

10.0 Executive Summary

This Milestone Report is the tenth in a series of eleven reports prepared for the proposed high-speed ground access system between Los Angeles International Airport (LAX) and Palmdale Regional Airport (PMD).

The intent of this Milestone is to serve as the culmination of efforts put forth in the previous milestones and to develop the framework for the future decision on a project for the Southern California Association of Governments' (SCAG) intra-regional high-speed rail network.

Milestone 10 consists of six primary components:

- 10.1 Project Background
- 10.2 Study Process and Findings
- 10.3 Technology Alternatives and Selection
- 10.4 Proposed System Configuration
- 10.5 Cost Estimates and Financial Plan
- 10.6 Next Steps

Study Process

The LAX-PMD High Speed Ground Access System study effort began with three general system configurations. These configurations were:

- **Base:** *Palmdale-Santa Clarita-Van Nuys-West Los Angeles-Los Angeles International Airport (LAX).*
- **“S” Configuration:** *Palmdale-Santa Clarita-Van Nuys (option)-Union Station-West LA (option)-LAX.*
- **Tunnel:** *Palmdale-Union Station-LAX. Through San Gabriel Mountains.*

The tunnel configuration was eliminated due to high potential costs and low ridership potential, since it misses Santa Clarita and the San Fernando Valley.

A series of alignment alternatives was defined and analyzed using basic technical criteria (length, travel time, ridership potential, relative costs, environmental fatal flaws, etc.) to produce a short list of alignment segments between LAX and PMD. These were combined into the three final project alternatives that were the focus of this study.

Project Alternatives

The LAX-PMD High Speed Ground Access System will be a system that will serve as an airport and urban center connector while reducing automobile congestion in the Southern California region. The Project Study Team has evaluated multiple route alignments, station locations, service technologies, and system operations to develop three short-listed potential alignments, ten potential stations serving the various alignments, and recommended technologies. The three recommended short-list alternative routes are:

1. **Airport Connector** - Alternative 1 (Metrolink Antelope Valley Line, Golden State I-5 Freeway, and San Diego I-405 Freeway) is the fastest combination between LAX and PMD and best serves the airport connector role. The length of this alternative is 116 kilometers (72 miles). The initial estimate of the end-to-end travel time is 42 minutes. This is comparable to the desired 60-minute terminal-to-terminal connection time for air passengers, discussed in Milestone 2. The other two alternatives focus more on greater coverage of the study area and therefore have higher travel times.
2. **Transit Hubs** - Alternative 2 (Antelope Valley SR-14 Freeway, Metrolink Antelope Valley Line, and Santa Monica I-10 Freeway) includes the other short-listed alternatives, and is a compromise between the congestion relief and airport connector roles. This alternative is 153 kilometers (95 miles) in length, and has an estimated end-to-end travel time of 60 minutes.
3. **Maximum Coverage** - Alternative 3 (Antelope Valley SR-14 Freeway, Metrolink Antelope Valley Line, Golden State I-5 Freeway, Metrolink Ventura Line, and Santa Monica I-10 Freeway) achieves maximum penetration into the areas being served and therefore supports the role of congestion relief. The length of this alternative is estimated at 171 kilometers (106 miles), including the portion from Union Station to LAX that may be part of the California Maglev Project¹. The initial travel time estimate is 70 minutes from end to end.

The three alternative alignments are displayed in Exhibits 10.0-1 through 10.0-3 on the following pages.

Technology Selection

Three technologies were selected as finalists for consideration as the recommended technology for the LAX-PMD High-Speed Ground Access System, high-speed rail (HSR), very high-speed rail (VHSR), and very high-speed maglev (VHSM). Identification of the preferred technology was determined using a set of well-defined criteria established in conjunction with the Federal Transit Administration (FTA), Federal Railroad Administration (FRA) and Southern California Association of Governments (SCAG) goals. The categories are:

- Operations - maximum speed, average running speeds, geometrical constraints, and right-of-way impacts
- Service Levels - travel times, reliability, capacity, frequency and convenience of service, and rider comfort
- Risks - technological maturity and proven operations/costs
- Safety - potential for at-grade conflicts, the potential for derailment, FRA crash energy management requirements, and barrier requirements
- Energy - energy consumption and efficiency and petroleum reliance
- Environmental Impacts - noise, vibration, and visual impacts
- Ridership/Revenue - image and estimated daily boardings

¹ LAX-March Corridor, also studied by SCAG

Exhibit 10.0-1
AIRPORT CONNECTOR ALTERNATIVE



Length: 115 Km (72 Mi)

Maglev Costs (2000 \$):

Capital: \$8.2 billion

O&M: \$146 million/year

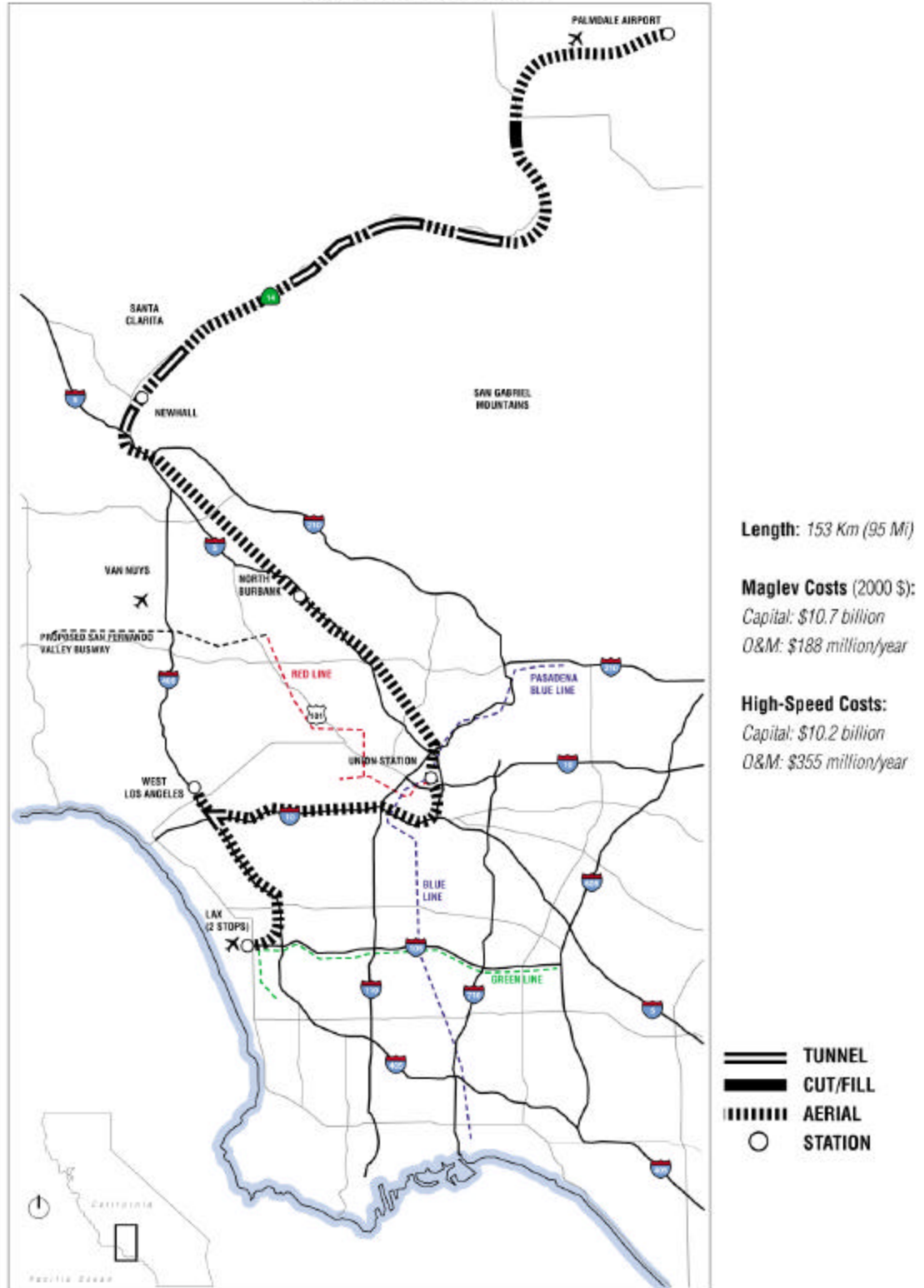
High-Speed Costs:

Capital: \$7.9 billion

O&M: \$281 million/year





TUNNEL
 CUT/FILL
 AERIAL
 STATION

Exhibit 10.0-2
TRANSIT HUBS ALTERNATIVE



[illegible]

High-Speed Costs:
Capital: \$11.7 billion
O&M: \$418 million/year

 TUNNEL
 CUT/FILL
 AERIAL
 STATION

- Facilities - stations and maintenance yards
- Costs - capital costs, annual operation and maintenance costs, and 20-year lifecycle costs

Each of the potential system technologies was evaluated using the above criteria. The VHSM technology was selected as the preferred alternative based upon the superior performance of the technology in several categories when compared to HSR and VHSR.

System Configuration

Using the preferred maglev technology, the operational characteristics of the system were developed. These characteristics were applied to each alternative to determine travel time and passenger load capabilities.

Operational Parameters

The following parameters, combined with the alignment data, influence train speed:

- Station Dwell – set at 2 minutes.
- Superelevation curves (banking) – limited to 12%.² Superelevation is a function of curve radius and will restrict the speed of a train before the curve, require slower speeds throughout the curve, and then allow acceleration coming out of the curve.
- The acceleration, braking and lateral acceleration limits – set at $3.22f/s^2$ (.1G). This value allows passengers to freely stand and walk about the cabin, rather than remain seated, during acceleration and braking. Higher acceleration levels would require passengers to remain seated when the train is either accelerating or decelerating.
- 10% grade climbing ability – allowed with minimal speed loss

Travel Time Parameters

- Total Operating Hours/Day – 18 Hours
- Total Peak Operating Hours/Day – 8 Hours
- Total Off-peak Operating Hours/Day – 10 Hours
- Headways, Peak and Off-Peak – 10 Minutes
- Turnaround time – There is a 30-minute layover at the end of every round trip. This time is not included in the one-way trip time calculations.

² TRI recommends 12% in normal operations.

Fleet Characteristics

Each 502-ft. long maglev train will consist of six vehicles coupled semi-permanently and will carry 600 passengers. The proposed system (and corresponding platform lengths) would couple two six-car consists for commuter operations during the morning and afternoon rush hours periods. The two types of vehicles are power cars and passenger cars.

The fleet sizes were estimated based on the round-trip time for each alignment alternative, the 10-minute service headway, the peak passenger load, and the capacity of either the standard six-car trainset or a twelve-car trainset. Spare vehicles are estimated at 20% of the peak load carrying capacity. The simulations used twelve-car trainsets (4 power cars and 8 passenger cars) for peak service and six-car trainsets (2 power cars and 4 passenger cars) for off-peak service. Peak service needs are used to define fleet size.

Alignment Alternative Characteristics

The following summaries describe the characteristics of the three proposed alignment alternatives. These characteristics include station locations, travel time, ridership, and estimated revenues. Additional detailed about each of the alternatives can be found in Section 10.4.

Airport Connector

Five stations are located along the 115 km (72 mi) route:

- LAX Commuter Platform (I-405/Arbor Vitae)/LAX Terminal (near Terminal 1)
- West Los Angeles (I-405/Wilshire Boulevard)
- Van Nuys (I-405/Roscoe Boulevard)
- Santa Clarita East (SR-14/Via Princessa)
- Palmdale Airport (future terminal)

Travel Time – 42 minutes, average, one-way

Fleet Size – 12 twelve-car train sets are needed at peak.

Weekday Daily Ridership – 102,500 passengers

Annual Ridership – 30,000,000 passengers

Total System Annual Revenues – \$417 million (in 2000 dollars)

The environmental impacts of the Airport Connector alternative are explained in detail in table 10.4-3 in Section 10.4.

Transit Hubs

This alternative is approximately 153 km (95 mi) in length and features six stations:

- LAX East Terminal Complex (near Terminal 1) and LAX Commuter Platform (I-405/Arbor Vitae);
- West Los Angeles (I-405, at Wilshire Boulevard);
- Los Angeles (L.A.) Union Station;
- Burbank (Metrolink corridor, near Hollywood Way);
- Santa Clarita East (SR-14 / San Fernando Road);
- Palmdale Airport (future terminal).

Travel Time – 60 minutes, average, one-way

Fleet Size – 15 twelve-car train sets are needed at peak.

Weekday Daily Ridership – 141,500 passengers

Annual Ridership – 41,500,000 passengers

Total System Annual Revenues – \$580 million (in 2000 dollars)

The environmental impacts of the Transit Hubs alternative are explained in detail in table 10.4-6 in Section 10.4.

Maximum Coverage

This alternative is 171 km (106 mi) in length and features seven stations:

- LAX East Terminal Complex (near Terminal 1) and LAX Commuter Platform (I-405/Arbor Vitae);
- West Los Angeles (I-405, at Wilshire Boulevard);
- Los Angeles (L.A.) Union Station;
- Burbank (Ventura Metrolink corridor, at I-5 near Olive Avenue);
- Van Nuys (I-405 near Roscoe Boulevard, north of Metrolink);
- Santa Clarita – Valencia (I-5 between Valencia and Magic Mountain Parkway);
- Palmdale Airport (future terminal).

Travel Time – 70 minutes, average, one-way

Fleet Size – 17 twelve-car train sets are needed at peak. The peak service fleet consists of 68 power cars and 136 passenger cars. Application of the 20% spare ratio typically used to size rail fleets, the overall fleet size is 82 power cars and 164 passenger cars.

Weekday Daily Ridership – 153,000 passengers

Annual Ridership – 45,000,000 passengers

The environmental impacts of the Maximum Coverage alternative are explained in detail in table 10.4-9 in Section 10.4.

Project Costs and Finances

Comparison of the capital and operating and maintenance costs for the alternative technologies and alignments indicate that while the VHSM technology has a higher initial capital cost, the lower annual operation and maintenance costs are due in large part to a smaller vehicle fleet requirement expected to quickly offset this disadvantage.

Capital costs were developed assuming the entire alignment is dual-lane guideway and the fleet is sized to support 10-minute headways during the peak period. Table 10.0-1 lists the estimated capital costs for High Speed Rail/Very High Speed Rail (HSR/VHSR) and Very High Speed Maglev (VHSM) technologies for each of the proposed alignments. Costs are planning-level estimates expressed in 2000 dollars and reflect a 5% level of conceptual engineering.

The seven major elements of the capital cost estimate are:

- Structures, Foundations and Tunnels
- Earthwork
- Stations and Maintenance Facilities
- Guideway, Power and Communications
- Maglev Vehicles
- Right-of-Way and Utilities
- Contingencies, Project Implementation and Environmental Mitigation

Table 10.0-1
LAX-PMD Capital Cost Estimates

Technology	Airport Connector	Transit Hubs	Maximum Coverage
VHSM Standalone	\$8.2 Billion	\$10.7 Billion	\$11.9 Billion
HSR/VHSR (for comparison)	\$ 7.9 Billion	\$10.2 Billion	\$11.7 Billion

Table 10.0-2 lists the estimated annual operations and maintenance costs for High Speed Rail/Very High Speed Rail (HSR/VHSR) and Very High Speed Maglev (VHSM) for each of the proposed alignments.

The five principal operating and maintenance cost categories include:

- Maintenance-of-Way (MOW) operations include the activities necessary to keep the guideway and related infrastructure in good operating order.

- Maintenance-of-Equipment (MOE) operations include both the activities necessary to keep the vehicle in good operating order and both exterior and interior cleaning.
- Transportation Operations refers to the costs of actually moving the trains carrying passengers.
- Passenger and Station services are a major portion of total O&M costs.
- General and Administration annual expenses, which cannot be readily assign to other subsections.

Table 10.0-2
LAX-PMD Annual Operations & Maintenance Cost Estimates

Technology	Airport Connector	Transit Hubs	Maximum Coverage
VHSM Standalone	\$184 Million	\$ 236 Million	\$267 Million
HSR/VHSR (for comparison)	\$ 281 Million	\$355 Million	\$418 Million

A multi-year cash flow model was developed, where the three alignments utilized short-term borrowing to fund planning and engineering costs, allocated Federal Transportation Infrastructure Finance & Innovation Act (TIFIA) funds and tax-exempt financing to fund the construction, vehicle purchase and other capital-related costs. The analysis did not incorporate Federal Transit Administration (FTA) New Starts funding, or any State and Local contributions. In order to assess the magnitude of the borrowing requirements, the analysis considered the length of time required to pay down the capitalized interest and principal requirements. This is the major feature of the project, and makes it difficult to finance. Specifically, revenue operations do not start until 2009, and the project builds on borrowing requirements through substantial capitalized interest accruals.

Due to the high amounts of borrowing required to construct the system, it may be difficult to secure private financing sources. Another factor limiting the potential for private funding is the extended time frame (minimum eight years) until revenue operations begin. Many private sources of financing will desire operating revenue return prior to the projected time frame.

It is highly probable that two factors would improve the financial outlook of the project even further. First, there are potential “savings” to the project if costs for the segment in common with the LAX-March project can be “shared”. With the LAX-PMD project itself, there are opportunities to select a shorter initial segment, allowing revenue operations to begin earlier and offset the initial capital investment (and interest) on the construction of the shorter segment.

Next Steps

The next steps for SCAG in development of this project are:

- Further engineering and environmental study to define the system in greater detail, refine costs and financial calculations, and determine impacts and mitigations for the project.
- Select a preferred alignment, including an initial segment, which would become the focus of study once adopted by SCAG.
- SCAG must also continue the work that has started in public and government outreach. It will be essential to build a consensus between government agencies affected by this project including cities along the route, the County of Los Angeles, Caltrans, and the owners of the railroad rights-of-way. Community and environmental groups must also be included in the project process to ensure the inclusion of all interested parties.

Issues are still present that would impact the selected recommended alternative and its final alignment. Selection of the final alignment will be based on a review of critical issues that have been uncovered in the previous studies and any new issues discovered during the refinement stage. Further definition of these critical issues and mitigating solutions will provide the basis for the preferred alignment alternative.

Once a recommended alignment has been defined for further study, the specific criteria should be used to define smaller segments of the alignment that can potentially be constructed by a private investor as the first phase of the LAX-PMD Maglev system. The criteria include:

- Initial Ridership and Growth Potential
- Initial Capital Costs and Operating Cash Flow Projections
- Constructibility
- Commercial and Residential Development Potential
- Transit Oriented Development Potential
- Connectivity and Station Placement
- Technology Constraints and Readiness
- Environmental Impacts and Constraints

Deployment Options

Environmental review of the project will be one of the next major phases in the development of this proposed high-speed rail system. Preliminary engineering is performed in conjunction with the environmental review of the project. The project will require clearance under the Federal Government's National Environmental Policy Act (NEPA) process and the State of California's California Environmental Quality Act (CEQA) process. To fulfill these requirements, SCAG must prepare a joint Environmental Impact Statement (EIS) and Environmental Impact Report (EIR). The EIS/EIR can be prepared to analyze a single recommended alignment or the document

can analyze all three proposed alignments in order to support the decision-making process that leads to adoption of a Locally Preferred Alternative (LPA), and help support selection of an initial segment.

There is currently no maglev system in regular revenue service, although, consortia in Japan, Germany, and the United States are pursuing this technology. The German maglev technology is currently being demonstrated by TRI and represents the most advanced system in operation. The German government has granted a Certification of Technical Readiness for the TRI technology. TRI is also building a system in China that is expected to enter revenue service in 2003 or 2004. Although the TRI Maglev technology is highly developed, Japanese systems may become competitive in the timeframes suggested in this investment report.

Due to the limited number of suppliers of this technology and the limited overall implementation expertise, maglev technology should be procured from a single entity, called the Design-Build-Entity (D-B-E) with a Design-Build-Operate-Maintain (DBOM) procurement program. The owner has the option to include some or all of the fixed facilities (guideway, track, stations, and power systems) in the same program as the operating system (vehicles, traction power, train control, and communications). The program could be separated into two or more DBOM programs. For example, the facilities and stations would be familiar to local designers and constructors and could be bid separately from the guideway and operating system as either a DBOM or a traditional Design-Bid-Build program. A balanced procurement strategy can be deployed that utilizes a DBOM program for the maglev technology and possibly the guideway, while more traditional contracting options could be used for the other facilities.