Downtown Natomas Airport

Green Line to the Airport

Transitional Analysis Report

Sacramento Regional Transit District
November 2010

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ES-1.0 EXECUTIVE SUMMARY

The Downtown Natomas Airport (DNA) Green Line is a 12.8 mile light rail transit (LRT) extension between Downtown Sacramento, South and North Natomas, and Sacramento International Airport (Figure ES-1). The Sacramento Regional Transit District (RT) is preparing a Transitional Analysis for the Green Line that will refine the Locally Preferred Alternative (including alignments and stations), provide detail on capital costs, operations and maintenance (O&M) costs, and ridership, and make implementation recommendations.

The Transitional Analysis addresses the Green Line to the Airport, excluding the segment to the River District which is under construction. The Transitional Analysis will:

- Identify the most cost effective project (capital costs, O&M costs, and ridership)
- Recommend a preferred option for segments adopted with design options
- Determine the Cost Effectiveness Index (CEI) for the various options
- Develop a timeline and action plan for re-entering FTA New Starts

There have been multiple studies of the Green Line corridor since the 1980's. The DNA Alternatives Analysis (2004) includes the current Locally Preferred Alternative (LPA) adopted by the RT Board in 2003. The DNA Green Line is also included in the current RT Transit Action Plan (2008) and the Sacramento Area Council of Governments (SACOG) Metropolitan Transportation Plan (2008). RT prepared an Administrative Draft Environmental Impact Statement/Report (ADEIS/R) for the DNA line in 2007. A Program Environmental Impact Report (EIR) was prepared for the entire DNA Green Line project in accordance with the California Environmental Quality Act (CEQA) and certified in 2008.

The DNA Green Line project, as described in the Program EIR, is a 12.8 mile LRT project between Downtown Sacramento, South and North Natomas, and Sacramento International Airport (Figure 1). The project includes stations, tracks, overhead catenary, traction power substations, park-and-rides, and a maintenance and storage facility. The project follows the Truxel Road alignment through South and North Natomas, and includes a section of dedicated right-of-way adjacent to the roadway in North Natomas. The project includes a new bridge over the American River, a bridge over I-80, and a bridge over State Route 99. The Green Line to the River District at 7th Street and Richards Boulevard is currently under construction.

Figure ES-1: Green Line

The Transitional Analysis considered LRT options with various stations, operating characteristics, and alignment lengths into North Natomas. Detail on LRT alignment, station, and parking refinements, operating assumptions, capital and O&M costs, and ridership is included for the following options:

- Option 1 - Airport
- Option 1A - Airport Express
- Option 2 - Club Center
- Option 3 - Gateway Park
- Option 4 - North Natomas Town Center

These options are illustrated in the following figures.

Figure ES-2: Green Line Option 1 - Airport

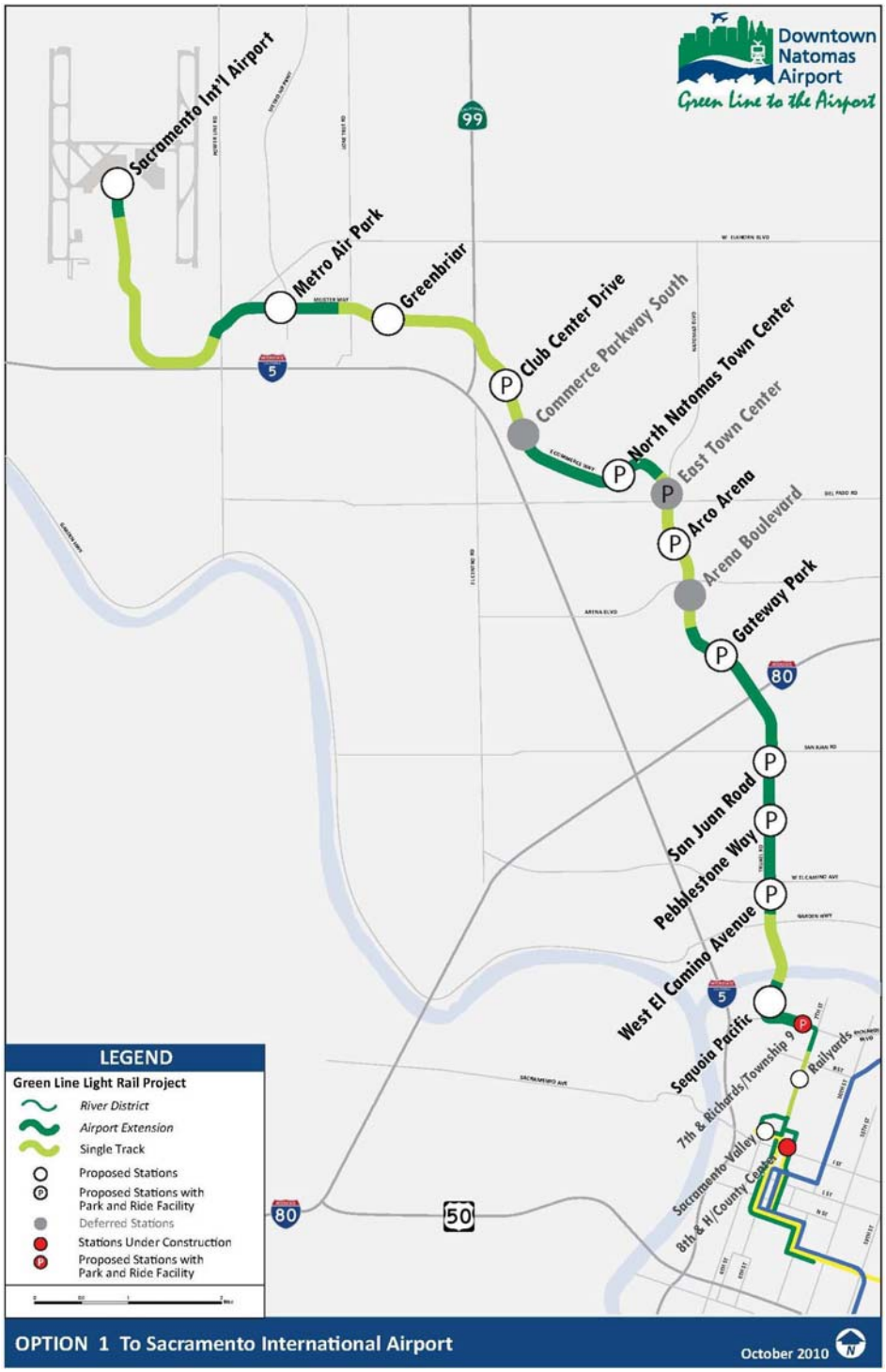


Figure ES-3: Green Line Option 1A - Airport Express

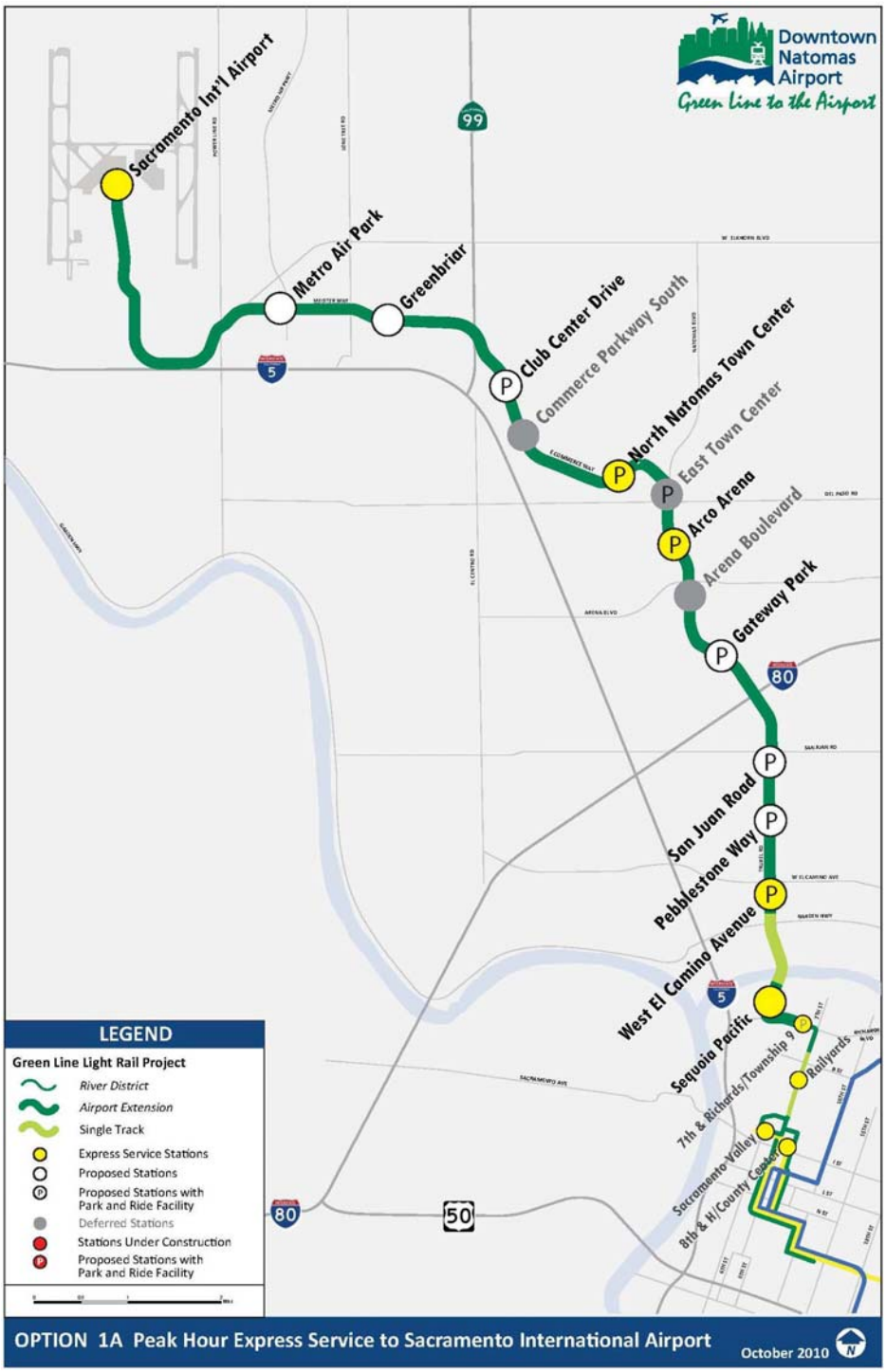


Figure ES-4: Green Line Option 2 - Club Center

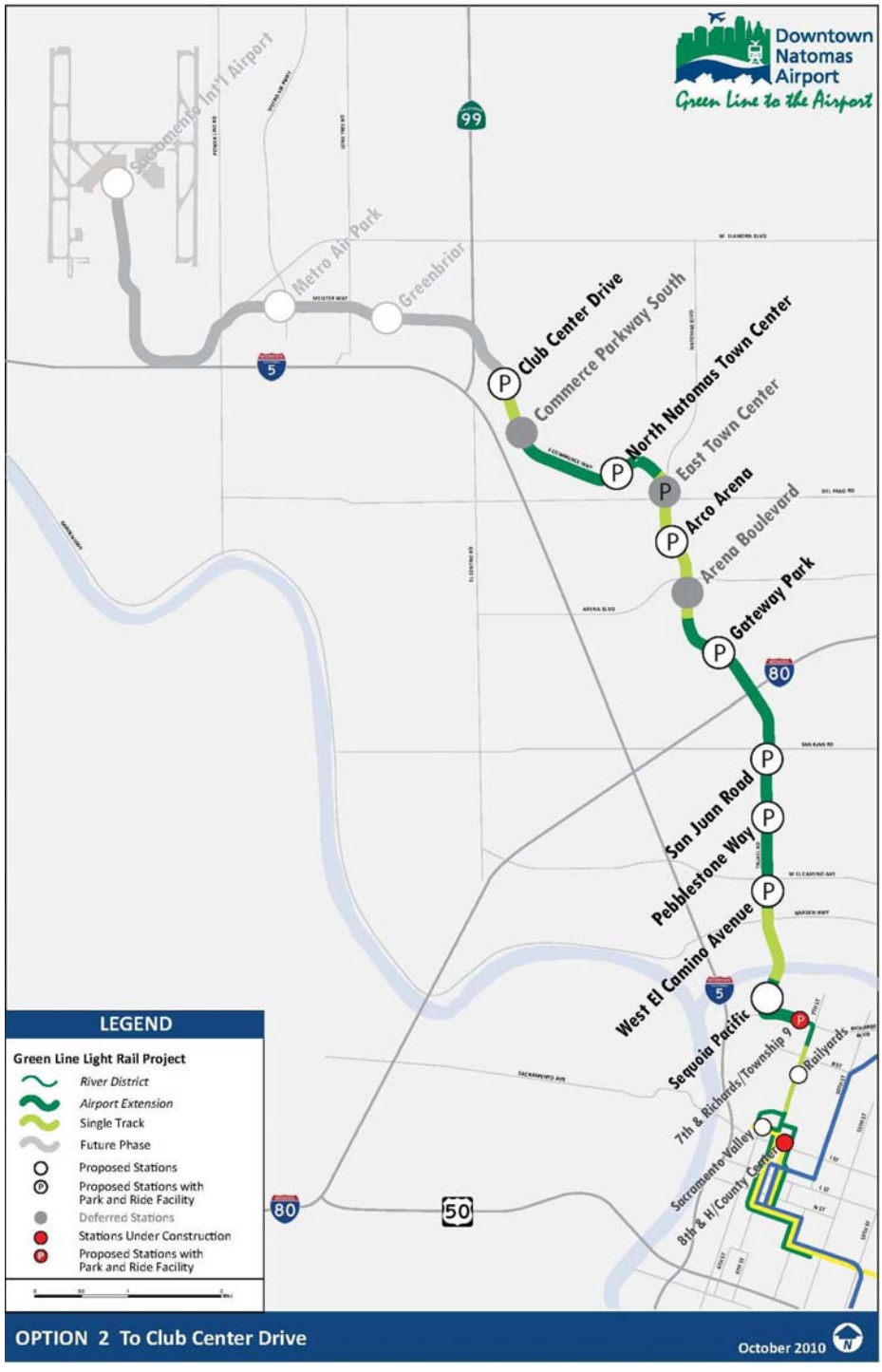


Figure ES-5: Green Line Option 3 - Gateway Park

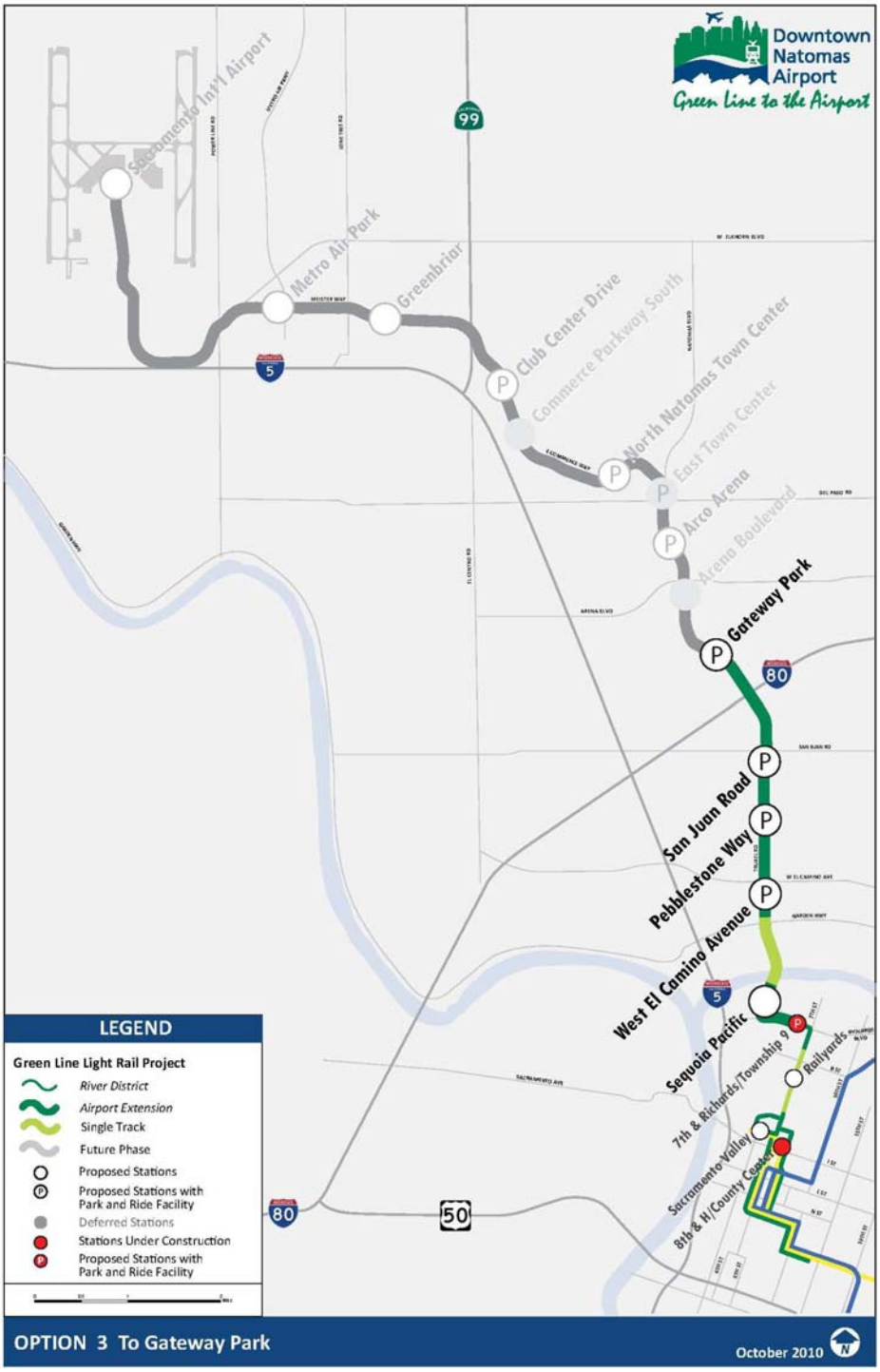
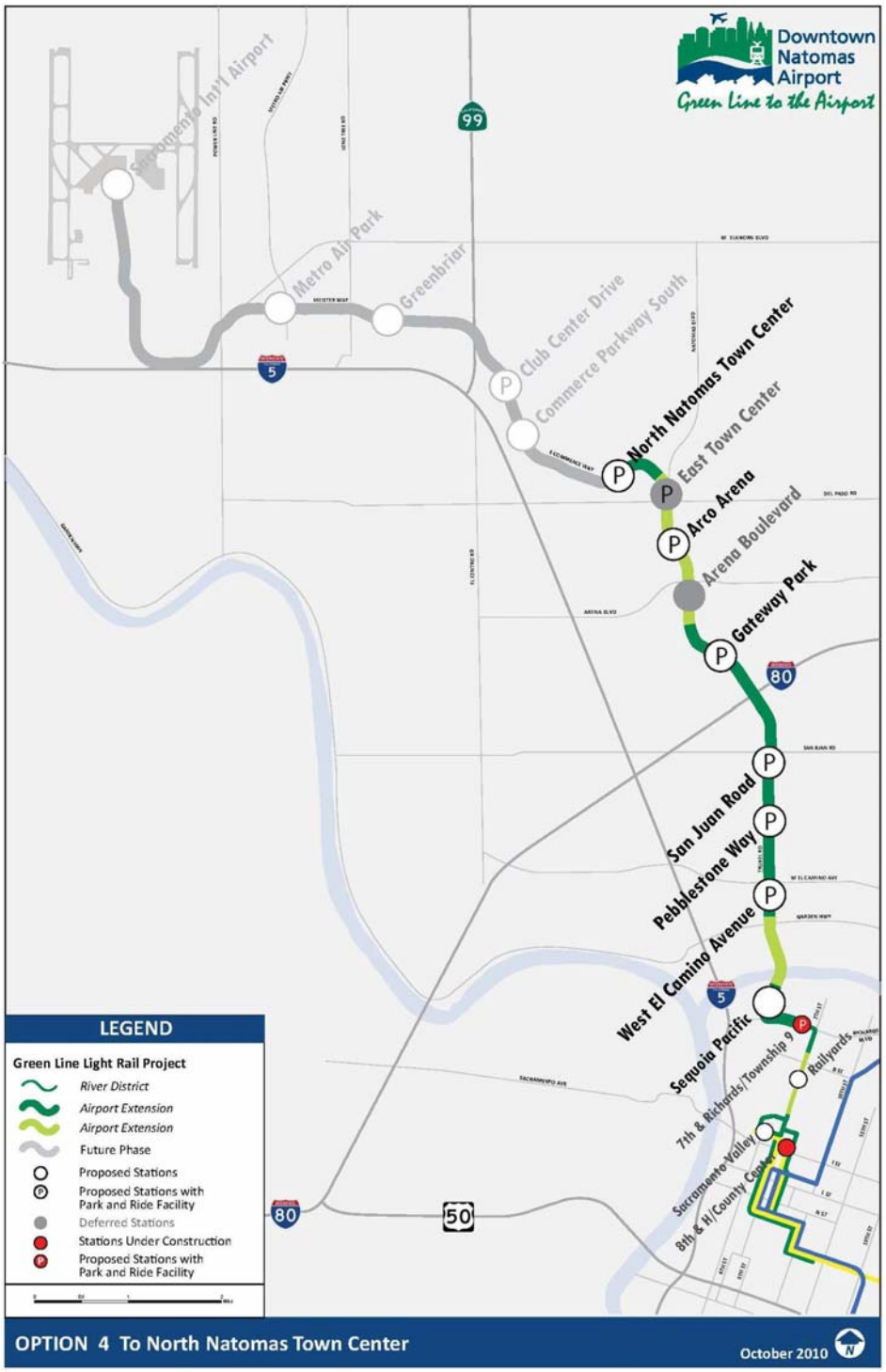


Figure ES-6: Green Line Option 4 - North Natomas Town Center



ES-1.1 Capital Costs

This section provides the capital cost estimate for the Baseline/TSM Alternative and the 5 Build Alternative LRT options being evaluated in the Transitional Analysis. The capital cost estimate includes the capital cost in base year dollars (2010) and year of expenditure dollars (YOE), as well as an annualized capital cost and cost per mile. Capital costs include the combined capital cost for the Green Line to the River District and the Build Alternative LRT options. The following table provides the capital cost estimate for the Baseline/TSM Alternative and the 5 Build Alternative LRT options.

Table ES-1: Capital Cost Estimate

	Baseline/ TSM	Airport	Airport Express	Club Center	Gateway	North Natomas
Capital Cost (2010)	$85,089,000	$756,426,000	$785,099,000	$561,457,000	$390,537,000	$495,712,000
Capital Cost (YOE)	NA	$894,777,000	$928,560,000	$661,199,000	$457,418,000	$582,896,000
Annualized	$8,518,000	$56,917,000	$59,907,000	$42,837,000	$29,709,000	$37,810,000
Cost Per Mile (2010)	$5,828,014	$59,843,829	$62,112,263	$71,160,583	$85,832,308	$74,880,967

Note: Includes capital cost for the Green Line to the River District.

ES-1.2 Operations and Maintenance

This section provides the O&M cost estimate for the Baseline/TSM Alternative and the 5 Build Alternative LRT options being evaluated in the Transitional Analysis. The annual O&M cost estimates are based on design year of 2035 operating plans and ridership projections. These "future" cost estimates, however, are presented in FY 2010 dollars. The following table provides the annual O&M cost estimates.

Table ES-2: O&M Cost Estimate

	Rt-Miles	Stations	Train-Hrs	Vehicle Miles	Total Annual O&M
FY 2010 RT LRT Unit Costs	**$ 66,010**	**$ 63,880**	**$384.03**	**$2.34**	**Cost (2010 dollars)**
No-Build & TSM/Baseline					
Green Line	4.72	1.0	9,940	187,800	
O&M Cost by Variable	**$ 311,567**	**$ 63,880**	**$ 3,817,258**	**$ 439,452**	**$ 4,632,157**
Green Line (to Airport)	27.22	16.0	29,830	1,497,500	
O&M Cost by Variable	**$ 1,796,792**	**$ 1,022,080**	**$ 11,455,615**	**$ 3,504,150**	**$ 17,778,637**
			Increment Over No-Build & TSM/Baseline		***$ 13,146,480***
Green Line Express (to Airport)	27.22	16.0	36,690	1,601,200	
O&M Cost by Variable	**$ 1,796,792**	**$ 1,022,080**	**$ 14,090,061**	**$ 3,746,808**	**$ 20,655,741**
			Increment Over No-Build & TSM/Baseline		***$ 16,023,584***
Green Line (to Club Center)	17.72	13.0	26,280	974,900	
O&M Cost by Variable	**$ 1,169,697**	**$ 830,440**	**$ 10,092,308**	**$ 2,281,266**	**$ 14,373,712**
			Increment Over No-Build & TSM/Baseline		***$ 9,741,554***
Green Line (to North Natomas)	15.18	11.0	19,890	835,200	
O&M Cost by Variable	**$ 1,002,032**	**$ 702,680**	**$ 7,638,357**	**$ 1,954,368**	**$ 11,297,437**
			Increment Over No-Build & TSM/Baseline		***$ 6,665,279***
Green Line (to Gateway Park)	11.04	7.0	19,890	523,200	
O&M Cost by Variable	**$ 728,750**	**$ 447,160**	**$ 7,638,357**	**$ 1,224,288**	**$ 10,038,555**
			Increment Over No-Build & TSM/Baseline		***$ 5,406,398***

Note: O&M costs include LRT service from 13th and R Streets.

ES-1.3 Cost Effectiveness

The FTA Cost Effectiveness Index (CEI) was tested for LRT options ending at various termini: Sacramento International Airport, Club Center Drive, Gateway Park Boulevard, and North Natomas Town Center. The formula that is used to calculate CEI is described below:

Cost Effectiveness Index = (Incremental Annualized Capital Cost + Incremental Annual O&M Cost) / Transportation System User Benefit

In order to determine the annualized capital cost, a detailed capital cost estimate was generated for each of the LRT options. Using the FTA Standard Cost Category (SCC) Worksheets, the cost figures were entered, contingencies and soft costs provided by RT were entered, the costs were distributed by year of expenditure, and SACOG's inflation rate was applied. In addition, a Baseline capital cost estimate was generated so that the differential capital cost could be generated. The SCC worksheet annualizes the capital cost based on the varying depreciation rates for each asset category, resulting in an annualized capital cost.

In order to determine the incremental annualized O&M cost, an operating plan was developed for each of the LRT options. From each of these operating plans, the route miles, train hours, car miles, peak cars, etc. were calculated. Using RT's actual 2010 O&M costs based on these parameters, the incremental annual O&M cost was estimated. In addition, a Baseline O&M cost estimate was generated so that the incremental O&M cost could be generated.

A ridership estimate and calculation of transportation system user benefits (TSUB) was performed for each of the LRT options. TSUB is a measure of the aggregate system-wide transportation travel time savings that result from the project as compared to the Baseline alternative. The total daily TSUB was calculated for each LRT option and then multiplied by an annualization factor of 305 to determine the total annual TSUB. The following table describes the TSUB hours for each LRT option.

The CEI was calculated by adding the incremental annualized capital and O&M costs for each LRT option and dividing by the TSUB. The following table describes the CEI results for the 5 LRT options evaluated in the Transitional Analysis.

Table ES-3: CEI Results

	Airport	Airport Express	Club Center	Gateway Park	North Natomas
Incremental Annualized Capital Cost	$48,399,000	$51,389,000	$34,319,000	$21,191,000	$29,292,000
Incremental Annualized Operating Cost	$9,567,600	$12,444,700	$9,012,700	$4,678,355	$5,937,200
Annual Multiplier	305	305	305	305	305
Daily TSUB Hours	7,650	8,640	6,080	4,860	6,060
Annual TSUB Hours	2,333,250	2,635,200	1,854,400	1,482,300	1,848,300
CEI	$24.84	$24.22	$23.37	$17.45	$19.06
Rating	Medium	Medium	Medium	Medium	Medium

All five of the Build Alternative LRT options are rated in the Medium category for CEI. The Airport, Airport Express, and Club Center options are at the low end of the Medium category, while the Gateway Park and North Natomas Town Center options are at the high end of the Medium category.

CEI is only one of several Project Justification Ratings that FTA uses. An overall project rating of Medium is required for the Approval to enter Preliminary Engineering and Final Design. The other evaluation factors are more subjective than CEI and depend on a variety of inputs. Overall, it is expected the project would receive a Medium or Medium-High Project Justification Rating, as summarized in the following table.

Table ES-4: Project Justification Rating

Cost Effectiveness	Mobility Improvements	Environmental Benefits	Operating Efficiencies	Land Use	Economic Development
20%	20%	10%	10%	20%	20%
Medium	Medium	High	Medium	Medium-Low	Medium-High

ES-1.4 Finance Plan

This section includes the financial analysis of the Green Line project. A financial analysis was completed to determine the financial capacity needed to compete for Federal funding in New Starts. The analysis determined that the Green Line to the Airport could be built and operated by RT with the addition of a new revenue source equivalent to a one-half cent sales tax collected within Sacramento County. The following table shows the capital funding plan for the Green Line to the Airport. It assumes the restoration of RT service due to recent budget reductions and excludes the Green Line to the River District.

Table ES-5: Capital Funding Plan (Airport)

Revenues	**Total**
New Starts	$428,388,500
Airport Contribution	$77,627,000
Developer Fees	$32,000,000
Measure B	$318,761,499
Total Revenues	**$856,776,999**
Capitol Costs (YOE)	$856,777,000

The financial analysis included an evaluation of a Green Line that is a New Starts project to North Natomas Town Center and a non-New Starts project to the Airport. The North Natomas Town Center option is less costly and requires about half of the local revenue needed for the option continuing to the Airport. This results in more funding for the expansion of the rest of the regional transit system while the Green Line is being built. The following table shows the capital funding plan for the incremental construction of the Green Line to the Airport with the Natomas Town Center segment being built first.

Table ES-6: Capital Funding Plan (North Natomas Town Center and Airport)

North Natomas Town Center	
Revenues	**Total**
New Starts	$272,448,000
Developer Fees	$29,000,000
Measure B	$243,448,000
Total Revenues	**$544,896,000**
Capital Costs (YOE)	$544,896,000
Airport	
STP/CMAQ	$20,000,000
Airport Contribution	$77,627,000
Developer Fees	$3,000,000
Measure B	$252,395,223
Total Revenues	**$353,022,223**
Capital Costs (YOE)	$353,022,223

The analysis of the North Natomas Town Center option indicates ample revenue to build the Green Line, implement service restoration, and implement some Transit Action Plan projects.

ES-1.5 Recommendations and Next Steps

This section outlines the recommendations and next steps for advancing the Green Line project. The Transitional Analysis concludes that RT can build and operate the Green Line to the Airport. The project falls within a Medium rating for FTA New Starts, has considerable community support, will significantly increase transit system ridership, and can be completed through an aggressive planning and construction schedule.

It is recommended that the funding for the project be approached as follows:

- Green Line option to North Natomas Town Center with 50% New Starts funding.
- Pursue a new local funding source that will provide matching Federal funds.
- Combine the new funding source with Federal funds from non-New Starts sources and a contribution from the Airport to extend the Green Line to the Airport.

Engineering and Urban Design Improvements

American River Bridge

Significant cost savings were identified for the American River Bridge by changing the assumed bridge type from a cast-in-place segmental bridge to a precast concrete girder or steel girder bridge. These bridge types make use of the construction road necessary to construct the bridge foundations and bridge columns. The disadvantage is that significantly more of the construction activities depend on non-flooded conditions in Discovery Park and rely on hope that a sensitive species will not decide to lay a nest near the construction site. Alternatively, since the last study was completed, structural engineers have discovered ways to design pre-cast segmental bridges to meet California seismic requirements. For a 20% or a $7.5 million increase in bridge cost, the flood or biological risks associated with the superstructure construction could be eliminated, which is still a significant cost savings over cast-in place segmental.

The American River Bridge would be designed and built to ultimately carry northbound and southbound tracks. Initially it would have a single track on one side of the bridge, and the other side would have a sidewalk and a northbound and a southbound bike lane. The single track bridge will support 15 minute train service. Long term, if a roadway bridge is built nearby, the bike lanes and sidewalk could be provided on the roadway bridge, and the LRT bridge could be double-tracked.

Truxel Road (South Natomas)

Design changes in South Natomas did not result in construction cost savings, but were nonetheless valuable because they identified a feasible way to incorporate LRT tracks into the median of Truxel Road without significant roadway widening or impact to traffic, while providing reliable and relatively fast LRT service. The tracks are assumed to be in the center median of Truxel Road with center platform stations and shared left turn lanes.

I-80 and Gateway Park Boulevard Crossings

The recommended design refinement takes advantage of the existing Truxel Road Bridge over I-80. Feasibility, traffic operations, and LRT operations are significantly improved by this option which accommodates exclusive LRT tracks in the median of the bridge by shifting traffic lanes out and widening the existing bridge. The LPA from the previous AA recommended a separate LRT bridge crossing I-80. The cost savings generated from eliminating the LRT bridge were put back into the project to elevate the tracks over Gateway Park Boulevard. An elevated platform at this location and an elevated pedestrian bridge across Truxel Road eliminates significant conflicts between trains, pedestrians, and the very high traffic volumes at this intersection.

Stations

There were small improvements found in FTA Transportation System User Benefits (TSUB) by deferring the stations that were generating the lowest ridership: Arena Boulevard, East Town Center, and Commerce Parkway. Travel time savings per station deferred is approximately 35 to 45 seconds. While this is not enough to save a train set and have a major impact on operating cost, the TSUB is the product of ridership and travel time savings, and deferring these stations improves TSUB by about 3%.

Parking

Parking supply in South Natomas was kept the same as it was in the Program EIR based on prior community concerns that additional parking supply might attract drivers from outside of South Natomas. It is assumed that parking in South Natomas will be provided in three different ways. First, the City of Sacramento would expand their parking lot at the South Natomas Community Center by 140 spaces and make those available for park-and-ride use. Second, RT would solicit proposals from the owners of the shopping centers near West El Camino and San Juan Road that in exchange for what it would cost to build structured parking, RT would contribute that sum toward the redevelopment of the shopping center and use of the necessary parking spaces. Third, RT will either be able to make use of the 2 acre parcel that they own on the west side of Truxel north of San Juan Road with the approval of a

new traffic signal at Mammoth Street, or RT will be able enter into an agreement to lease excess surface parking from one of the shopping centers.

Parking supply in North Natomas was increased by 215 spaces to match the demand for park-and-ride and increase ridership. Parking at Gateway Park Boulevard was assumed to be exactly what is required to be provided by the developers to the west and to the east of the station. The prior assumption that additional structured parking would be provided at Gateway Park has been eliminated. The additional 1,000 parking spaces shown by the ridership model as being needed in North Natomas are split evenly between Arco Arena and North Natomas Town Center. It is assumed that it will be possible to have an agreement for shared use parking during non-event periods with Arco Arena, and it is assumed that it will be possible to have an agreement with the City of Sacramento for RT to construct shared-use parking spaces on City property at North Natomas Town Center.

Single Track

The Green Line project has been planned to ultimately be double-tracked from end-to-end. The operations plan produced run-time estimates and string line diagrams that identified locations where southbound and northbound trains will pass so that single-track segments could be identified. It is possible to provide 15-minute service with single track located: 1) on 7th Street through Railyards, 2) across the American River, 3) from the end of the Gateway Park Viaduct to just past the former East Town Center station site, 4) from the former Commerce Parkway station site past the Greenbriar Station, and 5) from end of runway to just before the Airport Station. Longer segments of single-track could have been proposed, but the shared left turn concept in South Natomas does not work with a single track alignment, and it would have too much of an impact to retrofit areas of single track within streets or on the Gateway Park Viaduct. With the exception of Railyards and the American River Bridge, the areas identified for single-track are exclusive right-of-ways that can be easily modified.

Urban Design/Community Integration

The design elements presented and well received at the community review workshops are included in the cost estimates, including grass or paved track, the replacement of wood privacy fences in South Natomas, and the procurement of new low-floor streamlined European tram-type vehicles.

<u>Next Steps</u>

There are significant steps ahead to secure funding through the FTA Section 5309 New Starts program. The next milestone in the FTA process is Approval to Enter Preliminary Engineering (PE), which requires

a review of quantitative and qualitative measures used to determine the eligibility of the project to compete for New Starts funding.

Formally requesting entry into PE requires the submittal of documentation addressing specific criteria. One of the more important sections of the required documentation is the financial capacity of the transit agency. Without a new local source of funding, RT will not have the financial capacity to build and operate the Green Line until after FY 2022. In order for the project to be completed earlier than 2027, it would be necessary to pursue and obtain a new revenue source. Until this revenue source is secure, it is not likely that FTA would approve entry into PE. In addition, RT will need to discuss with FTA that it plans to apply the cost of the Green Line to the River District as local match for the New Starts project.

The project can be moved forward by completing the Project Specific Environmental Impact Statement and Report (EIS/EIR) and performing advanced conceptual engineering as necessary to support this effort. This will put the project in shovel-ready position for future Federal grant programs. A combination of Proposition A and Federal grant funds for the Green Line project could be used for this purpose. The FTA would have to approve the use of the grant for this purpose, and they would need to agree to issue a Notice of Intent and agree to process the EIS document. The immediate next steps would be to meet with SACOG and then FTA to present the findings of the Transitional Analysis and secure their agreement to move forward with the environmental document. The environmental document could be completed over a two-year period in parallel with the effort to secure a new revenue source.

Given the advanced conceptual engineering completed in support of the environmental documents, and the advancement of the engineering achieve during the Transitional Analysis, the requirements for PE can be completed in one year. Assuming that all possible project variations have been exhausted through the Transitional Analysis and the project configuration is firmly established, the preparation of final design plans, specifications, and estimates can be completed in one year. What will take the most time will be acquiring the various permits, approvals, agreements, and right-of-way that will be necessary to proceed, and it is recommended that each required item be tracked separately and may start during the PE phase.

The recommendation is to follow the standard design-bid-build process rather than use an alternative delivery method such as design-build. It is not anticipated that there will be a schedule or price advantage by going to design-build, and we believe that we have a better opportunity to reduce project risks during the final design period than could be transferred to a design-builder.

Construction is expected to take three years. The construction schedule would be controlled by the construction of the American River Bridge and Gateway Park Bridge with the elevated station. While there are areas of the project that will not require much work before track is laid (the dedicated right-of-ways in North Natomas), it is anticipated that track crews would start in these areas, followed by the median running segments in South Natomas, and finish with the bridges.

Vehicle procurement would start after the Full Funding Grant Agreement (FFGA). Assuming six months for procurement, six months of preconstruction activities, and six months of production before cars start coming out of the factory, and then deliveries of three vehicles a month comes to two and a half years, which would be completed six months prior to the end of construction.

1.0 INTRODUCTION

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1.1 Background

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Alternatives Analysis (AA)

The DNA Alternatives Analysis (2004) considered a wide range of transit technology and alignment alternatives for the Green Line corridor. The final transit technology options included bus rapid transit (BRT) and LRT while the final alignment options included Truxel Road to the Airport, I-5 between Downtown and I-80 and Truxel Road between I-80 and the Airport, and I-5 to Airport. The Locally Preferred Alternative (LPA) includes a LRT alignment on Truxel Road. This corridor was selected because it provided the best ridership, mobility, and cost effectiveness.

Figure 1: Green Line

Program Environmental Impact Report (EIR)

The DNA Program EIR (2008) addressed the general environmental impacts of the project at the program level. There will need to be additional environmental documentation provided for each individual segment of the Green Line, similar to what was prepared for the Green Line to the River District. The Green Line to the Airport will address environmental impacts at the project level.

Environmental Impact Statement/Environmental Impact Report (EIS/EIR)

An EIS/EIR will need to be prepared for the Green Line to the Airport. A summary of relevant information from the Administrative Draft Environmental Impact Statement/Report (ADEIS/R) from July 2007 is included as Appendix A. The purpose of this memo is to provide an overview of the information contained in the ADEIS/R that may be used in preparation of the future Draft EIS/EIR. The memo discusses the additional analysis that will need to be conducted in support of the Draft EIS/EIR.

1.2 Project Description

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1.3 Options Considered

The Transitional Analysis considered LRT options with various stations, operating characteristics, and alignment lengths into North Natomas. Detail on LRT alignment, station, and parking refinements, operating assumptions, capital and O&M costs, and ridership is included for the following options:

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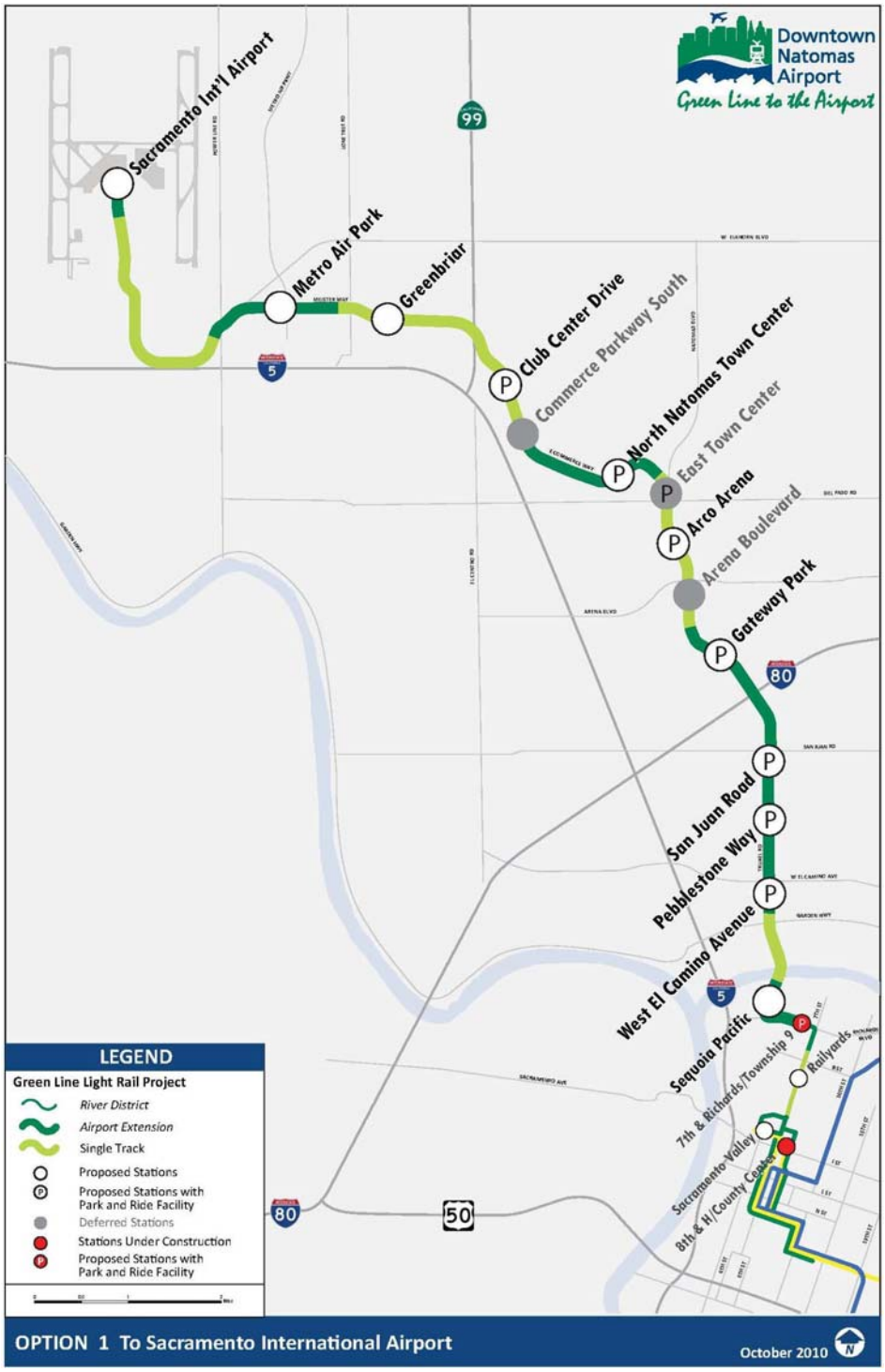


Figure 3: Green Line Option 1A - Airport Express

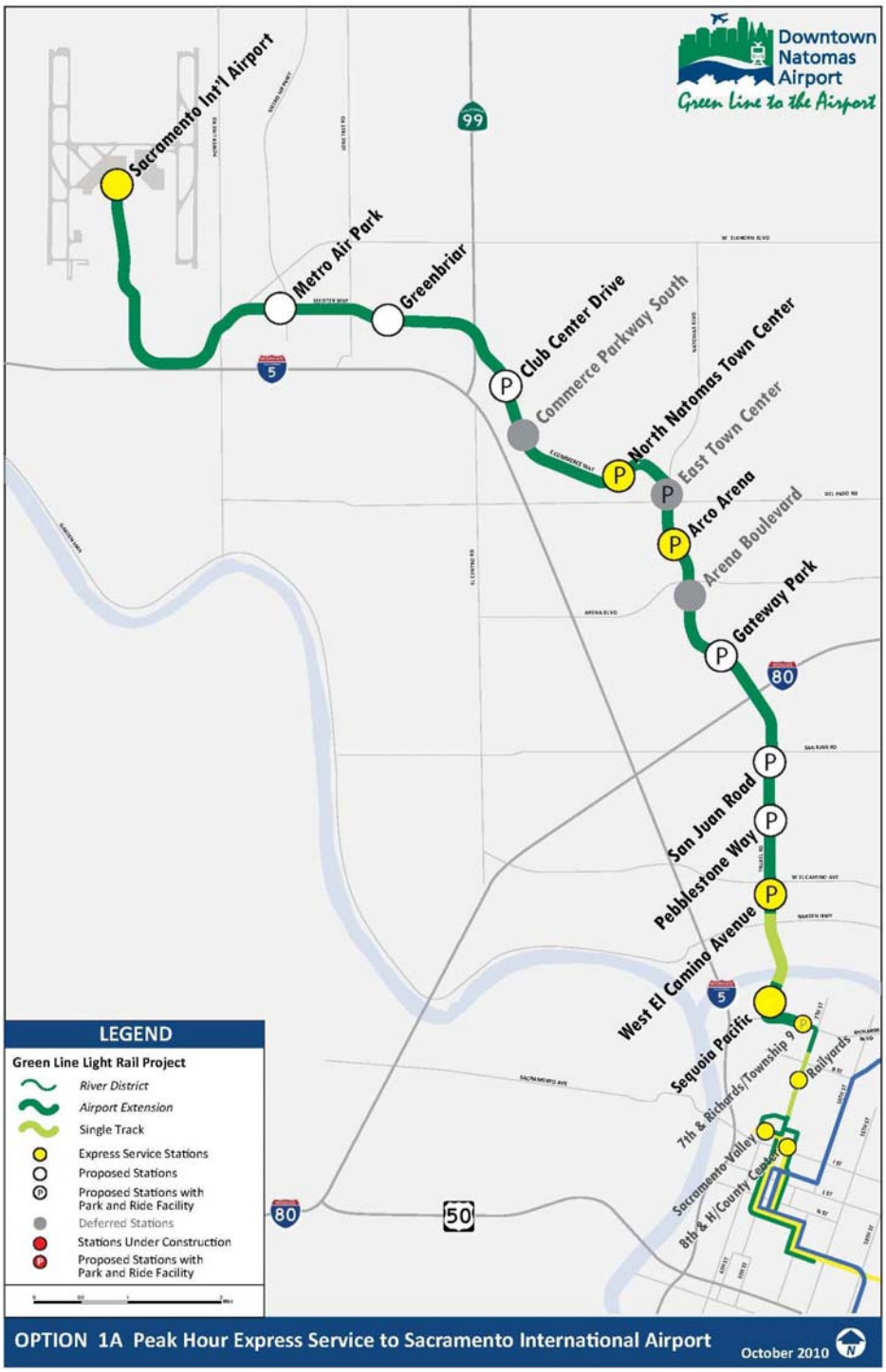


Figure 4: Green Line Option 2 - Club Center

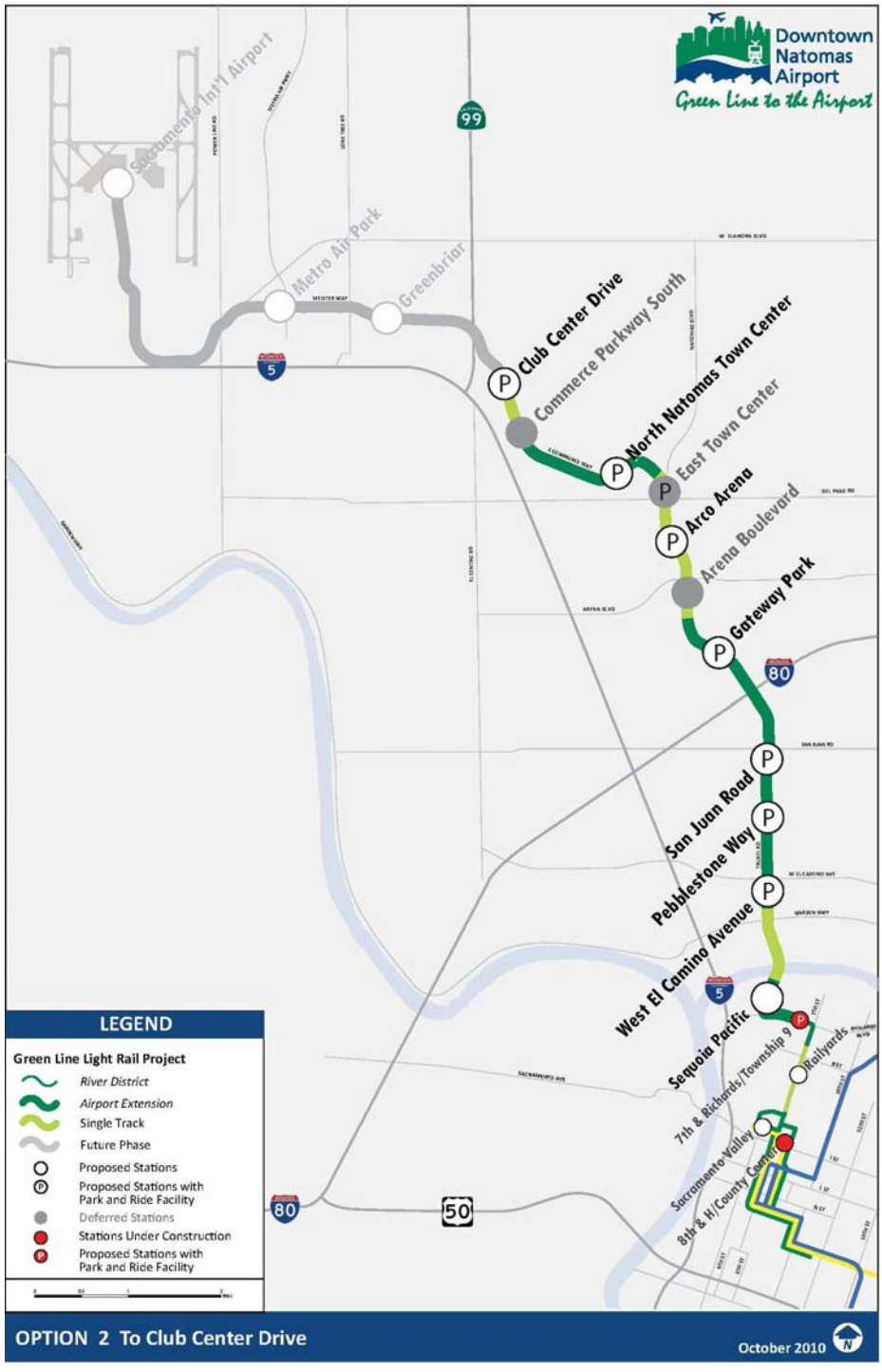


Figure 5: Green Line Option 3 - Gateway Park

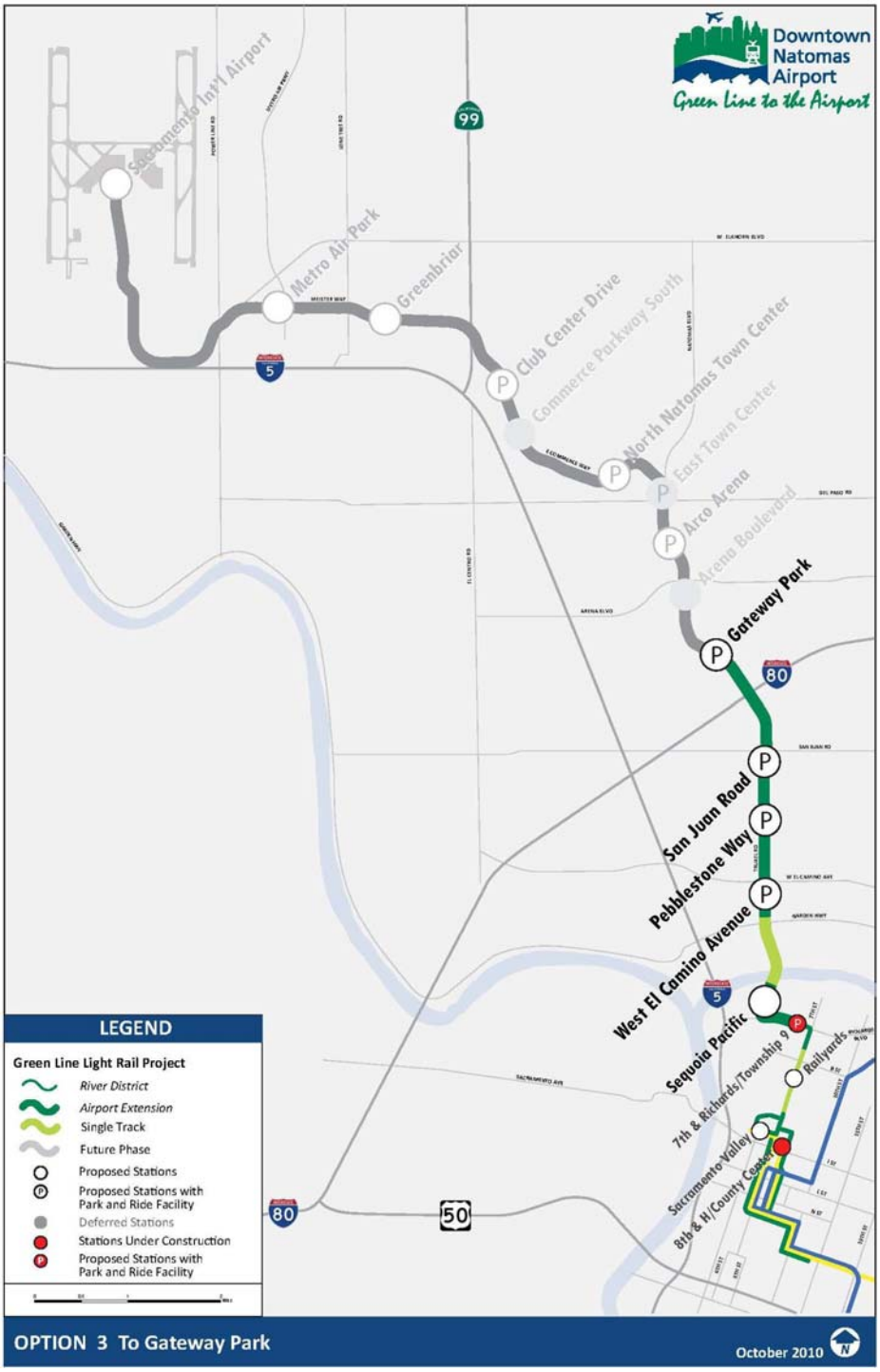
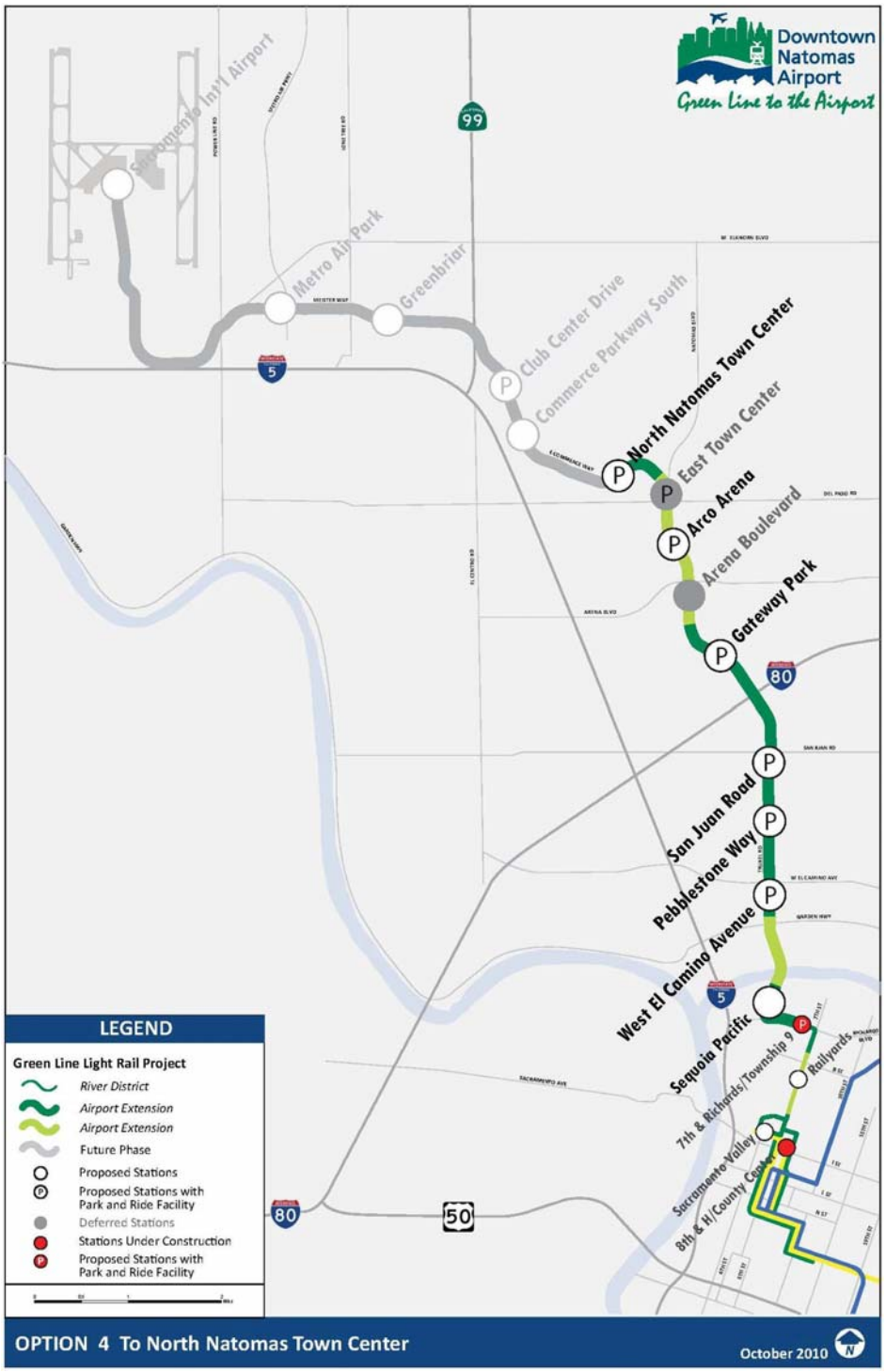


Figure 6: Green Line Option 4 - North Natomas Town Center



2.0 PURPOSE AND NEED

The Green Line project will serve one of the fastest growing areas of the Sacramento region. The purpose of the Green Line is to provide an improved transit connection in a high-demand corridor between Downtown Sacramento, South and North Natomas, and the Sacramento International Airport, as well as connect the corridor to the regional transit system.

2.1 Goals and Objectives

During the DNA Alternatives Analysis (2001-2003), a set of goals and objectives were developed for the corridor that both met the local needs and fulfilled FTA New Starts project justification criteria. The goals included:

Goal 1: Improve mobility within the Downtown to Airport corridor.

Objective: Develop a coordinated transportation system that is safe, efficient, and provides a balanced set of travel alternatives in the corridor.

Goal 2: Promote patterns of smart growth.

Objective: Ensure compatibility between land use policies and transportation policies to minimize the demand for and amount of automobile travel in the corridor.

Goal 3: Find cost-effective solutions for transportation problems in the corridor.

Objective: Make the most efficient use of limited financial resources.

Goal 4: Minimize community and environmental impacts.

Objective: Minimize community and environmental impacts of any transportation improvements in the corridor.

Goal 5: Provide solutions that are consistent with other planning efforts.

Objective: Ensure that the DNA Corridor study effort is consistent with all past and current planning efforts.

Goal 6: Develop and maintain strong community support.

Objective: Recommend transportation improvements consistent with the needs and desires of the residents of the corridor and that maximize community acceptance and political support.

2.2 Project Need

Sacramento residents have consistently ranked the Green Line project highly because it:

- Provides a direct transit link to the Airport
- Connects South and North Natomas with the greater Sacramento area
- Channels planned economic development into transit-oriented patterns
- Provides mobility options to combat congestion in the designated growth area of North Natomas
- Is an integral part of a regional transit system plan to serve the Sacramento region

The following criteria further define the need for the Green Line. These criteria range from connecting major activity centers to promoting economic development and improving transit service.

Connect Major Activity Centers

Connecting this corridor's major activity centers to the regional transit system is a key element to an integrated transportation approach. The Green Line extension is needed to support both existing and future activity centers, including Downtown Sacramento, the Railyards, South and North Natomas neighborhoods, Arco Arena, the Greenbriar development, Metro Air Park development, and the Sacramento International Airport.

Downtown Sacramento, Railyards, and the River District

Downtown Sacramento will continue to grow as one of the region's primary employment centers and will continue to be its cultural center. The proposed Green Line will serve Downtown's existing and future activity centers. Examples of Downtown employment and cultural destinations include the State Capitol, the Convention Center, Old Sacramento/Waterfront, the California State Railroad Museum, the Crocker Art Museum and Westfield Downtown Plaza shopping center.

The Railyards Project Area is located along the Green Line, just north of Downtown, and was adopted as a redevelopment area in 2009. This area will be the site of the Sacramento Intermodal Transportation Facility and is planned as a mixed-use, transit oriented development (TOD). The development plan

includes up to 2.4 million square feet of office uses; 12,000 residential units; 1.9 million square feet of retail, hotel and other commercial uses; and 29 acres of parks and open space. The Railyards Project is a proposed specific development within the project area with 1.3 million square feet of retail, restaurants, and mixed-use high-density housing; and 2.9 million square feet of office space, theaters, fine arts venues, parks, hotels, museums and historic buildings.

The River District is located along the Green Line, north of the Railyards Project Area, south of the American River and east of the Sacramento River. The River District Specific Plan (Administrative Draft July 2010) establishes planning and development standards for the redevelopment of approximately 740 acres of land. The River District envisioned in the Specific Plan will be a vibrant, mixed-use community connected to the surrounding neighborhoods by a network of local streets, LRT, and bicycle and pedestrian pathways. The plan will include approximately 8,100 residential units, 4 million square feet of office, 850,000 square feet of commercial/retail, 1.5 million square feet of industrial, 55 acres of parks and open space and 3,000 hotel units.

A number of important sites within the River District Area are currently approved for development. These include planned unit developments at Township 9, Discovery Center, Continental Plaza and an expansion at the existing State Lottery site. The six-story, 155,000 square foot Lottery development began construction in February 2010 and the first of 2,350 housing units in the 65 acre Township 9 project are expected to begin construction in 2011.

South and North Natomas

The Green Line extension will improve connectivity to the South and North Natomas neighborhoods. These neighborhoods are located between Downtown Sacramento and the Airport and will be served by the LRT line. The South Natomas neighborhood consists of established single family residential, multi-family residential, and neighborhood commercial centers with both the South Natomas Community Center and Natomas High School located along the Green Line.

North Natomas is the largest new growth area of the City of Sacramento and includes approximately 7,200 acres located in both the City and County. Natomas plans include the desire to integrate residential, commercial, industrial and civic uses with high capacity transit. Characteristics of the planned community include: a town center in the heart of community, a regional park, neighborhoods centered around elementary schools, and TOD around the future LRT stations.

Arco Arena

Arco Arena is a multi-purpose sports and entertainment arena that is home to the Sacramento Kings of the NBA. Arco Arena has a seating capacity of approximately 17,000 people and holds nearly 200 spectator events each year. Designated as a "Sports Complex" station in Sacramento 2030 General Plan, Arco Arena is intended to continue to be a stadium/arena station and/or to be the center of intense employment uses. The station is located in the designated North Natomas growth area. A renovated Arco Arena or a large mixed-use redevelopment project could be a major transit generator for special events and/or major employers.

Greenbriar

Greenbriar is a proposed mixed-use development project that would sit on 577 acres along the Green Line between Metro Air Park and State Route 99. This project would include nearly 3,500 residential units, about 50 acres of commercial development, a 10-acre elementary school, 50 acres of neighborhood parks and a 40-acre lake for storm water retention. The developer has identified a LRT station as an important component of the transit-oriented plan and developer fee regulations are in place to finance this station.

Metro Air Park

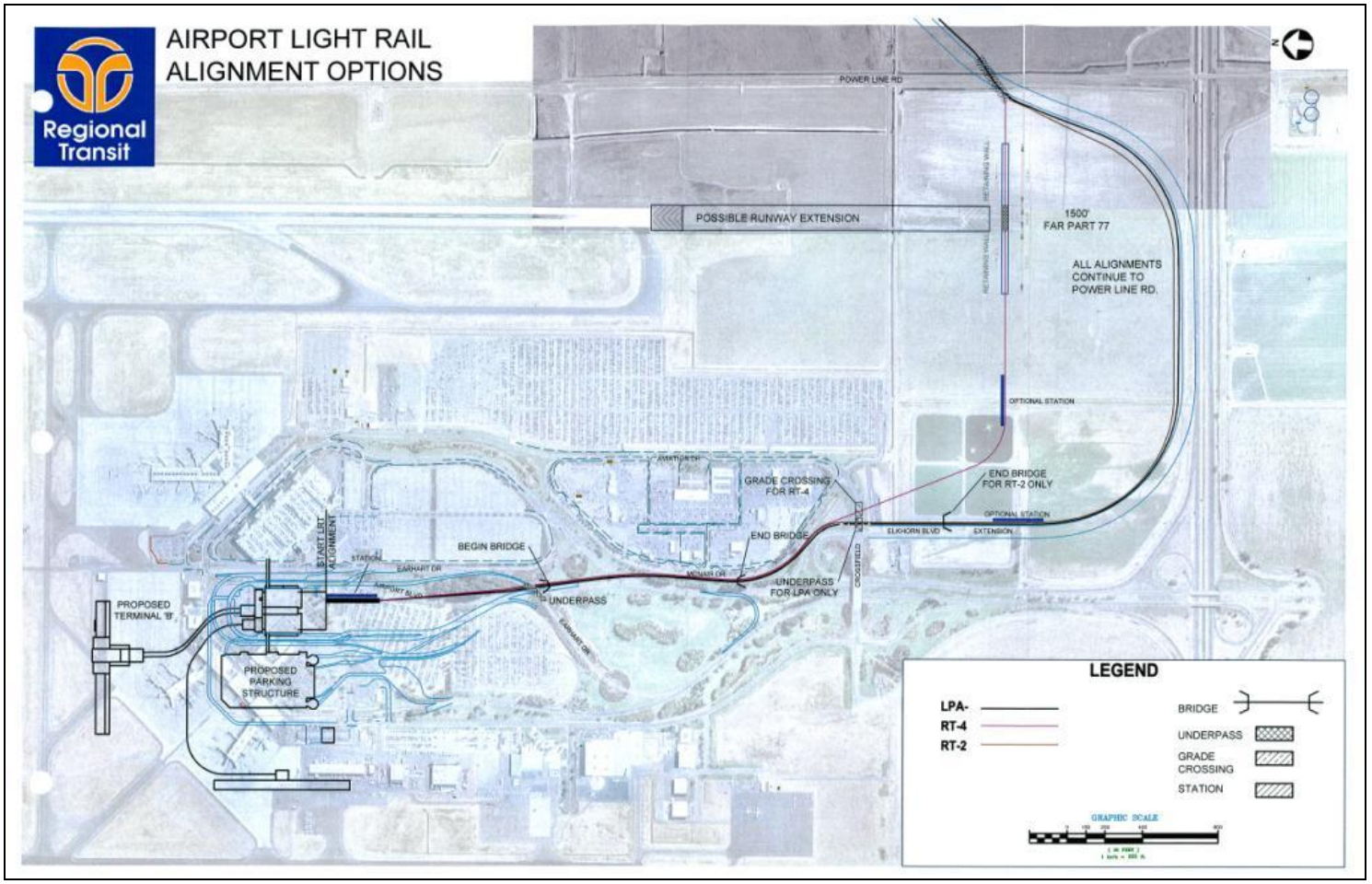
Metro Air Park is a 1,800 acre County-approved project just east of the Airport that will include 20 million square feet of warehouse, light manufacturing, offices, and retail space, and 950 hotel rooms. Developer fees will be collected to build the LRT station at this location immediately adjacent to the Airport.

Sacramento International Airport

The Sacramento International Airport (SMF) is the end of the Green Line. In 2008, the Sacramento County Airport System broke ground on a $1.08 billion terminal modernization project that will add 680,000 square feet of terminal space and a people mover to the airport. It will also include integrated customs facilities, a two-level roadway to separate arriving and departing traffic, and energy efficient and environmentally conscious design that is anticipated to receive LEED certification.

The County Department of Airports and RT have been working together to locate the LRT relative to the terminal expansion. The airport master plan incorporates the LRT route with a station directly adjacent to the terminals, as illustrated in the following figure.

Figure 7: Airport Station



Transit Supportive Economic Development

The Sacramento region has recognized the importance of directing future growth in transit-oriented patterns, and to that end has developed a number of planning documents to guide this vision. Transit-oriented development (TOD) is a key part of this region's strategy to foster economic development in cost-effective, environmentally friendly patterns.

In 2005, SACOG approved the Blueprint Scenario for 2050. This document highlights TOD as a way to direct future growth to existing infrastructure and expects that 41% of new jobs and 38% of new housing will fall within walking distance of transit. In 2008, the State of California approved Senate Bill 375, which mandates that regional transportation plans address the effects of new development on vehicle miles traveled, with the goal of reducing greenhouse emissions in California. Finally, RT has prepared a Transit Oriented Development Guide as part of the 2009 Regional Transit Action Plan. This guide promotes TOD as an important tool in delivering the goals of the Blueprint plan to increase transit ridership and widen transportation choices in the Sacramento region.

In addition to the regional framework, the City of Sacramento has designated the North Natomas area as the City's largest new growth area. The 1994 North Natomas Community Plan and North Natomas Development Guidelines were formulated to highlight transit-oriented investment. A core component of this plan is a proposed LRT line with a dedicated right-of-way. It identifies stations with higher densities and mix of land uses in anticipation of the future transit system. The Green Line will complete these plans with a high quality transit service that is integrated with and enhances planned corridor land use.

The Green Line is needed to support policies identified in these planning documents and to enhance the potential for the mixed use, higher density and pedestrian-oriented developments promoted in the proposed station areas. In turn, these developments will promote transit ridership, capture sales tax dollars through focused development, and increase development potential through shared and reduced parking demands.

Population and Employment Growth

North Natomas is a designated growth area within the City of Sacramento. During the early and mid 2000's, the area experienced explosive population and employment growth that has been mitigated the past several years by nationwide economic slowing trends and Natomas building restrictions pending flood levee protection upgrades.

As market conditions improve and Sacramento receives the anticipated FEMA approval to resume the issuing of building permits in 2013, North Natomas is projected to have significant population and employment growth over the next 20 years. Population and employment forecasts are available by Traffic Analysis Zone (TAZ) from SACOG. SACOG builds and maintains the Sacramento Metropolitan Travel Demand Model (SACMET), and regularly updates the base year and forecast year demographic/land-use data and networks.

Provide Mobility Options to Combat Roadway Congestion

There is limited north-south traffic capacity in the Sacramento region and significant growth will lead to higher traffic volumes on I-5, I-80 and parallel roadways. In addition, there are only two existing bridges across the American River within this three-mile wide corridor that limit north-south traffic capacity. As a result, by 2025, I-5 will be at level of service (LOS) "F" from Downtown to I-80, and nearing capacity north of the I-80 intersection. A new transit alignment is needed across the American River, and it will have the potential to provide travel time savings because it is a more direct connection between Downtown and South Natomas than the existing roadway bridges.

Improve Transit Service

The Green Line will provide the opportunity to expand the regional LRT system by linking the Airport and South and North Natomas neighborhoods with Downtown Sacramento, the Folsom Corridor, the I-80 corridor east of Downtown, and the extended South Line Corridor. In addition, the Green Line will provide intermodal connections to existing and new bus service, intercity rail service at the Sacramento Valley Station (existing Amtrak station), and to the Airport.

The Green Line is needed to improve transit service in the corridor, as existing service does not meet existing demand. While most existing transit service is oriented towards traditional employment centers such as Downtown Sacramento, the Green Line would also serve emerging activity centers, business districts, and neighborhoods in a manner that extends beyond the characteristics of the existing transit system. Examples of these service characteristics include:

- Longer span of service (18-20 hours per day)
- High frequency of service (no schedule needed)
- Simple route structure
- Uniform design (LRT or European tram vehicles and stations)
- Additional vehicle capacity

Existing transit service is shown in the following table and figures.

Table 1: Existing Transit Service

Route	Service	Frequency
11	Truxel with service to Downtown Sacramento	Monday-Friday, 30 minute service
13	Northgate with service to Arden/Del Paso Station on Blue Line	Monday-Friday, 30 minute peak/60 minute off-peak service
14	Norwood with service to Arden/Del Paso Station on Blue Line	Monday-Friday, 60 minute service
86	San Juan/Silver Eagle with service to Downtown & Marconi/Arcade Station on Blue Line	Monday-Friday, 30 minute service & Saturday/Sunday, 60 minute service
88	West El Camino with service to Downtown & Arden/Del Paso Station on Blue Line	Monday-Friday, 30 minute service & Saturday/Sunday, 60 minute service

Figure 8: Existing Transit Service

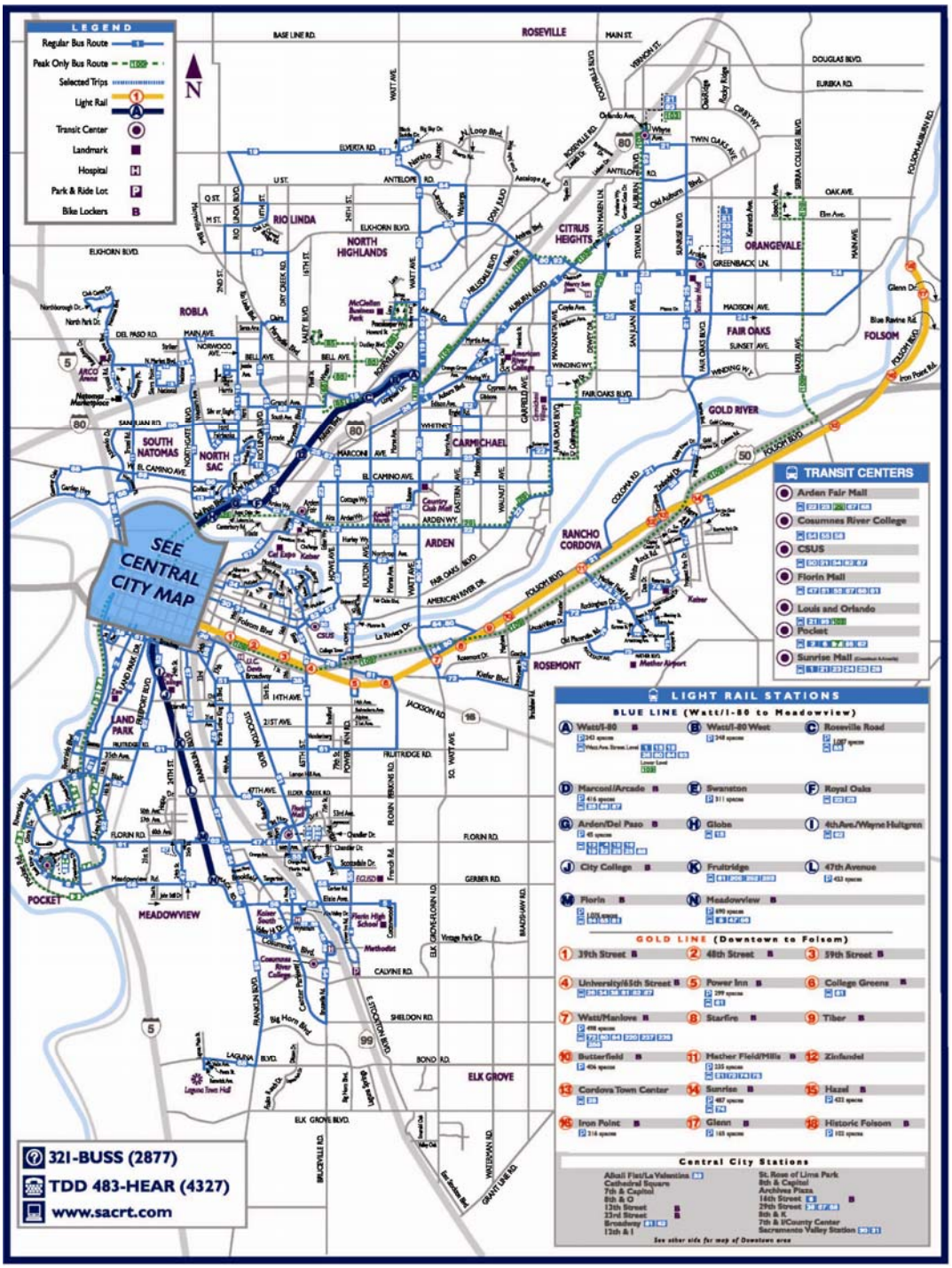
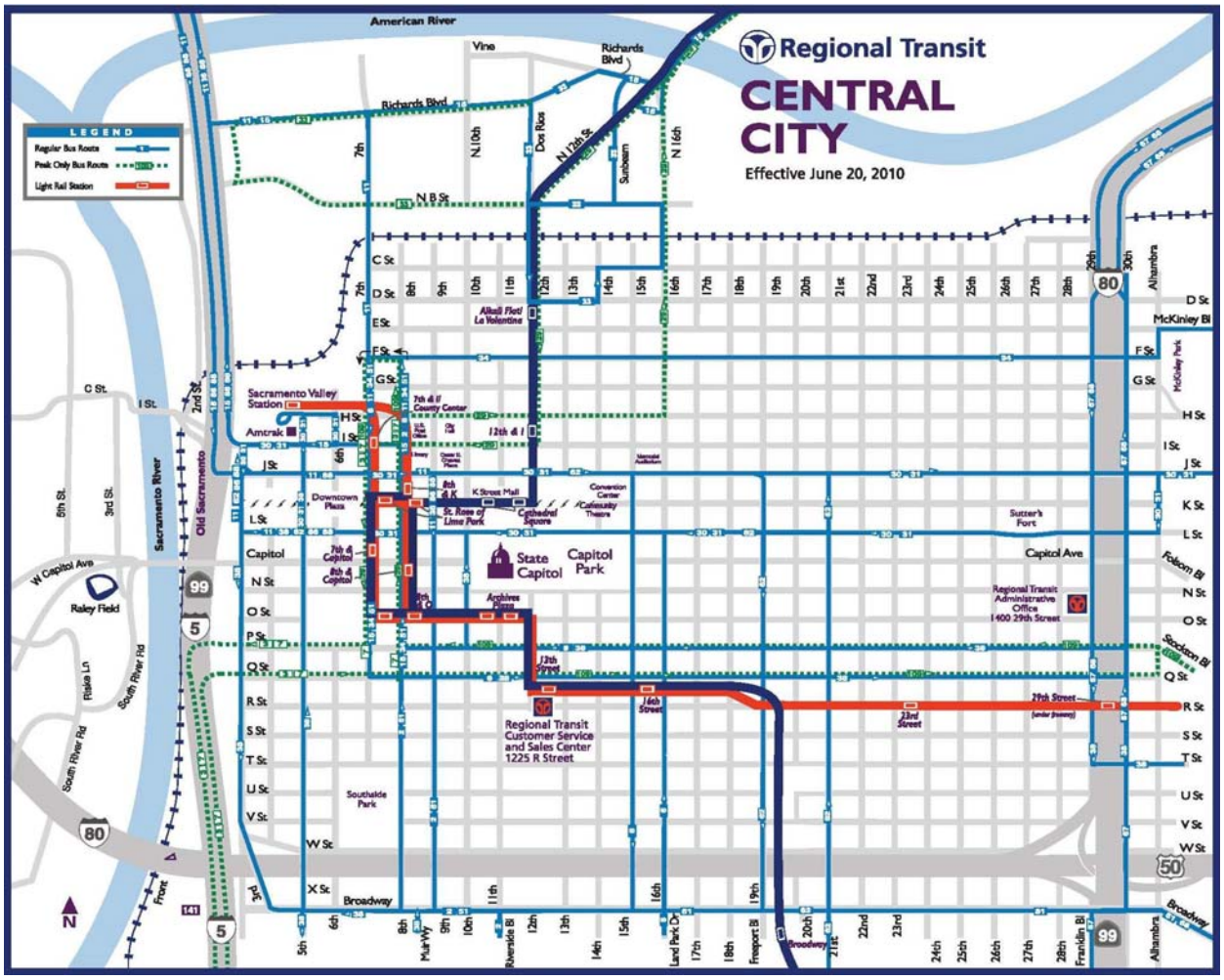


Figure 9: Existing Transit Service (Central City)



3.0 ALIGNMENT REFINEMENT

The Transitional Analysis includes a refinement of the Green Line LRT alignment to optimize the project and identify the most cost effective project.

3.1 American River Bridge/Sequoia Pacific

Alternative bridge types were identified for the American River crossing from the River Front Drive/Sequoia Pacific Boulevard intersection to Truxel Road/Garden Highway intersection. The proposed bridge alignment includes LRT tracks, a pedestrian sidewalk, and bicycle lanes. The total length of the bridge structure is approximately 2,300 feet. A technical memo on the American River Bridge is included as Appendix B.

The following bridge superstructures were evaluated:

- Option 1: Cast in place concrete box girder
- Option 2: New California wide flange girder/ spliced concrete girder
- Option 3: Structural steel girder
- Option 4: Structural steel space frame truss
- Option 5: Precast concrete segmental box girder

The following table provides of summary of the American River Bridge types.

Table 2: American River Bridge Types

Bridge Type	Advantages	Disadvantages
Cast in place concrete box girder	Predictable seismic performance Economical construction cost Shallow superstructure Aesthetics	Construction duration Falsework and shoring Environmental concerns
New California wide flange girder/ spliced concrete girder	Repeatability (girders can be cast quickly in the precast yard) Ease of construction and placement Falsework not required	Higher cost Transportation (large and long girders require special transport permits) Access required for crane Limited capacity on curved alignment
Structural steel girder	Ease of construction and placement Lightweight (reduce seismic forces on bents and foundations) Falsework not required	Cost (higher than concrete structures) Maintenance (require detailed inspection and maintenance) Transportation (large and long girders require special transport permits)
Structural steel space frame truss	Ease of construction and placement Lightweight (reduce seismic forces on bents and foundations) Falsework not required	Structural depth (large depth cannot fit above high flood level) Cost (higher than concrete structures)
Precast concrete segmental box girder	Repeatability (girder sections can be cast quickly in the precast yard) Ease of construction and placement Falsework not required	Cost (higher than conventional concrete construction) Equipment (special launching steel truss equipment required) Transportation (large and heavy segments require special transport permits)

The evaluation criteria include the length of the bridge span, costs, construction duration, environmental impacts, aesthetics, and LRT geometrics. The following table summarizes the evaluation criteria and results.

Table 3: American River Bridge Evaluation

Criteria	Ranking	Notes
Length of bridge span	1. Precast concrete segmental box girder 2. Structural steel girder 3. Precast concrete girder/ Spliced concrete girder 4. Cast in place concrete box girder	To minimize the environmental impacts to vegetation and wildlife habitat in the American River Parkway and Discovery Park, longer spans are preferred to reduce the number of columns and foundations required for the bridge construction.
Costs	1. Precast concrete girder/ Spliced concrete girder 2. Structural steel girder 3. Precast concrete segmental box girder 4. Cast in place concrete box girder	At this particular site, given the limited construction time due to rainy season and potential nesting periods the cost of the faster method is expected to be compensated by other saving due to faster construction speed.
Construction duration	1. Structural steel girder 2. Precast concrete girder/ Spliced concrete girder 3. Precast concrete segmental box girder 4. Cast in place concrete box girder	Construction start up and structure excavations are best suited after the rainy season. Access to the Discovery Park is limited to several months of the year when the ground is not flooded.
Environmental impacts	1. Precast concrete segmental box girder 2. Structural steel girder 3. Precast concrete girder/ Spliced concrete girder 4. Cast in place concrete box girder	Environmental issues include construction staging area, construction equipment, site clearing, construction access, traffic controls, noise, air quality, vegetation and wildlife habitat.
Aesthetics	1. Cast in place concrete box girder 2. Precast concrete segmental box girder 3. Precast concrete girder/ Spliced concrete girder 4. Structural steel girder	In general, a closed system such as a concrete box or steel box girder is favored aesthetically over an I-girder system.
LRT geometrics	1. Cast in place concrete box girder 2. Precast concrete segmental box girder 3. Structural steel girder 4. Precast concrete girder/ Spliced concrete girder	Alignment alternatives have been developed with different geometric conditions, horizontal and vertical curves.

All bridge types will require a construction road to construct the bridge foundations and bridge columns. For bridge types requiring staging and lifting of components from the ground (i.e. the concrete or steel girder bridges), the disadvantage is that significantly more of the construction activities depend on non-flooded conditions in Discovery Park and the lack of sensitive species. Within the last five years, structural engineers have discovered ways to design precast concrete segmental box girder bridges to meet California seismic requirements. For a 20% or a $7.5 million increase in bridge cost, the flood or biological risks associated with the superstructure construction could be eliminated, which is still a significant cost savings over a cast in place concrete box girder bridge (the type previously assumed and included in the cost estimate).

There remains an outstanding alignment issue just south of the proposed American River Bridge. As part of the River District Specific Plan, the City of Sacramento planned an extension of Sequoia Pacific Boulevard that they wanted the LRT alignment to follow. This alignment requires the acquisition and removal of a building just south of the American River. It is assumed that either the City of Sacramento will resolve the conflict, or that the LRT alignment will be modified to avoid the building.

3.2 Truxel Road (South Natomas)

Alternative LRT options for Truxel Road in South Natomas were developed and evaluated. These LRT options include a combination of mixed-flow, single and double track, shared left turns, roundabouts, split platforms, and single and double loaded platforms.

Truxel Road currently has 4 lanes of traffic, bike lanes, a continuous two-way left turn lane, and some on-street parking. There are dual left turns plus right turns at West El Camino Avenue and San Juan Road. The roadway is mostly fronted by single family homes, 14 of which that have front yards along Truxel Road. There are also apartment complexes and shopping centers at West El Camino Avenue and San Juan Road.

The objectives of the South Natomas LRT options are as follows:

- No full residential property acquisitions
- Minimize partial property acquisitions
- Provide fastest LRT service with highest reliability
- Minimize traffic impacts

It is assumed the LRT alignment will be in the middle of Truxel Road and existing on-street parking will be eliminated. Proposed station sites are located at West El Camino Avenue, Pebblestone Way, and San Juan Road. The following table describes the South Natomas LRT options.

Table 4: Truxel Road (South Natomas) LRT Options

LRT Option	Advantages	Disadvantages
Mixed Flow (Shared Lanes)	Minimizes ROW impacts (does not require much curb-and-gutter reconstruction) Retains two-way left turn lane	Train operations, speed, and reliability Impedes traffic; most potential conflict Waiting in left turn lanes between trains could be uncomfortable for drivers Transitions from semi-exclusive to mixed-flow and back is problematic
Single-Track	Allows left turn lanes adjacent to single track	Not efficient for train operations Requires a "shadow-lane" beyond intersection
Shared Left Turns at Intersections	Minimizes ROW Uses traffic signals to control traffic mid-block Provides additional pedestrian crossings	New type of traffic control for drivers
Roundabouts at Intersections	No delay for train Improves traffic flow Less ROW beyond intersection	Can be confusing for drivers Requires more ROW at intersection Pedestrian crossings
Split Platforms	The "shadow-lane" beyond the left turn lanes is used for the platforms	Adds fare vending equipment and longer walk to park-and-rides Requires ROW take (extends impact over longer distance)
Double Loaded Platforms	Shortens walk distances and better distributes passengers	Requires pedestrian-only signal (may not be approved that close to arterial intersections)

Based on an evaluation of the South Natomas LRT options and feedback from the Green Line Community Review meetings, the shared left turn option at intersections, similar to what was done in Houston, Texas, is recommended because it balances the needs of LRT options and vehicular turning movements, while minimizing the amount of right-of-way needed. Traffic is held mid-block for less than 10 seconds every 15 minutes to avoid conflicts with LRT. The figure below shows an example of a shared left turn in conjunction with METRO light rail in Houston, Texas.

Figure 10: Shared Left Turn Lane

Design changes in South Natomas did not result in construction cost savings, but were nonetheless valuable because they identified a feasible way to incorporate LRT tracks into the median of Truxel Road without significant roadway widening or impact to traffic, while providing reliable and relatively fast LRT service.

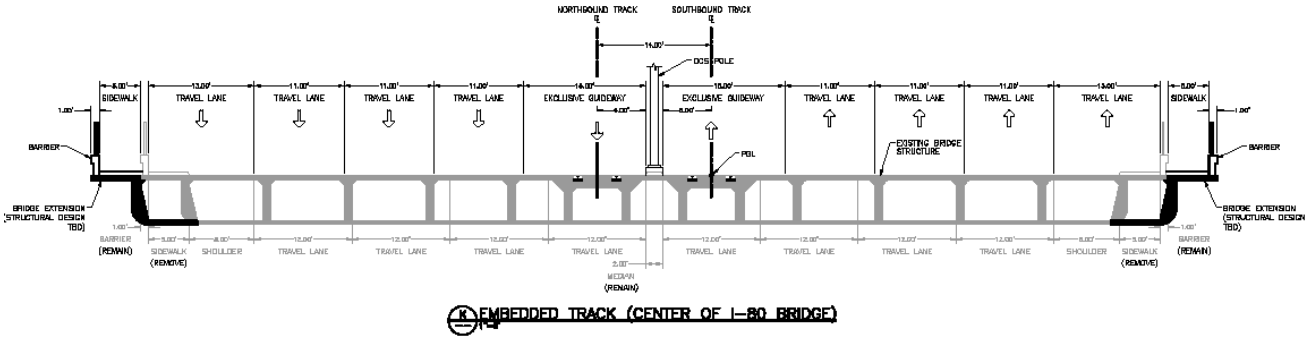
3.3 Gateway Park

LRT options for Gateway Park were developed and evaluated. These options include both the I-80 overcrossing and Gateway Park Boulevard. The AA was inconclusive on the best way to cross I-80 and Gateway Park Boulevard. It recommended carrying forward options including a new LRT bridge across I-80 and an at-grade crossing of Gateway Park Boulevard, running in mixed flow traffic across the existing bridge, or a new structure across I-80 and Gateway Park Boulevard without a station at Gateway Park Boulevard.

Truxel Road /I-80 Overcrossing

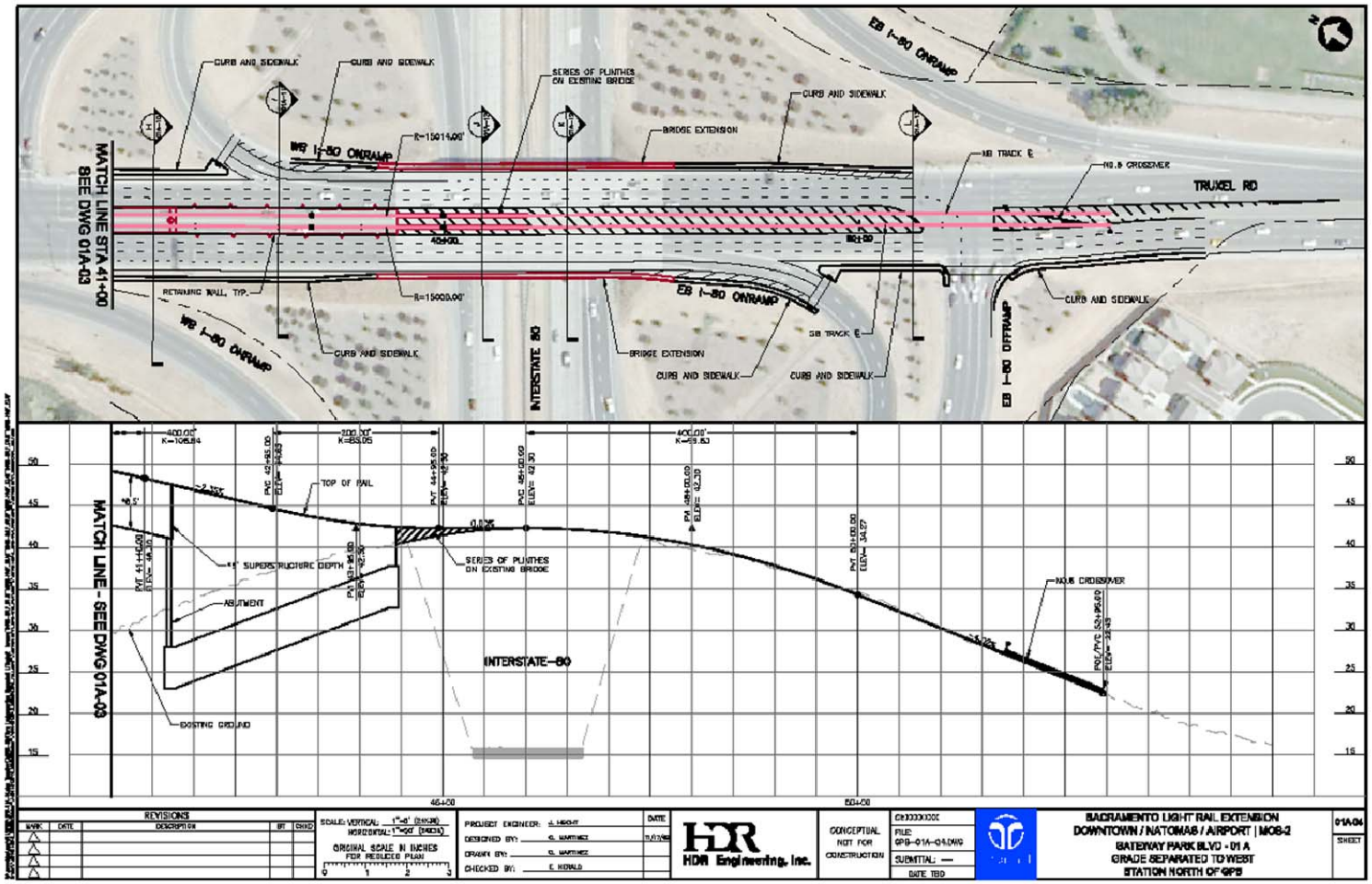
The Truxel Road/I-80 overcrossing was built with provision for LRT tracks. Therefore, it is recommended that the LRT use the existing I-80 overcrossing instead of a new LRT bridge. LRT will continue median running in semi-exclusive track from South Natomas. This will require the existing traffic lanes to be shifted to the outside. The bridge will need to be widened to accommodate bicycles and pedestrians, or they can be relocated to a separate crossing of I-80. The potential cross-section for LRT in the median of the existing Truxel Road/I-80 overcrossing is shown in the following figure.

Figure 11: Truxel Road/I-80 Cross Section



The Truxel Road/I-80 overcrossing with LRT in the median is shown in the following figure.

Figure 12: Truxel Road/I-80



Truxel Road/Gateway Park Boulevard

The intersection of Truxel Road/Gateway Park Boulevard presents challenges for LRT operation. New traffic counts for this intersection were gathered as part of this study. The existing conditions of Gateway Park Boulevard are as follows:

- Peak traffic volumes are Saturday from 2:30-3:30pm
- 2027 predicted volumes (2006) are occurring today
- 2035 will be LOS E without LRT, and LOS F with LRT at-grade
- Adding pedestrians walking to the LRT will result in an average delay per car of 4 min 5 sec

Therefore, it is recommended that LRT be grade separated at Gateway Park Boulevard. Because the Truxel Road/I-80 crossing is already elevated, the LRT alignment can transition from at-grade operation on the I-80 overcrossing to an elevated operation over Gateway Park Boulevard in a relatively short distance.

There are multiple options for an elevated LRT station at Gateway Park Boulevard, including:

- Option 1A - West Side, North of Intersection
- Option 1B - West Side, Over Intersection
- Option 2A - Median, North of Intersection
- Option 2B - Median, Over Intersection
- Option 3A - East Side, North of Intersection
- Option 3B - East Side, Over Intersection

The elevated LRT station options are shown in the following figures.

Figure 13: Gateway Option 1A - West Side, North of Intersection

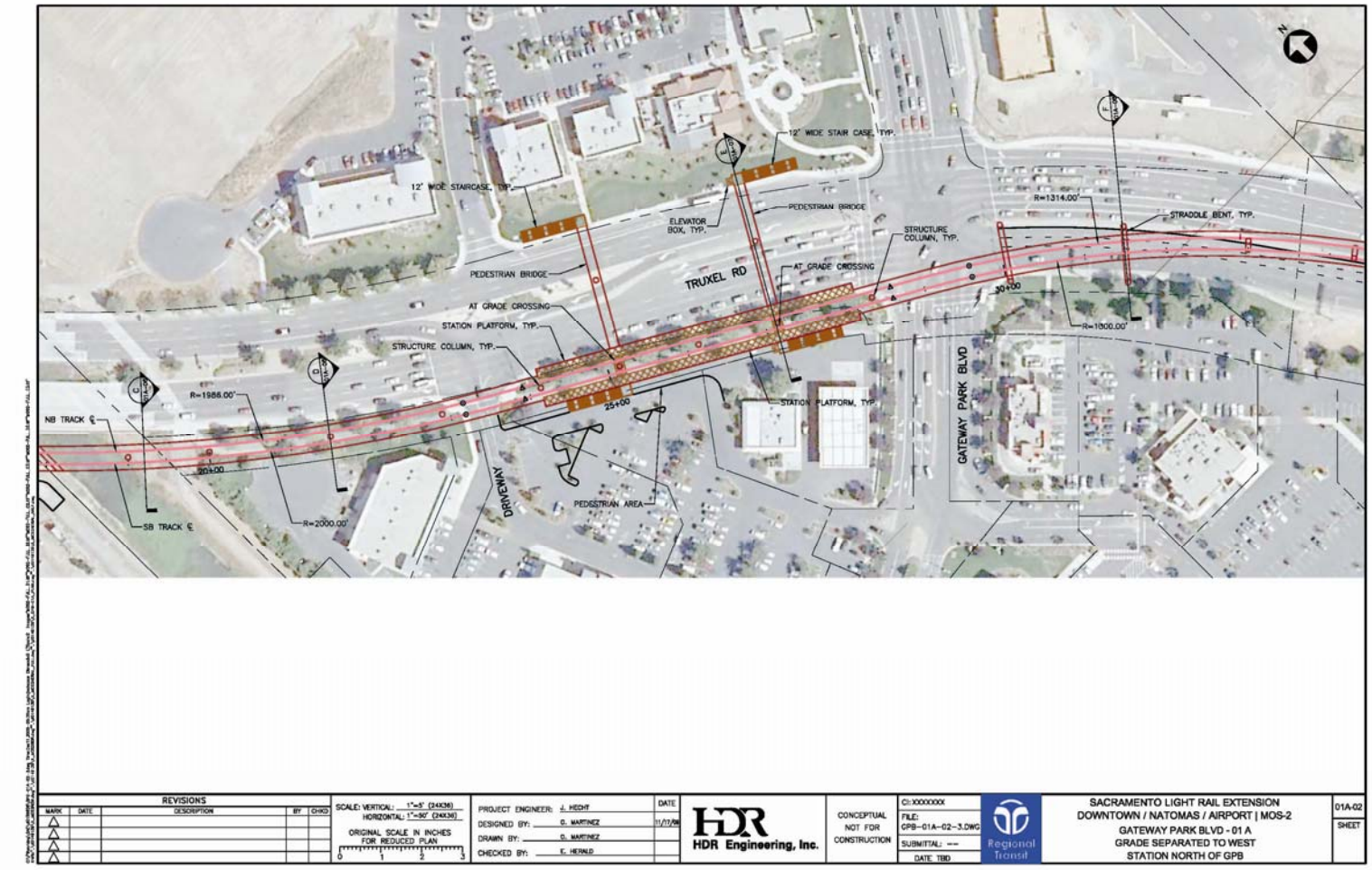


Figure 14: Gateway Option 1B - West Side, Over Intersection

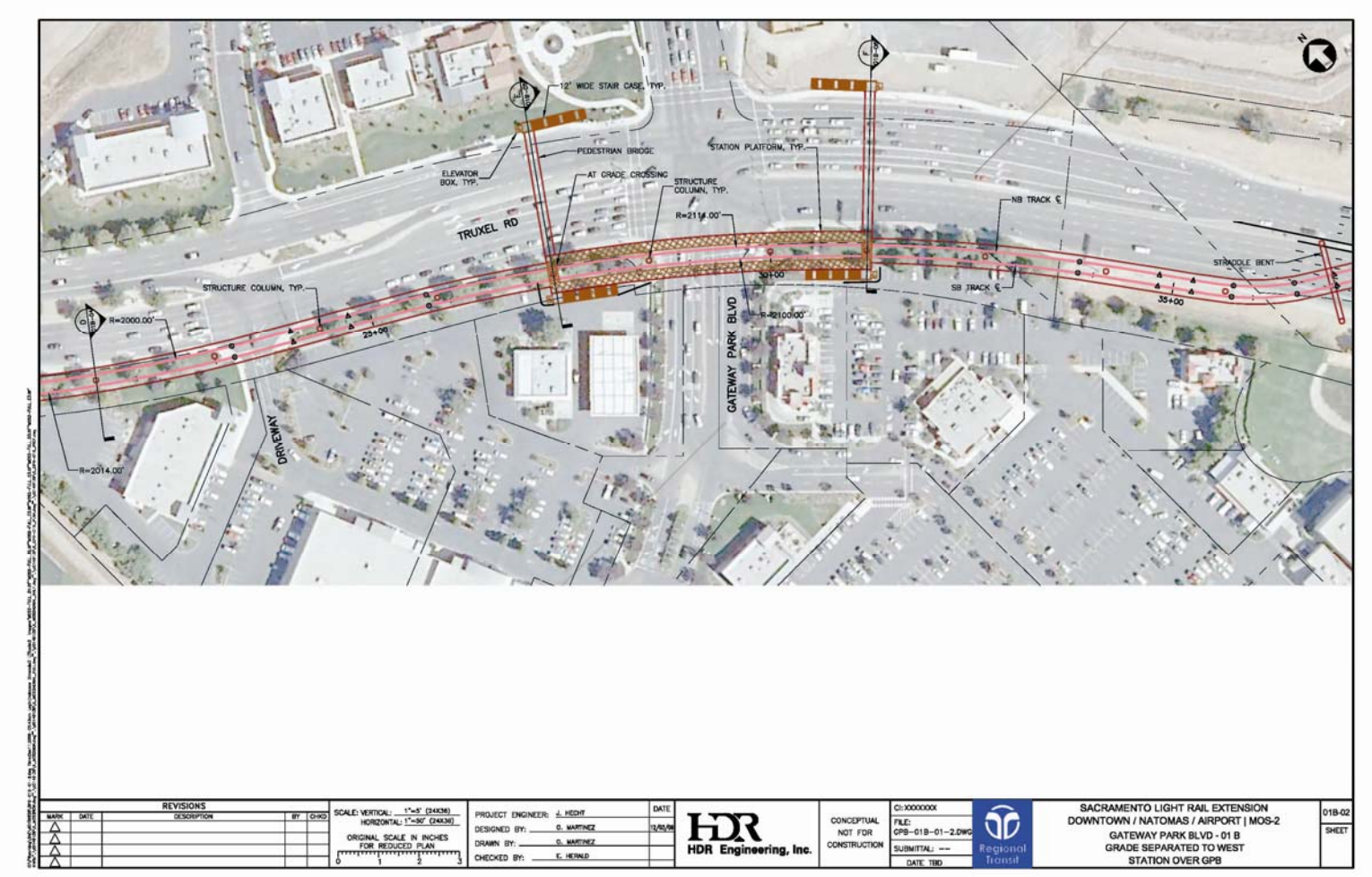


Figure 15: Gateway Option 2A - Median, North of Intersection

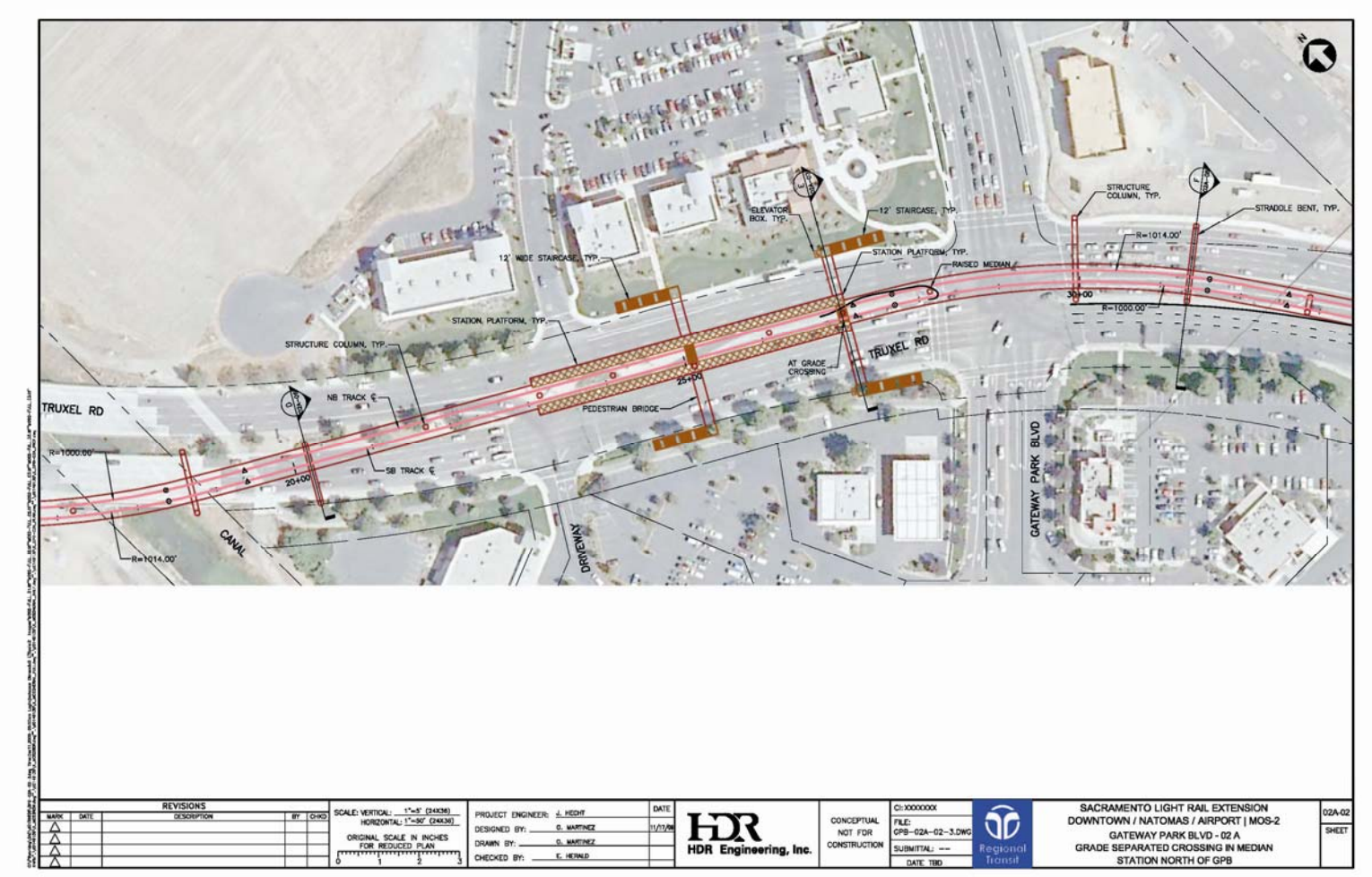


Figure 16: Gateway Option 2B - Median, Over Intersection

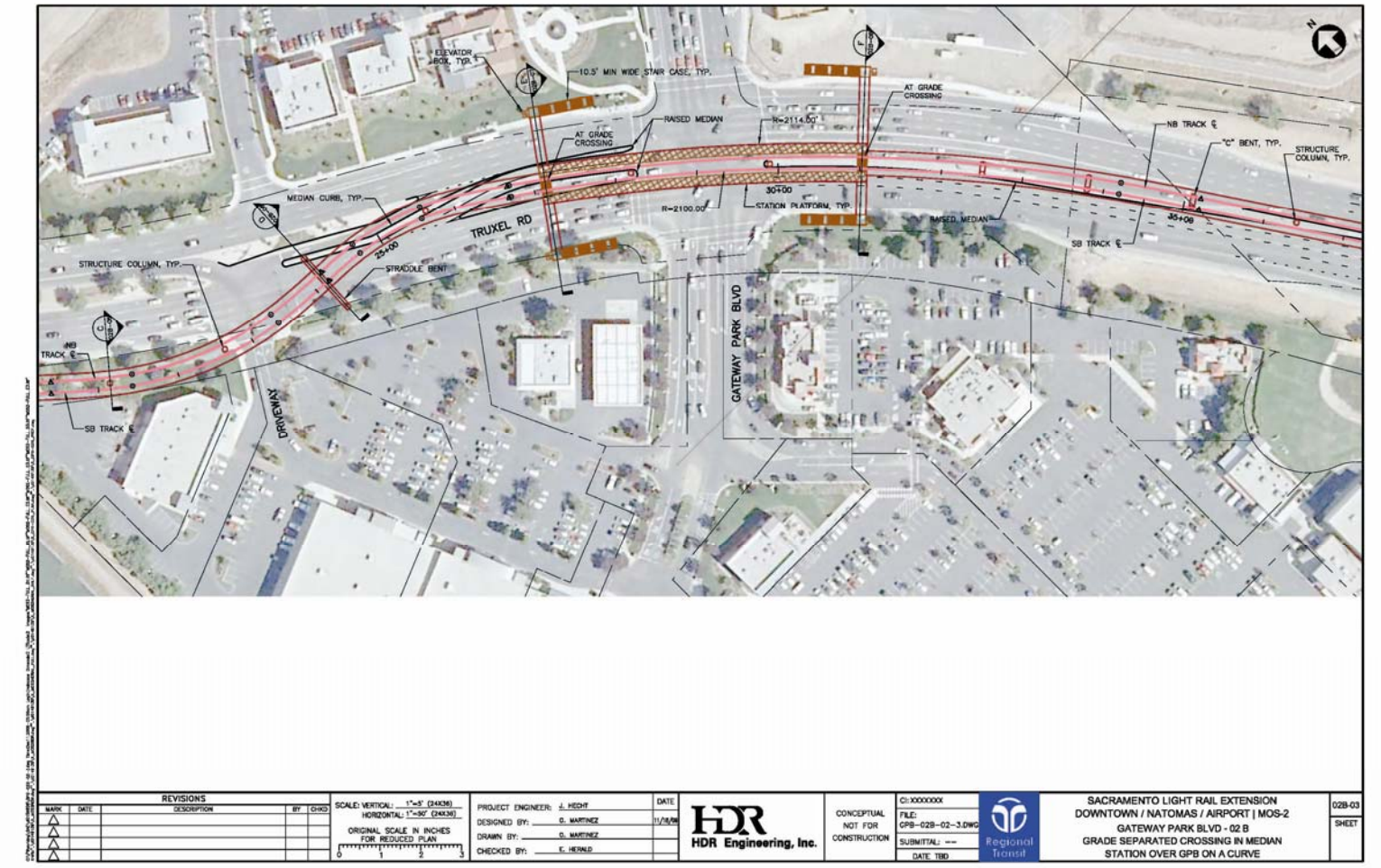


Figure 17: Gateway Option 3A - East Side, North of Intersection

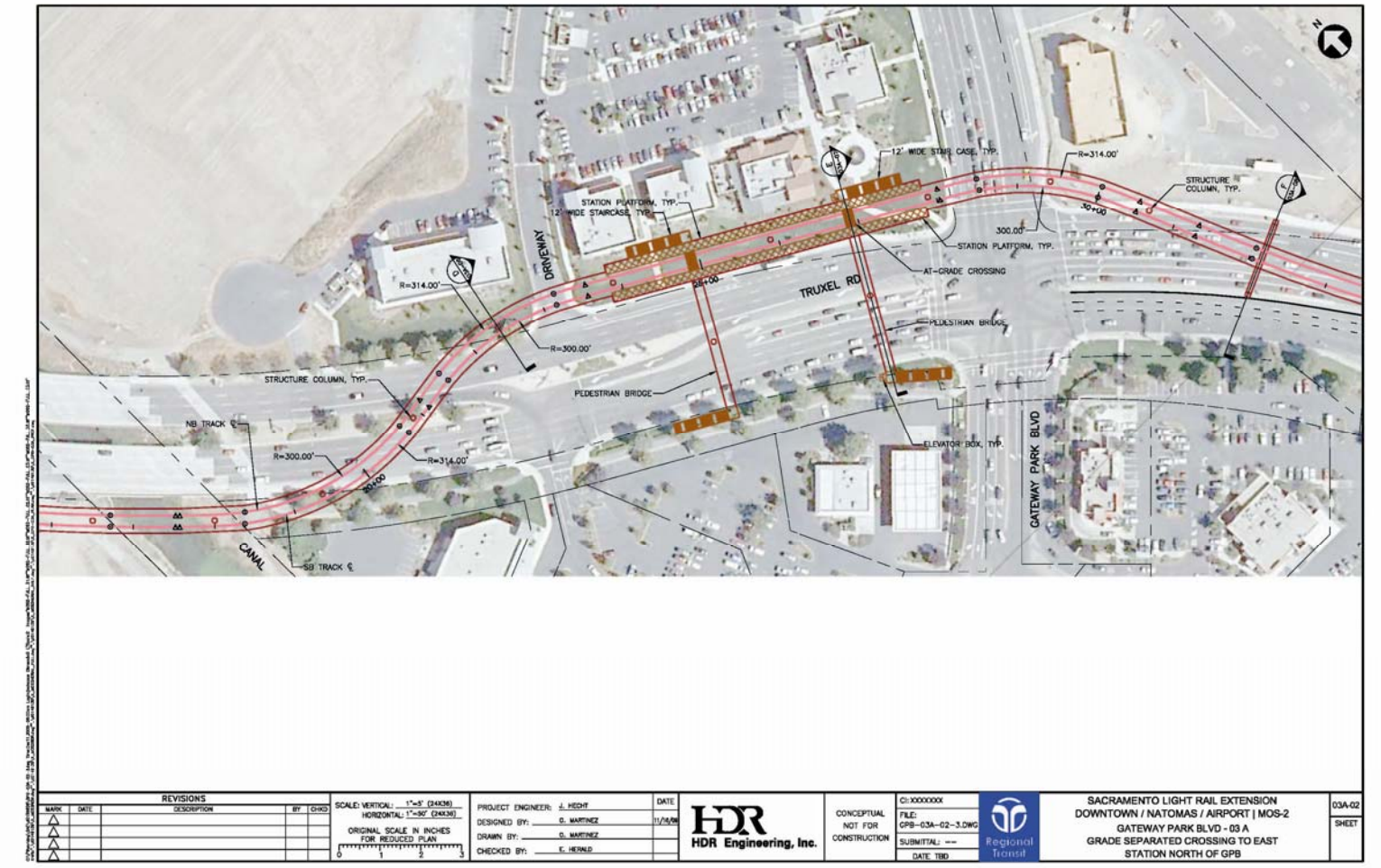
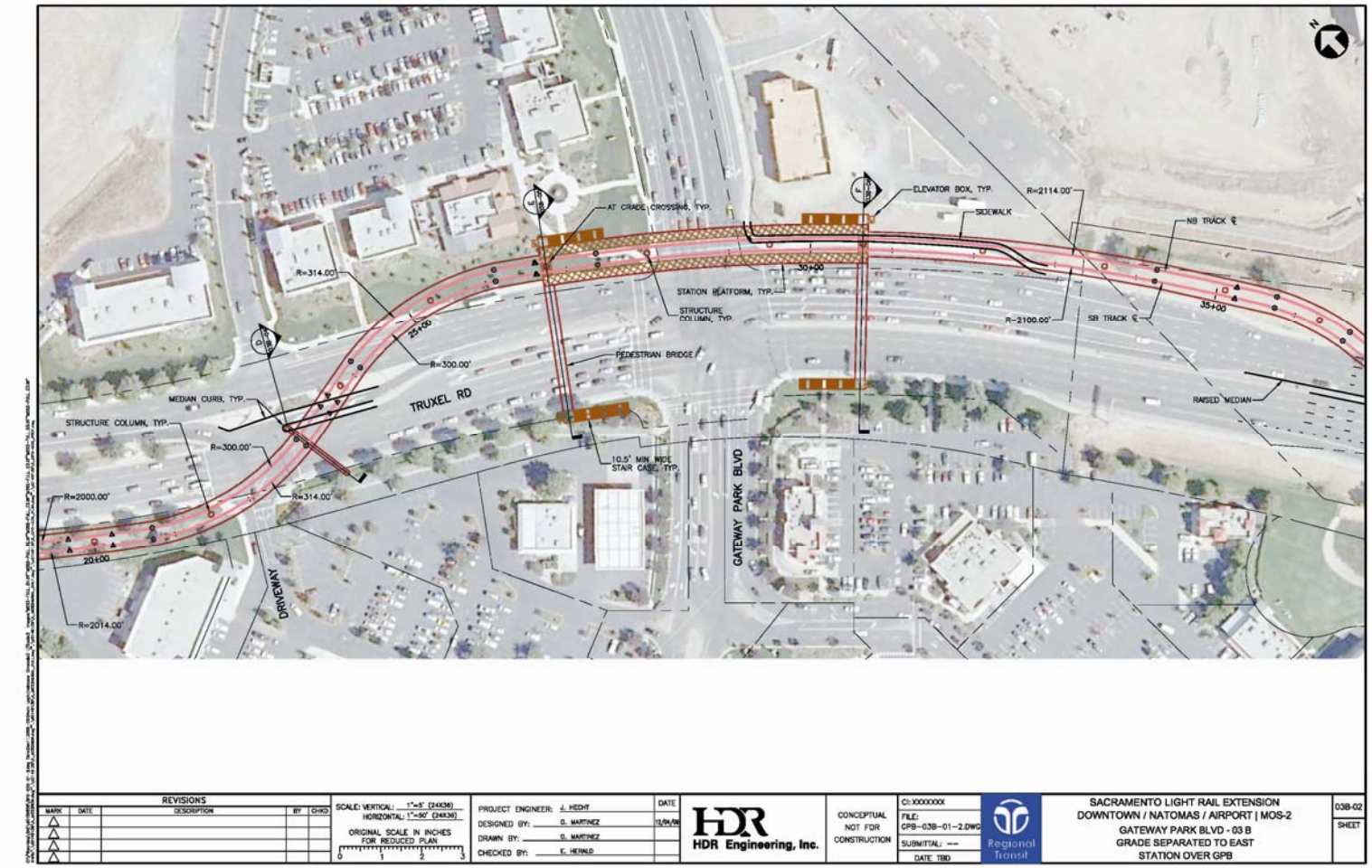


Figure 18: Gateway Option 3B - East Side, Over Intersection



The Gateway Park Boulevard LRT station options that use the west side (Options 1A and 1B) minimize the structure length and have the best track geometry by pulling to the inside of the curve. The LRT station options that are north of the intersection (Options 1A, 2A, and 3A) avoid a curved platform and provide better track geometry. Placing the LRT alignment and station over the intersection (Options 1B, 2B, and 3B) provides access to all four intersection quadrants and minimizes pedestrian crossings. The elevated LRT station options at Gateway Park Boulevard were presented at the Green Line Community Review meetings, however no recommendation was made.

Overall, significant costs savings were obtained with a design that takes advantage of the existing Truxel Road Bridge over I-80. Feasibility, traffic operations, and LRT operations are significantly improved by this option which accommodates exclusive LRT tracks in the median of the bridge by shifting traffic lanes out and widening the existing bridge. These cost savings were put back into the project to elevate the tracks over Gateway Park Boulevard. An elevated platform at this location and an elevated pedestrian bridge across Truxel Road eliminates significant conflicts between trains, pedestrians, and the very high traffic volumes at this intersection.

4.0 STATION AND PARKING REFINEMENT

The Transitional Analysis includes a refinement of the Green Line LRT stations and park-and-ride locations to optimize the project and identify the most cost effective project.

4.1 Stations

There are 14 stations under consideration for the Green Line: Sequoia Pacific, West El Camino, Pebblestone, San Juan, Gateway Park, Arena Boulevard, Arco Arena, East Town Center, North Natomas Town Center, Commerce Parkway, Club Center Drive, Greenbriar, Metro Air Park and Sacramento International Airport. A wide range of scenarios were tested to see if deferring a station(s) may enhance the performance of the Build Alternative. Optimization focused on the relationship between changes in ridership and changes to travel times. The results of this analysis lead to deferring of three stations: Arena Boulevard, East Town Center, and East Commerce Station. These stations had low ridership; only 710, 510, and 350 daily boardings respectively. Each of these stations was only 0.4 mile away from the next station, much closer than RT's Transit Station Spacing Criteria of one-mile in a suburban area. Travel model runs without these stations indicated that most users simply shifted to the next station. By deferring these three stations, LRT travel times from Downtown to the Airport improved by over two minutes, thereby improving the Transit System User Benefit (TSUB) by about 3%. During the Community Review Workshops in August 2010, it was confirmed that these three stations were seen to have the lowest utility of the stations being considered.

4.2 Parking

Parking supply in South Natomas was kept the same as it was in the Program EIR based on prior community concerns that additional parking supply might attract drivers from outside of South Natomas. It is assumed that parking in South Natomas will be provided in three different ways. First, the City of Sacramento would expand their parking lot at the South Natomas Community Center by 140 spaces and make those available for park-and-ride use. Second, RT would solicit proposals from the owners of the shopping centers near West El Camino and San Juan Road that in exchange for what it would cost to build structured parking, RT would contribute that sum toward the redevelopment of the shopping center and use of the necessary parking spaces. Third, RT would either be able to make use of the two acre parcel that they own on the west side of Truxel north of San Juan Road with the approval of a new traffic signal at Mammoth Street, or RT would be able enter into an agreement to lease excess surface parking from one of the shopping centers.

Park-and-ride catchment areas in the transportation demand model were indicating the need to expand beyond the 725 parking spaces being provided by the developers at Gateway Park, and it was previously assumed that there would be a need for a parking structure at Gateway Park. When these catchment areas were taken away, it showed there was strong demand for park-and-rides in North Natomas, and in areas other than Gateway Park. It was demonstrated through multiple runs of the model that the park-and ride demand would go to where the parking was being supplied. The location of the parking did not have a significant affect on demand. It was determined that beyond the 725 parking spaces at Gateway Park, there was a demand of 1,000 parking spaces in North Natomas, 215 spaces more than were previously planned.

For the purposes of the cost estimate, it was assumed that it will be possible to have an agreement with Arco Arena for the use of 500 spaces during non-event periods. Events normally occur outside of the typical 8am-5pm weekday work schedule associated with the primary users of the park-and-ride lot. When Arco Arena is charging for parking, persons wishing to park-and-ride will have the choice of paying for parking, or going to an alternative park-and-ride location. The other 500 spaces are assumed to be located at North Natomas Town Center. The cost estimate includes the construction cost of the parking lot, but assumes that it will be possible to have an agreement with the City for shared used parking either at the Regional Park or the future Town Center site. Other alternatives to meet the parking requirements would be an agreement with the Natomas School District or American River College for use of what may be surplus parking. During the course of the study, meetings were held with the City, Arco Arena, the Natomas School District, and American River College to begin to discuss these options.

5.0 CAPITAL COSTS

The Transitional Analysis includes a refinement of the Green Line LRT capital costs to optimize the project and identify the most cost effective project. This section describes the methodology, assumptions, and cost estimates developed for the Green Line.

5.1 Assumptions

Capital cost estimates were developed based on the following alternatives:

Baseline/TSM Alternative: Includes articulated bus service that parallels the Green Line LPA and serves the same stations between Downtown and Sacramento International Airport. However, the articulated bus service uses I-5 between Downtown and South Natomas because the Baseline Alternative does not include the American River Bridge.

Build Alternatives: Capital cost estimates have been prepared for the 5 Build Alternative LRT options with the following terminus station options:

- Airport
- Airport Express
- Club Center Drive
- North Natomas Town Center
- Gateway Park

5.2 Methodology

The capital cost methodology includes two steps. The first is a cost estimate developed as a general contractor's bid for a fully designed project, while the second is the input of this information into the FTA Standard Cost Category (SCC) workbooks.

The contractor's bid cost estimate for the Green Line includes the portion of the project that will be new construction. The FTA SCC workbook cost estimate includes the Green Line to the River District, which is currently under construction. The final bid estimate for the Green Line to the River District (Stacy and Witbeck 08-07-2009) was added to the SCC cost estimate for the purpose of comparing the capital costs, O&M costs, ridership, and user benefits of the entire Green Line under FTA guidelines.

Contractor's Bid Cost Estimate

A construction cost estimate was developed as a general contractor's bid for a fully designed project with construction oversight by the contracting agency. Costs are in Q2 2010 dollars. This is an Opinion of the Probable Construction Cost for the design developed to date, and includes additional assumptions made in support of planning for various terminus station options. The assumptions pertain to the development of the general contractor's bid. Contingencies, soft costs, and escalation were added to the construction cost estimate as it was entered into the FTA SCC workbook. The methodology used in the process of populating the SCC workbooks for the various terminus station options are explained in the next section.

Much of the civil and trackwork estimate was developed using a cost-based estimate method and did not rely on historical unit costs or available cost data bases. This was developed on quantity take-offs for bid Items typical for this work. For these items of work, contractor's cost was estimated for labor, equipment, permanent materials, and the expendable materials required for constructing such. There are work items such as bridges in which the only quantity is the square footage area of the bridge deck and unit costs were established from similar previous work with a breakdown into labor, equipment and materials. Specialty work such as communications and electrical was developed from unit cost history on similar work. Once the cost was determined for all items of work, there was an add-on for contractor's site specific field overhead and a subjective fee including profit and home office general and administrative costs. HCSS (Heavy Construction Systems Specialists, Inc.) software was used in estimating the work, which is preferred software of many highway-transit-heavy contractors in this country.

Craft wage rates are typically from local Davis-Bacon determinations with subjective adjustments for project conditions. Equipment rates are adjusted Blue Book, local equipment vendor and/or best source. Materials and subcontracted items are from recent quotes, data bases such as RS Means, or in some cases quotations from suppliers or subcontractors. Crew development, equipment choice and productivity for items typically self performed are from the estimator's cost history, development of such using resources such as the Caterpillar Handbook or other best sources.

The following describes the methodology used in developing quantities and costs for general categories of work in the full build cost estimate. It should be noted that any specific costs mentioned in this section are for full Build Alternative to the Airport and excludes the Green Line to the River District.

Mobilization

As this is an estimate to determine an Opinion of Probable Construction Cost, a percentage of the estimate for mobilization was not included. There will be actual mobilization cost and such included in the field overhead or other subcontracts. If this were to be taken to a bid level estimate a cost could be allocated to a mobilization item and with the allocation lowering the other bid item costs.

Environmental Controls

Costs are included for work such as silt fence and protection on in place utility systems. As this is a typically flat area it is assumed that controls will not be extensive.

Maintenance of Traffic

It is assumed there will need to be traffic controls especially in the roadway areas closer to Downtown.

Grading and Removables

The majority of the trackway was figured as grass track (49,000 LF of the 60,000 LF total). As this area is level, this work was figured to balance with without major cuts and fills. Grading was included at 2CY/LF and utilized both truck and small scraper to move from cuts to fills. In addition, 6 inches of topsoil was removed to stockpile near the site. There are 3 bridge structures (Gateway, SR-99, and Airport), where the approach fills to the bridges are contained with MSE wall construction. Areas of embedded slab include removal of the existing paved street and grading in this area for the new double track. Other removal included utilities, curbs and sidewalk. Quantities for these were based on best judgment as the details are not available at this level of planning.

Landscaping

A landscaping allowance of $50,000 per station, $404,000 for residential, and 42 acres of seeding at $3,000 per acre is included. Other aesthetics enhancements are unknown at this time and allowances for such are not included in this estimate.

Pavement Replacement

A quantity of 28,440 SY of pavement replacement consisting of grade preparation, aggregate base and asphalt paving is included in the estimate. This is based on paving a width of 6 feet for the length of curb replacement. The cost for this is $1,204,000. Included are the cost of sidewalk and curb and gutter

replacement for areas where the existing was removed to facilitate construction. Quantities are based on best judgment for the areas shown on the alignment.

Fencing

Two fencing items are included in this estimate. There is 4,550 LF of privacy fencing for residential property abutting the line. This will be aesthetically acceptable masonry in the range of 6 feet high. Also there is 58,240 LF of 36 inch steel picket fence for track separation. This totals $1,800,000 and is an area where further design may result in cost savings.

Bridges

There are six identified bridge structures with costs in this estimate. The two major cost bridges are the structures over the American River and Gateway Park Boulevard. The bridge over the American River has a direct cost of $24,610,000 and includes costs to go over the river and the adjacent environmentally sensitive area. The Gateway Park Bridge will include an elevated station. The bridge is of adequate width to enable station construction and the cost of the station is included in station costs. At this level of design the bridge structure type and other features are unknown and the cost included is the cost of deck area from other developed estimates and history.

Trackwork

Prior to adjustments made to take advantage of areas that could be single-tracked, the mainline track consisted of 120,436 TF or 60,218 RF of 115lb rail. This includes 14,244 TF of rail on plinth for the direct fixation on bridges, 8,240 TF of embedded rail in the street areas, and 97,952 TF of grass track for the remainder of the line. Within this line are four single crossovers and three double crossovers. There is also an additional single track line to a maintenance facility whose location is to be determined. Grass track is supported on concrete ties and includes rail boots on the track. Embedded track is designed as rigid pavement and also has rail boots.

Traction Electrification System/Overhead Catenary

The cost for this system includes a substation approximately every mile for a total of 12. Also included are the feeders from the stations to the track system. Each substation will be an aesthetically pleasing precast unit with associated civil works. The cost of the overhead catenary system was estimated from a take off of the system assuming double track center poles spaced every 130 FT with simple catenaries for each track. As the design stage has not developed the details for such costs were included for these quantities from previous history.

Signals

This cost includes train signals for the stations and crossovers and additional wayside line cost. Quantities are for those items for the contract length and provided facilities. Costs for the individual units are historical from other similar projects. The direct cost of this is $27,300,000 and as design progresses the cost of signals can be further refined. This estimate includes 13 gated crossings and 18 modifications to existing traffic signals. The 13 gated crossings are: Natomas Crossing Drive, Prosper Road, Arena Boulevard, Arco Arena East Entrance, Del Paso Road, New Market Drive, 2 gates for the traffic circle on New Market Drive, Kokomo Drive and New Market Drive, and 4 gates at East Commerce Way and Club Center Drive.

Maintenance Facility

A subcontract cost of $29 million is in the estimate for this facility. This price takes into account that this will be RT's second LRT maintenance facility and it will not be necessary to duplicate every expensive piece of equipment at this location. This amount is from previous projects for such facilities and is in the cost range of a several bay facility with management offices, full maintenance equipment, and the track and turn-outs for entry and exit. Further design could lower this cost if a less extensive facility is desired.

Stations

The full Build Alternative includes 11 Stations, including side or center platforms, elevated on bridge at Gateway and both side and center at the Airport. Each station includes concrete platforms, steel frames and canopies, security, electrical, mechanical and basic architectural items. The elevated station includes stairways and elevators for access. Stations are open air without restrooms. Stations will all have smart-card compatible fare collection equipment.

Utility Relocation

The estimate for utility relocations figured to be included within the construction contract is $11 million which is an allowance figured as 4% of the project cost excluding profit. At this level of planning, the scope of relocations has not been developed and this may be a conservative allowance as much of the project is a previously undeveloped right-of-way reserved for this LRT project which may have minimal or no utilities. Not included are any major utility relocations which are the responsibility of the owner. Further design will develop the scope and the potential of a lesser cost.

Start-Up and Testing

Within the estimate are directs costs of 2% of the total system amount plus an additional 9 personnel months of general contractor engineering. This is a cost range and will vary by contractor.

SCC Workbook Cost Estimate

The purpose of this section is to provide detail on the cost estimate by SCC category. As described early, the contractor's bid cost estimate excludes the Green Line to the River District, but that segment is being included in the SCC workbook cost estimate. This section provides detail and clarifications to the contractor's bid cost estimate in order to follow the categories of the SCC workbook. Variations that exist between the options are described where necessary. Items left unaddressed either have not been changed from the contractor's bid cost estimate and/or remain self explanatory based on description, cost, and quantities included in the documentation developed as back-up to the SCC workbooks.

It should be noted there was no specific cost estimate developed for North Natomas Town Center or the Airport Express options. Cost estimates for these options were derived from changes made to quantities assumed based on percentages of the overall project. For example, certain elements may have been calculated as a percentage of the overall project to the Airport, Club Center, or Gateway Park options. There may also be slight changes to unit costs between the options based on various factors included in the software program(s) utilized to develop the base estimates. Considering this, some unit costs are generalized or based on averages of other estimates.

The SCC workbook methodology is included in the following table.

Table 5: SCC Workbook Methodology

No.	Methodology
10	**Guideway & Track Elements** Cost estimate assumes 10.05 miles of at grade double and single track semi-exclusive guideway. Also assumes 1.36 miles of guideway on aerial structure for the American River Bridge with single track, sidewalk(s) and bike lanes, bridge and elevated structure between I-80 and just past the Gateway Park station (not including the actual elevated station), and small bridges in the Airport area. Assumes grass or embedded track on the majority of the system and direct fixation track on elevated structures. Small bridges in Airport area were not included for Club Center, North Natomas Town Center, and Gateway Park options. Additional 1.27 miles of guideway is assumed for the Green Line to the River District, but has been estimated using actual bid amounts because the project is already under construction.
10.10	All track other than grass track, or track on a plinth (direct fixation) is assumed to be embedded.
10.11	Grass track is assumed to be ballasted track covered with grass. Single track segments are included in this category with the exception of direct fixation track on the American River Bridge.
20	**Stations, Stops, Terminals, Intermodal**
20.01	Assumes 10 at-grade stations, with the Airport Station planned to include both center and side platforms. Also included in the estimate but not counted in the number of stations is the amount to be spent for stations in the Green Line to the River District. Platforms are 400 feet long and include accommodation for modest custom or kit-of-parts stations. Platforms will provide level-boarding access for low floor vehicles, and individual “mini-high” accessible platforms as needed. Includes full construction costs for stations from below ground to above ground. Center platform stations: West El Camino Avenue, Pebblestone, San Juan Road, North Natomas Town Center, Greenbriar, Metro Air Park, and Sacramento International Airport. Side platform Stations: Sequoia Pacific, Arco Arena, Club Center Drive, and Sacramento International Airport
20.02	All options include an elevated station at Gateway Park and include 2 stairways, 2 elevators, and pedestrian bridge and station entrance across Truxel Road.
30	**Support Facilities**
30.01	All options assume use of existing Administration building by staff.

Table 6: SCC Workbook Methodology

No.	Methodology
30.03	Heavy Maintenance facility: The Airport and Airport Express options assume a heavy maintenance facility plus equipment and yard. Assumes 600,000 sq. ft. total (15.15 acres) with 525,000 sq. ft. yard and approach track, access, etc; 135,000 sq. ft. maintenance facility for up to 50 vehicles. The cost is 29 million total. $1.96 million for cost of vacant rural land adjacent to the north end of the corridor is included in 60.01. Property values could change dramatically if market conditions improve given the land area contemplated for the facility lies within a proposed commercial/light industrial center. Estimate was developed mainly based on comparables (from $26 million to $68 million), but using the low end of the scale given this will be RT's second maintenance facility, and they would not need to duplicate every everything.
30.05	Yard and yard track: For all options other than Airport options. Assumes access and yard track for storage and light maintenance, such as interior cleaning of vehicles. The yard may include modest temporary facilities such as portable buildings or trailers for employee break rooms and supplies. The following area requirements have been assumed: Club Center option (4 acres), North Natomas Town Center and Gateway Park options (2 acres). Land costs included in 60.01.
40	**Site Work & Special Conditions**
40.03	Includes amount for the Green Line to the River District only and on all options.
40.05	A decorative masonry privacy fence in South Natomas is included.
40.07	Parking lots – For all options assume cost for surface parking at $4,500 per space. The cost for El Camino assumes half of the parking will be structured parking and half surface parking for a combined cost of approximately $10,500/space. No purchase of property has been assumed for any parking options. Parking by station: North Natomas Town Center (500 spaces but excluded in Gateway Park option, San Juan Road (200 spaces), and West El Camino Avenue (410 spaces).
50	**Systems**
50.03	Traction power supply: For all options, estimate assumes Traction Power Substations (TPSS) will be on public land at no cost to the project. Substations would be built in masonry buildings to fit better in the community and significantly reduce their footprint. Assumed 12 total to Airport, 7 to Club Center, 5 to North Natomas, and 4 to Gateway Park.
50.04	Traction power distribution: For all options, OCS assumes tapered, painted poles.
50.06	Fare collection: For all options, the cost per station is estimated at $200,000 based on conversations with RT regarding expected number TVMs per station (2). Cost of existing TVMs is $50,000 but it is unknown whether smart card readers will be included, so an allowance of an additional $50,000 per TVM was assumed.
50.07	Central Control: For all options, $1 million was added for expansion to the facility and was not adjusted per option because it is assumed scale of the facility would not change.

Table 6: SCC Workbook Methodology

No.	Methodology
60	**ROW, Land, Existing Improvements**
60.01	Purchase or lease of real estate: Property acquisition for Airport options that include the heavy maintenance facility consists of vacant rural land near Airport. For all other options, vacant suburban land will be purchased for yard and storage areas. Some properties that have been considered are City-owned, and there may be opportunity to avoid property acquisition costs.
70	**Vehicles**
70.01	LRT: Estimate includes low floor European tram-style 30 meter vehicles at $4 million each with a 10% discount by going to fewer 40 meter vehicles. A 10% allocated contingency assumed.  *Example of a European Tram. Source: Citadis.*
70.07	Spare parts: 10% of the total vehicle cost for spare parts.
80	**Professional Services** For all options the following percentages from total base year dollars, including allocated contingency, have been assumed:
80.01	Preliminary engineering: 5%
80.02	Final Design: 10%
80.03	Project management for design and construction: 7%
80.04	Construction administration and management: 9%
80.05	Professional liability and other non-construction insurance: 0% (assumed in other categories). $565,000 added that was part of bid for the Green Line to the River District. No allocated contingency added.
80.06	Legal; permits; review fees by other agencies, cities, etc.: 1%
80.07	Surveys, testing, investigation, inspection: 1%
80.08	Start up: 2%

5.3 Capital Cost Estimates

This section provides the capital cost estimate for the Baseline/TSM Alternative and the 5 Build Alternative LRT options being evaluated in the Transitional Analysis:

- Option 1 - Airport
- Option 1A - Airport Express
- Option 2 - Club Center
- Option 3 - Gateway Park
- Option 4 - North Natomas Town Center

The capital cost estimate includes the capital cost in base year dollars (2010) and year of expenditure dollars (YOE), as well as an annualized capital cost and cost per mile. Capital costs include the combined capital cost for the Green Line to the River District and the Build Alternative LRT options.

The following table provides the capital cost estimate for the Baseline/TSM Alternative and the 5 Build Alternative LRT options. The SCC worksheets are included in Appendix C.

Table 6: Capital Cost Estimate

	Baseline/ TSM	Airport	Airport Express	Club Center	Gateway	North Natomas
Capital Cost (2010)	$85,089,000	$756,426,000	$785,099,000	$561,457,000	$390,537,000	$495,712,000
Capital Cost (YOE)	NA	$894,777,000	$928,560,000	$661,199,000	$457,418,000	$582,896,000
Annualized	$8,518,000	$56,917,000	$59,907,000	$42,837,000	$29,709,000	$37,810,000
Cost Per Mile (2010)	$5,828,014	$59,843,829	$62,112,263	$71,160,583	$85,832,308	$74,880,967

Note: Includes capital cost for the Green Line to the River District.

6.0 OPERATIONS AND MAINTENANCE

The Transitional Analysis includes a refinement of the Green Line LRT operating and maintenance costs to optimize the project and identify the most cost effective project.

6.1 Assumptions

Operating plans were developed based on the following alternatives:

No-Build Alternative: Includes current Blue Line operations, Gold Line operations from Folsom to Sacramento Valley Station, and Green Line operations from 13th Street and R Street to Sacramento Valley Station. The Green Line will use the existing 7th and 8th Street alignments and new track on 7th Street north of the Sacramento Valley Station to 7th Street and Richards.

Baseline/TSM Alternative: Includes the No-Build alternative plus an articulated bus service that parallels the Green Line LPA and serves the same stations between Downtown and Sacramento International Airport. However, the articulated bus service uses I-5 between Downtown and South Natomas because the Baseline Alternative does not include the American River Bridge.

Build Alternatives: Five build alternatives have been analyzed in detail based on operations of an independent Green Line with the following terminus station options:

- Airport
- Airport (with express service)
- Club Center Drive (with articulated bus service to Airport)
- North Natomas Town Center (with articulated bus service to Airport)
- Gateway Park (with articulated bus service to Airport)

General operating assumptions and plans for each of the Green Line alternatives reflect estimated service levels. These assumptions include: span of service, vehicle capacity/loading standards, vehicle performance, and station dwell times. The operating plans include station-to-station run time estimates and operating requirements for each alternative. Operating assumptions and plans have been developed to remain consistent with RT's current LRT Design Criteria Manual.

Span of Service

The span of service for the proposed Green Line alternatives will be comparable to the weekday, Saturday and Sunday and holiday schedules for current RT Gold and Blue Line schedules, respectively. The following table summarizes the assumed span of service.

Table 7: Span of Service

Day of Week	Annual Days	Time Period	Hours
Monday-Friday	254	Early AM	5:00 a.m. – 6:00 a.m.
		AM Peak	6:00 a.m. – 9:00 a.m.
		Midday	9:00 a.m. – 3:30 p.m.
		PM Peak	3:30 p.m. – 7:00 p.m.
		Evening	7:00 p.m. – 10:30 p.m.
Saturday	52	All Day	5:00 a.m. – 10:30 p.m.
Sunday & Holidays	59	All Day	5:00 a.m. – 10:30 p.m.

Service Frequency

The following table summarizes the assumed service frequency for LRT and articulated bus service.

Table 8: Service Frequency

Day of Week	Time Period	Frequency
Monday-Friday	Early AM	15 minutes
	AM Peak	15 minutes
	Midday	15 minutes
	PM Peak	15 minutes
	Evening	30 minutes
Saturday	All Day	30 minutes
Sunday & Holidays	All Day	30 minutes

Vehicle Capacity and Passenger Load Standards

Vehicle capacity and passenger loading standards have been established in order to determine the service frequency and fleet requirements for each of the alternatives. The following table summarizes the assumed vehicle capacity (seats) and passenger loading standards.

Table 9: Vehicle Capacity and Peak Hour Passenger Loading Standards

Transit Mode	Seats	Load Standard	Total Capacity
LRT	76	175% of seats	133
Articulated Bus	41	158% of seats	65

The above load standards were used to determine the appropriate peak hour service frequency for the proposed alternatives. The projected AM or PM peak hour maximum line loads can be divided by the load standard (e.g., 76 * 1.75 = 133 for LRT) to determine the peak hour throughput required for that route. During off-peak hours, the load standard for all modes will be a maximum of 100% (i.e., no standees).

The train consist is based on projected ridership. The following table provides the train consist requirement based on peak hour passenger demand. Two-car trains are assumed during the weekday off-peak hours, late evening and Sunday service.

Table 10: Train Consist Requirement

	Green Line - Terminus Station			
	Airport	Club Center	North Natomas	Gateway Park
AM Peak 15 min Maximum Line Load	558	554	505	372
PHPD Pass/Car (175% of Seated)	133	133	133	133
Cars per Hour - Demand	16.8	16.7	15.2	11.2
Trains per Hour - Model	4	4	4	4
Cars per Train - Demand	4	4	4	3

Vehicle Performance

LRT vehicles are assumed to have a normal service maximum acceleration rate of about 2.5 miles per hour per second (mphps), with an average acceleration rate of 1.0 mphps from 0 to 65 mph. Normal service braking is assumed to be a constant 2.5 mphps from 65 mph to 0 mph. LRT vehicles are assumed to have a maximum allowable speed of 55 mph. However, sections of the alignment will have speed restrictions due to horizontal and vertical curves and station spacing. Station-to-station LRT time estimates have been developed based on these criteria.

Average Station Dwell Times

The average station dwell time (i.e., time to allow passengers to board and alight the transit vehicle) are assumed to be 20 seconds at all of the proposed Green Line stations. This average assumes that stations with higher ridership demand may require longer dwell times during operation, while low volume stations may require less dwell time.

End of Line Layovers

Transit operations plans will include time for end-of-line layovers. Layovers will provide sufficient time for drivers to take breaks as required by union agreement as well as provide for schedule recovery (i.e., a late bus or train can "catch up" to its schedule). Operations plans will include layovers at least 14% of estimated run time at the end-of-line station in order to maintain the scheduled cycle times.

Average Intersection Delay

No intersection delay will be incurred for operations for the at-grade alignment since a high level of signal priority will be provided. LRT operations will require a speed restriction of 35 mph when crossing signalized intersections.

Spare Ratio

The spare ratio is the percentage of extra vehicles in a fleet, over and above the number actually required to provide scheduled peak period service. A 20% spare ratio is assumed for the vehicle fleet for each alternative.

Deadhead Ratio

Transit system operations include non-revenue travel to and from maintenance facilities, such as rail yards and bus garages prior to and after revenue service. The deadhead ratio is based on the revenue hours and miles compared to the total hours and miles and will vary based on the location of the maintenance facility. Below are deadhead ratio assumptions used for the alternative based on 2008 National Transit Database (NTD) data for existing RT LRT service.

- 3% of Annual Revenue Miles
- 4% of Annual Revenue Hours

These assumptions are used as preliminary estimates of deadhead miles and hours and will be refined once specific maintenance facility locations are identified, typically near an end-of-line station.

6.2 Operating Plans

Operating plans were developed for all of the alternatives. Station-to-station train running times were calculated with a computer simulation model developed by HDR. The model was calibrated based on performance characteristics comparable of RT's current fleet of LRVs. Inputs to the run time model for these alternatives include speed restrictions for operations (mixed traffic, exclusive right-of-way and aerial alignments), horizontal curves, distances between stations, dwell times, and vehicle performance characteristics (acceleration and deceleration rates and maximum operating speeds).

Run Time Estimates

Detailed station-to-station run time estimate for the Green Line to the Airport for local and express service are included in Appendix D.

Operating Characteristics

The following tables provide detailed operating statistics and a summary of operating characteristics for each alternative. These tables are based on O&M costs for FY 2010.

Table 11: LRT Operating Characteristics (No Build and Baseline/TSM Alternatives)

Route	From	To	Run Time (min)	Distance (Miles)	Day	---Headway--- Peak	Base	Eve.	---Train Consist--- Peak	Base	Eve.	Peak Cars	-----Annual Revenue----- Car-Miles	Car-Hours	Train-Hours	Lay Over	Cycle Time	---Trains--- Peak	Base	Eve.
Green Line	13th & R	7th & Richards	12.0	2.4	M-F	15.0	15.0	30.0	2	2	2	4	151,100	16,000	8,000	3.1	30.0	2	2	1
					Sat	30.0	30.0	30.0	2	2	2		17,200	1,820	910			1	1	1
					Sun	30.0	30.0	30.0	2	2	2		19,500	2,070	1,030			1	1	1
ESTIMATED TOTALS:												4	187,800	19,890	9,940			2	2	1
NON-REVENUE/DEADHEAD:													5,600	800	400					
SPARE CARS:												1								
TOTAL CARS:												5								

Table 12: Articulated Bus Operating Characteristics (Baseline/TSM Alternative)

Route	From	To	Run Time (min)	Distance (Miles)	Day	---Headway--- Peak	Base	Eve.	---Bus Platoon--- Peak	Base	Eve.	Peak Buses	-----Annual Revenue----- Bus-Miles	Bus-Hours	Lay Over	Cycle Time	---Buses--- Peak	Base	Eve.
Green Line	13th & R	Airport	86.6	13.6	M-F	15.0	15.0	30.0	1	1	1	14	435,600	56,010	18.5	210.0	14	14	7
Articulated Bus					Sat	30.0	30.0	30.0	1	1	1		49,500	6,370			7	7	7
					Sun	30.0	30.0	30.0	1	1	1		56,200	7,230			7	7	7
ESTIMATED TOTALS:												14	541,300	69,610			14	14	7
NON-REVENUE/DEADHEAD:													16,000	2,800					
SPARE CARS:												3							
TOTAL CARS:												17							

Table 13: LRT Operating Characteristics (Build Alternative Airport)

Route	From	To	Run Time (min)	Distance (Miles)	Day	---Headway--- Peak	Base	Eve.	---Train Consist--- Peak	Base	Eve.	Peak Cars	-----Annual Revenue----- Car-Miles	Car-Hours	Train-Hours	Lay Over	Cycle Time	---Trains--- Peak	Base	Eve.
Green Line	13th & R	Airport	39.2	13.6	M-F	15.0	15.0	30.0	4	2	2	24	1,286,000	70,870	24,000	5.8	90.0	6	6	3
					Sat	30.0	30.0	30.0	2	2	2		99,100	5,460	2,730			3	3	3
					Sun	30.0	30.0	30.0	2	2	2		112,400	6,200	3,100			3	3	3
ESTIMATED TOTALS:												24	1,497,500	82,530	29,830			6	6	3
NON-REVENUE/DEADHEAD:													44,300	3,300	1,200					
SPARE CARS:												5								
TOTAL CARS:												29								

Table 14: LRT Operating Characteristics (Build Alternative Airport Express)

Route	From	To	Run Time (min)	Distance (Miles)	Day	---Headway--- Peak	Base	Eve.	---Train Consist--- Peak	Base	Eve.	Peak Cars	-----Annual Revenue----- Car-Miles	Car-Hours	Train-Hours	Lay Over	Cycle Time	---Trains--- Peak	Base	Eve.
Green Line	13th & R	Airport	39.2	13.6	M-F	15.0	15.0	30.0	3	2	2	18	1,078,600	59,440	24,000	5.8	90.0	6	6	3
Express Alt.					Sat	30.0	30.0	30.0	2	2	2		99,100	5,460	2,730			3	3	3
Local Serivce					Sun	30.0	30.0	30.0	2	2	2		112,400	6,200	3,100			3	3	3
ESTIMATED TOTALS:												18	1,290,100	71,100	29,830			6	6	3
NON-REVENUE/DEADHEAD:													38,100	2,900	1,200					
SPARE CARS:												4								
TOTAL CARS:												22								

Route	From	To	Run Time (min)	Distance (Miles)	Day	---Headway--- Peak	Base	Eve.	---Train Consist--- Peak	Base	Eve.	Peak Cars	-----Annual Revenue----- Car-Miles	Car-Hours	Train-Hours	Lay Over	Cycle Time	---Trains--- Peak	Base	Eve.
Green Line	13th & R	Airport	32.9	13.6	M-F	30.0	0.0	0.0	3	0	0	9	311,100	20,570	6,860	12.1	90.0	3	0	0
Express Alt.					Sat	0.0	0.0	0.0	0	0	0		0	0	0			0	0	0
Express Serivce					Sun	0.0	0.0	0.0	0	0	0		0	0	0			0	0	0
ESTIMATED TOTALS:												9	311,100	20,570	6,860			3	0	0
NON-REVENUE/DEADHEAD:													9,200	800	300					
SPARE CARS:												2								
TOTAL CARS:												11								

Table 15: LRT Operating Characteristics (Build Alternative Club Center)

Route	From	To	Run Time (min)	Distance (Miles)	Day	---Headway--- Peak	Base	Eve.	---Train Consist--- Peak	Base	Eve.	Peak Cars	-----Annual Revenue----- Car-Miles	Car-Hours	Train-Hours	Lay Over	Cycle Time	---Trains--- Peak	Base	Eve.
Green Line	13th & R	Club Center Drive	32.4	8.9	M-F	15.0	15.0	30.0	4	2	2	20	837,200	59,940	20,450	5.1	75.0	5	5	3
					Sat	30.0	30.0	30.0	2	2	2		64,500	5,460	2,730			3	3	3
					Sun	30.0	30.0	30.0	2	2	2		73,200	6,200	3,100			3	3	3
ESTIMATED TOTALS:												20	974,900	71,600	26,280			5	5	3
NON-REVENUE/DEADHEAD:													28,800	2,900	1,100					
SPARE CARS:												4								
TOTAL CARS:												24								

Table 16: LRT Operating Characteristics (Build Alternative North Natomas Town Center)

Route	From	To	Run Time (min)	Distance (Miles)	Day	---Headway--- Peak	Base	Eve.	---Train Consist--- Peak	Base	Eve.	Peak Cars	-----Annual Revenue----- Car-Miles	Car-Hours	Train-Hours	Lay Over	Cycle Time	---Trains--- Peak	Base	Eve.
Green Line	13th & R	North Natomas Town Center	26.9	7.6	M-F	15.0	15.0	30.0	4	2	2	16	717,200	47,240	16,000	3.1	60.0	4	4	2
					Sat	30.0	30.0	30.0	2	2	2		55,300	3,640	1,820			2	2	2
					Sun	30.0	30.0	30.0	2	2	2		62,700	4,130	2,070			2	2	2
ESTIMATED TOTALS:												16	835,200	55,010	19,890			4	4	2
NON-REVENUE/DEADHEAD:													24,700	2,200	800					
SPARE CARS:												3								
TOTAL CARS:												19								

Table 17: LRT Operating Characteristics (Build Alternative Gateway Park)

Route	From	To	Run Time (min)	Distance (Miles)	Day	---Headway--- Peak	Base	Eve.	---Train Consist--- Peak	Base	Eve.	Peak Cars	-----Annual Revenue----- Car-Miles	Car-Hours	Train-Hours	Lay Over	Cycle Time	---Trains--- Peak	Base	Eve.
Green Line	13th & R	Gateway Park	20.9	5.5	M-F	15.0	15.0	30.0	3	2	2	12	437,400	39,620	16,000	9.1	60.0	4	4	2
					Sat	30.0	30.0	30.0	2	2	2		40,200	3,640	1,820			2	2	2
					Sun	30.0	30.0	30.0	2	2	2		45,600	4,130	2,070			2	2	2
ESTIMATED TOTALS:												12	523,200	47,390	19,890			4	4	2
NON-REVENUE/DEADHEAD:													15,500	1,900	800					
SPARE CARS:												2								
TOTAL CARS:												14								

Table 18: Articulated Bus Operating Characteristics (Build Alternatives)

Route	From	To	Run Time (min)	Distance (Miles)	Day	---Headway--- Peak	Base	Eve.	---Bus Platoon--- Peak	Base	Eve.	Peak Buses	-----Annual Revenue----- Bus-Miles	Bus-Hours	Lay Over	Cycle Time	---Buses--- Peak	Base	Eve.
Green Line	Gateway Park	Airport	21.8	8.3	M-F	15.0	15.0	30.0	1	1	1	4	266,000	16,000	8.2	60.0	4	4	2
Articulated Bus					Sat	30.0	30.0	30.0	1	1	1		30,200	1,820			2	2	2
					Sun	30.0	30.0	30.0	1	1	1		34,300	2,070			2	2	2
ESTIMATED TOTALS:												4	330,500	19,890			4	4	2
NON-REVENUE/DEADHEAD:													9,800	800					
SPARE CARS:												1							
TOTAL CARS:												5							

*Articulated bus service not included with local and express service terminating at Airport

Table 19: Summary of Operating Characteristics

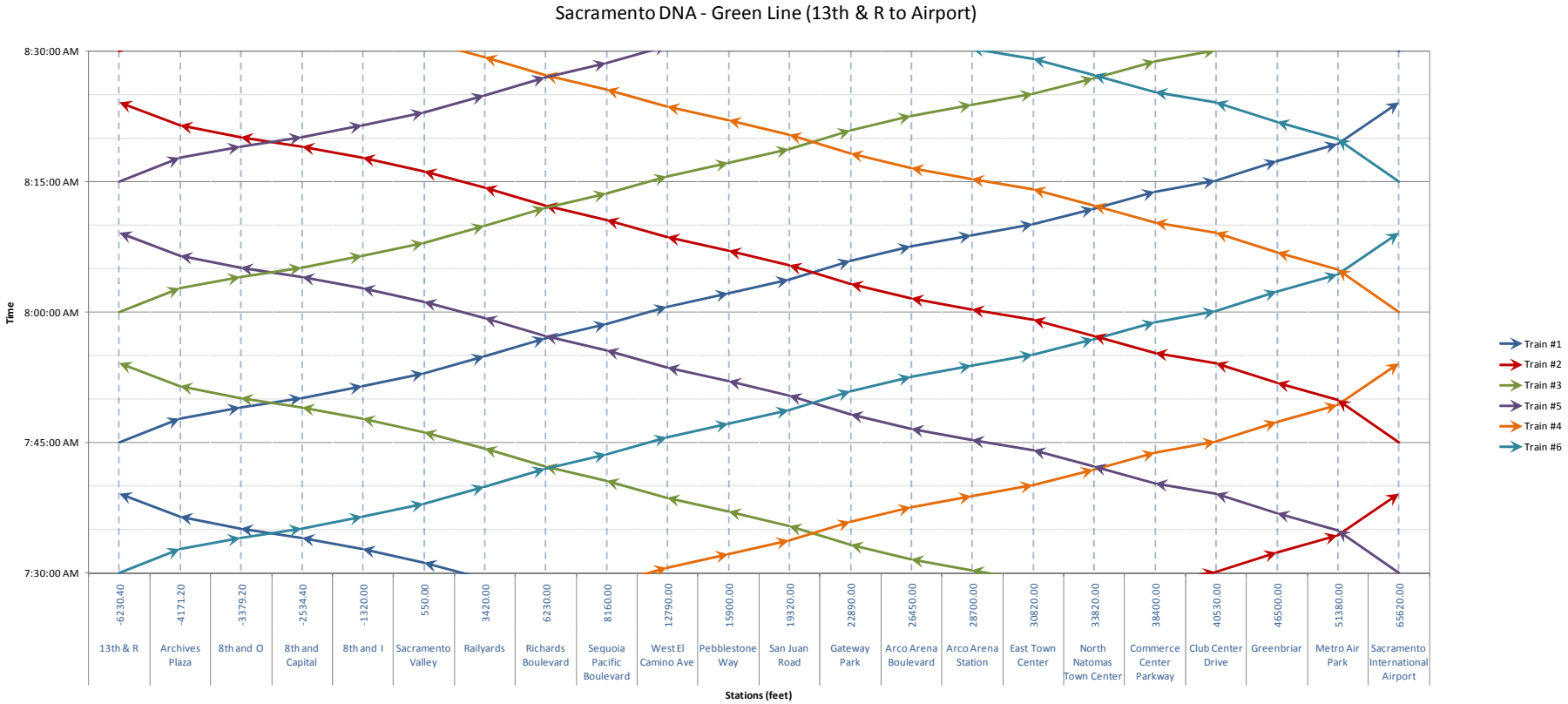
Input Measure	Green Line					
	No-Build Baseline/TSM*	Airport	Airport (Express)	Club Center	North Natomas	Gateway Park
LRT Operating Statistics – From 13th and R Streets						
One-Way Run Time (min)	12.0	39.2	39.2/32.9	32.4	26.9	20.9
Distance (miles)	2.4	13.6	13.6	8.9	7.6	5.5
Layover at Each End (min)	3.0	5.8	5.8/12.1	5.1	3.1	9.1
Cycle Time (min)	30.0	90.0	90.0	75.0	60.0	60.0
Peak Cars	4	24	27	20	16	12
Spares Cars	1	5	6	4	3	2
Total Fleet	5	29	33	24	19	14
Additional Cars Required	**n/a**	**24**	**28**	**19**	**14**	**9**
Articulated Bus Operating Statistics – Connection to the Airport						
One-Way Run Time (min)	86.6	n/a	n/a	21.8	21.8	21.8
Distance (miles)	13.6	n/a	n/a	8.3	8.3	8.3
Layover at Each End (min)	18.4	n/a	n/a	8.2	8.2	8.2
Cycle Time (min)	210.0	n/a	n/a	60.0	60.0	60.0
Peak Buses	14	n/a	n/a	4	4	4
Spares Buses	3	n/a	n/a	1	1	1
Total Fleet	17	n/a	n/a	5	5	5

*RT Articulated Bus Operating Statistics does not apply to No-Build Alternative

Single Track Analysis

A single track analysis was completed for the Green Line. Single-track sections require both directions of service to share a single track, usually to reduce construction costs or operate where right-of-way is limited. Single-track service may present operating and scheduling challenges that can reduce the capacity or frequency of service. In order to achieve the planned level of service, a single track analysis was conducted to determine, based on operating plans, locations where double track would be located to allow trains operating in opposing directions. Single track assumptions follow guidance from RT's track plan with single track segments designed for headways no shorter than 7.5 minutes and sections of double track at least a one mile in length to provide adequate distance for passing. The following is a string diagram that shows where trains meet during the peak service at 15 minute headways.

Figure 19: Single Track String Diagram



6.3 Operating and Maintenance Cost Estimates

This section describes the approach in developing the operating and maintenance (O&M) cost methodology to estimate O&M costs for each alternative.

Sacramento RT O&M Model Methodology

The O&M model that was used by RT for the South Line Phase 2 LRT extension project has been accepted by FTA. This Financial Forecasting Model has been applied to the Green Line project using a cost allocation methodology. This approach is appropriate given that RT can draw upon substantial historical cost data from existing bus and rail services.

Structure and Inputs

Annual O&M costs are calculated as a product of the cost factors and associated with the service level for FY 2010. Cost factors are calculated by dividing estimated/audited annual operating cost allocated between bus and rail modes by bus or rail service level.

To calculate annual operating cost for bus and rail, bus and rail direct costs are calculated first, and then indirect costs are allocated to bus and rail direct cost based on bus to rail direct cost split ratio. Operating expenses are segregated in the cost allocation model as follows:

- Labor
- Fringe Benefits
- Contracts/Professional Services
- Materials & Supplies
- Utilities
- Casualty & Liability
- Miscellaneous

Total direct and indirect O&M costs for each mode are then divided by appropriate service factors (e.g., vehicle hours, vehicle miles, number of stations, route miles) yielding unit cost factors as follows:

Rail

- Transportation cost per train hour
- Maintenance-of-way cost per route mile
- Maintenance cost per vehicle mile
- Facilities cost per station

Bus

- Operating/Maintenance cost per vehicle hour
- Operating/Maintenance cost per vehicle mile

These factors are then multiplied by projected service levels to obtain O&M costs for each mode for FY 2010.

Table 20: RT O&M Cost Model (FY 2010)

					Rail Total Costs Per Revenue Mile & Hour, Route Miles, Stations				
					Total Cost	Trans	Maint	Rail Maint. of Way	Rail Station Costs
RAIL **TOTAL** COSTS - FY10	Total Rail Cost		Rev. Veh. Miles						
Cost/Rev. Veh. Mile	$49,144,068	/	4,273,346	=	$11.50	$7.36	$2.34	$1.08	$0.72
	Total Rail Cost		Rev. Train Hrs.						
Cost/Rev. Train Hour	$49,144,068	/	81,931	=	$599.82	$384.03	$122.23	$56.13	$37.42
	Total Rail Cost		Route Miles						
Cost/Route Mile	$49,144,068	/	69.7	=	$705,383	$451,619	$143,743	$66,013	$44,009
	Total Rail Cost		# Rail Stations						
Cost/Rail Station	$49,144,068	/	48	=	$1,023,835	$655,506	$208,638	$95,815	$63,877
BUS **TOTAL** COSTS - FY10	Total Bus Cost		Rev. Veh. Miles		**Bus Total Costs Per Revenue Mile & Hour**				
Cost/Rev. Veh. Mile	$80,782,988	/	7,076,636	=	$11.42	$8.54	$2.87		
	Total Bus Cost		Rev. Vehicle Hrs.						
Cost/Rev. Vehicle Hour	$80,782,988	/	632,056	=	$127.81	$95.63	$32.18		

Bus: Total Costs = $2.874 X RM + $95.635 X RH

Rail: Total Costs = $2.344 X RM + $384.034 X RH + $66,012.77 X Route Miles + $63,876.53 X # Stations

Where:

RM = Revenue vehicle miles for bus and rail (excluding deadhead miles)

RH = Revenue vehicle hours for bus and revenue train hours for rail (excluding deadhead miles but including layover/recovery time)

Source: RT Financial Forecasting Model, September 2010

LRT and Bus O&M Cost Estimates

The estimated annual O&M costs of LRT operations for each of the Green Line alternatives are summarized in this section. The annual O&M cost estimates are based on design year of 2035 operating plans and ridership projections. These "future" cost estimates, however, are presented in FY 2010 dollars. The following tables provide the LRT and bus costs resulting from the Green Line extension alternatives.

Table 21: LRT Annual O&M Cost Estimates

	Rt-Miles	Stations	Train-Hrs	Vehicle Miles	Total Annual O&M
FY 2010 RT LRT Unit Costs	**$ 66,010**	**$ 63,880**	**$384.03**	**$2.34**	**Cost (2010 dollars)**
No-Build & TSM/Baseline					
Green Line	4.72	1.0	9,940	187,800	
O&M Cost by Variable	**$ 311,567**	**$ 63,880**	**$ 3,817,258**	**$ 439,452**	**$ 4,632,157**
Green Line (to Airport)	27.22	16.0	29,830	1,497,500	
O&M Cost by Variable	**$ 1,796,792**	**$ 1,022,080**	**$ 11,455,615**	**$ 3,504,150**	**$ 17,778,637**
			Increment Over No-Build & TSM/Baseline		***$ 13,146,480***
Green Line Express (to Airport)	27.22	16.0	36,690	1,601,200	
O&M Cost by Variable	**$ 1,796,792**	**$ 1,022,080**	**$ 14,090,061**	**$ 3,746,808**	**$ 20,655,741**
			Increment Over No-Build & TSM/Baseline		***$ 16,023,584***
Green Line (to Club Center)	17.72	13.0	26,280	974,900	
O&M Cost by Variable	**$ 1,169,697**	**$ 830,440**	**$ 10,092,308**	**$ 2,281,266**	**$ 14,373,712**
			Increment Over No-Build & TSM/Baseline		***$ 9,741,554***
Green Line (to North Natomas)	15.18	11.0	19,890	835,200	
O&M Cost by Variable	**$ 1,002,032**	**$ 702,680**	**$ 7,638,357**	**$ 1,954,368**	**$ 11,297,437**
			Increment Over No-Build & TSM/Baseline		***$ 6,665,279***
Green Line (to Gateway Park)	11.04	7.0	19,890	523,200	
O&M Cost by Variable	**$ 728,750**	**$ 447,160**	**$ 7,638,357**	**$ 1,224,288**	**$ 10,038,555**
			Increment Over No-Build & TSM/Baseline		***$ 5,406,398***

Note: O&M costs include LRT service from 13th and R Streets.

Table 22: Bus Annual O&M Cost Estimates

	Bus-Hrs	Bus-Miles	Total Annual O&M Cost (2010 dollars)
FY 2010 RT Bus Unit Costs	**$95.64**	**$2.87**	
TSM Alternative	**69,610**	**541,300**	
O&M Cost by Variable	**$ 6,657,500**	**$ 1,553,531**	**$ 8,211,031**
		Increment Over No-Build	***$ 8,211,031***
Build Alternative	**19,890**	**330,500**	
O&M Cost by Variable	**$ 1,902,280**	**$ 948,535**	**$ 2,850,815**
		Increment Over TSM/Baseline	***$ (5,360,217)***

Table 23: Cost Summary and Incremental Costs

Input Measure	No Build	Baseline/TSM	Green Line				
			to Airport	to Airport (Express)	to Club Center	to North Natomas	to Gateway Park
RT LRT Cost	$ -	$ -	$ 17,778,600	$ 20,655,700	$ 14,373,700	$ 11,297,400	$ 10,038,555
RT Bus Cost	$ -	$ 8,211,000	$ -	$ -	$ 2,850,800	$ 2,850,800	$ 2,850,800
Total Annual O&M Cost	**$ -**	**$ 8,211,000**	**$ 17,778,600**	**$ 20,655,700**	**$ 17,224,500**	**$ 14,148,200**	**$ 12,889,355**
Incremental Annual O&M Cost	***$ -***	***$ 8,211,000***	***$ 9,567,600***	***$ 12,444,700***	***$ 9,013,500***	***$ 5,937,200***	***$ 4,678,355***

(1) Incremental Cost of the Baseline/TSM Alternative is relative to the No-Build Alternative.

(2) Incremental cost of the build alternatives is relative to Baseline/TSM Alternative.

6.4 Issues

There are several outstanding issues related to O&M, specifically the extension of the Gold Line or Green Line through the corridor and the type of LRV to be used.

Extension of Gold Line or Green Line

A new Green Line will be introduced next year with the start of LRT service to 7th Street and Richards Boulevard, providing a combined headway of 5 minutes in Downtown. The addition of a Green Line allows the Gold Line to continue serving the Sacramento Valley Amtrak Station prior to the completion of the Sacramento Intermodal Transit Center and the new loop track back up to 7th Street via F Street. With the bypass track directly north on 7th Street and the loop track, it is possible to extend either the Green Line or the Gold Line north to Natomas.

The user benefits are unchanged with having a separate Gold Line and Green Line, assuming the transfers between them can be minimal in terms of time penalty. The cumulative transit travel time added by the transfer is balanced by the improved LRT headways in the Downtown area. The ability to provide a one-seat ride to the airport from any of the Gold Line Stations is an argument favoring a Gold Line extension. However, an extended Gold Line will mean a longer end-to-end run time, which could tax train operators and affect schedule reliability since delays tend to compound themselves.

Light Rail Vehicles

If RT intends for all future vehicle purchases to be low floor, then a Gold Line extension would require that the 21 station platforms on the Gold Line to Folsom to be raised sufficiently to provide ADA accessibility via a ramp to the new low floor vehicles. The 7 stations in Downtown that will be served by the Green Line to the River District are being raised for low floor accessibility as part of the Green Line to the River District project to 7th Street and Richards. RT's 26 Siemens vehicles from 1987 are scheduled for replacement in 2017. This replacement is in Sacramento's long range plan and capital budget, but is currently unfunded. The year 2017 is also the scheduled opening date for a Green Line extension to Natomas. Given this timing for the arrival of new vehicles, it will be possible for RT to use 100% low floor trains for either the Green Line or Gold Line options.

7.0 RIDERSHIP AND COST EFFECTIVENESS

The Transitional Analysis includes a refinement of the Green Line LRT ridership assumptions, methodology, and results to optimize the project and identify the most cost effective project. This section documents the travel forecasting methodology and findings, which is fundamentally a sensitivity analysis whereby the ridership gains and cost effectiveness are compared for the Build Alternative LRT options. To be competitive for FTA funding, the project needs to maximize transportation system user benefits (TSUB) while minimizing capital and O&M costs.

7.1 Assumptions

The Green Line to the River District is considered part of the overall project and the local funding for this segment is considered part of the 50% local share of the overall project funding. There is significant ridership for the Green Line to the River District in the forecast year of 2035 with the redevelopment of the River District and Railyards. Including the Green Line to the River District as part of the Build Alternative instead of part of the Baseline Alternative improves the TSUB while increasing the capital and O&M costs. Overall, it creates a small improvement in cost effectiveness.

7.2 Methodology

Travel Demand Forecasting Methodology

The travel forecasting analysis began with several assumptions and resources. First, the primary travel forecasting tool used for the Transitional Analysis was the Sacramento Metropolitan Travel Demand Model (SACMET) model. It has provided the basis for other recent transit alternatives analyses and New Starts projects. SACOG built and maintains SACMET, and regularly updates the base year and forecast year demographic/land-use data and networks; and working with a technical advisory committee to periodically update and enhance the model. Many of the Sacramento area local jurisdictions use the model as the basis for general plan updates, corridor studies, and environmental studies. For all of these reasons, the SACMET model provided the best starting point for travel forecasts for this project.

The analysis years selected for the Green Line match the adopted Metropolitan Transportation Plan (MTP) base and horizon years, with Year 2005 as base year, and Year 2035 as the planning horizon year. All transportation modeling networks used in the Green Line travel forecasts are consistent with the MTP 2035 adopted by the SACOG Board of Directors in 2007, except those changes that were needed to define the Green Line alternatives.

The demographic/land-use forecasts used as model inputs for the Green Line travel forecasting efforts matched the demographics/land-use in the regionally adopted 2035 MTP. However, some modifications were made to account for known large development projects in the Green Line corridor. These modifications were reviewed by SACOG staff in 2008.

Model Enhancements

Several enhancements were made to SACOG's SACMET travel demand model to improve the accuracy of ridership forecasts and estimates of mobility benefits of the Green Line. The modifications include the following:

- The SACMET transportation analysis zones (TAZs) are appropriately sized for regional forecasts to major transportation facilities. Even with that, most of the TAZs in the corridor were split into two to four smaller zones to better reflect land-use developments within walking distance to transit stations and bus stops.
- Parking cost is an important factor in a person's choice of travel mode. Estimates of existing and future auto parking costs in the Sacramento central city area used in SACMET had not been updated in some time. The City of Sacramento collected comprehensive data on parking inventory/capacity, parking usage and parking charges throughout the Central City in 2005 as part of the Sacramento Central City Parking Master Plan. The parking costs data from that effort was used to both update existing parking charges and to forecast future charges.
- During the model review, it was observed that the SACMET model over estimated RT bus travel times by about 7% to 8% when compared travel times in the published RT bus schedules. Appropriate refinements were made to the model's bus travel time factors to better replicate actual RT bus speeds.
- The model's initial boarding wait times, transfer wait times, and on-board time factors were adjusted so that the model closely replicated overall RT weekday LRT and bus boardings, and to better calibrate the model's apportionment of transit trips between LRT and bus modes.
- The development forecasts for the MTP were prepared between 2005 and 2007. Since that time, a concern was raised by RT that the three major developments in the Green Line corridor (Railyards, Metro Air Park, and Sutter Pointe projects) were moving forward and may not be reflected adequately in SACOG's allocation of 2035 growth. Revised development estimates were prepared to reflect these projects.

Airport Model

Working collaboratively with SACOG, SACMET was updated to incorporate a system of component models that 1) estimate passenger trips to and from the Sacramento International Airport, at individual

model TAZs throughout the region, 2) estimate the split of these trips by ground access mode (auto parked, auto dropped-off, transit, taxi, etc.), and 3) incorporate the resulting auto and transit trips into the models of trip assignment onto the highway and transit networks. Previous versions of this air passenger demand model only included intra-regional trips, that is, within the SACOG modeling region only. SACMET was updated to incorporate the explicit passenger demand from outside the SACOG modeling region into this airport model, along with the appropriate scaling of the internal trip generation.

FTA New Starts

FTA New Starts travel forecasting procedures require the use of a "fixed" person trip table for the horizon year with the distribution of person trips based on the Baseline Alternative. Therefore, all of the model sensitivity runs were based on the 2035 person trip table for the Baseline Alternative. The FTA New Starts travel forecasting procedures also require the use of "fixed" highway skims for the horizon year based on the Baseline Alternative too. New transit skims are generated for each alternative which is the primary differentiating input to the mode choice mode.

7.3 Alternatives

Station Deferral

There are 14 stations under consideration for the Green Line: Sequoia Pacific, West El Camino, Pebblestone, San Juan, Gateway Park, Arena Boulevard, Arco Arena, East Town Center, North Natomas Town Center, Commerce Parkway, Club Center Drive, Greenbriar, Metro Air Park and Sacramento International Airport. A wide range of scenarios were tested to see if deferring a station(s) may enhance the performance of the Build Alternative. Optimization focused on the relationship between changes in ridership and changes to travel times. The results of this analysis lead to deferring of 3 stations: Arena Boulevard, East Town Center, and East Commerce Station. These stations had low estimated walk access boardings. By deferring these 3 stations, LRT travel times from Downtown to the Airport improved by over 2 minutes.

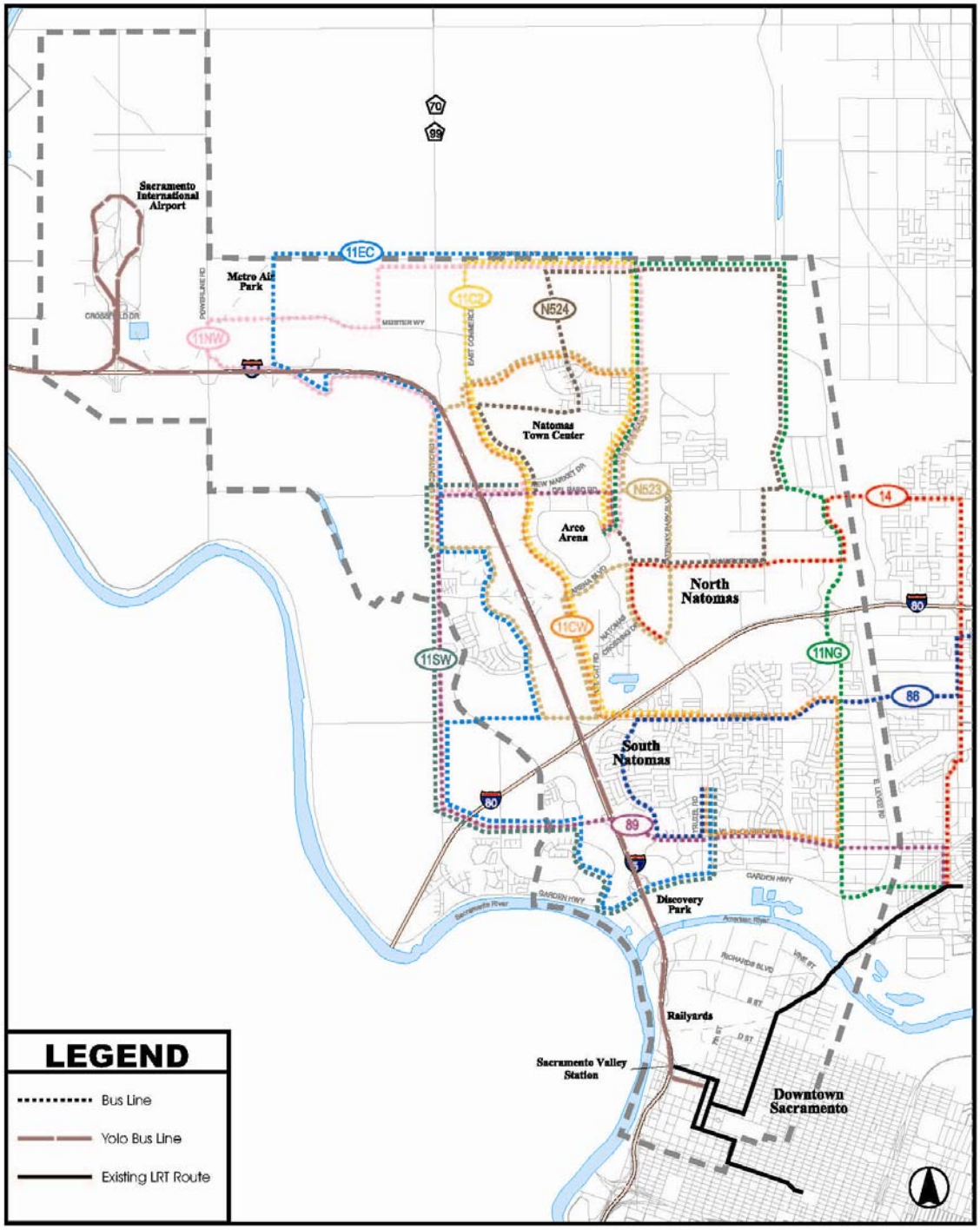
2035 Bus Routes

The 2035 bus system was based on the 2035 SACOG MTP transit network. Each bus route in the corridor was refined to better serve the proposed Baseline/Build stations. Bus service that was viewed as duplicative to the Baseline/Build was removed or modified. The following table and figure provide a description and illustration of the bus service in the corridor. The RT bus system (route alignment, bus stops and headways) was held constant between the Baseline and Build Alternative LRT options.

Table 24: 2035 Bus Routes

Route	Description	Headway (minutes)	
		Peak	Off-Peak
Route 14	Crosstown route between Arco Arena LRT and Swanston LRT/Commuter Rail stations via Del Paso Road, Main Avenue, Norwood Avenue, and Arden Way	15	15
Route 86	Western end of existing route follows current routing to Garden Highway, but instead of proceeding Downtown via I-5, it turns east to terminate at the West El Camino LRT Station	15	15
Route 89	Western end rerouted to serve West El Camino Avenue, El Centro Road, and Del Paso Road, connecting to West El Camino and Arco Arena LRT Stations. Eastern end extended to Swanston LRT/Commuter Rail Station.	30	30
11EC	Services West El Camino Avenue, El Centro Road, and Metro Air Park, connecting to West El Camino and Metro LRT Stations.	15	15
11C2	Services San Juan Rd, E. Commerce Way, and Natomas Blvd, connecting to San Juan, Natomas Town Center and Arco LRT Stations.	15	15
11NW	Meister Way, Del Paso Blvd, and Natomas Blvd, connecting to Metro Air Park, Natomas Town Center and Arco LRT Stations.	15	30
11CW	Services San Juan Rd, E. Commerce Way, and Natomas Blvd, connecting to San Juan, Natomas Town Center and Arco LRT Stations.	15	15
11NG	Crosstown route between Arco Arena LRT and Swanston LRT/Commuter Rail stations via Norwood Avenue, W. Elkhorn Blvd, and Natomas Blvd	15	30
11SW	Services West El Camino Avenue, El Centro Road, and E. Commerce Way, connecting to West El Camino and Natomas Town Center LRT Stations.	15	30
NS23	Services E. Commerce Way, N. Park Dr, Northborough Dr, and Natomas Blvd, connecting to Natomas Town Center and Arco LRT Stations.	15	15
NS24	Services El Centro Rd, Duckhorn Dr, N. Park Dr, Natomas Blvd, and Gateway Park Blvd, connecting to Natomas Town Center, Arco, and Gateway LRT Stations.	15	15
Yolo Transit	Express service on I-5 between Woodland, Airport, and Downtown Sacramento	45	n/a

Figure 20: 2035 Bus Routes



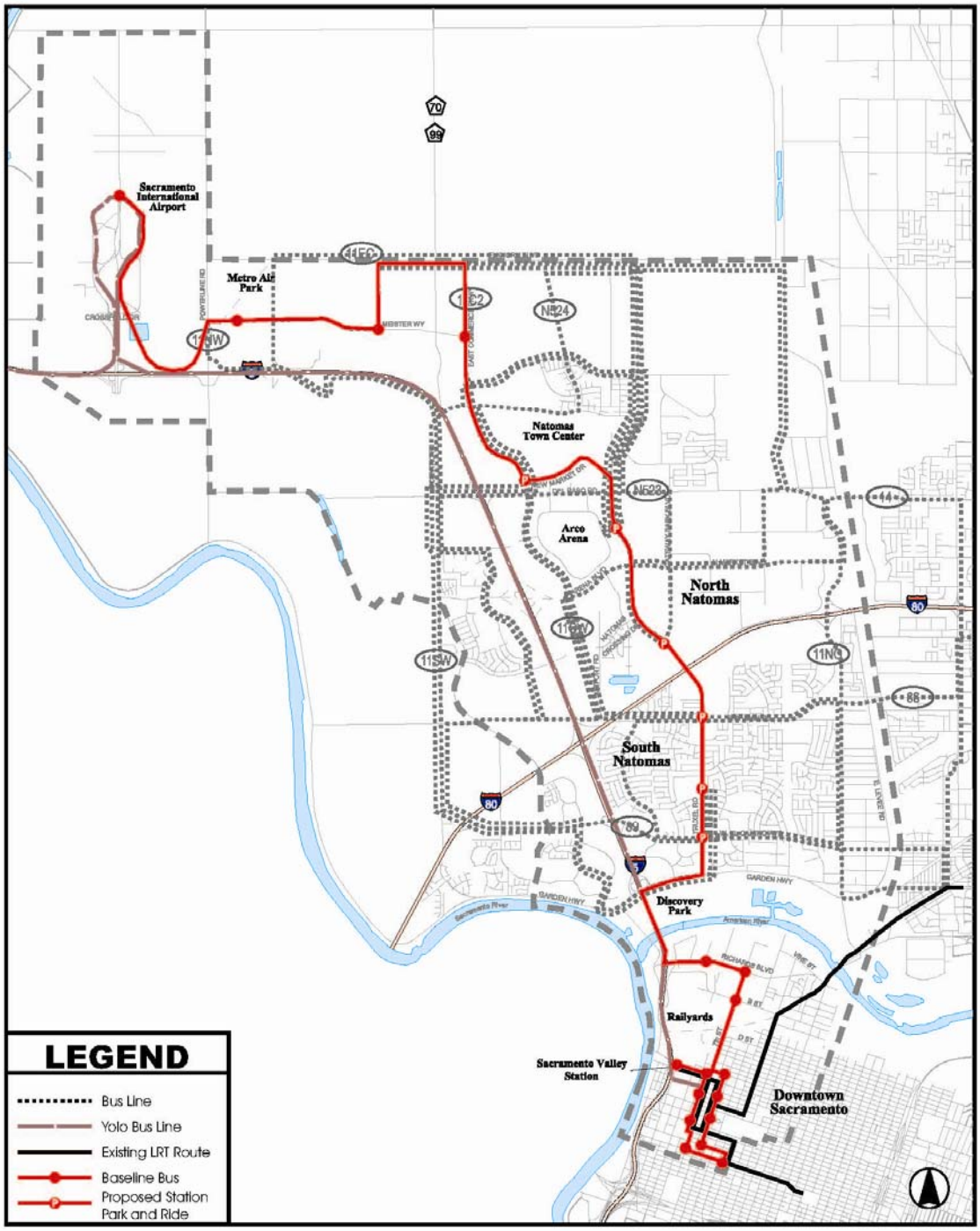
Baseline Alternative

The Baseline Alternative includes the same RT bus transit routes as the Year 2035 bus routes described above. The Baseline Alternative provides the following enhanced bus services in the corridor in place of the Build Alternative LRT options:

- Trunkline bus service from Downtown to the Airport traveling in mixed traffic flow. The route starts in Downtown at 13th/R Streets, follows the Gold Line to H Street and uses 7th Street to reach Richards Boulevard. The route uses I-5 to cross the American River and reach Garden Highway and follows Truxel Road to Del Paso Boulevard. It follows New Market Drive and then Commerce Way to reach the future extension of Meister Way which it uses to cross SR 99 and reach the Airport.
- 10 stations are assumed north of the American River
- The headways for the Baseline bus service match articulated bus capacity with forecasted ridership demand. Headways were estimated at 15 minutes during peak periods and 15 minutes during other periods.
- The routing of the Baseline Alternative on I-5 between Garden Highway and Richards Boulevard utilizes new auxiliary lanes, thereby avoiding traffic congestion on this portion of the freeway.
- Park-and-ride lots are provided at 6 stations: El Camino, Pebblestone, San Juan, Gateway, Arco Arena and North Natomas Town Center.
- The Baseline Alternative does not include the Green Line to the River District.

The Baseline Alternative is shown in the following figure.

Figure 21: Baseline Alternative



Build Alternative LRT Options

Various terminus station options were tested to determine if phasing options for the Green Line may be more cost-effective than implementation of the full LRT project. These include the following:

Airport

This option represents the full project from Downtown to the Airport and includes the following:

- The LRT route follows the Gold Line to Sacramento Valley Station, and uses 7th Street to reach Richards Boulevard. The route crosses the American River to reach Truxel Road. South of I-80, LRT operates in mixed traffic on Truxel Road. North of I-80, LRT will primarily travel in dedicated right-of-way adjacent to streets. It follows Truxel Road along the west side of the roadway to Del Paso Boulevard. It follows New Market Drive and Commerce Way to reach the future extension of Meister Way which it uses to cross SR 99 and reach the Airport.
- The LRT service operates on 15 minute headways.
- Like the Baseline Alternative, it includes 10 stations north of the American River with park-and-ride lots at 6 stations: El Camino, Pebblestone, San Juan, Gateway, Arco Arena and North Natomas Town Center.

Airport Express

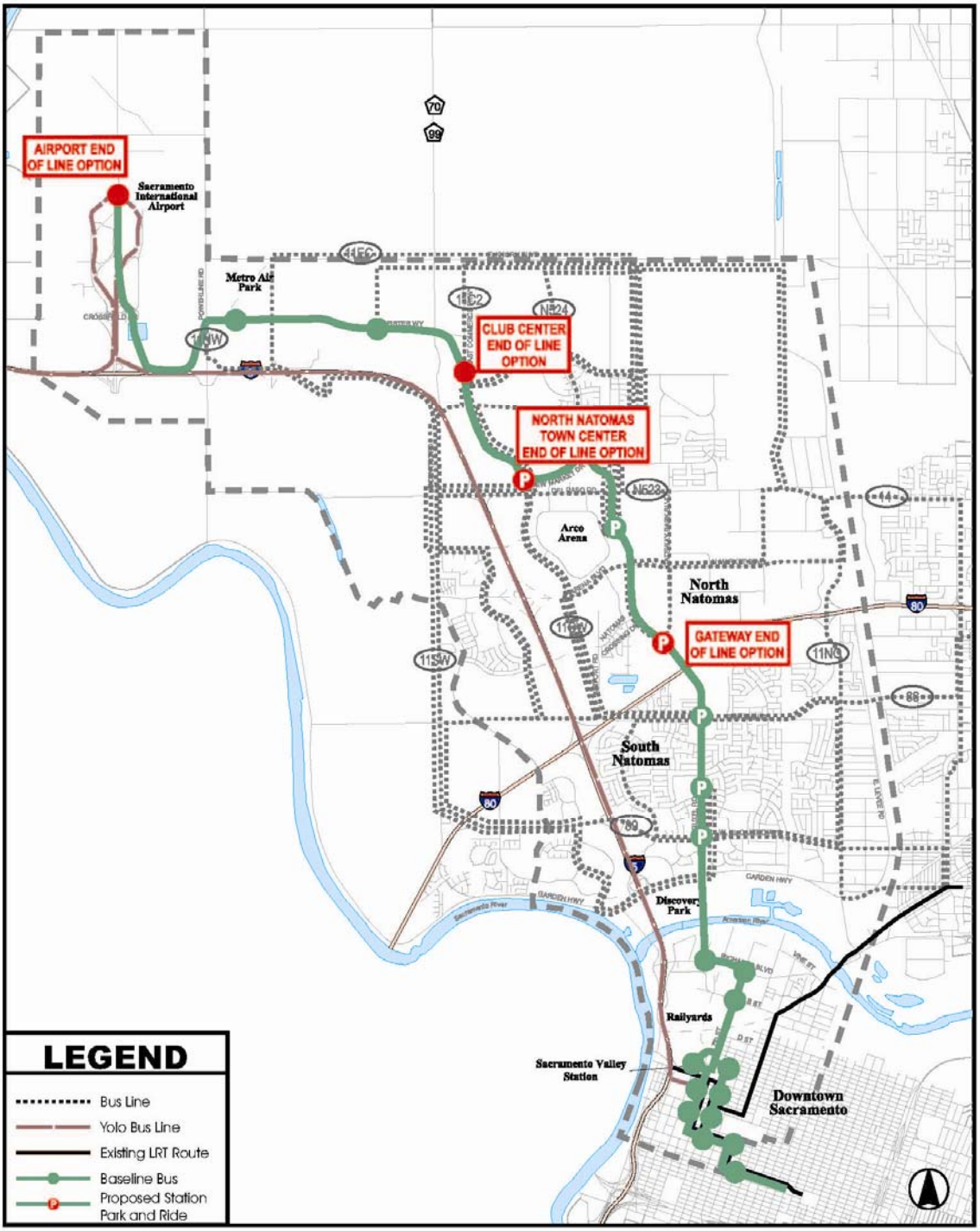
This option is the same as the Airport option except that express service is added during the peak period which provides faster travel times by skipping stops. Only 5 stations are served north of the American River: El Camino, Gateway, Arco Arena, North Natomas Town Center, and the Airport. The travel time with the express option between Downtown and the Airport improved travel times by almost 5 minutes.

Club Center, Gateway Park, and North Natomas Town Center

These options are the same as the Airport option but include interim end-of-line stations at Gateway Park, North Natomas Town Center, and Club Center. Bus service is provided between Gateway Park and the Airport.

The Build Alternative LRT options are shown in the following figure.

Figure 22: Build Alternative LRT Options



7.4 Performance Measures

Five key performance measures are reported, which capture the performance differences between the Baseline Alternative and the Build Alternative LRT options. Estimates of these performance measures are based on the 2035 forecasts:

- Travel Times. Travel times presented here are estimates of total travel time, or the times passengers are likely to experience in making an entire trip from beginning (e.g. a home location in the corridor) to a final destination (e.g., a job in Downtown Sacramento), including all trip segments.
- Linked Transit Trips. Linked transit trips are trips made by a transit passenger, including all segments getting from the beginning of a trip to a final destination. For this analysis, region-wide linked trips are presented, which include trips made on all transit operators. Some tabulations show region-wide linked trips broken down by corridor.
- Transit Mode Share. Mode share is defined as the percentage of all person trips made using transit. In the SACMET travel demand model, 7 modes of travel are forecasted: drive-alone, 2-person carpool, 3+ person carpool, walk-access transit, drive-access transit, walk, and bike. For some measures, walk- and drive- access transit are combined.
- Station or Line Passenger Boardings. For some areas within the corridor, the number and type of passenger boardings occurring at specific stations, transit centers, or stops are of interest. As such, tabulations of transit boardings at these locations are provided. Tallies of passenger boardings occurring at stations or stops in a specific transit route, or a portion of that route, are termed “line boardings”. The analysis corridors used for this project in all cases have at most one LRT line within the corridor, so tabulations of LRT boardings broken down by corridor can be taken as LRT line boardings for the line segments within the corridor.
- User Benefits. FTA has developed software for comparing transit alternatives, called SUMMIT. FTA requires SUMMIT to be used in the evaluation of all New Starts applications, and has specific guidelines on its use. In general, SUMMIT generates an estimated user benefit which would be generated by implementing a specific transit alternative, relative to a Baseline alternative. User benefit is defined as hours of travel time savings. SUMMIT estimates travel times savings by using a component of virtually every travel demand forecasting model: the mode choice sub-model. Specifically, SUMMIT uses the “logsum” or “composite utility” variable from the submodel, which tallies the total utility provided by all travel options available to a traveler. SUMMIT translates this variable into equivalent hours of travel time. The comparison requires that the only differences between the alternatives being compared be those directly attributed to the project.

Travel Times

Comparative average travel times for single occupancy vehicles (SOVs), high occupancy vehicles (HOVs), walk-access-transit, and drive-access-transit modes are provided. These travel times were estimated by averaging a range of times for a number of zones within each of a community area within the corridor, to a destination area within Downtown Sacramento.

In general, Year 2035 SOV drive times are forecasted to increase between 17% and 37% relative to Year 2005 travel times. Year 2035 HOV times are 4% to 25% lower than comparable SOV times, reflecting the time savings provided by planned HOV lanes on I-5 between the Airport and Downtown Sacramento, and ramp meters with HOV bypass lanes planned for many interchanges in the corridor.

The analysis of transit times indicates the following:

- Baseline transit times in 2035 (both transit/drive access and transit/walk access times) will be greater than today. However, transit travel times with the LRT options will be substantially less time than the Baseline and 2035 transit times will be lower than today for trips between Downtown and Natomas.
- Average “transit/drive access” times with the LRT options will be competitive with “drive alone” travel times, especially for trips from South Natomas and the Gateway station. These competitive travel times make drive-to transit a very attractive commute option since transit fares are substantially lower than parking cost in Downtown.
- Average “transit/walk access times” with the LRT options are significantly longer than drive-to-transit times given walk speeds on both ends of the trip. However, walk-to-transit times for those origins and destinations that are close to LRT stations can be substantially less than average walk-to-transit times and thus competitive with drive alone travel times.

Travel times for the AM peak period are shown in the following table.

Table 25: Travel Times

AM Peak Period Travel Times (minutes) by Mode					
Scenario		**Drive Alone**	**Car Pool**	**Transit/Walk Access**	**Transit/Drive Access**
South Natomas Near Pebblestone to Downtown Sacramento					
2005		16 to 19	16 to 19	35 to 38	35 to 38
2035Baseline/TSM		19 to 24	19 to 23	47 to 52	36 to 39
2035 End of Line LRT Options	Airport			29 to 32	22 to 24
	Airport + Express			28 to 31	20 to 22
	Club Center			29 to 32	22 to 24
	Gateway			29 to 32	22 to 24
	North Natomas T.C.			29 to 32	22 to 24
North Natomas—Gateway Park and Arco Area to Downtown Sacramento					
2005		18 to 22	18 to 22	44 to 49	42 to 47
2035Baseline/TSM		21 to 26	20 to 24	47 to 52	57 to 63
2035 End of Line LRT Options	Airport			35 to 38	27 to 30
	Airport + Express			33 to 37	24 to 27
	Club Center			35 to 38	27 to 30
	Gateway			35 to 39	27 to 30
	North Natomas T.C.			35 to 38	27 to 30
North Natomas—North Natomas Town Center Area to Downtown Sacramento					
2005		20 to 24	20 to 24	52 to 58	43 to 48
2035Baseline/TSM		24 to 29	22 to 27	58 to 64	62 to 69
2035 End of Line LRT Options	Airport			36 to 39	30 to 34
	Airport + Express			34 to 37	27 to 30
	Club Center			36 to 39	30 to 34
	Gateway			42 to 46	35 to 39
	North Natomas T.C.			36 to 39	30 to 34
Downtown Sacramento to Sacramento International Airport					
2005		33 to 38	23 to 28	43 to 47	n.a.
2035Baseline/TSM		44 to 52	33 to 40	49 to 54	n.a.
2035 End of Line LRT Options	Airport			41 to 45	n.a.
	Airport + Express			37 to 41	n.a.
	Club Center			49 to 54	n.a.
	Gateway			49 to 54	n.a.
	North Natomas T.C.			49 to 54	n.a.

Linked Transit Trips

This section summarizes 2035 linked transit passenger trips by corridor for the Baseline and LRT options. A linked trip includes all of the segments of a passenger's trip from its point of origin (e.g., home) to its final destination (e.g., work). Evaluating transportation improvements using linked trips is a common industry practice. This analysis indicates the following:

- Compared to the Baseline, the LRT options increase linked transit trips by 16% to 27% in the corridor north of the American River, with the highest increase for the full extension to the Airport. The LRT options will even increase linked transit trips outside the corridor and by about 3% to 5% on a regional basis.
- The Airport Express option does not significantly increase linked transit trips compared to an extension to the Airport without the express service.
- An end-of-line at either the North Natomas Town Center or the Club Center stations yields about 70% of the increase in linked transit trips as the full extension to the Airport.

Linked transit trips are shown in the table on the next page.

Transit Mode Share

This section summarizes 2035 transit mode share for key corridors in the region. Information on home-based-work trips and all trip purposes is provided. Mode shares are computed from person trips on a production-to-attraction basis. The analysis of mode shares indicates the following:

- A high percentage of work trips from the corridor to Downtown will use transit, with about 30% under the Baseline increasing to 34% to 37% with the LRT options.
- The percentage of trips using transit will be higher in the corridor than the regional average for both work and all trip purposes.

Mode share is shown in the table on the page after next.

Table 26: 2035 Linked Transit Trips

Area	Baseline (TSM)	End of Line Options				
		Airport	Airport Express	Club Center	Gateway	N. Natomas T.C
DNA Corridor (North of River)						
Trips	15,760	19,830	20,080	18,930	18,280	18,910
Change from TSM (+/- %)		25.8%	27.4%	20.1%	16.0%	20.0%
DNA Corridor (South of River)						
Trips	18,040	19,290	19,560	19,080	18,940	19,080
Change from TSM (+/- %)		6.9%	8.4%	5.8%	5.0%	5.8%
Rest of Downtown						
Trips	65,320	68,410	68,670	67,920	67,500	67,910
Change from TSM (+/- %)		4.7%	5.1%	4.0%	3.3%	4.0%
Rest of Region						
Trips	116,450	118,480	118,610	117,210	117,030	117,200
Change from TSM (+/- %)		1.7%	1.9%	0.7%	0.5%	0.6%
Regional Total						
Trips	215,570	226,010	226,920	223,140	221,750	223,100
Change from TSM (+/- %)		4.8%	5.3%	3.5%	2.9%	3.5%

Table 27: Mode Share

Corridor Mode Share for Home-Based Work (HBW) Trips							
			End of Line Options				
From	To	Baseline (TSM)	Airport	Airport Express	Club Center	Gateway	N. Natomas T.C
DNA/I-5 Corridor	Downtown	29.8%	35.4%	36.8%	35.4%	34.4%	35.4%
	DNA/I-5	2.0%	2.2%	2.3%	2.2%	2.1%	2.2%
	Watt/I-80	1.8%	1.9%	1.9%	1.9%	1.9%	1.9%
	Folsom/US50	4.2%	5.3%	5.6%	5.3%	5.2%	5.3%
	South Line	3.9%	4.5%	4.8%	4.5%	4.3%	4.5%
	West Sac	1.6%	1.8%	1.9%	1.8%	1.7%	1.7%
DNA Corridor Subtotal		*4.3%*	*4.9%*	*5.1%*	*4.9%*	*4.8%*	*4.9%*
Downtown	Downtown	43.9%	44.0%	44.0%	44.0%	44.0%	44.0%
Downtown	All Others	20.0%	20.8%	20.9%	20.7%	20.6%	20.7%
All Others	All Others	3.6%	3.6%	3.7%	3.6%	3.6%	3.6%
Total Region		**4.1%**	**4.2%**	**4.3%**	**4.2%**	**4.2%**	**4.2%**
Corridor Mode Share for All Other Trip Purposes							
DNA/I-5 Corridor	Downtown	11.9%	14.0%	14.0%	13.8%	13.5%	13.8%
	DNA/I-5	0.5%	0.6%	0.6%	0.6%	0.6%	0.6%
	Watt/I-80	0.7%	0.8%	0.8%	0.7%	0.7%	0.7%
	Folsom/US50	2.3%	3.2%	3.2%	2.7%	2.7%	2.7%
	South Line	2.0%	2.8%	2.8%	2.2%	2.2%	2.2%
	West Sac	1.0%	1.2%	1.2%	1.0%	1.0%	1.0%
DNA Corridor Subtotal		*1.0%*	*1.2%*	*1.2%*	*1.2%*	*1.1%*	*1.2%*
Downtown	Downtown	9.2%	9.4%	9.4%	9.3%	9.3%	9.3%
Downtown	All Others	6.7%	7.5%	7.5%	7.2%	7.1%	7.2%
All Others	All Others	0.7%	0.8%	0.8%	0.7%	0.7%	0.7%
Total Region		**1.0%**	**1.1%**	**1.1%**	**1.1%**	**1.0%**	**1.1%**

Station or Line Passenger Boardings

This section presents more detailed boardings breakdowns by station for the Baseline Alternative and the Build Alternative LRT options. For the each alternative, boardings are tabulated by station, and include transfers to and from RT buses, as well as direct walk and drive access boardings.

LRT, with any of the end-of-line options, shows a substantial increase in boardings compared to the Baseline Alternative. It should be noted than the Baseline Alternative does not include the Green Line to the River District. All of the LRT options result in a substantial increase in transit boardings at the Richards and Railyards LRT stations. If one focuses on boardings north of the American River, the analysis indicates the following:

- The full LRT extension to the Airport increases transit boardings north of the river from 4,560 for the Baseline Alternative to 14,150 for the Build Alternative (an increase of about 9,590). With express service, boardings for the full LRT extension to the Airport increase by another 600.
- With an end-of-line at either the North Natomas Town Center or the Club Center stations, the increase in boardings north the river (compared to the Baseline Alternative) is about 6,500 to 6,600, which is about 70% of the increase for the full LRT extension to the Airport.

Daily boardings by alternative are shown in the following tables.

Table 28: 2035 Daily Boardings (Baseline/TSM Alternative)

Station	Mode of Access					
			Transfer			Parking
	Walk	Drive*	Bus	LRT	Total	Demand
13th	10	0	0	0	10	0
Archives Plaza	0	0	0	0	0	0
8th/O	100	0	10	0	110	0
7-8th/Capital	130	0	40	60	230	0
St. Rose of Lima	60	0	40	30	130	0
7-8th/J-K	330	0	230	70	630	0
SP Intermodal	100	0	120	140	360	0
Railyards	910	0	10	0	920	0
Richards	900	0	10	0	910	0
Sequoia Pacific	240	0	40	0	280	0
El Camino	200	370	530	0	1,100	240
Pebblestone	120	110	0	0	230	70
San Juan	70	60	290	0	420	40
Natomas Gateway	400	330	500	0	1,230	220
Arco Arena Station	30	710	40	0	780	260
N.Natomas Town Center	60	0	190	0	250	210
Club Center Drive	50	0	10	0	60	0
Greenbriar	130	0	0	0	130	0
Metro Air Park	170	0	0	0	170	0
Airport	180	0	10	0	190	0
Total	4,190	1,580	2,070	300	8,140	1,040
North of River Total	1,410	1,580	1,570	0	4,560	1,040

*Includes only Park-and-ride at formal lots; does not include drop-off or “kiss-and-ride” trips.

Table 29: 2035 Daily Boardings (Build Alternative Airport)

Station	Mode of Access					
			Transfer			Parking
	Walk	Drive*	Bus	LRT	Total	Demand
13th	600	0	200	350	1,150	0
Archives Plaza	470	0	280	60	810	0
8th/O	2,680	0	170	70	2,920	0
7-8th/Capital	1,040	0	310	450	1,800	0
St. Rose of Lima	3,040	0	1,940	1,220	6,200	0
7-8th/J-K	2,870	0	1,960	650	5,480	0
SP Intermodal	450	0	550	630	1,630	0
Railyards	7,440	0	120	0	7,560	0
Richards	2,990	0	30	0	3,020	0
Sequoia Pacific	810	0	130	0	940	0
El Camino	440	640	1,170	0	2,250	420
Pebblestone	360	120	10	0	490	80
San Juan	260	340	1,110	0	1,710	220
Natomas Gateway	720	1,080	920	0	2,720	710
Arco Arena Station	390	570	650	0	1,610	380
N.Natomas Town Center	370	560	1,070	0	2,000	370
Club Center Drive	280	100	70	0	450	70
Greenbriar	370	310	0	0	680	200
Metro Air Park	690	0	0	0	690	0
Airport	1,500	0	50	0	1,550	0
Total	27,770	3,720	10,740	3,430	45,660	2,450
North of River Total	5,380	3,720	5,050	0	14,150	2,450

*Includes only Park-and-ride at formal lots; does not include drop-off or “kiss-and-ride” trips.

Table 30: 2035 Daily Boardings (Build Alternative Airport Express)

Station	Mode of Access					
			Transfer			Parking
	Walk	Drive*	Bus	LRT	Total	Demand
13th	620	0	200	350	1,170	0
Archives Plaza	500	0	330	180	1,010	0
8th/O	2,850	0	180	70	3,100	0
7-8th/Capital	1,120	0	330	510	1,960	0
St. Rose of Lima	3,240	0	1,970	1,530	6,740	0
7-8th/J-K	2,730	0	1,970	1,030	5,730	0
SP Intermodal	450	0	590	780	1,820	0
Railyards	8,120	0	130	0	8,250	0
Richards	3,300	0	70	0	3,370	0
Sequoia Pacific	760	0	100	0	860	0
El Camino	490	700	1,300	0	2,490	460
Pebblestone	260	120	10	0	390	80
San Juan	260	310	1,050	0	1,620	200
Natomas Gateway	760	1,080	930	0	2,770	710
Arco Arena Station	400	870	710	0	1,980	570
N.Natomas Town Center	380	800	1,090	0	2,270	530
Club Center Drive	280	30	60	0	370	20
Greenbriar	370	130	0	0	500	90
Metro Air Park	690	0	0	0	690	0
Airport	1,510	0	60	0	1,570	0
Total	29,090	4,040	11,080	4,450	48,660	2,660
North of River Total	5,400	4,040	5,210	0	14,650	2,660

*Includes only Park-and-ride at formal lots; does not include drop-off or “kiss-and-ride” trips.

Table 31: 2035 Daily Boardings (Build Alternative Club Center)

Station	Mode of Access					
			Transfer			Parking
	Walk	Drive*	Bus	LRT	Total	Demand
13th	580	0	200	300	1,080	0
Archives Plaza	450	0	260	60	770	0
8th/O	2,530	0	160	60	2,750	0
7-8th/Capital	990	0	290	430	1,710	0
St. Rose of Lima	2,910	0	1,810	1,140	5,860	0
7-8th/J-K	2,470	0	1,770	480	4,720	0
SP Intermodal	410	0	510	620	1,540	0
Railyards	7,350	0	120	0	7,470	0
Richards	2,930	0	30	0	2,960	0
Sequoia Pacific	780	0	100	0	880	0
El Camino	430	640	1,140	0	2,210	420
Pebblestone	350	120	10	0	480	80
San Juan	250	340	1,060	0	1,650	220
Natomas Gateway	720	1,080	800	0	2,600	710
Arco Arena Station	370	690	570	0	1,630	460
N.Natomas Town Center	340	680	1,220	0	2,240	450
Club Center Drive	220	100	70	0	390	70
Greenbriar	0	0	0	0	0	0
Metro Air Park	0	0	0	0	0	0
Airport	0	0	0	0	0	0
Total	24,080	3,650	10,120	3,090	40,940	2,410
North of River Total	2,680	3,650	4,870	0	11,200	2,410

*Includes only Park-and-ride at formal lots; does not include drop-off or “kiss-and-ride” trips.

Table 32: 2035 Daily Boardings (Build Alternative Gateway Park)

Station	Mode of Access					
			Transfer			Parking
	Walk	Drive*	Bus	LRT	Total	Demand
13th	570	0	190	290	1,050	0
Archives Plaza	430	0	260	60	750	0
8th/O	2,430	0	160	60	2,650	0
7-8th/Capital	970	0	290	420	1,680	0
St. Rose of Lima	2,770	0	1,750	1,060	5,580	0
7-8th/J-K	2,330	0	1,670	470	4,470	0
SP Intermodal	400	0	490	600	1,490	0
Railyards	7,280	0	100	0	7,380	0
Richards	2,900	0	30	0	2,930	0
Sequoia Pacific	760	0	90	0	850	0
El Camino	420	640	1,200	0	2,260	420
Pebblestone	340	120	10	0	470	80
San Juan	240	340	1,400	0	1,980	220
Natomas Gateway	560	1,460	1,940	0	3,960	960
Arco Arena Station	0	0	0	0	0	0
N.Natomas Town Center	0	0	0	0	0	0
Club Center Drive	0	0	0	0	0	0
Greenbriar	0	0	0	0	0	0
Metro Air Park	0	0	0	0	0	0
Airport	0	0	0	0	0	0
Total	22,400	2,560	9,580	2,960	37,500	1,680
North of River Total	1,560	2,560	4,550	0	8,670	1,680

*Includes only Park-and-ride at formal lots; does not include drop-off or “kiss-and-ride” trips.

Table 33: 2035 Daily Boardings (Build Alternative North Natomas Town Center)

Station Area[a]	Mode of Access					
	Walk	Drive*	Transfer		Total	Parking Demand
			Bus	LRT		
13th	580	0	200	300	1,080	0
Archives Plaza	450	0	260	60	770	0
8th/O	2,520	0	160	60	2,740	0
7-8th/Capital	990	0	290	430	1,710	0
St. Rose of Lima	2,910	0	1,810	1,140	5,860	0
7-8th/J-K	2,460	0	1,770	480	4,710	0
SP Intermodal	410	0	510	620	1,540	0
Railyards	7,350	0	120	0	7,470	0
Richards	2,930	0	30	0	2,960	0
Sequoia Pacific	770	0	100	0	870	0
El Camino	430	640	1,140	0	2,210	420
Pebblestone	350	120	10	0	480	80
San Juan	250	340	1,050	0	1,640	220
Natomas Gateway	720	1,080	800	0	2,600	710
Arco Arena Station	370	720	570	0	1,660	480
N.Natomas Town Center	320	750	1,420	0	2,490	500
Club Center Drive	0	0	0	0	0	0
Greenbriar	0	0	0	0	0	0
Metro Air Park	0	0	0	0	0	0
Airport	0	0	0	0	0	0
Total	23,810	3,650	10,240	3,090	40,790	2,410
North of River Total	2,440	3,650	4,990	0	11,080	2,410

*Includes only Park-and-ride at formal lots; does not include drop-off or “kiss-and-ride” trips.

User Benefits

The TSUB by corridor and scenario were estimated using SUMMIT. User benefit is a key variable in the cost effectiveness rating for FTA New Starts. A large portion of the user benefits are retained by each of the end-of-line options. Overall, the Build Alternative LRT options increase mobility benefits more than the Baseline Alternative.

Special event user benefits were estimated as well. As a part of the DNA Alternatives Analysis (2004), transit potential was analyzed using a special event spreadsheet model provided by the FTA and modified to represent ARCO Arena. For forecasting purposes, the analysis assumed the same event frequency and attendance from 2002 to estimate the cumulative year transit ridership. Using each end of line option's user benefit per new rider ratio averages, user benefits were estimated for special events at ARCO Arena. Since the calculated special event user benefits exceeded the FTA New Starts threshold, special event user benefits were capped at 5% of the subtotal.

User benefits are shown in the following table.

Table 34: Daily TSUB Hours

	End of Line Options				
Corridor	**Airport**	**Airport Express**	**Club Center**	**Gateway Park**	**North Natomas**
Downtown	2,350	2,670	2,060	1,770	2,050
DNA/I-5	3,790	4,330	3,200	2,680	3,190
Watt/I-80	450	500	220	140	220
Folsom/US50	310	320	160	140	160
South Line	280	290	110	100	110
West Sac	110	120	40	30	40
Subtotal	*7,290*	*8,230*	*5,790*	*4,860*	*5,770*
Special Event	360	410	290		290
Total	**7,650**	**8,640**	**6,080**	**4,860**	**6,060**
Change from EOL Airport		12.9%	-20.5%	-36.5%	-20.8%

7.5 Cost Effectiveness

The FTA Cost Effectiveness Index (CEI) was tested for LRT options ending at various termini: Sacramento International Airport, Club Center Drive, Gateway Park Boulevard, and North Natomas Town Center. The formula that is used to calculate CEI is described below:

Cost Effectiveness Index = (Incremental Annualized Capital Cost + Incremental Annual O&M Cost) / Transportation System User Benefit

Incremental Annualized Capital Cost

In order to determine the annualized capital cost, a detailed capital cost estimate was generated for each of the LRT options. Using the FTA Standard Cost Category (SCC) Worksheets, the cost figures were entered, contingencies and soft costs provided by RT were entered, the costs were distributed by year of expenditure, and SACOG's inflation rate was applied. In addition, a Baseline capital cost estimate was generated so that the differential capital cost could be generated. The SCC worksheet annualizes the capital cost based on the varying depreciation rates for each asset category, resulting in an annualized capital cost.

Incremental Annualized O&M Cost

In order to determine the incremental annualized O&M cost, an operating plan was developed for each of the LRT options. From each of these operating plans, the route miles, train hours, car miles, peak cars, etc. were calculated. Using RT's actual 2010 O&M costs based on these parameters, the incremental annual O&M cost was estimated. In addition, a Baseline O&M cost estimate was generated so that the incremental O&M cost could be generated.

Transportation System User Benefits (TSUB)

A ridership estimate and calculation of TSUB was performed for each of the LRT options. TSUB is a measure of the aggregate system-wide transportation travel time savings that result from the project as compared to the Baseline alternative. The total daily TSUB was calculated for each LRT option and then multiplied by an annualization factor of 305 to determine the total annual TSUB. The following table describes the TSUB hours for each LRT option.

Table 35: Annual TSUB Hours

	Airport	Airport Express	Club Center	Gateway Park	North Natomas
Daily TSUB Hours	7,650	8,640	6,080	4,860	6,060
Annual TSUB Hours*	2,333,250	2,635,200	1,854,400	1,482,300	1,848,300

*Assumes annualization rate of 305

Cost Effectiveness Index (CEI)

The FTA annually sets breakpoints for the CEI as part of its Annual Report on New Starts and typically does not recommend advancing a project through New Starts that has a Low CEI rating. The following table describes the current CEI breakpoints.

Table 36: CEI Breakpoints

Rating	CEI
High	$12.49 or under
Medium-High	$12.50 - $16.49
Medium	$16.50 - $24.99
Medium-Low	$25.00 - $31.49
Low	$31.50 or higher

The CEI was calculated by adding the incremental annualized capital and O&M costs for each LRT option and dividing by the TSUB. The following table describes the CEI results for the 5 LRT options evaluated in the Transitional Analysis.

Table 37: CEI Results

	Airport	Airport Express	Club Center	Gateway Park	North Natomas
Incremental Annualized Capital Cost	$48,399,000	$51,389,000	$34,319,000	$21,191,000	$29,292,000
Incremental Annualized Operating Cost	$9,567,600	$12,444,700	$9,012,700	$4,678,355	$5,937,200
Annual Multiplier	305	305	305	305	305
Daily TSUB Hours	7,650	8,640	6,080	4,860	6,060
Annual TSUB Hours	2,333,250	2,635,200	1,854,400	1,482,300	1,848,300
CEI	$24.84	$24.22	$23.37	$17.45	$19.06
Rating	Medium	Medium	Medium	Medium	Medium

Summary of CEI Results

All five of the Build Alternative LRT options are rated in the Medium category for CEI. The Airport, Airport Express, and Club Center options are at the low end of the Medium category, while the Gateway Park and North Natomas Town Center options are at the high end of the Medium category.

Because the Airport, Airport Express, and Club Center options are at the low end of the Medium category, it is possible that these options could drop to Medium-Low pending FTA review and comment. On the other hand, the Gateway Park and North Natomas options are at the high end of the Medium category and can be expected to remain strong as the project is reevaluated annually in the New Starts process. While the Gateway Park option performs well from a CEI standpoint, it does not meet the regional goal of getting to the Airport, nor does it serve the North Natomas community.

7.6 Other New Starts Project Justification Criteria

As previously mentioned, CEI is only one of several Project Justification Ratings that FTA uses. An overall project rating of Medium is required for the Approval to enter Preliminary Engineering and Final Design. The other evaluation factors are more subjective than CEI and depend on a variety of inputs. The following is a discussion of these other criteria.

Mobility Improvements

The Mobility Improvement measure looks at a number of factors, but primary consideration is how well the project serves transit dependents compared to the regional as a whole. It considers the number of transit dependents anticipated to use the project, their user benefits per passenger mile, and the share of user benefits received by transit dependents compared to the share system-wide. Forty two percent of the Green Line and system-wide transit ridership are transit dependents. Thirty nine percent of user benefits in the corridor come from transit dependents versus 36% system-wide. Given that transit dependent use and user benefits are about the same on the Green Line as compared to the system as a whole, the project is most likely to receive a Medium rating for Mobility Improvements.

Environmental Benefits

Projects in non-attainment areas for any transportation-related pollutants receive a High rating. Sacramento is a non-attainment area for air quality, and therefore this project is most likely to receive a High rating for Environmental Benefits.

Operating Efficiencies

The Operating Efficiency measure is based on the difference between system-wide O&M cost per passenger mile between the Build and Baseline alternatives. Given the size of the Sacramento's region's transit system, the Green Line project does not make an appreciable difference in the O&M cost per passenger mile and therefore most likely would receive a Medium rating. The South Line Phase 2 Project received the same Medium rating.

Land Use

The Land Use rating is prepared by Land Use Assessment Contractors hired by FTA. While they look at numerical measures of population, number of households, employment, and densities in a half-mile radius of the stations, there are not specific breakpoints for these numbers into ratings. And there are several other subjective factors that are used. Development character looks at the relationship of the buildings to the street: setbacks, human scale, entrance orientations. It also looks for roads narrow enough to be crossed easily, low to moderate traffic speeds, and continuous development with an absence of vacant land or parking lots, as well as pedestrian facilities for a compact grid system of streets with many alternative walking paths to proposed stations. Parking supply looks for a scarcity of parking and high parking costs. While this project directly serves Downtown Sacramento with strong employment and many activity centers, and there is decent residential development and some strong commercial land uses, as a whole, the project is competing against larger metropolitan areas with higher

numbers. In addition, while North Natomas was planned to be transit oriented in conjunction with the Green Line, but because development to date has not had the benefit of robust transit service, the character of development up to now has been primarily auto-oriented, and will not rate as well as it might be hoped for in relation to these other factors explained above. It is expected that the project would most likely receive a Medium-Low rating for Land Use.

Economic Development

The Economic Development measure is based on the existence and effectiveness of transit supportive plans and policies and evidence of higher density development projects advancing in areas adjacent to planned stations. The SACOG Blueprint, California Senate Bill 375, Sacramento RT Transit Oriented Development (TOD) Guide and Transit Action Plan, City of Sacramento General Plan, and the North Natomas Community Plan and Development Guidelines all provide strong rationale for a good rating. In addition, the plans for multiple projects in Downtown and in North Natomas, the Railyards, River District, Greenbriar, and Metro Air Park should allow the project to receive a Medium-High rating.

Other Considerations

The amount of funding being requested will make a difference in FTA's ability to advance the project through the New Starts process. Only 6 of the 19 non-exempt projects in FY 2011 New Starts report have a capital cost of less than $750 million, approximately the cost of the non-express option to the Airport. Projects requiring less funding but with ratings similar to more expensive projects will move forward more quickly, a fact that works in this project's favor.

Working against the project is the fact that one-quarter of the non-exempt projects in the FY 2011 New Starts report are in California, and RT's South Line Phase 2 is one of those projects. FTA tries to spread the wealth amongst regions. The number of California projects is likely to create challenges for the Green Line project for the foreseeable future.

Summary

Overall, it is expected the project would receive a Medium or Medium-High Project Justification Rating, as summarized in the following table.

Table 38: Project Justification Rating

Cost Effectiveness	Mobility Improvements	Environmental Benefits	Operating Efficiencies	Land Use	Economic Development
20%	20%	10%	10%	20%	20%
Medium	Medium	High	Medium	Medium-Low	Medium-High

8.0 STATION PLANNING

There are 14 stations under consideration for the Green Line: Sequoia Pacific, West El Camino, Pebblestone, San Juan, Gateway Park, Arena Boulevard, Arco Arena, East Town Center, North Natomas Town Center, Commerce Parkway, Club Center Drive, Greenbriar, Metro Air Park and Sacramento International Airport. Of these stations, 3 are proposed to be deferred (Arena Boulevard, East Town Center, and Commerce Parkway) and 2 stations are currently greenfields and will be developed as part of proposed major developments (Greenbriar and Metro Air Park). This section will focus on the 9 stations that are not being be deferred or planned and designed as part of a future large-scale development process.

8.1 Station Area Development

Each station will be looked at to determine its specific station type and how the proposed station area development may best support optimal use of the proposed LRT system. These supportive strategies fall under the category of transit-supportive or transit-oriented development (TOD). Although these have become a popular planning terms, there are some key strategies that governmental agencies can set in place to help form a vision for best practices and for successful station area development to become reality. Some of these key strategies are described below.

Station Type

There are multiple station types being considered for the Green Line. These station types include center stations in the median (such as along Truxel Road in South Natomas), side stations next to the roadway (such as along Truxel Road in North Natomas), and an elevated station (above the intersection of Truxel Road and Gateway Park Boulevard). During the Community Review (August 2010), a series of renderings were developed to better show how these station types fit into the context of the Natomas communities. The center, side, and elevated station renderings are shown in the following figures.

Figure 23: Center Platform (Aerial View)

Figure 24: Center Platform (View from Station Entrance)

Figure 25: Center Platform (View from Platform)

Figure 26: Center Platform (View from Crosswalk)

Figure 27: Side Station (Aerial View)

Figure 28: Side Station (View from Station Entrance)

Figure 29: Side Station (View from Platform)

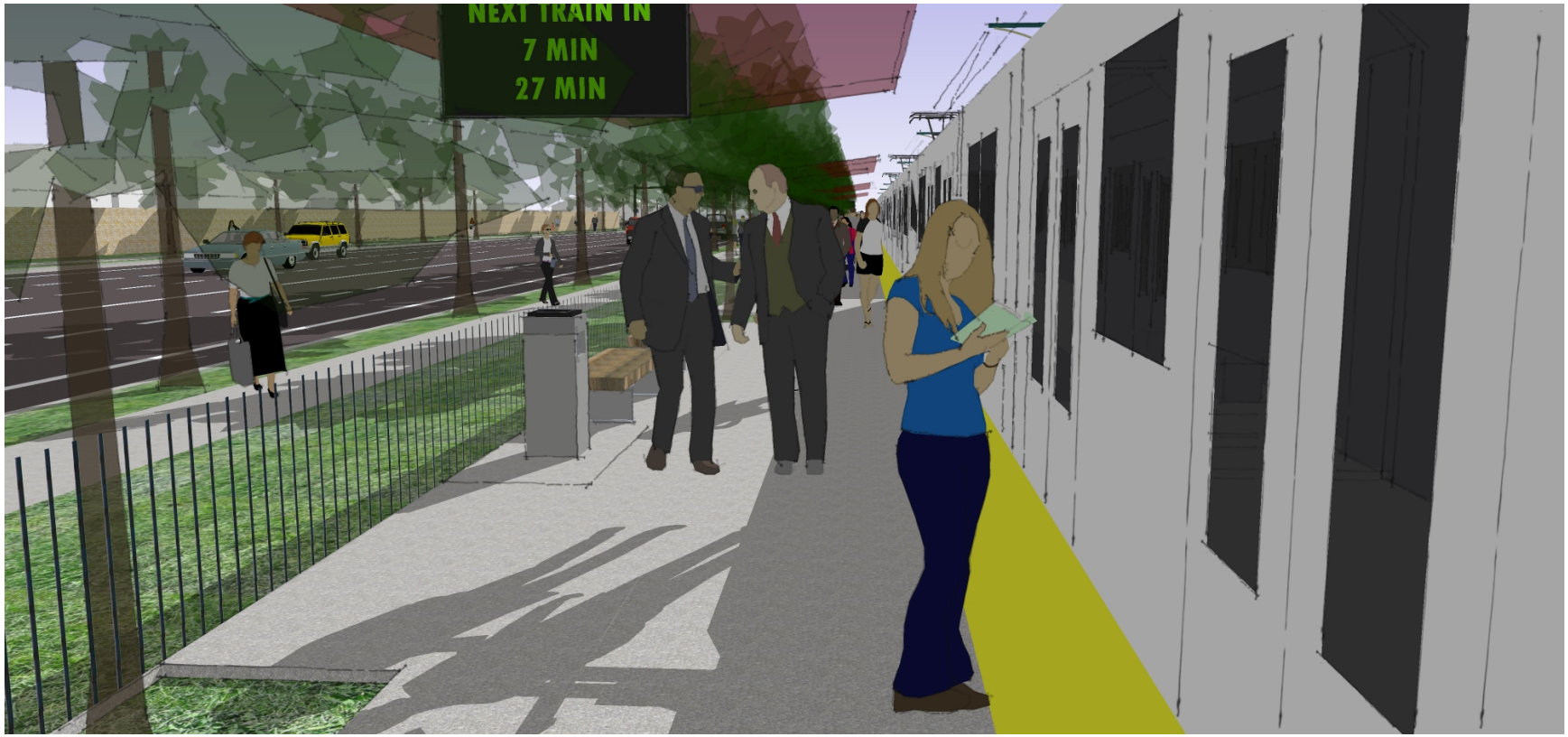
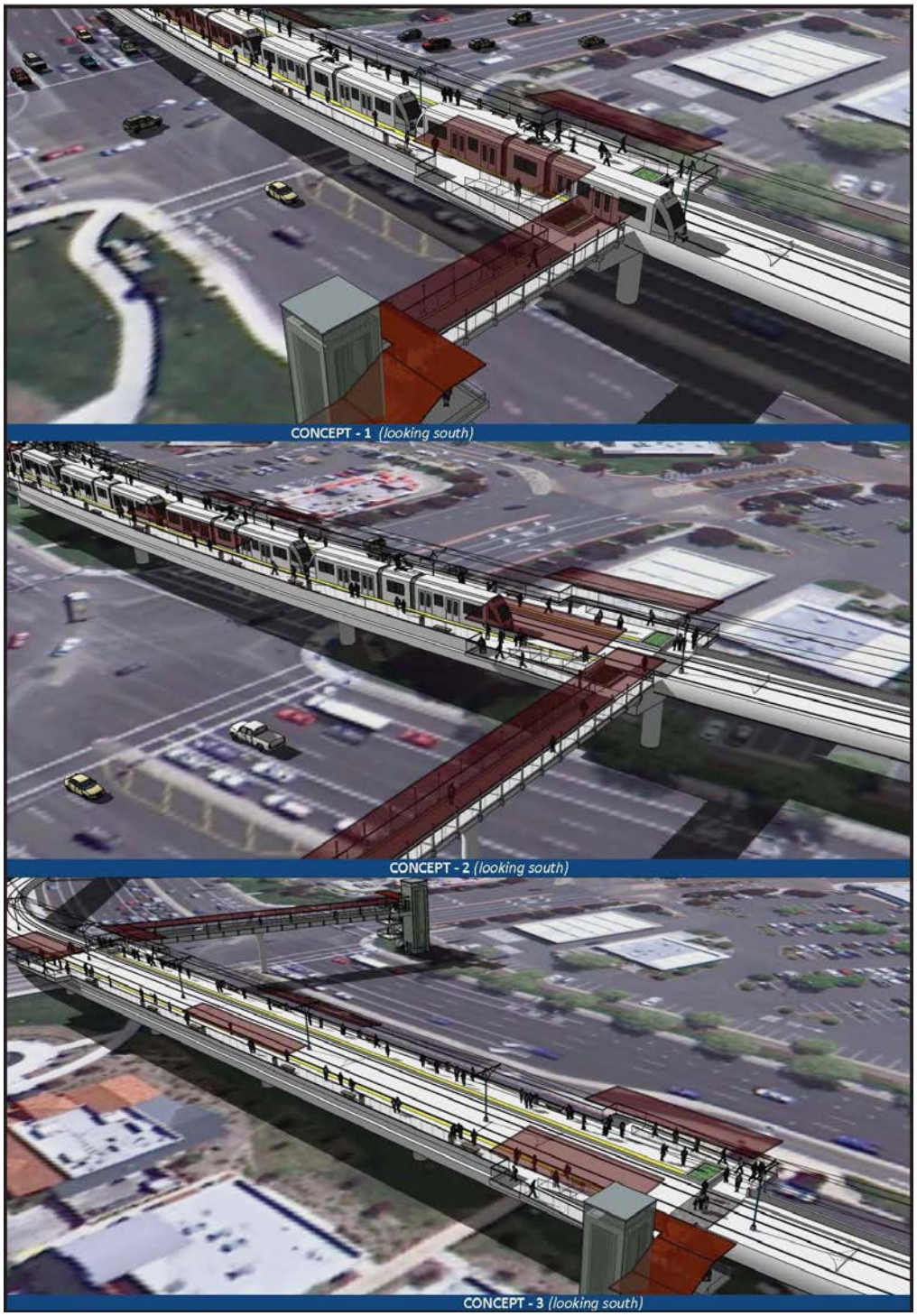


Figure 30: Side Station (View from Sidewalk)

Figure 31: Gateway Park Elevated Station (Aerial View Looking North)

Figure 32: Gateway Park Elevated Station (Aerial View Looking South)



Land Use

TOD requires supportive land use policies and zoning in order to maximize the high capacity transit investment. Land use that includes a mixture of uses and exists in higher densities can help to translate to increased transit ridership. A mixture of uses within walking distance of rail stations, such as housing and office uses located above street level retail, can lead to 24-hour a day activity in the station area. This in turn produces a lively street environment as pedestrians and bicyclists are not required to use automobiles to accomplish daily errands. Allowances for higher density residential and offices will bring an increased number of people within the station area and enhance the number of people riding transit. TOD zoning will typically include density bonuses, parking restrictions, reduced setbacks, and pedestrian amenities.

Some examples of transit-supportive land uses include: medium to high density residential, pedestrian oriented office complexes, government buildings, and schools. Examples of non-transit supportive land uses include: car dealerships, drive-through businesses, and "big box" stores with large parking lots.

Access

In addition to the land use strategies, the relationship of the street network to the transit line is also important. TOD works best where there is a finely grained network of streets that are highly connective (not cul-de-sacs) and offer many options for auto, pedestrian and bicycle trips. A network that offers many opportunities for auto trips allows streets to be narrower and friendlier to pedestrian and bicyclists, because all trips are not funneled into excessively wide arterial streets.

Within this street network, it is best if the main commercial and office street is the transit street. Transit works best where the line is located to transport riders from high density office, residential and retail developments. Developers will site their developments along the main street, not on a secondary street. Therefore, the transit street should be where the action is.

Amenities

It is important that station areas include pedestrian amenities and urban design features that encourage a sense of place within the community. Public investment in infrastructure and facilities can be a key piece of the equation in attracting private investment and setting the stage for successful TOD. These pedestrian amenities can include: wide sidewalks, street trees, pedestrian bridges, multi-use paths, and plazas.

Design Guidelines

Finally, a development with great TOD land use potential requires the implementation of TOD design guidelines and parking management strategies to aid its success. Specifics may vary within design and parking standards, but there are certain characteristics that have been proven to support transit usage and aid walkability.

TOD design standards & guidelines direct pedestrian-friendly and attractive design of pedestrian amenities, signage, lighting and building facades within the private developments. Buildings should be oriented to the street (rather than parking lots). They should maintain direct, close pedestrian connections to the street from the main entrance and ground level facades should include windows and uses (such as retail or restaurant) to engage the interest of pedestrians.

Parking management is a key factor to TOD developments. The subsidization of automobiles via free parking makes it very difficult for other modes of transportation to compete effectively. Successful TOD strategies include: placement of parking to the side or rear of buildings; shared parking between land uses with different peak hours; credits for on-street parking; employee incentives for alternative mode use; and parking maximums.

8.2 Individual Station Descriptions

This section provides individual station descriptions, including detail on the location, station type, land use, access, amenities, general design guidelines and/or considerations, and park-and-ride information.

Sequoia Pacific Station

Location

Sequoia Pacific Boulevard north of Richards Boulevard.

Station Type

Center (median platform) with station entrances at both ends.

Land Use

The station is located within the River District, which is comprised of primarily retail/wholesale uses, government offices, over 1,000 rooms in seven motels, and a mix of housing units home to approximately 600 residences. It is approximately one block west of the Township 9 mixed-use Planned

Unit Development that was approved in 2007, and is within the North 4th Street Sub Area of the River District Specific Plan area.

The land use component of the River District Plan calls for increases in square footage and units highlighted by an increase in approximately 7,500 residential units, 2.5 million square feet of office space, nearly 500,000 additional square feet of retail/wholesale space and almost 2000 hotel rooms. The only decrease planned is the amount of light industrial area which is projected to decrease to approximately 30% of its current space.

Access

The station will be highly accessible by all modes of transportation if the policies and guidelines set forth in the River District Plan are abided by. Richards Boulevard is to be a "complete street" and will remain the primary spine of the community. The River District Plan calls for all means of improvements including motorized and especially non-motorized modes of transport, and particular emphasis is given to pedestrian and bicycle connectivity to transit and the multitude of proposed parks and open space amenities and trails. In addition, the River District Plan calls for the enhancement of accessibility for the disabled community.

Amenities

Amenities for the station that will need to be included will primarily be oriented towards pedestrian and bicycle users, and should include abundant seating and areas protected from the elements, bicycle parking, and lockers. Consideration should also be given to provision of short-term bicycle and car rental facilities. Streetscape, parks and open space improvements, among other things, are called for in the River District and Township Plans.

Design Guidelines

New development will abide by design guidelines in support of the River District Plan, with guiding principles summarized as follows:

- Unique character and design that contributes to providing a sense of place
- Distinct neighborhoods with unique qualities
- Diverse and robust economy
- Maximized connectivity and multi-modal
- A model for sustainable development
- Improved safety and social conditions

- Overall livability improvements that includes scenic enhancements, parks and open space improvements, and outstanding community facilities and amenities

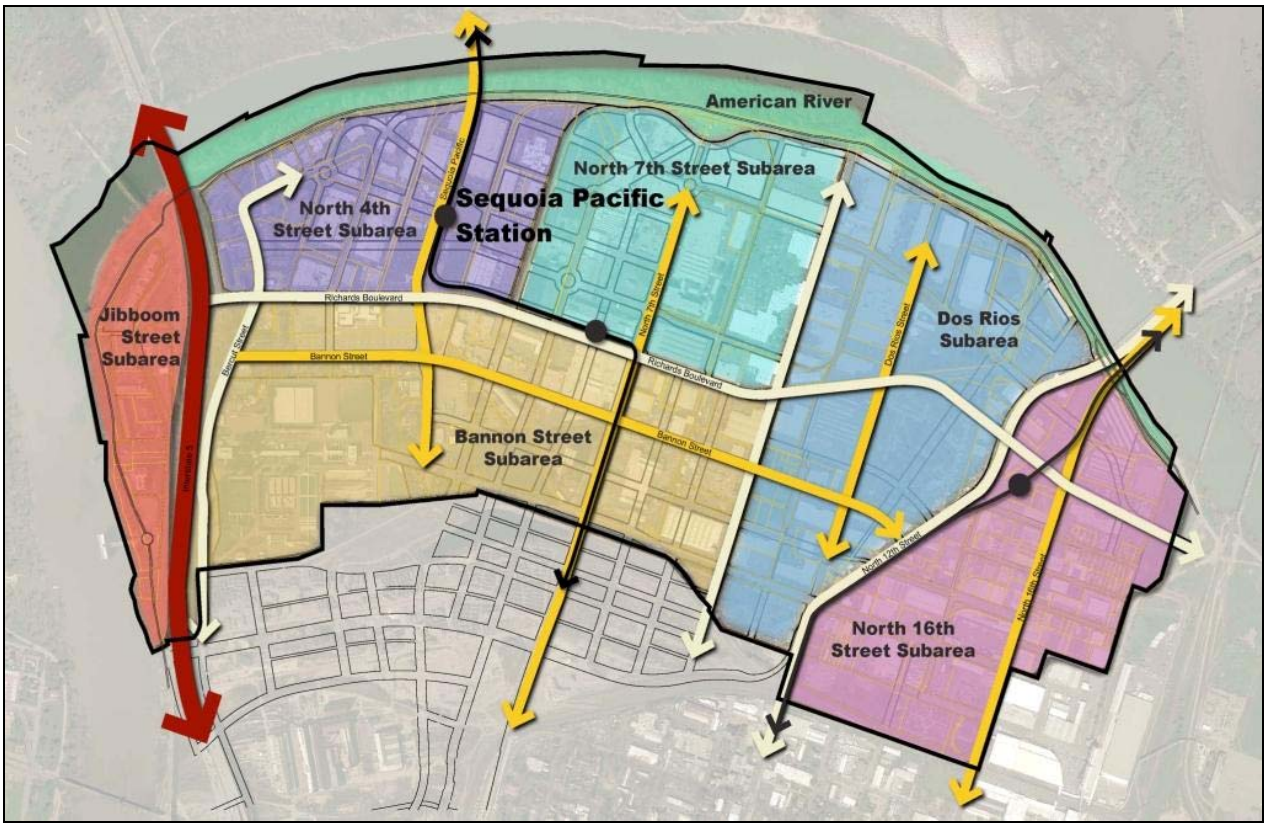
As the final design and configuration of the station may not be exactly as assumed during the development of the River District Plan, careful consideration will have to be taken to ensure the above guiding principals are maintained for the station and station area improvements.

Park-and-Ride

There are no park-and-ride spaces anticipated at the station given it's proximity to Downtown Sacramento, and the pedestrian and multi-modal emphasis of the proposed surrounding development. However, a location such as this may be suitable for short-term car rental/sharing facilities, and if so, a small parking area or reserved spaces on the street may be required.

A Sequoia Pacific Station diagram is shown in the following figure.

Figure 33: Sequoia Pacific Station (from River District Plan)



West El Camino Station

Location

South of West El Camino Avenue in Truxel Road right-of-way.

Station Type

Center (median platform) with entrances at one or both ends from Truxel Road crosswalks.

Land Use

The station is located at the intersection of two arterials with three of the four quadrants of the intersection dominated by neighborhood commercial centers. One quadrant of the intersection as well as a majority of the property surrounding the commercial centers is occupied predominately by multi-family residential uses with some offices uses. Larger office park-type development is located further southwest and west of the station, and single family development occurs in small pockets throughout.

The existing land use appears to be somewhat consistent with future land uses designated in the 2030 General Plan Land Use & Urban Form Designations for the South Natomas Community Plan Area, but is less dense. The NE, SE, and SW quadrants of the intersection are designated as a Suburban Center in the 2030 General Plan, with an allowed floor area ratio (FAR) up to 2.0. In comparison existing FAR for the properties on these three quadrants of the intersection appears to be in the range of .24 -.33.

The existing retail development on the SW corner combined with the office space just to the south accounts for approximately 70,000 square feet of building space combined with an FAR of probably less than .25. This area is specifically identified in the 2030 General Plan as an area that is expected to "Transform-Urban" which is described to mean existing urban areas expected to experience dramatic change through major development and redevelopment projects. Presumably this would also include taking advantage of the future transit opportunities and maximizing density to levels allowed in the 2030 General Plan. Additional Considerations:

Access

Pedestrian and bicycle access to the station will be via a well established sidewalk and bike network that already exists in South Natomas. If a station is developed with entrances at both ends of the platform, pedestrian access for the southern end may require a signal for safe crossing of Truxel Road. As redevelopment and/or TOD may occur at three quadrants of the Truxel/West El Camino intersection,

there will be the need to provide wider sidewalks with streetscape improvements to enhance the pedestrian environment.

Amenities

Amenities for the station that will need to be included will primarily be oriented towards pedestrian and bicycle users, and should include abundant seating and areas protected from the elements, bicycle parking and lockers. Consideration should also be given to provision of short-term bicycle rental facilities. For future development that may occur in the station area near park-and-ride facilities, consideration should be given to providing some convenience retail services.

Design Guidelines

Although existing uses including the large supermarket on the SE quadrant of the intersection appear to be more vibrant than the SW quadrant, the SE quadrant could also benefit from "Transform-Urban" designation to encourage higher density and TOD in the future. If market conditions do not favor complete redevelopment of the aging retail uses, perhaps some infill development adjacent to Truxel Road and West El Camino could occur to line the property with uses more easily accessible by pedestrians to transit. Construction of light rail on Truxel Road may provide the opportunity to plan and design enhancement to the streetscape.

Park-and-Ride

Designated to provide 410 spaces for park-and-ride, the exact location of the parking has not been determined. However, it is suggested the most favorable location for parking would be in either of the two southern quadrants of the intersection. If located near the intersection corners, then there may be only one station entrance required from the crosswalk across Truxel Road at the West El Camino intersection. If the majority of parking is located further south (on either or both sides of Truxel Road) then a second station entrance is recommended.

West El Camino Station diagrams for Options 1 and 2 are shown in the following figures.

Figure 34: West El Camino Station (Option 1)

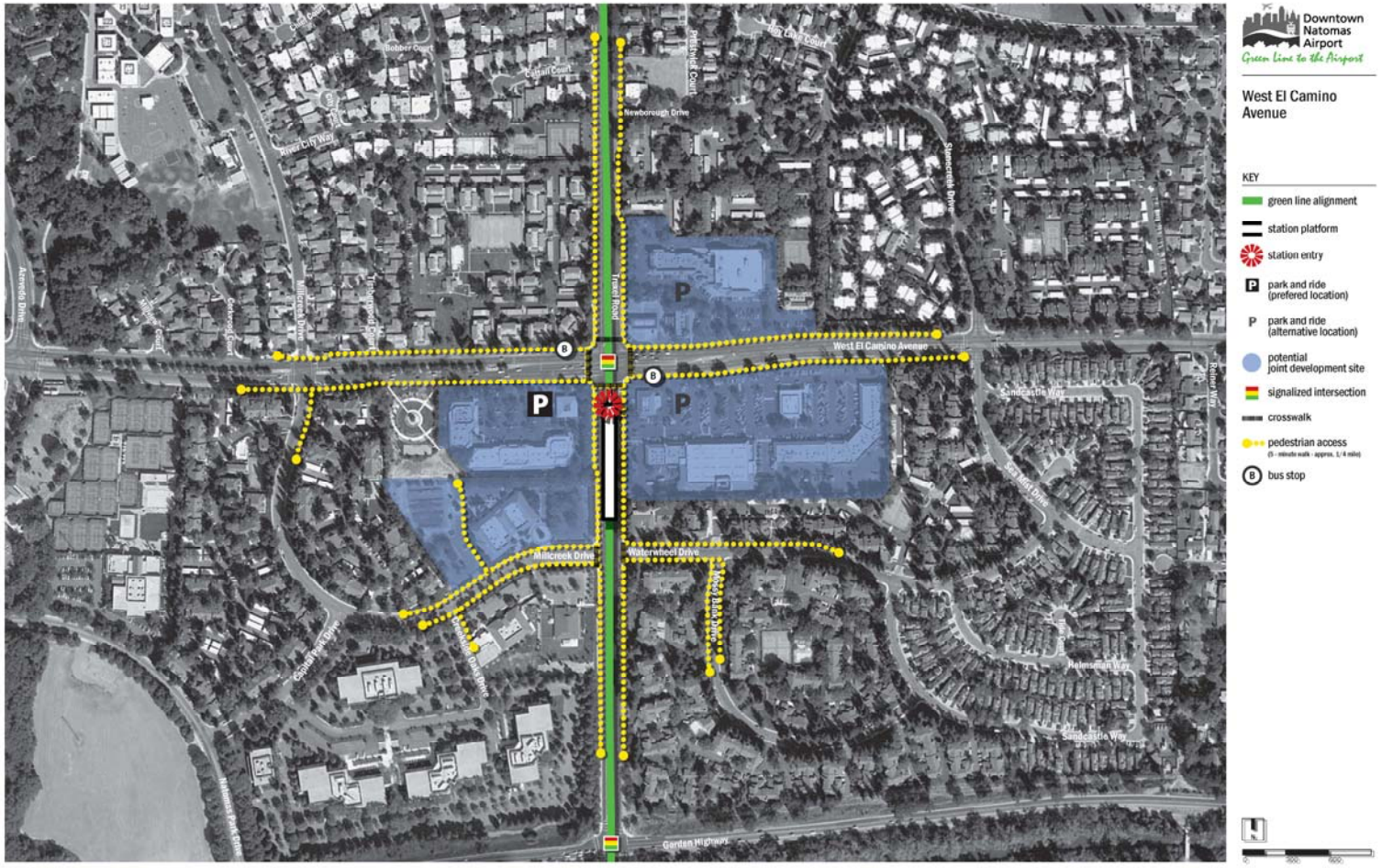
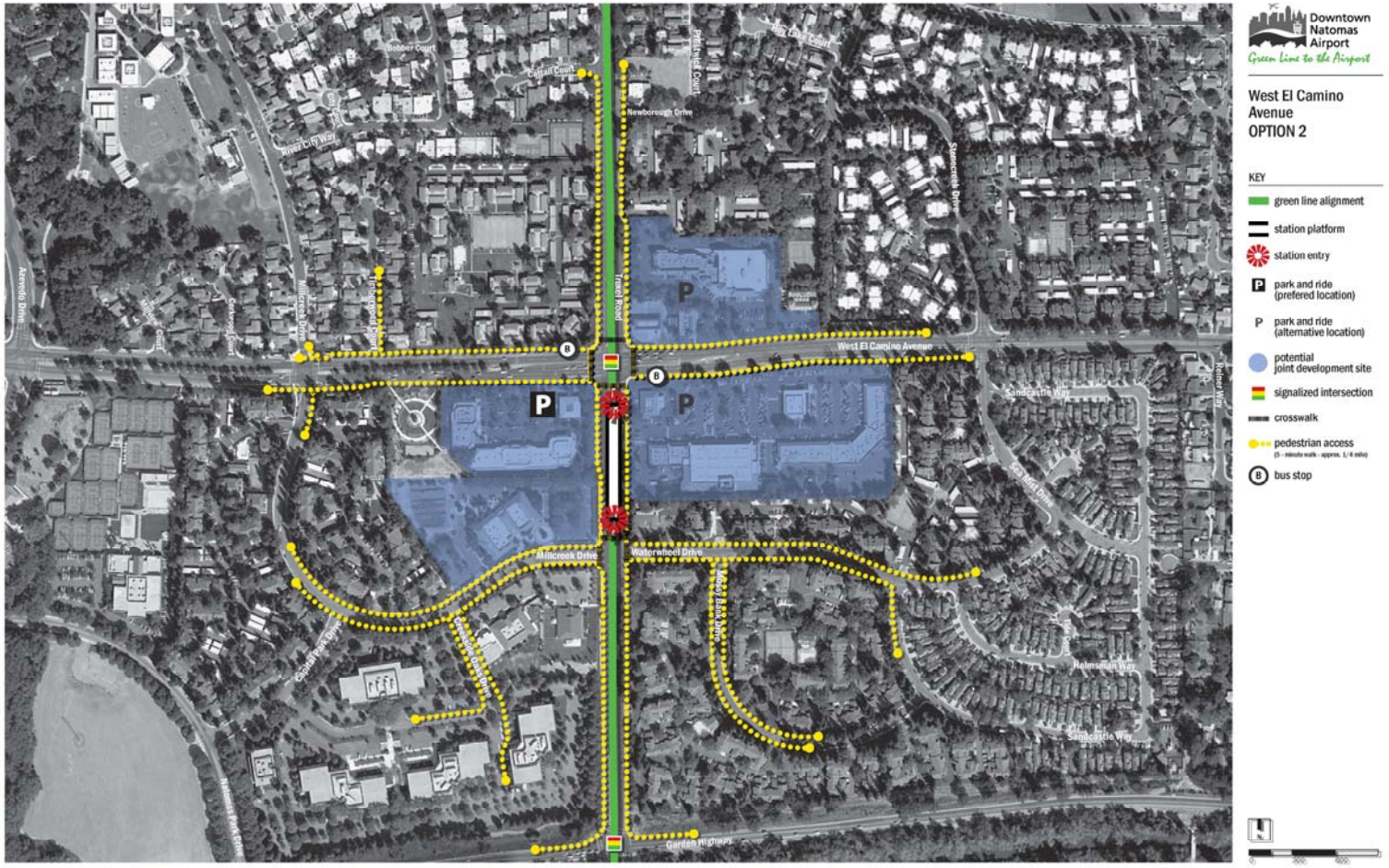


Figure 35: West El Camino Station (Option 2)



Pebblestone Way Station

Location

Truxel Road north of Pebblestone Way.

Station Type

Center (median platform) with one entrance at from Pebblestone Way crosswalk.

Land Use

The station will be located adjacent to the South Natomas Community Center, which is situated in predominately single-family residential area that contains approximately 1,700 units within ½-mile of the station. The community center is a recent addition to the neighborhood, and shares the site with a highly-popular neighborhood park. The community center and park host a number of weekend activities and because of this there has been a high level of community support for having a station at this location.

Use of the station will be highly dependent on local use by existing residents and users of the community center because there will not be opportunities for development or redevelopment of transit-oriented uses near the station within the foreseeable future. Land use designation and zoning are expected to remain as they are and there has been a high level of resistance to expropriations for this or any other aspects of the project.

Access

Although there is an adequate established sidewalk network in the area, there are some cases where access for pedestrians could be improved if obstacles were removed. North of the station along Truxel Road there are a number of cul-de-sacs that are located on the east side of walls and fences. If access gates were established at these points, residents that live on these cul-de-sac streets, and streets further east in the neighborhood would not have to walk so far out of the way to find streets and sidewalks that have direct access to Truxel Road.

For bicycles, the intention is to have striped bike lanes along Truxel Road, and bicycle traffic on smaller residential streets would remain as is today. For disabled access, it is expected that any lack of sidewalk ramps or other impediments would be corrected during project design and construction.

For vehicles, it may be necessary to establish drop-off/pick up pullouts along Truxel Road in the vicinity of the station to prevent too much traffic in the community center. This will need to be designed carefully to work with proposed parking access as discussed below.

Amenities

Amenities for the station that will need to be included will primarily be oriented towards pedestrian and bicycle users, and should include abundant seating and areas protected from the elements, bicycle parking and lockers. Consideration should also be given to provision of short-term bicycle rental facilities.

Design Guidelines

The station should be designed and developed as a walk-up neighborhood station that caters to local residents. The scale and materials utilized should be complementary of the single-family residential architecture that exists, but at the same time recognize the need for visibility, system identity and wayfinding.

Park-and-Ride

Ridership models identify a demand for parking at this location, but there are a number of issues and considerations that will require continued dialogue with neighborhood residents and stakeholders:

- There are currently 140 parking spaces planned to be located at the station. It is assumed these spaces would be constructed as an extension to the existing community center parking lot that follows a circular shape along the front of the building.
- How will possible traffic problems be resolved?
- Should this be shared parking with the community center or exclusive parking for RT?
- Depending on the arrangement chosen, how it will be managed and enforced?
- How will safety considerations be incorporated?

A Pebblestone Way Station diagram is shown in the following figure.

Figure 36: Pebblestone Way Station

San Juan Station

Location

Option 1: Truxel Road north San Juan Road.
Option 2: Truxel Road south San Juan Road.

Station Type

Option 1: Center median platform with one entrance on the south end from the San Juan Road intersection crosswalk, and the other entrance on the north end from approximately Mammoth Way and an alternative location for a park-and-ride facility.
Option 2: Center median platform with one entrance on the north from the San Juan Road intersection crosswalk.

Land Use

Predominant land uses within ¼ mile of the station area consists of multi-family residential at the NW and SE quadrants of the San Juan Road/Truxel Road intersection, a neighborhood commercial center at the SW quadrant of the intersection, and Natomas High School at the NE quadrant. The Sacramento 2030 General Plan does not call for any changes to these uses. However, similar to West El Camino Station, the existing retail area is designated in the 2030 Plan as a "Suburban Center" with allowable F.A.R. much higher than currently exists.

South Natomas is different from North Natomas with respect to the amount of new transit supportive development that can hopefully occur as growth in the corridor happens in the future. There are very few, if any, vacant parcels and the prospects for new development rely solely on the redevelopment of existing properties. There may be the opportunity at the SW corner of the intersection for redevelopment to occur, and if so, the property is large enough that a neighborhood-scale mixed use TOD could occur.

Access

Similar to El Camino and Pebblestone stations, the existing sidewalk network in the area is adequate to provide pedestrian access to the station. There may be some concern regarding the width of the sidewalks, especially near the intersections, because even today the area is crowded with students who use the crosswalks at San Juan Road to go to the Natomas High School. If redevelopment of the retail center were to occur, there would likely be even more demand for wider sidewalks, at least a block in

any direction from the station. Bicycle access is also expected to be good, and bike lanes will be included in Truxel Road when light rail is constructed.

For Option 1 where the station is located north of San Juan Road and includes a park-and-ride lot at Mammoth Way, a signalized crossing will be recommended to access the north entrance of the station at least from the west side of Truxel Road.

Amenities

Given the station's location within close proximity to Natomas High School, the retail center and multi-family housing, amenities that improve the transit experience for pedestrians and cyclists will be important.

Design Guidelines

The station should be designed and developed as a walk-up neighborhood station that caters to local residents. The scale and materials utilized should be complementary of the mix of surrounding architecture that exists, but at the same time recognize the need for visibility, system identity, and wayfinding.

Park-and-Ride

Park and ride is desired at this location and a need for 250 spaces has been identified. There are two options that have been discussed for the location of those spaces. One is at the location of the vacant lot near Mammoth Way on land dedicated to RT by a development approval, considering the station is developed north of San Juan Road. The other option locates parking at the SW quadrant of the San Juan Road/Truxel Road intersection, with the station located south of San Juan Road. Parking in this location would either be shared with the existing retail development primarily in what appears to be an underutilized parking area behind the retail center, and/or as part of a redeveloped TOD project.

San Juan Station diagrams for Options 1 and 2 are shown in the following figures.

Figure 37: San Juan Station (Option 1)

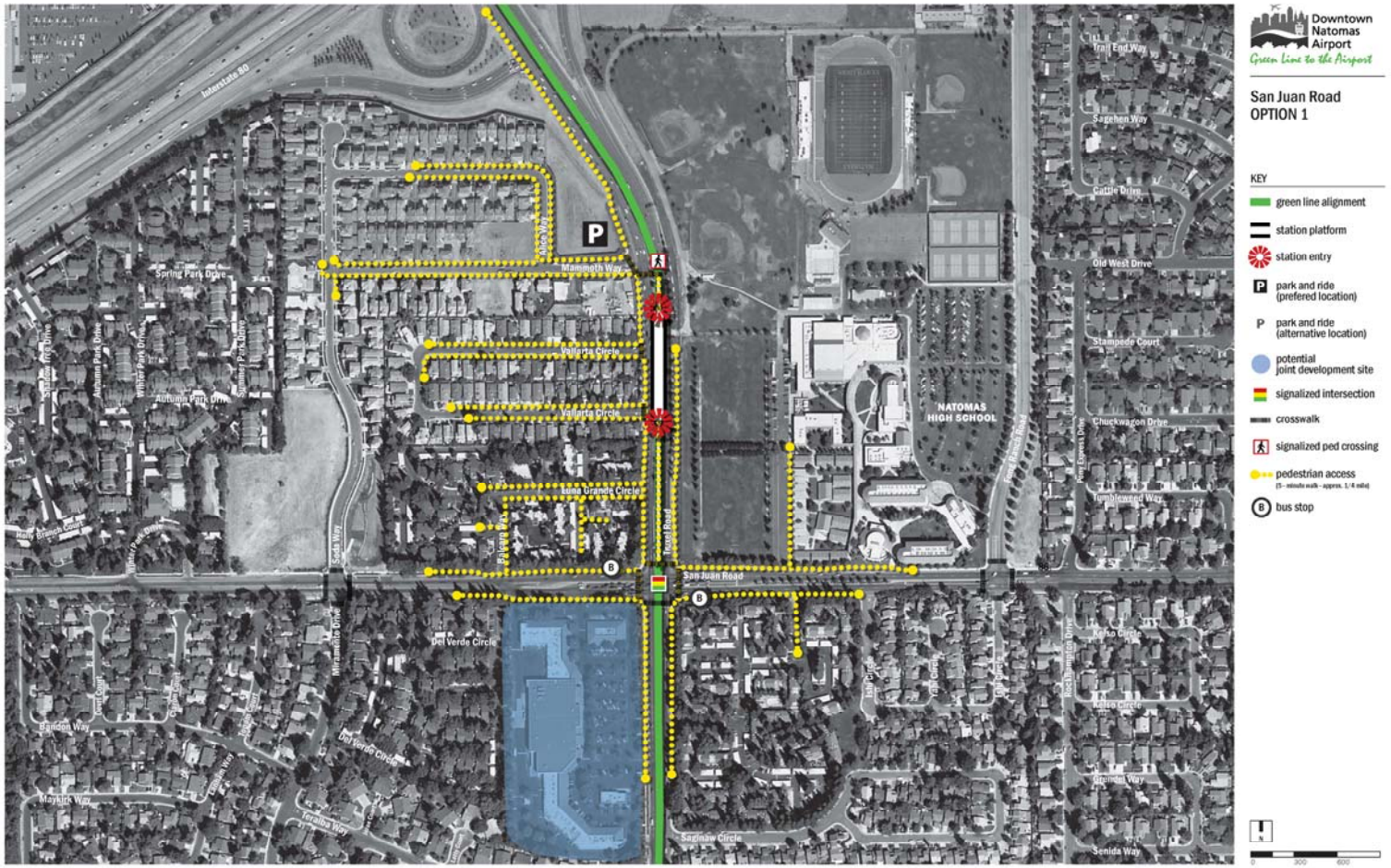


Figure 38: San Juan Station (Option 2)

Gateway Park Station

Location

A number of different concepts have been developed for the location of the elevated LRT guideway and station near Truxel Road and Gateway Park Boulevard. These alternatives were previously described in Section 3.0.

Station Type

Elevated station with side platforms.

Land Use

The Gateway Park station will be located in the core of a major auto-dominated regional commercial center. The North Natomas Community Plan, a specific plan for the 2030 Sacramento General Plan, calls for specific/unique uses and features in this area to include hotel and other travel commercial uses because of the proximity to I-80, and presumably so travelers can stay in the Gateway Park area and take LRT to destinations such as Downtown.

Interestingly, the Gateway Park area is not identified as an area receiving any specific designation such as an "opportunity area" or designation for special consideration like North Natomas Town Center, or even West El Camino Station's "Transform-Urban" designation. There are a number of developments planned in the Gateway Park area that primarily build out existing earlier phases of development and/or continue building upon established auto-oriented uses such as big-box stores and fast food establishments. This brings employment to the area and potential ridership increases, and thus could be considered transit-supportive given its walking distance from the station. However, there seems to be a lack of specific land use policy aimed at improving the physical arrangement of land use that better supports pedestrian friendly TOD.

Access

The station will be an elevated station with pedestrian access points from at least two quadrants of the Gateway Park Boulevard/Truxel Road intersection. Each of the access points will need to have and elevator and stairs, and consideration should be give in to having at least one access point be ramped. With future development at other quadrants of the intersection, additional access points could be added, so the station should be designed accordingly.

The Gateway Park Boulevard/Truxel Road intersection is a major vehicular crossing that is not pedestrian friendly. Careful consideration needs to be given to how the pedestrian environment and means for crossing the intersection can either be improved or prevented. The commercial area surrounding the station is definitely auto-dominated, but the development of a station in the intersection can serve as an opportunity to address pedestrian safety and access concerns.

Another important consideration for access is how bus transfers can occur, and with an elevated station this becomes a challenge. There will need to be direct vertical access from bus bays to the elevated station.

Amenities

The station and station environment will likely require increased amenities because of the high levels of ridership, the combination of being both a destination and origin of transit trips, and the elevated configuration of the station. Amenities should include: more seating opportunities, increase coverage or areas protected from the elements, more bike racks and lockers. Enhanced wayfinding will be important to lead people to the station and surrounding businesses and services. Information kiosks will be needed for tourists and visitors not familiar with the area.

Design Guidelines

There are a number of design considerations that are unique to this station because it is the only elevated station proposed on the Green Line. This coupled with problems of pedestrian access and safety, bicycle access, bus transfers and visual quality issues, presents a number of design challenges that will need to be overcome to make this station successful. Some of these challenges and possible solutions are summarized as follows:

- Although the aerial structure through the area will likely have a visual impact, it presents a unique opportunity to help provide identity and a sense of place if designed in a way to enhance the “gateway” that is implied by the name of the station. It truly can become a gateway to North Natomas and identify this important place along the Green Line.
- Making the area more pedestrian friendly will require design and construction of improved sidewalks, safety enhancements at intersections, public spaces and plaza areas, protection from the elements including canopies and shade trees, signs and other wayfinding devices, pedestrian-scale illumination, and in general, ways to mitigate the noise and appearance of Truxel Road.
- Revising land use policy to encourage future redevelopment to be more transit-oriented.

Park-and-Ride

There has been identified a need for 725 park-and-ride spaces to serve the station. Park-and-ride spaces were included as part of the original development approvals and are passed on to future owners as part of the development approval, but no recent discussion have occurred with local property owners about including these spaces on their property. There remain a number of issues primarily related to where exactly the spaces will be located and how they will be managed. Ideally the park-and-ride spaces will be located as close as possible to the vertical circulation elements that lead to station entrances, regardless of what side of Truxel Road they are.

Considering the volumes of vehicle traffic in the area, it will also be important to locate the parking so ingress and egress is visible and as free of delays as possible. This may or may not require separate entrances to the park-and-ride areas, and further analysis will be required. Additional considerations include how the parking might or might not be developed in conjunction with possible bus transfer areas, drop-off areas, or other vehicle-related aspects of the station development.

Gateway Park Station diagrams for Options 1, 2, and 3 are shown in the following figures.

Figure 39: Gateway Park Station (Option 1)

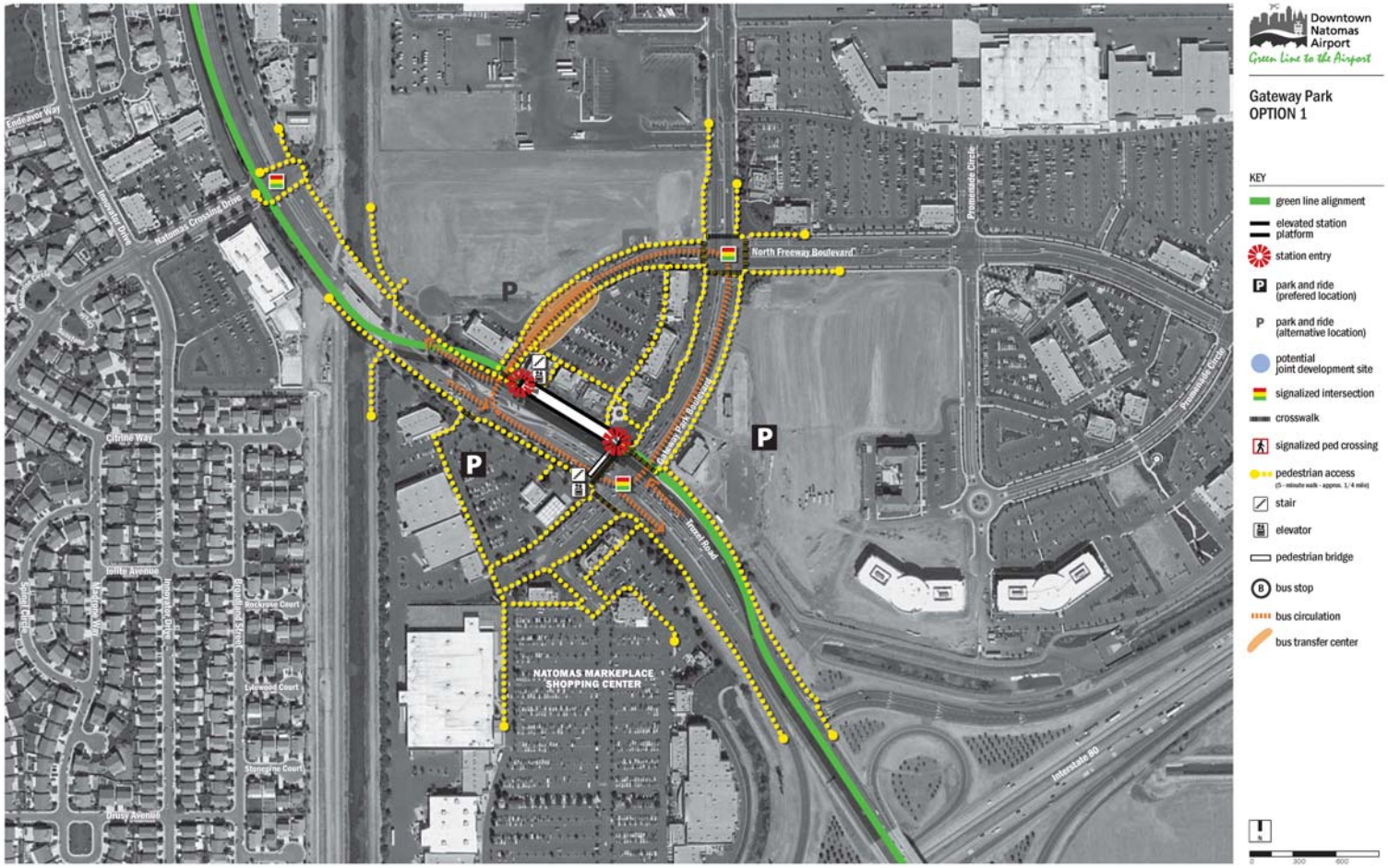


Figure 40: Gateway Park Station (Option 2)

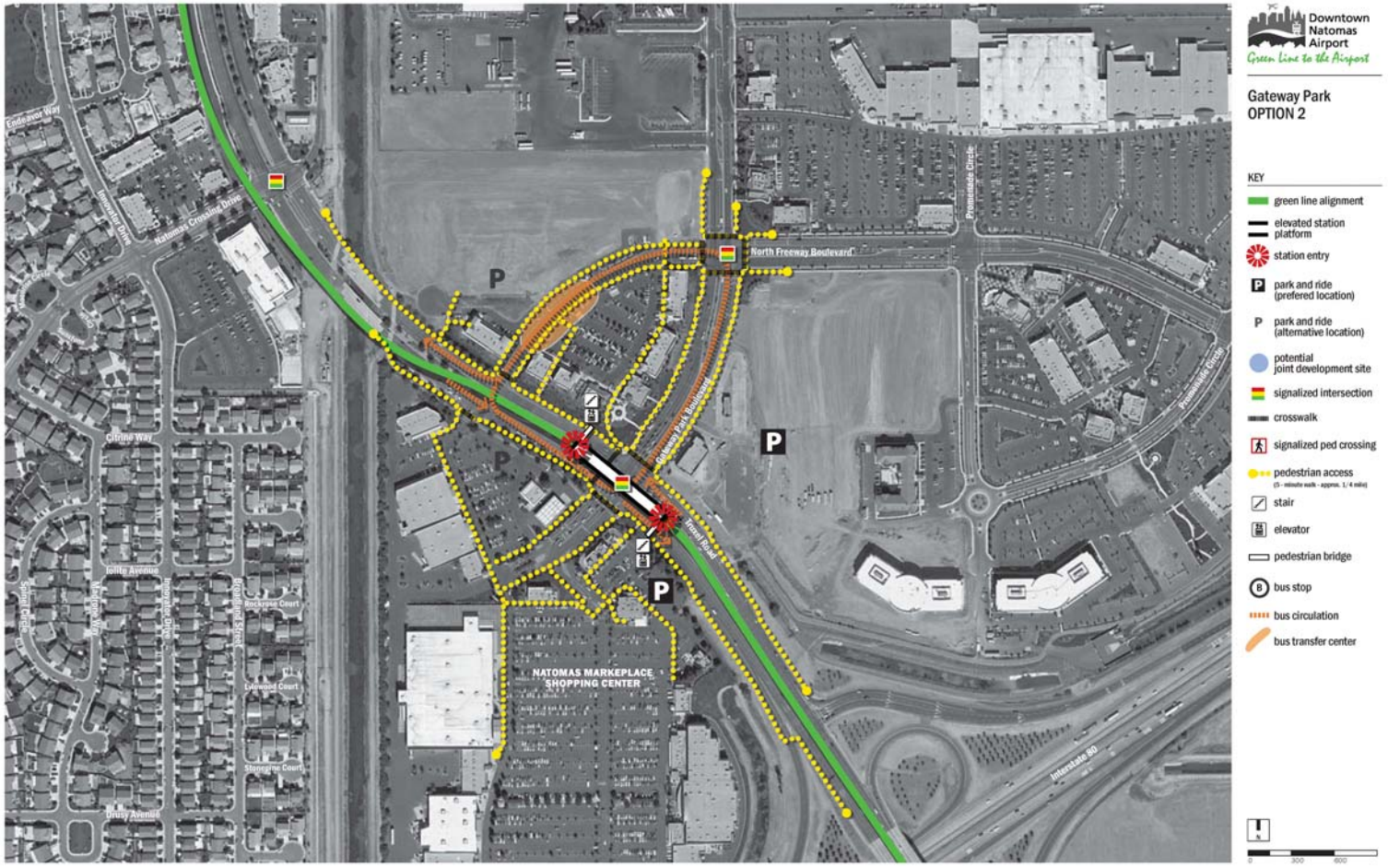
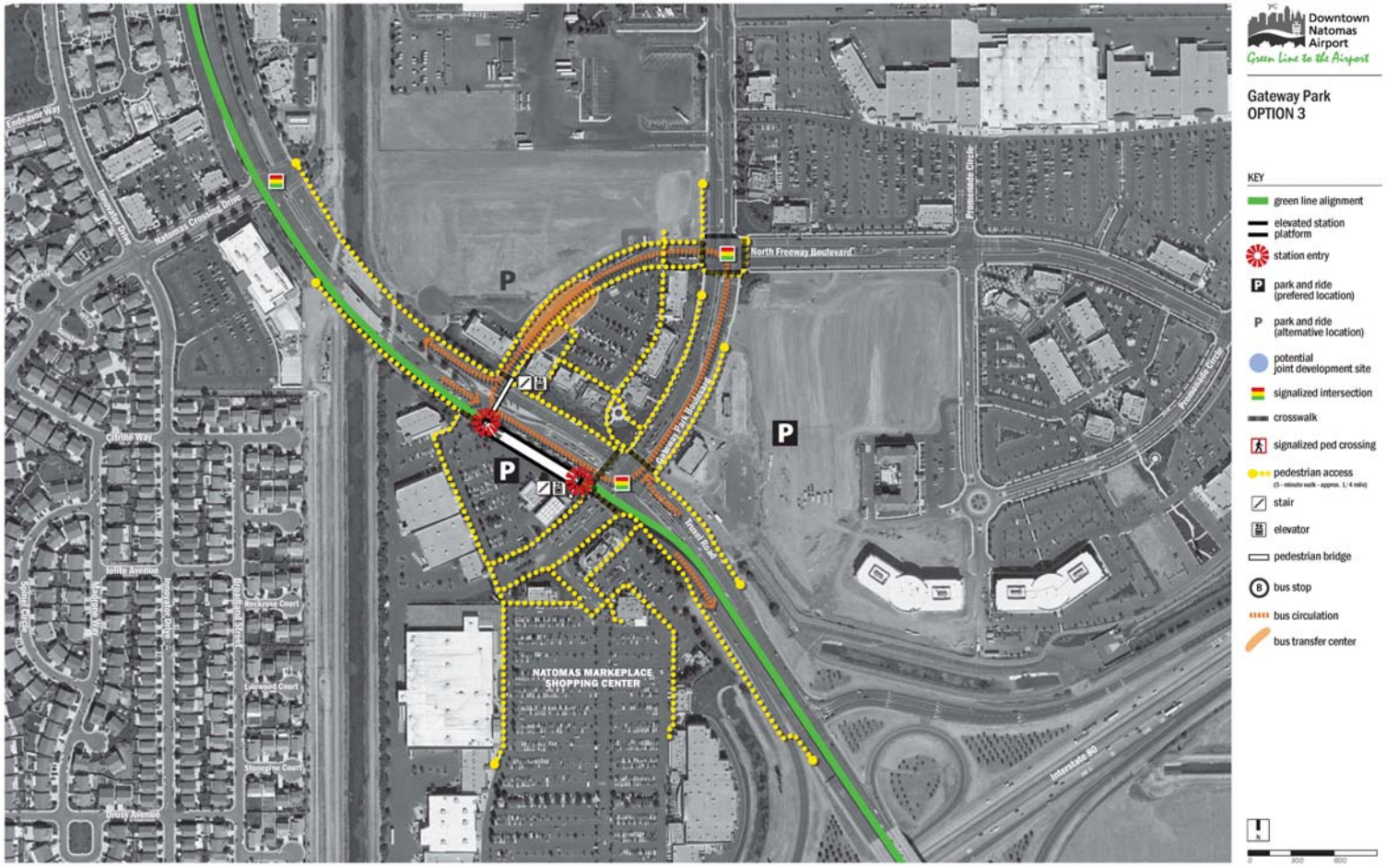


Figure 41: Gateway Park Station (Option 3)



Arco Arena Station

Location

West side of Truxel Road, south of the East Entrance to Arco Arena and 1/3 mile south of the intersection of Del Paso Road and Truxel Road.

Station Type

Side platforms (with tracks in center) with entrances at one or both ends.

Land Use

Designated as a "Sports Complex" station in Sacramento 2030 General Plan, Arco Arena is intended to continue to be a stadium/arena station and/or to be the center of intense employment uses. The station is located in the designated North Natomas growth area. It is bounded on the northeast and southeast by multi-family residential and on the south by a neighborhood commercial center. The station is bounded on the northwest, west, and east by vacant land. The large renovation or redevelopment site that houses Arco Arena, current home of the Sacramento Kings, sits to the west of the station.

Transit stations benefit most from intensive, mixed land use in the immediate station area. A renovated Arco Arena or a large mixed-use redevelopment project could be a major transit generator for special events and/or major employers. In addition, the region should make the most of the vacant land in the immediate station vicinity:

- Provide a mixture of uses (employment, commercial and residential) within walking distance of the rail station that have activity beyond 8am-5pm hours; that provide necessary community services, especially office uses; and are developed more intensely than surrounding areas.
- Per the North Natomas Development Guidelines (adopted 1994, amended 2003), residential projects should encourage a vertical mixture of uses within structures in the immediate proximity of the station, such as rental unit over retail, loft apartment over residence, or penthouse over apartments.

Access

The LRT route is along the major arterial street, Truxel Road, and this benefits the LRT with major developments sited along the street. However, the station area has a limited number of neighborhood

streets that offer opportunities for bicycle and pedestrian trips as well as auto trips. Future redevelopment should offer well connected streets with direct bicycle and pedestrian access to the station.

Amenities

The overall environment adjacent to the station area is dominated by the busy automobile traffic on Truxel Road. The region may choose to develop the following opportunities:

- A landscaped streetscape and multi-use path system would improve the pedestrian and bicyclist experience in accessing the LRT station.
- Future redevelopment should include multiple, direct pedestrian routes to access the station area.

Design Guidelines

The following actions will aid in the optimization of future development in the station area:

- Within the station area, guidelines should require buildings to be oriented to the street (rather than parking lots), to include direct pedestrian connections, and to include activity to engage pedestrian interest at ground level.
- A parking management plan should be developed for all developments within the station area to determine if shared parking or other management strategies can be utilized. This should include the development of shared park-and-ride spaces.

Park-and-Ride

Transportation models have identified the need for at least 1000 parking spaces in the North Natomas area, which can be split between the North Natomas and Arco Arena stations. The Green Line project identifies approximately 500-1000 parking spaces at the Arco Arena Station through shared use of Arena parking spaces during regular business hours, when not in use for special events. Discussions with property owner need to be completed to determine how many parking spaces could be used and where they could be located.

An Arco Arena Station diagram is shown in the following figure.

Figure 42: Arco Arena Station

North Natomas Town Center Station

Location

New Market Drive east of Town Center Drive, north of Del Paso Road and east of Truxel Road

Station Type

Center platform (with tracks on each side) with entrances at one or both ends.

Land Use

Designated as "Town Center" station in Sacramento 2030 General Plan, it is to be the center of the community; an intensified version of all uses, including commercial, residential, employment, civic and park uses. The station is located in the North Natomas Town Center area and within the Transform-Urban category of the Sacramento 2030 General Plan. It is bounded on the north by the largely undeveloped North Natomas Regional Park; to the south east by Inderkum High School, Los Rios Community College, and North Natomas Library; to the south by the future North Natomas Town Center; and to the west by multi-family residential development and a neighborhood commercial center. Additional single family residential development is located on the north beyond the Regional Park.

Transit stations benefit most from intensive, mixed land use in the immediate station area. Although civic uses have been sited in the station area, there are currently limited existing mixed use opportunities. In keeping with the 1994 North Natomas Community Plan vision of the Town Center, the region should take care to develop the following opportunities:

- Provide a mixture of uses within the Town Center area that are within walking distance of the rail station; have activity beyond 8am-5pm hours; provide necessary community services, especially office uses; and are developed more intensely than surrounding areas.
- Maintain current plan proposal to locate more intensive park features, such as the park administration center and aquatic center, on the south side of the Regional Park and within walking distance of the rail station.

Access

The station area has a relatively good network of connected neighborhood streets that offer opportunities for bicycle and pedestrian trips as well as auto trips. There are pedestrian benefits to the

siting of the station on New Market Drive in the heart of the future North Natomas Town Center. This also means that care will need to be taken to ensure that the station area provides sufficient access and visibility to attract the intense development called for in the land use plans.

Amenities

The surrounding station area has developed multiple pedestrian and urban design amenities. A multi-use path has been developed around the perimeter and across the Regional Park that includes landscape, pedestrian bridges, street furniture and public art. Surrounding residential developments to the north and west of the station area include multiple, direct pedestrian routes to access the station area.

Design Guidelines

The following actions will aid in the optimization of future development in the station area:

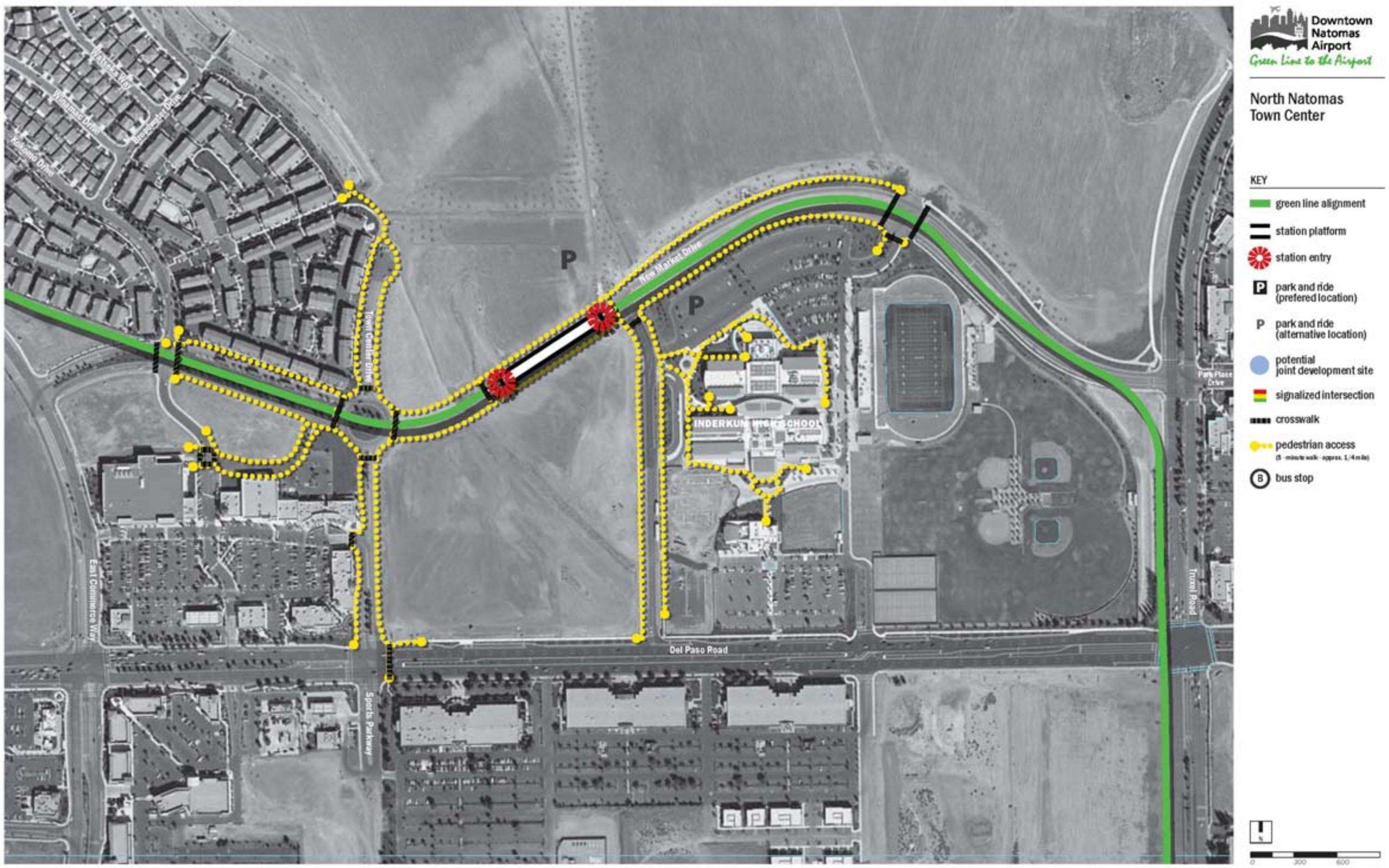
- Within the town center area, standards should require buildings to be oriented to the street (rather than parking lots), to include direct pedestrian connections, and to include activity to engage pedestrian interest at ground level.
- A parking management plan should be developed for all developments within the station area to determine if shared parking or other management strategies can be utilized. This should include the development of shared park-and-ride spaces.

Park-and-Ride

Transportation models have identified the need for at least 1000 parking spaces in the North Natomas area, which can be split between the North Natomas and Arco Arena stations. The Green Line Project plans provide approximately 500 parking spaces at the North Natomas Town Center Station through shared use of civic use parking facilities.

A North Natomas Town Center Station diagram is shown in the following figure.

Figure 43: North Natomas Town Center Station



Club Center Station

Location

East side of East Commerce Way north of North Park Drive and south of Club Center Drive, east of the I-5 freeway.

Station Type

Side platforms (with tracks in center) with entrances at one or both ends.

Land Use

Designated as a "North Village Center" station in Sacramento 2030 General Plan, it is primarily a mixed use development and residential neighborhood station. The station is located in the designated North Natomas growth area and within the Transform-Urban category of the Sacramento 2030 General Plan. It is bounded on most sides by greenfields slated for future mixed use (office, retail and residential) development. H. Allen Hight Elementary School is located to the south of the station. There is some single family development several blocks to the north and there is extensive single and multi-family development several blocks to the southeast. The ½ mile area surrounding the station is projected to have 1400 housing units in 2035.

Transit stations benefit most from intensive, mixed land use in the immediate station area. The region should take care to develop the following opportunities:

- Provide a mixture of uses within the station area that are within walking distance of the rail station; have activity beyond 8am-5pm hours; provide necessary community services, especially office uses; and are developed more intensely than surrounding areas.
- Per the North Natomas Development Guidelines (adopted 1994, amended 2003), provide a mixture of housing types and densities within the neighborhoods within walking distance of the station;
- Per the North Natomas Development Guidelines (adopted 1994, amended 2003), encourage vertical mixture within the same structure, such as rental unit over retail, loft apartment over residence, penthouse over apartments in the immediate proximity of the station.

Access

Adjacent developments to the station area have a relatively good network of connected neighborhood streets that offer opportunities for bicycle and pedestrian trips as well as auto trips. Future development should continue to offer well connected streets with direct bicycle and pedestrian access to the station.

Amenities

Adjacent North Natomas neighborhoods have developed multiple pedestrian and urban design amenities (e.g. the North Natomas Regional Park area). Future development should include direct and shaded pedestrian routes to access the station area.

Design Guidelines

The following actions will aid in the optimization of future development in the station area:

- Within adjacent station area, guidelines should require public or commercial buildings to be oriented to the street (rather than parking lots), to include direct pedestrian connections, and to include activity to engage pedestrian interest at ground level.
- A parking management plan should be developed for all development immediately adjacent to the station to determine if shared parking or other management strategies can be utilized. This should include the development of shared park-and-ride spaces.

Park-and-Ride

Transportation models have identified the need for 40 parking spaces, which have been stipulated as part of the development process.

A Club Center Station diagram is shown in the following figure.

Figure 44: Club Center Station

Airport Station

Location

On Sacramento International Airport property, between Terminals A and B.

Station Type

Center platform (with tracks on each side) with entrances at one or both ends, and also a side platform to allow for additional operational flexibility and passenger queuing.

Land Use

The station is located in the Sacramento International Airport, which carries over 10 million passengers annually. In 2008, the Airport began a $1.08 billion terminal modernization project that will add 680,000 square feet and a people mover to the airport. Airports provide tremendous opportunities for linking national and regional trips to the regional LRT system. Adding a mixture of supportive commercial and retail opportunities with convenient access to the Airport LRT station will enhance this connection.

Access and Amenities

To fully develop the potential of the airport station, the following actions should occur:

- There should be convenient and direct access from the station platform to both the ticketing facilities and to the baggage claim areas of the Airport.
- Vertical circulation and pedestrian paths should take into consideration the additional needs of passengers with baggage and the needs of persons with disabilities.

Design Guidelines

The following actions will aid in the optimization of development in the station area:

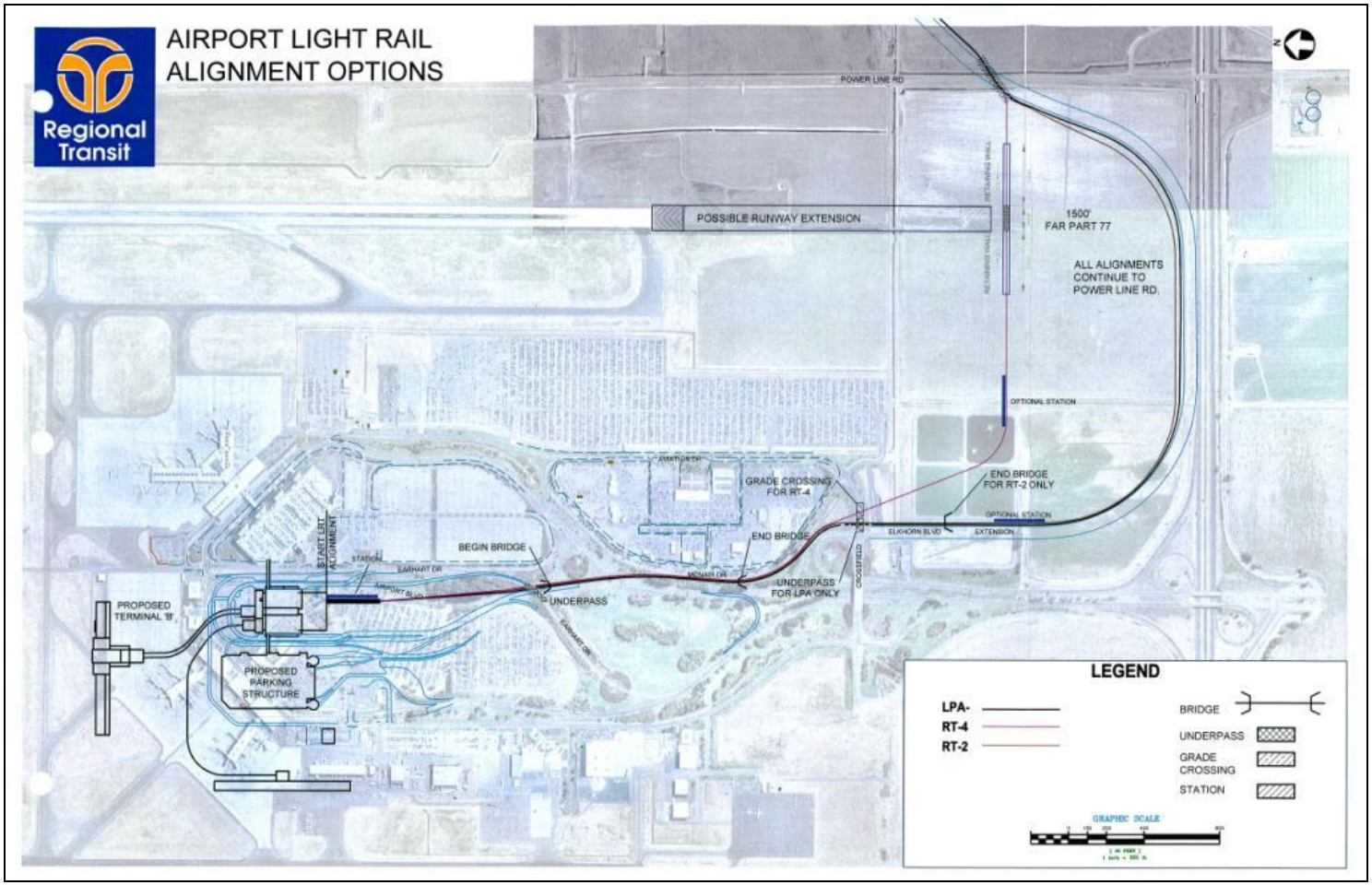
- Station wayfinding signs will be critical to direct passengers to appropriate areas of the Airport.
- Options should be investigated for the integration of transportation services to the car rental facility with the LRT line as part of an overall parking management plan.

Park-and-Ride

No park-and-ride spaces are anticipated.

An Airport Station diagram is shown in the following figure.

Figure 45: Airport Station



8.3 Context Sensitive Design Considerations

During the Green Line Community Review in August 2010, over 100 residents participated in exercises designed to update the community on possible station locations and configurations, proposed traffic engineering options, and urban design and art program initial phases. The process included several targeted meetings earlier in the month and a week long "drop in" community workshop. The following context sensitive directions are gleaned from this process as indicators of community preferences. However, due to the "drop in" nature of the process, it should be noted that the directions are usually the result of 15-30 people at a time contributing their insights. The overall sense was of a community that has continued support for the Green Line and that among the various interest groups there are several common themes that emerge.

Station Locations

More Desirable Station Locations

There are some station locations that won stronger levels of support. Pebblestone Way was supported by many South Natomas residents because it is seen as the "heart" of the community and reflects a desire to prioritize neighborhood connections. This was balanced by a concern that there should be a minimal park-and-ride presence (incorporated into existing community center parking), so that traffic would not be disrupted in this already established neighborhood. In addition, North Natomas Town Center and Arco Arena were supported because of the major uses located at the proposed stations and San Juan was identified as a strong location because of the adjacent high school.

Less Desirable Station Locations

Some station locations were seen as less strategic because they are in less built out areas or areas that may become stronger with future development or redevelopment: Arena Boulevard, Arco Arena, and East Town Center.

Truxel Road (South Natomas): Roundabouts or Shared Left Turns

Both roundabouts and shared left turns have been investigated as solutions that would allow the project to fit required traffic movements into intersections along Truxel Road in South Natomas without significant widening. Shared left turns (where LRT vehicles would move through the intersection within the left turn lane while traffic is delayed at a signal) were seen as a solution that would minimize right of way takings, but there was some confusion as to how the signaling would work. Roundabouts prompted

concerns regarding pedestrian crossings and need for larger right of way, but could serve as a gateway feature for the community.

Elevated Station Location: Gateway Park

Further development of the Gateway Park station locations will be required. Residents were shown options located on the west, center, or east sides of the intersection. In general, the west side of the intersection was preferred, because it is closer to existing uses. There was some interest in moving the station north of the intersection and desire to enhance pedestrian/bicycle connections across Truxel Road. Additionally, there was concern over the capital cost of the station and a sense that the station design is a landmark opportunity.

Station Neighborhood Fit

In general, the strongest community concerns were that pedestrians would be considered first in traffic movements around the station and this was coupled with a desire for improved bicycle and pedestrian access. There are very few station platforms in the center of the roadway in the RT LRT system. This led to concern and requests for further information on pedestrian safety at the intersections and in accessing the platforms.

Station Environmental Design Factors

There are many environmental factors that can contribute to the design of a station. The highest priority factor that was highlighted by residents was that safety and security would be provided at stations through Crime Prevention through Environmental Design (CPTED) principles. The next highest factors included: well lit connections, bicycle access and facilities, weather protection, reduction of energy through alternative sources, opportunities for TOD, and transit route and system information.

Public Art Program Initiation

Residents and an artist working group were asked the following questions about public art and the Green Line project:

- Why do you feel public art is important?
- What makes the Green Line area distinctive?
- How should artists be selected?
- What is the purpose, mission or function of public art?

Responses were varied and offer a range of insights and direction for the development of the Green Line public art program. In terms of artist selection, most desired the involvement of residents, community members, arts professionals, and RT.

9.0 FINANCE PLAN

This section includes the financial analysis of the Green Line project. A financial analysis was completed to determine the financial capacity needed to compete for Federal funding in New Starts. The analysis determined that the Green Line to the Airport could be built and operated by RT with the addition of a new revenue source equivalent to a one-half cent sales tax collected within Sacramento County.

9.1 Assumptions

This section describes the overall assumptions used in the Financial Forecasting Model (FFM). The FFM analyzes the financial feasibility of the Green Line project. The FFM assumes that recent RT service reductions are restored.

Operating Assumptions

The O&M costs and revenues in the FFM assume a new half cent sales tax measure, Measure B, is placed on the ballot in November 2012.

- It is assumed that 80% of Measure B would flow to Sacramento RT, as flexible funds that can be used for either operating or capital costs.
- Collection would begin in April 2013. This would result in FY 2013 receiving 25% of the annual allocation of the revenues.
- Starting in FY 2014, RT would receive a full year of its share of the sales tax revenue.
- The projected FY 2011 Measure A revenues were used to estimate new Measure B revenue beginning in FY 2013. It is assumed that Measure A and Measure B grow at the same rate.

The passage of Measure B and resulting financial capacity allows for a number of operating changes:

- RT service is restored in FY 2014, 3 years earlier than without Measure B.
- Bus service is enhanced in FY 2015 and FY 2016, doubling the growth in miles and hours.

Measure B revenues are also used to fully fund the increased reserve costs. The FTA has recommended 1.5 months worth of annual O&M costs. With the changes to the operating model described here, the amount of the needed reserve has increased. After all O&M budget needs are met, as outlined above, the remainder of funding flows to the capital portion of the FFM.

Capital Assumptions

The FFM assumption for the flow of surplus operating funds to the capital program permits for accelerated programs.

- Green Line to North Natomas Town Center is completed in FY 2018, while Green Line to the Airport is completed in FY 2021.
- Starting in FY 2021, after Green Line is completed, the annual capacity in the capital program ranges from a deficit of $28.6 million to a surplus of $94.1 million. The average annual capacity is $53.6 million. The remaining total capacity of the program (from FY 2021 to FY 2030) is $519.0 million.

Implications and Further Considerations

The capital program runs a deficit for 3 years: FY 2019, FY 2020, and FY 2021. To be successful in the pursuit of New Starts funding for the Green Line, this shortfall would need to be addressed. One approach includes the issuance of some form of debt. This would reduce the overall capacity of the program due to the need to pay debt service (principal and interest). Another approach would be to delay operating service increases or capital projects until after the projected years of deficit.

9.2 Financial Forecasting Model Results

The cost of the Green Line to the Airport places a demand on revenue which limits what can be spent on other RT projects during project development and construction. The following table shows the capital funding plan for the Green Line to the Airport. It assumes the restoration of RT service due to recent budget reductions and excludes the Green Line to the River District.

Table 39: Capital Funding Plan (Airport)

Revenues	**Total**
New Starts	$428,388,500
Airport Contribution	$77,627,000
Developer Fees	$32,000,000
Measure B	$318,761,499
Total Revenues	**$856,776,999**
Capitol Costs (YOE)	$856,777,000

The FFM included a financial evaluation of a Green Line that is a New Starts project to North Natomas Town Center and a non-New Starts project to the Airport. The North Natomas Town Center option is less costly and requires about half of the local revenue needed for the option continuing to the Airport. This results in more funding for the expansion of the rest of the regional transit system while the Green Line is being built. The following table shows the capital funding plan for the incremental construction of the Green Line to the Airport with the Natomas Town Center segment being built first.

Table 40: Capital Funding Plan (North Natomas Town Center and Airport)

North Natomas Town Center	
Revenues	**Total**
New Starts	$272,448,000
Developer Fees	$29,000,000
Measure B	$243,448,000
Total Revenues	**$544,896,000**
Capital Costs (YOE)	$544,896,000
Airport	
STP/CMAQ	$20,000,000
Airport Contribution	$77,627,000
Developer Fees	$3,000,000
Measure B	$252,395,223
Total Revenues	**$353,022,223**
Capital Costs (YOE)	$353,022,223

The analysis of the North Natomas Town Center option indicates ample revenue to build the Green Line, implement service restoration, and implement some Transit Action Plan projects.

10.0 RECOMMENDATIONS AND NEXT STEPS

This section outlines the recommendations and next steps for advancing the Green Line project.

10.1 Recommendations

Funding and Implementation Strategy

The Transitional Analysis concludes that RT can build and operate the Green Line to the Airport. The project falls within a Medium rating for FTA New Starts, has considerable community support, will significantly increase transit system ridership, and can be completed through an aggressive planning and construction schedule.

It is recommended that the funding for the project be approached as follows:

- Green Line option to North Natomas Town Center with 50% New Starts funding.
- Pursue a new local funding source that will provide matching Federal funds.
- Combine the new funding source with Federal funds from non-New Starts sources and a contribution from the Airport to extend the Green Line to the Airport.

The rationale for this recommendation is based on many factors, including:

- The CEI, perhaps the most important of the Project Justification ratings in New Starts, is projected to be Medium for both the North Natomas Town Center and the Airport options. A CEI of Medium is considered adequate for entry into New Starts. The Medium rating for North Natomas Town Center is very strong and will not likely change during the course of the project development, while the Airport rating poses some risk. A number of things can change a CEI rating through the project development process; the North Natomas Town Center option is much more likely to hold its Medium rating through Final Design.

- The Federal contribution for a New Starts project is usually apportioned annually. Experience has indicated that it is reasonable to expect an annual Federal apportionment no larger than $100 million for an area the size of Sacramento. The projected annual apportionment for the North Natomas Town Center is $90 million for 3 years; for the Airport it is $145 million for 3 years. Achieving the funding required beyond the $100 million amount will require RT to provide financing, thereby increasing the cost of the local match for the project.

- The Airport will provide funding for the extension of the Green Line on Airport property. Airport representatives have indicated that bonding capacity will not be available until at least 2017.

- The experience of other transit properties in building airport extensions is that the design and approval process is significantly slowed by Federal Aviation Administration (FAA) involvement due to security concerns. This could negatively affect the schedule of the entire Green Line project, if it were all to be built at once.

- The incremental construction of the Green Line to the Airport will allow additional financial capacity to make improvements to the bus network while the Green Line is under construction. Implementing the entire project at this time will not allow for investment in the transit system beyond the Green Line.

It is recommended that construction to the Airport start in FY 2018, immediately after completion of the New Starts project to North Natomas Town Center, and when Airport funding is in place.

Engineering and Urban Design Improvements

American River Bridge

Significant cost savings were identified for the American River Bridge by changing the assumed bridge type from a cast-in-place segmental bridge to a precast concrete girder or steel girder bridge. These bridge types make use of the construction road necessary to construct the bridge foundations and bridge columns. The disadvantage is that significantly more of the construction activities depend on non-flooded conditions in Discovery Park and rely on hope that a sensitive species will not decide to lay a nest near the construction site. Alternatively, since the last study was completed, structural engineers have discovered ways to design pre-cast segmental bridges to meet California seismic requirements. For a 20% or a $7.5 million increase in bridge cost, the flood or biological risks associated with the superstructure construction could be eliminated, which is still a significant cost savings over cast-in place segmental.

The American River Bridge would be designed and built to ultimately carry northbound and southbound tracks. Initially it would have a single track on one side of the bridge, and the other side would have a sidewalk and a northbound and a southbound bike lane. The single track bridge will support 15 minute train service. Long term, if a roadway bridge is built nearby, the bike lanes and sidewalk could be provided on the roadway bridge, and the LRT bridge could be double-tracked.

Truxel Road (South Natomas)

Design changes in South Natomas did not result in construction cost savings, but were nonetheless valuable because they identified a feasible way to incorporate LRT tracks into the median of Truxel Road without significant roadway widening or impact to traffic, while providing reliable and relatively fast LRT service. The tracks are assumed to be in the center median of Truxel Road with center platform stations and shared left turn lanes.

I-80 and Gateway Park Boulevard Crossings

The recommended design refinement takes advantage of the existing Truxel Road Bridge over I-80. Feasibility, traffic operations, and LRT operations are significantly improved by this option which accommodates exclusive LRT tracks in the median of the bridge by shifting traffic lanes out and widening the existing bridge. The LPA from the previous AA recommended a separate LRT bridge crossing I-80. The cost savings generated from eliminating the LRT bridge were put back into the project to elevate the tracks over Gateway Park Boulevard. An elevated platform at this location and an elevated pedestrian bridge across Truxel Road eliminates significant conflicts between trains, pedestrians, and the very high traffic volumes at this intersection.

Stations

There were small improvements found in FTA Transportation System User Benefits (TSUB) by deferring the stations that were generating the lowest ridership: Arena Boulevard, East Town Center, and Commerce Parkway. Travel time savings per station deferred is approximately 35 to 45 seconds. While this is not enough to save a train set and have a major impact on operating cost, the TSUB is the product of ridership and travel time savings, and deferring these stations improves TSUB by about 3%.

Parking

Parking supply in South Natomas was kept the same as it was in the Program EIR based on prior community concerns that additional parking supply might attract drivers from outside of South Natomas. It is assumed that parking in South Natomas will be provided in three different ways. First, the City of Sacramento would expand their parking lot at the South Natomas Community Center by 140 spaces and make those available for park-and-ride use. Second, RT would solicit proposals from the owners of the shopping centers near West El Camino and San Juan Road that in exchange for what it would cost to build structured parking, RT would contribute that sum toward the redevelopment of the shopping center and use of the necessary parking spaces. Third, RT will either be able to make use of the 2 acre parcel that they own on the west side of Truxel north of San Juan Road with the approval of a

new traffic signal at Mammoth Street, or RT will be able enter into an agreement to lease excess surface parking from one of the shopping centers.

Parking supply in North Natomas was increased by 215 spaces to match the demand for park-and-ride and increase ridership. Parking at Gateway Park Boulevard was assumed to be exactly what is required to be provided by the developers to the west and to the east of the station. The prior assumption that additional structured parking would be provided at Gateway Park has been eliminated. The additional 1,000 parking spaces shown by the ridership model as being needed in North Natomas are split evenly between Arco Arena and North Natomas Town Center. It is assumed that it will be possible to have an agreement for shared use parking during non-event periods with Arco Arena, and it is assumed that it will be possible to have an agreement with the City of Sacramento for RT to construct shared-use parking spaces on City property at North Natomas Town Center.

Single Track

The Green Line project has been planned to ultimately be double-tracked from end-to-end. The operations plan produced run-time estimates and string line diagrams that identified locations where southbound and northbound trains will pass so that single-track segments could be identified. It is possible to provide 15-minute service with single track located: 1) on 7th Street through Railyards, 2) across the American River, 3) from the end of the Gateway Park Viaduct to just past the former East Town Center station site, 4) from the former Commerce Parkway station site past the Greenbriar Station, and 5) from end of runway to just before the Airport Station. Longer segments of single-track could have been proposed, but the shared left turn concept in South Natomas does not work with a single track alignment, and it would have too much of an impact to retrofit areas of single track within streets or on the Gateway Park Viaduct. With the exception of Railyards and the American River Bridge, the areas identified for single-track are exclusive right-of-ways that can be easily modified.

Urban Design/Community Integration

The design elements presented and well received at the community review workshops are included in the cost estimates, including grass or paved track, the replacement of wood privacy fences in South Natomas, and the procurement of new low-floor streamlined European tram-type vehicles.

10.2 Next Steps

There are significant steps ahead to secure funding through the FTA Section 5309 New Starts program. The next milestone in the FTA process is Approval to Enter Preliminary Engineering (PE), which requires a review of quantitative and qualitative measures used to determine the eligibility of the project to compete for New Starts funding.

Formally requesting entry into PE requires the submittal of documentation addressing specific criteria. One of the more important sections of the required documentation is the financial capacity of the transit agency. Without a new local source of funding, RT will not have the financial capacity to build and operate the Green Line until after FY 2022. In order for the project to be completed earlier than 2028, it would be necessary to pursue and obtain a new revenue source. Until this revenue source is secure, it is not likely that FTA would approve entry into PE. In addition, RT will need to discuss with FTA that it plans to apply the cost of the Green Line to the River District as local match for the New Starts project.

The project can be moved forward by completing the Project Specific Environmental Impact Statement and Report (EIS/EIR) and performing advanced conceptual engineering as necessary to support this effort. This will put the project in shovel-ready position for future Federal grant programs. A combination of Proposition A and Federal grant funds for the Green Line project could be used for this purpose. The FTA would have to approve the use of the grant for this purpose, and they would need to agree to issue a Notice of Intent and agree to process the EIS document. The immediate next steps would be to meet with SACOG and then FTA to present the findings of the Transitional Analysis and secure their agreement to move forward with the environmental document. The environmental document could be completed over a two-year period in parallel with the effort to secure a new revenue source.

Once a new local revenue source is obtained, the documentation required for requesting entry into PE should be compiled and submitted to FTA. The FTA will need to review and approve the Baseline Report, and will need a complete set of the New Starts Project Justification Templates, and the project readiness documents on FTA's PE Checklist, such as the Project Management Plan, Rail Fleet Management Plan, Safety and Security Management Plan, and Before and After Study. Each FTA approval milestone needs to be planned well ahead and sufficient time needs to be allocated for its completion.

Given the advanced conceptual engineering completed in support of the environmental documents, and the advancement of the engineering achieve during the Transitional Analysis, the requirements for PE can be completed in one year. Assuming that all possible project variations have been exhausted

through the Transitional Analysis and the project configuration is firmly established, the preparation of final design plans, specifications, and estimates can be completed in one year. What will take the most time will be acquiring the various permits, approvals, agreements, and right-of-way that will be necessary to proceed, and it is recommended that each required item be tracked separately and may start during the PE phase.

Given that the schedule from the completion of the NEPA document to construction is more likely to be controlled by the permits, approvals, agreements, and right-of-way acquisitions than the actual preparation of plan sheets and design details, it is recommended that completion of final design occur before procuring the construction contract. It is believed that bid prices will be lower if the contractor is not taking on the risk of bidding a project with unapproved drawings. However, it is recommended that the project incorporate some of the procurement practices used in design-build that give the contractors an ability to influence the design and contract language by expressing concerns and proposing changes that would allow them to submit a more competitive bid. It is recommended that there be the use of pre-qualification, one-on-one meetings, and time in the bid schedule for design changes and the issuance of addenda as needed to take advantage of the valuable feedback obtained from the pre-qualified contractors. This up-front interaction with the contractors before the bids are opened should lead to a collaborative partnering relationship with the contractor rather than the sometimes adversarial relationships that come out of the low-bid process where a contractor feels they had no chance to influence an owner's one-sided contract.

The recommendation is to follow the standard design-bid-build process rather than use an alternative delivery method such as design-build. It is not anticipated that there will be a schedule or price advantage by going to design-build, and we believe that we have a better opportunity to reduce project risks during the final design period than could be transferred to a design-builder.

Construction is expected to take three years. The construction schedule would be controlled by the construction of the American River Bridge and Gateway Park Bridge with the elevated station. While there are areas of the project that will not require much work before track is laid (the dedicated right-of-ways in North Natomas), it is anticipated that track crews would start in these areas, followed by the median running segments in South Natomas, and finish with the bridges.

Vehicle procurement would start after the Full Funding Grant Agreement (FFGA). Assuming six months for procurement, six months of preconstruction activities, and six months of production before cars start coming out of the factory, and then deliveries of three vehicles a month comes to two and a half years, which would be completed six months prior to the end of construction.