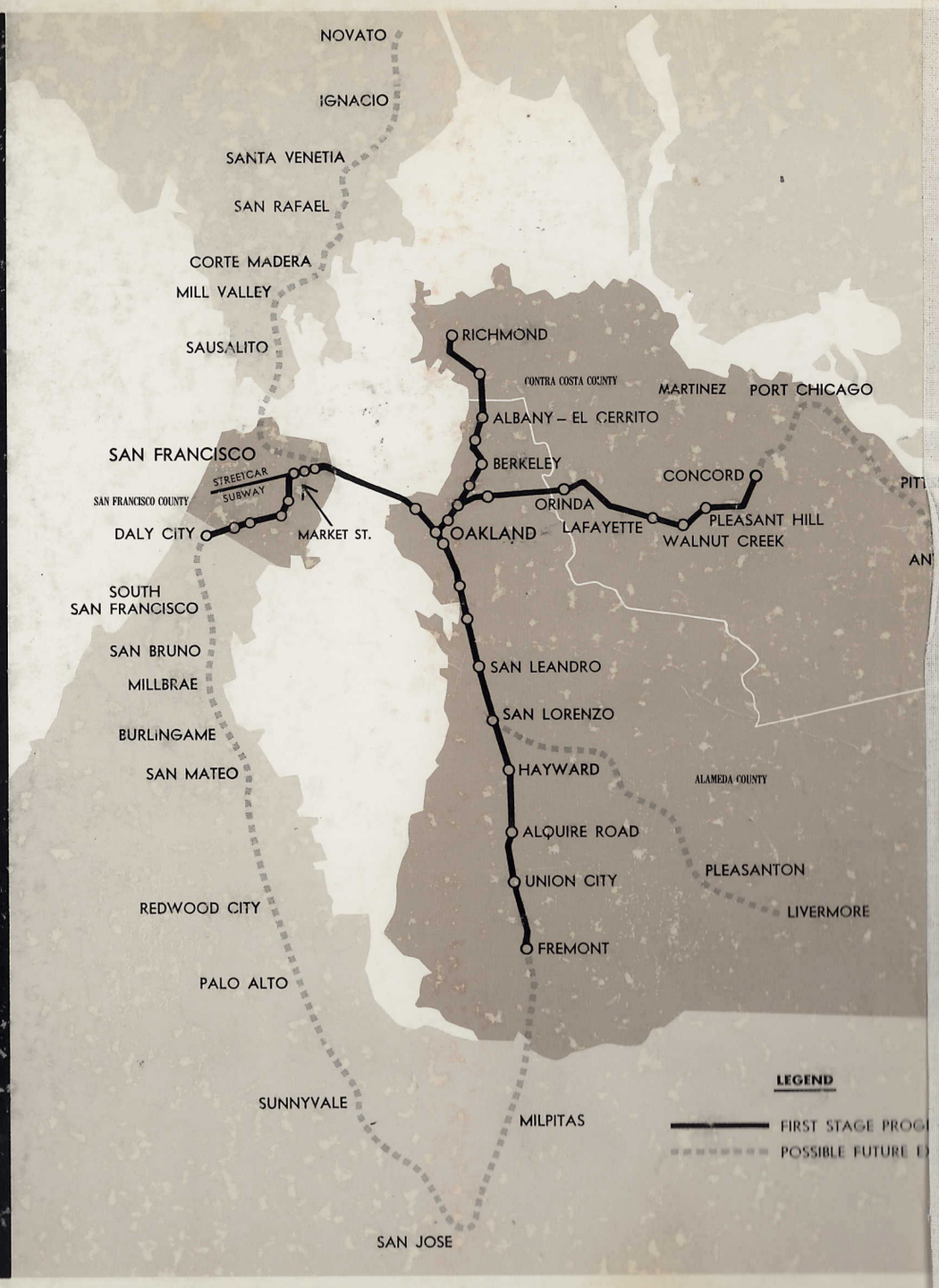
THE COMPOSITE REPORT BAY AREA RAPID TRANSIT MAY 1962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SAN FRANCISCO COUNTY
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SAN FRANCISCO
SAN BRUNO
MILLBRAE
SAN LEANDRO
SAN LORENZO
BURLINGAME
SAN MATEO
HAYWARD
ALAMEDA COUNTY
ALQUIRE ROAD
PLEASANTON
UNION CITY
REDWOOD CITY
LIVERMORE
FREMONT
PALO ALTO
SUNNYVALE
MILPITAS
SAN JOSE
LEGEND
FIRST STAGE PROG
POSSIBLE FUTURE E

THE COMPOSITE REPORT
BAY AREA RAPID TRANSIT
MAY 1962

Reports submitted to the San Francisco Bay Area Rapid Transit District describing the engineering, financial and economic phases of a rapid transit plan for Alameda, Contra Costa and San Francisco Counties.

by

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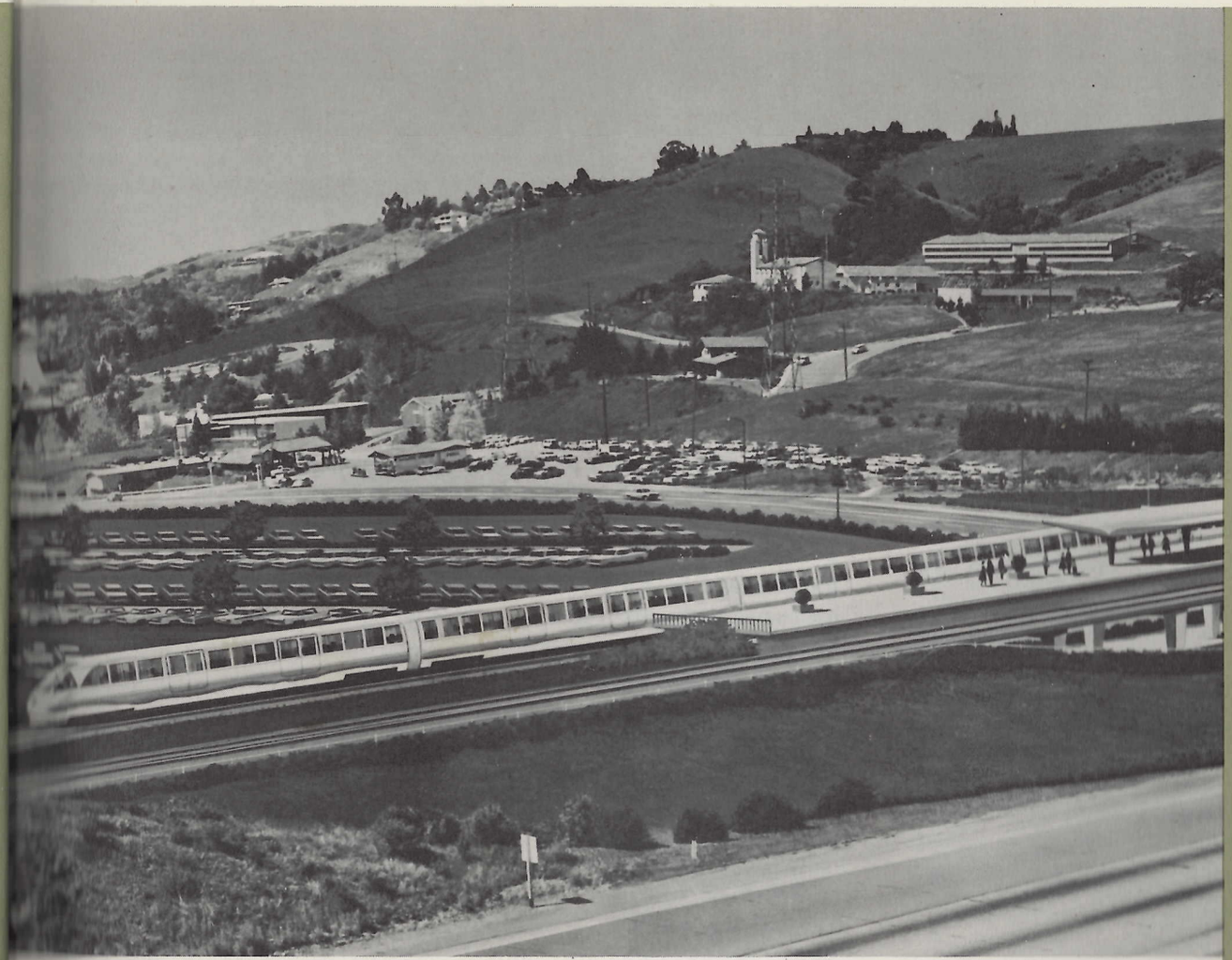

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INTRODUCTION

The reports bound in this volume describe a proposal to the San Francisco Bay Area Rapid Transit District for construction of a three-county regional rapid transit system. Included are descriptions of the physical rapid transit plan and its financing and an analysis of the need for and benefits of the system.

The reports present the findings, conclusions and recommendations of the engineering and financial consultants retained by the Bay Area Rapid Transit District, as well as those of its California financial advisor and economic consultant.

The engineering consultant states that construction and operation of a rapid transit system conforming generally to that set forth in the engineering report is feasible and can be accomplished within the estimated costs set forth. The financial consultant concludes that the system described in the engineering report is financially feasible.

The reports must be approved by the Boards of Supervisors of the three member counties, Alameda, Contra Costa, and San Francisco, prior to the holding of a District-wide election to secure voter approval of a bond issue necessary to finance construction of the system.

MAJOR FINDINGS

The consultants' reports contain the following basic conclusions regarding the proposed plan for rapid transit in the Bay Area, the need for rapid transit, the benefits it can bring to the area, its estimated costs, and the means for its financing:

- Metropolitan growth, decentralization, and specialization have made efficient transportation increasingly essential to the well-being of the Bay Area. Population of the Bay Area doubled in the twenty years between 194(1960 and the number of automobiles and the number of miles of auton travel have been growing even faster. Interurban travel by all forms of portation is estimated to increase by 51 per cent between 1960 and 1975 the central Bay Area counties. With interurban traffic rising so rapidly area severely constricted by topography, the consultants conclude that fre bridge, and parking improvements alone cannot meet the Bay Area's n ing transportation needs. Utilizing only a fraction of the space required modern freeway, rapid transit would provide far more passenger capacity automobiles on freeways, and at much less cost.
- The recommended initial program contemplates a regional rail rapid t system with electrically powered trains running on completely grade-sep right of way. The system includes about 75 miles of double track rout San Francisco, the line extends from the foot of Market Street to Daly A transit tube beneath San Francisco Bay connects San Francisco and land. In the East Bay, lines radiate from Oakland north to Richmond, Concord, and south to Fremont. A total of 37 stations is provided, to be l at major points of passenger origin and destination in all principal commu served, and off-street parking is provided at all stations except in San Fra and downtown Oakland and Berkeley.
- The system proposed includes 20 miles of underground construction way, tunnels, and the four-mile subaqueous tube), 31 miles of aerial con tion, and 24 miles of construction at grade. In San Francisco, some s will be made available for use by the streetcars of the San Francisco Mun Railway prior to ultimate rapid transit use.
- The plan envisions modern, lightweight trains moving under adv automatic train control at speeds up to at least 70 miles per hour and with age operating speeds of 50 miles per hour, including station stops, ge throughout the system. Service during peak hours is to be governed by d — with headways between trains of as little as 90 seconds. This schedu

vide capacity to move 30,000 seated passengers per hour in each direction
ach route.

Fixed elements of the system such as right of way, track construction, sta-
s, and power and control systems – but not including the Trans-Bay Tube –
estimated to cost $790,493,000, including allowances for inflation and pre-
rating expenses. These costs are proposed to be financed by District general
gation bonds in a recommended amount of $792,000,000 to be sold be-
en 1963 and mid-1970.

The start of construction is planned for January, 1964, and more than four-
hs of the system is expected to be completed and open to traffic by January
969. These sections would provide service between San Francisco and Oak-
and Richmond, Concord, Hayward, and Daly City. By July 1, 1971, the
nce of the system will be completed.

Rolling equipment for the system is estimated to cost $71,200,000 through
year 1978, when a total of 450 modern rapid transit cars will be required.
District's financing plan provides for rolling equipment requirements
ough 1971 to be financed from issuance of revenue bonds secured by a pledge
gross system revenues. Subsequent purchases of equipment are to be made
ctly from surplus net revenues from transit operations.

The Trans-Bay Tube and its approaches are estimated to cost $132,720,-
and are to be financed primarily by revenue bonds of the California Toll
dge Authority secured by combined net revenues of the San Francisco-
kland Bay Bridge, the San Mateo-Hayward Bridge and the Dumbarton
dge. Costs of the approaches ($40,594,000) are to be repaid by the District
of transit operating revenues.

Estimates of the District's engineering consultant indicate that, when the
stem is complete, available operating revenues will be sufficient to pay opera-
n and maintenance expenses, all interest and principal requirements of the
trict revenue bonds sold for purchase of equipment, and reimbursements to
California Toll Bridge Authority for the cost of approaches to the Trans-
Bay Tube. In addition, revenues will be available for purchase of additional rolling equipment and for other District purposes. The consultants conclude, therefore, that the proposed regional rapid transit system will be self-supporting except for payment of general obligation bonds sold to finance fixed elements of the system.

- The District's financing plan provides for sale of $792,000,000 of District general obligation bonds. These bonds would be supported out of taxes levied throughout the District. No principal would be paid prior to completion of the system, and during this period the tax rate would vary from about 14 cents per $100 assessed valuation in 1963/64 to 62 cents in 1968/69. Beginning in 1971/72 – after the rapid transit system is complete and in operation – both bond interest and principal would be paid from taxes. The maximum tax rate required is estimated at 67 cents per $100 assessed valuation, resulting in a cost of $27 per year to the typical Bay Area homeowner.
- General obligation bonds of the District require approval by a 60 per cent majority of the voters. After general obligation bonds have been authorized by the electorate, revenue bonds may be issued by the District for rolling stock financing, and the California Toll Bridge Authority can sell revenue bonds to finance the Trans-Bay Tube and its approaches.
- A regional rapid transit system is expected by the economic consultant to benefit the Bay Area by permitting increased concentration and specialization of business, industry, and other economic activity. The rapid transit system would help to reduce disorganized urban sprawl; to improve Bay Area living and working conditions; and to preserve and increase property values in the central cities, regional subcenters, and outlying areas.
- The regional rapid transit system would bring additional benefits to the area in terms of savings in travel times, reduction in accident costs, savings in automobile insurance, operation and parking costs, and savings in the cost of motor freight shipment. The annual value of these savings which can be measured is estimated at approximately $51,000,000 (1960 dollars) by 1975. Other

benefits, which cannot be measured precisely, would accrue: savings in the costs of constructing and maintaining an otherwise larger network of bridges and freeways, the increased potential for Bay Area economic growth, and the savings resulting from more efficient and orderly patterns of development and land use throughout the area.

- The estimated annual measurable benefits in the year 1975 exceed the approximately $42,000,000 (1960 dollars) which will be required in tax and bridge toll support of the system in that year. The economic consultant believes that the years beyond 1975 can be expected to show an even larger balance of values in favor of the rapid transit system.
- The proposed three-county regional rapid transit system is intended as the foundation for a larger regional rapid transit system for the entire Bay Area. Future extensions of the system have been anticipated in the development of routes.

HISTORY OF THE DISTRICT

The studies leading to formation of the San Francisco Bay Area Rapid Transit District were conducted by its predecessor, the San Francisco Bay Area Rapid Transit Commission. The Commission studied the long-range transportation needs of the nine Bay Area counties.

As a result of its recommendations, the District was created in 1957 by the California Legislature to include the five central counties of Alameda, Contra Costa, Marin, San Francisco, and San Mateo.

The District is governed by a Board of Directors appointed by Boards of Supervisors and committees of mayors within the member counties. It is an independent public agency with its own general manager and staff and has the authority to levy a tax up to five cents per $100 assessed valuation on all taxable property within the District. It also has the additional authority to levy taxes to support a general obligation bond issue if that issue is approved by the voters.

Marin and San Mateo Counties withdrew from the District pursuant to provisions of the District Act. Marin County withdrew primarily because an engineering review panel recommended against placement of rapid transit facilities on the Golden Gate Bridge. San Mateo County disapproved an earlier proposal of the District for a rapid transit system which included facilities in that county.

The engineering plan contained in this report therefore proposes physical facilities in the three counties of Alameda, Contra Costa, and San Francisco, and the financial plan is based on their financial resources. The plan allows for ultimate extension of the system as needed and desired and to the extent found to be feasible.

The District and its consultants have maintained close liaison with cities, counties, and other public and private agencies within the District, and these groups have been kept well-informed on the District's proposals during th the program was being formulated. Preliminary plans of routes and st have been submitted by the District to all cities and counties in the Di

Reports covering a system which included San Mateo along with the counties comprising the District were submitted to county Boards of S visors in October 1961, and hearings were held. The plan of routes and st now proposed for Alameda and Contra Costa Counties differs only sl from that on which hearings were held, and the plan in San Francisco ha modified to reflect views of San Francisco officials presented in the formal ing on the four-county plan.

DISTRICT CONSULTANTS

Since its formation in 1957 the District's principal function has been t a regional rapid transit system. In planning this system the District ha assisted by engineering, financial, and economic consultants and legal co

The District's principal consultants have been the following:

The general engineering consultant is a joint venture composed of Pa Brinckerhoff, Quade and Douglas, of New York City and San Francisco; Engineering Company, of San Francisco; and the Bechtel Corporation, Francisco. Parsons, Brinckerhoff, Quade and Douglas (then Parsons, Bri hoff, Hall and Macdonald) served as consultants to the San Francisc Area Rapid Transit Commission, the District's predecessor, in devel many of the basic concepts of regional rapid transit for the Bay Area.

Smith, Barney & Co., of New York City, is the District's financial co ant and is responsible for development of the Financial Plan. Stone & Y berg, of San Francisco, is financial advisor, having conducted studies financial impact of the transit plan on taxpayers and public agencies District. The consultants were advised and assisted by the District's ad committee on financing, of which Alan K. Browne, Vice President of the of America, is chairman.

The economic section of this report on the three-county system was pr by Van Beuren Stanbery, area economics consultant. Mr. Stanbery ha associated with Bay Area rapid transit studies from their inception, h served as consultant to the San Francisco Bay Area Rapid Transit Comm to Ebasco Services Incorporated in prior District studies, and to the D Special economic studies were made by the District staff and incorpora Mr. Stanbery in his report.

The transit proposal has been approved as to legality by Walla Kaapcke, a member of the firm of Pillsbury, Madison & Sutro, District G Counsel, and by George Herrington, of Orrick, Dahlquist, Herrington cliffe, the District's Special Bond Counsel.

THE ENGINEERING PLAN FOR BAY AREA RAPID TRANSIT

PARSONS BRINCKERHOFF-TUDOR-BECHTEL (A JOINT VENTURE)

PARSONS, BRINCKERHOFF, QUADE AND DOUGLAS
NEW YORK AND SAN FRANCISCO

TUDOR ENGINEERING COMPANY
SAN FRANCISCO

BECHTEL CORPORATION
SAN FRANCISCO

APRIL 1962

PARSONS BRINCKERHOFF — TUDOR — BECHTEL
General Engineering Consultants To
San Francisco Bay Area Rapid Transit District
833 MARKET STREET
SAN FRANCISCO — 3 — CAL.

April 17, 1962

San Francisco Bay Area Rapid Transit District
628 Flood Building
San Francisco, California

Gentlemen:

In accordance with the law establishing the District and in compliance with your directions we submit herewith our engineering report on a comprehensive rapid transit system to serve the Bay Area counties of Alameda, Contra Costa, and San Francisco. This report describes these facilities and includes estimates of construction cost, construction time, and anticipated revenues. Basic material has been drawn from our previous engineering report dated June 1961 pertaining to the five-county system then planned.

The design of the system is based upon advanced concepts and standards of service which you have endorsed. Working closely with experts in the transit field, we have studied transit methods, patronage, and operations to establish engineering feasibility of the major system components. Routes were developed in cooperation with representatives of local authorities and with the District.

Estimates of construction were carefully prepared based on typical designs adapted to the routes, with consideration given to actual field conditions to be encountered. Detailed analysis and research were devoted to the determination of patronage, revenues, operating costs, and car requirements. The experience of other transit systems was utilized where applicable. Careful attention was given to the unique characteristics of this system.

We estimate the total cost of constructing and acquiring the rapid transit facilities to be financed by your proposed

PARSONS, BRINCKERHOFF
QUADE & DOUGLAS
165 – Broadway
New York – 6 – N. Y.

TUDOR ENGINEERING CO.
595 Mission Street
San Francisco – 5 – Cal.

BECHTEL CORPORATION
220 Bush Street
San Francisco – 4 – Cal.

general obligation bond issue to be $790,493,000. In defining facilities for purposes of this estimate, we have not included rolling stock, the Trans-Bay Tube or routine District administration, inasmuch as these items will be separately financed. We have similarly excluded financing costs concerning which you will be advised by your financial consultants.

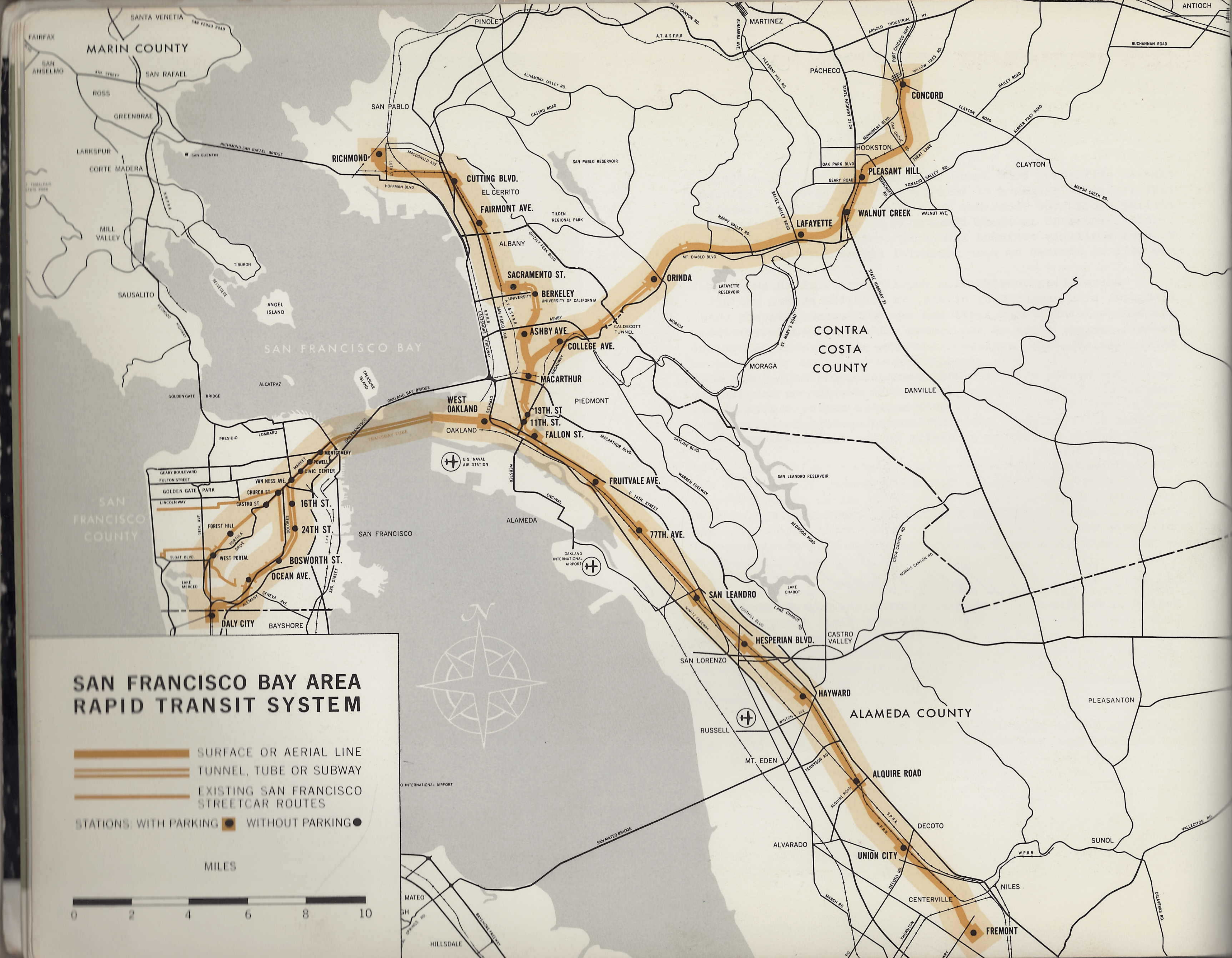
Correlating construction requirements with those of the financial plan prepared by others, we find the entire project can be completed within eight and one-half years. Within this overall period, parts of the system will be opened to service earlier as they are completed.

The system will earn sufficient revenues to pay all maintenance and operating costs and the debt service on the capital cost of rolling stock but not debt service on the capital cost of fixed construction. Construction and operation of the rapid transit system conforming generally to the facilities described herein are feasible.

Very truly yours,

PARSONS BRINCKERHOFF-TUDOR-BECHTEL

Walter S. Douglas Ralph A. Tudor John R. Kiely



SAN FRANCISCO BAY AREA
RAPID TRANSIT SYSTEM
SURFACE OR AERIAL LINE
TUNNEL, TUBE OR SUBWAY
EXISTING SAN FRANCISCO
STREETCAR ROUTES
STATIONS: WITH PARKING
WITHOUT PARKING
MILES
0
2
4
6
8
10
MARIN COUNTY
SAN FRANCISCO BAY
SAN FRANCISCO COUNTY
CONTRA COSTA COUNTY
ALAMEDA COUNTY
RICHMOND
CUTTING BLVD.
EL CERRITO
FAIRMONT AVE.
ALBANY
SACRAMENTO ST.
BERKELEY
UNIVERSITY OF CALIFORNIA
ASHBY AVE.
COLLEGE AVE.
MACARTHUR
19TH. ST
11TH. ST.
FALLON ST.
WEST OAKLAND
OAKLAND
PIEDMONT
FRUITVALE AVE.
77TH. AVE.
SAN LEANDRO
HESPERIAN BLVD.
HAYWARD
ALQUIRE ROAD
UNION CITY
FREMONT
ORINDA
LAFAYETTE
WALNUT CREEK
PLEASANT HILL
CONCORD
MONTGOMERY
POWELL
CIVIC CENTER
VAN NESS AVE.
CHURCH ST.
CASTRO ST.
16TH ST.
24TH ST.
FOREST HILL
WEST PORTAL
BOSWORTH ST.
OCEAN AVE.
DALY CITY
BAYSHORE
SAN FRANCISCO
ALAMEDA
CALDECOTT TUNNEL
OAKLAND BAY BRIDGE
GOLDEN GATE
BRIDGE
ALCATRAZ
TREASURE ISLAND
ANGEL ISLAND
SAUSALITO
TIBURON
MILL VALLEY
CORTE MADERA
LARKSPUR
GREENBRAE
ROSS
SAN ANSELMO
FAIRFAX
SAN RAFAEL
SANTA VENETIA
RICHMOND SAN RAFAEL BRIDGE
SAN QUENTIN
SAN PABLO
PINOLE
MARTINEZ
PACHECO
HOOKSTON
CLAYTON
ANTIOCH
SAN PABLO RESERVOIR
TILDEN REGIONAL PARK
LAFAYETTE RESERVOIR
MORAGA
DANVILLE
SAN LEANDRO RESERVOIR
LAKE CHABOT
CASTRO VALLEY
SAN LORENZO
RUSSELL
MT. EDEN
ALVARADO
DECOTO
CENTERVILLE
NILES
SUNOL
PLEASANTON
OAKLAND INTERNATIONAL AIRPORT
U.S. NAVAL AIR STATION
SAN MATEO BRIDGE
HILLSDALE
PRESIDIO
LAKE MERCED

SIC CONCEPTS AND STANDARDS

egional rapid transit system will form an impor- nd integral part of the total transportation facili- f the San Francisco Bay Area. The networks of ays, local streets, and local transit routes are all ial elements. By themselves, however, they can- rry the entire mounting burden of traffic, par- ly in periods of peak demand. Together, these rks and the rapid transit system mutually com- nt each other and afford the Bay Area the best ect for a balanced and economical combination culation facilities.

he Bay Area rapid transit system will abate motor ic congestion on the regional highways and in the n centers, will encourage a continued high rate ype of economic development, and will preserve nhance a high living standard. Rapid transit, as ived in this system, will complement the private obile as a mode of travel. At the same time, it compete with the automobile. The relative attrac- f rapid transit and the automobile, together with rtant considerations of public acceptability, were factors in establishing standards for rapid transit ds, equipment, and operation.

me of the salient standards established for the Area rapid transit system are the following:

egional rapid transit must be capable of minimum erage operating speeds of about 45 miles per ur, including station stops. To achieve this, the uipment must be capable of speeds of at least 70 iles per hour between stations and will in fact hieve average speeds of approximately 50 miles r hour generally throughout the system.

ervice during periods of peak travel should be gov- ned by demand, with headways as short as 90 conds to provide a capacity of at least 30,000 ated passengers per hour. Off-peak period service, cept late at night, should be as frequent as every minutes.

he system must be safe and dependable.

he rapid transit car must be comfortable, with ooth riding qualities, internal temperature con- ol, adequate ventilation, cooling and heating, ated windows, freedom from fumes, a low inter- l noise level, and a pleasing interior and exterior ppearance.

he regional system must penetrate the major cen- rs of business and commerce close to the ultimate stination of travelers to those centers.

he equipment must have a low external noise lev- el, and the system structure must be aesthetically acceptable.

- The adopted method of rapid transit must involve the minimum capital and operating expenditures consistent with these specified standards.

Speed and service standards require certain system and vehicle performance characteristics. These include high rates of acceleration and deceleration and high balancing speeds. To achieve these in turn requires easy alignment and minimum grades and complete grade separation of the rapid transit facility from all conflicting traffic.

The control of the trains must be reliable. Automatic train control by means of electronic computers is an essential part of this system.

Stations that serve primarily as a residential collector facility must have adequate and accessible parking facilities, and loading zones where automobiles and buses can pick up and discharge rapid transit passengers.

The location of the individual routes and stations is dictated basically by the requirements of the communities and the people to be served and the limitations imposed by topography and existing development. Any recommended plan of routes, stations, and structure represents a balancing of many interacting considerations, such as the patterns of origin and destination of the trips of interest and affinity to regional rapid transit, economy of construction and operation, impact on the community, aesthetics, and physical compatibility with existing and proposed development.

THE RAPID TRANSIT CAR

A basic feature in the development of a new rapid transit system is the evolution of the design of the car which must transport large numbers of people quickly, safely, comfortably, and economically. Performance specifications previously outlined were sent to all individuals and companies known to be professionally interested, and they were invited to submit transit proposals. Included were companies with records of accomplishment in transit car design, companies whose past work has been in other fields, and sponsors of several untraditional transit methods.

The various proposals received for transit methods generally fall into two main categories: suspended trains where support and guidance are combined in a structure above the train, and supported trains where the supporting structure is beneath the train.

Popular usage applies the term "monorail" to all suspended trains and to those forms of supported trains that appear to run on a single rail or beam. However, a true suspended monorail, where the car is hung from a single rail, is impractical for this high speed system due to the uncontrolled sway of the car. The problems of switching trains at high speed from one route to another have not been solved, and are inherent in varying degrees in most monorail systems.

A variation of monorail that holds considerable promise is the suspended duorail system. The car body is suspended from rubber-tired wheel and motor assemblies, which travel within a track structure shaped like an inverted "U." The duorail suspension permits use of a damping mechanism to restrict the sway to acceptable limits.

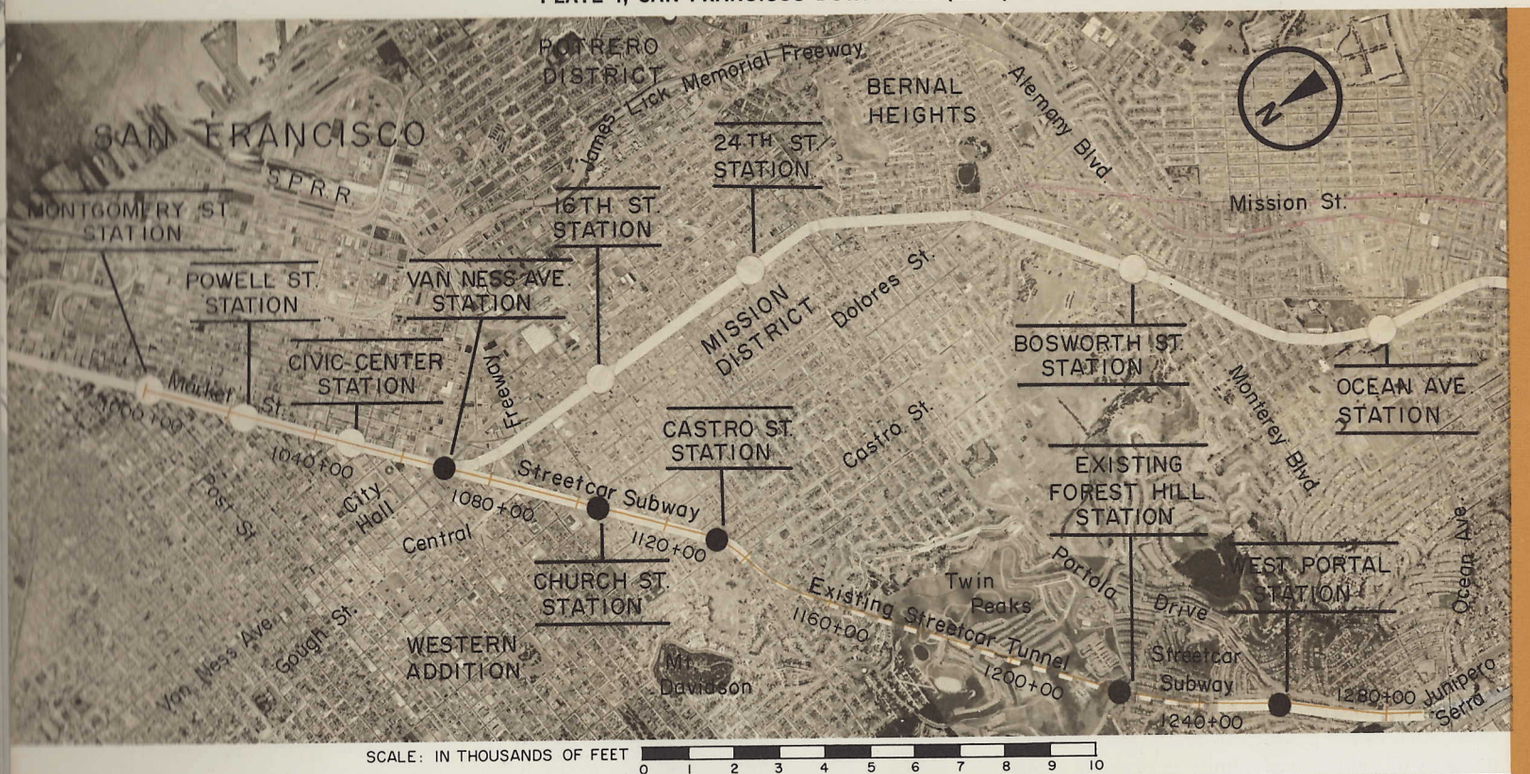
The suspended monorail always requires an overhead support structure even when in tunnels, subways, and at grade. For underground construction this increases size of the opening, and hence the cost. For aerial construction where clearance for surface traffic must be maintained, the required height of the structure considerably exceeds that of the aerial structure used for conventionally-supported trains. Since a significant portion of the proposed system is at grade, a costly overhead structure would be required for monorail where none is required for the conventional system.

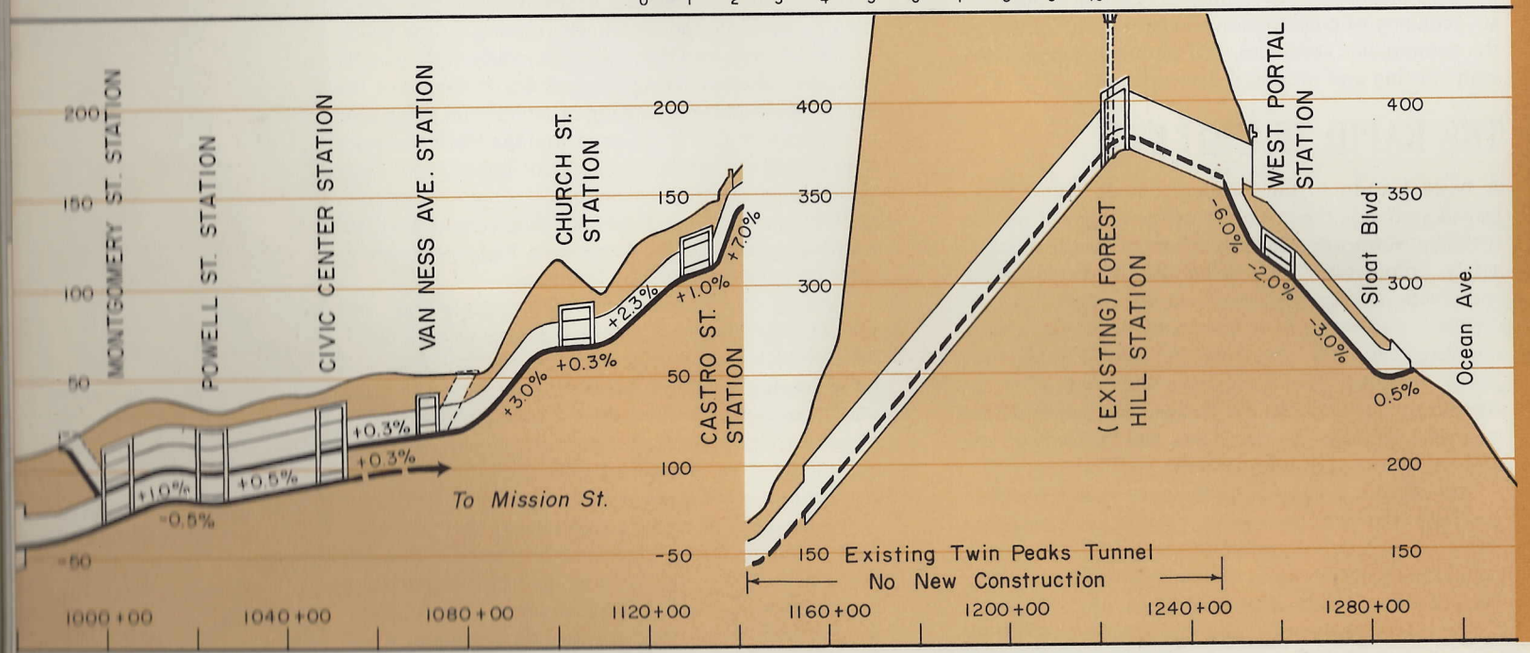
In the supported monorail design, the train rides on a single "rail" or concrete beam. This beam is straddled by multiple sets of wheels running on the beam. Stability is obtained through horizontally or diagonally mounted wheels bearing on the sides or flanges of the beam. A structure consisting of beams and some type of supports is always required, and the method cannot take as full economic advantage of ground level construction as can the conventionally supported system. Switching capabilities thus far demonstrated have not been acceptable to the large-scale high-speed operations contemplated for the Bay Area.

Among the proposals for truly untraditional and novel transportation systems were those using ground-effect vehicles, which ride on a thin cushion of air and on a guiding structure. Such vehicles are quite noisy and require more power than a rolling-wheel vehicle of comparable capacity. Ground-effect vehicles are not considered to be developed sufficiently to be suitable for use in a mass transportation system.

In the light of today's technology, the basic concepts and requirements set forth for the Bay Area system can be met by only one method of transportation that is proven. This method involves modern, lightweight, high-speed, stainless steel or aluminum trains

PLATE 1, SAN FRANCISCO DOWNTOWN (LEFT) AND TWIN PEAKS LINE (RIGHT), SEE TEXT P. 18





PARSONS BRINCKERHOFF-TUDOR-BECHTEL, ENGINEERS

supported on steel wheels running on continuo rails and operated by automatic train control.

The adoption of this transportation metho basis for the estimates in this report does not fo continuing analysis and possibly ultimate selec any different or untraditional method. In cons the potential advantages and disadvantages o methods of rapid transit, comparison can be ma this modern proven system. Any other transit to be adopted should serve as well or better, and be of equal or less cost.

The prototype car is 67 feet, 3 inches long; 5 inches wide; and seats 76 passengers. The u weight of the car is under 800 pounds per s achieve the required rates of acceleration each self-propelled. Power is supplied by third rail tric motors driving each of the four axles. Do of the sliding type, and the windows are perm sealed. The interior as well as exterior appear the rapid transit car is attractive. Suitable ven and cooling and heating, freedom from fume low noise level are necessary for passenger and satisfaction. Smooth riding qualities are e

In addition the vehicle is safe to passeng employees, and requires the minimum outlay f tal costs of way and equipment and for costs of ing and maintaining the system.

POWER AND PROPULSION

Numerous methods of propulsion and power have been studied and evaluated in correlati the studies of various transit methods. Power for a rapid transit system is usually direct-curre trical energy purchased as alternating current a rectified to direct current. Operation of trains ways and long tunnels precludes the use of gas diesel powered equipment producing noxious While some potential does exist for new energy es in the long-range future, the use of bulk-ge electric energy is still the most practical, efficie economical method for today's application.

Three main types of electric motors have teristics more or less suited to traction appli The polyphase induction motor is an extreme ged, low-maintenance, and low-cost motor w significant advantage that three-phase alternati rent could be utilized directly without the nece providing rectifying equipment to convert the to direct current. This motor, however, is ess a constant-speed machine, requiring additional

PLATE 2, MISSION LINE, SEE TEXT P. 20

devices which introduce complications that the advantages of the motor. Also, the problem h sferring polyphase energy from the trackside to fo ving car has not yet been solved satisfactorily. ec single-phase series motor has been used in loco- ns but it is being replaced by lighter, more effi- o propulsion equipment. It does not offer any ad- a e for the proposed system.

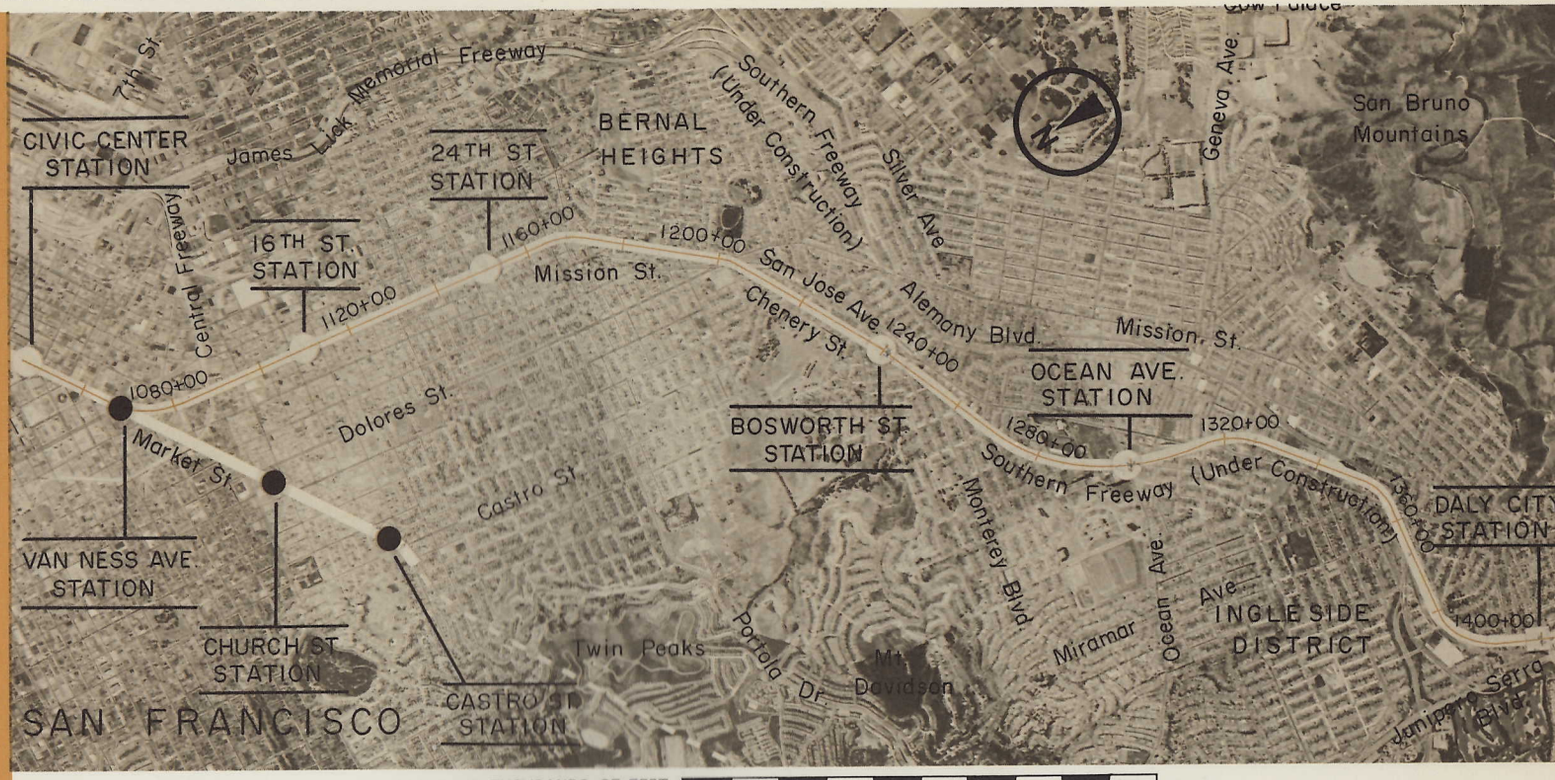
t e direct-current series motor is the most widely d r transit purposes. Its design has been devel- to a high degree of refinement and today this ; is comparatively light, rugged, compact, and n t, requiring a minimum of maintenance. Alter- s propulsion methods proposed so far have such c tions in performance, current collection, or size l ight that the direct-current series motor is the p l choice now as a basis for estimating costs. This m not preclude ultimate adoption of a superior al- r ive should one become available prior to the n hen final selection must be made.

irect-current equipment normally is available in c voltage ranges — 750 volts, 1500 volts, and 3000 s However, the design of equipment for use on g voltages up to 750 volts is the most highly de- f d. Such equipment is light and compact, and the f ed control equipment is reliable and low in cost. a ic braking is feasible without complication. e quently, the lower-voltage equipment has been a as the basis of design and estimate.

The proposed method of supplying power to the car r the trackside is a third-rail system. The system is i ed with direct-current power at frequent inter- r throughout its length. Three-phase alternating cur- c is purchased and distributed to trackside substa- u which convert the alternating current to direct c t.

AIN CONTROL D FARE COLLECTION

fundamental that this rapid transit system include a integrated automatic control system, assuring e highest degree of safe and reliable service. To e the specified high-speed, short-headway opera- v of trains over extended periods of time, normal o operation must be completely automatic. In the e of all control functions, the "fail-safe" principle o ation is observed to insure complete safety. The e of any control element causes a train to react i safe manner, including stopping the train.



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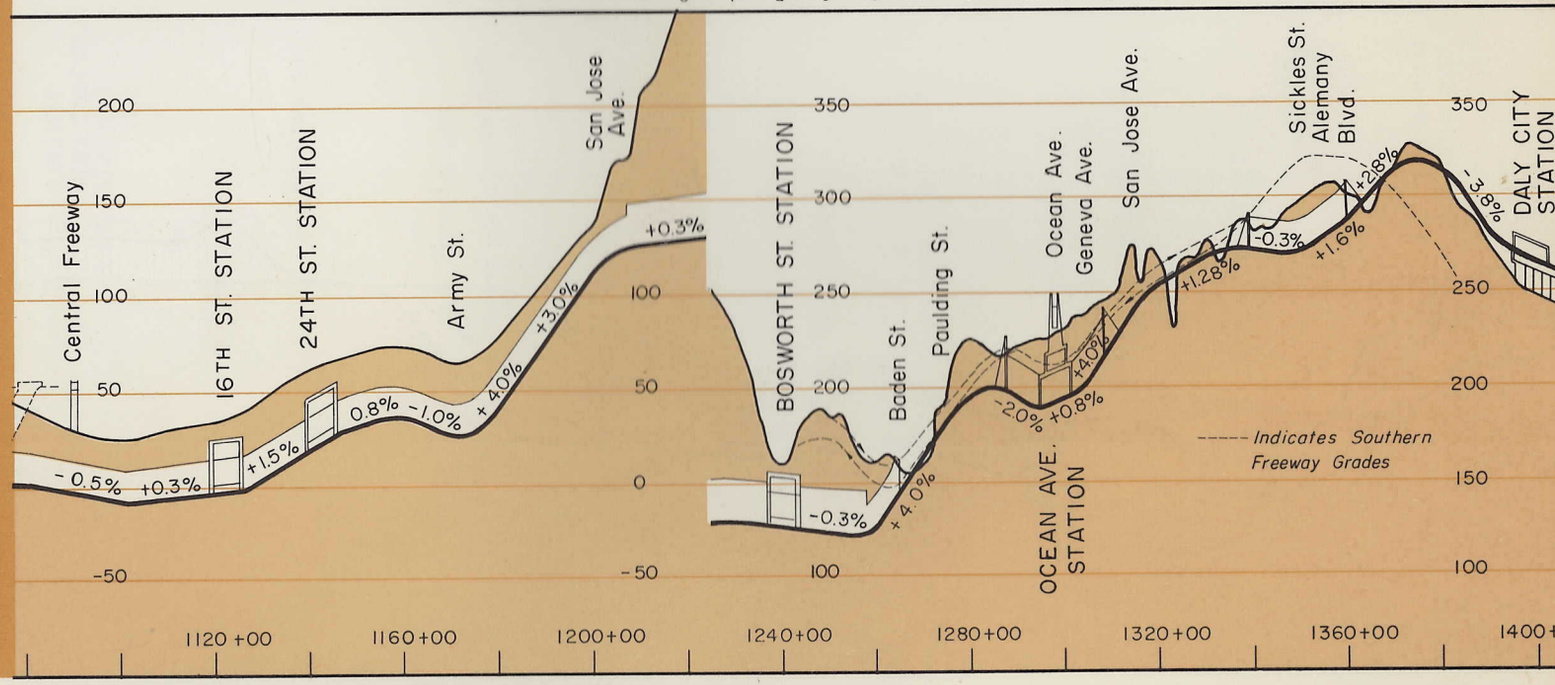

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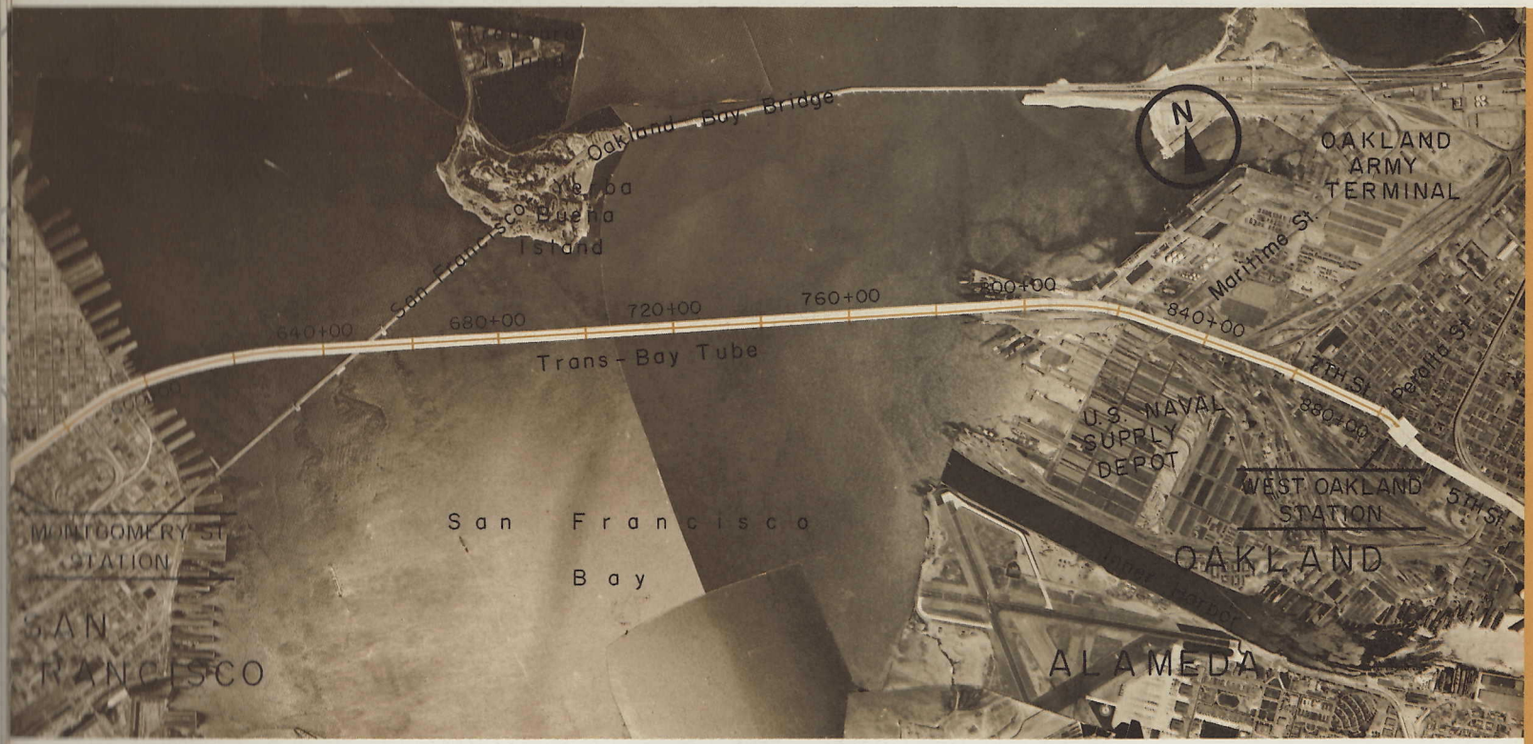

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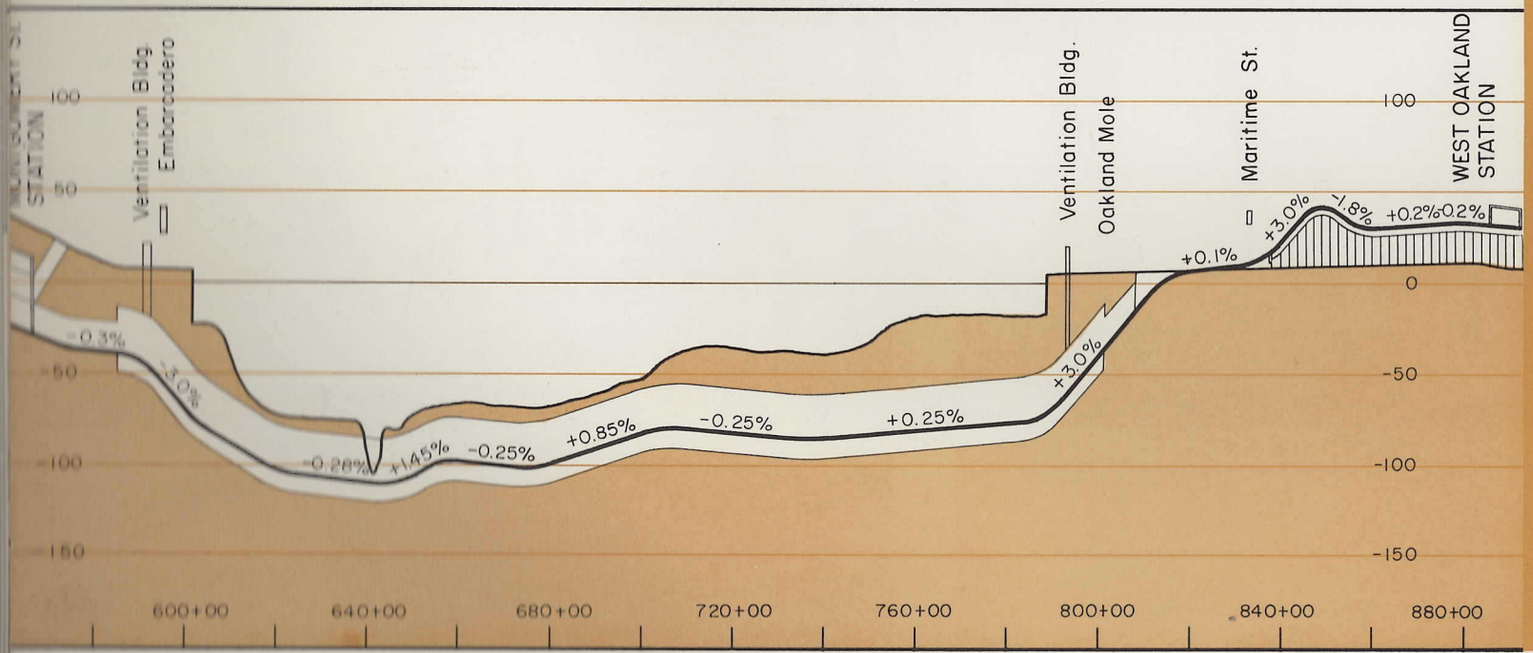


To achieve complete automatic operation of train movement, the control system must be of performing a variety of functions through ed subsystems.

The make-up of each train is determined by and patronage data accumulated in an element *central supervisory control system*. Daily con affecting the movement of people and traffic are ated to determine the frequency and size of tra patched. A coded train number in the *train ide tion system* is available to other control comp along the route, which react to set turnouts for routing and to determine the proper stopping p station platforms.

The *route control system* governs moveme trains between stations by controlling the accele running speed, and deceleration to conform t predetermined speed limits applicable to each of track. A *block control system* performs a function and is capable of overriding all other of control, either manual or automatic, to cause to decrease speed or to stop should it approa close to another train. Thus, a specific minimum ing between trains is always maintained, ma safe speed limits cannot be exceeded, and if a command is not received at all times, the train to a stop.

The *passenger station control system* assume trol of the train as it approaches a station, and matically stops the train at a predetermined p The doors are opened and closed, the train is aut cally started, and the control is returned to the control system.

The *train-borne control system* detects com or transmits information to trackside or othe tions. As a received command is interpreted, th trical controls of the train are altered as neces obey the command.

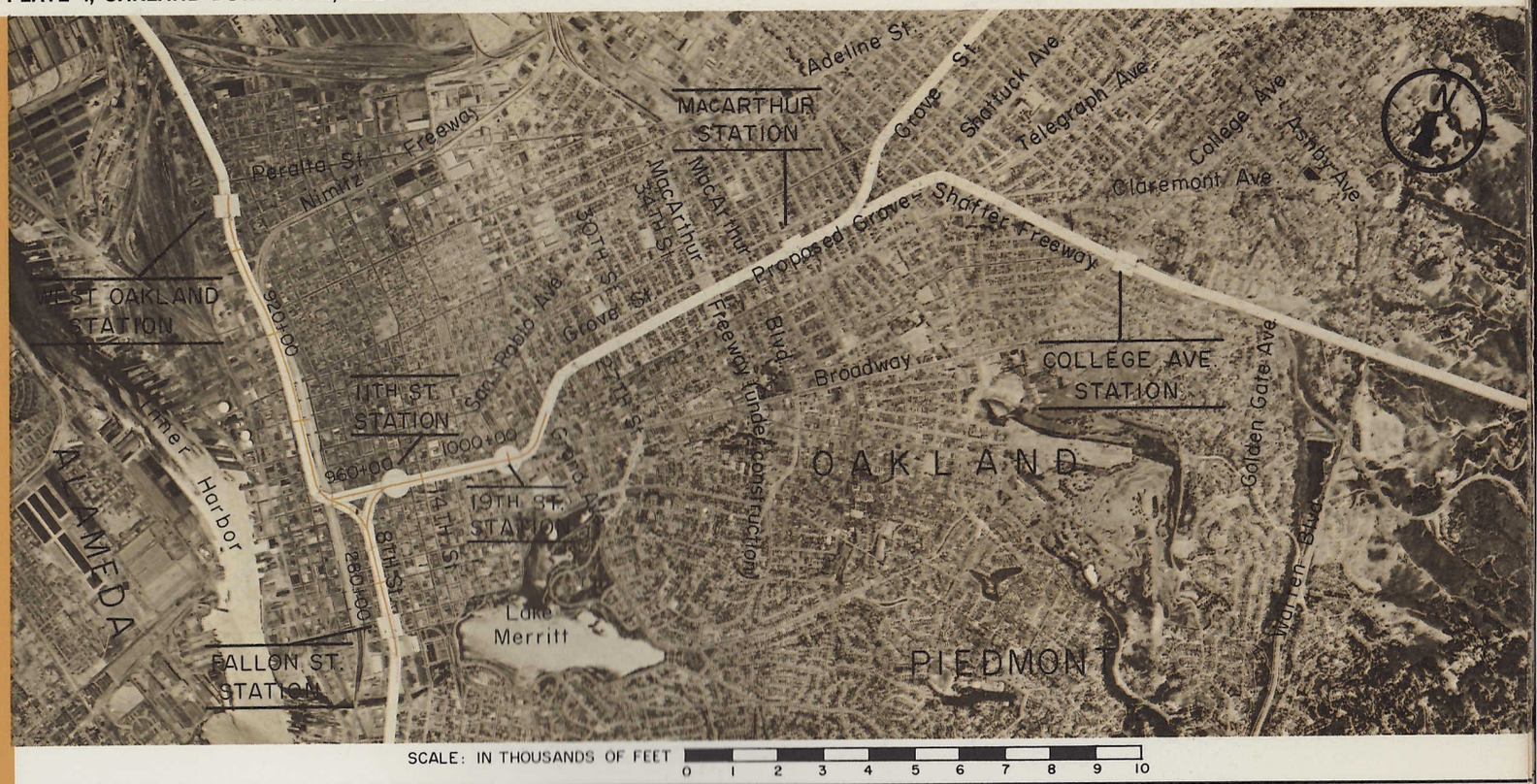
The heart of the automatic control system i dustrial type control computer. This computer tors the operation of the entire system by con checking the location and movement of all trai nouncing abnormal conditions, adjusting the st time at stations to meet local requirements, an forming many other system-wide control functi

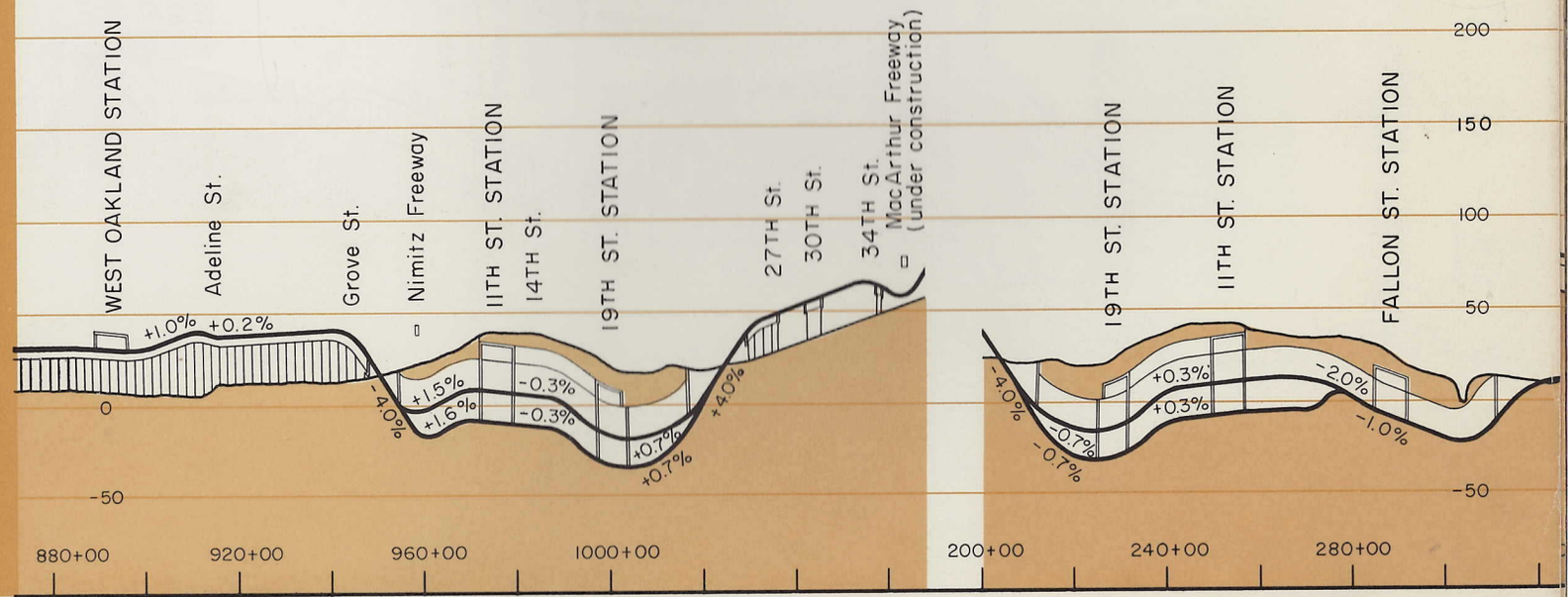
A single attendant aboard each train visually tors the operation of the train. He normally per no function except to observe an annunciator or panel and watch the track for physical obstru The only overriding operating functions he ca form are to reduce speed or stop the train.

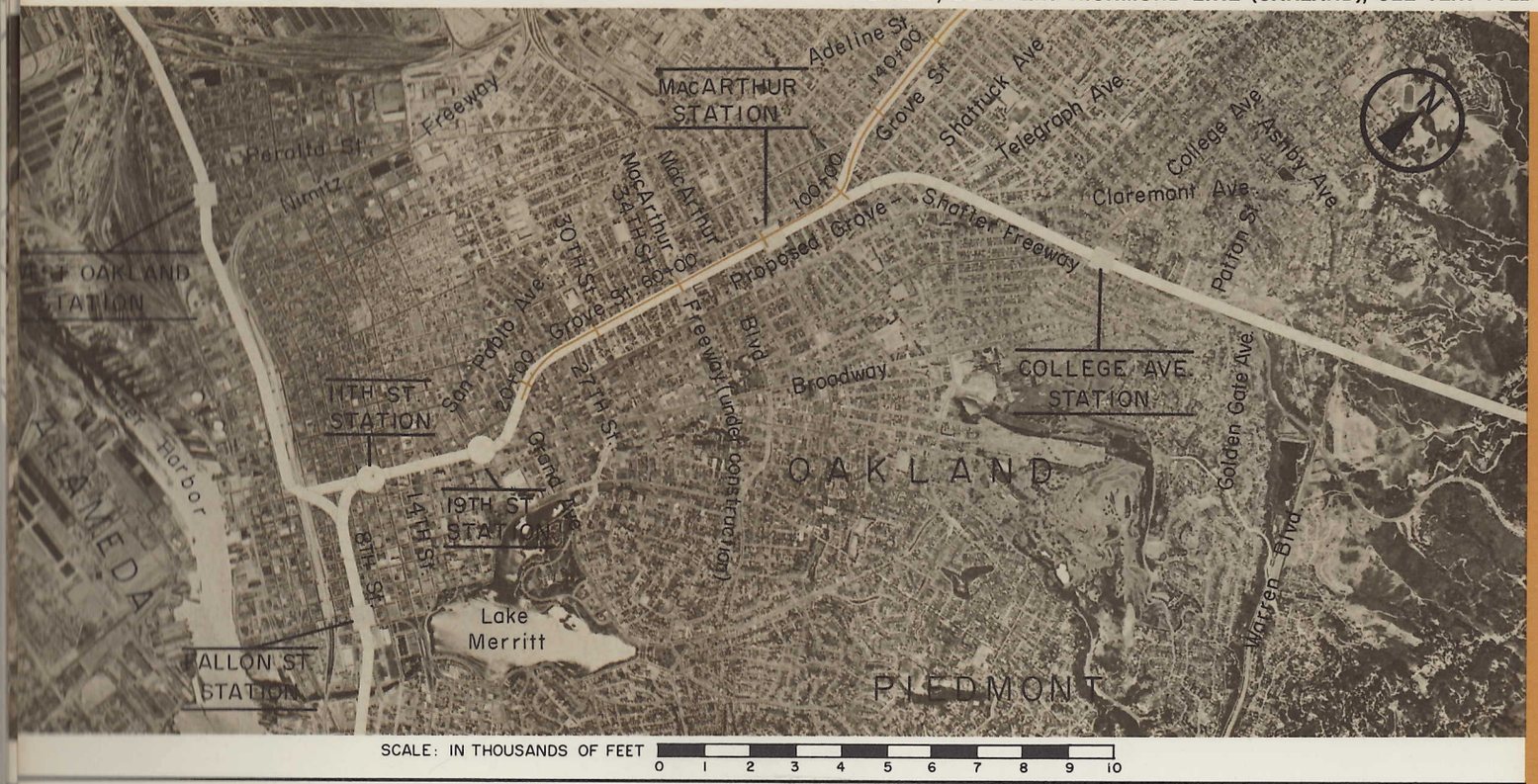
flexibility of control and communications af-
by the automatic control system concept leads
to the incorporation of an automatic charge-
fare collection system designed particularly
convenience of the regular commuter. The
ds of operation of the fare collection system are
ted with the standards established for the entire
concept. Large numbers of passengers must be
modated without delays, and the fare collection
on, whether cash or credit, must be simple, con-
and accurate.
cash-fare passenger purchases a coded card or
for the trip which indicates the boarding point
e fare paid. This permits entry to the system.
destination, the token is deposited in an exit
e which determines whether the correct fare
paid.
charge-account passenger inserts his identifica-
rd in a turnstile, which records his identification
arding point. A similar operation at the exit
e records his destination. This information is
the central digital computer, correlated, and
e added to the rider's charge account. The
account system with its automatic recording and
offers simplicity and convenience for the pas-
This modern method of charging for service is
ed to encourage and retain patronage.

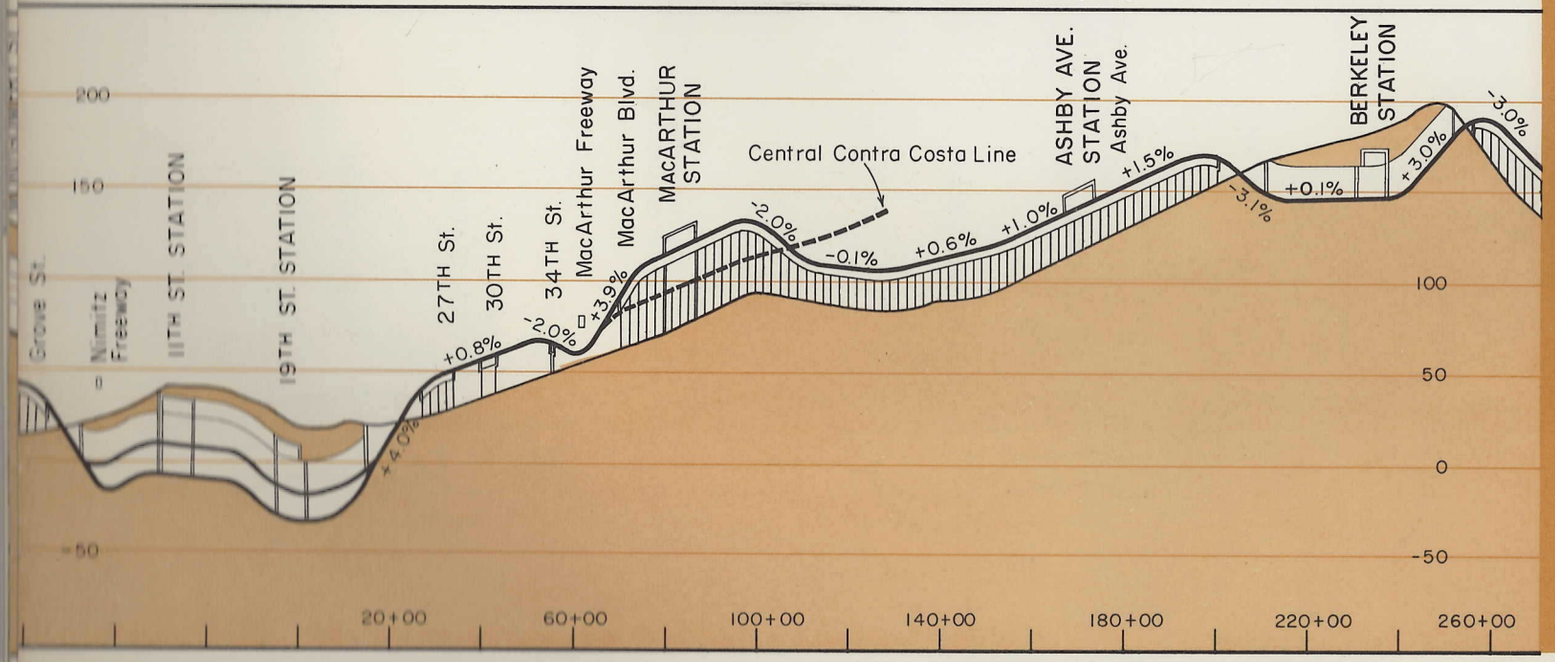
NSIT STRUCTURES

eloping the routes, three basic types of construc-
utilized – surface or on-grade construction,
ed or aerial construction, and underground con-
ion. All three – together with any modification
provide a fully grade-separated right of way.
rapid transit facility can be constructed on
close to the ground surface where appropriate
of way are available or are attainable reason-
This type of construction is often least expensive,
ions are most readily accessible, and it blends
the surroundings. Surface construction is pro-
alongside existing railroads, on median areas of
, and on rural private rights of way.
ssed or open-cut construction is a modifica-
on-grade construction. The transit facility is
in an open excavation, of sufficient depth to
ground-level overpasses to serve cross traffic.
variation is the placing of the facility on fill
ankment above the level of the existing ground.
traffic is then carried through underpasses be-
the transit line.









In aerial construction the transit facility i on narrow elevated structures, making virtu limited circulation available for cross traffic construction is considered acceptable in street a minimum width between building lines of l This provides separation of the transit structu adjacent buildings and results in a light, shad thoroughfare for the pedestrian and the p owner. Aerial structures are located in the c wide streets, on boulevard median strips, a railroads and freeways, and on private rights

Underground construction is the most ex It is utilized only where physical barriers ne it, or where above-surface space is not avail transit or is prohibitively expensive. In unde construction a distinction must be made betw ways and tunnels. As applied to the transit s subway is an underground railway involving accessible from the surface, and it is most usu der an urban street. A subway makes poss direct delivery of passengers to densely built congested downtown centers. A tunnel, on th hand, is a continuous underground passage or under a physical barrier. Examples are th through the Berkeley Hills and the underwat ing of San Francisco Bay.

A prior report concerning the Trans-Bay T submitted by Parsons Brinckerhoff-Tudor-Be the District in July 1960. The "Trans-Bay Tub neering Report" contains a detailed discussio design, construction and alignment of the tu principal observations and findings are:

- Construction of the Trans-Bay Tube is enti sible from the engineering standpoint.
- Stresses induced in the tube by earthquake of sufficient magnitude to exert a contro fluence on the design of the structure.
- Use of a precast concrete tube with metal the underwater crossing between shore p recommended.
- Use of twin shield-driven tubes for the San cisco approach into Market Street will redu interference and disturbance to the Ferry B
- Cut-and-cover construction in a braced should be used for the Oakland approach Oakland Mole.

STATIONS

The regional rapid transit system transports between outlying suburban areas and the cent

y is nd the transit stations are the points where the rtu ers gain access to the system. Those stations in fic urban centers usually collect passengers from ee sidential areas, and it is necessary that loading f l king provisions be made to handle local feeder ctu s such as buses and private automobiles. Sta- ad downtown districts deliver passengers general- p lain walking distance of most business centers, c re the destinations of the majority of the pas- al . At these stations, parking facilities are not ts d.

ex the time of final design each station must be de- n to fit its specific site, purpose, and flow of pa- ail At this present stage of the studies, typical sta- de signs are considered adequate. Typical designs w on-grade, aerial, and subway stations for all s rious combinations of number of tracks, plat- g ypes, mezzanine arrangements, and single and su evel stations.

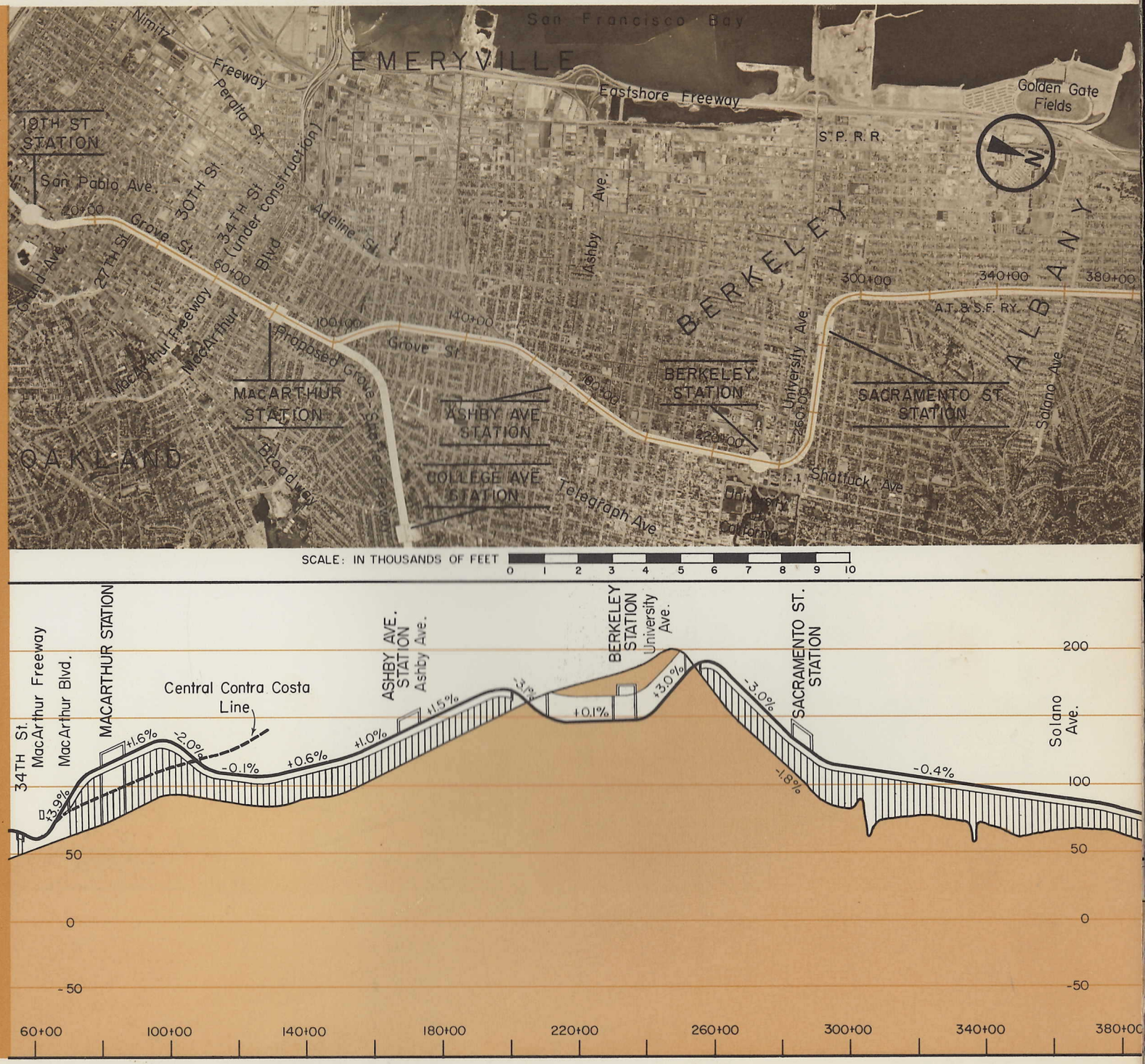
ss quately-wide platforms are provided at all sta- ilt and for safety and convenience, large clear- th are maintained between the platform edges and e lumns, stairwells, and walls. Aerial stations have h s and reversible escalators between the ground t nd platform levels, and subway stations have s and reversible escalators between the mezza- T nd platform levels. Full-length mezzanines are B d in and between all downtown subway stations u ce sidewalk congestion and facilitate direct o to adjacent buildings.

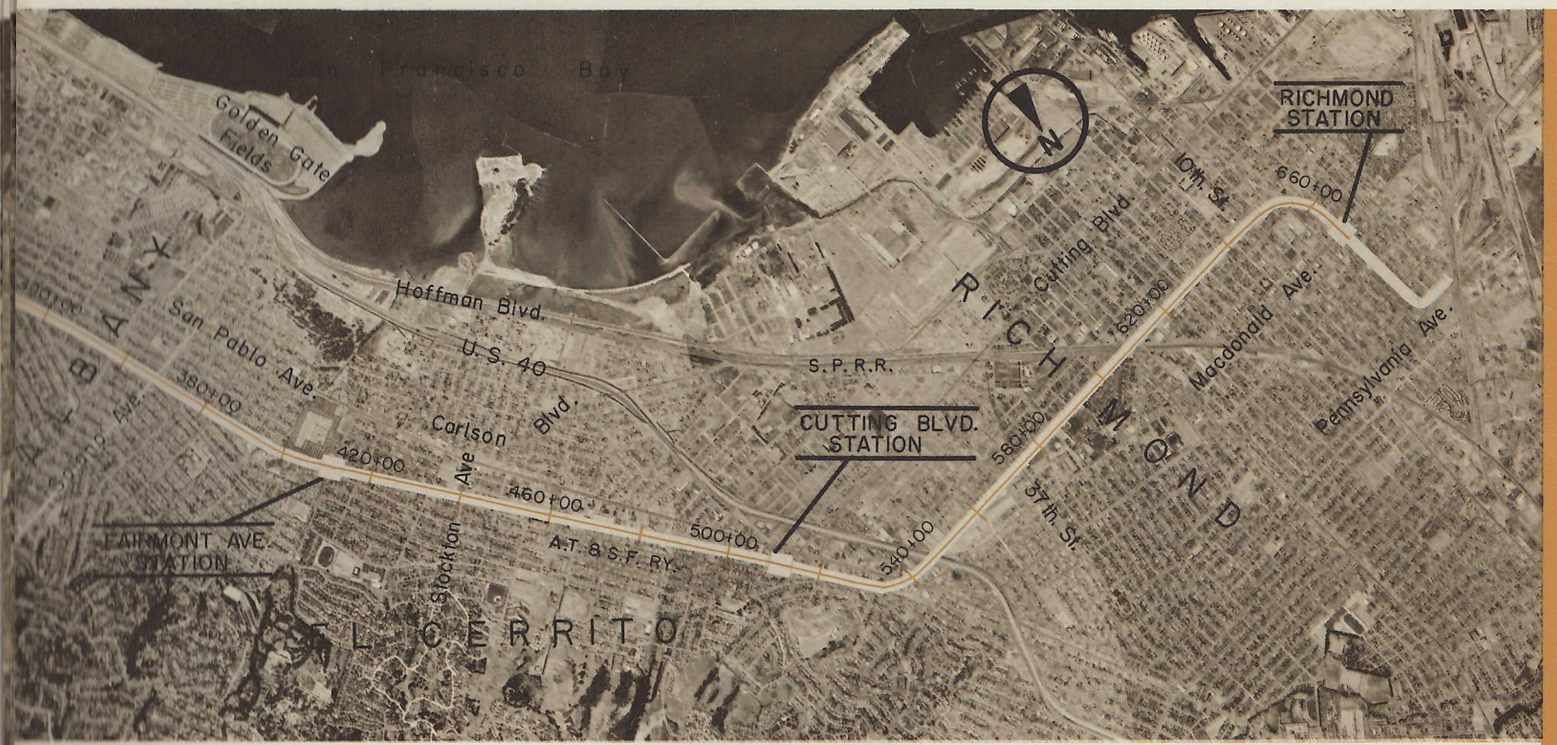
DS AND SHOPS

are three strategically located line yards and one main yard. Each line yard contains tracks for of cars, facilities for making up trains, and for cleaning, inspection, and routine main- of the equipment. The main yard provides for functions and in addition has facilities for major and heavy maintenance.

ROUTES

tern of development in the San Francisco Bay is influenced largely by topography. The princi- ors are well established, and the main travel s are well defined. The proposed system of transit is oriented to serve these centers of de- nd and to follow these established travel corri- Future extensions and possible expansion of the have also been anticipated in the development





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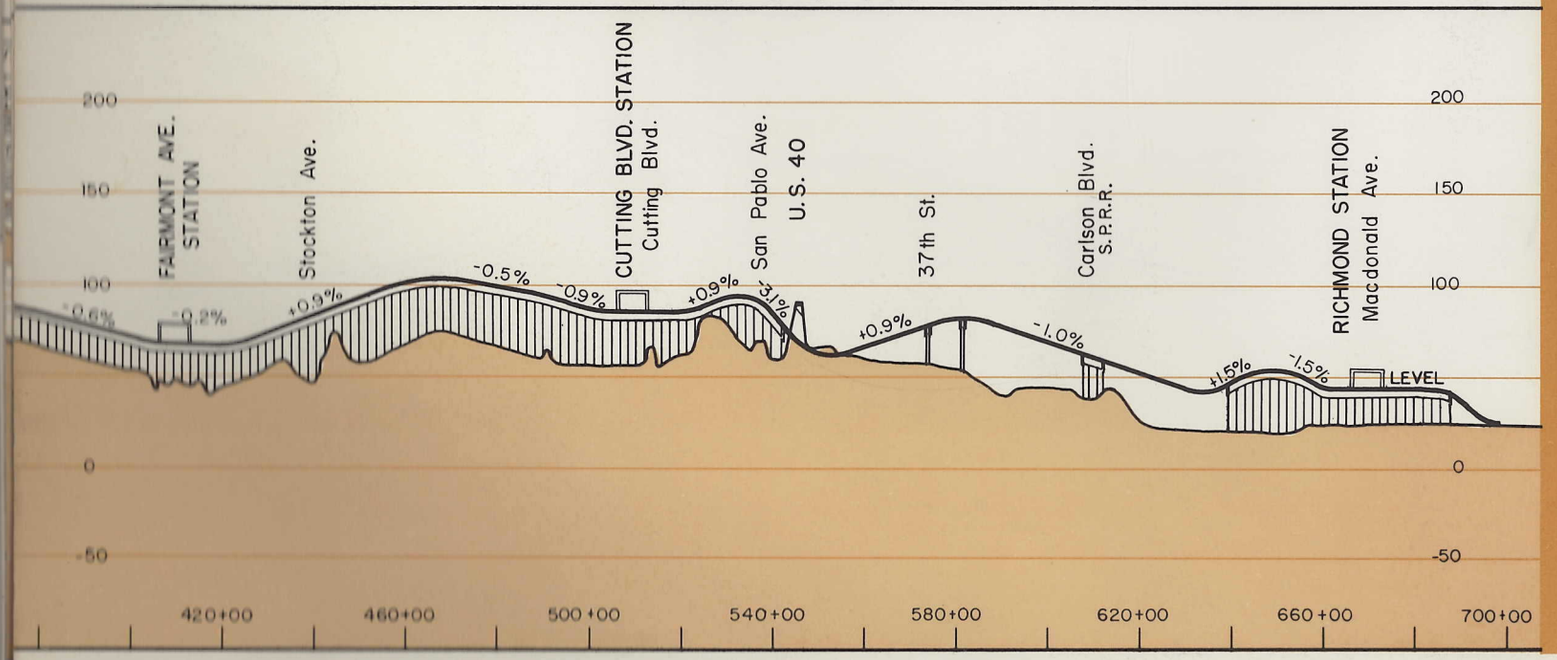


PARSONS BRINCKERHOFF-TUDOR-BECHTEL, ENGINEERS

of routes.

In selecting routes and types of constructio natives and evaluations were presented to t Francisco Bay Area Rapid Transit District in of engineering reports. Upon due considerat consultation with all concerned, the plan whic erally described herein was devised and used a for this report.

The system includes stations serving the do areas of San Francisco and Oakland, which ha business populations. Connecting lines and serve the interrelated communities of the Ba West Bay and East Bay are connected by th Bay line with several rapid transit lines radiati this central-core area.

From downtown Oakland, the Berkeley-Ri Line proceeds through Berkeley and into Cont County. The Central Contra Costa Line pie Berkeley Hills to the east and serves central Costa County. The Southern Alameda Cou serves the south East Bay. From downtown S cisco, the Mission Line crosses San Francisc south and proceeds to Daly City. The Twin Pe serves the western part of San Francisco Co tially through the use of streetcar operations.

For estimating purposes the system is divi eight major segments: San Francisco Downto sion Line, Twin Peaks Line, Trans-Bay Line, Downtown, Berkeley-Richmond Line, Centra Costa Line, and Southern Alameda County L descriptions on these pages specify the segme daries. In the section on estimates, construct are listed for each segment.

In all, there are about 75 miles of two-tra transit line and 37 stations. Underground con is proposed for 20 miles, aerial construction miles, and on-grade construction for 24 mi underground portion includes about 11 miles way, 5 miles of tunnels, and 4 miles of sub tube.

SAN FRANCISCO DOWNTOWN AND TWIN PEAKS LINE

(Plate 1, p. 12)

The San Francisco Downtown element of Area regional rapid transit system consists of track, two-level subway beneath Market Str the Trans-Bay Tube to Van Ness Avenue and track, single-level subway from Van Ness A

…ting Twin Peaks Tunnel.

…Montgomery Street, the lower level of the Mar… …treet subway joins the San Francisco approach … Trans-Bay Tube. This level extends to about …ness Avenue, where it leaves Market Street to … with the subway in Mission Street. The two- …subway proceeds along Mission Street and at …Street becomes the Mission Line.

…upper level and the subway to Twin Peaks are …accommodate rapid transit trains at a future …and will be utilized initially by streetcars of the …ancisco Municipal Railway.

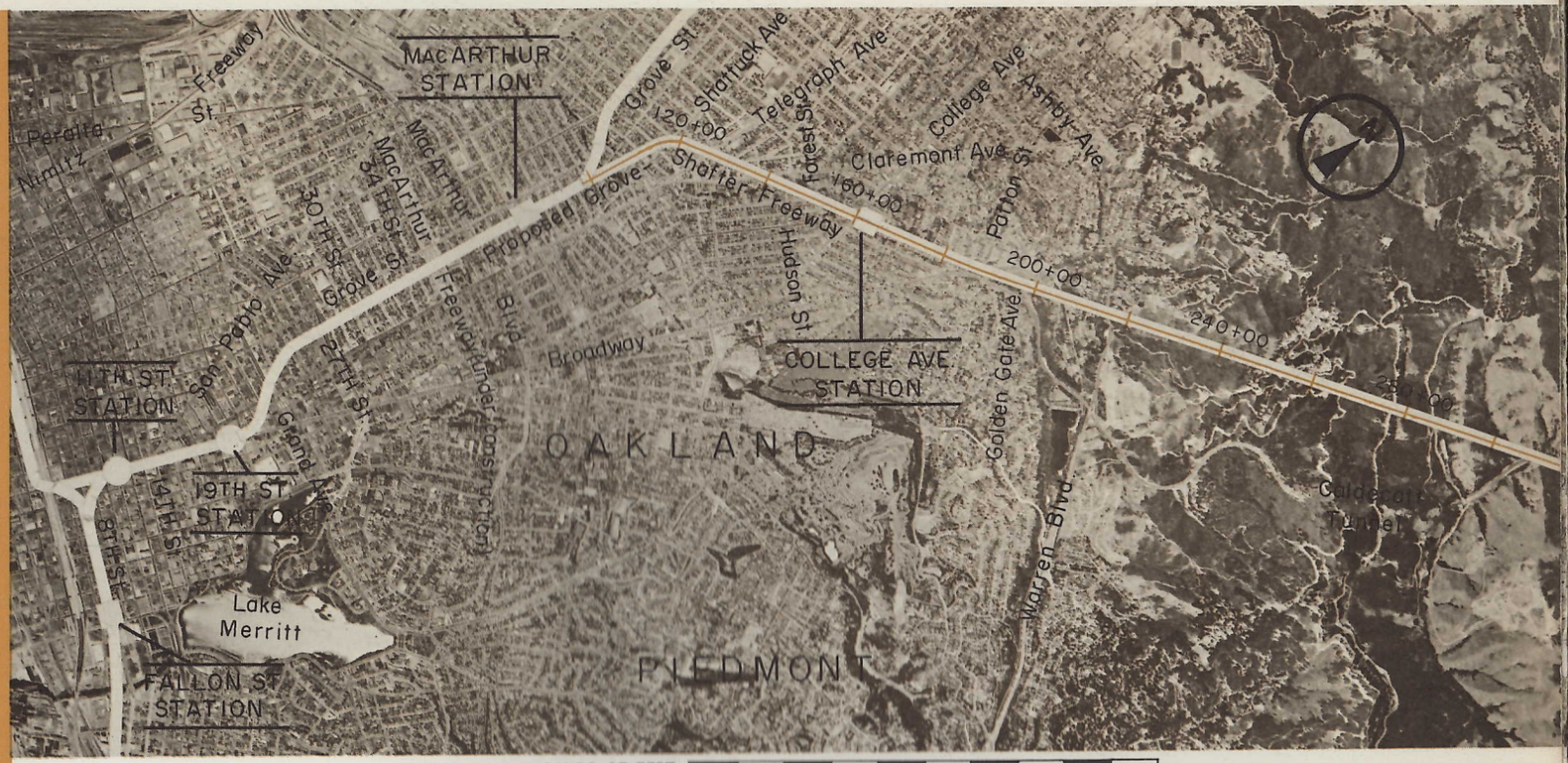
…sh levels of the Market Street subway are served …ee stations in Market Street. The Montgomery …Station serves the financial district; the Powell …Station serves the commercial and shopping …and the Civic Center Station serves the Civic …and vicinity. These stations have full mezza- …and are connected by a continuous mezzanine …ding effective distribution of patrons.

…Market Street west of Civic Center, stations are …ed at Van Ness Avenue, Church Street, and …Street. Ramp connections are provided just off …et Street to surface streetcar operations in Du- …Avenue and Church Street.

…t of Twin Peaks a rapid transit subway for …e by streetcars is planned extending from the …g Twin Peaks Tunnel to a point just west of St. …is Circle where surface operations resume. The …Portal Station is in subway in West Portal Ave- …t Vicente Street. Ramp connections to surface …r operations are included in Ulloa Street and …ern Serra Boulevard. This section west of Twin …is identified as the Twin Peaks Line.

…ll five streetcar lines operate beneath Market …t in the downtown area to the general vicinity of …Street. One-way ramp connections are provided …h Front and Davis Streets between California …t and Market Street to permit the return to sur- …perations.

…e Market Street subway and the connection to …Mission Line are 1.9 miles long and include three …. The Market Street connection to the existing …Peaks Tunnel is 1.4 miles long and includes …stations. The Twin Peaks Line is 0.8 miles long …cludes one station.



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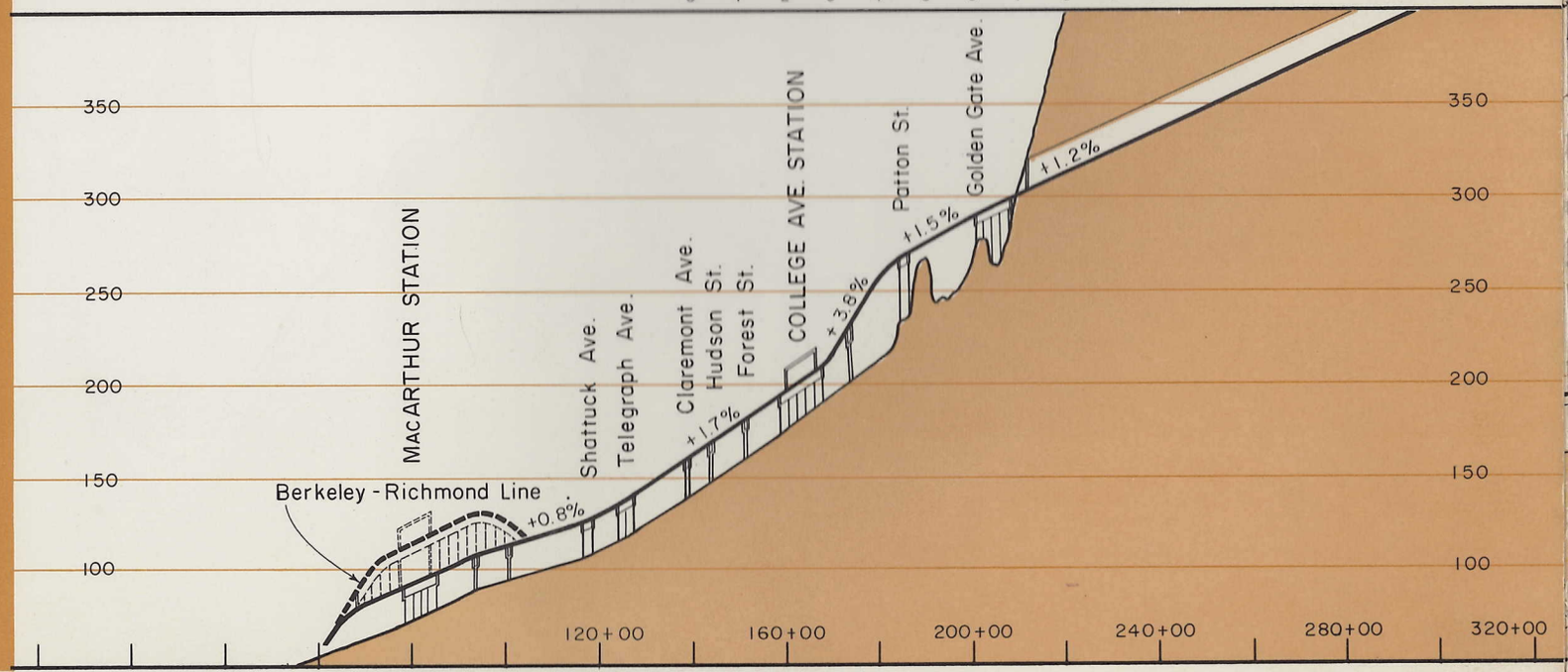

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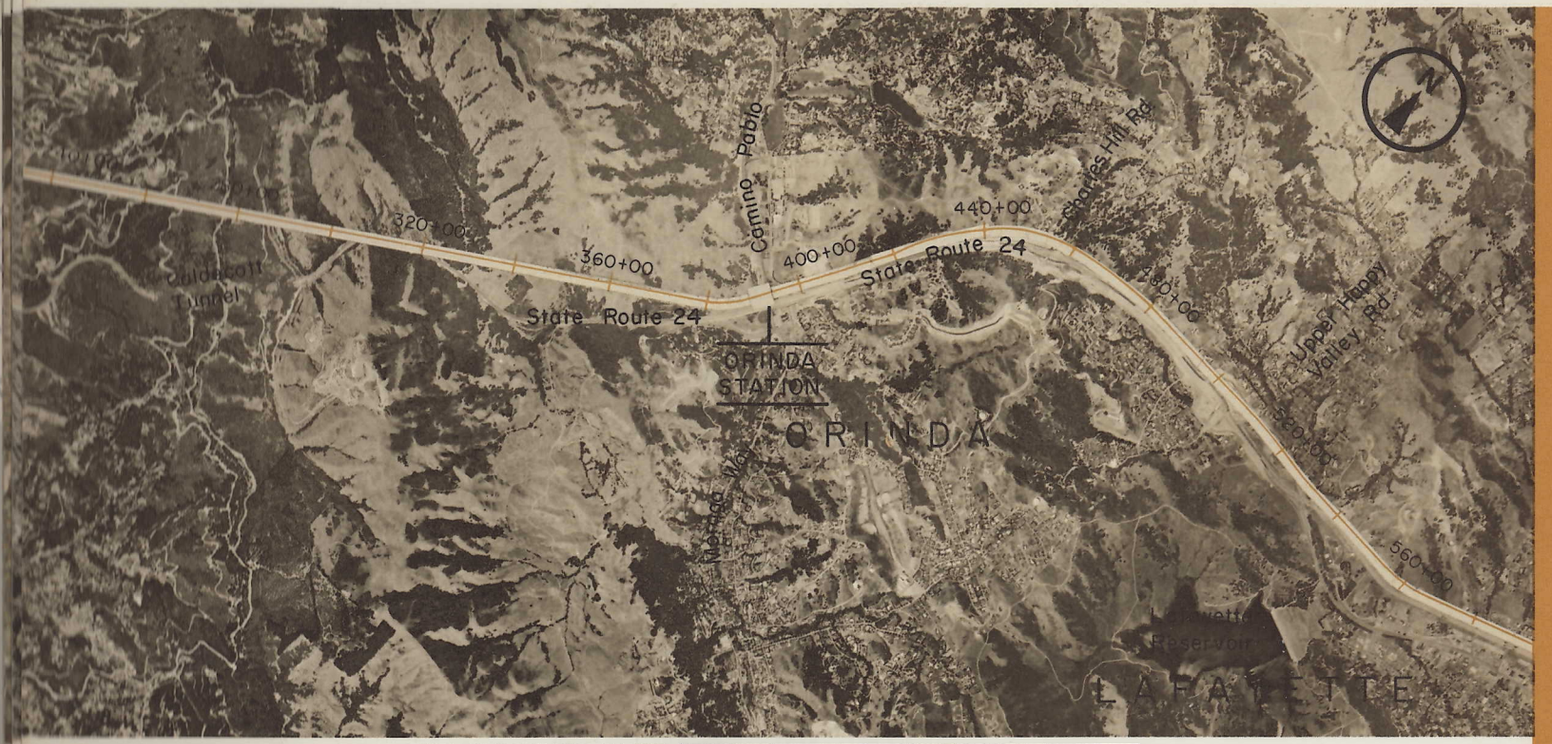

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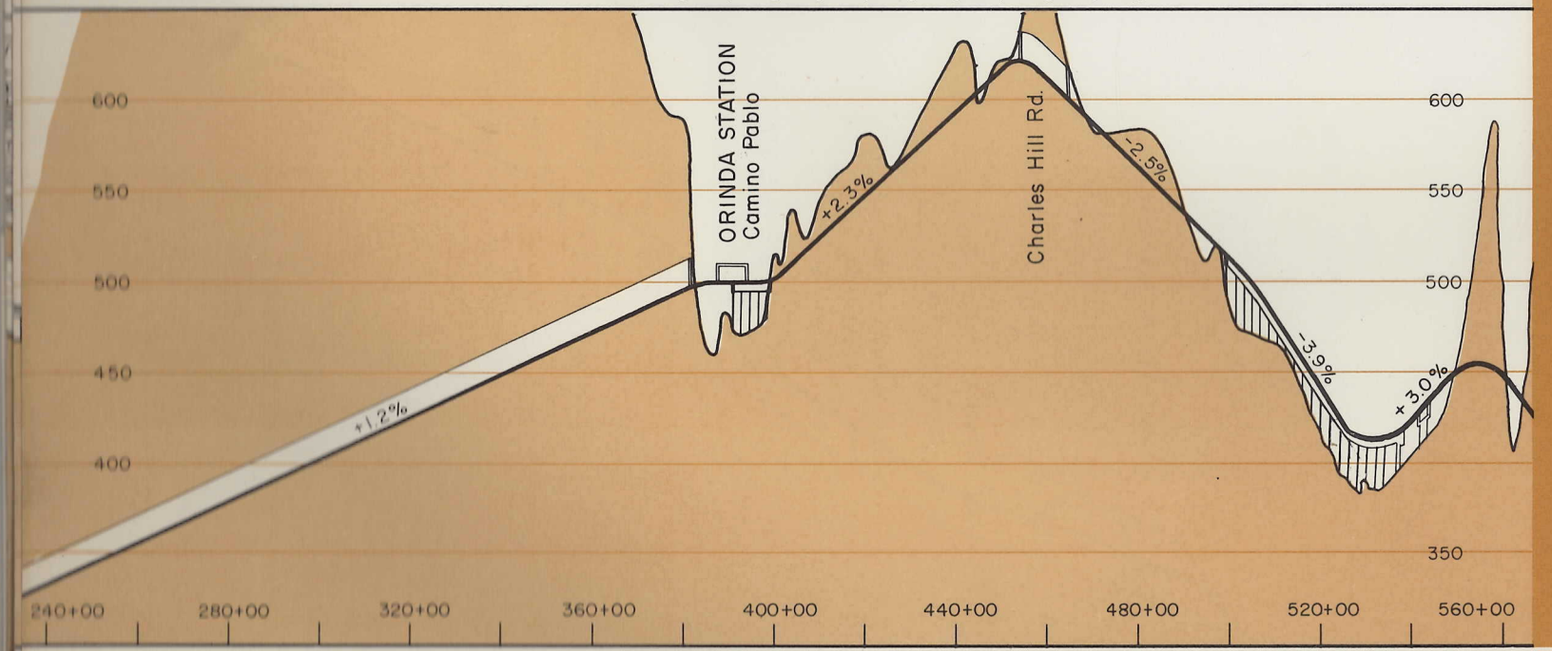


MISSION LINE

(Plate 2, p. 13)

The Mission Line leaves San Francisco Downt Mission Street, beginning at 14th Street. T track, single-level subway beneath Mission S cludes stations at 16th and 24th Streets in the District.

Near 30th Street the subway leaves Missio and swings westward through a tunnel under Heights to a subway station beneath Diamon at Bosworth Street. Continuing underground crosses under Monterey Boulevard and en alignment of the Southern Freeway.

At the Baden Street overcrossing the trac to the surface in the median of the freeway Ocean Avenue a center-platform station is At Sickles Street the tracks leave the freeway in tunnel beneath the eastbound Southern lanes, Alemany Boulevard, and San Jose Ave on-grade section between the freeway and Street carries the line into Daly City.

Entering Daly City the line rises on aerial s along the east side of the proposed Junipe Southern Freeway interchange to a termina just north of Knowles Avenue.

The Mission Line is 6.0 miles long and incl stations.

THE TRANS-BAY LINE

(Plate 3, p. 14)

The Trans-Bay Line consists of the Trans-B and its approaches, connecting San Franci Oakland.

The San Francisco approach joins San F Downtown at the east end of the Montgome Station in Market Street and extends to the we lation building located at the south corner of barcadero and Market Street. The Market St way is extended by cut-and-cover constru Beale Street, where the upper level turns in Street. There a transition section from the lo leads to twin shield-driven tubes which carry t beneath The Embarcadero and the south win Ferry Building.

The Trans-Bay Tube begins at the west ve building and extends across the Bay to the ea lation building. The subaqueous tube follows ment between Piers W4 and W5 of the San Fr Oakland Bay Bridge and to the opposite shor

d Mole the tracks come to surface after passing
h a subway section.
e Oakland approach to the tube extends from
t ventilation building to the West Oakland Sta-
he tracks are on grade leaving the Oakland
passing beneath the Maritime Street overpass.
e rises on aerial structure to cross over tracks
Southern Pacific Railroad and to occupy the
of a widened 7th Street. Proceeding east on
eet to Peralta Street, the Trans-Bay Line reach-
West Oakland Station, which is the beginning of
kland Downtown segment.
Trans-Bay Line including the tube and its ap-
hes is 6.0 miles long.

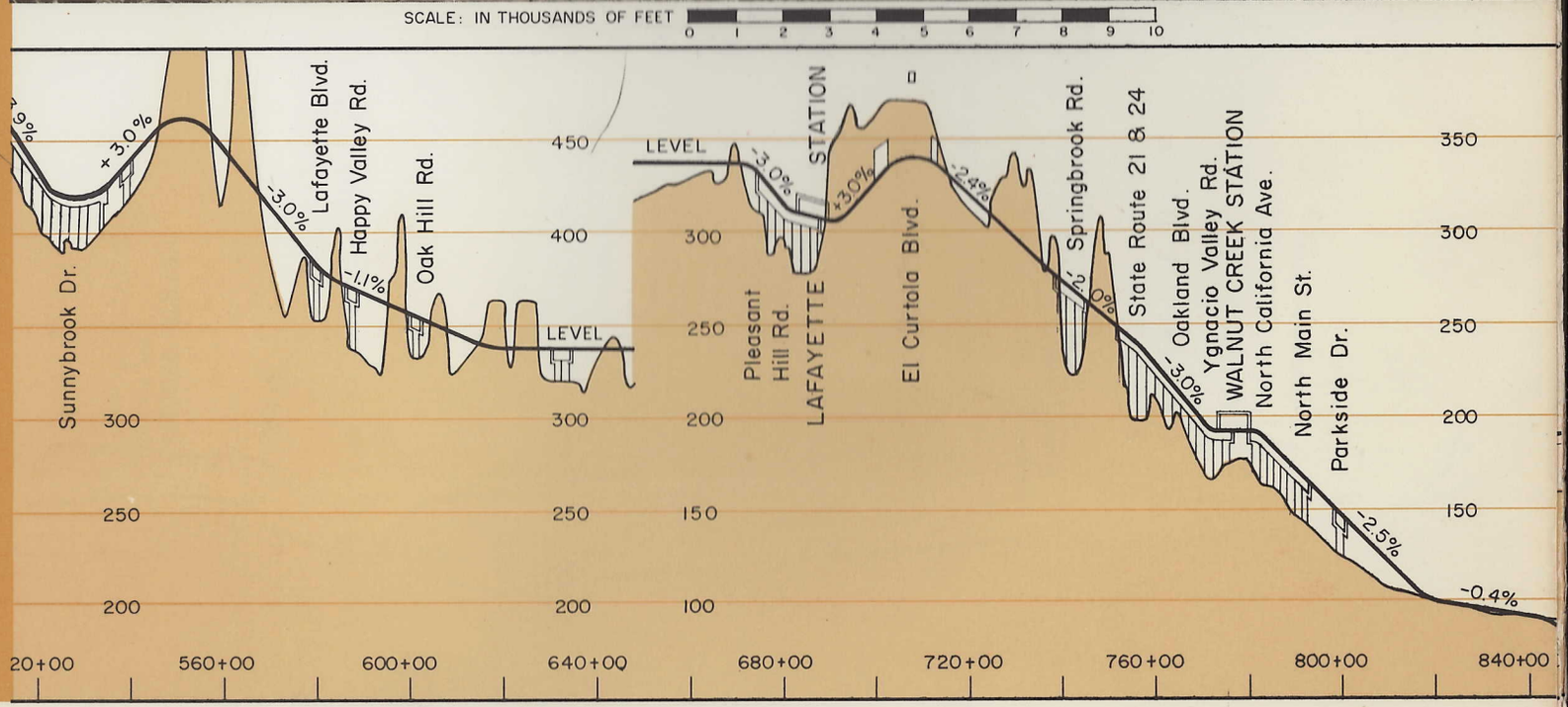
LAND DOWNTOWN

4, p. 15)

Oakland Downtown segment is the junction of
es radial East Bay lines and the Trans-Bay Line.
ute into downtown Oakland from the Trans-
ine begins at the West Oakland Station near Pe-
street. The line is on aerial structure in private
of way, paralleling 5th Street. At Grove Street
descends to subway, curves northward, and
beneath Washington and 5th Streets, the ele-
Eastshore Freeway structure, and Broadway. Un-
ound track connections permit direct movement
ins between the Broadway subway, the Southern
ia County Line and the Trans-Bay Line.
e heart of the Oakland complex is the three-
two-level subway in Broadway. On the two-track
level, northbound trains operate to Richmond
ound along with express trains to and from San
On the lower level, southbound trains op-
to Fremont or San Francisco. This complex in-
the 11th Street Station and the 19th Street Sta-
both have mezzanines which are connected by
underground mall or walkway, providing distri-
of patrons to the street level and to adjacent

th of the 19th Street Station, the subway curves
ward the Grove-Shafter Freeway and pass-
th private property, 23rd Street, Telegraph
and West Grand Avenue to a portal marking
tion between the Oakland Downtown segment
the Berkeley-Richmond Line. In this section the
subway becomes a three-track, one-level

Downtown also includes the subway in
which joins the Southern Alameda County



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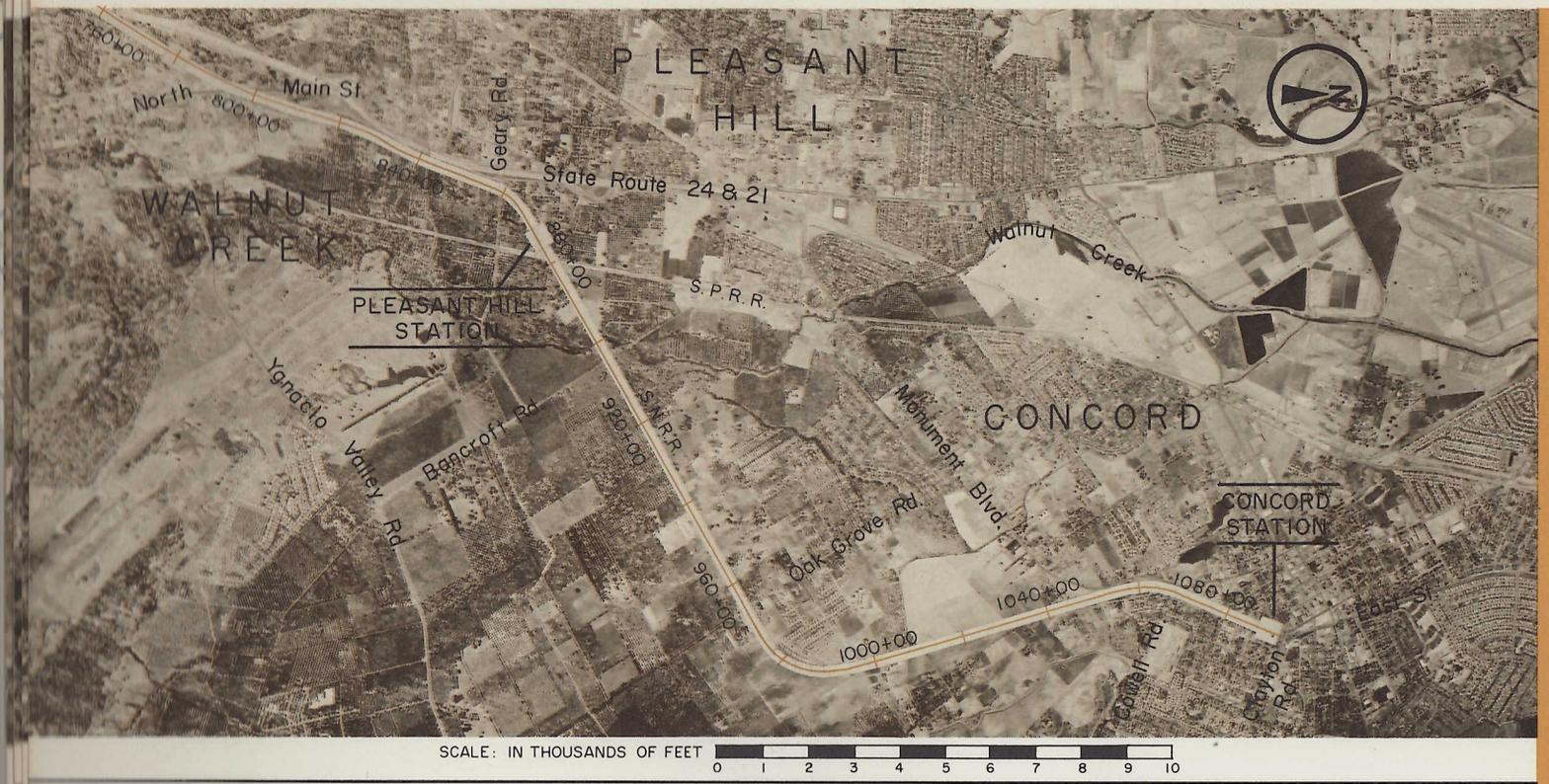
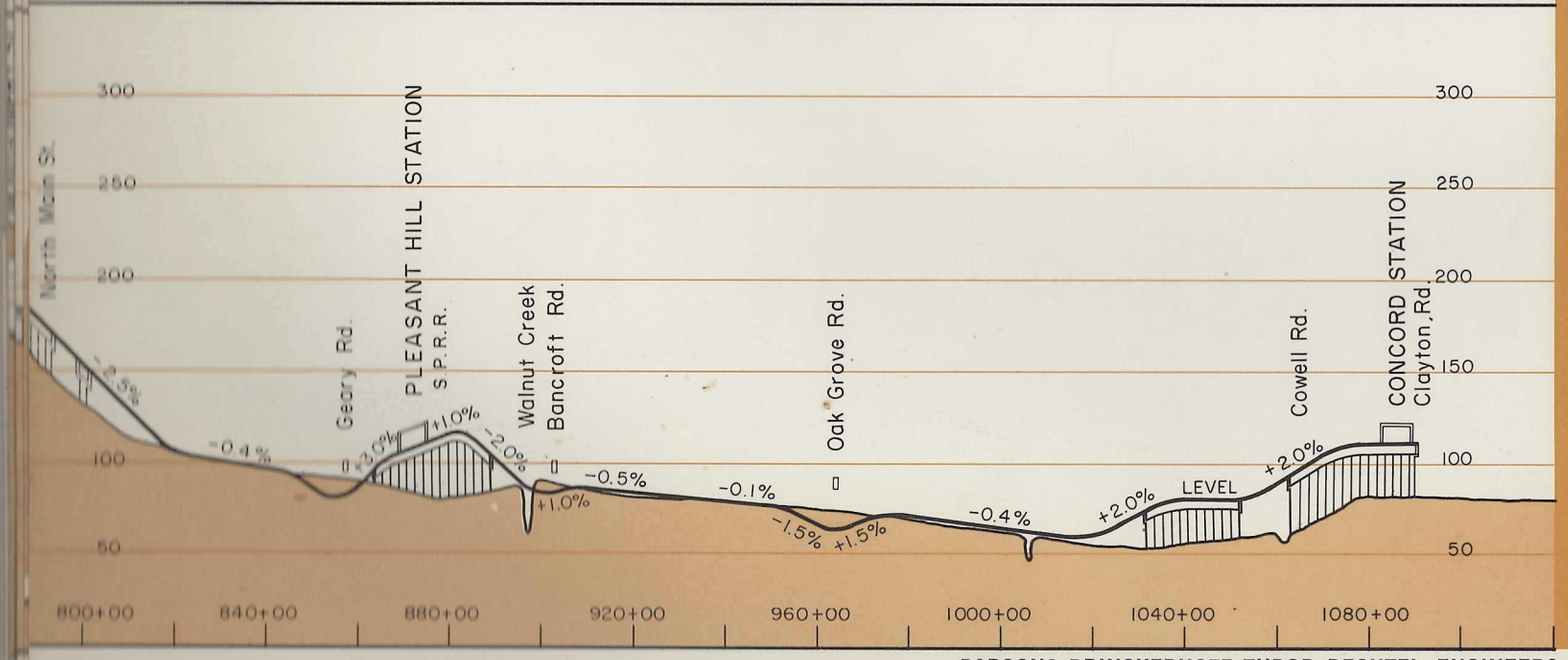




Line south of the Fallon Street Station.

Oakland Downtown, including the connectio Trans-Bay Line and to the Southern Alameda Line, is 3.2 miles long and contains four stati

THE BERKELEY-RICHMOND LINE

(Plates 5-7, pp. 16-18)

From the northern portal of the Broadway the Berkeley-Richmond Line enters the media Grove-Shafter Freeway, passing beneath th bound freeway lanes. The line, three track point, continues on embankment or on stru the same grade as the freeway. At 32nd St rapid transit right of way widens to accomm fourth track. All four of these tracks pass be MacArthur Freeway before the center pair rises on structure to approach the MacArthu at 40th Street. This station has two track le lower two tracks continue as the Central Con Line in the freeway median toward the Berke Tunnel. The two tracks to Richmond depart upper level of the MacArthur Station and c the southbound freeway lanes. Commencing Street in Oakland, the aerial line proceeds from the freeway to Grove Street.

Along Grove Street, from 45th Street to 63 the aerial transit line is in the street median. mode of construction is continued northwa Adeline Street to the Ashby Avenue Station, located in the center of the street, approxima way between Woolsey Street and Ashby Aven the station the line continues northward al tuck Avenue to Derby Street, which marks t ning of a transition from aerial structure to The subway portal is located at the south Dwight Way.

Subway construction is continued through Berkeley, passing through the Berkeley Statio ter Street and emerging from a portal on the of Milvia Street. The Milvia Street portal beginning of a transition back to an aerial occupying the median of a widened Hearst A the Sacramento Street Station. The line cur ward at Francisco Street to join the Atchison and Santa Fe Railroad right of way. From to Richmond, construction consists of aerial along the west side of the railroad. Stations a at Fairmont Avenue and immediately south o Boulevard in El Cerrito.

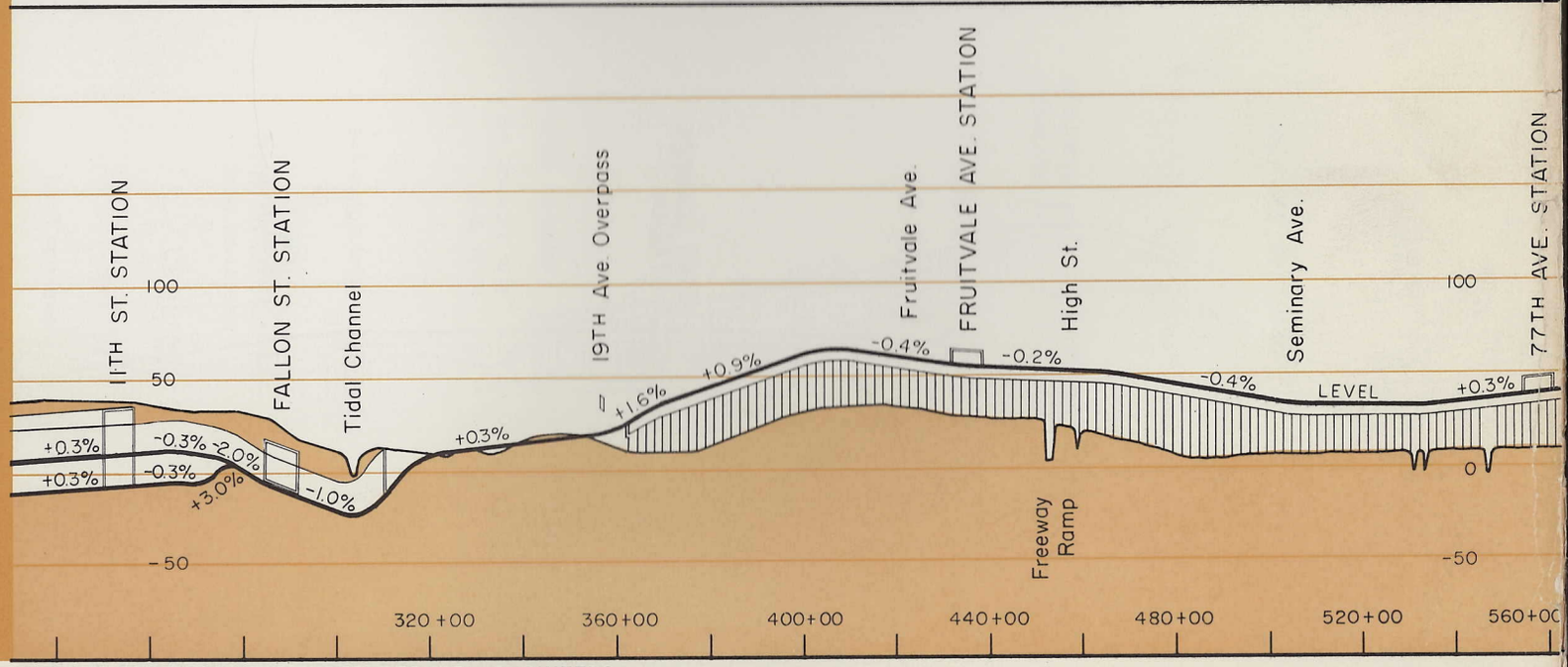
The route enters Richmond parallel to the

of way, passes beneath the Eastshore Freeway
remains to the south of the railroad. Construction
side the railroad is on embankment. At 10th
the line crosses over the Santa Fe tracks on
structure and turns into the Richmond Station
donald Avenue between 5th and 6th Streets in
mond. North of the station the line descends to
to enter the maintenance and storage yard ad-
to Pennsylvania Avenue.
Berkeley-Richmond Line is 12.8 miles long
seven stations.

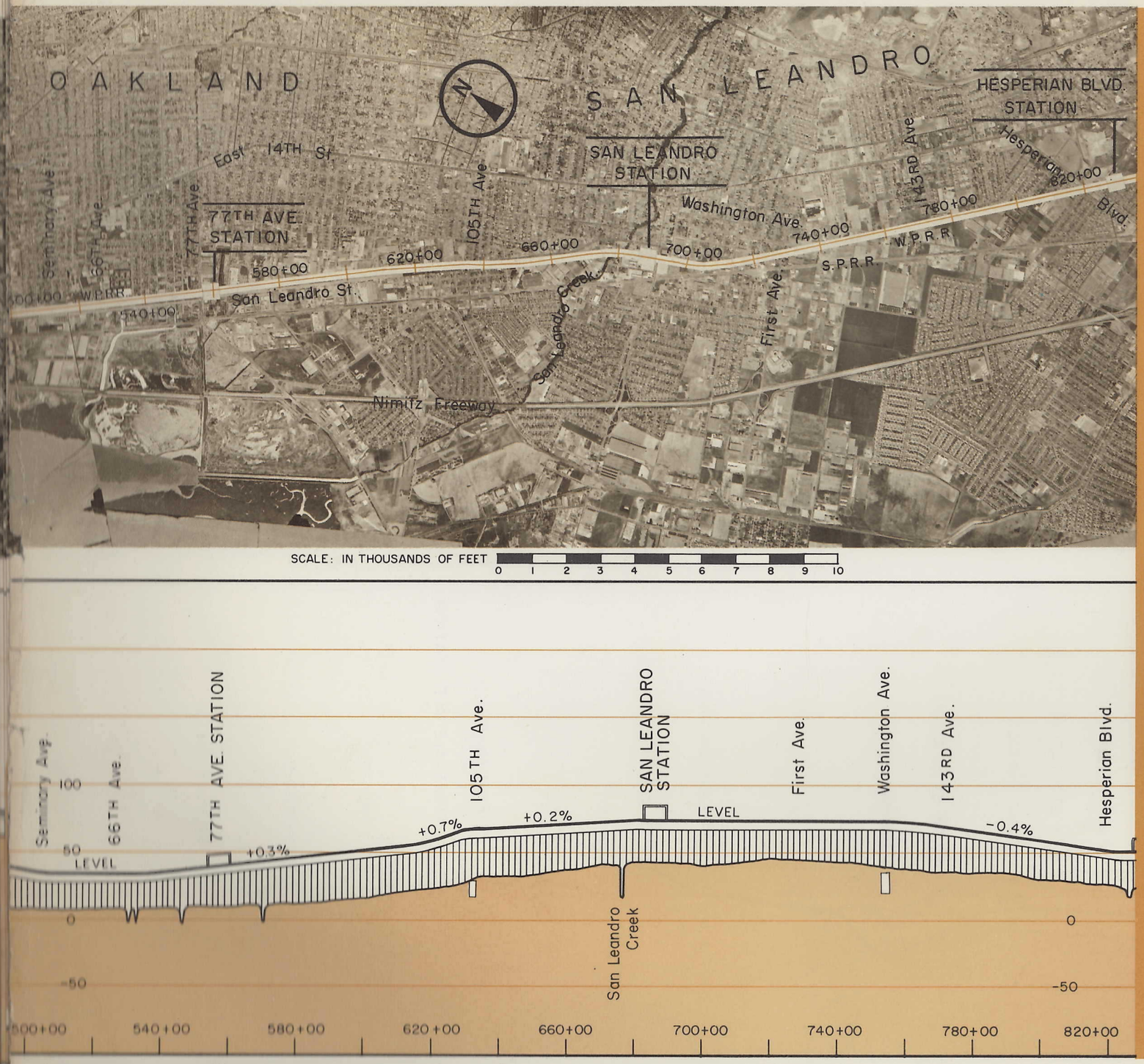
RAL CONTRA COSTA LINE

8-11, pp. 19-22)

entral Contra Costa Line begins north of the
rthur Station at grade in the median of the ele-
Grove-Shafter Freeway. A station is provided at
Avenue. The line continues in the median of
eway to Patton Street where the rapid transit
leave the freeway by crossing in subway under
bound freeway lanes and enter a 3.3-mile tun-
the north of, and far below, the existing Calde-
unnel. After entering Contra Costa County and
ing from the tunnel at the Orinda Station, the
es on aerial structure over the ramps of the
Route 24-Camino Pablo interchange.
eeding easterly the line remains on the north
parallel to the freeway all the way to the State
21 State Route 24 interchange in Walnut Creek.
Orinda Station to Acalanes Road interchange
Lafayette, construction is on grade except for a
under the crest of the hill at Charles Hill Road.
bridges over the ramps of the Acalanes Road
change, Upper Happy Valley Road, and Sunny-
Drive, then continues eastward on embankment
to the Pleasant Hill Road interchange.
structures are included at Lafayette Boulevard,
Valley Road, Oak Hill Road and the aqueducts
East Bay Municipal Utility District. Aerial struc-
ries the line over the Pleasant Hill Road inter-
to the Lafayette Station.
the Lafayette Station to the State Route 21-
24 interchange, the line continues on grade,
on embankment except for short under-
portions beneath the ramps of El Curtola
interchange and aerial structure over Hill-
Springbrook Roads. The line crosses the free-
erial structure at the Oakvale Road overpass
Creek and continues on structure along and
Boulevard to the site of the Walnut



PARSONS BRINCKERHOFF-TUDOR-BECHTEL, ENGINEERS



Creek Station just north of Ygnacio Valley R station is located generally between Riviera a California Avenues.

North of the Walnut Creek Station the li over North California Avenue on aerial stru an alignment along the Sacramento-Northern right of way. After crossing North Main Stree proceeds on embankment and on grade, ex street separation structures at Parkside D Geary Road. After crossing under Geary line rises and utilizes aerial construction to t ant Hill Station in Walden.

Beyond the Pleasant Hill Station the line to grade after crossing over the Southern Pacif Structures provide for Bancroft and Oak Gro to cross over the rapid transit tracks. The rap tracks are on grade east of the Sacramento- Railroad to San Miguel Road and then ascend structure and proceed into the Concord S Clayton Road. A transit vehicle storage yard between the Pleasant Hill and Concord Stat

The Central Contra Costa Line is 18.9 m and includes six stations.

SOUTHERN ALAMEDA COUNTY LINE

(Plates 12-16, pp. 23-27)

The Southern Alameda County Line begins Exposition Building and beyond the Fallon S tion in 8th Street in Oakland. Proceeding s the subway leaves the alignment of 8th Stre beneath the channel of Lake Merritt Inlet, follows 7th Street. After passing beneath 5th the tracks come to the surface along the ea the Western Pacific Railroad main line tra rapid transit tracks remain on grade along th until they pass beneath the 19th Avenue ov where they rise on aerial structure and ente dian of East 12th Street. The line continue median to Fruitvale Avenue. Both the Fruit nue Station at 36th Avenue and the transit li ward to 47th Avenue are located immediate the Western Pacific tracks.

At 47th Avenue the line crosses the Weste tracks to occupy a narrow strip between th and San Leandro Street. The line continues this strip on aerial structure to 105th Aven station at 77th Avenue. At 105th Avenue, t ture once again crosses to the east side of th Pacific tracks, remaining there to Hayward. T San Leandro Station is located at Davis St

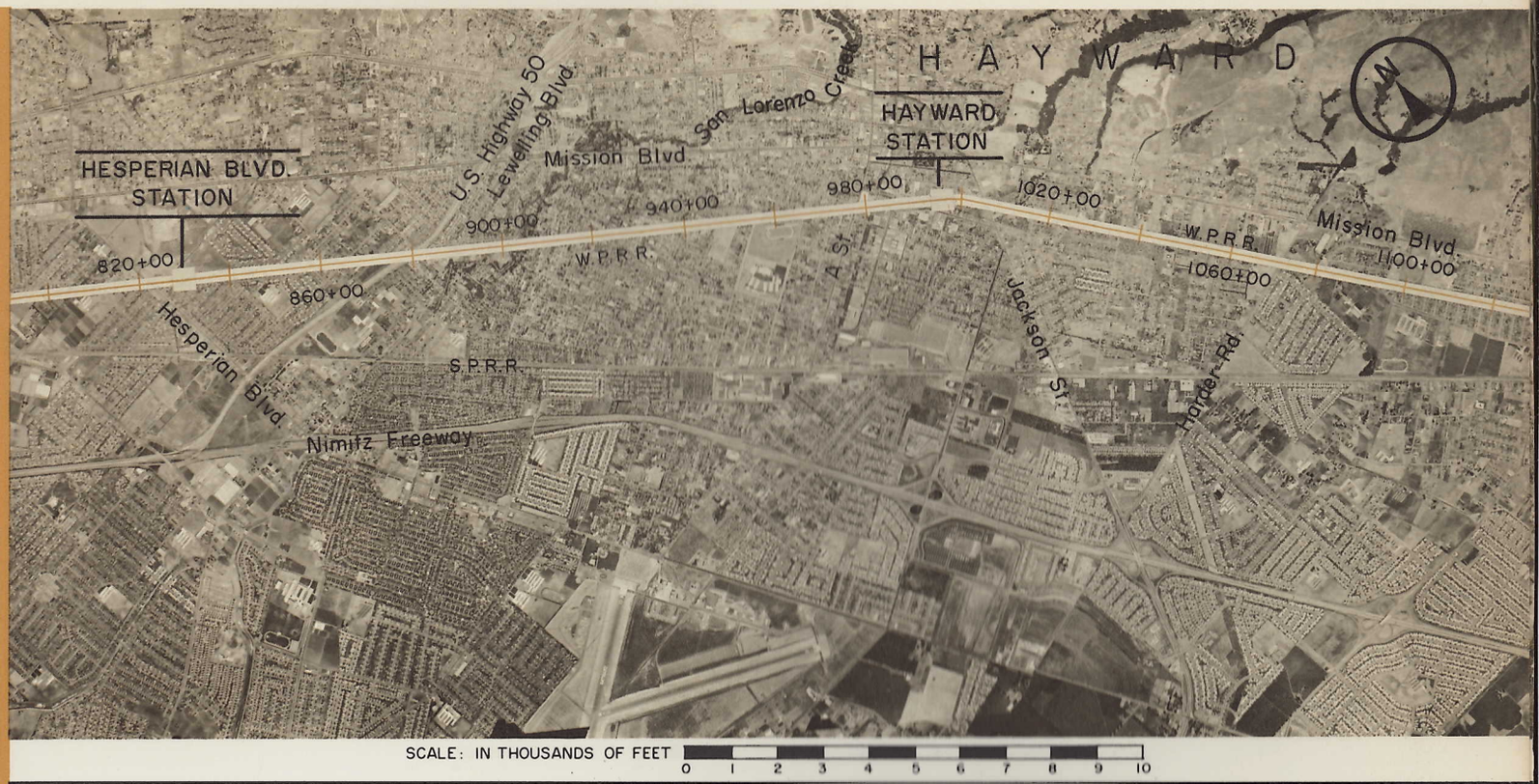
ntinues on structure through San Leandro, and
t station is located at Hesperian Boulevard.
pid transit tracks descend to grade to pass under
ting U. S. Highway 50 structure. Aerial con-
on resumes and continues through Hayward.
ayward Station is located just north of Jackson

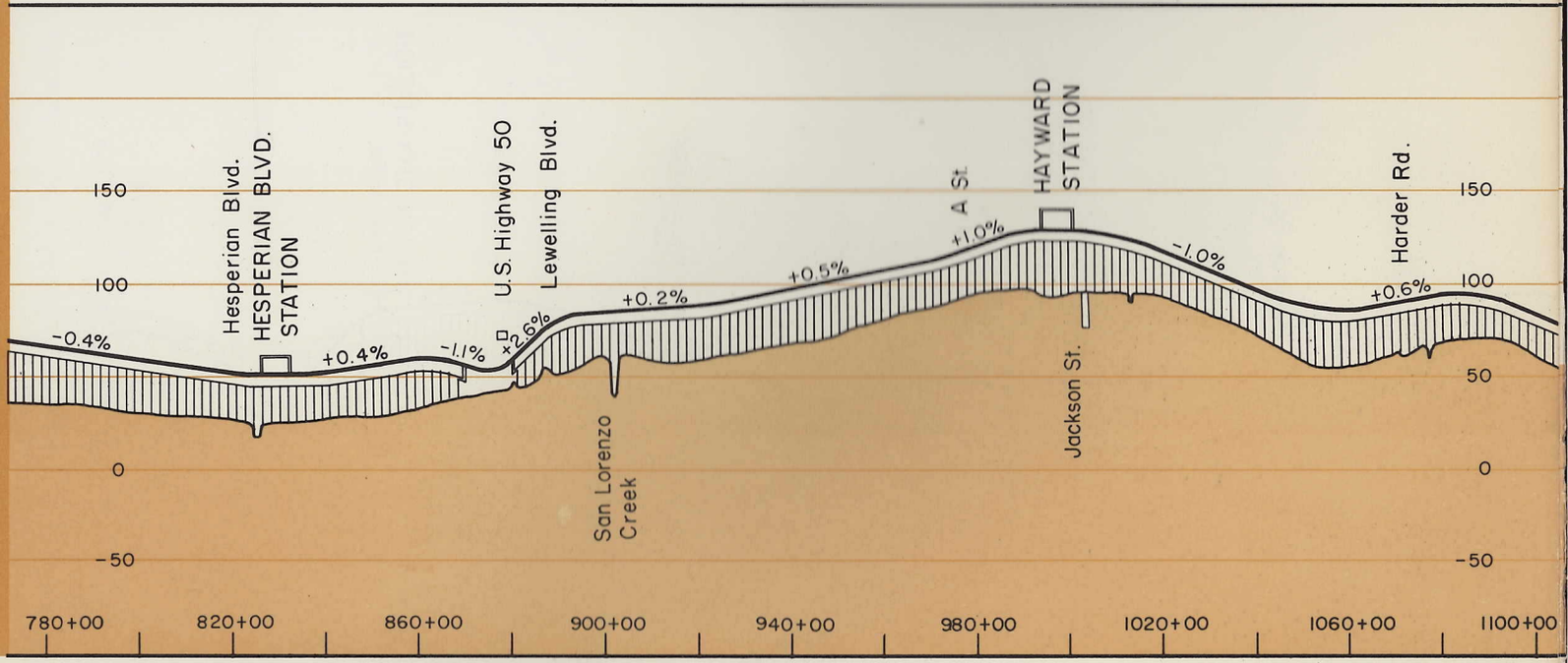
route crosses to the west of the Western Pacific
d immediately south of Jackson Street and
s the railroad. A station is provided at Alquire
nd the Union City Station is located at Decoto
torage and maintenance facilities are provided
ote Road.
Alameda Creek about three miles south of De-
oad, the rapid transit line curves southward
rom the railroad to a terminal station in Fre-
t Mowry Avenue. The Fremont station is orient-
erve the future urban core as planned in the
nt General Plan.
Southern Alameda County Line is 23.0 miles
d contains eight stations.

TRUCTION COSTS

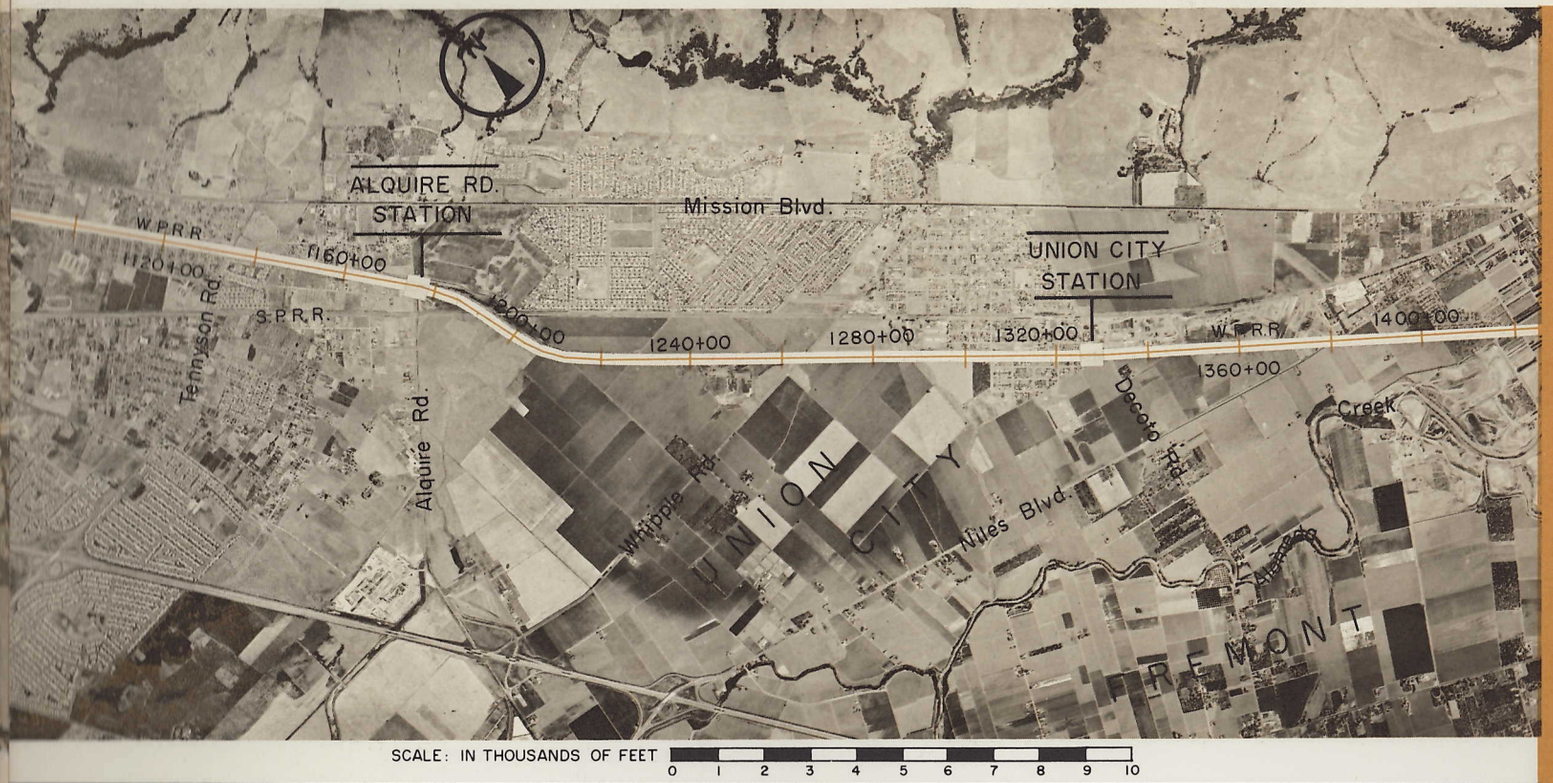
timate of construction costs takes into account
gnificant physical factors as route alignment
de, type of construction, geological conditions,
ning requirements, traffic maintenance, utility
on, and rights of way. It is based on San Fran-
Area price levels with allowances to provide
ure inflation. Included are all costs necessary
design and construction of the described sys-
dy for operation, with the exception of rolling
financing charges, and District administrative
. The construction costs of the system and the
Tube are summarized in the tables on page

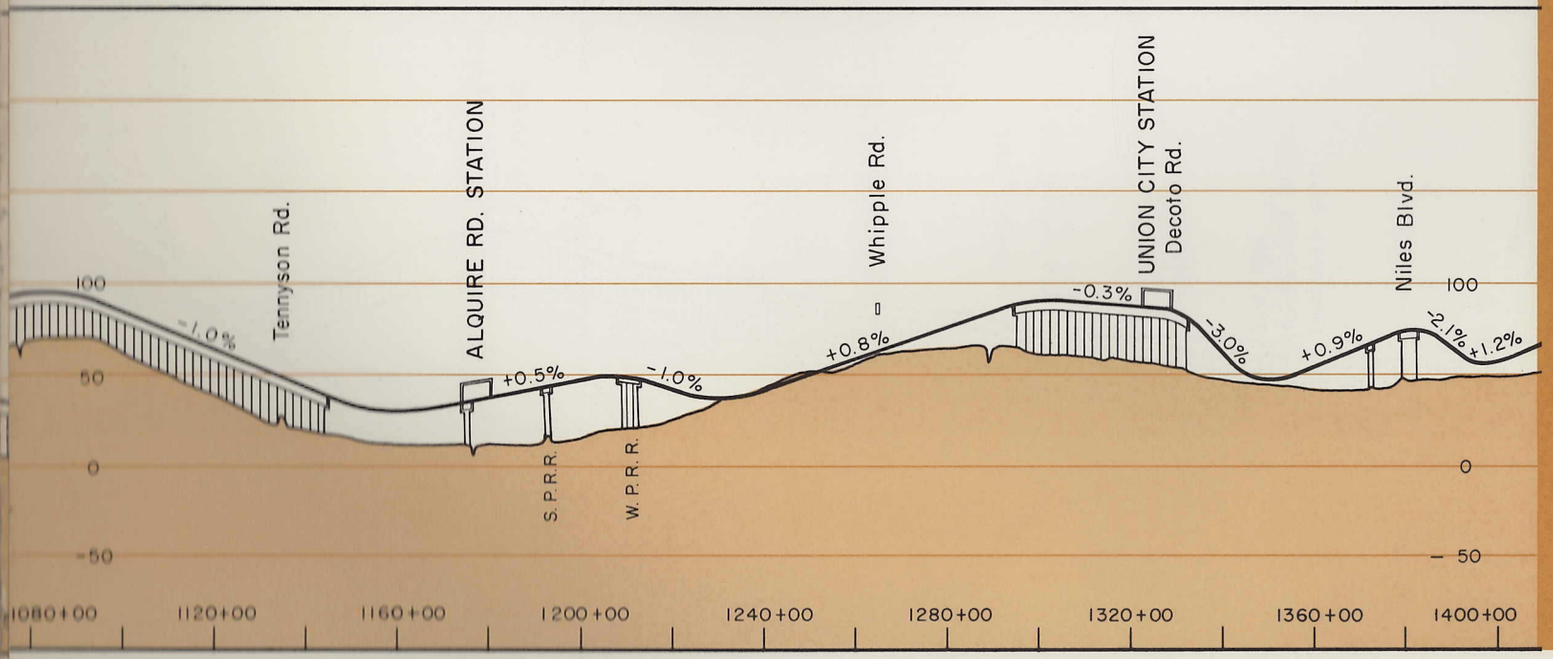
timate has been accurately developed to a
detail commensurate with the thoroughness
location and completeness of design informa-
ilable. Typical designs were prepared for each
of the work in sufficient detail so that accurate
tion of the quantities of materials could be
Construction methods and procedures utilized
work in this and other areas were studied
and the construction methods and cost esti-
major portions of the work were reviewed
ulted consultants.
emphasis was placed on determination of
ity and the extent and location of earth faults
ility of the tunnels; on subsidence problems,





PARSONS BRINCKERHOFF-TUDOR-BECHTEL, ENGINEERS





PARSONS BRINCKERHOFF-TUDOR-BECHTEL, ENGINEERS

ground water, and soil conditions to be enc
and on the materials composing the Bay bot
the route of the tube. Investigation was acc
through actual field inspection by engineer
gists, supplemented by review of geological
gineering reports, and past experience, as
core borings in the bottom of the Bay.

The estimated costs associated with the
underpinning of adjacent structures durin
struction period were established by enlisti
operation of local engineers and architects
ing foundation plans of typical importa
structures along the subway routes.

In order to develop the costs for utility
the respective utility organizations were c
determine the extent of interference that m
ticipated. In some cases estimates were dev
this work by the controlling agency.

The estimated costs of acquisition of
rights of way were established by local sp
perienced in the appraisal of property a
with local trends of real estate values.

The construction estimate reflects wag
material prices in effect in the San Francisc
at the end of the first quarter of 1960, the
the basic estimates were prepared. Careful
cost trends in heavy construction in Cali
throughout the nation during the period
indicates that inflation has substantially inc
struction costs over the years. Allowance
sate for cost increases actually realized sinc
for a probable continuing inflationary trend
major portion of the construction period
this project was considered a necessary
estimate. Accordingly an amount of ap
153 million dollars was provided in the
the system and the Trans-Bay Tube. This
least five per cent for the inflation actually
since the basic estimates were prepared an
teen per cent for a future allowance.

The cost of the rapid transit system, in
Trans-Bay Tube and its approaches, is divi
cost items in the summary tables. The elem
ed in each item are as follows:

TRACK AND STRUCTURES. Costs to construc
structures between stations, including all
such as track work, site preparation, stre
and restoration, fencing, traffic maintenan
construction period, grade separation str
protection of existing buildings.

STATIONS. Costs of all station construction

track structure within the station, the parking and area construction, and the fare collection sys- Related costs are identical with those listed above der "Track and Structures."

AND SHOPS. Costs for transit yard facilities; service, inspection, and routine maintenance buildings equipment; track work within the yard limits and tracks; and other components incident to the stor- maintenance and repair of transit rolling stock equipment. The cost of the administration and op- center is included in this item.

ELECTRIFICATION. Costs of the electrical system to nish power for train propulsion and control, includ- such items as utility connections, sub-stations, the rail for train power, and incidental electrical ilities.

CONTROL. All costs of the automatic train con- system.

UTILITY RELOCATION. All costs incidental to the re- and maintenance of utility installations neces- by construction of the transit system. Electric distribution, communication, gas, water, steam, and storm drainage are affected.

ENGINEERING AND CHARGES. These costs include fees architectural and engineering services as well as construction management costs during the construc- period. Interest during construction, operating ex- financing charges, and District administrative are not included.

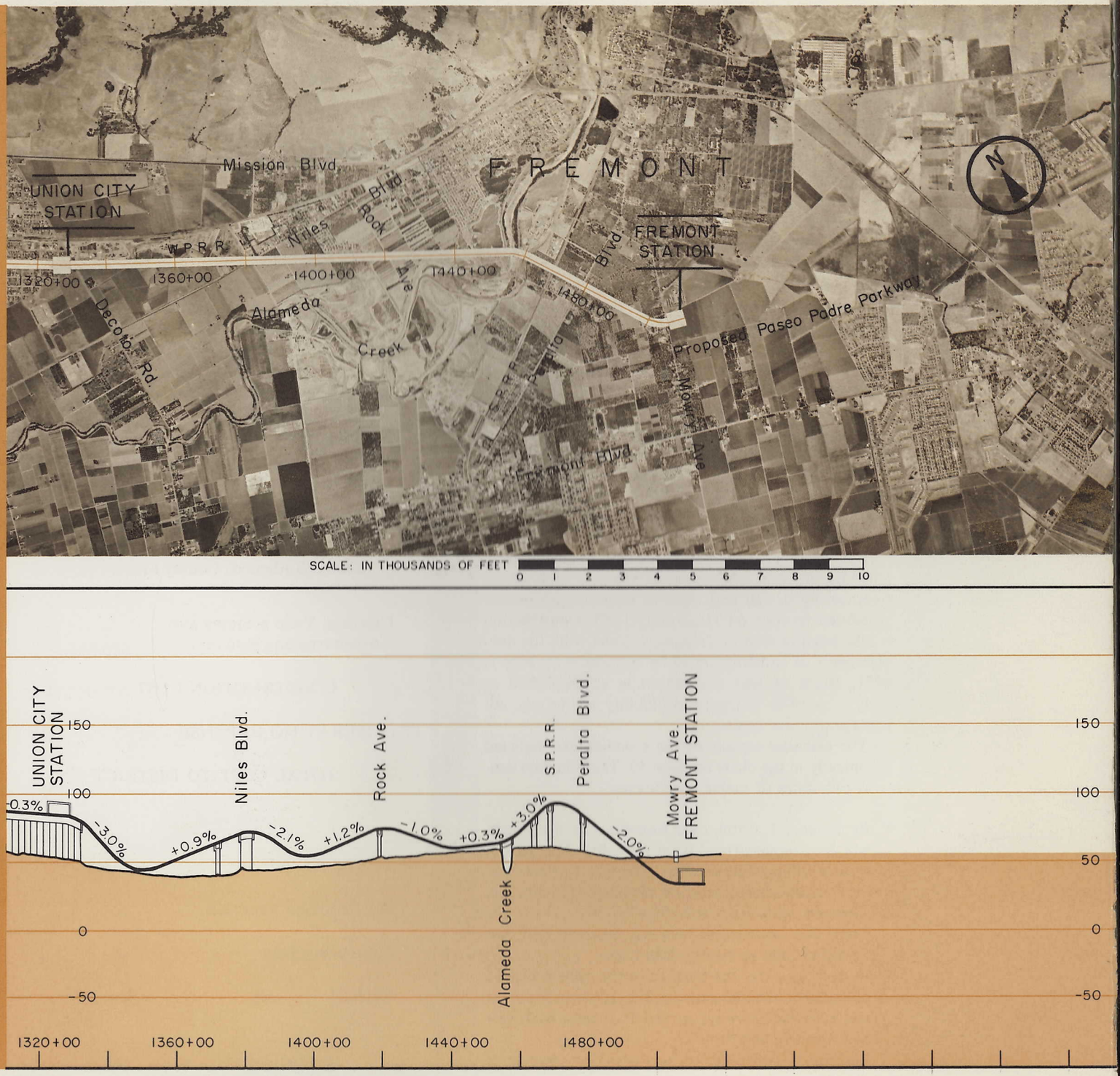
RIGHT OF WAY. All costs relative to the acquisition of required for the construction of the transit as well as for the demolition of existing im- the cost of title investigations, appraisals negotiating and legal expenses incident to the right acquisition.

CONTINGENCIES. A contingency is included amounting per cent of the sum of all construction costs in- engineering and charges and right of way.

ESCALATION. This cost is an allowance to cover realized anticipated increases in construction costs over the quarter 1960 price levels used in preparing the

PRE-OPERATING EXPENSES. Before formal revenue op- can begin over any completed segment of the transit system, it will be necessary to plan opera- recruit and train personnel, and perform other preparatory functions. These pre-operating expenses addition to the capital cost of construction of the and they are estimated at a cost of $7,000,000. total of the capital cost of construction and the operating expense is $790,493,000, and it is this

PLATE 16, SOUTHERN ALAMEDA COUNTY LINE (FREMONT), SEE TEXT P. 24



PARSONS BRINCKERHOFF-TUDOR-BECHTEL, ENGINEERS

amount that must be provided from the issuance of general obligation bonds by the District.

CONSTRUCTION SCHEDULE AND DRAWDOWN OF FUNDS

Construction of 75 miles of rapid transit facilities in a metropolitan area is a task of major dimension requiring careful scheduling and years of continuous construction. Among the important factors governing the schedule are the capacity of the construction industry to assimilate the work, the opening to service of partial segments, and the ability of the District to provide funds and to acquire the necessary right of way. A schedule in balance with these factors is required not only to assure early beginning of service, but also to avoid imposing unnecessarily high costs.

The construction schedule establishes the rate at which funds are needed. Commitment and use of money at all times must be within the ability of the District to borrow funds. The District's financial advisor has provided an estimate of future bonding capacity designed to give the District strong assurance of its ability to finance work within the estimated limits.

Recognizing these major factors, a construction schedule of eight and one-half years is established. Engineering design and right of way acquisition are scheduled to start on January 1, 1963. Construction is scheduled to start on January 1, 1964, with the final increment of construction to be completed by July 1, 1971. Right of way acquisition is accomplished as early as possible to insure availability and to take advantage of lower costs.

The essential aspects of the schedule are depicted graphically in the chart on page 30. The schedule contains two dates of major significance.

- By January 1, 1969, over four-fifths of the system will be completed and open to traffic. This partial system will provide service in the East Bay between the Oakland central business district and Richmond, Concord, and Hayward. It will also include the Trans-Bay connection between Oakland and San Francisco and service to Daly City.
- By July 1, 1971, the balance of the system will be completed, including service extensions to Fremont and streetcar subways in San Francisco both east and west of Twin Peaks.

Within this schedule, various useable segments of

SUMMARY OF ESTIMA

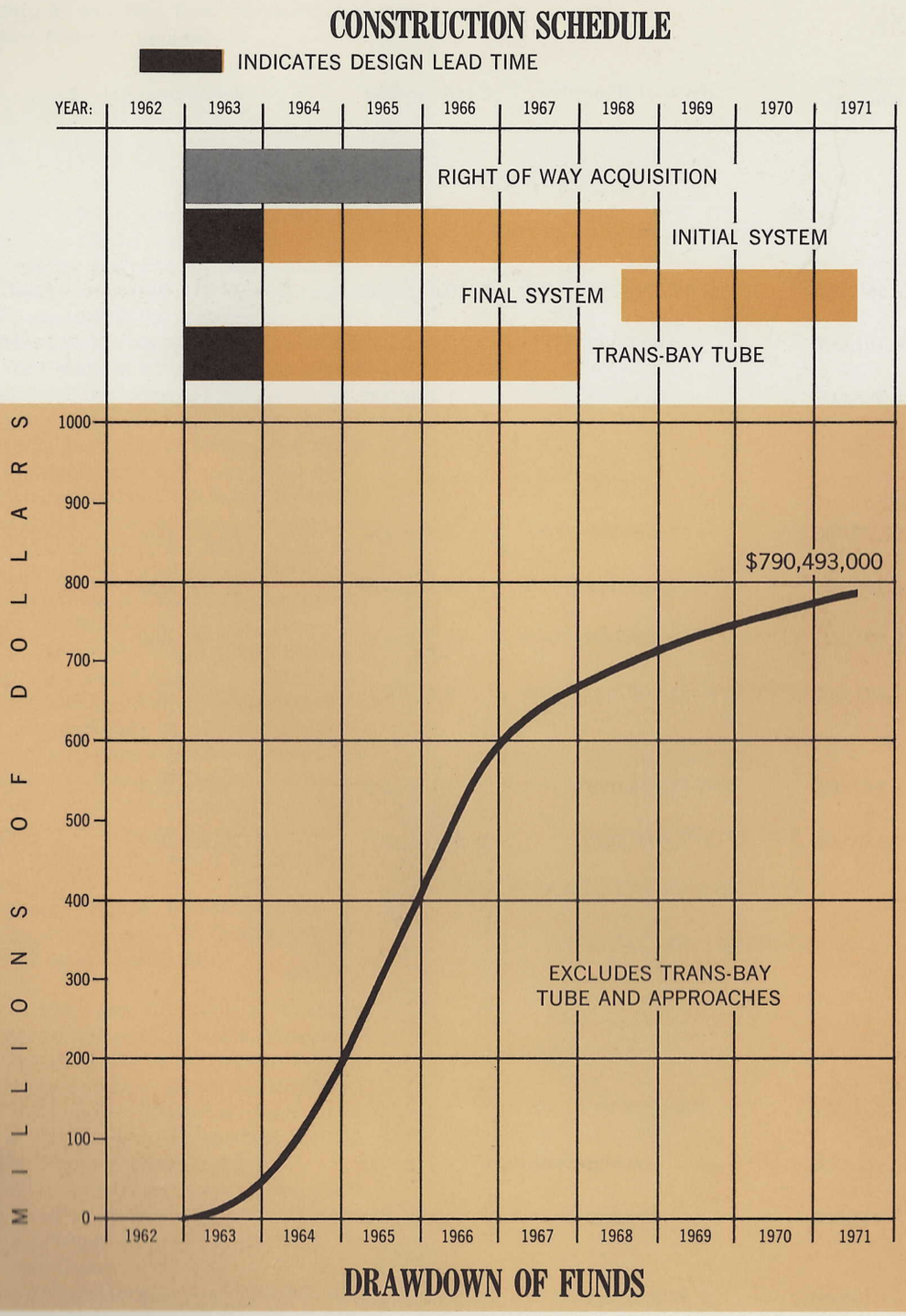
Lines	*Track & Structures*	*Stations*	Y
CONSTRUCTION COST			
WEST BAY ROUTES			
San Francisco Downtown	$ 50,883,000	$ 31,558,000	
Mission Line	37,673,000	15,527,000	
Twin Peaks Line	7,639,000	2,376,000	
EAST BAY ROUTES			
Oakland Downtown	26,729,000	15,677,000	
Berkeley-Richmond Line	32,947,000	13,989,000	$
Central Contra Costa Line	68,170,000	10,696,000	
Southern Alameda County Line	42,114,000	11,590,000	
CENTRAL YARD & SHOPS AND ADMINISTRATION BUILDING	–	–	
CONSTRUCTION COST	$266,155,000	$101,413,000	$
PRE-OPERATING EXPENSE			
TOTAL COST TO DISTRICT			

TRANS-BAY

TRANS-BAY LINE		
San Francisco Approach	$ 16,996,000	–
Subaqueous Tube	57,284,000	–
Oakland Approach	6,787,000	–
TOTAL COST	$ 81,067,000	–

ARUCTION COST & PRE-OPERATING EXPENSE

Y... S...	*Train Control*	*Utility Relocation*	*Engineering & Charges*	*Right of Way*	*Contingencies*	*Inflation*	*Total*
	$ 251,000	$ 11,781,000	$ 9,569,000	$ 2,994,000	$ 10,825,000	$ 23,816,000	$142,892,000
	910,000	7,808,000	6,561,000	4,427,000	7,661,000	16,853,000	101,119,000
	—	284,000	1,046,000	—	1,150,000	2,530,000	15,181,000
	610,000	6,549,000	5,120,000	12,585,000	6,890,000	15,158,000	90,951,000
	2,286,000	2,727,000	6,201,000	27,365,000	9,558,000	21,028,000	126,162,000
	3,146,000	2,075,000	9,724,000	10,220,000	11,719,000	25,781,000	154,690,000
	3,620,000	2,712,000	7,681,000	13,739,000	9,823,000	21,610,000	129,663,000
	5,817,000	—	1,348,000	2,464,000	1,730,000	3,806,000	22,835,000
	$ 16,640,000	$ 33,936,000	$ 47,250,000	$ 73,794,000	$ 59,356,000	$130,582,000	$783,493,000
							7,000,000
							$790,493,000
	$ 76,000	$ 720,000	$ 1,863,000	—	$ 2,050,000	$ 4,510,000	$ 27,060,000
	564,000	1,470,000	6,341,000	$ 47,000	6,979,000	15,354,000	92,126,000
	259,000	370,000	843,000	977,000	1,026,000	2,256,000	13,534,000
	$ 899,000	$ 2,560,000	$ 9,047,000	$ 1,024,000	$ 10,055,000	$22,120,000	$132,720,000



the system will be opened to service as complet segment of route must be available early fo testing the equipment and control system and f ing personnel.

Although the Trans-Bay Tube is to be finan built by the California Toll Bridge Authority, t struction of the tube and the remainder of th must be closely coordinated. Engineering d the tube should begin concurrently with that initial parts of the rapid transit system. Act struction requires four years and should be co by January 1, 1968.

Relating the estimated capital cost of the including the pre-operating expenses, with t struction schedule and applying a reasonable expenditure for each of the components, th down of funds was established. Shown on pag detailed tabulations of the estimated drawd funds.

PATRONAGE

Estimates of patronage are the basis for a fo rapid transit revenue, operating expense, and ments for rolling stock. The forecast of traffic which will be attracted to the proposed rapi system is a key element in economic studies o tem. In addition, detailed patronage estimat some of the parameters in physical features ice to be provided, thus serving as a contro excess or deficiency in design. An extensive d tation of past and present Bay Area travel c istics was the foundation for patronage studi BAY AREA TRAFFIC STUDIES. The origin-de survey is the tool for measuring traffic volu patterns. This involved division of the Bay A a number of logically defined traffic zones measurement of traffic volumes within, an through these zones by origin, destination, tim mode of travel, and purpose of trip. The prin veys available include one conducted throug Bay region in 1954 for the San Francisco Rapid Transit Commission and another, the Metropolitan Traffic Survey, conducted by state, and local highway agencies in 1946-19

Both of these studies were updated to the in terms of annual average weekday traffic. survey was updated by means of transit growth factors developed from actual chang volumes, as measured at nine cordon lines str placed so as to intercept all major highway

...ts of significance in rapid transit planning. ...ternal auto person-trips in the 1946-1947 sur... ...updated by means of analysis which meas... ...nges in motor vehicle registration within each ...ne as well as changes in motor vehicle usage ...rage auto occupancy. Zones of heavy retail and ...l concentration were specially treated. Inter... ...n person-trip volumes were updated by analy... ...traffic records for individual transit routes.

...Projection. Once accurate travel movement ... for 1959 was determined, it was necessary ... future volumes and patterns. The year 1975 ...ted as a time base for forecasting traffic move... ...between regional cordon areas. Two separate ... were used in obtaining the final projection ... rapid transit traffic. The first method uti... ...special analysis to provide a measurement of ...tion and the generation of trips between ...sidering pertinent factors such as jobs, resi... ...population, auto registration, and travel time. ... yielded separate predictions of commute ... those trips made for other purposes on an ...erage weekday in 1975.

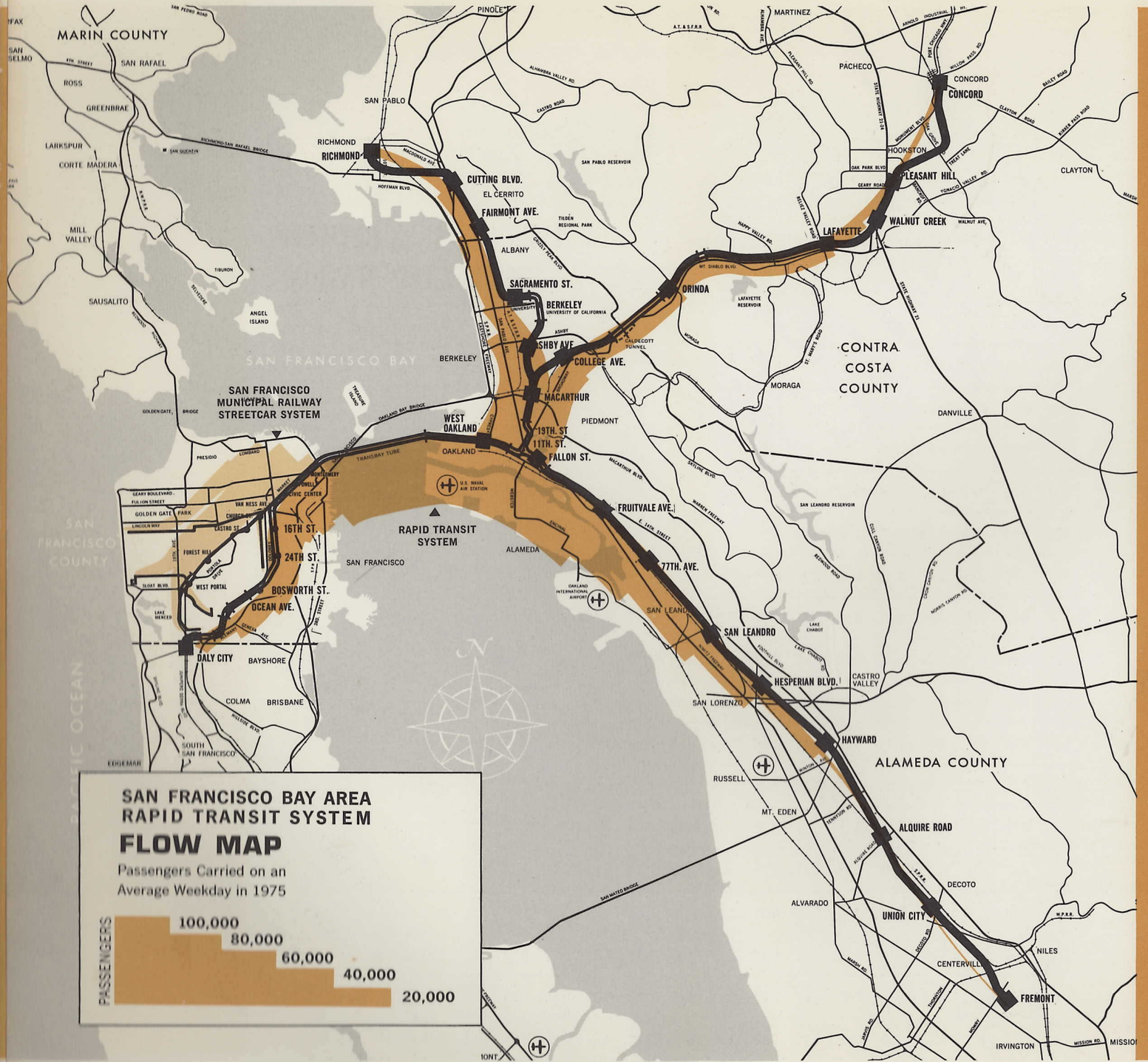
...second method used to forecast 1975 traffic ...tion of 1959-level data by means of a com... ...series of factors derived primarily from the ... extrapolation of present trends. The two ... were conjoined and used to develop the final ... factors employed for forecasting rapid tran...

...Research. The many unique features of ...d Bay Area rapid transit system, such as its ... frequent service, long average length of ... regional character, indicated the necessity for ...dy of the numerous factors influencing traf... ...tion between highway and transit facilities. ... investigation was made of these factors ... of the origin-destination, population, ve... ...ation, personal income, travel time, cost, ... other data available in the project area. ... concentrated, among other sources, on avail... ... from the 1954 origin-destination survey. ...tively high volumes of interurban passen... ... served by a balanced combination of ... lines, bus routes, and highway facilities, ...ified and permitted evaluation of several ...significance in estimating rapid transit uti...

...ical importance were whether the travel ... peak periods in the peak direction, ... trip is between home and work or for

TYPICAL FARES BETWEEN SELECTED STATIONS

	DALY CITY	OCEAN AVENUE	24th STREET	CIVIC CENTER	POWELL STREET	MONTGOMERY STREET	11th STREET	19th STREET	MacARTHUR	ORINDA	WALNUT CREEK	CONCORD	FREMONT	HAYWARD	SAN LEANDRO	FRUITVALE	FALLON STREET	BERKELEY	FAIRMONT AVENUE	RICHMOND
DALY CITY	$0.25																			
OCEAN AVENUE	0.25	$0.25																		
24th STREET	0.25	0.25	$0.25																	
CIVIC CENTER	0.25	0.25	0.25	$0.25																
POWELL STREET	0.25	0.25	0.25	0.25	$0.25															
MONTGOMERY STREET	0.55	0.50	0.40	0.40	0.35	$0.35														
11th STREET	0.55	0.50	0.45	0.40	0.35	0.35	$0.25													
19th STREET	0.55	0.55	0.45	0.45	0.40	0.40	0.25	$0.25												
MacARTHUR	0.70	0.65	0.60	0.55	0.55	0.55	0.25	0.25	$0.25											
ORINDA	0.80	0.80	0.75	0.70	0.70	0.70	0.45	0.40	0.40	$0.25										
WALNUT CREEK	0.95	0.90	0.85	0.80	0.80	0.80	0.55	0.55	0.50	0.40	$0.25									
CONCORD	1.00	0.95	0.90	0.85	0.85	0.85	0.60	0.60	0.65	0.75	0.90	$1.00								
FREMONT	0.80	0.75	0.70	0.65	0.65	0.65	0.40	0.40	0.45	0.55	0.70	0.80	$0.30							
HAYWARD	0.70	0.65	0.60	0.55	0.55	0.55	0.25	0.30	0.35	0.45	0.60	0.70	0.45	$0.25						
SAN LEANDRO	0.60	0.55	0.50	0.45	0.45	0.45	0.25	0.25	0.25	0.35	0.50	0.60	0.50	0.35	$0.25					
FRUITVALE	0.60	0.50	0.45	0.40	0.35	0.35	0.25	0.25	0.25	0.30	0.45	0.55	0.60	0.40	0.25	$0.25				
FALLON STREET	0.60	0.60	0.55	0.50	0.50	0.50	0.25	0.25	0.25	0.30	0.45	0.55	0.70	0.50	0.40	0.25	$0.25			
BERKELEY	0.70	0.65	0.60	0.55	0.55	0.55	0.25	0.25	0.25	0.40	0.50	0.60	0.75	0.55	0.45	0.35	0.30	$0.25		
FAIRMONT AVENUE	0.80	0.75	0.70	0.65	0.65	0.65	0.40	0.40	0.35	0.45	0.60	0.70	0.85	0.65	0.55	0.45	0.40	0.25	$0.25	
RICHMOND																				



some other purpose, and whether the trip is t
a major business district. For each category
tial rapid transit trip, the ratio of door-to-d
time by rapid transit to door-to-door trave
automobile was determined to be the best
ment of propensity to use rapid transit.

A series of time-ratio diversion curves w
oped for all regional traffic of potential inter
id transit; for peak-period, peak-direction w
having one or both trip terminals in down
Francisco or Oakland; for similar trips havi
trip terminal in downtown San Francisco or
and for all other trips, separately with and w
terminals in downtown San Francisco or Oak
internal San Francisco and internal East B
two additional time-ratio curves, different
tween downtown and non-downtown trips,
veloped.

RAPID TRANSIT PATRONAGE. Once route selec
ies had determined the location of rapid tr
and stations, it was possible to define trips
to rapid transit. These are trips of sufficient l
with origins and destinations in suitable pro
geographic orientation to rapid transit lin
be susceptible to diversion to rapid transit
door peak and off-peak travel times for ca
rapid transit and by automobile were calcul
the expanded network of freeways, arterials
streets assumed to be available during the
which patronage estimates were to be prepa
of travel time via rapid transit to travel tim
mobile were then computed, and by applica
diversion curves, rapid transit passenger vol
estimated.

The intra-San Francisco and inner East
mates of patronage and revenue were adjust
for the effect of the higher cost of a combi
car-rapid transit trip or bus-rapid transit trip
to the cost for a streetcar or bus trip today

The flow map on this page depicts th
rapid transit traffic for an average weekda
Annual patronage estimates for the years
cast, 1969 through 1980, are presented in
tion on page 34.

GENERAL ASSUMPTIONS. The estimates of
and those of revenue, operating expense, a
ments for rolling stock are based upon cer
assumptions as follows:

1. The same general trends of economic a
business conditions experienced during th
years in the Bay Area will continue thro

of the estimate.
quate access and parking areas will be provided
patrons at rapid transit stations. These facilities
included in this plan and in the estimates of
truction cost.
transit service in the Bay Area will be co-
ated with regional rapid transit in order to
re-routing, where feasible, of existing inter-
and local transit operations to act as feeders
regional rapid transit system.
San Francisco Bay Area Rapid Transit District
retain essentially the same powers delegated to
existing law to establish fares, concession rates
fees.
e will be no legislation adversely affecting the
operation, condition, or financial obligations of
San Francisco Bay Area Rapid Transit District
rapid transit system.
rates of toll charged for vehicular passage
San Francisco Bay will not be reduced to an
that will significantly prejudice the relative
tion of rapid transit compared to the private
mobile.
ssary planning for the Bay Area will be com-
mentary to and not detractive of the functions
rapid transit system.
appropriate policy of advertising and public
tion will be followed by the District to en-
e rapid transit patronage.

AND REVENUE

of proposed station-to-station rapid transit
developed. Of prime significance is the neces-
rapid transit fare levels be equated to the cost
travel modes, principally the automobile. This
thorough investigation of typical auto travel
costs, including the effects of auto occu-
tolls, parking fees, and the costs of gaso-
and normal tire wear. In addition, existing
and cash transit fares were taken into con-
In determining comparable rapid transit
the costs of any necessary increments of
were included.
found desirable and feasible to employ a fare
based on distance travelled, rather than on
fare or zone-fare types of tariff. A spe-
fare results for each station-to-station trip.
schedule provides a minimum fare of 25 cents
ing up to eight miles, with a gradual decline
per mile as distance travelled increases, vary-
ing between 3.2 cents per mile at eight miles to 2.25 cents per mile for the longest trips. An additional 10 cents is added to the fare for trips that involve crossing San Francisco Bay. Typical station-to-station fares are illustrated in the table on page 31.

Fare revenue was estimated by multiplication of the projected rapid transit passenger volumes for each station-to-station movement times the fare for that movement. Investigation of additional potential sources of revenue resulted in an estimate of about one per cent of fare revenue as income from advertising and concessions. Total estimated revenue for the years of forecast 1969 through 1980 is tabulated on page 34.

OPERATIONS

The proposed route network and the estimates of rapid transit patronage were the bases for estimating daily train operations. The way in which lines and train service should be interconnected was developed, resulting in a physical track framework within which all major traffic movements between lines are directly accommodated. Trains are not, however, able to travel directly between the Central Contra Costa Line and the Berkeley-Richmond Line.

Patterns of service are expected to vary through the day, and accordingly, schedules of train operations were prepared. These provided the basis for determining a large part of rapid transit operating expense, including costs of traction power, train attendants, rolling stock maintenance, and other items. Scheduling analysis also furnished an actual count of rolling stock requirements and the car storage space needed as well as a test of the adequacy of track capacities at critical sections.

Using plans of the proposed routes, performance data for the prototype rapid transit car, and the stop-intervals at each station, running times for the entire system were calculated. These are shown in the adjacent table. Working timetables were then constructed taking into account all necessary practical considerations, such as minimum safe headway between trains, time needed for switching in yards, the minimum time required for reversing trains at turnback points, layover time requirements for attendants, and the like.

Analysis of the completed working timetables allowed estimation of daily car-miles operated, the maximum number of cars in each yard at any one time, and other data pertinent to operating expense estimates. The number of employees required and their working hours and wages were determined by pro

PEAK-HOUR TRAIN TRAVEL TIMES

Line and Station	*Minutes Between Stations*	*Minutes From First Station*
MISSION – TRANS-BAY – CENTRAL CONTRA COSTA LINES		
Daly City	–	–
Ocean Ave. (San Francisco)	2	2
Bosworth St. (San Francisco)	2	4
24th St. (San Francisco)	2	6
16th St. (San Francisco)	2	8
Civic Center (San Francisco)	2	10
Powell St. (San Francisco)	1	11
Montgomery St. (San Francisco)	1	12
West Oakland	6	18
11th St. (Oakland)	2	20
19th St. (Oakland)	1	21
MacArthur (Oakland)	2	23
College Ave. (Oakland)	3	26
Orinda	4	30
Lafayette	6	36
Walnut Creek	2	38
Pleasant Hill	3	41
Concord	4	45
SOUTHERN ALAMEDA COUNTY – BERKELEY - RICHMOND LINES		
Fremont	–	–
Union City	3	3
Alquire Road (Hayward)	3	6
Hayward	4	10
Hesperian Blvd. (San Lorenzo)	4	14
San Leandro	3	17
77th Ave. (Oakland)	3	20
Fruitvale Ave. (Oakland)	3	23
Fallon St. (Oakland)	3	26
11th St. (Oakland)	1	27
19th St. (Oakland)	1	28
MacArthur (Oakland)	2	30
Ashby Ave. (Berkeley)	3	33
Berkeley	2	35
Sacramento St. (Berkeley)	2	37
Fairmont Ave. (El Cerrito)	2	39
Cutting Blvd. (El Cerrito)	3	42
Richmond	3	45

forma assignment of personnel.

OPERATING EXPENSE. Estimating operating expense for such a modern, highly automated, high speed, regional, rapid transit system was largely a unique undertaking, necessitating detailed evaluation of each element of expense. Experiences on existing systems did not generally provide valid comparisons. Because of the high schedule speeds, car-miles will be generated at a much faster rate than on presently operating systems, and many items of operating expense including the salaries of train attendants and annual cost of administration, station operations, and maintenance of way and structures will be distributed over a greater number of car-miles. As a result, operating expense per car-mile will be relatively low in comparison to existing rapid transit systems using cars of similar capacity.

In preparing estimates of operating expense, the Interstate Commerce Commission expense classifications for electric railways were generally followed. Wherever applicable, with the several qualifications discussed in the preceding paragraph, the experience of existing American rapid transit systems was used as a general guide. Due to the participation of Mr. Donald C. Hyde, General Manager of the Cleveland Transit System, as consultant for this phase of study, the operating expense data from the Cleveland rapid transit system were particularly valuable. Enhancing this value was the fact that, of the existing systems, Cleveland's system is one of the fastest and most modern.

The estimate for maintenance of way and structure considered experience with comparable existing facilities, as well as local conditions expected in the Bay Area, such as the normal character of construction and the absence of frost conditions.

The largest single category of operating expense included energy and demand charges for traction power, for which the estimate was based on data developed from the train scheduling analysis.

An additional cost, called pre-operating expense, was included for a limited period preceding the opening of each major system section. Pre-operating expense includes amounts necessary for planning, recruiting, training, and other preparation prior to the opening of revenue service.

For the calendar years 1967 and 1968, the first two years of partial operation, and for the period of pre-operating expense which precedes the opening of revenue service, operating expenses will be met with a reasonable margin by gross fare and concession revenues plus the nominal sum which is included in the capital cost estimates for pre-operating expense. During these

PATRONAGE, REVENUE AND OPERATING EXPENSE ESTIMATES

Fiscal Year Beginning July 1	*Total Passenger Trips*	*Gross Fare and Concession Revenue*	*Total Operating and Pre-Operating Expense*	*Ne Oper Reve*
1969**	93,964,000	$28,449,000	$17,376,000	$11,07
1970	69,401,000	21,383,000	12,273,000	9,11
1971	72,738,000	22,571,000	12,589,000	9,98
1972	74,991,000	23,416,000	12,979,000	10,43
1973	76,324,000	23,956,000	13,234,000	10,72
1974	77,137,000	24,284,000	13,389,000	10,89
1975	77,811,000	24,539,000	13,510,000	11,02
1976	78,470,000	24,790,000	13,624,000	11,16
1977	79,132,000	25,045,000	13,745,000	11,30
1978	79,790,000	25,299,000	13,873,000	11,42
1979	80,432,000	25,543,000	13,980,000	11,56
1980	81,081,000	25,788,000	14,074,000	11,71

**18-month period: January 1, 1969 - June 30, 1970.

ROLLING STOCK REQUIREMENTS

Calendar Year Beginning January 1	*Cumulative Number of Cars*	*Cumulative Cost*
1967	60	$ 9,180,000
1968	250	39,200,000
1969	330	52,000,000
1970	370	58,400,000
1971	390	61,600,000
1972	410	64,800,000
1973	420	66,400,000
1974	430	68,000,000
1975	430	68,000,000
1976	440	69,600,000
1977	440	69,600,000
1978	440	69,600,000
1979	450	71,200,000
1980	450	71,200,000

ly years of operation no net revenue should be ated for the purpose of rolling stock debt

l annual operating expense plus pre-operating for the years of the forecast, 1969 through tabulated on page 34.

VENUE. Net revenue equals gross fare and con- revenue minus total operating and pre-operat- ense. Net revenue is shown on page 34.

Inflation is included in the estimates of revenue erating expense. Fares and revenues would be sufficiently in inflationary periods to meet rising g expenses and still provide the proportional of net revenue indicated in the estimates.

estimated that the net revenue in each year of ast is sufficient to cover debt service on roll- with a reasonable margin. Construction costs, must be met from other sources.

LING STOCK REQUIREMENTS

velopment of a rapid transit car included prep- of estimates of car cost. This study included ration of the possible effects on cost due to fi- g assumptions, inflation, shipping charges, in- and contingencies; and resulted in a total t per car of from $153,000 to $160,000, de- g on the date of fabrication.

d on results of the train operation analyses, the r of cars required during each year was esti- During the early years of rapid transit opera- fficient cars would be available to provide fully ctory service despite the presence of only par- developed patronage levels. A seven per cent for spare equipment has been included.

total number of cars required for each year of m 1967 through 1980, and their cumulative tabulated on page 34.

DRAWDOWN OF FUNDS

Rapid Transit System

Date Ending	*Cumulative Expenditure*
1/1/63	0
4/1/63	$ 5,000,000
7/1/63	12,000,000
10/1/63	25,000,000
1/1/64	45,000,000
4/1/64	70,000,000
7/1/64	100,000,000
10/1/64	140,000,000
1/1/65	190,000,000
4/1/65	240,000,000
7/1/65	310,000,000
10/1/65	370,000,000
1/1/66	420,000,000
4/1/66	475,000,000
7/1/66	525,000,000
10/1/66	560,000,000
1/1/67	590,000,000
4/1/67	620,000,000
7/1/67	640,000,000
10/1/67	655,000,000
1/1/68	670,000,000
4/1/68	682,000,000
7/1/68	693,000,000
10/1/68	703,000,000
1/1/69	712,000,000
4/1/69	723,000,000
7/1/69	730,000,000
10/1/69	740,000,000
1/1/70	748,000,000
4/1/70	755,000,000
7/1/70	763,000,000
10/1/70	772,000,000
1/1/71	779,000,000
4/1/71	786,000,000
7/1/71	790,493,000

Trans-Bay Tube & Approaches

Date Ending	*Cumulative Expenditure*
1/1/63	0
4/1/63	$ 1,000,000
7/1/63	2,000,000
10/1/63	3,000,000
1/1/64	4,000,000
4/1/64	6,000,000
7/1/64	9,000,000
10/1/64	14,000,000
1/1/65	19,000,000
4/1/65	29,000,000
7/1/65	37,000,000
10/1/65	48,000,000
1/1/66	60,000,000
4/1/66	73,000,000
7/1/66	86,000,000
10/1/66	98,000,000
1/1/67	111,000,000
4/1/67	120,000,000
7/1/67	128,000,000
10/1/67	131,000,000
1/1/68	132,720,000

THE FINANCIAL PLAN FOR BAY AREA RAPID TRANSIT

SMITH, BARNEY & CO.
NEW YORK

APRIL 1962

SMITH, BARNEY & CO.

20 BROAD STREET
NEW YORK 5, N.Y.
DIGBY 4-9600

April, 1962

Board of Directors
San Francisco Bay Area Rapid Transit District
628 Flood Building
San Francisco 2, California

Gentlemen:

In accordance with the Contract between the San Francisco Bay Area Rapid Transit District (the "District") and Smith, Barney & Co. (the "Financial Consultant") dated October 8, 1959, and particularly Part A of such Contract and your Resolution No. 208 approved on March 8, 1962, we are pleased to submit herewith our report containing the Financial Plan for the District's proposed Three-County Rapid Transit System (the "System").

The current report is a revision of our previous reports to you dated June, 1961 and October, 1961 pertaining to the proposed Five-County System and Four-County System, respectively, and is of the same scope as the aforementioned reports except that it pertains to the Three-County System now proposed.

Under the Three-County System no facilities are located in the Counties of Marin and San Mateo, with the exception of one station at Daly City in San Mateo County. We have throughout this report excluded any support for the District from either of these counties whether in assessed valuation available to support bonds, taxes, revenues or any other form.

Based upon the information supplied to us by the District, the District's California Financial Advisor, Bond Counsel, General Counsel and the Engineers, and upon the various assumptions set forth in our report, it is our opinion that the proposed Three-County Rapid Transit System as described in the report of Parsons Brinckerhoff-Tudor-Bechtel dated April 17, 1962 is financially feasible.

We wish to express our appreciation for the valuable assistance and cooperation we have received from the District, its staff and legal counsel, Bond Counsel, Consulting Engineers and the California Financial Advisor throughout the studies we have made relative to the District's finances and in the preparation of this Report.

Very truly yours,

Smith, Barney & Co.

AL BASIS FOR REPORT

preparation of the Financial Plan, we have carefully
the San Francisco Bay Area Rapid Transit District
isting of Sections 28,500 to 29,757, inclusive, of
ifornia Public Utilities Code (herein referred to as
Act") and Article 5, Chapter 2, Division 17 of the
and Highways Code (Sections 30,770 et seq.), deal-
the construction of the Rapid Transit Tube beneath
ncisco Bay. Certain portions of these enactments are
ted below. Summarizations have been prepared by
ncial Consultant and reviewed by the District's Gen-
nsel, Mr. W. L. Kaapcke, and by the District's Bond
Orrick, Dahlquist, Herrington & Sutcliffe. The Fi-
Plan contained in this report has been prepared in
ity with these statutory provisions.
ain sections are of particular importance as the foun-
of the Financial Plan and are summarized briefly

ACT

FINANCING
Act provides that the District may finance the cost of
m through the issuance of various types of obliga-
the limitations, among others, outlined briefly

General Obligation Bonds – Subject to approval
ds of Supervisors of each of the counties com-
District, and whenever three-fifths of the votes
special election or on any proposition submitted
in favor of incurring the indebtedness set forth
position, the Board may provide for the author-
issuance of general obligation bonds of the Dis-
the amount authorized at such election with the
qualifications, among others:
No such debt shall exceed fifteen percent (15%)
valuation of taxable property within the Dis-
Act, Section 29,150). General Counsel for the
advised that, pursuant to this provision, the Dis-
uthorize and submit to the voters a bond issue
ds 15% of the *current* assessed valuation, but at
issuance and sale of any such bonds, the amount
then being issued plus the amount of bonds
ding may not exceed 15% of the assessed valua-
of such issuance and sale.
The bonds shall be dated, bear such interest
ceeding 6% per annum), mature in such years
ding 30 years from the date thereof) and be re-
upon such terms as the District may determine by
(The Act, Sections 29,173, 29,174, 29,178).

(iii) The District shall provide for the payment of principal of and interest on the bonds by the levy and collection of taxes upon all property in the District subject to taxation without limitation as to rate or amount. It is provided, however, that such taxes need not be so levied and collected to the extent that surplus revenues derived from the operation of the System or any appropriations which may be made to the District for such purpose may be available for the payment of debt service (The Act, Sections 29,121, 29,122 and 29,183). General Counsel to the District has advised that The Act permits the District to levy for this purpose only a uniform ad valorem general property tax upon all taxable property within the District as described in the above-cited sections of The Act.

(b) Bond Anticipation Notes – The District may borrow money in anticipation of the sale of bonds which have been authorized to be issued, provided that the maximum maturity of such bond anticipation notes may not exceed five years. Such notes shall be paid from any moneys of the District available therefor and not otherwise pledged or from the proceeds of the sale of bonds in anticipation of which the notes were issued (The Act, Section 29,234).

(c) Revenue Bonds – As an alternative procedure for the raising of funds, the District may issue bonds payable from revenues of any facility or enterprise to be acquired or constructed by the District in the manner provided by the Revenue Bond Law of 1941, constituting Sections 54,300 et seq. of the Government Code. No election shall be required in the case of revenue bonds authorized by the Board of Directors of the District for the acquisition of equipment such as cars, trolley buses and motor buses and rolling equipment if prior to such authorization a proposition for the issuance of general obligation bonds has been adopted by vote of the qualified voters of the District (The Act, Sections 29,240 and 29,241).

(d) Equipment Trust Certificates – The District may finance the purchase of equipment such as cars, trolley buses, motor buses and rolling equipment by means of the issuance and sale of equipment trust certificates payable solely from the revenues to be derived from the operation of the System or from available loans and grants (The Act, Sections 29,250 - 29,254).

(e) Special Assessment Bonds – In addition to all other powers granted by The Act, the District may finance its acquisition or construction program by special assessment proceedings pursuant to the Improvement Act of 1911 and the Improvement Bond Act of 1915 (The Act, Section 29,260).

2. TAXATION

(a) For Debt Service – The Board shall levy and collect annually until the general obligation bonds are paid, or until there is a sum in the treasury of the District sufficient to meet all future principal and interest requirements, a tax sufficient to pay the annual interest on the bonds and such part of the principal thereof as becomes due before the proceeds of the next general tax levy will be available (The Act, Section 29,121).

(b) For Other Purposes – For all purposes other than the payment of debt service on general obligation bonds, the District may levy a tax not exceeding five cents (5¢) per one hundred dollars ($100.00) of assessed valuation of taxable property within the District. Taxes levied pursuant to this section for maintenance and operation of the rapid transit System shall be supplemental to the revenues derived from such System and shall be limited to actual requirements (The Act, Section 29,123).

3. RATES AND CHARGES

The rates and charges to be fixed by the Board for service furnished by the System shall, insofar as practicable, result in revenue which will be sufficient to pay the costs of operation, repair, maintenance and depreciation of the System and provide for the purchase, lease or acquisition of rolling equipment, including provisions for interest, sinking funds, reserve funds or other funds required for the payment of any obligations incurred for the acquisition of rolling equipment and to provide funds for other purposes which the Board deems necessary and desirable to carry out the purposes of The Act (The Act, Section 29,038).

4. REIMBURSEMENT OF APPROPRIATIONS

The Board is required to repay to the General Fund of the State from the proceeds of the first sale of bonds by the District the amount advanced to the San Francisco Bay Area Rapid Transit Commission pursuant to Chapter 1239 of the Statutes of 1949, as amended, together with interest (The Act, Section 29,160).

B. TRANS-BAY TUBE FINANCING

Article 5, Chapter 2, Division 17 of the Streets and Highways Code (Sections 30,770 et seq.) directs the California Toll Bridge Authority (the "Authority") to undertake the financing of the San Francisco-Oakland Rapid Transit Tube (the "Trans-Bay Tube") which will constitute a vital link in the System. Certain of the more important provisions relating to the financing of the Trans-Bay Tube and to the Financial Plan are summarized as follows:

1. ENGINEERING AND PLANNING

Subject to the approval by the Federal Government to the use of toll revenue of the San Francisco-Oakland Bay Bridge (the "Bridge" or the "Bay Bridge") for the purpose of constructing the Trans-Bay Tube and the approval by the voters of the District of the issuance of general obligation bonds for financing of the System, the Authority is directed to use

up to $750,000 from the revenues of the Bridge for engineering plans for the construction of the Trans-Bay Tube. The Federal Government approved the use of the revenues of the Bridge to enable the Authority to comply with the provisions of this article by enactment of Public Law 86-388, 86th Congress, H. R. 8171 on February 20, 1960.

2. Financing

The Authority shall issue revenue bonds pursuant to the California Toll Bridge Authority Act to finance the construction of the Trans-Bay Tube and the Department of Public Works shall construct the Trans-Bay Tube. It is provided, however, that the financing of the Trans-Bay Tube shall be contingent upon the approval by the voters of the District of the issuance by the District of general obligation bonds, the amount of which, together with any other financing then provided for the District, will be not less than $500,000,000.

3. Use of Bridge Tolls and Revenues

The Authority is authorized to use for the reconstruction of the Bridge so much as necessary of the net revenues of the Bridge accruing up to July 1, 1961 (Streets and Highways Code Section 30,609), and is further directed by Article 6, Chapter 2, Division 17 of the Streets and Highways Code, (Sections 30,790 et seq.) to proceed with the reconstruction of the San Mateo-Hayward Bridge and authorized to apply to the cost thereof the requisite amount of the net revenues of the Bridge accruing up to and including June 30, 1964. Subject to the application of the net revenues of the Bridge to these purposes, such revenues, to the extent necessary, may be pledged to and used to pay for the cost of construction of the Trans-Bay Tube including, but not limited to, the payment of debt service on the revenue bonds to be issued by the Authority for that purpose.

Streets and Highways Code Section 30,794 further provides that if the Authority finances the cost of reconstruction of the San Mateo-Hayward Bridge by application thereto of the surplus revenues of the Bay Bridge, the Authority shall continue to assess and the Department of Public Works shall collect tolls for the use of the San Mateo-Hayward and Dumbarton Bridges at rates equal to or in excess of the rates charged for use of the Bay Bridge. All revenues so collected shall be paid into the same fund as the revenues of the Bay Bridge and shall be available for expenditure for the same purposes as the revenues of the Bay Bridge, including the pledging thereof as security for future issues of revenue bonds that may be authorized by the Authority.

We are advised by Bond Counsel to the District that pursuant to this Section, the net revenues of the San Mateo-Hayward and Dumbarton Bridges as well as those of the Bay Bridge would be available for pledge by the Authority as security for bonds issued to finance the construction of the Trans-Bay Tube.

4. Obligations of the District

In addition to the Trans-Bay Tube proper, the Authority is directed to finance construction of the "approaches" thereto, such approaches being defined as the facilities between the termini of the Trans-Bay Tube and the respective first rapid transit stations thereafter on each side of the Bay. The District is obligated to reimburse the Authority for the costs of such approaches, including, but not limited to, the financing costs attributable thereto. The terms of reimbursement are to be fixed by agreement between the District and the Authority over a period not less than the estimated period for retirement of the Authority's bonds and not longer than the full term of such bonds having the latest maturity. No other payments shall be required of the District for the use of the Trans-Bay Tube.

The District is also obligated to pay all costs of repair, maintenance, operation and insurance of the Trans-Bay Tube.

5. Expiration Date

If by November 30, 1963 the voters of the District have not approved the issuance of general obligation bonds for the construction of the System, the provisions of Article 5, Chapter 2, Division 17 of the Streets and Highways Code (Sections 30,770 et seq.) relating to the financing of the Trans-Bay Tube by the Authority shall be of no further force or effect.

FINANCIAL PLAN

The Financial Plan presented herein is divided into three principal sections, namely,

(A) THE FINANCING OF THE CONSTRUCTION OF FIXED BASIC ELEMENTS OF THE TRANSIT SYSTEM

(B) THE FINANCING OF THE PURCHASE OF ROLLING EQUIPMENT

(C) THE FINANCING OF THE CONSTRUCTION OF THE TRANS-BAY TUBE BY THE CALIFORNIA TOLL BRIDGE AUTHORITY.

In brief, our studies lead us to the following specific conclusions and recommendations:

(1) The fixed basic elements of the System should be financed by the issuance of general obligation bonds of the District secured by pledge of the District's full faith and credit. The District appears to have sufficient borrowing capacity for this purpose over the planned period of construction.

(2) The purchase of rolling equipment should be financed primarily by the issuance of revenue bonds secured by pledge of the gross operating revenues of the System. The revenues to be derived from the operation of the System, as estimated by the Engineers, appe vide a sufficient base for this financing.

(3) The Trans-Bay Tube and its approaches ar nanced by the California Toll Bridge Autho the proceeds of revenue bonds secured by pl combined net operating revenues of the Bay the San Mateo-Hayward and the Dumbarto The Authority appears to have sufficient re accomplish this financing.

Each of these recommendations is, of course, modification in the light of such conditions as m the time actual financing is undertaken.

The basic estimates relating to construction co requirements, requirements for rolling equipment nues and expenses were furnished to us by your Engineers, Parsons Brinckerhoff-Tudor-Bechtel a ed in their report to the District (see pages 25 to Similarly, the estimates of assessed valuations of property within the District used in our report we by Stone & Youngberg, the District's California Advisor (see page 59 herein).

A. FINANCING OF FIXED BASIC SYSTEM

1. Amount of Financing

The amount of financing required for the fixe ments of the System is governed by the cost of as estimated by the Engineers and must include, provision for the reimbursement to the General State of California of the amount advanced to th cisco Bay Area Rapid Transit Commission for rently amounting, with interest accrual, to ap $450,000, and provision for the cost of financin advertising, bond printing, legal costs and other extent it is not anticipated that the District wi expenses from other sources.

The Act provides that the District may in financing provision for the payment of bond int the construction period. In view of the facts t ability to service the bonds will not be depende completion of construction and (b) the Distric very little excess borrowing capacity after finan of construction of the System, as shown else report, we believe that the District should not c interest on its general obligation indebtedne construction period, but should provide for th interest by the levy of taxes pursuant to The A

The total amount of bonds required to be i fixed basic elements of the System thus would b 000 for the following purposes:

struction (1)	$790,493,000
on for Bond Issuance Expenses (2)	1,057,000
te Reimbursement	450,000
tal	$792,000,000

Reference is made to the report of the Consulting neers for details of the estimated construction cost. Partly a balancing item to round out bond issue. The of the District has made an analysis of the general inistrative and other expenses of the District during construction period and we are advised that such ex- can be met either from the moneys available for truction or from the proceeds of taxes to be levied that purpose pursuant to The Act. There is included bond financing for the fixed, basic System approxi- $1.33 per $1,000 bond to cover a portion of the directly attributable to the issuance of those bonds not to be paid from taxes.

truction cost — and consequently the amount of to be issued — may be offset to a minor degree by in- ings on the temporary investment of the proceeds District's bond issues pending their application to the of costs of construction. However, in view of the period of construction, the proposed issuance of relatively close correlation with the need for con- moneys and the flexibility which the District must choosing the exact time for issuing bonds, it is not ble at this time to estimate the extent of potential from this source.

FINANCING

preliminary studies prepared by Parsons, Brincker- and Macdonald and Stanford Research Institute Francisco Bay Area Rapid Transit Commission in a report to the Commission dated March 14, concluded that a regional rapid transit system under consideration by the District could on a self-supporting basis. In recognition of necessity for provision for the financing of the elements of the System from sources other than supported by operating revenues, the Legislature, provided that the District, subject to the approval Boards of Supervisors of the constituent counties and the vote of the qualified voters of the District, may general obligation bonds in an amount not exceed- the assessed valuation of taxable property within In determining the financial feasibility of a System, we have looked only to 15% of the tion of the three counties of the District in will be located.

undertaken during the past two years have resulted in estimates of costs and revenues which confirm the earlier conclusion that the revenues to be produced by the operation of the System — at least for many years — will provide but little margin over the amounts required to cover the costs of operation and maintenance, the purchase and renewal of rolling equipment, and the requisite reimbursement to the California Toll Bridge Authority for the cost of the approaches to the Trans-Bay Tube.

Exhibit VI (page 48) shows a detailed estimate of application of gross revenues of the System during the period commencing on January 1, 1969 and ending June 30, 1981. As indicated in this Exhibit, the estimated results of operation in 1975-1976, which might be termed as a "typical year" after a period of seasoning of the System are as follows:

Summary of Estimated Operating Results in a Typical Year (1975-1976)

Gross Operating Revenues		$24,539,000
Less: Debt Service on Revenue Bonds Issued for Equipment Purchases	$ 6,613,000	
Operating and Maintenance Expense	13,510,000	
Reimbursement of California Toll Bridge Authority	3,420,000	23,543,000
Balance of Revenues Available for Reserves, Equipment Purchases and Other Purposes		$ 996,000
Estimated Debt Service Requirement for General Obligation Bonds for Construction of Fixed Basic Elements of System (1975-76)		$42,990,000

Exhibit VI and the above summary clearly indicate that while the operation of the System is expected to produce small surpluses over and above direct costs, the amounts of such surpluses are not expected to be sufficient to support the bonds required to be issued for financing the construction cost of the fixed basic elements of the System, and the District must therefore finance such cost through the issuance of bonds secured by sources other than System revenues.

3. DISTRICT'S CAPACITY TO ISSUE GENERAL OBLIGATION BONDS

General Counsel to the District has advised that the District may authorize bond issues in excess of its *current* borrowing capacity under the limitation stipulated in The Act provided that at the time of issuance of such bonds, its outstanding general obligation indebtedness plus the amount of bonds then being issued does not exceed 15% of the assessed valuation.

We have determined on the basis of the information and estimates furnished to us by the Engineers and the California Financial Advisor that the District will have sufficient borrowing capacity under The Act to finance the estimated cost of construction of the fixed basic elements of the System within the construction period proposed by the Engineers. We accordingly recommend that the District authorize the issuance of $792,000,000 general obligation bonds, which it is contemplated will be issued on approximately the following schedule, to provide funds for the progressive construction of the System in accordance with the proposed construction schedule prepared by the Engineers:

EXHIBIT I

Proposed Schedule of Issuance of General Obligation Bonds

Date	*Amount*	*Date*	*Amount*
1/1/63	$52,000,000(1)	5/1/66	$55,000,000
1/1/64	45,000,000	9/1/66	30,000,000(2)
5/1/64	40,000,000	1/1/67	50,000,000
9/1/64	70,000,000	5/1/67	35,000,000
1/1/65	70,000,000	9/1/67	30,000,000
5/1/65	85,000,000(1)	7/1/68	35,000,000
9/1/65	70,000,000	7/1/69	25,000,000
1/1/66	75,000,000	7/1/70	25,000,000
			$792,000,000

(1) Includes $5,000,000 for progress payments on rolling equipment in each year.
(2) Reflects reimbursement of $10,000,000 to "general obligation construction fund" from proceeds of revenue bonds to be issued July 1, 1966 for purchase of rolling equipment. (See page 43).

In Exhibit II shown on page 44 there is indicated the relationship between the District's pro forma outstanding general obligation debt in accordance with the bond issue schedule shown in Exhibit I and the District's estimated borrowing capacity as determined by the California Financial Advisor. It is estimated that the District will have unused borrowing capacity in each year during the proposed construction period although the margin between outstanding debt and the debt limit stipulated by The Act will be meager during the final stages of the construction period.

It should be noted, however, that the California Financial Advisor has made the projections of assessed valuation and bond capacity deliberately conservative. In relation to these projections, the California Financial Advisor comments as follows:

"The projection of assessed valuation used here was pre-

pared for the purpose of scheduling construction and bond sales. The estimated valuations are lower than those actually expected to occur. There is a probability of 75 per cent that the valuations presented here will be equalled or exceeded in the years indicated."

Should assessed valuations grow at a more rapid rate than is currently estimated for planning purposes, it is probable that the District would wish to accelerate its borrowing and construction schedule accordingly to the extent that (a) the bond market might absorb, at reasonable interest rates, the larger bond issues required and (b) the construction program could be speeded up without unduly increasing costs. Any such decision to accelerate the District's financing and construction program also, of course, would be weighed in the light of the curtailment of the adverse effects of anticipated price inflation reflected in the Engineer's estimates of construction costs and the additional revenue potential involved.

4. Security of the Bonds

Under The Act, in the opinion of General Counsel to the District, the District's general obligation bonds are to be secured by the full faith and credit of the District, and the District will be obligated to levy against all taxable property within the three counties a uniform ad valorem property tax in the amount required for the payment of the principal of and interest on such bonds.

5. Scheduling Bond Offerings

In the planning of the public sales of its bonds under this long range financing program, the District must take into consideration not only the need for funds to meet the construction schedule but also the capacity of investment markets to meet those requirements on an acceptable basis. To assure a favorable reception for its borrowing requirements, we recommend that the District plan to limit its bond sales to a maximum of four in any one year and preferably restrict such sales, whenever possible, to three or less annually in amounts of from $25,000,000 to $75,000,000 each. An important factor in this respect that is not subject to appraisal at the present time, is the possible conflict in the market scheduling of the District's bond offerings with those of the State of California, other political bodies situated in the San Francisco Bay Area in particular and the other major governmental units in the State in general. California and its subdivisions have been in the market frequently for large amounts of money in recent years and in 1961 borrowed in the aggregate more than any other state – $1,312,894,000 of the nationwide state and municipal borrowings of $8,329,575,000 (Source: THE BOND BUYER). There appears to be no valid reason to expect that the pace of the borrowing needs of the State and its local units will slacken materially over the proposed period of construction of the System. From present indications, it would appear, on the contrary, that an important increase in the volume of such borrowing during that period must be anticipated.

To assure the District of maximum flexibility in meeting its borrowing requirements with a minimum of marketing conflict with the State and its other governmental units, and to permit the District to defer long term borrowings temporarily in the event of adverse market conditions, The Act provides authorization for the issuance of notes to be issued in anticipation of the issuance of authorized general obligation bonds.

While, for planning purposes, it has been necessary to set forth in Exhibit I a definite schedule of prospective bond offerings calculated, in amount and time of issuance, to provide funds as needed for the construction of the System, it should not be inferred that this is a fixed and inflexible schedule. The District will need to appraise continuously its fund requirements, the condition of the bond market, the schedule of bond offerings by the State and other municipal agencies, and the growth of the District's borrowing capacity as evidenced by the trend of assessed valuation of taxable property. The interplay of these various factors will be instrumental in leading the District to a decision as to the timing and amount of each individual bond offering.

6. Bond Maturities and Debt Service Requirements

In scheduling the maturities of its general obligation bonds, we believe that the District should establish three guiding principles: (a) the average life of the bonds should be no longer than the estimated useful life of the basic fixed elements of the System; (b) the maturities of the bonds should be scheduled in such a manner that the tax burden for debt service will be equitably allocated over the life of the bonds and at the same time provide the necessary flexibility for the issuance of additional bonds as subsequent stages of construction or major items of remodeling or improvement may prove necessary or desirable; and (c) the maturity schedule should be designed to appeal to a broad investment market and thus attract as favorable bids as possible.

We are advised by the Engineers that they have studied the useful life of the various components of the System, and while it is probable that in some instances the useful life will exceed that which is indicated, the efficient use expectancy of those structures and equipment, in the opinion of the Engineers, should be anticipated in accordance with the following schedule:

Estimated Useful Life of Facilities

Item	*Life*
Track and Structures	40 to
Stations	40 to
Yards and Shops	
Fixed Structures	40 } A
Machinery and Equipment	20 }
Electrical Equipment	
Power Equipment	40 }
Rectifiers	20 } A
Communication	20 }
Rolling Equipment	20
Right of way	No lin

Under The Act, the District may issue bonds turities as long as 50 years from their date. Were t to fix the maximum legal maturity for its bonds is the schedule shown in Exhibit I, the final maturit July 1, 2020. Such a maturity schedule would re lowest possible *annual* debt service requirements same time would, of course, mean that the total am able for interest over the life of the bonds would than would be the case if shorter maturities were

An alternative plan was adopted which would lower total interest cost and a shorter maturity The method of accomplishing this, as suggested nance Committee of the Board of Directors of upon recommendation of the District's Financi Board, is to levy a constant tax rate equal to would occur in the first year of principal matur schedule providing for level debt service and a term of 50 years. This would result in a schedule ing maturities with (a) an annual tax rate of $.70 of assessed valuation; (b) retirement of the last bonds in 1999, about 37 years after the first bon (c) a total interest cost reduction of approxim 500,000 compared with the 50-year schedule.

Some of the other principles upon which th schedule is predicated are the following:

(a) The first bond maturity is July 1, 197 was chosen so as to eliminate the necessity of h for principal payments until the entire system ha pleted and is available for use in all of the three which facilities are to be located. The final sec system, as presently planned, will be complete 1971, and taxes to pay the July 1, 1972 matur levied in the 1971-72 fiscal year.

(b) To determine the aggregate amount o pal maturities in each year, we have applied the rate of $.708 per $100 of assessed valuation to assessed valuations estimated by the Californ

...as discussed on page 59.

(c) The principal maturities for the individual bond ... of the District proposed to be offered for sale in ac... with the schedule shown in Exhibit I are shown in ... II (page 52). These amounts have been calculated ...ving to the aggregate annual maturities for the entire ...,000 bonds the ratio between the amount of each ...ual issue and $792,000,000.

...scheduling the maturities for its individual bond issues ... are offered for sale during the construction period, ...trict will need to make adjustments to reflect the ...amounts of bonds being offered, the effective coupon ...ed upon then existing market conditions and the ...trends in assessed valuations and projections thereof ...life of the bond issues. Obviously, the periodic re... of these factors is likely to result in deviations from ...maturity schedules set forth herein for planning ...

...NCING OF THE COST OF ... EQUIPMENT

...minary studies for the San Francisco Bay Area ...Commission, Parsons, Brinckerhoff, Hall and ...estimated that the net operating revenues pro... the operation of the System would be sufficient to ...obligations issued to pay the cost of rolling equip... The Act not only provided alternative methods ...such equipment but also made provision for the ...of a fare schedule to provide revenues ade... the payment of the interest on and the amortiza... ...issued for that purpose.

...engineering studies as set forth in the report of ..., in our opinion, substantiate the belief that ...is justified in planning on the financing of its ...purchases primarily through the medium of bonds ...by pledge of the gross revenues of the System, ...ingly recommend that the District authorize ...revenue bonds for that purpose. Such reve... ...may be issued by the District pursuant to Article ...of The Act in the manner provided by the ...Law of 1941. We have studied the Revenue ...1941 and discussed its provisions with Bond ...District and believe that its provisions will not ...ility of the District to issue and market bonds ...of acquisition of its rolling equipment.

...recommend herein that the District plan to ...equipment purchases primarily through the me... ...bonds, we believe the District should not ...financing thereof from the proceeds of general ...should its borrowing capacity expand at a more rapid rate than is currently projected or should the costs of construction of the fixed, basic portions of the System be less than now estimated. The District should be prepared to analyze these factors and appraise the market for both revenue and general obligation bonds at that time in determining its course of action in this regard.

1. Amount of Financing

(a) Capital Requirements

The report of the Consulting Engineers shows the number of cars required for each fiscal year of operation up to the year 1979-80 and the aggregate capital cost thereof. Attached to this report as Appendix A (page 50) is a copy of a letter in which the engineers outline a proposed method by which the District may make progress payments on the equipment and schedule its fund requirement. Under the proposed schedule the District would pay 10% of the capital cost at the time of placing its order, 40% approximately midway between the order date and the delivery date and 50% upon delivery. The amounts required on various dates for these progress payments are shown in detail in Appendix A and in summary in Exhibit IV (page 46).

(b) Proposed Schedule of Financing

To accommodate this progressive equipment fund requirement, we recommend that the District authorize an amount of revenue bonds sufficient to pay the costs thereof and that it issue and sell such revenue bonds as funds are required for that purpose during the course of the construction period. Provision should be made in each bond issue for (a) the acquisition cost of the particular cars to be purchased or progress payments to be made (b) interest on the bonds during the period between the date of issuance of the bonds and the date when bond interest will be payable from operating revenues (herein assumed to be July 1, 1969) and (c) expenses of issuance of the bonds (estimated herein at approximately $2.00 per $1,000 bond). As in the case of the general obligation financing for the fixed basic elements of the System, temporary investment of bond proceeds will offset the total cost to a limited but, at this time, undeterminable degree.

Section A of Exhibit IV is a tentative schedule of revenue bond issues to be marketed to provide the funds at the time and in the amounts conforming with the Engineers' estimates of the fund requirements for equipment purchases.

It will be noted that the date for the first revenue bond issue for the purchase of equipment, in accordance with this schedule, is July 1, 1966, whereas approximately $10,000,000 will be needed prior to that date for progress payments. We do not recommend that the District plan to market revenue bonds prior to July 1, 1966 because we doubt that investors will be receptive to such an offering until contracts have been let for the construction of the segments constituting the basic portions of the System for which the major part of the equipment will be required. By July 1, 1966, according to the Engineers, there should be under contract the various segments, including the Trans-Bay Tube, for which the initial 250 cars will be required and we have, accordingly, chosen that date as the target date for the issuance of the initial series of revenue bonds.

It is proposed that the District obtain funds for the progress payments required to be made prior to July 1, 1966 by marketing $10,000,000 general obligation bonds, in addition to those required for construction of the fixed, basic elements of the System, as follows: $5,000,000 on January 1, 1963 and $5,000,000 on May 1, 1965. The first issue of revenue bonds scheduled for July 1, 1966 would then include provision for reimbursing the "general obligation construction fund" for the amount expended therefrom for equipment progress payments, and the general obligation bond issue scheduled for that date could be reduced by a like amount. Exhibit I, the *Proposed Schedule of Issuance of General Obligation Bonds*, reflects this transaction. Theoretically, the District might defer its initial revenue bond financing beyond July 1, 1966. We have not recommended such a procedure, however, because, on the basis of the estimates, the borrowing requirements for the fixed, basic elements of the System, as set forth herein, will be of such aggregate magnitude that the District will have insufficient margin within its debt limit for additional general obligation borrowing for the scheduled equipment purchases.

It is further proposed that issuance of revenue bonds for equipment purchases be reduced or terminated at such time and to such extent as the net revenues of the System (after payment of revenue bond debt service, operating and maintenance expenses, reserves for debt service and reimbursement of the California Toll Bridge Authority for the approaches to the Trans-Bay Tube) are sufficient for equipment progress payments. The calculations herein indicate that, of the total estimated capital cost of $71,200,000 for equipment in the years ending 1978-79, approximately $5,440,000 required in the years 1972-73 to 1978-79 can be financed from net revenues of the System, and Section B of Exhibit IV reflects this proposed method of financing.

2. Bond Service Requirements

The Engineers have advised us that the equipment to be purchased for the System will have a minimum expected useful life of 20 years and we have accordingly assumed that the bonds to be issued for the purchase thereof will have a final maturity approximately 20 years from the date of delivery of such equipment. Market acceptability at the time of bond offering will be an important factor in the determination of whether term bonds with amortization requirements sufficient to retire the bonds by maturity or serial

bonds will best meet the District's requirements, but we believe that whichever type of bond is sold, the District should provide for the payment of interest and repayment of principal on approximately a "level debt service" schedule commencing in the year 1972-73 and ending in approximately the twentieth year after delivery and placing in use of the equipment thus financed.

Exhibit V (page 47) shows a tentative schedule of debt service requirements for $72,875,000 revenue bonds issued in accordance with the schedule in Exhibit IV, while Appendix C (page 53) shows the computation in detail of the bond amortization requirements.

3. Application of System Operating Revenues

Under The Act, the District is required, insofar as practicable, to set rates and charges for the services furnished by the System such that revenues will be sufficient to pay the costs of operation, repairs, maintenance and depreciation of the System and provide for the purchase, lease or acquisition of rolling equipment, including provision for the payment of interest on and principal of obligations incurred for the acquisition of such rolling equipment. In addition to paying from revenues the items enumerated above, the District will need to make provision in accordance with an agreement between the District and the California Toll Bridge Authority for the amounts required to be paid to the Authority in reimbursement of the cost of construction of the approaches to the Trans-Bay Tube.

In its resolutions authorizing the issuance of revenue bonds, the District will be required to enter into agreements with its bondholders as to the "flow of funds" or the establishment of priorities for the application of its revenues. We recommend that the District covenant in its resolutions to apply revenues to the following purposes in the priority order indicated:

First: Provision for debt service requirements on bonds issued to finance the purchase of rolling equipment;

Second: Payment of the costs of operation and maintenance of the System;

Third: Provision for a reserve account to prevent default in the payment of debt service of rolling equipment obligations. We recommend that the District set aside in its reserve fund (a) a fixed amount equal to 20% of the annual debt service requirements for the Revenue Bonds and (b) any surplus revenues remaining after reimbursement of the California Toll Bridge Authority as required in "Fourth" below, both of such payments to continue until there is on deposit in such reserve fund an amount equal to the interest becoming due and payable on the Revenue Bonds during the ensuing 12 months;

Fourth: Reimbursement of the California Toll Bridge Authority for the costs of the approaches to the Trans-Bay Tube;

Fifth: Provision for such reserves as may be recommended by the District's Consulting Engineers for renewals and replacements to the System, other than rolling equ
The Engineers recommend that the District accumu
renewal and replacement of certain components of
tem a fund of $8,000,000 at the rate of $5,000,000
the first ten years of operation and $3,000,000 du
second ten years; and

Sixth: Surplus revenues to be available for pur
equipment, financing of extensions of or improve
the System, or to payment of debt service on the
general obligation bonds, as may be determined by t
of Directors.

Exhibit VI (page 48) is a schedule of the appli
the revenues of the System as estimated by the
in accordance with the above recommended "flow o
It will be noted that during the period under review
revenues provide but little margin or surplus over a
the direct costs of operating the System and payin
rolling equipment, although the margin of profit
operations is estimated to improve steadily over th

4. Coverage of Debt Service Requirements

In order to enhance the marketability of the
revenue bonds, we recommend that the District est
debt service requirements of such bonds as a first
the gross operating revenues of the System and
its authorizing bond resolutions that there will be
in the bond service fund for such bonds monthly,
first revenues received in such month, beginning
prior to the first interest date when interest will b
from revenues, one-sixth of the interest payable o
succeeding interest payment date and beginnin
months before the first date when a serial maturity
tization installment is due, one-twelfth of the a
principal (or amortization installment) becoming
next succeeding bond maturity date (or amortizat
The Revenue Bond Law of 1941, pursuant to w
revenue bonds will be issued, provides that funds
purposes, including operating and maintenance
shall not be apportioned from revenues until such
have been first applied to the payment of debt s
quirements, unless otherwise provided by the issu

In accordance with this recommended provisio
service, Exhibit VII (page 49) shows the relati
tween gross revenue as estimated by the Engine
tentative schedule of debt service requirements
Exhibit V. It will be noted that, as the System be
lished on a regional basis by completion and pla
eration the various segments thereof, the margin
debt service requirements is expected to impro

5. Alternative Method of Financing

The Act provides that the District may finan
chase of its rolling equipment through the media

EXHIBIT II
CALCULATION OF THREE-COUNTY GENERAL OBLIGATION BOND BORROWING CAPACITY

(figures in thousands)

Fiscal Year	*Estimated Assessed Valuation*	*Borrowing Limit (15% of Assessed Valuation)*	*Bonds Issued*	*Bonds Outstanding at end of year*	*Borrowing Margin*
1962-63	$4,040,000	$606,000	$ 52,000	$ 52,000	$554,000
1963-64	4,192,000	628,800	85,000	137,000	491,800
1964-65	4,344,000	651,600	225,000	362,000	289,600
1965-66	4,504,000	675,600	200,000	562,000	113,600
1966-67	4,665,000	699,750	115,000	677,000	22,750
1967-68	4,825,000	723,750	30,000	707,000	16,750
1968-69	4,985,000	747,750	35,000	742,000	5,750
1969-70	5,144,000	771,600	25,000	767,000	4,600
1970-71	5,299,000	794,850	25,000	792,000	2,850

EXHIBIT III

SUMMARY SCHEDULE OF DEBT SERVICE REQUIREMENTS – GENERAL OBLIGATION BONDS

(figures in thousands)

Bonds Outstanding at Beginning of Year	*Aggregate Principal Maturities (1)*	*Interest (2)*	*Total Debt Service Requirements*	*Estimated Proceeds from Tax Levy of $0.708 per $100 of Assessed Valuation (3)*
$ —	$ —	$ —	$ —	$ —
52,000	—	4,287(4)	4,287(4)	—
137,000	—	9,780	9,780	—
362,000	—	18,680	18,680	—
562,000	—	24,713	24,713	—
677,000	—	28,080	28,080	—
707,000	—	29,680	29,680	—
742,000	—	30,680	30,680	—
767,000	—	31,680	31,680	—
792,000	6,910	31,680	38,590	38,600
785,090	8,295	31,403	39,698	39,698
776,795	9,710	31,071	40,781	40,781
767,085	11,216	30,683	41,899	41,899
755,869	12,756	30,234	42,990	42,990
743,113	14,363	29,724	44,087	44,087
728,750	16,027	29,150	45,177	45,177
712,723	17,766	28,509	46,275	46,275
694,957	19,560	27,798	47,358	47,358
675,397	21,426	27,015	48,441	48,441
653,971	22,836	26,158	48,994	48,994
631,135	24,280	25,245	49,525	49,525
606,855	25,782	24,274	50,056	50,056
581,073	27,344	23,243	50,587	50,587
553,729	28,969	22,149	51,118	51,118
524,760	30,659	20,990	51,649	51,649
494,101	32,416	19,764	52,180	52,180
461,685	34,244	18,467	52,711	52,711
427,441	36,003	17,097	53,100	53,100
391,438	37,443	15,657	53,100	53,100
353,995	38,941	14,159	53,100	53,100
315,054	40,498	12,602	53,100	53,100
274,556	42,118	10,982	53,100	53,100
232,438	43,803	9,297	53,100	53,100
188,635	45,555	7,545	53,100	53,100
143,080	47,377	5,723	53,100	53,100
95,703	49,272	3,828	53,100	53,100
46,431	46,431	1,857	48,288	53,100
	$792,000	$753,884	$1,545,884	

Reference is made to Appendix B for proposed maturities for the individual issues of bonds of the District.
At an assumed coupon rate of 4%.
Calculated by applying a uniform annual tax rate of $0.708 per $100 of assessed valuation to the projected assessed valuation as estimated by the California Financial Advisor.
Includes $1,040,000 interest accrued in the fiscal year 1962-63 but paid in 1963-64.

ment trust certificates of the type customarily used by private corporations engaged in the rapid transit business. Under this type of financing a trustee would issue certificates, pay for the equipment with the proceeds thereof and retain title thereto until the certificates are retired. In turn, the trustee would enter into a lease agreement with the District pursuant to which the District would have full control and use of the equipment and would pay the trustee, from revenues, annual amounts equivalent to the requirements for principal and interest on the certificates plus the expenses of the trustee in administering the trust. Should the District default in the payment of the stipulated rentals, the trustee would be authorized, under the lease, to repossess the equipment and make such disposition thereof as, in the judgement of the trustee, is in the best interest of the certificate holders.

While this method has been used for many years with conspicuous success by railroad operators, its use among municipally-owned transit systems has been infrequent and confined to relatively small amounts.

An important reason for the acceptability of this type of security is the fact that the equipment purchased is assumed to be of a type for which there is a ready market should default by the lessee necessitate selling of the equipment by the trustee to satisfy the lien of the certificate holders. In the case of a rapid transit system such as that proposed for the District, this particular security element, in our opinion, would be of questionable value inasmuch as the proposed equipment is a peculiarly specialized type and not generally adaptable to other rapid transit systems now in existence.

Aside from the specialized nature of the District's proposed equipment, other factors have been considered in reaching a decision as to the recommended method for financing equipment purchases by means of revenue bonds rather than by means of equipment trust certificates. Of these, the more important are:

(a) Whereas municipal revenue bonds are often issued to finance the full amount of the capital cost of revenue-producing enterprises, it is customary, in issuing equipment trust certificates, for the issuer to make a cash "down payment" of approximately 20% to 25% to establish an initial equity which increases as certificates are retired. The net effect of such a procedure would be that, of the total cost of the equipment, the District could anticipate paying only, say, 80% from the proceeds of equipment trust certificates and would be required to pay the balance from sources other than such financing. As noted previously herein the District is expected to have but little borrowing capacity after financing the cost of construction of the System, and, this being the only apparent source of funds for a "down payment," it has been considered impracticable to recommend a form of financing which would require such a down payment.

EXHIBIT IV

PROPOSED FINANCING OF CAPITAL REQUIREMENTS FOR ROLLING EQUIPMENT

(figures in thousands)

A. Requirements To Be Financed by Issuance of Bonds

Capital Requirement (1)		*Date of Issuance of Revenue Bonds*	*Capital Cost Financed*	*Capitalized Interest (2)*	*Estimated Financing Expenses (3)*	*Principal Amount of Revenue Bonds*
Date Required	*Amount*					
7/1/63	$ 153	7/1/66(4)	$26,110	$4,350	$ 65	$30,525
1/1/64	765					
1/1/65	3,002					
7/1/65	3,672					
1/1/66	2,045					
7/1/66	15,833					
1/1/67	640					
7/1/67	20,130	7/1/67	20,450	2,152	48	22,650
1/1/68	320					
7/1/68	8,960	7/1/68	9,280	464	16	9,760
1/1/69	320					
7/1/69	4,480	7/1/69	4,640	—	10	4,650
1/1/70	160					
7/1/70	2,880	7/1/70	5,280	—	10	5,290
1/1/71	160					
7/1/71	2,240					
Sub-Totals	$65,760		$65,760	$6,966	$149	$72,875

B. Requirements To Be Financed from Operating Revenues

Capital Requirement (1)		*Fiscal Year of Payment*	*Amount Paid*			
Date Required	*Amount*					
7/1/72	$ 1,440	1972-73	$ 1,600	—	—	—
1/1/73	160					
7/1/73	800	1973-74	800	—	—	—
7/1/74	640	1974-75	640	—	—	—
7/1/75	800	1975-76	960	—	—	—
1/1/76	160					
7/1/77	640	1977-78	640	—	—	—
7/1/78	800	1978-79	800	—	—	—
Sub-Totals	$ 5,440		$ 5,440	—	—	—
Grand Totals	$71,200		$71,200	$6,966	$149	$72,875

NOTES: (1) As estimated by the Engineers.
(2) Interest capitalized from date of bonds to July 1, 1969 at 4¾%.
(3) Approximately $2.00 per bond — partly a balancing item to round out bond issue.
(4) It is proposed that the capital requirements prior to July 1, 1966 would be paid from the proceeds of $10,000,000 General Obligation Bonds issued $5,000,000 on January 1, 1963 and $5,000,000 on May 1, 1965. Out of the proceeds of the initial issue of Revenue Bonds on July 1, 1966, the "general obligation construction fund" would be reimbursed for the amount paid therefrom for capital requirements for equipment.

(b) Underwriters of and investors in obligatio type the District would issue pursuant to the Reven Law of 1941 are fully familiar with the features of (and weakness) in such bonds, but, in our opinion, tively unfamiliar with the security provisions of eq trust certificates. We believe that, accordingly, the bonds in the amounts required are likely to have market acceptability than a comparable amount ment trust certificates in the customary legal form sequently are likely to result in an interest cost mo tageous to the District.

C. FINANCING BY CALIFORNIA TOLL BRIDGE AUTHORITY OF THE TRANS-BAY TUBE

1. Relationship Between the District and Authority

When the voters of the San Francisco Bay A Transit District have approved the issuance of ge gation bonds, the amount of which, together with financing then provided by the District, will be no $500,000,000, the California Toll Bridge Author obligated to proceed with the financing and cons the Trans-Bay Tube between San Francisco and O

The Trans-Bay Tube will constitute a vitally part of the rapid transit System, and a brief anal financial aspects thereof has been included in t for two primary reasons, namely –

(a) The District, we believe, will wish to h ance that the Authority has ample resources to financing and construction of the Trans-Bay Tub time schedule prepared by the Engineers for th tion and placing in operation of the System as a

(b) Article 5, Chapter 2, Division 17 of and Highways Code (Sections 30,770 et seq.) sti the District must reimburse the Authority for the approaches to the Trans-Bay Tube, as defined, in financing costs attributable thereto. Said Article f ulates that the terms of reimbursement are to b agreement between the District and the Author reimbursement is to extend over a period not le estimated period for retirement of the Author and not longer than the full term of such bonds latest maturity. To permit the District to analyz of its obligation pursuant to this provision, th necessary to determine not only the costs of th proaches, including the financing costs attributa but also to determine the probable maturity re bonds which will be issued by the Authority.

2. Resources of the Authority

With the approval of your General Manag

ion[illegible]ed the financing of the Trans-Bay Tube with appro-
en[illegible] officials of the Department of Public Works of the
of [illegible] of California, and have been furnished the following
n, [illegible]mation upon which our analysis has been predicated:
eq[illegible] (a) All of the bonded indebtedness incurred by the
ne[illegible]rity to finance construction and/or acquisition of the
ve [illegible]Bridge and the San Mateo-Hayward and Dumbarton
[illegible] has been retired, and the Authority does not intend
n[illegible] further indebtedness for capital improvements to
or[illegible] crossings. The Authority is obligated by Article 6,
[illegible] 2, Division 17 of the Streets and Highways Code
[illegible] 30,790 et seq.) to deposit in a single fund the net
[illegible] of these bridges and to apply such fund to (1) the
[illegible]truction of the Bay Bridge, (2) the reconstruction of
[illegible] Mateo-Hayward Bridge, as directed by the Legisla-
[illegible] (3) thereafter, to the extent necessary, the financ-
[illegible] Trans-Bay Tube.

[illegible] As of December 31, 1961, the Authority had ex-
[illegible] approximately $15,800,000 on the reconstruction of
[illegible] Bridge, and anticipated that an additional $16,700,-
[illegible] be required for that purpose. At the same date,
[illegible]rity had an unexpended balance of approximately
[illegible] in the fund set aside for the reconstruction of
[illegible] Bridge and the San Mateo-Hayward Bridge.

[illegible] Under Article 6, Chapter 2, Division 17 of the
[illegible] Highways Code (Sections 30,790 et seq.) the
[illegible] is authorized to construct a new high level bridge
[illegible] of the San Mateo-Hayward Bridge, and the Au-
[illegible] proceeding with this construction at an estimated
[illegible],000,000. The Authority is authorized by the
[illegible] apply to that purpose so much as may be necessary
[illegible] set aside for reconstruction of the Bay Bridge
[illegible]ding for the reconstruction of said Bay Bridge)
[illegible]venues of the Bay Bridge, the Dumbarton Bridge
[illegible] Mateo-Hayward Bridge accruing up to and in-
[illegible] 30, 1964.

[illegible] The earnings record of the Bay Bridge and the
[illegible] Hayward and Dumbarton Bridges for the fiscal
[illegible] June 30, 1961 was as follows:

Operating Results – San Francisco-Oakland Bay, San Mateo-Hayward and Dumbarton Bridges

Toll Revenue	$14,206,441
Rentals	236,481
Other Income (net)	(583)
Gross Revenues	$14,442,339
Operating Expenses including Insurance	$ 2,096,943(1)
Capital Improvements	204,538(2)
Total Expenses	$ 2,301,481
Balance of Revenues	$12,140,859(3)

(1) Maintenance cost of all three bridges is paid from State Highway construction funds.

(2) Expended for rehabilitation of Dumbarton Bridge; expected to be a non-recurring item after completion of bridge remodeling and reconstruction.

(3) In addition to the above income, the Authority reported investment income of $1,499,522. It is probable that most, if not all, of the moneys now invested will be expended over the next two years for reconstruction of the Bay Bridge and the San Mateo-Hayward Bridge, and consequently this item is likely to become of decreasing importance.

3. Financing of Bridge Improvements

If combined net bridge revenues amount to approximately $12,300,000 annually, the Authority should be able to provide for the estimated costs of the proposed reconstruction of the Bay Bridge and the San Mateo-Hayward Bridge from revenues accruing up to June 30, 1964. In summary, the capital requirements and resources available therefor will be approximately as follows:

Requirements	
Balance of Cost of Bay Bridge Reconstruction	$16,700,000
Balance of Construction Cost of San Mateo-Hayward Bridge	68,500,000
Total	$85,200,000
Resources	
Balance in Bay Bridge Toll Revenue Fund (12/31/61)	$54,375,000
Net Revenues to accrue (1/1/62 - 6/30/64)	30,750,000
Total	$85,125,000

Based upon the above-indicated fund requirements, we have assumed herein that the Authority will have no moneys

EXHIBIT V

SUMMARY OF DEBT SERVICE REQUIREMENT – REVENUE BONDS (1)

(figures in thousands)

Fiscal Year	*Bonds Outstanding at Beginning of Year*	*Principal Amortization*	*Interest (2)*	*Total Debt Service*
1966-67	$30,525	–	Capitalized	Capitalized
1967-68	53,175	–	Capitalized	Capitalized
1968-69	62,935	–	Capitalized	Capitalized
1969-70	67,585	–	$ 3,210	$ 3,210
1970-71	72,875	–	3,462	3,462
1971-72	72,875	–	3,462	3,462
1972-73	72,875	$ 3,151	3,462	6,613
1973-74	69,724	3,300	3,312	6,612
1974-75	66,424	3,458	3,155	6,613
1975-76	62,966	3,622	2,991	6,613
1976-77	59,344	3,794	2,819	6,613
1977-78	55,550	3,974	2,639	6,613
1978-79	51,576	4,164	2,450	6,614
1979-80	47,412	4,361	2,252	6,613
1980-81	43,051	4,567	2,045	6,612
1981-82	38,484	4,785	1,828	6,613
1982-83	33,699	5,012	1,601	6,613
1983-84	28,687	5,251	1,363	6,614
1984-85	23,436	5,500	1,113	6,613
1985-86	17,936	5,761	852	6,613
1986-87	12,175	6,034	578	6,612
1987-88	6,141	3,429	292	3,721
1988-89	2,712	1,540	129	1,669
1989-90	1,172	763	56	819
1990-91	409	409	19	428
		$72,875	$43,090	$115,965

NOTES: (1) Reference is made to Appendix C for further details of the computation of bond amortization requirements.

(2) At an assumed coupon rate of 4¾%.

EXHIBIT VI
ESTIMATED APPLICATION OF SYSTEM REVENUES

(figures in thousands)

Fiscal Year	*Estimated Gross Revenues (1)*	*Debt Service Requirements for Revenue Bonds (2)*	*Estimated Operating and Maintenance Expenses (1)*	*Mandatory Deposit in Bond Reserve Fund (3)*	*Estimated Reimbursement to California Toll Bridge Authority (4)*	*Estimated Balance of Revenues*	*Estimated Additional Deposit into Bond Reserve Fund (3)*	*Estimated Withdrawals from Bond Reserve Fund (5)*	*Estimated Cumulative Balance of Revenues Available for Equipment Purchases and Other Purposes*	*Moneys Applied to Purchase of Equipment (6)*	*Estimated Surplus Available for Other Purposes*
1969-70(8)	$28,449	$3,210(9)	$17,376	$642	$5,130	$2,091	$2,091	—	—	—	—
1970-71	21,383	3,462	12,273	692	3,420	1,536	37	—	$1,499	—	—
1971-72	22,571	3,462	12,589	—	3,420	3,100	—	—	4,599	$1,600	$1,000
1972-73	23,416	6,613	12,979	—	3,420	404	—	$150	2,553	800	1,000
1973-74	23,956	6,612	13,234	—	3,420	690	—	157	1,600	640	—
1974-75	24,284	6,613	13,389	—	3,420	862	—	164	1,986	960	1,02
1975-76	24,539	6,613	13,510	—	3,420	996	—	172	1,168	640	52
1976-77	24,790	6,613	13,624	—	3,420	1,133	—	180	1,313	800	51
1977-78	25,045	6,613	13,745	—	3,420	1,267	—	189	1,456	—	1,45
1978-79	25,299	6,614	13,873	—	3,420	1,392	—	198	1,590	—	1,59
1979-80	25,543	6,613	13,980	—	3,420	1,530	—	207	1,737	—	1,73
1980-81	25,788	6,612	14,074	—	3,420	1,682	—	217	1,899	—	1,89

NOTES: (1) As estimated by the Engineers.

(2) See Exhibit V.

(3) In calculating amounts to be deposited in Bond Reserve Fund, it is assumed that there will be accumulated therein an amount equal to the interest due during the ensuing fiscal year by (a) mandatory deposits equal to 20% of the debt service on Revenue Bonds payable in each fiscal year, plus (b) all surplus revenues remaining at the end of each fiscal year until the required reserve has been accumulated.

(4) See text under FINANCING BY CALIFORNIA TOLL BRIDGE AUTHORITY OF TRANS-BAY TUBE.

(5) It is assumed that moneys in the Bond Reserve Fund in excess of the requirement of t fund will be withdrawn and treated as revenues. Excesses occur by reason of bond re ments.

(6) It is assumed that, to the extent required, surplus moneys will be applied, first, to the p chase of rolling equipment. The aggregate of the amounts so applied herein is $5,440,

(7) Of this surplus, the Engineers recommend that $5,000,000 during the first ten year operation and $3,000,000 during the second ten years be reserved as a fund for rene and replacements of various components of the System.

(8) Covers 18 months' period from January 1, 1969 to June 30, 1970.

(9) Bond interest from July 1, 1969-June 30, 1970, balance capitalized.

available for the Trans-Bay Tube project prior to July 1, 1964, but after that date all net revenues of the three bridges will be available for the Trans-Bay Tube, including the payment of debt service requirements on any bonds issued by the Authority therefor.

4. CAPITAL REQUIREMENTS AND FINANCING FOR TRANS-BAY TUBE

(a) Assumptions – The report of the Consulting Engineers shows a tentative schedule of fund requirements for the estimated $132,720,000 construction of the Trans-Bay Tube and its approaches. It is expected that the Authority will wish to undertake independent engineering studies (probably by the Division of San Francisco Bay Crossings) prior to the construction of the Tube, but we have assumed herein that the results of any such studies will corroborate the findings of the District's Engineers as to cost and fund requirements.

In our studies of the Trans-Bay Tube capital requirements and the financing thereof, we have made certain other assumptions, as follows:

(i) Inasmuch as the bonds to be issued by the Authority for the financing of the costs of construction of the Tube will not depend for their security upon the earnings of the Tube, but rather upon net bridge revenues, the Authority should be able to issue such bonds at any time and in such amounts as may be required to meet accruing construction costs and pledge as security the net bridge revenues accruing after July 1, 1964. If the District is to market equipment revenue bonds by July 1, 1966, however, it will be important that the entire Tube and approaches be under contract prior to that date. For that reason, we have assumed th thority will complete its bond financing for th July 1, 1965 and complete the letting of contra as practicable thereafter.

(ii) The Authority will have no net bridg available for debt service prior to July 1, 1964, quently all bond interest payable prior to that d capitalized.

(iii) The estimated construction period f extends to January 1, 1968, and we have assum Authority, to the greatest extent possible, will wi to construction the net bridge revenues accru July 1, 1964 and January 1, 1968. In calculating bond amortization schedule for the Authority's therefore, we have provided no amortization

(iv) The Authority will have a broad latitude in ing the maturity of the bonds to be issued for the Bay Tube, and the annual requirements for interest mortization of such debt would normally vary accord- the maturity chosen. We have assumed that, in order rket as attractive a bond as possible, the Authority will to fix the bond maturity – and hence the annual debt requirements – so that annual net bridge revenues rovide debt service coverage of about 150%.

(v) The toll rates charged for use of the three toll s will remain at the current level.

(b) Bond Issues – To provide the moneys needed to the capital requirements for the Trans-Bay Tube in an manner, we believe the Authority might logically for the sale of two bond issues, as follows:

(i) Initial Issue as of January 1, 1963

Requirement (1)	$37,000,000
Interest (1/1/63 - 6/30/64) (2)	2,518,125
Discount (at 2%) and financing costs	829,500
Gross Requirement	$40,347,625
Estimated income from interim investment of construction fund and capitalized interest fund (3)	$ 847,625
Net of Bond Issue	$39,500,000

Covers capital fund requirements from January 1, to July 1, 1965.
Interest calculated at 4¼%.
Partly a balancing item to round out the bond issue.

(ii) Second Financing as of July 1, 1965

Requirement (1)	$95,720,000	
Amount to be provided Bridge revenues (2)	25,000,000	$70,720,000
Discount (at 2%) and financing costs		1,485,750
Gross Requirement		$72,205,750
Estimated income from interim investment of construction fund (3)....		$ 1,455,750
Net Bond Issue		$70,750,000

Covers capital fund requirements from July 1, 1965 to July 1, 1968, the estimated date of completion of the project.

(3) Estimated that the balance of net bridge revenues available after payment of bond interest (adjusted for the probable elimination of investment income) during the period July 1, 1964 to January 1, 1968 will be approximately $29,600,000, as follows:

Period	Estimated Net Revenues	Estimated Bond Interest	Estimated Balance Available for Tube Construction
7/1/64- 6/30/65	$12,300,000	$ 1,678,750	$10,621,250
7/1/65- 6/30/66	12,300,000	4,685,625	7,614,375
7/1/66- 6/30/67	12,300,000	4,685,625	7,614,375
7/1/67-12/30/67	6,150,000	2,342,813	3,807,187
	$43,050,000	$13,392,813	$29,657,187

We have assumed that a minimum of $25,000,000 will be available for Tube Construction.

(3) Partly a balancing item to round out the bond issue.

EXHIBIT VII
ESTIMATED COVERAGE FOR DEBT SERVICE REQUIREMENTS FOR REVENUE BONDS

(figures in thousands)

Fiscal Year	*Estimated Gross Revenues (1)*	*Debt Service Requirements (2)*	*Estimated Times Debt Service Requirements Earned*
1969-70(3)	$28,449	$3,210	8.86
1970-71	21,383	3,462	6.18
1971-72	22,571	3,462	6.52
1972-73	23,416	6,613	3.54
1973-74	23,956	6,612	3.62
1974-75	24,284	6,613	3.67
1975-76	24,539	6,613	3.71
1976-77	24,790	6,613	3.75
1977-78	25,045	6,613	3.78
1978-79	25,299	6,614	3.83
1979-80	25,543	6,613	3.86
1980-81	25,788	6,612	3.90

NOTES: (1) As estimated by the Engineers.
(2) See Exhibit V and Appendix C.
(3) 18 months period from January 1, 1969 to June 30, 1970.

5. Prospective Bridge Revenues

While the three bridges, based upon recent history, may apparently be counted upon to produce approximately $12,-300,000 net revenues annually prior to the opening of the rapid transit tube, it is expected that the existence of the Tube will, at least for a few years, result in a diminution of bridge traffic and toll revenues. The District's Engineers, as shown in Appendix D (page 54), have prepared an estimate of the effect of existence of the Tube upon traffic and revenues of the Bay Bridge for the years 1968-9 through 1980-81. It is assumed that gross revenues of the San Mateo-

Hayward and Dumbarton Bridges will continue at approximately $2,350,000.

For the purposes of the current analysis we have assumed that the Authority's costs of operating the bridges in future years will be approximately $2,300,000, as in 1960-61, that is to say that increased costs of operating the new San Mateo-Hayward Bridge will offset the non-recurring expense in 1960-61 for rehabilitation of the Dumbarton Bridge.

The projection of operating results of the bridges, with the rapid transit System in existence, based upon these estimates and assumptions, is thus as follows:

PROJECTED OPERATING RESULTS OF TRANS-BAY BRIDGES

Fiscal Year	*Estimated Gross Revenue*	*Assumed Operating Expenses*	*Estimated Net Revenues*
1968-69	$14,206,000	$2,300,000	$11,906,000
1969-70	14,147,000	2,300,000	11,847,000
1970-71	14,340,000	2,300,000	12,040,000
1971-72	14,592,000	2,300,000	12,292,000
1972-73	14,778,000	2,300,000	12,478,000
1973-74	15,016,000	2,300,000	12,716,000
1974-75	15,294,000	2,300,000	12,994,000
1975-76	15,571,000	2,300,000	13,271,000
1976-77	15,836,000	2,300,000	13,536,000
1977-78	16,105,000	2,300,000	13,805,000
1978-79	16,273,000	2,300,000	13,973,000
1979-80	16,273,000	2,300,000	13,973,000
1980-81	16,273,000	2,300,000	13,973,000

Average annual net bridge revenues over this thirteen year period are thus estimated at approximately $13,000,000, or some $900,000 more than the net revenues in the most recently completed fiscal year of the Authority.

6. Bond Maturity

If the Authority is to fix its bond maturity (or maturities) in a manner calculated to afford debt service coverage of approximately 150% with annual net revenues averaging about $13,000,000, it could assume the obligation to pay aggregate annual principal and interest of about $8,600,000 ($13,000,000 ÷ 1.50 = $8,667,000). Assuming a coupon rate of 4¼% the Authority could retire its $110,250,000 bonds on a "level debt service" schedule in 19 annual installments with resultant annual debt service of $8,573,500 and we have assumed for planning purposes herein that the Authority's bonds would mature within a period of 19 years from January 1, 1968, or by January 1, 1987. In calculating coverage for the Authority's bonds we have not taken into consideration, as revenues of the Authority, the amounts which it is planned would be paid to the Authority by the

APPENDIX A

PARSONS BRINCKERHOFF — TUDOR — BECHTEL
General Engineering Consultants To
San Francisco Bay Area Rapid Transit District

YUkon 6-5858 833 Market Street San Francisco — 3 — Cal.

March 21, 1962

Mr. K. M. Hoover, Chief Engineer
San Francisco Bay Area Rapid Transit District
628 Flood Building
San Francisco 2, California

Dear Mr. Hoover:

With our letter of March 19, 1962 we provided estimates of patronage, revenue, operations, and rolling stock for the proposed three-county rapid transit system.

For financial planning purposes it has been necessary to make assumptions as to the timing of the cash requirements for rolling stock purchase payments. We have assumed that 10 per cent of the cost of rolling stock would be paid upon date of order, 40 per cent upon the approximate median date of fabrication, and the remaining 50 per cent upon date of delivery, with 10 per cent of the last 50 per cent withheld until the delivered cars could be adequately tested.

Two and one-half years have been allowed between order and delivery dates for each group of cars, plus one-half year between delivery date and assumed date of opening to revenue service. An exception to the above assumption is made only for the first ten cars, in which instance the period between delivery and start of revenue service is increased to one year, for the purpose of adequate testing.

Most rolling stock orders are based on payment due "30 days net" f.o.b. at plant. However, the 10 per cent - 40 per cent - 50 per cent progress payments assumed herein would substantially ease the manufacturer's short-term financing problem during fabrication. Since the District will be able to borrow money at lower interest rates, this might have the effect of slightly lowering the cost per rapid transit car.

Both the progress payment schedule and the periods allowed for fabrication and testing after delivery are conservative from the District's standpoint to allow for contingencies.

Very truly yours,

PARSONS BRINCKERHOFF-TUDOR-BECHTEL

J. E. Everson

Parsons, Brinckerhoff
Quade & Douglas
165 - Broadway
New York - 6 - N. Y.

Tudor Engineering Co.
595 Mission Street
San Francisco - 5 - Cal.

Bechtel Corporation
220 Bush Street
San Francisco - 4 - Cal.

SAN FRANCISCO BAY AREA RAPID TRANSIT DISTRICT

PARSONS BRINCKERHOFF-TUDOR-BECHTEL

RAPID TRANSIT SYSTEM ROLLING STOCK AND ROLLING STOCK FUND REQUIREMENTS
(For system serving Alameda, Contra Costa, and San Francisco Counties)

DATE PLACED IN SERVICE	TOTAL COST -- Thousands of Dollars	FUND REQUIREMENTS - DOLLARS IN THOUSANDS					
		At Order Date		At Median Date		At Delivery Date	
		Date	10% Payment	Date	40% Payment	Date	50% Payment
1/1/66	$ 1,530	7/1/63	$ 153	7/1/65	$ 612	1/1/66	$ 765
1/1/67	7,650	1/1/64	765	7/1/65	3,060	7/1/66	3,825
1/1/68	30,020	1/1/65	3,002	7/1/66	12,008	7/1/67	15,010
1/1/69	12,800	1/1/66	1,280	7/1/67	5,120	7/1/68	6,400
1/1/70	6,400	1/1/67	640	7/1/68	2,560	7/1/69	3,200
1/1/71	3,200	1/1/68	320	7/1/69	1,280	7/1/70	1,600
1/1/72	3,200	1/1/69	320	7/1/70	1,280	7/1/71	1,600
1/1/73	1,600	1/1/70	160	7/1/71	640	7/1/72	800
1/1/74	1,600	1/1/71	160	7/1/72	640	7/1/73	800
1/1/75	-	1/1/72	-	7/1/73	-	7/1/74	-
1/1/76	1,600	1/1/73	160	7/1/74	640	7/1/75	800
1/1/77	-	1/1/74	-	7/1/75	-	7/1/76	-
1/1/78	-	1/1/75	-	7/1/76	-	7/1/77	-
1/1/79	1,600	1/1/76	160	7/1/77	640	7/1/78	800
1/1/80	-	1/1/77	-	7/1/78	-	7/1/79	-
	$ 71,200						

District under a reimbursement agreement. While these amounts would probably be used by the Authority for bond retirement, it is not clear under Article 5, Chapter 2, Division 17 of the Streets and Highways Code (Sections 30,770 et seq.) that such amounts would be pledged as security for the Authority's bonds.

7. District's Obligation to Reimburse Authority for Costs of Trans-Bay Tube Approaches

Under Article 5 the District will be obligated to reimburse the Authority for the costs (including financing costs) of the approaches to the Trans-Bay Tube over a period no longer than the latest maturity of the Authority's bonds, or, on the basis of the above-mentioned estimates, assumptions and calculations, by January 1, 1987. The annual amounts to be paid to the Authority by the District will be subject to negotiation between the District and the Authority and consequently are not susceptible of precise determination at this time. We have assumed that such negotiations will not result in the District's paying to the Authority an annual amount greater than would result from a straight-line amortization of such costs over the 18 year period commencing January 1, 1969 (the date when the Engineers estimate that revenues will be available for other than operating expenses) and ending January 1, 1987, the year of the estimated final maturity of the Authority's bonds.

The costs to be allocated over this 18 year period are calculated herein as follows:

(a) The proportion of reimbursable costs is determined by relating the estimated capital cost of the Tube approaches to the estimated total capital cost of the Tube and its approaches, i.e. the ratio of $40,594,000 to $132,720,000 or 30.58%.

(b) The total cost of the Tube and approaches, including financing costs, on the basis of the estimates and assumptions hereinbefore noted, will be:

Principal Amount of Bonds	$110,250,000
Interest to final bond maturity	66,039,000
Earnings of Bridges contributed to construction costs of Tube	25,000,000
Total	$201,289,000

(c) The share of estimated total cost allocable to the District on account of the construction of the approaches is thus 30.58% of $201,289,000 or $61,554,175.

Distribution of this cost on a straight line basis over the 18 year period 1969-1987 would result in annual costs to the District of approximately $3,420,000, and this figure has been used in Exhibit VI herein in analyzing the District's prospective results of operation of the System.

It should be noted that at the time the Authority undertakes its financing program it will probably wish to retain

APPENDIX B

PROPOSED SCHEDULE OF DEBT SERVICE REQUIREMENTS–GENERAL OBLIGATION BONDS

(figures in thousands)

Fiscal Year	*Serial Maturities*																*Total Maturities*	*Interest at 4%*	*Total Ser*
	$52,000 (1/1/63) (1)	$45,000 (1/1/64)	$40,000 (5/1/64)	$70,000 (9/1/64)	$70,000 (1/1/65)	$85,000 (5/1/65)	$70,000 (9/1/65)	$75,000 (1/1/66)	$55,000 (5/1/66)	$30,000 (9/1/66)	$50,000 (1/1/67)	$35,000 (5/1/67)	$30,000 (9/1/67)	$35,000 (7/1/68)	$25,000 (7/1/69)	$25,000 (7/1/70)			
1971-72	$ 454	$ 393	$ 349	$ 611	$ 611	$ 742	$ 611	$ 654	$ 479	$ 262	$ 436	$ 305	$ 262	$ 305	$ 218	$ 218	$ 6,910	$ 31,680	$
1972-73	545	471	418	734	734	890	734	785	576	314	524	366	314	366	262	262	8,295	31,403	
1973-74	637	552	490	858	858	1,042	858	919	675	368	613	429	368	429	307	307	9,710	31,071	
1974-75	735	637	566	992	992	1,203	992	1,062	779	425	708	497	425	497	353	353	11,216	30,683	
1975-76	838	725	644	1,127	1,127	1,369	1,127	1,208	886	483	805	564	483	564	403	403	12,756	30,234	
1976-77	943	816	725	1,269	1,269	1,542	1,269	1,360	996	544	908	635	544	635	454	454	14,363	29,724	
1977-78	1,052	911	809	1,416	1,416	1,721	1,416	1,518	1,113	607	1,011	709	607	709	506	506	16,027	29,150	
1978-79	1,166	1,009	897	1,570	1,570	1,908	1,570	1,682	1,234	673	1,122	785	673	785	561	561	17,766	28,509	
1979-80	1,283	1,111	988	1,729	1,729	2,099	1,729	1,852	1,359	741	1,235	864	741	864	618	618	19,560	27,798	
1980-81	1,406	1,217	1,082	1,893	1,893	2,300	1,893	2,029	1,488	812	1,353	947	812	947	677	677	21,426	27,015	
1981-82	1,498	1,297	1,153	2,019	2,019	2,450	2,019	2,163	1,585	865	1,441	1,009	865	1,009	722	722	22,836	26,158	
1982-83	1,594	1,380	1,226	2,146	2,146	2,606	2,146	2,299	1,686	920	1,533	1,073	920	1,073	766	766	24,280	25,245	
1983-84	1,693	1,465	1,303	2,279	2,279	2,767	2,279	2,441	1,791	976	1,627	1,139	976	1,139	814	814	25,782	24,274	
1984-85	1,795	1,553	1,382	2,417	2,417	2,935	2,417	2,589	1,899	1,036	1,726	1,208	1,036	1,208	863	863	27,344	23,243	
1985-86	1,902	1,646	1,463	2,561	2,561	3,109	2,561	2,743	2,011	1,098	1,828	1,280	1,098	1,280	914	914	28,969	22,149	
1986-87	2,012	1,742	1,549	2,709	2,709	3,290	2,709	2,904	2,129	1,161	1,936	1,355	1,161	1,355	969	969	30,659	20,990	
1987-88	2,137	1,842	1,637	2,865	2,865	3,479	2,865	3,069	2,250	1,227	2,045	1,432	1,227	1,432	1,022	1,022	32,416	19,764	
1988-89	2,248	1,946	1,729	3,027	3,027	3,675	3,027	3,243	2,379	1,297	2,163	1,513	1,297	1,513	1,080	1,080	34,244	18,467	
1989-90	2,364	2,046	1,819	3,182	3,182	3,864	3,182	3,409	2,500	1,364	2,273	1,591	1,364	1,591	1,136	1,136	36,003	17,097	
1990-91	2,458	2,127	1,892	3,309	3,309	4,018	3,309	3,546	2,601	1,418	2,364	1,655	1,418	1,655	1,182	1,182	37,443	15,657	
1991-92	2,556	2,213	1,967	3,442	3,442	4,179	3,442	3,688	2,704	1,475	2,458	1,721	1,475	1,721	1,229	1,229	38,941	14,159	
1992-93	2,659	2,301	2,045	3,579	3,579	4,346	3,579	3,836	2,812	1,534	2,558	1,790	1,534	1,790	1,278	1,278	40,498	12,602	
1993-94	2,765	2,393	2,127	3,723	3,723	4,520	3,723	3,989	2,926	1,595	2,659	1,861	1,595	1,861	1,329	1,329	42,118	10,982	
1994-95	2,875	2,489	2,214	3,871	3,871	4,701	3,871	4,148	3,042	1,659	2,765	1,936	1,659	1,936	1,383	1,383	43,803	9,297	
1995-96	2,991	2,588	2,301	4,026	4,026	4,889	4,026	4,314	3,164	1,726	2,876	2,013	1,726	2,013	1,438	1,438	45,555	7,545	
1996-97	3,111	2,692	2,393	4,187	4,187	5,085	4,187	4,486	3,290	1,795	2,991	2,094	1,795	2,094	1,495	1,495	47,377	5,723	
1997-98	3,235	2,800	2,488	4,355	4,355	5,288	4,355	4,667	3,422	1,866	3,111	2,177	1,866	2,177	1,555	1,555	49,272	3,828	
1998-99	3,048	2,638	2,344	4,104	4,104	4,983	4,104	4,397	3,224	1,759	2,931	2,052	1,759	2,052	1,466	1,466	46,431	1,857	
TOTALS	$52,000	$45,000	$40,000	$70,000	$70,000	$85,000	$70,000	$75,000	$55,000	$30,000	$50,000	$35,000	$30,000	$35,000	$25,000	$25,000	$792,000	$576,304	

NOTE: (1) Numbers in parentheses represent the issue dates of bonds as shown in Exhibit I.

APPENDIX C

SCHEDULE OF DEBT SERVICE REQUIREMENTS FOR REVENUE BONDS FOR PURCHASE OF ROLLING EQUIPMENT

(figures in thousands)

	Amortization Installments							
	$30,525 dated 7/1/66 (1)	*$22,650 dated 7/1/67*	*$9,760 dated 7/1/68*	*$4,650 dated 7/1/69*	*$5,290 dated 7/1/70*	*Total Amortization*	*Interest at 4¾%*	*Total Debt Service*
67	—	—	—	—	—	—	Capitalized	Capitalized
68	—	—	—	—	—	—	Capitalized	Capitalized
69	—	—	—	—	—	—	Capitalized	Capitalized
70	—	—	—	—	—	—	$ 3,210	$ 3,210
71	—	—	—	—	—	—	3,462	3,462
72	—	—	—	—	—	—	3,462	3,462
73	$ 1,441	$ 978	$ 386	$ 169	$ 177	$ 3,151	3,462	6,613
74	1,510	1,023	404	177	186	3,300	3,312	6,612
75	1,582	1,072	423	186	195	3,458	3,155	6,613
76	1,657	1,123	444	194	204	3,622	2,991	6,613
77	1,735	1,176	465	204	214	3,794	2,819	6,613
78	1,818	1,232	487	213	224	3,974	2,639	6,613
79	1,904	1,291	510	224	235	4,164	2,450	6,614
80	1,995	1,352	534	234	246	4,361	2,252	6,613
81	2,089	1,416	560	245	257	4,567	2,045	6,612
82	2,189	1,483	586	257	270	4,785	1,828	6,613
83	2,293	1,554	614	269	282	5,012	1,601	6,613
84	2,402	1,628	643	282	296	5,251	1,363	6,614
85	2,516	1,705	674	295	310	5,500	1,113	6,613
86	2,635	1,786	706	310	324	5,761	852	6,613
87	2,759	1,871	739	324	341	6,034	578	6,612
88	—	1,960	774	339	356	3,429	292	3,721
89	—	—	811	356	373	1,540	129	1,669
90	—	—	—	372	391	763	56	819
91	—	—	—	—	409	409	19	428
113	$30,525	$22,650	$9,760	$4,650	$5,290	$72,875	$43,090	$115,965

(1) The amounts and dates at the head of each column represent the various bond issues proposed to be sold in accordance with the schedule in Exhibit IV.

its own construction and traffic engineers to make independent surveys of the costs of construction of the Tube and potential revenues applicable to debt service. At that time, also, the Authority presumably will make commitments concerning a definitive financial program which may differ in various respects from that assumed herein. While it is not possible at this time to determine what these commitments may be, we have discussed the subject in general terms with appropriate officials of the Department of Public Works and the District and believe that the tentative plan outlined herein constitutes a logical initial approach to the problem of financing the Tube, for the purposes of this Report, and that the amount above indicated as the District's obligation is a reasonably close approximation of the amount of the District's maximum liability under existing law.

COVENANTS RELATING TO THE DISTRICT'S BONDS

In issuing its bonds — and particularly when revenue bonds are issued for the purpose of acquisition of rolling equipment — the District will be required to enter into specific agreements with its bondholders relating, among other things, to the following:

1. Application of Bond Proceeds

Separate construction funds must be established for the respective proceeds of general obligation bonds and revenue bonds. While it is true that specific covenants of this nature are not customarily required relative to capital expenditures for projects financed by general obligation bonds, we believe that such covenants will be necessary in this instance to assure the marketability of the proposed revenue bonds, due to the fact that the security of those revenue bonds will be dependent upon the timely completion of the System which will be financed by means of the District's tax supported general obligations.

Expenditure of moneys from either construction fund should be made only upon the filing with a trustee of authorizing certificates of the District's consulting engineer and a designated officer or officers of the District. Moneys on hand in such funds, pending their application to the payment of the costs of construction, should at all times be invested, preferably in obligations of the United States Government with maturities coordinated with the anticipated cash requirements of the funds.

Provision should be made by the District for the disposition of any balance remaining in the construction funds upon the completion of construction of the basic, fixed System and the acquisition of the rolling equipment. It does

not appear that these amounts could be of major significance, however, inasmuch as it is anticipated herein that both the general obligation bonds and the revenue bonds will be issued at periodic intervals as funds are needed rather than in large amounts considerably in advance of actual requirements for moneys.

2. Application of Revenues

The source of funds for the payment of the general obligation bonds will be general property taxes, and the District will be obligated to levy and collect taxes sufficient for bond principal and interest as the same become due and payable.

The bond resolutions securing the revenue bonds must contain provision for the creation of specific funds for the disposition of operating revenues. There has been recommended elsewhere herein the order of priority of such funds, and the bond resolutions, in our opinion, should be drawn substantially in accordance with those recommendations.

3. Redemption of Bonds Prior to Maturity

In consideration of the fact that the proposed financing for both the construction of the fixed, basic system and the acquisition of the rolling equipment will cover a period of years, during which money market conditions may vary considerably, we do not consider it advisable at this time to recommend specific terms upon which the District may redeem its bonds prior to maturity. In general, we believe that the District should endeavor to avoid the issuance of long term non-callable bonds, and, to the extent that the investment markets at the time of bond issuance are receptive to callable bonds upon acceptable terms, we recommend that the District assure itself of any favorable refunding opportunities that may occur in future years.

APPENDIX D

PARSONS BRINCKERHOFF — TUDOR — BECHTEL
General Engineering Consultants To
San Francisco Bay Area Rapid Transit District
YUkon 6-5858 833 Market Street San Francisco — 3 — Cal.

March 26, 1962

Mr. K. M. Hoover
San Francisco Bay Area
Rapid Transit District
628 Flood Building
San Francisco 2, California

Dear Mr. Hoover:

Transmitted herewith are a statement and tabulations of the estimated effects which the February, 1962 three-county rapid transit system would have on the vehicular traffic and gross revenues of the San Francisco-Oakland Bay Bridge.

In preparing these estimates, reference has been made to pertinent past and current reports, records, and forecasts of traffic, revenue, expense, and other relevant aspects, including financing, of existing and proposed Bay crossings. Among the most important of these are:

(a) "Report on Traffic and Earnings: Southern Crossing and San Francisco-Oakland Bay Bridge", Coverdale & Colpitts, January 1958

(b) "Report on a Proposed Public Authority for the Bay Area for the San Francisco Bay Area Council, Inc.", Coverdale & Colpitts, November 1958

(c) Annual "Report on Examination of Statements Relating to Traffic, Revenues, and Revenue Funds; San Francisco-Oakland Bay Bridge", California Department of Public Works, Division of Highways

(d) Annual "Financial Statements - San Francisco-Oakland Bay, San Mateo-Hayward and Dumbarton Bridges", California Department of Public Works, Division of Highways

(e) Monthly "State of California - San Francisco-Oakland Bay Bridge Record of Vehicular Traffic"

(f) University of California, I.T.T.E. Traffic Survey Series A-1 through A-12; Bay Bridge Toll Plaza

The estimates for the San Francisco-Oakland Bay Bridge for the fiscal year beginning July 1, 1968 through 1980 are tabulated on the attached sheet. The Transbay Tube is scheduled to be open for revenue service on January 1, 1968. For the fiscal year of 1967, the study indicates that the losses in total vehicles and toll and rental revenue would be less than four per cent.

Parsons, Brinckerhoff
Quade & Douglas
165 - Broadway
New York - 6 - N. Y.

Tudor Engineering Co.
595 Mission Street
San Francisco - 5 - Cal.

Bechtel Corporation
220 Bush Street
San Francisco - 4 - Cal.

The future forecasts of revenue vehicles, toll and other revenue, and the vehicular capacity of the Bay Bridge are taken from the most recent reports of the traffic engineering consultants for the Bridge. These forecasts have been checked and adapted to serve as a valid basis for this study. The revenue other than tolls shown in the attached tabulation includes rental revenue, a portion of which is subject to change with the advent of rapid transit. "Investment" and "Miscellaneous" revenue are not tabulated, and are not considered to be affected directly by rapid transit; the latter category is presently extremely small in amount.

It will be noted that the volume of total vehicles and revenue estimated to be lost to rapid transit steadily diminishes until the assumed capacity of the Bridge is reached approximately in the fiscal years beginning in 1978 or 1979. Rapid transit will attract a significant number of automobile trips, and the proportion of automobiles to total vehicles in Bay Bridge traffic in the later years of the estimate will be slightly lower than in the earlier years. Thus, the average toll per vehicle will be increased with the slightly increased proportion of commercial vehicles in those later years. The study, therefore, indicates that in the fiscal years beginning in 1977-1980, with vehicular capacity approached or fulfilled, the Bridge's total revenue will actually be slightly greater with rapid transit than without it. For conservatism, however, the total Bridge revenue under the two conditions, with and without rapid transit, may be taken as equal.

We would be pleased to discuss these estimates with you and those designated by you. There is a large amount of supporting data and analyses available as background information.

Very truly yours,

PARSONS BRINCKERHOFF-TUDOR-BECHTEL

J. E. Everson

J. E. Everson

SAN FRANCISCO BAY AREA RAPID TRANSIT DISTRICT

PARSONS BRINCKERHOFF-TUDOR-BECHTEL

EFFECT OF RAPID TRANSIT SYSTEM ON TRAFFIC AND REVENUES OF SAN FRANCISCO-OAKLAND BAY BRIDGE

(For system serving Alameda, Contra Costa, and San Francisco Counties)

Fiscal Year Beginning July 1	TRAFFIC - VEHICLES IN THOUSANDS					REVENUE - DOLLARS IN THOUSANDS				
	Without Rapid Transit			Absorbed by Rapid Transit	With Rapid Transit	Without Rapid Transit			Absorbed by Rapid Transit	With Rapid Transit
	Revenue Vehicles	Free Vehicles	Total Vehicles			Toll Revenue	Other Revenue*	Total Revenue*		
1968	41,735	1,169	42,904	3,822	39,082	12,842	200	13,042	1,186	11,856
1969	42,675	1,195	43,870	5,332	38,538	13,133	200	13,333	1,536	11,797
1970	43,635	1,222	44,857	5,843	39,014	13,431	200	13,631	1,641	11,990
1971	43,775	1,225	45,000	5,264	39,736	13,478	200	13,678	1,436	12,242
1972	43,775	1,225	45,000	4,746	40,254	13,478	200	13,678	1,250	12,428
1973	43,775	1,225	45,000	4,016	40,984	13,478	200	13,678	1,012	12,666
1974	43,775	1,225	45,000	3,127	41,873	13,478	200	13,678	734	12,944
1975	43,775	1,225	45,000	2,340	42,760	13,478	200	13,678	457	13,221
1976	43,775	1,225	45,000	1,388	43,612	13,478	200	13,678	192	13,486
1977	43,775	1,225	45,000	530	44,470	13,478	200	13,678	-77	13,755
1978	43,775	1,225	45,000	0	45,000	13,478	200	13,678	-245	13,923
1979	43,775	1,225	45,000	0	45,000	13,478	200	13,678	-245	13,923
1980	43,775	1,225	45,000	0	45,000	13,478	200	13,678	-245	13,923

* Exclusive of "Investment and Miscellaneous" Income

March 26, 1962

THE FINANCIAL IMPACT OF BAY AREA RAPID TRANSIT

STONE & YOUNGBERG
SAN FRANCISCO

APRIL 1962

DANIEL STONE
BENJAMIN J. BAUM
DON M. DAVIS
RICHARD P. GROSS

STONE & YOUNGBERG
MUNICIPAL FINANCING CONSULTANTS
1314 RUSS BUILDING
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EDWARD W. BURNETT
DAVID E. HARTLEY
PATRICK J. KAVANAUGH
BARRY M. NEWMAN
EDWIN A. WELLS, JR.
EVERETT D. WILLIAMS

April 19, 1962

Board of Directors
San Francisco Bay Area
Rapid Transit District
628 Flood Building
San Francisco 2, California

Gentlemen:

In accordance with terms of the agreement referred to in your Resolution No. 201, adopted December 28, 1961, we are pleased to submit our report on Financial Impact of Proposed Regional Rapid Transit System on Bay Area Taxpayers and Public Agencies (Three-County System). The report is a revision of our reports dated July 24, 1961, and October 11, 1961, which were based on five-county and four-county systems. The present report is based on a three-county system consisting of the counties of Alameda, Contra Costa, and San Francisco, as described in the report of Parsons Brinckerhoff-Tudor-Bechtel submitted to the District by letter April 17, 1962. It assumes no support of the District from either Marin or San Mateo Counties whether in assessed valuation available to support bonds or in tax revenues.

Our analysis presents estimates of tax rates required to pay District bond interest and principal and of the probable annual costs to typical homeowners. Data on existing tax-supported debt are presented and compared with proposed District debt, and the effect on other agencies selling bonds is examined.

In addition to supplying you with the above-mentioned Financial Impact Report, we have also prepared a summary report concerning all principal engineering, financial, and economic aspects of the proposed three-county rapid transit system, which is contained in the "Introduction and Summary" portion of the report entitled "The Composite Report, Bay Area Rapid Transit, May 1962" attached.

The cooperation of the District staff and its consultants is gratefully acknowledged.

Very truly yours,

STONE & YOUNGBERG

Richard M. Bartle

Richard M. Bartle

RMB:bp

UMMARY

is report examines the financial impact of the proposed 92,000,000 general obligation bond issue for the revised id transit plan for three counties of the San Francisco y Area Rapid Transit District. It attempts to place this d issue in perspective for the benefit of the District Board Directors and the people of the District in their considera- of the proposed regional rapid transit system.

Conclusions of this report may be stated briefly as fol- s:

1. The District's Financial Plan is based on a maximum rate of 70.8 cents per $100, and maturities are to be duled so as not to exceed this limit. Sale of bonds in ac- dance with the District's financial plan would result in mated tax rates up to 62 cents per $100 assessed valua- during construction and a maximum of 67.3 cents fol- g completion of the system.

2. The median value of single family homes may be as- d at $16,000, resulting in an assessed valuation of about 00. The estimated maximum annual cost of Transit Dis- bonds to this typical home is $27.

3. The 1961/62 average combined tax rate in the three Area counties is $8.76 per $100. The maximum Transit ct bond rate of 67 cents would represent 7.6 per cent total.

4. Present tax-supported debt in the three counties is $410,000,000 or 10.54 per cent of total assessed val- Net total debt of the three counties probably will 24 per cent of assessed valuation after all of the pro- District bonds have been sold.

While this increase in debt would not be likely to pre- ny county served by the system from selling bonds for projects, it may result in some increases in interest be paid. This effect will be noted particularly by gencies which do not now have well established credit.

The schedule of bond sales in the District's Financial ovides for sale of bonds at a more rapid rate than is at present with all the District's public agencies. trict will average over $100,000,000 per year in sales years with a peak of $300,000,000 in one year. mounts should be compared with the current rate of erings by all public agencies in the three counties: 100,000,000 per year, total.

ODUCTION

ncial Plan for the three-county system submitted to d of Directors of the San Francisco Bay Area Rapid District by Smith, Barney & Co., the District's finan- ultants, recommends authorization of $792,000,000 of general obligation bonds to be sold over seven and one-half years. This report considers the financial impact of this bond issue on property owners and other public agencies within the three counties. It attempts to place this large bond authorization and the tax rates required to service it in proper perspective to aid the Board of Directors and citizens within the District in evaluating the District's proposed regional rapid transit system.

Four analyses are presented:

1. Estimated future tax rates for Transit District bond interest and principal and probable annual costs to typical District property owners.

2. Relationship of indicated tax rates to combined tax rates for other purposes in the three counties.

3. Effect of additional overlapping bonded debt on future bond sales of other public agencies.

4. Comparison of the proposed District bond sale schedule with volume of bonds currently being sold in the three counties.

INDICATED FUTURE TAX RATES

The District's Financial Plan provides for sale of general obligation bonds over seven and one-half years (1963-1970), with serial maturities beginning in July 1972, about two years after the last bond sale and one year after the completion of the last segment of the transit system. The plan provides for principal payments each year from 1972 until the final outstanding bonds are retired in the year 1999.

The schedule of general obligation bond service requirements established in the Financial Plan reflects several important policy decisions by the District. Interest during the construction period is to be paid from current taxes rather than capitalized and paid from bond proceeds. No principal payments are to be made during the construction period.

The District's financing capacity during the construction period is based on a conservative projection of future assessed valuations.* This projection was considered appropriate for construction scheduling since the District was not made dependent on great increases in assessed valuation in order to have needed bonding capacity under its legal debt limit of 15 per cent of assessed valuation.

The Financial Plan utilizes this same conservative projection in its suggested bond maturity schedules. Under this plan annual bond service requirements increase annually from less than $39 million in 1971/72 to slightly more than $48 million in 1980/81 and then more gradually to a peak of about $53 million in 1989/90. This schedule was designed to result in approximately constant tax rates from 1971/72 until 1989/90, all based on the conservative trend of future valuations. The Financial Plan is based on the premise that tax rates would not exceed 70.8 cents per $100.

We believe the assessed valuation of the District actually will increase at a somewhat more rapid rate** than that on which estimates of future District bonding capacity are based. The exact schedule of maturities for any series of District bonds will be established at the time bonds are sold. Before each sale the District will have an opportunity to review its financing needs and future tax requirements. With the more rapid increase in assessed valuation which can reasonably be expected, the District will have two basic alternatives:

1. Maintain the maturity schedules as outlined, holding the tax rate below 71 cents in all years. Our opinion is that the schedule of bond service requirements used in the Financial Plan will result in a probable maximum tax rate of 67 cents.

2. Adjust the maturity schedule according to a set level such as the newer projections of valuations so that actual tax rates will remain closer to 71 cents. If this is done, the total bond issue will be retired earlier and the total amount of interest paid over the life of the bonds reduced.

Taxpayers of the three counties can be assured with near certainty that the total tax rate for District bond service will not exceed 71 cents per $100 assessed valuation. In the unlikely event that assessed valuation grows at a slower rate than projected, the District may be obliged to change its schedules for construction and sale of bonds and adjust maturity schedules for later bond issues. The District policy which led to the development of the Financial Plan anticipates that no maturity schedule will be established which would require a rate higher than 71 cents in any year.

The District's Financial Plan assumes an extension to 1989/90 of the very conservative projection of future assessed valuation on which the construction schedule was based. While the projection of valuations used is considered entirely appropriate for the purpose of engineering and financial planning, valuations are expected actually to be somewhat higher, as discussed in previous paragraphs.

Table I on page 60 shows total District tax rates applicable under the maturity schedule proposed in the Financial Plan and with an interest rate of 4 per cent. Tax rates are shown for two projections of assessed valuation: that used for construction scheduling and that which we consider most

*This projection is that which is termed "75 per cent probable." We consider that there is a probability of 75 per cent that this trend of future valuations will be equalled or exceeded.

**This is the so-called "50 per cent probable" projection and, by definition, is the trend of future valuations believed most likely to prevail. The 75% projection and its conservative extension beyond the construction period results in total District valuation reaching $7.5 billion in 1989. The more likely (50% probable) projection shows the District valuation reaching $7.4 billion by 1980. A 1989 valuation of at least $8.2 billion may be assumed.

TABLE I

ANNUAL COSTS TO BE PAID FROM TAXES AND ANNUAL TAX RATES REQUIRED BASED ON PROJECTION OF ASSESSED VALUATION ON WHICH CONSTRUCTION SCHEDULE IS BASED AND MOST PROBABLE DISTRICT ASSESSED VALUATION

		Based on Projection of Assessed Valuation Used for Construction Schedule			*Based on Most Probable Trend of Assessed Valuation*		
Fiscal Year	*Total Bond Service (in thousands)*	*Administrative and General Expenses Paid from Taxes (in thousands)*	*Total District Costs Paid from Taxes (in thousands)*	*Estimated Assessed Valuation (in millions)*	*Indicated Tax Rate per $100 A.V.*	*Estimated Assessed Valuation (in millions)*	*Indicated Tax Rate per $100 A.V.*
1963/64	$ 4,287	$1,650	$ 5,937	$4,192	14.2¢	$4,239	14.0¢
1964/65	9,780	2,150	11,930	4,344	27.5	4,414	27.0
1965/66	18,680	2,200	20,880	4,504	46.4	4,605	45.3
1966/67	24,713	2,300	27,013	4,665	57.9	4,794	56.3
1967/68	28,080	2,200	30,280	4,825	62.8	4,985	60.7
1968/69	29,680	2,275	31,955	4,985	64.1	5,175	61.7
1969/70	30,680	1,350	32,030	5,144	62.3	5,359	59.8
1970/71	31,680	955	32,635	5,299	61.6	5,549	58.8
1971/72	38,590		38,590	5,452	70.8	5,734	67.3*
1972/73	39,698		39,698	5,607	70.8	5,918	67.1
1973/74	40,781		40,781	5,760	70.8	6,104	66.8
1974/75	41,899		41,899	5,918	70.8	6,288	66.6
1975/76	42,990		42,990	6,072	70.8	6,473	66.4
1976/77	44,087		44,087	6,227	70.8	6,657	66.2
1977/78	45,177		45,177	6,381	70.8	6,842	66.0
1978/79	46,275		46,275	6,536	70.8	7,026	65.9
1979/80	47,358		47,358	6,689	70.8	7,213	65.7
1980/81	48,441		48,441	6,842	70.8	7,400	65.5
1989/90**	53,100		53,100	7,500	70.8	8,200	64.8

*If the District decides to retire its indebtedness more rapidly, a higher rate could be established beginning in 1971/72.
**A conservative extension of the expected trend of assessed valuation to 1989/90 results in an estimate of $7.5 billion for that year. This is the earliest year of maximum bond service. No valuation projections were made for years after 1989/90. Since debt service does not increase after this year, a declining tax rate may be expected.

Note: The above rates may require modest adjustment to allow for possible delinquincies, etc.

likely. Total costs paid from taxes include certain admin trative and general District expenses in the years prior completion of the system.

The Financial Plan assumes an interest rate of 4 per c

To relate these probable tax rates to the costs to in vidual taxpayers within the District is difficult because the wide range of individual assessed valuations. On basis of the rates above, each taxpayer should be able to e mate the cost of transit bonds to him in terms of ann taxes. Costs to renters will be similarly calculated if assu to be passed on by owners.

Current indications are that about half of the single-fa residences in the three counties are assessed at betw $3,000 and $6,000, indicating market values between $ 000 and $24,000.

Table II on page 61 shows the probable annual cos property owners with assessed valuation in this $3,00 $6,000 range during key periods of the construction sc ule. The median assessed valuation is probably near $4 ($16,000 market value) and the maximum tax for this va tion is about $27 per year.

COMPARATIVE TAX RATES

As shown in the discussion above, the maximum tax ra be expected for payment of interest and principal on T District bonds, according to the schedule of the Fin Plan, is about 67 cents per $100 assessed valuation financial report estimates total debt service at less tha million in the first year principal is to be paid, risin mately to $53,100,000.

District bond service requirements and tax levies sh be considered in relation to tax rates and tax levies no vailing in the three counties.

Table IV on page 61 shows the total 1961/62 tax for city, county, school, and other purposes in each three counties and shows the weighted average tax r each county.

The average combined tax rate in the three counti 1961/62 was $8.76 per $100, as shown in the table 67-cent rate which would be the Transit District's ma represents 7.65 per cent of this total.

Tax levies, tax rates, and taxes per capita in the Ba have been increasing steadily. Table III on page 61 s average combined tax rates and total tax levies in the counties for 1939/40, five-year intervals beginning in 1 50, and the last two fiscal years.

These data would indicate that economic and other in the Bay Area are causing steady increases in tax ra the amounts raised from local property taxation. T levy for Transit District bonds is estimated at a m

TABLE II

ESTIMATED ANNUAL TAXES FOR ALL DISTRICT PURPOSES, INCLUDING BOND INTEREST AND PRINCIPAL
BASED ON BOND MATURITY SCHEDULES PRESENTED IN FINANCIAL PLAN,
ALAMEDA, CONTRA COSTA, AND SAN FRANCISCO COUNTIES

	Tax Rate Per $100	*Assessed Valuation*			
		$3,000	*$4,000*	*$5,000*	*$6,000*
)63/64, Start of Construction	14.0¢	$ 4.20	$ 5.60	$ 7.00	$ 8.40
)68/69, More than 80% complete	61.7	18.50	24.70	30.85	37.00
obable maximum (Alternate 1, Page 59)	67.3	20.20	26.90	33.65	40.40
ssible maximum (Alternate 2, Page 59)*	70.8	21.25	28.30	35.40	42.50

his rate would prevail if the District decided to provide for accelerated retirement of debt and approximately constant tax rate.

TABLE IV

1961/62 ASSESSED VALUATIONS, TAX LEVIES, AND AVERAGE TAX RATES,
THREE BAY AREA COUNTIES

nty	*Assessed Valuation (1,000's)*	*Annual Tax Levy (1,000's)*					*Average Combined Tax Rate (per $100 A.V.)*
		City	*County*	*School*	*Other*	*Total Tax Levy*	
eda	$1,495,255	$30,880	$ 34,675	$ 63,762	$ 9,274	$138,591	$9.27
ra Costa	918,308	7,197	21,317	41,789	8,603	78,906	8.59
Francisco	1,482,218	—	90,869*	32,360	425	123,654	8.34
-county total	$3,895,781	$38,077	$146,861	$137,911	$18,302	$341,151	$8.76

of City and County of San Francisco are shown under "County" except for school taxes.

TABLE III

TAX RATES, TAX LEVIES, AND TAXES PER CAPITA,
THREE BAY AREA COUNTIES

Year	*Average Combined Tax Rate per $100*	*Total Tax Levy (1,000's)*	*Tax Levies Per Capita***
1939/40	$4.14	$ 58,274	$100
1949/50	6.24	126,968	87
1954/55	7.28*	187,361	—
1959/60	8.42	298,770	149
1960/61	8.71	323,168	157
1961/62	8.76	341,151	162

*Because of a state-ordered reassessment in 1955/56 the average tax rate fell in that year to $6.92 while assessed valuation and the total tax levy increased.
**Expressed in constant 1961 dollars.

of $17 per capita per year in the period 1973 to 1988. This overall figure reflects taxes paid by industry, business, utilities, and other non-residential taxpayers.

EFFECT OF DEBT ON OTHER AGENCIES

Consideration should be given to the effect of the prospective Transit District debt on other public agencies in the three counties. One of the principal measures used by bond buyers in evaluating general obligation bonds of a city, county, or district is the total tax-supported debt burden. Sale of Transit District general obligation bonds in the amounts indicated in the District's Financial Plan would increase total tax-supported debt substantially.

This increase in overlapping debt is not expected to prevent any local public agency in the District from financing a needed project. Any effect of the added debt would be noted in interest rates to be paid on future issues. The following paragraphs analyze present and possible future total debt within the three affected District counties.

Table V on page 62 shows our estimate of total gross and net overlapping bonded debt applicable to three counties in the San Francisco Bay Area Rapid Transit District, as of July 2, 1961, immediately following the end of the latest completed fiscal year.

Debt is divided among the three counties in the District

TABLE V

STATEMENT OF APPLICABLE OVERLAPPING GENERAL OBLIGATION BONDED DEBT
AS OF JULY 2, 1961

	Alameda County	*Contra Costa County*	*San Francisco County**	*Total Three Counties in San Francisco Bay Area Rapid Transit District*
County	—	$ 7,830,000	—	$ 7,830,000
Cities	$ 35,364,000	6,635,250	$ 184,741,000	226,740,250
School Districts**	91,333,000	61,640,000	47,490,000	200,463,000
Other Districts**	121,286,500	63,223,800	15,171,000	199,681,300
GROSS OVERLAPPING BONDED DEBT	$ 247,983,500	$139,329,050	$ 247,402,000	$ 634,714,550
Less: Self-supporting debt	83,319,000	42,989,000	97,706,000	224,014,000
NET OVERLAPPING BONDED DEBT	$ 164,664,500	$ 96,340,050	$ 149,696,000	$ 410,700,550
Assessed Valuation 1961/62	$1,495,255,166	$918,308,410	$1,482,218,908	$3,895,782,484
Ratios to Assessed Valuation:				
Gross Debt	16.58%	15.17%	16.69%	16.29%
Net Debt	11.01%	10.49%	10.10%	10.54%
Population, 1960 census	905,670	409,030	742,855	2,057,555
Per Capita:				
Assessed Valuation	$ 1,651	$ 2,245	$ 1,995	$ 1,893
Gross Debt	274	341	333	308
Net Debt	182	236	202	200

*Bonds of City and County of San Francisco, except those for school purposes, are shown under "Cities."
**Intercounty district debt is allocated according to assessed valuation.

TABLE VI

PRINCIPAL AMOUNTS OF GENERAL OBLIGATIONS SOLD,
ALL PUBLIC AGENCIES, BY COUNTY*

	1958/59	*1959/60*	*1960/61*	*9 Months 1961/62*
Alameda	$43,342,000(21)	$20,717,000(23)	$43,523,000(33)	$42,348,000(19)
Contra Costa	10,809,000(24)	7,087,000(16)	23,119,000(17)	5,574,000(11)
San Francisco	31,025,000(2)	—	32,730,000(2)	27,300,000(1)
Three-county total	$85,176,000(47)	$27,804,000(39)	$99,372,000(52)	$75,222,000(31)

*Intercounty districts are shown entirely in the county within which the most valuation is located.

—by county, city, school district, and other district purpos
Only debt included is that supported by the power of
limited taxation. Revenue bonds, assessment bonds,
other special obligations are not included.

Net overlapping debt, most commonly used measure
total debt in the District supported by taxes on proper
is determined by deducting from the gross total the amou
of self-supporting debt applicable. Self-supporting debt
that which is serviced from revenues of a public enterpr
thus not requiring the application of tax revenue to the p
ment of interest and principal. Major examples of self-
porting debt included are bonds issued for water purpo
(City and County of San Francisco, East Bay Munici
Utility District) and other agencies with great revenue-p
ducing ability, such as the Golden Gate Bridge and H
way District.

The analysis in Table V shows total debt and shows
the ratios of debt to assessed valuation for all counties
the assessed valuation and debt per capita.

The analysis shows gross total debt in the three coun
of $634,714,550 and net total debt of $410,700,550.
meda County accounts for the largest share of each of
totals although gross debt in San Francisco is nearly as
School districts account for about 32 per cent of the
debt and 49 per cent of net debt. No school district
self-supporting.

Ratios of gross debt to assessed valuation vary sub
tially among counties in the District, but much less vari
is observed among ratios of net tax-supported debt to
tion. The three-county average net debt is 10.54 per cent
the range among counties is 10.10 per cent to 11.01 per

Somewhat more variation is noted in the per capita
figure. Gross debt is $308 per capita for three counties,
a range from $274 to $341. Net debt is $200 for the
counties and the range is $182 to $236.

A previous study, made as of February 2, 1959, sho
net overlapping debt for five counties of 11.10 per cent
there has been relatively little change in this ratio in
than two years. Gross debt was 14.77 per cent in 19
has increased to a current three-county level of 16.29
latter increase results from several large sales of new
nue-supported issues, largely for water purposes.

All of these ratios are in a range considered very f
able by most buyers of California municipal bonds,
the larger cities and counties in the District enjoy high
ratings, at least in part as a result of their moderate
ratios.

Authorization and sale of $792,000,000 of Tran
trict bonds would change this debt statement substa
The amount proposed is about 1.93 times the pres
overlapping debt for all public agencies in the three

is more than 1.25 times the present gross outstanding ded debt.

Because of the debt limit applicable to the Transit Dis- , 15 per cent of assessed valuation, its entire authorized unt of bonds could not be sold immediately even if au- ized. As outlined in the Financial Plan, bonds would be over seven and one-half years, during which time the rict's assessed valuation can be expected to increase. ard the end of the construction period outstanding rapid it debt would probably be about 14 per cent of assessed ation.

nce we can reasonably expect the ratio of non-transit to assessed valuation to remain close to its present level, hree counties thus face the prospect in future years of g the overall net debt ratio increased by transit bonds an existing level of 10.54 per cent to more than 24 per Assessed valuation per capita in the three counties is g to increase and may reach almost $2,400 per capita 971/72, when transit debt will reach its maximum. At me net debt per capita, including transit bonds, may be $530.

e have analyzed the 31 sales of bonds by public agen- within the three counties during the first three quarters 61/62. A wide range of ratios of gross and net debt to ed valuation were noted for these sales. The range of total debt ratios was from 9.44 per cent to 27.53 per with a median of 20.28 per cent. Half of all sales had between 15.5 and 21.5 per cent.

e range of net debt ratios was from 8.48 to 22.53 per with a median of 15.47 per cent. Half of the sales had between 11 and 18 per cent. Per capita net debt ranged 81 to $453 for these 31 sales. The median was $225 pita with half of the sales lying between $170 and The largest public agencies in the Bay Area have ratios debt to assessed valuation of between 10 and 13 per Rapid transit debt would increase these net ratios by to 14 per cent by the end of the construction period. r 1970, when the last transit bonds are scheduled for e percentage of total Bay Area debt attributable to nsit District will decline for several reasons. Assessed n of the District will continue to increase, and transit ill represent a steadily declining percentage of this District bonds will mature beginning in 1972 and, as nature, the District's total debt will decline. As a third here is the possibility that operating revenues can be in future years to the payment of bond interest and l, thus removing some of the Transit District's debt tax-supported category.

ttempt to evaluate quantitatively the effect of this l debt on bonds to be sold in the future by cities, , and school districts in the three counties would be extremely difficult if not impossible. Taken by itself, however, this increase in debt would probably have the effect of increasing interest rates somewhat on these future bonds although not actually preventing sale of bonds by agencies in the three counties.

We would expect little effect to be noted on bonds of San Francisco, Oakland, East Bay Municipal Utility District, and other large agencies with well established credit. More effect will be noted on bonds of smaller agencies and on those with less well established credit ratings. The upper limit of the increase in interest rates which might result from the increase in overlapping debt is expected, in our opinion, to be generally about ½ of 1 per cent and only a relatively few agencies would find their financing costs increased this much.

All of these possible increases in the cost of public financing could be offset by other factors, many of which may be attributed to construction of a rapid transit system. If rapid transit and related improvements stimulate the growth of new taxable wealth faster than reflected in our projection, the adverse effect of increased debt on interest rates of bonds issued by local agencies in the District may be offset within a few years. If bond buyers can be convinced of the need for and benefits to result from construction of this modern rapid transit system, the additional debt overlapping other public agencies may have little net effect on their financing costs.

ANNUAL BOND SALE VOLUME

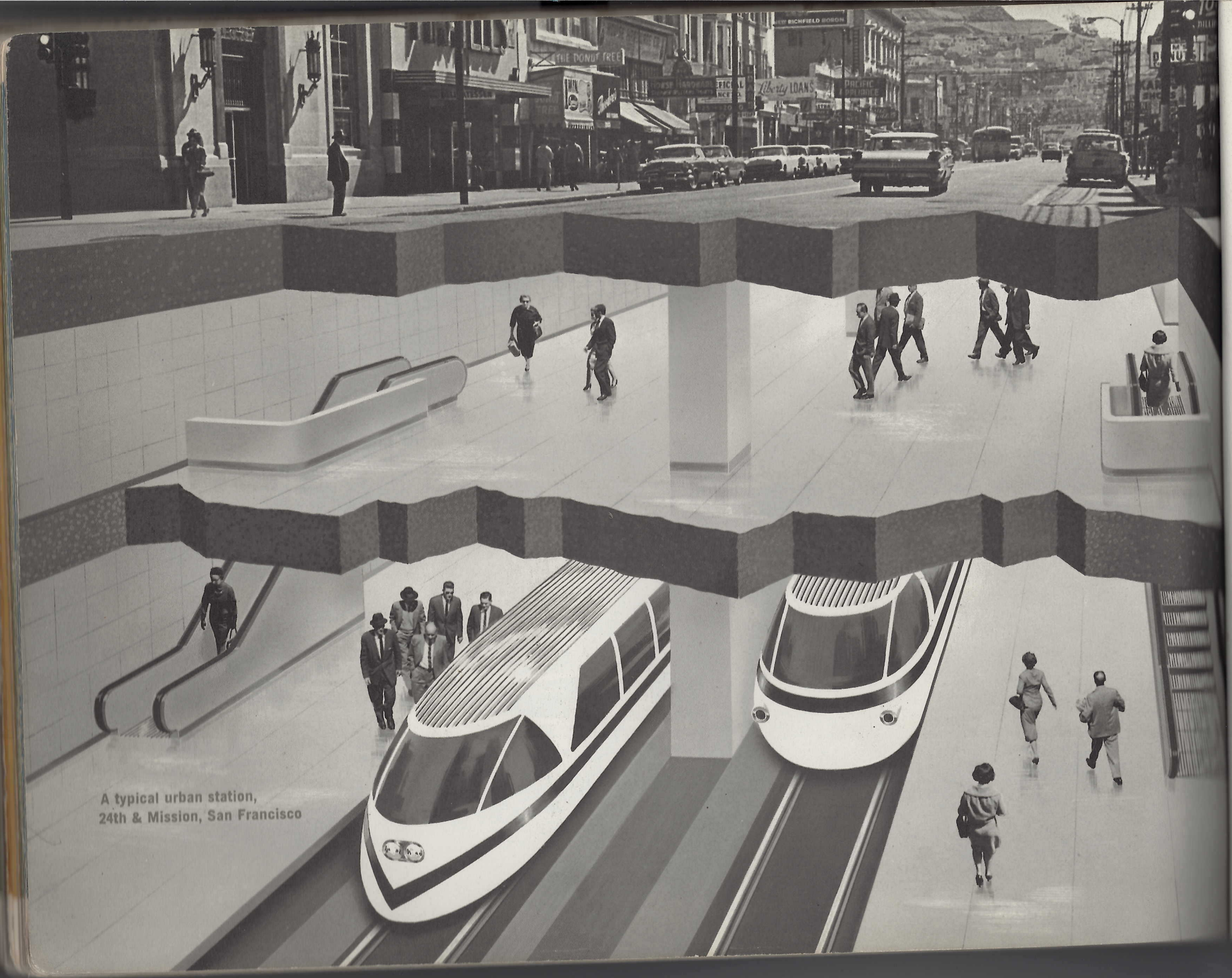
The annual amounts of bonds to be sold under the Financial Plan should be considered in perspective to indicate the magnitude of the program under consideration. Bonds are sold over a 7½ year period at an average annual rate of more than $100 million. The Financial Plan provides for sale of $540 million of bonds in 1964, 1965, and 1966 with $300 million within a single 12-month period. The largest single sale proposed is $85 million.

All public agencies in the three counties sold a total of more than $212 million of bonds in 138 sales during the last three completed fiscal years and more than $75 million in 31 sales in the first three quarters of 1961/62. Largest sale was the $30 million sale of East Bay Municipal Utility District bonds. The proposed District sales are so large that times of sales by other agencies may have to be adjusted to avoid conflicts with the District.

Table VI on page 62 shows the number of issues and principal amount of bonds sold by public agencies in each of the three counties since July 1, 1958.

THE LOOK OF RAPID TRANSIT

A Selection of Photo-Renderings Typical of the Proposed Bay Area Rapid Transit System



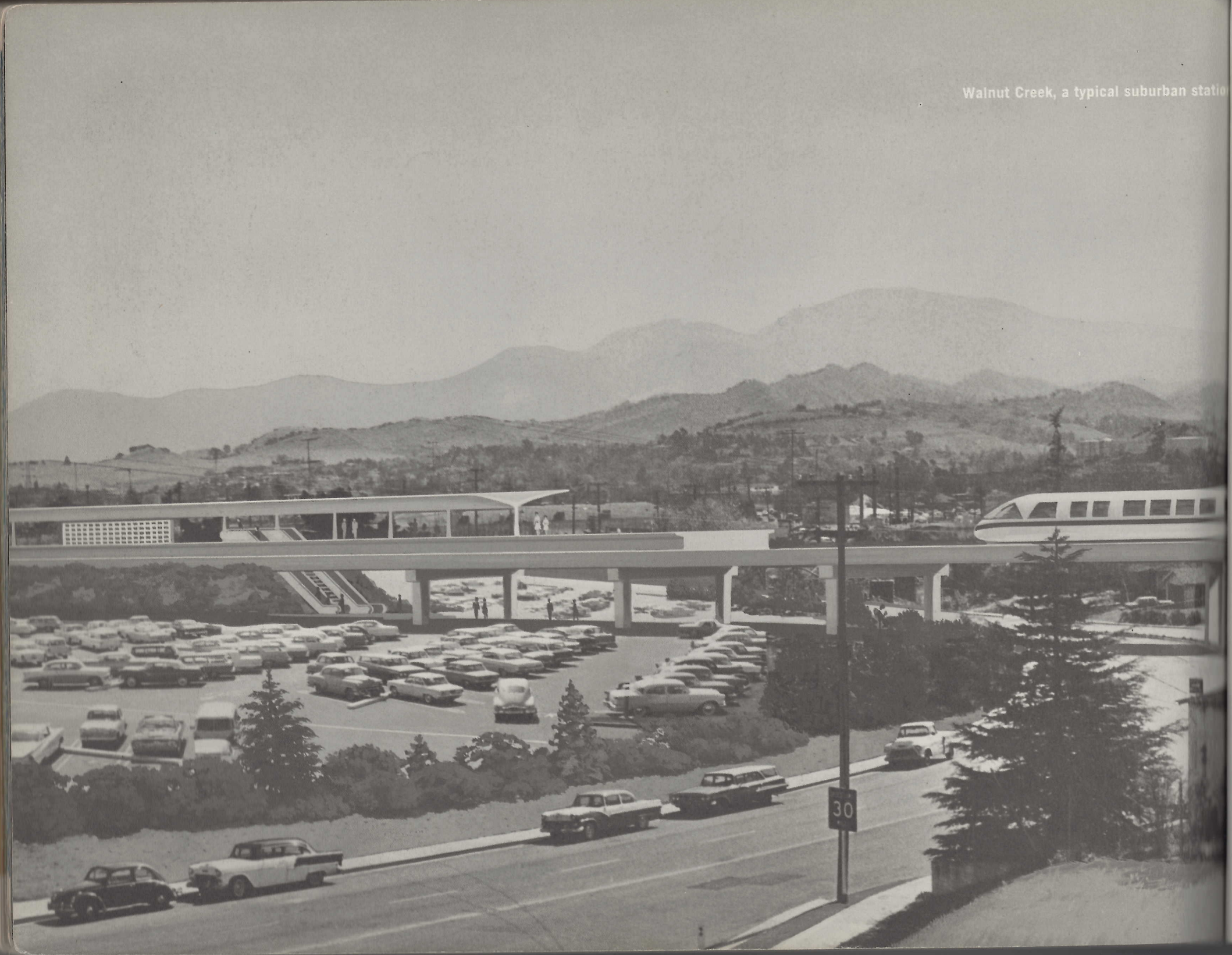
A typical urban station,
24th & Mission, San Francisco

The Market Street subway complex, San Francisco

The Trans-Bay Tube, linking East Bay and West Bay

The Broadway subway complex, Oakland

The Shattuck Avenue subway, Berkeley



Walnut Creek, a typical suburban statio

The passenger boarding level

Hesperian Boulevard, San Leandro-San Lorenzo

THE ECONOMIC EFFECTS AND BENEFITS OF BAY AREA RAPID TRANSIT

VAN BEUREN STANBERY
SAN FRANCISCO

APRIL 1962

VAN BEUREN STANBERY
AREA ECONOMICS CONSULTANT
3527 WEBSTER STREET
SAN FRANCISCO 23, CALIF.

April 17, 1962

Board of Directors
San Francisco Bay Area
Rapid Transit District
628 Flood Building
San Francisco 2, California

Gentlemen:

Transmitted herewith is my report "Economic Effects and Benefits of the Rapid Transit System" in accordance with our contract dated March 29, 1962.

The report contains an analysis of Bay Area economic trends affecting the need for the rapid transit system proposed to be constructed in the three counties of Alameda, Contra Costa and San Francisco. Its conclusions are made in reference to the system described in the engineering report submitted to the District by Parsons Brinckerhoff-Tudor-Bechtel by letter dated April 17, 1962, and the financial report submitted to the District by Smith, Barney & Co. by letter dated April 1962.

The proposed rapid transit system would be an important aid to the physical and economic development of the three counties and the entire Bay Area. It would be a logical first step towards an integrated regional transportation network of highways and modern rapid transit. Because its principal benefits would be indirect and cumulative over the years, only a few of them could be quantitatively evaluated. The most valuable benefits from the rapid transit system would be its effect in alleviating traffic congestion, increasing personal mobility and expanding the Bay Area's advantageous concentrations of business and industry as described in this report.

Acknowledgment is made to the District's engineering consultants and staff for the data, analyses and projections of personal travel, highway requirements and deficiencies,

and the capacity and effects of the transit system in reducing future traffic congestion. The District's staff also adjusted the value of the measurable benefits for the three-county system based upon analyses initially made by Ebasco Services Incorporated for a five-county system, and gave valuable aid in preparing this report.

The data and analyses in the January 1956 report, "Regional Rapid Transit," prepared for the San Francisco Bay Area Rapid Transit Commission by Parsons, Brinckerhoff, Hall and Macdonald, and the June 1961 report of Ebasco Services Incorporated, "Rapid Transit System Economic Review," also provided valuable information and guidance.

Prepublication copies of data from the 1960 census of population were helpful in projecting future population and number of inter-county commuters.

Respectfully submitted,

Van Beuren Stanbery

Van Beuren Stanbery

SUMMARY

NEED FOR RAPID TRANSIT

The continuing increase of highway traffic congestion threatens the future growth and well-being of the San Francisco Bay Area. The central cities of San Francisco and Oakland particularly are vulnerable.

The population of the nine-county Bay Area, now in excess of 3,700,000 people, more than doubled during 1940-60, growing by more than 1,900,000 persons. By 1980, the population is expected to reach 6,020,000, increasing by 64 per cent and adding an additional 2,380,000 people. By the year 2000, the Bay Area is expected to have more than 8,300,000 residents.

The Bay Area is experiencing an even more explosive increase in automobile travel. During the 10 years between 1950 and 1960, the number of automobiles in the five central counties of Alameda, Contra Costa, Marin, San Francisco and San Mateo increased more than three times as fast as the population in the driving ages, 16 years and over. By 1975, the total population of these counties is expected to grow by 36 per cent over 1960, while the number of automobiles is expected to be up 58 per cent, inter-county commuters up 41 per cent, and interurban travel by all forms of transportation up 51 per cent.

The crux of the Bay Area's congestion problem is the growing use of automobiles and the declining use of public transit, especially during the peak travel hours.

The most serious traffic congestion occurs during the peak periods of commuter movements each workday morning and evening. These recurring travel peaks cause severe blockages and delays on principal highways and in the downtown sections of larger cities.

In the five years between 1954 and 1959, the peak period automobile traffic through the six principal traffic gateways between the central cities and suburbs rose 44 per cent, while patronage on existing transit facilities declined 15 per cent. The District's engineers estimate that if future traffic congestion at the six gateways were eliminated, by 1975 the potential increase of peak period travel of all kinds at these gateways would be 53 per cent.

The losses from delays through traffic congestion already are appreciable. Unless averted, they will become much greater in the future.

Freeway, bridge and parking improvements *alone* cannot meet the Bay Area's rapidly increasing transportation needs. Because more than one-half of all travel is crowded into the morning and evening rush hours, excessive amounts of space and money would be required to accommodate all trips at these times by automobiles alone. Rapid transit, utilizing only a fraction of the space of a modern freeway, would provide many times the passenger capacity of automobiles on freeways through the strategic corridors and at less cost.

To provide for the future increase of its internal travel, the Bay Area needs an integrated regional transportation network of freeways and modern rapid transit, each serving the travel need it is best equipped to satisfy.

The rapid transit system proposed for Alameda, Contra Costa and San Francisco Counties is a logical and major first step toward such an ultimate coordinated regional network. It would eliminate most of the estimated peak-hour highway deficiencies at four major bottlenecks in those counties. It would expedite travel among outlying areas of Alameda and Contra Costa Counties and the cities of Richmond, Berkeley, Oakland and San Francisco. It would lessen traffic congestion in Oakland and San Francisco and expedite travel between their residential sections and downtown districts.

ECONOMIC EFFECTS AND BENEFITS OF THE RAPID TRANSIT SYSTEM

The concentration and specialization of industry and business in advantageous locations are important factors in the Bay Area's highly developed and remunerative economy. These profitable concentrations, particularly of specialized financial, business and governmental headquarters and services in the central cities, have made the area's widely separated communities highly dependent on one another and on the unobstructed movements of people and goods among and within them.

While the suburban communities and outlying areas are absorbing most of the area's population growth, the central cities are increasing their employment in specialized activities and services. The number of inter-city and inter-county commuters in the five central counties has been increasing faster than the total population and is expected to continue to do so in future decades. These commuters serve a vital function in metropolitan economic growth, and they benefit both the suburban communities where they live and the larger cities in which they work.

By reducing traffic congestion and providing an additional means of transportation, the three-county rapid transit system would bring manifold benefits to each of its counties, the entire Bay Area and the State of California. Its larger and more important benefits would be indirect and cumulative over the years.

The rapid transit system would aid the future growth of the individual counties and the Bay Area by helping to:

1. Maintain and encourage profitable concentrations of business and industry and lessen disorganized urban sprawl.
2. Improve the area's living and working conditions, economic efficiency and availability of workers, and attract a larger share of the nation's future economic growth.
3. Preserve and increase property values in the central cities, regional sub-centers and outlying areas.
4. Permit more economic use of the additional thousands of acres of land that otherwise would be required for highway expansions, and parking facilities in central business districts.

The rapid transit system would benefit the State and local Bay Area governments by inducing more efficient use of public funds for future transportation and other public improvements by:

1. Reducing the need for available highway user funds to construct extremely expensive freeways into the concentrated metropolitan centers, and thus permitting many more route-miles of needed, less costly facilities in suburban and other areas.
2. Helping to contain urban sprawl and thereby lessening the cost of providing necessary public services such as water, gas, public schools, and sewers.
3. Protecting and increasing governmental revenues through the greater economic growth that a rapid transit system would induce.
4. Reducing the usurpation of valuable tax producing and job producing land and structures which would otherwise be required for excessive numbers of freeways and parking facilities.

The rapid transit system would benefit families and individuals in the three counties by giving them a new and improved type of public transportation, and it would reduce their growing dependence upon automobiles alone. The rapid transit system would:

1. Increase the mobility and job potentials of workers.
2. Provide improved transportation for those without automobile, or without enough automobiles in the family for all trips for each member.
3. Expand the social, educational and recreational opportunities of residents within the three counties.

While only a few of the benefits of the rapid transit system could be estimated in monetary terms, by 1975 the estimated annual value of those benefits which could be measured is $50,947,000. These benefits include such things as the value of savings in travel time, reduced accident costs on freeways, savings in commuter-automobile insurance, savings in automobile parking costs, savings in motor freight shipments, and savings in traffic control costs.

The measurable benefits *do not* include such things as the additional costs of constructing and maintaining a vastly increased network of freeways and bridges which would be needed without rapid transit. The measurable benefits

not include the value of increasing the area's potential economic growth, and the reduction in costs of urban elopment which would result from the lessening of urban awl.

These measurable benefits are greater in value than the l annual fixed rapid transit capital charges for which tax ridge toll support is required – $42,376,600 in 1975. The favorable balance of values from the system is ex- ted to grow in years beyond 1975.

ED FOR RAPID TRANSIT

ng with other large metropolitan areas, the San Francisco Area faces a potential crisis in its internal transporta- The rapid growth of population and automobile travel eating serious traffic congestion in many places. Existing urban transit facilities are inadequate and their passen- travel has declined. Despite the expenditure of more than 0 million of public funds annually for street and high- improvement in the area, traffic congestion continues well.

he proposed transit system is a bold step toward reshap- he type and quality of interurban public transportation ce in Alameda, Contra Costa and San Francisco Coun- By providing faster, safer and cheaper travel among counties it would divert thousands of travelers from automobiles, and alleviate highway congestion.

WTH OF POPULATION AND ERURBAN TRAVEL

ng the 1950-60 decade, the population of the nine Bay counties increased by 958,000 to 3,639,000 persons – per cent increase. The population of the six-county San cisco-Oakland Metropolitan Area, comprised of the five al counties of Alameda, Contra Costa, Marin, San cisco and San Mateo, plus Solano County, grew 24.6 ent, the fourth highest growth rate among the nation's rgest metropolitan areas. In the decade, however, the of San Francisco, Oakland and Berkeley lost popula- despite gains in their local employment.

uring the 20 years, 1960 to 1980, the nine-county Bay is expected to increase its population to 6,020,000 per- By the year 2000, more than 8,300,000 people are ex- d to live in the Bay Area.

ojections of the total population of each of the nine ies are shown in Table I, adjacent. These projections developed in March, 1962, from new data on popula- nd employment within and outside county of residence ted by the 1960 Census. They assume that the rapid transit system proposed for the three core counties will be built and fully operating by 1971.

Another important factor is the locational pattern of homes and jobs. As pointed out by Ebasco Services Incorporated, in its report, "Rapid Transit System Economic Review" prepared for the San Francisco Bay Area Rapid Transit District, June 1961, the suburban cities and unincorporated areas are absorbing most of the Bay Area's net gain in population, manufacturing industries and consumer shopping facilities. At the same time, the central cities are increasing their employment in activities such as specialized trade and services and the headquarters offices of business and financial organizations and governmental agencies. While the suburban areas are becoming more diversified, the core areas are becoming more highly specialized in those functions which provide concentrated employment and services to the entire metropolitan area as well as to surrounding regions.

A significant result of this pattern of metropolitan growth has been the large increase of travel between suburban areas and the central cities of San Francisco, Oakland and Berkeley. For example, between 1954 and 1959, rush period traffic by all modes of travel passing through the six principal gateways to the central cities increased 29 per cent and the automobile traffic alone increased 44 per cent, as shown in Table II on page 78. Conservative estimates by the District's engineers indicate that passenger travel through these gateways by all modes will increase by more than 50 per cent by 1975.

Highway traffic congestion is beginning to limit physical access to existing plants, offices, and homes, and threatens the potential development of both central cities and suburbs. Higher-capacity inter-community travel arteries are required to retard "urban sprawl" and to maintain an efficient organization of living and working areas.

EXPLOSIVE INCREASE OF AUTOMOBILE TRAVEL

The Bay Area's traffic problem is intensified by the explosive increase of internal travel by automobile. The number of automobiles is increasing much faster than either population or employment. During 1950-1960 the number of automobiles registered in the nine Bay Area counties increased 58 per cent compared to the total population gain of 36 per cent.

TABLE I

TOTAL POPULATION OF SAN FRANCISCO BAY AREA COUNTIES

County	*U.S. Census (000) April 1*			*Projections (000) July 1*		
	1940	*1950*	*1960*	*1970*	*1975*	*1980*
Alameda	513.0	740.3	908.3	1110	1227	1350
Contra Costa	100.5	299.0	409.0	560	645	740
Marin	52.9	85.6	146.8	240	292	350
San Francisco	634.5	775.4	740.3	750	750	750
San Mateo	111.8	235.7	444.4	640	726	800
FIVE COUNTY TOTAL	1412.7	2136.0	2648.8	3300	3640	3990
Napa	28.5	46.6	65.9	92	110	132
Santa Clara	174.9	290.5	642.3	1030	1205	1350
Solano	49.1	104.8	134.6	176	214	260
Sonoma	69.1	103.4	147.4	210	246	288
FOUR COUNTY TOTAL	321.6	545.3	990.2	1508	1775	2030
NINE COUNTY TOTAL	1734.3	2681.3	3638.9	4808	5415	6020

SOURCE: Projections by Van Beuren Stanbery, March 29, 1962.

FIGURE 1

TABLE II

INTERURBAN PASSENGER TRAVEL THROUGH SIX BAY AREA GATEWAYS, 6 TO 9 A.M. AND 4 TO 7 P.M. ON AN AVERAGE DAY

	1954	*1959*	*Per Ce Chan*
Person Trips via Public Transit	83,992	71,140	−15%
Person Trips via Private Automobile	266,854	381,105	+43%
Total Person Trips	350,846	452,245	+29%
Total Private Automobiles	154,251	221,573	+44%
Average Number Persons per Private Vehicle	1.73	1.72	No Chan

SOURCE: Parsons Brinckerhoff-Tudor-Bechtel

Moreover, the population aged 16 years and over in the central counties grew only 14 per cent while the number automobile registrations rose 47 per cent. Thus, the upsu of automobile registrations was 3.3 times as great as the crease in population in the driving ages. Even San Francis which lost 35,000 population, gained 27,000 automobi for an increase of 11.4 per cent.

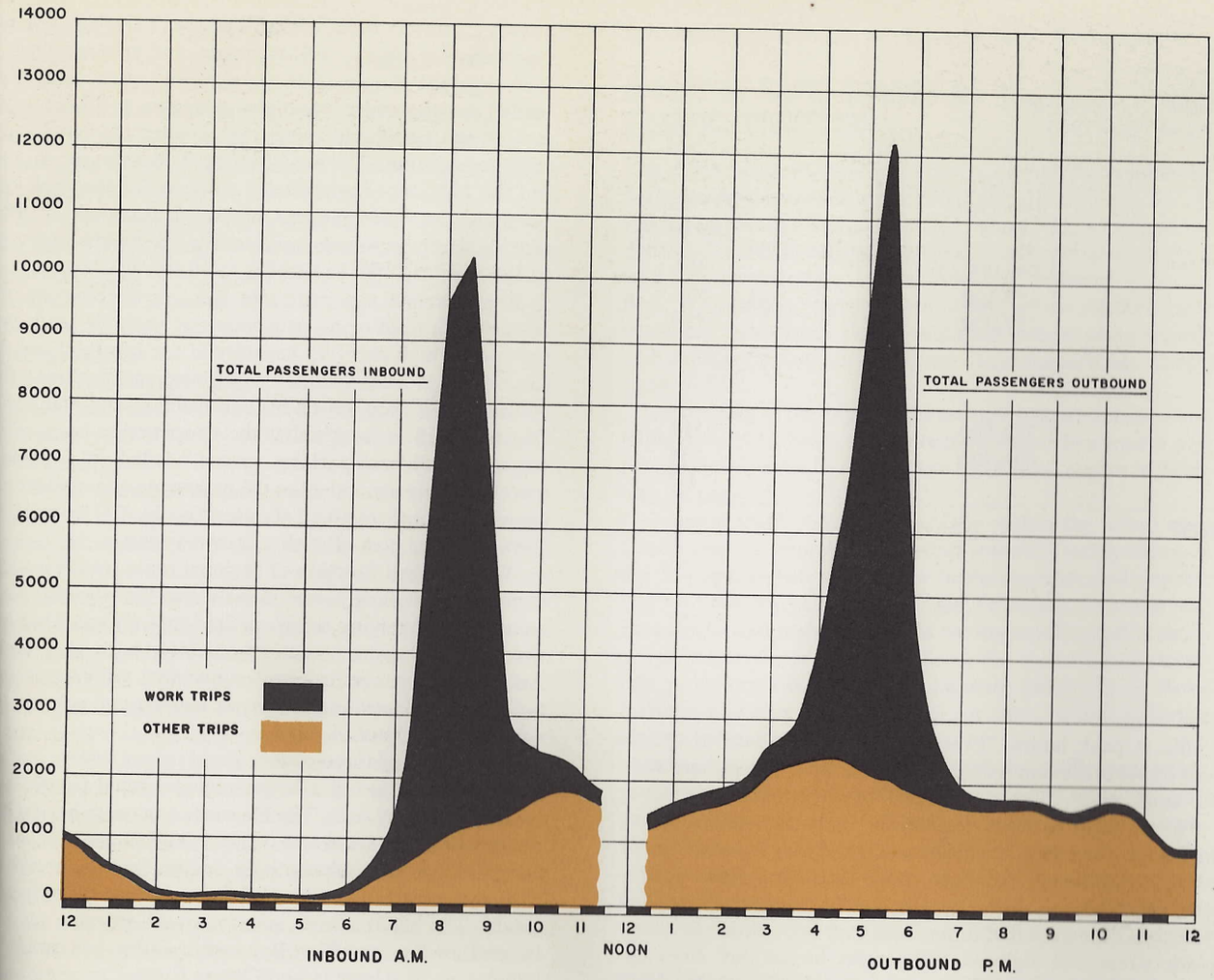
With the future rise of the income level and a shar increase in residents of driving age, the number of auto biles and local travel therein should continue to incre much faster than the whole population in the Bay Area 1960 the nine Bay Area counties had 1,488,000 regist automobiles, and in 1980 they are expected to have 2,9 000 – approximately twice as many as in 1960.

DECLINE OF TRANSIT TRAVEL

The area's transportation problem has been further inte fied by the decline of inter-county travel on existing r transit. Between 1954 and 1959, interurban transit t through the major Bay Area traffic gateways declined 1 cent at rush hours, contributing materially to the 44 per rise in automobile traffic (Table II).

TOPOGRAPHY AND INTERURBAN TRANSPORTATION

Transportation among the Bay Area's communities is han capped by the separations imposed by its topography. Francisco Bay and San Pablo Bay split the region into



PEAK HOUR VOLUMES OF PASSENGERS AT SAN FRANCISCO - PENINSULA GATEWAY

(ACCORDING TO PURPOSE OF TRIP)

PREPARED FOR SAN FRANCISCO BAY AREA RAPID TRANSIT COMMISSION BY PARSONS, BRINCKERHOFF, HALL & MACDONALD SAN FRANCISCO NEW YORK

GURE 2

parts – East Bay, West Bay, and North Bay. Moreover, the ring of hills rimming the Bay forces inter-community traffic through narrow gorges or tunnels. Thus, the area's physical configurations have created transportation bottlenecks at entrances to San Francisco, Oakland and Berkeley.

The most serious traffic congestion in the Bay Area now occurs mainly in two categories. One is blockage and stalling on arterial highways at the gateways to the central cities, and other freeway bottlenecks. The other is the overcrowding of vehicles in downtown business districts. These two types of congestion are closely related: the more automobiles that pour into the downtown districts from the suburbs, the greater the vehicular over-crowding.

THE PEAK-HOUR PROBLEM

The millions of daily trips in the Bay Area are of various lengths and for a variety of purposes. These trips are grouped generally, however, as "local" or "interurban"; "work" or "other"; and "rush-hour" or "non rush-hour" trips. While rapid transit, directly or indirectly, will substantially improve the conditions of travel for all types of trips, its primary role is to carry most efficiently the high volumes of passenger traffic which are compressed into the morning and evening rush hours along the main travel arteries connecting residential areas with the employment centers and subcenters.

This traffic funnels mainly through six major interurban traffic gateways, illustrated in Figure 1, on page 78, along narrow corridors formed by bridges, tunnels, mountains and waterfronts. The volume of interurban travel through these gateways, averaging more than 10 miles per trip, begins to rise sharply about one hour before the peak traffic flow is reached, and then declines for another hour before leveling out. As shown in Figure 2 on this page, the day-time traffic volumes along these routes are as much as ten times higher at the peak of traffic than at the mid-day low. Thus, within a two to three hour period each morning and evening, the demand upon transportation facilities is great. During these two rush periods, more than one-half of all interurban daily travel takes place; and interurban transportation facilities must be designed to accommodate it. The peak-hour problem is essentially a mass transportation problem.

HIGHWAY DEFICIENCIES

Extensive studies were conducted by the District's engineers to determine future regional traffic flows. Traffic volumes were projected from the expected future land-use pattern and concentrations of population, business and industry. The projections of population and travel in the five central coun-

TABLE III

SELECTED FACTORS ACTIVE AS TRAFFIC GENERATORS,
FIVE BAY AREA COUNTIES,(1) 1960 AND 1975

Traffic Generators	*Annual Average*		*Per Cent Increase*
	1960	*Projected 1975*	
Five County Population	2,669,400 (2)	3,640,000 (3)	36%
Number of Automobiles (3)	1,068,700	1,689,400	58%
Inter-County Commuters (4)	182,000	257,000	41%
Weekday Regional Passenger Trips through Six Major Gateways on Highway and Transit Facilities (5)			
24 hour 2-way total	878,500 (6)	1,322,500	51%
6 hour 2-way peak total (6-9 A.M. and 4-7 P.M.)	452,200 (6)	692,200	53%

(1) Counties of Alameda, Contra Costa, Marin, San Francisco and San Mateo.
(2) Estimate for July 1, 1960, by California State Department of Finance.
(3) Van Beuren Stanbery, March 29, 1962.
(4) From Table VIII.
(5) Parsons Brinckerhoff-Tudor-Bechtel.
(6) 1959 actual traffic data.

ties assumed that transportation facilities would be provided to enable traffic to circulate freely. Projections of interurban passenger movements through the six principal gateways and some major factors generating these movements are shown in Table III on this page.

These projections indicate that by 1975, with population of the five counties increasing by 36 per cent over 1960, there will be a 41 per cent increase in inter-county commuters, a 58 per cent increase in number of automobiles, and a 51 per cent increase in interurban travel by all modes of transportation.

The capability of existing and planned freeways and present transit to handle these potential future traffic volumes also was analyzed. The analysis showed that substantial deficiencies in peak-hour highway traffic capacity would prevent the free movement of traffic.

Currently, 48 lanes of highways serve the region's transportation needs through the six gateways, plus two major bus systems and one rail line. By 1975, it is expected that 32 more lanes of freeways will be built, totaling 80 lanes through the gateways. In view of the potential increase in automobile traffic, the equivalent of an additional but as yet unplanned 40 lanes of freeways and bridges and more than 36,000 additional parking spaces would be required in San Francisco, Oakland and Berkeley to permit "free-flowing" traffic at peak hours. "Free-flow" is the standard of speed and travel times that would prevail on rapid transit lines and for automobiles in uncongested off-peak periods.

In an effort to meet the rapidly increasing demands for highways, the rate of per capita expenditures for state highways in California has risen more than three times faster than per capita personal incomes over the last ten years. The State has estimated that it may cost over $6.4 billion to overcome street and highway deficiencies in the Bay Area by 1980. This includes $2.7 billion for state highways and $3.7 billion for city and county streets and highways as shown in Table IV on page 84.

The State Department of Public Works also has indicated that efficient operation of its freeways will depend on the reinvigoration of interurban transit in the Bay Area.

AN INTEGRATED TRANSPORTATION NETWORK

To provide for the continuing rapid increase of its internal travel, the Bay Area needs a comprehensive, integrated transportation network. The network should include adequate facilities for travel by both motor vehicles and mass transit, each serving that part of the total travel for which it is best suited.

An extensive, region-wide system of freeways and highways is a primary requirement. The area's freeway and highway system is already well advanced and progressing.

A regional system of modern rapid transit lines also is needed to supplement the highway system to absorb a large part of the rush-hour travel that creates the most serious traffic congestion. The regional rapid transit system would add the high carrying capacity required for the peak travel demands that freeways and highways alone are unable to provide. Each two-track rapid transit line would have a scheduled carrying capacity equivalent to 30 freeway lanes.

Rapid transit can penetrate the heavily built-up urban centers with little or no usurpation of valuable land. It can provide its high carrying capacity at far less total cost than can freeways and downtown parking space alone. Based upon costs of facilities under construction and planned, the District's staff estimates that the construction costs of freeways, bridges and parking spaces needed to provide the travel capacity equivalent to the patronage of a modern rapid transit system through all six gateways by 1975 would be at least *twice* the cost of such a transit system.

The principal function of regional rapid transit is to meet enough of the peak period demands so that the more costly alternative of relying solely on freeways and parking facilities can be avoided. Another objective is to give the Bay Area a fast, economical, and convenient public transportation service connecting the major centers and subcenters of activity at all times of the day.

The proposed three-county rapid transit system is the important foundation of a larger regional rapid transit system for the entire Bay Area. The District's engineers have planned the three-county system to pass through four of the six traffic gateways and substantially reduce and in some cases eliminate peak-hour traffic deficiencies along those four corridors. The rapid transit system would expedite travel between East Bay and West Bay communities, and among outlying areas of Alameda and Contra Costa Counties, and the cities of Richmond, Berkeley, Oakland and San Francisco. It also would expedite travel within San Francisco and Oakland by lessening traffic congestion on their streets and providing faster movement between their downtown business districts and residential areas.

EFFECT OF RAPID TRANSIT ON THE TRANSPORTATION PROBLEM

CATEGORIES OF TRAVELERS

Three general categories of travelers must be considered in appraising the effects of the transit system in reducing

fic congestion:

1. Those who *must use public transportation* because they er cannot drive or do not have an available automobile. s group includes persons who are either too young – or rwise unable to obtain an automobile driver's license – members of a family that does not have a sufficient num- of automobiles for all trips of each member.

2. Those who *must use an automobile* because their trip ern varies substantially from the fixed routes of public sportation systems, or because their vehicle must contain age space. This group includes travelers such as doctors, smen, repair men, recreation seekers, and operators of mercial vehicles.

3. Those who *may use either public transportation or an mobile,* but whose trip pattern conforms to the routes of ic transportation facilities. These persons have the op- of choosing either their private automobile or public it – if its standards of service are acceptable.

he transit system has been designed to provide ease of ement throughout the region for the large number who ot have an automobile at their disposal, and to improve ic transit service so that it will divert a much larger pro- on of those travelers who can choose between automo- and transit. Such a diversion would improve traffic and ing conditions for those who must use an automobile. he largest proportion of rapid transit travelers will be who have a choice between the automobile and transit, who will find rapid transit a faster and more convenient od of travel. This is borne out by existing rapid transit ms in other metropolitan areas.

or example, a recent report of reasons given for travel pid transit and commuter railroad lines in the Penn- nia-New Jersey area shows that 63 per cent of their rban transit passengers have a choice, and choose the nes. The remaining 37 per cent either have no automo- vailable or cannot drive. Seventy-five per cent of the ers using the rail transit by choice cited greater con- nce, avoidance of congestion, or faster time, while less 0 per cent mentioned cost savings as the principal rea- r riding the transit lines.

ore than three-quarters of daily rapid transit patrons in y Area would be commuters, traveling between home ork, and using the facilities during the critical rush s. Most Bay Area residents served by rapid transit, er, would use the system at one time or another. A re- Bay Area survey by Facts Consolidated has indicated hile approximately one-fourth of all persons owning tomobile in the five central counties would make rapid their *usual* mode of travel if it were available, nearly cent of persons with an automobile at their disposal use rapid transit at varying frequencies, some often and others occasionally, as shown in Table V on page 84.

EFFECT OF RAPID TRANSIT ON TRAFFIC CONGESTION

The effect of rapid transit in relieving congestion caused by highway deficiencies is shown in Table VI on page 85. At the four gateways served by rapid transit, highway capacity deficiencies would be reduced from 22,400 persons per hour to 3,700, permitting a high standard of highway vehicular flow. In addition, rapid transit would divert 48,000 more work-day autos from city streets than does existing transit, and reduce central city parking requirements by 23,400 stalls.

According to the engineering estimate, rapid transit would triple daily peak-hour, peak-direction interurban transit patronage through the four gateways by 1975, as shown in Table VII on page 85.

Internal traffic movement wholly within the urban core would also be improved by rapid transit. Twenty-three of the 37 rapid transit stations are in the concentrated population and employment areas of San Fransisco, Oakland and Berkeley – and provide a means for improved travel in those congested areas. In San Francisco, the inclusion of streetcars in subways is expected to increase patronage on those facilities alone by as much as 20 per cent, further reducing surface congestion.

Most important to the solution of the traffic congestion problem is that a substantial majority of rapid transit passengers would be comprised of persons diverted from automobiles. Of the 258,600 daily rapid transit trips in 1975, 157,400, or 61 per cent, would be diverted from automobiles, with the balance transferring from existing transit systems.

ECONOMIC EFFECTS AND BENEFITS OF THE RAPID TRANSIT SYSTEM

TYPES OF BENEFITS

Rapid transit would aid in the future development of each of the three counties, the Bay Area and the State of California. It would lessen the usurpation of valuable property for highways and parking, and, in coordination with an improving highway system, make possible a more efficient use of State and local public expenditures for needed transportation improvements.

It would benefit families and individuals in Alameda, Contra Costa and San Francisco Counties by giving them a new and improved means of economical public transportation.

The larger and most important gains from the system would be indirect and cumulative over the years. Only a few of the benefits could be quantitatively estimated in monetary terms as shown in following sections. However, the annual value of measurable benefits alone will be greater than the total annual capital costs of the system supported by taxes and bridge tolls.

The following review shows in detail how the transit system would benefit the State and the Bay Area.

ECONOMIC SPECIALIZATION AND INTER-DEPENDENCE OF BAY AREA COMMUNITIES

The Bay Area has a highly developed and remunerative economy. In 1949, the latest date for which comparable data are available, the San Francisco-Oakland Standard Metropolitan Area had the third highest median income among the nation's 14 metropolitan areas with a million or more population. It also had the third largest percentage of total civilian employment in the highest paid occupations (proprietors, managers, officials, professional and technical workers). The majority of these high-paying jobs are in San Francisco, Oakland and Berkeley.

A major factor in the area's high level of development has been the efficient clustering of its industry and business in strategic locations. A hierarchy of urban centers and subcenters has emerged, each specializing in some of the activities essential to the economic life of the metropolitan area. Thus, each Bay Area city or community is dependent upon other communities for many things which it does not possess, such as various types of manufactured goods, business and governmental services, hotels, educational and cultural institutions.

For example, the Bay Area's largest and most specialized trade, financial and service enterprises and headquarters offices are concentrated in San Francisco and Oakland, where they can best serve regional and distant customers, and one another. The central business districts provide the region with highly developed centers of business and communication.

These physical and functional concentrations have brought about economies of large scale operations, face-to-face negotiations and the pooling of a great variety of skills and small businesses to serve the larger organizations as well as the public.

Most of the area's manufacturing and warehousing activities are clustered in industrial districts convenient to water, rail or truck transportation. While many of these activities are linked with the economies or facilities of the central

cities, most of the Bay Area's industrial growth is now taking place in suburban subcenters.

As indicated, commercial subcenters also are expanding in the outlying areas, as are the clusters of research, medical and educational institutions. These subcenters serve a mushrooming suburban population and also provide their special services to others in the area.

While the employment centers and subcenters are growing in size and number, population is expanding in an ever-widening area of predominantly single-family homes. Trips between these homes and the various activities in the region are increasing in both number and length.

The area's advantageous economic organization was made possible by the continual improvement in its internal transportation facilities – the ferries and early interurban rail lines, then the bridges and the freeways. The maintenance and expansion of the area's efficient organization depend upon continued improvement of its internal transportation that will permit unobstructed travel at all times among its widely separated, interdependent communities.

ECONOMIC DEPENDENCE ON COMMUTERS

INCREASE OF COMMUTING. In terms of commuters, the economic interdependence of the Bay Area's counties is increasing rather than diminishing. In 1960, one of every five employed residents of the San Francisco-Oakland Metropolitan Area worked in a county other than the one in which he lived. And while the population of the five central counties increased 23 per cent from 1950 to 1960, the number of inter-county commuters among them rose 30 per cent to a total of 182,000. From 1960 to 1975, inter-county commuters are expected to increase 41 per cent, compared to a population gain of 36 per cent (Table III). These figures do not include the even larger number of residents commuting long distances within their home county and those whose jobs are outside the five central counties.

IMPORTANCE TO URBAN CENTERS. The core cities and other urban centers are highly dependent on commuters from the suburban areas. Sixty-one per cent of all inter-county commuters among the five central counties in 1960 worked in San Francisco. This city then provided the jobs for about 43 per cent of all employed persons in those counties but had only 28 per cent of their population. San Francisco accounts for 70 per cent of the five-county total employment in finance, insurance and real estate and 50 per cent of the jobs in services, transportation, communications and utilities.

More than 25 per cent of all the jobs in San Francisco are filled by commuters living elsewhere. Furthermore, all its net increase of about 28,000 jobs during 1950-1960 was filled by commuters. Nearly all these additional jobs were in the service categories.

The size of the resident labor forces of San Francisco and Oakland remained about the same during the 1950's. The latest projections indicate that they will probably continue at the 1960 level to 1975 and 1980. Hence, a rising inflow of commuters from suburban areas will be needed to man the expected increase of urban center specialized jobs.

IMPORTANCE TO SUBURBAN AREAS. Commuters to the cities raise the economic and social levels of the suburbs where they live. The three counties with the largest proportions of residents commuting to outside employment centers – San Mateo, Marin and Contra Costa – enjoy the highest income levels among the nine Bay Area counties. They also had the highest growth rates in the five central counties during the 1950's. San Mateo and Marin Counties also had the lowest percentages of unemployment of all Bay Area counties in both 1950 and 1960.

It is estimated that more than one and one-half billion dollars from inter-county commuter incomes are returned to communities of residence in the five central counties, thereby increasing the demands for homes and local goods and services, as well as adding to the revenues of local governments. Each commuter also creates an average of one additional job in his community in services to himself and his family.

SPECIFIC BENEFITS OF RAPID TRANSIT

PRESERVATION AND ENHANCEMENT OF URBAN CENTERS AND SUBCENTERS. Rapid transit would help to preserve and expand the existing organization of urban and suburban areas, especially the advantageous concentration and specialization of employment in the core cities and regional subcenters. Not only are they highly productive, but their huge fixed investments are at stake. These existing cities should be fully permitted to contribute to, and participate in, the economic growth of the region as a whole.

The investment in private land, improvements, personal property and inventories in the three-county area to be served by rapid transit is over 16 billion dollars today, and should rise to more than 25 billion dollars by 1975. This does not include the added billions of dollars in public improvements developed to facilitate daily business and living. Rapid transit will reduce much of the congestion which threatens these values. The cost of rapid transit structures and rolling equipment, by comparison, will be less than four per cent of the market value of these private properties upon completion of the system.

INCREASED PROPERTY VALUES. Rapid transit should not only stabilize existing property values, but also stimulate a substantial increase in them. The system will build vastly increased transportation capacity within the counties to served, making it possible for cities to develop to a lar potential without the limitations imposed by highway pacity deficiencies. Existing Bay Area cities, both centers subcenters, will not reach their potential level of devel ment if traffic congestion prevents maximum desirable u zation of land and improvements. Within the framework local community planning and zoning, rapid transit stati will promote such utilization by stimulating greater devel ment of clusters of businesses, industry and homes, there strengthening the local economic base of trade, employm and property value.

A recent example of the effect of added transportat capacity created by rapid transit is the new Yonge St rapid transit line constructed in Toronto, Canada in 19 It has encouraged development and redevelopment along entire route, thus adding millions of dollars to assessm rolls. According to the Toronto Transit Commission, the crease in property tax revenue attributed solely to the in lation of the rapid transit system is more than enough nually to liquidate the cost of the Yonge Street Subway l

EFFECT UPON COSTS OF URBAN SPRAWL. Rapid tra would help to prevent disorganized urban sprawl with destructive economic and social effects. Increased use of automobile has had both good and bad effects upon the velopment of our metropolitan areas. Extensive road bu ing has provided more flexibility in locating homes, busin and industry, but it has also led to inefficient "leap-frog and "ribbon" development of land. A U. S. Senate Ban and Currency Committee study on mortgage credit n that: "The outward thrust of our urban area is character by scatter and dispersion of land development activ throughout the periphery . . .This uncoordinated proces land development imposes added costs on the home ow which could be avoided if land development were or and compact."*

A subsequent study by Henry B. Schechter, Finan Economist for the Housing and Home Finance Agency, dicated that the increased cost of such things as local t portation, water, gas, public schools, sewerage, and h ways – attributable to the economic inefficiencies of ur sprawl – may have been five billion dollars between 19 The report concluded: "If the present urban growth pat continue without increased planning for coordinated l use, related inefficiencies in performance of everyday f

*R. U. Ratcliff, "The Provision of Adequate Building Sites in Sixties," *Study of Mortgage Credit*, Washington, D.C. (U. States Senate Banking & Currency Committee, 1958), pp. 16

s and in provision of necessary services will also continue row."**

Rapid transit will tend to reduce the "scatteration" of an development. The development of nucleated centers subcenters would be greatly aided if served by a high-city transportation system integrating freeways and rapid sit. To place increasing dependence upon the automo- to perform all of the region's passenger transportation ctions is inevitably to choose the alternative of dispersion diminishing regional mobility.

MPROVED EMPLOYMENT CONDITIONS. Rapid transit ld improve employment conditions in two principal ways. t, it would assist in attracting to the Bay Area a larger e of the future economic growth of the State and nation. id transit would improve living and working conditions, rating efficiency, and the choices of business and indus- locations in the area, especially in the three core coun- to be initially served. Plants and offices seeking expan- in the West will be influenced to locate in a region which developed modern and balanced transportation facilities long-term needs, minimizing the costly and frustrating ts of traffic congestion associated with metropolitan wth.

econd, increased regional mobility of the labor force rapid transit will mean that persons seeking employ- will have many more job opportunities within conven- transportation access. Concurrently, employers will have der regional labor pool from which to fill their employ- needs as they arise. The net result will be that job va- ies will be filled faster, reducing the rate and cost of nployment.

MPROVED ACCESS TO SOCIAL, CULTURAL, AND RECREA- AL OPPORTUNITIES. Rapid transit will markedly benefit fic types of users in addition to the commuting wage r.

or example, the convenience, safety, and daytime train vals of the system will appeal to elderly persons. Many r citizens do not want to face the rigors and hazards of ay driving, or the inconvenience of parking. Many of are retired and thus have the time to take advantage of eak public transportation if it serves them adequately. he system, with direct delivery to several major educa- l institutions, will accommodate the daily travel require- s of many of the Bay Area university students. This is ially true at institutions with a strong reliance upon nuting students.

ith rapid transit operating, the shopping, entertainment ultural availabilities open to Bay Area residents of the

ry B. Schechter, "Cost-Push of Urban Growth," (reprinted *Land Economics*, February 1961), Housing and Home Fi- e Agency, Washington 25, D.C.

1970s and 1980s will be greatly expanded. The system will be safe and convenient – with assured and direct delivery to a range of stores, theaters, athletic stadia, educational institutions, parks and museums. The leisure time "mix" for the typical Bay Area resident can become much more varied and meaningful.

In summary, rapid transit will enable the people of the San Francisco-Oakland Metropolitan Area to make better contact with the expanding physical and social environment in which they live.

MORE EFFICIENT TRANSPORTATION EXPENDITURES. Neither freeways nor transit, at any cost, can perform all of the transportation functions of the other. The function for which the transit system is peculiarly suited is the fast transportation of great volumes of people with little or no utilization of ground space.

As a matter of practical planning, it is unlikely that enough land space can be obtained to handle efficiently all potential traffic increases in the heavily urbanized areas by automobiles on freeways. While it is evident that rapid transit will substantially reduce the requirements for freeways and central city parking spaces, it is beyond the scope of this report to estimate the cost of providing them in lieu of rapid transit – if, in fact, the freeway and parking construction to handle all future movements were at all practicable.

A less academic consideration, however, is the fact that six and eight lane freeways being studied in San Francisco, for example, are estimated to cost an average of $24 million per mile, while the cost of freeways with the same capacity in outlying areas averages $5 million per mile. Each reduction of one mile of future freeway from the central cities' needs will mean the earlier completion of many times that length of freeway in suburban and other areas.

ECONOMICAL TRAVEL. Rapid transit would provide a high standard of public transportation at low cost. For example, the average trip length on the system would be approximately 10 miles each way with a fare of 30 cents including station parking, or 60 cents round-trip. Ebasco Services Incorporated previously found that the average cost of automobile operation and maintenance is approximately 5 cents per mile. Add to this an 80 cent parking charge in the central cities and the same trip which would cost the rapid transit passenger 60 cents would cost the automobile driver $1.80. A commuter's round-trip of 20 miles each way, including a Bay crossing, would cost the rapid transit passenger $1.30 compared to $3.20 for the automobile driver on this basis.

These automobile travel costs of 5 cents per mile do not include payments for such things as depreciation, license fees and insurance. With rapid transit available, many workers in the Bay Area will find it unnecessary to undergo the expense of purchasing and maintaining an additional automobile in order to have convenient access to his place of work and at the same time provide needed automobile transportation for his family's daytime activities.

While it is possible to lower the cost of automobile transportation by sharing in a car pool arrangement, the car pool is associated with an inflexible schedule. Many Bay Area travelers find the flexibility of schedule more controlling than cost in determining choice of travel methods.

SOME MEASURABLE BENEFITS

The value of transportation of one form or another is found in almost everything we do or buy. It is impossible to isolate the precise value of transportation, such as that of rapid transit, from all of the activities it makes possible, especially when the user is only one of the many beneficiaries. But some of the values of rapid transit do lend themselves to quantitative measurement of a general nature, and they are discussed below.

TIME SAVINGS. Rapid transit travel times, especially during peak traffic hours, are much shorter than those for existing transit or by automobile on today's congested streets and highways. Rapid transit will not only provide faster service by public transportation, but also, due to consequent substantial relief of vehicular congestion in future years, increase the rush hour speeds of automobiles and trucks on freeways and city streets.

The District's staff has estimated that by 1975 rapid transit would generate travel time savings amounting to 44,359,000 hours annually. At the value of 92 cents per hour, recommended by Ebasco Services Incorporated, the value of time saved would total $40,810,000 annually.

Time saved on rapid transit and freeways for regional trips averages 15 minutes per trip. Time saved on rapid transit for trips wholly within the internal areas of San Francisco and central East Bay would range up to 15 minutes. A major portion of the time savings would accrue to riders of the San Francisco Municipal Railway routes "J," "K," "L," "M," and "N" as a result of placing the street cars in subways on Market Street and west of Twin Peaks Tunnel.

This estimate excludes the value of additional time which would be saved by the speeding of surface transit and auto traffic on city streets.

SAVINGS IN MOTOR FREIGHT COSTS. Trucks traveling at the rush hours would experience time savings similar to those of motorists because of the reduction of vehicular congestion along principal highways. The estimated value of time saved for peak-period motor truck trips, calculated at $5 per hour for truck and driver, is $2,128,000 annually. This saving does not include the larger savings in shipments

TABLE IV

ESTIMATED STREET AND HIGHWAY NEEDS IN BAY AREA AND CALIFORNIA BY 1970 AND 1980
(Thousands of Dollars)

County	By 1970			Cumulative to 1980		
	City & County Needs	State Highway Needs	Total Street & Highway Needs	City & County Needs	State Highway Needs	Total Street & Highway Needs
Alameda	$ 427,952	$ 299,390	$ 727,342	$ 645,443	$ 612,290	$ 1,257,733
Contra Costa	237,072	183,377	420,449	343,342	275,588	618,930
Marin	91,238	67,818	159,056	149,724	121,513	271,237
San Francisco	205,116	393,794	598,910	265,754	435,795	701,549
San Mateo	205,079	215,420	420,499	318,231	629,954	948,185
FIVE COUNTY TOTAL	$1,166,457	$1,159,799	$ 2,326,256	$ 1,722,494	$ 2,075,140	$ 3,797,634
Napa	65,236	59,738	124,974	93,811	68,914	162,725
Santa Clara	542,042	252,735	794,777	1,589,536	319,003	1,908,539
Solano	46,432	59,515	105,947	107,587	96,865	204,451
Sonoma	88,370	107,343	195,713	140,260	144,514	284,774
FOUR COUNTY TOTAL	$ 742,080	$ 479,331	$ 1,221,411	$ 1,931,194	$ 629,296	$ 2,560,490
NINE COUNTY TOTAL	$1,908,537	$1,639,130	$ 3,547,667	$ 3,653,688	$ 2,704,436	$ 6,358,124
CALIFORNIA TOTAL	$7,611,431	$6,473,829	$14,085,260	$12,751,995	$11,280,699	$24,032,694

SOURCE: California State Department of Public Works.

TABLE V

NUMBER OF RESPONDENTS WHO HAVE ONE OR MORE CARS IN THEIR FAMILY, AND WHO WOULD USE RAPID TRANSIT IF AVAILABLE IN THEIR COUNTY

	Total	By County				
		Alameda	Contra Costa	Marin	San Francisco	San Mateo
Per cent saying they would leave their car home . . .						
Usually	23.9%	22.2%	17.3%	29.0%	34.5%	19.2%
Often	17.3	18.6	21.7	11.7	12.1	20.1
Occasionally	36.2	40.1	41.9	32.9	28.4	35.5
Total of "would use"	77.4	80.9	80.9	73.6	75.0	74.8
Never	21.2	18.3	18.2	26.4	20.8	24.3
Don't know	1.4	.8	.9	—	4.2	.9

SOURCE: Facts Consolidated, *Public Opinion Survey for the San Francisco Bay Area Rapid Transit District*, August, 1959.

and delivery of goods through lessening traffic congestion in downtown business districts.

SAVINGS IN TRAFFIC ACCIDENT COSTS AND COMMUTER INSURANCE PREMIUMS. According to the California State Division of Highways, reportable death and personal injury accidents average 5.0 per ten million miles of highway travel and reported property damage accidents average 6.7 per million miles of travel. Ebasco Services Incorporated estimated the average cost of each death and personal injury accident at $4,000, and the National Safety Council estimates the average cost of reported property damage accidents at $300 each. Applying these rates to the estimated 286,896,100 miles of automobile travel diverted to the rapid transit system in 1975, the estimated reduction of reported accidents involving death, personal injury and property damage would produce savings of $630,000 to rapid transit passengers.

Because of the extra hazards of driving automobiles in congested rush periods, commuters traveling more than [illegible] miles to work (one way) are charged an added increment for automobile insurance. This added annual insurance cost for Bay Area automobile commuters averages $33 per automobile. The increased patronage on interurban transit facilities due to the installation of rapid transit would reduce the number of automobiles used for daily commuting by an estimated 39,000. With the $33 per automobile insurance reduction, annual savings to rapid transit passengers would be $1,287,000.

SAVINGS IN AUTOMOBILE PARKING COSTS. As a result of rapid transit, 23,400 fewer automobiles would be parked in the central cities in 1975. Surveys by Ebasco Services Incorporated indicate that the charges for all-day parking in 1[illegible] were $1.00 in San Francisco, 55 cents in Oakland and 50 cents in Berkeley. The weighted average charge for the 23,400 automobiles would be 72.5 cents.

The cost of land and structure to provide parking [illegible] in the downtown sections of these cities has been rising rapidly. It seems likely that the charges for all-day parking in the three cities in 1975 would be substantially higher than those shown above. Hence an average parking charge of $1.00 per day in 1975 (in terms of 1960 dollars) was estimated for the 23,400 reduction in automobile parking. Multiplying the average daily savings of $23,400 in parking charges by the 250 working days per year, produces a total annual savings of $5,850,000 to rapid transit passengers diverted from automobiles in 1975.

REDUCED TRAFFIC CONTROL COSTS. The estimated reduction in cost of controlling freeway traffic because of the diversion of automobile passengers to rapid transit is estimated to be $242,000 annually. These savings have been computed from the projected mileages of automobile travel that [illegible]

eliminated in the three counties served by rapid transit d the average cost to the State Highway Patrol of control- g freeway traffic per million miles of automobile travel. Actual traffic control cost savings would be even greater ce this estimate does not include additional savings in the ts of controlling traffic from the reduction of congestion other highways and streets, particularly in the downtown tions of San Francisco and Oakland.

SUMMARY OF MEASURABLE SAVINGS. The total annual ue of measurable benefits from the rapid transit system 1975 is $50,947,000 (in 1960 dollars) distributed as lows:

vel time	$40,810,000
cident costs	630,000
tomobile insurance	1,287,000
tomobile parking charges	5,850,000
tor freight shipments	2,128,000
ffic control costs	242,000
Total	$50,947,000

comparison to these measurable benefits, the annual rapid sit system capital costs supported by taxes and bridge s in 1975 is estimated to be $42,376,600 (1960 dollars).* The annual $50,947,000 value resulting from rapid transit s not include the very large savings in additional bridges freeways which would be needed without rapid transit. It should also be noted that the types of savings listed are those which, for the most part, cannot be achieved facilities for the automobile. For example, if a vastly eased network of freeways and bridges were built to e traffic more swiftly between cities, the increased deluge utomobiles in the cities themselves would likely com- nd time losses there.

With the great growth of population, employment, and el which lies ahead for the Bay Area, the influence of d transit in establishing efficient travel patterns – and system's large reserve capacity to absorb growing vol- s of traffic into the foreseeable future – would make d transit an invaluable tool for aiding the area's eco- ic growth, and for creating conditions for a high stand- of metropolitan living.

ues of measurable benefits were calculated on the basis of 1960 e levels. Engineering construction costs were also based on 1960 es, but were increased by approximately 20 per cent to reflect ible price inflation during the 8½-year construction period.

TABLE VI

POTENTIAL PEAK-HOUR, PEAK-DIRECTION INTERURBAN HIGHWAY DEFICIENCIES AT SIX GATEWAYS IN 1975 EXPRESSED IN PERSONS PER HOUR

Gateway	*Estimated 1975 Without Rapid Transit*	*Estimated 1975 With Rapid Transit At Four Gateways*
Trans-Bay	12,000	3,200*
Berkeley Hills	4,600	200*
Cerrito Creek	3,100	300*
San Leandro	2,700	None*
FOUR GATEWAYS	22,400	3,700*
Peninsula	7,600	7,600
Golden Gate	6,600	6,600
SIX GATEWAYS	36,600	17,900

*Bay Area Rapid Transit District service installed.
SOURCE: Parsons Brinckerhoff-Tudor-Bechtel.

TABLE VIII

OUT-COMMUTERS FROM THE FIVE CENTRAL COUNTIES, ANNUAL AVERAGE, 1960 AND 1975 (1)

County	*1960 (2)*	*1975 (3)*	*Per Cent Increase*
Alameda	35,700	49,000	37.3%
Contra Costa	46,225	73,000	57.9
Marin	19,290	34,000	76.3
San Francisco	19,350	22,000	13.7
San Mateo	61,390	79,000	28.9
TOTAL	181,955	257,000	41.2%

(1) Civilian residents of the county employed in the other four listed counties.
(2) Based on data from the 1960 Census of Population.
(3) Projections by Van Beuren Stanbery, March, 1962.

TABLE VII

PEAK-HOUR, PEAK-DIRECTION INTERURBAN TRANSIT PASSENGERS TRAVELING THROUGH PRINCIPAL TRAFFIC GATEWAYS, 1959 AND 1975

Gateway	*Passengers*			*Transit Per Cent of Total Peak-Hour, Peak-Direction Passenger Traffic*	
	1959 Actual	*1975 Estimated*	*Per Cent Change*	*1959 Actual*	*1975 Estimated*
Trans-Bay	7,000	16,700*	+139%	40%	55%
Berkeley Hills	1,400	5,900*	+321%	21%	35%
Cerrito Creek	900	3,700*	+311%	11%	21%
San Leandro	300	5,200*	+1,633%	2%	24%
FOUR GATEWAYS	9,600	31,500*	+228%		
Peninsula	10,300	9,700	– 6%	39%	25%
Golden Gate	2,400	2,300	– 4%	27%	14%
SIX GATEWAYS	22,300	43,500	+95%		

*Bay Area Rapid Transit District service installed.
SOURCE: Parsons Brinckerhoff-Tudor-Bechtel.

SUMMARY OF DATA FURNISHED PURSUANT TO PUBLIC UTILITIES CODE SECTION 29,152

A. A general description of the facilities to be acquired and constructed from the proceeds of the proposed bond issue is an adequate, modern, interurban mass transit system extending through the City and County of San Francisco to the vicinity of Daly City in the County of San Mateo; and from San Francisco eastward to Oakland in the County of Alameda; from Oakland to the vicinity of Richmond in Contra Costa County; from Oakland to the vicinity of Concord in the County of Contra Costa and from Oakland to the vicinity of Fremont in the County of Alameda.

The Composite Report, Bay Area Rapid Transit, May 1962, describes this general system and determines the engineering feasibility of this general system. Construction plans and specifications remain, of course, to be prepared before construction bids are obtained and construction begins; and circumstances then existing may well result in some variations within this general framework.

B. The estimated total cost of constructing and acquiring such facilities is $790,493,000.

C. The estimated period of construction of such facilities is from January 1, 1964, through July 1, 1971, preceded by a period for design and right of way acquisition starting January 1, 1963.

D. An estimate of the revenues which may be expected to be derived therefrom is:

Fiscal Year	*Gross Fare and Concession Revenue*	*Net Operating Revenue*
1969/70*	$28,449,000	$11,073,000
1970/71	21,383,000	9,110,000
1971/72	22,571,000	9,982,000
1972/73	23,416,000	10,437,000
1973/74	23,956,000	10,722,000
1974/75	24,284,000	10,895,000
1975/76	24,539,000	11,029,000
1976/77	24,790,000	11,166,000
1977/78	25,045,000	11,300,000
1978/79	25,299,000	11,426,000
1979/80	25,543,000	11,563,000
1980/81	25,788,000	11,714,000

*18-month period: January 1, 1969-June 30, 1970.

E. The amount of bonds which will be required to pay estimated total cost of constructing and acquiring such facilities is $792,000,000, including incidental expenses of project and of bond issuance of $1,057,000, reimbursem to the State of California for rapid transit commission penses of $450,000, and construction costs of $790,493,0

F. An estimate of the taxes required to be levied in A meda, Contra Costa, and San Francisco Counties for District purposes is:

Fiscal Year	*Total Annual Costs Paid from Taxes*	*Probal Tota Tax R per $1*
1963/64	$ 5,937,000	14
1964/65	11,930,000	27
1965/66	20,880,000	45
1966/67	27,013,000	56
1967/68	30,280,000	61
1968/69	31,955,000	62
1969/70	32,030,000	60
1970/71	32,635,000	59
1971/72	38,590,000	67
1972/73	39,698,000	67
1973/74	40,781,000	67
1974/75	41,899,000	67
1975/76	42,990,000	66
1976/77	44,087,000	66
1977/78	45,177,000	66
1978/79	46,275,000	66
1979/80	47,358,000	66
1980/81	48,441,000	66
1981/82	48,994,000	65
1982/83	49,525,000	65
1983/84	50,056,000	65
1984/85	50,587,000	65
1985/86	51,118,000	65
1986/87	51,649,000	65
1987/88	52,180,000	65
1988/89	52,711,000	65
1989/90 through 1997/98	53,100,000	65
1998/99	48,288,000	64

*District assessed valuation assumed to remain constant at 7.5 bill after 1989/90.

The sole source from which such taxes will be obtain a general tax levy on the taxable property within the Dist

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