REPORT

TO

THE LOS ANGELES METROPOLITAN TRANSIT AUTHORITY

ON

A MONORAIL RAPID TRANSIT LINE

FOR

LOS ANGELES

PART 1

ECONOMIC FEASIBILITY OF THE MONORAIL SYSTEM

January 15, 1954

COVERDALE & COLPITTS
CONSULTING ENGINEERS
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January 15, 1954

The Los Angeles Metropolitan Transit Authority
2233 Beverly Boulevard
Los Angeles, California

Dear Sirs:

Complying with your request as expressed in our agreement of April 15, 1953, we have made a study of the economic feasibility of the construction, maintenance and operation of a monorail rapid transit line between the San Fernando Valley and Long Beach and herewith transmit our report.

For the purpose of this study we have associated with ourselves, with your approval, Ruscardon Engineers of Los Angeles and Gibbs & Hill, Inc., Engineers and Constructors, of New York; the former to study origins and destinations of persons within the study area, other traffic matters, population and economic statistics; the latter to estimate the cost of construction and of operation of the proposed monorail system.

The report, therefore, is presented in three parts as follows:

Part I - Economic Feasibility of the Monorail System - Coverdale & Colpitts

Part II - Traffic, Population and Economic Data - Ruscardon Engineers

Part III - Monorail System Design, Estimates of Construction Costs and of Operating Expenses - Gibbs & Hill, Inc.

A mass of information has been accumulated and, although a small part only is reproduced in this report, it is all available for the use of the Authority.

I - INTRODUCTION

The Los Angeles Metropolitan Transit Authority was created by an Act of the California Legislature of 1951 as an instrumentality to carry out the State policy of developing interurban rapid-transit systems in the various metropolitan areas for the benefit of the people.

Under the Act the Authority has engaged engineers and instructed them to make an economic study of the feasibility of the construction, maintenance and operation of a mass rapid-transit system by means of monorail located within the limits prescribed by Section 2.7 of said Act, viz.: ".... the entire San Fernando Valley west of the west boundary of the City of Glendale, and within four (4) miles on each side of the main channel of the Los Angeles River from San Fernando Valley to the mouth of the river at Long Beach....".

The Authority, supported by funds appropriated by the Los Angeles County Board of Supervisors, on April 15, 1953 engaged Coverdale & Colpitts to act as the Consulting Engineers to the Authority and to make a study as described below.

SCOPE OF THE ENGAGEMENT

Under the agreement of April 15, 1953 with the Authority, the scope of the work to be performed by the Engineers is to determine:

"A. Whether the monorail rapid transit route within the operating area described in the Act creating the Authority, would, if adopted, be a proper beginning for the development of rapid transit throughout Los Angeles County, and whether or not such a monorail line will integrate appropriately with any other future plan of rapid transit for the metropolitan area of Los Angeles County.

"B. What the traffic potential is for the monorail route, to be selected by Engineers within the area generally described in the recitals hereof, in terms of payload and revenue, and a determination of the needed stations, speeds of operation and other operating factors.

"C. The development of engineering design and costs for monorail installation on the route; this, however, to be limited to the designs and estimates essential for an economic study, and not to be carried up to the point of design for construction.

"D. Engineers are to:

(a) Select route within the limits specified which seems most appropriate for purposes of this study;

(b) Estimate the probable number of passengers to be carried on each section of the line;

(c) Estimate the reasonable fares to be charged section to section;

(d) Determine optimum location of stations;

(e) Estimate the extent and cost of providing auxiliary or feeder bus service directly supplementary to the route;

(f) Evaluate the proposed line relative to competitive facilities; trolley cars, trolley buses, motor buses and automobiles on streets and on the highway system (including freeways);

(g) Estimate probable annual revenue, operating expenses and amount available for debt service;

(h) Estimate probable amount of revenue bonds that could be supported from this operation at the present and in the future;

(i) Prepare a complete report on the project combining the report of Ruscardon Engineers and Gibbs & Hill and their own studies in one volume and furnish 100 copies thereof to the Authority.

"If in the course of the study by Engineers it becomes obvious that there is some other means of transportation likely to be more economical than the monorail system, said Engineers agree to so advise Authority.

"In the survey and report, due consideration is to be given by Engineers to the relationship of this specific project to the present and prospective development of mass transportation facilities in the County and in the City of Los Angeles."

The Consulting Engineers, with the approval of the Authority, engaged the services of Gibbs & Hill, Inc., Engineers, of New York, experts in the field of monorail systems and electric traction generally, to make preliminary designs and estimates of construction cost and maintenance and operating expenses of a monorail rapid-transit system for Los Angeles; and the services of Ruscardon Engineers of Los Angeles to collect the data necessary for a determination of the potential number of prospective passengers for such a rapid-transit system, including origin and destination information; travel patterns by bus, street car and private automobiles; population trends; parking locations and cost; use of freeways, land use, and other pertinent economic factors.

The work by these associated engineering firms has all been carried out under the supervision of and in collaboration with the Consulting Engineers.

The report which follows is divided into three parts, each one presenting the findings and opinions of the respective associated engineering firms:

Part I - "Economic Feasibility of the Monorail System" was prepared by Coverdale & Colpitts.

Part II - "Traffic, Population and Economic Data" was prepared by Ruscardon Engineers.

Part III - "Monorail System Design, Estimates of Cost and of Operating Expenses" was prepared by Gibbs & Hill, Inc.

GENERAL CONSIDERATIONS

In studying the problem of rapid mass transportation in the Los Angeles metropolitan area it is essential to take into consideration the fact that transportationwise and in relation of city layout to transportation facilities, Los Angeles of the great cities of the United States is in a class by itself. At the present time, Los Angeles and Philadelphia metropolitan districts may be said to be in a tie for third and fourth places,

being exceeded in size only by New York and Chicago. New York, Chicago and Philadelphia have mass rapid transit consisting of systems of subways and elevated railways. The City of Boston, which has a population in its metropolitan district of 2,233,448, also has a subway and elevated system. The rapid-transit development in these four cities commenced in the last quarter of the last century and culminated, except as to the Chicago subway, in the first quarter of the present century. Of all these large cities, Los Angeles is the only one in which the major part of its population development has occurred since the advent of the automobile as the primary means of transportation in America. Possibly, as a result of the availability of the automobile and the resulting convenience of individual transportation, Los Angeles has been developed as a city of individual homes, rather than one of great areas of apartment houses.

As indicated in Part II, page 4, of this report the inhabitable part of metropolitan Los Angeles as of 1953 had a population density of 4,650 persons per square mile. Population, area and density of the whole County and of other urban counties in the United States are shown below:

1950 Census

County	Population (000)	Area (Square Miles)	Density (Persons per Square Mile)	Related City
Los Angeles, Calif.	4,152	4,071	1,020	Los Angeles
Bronx, Kings, New York and Queens counties combined	7,700	254	30,591(Avg.)	New York
Cook, Ill.	4,509	954	4,726	Chicago
Philadelphia, Pa.	2,072	127	16,312	Philadelphia
Wayne, Mich.	2,435	607	4,012	Detroit
Suffolk, Mass.	896	55	16,302	Boston

The population of Los Angeles County has grown over the past four decades as shown in Table 2, Part II, and abstracted below:

Year	Population
1910	504,000
1920	936,000
1930	2,208,000
1940	2,786,000
1950	4,152,000

If we take 1920 as the beginning of the common use of automobiles, the increase in population of Los Angeles County from 1920 to 1950 is 343 per cent.

The use of individual automobiles for transportation was encouraged by the construction of an extensive boulevard system throughout the County. These boulevards were the predecessors of the freeways. Their existence enabled a wide dispersion of residences and hence led to the low density to which reference has just been made.

Los Angeles, however, was not without a suburban transit system which was provided by the construction in the first decade of this century of Pacific Electric Railway. Operation into the station at Main and Sixth streets commenced with rail lines and is still carried on by some lines up until the present, while certain bus lines also terminate there. Most of the railway lines which reach Los Angeles at this station, such as the line to Pasadena and that to San Bernardino and Riverside, have been discontinued and an application is now before the Public Utilities Commission of the State of California to permit discontinuance of the lines between Long Beach and San Pedro and Los Angeles.

The Pacific Electric Railway Lines west and north of Los Angeles to Santa Monica, Van Nuys, Glendale and Burbank reached the city at the subway

terminal at Hill Street between Fourth and Fifth streets. These lines were in operation by 1912 and have been gradually discontinued by the authority of the Department of Public Utilities so that at the present time the only operating lines are those to Glendale and Burbank and one on Santa Monica Avenue to Beverly Hills.

A tabulation of the total number of passengers carried by the Pacific Electric Railway is shown on page 9. It will be observed that the most recent peak movement was 177,823,000 bus and rail passengers in 1945, during a period of great war activity in Los Angeles and while the use of motor fuel was restricted for the greater part of the year. Since 1945, the passengers carried by these lines have been greatly reduced. Buses were substituted for most of the rail lines as rail service was discontinued, but the passengers carried by the buses do not approach in number those that were carried by the railway lines in earlier years. The loss of passengers by this suburban transit facility is not an unusual phenomenon. It has been a common experience in most cities in the United States both east and west.

Urban transportation has been furnished by Los Angeles Transit Lines operating both rail facilities and bus lines widely distributed throughout the City. Los Angeles Transit Lines reached its peak of passenger traffic in 1947. The decline in riding on both the Pacific Electric Railway Lines and the Los Angeles Transit Lines seems to have been caused by the increasing use of passenger automobiles, stimulated by the provision of an extensive system of boulevards and freeways. Other bus companies are operating in other parts of the district carrying smaller numbers of passengers. In 1921 there was one automobile in Los Angeles County to each 6.4 persons; in 1953, one to every 2.4 persons. In automobile ownership in proportion to population, no city in the world compares with Los Angeles (Part II, page 47).

The Pacific Electric Railway at the peak of its activities was operating 1,105 miles of passenger railway trackage. As of 1952 it was operating 366 miles of railway lines.

Total Revenue Passengers
(Fare and Transfer) Rail and Bus

Year	Pacific Electric Railway	Los Angeles Transit Lines
	(000)	
1936	80,573	271,040
1937	84,890	291,844
1938	78,265	292,412
1939	75,465	259,713
1940	79,840	241,767
1941	77,766	251,045
1942	99,166	282,368
1943	137,405	310,976
1944	168,427	321,193
1945	177,823	325,661
1946	174,083	359,128
1947	163,408	439,812
1948	143,921	397,879
1949	125,698	368,004
1950	109,321	317,749
1951	100,517	283,005
1952	92,475	256,947

In 1952 vehicle mileage for various types of service was as follows:

Pacific Electric Railway Company

Type of Service	Vehicle Mileage
Interurban rail lines	2,066,169
Local rail lines	3,524,105
Total rail lines	5,590,274
Interurban coach lines	12,466,010
Local motor coach lines	9,864,146
Total motor coach lines	22,330,156
Total all lines	27,920,430

In March 1953 the sale of the passenger service of the Pacific Electric Railway Company to Metropolitan Coach Lines was announced.

The Los Angeles Transit Lines at the height of its activity was operating a total of about 650 miles of single track and bus lines. As of the end of 1952, it had 238 total miles of single track, 246 miles of bus lines and 23 miles of coach lines.

Los Angeles has in process probably the most extensive system of freeway construction planned by any city in the United States. The freeways in use, under construction, planned and contemplated are shown by the map, Figure 18, Part II. The first freeway to be constructed was the Arroyo Seco between Los Angeles and Pasadena, the first section of which was opened in 1940. This was followed by the Hollywood Freeway now in use between its connection with Santa Ana Freeway and Hollywood Boulevard. Early in 1954 it will be completed through Cahuenga Pass to Ventura Boulevard. The Harbor Freeway which eventually will extend to San Pedro is under construction and has been completed between a junction with Arroyo Seco and Hollywood Boulevard, and Sixth Street, Los Angeles. The Los Angeles River Freeway is under construction and has been completed a short distance northward from the Pacific Coast Highway. The Ramona Freeway is under construction and is now completed between the Santa Ana Freeway and Atlantic Avenue. The Santa Ana Freeway is completed between Spring Street (Civic Center) and Lakewood Boulevard. The freeways that have been constructed are all in use to a high percentage of their capacity and are even now occasionally subject to congestion at peak hours. When those that are now projected, as shown on the map above referred to, are completed, they in turn will soon attract additional traffic and it will not be many years before they also will become congested.

The population of Los Angeles County is estimated to increase from 4,650,000 in 1953 to 5,500,000 by 1960, an increase of 18 per cent. In the following twenty years it is estimated to increase so that by 1980 it will be 7,500,000, or 61 per cent more than in 1953 (Part II, page 20). Moreover, the population in the more thinly settled portions of the County is expected to increase at an even faster rate. In 1950 approximately 55 per cent of the population in a circle of 20 miles radius from the center of Los Angeles lived in the area between the 8-mile and the 20-mile circle. The population in this area is expected by 1960 to constitute 60 per cent of that within the 20-mile circle. The population within the 20-mile circle roughly corresponds to that of the County (Part II, page 33). / Thus a greatly increasing load will be placed on the freeway system. It will be increasingly expensive to build freeways within the built-up parts of Los Angeles. Thus the use of the automobile will become less convenient than at present. It will be essential for the metropolitan area to have some form of rapid mass transportation which will relieve the city streets and highways of strangling congestion. The capacity of even a 6-lane freeway is limited and, if its traffic is restricted to passenger automobiles alone, cannot carry in individual automobiles, without a high degree of congestion, more than between 6,000 and 7,000 passengers in the direction of heaviest travel in the peak hour. This capacity can be increased materially by the use of buses but the use of buses on the freeways, even with turnouts at stops, will reduce the capacity for individual automobiles. /

In view of this background it is obvious that a mass rapid-transit system that would be successful must handle passengers in comfort at a high rate of speed and not at 20 to 24 miles an hour and with 100 per cent or greater overload, as is common in certain cities in the East. Hence the monorail operation discussed herein is designed to have an over-all speed of

upwards of 40 miles per hour including the stops and a sufficient number of cars to keep the percentage of standees, even at the most crowded hours, at not over 50 per cent of the seating capacity. Further, the fares must be not greater than the presently prevailing rates.

The requirements of comfortable and speedy travel apply to any system of mass rapid transit that may eventually be developed in Los Angeles.

II - BRIEF DESCRIPTION OF THE PROJECT

LOCATION

The projected monorail rapid-transit line is located between the San Fernando Valley and Long Beach through Los Angeles, within the area previously defined (hereinafter referred to as the Study Area). A number of different routes within this area were studied. A route along the Los Angeles River appeared to have the advantage as to capital cost, but was inferior as to access to traffic centers. A mass rapid-transit line, to be most useful, must serve the maximum number of potential riders and carry them along the routes they desire to travel.

The route selected is shown on the map, Plate I. The northern terminus of the line is at or near Pancrama in the San Fernando Valley. It extends along Van Nuys Boulevard to Chandler Boulevard, along Chandler to Vineland Avenue, south on Vineland, Cahuenga Pass Freeway to Highland Avenue, using for the most part up to this point the right-of-way formerly used by the Pacific Electric Line. It then extends southerly on Highland Avenue to Sunset Boulevard, east on Sunset to Hill Street, reaching Hill Street by crossing above Hollywood Freeway and using some private right-of-way along Hill (in subway) to Washington Boulevard, thence on private right-of-way, on elevated structure to Broadway near 22nd Street and along Broadway to Main Street at 35th Street; along Main to Florence Avenue, east on Florence to Pacific Boulevard, south on Pacific Boulevard and Long Beach Boulevard (American Avenue) to Long Beach, the southern terminus.

The study contemplates an elevated monorail line along the whole route, except on Hill Street between Temple Street and Washington Boulevard where it would be underground in subway.

The study area traversed by this location as pointed out in Part II of this report presently contains more than half of the population of the County

with an average density of 7,500 per square mile, which is 60.0 per cent greater than in the metropolitan area as a whole. The population of the study area is expected to increase ratably with the balance of the County with a slightly greater proportion of the County's population in 1980 than at present. (See Part II, pages 28-31).

Because of these factors, it is evident that an interurban rapid-transit line connecting San Fernando Valley, North Hollywood, Hollywood, downtown Los Angeles, the industrial area southeast of the Central Business District, Compton and Long Beach is in a position to serve the area well and, particularly in combination with existing surface transportation systems, can perform a most useful transportation service. The projected monorail is definitely an interurban or suburban rather than an urban mass transit facility and as a transportation facility is to be compared with Pacific Electric Lines and automobile transportation on the freeways and highways as a means of access to the business and manufacturing districts of Los Angeles from the residential areas rather than with an urban mass distribution system such as we find in the rapid-transit systems of the larger cities of the East. It is essential that any interurban or suburban railway system be so designed as to integrate fully with distribution facilities within the cities which it serves. The projected monorail system, as will be shown later, is able, through the use of the existing bus and rail lines, to distribute to their ultimate destinations passengers reaching the central areas of Los Angeles by monorail from the north and the south. This is particularly true in the industrial centers of Vernon, Southgate, Maywood and Bell, where Los Angeles Transit Lines facilities are available to permit the transfer of passengers between monorail and surface lines serving the manufacturing plants. On the north the communities of Glendale and Burbank may be reached from Glendale Boulevard Station either by existing motor-bus lines or by private automobile. As other rapid-transit lines may be developed in Los Angeles either to carry

suburban or urban traffic, such facilities could be integrated with the projected monorail system. The method of transfer, if the trip were not continuous, would depend on the type of system eventually developed.

There is not now in any city in the world any suburban or interurban service operating at the over-all speed contemplated for this line. All of the various elements entering into the design have been tried and tested. The only thing that could be considered an innovation is the assembly of all of these particular features in this type of operation. The monorail system contemplated herein is not at all comparable with the one that has been operating in Germany for many years.

THE MONORAIL STRUCTURE

In the monorail system that has been studied, the cars are suspended from a single rail which is carried on a girder supported at intervals by transverse bents, generally in the form of a T with the columns centrally located in the streets, so as to interfere as little as possible with street traffic. A more detailed description of the monorail line is to be found in the accompanying report of Gibbs & Hill, Inc., Part III of this report. A perspective of the system as it would appear from near Glendale Boulevard is shown in the frontispiece.

STATIONS

The stations on the overhead portion of the line are generally over the streets, with mezzanines below the train platforms, and stairways or escalators for access either on sidewalks or on private property. Several stations, where the tracks curve from one street to another at right angles, are on the private property over which the structure is to be built.

Seventeen stations are proposed, including the two termini, as follows:

	Distance from Panorama (miles)	Distance from Each Station to the Next (miles)
PANORAMA, at Roscoe Boulevard	0	1.9
VAN NUYS, at Van Owen Street	1.9	2.8
CHANDLER BOULEVARD, at Woodman Avenue	4.7	3.2
NORTH HOLLYWOOD, Chandler at Tujunga Avenue	7.9	2.2
VINELAND AVENUE, at Ventura Boulevard	10.1	4.1
HOLLYWOOD, Highland Avenue at Sunset Blvd.	14.2	5.3
GLENDALE BOULEVARD and Sunset Boulevard	19.5	2.2
CIVIC CENTER (Subway) Hill Street at Temple	21.7	0.9
SEVENTH STREET (Subway) at Hill Street	22.6	2.4
BROADWAY PLACE and 35th Street	25.0	3.0
MAIN STREET, at Florence Avenue	28.0	2.9
PACIFIC BOULEVARD and Florence Avenue	30.9	3.2
IMPERIAL HIGHWAY	34.1	2.4
COMPTON	36.5	4.5
SAN ANTONIO DRIVE	41.0	3.1
PACIFIC COAST HIGHWAY	44.1	1.6
LONG BEACH, American Avenue at Broadway	45.7	-

These stations are tentative and subject to change if final study indicates the desirability thereof. For a typical layout see Part III.

The total length of the line from Panorama to Long Beach is 45.7 miles; the seventeen stations average 2.8 miles apart.

CARS

The cars proposed are of modern design, all-metal construction, and seat 67 passengers each. The station platforms are to accommodate trains of six cars, with the structure so designed as to permit readily lengthening to accommodate eight-car trains. A diagram of the car is shown in Part III.

SPEED

With high rates of acceleration and deceleration, and with the stations averaging 2.8 miles apart, a maximum speed between stations of 60 miles per hour can be reached, and an average over-all speed, including an allowance of 20 seconds for each station stop, of approximately 41 miles per hour, maintained.

MILEAGES AND TIME BETWEEN STATIONS

The following tables show: first, the distance in miles between stations, and, second, the running times between stations, including a 20-second stop at each station.

MILES BETWEEN STATIONS

	Panorama	Van Nuys	Chandler at Woodman	North Hollywood	Ventura	Hollywood	Glendale Boulevard	Civic Center	Hill and 7th	Broadway Place	Main and Florence	Florence and Pacific	Imperial Highway	Compton	San Antonio Drive	Pacific Coast
Van Nuys	1.9															
Chandler at Woodman	4.7	2.8														
North Hollywood	7.9	6.0	3.2													
Ventura	10.1	8.2	5.4	2.2												
Hollywood	14.2	12.3	9.5	6.3	4.1											
Glendale Boulevard	19.5	17.6	14.8	11.6	9.4	5.3										
Civic Center	21.7	19.8	17.0	13.8	11.6	7.5	2.2									
Hill and 7th	22.6	20.7	17.9	14.7	12.5	8.4	3.1	0.9								
Broadway Place	25.0	23.1	20.3	17.1	14.9	10.8	5.5	3.3	2.4							
Main and Florence	28.0	26.1	23.3	20.1	17.9	13.8	8.5	6.3	5.4	3.0						
Florence and Pacific	30.9	29.0	26.2	23.0	20.8	16.7	11.4	9.2	8.3	5.9	2.9					
Imperial Highway	34.1	32.2	29.4	26.2	24.0	19.9	14.6	12.4	11.5	9.1	6.1	3.2				
Compton	36.5	34.6	31.8	28.6	26.4	22.3	17.0	14.8	13.9	11.5	8.5	5.6	2.4			
San Antonio Drive	41.0	39.1	36.3	33.1	30.9	26.8	21.5	19.3	18.4	16.0	13.0	10.1	6.9	4.5		
Pacific Coast	44.1	42.2	39.4	36.2	34.0	29.9	24.6	22.4	21.5	19.1	16.1	13.2	10.0	7.6	3.1	
Long Beach	45.7	43.8	41.0	37.8	35.6	31.5	26.2	24.0	23.1	20.7	17.7	14.8	11.6	9.2	4.7	1.6

RUNNING TIME BETWEEN STATIONS - MINUTES

	Panorama	Van Nuys	Chandler at Woodman	North Hollywood	Ventura	Hollywood	Glendale Boulevard	Civic Center	Hill and 7th	Broadway Place	Main and Florence	Florence and Pacific	Imperial Highway	Compton	San Antonio Drive	Pacific Coast
Van Nuys	3															
Chandler at Woodman	7	4														
North Hollywood	12	9	5													
Ventura	15	12	8	3												
Hollywood	21	18	14	9	6											
Glendale Boulevard	29	26	22	17	14	8										
Civic Center	32	29	25	20	17	11	3									
Hill and 7th	34	31	27	22	19	13	5	2								
Broadway Place	37.5	34.5	30.5	25.5	22.5	16.5	8.5	5.5	3.5							
Main and Florence	41.5	38.5	34.5	29.5	26.5	20.5	12.5	9.5	7.5	4						
Florence and Pacific	45.5	42.5	38.5	33.5	30.5	24.5	16.5	13.5	11.5	8	4					
Imperial Highway	50.5	47.5	43.5	38.5	35.5	29.5	21.5	18.5	16.5	13	9	5				
Compton	54	51	47	42	39	33	25	22	20	16.5	12.5	8.5	3.5			
San Antonio Drive	60.5	57.5	53.5	48.5	45.5	39.5	31.5	28.5	26.5	23	19	15	10	6.5		
Pacific Coast	65	62	58	53	50	44	36	33	31	27.5	23.5	19.5	14.5	11	4.5	
Long Beach	67	64	60	55	52	46	38	35	33	29.5	25.5	21.5	16.5	13	6.5	2

The running time in minutes from the center of Los Angeles to various points by Monorail as compared with Pacific Electric Rail and Bus Lines is shown below:

Stations	Monorail (From 7th and Hill streets)*	Pacific Electric (From 6th and Main Street Terminal)
South		
Broadway Place	4	12
Main Street	8	27
Pacific Boulevard	12	28
Imperial Highway	17	30
Compton	20	30
Pacific Coast Highway	31	52
Long Beach	33	60
		(From 4th and Hill Street Subway Terminal)
North		
Glendale Boulevard	5	6
Hollywood	13	23
North Hollywood	22	45
Van Nuys	31	65
Panorama	34	78

* Two minutes longer from Civic Center to stations on the South and two minutes less to stations on the North.

Thus it appears that to those located near the stations Long Beach is brought almost as close to the business center of Los Angeles in respect of time as Compton is at present; and, on the north, North Hollywood is brought closer than Hollywood.

PARKING LOTS

At all the stations, except the two in the central business district and the one at the southern terminus, large parking lots will be maintained, as shown on the following page, where prospective passengers may park their cars at a nominal fee for the day and take the rapid transit to their destination, thus avoiding the necessity to drive through traffic congestion; and saving time,

cost, parking difficulties, and wear and tear on the nerves. The availability of such parking space in connection with rapid transit has proven useful in other localities as a means of widening the area served by interurban rapid transit.

Stations	Parking Lot Capacity - Number of Cars that Can Be Parked
PANORAMA, at Roscoe Boulevard	400
VAN NUYS BOULEVARD, at Van Owen Street	300
CHANDLER BOULEVARD, at Woodman Avenue	324
NORTH HOLLYWOOD, - Chandler at Tujunga Avenue	255
VINELAND AVENUE, at Ventura Boulevard	369
HOLLYWOOD, Highland Avenue at Sunset Boulevard	297
GLENDALE BOULEVARD and Sunset Boulevard	311
CIVIC CENTER - Hill Street at Temple (subway)	-
SEVENTH STREET (subway) at Hill Street	-
BROADWAY PLACE and Thirty-fifth Street	255
MAIN STREET at Florence Avenue	351
PACIFIC BOULEVARD and Florence Avenue	324
IMPERIAL HIGHWAY	311
COMPTON	447
SAN ANTONIO DRIVE	324
PACIFIC COAST HIGHWAY	257
LONG BEACH - American Avenue at Broadway	-

TRAIN OPERATION

From the riding habits of potential riders that have been studied, it is believed that most of the traffic will be from the northern and southern portions of the line to and from the business and civic centers, with access to

the industrial areas obtained in part by transfer to existing surface lines. There is also a substantial movement between North Hollywood and Hollywood, and between Hollywood and downtown Los Angeles.

The line has been divided for operation into the Northern and Southern Divisions.

The Northern Division would be between Panorama and Washington Boulevard, where the trains operating on this Division would turn back. The Southern Division would be between Long Beach and Civic Center or possibly Glendale Boulevard, where these trains would turn back. It is contemplated that trains on both divisions would operate during peak periods on a three-minute headway.

The portion of the line between Civic Center and Washington Boulevard would be common to the two divisions. On this common portion, in the peak periods, unless the volume of traffic on the two divisions is in balance, there might be a train every one and one-half minutes to provide a three-minute headway for trains on each division beyond the common portion of the line.

Turning the trains that are limited to operation on one division only will require turn-back loops, one north of Civic Center (or Glendale) and one at Washington Boulevard.

As the densest traffic appears to be potential to the part of the line between North Hollywood and Compton, turn-back loops are provided, one west of North Hollywood and one south of Compton. These loops permit of adjusting train operation to passenger load by providing more frequent service on the most heavily traveled part of the line without requiring excessive train mileage over those parts where the demand is less.

SIGNALS

The signal system is designed for a maximum of 40 trains per hour in one direction on a single track, or a train interval of one and one-half minutes.

The signal system is the most modern yet designed and the most nearly "foolproof". It includes cab signal indication so that the motorman is given notice of signal aspects ahead, thus avoiding any possible confusion with background colored lights. It is equipped to stop trains automatically should a motorman inadvertently fail to obey a stop signal.

INSPECTION FACILITIES, SHOPS AND STORAGE YARDS

The principal shops for heavy repairs are planned at a point about 2.5 miles west of the North Hollywood Station. At this location there will also be a storage yard and inspection facilities, as well as a turnaround loop, these chiefly for the Northern Division.

For the Southern Division a storage yard, inspection facilities, and a turnaround loop are to be at a location about two miles south of the station at Compton. For heavy repairs the cars of this Division will be taken to the shops west of North Hollywood.

A more complete description of these facilities with drawings appears in Part III in the report of Gibbs & Hill, Inc.

ALTERNATE FORM OF RAPID TRANSIT

The type of transportation service described above could be carried out equally well by another form of surface-free transportation; substituting for the monorail a modern elevated railroad. The location of the line and of the stations would be identical with the monorail. Such a railroad would be elevated in the same location in which the monorail is elevated; would be in subway along Hill Street, and, at the northerly end, on the part of the route

formerly private right-of-way of Pacific Electric, this line might be at grade, on embankment, or depressed with grade crossings eliminated. It would be possible to build an elevated railroad with solid ballasted floors reducing the noise ordinarily caused by the passage of trains along such a railroad. The cars would be modern, light-weight, comfortable cars so designed as to eliminate all possible noise. Such an elevated railroad is far different from those now operating in New York, Boston, Philadelphia and Chicago, and would be far less objectionable to abutting property owners than the elevated railroads in the cities mentioned, but in that respect would be substantially more objectionable than the proposed monorail. This form of rapid transit has the advantage of having been thoroughly tested in practice, and is probably more flexible than monorail as to the provision of branch lines and interconnections with rail lines in subways if such form of urban mass transit should eventually be adopted in Los Angeles. The cost of construction of such a system would be greater where built as elevated railroad on the streets but less as to the portion on private right-of-way north of Cahuenga Pass and less in the subway section. The cost of operation would differ only as to track maintenance which would probably be greater than the maintenance of the monorail structure.

III - SOURCES OF TRAFFIC FOR THE PROJECT

Sources of traffic for the project are basically the long-haul passengers of the present transit systems, rail, bus and trolley coach, and persons now moving by private automobile on the streets and freeways.

In 1952 the Pacific Electric Railway Company carried a total of 92,475,000 revenue, including transfer, passengers. On the basis of the first nine months we estimate that 88,483,000 were carried in 1953 or a decline of about four per cent. Assuming 251 weekdays per year and 35 per cent additional for Saturdays, Sundays and holidays, it appears that the 1953 average weekday total for Pacific Electric was about 261,000 passengers.

On Wednesday, April 15, 1953, Pacific Electric made a 24-hour check on passengers entering and leaving downtown Los Angeles and found a total of 160,185. Assuming Wednesday, April 15, 1953, to be an average weekday, this indicated that about 60 per cent of total riders entered or left downtown Los Angeles.

The above figures represent the total passengers carried by the Pacific Electric Railway Company, only part of which, however, came from sections within the Monorail study area, and, therefore, represent the number which can be considered potential to Monorail. Listed on the following page are the Pacific Electric lines which now operate in the Monorail study area. The northern and southern divisions conform with the method of study of the potential Monorail traffic, described hereinafter. These are separated into the lines operating between the Subway Terminal Building and points to the north and west, referred to herein as the Northern Division, and those operating between the station at Main and Sixth streets and points to the south and southeast, referred to herein as the Southern Division.

Line	Passengers Entering Downtown Los Angeles Wed., April 15, 1953	Total Traffic for Lines - Estimated Average Weekday 1952
Northern Division		
No. 28 - West Hollywood	2,790	5,540
No. 32 - Hollywood Blvd.- Beverly Hills	8,368	22,300
No. 83 - Sunset Blvd.	14,077	20,200
No. 86 - Van Nuys via Riverside Drive	3,794	4,600
No. 91 - Echo Park Ave.- Vermont Ave.	11,144	16,700
No. 93 - San Fernando Valley	5,243 (1)	10,300 (2)
Total Northern Division	45,416	79,640
Southern Division		
No. 6 - Long Beach	6,948	8,850
No. 7 - San Pedro	4,639	7,350
No. 11 - Bellflower	2,486	2,610
No. 25 - Watts	6,435	10,000
Total Southern Division	20,508	28,810
Grand Total	65,924	108,450

(1) Line 93 - Bus Line - replaced Line 33.
(2) Line 33 - Rail Line - discontinued December 27, 1952, replaced by Line 93.

As indicated above, about 60 per cent of the above passengers enter the downtown business district.

In the past, the Pacific Electric Railway Company from time to time made origin and destination studies on its various lines and this information was made available to us through the courtesy of the Company. These origin and destination studies of passengers were made for the purpose of studying the traffic flow characteristics of each particular line, and zones were used which would provide the type of information desired; for instance, on November 8, 1951 the Pacific Electric Railway Company made an origin and destination study on the San Fernando line, route No. 33, the results of which study were summarized on

the basis of 28 zones, beginning with a zone for the subway terminal on Hill Street near Fourth Street and extending to a zone for the section of the line from Victory Boulevard to Sherman Way. These 28 zones divided the route into a large number of small sections which provided much detailed information as to passenger riding. We did not require information in such detail and we, therefore, consolidated these 28 zones into 8 larger zones suitable for study relative to the proposed location of Monorail stations. The Pacific Electric Railway origin and destination count was consolidated into these larger zones and therefore, provided us with information which was indicative of the manner in which traffic could be expected to move on the Monorail system.

In our analysis, a number of such origin and destination counts were used both for the northern division and the southern division; the lines in the northern division being the Hollywood Boulevard line, the San Fernando Valley line, Riverside Drive line and the Sunset Boulevard line. These figures indicated that about 70 per cent of all traffic in the Monrail area entered the downtown business section including the Civic Center and that of the total traffic moving in the area, about 43 per cent came from the Hollywood section and about 22 per cent from the vicinity of the Glendale Boulevard station.

In the southern division origin and destination counts were available for the Long Beach line, the San Pedro line, the Watts line, and the Bellflower line. These origin and destination counts by Pacific Electric had been analyzed in detail similar to the northern lines and we, therefore, in turn consolidated these small zones into a lesser number of large zones related to our proposed Monorail location stations. In the case of the southern division it appeared that 65 per cent of the total passengers moving along the line had origins or destinations in the downtown business section, and, furthermore, that about 33 per cent of the total traffic moved from the downtown section to the Lynwood-Compton area.

While the above figures are not completely reconcilable in part because the data were taken in different years, considered together they indicate that 60-70 per cent of transit riders enter the downtown business section.

In the case of the Los Angeles transit lines there were no such origin and destination surveys available, but we did have information of passengers carried by each line. From a study of this information we estimated the number of passengers potential to the Monorail as shown below:

Line	1952 Total (000)	Estimated Percentage Potential to the Monorail	Estimated 1952 Potential to the Monorail (000)	Estimated Average Weekday Potential Traffic 1952
Northern Division				
Melrose Ave. W. Olympic Blvd.	11,690	33	3,897	11,500
W. Adams Blvd. Temple St.	12,690	33	4,233	12,500
Beverly Blvd.	6,814	33	2,271	6,700
Subtotal			10,401	30,700
Southern Division				
S. Vermont and Union Station	6,142	100	6,142	18,100
W. Jefferson and Huntington Park	15,312	33	5,104	15,050
San Pedro and W. Seventh St.	12,072	67	8,048	23,800
S. Broadway and Civic Center	6,937	100	6,937	20,500
W. 54th St. and N. Main St.	5,421	33	1,807	5,300
W. 48th St. and Lincoln Park	4,623	33	1,541	4,500
Maple and S. Figueroa St.	9,934	100	9,934	29,400
Subtotal			39,513	116,650
Grand Total			49,914	147,350

In the year 1952 the Los Angeles Transit Lines, as a whole, carried 256,946,000 revenue passengers including transfers. The above, therefore, indicates that approximately 20 per cent of total passengers on the Los Angeles Transit Lines would be potential to the Monorail system.

The second basic source of traffic for the Monorail system will be the persons now moving by private automobile on the streets and freeways. The freeway system in Los Angeles has been under construction for a number of years; the Arroyo Seco Freeway to Pasadena being the first, a section of which was opened in 1940. See Part II, Figure 18. The first section of the Hollywood Freeway followed shortly thereafter and construction has continued, subject to interruption during World War II, to the present date. Early this year, 1954, it is expected that the Hollywood Freeway will be open to traffic from Spring Street in downtown Los Angeles through Cahuenga Pass and to its connection with Ventura Boulevard at Vineland Avenue.

At Spring Street, proceeding easterly, the name changes to the Santa Ana Freeway which crosses the Los Angeles River and proceeds in an easterly and southeasterly direction, and is currently completed about as far as Whittier. The Arroyo Seco Freeway now connects with the Hollywood Freeway near the Civic Center by means of a four-level intersection, and the freeway system continues south from this point under the name of the Harbor Freeway which is presently open to about Wilshire Boulevard. Continuation of the Harbor Freeway farther south is under construction, and will eventually extend as far as San Pedro.

The Los Angeles River Freeway which will ultimately connect the Santa Ana Freeway, from the vicinity of Atlantic Avenue, with Long Beach is also under construction and is opened for a short distance near its southern end. Other elements of the proposed freeway system are either open, under construction or

in various phases of planning and financing, but these briefly described above are the principal ones from which patronage for the Monorail system can be expected to be drawn.

As indicated above, sections of the freeway system have been opened at various times in the very recent past and it is expected that additional lengths will be completed in the near future. For this reason traffic counts quickly decline in value because of the rapidly changing traffic pattern. Furthermore, other traffic counts have been delayed until particular sections of a freeway are opened so that a continuity of comparable traffic data within the city has been lacking.

Among the principal sources of information for traffic which we consider potential to the Monorail system were the cordon counts made by the City of Los Angeles, Department of Traffic Engineering, over a series of years around the central business district. This central business district was defined for the purpose of these counts as being the area bounded on the northeast by Sunset Boulevard, on the northwest by Figueroa Street, on the southwest by Pico Boulevard, and on the southeast generally by Los Angeles Street. A discussion of the trend shown by these cordon counts is presented in Part II of this report, Table 9 and Figure 13. It should be noted that these cordon counts generally covered a 16-hour period from 6:00 A.M. to 10:00 P.M.

Since the last of these cordon counts, important sections of the freeway system have been completed and a readjustment of the normal traffic pattern has taken place. In 1952 the Institute of Transportation and Traffic Engineering of the University of California made a study of the traffic on certain major streets parallel to the Hollywood Freeway northwest of the central business district prior to the opening of the Freeway, and also a study of traffic

on these same major streets and the Hollywood Freeway subsequent to its opening. Results of this study indicated very little change in total traffic moving but that the Freeway was carrying approximately 28 per cent of the total traffic in the band studied. Certain previously major routes showed substantial losses in traffic, such as, Sunset Boulevard, which showed a decline of 40 per cent; Temple Street, which showed a decline of 45 per cent, and First Street which showed a decline of 32 per cent.

Since the total traffic moving did not vary abnormally, we used the 1950 cordon counts as a basis of estimating traffic potential to the Monorail area. We assumed that traffic entering the central business section on the northwest from Sunset Boulevard to Third Street, inclusive, was traffic coming from areas directly potential to the Monorail and also that traffic entering and leaving the central business district on the southwest from Figueroa Street to Los Angeles Street, inclusive, was also directly potential to the Monorail. We adjusted the 16-hour counts to an estimated 24-hour count on the basis of Division of Highways traffic counts on the Hollywood Freeway which indicate that about 87 per cent of total 24-hour traffic moves in the 16-hour period from 6:00 A.M. to 10:00 P.M. We increased this estimated 24-hour traffic by 19 per cent on the basis of Division of Highway traffic counts in the area to arrive at an estimate for 1953. This indicated that about 150,000 vehicles were entering the central business district from the Monorail study area northwest of the central business district, a large portion of which is now using the Hollywood Freeway. This compares with total traffic on the Hollywood Freeway of about 120,000 vehicles per day as indicated by a traffic count made by the Division of Highways 500 feet east of Glendale Boulevard, Friday, July 24, 1953, when 60,254 vehicles were counted in the westbound direction only. From the Monorail area to the south, it appeared that about 198,000 vehicles per day were entering and leaving the central business district.

Traffic volume counts at other locations or routes which may be considered sources of patronage for the Monrail system are as follows. All of these counts were made by the Division of Highways and represent 16 hours of an average weekday in July 1953. We have expanded these counts to an estimated 24-hour period by use of the factor developed above, which indicated that the 16-hour period represented about 87 per cent of the 24-hour period.

Street	Intersection	Leg of Intersection	Estimated 24-Hour Traffic
Hollywood Freeway	Santa Monica	NW	57,200
Hollywood Freeway	Santa Monica	SE	79,300
Cahuenga Pass Freeway	Highland Avenue	S	44,700
Cahuenga Pass Freeway	Highland Avenue	SE	72,500
Ventura Boulevard	Lankershim Boulevard	E	76,600
Figueroa Street	Slauson Avenue	N	36,000
Figueroa Street	Slauson Avenue	S	38,700
Figueroa Street	Manchester Avenue	N	31,000
Figueroa Street	Manchester Avenue	S	29,000
Atlantic Avenue	Firestone Avenue	N	40,500
Atlantic Avenue	Firestone Avenue	S	32,500
Atlantic Avenue	Artesia Avenue	N	21,600
Atlantic Avenue	Artesia Avenue	S	21,800

To the northwest of the central business section traffic arteries other than the Hollywood Freeway still carry substantial volumes and would be major sources of passenger traffic for the System. These would include Glendale Boulevard, Beverly Boulevard, and Third Street as the most important while, undoubtedly, some traffic from as far south as Wilshire Boulevard and possibly Olympic, and as far north as Riverside Drive and San Fernando Road might also be attracted to the use of the System.

In San Fernando Valley, practically all of the traffic moving between areas near or to which Monorail stations would be accessible, and Hollywood and the central business district, represent sources of traffic which the Monorail system could serve beneficially. This traffic now moves into these areas via

Ventura Boulevard, Lankershim Boulevard and Vineland Avenue; another main route is Barham Boulevard, now serving as a means of communication between the upper San Fernando Valley and the Hollywood area. Traffic from the vicinity of San Fernando now using San Fernando Road, if destined for the central business district or areas south or southeast therefrom, might well find use of the Monorail system attractive.

To the south of the central business district there are many important highway routes to the industrial sections, as well as to the Long Beach-San Pedro areas from the center business district. These will be augmented in the near future, undoubtedly before a Monorail system can be completed, by the opening of the Harbor Freeway to San Pedro and the Los Angeles River Freeway to Long Beach. These two freeways will undoubtedly draw interurban traffic from the present arteries, such as, Figueroa Street, Broadway, Main Street, Avalon Boulevard, and Long Beach Boulevard, all of which is a potential source of traffic for the Monorail system but as to which the freeways, on their completion, will be very competitive with the Monorail system on a time basis.

IV - ESTIMATED TRAFFIC AND REVENUE

In developing the potential traffic for the Monorail system, two basically different methods were used. The first method involved a study of present-day rail and bus riding, together with a study of current automobile traffic on the streets and freeways. The second method employed an origin and destination study of industrial employees in the Los Angeles area prepared by Ruscardon Engineers.

In the first method, further use was made of the origin and destination studies of the Pacific Electric Railway Company referred to in Chapter III. We assumed that the travel pattern of the estimated Los Angeles Transit Lines passengers entering the downtown business section was the same as that of the Pacific Electric riders as to origins and destinations outside the central business district and as to complete trips which did not enter the district, and we, therefore, distributed the Los Angeles Transit Lines passengers accordingly. The sum of the Pacific Electric Railway and the Los Angeles Transit Lines riders as developed above is an indication of the present-day riding pattern on the existing transit lines relative to the Monorail system as currently proposed.

Likewise, the automobile traffic estimated as entering the central business district from areas potential to the Monorail system as described in Chapter III was assumed to have the same origin and destination pattern as that of the Pacific Electric Railway, and it was distributed in the same manner.

During the course of this study, Ruscardon Engineers made vehicular volume counts and also made an analysis of the number of persons carried per automobile during the period of such counts. Studies were made at nine different locations in the area on various weekdays in June and July 1953, one of which is shown on Table 12, page 66, Part II. As to the vehicles observed, each vehicle on the average carried about 1.45 persons, including the driver.

The estimated number of automobiles moving from each zone to every other zone was, therefore, multiplied by 1.45 to obtain an estimate of the number of persons moving over the streets and freeways within the area in accordance with this pattern. By combining the zone-to-zone flow of passengers by rail, bus and individual automobiles, we estimated total potential riders for the Monorail system, distributed by zones and related to the proposed Monorail stations.

Considering that the major portion of all potential traffic, both transit and automobile, enters the downtown business section, and since such traffic was used as the base for this estimate, we believe the method of distribution to be reasonable.

The estimate of vehicular riders used above was checked at locations outside the central business district by comparison with available counts. Two such locations were Cahuenga Pass on the north and across a screen line in the vicinity of Imperial Highway between Figueroa Street and Atlantic Avenue on the south. In both cases, the vehicular traffic estimated as potential to the Monorail was less than the actual total traffic at the particular location. This was to be expected because the Monorail traffic does not include strictly local movements. While this process did not result in a precise check, it was felt that the degree of corroboration was satisfactory within the limits of the information available.

These computations produced an estimated total potential for the Monorail system within the study area of 785,000 persons for an average weekday in 1953; of which about 15 per cent were present-day transit riders and about 85 per cent were present riders in individual automobiles on the streets and freeways.

The second basis for estimating potential traffic was the origin and destination survey of employed persons (comprised very largely of industrial

employees) compiled by Ruscardon Engineers and more fully described in Part II of this report. The place of business and home addresses of these employed persons were summarized by postal zones in the Monorail study area. We consolidated origin and destination information obtained by this study by assembling these zones into larger groups which could be compared as to time and distance characteristics relative to present-day transit lines, highway routes and the proposed Monorail route. A summarization of the employed persons in such zones indicated that out of a total of 391,000 (Part II, page 78) in the study area, there were approximately 153,000 employees, the location of whose homes would make them potential users of the Monorail system. (See pages 47 to 50.)

The Ruscardon Engineers study was based largely on employees in manufacturing industries. In certain sections of the area; namely, Hollywood and downtown Los Angeles, that study also included employees in other categories, all as discussed in Part II, page 85 of this report. Ruscardon Engineers estimate that, assuming employees in manufacturing industries are 100 per cent potential to the Monorail, employees in other categories are potential in various degrees as indicated in Part II, page 86 and that, on the average, these other employees are potential to the extent of approximately 50 per cent of those engaged in manufacturing.

Therefore, we increased the potential riders determined from industrial employees for each zone-to-zone movement by 50 per cent.

Since the Ruscardon Engineers origin and destination survey was based entirely on employed persons, it is believed that the potential so indicated represents what would be largely peak-hour traffic, that is, riding from home to work and vice versa. Since a large portion of these people now move by private automobile, as indicated by the relationship between total riders on present-day transit lines and the estimated automobile traffic shown above, page 35, 15 per cent by transit and 85 per cent by automobile, it is believed

that the peak-hour traffic should be expanded to the full twenty-four hours on the basis of daily travel pattern of automobiles on the highways.

Traffic counts made by the California Division of Highways on the Hollywood Freeway, July 24, 1953, indicate that in the three busiest hours of the morning and the three busiest hours of the afternoon, a total of 41.3 per cent of the 24-hour traffic is carried. We have, therefore, assumed that as far as potential traffic is concerned, total employed persons represent 40 per cent of all traffic available. Expansion of these figures indicates, therefore, that there is an average weekday potential to the Monorail of about 1,115,000 passengers developed as shown below:

Total potential workers from Ruscardon Engineers origin and destination study	153,000
Two trips per day per worker; that is, to and from work	306,000
Increase by 50 per cent for estimated potential workers in other categories	460,000
Expand to 24-hour traffic assuming workers represent 40 per cent of total potential rides	1,115,000

This figure of 1,115,000 compares with the estimated 785,000 potential daily rides produced from the study of transit and automobile riding. It is believed that the larger figure is probably more nearly correct because of the general coverage of the survey, and also because the smaller figure represents only an expansion of Pacific Electric origin and destination studies which were made on different dates and for a different purpose, and exclude any allowance for through riders. In any event, both figures are of the same order of magnitude and it appears probable that for the particular location of the Monorail and the proposed station sites, limits of the total potential traffic are established by these totals.

In estimating that portion of the potential Monorail traffic which could be expected to use the proposed facility, consideration was given to relative time, distance and cost of use as compared with the use of alternate means of travel. For such determination we studied the time required to travel between selected common points of each zone to each other zone by three methods; namely, present-day transit riding, highway riding in individual automobiles, and riding by the proposed Monorail. Comparisons of distances traveled were made, but these seemed less important than time. Cost studies were also made, including a relation of the differences in distances where they affected cost of the trip.

As to present transit riding, we estimated the time and cost required to travel from each zone to every other zone by the best present transit facilities available. Where necessary, these times included walking time across downtown Los Angeles from the subway terminal to the Pacific Electric terminal at Sixth and Main streets. No time, however, was included for waiting when transfer between lines was necessary. Costs included cash fares and any transfer costs.

Time and distance studies pertaining to the use of highways, streets and freeways were made by our engineers as the result of many trips over existing routes. We estimated time and distance over future routes on the basis of distances taken from maps and speeds as determined from our experience on existing highways of similar construction. We assumed for purposes of our estimates that at the time of commencement of the Monorail operation, the Harbor Freeway would be completed between Los Angeles and San Pedro, and the Long Beach Freeway between Santa Ana Freeway and Long Beach. Travel time on the freeways was estimated to be at an over-all average of 45 miles per hour. Direct automobile costs were calculated on the basis of three cents per mile for fuel, oil and tires, and in the case of the Hollywood zone and the Central Business District

zones, an average daily parking cost of 50 cents. Vehicular costs were divided by 1.45 (the average persons per automobile) to allow for a theoretical distribution of the total cost of operating the vehicle to individual persons.

In the case of the Monorail, time between stations was calculated on the basis of an average speed of 41 miles per hour including stops and, in addition, five minutes was added for ascent and descent from station platforms and for the waiting time for trains. Where Monorail stations were not at the common points of the zones, it was assumed that either automobile or mass transit facilities would be used to get to the Monorail station and these costs and times were included. Use of private automobiles to get to and from the Monorail stations was restricted to one end of the trip.

For example, we estimate that from Panorama to Hollywood, the time required by existing transit is 56 minutes, by the present highway system 36 minutes, and by the Monorail would be about 25 minutes. From Panorama to 7th and Hill streets by existing transit facilities is 78 minutes, by highway is 50 minutes, and by Monorail would be about 36 minutes. In all of the above cases, estimated cost via Monorail would be the cheapest. From Hollywood to 7th and Hill streets by existing transit is about 35 minutes, by highway system is about 20 minutes, and by Monorail is estimated to be about 25 minutes. In this case, use of the highways represents the best means of travel in relation to time, although as to costs, the existing transit is the cheapest. From 7th and Hill streets to Compton, the estimated time by existing transit is 40 minutes, by highway, 38 minutes, and by Monorail would be about 24 minutes. From 7th and Hill streets to the terminal station in Long Beach, the existing transit schedule is over an hour; by highway the time would be about 55 minutes using the Los Angeles River Freeway, while the Monorail would provide transportation in about 37 minutes. In the cases of both of these last trips, the cost by Monorail is estimated to be the cheapest.

Comparison of time and cost by use of the proposed Monorail system with present mass transit facilities indicated that in almost all cases the Monorail system would provide quicker service than the present facilities at, except in the case of short hauls within about an eight-mile radius circle centered downtown, lower cost. Comparison of the time and cost of the use of the proposed Monorail system with the use of automobiles on the highways and assumed freeway systems indicated that in most cases the Monorail system would be less expensive than use of private automobiles and, while generally somewhat slower, would in many cases be faster depending chiefly on the origin and destination of the trip relative to a Monorail station.

In our opinion, time saving will be the most important measurable factor in diverting automobile users from their present method of transportation to the Monorail. For this reason, we estimated diversions to the Monorail from the highway system on the basis of time saving alone, and on the scale indicated below:

Time Saving of the Monorail vs. Highway System (Minutes)	Estimated Percentage Diversion to the Monorail System
0	20
5	60
10	100

These percentages were applied to the group zone-to-zone potential industrial employee traffic from Ruscardon Engineers and the resultant sum, 46,600, indicates our estimate of the number of industrial employees who would use the Monorail. Since each employee could be assumed to make two trips a day, that is, to and from work, this figure was doubled, 93,200, and is our estimate of the total rides which we would expect for the Monorail from industrial workers. On page 37 above we estimated the corresponding potential at 306,000 and our estimated diverted traffic of 93,200 represents about 30 per cent of this potential.

On page 37 above we discussed the ratio of the potential of manufacturing employees to total employees, and indicated that we believe this ratio should be approximately 50 per cent. Since these other workers, however, may be less restricted as to hours of employment and may have some need of their automobiles, at their places of business, we believe that the estimated rate of diversions for other than industrial employees should be reduced by one-half, and therefore have increased our estimated manufacturing employees by 25 per cent instead of 50 per cent to account for employees in other categories. This process produces estimated diverted peak-hour traffic for all employees, of 116,500 passengers. Compared with the total estimated peak-hour potential of 460,000, this estimated diversion total represents about 25 per cent.

As discussed under potential traffic, peak-hour traffic on the highways in the Los Angeles area represents about 40 per cent of total 24-hour traffic. Experience on the transit lines indicates that their peak-hour traffic is about 50 per cent of total 24-hour traffic, and therefore, we have assumed that the above figure of 116,500 peak-hour passengers would be about 50 per cent of the 24-hour total. On that basis our estimate of average weekday traffic becomes 233,000.

Compared with our estimated 24-hour potential of 1,115,000, our estimated diverted passengers represent about 20 per cent. See table on the following page.

	Potential	Diverted	Per Cent Diverted of Potential
Number of manufacturing employees (from Ruscardon Engineers Survey)	153,000	46,600	
Two trips per day per employee; that is, to and from work	306,000	93,200	30.5
Percentage increase to account for employees in categories other than manufacturing	50%	25%	
Estimated peak-hour total	460,000	116,500	25.3
Estimated per cent peak-hour to 24-hour total	40%	50%	
Total average weekday traffic	1,115,000	233,000	20.3

For the purpose of this study, we have assumed that fares to be paid by passengers would be collected by the turnstile method. We propose at this time that a zone system of fares be adopted. We have tentatively set up a northern zone extending from the northern terminus of the line to and including the Hollywood station, a central zone comprising the Glendale station, the Civic Center station and the 7th and Hill streets station, and a southern zone from the Broadway Place station to the southern terminus of the line. The platforms of the stations and the waiting rooms would be separated by a grill or other partition, except at the three central stations and at the two terminii.

Turnstiles in the three center stations will require a dime either to enter or to leave, so that a passenger going, for example, from 7th and Hill to Glendale Boulevard would deposit a dime upon entering the station and another upon leaving - the total fare being 20 cents.

At the stations south of 7th and Hill, passengers would deposit a quarter upon entering to go north but nothing upon leaving, so that the fare is 25 cents between any of these stations in the northbound direction. If such

passengers, however, ride to any of the three central stations, they deposit a dime upon leaving, so that the total fare to any of these three stations from the south is 35 cents. If they ride further north than Glendale Boulevard, they deposit a quarter upon leaving, making the fare from any station on the Southern Division south of 7th and Hill to any station on the Northern Division north of Glendale Boulevard, 50 cents.

Similarly, in the opposite direction from north to south.

Applying the above fares to the estimated weekday zone-to-zone traffic indicates that from the 233,000 estimated average weekday passengers, a total of $69,321 would be collected, or an average of $0.298 per passenger.

We have also considered the situation where the line would be constructed only from North Hollywood to Compton. In the case of the long line our estimates show passengers boarding at the three stations at either end of the line. In the case of the short line, these three stations, at the ends of the long line, six in all, would be eliminated. We estimate that any passengers using these stations in the case of the long line, to and from the Central Business District or to short line stations beyond, would also be patrons of the short line. To stations nearer than the Central Business District we estimate that 50 per cent of the passengers for the long line would be retained in the case of the short line. Long line traffic between two stations, which would both be eliminated in the case of the short line, was excluded entirely from short line traffic estimates. The zones for fare payments would remain the same and the rate of fare would remain the same.

On the above basis, we estimate that total average weekday traffic would be 205,109 passengers from whom would be collected total revenue of $62,252, or an average of $0.304 per passenger.

We expanded the estimated average weekday totals for the long and short lines to an estimated year as described previously; that is, assuming 251 weekdays

per year and adding 35 per cent for Saturdays, Sundays and holidays, or an equivalent of about 339 weekdays. As a result of this, we estimate that for a full year, results of operation would be as shown in the tables on pages 45 and 46, and summarized below:

	Long Line Panorama-Long Beach	Short Line North Hollywood-Compton
Estimated annual passengers	78,952,000	69,501,000
Estimated annual revenue	$23,489,000	$21,094,000

It should be recognized that the above estimates were arrived at on the basis of an analysis of available information, plus an origin and destination survey of only one category of potential users for such a rapid-transit system. It is believed that these estimates are reasonable for the purpose.

PANORAMA - LONG BEACH

ESTIMATED TOTAL TRAFFIC AND REVENUE

		Average Weekday						Estimated Full Year x 338.85
		Panorama-Woodman	No. Hollywood-Hollywood	Glendale-Downtown	Broadway Place-Compton	San Antonio Drive-Long Beach	Total Panorama-Long Beach	
Panorama-Woodman	Traffic	820	22,485	14,390	3,815	385	41,895	
	Fare	$0.25	$0.25	$0.35	$0.50	$0.50		
	Revenue	$205	$5,621.25	$5,036.50	$1,907.50	$192.50	$12,962.75	
No. Hollywood-Hollywood	Traffic		25,795	16,725	5,180	260	47,960	
	Fare		$0.25	$0.35	$0.50	$0.50		
	Revenue		$6,448.75	$5,853.75	$2,590	$130	$15,022.50	
Glendale-Downtown	Traffic			20,565	58,270	7,515	86,350	
	Fare			$0.20	$0.35	$0.35		
	Revenue			$4,113	$20,394.50	$2,630.25	$27,137.75	
Broadway Place-Compton	Traffic				33,920	14,865	48,785	
	Fare				$0.25	$0.25		
	Revenue				$ 8,480	$3,716.25	$12,196.25	
San Antonio Drive-Long Beach	Traffic					8,010	8,010	
	Fare					$0.25		
	Revenue					$2,002.50	$2,002.50	
Total Panorama-Long Beach	Traffic	820	48,280	51,680	101,185	31,035	233,000	78,952,000
	Revenue	$205	$12,070	$15,003.25	$33,372	$8,671.50	$69,321.75	$23,489,000
Average fare							$0.298	

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NO. HOLLYWOOD - COMPTON

ESTIMATED TOTAL TRAFFIC AND REVENUE

		Average Weekday				Estimated Full Year x 338.85
		No.Hollywood-Hollywood	Glendale-Downtown	Broadway Place-Compton	Total No.Hollywood Compton	
No. Hollywood-Hollywood	Traffic	37,037	31,115	9,255	77,407	
	Fare	$0.25	$0.35	$0.50		
	Revenue	$9,259	$10,890	$4,627	$24,776	
Glendale-Downtown	Traffic		20,565	65,785	86,350	
	Fare		$0.20	$0.35		
	Revenue		$ 4,113	$23,025	$27,138	
Broadway Place-Compton	Traffic			41,352	41,352	
	Fare			$0.25		
	Revenue			$10,338	$10,338	
Total N. Hollywood-Compton	Traffic	37,037	51,680	116,392	205,109	69,501,185
	Revenue	$9,259	$15,003	$37,990	$62,252	$21,094,090
	Average fare				30.35¢	

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GROUPS OF POSTAL ZONES FOR STUDY OF TRAFFIC TO AND FROM THE SOUTH OF THE GROUP

Group	Postal Zone	
	Number	Name
100	80	Pacoima
	83	San Fernando
101	69	Chatsworth
	79	Northridge
102	71	Canoga Park
	72	Reseda
	90	Van Nuys
104	86	Sun Valley
105	78	North Hollywood
106	73	Encino
	87	Tarzana
	89	Universal City
	92	Woodland Hills
107	68	Burbank
108	28	Los Angeles
109	38	Los Angeles
110	36	Los Angeles
111	4	Los Angeles
112	5	Los Angeles
113	27	Los Angeles
114	26	Los Angeles
	29	Los Angeles
	39	Los Angeles
115	All	Glendale
116	12	Los Angeles
	31	Los Angeles
	32	Los Angeles
	41	Los Angeles
	42	Los Angeles
	65	Los Angeles

GROUPS OF POSTAL ZONES FOR STUDY OF
TRAFFIC TO AND FROM THE SOUTH OF THE GROUP

Group	Postal Zone	
	Number	Name
117	33	Los Angeles
	63	Los Angeles
119	13	Los Angeles
	14	Los Angeles
	17	Los Angeles
120	6	Los Angeles
	7	Los Angeles
	11	Los Angeles
	15	Los Angeles
	18	Los Angeles
121	1	Los Angeles
	21	Los Angeles
	22	Los Angeles
	23	Los Angeles
	58	Los Angeles
	66	Bell
	75	Huntington Park
	77	Maywood
122	72	Downey
	76	Lynwood
	85	South Gate
123	70	Compton
	81	Paramount
124	67	Bellflower
125		

GROUPS OF POSTAL ZONES FOR STUDY OF TRAFFIC TO AND FROM THE NORTH OF THE GROUP

Group	Postal Zone	
	Number	Name
200	90	Van Nuys
201		
202	78	North Hollywood
203	89	Universal City
204	5	Los Angeles
	6	Los Angeles
	18	Los Angeles
	28	Los Angeles
	36	Los Angeles
	38	Los Angeles
205	27	Los Angeles
	29	Los Angeles
206	26	Los Angeles
207	39	Los Angeles
208	12	Los Angeles
	22	Los Angeles
	23	Los Angeles
	31	Los Angeles
	32	Los Angeles
	33	Los Angeles
	63	Los Angeles
209	7	Los Angeles
	15	Los Angeles
210	13	Los Angeles
	14	Los Angeles
	21	Los Angeles
211	11	Los Angeles
	58	Los Angeles
212	1	Los Angeles
	2	Los Angeles

GROUPS OF POSTAL ZONES FOR STUDY OF TRAFFIC TO AND FROM THE NORTH OF THE GROUP

Group	Postal Zone	
	Number	Name
213	66	Bell
	72	Downey
	75	Huntington Park
	77	Maywood
	85	South Gate
214	59	Los Angeles
215	76	Lynwood
216	5	Long Beach
	11	Long Beach
	67	Bellflower
	70	Compton
	81	Paramount
217	6	Long Beach
	7	Long Beach
	8	Long Beach
	15	Long Beach
218	10	Long Beach
219	74	San Pedro
	84	Harbor City
220	91	Wilmington
221	3	Long Beach
	4	Long Beach
	12	Long Beach
	13	Long Beach
	14	Long Beach
222	2	Long Beach

V - ESTIMATED COST OF CONSTRUCTION

The cost of construction of the Monorail system described in Chapter II, above, has been estimated by Gibbs & Hill, Inc., Consulting Engineers, and is set forth in some detail in Part III of this report. The following is a condensation thereof. The estimates are based on prices and wages in effect at the end of 1953. The estimates are presented for a line between:

(a) Panorama and Long Beach, and

(b) North Hollywood and Compton

These estimates are set forth below. To the construction costs estimated by Gibbs & Hill, Inc. we have added allowances for the Authority's administration, legal expenses and taxes during construction, working capital, interest during construction, and cost of financing and so have produced an estimate of the amount of financing required. No separate allowance is included for patent rights and royalties other than included in the cost of equipment. Gibbs & Hill, Inc. advise that to the best of their knowledge no such allowance is needed.

BETWEEN PANORAMA AND LONG BEACH - 45.7 MILES

Gibbs & Hill, Inc. estimate the construction cost as follows (pages 15-17, Part III):

The structure, including steel, foundations and stations (except two in subway section)		$ 61,104,175
The equipment, including trolleys, rail, signals and intercommunication system, substations and power distribution, complete except cars		13,830,249
Subway structure, including two stations (under Hill Street)		21,800,000
Repair shops and storage yards, completely equipped		6,081,011
Land acquisition, including parking lots		3,261,030
Cars for beginning of operation,		
131 cars at $80,000	$10,480,000	
Equipment for inspection and maintenance	110,000	10,590,000
Miscellaneous expenses including model testing and development, procurement of equipment and material, field surveys, engineering expense, insurance during construction, and placing equipment into operation and training personnel		10,500,000
Contingencies		10,000,000
Total		$137,166,465
We have added the following item:		
Authority administration and taxes during construction		$ 1,833,535
Total Cost		$139,000,000
Interest during construction (2-1/2 years net at 5 per cent of bond issue)		20,651,000
Cost of financing (at 3 per cent of total bond issue)		4,956,000
Total Capital Cost		$164,607,000
Working Capital		600,000
Total Requirements		$165,207,000

BETWEEN NORTH HOLLYWOOD AND COMPTON - 28.6 MILES

Gibbs & Hill, Inc. estimate the construction cost of this part of the line as follows (pages 18-20, Part III):

Structure, including steel, foundations and stations (except two in subway section)		$ 43,346,855
Equipment, as above		10,022,766
Shops and yards		5,719,011
Subway structure		21,800,000
Land, including parking lots		2,308,900
Miscellaneous expenses including model testing and development, procurement of equipment and material, field surveys, engineering expense, insurance during construction, and placing equipment into operation and training personnel		8,650,000
Cars for beginning of operation,		
117 cars at $80,000	$9,360,000	
Equipment for inspection and maintenance	110,000	9,470,000
Contingencies		10,000,000
Total		$111,317,532

We have added the following item:

Authority administration and taxes during construction	$ 1,442,468
Total Cost	$112,760,000
Interest during construction (2-1/2 years net at 5 per cent of bond issue)	16,747,000
Cost of financing (at 3 per cent of total bond issue)	4,019,000
Total Capital Cost	$133,526,000
Working Capital	450,000
Total Requirements	$133,976,000

Experience in cities where elevated railways have been built indicates the possibility of claims of abutting property owners for damages to the value of their real estate. The Monorail location, except where it is in private right-of-way or in subway, is in wide streets, is in general higher, and interferes substantially less with light, air and access than did the elevated railways. The question of whether such damages will be claimed or proved is at present unanswerable and no allowance therefore has been made. Experience generally has been that provision of transportation facilities has increased the assessed valuation of real estate so located as to benefit from the new lines. This is a benefit which would accrue to the municipality involved and not to the line.

We have not included any allowance for acquisition of right-of-way.

VI - ESTIMATED COST OF MAINTENANCE AND OPERATION

The cost of maintenance and operation has been estimated by Gibbs & Hill, Inc. and is set forth in Part III of this report. We have also prepared such estimates including the costs of maintenance of way, maintenance of equipment, operation of trains, power and general overhead. Details of organization have been considered, including the various departments such as the following:

Executive
Transportation
Engineering
Line Equipment
Track and Structures
Car Maintenance
Secretaries
Payroll
Personnel
Accounting
Revenue
Purchase and Stores
Law and Real Estate
Transportation Costs
Medical
Lost Property
Police

A hypothetical budget for these departments was set up and the total expenses, together with the estimated cost of power, indicated for the appropriate number of car-miles required to perform the service, were 33.8 cents per car-mile, which corroborated the estimate of Gibbs & Hill, Inc. (pages 13 and 14, Part III). We have increased this figure somewhat to cover social security and other payroll taxes, workmen's compensation and other insurance. These estimates are based on existing levels of prices and wages.

The operating expenses and the necessary fares required to cover operating expenses and fixed charges have been estimated both for the 45-mile line from Panorama to Long Beach and for the 32-mile line from North Hollywood to Compton, as follows:

Between Panorama and Long Beach

Operating Expenses:	
Maintenance of way and structures	$ 1,220,000
Maintenance of equipment	1,750,000
Operating cars	2,426,000
(This is based on one motorman and one guard per train)	
Power	1,750,000
General administrative expenses	875,000
Total	$ 8,021,000
(This is equivalent to 33.8 cents per car-mile for 23,750,000 car-miles a year)	
Allowance for Social Security, Compensation and other insurance	750,000
Total Operating Expenses	$ 8,771,000
For purposes of computing interest the rate is taken at 5 per cent per year; and for amortization of debt a period of 20 years at 3 per cent per year.	
Interest at 5 per cent and amortization at 3 per cent of the total bond issue	13,216,000
Total Annual Expenses and Charges, except Taxes	$21,987,000

Because of the relatively high cost of the property, the State, City and County taxes, calculated in the manner applied to utilities in Los Angeles, produce a very high figure in proportion to operating expenses. For that reason we have shown the expenses and charges before taxes as well as after taxes.

In the Act creating the Los Angeles Metropolitan Transit Authority, Section 4.21 of Chapter 4 states:

> "The authority shall pay to each public corporation in which property of the authority is situated an amount equal to the amount which would be paid in taxes and assessments on such property if it were privately owned. The amount of such payments shall be computed in the same manner as taxes or assessments on such property would be computed if it were privately owned, except that for this purpose the property of the authority shall be valued at appropriate times by the State Board of Equalization, and its determination thereof shall be final. This section shall not be applicable to bonds issued by the authority."

In accordance with the language of this Act, we have computed taxes on this property at the rates that have been furnished to us by the Authority at 2 per cent of the gross revenue and 6-1/2 per cent on the assessed valuation of the property, which is taken at one half of the cost; in this case, one half of $139,000,000 prior to the addition of items of interest during construction and the cost of financing.

As computed in this way the total taxes payable the first year are less than $5,000,000, which is five eighths of all of the total operating expenses, before taxes. Taxes amount to about 25 per cent of the sum of operating expenses, interest and amortization on investment and taxes.

Total Annual Expenses and Charges, except Taxes (as shown on the preceding page)	$21,987,000
Taxes include a franchise tax of 2 per cent on the gross revenue and a property tax of 6-1/2 per cent on the assessed valuation of the property, which has in this case been taken at half the cost or $69,500,000.	
If taxes are to be paid, the additional amount to be earned is estimated at	4,988,000
Making the total, including taxes, of	$26,975,000
Taking the average passengers at 233,000 per weekday, or 79,000,000 per year, the average fare per passenger needed to earn expenses and interest and amortization is	$0.28
and to earn taxes as well	$0.341

Between North Hollywood and Compton Line - 28.6 Miles (32 miles for operation)

Operating Expenses:	
Maintenance of way and structures	$ 901,556
Maintenance of equipment	1,292,698
Operating cars	1,792,588
(This is based on one motorman and one guard per train)	
Power	1,290,944
General administrative cost	631,440
Total	$ 5,909,226
(This is equivalent for 17,540,000 car-miles per year to 33.7 cents per car-mile)	
Allowance for Social Security, Compensation and other insurance	591,000
Total Operating Expenses	$ 6,500,000
Interest at 5 per cent and amortization at 3 per cent on bond issue of $133,976,000	10,718,000
Total Annual Expenses and Charges, before Taxes	$17,218,000
Taxes, two per cent on the gross revenue of $21,000,000 and a property tax of 6-1/2 per cent on the assessed valuation of the property, which in this case has been taken at half the cost or $61,135,000.	
If taxes are to be paid, the additional amount to be earned is estimated at	4,087,000
Making the total, including taxes	$21,305,000
Taking the average passengers per weekday at 205,000 equivalent to 69,500,000 per year, the average fare needed to earn expenses and fixed charges other than taxes is	$0.248
and including taxes	$0.307

No specific allowance has been included above for depreciation. If such an allowance were to be set up it would be in the order of about 8 per cent of gross earnings. This would amount to (a) $1,898,000 in the case of the longer line, and (b) $1,704,000 in the case of the shorter line, as compared with the annual amounts required for amortization of debt of $4,956,000 and $4,019,000, respectively. These latter figures are derived in Chapter VII following. The application to depreciation reserves of funds set aside for amortization is an entirely proper and normal procedure.

VII - CAPITAL REQUIREMENTS AND COMMENTS ON FINANCING

In the following, separate consideration is given to the two cases:

(a) line extending between Panorama and Long Beach

(b) line extending between North Hollywood and Compton

LINE BETWEEN PANORAMA AND LONG BEACH

In Chapter IV, above, the passenger revenue was derived as follows:

Line between Panorama and Long Beach	$23,489,000
To this should be added an allowance for income from advertising privileges, car cards, station posters and other concessions estimated at one per cent of passenger revenue, or	235,000
making gross revenues	$23,724,000
Operating expenses, excluding taxes, were estimated in Chapter VI at	8,771,000
leaving, available for depreciation, taxes and debt service,	$14,953,000
The total bond issue required was derived in Chapter V as $165,207,000.	
Annual interest on this amount at 5 per cent is	$ 8,260,000
and the annual amount necessary to retire the debt in 20 years (3 per cent) is	4,956,000
making total annual charges	$13,216,000
The amount available before taxes shows a coverage over interest alone of	$ 6,693,000
or, the interest is earned	1.81 times
Taxes, as estimated in Chapter VI, are	$ 4,988,000
leaving the total available for depreciation and debt service	$ 9,965,000
This shows a coverage over interest alone of	$ 1,705,000
or, the interest is earned	1.21 times
The "amount available" after taxes to meet debt service of $13,216,000 is deficient by	$ 3,251,000

LINE BETWEEN NORTH HOLLYWOOD AND COMPTON

Similarly, in Chapter IV:

Passenger revenue was derived as	$21,094,000
To this is added an allowance for advertising privileges, etc., of one per cent	211,000
making gross revenues	$21,305,000
Operating expenses, excluding taxes, were estimated in Chapter VI at	6,500,000
leaving, available for depreciation, taxes and debt service,	$14,805,000
The total bond issue required was, from Chapter V, $133,976,000.	
Annual interest charges at 5 per cent are	$ 6,699,000
and the annual amount necessary to retire the debt in 20 years (3 per cent) is	4,019,000
making total annual charges	$10,718,000
The amount available before taxes shows a coverage over interest alone of	$ 8,106,000
or, the interest is earned	2.21 times
Taxes, as estimated in Chapter VI, are	$ 4,087,000
leaving the total available for depreciation and debt service	$10,718,000
This shows a coverage over interest alone of	$ 4,019,000
or, the interest is earned	1.60 times
There is just sufficient earnings after taxes to cover total annual requirements for debt service amounting to	$10,718,000

From the above it appears that for both conditions there is a margin before taxes over and above the amounts needed to pay interest at 5 per cent and retire the debt in 20 years. After taxes there is a deficiency of $3,371,000 in the case of the longer line and just sufficient in the case of the shorter.

No allowance has been made for increase in traffic although the projected population of Los Angeles County in 1960, which is only two years after

the earliest year in which the system could be put in operation, is 5,500,000 or approximately 25 per cent greater than in 1953 (see Part II, page 19) and the growth in the area farthest from the center of Los Angeles and therefore most likely to use the Monorail is projected at a much more rapid rate than the areas nearer to the center of the City (see Table 4, page 28, Part II). We are of opinion that such growth will increase the earnings over and above those which we have estimated as of the present year.

The annual charges for amortization are several times the amount needed as provision for depreciation. If an allowance were to be set up it would be in the order of about eight per cent of gross revenue; $1,898,000 in the case of the longer line, and $1,704,000 in the case of the shorter as compared with annual amortization requirements of $4,956,000 and $4,019,000, respectively.

If the test of economic feasibility of a project is the ability to pay interest on and pay off the debt within a reasonable period, say 20 years, then the Monorail system herein described would be feasible in the case of the line between Panorama and Long Beach only with substantial relief in the matter of taxes. In the case of the initial construction between North Hollywood and Compton, the result is more favorable even after taxes estimated on the conventional basis. In the latter case the estimated earnings after taxes would be sufficient to pay interest and retire the debt in 20 years. This indicates economic feasibility subject to determination of the matter of damages for use of city streets, to approval by Public Utilities Commission and successful financing.

As to whether or not this project could be financed by an issue of revenue bonds is another matter. The only revenue bonds secured solely by earnings of a traction property that we know of are Chicago Transit Authority. In

that case the Authority has complete and undisputed authority over service and rates and, in fact, is required to maintain rates at a level sufficient to produce certain reserves and interest and amortization requirements. The many issues of revenue bonds on highway facilities secured by tolls, such as the bonds issued by California Toll Bridge Authority, are based on the Authority's right and obligation to fix toll rates at levels sufficient to meet all bond requirements.

The Chicago Transit Authority, as of December 31, 1952, had outstanding $128,000,000 of revenue bonds, of which $105,000,000 carried interest at various rates, 3-1/4 per cent to 3-3/4 per cent, depending on year of maturity, but $65,000,000 of them maturing in 1978 bear interest at 3-3/4 per cent. $23,000,000 issued in 1952 mature in 1982 and bear interest at 4-1/2 per cent. In addition, there are $15,000,000 of equipment trust certificates authorized, but they are secured directly by the equipment.

For the year 1952 gross earnings of Chicago Transit Authority were $117,122,567 and the amount available for depreciation, reserves and debt service was $16,406,427, as compared with charges of $4,810,892, a coverage of 3.4 times. The amount available after depreciation and rental is $6,650,092, a coverage of 1.38 times.

In the instant case, the Act creating the authority provides that the Authority "shall be subject to the same regulations, restrictions and restraints as if it were a privately owned and operated carrier and shall be subject to the jurisdiction of the Public Utilities Commission and all other laws applicable to privately owned and operated carriers" (Chapter 3, Section 3.2). Furthermore, the question of the amount of damages, if any, payable to property owners abutting on the streets used by the Monorail is indeterminate.

We are of opinion that these restrictions would make it very difficult, if not impossible, to sell revenue bonds on any project. In this project the margin should be greater than normal because the general investing public would consider a Monorail system as an innovation not yet proven in practice, and in an industry which has ceased to have a strong appeal to the investor.

VIII - CONCLUSIONS

As a result of the combined study described above, in which there were associated with us the firms of Ruscardon Engineers and Gibbs & Hill, Inc., and in conformity with the contract we have reached the conclusions as set forth below.

FIRST:

Los Angeles in respect of transportation requirements is of all the great cities in the United States in a class by itself. The density of population of the portion of the County south of the mountains is estimated at 4,650 per square mile, which is a fraction of the density in either New York, Philadelphia or Boston. Of all the cities in the United States, Los Angeles is the one which has attained the greatest part of its growth since the advent of the automobile. The population has increased 343 per cent between 1920 and 1950. In 1921 there was one automobile for every 6.4 persons; in 1953 one to every 2.4 persons. In automobile ownership in proportion to population, no city in the world compares with Los Angeles. The use of the automobile has been fostered by boulevard and freeway construction, both that completed and that which is now in progress and planned. With the great increase in the number of automobiles and the facilities provided for their use, the use of mass transit has rapidly declined.

The estimated population of the County of Los Angeles in 1953 is 4,650,000 persons. It is estimated that by 1960 it will have increased to 5,500,000, a growth of 18 per cent, and by 1980, 26 years from now, to 7,500,000, an increase over 1953 of 61 per cent. Moreover, it is estimated that the major part of the growth will occur in the suburbs. This is the section of the County where the density at the present time is lowest. In the light of these circumstances where the population of Los Angeles has been largely dependent for

transportation on the individual automobile, it is apparent that any rapid-transit system, to be effective, must carry passengers at high speed and in comfort.

SECOND:

A Monorail rapid-transit route as proposed in this report, located within the area described in the Act creating the Authority would, if adopted, be a proper beginning for the development of rapid transit throughout Los Angeles County.

This route connects the important San Fernando Valley with Hollywood, Los Angeles, including the downtown central business area, the industrial areas of Vernon, Southgate, Maywood, Huntington Park and Lynwood (some of these latter reached in conjunction with Los Angeles Transit Lines by means of transfer), Compton and Long Beach. The area studied, which was that defined by the Act creating the Authority, contains more than half of the population of Los Angeles County. Residential developments predominate at both ends of the line, business and manufacturing establishments at the center. This line would bring the area in San Fernando Valley as close to the business center of Los Angeles measured by time of transit as Hollywood now is by present means of mass transportation. Whether or not the number of people entering the Central Business District decline in the future or continue in approximately the same volume as at present, the growing congestion of the highways - even of the freeways - will induce people to use rapid-transit lines insofar as they are available, particularly those that compete reasonably well in time with transportation by individual automobile.

The ability of this system to transport passengers from Panorama and Van Nuys on the north to the Central Business District in less than the time required for a trip by existing public transit facilities from Hollywood, and,

on the south, from Long Beach in less time than required by existing public transit facilities from Compton to the Central Business District will insure a substantial passenger load largely obtained by diversion of passengers from automobiles.

Such a system can be constructed for far less cost than additional freeways for automobiles and can carry with comfort more people than a six-lane freeway.

THIRD:

Considering that the Monorail system is an interurban railroad rather than an urban distribution facility, it can be integrated appropriately with any future plan of rapid transit that may be adopted for the metropolitan area of Los Angeles County. At the present time no such plan exists. If the Monorail system is built in the general location shown, future interurban lines can be so located as to provide for convenient interchange of passengers and the same statement may be made as to local distribution facilities.

FOURTH:

A Monorail system, such as proposed, will furnish a faster service than any other interurban railroad in the country.

The length of the line between Panorama City in San Fernando Valley and Long Beach is slightly more than 45 miles. A through train will traverse this distance, making all stops, in 67 minutes. Seventeen stations are provided averaging 2.8 miles apart. The cars are designed to seat 67 people; may operate in peak hours in 6-car trains at 3-minute intervals, with the number of passengers limited to 100 per car. The average over-all speed including stops is 41 miles per hour. The system will be equipped with the most modern and "fool-proof" signal system to prevent any possible train operating accidents. Since no Monorail system of this type is in operation anywhere (that in Germany is not

comparable) we recommend that prior to placing this system in operation a test section be constructed of sufficient size to enable study of the operating features of the system including the riding characteristics of curves, the operation of signals, the accessibility of electric distribution system and running rails for inspection, and the acceleration and braking of cars.

FIFTH:

The same type of service could be performed by another form of surface-free transportation such as a modern elevated railroad, following the identical route suggested for the Monorail. Such type of facility should be considered.

SIXTH:

The route selected by the engineers and shown on Plate I is presented for public discussion, subject to reasonable adjustment, and is the one that will produce the most traffic and be the least costly to build within the prescribed area.

SEVENTH:

If the construction of the Monorail system were to be authorized at the present time, it would be possible to have it in operation by 1960 and at that time the estimated annual number of passengers that would be carried on a line extending from Panorama on the north to Long Beach on the south would be 79,000,000. If the length of the line were to be curtailed so that the northern terminus would be at North Hollywood and the southern terminus at Compton, the number of passengers is estimated at 69,500,000. Considering the increase in population forecast for the San Fernando Valley and for the section of the County south and southeast of Compton, there is every reason to expect a future substantial growth in passengers.

We estimate that these passengers will be distributed as follows:

	Long Line	Short Line
On the northern end of the line	27,200,000	23,095,000
On the southern end of the line	41,554,000	36,300,000
Within center zone	6,976,000	6,971,000
Through riders	3,270,000	3,134,000
Total	79,000,000	69,500,000

EIGHTH:

We have predicated our conclusions as to traffic and revenues on a base fare of 25 cents for each of the northern and southern zones and a fare of 20 cents in the central zone, with a 35-cent fare from either the northern or southern zone to the central zone, and 50 cents for through riders, that is, from the northern zone to the southern zone, or the reverse. These fares are, for the longer rides, substantially less than those charged by existing forms of mass transportation. For shorter rides they are somewhat greater, but carry the passengers with greater speed, and with more comfort. These rates were set up tentatively for purposes of computation and not necessarily as a recommendation for adoption at this time.

NINTH:

The matter of the provision of feeder bus service supplementary to the route may best be obtained by co-ordination with the existing transportation lines. On the north end of the line there is an opportunity for joint service from Glendale Boulevard station to Burbank and Glendale and from Van Nuys or Panorama to San Fernando and the northerly and westerly parts of the valley; and from Hollywood station to Santa Monica. On the south end of the line there is an opportunity for joint service from the stations at Broadway Place and Main Street, in particular, and the industrial area lying east of these stations.

TENTH:

Automobile parking spaces are provided at most of the stations, particularly those at the extremities of the line. Such facilities have proved to be of substantial value in attracting traffic.

ELEVENTH:

We estimate that to construct and equip a monorail system, as described:

(a) between Panorama City and Long Beach will require a bond issue of $165,207,000

(b) if the portion of the line between North Hollywood and Compton be built initially, we estimate such construction and equipment will require a bond issue of $133,976,000

TWELFTH:

We showed the estimated results of operation of the Monorail system in Chapter VII. For the Panorama-Long Beach line, it is apparent that the interest coverage before taxes and depreciation is 1.81. After taxes it is 1.21; but there is a deficiency after taxes as to complete debt service of $3,251,000. This deficiency might be reduced or eliminated with growth of traffic in future years, for which we have not made specific allowance. Without such increase in earnings the amount available to amortize the debt after payment of interest would be $1,705,000, which would require about 36 years to retire the $165,207,000 of bonds. Moreover, depreciation would ordinarily be figured at 8 per cent of gross revenues, or $1,898,000 a year. The amount required for amortization may be used in building up a depreciation reserve, but in this case the balance of $1,705,000 after taxes and interest is insufficient for annual depreciation.

The Los Angeles Transit Authority by the terms of the Act of 1951 is subject to regulation by the Public Utilities Commission of the State of California and subject to the payment of taxes.

Regulation by the Public Utilities Commission relates to routes, service and rates, as well as to other operating matters. This is in marked distinction to the characteristics of other revenue bonds, of which many million dollars are outstanding on toll highway, bridges and other facilities. For instance, the bonds issued by California Toll Bridge Authority secured by tolls are based on the Authority's right and obligation to fix toll rates at levels sufficient to meet all bond requirements. This is the normal requirement of any public revenue bond issue. Tax exemptions are granted to the California Toll Bridge Authority, the Chicago Transit Authority, and substantial tax relief is allowed the New York Port Authority. The combination of novelty of design, of high taxes shown in this report, subjection of the Authority to the Public Utilities Commission and the uncertainty of assessment of damages for the structure in city streets would, in our opinion, impose a handicap to the sale of these bonds as public revenue bonds. As to this matter the advice of a financial advisor should be sought.