

UC Berkeley

IURD Working Paper Series

Title

Shall We Tear Down Embarcadero?

Permalink

<https://escholarship.org/uc/item/7817259b>

Author

Hall, Peter

Publication Date

1990-03-01

Peer reviewed

Working Paper 512

SF DEBATE

Shall We Tear Down
the Embarcadero?

Peter Hall

March 1990

University of California at Berkeley

\$4.50

CONTENTS

Chapter

1. THE ISSUE
2. THE EMBARCADERO
3. THE 1974 REPLACEMENT PLAN
4. THE 1984 REPLACEMENT PLAN
5. SUMMING UP

ESSENTIAL ABBREVIATIONS

CALTRAIN	The Peninsula Commute Service, operated for Caltrans by the Southern Pacific Railroad
CALTRANS	California Department of Transportation
DOT	United States Department of Transportation
MTC	Metropolitan Transportation Commission
SFBOS	San Francisco Board of Supervisors

1. THE ISSUE

Should we tear down the Embarcadero?

The question, in March 1990, is more real and more urgent than ever in the three decades since San Francisco's Embarcadero Freeway was built. For the two-level elevated freeway, subject of violent controversy almost since the day it was first proposed in the late 1940s, has been closed since October 17: the evening of the Loma Prieta earthquake, which tragically destroyed the similar I-880 Cypress structure in Oakland. The Cypress has been torn down. The fate of the Embarcadero hangs in the balance.

The 60,000 trips a day that used to travel on the Embarcadero are clearly not traveling on it any more. Less clear is what has happened to them. Some are on surface streets, adding noticeably to downtown congestion. Some are not happening at all, because people have been deterred from making trips. Loud complaints have come from owners of businesses in Chinatown and Fisherman's Wharf, who say that they have suffered serious loss of trade. They want the freeway rebuilt as soon as possible.

In February, a California Senate Transportation Committee sat for two days in San Francisco, under the Chairmanship of ex-San Francisco supervisor Senator Quentin Kopp, to hold hearings on the Embarcadero's future. The California Department of Transportation [Caltrans] declared that it would start to rebuild and fortify the structure in May unless the City of San Francisco produced the money to meet the additional costs of demolishing the freeway and replacing it with a depressed roadway. According to engineers T.Y. Lin, hired by Caltrans, the cost of strengthening would be between \$14 and 15 million. Within the city, opinion is as divided as ever it was: anti-freeway

campaigners are lined up on one side, Chinatown and Fisherman's Wharf business interests on the other.

The local media have done their best to report the controversy day by day as it unfolds, but it is not their job to produce any kind of in-depth analysis of the issues. This is why IURD--the Institute of Urban and Regional Development of the University of California at Berkeley--has decided to fill the gap. This paper seeks to summarize the issues at stake. It presents a profile of the Embarcadero and its role in the highway system of the city; outlines the two major alternatives that have been suggested; and attempts at least a preliminary evaluation of them.

An important word of warning: produced at speed, against a severe time constraint imposed by the urgency of the decision, this paper cannot pretend to offer the detailed, considered evaluation that the entire issue deserves. Indeed, one of the problems now is that the whole question is being determined in such a hurry, without adequate analysis. But, lacking such analysis, this paper tries at least to set out some of the major considerations at issue.

2. THE EMBARCADERO FREEWAY

The Embarcadero Freeway was planned in the late 1940s as part of an elaborate scheme to build elevated expressways along almost the entire length of the San Francisco waterfront; it was conceived as an essential link between I-280, the Bay Bridge, and the Golden Gate Bridge, but also as part of a system including a southern Bay crossing to Alameda and an additional Peninsula freeway between the Bayshore Freeway (US 101) and I-280. When the Freeway was designed in 1953, it ran through what was then a primarily industrial area; the subsequent transformation of the waterfront was never taken into account.

Built during the 1950s, the Embarcadero was completed in 1965 with the opening of the Washington and Clay ramps. By that time, massive opposition had halted the rest of the San Francisco freeway program, including both the continuation of the Embarcadero to the Golden Gate bridge in one direction and its linkage to I-280--completed as far as China Basin in 1974--in the other; the Embarcadero was thus left as an anomalous feeder from the Bay Bridge: in effect, a 1.2-mile on-off ramp.

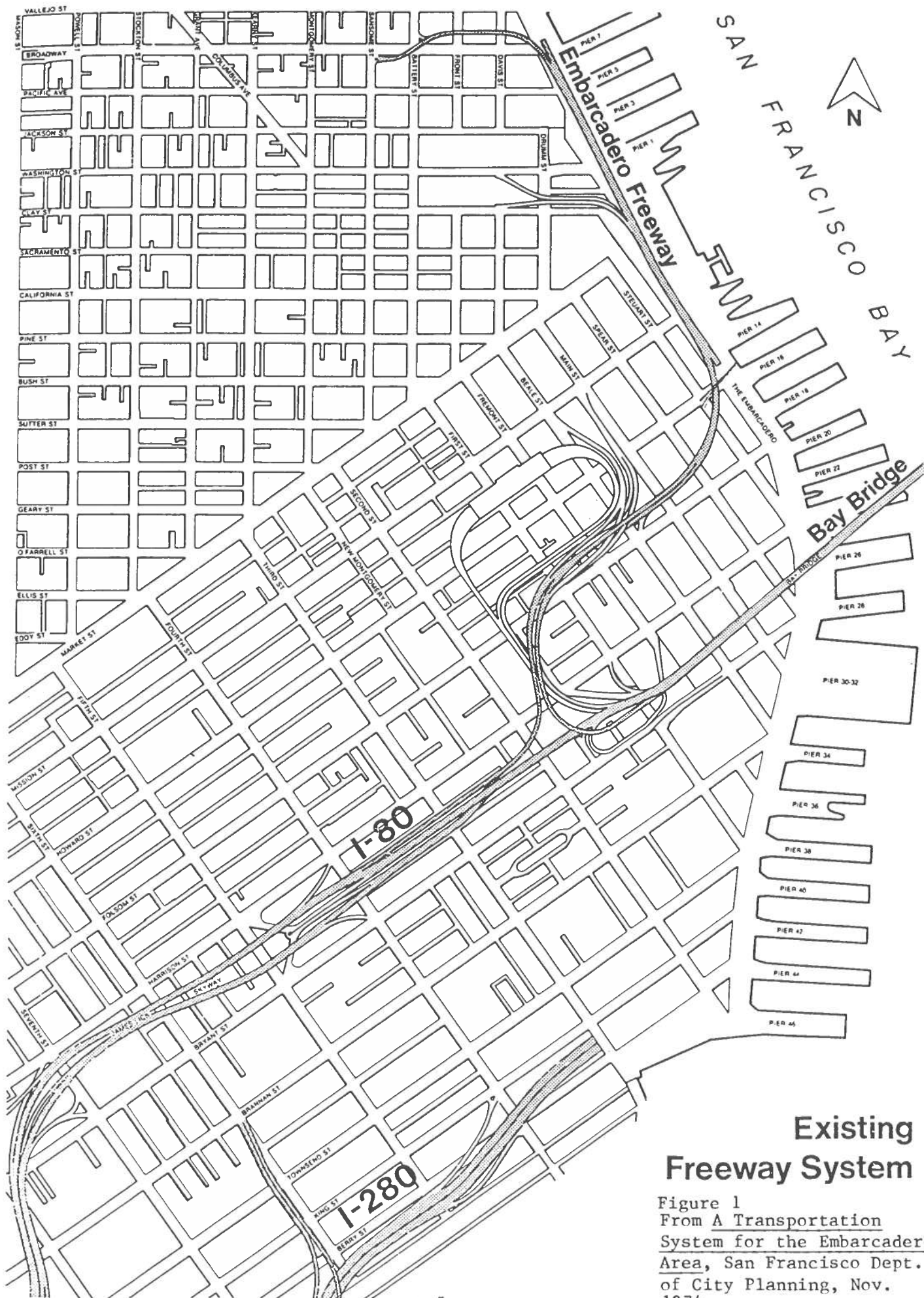
The Freeway begins with a delta junction from I-80 near the original end of the Bay Bridge, parts of which can still be seen buried within the new structure. It immediately goes into double-deck formation and effectively performs a U-turn to run in an ENE direction, parallel to the Bay Bridge, towards the waterfront. Arriving there at the intersection of Howard Street and the Embarcadero, the double-deck structure makes a right-angle turn to run NNW above the original Embarcadero roadway; here it meets an abandoned stub, designed as the connection to I-280. Passing over the original end of Market Street at the Ferry Building, now sealed by the Justin Herman Plaza, it gives off double-deck on-off ramps to Washington and Clay. Approximately one mile

north, it gives off similar ramps to Broadway. This however is the end of the freeway, since the proposed northward extension towards Fisherman's Wharf stands as another abandoned stub (Fig. 1).

Throughout its length, the Embarcadero is a four-lane structure with two lanes on each deck, apart from entry/exit lanes. The main part of the structure, from Howard Street to Broadway, is built to carry three lanes on each level, but one lane is effectively out of use in order to funnel flows on and off the two lanes in each direction on Broadway itself, at one end, and on the link structure to I-80, at the other.

During the freeway's construction, though the design of the Washington-Clay ramps was varied to accommodate the Golden Gateway Redevelopment Area, the double-deck structure became an increasingly anomalous eastern boundary to a prestigious business and residential district, including the Justin Herman Plaza and Park, which stand under the freeway's shadow, separated by it from the historic Ferry Building. By the mid-1970s, further, the Port had virtually abandoned the historic piers on the other side of the freeway, and the Port Commission had declared that the piers on either side of the Ferry Building were open for redevelopment and reuse.

As I-480, the Embarcadero is part of the Interstate Highway system. In 1973, an amendment to the Federal Highway Act, Title 23, authorized withdrawal of parts of the system that had never been constructed, and their substitution by other highway or transit projects. In 1980 the San Francisco Board of Supervisors adopted a resolution to withdraw the I-280--Embarcadero link and the Metropolitan Transportation Commission [MTC] agreed; a formal request by Mayor Feinstein and Governor Brown, submitted in December 1980, was approved by the U.S. Department of Transportation [DOT] in 1981; in 1983 came approval of the Transfer Concept Program, making about \$90 million [in then values] for



Existing Freeway System

Figure 1
From A Transportation
System for the Embarcadero
Area, San Francisco Dept.
of City Planning, Nov.
1974.

alternative projects in this corridor. This history is important, because--as will be seen in Chapter 4--it is possible but not certain that replacement of the Embarcadero may make use of these Federal funds.

3. THE 1974 REPLACEMENT PLAN

In 1973 the San Francisco Board of Supervisors passed a Resolution, 828-73, calling for demolition of the Embarcadero Freeway and extension of I-280, and calling upon the City's Department of City Planning to undertake a short-term study of alternatives to both projects. The resulting study, undertaken in consultation with CALTRANS, the MTC, and DOT, was published in Fall 1974.

It has two main sections: the first on the I-280 link, the second on the Embarcadero. Since the first was effectively accepted and the alternative ground-level roadway is at an advanced stage of design, it serves merely as background to the other.

The report concluded:

It is physically possible to demolish the Embarcadero Freeway and to accommodate its traffic function on an alternative roadway. There appears to be no more desirable place for the City to route the traffic carried by the existing freeway than in The Embarcadero right-of-way, where there is no cross-interference with the major Market Street and Mission Street transit routes ... the traffic can be accommodated as part of a general four-lane [two lanes in each direction] roadway along The Embarcadero with provision for an extra lane in each direction, functioning as on and off ramps, and limited access between the approach to the Bay Bridge and Clay/Washington Streets. Traffic could be subjected to some increased congestion during part of the peak periods; however, it is possible to ameliorate congestion problems through design details (San Francisco Department of City Planning 1974, 21).

The Replacement Highway

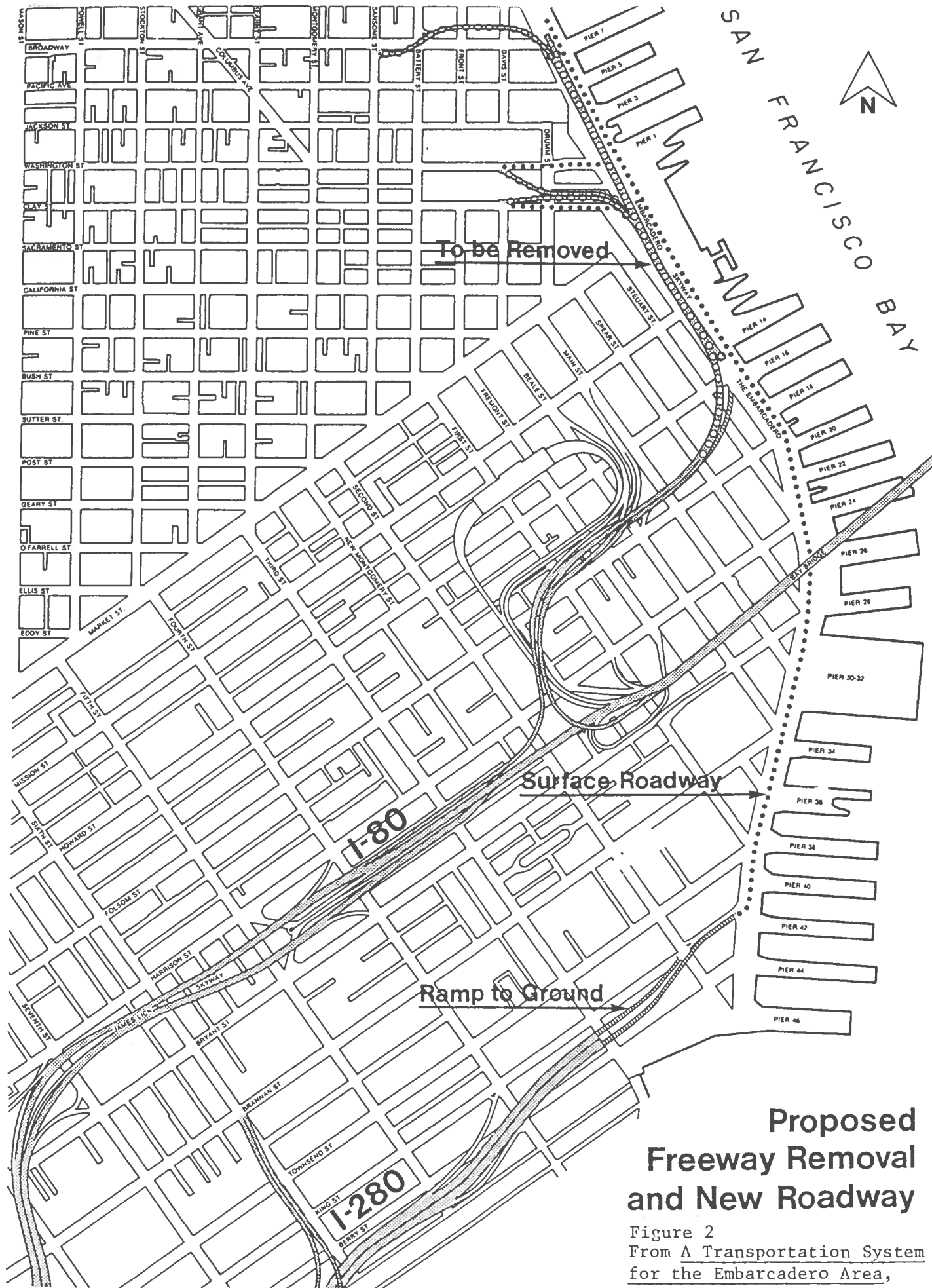
The alternative proposal called for removal of the Embarcadero from Beale Street to its present terminus at Broadway. The exit from I-80 would be brought down from east of the Main Street ramp to grade [street level] at the intersec-

tion of Howard Street and The Embarcadero. The alternative would be primarily a surface roadway, with four lanes--two in each direction--for most of its length, with auxiliary queuing lanes at signal-controlled intersections. There would be six lanes--three in each direction--between Howard Street and Washington Street; and the roadway would be depressed under the end of Market Street, with underground on and off ramps to Clay and Washington Streets (Figs. 2 and 3).

The design could provide for sidewalks and an exclusive bikeway, eligible for federal funding; and a new transit system could be incorporated, running from a terminal on King Street at Fourth Street, adjacent to the Caltrain commuter rail terminal, to Fisherman's Wharf and possibly onward to the Golden Gate National Recreational Area. The design would also need to allow for continuing operation of the existing freight rail tracks along the waterfront, and to leave space for apron working and loading areas in front of each of the piers, a considerable number of which were then in maritime use and were intended to remain so.

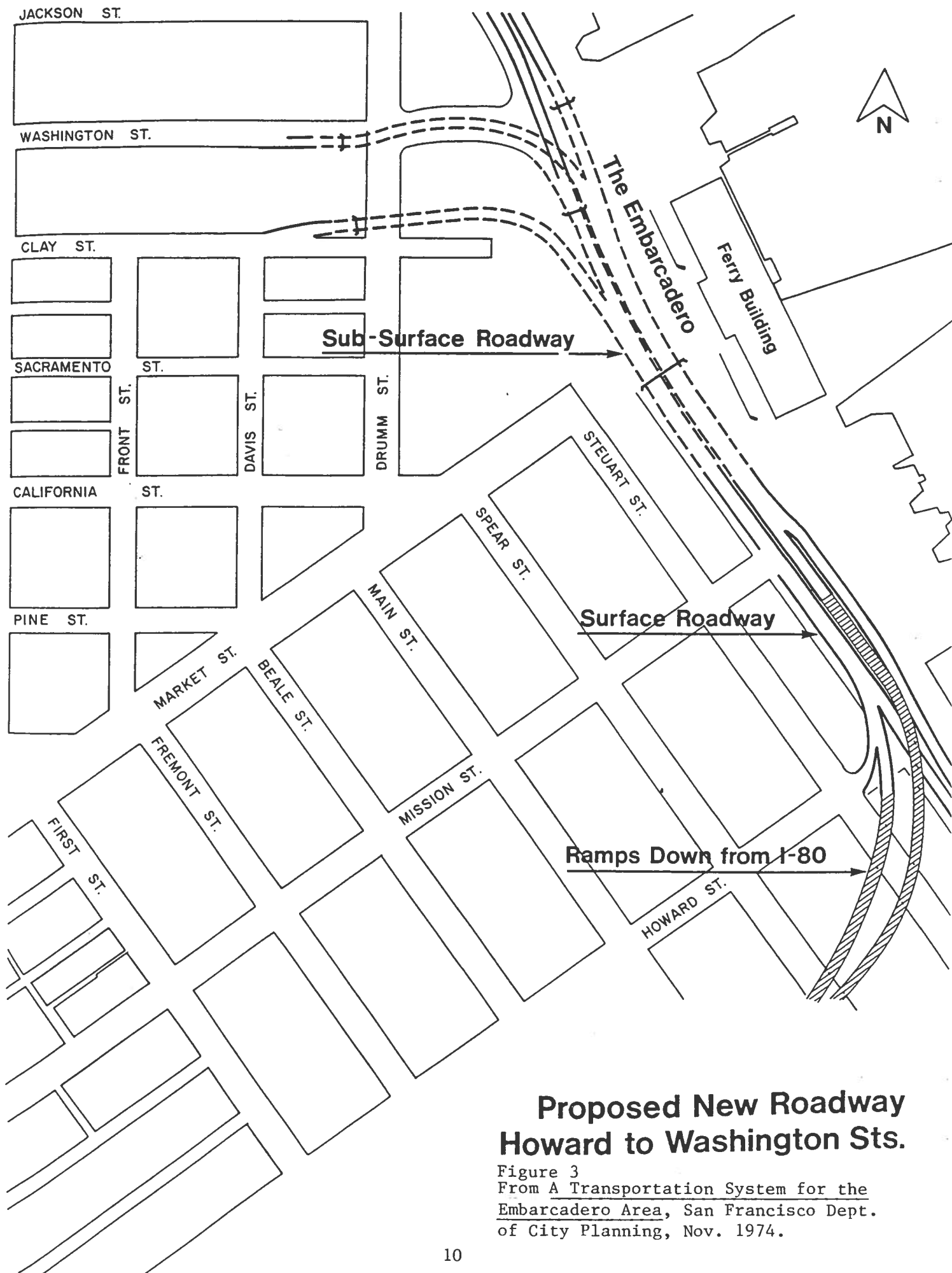
Costs and Timing

The cost of demolition of the existing Embarcadero structure was estimated by Caltrans at \$10-11 million at 1974 values; the cost of reconstructing the roadway from Howard to Washington was estimated to be between \$14 and \$17.3 million, depending on the length of the undergrounding of the Clay-Washington ramps, making a grand total for demolition and reconstruction of \$24-28.3 million in 1974 dollars. Using the Federal Highways Administration Composite Construction Cost Index as a deflator, this would give a 1988 value of \$19-21 million for the demolition and \$27-33 million for the reconstruction, a grand total of \$46-55 million.



Proposed Freeway Removal and New Roadway

Figure 2
From A Transportation System
for the Embarcadero Area,
San Francisco Dept. of City
Planning, Nov. 1974.



Proposed New Roadway Howard to Washington Sts.

Figure 3
From A Transportation System for the
Embarcadero Area, San Francisco Dept.
of City Planning, Nov. 1974.

The report gave a time schedule for the entire works. Removal of the structure would take an estimated 390 work days, during which the ramping down from The Embarcadero exit from east of the Main Street exit to the surface at Howard Street and The Embarcadero could be simultaneously undertaken. The depressed sections of the roadway could be constructed in another 900 days. The report concluded:

Taking into account weekends, holidays and periods of no construction during the rainy season, the time frame for demolition and reconstruction may be conservatively estimated as 5-1/2 to 6-1/2 years. There is expected to be major peak hour traffic congestion problems during much of the construction period, but at least two lanes in each direction would be maintained in service throughout that period (San Francisco Department of City Planning 1974, 24).

These timings, in retrospect, seem very attenuated. The 1984 report, to be reviewed in Chapter 4, gave total construction times varying from 3 to 3-1/2 years for operations of similar or greater complexity, involving the construction of new transit links. And, in circumstances very similar to those which attend the closure of the Embarcadero, Caltrans contractors demolished the damaged Cypress structure in Fall 1989 in a space of only about two months.

Benefits of Demolition

The report listed a large number of potential advantages of the proposed scheme. It would restore the historic relationship between Downtown, Market Street, and the Ferry Building. It would enhance public access to--and the visual quality of--the waterfront and the Justin Herman park. It would improve pedestrian access from Market Street, the Embarcadero transit and ferry transit interchange, and Justin Herman park. Some through traffic through North Beach, Broadway, and Telegraph Hill would re-route to the new direct waterfront route.

Noise would be reduced. The scheme would enhance Port revenues from development of the piers north and south of the Ferry Building, and release land under the Broadway ramp for development, thus improving City tax rolls.

No action was taken at the time, though the 1.4-mile I-280 connection was never completed and was finally abandoned; part of the existing I-280 structure, completed in 1974 but never opened to traffic, is due to be demolished as part of the Mission Bay redevelopment, cutting the on-off ramps back from Fourth to Sixth Streets. Assuming the Mission Bay development proceeds as planned--likely but not certain at the time of writing this paper--then a surface-level boulevard would run, roughly as proposed in the 1974 report, from Mission Bay to the Ferry Building.

Mayor Agnos Revives the Plan

It was the 1974 plan which was resuscitated and presented by Mayor Art Agnos to the February 1990 California Senate Hearing as an alternative to the reconstruction of the Embarcadero. It is this plan, therefore, that is now urgently under consideration. It is not however the only official alternative.

4. THE 1984 REPLACEMENT PLAN

Because the 1973 amendment to the Federal Highway Act specifically authorized withdrawal of unbuilt parts of the Interstate System and their substitution by other projects, work began on a Transfer Concept Program [TCP] for the missing I-280-Embarcadero link and the Embarcadero itself. The outcome was a Draft Environmental Impact Report, published jointly by Caltrans, the City and County of San Francisco, and the MTC, in 1984 (California Department of Transportation 1984).

The Eight Alternatives in the 1984 Study

The report covered the entire Embarcadero Corridor between the end of I-280 and Fort Mason. It incorporated not only alternative treatments of the Embarcadero Freeway, but also additional ramps to link I-280 to the surface street system, reconstruction of the Embarcadero surface roadway, a Muni Metro extension to the Caltrain depot, extension of the Caltrain service to downtown San Francisco, development of a new Muni E-line streetcar along the entire waterfront from Mission Bay to Fisherman's Wharf and beyond, parking provision, Transportation Systems Management (TSM), and other elements.

The report combines these elements in different ways into eight design alternatives, derived from a much longer list. Table 1 summarizes these elements and their combinations into each alternative. Alternative I is the Do-Nothing, status-quo option: it includes some minimal elements including TSM improvements; the other seven involve varying degrees of investment. Alternatives II and VI also involve keeping the freeway, but with other improvements.

Table 1

THE 1984 STUDY ALTERNATIVES

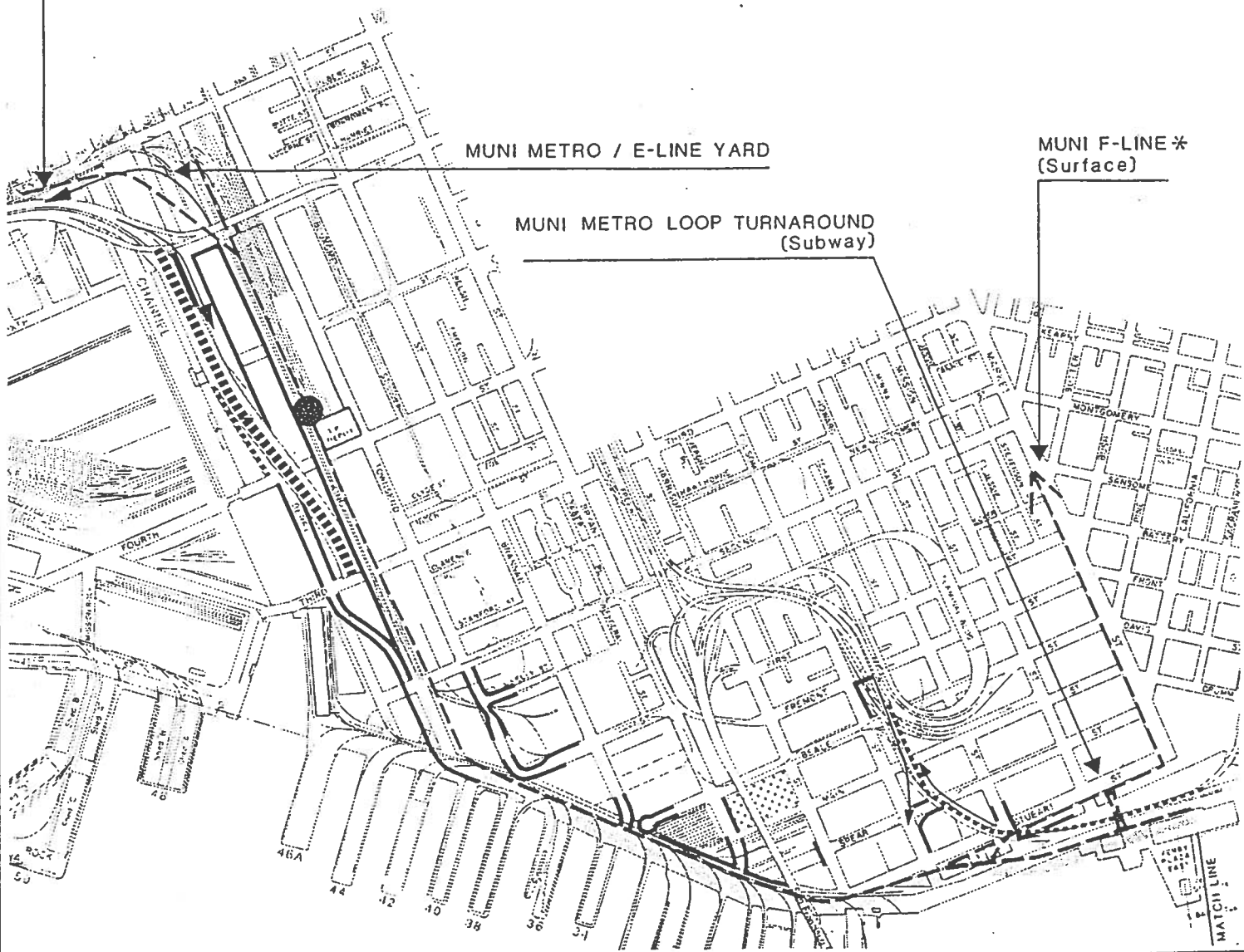
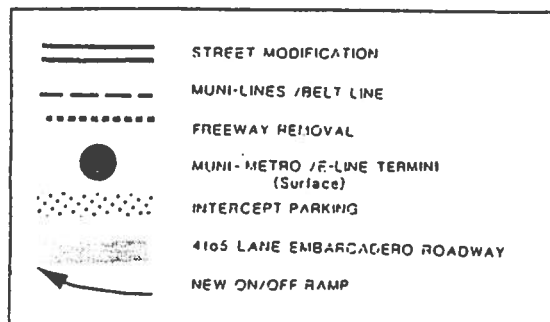
	Embarcadero Freeway	Embarcadero Roadway	I-280 Ramps	Muni Metro	Muni E-Line
I	[Do-Nothing Alternative: All Elements as Existing]				
II	Stays	4 Lanes	Stay	Turnback	Bus
III	Remove	4 Lanes	Stay	Turn+4th St	Rail
IV	Remove+Off-Rmp	4-6 Lanes	6th St	Loop+4th St	Rail
IV-A	Remove+On,Off	4-6 Lanes	6th St	Loop+4th St	Rail
V	Remove+On,Off	4-6 Lanes	6th St	+Caltrn Surfce	Rail
V-A	Remove+On,Off	4-6 Lanes	6th St	+Caltrn Subway	Rail
VI	Stays	4 Lanes	Stay	Turn/At Grde	Rail

Source: California Department of Transportation 1984, Table I-2.

Five others--III, IV, IV-A, V, and V-A--involve removal of the Embarcadero Freeway from Beale Street to Broadway, and its replacement by a new roadway at surface level. But only two of these--IV-A, V, and V-A--have both on- and off-ramps, permitting free movement in both directions between the existing I-80 connection and the new Embarcadero surface roadway. Most of the differences between these options concern the treatment of transit service between Mission Bay and Market Street, and do not substantially affect the analysis of the removal of the freeway. So, for simplicity, the following analysis refers only to Option IV-A, which--as will emerge--proves the most efficient of the freeway-removal options.

Option IV-A involves cutting I-280 back from Fourth Street to Berry and King streets near Sixth Street, from where a surface-level Embarcadero roadway would be built; it would vary in width from eight lanes near the I-280 ramps, through four lanes along most of its length, to five lanes (two northbound and three southbound) near Broadway. The Embarcadero Freeway would be removed, as already stated, from Beale Street to Broadway; there would be a new off-ramp exiting eastbound at Spear Street, and a new on-ramp extending from the intersection of the Embarcadero roadway with Howard Street (Fig. 4). The effect, as shown in Fig. 4, is that southbound traffic would have a free passage on to the on-ramp but that northbound traffic would exit from the I-80 link on to Spear Street, thence turning left through a signal-controlled intersection on to the Embarcadero roadway. Traffic in both directions to and from Washington and Clay Streets, and to and from Broadway, would turn through signal-controlled intersections. The option includes an extension of the Muni Metro from its present Embarcadero terminus to Mission Bay, via an underground turnaround loop east of the present terminus, thence emerging to surface to run as part of the roadway. Here, at

BELT LINE



ALTERNATIVE IVA

(See Figures III-13 and III-14 for enlargements of China Basin and Ferry Building Segments)

Figure 4, Part 1

From "I-280 Transfer Concept Program," Environmental Impact Report, September 1984.

* NOTE: PROPOSED F-LINE NOT PART OF I-280 TCP STUDY

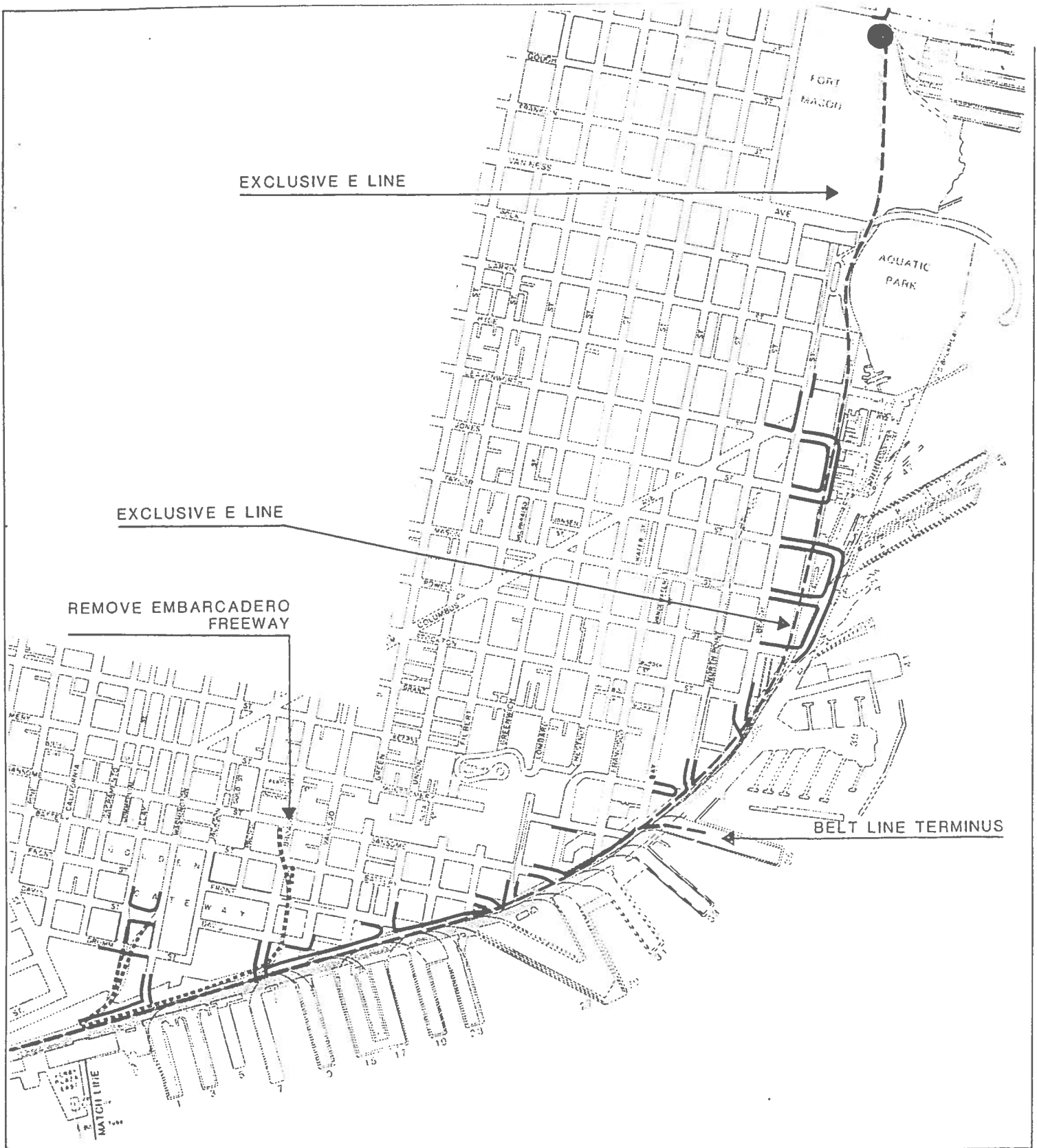


Figure 4, Part 2

From "I-280 Transfer Concept Program," Environmental Impact Report, September 1984.

SCALE 0 400 800 1600 FEET



III-12

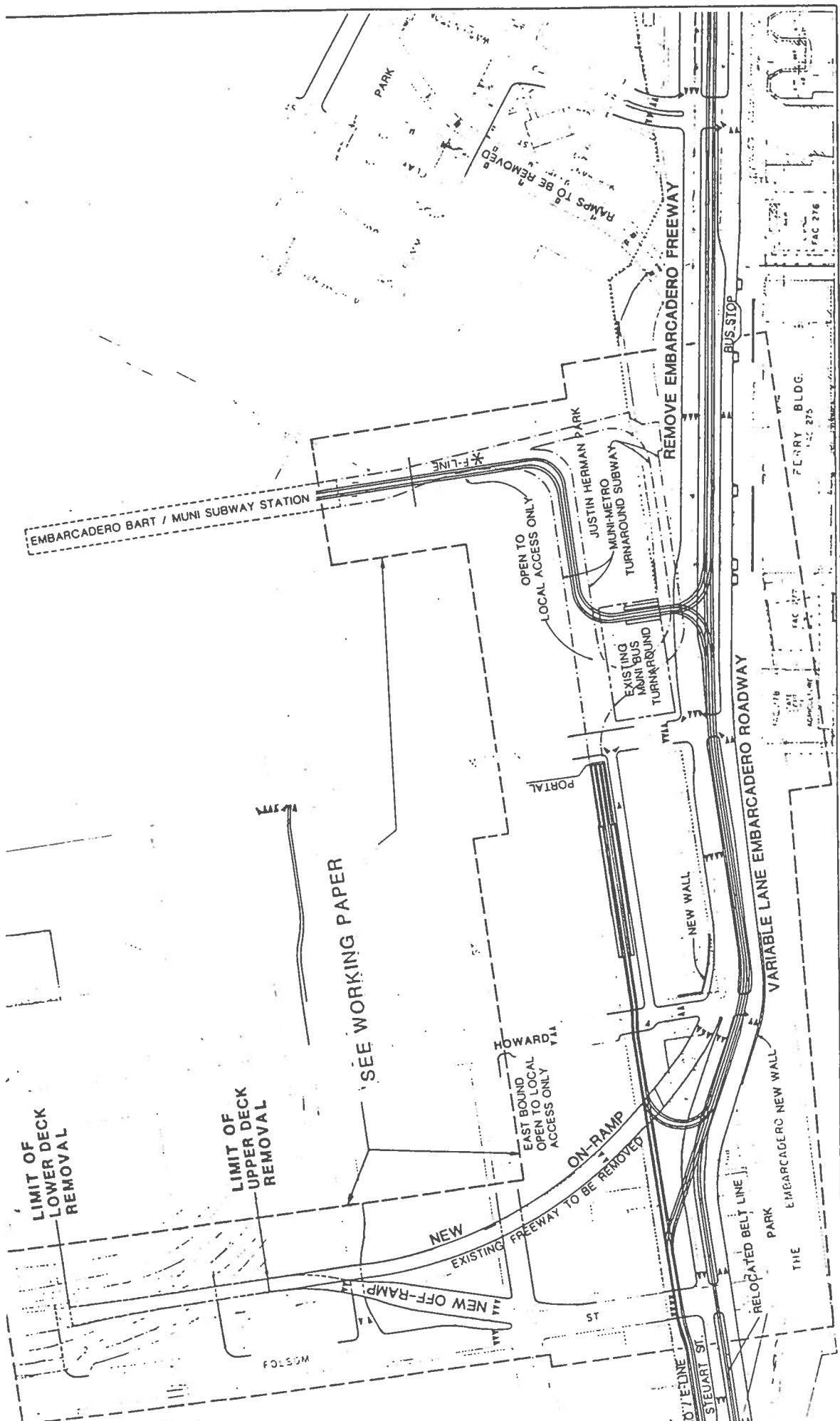
Howard Street, it would join the new E-line, which would run at surface level as part of the roadway all the way from Fort Mason, via Fisherman's Wharf, to Mission Bay. Further, this line would connect at the Ferry Building with the restored surface-level F-line service along Market Street.

At the Ferry Building, Option IV-A provides three alternatives for pedestrian access from Market Street and the Embarcadero transit terminus: at surface, via underground passage, and via above-ground bridge (Figs. 5 and 6).

Costs, Financing, and Timing

The alternatives have very different cost tags attached to them, which are summarized in Table 2. But it is important to notice that in large measure these result from treatment of the transit options, and from highway improvements [including additional intercept parking provision] outside the immediate Embarcadero Freeway/replacement roadway. The costs directly associated with the removal of the freeway, and its replacement, are set out in the left-hand columns. Alternative IV-A would cost \$20.5 million [in 1983 dollars] for removal, and another \$38.7 million for the replacement roadway, total \$59.2 million; it is the most expensive of all the alternatives in this regard, because it makes the most elaborate provision in terms of on-and off-ramps and lanes. Equivalent 1988 costs are \$25.8 million for removal, \$48.8 million for replacement, total \$74.6 million. The operating costs, in contrast, do not vary very greatly as between the options; most of the significant differences concern transit, not the Embarcadero Freeway/roadway.

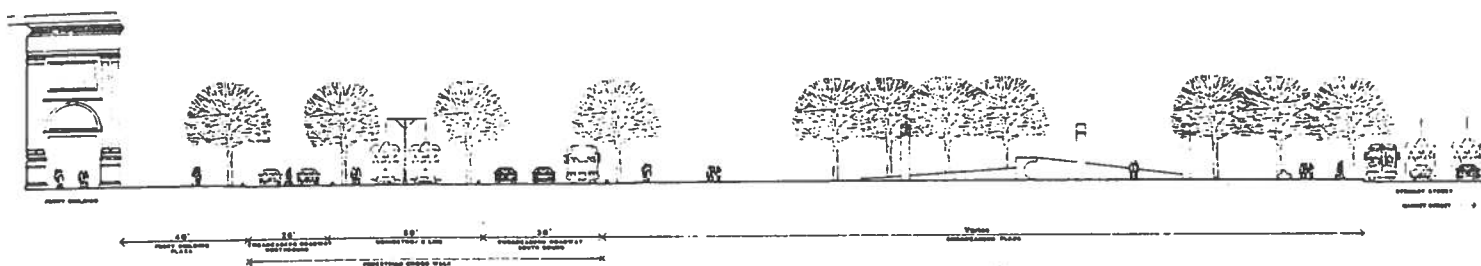
One critical question about the costs is who would pay for them. The answer, unfortunately, is unclear. In 1984, a federal fund of \$88.8 million



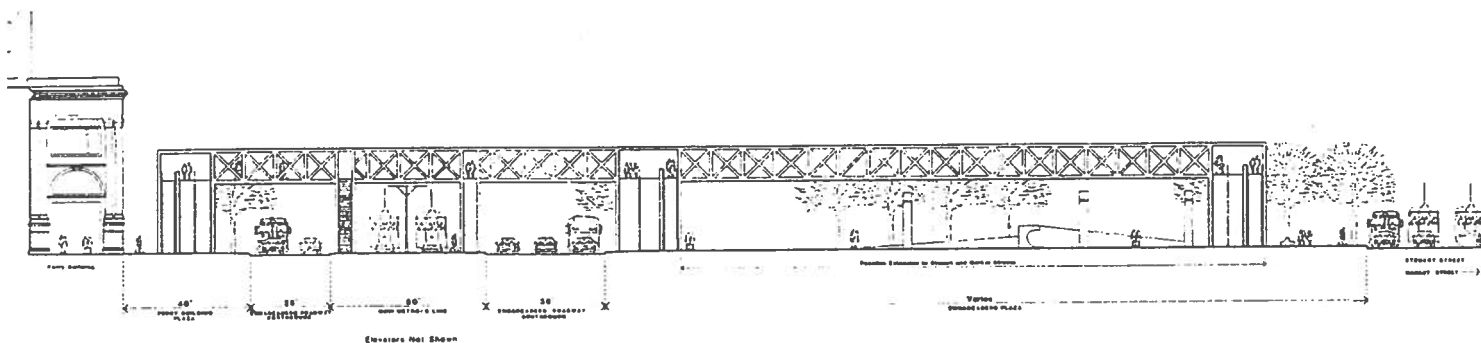
ALTERNATIVE IV-A: ENLARGEMENT OF FERRY BUILDING SEGMENT

Figure 5
From "I-280 Transfer Concept Program," Environmental Impact Report, September 1984.

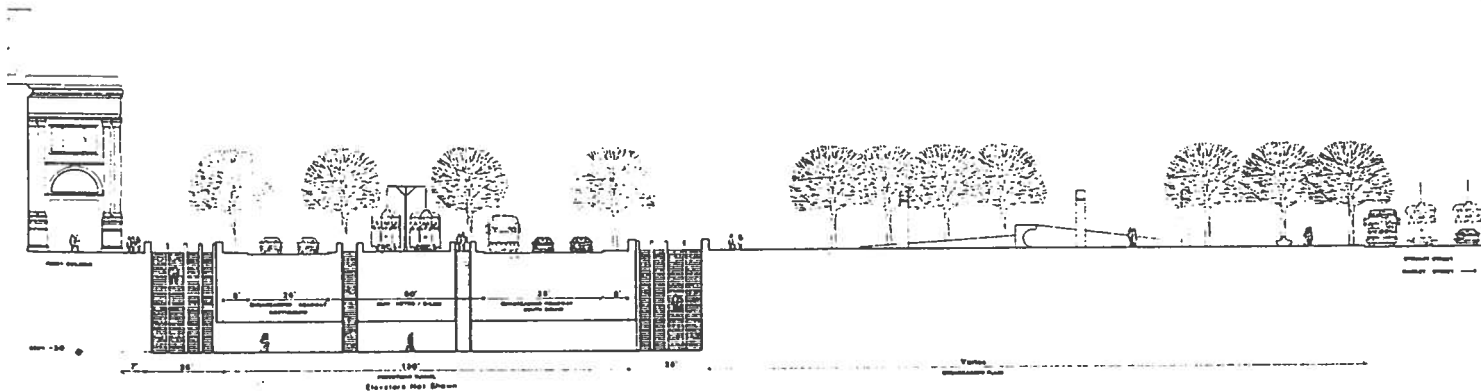
* NOTE: PROPOSED F-LINE NOT PART OF I-280 TCP STUDY



A. At-grade



B. Overcrossing



C. Undercrossing

FERRY BUILDING PEDESTRIAN ACCESS DESIGN OPTIONS

SCALE 0 10 20 60 FEET

Figure 6
From "I-280 Transfer Concept Program," Environmental Impact Report,
September 1984.

III-15

Table 2

THE 1984 STUDY ALTERNATIVES: COSTS

	Capital (\$ Million, 1983)				Operating/Maintce (\$ Million)			
	Embarcadero Fwy	Rdwy	Other Hwy	Transit	Embarcadero Fwy	Rdwy	Other Hwy	Transit
Now	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
I	0	0	0.6	3.6	0.1	0.1	0.1	1.0
II	0	31.7	14.8	35.1	0.1	0.2	0.6	4.0
III	8.9	25.3	48.6	96.1	0.0	0.2	1.6	6.9
IV	15.7	36.5	61.8	103.5	0.0	0.2	1.5	6.9
IV-A	20.5	38.7	65.3	94.3	0.0	0.2	1.5	7.0
V	20.4	24.2	52.5	267.8	0.0	0.2	1.5	5.2
V-A	20.4	24.5	53.5	425.7	0.0	0.2	1.5	5.2
VI	0	29.2	49.7	239.0	0.1	0.1	1.5	4.7

Source: California Department of Transportation 1984, Table I-2.

had been designated as the I-280 Transfer Concept Fund. Its release would be dependent on 15 percent local matching funds, which would bring it to \$104.5 million, but would in any event be at the discretion of the Secretary for Transportation. What is not certain is whether the funds could be applied to the removal of the Embarcadero. Preliminary discussion with the Federal Highway Administration and the Urban Mass Transit Administration indicated that they could not, unless it could be demonstrated "that the removal was a necessary incidental item related to an eligible highway or transit project."

The closure of the Embarcadero may of course have materially affected this position. Assuming that Transfer Concept Program funds could be applied to demolition and replacement, and also that there would be no Federal claw-back of funds for I-280 consequent on its cutting-back from Forth to Sixth Street, Table 3 summarizes the likely financial implications. None of the freeway-removal options could be completely covered by TCP funds; the remainder would need to come from a variety of other federal, state, and local sources, but the report suggests that additional federal funds from other budget headings are unlikely to be forthcoming in the short term. The unfunded needs range from \$28.5 million for Alternative III to \$63.5 million for Alternative V-A, all figures allowing for inflation at 8 percent per year (California Department of Transportation 1984, V-31-V-33 and VIII-31. The local matching funds required range from \$15.7 million for Alternative III to \$113.2 million for Alternative V-A, all figures again in inflated dollars.

There would of course also be losses during the construction period, some expressible in dollars, some not. The report states that "Construction activity ... would produce varying degrees of short-term inconvenience and disruption of local activities. Inconveniences would generally take the form of temporary restrictions of access, temporary land use changes, traffic delays, rerouting

Table 3

THE 1984 STUDY ALTERNATIVES:
FINANCIAL ASPECTS

	Transfer Concept Fund Shortfall	Remaining Highway Funds Required	Local Matching Funds Required
Now	Nil	Nil	Nil
I	Nil	Nil	Nil
II	0.3	0	15.7
III	144.5	28.5	36.5
IV	190.0	35.1	41.4
IV-A	189.3	37.0	40.6
V	426.6	62.6	86.2
V-A	529.1	63.5	113.2
VI	338.4	59.3	71.1

Source: California Department of Transportation 1984, Table VIII-2.

of transit service and pedestrians, and impacts on nearby areas from noise and dust generation" (California Department of Transportation 1984, V-110). During demolition, traffic would need to be diverted during work hours, but could otherwise be maintained; no one intersection or street would be interrupted for more than five or six days. Reconstruction of the Embarcadero surface road and associated street improvements would take up to three years; the touch-down ramps would take approximately 12-15 months, with work proceeding concurrently. All the demolition-and-replacement options would take between 38 and 42 months in all, and all involve periods of simultaneous construction for all the elements involved, concentrated in the first 12-18 months.

Transportation Benefits and Costs

The options however not only have different price tags; they bring different costs and benefits in terms of their projected performance, both for highway users and for transit passengers. These are summarized in Table 4. Of the five freeway-removal options, III through V-A, IV-A performs the best in terms of the critical measure of added person-hours of travel [only 4,200 in the Year 2000 PM peak] and second-best in terms of block-hours of queueing at congested intersections [75 in all]. It is one of a number of options that bring actual benefits to transit users because they embody generous transit-investment packages.

One particular point in this analysis, which is bound to receive special attention, is the effect of the schemes on traffic delays. Table 5 gives sample times for the evening peak hour in the Year 2000. It shows that many typical journeys would take slightly longer if the freeway were removed.

Table 4

THE 1984 STUDY ALTERNATIVES:

TRAFFIC IMPLICATIONS

	For Highway Users			For Transit Users	
	Added Person-Hrs Travel	Block Hours Queueing	Reduced Vehicle Miles	Added Person-Hrs Travel	Total Linked Trips
Now	Nil	20	Nil	Nil	15,000
I	2,400	55	Nil	1,500	24,600
II	1,900	49	400	500	28,600
III	5,400	139	14,800	1,900	45,100
IV	5,300	128	14,800	1,200	45,500
IV-A	4,200	75	14,800	-400	45,700
V	4,500	75	22,700	-800	51,100
V-A	4,600	68	25,900	-1,100	52,000
VI	2,400	47	11,900	-1,000	42,200

Source: California Department of Transportation 1984, Table I-2.

Table 5

THE 1984 STUDY ALTERNATIVES:
PM PEAK PERIOD HIGHWAY TRAVEL TIMES

Door-to-Door Times in Minutes

From To	Financial District Fisherman's Wharf	Fisherman's Wharf SP Depot	Financial District Oakland	Fisherman's Wharf Oakland	Financial District San Mateo
Now:	16	17	36	40	47
2000:					
I	17	17	37	41	48
II	18	19	37	42	48
III	18	26	39	49	50
IV	18	25	39	48	50
IV-A	18	26	40	44	49
V	18	26	37	44	49
V-A	18	25	40	44	49
VI	18	23	40	42	48

Source: California Department of Transportation 1984, Table E-6.

However, of the freeway-removal options, some options perform significantly better than others. Overall, IV-A emerges as perhaps the strongest of these options. Table 6 presents a different measure: the effect on the freeway system in the morning peak, when congestion on off-ramps may back up into the system itself. It shows, as would be expected, that all the freeway-removal options produce less capacity than retention. However, two of them, V and V-A, show a small surplus capacity overall, while IV and IV-A show only a small deficiency. The resulting congestion on I-80 would add one or two minutes of vehicle delay compared with Alternative I, the Do-Nothing option.

Based on these figures of costs and traffic consequences, the report goes on to evaluate the eight alternatives in great detail. One key cost-benefit measure is peak-period travel time through the corridor, expressed as equivalent annual cost per person-hour of travel time reduced. Alternative III proves the worst case here, because it removes the freeway without providing replacement ramps. In comparison, Alternatives I (Do-Minimum) and II, which also involves retention of the freeway, show savings, simply because they cost less. But Alternative IV-A proves to be the most efficient of the remaining options, followed in order by VI, V, IV, and V-A (Table 7).

The report also considers the efficiency of the alternatives in terms of transit service, expressed as equivalent annual cost per additional rider, projected for the year 2000. The standard of comparison here is Alternative I, the Do-Nothing option. Relative to it, Alternatives III, IV, and IV-A are almost equally efficient and are nearly 2.5 times more efficient than II or V; V-A and VI are the least efficient (Table 8). In addition to the cost-per-rider criterion, IV and IV-A have added efficiency because they include the Muni Metro subway turnaround loop at the Embarcadero terminus, which significantly improves the system's capacity and operational efficiency.

Table 6

THE 1984 STUDY ALTERNATIVES:
IMPACT ON FREEWAY SYSTEM

Year 2000 AM Peak Hour: Off-Ramps

	Bay Bridge Westbound	I-80 Eastbound	Overall
	Ramp Surplus/Deficiency		
I	+970	+220	+1,190
II	+970	+220	+1,190
III	-780	-880	-1,660
IV	+60	-100	-40
IV-A	+60	-100	-40
V	+60	0	+60
V-A	+60	0	+60
VI	+970	+220	+1,190

Source: California Department of Transportation 1984, Table V-10.

Table 7

THE 1984 STUDY ALTERNATIVES:
TRAVEL TIME REDUCTION EFFICIENCY (COST-EFFECTIVENESS)

Annual PM Peak Travel Hours, relative to Alternative III,
\$/person-hour:

Alternative	\$ Cost (Saving) per Person-Hour of Travel Time Reduced
I	(18.0)
II	(6.7)
III	Nil
IV	\$13.0
IV-A	\$3.1
V	\$12.6
V-A	\$20.6
VI	\$5.5

Source: California Department of Transportation 1984, Table I-4.

Table 8

THE 1984 STUDY ALTERNATIVES:
EQUIVALENT ANNUAL COST OF ADDING ANNUAL TRANSIT RIDERS

Relative to Alternative I, \$/additional rider

Alternative	Linked Transit (excluding duplication)
I	Nil
II	2.49
III	1.04
IV	1.08
IV-A	1.00
V	2.34
V-A	3.52
VI	3.41

Source: California Department of Transportation 1984, Table I-3.

Other Costs and Benefits

The report further goes into great detail on the environmental impacts of the options, including those that cannot be expressed in dollar terms or indeed in any quantitative terms at all. A selection of some of the most significant is set out in Table 9. It is clear that the impacts are quite complex, and that an alternative that functions well on one criterion may not function as well on another. Further, the impacts result from the combined effect of all the elements--including factors like extension of Caltrain service, outside the immediate freeway corridor. The table does not allow us to isolate the environmental consequences of the freeway demolition by itself, except in the case of the urban design considerations listed in the left-hand two columns. In terms of urban design, the freeway-demolition alternatives, especially IV-A, V, and V-A, score highest. IV and IV-A also give appreciable gains in developable land; the others result in losses. The demolition alternatives also show up well in terms of energy conservation, with V-A outstanding; but VI, which retains the freeway, also does well. All the freeway-demolition alternatives give benefits in noise reduction except V, which has both positive and negative impacts. III, IV, and IV-A also give a good balance between negative and positive impacts on historic resources, but for V and V-A this balance is negative. Overall, though it is difficult to summarize these very different measures, Alternative IV-A consistently does either outstandingly well or quite well on these design and environmental impact measures.

Table 9

THE 1984 STUDY ALTERNATIVES:
URBAN AND ENVIRONMENTAL IMPACTS

	Urban Design		Develop-	Energy:	Noise	Historical
	Embarcadero	Rdwy	able	Barrels		Resources:
	Fwy		Land	Oil		Neg/Pos
			000 sq ft	Saved		Impacts *
Now	Nil	Nil	Nil	Nil	Nil	Nil
I	0	0	Nil	Nil	0	0
II	0	+	-206	-980	0	0
III	+	++	-172	1,600	+	-4,+8
IV	+	++	705	2,100	+	-4,+8
IV-A	++	++	448	5,500	+	-4,+8
V	++	++	-545	8,900	+ & -	-7,+8
V-A	++	++	-445	11,800	+	-8,+8
VI	0	+	-633	4,500	-	-7,+3

Symbols: Performance Relative to Alternative I:

++ More Attractive
+ Somewhat More Attractive
0 About the Same
- Somewhat Less Attractive
-- Less Attractive

* Numbers affected: + positively; - negatively.

Source: California Department of Transportation 1984, Table I-2.

The Overall Assessment

Finally, the report sums up its entire analysis in terms of a Goals Achievement Analysis (Table 10). Alternative VI performs best on the critical consideration of transportation service, but performs poorly on urban design, environmental, cost, and financial aspects. Alternatives II, IV-A, V, and V-A also perform well for transportation service and do better on other aspects; in particular, IV-A does best on urban design and land use considerations, joint best on environmental considerations, cost, and equity considerations. It performs negatively only on financial feasibility, though less so than V and V-A; none of the freeway-demolition options perform positively on this criterion.

Overall, though the report does not state this conclusion explicitly, it is difficult to avoid the conclusion that--apart from the critical consideration of financial feasibility--Alternative IV-A emerges as overall the best, and certainly the best of the freeway-demolition options.

The 1984 analysis is the most complete analysis yet made of the results of demolishing the Embarcadero. It is vitiated by only one fact: that it nowhere considers the specific option proposed in the 1974 report, which included full free-flow ramping from the I-80 connector to the Embarcadero, and free-flow underground ramps at Washington and Clay Streets. This is unfortunate: first, because this latter is the option now under consideration; secondly, because it is almost self-evidently more efficient in handling the Embarcadero traffic flows than even the most elaborate options--specifically, IV-A--considered in 1984. In the following chapter, we discuss the implications of this failure.

Table 10

THE 1984 STUDY ALTERNATIVES:
GOALS ACHIEVEMENT ANALYSIS SUMMARY

	Transp'tn Service	Urban Design/ Land Use	Envl	Cost/ Cost Effectv's	Final Feasi- bility	Equity	Economic & Social Factors*
I	0	F-1	0	0	0	0	0
II	+	A-5	0	+	++	+	0
III	-	A-3	+	--	-	++	+
IV	0	A-2	++	0	-	++	+
IV-A	+	A-1	++	+	-	++	+
V	+	F-2	-	-	--	+	++
V-A	+	A-4	-	-	--	++	++
VI	++	F-3	--	-	--	+	+

* Numbers involved

Symbols: Performance Relative to Alternative I:

++ More Attractive
+ Somewhat More Attractive
0 About the Same
- Somewhat Less Attractive
-- Less Attractive

Urban Design Ranking System:

Positive Impacts A-1 BEST
A-5
Negative Impacts F-1
F-5 WORST

Source: California Department of Transportation 1984, Table I-1.

5. SUMMING UP

This concluding chapter first briefly summarizes the evidence, and then tries to suggest a way to balance the complex factors that must go into the critical decision: whether or not to tear down the Embarcadero.

Summarizing the Evidence

There have been two major official studies of the removal of the Embarcadero in the last twenty years: one by the San Francisco City Planning Department in 1974, one by Caltrans in association with the City and Metropolitan Transportation Commission (MTC) in 1984. Both have concluded that removal and replacement of the freeway would be physically feasible. Both have costed the operation. Both have considered the impact on traffic and transportation, the second (1984) in great detail. That same 1984 report has also considered a wide variety of other impacts, and has tried to reach an overall appraisal of a number of alternative treatments.

The 1974 report proposed a four-lane roadway along the Embarcadero with provision for an extra lane in each direction, functioning as on- and off-ramps, and limited access between the ramps from the Bay Bridge and Clay/Washington Streets; the road would be depressed under the end of Market Street, with underground on- and off-ramps to Clay and Washington. The roadway would effectively offer near-freeway standards to this point, and good quality arterial standards onward to Fisherman's Wharf. A new transit system could be incorporated. The cost was estimated at \$24-28.3 million at 1974 values or \$46-55 million at 1988 values. The operation was estimated to take 5-1/2 to 6-1/2 years, a time that seems extended in the light of subsequent estimates and

actual experience with demolition of the Cypress structure in Oakland. The report cited a large number of civic design and environmental benefits that would result.

The 1984 study incorporated no less than eight options, ranging from Do-Nothing to demolition and construction of a new surface-level roadway. For reasons that are not clear, it failed to include the specific proposal in the 1974 report among these eight options. This is unfortunate, because the 1974 proposal for a ground-level plus underground roadway--with complete free-flow ramps at Howard Street and at Washington/Clay Streets--would almost certainly have performed better in traffic terms than any of the options in the 1984 study. It is also the option which Mayor Art Agnos produced at the February 1990 hearings, and which is now under consideration by the City.

Among the options considered in 1984, there was no clear outright winner: some performed better on traffic grounds, others on design and environmental grounds. But one option, IV-A, consistently scored at or near the top on nearly every basis except cost. It was one of five options that called for removal of the freeway. It would replace it with a surface-level roadway with between four and six lanes, with on- and off-ramps connecting to the Bay Bridge: one of these, the off-ramp from I-80, would not however give free-flow access on to the roadway but would require a signal-controlled turn on to it. It would incorporate a new E-Line Muni rail service and an extension of Muni Metro from the present Embarcadero terminus to Mission Bay.

Because Option IV-A was the most elaborate in traffic terms, it was also the costliest in highway capital expenditure; its operating costs were however not notably higher than those of other options. But it was not by any means the costliest in its requirement for highway funds, so long as Transfer Concept funds could be drawn from the Interstate Program to help pay for it. It would not

perform as well in traffic terms as the freeway: it would bring marginal increases in peak-hour journey times and additional times spent queueing at inter-sections, but it was the most satisfactory of the freeway-removal options in this regard. When traffic efficiency was compared with cost in a cost-effectiveness calculation, it performed satisfactorily. It also gave an exceptionally high level of urban design and environmental benefits; and it performed best, on balance, of all the options in an overall goals-achievement analysis.

So, despite the obvious difficulty, some way needs to be found to bring this option into comparison with the 1974 proposal.

Comparing Costs

There is the additional complication that, produced as they were by a different agency, the 1974 cost figures are not directly comparable with the 1984 ones. But, insofar as the 1984 figures were produced by Caltrans and the 1974 figures in consultation with the same agency, a tentative comparison can be made. This is set out in Table 11.

Table 11 also includes the latest estimates for full strengthening of the Embarcadero Freeway, reduced to the same 1988 dollar basis. But these also present problems, because there are two very different estimates: one from Caltrans, of \$10-15 million (1990 values) for strengthening to reopen the roadway; another from T.Y. Lin International of San Francisco, the engineering consultants hired by Caltrans, who recommend an additional \$50 million be spent on a combination of steel I-beam splints and steel-plate jackets on all 120 columns along the length from Howard Street to Broadway. In Table 11, these have been deflated to 1988 values by using the FHA average cost index change from 1983 to 1988, the latest figure available.

Table 11

THE 1974, 1984, and 1990 PROPOSALS: COSTS

	\$ Million, 1988 Values		
	1974 Proposal	1984 Option IV-A	1990 Strengthen
Freeway Removal	19.3-21.2	25.8	
Replacement Roadway	27.0-33.4	48.8	
Total	46.3-54.6	74.6	
Freeway Strengthening:			
Interim			9.0-13.4
Eventual			58.2?

Source: 1974 and 1984 reports; inflated by Federal Highway Administration Composite Cost Index; San Francisco Examiner, January 8, 1990.

Table 11 highlights the unique difficulty of the choice now facing San Francisco's elected officials, for it presents a classic problem of decision-making in uncertainty. Almost the only reasonably safe figures in the table are the 1984 costs. The 1974 figures are suspect because they are difficult to reconcile with the 1984 ones: it is obviously strange that an apparently superior solution appears to cost less than a simpler one. Part of the explanation may be that the 1984 scheme also makes specific provision for rapid transit facilities which, though costed separately, may make construction of the roadway more expensive. Since this investment is firmly proposed for sometime in the 1990s, and funds are likely to be available for it, a large part of the cost of the "replacement" roadway is likely to be incurred come what may. Equally, the 1990 estimates for making the freeway safe vary very widely, dependent on whether one accepts the immediate Caltrans figures or the long-term estimates.

Reaching a Resolution

Given these huge uncertainties, and the need to reach a firm decision in a very constrained time-frame, the city might do well to start from a series of propositions.

1. If demolition/replacement costs no more than satisfactory strengthening, and performs as effectively as the freeway, then the freeway should be demolished.

2. If it costs more, and if again it performs as effectively, the question is how much the community is willing to pay in dollars for a gain in tax rolls which can be measured in dollars, and for a gain in amenity which can not.

3. If it costs more, and in addition performs less effectively, the question is how much the community is willing to pay in dollars and lost time for these same qualities.

The first essential, it seems clear, is to establish the true cost of adequate long-term strengthening of the structure. If it is really of the order of \$60 million, then the comparison is a very close one. By demolishing the structure, the community would pay a small cost penalty--at most \$16 million, most or all of which would probably need to be paid in any event as part of the reconstruction of the waterfront for transit.

By adopting the 1984 option IV-A, it would also incur some peak-hour time penalties. These are marginal, and are certainly not of an order that is likely to deter visitors or cause business losses. The congestion on the streets in early 1990 and its effect on San Francisco businesses, it needs stressing, arise from the unique circumstance of closure of the Embarcadero without any readily accessible alternative. That would not occur with any long-term solution.

By adopting the 1974 plan (the "Agnes Plan"), the San Francisco community could avoid most or all of these time penalties, but almost certainly at some additional money cost. This plan should perform almost as satisfactorily in terms of traffic flow as the freeway. It is even likely, but not certain, that it could bring actual improvements in highway accessibility (gains in time) to Fisherman's Wharf, which would have far better direct access from the Embarcadero and Financial District than it now enjoys. In addition, the transit improvements would also bring better accessibility to that area, though these will probably occur in any event.

Admittedly, for both options there would be intermediate costs during the demolition and construction period. How serious these would be would depend

both on the overall construction time and on its phasing. The overall period would almost certainly be much less than the 5-1/2 to 6-1/2 years suggested in the 1974 report, and is more likely to be 3 to 3-1/2 years suggested in the 1984 study. As to phasing, if the freeway were demolished within a few months, as Caltrans achieved with the Cypress structure, and if temporary ramps for car traffic could be provided while construction of the permanent on- and off-ramps took place, then both the 1974 and 1984 reports suggest that a reasonable traffic flow could be maintained during the construction period, especially at nights and weekends.

Not all the costs of these options would necessarily fall on the city or on the state. Some, as suggested in the 1984 study, might be financed under the Interstate Transfer Concept Program. This is the final element of uncertainty. But in the light of the earthquake and the certain need for strengthening, use of these funds appears more feasible than it did in 1984.

In return for demolition, whichever option were chosen, the city would gain some significant increases in tax rolls on top-quality real estate along the waterfront. It would also gain in urban design and environmental quality, on which no dollar value can be set; it must be a matter of individual judgment. But, insofar as visitors to the city are attracted by its unique ambience, it should not be regarded as purely a matter of sentiment.

The answer to the question, Should we Tear the Embarcadero Down?, is still not completely clear or unambiguous. But, since the earthquake, the balance of the answer looks very different than in 1987, when San Francisco voters rejected a proposition to demolish the structure. Whatever the answer, this is probably San Francisco's last chance to give it for the next fifty years--or until the really big earthquake, whichever is sooner.

REFERENCES

California Department of Transportation, City and County of San Francisco,
Metropolitan Transportation Commission (1984) I-280 Transfer Concept
Program: Environmental Impact Report. San Francisco: City and County of
San Francisco.

San Francisco Department of City Planning (1974) A Transportation System for
the Embarcadero Area. San Francisco: Department of City Planning.