet of platform. All other station services are in the detached concourse.

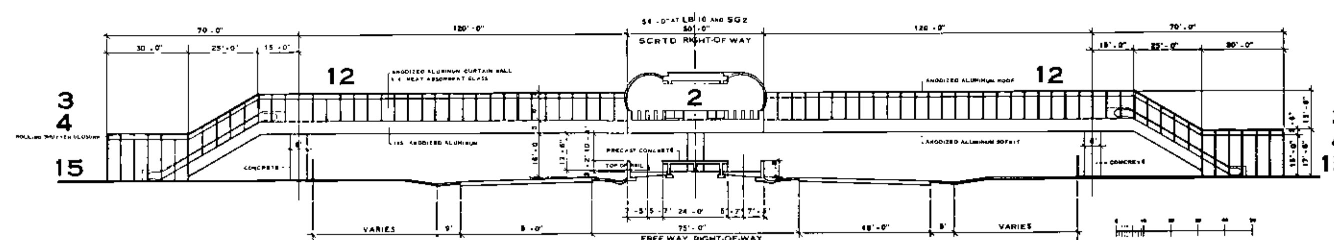
The version shown provides access from both sides of the facility. The ticketing concourse, housing the fare vending equipment and turnstiles, is located on the level above the center platform and track area. The use of end-loaded platforms permits the installation of as many as three escalators in a single bank where the center platform width is limited by the available right-of-way. This arrangement provides a clear platform without obstructions, and imposes minimum requirements for turnstiles at the concourse level.



1 PASSENGER PLATFORM
2 CONCOURSE LEVEL
3 STREET LEVEL
4 KISS AND RIDE
5 ESCALATOR TO PLATFORM
6 TICKET VENDING EQUIPMENT
7 ATTENDANTS BOOTH
8 TURNSTILES
9 TRANSFER EQUIPMENT
10 EMERGENCY EXIT GATES
11 ELECTRIFIED THIRD RAIL
12 PASSENGER OVERCROSSING
13 SAFETY WALL
14 SAFETY STRIP
15 BUS LOADING
16 EMERGENCY LANE
17 INBOUND TRACK
18 OUTBOUND TRACK
19 TERRAZZO FLOOR AND WALL
20 TERRAZZO STAIR
21 HEAT REFLECTIVE GLASS
22 ANODIZED ALUMINUM PANELS
23 ANODIZED ALUMINUM CEILING
24 ANODIZED ALUMINUM SPANDREL



CONCOURSE PLAN



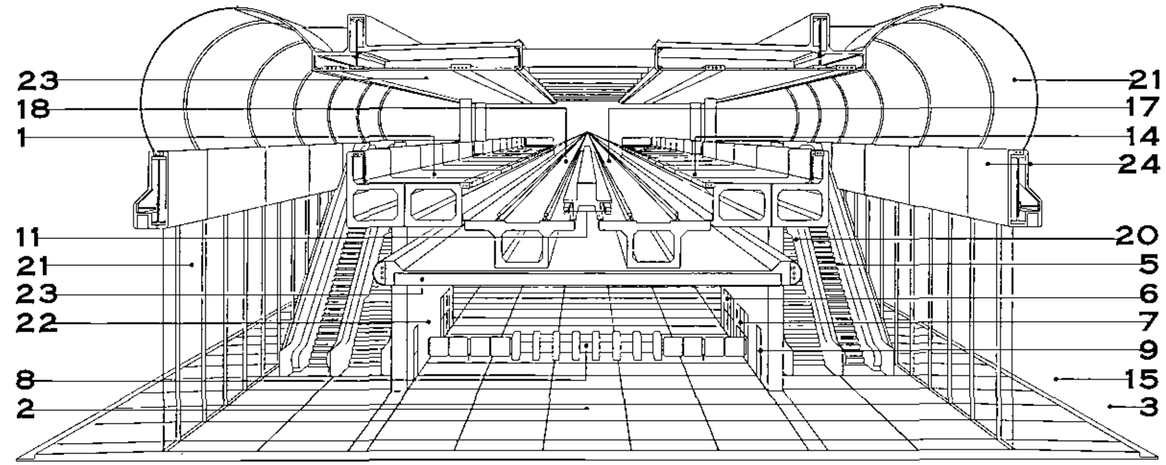
CROSS SECTION

AERIAL

The aerial way structure configuration provides the grade separation necessary to permit surface traffic to move unimpeded under the transit line of travel. Segments of aerial alignment occur in private right-of-way and in the street median. Where private right-of-way is obtained, the station site is located between cross streets, and the 16-foot minimum clearance requirement at these cross streets is established from the bottom of the long span girder. The ticketing concourse is built on-grade under the platform structure and permits direct access to the station entrance by pedestrians, and by patrons using the bus, kiss-and-ride and parking facilities. Side platforms are utilized for the typical version of this station in order to permit the trackage to continue through the station at a constant width with single-column support.

Variations of this concept include an on-grade concourse under a center-loaded center platform used at locations where the distance between tracks is sufficient to permit the platform to be built between; and an elevated concourse under a center-loaded center platform where complete separation of pedestrian and vehicular traffic is attained with elevated moving walks and overcrossings feeding directly into the raised concourse.

Where the aerial alignment is in a street median, access to a concourse within the median would require a crossing at street level. Therefore, the station design developed for this type of right-of-way features an elevated mezzanine to provide access to the side platforms above, and an over-crossing to private property beside the thoroughfare where the detached ticketing concourse and all pedestrian and vehicular access and parking is located.



1 PASSENGER PLATFORM
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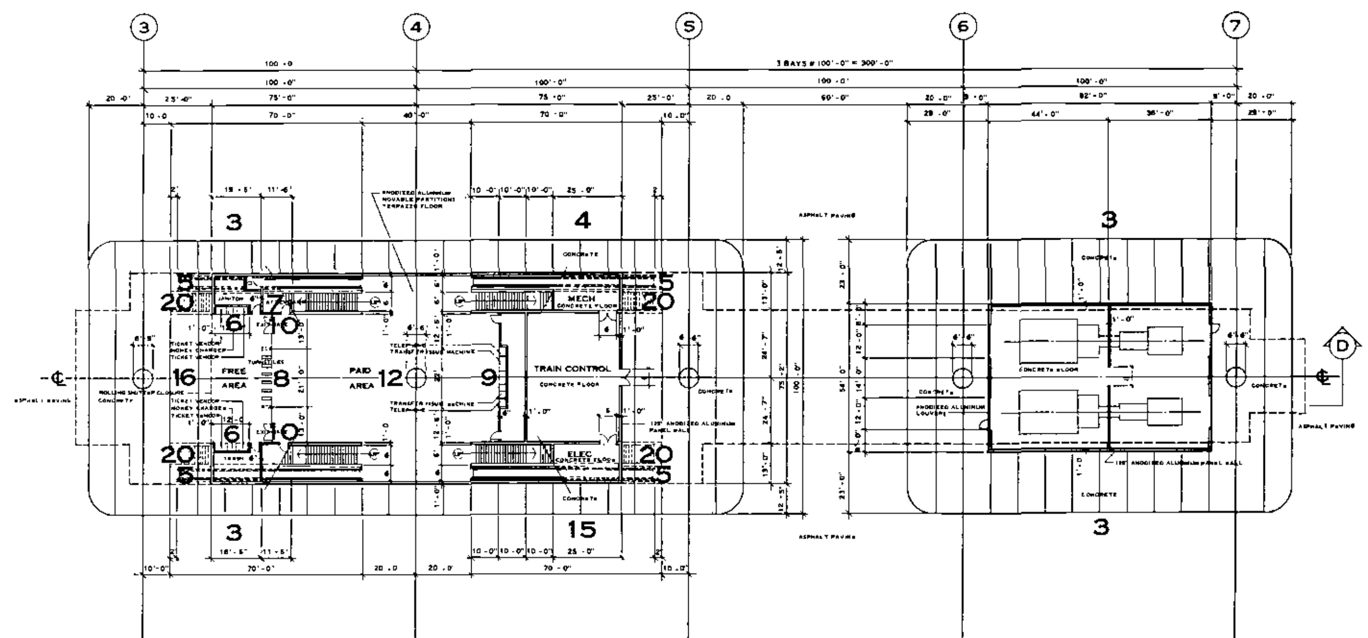
6 TICKET VENDING EQUIPMENT
7 ATTENDANTS BOOTH
8 TURNSTILES
9 TRANSFER EQUIPMENT
10 EMERGENCY EXIT GATES
11 ELECTRIFIED THIRD RAIL
12 PAID AREA
13 CENTER BARRIER
14 SAFETY STRIP
15 BUS LOADING
16 FREE AREA
17 INBOUND TRACK
18 OUTBOUND TRACK
19 TERRAZZO FLOOR AND WALL
20 TERRAZZO STAIR
21 HEAT REFLECTIVE GLASS
22 ANODIZED ALUMINUM PANELS
23 ANODIZED ALUMINUM CEILING
24 ANODIZED ALUMINUM SPANDREL



TICKET CONCOURSE PLAN

ELECTRICAL SUBSTATION

URBAN DESIGN

All stations must perform the same functions. However, physical site conditions, variations in passenger loads, and existing and future plans of the community require special treatments at many stations. All must fit within a framework of aesthetics, basic standardization, and continuity in design. Several sites presented special situations and opportunities for the transit facility to contribute to, and be an integral part of, the urban development.

SEVENTH AND FLOWER

Two stations are joined together at this location to provide a full passenger interchange between the Wilshire line and the Airport-Southwest line. Both feature a 3-platform station. The Wilshire line station accommodates heavy transfer movement on the center platform and the side platforms are used for boarding and alighting passengers. The Airport-Southwest line station has separate platforms for the Airport Express passengers and the local transit patrons.

Due to extremely heavy passenger movements through these stations and restricted street width, special entrances will be provided through private property. Special features incorporated into the design include a ticketing and information building for express passengers, and off-street taxi, bus and automobile pickup and drop-off areas.

EL MONTE TERMINAL

The El Monte station, terminal of the San Gabriel Valley Corridor, is designed to accommodate a high passenger volume as well as an exceptional number of private vehicles. The majority of these vehicles will utilize the San Bernardino Freeway as an arrival or exit route. Accordingly, a design was developed which provides direct freeway access via a 100-foot, six lane divided traffic-way through the parking area between the station and freeway. Station area design separates automobile and bus traffic. Because of its large size, a moving sidewalk in the median of the traffic-way will facilitate access to the station from the 4300 car parking area.

METROPORT STATION

This station forms the northerly terminus of the Airport Express service. It is located within the existing railroad platform area of the Los Angeles Union Passenger Terminal and within the proposed Metroport development. The Metroport station is constructed on-grade with separate center platforms; one for local passengers, and the other for Airport Express service, incorporating special provisions for handling baggage and U.S. Mail. The station's ticketing lobby for airport passengers will be located in a separate concourse, adjacent to the Metroport's airline ticket counters. After airline passengers purchase their fares, they will descend by escalators to the platform and waiting train. Baggage checked in the ticketing lobby will be placed in standardized containers and moved by mechanical conveyors to the baggage-loading area on the station's center platform. Similarly, U.S. Mail will be placed in standardized containers at the Post Office's Terminal Annex and conveyed to the baggage loading area.

L.A.X. STATION

At the southerly terminus of the Airport Express service, a center platform aerial station will be located within the Los Angeles International Airport, and will be compatible with the existing and proposed development. Special features of this station are the provisions for handling baggage and U.S. Mail. In addition, certain areas are planned for a passenger interchange with the airport's future internal distribution system, and baggage and U.S. Mail transfer to the airport's future baggage handling system. The station concourse is located below the platform level.

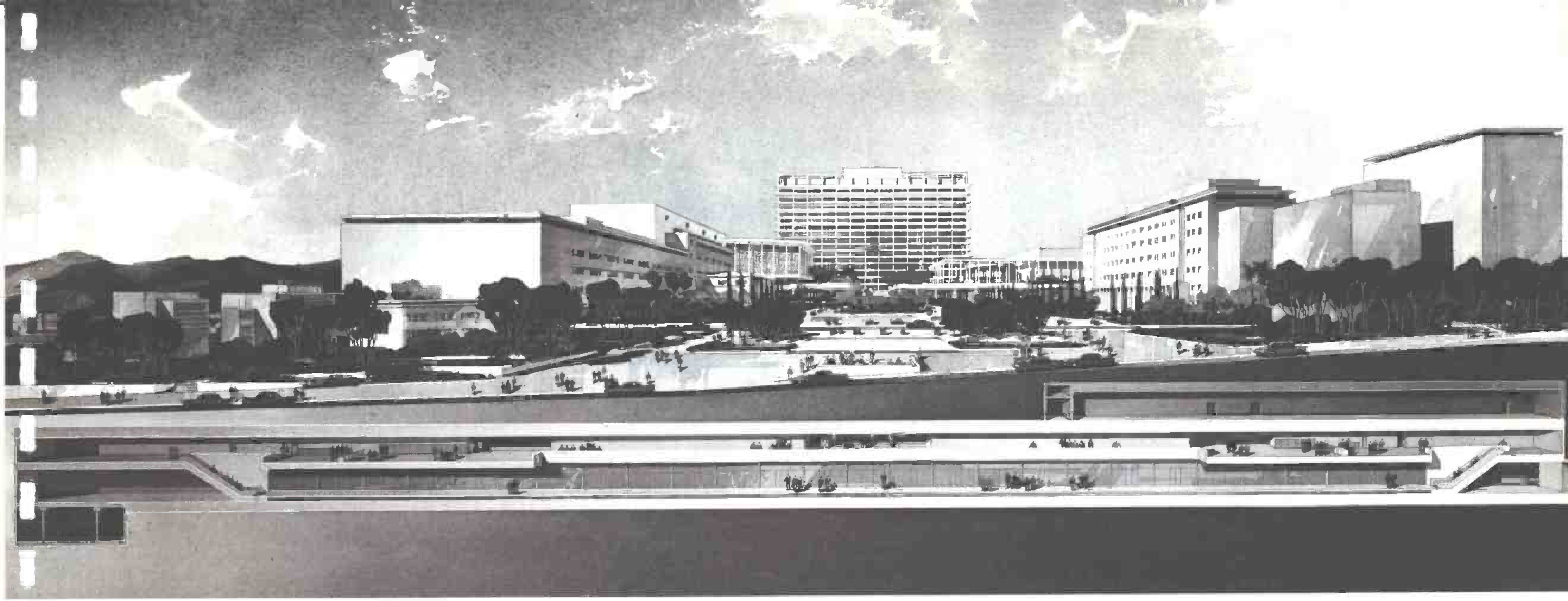
COMPTON STATION

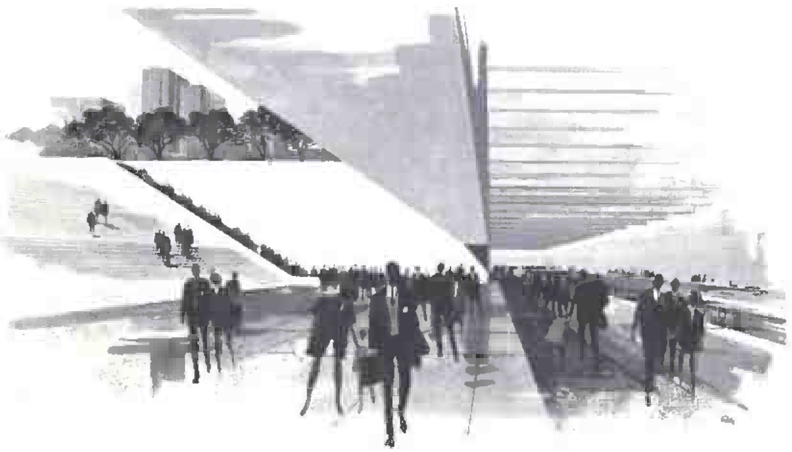
The Compton station, located in the median of the proposed Industrial Freeway and adjacent to the Southern Pacific Railroad track, was planned to fit the proposed Civic Center master plan of the City of Compton. The station will be provided with special detached entrance facilities located on each side of the station. These entrance facilities will be designed and positioned to be compatible with the Civic Center mall. The station site layout, including location of bus and automobile access, has been coordinated with the master plan to make the transit facilities an integral part of the Civic Center environment. The architecture of the structures and the landscape treatment of the site will be in harmony with the style and quality of the City's facilities.

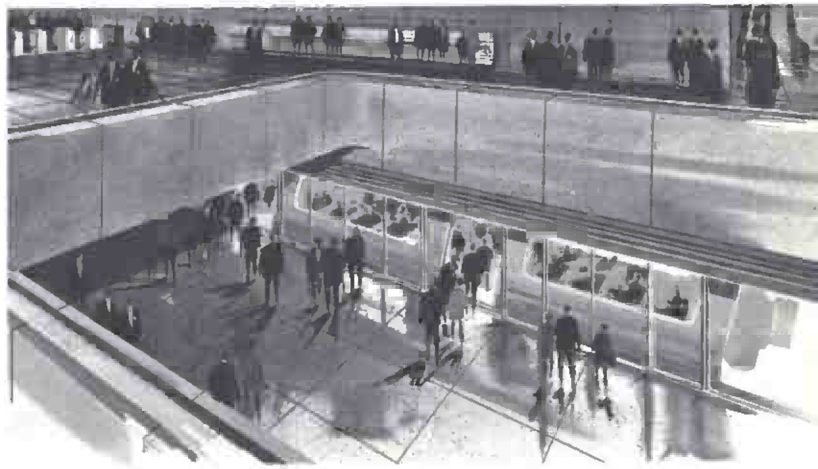
CIVIC CENTER

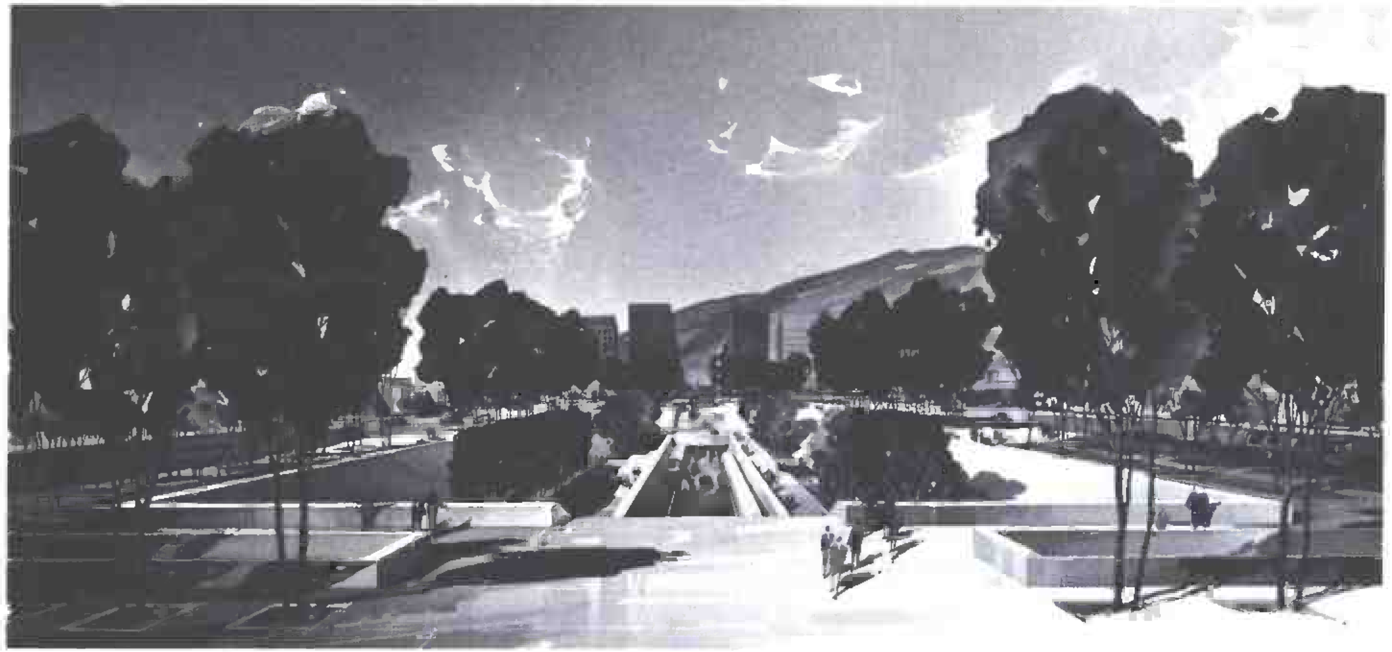
The Civic Center station, running under Broadway north from First Street, has a passenger interchange with the Airport-Southwest station under First Street. The depth of the Broadway subway tends to inhibit the development of a major exit to street level toward Temple Street. However, a great open stairway with flanking escalators will be coordinated with the Mall plan. This will permit light and air to flood the station interior, and provide a dramatic approach to the City Hall, the focal point of the Civic Center.

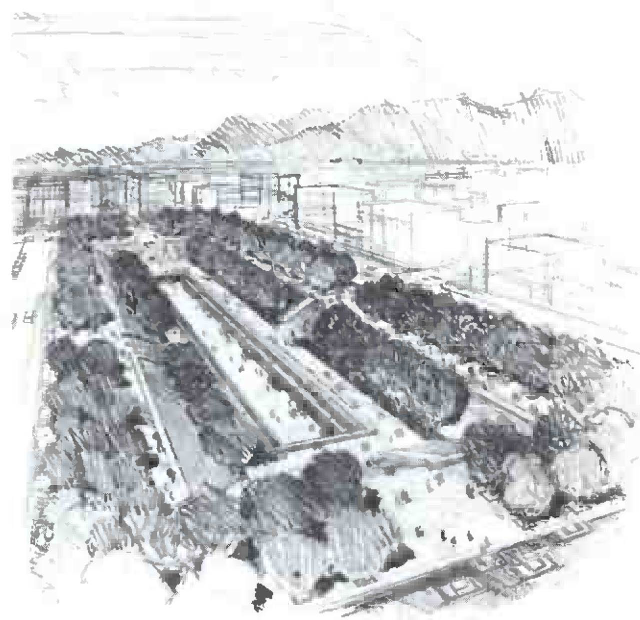
Various views of the Civic Center Station ➡

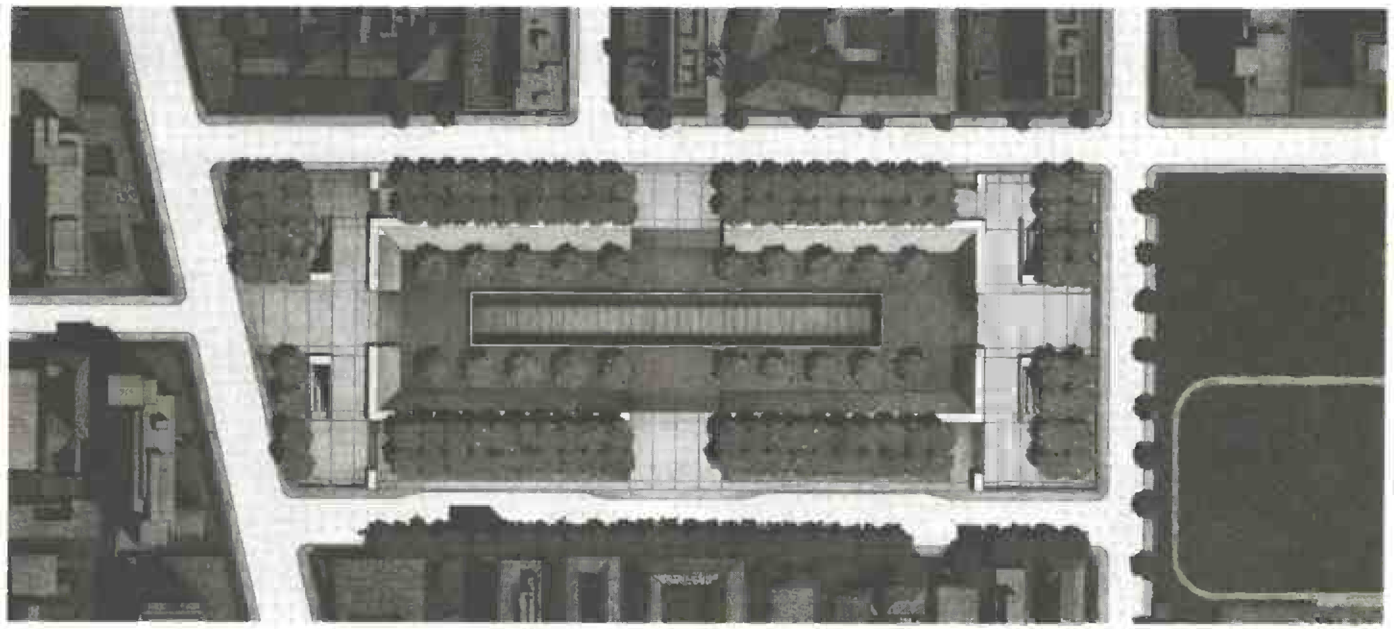












HOLLYWOOD-LA BREA

The site for the La Brea station in Hollywood is halfway between Hollywood and Sunset Boulevards on the east side of La Brea Avenue. A trend to higher intensity use in this neighborhood is reflected in recent construction of high-rise and other smaller modern buildings nearby. Rapid transit will accelerate this trend for new commercial and cultural development, and generate a high degree of activity in the area. An open plaza will be specifically designed to accommodate the rapid transit, buses, automobiles, taxicabs, pedestrians and other activities.

This design will feature a beautifully landscaped plaza-mall which will provide a park-like atmosphere. The station platforms will be open to natural light and air, a desirable feature in the Los Angeles climate. This station design was submitted in a recent United States Department of Housing and Urban Development Merit Award competition and received one of the major awards.

SUBWAY ENVIRONMENTAL CONTROL

Climate control in subway stations has been established as a primary design objective to provide a pleasant, comfortable environment for the transit patron. With the current trend toward modern, high speed transit vehicles, provisions must be made for removal of heat generated by electrical equipment in the subway system. To meet the requirements for climate control in subway stations, the use of mechanical refrigeration is necessary. Numerous methods for providing a comfortable subway environment have been explored. Of all of these, the two methods found most feasible were a system of air-conditioning the station only by utilizing train screens to separate the platform from the track area, and another system consisting of total air-conditioning for the subway. The ultimate system will be determined at the time of final design. However, for purposes of this report, design and cost estimates are based upon air-conditioning the station only. With this system, a satisfactory temperature control in subway stations and tunnels can be attained through an integrated and balanced combination of ventilation and cooling systems. Features of the system are as follows:

- **STATION VENTILATION AND AIR TEMPERATURE CONTROL**

  Air from the surface is drawn into the subway stations through grills in median islands, sidewalks, or other selected locations. Filtered air is blown continuously throughout the length of each platform. The air then circulates up each escalator and stairwell, through the mezzanines and corridors, and into the street. The platform areas are slightly pressurized to prevent leakage of tunnel air into the station around platform door edges. When required, mechanical refrigeration will cool station ventilation air. Cool, fresh filtered air is circulated through all public areas. Thermostatic controls maintain station temperatures midway between those on the street and in the trains, eliminating rapid temperature adjustment for the passengers.

- **UNDER-CAR SWEEP**

  The modern rapid transit vehicle contains a great deal of heat-producing, car-borne equipment. While the train is standing in a station, heat from its electrical machinery and braking system is being rapidly released. Fans mounted below the station platforms sweep the hot air from beneath the cars into plenums which run the full length of the platform structure, one for each track. From this point the air is discharged to the surface via vent shafts or ducts.

- **TRAIN PISTON ACTION**

  The trains running through the tunnels produce a piston action which moves large masses of tunnel air in front of and behind each train. Vent shafts open to the surface allowing heated air to be pushed out of the system and outside air drawn in. Vent shafts have been located along the line to control the subway tunnel temperature.

- **MECHANICAL VENTILATION**

  In the event a train slows down or stops in a tunnel, emergency fans located in tunnel vent shafts will be placed in operation to maintain the required air movement.

JV-22

FARE COLLECTION

An automatic fare collection system insures an economical, efficient and extremely accurate operation, and concurrently facilitates passenger speed and convenience in entering and departing from the transit system. This is possible with the use of reliable solid state electronic circuitry coupled with a magnetically encoded ticket development which will provide the system with a most modern automatic fare collection system.

Three automatic fare collection methods were considered:

- Stored ride
- Point to point
- Stored fare

The stored ride method was selected as the most desirable system because it is more flexible than the point to point system for the non-commuter rider, and because the high percentage of commuter patronage would minimize the convenience value inherent in the more sophisticated stored fare system.

Tickets suitable for use in automatic systems have been developed. They are of convenient size and shape, inexpensive, durable, and capable of retaining the data necessary for fare collection transactions at the turnstiles. This is a plastic ticket similar in size and shape to a commercial credit card. A part of the ticket contains magnetic material which stores all required transactional data as patrons pass through the turnstiles.

The required fare collection equipment includes automatic change makers, ticket vending machines, turnstiles, agent readers, and transfer dispensers. Automatic change makers accept coins and bills and return specific combinations of change, and they are conveniently located adjacent to ticket vending equipment. The ticket vending machines dispense single and multiple ride tickets. The ticket, when issued, is magnetically encoded with the ride value and the number of rides. A fare table displaying the ride cost between stations is located on the face of each vending machine. It is estimated that transactions at these machines will take only ten to fifteen seconds.

Passengers will then enter the system by passing through turnstiles designed for use either as entrance or exit gates. They are programmed by the station agent to operate in the direction dictated by passenger traffic volume. The entrance gate encodes the entrance station and admits the patron. When the ticket is inserted in the exit gate, a ride is subtracted and the ticket is returned to the patron. After all rides are used, the ticket is captured and stored in the gate. Turnstiles are designed to handle thirty patrons per minute.

If a turnstile rejects a ticket, the agent reader equipment is capable of displaying all information stored on the ticket. This information consists of ride value, number of rides remaining, number of rides initially purchased, and the number of the vending machine that dispensed the ticket. The reader allows the station agent to determine why the ticket is being rejected by the automatic equipment.

Transfer dispensing machines are available in the paid area of stations for bus connections.

Interior of the Vine Street Station in the San Fernando Valley Corridor

TRANSIT VEHICLES

GENERAL

The transit vehicle has been developed to provide passengers with an environment equal to or better than the private automobile. During peak hours it will transport them more safely, more comfortably, more reliably, and faster than the private automobile.

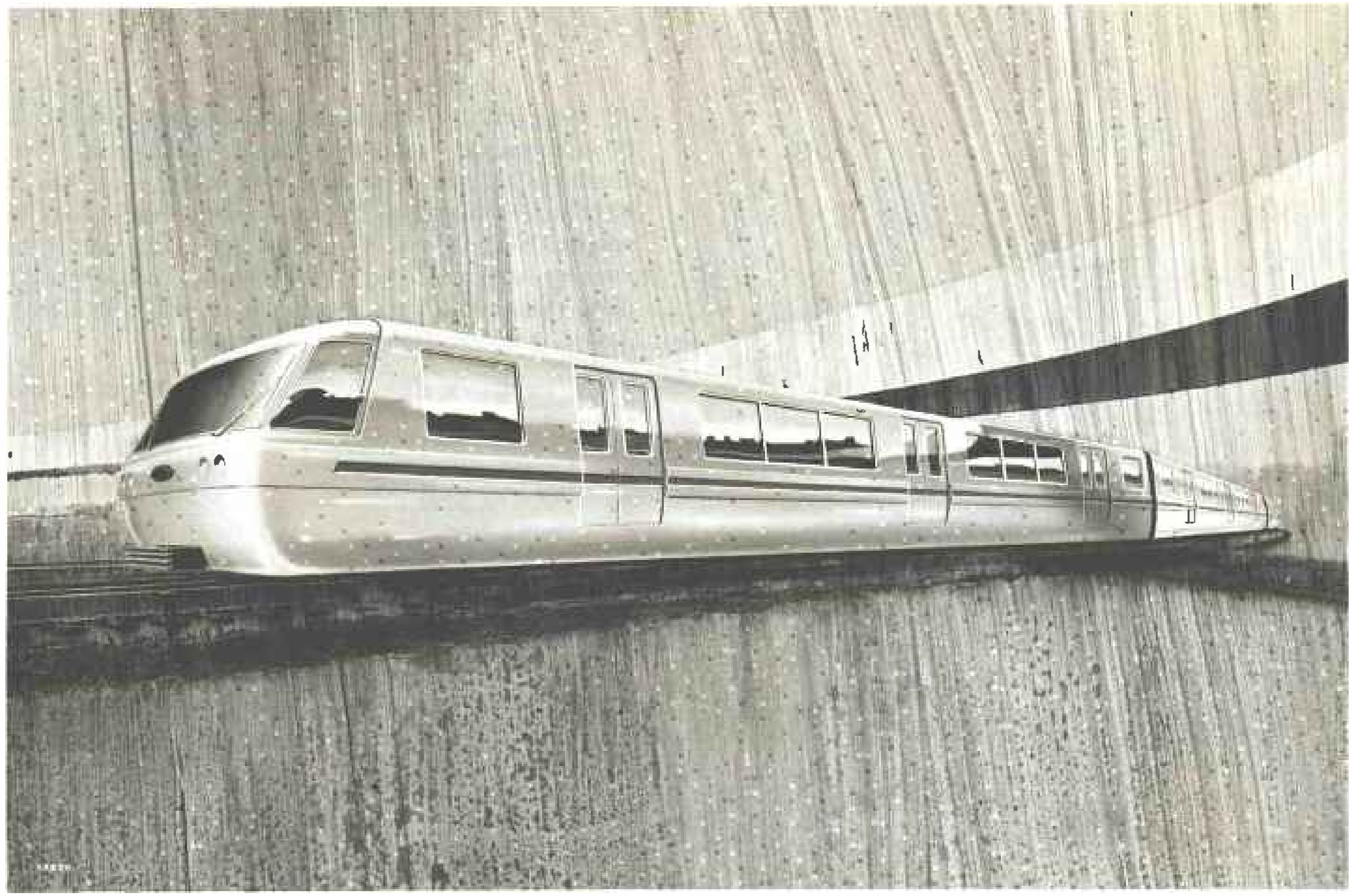
In order to provide a system with great public appeal, this vehicle design is a product of the most advanced thinking in current transit technology. The styling and mechanical equipment of the cars have been carefully studied and are the latest available designs. Performance features are uniquely suited to meet the demanding requirements of the Los Angeles Metropolitan Area.

Two types of these ultra modern, lightweight, electrically propelled cars with steel wheels on steel rails will be employed on the system for rapid transit service and airport express. The cars will be quite similar except for interior modifications to accommodate the airline passenger and his luggage.

THE RAPID TRANSIT VEHICLE

With passenger loads projected far into the future, this vehicle has been designed to move peak hour passengers most safely, efficiently and comfortably. The number of cars needed is based on peak hour requirements. In operation, trains up to 600 feet long carrying 1000 passengers will be employed. Trains are initially formed by the use of two end cars (A car) and if greater length is required, middle cars (B cars) are added. Automatic control equipment is on the "A" cars only. The following tabulation indicates the total number of cars required for each of the systems:

Type	*Recommended Five-Corridor System*	*Four-Corridor System*
A cars	200	148
B cars	556	390



Transit Vehicle Concept Design

Based on current technology, the optimum vehicle for the Southern California Rapid Transit District operational plan is 75′ long.

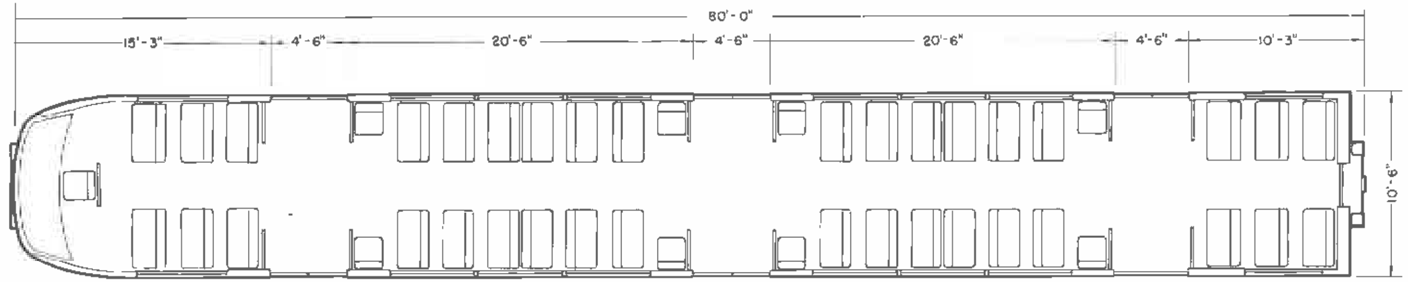
Once this car length was established, investigations were conducted to tailor it to passenger flow and access requirements. These studies are summarized in the following table of general dimensions:

Length, nominal A cars	80′-0″
B cars	75′-0″
Height – Rail to top of roof	10′-10″
Headroom – Aisle	7′-2″
Floor height above rail	40″
Exterior width at floor level	10′-6″
Aisle width	30″
Two-passenger seat width	44″
Width of door opening	4′-6″
Track gauge	4′-8½″
Seating capacity (A and B cars)	80

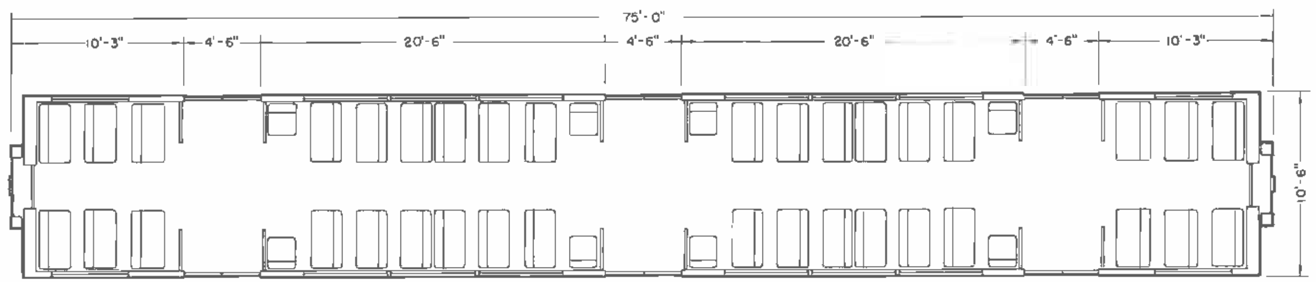
Studies and analyses of environmental control requirements determined that the vehicle must be completely air-conditioned for maximum passenger comfort. Clean, filtered, treated air will be continuously circulated through the vehicle to maintain an appropriate temperature differential between the vehicle and the ambient outside temperature.

Sound insulation and vibration damping features will provide effective sound control and produce a quiet, comfortable environment for the passenger.

TRANSIT VEHICLE SEAT LAYOUT



'A' CAR



'B' CAR

Each vehicle will be powered by four electric motors rated at 150 HP and operating at 900 volts D.C. Top speed will be 75 miles per hour. Each motor will be geared to a wheel axle. Electric dynamic braking as well as friction brakes assure safe, smooth stops.

On-board control and communication equipment will be included as integral component parts of the overall system. These vehicles are capable of fully automatic control during normal operation.

The vehicle exteriors and interiors are classically styled for long lasting appeal. Colors, fabrics and finish materials have been carefully selected to be aesthetically pleasing, comfortable to the rider and easy to maintain.

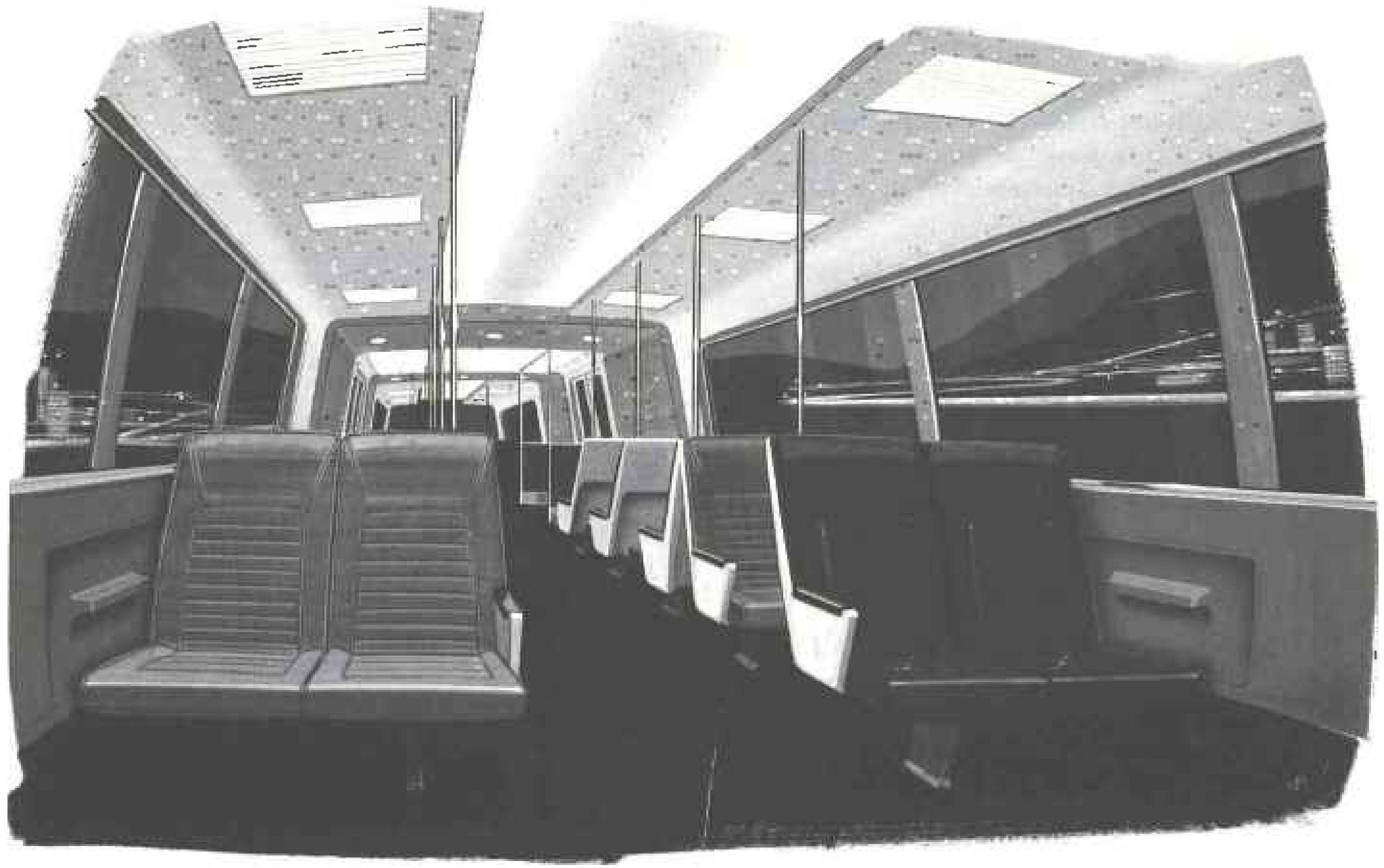
The most comfortable seating arrangement selected for the combination of height and width of the car is of the two and two transverse type. The cushioned seats are of modern design upholstered with resilient, breathable material.

The large window areas are made of safety glass, and treated to reduce the heat load for the environmental air control system. The floors are carpeted to provide greater safety against slipping as well as an appearance superior to tile. Carpeting will also contribute substantially to improved acoustics and heat insulation.

THE AIRPORT EXPRESS VEHICLE

The Airport Corridor is unusual in that both express and local service will use the same tracks. The base vehicle employed for transit service will be adapted for Airport Express service by modifying seating arrangements and providing space for hand baggage.

This vehicle, like the transit vehicle, will have environmental control, sound insulation, and vibration damping control. Vehicle dimensions, propulsion and control features will also be identical with the transit car. In addition to the special passenger vehicles for the Airport Express service, there will be an exclusive baggage and mail car in each train. This car will be similar to the passenger car in all aspects with the exception of the interior.



Interior of Rapid Transit Vehicle

ELECTRIFICATION

The complex electrical requirements of the system range from high voltage bulk propulsion power to normal station illumination, and the proper functioning of each component is vital to the operation of the system. The use of electric power will permit an efficient and smog-free operation plus the attainment of the desired high reliability of transit service. The electrification method selected and developed for this transit system completely satisfies all requirements for safety and reliability.

Propulsion system design is predicated on providing sufficient power for continuous, efficient, and uninterrupted operation throughout the system. A dual circuit system is employed which provides two power sources to the contact rail to assure attainment of all service objectives. Adequate power for operation of train control, communication, lighting, and automated fare collection facilities is supplied from dual sources at each station to allow system operation during local power outages. Power conversion units are located at or near stations where the greatest demand for power occurs for train acceleration, and to minimize contact rail voltage drop. Stepless propulsion motor control, with automatic train control, provides exceptionally smooth acceleration and deceleration for passenger comfort.

Power can be purchased from local utility companies and served through seven points of connection for the Recommended Five-Corridor System. A 900 volt DC contact rail system proved most economical to supply the transit vehicles. A third rail position was considered more desirable because it eliminated massive and unsightly catenary overhead structures.

CONSIDERATION OF ALTERNATIVE SYSTEMS

Alternate methods for each propulsion system element were considered and evaluated both on a basis of individual merit, and as a part of the total system. These considerations included various possible sources of power, power transmission systems and transferal to vehicles, power conversion, and propulsion power voltage.

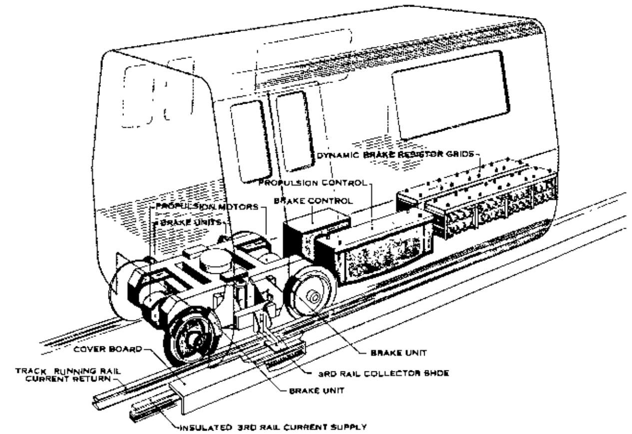
The DC system used for estimating purposes possesses proven operational capabilities. However, in light of continuing development, a single phase medium voltage, AC contact rail system employing regenerative train braking is under continuous study because of its potentials to reduce subway ventilation cost, to mitigate stray currents, and of possible propulsion power cost savings.

PROPULSION POWER AND BRAKING

Four propulsion motors on each vehicle will be capable of propelling the vehicle up to 75 miles per hour. Both the DC series and separately excited motors are considered suitable for the system. On-board propulsion equipment includes control devices regulating the direct current voltage level to modulate motor torque and vehicle speed. These on-board control devices will utilize recently developed, highly reliable and economical thyristors as stepless controllers. The thyristors, used in conjunction with switches and resistors, will provide stepless dynamic braking in combination with a mechanical braking system.

SUBSTATION DESIGN

Rectifier substations will take maximum advantage of the primary power dual circuit arrangement and can transfer power supply from either circuit to either of two rectifier transformers. Power will be transferred automatically from one circuit to the other in case of an outage. The transformer rectifiers will supply the peak hour demand of track sections with a daily maintenance availability of 10 hours for one of the two transformer rectifier assemblies during off-peak periods. All circuit breakers are arranged for remote operation from central control.



PROPULSION AND BRAKING DIAGRAM

PASSENGER STATIONS

Electrical service for critical loads at passenger stations is transferable from the local utility circuit (the normal power source) to the propulsion power circuit during local circuit outage. In case of temporary outage of all external supply, battery powered emergency lighting will be actuated.

For passenger convenience and safety, normal lighting on station platforms is at least 25 footcandles intensity, and lobbies and entries will have not less than 40 footcandles intensity. Access stairs are illuminated to 100 footcandles during daylight hours of illumination, and emergency lighting facilities will provide illumination of at least 5 footcandles throughout all passenger areas. Train control will function for at least two hours under battery power if both normal station and propulsion power is shut down.

CONTROL AND COMMUNICATIONS

A tested and proven control and communication system concept will provide absolute safety and dependability for the transit system, and enable trains to operate smoothly at high speeds and close headways. The system employs advanced, computerized control and communication equipment that has already vastly improved operating efficiency in other industries. This new equipment is used in combination with improved versions of traditional safety devices.

A compact electronic computer on each train will regulate its operation according to continuous safety and control intelligence input from wayside transmitters.

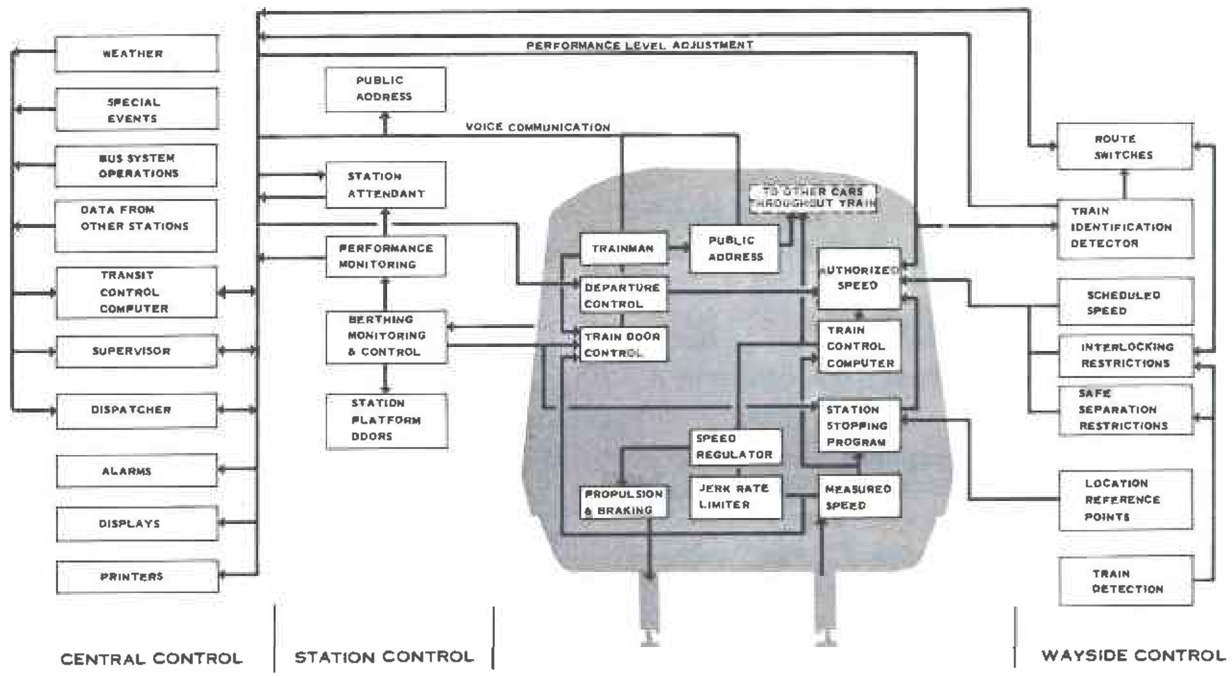
High speed data channels will deliver train performance data to the central control system where a sophisticated digital computer system will permit Dispatchers and Supervisors to manage and coordinate movement of trains and buses throughout their entire routes. The integrated control and communication system will compare moment-to-moment positions and movements with schedules, conditions and requirements.

The data transmission system will also deliver status and control information between the control center and widely dispersed, unattended installations such as electric substations and subway ventilation motors.

A high quality, overall voice communication system will deliver information to passengers and keep supervisory and maintenance people in constant contact with all offices and work areas to insure uninterrupted, safe, comfortable, reliable and coordinated service.

SAFETY

The safety system will maintain safe distances between trains. Enforced safe separation will be equal to the train's maximum stopping distance plus a wide margin of safety.



AUTOMATIC TRAIN CONTROL FUNCTIONAL SCHEMATIC

Each train will proceed at authorized speed only as long as it is separated from the train ahead by more than a safe distance. When the distance between trains approaches the safe limit, the speed of the following train will be automatically reduced. If the following train enters the safe-separation limit, including the added safety factor, it will be automatically brought to a controlled stop.

Precision station stopping will be accomplished by means of speed-distance programs stored within train control computers. Precise distance from the station stopping position will be electronically signalled from wayside location points. If a train is unexpectedly delayed in the station ahead, the safety sub-system will enforce safe separation instead of programmed stopping.

In addition, a route protection sub-system of the control system will make it impossible for a train to enter a route section not scheduled for that train. Route protection intelligence will be transmitted to trains approaching the route only when:

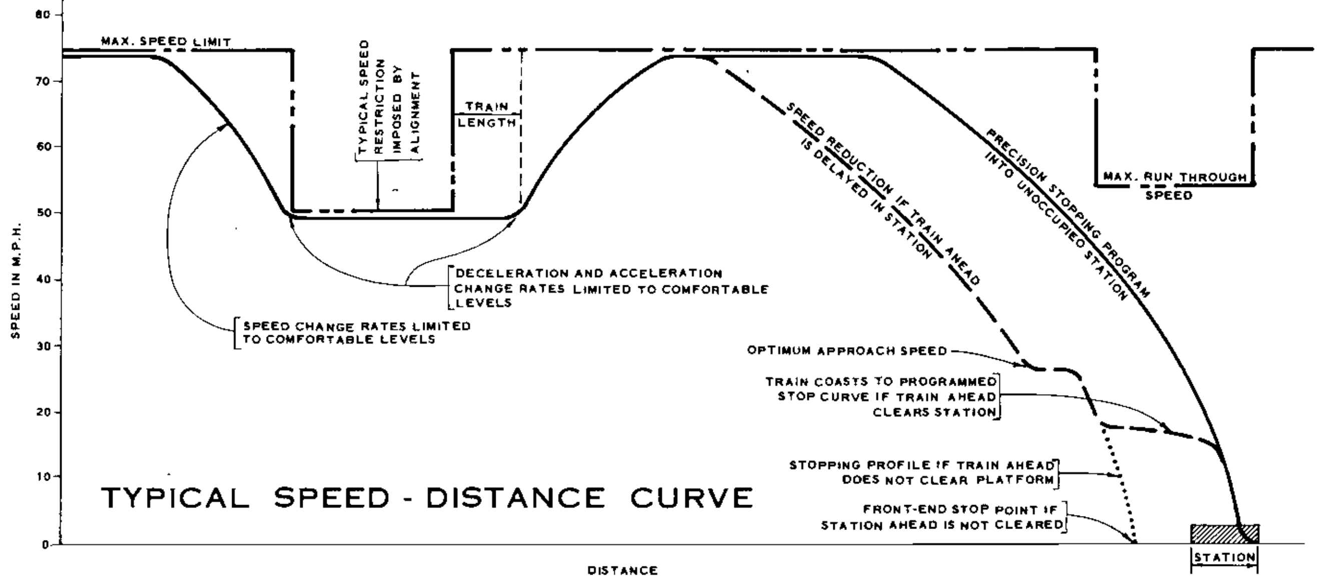
- All track switches are in proper position.
- The route is clear.
- No other trains are approaching.

In the event the approaching train does not receive the intelligence data, a stop routine is automatically initiated.

FAST CONTROL RESPONSE

Systems analysis of train operation requirements related to the need for safety at high speeds and close headways proved automatic train operation (ATO) to be decisively superior to manual operation. Its response to control and safety intelligence from wayside transmitters is consistently faster than that attainable in manual or semi-automatic operations.

By initiating control actions such as acceleration and deceleration directly and instantaneously, the ATO computer minimizes the difference between actual, measured, and authorized speed. As the schematic diagram illustrates, authorized speed depends upon



TYPICAL SPEED - DISTANCE CURVE

scheduled speed, and it is limited by safe separation requirements and interlocking restrictions. Authorized speed is further modified at times by precision stopping programs, station departure control, and performance level adjustment data transmitted from central supervision.

Automatic departure control can be overridden by train or station attendants, or by a central control dispatcher. Departure control is further interlocked with train door and train screen control.

Control intelligence within the ATO equipment initiates performance level adjustments to maintain correct inter-station running time.

If any part of the automatic control and communication equipment should malfunction, the remaining equipment and the propulsion and braking equipment will automatically assume a safe operating status. The train attendant can manually operate the train at reduced speed in emergencies, and in storage and maintenance yards.

COMFORT

By making all train movements smooth and gentle, automatic train control will greatly enhance passenger comfort. It will change speeds promptly enough to keep time-in-transit to a minimum—yet it will initiate and discontinue acceleration and braking actions very smoothly. Overly fast starts and sudden stops are eliminated.

As a train moves between stations, its speed will change as illustrated by the speed-distance curve diagram. The shape of this speed-distance curve is determined by three influences:

- Speed limits and speed restrictions establish limitations within which the curve must be contained.
- Changes in speed, acceleration and braking rate, will be limited to rates that insure smooth riding comfort.
- Changes in acceleration and braking rates will never exceed one-and-one-half miles per hour per second per second.

On-board ATO equipment will regulate running speed within a range of plus-or-minus two-and-one-half percent of maximum speed. For maximum performance level operation, running speed will be maintained as close as possible to the upper-limit level.

As the curve indicates, speed reduction for the speed restriction will begin early enough to stay entirely within the outside limitation. The train will continue at the restricted speed until its entire length has passed into the higher speed-limit region. If the station ahead is unoccupied, the train continues at top speed until it reaches the exact point where it should begin to decelerate for its programmed stop and for smooth, precise berthing.

If however, the station platform ahead is occupied by a train that has been delayed, controlled braking will begin at a point that will maintain safe separation between trains. If the train ahead does not clear the station, controlled braking will continue until the speed has been reduced to an optimum approach speed.

If the station is still occupied, full braking will begin. In the example illustrated by the curve, the train reduces its speed to about 20 miles per hour before the train ahead clears the station. Then it coasts to the programmed stopping curve and decelerates to the precise berthing position. As the dashed curve shows, the train would have stopped a safe distance away if the preceding train had not departed.

COORDINATED SERVICE

Regular schedules will meet all normal transit requirements, and special schedules will be initiated to meet seasonal changes, and planned commercial, cultural and sports activities. Unexpected variations arising from unscheduled occurrences, and from surges in other transportation modes will be met without difficulty by central control center supervision.

A high-speed computer system will analyze incoming data, and quickly select the best alternative to compensate for any unusual circumstances. Corrective alternatives include:

- Performance level adjustments.
- Station dwell time adjustments.
- Revision of entering order where routes merge.
- Change in length of trains entering service.
- Addition or withdrawal of trains from service.
- Route schedule alteration.

WAY STRUCTURE CONFIGURATIONS

One of the dominant items influencing community acceptance of any given section of the proposed transit route is the configuration used in traversing the area. This involves a range of considerations involving values such as aesthetics, noise, and physical barriers. It also involves the economic factors of land value and construction cost. In an area as large as the Los Angeles Basin, with its vast residential area and a well defined regional core, it is extremely important that the rapid transit system provide the maximum possible coverage. This in turn requires that the per mile cost be minimized since a major portion of total system cost is in way structures and stations. Therefore, various configurations have been investigated including aerial structures, surface, open cut and subway.

ALIGNMENT CONSIDERATIONS

Much of the decision on configuration selection is governed by the location of a particular route segment. For example, while an at-grade configuration is the least costly and easiest to construct of all configurations, it is limited in its application by the requirement of complete grade separation of transit and other traffic. Therefore, this configuration is applicable only where grade separation already exists, as in the case of a freeway median, or is not required, as in the case where the transit line closely parallels an existing physical barrier such as a river.

The open cut or depressed configuration provides capability for grade separation but encounters serious problems with existing utilities, particularly gravity systems such as sewers and storm drains, which must cross the alignment. Therefore, this configuration is most applicable in areas where the route parallels the natural slope of the surrounding terrain and utility crossings are minimal. Further, due to the very long transition length required when changes in configuration are made, this configuration is applicable when at least one end of the segment under consideration is in subway and transition can thereby be avoided. This configuration, by its nature,

Aerial Way Structure in street median

requires acquisition of private right-of-way to accommodate the slope requirement of the open cut.

The aerial structure is not appreciably affected by utilities or topography. It is also the most favorable from the transit riders point of view, and modern structural techniques plus careful landscaping, as demonstrated by the freeway system, will produce an aesthetically acceptable configuration. However, one of two conditions must be present to permit use of the aerial structure. Either existing streets or other public rights-of-way must be of adequate width to permit the structure to be incorporated without disruption of traffic flow, or the adjacent land value must be such that acquisition cost of private right-of-way does not become prohibitive.

The subway is the least influenced by the physical surroundings and topography. However, the high cost of construction limits the use of this configuration to those areas where physical features such as topography prohibit use of another configuration, as in crossing the Hollywood Hills, or where adjacent property values are such that right-of-way acquisition for another configuration becomes prohibitive.

AESTHETICS

The aesthetic considerations in connection with route configurations involve architectural design and landscape treatment of the transit way and station. The basic considerations in the aerial way concepts include:

- Simplicity of shape
- High quality, uniform finish and texture
- Proper proportion of mass to height and span
- Landscape treatment
- Acoustical considerations

On this basis, structures can be aesthetically pleasant, integral with their surroundings, and also provide a strong design element which will be a positive force in creating an aesthetic urban environment.

Whether or not the transit facility is visually appealing will often depend upon the quality of right-of-way landscaping. The California State Division of Highways has set a precedent in regard to landscaping which must be matched or exceeded if rapid transit is to gain community acceptance. This standard is equally applicable to all configurations, and to supporting features such as parking lots, pedestrian walkways, etc.

Through careful design of both way structures and stations, combined with a high standard of landscape treatment, an attractive belt of open space will be created within the urban area much like a strip park. Where the transit way is in an aerial configuration, this area will be completely open and accessible to residents of the area. These areas can provide much needed pedestrian walkways which will be pleasant and uncongested. In some areas, the right-of-way will also be utilized as parking area for adjacent commercial activity and permit greater utilization of commercial frontage by reduction of on-site parking requirements.

ACOUSTICAL CONSIDERATIONS

The constantly increasing sound level in urban areas has become a serious concern to urban planners and residents alike. Therefore, the preliminary design studies have included a special in-depth study and analysis of sound and vibration control throughout the system. These studies have included a determination of sound levels and vibrations to be produced by the transit trains in various configurations; measurement of existing sound levels in the areas traversed by the proposed routes; evaluation of acceptable sound levels, and a determination of sound control techniques which will produce acceptable conditions.

These studies have clearly shown that the sound level produced by an eight car train traveling at 70 mph will be less than that produced by the average Los Angeles freeway and approximately equal to a busy city street. This is accomplished by incorporating a sound barrier into the way structure in the form of a small wall at the edge of the structure, use of continuously welded rail, and reasonable maintenance of the transit vehicle and track surface. All of these measures have been included in the preliminary design of the system and all technological advances and control techniques will continue to be reviewed for incorporation into final design in an effort to reduce sound even further.

BARTD Photo

Linear Parkway Concept of Landscaping Aerial Structures, Bay Area Rapid Transit System.

WAY STRUCTURES

Way structures are the backbone of any rapid transit system. They are its most visible feature, the most critical safety element, and the largest capital investment item of the entire system. A large percentage of the system will be built on or above ground, and way structures will have a strong physical, economic and aesthetic impact on the communities traversed. As a structural system, they must be capable of supporting high speed trains safely over the economic life of the project. The way structure design will incorporate the key features of safety and visual attractiveness combined with economy of construction, low maintenance cost, and minimum disruption during construction.

The following paragraphs treat some of the normal types of structure loads along with additional design considerations. Loads for these rapid transit facilities are as accurately predictable as those for more conventional structures used by the public, and all safety factors are in agreement with local and conventional building codes.

For these structures, all local code requirements have been met or exceeded. Basically, the Uniform Building Code (UBC) has been followed, and special codes, such as those for railroad or highway bridges, have been applied where appropriate. In addition, all structural criteria were reviewed with the Structural Engineers Association of Southern California.

MOVING CAR LOADS AND IMPACT

Aerial structures must primarily support the trains safely, and these trains may consist of a few cars, or be 600 feet long. The magnitude and distribution of the moving car loads vary considerably. Speeds change from 0 to 75 mph. The suspension system for the cars will compensate for track irregularities, passenger imbalance, wind, girder deflection and similar effects, but train acceleration and movement will cause vertical and lateral forces which will add to existing forces in these directions. These forces, or impacts, have been included as a percentage of the loadings, and Bay Area Rapid Transit District test track findings were applied to all design conditions.

SEISMIC AND WIND CONSIDERATIONS

Structural design for such facilities in the Los Angeles area must include special seismic considerations. Past experience, scientific measurements and data, and current scientific theory indicate that there will be seismic disturbances in the future. Therefore, seismic design criteria for the way structures was carefully considered and incorporates the recommendations of the Structural Engineers Association of Southern California. Along with other members of the Structural Engineers Association in the State, the findings of this group form the basis for seismic design provisions in all local and regional building codes.

Generally, tunnels and similar underground structures do not experience damage from earthquakes. Basically, the structure moves with the earth and at the same period of vibration as the earth. Therefore, there is little or no net resultant seismic force exerted on the structure.

As none of the transit corridors cross an active fault or fault zone, or otherwise require any special treatment due to unique soil conditions, there are no special design considerations required. The structures designed for the Los Angeles area will be structurally and operationally safe under all anticipated loading conditions, including earthquakes.

Based on the detail evaluation of available wind records, predicted winds and results of special model studies of moving transit vehicles by Stanford Research Institute, realistic wind loadings were established and included in the design criteria.

SOILS

Preliminary soils investigation was conducted which included the compilation of existing data supplemented with test borings and laboratory analysis as required. Special conditions which exist in the La Brea Tar Pits, rivers, and difficult construction areas have been investigated, and no major problems are anticipated.

UNDERPINNING

It will frequently be necessary to underpin or support foundations where tunnels for rapid transit are close to existing foundations of buildings of four stories or more in height, or are located under existing buildings. Underpinning is generally required for all buildings adjacent to subway stations. If a tunnel is located under buildings three stories or less in height, except for special cases, no underpinning is required if the depth from the bottom of the existing foundation to the top of a tunnel is at least equal to the outside diameter of the tunnel.

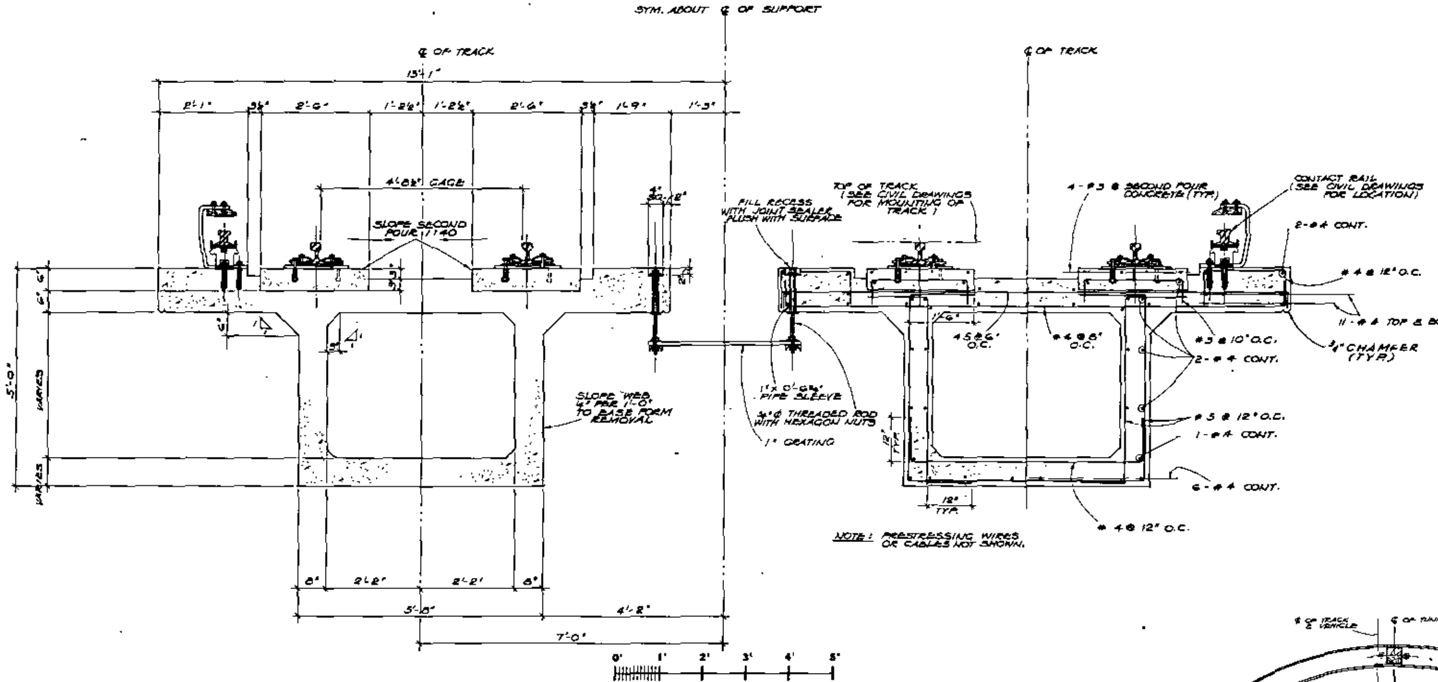
AERIAL WAY STRUCTURES

Aerial structures of single column, double girder design with a normal span of 80 ft. to 110 ft. have been selected as best meeting requirements of aesthetics, cost and modern prefabrication techniques. Basic shapes and sections have been developed which utilize two different types; an all concrete section, and a composite section using structural steel girders supporting a reinforced concrete deck. For purposes of this report, the concrete section has been used in the development of both the design and cost estimate. However, both types will be considered in the final design to take advantage of any advances in construction techniques or construction cost reduction.

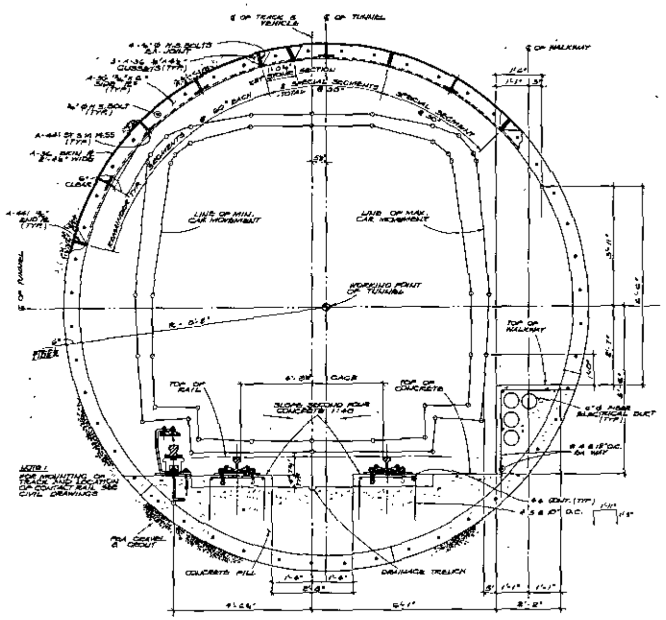
For typical column height and spacing, the basic column size will be 5′-0″ in diameter, supported on reinforced concrete piles. The girders will be 5′-0″ in depth for typical spans up to 110 ft. in length.

SUBWAY TUNNELS

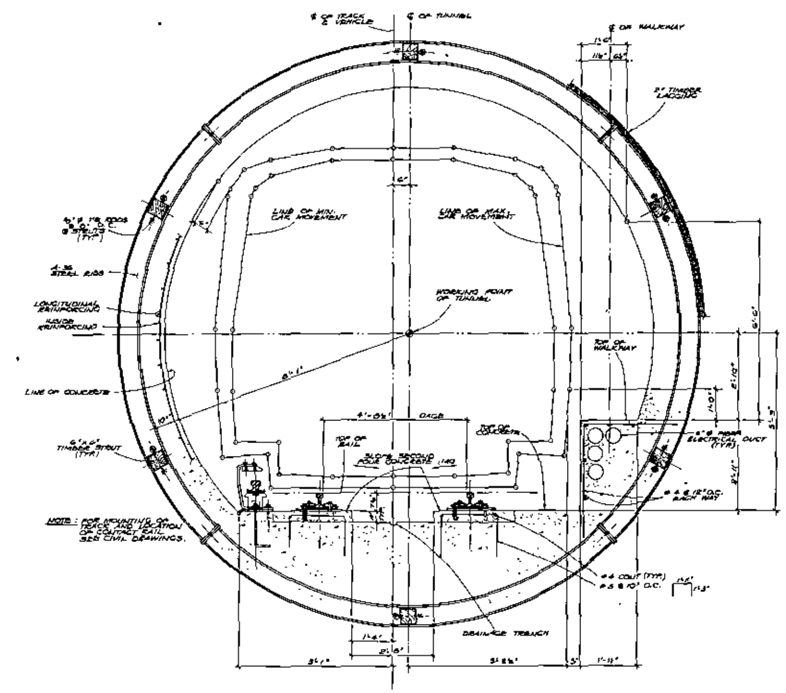
The twin tube tunnel section design selected for typical underground construction was based on subsurface soil conditions, economy, speed and safety of construction using tunnel shields, and for certain inherent advantages in tunnel ventilation. The inside diameters of the tunnel sections will be 16′-6″ on tangent sections, 17′-0″ on curves with a minimum radius of 1000 ft., and 17′-3″ on curves with a radius of less than 1000 ft. The material for tunnel lining can be either steel liner plates or concrete with steel ribs.



TYPICAL SECTION THROUGH
PRESTRESSED AERIAL GIRDERS



TYPICAL SECTION OF
STEEL LINER PLATE TUNNEL
TANGENT TRACK



TYPICAL SECTION OF
REINFORCED CONCRETE TUNNEL
TANGENT TRACK

ROUTE AND STATION LOCATIONS

El Monte Terminal in the San Gabriel Valley Corridor

WILSHIRE CORRIDOR

ROUTE DESCRIPTION

The route begins in a subway configuration at Union Station in Macy Street about 600 ft. east of Alameda Street. Leaving the station, the line turns southerly on a 1600 ft. radius curve crossing under the Hollywood Freeway to enter Broadway. Proceeding southerly on Broadway, the line continues in subway to 6th Street, where it meets the Wilshire-Long Beach Interchange structure. The Wilshire-Long Beach Interchange structure is situated at the intersection of 7th Street and Broadway, and provides full interchange capability for trains proceeding west on Wilshire, east on San Gabriel Valley, and south on Long Beach Corridors. The interchange structure occupies public and private property on 7th Street and Broadway. The Wilshire Corridor line continues west on 7th Street from the interchange, crosses under the Harbor Freeway and proceeds to a point at Carondelet Street where it turns northwesterly on a 3000 ft. radius reverse curve, entering private property in subsurface easement for the horizontal transition to Wilshire Blvd. Entering Wilshire Blvd. at Wilshire Place, the line continues westerly along Wilshire in subway to a point near Peck Dr. in Beverly Hills, where it turns southwesterly on a 2000 ft. radius curve to enter private property in subsurface easement for the transition to Young Street. Entering Young Street at about Lasky Drive the line proceeds westerly in subway to Moreno Drive where it enters and proceeds under the property of the Beverly Hills High School to a position in Constellation Ave. at Century Park East. The alignment follows Constellation Avenue to the westerly limit of Century City at Century Park West where it turns northerly on a 2000 ft. radius curve through subsurface easement to Thayer Avenue near Kinnard Avenue. Proceeding along Thayer Avenue, near Wilkins Avenue, the line turns westerly along a 2000 ft. radius curve under private property in subsurface easement to Wilshire Blvd. near Westholm Avenue. Proceeding west along Wilshire Blvd., the line continues in subway to San Vicente Blvd., enters property of the Veterans Administration in subsurface easement to Goshen Street where the line ends at a terminal station between Federal Avenue and Barrington Avenue. The route for the Four-Corridor System will follow the same alignment to the La Cienega station which will be the termination of the Wilshire Corridor under that system.

STATIONS

Locations and types of stations for this route are listed in the following table:

Station Location	Access			Station Type	*Travel Time in Min-Sec
	Bus	K&R	Park		
Union Station	x	–	–	Subway	4:27
Civic Center	x	–	–	Subway	3:04
6th & Broadway	x	–	–	Subway	1:39
7th & Flower	x	–	–	Subway	0:00
Lucas	x	–	–	Subway	1:20
Alvarado	x	–	–	Subway	2:51
Vermont	x	–	–	Subway	4:23
Normandie	x	–	–	Subway	5:34
Wilshire-Western	x	–	–	Subway	6:55
Wilshire-Crenshaw	x	–	–	Subway	8:19
Wilshire-La Brea	x	–	–	Subway	10:29
Fairfax	x	–	–	Subway	12:16
La Cienega**	x	x	x	Subway	13:53
Beverly Hills	x	–	–	Subway	15:58
Century City	x	–	–	Subway	17:56
Westwood	x	–	–	Subway	20:24
Barrington	x	x	x	Subway	21:57

* Schedule Time – from 7th and Flower including 20-second dwell time at stations.

** Terminal Station for Four Corridor System.

SAN FERNANDO VALLEY CORRIDOR

ROUTE DESCRIPTION

The route begins in a subway configuration at the Wilshire-San Fernando Valley Interchange on Wilshire Blvd. at Gramercy Place. The alignment turns northerly along a 600 ft. radius curve under private property in subsurface easement to Wilton Place at about 6th Street and proceeds northerly under Wilton Place to 2nd Street where it becomes an open cut section on private right-of-way east of Ridgewood Pl. The line continues northerly in open cut and returns to subway configuration at Fernwood Ave. It then turns west along a 1500 ft. radius curve under private property in a subsurface easement to Selma Avenue at Gower Street. The line continues westerly under Selma Avenue to Highland Avenue and under the athletic field of Hollywood High School to Orange Drive, under private right-of-way to La Brea Avenue, under Hawthorn Avenue to Formosa Street, and then turns north on a 2000 ft. radius curve in a tunnel under the Hollywood Hills. The tunnel emerges about 400 ft. north of the Hollywood Freeway and west of Lankershim Blvd. where it becomes an aerial structure. The route continues across the Los Angeles River and enters private right-of-way east of Lankershim at Chiquita Street. The aerial structure parallels Lankershim Blvd. in private right-of-way to Magnolia Avenue and turns west on an 1800 ft. radius curve to the Southern Pacific Company's right-of-way in the median of Chandler Blvd. It then proceeds along Chandler in aerial easement within the median to Coldwater Canyon Blvd. where the Southern Pacific right-of-way diverges and the transit line continues in the Chandler median to Van Nuys Blvd. The aerial structure continues across Van Nuys Blvd. and crosses on private right-of-way to the west side of Vesper on 1000 ft. radius curves. The line continues north in private right-of-way parallel to Vesper, and crosses to the east side of Tobias Avenue to the north of Victory Blvd. It then continues to Gault Avenue where it turns west on a 1200 ft. radius curve to enter the median of Sherman Way. The line proceeds west on an aerial structure to Van Nuys Airport, and changes to subway configuration under the runway through the existing north auto tunnel, which is to be replaced by a new auto tunnel immediately north. The line returns to aerial structure and continues westward in the median of Sherman Way, terminating at Tampa Avenue with a storage yard located west of Tampa. The Four-Corridor System terminates at a storage yard and terminal station at Balboa Blvd.

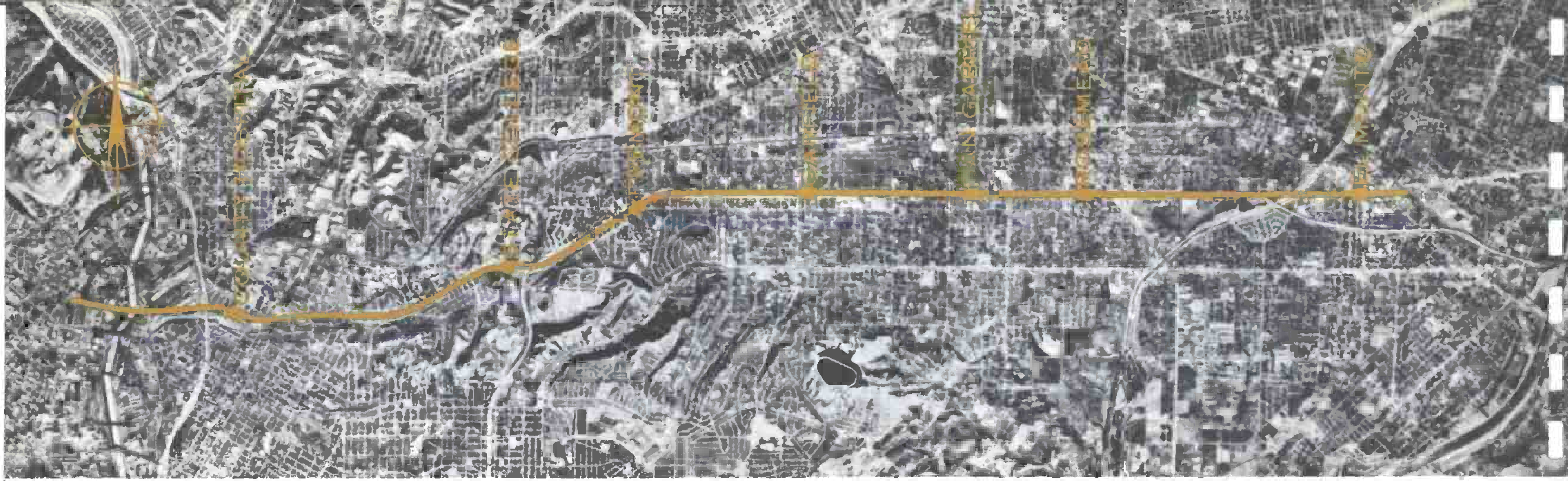
STATIONS

The Western Avenue station, while not part of this corridor, is vital to this route because it provides passenger transfer to trains for Wilshire West and San Gabriel Valley. Location and types of stations for this route are listed in the following table:

Station Location	Access: Bus	Access: K&R	Access: Park	Station Type	*Travel Time in Min-Sec
Beverly Blvd.	x	x	–	Open cut	9:39
Santa Monica Blvd.	x	x	–	Open cut	11:27
Vine	x	x	–	Subway	13:27
Hollywood-La Brea	x	x	–	Subway	15:05
Universal City	x	x	x	Aerial	19:02
North Hollywood	x	x	x	Aerial	21:28
Laurel Canyon	x	x	x	Aerial	23:40
Fulton	x	x	x	Aerial	25:52
Burbank Blvd.	x	x	x	Aerial	28:21
Van Nuys	x	x	x	Aerial	30:06
Sherman Circle	x	x	x	Aerial	31:48
Sepulveda	x	x	x	Aerial	33:39
Balboa**	x	x	x	Aerial	36:12
Lindley	x	x	x	Aerial	38:24
Tampa	x	x	x	Aerial	40:16

* Schedule Time – from 7th and Flower including 20-second dwell time at stations.

** Terminal Station for Four Corridor System.



SAN GABRIEL VALLEY CORRIDOR

ROUTE DESCRIPTION

The alignment begins at the east end of Union Station about 600 ft. east of Alameda Street, and proceeds easterly in subway configuration along Macy Street to Lyon Street, where it diverges on a 3200 ft. radius curve in subsurface easement on a line under the Los Angeles River and Mission Road, and surfaces at a portal in the Southern Pacific Company's right-of-way at the District's Macy Yard. After the yard connection, the tracks run at-grade along the Southern Pacific right-of-way, in joint use with a Southern Pacific track to Cornwell Street, where the Southern Pacific line turns north over a grade separation structure. The transit tracks proceed easterly at-grade from Cornwell Street in the Southern Pacific right-of-way, then under existing grade separations for Soto Street, Herbert Street, Eastern Avenue, through the Long Beach Freeway interchange, and enter the median of the San Bernardino Freeway, about 1000 ft. east of the interchange. The alignment proceeds at-grade in the Southern Pacific right-of-way in the freeway median, passing over existing street interchange structures at Fremont, Atlantic, Garfield, San Gabriel, Rosemead, and Walnut Grove Blvds. The right-of-way leaves the freeway median through Gibson overpass and continues easterly through the grade separation for the Rio Hondo Yard connection, crosses the Rio Hondo River on a bridge structure, changes to an aerial structure before reaching Hoyt Avenue, and terminates at the El Monte station. This route is identical under either the Recommended Five-Corridor System or the Four-Corridor System.

STATIONS

Locations and types of stations for this route are listed in the following table:

Station Location	Access			Station Type	*Travel Time in Min·Sec
	Bus	K&R	Park		
County Hospital	x	x	–	On-grade	6:44
State College	x	x	–	On-grade	10:10
Fremont	x	x	x	On-grade	12:07
Garfield	x	x	x	On-grade	14:29
San Gabriel	x	x	x	On-grade	16:31
Rosemead	x	x	x	On-grade	18:15
El Monte	x	x	x	Aerial	20:43

* Schedule Time – from 7th and Flower including 20-second dwell time at stations.

LONG BEACH CORRIDOR
ROUTE DESCRIPTION

The route begins in subway at the Wilshire-Long Beach Interchange located at 7th and Broadway. The subway alignment proceeds southerly along Broadway from the end of the Interchange near 9th Street to a point about 700 ft. beyond Washington Blvd. There it turns eastward on a 1600 ft. radius curve to enter private property north of 25th Street and then surfaces to become an aerial structure. The aerial route continues parallel to 25th Street to Central Avenue, where it turns southward on a 1000 ft. radius curve to private right-of-way parallel to, and east of Central Avenue. This alignment continues to Firestone Boulevard, turns eastward on a 1300 ft. radius curve to follow private right-of-way north of 91st Street to Elm Street. There it turns southward on a 1150 ft. radius curve, and changes from aerial structure to at-grade configuration, joining the median of the proposed Industrial Freeway at about 97th Street. Following the Industrial Freeway, the alignment proceeds south, parallel to Grape Street and Willowbrook Avenue, to Greenleaf Blvd where it changes during a 2500 ft. radius reverse curve from freeway median at grade to aerial easement over the Southern Pacific Company's right-of-way. The alignment then proceeds through the grade separation structure for the Dominguez Yard and Shops about 1000 ft. south of Greenleaf Boulevard. Proceeding southeasterly on the Southern Pacific right-of-way on aerial structure from the Dominguez Yard, the line crosses the Los Angeles River and turns south to enter the Los Angeles County Flood Control District property on a 2500 foot radius curve. There it changes from an aerial structure to a retained embankment configuration. The alignment proceeds southerly along the Los Angeles River in Los Angeles County Flood Control District property to a point about 2000 ft. beyond the Long Beach Freeway interchange. It then turns eastward on a 1250 ft. radius curve and becomes a subway configuration under the Long Beach Freeway and Ocean Avenue. Proceeding east along Ocean Avenue, the subway ends at the Long Beach Terminal station at Ocean and Pine interconnecting with the proposed Transportation Center. This route is identical under either the Recommended Five-Corridor System or the Four-Corridor System.

STATIONS

Location and type of stations on this route are listed in the following table:

Station Location	Access			Station Type	*Travel Time in Min-Sec
	Bus	K&R	Park		
Olympic	x	–	–	Subway	2:04
Washington	x	–	–	Subway	3:36
Adams	x	x	–	Aerial	5:48
Vernon Avenue	x	x	–	Aerial	7:25
Gage	x	x	x	Aerial	9:45
Firestone	x	x	x	Aerial	11:52
Watts	x	x	x	On-grade	14:51
Imperial	x	x	x	On-grade	16:53
Compton	x	x	x	On-grade	19:44
Del Amo	x	x	x	Aerial	23:53
Wardlow	x	x	x	On-grade	26:28
Pacific Coast	x	x	x	On-grade	29:01
Long Beach	x	–	–	Subway	31:46

* Schedule Time — from 7th and Flower including 20-second dwell time at stations.

AIRPORT-SOUTHWEST CORRIDOR

ROUTE DESCRIPTION-LOCAL

The Airport-Southwest Corridor route begins on-grade at Union Station. The route proceeds southerly on-grade in private easement to the Hollywood Freeway, transitions to aerial structure and continues southerly to a 750 foot radius curve. At the northwest corner of Alameda Street and First Street, the route portals to a subway configuration and continues to a point in First Street approximately 500 feet west of Alameda Street, then westerly to a 750 foot radius curve north of Hill Street. The route continues in subsurface easement southwesterly through the Bunker Hill Urban Renewal Project to a 1000 foot radius curve where it turns southerly in Flower Street at Fifth Street. The route continues southerly in subway under Flower Street, entering private property in a subsurface easement west of 28th Street and proceeds southerly to a portal near 30th Street. The route transitions into aerial structure and continues southerly in private right-of-way, to a point near 35th Street, and traverses a 1000 foot curve to the median in Exposition Boulevard. The aerial structure continues westerly in Exposition Boulevard in aerial easement, jointly utilizing the median with tracks of the Southern Pacific Company to Gramercy Place. The route enters private right-of-way at the north side of Rodeo Road, to a point near Arlington Avenue, where it turns southerly on a 1000 foot radius curve to the west side of Roxton Ave. The route, in private right-of-way, continues southerly to a point 900 feet north of Santa Barbara Avenue, turns southwesterly on a 1000 foot curve into the median of Leimert Boulevard and continues to 11th Avenue, where it traverses a 1000 foot radius curve in Leimert to proceed southerly in the median of Crenshaw Boulevard to 66th Street. Turning westerly, the route enters the right-of-way of the Atchison, Topeka and Santa Fe Railroad west of Victoria Avenue, and continues southerly and westerly in aerial structure, in joint use of the railroad right-of-way along Redondo Boulevard and Florence Avenue to a point near Portal Avenue. At this point the route enters private right-of-way west of the railroad right-of-way and proceeds southerly adjacent to Portal Avenue and Aviation Boulevard, transitioning to a cut and cover configuration south of 104th Street and returning to an aerial configuration south of Imperial Boulevard, to 139th Street. The route then turns southeasterly, through private right-of-way, terminating in a storage yard east of Aviation Boulevard and south of Rosecrans Boulevard. This corridor is included only in the Recommended Five-Corridor System.

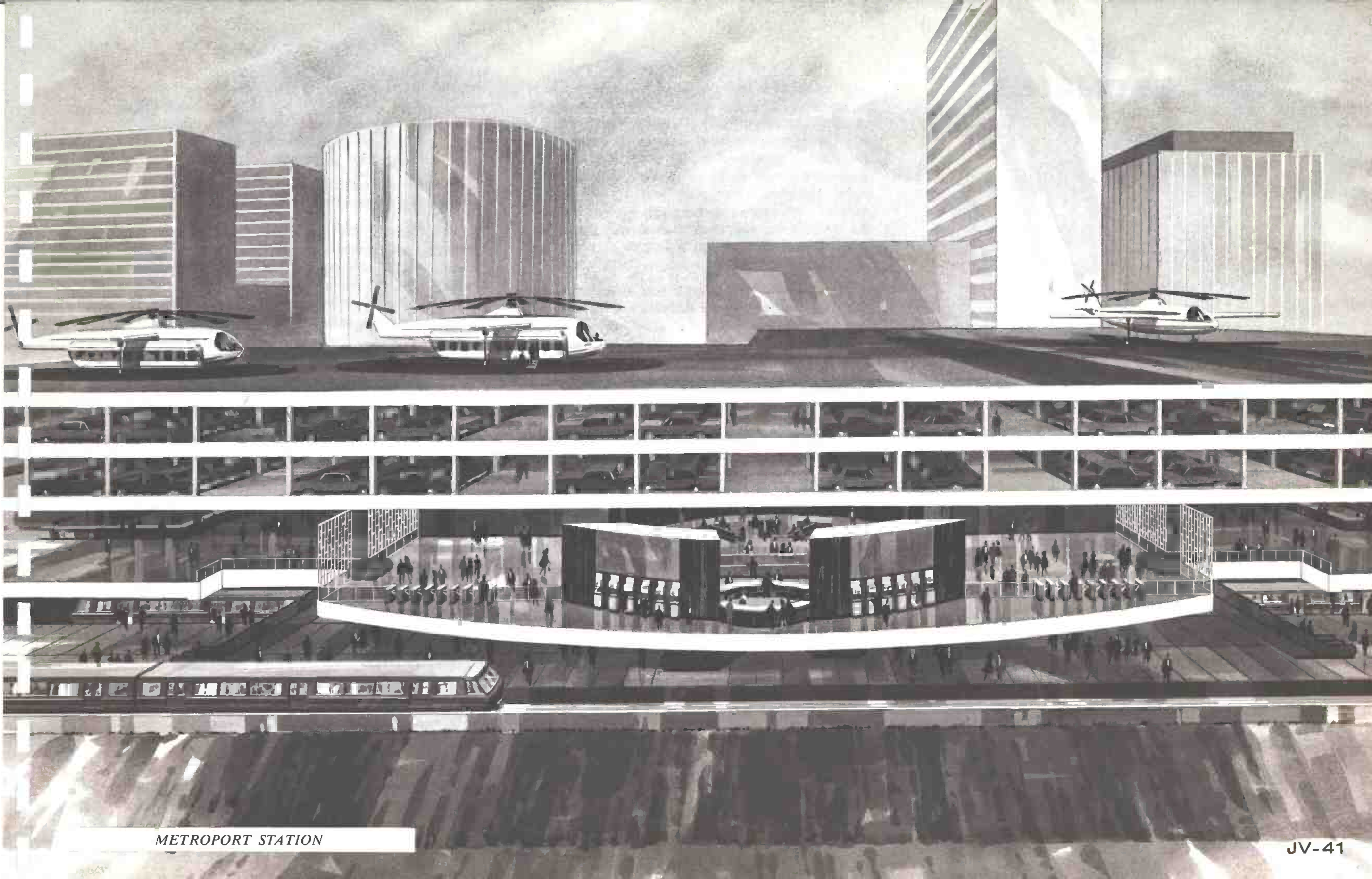
AIRPORT EXPRESS ROUTE

The Airport Express route of the Airport-Southwest Corridor is identical to the local route from the Metroport station, adjacent to Union Station, to a point 650 feet north of Century Boulevard. At this point the express route turns westerly from the local route via an 800 foot radius curve and continues in aerial structure in the south side of Century Boulevard to a terminus within the Los Angeles International Airport.

Locations and type of stations on this route are:

Station Location	Access			Station Type	*Travel Time in Min-Sec
	Bus	K&R	Park		
Local					
Metroport	x			On-grade	4:52
Civic Center	x		–	Subway	2:34
Bunker Hill	x		–	Subway	1:24
7th & Flower	x		–	Subway	0:00
Convention Center	x		–	Subway	1:28
Exposition Park	x		–	Aerial	4:33
Western	x		–	Aerial	6:32
Crenshaw-54th	x	x	x	Aerial	10:17
Inglewood	x	x	x	Aerial	13:44
Manchester	x	x	x	Aerial	16:13
Century	x	x	x	Aerial	17:55
El Segundo	x	x	x	Aerial	20:30
Rosecrans	x	x	x	Aerial	21:56
Express					
Metroport	x	x	**	On-grade	4:28
7th & Flower	x	x	–	Subway	0:00
L.A.X.	—	—	**	Aerial	14:24

* Schedule Time – from 7th and Flower including 20-second dwell time at stations.
** Parking provided by others.



METROPORT STATION

COST ESTIMATES

Construction of a totally new rapid transit system of the magnitude proposed includes many unique factors which will influence the final cost of the program. A transit system involves many different types of construction which require special skills, materials, and equipment not common to the construction industry of the region. Therefore, the proposed program was carefully analyzed with respect to type and quantity of labor and material required, physical conditions of the construction areas, methods and techniques of construction most adaptable to the program, etc.

In order to arrive at a reliable cost estimate, detailed preliminary engineering of facilities and systems was accomplished, and preliminary drawings and outline specifications were prepared which formed the basis for quantity take-off of labor, material and equipment. Estimates of costs were then developed based on a careful and detailed analysis of 1967 construction costs, prices, construction conditions existing in this area, and the program schedule.

Allowing for a one year engineering lead time prior to the beginning of construction, the total design and construction period for the Recommended Five-Corridor System and Four-Corridor System will be 8 years and 7 years respectively. Thus, based on the assumption that final engineering design will commence on January 1969, the Recommended Five-Corridor System will be completed and in full operation by the end of 1976. The Four-Corridor System would be operational by the end of 1975.

For construction efficiency and minimum disruption to communities, major portions of the subway will be constructed by tunneling. The twin tube subway tunnels will be constructed by using shields or continuous mining machines. Employment of either technique is determined by sub-surface conditions. Special tunnel structures and subway stations will be constructed by the cut and cover method. Excavations will be completely decked over to maintain vehicular traffic flow during the construction period.

Aerial way structures may utilize precast or prefabricated girders which will be hauled to the construction areas and lifted into place. This method is economical, fast, and will minimize disruption of vehicular traffic and the community in general.

The construction cost estimates as shown on the summary tables consist of the following:

STRUCTURES AND ROADBEDS – Includes cost of tunnels, aerial structures, special structures, earthwork, tunnel ventilation structures and equipment, retaining walls, slope protection, landscaping, necessary street work, drainage facilities, fencing, trackage, and all related construction items.

STATIONS – This line item is comprised of all structures and facilities required to handle passengers at points of access to the transit system including site preparation, structures, parking areas, escalators, ticketing equipment, ventilation and air-conditioning, plumbing, electrical power and lighting, landscaping and all related construction.

PROPULSION POWER – Includes all facilities and equipment required for providing and distributing the electrical power for vehicle propulsion.

CONTROL AND COMMUNICATION – Includes all costs of electrical and electronic facilities and equipment required to operate the entire system automatically.

UTILITY RELOCATION – Costs included are for removing, relocating, replacing, supporting and maintaining all services affected by the construction.

UNDERPINNING – This item covers temporary and permanent protection of the structural integrity of all buildings and structures which come within the influence of this construction project.

YARDS AND SHOPS – This item is comprised of the storage yard facilities, buildings and equipment for servicing, repairing, and maintaining the transit vehicles.

PROJECT MANAGEMENT, ENGINEERING DESIGN, CONSTRUCTION MANAGEMENT AND DISTRICT PRE-OPERATING EXPENSE — These costs cover project administration, detail planning, final design, preparation of construction plans and specifications, control surveying, soils investigation, construction management and inspection, general procurement and other related professional services. Also included are all costs and expenses for testing and trial operation of the system prior to the start of actual operations.

CONTINGENCY — Although the basic estimate of costs has been reliably determined, and is based on preliminary drawings and current construction prices and conditions, it is normal and necessary to provide for contingencies. A contingency sum equivalent to 15 percent of the basic estimate of construction cost is provided to cover the unknown and unanticipated conditions which may develop during design and construction.

ESCALATION — Based on current and historical trends, it is anticipated that wages and prices will continue to increase along with other cost factors such as taxes, interest rates, working conditions and regulations.

It is necessary to provide for increases to the 1967 prices used to develop the basic estimate of costs. The projection of this cost increase for a long term construction project is a complex task and can only be based on past experience, and careful consideration of future anticipated trends as related to construction work. The allowance for escalation has been based on 7% per year. Thus a delay of one year in the program could add an additional $132,000,000 in construction cost.

VEHICLES

The cost of the required vehicles includes base costs, taxes, delivery and installation in the system, and those costs of the control and communication equipment installed as an inherent part of each car plus an allowance for escalation.

SYSTEM COST SUMMARY

Recommended Five-Corridor System

The summary of estimate of costs for this system is presented with a breakdown of the estimate into major cost items described above. Also presented, in tabular form, is the summary of cash flow for this system. The cash flow projects the annual expenditure from the commencement of the final design work beginning January 1969, through to the completion of the construction work by the end of the 1976 calendar year.

ESTIMATE OF COSTS
RECOMMENDED FIVE-CORRIDOR SYSTEM
(In Thousands of Dollars)

1.	Structures and Roadbeds	$ 465,264
2.	Stations	379,882
3.	Electrification	98,765
4.	Control and Communication	53,814
5.	Utility Relocation	23,314
6.	Underpinning	33,494
7.	Yards and Shops	15,801
8.	Project Management, Engineering, Construction Management and District Pre-Operating Expense	139,143
9.	Contingency	181,422
10.	Escalation on Construction	622,741
	Subtotal	$2,013,640
11.	Vehicles (Includes Controls and Escalation)	213,451
	TOTAL	**$2,227,091**

CASH FLOW SUMMARY
RECOMMENDED FIVE-CORRIDOR SYSTEM
(In Thousands of Dollars)

Period	Annual Expenditure	Accumulated Total
1-1-69/6-30-69	8,606	8,606
7-1-69/6-30-70	52,542	61,148
7-1-70/6-30-71	164,113	225,261
7-1-71/6-30-72	333,475	558,736
7-1-72/6-30-73	497,684	1,056,420
7-1-73/6-30-74	551,571	1,607,991
7-1-74/6-30-75	385,452	1,993,443
7-1-75/6-30-76	193,732	2,187,175
7-1-76/12-31-76	39,916	**2,227,091**

Four-Corridor System Costs

The summary cost estimate and cash flow for this system is presented in similar form and detail to that described previously for the Recommended Five-Corridor System. The cash flow for this system reflects the total time of 7 years from commencement of final design to the completion of the construction work by the end of the 1975 calendar year.

ESTIMATE OF COSTS
THE FOUR-CORRIDOR SYSTEM
(In Thousands of Dollars)

1.	Structures and Roadbeds	$ 301,993
2.	Stations	248,002
3.	Electrification	69,135
4.	Control and Communication	40,590
5.	Utility Relocation	14,521
6.	Underpinning	16,400
7.	Yards and Shops	13,644
8.	Project Management, Engineering, Construction Management and District Pre-Operating Expense	91,557
9.	Contingency	119,376
10.	Escalation on Construction	378,900
	Subtotal	$1,294,118
11.	Vehicles (Includes Controls and Escalation)	149,278
	TOTAL	**$1,443,396**

CASH FLOW SUMMARY
THE FOUR-CORRIDOR SYSTEM
(In Thousands of Dollars)

Period	Annual Expenditure	Accumulated Total
1-1-69/6-30-69	4,507	4,507
7-1-69/6-30-70	26,415	30,922
7-1-70/6-30-71	108,775	139,697
7-1-71/6-30-72	259,215	398,912
7-1-72/6-30-73	403,975	802,887
7-1-73/6-30-74	394,298	1,197,185
7-1-74/6-30-75	205,175	1,402,360
7-1-75/12-31-75	41,036	**1,443,396**

ESTIMATES OF TRAFFIC, REVENUES AND EXPENSES

COVERDALE & COLPITTS

CONSULTING ENGINEERS

140 BROADWAY

NEW YORK, N.Y. 10005

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WILLIAM H. COVERDALE (1904-1949)
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(212) 943-7400

CABLE ADDRESS: COVERCOL

March 8, 1968

Southern California Rapid Transit District
1060 South Broadway
Los Angeles, California 90015

Gentlemen:

Submitted herewith are our estimates of traffic, revenues and expenses for the five corridor rapid transit rail-bus system recommended by the Southern California Rapid Transit District. Significant findings are as follows:

> Population forecasts for Los Angeles County indicate a gain of nearly 2,000,000 persons by 1980.
>
> Present and planned freeways will not be adequate, in our opinion, to serve the resulting increase in travel demand.
>
> The recommended rapid transit system will provide substantial additional capacity in the areas of greatest demand.
>
> Over 67 percent of the 1980 residents of Los Angeles County will live within 10 minutes' travel time of proposed rail routes.
>
> Nearly 42 percent of the job locations in 1980 will be within one mile of the rail routes.
>
> We estimate that over 1,400,000 daily rides will be carried on the combined rail-bus system by 1980 and, of these, 477,000 rides will be carried on the proposed rail system alone.
>
> We believe, therefore, that the system will serve a real need and have a favorable impact on the development of the area.

We wish to express our gratitude to the District's Board and its staff members who have cooperated with us in the course of this study and who have made valuable contributions toward its completion.

Respectfully submitted,

Coverdale & Colpitts

Consulting Engineers

ERG:gl

ESTIMATES OF TRAFFIC, REVENUES AND EXPENSES FOR PROPOSED RAPID TRANSIT RAIL-BUS SYSTEM

Coverdale & Colpitts has prepared estimates of traffic, revenues and expenses for the Southern California Rapid Transit District's proposed rapid transit rail-bus system for the year 1980. The principal findings of our study are summarized below.

RECOMMENDED FIVE CORRIDOR RAPID TRANSIT SYSTEM

The five-corridor rapid transit system recommended by the District will consist of five high-speed rail routes, completely grade-separated, providing regular service for five principal travel corridors: Wilshire, San Gabriel Valley, San Fernando Valley, Long Beach and Airport-Southwest. The terminals will be located, respectively, at Barrington Avenue north of Wilshire Boulevard, Tyler Avenue in El Monte, Tampa Avenue and Sherman Way, Ocean Boulevard and Pine Avenue in Long Beach, and Rosecrans Avenue and Aviation Boulevard. The first four routes will operate over common trackage in the Wilshire Corridor between the Wilshire-Western and 7th and Flower Stations.

In the Airport-Southwest Corridor, the planned route will provide both regular rapid transit and express service, the latter between the Metroport Station and L.A.X. Station located at the Los Angeles International Airport.

The recommended five-corridor system will have 89 route miles and 66 stations. The station locations have been planned to provide convenient passenger access to areas of residential and employment concentration and still permit high average train speeds.

Frequent service will be provided by the system. During the peak periods of heaviest demand, headways between trains on each corridor will be as close as three to four minutes, and in the common section of the Wilshire Corridor, one and one-half minutes. On each corridor, headways in the mid-day period will be ten minutes, and in the evening 15 minutes. Headways on the Airport Express service will be 15 minutes throughout the day. The complete system is planned to be in operation in 1977.

The service area of the proposed system will extend beyond the immediate vicinity of the five routes and will serve a substantial portion of Los Angeles County as a result of the District's plans for an extensive feeder bus system. The proposed feeder bus system will be comprised of new bus routes, extensions to existing routes and a higher level of service on present District lines which will serve the proposed stations. Parking lots and "kiss and ride" facilities planned at suburban stations also will provide a convenient means for passengers to reach the rapid transit system from a wide area.

LOS ANGELES METROPOLITAN AREA

Los Angeles County is one of the fastest growing areas in the country. Its population passed 4,000,000 in 1948; 5,000,000 in 1955; 6,000,000 in 1960; 7,000,000 in 1966; and is estimated by the Regional Planning Commission to reach 9,000,000 in 1980. These large increases in population, including a high rate of in-migration, are indicative of the many attractions, both natural and man-made, offered by the area to its residents. The fact that this growth has been sustained shows the vitality and strength of the local economy in providing jobs for the ever increasing number of employees added to the local labor force.

Such a high rate of growth has, of course, resulted in many problems of community development, not the least of which is local transportation. Community efforts to date have sought to meet this growing problem by establishment of an extensive freeway system and improvements to the arterial and local streets. There are approximately 332 miles of freeway in Los Angeles County, and the 1980 Master Plan provides for a total of 1,029 in the County. While the freeway system serves an essential function for a large number of daily commuters, peak period demand already exceeds capacity in many sections and continues to increase. In order for the area to accommodate the expected population growth of 2,000,000 between now and 1980, it will be necessary that there be sufficient transportation facilities, particularly between homes and jobs. We believe that the present and planned freeways will not be adequate for this purpose and additional transportation capacity will be essential, particularly in the urban core area where the provision of more freeways beyond those planned for 1980 would be difficult to accomplish because of the density of development.

In our opinion, the recommended rapid transit system will provide this additional capacity that will not only permit continued orderly growth but will stimulate further development of both population and employment in its service area.

Our analysis of population data shows that 67 percent of the total population of Los Angeles County lies within the residential service area. This area is generally within 10 minutes travel time of the stations and extends beyond where there is ease of access on freeways and arterial streets.

Proximity of rapid transit stations to places of employment is of utmost importance. The system has been planned to serve many areas of high employment concentration in the County. We have defined the employment service area as a band extending approximately one mile on either side of the proposed route alignments. This is a much more restricted area than the residential service area previously described. This represents the area to which passengers can most readily be attracted at the work end of their trips. Compilation of 1980 employment estimates made by the Los Angeles Regional Transportation Study (LARTS) shows that approximately 1,471,000 persons will be employed in these areas. This is 42 percent of the estimated 1980 total employment of 3.5 million in Los Angeles County.

We believe that the high percentage of population and employment within the proposed system's service areas show the significant contribution that the system can make in serving the community's transportation needs.

ESTIMATED RAPID TRANSIT PASSENGER TRAFFIC

We estimate that in 1980 the recommended five-corridor rapid transit system will serve 138,000,000 passengers annually. This is equivalent to 477,000 passengers on an average weekday. Over 75 percent of the weekday trips will occur during the two-hour morning peak period and the two-hour afternoon peak period. These passenger estimates do not include the Airport Express Service which is discussed later in the report.

A large percentage of passengers who will use the system will be diverted from automobiles. The 1980 annual trips that would be made by automobile in the absence of the rapid transit system amount to 100,000,000, of which 89,000,000 would occur in the morning and evening rush periods. In these peak periods of greatest traffic congestion, the rapid transit system would divert about 20% of the medium and long-haul auto trips traveling along the five corridors. Therefore, we believe that the proposed system will furnish significant traffic relief in the areas served.

METHOD OF ESTIMATING PASSENGERS

Detailed information was obtained and analyzed respecting both patrons of the District's bus system and automobile travelers as to origins and destinations of trips, travel times, trip purposes and time of day of travel.

To obtain data on current travel patterns of bus passengers, we undertook a passenger survey, in cooperation with the District's staff, on 38 of the District's bus lines which serve the five corridors. Responses to questionnaires were received from 53,917 bus passengers, representing a sample of 34.7% of the one-way passengers on the lines surveyed. Replies to the questionnaires were converted into numerical codes to permit use of electronic data processing whereby a complete inventory of bus travel patterns in the service area of the rapid transit system was obtained.

Similar data on trips via automobile was obtained from the Los Angeles Regional Transportation Study. LARTS is engaged in continuous and comprehensive regional transportation planning in a five-county area of Southern California. The study area includes Los Angeles, Orange, San Bernardino, Riverside and Ventura Counties.

The availability of LARTS trip data was an important contribution to our study as it provided information on projected automobile trips at 1980 conditions that would not otherwise have been readily available. By using LARTS projections as input for our study, we were able to prepare estimates based on data consistent with those being used by other transportation planning agencies in the area.

The travel data developed by LARTS is based on land-use study and estimated population and employment for each census tract in the study area for the year 1980. Travel volumes between each pair of area zones (which are groups of census tracts) were forecast using a vehicle transportation gravity type model in which vehicle trip movements are synthesized by use of mathematical relationships. These relationships were developed from sampling of travel characteristics by means of home interviews and from various special studies.

The LARTS estimates of 1980 population and employment did not include the assumption that a rapid transit system would be in operation. It is our opinion that such a system would have a noticeable impact on the development of the areas near the stations. We believe that in the core area served by all five routes, the employment growth will exceed that forecast by LARTS and that this added employment will have impact on the residential areas served by the system. Therefore, to account for the impact of rapid transit, we have included additional home-to-work trips between these areas.

Using bus and auto trip data, we then estimated the number of passengers that would be diverted from the two modes to a rapid transit system. The factors influencing the choice of mode include: travel time, travel costs, convenience, safety, reliability and comfort. We believe that the travel time of one mode compared with the other is the most significant factor in determining modal split, and major differences in travel costs are another important consideration.

It was necessary, therefore, to determine travel times between points of origin and destination by the three modes – bus, auto and rapid transit – at estimated 1980 conditions. These assumed conditions include completion of the State Division of Highways' Master Freeway Plan and the increased auto congestion resulting from a greater number of automobiles in the areas. Within the service areas of the system being studied, there were nearly 50,000 combinations of zone pairs for which travel times were calculated by computer.

Travel time comparisons between the modes were made using the total trip time from place of origin to place of destination at estimated 1980 conditions. For bus travel this included time to reach the bus line, wait for a bus, travel on bus and to reach destination. For auto travel this included unparking time, travel time on freeway or arterial street (for which we used estimates made by LARTS as a source) and parking time. For rapid transit travel this included time to reach station either by walking, feeder bus or auto, time to enter station, waiting time, travel time on train, time to leave station and time to reach destination from station.

In estimating the number of trips to be diverted from bus and auto by application of travel time comparisons, we considered the time of day during which the trip was made, the length of the trip and whether or not it was destined to the Los Angeles Central Business District.

Results from detailed analysis of this source data is summarized below for an average 1980 weekday. The table shows the number of potential trips in the service area, defined as those medium and long-haul trips traveling in the corridor generally along the alignment of the proposed routes, and those trips estimated as diverted to rapid transit. The peak period occurs from 7:00 a.m. to 9:00 a.m. and from 4:00 p.m. to 6:00 p.m.

RECOMMENDED FIVE-CORRIDOR SYSTEM
ESTIMATED POTENTIAL AND DIVERTED TRIPS
1980 AVERAGE WEEKDAY

	1980 Average Weekday	
	Potential Trips	Trips Diverted To Rapid Transit
Trips Via Bus		
Peak	96,200	70,000
Off-Peak	100,000	61,000
All Day	196,200	131,000
Trips Via Auto		
Peak	1,604,800	307,000
Off-Peak	3,911,100	39,000
All Day	5,515,900	346,000
Trips Via Bus and Auto Combined		
Peak	1,701,000	377,000
Off-Peak	4,011,100	100,000
All Day	5,712,100	477,000

A flow map showing the number of passengers on a 1980 average weekday along each of the five routes of the system is shown in Exhibit 1.

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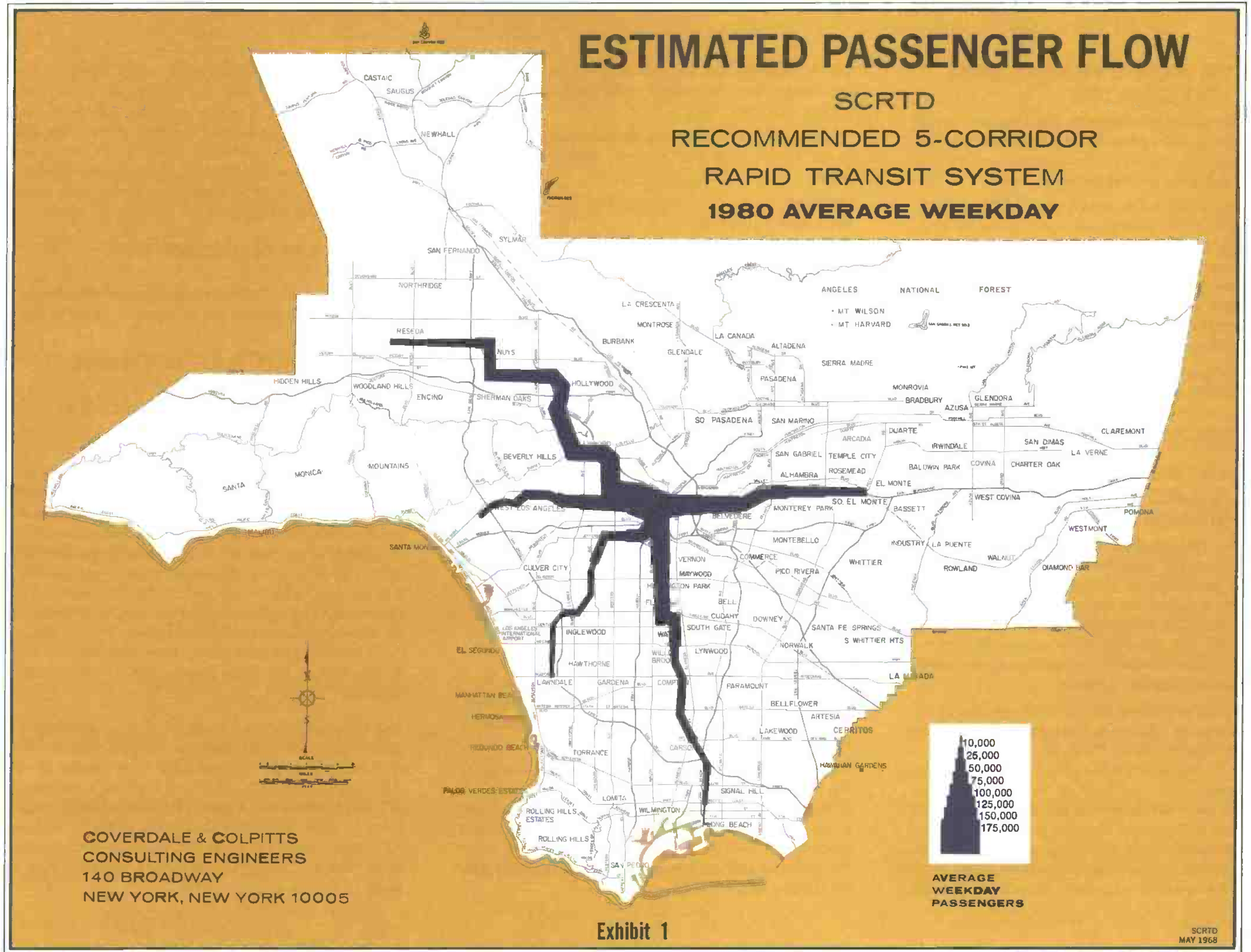
ESTIMATED PASSENGER FLOW
SCRTD
RECOMMENDED 5-CORRIDOR
RAPID TRANSIT SYSTEM
1980 AVERAGE WEEKDAY
CASTAIC
SAUGUS
NEWHALL
SYLMAR
SAN FERNANDO
NORTHRIDGE
RESEDA
HIDDEN HILLS
WOODLAND HILLS
ENCINO
SHERMAN OAKS
HOLLYWOOD
BURBANK
GLENDALE
MONTROSE
LA CRESCENTA
LA CANADA
ALTADENA
PASADENA
SIERRA MADRE
ANGELES
NATIONAL
FOREST
MT WILSON
MT HARVARD
MONROVIA
BRADBURY
AZUSA
GLENDORA
CLAREMONT
SAN DIMAS
LA VERNE
SO PASADENA
SAN MARINO
ARCADIA
DUARTE
IRWINDALE
SAN GABRIEL
TEMPLE CITY
ROSEMEAD
ALHAMBRA
BALDWIN PARK
COVINA
CHARTER OAK
EL MONTE
SO. EL MONTE
MONTEREY PARK
BASSETT
WEST COVINA
POMONA
WESTMONT
BEVERLY HILLS
MONICA
SANTA
MOUNTAINS
SANTA MONICA
CULVER CITY
BELVEDERE
MONTEBELLO
INDUSTRY
LA PUENTE
COMMERCE
VERNON
MAYWOOD
PICO RIVERA
WHITTIER
ROWLAND
WALNUT
DIAMOND BAR
BELL
CUDAHY
SOUTH GATE
DOWNEY
SANTA FE SPRINGS
S WHITTIER HTS
NORWALK
LOS ANGELES INTERNATIONAL AIRPORT
INGLEWOOD
EL SEGUNDO
HAWTHORNE
LYNWOOD
LA MIRADA
LAWNDALE
GARDENA
PARAMOUNT
MANHATTAN BEACH
BELLFLOWER
ARTESIA
HERMOSA
LAKEWOOD
CERRITOS
REDONDO BEACH
TORRANCE
HAWAIIAN GARDENS
PALOS VERDES ESTATES
LOMITA
SIGNAL HILL
ROLLING HILLS ESTATES
WILMINGTON
LONG BEACH
ROLLING HILLS
SAN PEDRO
10,000
25,000
50,000
75,000
100,000
125,000
150,000
175,000
AVERAGE
WEEKDAY
PASSENGERS
COVERDALE & COLPITTS
CONSULTING ENGINEERS
140 BROADWAY
NEW YORK, NEW YORK 10005
SCRTD
MAY 1968

Exhibit 1

FEEDER BUS SYSTEM AND PARKING SPACES

In order to attract passengers to the proposed system from as wide an area as possible, it is important that convenient access be available to the stations, both by connecting feeder buses and automobiles.

An extensive feeder bus network is planned. Many of the present lines of the District will serve as feeder lines, either using their present routes or with minor route modifications. Other present lines will be extended. Additionally, new lines will be established so that all stations of the system will have convenient bus service. We propose the establishment of approximately 115 new feeder bus lines having one-way route mileage of over 300 miles.

Over 28,000 parking spaces will be provided on the system, principally at suburban stations, and there will be convenient facilities at these stations for dropping off and picking up passengers by automobile.

ESTIMATED RAPID TRANSIT FARES AND REVENUES

FARE SCHEDULE

A proposed fare schedule has been prepared for the rapid transit system. It has been developed to attract the maximum patronage as well as to provide sufficient revenues for the District to meet its operating and maintenance expenses. The proposed fare schedule is necessarily related to the fare schedule of the present bus system, inasmuch as both the rapid transit and bus service will be operated as an integrated system.

The proposed rapid transit fare schedule provides for the same minimum fare as on the bus system. Based on the bus fare in effect in March 1968, this would be a minimum fare of 30¢ and would apply to rides up to five miles in length. Fares for rides of longer distances are determined on a declining rate per mile to reflect the relative fixed and variable costs per passenger. The fare for the maximum length trip of 47 miles between the Long Beach and Tampa Stations would be $1.00 which would be at a rate of 2.1¢ per mile. A moderate discount will be available for multiple-ride tickets. Passengers transferring from one rapid transit line to another will not pay a transfer charge.

Fares for single-ride tickets for representative trips based on the March 1968 fare level are shown in the table below.

STATIONS	FARES
Barrington to Civic Center	65¢
El Monte to State College	45
Tampa to Wilshire-Western	85
Watts to Olympic	45
Van Nuys to Adams	85
Fremont to Union Station	30
Long Beach to Compton	55
El Segundo to Exposition Park	55
Inglewood to County Hospital	65

Rapid transit passengers will be able to transfer to and from feeder buses without paying an additional 30¢ base fare. They will pay only a transfer charge of 5¢ for bus trips of less than two miles and an additional 8¢ for each zone thereafter, in accordance with the bus fare structure in effect in March of 1968.

PASSENGER REVENUES

The fare to be charged for each station-to-station trip has been applied to the traffic volume estimated above to determine the passenger revenue. The estimated 1980 passenger revenue of the recommended rapid transit system will be $70,000,000, based on above described fare schedule.

OTHER REVENUES

Other revenues will be generated by the rapid transit system including parking, concession and advertising revenues.

We recomend that there be a 25¢ charge for all-day parking in those spaces most convenient to the station entrances. We believe that this fee would be appropriate for about 5,800 of the 28,000 spaces. These spaces would produce $400,000 in annual revenues, which will cover the operating and maintenance expenses associated with the parking lots.

The District plans to lease space within many of the stations to concessionaires for the purpose of offering goods and services of a quality consistent with the design and standards of the system. The sale of space for appropriate advertising within the cars and restricted areas within the stations will provide another source of revenue. A reasonable expectation of revenue from these sources is $600,000 per year.

TOTAL RAPID TRANSIT REVENUE

In summary, total 1980 rapid transit revenues from passengers and other sources are estimated at $71,000,000.

ESTIMATED RAPID TRANSIT OPERATING AND MAINTENANCE EXPENSES

PLAN OF OPERATION

The Plan of Operation of the recommended rapid transit system provides for train routing as follows: the Wilshire and San Gabriel Valley lines will operate as one route, San Fernando Valley and Long Beach lines will operate as another route and the Airport-Southwest line will operate independently. Passenger transfer between the Wilshire-San Gabriel route and the San Fernando-Long Beach route can be accomplished across the platform at the Wilshire-Western and 7th and Flower Stations. Transfer facilities to and from the Airport-Southwest line will be provided at the Civic Center and 7th and Flower Stations.

The District's staff has prepared a train schedule to accommodate the 1980 passenger volumes estimated for each route. The plan provides for train lengths up to eight cars which will be capable of handling a maximum of 1,000 passengers per train. Minimum schedule headways in rush periods will be two minutes, with a 90-second capability. The hours of operation are assumed to be from 5:00 a.m. through 1:00 a.m., seven days a week.

The train schedule will require 739 cars to operate, including spares, and indicates that 40,338,000 car miles per year will be needed to serve the estimated passenger volumes.

RESPONSIBILITY FOR ESTIMATES

Estimates of annual operating and maintenance expenses incurred in the operation of the proposed system have been made based on the estimated passenger volumes to be carried, the train schedule, the planned facilities and practices of other rapid transit systems. The estimates of maintenance of way, maintenance of equipment and power costs have been prepared by Kaiser Engineers/ DMJM, a Joint Venture, and consolidated with our estimates of transportation and general and administrative expenses. The operating and maintenance expenses associated with the airport express service are not included.

The expense estimates have been prepared by estimating the man-hours needed to operate and maintain the planned system. The wage rates used in calculating labor costs are those in effect in March 1968 for comparable job positions within the District's work force. Similarly, employee benefits included in the estimates are those in effect for District employees as of the same date. Material costs are those in effect as of March 1968. The general categories of expenses are described and itemized below.

MAINTENANCE OF WAY

This category includes the expenses of maintaining fixed facilities such as subways, aerial structures, tracks, stations, electrical and control equipment, power systems, fare collection equipment, escalators, landscaping, fencing and parking lots. The Joint Venture estimates this annual expense at $6,700,000.

MAINTENANCE OF EQUIPMENT

This category includes expenses of maintaining, inspecting, repairing and cleaning of rolling stock. The Joint Venture estimates this annual expense at $3,300,000.

POWER

This category includes the expense of providing traction power for the propulsion of the cars and auxiliary power for station illumination and operation of machinery, such as escalators, fans, pumps and other power equipment. The Joint Venture estimates this annual expense at $5,600,000.

TRANSPORTATION

This category includes the wages of the train attendants, station attendants, porters, platform men and other personnel and material directly associated with train operation. We estimate this annual expense at $10,000,000.

GENERAL AND ADMINISTRATIVE EXPENSE

This category includes the administrative personnel required in such functions as accounting, purchasing, scheduling, personnel, etc. that will be added to the District's present staff as a result of the rapid transit system; insurance expenses including liability and property damage insurance; employee benefits for rapid transit employees; and other administrative expenses. We estimate this expense at $4,200,000.

The table below summarizes the estimated annual operating and maintenance expenses for the rapid transit system for 1980 service levels at March 1968 wage and cost levels.

Expense Categories	Annual Expense
Maintenance of Way	$ 6,700,000
Maintenance of Equipment	3,300,000
Power	5,600,000
Transportation	10,000,000
General and Administrative	4,200,000
Total	$29,800,000

AIRPORT EXPRESS ROUTE—REVENUES AND EXPENSES

A supplemental service has been planned to provide express service between the proposed "Metroport" at Union Station and a special branch and terminal serving Los Angeles International Airport (LAX) with an intermediate stop at 7th and Flower.

Day & Zimmermann has developed a Plan of Operation for this special service which would initially provide for four-car express trains operating on a fifteen minute headway for 20 hours a day. These express trains would be in addition to regular Airport-Southwest route trains operating on the same tracks.

Additional operating and maintenance expenses for the express service and the expense of handling the mail and baggage on the Airport-Southwest route have been estimated by the Joint Venture and ourselves to total $2,100,000 annually at March 1968 wage and cost levels. This includes provision for the added personnel that may be required because of the special nature of the service.

Based on a proposed fare of $1.50 for a one-way trip, 1,400,000 passengers annually would be required to cover additional operating expenses and this volume could be accommodated on the initial service proposed. Any additional revenue from the handling of mail would reduce the number of passengers required. The Los Angeles Department of Airports in the preliminary planning for its Downtown Air Terminal estimates that by 1975 the International Airport will serve 57.5 million passengers. On this basis, the passenger volumes required on the Express service to pay operating expenses are a reasonable minimum expectation.

The actual level of utilization in future years of the various Los Angeles airports, including proposed Metroports, and the travel volumes to, from and between these facilities will depend largely on policy decisions yet to be made by the Department of Airports. Estimates of traffic on the Airport Express would depend on these decisions and could substantially exceed the number required to cover initial operating expenses. However, for the purpose of this report, we have assumed that revenues from the Airport Express will offset the additional operating and maintenance expenses for the service.

EFFECT OF RAIL RAPID TRANSIT ON THE BUS SYSTEM

The proposed rapid transit system will affect the existing bus system by attracting a substantial number of new passengers to feeder bus services, and by diverting to the rail lines passengers whose journeys will be more satisfactorily made by that mode. Estimates indicate that annual feeder bus trips will total 155,700,000 while trips diverted to the rail lines will total approximately 38,000,000, for a net increase in bus system passengers of 117,700,000.

A network of 115 new bus lines comprising 300 miles of route will be required to accommodate passengers of the feeder service. The District staff has prepared tentative schedules for the feeder bus lines and estimates that 1,100 buses will be required for that service, offset in part by a reduction in requirements on existing lines from which passengers are diverted, of approximately 300 buses. The net increase in equipment required for the feeder service is thus 800 scheduled buses plus an allowance for spares, and the net increase in operating expense is estimated at $13,500,000 per annum at 1968 wage and price levels.

Revenues from diverted bus passengers will be collected on the rail system, and the feeder services are estimated to collect some $10,900,000 per annum in transfer and zone increment fares at rates previously described.

1980 CONSOLIDATED OPERATING RESULTS—RAPID TRANSIT RAIL-BUS SYSTEM

The number of revenue and transfer passengers that will be carried in 1980 on the Recommended Five-Corridor Rapid Transit System and the bus system is estimated in the following table.

1980 PASSENGER ESTIMATES
RECOMMENDED FIVE-CORRIDOR RAPID TRANSIT RAIL-BUS SYSTEM

	Passenger Traffic	
	Average Weekday	Annual
Rapid Transit Revenue Passengers	477,000	138,300,000
Bus System Revenue and Transfer Passengers	929,000	280,300,000
Total System Passengers	1,406,000	418,600,000

The estimated year 1980 operating results of the District's five-corridor rapid transit and bus system at 1968 fare and cost levels have been consolidated in the following table:

	Dollars (Millions)
Passenger Revenues	$114.3
Other Revenues	1.6
Total Revenues	$115.9
Operating & Maintenance Expenses	$ 88.5
Reserve for Replacements	14.5
Total Expenses	$103.0
Available for Service Improvements and/or Partial Offset for Increases in Cost Levels by 1980	$ 12.9

A reserve fund has been provided so that the District can make necessary replacements of rolling stock and other facilities with relatively short service lives. We have estimated that $14,500,000 will provide sufficient funds to make necessary replacements for the five-corridor rapid transit system and the enlarged bus system.

It is reasonable to assume that by 1980 wage rates and other costs will rise from the March 1968 levels on which these estimates are based. Some of these anticipated higher costs can be absorbed by the District from its revenues and we suggest that the difference between the estimated revenues, and expenses shown in the above table be assigned for this purpose and for improvements in the bus service throughout the District.

TRAFFIC, REVENUE AND EXPENSE ESTIMATES FOR A FOUR-CORRIDOR RAPID TRANSIT SYSTEM

The District also requested a report on the estimated traffic, revenues and expenses on a more limited four-corridor rapid transit system. The four-corridor system is similar to the recommended five-corridor system except that it excludes the Airport-Southwest route and shortens the Wilshire route by 5.4 miles and the San Fernando Valley route by 3.0 miles. The four-corridor system to which the current estimates relate differs in some instances in alignment and station locations from the four corridor system studied for the Preliminary Report.

This system of 62 route miles is comprised of the Wilshire route with its terminal at La Cienega Boulevard, San Gabriel Valley route with its terminal at Tyler Avenue in El Monte, the San Fernando Valley route with its terminal at Balboa Boulevard and Sherman Way, and the Long Beach route with its terminal at Ocean Boulevard and Pine Avenue in Long Beach. There are 46 stations.

This system includes broad coverage by a feeder bus network which we estimate would require approximately 260 one-way miles of route on nearly 90 new lines, and provision for a total of approximately 21,000 parking spaces at 23 of the suburban stations.

Approximately 52 per cent of the population of Los Angeles County lives within the residential service area of the four-corridor system. Analysis of estimated 1980 employee data for the areas within one mile of the stations indicates 37 per cent of the County's estimated employment will be within this narrowly defined service area.

The same methodology, source data, and criteria were used to prepare the traffic, revenue, and expense estimates for this system as for the recommended five-corridor system. The proposed fare schedule is based on the same premises as used previously.

We estimate that on an average weekday in 1980 the four corridor system will carry 364,000 passengers and for the year, 105,600,000 passengers. Passenger revenue generated by this traffic at March 1968 fare levels, would amount to $52,100,000. Other revenues would be $1,000,000.

The train schedule prepared by the District staff to accommodate the 1980 estimated traffic shows that 28,308,000 car miles per year would be operated and that 538 cars, including spares, would be required. The annual operating and maintenance expenses, prepared on the same bases as for the recommended five-corridor system, are estimated to be $22,300,000, based on the March 1968 wage and cost levels.

The feeder bus network required for this system would carry an estimated 116,900,000 annual passengers while trips diverted to the rapid transit system would be approximately 30,500,000 for a net increase in bus passengers of 86,400,000 annually.

The feeder bus network would require 850 buses which would be offset in part by 230 buses that could be reassigned as a result of diversions. Thus, a net increase of 620 scheduled buses plus an allowance for spares would be required. The net increase in operating expenses is estimated at $10,500,000 annually at March 1968 cost levels. Estimated revenues from the feeder bus system would be $8,100,000, while the fares from diverted passengers would be collected on the rapid transit system.

The table below shows the estimated number of passengers that would use the bus and four-corridor rapid transit systems, both for an average 1980 weekday and on an annual basis.

1980 PASSENGER ESTIMATES
FOUR-CORRIDOR RAPID TRANSIT
RAIL-BUS SYSTEM

	Passenger Traffic	
	Average Weekday	Annual
Rapid Transit Revenue Passengers	364,000	105,600,000
Bus System Revenue and Transfer Passengers	828,000	251,100,000
Total System Passengers	1,192,000	356,700,000

The consolidated operating results including reserves for replacements are presented in the following table for the District's bus system and the four-corridor rapid transit system for the year 1980. The fare levels and the wage and cost levels used for these estimates are as of March 1968.

	Dollars (Millions)
Passenger Revenues	$ 98.5
Other Revenues	1.6
Total Revenues	$100.1
Operating & Maintenance Expenses	$ 78.1
Reserve for Replacements	12.0
Total Expenses	$ 90.1
Available for Service Improvements and/or Partial Offset for Increases in Cost Levels by 1980	$ 10.0

As with the five-corridor system, it is reasonable to assume for the four-corridor system that by 1980 wage rates and other costs will rise from the March 1968 levels on which these estimates are based. Some of these anticipated higher costs can be absorbed by the District from its revenues and we suggest that the difference between the estimated revenues and expenses shown in the above table be assigned for this purpose and for improvements in the District's bus service.

FINANCING RAPID TRANSIT

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March 21, 1968

Southern California Rapid Transit District
1060 South Broadway
Los Angeles, California 90015

Gentlemen:

Pursuant to our contract dated November 29, 1967, we are pleased to submit our report relating to financing rapid transit facilities for the Southern California Rapid Transit District.

The estimated cost of the recommended five-corridor system is $2,514,861,000. It appears that the issuance of general obligation bonds of the District is the most feasible and economical method of financing the system. Bonds would be authorized in an amount sufficient to finance all major elements of the project with adequate allowance for inflation and contingencies. The total amount of bonds to be authorized is within the borrowing limit of the District estimated for 1968/69.

Based upon hearings conducted in connection with the Preliminary Report, it appears to be the preponderant opinion that, if possible, the property tax should not be the source of funds to meet bond service costs but that other sources of revenue requiring additional legislative authorization should be explored. One such source is the general sales tax.

It is estimated that proceeds of a 1/2 of 1% general sales tax in the District would meet all bond service requirements for the recommended five-corridor system. No property tax would then be required.

Two transportation-related taxes were considered in the Preliminary Report: the removal of the exemption of gasoline from the sales tax and the imposition of a 1% in lieu motor vehicle tax. Neither of these would in itself generate annual funds in the District sufficient to meet debt service requirements for either the recommended five-corridor system or for the more limited four-corridor system.

We appreciate the cooperation of the District's staff and its consultants in the preparation of our report and look forward to working with you in the future.

Sincerely,

STONE & YOUNGBERG

James S. Saffran
James S. Saffran

JSS:bp

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FINANCING MAJOR TRANSIT FACILITIES FOR THE SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT

This summary financing report presents the basic findings, conclusions, and recommendations of the District's consultants relating to financing major transit facilities for the Southern California Rapid Transit District. A financing study was prepared by the District in October 1967, as a part of the Preliminary Report of the District, which was distributed to each affected city and county, as required by law, and to the people of the Los Angeles Metropolitan Area for critical review and comment.

SUMMARY OF FINANCING PROGRAM, PRELIMINARY REPORT

The financing analyses presented in the Preliminary Report were based on a 62-mile, four-corridor system with a total estimated project cost of $1,571,702,000. The preliminary financing plan contemplated authorization and issuance of District-wide general obligation bonds with debt service to be met from ad valorem property taxes, or from alternative sources of funds which would require additional legislative authorization. It was assumed that certain Federal grants would be obtained and that some net operating revenue would become applicable to debt service.

The study concluded that if the system were to be constructed with bond service costs met entirely from property taxes, the required increase in the tax rate (per $100 assessed valuation) would be approximately 6¢ in the first year, rising gradually to a maximum of 41¢ in the sixth year, and decreasing annually thereafter.

If, however, a 4% sales tax on gasoline were applied to construction costs and annual debt service, the maximum increase in the ad valorem property tax rate would be approximately 14¢ in the seventh year, and would decline each year thereafter. It was pointed out in the Preliminary Report that no special taxes had yet been made available to the District as a supplement to or substitute for the property tax.

COMMUNITY REACTION TO THE PRELIMINARY REPORT

Reaction by the public to the methods of financing presented in the Preliminary Report and to the sources of funds suggested to meet annual debt service costs has been extensive. A great many thoughtful alternatives have been proposed which have been considered in detail by the District. It appeared to be the preponderant opinion that, if possible, the ad valorem property tax should not be the source of funds to meet annual debt service costs, but that other sources of revenue, such as special tax levies requiring new and additional legislative authorization, should be explored to eliminate the need for additional property taxes to be levied against already heavily burdened property owners.

Another major conclusion was that the proposed system should be revised and enlarged. Accordingly, the District, in this Final Report, recommends an 89-mile, five-corridor system which includes the Airport-Southwest corridor line and involves extension and realignment of the four-corridor system originally recommended in the Preliminary Report.

Financing the five-corridor system is the principal subject of this section of the Final Report. Financing requirements are shown also for the more limited four-corridor system.

EXISTING STATUTORY AUTHORITY FOR FINANCING

The Southern California Rapid Transit District operates under authority of the Southern California Rapid Transit District Law, Part 3, Division 10 (commencing with Section 30000) of the Public Utilities Code. The District has the power of eminent domain and authority to issue bonds. Bonds other than revenue bonds without priority over other bonds require an approving vote of electors. The District Law, as amended, authorizes the financing of rapid transit construction and other types of facilities through the issuance of a variety of bonds. These include: (1) general obligation bonds financed by an ad valorem property tax, (2) general obligation bonds financed from transit revenues or special taxes, and if such revenues or taxes are insufficient then from an ad valorem property tax, (3) limited tax bonds financed by revenues, special taxes or other funds excluding an ad valorem property tax, (4) revenue bonds financed by operating revenues, (5) equipment trust certificates financed by operating revenues or grants or loans, (6) improvement district bonds payable from an ad valorem property tax levied only within said improvement district.

The District is especially empowered to accept or apply transit funds, contributions or loans from the Federal Government, the State of California, or any public agency for the acquisition, construction, maintenance or operation of transit facilities. Transit funds or revenues are broadly defined in the Act, permitting great flexibility in the enactment of legislation providing alternative sources of revenue to meet debt service on District bonds.

COSTS AND SCHEDULES OF EXPENDITURES

The recommended five-corridor system is estimated to cost a total of $2,514,861,000. The consulting engineers have estimated that construction will cost $2,013,640,000 and rapid transit vehicles $213,451,000. Right-of-way costs are estimated by the District at $204,000,000 and feeder buses at $44,270,000. Preliminary engineering for future additions to the proposed system is included at $8,000,000. The District has outstanding revenue bonds issued to finance its existing bus system and these bonds, under the applicable indenture, must be refunded in any financing of the rapid transit system. The total project cost includes $31,500,000 for the retirement of these bonds on March 1, 1969.

The cost estimates take into account specific route alignment, type of construction, and special problems of grade separation. The estimates are for a completely operable system, including rolling equipment, with a substantial allowance for price inflation, incidentals, and contingencies.

The schedule of annual cash requirements for the project is shown below. The construction program has been developed to coordinate various elements of the project in order to bring operable sections of the system into service as soon as possible. Right-of-way acquisition procedure could commence as soon as bonds were authorized. Time is provided in the schedule to permit final design and preparation of detailed plans and specifications. It is assumed that detailed design will begin on January 1, 1969. Construction would then begin in mid-1970. The first trains would be in service by 1975 and the entire five-corridor system would be complete and in operation in 1977.

TABLE 1
RECOMMENDED FIVE-CORRIDOR SYSTEM
PROJECT CASH REQUIREMENTS
(In Thousands)

Fiscal Year	Amount
1968/69	$ 49,106
1969/70	72,542
1970/71	214,113
1971/72	395,075
1972/73	555,684
1973/74	568,071
1974/75	405,452
1975/76	210,732
1976/77	44,086
TOTAL	$2,514,861

THE BONDS

The District's financing consultants recommend general obligation bonds to be paid from proceeds of special taxes other than general property taxes as the most feasible and economical method of financing a rapid transit system for the people of the District. The bonds would be secured by the full faith and credit of the District, including the power to levy ad valorem property taxes should there be any deficiency in the amount of funds yielded by the special taxes. General obligation bonds represent the least costly means by which the District can borrow the substantial sums needed to finance the proposed project and, in addition, offer the greatest flexibility in meeting debt service costs through various sources of revenue other than the property tax.

The bonds would be authorized in an amount sufficient to finance all major elements of the project, including rolling stock, with adequate allowance for inflation and contingencies. The bond authorization would not be dependent on the future availability of Federal grants or other funds. If such funds become available, the District will be able to realize corresponding savings in financing requirements, and authorized bonds not needed could be cancelled or reserved for second-stage development.

The bonds are proposed to be sold in series over a period of years as construction funds are required. The bonds would mature in specified amounts in specified years. Bonds would be sold by competitive bidding and the actual interest rates established at the competitive sales.

The District Act provides that the District shall not incur an indebtedness which exceeds in the aggregate 15% of the assessed value of all real and personal property in the District. Table 2 shows estimates of assessed valuation for years 1968/69 to 1985/86. The District's corresponding borrowing capacity for these years is also shown. The assessed valuation forecast for 1985/86 of $25,641,000,000 represents an annual rate of growth of approximately 2.5% over the 1967/68 assessed valuation of $16,573,000,000. This rate of growth is less than half the actual rate over the last decade, and is believed to be conservative. The indicated total amount of bonds to be authorized for the recommended system is $2,515,000,000, which is within the borrowing limit of the District estimated for 1968/69.

The financing methods considered in this report are based upon the following assumptions regarding the bonds to be issued:

- 1. The interest rate will be 4½% per annum.
- 2. Interest during construction is not to be capitalized.
- 3. Principal payments are to begin approximately one year after the estimated time of completion of construction.
- 4. Each series of bonds is to mature over a period of approximately 40 years.
- 5. The first series of bonds is to be issued in January 1969 and additional series are to be issued at the beginning of each fiscal year thereafter in the net amount required for the project in that fiscal year.

The last two assumptions are made for analytical convenience. Forty years is approximately the longest period over which the bonds could reasonably be amortized. Each series of bonds would in practice be tailored to market conditions, which might well favor a shorter term for the bonds. The timing of bond sales too may be adjusted to the extent permitted by the construction program, conditions in the municipal bond market, or other factors. The financing program in this Final Report is based upon existing financial conditions and other information available, but the final financing provision will be determined and set forth in the ordinance calling any bond election or at the time of issuance and sale of any bonds.

The interest rate on the bonds is to be set by competitive bidding over the next eight years or more, and the effective average rate may prove to be more or less than the 4½% which is assumed here. A difference of ½% in the rate would change the amount required for equal annual bond service by approximately 7%.

TABLE 2
ESTIMATED DISTRICT ASSESSED VALUATION AND BONDING CAPACITY
(In Thousands)

Fiscal Year	Estimated Assessed Valuation	Estimated District Bonding Capacity
1968/69	$17,077,000	$2,562,000
1969/70	17,581,000	2,637,000
1970/71	18,084,000	2,713,000
1971/72	18,588,000	2,788,000
1972/73	19,092,000	2,864,000
1973/74	19,596,000	2,939,000
1974/75	20,099,000	3,015,000
1975/76	20,603,000	3,090,000
1976/77	21,107,000	3,166,000
1977/78	21,611,000	3,242,000
1978/79	22,114,000	3,317,000
1979/80	22,618,000	3,393,000
1980/81	23,122,000	3,468,000
1981/82	23,626,000	3,543,000
1982/83	24,130,000	3,619,000
1983/84	24,633,000	3,694,000
1984/85	25,137,000	3,770,000
1985/86	25,641,000	3,846,000

Most of the bonds issued should be made subject to redemption prior to maturity, at the option of the District. This would permit the District to apply available funds to the acceleration of debt retirement. Perhaps more importantly, it would permit the District to refund the bonds if lower interest rates become available. Since bond interest rates are now at the highest level in over 30 years, the prospect of advantageous refunding would seem very good. For this reason, the bond service requirements shown in this report may well be higher, for most years, than those the District would actually have to meet.

SOURCES FOR BOND SERVICE

CURRENT SOURCES

The only sources of revenue for bond service so far specifically authorized for the District are: (1) operating revenues of the system, and (2) ad valorem taxes on property within the District subject to an approving vote of electors.

Studies of traffic, revenues, and expenses of the system have been conducted for the District by Coverdale and Colpitts, consulting engineers. Their report indicates that operating revenues from the recommended rapid transit rail-bus system will meet all maintenance and operating costs and provide for replacement of rolling stock and other equipment. No surplus, however, is projected to become available for payment of bond service.

If the system were to be paid for from proceeds of bonds supported entirely by property taxes, bonds would be issued over the construction period in the ultimate total amount of $2,515,000,000 (the estimated cost of the system). For assessed valuations as shown in Table 2, and for equal annual bond service to final maturity in 2016, a maximum of 64¢ per $100 assessed valuation would be needed for the bonds in 1977/78, declining in later years as the District's assessed valuation increased.

A strong and statewide resistance to increase of the property tax rate is shown by the defeat in many recent elections of propositions authorizing the issuance of general obligation bonds. Hearings in connection with the District's Preliminary Report also indicated great opposition to any dependence upon the property tax for payment of District bonds. Accordingly, the District has determined to seek more acceptable means of financing.

ALTERNATIVE SOURCES

Among the alternative sources of funds, three have been especially considered: an increase in the general sales tax, the removal of the present exemption of gasoline from the sales tax, and an increase in the in lieu tax on motor vehicles. The provision of any such source of funds would still leave the property tax as the ultimate security of the bonds. No property taxes, however, would be levied so long as adequate alternative funds were available.

Assembly Bill 101, as amended on March 6, 1968, would permit the District to levy a general sales tax (a "retail transactions and use tax") of up to ½%. The tax would be administered and collected by the state together with its own sales and use taxes. It could be applied only if approved by the electorate, and only in the amount and for the purposes specified in the transit system bond election. In particular, the purposes of the tax could include payment of the principal and interest of District bonds as well as payment of costs of construction.

Table 3 includes estimates of the yield to the District of a ½% general sales tax. These projections assume that taxable sales within the District will grow at the rate of 4% per year, taking as base the taxable sales in Los Angeles County for the fiscal year 1966/67.

Tables 3 and 4 indicate that the projected sales tax proceeds are sufficient to meet all bond service requirements without recourse to the property tax.

Table 3 shows funds available to the project in comparison to funds required for each fiscal year to 1981/82. During the construction period no bonds are scheduled for retirement; expenditures are for construction and for bond interest only. The funds available include proceeds of the ½% sales tax and of bond sales as shown. The bond proceeds are assumed to be in hand at the beginning of each fiscal year, while project costs are spread out evenly over the year. Investment of the funds pending expenditure (at the same 4½% rate assumed for bond interest paid) would produce the amounts shown under "Interest Earned."

Under the assumptions made, it is seen that, in each fiscal year shown, total funds available cover total funds required, and that sales tax proceeds exceed bond service requirements.

Table 4 shows the estimated annual bond service requirements to final maturity of the bonds in 2016, forty years after the scheduled date of sale of the last series of bonds. It is seen that annual sales tax proceeds of $121,200,000, estimated for 1981/82, would be sufficient to meet all later bond service requirements.

The conclusions reached depend, of course, upon the assumptions made. Given the schedule of project cash requirements, the critical asumptions concern the interest rate of the bonds and the rate of growth of taxable sales.

The bonds would be general obligations of the District, expected to be fully self-supported (by the general sales tax) but backed by an unlimited tax on substantially all taxable property in Los Angeles County. As such they should command an excellent credit rating and receive favorable market acceptance. They would be sold over a nine-year period, allowing ample time for correction of abnormally high interest rates, such as those now prevailing may be presumed to be. Under these conditions, an effective overall interest rate of 4½% for the bonds would seem to be a conservative expectation.

TABLE 3
RECOMMENDED FIVE-CORRIDOR SYSTEM
ESTIMATED ANNUAL FUND REQUIREMENTS AND SOURCES OF FUNDS
(In Thousands)

	Funds Required			Funds Available			
Fiscal Year	Project Cash Requirement	Bond Service①	Total Funds Required	Bonds Issued	Interest Earned	0.5% Sales Tax	Total Funds Available
1968/69	$ 49,106	$ 293	$ 49,399②	$ 13,000	$ 146	$ 36,400	$ 49,546②
1969/70	72,542	585	73,127	—	—	75,700	75,700
1970/71	214,113	6,885	220,998	140,000	3,150	78,700	221,850
1971/72	395,075	21,645	416,720	328,000	7,380	81,900	417,280
1972/73	555,684	44,325	600,009	504,000	11,340	85,200	600,540
1973/74	568,071	68,445	636,516	536,000	12,060	88,600	636,660
1974/75	405,452	86,040	491,492	391,000	8,797	92,100	491,897
1975/76	210,732	95,310	306,042	206,000	4,635	95,800	306,435
1976/77	44,086	97,155	141,241	41,000	922	99,600	141,522
1977/78		103,155	103,155			103,600	103,600
1978/79		106,885	106,885			107,800	107,800
1979/80		111,435	111,435			112,100	112,100
1980/81		115,760	115,760			116,600	116,600
1981/82		120,860	120,860			121,200	121,200③

①See Table 4.
②From January 1, 1969.
③Annual amount sufficient to cover bond service to the final maturity of the bonds July 1, 2016. See Table 4.

TABLE 4

RECOMMENDED FIVE-CORRIDOR SYSTEM
ESTIMATED BOND SERVICE REQUIREMENTS
(In Thousands)

Fiscal Year	Bonds Outstanding	Interest @ 4½%	Principal Maturing	Total Bond Service
1968/69	$ 13,000[1]	$ 293	$ —	$ 293
1969/70	13,000	585	—	585
1970/71	153,000	6,885	—	6,885
1971/72	481,000	21,645	—	21,645
1972/73	985,000	44,325	—	44,325
1973/74	1,521,000	68,445	—	68,445
1974/75	1,912,000	86,040	—	86,040
1975/76	2,118,000	95,310	—	95,310
1976/77	2,159,000	97,155	—	97,155
1977/78	2,159,000	97,155	6,000	103,155
1978/79	2,153,000	96,885	10,000	106,885
1979/80	2,143,000	96,435	15,000	111,435
1980/81	2,128,000	95,760	20,000	115,760
1981/82	2,108,000	94,860	26,000	120,860
1982/83	2,082,000	93,690	27,000	120,690
1983/84	2,055,000	92,475	28,000	120,475
1984/85	2,027,000	91,215	29,000	120,215
1985/86	1,998,000	89,910	31,000	120,910
1986/87	1,967,000	88,515	32,000	120,515
1987/88	1,935,000	87,075	34,000	121,075
1988/89	1,901,000	85,545	35,000	120,545
1989/90	1,866,000	83,970	37,000	120,970
1990/91	1,829,000	82,305	38,000	120,305
1991/92	1,791,000	80,595	40,000	120,595
1992/93	1,751,000	78,795	42,000	120,795
1993/94	1,709,000	76,905	44,000	120,905
1994/95	1,665,000	74,925	46,000	120,925
1995/96	1,619,000	72,855	48,000	120,855
1996/97	1,571,000	70,695	50,000	120,695
1997/98	1,521,000	68,445	52,000	120,445
1998/99	1,469,000	66,105	55,000	121,105
1999/00	1,414,000	63,630	57,000	120,630
2000/01	1,357,000	61,065	60,000	121,065
2001/02	1,297,000	58,365	62,000	120,365
2002/03	1,235,000	55,575	65,000	120,575
2003/04	1,170,000	52,650	68,000	120,650
2004/05	1,102,000	49,590	71,000	120,590
2005/06	1,031,000	46,395	74,000	120,395
2006/07	957,000	43,065	78,000	121,065
2007/08	879,000	39,555	81,000	120,555
2008/09	798,000	35,910	85,000	120,910
2009/10	713,000	32,085	89,000	121,085
2010/11	624,000	28,080	93,000	121,080
2011/12	531,000	23,895	97,000	120,895
2012/13	434,000	19,530	101,500	121,030
2013/14	332,500	14,962	106,000	120,962
2014/15	226,500	10,193	110,800	120,993
2015/16	115,700	5,206	115,700	120,906

[1] FROM 1/1/1969

In the last decade, statewide taxable sales, adjusted for comparability, have grown at a rate of more than 5½% per year. It seems likely that the rate will be at least this high in the future. The assumption in Table 3 of a rate of growth of only 4% per year is expected to provide an ample allowance for adjustments between gross countywide sales tax collections and net sales tax proceeds to the District.

In addition to the general sales tax, other special taxes have also received considerable attention as sources of revenue for bond service. The District's Preliminary Report examined the applicability to the District of a 4% sales tax on gasoline and of an additional 1% in lieu tax on motor vehicles. Both of these taxes were estimated to yield approximately the same annual amounts ranging from about $40,000,000 in 1969/70 to about $50,000,000 in 1980/81.

Either of these potential sources of funds would thus produce essentially half the annual amounts shown in Table 3 for the ½% general sales tax. On this basis, all bond service requirements for the recommended five-corridor system could be met, without levying a property tax, given any two of the following sources of funds, or their equivalents:

a) ¼% general sales tax.

b) 1% in lieu motor vehicle tax.

c) 4% sales tax on gasoline.

Neither the in lieu tax nor the sales tax on gasoline, at the rates specified, could in itself support the bonds for the recommended system. And neither has the reliability to be expected from the general sales tax, with its highly diversified base.

FUTURE EXPANSION

The project costs discussed above include $8,000,000 intended to finance the preliminary engineering of the second-stage development of the Master Plan Concept.

Funds for the second-stage construction could come from one or more of several sources, including:

a) Federal or state grants or loans.

b) Special taxes.

c) District bonds.

Federal assistance in the solution of urban problems will probably increase substantially above present levels. Efficient mass transportation is already established as an important goal for the application of federal funds.

Table 3 shows the general sales tax proceeds reaching the level of maximum bond service requirements in 1981/82. Further growth in such a source of funds at the rate of over $4,000,000 a year is probable and could, if authorized, be used for additions to the system.

THE FOUR-CORRIDOR SYSTEM

A 62-mile, four-corridor system was recommended by the District in its Preliminary Report. It has been revised in general accordance with recommendations submitted in response to the Preliminary Report. This revision is responsible for the increase in estimated total cost of the system from $1,571,702,000, in the Preliminary Report, to the present estimate of $1,666,926,000.

Construction is now estimated to cost $1,294,118,000; rapid transit vehicles $149,278,000; rights-of-way $149,000,000; and feeder buses $35,030,000. As in the five-corridor system, preliminary engineering for eventual extension of the system is budgeted at $8,000,000 and refunding of the existing revenue bonds will cost $31,500,000.

TABLE 5
FOUR-CORRIDOR SYSTEM
PROJECT CASH REQUIREMENTS
(In Thousands)

Fiscal Year	Amount
1968/69	$ 45,007
1969/70	46,415
1970/71	158,775
1971/72	310,815
1972/73	426,975
1973/74	405,298
1974/75	220,605
1975/76	53,036
TOTAL	$1,666,926

The schedule of annual cash requirements for the four-corridor system is shown on Table 6. Construction would begin in mid-1970 and is scheduled to be completed in six years, a year sooner than for the five-corridor system.

Construction of the four-corridor system, if supported only by property taxes, would require a maximum tax rate, in 1976/77, of 42¢ per $100 assessed valuation, compared to a 64¢ tax rate in 1977/78 for the five-corridor system.

The District would be able to finance the four-corridor system, without recourse to any property tax, by the levy of a general sales tax of under 0.4%. This is demonstrated in Tables 6 and 7, with the same major assumptions as in the corresponding Tables 3 and 4 for the five-corridor system.

With the four-corridor system, a 4% sales tax on gasoline would not, in itself, suffice to meet bond service requirements. It would need to be supplemented by approximately a 0.1% general sales tax, or a 0.4% in lieu motor vehicle tax, or some other equivalent tax.

Of the sources of funds which have been considered, the general sales tax, for the four-corridor system as for the five, would appear to offer advantages in simplicity as well as reliability.

TABLE 6
FOUR-CORRIDOR SYSTEM
ESTIMATED ANNUAL FUND REQUIREMENTS AND SOURCES OF FUNDS
(In Thousands)

	Funds Required			Funds Available			
Fiscal Year	Project Cash Requirement	Bond Service①	Total Funds Required	Bonds Issued	Interest Earned	0.4% Sales Tax	Total Funds Available
1968/69	$ 45,007	$ 382	$ 45,389②	$ 17,000	$ 191	$ 29,100	$ 46,291②
1969/70	46,415	765	47,180	—	—	47,200③	47,200
1970/71	158,775	4,635	163,410	86,000	1,935	76,400③	164,335
1971/72	310,815	16,155	326,970	256,000	5,760	65,500	327,260
1972/73	426,975	33,435	460,410	384,000	8,640	68,100	460,740
1973/74	405,298	50,400	455,698	377,000	8,483	70,900	456,383
1974/75	220,605	59,490	280,095	202,000	4,545	73,700	280,245
1975/76	53,036	61,155	114,191	37,000	833	76,600④	114,433

①See Table 7.
②From January 1, 1969.
③Surplus of $13,400,000 in 1969/70 transferred to 1970/71.
④Annual amount sufficient to cover bond service to final maturity of the bonds July 1, 2015. See Table 7.

TABLE 7
FOUR-CORRIDOR SYSTEM
ESTIMATED BOND SERVICE REQUIREMENTS
(In Thousands)

Fiscal Year	Bonds Outstanding	Interest @ 4½%	Principal Maturing	Total Bond Service
1968/69	$ 17,000①	$ 382	$ —	$ 382
1969/70	17,000	765	—	765
1970/71	103,000	4,635	—	4,635
1971/72	359,000	16,155	—	16,155
1972/73	743,000	33,435	—	33,435
1973/74	1,120,000	50,400	—	50,400
1974/75	1,322,000	59,490	—	59,490
1975/76	1,359,000	61,155	—	61,155
1976/77	1,359,000	61,155	13,000	74,155
1977/78	1,346,000	60,570	14,000	74,570
1978/79	1,332,000	59,940	15,000	74,940
1979/80	1,317,000	59,265	15,000	74,265
1980/81	1,302,000	58,590	16,000	74,590
1981/82	1,286,000	57,870	17,000	74,870
1982/83	1,269,000	57,105	17,000	74,105
1983/84	1,252,000	56,340	18,000	74,340
1984/85	1,234,000	55,530	19,000	74,530
1985/86	1,215,000	54,675	20,000	74,675
1986/87	1,195,000	53,775	21,000	74,775
1987/88	1,174,000	52,830	22,000	74,830
1988/89	1,152,000	51,840	23,000	74,840
1989/90	1,129,000	50,805	24,000	74,805
1990/91	1,105,000	49,725	25,000	74,725
1991/92	1,080,000	48,600	26,000	74,600
1992/93	1,054,000	47,430	27,000	74,430
1993/94	1,027,000	46,215	28,000	74,215
1994/95	999,000	44,955	30,000	74,955
1995/96	969,000	43,605	31,000	74,605
1996/97	938,000	42,210	32,000	74,210
1997/98	906,000	40,770	34,000	74,770
1998/99	872,000	39,240	35,000	74,240
1999/00	837,000	37,665	37,000	74,665
2000/01	800,000	36,000	39,000	75,000
2001/02	761,000	34,245	40,000	74,245
2002/03	721,000	32,445	42,000	74,445
2003/04	679,000	30,555	44,000	74,555
2004/05	635,000	28,575	46,000	74,575
2005/06	589,000	26,505	48,000	74,505
2006/07	541,000	24,345	50,000	74,345
2007/08	491,000	22,095	52,000	74,095
2008/09	439,000	19,755	55,000	74,755
2009/10	384,000	17,280	57,000	74,280
2010/11	327,000	14,715	60,000	74,715
2011/12	267,000	12,015	63,000	75,015
2012/13	204,000	9,180	65,000	74,180
2013/14	139,000	6,255	68,000	74,255
2014/15	71,000	3,195	71,000	74,195

①FROM 1/1/1969

BENEFIT-COST ANALYSIS

STANFORD RESEARCH INSTITUTE
MENLO PARK, CALIFORNIA 94025

March 21, 1968

Southern California Rapid Transit District
1060 South Broadway
Los Angeles, California 90015

Gentlemen:

Enclosed with this letter is our final summary report, analyzing the benefits and costs of the five-corridor rapid transit system. Our staff, composed of economists, sociologists, operations analysts, and engineering economists, has studied many potential impacts of the proposed system. We have analyzed traveler and community effects, both measurable and unmeasurable, in terms of their economic and sociological impacts. Our analysis indicates that the benefits that will accrue from the proposed project clearly exceed its costs. Thus, the project represents a justifiable expenditure of public funds.

We express our appreciation to the staff of the District and the various consultants for their assistance. Especially helpful were Coverdale & Colpitts and Control Data Corporation. We also thank the staff of the Los Angeles Regional Transportation Study, who provided the basic travel data for the research, and many other organizations, both public and private, which assisted by providing data and information to our staff.

Sincerely yours,

Dan G. Haney
Dan G. Haney
Project Manager

BENEFIT-COST ANALYSIS

INTRODUCTION AND CONCLUSIONS

The proposed rapid transit system represents a major investment by the residents of the Southern California Rapid Transit District that would drastically change the current trend of overwhelming dependence on the private automobile for local travel. Similar programs for creating or redeveloping rapid transit are being considered or are under way in nearly every large city across the nation.

In the past, public officials or the general public have frequently made decisions on new transportation facilities without definitive information as to whether the economics of the investment were sound. As a part of the process of judging the overall attractiveness of the project it is necessary to analyze the impacts of benefits. The benefits of a rapid transit system fall to many people, not just to the transit user: the automobile driver finds that freeways are less congested; the businessman finds new potential employees who will commute to his plant site; and the property owner finds that his real estate has gained in value. Thus, it is fitting that others besides the user should pay.

Planning in such cities as New York, San Francisco, Atlanta, Baltimore, and Washington, D.C. has included a major reappraisal of the means of paying for rapid transit. It has been concluded that asking the user of the system to pay the total costs, including the building as well as the operating of the system, is both unrealistic and unfair.

There is a need, then, to analyze the total benefits that the proposed rapid transit system will generate and to illustrate whether the total benefits are in excess of the total costs, as well as to identify the recipients of the benefits. A comprehensive benefit cost analysis can accomplish these objectives. Such analyses have been conducted on many projects involving public expenditures. In the transportation field, they concern themselves more frequently with only the benefits that accrue to the transportation system user. Studies that include consideration of both traveler and community benefits are less frequently found. Properly accomplished, such studies allow a systematic and professionally accepted means of evaluating the total economic and social implications of a public investment. Such an evaluation is necessary if the residents of SCRTD (Southern California Rapid Transit District) are to make an informed, responsible decision on adoption of the proposed system.

OBJECTIVE

The overall objective of the research conducted by Stanford Research Institute was to analyze the benefits and costs associated with the five-corridor rapid transit system proposed by the Southern California Rapid Transit District. Specifically, the study (1) evaluated the direct costs and benefits accruing the rapid transit users and automobile travelers and (2) identified and appraised the community benefits and costs accruing to the public.

The analysis is based on estimates of system patronage developed by SCRTD's consultants. It has been addressed to two alternatives – to build or not to build the five-corridor system. No recommendations are made concerning the financial plan.

CONCLUSIONS

1. Stanford Research Institute, on completion of a benefit/cost analysis, has concluded that the proposed rapid transit development represents a sound public investment relative to accepted standards of expected public benefits and costs.

2. The total benefits to district residents expected to be generated by the proposed rapid transit project are estimated to be valued at $253 million annually. They are 87 percent greater than the estimated annual costs of the project (for debt repayment), indicating a net annual benefit of $117 million.

3. These estimates are conservative. The actual total benefits could be as much as half again as large.

4. Total benefits have been estimated at $ 85 million per year (in 1968 dollars) in traveler benefits, $109 million per year (in 1968 dollars) in community benefits, plus an annual adjustment of $59 million for inflationary effects. These benefits are compared with an average annual cost (inflated dollars) of $136 million. Both benefits and costs have been properly adjusted to reflect the time value of money.

5. Of the total benefits, 44 percent will accrue to travelers. These benefits (in 1968 dollars) will include:

- Travel time saved valued at $40 million annually.
- An expected $46 million savings in automobile operating costs.
- A $23 million annual reduction in the cost of parking automobiles.
- A cost savings of $3 million per year as some families avoid becoming two-car families or shift from two to one car situations.
- A reduction in highway accident costs valued at $5 million annually. In addition, 32 fatalities per year and 1,900 injuries should be avoided.

System users will pay an annual $50 million in transit fares and transit station parking fees in return for the benefits cited above, leaving a net traveler benefit of $85 million per year.

6. Travel to and from the airport will be significantly improved to the benefit of businessmen and others who now leave their origins as much as 1½ or 2 hours before flight departure to guard against the possible delays in surface transportation.

7. The parking cost saving of $23 million per year is one of the most significant traveler benefits because it represents not only a substantial savings to rapid transit users or their employers, but it also indicates that a substantial amount of land now used for parking might be available for other, more productive uses.

8. Of the total benefits, 56 percent – $109 million in 1968 dollars – will accrue to the community as a whole. Some of the benefits are:

- Economic output amounting to $30 million per year through decreased structural unemployment.
- An additional decrease in construction industry cyclical unemployment valued at $270 million over the seven-year period of system building.
- An increase in business productivity estimated to be worth a minimum of $15 million per year.
- Similar improvements in government productivity estimated at a minimum of $15 million.
- A much wider range of choices and opportunities for both automobile drivers and nondrivers in residential possibilities, travel habits, and accessibility to the facilities of the community. This is valued at $25 million annually.

There will be additional benefits in civil defense improvements, air pollution reduction, highway expenditures, and housing efficiencies.

9. There will be a major change in real estate values and land uses. The capitalized value of the total benefits is about $3 billion. A sizable portion of this total will be translated into higher property values and rents as buyers and renters bid to reap the benefits that can be obtained through the use of certain land parcels with appreciated locational value. This will produce a net increase in the value of property. This increase in value is included in the benefit total, not under real estate appreciation but under the specific productivity improvements that will generate property appreciation.

10. Many benefits will fall outside the district boundaries to residents throughout the state and the nation. Examples are the improved airport access for visitors and the reduced unemployment compensation costs that are paid by employers outside the District.

11. Finally an additional benefit, not expressable in dollar terms but perhaps the most important, will be the opportunity that rapid transit will present for the community to regain control of their urban environment, to shape the land use closer to their desires, to reverse the trend of sprawl, sterility, and burdening government costs, to make what appears to be the best, first major step toward a more balanced and diversified community.

ANALYSIS OF TOTAL BENEFITS AND COSTS

A benefit cost study is a systematic way of comparing the costs and the benefits obtained by expending those costs for alternative courses of action. Conducting such a systematic comparison entails a number of operations. One way to group them is in the following three-step procedure:

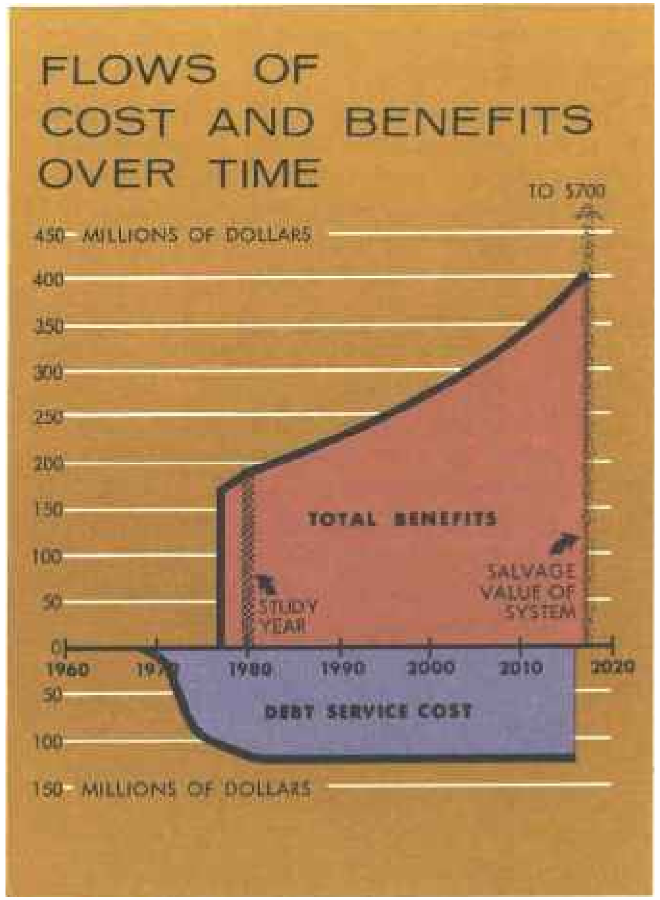
- 1. Identify and measure the relevant costs and benefits.
- 2. Reduce the costs and benefits that occur at different times to an equivalent value.
- 3. Prepare indexes of comparison.

IDENTIFY AND MEASURE BENEFITS AND COSTS

The level of economic activity in a region such as the Los Angeles area is the result of many individual decisions on how to allocate financial resources among the available goods and services. To predict the economic impact of a major public expenditure such as that required for rapid transit system construction, it is necessary to predict how some of these decisions would differ between the hypothetical conditions: that the rapid transit system existed and that it did not. To make this prediction we have simplified the analysis by grouping individuals into three groups – the travelers, the community, and all suppliers of goods and services that are purchased by the travelers and the community members. It should be noted that there is a considerable overlap between the travelers and the community members, in that most community members are travelers at one time or other, and travelers are, for the most part, members of the community. It should also be noted that the suppliers of goods and services include suppliers of governmental and municipal services as well as suppliers of goods and services in the private sector. Thus, the Rapid Transit District is included in this third group.

The basic analysis is an examination of the differences between the amounts of money paid out by the community and the travelers to the third group, the change in the amount of time used by the travelers in their journeys, and the changes in the per-capita economic output of the region. The travel time must be considered because it is another cost of traveling, just as are the monetary costs. The per capita level of economic activity is considered because it is a measure of the standard of living for individuals in the region

BENEFITS. The benefits for the year 1980 are estimated to be $194 million, using 1968 dollars. Of this amount, $85 million are traveler benefits and $109 million, community benefits. Detailed discussions of the traveler and community benefits are presented in later sections. These benefits are projected to be constant, in constant dollars, to the end of the study period. However, because the purchasing power of the dollar is expected to change, the benefits were adjusted for anticipated inflation. The result of the projection and adjustment, which makes benefits and costs comparable, is shown in the illustration, "Flows of Cost and Benefits over Time."



Detailed data for travel in the post-1980 era are not available. For that reason benefits were estimated for only the study year 1980, and assumed to be constant thereafter. We believe that it can be successfully argued that the benefits would actually grow, if the anticipated growth of the region occurs. The assumption of constant benefits is conservative in the face of the anticipated growth, and, since the benefits exceed costs under this assumption, growth of benefits would not change the attractiveness of the rapid transit system. Only if an overall decline of population or economic activity occurs in the region can the benefits be expected to drop below the initial level, and it is generally agreed that the probability of a significant and prolonged decline is small.

The value of the benefits to be received has been estimated in terms of present-day dollars. The amount of money required to pay the interest and principal due each year on the bonds is fixed by the bond terms, but may decline in value by today's standards because of decreased purchasing power of the dollars used to make these payments. We have therefore increased the benefits at a constant annual rate to make the value of the benefits and the amount of money paid for bond service in any year equivalent.

There has been a general trend toward lower purchasing power of the dollar. The cost of living, measured by the consumer price index produced by the U.S. Bureau of Labor Statistics, has increased in every year but one since 1949. The rate of price increases varies widely from product to product and from year to year, due to public policy, reflected by governmental spending, and as a result of the dynamics of the economy. It is generally agreed that the overall value of the dollar is decreasing at a rate between 1.5 and 2.0 percent per year for the United States, and estimates for Southern California tend toward the higher figure. We have therefore used 2 percent as the rate of increase in the value of increase in benefits.

The benefits can be expected to continue as long as the system is maintained in operating condition and not replaced by one that offers improved benefits. We have assumed that 40 years would be required to develop a technology that would make replacement economically feasible in comparison with the then existing rapid transit system.

COSTS. The community costs required for the rapid transit system operation are the taxes that must be paid to service the construction bonds. The annual disbursements for principal and interest are given in the Stone and Youngberg report. The pattern of these payments is shown in the adjoining illustrations.

The salvage value of the system at the end of its useful life is credited against the system costs. If the system is replaced because of the availability of a better system employing advanced technology, parts of the currently proposed system can probably be used in the new system. We have assumed that the entire value of the rights-of-way, and one-fourth the value of the construction would be useful in any system that might replace the currently proposed system. The value of the rights-of-way and the useful structures is $700 million and will be received at the end of the study period, 40 years after the complete system begins operation.

RECONCILE BENEFITS AND COSTS OCCURRING AT DIFFERENT TIMES

As in most investments, costs of the rapid transit system occur before the benefits (see adjoining figure). But most people generally consider that dollars received or spent in the near future are more valuable than those received or spent in the distant future. This difference in value is accounted for by the fact that the dollars received earlier can be invested and can earn interest before the distant future dollars are received. Even if not invested, the near-future dollars can be used for purchasing goods or services and the benefits from these goods and services can be enjoyed sooner.

To adjust the benefits and costs for time differences, it is necessary to discount them, or multiply them by a factor that depends on the time of their occurrence and a rate of interest. Discounting is widely used in the financial community to express the difference between funds received at different times. The rate at which the costs and benefits in the study should be discounted depends on the value of money over time to those who must bear the costs. For public investments, a rate of six percent is used because research has shown that funds left in private hands, rather than being collected in taxes, would earn about six percent for the taxpayers. By applying formulas based on this interest rate, the benefits and costs occurring in future years can be converted into their worth at the present time. Using other formulas based on the interest rate and study period, this value at the present time can further be converted to an equivalent annual cost. The equivalent annual cost may be thought of as the annual amount that would have to be spent to repay a loan with interest.

PREPARE INDEXES OF COMPARISON

A number of indexes can be prepared to express the relative attractiveness of the alternatives studied. These indexes are the net present value, which is the difference between the present value of the benefits and the present value of the costs; the benefit/cost ratio, which is the ratio of the present value of the benefits to the present value of the costs; the return on investment, which is the interest rate at which the present value of the costs is exactly equal to the present value of the benefits; or the net equivalent annual benefit, which is the difference between the annual benefits and the annual costs. The latter index has been chosen for this study.

The table, "Computation of Net Equivalent Annual Benefit," shows how the annual equivalent benefits and costs and the net equivalent were computed.

COMPUTATION OF NET EQUIVALENT ANNUAL BENEFIT FOR 40 YEARS BEGINNING IN 1977

	Millions of Dollars
Computed benefit for 1980 (in 1968 dollars)	$194.3
Adjustment for inflation (averaged over 40 years)	58.5
EQUIVALENT ANNUAL BENEFIT	$252.8
Annual debt service payments (During period of level payments)	120.9
Adjustment to convert debt service payment schedule to average annual cost over 40 years	19.3
	$140.2
Less: Equivalent annual value of $700 million salvage value of ROW and structures received in 2017	4.5
EQUIVALENT ANNUAL COST	$135.7
NET EQUIVALENT ANNUAL BENEFIT	$117.1

TRAVELER BENEFITS

The introduction of a rapid transit system into the region served by the District will reduce the cost of traveling in the region. This reduction produces the traveler benefit. The costs of traveling are made up of the value of the time consumed in traveling, the fares paid for public transportation, and the costs of operating, parking, owning, and incurring accidents associated with private automobiles and truck travel.

The rapid transit riders receive the major portion of the traveler benefits, because their decision to use the transit results from a recognition that the cost of their travel will be lower if they do so. The amount of savings and the kind of saving to the transit rider will depend on the time of day he uses the system and on whether he formerly used a bus or private auto for his travel. For example, bus riders will save time by using transit, where it is available, under almost all conditions, but their fares will be about the same. On the other hand, auto users during the peak hours will have an overall saving by using transit even though their fares increase, because of reductions in their travel time, vehicle operating costs, parking costs, ownership costs, and accident costs. Auto users who use transit during off-peak hours will find that their savings in operating, parking, ownership, and accident costs are almost exactly balanced by the increase in travel time and the fares that they pay. For this reason, the discussion of benefits to rapid transit patrons who are former auto users refers to peak hours only.

Other groups also save travel costs because of rapid transit—airport service patrons, auto users still using the highways, truckers, and bus riders. The airport patrons save time over all forms of travel over streets and freeways. They may also save taxi fares; vehicle operating, parking, and accident costs; or auto rental fees, depending on their former means of travel. Auto users who decide to use transit will contribute to reduced traffic congestion during peak traffic hours, and, and as result, auto users and truckers will save time and operating costs during these periods. Finally, the bus riders still on the buses will benefit from a cash flow surplus that is predicted for the rapid transit operation. This surplus can be used to provide better service and, hence, a time saving for the bus riders, or it can be used to avoid fare increases. The adjoining table, "How Travelers Benefit from Rapid Transit," shows the increases and reductions in travel costs for various travelers, along with the overall traveler benefit.

HOW TRAVELERS BENEFIT FROM RAPID TRANSIT
(Millions of Dollars per Year)

Cost Item	Change in Cost: Reduction	Change in Cost: Increase
Rapid transit patrons		
Total value of travel time consumed	$ 38.3	$
Vehicle operating costs	42.0	
Parking costs	22.7	
Vehicle ownership costs	3.4	
Accident costs	4.7	
Fares and parking fees		49.5
Motorists		
Vehicle operating costs	4.5	
Total value of travel time consumed	*	
Truckers		
Total value of travel time consumed	1.2	
Bus riders — service improvements or fare reductions	14.9	
Airport service patrons	3.1	
Totals	$134.8	$49.5
OVERALL TRAVELER BENEFIT	$85.3	

*Included with reduction in total value of travel time for rapid transit patrons because of computational procedures used.

ANALYSIS OF TRAVEL IN LOS ANGELES

A large-scale computer was used to determine the routes, speeds, and volumes of automobile travel over freeway and street segments for the more than nine million daily peak-period trips that are forecast for 1980 in the area served by the Rapid Transit District. This computation provides the basis for estimating highway travel costs without rapid transit. The data on the trips were supplied by LARTS (Los Angeles Regional Transportation Study). The program used to process the data is adapted from one developed by the U.S. Bureau of Public Roads and has been used extensively in the analysis of urban traffic movements. The computer analysis was repeated after the trips diverted from automobiles had been removed from the system, and new routes, speeds, and travel times were computed for the remaining trips. These two computations also provide the basis for estimating highway costs with and without rapid transit.

Estimates of the transit patronage and amount of time expended by rapid transit patrons who were former bus riders and those who were auto users were made by Coverdale & Colpitts, as were data on the time that the bus riders would have expended had there been no rapid transit.

Data for the airport line were estimated by the District. The volume estimated is the break-even volume for the airport service and may well be quite conservative depending on development of the terminal facilities by the Department of Airports. (See District discussion.)

TOTAL VALUE OF TIME CONSUMED BY TRAVELERS

Travel time is valuable, as several studies of the additional amount of money travelers are willing to pay to save time have shown. The adjoining tabulation of total value of travel time shows the amount of time and its total value for several groups of travelers. The amount of time that auto users and former auto users save during peak hours was determined from the computer analysis. Because the total travel time for all auto users with rapid transit was subtracted from total travel time without rapid transit, it is not possible to separate the components of change in time between those who are diverted to transit and those who remain auto users. Time savings in trucking operations were estimated from data on the average speed increase with rapid transit.

TOTAL VALUE OF TIME CONSUMED BY TRAVELERS

Travelers	Savings in Daily Hours (thousands)	Savings in Total Value of Travel Time: Daily (thousands of dollars)	Savings in Total Value of Travel Time: Annually (millions of dollars)
1. Rapid transit patrons			
Former auto users	23.5	$66.4	$16.9
Former bus users			
Weekday	29.0	82.0	20.9
Weekend	8.5	24.0	2.6
2. Truckers	.8	4.8	1.2
3. Auto users (after rapid transit operation begins)	*		
Equivalent annual cost of travel time lost during construction period			−2.1
TOTAL			$39.5

*Because of computational procedures used these savings are included with savings of rapid transit patrons who are former auto users.

A value of time of $2.82 per person per hour was used. This value, at least $1.00 per hour higher than values that were used in earlier benefit/cost studies, was determined in a recent SRI study of the behavior of commuting motorists in several areas of the country. This value is supported by another study recently reported to the Highway Research Board. The value of time for truck operations of $5.75 per hour was used; this value was determined by a study performed by the Texas Transportation Institute.

While there is every reason to believe that the value of time used is a representative average for a large number of commuters, it is possible that the value of time for bus riders may be somewhat lower than this value, and the value of time for the airport service patrons might be higher.

There will be some increase in travel time during the construction period, primarily because of detours necessitated by excavation for subway portions of the rapid transit system. We estimate that the total lost time will be worth $26.5 million. This has been converted into an equivalent annual cost of $2.1 million over the 40-year study period.

VEHICLE OPERATING COSTS

Motorists who elect to use rapid transit will save money by not using their automobiles. Those motorists who remain on the street system will experience a cost savings during peak traffic hours because of reduced congestion. The table, "Vehicle Operating Costs Saved by Rapid Transit Use," summarizes the savings.

Vehicle operating costs are those that vary with the number of miles driven. The cost items included are fuel, oil, maintenance parts and labor, tires, and so on. Depreciation, registration, and part of the insurance costs are discussed under vehicle ownership cost savings. (Insurance costs are divided into two categories: liability and collision insurance cost, which is included in the next section under accident costs, and fire and theft insurance cost, which is included under ownership costs.)

The cost of operating the vehicle was carefully estimated in relation to anticipated traffic conditions with and without rapid transit. These costs were determined from data on the cost of operating the vehicle under various conditions such as running at constant speed, going through deceleration and acceleration cycles, and stopping. The frequency of occurrence of these conditions was determined from data taken from observation in the San Francisco Bay area and confirmed by a limited sample of data taken in the Los Angeles area. The curves entitled "the cost of congested driving" exhibit the result of combining these two sets of data.

Reduction in vehicle-miles for peak hours was determined from the computer analysis of traffic in the area. For airport service trips, average percentages of freeway and arterial driving were assumed. Reductions in costs for auto users after rapid transit were estimated from the volumes determined by the computer analysis and the data shown by the curves showing the cost of congested driving.

Truck operators will also experience operating cost savings during peak hours because of reduced congestion. It was not possible to estimate their saving, but we believe it to be small.

Because of the inconveniences to motorists during the construction period, there will also be an increase in the number of vehicle miles driven. These additional miles, together with additional stops that must be made at detours, increase the costs of operating the motor vehicles in the area of the construction. We estimate that this increase in cost will be $16.8 million over the construction period. This is equivalent to an annual cost of $1.3 million over the 40-year study period.

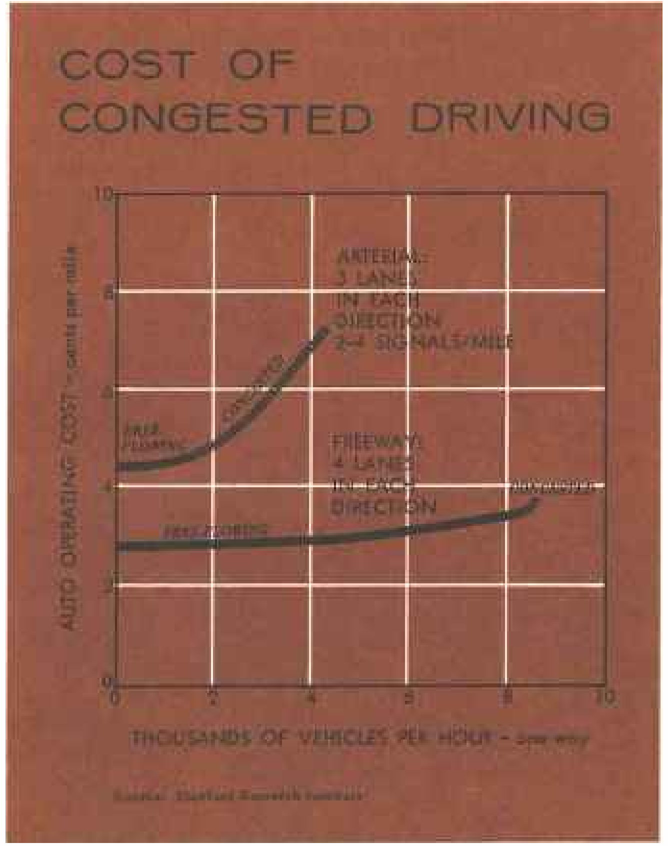
PARKING COSTS

Savings in parking cost that will equal or exceed the rapid transit fare may strongly influence many motorists who decide to use rapid transit. These savings will accrue to the individual traveler as well as to employers and business proprietors who must provide parking spaces.

VEHICLE OPERATING COSTS SAVED BY RAPID TRANSIT USE

	Type of Facility	Daily Reduction in Vehicle Miles Driven (thousands)	Cost per Vehicle Mile (dollars)	Total Cost Saving: Daily (thousands of dollars)	Total Cost Saving: Annually (millions of dollars)
Rapid transit patrons diverted from autos	Freeway	2,763.0	$.030	$ 82.9	$ 21.1
	Arterial and local streets	1,464.9	.056	82.0	20.9
Total saving for rapid transit				$164.9	$ 42.0
Motorists who continue to travel by automobile	Freeway			18.2	4.6
	Arterial and local streets			4.7	1.2
Total saving for remaining motorists				$ 22.9	$ 5.8
Motorists during construction period (equivalent annual cost of additional vehicle operating costs)					– 1.3
Total operating cost saved annually					$ 46.5

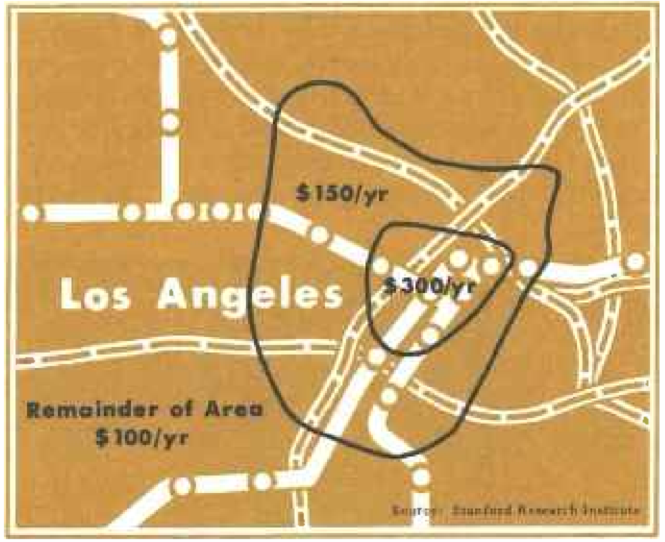
Rapid transit will result in an estimated reduction of 117,700 parking spaces needed, at an annual savings of $22.7 million in the cost of providing these spaces.



The number of spaces no longer required was estimated by determining the daily reduction in the number of vehicles arriving in the area of each station location during the peak traffic hours. For the downtown and Wilshire areas, it was assumed that all arriving vehicles would be parked off-street. For other areas, 90 percent of all arrivals during peak hours would park off-street.

It was further assumed that one parking space would be required for each peak-hour commuter who formerly used off-street parking, at an annual cost per space ranging from $300 per year downtown to $100 per year in outlying areas, as shown by the map contours on the accompanying illustration, "Cost of Providing a Commuter Parking Space."

COST OF PROVIDING A COMMUTER'S PARKING SPACE



The cost of providing parking to the rapid transit patrons at station locations is included in the system cost, and is therefore not counted here. Likewise, the parking fees paid by some rapid transit patrons at suburban lots is included in the item—fares and parking fees. Finally, the cost of parking at the residence end is not counted. (See discussion of automobile ownership costs.)

VEHICLE OWNERSHIP COSTS

Availability of rapid transit will allow some former auto users to sell their cars or to use these vehicles for other purposes. The values of these vehicles no longer needed or used for other purposes are a benefit that can be assigned to the rapid transit system.

Not all persons who switch to rapid transit will save ownership costs. Some will continue to park their cars all day at the rapid transit parking lots. Other families who own a second car that is used solely for commuting to and from work might be able to sell that car. Still others having only one car might avoid buying a second car if the first one were not used for commuting purposes.

The reduction in number of vehicles needed was determined as shown in the table, "Auto Ownership Cost Reduction." The fraction of the potential reduction was determined from an analysis of the increase in the number of multicar households predicted between 1960 and 1980.

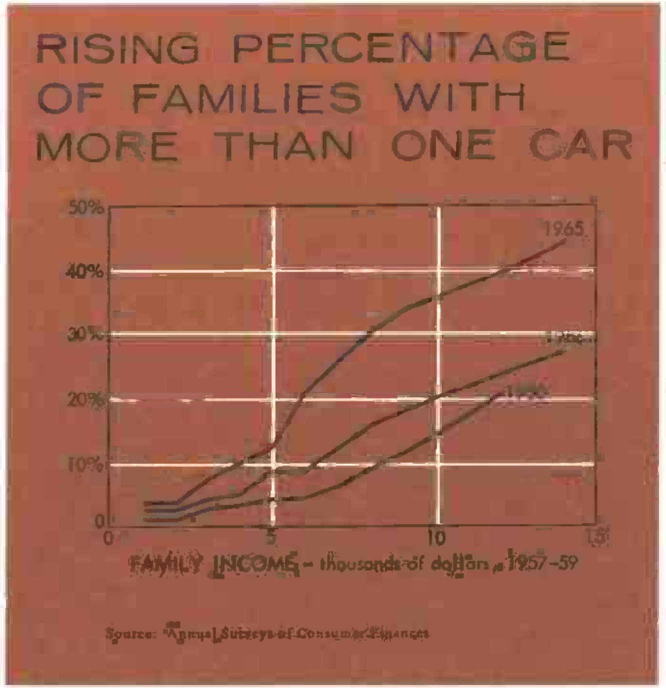
AUTO OWNERSHIP COST REDUCTION

Daily reduction in auto commuter round trips		128,000
Less: number of autos parked all day in R.T. lots		28,000
Potential reduction in number of autos owned		100,000
Assumed reduction in number of autos owned		10,000
Annual ownership cost per auto:		
Depreciation	$300	
Fire and theft insurance	25	
Registration (exclusive of in-lieu taxes)	10	
Subtotal	$335	
TOTAL ANNUAL SAVINGS		$3.4 million

The cost of garaging the vehicle at home is also a cost of vehicle ownership and can be substantial in some densely developed areas. In the residential developments anticipated around the transit stations, the need for allowing for parking space is a very real cost. Many users of rapid transit, however, will not live in such dwellings. Those who live in single family dwellings can park outside because of the mild climate of Southern California. There is also considerable difficulty in allocating the cost of home ownership between living space and garage. For these reasons, at-home parking costs have not been included.

ACCIDENT COSTS. Accident cost savings result from the reduction in vehicle miles driven and the fact that transit service is usually accident-free compared with auto use. Accident costs include the damages paid as a result of the accident and, since many accidents result in insurance claims, the cost of adjusting and paying the claim. These costs are the results of monetary damage payments only.

The reduction in accident costs may be reflected in lower insurance premiums, both because fairly frequent adjustments are made on the rates in areas, depending on local experience, and through elimination of the increased premium paid for commuting over extended distances. A portion of this saving would go to the transit users who switched from autos; the remainder would spread throughout the county in the form of lower premiums for everyone.



ACCIDENT COST REDUCTION

Type of Facility	Daily Vehicle-Mile Reduction (thousands)	Accident Cost Rate, Dollars per thousand Vehicle-Miles	Accident Cost Reduction Daily (thousands of dollars)	Accident Cost Reduction Annually (millions of dollars)
Freeways	2,763.0	$3.017	$ 8.6	$2.2
Arterials and local streets	1,464.9	6.822	10.0	2.5
Total accident cost reduction				$4.7
AND				

32 Fatalities per year
1,900 Serious Injuries per year

Monetary damage payments may not compensate adequately for the loss and suffering resulting from fatalities and injuries that are due to traffic accidents. The damage payments and the losses are always difficult to equate, since there is no agreed method for valuing the loss of life or the pain of injury. The value of reducing accident injuries and fatalities by reducing the number of vehicle-miles driven, to the extent that the damage payments fail to compensate, must be counted as a direct but nonmonetary benefit.

FARES, PARKING FEES, AND CASH FLOW SURPLUS

FARES AND PARKING FEES. Since only part of the total fares and parking fees anticipated for the transit system operations were shown in the traveler cost tabulation, there are two reasons why the total amount of fares and fees was not included. First, former bus riders who change to rapid transit will pay very nearly the same fares as they did on buses, since the fare structure is almost identical. This amount, therefore, does not represent an increase in total transportation cost. Second, we have stated that benefits and costs to auto users who

FARES AND FEES (Millions of Dollars)

Item	Annual Amount
Fares paid on rapid transit by former auto users during peak traffic periods	$42.9
Fares paid on feeder bus system by former auto users during peak traffic periods	6.2
Parking fees paid by former auto users during peak traffic hours	0.4
Total increase in traveler fares and fees*	$49.5
Fares paid on rapid transit and feeder buses by former auto users during off-peak traffic hours and weekends	13.7
Fares paid on rapid transit and feeder buses by former bus riders	18.0
TOTAL FARES AND FEES	$81.2
Other revenue	.9
ESTIMATED REVENUE FOR RAPID TRANSIT AND FEEDER BUSES	$82.1

BENEFITS TO BUS RIDERS (Millions of Dollars)		
Item		**Annual Value**
Total revenue from Rapid transit and feeder bus operations		$82.1
Operating expenses for Rapid transit and feeder bus operations		−48.6
Equivalent annual cost of replacements*		− 6.0
AVAILABLE FROM RAPID TRANSIT AND FEEDER BUS OPERATIONS		27.5
Reduction in bus system fares:	$18.0	
Reduction in bus system costs:	5.4	
Reduction in bus system net revenues		−12.6
NET BENEFIT AVAILABLE		14.9

*This is the amount of money invested at 6 percent annually that would accrue to an amount necessary to pay for the replacements when they become necessary.

change to rapid transit will pay very nearly the same fares as they did on buses, since the fare structure is almost identical. This amount, therefore, does not represent an increase in total transportation cost. Second, we have stated that benefits and costs to auto users who change to transit for off-peak and weekend travel will exactly balance, and none of the benefits or costs has been included. Their fare payments have therefore been removed. The table, Fares and Fees shows a reconciliation of this number with the estimated revenues.

CASH FLOW SURPLUS. It is the stated policy of the District that any revenue surplus generated by rapid transit operations will be used to improve bus service and to avoid fare increases rather than pay off the construction bonds. The tabulation entitled "Benefits to Bus Riders" shows that there will be an operating surplus of revenues over operating costs for the rapid transit and feeder bus systems. This surplus will cover the equivalent annual cost of equipment replacement, discounted and averaged over the study period, and the loss in net revenues on the bus system. A net benefit to the bus riders will remain as additional service improvements or fare reductions.

BENEFITS TO AIRPORT SERVICE PATRONS

Former Mode of Travel	Estimated Number of Patrons Per Year (Thousands)	Reduction in Cost of Travel to Downtown Per Trip, (Dollars): Value of Time	Vehicle Operating Cost	Parking Cost	Fare Cost	Total	Annual Benefit (Millions of Dollars)
Airport Limousine	840	$1.17	$ —	$ —	$ —	$1.17	$ .98
Taxi	140	.94	—	—	5.00	5.94	.83
Rental Vehicle	112	1.17	1.50	.50	1.50	4.67	.52
Private Vehicle	308	1.17	0.66	2.00	−1.50	2.33	.72
Total	1,400						$3.05

BENEFITS TO AIRPORT SERVICE PATRONS

The Airport Department estimates that passenger volume at Los Angeles International Airport will increase from 17 million in 1967 to 57.5 million in 1975. However, parking and street access facilities will be severely taxed if these volumes are achieved. Should these facilities become overcrowded, airport travelers would encounter a severe bottleneck on the ground side of the passenger terminals. The airport service to be offered as part of the rapid transit system will offer a partial solution to this bottleneck and will provide substantial benefits to travelers between the airport and the downtown Los Angeles area. The express service will be considerably faster than any service over the city streets, and the congestion and parking delays will also be eliminated. On the other hand, the proposed fare is about the same as that charged by the existing limousine service. Thus, those who choose the rapid transit over the limousine will benefit from a time saving at no increase in fare. The proposed fare is much less than the taxi fare or the cost of auto rental or the cost of operating a private auto from the downtown area to the airport and parking there. The table, "Benefits to Airport Service Patrons," shows the per-trip benefits estimated for airport service patrons who were former limousine, taxi, rental car, and private auto users. At this time no detailed information on the numbers and destinations of airport service patrons is available. Estimation of the total magnitude of the benefits to these patrons is therefore less certain than the other benefit computations. We have, however, estimated benefits based on the District's estimate of the 1.4 million airport service patrons who are needed for the service to break even. These total benefits are also shown on the table, "Benefits to Airport Service Patrons" and on the summary table, "How Travelers Benefit from Rapid Transit."

COMMUNITY BENEFITS AND COSTS

Community benefits are those that accrue to the population as a whole, as a by-product, or as a consequence of the traveler benefits. For example, an employer receives a benefit if he finds his costs of supplying parking are reduced because workers have elected to ride rapid transit rather than drive to work. Some community benefits are "net" benefits, e.g., they can properly be added to the traveler benefits to obtain the total. Other community benefits are not countable, but are simply reflections of the traveler benefits. These benefits are still important, because they are perceived and valued by the persons or institutions on whom they fall. Some areas of rapid transit impacts that are discussed in this report do not produce true benefits (e.g., improvement in economic output). These are discussed only because they are often erroneously included in benefit cost analyses and might be conspicuous by their absence.

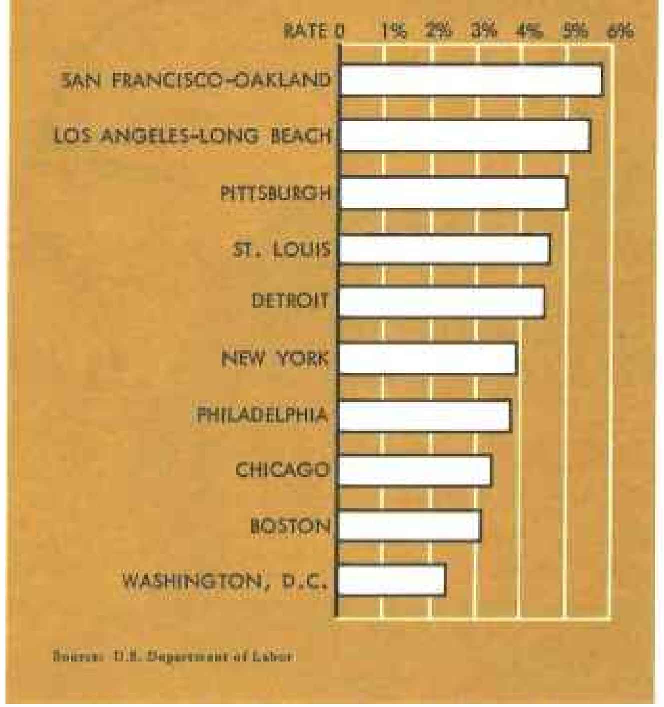
DOLLAR VALUE OF COMMUNITY BENEFITS AND COSTS

Benefit Item	Annual Benefit ($ Million)
Unemployment Reduction	30
Construction Employment Benefits*	24
Real Estate Effects	**
Business Productivity Increases	15
Government Productivity Increases	15
Civil Defense Improvements	+
Environmental Effects (Air Pollution)	+
Highway Construction Impacts	+
Improvements in Life Style	25
Tax Effects	**
Retail Sales Effects	**
Housing Efficiencies	+
Total Net, Approximately	109+

*Benefits in employment due to the rapid transit construction are valued at $270 million as a benefit that will be generated over the construction period. This is converted to a hypothetical equivalent annual benefit of $24 million.

**These benefits are merely reflections of benefits counted elsewhere and are excluded to avoid double counting.

In this section, each community benefit item is analyzed, discussed, and where possible given a dollar value (1968 dollars). Many items are essentially immeasurable, and, in these cases, a highly conservative dollar credit is taken. Where the benefit is either small or totally uncertain, a "plus" rather than a dollar value is indicated. Thus, the dollar value of the total of community benefits is undoubtedly understated by a considerable extent. The $109+ million annual community benefit estimated could easily be twice the amount.



UNEMPLOYMENT RATES FOR THE LARGEST METROPOLITAN AREAS

UNEMPLOYMENT EFFECTS

The unemployment rate in Los Angeles County averaged 5.6 percent in 1967, a rate that was well above the national average of 3.8 percent. The increased mobility provided by rapid transit should produce a small reduction in the unemployment rate in Los Angeles both in the short and long run. Even though the percentage reduction is small, the resulting dollar benefits are large.

A major cause of unemployment in the Los Angeles area, as in most urban areas, is attributable to the economy's inability to produce jobs for all members of the labor force. This is often referred to as demand-deficient unemployment. The volume of such joblessness in a given region can be reduced only through increases in government spending, increases in business capital outlays, a rise in personal consumption relative to income, or attraction of new business activity to the area.

The other categories of unemployment–frictional and structural – stem not from lack of jobs but from the inability of the market place to match the jobless to the available jobs expeditiously. Both, in part, reflect the effects of spatial dispersion in a region such as the Los Angeles basin. Frictional unemployment refers to short term joblessness reflecting the time required for a worker to find the right job. Structural unemployment is a long term phenomenon, reflecting substantial barriers between workers and jobs–outmoded skills, inadequate transportation, and sex and race discrimination. These barriers are not likely to be removed by the normal workings of the market place.

THE LOS ANGELES ECONOMY

Los Angeles County has experienced several periods of high unemployment during the past decade, and the unemployment rate has exceeded national averages since 1963. During a recent month, however, there were 40,000 unfilled jobs at the same time that more than 130,000 unemployed workers were seeking jobs. Demand-deficient unemployment, therefore, amounted to about 90,000, the excess of workers over local job opportunities. The remaining 40,000 reflected the structural and frictional components of unemployment.

Because the reduction of demand-deficient unemployment depends, in part, on government and business decisions that are external to the area, it is risky to make assumptions about its future level. A boom in a particular industrial sector could bring a sharp decline in this type of joblessness. Frictional and structural unemployment, however, are likely to increase as employment grows, as skill requirements rise, and as industrial dispersion continues. Projecting past trends to 1980 suggests that some 55,000 persons of these types will be jobless.

EFFECTS ON FRICTIONAL AND STRUCTURAL UNEMPLOYMENT

An analysis of the spatial factors in unemployment indicates that over the years an outward migration of manufacturing and warehousing has occurred, accompanied by a buildup of office-oriented activities in the central area. The result has been labor shortages of white collar workers in the central area and a shortage of production workers in some outlying areas. A surplus of blue collar workers in the south-central and eastern sections of the city now burdens the economy and remains a source of serious social problems.

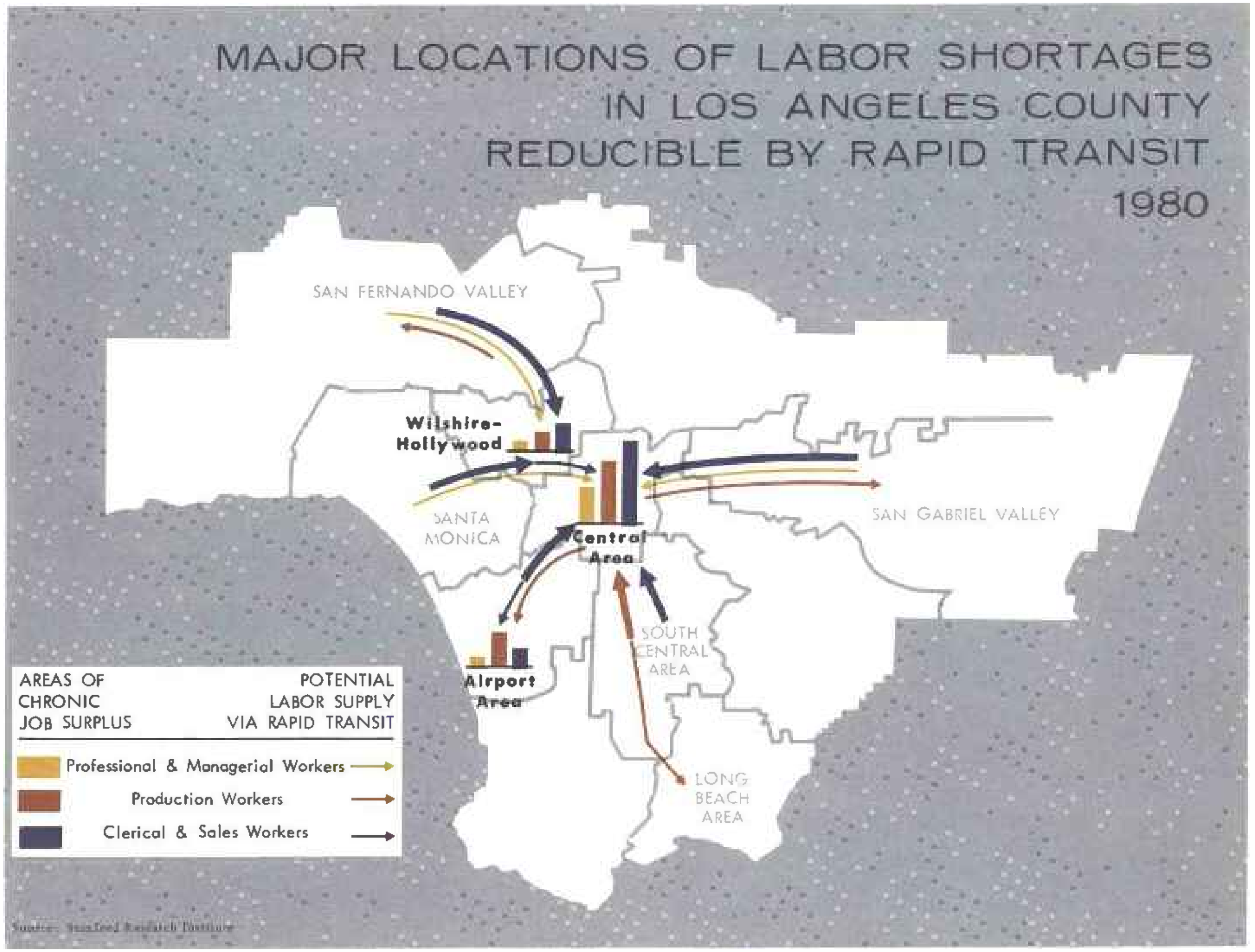
An analysis of skills requirements and geographical locations of unfilled jobs and unemployed workers suggests that by 1980, rapid transit improvements to labor mobility could reduce the monthly jobless total by 4,200 through improved access to areas of labor shortage. This figure was estimated by matching skill level of jobs in shortage areas to jobless workers, without automobiles, who live in areas where commute time would be greater than 45 minutes without rapid transit and less than 45 minutes with rapid transit. No credit is taken for increase in labor mobility because of transit-related improvements in freeway travel. This conservative criterion suggests that in 1980 the rapid transit impact would reduce the unemployment rate by about 0.1 percentage point. Thus, a rate of 5.0 would be reduced to 4.9 percent.

EFFECT ON DEMAND-DEFICIENT UNEMPLOYMENT

A long term reduction in demand-deficient unemployment will occur if new industry is attracted to the county because of more satisfactory transportation. This is most likely to occur in the central area and possibly in the airport aerospace industrial area as labor supply problems are relieved in those locations.

EFFECTS ON CONSTRUCTION INDUSTRY UNEMPLOYMENT

Rapid transit construction will add an average of 5,300 jobs for construction workers to the economy over a 7-year construction period, with peak employment in excess of 8,000. The current unemployment among construction workers exceeds 10,000 and is rising. Because the rapid transit requirements are so large, a major impact on unemployment can be expected. The magnitude of this impact is difficult to estimate because construction employment is highly cyclical (rising to 150,000 jobs in 1964; falling to 122,000 jobs in 1967). Thus, the impact

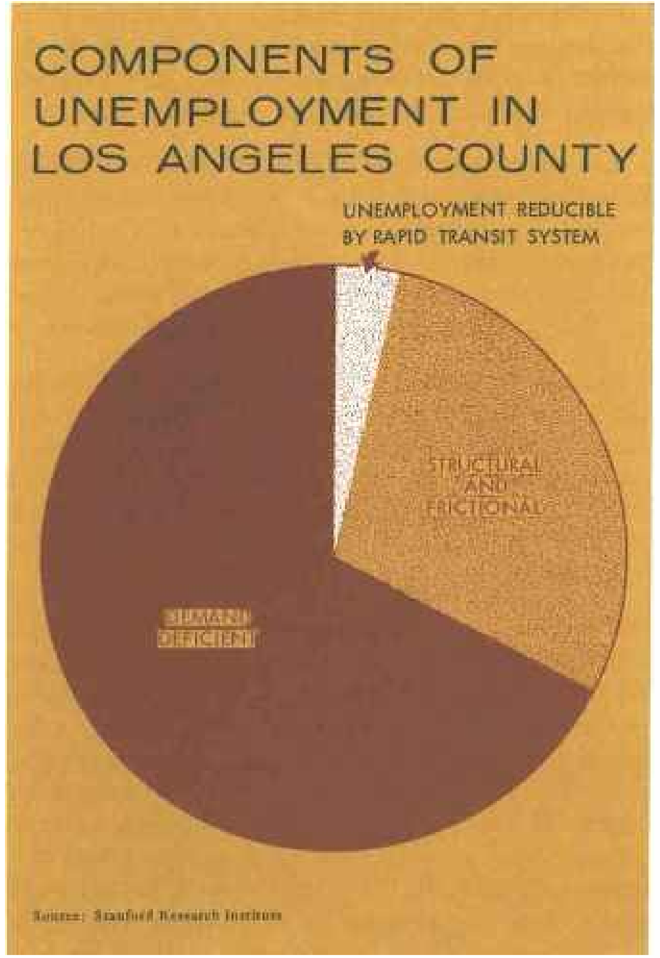


will be highly dependent on the timing of the rapid transit construction period with respect to the natural swings in the construction industry. If rapid transit building occurs during a period of high construction unemployment, a major benefit equal to the wages of possibly 4,000 otherwise unemployed workers could be claimed. If a major boom in housing occurs simultaneously with the rapid transit construction, there will be only unfilled jobs, competition for skilled workers, and immigration of labor. In this case, little or no benefit will result. In the face of this uncertainty but after studying the timing and magnitude of the expected employment that will be generated, we have estimated that a reduction in construction unemployment will occur equal to 50 percent of the average magnitude of the SCRTD construction work force. This will amount to 50 percent of 37,100 man-years of labor, valued at $14.500 per man-year, or about $270 million over the construction period from 1971 to 1977.

Additionally, millions of dollars of local expenditures for materials, machinery, and services will be a further short term aid to employment demand and will be a major boon to local industry.

EFFECTS ON HARD CORE UNEMPLOYMENT

Los Angeles County is characterized by several poverty areas with jobless rates as much as three times greater than national averages. Further, joblessness in these areas tends to be of long duration. It is not expected that rapid transit alone will have a major impact on this hard core unemployment problem which reflects the isolation of the areas, the need for skill development, and the persistence of racial discrimination. To the degree that poor transportation is a factor in such unemployment, the most amenable solution appears to be selected bus routings connecting small numbers of potential workers with specific industrial locations. Such service might be provided in part by the increased feeder bus service planned with the rapid transit system. Additionally, some reverse commuting of workers from the central low income areas to the industrial sites in suburbs via rapid transit seems likely.



EFFECTS ON WELFARE COSTS

Some of the employment gains cited above will accrue to welfare recipients, which in turn, will reduce the public costs of welfare payments to these recipients. This reduction must be considered an internal transfer, and to count it would result in double counting. Additionally, the effect is likely to be small. Of the nearly 400,000 persons on welfare in the county, the vast majority are not potential participants in the labor force because of their age, medical condition, dependent children, and so on. It is estimated that only slightly more that 400 persons on welfare in the county are both trainable or employable and geographically located so that rapid transit will aid them. It is estimated that the time on welfare for these recipients might be halved, allowing a welfare cost reduction of $165,000 per year. More important than this reduction in welfare cost would be the fact of the employment of these people and their return to contributing to the economy.

EFFECTS ON UNEMPLOYMENT COMPENSATION COSTS

Another important internal transfer generated by decreased unemployment would be the reduction in unemployment compensation assessments on California employers. The $30 million gain in gross salaries is accompanied by a $6 million decrease in unemployment compensation payments. About ¾ of these savings will accrue to local businesses since the mechanics of unemployment compensation taxation tend to reward employers in areas where unemployment improvements occur. The remainder of these savings will accrue to businesses outside the district.

SUMMARY OF BENEFITS

A credit for a permanent reduction in structural and frictional unemployment of 4,200 man-year equivalents is valued as a $30 million annual benefit or increase in the county economic output. This is based on increased wages valued at about $7,000 per man-year. The short term change employment demand because of rapid transit construction is valued at $270 million in economic output spread over a 7-year period.

No credit was taken for improvement in demand by attracting new industry to the central area although such an event is quite likely. It is noted that there are currently 9,700 unfilled jobs in the central area. We have assumed a reduction of 2,700 through reduction in transportation barriers. New employment will be added, tending to add to job surpluses. Further unemployment reductions should occur, but the mechanics of this become complex and the predictions speculative.

REAL ESTATE APPRECIATION

Effects that rapid transit will have on property values are not counted as either a net benefit or a net cost but are looked on as an internal transfer within the economy. When property is sold or rented at appreciated values, some buyer or renter must pay these appreciated values. No net economic efficiency is realized purely as a result of the change in land values. However, it is important to note the value of such property appreciation since it represents equity earnings to a sector of the society – the present property owners. The appreciation provides the incentive to develop the affected properties more intensely and improve business and government productivity and housing efficiency.

THEORY OF RAPID TRANSIT AND REAL ESTATE PRICES

Development of rapid transit improves access times and reduces travel costs between origins and destinations. When this happens, some of the traveler's time and cost savings are reflected in the value of land parcels whose "locational value"[1] has been enhanced. There will be a net increase in real estate values because there will be a net increase in the economic efficiency of the area. (See definition of benefit.) The new capital attracted plus a portion of the saved traveler costs will be used to bid up real estate prices as individuals attempt to capture private gains from a more efficient economy.

Thus, rapid transit will cause changes in both the relative values of various properties and a net appreciation of the total real estate value of the community. Furthermore, it will tend to attract some new development that might not otherwise have occurred and structure it near the the rapid transit lines. Historical analysis of various cities helps to predict the real estate impacts that will occur in Los Angeles County.

HISTORICAL DATA

The basic New York rapid transit (subway and elevated) system was built between 1900 and 1920. Two types of real estate impacts followed. First, property values within walking distance (1,000 to 2,000 feet) of the rapid transit stops increased by factors of from 5 to 15 times. Part of this increase was in land values and part was reflected in increased intensity of development of structures on the affected properties. Second, the development of rapid transit appears to have spurred some property appreciation throughout New York City.

In Cleveland, homes adjoining the Shaker Heights Rapid Transit completed in 1920 still cost some $2,000 more than other homes nearby. Since the new 15-mile Cleveland rapid transit system was built in 1955, commercial and apartment buildings valued at $169 million have been built in the immediate vicinity of its 16 stations.

A recent event was the sale of a 99-year lease of the air rights over the Windermere rapid transit station in the eastern Cleveland suburbs. This sale illustrates the added value generated in the area around a suburban terminal that became a major travel activity center and an ideal location for high rise residential and commercial buildings.

The economic impact of the rapid transit-generated development in Toronto is now well-known. The original 4½ mile long Yonge Street subway, costing $67,000,000 and completed in 1953, is believed to be a major factor (along with a new city hall development) in igniting a $10 billion development explosion in the Toronto area. During 1953-57, property assessments in the rapid transit corridor grew at a rate 200 percent higher than the remainder of the city. This largely reflects the attraction of new high rise development in positions with direct access to the subway, particularly at the suburban terminal of the transit line. It is noteworthy, however, that there was considerable simultaneous growth in property values in the distant automobile-oriented Toronto suburbs.

Construction of the Bay Area Rapid Transit system (BART) is now visible in the East Bay area. Initial system operation is planned for the early 1970s. Only minor and scattered property developments in reaction to the system under construction have occurred to date. Developers, in general, apparently feel that it is too early to invest in property adjoining corridors or stations. This is consistent with the history of rapid transit impacts. Excluding some cases of property speculation in New York and Toronto, the economic effects have usually followed commencement of rapid transit operations. This wait-and-see attitude is highly probable in auto-oriented California areas.

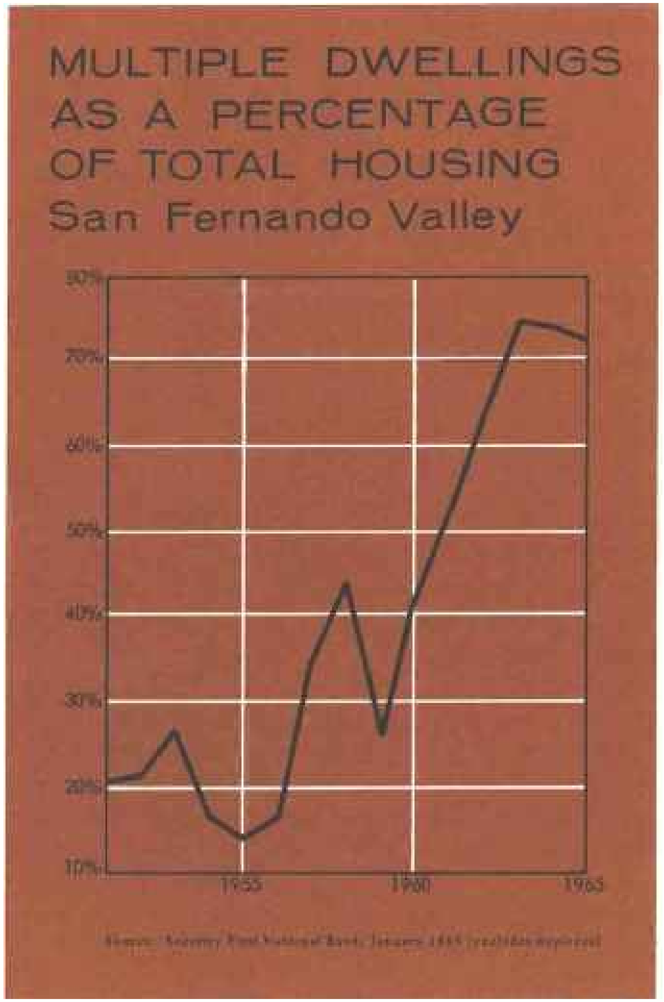
REAL ESTATE IMPACTS IN LOS ANGELES COUNTY

Future development of the land use pattern in the Los Angeles area appears sensitive to rapid transit. The current growth rate in the residential and commercial structures that tend to be transit-related is high. Specifically, large apartment and office buildings (sometimes combined in a single structure) are leading elements in new construction. The trend of apartment buildings capturing an increasing share of the housing market already exists and will be greatly amplified by the abnormally large percentage of the population (including part of the post-World War II baby boom) moving into the 20-to-30 age group and demanding apartment dwellings. The trend in office development derives from the increasing share of employment in the service industries, such as insurance, banking, and white collar jobs within manufacturing.

Considering zoning patterns, present development trends, land prices, and other factors, it is likely that the San Fernando and San Gabriel corridors may be the location for a large share of the suburban high-rise trends. These corridors will become excellent residential locations for clerical, technical, and professional employees that commute to central area jobs. The rapid transit-induced improvements in labor supply should spur vigorous redevelopment in the El Monte, central Los Angeles, and Long Beach areas, and the airport-aerospace industry complex.

EFFECTS ON POPULATION GROWTH AND HOLDING CAPACITY

The Los Angeles City Planning Commission has made studies of four alternative land use patterns adaptable to the future Los Angeles metropolitan area. Two of these assume extensive rapid transit systems, one assumes



rapid transit in the core area, and one assumes no rapid transit. Each is designed to afford reasonable living standards and mobility. These land use studies indicate that the area with extensive rapid transit can accommodate a 10 percent higher population density because rapid transit generates high-rise clusters of buildings and concentrations of population and is capable of servicing the high-volume transportation needs resulting from these concentrations.

These higher potential densities can be used to accommodate either a larger population or more open spaces and recreational areas. In either event, the higher densities will add to the property appreciation effect triggered by the enhanced efficiency of the economy.

IMPROVED BUSINESS PRODUCTIVITY

A significant part of the community benefits from the proposed rapid transit system will derive from the capacity of business establishments to improve the quality or quantity of goods and services per unit of input. This increment is reflected in increased regional output or reduced costs. Part of the improvement may be passed on to households in the form of lower consumer prices and part will be retained by businesses.

The present transportation impacts on business productivity are indicated in a recent industrial survey conducted by the Los Angeles Regional Planning Commission. Of those businesses responding, about 60 percent indicated that the lack of public transportation was a hindrance to their operations. Additionally, SRI staff members conducted interviews with business leaders to discuss the details of these transportation problems. Among fields covered in the interviews were insurance, banking, utilities, garment manufacturing, aerospace, electronics, and corporate headquarters of all fields. Conclusions follow.

IMPROVED LABOR SUPPLY

A major benefit to business will come through improvement of labor supply, particularly in areas where this is currently a critical problem. This can allow better matches between workers and jobs with the employer obtaining better skills at a given wage rate or similar skills at a lower rate. The garment industry, the banking and insurance activities in the downtown area, and the aerospace industry in the airport vicinity are examples where such productivity increases should occur.

The improved balance between labor supply and employment should result in reduced turnover. (With the reduction in unfilled jobs as previously described, there should be a reduction in the turnover rate that normally accompanies chronic labor shortages.) Reduced turnover means reduced hiring costs that now can be as much as $1,500 per new employee and training costs that can be as much as $1,000 per new employee.

Benefits also occur through the reduction of labor shortages as a result of the elimination of production bottlenecks that the scarcity of workers with particular skills cause. Benefits might also occur if the increased supply of labor enables an employer to put on additional work shifts at an existing location when the need arises.

IMPROVED ENVIRONMENTAL FACTORS

A number of other business-related factors are attributable to traffic congestion. If congestion were alleviated, increases in productivity would result from:

- Better movement of goods to and from businesses — the commute peaks on the freeways often necessitate reshuffling shipping and receiving operations to hours different from those of the production facility. This is especially true in downtown area streets where congestion at the rush hours limits truck access to many establishments.

- Faster access in passenger travel between businesses and from businesses to airports and other public facilities. (These are benefits obtained through travel but not counted under traveler benefits since they occur mainly during nonrush periods.) Greatest benefits will accrue to downtown establishments and on-line establishments away from downtown that have special ties to one another requiring many face-to-face contacts. Included are garment buyers and manufacturers, data processing firms, pharmaceutical retailers and hospitals, office supply companies, and financial institutions.

- Improvement in employee morale and attendance, because of shorter or easier home-to-work trips.
- Some economies of scale because of enlarged labor supply. Examples of the types of expansion that might be possible are the new annex to the Occidental Life office building or further enlargement of the TRW, Inc. complex in the Hawthorne area.

PROFITS ON HIGHER MANPOWER UTILIZATION RATES

Previously, a $30 million annual increase in wages was estimated from reduced unemployment. Clearly, a business profit will be generated from this new employment, which should be at least 10 percent of these incremental wages.

BETTER UTILIZATION OF SPACE THROUGH REDUCED PARKING*

Because of the present heavy automobile use and the geographic dispersal that limits the use of ride pools, obtaining parking near job sites is a critical problem in Los Angeles County. A local ordinance now requires that new commercial structures provide adequate off-street parking spaces for employees and customers.

Many downtown concerns charge employees and customers for the use of these spaces, while companies in outlying areas, especially those not served by public transit, often do not. While companies that charge for spaces may recoup at least part of their costs, those that do not charge are, in effect, providing an additional employee benefit or customer service. Regardless of who pays for the space, it is a real cost to the community.

Rapid transit can benefit the business concern in either of two ways. By reducing the demand for parking space, the company is relieved of the need to acquire additional space. If there is an actual reduction in the need for space at a particular location, the business may be able to put the land made available to better use, e.g., by expansion of facilities on site.

It is estimated that rapid transit may allow a reduction of 117,700 parking spaces. This reduction would be obtained through a slowdown of parking construction during the 1975-85 time period. This reduction represents a $23 million annual savings (counted under traveler benefits), a major portion of which would accrue to the business community.

*The total benefit derived from reduced parking requirements is subsumed under Traveler Benefits and is only discussed here in relation to the business community.

PARKING REQUIREMENTS

Type of Establishment	Ratio of Parking Space To Gross Floor Space
Banks	1.31
Libraries	1.00
Medical Buildings	.92
City-County Offices	.88
Post Offices	.83
Drug Stores	.70
Department Stores	.68
Restaurants	.51
YMCA-YWCA	.39
Offices	.36
Variety Stores	.27

SUMMARY OF BENEFITS

Most of these benefits are not susceptible to measurement. They appear to be of significant size. One indication of their value is the fact that the Los Angeles Chamber of Commerce has publicly registered strong support for an extensive rapid transit system.

The total nongovernment output of the Los Angeles County economy was $18.5 billion in 1967 — it should be about $30 billion in 1980. Business productivity benefits are estimated to be a conservative $15 million per year, 0.05 percent of the gross business activity in 1980.

IMPROVED GOVERNMENT PRODUCTIVITY

Local government in Los Angeles County is big business. Total expenditures by the county and city governments, special districts, and authorities are over $2 billion per year. This does not include the expenditures in the county by the state and federal governments (e.g., state school systems). In 1980, local government expenditures will be $3 billion if government merely grows at the same rate as the Gross National Product. It stands to reason that if the inclusion of rapid transit in the area increases the efficiency of local government in only a minor way, the dollar value of savings should be in the multimillion dollar per year range.

IMPROVED LABOR SUPPLY

Most of the government employment in the district is centered around the Civic Center in downtown Los Angeles. This is an area of critical labor supply problems and an area where access will be greatly enhanced, allowing government to improve significantly the quality of labor force (see the travel time isogram of commute times to the Civic Center). In a $3-billion government operation, the efficiencies available through a massive improvement in labor supply should be significant. A cost reduction of one tenth of one percent would produce a $3 million saving annually.

EFFECTS ON MUNICIPAL COSTS

It is commonly accepted that a major factor that affects the per-capita costs of municipal services is the intensity of land use in residential and employment areas. This is a logical premise since the cost of supplying transportation, sewage, fire protection, police protection, and other services is highly sensitive to the distances over which government personnel must travel to provide the services. It is also likely that rapid transit should cause a 10 percent increase in land-use intensities. (See previous discussion under real estate analysis.) Thus, municipal service costs should be lower than without rapid transit.

Studies of the likely savings traceable in this manner to rapid transit effects on density indicate that the benefit is smaller than one might anticipate. A major analysis was done of the Northeast Illinois metropolitan area evaluating the impact of various land patterns and densities on municipal costs. The effect turned out to be too small to measure. It was believed to be on the order of 1 percent or possibly less. The only systematic research that was designed to measure this effect was done on a hypothetical city structure with varying densities, family income levels, and service standards. It indicated that a 10 percent increase in density might reduce local government costs by 0.33 percent. We have used this reduction as the likely effect of rapid transit in the Los Angeles area. This factor when applied to local government annual expenditures of $3 billion in 1980 would produce a $10 million annual benefit.

PARKING*

A major cost savings should occur in the area of government-furnished parking. This is a major government expenditure related to governmental administrative services, educational facilities, health facilities, and so on. The total costs are likely to be higher in 1968 since Los Angeles County is planning free parking for all of its employees.

Within the city and state colleges and universities, parking is a major problem in cost, irritation, and waste of valuable time for students and faculty. (Often every day starts with the search for a parking place.) Looking at costs alone, the school may pay about $100 per year to supply and maintain each parking stall. The student pays $50 per year to use the stall. The policy of the State College system is to supply one stall per two students. There are nearly 300,000 full-time students in public schools of higher education in the county. Thus, the governmental costs connected with parking in the area of education alone are in millions of dollars. Government should be a major recipient of the $23 million parking saving isolated under traveler benefits above.

*In this study, total parking costs have been subsumed under traveler benefits and are merely commented on here.

SUMMARY OF GOVERNMENT PRODUCTIVITY BENEFITS

This analysis indicates that a $10 million annual benefit might be generated in reduced municipal costs and a benefit of at least $3 million might be generated through improved labor supply. Parking cost savings should be quite large but are counted under traveler benefits. A conservative $15 million annual benefit is taken as the total.

IMPROVED CIVIL DEFENSE CAPABILITY

The cold war has required a low-level but continued U.S. preparedness against nuclear attack. The key element of preparedness has been the fallout shelter program, which has been hampered by an insufficient number of shelter spaces in urban areas, an overconcentration of these spaces in the central city areas (with no way for the people to get to the shelter fast enough), and an insufficient capability for evacuating the population outward if this strategy were called for.

Thus, the civil defense program in Los Angeles and in other U.S. cities is constrained by lack of fallout shelter and lack of a reliable, high-capacity means of mobility. Rapid transit will supply additional shelter space in the subway portions. Although the additional shelter space will possibly be in areas already with an excess of shelter space over resident population, these areas accommodate a large daytime business population, and the rapid transit system will also supply the needed mobility between the present areas of excess shelter and the population. Thus, the proposed rapid transit system will represent a major improvement to the civil defense program of Los Angeles County.

SUMMARY OF BENEFITS

Should a nuclear attack on the United States occur, the public benefit of having rapid transit would be immeasurably large. It can only be said that a benefit is entailed, but one with which Los Angelenos have not indicated a large concern. Thus, a mere "plus" benefit is taken.

ENVIRONMENTAL EFFECTS

AIR POLLUTION

Air pollution is one of the most critical problems of the Los Angeles basin. Motor vehicles are responsible for about 90 percent of pollutants discharged in the air daily over Los Angeles, or about 12,000 tons.

The proposed, electrically-powered rapid transit system will reduce pollution by diversion of automobile travel and particularly by relieving the stop-and-go congested rush hour traffic that contributes heavily to pollution. It is estimated that the reduction will be on the order of 300 tons per day. Additionally, basic standby mobility is provided in case critical air pollution conditions should require a temporary ban of automobile traffic.

As valuable as this reduction might be, it is only part of the total program for resolving the air pollution problem. The major effort is being focused on the automobile. It has been estimated that current modifications that California requires of new automobiles, if they prove effective, will eliminate about two-thirds of the hydrocarbon and carbon monoxide emissions. This will reduce emissions from automobiles to an estimated 7,700 tons per day in 1980. The only known solution for a third major pollutant, nitrogen oxide, is to reduce automobile travel. Rapid transit will be helpful toward this end.

Although some experts assert that any reduction in air pollution has immeasurable value, the actual economic value relative to the public's health and property is unknown.

NOISE

Urban noise is becoming a major problem in the large metropolitan areas. Essentially no research has been made as to causes, but transportation is popularly considered a major source. Test operations of the BART system indicate that modern rail rapid transit systems can be extremely quiet and should not contribute to urban noise. However, rapid transit should have little effect on overall transportation noise. Some auto traffic will be diverted but freeways, even when free-flowing, will still be as noisy as before.

SUMMARY OF BENEFITS

Because of the intangible values of air pollution reduction and the secondary role that rapid transit must play in this problem, only a minor benefit can be assumed. No apparent credit can be identified in noise reduction. A mere "plus" is taken as the total annual benefit.

HIGHWAY CONSTRUCTION IMPACTS

It is not intended that rapid transit will reduce the need for highway projects in Los Angeles County. The total share of federal and state highway funds allocated to Southern California will be needed and should be spent with or without rapid transit. The same can be said of county roads and city streets. However, one very important net benefit should develop. Rapid transit should render unnecessary further freeway building in the central area, where freeways are inordinately expensive. Thus, if rapid transit can displace or reduce this need, the highway funds can be reallocated to building considerably more freeway mileage in the suburbs. Thus, the District will eventually have more auto mobility for the currently planned level of highway expenditures.

IMPROVEMENTS IN URBAN LIFE STYLE

There are a number of nonmonetary improvements that rapid transit should bring to many District residents to broaden their range of choice of mobility as well as residential possibilities that will enrich their "style of urban life." These benefits will fall both to those who do and do not see themselves as automobile drivers.

THE NONDRIVER

Although Los Angeles has a high rate of automobile ownership (2.4 persons per auto in 1960, 2.1 anticipated in 1980), there are still many District residents who do not fully participate in today's automobile economy. For example, more than one-third of the women of driving age do not have driver's licenses; one household out of seven has no car. The present public transit system has contracted its frequency of service over time and has not fully expanded with the population. As a result, the "limited mobility group," those not having direct claim to an automobile, have found their mobility shrinking with each passing year.

In the Los Angeles area, those without automobile mobility are vastly limited in their opportunity to travel to schools, hospitals, sporting events, distant medical or professional offices, and the many social and cultural activities that are spread over the 1,500 square miles of coastal Los Angeles County.

A detailed analysis of the "limited mobility group" included all persons 10 years of age or over, which is the age when the need for independent mobility starts. It has included all those who have at best second or third claim to the family auto — the housewife in a one-car family or the teenager who does not own his own car. This group totaled 2.3 million of the populace in 1960 and will be 3.1 million in 1980. Thus, the need for public transit will grow over time, not shrink.

The proposed rapid transit system, with its planned feeder buses, will connect a large portion of the residential areas to most major recreational, social, cultural, and educational attraction centers throughout the district. This will return to many of those in the limited mobility group greatly improved access to the community.

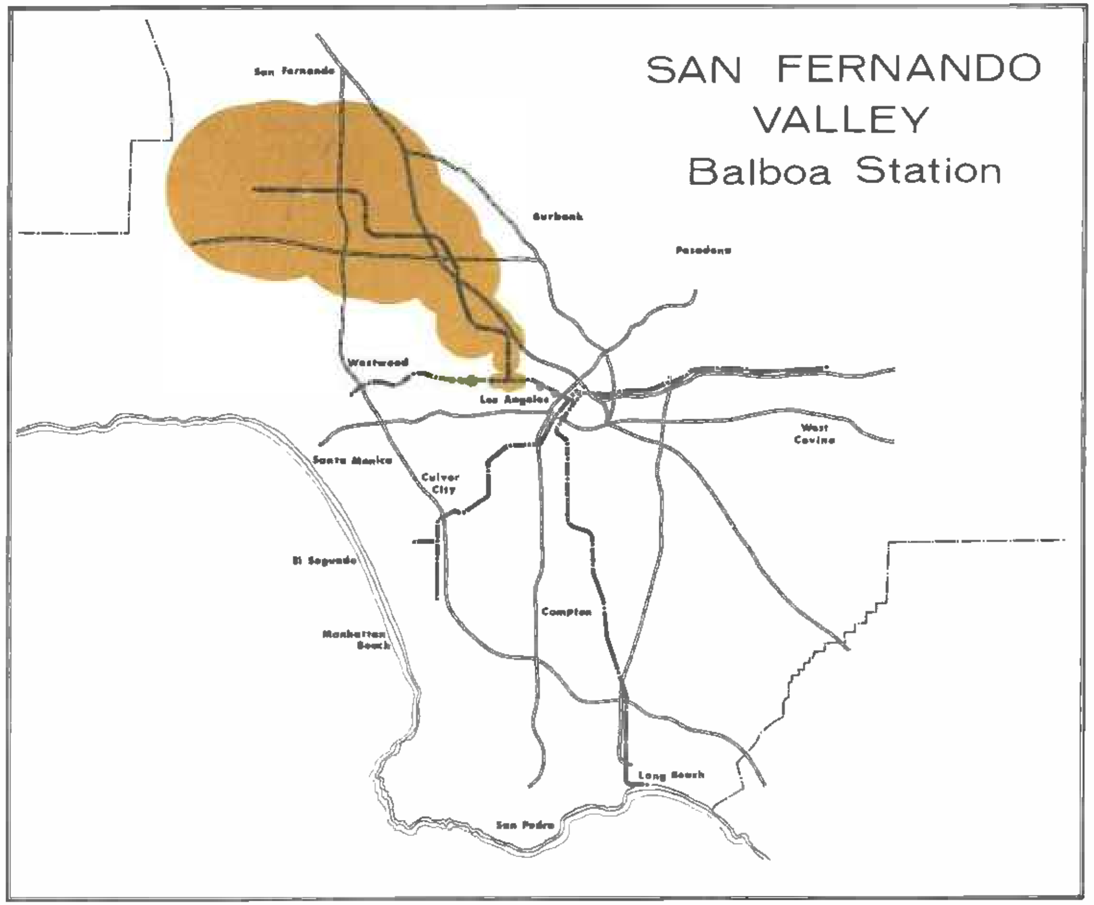
NUMBER OF PERSONS IN THE LIMITED MOBILITY GROUP*
(In Thousands)

	1960 Households				1980 Households			
	No Car	One Car	2+ Cars	Total	No Car	One Car	2+ Cars	Total
Heads of Households	335	These people have first claim to an automobile		335	270	These people have first claim to an automobile		270
Other Adults	67	990		1,057	54	1,325		1,379
Teenagers (16 to 20)	16	156	99	271	16	288	332	636
Preteens (10 to 15)		600		600		854		854
	Grand Total			2,263	Grand Total			3,139

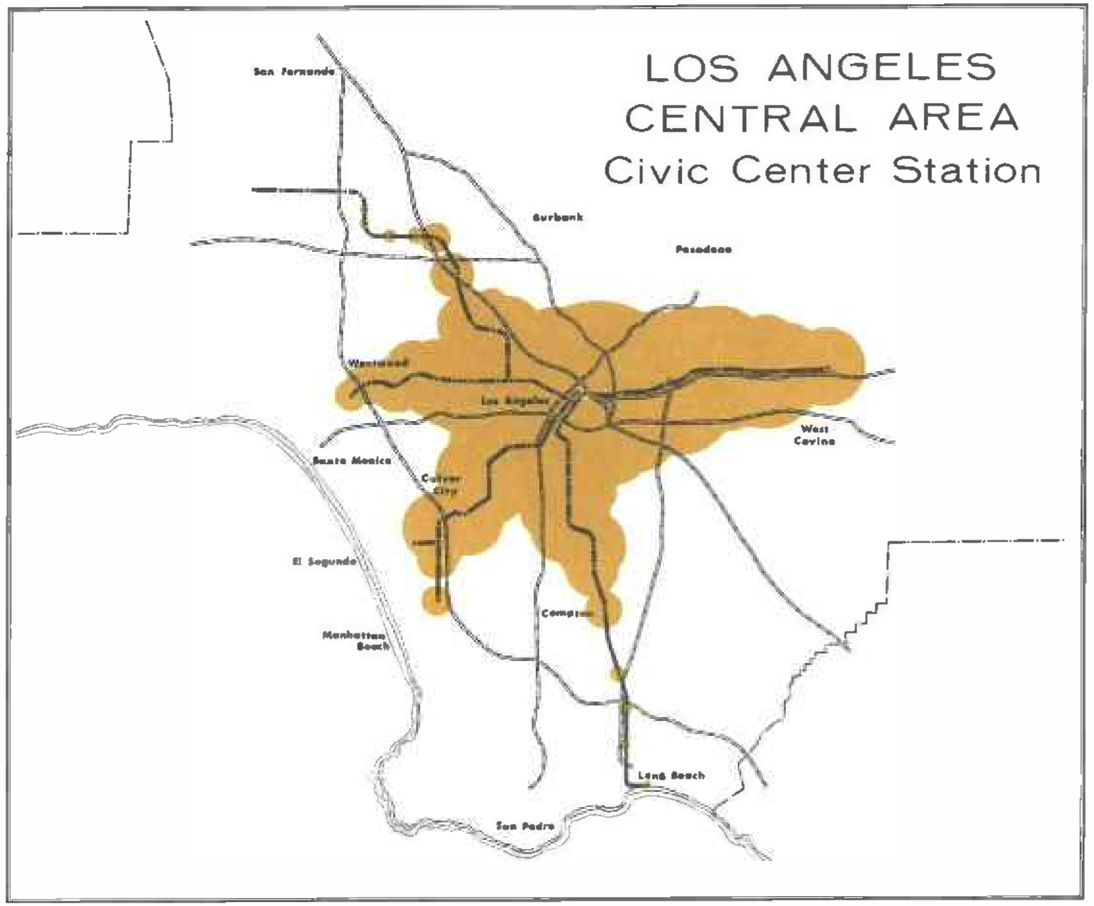
*Numbers in shaded sections of table refer to those who have less than first claim to an automobile, are often dependent on public transportation.

IMPROVED ACCESSIBILITY WITH RAPID TRANSIT

The adjoining maps illustrate the distance that may be traveled using the proposed rapid transit system from four locations within the Los Angeles Area. In each illustration it is assumed that a person starting at the rapid transit station identified travels by the optimum combination of nonautomotive travel modes—rapid transit, feeder bus, and walking. The perimeter of the area, depicted in ochre color, is the distance he can travel in 45 minutes in any direction.

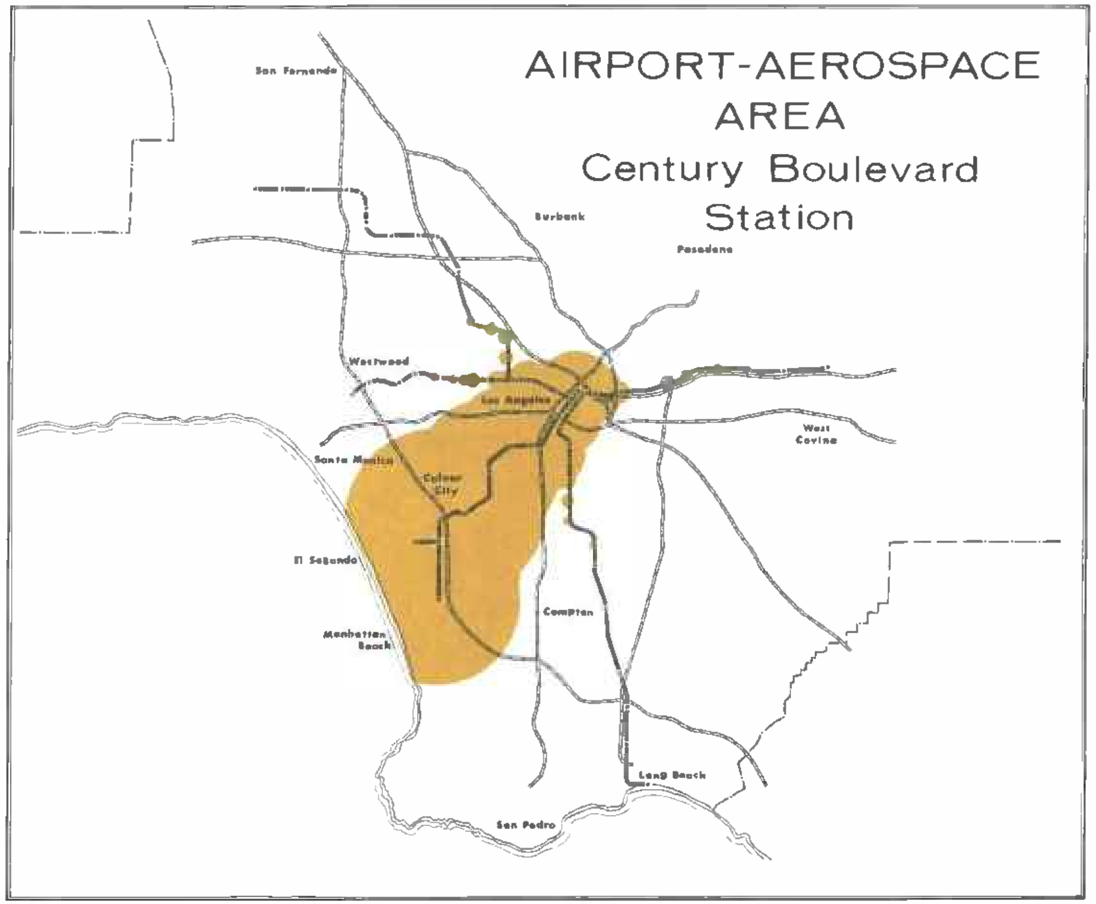


Source: Stanford Research Institute

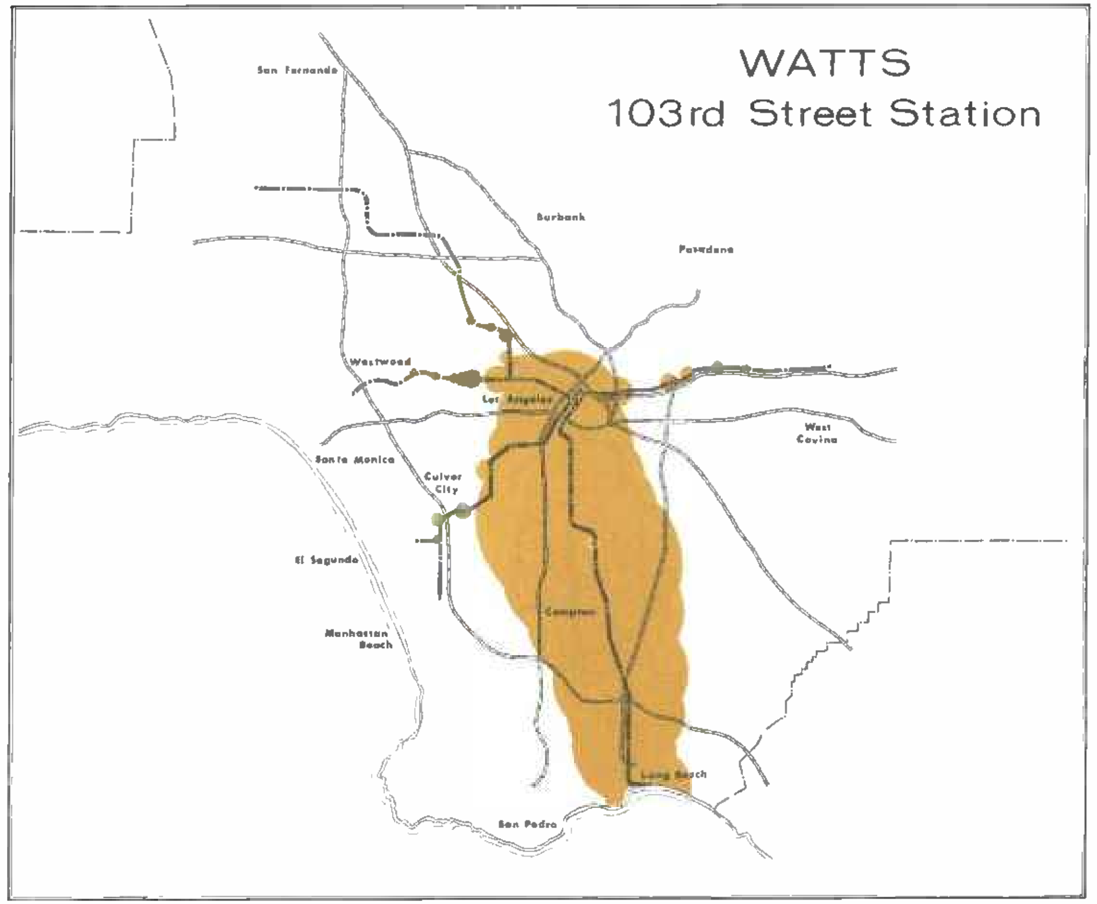


Source: Stanford Research Institute

These maps are included for illustrative purposes but were also used for quantitative analysis. The San Fernando Valley and airport-aerospace isograms were used to analyze the improvements in labor supply afforded to suburban employers. The Civic Center illustration was used to analyze the greater access to and within the central area afforded to persons who do not have an automobile at their disposal. The Watts illustration was used to analyze the increased mobility for persons of that area and the increase in potential jobs that would be within reasonable commute times.



Source: Stanford Research Institute



Source: Stanford Research Institute

CULTURAL, RECREATIONAL, AND SERVICE CENTERS LOCATED AT STATIONS

CULTURAL CENTERS
- Los Angeles County Art Museum
- Shrine Civic Auditorium
- Music Center
- County Museum of History and Science (Museum of Natural History)
- California Museum of Science and Industry
- Proposed Air, Space, and Missile Museum in the Armory

MAJOR TOURIST CENTERS
- Universal City
- Farmers Market
- Miracle Mile
- Paramount Studios
- Columbia Square
- Grauman's Chinese Theater
- Convention and Exhibit Center
- Restaurant Row
- Chinatown, Olvera Street, and Plaza

MAJOR SPORTS CENTERS
- L. A. Memorial Coliseum
- L. A. Memorial Sports Arena
- Long Beach Arena

COLLEGES AND UNIVERSITIES
- California State College at Los Angeles
- Los Angeles Trade Technical College
- Los Angeles Valley College
- University of Southern California
- University of California at Los Angeles

HOSPITALS
- Los Angeles County—University of Southern California Medical Center
- Sawtelle Veterans
- U.C.L.A. Medical Center
- California Lutheran
- Good Samaritan
- St. Vincents

GOVERNMENT CENTERS
- Los Angeles Civic Center
- Long Beach Civic Center
- Van Nuys Civic Center

PARKS
- Exposition Park
- MacArthur Park
- North Hollywood Park
- Centinela Park
- Hancock Park

THE OTHER DISTRICT RESIDENTS

Many residents feel that their automobile or automobiles give them all the mobility they need. Are there improvements in life style that they might anticipate?

Primarily they will enjoy greater ranges of choice in the pattern of living and traveling. One may live in a high-rise apartment within walking distance (or possibly above) a rapid transit station. His automobile may be garaged nearby, but many trips may be taken without it. Those who wish to remain in single family residential areas will find the growing pressure to develop apartments in their neighborhood greatly reduced. It is anticipated that future demand for apartments will be partially absorbed by the high-rise growth that should cluster about the rapid transit stations.

The rapid transit impact on land-use development will allow other benefits to occur. The Los Angeles City Planning Commission forecasts a doubling of the land available for recreational and open space purposes if rapid transit is installed. Their estimate indicates that 11 percent of total land area is available for open space recreational use without rapid transit and 22 percent with rapid transit.

Even for some of those totally committed to the automobile, the rapid transit system will act as an effective standby mode of transport in an emergency (for example, when their car breaks down or when a critical air pollution condition curtails auto movement temporarily).

SUMMARY OF BENEFITS

Both the nondriver and the driver will receive these opportunities for life style changes through rapid transit. There are no methods by which the value of the satisfactions received can be estimated. Some benefits might be extreme: For a person in need of medical attention who could reach a specialized medical care center that otherwise he could not visit, the value might be immeasurable; for a youth who could attend a government-sponsored university where otherwise he would miss a college education, the loss both individually and to the community is large. The increased monetary return from a typical college education is estimated at one quarter of a million dollars. On the other hand, some families may find only occasional interest in the rapid transit, exercising their choice only once or twice a year as they decide to take the transit to a football game and "skip the parking problem."

Our analysis of life style improvements indicates that the benefits may be valued at least at $25 million per year. This estimate is quite conservative, being equal to $2.75 per capita per year, the price of a ticket to a sporting event or a concert.

RETAIL SALES IMPACTS

The impact on retail sales is not included as a net benefit but as an important internal transfer. It is discussed because it is expected that some businesses will feel an impact. In the discussion of real estate impacts, it was estimated that the ability of the District area to hold population would increase by 10 percent with rapid transit. As a consequence, the economy of the District will be larger, and as an example, retail sales will be greater.

Merchants will benefit from the increased sales. However, these effects do not represent a net benefit to the community, they represent only more sales by more merchants to more customers. No increase in productivity is realized.

On the other hand, there will undoubtedly be temporary losses in retail sales by merchants whose stores front on construction work. Such sales will be displaced to other merchants. The disbenefited merchants should expect an offsetting increase in business when the project is completed.

HOUSING EFFICIENCIES

The type of high-rise residential structure associated with rapid transit stations can lead to certain efficiencies in housing construction. It may be possible to revise parking ordinances to allow less parking spaces per apartment occupant. Some experience in the market place may be necessary before such efficiencies can be incorporated into the structure design. Further ground space can be saved where apartment or office buildings are built using the air space over the transit station.

TAX EFFECTS

INDUCED GROWTH AND LOCAL TAXES

Since rapid transit will probably tend to increase the population of the district, the increase will raise the tax base for all types of local tax revenue. Offsetting this increase is the fact that more residents require more municipal services. No net gains occur unless efficiencies in government services are gained. There are some such gains as a result of higher densities, and credit is taken for them under government productivity.

New industry will precede or accompany this population increase. The net tax effect of a new industry may be positive, if the industry is capital intensive or hires preponderantly high salaried personnel, negative if it is labor intensive using a preponderance of medium and lower salaried employees (e.g., clerical and other office personnel). Rapid transit tends to attract new industry that is in the second category, suggesting that little argument can be made for net tax improvements. However, since industrial growth should be accompanied by lowered unemployment, the net tax effect may be a standoff or even an improvement. The logic of this is that some of the labor of the attracted labor-intensive industry is already here as members of the unemployed, and no increase in municipal service is needed for these people.

LOSSES OR GAINS TO PROPERTY TAX BASE

The construction of the system will require that nearly 700 acres of private property be purchased for right-of-way, station property, parking areas, and so forth. Will this produce a loss of assessed valuation to the property tax base? Will the remaining taxpayers have to pay more?

It has been previously argued that there will be a net rise in real estate values as a portion of the $1.3 billion in capitalized traveler benefits is imputed to property values. This will cause an increase in the total assessed valuation. The question is then whether the assessed valuation of the expected real estate appreciation will exceed the assessed valuation of the displaced property.

The answer appears to be that there will be a net increase. The expected market value of the private property to be purchased might be less than $200 million (this figure includes acquisition costs and contingencies). If only 7 percent of the $194 million in traveler and community benefits is translated to real estate values, the total assessed valuation will remain unchanged. Judging from historical evidence from other cities where rapid transit has been built, much more than 7 percent of the benefits will eventually be imputed to property values. There will also be growth as a result of induced higher land use intensities. Thus, there should be a net upward impact on the county's assessed valuation.

EFFECTS ON STATE AND FEDERAL TAXES

The net increase in economic output from higher productivities and induced growth will increase income taxes, sales taxes, and other taxes collected locally by the state and federal governments. The net property appreciation will result in increased capital gains taxes flowing into the federal treasury.

SUMMARY OF TAX EFFECTS

There will be a net rise in some form of taxes to service rapid transit bonds. Besides this "cost," all local, state, and federal tax bases will increase from induced growth. Some tax rate reductions can be forseen. A number of the benefits cited will contribute to lower taxes — employment of some welfare recipients, increased business productivity (higher tax revenues without increases in government service costs), and increased government productivity (same level of services at reduced costs). However, the total of these potential tax rate reductions appears to be small.

DISTRIBUTION OF BENEFITS TO GROUPS IN THE COMMUNITY

The adjoining chart summarizes the principal benefits that have been identified in this study. It is arranged so that it displays not only the type of benefit, but also the group on whom the benefit (or disbenefit) falls.

By reading across a single line in the chart, one can study all the major effects that accrue under a single benefit item. By reading down a column, it is possible to appraise all the effects that accrue to a group of persons. Note that many persons will associate themselves with more than one group. The distinction is made simply to facilitate intergroup comparsion of effects.

The net effect column shows the sum of all group effects in terms of various numbers of plus signs. The number of plus signs indicates the relative magnitude of the net benefit.

Even though each line shows a net plus (except for real estate, which is not counted), some negative effects may accrue to some groups. The proposed rapid transit is no different from other government programs in which some persons are inevitably penalized or disbenefited. Property owners in the path of the rapid transit right-of-way who lose their property may feel that they have not been adequately compensated. Businesses near the construction area may temporarily lose sales. Some properties near the right-of-way may actually decline in value. On an overall view, the magnitude of the positive benefits offsets these negative effects.

This project will also result in a considerable amount of transfer of benefit from one group or person to another. Renters, for example, may find that they have passed a portion of their travel benefits that accrue because of rapid transit on to property owners in increased rents. Business proprietors and property owners who benefit from the system implementation will pass some of their profit on to local, state, and the federal government in increased taxes. These monies, in turn, will be passed back to the populace in government service. Thus, the process of benefit transfer results in an ultimate diffusion of benefits that affects people much more broadly than would be judged from a study of traveler benefits alone.

TERMS USED IN THE BENEFIT/COST DISCUSSION

- BENEFIT—A savings in an allocation of a resource, such as capital or manpower; an increase in economic output, such as might result from more efficient uses of resources; or an increase in satisfaction, such as might accrue to an individual living under more pleasant surroundings—in other words, a benefit is something that improves the overall standard of living in the community.
- COST—A monetary outlay for value of goods or services received. In this report, the term "system cost" is the equivalent annual outlay for repayment of the construction bonds.
- TRAVELERS—Those whose travel path includes part of the surface transportation system — streets, buses, or transit—within the area served by RTD.
- TRAVELER BENEFIT—A time saving, cost saving, or other benefit accruing to travelers.
- COMMUNITY—The individual and businesses of the Rapid Transit District and other areas affected by the rapid transit system.
- COMMUNITY BENEFITS—The benefits that accrue to individual members of the community or to the community as a whole, other than traveler benefits. Among the community benefits are reduced unemployment, improved environment, and improved business productivity.
- INTERNAL TRANSFER—A transaction between community members that does not result in an increase in economic output of the community (a welfare payment, for example).
- NET BENEFIT—The annual equivalent of the sum of the cost savings, other resource savings, increases in economic output, and increases in satisfactions; less associated costs and disbenefits (such as transit fares, operating costs, and lost sales revenue).
- STUDY PERIOD—The period of time over which benefits and costs are assumed to flow. The study period starts at the beginning of the first year of complete operation and ends when the system is substantially converted to the next generation system. The results are reported here for a 40-year study period, although the effects of longer and shorter periods were investigated.
- STUDY YEAR—The year for which the benefits were estimated. The year 1980 is used for this economic analysis.

DISTRIBUTION ANALYSIS

BENEFIT ITEM	NET EFFECT	Effect On Gen. Consumers and Area Residents	Effect On Work Force	Effect On Owners of Property	Effect On Business	Effect On Local Government	Effect On Federal and State Government
TRAVEL BENEFITS DURING PEAK HOURS	++++	Reduced time and cost for shopping and school trips on R.T. and on suburban freeways.	Reduced time and cost for work trips on R.T. & freeways.	o	o	o	Lower gasoline tax revenues.
REDUCED UNEMPLOYMENT	+++	o	Greater income for those who find jobs or are able to find better jobs.	o	Lower payments for unemploy-ment. More retail sales. More profit on larger & better labor.	Higher sales tax receipts.	Larger receipts from federal and state income taxes & sales taxes.
IMPROVED BUSINESS PRODUCTIVITY	++	Lower prices set by some firms who experience lower costs.	o	o	More profit from lower travel costs. larger markets. lower parking costs. econo-mies of scale.	o	Larger receipts from federal and state income taxes.
IMPROVED GOVERNMENT PRODUCTIVITY	++	Lower taxes because of reduced govt. costs.	o	o	o	Better work force. Lower costs of govt. services. reduced park-ing needs.	Lower costs for some state and federal services.
REAL ESTATE APPRECIATION	Not counted as a net effect.	Renters pay higher rent in affected areas.	o	Increased values in tributary area. Very little effect outside tributary area.	Higher rents for business properties in tributary area.	Higher costs of property in tributary area. Increased property tax potential.	Larger receipts in income taxes from property owners' rental incomes.
IMPROVED MOBILITY AND LIFE STYLE	+++	Better mobility for non-drivers. Better airport access. Earlier suburban freeways. Open space potential.	Better mobility for non-drivers on work trips.	o	Higher attraction of new workers to the area.	o	o
REDUCED ENVIRONMENTAL POLLUTION	+	Reduced air pollution throughout the region. No net reduction of noise.	o	o	o	o	o
IMPROVED HOUSING EFFICIENCY & OPPORTUNITY	+	Better variety and choice in housing. Reduced high-rise pressure in suburbs.	o	Intense use of land around stations results in less land per housing unit.	o	o	o
BENEFITS DUE TO SYSTEM CONSTRUCTION	++	o	Construction employees who would be unemployed without R.T. project produce net benefit	o	Lower payments for unemployment.	o	o
INCREASED CIVIL DEFENSE READINESS	+	More shelter in subways. Better ability to move to shelter or evacuate.	o	o	o	o	o