SOUTHERN CALIFORNIA ASSOCIATION OF GOVERNMENTS
MAGLEV DEPLOYMENT PROGRAM

PART 1 - MILESTONE 2
PART 2 - MILESTONE 1
PART 3 - MILESTONE 1

PRELIMINARY ENGINEERING
TECHNICAL ANALYSIS REPORT

July 2006

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EXECUTIVE SUMMARY

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Executive Summary

This milestone report on Preliminary Engineering and Technical Analysis is the second report in the Part 1 and first report in the Part 2 and 3 work elements of the Phase 2 SCAG Maglev Deployment Program. The report is meant to be a supplement to the Preliminary Engineering Plans. The program divides the Initial Operating Segment (IOS) into three parts for grant funding purposes. The report discusses unique design considerations associated with each of the three parts and summarizes the characteristics of the summation of the parts into three optional alignments for the IOS.

The three program parts are summarized as follows:

- **Part I:** West Covina to Ontario International Airport (19 to 21 miles depending on alignment), with two stations: one in Ontario Airport and the other in West Covina or the City of Industry. Part I includes alignment options on the I-10, SR-60, and UPRR alignment alternatives.

- **Part II:** Los Angeles Union Passenger Terminal to West Covina (18 to 20 miles depending on alignment), with a station in Los Angeles Union Station. Part II also includes alignment options on the I-10, SR-60, and UPRR alignment alternatives.

- **Part III:** West Los Angeles to Los Angeles Union Passenger Terminal (17 miles), with a station in West Los Angeles. Part III includes a single alignment on the I-10. This was identified and adopted by the RC as currently the only acceptable corridor to connect Downtown Los Angeles with West Los Angeles for maglev.

The resulting corridor options formed by connecting the three parts together into possible alignments are summarized as follows:

- **I-10 Alignment:** This alignment is approximately 54.0 miles long and connects West Los Angeles to Downtown, to West Covina and Ontario. The alternative utilizes the Interstate 10 (I-10) freeway corridor for the majority of the length, but also utilizes existing railroad corridors within Downtown Los Angeles, Pomona, and Ontario. From West Los Angeles, it follows the I-405 freeway to the I-405/I-10 interchange area where it transitions to the I-10 freeway going east. The alignment continues east along I-10 to the Los Angeles River, where it turns north and connects to Union Station in Downtown Los Angeles. From Downtown Los Angeles it connects to West Covina along the I-10. From West Covina, the alignment continues east along the I-10 and SR-71 freeways to the UPRR corridor within the City of Pomona. Here the alignment transitions into the UPRR corridor and continues east to Ontario Airport.

  The total travel time between the West Los Angeles and Ontario Airport stations is 33.5 minutes, which results in an average speed of 98 mph (156.9 kph) including station dwell times. The top speed along the alignment is 250 mph (400 kph), which is achieved between the West Covina and Ontario Airport stations. The straight nature of the alignment along the UPRR corridor east of SR-71 within Part 1 allows the Maglev technology to maximize its speed capabilities.

- **UPRR Alignment:** This alignment is approximately 56.4 miles long and connects West Los Angeles to Downtown, the City of Industry and to Ontario. From the West Los Angeles station to the Valley Boulevard interchange along I-10 within the City of El Monte, this alignment is identical to the I-10. At this interchange, the UPRR alignment transitions into the Valley Boulevard median and follows Valley Boulevard and the Union Pacific Railroad (UPRR) right-of-way (ROW) through the San Gabriel Valley into Ontario. East of SR-71 to the Ontario Airport station, the UPRR alignment is identical to the I-10 alignment.

  The total travel time between the West Los Angeles and Ontario Airport stations is 33.9 minutes, which results in an average speed of 100 mph (161.2 kph) including station dwell times. The
slightly greater travel time compared to the I-10 alignment is attributed to the longer alignment length. The top speed along the alignment is 250 mph (400 kph), which is achieved between the West Covina and Ontario Airport stations.

- **SR-60 Alignment:** This alignment is approximately 58.4 miles long and connects West Los Angeles to Downtown, to City of Industry/Puente Hills and Ontario. From the West Los Angeles station to the I-10/I-710 interchange east of Downtown Los Angeles, this alignment is identical to the I-10. At the I-710 interchange the alignment transitions to the south along the I-710 corridor and then to the east along the SR-60 and SR-57 corridors through the San Gabriel Valley. North of the Temple Avenue interchange along SR-57, the alignment transitions east into the Metrolink railroad corridor within the City of Pomona. East of the merge of the UPRR and Metrolink railroad corridors to the Ontario Airport station, the SR-60 alignment is identical to the I-10 alignment.

The total travel time between the West Los Angeles and Ontario Airport stations is 34.8 minutes, which results in an average speed of 100 mph (161.2 kph) including station dwell times. The greater travel time compared to the I-10 alignment is attributed to the longer alignment length. Although almost 5 miles longer than the I-10 alignment, the overall travel time increase between West Los Angeles and Ontario is less than 1 minute. This can be attributed to the higher top speed, 260 mph, that is obtained along the SR-60 corridor between the LAUPT and Puente Hills stations.

The design approach used for the development of the preliminary engineering of the IOS was fundamentally a balancing act between the need to optimize performance and to minimize impact and costs. The design approach used the following considerations and the details are summarized in the milestone report.

- Use of Public Rights of Way
- Develop Fully Elevated Alignment
- Maximize Speed
- Minimize Impacts
- Minimize Costs

Design of the IOS alignment considered the following base information developed through a combination of data research and new mapping information. The information is summarized in detail in the milestone report.

- Geotechnical Information
- Base Mapping
- Aerial and Topographical Data
- Right of Way Mapping
- Utility Identification
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I. Introduction

A. Purpose of this Milestone

This milestone report on Preliminary Engineering and Technical Analysis is the second report in the Part 1 and first report in the Part 2 and 3 work elements of the Phase 2 SCAG Maglev Deployment Program. As discussed previously, the program divides the Initial Operating Segment (IOS) into three parts for grant funding purposes. The numbering sequence follows products identified by the Federal Railroad Administration (FRA) and SCAG for the individual task deliverables. For the purpose of developing a cohesive report documenting the engineering effort, this report consolidates the discussion for each of the three parts into one document summarizing the IOS. A section has been devoted to the unique components associated with the design of each part. The intent of this report is to provide a summary of the technical work completed in the development of the engineering and the approach used for the design and development of the plans and profiles for the IOS. The information provided in this report is meant to clarify the design approach used in the development of the plan and profiles. This report is also augmented by information from the Refined Cost Estimate Milestone report.

B. Report Sections

The milestone report contains five primary sections. They are:

1. Introduction
2. Background
3. Components of Engineering
4. Summary of Alignments
5. Appendices

Section 1, this section, summarizes the purpose of this milestone report and layout of the document. Section 2 is the Background Section, highlighting the background and previous history of the SCAG Maglev Program that has led to this point. Section 3 is the Components of Engineering section. This part of the report details the information used in the design of the alignment. Information such as the design approach, degree of engineering, geotechnical information, structural types and resulting alignment configuration are discussed. This section also contains the information that is specific for each of the three IOS segment parts as defined by the grants. Section 4 converges the three parts and summarizes the three IOS alignment options. Finally, the Appendix section compiles additional relevant project information on the design criteria, system operational summary characteristics, seismic and soils report and preliminary construction logistics report.

C. Project Description

C.1 Description of Parts

The overall project is an Initial Operating Segment that runs from Ontario Airport, through the San Gabriel Valley and Downtown Los Angeles (Union Station) and finally to West Los Angeles. The distance is approximately 54 miles connecting the population centers of Los Angeles with the San Gabriel Valley and San Bernardino County. Prior work had selected three viable corridors for a maglev alignment for the IOS. The corridors are I-10, UPRR Corridor, and SR-60. For Phase 2, these freeways and the rail corridor are carried forward in the preliminary engineering. The purpose of preliminary engineering is to create a mathematized horizontal and vertical alignment that definitively marks the “footprint” of the Maglev system. Once the alignment satisfies the system requirements and is delineated on the project plans, it establishes a reference that can be used for environmental assessment and accurate cost estimating.
I. INTRODUCTION

Pomona, and Ontario. From West Los Angeles, it follows the I-405 freeway to the I-405/I-10 interchange area where it transitions to the I-10 freeway going east. The alignment continues east along I-10 to the Los Angeles River, where it turns north and connects to Union Station in Downtown Los Angeles. From Downtown Los Angeles it connects to West Covina along the I-10. From West Covina, the alignment continues east along the I-10 and SR-71 freeways to the UPRR corridor within the City of Pomona. Here the alignment transitions into the UPRR corridor and continues east to Ontario Airport.

UPRR Alignment: The alignment is approximately 56.4 miles long and connects West Los Angeles to Downtown Los Angeles, the City of Industry and to Ontario. This alignment, from the West Los Angeles station to the Valley Boulevard interchange along I-10 within the City of El Monte, is identical to the I-10. At this interchange, the UPRR alignment transitions into the Valley Boulevard median and follows Valley Boulevard and the Union Pacific Railroad (UPRR) right-of-way (ROW) through the San Gabriel Valley into Ontario. The UPRR alignment is identical to the I-10 alignment from east of SR-71 to the Ontario Airport station.

SR-60 Alignment: The alignment is approximately 58.4 miles long and connects West Los Angeles to Downtown, to City of Industry/Puente Hills and Ontario. This alignment, from the West Los Angeles station to the I0-10/I-710 interchange east of Downtown Los Angeles, is identical to the I-10. At the I-710 interchange the alignment transitions to the south along the I-710 corridor and then to the east along the SR-60 and SR-57 corridors through the San Gabriel Valley. North of the Temple Avenue interchange along SR-57, the alignment transitions east into the Metrolink railroad corridor within the City of Pomona. The SR-60 alignment is identical to the I-10 alignment from east of the merge of the UPRR and Metrolink railroad corridors to the Ontario Airport station.
As discussed in the introduction, the grant funding requirements specified is to divide the IOS alignment into three parts. They are the following:

**Part I:** West Covina to Ontario International Airport (19 to 21 miles depending on alignment), with two stations: one in Ontario Airport and the other in West Covina or the City of Industry. Part I includes alignment options on the I-10, SR-60, and UPRR alignment alternatives.

**Part II:** Los Angeles Union Passenger Terminal to West Covina (18 to 20 miles depending on alignment), with a station in Los Angeles Union Station. Part II also includes alignment options on the I-10, SR-60, and UPRR alignment alternatives.

**Part III:** West Los Angeles to Los Angeles Union Passenger Terminal (17 miles), with a station in West Los Angeles. Part III includes a single alignment on the I-10. This was identified and adopted by the RC as currently the only acceptable corridor to connect Downtown Los Angeles with West Los Angeles for maglev.

The format of the report discusses the alignment from west to east, that is from Part 3 to Part 1 (West Los Angeles to Ontario) to match the engineering plans (see Preliminary Engineering Plans). The reason for this is to follow the naming convention established in the scope of work and to be consistent with the standard engineering convention of having the North Arrow pointed up on the plans.

**C.2 Alignment Options**

Piecing together the three parts results in three distinct alignment options between West Los Angeles and Ontario. They are as presented below:

**I-10 Alignment:** The alignment is approximately 54.0 miles long and connects West Los Angeles to Downtown, to West Covina and Ontario. The alternative utilizes the Interstate 10 (I-10) freeway corridor for the majority of its length, but also utilizes existing railroad corridors within Downtown Los Angeles,
II. Background

A. Maglev Program History

United States Government Agencies and Legislators have been envisioning methods to realize a high-speed ground transportation system for several decades. The National Maglev Initiative (NMI) was formed in April of 1990 and included United States Department of Transportation, U.S. Army Corps of Engineers, Department of Energy and other agencies to conduct and coordinate further research and evaluate maglev technology as a means to improve surface transportation. NMI also determined the appropriate role for the Federal Government in advancing the technology.\(^1\) After many years of careful analysis and study, the conclusion was that maglev is a viable technology for deployment in the U.S. In 1998, the Transportation Equity Act for the 21st Century (TEA-21) established the Maglev Deployment Program to analyze, plan, and build a maglev system in the U.S.

During this period, the Southern California Association of Governments (SCAG) was looking for an innovative technology to address a number of significant issues facing the region. The issues included the need for high-speed, high capacity travel for a large dispersed region, air quality requirements that require a non-polluting means of transportation, the ability of a system to integrate with land use and focus growth, the ability to develop an industry to help replace lost manufacturing jobs in the region, the need for a fast and reliable means to link regional airports and make aviation decentralization possible, and finally, a financially sustainable system capable of operating without government subsidies. Through the process of very thorough evaluation, starting with the SCAG Regional Transportation Plan (RTP) in 1998 and a number of studies and RTPs since then, SCAG identified maglev as a preferred technology.

Under TEA-21, the Department of Transportation initiated a competition to plan and implement a maglev project within the United States. Applications for the projects were solicited from various states and in May 1999, seven projects were selected to participate in the program. The seven selected projects included:

- Pittsburgh, Pennsylvania
- Baltimore, Maryland to Washington D.C.
- Atlanta, Georgia
- Port Canaveral to Kennedy Space Center and Space Coast Regional Airport, Florida
- New Orleans, Louisiana
- Las Vegas, Nevada to California State Line
- Los Angeles, California

In June, 2000, SCAG submitted the Southern California Maglev project description to the Federal Government for further funding and development. The proposed project was to provide high-speed maglev service between major activity centers in high-density, fast growing urban areas. The project study area extended between Los Angeles International Airport (LAX), West Los Angeles, Downtown Los Angeles at the Los Angeles Union Passenger Terminal (LAUPT or better known as Union Station), San Gabriel Valley, Ontario International Airport (ONT), Riverside, San Bernardino and March Inland Port (MIP). The project length was approximately 92 miles and connected three counties together – Los Angeles, Riverside and San Bernardino.

The SCAG project was considered to be the best technical project in terms of application of the technology, local need and consistency with regional planning efforts. However, the SCAG program lacked political support and ultimately did not make the short list in the government down selection process. It was also felt by the Federal Government that the project was too ambitious in scope as an initial starter program for maglev. They believed that the length of the system was too long to use as a test application of the technology and suggested an identification of a smaller Initial Operating Segment.

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II. BACKGROUND

Phase 2
Preliminary Engineering and
Technical Analysis Report

(IOS). Ultimately, the Federal program stalled as the money earmarked in TEA-21 for maglev deployment was never made available to any of the short listed projects in the United States.

B. IOS Selection

Despite the outcome of the Federal program, SCAG continued to study the application of the technology. This was due to the continued development of the technology, both in the United States and overseas, and the need for a high-speed transportation solution for the region. Further financial analysis indicated that the program has the potential to be financially viable and self-sustaining in the region. This led to the continued study of the maglev technology along with other available technologies\(^2\) and eventually a selection by the SCAG Regional Council (RC) in 2002 of an IOS for the system. The IOS system is approximately 54 miles long that connects West Los Angeles to LAUPT, the San Gabriel Valley and Ontario Airport. The vision is for this to be the initial starting point to prove the technology and operate the system in a manner to address some of the challenges to the program and the region including aviation decentralization and financial sustainability.

C. SCAG Maglev Deployment Program

Currently, the SCAG Maglev Deployment Program is in the second phase of development. The first phase was completed by the Lockheed Martin consultant team in May 2003. The work included predeployment studies, financial and private/public partnering investigations, and the selection of the IOS. The second phase of the program, the current work effort, is focused on the development of enhanced engineering and cost estimating for the system. Detailed plans and profiles are developed for the alignment options, layout concepts are developed for the intermodal stations and maintenance facilities, operational analysis, capital cost estimates and high-level stakeholder outreach are all components of this second phase work. This report details the preliminary engineering of the IOS in the Phase 2 work effort.

\(^2\) LAX-PMD High Speed Ground Access Study, IBI Group, November 2001
III. Components of Engineering

A. Design Approach

As specified by the Regional Council of SCAG, the design approach to be used for the development of the preliminary engineering for the IOS is very succinct. The system should maximize the use of public sector rights of way and system speeds to the extent possible and minimize the potential impacts and cost to the system. The key aspects that influenced the design of the system are as follows:

- Use of Public Rights of Way
- Develop Fully Elevated Alignment
- Maximize Speed
- Minimize Impacts
- Minimize Costs

The alignments of the IOS are fundamentally a balancing act between the need to optimize performance and to minimize impact and costs. The following paragraphs elaborate on the specific design aspects.

A.1 Use of Public ROW

- The use of public rights of way is key to the ability to finance the project. Use of corridors provides better utilization and increased value to the public investments. A primary challenge encountered during the alignment engineering related to designing within limited right of way, sharp horizontal freeway curves and existing structure heights at freeway to freeway interchanges. A detailed description of project constraints for each project part is provided in Section III.E. To the extent possible, the designs stayed within the public right of way.

- Meetings with local agencies, potential private sector stakeholders, and Caltrans were held throughout Phase 2. The IOS Summary report provides additional detail on these meetings. For the engineering effort, meetings were held to request data, present concepts and to document issues or concerns about the project. During the Phase 1 Predeployment Analysis, freeway segments were reviewed in close cooperation with Caltrans District 7 (Los Angeles) staff to determine potential conflicts with existing facilities or future projects. For the Phase 2 work, Caltrans was engaged in the maglev program providing staff resources for project meetings; assisting with as-built plan collection; and providing current planning documents for the I-10 and SR-60. As a result of this coordination, Caltrans projects in the design and/or advanced planning stages were graphically depicted on the Preliminary Engineering Plans and accounted for during the alignment design. Table 1 below summarizes the location, description and other pertinent project information that can be referenced for subsequent design phases.

A.2 Develop Fully Elevated Alignment

- The general design approach associated with locating the alignment within public rights of way was to avoid impact on the existing facilities within the right of way. In areas where impacts were unavoidable due to space limitations, these impacts had to be mitigated through relocation of existing facilities, widening, the construction of raised medians, right of way acquisition, etc. Although the construction cost associated with at-grade guideway is less than an elevated, the resultant ground-level construction footprint is much larger.

- Ground-level impacts associated with an elevated alignment can be localized to the support column locations. The cost of mitigating impacts resulting from the construction of an at-grade system coupled with the guideway construction cost would typically be greater than building an elevated system. In the roadway rights of way utilized for the IOS alignments (freeways, local streets), room available to locate the guideway was limited to roadway medians and areas outside of the roadway footprint. As such, an elevated guideway alignment was utilized wherever feasible in order to minimize ground-level impacts along the alignment corridors and to minimize the resultant construction cost.
### TABLE 1
**PROPOSED CALTRANS FREEWAY IMPROVEMENT PROJECTS WITHIN ALIGNMENT CORRIDORS**

<table>
<thead>
<tr>
<th>Caltrans Project No.</th>
<th>Alignment</th>
<th>From Sta</th>
<th>To Sta</th>
<th>Project Description</th>
<th>Project Limits</th>
<th>Project Status</th>
<th>Caltrans EA No.</th>
<th>Information Shown On Alignment Plans</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I-10</td>
<td>100+00</td>
<td>222+00</td>
<td>Add NB HOV lane along I-405</td>
<td>I-10 to I-101</td>
<td>PR/ED currently under preparation</td>
<td>120300</td>
<td>Improvements exactly as identified in PR/ED</td>
<td>CADD file of proposed improvements obtained from Caltrans and referenced into plans</td>
</tr>
<tr>
<td>2</td>
<td>I-10</td>
<td>1710+00</td>
<td>1832+00</td>
<td>Construct one HOV lane in each direction along I-10</td>
<td>SR-605 to Puente Avenue</td>
<td>PR approved on 12/31/02. Currently under final design.</td>
<td>117071</td>
<td>Approximate limits of proposed widening shown in plans</td>
<td>Limits depicted on plans based on review of PR.</td>
</tr>
<tr>
<td>3</td>
<td>I-10</td>
<td>1832+00</td>
<td>2050+00</td>
<td>Construct one HOV lane in each direction along I-10</td>
<td>Puente Avenue to Citrus Street</td>
<td>PR approved on 12/31/02. Currently under final design.</td>
<td>117080</td>
<td>Approximate limits of proposed widening shown in plans</td>
<td>Limits depicted on plans based on review of PR.</td>
</tr>
<tr>
<td>4</td>
<td>I-10</td>
<td>2050+00</td>
<td>2136+00</td>
<td>Construct one HOV lane in each direction along I-10</td>
<td>Citrus Street to SR-57</td>
<td>PR approved on 12/31/02. Currently under final design.</td>
<td>119340</td>
<td>Approximate limits of proposed widening shown in plans</td>
<td>Limits depicted on plans based on review of PR.</td>
</tr>
<tr>
<td>5</td>
<td>I-10</td>
<td>2362+50</td>
<td>2381+00</td>
<td>Upgrade SR-71 from 4 lane expressway to 8 lane freeway</td>
<td>0.1 Km south of I-10 to Los Angeles County Line</td>
<td>PR approved on 6/27/02. Currently under final design.</td>
<td>210600</td>
<td>Approximate limits of proposed widening shown in plans</td>
<td>Limits depicted on plans based on review of PR.</td>
</tr>
<tr>
<td>6</td>
<td>SR-60</td>
<td>1732+00</td>
<td>2060+00</td>
<td>Construct HOV lanes and sound walls along SR-60</td>
<td>SR-605 to SR-57</td>
<td>PR approved on 9/29/00. Currently under final design.</td>
<td>1294U1</td>
<td>Approximate limits of proposed widening shown in plans</td>
<td>Limits depicted on plans based on review of PR. Widening is not continuous within this segment.</td>
</tr>
</tbody>
</table>
A.3 Maximize Speed

- The desired maximum speed is 310 mph (500kph), which maximizes maglev technology benefits and minimizes travel times. Designing a system that can achieve this speed requires essentially a straight track alignment between West Los Angeles and Ontario Airport. Constructing a system of this nature within the LA Metro area is essentially impossible due to the congested urban environment.

- In recognition of this fact, TRI design criteria recommends a design speed within congested urban areas of 125 mph -185 mph (200 - 300 kph) and a design speed within suburban areas of 185 - 250 mph (300 - 400 kph). For this project, a 125 mph (200 kph) sustained design speed between stations was established as a target minimum. The maintenance of this speed along the alignment requires the use of horizontal curves with a minimum radius of 3300' (1000m).

A.4 Minimize Impacts

- An elevated guideway alignment would reduce the construction footprint to the size of the foundation for each support column. An elevated system also reduces right of way and construction related impacts within the developed areas, the potential for pedestrian conflicts, and reduces noise impacts.

- Utilize existing public rights of way to locate the guideway alignment such as freeway, publicly owned rail, and City street corridors.

- Freeway corridors are typically the most desirable if there is room available within the right of way and any available “space” between freeway and right of way line to locate guideway columns.

- Railroad corridors, publicly owned (i.e. Metrolink) or privately owned (i.e. UPRR & BNSF), are the least desirable location to utilize for placing the elevated structures supports. This is due to their resistance in the past to allow shared use of the corridor by other entities.

- City streets are ideal if they are set up in grid system as in many urban areas where streets are typically straight. Center median/turn lane or curb lanes are utilized to locate guideway columns. Impacts on traffic, existing homes and businesses along streets can be extensive. In this case, it may require street widening or the use of outrigger bents at the intersection approaches to span over the intersections.

A.5 Minimize Costs

- Construction of an at-grade guideway section is the most economical one. Aerial guideways are generally more expensive than at-grade guideways, however, guideways on bridges or in tunnels are the most expensive. Right of way costs associated with buildings make the overall cost of at-grade guideway construction more expensive than aerial guideways. Guideway on bridges is only used when standard aerial guideway is not sufficient to pass over/around the existing landscape (typically above 60' high or over 100' span lengths). Due to its high cost, tunneling is typically only used when necessary due to adverse topography such as steep hills and mountainous terrain. As such, aerial guideway is typically utilized in urban areas for alignment design.

- It is desirable to minimize the guideway height above ground as much as possible in order to keep guideway substructure costs down, while still providing the minimum required vertical clearance below the structure for vehicular and rail traffic. This can be difficult within freeway corridors, because the guideway must travel over existing overcrossings and freeway connectors. Along rail corridors, the guideway must cross over existing grade separations, which can result in a high elevated guideway. Along city streets, there are typically fewer structures the guideway has to travel over, so a lower overall guideway profile can be maintained.

B. Degree of Engineering

The preliminary engineering plans and profiles have been developed to a level that would allow reasonable costs estimates to be prepared for the system. The Refined Cost Estimate Milestone Report summarizes the results of the cost estimation effort. The level of design is consistent with a 3% - 10%
level of design. The focus of this design effort has been to identify the location of significant existing and future funded infrastructure, such as planned freeway expansions and major utilities, and to produce a design that accounts for these challenges. Further, a significant component of the alignment design is devoted to developing and costing the structures that are needed for an elevated alignment of maglev in an operational transportation corridor. The engineering that is discussed in this report and presented in the Preliminary Engineering Plans accomplishes these goals but it should be noted that further engineering and design will be needed to get to construction level documents.

C. Base Information

C.1 Geotechnical Information

A preliminary geotechnical study was conducted as part of this phase of the project in order to develop the geotechnical design parameters that would serve as the basis of the structure design work, including the development of the structure and foundation types discussed within Section D.2, the Structure Design Analysis section. This study utilized a compilation of published geotechnical and historical seismic data available for the project area including existing geologic reports and maps, Caltrans publications, and as-built plans for existing bridges. Due to limitations in scope, new soil surveys and test borings have been reserved for future phases of design. A copy of the Preliminary Geotechnical Design report prepared as part of the project is included in the Appendix.

The guideway seismic design philosophy for the Maglev system was to provide a high level of assurance that operation can be restored shortly after a moderate Operating Design Earthquake (ODE) and that public safety is maintained during a very large Maximum Credible Earthquake (MCE). A two-level seismic design criterion was therefore adopted. For this phase of the study it was assumed adequate to analyze the structures for only ODE forces generated by using the low level response spectrum, provided in the Geotechnical report, in the analyses to determine the size of structures components for the purpose of estimating the cost of substructures along the Maglev alignment. Structures’ performances are generally checked for MCE forces at the final design stage.

Design of foundations for the substructures were based on the geotechnical recommendations developed for the regions along the guideway alignment. It was assumed that all substructures would be founded on cast-in-drilled hole concrete piles because of their favorable construction logistics and minimizing effects on the existing structures. In addition, the costs for such foundations would provide sufficient latitude to cover other options that might be adopted for final design.

In order to further advance the structural design in a subsequent phase, a significant amount of additional geotechnical data will be required. This will include the need for “site specific” geotechnical data along the alignment which must be obtained through sample borings. This boring information will be used to accurately locate and size columns, design column foundations, and to size the guideway superstructure where a special structure is required.

C.2 Base Mapping

In order to define design constraints along the candidate alignment corridors evaluated as part of this project phase, base mapping was prepared to capture the following elements:

- Existing surface level site conditions along the candidate alignment corridors, including existing roadway and building locations.
- Vertical topography and elevation data along proposed alignment corridors.
- Limits of existing public rights of way along proposed alignment corridors.
- Locations of existing major utilities along proposed alignment corridors.

This mapping served as the basis for the conceptual alignment design conducted as part of the preparation of the Preliminary Engineering Plans. A detailed description of the base mapping prepared as part of this project phase is provided below.
C.5 Utilities
An existing utilities base map was prepared as part of the project that identifies existing major utilities within the freeway and railroad corridors. The major utility features identified within the base mapping included the following:

- Drainage: All storm drains over 48” in diameter, box culverts, and open channels.
- Sewer: All sewer lines greater than 36” in diameter.
- Water: All water lines greater than 24” in diameter.
- Electrical: Overhead and underground lines greater than 66KV in size.
- Any/all Caltrans identified high risk utilities.

This base map was used in the preparation of the Preliminary Engineering Plans, with these existing utilities shown and identified within the layouts of the plan/profile sheets included within the plan set. In order to more accurately determine specific utility impacts associated with this project, this base map should be supplemented with the following additional information during later project phases:

- Once proposed column locations are defined along aerial guideway segments, locations of all subsurface existing utilities in the vicinities of these columns should be identified.
- Precise horizontal and vertical locations of all overhead utility lines in the vicinity of aerial guideway segments.
- Locations of all subsurface utilities in the vicinities of proposed columns along aerial guideway segments once these column locations are identified.
- Locations of all subsurface utilities along any alignment segments requiring excavation or tunneling.

D. Structure Types

D.1 Foundation Design
Although a number of foundation alternatives could be considered for the support of the MAGLEV aerial structures, skin friction values and depth to fixity were provided for preliminary design of cast-in-drilled hole (CIDH) concrete piles. It was assumed that diameters would range from about 2 to 3 feet. The selection of CIDH piles was based on the perception of more favorable construction logistics and minimizing adverse effects on existing structures. In addition, the costs for CIDH piles were expected to provide sufficient latitude to cover other options that might be adopted for final design.

No unusual resistance to drilling for piles is expected. However, some contingencies should be provided in recognition of groundwater and its adverse impacts at many locations along the alignment.

Liquefaction will also potentially affect foundations at many locations. Where liquefaction is not severe, and where there is no surface manifestation, it will be possible to accommodate conditions by extending the piles. At other locations where liquefaction is potentially severe and/or where surface effects will impact lateral capacity, it may be necessary to mitigate conditions by ground improvement techniques. Due to existing development along the alignments, it is likely that less disruptive methods such as compaction grouting, vibro-flotation or deep-soil mixing will be better suited for use on the project.

D.2 Structure Design Analysis

Guideway Beams
The Maglev vehicle runs on a guideway beam that sits on an at-grade concrete slab, an elevated concrete bridge structure, or spans between columns depending on the application and structure type utilized (see discussion below). The guideway beam is prefabricated in a manufacturing facility located within project vicinity and transported to the portion of the alignment under construction. The
location or locations of the beam manufacturing facility will be determined in a subsequent project phase. The guideway beam serves three important system functions:

- Supports the weight of the vehicle and transfers the corresponding loads to the ground.
- Guides the vehicle along its route
- Provides the apparatus for the mounting of the functional components, which are the guideway portion of the long-stator linear motor and provides the reference for the vehicle locations.

Transrapid International (TRI) has developed two standard guideway beam types that are typically used depending on the specific application. These guideway beam designs allow for the flexibility of elevated, at grade, bridge, or tunnel operations. The characteristics of the two guideway beam types are as follows:

- **Type I Guideway Concrete Beam** – This single-span beam is designed for a standard length of up to 100’ and a height of 6’-6”. Type 1 guideway beams are used along aerial guideway segments with a maximum span length between support columns of 100’.
- **Type III Concrete Guideway Beam** – This beam is typically used in at-grade applications. This single-span beam is design for a standard length of 20’ and a height of 1’-4”. The beam is mounted on a pedestal that is fixed to a continuous concrete slab foundation or bridge deck. The pedestal height can vary to allow for a minimum height of 4’-1” to a maximum of 11’-6” from its base to the top of the guideway beam.

Additional details regarding the various guideway beam types, including appropriate dimension, can be found within the Transrapid Guideway System Overview report included in the Appendix. Type I and Type III guideway beams are depicted within the typical section drawings included within Figures 1-7.

**Guideway Structure Support Types**

Seven basic guideway-structure types were developed for use within this phase of the project in order to accommodate the various site conditions and design constraints encountered along the alignment corridors. Five of the seven structure types were different types of aerial guideway configurations, with the following design constraints dictating what type was used along specific segments:

- Need to support standard aerial guideway (span of approx. 100’) with a single column and minimum foundation area
- Need to span greater than 100’ between guideway columns.
- Inability to locate guideway columns directly below guideway centerline.

These five types of aerial guideway structures were widely used along all portions of the IOS alignments. The other two structure types were developed in order to accommodate site specific conditions along two short segments of the I-10 and SR-60 alignments where site conditions precluded the use of an aerial guideway structure. The following discussion provides a description of each of the seven types of guideway structures, and the specific design constraints that dictated its use.

All substructures are assumed to be founded on cast-in-drilled hole (CIDH) concrete piles for this phase of study. Design of the foundation has been based on recommendations provided in the Geotechnical Report for the project.

**Structure Type 1**

This elevated structure utilizes Type I guideway beams supported on single-column type bents spaced at a maximum of 100’ apart. This structural arrangement, which was utilized wherever space was available to accommodate guideway columns at this spacing, is the most economical aerial
guideway section. A typical Type 1 guideway section is shown in Figure 1. The size of each circular column is a function of height, which varies from 6’ as a minimum and increases with column height. The height of the column is governed by the minimum vehicle clearance requirements from a roadway surface to the soffit of the structure.

**Structure Type 2**

Structure Type 2 is similar to the Type 1 in that it utilizes single columns spaced at a maximum of 100’ to support a Type I guideway beam. However, the supports are single rectangular column cantilever type bents (c-bents). C-bents were utilized where the columns could not be placed directly under the centerline of the guideway. The offset between the guideway centerline and the centerline of the column is limited to approximately 15’. This limitation was due to space constraints caused by the larger column size and bent cap. A typical Type 2 guideway section is shown in Figure 2.

**Structure Type 3**

Similar to the Structure Type 2 section, the Structure Type 3 section utilizes a Type I guideway beam and was used at locations where the guideway beam cannot be supported by a single column. It was used at locations where the offset between guideway centerline and column centerline exceeds the 15’ maximum associated with the Structure Type 2. Instead, this section utilizes a Type I guideway beam supported by an outrigger bent that straddles between two columns. The spacing between the two columns supporting the outrigger bent varies to a maximum of approximately 160’. Similar to Structure Types 1 and 2, the spacing between the outrigger bent and adjacent bents or columns is limited to 100’. Outrigger bent depth and column size vary based on the guideway height and bent span. Structure Type 3 is typically used when the alignment must transition from one side of an existing roadway or railroad to the other without impacting the facility below. A typical Type 3 guideway section is shown in Figure 3.

**Structure Type 4**

Structure Type 4 is used at locations where the guideway span greater than 100’ must be accommodated. This structure type utilizes a Type III guideway beam mounted on top of a concrete bridge superstructure supported on single column bents. Structure Type 4 is typically utilized at perpendicular roadway crossings where:

- The guideway must traverse over an existing roadway bridge that is wider than approximately 80’.
- The guideway must traverse over an existing roadway greater than approximately 90’ in width that has no room within its median to locate a guideway column.

The bridge superstructure is constructed as a conventional cast-in-place post-tensioned concrete box girder, similar to a freeway viaduct. The bridge structure depth and column diameter vary depending on the span length and guideway height. A typical Type 4 guideway section is shown in Figure 4.

**Structure Type 5**

Structure Type 5 is similar to Structure Types 3 and 4 in that it utilizes the bridge superstructure described as part of Type 4 that is supported by outrigger bents described as part of Type 3. It is used at locations where outrigger bents are required and guideway spans must exceed 100’. Structure Type 5 is typically used to span over large intersections where the guideway alignment runs along a local street median. A typical Type 5 guideway section is shown in Figure 5.

**Structure Type 6**

Structure Type 6 is a retained cut section that is required along a short segment the I-10 alignment adjacent to Forest Lawn Memorial Park. Within this segment, the alignment deviates outside of the freeway right of way at several locations and encroaches into the sides of tall hills that line both sides
of the freeway. Within these encroachment areas, the guideway is cut into the existing hillsides. The cut section is retained by a concrete soil nail wall, while Type III guideway beams are supported on a continuous concrete slab foundation. A typical Type 6 guideway section is shown in Figure 6.

**Structure Type 7**

Structure Type 7 is a bored tunnel section that is required along a short segment of hilly terrain located along SR-60 where the alignment transitions east from the SR-57 corridor into the Metrolink corridor. The height of the hills within this undeveloped land precludes the use of an elevated section and requires the use of a tunnel. The cross sectional dimensions of the tunnel as shown within the Structure Type 7 typical section in Figure 7 are dictated by the vehicle clearance envelope as specified by TRI for Maglev operation. Structure Type 7 utilizes a Type III guideway beam, which is supported by a continuous concrete slab foundation along the tunnel floor. The resultant length of this tunnel is approximately 3000', with a maximum depth of cover of approximately 190'.

**E. Alignment Details**

This section includes a detailed discussion of the specific design approach used and design related issues encountered for each of the three alignments considered as part of this project. This discussion is organized by part for each of the three alignments, with each discussion following the alignment as it is presented from west to east within the Phase 2 Preliminary Engineering Plans.

The discussion for each part includes an alignment description summary, a summary of the design approaches that governed the alignment location, and a summary of engineering opportunities and constraints encountered. Within the opportunities and constraints summary, specific engineering constraints are addressed related to the following issues:

- **Profile constraints:** locations along the alignment where design constraints resulted in a guideway profile exceeded 60' above ground.
- **Structures impacted:** locations along the alignment where a significant number of existing structures were impacted due to alignment constraints.
- **Design speed constraints:** locations along the alignment where the design speed was constrained relative to the target design speed of 125 mph due to alignment constraints.

Also included within each part is a summary of potential traffic impacts to existing roadway facilities along the alignment corridors related to the construction of the system. For details on the proposed stations, refer to the station report and concept drawings.

**E.1 Part 3 (Common to All Alignments)**

**E.1.1 Alignment Description**

The alignment within Part 3 is common to all three IOS alignments (I-10, SR-60, and UPRR) considered as part of the Phase 2 work. Part 3 includes the portion of these alignments between West Los Angeles and downtown Los Angeles and includes the West Los Angeles station. Part 3 terminates just south of the LAUPT station at Sta. 969+00. The Part 3 alignment follows the I-405 and I-10 freeway corridors from West Los Angeles into downtown Los Angeles, where it turns north into the west side of the BNSF railroad corridor along the Los Angeles River. From the UPRR corridor, the alignment veers to the west and follows the alignment of Garey Street into the LAUPT station within the existing Union Station complex.
Figure 1
Structure Type 1 Typical Section
Figure 2
Structure Type 2 Typical Section
Figure 3

Structure Type 3 Typical Section

Structure Type 3 - Typical Section
(Span Length ≤ 100′)
Figure 4
Structure Type 4 Typical Section
Figure 5
Structure Type 5 Typical Section

STRUCTURE TYPE 5 - TYPICAL SECTION
(SPAN LENGTH) 100'
Figure 6
Structure Type 6 Typical Section
Figure 7
Structure Type 7  Typical Section

STRUCTURE TYPE 7 - BORED TUNNEL
E.1.2 Design Approach

The design approach along the I-405 and I-10 corridors was to utilize any available room within the freeway right of way outside of the freeway to locate guideway columns, while providing an alignment that allows for the maintenance of a minimum design speed of 125 mph. As stated, this requires the use of horizontal curves with a minimum radius of 3280’. Outrigger and cantilever bents (structure types 2 and 3) were used to traverse over the freeway through transitions from one side to the other as well over interchange ramps.

East of Hoover Street to the Los Angeles River, the existing I-10 freeway is constructed on an elevated viaduct structure. This precluded the ability to transition from one side of the freeway to the other within this segment. As a result, the guideway alignment had to be located on the north side of the freeway viaduct within this segment in order to make the turn from the I-10 corridor into the BNSF right of way along the Los Angeles River. In order to minimize impacts to the existing structures adjacent to the freeway within this segment, the guideway alignment was kept as close to the freeway as possible.

North of I-10 in downtown Los Angeles, the approach was to transition from the I-10 corridor and run adjacent to the BNSF railroad corridor on the west side of the Los Angeles River from 7th Street to Whittier Boulevard. Available space within this segment is constrained, and several buildings located adjacent to the rail right of way may be impacted by the superstructure portion of the guideway. Due to the height of the guideway within this segment, it may be possible to construct the guideway without the superstructure impacting the buildings. The exact nature of the impacts to these buildings should be further investigated in a subsequent project phase.

North of Whittier Boulevard where the rail right of way widens out to accommodate the rail yard, the guideway alignment veers westerly to utilize the available space along the western edge of the rail yard to locate guideway columns. North of the rail yard, the alignment was dictated by the location of the LAUPT station within the Union Station complex. Between the rail yard and the 101 freeway, many existing buildings will be impacted by the alignment. In addition, a portion of Garey Street may need to be closed between Temple and Ducommon Streets to accommodate guideway columns. This portion of the alignment is subject to change as the optimal location of the LAUPT station is more fully evaluated in later phases of the project.

E.1.3 Opportunities and Constraints

In general, the guideway profile along the I-405 and I-10 corridors was controlled by the need to provide the necessary minimum clearance over the many freeway overcrossings traversed by the alignment. In an attempt to minimize the overall guideway height, the profile was typically raised at these overcrossing locations and lowered again once they were crossed. Significant profile constraints were encountered at the following locations within Part 3:

- Through the I-10/I-405 interchange, the alignment must cross over several freeway to freeway connectors. This results in a profile through the interchange with a maximum guideway height of approximately 80’ above ground.

- The close spacing of the Western and Crenshaw Boulevard overcrossings along I-10 resulted in a sustained maximum guideway height of approximately 65’ above ground where the guideway crosses the two bridges.

- Approximately 1600’ of special structure types 4 and 5 guideway was required in order to traverse the freeway to freeway connectors within the I-10/I-110 interchange. The guideway profile through the interchange must accommodate the minimum vertical clearance over the over the NB I-110 to WB I-10 connectors, which are the highest connectors within the interchange. The resultant maximum guideway height through the interchange is approximately 85’ above ground.
• The profile along the BNSF corridor adjacent to the LA River is dictated by the 7th Street, Whittier Boulevard, and 4th Street bridges, which are traversed by the alignment. In order to provide the necessary clearance over these bridges, the guideway profile varies between 60’ to 80’ above ground for several thousand feet.

The density of the existing development within downtown Los Angeles resulted in impacts to a significant number of structures along the alignment within Part 3 east of the I-10/I-110 interchange. The following are locations where a significant number of existing structures were impacted by the guideway due to alignment or right of way constraints:

• Since many buildings are located immediately adjacent to the freeway viaduct along the north side of I-10 between Sta. 705+00 and 860+00 within downtown Los Angeles, available room to locate guideway columns was severely constrained. As a result, many buildings are impacted by the alignment within this segment.

• Through the curve between Sta. 805+31 and 845+02, the alignment deviates significantly away from the freeway and impacts a large number of structures. This deviation is a result of the curve radius necessary to maintain the desired design speed through this segment.

• A significant number of buildings are impacted as the alignment turns north from I-10 and continues through downtown Los Angeles into Union Station. Although the BNSF railroad corridor is utilized for a portion of this segment, impacts to a significant number of buildings within this densely developed area are unavoidable.

E.1.4 Design Speed

The resultant speed profile generated by TRI for the Part 3 alignment is shown in Figures 8-10. An overall speed profile between the West LA and Ontario Airport station was generated for each alignment considered as part of this project (I-10, SR-60, and UPRR). The limits of each Part 1-3 are identified at the top of each speed profile. Since Part 3 is common to all 3 alignments, the resultant speed profile within Part 3 is identical in all three alignments.

There were three locations along the alignment within Part 3 where the design speed was significantly constrained relative to the target sustained speed of 125 mph:

• Horizontal curve from I-405 corridor to I-10 corridor (Sta. 207+84 to Sta 230+01). In order to keep with alignment within the freeway right of way within the curve, a radius of 1450’ was used which restricted the design speed to approximately 80 mph in the vicinity of the curve. The necessary radius to allow for a 125 mph design speed would have resulted in substantial impacts to the residential neighborhood within the northeast quadrant of the interchange.

• Horizontal curve from I-10 corridor to BNSF railroad corridor (Sta. 859+98 to Sta. 893+70.88). The desire to provide a balance between maintaining design speed while minimizing impacts to the existing structures within this area resulted in a curve radius of 2000’. Given the approaching stop at the LAUPT station, maintaining a higher design speed through this curve was not critical. The impact of the radius through this curve was to reduce the length between the West Los Angeles and LAUPT stations in which the vehicle’s target design speed could be maintained prior to its stop at the LAUPT station.

• Radii of the reversing curves within the westward transition from the BNSF corridor to North Garey Street in Downtown Los Angeles were restricted to less than the target in order to minimize impacts to the existing structures through the transitions. A 3280’ radius through the curve from Sta. 929+57 to 952+28 would have resulted in significantly
greater impacts to adjacent buildings than those resulting from the 2132’ radius shown in the plans. Since the vehicle must come to a stop at the LAUPT station located just north of this curve, an increase in this curve radius would have minimal effect on the travel time between the West LA and LAUPT stations.

These three locations are graphically identified within the I-10 speed profile in Figure 8.

**E.1.5 Traffic Impacts Related to Construction**

**I-405 Freeway (Wilshire Boulevard to I-10)**

The maglev alignment parallels the I-405 freeway within this segment, and is located on the east side of the freeway for a majority of its route adjacent to the freeway. Consistent with the approach employed in other freeway segments, the construction areas along the freeway shoulders will be protected by k-rail and other safety barriers. Temporary restriping plans will be developed to assist in accommodating the construction barriers and work areas. The objective of the restriping plans will be to maintain all existing freeway travel lanes during construction. Traffic controls will also be necessary on Cotner Avenue where the maglev alignment travels between this roadway and the I-405 freeway. Temporary closures on Cotner Avenue may be necessary to avoid impacts to the I-405 freeway during installation of the guideway beams. Traffic detour plans will be developed with LADOT to address these closures.

Two crossings of the I-405 freeway occur within this segment. Construction of the guideway support structure and installation of the guideway beams in these crossing sections will require temporary closures of the freeway in these locations. The temporary freeway closures will be coordinated with Caltrans and will be limited to overnight and weekend time periods when traffic volumes are lower. Appropriate traffic detour routes will be developed with Caltrans and local jurisdictions to redirect traffic during the closure period and minimize impacts to local streets.

Temporary roadway closures will also be necessary on east-west streets that cross the guideway alignment. Intermittent closures will be necessary as the guideway support structures are constructed and the guideway beams are installed above the impacted roadways. Because the impacted streets in this segment are major regional traffic corridors, roadway closures will be limited to overnight hours as feasible.

**I-10 Freeway (I-405 to Los Angeles River)**

The maglev alignment is located north of the freeway for a majority of this segment. The I-10 features a collector distributor roadway in the westbound direction parallel to the westbound freeway mainline traffic lanes for a significant portion of this segment. The configuration of construction activities will attempt to limit traffic impacts resulting from construction of the maglev alignment to the collector distributor section of the westbound freeway and minimize impacts to the mainline traffic lanes. Restriping of the collector-distributor lanes and the freeway mainline lanes may be necessary to accommodate the construction activities.

Traffic impacts on I-10 between the Los Angeles River and the I-110 freeway during construction are anticipated to be minimal due to the location of the I-10 on an elevated viaduct within this segment. The maglev alignment will be constructed on a separate structure away from the freeway in this segment, helping to avoid potential traffic impacts.

The maglev alignment crosses the I-10 freeway four times within this segment. A crossing of the I-110 freeway is also necessary near the Los Angeles Convention Center. Construction of the guideway support structure and installation of the guideway beams in these crossing sections will require temporary closures of the freeway in these locations. The temporary freeway closures will be coordinated with Caltrans and will be limited to overnight and weekend time periods when traffic volumes are lower. Appropriate traffic detour routes will be developed with Caltrans and local jurisdictions to redirect traffic during the closure period and minimize impacts to local streets.
C.3 Aerial and Topographic Base Mapping

The base mapping used for the purpose of the design for this project was developed using aerial photography shot along the alignment corridors in September, 2005. This photography was used as the basis in the preparation of the following project mapping:

- Orthorectified electronic aerial photo-mapping was prepared by digitally scanning the aerial photos, electronically modifying the photos to the proper scale and base coordinates, and merging the photos into a series of electronic strip maps which were compatible with the CADD software used for alignment design.

- Digital terrain models (DTM’s) were developed using a photogrammetric process to model the existing natural terrain along the alignment corridors. These models were used to produce the existing ground lines shown within the alignment plans. Using these models, existing digital contour mapping was prepared along the alignment corridors using a 4’ contour interval.

The accuracy of this mapping was consistent with the 3% level of design assumed for this project. More detailed and accurate mapping will likely be required for design in subsequent project phases. The aerial photo-mapping is shown as a background within the layout portions of the preliminary engineering plans, while the modeled existing ground lines along the alignments are shown within the plan/profile sheets of the plans.

C.4 Right of Way

Existing and future-base right of way mapping was compiled along the alignment corridors and used as a basis of design for the horizontal alignments shown within the Preliminary Engineering Plans. The following resources were utilized in the development of the project right of way base mapping:

- **Freeways (existing):** Existing rights of way were identified and included within the base map based upon hard-copy review of available existing Caltrans right of way maps. For freeway segments within the limits of proposed widening as identified in Table 1, the appropriate planning documents were reviewed to determine where (if any) additional right of way was to be acquired for these improvements. These proposed right of way limits were input into the base map. For freeway segments where no right of way mapping was available, existing right of way lines were approximated through visual inspection of existing fence lines and other features within the project aerial photo-mapping.

- **Local Streets:** Existing local street rights of way along the alignments corridors were identified and included within the base map through research and review of existing right of way and parcel records obtained from the various cities along the alignments.

- **Railroad Corridors:** Existing railroad rights of way along the alignment corridors were identified and included within the base map based upon hard-copy review of available as-built plans and other right of way mapping made available from the various railroad owners, including UPRR and BNSF.

This base map was used in the preparation of the Preliminary Engineering Plans, with the appropriate right of way lines shown within the layouts of the plan/profile sheets included within the plan set. More detailed right of way mapping will be required during subsequent project phases to more accurately define right of way impacts associated with the project.
Figure 8
I-10 Alignment Speed Profile
Temporary roadway closures will also be necessary on north-south streets that cross the guideway alignment. Intermittent closures will be necessary as the guideway support structures are constructed and the guideway beams are installed above the impacted roadways. Roadway closures will be limited to overnight hours as feasible.

Los Angeles River segment (I-10 to Union Station)

The maglev alignment does not follow existing freeway or street rights-of-way within this segment for any significant distance. This situation is due primarily to the absence of a major freeway or street corridor in the vicinity of the alignment. The primary street traffic impacts resulting from the guideway construction will occur on streets and freeways that cross the maglev alignment.

The major crossing of the alignment involves the US-101 freeway immediately south of Union Station. Traffic control measures will necessary for the US-101 freeway to protect the construction work areas and ensure safe travel for freeway traffic during construction. Temporary closures of the freeway may be necessary during construction of the guideway support structure and the installation of the guideway beams. These closures will be limited to overnight and weekend time periods as feasible.

Several east-west streets will cross the maglev alignment within this segment. The approach to traffic control on these streets will be similar to that implemented for the US-101 freeway. Lane closures will be avoided as much as possible. Temporary road closures may be necessary to accommodate guideway support structure construction and guideway beam installation. These temporary closures will primarily be limited to the overnight and weekend time periods. Extended roadway closures may be feasible depending on traffic conditions on adjacent streets. These closures would be coordinated with the City of Los Angeles Department of Transportation (LADOT) to minimize potential traffic impacts.

**E.2 Part 2 (I-10 Alignment)**

**E.2.1 Alignment Description**

The I-10 alignment within Part 2 connects the LAUPT station in downtown Los Angeles to the West Covina Station along I-10 in West Covina. Part 2 terminates just west of the West Covina Station at Sta. 1915+00. The alignment follows the existing UPRR corridor from the LAUPT station to the point where the railroad turns sharply northward approximately 3500' east of Soto Street within the City of Los Angeles. From this point, the guideway alignment exits the UPRR corridor and continues easterly through several industrial properties and along Medfort Street towards I-10. In the vicinity of the Eastern Avenue overpass, the alignment enters the I-10 corridor and follows the I-10 corridor into West Covina. The West Covina station is located along the south side of I-10 within parking lot at the Plaza at West Covina shopping center.

**E.2.2 Design Approach**

Along the UPRR corridor east of the Los Angeles River, the design approach was to utilize available room along the north side of the rail corridor within or adjacent to Alhambra Avenue and Valley Boulevard to locate guideway columns. The guideway structure itself would aerially encroach into the rail right of way within this segment, so a minimum vertical clearance of 23’ above the existing tracks was maintained.

Along Alhambra Boulevard between Sta. 1048+00 and 1063+00, guideway columns would be constructed immediately adjacent (but outside) of the UPRR right of way. The columns may encroach into Alhambra Avenue and require a slight reduction in the existing roadway width to accommodate the columns. Along Valley Boulevard, the existing buffer between the street and the railroad right of way was utilized to locate guideway columns. Columns would be immediately
adjacent to, but not encroach into the rail right of way. Between the LAUPT Station and the Los Angeles River, encroachment into the existing rail right of way could not be avoided as the alignment turned east. Encroachment can be minimized through the use of cantilever (structure type 2) and outrigger bents (structure types 3 and 5), the columns for which could be strategically located outside the rail right of way whenever feasible.

Along the I-10 corridor, the design approach was to utilize any available room within the freeway right of way outside of the freeway to locate guideway columns. Available room within the I-10 right of way within this segment was severely constrained either by the footprint of the existing freeway or the widening currently proposed (see entries 2-4 on Table 1). As a result, the alignment was pushed out onto adjacent frontage roads along many portions of this segment. Portions of the alignment with no frontage roads and no room within the freeway right of way typically resulted to impacts to existing structures adjacent to the freeway. The availability and locations of frontage roads along the I-10 corridor dictated what side of the freeway the alignment was shown.

From Sta. 1270+00 to Sta. 1545+00, the alignment follows both the Ramona Road and Flair Drive frontage roads, where available, along the south side of I-10. Both roads would require modification in order to accommodate the guideway columns. The specific type of modification could range from the construction of a raised median, to reduction of the existing width, to widening depending on the existing roadway width. The plans identify suggested modifications, if any, along these frontage roads. The uses along this segment of the I-10 are mostly residential, with many existing homes impacted by the alignment along portions with no frontage roads. From Sta. 1580+00 to Sta. 1875+00, both the Brockway Avenue and Garvey Avenue frontage roads along the north side of I-10 are utilized to accommodate the guideway columns. The uses along this segment of the I-10 are a mixture of commercial, industrial, and residential, with fewer structures impacted than in the previous segment.

The location of the station within the parking lot of the Plaza at West Covina shopping center dictated the alignment location on the south side of I-10 along the most easterly portion of the Part 2 alignment.

**E.2.3 Opportunities and Constraints**

Relative to Part 3, a lower profile could be accommodated along I-10 within part 2 due to the fewer number of freeway crossings that had to be traversed. Significant profile constraints were encountered at the following locations along the I-10 alignment within Part 2:

- A relative high guideway profile between Sta. 1178+00 and Sta. 1215+00 was required for two reasons. The first was due to the depressed nature of the freeway relative to the adjacent roadways where the alignment enters the I-10 corridor. The second was due to the need to traverse over the SB I-710 to EB I-10 connector within I-10/I-710 interchange. These two factors result in a sustained guideway profile that varies in height from 60' to 90' above ground.

- Two crossings resulted in a relatively high guideway profile between Sta. 1699+00 and 1730+00. The first crossing involved a set of SCE overhead power transmission lines that run along the east side of the San Gabriel River. These lines are supported by large lattice type towers and are likely 50' above ground at a minimum. The second crossing was of the San Gabriel (SR-605) Freeway through the I-10/SR-605 interchange. These two crossings result in a sustained guideway profile that varies in height from 60' to 80' above ground. The elevation of the electrical lines at the crossing should be accurately measured during the next phase of the project to determine the feasibility of the guideway alignment crossing over the lines at their present elevation, lowering the lines, or a combination of both.
The following are locations where a significant number of existing structures were impacted by the guideway due to alignment or right of way constraints within Part 2:

- Several structures, athletic fields, and other facilities within the Mount Keppel High School campus were impacted by the alignment along the south side of the I-10 corridor between Sta. 1355+00 to 1378+00.
- A significant number of homes were directly impacted by the alignment along the south side of the I-10 corridor between Sta. 1387+00 and Sta. 1458+00.
- There may be significant secondary impacts to existing structures along any frontage roads that will need to be widened to accommodate guideway columns as identified on the plans. These impacts and their potential mitigation need to be more fully assessed in a subsequent phase of the project.

**E.2.4 Design Speed**

The resultant speed profile generated by TRI for the I-10 alignment within Part 2 is included as part of the overall speed profile shown in Figure 8. As shown in the profile, there were no segments of the I-10 alignment within Part 2 where the design speed was significantly constrained below the sustained target of 125 mph.

**E.2.5 Traffic Impacts Related to Construction**

*Union Pacific Rail Corridor (Union Station to I-10/I-710 Interchange)*

The maglev alignment follows the Union Pacific rail corridor between Union Station and the I-10/I-710 interchange. In the segments where Valley Boulevard parallels the rail corridor, k-rail and other protective measures will be implemented to protect the construction work areas. Temporary restriping of Valley Boulevard may be necessary to accommodate the construction activities. As was the case with the Union Pacific/Valley Boulevard segments in the San Gabriel Valley, temporary closures of one or both directions of Valley Boulevard may be necessary to facilitate the installation of the maglev guideway beams. These closures will be limited to overnight and weekend time periods to minimize traffic impacts to Valley Boulevard and adjacent streets. Temporary roadway closures will also be necessary on north-south streets that cross the guideway alignment in this segment. Intermittent closures will be necessary as the guideway support structures are constructed and the guideway beams are installed above the impacted roadways. Roadway closures will be limited to overnight hours as feasible.

*I-10 Freeway (I-710 Freeway to West Covina)*

The maglev alignment in Part 2 of the I-10 freeway continues to follow the freeway alignment outside the freeway shoulder rather than in the freeway median. As is the case with the Part 3 segment, construction activities within the freeway shoulder will require the installation of k-rail barriers alongside freeway traffic. If necessary, temporary restriping of the freeway lanes will occur to accommodate the k-rail and construction work area. The restriping plan will be designed to maintain the same number of travel lanes on freeway that exist prior to the start of construction. Temporary shoulder closures may be necessary to accomplish this objective.

The maglev alignment will be located on either the north or south side of freeway, depending on the specific segment. Changes in the alignment are necessary because of curves in the freeway alignment and to take advantage of available freeway right-of-way. Maglev construction activities in the peak traffic periods will be minimized to limit potential traffic impacts during peak travel times. Traffic impacts during construction will be limited to a single side of the freeway as much as possible, minimizing the total amount of traffic impacted by construction activities.
The maglev alignment crosses the I-10 freeway five times within this segment. One crossing of both the I-605 and I-710 freeways also occurs within this segment. Construction of the guideway support structure and installation of the guideway beams in these crossing sections will require temporary closures of the impacted freeways. These closures will be coordinated with Caltrans and will be limited to overnight and weekend time periods when traffic volumes are typically lower. Appropriate traffic detour routes will be developed with Caltrans and local jurisdictions to redirect traffic during the closure period and minimize impacts to local streets.

Temporary roadway closures will also be necessary on north-south streets that cross the freeway and the maglev guideway alignment. Intermittent closures will be necessary as the guideway support structures are constructed and the guideway beams are installed above the impacted roadways. Roadway closures will be limited to overnight hours as feasible.

**E.3 Part 2 (SR-60 Alignment)**

**E.3.1 Alignment Description**

The SR-60 alignment within Part 2 deviates from the I-10 alignment at Sta. 1164+31 just west of the Eastern Avenue overcrossing along I-10. The alignment turns south and follows the I-710 corridor to SR-60. At the I-10/SR-60 interchange, the alignment turns east and runs along the SR-60 corridor to the Puente Hills station within the City of Industry. The Puente Hills station is located along the north side of the freeway directly across from the Puente Hills mall. Part 2 terminates just west of the station at Sta. 2065+00.

**E.3.2 Design Approach**

Along the I-710 and SR-60 corridors, the design approach was to utilize any available room within the freeway rights of way outside of the freeway to locate guideway columns. Unlike I-10 through Part 2, significant portions of the I-710 and SR-60 corridors do have available room within their rights of way to accommodate guideway columns. This resulted in a rather straightforward design for this alignment as the two corridors were followed as closely as possible to take advantage of this available room.

On which side of the freeway the alignment was located was typically determined by which side had more available space to locate columns. This factor dictated the location of the Puente Hills station on the north side of the SR-60 rather than on the south. Alignment location was also dictated by the need to fit large enough horizontal curves within the right of way to maintain a minimum design speed of 125 mph, which resulted in the need to transition from one side of the freeway to the other at several locations.

The guideway alignment deviated outside of the freeway corridor in the vicinity of the Montebello Town Center mall in order to maintain vehicle design speed through this segment. Back to back reversing curves along the SR-60 freeway within this segment precluded the alignment from staying within the freeway corridor if an acceptable design speed were to be maintained. Within this segment, the alignment is shown to traverse through the mall parking lots and over the Town Center Drive. No structures are impacted within this segment.

**E.3.3 Opportunities and Constraints**

Significant profile constraints were encountered at the following locations along the SR-60 alignment within Part 2:

- Through the curve from the I-10 corridor into the I-710 corridor, the alignment crosses through an office complex located in the southwest quadrant of the I-10/I-710
Further study should be completed in a subsequent phase of the project to assess the feasibility of aerial encroachment over existing structures with regard to the need to provide access to the guideway structure for maintenance and emergency purposes.

**E.3.4 Design Speed**

The resultant speed profile generated by TRI for the SR-60 alignment within Part 2 is included as part of the overall speed profile shown in Figure 9. As shown in the profile, there was one segment of the alignment within Part 2 where the design speed was significantly constrained relative to the target sustained speed of 125 mph:

- In order to stay within the freeway right of way along I-710 from I-10 to SR-60, horizontal curve radii along the alignment were significantly constrained relative to the 3280’ radius needed to maintain a design speed of 125 mph. Using a 3280’ radius through these curves would have resulted in unreasonably large impacts to existing homes, office buildings, and other structures within this alignment segment. As a result, the design speed within this segment was constrained to approximately 110 mph.

As shown within the speed profile, the target design speed of 125 mph was either met or exceeded along the SR-60 corridor east of I-710 segment within Part 2.

**E.3.5 Traffic Impacts Related to Construction**

**SR-60 Freeway (I-10/I-710 interchange to Puente Hills Mall)**

The maglev alignment will be located along the shoulder of the SR-60 freeway within Part 2. The alignment will transition between the north and south sides of the freeway depending on available right-of-way and curves in the freeway alignment. Consistent with the approach employed in other freeway segments, the construction areas along the freeway shoulders will be protected by k-rail and other safety barriers. Temporary restriping plans will be developed to assist in accommodating the construction barriers and work areas. The objective of the restriping plans will be to maintain all existing freeway travel lanes during construction.

The maglev alignment has eight freeway crossings within this segment. Four crossings occur along the SR-60 freeway. Three crossings occur on the segment of the I-710 freeway between SR-60 and I-10. One crossing of I-10 is necessary at the I-710 interchange to follow the alignment to Union Station. Construction of the guideway support structure and installation of the guideway beams in these crossing sections will require temporary closures of the freeway in these locations. The temporary freeway closures will be coordinated with Caltrans and will be limited to overnight and weekend time periods when traffic volumes are lower. Appropriate traffic detour routes will be developed with Caltrans and local jurisdictions to redirect traffic during the closure period and minimize impacts to local streets.

**E.4 Part 2 (UPRR Alignment)**

**E.4.1 Alignment Description**

The UPRR alignment within Part 2 deviates from the I-10 alignment at Sta. 1590+31, which is just east of Santa Anita Avenue within the City of El Monte. From here, the alignment transitions from the north side of I-10 to the south and turns into the median of Valley Boulevard. The alignment continues along the median of Valley Boulevard to where the Valley Boulevard alignment deviates from the UPRR railroad corridor just east of Turnbull Canyon Road within the City of Industry. The alignment then transitions into the north side of the UPRR corridor to where Valley Boulevard rejoins the UPRR corridor alignment approximately 4000' west of Azusa Avenue. Here
interchange. This office complex sits on a hill above the two freeways. The alignment crosses over an access road into this complex at approximately Sta. 1200+00, which controls the guideway profile through this horizontal curve. The resultant guideway profile varies in height from 60’ to 80’ above ground from Sta. 1181+00 to Sta. 1195+00 and from Sta. 1201+00 to 1207+00.

- Through the I-710/SR-60 interchange, the alignment must traverse over the EB SR-60 to NB I-710 and WB SR-60 to NB I-710 freeway connectors. This results in a profile height of approximately 85’ above ground over the connectors.

- At approximately Sta. 1708+00, the alignment crosses a series of SCE overhead electrical transmission lines supported by large lattice type towers that run along the west side of the San Gabriel River. The actual elevation of the lines at the crossing is unknown, but they are likely a minimum of 50’ above ground. In order for the guideway to safely traverse over these lines without any impact, the resultant profile at the crossing will be a minimum of approximately 80’ above ground. It also results in a guideway height over the San Gabriel River just east of the crossing of approximately 90’ above ground. The elevation of the electrical lines at the crossing should be accurately measured during the next phase of the project to determine the feasibility of the guideway alignment crossing over the lines at their present elevation, lowering the lines, or a combination of both.

- The large hill along the south side of the SR-60 within the City of Industry is the site of the former Los Angeles County Sanitation District landfill. This hill rises steeply from its base along the southern edge of the SR-60 freeway. As the alignment runs adjacent to this hill along the south side of SR-60 from Sta. 1785+00 to Sta. 1850+00, a retained cut (structure type 6) section may be required. The need for this type of section should be more fully evaluated in a later phase of the project. If it is determined in a later phase that encroachment into this hillside is not feasible for any reason, an alternate alignment along the north side of SR-60 may need to be investigated.

The availability of room within the I-710 and SR-60 corridors to locate guideway columns resulted in fewer impacted structures within Part 2 relative to the I-10 alignment. The following are locations where a significant number of existing structures were impacted by the guideway due to alignment or right of way constraints:

- Although not directly impacted by the guideway, several homes along the north side of the freeway between Sta. 1673+00 and 1685+00 would be close enough to the guideway so that it would aerially encroach into these properties.

- The proposed widening of SR-60 to add HOV plans (see project no. 6 on Table 1) constrains the amount of available space between the freeway and the right of way between Sta. 1802+50 and Sta. 1957+00. As such, the guideway would encroach into or aerially over a significant number of homes adjacent to both sides of the freeway within this segment.

- The alignment travels along the north side of SR-60 from Sta. 2005+00 to Sta. 2035+00, where several structures within an office park are located immediately adjacent to the freeway. Based on the current alignment, the guideway structure would encroach into the airspace over these buildings. If these buildings are to be maintained in place after the guideway construction, the top of building elevations for these structures will need to be more accurately determined in a subsequent project phase.
the guideway alignment transitions back into the median of Valley Boulevard. Part 2 terminates at Sta. 1957+00, just west of where the Valley Boulevard and UPRR corridors rejoin.

E.4.2 Design Approach

Along Valley Boulevard, the design approach was to utilize the roadway median to locate guideway columns. Where no raised median currently exists along Valley Boulevard, one would be constructed in order to protect the guideway columns from roadway traffic. Through intersections and along intersection approaches, outrigger bents (structure types 3 and 5) would be utilized in order to span intersections and maintain left turns. Over the San Gabriel River, it was necessary to transition the guideway structure off the median of Valley so it could cross the river independently. East of the river, the guideway alignment transitions back into the median of Valley Boulevard.

Within the portion of the alignment along the UPRR corridor, the north side of the corridor was chosen due to the greater availability of room to locate guideway columns relative to the south side. There are a number of large industrial buildings located immediately adjacent to the rail right of way along the south side within this alignment segment. Outrigger bents would be used to span westbound Valley Boulevard and the rail right of way where the guideway alignment transitions from Valley Boulevard median to the north side of the UPRR corridor. Along the UPRR corridor, guideway columns would be placed just outside the rail right of way along its north side. The guideway structure itself may aerially encroach into the rail right of way within segments, so a minimum vertical clearance of 23’ above the existing tracks was maintained.

E.4.3 Opportunities and Constraints

In general, a relatively low profile height of approximately 25’-30’ above the existing Street could be maintained along much Valley Boulevard within Part 2. The only exceptions were at freeway and grade separation crossings, where a higher profile was required in the vicinity of the crossing to provide the required clearance over these facilities. The only significant profile constraint was encountered at the crossing of the San Gabriel River Freeway (I-605) at Sta. 1713+00. This crossing resulted in a profile elevation that is approximately 60’ above ground for approximately 1000’. No other significant profile constraints were encountered along the UPRR alignment within Part 2.

Utilizing the median of Valley Boulevard to locate guideway columns resulted in relatively few impacted structures. Where outrigger bents are required along intersections and intersection approaches, a number of structures will likely be impacted by the locations of outrigger bent columns. These impacts will be more clearly identified during a subsequent project phase when specific column locations are determined. The following are locations within Part 2 where a significant number of existing structures were impacted by the guideway due to alignment or right of way constraints:

- A number of existing commercial structures along the south side of Valley Boulevard adjacent to I-10 are impacted where the alignment transitions from the I-10 corridor into the Valley Boulevard median. These impacts are the result of the 3000’ utilized within this curve in an attempt to maintain design speed. A smaller radius would result in a less significant impact to these properties, but the design speed would be compromised.

- A series of structures, including several homes, located between Old Valley Boulevard and the UPRR right of way from Sta. 1917+00 to 1934+00 will be impacted by the alignment. On either side of this series of structures, the existing UPRR right off way extends to Old Valley Boulevard. Along these structures, the right of way is pinched so that the right of way line is along the southern edge of these properties. As such, they come in direct conflict with the guideway alignment that runs along the north side of the
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UPRR corridor. Large industrial buildings are located directly adjacent to the right of way line on the other side of the rail corridor.

**E.4.4 Design Speed**

The resultant speed profile generated by TRI for the UPRR alignment within Part 2 is included as part of the overall speed profile shown in Figure 10. As shown in the profile, there were no segments of the alignment within Part 2 where the design speed was significantly constrained below the sustained target of 125 mph. In fact, the sustained design speed exceeded 125 mph within the limits of Part 2 outside of the stop at the City of Industry station.

**E.4.5 Traffic Impacts Related to Construction**

Union Pacific Railroad Corridor/Valley Boulevard (Peck Road/I-10 Interchange to Azuza Avenue)

The maglev alignment is located within the Valley Boulevard roadway right-of-way for the majority of this segment. The alignment deviates from Valley Boulevard and follows the Union Pacific rail corridor for a short segment near Hacienda Boulevard where Valley Boulevard has a significant curve to the south. The alignment along Valley Boulevard is proposed to be located in the existing roadway median for a majority of this section of the alignment. Temporary lane closures on Valley Boulevard will be necessary to accommodate construction activities. K-rail barriers would be installed for both directions of travel to protect construction activities in median from adjacent roadway traffic. A minimum of one travel lane in each direction of Valley Boulevard will be maintained as much as feasible during construction.

Installation of the maglev guideway beams will present the greatest challenge to maintaining traffic flow on Valley Boulevard. During the installation process, a potential approach to maintaining two-way traffic would be to close one direction of travel on Valley Boulevard on either side of the existing median. Two-way traffic would then be shifted to the remaining open side of the roadway. This operation would allow for placement of the crane within the Valley Boulevard right-of-way and should provide adequate work area for the beam installation. Temporary access detours to properties located along Valley Boulevard may be necessary during these closures. These temporary access plans will be developed in greater detail in later phases of design.

Temporary roadway closures will also be necessary on north-south streets that cross the guideway alignment. Intermittent closures will be necessary as the guideway support structures are constructed and the guideway beams are installed above the impacted roadways. Roadway closures will be limited to overnight hours as feasible.

The crossing of the I-605 freeway will also require specific traffic control measures to minimize impacts to freeway traffic. Potential freeway closures may be necessary for short time periods while the guideway substructure is constructed and the guideway beams are installed. These closures will be limited to overnight time periods to minimize traffic impacts to the I-605. Temporary restriping on the I-605 will also be necessary during the construction time period in order to accommodate k-rail installed adjacent to the work zones.

**E.5 Part 1 (I-10 Alignment)**

**E.5.1 Alignment Description**

The I-10 alignment within Part 1 connects the West Covina Station within the Plaza At West Covina shopping center to the Ontario Airport Station within the City of Ontario. From the West Covina station, the alignment continues east along the I-10 corridor to the Kellogg Hill (I-10/SR-57) interchange within the City of Pomona. At the Kellogg Hill interchange, the alignment
transitions from the south side of the I-10 corridor to the west side of the SR-71 corridor and continues along SR-71 to the UPRR corridor located just north of Mission Boulevard.

The alignment transitions from SR-71 into the UPRR corridor and follows the corridor east into the City of Ontario. At the point where the UPRR alignment deviates southward from State Street just east of Campus Avenue, the alignment enters into the median of State Street and follows the State Street alignment to Grove Avenue. East of Grove Avenue, the guideway alignment runs along the south side of Airport Avenue towards Ontario Airport. The alignment then transitions to the north over Airport Road and terminates at the Ontario Airport station located within the existing vacant area north Guasti Road and east of the Cucamonga Creek flood control channel.

E.5.2 Design Approach

The design approach along the I-10 alignment within Part 1 was the same as it was for Part 2. As in Part 2, very little room was available within the freeway right of way outside either the existing or proposed freeway (project nos. 3 and 4 in Table 1) to locate guideway columns. The Garvey Avenue frontage road along the south side of I-10 was utilized where possible to locate guideway columns, with the necessary roadway modifications identified within the plans. East of the West Covina station, the alignment was kept along the south of I-10 to Grand Avenue where the freeway enters a series of horizontal curves. Through these curves, the alignment transitions back and forth across the freeway in order to accommodate curves that allow for the maintenance of the 125 mph target design speed. Through this section of the I-10, the freeway climbs into hilly terrain as it approaches the Kellogg Hill interchange. As it crosses back and forth across I-10, the alignment deviates from the right of way along several portions of this alignment segment in the vicinity of Forest Lawn Memorial Park. Due to the hilly terrain adjacent to the freeway, the alignment cuts into the sides of the hills adjacent to the freeway as it deviates from the right of way. A retained cut section (structure type 6) is utilized to support the guideway within these alignment segments.

Through the Kellogg Hill interchange, the desire was to be along the south side of I-10 due to the elevation of SR-57 relative to the rest of the interchange. This is a four level interchange, with SR-57 being the top level. In addition, SR-57 climbs sharply from south to north through the interchange. As a result, the SR-57 was crossed as far south as possible in within the interchange in order to minimize the resultant guideway structure height.

The design approach along the SR-71 corridor was to utilize available space between the southern edge of the existing/proposed freeway (see project no. 5 on Table 1) and the right of way line to accommodate guideway columns.

The design approach along the UPRR corridor from SR-71 to East End Avenue at Sta. 2570+00 was to run along the south side of the UPRR corridor and locate guideway columns adjacent to (but outside) the southerly right of way. First/State Street (The Street name changes from First to State at the San Bernadino County line) runs parallel to the UPRR corridor along its south side within this segment, which provides access to the many industrial and commercial uses south of the railroad. The road, which is two lanes with intermittent on-street parking, runs immediately adjacent to the rail corridor with little or no buffer separating the two. For much of the alignment within this segment, columns would be located within the existing street. As such, the plans call for the reduction in the width of State Street or the removal of on-street parking along several portions so that guideway columns can be accommodated.

East of Sta. 2590+00, a rectangular drainage channel runs between the rail corridor and First/State Street. Along this segment, the width of the street is narrower in order to accommodate the drainage channel. The alignment within this segment runs within the rail corridor rather than in State Street due to the potential significant impacts associated with the widening required to accommodate the guideway columns within the street. The alignment was located within the UPRR corridor such that guideway columns would be constructed between the
southernmost track and the drainage channel. A CIDH caisson type foundation will be required for the guideway columns within this segment so as not to impact the drainage channel. The alignment was located to provide a minimum offset of 15’ from the centerline of the existing track to the face of the guideway columns.

East of Campus Drive where the railroad veers southward, the guideway alignment crosses over the existing tracks and enters into the median of State Street. The design approach along this portion of State Street was similar to that used for Valley Boulevard along UPRR alignment within Part 2. The street will have to be widened to a minimum width of 50 and a raised median constructed in order to accommodate the guideway columns.

East of Grove Avenue the alignment transitions northward within airport property in order to follow Airport Drive into Ontario Airport. There are plans to construct a new air cargo facility, called the Pacific Gateway Cargo Center, south of Airport Road between the West Cucamonga Creek Channel and Vineyard Avenue. The alignment was designed to avoid these proposed cargo buildings as it transitions north to Airport Road. Along Airport Road, the approach was to locate guideway columns along the south side of Airport Road within the surface parking lots for this new cargo facility. The south side of Airport Road was chosen rather than the roadway median due to the number of outrigger bents that would be required to maintain the westbound left turn pockets that are to provide access into the cargo facility. East of the proposed cargo facility along Airport Road, guideway columns will be located within the surface parking lot along the south side of the street. The alignment will then cross both Airport Road and the UPRR corridor using a series of outrigger bents and continue to its terminus at the Ontario Airport Station.

E.5.3 Opportunities and Constraints

Significant profile constraints were encountered at the following locations along the I-10 alignment within Part 1:

- In the vicinity of Sta. 2210+00 along the I-10 corridor, the alignment deviates outside of the freeway right of way along its north side. As it does, the existing ground drops away very steeply and results in a maximum profile height of approximately 100’ for a few hundred feet.

- The need to cross over SR-57 through the Kellogg Hill interchange has a profound impact on the guideway profile in the vicinity of the crossing. Since the elevation of SR-57 at the crossing is approximately 100’ higher than the ground on either side, the profile must reach a maximum height of approximately 120’ above ground as it crosses the freeway. This sort of elevation pushes the boundaries of what can feasibly be constructed. Another factor that impacts the height of the guideway over the freeway is that SR-57 is on a bridge in the location of the crossing. As a result, the guideway must clear-span the freeway and adjacent connector ramps. This 200’ span results in a structure depth of approximately 14.5’.

An alternative alignment was considered that reduced the profile height over SR-57 by approximately 10'-15’. This alignment option is shown on plan sheet nos. 42 and 43 of the I-10 alignment. This more southerly alignment cuts through the office park in the southeast quadrant of the interchange in order to shift the crossing of SR-57 to the south by approximately 250’. The freeway crossing at this location can be accommodated with a standard (type 1) guideway structure. Constraints associated with this alignment include encroachment into a residential area along the west side of Ridgeway Street and impacts to a large industrial property on the east side of Ridgeway. This alignment as well as other potential alignments through the Kellogg Hill interchange should be more fully investigated in a subsequent phase of the project.

No other significant profile constraints were encountered along the I-10 alignment within Part 1.
There were no significant direct impacts to any structures along the I-10 alignment within Part 1. There may be significant secondary impacts to existing structures along State Street and any frontage roads along I-10 that will need to be widened to accommodate guideway columns as identified on the plans. These impacts and their potential mitigation need to be more fully assessed in a subsequent phase of the project.

**E.5.4 Design Speed**

The resultant speed profile generated by TRI for the UPRR alignment within Part 2 is included as part of the overall speed profile shown in Figure 8. As shown in the profile, the only location within Part 1 where the design speed was significantly constrained relative to the intended sustained speed of 125 mph was at the transition from the SR-71 corridor to the UPRR corridor within the City of Pomona. A 2200’ radius curve was used through this transition in an attempt to keep the alignment within public or rail rights of way. This constrained the design speed through the curve to approximately 100 mph. Providing a 3280’ curve at this location would have resulted in significant impacts to the structures located within the industrial area in the northeast quadrant of the interchange. At the same time, the reduction in the overall travel time between the West Covina and Ontario stations resulting from this larger radius would have been insignificant (less than 30 seconds).

The target design speed of 125 mph was far exceeded within the portion of Part 1 along the UPRR corridor between SR-71 and the Ontario Airport station. This portion of the Part 1 segment, which is consistent among all three alignments, allows for the highest speed along any portion of the three alignments due to its straight nature. A maximum speed of 250 mph is achieved along this segment.

**E.5.5 Traffic Impacts Related to Construction**

**I-10 Freeway (West Covina to SR-71)**

The Part 1 I-10 maglev alignment in the San Gabriel Valley follows the I-10 San Bernardino Freeway between the Plaza at West Covina mall and the SR-71 freeway. The proposed maglev alignment is located primarily alongside the freeway, within the freeway shoulder rather than in the freeway median. Construction activities within the freeway shoulder will require the installation of k-rail barriers alongside freeway traffic. If necessary, temporary restriping of the freeway lanes will occur to accommodate the k-rail and construction work area. The restriping plan will be designed to maintain the same number of travel lanes on the freeway that exist prior to the start of construction. Temporary shoulder closures may be necessary to accomplish this objective.

Construction of the maglev alignment is anticipated to have a greater potential impact to traffic operations on the eastbound I-10 freeway given the presence of the alignment on the south side of the freeway. The I-10 freeway experiences heavy directional traffic flows with peak travel occurring in the westbound direction in the AM peak and eastbound in the PM peak. Maglev construction activities in the PM peak period will be minimized to limit potential traffic impacts during peak travel times.

The maglev alignment crosses the I-10 freeway three times within this segment. All three crossings occur near Kellogg Hill where the I-10 alignment includes several significant curves as the freeway climbs the hill grade. Construction of the guideway support structure and installation of the guideway beams in these crossing sections will require temporary closures of the I-10 freeway. These closures will be coordinated with Caltrans and will be limited to overnight and weekend time periods when traffic volumes are lower. Appropriate traffic detour routes will be developed with Caltrans and local jurisdictions to redirect traffic during the closure period and minimize impacts to local streets.
Temporary roadway closures will also be necessary on north-south streets that cross the guideway alignment. Intermittent closures will be necessary as the guideway support structures are constructed and the guideway beams are installed above the impacted roadways. Roadway closures will be limited to overnight hours as feasible.

Union Pacific Railroad Corridor (SR-71 to Ontario Airport)

Within this segment of the IOS, the maglev alignment will be located primarily within the right-of-way of State Street/1st Street, a local arterial roadway that parallels the south side of the Union Pacific right-of-way. Within the City of Ontario, the roadway is referred to as State Street. After crossing into the City of Pomona, the roadway changes to be called 1st Street. This roadway is a wide industrial collector roadway that provides a curb-to-curb width of at least 40 feet. The roadway serves industrial land uses along most of its length, and as a result, experiences a high percentage of truck trips compared to a typical city street.

Construction of the maglev alignment within this segment will require the installation of a k-rail barrier along State Street/1st Street to protect the guideway columns and construction activities from adjacent roadway traffic. The construction work footprint will be designed to maintain two-way travel on State Street/1st Street as much as feasible. If maintaining two lanes of travel is not feasible for certain segments of the roadway because of construction work area requirements, one-way travel may be necessary with traffic in the opposing direction temporarily detoured to Mission Boulevard, located 1/4 mile south of State Street/1st Street.

Temporary roadway closures will also be necessary on north-south streets that cross the guideway alignment. Intermittent closures will be necessary as the guideway support structures are constructed and the guideway beams are installed above the impacted roadways. Roadway closures will be limited to overnight hours as feasible.

Temporary roadway closures of State Street/1st Street may also be necessary while the maglev guideway beams are placed on the substructure. The guideway beams must be lifted by a crane that will require a working area adjacent to the guideway. In these instances, the guideway installation activities will be limited to evening and overnight hours when adjacent business are not operating. As an alternative, temporary access to adjacent businesses could be provided from nearby streets if available.

E.6 Part 1 (SR-60)

E.6.1 Alignment Description

Within Part 1, the SR-60 alignment continues east along the SR-60 corridor from the Purente Hills station to SR-57 within the City of Diamond Bar. From the SR-60/SR-57 interchange, the alignment follows the SR-57 corridor north past the Temple Avenue interchange. Just north of the Temple Avenue interchange, the alignment deviates from the SR-57 corridor and turns eastward into a tunnel section. The alignment traverses a hilly, undeveloped area east of SR-57 within a tunnel (structure type 7) and portals out of the tunnel just west of Humane Way within the City of Pomona. The alignment transitions into the Metrolink corridor in the vicinity of SR-71 and continues along the south side of the Metrolink corridor to where it merges with the UPRR corridor. The SR-60 alignment merges with the I-10 alignment along the UPRR corridor at I-10 Sta. 2434+03.

E.6.2 Design Approach

The design approach along SR-60 corridor through Part 1 was identical to that in Part 2. The intent was to stay within the freeway corridor as much as possible while providing for a minimum
design speed of 125 mph. The alignment stayed entirely within the freeway from the Puente Hills Station to the SR-57 merge. Between the SR-57 merge and Grand Avenue, the alignment deviated outside of the freeway right of way into the vacant land along the north side of the freeway. This allowed the alignment to avoid the series of new freeway to freeway connectors currently under construction within and east of the interchange.

Where the alignment transitions from the SR-57 to the Metrolink corridor, the decision was made to provide a horizontal curve that allowed for the maintenance of the target design speed although it meant a potentially longer tunnel. A smaller curve could have been used to reduce tunnel length and transition into the Metrolink corridor more quickly, but it would have come at a significant sacrifice to the design speed. The target design speed was well exceeded east of this transition to the Puente Hills station (200 mph max.), and it was well exceeded along the UPRR corridor into Ontario (240 mph max.). A tight radius curve at this location would have resulted in a significant constraint to the overall achieved design speed and travel time between the Puente Hills and Ontario Airport stations.

Along the Metrolink corridor, the approach was to locate guideway columns just outside the rail right of way along its south side so as to minimize impacts to the properties adjacent to the rail corridor. The guideway structure itself will aerially encroach into the rail right of way within segment, so a minimum vertical clearance of 23’ above the existing tracks was maintained.

**E.6.3 Opportunities and Constraints**

Significant profile constraints were encountered at the following locations along the SR-60 alignment within Part 1:

- The guideway alignment must cross over the existing NB SR-57 to WB SR-60 connector at Sta. 2435+00 where the two freeways merge within the City of Diamond Bar. This results in a profile elevation that is a maximum of approximately 70’ at the crossing.

- An 85’ high segment of elevated guideway and a 2940’ long tunnel are required to negotiate the hilly terrain located between the SR-57 and Metrolink corridors within the City Pomona. Due to its depth, boring would be required to construct the tunnel. This type of tunneling is costly, complicated, and time consuming. Avoiding this hill to reduce or eliminate the need for a tunnel is possible, but it would come at a significant sacrifice to the overall vehicle design speed for this alignment. In addition to maintaining design speed, the larger radius allowed the alignment to avoid the rendering plant along the south side of the Metrolink corridor just west of Humane Way. A shorter radius would result in a significant impact to this complex. If continued into a subsequent phase of design, this alignment segment should be further evaluated to more fully assess the feasibility and resultant cost and schedule implications of constructing this tunnel. In addition, alignment options through this hill should be evaluated in further detail with regard to the overall design speed in order to optimize design speed while minimizing tunnel length.

There were no locations along the SR-60 alignment within Part 1 where a large number of structures were impacted by the alignment, although some isolated structures were impacted. The locations where existing structures were impacted by the guideway due to alignment or right of way constraints are as follows:

- Two commercial properties along the north side of Golden Springs Drive just east of Brea Canyon Road are impacted by the alignment.

- The alignment traverses over the southern portion of the rendering plant located along the south side of the Metrolink corridor just west of Humane Way. On the east side of
Humane Way, the alignment impacts an office building located along the southern edge of the Metrolink corridor.

**E.6.4 Design Speed**

As shown in Figure 9, there were no locations along the SR-60 alignment where the design speed was significantly constrained below the target design speed of 125 mph. Although the 3250’ radius curve through the transition from the SR-57 to the Metrolink corridor allowed for a design speed just under 125 mph, this location still presented a significant constraint relative to the design speeds that were achieved to the west along SR-60 and to the east along the UPRR corridor. A larger radius through this curve would have resulted in impacts to the residential complex located between SR-57 and Mission Boulevard north of Temple Avenue. In addition, the properties located between Humane Way and the SR-71 freeway south of the Metrolink corridor would be more significantly impacted by a larger radius.

**E.6.5 Traffic Impacts Related to Construction**

SR-60 Freeway (Puente Hills Mall to SR-71)

As is the case with the I-10 alignment alternative in Part 1, the maglev alignment in the SR-60 corridor will generally follow the freeway alignment outside of the freeway shoulder. The maglev alignment is located primarily north of the SR-60 freeway, meaning that a majority of the traffic impacts resulting from construction of the maglev guideway will occur in the westbound direction. K-rail and other safety barriers will be installed to protect the construction areas from adjacent freeway traffic. Temporary restriping plans for the SR-60 freeway will be developed in coordination with Caltrans to accommodate the construction activities. The restriping plans will attempt to maintain the same number of travels lanes on the SR-60 freeway that exist when construction begins.

The maglev alignment has four freeway crossings within this segment. Construction of the guideway support structure and installation of the guideway beams in these crossing sections will require temporary closures of the freeway in these locations. All freeway crossings occur on the SR-60 portion of the alignment, no crossings occur over the SR-57. The temporary freeway closures will be coordinated with Caltrans and will be limited to overnight and weekend time periods when traffic volumes are lower. Appropriate traffic detour routes will be developed with Caltrans and local jurisdictions to redirect traffic during the closure period and minimize impacts to local streets.

**E.7 Part 1 (UPRR Alignment)**

**E.6.1 Alignment Description**

Part 1 within The UPRR alignment begins at Sta. 1957+00 and continues west along the median of Valley Boulevard to the City of Industry station. The City of Industry station is located along the Valley Boulevard median just east of South Hurley Street. The alignment continues along the median of Valley Boulevard east of the station to Brea Canyon Road, where Valley Boulevard turns northward away from the UPRR corridor.

Just east of Brea Canyon Road, the alignment transitions over the eastbound lanes of Valley Boulevard and continues to follow along the north side of the UPRR corridor. The alignment traverses through the vacant land bounded by the San Jose Creek on the north and the UPRR right of way on the south. At approximately Sta. 2360+00, the alignment transitions from the north side to the south side of the UPRR corridor and continues following the railroad east through the existing agricultural land towards Pomona Boulevard.
At the location where the UPRR corridor intersects Pomona Boulevard, the alignment transitions from the south side of the railroad right of way into the Pomona Boulevard median. The alignment continues to follow the Pomona Boulevard median over SR-57 to where Pomona Boulevard turns and merges with the UPRR corridor at Sta. 2490+00. At this point, the alignment transitions into the south side of the UPRR corridor and continues east to Sta. 2525+94 where the UPRR terminates. At its terminus, the UPRR alignment joins the I-10 alignment at Sta. 2395+97.40.
Figure 9

SR-60 Alignment Speed Profile
E.6.2 Design Approach

The design approach along Valley Boulevard within Part 1 was identical to that in Part 2. East of Brea Canyon Road, the alignment of Valley Boulevard becomes very circuitous and precluded the guideway alignment from continuing within the median. As such, the existing vacant and agricultural land that runs adjacent to the UPRR corridor east of Brea Canyon Road was utilized to locate guideway columns.

At the point in which the UPRR alignment merges once again with Valley Boulevard, the guideway alignment could have continued following the UPRR corridor or turned onto Pomona Boulevard. Pomona Boulevard was chosen rather than the UPRR corridor for the following reasons:

- Large industrial buildings line the east/south side of the UPRR right of way north of Pomona Boulevard, many of which would have been impacted by an alignment along the east side of the UPRR corridor. If the alignment had transitioned over the railroad corridor into the median of Valley Boulevard, it would have had to transition back where Valley deviates from the railroad just west of SR-57. These two transitions would have required a series of costly outrigger bents in order to not impact the railroad.

- Pomona Boulevard is a wide, two-lane street with relatively low traffic. A raised median can likely be constructed in the median of the street without significant impacts to the existing roadway or adjacent properties.

In order to “cleanly” match the I-10 alignment along the south side of the Metrolink corridor, the UPRR alignment is shown to travel within the UPRR corridor along its southern edge for approximately 3400’ east of its terminus (Sta. 2491+00 to Sta. 2525+97). An offset of approximately 31’ is provided between the guideway alignment and the center line of the nearest adjacent track. The length of encroachment into the UPRR corridor within this segment can likely be reduced by keeping the alignment within the Pomona Boulevard median as it turns to the east and runs adjacent to the railroad. This alignment would require a series of reversing horizontal curves as it crosses over SR-57 in order to transition to the north to match the I-10 alignment at Sta. 2525+97. If the UPRR alignment is carried forward into a subsequent project phase, this alignment variation should be further considered.

E.6.3 Opportunities and Constraints

Similar to Part 2, a relatively low profile could be maintained along Valley Boulevard within Part 1 due to the few number of grade separations. Several crossings of existing facilities did result in significant profile constraints at the following locations:

- The crossing of the SR-57 freeway resulted in a maximum profile height of approximately 60’ above ground.
- The adjacent Humane Way and SR-71 grade separations over the UPRR corridor result in a sustained profile height of approximately 60’ between the two bridges.

For the alignment segment along Valley and Pomona Boulevards, there are no existing structures directly impacted by the guideway within the roadway median. As discussed within the UPRR Part 2 summary, there may be secondary impacts to existing structures at intersection locations resulting from outrigger bent columns. These impacts would be more clearly identified in a subsequent project phase. Because of the availability of undeveloped land along the UPRR corridor between Brea Canyon Road and Pomona Boulevard, there are no impacts to any structures within this segment.
E.6.4 Design Speed

The resultant speed profile generated by TRI for the UPRR alignment within Part 1 is included as part of the overall speed profile shown in Figure 10. As shown in the profile, there were no segments of the alignment within Part 1 where the design speed was significantly constrained below the sustained target of 125 mph. In fact, the sustained design speed exceeded 125 mph within the limits of Part 1 outside of the stops at the City of Industry and Ontario Airport stations.

E.6.5 Traffic Impacts Related to Construction

Union Pacific Railroad Corridor/Valley Boulevard (Azuza Avenue to SR-71)

The maglev alignment is located within the Valley Boulevard roadway right-of-way for the majority of this segment. The alignment is proposed to be located in the existing roadway median. Temporary lane closures on Valley Boulevard will be necessary to accommodate construction activities. K-rail barriers would be installed for both directions of travel to protect construction activities from adjacent roadway traffic. A minimum of one travel lane in each direction of Valley Boulevard will be maintained as much as feasible during construction.

Installation of the maglev guideway beams will present the greatest challenge to maintaining traffic flow on Valley Boulevard. During the installation process, a potential approach to maintaining two-way traffic would be to close one direction of travel on Valley Boulevard on either side of the existing median. Two-way traffic would then be shifted to the remaining open side of the roadway. This operation would allow for placement of the crane within the Valley Boulevard right-of-way and should provide adequate work area for the beam installation.

Temporary roadway closures will also be necessary on north-south streets that cross the guideway alignment. Intermittent closures will be necessary as the guideway support structures are constructed and the guideway beams are installed above the impacted roadways. Roadway closures will be limited to overnight hours as feasible.
Figure 10

UPRR Alignment Speed Profile

TARGET DESIGN SPEED

BEGIN U.P.R.R. ALIGNMENT

U.P.R.R./VALLEY BLVD. CORRIDOR
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IV. Summary of Alignment Options

A. I-10

The I-10 alignment as shown within the Preliminary Engineering Plans includes stations at West Los Angeles, LAUPT (Union) Station, West Covina and Ontario Airport. The total length of the alignment as shown in the plans is 54.0 miles. This alignment is shown in detail in plan/profile sheets 1-54 within the Preliminary Engineering Plans and identified in the diagram below.

The Central Maintenance Facility for this alignment is located within the City of Ontario approximately 2 miles west of the Ontario Airport station. The facility is located within the area bounded by State Street to the north, the UPRR corridor to the south, Grove Avenue to the east, and Bon View Avenue to the west. The City of Ontario requested that the maintenance facility be located within this area as it is currently being redeveloped under the City of Ontario Quiet Home program. Under the program, the City has either acquired or is in the process of acquiring all of the properties currently located within this area in cooperation with the FAA due to their close proximity to their airport. For the purposes of developing a conservative preliminary engineering cost estimate, the Decentral Maintenance Facility is located at the alignment’s western terminus in West Los Angeles. This facility can be located anywhere along the IOS alignment, preferably near the west end of the alignment to facilitate the placement of trains for the beginning of revenue service each day. The proposed site for the facility is located just north of the West Los Angeles station within the existing Veterans Administration Medical Center property in an area currently used for storage and other maintenance uses. Additional analysis of potential sites for the Decentral Maintenance Facility will occur in subsequent phases of design. Layouts of both facilities are included within the Preliminary Engineering Plans.

Figure 11 summarizes the TRI calculated travel time and speed data associated with this alignment. This data is summarized for the alignment segments between each of the four stations and for the entire alignment. The data shown within the table is based on preliminary analysis completed in this phase of the design. As shown in the table, the total travel time between the West Los Angeles and Ontario Airport stations is 33.5 minutes, which results in an average speed of 98 mph (156.9 kph) including station dwell times. The top speed along the alignment is 250 mph (400 kph), which is achieved between the West Covina and Ontario Airport stations. As discussed within the alignment summary in Section E1 and shown in Figure 8, the straight nature of the alignment along the UPRR corridor east of SR-71 within Part 1 allows the maglev technology to maximize its speed capabilities.

B. SR-60

The SR-60 alignment between West Los Angeles and Ontario as shown within the Preliminary Engineering Plans includes stations at West Los Angeles, LAUPT (Union) Station, the City of Industry (Puente Hills), and Ontario Airport. The total length of this alignment is 58.4 miles, 4.8 miles longer than the I-10 alignment. This alignment is shown in detail in plan/profile sheets 83-100 within the Preliminary Engineering Plans and identified in the following diagram. The Central and Decentral Maintenance Facility locations for the UPRR alignment are identical to the I-10 alignment.
Figure 11 summarizes the TRI calculated travel time and speed data associated with this alignment. This data is summarized for the alignment segments between each of the four stations and for the entire alignment. The data shown within the table is based on preliminary analysis completed in this phase of the design. As shown in the table, the total travel time between the West Los Angeles and Ontario Airport stations is 34.8 minutes, which results in an average speed of 100 mph (161.2 kph) including station dwell times. The greater travel time compared to the I-10 alignment is attributed to the longer alignment length. Although almost 5 miles longer than the I-10 alignment, the overall travel time increase between termini is less than 1 minute. This is attributed to the higher top speed (260 mph) that is obtained along the SR-60 corridor between the LAUPT and Puente Hills stations.

The highest average speed along the alignment was 250 mph (385 kph), is achieved between the West Covina and Ontario Airport stations. As discussed within the alignment summary in Section E1 and shown in Figure 9, the straight nature of the alignment along the UPRR corridor east of SR-71 within Part 1 allows the maglev technology to maximize its speed capabilities. The length of the segment within the UPRR corridor in Part 1 is slightly less than the I-10 alignment, which results in the slightly lower top speed.

C. UPRR

The UPRR alignment between West Los Angeles and Ontario as shown within the Preliminary Engineering Plans includes stations at West Los Angeles, LAUPT (Union) Station, the City of Industry, and Ontario Airport. The total length of this alignment is 56.4 miles, 2.4 miles longer than the I-10 alignment. This alignment is shown in plan/profile sheets 83-100 within the Preliminary Engineering Plans. The Central and Decentral Maintenance Facility locations for the UPRR alignment are identical to the I-10 alignment.

Figure 11 summarizes the TRI calculated travel time and speed data associated with this alignment. This data is summarized for the alignment segments between each of the four stations and for the entire alignment. The data shown within the table is based on preliminary analysis completed in this phase of the design. The total travel time between the West Los Angeles and Ontario Airport stations is 33.9 minutes, which results in an average speed of 100 mph (161.2 kph) including station dwell times. The slightly greater travel time is attributed to the longer alignment length. The top speed is 250 mph (400 kph) between the West Covina and Ontario Airport. As discussed within the alignment summary in Section E1 and shown in Figure 10, the straight nature of the alignment along the UPRR corridor east of SR-71 within Part 1 allows the maglev technology to maximize its speed capabilities.
Figure 11
Trip Time and Speed Summary

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<th>Stations</th>
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<th>SR-60 Corridor</th>
<th>UPRR Corridor</th>
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<td>Trip/Station Time</td>
<td>Top / Ave. Speed</td>
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</tbody>
</table>

Trip times are rounded up (to be conservative).
Values corrected from previous version shown in red.
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