A PRELIMINARY DISCUSSION OF POSSIBLE OPTIONS FOR USE OF THE BUNKER HILL TRANSIT TUNNEL

Prepared for:
City of Los Angeles Department of Transportation
Los Angeles Community Redevelopment Agency

Prepared by the Joint Venture of:
Schimpeler•Corradino Associates / Delon Hampton & Associates

In Association with:
Myra L. Frank & Associates / KDG Development and Consulting

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INTRODUCTION

BUNKER HILL TRANSIT TUNNEL STUDY AND THIS "WHITE PAPER"

The City of Los Angeles is reviewing opportunities for fully utilizing the Bunker Hill Transit Tunnel (BHTT). The BHTT consists of easements and actual tunnel segments that bisect some of the most attractive office, retail, residential and entertainment-related space in downtown Los Angeles (Figure 1). In view of the intensity of existing and future development in downtown, and the corresponding demand for transportation generated by that development, the BHTT is potentially a highly valuable element of the transportation infrastructure serving the area. The current BHTT Study is designed to consider ways to effectively use this untapped resource.

This white paper, and the more extensive report it summarizes, represent the completion of the first phase or milestone of the four-phase study. The phases are described as follows:

- **PHASE 1: White Paper** -- Identify, on a preliminary basis and in broad terms, potentially attractive and feasible opportunities, along with the issues and constraints associated with uses for the BHTT. The paper is to serve as a springboard for discussion among local public and private sector decision-makers, and other parties potentially key to the implementation feasibility of any resulting plan for the BHTT.

- **PHASE 2: First-Level Screening of Generalized Scenarios** -- Compare up to six scenarios for use of the BHTT, in terms of physical feasibility, patronage (in orders of magnitude), connectivity to existing and planned transportation facilities, and consistency with City goals and policies. Select specific alternatives to explore further.

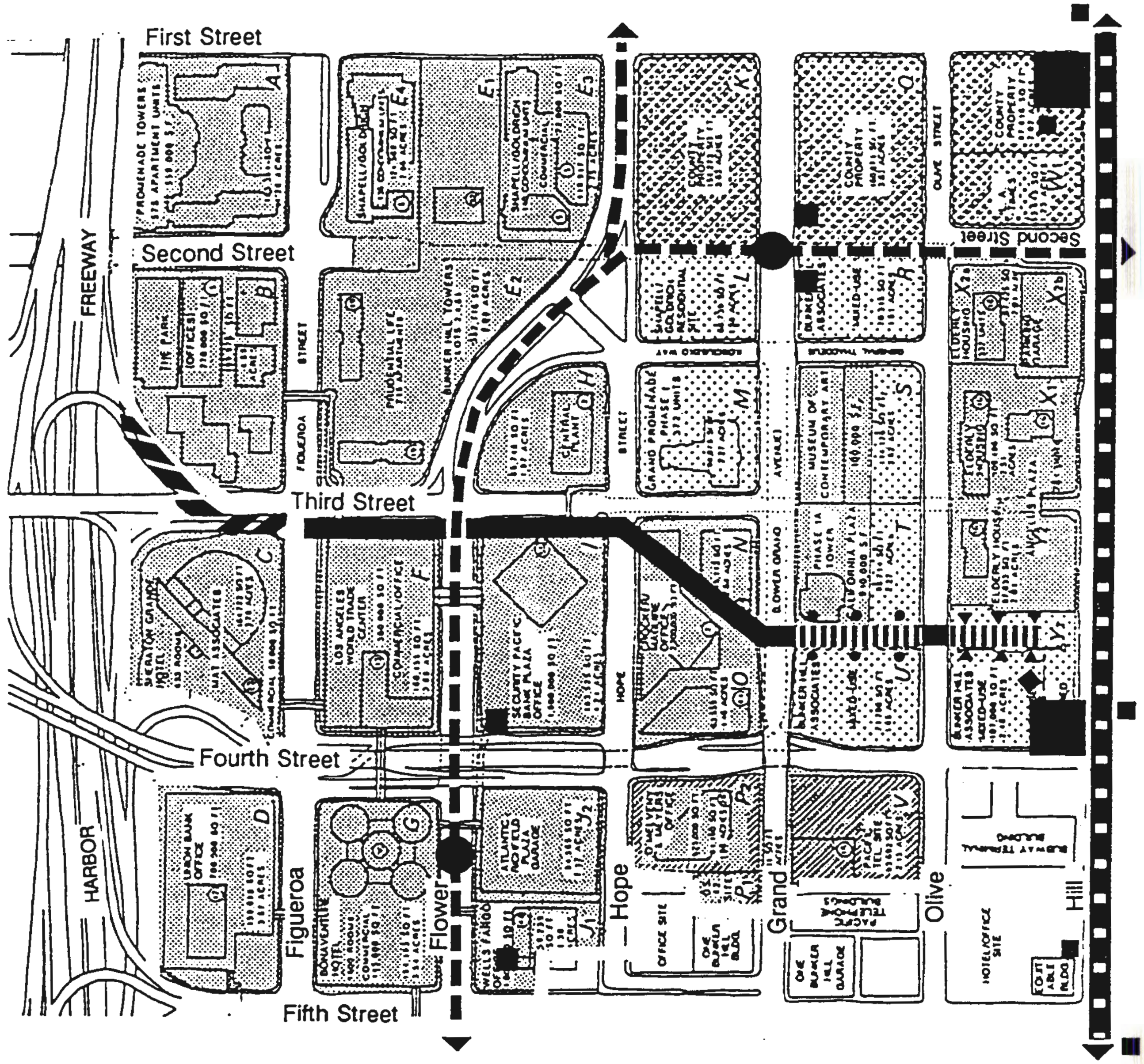
- **PHASE 3: Second-Level Screening of Specific Alternatives** -- Compare specific alternatives in terms of patronage (detailed modeling), environmental concerns, cost and cost-benefit, the ability to be financed, institutional arrangements, and implementation strategies. Formulate recommendations.

- **PHASE 4: Disseminate Study Findings** -- Prepare a written report, and make verbal presentations of the study findings.

Public input is sought at each phase of the study.

CURRENT DOWNTOWN DECISION-MAKING CONTEXT

Downtown Los Angeles is in a period of perhaps unprecedented volatility; the term "renaissance" is often applied. Its form is rapidly being redefined through a series of decisions regarding large transportation and land use investments.



Easement for Right-of-Way	Light Rail Alignment Under Study
Reserved Tunnel Easement	Metro Rail
Tunnel Under Construction	Metro Rail Station
Tunnel or Deck Related Construction Completed	Portal
Tunnel to be Constructed	LRT Station

Figure WP-1

Bunker Hill Area and Tunnel

The Land Use Context

The downtown Los Angeles skyline is literally changing daily. Seven million square feet of office space are currently under construction in the core area. In the Bunker Hill, Central Business District (CBD), and Little Tokyo redevelopment areas, 38 million square feet of new development is projected to occur over the next 10 to 15 years. Los Angeles has overtaken San Francisco as the financial center of the western United States, and as the gateway to the Pacific Rim.

In Central City West, just west of the Harbor Freeway, a proposal for building up to 25 million square feet of commercial development, plus up to 12,000 dwelling units, would bring that area to a density comparable to that of the CBD proper. To the north and east, futures for City North and the Alameda Corridor are under study, amid considerable private sector investment activity. To the south, the mixed-use South Park area is planned eventually to include up to 15,000 dwelling units and about 10 million square feet of commercial space. Further south, development stretching down the Figueroa Street corridor will ultimately link downtown to the University of Southern California (USC)/Coliseum area and beyond.

Downtown is home to multi-billion dollar retail and wholesale trades in jewelry, apparel, and produce. The approximately 42,000 Federal, State, and local government employees in the Civic Center area represent one of the largest concentrations of public employees west of the Mississippi.

Several major activity centers in downtown are currently undergoing development. The Convention Center has just broken ground on a $390 million expansion from 28 to 63 acres, including a 350,000 square foot exhibition hall. The 63-year-old Los Angeles Central Library is in the midst of a complete rehabilitation and expansion. And the proposed 2,500-seat Walt Disney Concert Hall would join with the 6,000 seats of the three major performance areas of the Music Center across the street, to create a world-class performing arts complex.

The Transportation Context

Figure 2 illustrates major existing and planned transportation facilities in the region (Los Angeles County) and downtown. Two new regional facilities are already under construction in downtown: the heavy rail transit (HRT) Metro Red Line, initially running from Union Station to Wilshire at Alvarado, with a second-phase extension to North Hollywood; and the light rail transit (LRT) Metro Blue Line from Long Beach to Seventh and Flower Streets in downtown L. A. The existing El Monte Busway will soon be extended into Union Station, with buses ultimately feeding in to Metro Rail rather than continuing downtown.

Two other regional fixed-guideway facilities related to downtown are also under construction: a light rail line and high-occupancy vehicle (HOV) lanes in the median of the Century Freeway; and the 20-mile Harbor Freeway Transitway. In addition, a number of other potential regional transportation facilities directly affecting downtown are under study. Decisions on the alignment of the light rail extension to Pasadena will be made within the next three months. Other facilities being discussed for future implementation include:

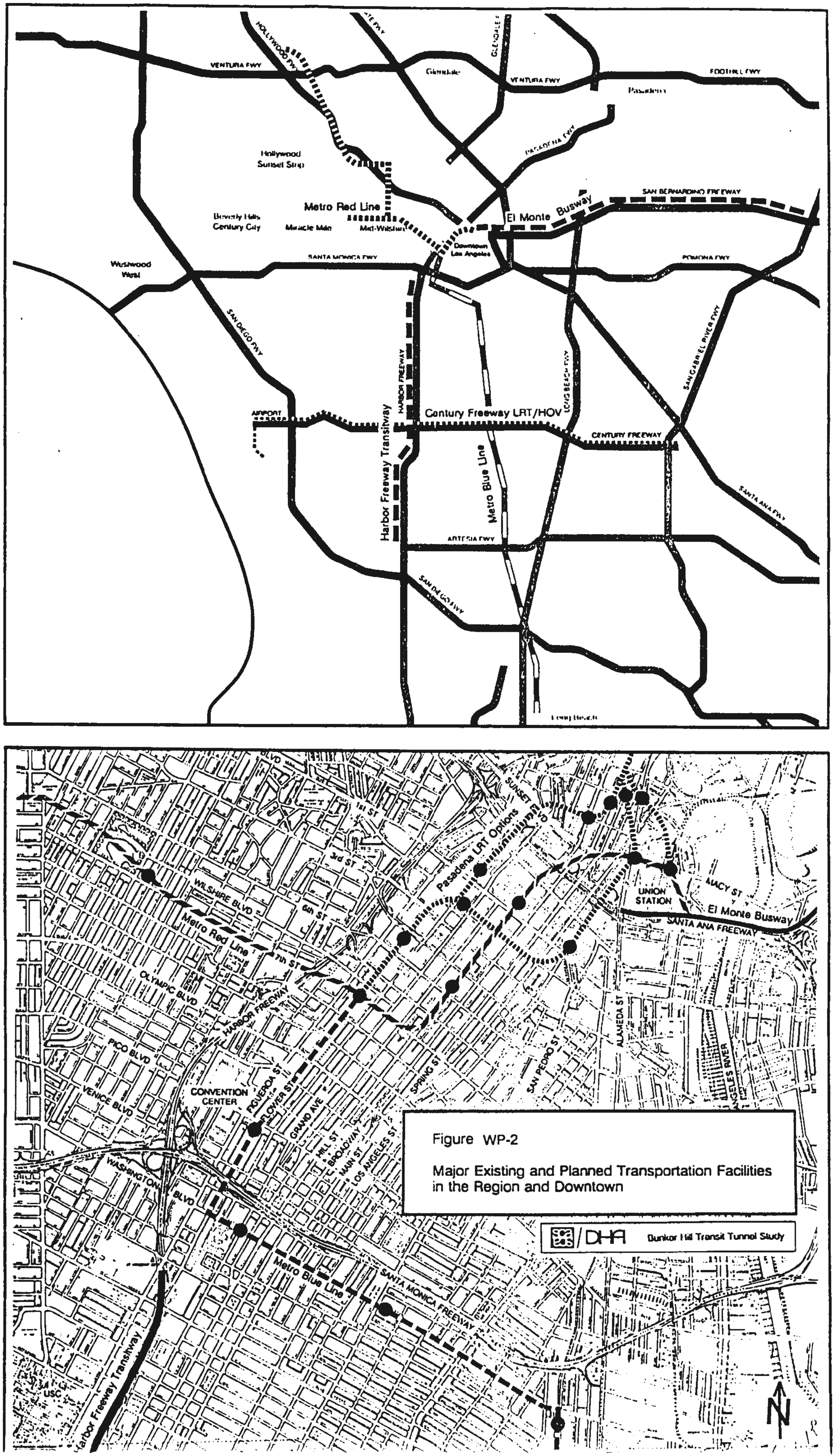


Figure WP-2

Major Existing and Planned Transportation Facilities in the Region and Downtown

- the eastern extension of Metro Rail into the Santa Ana Corridor;
- western extensions of Metro Rail to Santa Monica and through the San Fernando Valley;
- extended and new transitways along the Harbor Freeway, Bixel Street, and Glendale Boulevard, creating a continuous north-south corridor from the Artesia (91) Freeway to the City of Glendale;
- a transitway down the concrete-lined bed of the Los Angeles River from the San Fernando Valley to Union Station; and
- new and expanded commuter rail service between Union Station and San Bernardino, Ventura, and Orange/San Diego Counties.

The considerable investment in fixed-guideway transit facilities represents one form of transportation policy for downtown. Other, more intangible policies are also part of the transportation context. These policies include:

- the peripheral parking program of the Community Redevelopment Agency, which mandates, for new developments within the most congested zone of downtown, substituting a portion of code-required on-site parking with parking in specially-designated areas on the periphery of downtown; and
- Regulation XV of the Air Quality Management District, which requires medium and large downtown employers to develop plans for achieving an average occupancy of 1.75 persons per vehicle for peak period commute trips.

Downtown Transportation Issues

With the land use and transportation activities sketched above, Los Angeles is being transformed into what is by nearly any standard a world-class city. However, the new downtown will retain and create some transportation problems that are not fully addressed by the facilities currently existing and under consideration.

The two rail lines being built will function as a regional transportation system bringing trips into downtown, but will be of limited value for serving mid-day circulation within downtown. The two lines have a pronounced north - south orientation; east - west linkages are needed to balance the system. The two lines meet at only one point (Seventh and Flower); it is desirable to increase the connectivity of the rail system. Union Station will become a major interceptor for downtown-oriented trips, with the single Metro Red Line potentially the only fixed-guideway distribution mechanism within downtown.

Finally, there are some notable gaps in the fixed-guideway transportation system that is emerging for downtown -- that is, there are a number of activity areas not well-served by existing and proposed facilities. Equity issues are raised by a multi-billion dollar rail system that almost exclusively serves the white-collar employment base on the north and west sides of downtown. In downtown itself, un- or under-served areas include Little Tokyo and the

eastern half of the Civic Center area, the southern half of the Broadway/Spring Theater District, the 55,000 employees of the Eastside Industrial Area, and the eastern half of South Park. There are other potentially underserved sectors in the greater downtown area. The BHTT, with its east - west alignment through high-density development, may be a building block in an integrated, systemic solution to some of these problems.

DEVELOPMENT OF THE BUNKER HILL TRANSIT TUNNEL

Initial Impetus – Peripheral Parking for Bunker Hill

In 1969, a study commissioned by the Los Angeles Community Redevelopment Agency noted that "an essential element of the total Bunker Hill renewal program is a 'people mover' system linking the various developments within Bunker Hill to satellite parking concentrations." The need for such a satellite parking concept was described as an outgrowth of the inability of the street network surrounding Bunker Hill to accommodate all of the traffic generated by the total proposed developments. The Central City East area was identified as providing the best opportunity for developing a parking program which could fulfill the needs of Bunker Hill. Because of the distance between Bunker Hill and possible satellite parking facilities, and because of the extensive elevation differentials, a circulation system was thought to be necessary to link the two areas.

Downtown People Mover

This original people mover concept serving Bunker Hill evolved over a period of years into the proposed Downtown People Mover (DPM) System. Figure 3 shows the alignment that was eventually identified in the 1980 Final Environmental Impact Statement for a Los Angeles DPM System. The alignment would have joined Union Station northeast of downtown to the Convention Center southwest of downtown, with a one-way circulation loop within the Bunker Hill area. The Federal Urban Mass Transportation Administration (UMTA) awarded $125 million to Los Angeles for design and construction of the system, but the DPM was then defunded in 1981. Sufficient funding was obtained, however, to finish construction of the tunnel through the Bunker Hill area.

As part of the transition process, UMTA agreed to fund 80% of the remaining cost of completing the tunnel through Bunker Hill. That completion cost is estimated at $3.8 million, which includes $760,000 in Bunker Hill tax increment funds. A condition of the agreement was that the BHTT be placed into mass transit operation (a) within one year after the opening of Metro Rail to revenue service, or (b) within one year after the completion of California Plaza Phase IIA, whichever comes first. Failure to meet that implementation deadline could necessitate the return of $3 million from the City of Los Angeles to UMTA.

A number of things have changed since 1981. For one thing, employment in the downtown core has already exceeded the 1990 forecast on which DPM patronage estimates were based. Further, the DPM analysis did not take into account the growth that is now developing in the greater downtown area -- Central City West and elsewhere. The Metro Red Line has shifted alignment slightly, largely in response to the defunding of the DPM. The Metro Blue Line was not taken into account at the time.

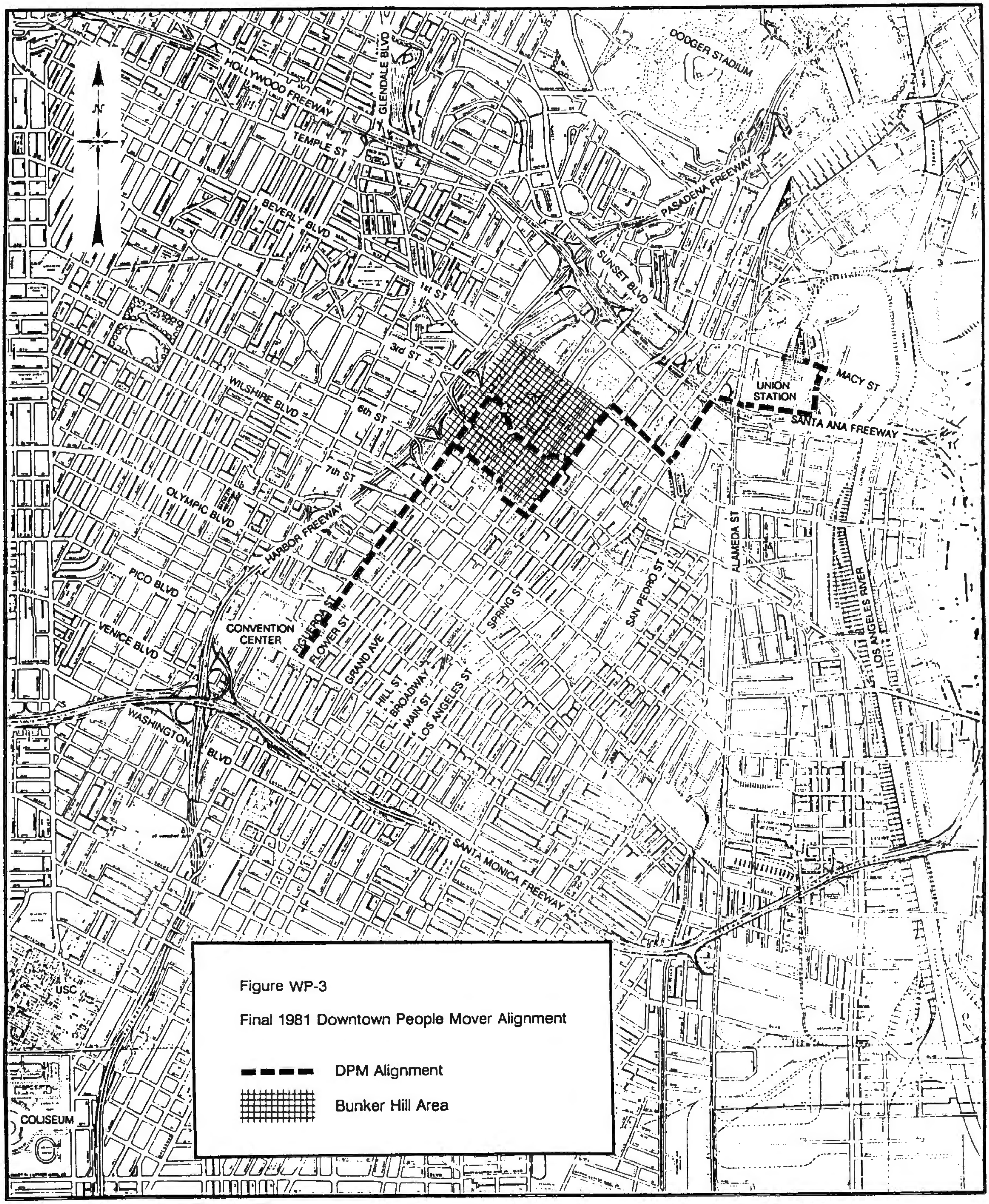


Figure WP-3

Final 1981 Downtown People Mover Alignment

Collectively, these things suggest that: (i) the patronage-related justification for a DPM <u>concept</u> may be as strong as ever; but that (ii) the justification for the original DPM <u>route</u>, with its predominantly north - south orientation, has been made obsolete with the current configuration of the Metro heavy rail transit and light rail transit systems downtown. Rather than unnecessarily duplicating service provided by the Red and Blue Lines, it may be possible to use the BHTT to complement the regional rail system, resulting in a carefully integrated DPM/HRT/LRT service for the growing and congested Los Angeles urban core.

PRELIMINARY INTERVIEWS

To initiate this study, a series of interviews was held with individuals who had participated in the development of the original Downtown People Mover System, and with officials affecting transportation systems in the Central Business District of Los Angeles. Their recommendations were followed in developing and guiding the study scope and issues related to the BHTT and its possible uses. Those recommendations may be loosely organized as relating to **land use**, **transportation**, and **implementation** of a BHTT-based service.

Land use-related recommendations included admonitions to: (1) Keep the long-range future (say, 50 years from now) of downtown in mind (that time frame will see a good deal of infill development and expansion that is not yet planned); and (2) Focus attention on currently unserved markets, such as Central City West, Little Tokyo, and potential peripheral parking facilities.

Specifically **transportation-related** recommendations included suggestions to: (1) Investigate in detail potential linkages of the BHTT to existing/planned transportation facilities such as Metro Rail, the Pasadena LRT, the Glendale Transitway, and DASH lines; and (2) Focus attention on east - west connections across downtown.

Finally, **implementation-related** recommendations included the following advice: (1) Begin political consensus-building early; (2) Pursue private-sector financing as an essential ingredient to the economic viability of a BHTT-based system; (3) Plan for phased implementation of the ultimately-desired system, considering, e.g., preliminary use of the tunnel for DASH buses or for a moving sidewalk; and (4) Conduct early right-of-way protection through tying developer agreements to dedication of transit easements.

DESCRIPTION OF THE TUNNEL AND OF POTENTIALLY APPLICABLE TECHNOLOGIES

DESCRIPTION OF THE EXISTING BUNKER HILL TRANSIT TUNNEL AND EASEMENTS

Tunnel Profile

Vertical and horizontal cross-sections of the BHTT and surrounding areas are shown in Figure 4. The "tunnel" actually consists of three types of facility:

(1) **Sections of building basements set aside for use by a people mover system (1,346 feet).** These are either built, under construction, or planned for construction in the future.

(2) **Sections of already-constructed tunnel beneath streets (266 feet).** This includes Hope Street, Grand Avenue, and Olive Street.

(3) **Rights-of-way for an aerial system from the locations where the tunnel breaks grade (about 1300 feet).** To the west, the right-of-way continues across the World Trade Center, whose deck (currently in use as a tennis court) has been structurally reinforced to support a people mover station. There is an easement across Figueroa and curving northward to the Harbor Freeway. To the east, the right-of-way continues to Hill Street and turns north along Hill Street to Third Street.

Several dimensions could restrict the kinds of systems that could operate in the tunnel as it is presently constructed. These include:

- **height** (minimum 14'-6") -- some vehicles are too high to fit;
- **width** (minimum 17'-3") -- for most systems, two vehicles could not pass each other in this section;
- **horizontal curve** (minimum 100' radius) -- some systems require a larger turning radius;
- **grade** (maximum 5.5%) -- some systems require shallower slopes; and
- **vertical curve** (maximum 20' per 1% change in slope) -- some systems require a slower change in grade.

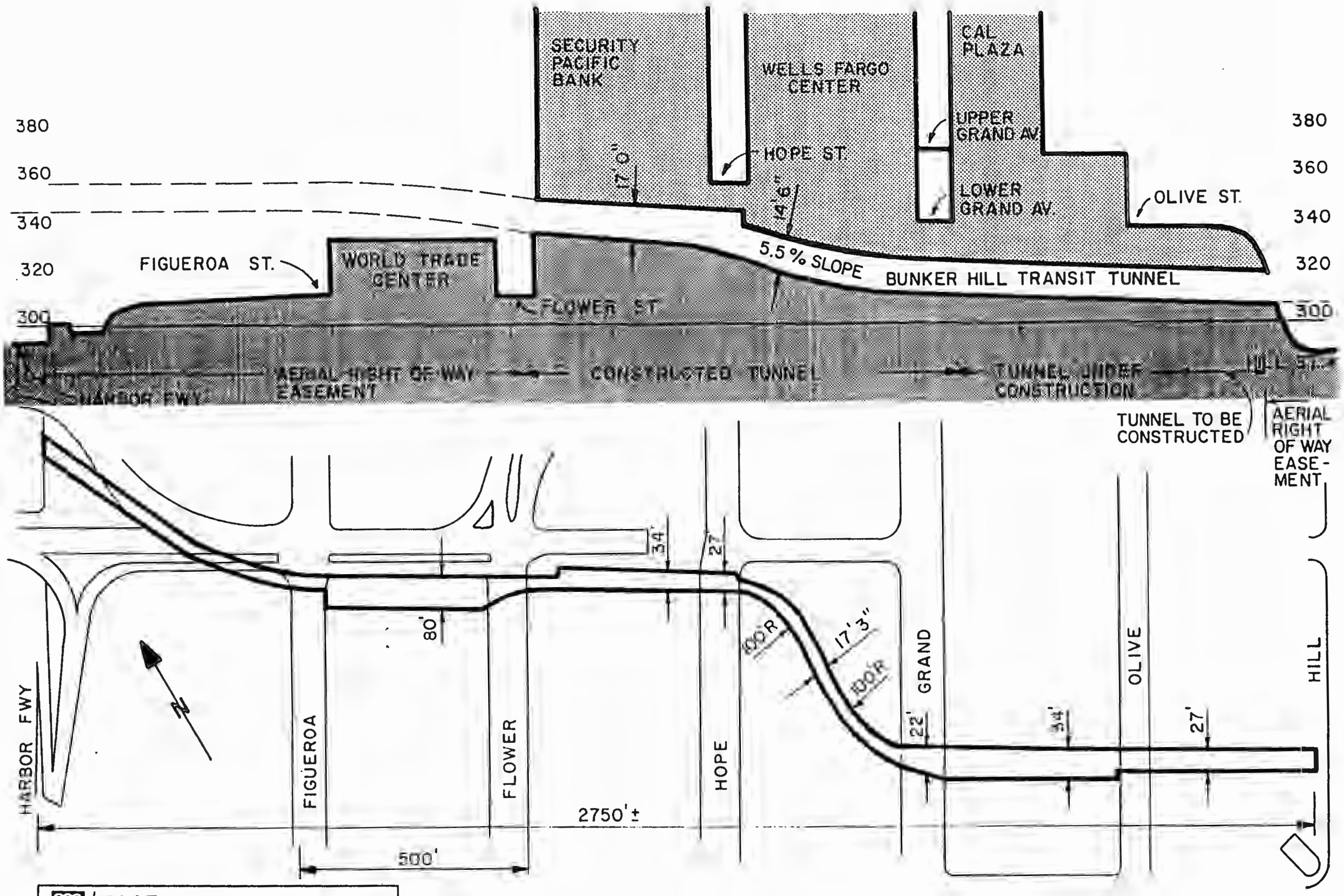
All of these restrictions are found in the tunnel segment below the Wells Fargo Center.

Engineering Constraints on Two-Way Service through the Tunnel

For most of its length, the existing sections of the BHTT are at least 32' wide. However, the usable portion of the tunnel narrows to 17'-3" under the Wells Fargo Building. This

Figure WP-4

B.H.T.T. PLAN & SECTION OF TUNNEL & EASEMENTS



SCAG/DHA Bunker Hill Transit Tunnel Study

bottleneck imposes serious constraints on the ability to provide simultaneous two-way service within the tunnel envelope.

Potential options for dealing with this constraint include: (1) providing two-way service using technology that does fit within the existing width; (2) permitting two-way traffic, using larger vehicles, with switching safeguards to prevent collisions on the bottleneck portion of track; (3) widening the tunnel; (4) digging another tunnel underneath the existing one; and (5) using the tunnel as part of a one-way loop.

A BRIEF OVERVIEW OF POTENTIALLY APPLICABLE TECHNOLOGIES

If the BHTT is to be used for transportation purposes, a variety of technologies can be considered. At the low end (of cost, capacity, and speed), the simple moving sidewalk should not be overlooked. Beyond that, vehicular technologies can be broadly grouped into six categories, with wide variations within categories.

This section contains a short, non-technical overview of each of these seven types of technologies. The textual descriptions below are followed by a summary in Table 1. No single system is intrinsically superior; the best technology for the BHTT depends on a number of factors, including:

- whether or not the right-of-way is extended beyond Bunker Hill;
- the importance of being able to physically link to other systems (such as LRT);
- the maturity and reliability of the technology;
- cost/engineering feasibility; and
- projected patronage.

These factors will be analyzed in greater depth throughout this study, eventually leading to a recommended system.

Moving sidewalk

Moving sidewalks are employed at most larger airports to convey passengers between the terminal and boarding gates. They operate continuously at about 2 miles per hour; because of the continuous operation, they can carry large numbers of people. The actual capacity depends on the width of the walkway installed, but ranges between 3,000 and 10,000 people per hour.

Two-way service can fit into the existing tunnel, but numerous walkway segments will be needed to serve the full length of the guideway. The horizontal curves will require a series of short walkways set on the tangents of the curves. Access can be provided to all buildings along the tunnel right-of-way.

Rubber-tired

A typical rubber-tired system involves vehicles which are roughly a cross between a streetcar and a bus, running on a dedicated right-of-way (usually concrete), with an automatic guidance system (either from a center or side rail), and either automatic control or a driver.

The vehicles range in size from a small minibus to streetcar size and can usually be linked into trains of several cars to increase passenger capacity. Capacity ranges from 3,000 to 15,000 passengers per hour; the system runs at speeds of between 30 and 50 miles per hour.

Most of these systems are too wide to allow simultaneous two-way operation in the narrowest section of tunnel. Most of them can operate as a one-way loop or one-track shuttle system in the tunnel as constructed. These systems will typically require storage and maintenance yard space not available in the existing tunnel section and rights-of-way.

Steel wheel/light rail

Urban rail systems are usually defined as heavy rail or light rail. Heavy rail systems, like the Metro Red Line under construction, have large, heavy vehicles running on full weight rails. Heavy rail systems are not considered suitable for use in the BHTT because of their size and weight, and the limitations of the tunnel's turning radii and slopes. Light rail systems have lighter vehicles and lighter-weight (but usually standard-gauge) tracks. They run at slower speeds, and are capable of negotiating tighter turns and steeper slopes than heavy rail systems. These are the systems described below as steel wheel systems.

Steel wheel systems, such as the Los Angeles - Long Beach Metro Blue Line, are the modern equivalent of the old Red Cars. They consist of steel wheeled vehicles running on steel tracks with either automatic or driver operation. Most of these systems are of similar size and capacity, roughly equivalent to the old streetcars. They generally operate at speeds of approximately 50 miles per hour.

Steel wheel systems have a good reliability record and cost around $60 million per mile to construct, excluding purchase of right-of-way. Passenger capacity is generally about 20,000 per hour.

All of these systems are too wide to provide simultaneous two-way service in the tunnel bottleneck. Most of them can operate as a one-way loop or one-track shuttle in the existing tunnel. Some may need modified electrical collector systems. Maintenance and storage yards will be needed for a system of this type. With compatible vehicles and tracks, the possibility exists of connecting to the LA-LB or Pasadena light rail line to permit sharing maintenance and storage facilities.

Monorail

Monorails are split into two basic groups: top-riding, and underslung. Top-riding monorails usually utilize a concrete box beam, with a rubber-tired vehicle riding on top and guide wheels at the sides. Vehicle size can range from small "personal" vehicles through streetcar up to heavy rail size. Train capacity ranges from 7,000 to 50,000 passengers per hour. Typical operating speeds vary from 20 to 70 miles per hour. The best-known examples of this type of system are the monorails at Disney amusement parks, with vehicles of approximately streetcar size.

Underslung monorail systems are similar in appearance to ski resort cable cars, with vehicles suspended below a single slender steel track. Only the smaller top-riding monorail

systems will fit in the BHTT because of the restricted turning radius -- both vertical and horizontal -- of the larger systems. The underslung monorails tend to have excessive height requirements, which preclude their use in the BHTT. Maintenance and storage yards will be needed for any of these systems.

Magnetic levitation

Only one "maglev" system is in operation at this time (the M-bahn in Germany). Vehicle sizes for this system are roughly equivalent to those of the old streetcars. Magnetic levitation is used to hold the vehicle above the track, therefore reducing rolling resistance. The system in operation has a speed of 50 miles per hour and a capacity of 9,000 passengers per hour.

The only maglev system in production has too wide a turning radius to accommodate the curves in the existing BHTT.

Cable-driven

Cable-driven systems can run on steel rails, rubber tires, or air cushion. They differ from other system types in that traction is supplied from a stationary motor driving a cable rather than being self-propelled by on-board motors. The chief advantages of the cable drive are reliability and reduction of weight and complexity in the passenger cars. The disadvantage is that vehicles are restricted in the distance they can run, to about a mile for a single-cable system, or about five miles for multiple-cable systems with change-over mechanisms.

These systems operate at relatively low speeds of 15 - 20 miles per hour, and capacities can range from a few hundred to 20,000 passengers per hour. Costs vary widely depending on the system chosen.

The cable-driven systems vary widely in their abilities and sizes. Most of them can fit in the tunnel as it exists, and some could provide simultaneous two-way operation. Most of the systems can operate over the full length of the existing tunnel. However, some systems are incapable of negotiating horizontal curves, and some are incapable of transitioning between level and sloping track. Maintenance and storage space will be needed for most of these systems, although for some, maintenance takes place directly on the tracks. In either case, the space requirements are generally smaller than for other technologies: they can usually be accommodated on a spur track or tunnel section behind the main traction motors.

Dual-mode (electric/conventional) bus

The dual-mode bus is a recently-developed technology. The dual-mode vehicle is a bus which can be operated either (i) by a diesel engine on normal streets with a human driver, or (ii) by an electric motor on a dedicated or shared guideway in automatic or manual modes. Two dual-mode systems are now in production. They can be operated at speeds of more than 40 miles per hour, and have capacities of between 3,000 and 10,000 passengers per hour.

These vehicles can operate within the tunnel as it exists, but only in one direction at a time in the narrow section. Maintenance and storage yards can be remotely located because of the ability to drive these vehicles on the street.

TABLE WP-1

KEY CHARACTERISTICS OF VARIOUS PEOPLE-MOVER TECHNOLOGIES

Technology	Typical Capacity[1] (Pax/hr)	Maximum Speed (mph)	Maximum Sys. Length (miles)	Construction Cost (millions per track mile)[2]	BHTT Constraints
Moving sidewalk	3,000 - 10,000	2	0.1	$8	length, curvature
Rubber-tired	3,000-15,000	30-50	N/A	30-60	width
Steel wheel/ light rail	20,000	50	N/A	60-80	width
Monorail:					
Top-riding	7-50,000	20-70	N/A	10-50	turning radii
Underslung	3,000	20	N/A	10-50	height
Magnetic levitation	9,000	50	N/A	30-50	turning radius
Cable-driven	100-20,000	15-20	5	10-50	width, length, curvature (for some)
Dual-mode	3,000 10,000	40+	N/A	10-60	width

[1] These capacities are generally based on 3-minute headways, which can be achieved by almost all systems. However, headway ranges vary within technologies: moving sidewalks have zero headways (continuous motion), most technologies have some systems which can operate at 2-minute headways, and at least one cable-driven system can achieve headways as low as 12 seconds.

[2] These figures do not include right-of-way acquisition, and are based on aerial or at-grade construction. Tunneling is an order of magnitude more costly.

POTENTIAL USES FOR THE BHTT

The Bunker Hill Transit Tunnel may or may not be viable as a stand-alone facility, serving Bunker Hill only. However, this study is also intended to look more broadly at how the BHTT may function as a piece of a transportation system serving a larger area of downtown. In exploring transportation roles for the tunnel and possible extensions, it is useful to keep in mind the various potential markets for a downtown transportation system. Such a system could fulfill two important functions: circulation, and distribution.

Circulation refers to serving midday, non-commute trips within the downtown area. **Distribution** refers to delivering a commute trip to its final downtown destination. A distribution mechanism would be needed for auto trips being intercepted at a peripheral parking lot, and for regional trips whose final line-haul stop (e.g., at Union Station or at the Pershing Square Metro Station) were some distance away from the desired destination. With the current emphasis on job-housing balance, wherein housing opportunities are increasingly being provided near the CBD, a distribution system could also serve the entire commute trip from those nearby residential centers to the CBD workplace.

POTENTIAL STAND-ALONE USES OF THE BHTT

Several potential stand-alone uses for the BHTT may be identified. Each of those uses can be viewed not only as a permanently stand-alone option, but also as a potential interim use of the tunnel -- a stage on the way to full implementation for some of the expanded options discussed in later sections.

Non-Transportation Uses

Opportunities

Several potential non-transportation uses of the BHTT may be appropriate. One such use is simply to allow the building owners to obtain the tunnel segments and easements for private use. Portions of the tunnel are currently being used for recreation, storage, and parking. The value of this tunnel and easements in terms of square feet of space on Bunker Hill is estimated at $25 million.

Another suggestion is to use the space for emergency storage (food, medical supplies) and/or communication. Alternatively, either independently of or in conjunction with transportation uses of the tunnel, the BHTT could be developed as an activity center in its own right: as a retail mall, for example -- a kind of mini-"Underground Atlanta".

Issues/Constraints

Any option other than permitting the continued use of existing tunnel segments by the affected building owners would require a financial analysis. Use of the tunnel as a retail mall raises the questions of whether development would be in private hands or (as in the case of the Los Angeles Mall next to City Hall) public, and whether the projected cash flow would justify the investment.

Another important issue is that the UMTA agreement associated with defunding the old DPM system stipulated that the tunnel be placed into "mass transit operation". Use of the tunnel for non-transportation purposes could necessitate the return of $3 million to UMTA. There may also be legal issues involved if the original easements negotiated for the DPM were specifically tied to transportation uses.

Perhaps the overriding issue to be considered for non-transportation uses of the tunnel is the opportunity cost of not using it for transportation purposes. The tunnel represents a nearly ready-made channel through one of the most densely developed parts of downtown. Providing a completely new transportation facility or service with equivalent capacity would be extremely costly.

Exclusive Guideway for DASH

Opportunities

The BHTT could serve as an exclusive guideway for a re-routed and/or enhanced DASH shuttle bus system. While a DASH route using the BHTT would serve a larger area than Bunker Hill only, this option is classified as stand-alone in the sense that the exclusive guideway portion of the route would not be expanded beyond the existing BHTT right of way, except for on- and off-ramp access to the existing street system.

This option would provide downtown circulation through Bunker Hill on a guideway that would avoid surface congestion. For electrically-propelled buses, the tunnel would provide adequate length for recharging batteries outside of mixed-flow traffic.

Issues/Constraints

Use of a conventional diesel bus would necessitate a ventilation system for the full length of the tunnel. Thus, electric buses should be considered in exploring this option. Also, the section of tunnel through the Wells Fargo Building is only wide enough for one-way traffic using this system. This suggests that a DASH route using the tunnel take the form of a one-way loop, with the remainder of the route traversing existing surface streets in mixed traffic.

This alternative would require construction of ramps connecting each end of the tunnel (above-grade at the west end) to the at-grade street system.

Internal Circulator

Opportunities

Table 2 summarizes existing development and planned improvements in the Bunker Hill area. Bunker Hill is already among the most densely developed sectors of the Los Angeles Central Business District, second only to the Financial Core area to the south. New development is projected to increase office space by 79%, adding nearly 7 million square feet to an existing 9 million. Retail/restaurant/service space will nearly double, to 1.1

million square feet. Hotel rooms will increase by 69%, and dwelling units by 45%. Existing development represents approximately 32,000 employees and some 6,000 residents. It is anticipated that, upon buildout, the Bunker Hill area will contain around 59,000 employees and 9,000 residents.

The steep gradients of the Bunker Hill area make some kind of internal circulation system desirable, while at the same time precluding the use of conventional buses in some areas. In particular, there is no through east-west transit service for Bunker Hill; stand-alone development of the BHTT could provide exactly that, at least in a local sense.

Of the 27 million existing and planned square feet of development in the Bunker Hill area, about 12 million square feet are contiguous to the BHTT. This represents an estimated total potential weekday market of at least 32,000 patrons. It is also relatively inexpensive to provide pedestrian linkages from the BHTT to the Metro Red Line on the eastern end, and to the proposed Pasadena Blue Line extension on the western end. This would increase the connectivity of the rail system downtown, and partially serve east-west demand patterns.

TABLE WP-2

TOTAL EXISTING AND PLANNED DEVELOPMENT IN BUNKER HILL

Land Use	Existing	Planned	Total	% Increase
Office square feet	8,672,000	6,812,755	15,484,755	78.6
Retail square feet	586,000	503,800	1,089,800	86.0
Hotel rooms	2,029	1,400	3,429	69.0
Dwelling units	2,988	1,350	4,338	45.2
Parking spaces	17,069	8,700	25,769	51.0

Issues/Constraints

One issue concerning a stand-alone Bunker Hill shuttle is that of user acceptance: will a user want to take a basement-level shuttle -- as opposed to using the existing (or future enhanced) aerial or ground-level walkway system? What is the difference in travel time among these alternatives?

Another issue is the ease with which a stand-alone system can later be extended to serve a larger area. Finally, there are certain engineering issues associated with this option.

POTENTIAL WESTERN LINKAGES

Opportunities

Potential Demand

Linking the BHTT to Central City West (CCW) could benefit several groups of people. As a **circulator**, the tunnel could provide CCW employees (about 26,500 today; potentially 79,000 under the proposed Specific Plan) easy access to CBD activity centers for mid-day work and non-work travel. Similar access would be provided for CBD employees to CCW. As a **distributor**, the BHTT could serve CBD-destined commuters parking at a peripheral lot at Crown Hill, transit users of the proposed Glendale/Bixel/Harbor transitway, and CCW residents (about 13,000 today; potentially 31,000 under the proposed Plan).

Pacific Electric Tunnel

The P.E. Tunnel can relate to the BHTT in two different ways. On one hand, reactivating the P.E. Tunnel, especially if it is reconnected around the blockage between Figueroa and Hope Streets, could provide service between the Central City West area and the CBD roughly comparable to that of the BHTT. This would suggest an either-or analysis of the two tunnels. On the other hand, there may be some synergies to be derived from connecting the two tunnels in some way.

Issues/Constraints

Any major extensions of the BHTT immediately raise questions about engineering and financial feasibility. One issue specific to western extensions is that the densest commercial development in CCW will take place in the southern end, while both a simple linear extension of the BHTT and the P.E. Tunnel would be most accessible to the residential northern end. Integrating service through the Bixel transit mall with the BHTT would need careful attention.

POTENTIAL EASTERN LINKAGES

Opportunities

Several important activity centers on the east side of downtown will not be directly served by the Metro Red Line, including the new, 825,000 square-foot State Office Building at Third and Spring; and Little Tokyo. An eastern extension of the BHTT, especially given the connections to the Red and Blue Lines discussed above, could serve this area in lieu of the Second Street alternative alignment of the Pasadena LRT.

Once the BHTT reaches Little Tokyo, it is perhaps natural to consider extending it further north to Union Station. That would provide for direct transfer capabilities to/from commuter trains, the El Monte busway, the Metro Red Line, the Santa Ana extension of the Metro Red Line, and peripheral parking.

Issues/Constraints

One concern with an extension to Union Station is that, between that point and Fifth and Hill, the Bunker Hill line will provide service partly competing with the Metro Red Line. For this reason, a Union Station connection should perhaps be considered a longer-term option, to be explored when it appears that demand would support two rail choices within the northeast sector of downtown. On the other hand, the possibility of using an area around Union Station for a storage and maintenance yard may make it a logical segment to include early on.

POTENTIAL ADDITIONAL LINKAGES

Opportunities

An extended BHTT could serve as the backbone for a larger loop system connecting a number of activity centers surrounding and within downtown. Such a system could provide new and/or improved service to major areas of existing and future development, including: South Park and the Convention Center, the Alameda Corridor and City North, and the Greyhound Bus Terminal and the garment/produce districts.

Issues/Constraints

Again, financial, engineering, environmental, and political feasibility are major questions. Such a system would be costly, but its costs -- and its benefits -- would be shared over a larger base of development.

PROMISING ALTERNATIVES FOR FURTHER STUDY

GUIDING FACTORS CONSIDERED THROUGHOUT THIS STUDY

In developing potential transportation uses of the BHTT, six general, partially overlapping, goals were considered. These same goals will be important throughout this study:

1. Fill in gaps between existing or proposed fixed guideway transit or highway systems.
2. Support areas of major existing land use development.
3. Support areas of major future land use development.
4. Serve peripheral parking intercept areas.
5. Serve cultural, entertainment, and sports facilities.
6. Provide additional transportation interchanges/linkages.

SPECIFIC PROMISING ALTERNATIVES FOR FURTHER STUDY

Non-transportation alternatives should not be ruled out at this early stage, although further work would be needed to identify a comprehensive range of options, as well as evaluation criteria. In view of the UMTA restriction on uses of the BHTT, perhaps it is appropriate to view non-transportation uses as a last-resort option, to be studied more extensively if it appears that transportation uses will not be cost-effective. The most promising alternatives at this point are the transportation-related ones.

Several kinds of transportation alternatives appear to warrant further study. Each of them is discussed further below. All except the comprehensive alternative are illustrated together in Figure 5.

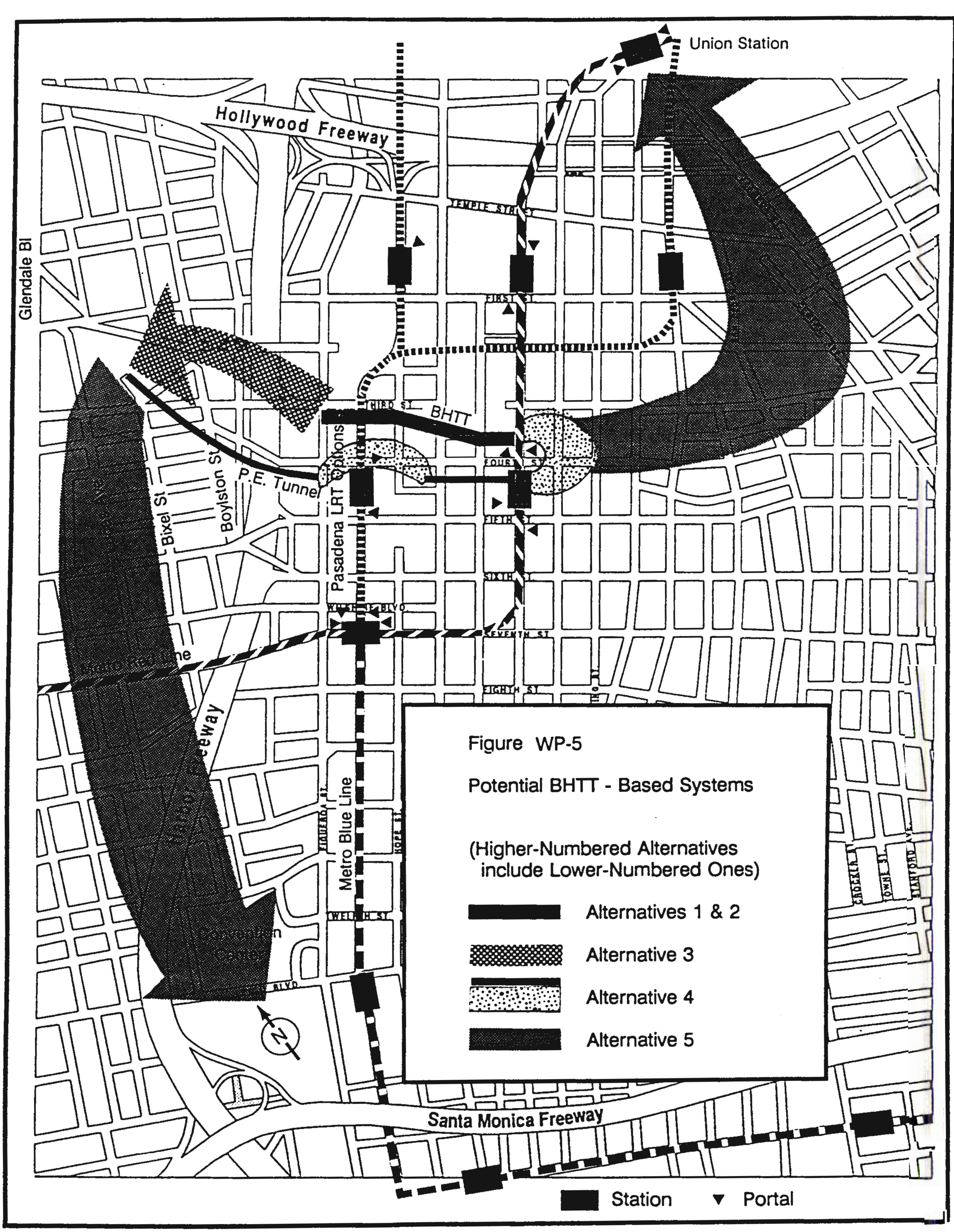
1. <u>Internal Circulator</u>

The existing Bunker Hill Transit Tunnel could be used as a two-way shuttle system to serve the Bunker Hill area, to transport people between buildings, and to serve as a link from the northwest entrance of the Metro Red Line Fifth and Hill Station into Bunker Hill. A connection could also be made via escalator and moving sidewalk to the proposed Pasadena Light Rail station at Fourth and Flower. This alignment would require the construction of a bridge across Flower Street to serve the World Trade Center, and construction of stations or drop offs within the various buildings served.

Technologies suitable to this short-run system might include moving sidewalks or some of the smaller cable driven systems such as the SOULE System. Maintenance areas for these technologies could be provided in areas of the existing tunnel which are wider than the minimum 17'3" section below the Wells Fargo building.

Pedestrian Linkages to Metro Red and Blue Lines

The Pershing Square (Fifth and Hill) Station of the Metro Red Line will run the length of the block between Fourth and Fifth Streets. The northwest portal of the station is nearly a block away from the planned California Plaza Station of the BHTT, and 60 - 70 feet


Union Station
Hollywood Freeway
Glendale Bl
Temple St
First St
Third St
BHTT
Fourth St
Fifth St
Sixth St
Wilshire Blvd
Seventh St
Eighth St
P.E. Tunnel
Bixel St
Boylston St
Pasadena LRT options
Metro Red Line
Harbor Freeway
Metro Blue Line
Figueroa St
Hope St
Twelfth St
Convention Center
Santa Monica Freeway
Figure WP-5
Potential BHTT - Based Systems
(Higher-Numbered Alternatives include Lower-Numbered Ones)
Alternatives 1 & 2
Alternative 3
Alternative 4
Alternative 5
Station
Portal
N

lower. The proposed Cal Plaza Phase III building is planned to have a set of retail terraces joined by escalators that will link the Metro Station to the Cal Plaza development. This escalator system can serve to connect the BHTT to Metro Rail.

As for the Blue Line extension, the proposed station at Fourth and Flower would have an entrance just north of Fourth Street, less than a block from the Security Pacific / World Trade Center sections of the BHTT at Third and Flower. The Bunker Hill "tunnel" is actually some 30 feet above ground level at the intersection of Third and Flower, while the LRT tunnel will be about 20 feet underground. Nevertheless, it is entirely feasible to connect the BHTT to the north entrance (at ground level) of the LRT station, by a moving walkway and escalators. The moving walkway could proceed south on Flower alongside the Security Pacific Building at third-story level, then join an escalator down to the station entrance.

2. <u>Guideway for Electrified DASH</u>

This alignment could also be used for a dedicated DASH bus route with a linear induction charging system for electric buses within the tunnel section. This would require construction of on- and off-ramps to link the tunnel to the existing street system. Buses would enter the tunnel via a ramp from Hill Street, would have stops at the California Plaza and Security Pacific Buildings and would descend to the present grassy median in Third Street via a ramp from the west side of the Security Pacific Building bridging over Flower Street. The DASH bus would then join the surface street traffic on Figueroa Street. Some modifications to the street traffic system at Figueroa such as a dedicated bus lane and separate traffic lights may be required.

3. <u>Extended Shuttle</u>

The internal circulator discussed above could be extended into Central City West. This would create east-west connectivity to this fast emerging development area, and could also help to alleviate traffic congestion in the Bunker Hill area by allowing easy access to Bunker Hill for people parking in peripheral lots to the west of the Harbor Freeway.

A cable shuttle system would be ideally suited to this type of application. Moving sidewalks would provide plenty of capacity but would be less suitable because of their slow speed. Maintenance areas could be provided within the wider tunnel sections or at the west end of the system in Central City West.

This option would require the construction of a bridge across Flower Street to the proposed World Trade Center station, and an aerial guideway from there across Figueroa Street and the Harbor Freeway and into Central City West. An additional station would be constructed in CCW, and possibly a maintenance and storage yard.

4. <u>BHTT/P.E. Tunnel Loop</u>

This one- or two-way loop system uses all of the currently existing but unused sections of tunnel formerly used or intended for use as transportation rights of way and connects them together with the minimum of additional construction.

The narrow section of tunnel under the Wells Fargo Building restricts the existing tunnel to a one-way system for most technologies. However, the total length of the system is within the maximum length range of one or two of the small cable shuttle systems which could be run as a two-way system in this narrow section.

Light rail and other automated guideway transit (AGT) systems could be run as a two-way loop. There would be a short one-way section within the Wells Fargo Building, with a sophisticated automatic control to allow passage of vehicles from opposite directions in this area. Alternately, a two-way loop system could be achieved by constructing space for a second track alongside or below the existing one in the Wells Fargo bank area.

On the other hand, the argument for a two-way system is less compelling for this particular alignment than it would be for larger loops, since the two tunnels are only about a block apart for most of their length.

A maintenance area for this system could be created in Central City West close to Beaudry and First Street, or if a compatible light rail technology were chosen, a connection could be made to the Pasadena Light Rail system so that its maintenance facilities could be utilized.

Construction for this option will be more extensive than for the preceding three suggestions. In addition to the aerial guideway described in the above alternative (which would join the BHTT to the P.E. Tunnel at Crown Hill to the west), major guideway construction associated with this alignment includes (i) a diversion tunnel to link the two pieces of the P.E. Tunnel, and (ii) an eastern loop to join the BHTT to the P.E. Tunnel.

The total length of existing tunnel is a little more than one mile. New guideway totals a little over one mile also, approximately 65% of which is tunnel, the remainder being elevated. Connections would be made to the Blue Line at Fourth and Flower and to the Red Line at Fourth and Hill Street, where a knock out panel exists for a new portal.

5. <u>Loop with Extensions</u>

A two-way shuttle system could be created from Union Station through Little Tokyo, Bunker Hill, Central City West and down to the Convention Center, using BHTT as the starter section. To accomplish this effectively, the BHTT would need to be widened to accommodate two-way traffic or the Pacific Electric Tunnel would have to be linked in to create the second track as described in the previous alternative. The sections of new guideway would be above grade.

This alternative is too long for cable driven systems but is suited for light top riding monorail, rubber tired or light rail technologies. A maintenance area for the system could be created at Union Station or in an area close to Venice or Washington to the west of the Harbor Freeway and north of the Santa Monica Freeway.

Construction for this option would again be extensive. The major guideway construction elements (in addition to widening the BHTT or joining it with the P.E. Tunnel as described

above) would be (i) an aerial guideway linking the eastern end of the BHTT to Union Station through Little Tokyo, and (ii) an aerial guideway proceeding south from Crown Hill, through CCW and over to the Convention Center.

The total length of existing tunnel used would be 1/3 mile if the BHTT alone were used or one mile if both the BHTT and the Pacific Electric Tunnel were used. The total length of the system would be about 4 miles (4-3/4 if the P. E. Tunnel is used). Connections would be made to the Red Line at Union Station and at Fourth and Hill, and to the Blue Line at Fourth and Flower and at Pico and Flower.

6. Phased Comprehensive Automated Downtown Circulator Systems

The systems described above are capable of being expanded to create a Comprehensive Downtown Circulator System. Naturally, technologies such as moving sidewalks and cable-driven vehicles are precluded in a comprehensive system. There are any number of potential alignments for such a comprehensive downtown circulator system, but most logical alternatives have a number of factors in common.

1. They have a starter section usually utilizing the BHTT (and possibly also the Pacific Electric Tunnel) as a minimum operable segment, which can be connected to an area where it is possible to create a maintenance and storage yard.

2. They provide east - west connectivity in the Bunker Hill area and in the South Park area. This is also possible in the Civic Center area as well.

3. They connect to the existing and proposed infrastructure of transportation systems, including the Red Line, the Blue Line, Union Station, the Greyhound Station, the Harbor/Glendale HOV lanes, and so on.

4. They provide service to areas of need that are served neither by existing nor by proposed transportation systems.

5. They are phased in three or four steps which are each capable of being engineered and constructed in a 3-5 year time frame.

6. The total length of each system is between 13 and 16 miles.

7. They are capable of using a variety of technologies from light top riding monorail though rubber tired to light rail. If it is decided to proceed with a comprehensive system, a full study will be required to decide the technology to use, the alignment, and the phasing.

TECHNOLOGIES ELIMINATED AND WHY

During the course of this preliminary study, a number of technologies have been discussed and some have been suggested for the various conceptual options. The general discussion following will endeavor to illustrate why various technologies are suited to one type of alternative and not to another.

1. Constraints within the BHTT itself preclude further consideration of at least two classes of technology: heavy rail transit like the Metro Red Line, and maglev. The larger monorail systems are also excluded.

2. The least costly transportation alternative, the internal circulator, falls under the category of very short run (one mile and less) high capacity multiple stop systems. Because of the short length, high capacity and relatively slow speed necessitated by many stops, moving walkways and cable shuttle systems are suitable. Larger, high-speed systems such as light rail and the larger rubber tired systems are not well-suited because of the extensive maintenance facilities required, the more expensive infrastructure required and the inefficiency of starting and stopping the trains.

3. The third and fourth alternatives proposed (the BHTT extended west, and a BHTT/P.E. Tunnel loop) can be classified under high-capacity, multiple-stop, short-run (up to four miles) systems. These alignments are suitable for the larger rail girded cable traction systems and for some of the smaller rubber tired and monorail systems. Both of these technologies require more infrastructure and support systems than the very short-run systems, but less than the large rubber tired systems and light rail systems. Moving walkways are not suitable for distances of more than one mile because of their very slow speed.

4. The fifth and sixth alternatives (loop with extensions, and comprehensive systems) are classified as longer systems (over four miles). Four miles is about the limit for cable systems even with multiple loops and changeovers, so they are virtually eliminated from this group of alignments. The small monorail and small rubber-tired systems can still be used and may be the best choice for these alignments, the decision points being the capacity required for the system and speed at which it is desired to operate the system. The smaller systems are capable of speeds of 20 mph and capacities of 6-10,000 people per hour. The larger systems operate at speeds of 30-50 mph and have capacities of up to 20,000 people per hour.

5. The dual-power systems could be used for any of the alternatives discussed, but they suffer from the same problems as all-street systems to the extent that for part of their routing they have to contend with street traffic. If used exclusively in automated mode they are less efficient than a totally dedicated (single-power) system, and therefore they should be regarded as a stop-gap or compromise solution. They are also less reliable than a dedicated automated guideway transit system.

DECISION POINTS AND WINDOWS OF OPPORTUNITY

It is clear that the set of reasonable options for use of the BHTT is affected by developments in other studies that are also underway. In particular, the following factors significantly impact BHTT options:

- which alignment of the Pasadena LRT is selected;
- how the Central City West plan shapes up; and

o what happens to the most recent proposals for use of the Pacific Electric Tunnel.

To a longer term, but not necessarily lesser, extent, future plans for areas such as City North, the Alameda Corridor, and the Figueroa Corridor could impact choices for the BHTT. At the same time, the impact should not all be in one direction. That is, the availability of the BHTT may generate opportunities that are superior from a system-wide standpoint to those proposed without consideration of the tunnel. Thus, discussions on the role of the BHTT need to be integrated with these and other relevant activities concerning downtown Los Angeles.

Also, the timing of key decisions can affect the costs associated with various BHTT options. For example, significant economies could be achieved by coordinating BHTT-related construction with construction on nearby projects. While it may be too late to modify activities related to the construction of the Metro Red Line tunnels at Fifth and Hill and the California Plaza Phase II building, coordination should be possible for the interface of the west end of the existing BHTT with the proposed Pasadena LRT line. Another example of the importance of timing is the opportunity afforded by the approval process for new developments to secure early preservation of rights of way and easements for an extended BHTT system.

SUMMARY AND NEXT STEPS

This white paper has identified some promising uses for the Bunker Hill Transit Tunnel, in the context of ongoing land-use and transportation activities in downtown Los Angeles. While it is too early to judge the ultimate feasibility of any of the options, it is easy some attractive possibilities for improving downtown circulation, providing better service to major activity areas, and linking together key elements of the downtown transportation infrastructure.

The remainder of this study will explore these options further. In particular, the various conceptual alternatives presented here will be compared in terms of projected patronage, engineering feasibility, cost-effectiveness, financing plans, and environmental concerns. Institutional and phased implementation questions will also be addressed by this study. The outcome will be a set of recommendations to the City of Los Angeles regarding the use of the Bunker Hill Transit Tunnel.

I. INTRODUCTION

A. BUNKER HILL TRANSIT TUNNEL STUDY AND THIS REPORT

The City of Los Angeles is reviewing opportunities for fully utilizing the Bunker Hill Transit Tunnel (BHTT). The BHTT consists of easements and actual tunnel segments that bisect some of the most attractive office, retail, residential and entertainment-related space in downtown Los Angeles (Figure 1). In view of the intensity of existing and future development in downtown, and the corresponding demand for transportation generated by that development, the BHTT is potentially a highly valuable element of the transportation infrastructure serving the area. The current BHTT Study is designed to consider ways to effectively use this untapped resource.

This report represents the completion of the first phase or milestone of the four-phase study. The phases are described as follows:

- **PHASE 1: White Paper** -- Identify, on a preliminary basis and in broad terms, potentially attractive and feasible opportunities, along with the issues and constraints associated with uses for the BHTT. The paper is to serve as a springboard for discussion among local public and private sector decision-makers, and other parties potentially key to the implementation feasibility of any resulting plan for the BHTT. The executive summary of this report serves as the white paper of Phase 1.

- **PHASE 2: First-Level Screening of Generalized Scenarios** -- Compare up to six scenarios for use of the BHTT, in terms of physical feasibility, patronage (in orders of magnitude), connectivity to existing and planned transportation facilities, and consistency with City goals and policies. Select specific alternatives to explore further.

- **PHASE 3: Second-Level Screening of Specific Alternatives** -- Compare specific alternatives in terms of patronage (detailed modeling), environmental concerns, cost and cost-benefit, the ability to be financed, institutional arrangements, and implementation strategies. Formulate recommendations.

- **PHASE 4: Disseminate Study Findings** -- Prepare a written report, and make verbal presentations of the study findings.

Public input is sought at each phase of the study.

B. CURRENT DOWNTOWN DECISION-MAKING CONTEXT

Downtown Los Angeles is in a period of perhaps unprecedented volatility; the term "renaissance" is often applied. Its form is rapidly being redefined through a series of decisions regarding large transportation and land use investments. While these activities will be discussed in greater detail in Chapter II, a broad overview is provided here. Figure 2 serves to illustrate the context of a potential role for the Bunker Hill Transit Tunnel.

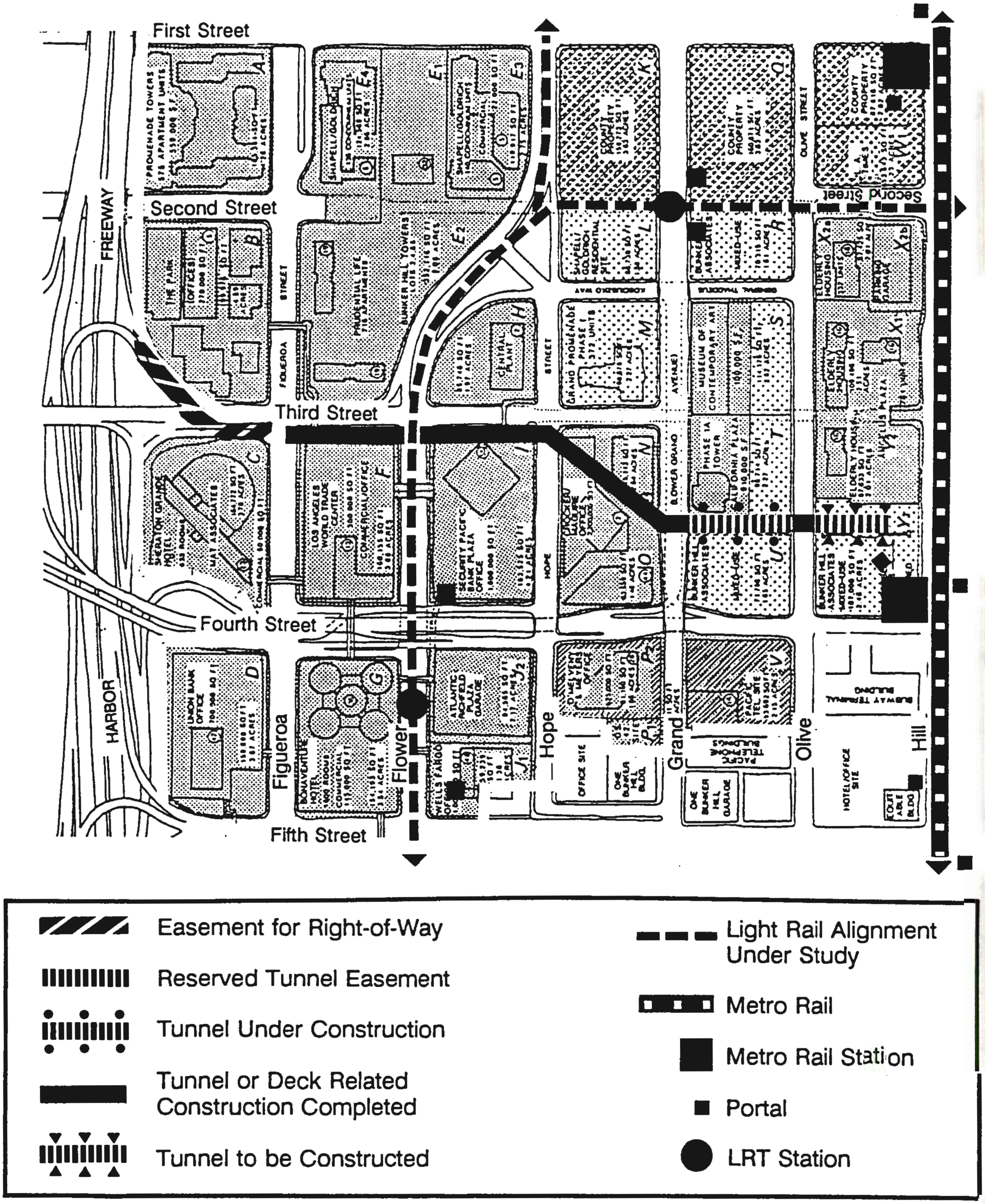


Figure 1

Bunker Hill Area and Tunnel

Figure 2

DOWNTOWN LOS ANGELES CONTEXT

1. The Land Use Context

The downtown Los Angeles skyline is literally changing daily. Seven million square feet of office space are currently under construction in the core area. In the Bunker Hill, Central Business District (CBD), and Little Tokyo redevelopment areas, 38 million square feet of new development is projected to occur over the next 10 to 15 years.[1] Los Angeles has overtaken San Francisco as the financial center of the western United States, and as the gateway to the Pacific Rim.

In Central City West, just west of the Harbor Freeway, a proposal for building up to 25 million square feet of commercial development, plus up to 12,000 dwelling units, would bring that area to a density comparable to that of the CBD proper. To the north and east, futures for City North and the Alameda Corridor are under study, amid considerable private sector investment activity. To the south, the mixed-use South Park area is planned eventually to include up to 15,000 dwelling units and about 10 million square feet of commercial space. Further south, development stretching down the Figueroa Street corridor will ultimately link downtown to the University of Southern California (USC)/Coliseum area and beyond.

Downtown is home to multi-billion dollar retail and wholesale trades in jewelry, apparel, and produce. The approximately 42,000[2] Federal, State, and local government employees in the Civic Center area represent one of the largest concentrations of public employees west of the Mississippi.

Several major activity centers in downtown are currently undergoing development. The Convention Center has just broken ground on a $390 million expansion from 28 to 63 acres, including a 350,000 square foot exhibition hall. The 63-year-old Los Angeles Central Library is in the midst of a complete rehabilitation after being nearly destroyed by two fires. And the proposed 2,500-seat Walt Disney Concert Hall would join with the 6,000 seats of the three major performance areas of the Music Center across the street, to create a world-class performing arts complex.

2. The Transportation Context

Two new regional transportation facilities are already under construction in downtown: the heavy rail transit (HRT) Metro Red Line, initially running from Union Station to Wilshire at Alvarado, with a second-phase extension to North Hollywood; and the light rail transit (LRT) Metro Blue Line from Long Beach to Seventh and Flower Streets in downtown L. A. The existing El Monte Busway will soon be extended into Union Station, with buses ultimately feeding in to Metro Rail rather than continuing downtown.

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1 "Status of Development Projects" (map and table), Los Angeles Community Redevelopment Agency, July 1989 (see summary Table A-3 in Appendix A).

2 According to Exhibit F-5, p. F-13, of the **Los Angeles Central Business District Employee Travel Baseline Survey Final Report**, prepared for the Los Angeles Community Redevelopment Agency, April 1987, there were 42,046 office employees alone in the Civic Center/Little Tokyo area in June 1986.

In addition, a number of other potential regional transportation facilities directly affecting downtown are under study. Decisions on the alignment of the light rail extension to Pasadena will be made within the next six months. Other facilities being discussed for future implementation include:

- o the eastern extension of Metro Rail into the Santa Ana Corridor;
- o western extensions of Metro Rail to Santa Monica and through the San Fernando Valley;
- o extended and new transitways along the Harbor Freeway, Bixel Street, and Glendale Boulevard, creating a continuous north-south corridor from the Artesia (91) Freeway to the City of Glendale;
- o a high-occupancy vehicle (HOV) / transitway down the concrete-lined bed of the Los Angeles River from the San Fernando Valley to Union Station; and
- o new and expanded commuter rail service between Union Station and San Bernardino, Ventura, and Orange/San Diego Counties.

3. Downtown Transportation Issues

With the land use and transportation activities sketched above, Los Angeles is being transformed into what is by nearly any standard a world-class city. A careful look at Figure 2, however, shows that the new downtown will retain and create some transportation problems that are not fully addressed by the facilities currently existing and under consideration.

The two rail lines being built will function as a regional transportation system bringing trips into downtown, but will be of limited value for serving mid-day circulation within downtown. The two lines have a pronounced north - south orientation; east - west linkages are needed to balance the system. The two lines meet at only one point (Seventh and Flower); it is desirable to increase the connectivity of the rail system. Union Station will become a major interceptor for downtown-oriented trips, with the single Metro Red Line potentially the only fixed-guideway distribution mechanism within downtown.

Finally, there are some notable gaps in the fixed-guideway transportation system that is emerging for downtown -- that is, there are a number of activity areas not well-served by existing and proposed facilities. Equity issues are raised by a multi-billion dollar rail system that almost exclusively serves the white-collar employment base on the north and west sides of downtown. In downtown itself, un- or under-served areas include Little Tokyo and the eastern half of the Civic Center area, the southern half of the Broadway/Spring Theater District, the 55,000 employees[3] of the Eastside

[3] Derived from Exhibit 8 of the Community Redevelopment Agency memorandum entitled, "Downtown Demographics and Land Use" (September 8, 1989).

Industrial Area, and the eastern half of South Park. In greater downtown, potentially underserved areas include Central City West, the USC/Coliseum, and Dodger Stadium. The BHTT, with its east - west alignment through high-density development, may be a building block in an integrated, systemic solution to some of these problems.

C. DEVELOPMENT OF THE BUNKER HILL TRANSIT TUNNEL

1. Initial Impetus – Peripheral Parking for Bunker Hill

In 1969, a study commissioned by the Los Angeles Community Redevelopment Agency noted that "an essential element of the total Bunker Hill renewal program is a 'people mover' system linking the various developments within Bunker Hill to satellite parking concentrations." The need for such a satellite parking concept was described as an outgrowth of the inability of the street network surrounding Bunker Hill to accommodate all of the traffic generated by the total proposed developments. The Central City East area was identified as providing the best opportunity for developing a parking program which could fulfill the needs of Bunker Hill. Because of the distance between Bunker Hill and possible satellite parking facilities, and because of the extensive elevation differentials, a circulation system was thought to be necessary to link the two areas.

2. Downtown People Mover

This original people mover concept serving Bunker Hill evolved over a period of years into the proposed Downtown People Mover (DPM) System. Figure 3 shows the alignment that was eventually identified in the 1980 Final Environmental Impact Statement for a Los Angeles DPM System. The alignment would have joined Union Station northeast of downtown to the Convention Center southwest of downtown, with a one-way circulation loop within the Bunker Hill area. The Federal Urban Mass Transportation Administration (UMTA) awarded $125 million to Los Angeles for design and construction of the system, but the DPM was then defunded in 1981. Sufficient funding was obtained, however, to finish construction of the tunnel through the Bunker Hill area.

As part of the transition process, UMTA agreed to fund 80% of the remaining cost of completing the tunnel through Bunker Hill. That completion cost is estimated at $3.8 million, which includes $760,000 in Bunker Hill tax increment funds. A condition of the agreement was that the BHTT be placed into mass transit operation (a) within one year after the opening of Metro Rail to revenue service, or (b) within one year after the completion of California Plaza Phase IIA, whichever comes first. Failure to meet that implementation deadline could necessitate the return of $3 million from the City of Los Angeles to UMTA.

A number of things have changed since 1981. For one thing, the patronage forecasted for the DPM was predicated on a 1990 downtown employment of 251,000,

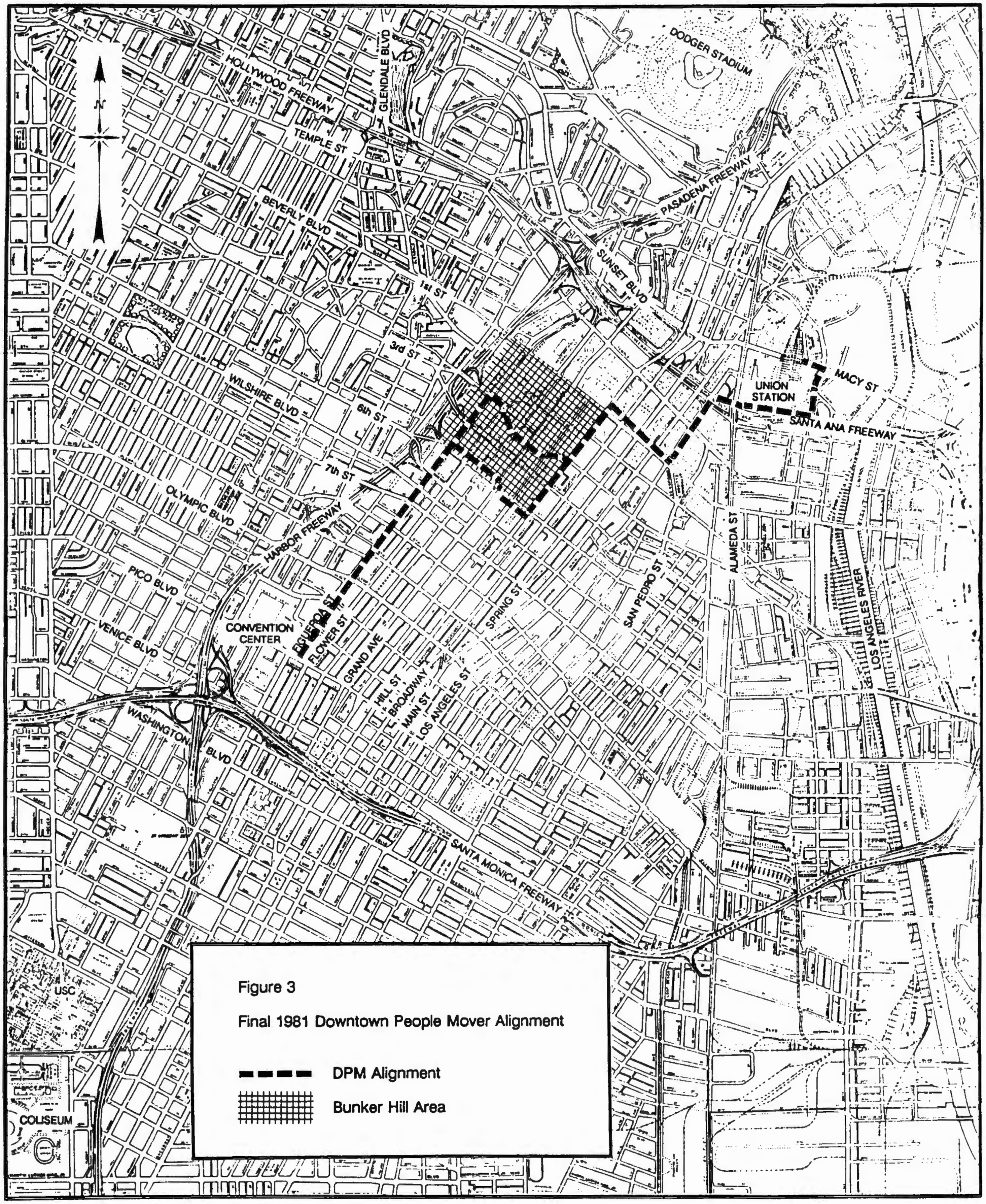

Figure 3

Final 1981 Downtown People Mover Alignment

and a year 2000 employment of 297,000[4]. But the estimated 1989 downtown employment of 264,000[5] already exceeds the 1990 forecast. Further, the DPM analysis did not take into account the growth that is now developing in the greater downtown area -- Central City West and elsewhere. The Metro Red Line has shifted alignment slightly, largely in response to the defunding of the DPM. The Metro Blue Line was not taken into account at the time.

Collectively, these things suggest that: (i) the patronage-related justification for a DPM concept may be as strong as ever; but that (ii) the justification for the original DPM route, with its predominantly north - south orientation, has been made obsolete with the current configuration of the Metro heavy rail transit and light rail transit systems downtown. Rather than unnecessarily duplicating service provided by the Red and Blue Lines, it may be possible to use the BHTT to complement the regional rail system, resulting in a carefully integrated DPM/HRT/LRT service for the growing and congested Los Angeles urban core.

D. PRELIMINARY INTERVIEWS

To initiate this study, a series of interviews was held with individuals who had participated in the development of the original Downtown People Mover System, and with officials affecting transportation systems in the Central Business District of Los Angeles. Their recommendations were followed in developing and guiding the study scope and issues related to the BHTT and its possible uses. Those recommendations may be loosely organized as relating to **land use**, **transportation**, and **implementation** of a BHTT-based service.

Land use-related recommendations included admonitions to: (1) Keep the long-range future (say, 50 years from now) of downtown in mind (that time frame will see a good deal of infill development and expansion that is not yet planned); and (2) Focus attention on currently unserved markets, such as Central City West, Little Tokyo, and potential peripheral parking facilities.

Specifically **transportation-related** recommendations included suggestions to: (1) Investigate in detail potential linkages of the BHTT to existing/planned transportation facilities such

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4 **Demand Models and Patronage Forecasting for the Los Angeles Downtown People Mover Program**, prepared by Peat, Marwick, Mitchell & Co. for the Los Angeles Downtown People Mover Authority, November 1981, p. V.4.

5 According to the Los Angeles Community Redevelopment Agency memorandum: "Downtown Demographics and Land Use" (September 8, 1989), Exhibit 8, as amended, current employment in major sectors in the CBD, Bunker Hill, and Little Tokyo redevelopment areas totals 235,475. But that figure does not include the retail or service/institutional sectors, although it does include hotel. According to Exhibit 34, p. 67 of **Assessment of Workplace and On-Board Transit Surveys for Los Angeles Downtown People Mover Program, Task 1 Final Report**, prepared by Peat, Marwick, Mitchell & Company for the Los Angeles Downtown People Mover Authority, April 1981, retail employment in 1980 was 17,160, and service/hotel/institutional employment was 16,080. So 236,000 + 17,000 + 16,000 - 5,000 (to avoid double-counting hotel employment) = 264,000 is a conservative estimate of current downtown employment. Note that Little Tokyo is included in the CRA total, but is not counted in the DPM report numbers.

as Metro Rail, the Pasadena LRT, the Glendale Transitway, and DASH lines; and (2) Focus attention on east - west connections across downtown.

Finally, **implementation-related** recommendations included the following advice: (1) Begin political consensus-building early; (2) Pursue private-sector financing as an essential ingredient to the economic viability of a BHTT-based system; (3) Plan for phased implementation of the ultimately-desired system, considering, e.g., preliminary use of the tunnel for DASH buses or for a moving sidewalk; and (4) Conduct early right-of-way protection through tying developer agreements to dedication of transit easements.

E. STRUCTURE OF THIS PAPER

The rest of this paper is organized as follows:

- **Chapter II:** provides a transportation and land use context in which to view the BHTT. Existing and future development and transportation patterns, for Bunker Hill in particular and downtown in general, are reviewed. Transportation issues not adequately addressed by currently-planned systems are summarized.

- **Chapter III:** describes the initial building blocks of any potential BHTT system, to anchor the later discussion of specific configurations. First, the alignment and dimensions of the existing tunnel are described. Then, a brief, non-technical overview of potentially applicable technologies is presented, with particular attention given to the feasibility of implementing each technology within the envelope of the existing tunnel.

- **Chapter IV:** begins to explore optional roles for the BHTT in addressing the issues identified in Chapter II. A variety of scenarios is sketched, ranging from stand-alone uses of the BHTT (non-transportation as well as transportation) to major extensions of the tunnel. Key opportunities, issues, and constraints associated with each scenario are suggested.

- **Chapter V:** defines specific alternatives that appear to warrant further study. The factors used in developing the alternatives are presented. Each option is graphically portrayed, and key engineering issues are discussed.

- **Chapter VI:** presents other issues that are important to the development of the BHTT, including legal and institutional, financing mechanisms, and environmental impacts.

- **Chapter VII:** synthesizes the findings of the paper: the technologies that are eliminated from further consideration are identified; specific options showing promise for further study are reviewed; and decision points and windows of opportunity are highlighted.

II. LAND USE AND TRANSPORTATION IN DOWNTOWN LOS ANGELES

The Bunker Hill Transit Tunnel may or may not be viable as a stand-alone facility, serving Bunker Hill only. Stand-alone options for the tunnel will be discussed in Chapters IV and V, and explored in greater depth throughout this project. However, this study is also intended to look more broadly at how the BHTT may function as a piece of a transportation system serving a larger area of downtown. To provide a foundation for exploring those kinds of possibilities, it is useful to review the land use and transportation environments in greater downtown Los Angeles. In this chapter, existing and future conditions are broadly sketched, in the context of relevant policies affecting land use and transportation.

A. LAND USE CONDITIONS AND POLICIES

The greater downtown area includes more than 80 million square feet of office, retail, institutional, residential, cultural and industrial land uses[6] with a population of about 30,000, and an employment of approximately 264,000 persons. The discussion of land use conditions and policies in the downtown area is organized by subareas:

- Bunker Hill;
- the CBD Redevelopment Area (including the Financial Core, Civic Center, South Park, Eastside Industrial, and Broadway/Spring Districts);
- Little Tokyo;
- Chinatown and City North; and
- other subareas (including Central City West and the Alameda Corridor).

Bunker Hill is given the most attention, with some detail also provided for the Financial Core, the Civic Center, Little Tokyo, South Park, and Central City West. Figures 4 - 8 portray existing and future development levels in those areas for which data are available.[7]

1. Bunker Hill Area

a. Background

The Bunker Hill area is in the northwestern portion of downtown L. A. For the purposes of this paper, "Bunker Hill" or "the Bunker Hill area" is defined to be the area bounded by First Street, Hill Street, Fifth Street, and the Harbor Freeway.

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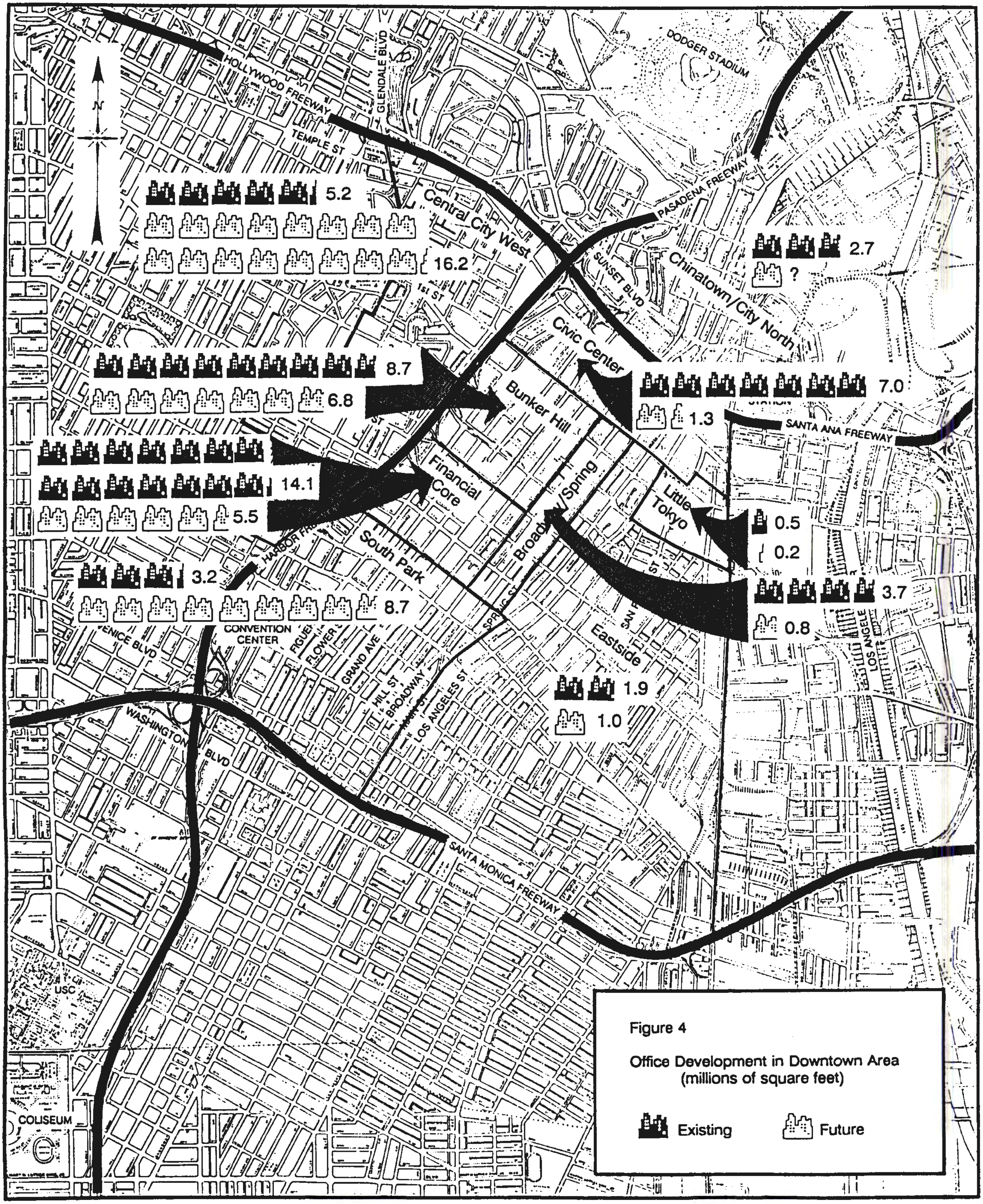
6 According to the 1985 Tax Assessor's Data Base for the Metro Rail Phase I Benefit Assessment District.

7 The numbers in these figures should be viewed as rough estimates. For some areas, complete data were not available; partial numbers are shown. The CRA, through the consultant Economic Research Associates, is presently conducting a demographic study of downtown. That study will eventually provide definitive current data and future projections for many of the areas discussed in this section. Thus, the estimates presented here are subject to change as that study progresses.



N
HOLLYWOOD FREEWAY
TEMPLE ST
GLENDALE BLVD
DODGER STADIUM
PASADENA FREEWAY
SUNSET BLVD
1st ST
Central City West
5.2
16.2
Chinatown/City North
2.7
?
Civic Center
7.0
1.3
SANTA ANA FREEWAY
8.7
6.8
Bunker Hill
14.1
5.5
Financial Core
Broadway/Spring
Little Tokyo
0.5
0.2
3.7
0.8
South Park
HARBOR FWY
3.2
8.7
CONVENTION CENTER
VENICE BLVD
FLOWER ST
GRAND AVE
HILL ST
BROADWAY
LOS ANGELES ST
Eastside
1.9
1.0
WASHINGTON BLVD
SANTA MONICA FREEWAY
USC
COLISEUM
Figure 4
Office Development in Downtown Area (millions of square feet)
Existing
Future

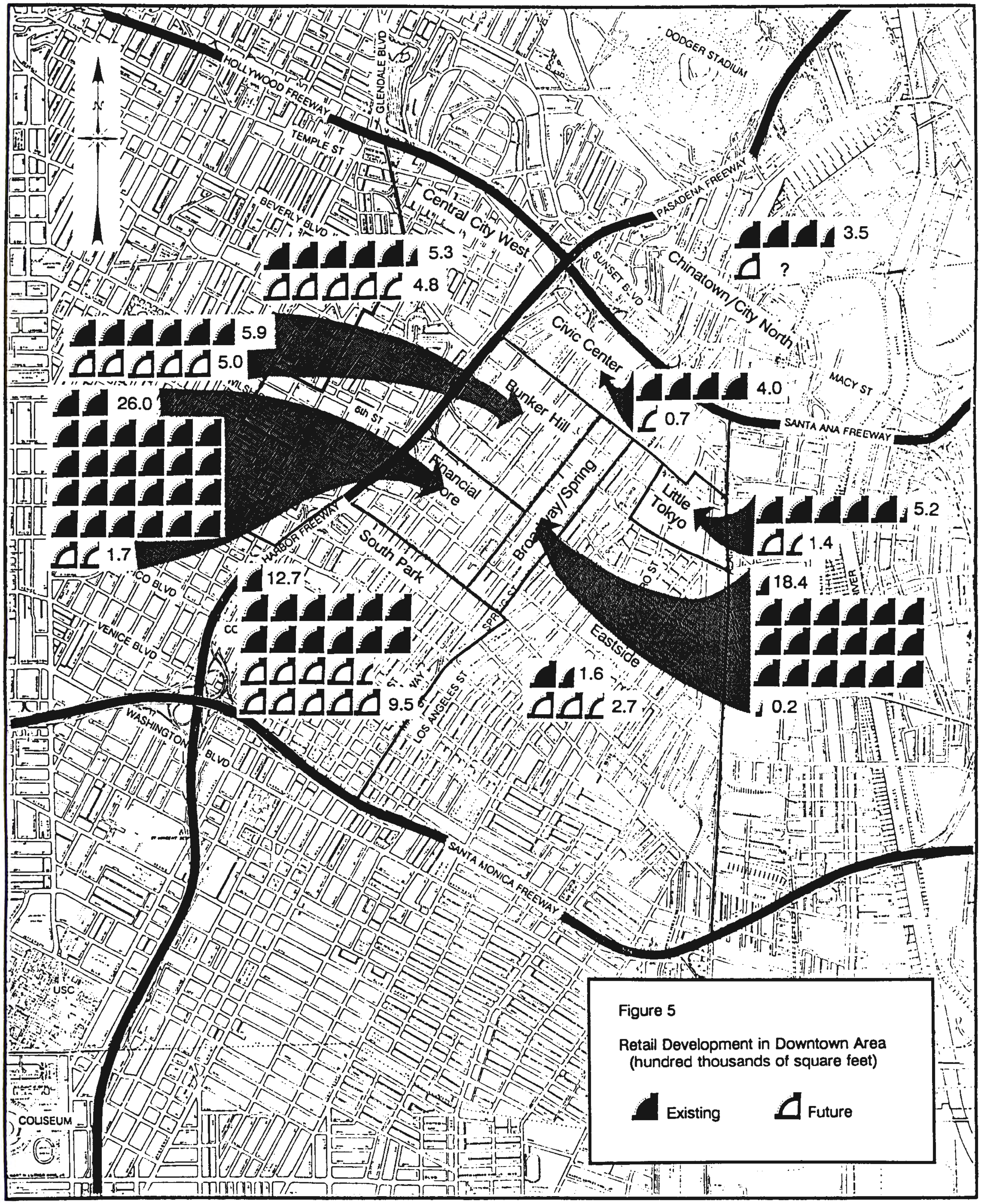


Figure 5

Retail Development in Downtown Area
(hundred thousands of square feet)

Existing Future

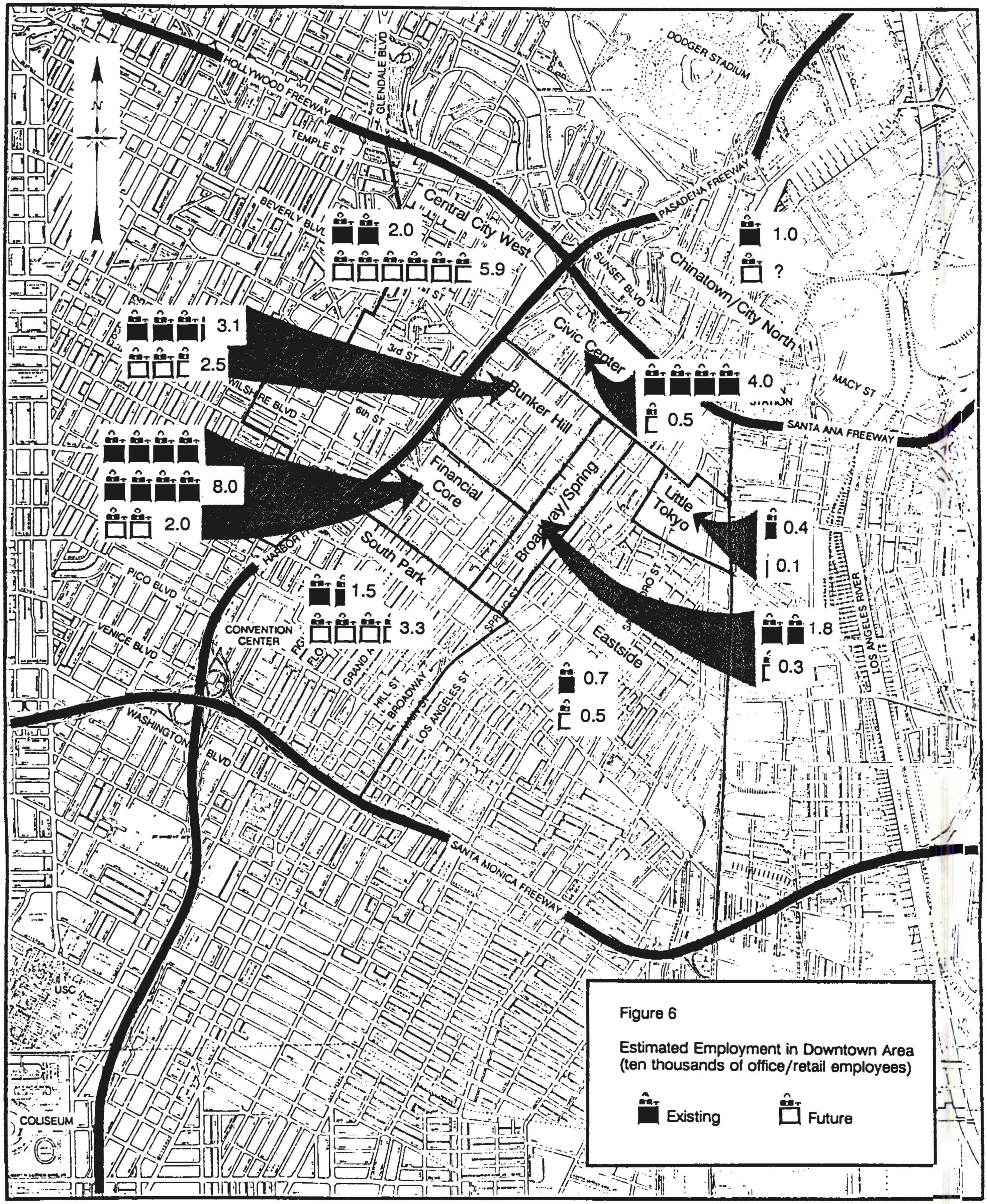


Figure 6

Estimated Employment in Downtown Area
(ten thousands of office/retail employees)

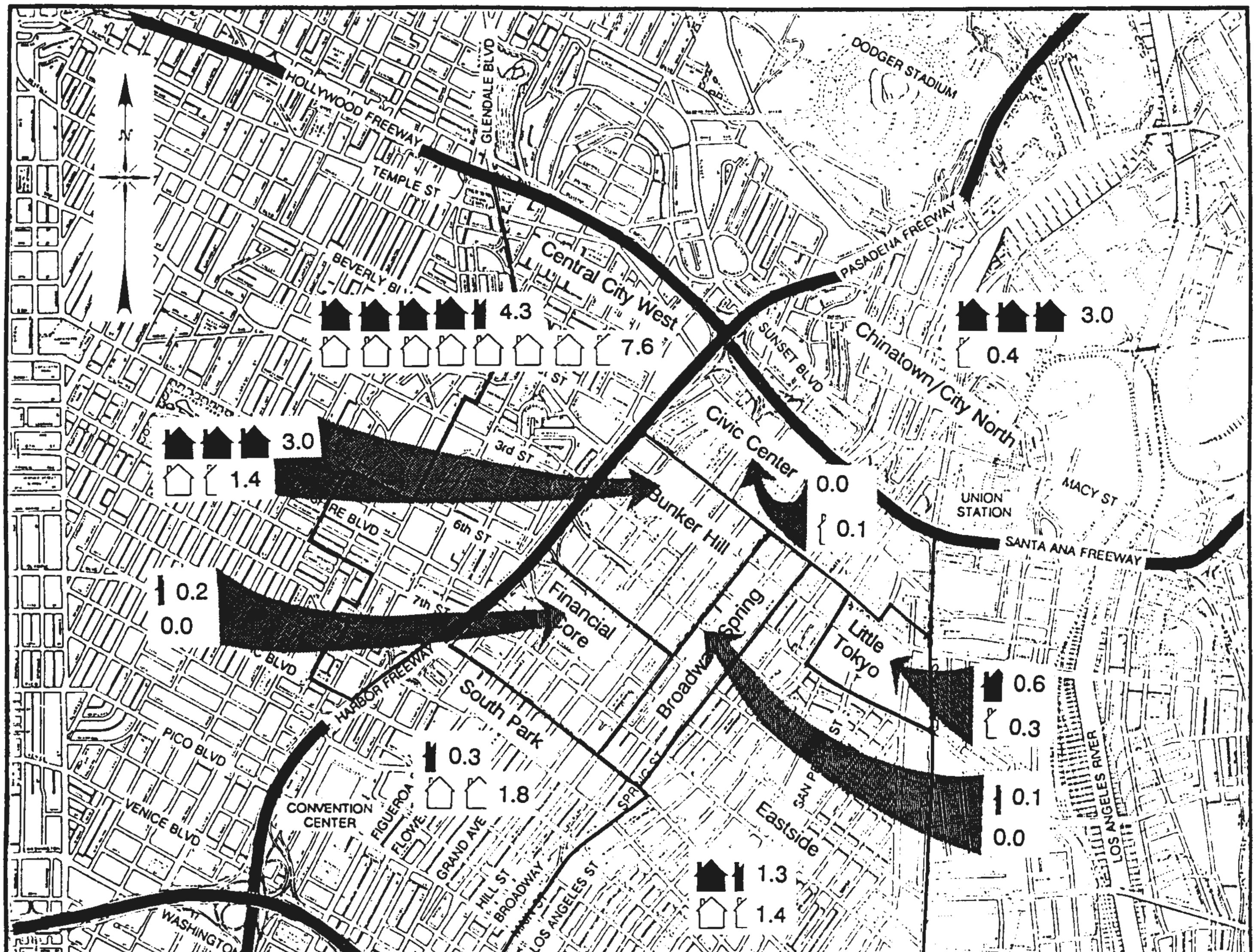
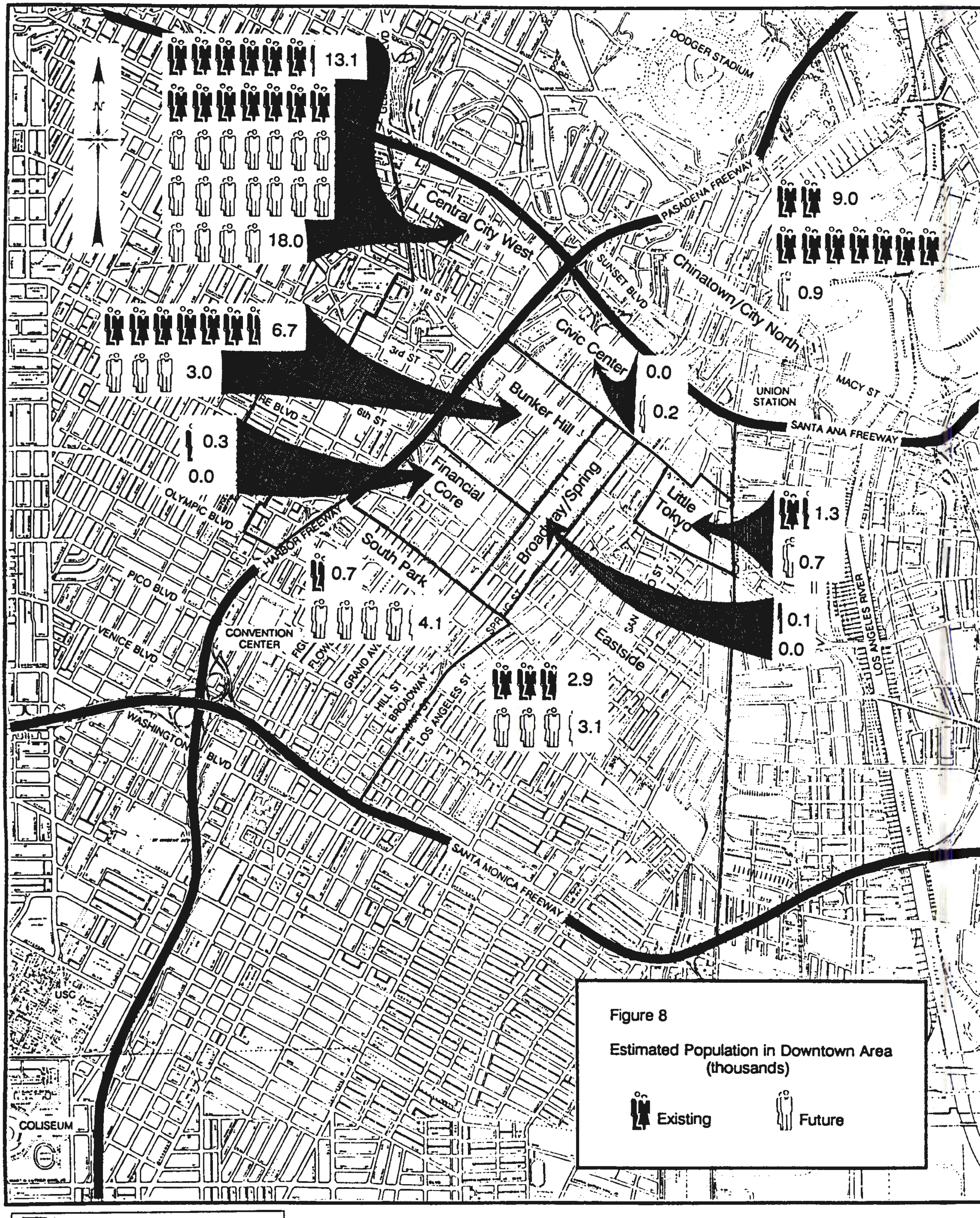


Figure 7

Residential Development in Downtown Area
(thousands of dwelling units)


13.1
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DODGER STADIUM
PASADENA FREEWAY
Central City West
Chinatown/City North
SUNSET BLVD
1st ST
3rd ST
6th ST
Civic Center
Bunker Hill
UNION STATION
MACY ST
SANTA ANA FREEWAY
Financial Core
Broadway/Spring
Little Tokyo
OLYMPIC BLVD
HARBOR FREEWAY
South Park
PICO BLVD
VENICE BLVD
CONVENTION CENTER
GRAND AV
HILL ST
BROADWAY
LOS ANGELES ST
Eastside
LOS ANGELES RIVER
WASHINGTON BLVD
SANTA MONICA FREEWAY
USC
COLISEUM
Figure 8
Estimated Population in Downtown Area (thousands)
Existing
Future

The 133-acre Bunker Hill Redevelopment Project is the oldest redevelopment project downtown, formally created in 1959 (the southern boundary of the redevelopment area differs slightly from the one defined above; it is irregular between Flower and Hill Streets). Among the goals that were established for the area at the time of its creation, the one that is still most relevant is: "The improvement of Bunker Hill's tax base through mixed-use development, including commercial, residential and public services."[8]

b. **Existing and Future Land Use Conditions**

Mixed-use development indeed characterizes Bunker Hill today. As summarized in Table 1, the variety of land uses in the area includes the following:

- **office** (8.7 million square feet): the Los Angeles World Trade Center, Security Pacific Plaza, Wells Fargo Center, California Plaza Phase IA, Union Bank, and O'Melveny and Meyers, among others;
- **retail/restaurant** (586,000 square feet);
- **hotel** (2,029 rooms): the Sheraton Grande and the Bonaventure;
- **residential** (2,988 dwelling units): Bunker Hill Towers, Promenade Towers, Promenade West, Promenade Plaza, Grand Promenade Phase I, and Angelus Plaza; and
- **cultural/entertainment**: the Museum of Contemporary Art, with the outdoor Spiral Court performance plaza.

The major existing developments in the Bunker Hill area are individually described in Table A-1 of Appendix A.

Table 2 tabulates the Bunker Hill development planned to take place within the next five to ten years; individual developments are described in Table A-2 of Appendix A. Table 3 summarizes existing development and planned improvements in the Bunker Hill area. New development is projected to increase office space by 79%, adding nearly 7 million square feet to an existing 9 million. Retail/restaurant/service space will nearly double, to 1.1 million square feet. Hotel rooms will increase by 69%, and dwelling units by 45%. Taken together, these numbers represent substantial near-term growth for the Bunker Hill area.

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[8] **Bunker Hill Redevelopment Project Biennial Report, 1986-1988.** CRA/LA, November 1988, p.2.

TABLE 1

EXISTING DEVELOPMENT IN BUNKER HILL

	Contiguous to BHTT	Non-Contiguous to BHTT	Total Bunker Hill
Office square feet	5,285,000	3,387,000	8,672,000
Retail square feet	320,000	266,000	586,000
Hotel rooms	485	1,544	2,029
Dwelling units	1,808	1,180	2,988
Parking spaces	8,520	8,549	17,069

TABLE 2

PLANNED DEVELOPMENT IN BUNKER HILL

	Contiguous to BHTT	Non-Contiguous to BHTT	Total Bunker Hill
Office square feet	2,190,000	4,622,755	6,812,755
Retail square feet	91,800	412,000	503,800
Hotel rooms	450	950	1,400
Dwelling units	750	600	1,350
Parking spaces	3,715	4,985	8,700

TABLE 3

TOTAL EXISTING AND PLANNED DEVELOPMENT IN BUNKER HILL

Land Use	Existing	Planned	Total	% Increase
Office square feet	8,672,000	6,812,755	15,484,755	78.6
Retail square feet	586,000	503,800	1,089,800	86.0
Hotel rooms	2,029	1,400	3,429	69.0
Dwelling units	2,988	1,350	4,338	45.2
Parking spaces	17,069	8,700	25,769	51.0

Existing development represents approximately 32,000 employees[9] and some 6,000[10] residents.

It is anticipated that, upon buildout, the Bunker Hill area will contain:

- o 15.5 million square feet of office space (including government),
- o 1.1 million square feet of retail space,
- o 4,300 dwelling units,
- o 3,429 hotel rooms, and

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9 **The Los Angeles Central Business District Employee Travel Baseline Survey Final Report**, prepared for the Los Angeles Community Redevelopment Agency, April 1987, p. F-13, estimates a June 1986 office employment for Bunker Hill of **23,628**. This figure evidently does not include employment within the Pacific Bell, Subway Terminal, and Equitable Buildings, assumed for this paper to be in Bunker Hill. Assuming an average 235 square feet per employee and a 15% vacancy rate, these three buildings contain about **3,500** employees. It also does not include several buildings completed or occupied since June 1986, including: California Plaza Phase IA, the Museum of Contemporary Art, and Promenade Towers -- about **3,300** employees. Finally, it does not include employment in retail (about 900 employees, assuming 500 square feet per employee and a 25% vacancy rate), hotel, service, and institutional sectors (about **2,000** employees altogether).

10 According to Exhibit 2 of the Community Redevelopment Agency memorandum entitled, "Downtown Demographics and Land Use" (September 8, 1989), the average household size in the downtown core is 2.41. That average, applied to the 2,988 existing dwelling units in Bunker Hill, less an assumed 7% vacancy, yields a population estimate of 6,700. However, household sizes for Bunker Hill are likely to be lower than the areawide average, with relatively high proportions of households composed of career singles, "double income, no children" couples, or one or two elderly persons. Arbitrarily assuming an average household size of 2.0 for Bunker Hill yields an estimate of 5,560 residents.

- two major (MOCA and Walt Disney Concert Hall) and several minor entertainment/ cultural centers.

Altogether, this represents about 27 million square feet of development: around 59,000 employees and 9,000 residents.

Total parking for this buildout will be about 25,000 spaces[11], which clearly will not be able to fully service the anticipated development described above. This is due in part to a conscious policy of the Community Redevelopment Agency to promote the provision of peripheral parking in lieu of spaces in the CBD (see Subsection B.1.a.). Provision of alternatives to the automobile for access to this area is clearly a key concern, and was the original impetus for the proposed DPM in downtown Los Angeles.

c. Development Density

Bunker Hill is among the most densely developed sectors of the Los Angeles Central Business District. Downtown as a whole averages 2.3 square feet of development (excluding parking but including residential) per square foot of land. The Bunker Hill area is nearly twice that density, with 4.2 square feet of development per square foot of land. Only the Financial Core area just south of Bunker Hill is more intensely developed, with a ratio of 6.6 square feet of development per square foot of land.[12]

When all currently planned developments are completed, the Bunker Hill Redevelopment Area will have reached the 5:1 Floor Area Ratio (FAR) cap on commercial development established by the last amendment to the Redevelopment Plan, in the early 1970s. There is a provision for raising that cap to 6:1, on the condition that regional access to the area be improved so as to become adequate.

Raising the cap would permit up to 4 million square feet of space (representing about 14,000 employees) to be added to Bunker Hill. The County of Los Angeles has the first right to build part or all of that increment, and has indicated contingency plans to use about half of it. Private developers have expressed interest in building the other half.

Preliminary studies have indicated that the Metro Red and Blue Lines alone will not sufficiently improve regional access to justify lifting the cap. The Bunker Hill Transit Tunnel may play a role in increasing that access to the point that the FAR limit can be raised.

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11 "Parking Report: Traffic Impact Zone", CRA/LA and LADOT, September 1989, pp. 3 and 4.

12 Calculated from the Tax Assessor's Data Base (1985).

2. CBD Redevelopment Area

With an ordinance adopted in 1975, a major portion of downtown Los Angeles became the CBD Redevelopment Area. According to the Redevelopment Plan, "The basic objective of the Project is the eradication of blighting influences within the Project area and the prevention of their reoccurrence through the redevelopment of land uses consistent with the environmental, economic and social goals of the community."[13] A full list of planning goals and objectives for the CBD Redevelopment Area is provided in Table A-4 of Appendix A.

The CBD Redevelopment Area contains a variety of subareas, each with a different character, but whose boundaries in a practical sense overlap somewhat: the Financial Core, the Civic Center, South Park, the Eastside Industrial Areas, and the Broadway/Spring Historic Core. These subareas are discussed separately below.

a. Financial Core

The Financial Core, as its name suggests, is the heart of banking and other financial activity for the region. It is also, as indicated earlier, the most densely developed portion of downtown, with about 14 million square feet of office space and 2.6 million square feet of retail in the area bounded by Fifth, Hill, Eighth, and the Harbor Freeway.

Two major highrises are currently under construction in the Financial Core: the 52-story, 880,000 square foot Figueroa at Wilshire Tower; and the 53-story, 976,000 square foot 777 Tower (Citicorp Plaza Phase II) at 777 South Figueroa. In all, about 5.5 million square feet of office space alone are projected to be added to the Financial Core over the next 10 - 15 years, an increase of 39%.

b. Civic Center

The Civic Center contains a high concentration of Federal, State, County, and City employees and facilities. Some of the major public buildings found within the area bounded approximately by the 101 Freeway, Alameda Street, First Street, and the I-110 Freeway are: City Hall, the Federal Building, the Parker Center City Police Building, the U. S. Courthouse, the Hall of Justice, the Criminal Courts Building, the County Administration Building, the County Courthouse, and the Department of Water and Power Headquarters Building. That area also contains the Music Center complex, whose three facilities (the 3,200-seat Dorothy Chandler Pavilion, the 2,000-seat Ahmanson Theater, and the 750-seat Mark Taper Forum) attracted more than one million patrons in the 1988-89 performance season.

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[13] **Redevelopment Plan: Central Business District Redevelopment Project**, Community Redevelopment Agency, City of Los Angeles, 1975, p. 14.

A number of other civic facilities are located just outside the area, including the L. A. City Board of Education Building north of the 101 Freeway, the Caltrans District 7 office at 120 South Spring Street, the new State Office Building under construction at Third and Spring, and several existing and planned city and state office locations in Little Tokyo.

c. **South Park**

The CBD Redevelopment Plan for the 1500-acre South Park area states:

> "The predominant land use in the South Park Development Area shall be housing, to be designed for various income groups and family sizes. The remaining land shall be occupied by a significant amount of open space and by commerce. The provision of housing and open space are to be accomplished as a first priority. It is essential that specialized facilities and amenities, such as day care centers, playgrounds and recreation areas designed for various age groups be developed in conjunction with the new housing."[14]

Thus, South Park is intended to provide some residential balance to the job-rich Central Business District.

The residential core of South Park has seen the recent completion of the Metropolitan development, containing 270 rental units; and groundbreaking on the Del Prado Housing complex, to contain another 192 units. South Park is eventually envisioned to include up to 15,000 dwelling units.

In general, the commercial development within South Park is focused along Figueroa Street and west to the Harbor Freeway. An important anchor for future commercial development in South Park is the Los Angeles Convention Center. The Convention Center has recently begun a $390 million expansion designed to upgrade the region's comparatively poor standing in terms of convention-related visitors per year.

In addition to the 650,000 square foot, 35-story building currently under construction at 865 South Figueroa, several major commercial developments have been proposed for South Park, including:

- o the 1.9 million square foot Pacific Basin Plaza complex, involving a 1,781-room hotel (the largest in the County and the only hotel within walking distance of the Convention Center) and a 30-story office tower;
- o the 474,000 square foot, 28-story R&T Building at Eighth and Figueroa;
- o the RCI Tower at Ninth and Figueroa; and

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[14] **Redevelopment Plan: Central Business District Redevelopment Project, CRA, p.22.**

- the Metropolis complex adjoining the Harbor between Seventh and Eighth Streets, including 1.8 million square feet of office space and a 500-700 room hotel.

These and other planned developments would more than triple the office space in South Park, from 3.2 million to 12 million square feet.

South Park will ultimately be linked (in a metaphysical as well as physical sense) to the Financial Core by the Hope Street Promenade, a 1.2-mile strip of retail and pedestrian-oriented development stretching from the Central Library on the north to the Santa Monica Freeway on the south.

d. **Eastside Industrial**

The Eastside Industrial Area is in the southeast quadrant of downtown, including large sections which are not part of any redevelopment area. It is characterized by light industrial activity (manufacturing, warehousing, wholesaling, and some retailing), and is home to the produce and flower industries and the $1 billion/year garment industry.

In view of the industrial character of this area, the office employment shown in Figure 6 is a misleading indicator of activity. Eastside contains an estimated 55,000 employees, including 43,000 in the garment industry alone. Development activity in this sector of downtown is focused on rehabilitation of existing buildings rather than on major new construction.

e. **Broadway/Spring Historic Core**

Spring Street was formerly the financial hub of downtown Los Angeles, the "Wall Street of the West". Broadway, in an echo of its New York namesake, was the entertainment center of the city, home to ornate theaters such as the Million Dollar and Palace Theaters, and other historic structures such as the 94-year-old Bradbury Building.

Today, the area forms the western fringe of Skid Row. However, Broadway is a flourishing retail-oriented corridor, anchored in the north by the venerable Grand Central Market, and in the south by apparel industry activity. Redevelopment efforts continue to bear fruit in the office sector as well. It is hoped that the soon-to-be-completed 825,000 square foot State Office Building at Third and Spring will further accelerate the revitalization of this area.

3. <u>Little Tokyo</u>

Little Tokyo was the second redevelopment area to be defined in downtown, established in 1970. Today, it is characterized by medium-density mixed-use development, including (see Table A-5 in Appendix A for a complete list of existing and planned developments):

- o office (about 350,000 square feet);
- o retail (half a million square feet);
- o hotel (the 448-room New Otani and the 174-room Hotel Tokyo);
- o residential (568 dwelling units in several developments); and
- o cultural (the Higashi Hongwanji Buddhist Temple, the Union Church, the Japan American Theatre, and the Japanese American Cultural Center).

This represents about 2.3 million square feet. At least 1.2 million square feet of new development are planned for Little Tokyo, and that does not include several proposed major facilities (such as the Volk Office Building at First and Central) which are not yet well-defined.

4. Chinatown and City North

The Chinatown/City North area can be considered the "historical, cultural and transportation heart of Los Angeles."[15] It is approximately bounded by the Pasadena Freeway on the north and west, the Golden State Freeway on the east, and the Hollywood Freeway on the south. Dodger Stadium lies just to the west. The area has three distinct zones: Chinatown, with medium-density mixed-use development (primarily residential and retail); Olvera Street/El Pueblo, the historic birthplace of Los Angeles now serving as a cultural and tourist attraction, together with nearby Union Station; and the predominantly industrial and vacant area along the Los Angeles River (including the 56-acre "Cornfields", an unused railyard just east of Broadway which was the original site of Chinatown).

The City North area was recently the subject of a brainstorming planning session sponsored by the City Planning Department. The proposal which was the outcome of that session included replacing the railyards area with a major housing and open space development (up to 15,000 dwelling units), to be called the River Park Area, and building a tram connecting the Chinatown LRT stop to Dodger Stadium. The proposal also emphasized pedestrian links among the three zones and between Olvera Street and the Civic Center. Plans for this area will be refined over the next several months.

5. Other Areas

a. **Central City West**

For a long time, the Harbor Freeway served as a physical and psychological western boundary to downtown Los Angeles. In recent years, however, several major developments have joined Unocal headquarters and Pacific Bell in the area just west of the freeway, including the WCT building on Wilshire Boulevard, the Pacific Stock Exchange, and the new ARCO Building. Other developments have been approved, notably the Watt City Center (the first

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[15] Los Angeles Design Action Planning Team report to the City of Los Angeles, December 5, 1989, p. 3.

phase involving a 27-story, 600,000 square foot office tower) at Bixel and Seventh. Plans have been advanced for a number of additional specific developments, but an "Interim Control Ordinance" is in effect which delays further activity while the new proposed Specific Plan is being reviewed.

A consortium of property owners and developers, in coordination with the City of Los Angeles, has spearheaded the preparation of a Transportation/Land Use Specific Plan for the CCW area, roughly bounded by Temple Street to the north, Glendale/Witmer/Union to the west, Olympic Boulevard to the south, and the Harbor Freeway to the east. The Plan analyzes the transportation impacts of two levels of development.

In the first scenario, office development is assumed to nearly quadruple, from 5.2 million square feet today, to 21 million square feet in the future. Other land uses would bring total commercial development to about 25 million square feet. The second scenario assumes a 36 million square feet level of total commercial development. For both scenarios, housing is assumed to increase by 177%, from 4,300 dwelling units today to 11,900 in the future. Existing and future housing will be located primarily in the northern portion of the CCW area. High-density office development will cluster to the east and south portions of the area, along Beaudry, Boylston, Bixel, Wilshire, and Seventh Streets.

These two levels of development are approximately 38% and 54%, respectively, higher than the current size of the CBD proper. Put another way, the lower scenario would involve a level of new development roughly equivalent to that found in the existing Financial Core area. For the CCW area as a whole, the 25 million square feet level of development represents an average FAR for commercially-zoned property of 3.0:1.

b. Alameda Corridor

The Alameda Corridor, or "East of Alameda", is currently characterized by warehousing and other light industrial activities, with a relatively recent influx of artists taking up residence in the "loft district" in the northern portion. However, the corridor has lately been the focus of considerable speculative investment, in some cases pushing prices well above the level that could be supported by industrial uses. There are scattered proposals for large commercial and mixed-use developments in the corridor, but these all depend on whether the area is rezoned to permit higher densities.

B. TRANSPORTATION CONDITIONS AND POLICIES

The existing and proposed levels of development described in Section A create the demand for transportation to, from, and within the downtown area. In this section, transportation conditions and policies in downtown Los Angeles are described. First, relevant policies are discussed. Then, existing demand characteristics are presented. This is followed by a profile of downtown transportation supply -- a description of major existing, planned and

proposed transit facilities and services. Finally, important transportation issues facing downtown are discussed.

1. Transportation Policies

A number of agencies have authority to formulate transportation policies affecting downtown, including the Community Redevelopment Agency (CRA), the City of Los Angeles, and the Air Quality Management District (AQMD). The following subsections briefly describe some important policies established by these agencies.

a. Traffic Impact Zone/Peripheral Parking

The City of Los Angeles has defined the Traffic Impact Zone (TIZ) as the specific part of downtown that experiences the highest levels of congestion now and will continue to do so in the future. This zone, as shown on Figure 9, is bounded by the Harbor (110) and Santa Ana (101) Freeways, Broadway Street, and Olympic Boulevard. A policy priority is to reduce the number of vehicles entering the TIZ.

In April 1987, the Los Angeles Community Redevelopment Agency adopted a Peripheral Parking Program for new developments within the TIZ that exceed 100,000 leasable square feet. The program requires developers to substitute between 25% and 40% of code-required parking downtown with an equal number of spaces in certain designated peripheral parking areas, or alternative sites if certain criteria are met. Shuttle bus service linking the designated parking areas to the new development must be provided.

Currently, two areas are designated for peripheral parking: Union Station to the northeast and the Convention Center to the southwest (not coincidentally, the two terminal points of the old DPM alignment). The **Downtown Los Angeles Peripheral Parking Program** report lists a third recommended location for possible future implementation, in the Temple/Beverly/Glendale Boulevard area northwest of downtown. An extended BHTT could be integrated into the Peripheral Parking Program by serving additional peripheral lots in that area and/or east of downtown. Affected developers could partially or completely fulfill the requirement to provide shuttle service by helping to underwrite the capital and operating costs of an extended BHTT.

The relationship of the BHTT to the peripheral parking issue is twofold: (i) a BHTT-based system (whether stand-alone or expanded) may obviate the need for an automobile during the workday (e.g. for lunch) by connecting a number of downtown activity centers, thereby making peripheral parking a more attractive option; and (ii) an expanded BHTT may act as a shuttle service from peripheral parking lots to downtown destinations.

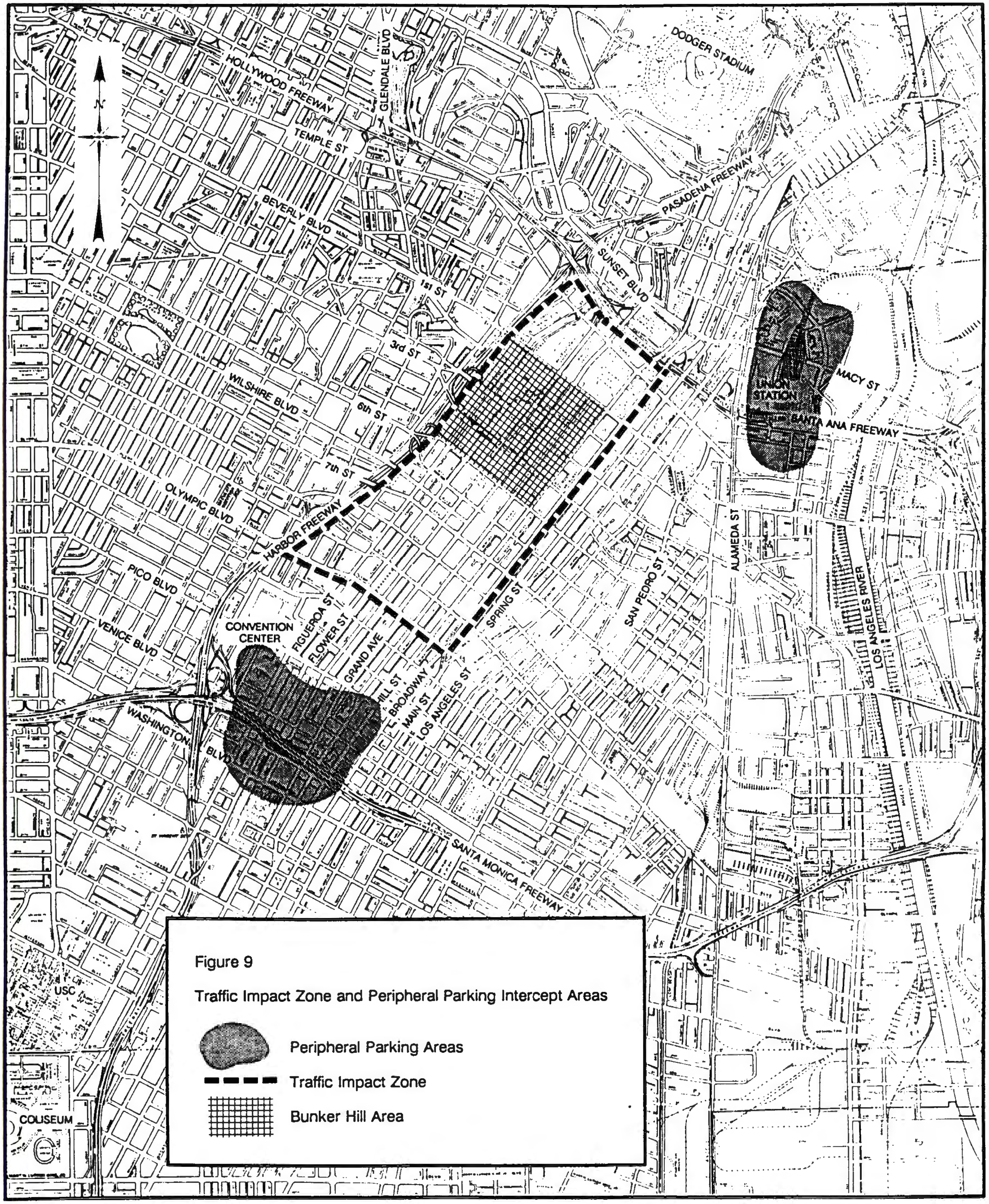


Figure 9

Traffic Impact Zone and Peripheral Parking Intercept Areas

b. **TRIP Ordinance**

The Los Angeles City Council adopted the Transportation Reduction and Improvement Program (TRIP) Ordinance in 1987. The TRIP Ordinance explicitly recognizes the link between development and traffic. It permits new development to be assessed a fee for each new peak-hour vehicle trip created, with the money to be used for transportation improvements. The Central City West Specific Plan proposes a $16,490 fee per trip, to provide $281 million for transportation measures.

c. **Regulation XV and Other Air Quality Regulation**

In 1987, the AQMD adopted Regulation XV, which establishes targets for peak-period vehicle occupancy. The target for downtown is 1.75 persons per vehicle (the current occupancy is about 1.67). Firms with more than 100 employees at a single site are subject to the regulation, and must annually submit a plan to the AQMD for achieving the target.

Discussion is ongoing about the feasibility of extending Reg XV to smaller employers, using a multi-firm Transportation Management Association (TMA) as an umbrella coordinator. The AQMD has also expressed the intention of evaluating proposed new development on the basis of the contribution of that development to job-housing balance.

2. Demand profile

As will be further discussed in Chapter IV, the BHTT, especially as part of an expanded system, could serve two distinct functions: (i) the final-leg distribution of downtown-oriented commuters transferring from a line-haul mode such as rail (e.g. at Union Station) or auto (e.g. at a peripheral parking lot); and (ii) circulation within downtown for midday trips. In that light, it is important to review existing demand patterns for both types of trips.

a. **Commute Trips -- Mode Split and Directions of Travel for Downtown Workers**

A previous study[16] found the following distribution of commuter trips into downtown:

22% from the northwest;
18% from the west;
13% from the south;
23% from the east; and
24% from the northeast.

[16] The **Downtown Los Angeles Peripheral Parking Program** report, LACRA and LADOT with Brophy & Associates, COMSIS Corporation, Hunnicut & Associates, and Williams-Kuebelbeck & Associates, October 1986.

As for mode split, about 60% of office workers commuting to downtown drive alone, 17% carpool or vanpool, and 21% use transit as their primary mode to work[17] (see Table 4).

The profile for the Bunker Hill area of downtown is markedly different from the average, with a much higher drive alone share (70%) and much lower shared ride (11%) and transit shares (16%) than the average. The lower transit share might be explained on the basis of the difficulty in providing direct transit service throughout the Hill, but the same cannot be said for the shared-ride mode.

It is of interest to compare the mode split for Bunker Hill to that for the Financial Core -- two contiguous areas that, *a priori*, might be assumed to be quite similar. Table 4 indicates that the shared ride proportions are about the same for each area, while the Financial Core has a lower drive alone share (62%) and a higher transit share (25%) than Bunker Hill. On the surface, at least, it appears that Bunker Hill commute trips lost to transit are virtually completely captured by the drive alone rather than shared-ride alternative.

These observations underscore the desirability of improving transit service -- as well as the attractiveness of ridesharing -- to downtown in general, and to Bunker Hill in particular. The BHTT could provide direct transit service through the heart of Bunker Hill, and an expanded BHTT could serve both the transit users of an HOV facility (such as the El Monte Busway or the proposed Glendale HOV lane), and the rideshare users that park in a peripheral lot.

TABLE 4

MODE SPLIT FOR DOWNTOWN OFFICE WORKERS

	Total	Traffic Impact Zone	Bunker Hill	Financial Core
Drive Alone	60%	64%	70%	62%
Shared Ride	17	16	11	12
Transit	21	18	16	25
Walk/Other	2	2	3	1

[17] The Los Angeles Central Business District Employee Travel Baseline Survey Report, April 1987.

b. Midday Trips – Generation Rate and Mode Split

Planning studies done for the original Downtown People Mover provide useful data on midday trip generation and mode split characteristics in downtown Los Angeles. A workplace survey was conducted in June 1980, sampling employees across all industries and occupations. The survey found that overall, 1.1 midday trips per employee were made. Of all employees, 37.2% actually made midday trips outside their place of employment. For those making midday trips, an average of 2.99 trips per employee were made.[18]

Table 5 shows the mode split for those midday trips.[19] More than half (54%) were walk trips; for another 31%, the respondent drove an automobile. For half of the remaining 15%, no mode was specified, while the other half was spread over auto passenger, minibus (DASH), regular bus, and bicycle.

Of course, this survey reflected behavior at the time, not behavior with a DPM system in place. The presence of a DPM would cause mode shifts to occur, and would also generate trips that would not otherwise have been made. According to the patronage forecasting models developed in the early 1980s, the Los Angeles DPM would have generated an additional 5.6% midday circulation trips, and would have captured an 8.2% share of the total midday circulation trips.[20]

TABLE 5

MODE SHARES FOR MIDDAY TRIPS

Mode	Share
Auto Driver	31.10
Auto Passenger	2.84
Minibus	3.05
Bus	1.45
Bicycle	0.02
Walk	54.10
No Response	7.43

TOTAL	99.99

18 **Assessment of Workplace and On-Board Transit Surveys for Los Angeles Downtown People Mover Program.** Task 1 Final Report, Downtown People Mover Evaluation Program. Peat, Marwick, Mitchell & Co., for Los Angeles Downtown People Mover Authority, April 1981, Exhibit 38, p.72.

19 **Assessment of Workplace and On-Board Transit Surveys . . .**, Exhibit 40, p.74.

20 **Demand Models and Patronage Forecasts for the Los Angeles Downtown People Mover Program.** Tasks 3, 4, and 5 Final Report, Downtown People Mover Evaluation Program. Peat, Marwick, Mitchell & Co., for the Los Angeles Downtown People Mover Authority, November 1981, pp. VI.2-3.

3. Supply Profile

Figure 10 illustrates major existing and planned transportation facilities in the region (Los Angeles County) and downtown. Figure 11 portrays proposed facilities in the greater downtown area. These exclusive guideway projects are described in Subsections **a (Rail Lines)** and **b (HOV Lanes/Transitways)** below. Existing services not requiring dedicated guideways are briefly described in Subsections **c (DASH)** and **d (RTD and Other Bus)**.

a. Rail Lines

i. Metro Rail (Metro Red Line)

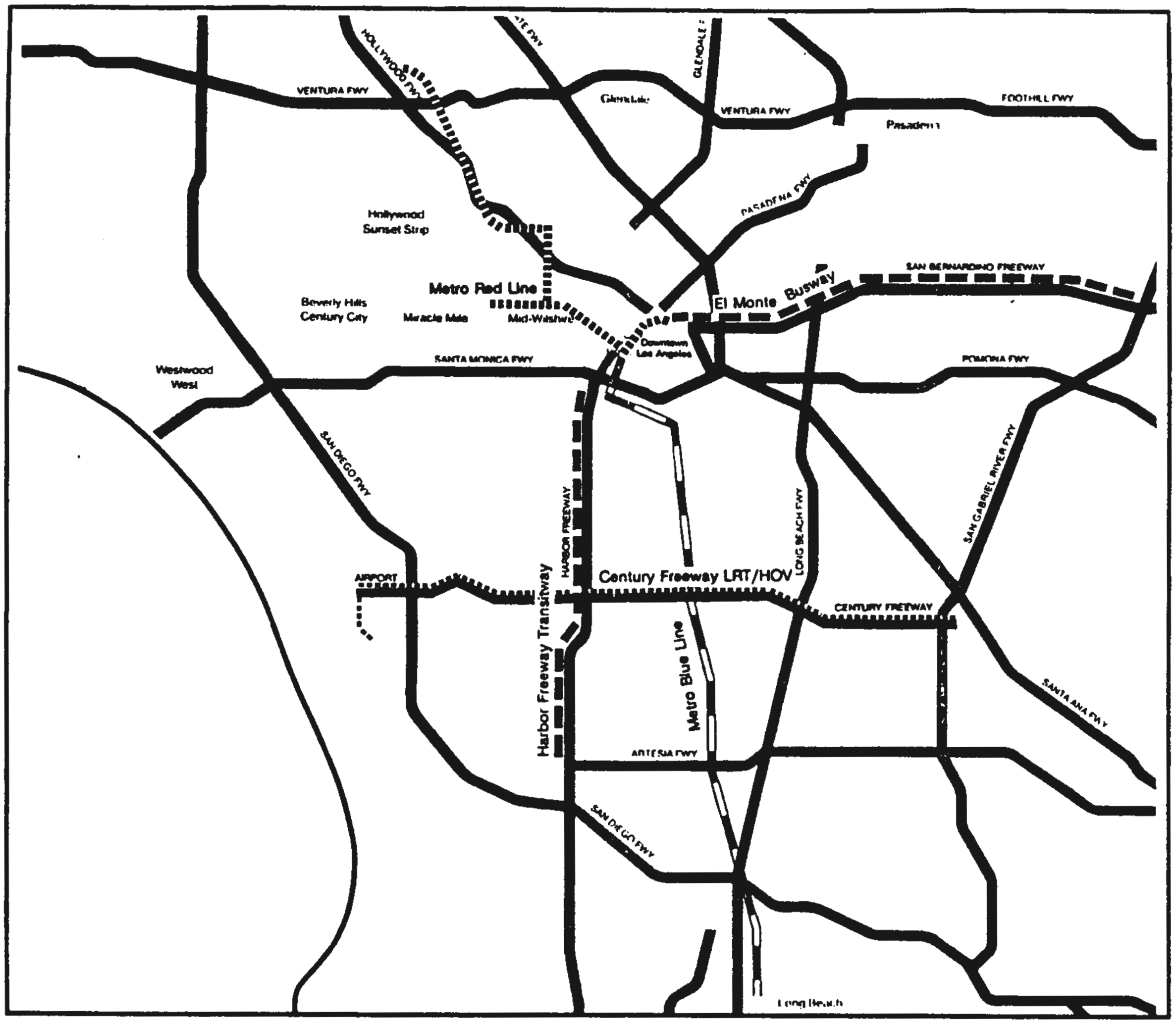
The first segment of the Metro Red Line (heavy rail subway) is under construction, with completion scheduled for late 1993. The 4.4-mile, $1.25 billion segment begins at Union Station, northeast of downtown, with stations at the Civic Center (First and Hill), Pershing Square (Fifth and Hill), Metro Center (Seventh and Flower), and Wilshire and Alvarado. The 13.2-mile second and third phases of Metro Rail construction will extend the Red Line westward to Wilshire and Western, and northward to North Hollywood. Eleven stations will be added in these phases; construction is scheduled to begin in 1993 and be completed by the year 2000.

ii. Los Angeles - Long Beach Light Rail (Metro Blue Line)

The 21-mile Los Angeles - Long Beach light rail transit (LRT) line, or Metro Blue Line, is under construction, with completion of the above-ground portion of the system (i.e., to Pico and Flower) scheduled for mid-1990, and completion of the subway portion (to Seventh and Flower) scheduled for 1991.

iii. Pasadena Light Rail

A Revised Draft Environmental Impact Report has recently been released for public comment on alternative alignments for the Pasadena LRT. One alternative, the "Union Station - No Subway" option, begins at Union Station and proceeds north. All other alternatives begin from the Seventh and Flower terminus of the LB-LA line, and proceed north, generally underneath Flower, as far as Second Street. At Second Street, two main options are under consideration. One proceeds generally north through Chinatown; the other proceeds east under Second Street, turning north along Los Angeles Street (or another street) and serving the Civic Center, Little Tokyo, and Union Station. Other options are being studied for the remainder of the route into Pasadena.



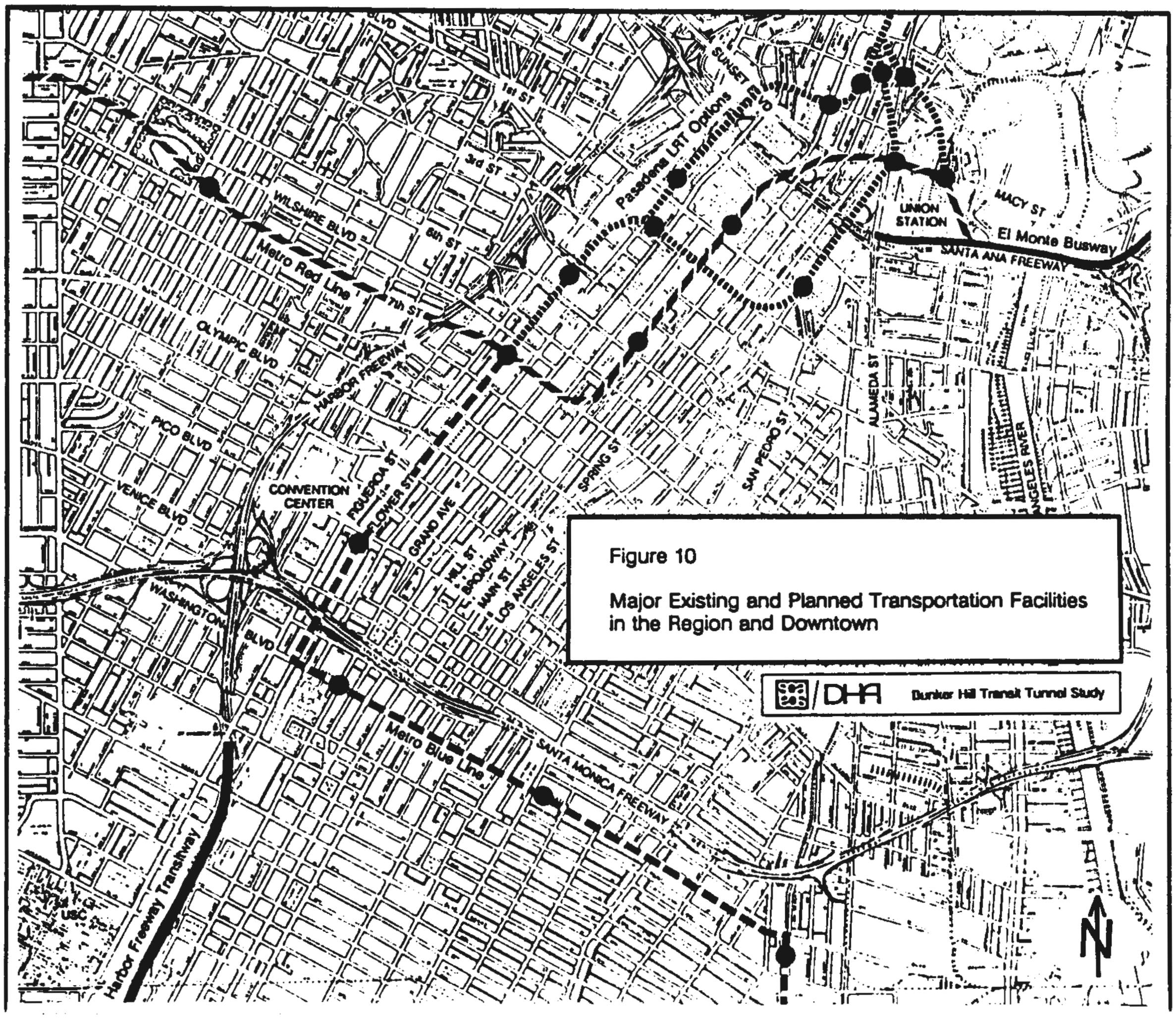


Figure 10

Major Existing and Planned Transportation Facilities in the Region and Downtown

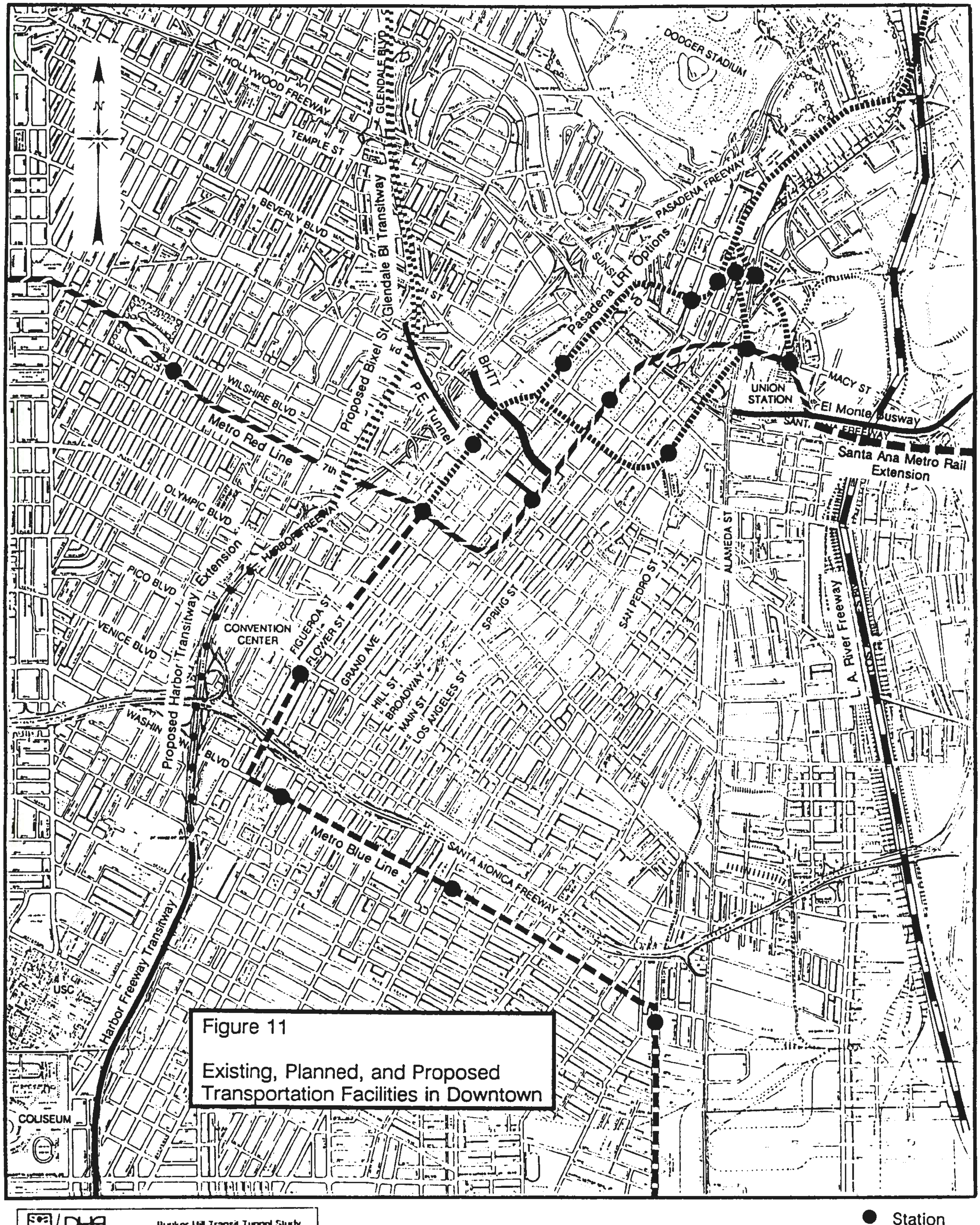


Figure 11

Existing, Planned, and Proposed Transportation Facilities in Downtown

iv. Other Rail Lines

A light rail line is currently under construction in the median of the Century Freeway. Environmental studies are also underway for other rail lines and extensions. Several alignments are under consideration for the Santa Ana extension of Metro Rail, all of which proceed generally east and south from Union Station and end up roughly following the Santa Ana Freeway to Norwalk. Other corridors with rail lines in the planning stages include the Coastal Corridor, the San Fernando Valley, and the Wilshire/Metro Core area out to Santa Monica.

b. HOV Lanes/Transitways

The terms "high-occupancy vehicle (HOV) lane (or facility)" and "transitway" are often used interchangeably. They are typically open both to buses and to carpools or vanpools. A carpool may be defined as two or more people or three or more people in the vehicle.

The only existing HOV facility serving downtown is the El Monte Busway in the median of the San Bernardino Freeway, stretching from El Monte in the San Gabriel Valley to near Union Station. An extension of the busway to Alameda Street near Union Station is close to completion; eventually, a transfer facility to Metro Rail will be furnished.

Two regional transitways are under construction. One is in the median of the 17-mile Century Freeway (in addition to the light rail line mentioned above), with two carpool/bus lanes in each direction. Completion is planned in late 1993. The other is the 20-mile Harbor Freeway Transitway, stretching from the Artesia Freeway to just south of the Santa Monica Freeway. Construction began in the spring of 1989, and completion is scheduled for 1995.

Several HOV facilities are under discussion in the downtown area. The Central City West Specific Plan proposes a number of transportation improvements to accommodate the increased demand the CCW development would create. Potential HOV facilities include:

- o extending the elevated Harbor Freeway transitway/HOV facility (which is currently planned to exit the freeway at 23rd Street and Figueroa) northward along the freeway (passing under the Santa Monica Freeway), to the vicinity of Wilshire and Bixel;
- o a "transit mall" (tunnel) under Bixel Street from Wilshire to Crown Hill, at Glendale/ Second and Beverly, with a potential peripheral parking structure at Crown Hill;
- o an elevated transitway over Glendale Boulevard from Crown Hill to the Hollywood Freeway; and

- an at-grade reversible HOV lane up Glendale Blvd. north of the Hollywood Freeway to join the previously proposed HOV lanes on the Glendale Freeway.

These facilities would create a practically continuous exclusive-guideway HOV/transit corridor between the Artesia Freeway and the City of Glendale.

State Assemblyman Richard Katz has spearheaded a proposal to build an HOV facility down the concrete-lined Los Angeles River, extending 35 miles from Canoga Park in the San Fernando Valley to Union Station (from Union Station south to the harbor -- 15 miles -- it is proposed to use the river as an exclusive facility for trucks). A preliminary feasibility study, sponsored by the Los Angeles County Transportation Commission (LACTC), is nearly completed.

Finally, discussions have recently resurfaced regarding the use of the Pacific Electric (P.E.) Tunnel for high-occupancy vehicles and DASH buses. Beginning in 1929, the tunnel carried "Red Line" trolley cars from Crown Hill (Glendale Boulevard/Second Street at Beverly Boulevard), to the Subway Terminal Building at Fourth and Hill. It has not been used for transportation since 1955[21].

The P.E. Tunnel is no longer continuous along its entire length. Construction of the Bonaventure Hotel (originally the "Portman Hotel") blocked the P.E. Tunnel essentially at Figueroa Street. Later construction of the ARCO parking garage filled in a portion of the tunnel east of Figueroa Street, leaving clear a three-block segment at the eastern end. Various studies have been performed in the past regarding the reuse of this tunnel.

c. DASH

The Downtown Area Short Hop (DASH) shuttle bus service has been available since the mid-1970s. Operated by the Los Angeles Department of Transportation (LADOT), the service last year divided into two routes to provide better coverage of downtown activity points. One route serves Chinatown, Olvera Street and Union Station, the Civic Center, Bunker Hill, and Central City West. The other route serves Little Tokyo, the Civic Center, Bunker Hill, the Financial Core, Seventh Street retail, the Garment District, and South Park.

DASH is in operation between 7:00 a.m. and 6:00 p.m. on weekdays, with 6- to 10-minute headways; and from 10:00 a.m. to 5:00 p.m. on Saturday, with 15-minute headways. The fare is $0.25. The daily patronage is estimated at 4,200 to 4,600.

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21 **Pacific Electric Tunnel Transit Study**, City of Los Angeles Bureau of Engineering, September 1975.

d. **RTD and Other Bus**

Downtown L.A. is served by about 132 bus lines: 117 operated by the Southern California Rapid Transit District (SCRTD), and 15 by a total of 6 other operators, including LADOT. About 17,500 bus trips are made into and out of the CBD each weekday, carrying about 305,000 passengers.

4. Transportation Issues Facing Downtown

When existing and future transportation conditions are examined in the context of existing and future development, several issues emerge -- issues which the BHTT may play a role in addressing. These issues are discussed below, under headings that are conceptually distinct but, in practice, not mutually exclusive.

a. **The Need for Improved Internal Circulation**

If downtown employees are to be persuaded to leave their automobiles at home or in peripheral parking lots, some viable alternatives for midday travel must be provided. That is, the internal circulation system for downtown must be improved. Current and planned options -- bus, walking, and Metro Rail -- are inadequate.

The DASH shuttle was instituted to partially address the need for internal circulation, and its performance has met or exceeded expectations. But DASH buses travel the same congested streets as everyone else, and thus the level of service they can provide is constrained. At midday, for example, it can take 45 minutes for DASH to travel from the heart of the Financial District to the heart of Chinatown -- which reduces its attractiveness for lunchtime excursions.

Downtown Los Angeles is not particularly "pedestrian-friendly". Plans for an extensive pedway system have been advanced in the past, but have been only incompletely realized, primarily in the overhead walkways linking several buildings on Bunker Hill. Pedestrian amenities are being incorporated into the planning and construction of a number of new developments (including, notably, the Bunker Hill Steps under construction next to the First Interstate World Center). But such efforts are scattered, and even at their most complete level cannot efficiently serve all the internal circulation needs of an area the size of greater downtown Los Angeles.

The two rail lines under construction through downtown are expected to carry many midday trips. But these limited-stop facilities will serve only a portion of the greater downtown area, leaving a number of activity centers unconnected.

b. **The Need for Improved Distribution**

Similarly, those same existing and planned transportation systems are limited in their ability to distribute commute trips to their final downtown destination. For example, Union Station is being designed to be a major interceptor for trips coming from the north, east, and southeast sectors: on commuter rail, the El Monte Busway, the Santa Ana extension of Metro Rail, and potentially an L. A. River Freeway, as well as carpoolers parking in the peripheral lot there. Yet the Metro Red Line is the single option currently planned to distribute those trips through downtown. (Some proposed versions of the Pasadena LRT would also connect Union Station with downtown.)

c. **System Geometry**

As currently constituted, the Metro Red and Blue Lines will intersect at only one location: Seventh and Flower (again, some potential alignments of the Pasadena extension of the Blue Line would also meet the Red Line at Union Station). Increasing the connectivity of the rail system through additional linkages would increase its attractiveness to users by providing multiple route and destination options.

Specifically, the rail alignments through downtown have a distinct north - south orientation. The east - west demand patterns emerging through the major developments occurring on both sides of downtown will not be well-served. Such east - west linkages are needed to match the transportation infrastructure to patterns of land use development and transportation demand.

d. **Service to Major Activity Centers**

Finally, in view of the geographically extensive development patterns in downtown and the immediate vicinity, it is clear that a number of major activity centers are not served by any exclusive guideway facility. Examination of Figure 11, for example, shows gaps in the fixed guideway infrastructure in the east and southeast portions of downtown proper. Key destinations in the greater downtown area (such as USC and Dodger Stadium) are also un- or under-served.

III. DESCRIPTION OF THE TUNNEL AND OF POTENTIALLY APPLICABLE TECHNOLOGIES

A. DESCRIPTION OF THE EXISTING BUNKER HILL TRANSIT TUNNEL AND EASEMENTS

1. Tunnel Profile

Vertical and horizontal cross-sections of the BHTT and surrounding areas are shown in Figure 12. The "tunnel" actually consists of three types of facility:

(1) **Sections of building basements set aside for use by a people mover system (1,346 feet).** These are either built, under construction, or planned for construction in the future. The 336'-portion of the tunnel within the Security Bank Building basement is 34' wide, about 18' high, and appears about 20' above grade on the southeast corner of Third and Flower. It then runs parallel to (but higher than) the Third Street automobile tunnel, continuing across Hope Street and entering the lowest basement floors of the Wells Fargo Center.

In the Wells Fargo building, the tunnel's width is reduced to 17'-3" and its height to 14'-6". This 418' section of tunnel makes a downward-sloping "S" curve to Grand Avenue midway between Third and Fourth Streets, where it widens out again to 27' and passes under Grand. The 322'-section of tunnel between Grand and Olive is under construction as part of the California Plaza Phase IIA development. It is 42' wide, and was originally planned to be a DPM station. The 270' of the tunnel between Olive and its emergence from the ground near Hill Street will be built as part of California Plaza Phase III.

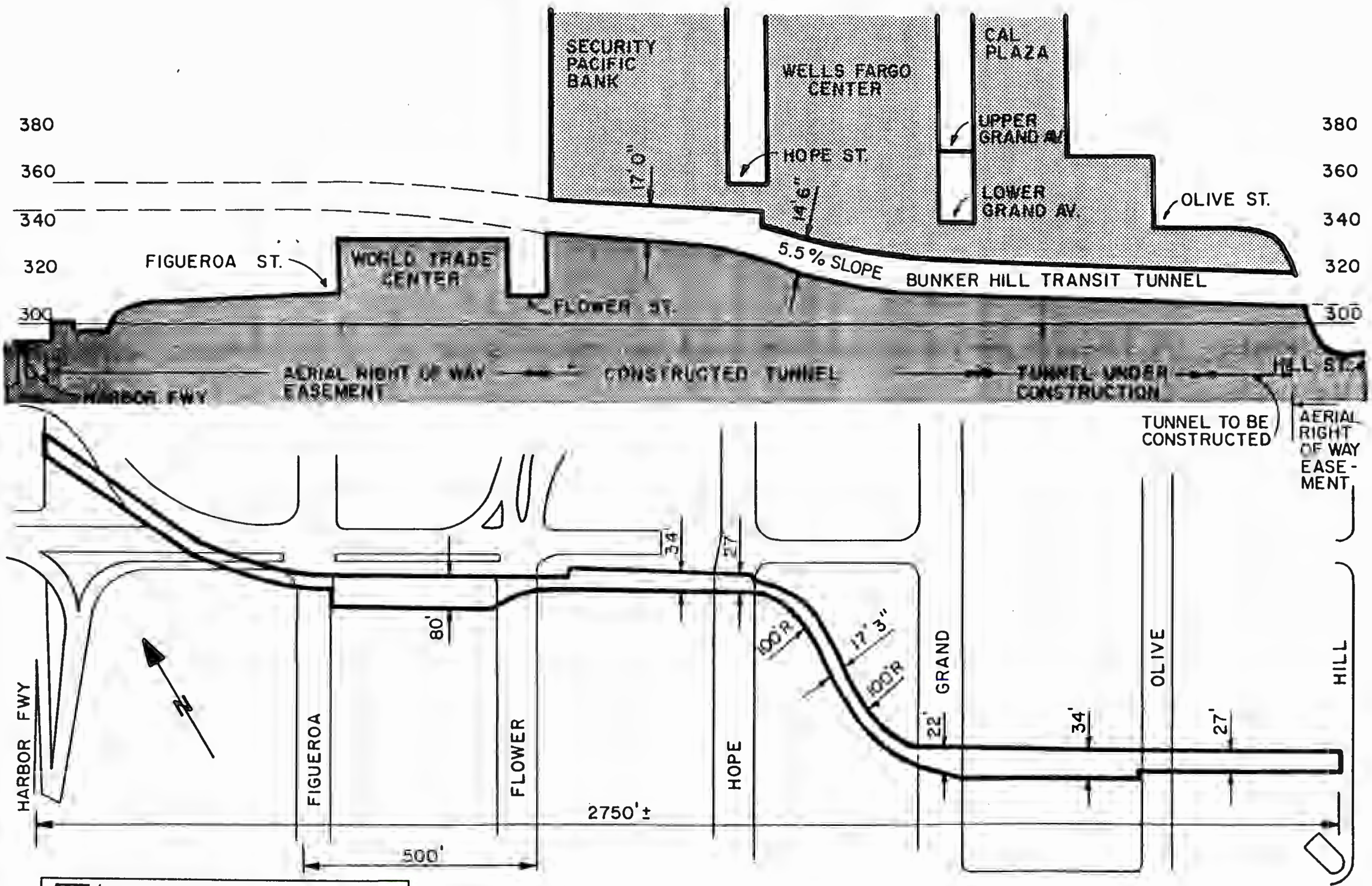
(2) **Sections of already-constructed tunnel beneath streets (266 feet).** This includes Hope Street (90'), Grand Avenue (86'), and Olive Street (90').

(3) **Rights-of-way for an aerial system from the locations where the tunnel breaks grade (about 1,300 feet).** To the west, the right-of-way widens to 80'. It continues 310' across the World Trade Center, whose deck (currently in use as a tennis court) has been structurally reinforced to support a people mover station. There is a 700' easement across Figueroa and curving northward to the Harbor Freeway. To the east, the right-of-way continues to Hill Street and turns north along Hill Street to Third Street.

The portions of tunnel within building basements will need some additional construction work to separate the tunnel from the building uses. This will typically consist of constructing concrete block walls and removing knock-out wall and floor panels installed so that the tunnel sections could be used by the building owners until needed for the people mover.

Figure 12

B.H.T.T. PLAN & SECTION OF TUNNEL & EASEMENTS



/DHA Bunker Hill Transit Tunnel Study

Several dimensions could restrict the kinds of systems that could operate in the tunnel as it is presently constructed. These include:

- o **height** (minimum 14'-6") -- some vehicles are too high to fit;
- o **width** (minimum 17'-3") -- for most systems, two vehicles could not pass each other in this section;
- o **horizontal curve** (minimum 100' radius) -- some systems require a larger turning radius;
- o **grade** (maximum 5.5%) -- some systems require shallower slopes; and
- o **vertical curve** (maximum 20' per 1% change in slope) -- some systems require a slower change in grade.

All of these restrictions are found in the tunnel segment below the Wells Fargo Center. The most important of these constraints is width; it is discussed further below. In the following Section B, potentially applicable technologies for the BHTT are described, with particular attention given to the effect of these BHTT constraints on the engineering feasibility of each technology.

2. <u>Engineering Constraints on Two-Way Service through the Tunnel</u>

For most of its length, the existing sections of the BHTT are at least 32' wide. However, the usable portion of the tunnel narrows to 17'-3" under the Wells Fargo Building (formerly called the Crocker/Maguire Building). This bottleneck imposes serious constraints on the ability to provide simultaneous two-way service within the tunnel envelope. Not even two 8'6" DASH buses could safely pass each other within that section.

Potential options for dealing with this constraint include: (1) providing two-way service using technology that does fit within the existing width; (2) permitting two-way traffic, using larger vehicles, with switching safeguards to prevent collisions on the bottleneck portion of track; (3) widening the tunnel; (4) digging another tunnel underneath the existing one; and (5) using the tunnel as part of a one-way loop. These options will be explored as appropriate.

For an alignment with a linear (rather than a loop) configuration (e.g., the BHTT alone or with linear extensions), two-way operation can be achieved simply with a back-and-forth shuttle on a single track. However, there would be practical limits on the length and the capacity of such a system (dictated by maximum desirable wait times). It is likely that option (2) above, in the form of a shuttle on two tracks except through the bottleneck, would be more cost-effective in any given scenario.

B. A BRIEF OVERVIEW OF POTENTIALLY APPLICABLE TECHNOLOGIES

If the BHTT is to be used for transportation purposes, a variety of technologies can be considered. At the low end (of cost, capacity, and speed), the simple moving sidewalk should not be overlooked. Beyond that, vehicular technologies can be broadly grouped into six categories, with wide variations within categories.

This section contains a short, non-technical overview of each of these seven types of technologies. The textual descriptions below are followed by a summary in Table 6. More detailed comparison charts on the various technologies are included in Appendix B, for all system manufacturers from which information was available.

No single system is intrinsically superior; the best technology for the BHTT depends on a number of factors, including:

- whether or not the right-of-way is extended beyond Bunker Hill;
- the importance of being able to physically link to other systems (such as LRT);
- the maturity and reliability of the technology;
- cost/engineering feasibility; and
- projected patronage.

These factors will be analyzed in greater depth throughout this study, eventually leading to a recommended system (or systems -- it may, for example, be desirable to provide interim service with one system such as a moving sidewalk, and migrate to another system as patronage and finances warrant expansion of the facility).

1. Moving sidewalk

a. Description

Moving sidewalks are employed at most larger airports to convey passengers between the terminal and boarding gates. They operate continuously at about 2 miles per hour; because of the continuous operation, they can carry large numbers of people. The actual capacity depends on the width of the walkway installed, but ranges between 3,000 and 10,000 people per hour.

The major drawbacks of a moving walkway system are its limited length (400-500 feet) and slow speed. The length restriction can be partially offset by using several walkways in series with a short gap between each segment. Moving walkways can only be used on straight runs, but can operate on constant inclines of up to 15°.

b. Feasibility for BHTT

Two-way service can fit into the existing tunnel, but numerous walkway segments will be needed to serve the full length of the guideway. The horizontal curves will require a series of short walkways set on the tangents

of the curves. Access can be provided to all buildings along the tunnel right-of-way.

2. Rubber-tired

a. Description

A typical rubber-tired system involves vehicles which are roughly a cross between a streetcar and a bus, running on a dedicated right-of-way (usually concrete), with an automatic guidance system (either from a center or side rail), and either automatic control or a driver. The vehicles range in size from a small minibus to streetcar size and can usually be linked into trains of several cars to increase passenger capacity. Capacity ranges from 3,000 to 15,000 passengers per hour; the system runs at speeds of between 30 and 50 miles per hour.

Systems running on rubber tires are usually quieter than those running on steel tracks, and most installed systems have a good reliability record. Costs range from $30 - 60 million per mile (excluding purchase of right-of-way), depending on the size of the proposed system.

The technology chosen for the original Los Angeles DPM was a rubber-tired system, but none of the three manufacturers whose systems were evaluated in depth are in production today.

b. Feasibility for BHTT

Most of these systems are too wide to allow simultaneous two-way operation in the narrowest section of tunnel. Most of them can operate as a one-way loop or one-track shuttle system in the tunnel as constructed. These systems will typically require storage and maintenance yard space not available in the existing tunnel section and rights-of-way.

3. Steel wheel/light rail

Urban rail systems are usually defined as heavy rail or light rail. Heavy rail systems, like the Metro Red Line under construction, have large, heavy vehicles running on full weight rails. The vehicles are capable of being linked into long trains (e.g., eight cars), with capacities on the order of 50,000 passengers per hour. They can achieve high speeds, in excess of 70 miles per hour. Heavy rail systems are not considered suitable for use in the BHTT because of their size and weight, and the limitations of the tunnel's turning radii and slopes. Light rail systems may have lighter vehicles and lighter-weight (but usually standard-gauge) tracks. They run at slower speeds, and are capable of negotiating tighter turns and steeper slopes than heavy rail systems. These light rail systems are the ones described below as steel wheel systems.

a. Description

Steel wheel systems, such as the Los Angeles - Long Beach Metro Blue Line, are the modern equivalent of the old Red Cars. They consist of steel wheeled vehicles running on steel tracks with either automatic or driver operation. Most of these systems are of similar size and capacity, roughly equivalent to the old streetcars. They generally operate at speeds of approximately 50 miles per hour.

Steel wheel systems have a good reliability record and cost around $60 million per mile to construct, excluding purchase of right-of-way. Passenger capacity is generally about 20,000 per hour.

b. Feasibility for BHTT

All of these systems are too wide to provide simultaneous two-way service in the tunnel bottleneck. Most of them can operate as a one-way loop or one-track shuttle in the existing tunnel. Some may need modified electrical collector systems. Maintenance and storage yards will be needed for a system of this type. With compatible vehicles and tracks, the possibility exists of connecting to the LA-LB or Pasadena light rail line to permit sharing maintenance and storage facilities.

4. Monorail

a. Description

Monorails are split into two basic groups: top-riding, and underslung. Top-riding monorails usually utilize a concrete box beam, with a rubber-tired vehicle riding on top and guide wheels at the sides. Vehicle size can range from small "personal" vehicles through streetcar up to heavy rail size. Train capacity ranges from 7,000 to 50,000 passengers per hour. Typical operating speeds vary from 20 to 70 miles per hour. The best-known examples of this type of system are the monorails at Disney amusement parks, with vehicles of approximately streetcar size.

Underslung monorail systems are similar in appearance to ski resort cable cars, with vehicles suspended below a single slender steel track. These systems are generally of lower capacity and operate at lower speeds, around 20 miles per hour. Capacities are usually about 2,000 - 3,000 passengers per hour.

Costs for both types of systems range from $10 to $50 million per mile, depending on the system used, but are generally lower than for other systems because of the smaller track construction costs.

b. **Feasibility for BHTT**

Only the smaller top-riding monorail systems will fit in the BHTT because of the restricted turning radius -- both vertical and horizontal -- of the larger systems. The underslung monorails tend to have excessive height requirements, which preclude their use in the BHTT. Maintenance and storage yards will be needed for any of these systems.

5. <u>Magnetic levitation</u>

a. **Description**

Only one "maglev" system is in operation at this time (the M-bahn in Germany). Vehicle sizes for this system are roughly equivalent to those of the old streetcars. Magnetic levitation is used to hold the vehicle above the track, therefore reducing rolling resistance. The existing system uses rail guidance with guide wheels; however, technology is being developed which uses magnetic guidance as well as levitation. The system in operation has a speed of 50 miles per hour and a capacity of 9,000 passengers per hour.

b. **Feasibility for BHTT**

The only maglev system in production has too wide a turning radius to accommodate the curves in the existing BHTT.

6. <u>Cable-driven</u>

a. **Description**

Cable-driven systems can run on steel rails, rubber tires, or air cushion. They differ from other system types in that traction is supplied from a stationary motor driving a cable rather than being self-propelled by on-board motors. The chief advantages of the cable drive are reliability and reduction of weight and complexity in the passenger cars. The disadvantage is that vehicles are restricted in the distance they can run, to about a mile for a single-cable system, or about five miles for multiple-cable systems with change-over mechanisms.

These systems operate at relatively low speeds of 15 - 20 miles per hour, and capacities can range from a few hundred to 20,000 passengers per hour. Costs vary widely, depending on the system chosen.

b. **Feasibility for BHTT**

The cable-driven systems vary widely in their abilities and sizes. Most of them can fit in the tunnel as it exists, and some could provide simultaneous two-way operation. Most of the systems can operate over the full length of the existing tunnel. However, some systems are incapable of negotiating

horizontal curves, and some are incapable of transitioning between level and sloping track. Maintenance and storage space will be needed for most of these systems, although for some, maintenance takes place directly on the tracks. In either case, the space requirements are generally smaller than for other technologies: they can usually be accommodated on a spur track or tunnel section behind the main traction motors.

7. <u>Dual-mode (electric/conventional) bus</u>

a. **Description**

The dual-mode bus is a recently-developed technology. The dual-mode vehicle is a bus which can be operated either (i) by a diesel engine on normal streets with a human driver, or (ii) by an electric motor on a dedicated or shared guideway in automatic or manual modes. Two dual-mode systems are now in production. They can be operated at speeds of more than 40 miles per hour, and have capacities of between 3,000 and 10,000 passengers per hour.

b. **Feasibility for BHTT**

These vehicles can operate within the tunnel as it exists, but only in one direction at a time in the narrow section. Maintenance and storage yards can be remotely located because of the ability to drive these vehicles on the street.

TABLE 6

KEY CHARACTERISTICS OF VARIOUS PEOPLE-MOVER TECHNOLOGIES

Technology	Typical Capacity[22] (Pax/hr)	Maximum Speed (mph)	Maximum Sys. Length (miles)	Construction Cost (millions per track mile)[23]	BHTT Constraints
Moving sidewalk	3,000 - 10,000	2	0.1	$8	length, curvature
Rubber-tired	3,000-15,000	30-50	N/A	30-60	width
Steel wheel/ light rail	20,000	50	N/A	60-80	width
Monorail:					
Top-riding	7-50,000	20-70	N/A	10-50	turning radii
Underslung	3,000	20	N/A	10-50	height
Magnetic levitation	9,000	50	N/A	30-50	turning radius
Cable-driven	100-20,000	15-20	5	10-50	width, length, curvature (for some)
Dual-mode	3,000 10,000	40+	N/A	10-60	width

22 These capacities are generally based on 3-minute headways, which can be achieved by almost all systems. However, headway ranges vary within technologies: moving sidewalks have zero headways (continuous motion), most technologies have some systems which can operate at 2-minute headways, and at least one cable-driven system can achieve headways as low as 12 seconds.

23 These figures do not include right-of-way acquisition, and are based on aerial or at-grade construction. Tunneling is an order of magnitude more costly.

IV. <u>POTENTIAL USES FOR THE BHTT</u>

This chapter attempts to convey a "big picture" sense of possibilities for the BHTT, ranging from non-transportation options for the tunnel alone, to using the tunnel as a starter segment for a comprehensive phased downtown circulation system. Opportunities, issues, and constraints associated with the tunnel itself and with linking the tunnel to other parts of the city are discussed at a general level. In Chapter V, after the full range of possibilities has been discussed, various specific alignments are presented for further consideration. At this stage of the study, the purpose of these two chapters is not to provide all the answers, but to raise the major questions involved.

In exploring transportation roles for the tunnel and possible extensions, it is useful to keep in mind the various potential markets for a downtown transportation system. Such a system could fulfill two important functions: circulation, and distribution. **Circulation** refers to serving midday, non-commute trips within the downtown area. **Distribution** refers to delivering a commute trip to its final downtown destination. A distribution mechanism would be needed for auto trips being intercepted at a peripheral parking lot, and for regional trips whose final line-haul stop (e.g., at Union Station or at the Pershing Square Metro Station) were some distance away from the desired destination. With the current emphasis on job-housing balance, wherein housing opportunities are increasingly being provided in and near the CBD, a distribution system could also serve the entire commute trip from those nearby residential centers to the CBD workplace -- or the reverse trip from a CBD residence to a nearby workplace.

In keeping with these two functions, the patronage forecasting work conducted for the old DPM identified four market segments for a people-mover system, two related to distribution (auto and transit users), and two related to circulation (CBD workers and non-CBD workers).

A. POTENTIAL STAND-ALONE USES OF THE BHTT

Several potential stand-alone uses for the BHTT may be identified. Each of those uses can be viewed not only as a <u>permanently</u> stand-alone option, but also as a potential <u>interim</u> use of the tunnel -- a stage on the way to full implementation for some of the expanded options discussed in later sections.

1. <u>Non-Transportation Uses</u>

a. Opportunities

Several potential non-transportation uses of the BHTT may be appropriate. One such use is simply to allow the building owners to obtain the tunnel segments and easements for private use. Portions of the tunnel are currently being used for recreation, storage, and parking. The value of this tunnel and easements in terms of square feet of space on Bunker Hill is estimated at $25 million.

Another suggestion is to use the space for emergency storage (food, medical supplies) and/or communication. Alternatively, either independently of or in conjunction with transportation uses of the tunnel, the BHTT could be

developed as an activity center in its own right: as a retail mall, for example - - a kind of mini-"Underground Atlanta".

b. **Issues/Constraints**

Any use other than permitting the continued use of existing tunnel segments by the affected building owners would require a financial analysis (including cost-benefit). An "apples-to-apples" comparison of the relative merits of widely disparate options (e.g. emergency storage versus retail mall) could be problematic. Use of the tunnel as a retail mall raises the institutional question of whether development would be in private hands or (as in the case of the Los Angeles Mall next to City Hall) public.

Another important issue is that the UMTA agreement discussed in Section I.C.2 stipulated that the tunnel be placed into "mass transit operation". Use of the tunnel for non-transportation purposes could necessitate the return of $3 million to UMTA. There may also be legal issues involved if the original easements negotiated for the DPM were specifically tied to transportation uses.

Perhaps the overriding issue to be considered for non-transportation uses of the tunnel is the opportunity cost of <u>not</u> using it for transportation purposes. The tunnel represents a nearly ready-made channel through one of the most densely developed parts of downtown. Providing a completely new transportation facility or service with equivalent capacity would be extremely costly.

2. <u>Exclusive Guideway for DASH</u>

a. **Opportunities**

The BHTT could serve as an exclusive guideway for a re-routed and/or enhanced DASH system. While a DASH route using the BHTT would serve a larger area than Bunker Hill only, this option is classified as stand-alone in the sense that the exclusive guideway portion of the route would not be expanded beyond the existing BHTT right of way, except for on- and off-ramp access to the existing street system.

This option would provide downtown circulation through Bunker Hill on a guideway that would avoid surface congestion. For electrically-propelled buses, the tunnel would provide adequate length for recharging batteries outside of mixed-flow traffic.

b. **Issues/Constraints**

Use of a conventional diesel bus would necessitate a ventilation system for the full length of the tunnel. Thus, electric buses should be considered in exploring this option. Also, the section of tunnel through the Wells Fargo

Building is only wide enough for one-way traffic using this system. This suggests that a DASH route using the tunnel take the form of a one-way loop, with the remainder of the route traversing existing surface streets in mixed traffic.

This alternative would require construction of ramps connecting each end of the tunnel (above-grade at the west end) to the at-grade street system.

This is the only alternative which involves substantial replacement of existing service (the conventional DASH buses), rather than adding new service. As such, perhaps the most appropriate comparison to make in evaluating this alternative is the cost-effectiveness of an electrified DASH service using the BHTT, versus that of the conventional DASH service. And, as for all alternatives, it is important to evaluate system-wide impacts (i.e., on all transportation modes), not just stand-alone impacts.

3. <u>Internal Circulator</u>

a. **Opportunities**

The steep gradients of the Bunker Hill area make some kind of internal circulation system desirable, while at the same time precluding the use of conventional buses in some areas. In particular, there is no through east-west transit service for Bunker Hill; stand-alone development of the BHTT could provide exactly that, at least in a local sense.

Of the 27 million existing and planned square feet of development in the Bunker Hill area, about 12 million square feet are contiguous to the BHTT (see Tables 1 and 2). This represents an estimated:

- o 4,800 residents[24] (who could have work, shop, eat, and entertainment destinations along the BHTT corridor);
- o 27,000 office employees[25] (who could have midday or after-work shop, eat, and entertainment destinations in the corridor); and
- o 1,000 hotel guests[26] (who could have all-day shop, eat, or entertainment destinations in the corridor);

[24] 2,558 contiguous dwelling units X 0.93 assumed occupancy factor X 2.0 assumed persons per household (see Footnote 2) = 4,758.

[25] 7,475,000 contiguous office square feet X 0.85 assumed occupancy factor / 235 square feet per employee (CBD average, according to **Employee Travel Baseline Survey**) = 27,037.

[26] 935 contiguous hotel rooms X 0.70 assumed occupancy X 1.5 assumed persons per room = 982.

for a total potential weekday market of at least 32,800 patrons. This estimate is conservative in that it doesn't account for the origins and destinations within walking distance of the BHTT (e.g., within a block of either terminus), but only those directly adjacent to the tunnel. It also counts only office employees, not retail, hotel, and other employees, and does not include visitors to the area.

It is also relatively inexpensive to provide pedestrian linkages from the BHTT to the Metro Red Line on the eastern end, and to the proposed Pasadena Blue Line extension on the western end (see Section V.B.2). This would increase the connectivity of the rail system downtown, and partially serve east-west demand patterns.

b. **Issues/Constraints**

One issue concerning a stand-alone Bunker Hill shuttle is that of user acceptance: will a user want to take an elevator/escalator down to the basement, get on a shuttle or a moving sidewalk for a short hop, disembark in another basement, and then take another escalator up to ground level -- as opposed to using the existing (or future enhanced) aerial or ground-level walkway system? What is the difference in travel time among the alternatives?

Another issue is the ease with which a stand-alone system can later be extended to serve a larger area. Is it more cost-effective to start with a higher-capacity technology than is initially needed, or later to replace a low-capacity technology with a higher one? Finally, there are certain engineering issues associated with this option, which are discussed at greater length in Section V.B.1.

B. POTENTIAL WESTERN LINKAGES

1. Opportunities

a. **Potential Demand**

Linking the BHTT to Central City West could benefit several groups of people. As a **circulator**, the tunnel could provide CCW employees (about 26,500 today; potentially 79,000 under the proposed Specific Plan) easy access to CBD activity centers for mid-day work and non-work travel. Similar access would be provided for CBD employees to CCW. As a **distributor**, the BHTT could serve:

- o CBD-destined commuters, including
  - -- those parking at a peripheral lot at Crown Hill;
  - -- transit users of the proposed Glendale/Bixel/Harbor transitway; and

-- CCW residents (about 13,000 today; potentially 31,000 under the proposed Plan); and

o CCW-destined commuters who are residents of the CBD.

b. Pacific Electric Tunnel

The P.E. Tunnel (see Section II.B.3.b) can relate to the BHTT in two different ways. On one hand, reactivating the P.E. Tunnel, especially if it is reconnected around the blockage between Figueroa and Hope Streets, could provide service between the Central City West area and the CBD roughly comparable to that of the BHTT. This would suggest an either-or analysis of the two tunnels. On the other hand, there may be some synergies to be derived from connecting the two tunnels in some way.

2. Issues/Constraints

Any major extensions of the BHTT immediately raise questions about engineering and financial feasibility. Engineering issues associated with specific alignments are touched on in Chapter V, and financing possibilities are presented at a very general level in Chapter VI. One issue specific to western extensions is that the densest commercial development in CCW will take place in the southern end, while both a simple linear extension of the BHTT and the P.E. Tunnel would be most accessible to the residential northern end. Potential Metro Red and Blue Line users destined for CCW would probably not transfer to the BHTT line if they subsequently had to transfer again to a bus (running through the proposed Bixel transit mall) to reach their final destination.

C. POTENTIAL EASTERN LINKAGES

1. Opportunities

a. Serve Little Tokyo/CBD Circulation

Several important activity centers on the east side of downtown will not be directly served by the Metro Red Line, including the new, 825,000 square-foot State Office Building at Third and Spring; and Little Tokyo, with at least 2.3 million existing and an additional 1.2 million planned square feet of development. The Second Street alternative of the Pasadena LRT was proposed partially in an effort to address this lack of coverage. However, the only LRT station proposed for that particular area would be at First and Los Angeles -- only 3/10 mile from the Red Line station at First and Hill, and off-center, at best, relative to projected development in Central City East. An eastern extension of the BHTT, especially given the connections to the Red and Blue Lines discussed above, could serve this area in lieu of the Second Street alternative alignment of the Pasadena LRT.

b. Distribute Union Station Trips

Once the BHTT reaches Little Tokyo, it is perhaps natural to consider extending it further north to Union Station. That would provide for direct transfer capabilities to/from:

- commuter trains;
- the El Monte busway;
- the Metro Red Line;
- the Santa Ana extension of the Metro Red Line; and
- peripheral parking.

2. <u>Issues/Constraints</u>

One concern with an extension to Union Station is that, between that point and Fifth and Hill, the Bunker Hill line will provide service partly competing with the Metro Red Line. For this reason, a Union Station connection should perhaps be considered a longer-term option, to be explored when it appears that demand would support two rail choices within the northeast sector of downtown. On the other hand, the possibility of using an area around Union Station for a storage and maintenance yard may make it a logical segment to include early on.

D. POTENTIAL ADDITIONAL LINKAGES

1. <u>Opportunities</u>

An extended BHTT could serve as the backbone for a larger loop system connecting a number of activity centers surrounding and within downtown. Such a system could:

- provide service to activity centers currently not well-served, such as USC/Coliseum, Dodger Stadium, the northern portion of CCW, Greyhound Bus Terminal, and garment/produce districts;

- improve service to areas that will have some service, such as South Park and the Convention Center; and

- provide service in the future to areas that will experience significant future growth that is not currently being planned for, such as the Alameda Corridor and City North.

2. <u>Issues/Constraints</u>

Again, financial, engineering, environmental, and political feasibility are major questions. Such a system would be costly, but its costs -- and its benefits -- would be shared over a larger base of development.

V. PROMISING TRANSPORTATION ALTERNATIVES FOR FURTHER STUDY

In this chapter, general transportation alternatives that show promise for further study are discussed. First, factors that were considered in developing the suggested options are presented. Then, a set of six alternatives is described and illustrated. In general, each alternative builds on the preceding ones, with options ranging from a strictly stand-alone system to phased comprehensive automated downtown circulation systems. It was considered premature to pinpoint specific alignments at this stage, except where well-defined rights of way already exist (i.e., for the BHTT and P.E. Tunnel). Thus, the options discussed below are presented simply in terms of conceptual alternatives that might make sense as self-contained systems. Key engineering issues associated with each concept are sketched.

A. GUIDING FACTORS CONSIDERED THROUGHOUT THIS STUDY

Six general, partially overlapping, goals are considered important to this study. In particular, these goals guided the process of generating the options proposed in the remainder of this chapter:

1. **Fill in gaps between existing or proposed fixed guideway transit or highway systems.**

   Such gaps in the transportation infrastructure mainly fall into east - west corridors, and may be found, to a greater or lesser degree, in or around: Bunker Hill, Central City West, Little Tokyo, Dodger Stadium, eastern South Park, the USC / Coliseum Area, and the Eastside Industrial Area, including the Garment District and the Greyhound Bus Station. Depending on the ultimate alignment of the Pasadena LRT, Chinatown may also represent a gap in transportation facility location.

2. **Support areas of major existing land use development.**

   Areas in which there is significant development today and in the near-term future (0 to 5 years) include Bunker Hill, the Financial Core, the Civic Center, Central City West, Little Tokyo, South Park, Chinatown, and the Garment District.

3. **Support areas of major future land use development.**

   Areas in which major development will occur in the medium-to-long-term future, in addition to existing development, include: all the areas listed under number 2 (that is, each of those areas will continue to see significant development activity, with the possible exception of the Garment District), City North, the Alameda Corridor, and the South Figueroa Corridor to USC/Coliseum and beyond.

4. **Serve peripheral parking intercept areas.**

   The currently designated peripheral parking areas are at Union Station and the Convention Center. Other areas may be so designated in the future.

5. **Serve cultural, entertainment, and sports facilities.**

Major cultural, entertainment, and sports facilities in the greater downtown area include: Dodger Stadium, the Coliseum, the Music Center complex (including the proposed Disney Concert Hall), the Museum of Contemporary Art, the Convention Center, and the Central Library. The Metropolis in South Park is seeking ideas for incorporating a major cultural facility into that development. There are numerous smaller museums and performance venues throughout downtown.

6. **Provide additional transportation interchanges/linkages.**

Opportunities for linkages may exist with Union Station (including commuter rail, the El Monte Busway, and the proposed L. A. River Freeway, as well as Metro Rail), the Metro Red Line, the Metro Blue Line (including the proposed Pasadena Extension), the proposed Glendale/Bixel/Harbor Transitway/HOV facility, and the Greyhound Bus Station.

B. INTERNAL CIRCULATOR

The existing Bunker Hill Transit Tunnel is shown in Figure 13. It could be used as a two-way shuttle system to serve the Bunker Hill area, to transport people between buildings, and to serve as a link from the northwest entrance of the Metro Red Line Fifth and Hill Station into Bunker Hill. A connection could also be made via escalator and moving sidewalk to the proposed Pasadena Light Rail station at Fourth and Flower. This alignment would require the construction of a bridge across Flower Street to serve the World Trade Center, and construction of stations or drop offs within the various buildings served.

1. Suitable Technologies

Technologies suitable to this short-run system might include moving sidewalks or some of the smaller cable driven systems such as the SOULE' System. For these technologies, maintenance areas could be provided in portions of the existing tunnel which are wider than the minimum 17'3" section below the Wells Fargo building.

a. Moving Sidewalk

The tunnel as it exists could be used for a two-way moving walkway system, such as those commonly found connecting passenger facilities in airports. The suggested station platform at the World Trade Center and a bridge over Flower Street could be built to extend the system to Figueroa Street. Drop-off locations could be incorporated into all buildings through which the system will pass.

This system could be built within the confines of the existing rights of way and the already-constructed tunnel sections. It would not require maintenance yards as such, and any workshop areas needed could be contained within the existing rights of way. The slow speed of the system renders it unsuitable for

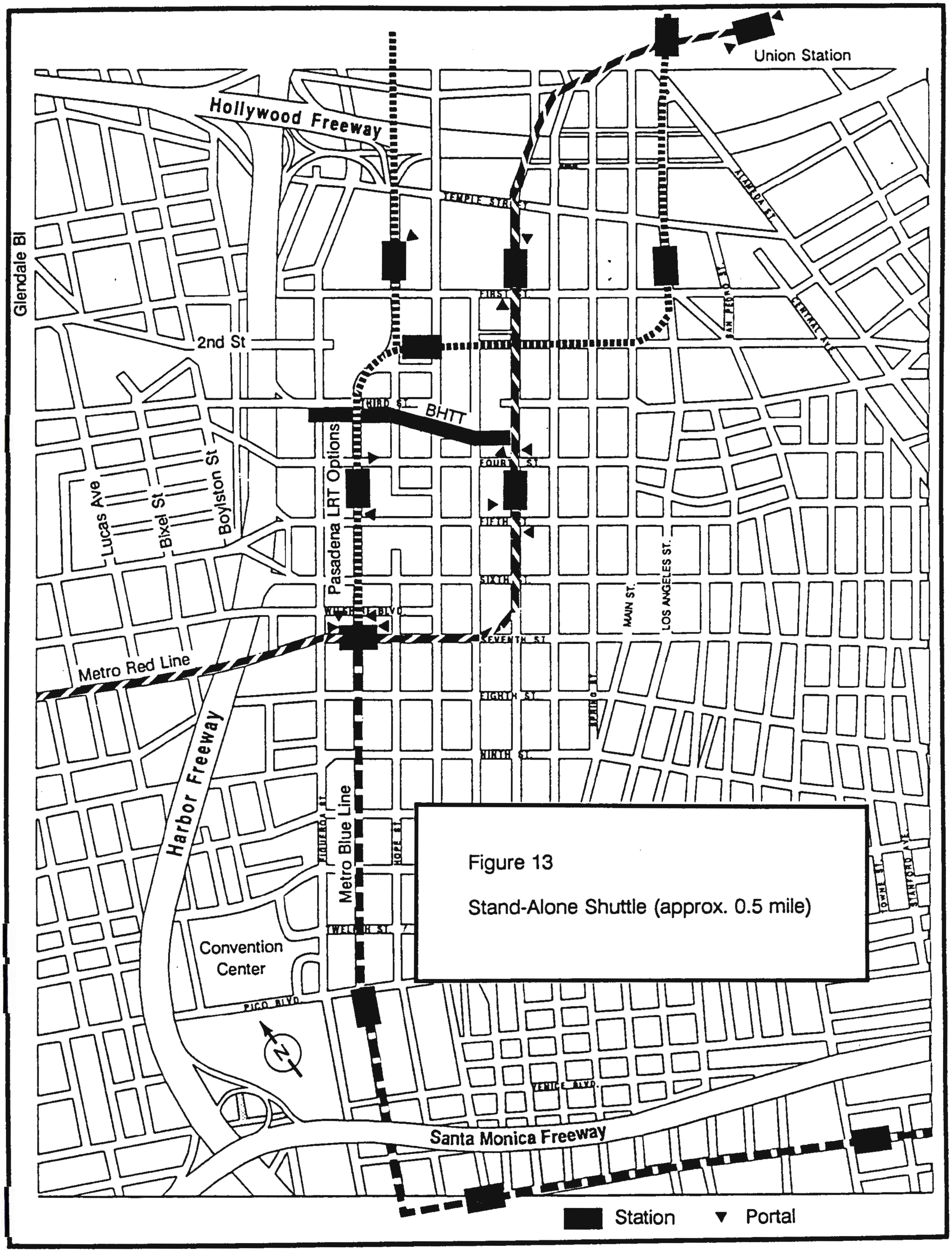


Figure 13

Stand-Alone Shuttle (approx. 0.5 mile)

longer distance travel, but the ability to immediately access and exit the system makes it very convenient for short-distance travel.

A moving walkway system creates some problems for the elderly and handicapped in mounting and dismounting the system.

b. **People Mover Shuttle**

A two-way (one-track, bi-directional) people mover system could operate in the existing tunnel sections from the World Trade Center to California Plaza. This would require construction of stations at those two locations; an additional station could be constructed in the Security Pacific Building.

This system has the disadvantage that it uses a technology not presently employed in the Los Angeles area. People mover systems that will fit into the existing Wells Fargo tunnel section may have restricted capacity because of the limitations on vehicle size. On the other hand, the larger cable-driven systems would require separate yard areas for maintenance and storage. A site for a storage and maintenance yard does not appear to be available adjacent to the existing sections of tunnel. For the larger systems, then, this option would probably not be realistic without extensions into Central City West or toward Union Station where it is likely that storage and maintenance sites could be found.

2. <u>Pedestrian Linkages to Metro Red and Blue Lines</u>

The Pershing Square (Fifth and Hill) Station of the Metro Red Line will run the length of the block between Fourth and Fifth Streets. The northwest portal of the station is nearly a block away from the planned California Plaza Station of the BHTT, and 60 - 70 feet lower. The proposed Cal Plaza Phase III building is planned to have a set of retail terraces joined by escalators that will link the Metro Station to the Cal Plaza development. This escalator system can serve to connect the BHTT to Metro Rail.

As for the Blue Line extension, the proposed station at Fourth and Flower would have an entrance just north of Fourth Street, less than a block from the Security Pacific / World Trade Center sections of the BHTT at Third and Flower. The Bunker Hill "tunnel" is actually some 30 feet above ground level at the intersection of Third and Flower, while the LRT tunnel will be about 20 feet underground. Nevertheless, it is entirely feasible to connect the BHTT to the north entrance (at ground level) of the LRT station, by a moving walkway and escalators. The moving walkway could proceed south on Flower alongside the Security Pacific Building at third-story level, then join an escalator down to the station entrance. An escalator can require as little as 47 horizontal feet to drop 30 vertical feet, so there is ample room within the estimated 500 feet between Third and Fourth Streets.

C. GUIDEWAY FOR ELECTRIFIED DASH

This alignment could also be used for a dedicated DASH bus route with a linear induction charging system for electric buses within the tunnel section. This would require construction of on- and off-ramps to link the tunnel to the existing street system. As shown in Figure 14, buses would enter the tunnel via a ramp from Hill Street, would have stops at the California Plaza and Security Pacific Buildings and would descend to the present grassy median in Third Street via a ramp from the west side of the Security Pacific Building bridging over Flower Street. The DASH bus would then join the surface street traffic on Figueroa Street. Some modifications to the street traffic system at Figueroa such as a dedicated bus lane and separate traffic lights may be required.

D. EXTENDED SHUTTLE

The stand-alone system shown in Figure 13 could be extended into Central City West, as shown in Figure 15. This would create east-west connectivity to this fast emerging development area, and could also help to alleviate traffic congestion in the Bunker Hill area by allowing easy access to Bunker Hill for people parking in peripheral lots to the west of the Harbor Freeway.

A cable shuttle system would be ideally suited to this type of application. Moving sidewalks would provide plenty of capacity but would be less suitable because of their slow speed. Maintenance areas could be provided within the wider tunnel sections or at the west end of the system in Central City West.

This option would require the construction of a bridge across Flower Street to the proposed World Trade Center station, and an aerial guideway from there across Figueroa Street and the Harbor Freeway and into Central City West. An additional station would be constructed in CCW, and possibly a maintenance and storage yard.

E. BHTT/P.E. TUNNEL LOOP

As shown in Figure 16, this one- or two-way loop system uses all of the currently existing but unused sections of tunnel formerly used or intended for use as transportation rights of way and connects them together with the minimum of additional construction.

The narrow section of tunnel under the Wells Fargo Building restricts the existing tunnel to a one-way system for most technologies. However, the total length of the system is within the maximum length range of one or two of the small cable shuttle systems which could be run as a two-way system in this narrow section.

Light rail and other automated guideway transit (AGT) systems could be run as a two-way loop. There would be a short one-way section within the Wells Fargo Building, with a sophisticated automatic control to allow passage of vehicles from opposite directions in this area. Alternately, a two-way loop system could be achieved by constructing space for a second track alongside or below the existing one in the Wells Fargo bank area.

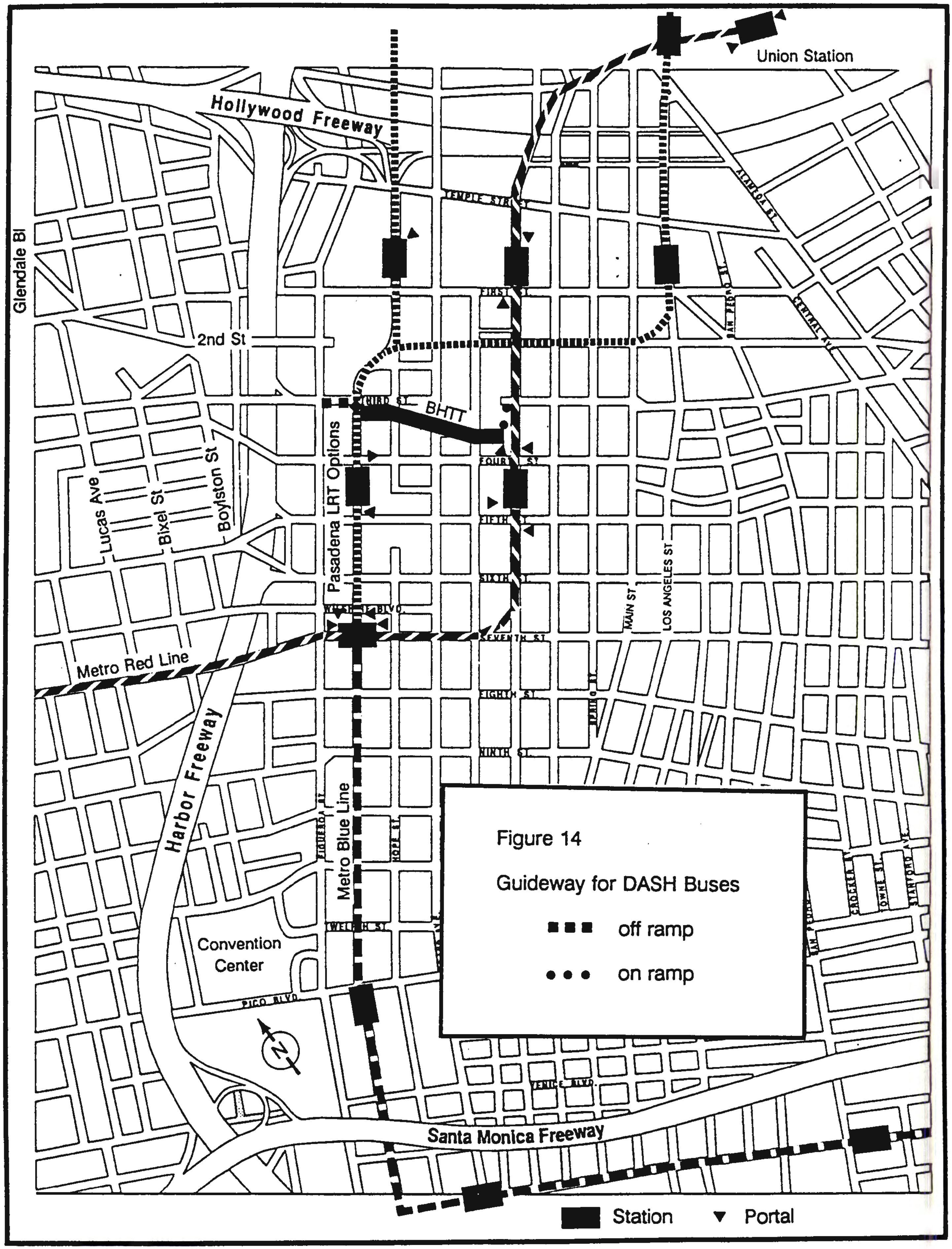


Figure 14

Guideway for DASH Buses

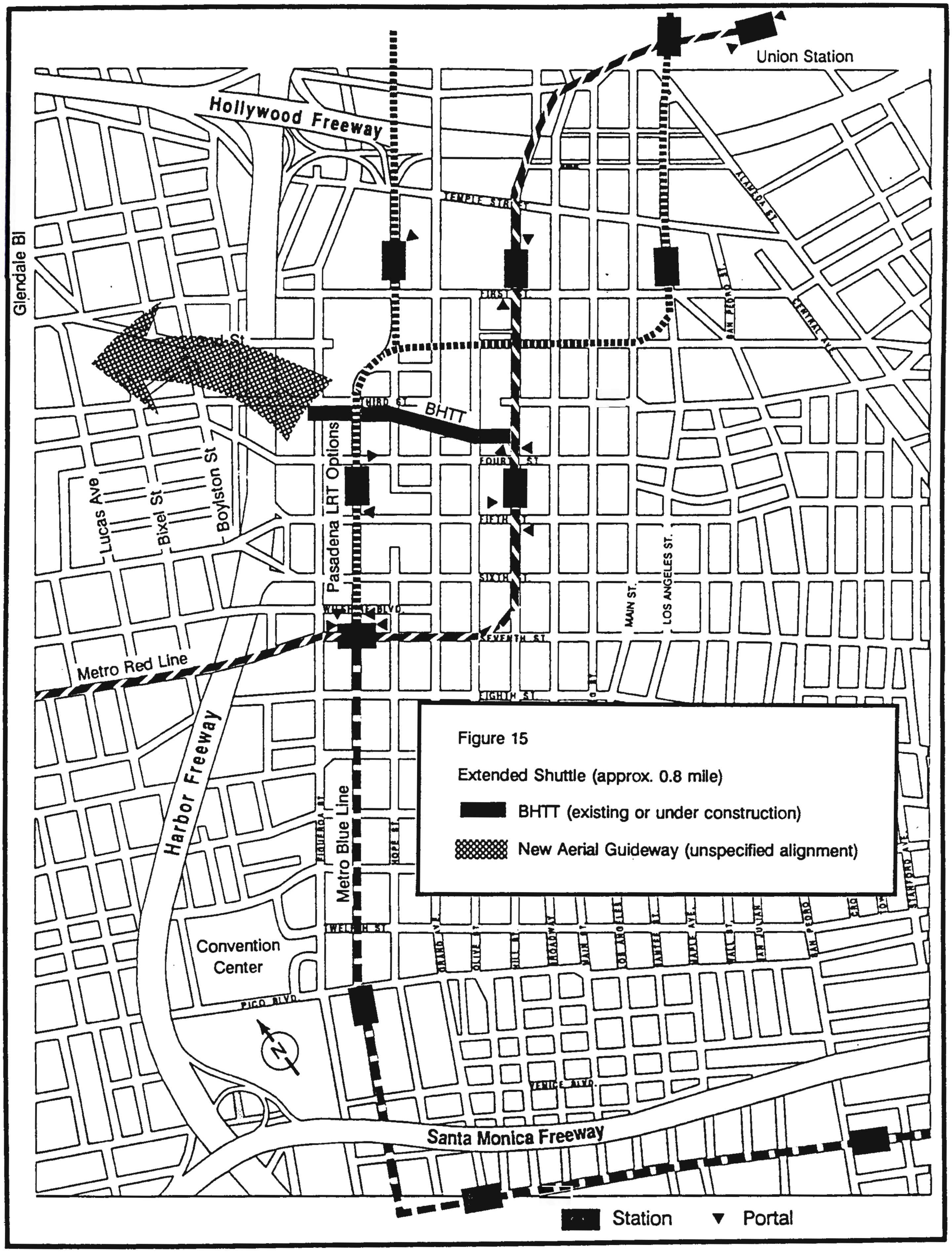


Figure 15

Extended Shuttle (approx. 0.8 mile)

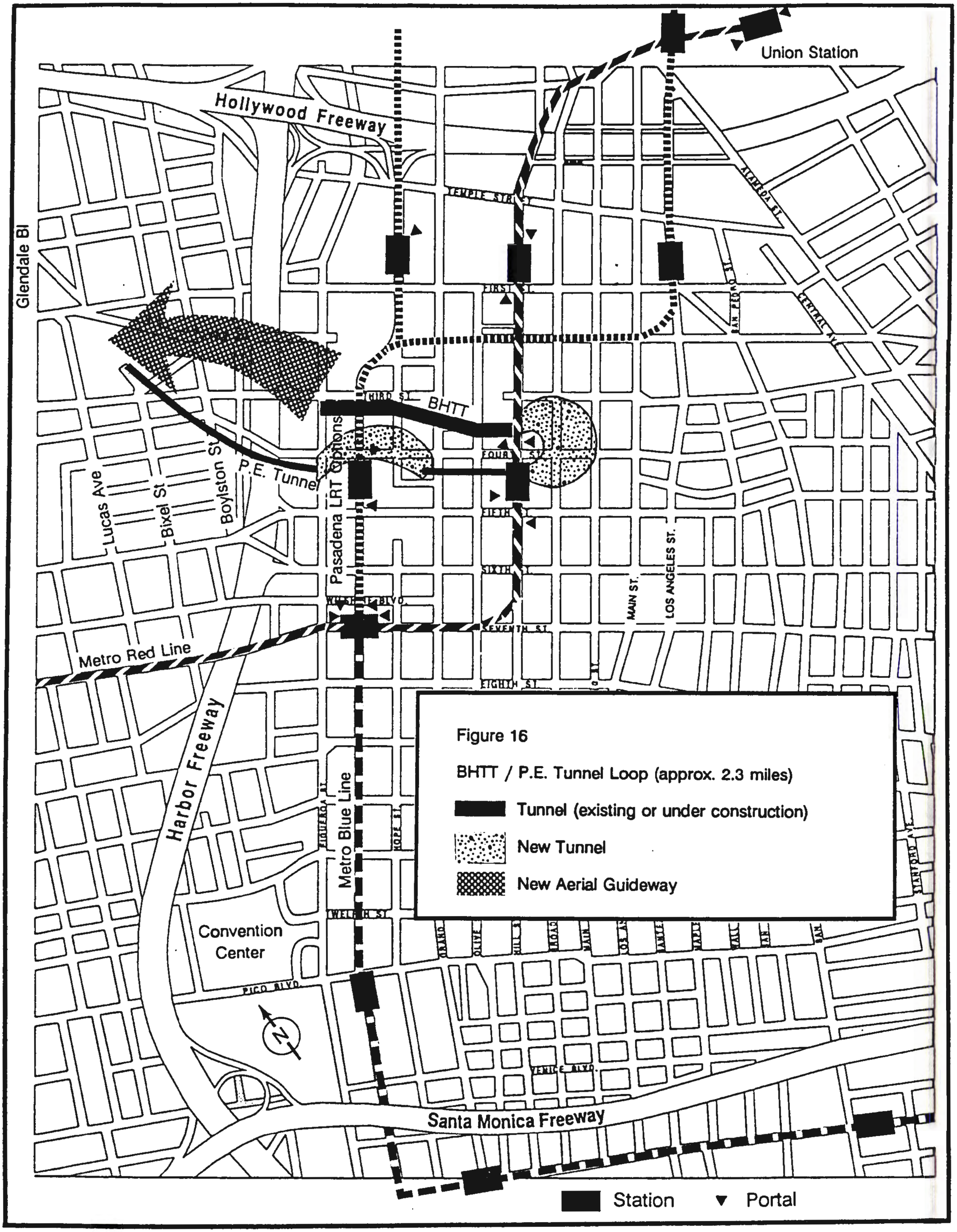


Figure 16

BHTT / P.E. Tunnel Loop (approx. 2.3 miles)

On the other hand, the argument for a two-way system is less compelling for this particular alignment than it would be for larger loops, since the two tunnels are only about a block apart for most of their length.

A maintenance area for this system could be created in Central City West close to Beaudry and First Street, or if a compatible light rail technology were chosen, a connection could be made to the Pasadena Light Rail system so that its maintenance facilities could be utilized.

Construction for this option would be more extensive than for the preceding three suggestions, and would involve five major elements:

1. An aerial guideway would be constructed, proceeding from the western end of the existing BHTT across the World Trade Center, Figueroa Street and the Harbor Freeway. West of the Harbor, the guideway would follow an unspecified alignment to the entrance of the Pacific Electric Tunnel.

2. The Pacific Electric Tunnel would require lining to enable it to be again used for transit purposes.

3. The section of the Pacific Electric Tunnel destroyed during the construction of the Bonaventure Hotel and Arco Parking Garage would require construction of a diversion tunnel along Fourth Street. This tunnel could also include a rail connection to the Pasadena extension of the Metro Blue Line if a light rail technology were chosen.

4. An eastern tunnel loop would need to be constructed, to connect the ends of the two existing tunnels. This section of tunnel could serve the new State Office Building at Third and Spring Streets.

5. Completion of the BHTT (e.g., tracks, station areas) would be required, in keeping with the technology chosen.

The total length of existing tunnel is a little more than one mile. New guideway totals a little over one mile also, approximately 65% of which is tunnel, the remainder being elevated. Connections would be made to the Blue Line at Fourth and Flower and to the Red Line at Fourth and Hill Street, where a knock out panel exists for a new portal.

F. LOOP WITH EXTENSIONS

As shown in Figure 17, a two-way shuttle system could be created from Union Station through Little Tokyo, Bunker Hill, Central City West and down to the Convention Center, using BHTT as the starter section. To accomplish this effectively, the BHTT would need to be widened to accommodate two-way traffic or the Pacific Electric Tunnel would have to be linked in to create the second track as described in the previous alternative. Using the BHTT alone as it exists would reduce capacity of the systems by 60% or more because of the increased headway time required to negotiate the single-track section of the BHTT with two-way traffic. The sections of new guideway would be above grade.

This alternative is too long for cable driven systems but is suited for light top riding monorail, rubber tired or light rail technologies.

A maintenance area for the system could be created at Union Station or in an area close to Venice or Washington to the west of the Harbor Freeway and north of the Santa Monica Freeway.

Construction for this option would again be extensive. The major elements include:

1. To the east of the BHTT, an aerial guideway would need to be constructed eastward to Union Station through Little Tokyo. Modification at Union Station would be required to construct a station and provide connectivity to other systems.

2. To the west, an aerial guideway would need to be constructed. The first section would link the BHTT to Crown Hill in CCW, as described in element (1) of the previous alternative. The second section of aerial guideway would proceed south from Crown Hill through CCW, and over the Harbor Freeway to the Convention Center. It would terminate at the Pico and Flower station of the Metro Blue Line.

3. A maintenance yard would need to be constructed either at Union Station or near Venice or Washington, west of the Harbor Freeway.

4. The BHTT will have to be widened or double-decked in the Wells Fargo Building area or the Pacific Electric Tunnel will need to be constructed into the system as described in the previous alternative.

5. Stations will need to be finished within the existing BHTT and the existing tunnel completed, in keeping with the chosen technology.

The total length of existing tunnel used would be 1/3 mile if the BHTT alone were used or one mile if both the BHTT and the Pacific Electric Tunnel were used. The total length of the system would be about 4 miles (4-3/4 if the P. E. Tunnel is used). Connections would be made to the Red Line at Union Station and at Fourth and Hill, and to the Blue Line at Fourth and Flower and at Pico and Flower.

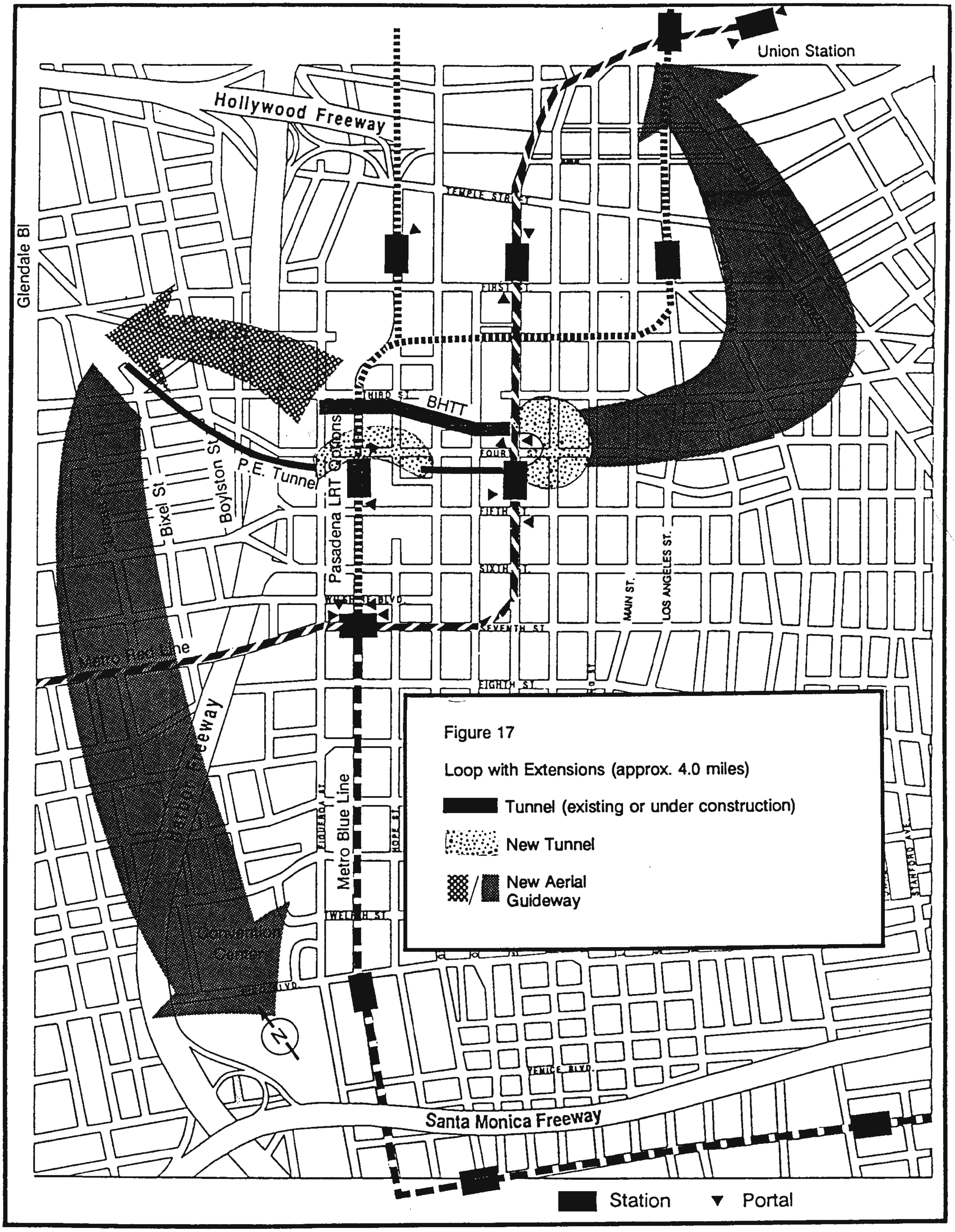


Figure 17

Loop with Extensions (approx. 4.0 miles)

G. PHASED COMPREHENSIVE AUTOMATED DOWNTOWN CIRCULATOR SYSTEMS

Most of the systems described above are capable of being expanded to create a Comprehensive Downtown Circulator System. Naturally, technologies such as moving sidewalks and cable-driven vehicles are precluded in a comprehensive system. The alignments shown in Figure 18 are representative of the scope that this kind of system could cover, a system that would provide public transport service to the Downtown area, and connection to commuter rail, Amtrak and Greyhound Bus systems. A system this comprehensive would eliminate the need to drive an automobile into downtown Los Angeles for many people.

The comprehensive downtown circulator systems have a number of factors in common.

1. They have a starter section usually utilizing the BHTT (and possibly also the Pacific Electric Tunnel) as a minimum operable segment, which can be connected to an area where it is possible to create a maintenance and storage yard.

2. They provide east - west connectivity in the Bunker Hill area and in the South Park area. This is also possible in the Civic Center area as well.

3. They connect to the existing and proposed infrastructure of transportation systems, including the Red Line, the Blue Line, Union Station, the Greyhound Station, the Harbor/Glendale HOV lanes, and so on.

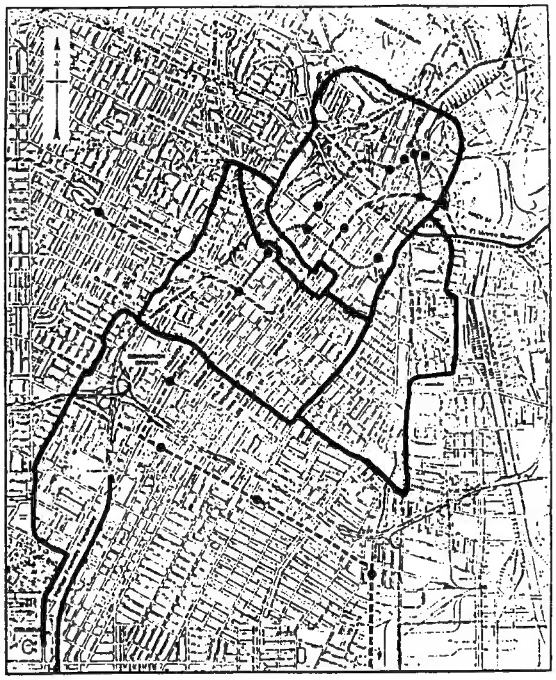
4. They provide service to areas of need that are served neither by existing nor by proposed transportation systems.

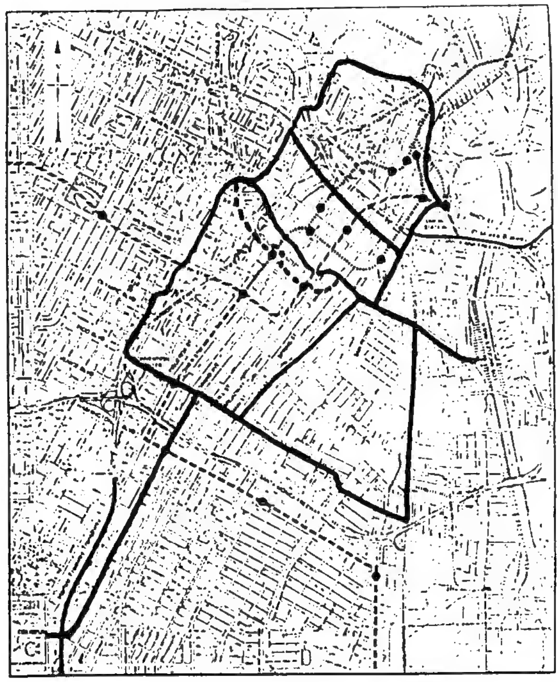
5. They are phased in three or four steps which are each capable of being engineered and constructed in a 3-5 year time frame.

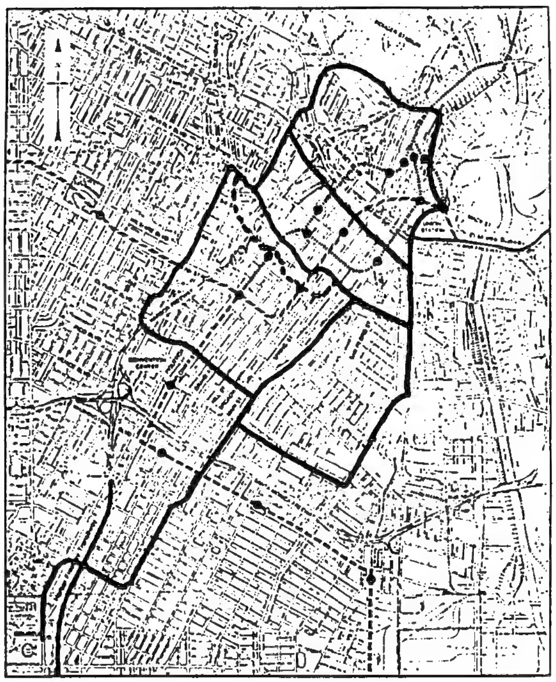
6. The total length of each system is between 13 and 16 miles.

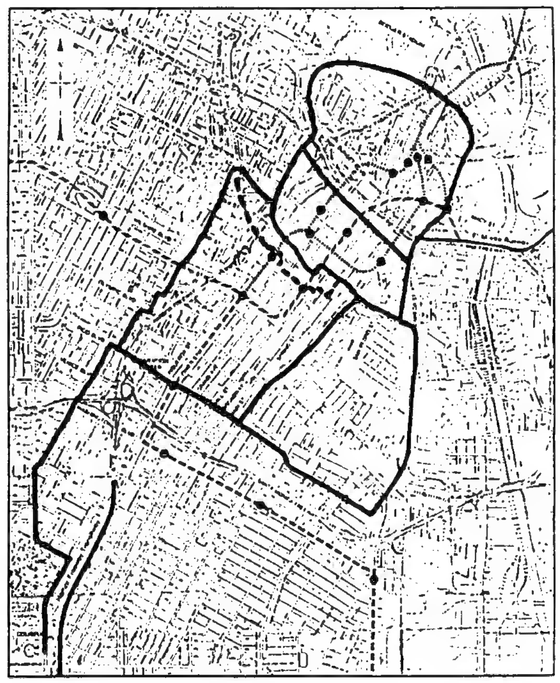
7. They are capable of using a variety of technologies from light top riding monorail though rubber tired to light rail. If it is decided to proceed with a comprehensive system, a full study will be required to decide the technology to use, the alignment, and the phasing.

8. Operation of these systems would be achieved by having three or four inner loops running clockwise, surrounded by an outer loop running counter-clockwise. The loops would be joined at the corners for the purpose of moving rolling stock around the system (e.g., to maintenance yards). Generally, trains would circulate at close headways on each loop, and passengers would transfer to the outer loop to travel between loops. This type of system simplifies train control and increases the capacity of the system by minimizing headways. Connections to the USC/Coliseum area would be achieved with a two-way shuttle system.









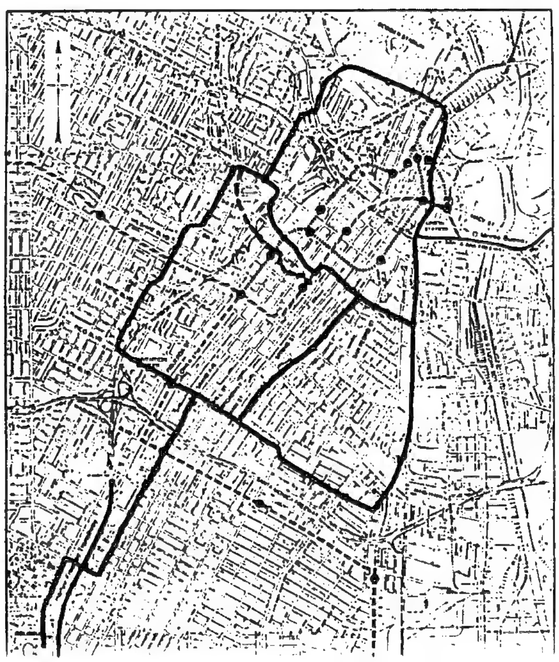


Figure 18

Examples of Comprehensive Systems

Metro Red Line

Metro Blue Line

BHTT and Easements

Pasadena LRT Options

Suggested Alignments

VI. OTHER ISSUES

The preceding chapters focused mainly on issues relating to the market for, and the engineering feasibility of, various transportation uses of the BHTT. There are a variety of other issues associated with developing the BHTT as well. This chapter provides an overview of legal and institutional, financial, and environmental issues.

A. LEGAL AND INSTITUTIONAL

Implementation of any of the alternative uses for the Bunker Hill Transit Tunnel discussed in the previous sections will likely require development of new institutional and organizational structures. This section examines alternative institutional arrangements to address the two key issues associated with development of a transit system in the BHTT: 1) identification of the agency (or agencies) to be responsible for constructing and operating the system; and 2) identification of the agency to be responsible for developing agreements with property owners to integrate the system into existing and future properties. In addition, institutional structures to implement non-transportation uses of the BHTT are examined.

1. Existing Transportation Institutional Context

To establish the context for development of a transit system for the BHTT, it is useful to examine the existing structure of transportation agencies in the area. Currently, there are four agencies involved in the provision of mass transportation facilities and services in downtown Los Angeles.

a. City of Los Angeles Department of Transportation (LADOT)

As a major department of City government, LADOT plans, designs and operates transportation facilities and services throughout the City. With the DASH and Commuter Express systems, LADOT is the third largest transit operator in the county. In particular, LADOT operates the two-route DASH bus system which provides internal circulation for downtown Los Angeles. The DASH system is designed to provide frequent service to the high density office and commercial core of downtown.

b. Southern California Rapid Transit District (SCRTD)

SCRTD is the largest all-bus transit operator in the country. It operates bus service throughout downtown Los Angeles as well as to many other widely dispersed destinations within the Los Angeles region. In addition, SCRTD is constructing the first phase of the heavy rail Metro Red Line in downtown Los Angeles and will operate this rail line when completed.

c. Los Angeles County Transportation Commission (LACTC)

LACTC was created in 1976 to provide for County-wide transportation decision-making. With the passage of Proposition A in 1980, LACTC was

given responsibility for using revenue from the one-half cent County sales tax to construct public transit improvements, including the design of a 150-mile, 13-corridor rail transit network. Of these 13 corridors, two potentially relate to the BHTT: 1) the Los Angeles-Long Beach Metro Blue Line, which is currently under construction and due to open in 1990; and 2) the Los Angeles-Pasadena Line, which is in the planning stages. At present, LACTC is overseeing the planning and construction of these rail lines. SCRTD has been designated as the operator of the Blue Line, although a decision regarding the operator for other rail lines to be constructed by LACTC has not yet been made.

d. **State of California Department of Transportation (Caltrans)**

Caltrans is the owner/operator and responsible agency for over 16,000 miles of state highways in California. Caltrans is funded by user fees collected through gasoline taxes and other transportation-related user charges. Any project on a state highway is considered a Caltrans project, even if the project is partially or fully funded by others.

Caltrans' Harbor Transitway project will provide service to the southern edge of downtown Los Angeles. Future extensions of this project or other roadways dedicated to transit use could interface with the BHTT and other transit facilities as discussed elsewhere in this document. However, Caltrans acts as the construction agency only for roadway and busway projects, and does not involve itself in the construction of rail mass transportation facilities, except as a funding partner. Where mass transit facilities are to be constructed, Caltrans typically coordinates its construction activities with the agency having primary responsibility for constructing the transit system. An example of this arrangement occurred with the development of the Century Freeway. This freeway is being constructed under Caltrans while the light rail system is to be constructed by LACTC.

2. Institutional Options for Constructing and Operating a BHTT Transit System

Given the current structure of transportation agencies in downtown Los Angeles, numerous institutional options exist for the construction and operation of transit facilities in the BHTT. There are three principal approaches to transit system construction and operation. These include:

- the **traditional** approach, where construction and operation are managed completely by the public sector;
- the **turnkey** approach, where the system is constructed by the private sector and then turned over to the public sector for operation; and
- the **franchise** approach, where the system is built and operated by the private sector, under the oversight of the public sector.

Regardless of the degree of privatization selected, a "responsible agency" is typically designated to provide overall coordination of the design and procurement for the system. Other agencies may then be designated to provide specific construction and/or operational assistance as desired. This assistance may be provided either through existing transportation agencies or by creating a new agency.

a. **Traditional Approach**

In the traditional approach, the construction and operation of the transit system is the responsibility of the public sector. The responsible agency develops routes and station locations and designs the system, either by using its own personnel or by contracting out these services. The agency then contracts for construction services required to complete the project and provides all oversight required through the construction process. Finally, a public agency is designated to operate the system when completed.

The traditional approach has been the model generally used for transportation projects in downtown Los Angeles and could be easily employed to implement transportation uses in the BHTT. For example:

- The system could be constructed and operated by LADOT, in much the same way as the DASH system. This arrangement could be particularly effective if the BHTT is to serve as an exclusive DASH guideway, or otherwise interface with the DASH system, or is designated to ultimately serve as a replacement for DASH. Alternatively, LADOT could construct the system and designate SCRTD, the only other agency in the downtown area with transit operating experience, as the system operator.

- The system could be constructed and operated by SCRTD, with its extensive existing organization for mass transit system development. Use of the BHTT as an internal circulator, particularly as a connector to the Metro Red and Blue Lines, could be facilitated by this structure.

- The system could be constructed by LACTC, in a manner similar to the Metro Blue Line construction. At present, however, LACTC has no capability to operate a rail system. Designation of LACTC as the responsible agency would require creation of a new operational organization within the LACTC or the designation of SCRTD or LADOT as the system operator.

- The traditional approach may also be implemented by creation of a new public agency specifically for this project. This scenario was proposed for the Downtown People Mover project, which would have been constructed by a new independent Downtown People Mover Authority. The Authority was to dissolve and turn the operation of the DPM over to SCRTD one year after the inauguration of revenue service.

b. **Turnkey Approach**

The turnkey approach involves a private sector provider of transit equipment who constructs the system, and then subsequently turns the completed system over to a public agency to operate. The organizational structure for this approach is similar to the traditional approach, with a responsible agency designated to oversee the private contractor responsible for constructing the system, while the same agency or another agency is designated as the system operator.

The responsible agency provides location, design and operating parameters, although in lesser detail than under the traditional approach, and designates the technology to be used for the system. The private sector contractor is then responsible for fitting the particular system to be provided to meet the parameters of the responsible agency. After the selection of a provider, the system is built, all equipment is installed and tested and, typically, training is provided to the operating agency. The operating agency then assumes responsibility for the daily operation of the system.

The primary difference between the traditional approach and the turnkey approach is the reduced role of the responsible agency in providing specific design and construction details. As with the traditional approach, the turnkey approach may be implemented from the existing structure of transportation agencies, by the creation of a new agency, or through a combination of both. Any of the three agencies discussed above (LADOT, SCRTD or LACTC) would be capable of serving as the responsible agency to select and oversee a contractor providing a turnkey system. Alternatively, a new entity could be created for this purpose. Either LADOT or SCRTD would be capable of serving as the operating agency, or a new organization could be created.

c. **Franchise Approach**

In the franchise approach, the responsible agency contracts with a private sector provider for system design, construction, operations and maintenance. The provider also provides some or all of the financing for the system. In general, the provider is granted an exclusive franchise to provide the specified services for the public. A franchise agreement may include own/leaseback provisions, public sector capital investments and/or operating subsidies to ensure the financial viability of the franchise arrangement for both public and private sector participants.

The franchise approach frequently has been used in local government transportation programs to provide contracted City-wide taxi services. In this approach, the responsible agency is required to exercise effective regulatory control over the franchisee to ensure that adequate levels of service are provided at a reasonable cost.

The organizational structure for the franchise approach differs substantially from the previous two approaches. In this approach, only one agency is typically designated to oversee all aspects of the construction and operation of the system. This approach may be implemented from the existing structure of transportation agencies, or a new agency might be created to perform these functions. LADOT, SCRTD or LACTC would each be capable of fulfilling these requirements.

3. <u>Institutional Options for Developing Agreements With Private Property Owners</u>

An additional issue raised by using the BHTT to improve downtown transportation and circulation involves the agreements which would be required with existing property owners. If the BHTT is designated for use as a transportation facility, and if the economic benefits provided by the transit system are to be adequately captured, specific agreements will need to be reached with the owners of all properties which will connect to the facility. These agreements must address system capabilities and service to be provided in each individual building, design details for station platforms and facilities (including provisions for the future expansion of service), payments to be provided (e.g., connection fees, lease arrangements), and operational details (e.g., hours of operation, responsibility for security and maintenance).

There are essentially two organizational options for addressing these requirements. First, under any of the three approaches outlined above, the necessary agreements could be developed by the responsible agency. Additionally, under the traditional or turnkey approaches, the agreements could become the responsibility of the system operator. Within the existing transportation agencies, both LACTC and SCRTD are experienced and specifically authorized by law to negotiate joint development agreements.

Because the negotiation of agreements with private property owners is a separate issue outside the transportation field, the second option would involve designating an outside agency to work with the responsible agency/system operator to complete these agreements. Existing agencies which could provide this capability might include the Community Redevelopment Agency, with its extensive experience in negotiating agreements with developers and property owners in redevelopment project areas, and real estate specialists within the City of Los Angeles Department of General Services.

Alternatively, a new agency could be created for this purpose or it could be fulfilled through private sector contracting. If an outside entity is involved, it will be necessary to establish a structure which clearly distinguishes the responsibilities of the transportation agency and the agency responsible for development agreements in order to allow for effective coordination between the agencies. For example, a joint organization consisting of staff from the two agencies could be established or the development agreement agency could provide services to the transportation agency on a contract basis. Further, depending upon the precise nature of the agreements to be developed and the agency designated to enter into these agreements, additional legal authority for that agency could be required.

4. Institutional Options for Non-Transportation Use of the BHTT

Finally, if the BHTT is designated for non-transportation uses, such as storage, parking, or as a retail mall, an organizational structure would be needed to implement the designated uses. Continuation of the current use of the tunnel, as storage and parking, would not likely require any new organizational structure. However, development of the BHTT for a new use, such as a retail mall, would require an agency experienced in managing private sector tenants in publicly-owned space. Candidates for this function would include the City Department of General Services or the Community Redevelopment Agency, both of which are experienced in such matters.

B. FINANCING MECHANISMS

Funds for transit operating and capital expenses are derived from traditional and innovative funding sources. Traditional funds are available from federal, state and local agencies which administer funds to operators of public transit facilities. Innovative funding sources include such mechanisms as: access, development, and parking fees; tax increment financing; benefit assessment districts; cost sharing; and joint development.

1. Traditional Funding Sources

a. Proposition A Tax Revenues (Capital or Operating)

Los Angeles County voters approved, for transit uses, a 1/2-cent retail sales tax in 1980. These funds, administered by the Los Angeles County Transportation Commission (LACTC), are accumulated in three categories: the rail construction fund for heavy and light rail construction; the discretionary fund distributed by formula for transit operating expenses; and the local return fund distributed to Los Angeles County and to cities for transit projects.

b. Transportation Development Act (TDA) Funds (Mostly Operating)

TDA Article 4 funds are derived from the 1/4-cent portion of the California six cent state sales tax. In effect, TDA funds were to be generated by imposing the state sales tax (then 5%) on motor vehicle fuel. However, it was observed that a 5 percent tax on motor fuels was approximately equal to a 1/4 percent tax on all retail sales (including motor vehicle fuels). A uniform tax on all sales was much simpler to implement than two separate tax programs, one for fuel sales and one for all other retail sales. The 1/4 cent portion went to the TDA account and the rest to the General Fund. These funds are distributed by formula to transit agencies throughout California. A portion of these funds are used to provide the 20 percent local match for UMTA Section 9 capital grants and for debt service payments on capital expenditures. The balance of these funds is used to meet operating expenses.

c. **State Transit Assistance (STA) Funds (Capital or Operating)**

STA funds are available through the Transportation Planning and Development (TP&D) Fund. The TP&D funds are generated from the so-called spillover provisions of the State sales tax. When the price of motor fuel rises above a certain level, excess or spillover revenues are collected on fuel sales. The TP&D fund represents an attempt to capture a portion of these spillover revenues for their intended purpose, transportation development. These spillover funds are quite small now but they could be substantial when the price of motor fuels begins to climb to the $1.50 or $2.00 per gallon level over the next several years.

d. **State Guideway Fund (Capital Only)**

The Guideway funds are derived from the TP&D Fund and from Article 19 funds for Proposition 5 counties. Article 19 funds are derived from the state gallonage tax on motor vehicle fuels and distributed by formula to California counties. Proposition 5 allows counties, if voters approve, to use a portion of their fuel tax monies for transit guideway construction. Approximately one-half the funds are distributed to eligible counties by formula and the balance is administered by the California Transportation Commission to fund both highway and transit guideway projects on a priority basis.

e. **Urban Mass Transit Administration (UMTA) Funds (Capital and Operating)**

UMTA Section 9 funds are distributed by formula to transit agencies for operating and capital grants. LACTC policy is to restrict capital grants to bus-related purposes. UMTA Section 3 funds are discretionary in nature but all such funds accruing to Los Angeles County are reserved for Metro Rail (heavy rail) construction. Moreover, speculation persists that these Federal funds may not be renewed by Congress.

f. **Fare Box and Other Revenues (Operating)**

The remaining sources of traditional funds are those derived from the fare boxes and other miscellaneous income generated by the transit agency.

2. <u>Innovative Funding Sources</u>

A variety of innovative financing techniques for transportation infrastructure have been suggested and implemented over the past several years. Many of these came about in the 1970s partly as a result of such factors as the energy crisis, high interest rates, federal budgetary restraints, and strong resistance to increases in property and other taxes. The onset of the 1980s was accompanied by several years of double digit inflation and administrative efforts at the federal level to reduce dramatically the UMTA Section 3 and Section 9 funding levels for transit.

As federal support decreases and transportation needs increase, many agencies are searching for new funding mechanisms. In general, these innovative techniques are grouped into four categories: cost sharing by property beneficiaries; joint development approaches; user charges; and marketing approaches. These can typically be used for either capital or operating expenses, subject to any previously established legal restrictions.

a. **Cost Sharing by Property Beneficiaries**

The basic premise of any cost sharing strategy is that transportation improvements result in benefits to property owners and others in the vicinity of the improvement, especially at specific stations or stop areas. A portion of these benefits are captured and used to provide for either capital or operating expenses of the new transportation system.

i. **Benefit Assessment** presumes that some or all of the costs for a transportation improvement should be paid for by property owners benefitting from the project. In general, a benefit assessment district is formed which includes the benefitting properties. The assessment fee is calculated based on such factors as floor area, site size, distance from the transportation improvement, and so on. Fees may be assessed over a period of years. In this way, the fees can provide debt service on a bond issue sold to help pay construction costs. On the other hand, such recurring fees could be used to pay operating expenses. The annual amount raised is a function of the assessment fee and the number of assessable units within the benefit assessment district. The Southern California Rapid Transit District is implementing several Benefit Assessment Districts designed to generate $205,000,000 in bond proceeds for Metro Rail Construction.

ii. **Tax Increment Financing (TIF)** is a method of funding public investments in an area scheduled for redevelopment by capturing all or a portion of the increased tax revenues that will result if the public improvement stimulates private investment in the designated area. These funds can be used as debt service to finance a bond issue sold to defray a portion of construction costs. The TIF process begins with the designation of a defined, blighted area where redevelopment is necessary and a planned program of improvements has been approved. At that time, the existing tax base is termed the base year.

The efforts of the redevelopment agency then are directed toward attracting private development to the area which results in growth of the tax base or an annual basis. The tax increment is defined as revenue resulting from the difference between the base year and the current year and is diverted to the redevelopment agency for debt service and other purposes. The theory of TIF is supported by the following:

- o Private redevelopment would not take place without public investment. Thus, the redevelopment agency earns its way by planning, land assembling, and implementing public works projects.

- o Generally, the tax base in a redevelopment district is stagnant or declining and the tax increase would not have occurred but for the public investment.

- o The taxing authorities will realize the benefit of the increment when the bond issue is retired over a 15 to 30 year period.

In many states, TIF initially was to be used only to redevelop a slum or blighted area. However, several states now employ TIF for other purposes as well: low income housing; transportation and parking facilities; and employment opportunities. In most states, TIF applies only to the property tax but may be applicable to the retail sales tax. The base year sales tax represents the sales taxes collected within the redevelopment area in the 12 months prior to plan approval. After this date, any sales taxes in excess of the base year sales tax are used to help fund the public improvement. This approach could prove very useful in the revival of a downtown area. Moreover, in those states where sales tax revenues accrue mostly to the state rather than to municipalities, this approach could provide a method of funding state involvement in central city redevelopment.

iii. **Connector Fees** are especially applicable to rail transit financing. Connector fees are charges to owners and developers of buildings adjacent to a transportation facility for the right to be physically connected to it. Such fees may be: lump sum payments for knockout panels or plazas; annual payments to offset operating costs; or dedication of property for stations or easements.

iv. **Negotiated Investments** are agreements between a developer and a public body in which the developer agrees to contribute a fixed sum towards an improvement that will benefit his development in exchange for a concession by the public body. Local government can use zoning and building permit authority to bargain for the payment of transit or other improvements. This approach, of course, must be viable from a legal standpoint. Interagency cooperation is very important because the transportation agencies generally have no control over zoning and land use policy.

v. **Transportation Corporations or Districts** are non-profit organizations established to promote and develop transportation facilities. In some states, such corporations have the power: to receive gifts or grants; to secure dedication of rights-of-way; to acquire land; to borrow; to assess taxes; to design and construct transportation facilities; to issue tax-

exempt bonds; to negotiate contracts; and to establish benefit assessment programs for bond retirement. The Corporation can be dissolved when the indebtedness is paid and a local government unit has agreed to maintain the facility.

vi. **Impact Requirements** are charges or conditions imposed on developers to compensate for the impact of their developments. The requirements may range from a fee of so many dollars per square foot or dollars per peak period vehicle trip generated to sponsorship of a ride-sharing program. Developers argue that such fees impede growth and economic development. Citizen groups argue that such fees are much too low. In San Francisco, developers of new office space can be required to pay up to $5 per square foot to compensate for the impact of their development on transit services. In Los Angeles, the Coastal Corridor Specific Plan set a base impact fee of $2,010 per p.m. peak vehicle trip generated. As observed in Section II.B.1.b, the draft Central City West Specific Plan proposes to exact a $16,490 fee per vehicle trip.

vii. **Density Fees:**

- **Density Transfers:** Often, a developer wishes to construct a building that is higher than the Floor Area Ratio restrictions in that area would permit. In such cases, the developer can sometimes buy the air rights above one or more existing developments that are lower than the FAR limit, and transfer those rights to his own proposed building. Usually a public benefit tax is exacted on the amount of space that is transferred. This process is referred to variously as density-rights transfer, or Transfer of Floor Area Ratio (TFAR).

  In the past, this process has been handled on a case-by-case basis. In 1988, the Los Angeles City Council directed the CRA to prepare guidelines for density transfers that could be uniformly applied. The CRA has proposed that a fee of $35 per transferred square foot be assessed on all future density transfers. CRA projects revenues from this source to be $209 million over the next 20 years. This proposal is still under evaluation by the City Council, with an interim fee of $5 per square foot in effect. The fees are used for housing, open space, child care, and transportation facilities. Thus, some density transfer funds may be available for a downtown circulation system.

- **Raising the FAR Limit for Bunker Hill:** As mentioned in Section II.A.1.c, the FAR cap in Bunker Hill is currently 5.0:1. The cap may be raised to 6.0:1, contingent on sufficiently improved regional access to the area. The city may wish to

assess a public benefit tax on the increment of development permitted by raising the FAR limit. Some or all of that tax could be used to fund transportation improvements benefitting the Bunker Hill area.

b. **Joint Venture Approaches**

Frequently, there are occasions when it is mutually beneficial for the private and public sectors to cooperate in financing transportation improvements. Three joint venture approaches are: land/air rights leases; donations; and joint development.

i. **Land/Air Rights Leases** are effective instruments for allowing land parcels to return full value to their owner. A transportation agency may own land it no longer needs, or it may be using only a portion of the parcel as, e.g., a transit station. The agency can lease the air, surface, or subsurface development rights for the parcel to a private developer. Leasing such rights can be a problem if eminent domain powers were used to assemble a land parcel with space in excess of that needed for the transportation project. On the other hand, the transportation improvement may be solely responsible for the leasing potential of the space.

ii. **Donations** of money for capital improvements or of real property for transit sites can be obtained from the private sector. Such donations often are made for highly visible projects with appropriate recognition for the company or individual or to ensure greater access to particular land parcels. The transportation agency must be able to accept donations or to establish a mechanism (e.g., a non-profit committee) to accept the donations and provide for tax write-offs for the donors.

iii. **Joint Development** is a technique in which private developers share operating and/or capital construction costs of transportation facilities that are integrated with their development, in anticipation of gaining a competitive advantage over similar non-integrated developments. The private sector group(s) involved in the joint development project must be included in the design stage of the facility. This assures both the developer and the transportation agency that the facility will meet their respective objectives.

c. **User Charges**

User charges are direct or indirect charges to, or payments by, the users of transportation systems. Tolls and fares are direct payments, while indirect payments include vehicle taxes and fees, commercial parking lot taxes, and motor fuel taxes.

i. **Vehicle Taxes and Fees** include: driver's license fees; registration fees; vehicle excise taxes; personal property taxes; and so on. These revenues are used for both transportation and non-transportation purposes. In general, the transportation uses are restricted to highway applications. However, some states allow municipal property taxes or surcharges on motor vehicles with the proceeds shared by local transit districts.

ii. **Tolls** are fees charged for access to roads, bridges, and tunnels. The majority of these funds are used for highway purposes but some municipalities (e.g. New York and San Francisco) use toll revenues to help finance transit facilities.

iii. **Commercial Parking Taxes** are taxes levied on commercially operated parking lots and garages. In addition to raising tax revenues, commercial parking taxes may change parking habits and result in increased transit ridership. On the other hand, such taxes could discourage downtown visitors. In the interest of fairness, all long-term downtown parkers should pay the parking tax, not just parkers in commercial lots.

iv. **Motor Fuel Taxes** are gasoline and diesel fuel taxes levied by every state and the federal government to help finance highway construction and maintenance. Virginia, Illinois, Florida, and Tennessee also allow <u>local</u> jurisdictions to tax motor fuels, with a portion of such income reserved for transit uses.

d. **Marketing Approaches**

Advertising and concessions are widely used transit agency revenue sources throughout the United States.

i. **Advertising** in transit stations and vehicles and along highways is very popular because of the large volume of potential customers in daily contact with such advertising. Common advertising mechanisms for transit include: kiosks in terminals; display cases; audio-visual displays; and panels on and in trains and buses. The costs associated with security and with repairing vandalism damage can be problems with this approach.

ii. **Concessions** consist of manned retail outlets such as newsstands and food outlets, and of mechanical devices such as telephones, automated teller machines, and vending machines. The station design must consider the location of such facilities to allow sufficient access path space and avoid congestion. Concessions also generate additional maintenance, refuse collection, and security costs.

3. Other Considerations

Some factors which must be considered in the application of any of these techniques include the following:

- o These funds are sometimes available for operating costs or capital improvement costs but not both.
- o Enabling legislation exists for some of these techniques. Such legislation often includes guidelines and limitations to be adhered to in implementing the funding mechanisms (such as restrictions to capital or operating cost uses).
- o In some instances, implementation will be challenged immediately through civil action.
- o Enabling legislation at the state level, local ordinances, or election by the citizenry will be required prior to implementation of some measures.
- o Public and private interest reactions to various proposals may range from general acceptance to outspoken rejection.
- o Finally, it is advantageous for a transportation agency to be creative in the generation and application of innovative financing techniques.

C. ENVIRONMENTAL IMPACTS

Environmental impacts associated with the use of the Bunker Hill Transit Tunnel would vary according to the types of uses developed. A precise description of the environmental impacts of various tunnel uses will be developed once proposed uses are well defined. This section, however, reviews major environmental issues typically associated with some tunnel uses currently under discussion. Other impacts may become evident should additional alternative uses of the tunnel be identified.

Current uses of the tunnel and easements include storage, parking, recreation, and vacant floor area. No significant environmental impacts should exist for continuation of these uses, assuming, for example, that stored materials are not hazardous nor toxic and that adequate ventilation exists for the parking areas.

1. Stand-Alone Uses

Stand-alone uses of the BHTT could include: (1) non-transportation uses, (2) an exclusive guideway for DASH, and (3) internal circulation.

a. Non-transportation Uses

Environmental impacts associated with non-transportation uses would depend upon the types of uses proposed. Should these uses be an extension of

current adjacent uses, (i.e., parking, office, commercial), the environmental impacts would be similar to those created by the initial redevelopment of the area (e.g., traffic, noise, air pollution) and would not be expected to be significant due to the size of the current tunnel area in relation to the full Bunker Hill development.

b. **Exclusive Guideway for DASH**

Should the tunnel be utilized as an exclusive guideway for the local DASH circulator bus system, a number of environmental impacts could become important. One proposal would use electric vehicles for DASH buses passing through the tunnel (see Section V.C). This technology could allow buses to recharge their electric batteries as they pass through the tunnel section and to leave the tunnel with sufficient stored power to complete their routes on city streets.

A major advantage of this approach is the lack of vehicle emissions from these vehicles travelling on the streets and particularly in the tunnel. Safety to passengers and pedestrians near the electrical charging areas would be of concern, although this potential impact could be mitigated through careful design and engineering.

Since the DASH buses could utilize current city streets for their routes outside the tunnel, this alternative could involve only limited amounts of fixed guideway construction. At a minimum, some form of guideway would be needed at each end of the current tunnel to allow DASH vehicles to begin and end the street portions of their routes. The types of impacts arising from the construction and operation of these guideways would be similar to those described below for fixed guideway alternatives. To the extent that this alternative involves less guideway construction and operation, the levels of most impacts would be reduced accordingly.

c. **Internal Circulator**

Development of the tunnel as an internal circulator (e.g., pedestrian passageways, pedways or moving sidewalks -- see Section V.B) likely would not involve any major adverse environmental impacts. Impacts could occur during construction (e.g., noise, dust), but they would be of short duration, and mitigation measures could be used to minimize them.

2. <u>Fixed Guideway Extensions of Tunnel</u>

The BHTT could be extended, as originally envisioned, through construction and operation of a fixed guideway transit system in any of a number of directions. Site-specific environmental impacts could be defined following selection of alternative alignments and technologies for a fixed guideway extension. This section highlights key environmental concerns that are likely to be encountered under an <u>elevated</u> fixed guideway extension option, e.g., (1) transportation/ access, (2) business and

residential displacements and disruption, (3) visual/aesthetics, (4) traffic/ parking, (5) noise/vibration, (6) archaeological/historic/cultural, (7) utilities, (8) air quality, (9) energy, (10) safety/security, (11) land use/local plans/growth, (12) economic/fiscal, (13) soils/ geology, and (14) vegetation/wildlife. Other types of impacts may occur but are not considered critical to this discussion.

a. **Transportation/Access**

An important aspect of any fixed guideway extension of the BHTT likely would be improved access, both in terms of local circulation among downtown land uses (employment, retail/shopping, parking, entertainment, etc.) and in terms of linkages with regional transportation systems (regional bus, Metro Rail, light rail). This subject is discussed throughout this paper.

To the extent that a fixed guideway extension of BHTT increases the use of regional transit systems, reduces the number of vehicular trips taken (e.g., through improved access to downtown employment, goods and services), reduces traffic congestion in downtown and/or reduces automobile travel, particularly by single-occupancy vehicles, the impacts associated with this alternative would be beneficial in terms of reduced air pollution, traffic congestion, and energy consumption.

b. **Business and Residential Displacements and Disruption**

Placement of an elevated fixed guideway in a downtown urban area could require the displacement of businesses or residences. Full and partial acquisition of parcels could be necessary for stations, guideways and ancillary structures. Temporary construction easements also could be necessary.

Placement of an aerial guideway in street rights-of-way could minimize displacement impacts and reduce property acquisition costs; however, this approach could lead to adverse traffic and parking impacts (discussed below) and may not provide the types of direct access desired for the system.

Various federal and state laws provide for uniform and equitable treatment of eligible residents, business concerns and non-profit organizations that could be displaced by construction and operation of a fixed guideway extension of the BHTT.

Construction impacts, e.g., noise, vibration, dust, traffic disruption, and reduced access could affect local businesses and residences. A number of mitigation measures could be applied to reduce these impacts (e.g., noise and vibration standards, site-watering to control dust, traffic and pedestrian access plans).

c. **Visual/Aesthetics**

An aerial guideway extension of the BHTT could have visual/ aesthetic impacts on land uses in the vicinity of the guideway. Although various technologies would involve different guideway dimensions, the guideway would present a visual presence affecting the views of adjoining land uses and potentially obstructing the views of significant visual or historic resources.

These visual/aesthetic impacts could be mitigated partially through use of landscaping and application of design elements that are integrated to the extent possible with the surrounding environment and buildings.

Views for system users could be of some interest due to the elevated nature of the guideway.

d. **Traffic/Parking**

As noted earlier, displacement impacts and property acquisition costs could be reduced by locating fixed aerial guideways in street rights-of-way. This approach, however, could reduce sidewalk widths, the number of street traffic lanes, and/or the amount of on-street parking. Impacts associated with these reductions could be significant, depending upon the streets where the guideway is located.

One purpose for development of a BHTT guideway extension could be reduction in traffic levels and congestion in the Bunker Hill and downtown area. During an evaluation of specific alternatives, these benefits could be reviewed and compared with the potential traffic disruption resulting from the placement of guideways in the street rights-of-way. Should on-street parking need to be removed, an evaluation also would need to be made of the impacts that reduced parking could have on adjoining land uses.

Guideway construction could affect both the traffic and parking along the alignment during the construction period. Such impacts could be mitigated through the application of traffic and parking plans during this period (i.e., worksite traffic control plans). To the extent that the guideway is not located in the street rights-of-way, these traffic and parking impacts could be reduced.

e. **Noise/Vibration**

Noise and vibration impacts associated with an elevated guideway extension of the BHTT would vary depending on the technology selected, the guideway materials and construction techniques, the soil types and geology along the alignment, and distances to noise sensitive receptors. These impacts could be evaluated on a site-specific basis once alternative technologies and alignments were well defined.

A number of approaches could be considered for reduction of noise and vibration impacts. For example, a technology could be selected that produces minimal noise/vibration, an alignment could be adopted that least affects adjoining noise receptors, sound walls could be installed, and so on.

f. **Archaeological/Historic/Cultural**

Impacts on archaeological, historic and cultural resources would be site-specific and could be defined only once alternative alignments had been identified for the BHTT guideway extensions. Both construction and operational impacts of the elevated guideway on archaeological, historic and cultural resources would need to be considered.

In general, for those areas where the guideway would be close to public streets, the potential for significant archaeological resources to be encountered could be less. The converse could also be assumed. This assumption is based on the general disturbance in downtown Los Angeles to those areas that have been in the past taken for public uses. In some in-block areas, the potential exists for essentially undisturbed remains.

One approach to assuring that archaeological resources are not destroyed during construction is to have a resident archaeologist at construction sites, as was done for the Metro Rail project.

For historic resources, an Area of Potential Effect (APE) is defined, usually two parcels deep along the alignment. Buildings within the APE that are of historical significance, e.g., worthy of nomination to the National Register of Historic Places, are carefully reviewed in terms of potential impacts. Historic resources are reviewed in cooperation with the State Historic Preservation Office. Of particular concern could be the visual impacts on these structures from elevated guideways. Noise and vibration impacts would also need to be considered.

Impacts on cultural resources, e.g., parkland, would also need to be evaluated. For example, should the project involve federal funding and the taking of parkland, a number of findings would need to be made under federal law.

g. **Utilities**

Impacts on utilities could occur during construction of the guideway. These impacts would be site- and alignment-specific. Construction would need to be coordinated with utility companies that have utilities along the alignment.

h. **Air Quality**

A fixed guideway extension of BHTT could: (1) increase the use of regional transit systems, (2) reduce the number of vehicular trips taken (e.g., through improved access to downtown employment, goods and services), (3) reduce

traffic congestion in downtown, and/or (4) reduce automobile travel, particularly by single-occupancy vehicles. The extent to which these actions occur would determine the beneficial impacts that the project could have on air quality in the downtown and region.

Construction of the guideway could produce dust impacts, although this could be mitigated through site watering.

i. **Energy**

As with air quality, beneficial energy impacts would be related to the extent to which a fixed guideway extension of BHTT increases the use of regional transit systems, reduces the number of vehicular trips taken, reduces traffic congestion and/or reduces vehicle miles traveled. Use of energy by the system would be dependent upon the technology utilized.

j. **Safety/Security**

Safety impacts relate to the potential for accidents on the system. The system would need to be designed to appropriate safety standards, including necessary facilities for evacuation of the system and consideration of potential earthquake events. Coordination with the Los Angeles Fire Department would be required. Placement of the guideway in street rights-of-way potentially could produce sight distance problems for street traffic at some locations. Site-specific design considerations would need to be applied to mitigate this potential impact.

Security impacts relate to the potential for criminal activities on the system. Consideration would need to be given to the need for security personnel and/or equipment (e.g., surveillance cameras) as a component of the system. Coordination with or use of the Los Angeles Police force could be required.

k. **Land Use/Local Plans/Growth**

The relationships of the proposed system to land use, local plans and growth are critical impacts associated with the extension of the BHTT. These impacts are discussed in some detail throughout this paper.

In general, it appears that provision of an extension to the BHTT could be supportive of the plans for continued growth in downtown and in the Bunker Hill area specifically. Such a system, at a minimum, could aid in accommodating this growth.

l. **Economic/Fiscal**

The economic and fiscal impacts associated with a BHTT extension could involve a number of factors, including creation of jobs during construction and operation, the need for system funding, and potential impacts on the

subregional economies of the Bunker Hill and downtown areas and on the overall regional economy.

Economic impacts would be apparent for the private sector should it become part of the system funding, as was proposed for the original Los Angeles Downtown People Mover, and as would almost certainly be the case for a new system.

m. Soils/Geology

The types and location of specific soils and geologic formation could affect the design and construction techniques utilized for various options. For example, location of fault lines could affect system location, design and costs, as could the presence of hazardous soils, as were discovered during the construction of the Metro Rail project.

n. Vegetation/Wildlife

Vegetation and wildlife impacts in downtown would be expected to be minimal, given the dense urban character of this area.

VII. WHAT'S NEXT?

A. TECHNOLOGIES ELIMINATED AND WHY

During the course of this preliminary study, a number of technologies have been discussed and some have been suggested for the various conceptual options. The appendix has a more detailed description of the specific systems available, and reasons for eliminating some of them from further consideration. However, the general discussion following will endeavor to illustrate why various technologies are suited to one type of alternative and not to another.

1. Constraints within the BHTT itself preclude further consideration of at least two classes of technology: heavy rail transit like the Metro Red Line, and maglev. The larger monorail systems are also excluded.

2. The least costly transportation alternative, the internal circulator, falls under the category of very short run (one mile and less) high capacity multiple stop systems. Because of the short length, high capacity and relatively slow speed necessitated by many stops, moving walkways and cable shuttle systems are suitable. Larger, high-speed systems such as light rail and the larger rubber tired systems are not well-suited because of the extensive maintenance facilities required, the more expensive infrastructure required and the inefficiency of starting and stopping the trains.

3. The third and fourth alternatives proposed (the BHTT extended west, and a BHTT/P.E. Tunnel loop) can be classified under high-capacity, multiple-stop, short-run (up to four miles) systems. These alignments are suitable for the larger rail-guided cable traction systems and for some of the smaller rubber tired and monorail systems. Both of these technologies require more infrastructure and support systems than the very short-run systems, but less than the large rubber tired systems and light rail systems. Moving walkways are not suitable for distances of more than one mile because of their very slow speed.

4. The fifth and sixth alternatives (loop with extensions, and comprehensive systems) are classified as longer systems (over four miles). Four miles is about the limit for cable systems even with multiple loops and changeovers, so they are virtually eliminated from this group of alignments. The small monorail and small rubber-tired systems can still be used and may be the best choice for these alignments, the decision points being the capacity required for the system and speed at which it is desired to operate the system. The smaller systems are capable of speeds of 20 mph and capacities of 6-10,000 people per hour. The larger systems operate at speeds of 30-50 mph and have capacities of up to 20,000 people per hour.

5. The dual-power systems could be used for any of the alternatives discussed, but they suffer from the same problems as all-street systems to the extent that for part of their routing they have to contend with street traffic. If used exclusively in automated mode they are less efficient than a totally dedicated (single-power)

system, and therefore they should be regarded as a stop-gap or compromise solution. They are also less reliable than a dedicated automated guideway transit system.

B. SPECIFIC PROMISING ALTERNATIVES FOR FURTHER STUDY

Non-transportation alternatives should not be ruled out at this early stage, although further work would be needed to identify a comprehensive range of options, as well as evaluation criteria. In view of the UMTA restriction on uses of the BHTT, perhaps it is appropriate to view non-transportation uses as a last-resort option, to be studied more extensively if it appears that transportation uses will not be cost-effective. The most promising alternatives at this point are the transportation-related ones.

Several kinds of transportation alternatives appear to warrant further study. In order of increasing scale, the alternatives focused on in this white paper are:

1. A short, two-way shuttle within Bunker Hill.

2. Use of the tunnel as an exclusive guideway for an electrified DASH bus system.

3. A longer two-way shuttle, linking Bunker Hill to Central City West.

4. An extended two-way shuttle providing a link from Union Station, through Little Tokyo, Bunker Hill, and Central City West, to the Convention Center.

5. A comprehensive Los Angeles downtown circulator system. No plan presently exists for such a system, coordinated to the existing and developing needs of one of the fastest-growing downtown areas in the world.

C. DECISION POINTS AND WINDOWS OF OPPORTUNITY

It is clear that the set of reasonable options for use of the BHTT is affected by developments in other studies that are also underway. In particular, the following factors significantly impact BHTT options:

- which alignment of the Pasadena LRT is selected;

- how the Central City West plan shapes up; and

- what happens to the most recent proposals for use of the Pacific Electric Tunnel.

To a longer term, but not necessarily lesser, extent, future plans for areas such as City North, the Alameda Corridor, and the Figueroa Corridor could impact choices for the BHTT. At the same time, the impact should not all be in one direction. That is, the availability of the BHTT may generate opportunities that are superior from a system-wide standpoint to those proposed without consideration of the tunnel. Thus, discussions on the role of the BHTT need to be integrated with these and other relevant activities concerning downtown Los Angeles.

Also, the timing of key decisions can affect the costs associated with various BHTT options. For example, significant economies could be achieved by coordinating BHTT-related construction with construction on nearby projects. While it may be too late to modify activities related to the construction of the Metro Red Line tunnels at Fifth and Hill and the California Plaza Phase II building, coordination should be possible for the interface of the west end of the existing BHTT with the proposed Pasadena LRT line. Another example of the importance of timing is the opportunity afforded by the approval process for new developments to secure early preservation of rights of way and easements for an extended BHTT system.

D. SUMMARY AND NEXT STEPS

This white paper has identified some promising uses for the Bunker Hill Transit Tunnel, in the context of ongoing land-use and transportation activities in downtown Los Angeles. While it is too early to judge the ultimate feasibility of any of the options, it is easy to see some attractive possibilities for improving downtown circulation, providing better service to major activity areas, and linking together key elements of the downtown transportation infrastructure.

The remainder of this study will explore these options further. In particular, the various conceptual alternatives presented here will be compared in terms of projected patronage, engineering feasibility, cost-effectiveness, financing plans, and environmental concerns. Institutional and phased implementation questions will also be addressed by this study. The outcome will be a set of recommendations to the City of Los Angeles regarding the use of the Bunker Hill Transit Tunnel.

APPENDIX A:

SUPPLEMENTAL LAND USE DATA

TABLE A-1

EXISTING MAJOR DEVELOPMENTS IN BUNKER HILL AREA

CONTIGUOUS TO BUNKER HILL TRANSIT TUNNEL

Sheraton Grande Hotel - Southwest corner Third and Figueroa Streets
13 stories; 420,000 square feet:
50,000 square feet office
50,000 square feet retail
485 hotel rooms
500 parking spaces

The Park Offices - Northwest corner Third and Figueroa Streets
5 stories:
260,000 square feet office
10,000 square feet retail
270 parking spaces

Bunker Hill Towers - Northeast corner Third and Figueroa Streets
19 - 32 stories:
10,000 square feet retail
715 dwelling units
1,300 parking spaces

Los Angeles World Trade Center - Northeast corner Fourth and Figueroa Streets
13 stories:
200,000 square feet office
100,000 square feet retail
350 parking spaces

Security Pacific Plaza - Southwest corner Third and Hope Streets
55 stories:
1,600,000 square feet office
20,000 square feet retail
1,600 parking spaces

Wells Fargo Center (formerly Crocker/Macguire) - 300 block S. Grand Avenue
44 - 54 stories:
2,240,000 square feet office
80,000 square feet retail
1,100 parking spaces

California Plaza Phase IA - 300 block S. Grand Avenue
42 stories:
880,000 square feet office
30,000 square feet retail
1,000 parking spaces

Angelus Plaza - 300 block S. Olive Street
7 - 17 stories:
55,000 square feet office
20,000 square feet retail
1,093 dwelling units
2,400 parking spaces

TABLE A-1 (continued)

ELSEWHERE IN BUNKER HILL

Union Bank - Northwest corner Fifth and Figueroa Streets
42 stories:
620,000 square feet office
10,000 square feet retail
645 parking spaces

Promenade Towers - 123 South Figueroa (at Second Street)
15 - 17 stories:
26,000 square feet office
40,000 square feet retail
533 apartment units
880 parking spaces

Promenade West - Southeast corner First and Figueroa Streets
5 stories:
135 condominium units
230 parking spaces

The Promenade - Southwest corner First and Hope Streets
5 stories:
25,000 square feet retail
140 dwelling units
300 parking spaces

Grand Promenade Phase 1 - Northwest corner Third Street and Grand Avenue
32 stories:
25,000 square feet office
10,000 square feet retail
372 dwelling units
594 parking spaces

Bunker Hill Heating/Cooling Plant - Northeast corner Third and Flower Streets
2 stories:
65,000 square feet office

Museum of Contemporary Art - 300 block South Grand Avenue
100,000 square feet of exhibition space
retail
parking
outdoor performance area (Spiral Court)

Bonaventure Hotel - Northwest corner Fifth and Flower Streets
35 stories:
145,000 square feet retail
1,544 hotel rooms
1,500 parking spaces

YMCA and Arco Garage - Southeast corner Fourth and Flower Streets
2 - 12 stories:
70,000 square feet office
1,800 parking spaces

TABLE A-1 (continued)

444 Plaza (formerly Wells Fargo Building) - 444 South Flower Street
48 stories:
1,000,000 square feet office
20,000 square feet retail
900 parking spaces

O'Melveny & Meyers Building - 400 South Hope Street
26 stories:
620,000 square feet office
5,000 square feet retail
650 parking spaces

Pacific Bell Building - Southeast corner Fourth and Grand Streets
16 stories:
350,000 square feet office
300 parking spaces

Subway Terminal Building - 400 block of Hill Street
522,000 square feet office
550 parking spaces

Equitable Building - Northwest corner Fifth and Hill Streets
89,000 square feet office
11,000 square feet retail
200 parking spaces

Sources: "Status of Development Projects" (map and table), Los Angeles Community Redevelopment Agency, July 1989; and Tax Assessor's data base (1985).

TABLE A-2

PLANNED DEVELOPMENTS IN BUNKER HILL AREA

CONTIGUOUS TO BUNKER HILL TRANSIT TUNNEL

California Plaza Phase IB (Museum Tower) (planned construction 1989-90) - 300 block of South Olive Street

- 20 stories:
- 5,800 square feet retail
- 220 dwelling units
- 270 parking spaces

California Plaza Phase IIA (planned construction 1989-90) - 300 block of South Olive Street

- 60 stories:
- 1,270,000 square feet office
- 40,000 square feet retail
- 1,300 underground parking spaces
- outdoor garden/performance plaza -- 1-1/2 acres

California Plaza Phases IIB and IIIB (planned construction 1991-95) - 300 block of South Olive

- 25 stories:
- 20,000 square feet retail
- 530 dwelling units
- 795 parking spaces

California Plaza Phase IIIA (planned construction 1991-95) - northwest corner Fourth and Hill Streets

- 45 stories:
- 920,000 square feet office
- 21,000 square feet retail
- 1,080 parking spaces
- Dance Gallery, Cineplex

California Plaza Hotel (planned construction 1989) - 300 block of South Olive Street

- 18 stories:
- 5,000 square feet retail
- 450 hotel rooms
- 270 parking spaces

ELSEWHERE IN BUNKER HILL

Walt Disney Concert Hall (planned construction 1991-95) - First Street between Hope and Grand (County Parcel K)

- 3.6 acre site; 2,500 seat auditorium
- 45,000 square feet retail
- 400 hotel rooms
- 1000 parking spaces (estimated)

County Parcel Q (planned construction 1991-95) - block bounded by First, Second, Grand and Olive Streets

- 1,375,755 square feet office
- 100,000 square feet retail
- 925 parking spaces
- child care facility

TABLE A-2 (continued)

First Interstate World Center (Library Square), Phase 1 (construction completed 1989) - 633 West Fifth Street

73 stories:
1,225,000 square feet office
75,000 square feet retail
300 parking spaces

Southern California Gas Center (planned construction 1989-90) - north side of Fifth Street, between Olive and Grand

52 stories:
1,150,000 square feet office
50,000 square feet retail
900 underground parking spaces

Grand Promenade Phase II (planned construction 1991-95) - 200 block South Grand Avenue

25 stories:
20,000 square feet office
10,000 square feet retail
300 dwelling units
460 parking spaces

Grand Promenade Phase III (planned construction 1996 or beyond) - 200 block South Grand Avenue

15,000 square feet office
10,000 square feet retail
300 dwelling units
450 parking spaces

One Bunker Hill Building Phase 2 (planned construction 1989) - northwest corner of Fifth and Grand

8,000 square feet restaurant
75 underground parking spaces

Pershing Square Center (planned construction 1991-95) - northeast corner Fifth and Olive Streets

38 stories:
837,000 square feet office
100,000 square feet retail
540 hotel rooms
875 parking spaces

Union Bank Square - northwest corner Fifth and Figueroa Streets

11 new retail spaces,
720-1786 square feet each — assume 14,000 s.f. retail total

Sources: "Status of Development Projects" (map and table), Los Angeles Community Redevelopment Agency, July 1989; and Quarterly Commercial Real Estate Report of the **Downtown News**, July 31, 1989.

TABLE A-3

PROJECTED GROWTH IN BUNKER HILL, LITTLE TOKYO, AND CENTRAL BUSINESS DISTRICT REDEVELOPMENT AREAS

Under construction beginning:	Office Square Feet	Retail Square Feet	Hotel Rooms	Dwelling Units
1989	6,533,300	774,300	568	1,303
1989-90	5,273,500	736,250	2,050	1,048
1991-95	10,184,500	541,900	1,990	2,159
1996-beyond	1,779,800	253,000	500	300
TOTAL	23,771,100	2,305,450	5,108	4,810

TOTAL SQUARE FEET OF NEW DEVELOPMENT:

Office	23,771,100
Retail	2,305,450
Hotel	5,748,708[1]
Residential	5,975,634[2]
TOTAL	37,800,892

Source: "Status of Development Projects" (map and table), CRA/LA, July 1989.

1 According to the Tax Assessor's data base, the Sheraton Grande (485 rooms) and the Bonaventure (1,544 rooms) together occupy 2,283,502 square feet of hotel space (not including office and retail space). Applying the same ratio (1,125 square feet per room) to 5,108 new hotel rooms yields the indicated estimate.

2 According to the Tax Assessor's data base, the 2,083 dwelling units included in the Angelus Plaza, Bunker Hill Towers, Promenade West, and Promenade Plaza (or The Promenade) developments total 2,587,785 square feet of residential space. Applying the same ratio (1,242 square feet per dwelling unit) to 4,810 new dwelling units yields the indicated estimate.

TABLE A-4

PLANNING GOALS AND OBJECTIVES OF THE CBD REDEVELOPMENT AREA[3]

1. To assist in the development of Downtown as a major center of the Los Angeles metropolitan region, within the context of the Los Angeles General Plan as envisioned by the concept and City-wide Plan portions thereof.

2. To create a climate which will prepare Central City to accept that share of anticipated regional growth which is economically and functionally attracted to it.

3. To organize growth and change, to reinforce viable functions, and to facilitate the renewal or rehabilitation of deteriorated and underutilized areas.

4. To create a modern, efficient and balanced urban environment for people, including a full range of around-the-clock activities and uses, such as recreation and housing.

5. To create a symbol of pride and identity which gives Central City a strong image as a major center of the Los Angeles region.

6. To provide an integrated transportation system which will allow for efficient movement of people and goods while enhancing the environment, giving special attention to separation of the pedestrian and the automobile.

7. To achieve excellence in design, based on how Central City is to be used by people, giving emphasis to parks, green spaces, street trees, and places designed for walking and sitting.

8. To preserve key landmarks which highlight the history and unique character of the City -- blend old and new in an aesthetic realization of change or growth with distinction. Within the Project area, the Cultural Heritage Board of the City of Los Angeles has designated the following structures as historical monuments:

   a. Bradbury Building, 304 South Broadway

   b. St. Joseph's Church, 218 East 12th Street

   c. St. Vibiana's Cathedral, 114 East 2nd Street

   d. Fire Station #23, 225 East 5th Street

   e. California Club, 538 South Flower

   f. Central Library, 630 West 5th Street

   g. Biltmore Hotel, 515 South olive

   h. Philharmonic Auditorium, 427 West 5th Street

   i. St. Paul's Cathedral, 615 South Figueroa

   j. Los Angeles Athletic Club, 431 West 7th Street

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[3] **Redevelopment Plan: Central Business District Redevelopment Project**, Community Redevelopment Agency, City of Los Angeles, 1975, pp. 15-18.

k. Palm Court, Alexandria Hotel, 5th and Spring Streets

l. Cole's P.E. Buffet, 118 East 6th Street

m. Garfield Building Lobby, 403 West 8th Street

n. Global Marine Building, 811 West 7th Street

9. To provide a full range of employment opportunities for persons of all income levels.

10. To provide high and medium density housing close to employment and available to all ethnic and social groups, and to make an appropriate share of the City's low and moderate income housing available to residents of the area.

11. To provide the public services necessary to the solution of the various social, medical and economic problems of Central City residents, especially the Skid Row Population.

12. To establish an atmosphere of cooperation among business, special interest groups and public agencies in the implementation of this Plan.

TABLE A-5

EXISTING AND PLANNED DEVELOPMENTS IN THE LITTLE TOKYO AREA

DEVELOPMENTS COMPLETED

Brunswig Square (Rehab) - Southwest corner Second Street and Central Avenue
8 stories:
120,000 square feet office
30,000 square feet retail
150 parking spaces

Bunmiedo Building - 300 block E. Second Street
2 stories:
5,000 square feet office
2,000 square feet retail

California First Bank Building - Northeast corner Second and San Pedro Streets
6 stories:
60,000 square feet office
61 parking spaces

Higashi Hongwanji Buddhist Temple - Northeast corner Third Street and Central Avenue
2 stories:
20,000 square feet office
44 parking spaces

Honda Plaza - Southeast corner Second and San Pedro Streets
2 stories:
6,000 square feet office
29,000 square feet retail
60 parking spaces

Hotel New Otani - Southeast corner First and Los Angeles Streets
22 stories:
20,000 square feet retail
448 hotel rooms
196 parking spaces

Hotel Tokyo/Unipac - 300 block E. First Street
10 stories:
13,000 square feet retail
174 hotel rooms
25 parking spaces

Japan American Theatre - 200 block S. San Pedro Street
2 stories:
31,000 square feet office

TABLE A-5 (continued)

Japanese American Cultural Center - 200 block S. San Pedro Street
6 stories:
48,000 square feet office

Japanese Village Plaza - 200 block E. First Street
2 stories:
6,500 square feet office
73,500 square feet retail
205 parking spaces

Little Tokyo Plaza - 300 block E. Second Street
4 stories:
20,000 square feet office
18,000 square feet retail

Little Tokyo Square - Southwest corner Third and Alameda Streets
3 stories:
277,900 square feet retail
450 parking spaces

Little Tokyo Towers - 300 block E. Third Street
16 stories:
301 dwelling units
75 parking spaces

Mitsui Manufacturers Bank Building - Southeast corner San Pedro and Second Streets
5 stories:
16,000 square feet office
30,000 square feet retail

Miyako Gardens - 200 block S. Central Avenue
4 stories:
100 dwelling units
75 parking spaces

Sho Tokyo Parking Facility - 300 block E. Second Street
5 stories:
3,000 square feet retail
378 parking spaces

Tokyo Villa - Northwest corner Third and Alameda Streets
4 stories:
167 dwelling units
308 parking spaces

Union Church - Southeast corner First and Los Angeles Streets
19,000 square feet office
47 parking spaces

TABLE A-5 (continued)

PLANNED DEVELOPMENTS

Allright Parking/Shopping Complex - Northeast corner Second Street and Central Avenue
7 stories:
6,000 square feet office
30,000 square feet retail
352 parking spaces

Centenary United Methodist Church - Southeast corner Third Street and Central Avenue
2 stories:
22,000 square feet office
93 parking spaces

Little Tokyo Professional Building - Southeast corner Third and San Pedro Streets
10 stories:
75,000 square feet office
44,000 square feet retail
376 parking spaces

Japanese American National Museum - Northeast corner E. First Street and Central Avenue
3 stories:
33,500 square feet office

Jo Do Shu Buddhist Temple - Southwest corner Third Street and Omar Avenue
2 stories:
3 dwelling units
10 parking spaces

Miyatake Building - 300 block E. First Street
2 stories:
3,500 square feet office
3,500 square feet retail

San Nana Go - Northwest corner Second Street and Central Avenue
3 stories:
15,000 square feet office
30,000 square feet retail
110 parking spaces

Taira Hotel and Condominium - Northwest corner Third and San Pedro Streets
10 stories:
400 hotel rooms
100 dwelling units
315 parking spaces

East West Players Theatre (Rehab) - Northeast corner First and San Pedro Streets
3 stories:
14,000 square feet office

Ginza Plaza - Northeast corner Second Street and Central Avenue
10 stories:
35,000 square feet retail
200 dwelling units
400 parking spaces

TABLE A-5 (continued)

Weller/First Street Project - Southeast corner First Street and Onizuka Way
To Be Determined

San Angelus Mixed Use Project - Southeast corner Second and Los Angeles Streets
To Be Determined

Volk Office Building - Southeast corner First Street and Central Avenue
To Be Determined

TOTAL LITTLE TOKYO DEVELOPMENT:

Land Use	**Existing**	**Planned**	**Total**	**% Increase**
Office square feet	351,500	169,000	520,500	48.1
Retail square feet	496,400	142,500	638,900	28.7
Hotel rooms	622	400	1,022	64.3
Dwelling units	568	303	871	53.3
Parking spaces	2,074	1,656	3,730	79.8

Source: "Status of Development Projects" (map and table), CRA/LA, July 1989.

APPENDIX B:

SUPPLEMENTAL TECHNOLOGICAL DATA

* : Will fit 2-way in existing tunnel
** : Will fit 1-way in existing tunnel
*** : Will fit 1-way with modifications to existing tunnel
☐ : Will not fit in existing tunnel
○ : Insufficient information to make a judgement

AVAILABLE CIRCULATOR SYSTEMS AND THEIR CHARACTERISTICS

SYSTEM TYPE	RUBBER TIRED AUTOMATIC GUIDED SYSTEMS													
MANUFACTURER	WESTINGHOUSE	WESTINGHOUSE	MATRA/VAL	NEWTRAM (VOUGHT)	VONA	MITSUBISHI HEAVY INDUSTRIES	MITSUBISHI HEAVY INDUSTRIES	NIIGATA ENG CO	PARA TRAM TOKYO CAR CO	KAWASAKI HEAVY INDUSTRIES	KRT KOBE STEEL LTD	KRT KOBE STEEL LTD	FAST FUJI CAR MFG	FAST FUJI CAR MFG
MODEL	** C100	** C45	*** 256	○	**	**	**	**	**	**	**	**	**	**
HEIGHT CAR TOTAL	11'-1" 13'-0"	10'-2" 11'-11"	10'-10"		11'-0" 12'-0"	9'-8"	10'-10"	10'-2"	10'-7"	10'-6"	8'-11"	10'-7"	10'-3"	10'-6"
WIDTH CAR TOTAL	9'-4" 12'-5"	8'-5½" 10'-0"	6'-10"		8'-0" 10'-0"	7'-4"	8'-2½"	7'-6"	8'-0"	7'-10"	6'-9"	7'-8"	7'-6"	8'-2"
LENGTH	33'-8" 41'-10"	22'-0" 26'-5"	87'-0"		25'-4"	19'-0"	29'-4"	26'-8"	26'-8"	21'-6" 30'-4"	19'-0"	26'-8"	21'-4" 29'-4"	43'-4"
MAXIMUM GRADE	10%	10%	10%		6%	10%	10%	10%	7%	10%	10%	9%	10%	10%
MINIMUM HORIZONTAL CURVE RADIUS (FT)	75'-0" @ 13 MPH	75'-0" @ 13 MPH	135'		50'-0"	50'-0"	50'-0"	66'-0"	100'-0"	66'-0"	31'-0"	50'-0"	76'-0"	76'-0"
MINIMUM VERTICAL CURVE 1% CHANGE			3300'R 31'-0"											
MAXIMUM CARS PER TRAIN	3	3	4	4 STD 6 MAX	3	6	6	6	6	6	6	6	6	6
CAR CAPACITY DESIGN CRUSH	100 150	45 68	160		70 75	32	75	75	75	30 75	30	75	50/75	130'
TRAIN CAPACITY PASS./HR. 3 MIN HDWY	9,000	4,000	10,000	7,200	4,500	4,000	9,000	9,000	9,000	9,000	3,600	9,000	6,000/9,000	15,600
SPEED MAXIMUM OPERATING	30 MPH	30 MPH	50 MPH	38 MPH	38 MPH									

* : Will fit 2-way in existing tunnel
** : Will fit 1-way in existing tunnel
*** : Will fit 1-way with modifications to existing tunnel
□ : Will not fit in existing tunnel
○ : Insufficient information to make a judgement

AVAILABLE CIRCULATOR SYSTEMS AND THEIR CHARACTERISTICS

SYSTEM TYPE	STEEL WHEEL SYSTEMS													
MANUFACTURER	UTDC	UTDC	UTDC	UTDC	UTDC	TGI / BOMBARDIER	TAU/BN/ BOMBARDIER	AEROMOVEL RADSCO	GEC / MOWLEM					
MODEL	** TORONTO LRV	** TORONTO ALRV	** DETROIT ALRTV	** VANCOUVER ALRTV	** SANTA CLARA ALRTV	**	○	□						
HEIGHT CAR TOTAL	11'-0"	11'-0"	10'-3"	10'-3"	11'-2½" 13'-0"	11'-1¾" 12'-8¾"		15'-6"						
WIDTH CAR TOTAL	8'-4"	8'-6"	8'-2½"	8'-2½"	8'-8½"	8'-8½"		9'-3"						
LENGTH	52'-7"	75'-1"	41'-8"	41'-8"	88'-6"	89'-2"		43'±						
MAXIMUM GRADE	8%	8%	6%	6%	6.4%	6%	6%	4-10%						
MINIMUM HORIZONTAL CURVE RADIUS (FT)	36'-0"	36'-0"	60'-0"	60'-0"	82'-0"	82'-0"	32'-0"	85'±						
MINIMUM VERTICAL CURVE 1% CHANGE	460'R 4'-7"	800'R 8'-0"	1000'R 10'-0"	1000'R 10'-0"	1660'R 16'-6"	1150'R 11.5'		340' 3.4'						
MAXIMUM CARS PER TRAIN	6	4	2	6	4	4		4	2 OR MORE					
CAR CAPACITY DESIGN CRUSH	94 142	159 257	73 112	73 107	166 257	211 256	115 130	150						
TRAIN CAPACITY PASS./HR. 3 MIN HDWY	17,000	20,000	4,480	12,840	20,000	20,000	20,000	12,000	8,000					
SPEED MAXIMUM OPERATING	58 MPH 50 MPH	56 MPH 50 MPH	62 MPH 56 MPH	62 MPH 56 MPH	65 MPH 56 MPH	55 MPH	36 MPH	47 MPH 28 MPH	50 MPH					

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AVAILABLE CIRCULATOR SYSTEMS AND THEIR CHARACTERISTICS

SYSTEM TYPE	MONORAIL SYSTEMS													
MANUFACTURER MODEL	TGI/ BOMBARDIER ** UMI	TGI/ BOMBARDIER □ M	TGI/ BOMBARDIER ○ XM	ASTROGLIDE TITAN PRT SYSTEMS ○	VON ROLL/ VSL CORP ○	SIEMENS AG ○ H. BAHN.	ALWEG ○	HITACHI □						
HEIGHT CAR TOTAL	8'-11" 10'-3"	10'-5½" 15'-0"												
WIDTH CAR TOTAL	6'-6" 8'-0"	8'-4½" 10'-0"						10'-0"						
LENGTH	22'-1" 17'-4"	41'-5" 30'-2"						50'-0"						
MAXIMUM GRADE	12%	12%				7.5%		3% (STEEPER WITH SPECIAL TRACK)						
MINIMUM HORIZONTAL CURVE RADIUS (FT)	100'-0"	175'-0"												
MINIMUM VERTICAL CURVE 1% CHANGE	600'R 6'	1000'R 10'												
MAXIMUM CARS PER TRAIN	6 STD 10 MAX	6 STD 10 MAX	6 STD 10 MAX			1		4						
CAR CAPACITY DESIGN CRUSH	21 34	46 76	250	20-50		42		120 250						
TRAIN CAPACITY PASS./HR. 3 MIN HDWY	6,800	15,200	50,000		5,000	3,780		20,000						
SPEED MAXIMUM OPERATING	22 MPH	55 MPH	70 MPH		20 MPH									

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AVAILABLE CIRCULATOR SYSTEMS AND THEIR CHARACTERISTICS

SYSTEM TYPE	CABLE SYSTEMS								MAGNETIC SYSTEMS			DUAL MODE STREET + AGT		
MANUFACTURER MODEL	OTIS * *	SOULE *	POMA ○ 2000	MITSUBISHI * SKY CABLE	SKIRAIL * *	FUJI TEC (INCLINED ELEVATOR SYSTEMS) □	METROSHUTTLE 2000 VSL CORP ○		MAGNETIC TRANSIT □ M-BAHN			BN/ BOMBARDIER * *	AEG/ WESTINGHOUSE * *	
HEIGHT CAR TOTAL	9'-10" 10'-9"	7'-6" 9'-11¼"		11'-0"	13'-0"	20'-6"			9'-7" 11'-5"			11'-7"		
WIDTH CAR TOTAL	7'-4"/9'-10" 9'-10"	5'-0"		6'-0"	9'-0"	6'-3"/11'-4"			8'-2" 9'-7"			8'-1½"		
LENGTH	15'-0" 27'-0" 39'-0" 51'-0"	10'-0"		9'-0"		6'-0"			37'-10"			82'-2"		
MAXIMUM GRADE	8%	10%/12%	13%	30%	34%	20-50%						15%	18%	
MINIMUM HORIZONTAL CURVE RADIUS (FT)	60'-0"	48'-0" (100'-0" NORMAL)		70'-0"		STRAIGHT ONLY			166'-0"			40'-0" (47'-0" AGT)		
MINIMUM VERTICAL CURVE 1% CHANGE	3,000' R 30'-0"	400'-0" 4'-0"				STRAIGHT ONLY			2000' 20'-0"					
MAXIMUM CARS PER TRAIN	2 OR MORE			1		1			4'			2-3 IN AGT ONLY	1	
CAR CAPACITY DESIGN CRUSH	23-187	12-20		15		8 20			83 115			94 157		
TRAIN CAPACITY PASS./HR. 3 MIN HDWY	11,000	5,000	20,000	(20 SEC HDWY) 3,000	3,000				9,000			3000 9000(AGT)		
SPEED MAXIMUM OPERATING	25 MPH	12.5 MPH	22 MPH	13 MPH 8.5 MPH	22 MPH	2 MPH			50 MPH			44 MPH		