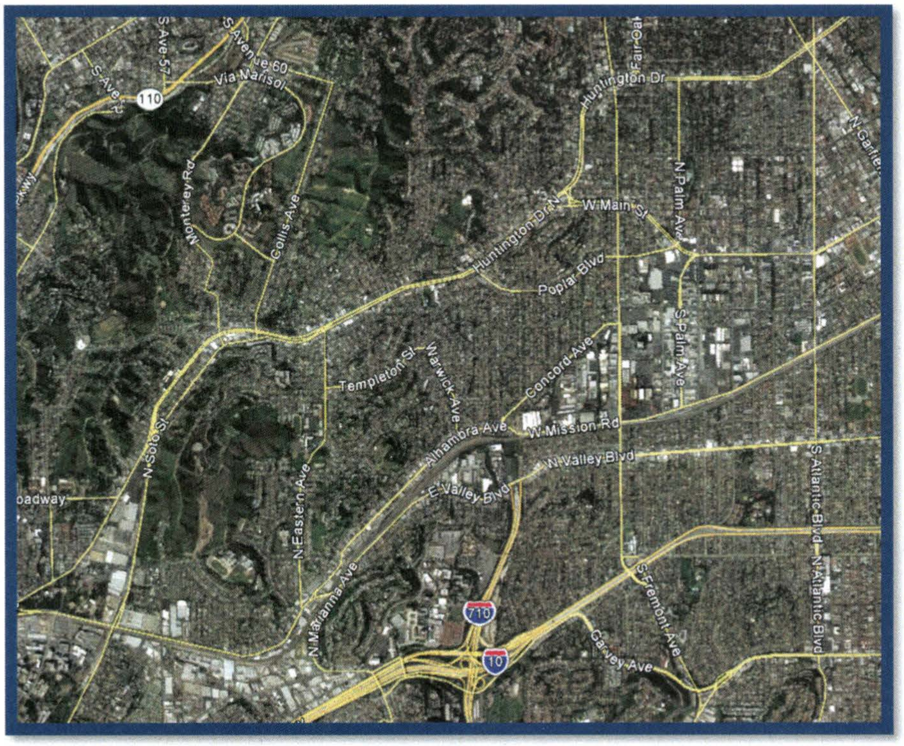
Final
Value Analysis Study Report



District 7, SR 710 North Study
Los Angeles County, California

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Value Analysis — Value Through Teamwork — California Department of Transportation

Metro
Los Angeles County Metropolitan Transportation Authority

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April 2014

Caltrans

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April 14, 2014

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Ms. Michelle Smith
Metropolitan Transportation Authority
One Gateway Plaza
Los Angeles, CA 90012-2952

Subject: Final VA Study Report, District 7, SR 710 North Study

Dear Ms. Smith:

This final report summarizes the results and events of the study conducted March 11 to 14, and March 25 to 27, 2013, at the Caltrans District 7 office. This report concludes the VA Study.

If you have any questions or comments concerning this final report, please do not hesitate to contact me at (208) 383-6299.

Sincerely,

CH2M HILL

Paul Johnson

Paul Johnson, CVS
VA Study Team Leader

c: John K. Lee, PE, PMP, Caltrans Project Manager
Albert Andraos, PE, Caltrans District 7 VA Coordinator
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FINAL VA STUDY REPORT

The Final VA Study Report documents the VA Study results and key supporting project information to put into perspective the results of the study and rationale for implementing or rejecting the various VA Alternatives. The results documented in this report are reported to FHWA and used in the Annual Report of the Caltrans VA Program.

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FINAL

ACRONYMS AND ABBREVIATIONS

AA	Alternatives Analysis
AB	aggregate base
ADA	Americans with Disabilities Act
ADS	Alternative Delivery Strategy
BRT	Bus Rapid Transit
Cal State LA	California State University, Los Angeles
Caltrans	California Department of Transportation
CEQA	California Environmental Quality Act
CM/GC	Construction Management/General Contractor
CMAR	Construction Management at Risk
DB	design-build
DBB	design-bid-build
ECI	Early Contractor Involvement
EMS	Enhanced Message Sign(s)
FAST	Function Analysis System Technique
FHWA	Federal Highway Administration
FLS	fire life safety
FT	freeway tunnel
GHG	greenhouse gas
HDM	Highway Design Manual
HOV	high-occupancy vehicle
HQ	Headquarters
I	Interstate
ID	Internal Design Diameter
ITS	Intelligent Transportation Systems
LCC	life-cycle cost
LCD	liquid crystal display
LED	light-emitting diode
LOS	Level of Service
LRT	light rail transit
LRTP	Long-Range Transportation Plan
Metro	Los Angeles County Metropolitan Transportation Authority
MSA	Metropolitan Statistical Area

MSAT	mobile-source air toxic
MSF	maintenance and storage facility
MTC	multimodal transportation center
NB	No Build
NEPA	National Environmental Policy Act
NFPA	National Fire Protection Association
NOI	Notice of Intent
NOP	Notice of Preparation
O&M	operations and maintenance
OMC	operations and maintenance center
PA/ED	Project Approval/ Environmental Document
PDT	Project Design Team
PID	Project Initiation Document
PPP	Public-Private Partnership (aka "P3")
PS&E	plans, specifications, and estimates
PTZ	pan tilt zoom
ROD	Record of Decision
ROW	right-of-way
RTP	Regional Transportation Plan
SCS	Sustainable Communities Strategy
SHPO	State Historic Preservation Office
SR	State Route
TAC	Technical Advisory Committee
TBM	tunnel boring machine
TDM	Transportation Demand Management
TOD	transit-oriented development
TSM	Transportation System Management
v/c	volume/capacity ratio
VA	Value Analysis
VASSR	Value Analysis Study Summary Report
VHT	vehicle hours traveled
VMS	Variable Message Sign(s)
VMT	vehicle miles traveled
yd^3	cubic yard(s)

VA Study Summary Report

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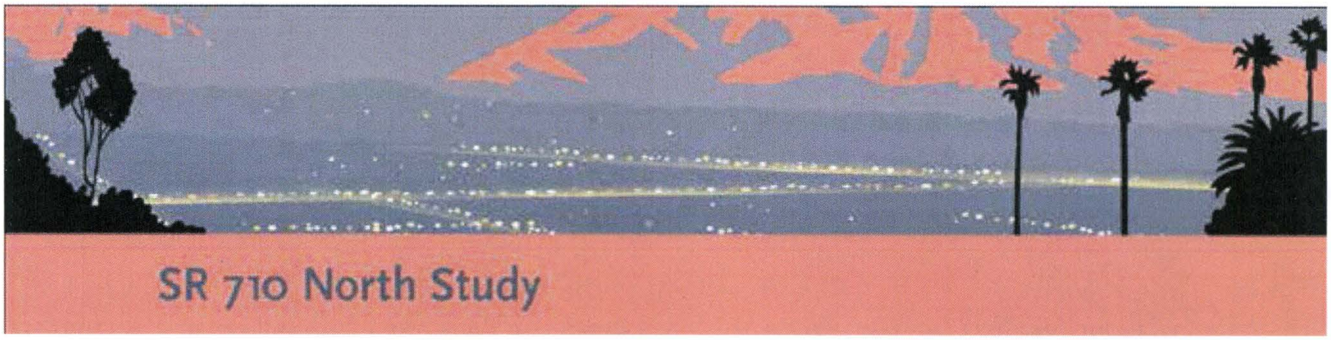
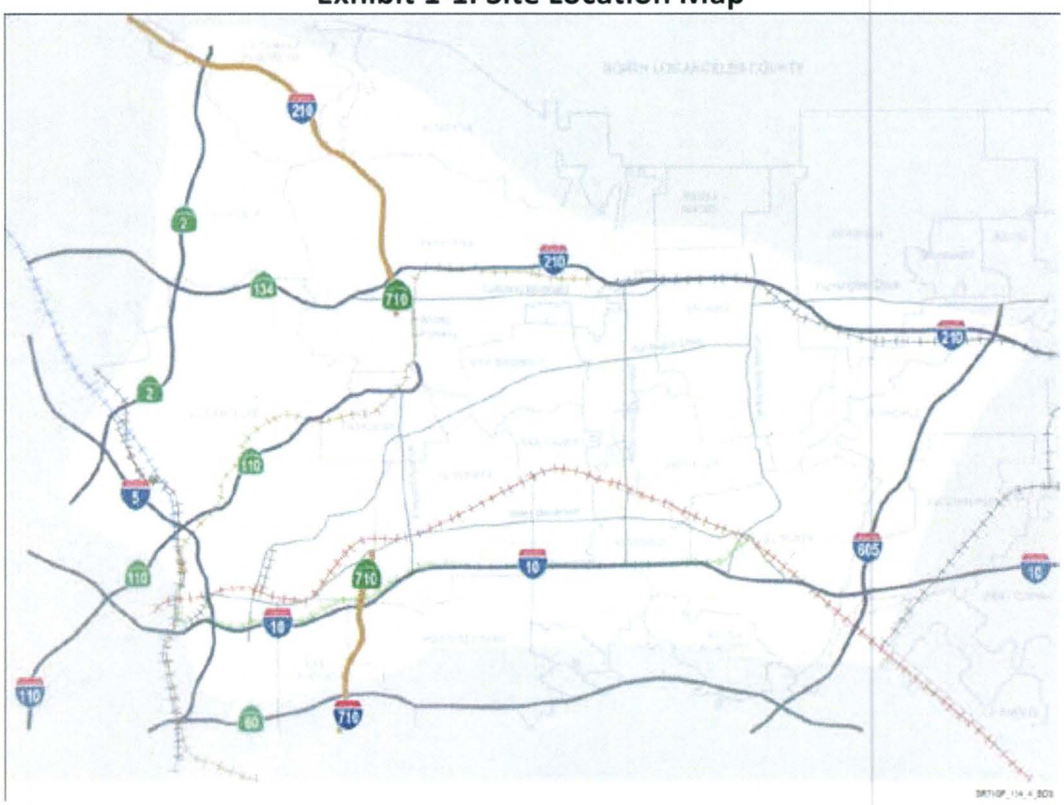


VA Study Summary Report

1. VA STUDY SUMMARY REPORT – FINAL RESULTS DISTRICT 7, SR 710 NORTH STUDY

This Final Value Analysis (VA) Study Report pertains to the State Route (SR) 710 North Study in Los Angeles, California (Exhibit 1-1). CH2M HILL facilitated the VA Study on behalf of the Los Angeles County Metropolitan Transportation Authority (Metro) and California Department of Transportation (Caltrans). A VA Orientation Meeting and site visit were held at the Caltrans District 7 office and the project vicinity between East Los Angeles and Pasadena, California, on March 11, 2013. The remainder of the 7-day VA Study was conducted at the Caltrans District 7 office and Metro office in Los Angeles, California, from March 11 to 14, and March 25 to 27, 2013, respectively.

Exhibit 1-1. Site Location Map



PROJECT SUMMARY

There are seven major east-west freeway routes (SR 118, US-101/SR 134/Interstate [I]-210, I-10, SR 60, I-105, SR 91, and SR 22) and eight major north-south freeway routes (I-405, US-101/US-170, I-5, SR 2, I-110/SR 110, I-710, I-605, and SR 57) in the central portion of the Los Angeles-Long Beach-Santa Ana Metropolitan Statistical Area (MSA). Of the eight north-south routes, five are located partially within the study area (I-5, SR 2, I-110/SR 110, I-710, and I-605), and two of these (I-110/SR 110 and I-710) terminate within the study area without connecting to another freeway. As a result, a very large amount of north-south regional travel demand is concentrated on a few freeways, or diverted to local streets within the study area. This effect is exacerbated by the overall southwest-to-northeast orientation of I-605, which makes it an unappealing route for traffic between the southern part of the region and the urbanized areas to the northwest in the San Fernando Valley, the Santa Clarita Valley, and the Arroyo-Verdugo region.

The lack of continuous north-south transportation facilities in the study area has the following consequences, which have been identified as the elements of need for the project:

- It degrades the overall efficiency of the larger regional transportation system.
- It causes congestion on freeways in the study area.
- It contributes to congestion on the local streets in the study area.
- It results in poor transit operations within the study area.

The Project Design Team (PDT) has provided their Alternatives Analysis (AA) Report (December 2012), which includes the five Alternatives that have been short-listed by Metro and Caltrans. The five Alternatives, and the associated total project costs for all elements of each Alternative, are currently estimated at the following values:

- No Build: $0
- TSM/TDM Alternative: $120,000,000
- Alternative BRT-6: $50,000,000
- Alternative LRT-4A: $2,600,000,000
- Alternative F-7: $5,425,000,000

PROJECT PURPOSE AND NEED

Based on the needs discussed above related to the regional transportation system, congestion on freeways in the study area, cut-through traffic that affects local streets in the study area, and the need for more transit within the study area, the following project purpose has been established.

The purpose of the proposed action is to effectively and efficiently accommodate regional and local north-south travel demands in the study area of the western San Gabriel Valley and east/northeast Los Angeles, including the following considerations:

- Improve efficiency of the existing regional freeway and transit networks.
- Reduce congestion on local arterials adversely affected due to accommodating regional traffic volumes.
- Minimize environmental impacts related to mobile sources.

A wide range of possible transportation alternatives was identified based on past studies and comments received during the "SR 710 Conversations" from stakeholders including elected officials, city and agency staff, and the community. The resulting options were evaluated and refined through sequential screening processes to identify the alternatives that best meet the need and purpose of the study. Thus, the alternatives recommended for further evaluation in the Project Approval/ Environmental Document (PA/ED) phase are as follows:

- The **No Build Alternative** should be updated to reflect the financially constrained project list in the 2012 Regional Transportation Plan/Sustainable Communities Strategy (RTP/SCS). This plan was adopted by the Southern California Association of Governments (SCAG) after the initiation of the AA, but it would be appropriate to update the No Build Alternative in the PA/ED phase to be consistent with the newly adopted plan. The ridership and travel demand forecasting in the PA/ED phase will be based on the 2012 RTP/SCS.
- The **Transportation System Management/Transportation Demand Management (TSM/TDM) Alternative** was found to have potential right-of-way (ROW) impacts, primarily resulting from the spot intersection and roadway segment improvements included in the alternative. These spot improvements should be refined in coordination with the local jurisdictions to maximize the benefits of the alternative and minimize its impacts. In addition, these improvements should be refined to identify opportunities to create "complete streets" that enhance the pedestrian and bicycle environment and to ensure that they do not detract from it. The other components of the TSM/TDM Alternative should also be reviewed and refined to look for additional opportunities to improve the performance of the alternative.
- **Alternative BRT-6**, like all of the Bus Rapid Transit (BRT) Alternatives, would displace a large amount of on-street parking. Therefore, refinements should be considered to its design, alignment, and/or operational characteristics to minimize the impact to on-street parking. Refinements should also be considered to maximize ridership and productivity (passengers per bus).
- **Alternative LRT-4A** station locations should be refined to maximize ridership of light rail transit (LRT), minimize property impacts, and to facilitate transfers to the Metro Gold Line at its northern and southern termini. Alternative LRT-4A/B could be combined with enhanced bus service, including feeder routes to its stations. By making Alternative LRT-4A/B the spine of a transit network that serves destinations to its east and west, and not solely along its alignment, it may be possible to attract additional transit ridership and improve the performance of this alternative.
- **Alternative F-7** should incorporate refinements to its design and alignment to minimize its impact. Potential tolled operations to improve its financial feasibility should also be evaluated. Restrictions on use by trucks should be evaluated to determine if they are effective at reducing impacts. Alternative F-7 could be combined with a BRT or other enhanced bus service to improve the transit-system-related performance measures of this alternative. Alternative F-7 was found to not increase transit ridership or transit mode share. By introducing a well-designed BRT or other enhanced bus service into Alternative F-7, it may be possible to diminish north-south transit travel times through the study area and attract additional transit ridership.

VA STUDY TIMING

The VA Study is being conducted at the preliminary engineering design phase, in March 2013, with the overall VA Study process targeted for completion by April 2014. Completion of the final environmental document is expected by summer of 2015. A Record of Decision (ROD) is scheduled for summer of 2015. The project Ready-to-List schedule has not yet been determined.

VA STUDY OBJECTIVES

The objective of the VA Study is to identify alternatives that improve project value. The VA Study is intended to focus on proposals that would help to finalize the scope of the project in order to help provide a fundable project and satisfy the local stakeholders.

KEY PROJECT ISSUES

The items listed below are the key drivers, constraints, or issues being addressed by the project and considered during this VA Study to identify possible improvements.

1. Lack of regional north-to-south and south-to-north connections results in cut-through traffic on local arterial streets, further exacerbating local congestion.
2. High levels of congestion on surface streets and freeways in the study area result in increased costs and travel time for individuals and businesses. It also results in more pollution and degradation of the quality of life.
3. Regional transit connections would benefit this densely populated area, and would improve livability and air quality.
4. Availability of funding could limit implementation of alternatives, with costs for additional ROW and escalation increasing over time.
5. High level of public scrutiny on potential impacts from all alternatives; consensus is needed to implement the project.

EVALUATION OF BASELINE CONCEPT

The VA Team had a significant advantage with the evaluation of the baseline concepts by utilizing the results from the AA Report. The SR 710 Study AA Report presents very detailed results in terms of the attributes critical to this project, and identifies limitations associated with the current design concept.

Based on the project purpose and need, eight objectives were established for the project as part of the AA. These objectives reflect the changes and improvements desired as a result of the project. The objectives established for the AA were required to satisfy the following guidelines:

- Be relevant to the project purpose and need.
- Be responsive to agency, stakeholder, and public concerns.
- Be independent of one another to avoid duplication or double-counting of performance measures.
- Be measurable using quantitative performance measures or clearly established qualitative performance measures.
- Be well defined and easily understood by all study participants.

The eight objectives that resulted are listed in Table 1-1.

Table 1-1. Project Objectives

Element of Need	Objective
Regional transportation system	1. Minimize travel time
Regional transportation system	2. Improve connectivity and mobility
Congestion on study area freeways	3. Reduce congestion on freeway system
Congestion on local streets	4. Reduce congestion on local street system
Transit operations in study area	5. Increase transit ridership
Environment and communities	6. Minimize environmental and community impacts related to transportation
Consistency with plans	7. Assure consistency with regional plans and strategies
Provide financially feasible transportation solutions	8. Maximize the cost-efficiency of public investments

The initial set of alternatives was evaluated against the project objectives.

Transportation System Performance

Five objectives are focused on the project need: minimizing travel times, improving connectivity and mobility, reducing congestion on the freeway system, reducing congestion on the local street system, and increasing transit ridership. For each of the objectives related to transportation system performance, detailed performance measures were developed. The performance measures associated with each of these objectives are listed in Table 1-2.

Table 1-2. Performance Measures - Transportation

Element of Need	Objective	Performance Measures
Regional Transportation System	1. Minimize travel time	• Point-to-point travel time - vehicular • Point-to-point travel time - transit • Reduction in vehicle hours traveled (VHT) • Percentage of travel on managed facilities
	2. Improve connectivity and mobility	• New interchanges/transit connections • Jobs reachable within fixed time • Transit boardings • Arterial volumes • Freeway throughput
Freeway system in the study area	3. Reduce congestion on freeway system	• Facility miles operating at Level of Service (LOS) F1 or worse • Facility miles operating at LOS E or F • Vehicle miles traveled (VMT) on congested freeway segments
Local street system in the study area	4. Reduce congestion on local street system	• Percent of intersections with congested approaches • Average volume/capacity ratio (v/c) on arterials • VMT on arterials • Arterial cut-through percentage • North-south travel on arterials
Transit system in the study area	5. Increase transit ridership	• Increase in transit ridership • Percent of population and employment within 1/4 mile of transit • Transit mode share

Environmental Impacts and Planning Considerations

In addition to transportation system performance measures, the initial set of alternatives was evaluated against the project objectives focused on environmental impacts and planning considerations. For each of these objectives, detailed performance measures were developed.

Table 1-3 presents the performance measures associated with each of these objectives. Because of the wide range of factors included within the objective to "Minimize environmental and community impacts related to transportation," this objective has been separated into three parts: property acquisitions, impacts on the human environment, and impacts on the natural environment.

Table 1-3. Performance Measures - Environmental

Value or Concern	Objective	Performance Measures
Environment and communities	1. Minimize environmental and community impacts related to transportation	• Property acquisitions • Residential or business acquisitions • Recreational/community sites impacted • Archeological sites impacted • Properties over 45 years old impacted • Significant historic resources impacted • Increase in noise exposure • Increase in mobile-source air toxics (MSATs) • Increase in regional criteria pollutants • Increase in greenhouse gas (GHG) emissions • Hazardous waste sites impacted • Visual intrusion in communities • Scenic corridors impacted • Natural environment areas of high paleontological sensitivity impacted • Exposure to adverse geotechnical conditions • Sensitive habitats impacted • Drainages impacted
Consistency with plans	2. Assure consistency with regional plans and strategies	• Consistency with RTP/SCS goals • Consistency with Measure R goals • Consistency with Metro Long-Range Transportation Plan (LRTP) goals

Cost Efficiency

One of the objectives identified for the SR 710 Study is to optimize the cost-efficiency of public investments. This objective was evaluated through three performance measures, as listed in Table 1-4.

Table 1-4. Performance Measures - Cost

Element of Need	Objective	Performance Measures
Provide financially feasible transportation solutions	1. Maximize the cost-efficiency of public investments	• Construction and ROW costs • Available funding • Technical feasibility

In maintaining continuity from the AA to the VA Study, the VA Team used the ratings of performance from the AA as the baseline assessment, and included the application of these same eight AA objectives in the evaluation of the proposals. What led the VA Team to the proposals were fundamentally two perspectives: cost and performance limitations of the original alternatives.

Cost was a significant driver in producing proposals. The large expense of some alternatives promoted a focus on ideas that might help reduce the cost of those alternatives. For example, the LRT Alternative has an expensive tunnel component; suggesting an option to that tunnel component may reduce cost while still maintaining performance.

Performance Attributes

The performance ratings of the baseline concepts provided a window into both the benefits and limitations of the original proposals. For example, the original Freeway Tunnel Alternative does not provide a very robust transit improvement. The VA Team pondered the opportunity to add transit options to the Freeway Tunnel Alternative. Performance attributes are listed in Table 1-5.

Table 1-5. Performance Attributes

SR 710 Study Performance Attributes
1. Minimize travel time.
2. Improve connectivity and mobility.
3. Reduce freeway congestion.
4. Reduce arterial congestion.
5. Increase transit ridership.
6. Minimize environmental and community impacts related to transportation.
7. Assure consistency with regional plans and strategies.
8. Maximize the cost-efficiency of public investments.

FINAL VA STUDY RESULTS

Two VA proposals were accepted for implementation resulting in a cost savings of $2,698,000,000. The performance improvement and the value improvement of these two proposals are not cumulative. They are specific to each individual proposal.

Seven VA proposals were accepted with modifications for implementation. The cost savings, performance improvement, and value improvement in this report do not account for the modifications of these proposals. Additionally, the cost savings, performance improvement, and the value improvement of these seven proposals are not cumulative. They are specific to each individual proposal.

Four additional recommendations were conditionally accepted but require further study beyond the scope of the value analysis. The cost savings, performance improvement, and value improvement of these four proposals are not cumulative. They are specific to each individual proposal.

ACCEPTED PROPOSALS

Proposal No. and Description	Initial Cost Savings	LCC Savings	Change in Schedule	Change in Performance
FT1. Single-Bore Tunnel with Demand Constrained by Variable Toll	**$2,500,000,000**	**(---)**	**Potential Decrease**	**+15%**

The proposal concept would adopt a single-bore tunnel with variable toll-constrained demand by implementing the following major elements:

- Single-bore tunnel with two levels, each with two lanes (northbound travel on the lower deck and southbound travel on the upper deck).
- Occasional stairs between the northbound and southbound lanes to facilitate emergency evacuation.
- Cut-and-cover sections at the north and south portals would be expanded to three lanes in each direction.
- Variable toll system implemented to limit traffic demand to correspond to the lower capacity that a single-bore would provide compared to two bores.
- Truck tolls to be set to discourage trucks (or trucks to be banned completely).

This proposal reduces cost nearly 45 percent, creates lower initial environmental impact due to reduced construction impacts, has fewer impacts on I-210 north and east of the project, has less air quality emissions from traffic using the tunnel, does not require splitting of traffic movement into two separate tunnels at the north and south portals, and saves the requirement for pedestrian and vehicular cross covers.

FT3. Raise the Profile at the North Portal by 40 feet, Retaining the Same Cover as the Base Design	**$198,000,000**	**(---)**	**Potential Decrease**	**0%**

The proposal concept would adopt raising the profile at the north portal by 40 feet and retaining the same cover as the base design by implementing the following major elements:

- Constructing a headwall at the existing portal location and backfilling it to a higher level to increase the cover at the portal location by 40 feet.
- Upper roadway can be located in a retained cut immediately adjacent to the bored tunnel portal.
- Lower roadway must initially be located in a simple cut-and-cover box until the point at which it has transitioned horizontally and is no longer located beneath the upper roadway.

This proposal eliminates the majority of the cut-and-cover tunnel adjacent to the north portal, and reduces the volume of excavation and backfill required in the portal area and transition to a surface alignment. Bridges at Del Mar Boulevard, West Green Street, and West Colorado Street would not need to be replaced. This proposal also creates the potential to reuse some of the spoil that is excavated to form the portal area as backfill behind the headwall, and creates a potential benefit for the ventilation/fire life safety (FLS) design because the overall tunnel length is effectively reduced by the length of the cut-and-cover. This proposal facilitates the provision of local on- and off-ramps adjacent to the portal.

Note: Because the cost data depicted above represent savings, a number in parentheses represents a cost increase.

ACCEPTED PROPOSALS/ALTERNATIVE WITH MODIFICATIONS

Proposal No. and Description	Initial Cost Savings	LCC Savings	Change in Schedule	Change in Performance
TSM1. Peak-Direction HOV Lane on Fremont Avenue and Fair Oaks Avenue During Peak Periods	**($5,100,000)**	**(---)**	**None**	**+12 %**

The proposal concept would adopt a peak-direction high-occupancy vehicle (HOV) lane on Fremont Avenue and Fair Oaks Avenue during peak periods by implementing the following major elements:

- Peak period HOV 2+ restrictions on one lane in the peak direction.
- Transit buses able to use the HOV lane.

This proposal would discourage cut-through traffic in the north-south corridor, encourages carpooling behavior and transit use, increases mobility without increasing vehicular volumes, provides for a less-congested lane for transit buses, and would be low cost to implement.

Modification: The design team indicated that this proposal will increase congestion and reduce capacity for general purpose lanes. However, as a follow-up to this proposal, the design team included a modified suggestion that incorporates a reversible lane on Fair Oaks Avenue to address congestion.

BRT1. BRT Enhanced Technology – Guided BRT Operation Combined with Passenger Information System and Intelligent Transportation Systems (ITS) Technologies	**($7,160,000)**	**(---)**	**None**	**+2 %**

The proposal concept would adopt BRT enhanced technology-guided BRT operation combined with passenger information system and ITS technologies by implementing the following major elements:

- Guided BRT system using guide wheels to enable a smoother and faster ride along busway in feasible areas.
- Standard BRT in areas where guided system is not feasible.
- Fully integrated real-time passenger information system.
- Active traffic signal priority systems, remote security monitoring, and integral real-time optimization of the corridor operation.
- Advanced fare collection systems.

This proposal could potentially accommodate higher speeds in the exclusive bus lanes, improve operation safety, create potential for narrow BRT lanes, and increase effectiveness of level boarding areas.

Modification: A guided busway would require contraction of a permanent curb, which would reduce flexibility for the local buses and prevent them from utilizing the busway/bus lane and stations, and preclude the possibility of opening the bus lane to parking outside of peak hours. The alternative is expected to impact several on-street parking locations permanently. The Study Team's goal is to minimize significant permanent impact to on-street parking. The guided busway proposal is rejected. However, the passenger information system and ITS technologies have been incorporated by the Study Team.

LRT2. Valley Boulevard Overcrossing of LRT	**$71,000,000**	**$94,100,000**	**None**	**0%, -1%**

The proposal concept would reconstruct Valley Boulevard on a structure to fly over the project by implementing the following major elements:

- Consolidating the LRT maintenance and storage facility (MSF) site.
- Descending the LRT mainline from an aerial guideway to grade on the MSF site.
- Raising the LRT mainline after Valley Boulevard structure to cross over the UPRR ROW and Mission Road.

Modification: This proposal will improve yard operations, reduce the length of the bored tunnel section and associated costs, eliminate the aerial structure for yard lead and connecting tracks, and reduce the total export of excavated material.

The main proposal to build Valley Boulevard over the LRT mainline is rejected. Although the design team agrees with some of the recommendations (such as locating the LRT below Valley Boulevard), the proposal to raise Valley Boulevard to create a unified yard underneath would have significant ROW impacts and increased cost for only minor operational benefit. The design team is currently studying the option of going below Valley Boulevard using a tunnel and providing continuous access to the rail yard over Valley Boulevard.

FT2. Car-Only Freeway Tunnel at 46.5-foot Internal Design Diameter (ID) vs. 52.5-foot ID	**$584,000,000**	**(---)**	**None**	**-37%**

The proposal concept would adopt a 46.5-foot ID tunnel by implementing the following major elements:

- Freeway tunnel designated as car only.
- Reduced vertical clearance of the tunnel.
- 12-foot lane widths.
- 8-foot shoulder width and 2-foot clearance on the other side.
- 10-foot vertical clearance and 2-foot clearance for Variable Message Signs (VMS).
- 4-foot-wide walkway in a structurally separated corridor so that it can act as emergency egress.
- 2.25-foot-thick road deck slabs.

This proposal results in a 48-foot ID. Reducing the lane widths to 11 feet and reducing the thickness of the road deck slabs to 2 feet results in an approximately 46.5-foot internal diameter.
A smaller-diameter tunnel boring machine (TBM) bore is beneficial for control of settlements and

impacts. This proposal also results in reduced fire size for ventilation/FLS design, no freight traffic from the Ports, and is more compatible with Fastrack express lanes.

Modification: Scenario 1 (reduced vertical clearance to 10 feet) and Scenario 2 (reduced vertical clearance to 10 feet, reduced lane width to 11 feet, and reduced road deck thickness to 2 feet as a result of reduced span and load) are rejected by Caltrans due to nonstandard elements. The proposed reduction for vertical clearance is rejected. However, the team is looking to reduce the vertical clearance to 15.5 feet from 16.5 feet and the horizontal clearances from the edge of traveled way to 2 feet and 8 feet in order to reduce the diameter of the tunnel. This proposal is currently being evaluated by Caltrans District and Headquarters (HQ) Design and will be implemented pending their approvals.

FT4. Additional SR 710 Access Located at the North Project Terminus	**($47,010,000)**	**(---)**	**(---)**	**+30%**

The proposal concept would adopt a new access point to the SR 710 from Pasadena by implementing the following major elements:

- One-way local street network.
- Additional access from northbound SR 710 to connect with Pasadena Avenue.
- Additional access from southbound SR 710 to connect with St. John Avenue.
- Access provided via two slip ramps that would begin just north of the TBM tunnel portal location.
- Wider footprint for the highway connections.
- Green Street and Del Mar Boulevard bridges widened by approximately 12 feet from those shown in the Alternative F-7.

This proposal provides additional north-south access to and from the Pasadena area, improves traffic operations at the SR 134/I-210/SR 710 system interchange, and does not require additional ROW.

Modification: This proposal merits further evaluation beyond the timeframe of the VA Study. The design team can look at providing an on-ramp at St. John Avenue and an off-ramp to Pasadena Avenue, which is more cost-effective than providing the on-ramp at Pasadena Avenue. The design team can also look at providing a slip ramp from Pasadena Avenue to the northbound 710/eastbound 210 connector ramp to improve access from downtown Pasadena. Providing an on-ramp from St. John Avenue and off-ramp to Pasadena Avenue has been determined to be feasible. This will increase the width of the cut-and-cover tunnel, require the use of more retaining wall to accommodate the ramps, and require design exceptions from Caltrans for consecutive on- and off-ramp spacing. The design team will provide design exceptions to Caltrans for their review and approval.

FT10. Networkwide Congestion Management by Vehicle Speed Control	**($47,900,000)**	**($1,420,000)**	**None**	**+15%**

The proposal concept would adopt networkwide congestion management by implementing the following major elements:

- Mandatory variable speed limits appropriate for the traffic conditions.
- Variable and Enhanced Message Signs (VMS/EMS).
- Systems advance freeway indicators.
- Installation of additional overhead gantries with VMS/EMS signage, loop detectors, back office hardware and software, vehicle license plate recognition cameras, and associated enforcement system for issue of citations.

This proposal will provide adaptable flexible network management, simple system control, and speed detection. This proposal will also improve accident response time, improve journey time reliability, maximize demand, minimize delay, minimize user stop/start travel, and minimize ramp tailback. Additionally, this proposal will enforce the speed limit and collect revenue with the use of video citations.

Modification: This proposal will be studied further beyond the timeframe of this VA Study. It was suggested to move this proposal under TSM. Elements of this proposal are included as part of the TSM Alternative.

BRT1-A1. Addition of BRT with Enhanced Technology to Freeway Tunnel Alternative Proposal No. FT1 and Alternative BRT-6A.	**($181,000,000)**	**(---)**	**None**	**+36 %**

This alternative is the combination of Alternative BRT-6A and Proposal FT1. The implementation of this VA Alternative will cost $181 million.

Modification: This proposal is rejected, although the improvements will be included in the BRT Alternative (just not the Freeway Tunnel Alternative). The additional enhanced technologies have been added to the BRT-6 alternative, along with many other refinements. Therefore, the BRT Alternative (based on refinements to BRT-6) will potentially perform much better than originally conceived.

It was determined that the best way to evaluate the additional enhanced technology improvements was with the BRT Alternative, and not the Freeway Tunnel Alternative. The Freeway Tunnel Alternative will include investigation of several options, including operation of freeway express bus/BRT operations within the tunnel lanes. In addition, the transit system enhancements that are part of the TSM Alternative will be included within the Freeway Tunnel Alternative. Therefore, the Freeway Tunnel Alternative will incorporate substantial transit service improvements, so will have increased potential to provide multimodal benefits. However, those additional enhanced technology benefits are most productive with the BRT Alternative, and not the Freeway Tunnel Alternative.

Note: Because the cost data depicted above represent savings, a number in parentheses represents a cost increase.

PROPOSALS REQUIRING FURTHER STUDY

Proposal No. and Description	Initial Cost Savings	LCC Savings	Change in Schedule	Change in Performance
BRT2. Multimodal Transportation Centers for BRT Alternative Combined with Single-Bore Freeway Tunnel with Managed Lanes (FT1)	**($111,000,000)**	**(---)**	**Potential Increase**	**+27 %**

The proposal concept would adopt multimodal transportation centers (MTCs) for the BRT Alternative combined with the single-bore Freeway Tunnel by implementing the following major elements:

- Construction of two multimodal transit/parking facilities; one at each end of the proposed BRT alignment.
- Managed/express lanes (combination of toll and HOV restrictions).

This proposal would allow car users to park their cars and transfer to a transit mode by providing an easy and affordable option for auto drivers to access the transit system or arrange for carpooling options. The multimodal transit/parking facilities could also provide bike facilities.

Reason for Requiring Further Study: The design team determined that the MTC at the south portal is not feasible because it would be impossible to provide access from the freeway to the southern MTC. It is also far from the BRT alignment, which would increase travel time. The team agreed that this could be a possibility at the north portal and determined further evaluation is necessary to assess the feasibility. Although this proposal specifies single bore, further evaluation will be done for both single and dual bore. The design team's evaluation indicates that providing for MTC is feasible for both single and dual bore; however, the implementation of this will not be considered as part of the ED. This proposal is not precluded from any Freeway Tunnel variation and could be added later. The feasibility of adding the MTC at the north end will be studied during future phases of the project.

FT6. Precast Elements for Tunnel Roadway Decks and Interior Walls	**$35,700,000**	**(---)**	**Decrease**	**-1%**

The proposal concept would adopt precast elements for tunnel roadway decks and interior walls by implementing the following major elements:

- Full moment connection between upper deck and lower walls.
- Lower deck precast elements that utilize an inverted U-section.
- Upper deck and lower walls cast as a U-section with a corbel to support the walkway panel.
- Upper walls that are single-wall elements.
- Double-deck precast system or lower deck precast system with a cast-in-place upper deck.

This proposal will cause a significant decrease in construction schedule to install roadway decks and walls, and will have a faster completion date as compared to cast-in-place. This proposal has the potential for quicker revenue generation if procured as a Public-Private Partnership (PPP or "P3"), would have reduced maintenance costs, and would have higher-quality concrete inside the tunnel. This proposal would possibly eliminate the batching plant onsite, as well as reduce shoring/forming/ rebar material required.

Reason for Requiring Further Study: This proposal deferred for consideration during future phases of the project. Additional details are needed including seismic design criteria.

FT8. Move to PPP Model of Delivery	**$1,070,000**	**(---)**	**(---)**	**+33%**

The proposal concept would adopt the PPP model of delivery as early as possible by implementing the following major elements:

- An early commitment by Metro that the project would be developed as a PPP project.
- Implementation of a type of pre-development agreement model to work with the concession teams before Final Environmental Clearance is complete.

This proposal could potentially leverage industry involvement to develop recommended solutions that are aligned with financial, technical, and phased implementation strategies for the entire corridor. This proposal allows use of low-cost tax-exempt or taxable funding, transfers risk to the private sector, could accelerate construction starts, could reduce construction cost and interest rate risks, and could also leverage existing Caltrans-owned property into the development of the project to lower the overall cost of the project. This proposal takes advantage of private-sector efficiencies and innovations in construction, scheduling, and financing; provides efficiencies in long-term operations and maintenance (O&M); and presents an opportunity to combine public and private uses in mixed-use developments to leverage economic development.

Reason for Requiring Further Study: This proposal is under consideration by Metro and will require that further study take place after this VA Study is complete. Metro, in conjunction with Caltrans, will evaluate this proposal further; the evaluation will not be conducted by the VA Team.

FT9. Utilize "Early Contractor Involvement" in the Project Delivery Options of the Corridor	**$500,000**	**(---)**	**(---)**	**+0%**

The proposal concept would adopt "Early Contractor Involvement" into the project delivery options of the corridor by implementing the following major elements:

Option 1

- Agency would use a qualifications-based approach to select a contractor early in the project development process.
- Agency compensates the contractor for actual costs, based on open-book accounts and records, plus a fee.

Option 2

- Hire, under a separate contract to the Owner, a team of specialized experts to review the drawings as the design is being processed.

This proposal would allow gained insight into specific details on construction means and methods, and agreed-upon risk allocation strategies; it also would offer some access to a construction entity that has built similar projects of this scope and scale. This proposal encourages better communication between contractor and agency, and could eliminate some unnecessary specifications or details on the final plans, specifications, and estimates (PS&E). Potential for overlapping design and construction phases may allow for faster project delivery.

Reason for Requiring Further Study: This proposal is under consideration by Metro and will require that further study take place after this VA Study is complete. The evaluation will not be conducted by the VA Team.

Note: Because the cost data depicted above represent savings, a number in parentheses represents a cost increase.

REJECTED PROPOSALS AND STRATEGIES

Proposal, Strategy, Alternative No.	Description	Reason for Rejection
BRT3	Streetcar along Alternative BRT-6A Alignment	When compared to the BRT Alternative, this proposal offers limited benefits. It would be very challenging to operate since sufficient ROW is not available for an exclusive ROW, thus forcing the streetcars to commingle with other local buses and vehicular traffic.
LRT1	LRT-4A Alignment on I-710 Median	This proposal does not offer significant cost savings. Currently, there are no plans to widen the I-710. Several hundred feet of existing alignment will be on mechanically stabilized earth wall, not structure, so cost savings would be less. This proposal would likely require design exception for nonstandard inside shoulder, or else significant widening of freeway. Design exception may not be achievable because shoulder is necessary for sight distance on radius section.
LRT3	Terminate LRT-4A Alignment at Gold Line North of Arroyo Seco Parkway (SR 110)	This proposal is rejected due to the proposed placement of the underground station, which would be perpendicular and closer to the Raymond fault, and the potential impact to historic properties eligible for national registry.
LRT4	LRT At-Grade between Mission Road and Fair Oaks Avenue	This proposal is rejected. Metro policy does not allow for LRT to run in the street as proposed (Metro runs at-grade but not at curb). There would be historic property impacts on Sheffield, including removal of historic properties for station.
LRT5	Hybrid LRT-4A/LRT-6 Alternative to Provide At-Grade LRT along Atlantic Boulevard	This proposal is rejected due to the significant amount of ROW and historic property impacts on Atlantic Boulevard, and traffic impacts at Mission Road/Atlantic Boulevard, Atlantic Boulevard/Garfield Avenue/Huntington Drive, and SR 110 and Fair Oaks.

Proposal, Strategy, Alternative No.	Description	Reason for Rejection
LRT6	Shortened Tunnel per LRT-4A Alternative – Mission Street Option	Upon further study, the Study Team concluded that the original LRT alternative is superior to the Mission Street Option because it better serves existing and future land uses, and provides better transit connections, as described below. Existing land uses: The proposed terminus of the original LRT Alternative at Fillmore is adjacent to Huntington Memorial Hospital and near other employment in Pasadena. Hospitals in particular tend to have large numbers of employees who are likely transit riders. VA proposal LRT6 terminates in an area of low-density residential and one- and two-story retail. So a direct connection to Fillmore is likely to serve more riders more conveniently. Future land uses: The proposed terminus of the original LRT Alternative at Fillmore is also in an area with the potential for a large amount of intensification. While there is existing employment, there are also quite a few larger parcels with older, less intense development. These parcels are suitable for intensification, which would be supported by additional transit service. VA proposal LRT6 terminates in an area with many smaller parcels, much of which are potentially historic. There is little potential for intensification of land uses to take advantage of the additional transit. Transit connections: The proposed terminus of the original LRT Alternative at Fillmore is served by five Metro routes, including a Metro Rapid, and Pasadena buses that serve a large part of the northwest San Gabriel Valley, so a terminus there provides good connectivity to a large number of destinations. VA proposal LRT6 terminates in an area served by a single Metro local route. Because it is not located

Proposal, Strategy, Alternative No.	Description	Reason for Rejection
		near a major regional thoroughfare, there is not much potential for providing additional convenient connections to the transit network serving a larger area.
FT5	Relocate South Portal to North of Mission Street	An agreement is already in place with the local community that the tunnel would begin south of Valley Boulevard.
FT7	Covered Depressed Freeway with a Landscaped Area for "At-Grade Section"	It will greatly increase the cost for the cut-and-cover section as well as the cost for the ventilation/FLS system. This proposal will also increase the complexity of the design of the cut-and-cover section since the roadway sections are consistently varying. There are multiple ramps that connect in this area for the I-10 interchange and the Valley Boulevard interchange, making this a safety concern by introducing conflict points within a tunnel section. This area is not conducive to an outdoor park.
LRT-S1	Combination of LRT1, LRT2, and LRT3 LRT-4A Alignment on I-710 Median, Valley Boulevard Overcrossing of LRT, and LRT-4A Alignment Terminus at Gold Line North of SR 110 Proposal Nos. LRT1, LRT2, and LRT3	This proposal is rejected due to significant ROW impacts.
FT-S1	Single-Bore Tunnel with Demand Constrained by Variable Toll (FT1) Combined with Car-Only Freeway at 46.5-foot Inside Diameter Proposal Nos. FT1 and FT2	This proposal is rejected due to significant ROW impacts and nonstandard elements that will not be approved by Caltrans.

Summation of Proposal Results

Twenty VA proposals and three strategies were developed by the VA Team. The implementation of these proposals will result in significant changes to the project. These include:

- Project Delivery Proposals
- TSM/TDM Proposals
- BRT Proposals
- LRT Proposals
- Freeway Tunnel Proposals
- New Build Alternatives:
  - Streetcar System
  - Streetcar System with Single-Bore Freeway Tunnel, or any Freeway Tunnel Alternatives
  - BRT Combined with Single-Bore Freeway Tunnel, or any Freeway Tunnel Alternatives

Strategy FT-S1 is the strategy recommended by the VA Team. In comparison to strategy LRT-S1, the FT-S1 strategy provides a significant initial cost savings, and provides a significantly greater change in performance. The Freeway Tunnel strategy better meets the needs of this project. The following charts summarize the proposal results. Further explanation of the charts is provided in the section titled Decision Science Application in Section 4 of this VA Study Report.

Comparing baseline alternatives and proposal results within modes is best accomplished with the benefit scores, benefit-to-cost ratios, and change in benefit-to-cost ratio graphs. The graphs below display the resulting comparisons within modes.

Exhibit 1-2

TSM/TDM Baseline and Proposal Performance Score and Value Score

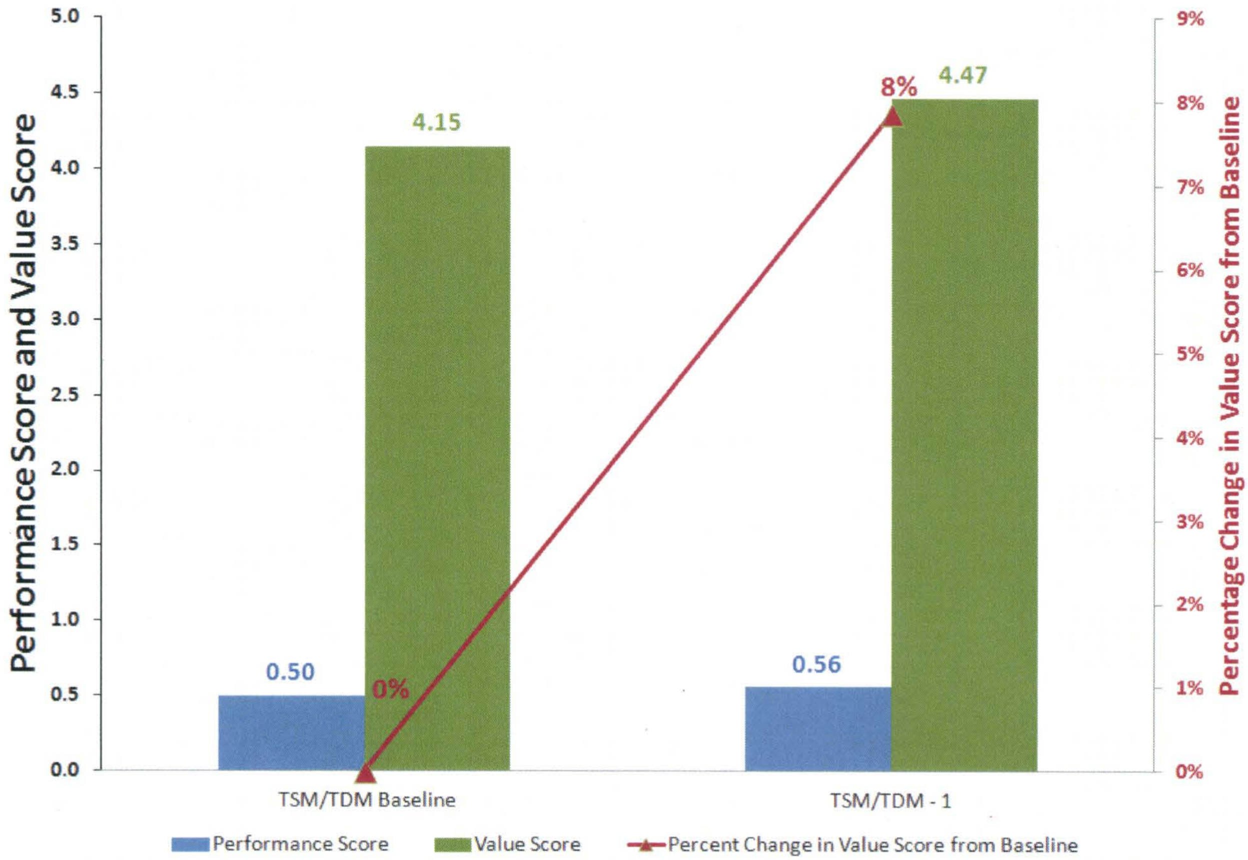


Exhibit 1-3

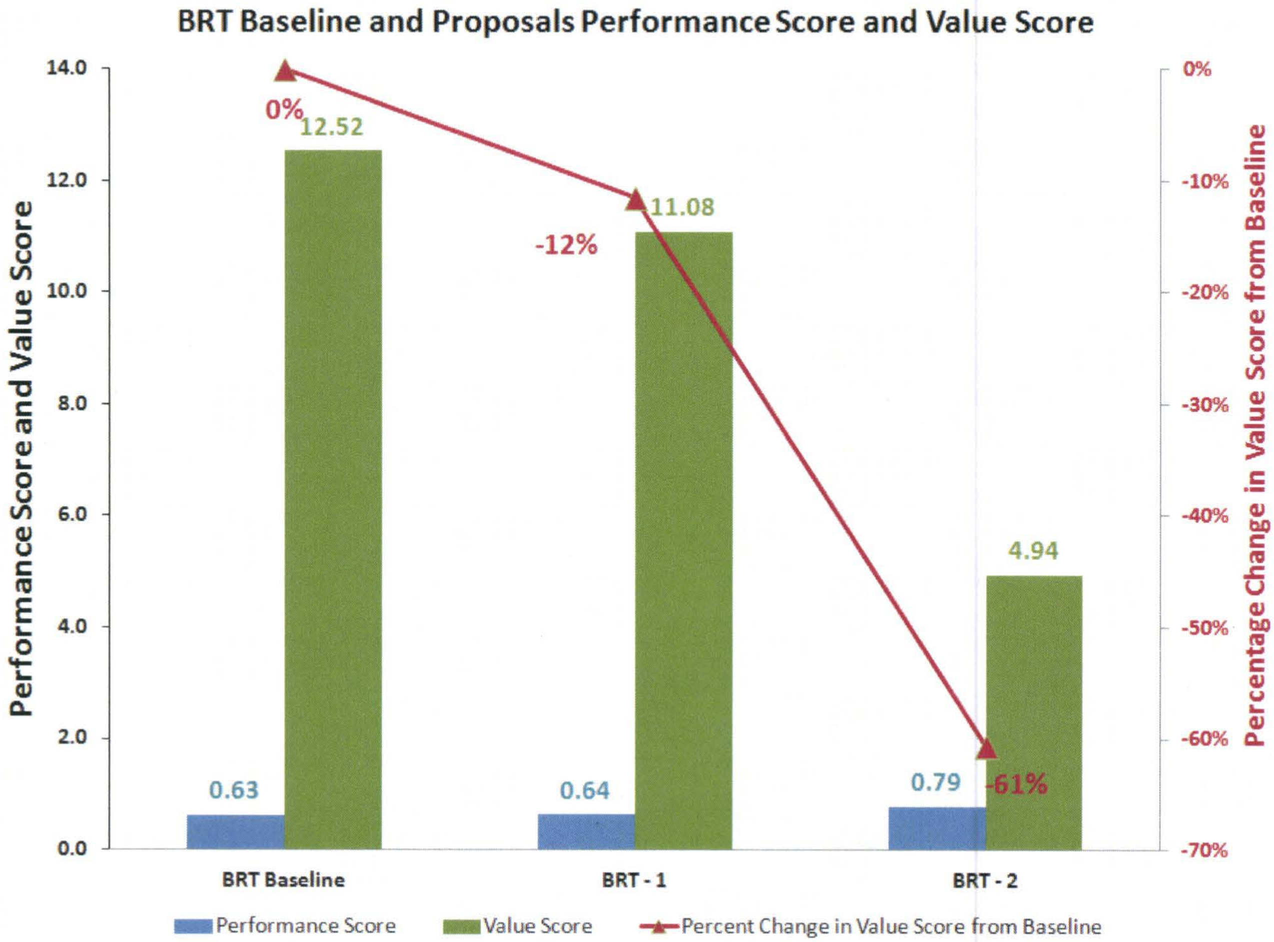

BRT Baseline and Proposals Performance Score and Value Score
Performance Score and Value Score
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Percentage Change in Value Score from Baseline
0%
-10%
-20%
-30%
-40%
-50%
-60%
-70%
0%
12.52
11.08
-12%
4.94
0.63
0.64
0.79
-61%
BRT Baseline
BRT - 1
BRT - 2
Performance Score
Value Score
Percent Change in Value Score from Baseline

Exhibit 1-4

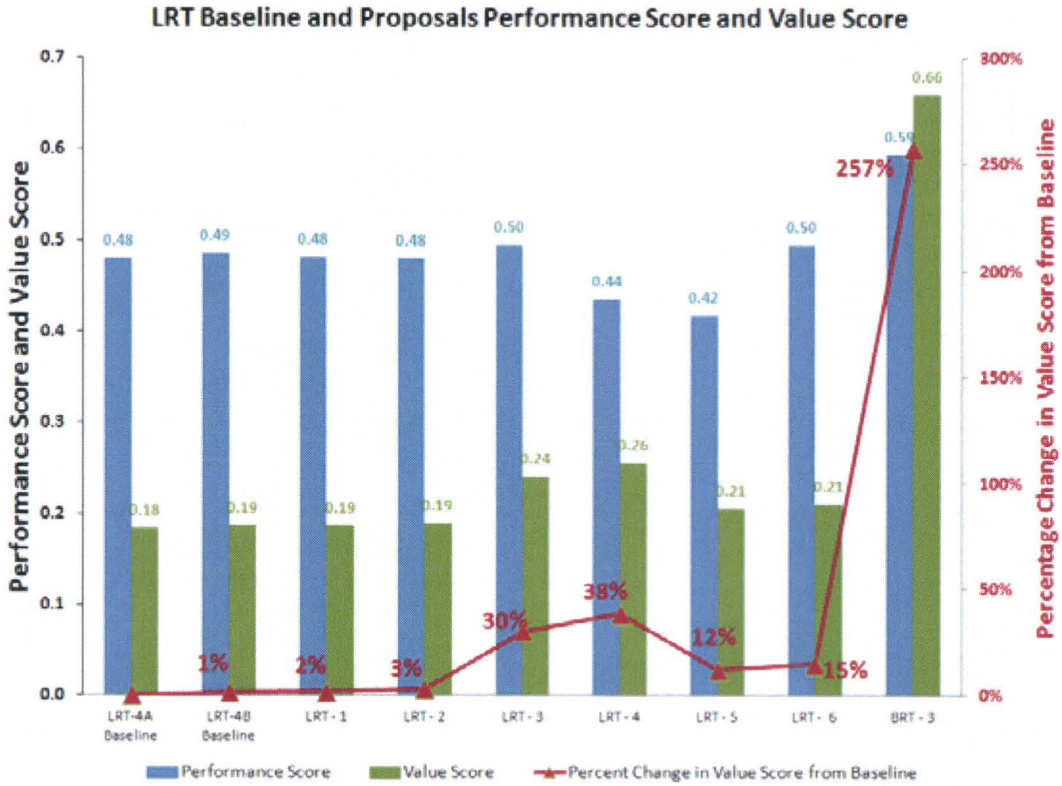


Exhibit 1-5

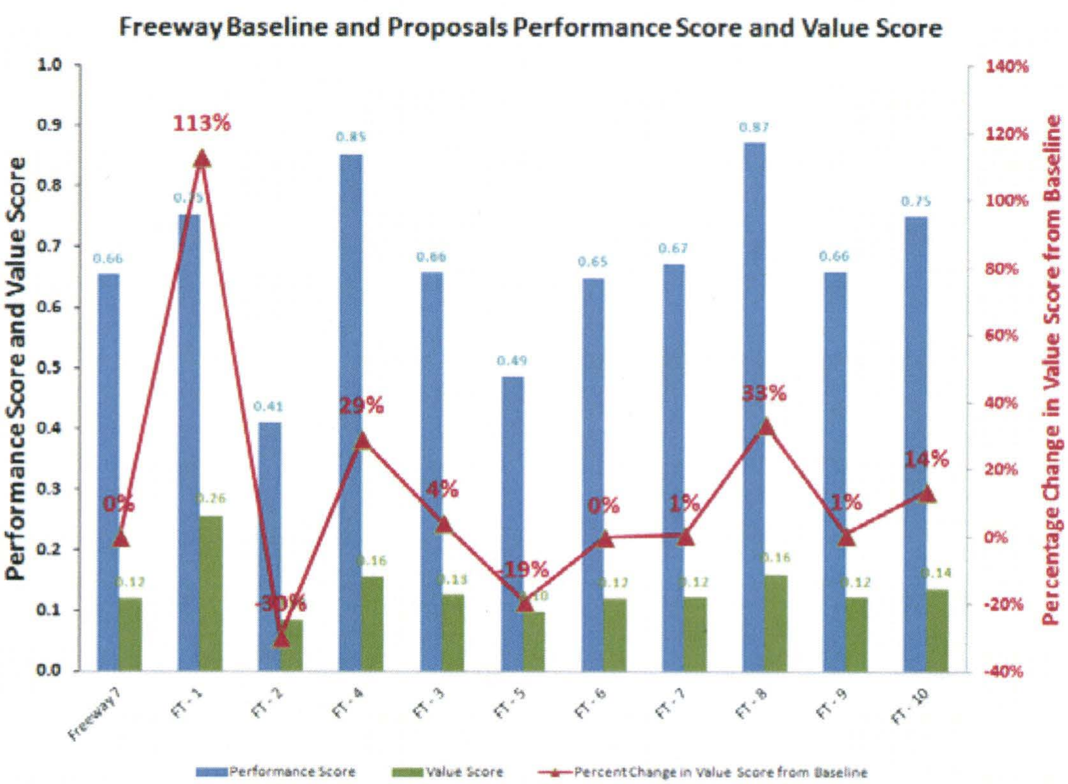


Exhibit 1-6

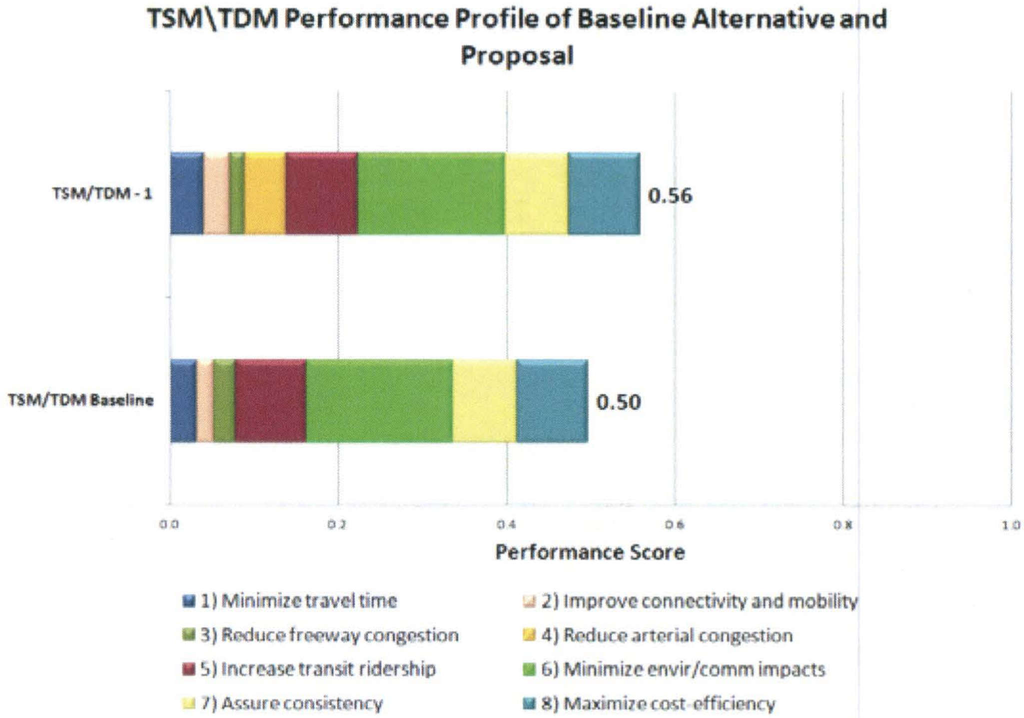


Exhibit 1-7

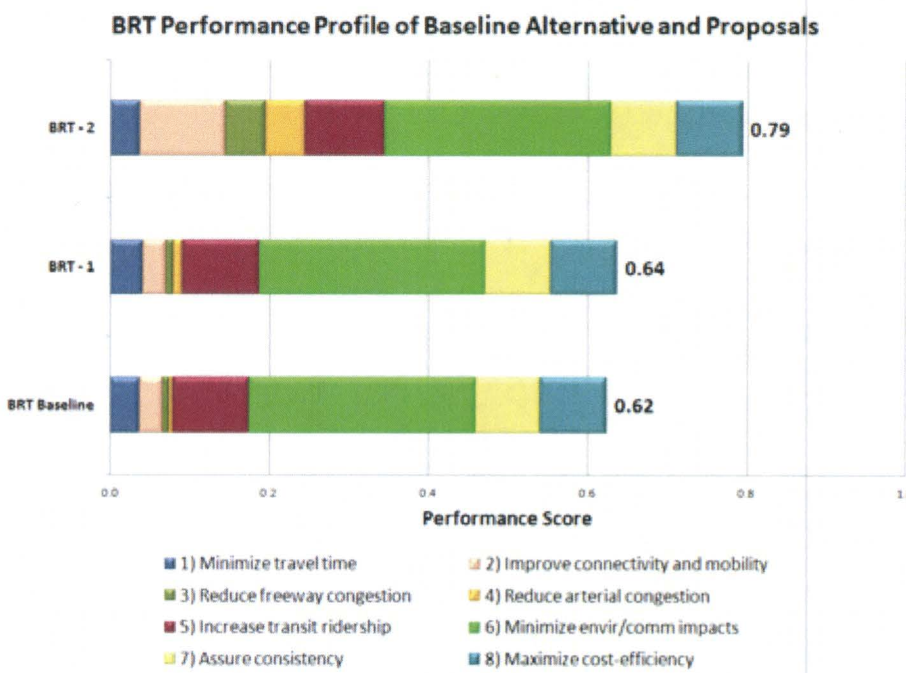


Exhibit 1-8

LRT Performance Profile of Baseline Alternatives and Proposals

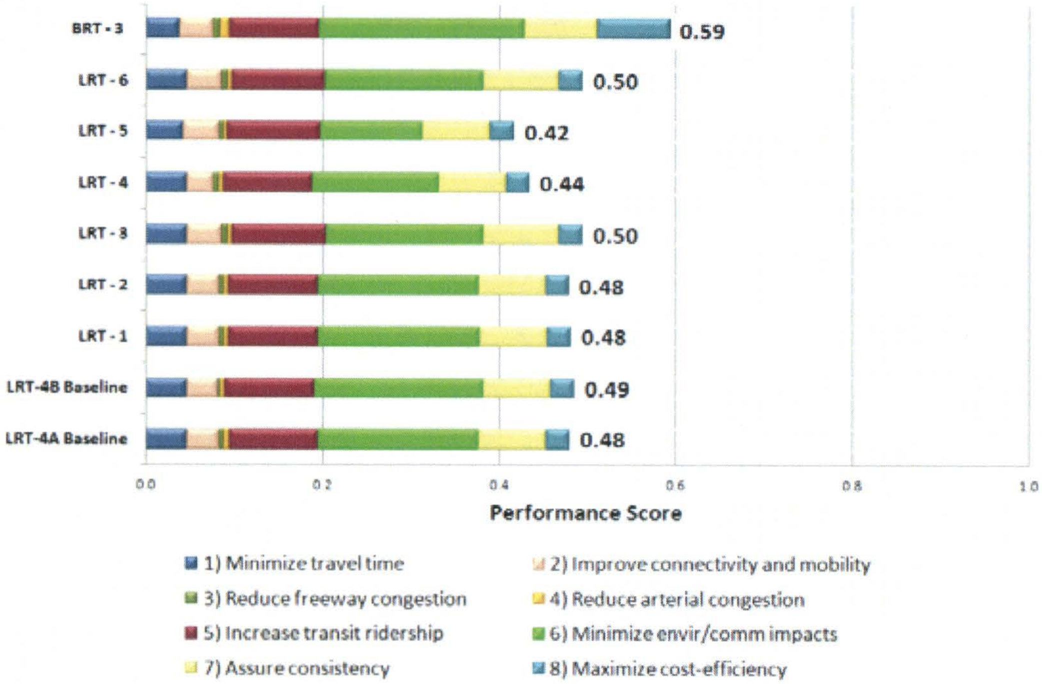
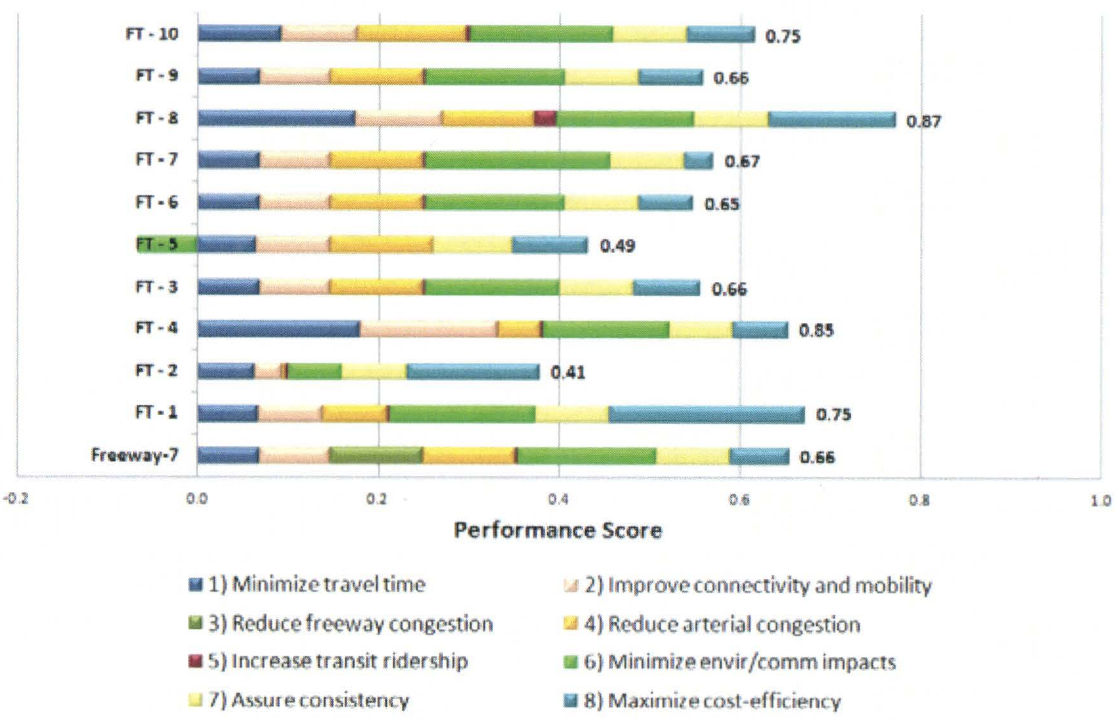


Exhibit 1-9

Freeway Performance Profile of Baseline Alternative and Proposals



VA TEAM

The VA Team and Key Project Contacts are listed in the following tables.

VA Team

Name	Organization	Title
Paul Johnson	CH2M HILL	VA Team Leader
Dan Speicher	CH2M HILL	Decision Analysis
Deborah Dagang	CH2M HILL	BRT Expert
Don Anderson	CH2M HILL	Geotechnical
Gustavo Ceballos	CH2M HILL	Transportation Planning
Andrew Leong	CH2M HILL	LRT Expert
Charles Nicholas	CH2M HILL	Financial Expert
Rick Hults	CH2M HILL	Cost Estimating
Brian Bellfi	CH2M HILL	Alternative Project Delivery
Kim Nokes	CH2M HILL	Roadway Design
Mark Johnson	CH2M HILL	Highway Tunnel Design
Cesar Tiscareno	CH2M HILL	Assistant VA Facilitator
Randy Anderson	Caltrans	HQ Structure Design
Andrew Ponzi	Caltrans	Structure Construction
Duke Nguyen	Caltrans	Assistant VA Coordinator
Derek Sim	Caltrans	Structure Construction
Lourdes Ortega	Caltrans	Environmental
Shiva Karimi	Caltrans	Geotech Studies
Jeff Yang	Caltrans	Structure Maintenance and Inspection
Cris Liban	Metro	Environmental
Matthew Crow	Metro	Tunnel Design/Construction
Lyn Calerdine	LSA	Environmental

Key Project Contacts

Name	Organization	Title
Michelle Smith	Metro	Project Manager
Abdi Saghafi	Caltrans	Corridor Manager
Derek Higa	Caltrans	Design Manager
Albert Andraos	Caltrans	District 7 VA Coordinator

VA Proposals

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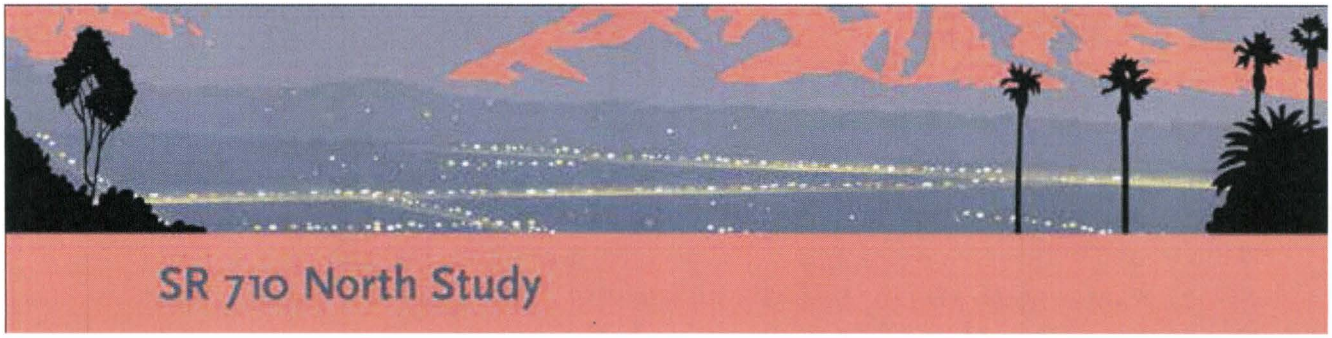


VA Proposals

2. VA PROPOSALS

FINAL

Each VA proposal consists of a summary of the original concept, a description of the suggested change, a listing of its advantages and disadvantages, a cost comparison, the change in performance and value, and a brief narrative comparing the original design with the proposal. Sketches, calculations, and performance measure ratings are also presented. The cost comparisons reflect a comparable level of detail as in the original estimate. A life-cycle cost (LCC) is not included with the proposals at this early conceptual design level.

A summary of the VA proposals, strategies, and alternatives is provided below. Complete versions of the VA proposals, strategies, and alternatives are included at the end of this section.

VA STRATEGIES

VA studies result in the development of a number of VA proposals. While it is possible for all proposals to be implemented, typically there are combinations of some proposals that may provide the best solution for the project. This is due to the fact that some proposals may be competing ideas or different ways to address the same issue. Some proposals are developed to answer a question raised by a decision maker or to resolve an open issue and found not to be beneficial to the ultimate project. As a result of these factors, the VA Team develops a VA strategy that represents their opinion of the best combination of proposals for the project to assist the decision makers in their evaluation of the VA proposals. The VA strategy is based on factors that include improved performance, likelihood of implementation, least community impact, cost savings, or any combination of project performance attributes. This information is a guide and is not intended to reject the other alternatives from project stakeholder consideration.

It must be noted that the potential cost and schedule benefits identified for the VA proposals are based on the expected value. The cost savings are cumulative, but the schedule savings are not.

The VA Team developed the following two strategies in this VA Study:

- Strategy No. LRT-S1 – This strategy is the combination of Proposals LRT1, LRT2, and LRT3. The VA Team determined that the implementation of this VA strategy will significantly reduce project costs by $1.4 billion.
- Strategy No. FT-S1 – This strategy is a combination of Proposals FT1 and FT2. The implementation of this VA strategy offers potential reduction in schedule and will significantly reduce project costs by $2.8 billion.

VA ALTERNATIVE

In addition to proposals and strategies during the VA Study, the VA Team developed a new build alternative, which the VA Team recommends be advanced with the other project design team's alternatives in the environmental phase:

- Alternative No. BRT-A1 – This alternative is the combination of Alternative BRT-6A and Proposal FT1. The implementation of this VA Alternative will cost $181 million.

VA PROPOSAL SUMMARY TABLES

Table 2-1 provides a summary of the VA proposals. Tables 2-2 and 2-3 present summaries of the VA strategies and VA alternatives, respectively.

Table 2-1. Summary of VA Proposals

Proposal No. and Description	Initial Cost Savings	LCC Savings	Change in Schedule	Performance Change	Value Change
TSM1. Peak-Direction HOV Lane on Fremont Avenue and Fair Oaks Avenue During Peak Periods	($5,150,000)	(---)	None	+12 %	+8%
BRT1. BRT Enhanced Technology – Guided BRT Operation Combined with Passenger Information System and ITS Technologies	($7,160,000)	(---)	None	+2 %	-12%
BRT2. Multimodal Transportation Centers for BRT Alternative Combined with Single-Bore Freeway Tunnel with Managed Lanes (FT1)	($111,000,000)	(---)	Increase	+27 %	-61%
BRT3. Streetcar along Alternative BRT-6A Alignment	$1,700,000,000	(---)	Increase	+24 %, +22 %	+257% +253%
LRT1. LRT-4A Alignment on I-710 Median	$29,400,000	(---)	Decrease	0 %, -1 %	+2%, 0%
LRT2. Valley Boulevard Overcrossing of LRT	$71,000,000	$94,100,000	None	0 %, -1 %	+3%, +2%

Table 2-1. Summary of VA Proposals

Proposal No. and Description	Initial Cost Savings	LCC Savings	Change in Schedule	Performance Change	Value Change
LRT3. Terminate LRT-4A Alignment at Gold Line North of Arroyo Seco Parkway	$540,000,000	$660,000,000	(---)	+3 %, +2 %	+30% +29%
LRT4. LRT At-Grade Between Mission Road and Fair Oaks Avenue	$896,000,000	$801,000,000	Decrease	-9 %, -10 %	+38%, +37%
LRT5. Hybrid LRT-4A/ LRT-6 Alternative to Provide At-Grade LRT Along Atlantic Boulevard	$576,000,000	$215,000,000	None	-13 %, -14 %	+12%, +10%
LRT6. Shortened Tunnel per LRT-4A Alternative – Mission Street Option	$262,000,000	$320,000,000	None	+3 %, +2 %	+15%, +13%
FT1. Single-Bore Tunnel with Demand Constrained by Variable Toll	$2,500,000,000	(---)	Decrease	+15%	+113%
FT2. Car-Only Freeway Tunnel at 46.5-foot ID vs. 52.5-foot ID	$584,000,000	(---)	None	-37 %	-30%
FT3. Raise the Profile at the North Portal by 40 feet, Retaining the Same Cover as the Base Design	$198,000,000	(---)	Decrease	0%	+4%
FT4. Additional SR 710 Access Located at the North Project Terminus	($47,000,000)	(---)	(---)	+30 %	+29%
FT5. Relocate South Portal to North of Mission Road	$369,000,000	(---)	Decrease	-26%	-19%

VA PROPOSAL LRT6
Shortened Tunnel per LRT-4A Alternative – Mission Street Option

Disposition Recommendation: *(Select one)*

☐ **AGREE** ☐ **AGREE WITH MODIFICATIONS** ☐ **FURTHER STUDY NEEDED** ☒ **DISAGREE**

Explain, comment, and/or discuss rationale for disposition recommendation:
This proposal was determined to be possible by the study team. Study team was concerned about impacts to downtown South Pasadena during construction. This proposal will be studied further within the time frame of the VA Study. Further study is needed to determine impact.

Upon further study, the study team concluded that the original LRT Alternative is superior to Mission Street Option because it better serves existing and future land uses, and provides better transit connections, as described below:

• Existing land uses: The proposed terminus of the original LRT Alternative at Fillmore is adjacent to Huntington Memorial Hospital and near other employment in Pasadena. Hospitals in particular tend to have large numbers of employees who are likely transit riders. VA proposal LRT6 terminates in an areas of low density residential and one and two-story retail. So a direct connection to Fillmore is likely to serve more riders more conveniently.

• Future land uses: The proposed terminus of the original LRT Alternative at Fillmore is also in an area with the potential for a large amount of intensification. While there is existing employment, there are also quite a few larger parcels with older, less intense development. These parcels are suitable for intensification, which would be supported by additional transit service. VA proposal LRT6 terminates in an area with many smaller parcels, much of which are potentially historic. There is little potential for intensification of land uses to take advantage of the additional transit.

• Transit connections: The proposed terminus of the original LRT Alternative at Fillmore is served by 5 Metro routes, including a Metro Rapid, and Pasadena buses that serve a large part of the northwest San Gabriel Valley, so a terminus there provides good connectivity to a large number of destinations. VA proposal LRT6 terminates in an area served by a single Metro local route. Because it is not located near a major regional thoroughfare, there is not much potential for providing additional convenient connections to the transit network serving a larger area.

VA PROPOSAL LRT3
Terminate LRT-4A Alignment at Gold Line North of Arroyo Seco Parkway (SR 110)

Disposition Recommendation: *(Select one)*

☐ **AGREE** ☐ **AGREE WITH MODIFICATIONS** ☐ **FURTHER STUDY NEEDED** ☒ **DISAGREE**

Explain, comment, and/or discuss rationale for disposition recommendation:
This proposal is rejected due to the proposed placement of the underground station which would be perpendicular and closer to the Raymond fault, and the potential impact to historic properties eligible for national registry.

VA PROPOSAL LRT4
LRT At-Grade between Mission Road and Fair Oaks Avenue

Disposition Recommendation: *(Select one)*

☐ **AGREE** ☐ **AGREE WITH MODIFICATIONS** ☐ **FURTHER STUDY NEEDED** ☒ **DISAGREE**

Explain, comment, and/or discuss rationale for disposition recommendation:
This proposal is rejected. Metro policy does not allow for LRT to run in the street as proposed (Metro runs at-grade but not a curb). There would be historic property impacts on Sheffield, including removal of historic properties for station.

VA PROPOSAL LRT5
Hybrid LRT-4A/LRT-6 Alternative to Provide At-Grade LRT along Atlantic Boulevard

Disposition Recommendation: *(Select one)*

☐ **AGREE** ☐ **AGREE WITH MODIFICATIONS** ☐ **FURTHER STUDY NEEDED** ☒ **DISAGREE**

Explain, comment, and/or discuss rationale for disposition recommendation:
This proposal is rejected due to the significant amount of right-of-way and historic property impacts on Atlantic Boulevard, and traffic impacts at Mission Road/Atlantic Boulevard, Atlantic Boulevard/Garfield Avenue/Huntington Drive, and SR 110 and Fair Oaks.

implementation of this will not be considered as part of the ED. This proposal is not precluded from any freeway tunnel variation and could be added later. The feasibility of adding the MTC at the north MTC will be studied during future phases of the project.

VA PROPOSAL BRT3
Streetcar along Alternative BRT-6A Alignment

Disposition Recommendation: *(Select one)*

☐ **AGREE** ☐ **AGREE WITH MODIFICATIONS** ☐ **FURTHER STUDY NEEDED** ☒ **DISAGREE**

Explain, comment, and/or discuss rationale for disposition recommendation:
This proposal is rejected. When compared to the BRT alternative, this proposal offers limited benefits. It would be very challenging to operate since sufficient right-of-way is not available for an exclusive right of way, thus forcing the streetcars to comingle with other local buses and vehicular traffic.

VA PROPOSAL LRT1
LRT-4A Alignment on I-710 Median

Disposition Recommendation: *(Select one)*

☐ **AGREE** ☐ **AGREE WITH MODIFICATIONS** ☐ **FURTHER STUDY NEEDED** ☒ **DISAGREE**

Explain, comment, and/or discuss rationale for disposition recommendation:
This proposal is rejected. It doesn't offer significant cost savings. Currently there are no plans to widen the I-710. Several hundred feet of existing alignment will be on MSE wall, not structure, so cost savings would be less. This proposal would likely require design exception for non-standard inside shoulder, or else significant widening of freeway. Design exception may not be achievable because shoulder is necessary for sight distance on radius section.

VA PROPOSAL LRT2
Valley Boulevard Overcrossing of LRT

Disposition Recommendation: *(Select one)*

☐ **AGREE** ☒ **AGREE WITH MODIFICATIONS** ☐ **FURTHER STUDY NEEDED** ☐ **DISAGREE**

Explain, comment, and/or discuss rationale for disposition recommendation:
The main proposal to build Valley over LRT is rejected. Although we agree with some of the recommendations (such as locating the LRT below Valley Boulevard), the proposal to raise Valley Boulevard to create a unified yard underneath would have significant right-of-way impacts and increased cost for minor operational benefit. The design team is currently studying going below Valley Boulevard using a tunnel and providing continuous access to the rail yard over Valley Boulevard.

ACTION RECOMMENDATION FORMS

Responses prepared by: CH2M HILL/Metro/Caltrans

Date: 11/13/13

VA PROPOSAL TSM1

Peak Direction HOV Lane on Fremont Avenue and Fair Oaks Avenue during Peak Periods

Disposition Recommendation: *(Select one)*

☐ **AGREE** ☒ **AGREE WITH MODIFICATIONS** ☐ **FURTHER STUDY NEEDED** ☐ **DISAGREE**

Explain, comment, and/or discuss rationale for disposition recommendation:

The study team indicated that this proposal will increase congestion and reduce capacity for general purpose lanes. However, as a follow up to this proposal, the study team included a modified suggestion by incorporating a reversible lane on Fair Oaks Avenue to address congestion.

VA PROPOSAL BRT1

BRT Enhanced Technology – Guided BRT Operation Combined with Passenger Information System and Intelligent Transportation Systems Technologies

Disposition Recommendation: *(Select one)*

☐ **AGREE** ☒ **AGREE WITH MODIFICATIONS** ☐ **FURTHER STUDY NEEDED** ☐ **DISAGREE**

Explain, comment, and/or discuss rationale for disposition recommendation:

A guided busway would require construction of a permanent curb, which would reduce flexibility for the local buses and prevent them from utilizing the busway/bus lane and stations, and preclude the possibility of opening the bus lane to parking outside of peak hours. The alternative is expected to impact several on-street parking locations permanently. The study team's goal is to minimize significant permanent impact to on-street parking. The guided busway proposal is rejected. However, passenger Information System and Intelligent Transportation Systems (ITS) technologies have been incorporated by the study team.

VA PROPOSAL BRT2

Multimodal Transportation Centers (MTC) for BRT Alternative Combined with Single Bored Freeway Tunnel with Managed Lanes (FT1)

Disposition Recommendation: *(Select one)*

☐ **AGREE** ☐ **AGREE WITH MODIFICATIONS** ☒ **FURTHER STUDY NEEDED** ☐ **DISAGREE**

Explain, comment, and/or discuss rationale for disposition recommendation:

The multimodal transportation center at the south portal is not feasible because it would be impossible to provide access from the freeway to the southern MTC; it is also far from the BRT alignment which would increase travel time. The team agreed that this could be a possibility at the north portal and determined further evaluation is necessary to assess the feasibility. Although this proposal specifies single bore, further evaluation will be done for both single and dual bore. Our evaluation indicates that providing for MTC is feasible for both single and double bore, however, the

Table 2-9. Summary of Accepted VA Proposals with Modifications

Proposal No.	Initial Cost Savings	LCC Savings	Change in Schedule	Performance Change	Value Change
TSM1	($5,150,000)	(---)	None	+12 %	+8%
BRT1	($7,160,000)	(---)	None	+2 %	-12%
LRT2	$71,000,000	$94,100,000	None	0 %, -1 %	+3%, +2%
FT2	$584,000,000	(---)	None	-37 %	-30%
FT4	($47,000,000)	(---)	(---)	+30 %	+29%
FT10	($47,900,000)	($1,420,000)	None	+15%	+14%

Note: Because the cost data depicted above represent savings, a number in parentheses represents a cost increase.

Table 2-10. Summary of Accepted VA Alternatives with Modifications

Strategy No.	Base Cost	Change in Schedule	Change in Performance	Value Change
VA Alternative BRT-A1	$181,000,000	None	+36 %	+152%

COMPLETED ACTION RECOMMENDATION FORMS

All Action Recommendation Forms are included below.

VA PROPOSAL DOCUMENTATION

All VA proposals are included below.

Table 2-6. Summary of Proposed VA Alternatives

Strategy No.	Base Cost	Change in Schedule	Change in Performance	Value Change
VA Alternative BRT-A1	$181,000,000	None	+36 %	+152%

Table 2-7. Summary of Proposed VA Strategies – Cumulative Study Savings

Strategy No.	Proposal Nos.	Initial Cost Savings	LCC Savings	Change in Schedule	Change in Performance	Value Change
VA Strategy LRT-S1	LRT1, LRT2, LRT3	$640,000,000	$784,000,000	Decrease	+4 % (LRT-4A)	+37%
					+2 % (LRT-4B)	+36%
VA Strategy FT-S1:	FT1, FT2	$2,788,000,000	(---)	Decrease	+19 %	+175%

Note: Because the cost data depicted above represent savings, a number in parentheses represents a cost increase.

Table 2-8. Summary of Accepted VA Proposals

Proposal No. and Description	Initial Cost Savings	LCC Savings	Change in Schedule	Performance Change	Value Change
FT1	$2,500,000,000	(---)	Decrease	+15%	+113%
FT3	$198,000,000	(---)	Decrease	0%	+4%

Table 2-5. Summary of VA Proposals

Proposal No.	Initial Cost Savings	LCC Savings	Change in Schedule	Performance Change	Value Change
TSM1	($5,150,000)	(---)	None	+12 %	+8%
BRT1	($7,160,000)	(---)	None	+2 %	-12%
BRT2	($111,000,000)	(---)	Increase	+27 %	-61%
BRT3	$1,700,000,000	(---)	Increase	+24 %, +22 %	+257% +253%
LRT1	$29,400,000	(---)	Decrease	0 %, -1 %	+2%, 0%
LRT2	$71,000,000	$94,100,000	None	0 %, -1 %	+3%, +2%
LRT3	$540,000,000	$660,000,000	(---)	+3 %, +2 %	+30% +29%
LRT4	$896,000,000	$801,000,000	Decrease	-9 %, -10 %	+38%, +37%
LRT5	$576,000,000	$215,000,000	None	-13 %, -14 %	+12%, +10%
LRT6	$262,000,000	$320,000,000	None	+3 %, +2 %	+15%, +13%
FT1	$2,500,000,000	(---)	Decrease	+15%	+113%
FT2	$584,000,000	(---)	None	-37 %	-30%
FT3	$198,000,000	(---)	Decrease	0%	+4%
FT4	($47,000,000)	(---)	(---)	+30 %	+29%
FT5	$369,000,000	(---)	Decrease	-26%	-19%
FT6	$35,700,000	(---)	Decrease	-1%	0%
FT7	$116,000,000	(---)	None	+3%	+1%
FT8	$1,070,000	(---)	(---)	+33%	+33%
FT9	$500,000	(---)	(---)	+1%	+1%
FT10	($47,900,000)	($1,420,000)	None	+15%	+14%

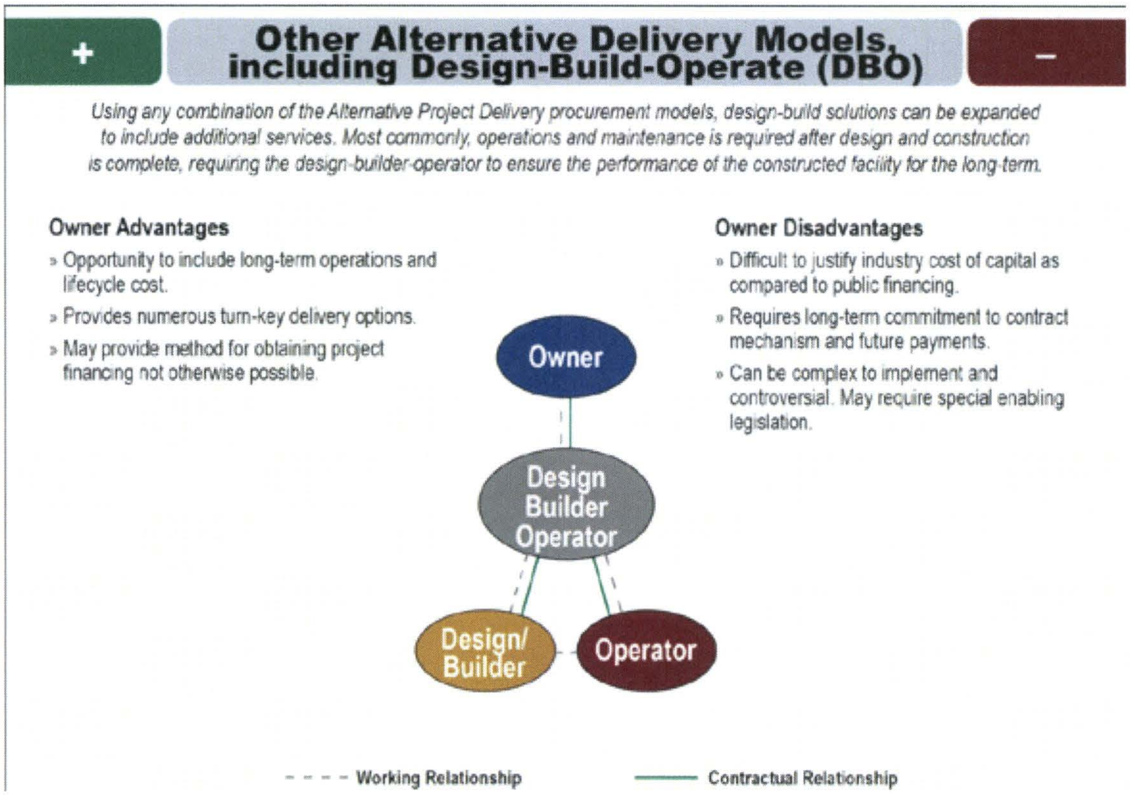
Note: Because the cost data depicted above represent savings, a number in parentheses represents a cost increase.

SUMMARY OF PERFORMANCE IMPROVEMENTS

Table 2-4. Summary of Proposed VA Proposal Performance Improvement

Proposal No.	Minimize Travel Time	Connectivity and Mobility	Freeway Congestion	Arterial Congestion	Transit Ridership	Environmental and Community Impacts	Consistency with Regional Plans and Strategies	Maximize Cost Efficiency of Public Investments
TSM/TDM1	Improved	Improved	-	Improved	Improved	-	-	-
BRT1	-	-	-	-	-	-	-	-
BRT2	-	Improved	Improved	Improved	-	-	-	-
BRT3	-	-	Improved	-	-	Improved	-	Improved
LRT1	-	-	-	-	-	-	-	-
LRT2	-	-	-	-	-	-	-	-
LRT3	-	-	-	-	Improved	-	Improved	-
LRT4	-	-	-	-	-	-	-	-
LRT5	-	-	-	-	Improved	-	-	-
LRT6	-	-	-	-	Improved	-	Improved	-
FT1	-	-	-	-	-	Improved	-	Improved
FT2	-	-	-	-	-	-	-	Improved
FT3	-	-	-	-	-	-	-	Improved
FT4	Improved	Improved	Improved	-	-	-	-	-
FT5	-	-	Improved	Improved	-	-	Improved	Improved
FT6	-	-	-	-	-	-	-	-
FT7	-	-	-	-	-	Improved	-	-
FT8	Improved	Improved	-	-	Improved	-	-	Improved
FT9	-	-	-	-	-	-	-	Improved
FT10	Improved	-	Improved	Improved	-	Improved	-	Improved

Exhibit 2-7



No Build Considerations

- **NB-C1: No Build (NB) and Transit Ridership**

  The number of cars on roads will continue to increase everyday unless alternative means of transportation are comfortable, effective, and economical. The VA Team has brainstormed an idea to increase ridership on the Gold Line by providing incentives such as lower fares and reliability. This will benefit the study area by decreased traffic congestion and increased economic activity.

Exhibit 2-5

+ Construction Management At-Risk –

Construction Management At-Risk provides owners with an excellent solution for engaging qualifications-selected contractors early in the design process while maintaining a two-contract relationship with engineers and constructors. This method improves collaboration, but requires a "forced marriage" between designer and builder and does not ultimately place delivery responsibility on a single entity.

Owner Advantages

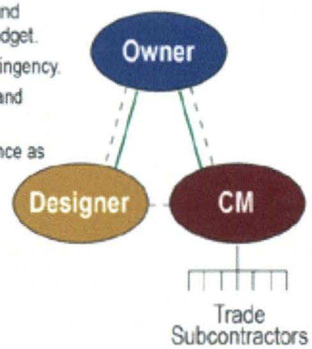
» Integrates constructibility earlier in the design process

» Provides true contractor-led estimates and scope revision during design to meet budget.

» Can reduce overall project risk and contingency.

» Can reduce design misunderstandings and potential for change orders.

» Allows qualifications and past performance as criteria when selecting a contractor.



Owner Disadvantages

» Relies on engineer's estimate for initial project costs.

» May create "forced marriage" for designer and contractor.

» Final construction scope subject to change order potential.

» Added costs for contractor pre-construction services (potentially offset by savings via early collaboration).

» Contractor selected based on fees without knowing full construction price.

» Separate design/construction contracts create multiple contacts and may not align business interests.

- - - - Working Relationship ——— Contractual Relationship

Exhibit 2-6

+ Performance-Based Design-Build (DB) with Target Price or Lump Sum –

Performance-Based Design-Build typically uses a two-phase procurement process, requiring short-listed design-builders to propose lump-sum best value solutions based on the Owner's project performance criteria, but with little or no pre-developed design. The selected design-builder works under a single contract and is required to deliver a facility that meets the performance criteria at the proposed price.

Owner Advantages

» Maximum potential for DB cost savings through design innovation during competitive procurement.

» Maximum transfer of design-related performance risk to design-builder.

» Minimal design work required prior to procurement, resulting in relatively low cost to prepare RFP.

» Fastest possible procurement and project delivery schedule.

» Perceived as "competitive" construction pricing, providing full contract cost at bid time.

» Designer and contractor selected based on past performance, qualifications, and single-entity teaming ability with interests aligned for project success.

» No contractor-initiated change orders.

» Owner has single point of contact and single contract for performance and guarantees.

Owner Disadvantages

» Proposal evaluation and selection can be complex.

» Limited ability to predict what will ultimately be proposed.

» Lump sum pricing may include excess risk and contingency due to undefined project scope.

» Limited opportunity for owner and design-builder collaboration on design during procurement process.

» If lifecycle cost is not analyzed or operations not included in scope, may result in higher O&M costs or undesirable project features.

» Limited ability for owner to adjust design and scope without resulting in change orders and price adjustments.

- - - - Working Relationship ——— Contractual Relationship

Alternative Delivery Strategies (ADS) Considerations

- **ADS-C1: Evaluate Alternative Delivery Strategies for the Preferred Alternative**

  It is suggested that when the final alternative(s) from the Environmental Clearance process is complete, ADS should be reviewed and evaluated including Early Contractor Involvement (ECI), Design-Build (DB) Delivery, Construction Management/General Contractor (CM/GC), or Construction Management at Risk (CMAR) as project delivery options for implementing the selected alternative(s). There could be Metro and Caltrans benefits related to schedule, cost, and project innovations that are further enhanced in each of these different project delivery models. This project delivery review and analysis should include a detailed risk allocation and assessment discussion so that project risks are allocated to those that are best able to manage them. These project risks could include risks associated with delivery, technology, and financial risks.

  Examples are shown below with advantages and disadvantages of just a few of the alternative delivery models.

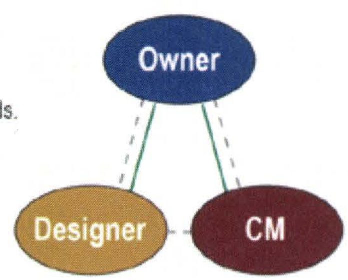
Exhibit 2-4

+	**Baseline: Design-Bid-Build**	–

The traditional baseline for project delivery, design-bid-build provides a proven, known procurement solution that will continue to be appropriate for many projects. However, design-bid-build has inherent disadvantages for many project types that the alternative project delivery methods described here can solve, providing additional tools and flexibility for owners.

Owner Advantages

- Well understood and time-tested process.
- Independent contracts for engineering and construction.
- Legal and widely used in all states and municipalities.
- More input into specific means and methods.



Owner Disadvantages

- Linear process takes time.
- Little collaboration between designer and contractor.
- Relies on engineer's estimates to program funding until late in the project.
- Hard bids subject to design omissions/errors and resulting change orders.
- Little opportunity for qualifications-based contractor selection.
- Separate contract for design and construction have Owner bearing all risk with project performance and budget.
- Lifecycle cost is Owner's responsibility and difficult to manage with three separate entities... Owner, Engineer, Contractor.

- - - - Working Relationship   ——— Contractual Relationship

- **FT-C17: Use Portions of Spoils on Caltrans-Owned Land at the South End of Project**

  Caltrans purchased the planned ROW for most of the proposed Long Beach Freeway extension between Valley Boulevard and Huntington Drive during the 1960s and 1970s. This ROW includes existing industrial parcels between Valley Boulevard and Concord Avenue, most of which have been cleared. The ROW north of Concord Avenue is primarily existing residential uses that Caltrans owns, but has not cleared; Caltrans rents the existing residences. Metro management has recommended that the project should not adversely impact the existing residences.

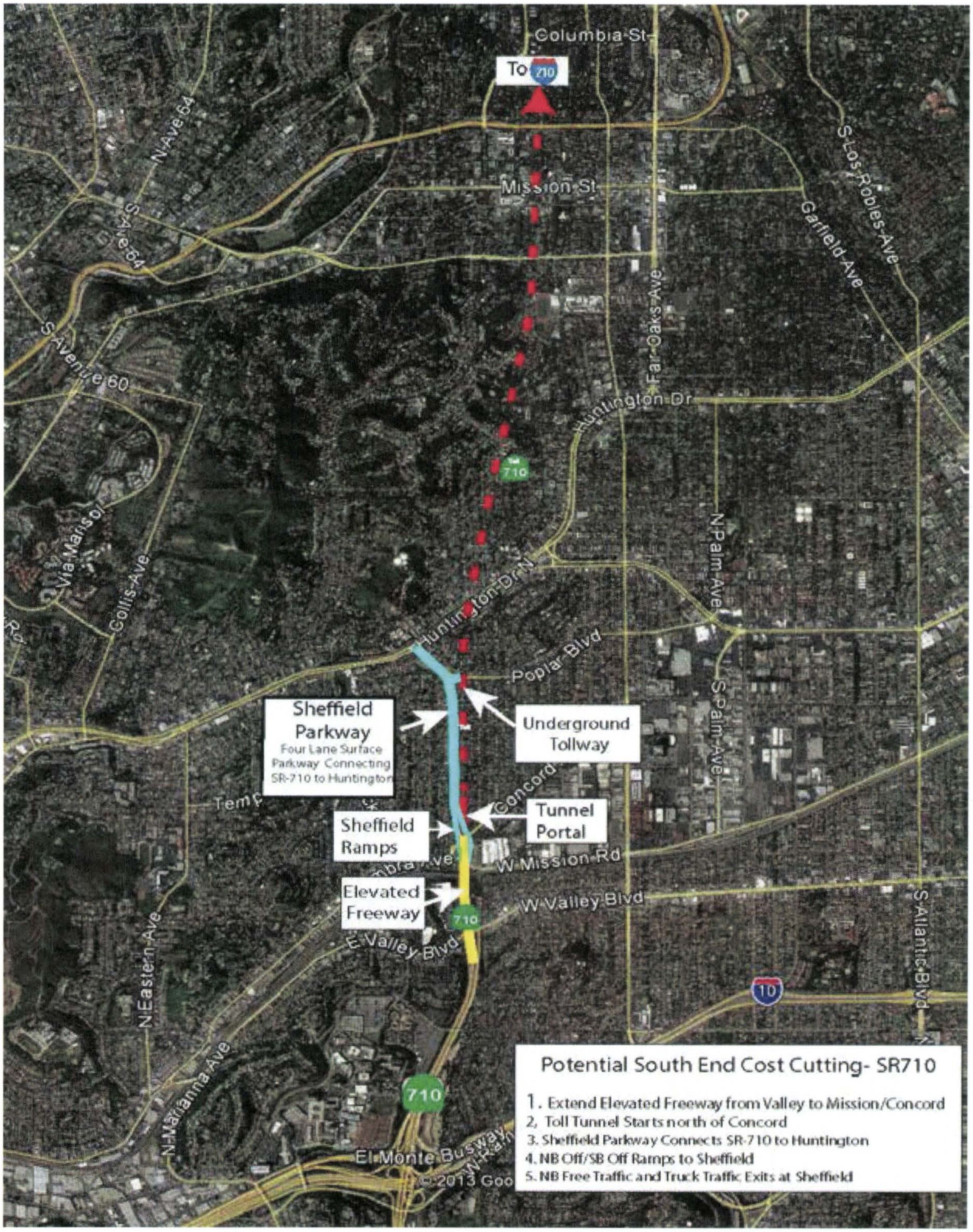
  The identified spoils disposal sites are either the Port of Los Angeles/Long Beach or the Irwindale sand and gravel pits. Caltrans owns approximately 15 acres of industrial land between Valley Boulevard and Concord Avenue along the originally planned route for the elevated freeway in this reach. Such fill would have been approximately 15 feet high (some of this planned fill was placed on the site immediately north of Valley Boulevard). However, the proposed tunnel project could still utilize the industrial sites as a spoil site, placing between 1/3 and 1/2 of single-bore tunnel spoils at a depth of up to 20 feet over the 15 acres. Additional spoils could be (1) used on Caltrans SR 710 ROW south of Valley Boulevard but north of the tunnel portal, or (2) used to create berms for Valley Boulevard and Mission Boulevard to rise up to the elevation of the pad. Optionally, the project could place a structural cap over the UPRR to bring the parcels together, and place additional material. Note that the height of the site with disposal would be similar to the height with the originally proposed freeway or the height of a typical single-family residence. Between 1/3 and 1/2 of the south portal spoils could be disposed of this way.

  Prior to reuse of the disposal site, Caltrans would need to assess which lands might be needed for future temporary use if and when the second bore was constructed. No permanent structures should be placed on this land. The deed should include temporary easements for such future construction including the removal and replacement of surface improvements.

  This alternative has two key benefits: Reduction by up to one-half in the export truck trips at the southern portal and reduction in pollution associated with these trips. Trips to the Port are approximately 25 miles each way; the return trip will almost certainly be unloaded. The consideration would reduce truck trips on the I-710 by approximately 72 trucks per day. The cost reduction and pollution reduction would be significant.

  At the end of the spoil disposal process, the spoil sites would be graded approximately flat. The local government would determine appropriate future land uses (industrial land uses, parks, and/or schools). Parks could be a particularly appropriate use; alternatively, a combination of transit center and transit-oriented development (TOD) could be constructed.

Exhibit 2-3. SR 710 Stubs



- **FT-C13: Precast Tunnel Components (May also be VA Recommendation)**

  Utilize more precast elements for the interior of the tunnel section to speed construction and minimize staging area. Address construction staging constraints for dealing with precast components, removal of earth from the bore, etc.

- **FT-C14: Project Spoils**

  During the PA/ED and PS&E phase, attempt to find areas for use of the spoils from the project. Address access through communities for transport of spoils. Contact the Port Authority to find out if they could utilize the spoils.

- **FT-C15: Create New Project Spoils Site over Existing SR 710**

  Construct a tunnel-like "roof" over portions of the existing SR 710 segment between I-10 and Valley Boulevard. Utilize tunnel spoils in the existing canyon that SR 710 passes through. Create flat usable space over the new tunnel/filled-in canyon, and use it for a park or expansion of Cal State LA.

- **FT-C16: Maximize Use of SR 710 Stubs**

  Maximize the use of the existing SR 710 stubs, north and south, versus more extensive reconstruction. This would affect the profile of the tunnel.

may be required at each end of the tunnel due to the length. The substation building may be able to be combined with the ventilation and OMC building. Substation buildings at each end of the tunnel are required due to two independent power sources being available to the tunnel. It is recommended to itemize the conceptual cost estimate to include two substation/ OMC /ventilation buildings. The potential locations of these buildings should be preliminarily identified at the earliest possible stage. It is anticipated that the buildings will be located at each end of the cut-and-cover tunnels.

- **FT-C8: Huntington Drive Connection**

  Huntington Drive is a major surface street through the area, but there is no proposed connection from the Freeway Tunnel to this major arterial. It will be very difficult to directly connect the tunnel to any surface route; as such the following concept was developed.

  This concept primarily works with an alternative that relocates the southern tunnel portal to a location north of Mission Road/Alhambra Avenue.

  Prior to entering the tunnel portal, a northbound Sheffield Drive/Huntington Drive off-ramp would exit the freeway and a southbound parallel on-ramp would enter the freeway. After the tunnel portal, the ramps would merge to become a four-lane divided parkway along existing Sheffield Avenue, requiring the removal of the houses along Sheffield. The roadway would be slightly depressed to reduce noise impacts. At Poplar Avenue, the Parkway would turn left to intersect Huntington Drive. This would effectively provide a southbound on-ramp and northbound off-ramp to Huntington Drive, and create an attractive parallel route to Fremont and Atlantic for local traffic to reach the SR 710 that could not otherwise access the freeway, or were diverted by toll costs and/or truck restrictions.

- **FT-C9: P3 Project with Development Agreement**

  Implement a P3 project with predevelopment agreement with the P3 concession team helping with the selection of the Preferred Alternative. Address this approach within the National Environmental Policy Act (NEPA)/ California Environmental Quality Act (CEQA) process. Keep the competitive tension in the selection process, versus sole source negotiations. Consider a hybrid process with early involvement, but still bidding the project to obtain the best value.

- **FT-C10: Early Consultation with Potential Contractor(s)**

  Bring a contractor on board early for construction advice. For example, obtain high-level input from a tunneling contractor. The contractor may not be able to bid later.

- **FT-C11: Express Lane Connections to I-10 Busway**

  Maximize the use of the express lane/managed lane concept by placing direct connections to the El Monte Busway (I-10 Express Lanes) and connections to potential I-210 Express Lanes.

- **FT-C12: Variable Speed Management Signs**

  Introduce wider-area VMS for variable speed enforcement for congestion management.

further investigated. This could help to reduce the amount of truck traffic on the local streets and freeway system. Spoils management should be fully investigated and documented during the environmental phase.

- **FT-C5: Reduce Depth of Cover of Tunnel for Reduction in Overall Length**

  The possibility of raising the profile of the tunnel to reduce excavation depths at the approaches and shorten the length of the tunnel should be considered. This could be accomplished by providing ground improvements such as deep soil mixing and jet grouting in the shallow depth areas near the portals. This may allow the TBM to start and end with a shallow cover depth. If a one-half tunnel diameter cover depth (with surface ground improvements) could be achieved at the beginning of tunneling, then the depth required for open excavation could be reduced and a slight savings in the overall tunnel length could be achieved. This reduced depth would make all the supporting retaining wall structures for portal areas shorter and would reduce the overall excavation quantity for the cut-and-cover portions. These savings would have to be compared against the cost of the additional ground improvements needed to maintain stability at the surface. It appears that some unrestricted areas (no homes or businesses) are available in front of and/behind the TBM tunnel portal headwall.

- **FT-C6: Structure Backfill, Aggregate Base, and Excavation Material**

  The conceptual cost estimate summary for Alternative F-7 does not appear to include a category for structural backfill for the cut-and-cover tunnels. The cut-and-cover tunnels include a total length of approximately 3,350 feet; backfill will need to be placed along the sides and on top of this length. This is assuming the excavation for the cut-and-cover tunnel will be sloped or temporary retaining placed away from the outside edge of the tunnels. It is approximated that over 200,000 yd^3 of structure backfill will be required. The possibility of using some of the spoils as structure backfill should be further explored. This would require a design exception, because the standard policy of the state is to backfill structures with structure backfill according to the standard specifications. The conceptual cost estimate does not appear to include an item for aggregate base (AB) below the cut-and-cover tunnels. It is anticipated that AB will be required for the base of the cut-and-cover tunnels to allow for placement of the drainage pipes and backfill material below the foundation. It is approximated that around 25,000 yd^3 of AB will be required for the cut-and-cover tunnels. Excavation material from the cut-and-cover tunnels should be quantified in the preliminary cost estimates and potential disposal locations identified in the environmental phase. The estimated quantity of cut-and-cover excavation is 435,000 yd^3. This is assuming an excavation zone 3,350 long by 100 feet wide by 35 feet high.

- **FT-C7: Control Building and Substation Buildings**

  The conceptual cost estimate summary for Alternative F-7 accounts for one control building at a cost of $15 million. It was unclear if this control building is the ventilation building and operations and maintenance center (OMC) as one building and at both portals, or if it is one control building at just one end of the tunnel. It is believed that at least one substation building will be required at each end of the tunnel and one operation and control building

However, the cross section drawings that were provided by the design team for the baseline Freeway Tunnel scheme indicate that a 4-foot-wide emergency access/egress walkway will be provided within a structurally separated and fire-rated cell that is located within each tunnel bore. The provision of these walkways means that it is not necessary to also provide the cross passages in order to comply with NFPA 502 requirements. It is therefore recommended that the cost of the cross passages be deleted from the cost estimate and that provisions of the 4-foot walkway be adopted as the preferred solution.

- **FT-C2: Relocate Larger Shoulder to Right Side of Traveled Way if Cross Passages and Vehicular Cross Passages can be Eliminated**

  If it is determined that the cross passages and vehicular cross passages can be eliminated, it is recommended to place the large (8- or 10-foot) shoulders on the right side of the traveled way. Emergency exit doors would also be provided on the right side instead of the proposed left side of the freeway. Typical state highways have the larger shoulder on the right side to allow for stranded vehicles, enforcement, and driver expectation. This would allow disabled vehicles moving in the right lane to safely pull over on the right side shoulder. Maintenance vehicles and personnel along with emergency vehicles would use the right side shoulder to access the tunnel. If the cross passages or vehicle cross passages cannot be eliminated, then it is recommended to keep the larger shoulders on the left side along with the emergency exit doors.

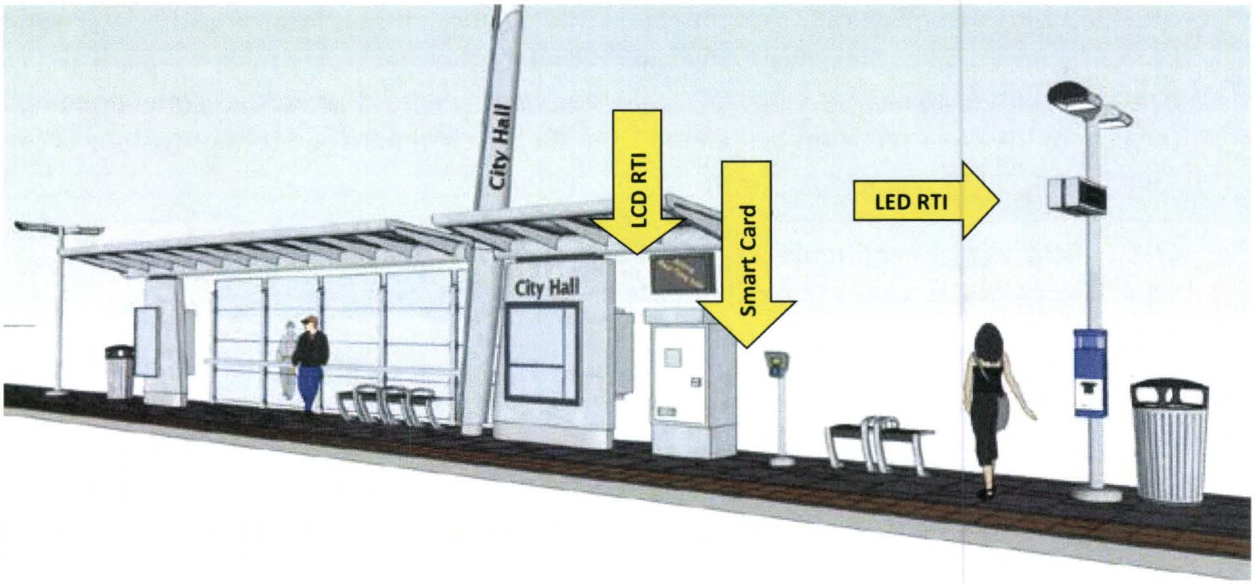
- **FT-C3: Staging Area**

  More staging area may be required at the north and south portals. A generalized staging area should be developed to ascertain if any additional ROW needs to be acquired. For the launching portal, the staging area should include laydown for materials; maintenance workshops; storage area for excavated spoils; access roads; equipment space for spoil removal; parking and field offices for contractors, owners, and onsite personnel; possible batching plant; and a temporary electrical substation. It is estimated that the launching pit pad for the TBM will need to be approximately 400 feet, which in itself will consume a significant portion of the existing staging area.

- **FT-C4: Spoils**

  It is estimated that between 3,100 and 3,400 cubic yards (yd^3) of spoils (depending on tunnel diameter) will be excavated from the tunnel on a daily basis (assuming 30 feet of tunnel advancement per day). It is approximated that between 4,600,000 and 5,000,000 yd^3 of spoils will be generated from the TBM excavation. Spoils will need to be stockpiled and then hauled away by trucks and/or train. The staging area for the spoils will need to be quite large in addition to all of the other elements discussed under staging area. It is estimated that over 310 to 340 dump truckloads per day will be required to remove the 3,100 to 3,400 yd^3 of spoils. It is recommended that this large area required for spoils be included in the staging area, and that potential locations for disposal of the spoils be determined. Spoils also may need to be tested for contamination and paleontology concerns. It was discussed in the VA meeting that the Port of Long Beach and/or the Port of Los Angeles may be looking for fill. Utilization of the UPRR trains as a potential transportation source for the spoils should be

Exhibit 2-2. Example Application of Real-Time Information and Off-Board Fare Collection



- **BRT-C3: BRT Route as Regional Route**

  In order to capture greater ridership, the VA Team discussed operating the BRT route as a regional route for greater regional connectivity. The BRT route would work like the Orange Line, which is a popular BRT route with exclusive ROW. If funding is limited, the BRT regional route could work as an interim measure.

- **BRT-C4: Transit-Oriented Development**

  The VA Team recommends transit-oriented development along the proposed BRT and LRT routes, such as those at Hollywood and Highland, Hollywood and Vine, and Hollywood and Western along the Red Line; Western and Wilshire, and Wilshire and Vermont along the Purple Line; and Del Mar along the Gold Line.

  Transit-oriented development and public transit increase transportation options for city residents when commuting to work, doing their shopping, or otherwise going out in the community. This could provide P3 opportunities such as apartments, retail, and education services. It could also be considered with or without the tunnel option.

FT Considerations

- **FT-C1: Elimination of Cross Passages Between Freeway Tunnel Bores**

  The baseline scheme cost estimate currently includes a significant cost for construction of cross passages between the Freeway Tunnel bores. These cross passages are provided to allow emergency egress of tunnel users from one bore to the other in the event of an incident within the tunnel, such as a fire. The cross passages would be spaced to comply with National Fire Protection Association (NFPA) 502 requirements.

Exhibit 2-1. Examples of Real-Time Information Signs

Real Time Information: LED Signs

Real Time Information: LCD Signs

These systems also provide the opportunity to give additional amenities to the transit rider, which makes taking the BRT bus even more attractive. Information such as local weather, event updates, and community activities can be provided to make waiting time more pleasant. Emergency information also can be disseminated more quickly and reliably to the traveling public.

Some initial cost assumptions are provided below:

- Traffic Signal Priority
  - $50,000 per intersection
  - 78 signalized intersections in corridor; 29 are already being modified/replaced in the base alternative; 49 intersections are to have traffic signal priority added
  - Total: $2.45 million
- Real-Time Information
  - 1 LED sign and 1 LCD monitor at BRT stop in each direction of travel (33)
  - $10,800 per LCD sign
  - $9,800 per LED monitor
  - Total: $0.68 million
- Off-Board Fare Collection
  - Smart card readers (one per each direction of travel per BRT stop: 33)
  - $1,682 per smart card reader = $55,506
  - Total: $.06 million

The VA Team suggests that the project team consider including these technologies with the BRT-6A Alternative. Examples of LED and LCD passenger information signs (Exhibit 2-1) and BRT station layout with real-time passenger information signs and a smart card reader (Exhibit 2-2) are shown below. Note that the example layout also includes a ticket vending machine, which may not be needed at a Metro BRT stop.

desired, such as textured paving, furniture, lighting, and landscaping. Costs for BRT stops could become substantial and should be accounted for in the cost estimate.

- Vehicles – not included in the cost estimate; unless the proposed mode is actually intended to be "enhanced bus" service, BRT vehicles should be accounted for in any new BRT system.
- MSF – not included in the cost estimate; where there is a new vehicle fleet to support a discrete transit system mode, there should also be an MSF to store, clean, and repair the vehicles; additionally, property acquisition is likely for the new facility site.
- Miscellaneous – does the Conceptual Cost Estimate include concrete bus pads, corresponding traffic signal priority system devices on the vehicles such as emitters or transponders, curb and sidewalk "bulb-outs" for BRT stops when adjoining street parking, and transfer facilities where BRT interconnects with the existing Gold Line stations at Atlantic, Fillmore, and Del Mar?

The VA Team suggests that the project team consider the observations made above in conjunction with refining the alternative and firming up the total cost for Alternative BRT-6A to proceed into advanced evaluation.

- **BRT-C2: Alternative BRT-6A; Passenger Information System and Intelligent Transportation Systems Technologies**

The effectiveness of Alternative BRT-6A would be improved with the addition of select, relatively low-cost passenger information and ITS technologies. The key components are:

- Passenger Information System: Real-time information displayed via light-emitting diode (LED) and liquid crystal display (LCD) signs at each BRT stop. Could also be accessible via a Web site or cell phone application. Passengers would be better able to manage the amount of time spent waiting at the BRT stop.
- Transit Signal Priority: Priority provided for BRT vehicles along the study corridor. Improves BRT travel time and schedule reliability.
- Advanced Fare Payment: Transit riders pay their fare before boarding the bus via a smart card reader, cell phone, or credit card. Metro plans to implement a similar system along Wilshire Boulevard.
- Other technology applications: There are a variety of other technology applications that could be cost-effectively applied if also used elsewhere in the Metro system. These include remote security monitoring and integral real-time optimization of the corridor operation. These are not included in the cost assumptions provided below.

The provision of real-time information and advanced fare payment collection reduces the dwell time by the BRT vehicle at the BRT stops. Transit riders are queued up and ready to board when the vehicle arrives, and already have the fare paid. This allows for boarding through all bus doors, not just the front door. The BRT bus driver is also freed up to assist any passengers who need help boarding the bus.

Geometric design details must take into account traffic volumes, land use, topography, and other factors. Since roundabouts can process traffic more efficiently than traffic signals and stop signs, roundabouts typically require fewer traffic lanes to accommodate the same amount of traffic. However, this idea was not advanced for cost-saving purposes, because the benefits are focused in the immediate area, and it does not benefit the overall system as a stand-alone proposal.

BRT Considerations

- **BRT-C1: Alternative BRT-6A Conceptual Cost Estimate**

  The total cost for Alternative BRT-6A is stated as $50,000,000 in Appendix B Conceptual Engineering Cost Estimates, found in Appendix F – Conceptual Engineering Report of the SR 710 AA Report. That information was also summarized in the March 4, 2013, handout of conceptual engineering cost summaries of the baseline alternatives provided to the VA Team.

  In the handout, the total cost included the following "BRT Large Cost Items":

  - Earthwork ~ $3.5 million
  - Structural Section ~ $7 million
  - Traffic Items ~ $10 million
  - Signalized Intersections ~ $5 million
  - Minor Items ~ $4 million
  - Mobilization ~ $3.4 million
  - Contingency ~ $11 million

  The VA Team observes that the total cost for the 14-mile BRT system may be understated. In general, BRT system projects around the country have been built in recent years or are being planned for implementation at $2 million to $20 million per mile. Since Alternative BRT-6A has a high percentage of operations within exclusive lanes in either single or both directions, a more representative cost estimate might be on the order of $10 million per mile x 14 miles = $140 million. With infrastructure design refinements and amenities to provide a more "rail-transit-like" ride, the cost could go up substantially.

  More specifically, Alternative BRT-6A does not appear to sufficiently address the following considerations:

  - ROW – no cost shown; although the intent of the BRT Alternative is to operate within existing ROW, running in mixed-flow traffic wherever exclusive lanes cannot be accommodated, additional ROW may be required at designated BRT stop areas as well for improving street geometry to bring older roadways up to current standards.
  - Stops – not identified in the cost estimate; BRT systems typically are "branded" with distinctive stops or stations to distinguish them from regular bus lines, using design treatments such as "shelters, off-board ticket vending machines, and public information such as real-time arrival displays indicating the proximity of buses to the stop" (from BRT Technical Memorandum in the AA Report); however, depending on public comment during the project development phase, additional amenities may be

Table 2-2. Summary of VA Strategies

Strategy Description	Initial Cost Savings	LCC Savings	Change in Schedule	Change in Performance	Value Change
Recommended VA Strategy VA Strategy FT-S1: Single-Bore Tunnel with Demand Constrained by Variable Toll (FT1) Combined with Car-Only Freeway Tunnel at 46.5-foot Inside Diameter Proposal Nos. FT1 and FT2	$2,788,000,000	(---)	Decrease	+19 %	+175%

Note: Because the cost data depicted above represent savings, a number in parentheses represents a cost increase.

Table 2-3. Summary of VA Alternatives

Strategy Description	Base Cost	Change in Schedule	Change in Performance	Value Change
VA Alternative BRT-A1: Addition of BRT with Enhanced Technology to Freeway Tunnel Alternative Proposal No. FT1 and Alternative BRT-6A	$181,000,000	None	+36 %	+152%

OTHER CONSIDERATIONS

TSM, TDM Considerations

- **TSM/TDM-C1: Huntington and Atlantic Roundabout**

  The VA Team brainstormed an idea to introduce a roundabout along Huntington Drive and Atlantic Avenue. Roundabouts improve the efficiency of traffic flow; they also reduce vehicle emissions and fuel consumption. While the initial construction cost of a roundabout varies by location, maintenance costs are lower for a roundabout than for intersections with signals. Roundabouts also can enhance aesthetics by providing landscaping opportunities.

Table 2-1. Summary of VA Proposals

Proposal No. and Description	Initial Cost Savings	LCC Savings	Change in Schedule	Performance Change	Value Change
FT6. Precast Elements for Tunnel Roadway Decks and Interior Walls	$35,700,000	(---)	Decrease	-1%	0%
FT7. Covered Depressed Freeway with a Landscaped Area for "At-Grade Section"	$116,000,000	(---)	None	+3%	+1%
FT8. Move to PPP Model of Delivery	$1,070,000	(---)	(---)	+33%	+33%
FT9. Utilize "Early Contractor Involvement" into the Project Delivery Options of the Corridor	$500,000	(---)	(---)	+1%	+1%
FT10. Networkwide Congestion Management by Vehicle Speed Control	($47,900,000)	($1,420,000)	None	+15%	+14%

Note: Because the cost data depicted above represent savings, a number in parentheses represents a cost increase. The data in this table represents initial cost savings, LCC savings, change in schedule, and value change of proposals in comparison to their respective baselines.

Table 2-2. Summary of VA Strategies

Strategy Description	Initial Cost Savings	LCC Savings	Change in Schedule	Change in Performance	Value Change
VA Strategy LRT-S1: LRT-4A Alignment on I-710 Median, Valley Boulevard Overcrossing of LRT, and LRT-4A Alignment Terminus at Gold Line North of SR 110. Proposal Nos. LRT1, LRT2, and LRT3	$640,000,000	$784,000,000	Decrease	+4 % (LRT-4A) +2 % (LRT-4B)	+37% +36%

VA PROPOSAL FT1

Single-Bore Tunnel with Demand Constrained by Variable Toll

Disposition Recommendation: *(Select one)*

☒ **AGREE** ☐ **AGREE WITH MODIFICATIONS** ☐ **FURTHER STUDY NEEDED** ☐ **DISAGREE**

Explain, comment, and/or discuss rationale for disposition recommendation:
The design team is already looking at this proposal. Some of the details in the proposal will not be done exactly. The design team will not be adding stairs, and the direction of travel proposed by the design team will be northbound on the top level and southbound on the bottom level. The concept of a single tunnel using a variable toll to control demand is currently being evaluated as one of the variation.

VA PROPOSAL FT2

Car-Only Freeway Tunnel at 46.5-foot Internal Design Diameter (ID) vs. 52.5-foot ID

Disposition Recommendation: *(Select one)*

☐ **AGREE** ☒ **AGREE WITH MODIFICATIONS** ☐ **FURTHER STUDY NEEDED** ☐ **DISAGREE**

Explain, comment, and/or discuss rationale for disposition recommendation:
Scenario 1 (Reduced vertical clearance to 10-feet) and Scenario 2 (Reduced vertical clearance to 10-feet, reduced lane width to 11-feet, reduced road deck thickness to 2-feet as a result of reduced span and load) are rejected by Caltrans due to non-standard elements. The proposed reduction for vertical clearance is rejected. However, the team is looking to reduce the vertical clearance to 15.5 feet from 16.5 feet and the horizontal clearances from the edge of traveled way to 2 feet and 8 feet in order to reduce the diameter of the tunnel. This proposal is currently being evaluated by Caltrans District and HQ Design and will be implemented pending their approvals.

VA PROPOSAL FT3

Raise the Profile at the North Portal by 40 feet Retaining the Same Cover as the Base Design

Disposition Recommendation: *(Select one)*

☒ **AGREE** ☐ **AGREE WITH MODIFICATIONS** ☐ **FURTHER STUDY NEEDED** ☐ **DISAGREE**

Explain, comment, and/or discuss rationale for disposition recommendation:
This proposal merits further study within the time frame of the VA Study. It has been determined to be feasible. It will reduce the amount of earthwork required to launch the TBM as well as reduce the height of the walls needed to construct the launching pit. It will increase the potential settlement zone above the tunnel bores, if no mitigation is provided. The potential settlement can be mitigated by the use of Earth Pressure Balance Tunnel Boring Machine. Grouting may be necessary at some locations also as additional mitigation measure to control settlement.

VA PROPOSAL FT4
Additional SR 710 Access Located at the North Project Terminus

Disposition Recommendation: *(Select one)*

☐ **AGREE** ☒ **AGREE WITH MODIFICATIONS** ☐ **FURTHER STUDY NEEDED** ☐ **DISAGREE**

Explain, comment, and/or discuss rationale for disposition recommendation:
This proposal merits further evaluation within the time frame of the VA Study. The design team can look at providing an on-ramp at St. John and an off-ramp to Pasadena, which is more cost-effective than providing the on-ramp at Pasadena. The design team can also look at providing a slip ramp from Pasadena to the northbound 710/eastbound 210 connector ramp to improve access from downtown Pasadena. It has been determined to be feasible to provide on-ramp from St. John Avenue and off-ramp to Pasadena Avenue. This will increase the width of the cut and cover tunnel, require the use of more retaining wall to accommodate the ramps, and will require design exceptions from Caltrans for consecutive on and off ramp spacing. The design team will provide design exceptions to Caltrans for their review and approval.

VA PROPOSAL FT5
Relocate South Portal to North of Mission Street

Disposition Recommendation: *(Select one)*

☐ **AGREE** ☐ **AGREE WITH MODIFICATIONS** ☐ **FURTHER STUDY NEEDED** ☒ **DISAGREE**

Explain, comment, and/or discuss rationale for disposition recommendation:
This proposal is rejected. An agreement is already in place with the local community that the tunnel would begin south of Valley Boulevard.

VA PROPOSAL FT6
Precast Elements for Tunnel Roadway Decks and Interior Walls

Disposition Recommendation: *(Select one)*

☐ **AGREE** ☐ **AGREE WITH MODIFICATIONS** ☒ **FURTHER STUDY NEEDED** ☐ **DISAGREE**

Explain, comment, and/or discuss rationale for disposition recommendation:
This proposal deferred for consideration during future phases of the project. Additional details are needed including seismic design criteria.

VA PROPOSAL FT7
Covered Depressed Freeway with a Landscaped Area for "At-Grade Section"

Disposition Recommendation: *(Select one)*

☐ **AGREE** ☐ **AGREE WITH MODIFICATIONS** ☐ **FURTHER STUDY NEEDED** ☒ **DISAGREE**

Explain, comment, and/or discuss rationale for disposition recommendation:
This proposal is rejected. It will greatly increase the cost for the cut and cover section as well as the cost for the ventilation/fire life safety system. This proposal will also increase the complexity of the design of the cut and cover section since the roadway sections are consistently varying. There are multiple ramps that connect in this area for the I-10 interchange and the Valley Boulevard interchange, making this a safety concern by introducing conflict points within a tunnel section. This area is not conducive to an outdoor park.

VA PROPOSAL FT8
Move to Public-Private Partnership (PPP) Model of Delivery

Disposition Recommendation: *(Select one)*

☐ **AGREE** ☐ **AGREE WITH MODIFICATIONS** ☒ **FURTHER STUDY NEEDED** ☐ **DISAGREE**

Explain, comment, and/or discuss rationale for disposition recommendation:
This proposal is under consideration by Metro, and will require further study to take place after this VA Study is complete. Metro in conjunction with Caltrans will evaluate this further and this will not be done by the Study Team.

VA PROPOSAL FT9
Utilize "Early Contractor Involvement" into the Project Delivery Options of the Corridor

Disposition Recommendation: *(Select one)*

☐ **AGREE** ☐ **AGREE WITH MODIFICATIONS** ☒ **FURTHER STUDY NEEDED** ☐ **DISAGREE**

Explain, comment, and/or discuss rationale for disposition recommendation:
This proposal is under consideration by Metro, and will require further study to take place after this VA Study is complete. The evaluation will not be done by the Study Team.

VA PROPOSAL FT10
Network wide Congestion Management by Vehicle Speed Control

Disposition Recommendation: *(Select one)*

☐ **AGREE** ☒ **AGREE WITH MODIFICATIONS** ☐ **FURTHER STUDY NEEDED** ☐ **DISAGREE**

Explain, comment, and/or discuss rationale for disposition recommendation:
This proposal will be studied further beyond the time frame of this VA Study. It was suggested to move this proposal under TSM. Elements of this proposal are included as part of the TSM alternative.

VA STRATEGY LRT-S1
Combination LRT1, LRT2, LRT3

Disposition Recommendation: *(Select one)*

☐ **AGREE** ☐ **AGREE WITH MODIFICATIONS** ☐ **FURTHER STUDY NEEDED** ☒ **DISAGREE**

Explain, comment, and/or discuss rationale for disposition recommendation:
This proposal is rejected due to significant right-of-way impacts.

VA STRATEGY FT-S1
Single-Bore Tunnel with Demand Constrained by Variable Toll (FT1) Combined with Car-Only Freeway Tunnel at 46.5 Feet Inside Diameter

Disposition Recommendation: *(Select one)*

☐ **AGREE** ☐ **AGREE WITH MODIFICATIONS** ☐ **FURTHER STUDY NEEDED** ☒ **DISAGREE**

Explain, comment, and/or discuss rationale for disposition recommendation:
This proposal is rejected due to significant right-of-way impacts and non-standard elements that will not be approved by Caltrans.

VA STRATEGY BRT-A1
Addition of BRT with Enhanced Technology to Freeway Tunnel Alternative

Disposition Recommendation: *(Select one)*

☐ **AGREE** ☒ **AGREE WITH MODIFICATIONS** ☐ **FURTHER STUDY NEEDED** ☐ **DISAGREE**

Explain, comment, and/or discuss rationale for disposition recommendation:

This proposal is rejected, although the improvements will be included in the BRT alternative (just not the Freeway Tunnel alternative). The additional enhanced technologies have been added to the BRT-6 Alternative, along with many other refinements. Therefore, the BRT alternative (based upon refinements to BRT-6) will potentially perform much better than originally conceived.

It was determined that the best way to evaluate the additional enhanced technology improvements was with the BRT alternative, and not the Freeway Tunnel alternative. The Freeway Tunnel alternative will include investigation of several options, including operation of freeway express bus/BRT operations within the tunnel lanes. In addition, the transit system enhancements that are part of the TSM alternative will be included within the Freeway Tunnel alternative. Therefore, the Freeway Tunnel alternative will incorporate substantial transit service improvements, so will have increased potential to provide multi-modal benefits. However, those additional enhanced technology benefits are most productive with the BRT alternative, and not the Freeway Tunnel alternative.

VA Proposal Documentation

VA Proposals

TSM1
BRT1 through BRT3
LRT1 through LRT6
FT1 through FT10

VA Strategies

LRT-S1
FT-S1

VA Alternative

BRT-A1

VA PROPOSAL NO. TSM1

Proposal Title: Peak-Direction HOV Lane on Fremont Avenue and Fair Oaks Avenue during Peak Periods

Initial Cost Savings:	($5,150,000)
Future Cost Savings:	$0
Net LCC Savings:	($5,150,000)
Change in Schedule:	None
Performance Change:	+12 %
Value Change:	+8 %

Description of Baseline Concept: The Transportation System Management/Transportation Demand Management (TSM/TDM) alternative consists of strategies and improvements to increase efficiency and capacity for all modes in the transportation system with lower capital cost investments and/or lower potential impacts, such as substantially increased bus service in the study area, active transportation (pedestrian and bicycle) facilities, intersection spot improvements, local street improvements, and Intelligent Transportation Systems (ITS) elements. Examples of TSM strategies include coordinated traffic signal timing in a congested area, ramp meters to time the entry of vehicles onto a freeway, and minor street widening and intersection improvements. TDM strategies include techniques to reduce the use of motor vehicles, shift the use of motor vehicles to uncongested times of the day, and/or improve transport options. These transit improvements are also included in the BRT and LRT alternatives, but are not included in the freeway and highway alternatives. A detailed list of the TSM/TDM proposed improvements is included in Chapter 2 of the SR 710 Study - Alternative Analysis Report.

Description of VA Proposal Concept: This modification to the TSM/TDM alternative introduces peak period HOV 2+ (high-occupancy vehicles with two or more persons) restrictions on one lane in the peak direction (e.g., southbound in the AM peak and northbound in the PM peak) on Fremont Avenue from the I-10 interchange (southern limit) to Huntington Drive (northern limit) and on Fair Oaks Avenue from Huntington Drive (southern limit) to Del Mar Boulevard (northern limit). Transit buses also will be able to use the HOV lane. See Exhibit 1 for a depiction of the proposed HOV 2+ corridor.

Advantages:

- Discourages cut-through traffic in the north-south corridor alleviating congestion.
- Encourages carpooling behavior as well as transit use, thereby reducing the number of vehicles on the road.
- Low cost to implement.
- Provides for a less-congested lane for transit buses.
- Increases mobility without increasing vehicular volumes.

Disadvantages:

- On-street parking impacts in the peak direction during peak period.
- Potential increase in congestion on the non-HOV lane (e.g., right-most lane) could affect local traffic accessibility.
- Potential opposition from the community due to lane restrictions and parking impacts.
- Requires police enforcement.

Proposal Title: Peak-Direction HOV Lane on Fremont Avenue and Fair Oaks Avenue during Peak Periods

Discussion: Significant cut-through traffic currently uses north-south local streets during peak hours to traverse the study area, rather than driving around the study area on congested freeways. This results in significant congestion and long queues on streets such us Fremont Avenue, Fair Oaks Avenue, and Atlantic Boulevard among others. The improvements proposed in the original TSM/TDM alternative would improve operations along these corridors, which in turn would encourage additional cut-through traffic. This is demonstrated by the Alternative Analysis evaluation when comparing results for the baseline TSM/TDM alternative to the no-build alternative. The baseline TSM/TDM alternative results in an increase in total daily volume on arterials and a corresponding reduction of daily volumes on freeways for vehicles crossing an east-west screenline. Furthermore, the evaluation shows that the improvements introduced in the TSM/TDM baseline would add approximately 8,000 more daily vehicles on arterials compared with the no-build condition.

This proposal is intended to discourage cut-through traffic from using north-south arterial corridors. Currently, the Fremont Avenue/Fair Oaks Avenue corridor is one of the busiest corridors in the area (see Exhibit 1). The proposal would help relieve congestion due to cut-through traffic in the corridor by encouraging the use of HOVs/transit over single-occupancy vehicles (SOVs). Since buses would be allowed to use the restricted lane, public transit would benefit from having a less congested lane available to traverse the corridor, which could result in shorter travel times. The proposal would restrict SOVs from using the left-most lane in the peak direction. In order to implement a restricted HOV lane in the peak direction, peak-period parking restrictions will be required along several segments in the corridor to maintain one lane open for local traffic at all times. While implementation costs should be minimal (basically pavement striping, signing, and police enforcement), community opposition could be high due to potential inconvenience for local traffic to access their destinations.

This alternative also could be considered in combination with the freeway tunnel alternative. Based on the traffic analysis conducted as part of the Alternatives Analysis, the proposed freeway alternative (F7) accomplishes significant volume reduction on local arterials. However, if arterials experience a significant operational improvement, they could ultimately attract more local and cut-through traffic to use local streets if freeways are congested or less reliable. Currently, cut-through traffic accounts for roughly 25 percent of the overall peak-hour volumes in the peak direction. A combined alternative of a freeway tunnel with a TSM/TDM strategy that includes a peak-direction HOV lane on the Fremont Avenue/ Fair Oaks Avenue corridor would help keep cut-through traffic away from the corridor while encouraging car-pooling initiatives among local drivers.

Cross sections within the corridor vary between a general 4-lane section for Fair Oaks Avenue and for Fremont Avenue between Huntington Drive and West (W.) Commonwealth Avenue (see Exhibit 2) to a 5-lane section on Fremont Avenue between W. Commonwealth Avenue and the interchange with I-10 (see Exhibit 3). Typical cross sections should allow for implementing the HOV restriction and maintain two travel lanes for all traffic in the off-peak direction and at least one travel lane for SOV in the peak direction.

Technical Review Comments: (---)

Project Management Considerations: (---)

Proposal Title: Peak-Direction HOV Lane on Fremont Avenue and Fair Oaks Avenue during Peak Periods

Discussion of Schedule Impacts: No impacts are anticipated to schedule due to project construction. Additional effort to conduct project outreach and consensus building is assumed to occur within the existing schedule.

Discussion of Risk Impacts:

- Schedule risk: if public opposition to taking parking and restricting lane use results in a schedule delay.
- Political acceptability: if local jurisdictions will support local impacts to accommodate through trips.

Exhibit 1: 2008 Daily Volumes on Arterials within the Study Area

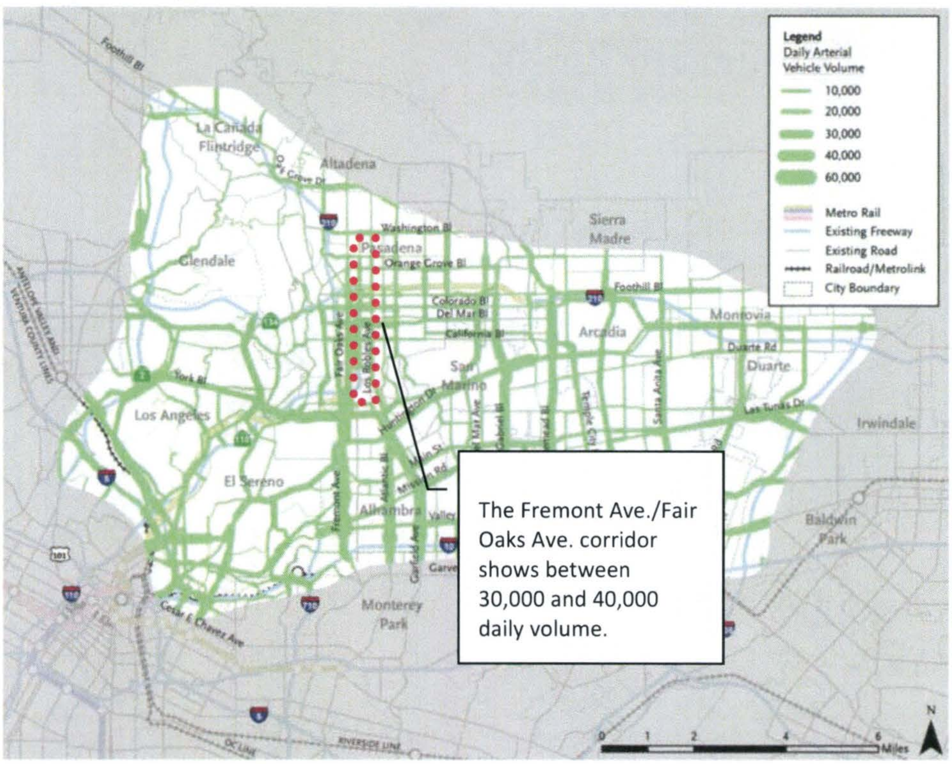


Exhibit 2. Typical Cross-Section for Fremont Avenue North of W. Commonwealth Avenue (Looking North)

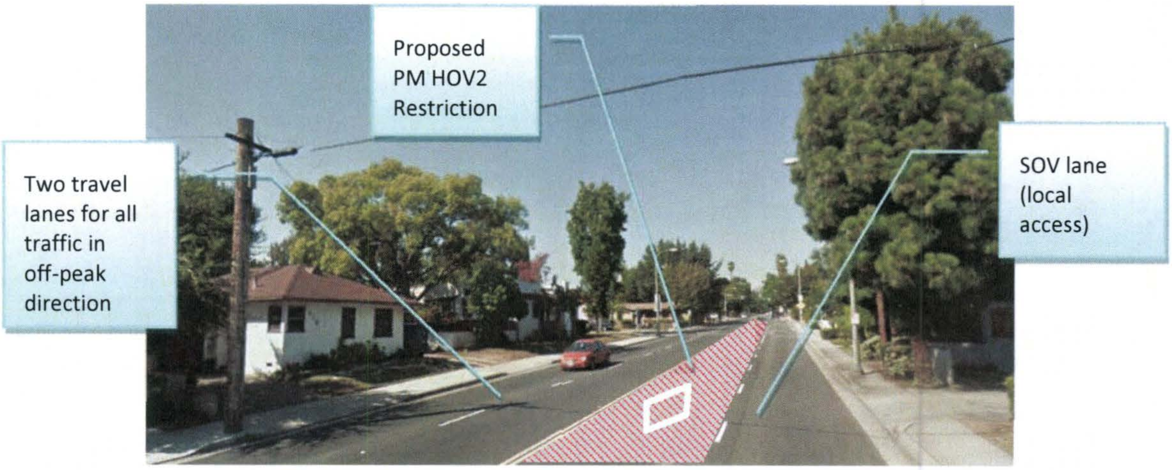
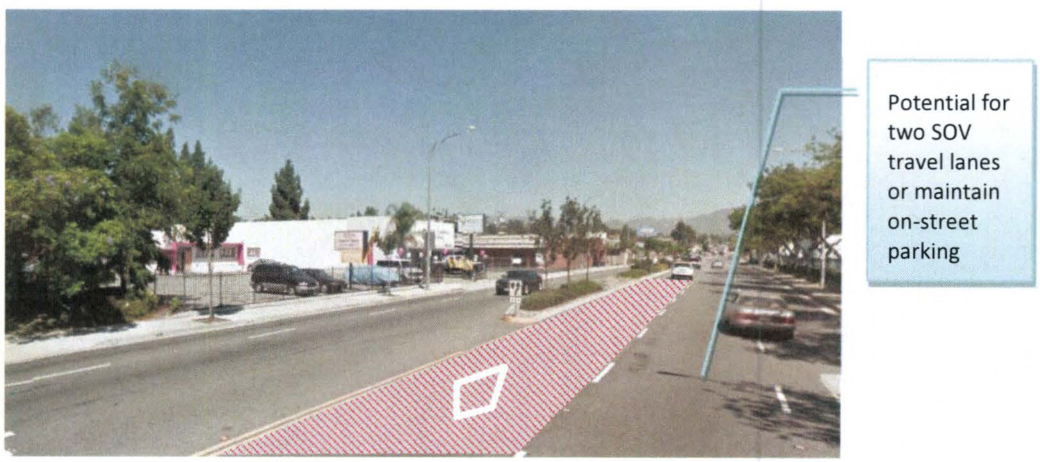


Exhibit 3. Typical Cross-Section for Fremont Avenue South of W. Commonwealth Avenue (Looking North)



Proposal Title: Peak-Direction HOV Lane on Fremont Avenue and Fair Oaks Avenue during Peak Periods

Exhibit 4. Performance Ratings

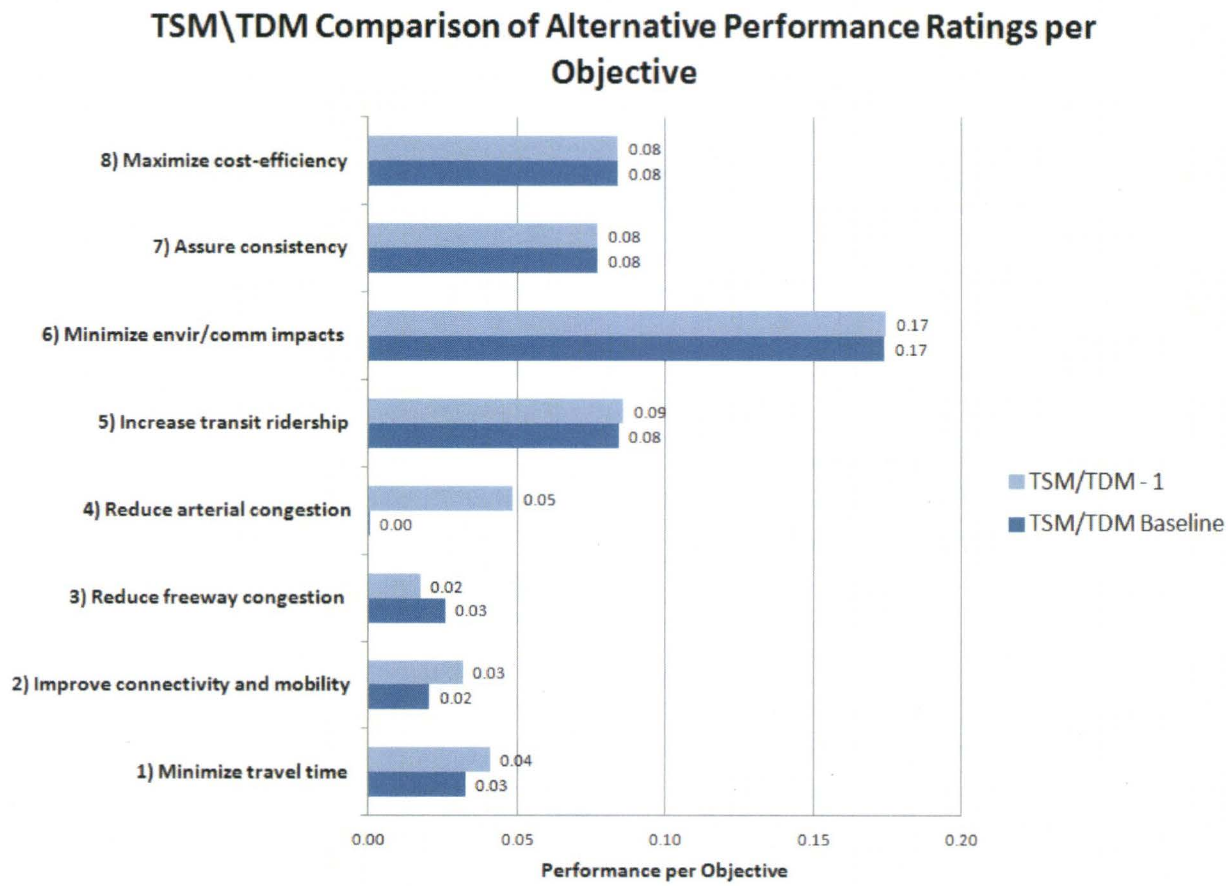


Exhibit 5. Performance Profile

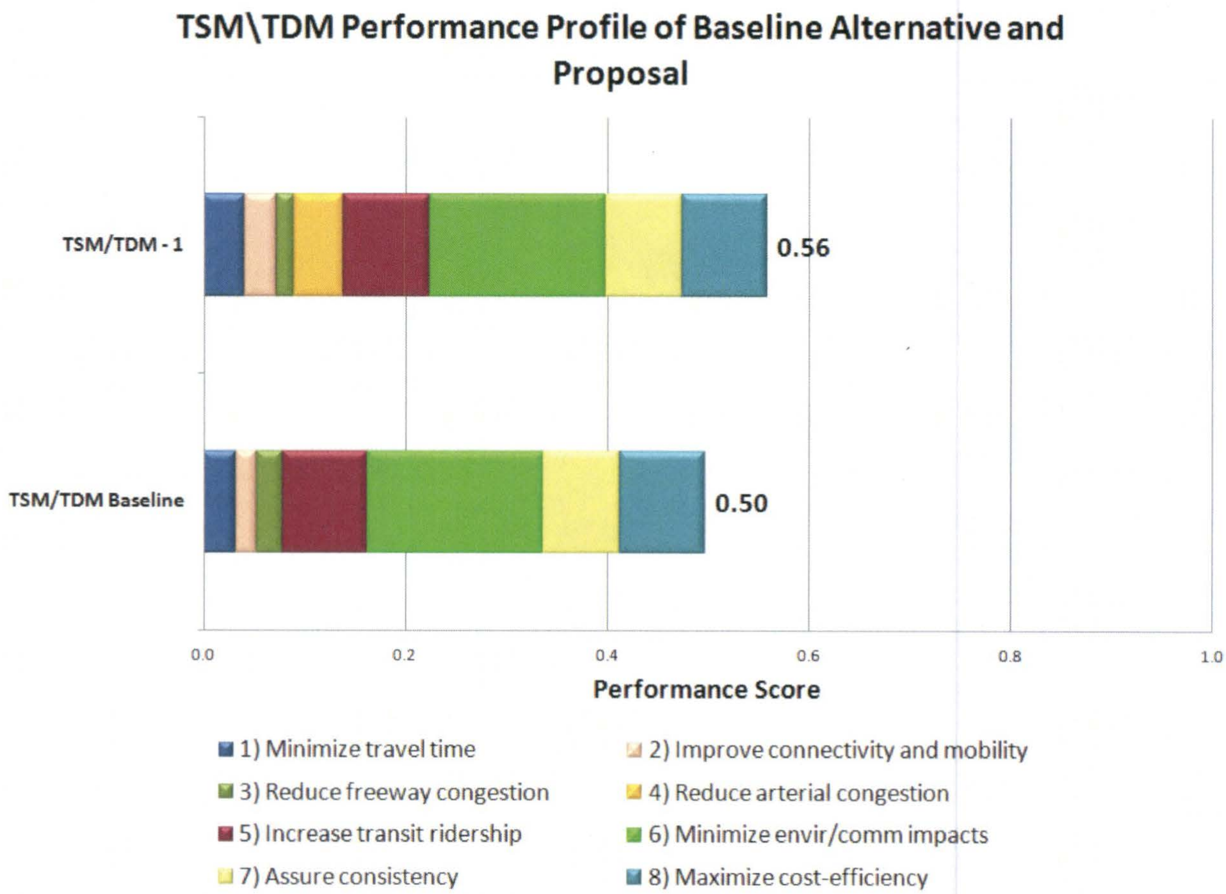


Exhibit 6. Benefit and Cost Performance

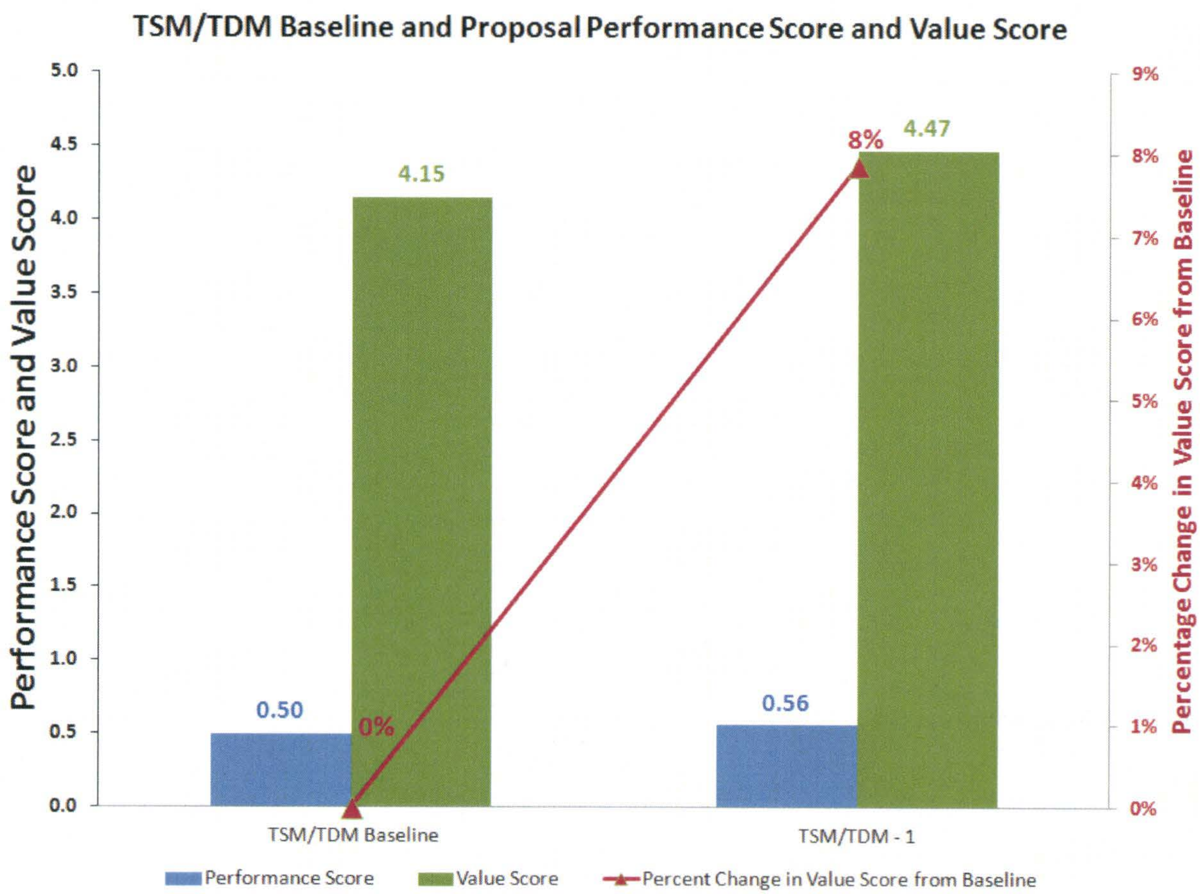


Exhibit 7. Performance Assessment

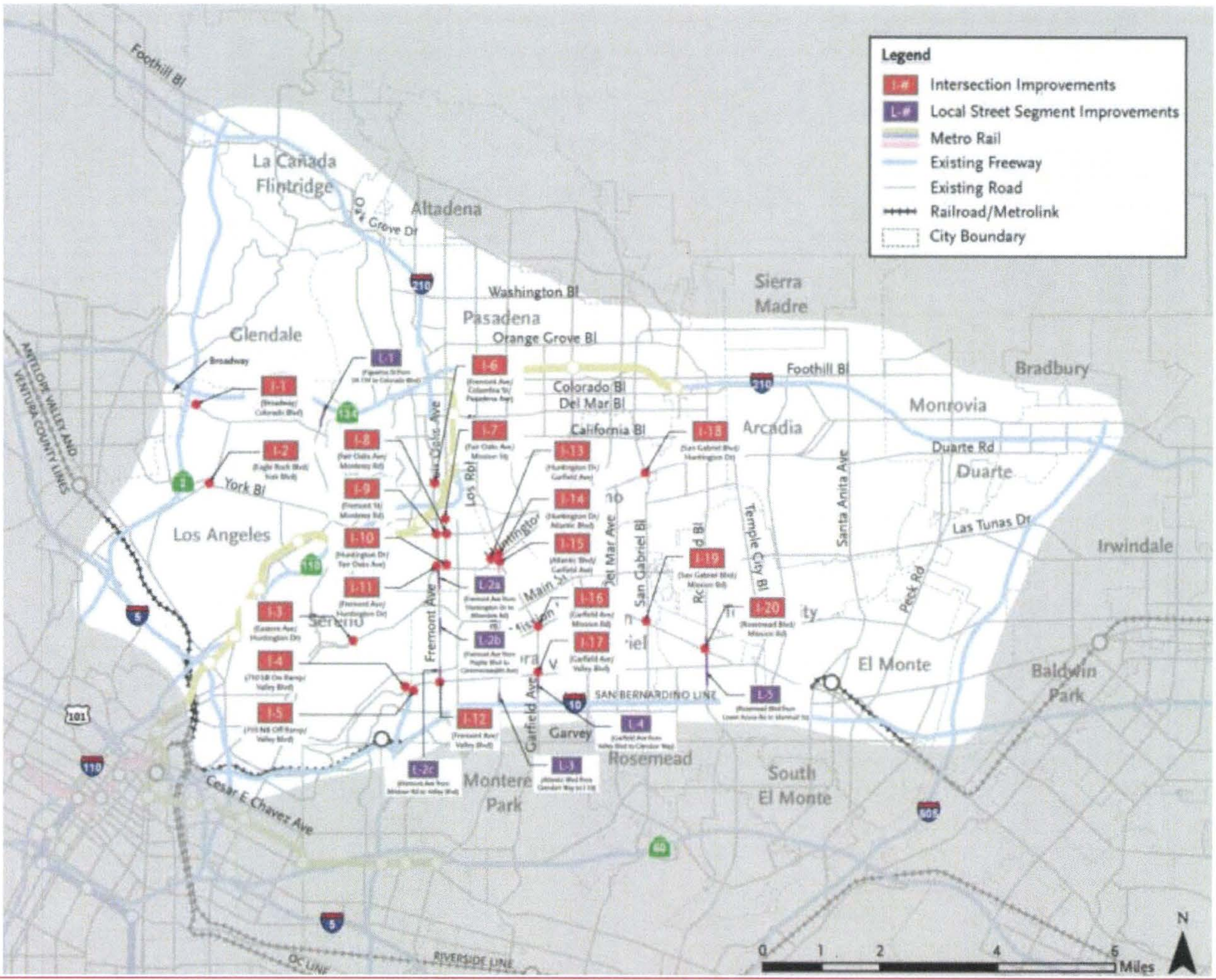
Performance Attributes (Objectives) Evaluation

Objectives	**Comment** (Influence of the VA Proposal upon the Objective)	**Rating** (VA Proposal "Improves Performance" or "No Change" or "Reduces Performance")
Minimize Travel Time	The proposal would minimize travel times for HOV 2+ and for transit within the corridor.	Improves performance
Improve Connectivity and Mobility	Mobility will be improved by encouraging carpooling.	Improves performance
Reduce Congestion on Freeway System	This proposal as a TSM/TDM stand-alone alternative would potentially result in increased congestion on the freeway system if existing cut-through traffic switches to freeway options instead of local roads.	Reduces performance
Reduce Congestion on Local Street System	The proposal would reduce congestion by discouraging cut-through traffic on north-south local street corridors.	Improves performance
Increase Transit Ridership	By allowing transit to use a restricted lane, transit travel times and reliability would potentially improve, resulting in increased transit ridership.	Improves performance
Minimize Environmental and Community Impacts Related to Transportation	Reducing the number of trips on local streets (by allowing only HOV 2+ during peak hours) will result in better air quality and less noise impacts.	Improves performance
Assure Consistency with Regional Plans and Strategies	Regional plans and strategies promote increasing mobility, reducing congestion, and increasing transit use within the area.	Improves performance
Maximize Cost Efficiency of Public Investments	This proposal increases mobility with minimal implementation and operating costs.	Improves performance

Proposal Title: Peak-Direction HOV Lane on Fremont Avenue and Fair Oaks Avenue during Peak Periods

Exhibit 8. Baseline Concept Sketch

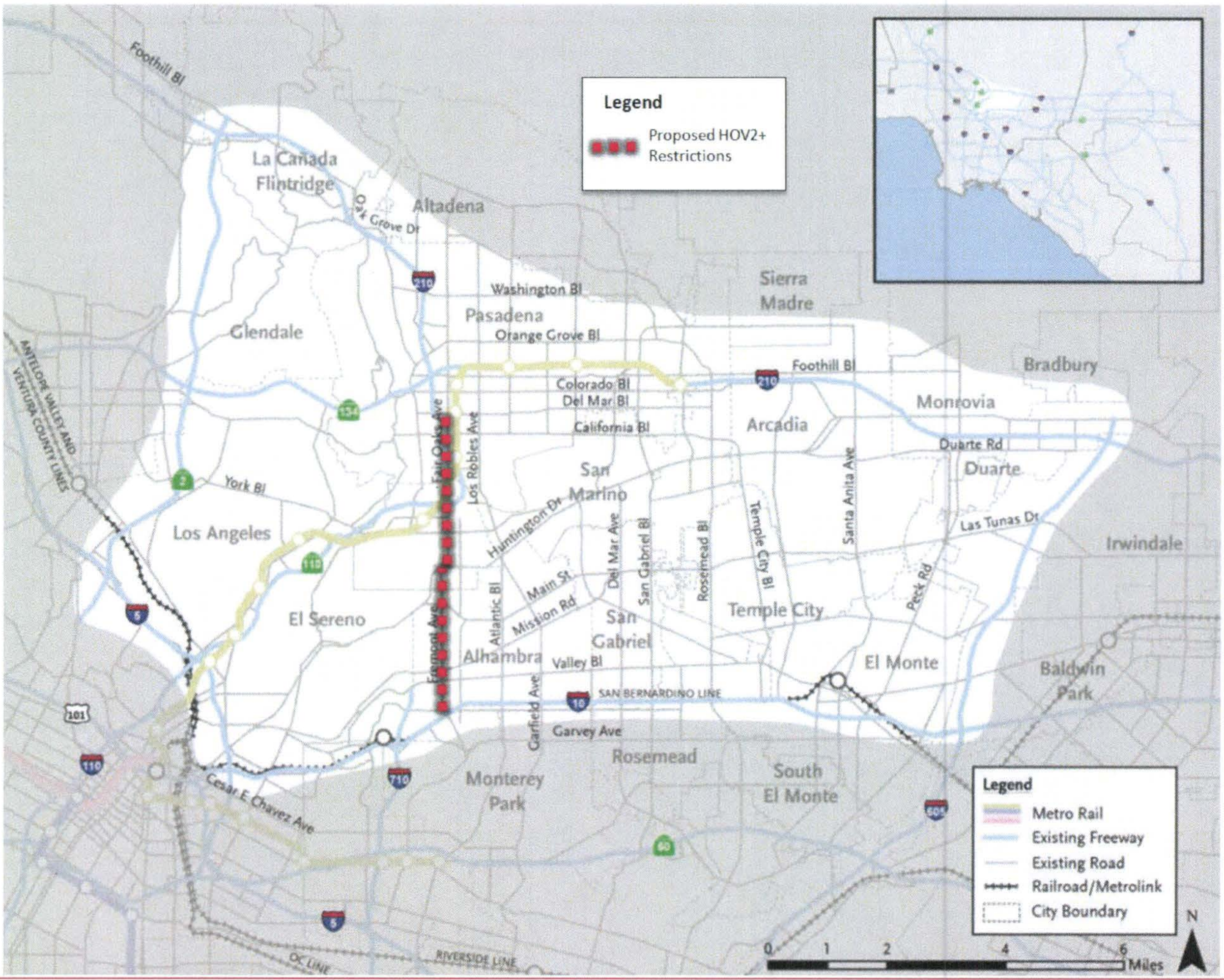
Proposed TSM/TDM Intersection and Local Roadway Improvements



Proposal Title: Peak-Direction HOV Lane on Fremont Avenue and Fair Oaks Avenue during Peak Periods

Exhibit 9. VA Proposal Concept Sketch

Proposed HOV2+ Restrictions on Fremont Avenue and Fair Oaks Avenue Corridor



Proposal Title: Peak-Direction HOV Lane on Fremont Avenue and Fair Oaks Avenue during Peak Periods

Exhibit 10. Initial Cost Estimates

INITIAL COSTS								ALT. NO.
CONSTRUCTION ELEMENT		*BASELINE CONCEPT*			*VA PROPOSAL CONCEPT*			
Description	Unit	Qty	Cost/Unit	Total	Qty	Cost/Unit		Total
Baseline Cost Estimate				$ 120,000,000.00	1	$ 120,000,000.0		$ 120,000,000
ROADWAY ITEMS								
Traffic Striping	LF			$ -	50,000	$ 0.5		$ 25,000
Changeable Message Signs	ea			$ -	80	$ 35,000		$ 2,800,000
Roadside Signs 1 Post	ea			$ -	80	$ 500		$ 40,000
				$ -				$ -
ROADWAY SUBTOTAL				$ -				*$ 2,865,000*
ROADWAY MARK-UP	*79.6%*			$ -				*$ 2,280,540*
ROADWAY TOTAL				$ -				*$ 5,145,540*
STRUCTURE ITEMS								
				$ -				$ -
				$ -				$ -
				$ -				$ -
				$ -				$ -
				$ -				$ -
STRUCTURE SUBTOTAL				$ -				$ -
STRUCTURE MARK-UP				$ -				$ -
STRUCTURE TOTAL				$ -				$ -
RIGHT-OF-WAY ITEMS								
Right-of-Way Acquisition				$ -				$ -
Utility Relocation				$ -				$ -
Relocation Assistance				$ -				$ -
Demolition				$ -				$ -
Title and Escrow Fees				$ -				$ -
RIGHT-OF-WAY TOTAL				$ -				$ -
ENVIRONMENTAL MITIGATION ITEMS								
				$ -				$ -
				$ -				$ -
CAPITAL OUTLAY SUPPORT ITEMS								
Reengineering and Redesign				$ -				$ -
Project Engineering				$ -				$ -
TOTAL		$		120,000,000.00	$			125,145,540
TOTAL (Rounded)				$120,000,000				$125,150,000
						SAVINGS		**($5,150,000)**

Life-Cycle Cost Estimates: The VA team did not provide future cost calculations for this proposal because it was not felt that significant differences in future costs between the VA proposal and the Baseline Alternative could be quantified or computed at this conceptual phase of design. The future cost difference for this VA proposal is therefore zero, and the Net Life Cycle Cost as shown in the cost summary at the top of this proposal is the same as the Initial Cost Saving (or Premium if a negative value is shown in parentheses).

VA PROPOSAL NO. TSM1

Proposal Title: Peak-Direction HOV Lane on Fremont Avenue and Fair Oaks Avenue during Peak Periods

Assumptions and Calculations:

- Pavement Striping: Assumed $0.50 per linear foot (lf)
- Variable message sign (VMS): Assumed $35,000 per sign and a total of 80 signs for the entire corridor
- Roadway markup: 79.6 percent

VA PROPOSAL NO. BRT1

Proposal Title: BRT Enhanced Technology – Guided BRT Operation Combined with Passenger Information System and Intelligent Transportation Systems Technologies

Initial Cost Savings:	($7,160,000)
Future Cost Savings:	$0
Net LCC Savings:	($7,160,000)
Change in Schedule:	None
Performance Change:	+2 %
Value Change:	-12 %

Description of Baseline Concept: Alternative BRT-6 would provide BRT service between Atlantic Boulevard at Whittier Boulevard and Pasadena City College (PCC) and the California Institute of Technology (Caltech) in Pasadena, as illustrated in Exhibit 5. BRT vehicles would travel along Atlantic Boulevard to Huntington Drive, and then travel briefly west along Huntington Drive to Fair Oaks Avenue, before traveling north along Fair Oaks Avenue into Pasadena.

In Pasadena, the BRT vehicles would travel along Colorado Boulevard, making a loop to PCC and Caltech via Hill Avenue, California Boulevard, and Lake Avenue. The total length of the route would be 13.8 miles. Alternative BRT-6 would operate in a combination of exclusive bus lanes and mixed-flow lanes. The exclusive lanes would generally be adjacent to the curb. Other Metro routes that share part of the alignment would also be able to use these lanes. The exclusive lanes would be created generally in existing right-of-way through a variety of methods, including restriping the roadway; prohibiting on-street parking; and narrowing medians, planted parkways, and sidewalks. No property acquisition would be required for Alternative BRT-6. In some areas, exclusive lanes could not be provided without substantial right-of-way acquisition. In these areas, the buses would share existing lanes with other traffic. Bus stops would be placed at approximately ½ mile intervals, at major activity centers and cross streets.

Description of VA Proposal Concept: The VA proposal calls for a hybrid system of guided BRT using guide wheels on the side of buses to enable a smoother and faster ride along the busway combined with standard BRT in areas where implementation of a guided system is not feasible. The guided bus technology could potentially accommodate higher speeds in the exclusive bus lanes, and safer operation overall as well as potential for narrow BRT lanes. Furthermore, this technology could increase the effectiveness of level boarding areas, which could further speed up the boarding process for disabled passengers. In addition, the proposal includes a fully integrated real time passenger information system. At BRT stops, the system would advise passengers of when the next bus would arrive, along with other useful information. Active traffic signal priority systems are also a major feature of the system, as is remote security monitoring and integral real-time optimization of the corridor operation. Other technology enhancements would include advance fare collection systems, such as paying for a bus pass with a cell phone or credit card. Metro plans to implement a similar system along Wilshire Boulevard.

Advantages:

- Guided bus system could provide for higher speeds and narrower lanes in areas with exclusive bus lanes, which would result in higher reliability and potential for reduced impacts to on-street parking and/or planted medians or sidewalks.
- Guided bus system could increase the effectiveness of level boarding areas, which could reduce the boarding time for disabled passenger, thereby increasing overall travel time reliability.
- Passenger information systems would result in higher reliability and attractiveness for the system.
- Real-time information provided at the BRT stations also could be made available remotely via Web sites and mobile phones.
- Provision of traffic signal priority for BRT buses would reduce vehicle travel times and improve travel time reliability.
- Advanced fare collection systems would result in less dwell time for the BRT buses by reducing the need for the bus driver to collect the fares on-board the bus, and allowing boarding through all doors.

Disadvantages:

- There would be an increase in construction costs.
- There is less flexibility for bus operation (guided bus system).
- Savings in roadway width due to narrow lanes could be offset by width of curb/separation at the edge of the guided busway.
- Level boarding is difficult to maintain on a bus. Tire inflation and loading on the bus are two factors that can influence actual clearance. If the bus floor is slightly lower, then the doors will hit the platform.
- Guided busway could only be applied in exclusive lanes. It would restrict access by non-BRT buses.
- Side roller wheels on BRT buses could make pulling up to non-guideway BRT stops more difficult. The bus would need to be parked farther away from the curb to accommodate the side roller wheels.
- There would be higher maintenance cost.
- Additional enforcement needs for advanced fare collection systems would be needed.
- Transit signal priority could impact other traffic operations, depending on specific implementation parameters.

Discussion: A guided busway is a special type of BRT system in which the lateral movement of the bus is controlled by side roller wheels. A few guided systems have been developed in cities in Germany, Australia, UK, and Japan. The guidance systems consist of a physical bus track that steers the bus by way of a mounted side roller wheel. These systems can have a positive effect on speed and safety since the guided busway better controls the movements of the vehicle. Guided busways also permit a more narrow lane to be constructed, and thus are helpful when road space is limited. However, guided systems are still relatively rare due to the added costs, complexity, lack of flexibility for bus operation and ability to react to emergencies, and needs for rerouting.

The potential for reducing the width of the exclusive bus lane could lessen the impacts on sidewalk, landscaped medians, and planted parkways, depending on the specific location. It is less likely that the narrower lanes as a result of the guided busway would reduce on-street parking impacts, as it would likely be a difference of 2 to 4 feet.

The identified advance technologies could be implemented independent of the guided busway. Strategies such as traffic signal priority, remote security monitoring, and integrated real-time corridor operation reduce BRT travel times, and increase schedule reliability by allowing the buses to traverse the corridor according to their planned schedule. Both recurring and non-recurring congestion are responded to much more quickly.

The provision of real-time information and advanced fare payment collection reduces the dwell time by the BRT vehicle at the BRT stops. Transit riders are queued up and ready to board when the vehicle arrives, and already have the fare paid. This allows for boarding through all bus doors, not just the front door. The BRT bus driver is also freed up to assist any passengers who need help boarding the bus.

These systems also provide the opportunity for additional amenities to the transit rider, which makes taking the BRT bus even more attractive. Information such as local weather, event updates, and community activities can be provided to make waiting time more pleasant. Emergency information can also be disseminated more quickly and reliably to the traveling public.

Technical Review Comments: (---)

Project Management Considerations: (---)

Discussion of Schedule Impacts: No impacts are anticipated to schedule.

Discussion of Risk Impacts:

- Roadway maintenance: Roadway and utility projects would require reinstallation of guidance components, potentially by contractors not familiar with the technology or proper construction techniques.
- Vehicle maintenance: BRT buses need to be operated outside the exclusive busway. There is potential for damage to the side roller wheels when pulling up to a non-busway BRT stop.
- Traffic signal priority would be maintained by the local jurisdiction. An agreement would be needed to ensure ongoing priority for BRT vehicles.
- Liability: Potential for an additional gap at non-busway BRT stops due to the side roller wheels, which could create a hazard situation for boarding passengers.

Proposal Title: BRT Enhanced Technology – Guided BRT Operation Combined with Passenger Information System and Intelligent Transportation Systems Technologies

Exhibit 1. Performance Ratings

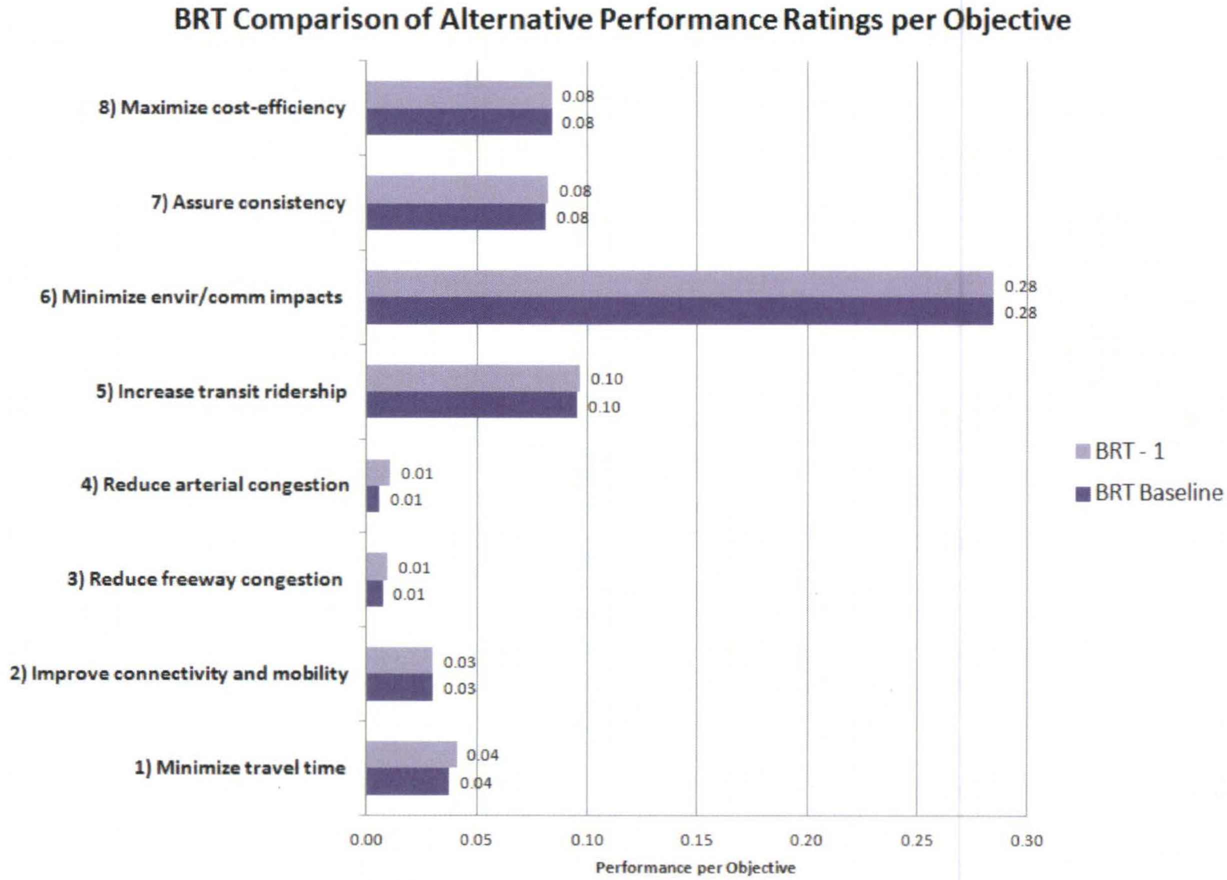
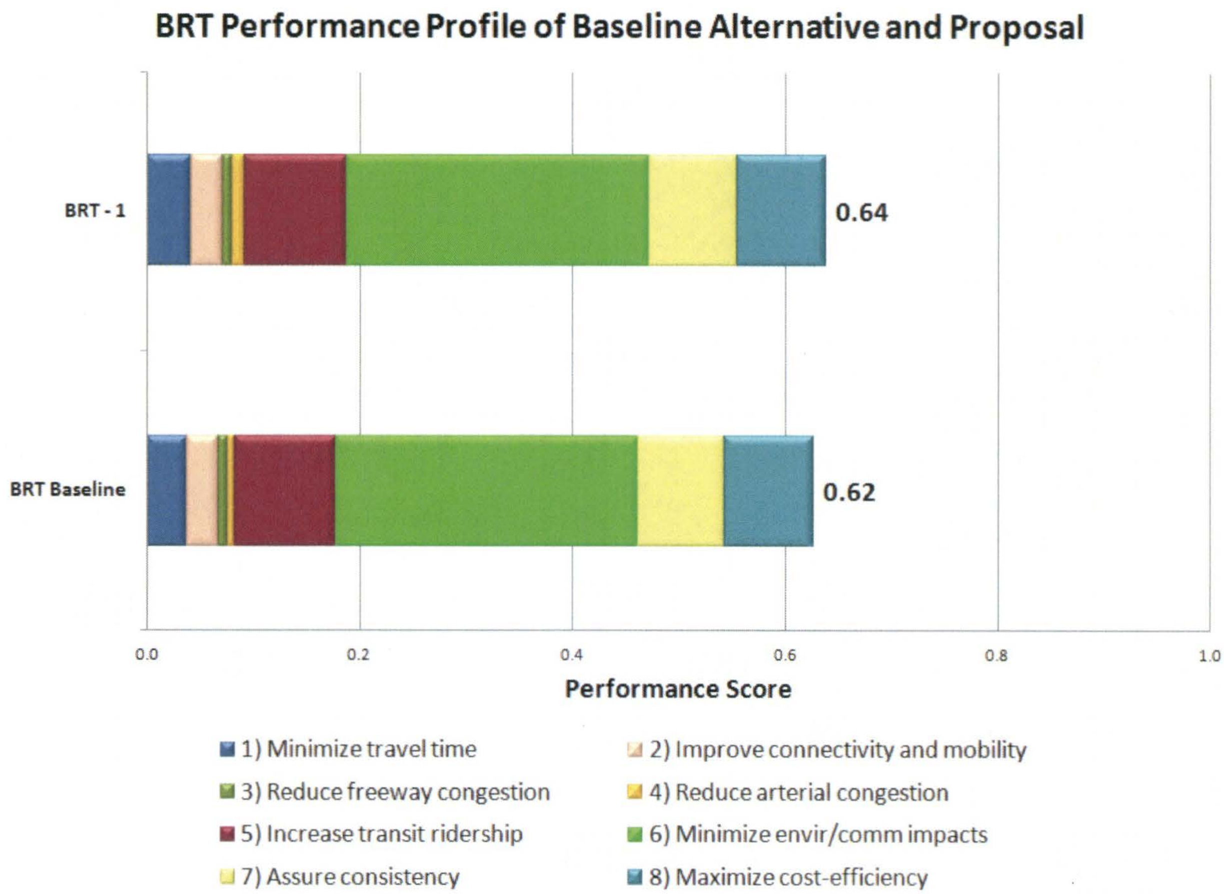


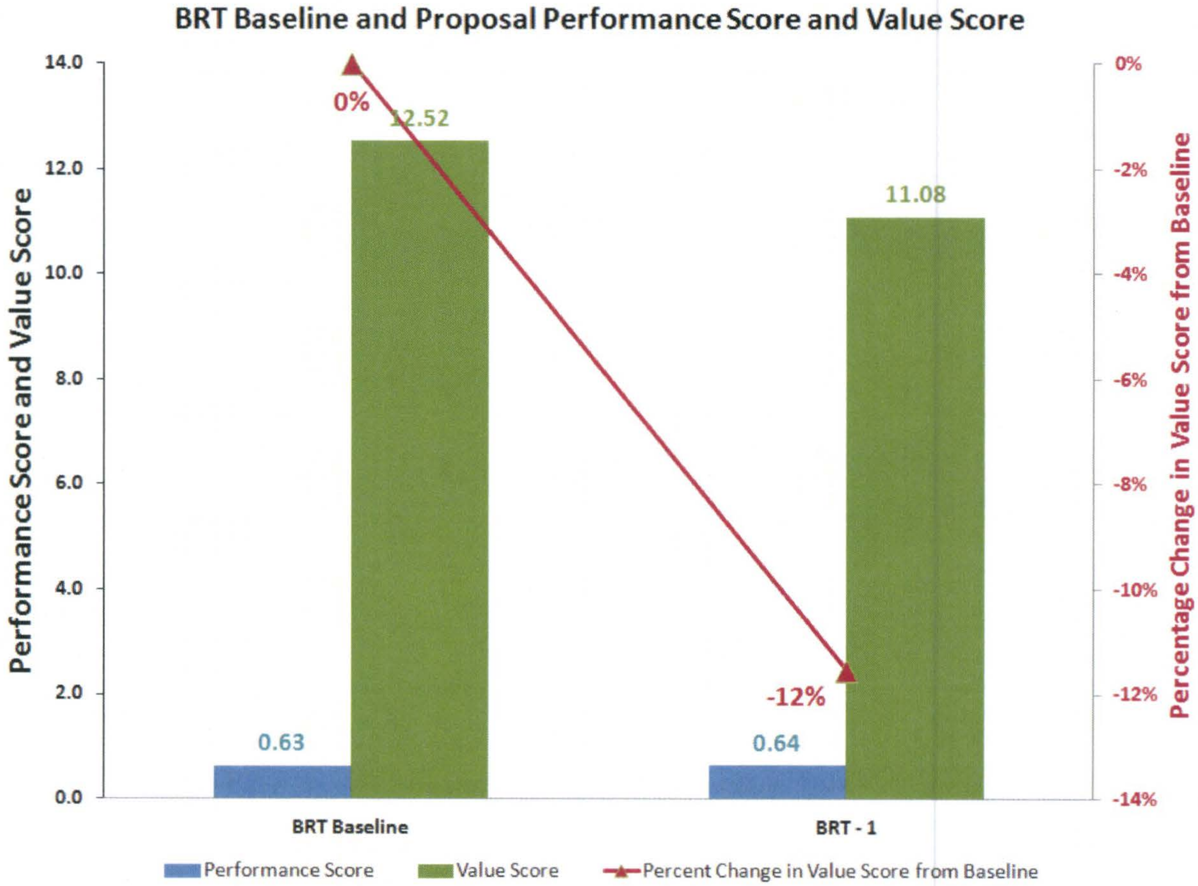
Exhibit 2. Performance Profile



VA PROPOSAL NO. BRT1

Proposal Title: BRT Enhanced Technology – Guided BRT Operation Combined with Passenger Information System and Intelligent Transportation Systems Technologies

Exhibit 3. Benefit and Cost Performance



Proposal Title: BRT Enhanced Technology – Guided BRT Operation Combined with Passenger Information System and Intelligent Transportation Systems Technologies

Exhibit 4. Performance Assessment

Performance Attributes (Objectives) Evaluation

Objectives	**Comment** **(Influence of the VA Proposal upon the Objective)**	**Rating** **(VA Proposal "Improves Performance" or "No Change" or "Reduces Performance")**
Minimize Travel Time	Guided bus technology increases speed of operation, thus resulting in shorter travel times. Advance technologies reduce dwell time and speeds travel through signalized intersections, resulting in shorter travel times.	Improves performance
Improve Connectivity and Mobility		No change
Reduce Congestion on Freeway System		No change
Reduce Congestion on Local Street System	Provision of traffic signal priority could impact mixed-flow operations at signalized intersections.	Reduces performance
Increase Transit Ridership	The system becomes more reliable, faster, thus potentially attracting higher ridership.	Improves performance
Minimize Environmental and Community Impacts Related to Transportation	Increased transit ridership would improve air quality and reduce noise impacts from single-occupancy vehicles (SOVs).	Improves performance
Assure Consistency with Regional Plans and Strategies	Regional plans and strategies promote increasing mobility, reducing congestion, and increasing transit use within the area.	Improves performance
Maximize Cost Efficiency of Public Investments	Guided busway would result in higher capital and operating costs. The advanced technologies increase mobility with minimal	No change (impacts offset each other)

Proposal Title: BRT Enhanced Technology – Guided BRT Operation Combined with Passenger Information System and Intelligent Transportation Systems Technologies

Objectives	Comment (Influence of the VA Proposal upon the Objective)	Rating (VA Proposal "Improves Performance" or "No Change" or "Reduces Performance")
	implementation and operating costs.	

Proposal Title: BRT Enhanced Technology – Guided BRT Operation Combined with Passenger Information System and Intelligent Transportation Systems Technologies

Exhibit 5. Baseline Concept Sketch (BRT6A Alternative)

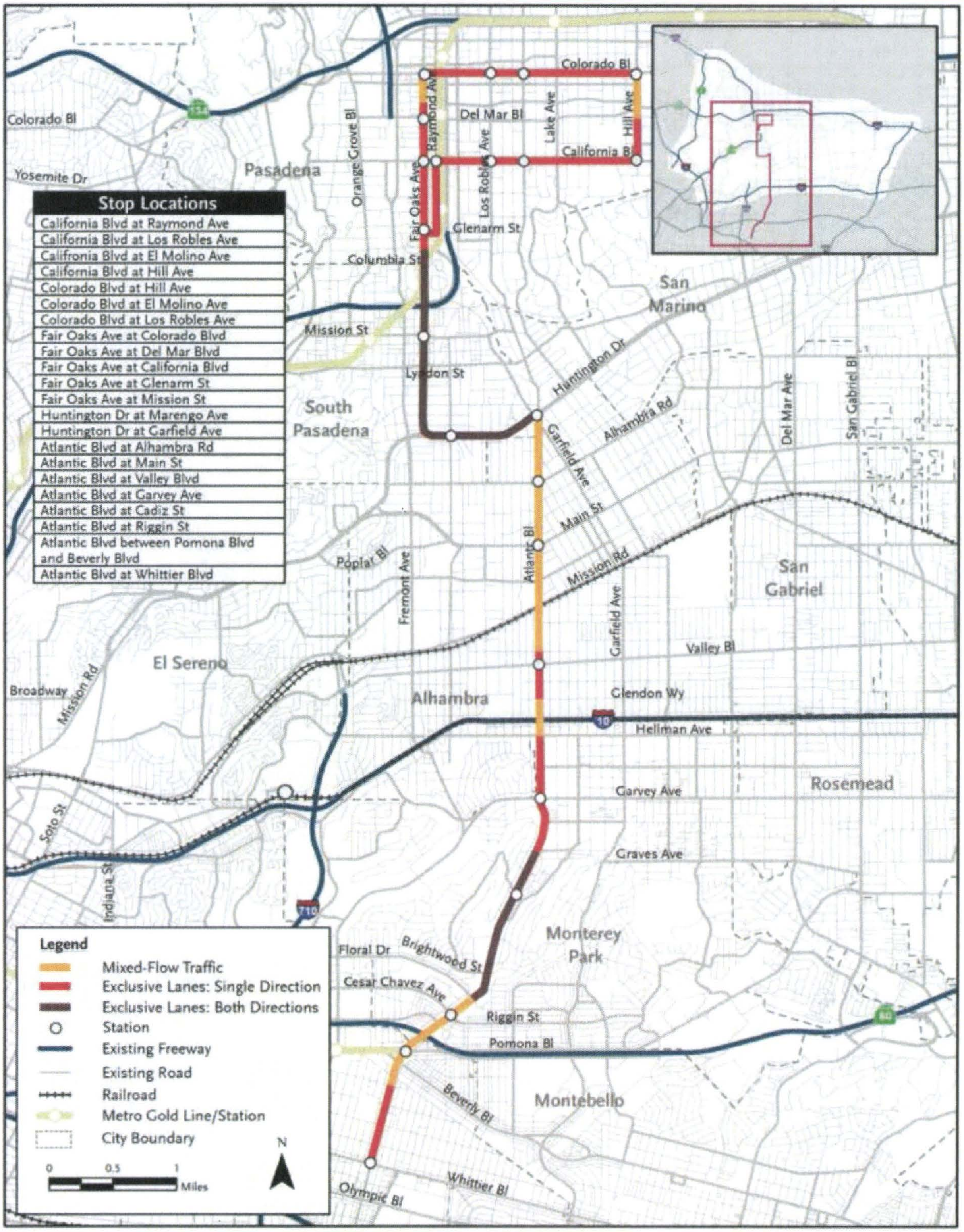


Exhibit 6. Examples of a Guided BRT System

Exhibit 7. Examples of Real-Time Information Signs

Real Time Information: LED Signs

Real Time Information: LCD Signs

Exhibit 8. Example Application of Real-Time Information and Off-Board Fare Collection

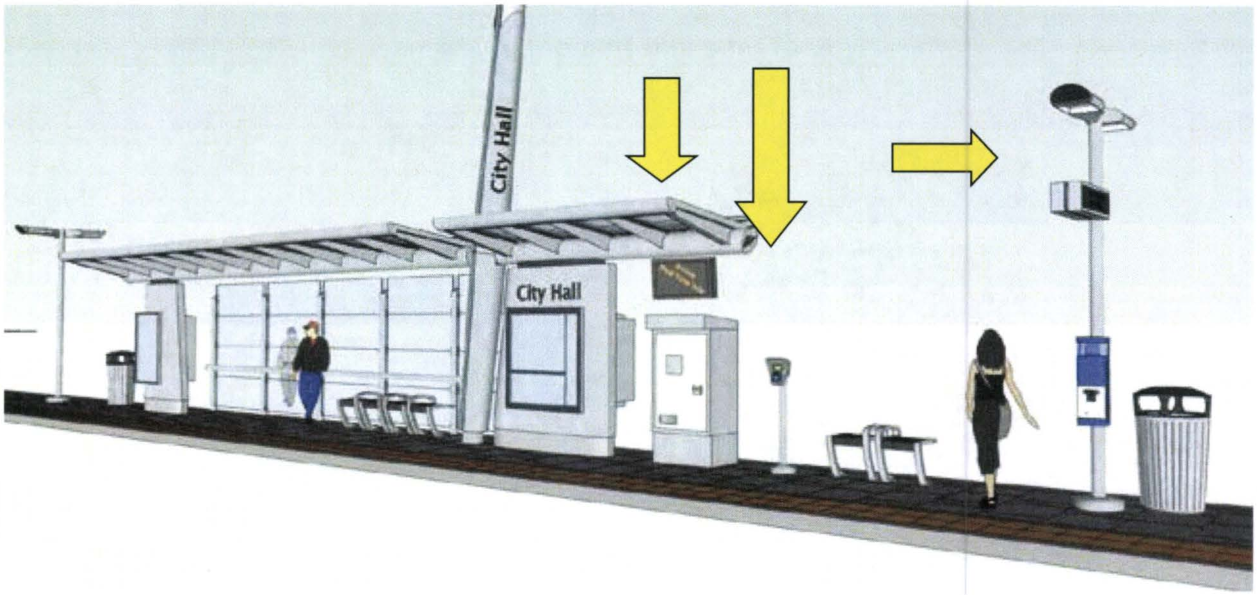


Exhibit 9. Initial Cost Estimates

INITIAL COSTS							ALT. NO.
CONSTRUCTION ELEMENT		*BASELINE CONCEPT*			*VA PROPOSAL CONCEPT*		
Description	**Unit**	**Qty**	**Cost/Uni**	**Total**	**Qty**	**Cost/Unit**	**Total**
Baseline Cost Estimate	LF			$ 50,000,000	1	$ 50,000,000	$ 50,000,000
ROADWAY ITEMS							
Guided Busway							
Concrete Curb	LF			$ -	42,420	$ 18	$ 763,560
Bus Side Rollers	ea			$ -	10	$ 3,700	$ 37,000
				$ -			$ -
Technology Elements							
TSP	ea			$ -	50,000	$ 49	$ 2,450,000
LED Real Time Info Signs	ea			$ -	33	$ 10,800	$ 356,400
LCD Monitor for RTI	ea			$ -	33	$ 9,800	$ 323,400
				$ -			$ -
Off-Board Fare Collection							
Smart Card Readers	ea			$ -	33	$ 1,682	$ 55,506
				$ -			$ -
ROADWAY SUBTOTAL				*$ -*			*$ 3,985,866*
ROADWAY MARK-UP	*79.6%*			*$ -*			*$ 3,172,749*
ROADWAY TOTAL				*$ -*			*$ 7,158,615*
ENVIRONMENTAL MITIGATION ITEMS							
				$ -			$ -
				$ -			$ -
CAPITAL OUTLAY SUPPORT ITEMS							
Reengineering and Redesign				$ -			$ -
Project Engineering				$ -			$ -
TOTAL		$		50,000,000	$		57,158,615
TOTAL (Rounded)				$50,000,000			$57,160,000
						SAVINGS	**($7,160,000)**

Life-Cycle Cost Estimates: The VA team did not provide future cost calculations for this proposal because it was not felt that significant differences in future costs between the VA proposal and the Baseline Alternative could be quantified or computed at this conceptual phase of design. The future cost difference for this VA proposal is therefore zero, and the Net Life Cycle Cost as shown in the cost summary at the top of this proposal is the same as the Initial Cost Saving (or Premium if a negative value is shown in parentheses).

Proposal Title: BRT Enhanced Technology – Guided BRT Operation Combined with Passenger Information System and Intelligent Transportation Systems Technologies

Assumptions and Calculations:

- Guided Busway
  - Assumed 8 miles for length of busway
    - Concrete curb ($16.82/linear foot [lf])
  - Addition of side rollers to each BRT vehicle (assume 10 vehicles to allow for rotation/spares)
    - $3,700/vehicle
- Traffic Signal Priority
  - $50k per intersection
  - 78 signalized intersections in corridor, 29 are already being modified/replaced in base alternative. 49 intersections to have traffic signal priority added.
- Real-Time Information
  - 1 LED sign and 1 LCD monitor at BRT stop and in each direction of travel (33)
    - $10,800 per LCD sign
    - $9800 per LED monitor
- Off-Board Fare Collection
  - Smart card readers (one for each direction of travel per BRT stop: 33)
    - $1,682 per smart card reader = $55,506
- Assume software is not an incremental cost to project.

VA PROPOSAL NO. BRT2

Proposal Title: Multimodal Transportation Centers for BRT Alternative Combined with Single Bored Freeway Tunnel with Managed Lanes (FT 1)

Initial Cost Savings:	($111,000,000)
Future Cost Savings:	$0
Net LCC Savings:	($111,000,000)
Change in Schedule:	Potential Increase
Performance Change:	+27 %
Value Change:	-61 %

Description of Baseline Concept: Alternative BRT-6 would provide BRT service between Atlantic Boulevard at Whittier Boulevard and Pasadena City College (PCC) and the California Institute of Technology (Caltech) in Pasadena. BRT vehicles would travel along Atlantic Boulevard to Huntington Drive, and then travel briefly west along Huntington Drive to Fair Oaks Avenue, before traveling north along Fair Oaks Avenue into Pasadena.

In Pasadena, the BRT vehicles would travel along Colorado Boulevard, making a loop to PCC and Caltech via Hill Avenue, California Boulevard, and Lake Avenue. The total length of the route would be 13.8 miles. Alternative BRT-6 would operate in exclusive bus lanes and mixed-flow lanes. The exclusive lanes would generally be adjacent to the curb. Other Metro routes that share part of the alignment would also be able to use these lanes. The exclusive lanes would be created generally in existing right-of-way through a variety of methods, including restriping the roadway; prohibiting on-street parking; and narrowing medians, planted parkways, and sidewalks. No property acquisition would be required for Alternative BRT-6. In some areas, exclusive lanes could not be provided without substantial right-of-way acquisition. In these areas, the buses would share existing lanes with other traffic. Bus stops would be placed at approximately ½ mile intervals, at major activity centers and cross streets.

This proposal, while part of the BRT Alternative, assumes that the BRT system functions as a complement to a freeway tunnel alternative. Specifically, a single bored freeway tunnel with two lanes in each direction, operated as a managed lanes facility (dynamic pricing toll) is assumed. Details for the single-tunnel proposal are included under Proposal No. F-1 in a separate document. The specifics and cost estimates included in this proposal only refer to those items related to the multimodal transportation centers.

Description of VA Proposal Concept: The proposed improvement includes the construction of two multimodal transit/parking facilities – one at each end of the proposed BRT alignment. The multilevel building would serve as a multimodal transfer center where car users can park their cars and transfer to a transit mode (BRT or other bus transit options). The main objective of the multimodal facility is to provide an easy and affordable option for auto drivers to access the transit system and leave their cars. In addition to these objectives, the facility also could be used to provide bike facilities (such as bikeshare) and for auto drivers to arrange for carpooling options. This proposal needs to be considered in combination with a freeway alternative with managed/express lanes (combination of toll and high-occupancy vehicle [HOV] restrictions). Under this combined alternative, single-vehicle users can park at the multimodal center and chose to either use transit or carpool with other drivers to use the freeway express lanes.

Proposal Title: Multimodal Transportation Centers for BRT Alternative Combined with Single Bored Freeway Tunnel with Managed Lanes (FT 1)

Advantages:

- Encourages a shift in transportation mode from autos to BRT.
- Provides opportunities for carpooling if combined with a freeway tunnel alternative with managed lanes.
- Could generate additional revenue through concessionaires.
- Provides for bike facilities.
- By providing more transportation options for single-occupancy vehicle (SOV) users at a single location and encouraging car-pooling behavior, this proposal has the potential to significantly enhance a combined alternative that includes a single bored freeway tunnel with managed lanes and a surface BRT service.

Disadvantages:

- Increases cost by adding construction of two 4-level parking facilities.
- No available right-of-way for multimodal facility at current end of proposed BRT alignment.
- Available right-of-way over cut-and-cover tunnel section is not adjacent to proposed BRT corridor (along Atlantic Boulevard and Fair Oaks Avenue).

Discussion: Based on the Alternative Analysis documentation, neither BRT nor LRT alternatives capture enough ridership to significantly reduce the existing auto demand that wants to traverse the region in the north-south direction. As a result, neither alternative achieves the objective of alleviating congestion and reducing cut-through traffic on local streets. The proposed multimodal centers at each end of the BRT (or LRT) alignments could significantly increase the attractiveness of the proposed new transit system, thereby encouraging more drivers to leave their cars at an accessible, convenient, yet affordable location where they can transfer to BRT or another public transit option.

The facilities could also serve to attract external revenue generation opportunities by providing services, amenities, and products to the public.

The proposed facilities would also work well with a tunnel-freeway alternative that includes managed lanes (dynamic toll pricing combined with HOV free use). The idea being that SOV users can arrange for carpooling opportunities at the multimodal center in order to access the freeway managed lanes for free. In addition, managing the demand through dynamic tolling on a freeway tunnel combined with surface BRT and multimodal transfer centers would eliminate the need for the construction of two tunnels (currently needed to handle the overall vehicle demand in four mainline lanes in each direction) and construct a single tunnel with two lanes in each direction.

The facilities would be designed to accommodate roughly 1,500 parking spaces in addition to the transit terminals and bike facilities. Assuming a four-level building, a 1,500-space garage will require a footprint of approximately 90,000 square feet. Finding locations for these facilities without right-of-way acquisition is the major challenge for this proposal. Under the proposed BRT6A alignment, there is no available right-of-way in the vicinity of either terminus and any intent to acquire properties in the area is likely to generate significant opposition from the nearby communities. One opportunity that could be further explored is locating the multimodal facilities on top of the cut-and-cover sections of the freeway tunnel. A cursory review of the proposed tunnel alignment shows that there are opportunities to construct a four-level facility semiburied over the cut-and-cover sections and take advantage of available right-of-way while reducing overall construction cost due to portions of the cost that will already be covered by the tunnel construction. The BRT alignment for this option would need to be extended to start at the north and south portals; however, it could quickly resume to the originally proposed alignment running along Atlantic Boulevard and Fair Oaks Avenue.

An example of a similar facility currently operating in Saint Paul, Minnesota, is shown in Exhibit 7. This particular facility allows transit riders to park their cars and wait for transit options in a climate-controlled waiting area. It also features bike share facilities and hybrid car charging stations.

Technical Review Comments: (---)

Project Management Considerations: (---)

Discussion of Schedule Impacts: Could potentially increase construction schedule due to additional construction of multimodal garages.

Discussion of Risk Impacts:

- Available right-of-way for multimodal centers/parking garages
- Impact of rerouting BRT line on ridership

Exhibit 1. Performance Ratings

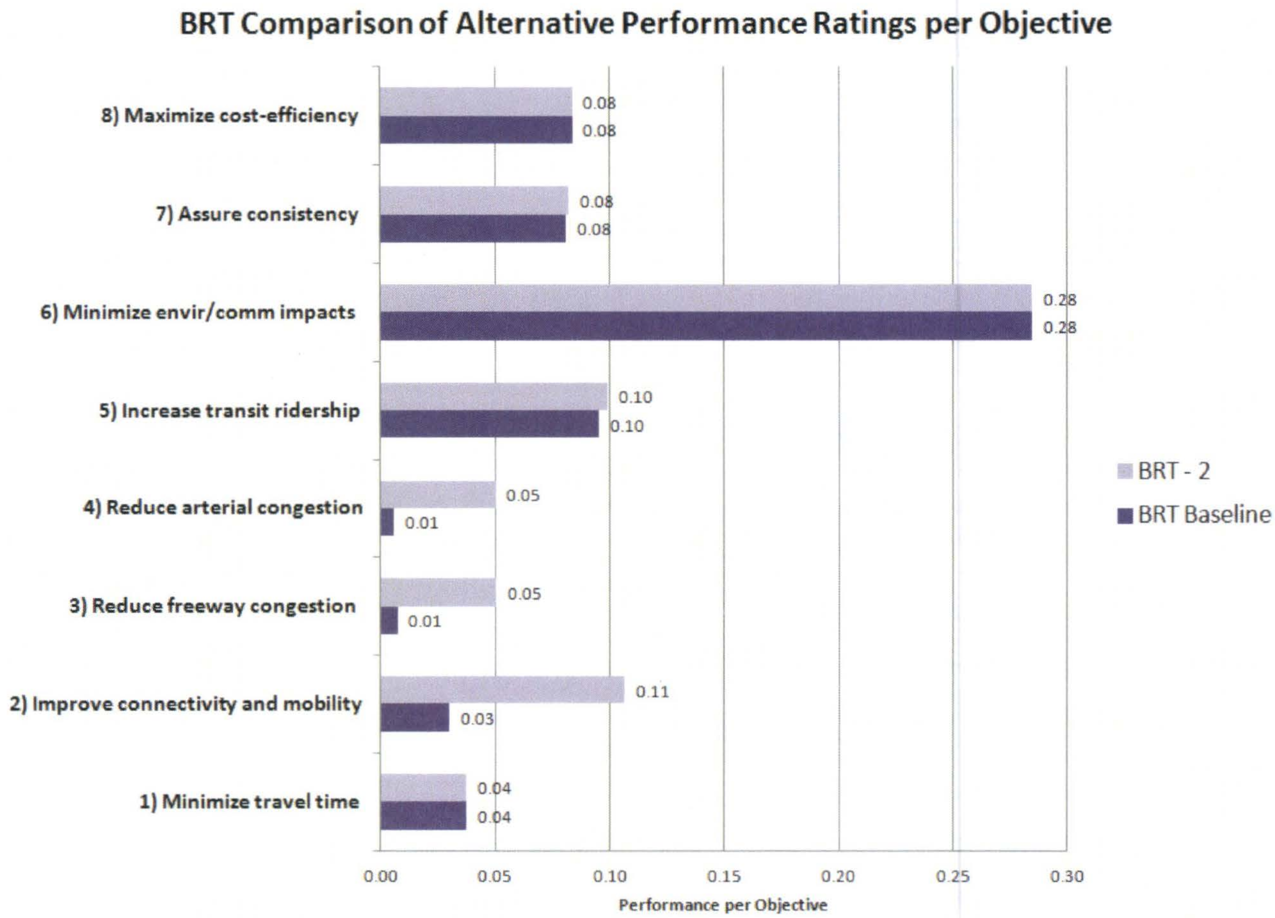
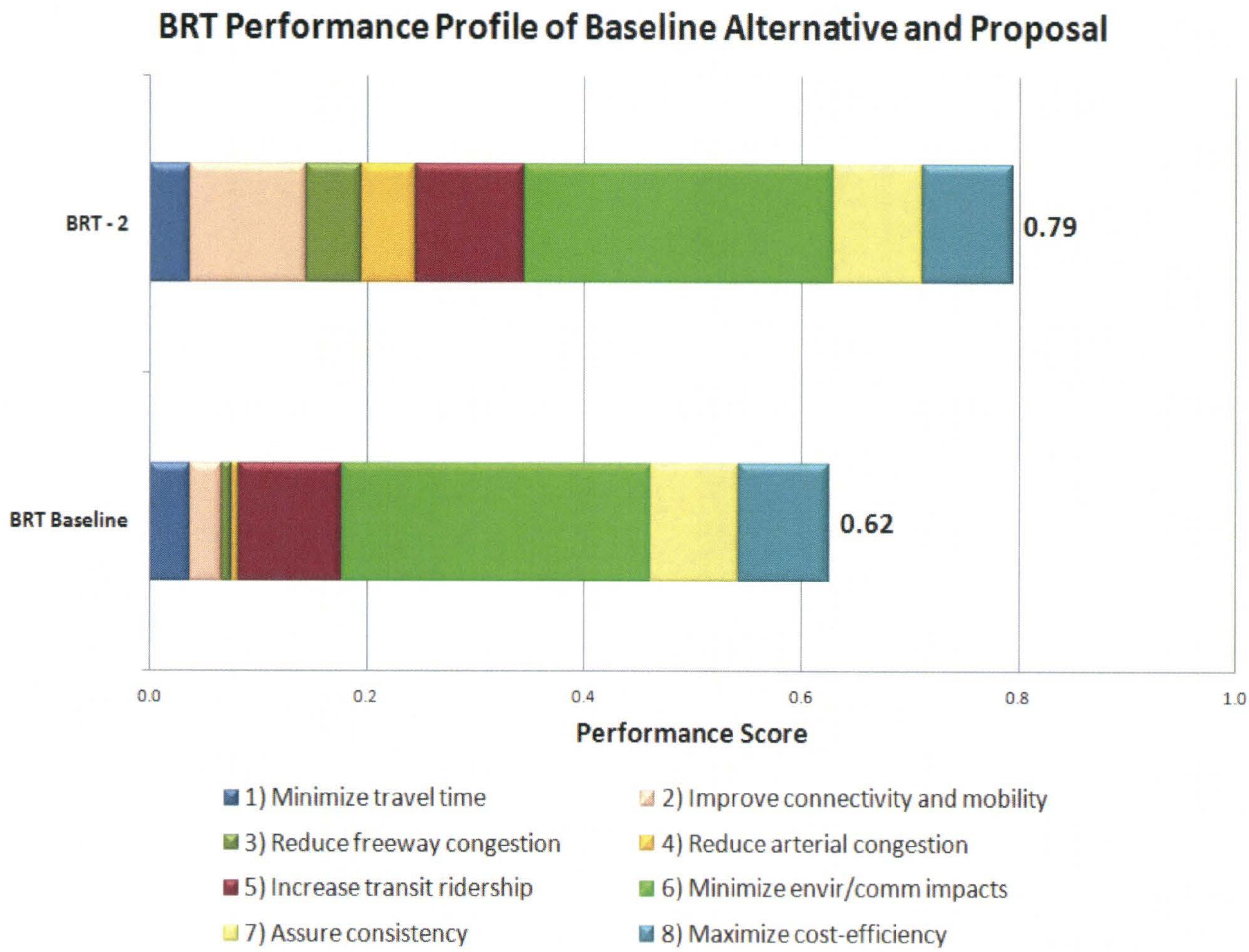
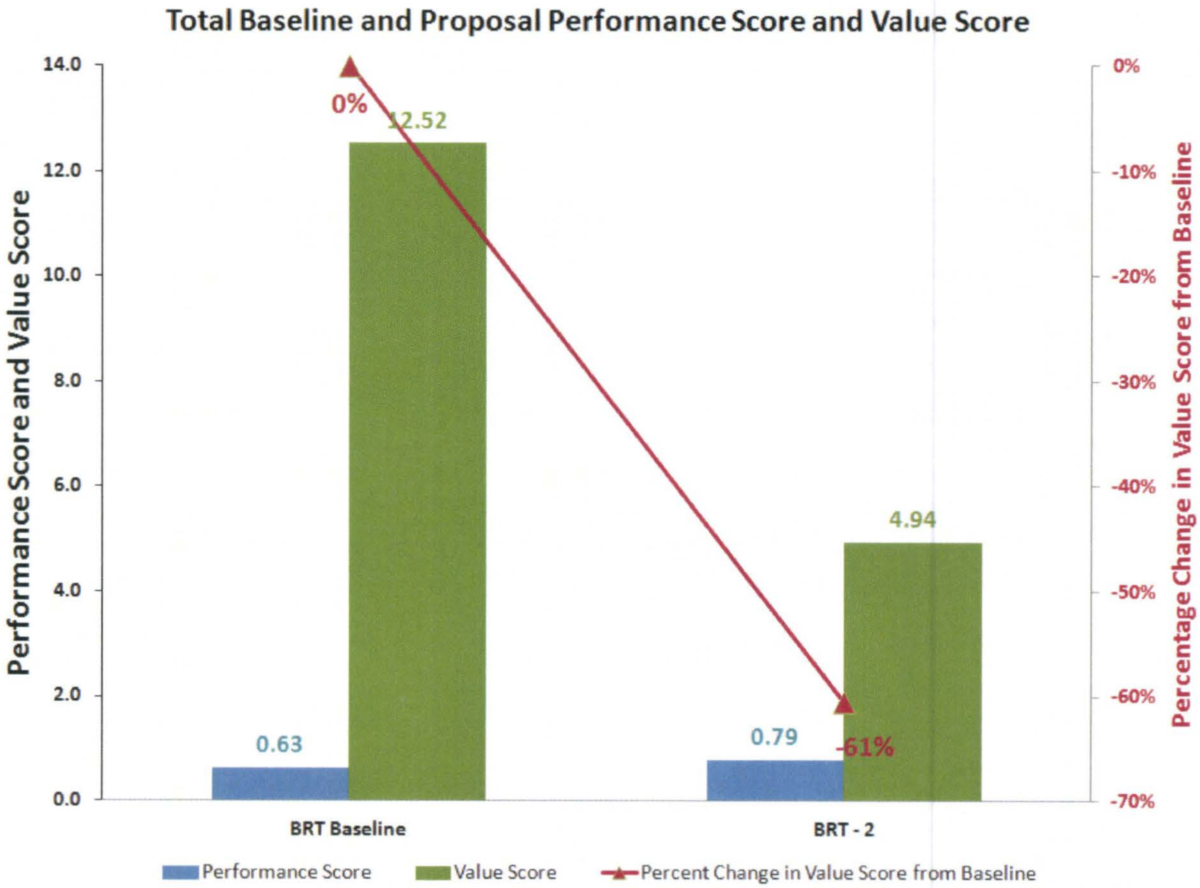


Exhibit 2. Performance Profile



Proposal Title: Multimodal Transportation Centers for BRT Alternative Combined with Single Bored Freeway Tunnel with Managed Lanes (FT 1)

Exhibit 3. Benefit and Cost Performance



Proposal Title: Multimodal Transportation Centers for BRT Alternative Combined with Single Bored Freeway Tunnel with Managed Lanes (FT 1)

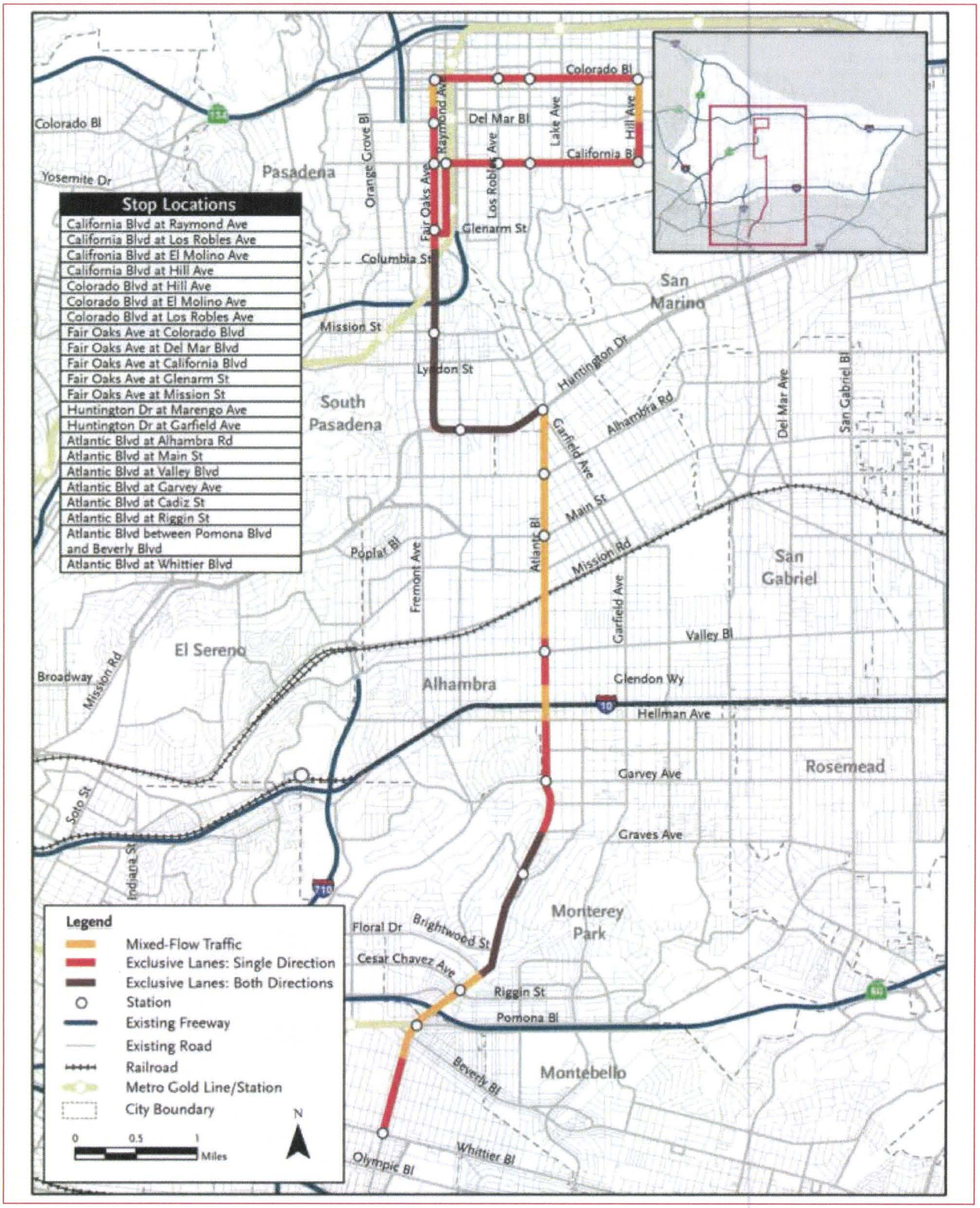
Exhibit 4. Performance Assessment

Performance Attributes (Objectives) Evaluation

Objectives	**Comment** **(Influence of the VA Proposal upon the Objective)**	**Rating** **(VA Proposal "Improves Performance" or "No Change" or "Reduces Performance")**
Minimize Travel Time		No change
Improve Connectivity and Mobility	The proposal would significantly increase both connectivity and mobility for the entire system.	Improves performance
Reduce Congestion on Freeway System	A combination of a single-tunnel freeway alternative, surface BRT, and north and south multimodal centers has the potential to handle the entire demand for the corridor, thus reducing congestion on the freeway system.	Improves performance
Reduce Congestion on Local Street System	A combination of a single-tunnel freeway alternative, surface BRT, and north and south multimodal centers has the potential to handle the entire demand for the corridor, thus reducing congestion and cut-through traffic on local streets.	Improves performance
Increase Transit Ridership	Providing convenient and affordable parking at multimodal centers at each end of the BRT alignment would significantly increase transit ridership.	Improves performance
Minimize Environmental and Community Impacts Related to Transportation	Reducing the number of trips on local streets (by increased transit ridership) will result in better air quality and less noise impacts.	Improves performance
Assure Consistency with Regional Plans and Strategies	Regional plans and strategies promote increasing mobility, reducing congestion, and increasing transit use within the area.	Improves performance
Maximize Cost Efficiency of Public Investments	This proposal increases mobility at a moderate construction cost. It optimizes the use of available right-of-way by using areas that will be part of the tunnel construction. It provides for opportunity for additional revenue generation through concessions.	Improves performance

Proposal Title: Multimodal Transportation Centers for BRT Alternative Combined with Single Bored Freeway Tunnel with Managed Lanes (FT 1)

Exhibit 5. Baseline Concept Sketch (BRT6A Alternative)



Proposal Title: Multimodal Transportation Centers for BRT Alternative Combined with Single Bored Freeway Tunnel with Managed Lanes (FT 1)

Exhibit 6. VA Proposal Concept Sketch

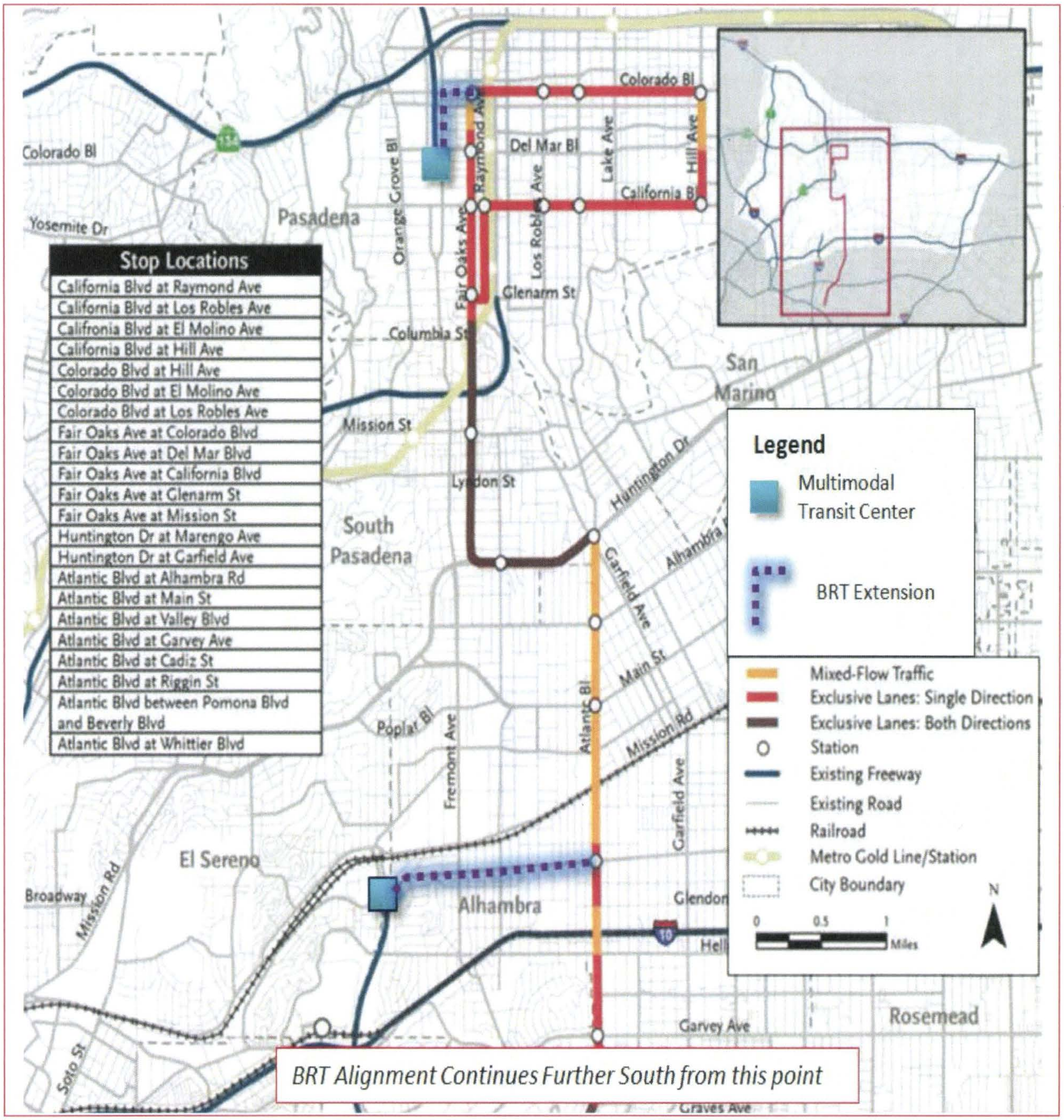
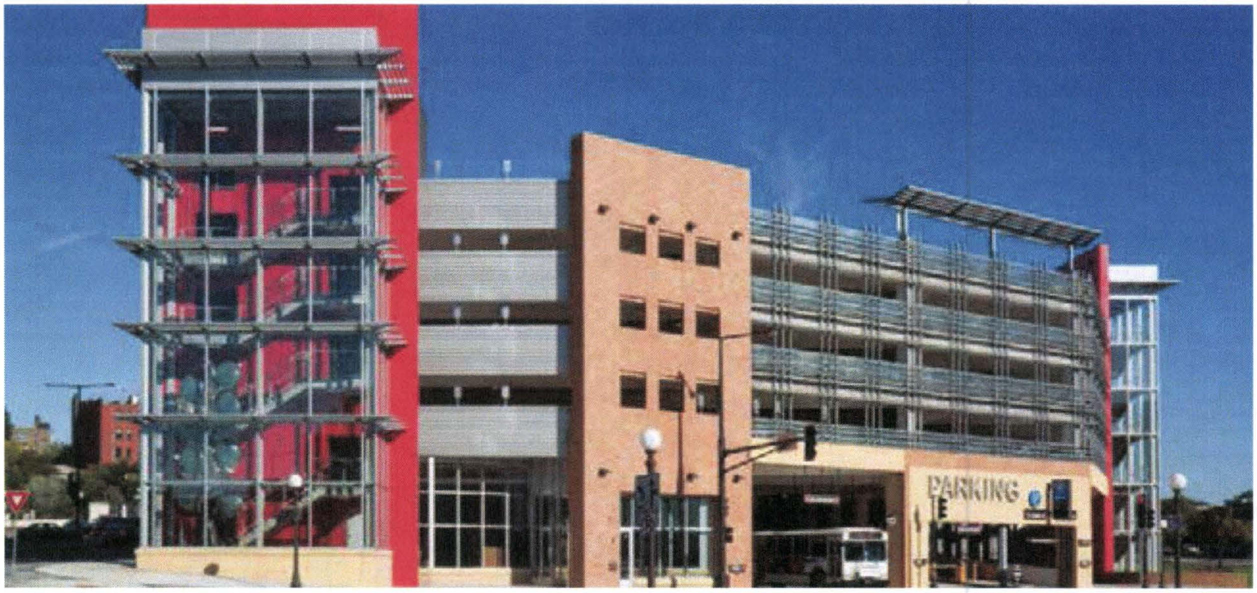


Exhibit 7. Example of Multimodal Transit/Parking Facility, Smith Avenue Transit Center in Saint Paul, Minnesota



VA PROPOSAL NO. BRT2

Proposal Title: Multimodal Transportation Centers for BRT Alternative Combined with Single Bored Freeway Tunnel with Managed Lanes (FT 1)

Exhibit 8. Initial Cost Estimates

INITIAL COSTS							ALT. NO.
CONSTRUCTION ELEMENT		*BASELINE CONCEPT*			*VA PROPOSAL CONCEPT*		
Description	**Unit**	**Qty**	**Cost/Unit**	**Total**	**Qty**	**Cost/Unit**	**Total**
Baseline Cost Estimate				$ 50,000,000	1	$ 50,000,000	$ 50,000,000
ROADWAY ITEMS							
				$ -			$ -
Northern extension of BRT alignment	$/mi			$ -	1.0	$ 365,000	$ 365,000
Southern extension of BRT Alignment	$/mi			$ -	4	$ 365,000	$ 1,460,000
				$ -			$ -
ROADWAY SUBTOTAL				$ -			*$ 1,825,000*
ROADWAY MARK-UP	*79.6%*			$ -			*$ 1,452,700*
ROADWAY TOTAL				$ -			*$ 3,277,700*
STRUCTURE ITEMS							
North Multimodal Center	$/space	0		$ -	1,500	$ 20,000	$ 30,000,000
South Multimodal Center	$/space	0		$ -	1,500	$ 20,000	$ 30,000,000
				$ -			$ -
				$ -			$ -
				$ -			$ -
STRUCTURE SUBTOTAL				$ -			*$ 60,000,000*
STRUCTURE MARK-UP	*79.6%*			$ -			*$ 47,760,000*
STRUCTURE TOTAL				$ -			*$ 107,760,000*
RIGHT-OF-WAY ITEMS							
RIGHT-OF-WAY TOTAL				$ -			$ -
ENVIRONMENTAL MITIGATION ITEMS							
				$ -			$ -
				$ -			$ -
CAPITAL OUTLAY SUPPORT ITEMS							
Reengineering and Redesign				$ -			$ -
Project Engineering				$ -			$ -
TOTAL		$		50,000,000	$		161,037,700
TOTAL (Rounded)				$50,000,000			$161,040,000
						SAVINGS	**($111,040,000)**

Life-Cycle Cost Estimates: The VA team did not provide future cost calculations for this proposal because it was not felt that significant differences in future costs between the VA proposal and the Baseline Alternative could be quantified or computed at this conceptual phase of design. The future cost difference for this VA proposal is therefore zero, and the Net Life Cycle Cost as shown in the cost summary at the top of this proposal is the same as the Initial Cost Saving (or Premium if a negative value is shown in parentheses).

Proposal Title: Multimodal Transportation Centers for BRT Alternative Combined with Single Bored Freeway Tunnel with Managed Lanes (FT 1)

Assumptions and Calculations:

- BRT alignment extension: assumed a cost per mile based on cost estimated for alternative BRT6A
  - Total BRT6A cost = $ 50,000,000
  - BRT6A Alignment Length = 13.8 miles
  - Cost per mile = 50,000,000 / 13.8 = 362,318 SAY: $ 365,000 / mile
  - Roadway markups: 79.6 percent
- Multimodal Center Buildings
  - Assumed 1,500 parking spaces in each facility
  - Assumed garage structure cost per space: $20,000/parking space
  - Total cost by facility = 1,500 spaces * 20,000 = $30,000,000 per facility
  - Garage markups: 79.6 percent

VA PROPOSAL NO. BRT3

Proposal Title: Streetcar along Alternative BRT-6A Alignment

Initial Cost Savings:	$1,700,000,000
Future Cost Savings:	$0
Net LCC Savings:	$1,700,000,000
Change in Schedule:	Increase
Performance Change:	+24% (Compared to LRT-4A)
	+22% (Compared to LRT-4B)
Value Change:	+257%
	+253%

Description of Baseline Concept: The current LRT-4A Alternative consists primarily of one-third aerial structures and two-thirds tunnel sections, with three aerial and four underground stations. From Mednick Avenue, the elevated alignment follows the right-of-ways (ROWs) of I-710 and SR 710 to Valley Boulevard where it transitions to a bored tunnel. It then runs easterly to travel under the roadways of Fremont, Fair Oaks, and Raymond Avenues. The elevated Mednick Avenue Station on the south end of the alternative is adjacent to the existing East Los Angeles Civic Center Station of the Gold Line; the terminus station on the north is near the existing Fillmore Station.

The current BRT-6A Alternative would provide at-grade service between Atlantic Boulevard at Whittier Boulevard and Pasadena City College (PCC) and California Institute of Technology (Caltech) in Pasadena. From Whittier Boulevard, the alignment follows Atlantic Boulevard to Huntington Drive to Fair Oaks Avenue north into Pasadena. In Pasadena, the alignment follows Del Mar Boulevard and loops around PCC and Caltech via Hill Avenue, Colorado Boulevard, and Lake Avenue. BRT vehicles would operate in exclusive bus lanes as well as in mixed traffic. Bus stops would be located at approximately half-mile intervals and at major activity centers and cross streets.

Description of VA Proposal Concept: Operate streetcars at-grade in exclusive lanes as well as mixed traffic along the Alternative BRT-6A alignment. Begin at Whittier Boulevard on the south end, with an interconnection to the existing Atlantic Station of the Gold Line. At the north end there are two options. The first option, in keeping with the no ROW acquisition objective of BRT, runs the streetcar along Fair Oaks Avenue to Glenarm Street, then completes a one-track loop along Raymond Avenue, California Boulevard, and back to Fair Oaks Avenue. There would be connectivity with the Gold Line in the vicinity of the existing Fillmore Station. The second option would be similar to VA proposal LRT-3, where the streetcar would terminate inside an aggregate 2-acre site at the northwest quadrant of Arroyo Seco Parkway (SR 110) and Fair Oaks Avenue, which would be acquired for the purpose of developing a multimodal transit facility. An option would be to construct a new Gold Line Station adjacent to the transit facility.

Advantages:

- Less costly than LRT.
- Runs at-grade and covers greater service area than the LRT alternative.
- Provides interconnection with the existing Gold Line.
- Avoids duplicating the Gold Line between South Pasadena and Fillmore.

Disadvantages:

- Will operate slower than LRT.
- Requires infrastructure for overhead traction power lines and maintenance facility.
- More costly than BRT.
- Does not extend east in Pasadena and loop around PCC and Caltech as does BRT-6A.

Discussion: This VA proposal for a streetcar is suggested primarily as a significantly less costly option to LRT-4A, although it is an attractive alternative to BRT-6A as well. While travel time for a streetcar along the BRT route would be slower than the proposed LRT-4A route that is partially underground in a bored tunnel (four of the seven stations are underground), it offers the coverage provided by BRT-6A through the same at-grade stops, but with the greater capacity of rail transit. Because operation is line-of-sight, streetcars do not require train control signals or communications (except for real-time messaging at the stops); systems infrastructure is much simpler than light rail. Even the Overhead Catenary System (OCS) is simpler, typically using a single contact wire for power rather than a dual-wire catenary system. As a lighter, more nimble version of rail transit than LRT, and traveling through the heart of the communities of Alhambra, El Sereno, and South Pasadena, the streetcar would offer a complementary interconnection between the south and north legs of the existing Gold Line.

Technical Review Comments: The additional vetting of the streetcar's viability includes identification of a suitable maintenance and storage facility (MSF) site. The vehicle fleet size would depend on the operating plan, but typically, a 9- to 10-mile-long system could be serviced by 18 to 22 streetcars, which includes revenue vehicles as well as spares. An appropriate site to store and maintain such a fleet would need to be approximately 4.0 to 4.5 acres in size.

Project Management Considerations: This VA proposal should be vetted through development of a preliminary operations plan for the streetcar that will also contribute to a preliminary modeling of ridership projections and estimate of fleet size. Additional research into potential property acquisitions for a maintenance facility and north terminus station would be necessary, as well as conceptual cost estimates.

Discussion of Schedule Impacts: Due to the additional infrastructure involved, streetcar would take longer to construct than BRT along the Alternative BRT-6A alignment. As an at-grade system, however, streetcar would require much less time than Alternative LRT-4A, more than half of which is in a bored tunnel.

Discussion of Risk Impacts: Property impacts, whether due to acquisition or adjacency to the streetcar system, would be the primary risk to the project. Certain environmental issues, such as noise, vibration, and visual, would also be project risks.

Exhibit 1. Performance Ratings

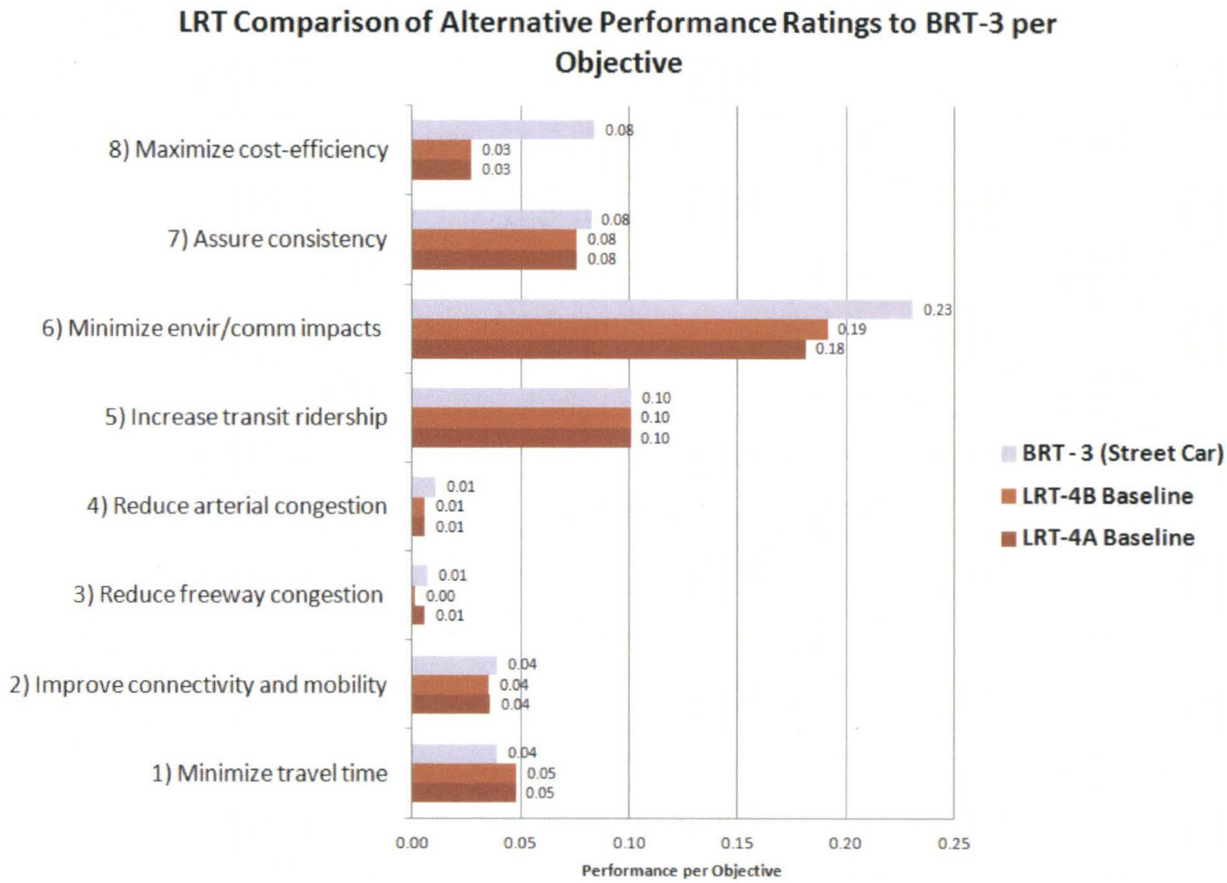


Exhibit 2. Performance Profile

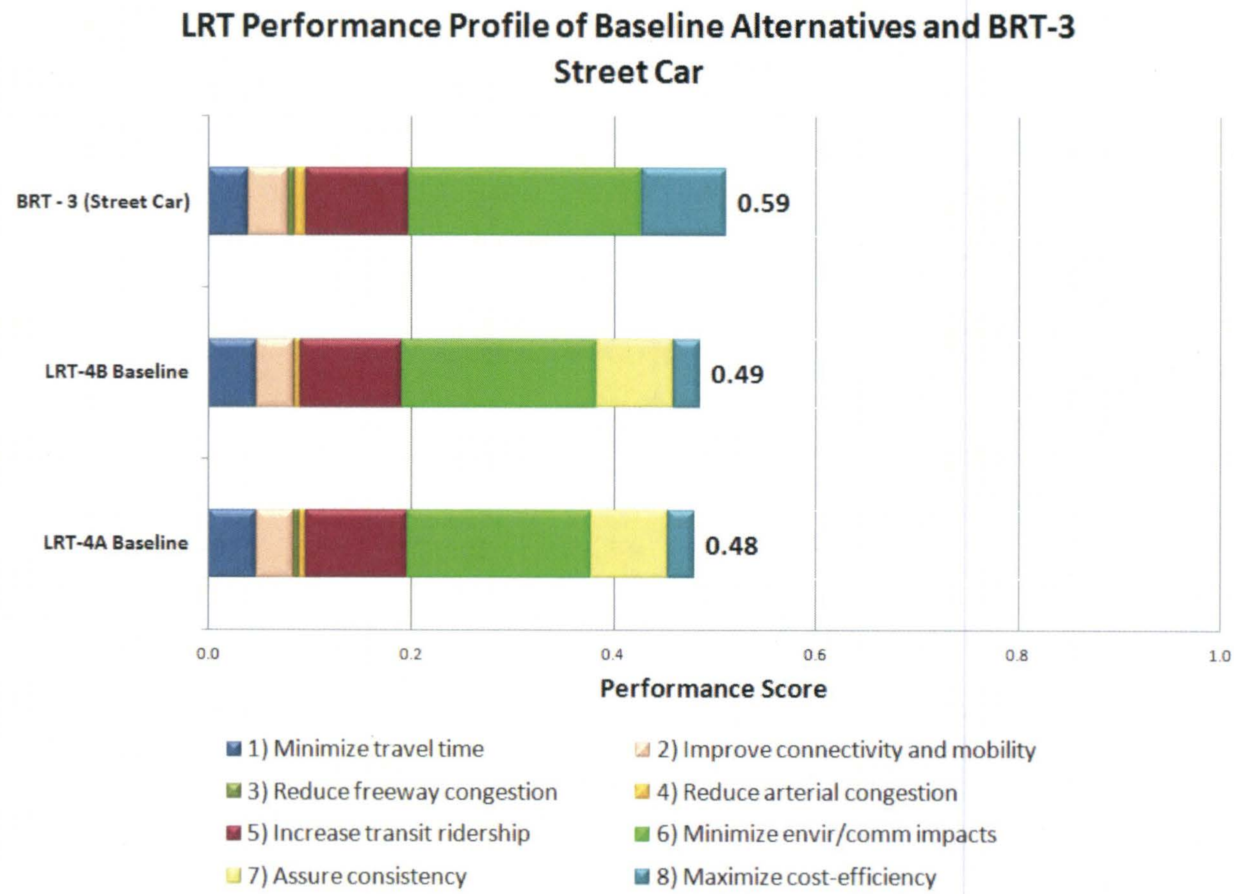


Exhibit 3. Benefit and Cost Performance

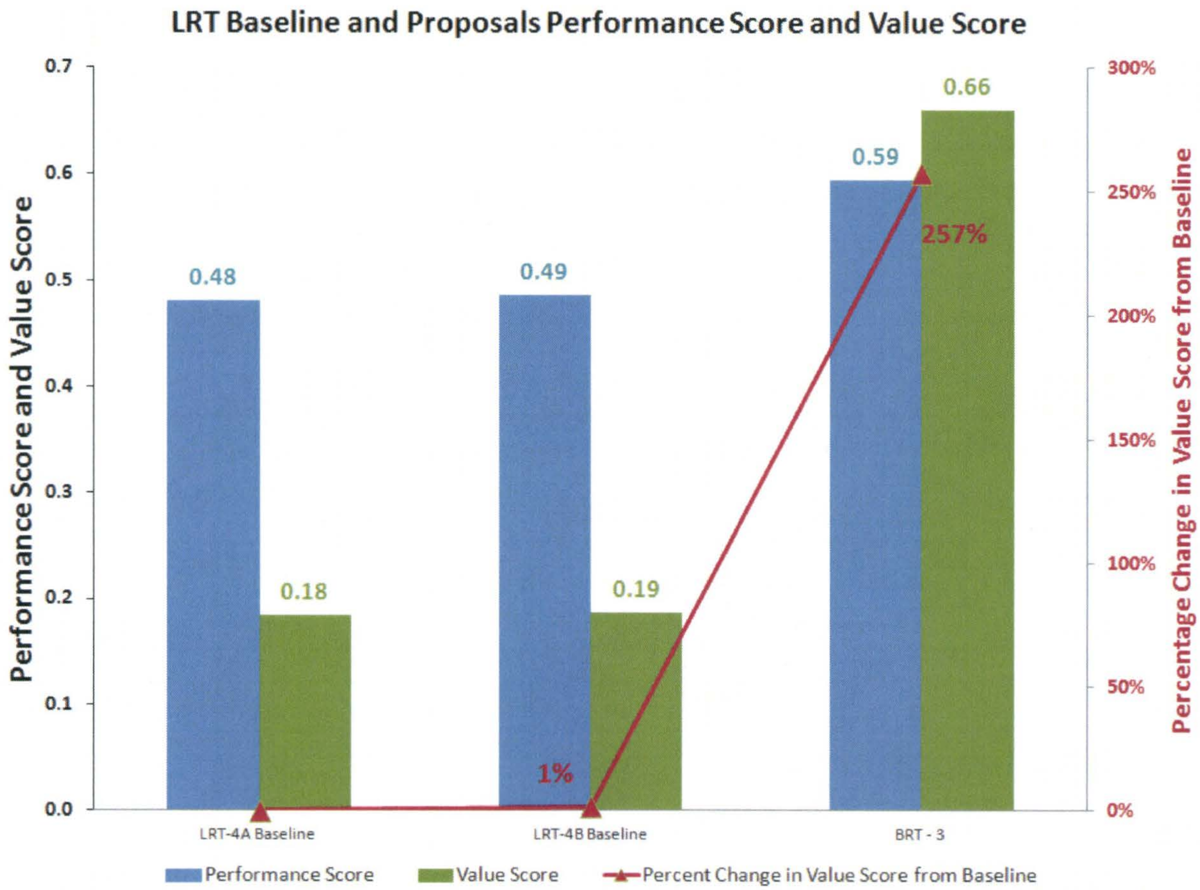
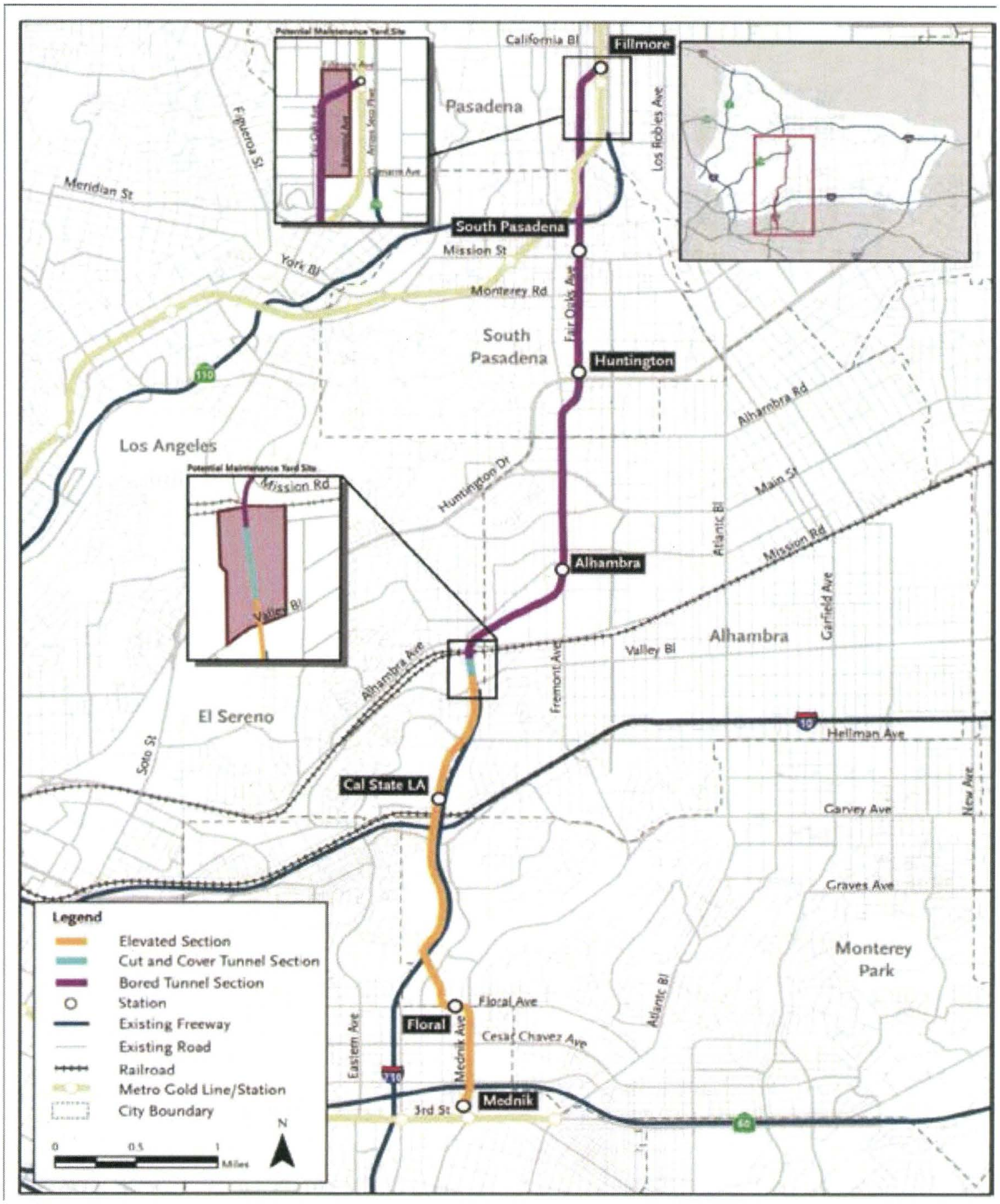


Exhibit 4. Performance Assessment

Performance Attributes (Objectives) Evaluation

Objectives	**Comment** (Influence of the VA Proposal upon the Objective)	**Rating** (VA Proposal "Improves Performance" or "No Change" or "Reduces Performance")
Minimize Travel Time	Longer than LRT; about the same as BRT.	No change
Improve Connectivity and Mobility	More stops along at-grade alignment improve connectivity and mobility (over LRT).	Improves performance
Reduce Congestion on Freeway System	Potentially takes limited number of cut-through traffic off freeways.	No change
Reduce Congestion on Local Street System	Would offer transit as a choice to local drivers and potential cut-through traffic.	Improves performance
Increase Transit Ridership	Offers another transit mode and connectivity via surface alternative.	Improves performance
Minimize Environmental and Community Impacts Related to Transportation	Will improve air quality (better than BRT) and travel experience on local streets; requires ROW acquisition.	Improves performance
Assure Consistency with Regional Plans and Strategies	Regional plans and strategies promote increasing mobility, reducing congestion, and increasing transit use within the area.	No change
Maximize Cost Efficiency of Public Investments	Higher cost than BRT in terms of capital, operation, and maintenance; but much lower cost than LRT in tunnel.	Improves performance

Exhibit 5. Baseline Concept Sketch



Alternative LRT-4A

Proposal Title: Streetcar along Alternative BRT-6A Alignment

Exhibit 6. VA Proposal Concept Sketch

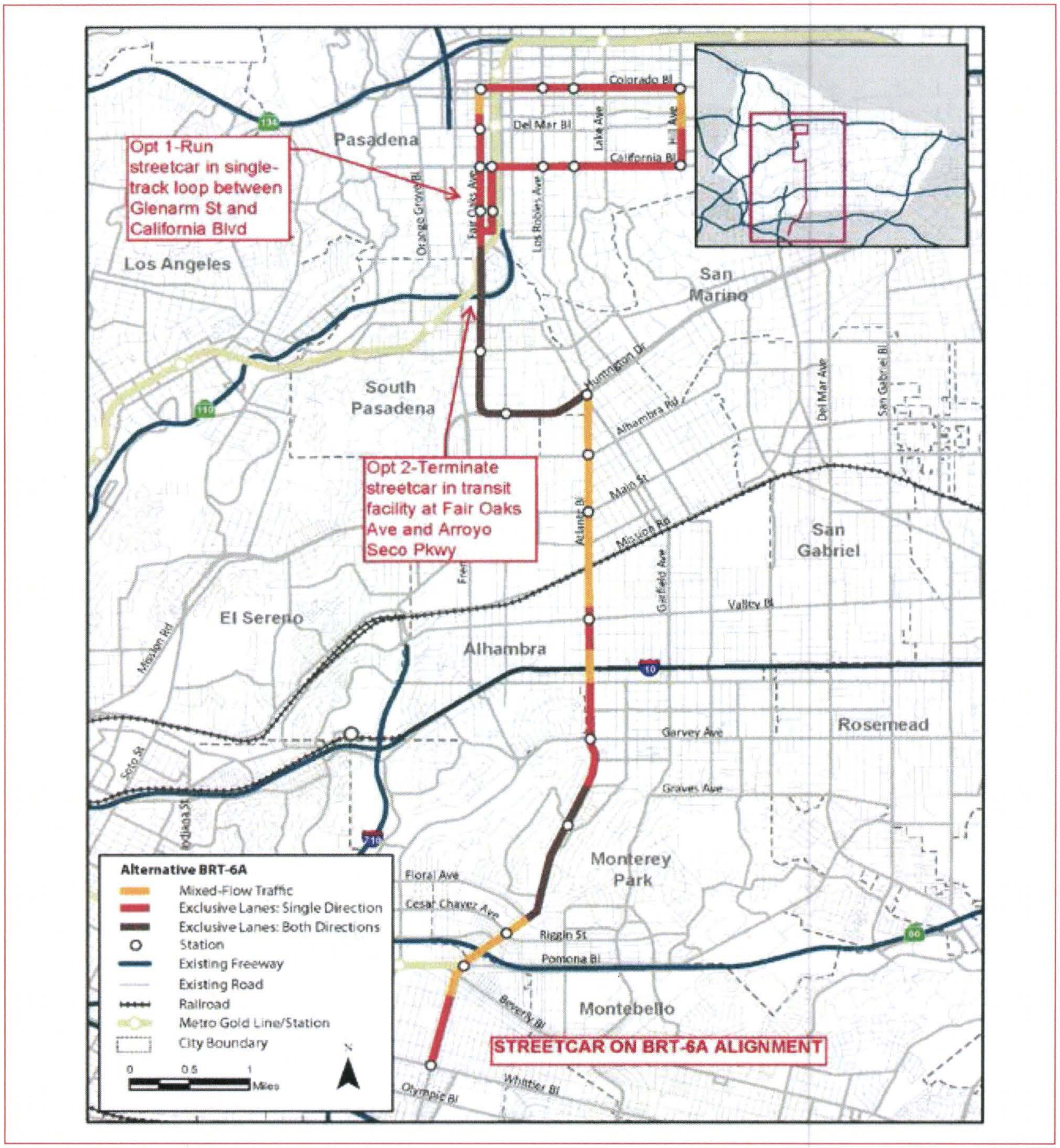


Exhibit 7. Example of Streetcar and LRT (Modern Streetcar on Left, LRT on Right)

Proposal Title: Streetcar along Alternative BRT-6A Alignment

Initial Cost Estimates: See Assumptions and Calculations section below for this proposal's initial cost calculation.

Life-Cycle Cost Estimates: The VA team did not provide future cost calculations for this proposal because it was felt that significant differences in future costs between the VA proposal and the Baseline Alternative could not be quantified or computed adequately during the limited VA study period. It is suggested that the project team will need to further evaluate this streetcar proposal by developing an operating plan, determining the proper fleet size, and estimating the annual operating and maintenance costs at a conceptual level of design. The future cost difference for this VA proposal is therefore zero, and the Net Life Cycle Cost as shown in the cost summary at the top of this proposal is the same as the Initial Cost Saving (or Premium if a negative value is shown in parentheses).

Assumptions and Calculations:

- Streetcar project costs in recent years around the country have ranged from $30 million to $60 million per mile.
- Property acquisition and vehicles are typically included in the total cost, as well as MSF.
- The streetcar alignment from Whittier to the north end loop in Pasadena is approximately 10 miles long, while the option that terminates in a transit transfer facility at Fair Oaks Avenue and SR 110 is about 9 miles in length.

For this VA proposal, a per-mile cost at the high-end of the typical range would yield the resulting project costs for the two streetcar options as compared with the Baseline Alternative LRT-4A shown below:

LRT Baseline Alternative	Streetcar to Raymond/Fair Oaks	Streetcar to Arroyo Seco/Fair Oaks
LRT-4A $2,600,000,000		
LRT-4B $2,425,000,000		
	10 mi x $60 M = $600,000,000	9 mi x $60 M = $540,000,000
Initial Cost (w/50% Contingency)	**$900,000,000**	**$810,000,000**
Total Savings over LRT-4A	*$1,700,000,000*	*$1,790,000,000*
Total Savings over LRT-4B	*$1,525,000,000*	*$1,615,000,000*

Included in the total project costs above would be the following specific elements:

- Vehicles = $120M - $150M
- MSF = $75M - $100M
- Property Acquisition for MSF site = $40M - $50M

VA PROPOSAL NO. LRT1

Proposal Title: LRT-4A Alignment on I-710 Median

Initial Cost Savings:	$29,400,000
Future Cost Savings:	$0
Net LCC Savings:	$29,400,000
Change in Schedule:	Decrease
Performance Change:	0% (LRT-4A)
	-1% (LRT-4B)
Value Change:	+2 % (LRT-4A)
	0 % (LRT-4B)

Description of Baseline Concept: Alternative LRT-4A would begin at an aerial station on Mednik Avenue adjacent to the existing East Los Angeles Civic Station on the Metro Gold Line. From there, the line would run north on Mednik Avenue on an elevated structure, then run west on Floral Drive, then turn north across Corporate Center Drive and enter the I-710 right-of-way (ROW). After entering I-710 ROW, the alignment would travel north, with a station at California State University, Los Angeles (Cal State LA), providing a transfer station for El Monte Busway and Metrolink service. Continuing north of Cal State LA, the alignment would enter a bored tunnel between Valley Boulevard and Mission Road. The tunnel alignment would travel northeast to Fremont Avenue, with a station near the Los Angeles County office building in Alhambra. The alignment would then run north under Fremont Avenue, shifting slightly east to Fair Oak Avenue, remaining in the tunnel. The station would be placed under Fair Oak Avenue near Huntington Drive and Mission Street. The alignment would continue in the tunnel under SR-110, and continue north to a terminus station near the existing Fillmore Station on the Metro Gold Line.

The stations of Alternative LRT-4A would be 1-1/4 mile apart on average. The length of Alternative LRT-4A would be approximately 7.6 miles. Park-and-ride facilities would be provided at all stations except Cal State LA and Fillmore.

Description of VA Proposal Concept: It is proposed that Alternative LRT-4A be modified to place the LRT track at-grade in the median along the south section of SR 710 between Corporate Center Drive and just south of the I-10/I-710 interchange, widening to the outside as required. From that point the LRT would transition to elevated guideway to the west of the Baseline alignment in order to avoid the complex of existing structures at the interchange, and then rejoin LRT-4A at the Cal State LA station. The cost of widening is more than offset by the cost of elevated structures in the current alignment.

Advantages:

- Reduces approximately 0.6 mile of elevated light rail track.
- Improves LRT operation by reducing incline to the proposed Cal State LA station.
- Less maintenance for elevated structures.
- Lower seismic risk for structures.
- Improves access for emergency services.
- Moves elevated structure out of landfill/fire prone hillsides.
- Enhances aesthetics.

Disadvantages:

- Possible freeway widening in spots.
- Requires construction of LRT bridges over I-10/I-710 interchange.
- Conflicts with the existing median columns on I-710/I-10 interchange.
- Roadway structural section will need to be reconstructed for outside shoulder areas (both directions) to accommodate relocated freeway lanes of traffic to allow placement of LRT tracks in the median.

Discussion: This proposal would reduce the length of the LRT elevated structure by incorporating approximately 0.6 mile of LRT track within California Department of Transportation (Caltrans) I-710 median ROW.

The original LRT alignment will be built along the landscaped hill slope west of the I-710. It will be necessary to construct multiple foundations and columns, which will result in major disruption to landscape and drainage facilities. The elevated alignment is located in an old landfill area that has been historically prone to wildfires. Also, the multiple sites for foundation construction can be potentially complicated when founded on old landfill areas.

Additionally, eliminating the long elevated structures will preserve the natural look of the already landscaped hillsides.

The proposal to realign a portion of the LRT to the median of I-710 has the advantage of limiting a fire hazard from the nearby landfill area. There is also a benefit in minimizing the seismic risk from building less elevated LRT structure. This also translates into less structure maintenance and improved emergency access.

In order to realign the portion of the LRT onto the median of I-710, it is required to reconstruct two median concrete barriers (Type 60) and widen the outside shoulder area in both directions of freeway travel. Since the permanent traffic will be restriped to the shoulder area, the structural pavement sections need to be constructed.

As the realigned track moves toward the north, it will encounter the I-710/I-10 interchange. It will encounter interfering interchange columns in the median and the shoulder areas in both directions, which will prevent LRT track placement through the interchange along the median. Therefore, it will require the track alignment to be built on an elevated structure (as shown in Exhibit 6) to connect to the Cal State LA station. The elevated LRT track will depart from the Cal State LA station to the north and tie back to the I-710 median.

Technical Review Comments: Traffic staging needs to be incorporated during construction of LRT track on the I-710 median. There can be impacts to the functioning electrical and drainage systems of the existing freeway facility. Traffic detective loops need to be reconstructed.

Project Management Considerations: Cooperative agreements are required with the owner (Caltrans), Cal State LA, local municipalities, Los Angeles County, and environmental agencies.

Discussion of Schedule Impacts: Construction time could be improved due to the ease of median at-grade track construction.

Discussion of Risk Impacts: There can be future impacts with Caltrans on future I-710/I10 roadway and bridge interchange improvements.

Exhibit 1. Performance Ratings

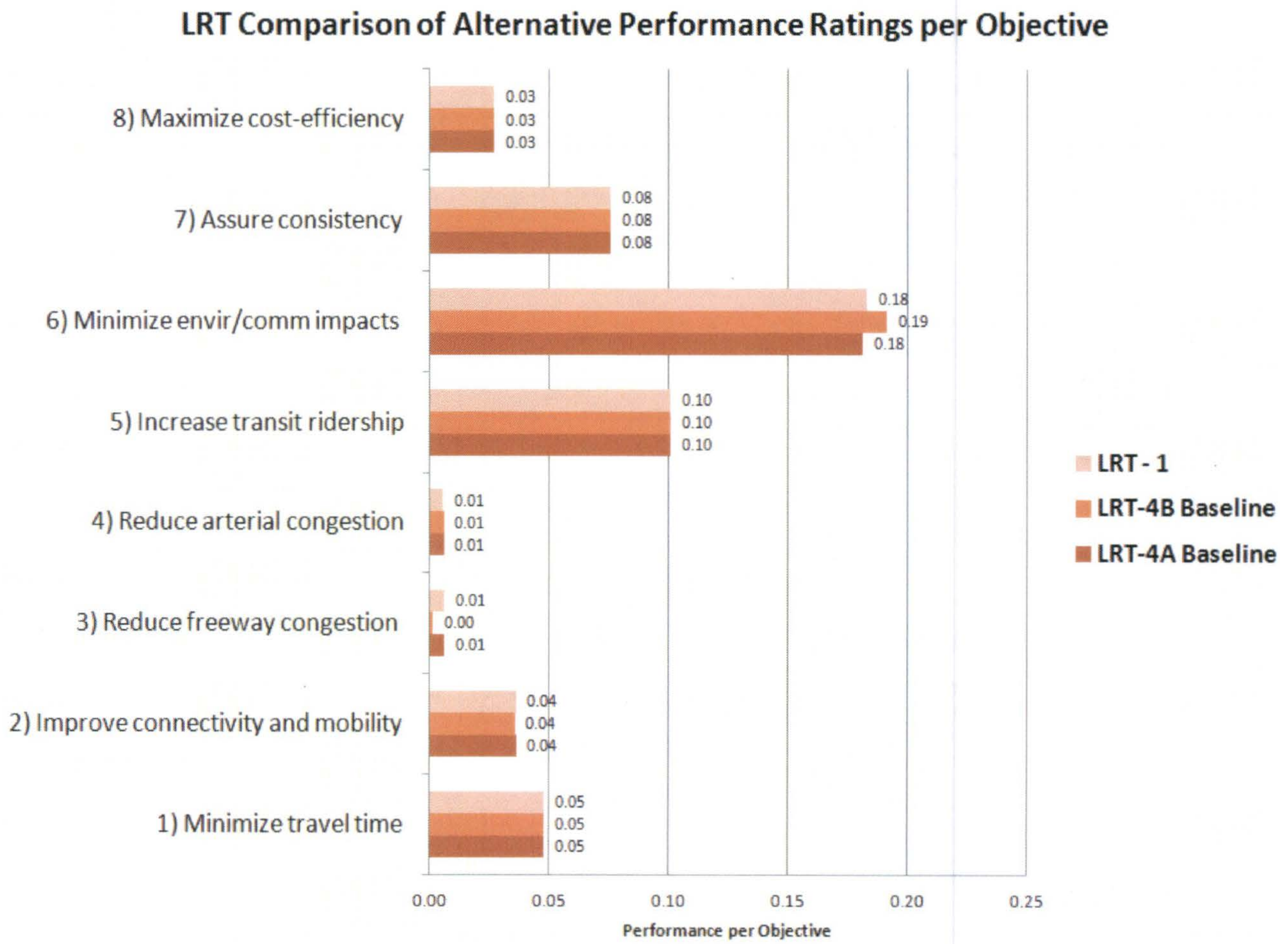


Exhibit 2. Performance Profile

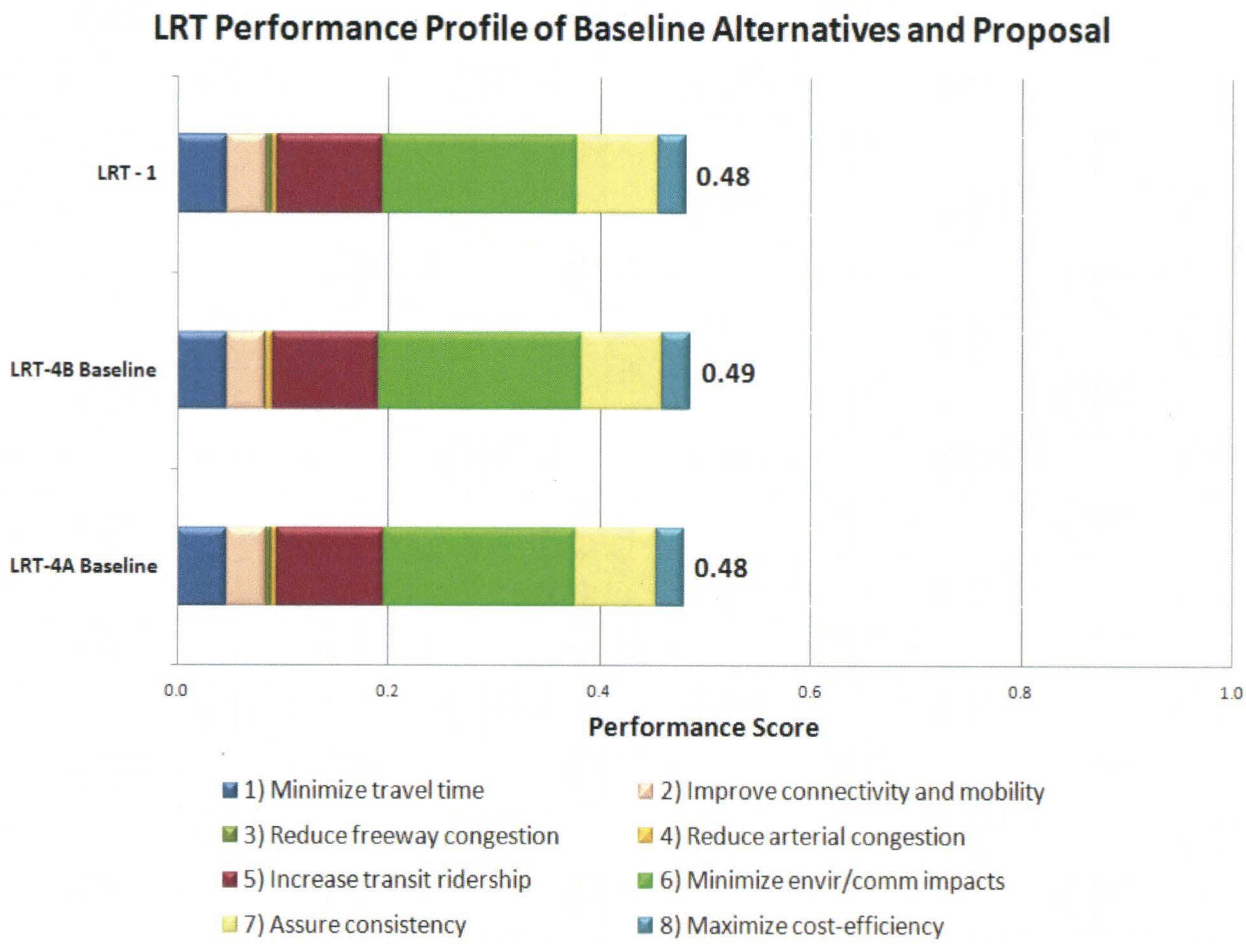


Exhibit 3. Benefit and Cost Performance

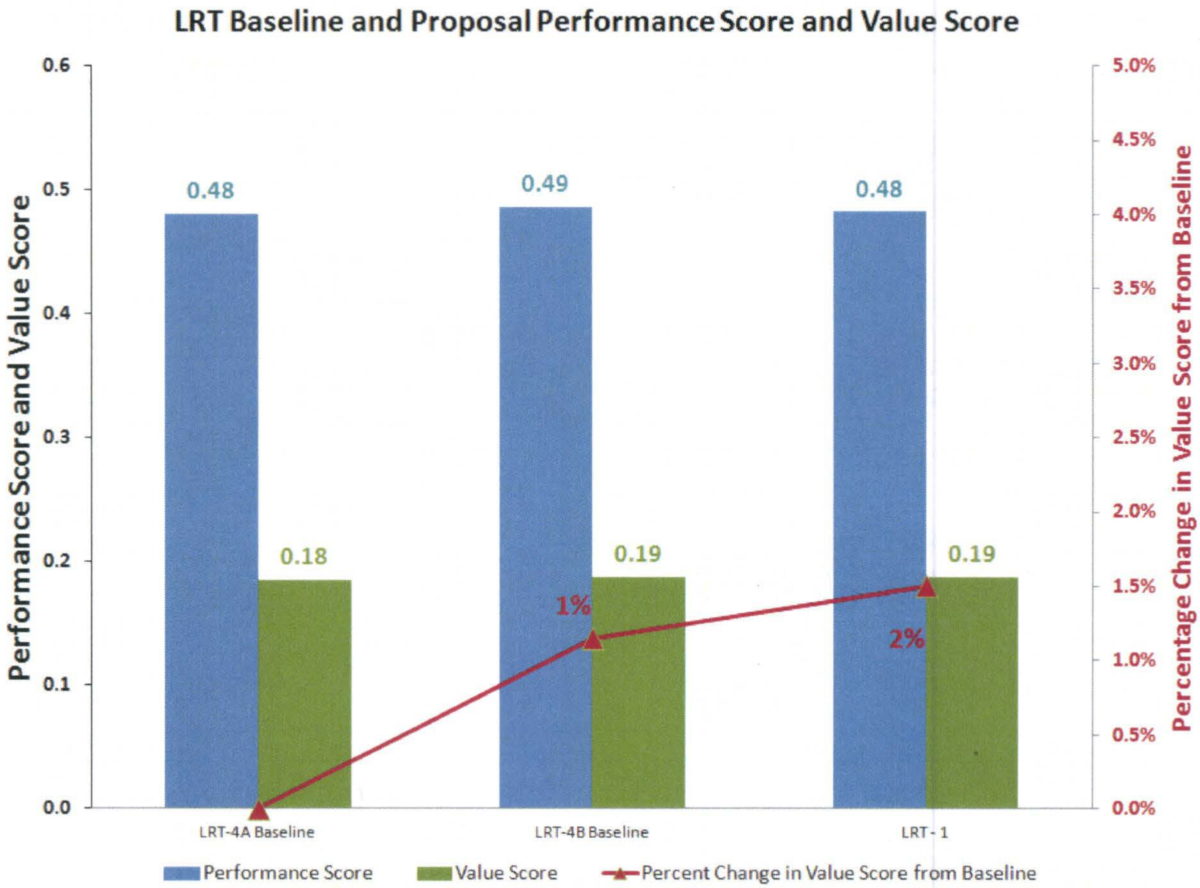


Exhibit 4. Performance Assessment

Performance Attributes (Objectives) Evaluation

Objectives	Comment (Influence of the VA Proposal upon the Objective)	Rating (VA Proposal "Improves Performance" or "No Change" or "Reduces Performance")
Minimize Travel Time	No change	No change
Improve Connectivity and Mobility	No change	No change
Reduce Congestion on Freeway System	No change	No change
Reduce Congestion on Local Street System	No change	No change
Increase Transit Ridership	No change	No change
Minimize Environmental and Community Impacts Related to Transportation	No change	No change
Assure Consistency with Regional Plans and Strategies	No change	No change
Maximize Cost Efficiency of Public Investments	Possible cost savings depending actual site conditions.	Possibly improves performance.

Exhibit 5. Baseline Concept Sketch

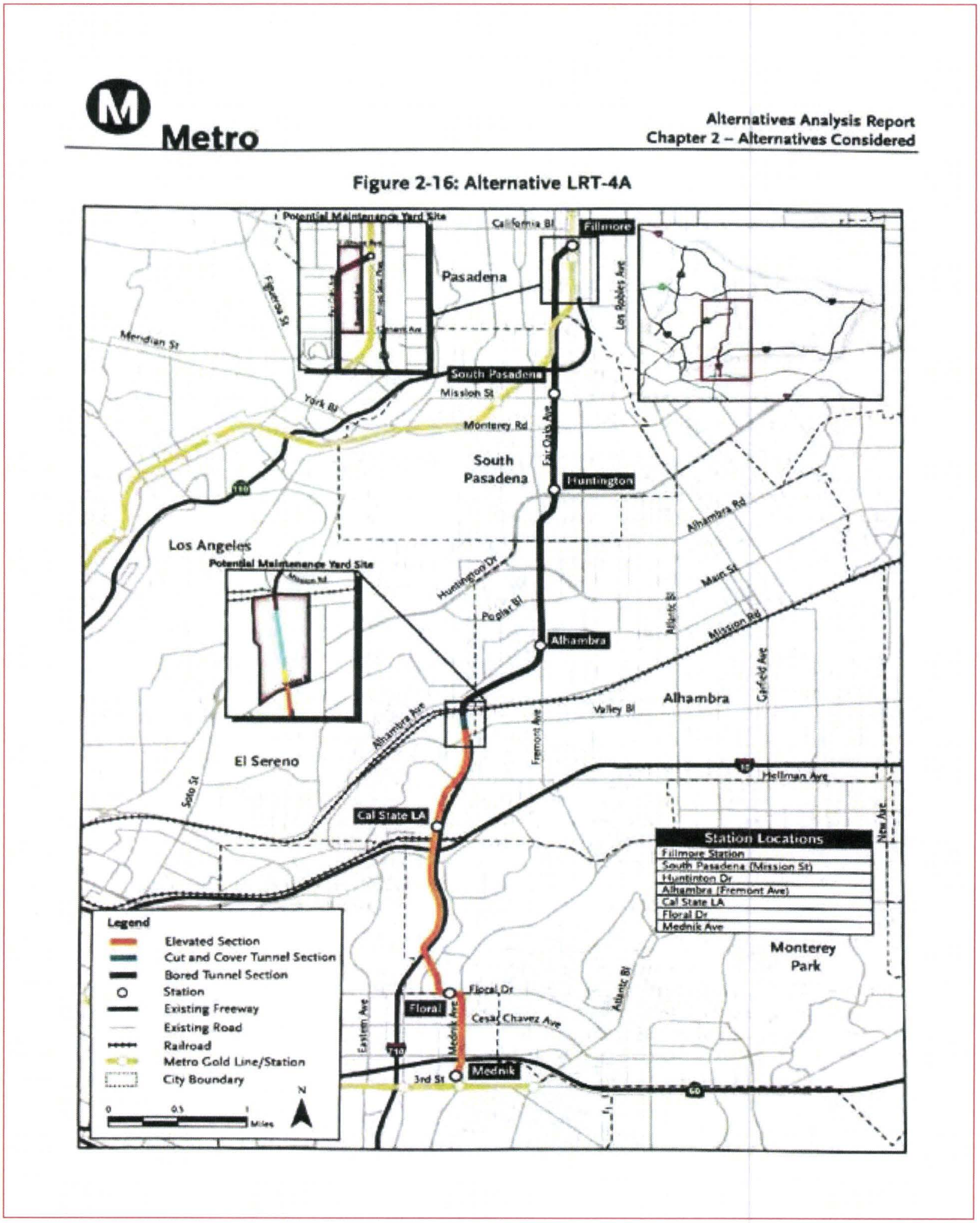
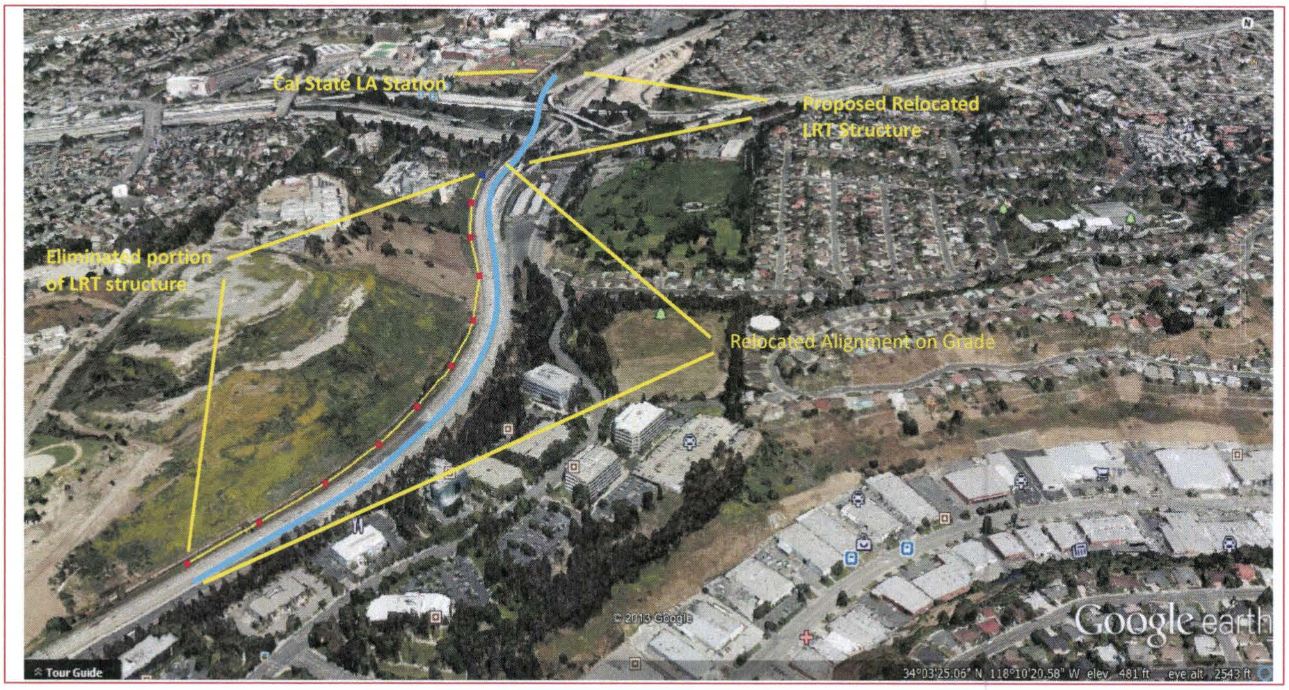


Exhibit 6. VA Proposal Concept Sketch

Interchange at I-710/10 (Proposed LRT bridge alignment)

Exhibit 7. VA Proposal Concept Sketch – Alignment Relocation



VA PROPOSAL NO. LRT1

Proposal Title: LRT-4A Alignment on I-710 Median

Exhibit 8. Initial Cost Estimates

INITIAL COSTS							ALT. NO. LRT-4A
CONSTRUCTION ELEMENT		*BASELINE CONCEPT*			*VA PROPOSAL CONCEPT*		
Description	Unit	Qty	Cost/Unit	Total	Qty	Cost/Unit	Total
ROADWAY ITEMS							
Roadway Widening	LF			$ -	6,500	$ 500	$ 3,250,000
Median Barrier (Type 60)	LF			$ -	6,500	$ 90	$ 585,000
K-rail	LF			$ -	13,000	$ 30	$ 390,000
Traffic Loop	LF			$ -	1	$ 100,000	$ 100,000
Traffic Striping	LS				70,000	$ 5	$ 350,000
Traffic Control	LS				1	$ 300,000	$ 300,000
Drainage	LS			$ -	1	$ 1,200,000	$ 1,200,000
ROADWAY SUBTOTAL				*$ -*			*$ 6,175,000*
ROADWAY MARK-UP	*79.5%*			*$ -*			*$ 4,909,125*
ROADWAY TOTAL				*$ -*			*$ 11,084,125*
STRUCTURE ITEMS							
10.041 guideway: Arial Typ Span	FT	16,589	$ 8,000	$ 132,712,000	13,421	$ 8,000	$ 107,368,000
10.03 guideway: At Grade in mixed traffic	RTE FT			$ -	3,168	$ 560	$ 1,774,080
				$ -			$ -
				$ -			$ -
				$ -			$ -
STRUCTURE SUBTOTAL				*$ 132,712,000*			*$ 109,142,080*
STRUCTURE MARK-UP	*72%*	1		*$ 95,154,504*	*1*		*$ 78,254,871*
STRUCTURE TOTAL				*$ 227,866,504*			*$ 187,396,951*
RIGHT-OF-WAY ITEMS							
Right-of-Way Acquisition				$ -			$ -
Utility Relocation				$ -			$ -
Relocation Assistance				$ -			$ -
Demolition				$ -			$ -
Title and Escrow Fees				$ -			$ -
RIGHT-OF-WAY TOTAL				*$ -*			*$ -*
ENVIRONMENTAL MITIGATION ITEMS							
				$ -			$ -
				$ -			$ -
CAPITAL OUTLAY SUPPORT ITEMS							
Reengineering and Redesign				$ -			$ -
Project Engineering				$ -			$ -
TOTAL				$227,866,504			$198,481,076
TOTAL (Rounded)				$227,870,000			$198,480,000
						SAVINGS	**$29,390,000**

Life-Cycle Cost Estimates: The VA team did not provide future cost calculations for this proposal because it was felt that the future cost difference is too minimal and obscure to effectively calculate. The annual cost of this proposal would be based on slightly increased travel time between Mednik Avenue and Cal State LA stations, due to vertical profile impact changing from aerial structure to at-grade along median and back to aerial structure. The conservative time penalty of 15 seconds calculates to 0.4% increase in light rail vehicle (LRV) travel time. The future cost difference for this VA proposal is therefore zero, and the Net Life Cycle Cost as shown in the cost summary at the top of this proposal is the same as the Initial Cost Saving (or Premium if a negative value is shown in parentheses).

Assumptions and Calculations: (---)

VA PROPOSAL NO. LRT2

Proposal Title: Valley Boulevard Overcrossing of LRT

Initial Cost Savings:	$71,000,000
Future Cost Savings:	$94,100,000
Net LCC Savings:	$165,100,000
Change in Schedule:	None
Performance Change:	0 % (LRT-4A)
	-1 % (LRT-4B)
Value Change:	+3 %
	+2 %

Description of Baseline Concept: The alignment of Alternative LRT-4A crosses over existing Valley Boulevard on an aerial structure and then descends quickly into a bored tunnel portal south of the UPRR trench and Mission Road. The yard lead track and a secondary connecting yard track are also elevated over Valley Boulevard, which splits the LRT maintenance and storage facility (MSF) site.

Description of VA Proposal Concept: Reconstruct Valley Boulevard on a structure to fly over the project, consolidating the LRT MSF site. The LRT mainline descends from an aerial guideway to grade on the MSF site. Immediately after crossing under the new Valley Boulevard structure, the LRT mainline rises on an aerial structure to cross over the UPRR right-of-way (ROW) and Mission Road before descending to enter the bored tunnel section. Depending on the constraints of Westmont Drive and Highbury Avenue (and adjoining properties) on the Valley Boulevard overcrossing profile for minimum LRT vertical clearance, the elevation of the MSF site could be raised to maximize the fill available from the existing freeway approaches.

Valley Boulevard from SR 710 Southbound On-Ramp

Advantages:

- Consolidates the LRT MSF onto one site and improves yard operations.
- Reduces the length of the bored tunnel section and associated costs.
- Eliminates the aerial structure for yard lead and connecting tracks.
- Total export of excavated material is substantially less than current alternatives.

Disadvantages:

- Requires a significant structure to carry Valley Boulevard and connecting SR 710 ramps.
- Requires ROW compensation in the form of reduced driveway access for properties abutting Valley Boulevard.
- Requires additional ROW north of Mission Road to accommodate tunnel portal.

VA PROPOSAL NO. LRT2

Proposal Title: Valley Boulevard Overcrossing of LRT

Discussion: This LRT alternative is proposed in order to reduce the length of the bored tunnel and consolidate the proposed MSF onto one continuous site to improve yard operations. The costs of a flyover structure to carry Valley Boulevard over the LRT yard and additional ROW acquisition to accommodate the tunnel portal would be more than offset by the substantial cost-savings of approximately 1,700 feet of bored tunnel and long-term operations of the MSF.

Technical Review Comments: The LRT mainline tracks would need to be realigned to the east side of the MSF site to minimize the aerial structure over the UPRR and Mission Road. The Valley Boulevard overcrossing would need to incorporate the SR 710 on- and off-ramps onto the new structure, although impacts to the cross-streets of Westmont Drive and Highbury Avenue would likely be minor. Excavation and export of materials from the existing highway approach embankments will be substantially less than current Alternatives LRT-4A and F-7, especially since the MSF site can be graded level on top of fill placed within the Valley Boulevard ROW and up to the UPRR ROW.

Project Management Considerations: Redesign the current layout for the yard tracks and run the mainline LRT tracks to the east side of the MSF. Revise the LRT alignment and profile north of Mission Road, and research the need for any additional ROW acquisition. Perform conceptual design for the Valley Boulevard overcrossing to ascertain impacts to side streets and SR 710 ramps. Perform revised cost estimates. (Contact the City of Alhambra to determine the feasibility of modifying Valley Boulevard and any construction constraints.)

Discussion of Schedule Impacts: No delay in schedule is anticipated as compared to Alternative-4A. The additional construction element of the Valley Boulevard overcrossing, to be constructed in stages, would likely be offset by the advantage of grading and constructing the MSF as one consolidated site.

Discussion of Risk Impacts: The project may incur additional time and costs due to concerns and/or requirements imposed by the City of Alhambra on constructing the Valley Boulevard overcrossing.

Exhibit 1. Performance Ratings

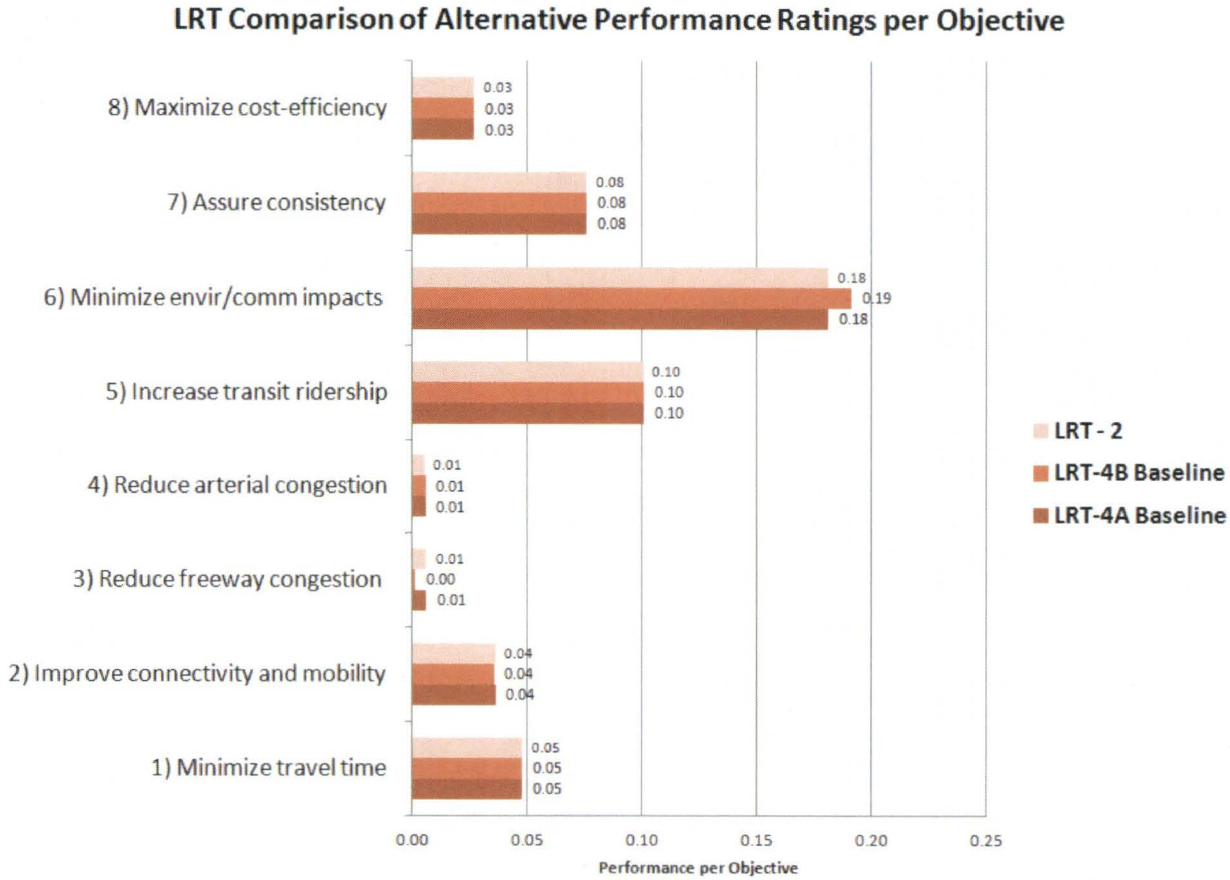


Exhibit 2. Performance Profile

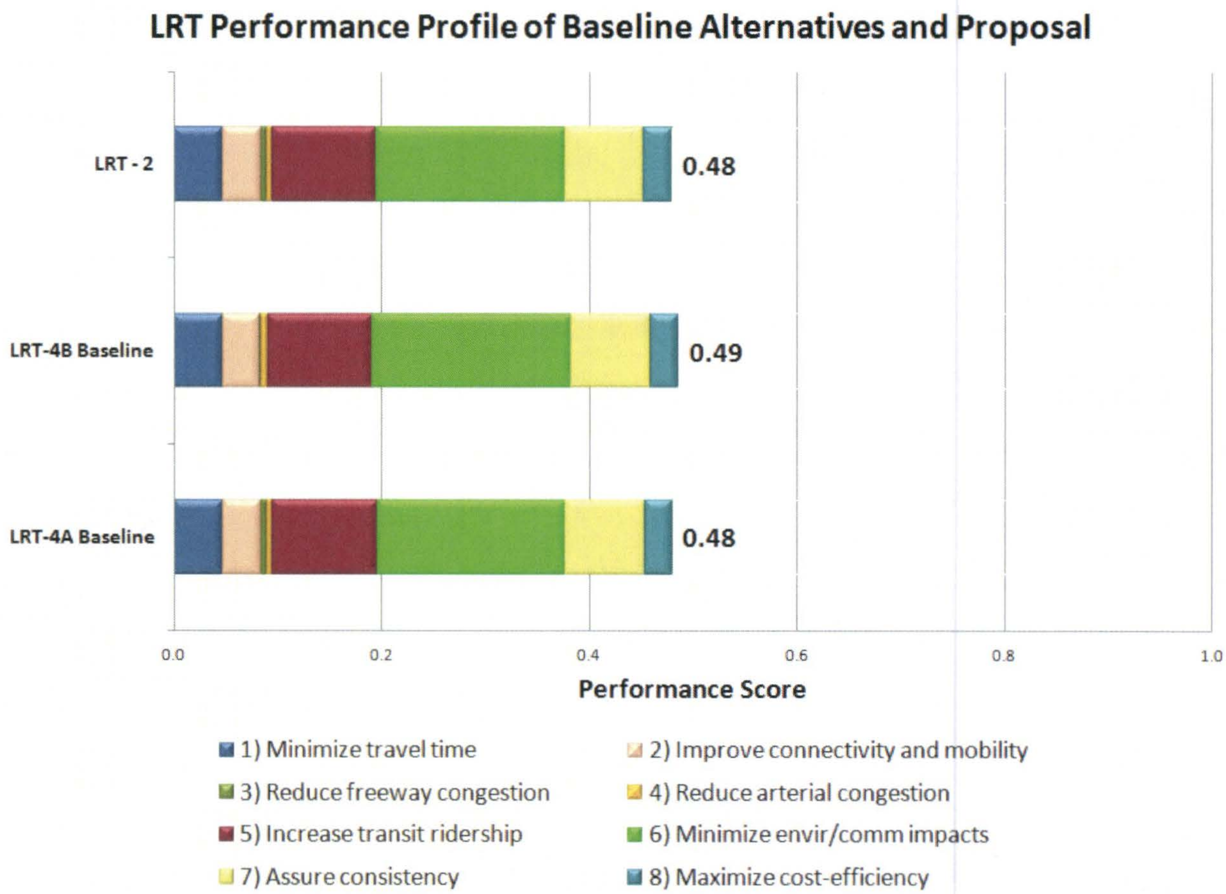


Exhibit 3. Benefit and Cost Performance

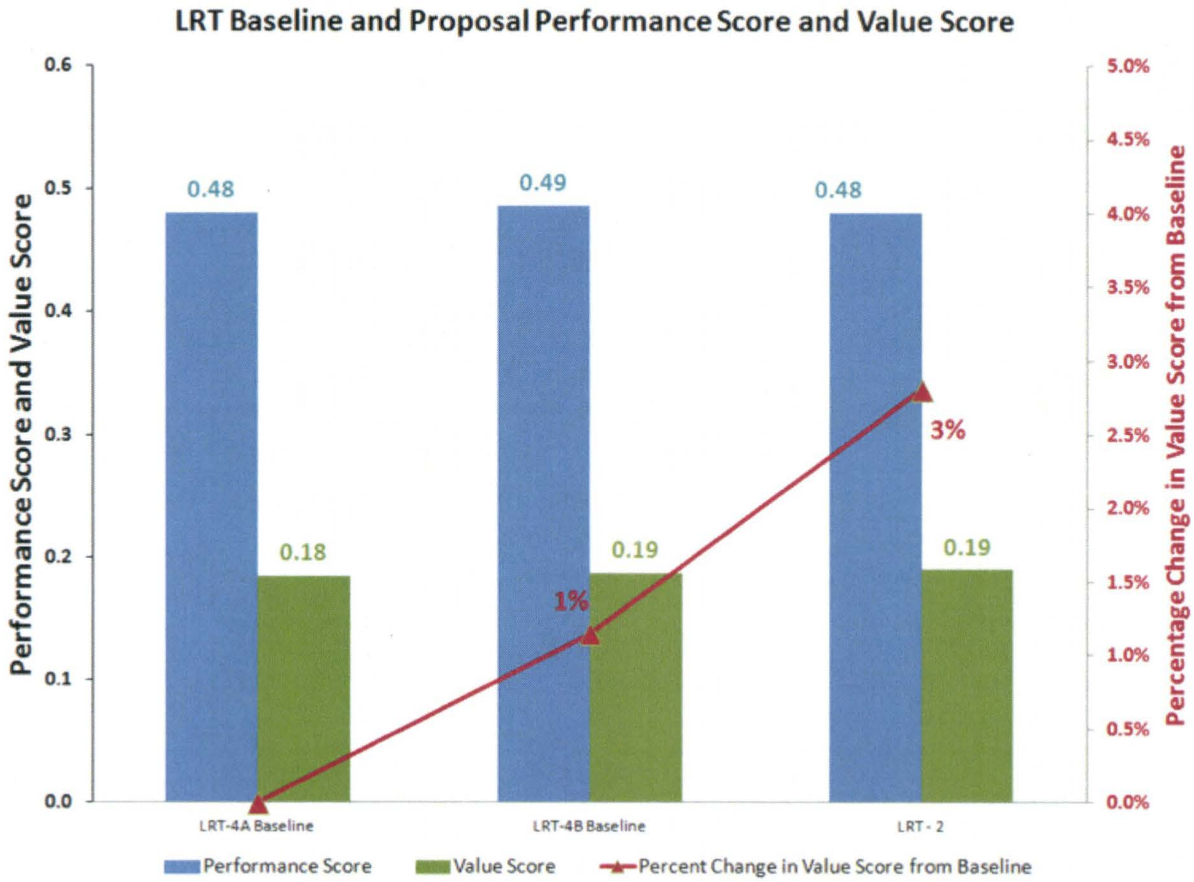


Exhibit 4. Performance Assessment

Performance Attributes (Objectives) Evaluation

Objectives	**Comment** (Influence of the VA Proposal upon the Objective)	**Rating** (VA Proposal "Improves Performance" or "No Change" or "Reduces Performance")
Minimize Travel Time	No appreciable loss in travel time from LRT-4A alternative.	No change
Improve Connectivity and Mobility	No appreciable change from LRT-4A.	No change
Reduce Congestion on Freeway System	Same as LRT-4A.	No change
Reduce Congestion on Local Street System	Less impact on Valley Boulevard from one unified MSF site rather than two sites.	No change
Increase Transit Ridership	Same as LRT-4A.	No change
Minimize Environmental and Community Impacts Related to Transportation	Same as LRT-4A.	No change
Assure Consistency with Regional Plans and Strategies	Same as LRT-4A.	No change
Maximize Cost Efficiency of Public Investments	Substantial cost-savings from reduced length of tunnel section	Improves performance

Exhibit 5. Baseline Concept Sketch

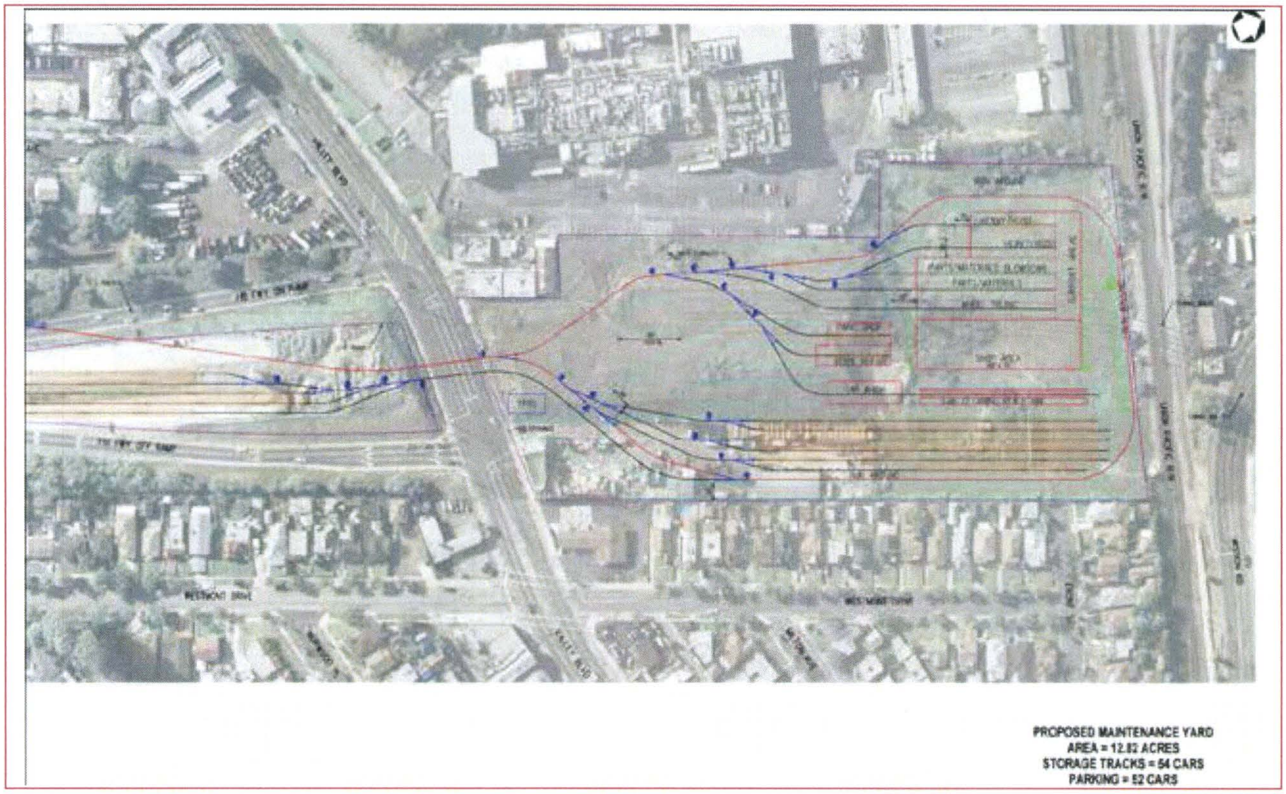


Exhibit 6. VA Proposal Concept Sketch

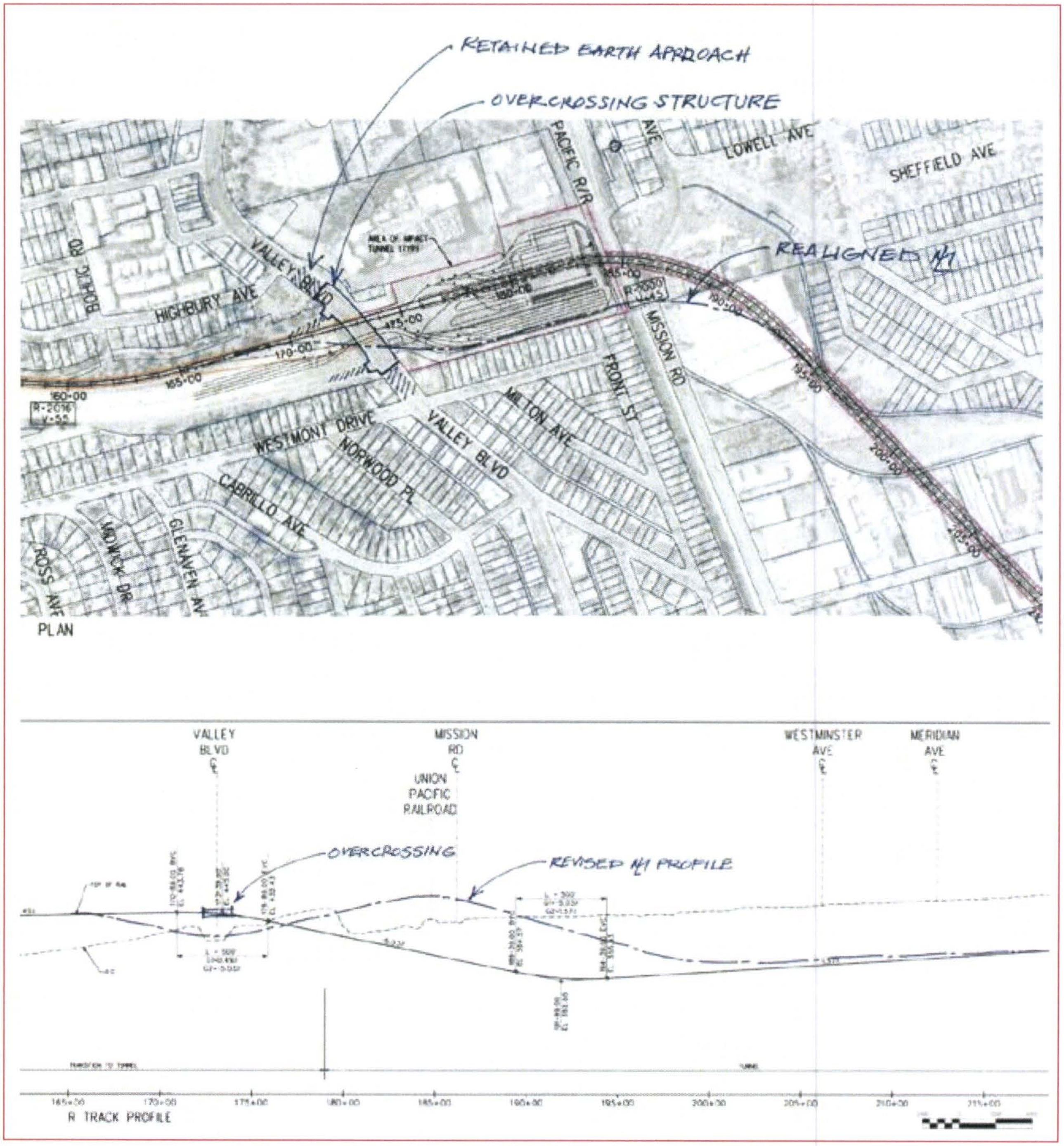


Exhibit 7. Initial Cost Estimates

INITIAL COSTS							ALT. NO.
CONSTRUCTION ELEMENT		*BASELINE CONCEPT*			*VA PROPOSAL CONCEPT*		
Description	**Unit**	**Qty**	**Cost/Unit**	**Total**	**Qty**	**Cost/Unit**	**Total**
ROADWAY ITEMS							
Roadway Structure	LF				500	$ 20,000	$ 10,000,000
Roadway Pavement	SF			$ -	48,000	$ 20	$ 960,000
Retained Earth Approach	LF			$ -	400	$ 3,000	$ 1,200,000
ROADWAY SUBTOTAL				*$ -*			*$ 12,160,000*
ROADWAY MARK-UP	*79.5%*			*$ -*			*$ 9,667,200*
ROADWAY TOTAL				*$ -*			*$ 21,827,200*
LRT ITEMS							
Guideway: At-grade	RF			$ -	400	$ 480	$ 192,000
Guideway: Aerial Typical Span	RF	400	$ 8,000	$ 3,200,000	1,300	$ 8,000	$ 10,400,000
Track: Direct Fixation	RF	1,700	$ 720	$ 1,224,000	400	$ 720	$ 288,000
Track: Ballasted	RF			$ -	1,300	$ 460	$ 598,000
LRT ITEMS SUBTOTAL				*$ 4,424,000*			*$ 11,478,000*
LRT ITEMS MARK-UP	*71.7%*			*$ 3,172,008*			*$ 8,229,726*
LRT ITEMS TOTAL				*$ 7,596,008*			*$ 19,707,726*
LRT TUNNEL ITEMS							
Bored Tunnel	RF	1,700	$ 49,600	$ 84,320,000			
LRT TUNNEL SUBTOTAL				*$ 84,320,000*			
LRT TUNNEL MARK-UP	*46.7%*			*$ 39,377,440*			
LRT ITEMS TOTAL				*$ 123,697,440*			
RIGHT-OF-WAY ITEMS							
R/W Acquisition (Commercial)	LS				1	$ 15,000,000	$ 15,000,000
R/W ITEMS SUBTOTAL							*$ 15,000,000*
R/W ITEMS MARK-UP	*25.0%*						*$ 3,750,000*
R/W ITEMS TOTAL							*$ 18,750,000*
ENVIRONMENTAL MITIGATION ITEMS							
				$ -			$ -
				$ -			$ -
CAPITAL OUTLAY SUPPORT ITEMS							
Reengineering and Redesign				$ -			$ -
Project Engineering				$ -			$ -
TOTAL		$		131,293,448	$		60,284,926
TOTAL (Rounded)		$		131,290,000			$60,280,000
						SAVINGS	**$71,010,000**

Assumptions:

a - Reduced driveway access for 5 properties.

b - Yard lead track can be developed off of mainline tracks at-grade within MSF site.

c - LRT-4A cost estimate did not itemize MSF nor earthwork costs; suggest that any potential export of excavated materials could be minimized by filling in Valley Blvd ROW for MSF site.

d - Bored tunnel unit cost based on LRT-4A cost estimate, and includes utilities and systems elements.

e - ROW unit costs based on proration of LRT-4A cost estimate, and includes relocation, clearance, and title/escrow fees.

f - Subsequent annual costs assumes 2.5% reduction of LRT-4A costs due to improved yard operations; revenue operations would be essentially the same.

Exhibit 8. Life-Cycle Cost Estimates

LIFE-CYCLE COSTS					ALT. NO.
Life-Cycle Period 50 Years		Real Discount Rate	3.00%	BASELINE	VA PROPOSAL
A. INITIAL COST				$2,600,000,000	$2,529,000,000
Service Life - Baseline Years; Service Life - Alternative Years			**INITIAL COST SAVINGS:**		**$ 71,000,000**
B. SUBSEQUENT ANNUAL COSTS					
1. Maintenance and Inspection					
2. Operating					
3. Energy					
			Total Subsequent Annual Costs:	$ 35,984,000	$ 35,085,000
			Present Value Factor (P/A):	25.730	25.730
			PRESENT VALUE OF SUBSEQUENT ANNUAL COSTS (Rounded):	**$ 925,860,000**	**$ 902,729,000**
C. SUBSEQUENT SINGLE COSTS	**Year**	**Amount**	**PV Factor**	**Present Value**	**Present Value**
			1.00000	$ -	
			1.00000		$ -
			1.00000	$ -	
			1.00000		$ -
			1.00000	$ -	
			1.00000		$ -
			1.00000	$ -	
			1.00000		$ -
			PRESENT VALUE OF SUBSEQUENT SINGLE COSTS (Rounded):	**$ -**	**$ -**
D. TOTAL SUBSEQUENT ANNUAL AND SINGLE COSTS (B+C)				**$ 925,860,000**	**$ 902,729,000**
E.			**TOTAL SUBSEQUENT COSTS SAVINGS:**		**$ 23,131,000**
F. TOTAL PRESENT VALUE COST (A+D)				**$ 3,525,860,000**	**$ 3,431,729,000**
				TOTAL LIFE-CYCLE SAVINGS:	**$ 94,131,000**

Assumptions and Calculations: (---)

VA PROPOSAL NO. LRT3

Proposal Title: Terminate LRT-4A Alignment at Gold Line North of SR 110

Initial Cost Savings:	$540,000,000
Future Cost Savings:	$660,000,000
Net LCC Savings:	$1,200,000,000
Change in Schedule:	(---)
Performance Change:	+3 % (LRT-4A)
	+2 % (LRT-4B)
Value Change:	+30 % (LRT-4A)
	+29 % (LRT-4B)

Description of Baseline Concept: The tunnel section of Alternative LRT-4A runs north along Fair Oaks Avenue, then transitions in the vicinity of State Street to Raymond Avenue where it terminates in an underground station adjacent to the existing Fillmore Station of the Gold Line. The tunnel boring machine (TBM) would likely be abandoned in place beyond the station limits.

Description of VA Proposal Concept: Raise the bored tunnel profile under Fair Oaks Avenue in the vicinity of Mission Street and continue along a reduced depth beneath the roadway, terminating in an underground station adjacent to the west side of Fair Oaks Avenue near the existing Gold Line. The alignment curves northwesterly into a site bounded generally by Fair Oaks Avenue, Mound Avenue, the Gold Line, and Arroyo Seco Parkway (SR 110). The site is of sufficient area for a plaza and entrance to the underground station as well as surface parking. Consider constructing a new Gold Line at-grade station immediately adjacent, with a pedestrian connection to the proposed end-of-line (EOL) station. The proposed South Pasadena Station is eliminated. Because the terminal station would be constructed using the cut-and-cover method, within a large property outside of the public right-of-way (ROW), the TBM could be extracted and salvaged.

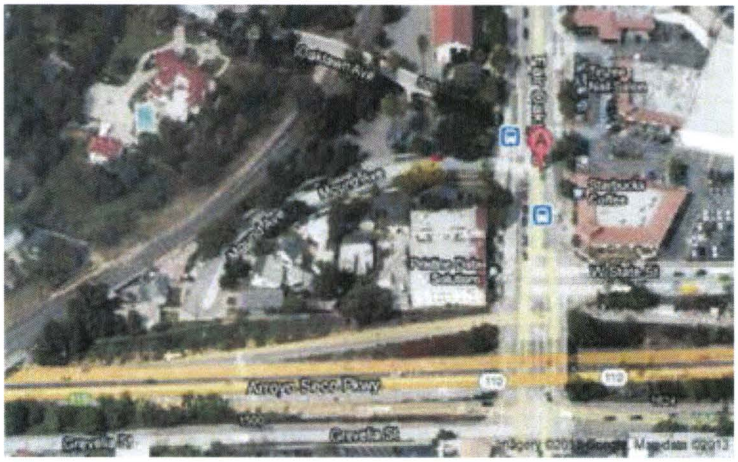
Advantages:

- Reduces bored tunnel by more than 1 mile.
- TBM can be removed from the tunnel.
- Avoids duplicating Gold Line between Arroyo Seco and Fillmore.
- Eliminates duplicative South Pasadena Station.
- Provides transfer point to Gold Line (via new Gold Line Station).
- EOL station area is immediately adjacent to existing Oaklawn Park-and-Ride.

Disadvantages:

- Requires acquisition of multiple contiguous properties and relocation.
- Could be potential Section 4(f) mitigation due to proximity to historic structures.

Discussion: This LRT proposal is suggested primarily to reduce the alignment length and avoid duplicating Gold Line coverage between South Pasadena and the existing Fillmore Station. There is significant property acquisition at the northeast quadrant of SR 110 and Fair Oaks Avenue. However, the consolidation of properties around Mound Avenue would provide an advantageous EOL site (approximately 1.8 to 2.0 acres) for the proposed LRT line – offering a unique multimodal transfer facility that could combine the services of a new LRT line, the existing Gold Line, an expanded park-and-ride, and the existing 260 bus route. This would be a highly visible transit facility located within an established mixed-development neighborhood.



Technical Review Comments: The LRT alignment should terminate as closely as possible to the Gold Line. To create a new Gold Line Station, the existing northbound track could be realigned to accommodate a nonparallel center platform (requiring a waiver from the Metro standard) in close proximity to the underground EOL station.

Project Management Considerations: Immediate tasks to vet this VA proposal include the following: research property ownerships at the EOL site and estimate acquisition and relocation costs; acquire the Gold Line alignment as-builts to determine preliminary design concepts for accommodating a station platform(s); and coordinate with Metro to review the possible routing of the 260 bus line into the transfer site.

Discussion of Schedule Impacts: Because the proposal tunnel alignment is over 1 mile shorter, it will take less time to construct. However, ROW acquisition and development of the EOL site may reduce those time savings.

Discussion of Risk Impacts: The property acquisition and relocation process for the necessary site upon which to develop the EOL station and transit transfer facility poses a high risk to the project schedule. The proximity of the EOL station and transit facility to the Raymond Fault is a high technical risk; a detailed geotechnical investigation should be conducted to assess the viability of the proposed site. Additionally, as the proposed transit facility is adjacent to the historic Oaklawn Avenue Bridge and nearby War Memorial Building, potential Section 4(f) issues will need to be evaluated.

Exhibit 1. Performance Ratings

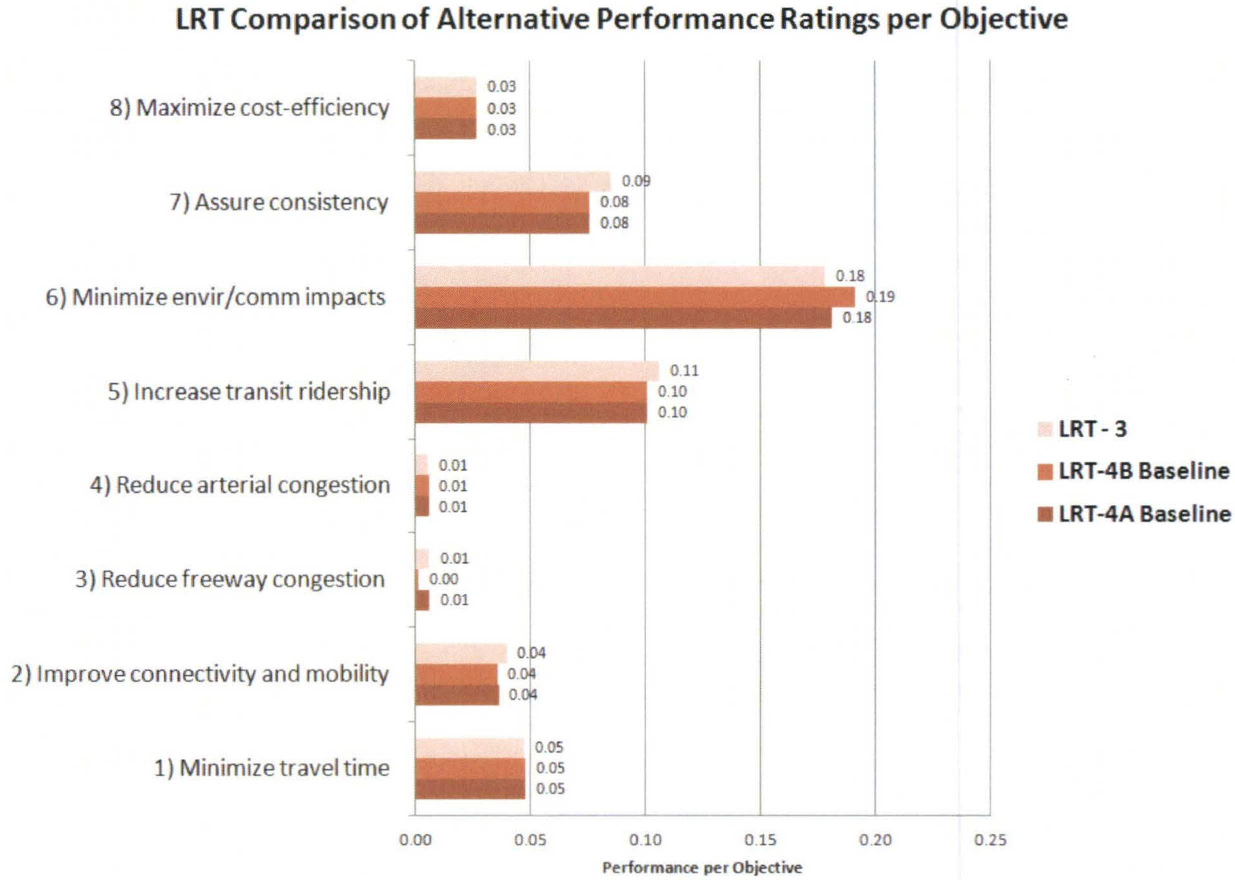


Exhibit 2. Performance Profile

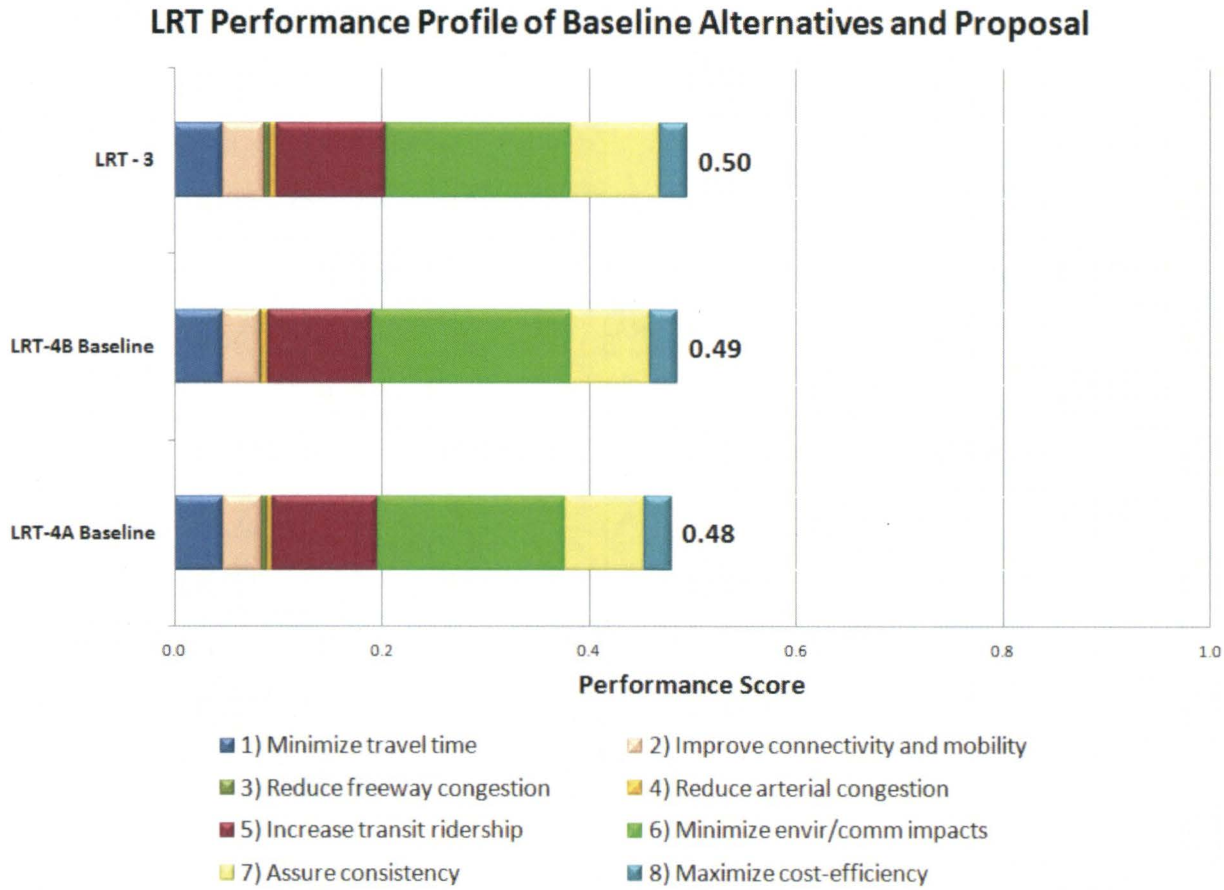


Exhibit 3. Benefit and Cost Performance

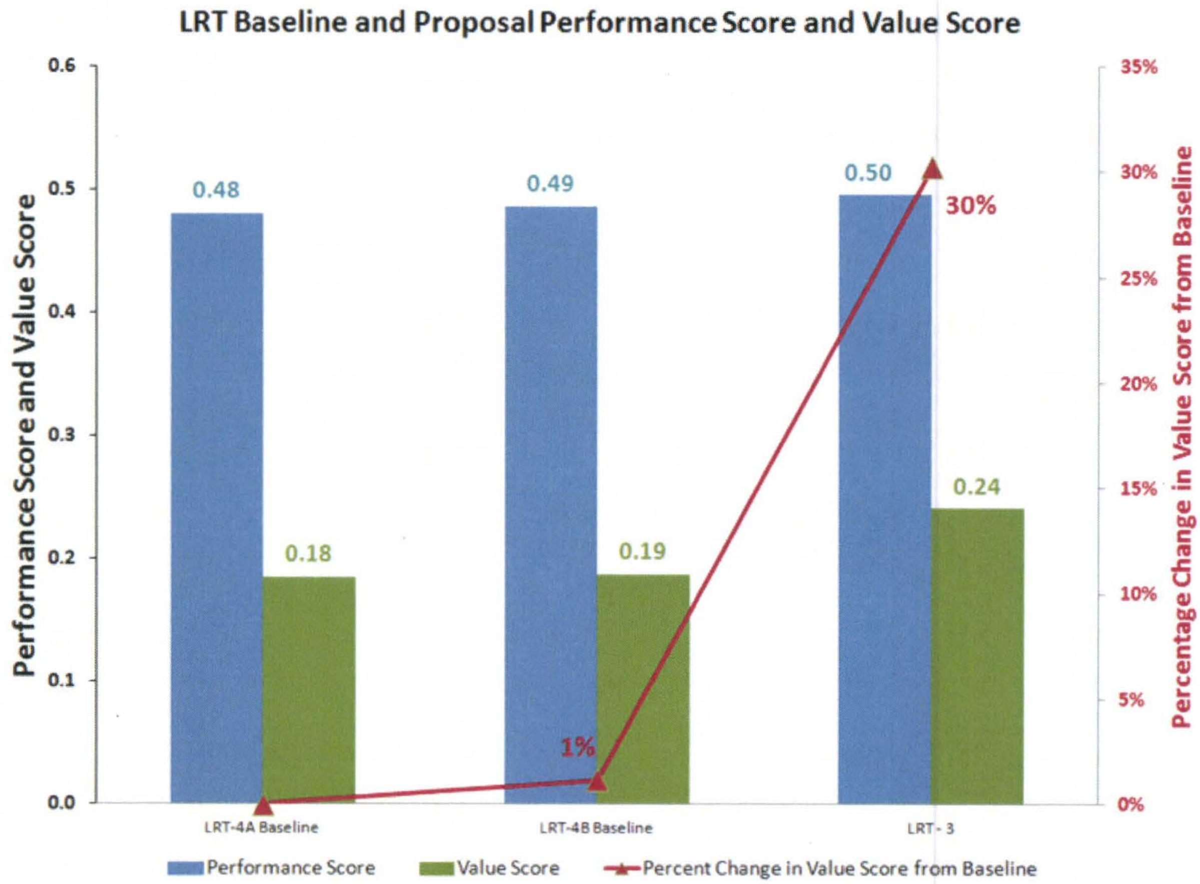


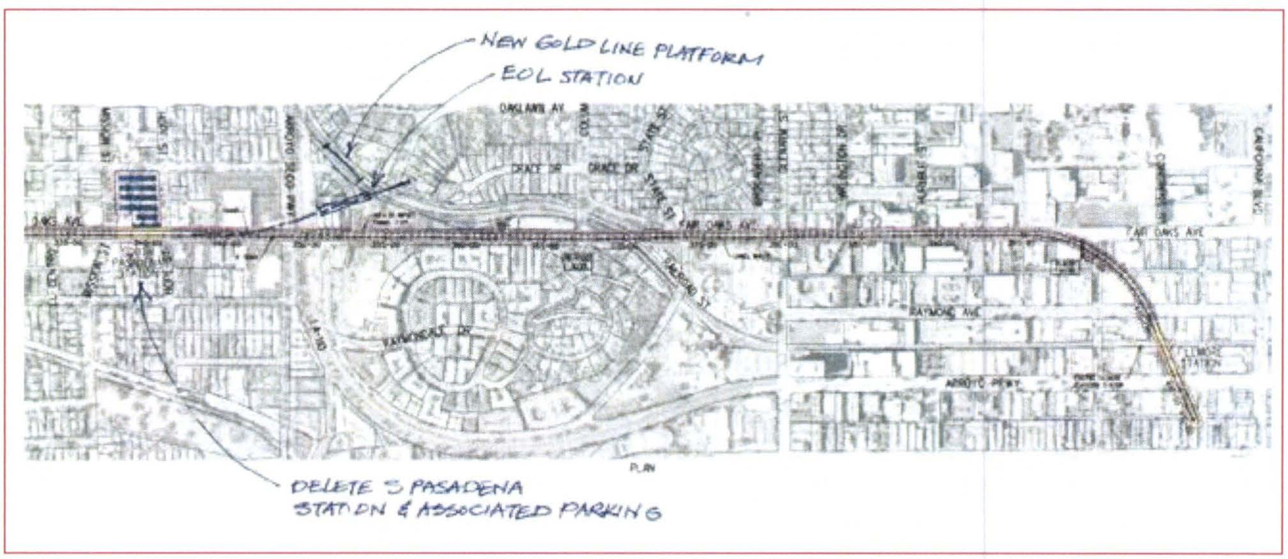
Exhibit 4. Performance Assessment

Performance Attributes (Objectives) Evaluation

Objectives	**Comment** (Influence of the VA Proposal upon the Objective)	**Rating** (VA Proposal "Improves Performance" or "No Change" or "Reduces Performance")
Minimize Travel Time	Shorter than LRT-4A, including north end connection to Gold Line.	Improves performance
Improve Connectivity and Mobility	Potential multimodal facility at EOL station site.	Improves performance
Reduce Congestion on Freeway System	Same as LRT 4-A.	No change
Reduce Congestion on Local Street System	Same as LRT-4A.	No change
Increase Transit Ridership	Shorter travel time, combined with multimodal transfer convenience.	Improves performance
Minimize Environmental and Community Impacts Related to Transportation	Same as LRT-4A.	No change
Assure Consistency with Regional Plans and Strategies	Added opportunity for multimodal connection.	Improves performance
Maximize Cost Efficiency of Public Investments	Although EOL station will be more costly, that cost will be offset by savings from deleting nearly 1 mile of bored tunnel.	Improves performance

Exhibit 5. Baseline Concept Sketch

Exhibit 6. VA Proposal Concept Sketch



Proposal Title: Terminate LRT-4A Alignment at Gold Line North of SR 110

Exhibit 7. Initial Cost Estimates

INITIAL COSTS							ALT. NO.
CONSTRUCTION ELEMENT		*BASELINE CONCEPT*			*VA PROPOSAL CONCEPT*		
Description	**Unit**	**Qty**	**Cost/Unit**	**Total**	**Qty**	**Cost/Unit**	**Total**
ROADWAY ITEMS							
Surface Parking				$ -			$ -
Traffic Signals: Minor Intersection	EA			$ -	1	$ 150,000	$ 150,000
				$ -			$ -
				$ -			$ -
ROADWAY SUBTOTAL				*$ -*			*$ 150,000*
ROADWAY MARK-UP	*79.5%*			*$ -*			*$ 119,250*
ROADWAY TOTAL				*$ -*			*$ 269,250*
LRT ITEMS							
Gold Line Track Realignment	LS			$ -	1	$ 5,000,000	$ 5,000,000
At-grade Station, Center Platform	EA			$ -	1	$ 3,800,000	$ 3,800,000
Transfer Facility Site	LS			$ -	1	$ 50,000,000	$ 50,000,000
Elevator/Escalator	EA	4	$ 250,000	$ 1,000,000			$ -
Ticket Vending Machine	EA	2	$ 860,000	$ 1,720,000			$ -
LRT ITEMS SUBTOTAL				*$ 2,720,000*			*$ 58,800,000*
LRT ITEMS MARK-UP	*71.7%*			*$ 1,950,240*			*$ 42,159,600*
LRT ITEMS TOTAL				*$ 4,670,240*			*$ 100,959,600*
LRT TUNNEL ITEMS							
Bored Tunnel	RF	5,500	$ 49,600	$ 272,800,000			
Track: Direct Fixation	RF	5,500	$ 720	$ 3,960,000			
Underground Station	EA	1	$ 110,000,000	$ 110,000,000			
Salvage TBM	EA	2	$ 15,000,000	$ 30,000,000	2	$ (15,000,000)	$ (30,000,000)
LRT TUNNEL SUBTOTAL				*$ 416,760,000*			*$ (30,000,000)*
LRT TUNNEL MARK-UP	*46.7%*			*$ 194,626,920*			*$ (14,010,000)*
LRT TUNNEL TOTAL				*$ 611,386,920*			*$ (44,010,000)*
RIGHT-OF-WAY ITEMS							
Right-of-Way Acquisition	LS	1	$ 25,000,000	$ 25,000,000	1	$ 40,000,000	$ 40,000,000
Utility Relocation				$ -			$ -
Relocation Assistance				$ -			$ -
Demolition				$ -			$ -
Title and Escrow Fees				$ -			$ -
RIGHT-OF-WAY SUBTOTAL				*$ 25,000,000*			*$ 40,000,000*
RIGHT-OF-WAY MARK-UP	*25.0%*			*$ 6,250,000*			*$ 10,000,000*
RIGHT-OF-WAY TOTAL				*$ 31,250,000*			*$ 50,000,000*
ENVIRONMENTAL MITIGATION ITEMS							
				$ -			$ -
				$ -			$ -
CAPITAL OUTLAY SUPPORT ITEMS							
Reengineering and Redesign				$ -			$ -
Project Engineering				$ -			$ -
TOTAL		$		647,307,160	$		107,218,850
TOTAL (Rounded)				$647,310,000			$107,220,000
						SAVINGS	**$540,090,000**

ASSUMPTIONS:

a - Bored tunnel unit cost based on LRT-4A cost estimate, and includes utilities and systems elements; excludes underground stations.

b - Assumes "Station 3" would be eliminated, and cost of underground station in LRT-4A cost estimate includes parking as shown on conceptual plan.

c - ROW unit costs based on proration of LRT-4A cost estimate, and includes relocation, clearance, and title/escrow fees.

d - Assumes ROW savings from parking associated with "Station 3".

e - ROW at EOL site based on acquisition of 8 residential and 6 commercial properties.

f - Transfer facility includes LRT plaza, parking, bus island, paving, lighting, shelters and furniture, landscaping.

g - Gold Line track realignment cost includes OCS.

h - Subsequent annual cost for life-cycle estimate based on proration of LRT-4A costs (proposed alignment is 13% shorter).

Exhibit 8. Life-Cycle Cost Estimates

LIFE-CYCLE COSTS					ALT. NO.
Life-Cycle Period 50 Years		Real Discount Rate	3.00%	BASELINE	VA PROPOSAL
A. INITIAL COST				$2,600,000,000	$2,060,000,000
Service Life - Baseline Years Service Life - Alternative Years		INITIAL COST SAVINGS:			$ 540,000,000
B. SUBSEQUENT ANNUAL COSTS					
1. Maintenance and Inspection					
2. Operating					
3. Energy					
Total Subsequent Annual Costs:				$ 35,984,000	$ 31,306,000
Present Value Factor (P/A):				25.730	25.730
PRESENT VALUE OF SUBSEQUENT ANNUAL COSTS (Rounded):				$ 925,860,000	$ 805,496,000
C. SUBSEQUENT SINGLE COSTS	Year	Amount	PV Factor	Present Value	Present Value
			1.00000	$ -	
			1.00000		$ -
			1.00000	$ -	
			1.00000		$ -
			1.00000	$ -	
			1.00000		$ -
			1.00000	$ -	
			1.00000		$ -
PRESENT VALUE OF SUBSEQUENT SINGLE COSTS (Rounded):				$ -	$ -
D. TOTAL SUBSEQUENT ANNUAL AND SINGLE COSTS (B+C)				$ 925,860,000	$ 805,496,000
E. TOTAL SUBSEQUENT COSTS SAVINGS:					$ 120,364,000
F. TOTAL PRESENT VALUE COST (A+D)				$ 3,525,860,000	$ 2,865,496,000
TOTAL LIFE-CYCLE SAVINGS:					$ 660,364,000

Assumptions and Calculations: (---)

VA PROPOSAL NO. LRT4

Proposal Title: LRT At-Grade between Mission Road and Fair Oaks Avenue

Initial Cost Savings:	$896,000,000
Future Cost Savings:	$801,000,000
Net LCC Savings:	$1,697,000,000
Change in Schedule:	Schedule Decrease
Performance Change:	-9 % (LRT-4A)
	-10 % (LRT-4B)
Value Change:	+38 % (LRT-4A)
	+37 % (LRT-4B)

Description of Baseline Concept: From the south, Alternative LRT-4A enters a bored tunnel between Valley Boulevard and the UPRR right-of-way (ROW) and Mission Road. It then curves and proceeds northeasterly until it reaches and continues under Fremont Avenue. South of Huntington Drive, it transitions northeasterly and continues under Fair Oaks Avenue into South Pasadena.

Description of VA Proposal Concept: This proposal suggests that, due to significant cost savings over Alternative LRT-4A, a more detailed assessment of the previously dropped Alternative LRT-4C alignment between Mission Road and Fair Oaks Avenue may be merited. From the south, the LRT alignment crosses over the UPRR ROW and Mission Road on an aerial structure and continues northerly until it transitions to grade at Sheffield Avenue north of Concord Avenue. It then continues along the median of Sheffield Avenue; one adjacent lane in each direction is maintained by widening the roadway up to the edge of the existing detached sidewalks. A station is proposed at the north end of Sheffield Avenue rather than farther south in order to minimize the displacement of residents. The station located between Stockbridge Avenue and Keats Street will have side platforms. The north end of the station may be elevated; from this point the alignment continues on an aerial structure, curving to the northeast over the southbound lanes of Huntington Drive before descending to grade within the median of Huntington Drive. The at-grade alignment continues along the median of Huntington Drive until it transitions to a bored tunnel just west of Fremont Avenue. The tunnel alignment then leaves the Huntington Drive ROW and transitions to Fair Oaks Avenue where it continues underground to South Pasadena.

Advantages:

- Much less costly than Alternative LRT-4A.
- LRT station is sited in the heart of the El Sereno residential community.
- Takes advantage of existing California Department of Transportation (Caltrans) ROW, but does not require relocation of residents.
- Requires less time to construct than the bored tunnel alternative.

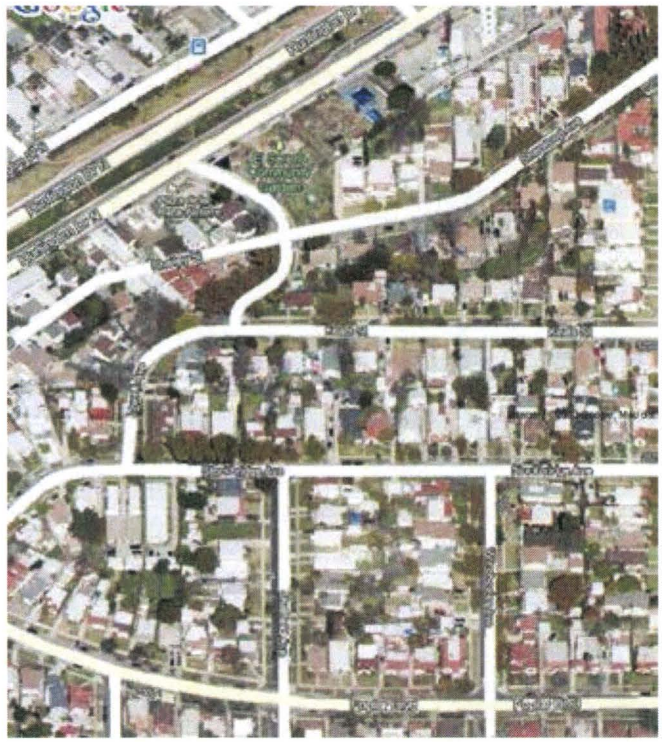
Disadvantages:

- Requires property acquisition for "Sheffield Station" area.
- Omits Alhambra Station and its commercial and retail destination ridership.
- Reduced operating speed through Sheffield Avenue and longer overall travel time than LRT-4A.
- Construction traffic impacts on Huntington Drive from staging of tunnel portal in median.

VA PROPOSAL NO. LRT4

Proposal Title: LRT At-Grade between Mission Road and Fair Oaks Avenue

Discussion: Although the LRT-4C alignment is only 200 feet shorter than LRT-4A between Mission Road and Fair Oaks Avenue, the proposal would greatly reduce the cost of the LRT alternative by maximizing the at-grade alignment sections. While the overall ridership may be less, without the Alhambra Station on Fremont Avenue, it offers another transit option to the El Sereno residential community. Alternative LRT-4C was previously dismissed from further evaluation because a portion of its alignment did not serve transit-supportive destinations, and because operating through an El Sereno residential neighborhood appeared to be an environmental justice issue. The tradeoffs, however, especially in the area of cost-savings, suggest that this alternative merits further review.



Technical Review Comments: Depending on the operations plan, an option to this at-grade VA proposal could be to run a single track along Sheffield Avenue between the aerial touchdown point east of Concord Avenue and the Sheffield Station.

Project Management Considerations: As Alternative LRT-4C was not advanced during preliminary screening, more detailed investigations will need to be conducted to confirm its viability. Conceptual level tasks include the following: review existing traffic patterns along Sheffield Avenue and determine any on-street parking needs; determine if LRT could operate on a single track between the California State University, Los Angeles (Cal State LA) Station and a new Sheffield Station; develop typical at-grade sections along Sheffield Avenue and Huntington Drive; review property acquisition required for the Sheffield Station area and beyond to Huntington Drive; evaluate noise and vibration impacts (and potential mitigation) along Sheffield Avenue; and evaluate potential impacts from constructing an aerial guideway structure over Lowell Avenue and the El Sereno Community Garden. The Community Garden sits on Los Angeles Department of Transportation land and may be a Section 4(f) issue. It may be appropriate to prepare a separate specialized technical report or background study for environmental justice.

Discussion of Schedule Impacts: Construction of a surface alignment would require less time than a bored tunnel alternative.

Discussion of Risk Impacts: Although the Caltrans ROW includes the first row of properties on each side of Sheffield Avenue, and very few residents in the community would be relocated due to the project, environmental justice is an issue that will need to be resolved. Through this stretch of the alignment, other impacts to be evaluated and mitigated as required include potential loss of parking and the placement of aerial structure piers on the El Sereno Community Garden.

Exhibit 1. Performance Ratings

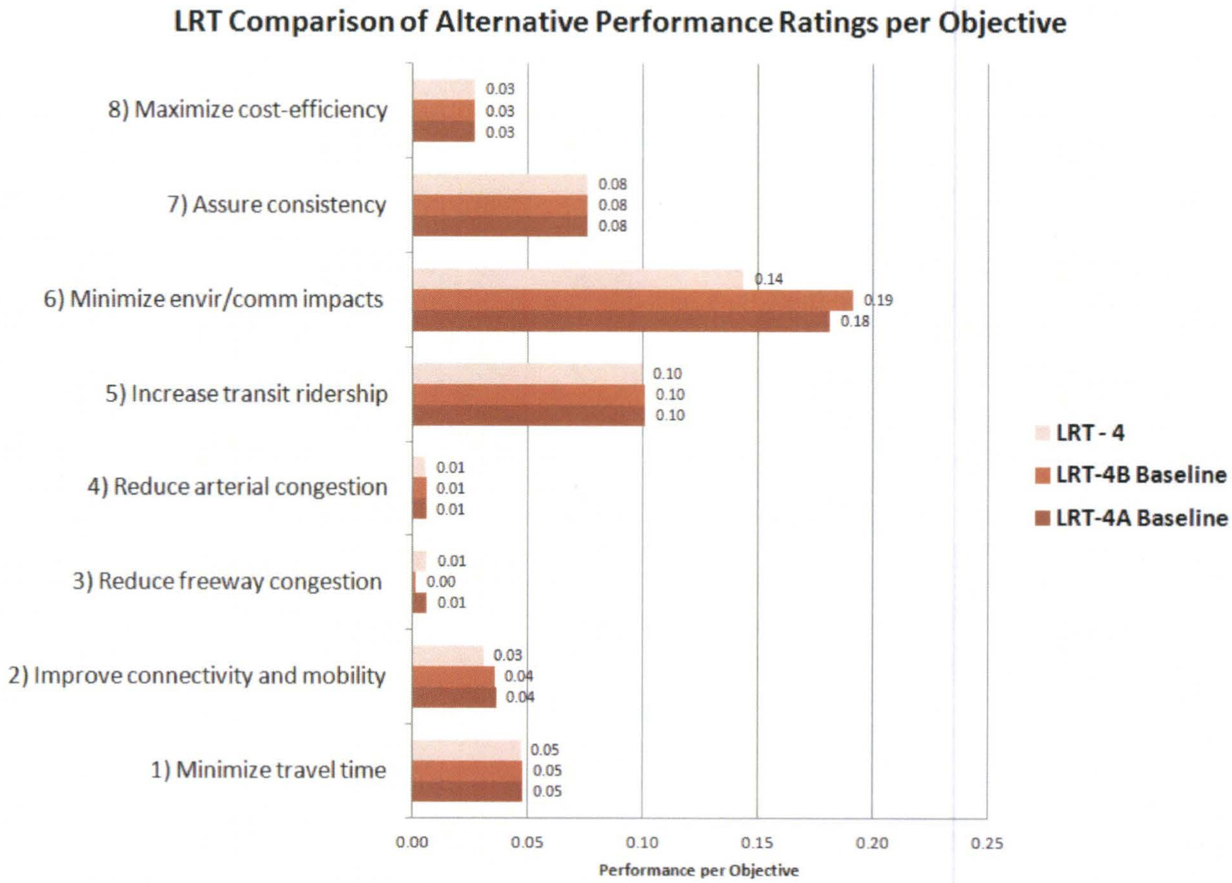


Exhibit 2. Performance Profile

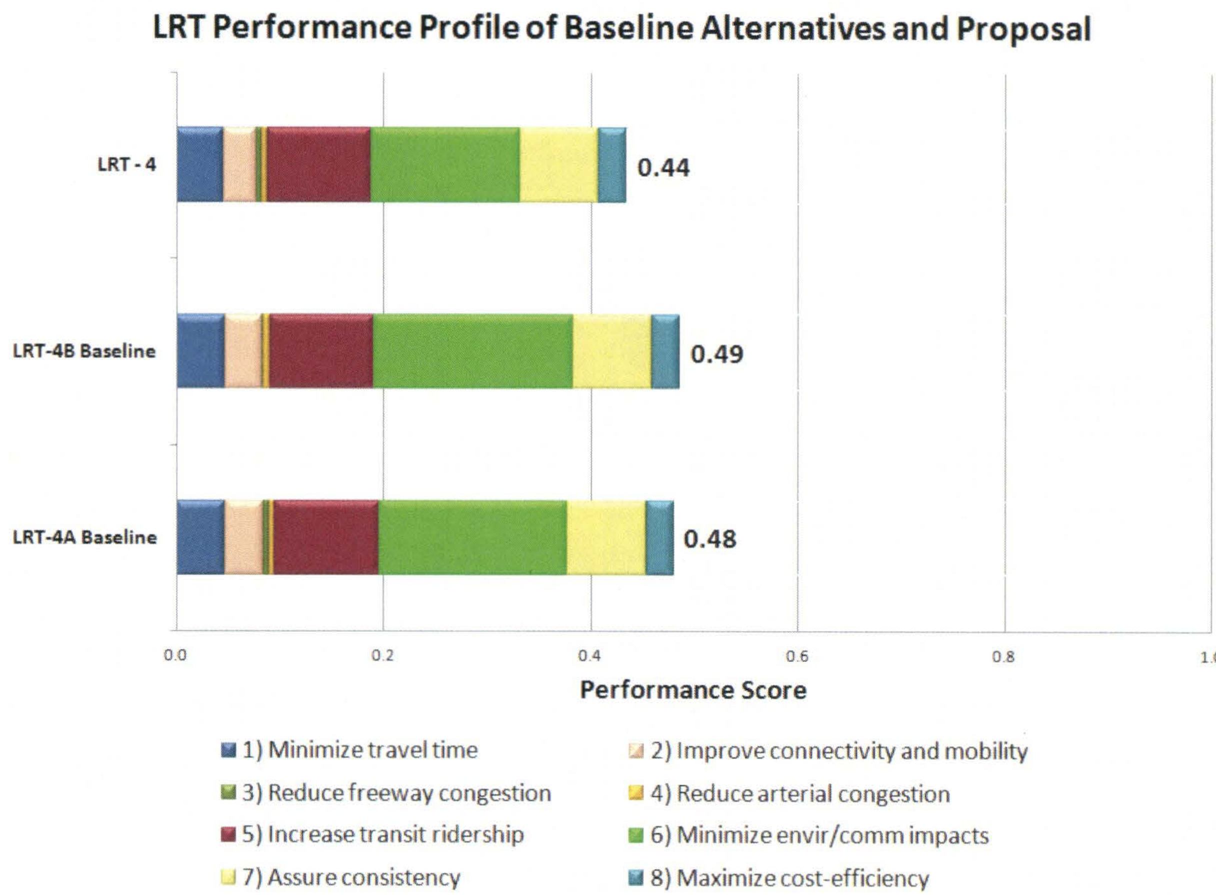


Exhibit 3. Benefit and Cost Performance

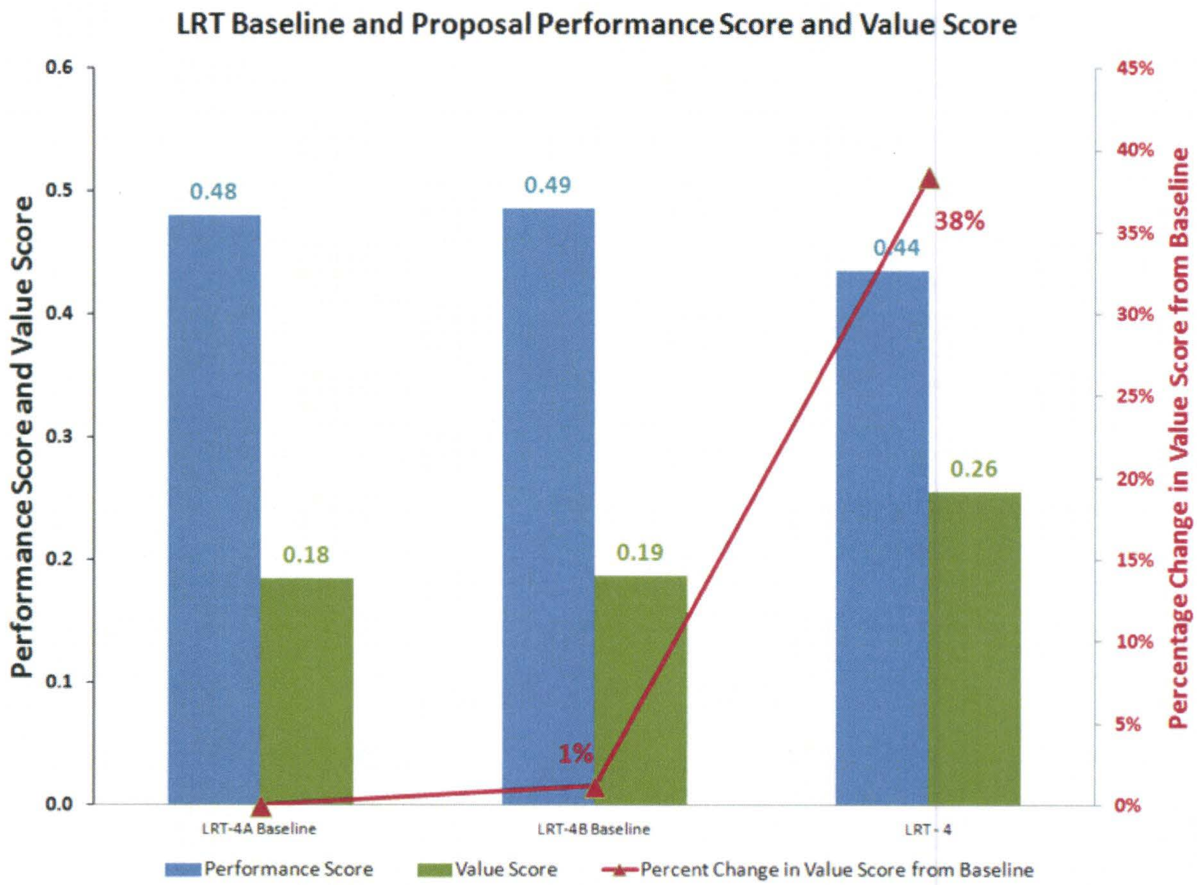


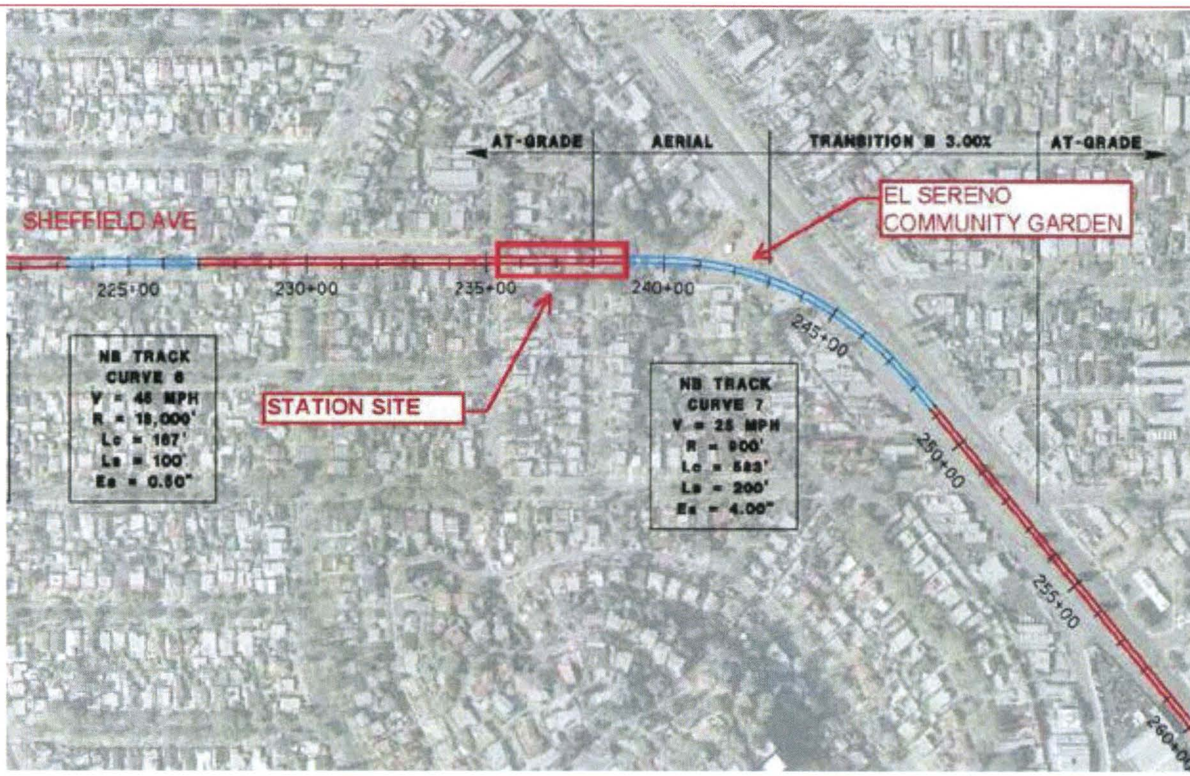
Exhibit 4. Performance Assessment

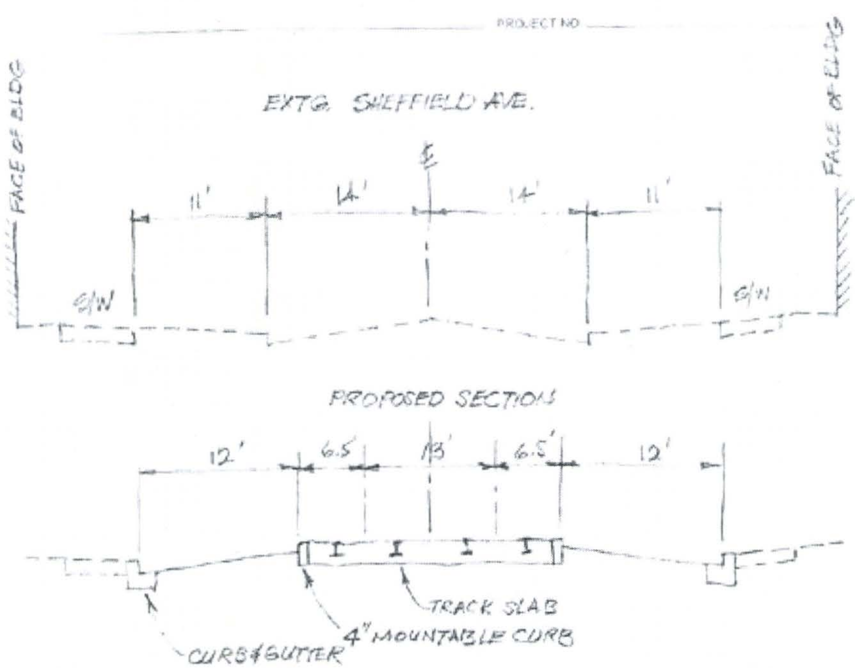
Performance Attributes (Objectives) Evaluation

Objectives	**Comment** (Influence of the VA Proposal upon the Objective)	**Rating** (VA Proposal "Improves Performance" or "No Change" or "Reduces Performance")
Minimize Travel Time	Reduces speed along Sheffield Avenue.	Reduces performance
Improve Connectivity and Mobility	Does not serve commercial and retail destinations like LRT-4A; however, provides transit option to "bedroom" community.	No change
Reduce Congestion on Freeway System	Same as LRT-4A.	No change
Reduce Congestion on Local Street System	Increased impact of at-grade vs. tunnel.	Reduces performance
Increase Transit Ridership	Does not serve commercial and retail, but line and stations are more visible than LRT-4A.	No change
Minimize Environmental and Community Impacts Related to Transportation	Potential impacts from ROW acquisition, noise and vibration, Section 4(f), and environmental justice; most or all could be mitigated.	Reduces performance
Assure Consistency with Regional Plans and Strategies	Similar to LRT-4A.	No change
Maximize Cost Efficiency of Public Investments	Significantly less costly than LRT-4A and likely requires less time for construction.	Improves performance

Exhibit 5. Baseline Concept Sketch

Exhibit 6. VA Proposal Concept Sketch





Sheffield Avenue – Typical Sections

Exhibit 7. Example of LRT in Median

This photograph shows the TriMet LRT in the median of Main Street through the residential area of Hillsboro, Oregon. Although it may not exactly represent the potential LRT on Sheffield Avenue, it offers similar street geometry and traffic functions.

Exhibit 8. Initial Cost Estimates

INITIAL COSTS								ALT. NO.
CONSTRUCTION ELEMENT		*BASELINE CONCEPT*			*VA PROPOSAL CONCEPT*			
Description	**Unit**	**Qty**	**Cost/Unit**	**Total**	**Qty**	**Cost/Unit**	**Total**	
ROADWAY ITEMS								
Roadway Preparation	SF			$ -	80,000	$ 10	$ 800,000	
Curb and Gutter	LF			$ -	7,000	$ 20	$ 140,000	
Roadway Pavement	SF			$ -	80,000	$ 25	$ 2,000,000	
ROADWAY SUBTOTAL				$ -			$ 2,940,000	
ROADWAY MARK-UP	79.5%			$ -			$ 2,337,300	
ROADWAY TOTAL				$ -			$ 5,277,300	
LRT ITEMS								
Guideway: At-grade in Local Street	RF			$ -	3,200	$ 560	$ 1,792,000	
Guideway: At-grade Exclusive ROW	RF			$ -	2,500	$ 480	$ 1,200,000	
Guideway: Aerial Typical Span	RF			$ -	4,000	$ 8,000	$ 32,000,000	
Guideway: Double MSE Walls	RF			$ -	800	$ 2,600	$ 2,080,000	
Track: Direct Fixation	RF	13,200	$ 720	$ 9,504,000	9,800	$ 720	$ 7,056,000	
Track: Embedded	RF			$ -	3,200	$ 920	$ 2,944,000	
At-Grade Station: Side Platform	EA			$ -	1	$ 4,500,000	$ 4,500,000	
Elevator/Escalator	EA	4	$ 250,000	$ 1,000,000			$ -	
Utilities: At-grade in Local Street	RF			$ -	3,200	$ 150	$ 480,000	
LRT Systems: At-grade	RF			$ -	3,200	$ 1,330	$ 4,256,000	
LRT ITEMS SUBTOTAL				$ 10,504,000			$ 56,308,000	
LRT ITEMS MARK-UP	72%			$ 7,531,368			$ 40,372,836	
LRT ITEMS TOTAL				$ 18,035,368			$ 96,680,836	
LRT TUNNEL ITEMS								
Bored Tunnel	RF	13,200	49,600	$ 654,720,000	1,300	49,600	$ 64,480,000	
Transition to Tunnel	RF			$ -	1,200	700	$ 840,000	
Underground Station	EA	1	110,000,000	$ 100,000,000			$ -	
TUNNEL ITEMS SUBTOTAL				$ 754,720,000			$ 65,320,000	
TUNNEL ITEMS MARK-UP	47%			$ 352,454,240			$ 30,504,440	
TUNNEL ITEMS TOTAL				$ 1,107,174,240			$ 95,824,440	
RIGHT-OF-WAY ITEMS								
Right-of-Way Acquisition	LS			$ -	1	$ 25,000,000	$ 25,000,000	
RIGHT-OF-WAY SUBTOTAL							$ 25,000,000	
RIGHT-OF-WAY MARK-UP	25.0%			$ -			$ 6,250,000	
RIGHT-OF-WAY TOTAL				$ -			$ 31,250,000	
TOTAL		$		1,125,209,608	$		229,032,576	
TOTAL (Rounded)				$1,125,210,000	$		229,030,000	
						SAVINGS	**$896,180,000**	

ASSUMPTIONS:

a - Bored tunnel unit cost based on LRT-4A cost estimate, and includes utilities and systems elements.

b - Assumes elimination of "Station 1" in LRT-4A cost estimate, including associated parking.

c - ROW unit costs based on proration of LRT-4A cost estimate, and includes relocaltion, clearance, and title/escrow fees.

d - Assumes ROW savings (2 commercial parcels) from deleted Station 1 parking.

e - Sheffield Station assumes acquisition of 6 residential properties, as well as easements for aerial guideway.

f - Subsequent annual cost for life-cycle estimate based on being similar to Alternative LRT-4B in operation (slightly slower, but fewer curves), but 2400 feet shorter.

Proposal Title: LRT At-Grade between Mission Road and Fair Oaks Avenue

Exhibit 9. Life-Cycle Cost Estimate

LIFE-CYCLE COSTS					ALT. NO.
Life-Cycle Period 50 Years		Real Discount Rate	3.00%	**BASELINE**	**VA PROPOSAL**
A. INITIAL COST				$2,600,000,000	$1,704,000,000
Service Life - Baseline Years Service Life - Alternative Years		**INITIAL COST SAVINGS:**			**$ 896,000,000**
B. SUBSEQUENT ANNUAL COSTS					
1. Maintenance and Inspection					
2. Operating					
3. Energy					
			Total Subsequent Annual Costs:	$ 35,984,000	$ 39,652,000
			Present Value Factor (P/A):	25.730	25.730
			PRESENT VALUE OF SUBSEQUENT ANNUAL COSTS (Rounded):	**$ 925,860,000**	**$ 1,020,237,000**
C. SUBSEQUENT SINGLE COSTS	**Year**	**Amount**	**PV Factor**	**Present Value**	**Present Value**
			1.00000	$ -	
			1.00000		$ -
			1.00000	$ -	
			1.00000		$ -
			1.00000	$ -	
			1.00000		$ -
			1.00000	$ -	
			1.00000		$ -
			PRESENT VALUE OF SUBSEQUENT SINGLE COSTS (Rounded):	**$ -**	**$ -**
D. TOTAL SUBSEQUENT ANNUAL AND SINGLE COSTS (B+C)				**$ 925,860,000**	**$ 1,020,237,000**
E.			**TOTAL SUBSEQUENT COSTS SAVINGS:**		**$ (94,377,000)**
F. TOTAL PRESENT VALUE COST (A+D)				**$ 3,525,860,000**	**$ 2,724,237,000**
				TOTAL LIFE-CYCLE SAVINGS:	**$ 801,623,000**

VA PROPOSAL NO. LRT4

Proposal Title: LRT At-Grade between Mission Road and Fair Oaks Avenue

Assumptions and Calculations: (---)

VA PROPOSAL NO. LRT5

Proposal Title: Hybrid LRT-4A/LRT-6 Alternative to Provide At-Grade LRT along Atlantic Boulevard

Initial Cost Savings:	$576,000,000
Future Cost Savings:	$215,000,000
Net LCC Savings:	$791,000,000
Change in Schedule:	None
Performance Change:	-13 % (LRT-4A)
	-14 % (LRT-4B)
Value Change:	+12 % (LRT-4A)
	+10 % (LRT-4B)

Description of Baseline Concept: Four Light Rail Transit (LRT) alternatives are described within the Value Analysis (VA) Report: Alternatives LRT 4A, 4B, 4D, and 6. Three of the four alternatives follow a similar route in the south – with an elevated section along the SR 710 alignment from the southern terminus to Mission Road. North of Mission Road the three alternatives are in either a bored tunnel or a cut-and-cover tunnel; the fourth alternative (LRT-6) is at-grade over most of the alignment, except for an elevated section crossing I-10.

Of the four LRT alternatives, Alternative LRT-6 is reported in the Alternative Analysis Report to be the least desirable, mainly because of limited right-of-way (ROW) along Atlantic Boulevard between Valley Boulevard and Huntington Drive. The limited ROW within this section is shown in the map below as the yellow zone requiring mixed-flow traffic for the Bus Rapid Transit (BRT). This section has insufficient roadway width to accommodate exclusive BRT lanes. A similar situation applies for use of an LRT on Atlantic Boulevard.

Figure 1. Requirements for mixed flow use in BRT

In addition to the proximity of commercial and residential structures along Atlantic Boulevard, historic structures and community services are identified along this alignment. Because of the limited ROW along Atlantic Boulevard, the estimate for Alternative LRT-6 includes a large cost for ROW acquisition. Although Alternative LRT-6 is one of four alternatives being considered in the Alternative Analysis Report, because of the high ROW costs and the impacts to historic and community facilities, it is identified by the design team as "clearly inferior."

VA PROPOSAL NO. LRT5

Proposal Title: Hybrid LRT-4A/LRT-6 Alternative to Provide At-Grade LRT along Atlantic Boulevard

Description of VA Proposal Concept: Combine Alternative LRT-4A and Alternative LRT-6 to create a hybrid alternative (Proposal LRT-5) that involves elevated structures south of Mission Road and an at-grade alignment along Atlantic Boulevard, Huntington Drive, and Fair Oaks Avenue north of Mission Road.

Advantages:

- Eliminates tunnel for entire alignment, thereby saving significant costs.
- Takes advantage of SR 710 ROW south of Mission Road, thereby reducing most conflicts with existing structures from the southern terminus to Mission Road.
- Provides visibility and simple at-grade access along Atlantic Boulevard, Huntington Drive, and Fair Oaks Avenue.
- Enhances user safety from aboveground entrance and exit.
- Serves local community along the route.
- Provides good connection between the Gold Line in the north, and south through a highly urbanized route.
- Offers potential for long-term best value to the community.

Disadvantages:

- Requires acquisition of multiple commercial and residential structures along Atlantic Boulevard.
- Results in significant disruption to local community along Atlantic Boulevard during construction.
- Will likely meet significant opposition along the route from all local communities.
- Creates a barrier for cross-traffic along Atlantic where the LRT crosses streets.
- Slows transit time because of at-grade travel in an urban setting.
- Increases potential for collisions between LRT vehicles and vehicles operating on streets.
- Limited benefit in terms of meeting original "closing the gap" objectives by not providing freeway connection between I 210 and SR 710.

Discussion: This VA proposal reduces construction costs and improves local transit by eliminating the tunnel section north of Mission Road. To accomplish this proposal, it will be necessary to purchase commercial and residential structures along Atlantic Boulevard. Most structures between Mission Road and Alhambra Road are commercial (with many parking areas and auto sales lots) or have enough frontage that could accommodate a 30-foot (minimum) property take. However, the proposed alignment between Alhambra Road and Huntington Drive has many residential structures. These residential structures – some of which are historic – would have to be relocated to other property or demolished. (To preserve as many of the historic structures as practical, they might be relocated to an existing, nearby commercial property to form a high-value historic residential area.) Beyond Huntington Drive, the alignment appears to be wide enough to accommodate the 30-foot width to operate an LRT.

VA PROPOSAL NO. LRT5

Proposal Title: Hybrid LRT-4A/LRT-6 Alternative to Provide At-Grade LRT along Atlantic Boulevard

The at-grade option north of Mission Road is identified as an alternative to current tunnel alignments as both a cost-saving measure and a transit enhancement. The baseline alternative (LRT-4A) places the LRT in a bored tunnel north of Mission Road. The length of this tunneled section is approximately 4 miles with a project cost estimate of approximately $1.3 billion. Costs for purchase, relocation, demolition, and assistance with relocation along Atlantic Boulevard are estimated to be approximately $867 million based on ROW acquisition from the Alternative LRT-6 cost estimate ($681 million) and the Alternative LRT-4A cost ($186 million after removing tunnel easement). This cost includes a 25 percent contingency for ROW purchase. The net savings appears to be at least $400 million (e.g., $1.3 billion - $867 million). No effort has been made to account for reduction in ROW costs between the terminus at Pomona and Mission Road in this estimate. At least some additional ROW savings are expected from ROW costs in Alternative LRT-6.

In addition to providing potential cost savings, Proposal LRT-5 (Hybrid LRT-4A/LRT-6) offers significant long-term benefits to the local community by providing a direct link to the Gold Line at the north and south terminus of the proposed alignment. Further, the alignment provides service to California State University, Los Angeles (Cal State LA), and to the commercial district along Atlantic Boulevard; this service is expected to increase development of and revenue to businesses along the route. The alignment also acts as a natural feeder line for people using Mission Road, Huntington Drive, and I-10 who want to access South Pasadena and other areas along the Gold Line LRT system.

As a further cost savings measure and system enhancement to Proposal LRT-5, the north terminus could be stopped at either of two locations:

- 110 Freeway Terminus: This location would be close to the intersection with the Gold Line and would not run north to Fillmore Station (see Proposal LRT-3), potentially saving the cost of an expensive undercrossing of the 110 freeway and the Gold Line.
- Mission Street Terminus: This location would turn the at-grade alignment westward at Mission Street, stopping at the Gold Line Station at Mission Street (see Proposal LRT-6).

Technical Review Comments: An LRT alignment along Atlantic Boulevard provides maximum long-term transit benefits to the local area. As shown in the map below, the alignment is consistent with Metro's vision of transit within the area by connecting the current Gold Line and serving future LRT 3 alignment along Alhambra Road. Further, Proposal LRT-5 passes through a major commercial and residential area without current, high-efficiency mass transit.

VA PROPOSAL NO. LRT5

Proposal Title: Hybrid LRT-4A/LRT-6 Alternative to Provide At-Grade LRT along Atlantic Boulevard

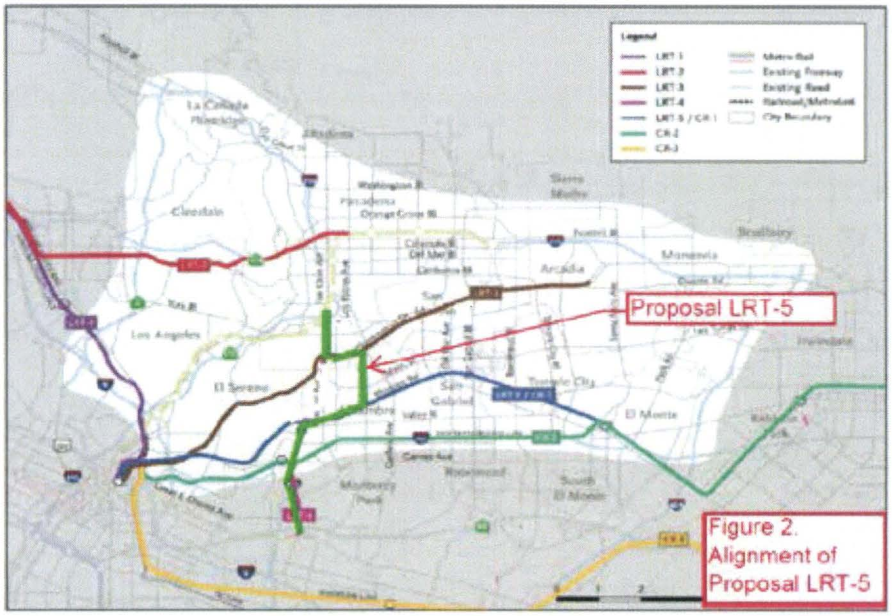


Figure 2. Alignment of Proposal LRT-5

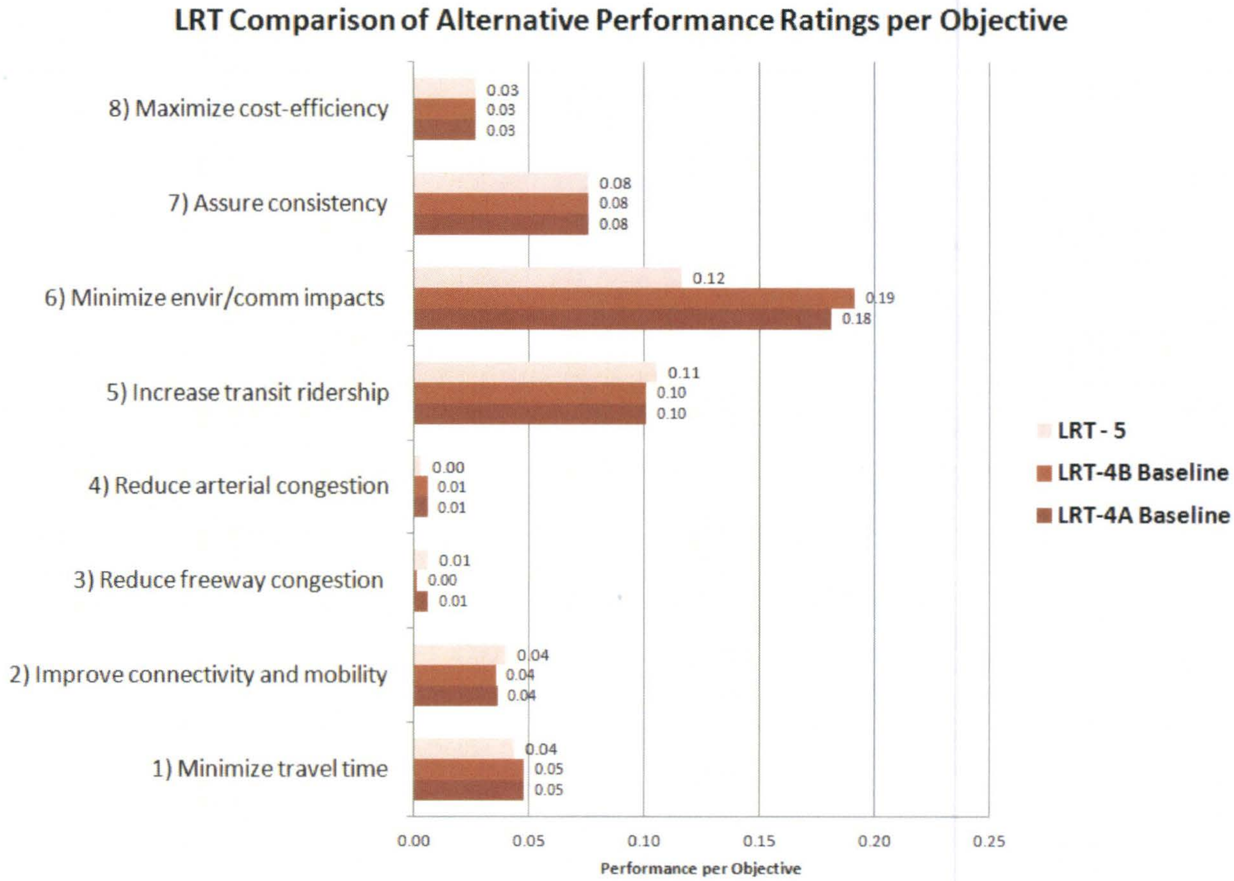
Project Management Considerations: The major hurdle for Proposal LRT-5 is an at-grade LRT along Atlantic Boulevard, Huntington Drive, and Fair Oaks Avenue. The project team concluded that the removal or relocation of structures along this section of Atlantic Boulevard led to an "inferior" rating. However, a street "fly-through" of this section of the alignment using Google Earth suggests that the property takes are not out of the question, and with a creative approach, possibly involving relocation of historic residential structures, Proposed LRT-5 is possible.

There is no question that Proposal LRT-5 would involve a number of significant challenges – relative to acquisition and demolition of existing commercial structures, relocation of historic houses, and local opposition to at-grade mass transit. However, the long-term benefits relative to cost savings, schedule enhancements, and future ridership suggest that this option should be reconsidered by the project team to confirm that this alternative is not viable. The reassessment should involve detailed evaluation of properties along the route, as well as review of long-term benefits to the businesses and those living along the alignment.

Discussion of Schedule Impacts: It is not clear whether Proposal LRT-5 would involve any increases or decreases in schedule. Clearly, property takes along the alignment, as well as the relocation of residential structures, will increase the schedule. However, construction of an at-grade alternative north of Mission Road will be much faster than the schedule required to tunnel beneath the area. The design schedule for the at-grade section also will be shorter.

Discussion of Risk Impacts: The primary risk of Proposal LRT-5 involves the acquisition of property along Atlantic Boulevard. If properties cannot be acquired, then this alternative is not viable. Even if properties can be acquired, the risk is that the price of acquisition could exceed the cost of tunneling.

Exhibit 1. Performance Ratings



Proposal Title: Hybrid LRT-4A/LRT-6 Alternative to Provide At-Grade LRT along Atlantic Boulevard

Exhibit 2. Performance Profile

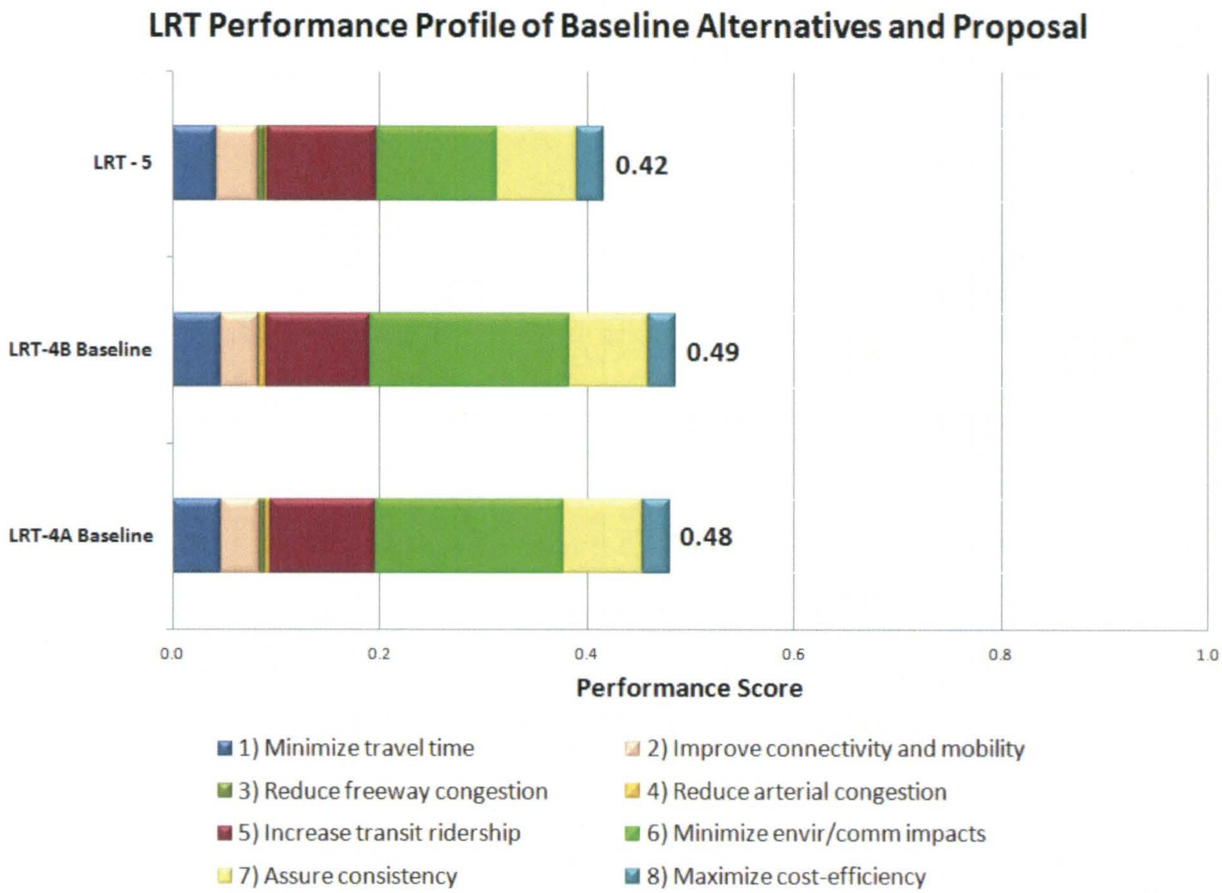


Exhibit 3. Benefit and Cost Performance

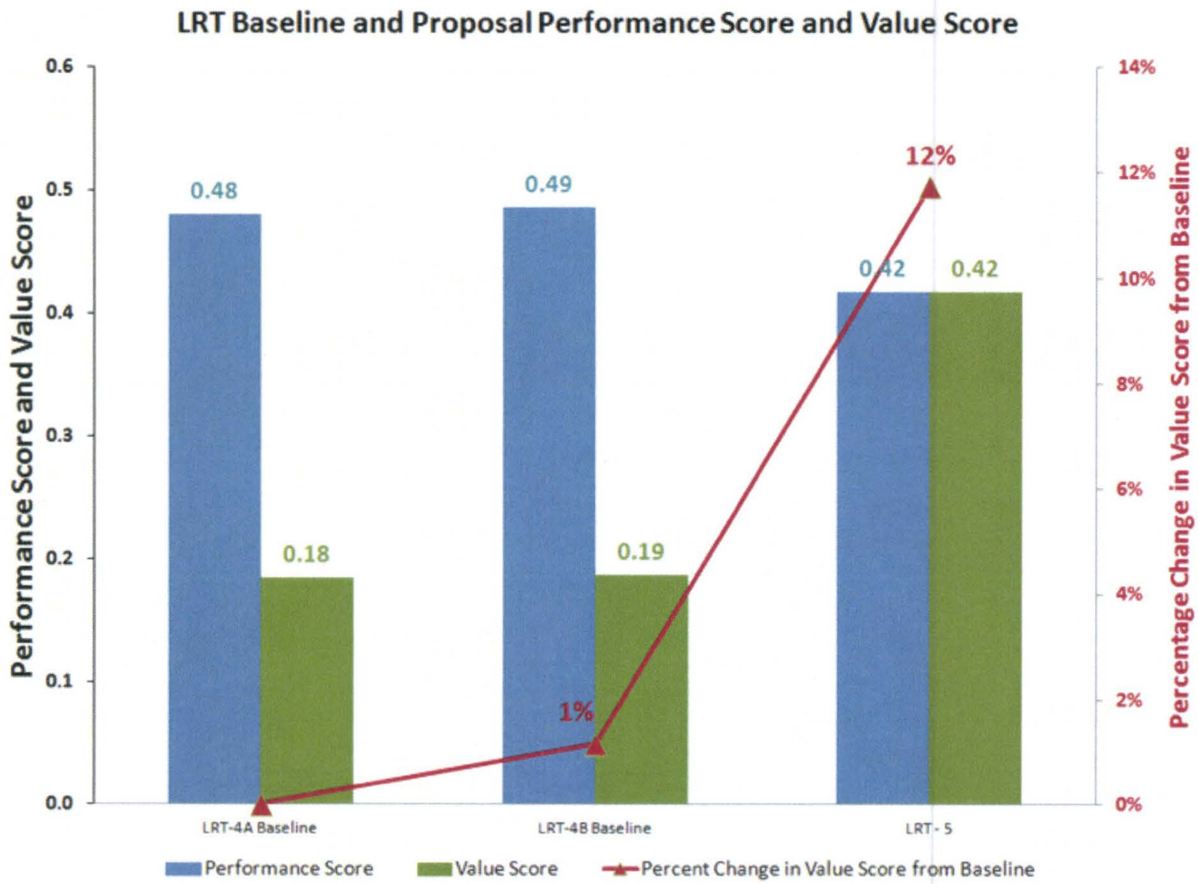
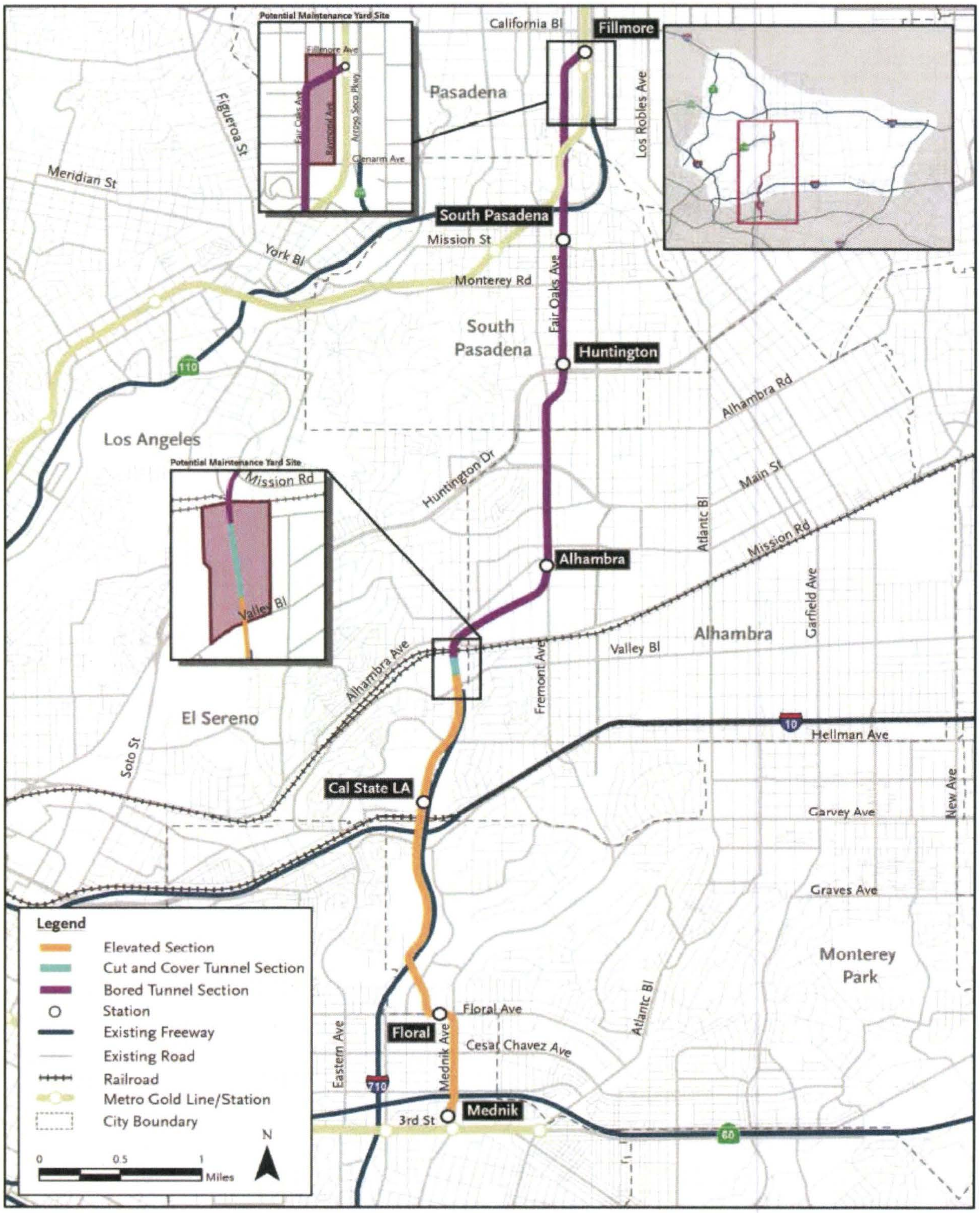


Exhibit 4. Performance Assessment

Performance Attributes (Objectives) Evaluation

Objectives	**Comment** (Influence of the VA Proposal upon the Objective)	**Rating** (VA Proposal "Improves Performance" or "No Change" or "Reduces Performance")
Minimize Travel Time	Longer than LRT in a tunnel.	Improves performance relative to existing conditions. Reduces performance relative to baseline LRT-4A.
Improve Connectivity and Mobility	More local access: visible system that people working or residing in the area can use. Avoids continued reliance on freeways to provide connectivity.	Improves performance relative to existing conditions. Improves performance relative to baseline LRT-4A because of better accessibility.
Reduce Congestion on Freeway System	No significant benefit to people wanting to travel from I 210 to SR 710 or vice versa. Could reduce use of freeway by people switching to mass transit.	No change relative to baseline LRT-4A.
Reduce Congestion on Local Street System	Would offer transit as a choice to local drivers and potential cut-through traffic.	Improves performance relative to existing conditions. Improves performance relative to baseline LRT-4A because of better accessibility.
Increase Transit Ridership	Offers reliable transit and connectivity via surface alternative.	Improves performance relative to existing conditions. Improves performance relative to baseline LRT-4A because of better accessibility.
Minimize Environmental and Community Impacts Related to Transportation	Will improve air quality (better than BRT and far better than freeway) and travel experience on local streets; requires ROW acquisition.	Improves performance relative to existing conditions. No change relative to baseline LRT-4A.
Assure Consistency with Regional Plans and Strategies	Regional plans and strategies promote increasing mobility, reducing congestion, and increasing transit use within the area.	Improves performance relative to existing conditions. No change relative to baseline LRT-4A.
Maximize Cost Efficiency of Public Investments	Lower capital cost than LRT in tunnel and similar in operating and maintenance cost to other LRT alternatives.	Improves performance relative to existing conditions. Improves performance relative to baseline LRT-4A.

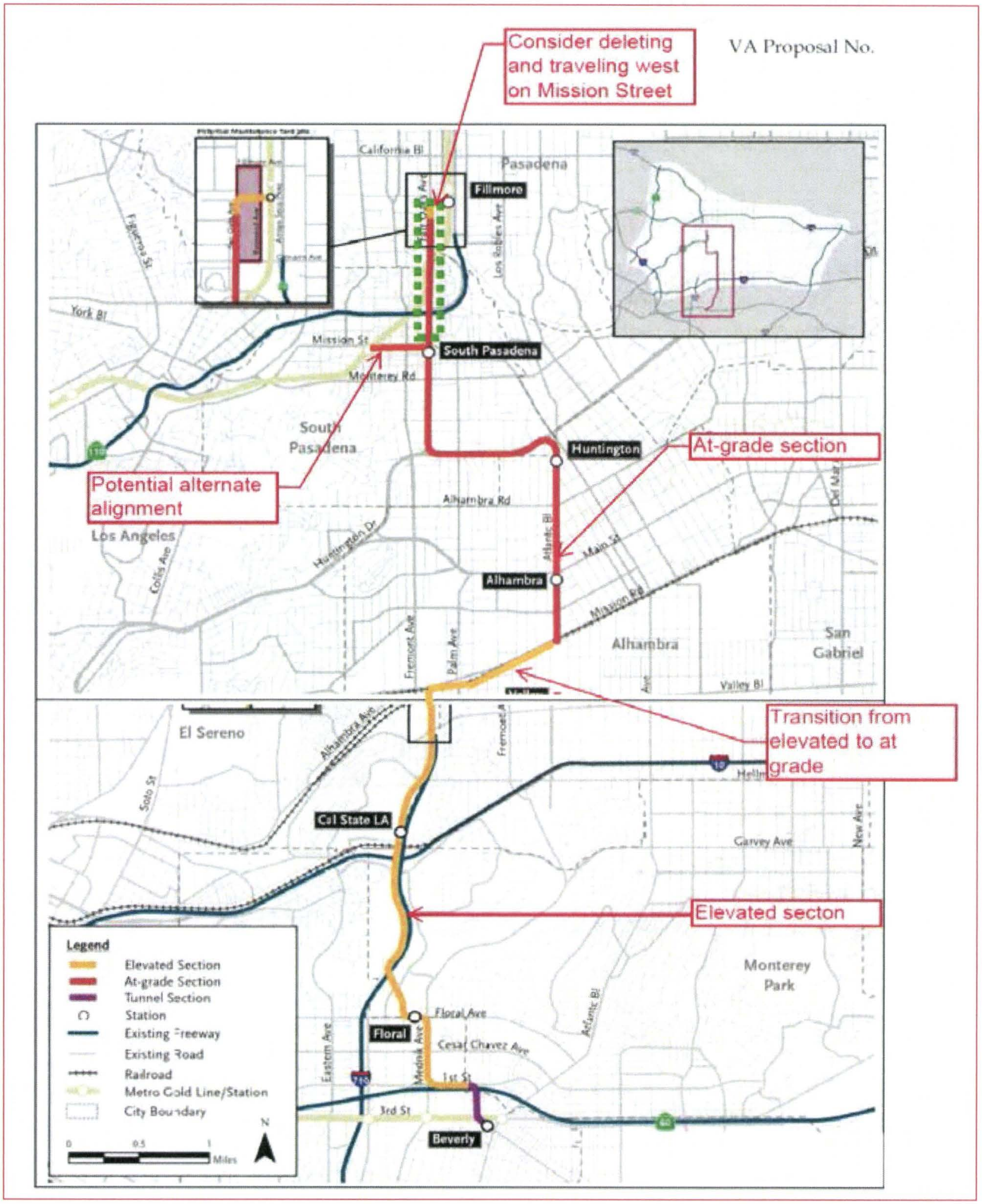
Exhibit 5. Baseline Concept Sketch



VA PROPOSAL NO. LRT5

Proposal Title: Hybrid LRT-4A/LRT-6 Alternative to Provide At-Grade LRT along Atlantic Boulevard

Exhibit 6. VA Proposal Concept Sketch



Proposal Title: Hybrid LRT-4A/LRT-6 Alternative to Provide At-Grade LRT along Atlantic Boulevard

Exhibit 7. Initial Cost Estimates, Proposal LRT-5

INITIAL COSTS							ALT. NO. Proposal LRT-5
CONSTRUCTION ELEMENT		*BASELINE CONCEPT*			*VA PROPOSAL CONCEPT*		
Description	**Unit**	**Qty**	**Cost/Unit**	**Total**	**Qty**	**Cost/Unit**	**Total**
TUNNEL ITEMS							
LRT Stations (4)		1	$ 420,000,000	$ 420,000,000	4	$ -	$ -
LRT Tunnel and Ventilation		1	$ 1,471,000,000	$ 1,471,000,000	1	$ -	$ -
TUNNEL SUBTOTAL				*$ 1,891,000,000*			$ -
TUNNEL MARK-UP				$ -			$ -
TUNNEL TOTAL				*$ 1,891,000,000*			$ -
NON-TUNNEL TRANSIT ITEMS							
				$ -	1	$ -	$ -
Support Faciity Heavy Maintenance		1	$ 60,000,000	$ 60,000,000	1	$ 60,000,000	$ 60,000,000
LRT Vehicles, Mob, Cont, Electrical		1	$ 439,000,000	$ 439,000,000	1	$ 1,017,000,000	$ 1,017,000,000
At-grade Stations		0	$ 20,000,000	$ -	4	$ 20,000,000	$ 80,000,000
Roadway Items		1	$ 19,000,000	$ 19,000,000			$ -
STRUCTURE SUBTOTAL				*$ 518,000,000*			*$ 1,157,000,000*
STRUCTURE MARK-UP				$ -			$ -
STRUCTURE TOTAL				*$ 518,000,000*			*$ 1,157,000,000*
RIGHT-OF-WAY ITEMS							
Right-of-Way Acquisition		1	$ 191,000,000	$ 191,000,000	1	$ 867,000,000	$ 867,000,000
				$ -			$ -
				$ -			$ -
				$ -			$ -
				$ -			$ -
RIGHT-OF-WAY TOTAL				*$ 191,000,000*			*$ 867,000,000*
ENVIRONMENTAL MITIGATION ITEMS							
				$ -			$ -
				$ -			$ -
CAPITAL OUTLAY SUPPORT ITEMS							
Reengineering and Redesign				$ -			$ -
Project Engineering				$ -			$ -
TOTAL				$2,600,000,000			$2,024,000,000
TOTAL (Rounded)				$2,600,000,000			$2,024,000,000
						SAVINGS	**$576,000,000**

Assumptions
1) LRT Vehicles, Mob, Cont, and electrical includes structual guideways
2) Deleted tunnel , tunnel ventilation, and tunnel stations
3) Added 4 at-grade stations at $20 million each
4) Assume that Support Facilities same for LRT-5 and baseline
5) Forced baseline estimate to match value developed by design team
6) Assume LRT items same as LRT-6 less 4 stations at $20 million each (added back in as separate line item)
7) Determine right-of-way cost by adding cost of LRT-4A ($186m after removing tunnel composent) to cost for LRT-6 ($681m)

Exhibit 8. Life-Cycle Cost Estimates

LIFE-CYCLE COSTS				ALT. NO. Proposal LRT-5
Life-Cycle Period 50 Years		Real Discount Rate	**BASELINE**	**VA PROPOSAL**
A. INITIAL COST			$2,600,000,000	$2,024,000,000
Service Life - Baseline 50 Years Service Life - Alternative 50 Years		**INITIAL COST SAVINGS:**		**$ 576,000,000**
B. SUBSEQUENT ANNUAL COSTS				
1. Maintenance and operational costs			$ 35,984,000	$ 50,000,000
Total Subsequent Annual Costs:			$ 35,984,000	$ 50,000,000
Present Value Factor (P/A):			25.730	25.730
PRESENT VALUE OF SUBSEQUENT ANNUAL COSTS (Rounded):			**$ 925,860,000**	**$ 1,286,488,000**
C. SUBSEQUENT SINGLE COSTS	**Year**	**Amount**	**Present Value**	**Present Value**
			$ -	
				$ -
			$ -	
				$ -
			$ -	
				$ -
			$ -	
				$ -
PRESENT VALUE OF SUBSEQUENT SINGLE COSTS (Rounded):			**$ -**	**$ -**
D. TOTAL SUBSEQUENT ANNUAL AND SINGLE COSTS (B+C)			**$ 925,860,000**	**$ 1,286,488,000**
E. TOTAL SUBSEQUENT COSTS SAVINGS:				**$ (360,628,000)**
F. TOTAL PRESENT VALUE COST (A+D)			**$ 3,525,860,000**	**$ 3,310,488,000**
TOTAL LIFE-CYCLE SAVINGS:				**$ 215,372,000**

Assumptions

1) Assumed O&M for hybrid LRT-5 would be similar to LRT-6 ($72m/year) but adjusted to run only 45 LRV's
2) Compute annual O&M as 45/65 * $72m/yr = $50m/year

VA PROPOSAL NO. LRT5

Proposal Title: Hybrid LRT-4A/LRT-6 Alternative to Provide At-Grade LRT along Atlantic Boulevard

Assumptions and Calculations: (---)

VA PROPOSAL NO. LRT6

Proposal Title: Shortened Tunnel per LRT-4A Alternative – Mission Street Option

Initial Cost Savings:	$262,000,000
Future Cost Savings:	$320,000,000
Net LCC Savings:	$582,000,000
Change in Schedule:	None
Performance Change:	+3 % (LRT-4A)
	+2 % (LRT-4B)
Value Change:	+15 % (LRT-4A)
	+13 % (LRT-4B)

Description of Baseline Concept: Alternative LRT-4A travels from the Mednik Station at the Gold Line in the south, north along SR 710 as an elevated alignment, drops into a cut-and-cover tunnel just north of Valley Boulevard, and then transitions into a bored tunnel. The bored tunnel section runs north beneath Fair Oaks Avenue and finally terminates at the Fillmore Station in Pasadena. Nearly a mile of the north portion of Alternative LRT-4A is parallel to and just west of the Gold Line.

A grade separation crossing will be required at two locations for Alternative LRT-4A. The first occurs at the undercrossing of Arroyo Seco Parkway (SR 110); the second occurs at the undercrossing of the Gold Line. To provide sufficient clearance beneath SR 110, the base of the tunnel will need to be roughly 70 to 80 feet below the existing ground surface. The terminus of LRT-4A is approximately a mile north of the Gold Line undercrossing.

Description of VA Proposal Concept: Reduce the length of tunneling for LRT-4A by turning the tunnel west at Mission Street and ending the proposed alternative where the Gold Line crosses Mission Street.

Advantages:

- Shortens tunnel by over 1 mile, thereby saving significant costs.
- Eliminates redundancy between the Gold Line and LRT-4A north of SR 110.
- Provides equal connectivity to the Gold Line in the north and south.
- Maintains alignment through a highly urbanized area.

Disadvantages:

- Terminates LRT-4A in a more congested area of Pasadena.
- Requires access from the end of the proposed tunnel to the Mission Street Station.
- Requires subsurface easements.
- May require a new parking structure if the existing parking at Mission Street is inadequate.

Discussion: This VA proposal reduces construction costs by terminating the north end of Alternative LRT-4A at the Gold Line on Mission Street. This change saves approximately two-thirds of a mile of tunnel construction, and eliminates the duplication of LRT services along the north end of the alignment between the undercrossing of SR 110 and the Fillmore Station. The net cost of tunneling is roughly $450 million per mile of bored tunnel (e.g., $1.471 billion for tunnel and ventilation over a distance of approximately 3.25 miles), based on tunneling costs provided by the design team. By reducing the tunnel length by two-thirds of a mile, nearly $300 million is potentially saved. Details of this option are shown in Exhibit 1.

Proposal Title: Shortened Tunnel per LRT-4A Alternative – Mission Street Option

Technical Review Comments: Additional studies will be required to determine whether the proposed terminus on Mission Street is technically feasible. This revised alignment requires a 90-degree turn of the tunnel from beneath Fair Oaks Avenue to beneath Mission Street. The radius of the turn will likely require going under an existing building and may require special tunneling methods (e.g., Sequential Excavation Method) because of the sharpness of the turn. The remainder of the alignment would be located beneath Mission Street. A pedestrian tunnel or access to Mission Street level will be required to connect the terminus of Proposal LRT6 to the existing Mission Street station.

An underground easement will be required if the tunnel goes under the existing, single-story bank on the corner of Fair Oaks Avenue and Mission Street. Another alternative is to purchase the building during construction and sell it after the LRT system is operating.

The area appears to have some space for construction staging; however, a focused reconnaissance is required to confirm conditions near the Gold Line on Mission Street. As noted above, a parking facility may be needed to support the increased use of the Mission Street Station.

Project Management Considerations: The main project management consideration is whether there are technical and economic advantages of ending the LRT-4A Alternative short of the Fillmore Station. Although the concept avoids the cost of nearly 1 mile of tunneling, it could have undefined logistics problems, and these may offset any savings. This option does not affect headways on the Gold Line, and does not require a new transit station. From a VA perspective, Proposal LRT-6 would seem to warrant further consideration by the design team.

Discussion of Schedule Impacts: There are no significant differences in schedule. A shorter tunnel will result in shorter construction duration; however, the time savings could be offset by more difficult logistics at the alternate terminus. The design schedule would be comparable to the baseline LRT-4A Alternative.

Discussion of Risk Impacts: The main risk associated with the proposal is construction impacts at the terminus. There also will be risks from effects of tunneling along Mission Street. These could include vibrations and increased construction traffic. The duration of these risks would, however, be limited.

Exhibit 1. VA Proposal LRT6

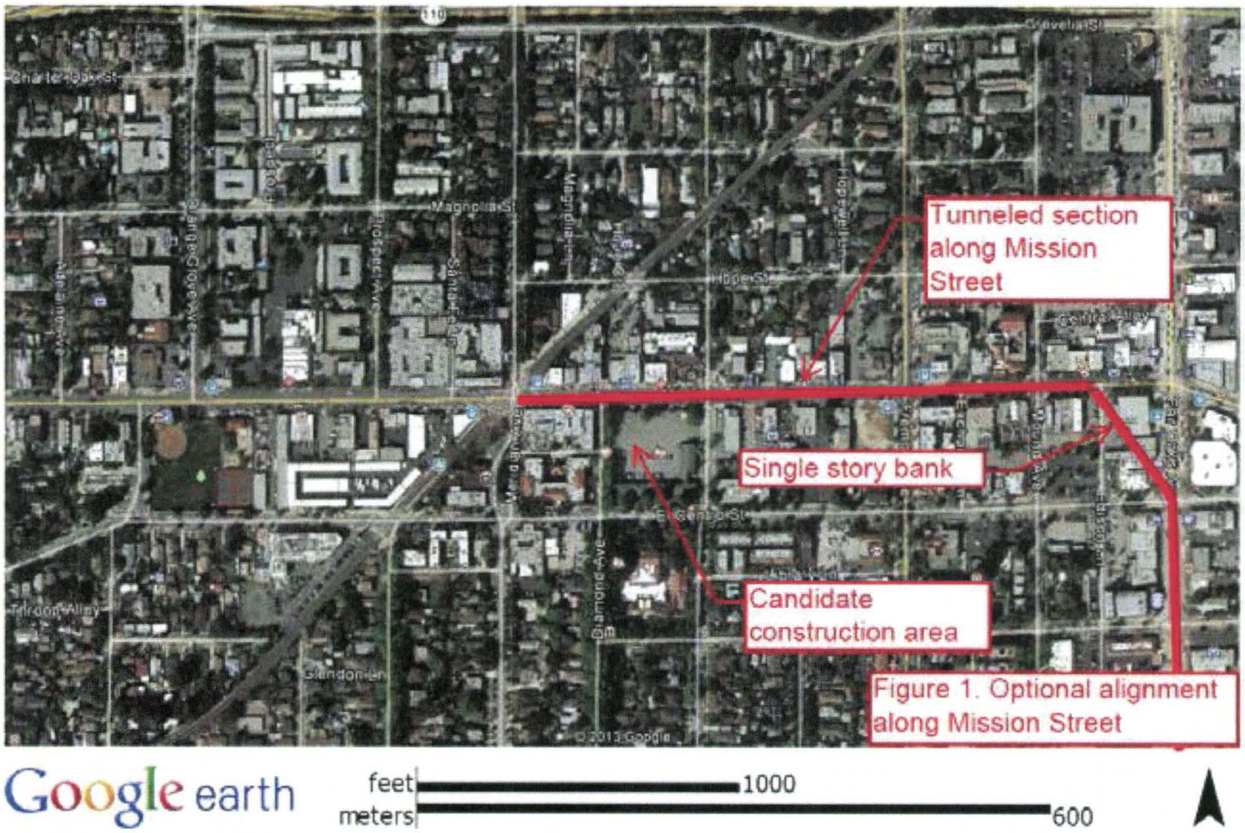


Exhibit 2. Performance Ratings

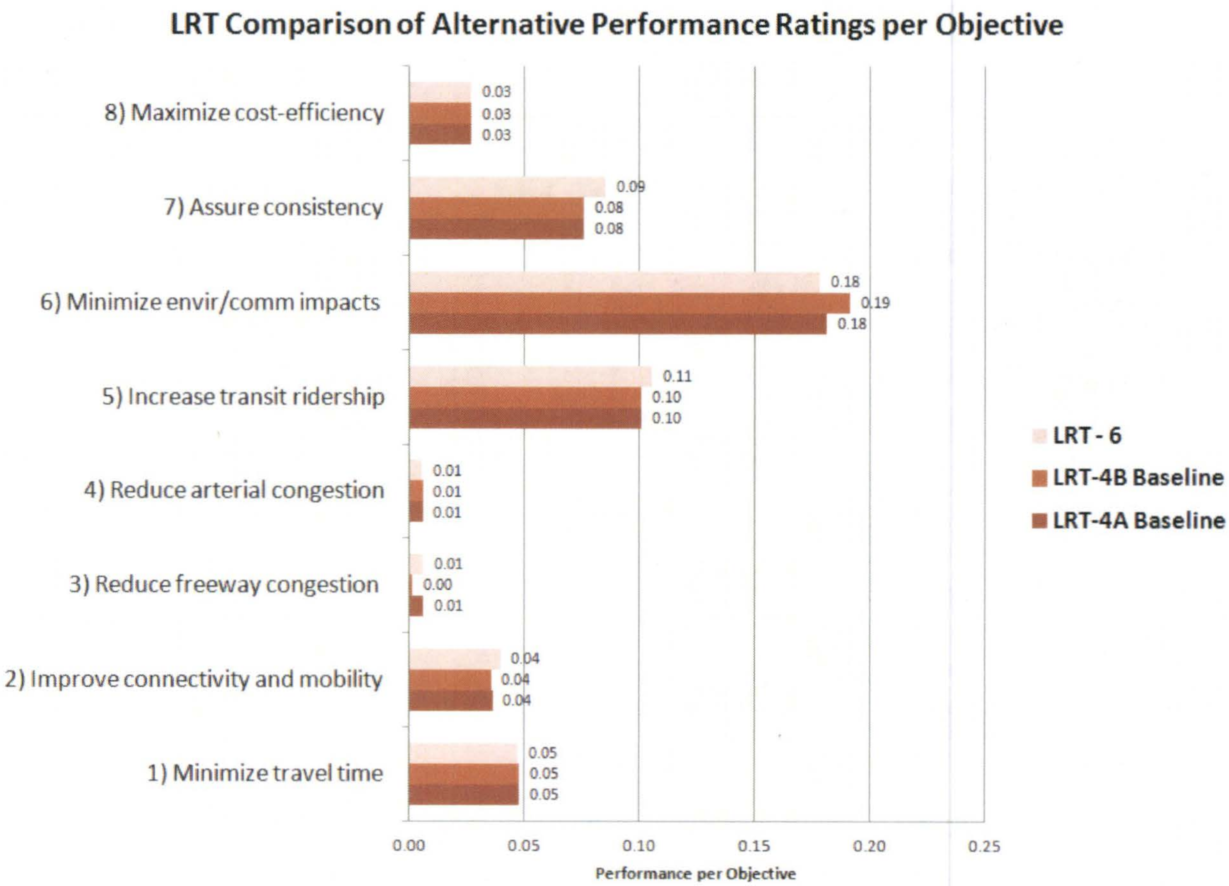


Exhibit 3. Performance Profile

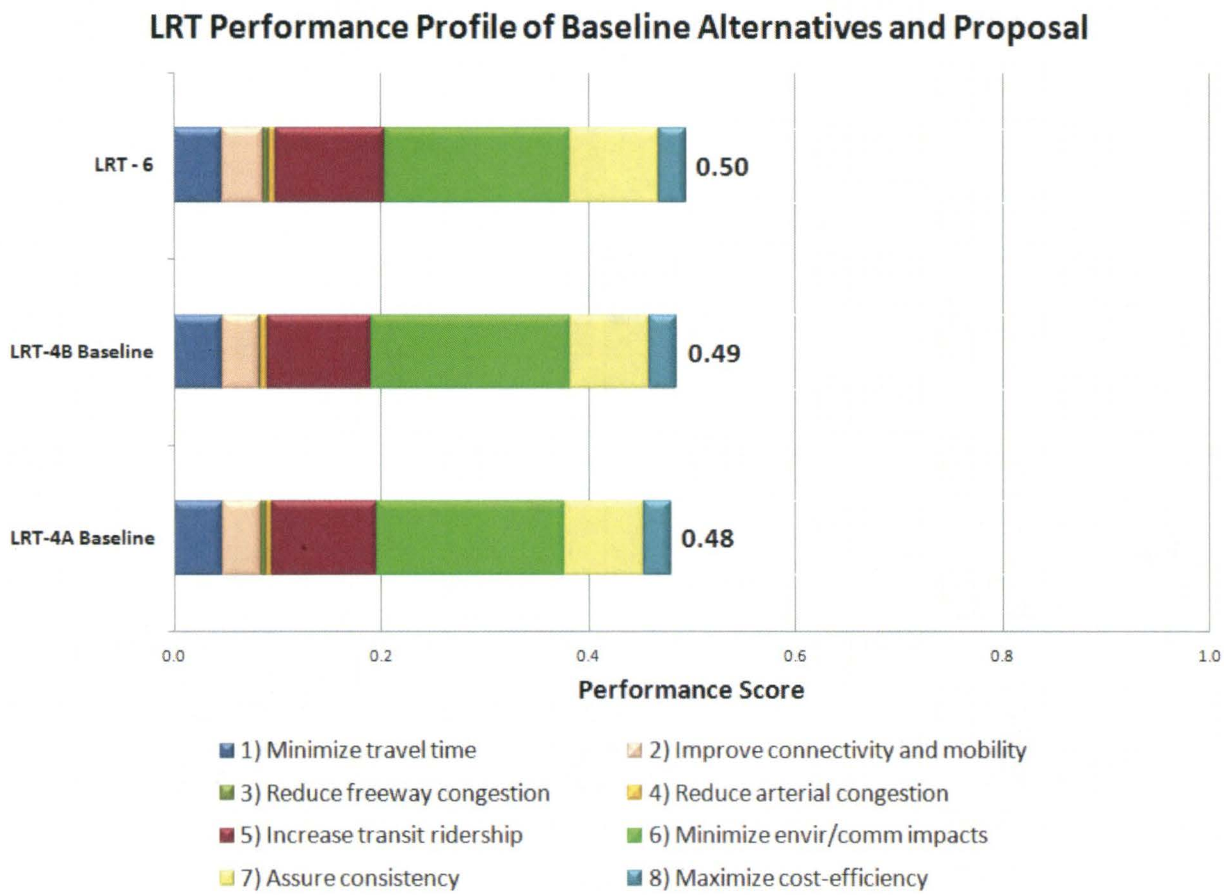


Exhibit 4. Benefit and Cost Performance

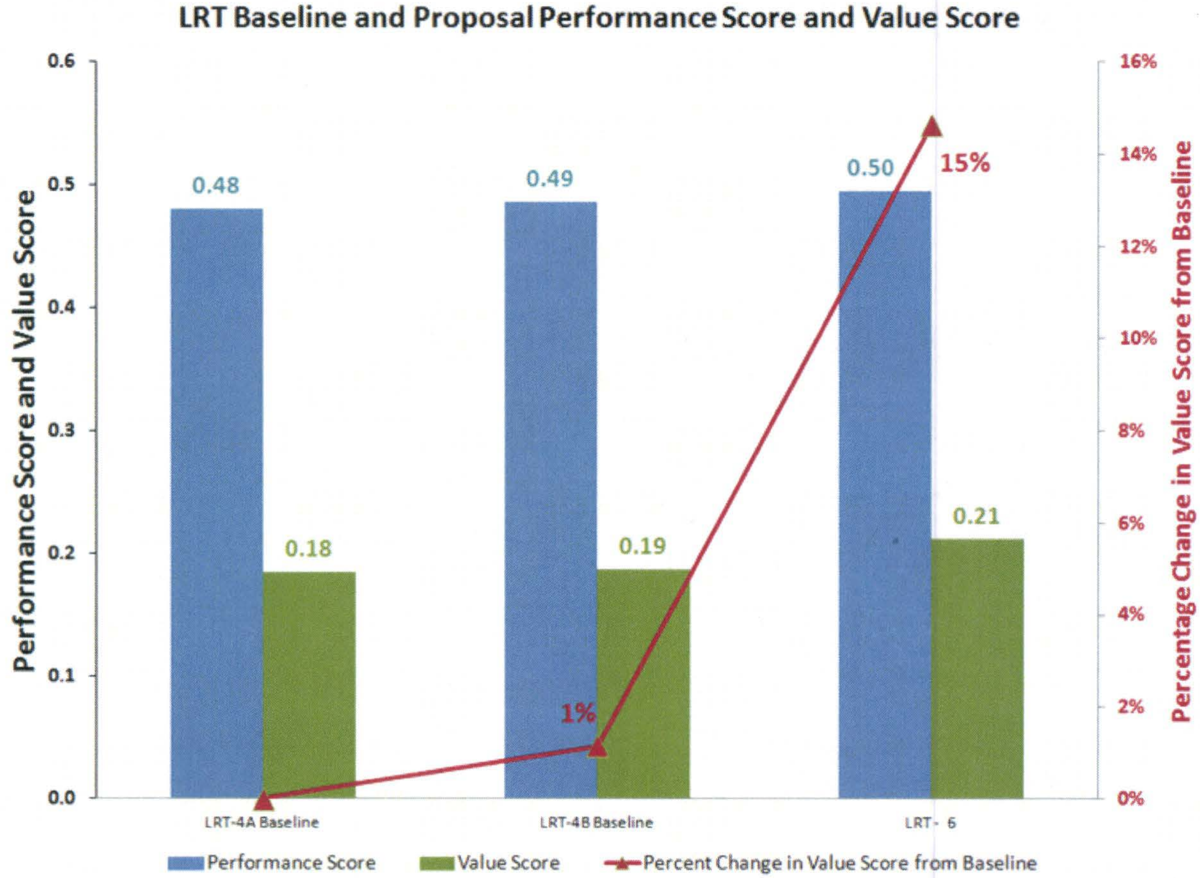


Exhibit 5. Performance Assessment

Performance Attributes (Objectives) Evaluation

Objectives	Comment (Influence of the VA Proposal upon the Objective)	Rating (VA Proposal "Improves Performance" or "No Change" or "Reduces Performance")
Minimize Travel Time	Shortens alignment and therefore shortens travel time on LRT. Still provides overall reduction in travel time for people along the alignment (between north and south termini).	Improves performance relative to existing conditions. No change relative to baseline LRT-4A.
Improve Connectivity and Mobility	Reduces the portion of the LRT that is parallel to the Gold Line. Improves overall efficiency of system and reduces costs. Less maintenance costs.	Improves performance relative to existing conditions. No change relative to baseline LRT-4A.
Reduce Congestion on Freeway System	No significant benefit to people wanting to travel from I 210 to SR 710 or vice versa. Could reduce use of freeway by people switching to mass transit.	Improves performance relative to existing conditions. No change relative to baseline LRT-4A.
Reduce Congestion on Local Street System	Would offer transit as choice to local drivers and potential cut-through traffic.	Improves performance relative to existing conditions. No change relative to baseline LRT-4A.
Increase Transit Ridership	Offers reliable transit and connectivity via surface alternative.	Improves performance relative to existing conditions. No change relative to baseline LRT-4A.
Minimize Environmental and Community Impacts Related to Transportation	Reduces amount of tunnel construction, which will reduce construction costs and duration. Will improve air quality (better than BRT and far better than freeway) and travel experience on local streets; requires ROW acquisition.	Improves performance relative to existing conditions. No change relative to baseline LRT-4A.
Assure Consistency with Regional Plans and Strategies	Regional plans and strategies promote increasing mobility, reducing congestion, and increasing transit use within the area.	Improves performance relative to existing conditions. No change relative to baseline LRT-4A.
Maximize Cost Efficiency of Public Investments	Lower capital cost than LRT that extends to Fillmore; similar to slightly reduced operating and maintenance cost compared to original LRT-4A alternative.	Improves performance relative to existing conditions and relative to baseline LRT-4A.

Exhibit 6. Baseline Concept Sketch

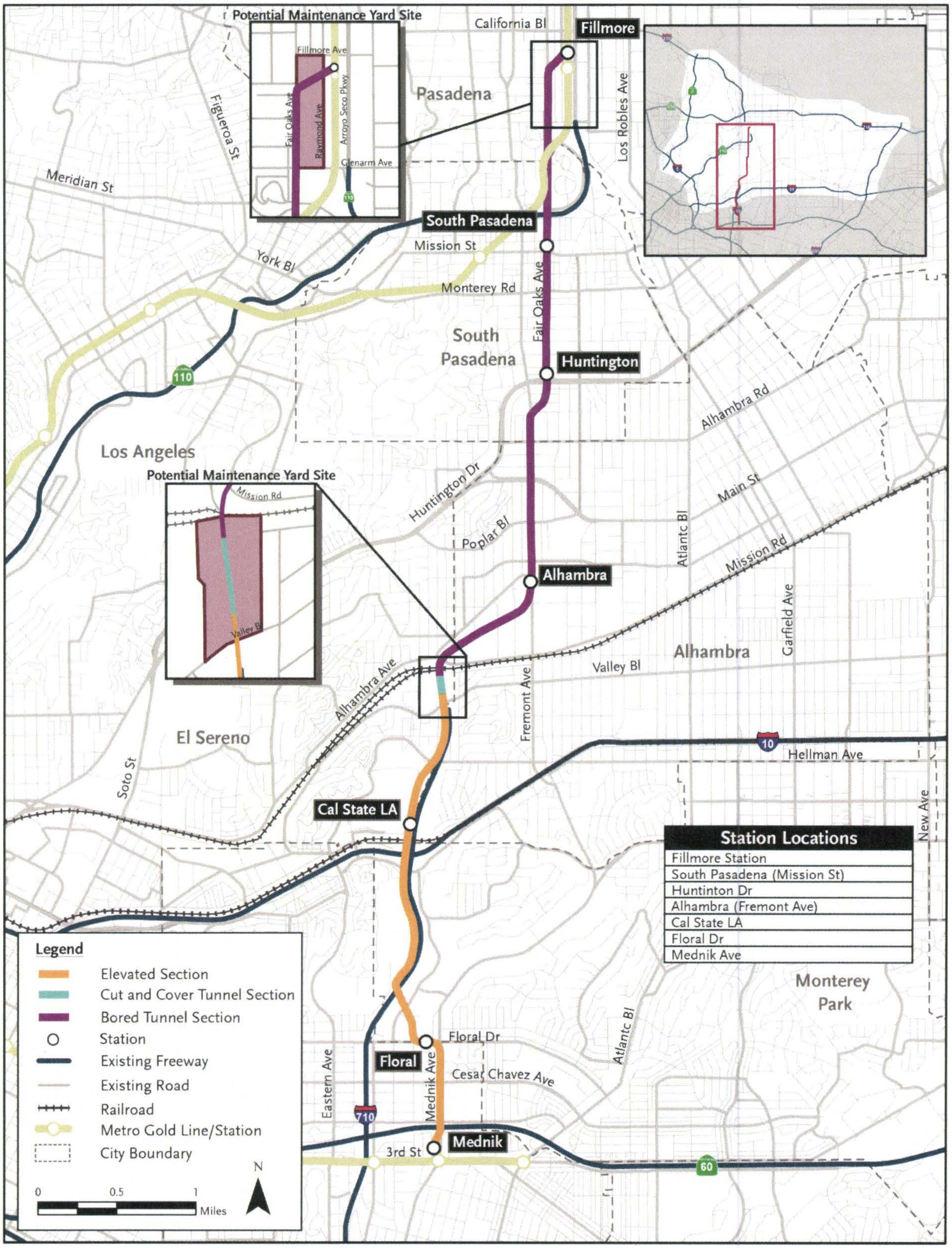
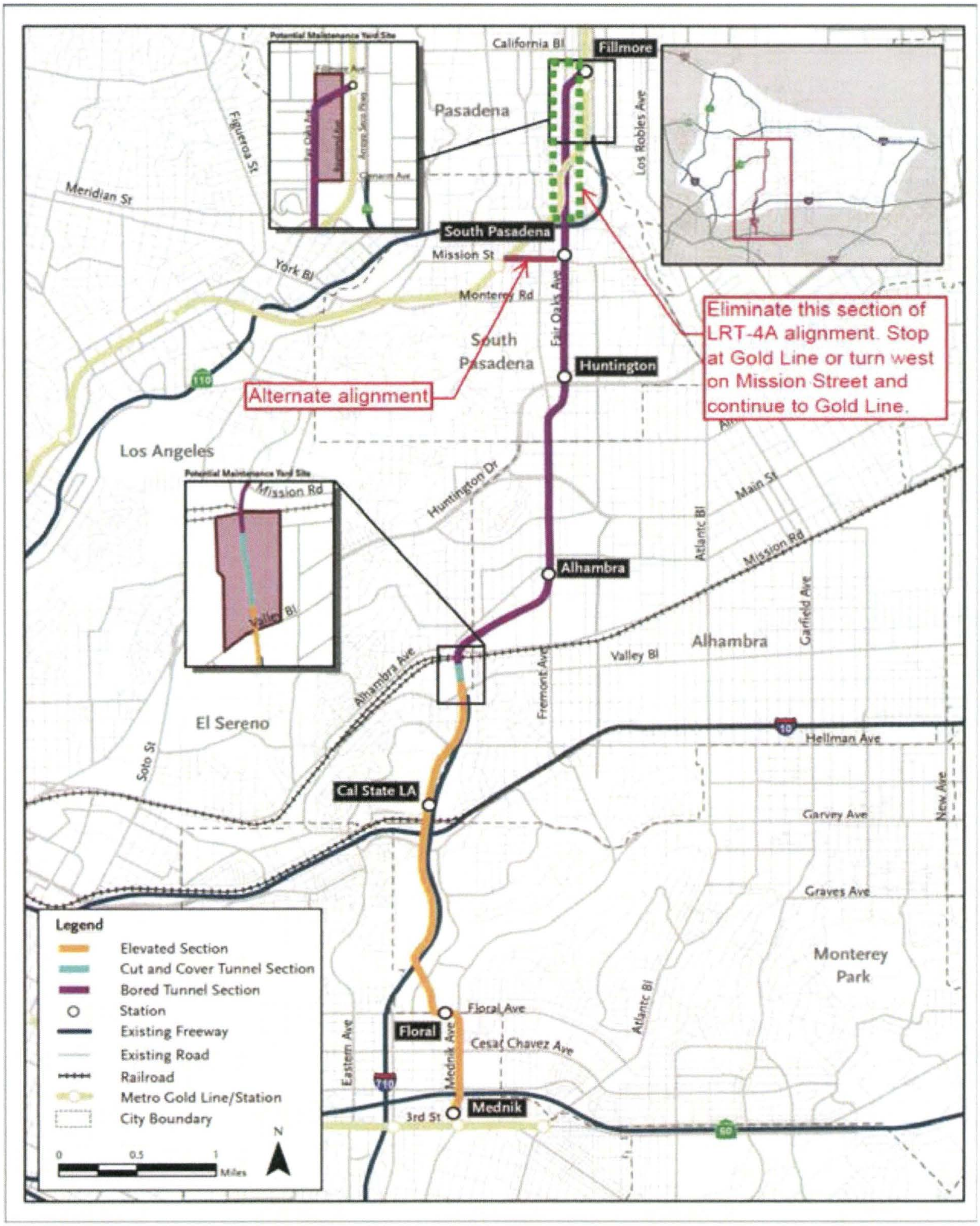


Exhibit 7. VA Proposal Concept Sketch



Proposal Title: Shortened Tunnel per LRT-4A Alternative – Mission Street Option

Exhibit 8. Initial Cost Estimates Proposal LRT-6 (Mission Street Option)

INITIAL COSTS								ALT. NO. Proposal LRT-6
CONSTRUCTION ELEMENT		*BASELINE CONCEPT*			*VA PROPOSAL CONCEPT*			
Description	Unit	Qty	Cost/Unit	Total	Qty	Cost/Unit	Total	
TUNNEL ITEMS								
LRT Vehicles, Mob, Cont. Electrical		1	$ 439,000,000	$ 439,000,000	1	$ 439,000,000	$ 439,000,000	
LRT Stations (4)		1	$ 420,000,000	$ 420,000,000	1	$ 420,000,000	$ 420,000,000	
LRT Tunnel and Ventilation		1	$ 1,471,000,000	$ 1,471,000,000	1	$ 1,209,000,000	$ 1,209,000,000	
TUNNEL SUBTOTAL				*$ 2,390,000,000*			*$ 2,128,000,000*	
TUNNEL MARK-UP				*$ -*			*$ -*	
TUNNEL TOTAL				*$ 2,390,000,000*			*$ 2,128,000,000*	
ROADWAY AND SUPPORT ITEMS								
Roadway		1	$ 19,000,000	$ 19,000,000	1	$ 19,000,000	$ 19,000,000	
Support Faciity Heavy Maintenance		1	$ 60,000,000	$ 60,000,000	1	$ 60,000,000	$ 60,000,000	
				$ -			$ -	
				$ -			$ -	
STRUCTURE SUBTOTAL				*$ 79,000,000*			*$ 79,000,000*	
STRUCTURE MARK-UP				*$ -*			*$ -*	
STRUCTURE TOTAL				*$ 79,000,000*			*$ 79,000,000*	
RIGHT-OF-WAY ITEMS								
Right-of-Way Acquisition (combined)		1	$ 191,000,000	$ 191,000,000	1	$ 191,000,000	$ 191,000,000	
				$ -			$ -	
				$ -			$ -	
				$ -			$ -	
				$ -			$ -	
RIGHT-OF-WAY TOTAL				*$ 191,000,000*			*$ 191,000,000*	
ENVIRONMENTAL MITIGATION ITEMS								
				$ -			$ -	
				$ -			$ -	
CAPITAL OUTLAY SUPPORT ITEMS								
Reengineering and Redesign				$ -			$ -	
Project Engineering				$ -			$ -	
TOTAL				$2,600,000,000			$2,338,000,000	
TOTAL (Rounded)				$2,600,000,000			$2,338,000,000	
						SAVINGS	**$262,000,000**	

Assumnptions

1) Assume total length of tunnel north of Mission Street = 1 miles
2) Assume reduce length length along Mission = 2800 feet
3) Assume net savings on tunnel = 5280 - 2800 = 4280 feet = 0.5 miles
4) Assume price per mile of tunnel = $1.471 billion/3.25 miles = $452 million
5) Assume cost of Mission Street alignment = $452 million * 0.5 = $262 million
6) Assume that right-of-way costs for new LRT-3A option same as LRT-4A. Decrease occurs for north of Mission; increase occurs along Mission
7) Forced cost estimate for baseline to match estimate provided by design team. Deducted tunnel savings from original tunnel cost estimate
8) Costs for LRT guideway included in baseline LRT cost estimate
9) Contingencies included in baseline costs for individual cost components per design team estimate
10) Right-of-way costs include acquisition, relocation assistance, demo, escrow, etc.

Proposal Title: Shortened Tunnel per LRT-4A Alternative – Mission Street Option

Exhibit 9. Life-Cycle Cost Estimates – Proposal LRT-6

LIFE-CYCLE COSTS					ALT. NO. Proposal LRT-6
Life-Cycle Period 50 Years		Real Discount Rate	3.00%	**BASELINE**	**VA PROPOSAL**
A. INITIAL COST				$2,600,000,000	$2,338,000,000
Service Life - Baseline 50 Years; Service Life - Alternative 50 Years		**INITIAL COST SAVINGS:**			**$ 262,000,000**
B. SUBSEQUENT ANNUAL COSTS					
1. Maintenance and operational costs				$ 35,984,000	$ 33,735,000
		Total Subsequent Annual Costs:		$ 35,984,000	$ 33,735,000
		Present Value Factor (P/A):		25.730	25.730
PRESENT VALUE OF SUBSEQUENT ANNUAL COSTS (Rounded):				**$ 925,860,000**	**$ 867,994,000**
C. SUBSEQUENT SINGLE COSTS	**Year**	**Amount**	**PV Factor**	**Present Value**	**Present Value**
			1.00000	$ -	
			1.00000		$ -
			1.00000	$ -	
			1.00000		$ -
			1.00000	$ -	
			1.00000		$ -
			1.00000	$ -	
			1.00000		$ -
PRESENT VALUE OF SUBSEQUENT SINGLE COSTS (Rounded):				**$ -**	**$ -**
D. TOTAL SUBSEQUENT ANNUAL AND SINGLE COSTS (B+C)				**$ 925,860,000**	**$ 867,994,000**
E. TOTAL SUBSEQUENT COSTS SAVINGS:					**$ 57,866,000**
F. TOTAL PRESENT VALUE COST (A+D)				**$ 3,525,860,000**	**$ 3,205,994,000**
		TOTAL LIFE-CYCLE SAVINGS:			**$ 319,866,000**

Assumptions

1) Assume maintenance and operations cost decrease in proportion to the reduction in transit length

2) Assume original length = 8 miles; assume LRT-3A (Mission Option) has length of 7.5 miles = 0.9375

Proposal Title: Shortened Tunnel per LRT-4A Alternative – Mission Street Option

Assumptions and Calculations: (---)

VA PROPOSAL NO. FT1

Proposal Title: Single-Bore Tunnel with Demand Constrained by Variable Toll

Initial Cost Savings:	$2,500,000,000
Future Cost Savings:	$0
Net LCC Savings:	$2,500,000,000
Change in Schedule:	Potential Reduction
Performance Change:	+15 %
Value Change:	+113 %

Description of Baseline Concept: The baseline proposal provides twin-bore tunnels, with each bore carrying two levels of traffic and two lanes on each level. Cut-and-cover tunnels are provided at each end through the portals. The easterly tunnel carries northbound traffic; the westerly tunnel carries southbound traffic. The tunnels would provide enough capacity to accommodate the 2035 forecast demand. However, the tunnels are anticipated to require tolls to be affordable to construct, which will reduce forecast demand by an unanticipated amount (to be determined in a traffic/revenue study), and will be a function of the amount of toll. It is unclear if sufficient tolls would be generated to support the dual-bore project, or that other funds would be required to construct.

Under the proposed system, traffic entering the northbound tunnel would need to segregate by ultimate destination at the I-210/SR-134 interchange prior to entering the tunnel. The lower deck would access only I-210 west (north toward La Canada/Flintridge), while the upper deck would access I-210 east and SR-134 west. Motorists would need to make the choice of ultimate destination prior upon entering the northbound tunnel at Valley Boulevard.

Description of VA Proposal Concept: The proposal would construct a single-bore tunnel with two levels, each with two lanes; northbound travel would be on the lower deck and southbound travel on the upper deck. The cut-and-cover sections would be similarly reduced to provide two lanes in each direction. The proposal would include occasional stairs between the northbound lanes to facilitate emergency evacuation. The cut-and-cover sections at the north and south portals would be expanded to three lanes in each direction to facilitate weaving for the interchanges at either end.

A variable toll system would be implemented to limit traffic demand to correspond to the lower capacity that a single bore would provide compared to two bores. Tolls would be set to reduce demand to the maximum capacity of the toll section, but are anticipated to be substantially more than the tolls for the double-bore version, even though costs would be reduced. This should make the toll financing much more viable, potentially running a surplus. As a variation of this proposal, a proportion of the toll profits could be used to subsidize bus and transit service in the area. Given that one truck requires the approximate capacity of three cars, trucks would either be banned or truck tolls would be set to discourage trucks. (See also truck ban variation.)

Advantages:

- Cost reductions approaching 45 percent; commensurate savings on financing costs.
- Lower initial environmental impact due to reduced construction impacts.
- Less impacts on I-210 north and east of the project.
- Less air quality emissions from traffic using the tunnel.
- Does not require splitting of traffic movement in two separate tunnels at the north and south portals.
- Saves requirement for pedestrian and vehicular cross overs.

Disadvantages:

- Does not meet the California Department of Transportation (Caltrans) Highway Design Manual (HDM) guideline that new facilitates should accommodate future travel demand 20 years after completion of the project; the remaining traffic that cannot be accommodated in the tunnel will remain on the surface street system or use other routes.
- A portion of cut-through traffic will remain on surface streets.
- Loss of economy-of-scale from constructing a second bore concurrently or in immediate sequence.
- The long-range construction of a future second bore would be challenging due to reduced available right-of-way at the north and south portals.

Discussion: There are several short-term advantages to a single-tunnel option. The cost of construction would be approximately 45 percent of the cost to construct two bores. Lower construction costs would reduce initial capital outlays, thereby making the project more financially viable. With lower costs associated with single-bore construction, the project might be more likely to recover a greater proportion of costs from toll revenue.

Construction-related environmental impacts of single-bore construction initially would be less than impacts associated with construction of two tunnels. For example, spoils generated by tunnel digging would be approximately half that of a two-tunnel option, which would reduce the impact of spoils disposal/relocation, and thus reduce traffic congestion and air pollution due to spoils transport. Other environmental impacts associated worker trips to the construction site would be reduced by approximately half. Air pollutants emitted from the tunnel should be reduced.

Long-range advantages of the single-tunnel option include the lack of a need to split traffic at the tunnel entrance. Because there would be only one level of traffic in each direction, driver confusion regarding lane selection would not be a factor. Reduced maintenance cost is another long-range advantage; less infrastructure means less to maintain.

There are several drawbacks to the single-tunnel option, both short term and long term. While there might be immediate cost savings by not constructing a second bore, the demand exists for both bores and the cost of constructing the second bore will only increase with time. The long-term cost associated with constructing a second bore well into the future could negate any short-term savings and economies-of-scale would be lost.

Constructing one tunnel does not reduce travel demand and does not adequately address that demand. Traffic would continue to burden local arterials. With construction of a limited-access facility, more traffic might be inclined to gravitate toward the corridor. If the facility cannot meet traffic demand, traffic congestion on local arterials could be exacerbated by drivers seeking alternatives to a clogged SR 710.

Technical Review Comments: Implementation of the second bore could be very difficult logistically.

Project Management Considerations: None.

Discussion of Schedule Impacts: Depending of the construction schedule assumptions, construction time could be reduced.

Proposal Title: Single-Bore Tunnel with Demand Constrained by Variable Toll

Discussion of Risk Impacts:

- The proposal could increase support from the Cities of LaCanada and Pasadena, particularly if trucks are banned.

- The proposal could engender opposition from new groups:
  - Interest groups opposed to toll roads.
  - Low income interests that believe that toll roads are elitist.
  - Truck groups that would otherwise support the project.
  - Current project supporters who believe that tolling the system would reduce the project benefits.

Exhibit 1. Performance Ratings

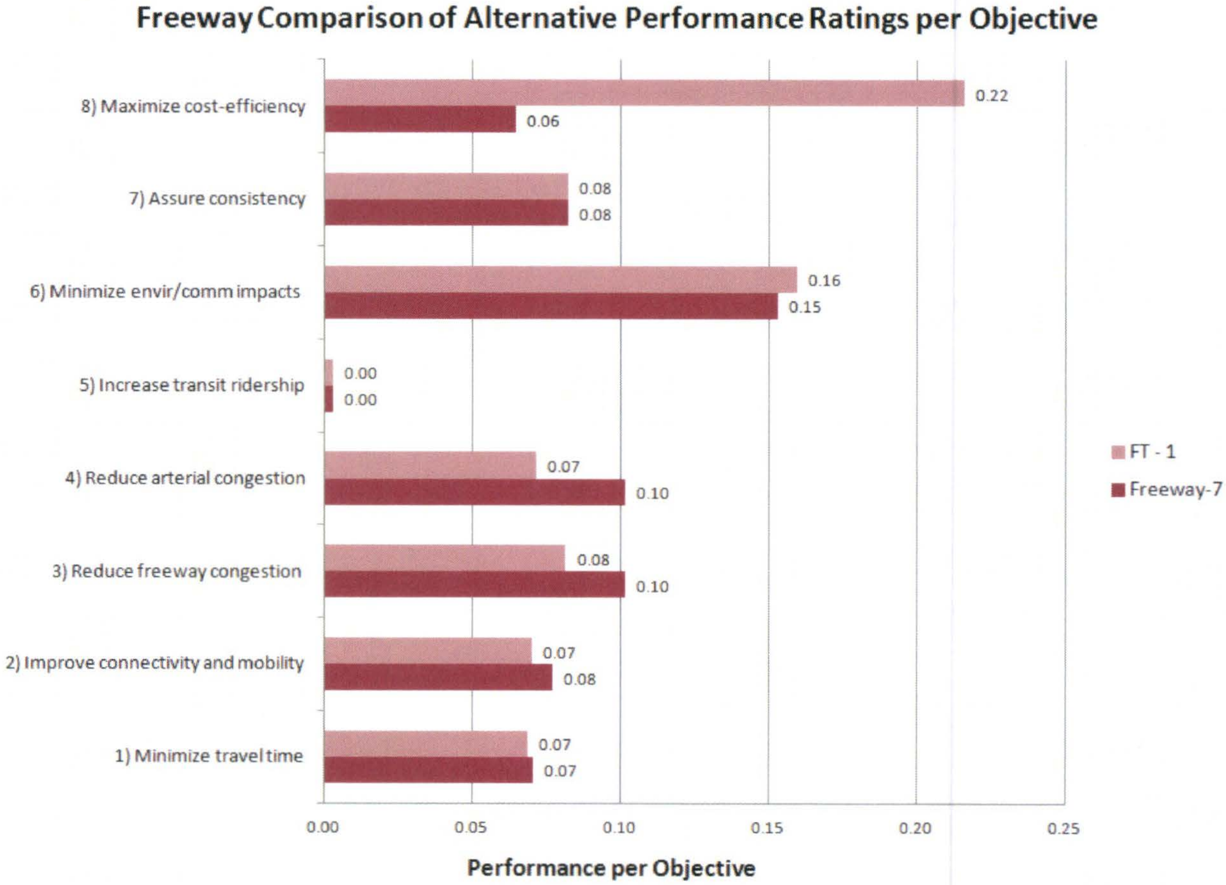
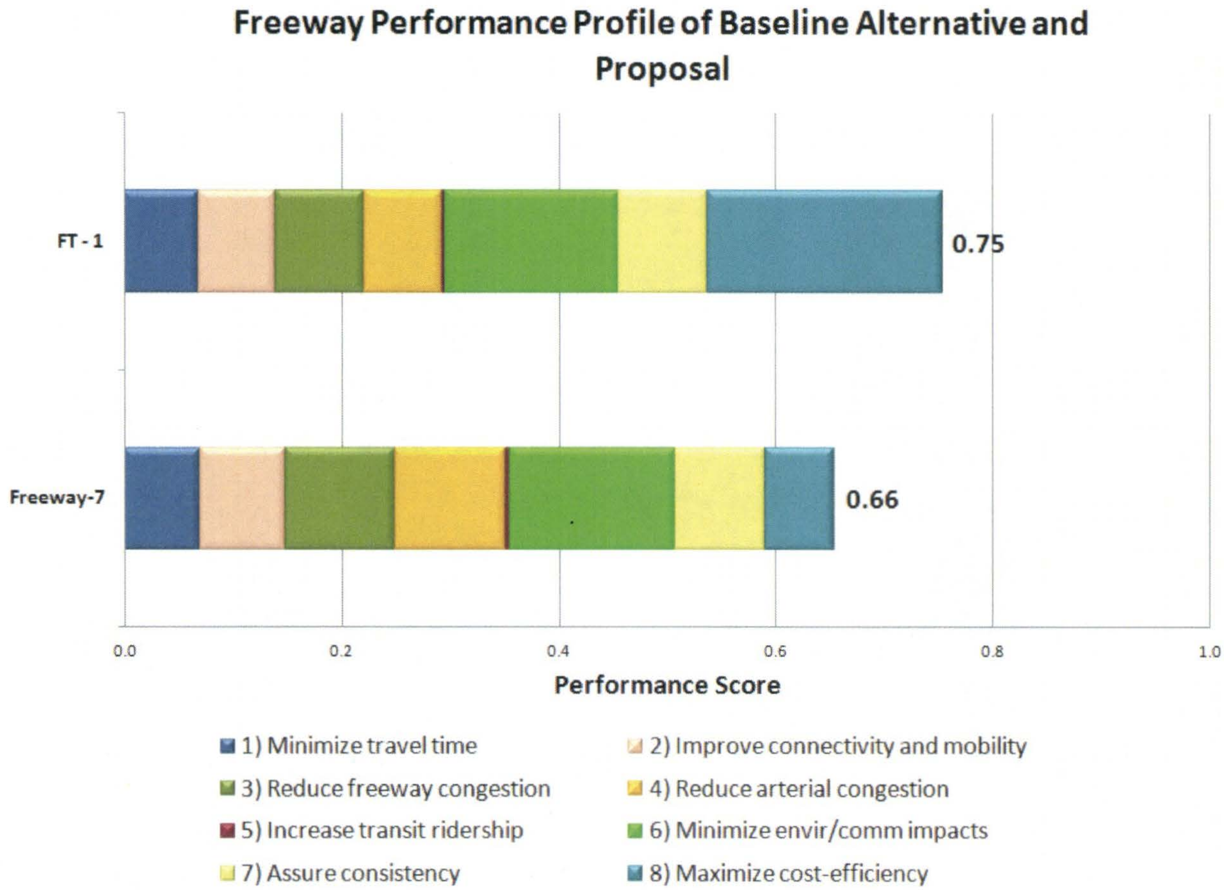


Exhibit 2. Performance Profile



Proposal Title: Single-Bore Tunnel with Demand Constrained by Variable Toll

Exhibit 3. Benefit and Cost Performance

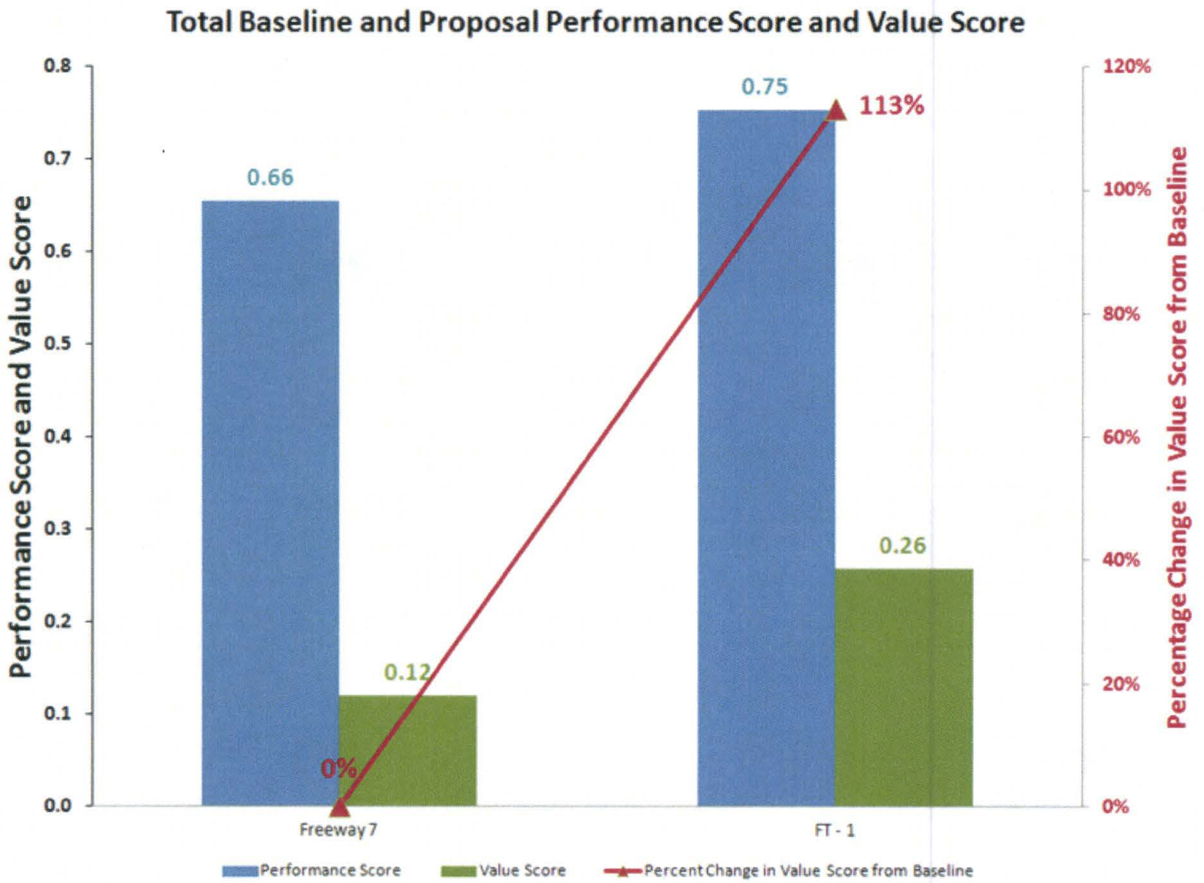


Exhibit 4. Performance Assessment

Performance Attributes (Objectives) Evaluation

Objectives	**Comment** (Influence of the VA Proposal upon the Objective)	**Rating** (VA Proposal "Improves Performance" or "No Change" or "Reduces Performance")
Minimize Travel Time	For persons who pay a toll, the objective will be met. Persons who do not pay a toll will still face greater travel times.	Reduces performance, but may make project financially viable.
Improve Connectivity and Mobility	For persons who pay a toll, the objective will be met. Persons who do not pay a toll will still face greater travel times.	Reduces performance, but may make project financially viable.
Reduce Congestion on Freeway System	Proportionately less reduction in freeway congestion.	Reduces performance, but may make project financially viable.
Reduce Congestion on Local Street System	For persons who pay a toll, the objective will be met. To the extent that persons do not pay the toll, performance objectives will not be met.	Reduces performance, but may make project financially viable.
Increase Transit Ridership	Residual unmet demand could be a candidate for transit. If tolls are used to subsidize enhanced transit, then transit usage could increase.	Potential to increase performance through enhanced transit as subsidized by tolls.
Minimize Environmental and Community Impacts Related to Transportation	Reduced construction air quality emissions, slight increase in long-term emissions. Imposition of tolls could lead Environmental Justice concerns; higher tolls could mean additional concern.	Potential to increase performance through transit subsidy from tolls.
Assure Consistency with Regional Plans and Strategies	Generally consistent.	No change.
Maximize Cost Efficiency of Public Investments	Highly efficient as you capture the high-value customer at a premium price.	Increased performance.

Exhibit 5. Baseline Concept Sketch

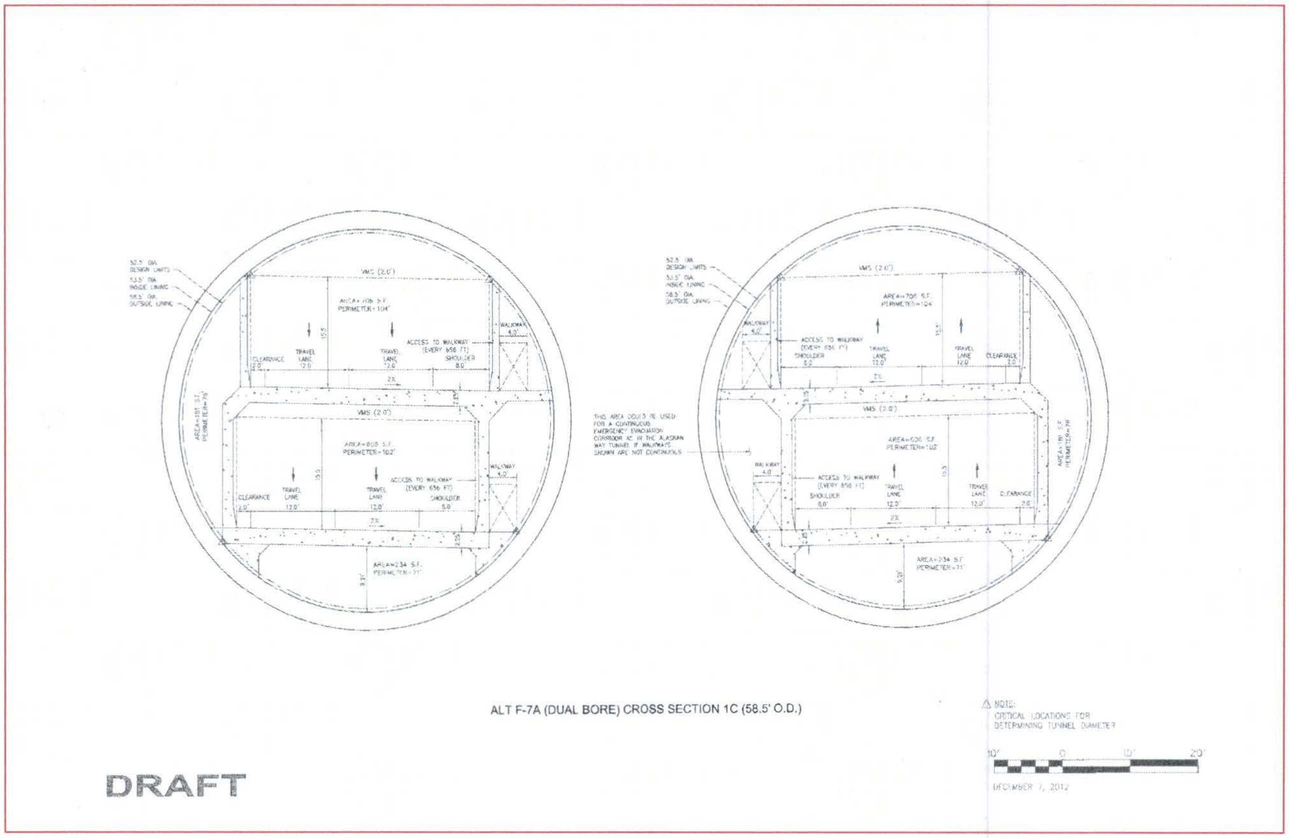


Exhibit 6. VA Alternative Concept Sketch

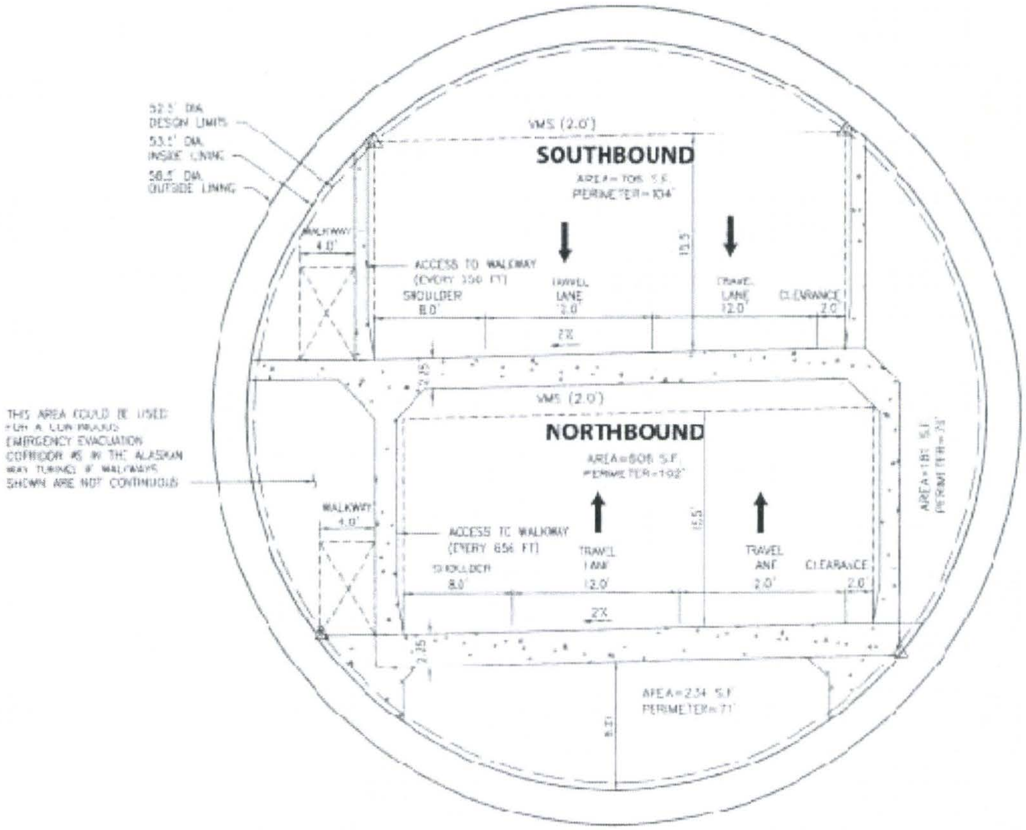


Exhibit 7. Initial Cost Estimates

INITIAL COSTS (REDUCTIONS FROM BASELINE) *DONE AS REDUCTIONS.....*							ALT. NO.
CONSTRUCTION ELEMENT		*BASELINE CONCEPT*			*ALTERNATIVE CONCEPT*		
Description	Unit	Qty	Cost/Unit	Total	Qty	Cost/Unit	Total
TUNNEL ITEMS							
Dual Bore Tunnel (including Markups)				$ 4,441,000,000	**50%**	**Reduce**	$ 2,220,500,000
STRUCTURE ITEMS							
South Cut and Cover Passages		3	$ 367,500	$ 1,102,500	0	$ -	$ -
South Cut and Cover Tunnel		1,750	$ 87,134	$ 152,484,500	0	$ -	$ -
STRUCTURE SUBTOTAL				*$ 153,587,000*			$ -
STRUCTURE MARK-UP		79.5%		*$ 122,101,665*			$ -
STRUCTURE TOTAL				*$ 275,688,665*			$ -
RIGHT-OF-WAY ITEMS							
Right-of-Way Acquisition				$ -			$ -
Utility Relocation				$ -			$ -
Relocation Assistance				$ -			$ -
Demolition				$ -			$ -
Title and Escrow Fees				$ -			$ -
RIGHT-OF-WAY TOTAL				*$ -*			$ -
ENVIRONMENTAL MITIGATION ITEMS							
				$ -			$ -
				$ -			$ -
CAPITAL OUTLAY SUPPORT ITEMS							
Reengineering and Redesign				$ -			$ -
Project Engineering							
TOTAL		$ 4,716,688,665			$ 2,220,500,000		
TOTAL (Rounded)		$4,716,690,000			$2,220,500,000		
						SAVINGS	**$2,496,190,000**

Life-Cycle Cost Estimates: The VA team's understanding is that annual operational and maintenance costs for the SR 710 North Study have not been calculated. Based on the *Caltrans 2011 Five-Year Maintenance Plan,* Caltrans is spending roughly $10,000 per year per lane mile to maintain its 50,000-lane-mile system. Applying this cost factor to the eight-lane 5.4-mile project would result in an annual maintenance cost of $110,000/year. However, the tunnel segment of the project would require special operational and maintenance costs that would not be captured in statewide averages and would likely be far greater.

The additional annual operational and maintenance costs of the proposed SR 710 freeway tunnel proposal would include electrical service for tunnel and roadway lighting, ventilation, operation of the toll system, pumping, and signage. The tunnel project would also require dedicated administrative and maintenance staff, operation of the toll system, and other special costs. Surface roadway segments will be landscaped, thus requiring water as well as maintenance. Finally, pavement surface will need to be rehabilitated on an ongoing basis. As noted above, these costs have not been estimated, but can be reasonably expected to be far higher than the typical annual maintenance costs for state highways, and are likely to be on the order of tens of millions of dollars per year.

Operations and maintenance costs, however, will likely scale with the number of lane miles constructed. For example, lighting costs would scale with the number of lanes. Ventilation costs would likely track with vehicle miles traveled, which will crudely track the number of lane miles. Thus, for any particular alternative proposal, the operational and maintenance cost change would be proportionate to the change in number of lane miles.

For Proposal FT1, the number of lane miles would be reduced by one-half. If the annual operations and maintenance budget for Alternative F7 is $20 million (an order-of-magnitude estimate), then the annual operations and maintenance budget for FT1 would be approximately $10 million. Again, the actual numbers are simply order-of-magnitude estimates, but the ratio is important.

Assumptions and Calculations: (---)

VA PROPOSAL NO. FT2

Proposal Title: Car-Only Freeway Tunnel at 46.5-foot Internal Design Diameter (ID) vs. 52.5-foot ID

Initial Cost Savings:	$584,000,000
Future Cost Savings:	$0
Net LCC Savings:	$584,000,000
Change in Schedule:	Negligible
Performance Change:	-37 %
Value Change:	-30 %

Description of Baseline Concept: The baseline concept is based on Alternative F-7 and is assumed to consist of a double-deck freeway, with two lanes per deck, providing the following vertical and horizontal clearances:

- 12-foot lane widths
- 8-foot shoulder width plus 2-foot clearance on the other side
- 15.5-foot vertical clearance plus 2-foot clearance for Variable Message Signs (VMS)
- 4-foot-wide walkway in a structurally separated corridor so that it can act as emergency egress
- 2.25-foot-thick road deck slabs

A baseline concept of the tunnel cross section with a 52.5-foot internal design diameter (ID) is provided in Exhibit 5. The tunnel would allow both trucks and car traffic.

Description of VA Proposal Concept: The proposal would designate the dual-bore freeway tunnel as car-only. This provides the potential to reduce the 15.5-foot vertical clearance (10-foot clearance has been assumed based on other similar projects, and because the International Building Code (IBC) requires 8.2 feet of clearance for handicapped vehicles in parking structures), which in turn would result in a reduction in the required tunnel diameter. This also could be accompanied by a slight reduction of the lane width from 12 feet to 11 feet to further reduce the required tunnel diameter, which may be acceptable in a car-only tunnel.

For the SR 710 VA Study, the following two scenarios have been evaluated to identify the reduction in tunnel diameter that may be possible, and the associated cost savings.

- **Scenario 1 – reduced vertical clearance to 10 feet**
  - 12-foot lane widths
  - 8-foot shoulder width plus 2-foot clearance on the other side
  - 10-foot vertical clearance plus 2-foot clearance for VMS
  - 4-foot-wide walkway in a structurally separated corridor so that it can act as emergency egress
  - 2.25-foot-thick road deck slabs

This results in an approximately 48-foot ID. See Exhibit 6 for a cross section of this scenario.

- **Scenario 2 – reduced vertical clearance to 10 feet, reduced lane width to 11 feet, reduced road deck thickness to 2 feet as a result of reduced span and load**
    - 11-foot lane widths
    - 8-foot shoulder width plus 2-foot clearance on other side
    - 10-foot vertical clearance plus 2-foot clearance for VMS
    - 4-foot-wide walkway in a structurally separated corridor so that it can act as emergency egress
    - 2-foot-thick road deck slabs

This results in an approximately 46.5-foot ID. See Exhibit 7 for a cross section of this scenario.

Advantages:

- Reduced tunnel diameter results in significantly reduced cost.
- Smaller-diameter tunnel boring machine (TBM) bore is beneficial for control of settlements and impacts.
- Reduced fire size for ventilation/ fire life safety (FLS) design, which will result in further cost savings.
- A car-only tunnel <u>cannot</u> attract any freight traffic from the Ports.
- A car-only tunnel is more compatible with fastrack express lanes.

Disadvantages:

- Potential for drivers to find the tunnel claustrophobic (mitigated in A86 tunnel by use of color and light. See Discussion section for more detail on A86 tunnel).
- Reduced flexibility as the tunnel will not be able to accommodate trucks or buses.
- Special low-clearance maintenance and emergency response vehicles would be required.

Discussion: The concept of a car-only tunnel has several precedents, the foremost example being the Paris A86 Highway Tunnel. The A86 tunnel is 6.2 miles long and has a double-deck arrangement with 2-lanes per deck. It has the following characteristics:

- 9.8-foot lane widths
- 8.2-foot shoulder width plus approximately 1-foot clearance on the other side
- 8.5-foot vertical clearance, including 2-foot clearance for VMS
- Internal diameter of 34.1 feet

The A86 tunnel has been in service for several years. As a result of the reduced vertical clearances, height detection technology is used to limit vehicles to less than 6 feet 6 inches in height; and a fleet of low-clearance emergency response and maintenance vehicles has been developed to service the tunnel. See Exhibit 8.

Proposal Title: Car-Only Freeway Tunnel at 46.5-foot Internal Design Diameter (ID) vs. 52.5-foot ID

A second tunnel, the Eurasia Tunnel in Istanbul, is currently in design and has a length of 2.5 miles, with a 9-foot 9-inch vertical clearance and an additional 2 feet for VMS. See Exhibit 9.

The reduction in tunnel diameter that results from adopting a car-only tunnel produces significant cost savings, such as:

- Smaller TBM with reduced purchase cost.
- Less spoil to be removed and disposed of.
- Smaller diameter will result in thinner tunnel segments due to reduced hoop load.
- Reduced road deck spans and traffic loads resulting in potentially thinner deck slabs.

A smaller-diameter TBM also may facilitate control of ground loss and associated ground movements, thereby limiting potential for impacts to existing utilities and structures, as well as the potential for marginally faster progress rates. It may also reduce the number of subsurface easements required, due to a narrower right-of-way (ROW). However, it is not guaranteed that these benefits would materialize.

A further benefit of excluding trucks from the tunnel would be that the design fire size could be reduced from the current 100-megawatt (MW) fire to 30-MW or less for a car fire. This would result in significant reductions in required cross sectional areas for supply and exhaust air, and is likely to produce significant cost savings associated with the ventilation and FLS equipment requirements and operational costs. However, due to time constraints, these savings have not been evaluated as part of the VA study.

The car-only tunnel also may be easier to "sell" to local communities, particularly those at the northern end of the proposed tunnel alignment where we understand there is concern about the possibility of the freeway tunnel encouraging trucks carrying freight from the Ports to change their current routes and pass through Pasadena. This would not be possible with a car-only tunnel.

A number of disadvantages have been listed above, such as the potential for the tunnel to be claustrophobic for some drivers, and the need for special low-clearance maintenance and emergency response vehicles to be purchased. However, the Paris A86 tunnel has shown that the first of these disadvantages can be mitigated through the appropriate use of light and paint. It also should be noted that we have assumed a 12-foot clearance for the SR 710 tunnel (traffic plus VMS) compared with only 8.5 feet for the A86 tunnel. The cost of purchasing the special low-clearance maintenance and emergency response vehicles would be negligible compared with the potential cost savings.

Technical Review Comments: This alternative is technically feasible; however it is recommended that the design team perform further due diligence on the reduction in tunnel diameter that is possible as a result of adopting a car-only tunnel. Further evaluation should also be performed of the impact that this would have on the ventilation design. It is anticipated that the ventilation design would become considerable less onerous, but analysis should be undertaken to quantify this.

Project Management Considerations: No impact on project management is expected.

VA PROPOSAL NO. FT2

Proposal Title: Car-Only Freeway Tunnel at 46.5-foot Internal Design Diameter (ID) vs. 52.5-foot ID

Discussion of Schedule Impacts: It is anticipated that this VA proposal would only have a minor impact on the schedule, with the potential for a marginal improvement in assumed TBM progress rate and delivery time due to the smaller diameter. However, as this impact is expected to be minor, it has not been specifically evaluated as part of the VA process.

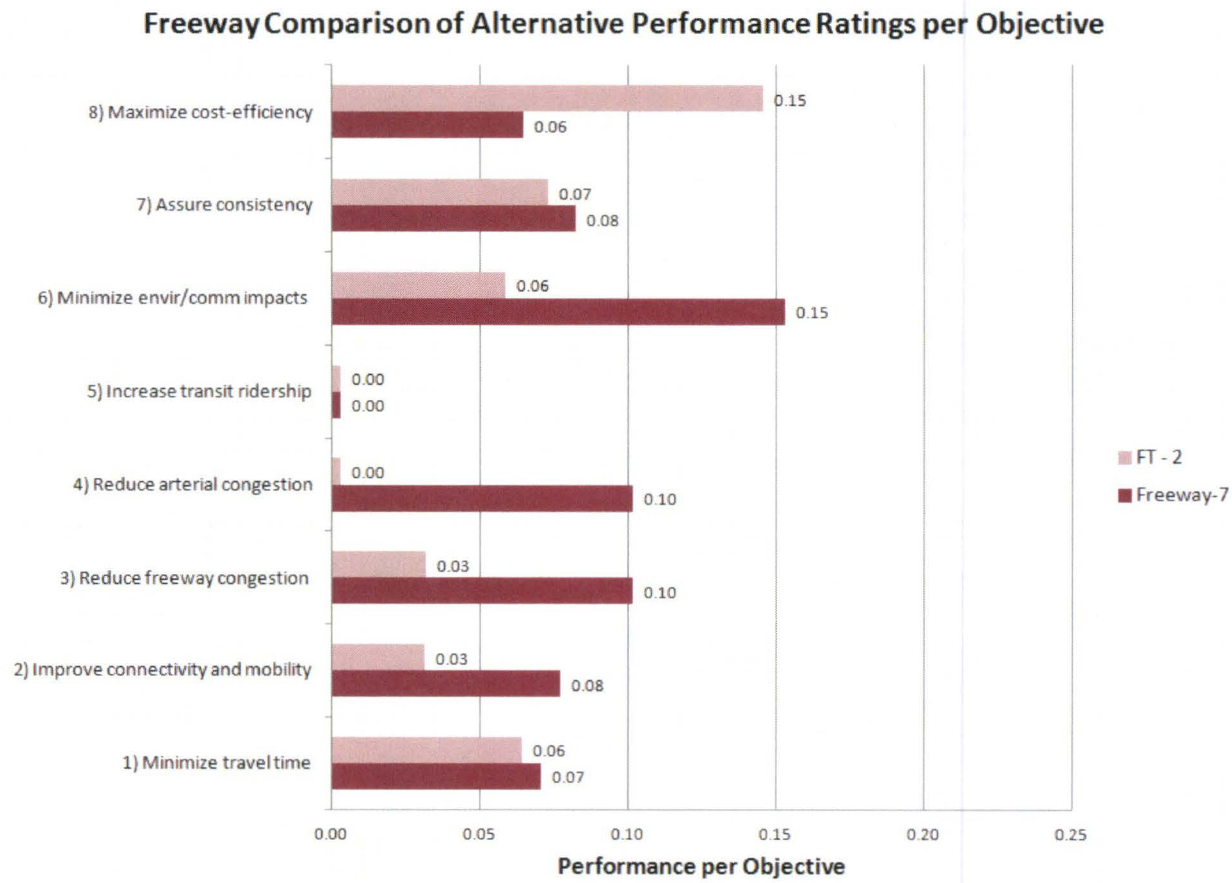
Discussion of Risk Impacts: In general, it is anticipated that this VA proposal mitigates (or partially mitigates) risks, particularly those associated with the following:

- Accidents within the tunnel, resulting fire size, and associated emergency response.
- Potential for ground movement induced by tunneling and associated impacts to structures and utilities.
- Public perception that the freeway tunnel will encourage freight traffic from the Ports to pass through Pasadena.

Additional risks that are created by the adoption of a car-only tunnel include:

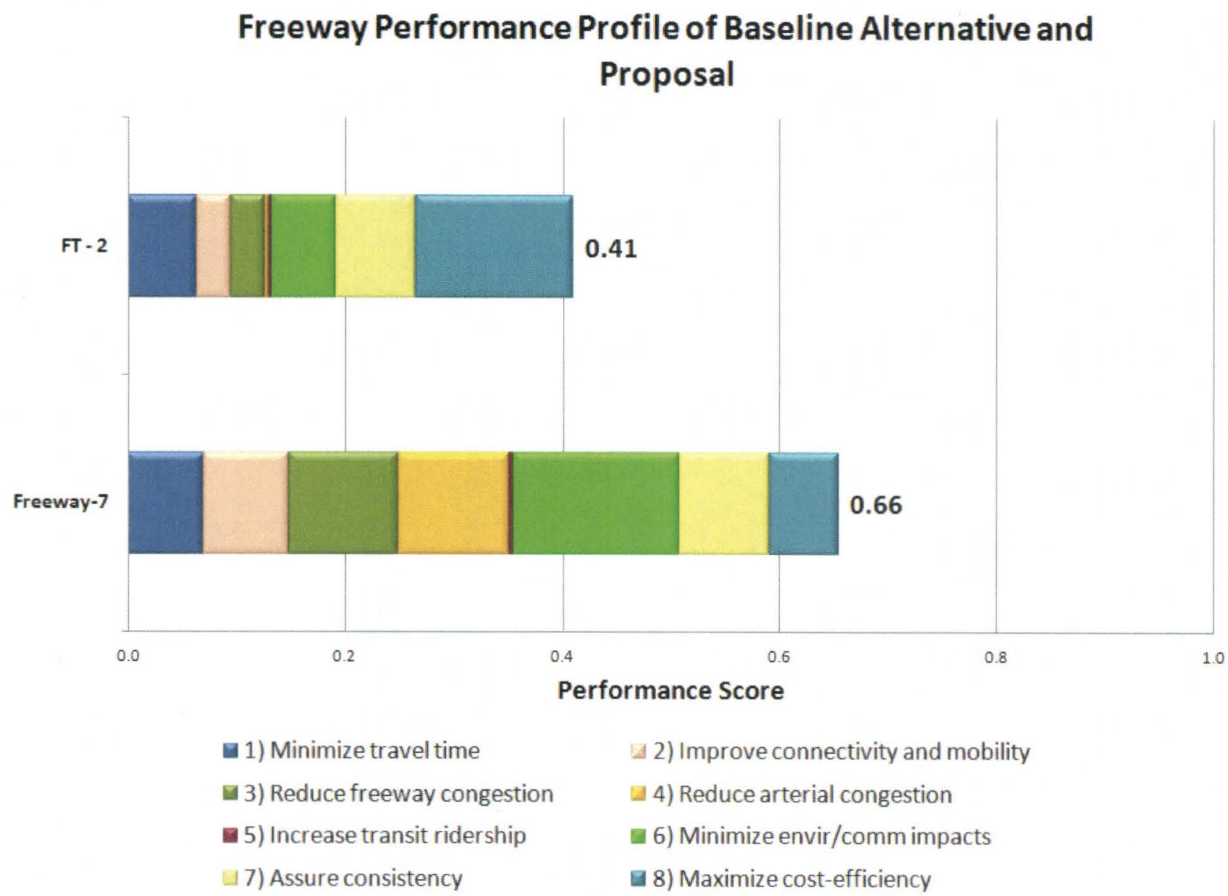
- Potential to mobilize opposition from the trucking and goods movement industries.
- Potential for some people to be put off from using the tunnel by the perception that the tunnel will seem claustrophobic.

Exhibit 1. Performance Ratings



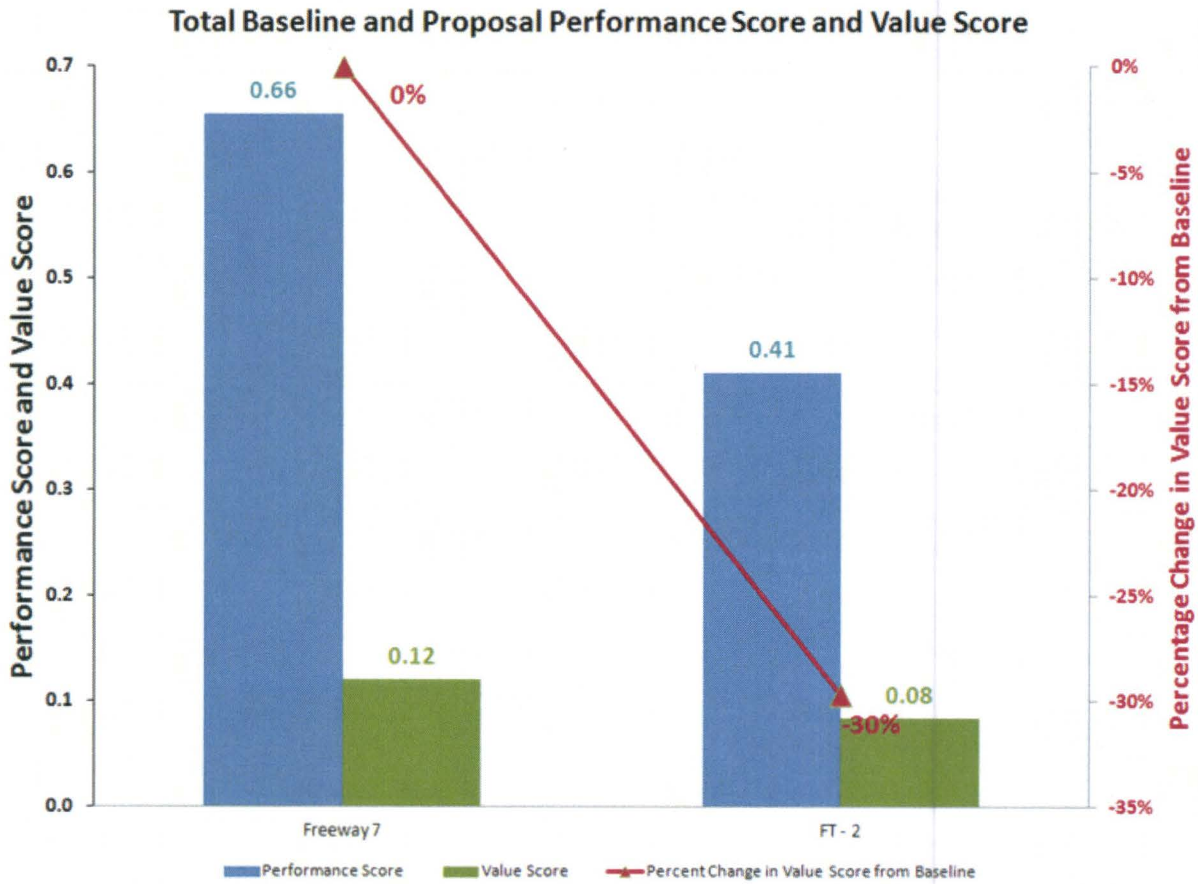
Proposal Title: Car-Only Freeway Tunnel at 46.5-foot Internal Design Diameter (ID) vs. 52.5-foot ID

Exhibit 2. Performance Profile



Proposal Title: Car-Only Freeway Tunnel at 46.5-foot Internal Design Diameter (ID) vs. 52.5-foot ID

Exhibit 3. Benefit and Cost Performance



Proposal Title: Car-Only Freeway Tunnel at 46.5-foot Internal Design Diameter (ID) vs. 52.5-foot ID

Exhibit 4. Performance Assessment

Performance Attributes (Objectives) Evaluation

Objectives	**Comment** **(Influence of the VA Proposal upon the Objective)**	**Rating** **(VA Proposal "Improves Performance" or "No Change" or "Reduces Performance")**
Minimize Travel Time	Not applicable.	No change
Improve Connectivity and Mobility	Does not allow trucks, but can therefore carry more cars.	No change
Reduce Congestion on Freeway System	Not applicable.	No change
Reduce Congestion on Local Street System	Not applicable.	No change
Increase Transit Ridership	Not applicable.	No change
Minimize Environmental and Community Impacts Related to Transportation	Reduced subsurface easements and pollution at portals.	Improves performance
Assure Consistency with Regional Plans and Strategies	Not applicable.	No change
Maximize Cost Efficiency of Public Investments	A 5 to 10 percent cost saving is possible for similar functionality.	Improves performance

Exhibit 5. Baseline Concept Sketch

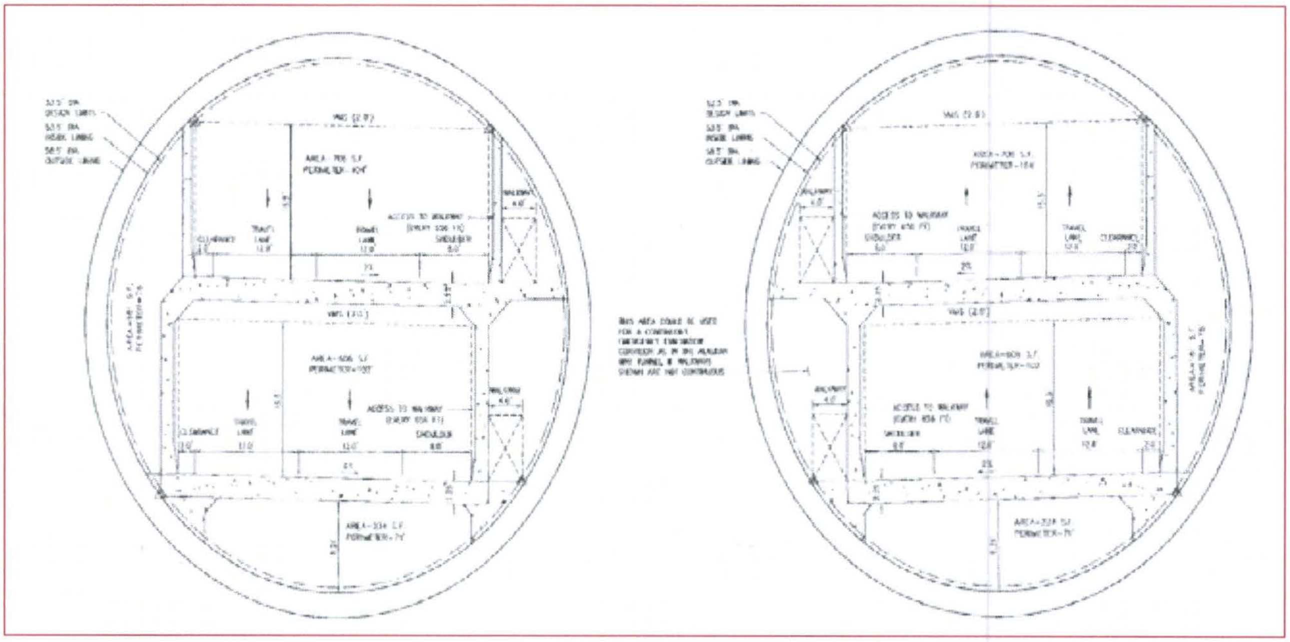
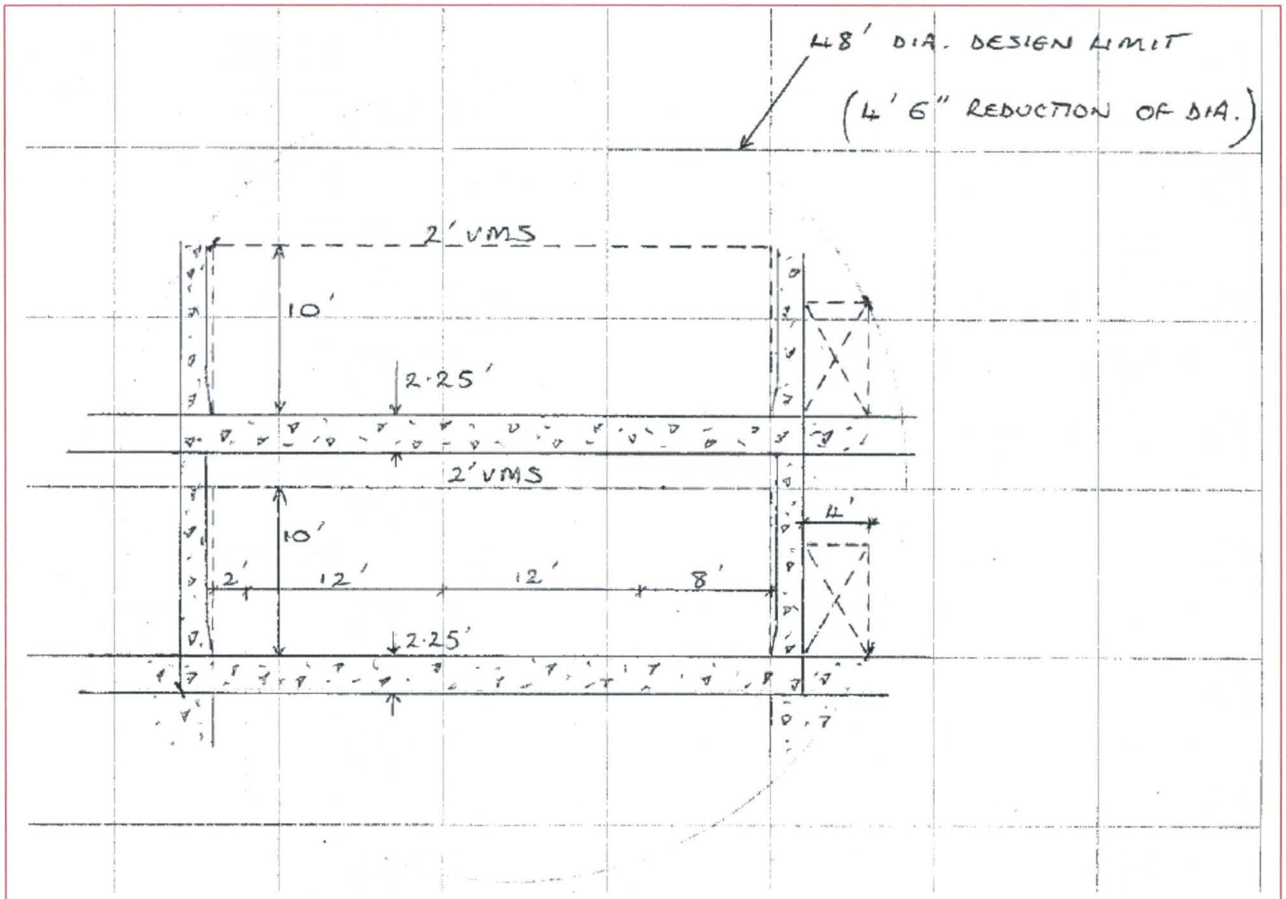
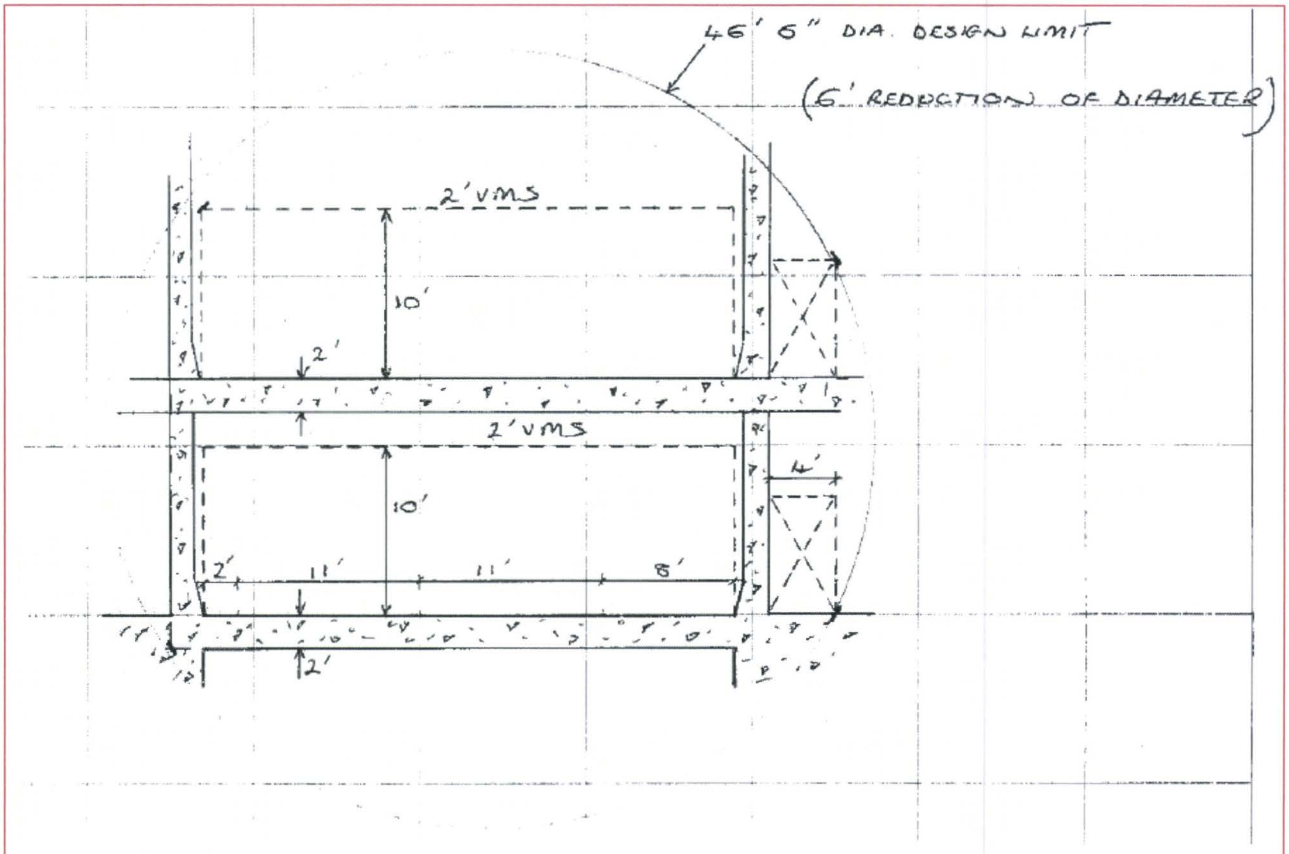


Exhibit 6. VA Proposal Concept Sketch, Scenario 1



Scenario 1 – Car-only tunnel with 12-foot lane widths with 10-foot vertical traffic clearance

Exhibit 7. VA Proposal Concept Sketch, Scenario 2



Scenario 2 – Car-only tunnel with 11-foot lane widths with 10-foot vertical traffic clearance

Exhibit 8. Paris A86 Tunnel Cross Section, 34.1-foot ID

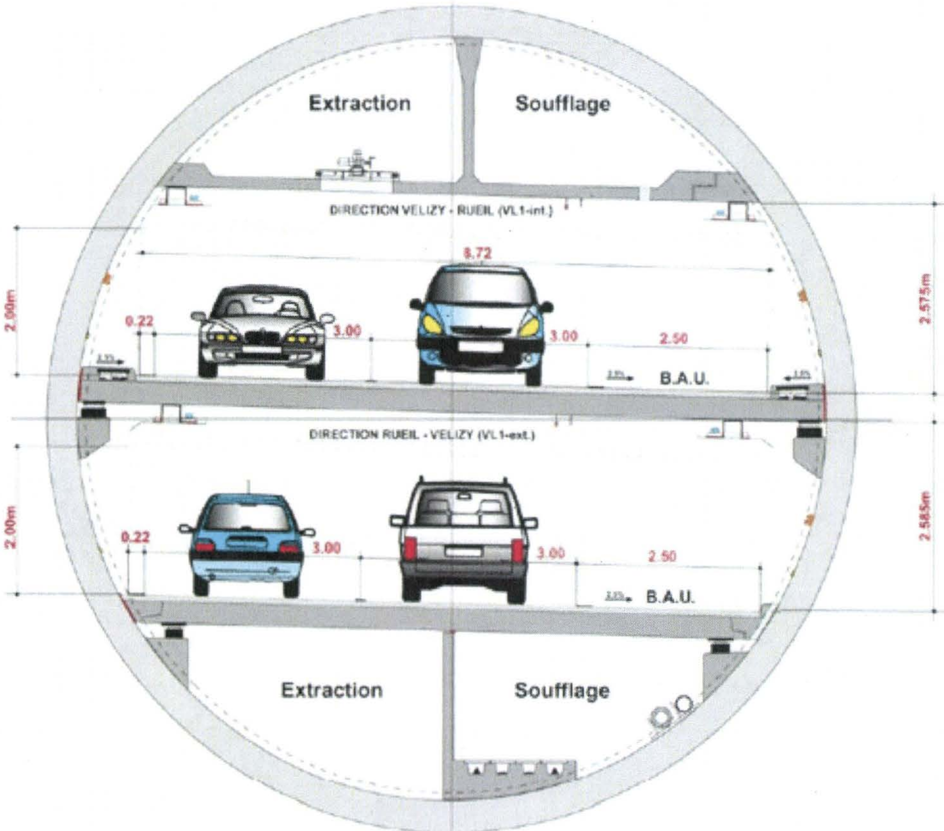
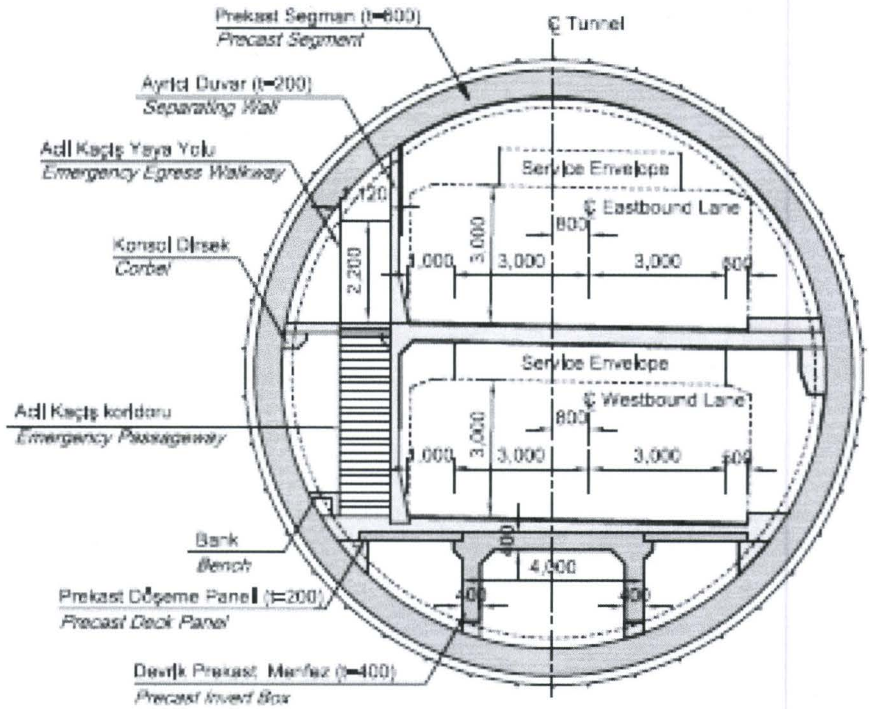


Exhibit 9. Planned Istanbul Eurasia Tunnel Cross Section



VA PROPOSAL NO. FT2

Proposal Title: Car-Only Freeway Tunnel at 46.5-foot Internal Design Diameter (ID) vs. 52.5-foot ID

Exhibit 10. Initial Cost Estimates

INITIAL COSTS								ALT. NO.
CONSTRUCTION ELEMENT		*BASELINE CONCEPT*			*VA PROPOSAL CONCEPT*			
Description	Unit	Qty	Cost/Unit	Total	Qty	Cost/Unit	Total	
STRUCTURE ITEMS								
TBM Purchase		1	$ 300,000,000	$ 300,000,000	1	$ 266,000,000	$ 266,000,000	
Tunnel Excavation		1	$ 1,600,000,000	$ 1,600,000,000	1	$ 1,340,000,000	$ 1,340,000,000	
Internal Structures		1	$ 220,000,000	$ 220,000,000	1	$ 195,000,000	$ 195,000,000	
Tunnel Contingency		1	$ 1,200,000,000	$ 1,200,000,000	1	$ 1,060,000,000	$ 1,060,000,000	
North & South C&C Tunnel		1	$ 503,000,000	$ 503,000,000	1	$ 377,250,000	$ 377,250,000	
STRUCTURE SUBTOTAL				*$ 3,823,000,000*			*$ 3,238,250,000*	
STRUCTURE MARK-UP			Included	$ -		*Included*	$ -	
STRUCTURE TOTAL				*$ 3,823,000,000*			*$ 3,238,250,000*	
ENVIRONMENTAL MITIGATION ITEMS								
				$ -			$ -	
				$ -			$ -	
CAPITAL OUTLAY SUPPORT ITEMS								
Reengineering and Redesign				$ -			$ -	
Project Engineering				$ -			$ -	
TOTAL		$		3,823,000,000	$		3,238,250,000	
TOTAL (Rounded)				$3,823,000,000			$3,238,250,000	
						SAVINGS	**$584,750,000**	

See attached estimate for details

Life-Cycle Cost Estimates: The VA team did not provide future cost calculations for this proposal because it was not felt that significant differences in future costs between the VA proposal and the Baseline Alternative could be quantified or computed at this conceptual phase of design. The future cost difference for this VA proposal is therefore zero, and the Net Life Cycle Cost as shown in the cost summary at the top of this proposal is the same as the Initial Cost Saving (or Premium if a negative value is shown in parentheses).

VA PROPOSAL NO. FT2

Proposal Title: Car-Only Freeway Tunnel at 46.5-foot Internal Design Diameter (ID) vs. 52.5-foot ID

Assumptions and Calculations:

The following is based on Scenario 2, with 11-foot traffic lanes, because this produces the greatest cost savings. It is also considered that an 11-foot lane width should be adequate in a tunnel that is designated car-only. Backup details for the cost estimate are provided below.

Major Components of Cost for TBM Tunnel

No.	Component	Assumed Relationship to Cost	Where is this covered in Baseline Cost Estimate?	Baseline Cost ($)
1	TBM Purchase	Diameter	Part of mobilization	Assume $300,000,000 (four TBMs)
2	Segment Manufacture	Diameter	Tunnel excavation	$1,600,000,000
3	Spoils Disposal	Volume	Tunnel excavation	
4	Internal Structures	Diameter	Tunnel roadway deck/slab	$220,000,000

Calculation of Cost Factors

No.	Option	Design Limit Diameter (feet)	Volume (cubic feet)	Cost Factor Based on Diameter	Cost Factor Based on Volume
1	Baseline	52.5	2,165	-	-
2	12-foot Lanes	48	1,810	0.914	0.836
3	11-foot Lanes	46.5	1,700	0.886	0.785

Segment manufacture and spoils removal are part of the $1.6 billion tunnel excavation baseline cost item. Base cost savings on average of "diameter" and "volume" cost factors; i.e., 0.875 for 12-foot lanes and 0.836 for 11-foot lanes.

Calculation of Cost Savings

No.	Option	Component	Baseline Cost	Cost Factor	Cost Saving
1	12-foot Lanes	Tunnel Excavation	$1,600,000,000	0.875	$200,000,000
		TBM Purchase	$300,000,000	0.914	$25,800,000
		Internal Structures	$220,000,000	0.914	$18,920,000
		Tunnel Contingency	$1,200,000,000	0.914	$103,200,000
		Total Savings			**$347,920,000**
2	11-foot Lanes	Tunnel Excavation	$1,600,000,000	0.836	$262,400,000
		TBM Purchase	$300,000,000	0.886	$34,200,000
		Internal Structures	$220,000,000	0.886	$25,080,000
		Tunnel Contingency	$1,200,000,000	0.886	$136,800,000
		Total Savings			**$458,480,000**

Note, savings associated with ventilation systems, reduced TBM power requirements, the seismic fault, and potential schedule savings due to increased progress rates are not included. Contingencies and markups are built in to the calculations.

The above calculations also do not include the savings that would arise from reducing the vertical clearance and/or lane width of the adjacent cut-and-cover tunnel sections outside the bored tunnel portals. The overall height of the cut-and-cover tunnel structure could be reduced by a total of approximately 11 feet. As a percentage of the overall height of the cut-and-cover box, this is approximately a 30 percent reduction in height. This would not, however, equate to an overall cost reduction of 30 percent of the south and north cut-and-cover tunnel costs, because the overall depth of excavation would be affected by a significantly smaller percentage. For the purposes of these calculations, assume a 25 percent reduction of cost for the south and north portal cut-and-cover sections.

- Total cost of south and north cut-and-cover tunnel sections in baseline scheme = $503,000,000 (including the 79.5 percent for contingency and markups).
- Therefore, the total cost savings associated with cut-and-cover tunnel works = $125,750,000

*Summary of Car-Only Tunnel Cost Savings for **Scenario 2** (Bored and Cut-and-Cover Tunnel):*

Total Cost Savings = $458,480,000 (bored tunnel) + $125,750,000 (cut-and-cover tunnel) = $584,230,000

- The above calculations have been performed for the twin-bore tunnel arrangement, but the principal of reducing vertical clearance is equally applicable to the single-bore tunnel option in VA Proposal FT-1. The cost savings associated with the single-bore tunnel would be 50 percent of those presented above. For Scenario 2, with 10-foot vertical traffic clearance and 11-foot lane widths the cost savings would be as follows:

  Cost Savings - $584,230,000/2 = $292,115,000

VA PROPOSAL NO. FT3

Proposal Title: Raise the Profile at the North Portal by 40 feet Retaining the Same Cover as the Base Design

Initial Cost Savings:	$198,000,000
Future Cost Savings:	$0
Net LCC Savings:	$198,000,000
Change in Schedule:	Possible Reduction
Performance Change:	0 %
Value Change:	+4 %

Description of Baseline Concept: The baseline concept is based on Alternative F-7. The transition from tunnel boring machine (TBM)-driven bored tunnel to cut-and-cover tunnel occurs at the north portal, which is located at Station 423 + 60. At this point, the top of the TBM tunnel has approximately 50 feet of cover to ground surface. The cut-and-cover tunnel has a length of 1,625 feet before transitioning to open cut and a surface alignment. The gradient throughout this section of the alignment is 3.5 percent. See attached exhibits for a long section of the baseline concept.

Description of VA Proposal Concept: The VA proposal is based on raising the alignment at the north portal by approximately 40 feet. This can be achieved by taking advantage of the fact that the ground level above the tunnel increases by approximately 40 feet at a distance of approximately 250 feet to the south of the portal location. By constructing a headwall at the existing portal location and backfilling to this higher level we can increase the cover at the portal location by 40 feet (see exhibits for an illustration of this concept). The bored tunnel alignment can then be raised by 40 feet.

Raising the alignment by 40 feet has the effect of almost eliminating the cut-and-cover tunnel. The upper roadway can be located in a retained cut immediately adjacent to the bored tunnel portal, while the lower roadway must initially be located in a simple cut-and-cover box until the point at which it has transitioned horizontally and is no longer located beneath the upper roadway (the lower roadways would transition inward toward one another). At that point, the lower roadway could also be located in retained cut. A cross section illustrating the typical arrangement once the lower roadway has transitioned to retained cut is included in the exhibits.

Advantages:

- Significant cost reductions due to elimination of the majority of the cut-and-cover tunnel adjacent to the north portal.
- Significantly reduced volume of excavation and backfill required in the portal area and transition to a surface alignment, resulting in less truck movements to remove the spoil.
- Potential to reuse some of the spoil that is excavated to form the portal area as backfill behind the headwall (providing the increased cover).
- Bridges at Del Mar Boulevard, West Green Street, and West Colorado Street would not need to be replaced.
- Potential benefit for the ventilation/fire life safety (FLS) design as the overall tunnel length is effectively reduced by the length of the cut-and-cover (approximately 1,600 feet).
- Facilitates the provision of local on- and off-ramps adjacent to the portal (see also VA Proposal 4).

Disadvantages:

- Potential location at which exhaust gases are emitted is much closer to Sequoyah School due to the elimination of most of the cut-and-cover tunnel.
- Increased traffic noise in the vicinity of Sequoyah School.
- Reduced cover to the TBM-driven tunnel as it passes beneath the residential areas to the south of the north portal, which could slightly increase settlements.
- Additional cost of retaining wall and placing the backfill, although this is minor compared with the potential cost savings.

Discussion: The existing baseline concept has been designed to provide close to one tunnel diameter of cover at the tunnel portal where the TBM will be launched. This follows typical industry practice for TBM portals. However, the alternative proposal enables this amount of cover to be maintained, while also allowing the alignment to be raised by approximately 40 feet. This is achieved through the use of a retaining wall and backfill to provide additional cover at the portal.

The main benefit of this alternative is that it largely eliminates the need for the cut-and-cover section of the tunnel, and also potentially enables the bridges at Del Mar Boulevard, West Green Street, and West Colorado Street to be saved because the alignment is back to existing grade before getting to these bridges.

The elimination of much of the cut-and-cover also has potential benefits for the ventilation/FLS design because it effectively provides a shorter tunnel to be ventilated. There will therefore be less demand on the ventilation equipment.

The major disadvantages include the potential for increased traffic noise and reduced air quality in the vicinity of Sequoyah School. This is a result of the fact that traffic using the upper roadway would leave the tunnel at the bored tunnel portal, rather than 1,625 feet further north at the end of the baseline scheme cut-and-cover section. However, with the adoption of air cleaning technology at the portals (scrubbers and electrostatic precipitators) it should be possible to mitigate the impact to air quality.

It was also noted above that the alternative proposal will reduce the cover to the TBM when tunneling beneath the residential and commercial areas located to the south of Sequoyah School. However, the cover should still be approximately one tunnel diameter or greater, and it is considered that this is sufficient to enable tunneling activities to be undertaken safely and with minimal impacts on surface or underground structures, assuming the application of best practices by the tunneling contractor.

Technical Review Comments: This alternative is considered to be technically feasible; however, it is recommended that the design team should perform further due diligence to confirm the amount of additional cover that could be provided by the retaining wall/backfilling concept. Further evaluation of the impact that this would have on the ventilation design should also be performed. It is recommended that the design team should take a more detailed look at whether this VA proposal enables the existing bridges at Del Mar Boulevard, West Green Street, West Colorado Boulevard, and Union Street to be saved.

Proposal Title: Raise the Profile at the North Portal by 40 feet Retaining the Same Cover as the Base Design

The design team could also make additional refinements and improvements to this alternative by considering the following:

- Potential to reduce the amount of cover that is required at the bored tunnel portal through ground treatment, etc.
- Potential to reduce the horizontal separation of the bored tunnels to less than one tunnel diameter through analysis of the actual ground conditions, loads, and stresses occurring in the pillar of soil located between the tunnels. Consideration of ground treatment as an improvement, in order to reduce the horizontal footprint of the excavation in the portal area.
- Consider increasing the gradient beyond the current 3.5 percent so that the alignment gets to grade more quickly. This will further shorten the retained cut-and-cover sections, as well as reduce the amount of excavation required in the portal area.

Project Management Considerations: No real impact on project management.

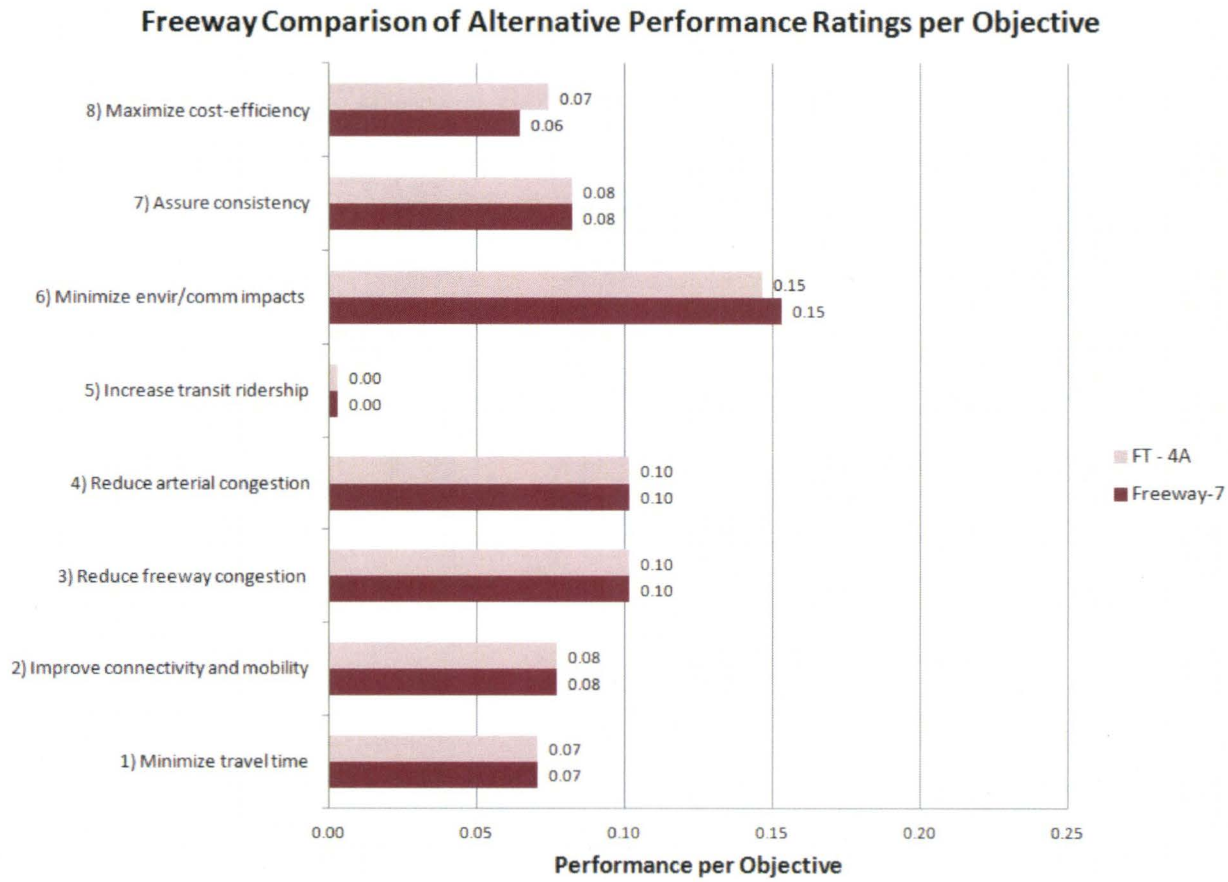
Discussion of Schedule Impacts: It is anticipated that this VA proposal may provide a minor improvement to the schedule. It is assumed that the construction of the cut-and-cover boxes required by the existing baseline scheme would need to occur after completion of the TBM tunnel, and that at least some of that work may be on the critical path. The alternative proposal significantly reduces the amount of cut-and-cover tunnel work required, and therefore has the potential to reduce the overall duration required to finish the north portal area once the TBM tunneling work is complete.

Discussion of Risk Impacts: In general, it is anticipated that this VA proposal has only a minor impact on risk, although it does potentially exacerbate some risks:

- The alternative could increase opposition from Sequoyah School and residents/business immediately adjacent to the north portal.
- A slight increase in risk associated with launching the TBM and then immediately passing beneath Sequoyah School and other properties with 40 feet less cover.

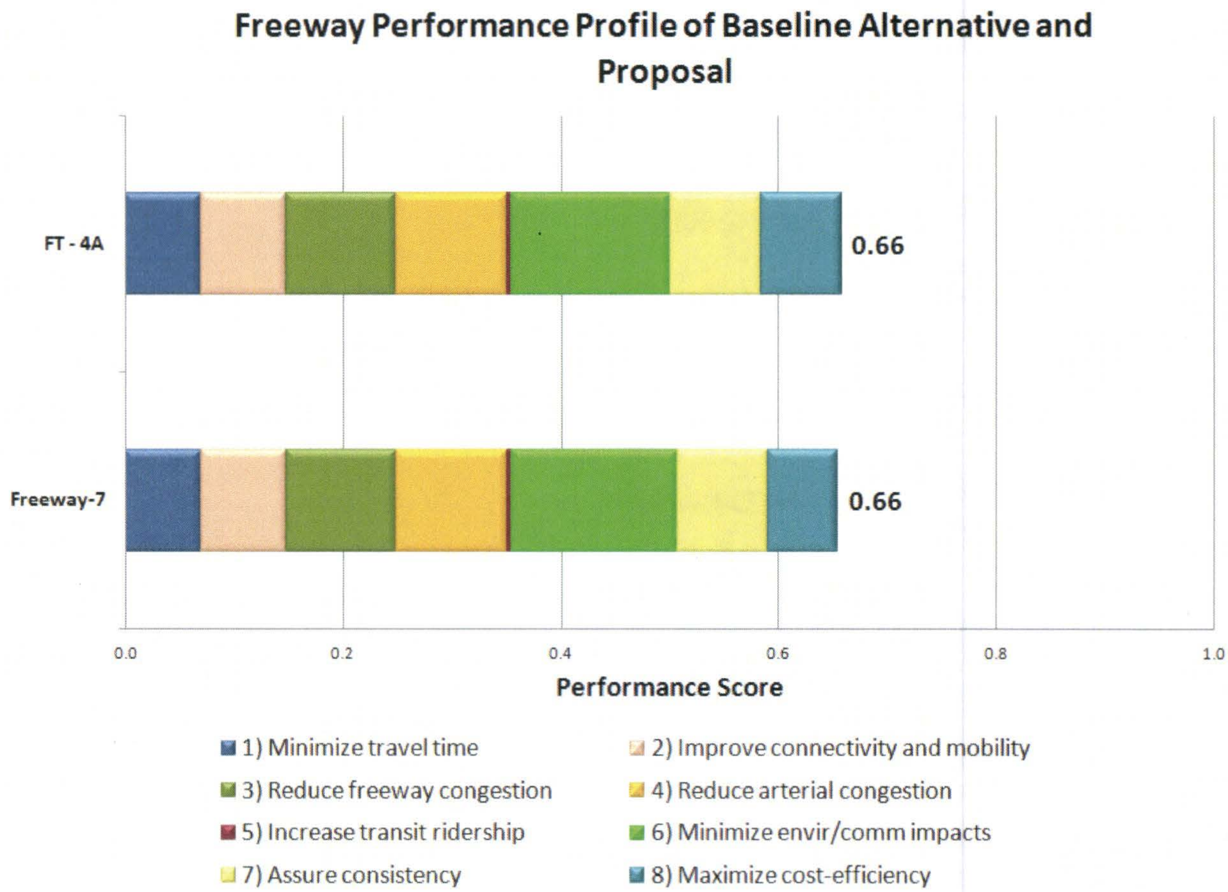
Proposal Title: Raise the Profile at the North Portal by 40 feet Retaining the Same Cover as the Base Design

Exhibit 1. Performance Ratings



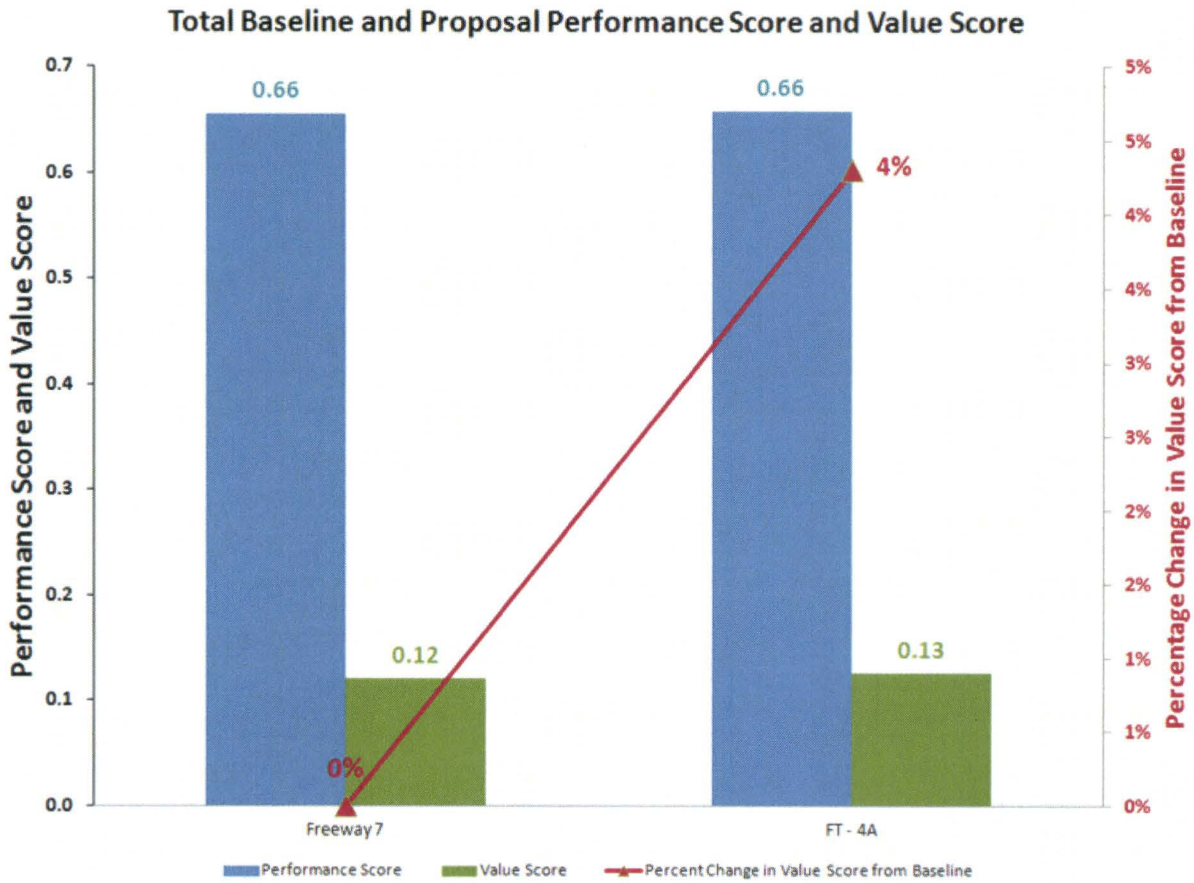
Proposal Title: Raise the Profile at the North Portal by 40 feet Retaining the Same Cover as the Base Design

Exhibit 2. Performance Profile



Proposal Title: Raise the Profile at the North Portal by 40 feet Retaining the Same Cover as the Base Design

Exhibit 3. Benefit and Cost Performance



Proposal Title: Raise the Profile at the North Portal by 40 feet Retaining the Same Cover as the Base Design

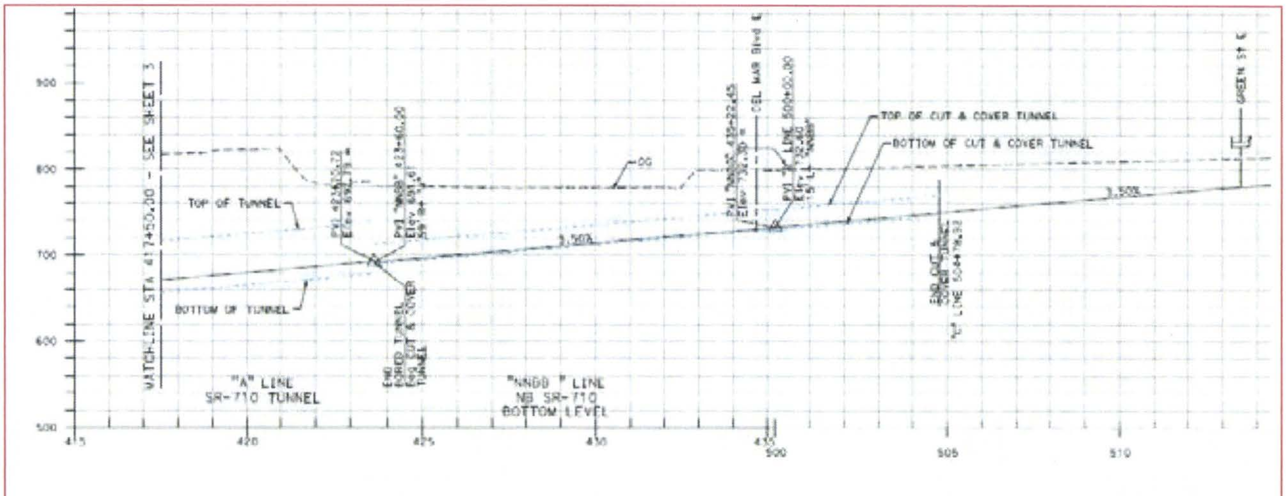
Exhibit 4. Performance Assessment

Performance Attributes (Objectives) Evaluation

Objectives	**Comment** **(Influence of the VA Proposal upon the Objective)**	**Rating** **(VA Proposal "Improves Performance" or "No Change" or "Reduces Performance")**
Minimize Travel Time	N/A	No change
Improve Connectivity and Mobility	Facilitates the local on-/off-ramps contained in VA Proposal FT4.	Improves performance
Reduce Congestion on Freeway System	N/A	No change
Reduce Congestion on Local Street System	N/A	No change
Increase Transit Ridership	N/A	No change
Minimize Environmental and Community Impacts Related to Transportation	Potentially reduces air quality and increases noise at Sequoyah School.	Reduces performance
Assure Consistency with Regional Plans and Strategies	N/A	No change
Maximize Cost Efficiency of Public Investments	Significant cost savings possible for similar functionality.	Improves performance

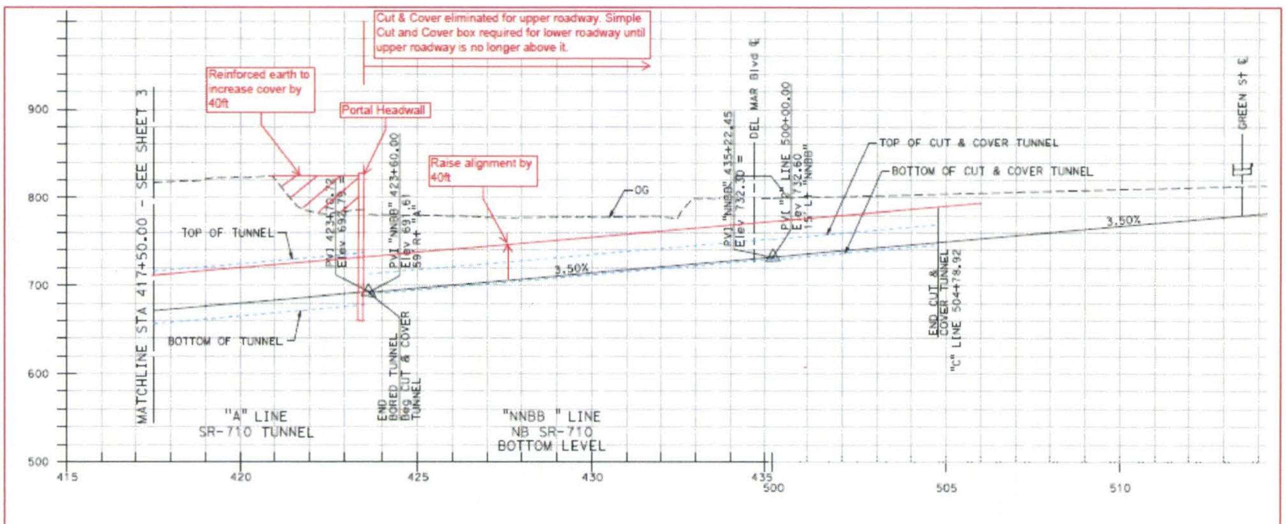
Proposal Title: Raise the Profile at the North Portal by 40 feet Retaining the Same Cover as the Base Design

Exhibit 5. Baseline Concept Sketch



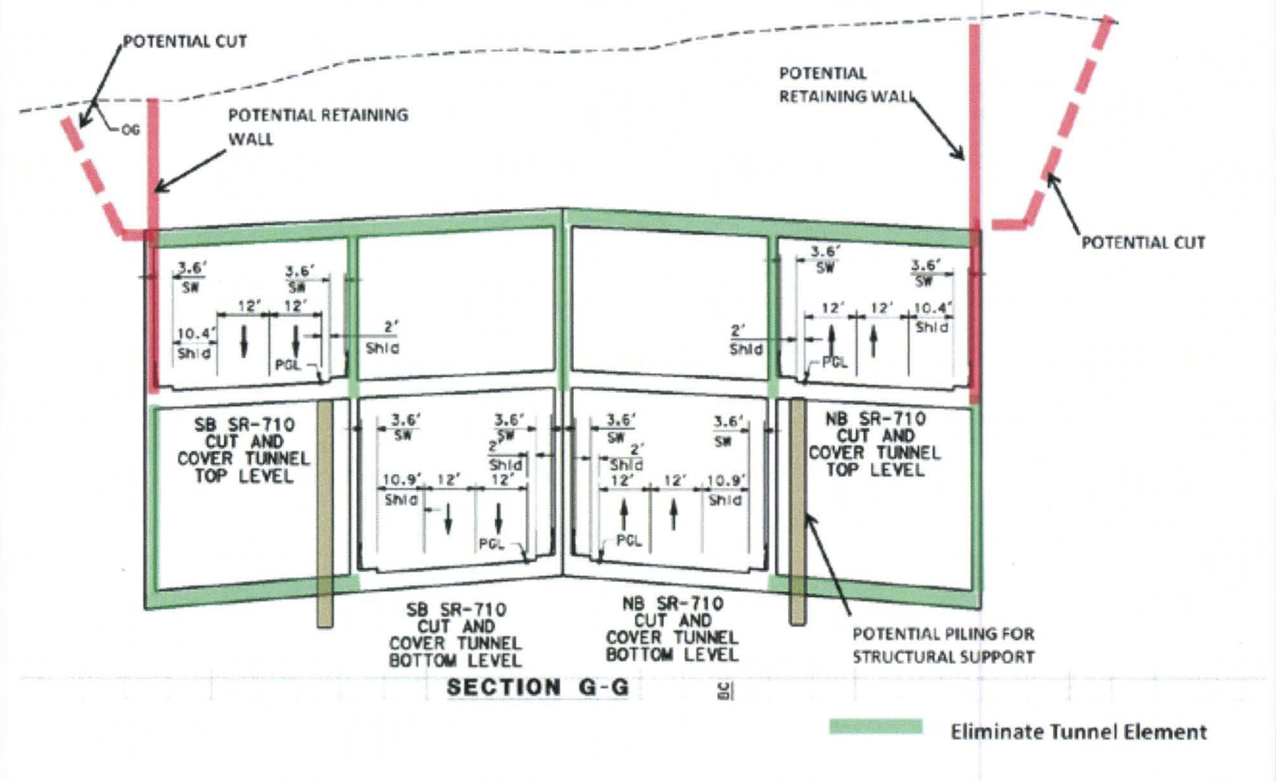
Vertical Alignment of Baseline Concept at North Portal

Exhibit 6. VA Proposal Concept Sketch



VA Proposal for North Portal with Revised Vertical Alignment Raised by 40 feet

Exhibit 7. Cross Section



Cross Section where Lower Roadway is no longer located beneath Upper Roadway

Proposal Title: Raise the Profile at the North Portal by 40 feet Retaining the Same Cover as the Base Design

Exhibit 8. Initial Cost Estimates

INITIAL COSTS								ALT. NO.
CONSTRUCTION ELEMENT		*BASELINE CONCEPT*			*VA PROPOSAL CONCEPT*			
Description	Unit	Qty	Cost/Unit	Total	Qty	Cost/Unit	Total	
STRUCTURE ITEMS								
Delmar Blvd OC		1	$ 6,375,000	$ 6,375,000	1	$ 1,000,000	$ 1,000,000	
West Colorado Blvd OC		1	$ 4,825,000	$ 4,825,000	1	$ 500,000	$ 1,000,000	
West Green Street OC		1	$ 10,900,000	$ 10,900,000	1	$ 1,000,000	$ 1,000,000	
West Union Street OC		1	$ 5,300,000	$ 5,300,000	1	$ 500,000	$ 1,000,000	
North Portal Headwall		240	$ 10,000	$ 2,400,000	240	$ 14,000	$ 3,360,000	
North Portal Backfill		0	$ 15	$ -	200,000	$ 15	$ 3,000,000	
North Cut & Cover Tunnel		1,600	$ 79,840	$ 127,744,000	460	$ 79,840	$ 36,726,400	
				$ -			$ -	
STRUCTURE SUBTOTAL				*$ 157,544,000*			*$ 47,086,400*	
STRUCTURE MARK-UP			79.50%	*$ 125,247,480*		*79.50%*	*$ 37,433,688*	
STRUCTURE TOTAL				*$ 282,791,480*			*$ 84,520,088*	
ENVIRONMENTAL MITIGATION ITEMS								
				$ -			$ -	
				$ -			$ -	
CAPITAL OUTLAY SUPPORT ITEMS								
Reengineering and Redesign				$ -			$ -	
Project Engineering				$ -			$ -	
TOTAL		$		282,791,480	$		84,520,088	
TOTAL (Rounded)				$282,790,000			$84,520,000	
						SAVINGS	**$198,270,000**	

Life-Cycle Cost Estimates: The VA team did not provide future cost calculations for this proposal because it was not felt that significant differences in future costs between the VA proposal and the Baseline Alternative could be quantified or computed at this conceptual phase of design. The future cost difference for this VA proposal is therefore zero, and the Net Life Cycle Cost as shown in the cost summary at the top of this proposal is the same as the Initial Cost Saving (or Premium if a negative value is shown in parentheses).

VA PROPOSAL NO. FT3

Proposal Title: Raise the Profile at the North Portal by 40 feet Retaining the Same Cover as the Base Design

Assumptions and Calculations: Assumptions are as follows:

- Raising the alignment enables the bridges at Del Mar Boulevard, Green Street, Colorado Boulevard, and Union Street to be saved with only minor work required.
- Unit rate for the existing baseline scheme portal headwall is assumed to be $10,000/linear feet (lf), based on the $6,000/lf quoted for a 40-foot+ retaining wall in the design team's cost estimate report. The alternative proposal increases the height of this headwall by 40 feet, so the unit cost has been increased to $14,000/lf.
- Volume of backfill required behind the new headwall is calculated as follows:
  - Plan area of backfill = (250 feet long x 240 feet wide) = 60,000 square feet (ft^2)
  - Average depth of backfill = 30 feet
  - Total volume of backfill = 30 x 60,000 = 1,800,000 ft^3 (67,000 cubic yards [yd^3])
- Unit cost for placement of backfill (using material excavated from portal area) = $15/$yd^3$
- Reduction on length of cut-and-cover is calculated as follows:
  - Current length of baseline scheme cut-and-cover = 1,600 feet
  - Alignment is raised by 40 feet, with a gradient of 3.5 percent, therefore corresponding reduction in length of required cut-and-cover = 1,140 feet.
  - Therefore, remaining length of cut-and-cover tunnel = 1,600 feet – 1,140 feet = 460 feet.

VA PROPOSAL NO. FT4

Proposal Title: Additional SR 710 Access Located at the North Project Terminus

Initial Cost Savings:	($47,000,000)
Future Cost Savings:	$0
Net LCC Savings:	($47,000,000)
Change in Schedule:	(---)
Performance Change:	+30 %
Value Change:	+29 %

Description of Baseline Concept: The baseline concept for the potential build Alternative F-7 provides direct connectivity between I-10 on the south to SR-134 and I-210 to the north. At the northern Project terminus the baseline concept provides access from SR 710 only to SR-134 and I-210 through the system interchange. The baseline concept replaces the existing bridges crossing over SR 710 including Del Mar Boulevard, Green Street, Colorado Boulevard, and W Union Street.

The limits of baseline concept are listed below.

Location	Sta	Sta	Length (Feet)
South Roadway	119+25	163+25	4,400
South Cut & Cover	163+25	180+00	1,675
TBM	180+00	423+75	24,375
North Cut & Cover	423+75	440+00	1,625
North Roadway	505+00	530+00	2,500

Description of VA Proposal Concept: The VA proposal concept would provide a new access to the SR 710 from Pasadena. The proposed VA concept utilizes one-way local street network to provide this access. Additional access would be provided from northbound SR 710 to connect with Pasadena Avenue. Additional southbound access to SR 710 would be provided from Saint John Avenue. Access would be provided via two slip ramps that would begin just north of the TDM tunnel portal location, see figure below.

The VA proposal maintains the horizontal tunnel alignment and the location of the TDM portal as illustrated in the Alternative F-7 exhibits. There is a potential to raise the profile grade of the tunnel alignment in the vicinity of the TDM Portal by approximately 40' which would reduce the overall change in grade between these new ramps and the surface streets. This VA proposal considers the profile shown for alternative F-7.

The spacing between the new southbound entrance ramp and the eastbound SR-134 to southbound SR 710 direct connector entrance ramp would be less than desirable and may affect traffic operations due to merging and weaving maneuvers. Therefore, the VA proposal concept would realign the SR-134 to southbound SR 710 direct connector ramp to function similar to a collector distributor roadway. The new access ramp from Saint John Avenue would connect to the SR-134 entrance ramp and these two movements would merge prior to connecting to southbound SR 710. This requires a wider foot-print for the highway connections; however, the speed of the ramps could be lower and traffic operations should be improved. The new southbound ramp from Pasadena Avenue is configured in such a way to allow the profile grade of the ramp to transition down to connect with the direct connector ramp from SR-134.

This configuration provides for approximately 1500 feet for the profile grade to meet the mainline profile.

The proposed VA concept for the exit ramp to Pasadena Avenue is configured in such a way to accommodate changes in speed associated with the new exit ramp. A parallel lane configuration would be proposed to provide for the exit to Pasadena Avenue. The parallel lane would allow for deceleration for the exit ramp traffic. This exit ramp would braid (cross under) with the new southbound entrance ramp from Pasadena Avenue. The profile grade of the new exit ramp would be in the range of 7 percent.

The new Green Street and Del Mar Boulevard bridges would be widened by approximately 12' from those shown in the potential build alternative F7 to accommodate additional left turn lanes.

Advantages:

- Additional north south access to and from the Pasadena area.
- Improve traffic operations at the SR-134 I-210/SR 710 system interchange.
- Proposal does not require additional right-of-way.

Disadvantages:

- Additional highway width to accommodate new ramp access.
- Local street traffic could increase due to motorist accessing the new ramps.
- Increase in Project Costs.

Discussion: See concept description above.

Technical Review Comments: The access would require some complex geometric configurations. The potential impact to the local street congestion would need to be evaluated in further detail before advancing the concept.

Project Management Considerations: The VA concept is an increase on overall Project costs. The potential value this brings compared with the increase costs would need to be considered by the Project management prior to advancing the concept. Changes to regional planning would also need to be considered by Project Management.

Discussion of Schedule Impacts: At this stage in the concept considerations the key schedule impact could be changes to Regional planning and community involvement related to advancing the concept.

Discussion of Risk Impacts: The potential for additional traffic on the local street network may create congestion to levels that cannot be mitigated. These types of risks would be considered as part of the concept development phase.

Exhibit 1. Performance Ratings

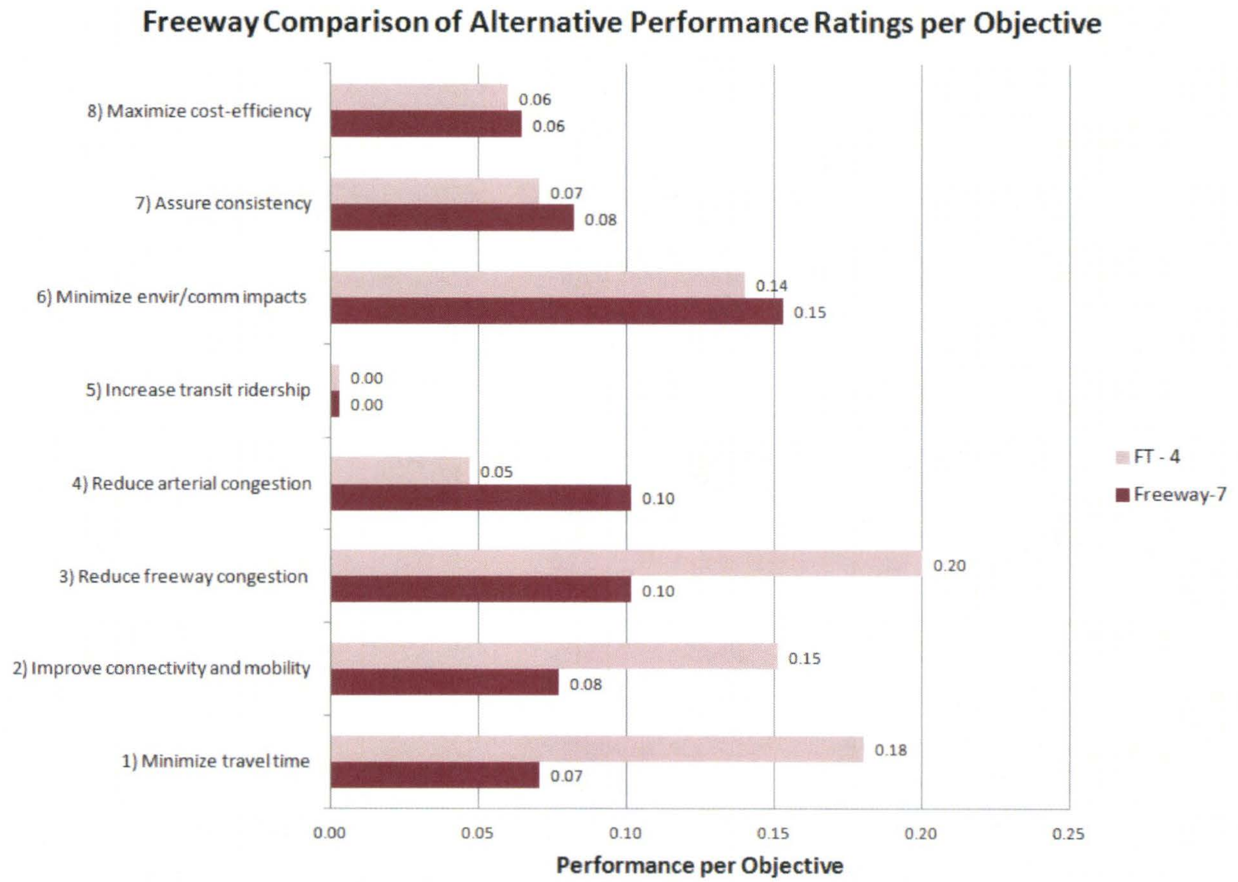


Exhibit 2. Performance Profile

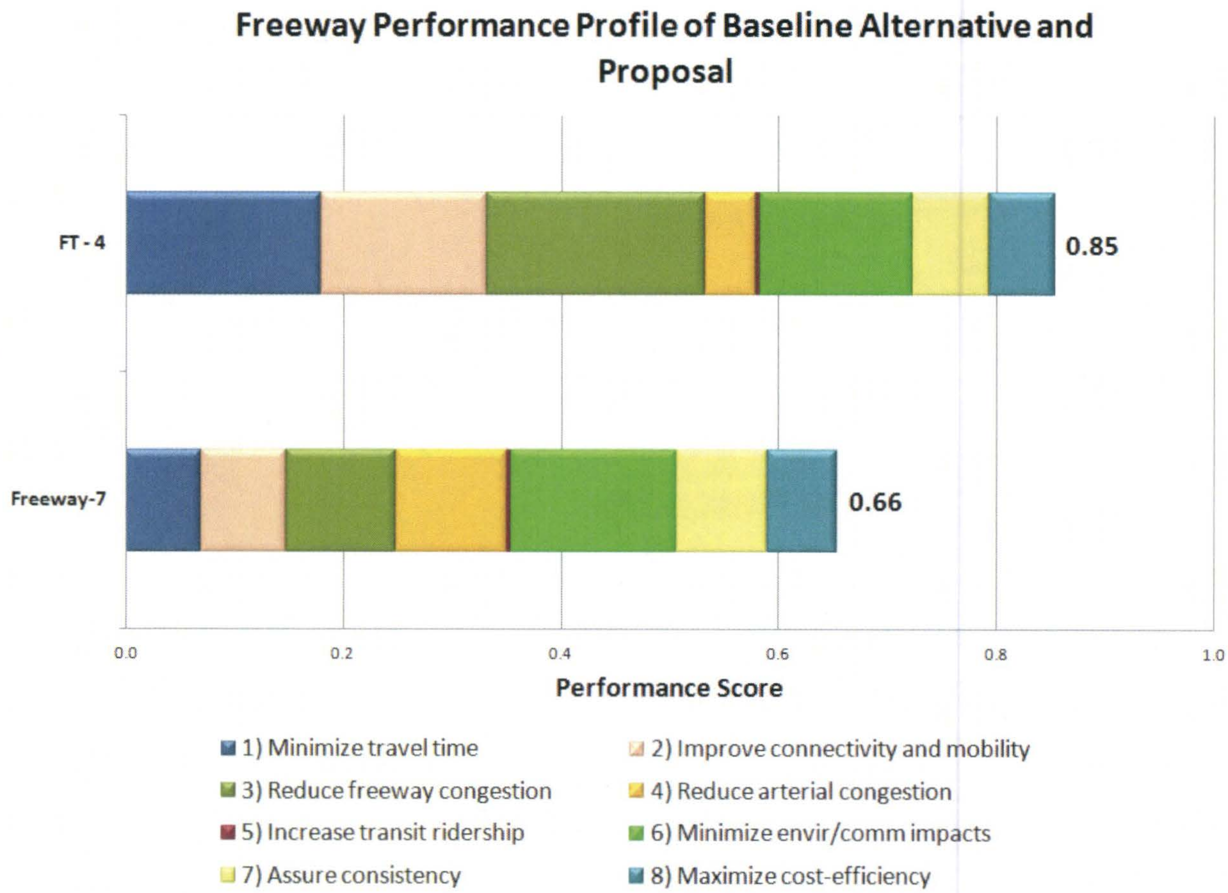


Exhibit 3. Benefit and Cost Performance

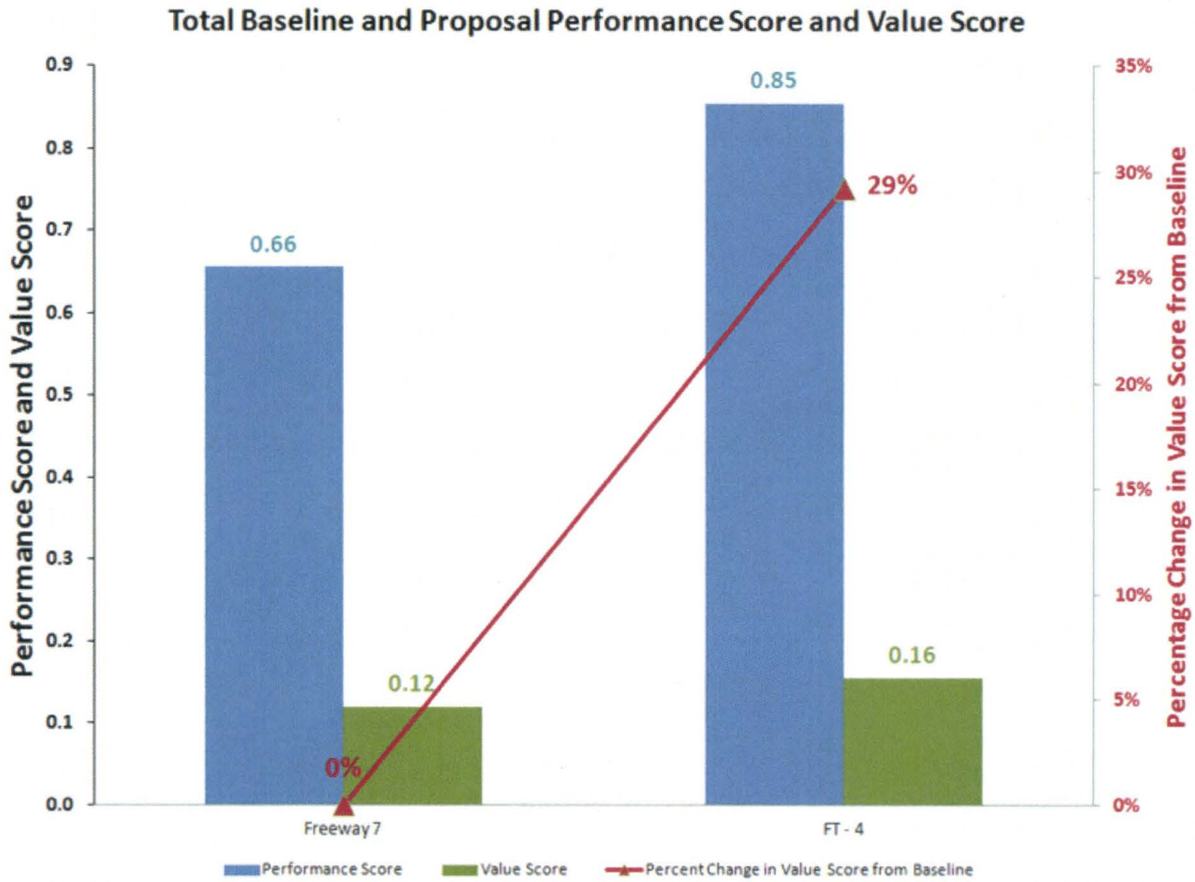
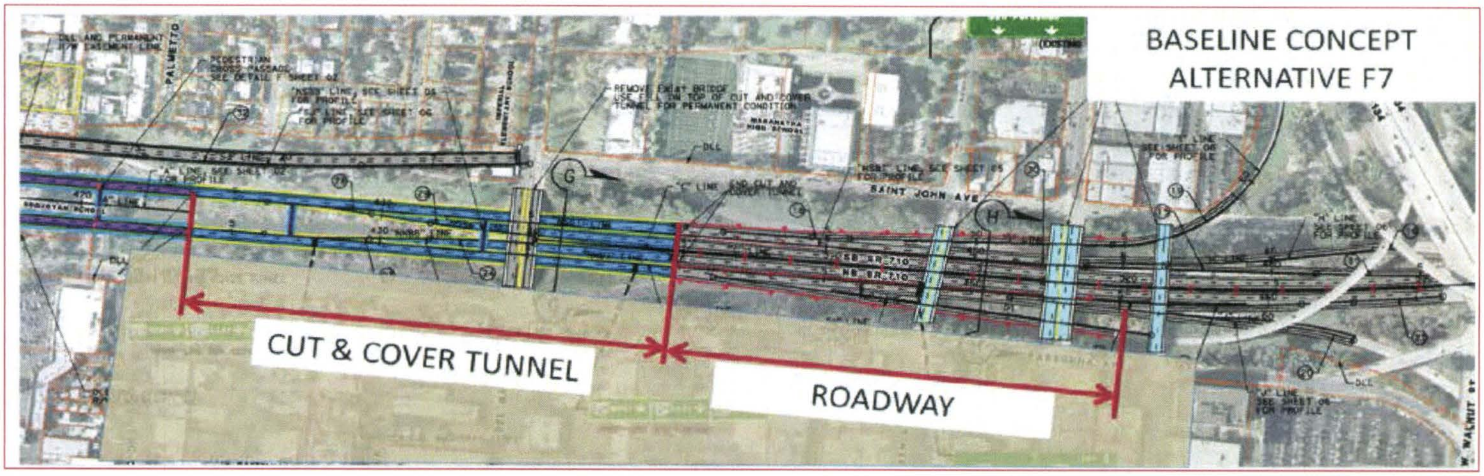


Exhibit 4. Performance Assessment

Performance Attributes (Objectives) Evaluation

Objectives	**Comment** (Influence of the VA Proposal upon the Objective)	**Rating** (VA Proposal "Improves Performance" or "No Change" or "Reduces Performance")
Minimize Travel Time	Reduces local traffic travel times to access SR 710	Improves Performance
Improve Connectivity and Mobility	Creates a new connection to SR 710 not provided as part of Baseline.	Improves Performance
Reduce Congestion on Freeway System	The new connection would potentially provide minor reductions congestion at the SR-134 & 1-210 system interchange.	Improves Performance
Reduce Congestion on Local Street System	The local street congestion could be adversely affected due to the new access to SR 710.	Reduces Performance
Increase Transit Ridership	The proposed VA concept may draw trips away from transit due to the new access to SR 710.	Reduces Performance
Minimize Environmental and Community Impacts Related to Transportation	The affects to the local street network could be viewed as an adverse affect to communities.	Reduces Performance
Assure Consistency with Regional Plans and Strategies	The VA proposed concept may not be consistent with regional plans.	TBD – Such a proposal could be reevaluated to be included in the regional plan as part of the environmental process.
Maximize Cost Efficiency of Public Investments	This VA proposal would require additional investment.	Reduces Performance

Exhibit 5. Baseline Concept Sketch



VA PROPOSAL NO. FT4

Exhibit 6. VA Proposal Concept Sketch

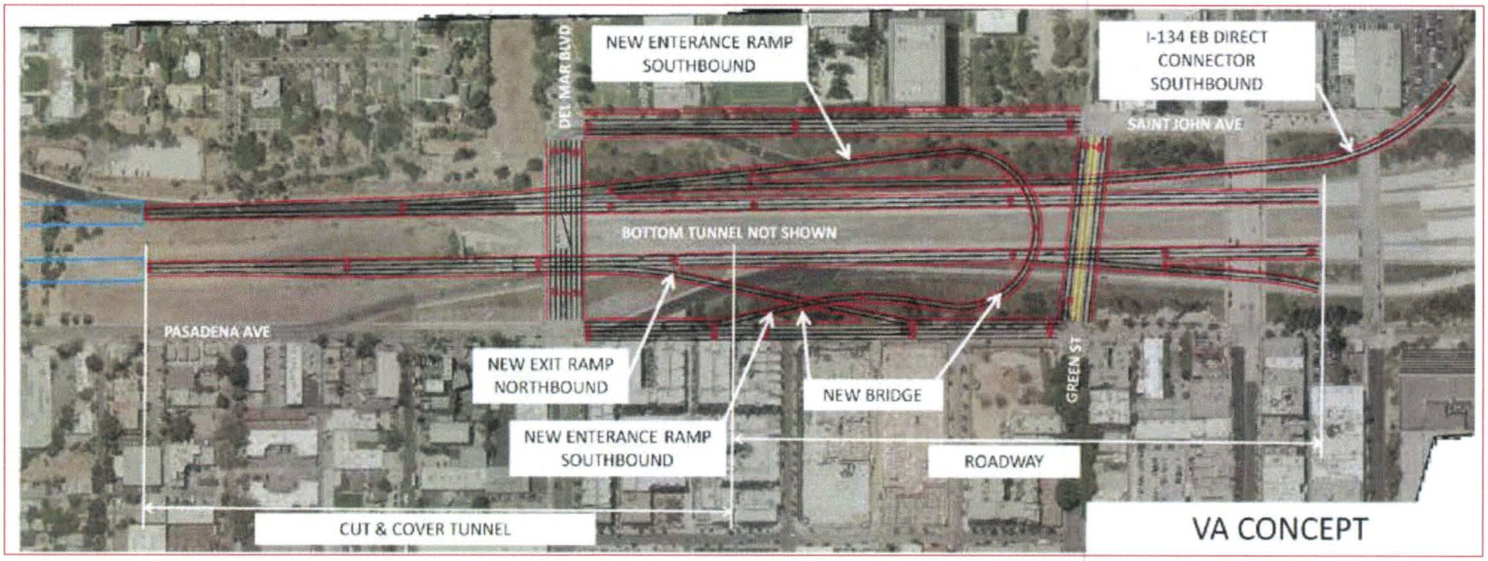


Exhibit 7. Initial Cost Estimates

INITIAL COSTS								ALT. NO. FT-4
CONSTRUCTION ELEMENT		*BASELINE CONCEPT*			*VA PROPOSAL CONCEPT*			
Description	Unit	Qty	Cost/Unit	Total	Qty	Cost/Unit	Total	
ROADWAY ITEMS								
Section 1, 2, 3 & 4	SF	342,000	$ 27	$ 9,234,000	445,000	$ 27	$ 12,015,000	
Section 5, 6, & 7	SF	342,000	$ 15	$ 5,130,000	445,000	$ 15	$ 6,675,000	
Section 8 (Additions)	SF	342,000	$ 61	$ 20,862,000	445,000	$ 61	$ 27,145,000	
				$ -			$ -	
ROADWAY SUBTOTAL				*$ 35,226,000*			*$ 45,835,000*	
ROADWAY MARK-UP				$ -			$ -	
ROADWAY TOTAL				*$ 35,226,000*			*$ 45,835,000*	
STRUCTURE ITEMS								
Bridges	SF	58,600	$ 443	$ 25,959,800	88,300	$ 443	$ 39,116,900	
Cut & Cover Tunnel	SF	323,400	$ 430	$ 139,062,000	354,400	$ 430	$ 152,392,000	
Section 10, 11, & 12	SF	323,400	$ 68	$ 21,991,200	354,400	$ 68	$ 24,099,200	
Section 12 (Additions)	SF	323,400	$ 252	$ 81,496,800	354,400	$ 252	$ 89,308,800	
				$ -			$ -	
STRUCTURE SUBTOTAL				*$ 268,509,800*			*$ 304,916,900*	
STRUCTURE MARK-UP				$ -			$ -	
STRUCTURE TOTAL				*$ 268,509,800*			*$ 304,916,900*	
RIGHT-OF-WAY ITEMS								
Right-of-Way Acquisition	LS	1	$ 75,000,000	$ 75,000,000	1	$ 75,000,000	$ 75,000,000	
				$ -			$ -	
				$ -			$ -	
RIGHT-OF-WAY TOTAL				*$ 75,000,000*			*$ 75,000,000*	
ENVIRONMENTAL MITIGATION ITEMS								
				$ -			$ -	
				$ -			$ -	
CAPITAL OUTLAY SUPPORT ITEMS								
Reengineering and Redesign				$ -			$ -	
Project Engineering				$ -			$ -	
TOTAL				$378,735,800			$425,751,900	
TOTAL (Rounded)				$378,740,000			$425,750,000	
						SAVINGS	**($47,010,000)**	

Life-Cycle Cost Estimates: The VA team did not provide future cost calculations for this proposal because it was not felt that significant differences in future costs between the VA proposal and the Baseline Alternative could be quantified or computed at this conceptual phase of design. The future cost difference for this VA proposal is therefore zero, and the Net Life Cycle Cost as shown in the cost summary at the top of this proposal is the same as the Initial Cost Saving (or Premium if a negative value is shown in parentheses).

Assumptions and Calculations: The comparison of costs between the Baseline Concept and the Proposed VA Concept are based on the overall costs for Alternative F-7 provided by the design team. These costs were divided into unit costs per the specific sections provided in the Conceptual Engineering Estimate and these unit costs were applied to both concepts. An area comparison of the two concepts was developed to quantify the difference between the two. The areas were divided into the limits of the bridges, cut and cover tunnel, and roadway section. The limits and areas are listed in the tables below.

VA Proposal FT4			
Limits of Concept Comparison	**Sta**	**Sta**	**Length**
Cut & Cover Tunnel	423+75	440+00	1625
Roadway	505+00	520+00	1500

Estimated Areas (SF)	Baseline	VA Concept
Roadway	342,000	445,000
Cut & Cover Tunnel	323,500	354,400
Bridges	58,600	88,300

VA PROPOSAL NO. FT5

Proposal Title: Relocate South Portal to North of Mission Street

Initial Cost Savings:	$433,000,000
Future Cost Savings:	$0
Net LCC Savings:	$433,000,000
Change in Schedule:	Constriction Time reduced by 0.75 years
Performance Change:	-26 %
Value Change:	-19 %

Upon reflection, this alternative was rejected in its present form due to environmental justice considerations. Essentially removing any homes along the entire route is considered unacceptable. Representatives of the City of Los Angeles have also requested that the tunnel begin south of Valley Boulevard to ensure that impacts to residents are minimized. While the proposal resulted in substantial cost savings, the environmental impacts are considered unacceptable, and the proposal should be rated "F". As part of its observations, the VA Team recommends additional focused study on the South Portal to identify alternative cost savings that can be developed while maintaining the constraints on tunnel entry and precluding the take of any residences. The balance of this proposal is continued for the record.

Description of Baseline Concept: The baseline proposal begins the cut-and-cover tunnels south of Valley Boulevard, and transitions to twin-bore tunnels between Valley Boulevard and the UPRR railroad, with each bore carrying two levels of traffic and two lanes on each level. The easterly tunnel carries northbound traffic; the westerly tunnel carries southbound traffic.

Description of VA Proposal Concept: The purpose of this proposal is to reduce costs by extending the surface (elevated) freeway on its originally planned 1970s alignment for approximately the first ½ mile; this would reduce costs and provide additional options for local access (once the freeway is subsurface in tunnels, providing local ramp access is very difficult).

The proposed revision changes the south end of the project to extend the originally planned elevated freeway through the primarily industrial area between Valley Boulevard and Mission Road, a distance of 0.63 mile. The project would construct a new bridge over Valley Boulevard and a new bridge over the UPRR and Mission Road. Mission Road would be realigned southerly to more closely follow the railroad, at a cost of relocating approximately six businesses (several of which may be owned by the California Department of Transportation [Caltrans]). The purpose of the Mission Road realignment is to shorten the freeway bridge over the railroad and Mission Road, and allow the freeway to begin its vertical curve toward tunnel conditions at the centerline of UPRR (Mission Road requires less vertical clearance than the railroad.). Concord Avenue would be realigned to terminate at realigned Mission Road east of the freeway, while Lowell Avenue would be extended to realigned Mission Road.

At a 5 percent grade (not assuming any assistance from the local grade), the freeway would need to descend approximately 65 feet to reach a point where tunnel boring machine (TBM) tunnels would be covered. This will require approximately 1,600 feet; the entrance to the deep bored tunnel(s) would be located south of Norwich. Approximately 45 residences would need to be removed along Sheffield to accommodate the portal entry.

VA PROPOSAL NO. FT5

Proposal Title: Relocate South Portal to North of Mission Street

Advantages:

- Cost reductions approaching $433 million due to replacement of the tunnel with surface freeway; commensurate savings on financing costs.
- Allows for weaving section SR 710 after southbound lanes rejoin; all lanes can access either I-710 or I-10.
- Provides Valley Boulevard on- and off-ramps to the north.
- Provides for Mission Road ramps.
- Provides for improved local access to the freeway.

Disadvantages:

- Removal of approximately 45 homes along Sheffield for the tunnel portal (most owned by Caltrans).
- Loss of businesses along Mission Road.
- Additional visual and noise impacts from elevated structure.
- South portal in residential neighborhood.

Discussion: This alternative would still provide capacity to meet the forecast demand along the SR 710 corridor while saving approximately $433 million, at a cost of removing 45 residences and 6 businesses.

Technical Review Comments: (---)

Project Management Considerations: (---)

Discussion of Schedule Impacts: Construction time could be reduced. The freeway could be extended to Mission Road while tunnel boring was underway, providing an access route for construction vehicles.

Discussion of Risk Impacts: The proposal could engender opposition from local residential groups in the Sheffield Avenue area. As noted above, this may have environmental justice impacts.

Exhibit 1. Performance Ratings

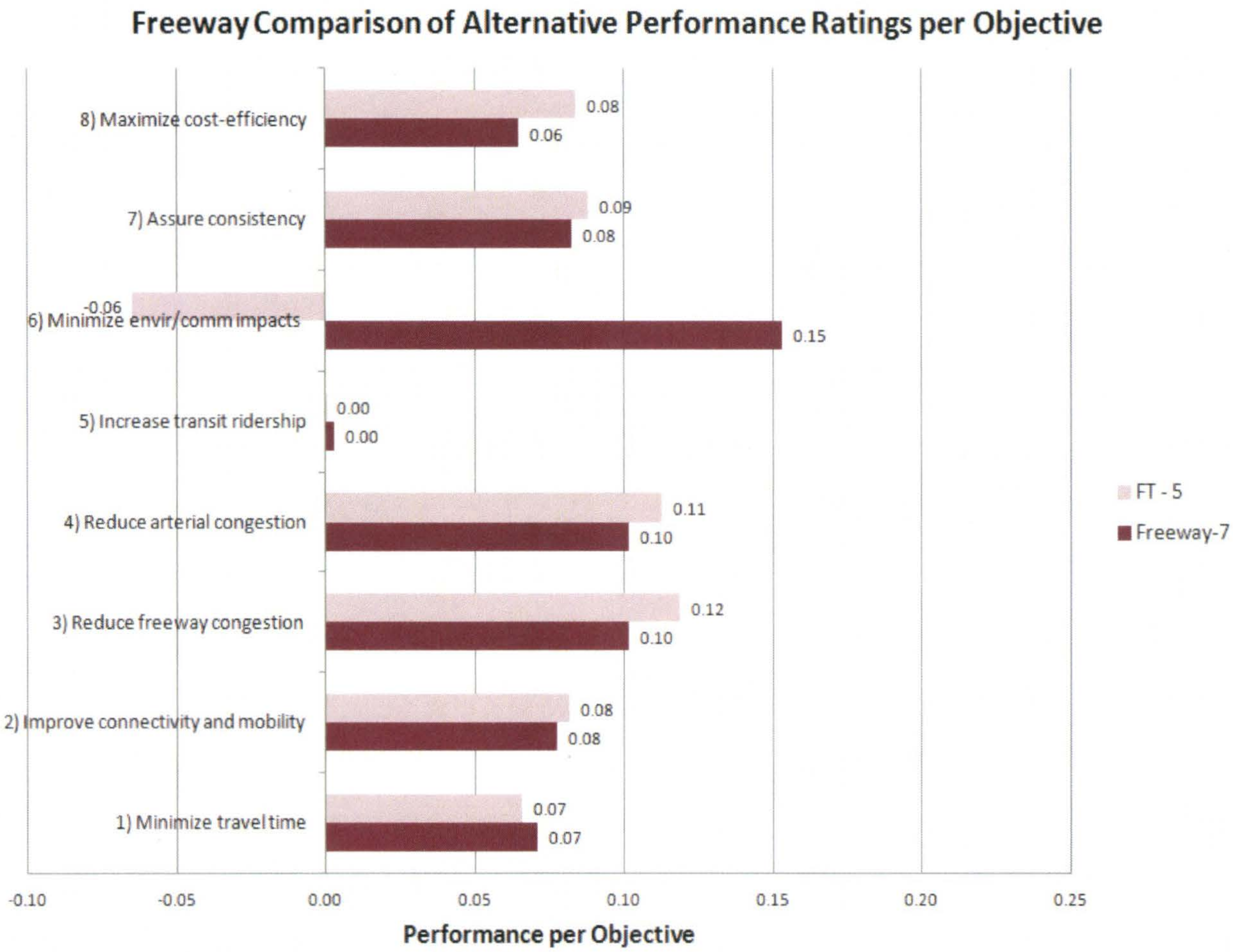


Exhibit 2. Performance Profile

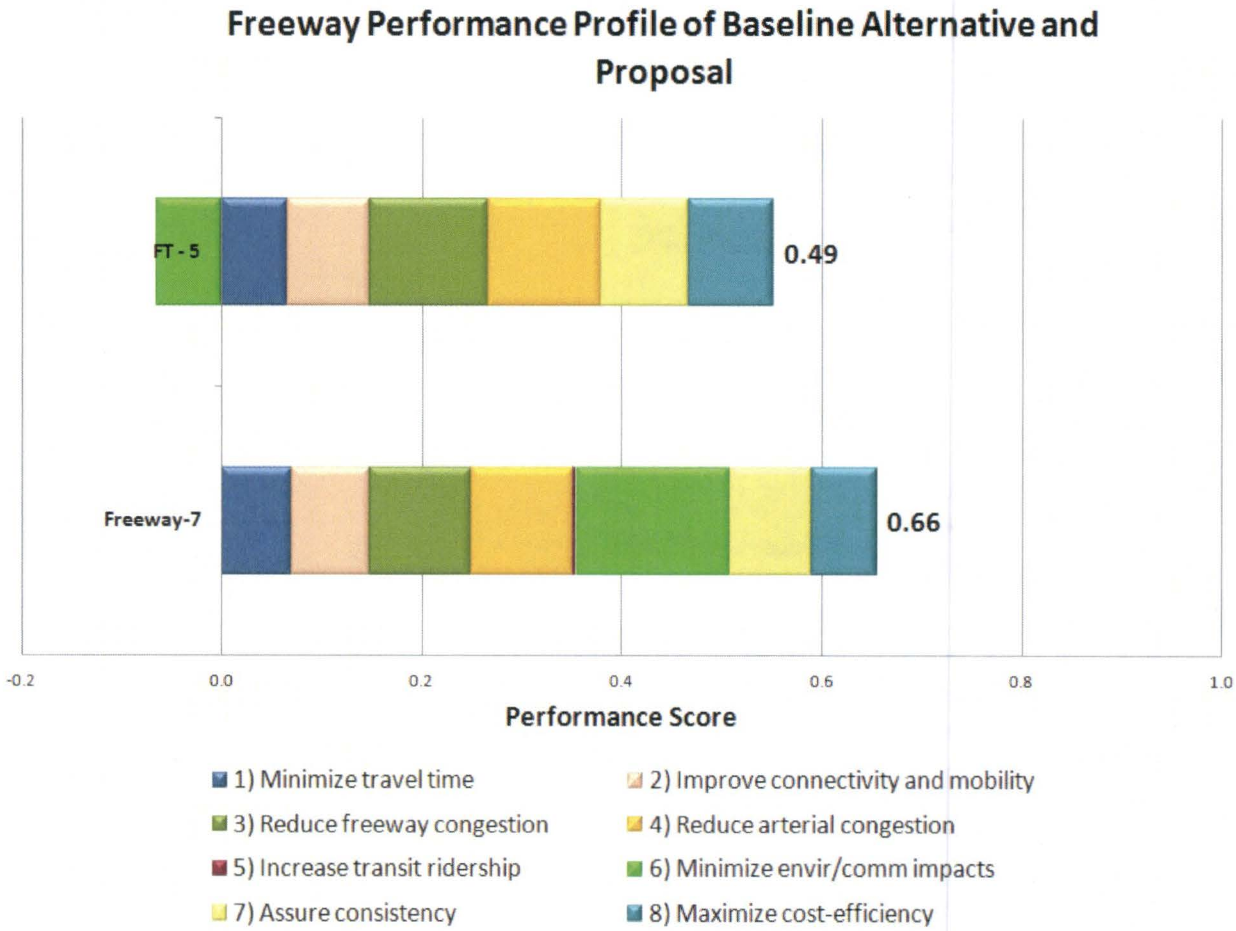
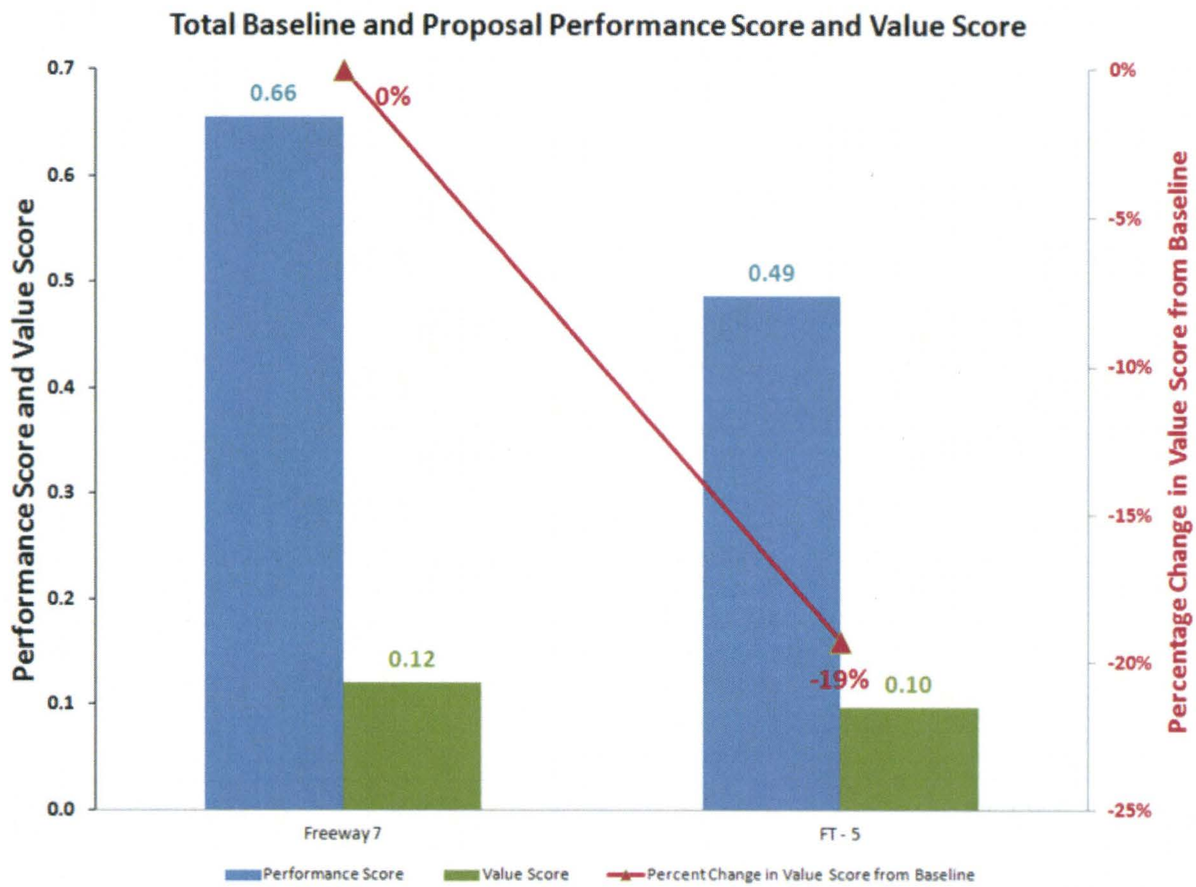


Exhibit 3. Benefit and Cost Performance



Proposal Title: Relocate South Portal to North of Mission Street

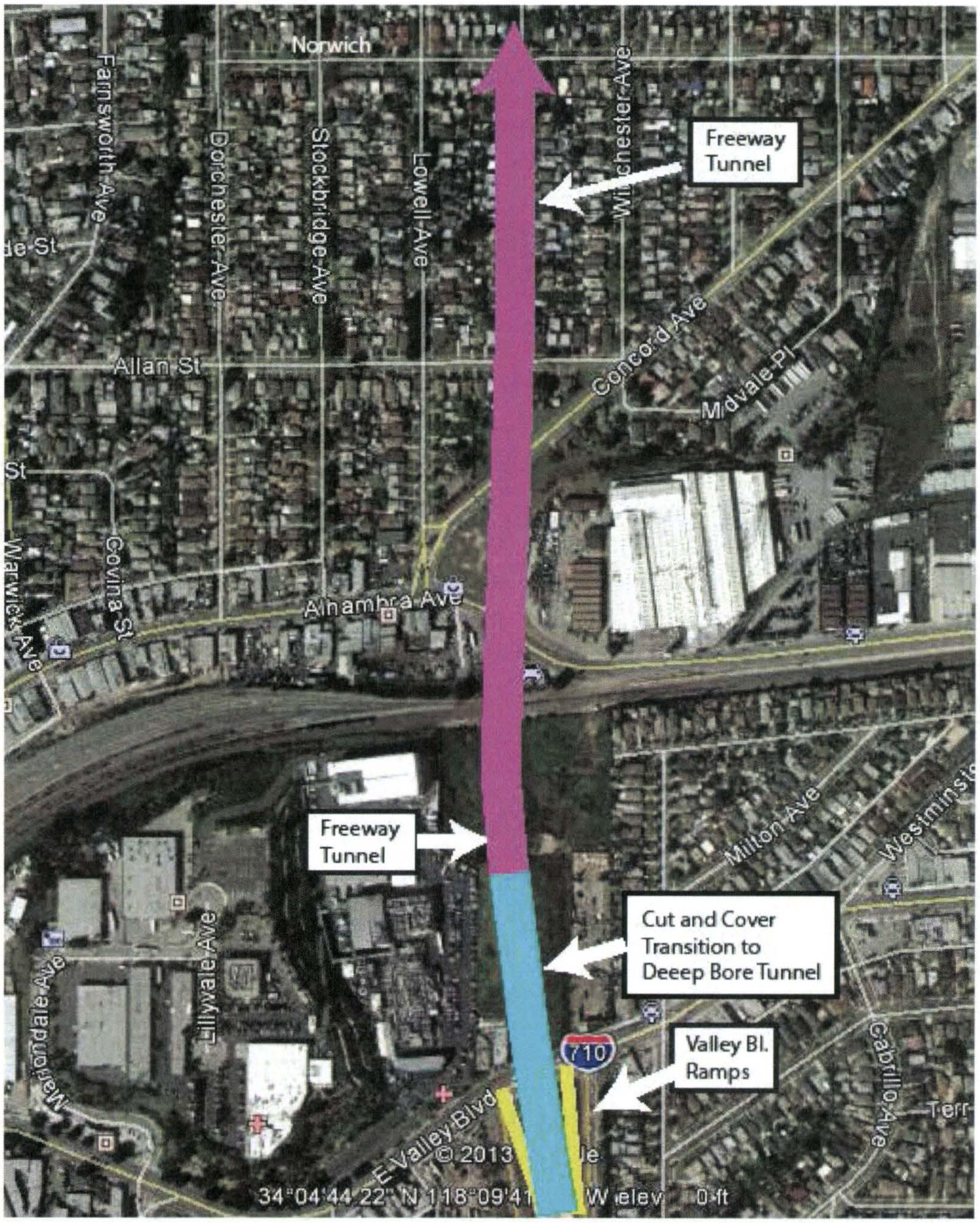
Exhibit 4. Performance Assessment

Performance Attributes (Objectives) Evaluation

Objectives	**Comment** (Influence of the VA Proposal upon the Objective)	**Rating** (VA Proposal "Improves Performance" or "No Change" or "Reduces Performance")
Minimize Travel Time	Meets objective as well as Alternative F-7.	May make project financially viable.
Improve Connectivity and Mobility	Local access will improve over Alternative F-7.	Improves performance, reduces costs.
Reduce Congestion on Freeway System	Meets objective as well as Alternative F-7.	Maintains performance, and may make project more financially viable.
Reduce Congestion on Local Street System	Improves performance by providing additional local access.	Maintains performance, and may make project more financially viable.
Increase Transit Ridership	Similar to Alternative F-7; slight reduction may occur due to increased access to freeway.	Reduces performance.
Minimize Environmental and Community Impacts Related to Transportation	Increased aesthetic, community, and noise impacts.	Reduces performance. The removal of homes may be considered unacceptable.
Assure Consistency with Regional Plans and Strategies	Generally consistent.	No change.
Maximize Cost Efficiency of Public Investments	Efficient due to reduced cost.	Increased performance.

Proposal Title: Relocate South Portal to North of Mission Street

Exhibit 5. Baseline Concept Sketch (Proposed F-7: South Portal)



Proposal: F7 (Existing) South Tunnel Portal

VA PROPOSAL NO. FT5

Proposal Title: Relocate South Portal to North of Mission Street

Exhibit 6. VA Proposal: South Portal

VA Proposal: Revised South Potral
Full Valley Interchange/Mission Interchange

Exhibit 7. Initial Cost Estimate

INITIAL COSTS (REDUCTIONS FROM BASELINE) DONE AS REDUCTIONS.....							ALT. NO.
CONSTRUCTION ELEMENT		*BASELINE CONCEPT*			*ALTERNATIVE CONCEPT*		
Description	**Unit**	**Qty**	**Cost/Unit**	**Total**	**Qty**	**Cost/Unit**	**Total**
TUNNEL ITEMS							
Length of tunnel	mi	4.17	$1,064,988,010	$ 4,441,000,002	3.70	1064988010	$ 3,940,455,637
STRUCTURE ITEMS							
Railroad Bridge/Mission/Concord	ea			$ -	1	$ 35,000,000	$ 35,000,000
Credit Hellman Br.		1	$ 4,175,000	$ 4,175,000			$ -
Minor Items							
Mobilization							
Additions							
Contingencies							
STRUCTURE SUBTOTAL				*			
STRUCTURE MARK-UP			79.5%	*$3,319,125*		79.5%	*$ 27,825,000*
STRUCTURE TOTAL				*$ 7,494,125*			*$ 62,825,000*
RIGHT-OF-WAY ITEMS							
Right-of-Way Acquisition				$ -			$ -
Utility Relocation				$ -			$ -
Relocation Assistance				$ -			$ -
Demolition				$ -			$ -
Title and Escrow Fees				$ -			$ -
RIGHT-OF-WAY TOTAL				*$ -*			*$ -*
Roadway Items							
Mainline Freeway	SQFT			$ -	432,115	$ 12	$ 5,185,380
Curb and Gutter					78,566	$20/LF	$ 1,571,328
Sidewalk					20,000	$5/SF	$ 100,000
Miscellaneous							
Minor Items							
Mobilization							
ROADWAY SUBTOTAL				$ -			$ 6,856,708
ROADWAY MARKUP				$ -		79.5%	$ 5,451,083
ROADWAY TOTAL				$ -			$ 12,307,791
CAPITAL OUTLAY SUPPORT ITEMS							
Reengineering and Redesign				$ -			$ -
Project Engineering							
TOTAL		$		4,448,494,127	$		4,015,588,428
TOTAL (Rounded)		$		4,448,500,000	$		4,015,600,000
						SAVINGS	**$432,900,000**

Proposal Title: Relocate South Portal to North of Mission Street

Life-Cycle Cost Estimates: The VA team's understanding is that annual operational and maintenance costs for the SR 710 North Study have not been calculated. Based on the *Caltrans 2011 Five-Year Maintenance Plan,* Caltrans is spending roughly $10,000 per year per lane mile to maintain its 50,000-lane-mile system. Applying this cost factor to the eight-lane 5.4-mile project would result in an annual maintenance cost of $110,000/year. However, the tunnel segment of the project would require special operational and maintenance costs that would not be captured in statewide averages and would likely be far greater.

The additional annual operational and maintenance costs of the proposed SR 710 freeway tunnel proposal would include electrical service for tunnel and roadway lighting, ventilation, operation of the toll system, pumping, and signage. The tunnel project would also require dedicated administrative and maintenance staff, operation of the toll system, and other special costs. Surface roadway segments will be landscaped, thus requiring water as well as maintenance. Finally, pavement surface will need to be rehabilitated on an ongoing basis. As noted above, these costs have not been estimated, but can reasonably be expected to be far higher than the typical annual maintenance costs for state highways, and are likely to be on the order of tens of millions of dollars per year.

Operations and maintenance costs, however, will likely scale with the number of lane miles constructed. For example, lighting costs would scale with the number of lanes. Ventilation costs would likely track with vehicle miles traveled, which will crudely track the number of lane miles. Thus, for any particular alternative proposal, the operational and maintenance cost change would be proportionate to the change in number of lane miles.

For Proposal FT5, the number of tunnel lane miles would be reduced by approximately 11 percent; thus a $20 million annual operations and maintenance budget would be reduced to approximately $17.8 million. Again the actual numbers are simply order-of-magnitude estimates, but the ratio is important.

Assumptions and Calculations: (---)

VA PROPOSAL NO. FT6

Proposal Title: Precast Elements for Tunnel Roadway Decks and Interior Walls

Initial Cost Savings:	$35,700,000
Future Cost Savings:	$0
Net LCC Savings:	$35,700,000
Change in Schedule:	Decrease
Performance Change:	-1 %
Value Change:	0 %

Description of Baseline Concept: The VA team's understanding of the tunnel roadway deck and interior walls is that these elements are to be cast-in-place (CIP) reinforced concrete. The interior of the tunnel is comprised of an upper and lower roadway deck and sidewalls that separate the decks from the plenums and emergency access plenums. The length of the decks and walls will be the entire length of the tunnel boring machine (TBM) tunnel. The upper deck will have a thickness of 2 feet 7 inches; the lower deck will be 2 feet 0 inches. The thickness of the upper deck walls will be 1 foot 0 inches; the lower deck walls will be 1 foot 6 inches. The total length of roadway decks and walls is 88,140 feet (Conceptual Cost Estimate Summary for Alternative F-7).

Description of VA Proposal Concept: The VA team is proposing to utilize precast deck elements and precast wall elements for the upper and lower decks if a full moment connection can be achieved between the upper deck and lower walls. The lower deck precast elements would utilize an inverted U-section with the inverted U section being cast as one unit with corbels to support the side deck panels. The upper deck and lower walls would be cast as a U-section with a corbel to support the walkway panel. The upper walls would be single-wall elements. It is anticipated that the lower deck would be thinner than the existing 2-foot 3-inch CIP deck. A monolithic CIP deck slab would be placed over the precast deck segments. The VA team proposal utilizes a double deck precast system, but another option to consider is a lower deck precast system and a CIP upper deck.

Advantages:

- Significant decrease in construction schedule to install roadway decks and walls. Savings in reduced construction schedule and contractor indirect costs.
- Potential for quicker revenue generation if procured as a P3, as construction schedule is reduced by the use of precast segments.
- Casting could be done in the same casting plant as tunnel segments.
- Faster completion date of tunnel and open to traffic as compared to CIP.
- Higher quality of concrete inside tunnel.
- Reduced maintenance costs.
- Better performing concrete for temperature loads.
- Possible elimination of batching plant onsite and reduction of shoring/forming/rebar material required.
- May be able to utilize trains for transporting precast segments from casting plant to site (track is near the south portals).

Disadvantages:

- Could require additional staging area for storage of precast segments.
- Would require a gantry system to deliver and install segments inside the tunnel.
- May have difficulty achieving full moment connections between upper deck and walls if U-shaped upper deck/lower wall segment is too large to transport.
- Inverted U-section at bottom deck will utilize more space in the lower plenum and may affect ventilation requirements or other planned use of lower plenum.

Discussion: (---)

Technical Review Comments:

- Some concern about the closure joints between the precast segment and residual cracking. CIP concrete deck slab over precast deck segments would minimize this concern. Precast sections would need to be thinner than the existing CIP to maintain the same vertical clearance.
- A full moment connection between precast segments is recommended.
- Single-deck precast segments have been used on the Brisbane Airport Link Tunnel Project and the Shanghai Yangtze River Tunnel. No information was found on double-deck precast segments.
- The SR 99 (Alaskan Way Tunnel) in Seattle, Washington is utilizing a precast lower deck and CIP upper deck. This option also should be studied for the SR 710 tunnel if precasting the upper deck is not feasible.

Project Management Considerations: Further studies should be performed on the feasibility and potential cost savings for utilizing precast segments. It may be possible to incorporate both designs (CIP and precast) in the contract documents as alternative designs to allow more competitive bidding between the contractors.

Discussion of Schedule Impacts: Potential savings in the overall construction schedule for the tunnel interior work.

Discussion of Risk Impacts: The following discussion describes the risks for this proposal.

- Opportunities
  - Reduction in overall project costs due to savings in construction schedule; and would be open sooner to traffic, which would help meet the project's purpose and need.
  - Potential reduction of construction truck traffic on the freeway system and local streets if precast segments can be transported by train and delivered to the site. Consider boring from the south end to incorporate delivery of the segments from this end. If boring needs to take place from the north end, then precast segments would need to be transported to the north end.
  - Utilizing a precast plant that uses a nonunion work force may help to offset the cost of manufacturing the precast segments. Union labor may be required for CIP work inside the tunnel.

- Threats
  - Potential reduction of local labor pool, disadvantaged businesses, and nonunion labor. The need for carpenters, iron workers, concrete workers, etc., and local concrete plants may be reduced by the use of precast material. This could cause an issue with achieving Disadvantaged Business Enterprise (DBE) and Disabled Veteran Business Enterprise (DVBE) goals if they are set for the construction contract.
  - May be difficult to achieve full moment connections of precast segment.
  - Size of upper U-section segment may be very large and heavy. Special equipment would need to be designed and implemented to transport large segments to the site and place them inside the tunnel.

Exhibit 1. Performance Ratings

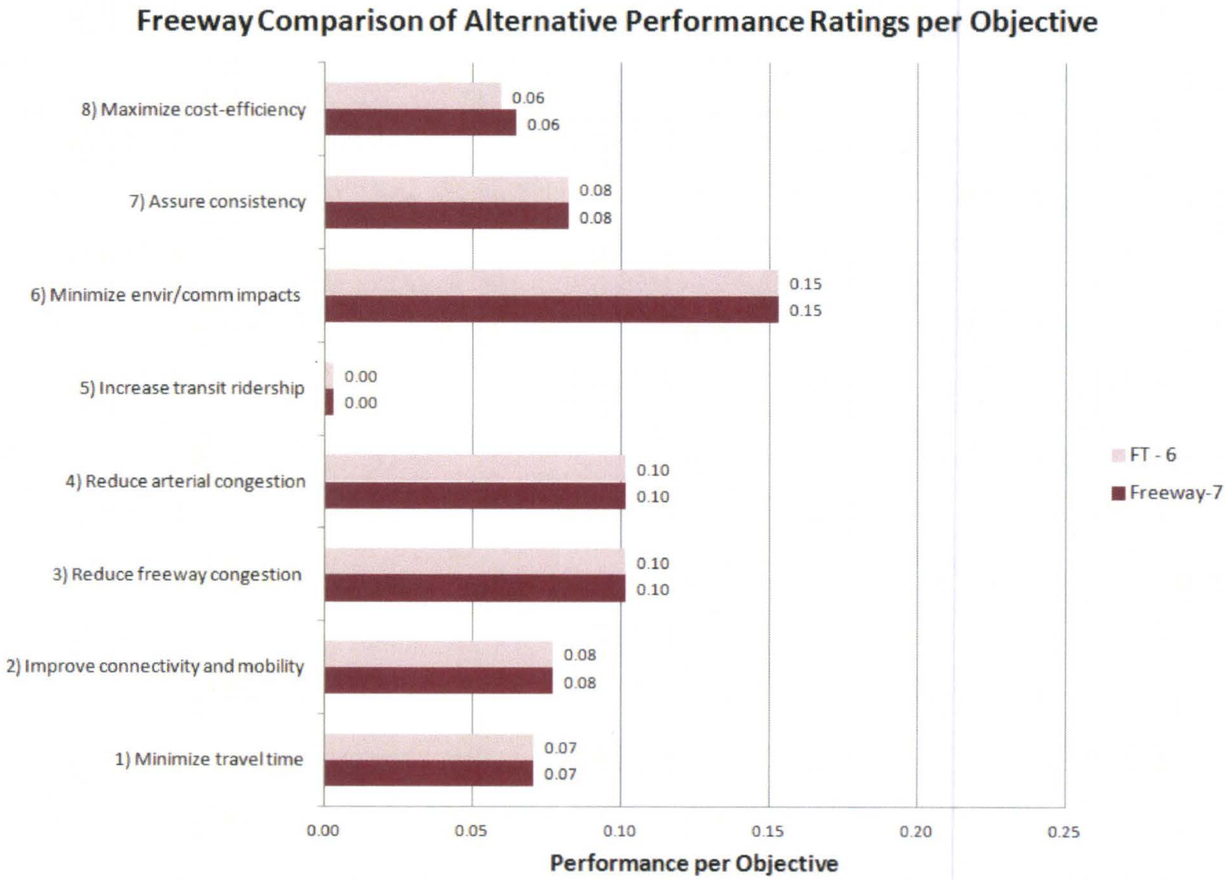


Exhibit 2. Performance Profile

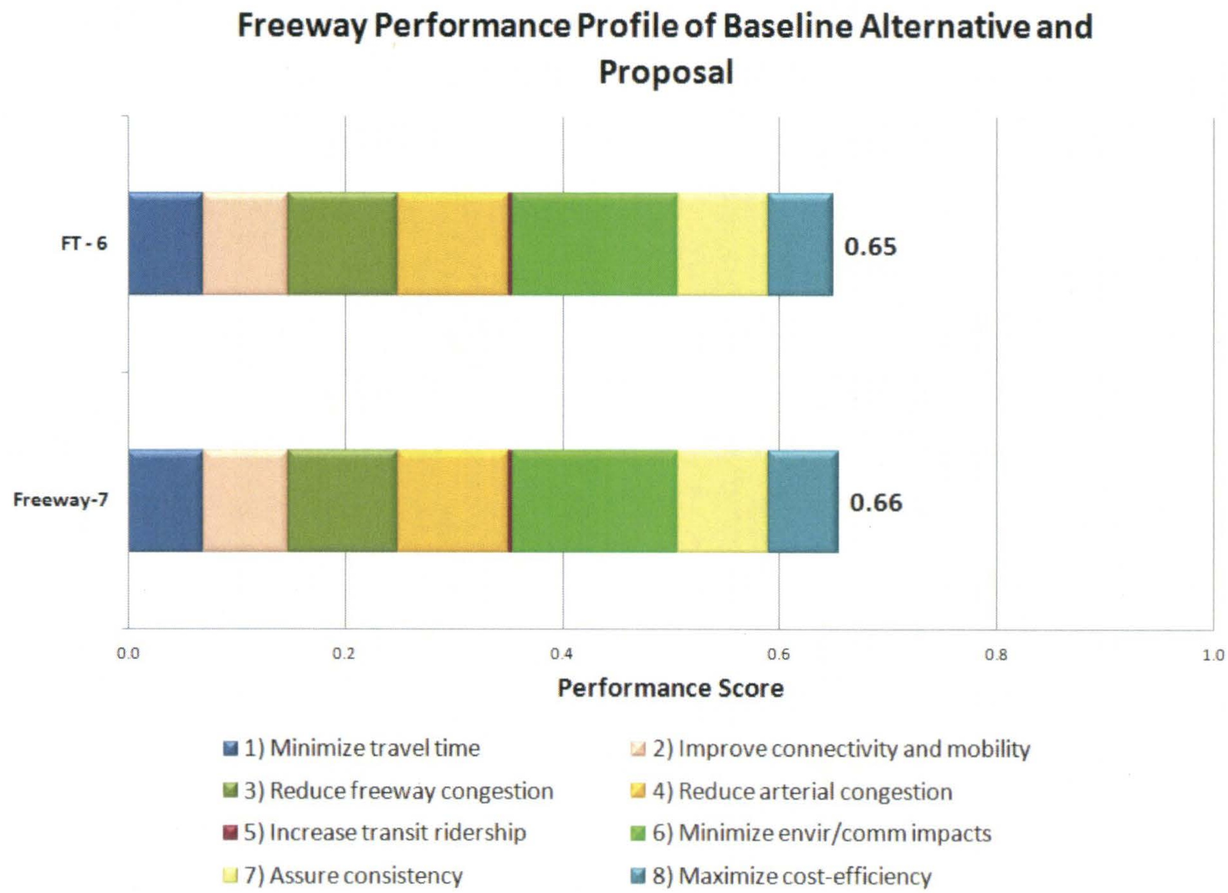


Exhibit 3. Benefit and Cost Performance

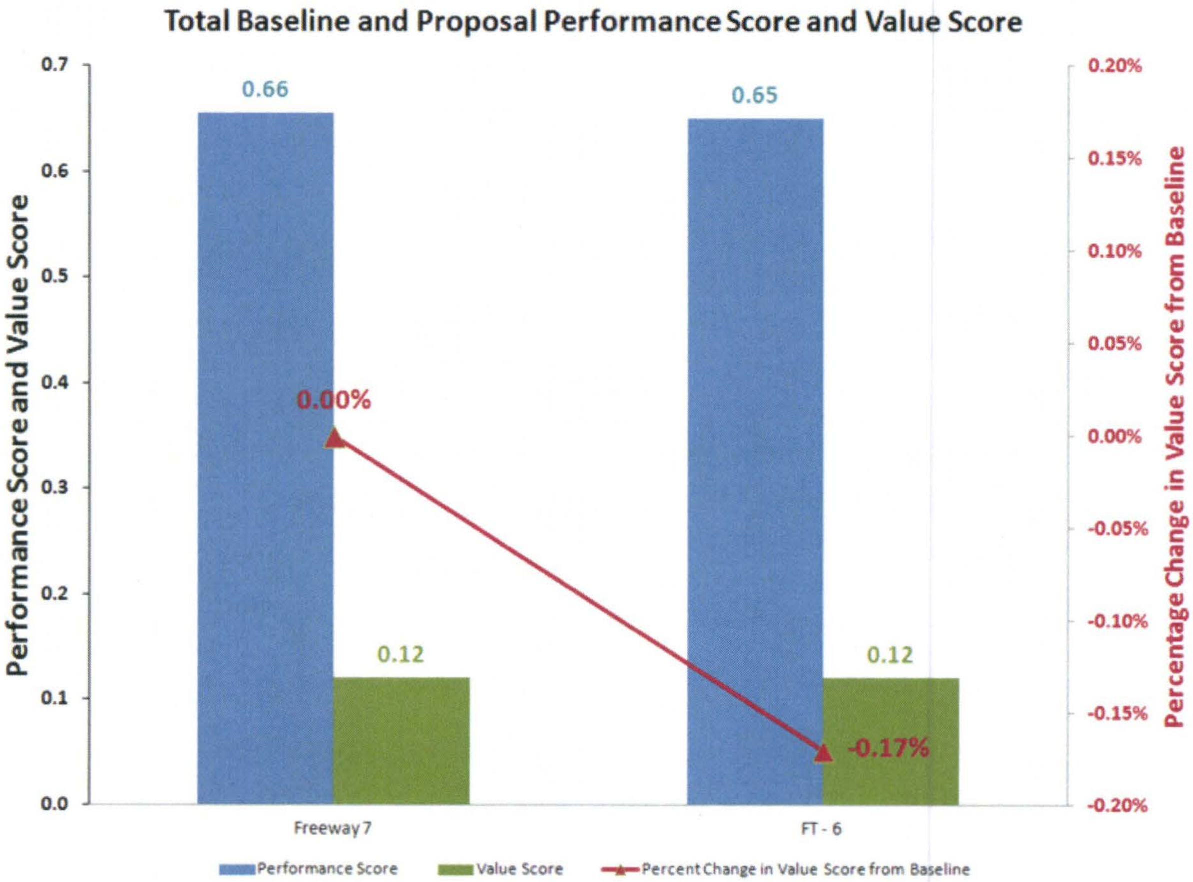


Exhibit 4. Performance Assessment

Performance Attributes (Objectives) Evaluation

Objectives	**Comment** **(Influence of the VA Proposal upon the Objective)**	**Rating** **(VA Proposal "Improves Performance" or "No Change" or "Reduces Performance")**
Minimize Travel Time	No change in travel time.	No change
Improve Connectivity and Mobility	No change.	No change
Reduce Congestion on Freeway System	Acceleration of construction will improve congestion faster.	Improves by accelerating construction
Reduce Congestion on Local Street System	Acceleration of construction will improve congestion faster.	Improves by accelerating construction
Increase Transit Ridership	Does not affect.	No change
Minimize Environmental and Community Impacts Related to Transportation	Reduction of construction traffic due to casting segments at the plant and rail transport to site.	Improves performance
Assure Consistency with Regional Plans and Strategies	Does not change.	No change
Maximize Cost Efficiency of Public Investments	Better concrete product with savings in construction schedule.	Improves performance

Exhibit 5. Baseline Concept Sketch

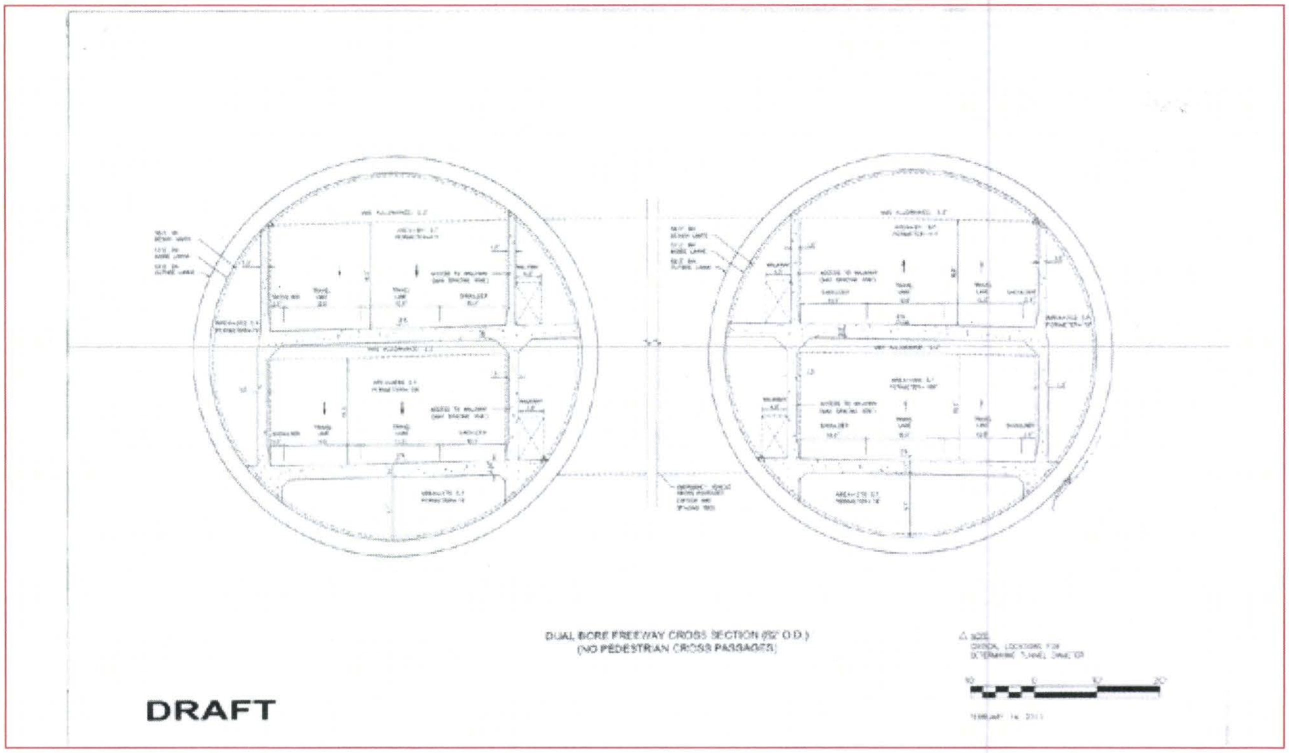


Exhibit 6. VA Proposal Concept Sketch

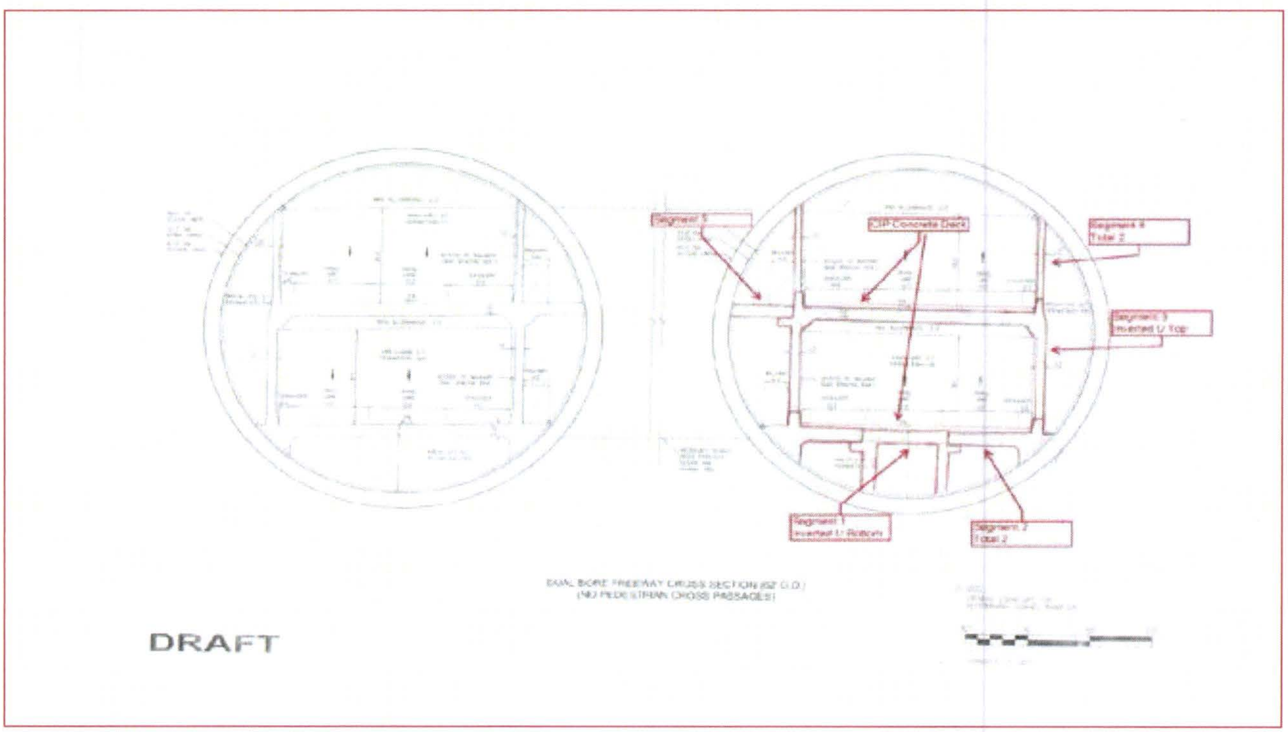


Exhibit 7. Brisbane Airport Link Tunnel Showing Installation of Single-Deck Precast Segments

Exhibit 8. Initial Cost Estimates

INITIAL COSTS								ALT. NO.
CONSTRUCTION ELEMENT		*BASELINE CONCEPT*			*VA PROPOSAL CONCEPT*			
Description	Unit	Qty	Cost/Unit	Total	Qty	Cost/Unit		Total
STRUCTURE ITEMS								
Roadway Deck slab and walls	lf	88,140	$ 1,725	$ 152,041,500	88,140	$ 1,725		$ 152,041,500
Indirect costs (assume 31%)		88,140	$ 775	$ 68,308,500	88,140	$ 620		$ 54,646,800
STRUCTURE SUBTOTAL				*$ 220,350,000*				*$ 206,688,300*
STRUCTURE MARK-UP			74%	*$ 163,059,000*		74%		*$ 152,949,342*
STRUCTURE TOTAL				*$ 383,409,000*				*$ 359,637,642*
CAPITAL OUTLAY SUPPORT ITEMS								
Reengineering and Redesign				$ -				$ -
Project Engineering				$ -				$ -
TOTAL		$		383,409,000	$			359,637,642
TOTAL (Rounded)				$383,410,000				$359,640,000
						SAVINGS		**$35,690,000**

Life-Cycle Cost Estimates: The VA team did not provide future cost calculations for this proposal because it was not felt that significant differences in future costs between the VA Proposal and the Baseline Alternative could be quantified or computed at this conceptual phase of design. The future cost difference for this VA proposal is therefore zero, and the Net Life Cycle Cost as shown in the cost summary at the top of this proposal is the same as the Initial Cost Saving (or Premium if a negative value is shown in parentheses).

VA PROPOSAL NO. FT6

Proposal Title: Precast Elements for Tunnel Roadway Decks and Interior Walls

Assumptions and Calculations:

- Assume 4-inch CIP concrete overlay deck.
- Assume 1-foot 6-inch thick walls and deck for bottom inverted U (Segment 1).
- Assume 1-foot 6-inch deck and same cross section for base of Segment 2.
- Assume 1-foot 6-inch thick walls and 2-foot 0-inch thick deck for upper inverted U (Segment 3).
- Assume 1-foot 0-inch thick section for Segments 4 and 5.
- Assume same material costs for CIP and precast.
- For estimating purposes, assume same cross sectional area as baseline.
- Substantial cost savings will be in the increased production rate and decreased schedule.
- Assume a reduction in indirect costs, contingency, and markup.
- Assume a 20 percent savings in time. The 20 percent estimated savings in time would be the low end of savings. It is projected that time savings as high as 40 percent could be achieved by utilizing precast. The cost savings is based on the 20 percent value.

Another important factor that should be considered when evaluating this precast alternative is the potential to complete the project sooner and the potential to generate revenue much sooner than the CIP basis of design. It is estimated that the roadway deck and walls would take around 24 months to be constructed. If the precast alternative can reduce the timeframe between 20 and 40 percent and assuming the average daily traffic (ADT) is 180,000 vehicles at $5 per vehicle, then revenue between $129,000,000 and $259,000,000 could be generated sooner as compared to the CIP.

VA PROPOSAL NO. FT7

Proposal Title: Covered Depressed Freeway with a Landscaped Area for "At-Grade Section"

Initial Cost Savings:	$116,000,000
Future Cost Savings:	$0
Net LCC Savings:	$116,000,000
Change in Schedule:	None
Performance Change:	+3 %
Value Change:	+1 %

Description of Baseline Concept: Freeway Alternative F-7 includes an at-grade section starting from south I-10 to north of Hellman Avenue, and a cut-and-cover section starting from north of Hellman Avenue to north of Valley Boulevard. Also, Freeway Alternative F-7 includes a cut-and-cover section starting from north of California Boulevard, and an at-grade section starting from south of Green Street to the I-210/Route 134 Interchange.

Description of VA Proposal Concept: It is proposed to use a covered depressed freeway section instead of an at-grade section (from STA 136 to STA 162 north of I-10; and from STA 505 to STA 525 south of I-210). This covered depressed freeway section will be approximately 75 feet wide and include two levels of travel ways below the ground. Each level will have four traffic lanes with two 8-foot-wide shoulders. The direction of traffic can be managed based on traffic demand daily. The cover will be a curved reinforced concrete cap about 24 feet high at the hinge point and 15.5 feet high at the edges.

The cap will be covered by light-weight concrete on top and excavated soil (reinforced with geogrid) on the sides. The pathway on top can be used for pedestrian and bikeway. Slope surface and surrounding area will be landscaped. Concrete-lined stepped waterfalls also may be used on the embankment slope to reduce noise transferred to the surface.

Advantages:

- Reduces risk of objects falling to the freeway from surrounding areas (compared to an uncovered depressed freeway).
- Minimizes noise transfer from the freeway to the neighboring communities (compared to the surface road).
- Impact on air quality will be mitigated (compared with surface road).
- Reduction of F-7 footprint (compared with one level surface road).
- Enhances the quality of the urban environment with green space and pedestrian and bicycle friendly paths.

Disadvantages:

- Cost of curved reinforced cap.
- Cost of reinforced earth (low cost).
- Footprint of embankment fill.

Discussion: This alternative will reduce the impact to surroundings, and therefore is more in line with community demands.

VA PROPOSAL NO. FT7

Proposal Title: Covered Depressed Freeway with a Landscaped Area for "At-Grade Section"

Technical Review Comments: The technical team was concerned about the footprint of the embankment fill.

Project Management Considerations: (---)

Discussion of Schedule Impacts: There will be no or minimal impact on the schedule.

Discussion of Risk Impacts: (---)

Exhibit 1. Performance Ratings

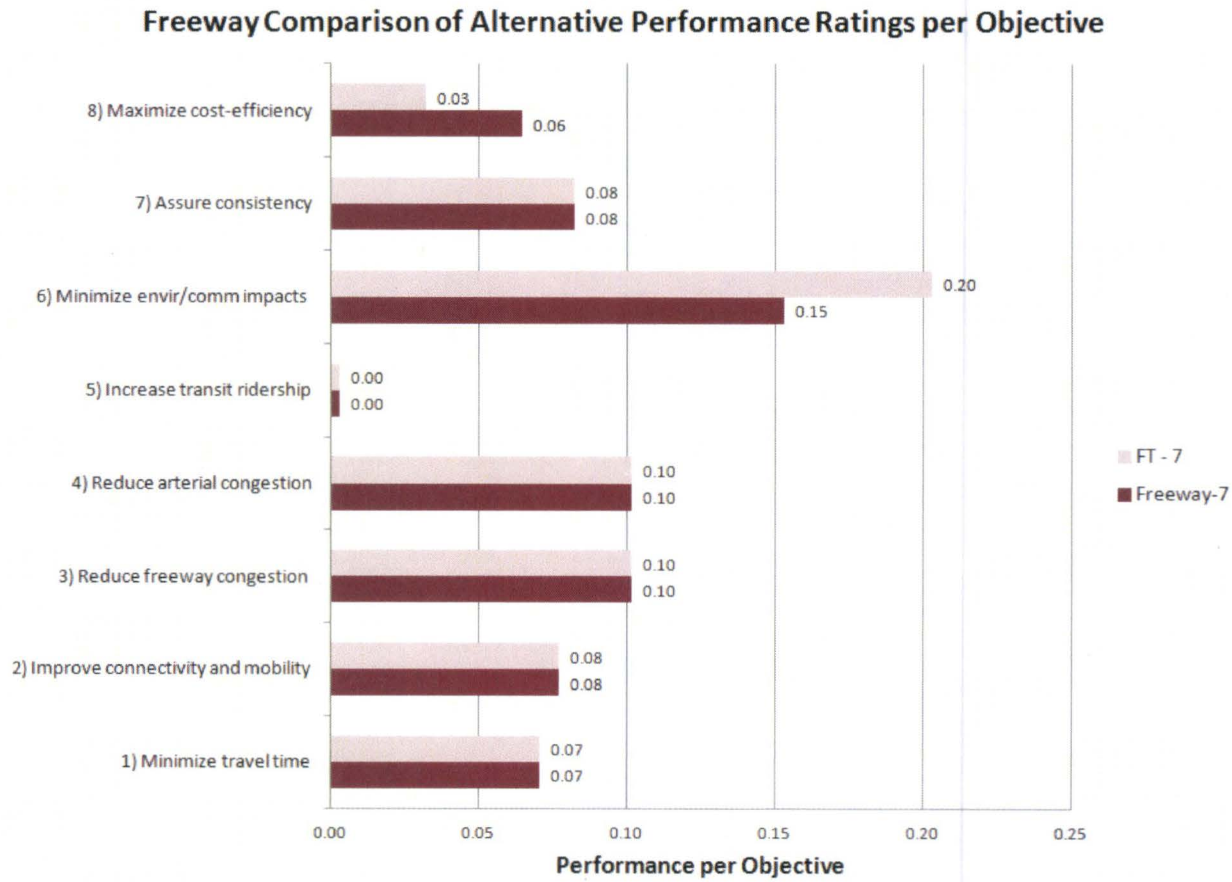


Exhibit 2. Performance Profile

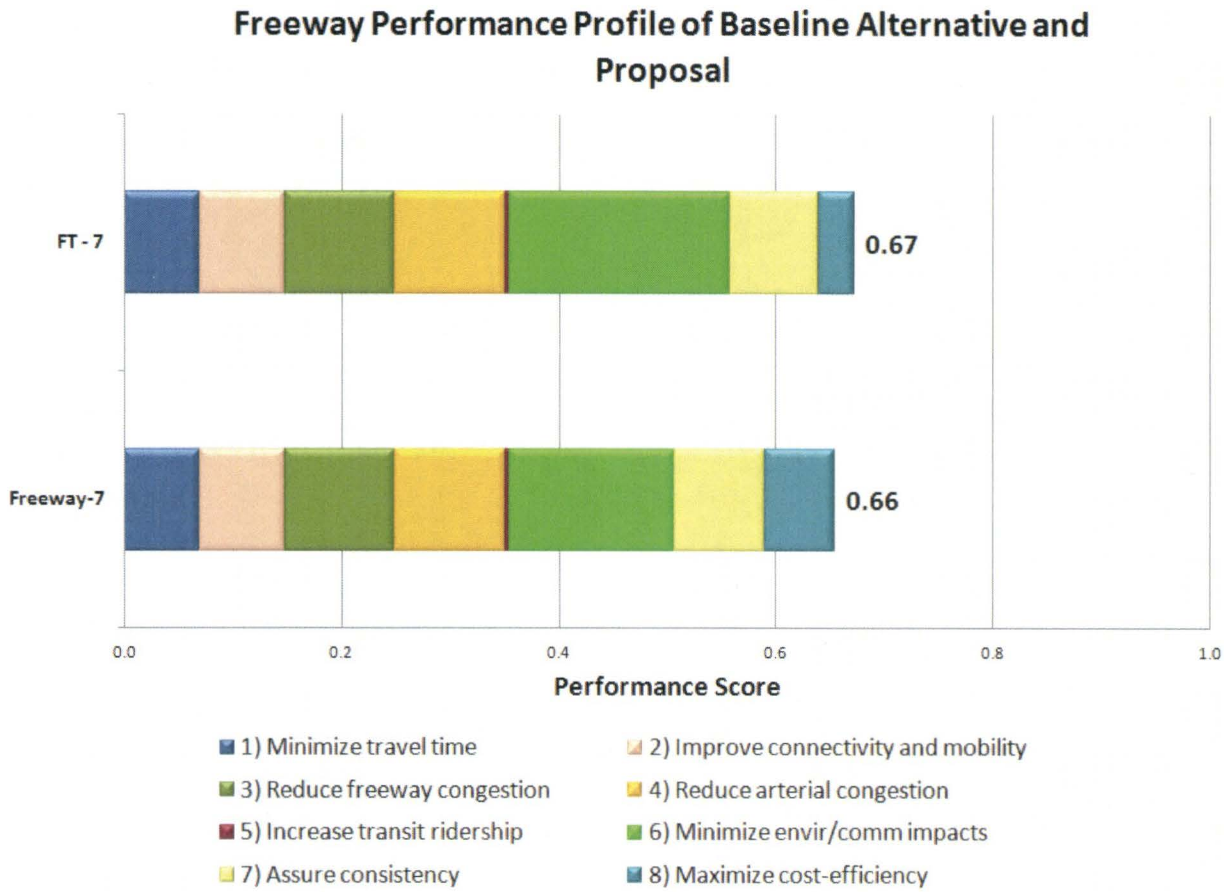


Exhibit 3. Benefit and Cost Performance

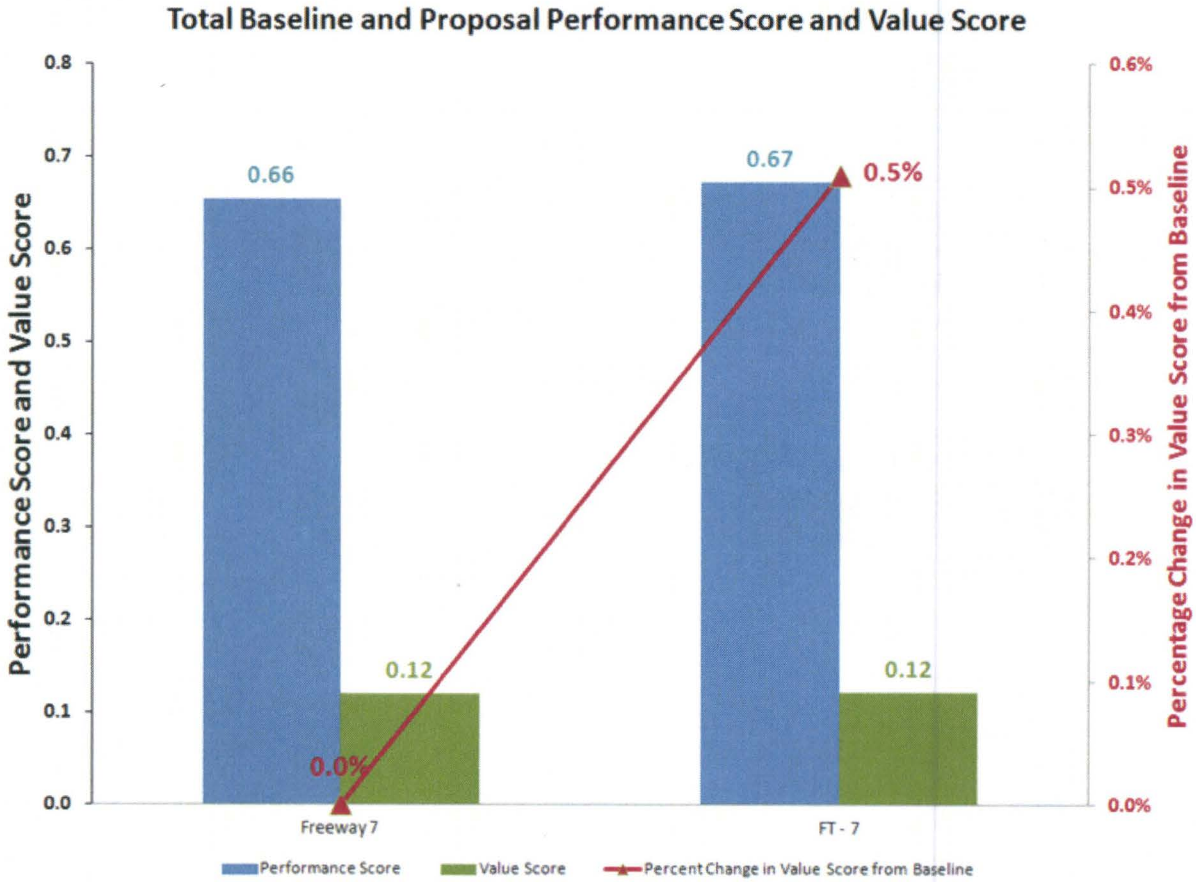
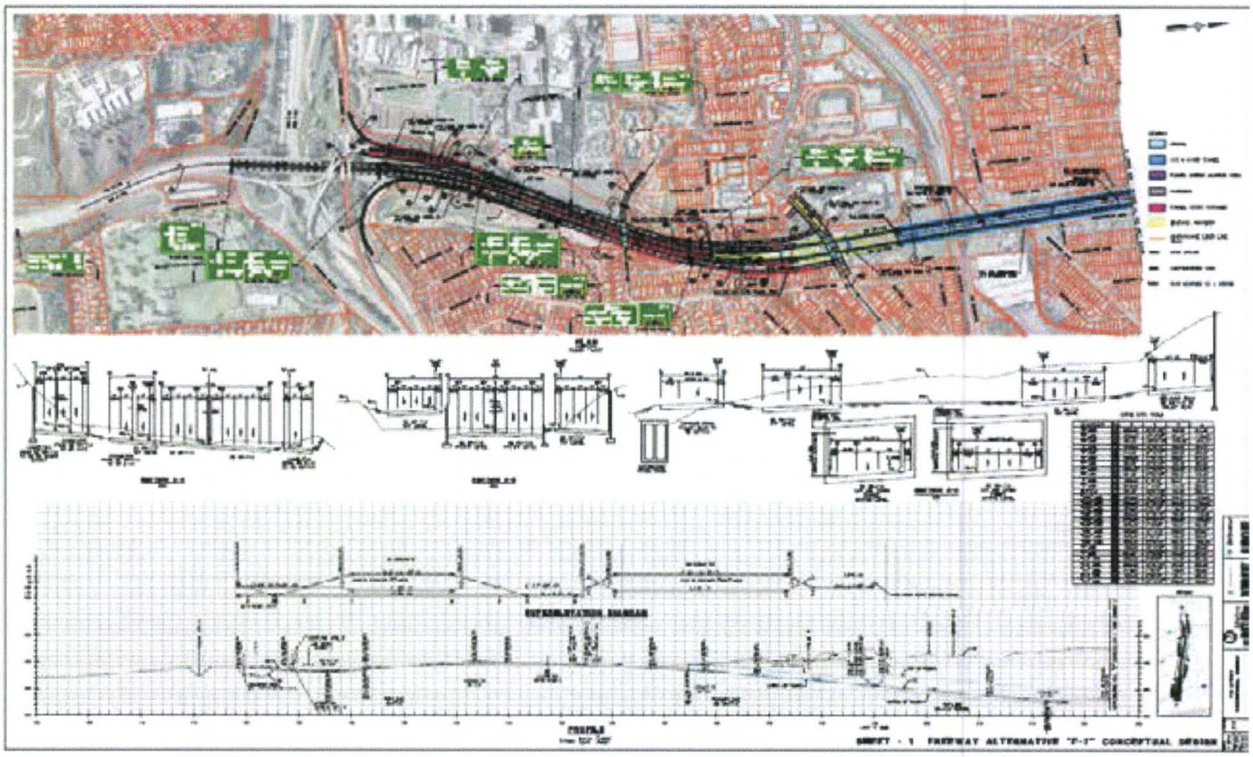


Exhibit 4. Performance Assessment

Performance Attributes (Objectives) Evaluation

Objectives	**Comment** **(Influence of the VA Proposal upon the Objective)**	**Rating** **(VA Proposal "Improves Performance" or "No Change" or "Reduces Performance")**
Minimize Travel Time	N/A	No change
Improve Connectivity and Mobility	N/A	No change
Reduce Congestion on Freeway System	N/A	No change
Reduce Congestion on Local Street System	N/A	No change
Increase Transit Ridership	Pathway for pedestrians and bikers.	Improves performance
Minimize Environmental and Community Impacts Related to Transportation	Improves noise and mitigates the impact on air quality.	Improves performance
Assure Consistency with Regional Plans and Strategies	Less impact on surroundings.	Improves performance
Maximize Cost Efficiency of Public Investments	Increases cost slightly.	Reduces performance

Exhibit 5. Baseline Concept Sketch



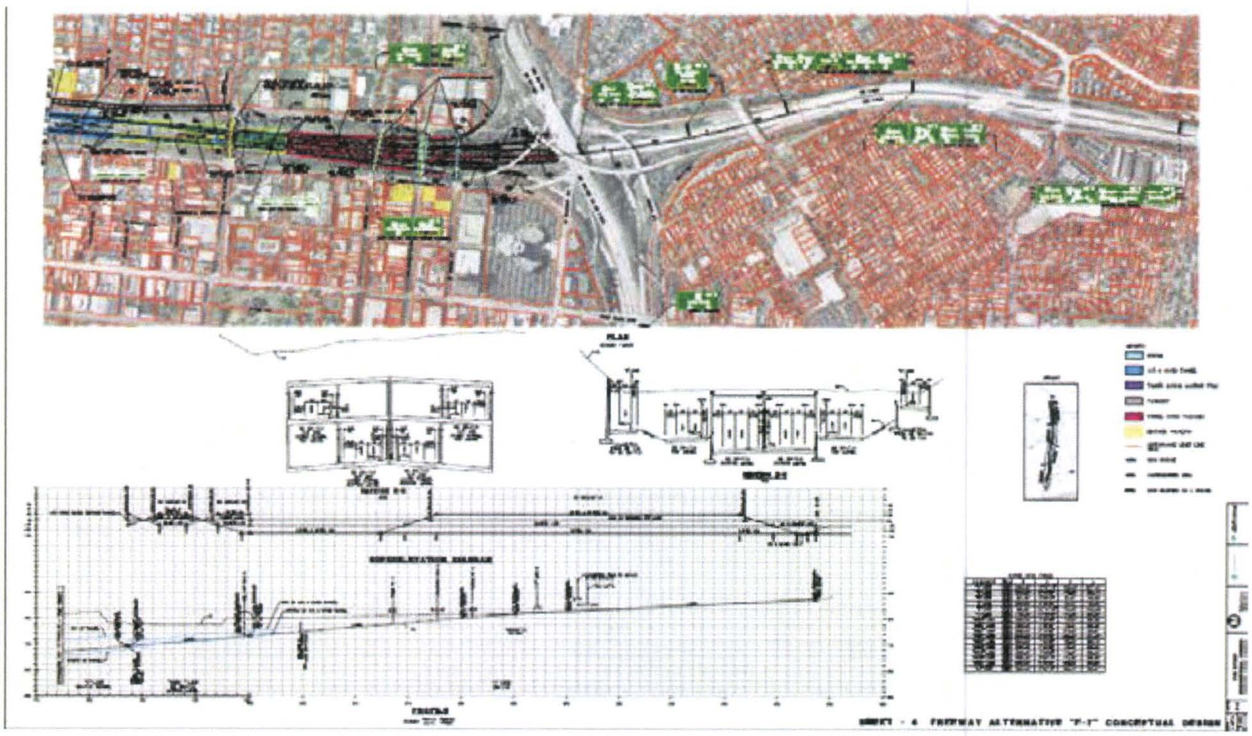
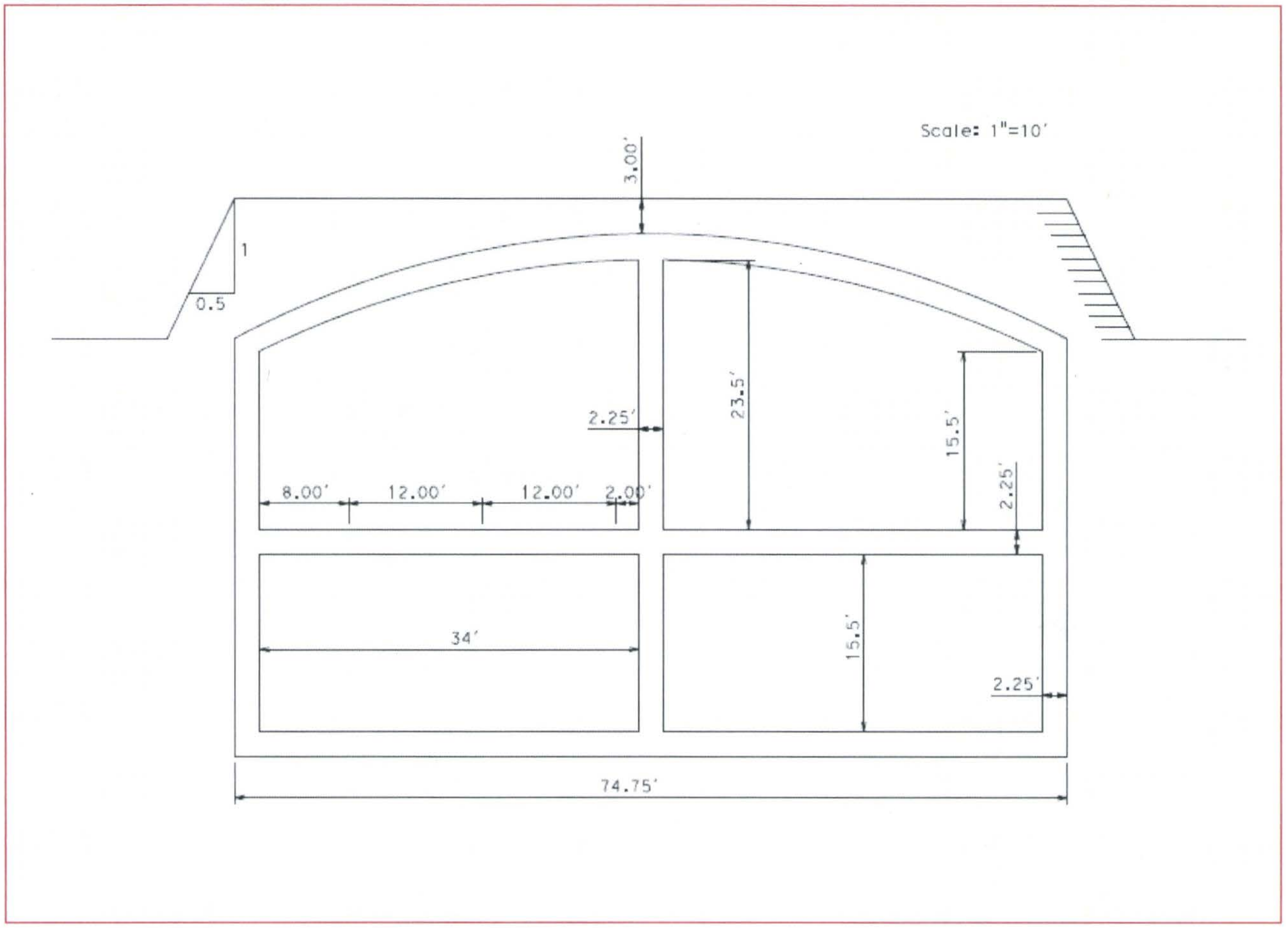


Exhibit 6. VA Proposal Concept Sketch



VA PROPOSAL NO. FT7

Proposal Title: Covered Depressed Freeway with a Landscaped Area for "At-Grade Section"

Exhibit 7. Initial Cost Estimates

INITIAL COSTS								ALT. NO.
CONSTRUCTION ELEMENT		*BASELINE CONCEPT*			*VA PROPOSAL CONCEPT*			
Description	Unit	Qty	Cost/Unit	Total	Qty	Cost/Unit	Total	
ROADWAY ITEMS								
From STA 136 to STA 162	SFT	546,000	$ 173	$ 94,458,000	0	$ 293	$ -	
length =Approx. 2600 foot				$ -			$ -	
2600 x 210=546,000				$ -			$ -	
From STA 505 to STA 525	SFT	420,000	$ 173	$ 72,660,000	0	$ 293	$ -	
ROADWAY SUBTOTAL				*$ 167,118,000*			*$ -*	
ROADWAY MARK-UP				*$ -*			*$ -*	
ROADWAY TOTAL				*$ 167,118,000*			*$ -*	
STRUCTURE ITEMS								
Cut and Cover from STA 136 to	SFT	0	$ 173	$ -	546,000	$ 293	$ 159,978,000	
STA 162, Approx. 2600 feet				$ -			$ -	
Cut and Cover from STA 505 to				$ -			$ -	
STA 525, Approx. 2000 feet	SFT	0	$ 173	$ -	420,000	$ 293	$ 123,060,000	
				$ -			$ -	
STRUCTURE SUBTOTAL				*$ -*			*$ 283,038,000*	
STRUCTURE MARK-UP				*$ -*			*$ -*	
STRUCTURE TOTAL				*$ -*			*$ 283,038,000*	
RIGHT-OF-WAY ITEMS								
Right-of-Way Acquisition				$ -			$ -	
Utility Relocation				$ -			$ -	
Relocation Assistance				$ -			$ -	
Demolition				$ -			$ -	
Title and Escrow Fees				$ -			$ -	
RIGHT-OF-WAY TOTAL				*$ -*			*$ -*	
ENVIRONMENTAL MITIGATION ITEMS								
				$ -			$ -	
				$ -			$ -	
CAPITAL OUTLAY SUPPORT ITEMS								
Reengineering and Redesign				$ -			$ -	
Project Engineering				$ -			$ -	
TOTAL				$167,118,000			$283,038,000	
TOTAL (Rounded)				$167,120,000			$283,040,000	
						SAVINGS	**($115,920,000)**	

Life-Cycle Cost Estimates: The VA team did not provide future cost calculations for this proposal because it was not felt that significant differences in future costs between the VA proposal and the Baseline Alternative could be quantified or computed at this conceptual phase of design. The future cost difference for this VA proposal is therefore zero, and the Net Life Cycle Cost as shown in the cost summary at the top of this proposal is the same as the Initial Cost Saving (or Premium if a negative value is shown in parentheses).

Proposal Title: Covered Depressed Freeway with a Landscaped Area for "At-Grade Section"

Assumptions and Calculations: For comparing the roadway cost with the proposed covered depressed freeway section, it was assumed that from STA 136 to STA 162 (2,600-foot length) and from STA 505 to STA 525 (2,000-foot length), the width of the roadway is approximately 210 feet (estimated average width of Sections AA, BB, and HH). The area of roadway was estimated based on the above-mentioned length and width. The total conceptual estimate for the F-7 roadway was divided into the area above to roughly estimate cost per square foot of roadway.

VA PROPOSAL NO. FT8

Proposal Title: Move to Public-Private Partnership (PPP) Model of Delivery

Initial Cost Savings:	$1,070,000
Future Cost Savings:	$0
Net LCC Savings:	$1,070,000
Change in Schedule:	(---)
Performance Change:	+33 %
Value Change:	+33 %

Description of Baseline Concept: The VA Team's understanding of the current concept is as follows: Finish environmental analysis (National Environmental Policy Act/California Environmental Quality Act [NEPA/CEQA]) completely, and then move sequentially into delivery (current delivery model may or may not utilize P3 model). It is anticipated that delivery models would be determined during the NEPA/CEQA process. This delivery model may require more detailed analysis of alternative options that may or may not be aligned with the necessary financial realities and plans for the corridor.

Description of VA Proposal Concept: Metro would make an early commitment that the project would be developed as a Public-Private Partnership (PPP) or "P3" project. PPP is a delivery method whereby a public entity partners with a private entity for the purpose of delivering public infrastructure. In the most typical of PPP variations, the private entity would be comprised of a design-build team, a maintenance firm, and a lending firm or developer. This entity would design, build, finance, maintain, and/or operate the facility for a set number of years, agreeing to meet specified performance criteria in exchange for lease payments or some other compensation. At the end of the specified period, the facility is returned to the public entity.

Various forms of P3 compensation include a fee contract, in which the P3 firm receives its compensation through a fee charged to the owner, and a concession contract, in which the P3 firm receives its compensation directly from the consumers rather than the owner.

The type of PPP model considered in this application would utilize a type of a Predevelopment Agreement model to work with the concession teams earlier than final environmental clearance is complete. This process could start the "information gathering" process or request for information (RFI) process very quickly before the environmental document is complete.

P3 has gained much attention due to its ability to provide a funding option for public entities that may be struggling to identify adequate sources of capital. While this approach is a good option as a means of bringing a project to reality, it is also a very complicated and deliberate process that needs to be carefully considered.

This process would provide direct feedback and engineering and construction input to the reality and details of the construction means and methods, the reality and details of the financing plan, and the reality and details of the technologies for tunnel construction, roadway construction, etc. This approach would <u>not</u> bypass the required NEPA/CEQA process, but work together to develop potential feasible and reasonable alternatives that work toward minimizing environmental impacts, and balances input from communities.

Examples of this early involvement are: Mid-Currituck Bridge Replacement in North Carolina and the Mid-Town Tunnel in Virginia.

Advantages:

- Targets alternative revenue and funding sources to close a funding gap. Can allow Metro and Caltrans to fill the funding gap of the project by leveraging public sector involvement – the money that is already programmed for the project will be advantageous as the developer will not have to cover all the initial costs of the project.
- Allows the use of low-cost tax-exempt or taxable financing.
- Transfers risk to the private sector.
- May not be subject to capital budget allocations or voter referendums:
  - Can accelerates construction starts
  - Reduces construction cost and interest rate risks (up to 20 percent)
- Takes advantage of private-sector efficiencies and innovations in construction, scheduling, and financing.
- Provides efficiencies in long-term operations and maintenance.
- Presents an opportunity to combine public and private uses in mixed-use developments to leverage economic development.
- Offers insights into specific details on construction means and methods, approaches to combining the alternatives, and financial viability.
- MAP 21 and the Office of Innovative Project Delivery for the Federal Highway Administration (FHWA) should be engaged and is looking for projects like this to accelerate.
- Could also leverage existing Caltrans-owned property into the development of the project and could lower overall cost of the project, allowing the option of developing the properties to lower initial capital expenditures.
- Would gain detailed insights into phasing options that would align specifically with funding plans.

Disadvantages:

- A high level of expertise is required to execute a P3 project. It is anticipated that a specialized team would be necessary to administer the process.
- There would be a perception that a loss of public control and flexibility could take place as part of the process.
- Need to include in the process "competitive-tension" so that the contract documents facilitate competitiveness early in the process.
- Will need to ensure NEPA/CEQA independence of solutions (not giving any preference to tunnel, LRT, etc.).
- Public perception of predetermined outcomes of technical solutions.
- Will likely bring up the tolling conversations earlier in the process as the existing Caltrans property will not likely make up the difference in the funding gap.
- May require special purpose entity to be established for the development of the project.

- The proposal process can be very expensive for all involved.
- Risk of bankruptcy or default of private sector entity.
- Concern about accountability and transparency.

Discussion: This project includes significant challenges from an engineering, environmental, and community perspective. There is a potential for resolving these challenges through a combination of technical solutions and complex build alternatives, coupled with substantial public input. However, it should be noted that key project drivers may ultimately depend on the overlying political realities, realistic funding opportunities, construction constraints, and community resistance for identifying viable solutions. The PPP process would leverage the private sector directly as part of identifying potential solutions. More importantly, the PPP process would provide advantages for defining viable funding sources, utilizing state-of-the-art technologies, and optimizing public expenditures related to construction and long-term maintenance of such a complex facility. For example, engaging the concession, engineering, and construction community early in the process of project development and delivery will allow the Owner's delivery team to get direct insights into project specifics that are tailored to this complex project based on specific details of the project financial plan and the required NEPA/CEQA process. Utilizing the PPP process may provide the best opportunity for identifying overall solutions that can become real.

This early involvement with the private sector is not new but is not widespread. A couple of examples that exist are the Mid-Currituck Bridge Replacement project where the North Carolina Turnpike Authority (NCTA) and North Carolina Department of Transportation (NCDOT) engaged the PPP market one year ahead of the final environmental clearance document.

Los Angeles Metro Transportation Authority (LAMTA) is also investigating PPP options in their current program of projects.

An additional consideration for the PPP process is that in a highly political environment, it can offer added shelter for the public entities involved due to the fact that they are just part of the team developing potential solutions.

Technical Review Comments: Concerns that industry has direct impact into the environmental clearance process will need to be mitigated, and the independency maintained throughout the final environmental document process.

Another concern about cost competitiveness will need to be considered as part of the final pricing process. Example ideas: Leave in contract options for both parties to withdraw and a way out for the owner to "Bid" the final construction documents.

Project Management Considerations: Implementation of this approach would require changes to the following items:

- Schedule concepts
- Costing
- Risk allocations
- Policy decisions
- Ownership structure

Proposal Title: Move to Public-Private Partnership (PPP) Model of Delivery

Discussion of Risk Impacts: Caltrans and Metro will need to develop policy, processes, and procedures that address the following:

- Risk allocation would be set out in the public development agreement (PDA) and the request for qualifications (RFQ), request for proposal (RFP), and final concession agreement
- Responsibility for permitting activities
- Responsibility for tolling and operations
- Unforeseen conditions
- Schedule
  - Permitting delays and challenges
  - Different options for tunnel construction
  - Methodology and stormwater requirements
- Cost
  - Design exceptions are discouraged
  - Approval of any design variances
  - Methods of tunnel, bridge construction, and stormwater management and mitigation requirements

Exhibit 1. Performance Ratings

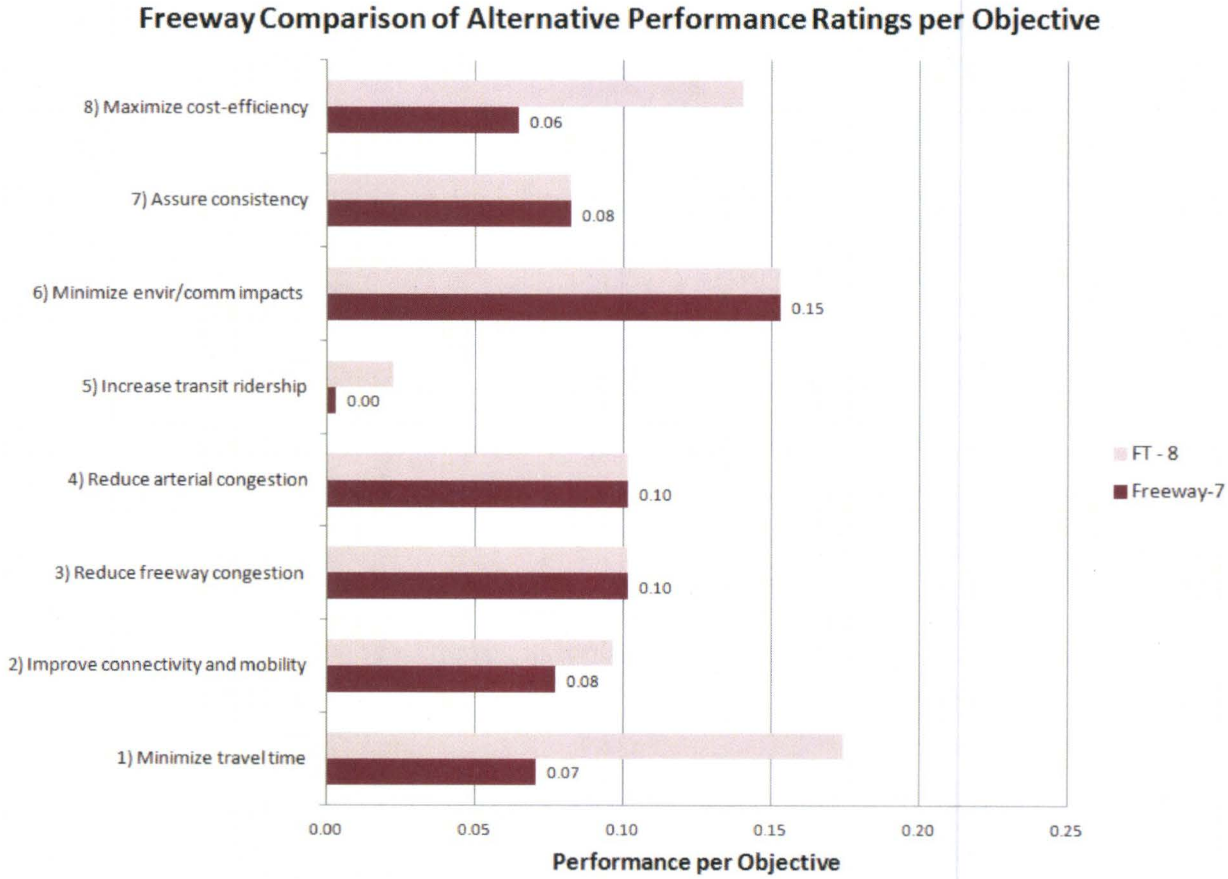


Exhibit 2. Performance Profile

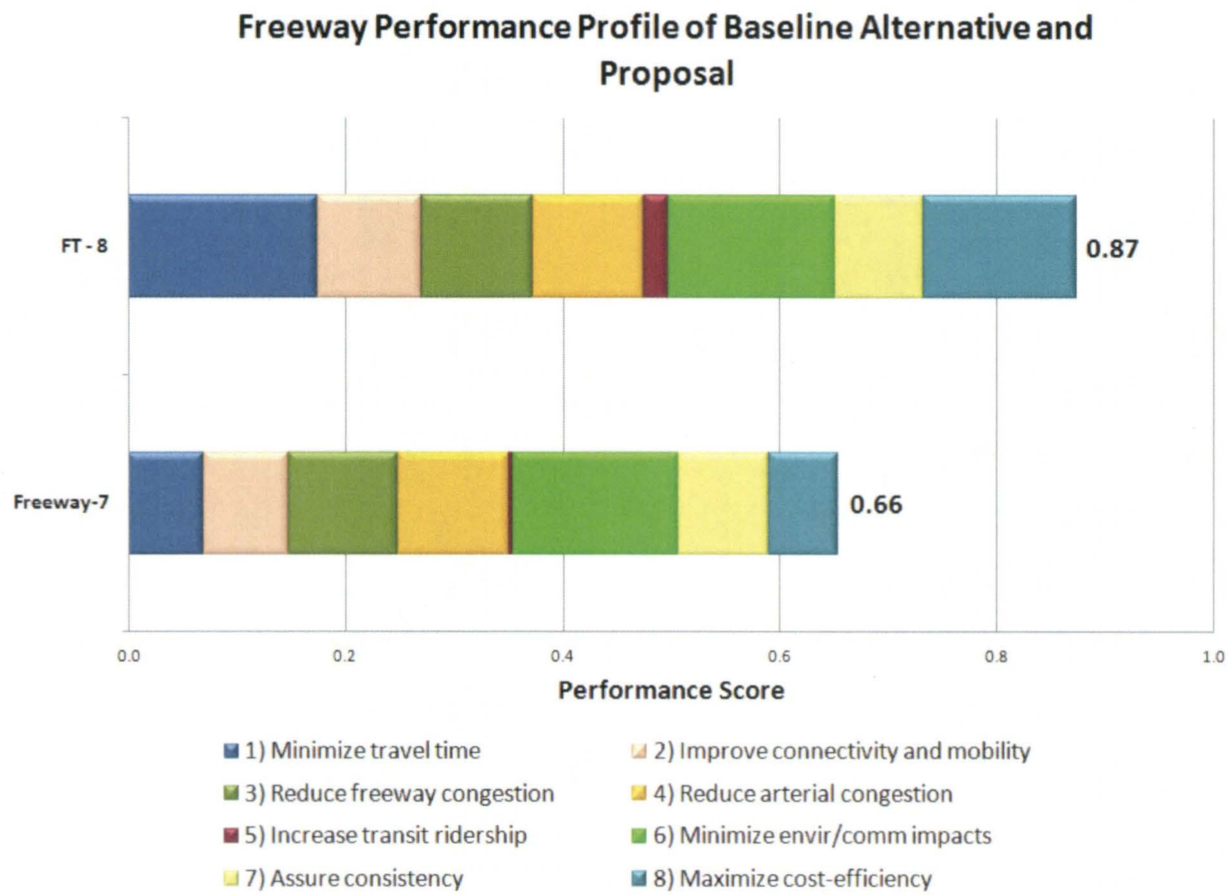


Exhibit 3. Benefit and Cost Performance

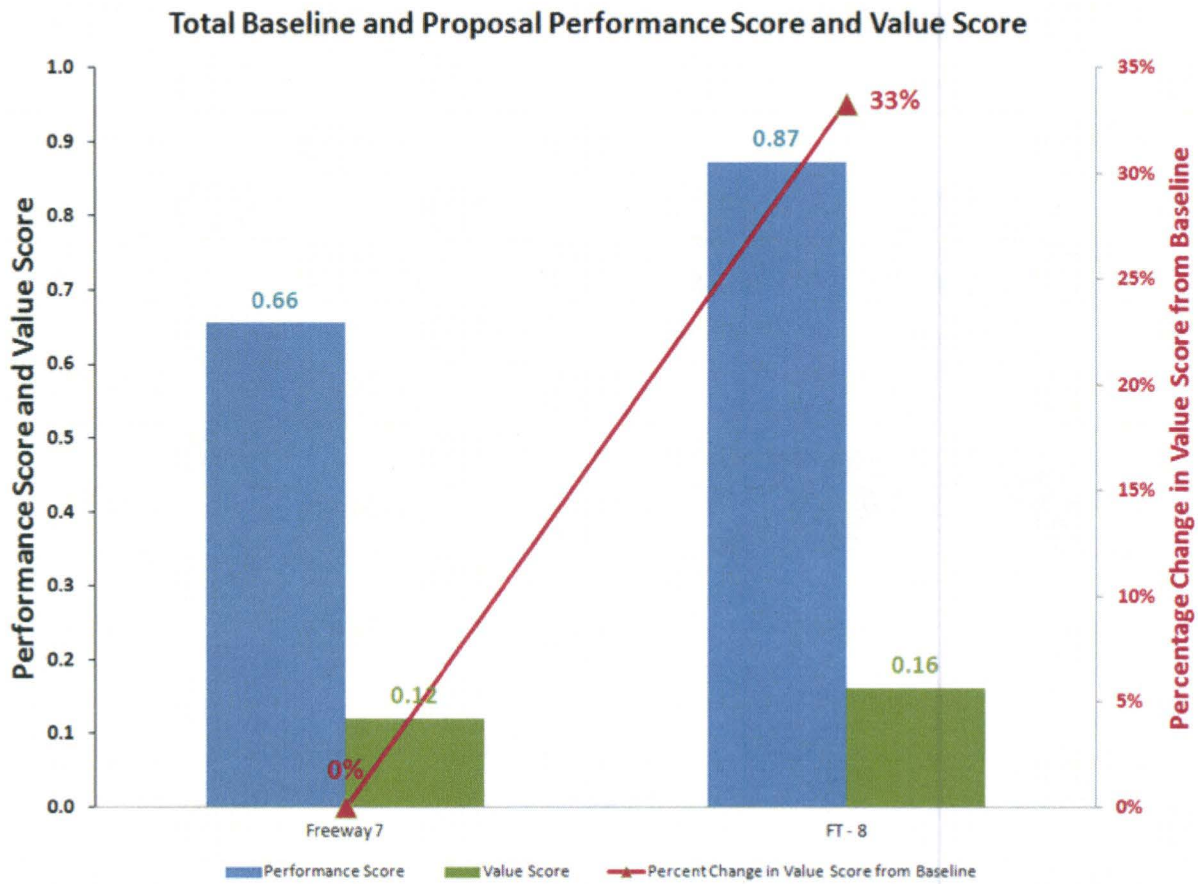


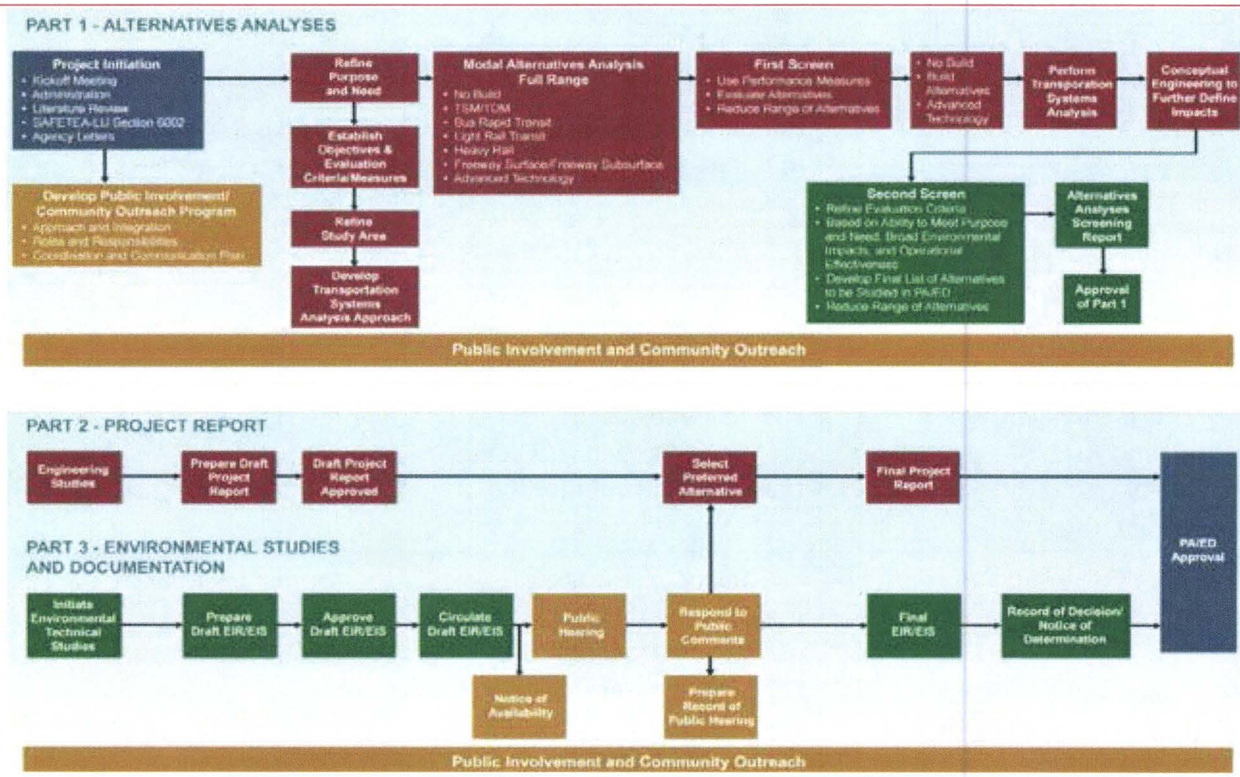
Exhibit 4. Performance Assessment

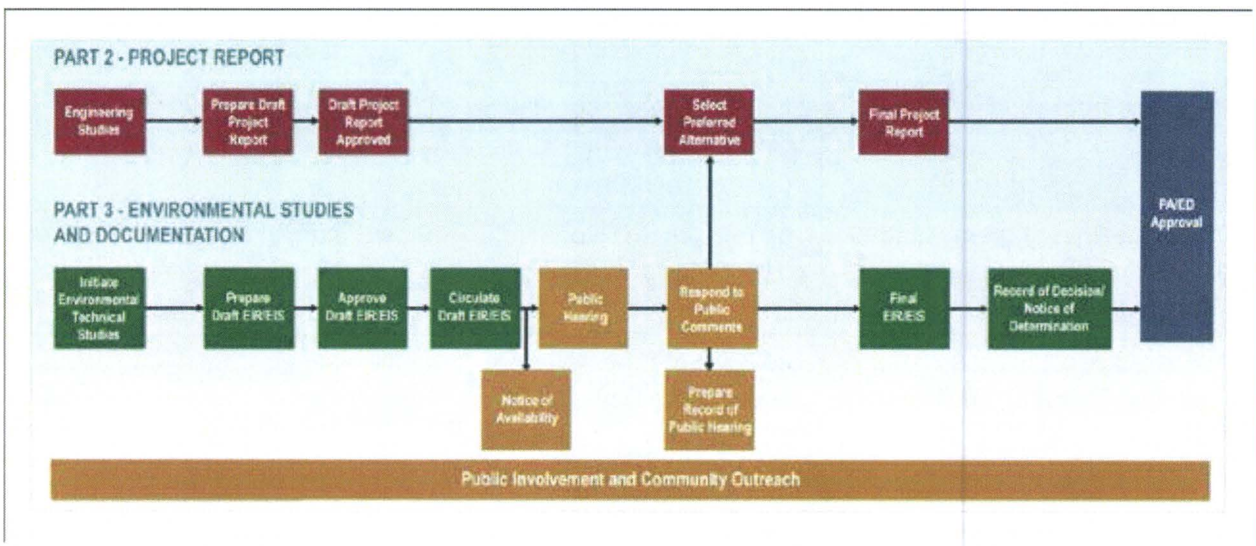
Performance Attributes (Objectives) Evaluation

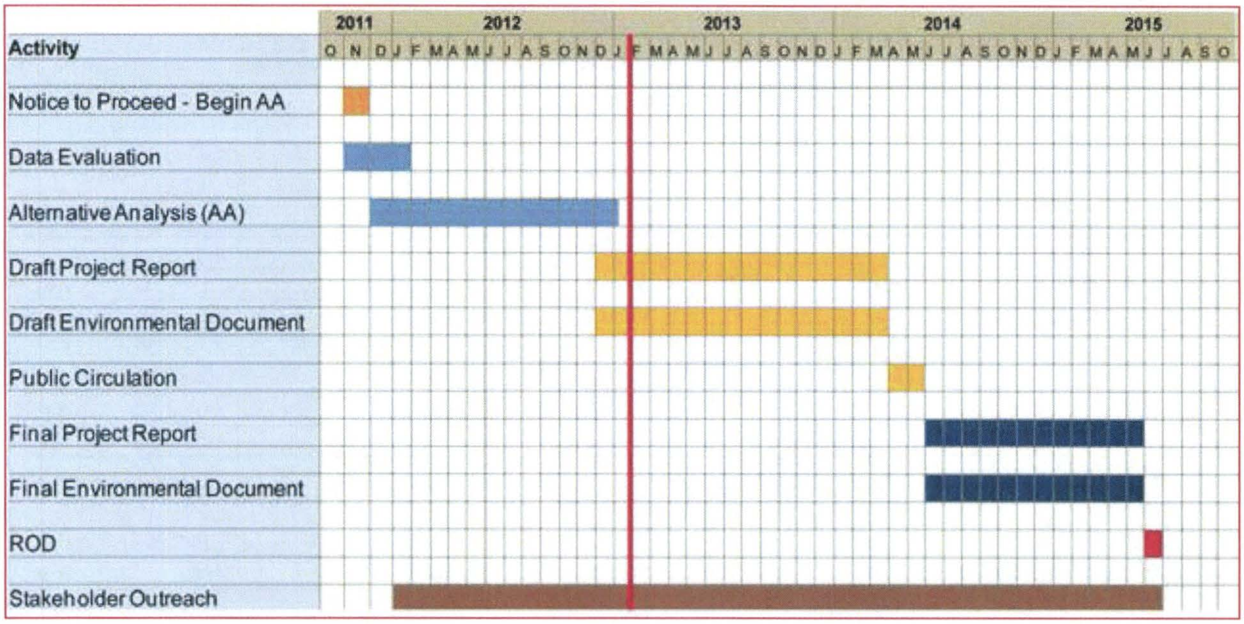
Objectives	**Comment** (Influence of the VA Proposal upon the Objective)	**Rating** (VA Proposal "Improves Performance" or "No Change" or "Reduces Performance")
Minimize Travel Time	The ability to advance the project earlier would reduce travel times sooner for the public.	Improved performance
Improve Connectivity and Mobility	The ability to advance the project earlier would reduce travel times sooner for the public.	Improved performance
Reduce Congestion on Freeway System	The ability to advance the project earlier would reduce congestion sooner for the public on the freeway system.	Improved performance
Reduce Congestion on Local Street System	The ability to advance the project earlier would reduce congestion sooner for the public.	Improved performance
Increase Transit Ridership	The PPP process would consider transit opportunities as part of potential solutions.	No change
Minimize Environmental and Community Impacts Related to Transportation	The PPP process would follow NEPA/CEQA procedures.	No change
Assure Consistency with Regional Plans and Strategies	The PPP potential solutions would be consistent with regional plans.	No change
Maximize Cost Efficiency of Public Investments	The PPP process may provide the best opportunity to maximize public investment.	Improved performance

Proposal Title: Move to Public-Private Partnership (PPP) Model of Delivery

Exhibit 5. Baseline Concept Sketch







2011
2012
2013
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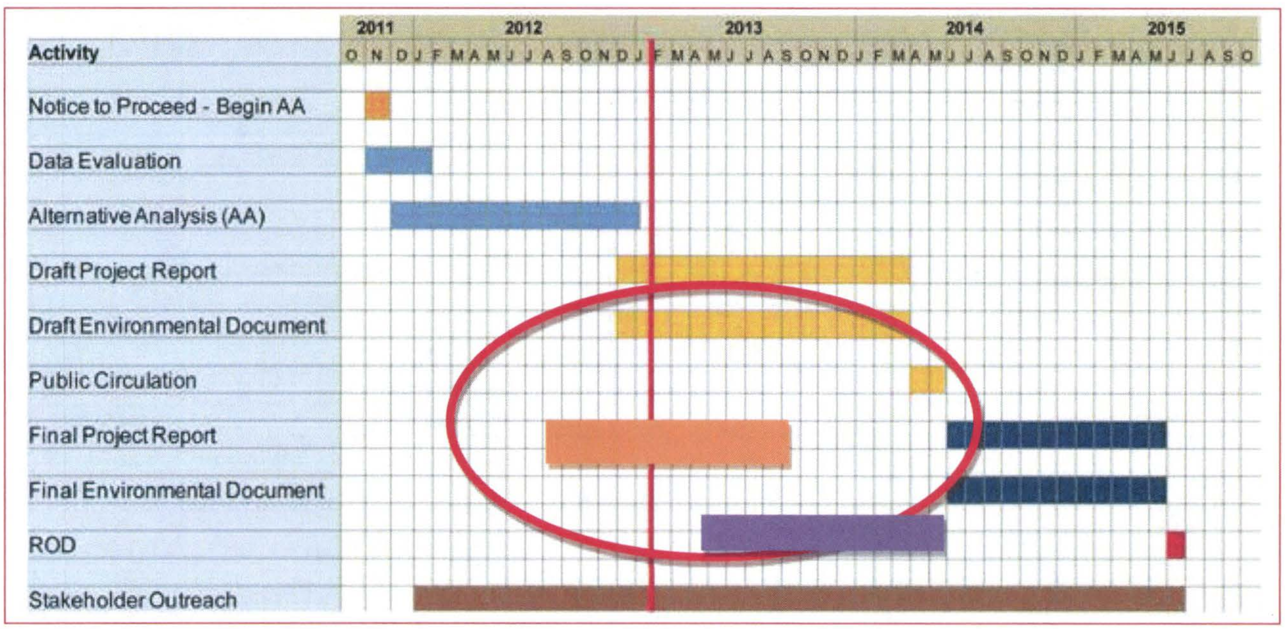
2015
Activity
O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O
Notice to Proceed - Begin AA
Data Evaluation
Alternative Analysis (AA)
Draft Project Report
Draft Environmental Document
Public Circulation
Final Project Report
Final Environmental Document
ROD
Stakeholder Outreach



2011
2012
2013
2014
2015
Activity
O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O
Notice to Proceed - Begin AA
Data Evaluation
Alternative Analysis (AA)
Draft Project Report
Draft Environmental Document
Public Circulation
Final Project Report
Final Environmental Document
ROD
Stakeholder Outreach

VA PROPOSAL NO. FT8

Proposal Title: Move to Public-Private Partnership (PPP) Model of Delivery

Exhibit 7. Initial Cost Estimates

INITIAL COSTS *Move to PPP Approach ($ in 1,000's)*							ALT. NO. FT-8
CONSTRUCTION ELEMENT		*BASELINE CONCEPT*			*VA PROPOSAL CONCEPT*		
Description	**Unit**	**Qty**	**Cost/Unit**	**Total**	**Qty**	**Cost/Unit**	**Total**
ROADWAY ITEMS							
Roadway	1	1	$ 332,000	$ 332,000	1	$ 265,600	$ 265,600
				$ -			$ -
				$ -			$ -
ROADWAY SUBTOTAL				*$ 332,000*			*$ 265,600*
ROADWAY MARK-UP			*incl*	$ -		*incl*	$ -
ROADWAY TOTAL				*$ 332,000*			*$ 265,600*
STRUCTURE ITEMS							
Structure	1	1	$ 574,000	$ 574,000	1	$ 459,200	$ 459,200
Freeway Tunnel and Ventilation	1	1	$ 4,441,000	$ 4,441,000	1	$ 3,552,800	$ 3,552,800
				$ -			$ -
				$ -			$ -
STRUCTURE SUBTOTAL				*$ 5,015,000*			*$ 4,012,000*
STRUCTURE MARK-UP			incl	$ -		*inccl*	$ -
STRUCTURE TOTAL				*$ 5,015,000*			*$ 4,012,000*
RIGHT-OF-WAY ITEMS							
Right-of-Way	1	1	$ 75,000	$ 75,000	1	$ 75,000	$ 75,000
RIGHT-OF-WAY TOTAL				*$ 75,000*			*$ 75,000*
ENVIRONMENTAL MITIGATION ITEMS							
				$ -			$ -
				$ -			$ -
CAPITAL OUTLAY SUPPORT ITEMS							
Reengineering and Redesign				$ -			$ -
Project Engineering				$ -			$ -
TOTAL				$5,422,000			$4,352,600
TOTAL (Rounded)				$5,420,000			$4,350,000
						SAVINGS	**$1,070,000**

Life-Cycle Cost Estimates: The VA team did not provide future cost calculations for this proposal because it was not felt that significant differences in future costs between the VA proposal and the Baseline Alternative could be quantified or computed at this conceptual phase of design. The future cost difference for this VA proposal is therefore zero, and the Net Life Cycle Cost as shown in the cost summary at the top of this proposal is the same as the Initial Cost Saving (or Premium if a negative value is shown in parentheses).

VA PROPOSAL NO. FT8

Proposal Title: Move to Public-Private Partnership (PPP) Model of Delivery

Assumptions and Calculations: The potential long-term positive and negative economic effects of PPPs will need to be considered throughout the process. Possible benefits include job creation, transfer of risk away from the public sector, the value of having certain infrastructure projects delivered more quickly, and the potential cost savings of PPPs—up to 40 percent, according to the U.S. Department of Transportation[165]—due to innovative contracting and integrated project delivery. We used 20 percent to be conservative.

VA PROPOSAL NO. FT9

Proposal Title: Utilize "Early Contractor Involvement" into the Project Delivery Options of the Corridor

Initial Cost Savings:	$500,000
Future Cost Savings:	$0
Net LCC Savings:	$500,000
Change in Schedule:	(---)
Performance Change:	+0 %
Value Change:	+1 %

Description of Baseline Concept: The VA Team's understanding of the current concept is as follows: Once the environmental document is complete, the typical practice would be to start the process of final design. This process would not typically include detailed construction means and methods input into the development of the plans, specifications, and estimates (PS&E) packages.

Description of VA Proposal Concept: Commit to utilize the practice of Early Contractor Involvement (ECI). There are two options to do this:

- <u>Option 1 – Utilize true ECI.</u>

  ECI is a hybrid of design-build project delivery methods from England involving qualifications-based design-builder selection and an open-book target pricing system. With the ECI delivery method, the agency would use a qualifications-based approach to select a contractor early in the project development process when the agency has only conceptual plans and an approved budget price.

  Once the contractor has been selected, additional design and planning is performed with the input of the entire delivery team to establish a target price for the project from that point forward. Various mechanisms are incorporated throughout the design and construction process for the contractor to share in savings, and participate in any losses, realized when actual costs are compared to the target price.

  The agency compensates the contractor for actual costs, based on open-book accounts and records, plus a fee. In addition, an incentive structure, similar to that described below, is established to motivate the contractor to design and construct the project within budget.

- <u>Option 2 – Hire under a separate contract to the Owner a team of specialized experts to review the drawings as the design is being progressed.</u>

  This option would preclude the team from participating with the final construction contract.

Advantages:

- Offers insight into specific details on construction means and methods, approach to combining the alternatives, and the financial viability.
- Provides agreed-upon risk allocation strategies.
- Offers some access to a construction entity that has built similar projects of this scope and scale.
- Could eliminate some unnecessary specifications or details on the final PS&E.

- Provides tailored construction packages to the details of the specific project.
- Allows contractor's expertise to be introduced earlier in the project development process.
- The open book target pricing system requires the contractor to operate in an open and collaborative way.
- Potential for overlapping design and construction phases may allow for faster project delivery.
- Encourages better communication between contractor and agency.

Disadvantages:

- Option 2 will eliminate the contractor that assists the Owner from the bidding pool.
- It will only be one contractor's view to means and methods for the tunnel.
- The absence of direct side-by-side price competition can lead to overly conservative and easily achievable performance targets.
- Open-book accounting structure and the risk of sharing in cost overruns may deter potential bidders.
- There would be increased procurement costs.

Discussion: Engaging a specialized tunnel construction contractor early in the process of project development and delivery will allow the Owner's delivery team to get direct insights into project specifics that are tailored to the project based on specific details of the project.

This has not yet been fully utilized in Caltrans contracting practices, but the United States Army Corps of Engineers (USACE) has utilized this methodology on complicated projects.

Technical Review Comments: If the ECI method Option 1 is applied on this project, there may be concerns about competitiveness on the final pricing, as the contractor would be negotiating the final costs not bidding the final costs.

Project Management Considerations: Implementation of this approach would require changes to the following items:

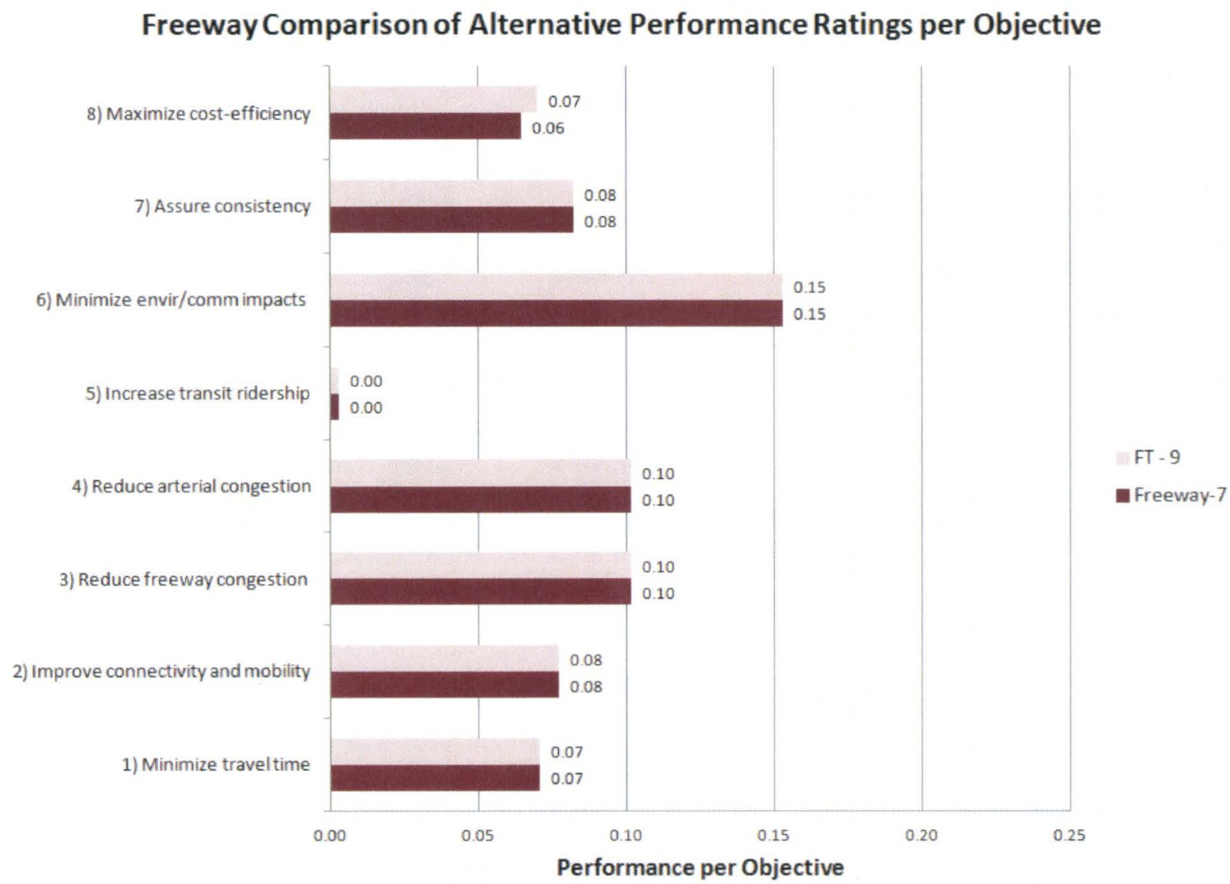
- Schedule concepts
- Costing
- Risk allocations
- Policy decisions
- Ownership structure

Discussion of Risk Impacts: Caltrans and Metro will need to develop policy, processes, and procedures that address the following:

- Responsibility for permitting activities
- Schedule
  - Permitting delays and challenges
  - Different options for tunnel construction
  - Methodology and stormwater requirements
- Cost
  - Design exceptions are discouraged
  - Approval of any design variances
  - Methods of tunnel, bridge construction, and stormwater management and mitigation requirements

Proposal Title: Utilize "Early Contractor Involvement" into the Project Delivery Options of the Corridor

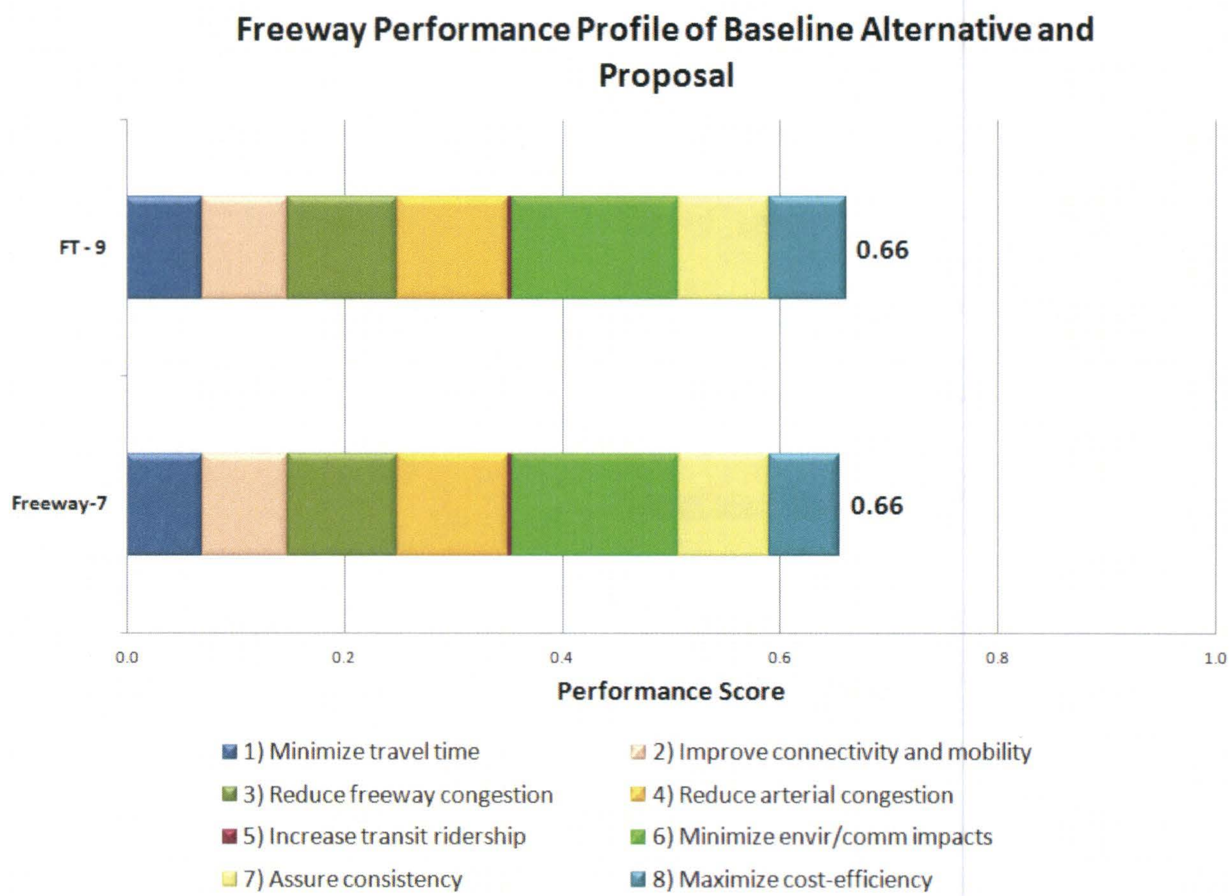
Exhibit 1. Performance Ratings



VA PROPOSAL NO. FT9

Proposal Title: Utilize "Early Contractor Involvement" into the Project Delivery Options of the Corridor

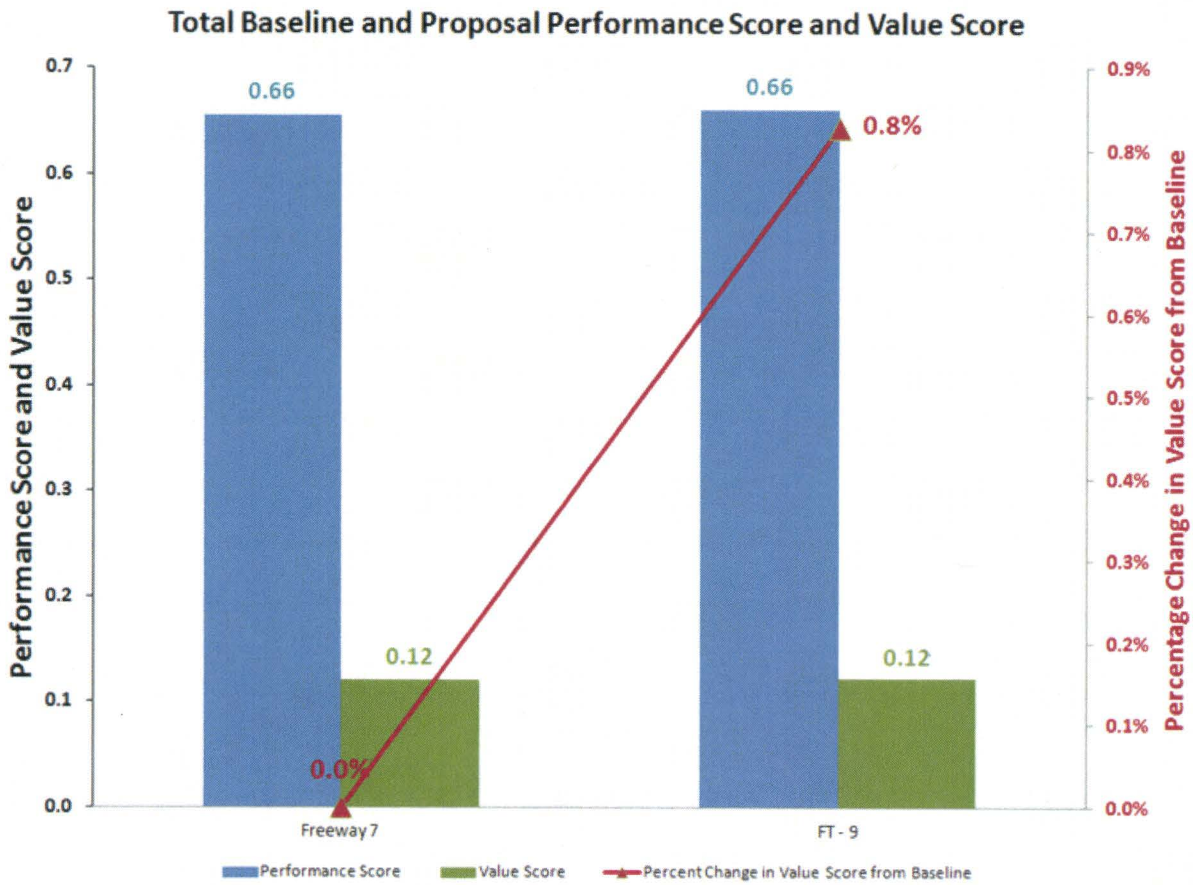
Exhibit 2. Performance Profile



VA PROPOSAL NO. FT9

Proposal Title: Utilize "Early Contractor Involvement" into the Project Delivery Options of the Corridor

Exhibit 3. Benefit and Cost Performance



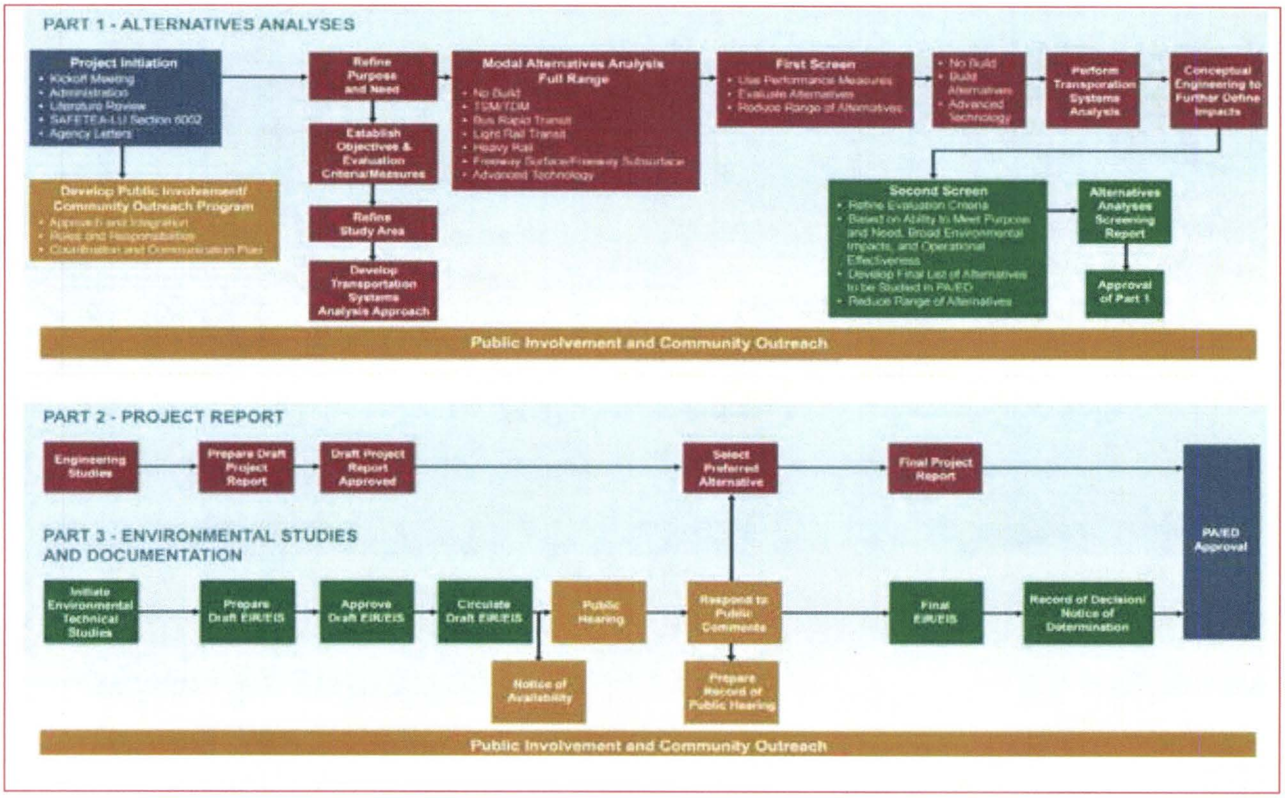
Proposal Title: Utilize "Early Contractor Involvement" into the Project Delivery Options of the Corridor

Exhibit 4. Performance Assessment

Performance Attributes (Objectives) Evaluation

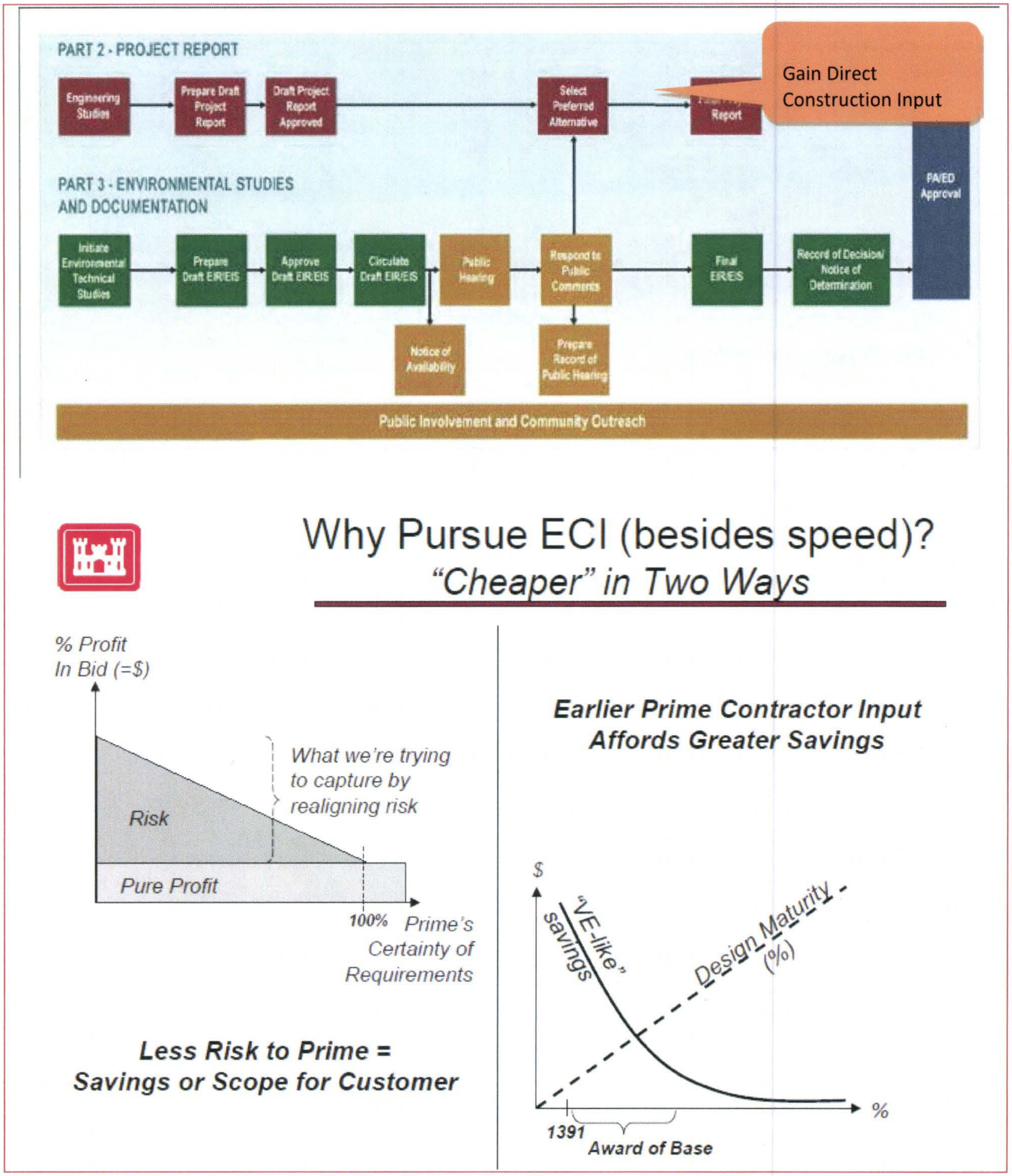
Objectives	**Comment (Influence of the VA Proposal upon the Objective)**	**Rating: VA Proposal: "Improves Performance" or "No Change" or Reduces Performance"**
Minimize Travel Time	The ECI solutions would be not change the Travel Times.	No change
Improve Connectivity and Mobility	The ECI solutions would be consistent with current mobility.	No change
Reduce Congestion on Freeway System	The ECI solutions would be consistent with current Congestion Management plans.	No change
Reduce Congestion on Local Street System	The ECI solutions would be consistent with existing plans.	No change
Increase Transit Ridership	The ECI solutions would not change transit ridership.	No change
Minimize Environmental and Community Impacts Related to Transportation	The ECI solutions will not change the Community Impacts or the Environmental requirements.	No change
Assure Consistency with Regional Plans and Strategies	The ECI solutions would be consistent with Regional plans.	No change
Maximize Cost Efficiency of Public Investments	The ECI process may provide opportunity to maximize public investment.	Improved performance

Exhibit 5. Baseline Concept Sketch



Proposal Title: Utilize "Early Contractor Involvement" into the Project Delivery Options of the Corridor

Exhibit 6. VA Proposal Concept Sketch



VA PROPOSAL NO. FT9

Proposal Title: Utilize "Early Contractor Involvement" into the Project Delivery Options of the Corridor

Exhibit 7. Initial Cost Estimates

INITIAL COSTS — *Early Contractor Involvement (ECI) Implmentation - (Estimate below in $1,000's)*								ALT. NO. FT9
CONSTRUCTION ELEMENT		*BASELINE CONCEPT*			*VA PROPOSAL CONCEPT*			
Description	**Unit**	**Qty**	**Cost/Unit**	**Total**	**Qty**	**Cost/Unit**	**Total**	
ROADWAY ITEMS								
Roadway	1	1	$ 332,000	$ 332,000	1	$ 315,400	$ 315,400	
				$ -			$ -	
ROADWAY SUBTOTAL				*$ 332,000*			*$ 315,400*	
ROADWAY MARK-UP			*incl*	*$ -*		*incl*	*$ -*	
ROADWAY TOTAL				*$ 332,000*			*$ 315,400*	
STRUCTURE ITEMS								
Structure	1	1	$ 574,000	$ 574,000	1	$ 315,400	$ 315,400	
Freeway Tunnel and Ventilation	1	1	$ 4,441,000	$ 4,441,000	1	$ 4,218,950	$ 4,218,950	
				$ -			$ -	
				$ -			$ -	
				$ -			$ -	
STRUCTURE SUBTOTAL				*$ 5,015,000*			*$ 4,534,350*	
STRUCTURE MARK-UP			incl	*$ -*		*incl*	*$ -*	
STRUCTURE TOTAL				*$ 5,015,000*			*$ 4,534,350*	
RIGHT-OF-WAY ITEMS								
Right-of-Way Acquisition	1	1	$ 75,000	$ 75,000	1	$ 75,000	$ 75,000	
RIGHT-OF-WAY TOTAL				*$ 75,000*			*$ 75,000*	
ENVIRONMENTAL MITIGATION ITEMS								
				$ -			$ -	
				$ -			$ -	
CAPITAL OUTLAY SUPPORT ITEMS								
Reengineering and Redesign				$ -			$ -	
Project Engineering				$ -			$ -	
TOTAL				$5,422,000			$4,924,750	
TOTAL (Rounded)				$5,420,000			$4,920,000	
						SAVINGS	**$500,000**	

Life-Cycle Cost Estimates: The VA team did not provide future cost calculations for this proposal because it was not felt that significant differences in future costs between the VA proposal and the Baseline Alternative could be quantified or computed at this conceptual phase of design. The future cost difference for this VA proposal is therefore zero, and the Net Life Cycle Cost as shown in the cost summary at the top of this proposal is the same as the Initial Cost Saving (or Premium if a negative value is shown in parentheses).

VA PROPOSAL NO. FT9

Proposal Title: Utilize "Early Contractor Involvement" into the Project Delivery Options of the Corridor

Assumptions and Calculations:

We assumed 5 percent cost reductions because more cost-effective solutions would be developed with input from the contractors. This is an assumption based on Design-Build Institute of America (DBIA) statistics that would indicate more specific construction team input offers better pricing and lowers risk pricing for the ultimate construction costs.

VA PROPOSAL NO. FT10

Proposal Title: Networkwide Congestion Management by Vehicle Speed Control

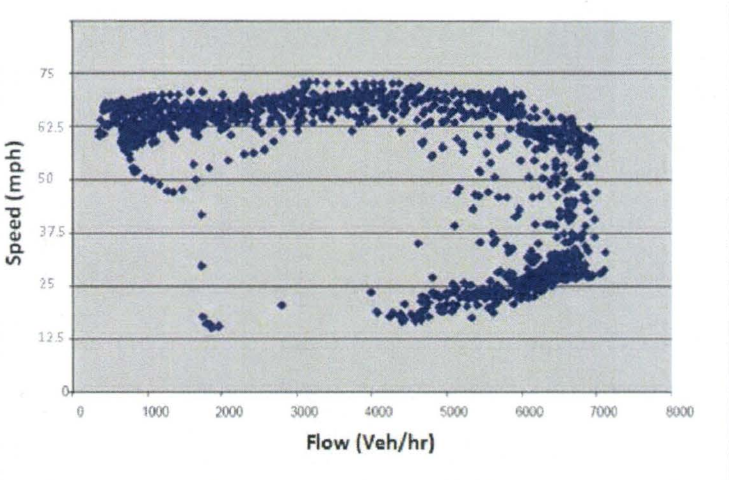
Initial Cost Savings:	($47,900,000)
Future Cost Savings:	($1,420,000)
Net LCC Savings:	($49,320,000)
Change in Schedule:	None
Performance Change:	+15 %
Value Change:	+14 %

Description of Baseline Concept: The concept is to install basic information signs for advance warning only, without congestion management of traffic. No tolling is included in the estimate, and it is assumed that no Variable Message Signs (VMS) are included for cut-and-cover tunnel alignments.

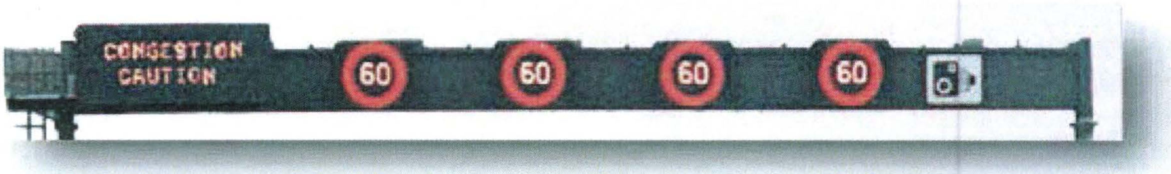
Description of VA Proposal Concept: The basic goal is to introduce traffic management to provide safe roads, reliable journeys, and informed road users. These goals apply to this proposal for networkwide congestion management. This proposal embodies those principals in respect to managing and controlling highway speeds and lane usage through the use of Variable and Enhanced Message Signs (VMS/EMS). The following summarizes the purpose of this option:

- Congestion management
- Information
- Safety
- Highway maintenance
- All lanes running

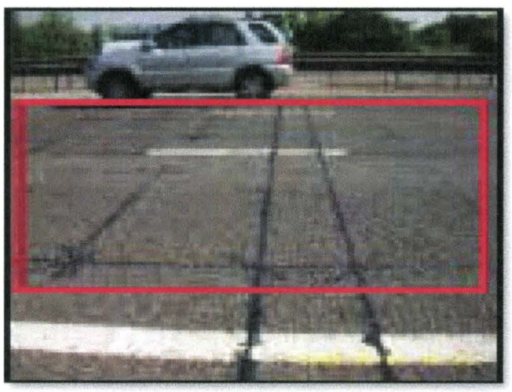
Figure 1 - Speed Flow Relationship



The basic principle for this proposal is congestion management using mandatory variable speed limits that are appropriate for the traffic conditions. This harmonizes traffic speeds and reduces the severity of shockwaves (stop-start driving). Smoothing traffic flow in this way helps to delay the onset of flow breakdown, as indicated in Figure 1, and advances the recovery of traffic flow from congested conditions.



The systems Advance Freeway Indicators (AFI) display 60 mile per hour (mph), 50 mph, and 40 mph speed limits through congestion signal settings in response to the traffic conditions on the highway and intersection ramps. The congestion signal settings respond to the number of vehicles per minute passing over loop detectors (the traffic flow). At calculated thresholds, the speed limit displayed to road users is reduced and increased as required. The system utilizes radar-based speed detection by cameras mounted on the overhead gantries, linked to the VMS displaying the speed limit. The system uses digital camera technology. When in operation, all evidence is automatically retrieved and recorded at a secure Police Operations Department.



The system will require installation of additional overhead gantries with VMS/EMS signage, loop detectors, back office hardware, and software as well as Vehicle License Plate Recognition cameras and associated enforcement system for issue of citations. The anticipated system will cover traffic management on the freeway tunnel alignment as well as select locations on the adjoining freeway network that have been identified as likely to have congested lanes by 2035. In the event dynamic toll rate setting is selected as an option for the tunnel, the signage and back office operations would be combined.

Advantages:

- Provides adaptable flexible network management.
- System is tried and tested (Europe).
- Offers simple system control.
- Improves accident response time (lane closure).
- Improves journey time reliability.
- Maximizes demand.
- Minimizes delay (accident and unplanned event).
- Minimizes delay (maintenance and construction).
- Minimizes user stop/start travel.
- Minimizes ramp tailback.
- Provides speed detection (instant or distance).

- Enforces speed limit.
- Collects revenue (video citation).
- Predicts and accommodates demand.
- Displays dynamic high-occupancy vehicle/high-occupancy toll (HOV/HOT) rate information.
- Provides an All Lane Running (ALR) system (includes shoulders).

Disadvantages:

- Relies on road user compliance.
- Requires additional network VMS signage.
- Speed detector location is known, which affects driver habits (slowing down at gantries).
- Objection to postal citation is expected.

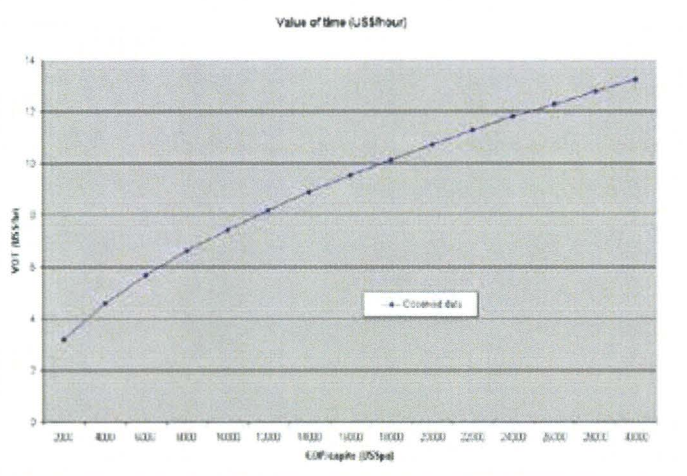
Discussion: The Baseline Concept does not include provision for extensive enhanced messaging or management of congestion through speed control on the existing and new freeway tunnel option. This option has been introduced in Europe, which has limited right-of-way (ROW) available to widen the existing highway network. Over the past 20 years, Continental Europe and the UK have experienced traffic levels that almost doubled and, as a result, congestion has become a serious problem for road users and national economies. It is estimated that 34 percent of congestion on the network is caused by incidents and roadwork; the remaining 66 percent is therefore caused by traffic density. In essence, the demand of the highway at a given time is exceeding its capacity, which is determined as the number of vehicles that can safely and smoothly traverse a section of highway in a given timeframe.

Peak-time stationary and slow-moving traffic is a regular occurrence at key points of a network, and as an example, none more so than the UK's M25 Motorway. The M25 is an outer beltway around London and is one of the busiest motorways in Europe carrying in excess of 200,000 vehicles per day. Congestion regularly occurs at several points, delaying thousands of motorists every day.

The intention of this proposal is to adopt one of the solutions implemented in Europe to improve highway capacity through the setting of variable speed and advance message signs to manage unexpected incidents and congestion. The principle is to adjust the flow of traffic through variable speed signage when slow-moving traffic is detected. This not only protects stationary road users by slowing the speed of approaching vehicles, but also reduces the habit of start-stop driving. These settings are largely a safety measure, dealing with traffic jams that have already formed. Congestion settings, however, attempt to deal with congestion before capacity is reached and help regain smooth traffic flow as demand drops.

The main aim is to reduce the traffic speed just before traffic flow reaches the critical level where flow breakdown is likely to occur. The controlling algorithm relies on the principle that the capacity of a section of freeway is not merely dependent on physical factors such as the incline of the road or the number of lanes, but also on how road users make decisions as to the use of the road space at a particular location and point in time.

Road User Behavior



Journey Time Reliability

The main factor determining road user behavior is how long it takes to drive from point A to point B and the consequent impact on stress when congestion occurs. Good journey time reliability is essential for road users to plan their journey when traveling on the freeway. The introduction of congestion management improves journey time reliability in certain key periods; assessment of a road user's value of time is also critical in establishing the level of tolls that could be charged for such reliability. It is worth noting that in some instances there may be increases in journey times on sections of highway due to networkwide implementation that reduces congestion on other sections. However, the increases should more than compensate by offering road users a more predictable overall journey.

Level of Driver Stress

Driver stress is difficult to quantify and measure. In the UK, surveys were conducted to gauge how road users felt about using the variable speed controlled freeway option. From the comments received it was clear that road users were positive about the specific benefits (such as increased journey time reliability and reduced stop-start driving), and a more calm driving experience when compared to other standard sections of freeway.

Lane Utilization

Capacity in turn is also affected by road user behavior as identified in trials for calculating site-specific flow thresholds. Two sections of highway with exactly the same vehicle mix and geography, at the same time, on the same day can require quite different thresholds because of user behavior. For instance, when vehicles are changing lane they are in effect taking up two lanes and reducing the capacity at that location. Lane changing also causes sharp braking and creates uneven headways. When there is a consistent stream of vehicles, as there may be when traffic flow levels approach capacity, then any sharp braking ripples back upstream in "shockwaves."

It is not simply the reduction of speed that increases capacity, but the changes to road user behavior that result from this. The VMS settings would read "Congestion Stay In Lane" as the advice to road users, as suggested explicitly in the message sign and also implied and encouraged in an accompanying reduced speed limit. By lowering the speed limit, the proportion of vehicles that can drive near it is increased and hence vehicles will drive at a more uniform speed and the need for lane changing will be reduced. Of course, lane changing will always be required for those leaving or joining the main lanes, but this approach aims to reduce lane changing for overtaking.

The introduction of variable speed control and ALR can result in a more balanced use spread evenly over all available lanes.

Why do we need controlled freeways?

Traffic demand can typically increases by 2 percent each year, and there is a need to manage this demand effectively to help keep the freeway flowing. To achieve this safely, changes in the traffic flows/speeds have to be smooth to maximize the highway's potential. The speed control system creates an environment to minimize the risk of flow breakdown (where traffic can become stationary on the freeway), reduce accidents as a result of flow breakdown, and produce more reliable journey times.

For example, many years of research has enabled the UK's Highways Agency to develop techniques and systems to achieve effective traffic control; these systems are constantly monitored and adjusted to maximize benefits and operational reliability.

As the traffic demand increases, inevitably the signals will be on more often and for longer periods. The signals and message signs also can be manually set by the police or Caltrans staff to complement or override automatic settings.

The Signal Controls

Advanced Indicators (AIs) are mounted on the gantries to display lane-specific instructions to drivers. These include:

- Speed limit
- Shoulder for emergency use only indicator (lane control)
- Lane is closed to traffic (stop)
- Lane divert arrows

There are two reasons for automatic signal and message sign settings: congestion and incidents.

Signals Set for Congestion

These are set in response to the number of vehicles per minute passing over loop detectors – the traffic demand. As demand increases so does the risk of flow breakdown and accidents. At carefully calculated thresholds, the signals are set to reduce the speed of traffic, smooth the flow, reduce the potential for flow breakdown and create a safer environment for the current traffic conditions. Initially, 60 mph signals are displayed on the gantries; then, as the traffic demand increases further, 50 mph or 40 mph signals are displayed.

Road users may not realize why these signals are set, and this is understandable as there may be no apparent reason for the settings. However, the system is detecting high traffic demand and is using the signals to prevent the congestion from deteriorating into flow breakdown. This makes the journey smoother and safer for all.

Signals Set for Incidents

These are set when the system detects very slow-moving or stationary traffic over a loop detector. The signals provide warnings to protect stationary or slowing traffic and produce a safer driving environment. When stationary traffic is detected, the system rapidly sets signals to 40 mph limits in the immediate area and 60 mph limits leading into this, to give advance warning to road users alerting them to reduce their speed. If the signal gantries are quite close together, the advance signals will be set to 50 mph limits. Message signs are also set with appropriate text to support this situation.

Incident settings are designed to protect stationary/slow-moving vehicles and the back of stationary traffic that can result from these. The incident detection system also works alongside the congestion system to control the speed of traffic in congested areas where flow breakdown has already happened. The signals can also be set manually, for example when maintenance works are being carried out.
A further example would be a single lane closure to all road users with the exception of police, fire, and emergency medical service (EMS) response vehicles. The signals are used to aid the management of lane closures. An example layout for an intersection approach ramp is shown in Figure 2.

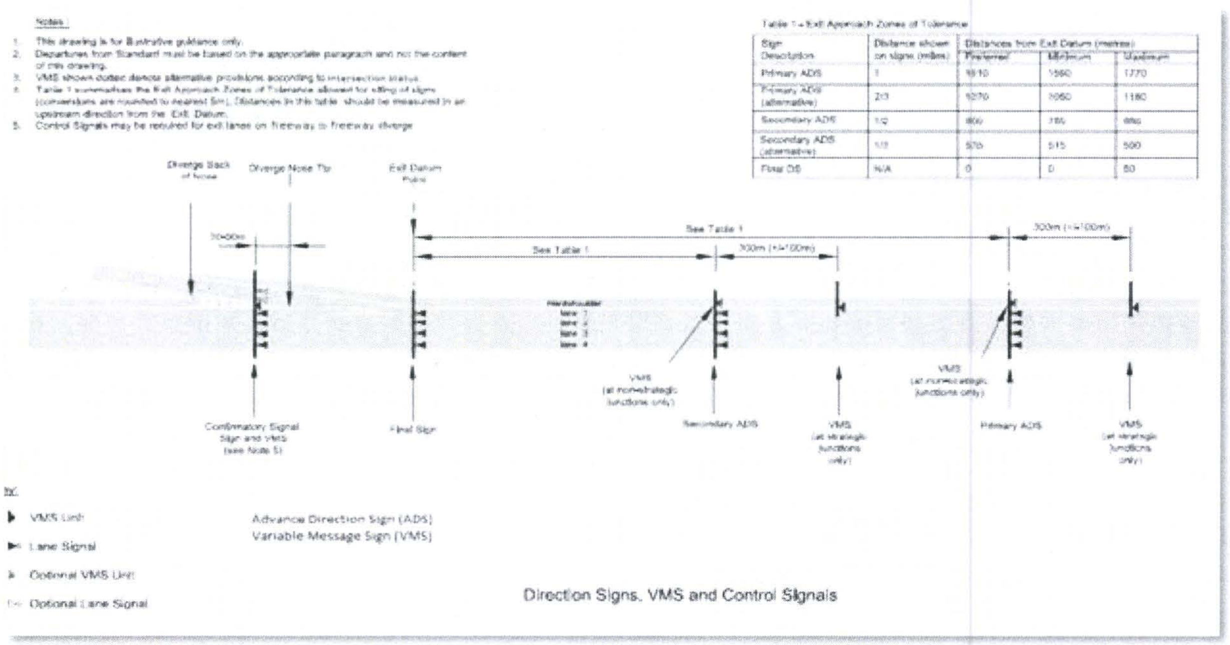
"Lane Control" Indicator

The Lane Control Indicator (broken Red X with no flashing lights) informs road users that a shoulder is reserved for emergency use only.

"Stop" Indicator

The Stop Indicator (solid Red X with flashing red lights) instructs road users that a lane is closed. This signal may be set over any lane, including the Shoulder. It is an offense to continue in the same lane beyond a Stop Indicator signal.

Figure 2 - Intersection Exit Ramp Approach



Message Signs

At regular intervals on the freeway, there are message signs giving text information to provide more details to road users about the situation ahead, and these reflect the signal activity. Examples of the automatic messages are "CONGESTION STAY IN LANE," "STATIONARY TRAFFIC AHEAD," or

"SLOW MOVING TRAFFIC AFTER NEXT INTERSECTION." Other messages such as "OBSTRUCTION" or "LANE CLOSED" can be set manually by the police or Caltrans staff.

The Whole Picture

The whole system is dynamic and responds minute by minute to the current conditions anywhere on the controlled network. The whole network is linked together to enable staged and smooth changes to the signals throughout a road user's journey.

Timing - why are the signals on so long?

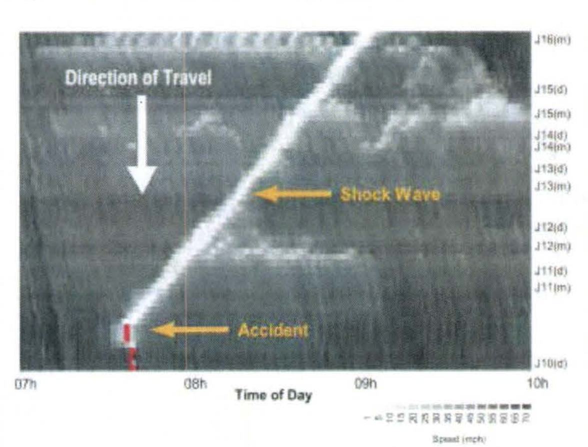
The signal system is intelligent and prevents the signals from changing the limits displayed or switching the signals "on and off" too quickly. This gives road users time to respond and ensures the signals are not confusing. Once the signals are on, timing delays are introduced to stop signals from switching off prematurely. Studies have shown that after heavy congestion has occurred, it is vital to control the recovery of traffic speeds and let the traffic flow recover safely. This minimizes the risk of further flow breakdown or traffic incidents reoccurring.

Monitoring

Traffic analysis tools allow traffic engineers to pinpoint areas on the freeway that have recurrent congestion, which enables the development of new strategies and solutions. Being able to see the whole freeway provides an understanding of the mechanisms that cannot be seen from a single road user's perspective.

The example plot in Figure 3 from a freeway in the UK shows time in hours on the horizontal axis and the intersections (distance) marked on the vertical axis. The background on this plot, black to white, represents traffic speed. Slow speeds are in white, fast speeds are in black.

Figure 3 - Shockwave Progression



An accident occurred on this freeway near intersection 10 (at the bottom of the plot). Although it only took a few minutes to clear the accident, its effects were felt an hour and a half later by road users at intersection 16. The slowing of speeds is shown as the diagonal white line (a shockwave). Road users at intersection 16 will never see what caused the incident or even know when or where it occurred, but it still presents the same hazard to that road user in the form of a shockwave of reduced speeds, which can lead to heavy braking and increased risk of accidents.

What can cause a shockwave?

Road users experiencing a shockwave find that they suddenly have to slow down, then a few moments later they can speed up again. The causes of this "stop-start" driving are varied; some are due to incidents, some are due to traffic conditions (e.g., merging at an intersection), some are due to the physical layout of the road, and others appear to have no cause. Studies have shown that a shockwave occurs when the density of the traffic reaches a critical level. Unstable traffic speeds combined with sudden braking creates a shockwave that travels back through the traffic at about 12 mph.

Figure 4 - The Signal Controls

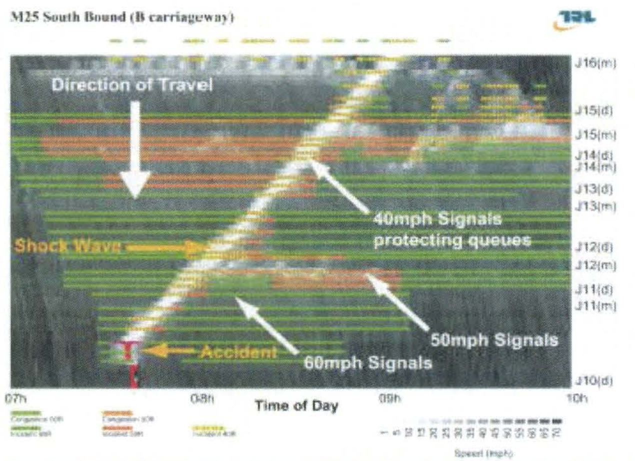


Figure 4 is a plot of the same shockwave from Figure 3 and shows the signal activity overlaid and the system in operation with the 40 mph signal limits (yellow on the plot) protecting the back of the stationary traffic produced by the shockwave.

Speed Enforcement

It is essential to the operation of Controlled Freeways that there is compliance with the mandatory speed limits that are set. Speed cameras are used to enforce the displayed speed limit. The enforcement system operates on all lanes of the freeway and enforces the speed limits that vary with the traffic conditions. The signals confirm to the enforcement system the actual speed limit being displayed at the precise time of an offense.

Journey Time and Space

When traveling through a controlled section with the signals displaying 60, 50, or 40 mph speed limits, a road user may be unaware of whether the signals are set due to high demand on that part of the freeway or whether there is an incident, stationary traffic on the main lanes, or perhaps stationary traffic on an exit ramp affecting the main lanes. The messaging, congestion, and incident control systems work together to provide the best advice to road users; and the message sign text is provided to give additional information on the situation ahead.

When a 40 mph signal is displayed, it is usually due to an incident, resulting stationary traffic, or congestion that has resulted in flow breakdown. Depending on the event, and how long it was since it occurred, road users may never see what caused it, especially if they have stationary traffic in a long tailback of traffic. The 40 mph settings also can be as a result of slow-moving traffic management vehicles at night; in this case, the signals warn road users of potential hazards ahead. Sometimes, it is possible to see what appears to be an unusual sequence of signals on the gantries. This can be caused by a combination of traveling speed and the system controls responding to a change in the traffic conditions.

All Lane Running (ALR)

A by-product of this proposal is the opportunity to implement temporary or permanent conversion of the network shoulders to a running lane, along with the ability to dynamically control mandatory speed limits. This is a key aspect of what is known as an ALR system. This removes the complex operating procedures related to opening and closing the shoulder, and brings associated capital and operational cost savings.

The permanent or temporary conversion of the shoulder on the network and/or tunnel freeway to a running lane would also apply through intersections. However, this does not preclude the provision of a lane-drop/lane-gain arrangement between exit and entry ramps where this is fully justified on the grounds of safety, operational performance, or cost.

For many intersections where the majority of traffic continues along the mainline, the provision of an additional lane between ramps is likely to be the optimum solution. However, there may be situations where the cost is prohibitive, for example due to the need to replace or modify bridges. Conversely, if a junction has very high diverge and merge flows, then providing an additional lane through the junction may not be beneficial, as it is likely to cause flow breakdown. The efficient operation of ALR systems is dependent on:

- Compliant driver behavior in relation to speed limits
- Appropriate and relevant information being delivered to the driver at a timely rate, so as not to cause overload of information or leave the driver in doubt regarding what to do

The infrastructure, technology, and procedures put in place enable the network to be managed in a way that delivers a level of driver compliance necessary to support the delivery of performance benefits.

Virginia Department of Transportation (VDOT) Adopts Hard Shoulder Running - September 5, 2008

The Virginia Department of Transport (VDOT) currently operates a managed lane strategy on the I-66 in Fairfax County that allows use of the shoulder during peak hours. At the same time, the lane adjacent to the median is converted to a temporary HOV lane. A study recently published by the U.S. Transportation Research Board concludes that the system in Virginia is a cost-effective and efficient means of increasing the capacity of the route. The study found no evidence that use of shoulder running at peak times had any effect on the number or characteristics of accidents in the study area, and goes on to recommend shoulder running as a strategy that should be considered elsewhere in the U.S. with the addition of a number of advanced signaling and traffic management features such as incident detection systems and VMS. Speed limits with and without shoulder running are 55 mph.

VA PROPOSAL NO. FT10

Proposal Title: Networkwide Congestion Management by Vehicle Speed Control

In an attempt to combat increased traffic congestion, VDOT is embracing the use of highway shoulders to increase traffic capacity during peak periods, using electronic signs indicating when the shoulders are open or closed. VDOT has extended the hours of operation of hard shoulder running on I-66 between I-495 and Route 50 in Fairfax County, adding an extra hour in the morning and afternoon. This is the busiest section of I-66, with up to 196,000 vehicles on an average weekday. Traffic pattern studies have shown that eastbound congestion regularly extends beyond 10:00 hours, and westbound congestion frequently begins by 14:00 hours.

VDOT's use of shoulder running is being extended after a study

VDOT has conducted a comprehensive safety study of the corridor, which showed no significant difference in the number of accidents on I-66 when the shoulder is open. Larger electronic signs have been installed to alert motorists to the nine emergency pull-off areas throughout the corridor. VDOT also plans to open the shoulder lane during traffic incidents or when one or more lanes are closed for planned or emergency roadwork. This will be done in coordination with Virginia State Police and emergency responders. (www.Traffictechnologytoday.com)

Frequently Asked Questions

Why do I see 60 mph limits when there appear to be low flows of traffic and the traffic is moving freely?

Traffic often travels along a freeway in discrete congested blocks or "platoons." Road users traveling between these platoons may not be able to see the congested traffic in front or behind. By the use of variable speed limits, traffic is prevented from catching up with the platoons in front of them, thereby keeping the platoons apart and stopping the moving stationary traffic from growing. This reduces the potential for flow breakdown to occur (when traffic can be brought to a standstill).

Figure 5 - Effects of Platooning

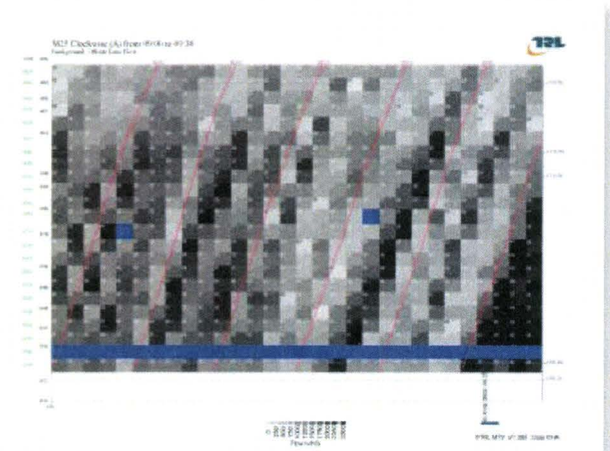


Figure 5 provides a traffic plot of the platooning effect. The numbers and shading in each cell show the flows per minute in the outside lane. The red lines represent typical journeys through the network. The plot shows how vehicles can travel between the platoons, with road users only seeing low flows, despite high overall flows on the freeway.

Why are 40 mph limits often followed by sections of heavy congestion?

The incident controls are in operation and the system is protecting the back of the stationary traffic as the vehicles move from shockwave to shockwave. When a 40 mph limit is set, a speed limit of 60 mph or 50 mph is also set upstream to warn of the stationary traffic ahead.

If road users see a 40 mph signal become set as they approach a gantry, this means that stationary traffic has formed ahead.

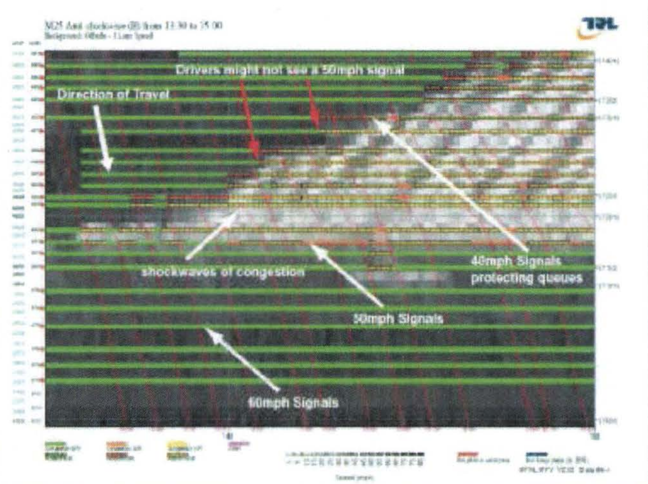


Figure 6 shows how the signals typically react to stationary traffic, and how road users can see different signal settings according to their time of travel.

Why do I see 40 mph limits (or lower) overnight, with no apparent cause?

Road maintenance is often carried out late at night and in the early hours of the morning. The signals are used to support the laying out and removal of the traffic management signs and, as this is a dangerous activity. Occasionally, road users can encounter signals just before the signs are laid out, or just after they are removed.

Why do I see what appear to be inappropriate signals and messages on the gantries?

The system is responding to a real event that is happening at that moment, further ahead of road users. It is possible that by the time road users arrive at the location of the event, there is no apparent cause, and the traffic conditions have resolved themselves.

Technical Review Comments: The basic concept for Alternative F-7 does not appear to include traffic items for the tunnel and cut-and-cover sections, such as VMS signage, within Appendix B Conceptual Engineering Cost Estimates. The traffic items that have been assessed are assumed to be isolated to approximately 2.4 miles of grade freeway. It is noted that there is no estimate for tolling equipment.

In addition, two lines of cost under Section 5 (traffic items of Appendix B Conceptual Engineering Cost Estimates) have been omitted from the Subtotal Roadway Items Sections 1 through 5:

Fiber Optic and Twisted Pair Cable System	4.8	MI	$650,000	$3,250,000
Signalized Intersections	2.0	EA	$270,000	$ 540,000

The initial cost estimate below has included the amount for fiber optic that must be subtracted from the cost comparison of ($47,960,000) for a revised amount of ($44,710,000) following subtraction of $3,250,000 as well as the section mark up of 79.4 percent for a total of ($42,129,500).

VA PROPOSAL NO. FT10

Proposal Title: Networkwide Congestion Management by Vehicle Speed Control

This VA Proposal FT10 includes an estimate of the tolling equipment, which approximates to $7,000,000 for tolling at tunnel portals. This will reduce the price premium further to ($35,129,500).

Project Management Considerations: Requires oversight of integration with Fastrack Express Lanes for tolling, and police operations for enforcement.

Discussion of Schedule Impacts: This proposition may be implemented though a phased introduction, initially implemented along the approaches to the tunnel as well as at intervals along the alignment for traffic control of unplanned incidents and planned events such as tunnel maintenance. It is believed that there would be no effect on the critical path for completion of the freeway tunnel option.

Following this pilot introduction, it is suggested that activities be concentrated at the existing main intersections with the I-10 and I-210. The works that would affect traffic flows would include diamond cutting roadway for installation of loop detectors, and erection of gantries across the freeway lanes as well as roadside equipment boxes for control and operation of the system. A fiber optic interconnection with the operations center at either end of the tunnel would also be required to accommodate data retrieval and the pan, tilt, and zoom (PTZ) camera operation as well as enhanced digital cameras for enforcement.

A much wider introduction could then be considered to improve traffic flow throughout the network of freeways within the study area.

Discussion of Risk Impacts: The predominant risk to successful implementation of this proposal would be road user acceptance and compliance with speed and lane restrictions, which would be subject to video enforcement and mailbox citations. The opportunity and benefit of more reliable journey times may not be appreciated by a proportion of the road users.

Exhibit 1. Performance Ratings

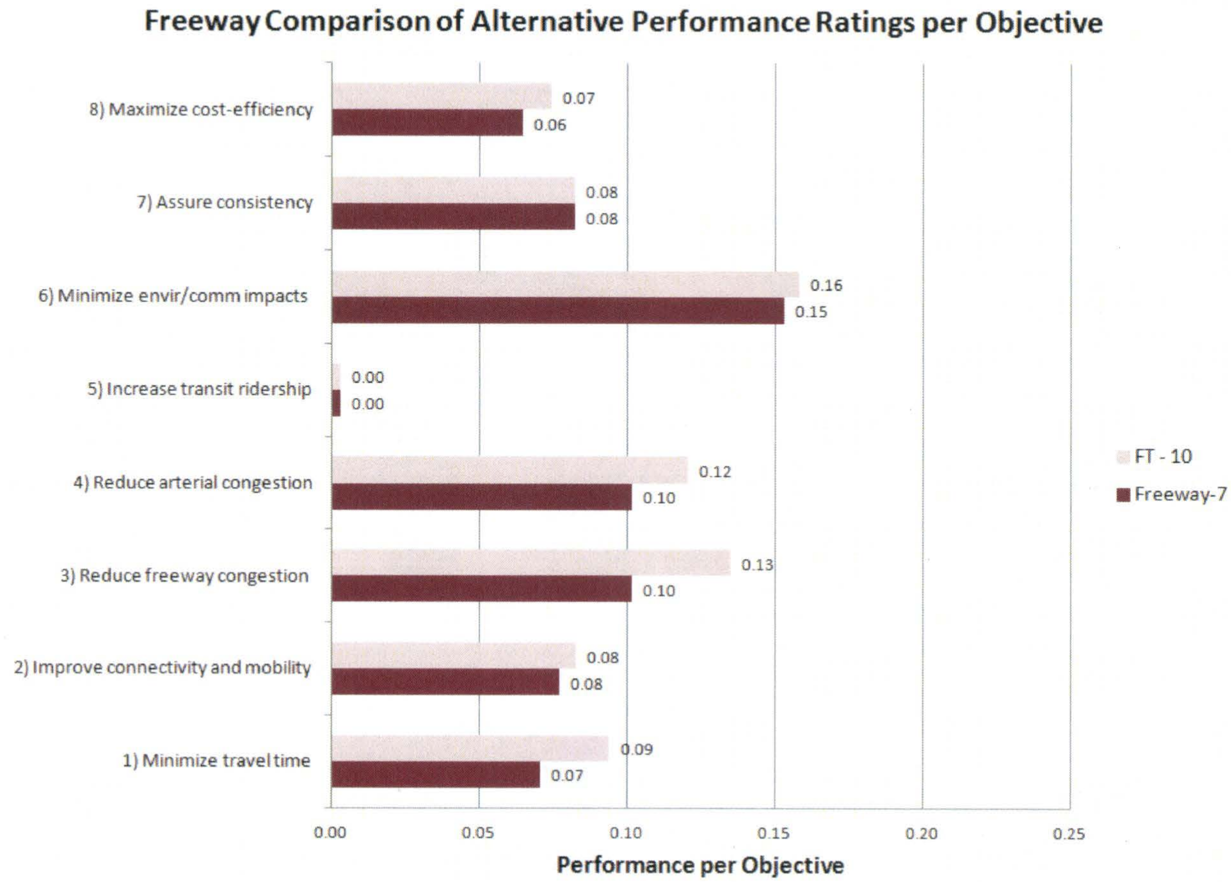


Exhibit 2. Performance Profile

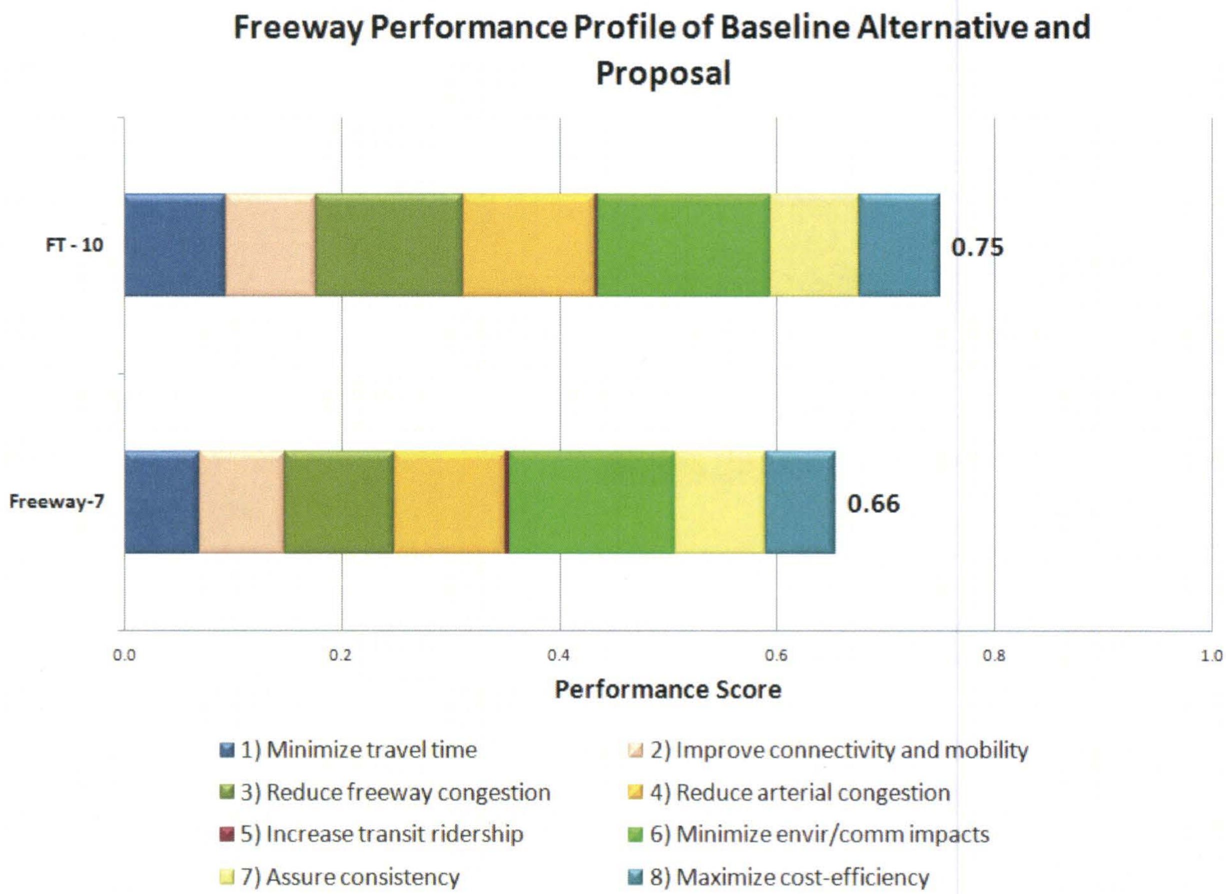


Exhibit 3. Benefit and Cost Performance

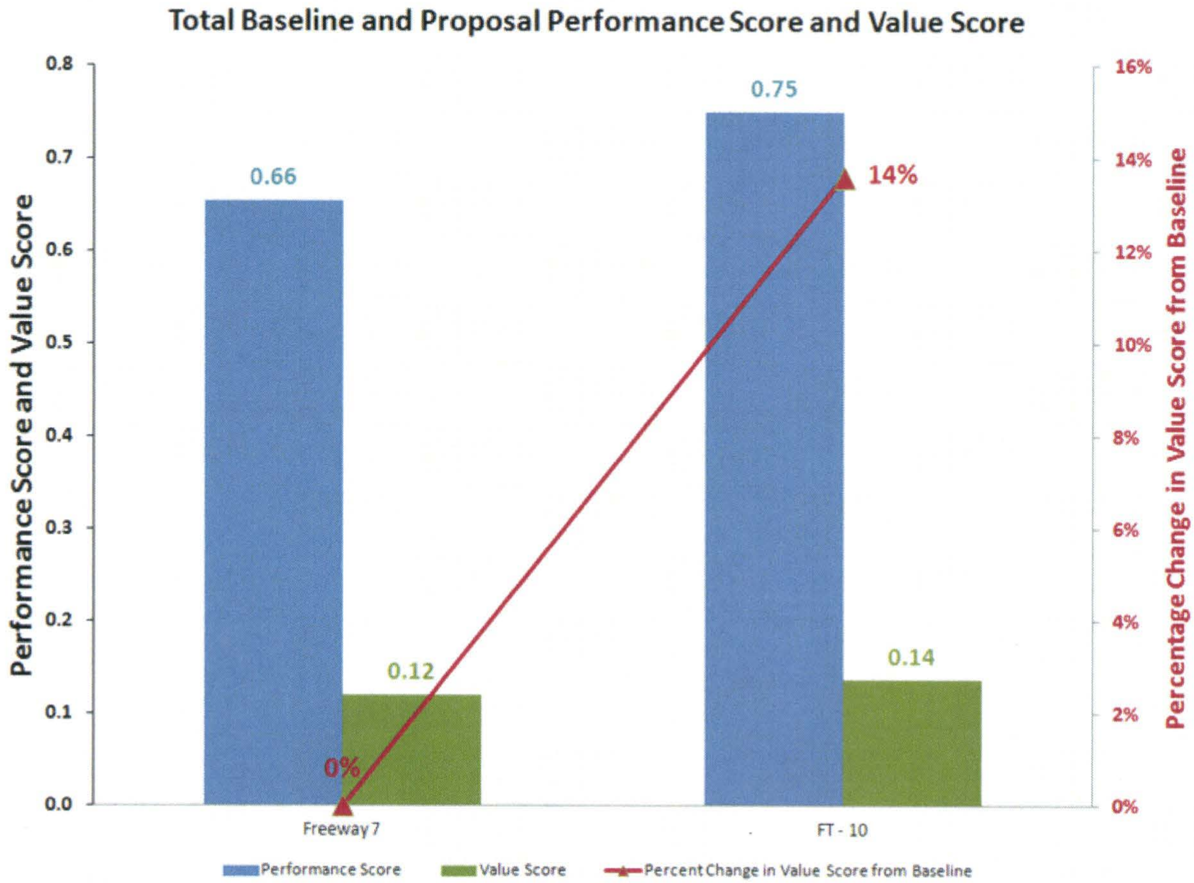


Exhibit 4. Performance Assessment

Performance Attributes (Objectives) Evaluation

Objectives	**Comment** **(Influence of the VA Proposal upon the Objective)**	**Rating** **(VA Proposal "Improves Performance" or "No Change" or "Reduces Performance")**
Minimize Travel Time	Performance will be improved, lane and speed control has been clearly demonstrated as beneficial in European studies.	Improves performance
Improve Connectivity and Mobility	Local operations will be significantly improved with full implementation as choke points for congestion may be addressed as a networkwide approach to traffic management. This will also improve ability of transit-orientated travelers to reach multimodal hubs.	Improves performance
Reduce Congestion on Freeway System	Dynamic traffic control during unplanned incidents or maintenance operations provides the ability to maintain the flow of traffic if these events extend into peak periods due to unforeseen circumstances.	Improves performance
Reduce Congestion on Local Street System	A reduction in freeway congestion would deter road users from taking local roads to avoid traffic jams.	Improves performance
Increase Transit Ridership	Increased freeway capacity and congestion reduction could improve access to transit facilities on the local network. Could increase bus ridership on expanded Fastrack Express Lanes operation due to consistent journey time reliability.	No change
Minimize Environmental and Community Impacts Related to Transportation	Difficult to ascertain whether there would be objection to additional cross-freeway gantries as well as intermediate VMS posts and signs.	No change
Assure Consistency with Regional Plans and Strategies	Regional plans will include congestion reduction strategies.	Improves performance
Maximize Cost Efficiency of Public Investments	A reduction in congestion without the necessity to expand existing freeways and construct additional lanes will be a long-term benefit to the purse.	Improves performance

VA PROPOSAL NO. FT10

Proposal Title: Networkwide Congestion Management by Vehicle Speed Control

Exhibit 5. Initial Cost Estimate

INITIAL COSTS							ALT. NO. FT-10
CONSTRUCTION ELEMENT		*BASELINE CONCEPT*			*VA PROPOSAL CONCEPT*		
Description	**Unit**	**Qty**	**Cost/Unit**	**Total**	**Qty**	**Cost/Unit**	**Total**
TRAFFIC ITEMS							
Fibre Optic & Twisted Pair cable System	mile	2.4	$ 270,833	$ 650,000	11.25	$ 269,000	$ 3,026,250
Misc Traffic Items - Loop detectors, ramp metering, count sta, traffic control system, TMP	mile	2.4	$ 2,000,000	$ 4,800,000	11.25	$ 518,466	$ 5,832,746
Remove & Delineate Traffic Striping & Markings	mile	2.4	$ 560,000	$ 1,344,000	11.25	$ 47,307	$ 532,203
Miscellaneous - Lighting, call box, CCTV, Elec Service for irrigation, Overhead sign	mile	2.4	$ 1,600,000	$ 3,840,000	2.40	$ 1,600,000	$ 3,840,000
Construction staging	mile	2.4	$ 3,200,000	$ 7,680,000	2.40	$ 3,200,000	$ 7,680,000
Temporary ITS and Integrating TIMS & TMC	mile				11.25	$ 539,589	$ 6,070,376
Advance Freeway Indicators, Enhanced Digital Cameras, Speed Detection Radar, All Electronic Tolling (AET)					11.25	$ 1,734,698	$ 19,515,352
TRAFFIC SUBTOTAL	mile	2.4		***$ 18,314,000***			*$ 46,496,927*
TRAFFIC MARK-UP	**79.4%**			***$ 14,541,316***	**38.6%**		*$ 17,947,814*
Minor Items	15%				*6%*		
Mobilization	13%				*6%*		
Additions	12%				*27%*		
Contingencies	40%						
TRAFFIC TOTAL				***$ 32,855,316***			*$ 64,444,740*
CAPITAL OUTLAY SUPPORT ITEMS							
Reengineering and Redesign				$ -	20%		$ 12,888,948
					11%		$ 6,766,698
Project Engineering	10%			$ 3,285,532			$ -
TOTAL		$		36,140,848	$		84,100,386
TOTAL (Rounded)				$36,140,000			$84,100,000
					lane mile	**SAVINGS**	**($47,960,000)**

VA PROPOSAL NO. FT10

Proposal Title: Networkwide Congestion Management by Vehicle Speed Control

Exhibit 6. Life-Cycle Cost Estimates

Life-Cycle Period	Years		Real Discount Rate		BASELINE	VA PROPOSAL
A. INITIAL COST						
Service Life - Baseline		Years	**INITIAL COST SAVINGS:**			$ -
Service Life - Alternative		Years				
B. SUBSEQUENT ANNUAL COSTS				**$/mile**		
Current Maintenance			37.36%	$24,700		
Routine Maintenance			2.37%	$1,600		
Technology Maintenance			9.11%	$6,000		
Technology PFI (Management Costs)			0.00%	$0		
Technology PFI (Service Payments)			2.31%	$1,500		
				Total Subsequent Annual Costs:	$ -	$ -
				Present Value Factor (P/A):	0.000	0.000
				PRESENT VALUE OF SUBSEQUENT ANNUAL COSTS (Rounded):	$ -	$ -
C. RENEWAL COSTS	**Period**	**Year**	**Amount per unit**	**PV Factor (P/F)**	**Present Value**	**Present Value**
Fixed Sign - Gantry	15		$15,350	1.00000		$ 15,350
Fixed Sign - Post	15		$3,797	1.00000		$ 3,797
Gantry - Cantilever (ADS)	30		$124,800	1.00000		$ 124,800
Gantry - Dual Span (150ft)	30		$208,014	1.00000		$ 208,014
Gantry - Dual Span (180ft)	30		$309,554	1.00000		$ 309,554
Gantry - Single Span (90ft)	30		$113,560	1.00000		$ 113,560
Gantry - Slip Road	30		$92,212	1.00000		$ 92,212
AFI - Controller	13		$10,105	1.00000		$ 10,105
AFI - Over Shoulder	13		$22,932	1.00000		$ 22,932
AFI - Over Running Lane	13		$22,932	1.00000		$ 22,932
AFI - Post Mounted	13		$23,400	1.00000		$ 23,400
AFI - Qty with housing	13		$16,536	1.00000		$ 16,536
ERT	15		$2,835	1.00000		$ 2,835
Fixed CCTV Camera	10		$2,219	1.00000		$ 2,219
Enforcement Camera	8		$173,129	1.00000		$ 173,129
Enforcement Dummy Camera	8		$121,190	1.00000		$ 121,190
Loop Controller	10		$2,487	1.00000		$ 2,487
Loops Feeder Cable	10		$1,239	1.00000		$ 1,239
Variable Message Sign	15		$84,240	1.00000		$ 84,240
Taper Positions Signs	13		$11,700	1.00000		$ 11,700
PTZ Camera	8		$9,641	1.00000		$ 9,641
Ramp Metering Sites	15		$31,200	1.00000		$ 31,200
Equipment Cabinet	13		$20,218	1.00000		$ 20,218
				PRESENT VALUE OF SUBSEQUENT SINGLE COSTS (Rounded):	**$ -**	**$ 1,423,000**
D. TOTAL SUBSEQUENT ANNUAL AND SINGLE COSTS (B+C)					**$ -**	**$ 1,423,000**
E.				**TOTAL SUBSEQUENT COSTS SAVINGS:**		**$ (1,423,000)**
F. TOTAL PRESENT VALUE COST (A+D)					**$ -**	**$ 1,423,000**
					TOTAL LIFE-CYCLE SAVINGS:	**$ (1,423,000)**

Assumptions and Calculations: (---)

VA STRATEGY NO. LRT-S1

Strategy Title: Combination LRT1, LRT2, LRT3

Initial Cost Savings:	$640,000,000
Future Cost Savings:	$784,000,000
Net LCC Savings:	$1,424,000,000
Change in Schedule:	Reduced
Performance Change:	+3 % (LRT-4A)
	+2 % (LRT-4B)
Value Change:	+37 % (LRT-4A)
	+36 % (LRT-4B)

Description of Baseline Concept: (---)

Description of VA Strategy Concept: In developing VA proposals for alternatives to the LRT Baseline of the SR 710 Alternatives Analysis Study, the team focused on cost savings, less intensive construction methods and community impacts, improved function of transit facilities, and adherence to the performance objectives of the project. A number of viable alternatives were developed; a few are stand-alone proposals. However, three of the other VA proposals consist of modifications to discrete, nonoverlapping stretches of the approximately 7.6-mile-long Baseline Alternative LRT-4A alignment. These proposals are briefly described below.

- LRT1 – Place the LRT alignment along the south end within the median of I-710 from Corporate Center Drive to just south of the existing I-10/I-710 interchange; from that point, the LRT would transition to elevated guideway to the west of the Baseline alignment in order to avoid the complex of existing structures at the interchange, and then rejoin LRT-4A at the California State University, Los Angeles (Cal State LA) Station.
- LRT2 – Build a highway structure for Valley Boulevard to fly over a consolidated LRT maintenance and storage facility (MSF) site. The LRT mainline tracks transition from elevated south of Valley Boulevard to grade at the MSF, then cross UPRR and Mission Road on elevated guideway before descending to rejoin the LRT-4A underground, and reduce the quantity of bored tunnel by approximately 1,700 route feet.
- LRT3 – Terminate the LRT on the north end at the northwest quadrant of Arroyo Seco Parkway and Fair Oaks Avenue and eliminate approximately 5,500 route feet of bored tunnel and an underground station. The terminal site could be developed into a multimodal transit facility with the integration of existing bus service (No. 260 line), park-and-ride spaces, and a new Gold Line at-grade station.

Advantages: The major thread in each of these VA proposals is the significant reduction of costly structures, using at-grade and elevated guideways whenever feasible in lieu of aerial structures or bored tunnels. There are many advantages of the collective modifications proposed by this combined proposal over the Baseline Alternative:

- Reduced capital cost
- Shorter construction schedule
- Improved LRT yard operations at the consolidated MSF site
- Reduction of LRT alignment that duplicates the Gold Line
- Avoidance of landfill and fire-prone hillsides

- More visibility of LRT system
- Opportunity for multimodal transit facility at north terminal site

Disadvantages: There are also some disadvantages, but most could be considered as challenges that can be addressed during project development:

- Additional right-of-way (ROW) acquisition required in LRT2 and LRT3, in particular, the residential and commercial relocations at the 2-acre multimodal site
- Freeway widening at the south end of I-710, but within existing ROW
- Traffic impacts during construction of Valley Boulevard overpass
- Increased seismic risk from proximity of Raymond Fault to north terminus in LRT3
- Potential Section 4(f) mitigation due to proximity of terminus in LRT3 to historic structures

Discussion: (---)

Technical Review Comments: (---)

Project Management Considerations: (---)

Discussion of Schedule Impacts: (---)

Discussion of Risk Impacts: (---)

Performance Attributes (Objectives) Evaluation: (---)

Assumptions and Calculations: The significant capital and life-cycle cost savings that can be realized from the proposed combination of LRT alternatives is worthy of consideration. Because there is no overlap of the alignment and facility modifications proposed by each of the three alternatives, the aggregate total savings can be summarized as follows:

	Initial Savings	Life-Cycle Savings
LRT1	$29,390,000	$29,390,000
LRT2	71,010,000	94,131,000
LRT3	540,090,000	660,364,000
TOTAL	$640,490,000	$783,885,000

Exhibit 1. Performance Ratings

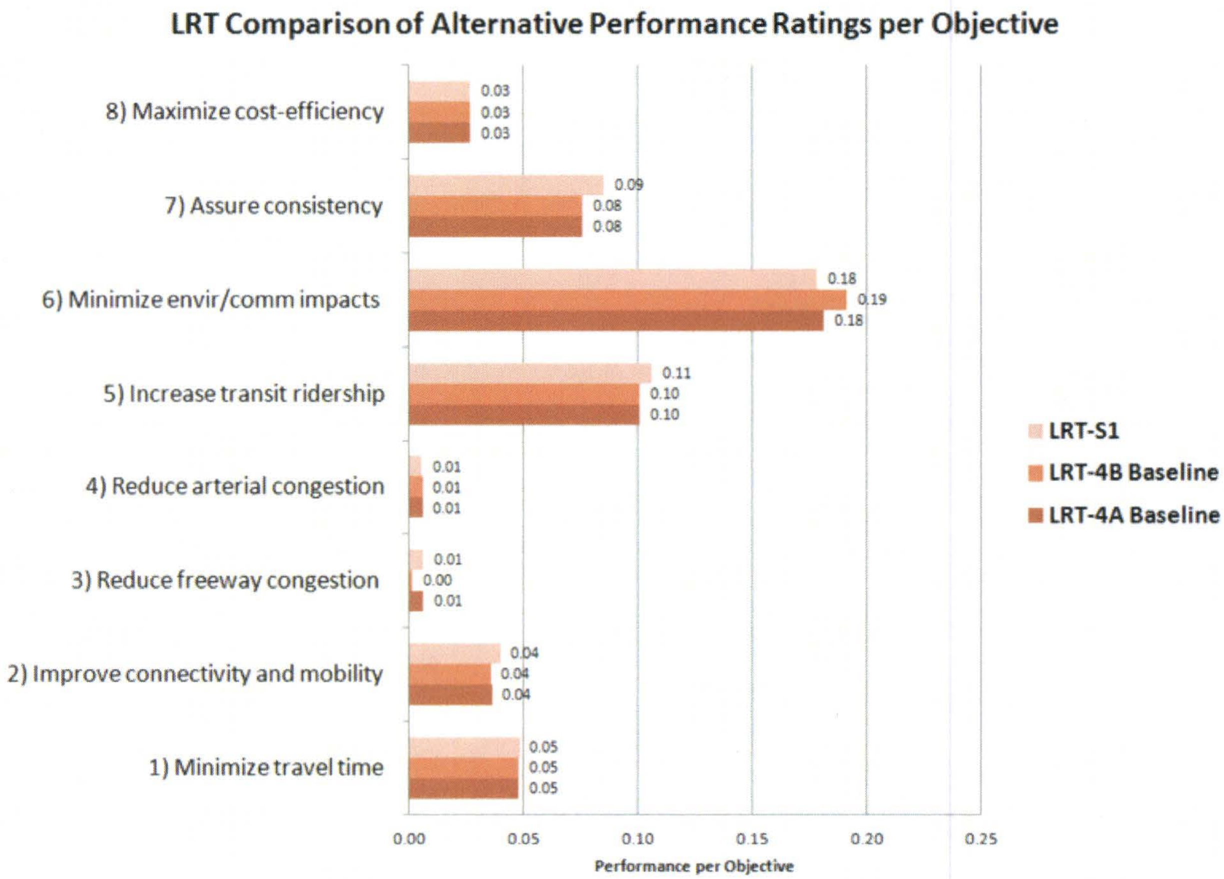


Exhibit 2. Performance Profile

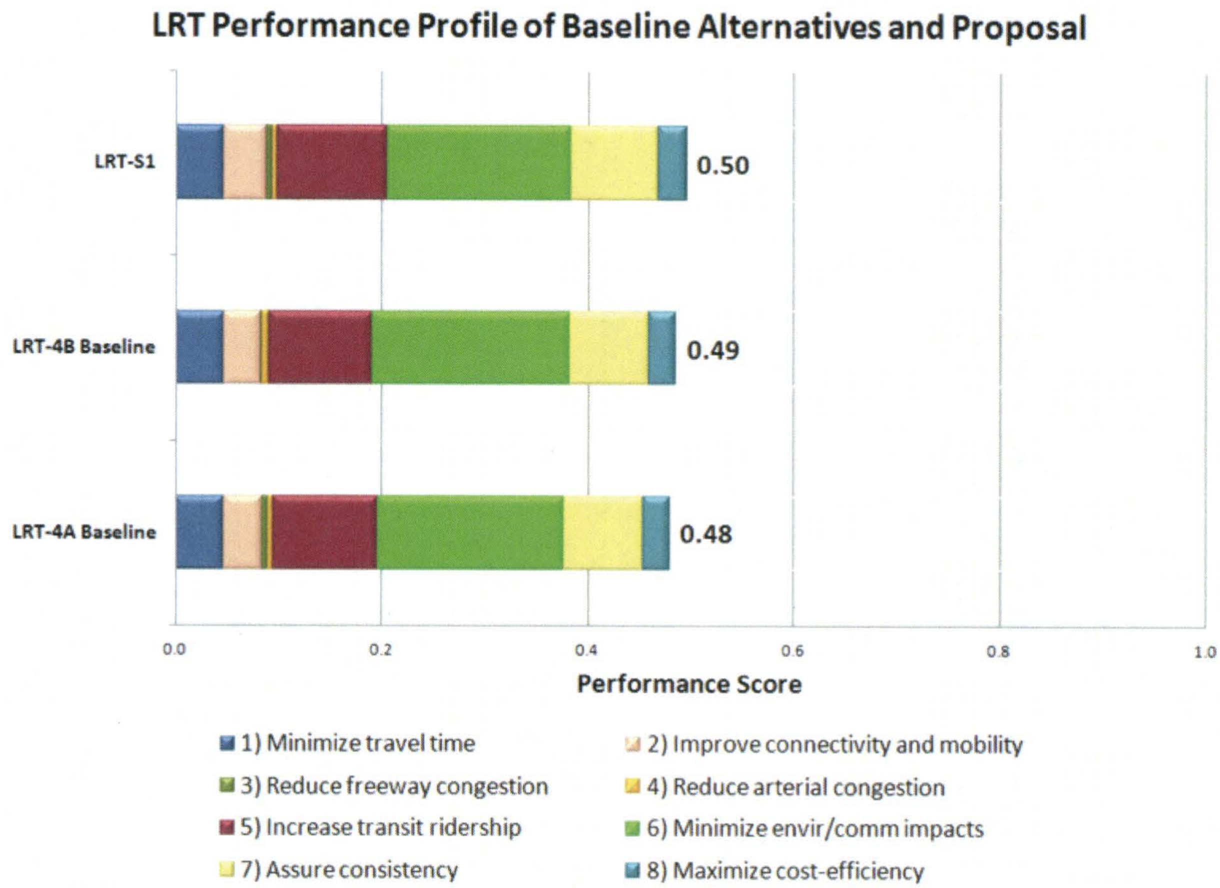
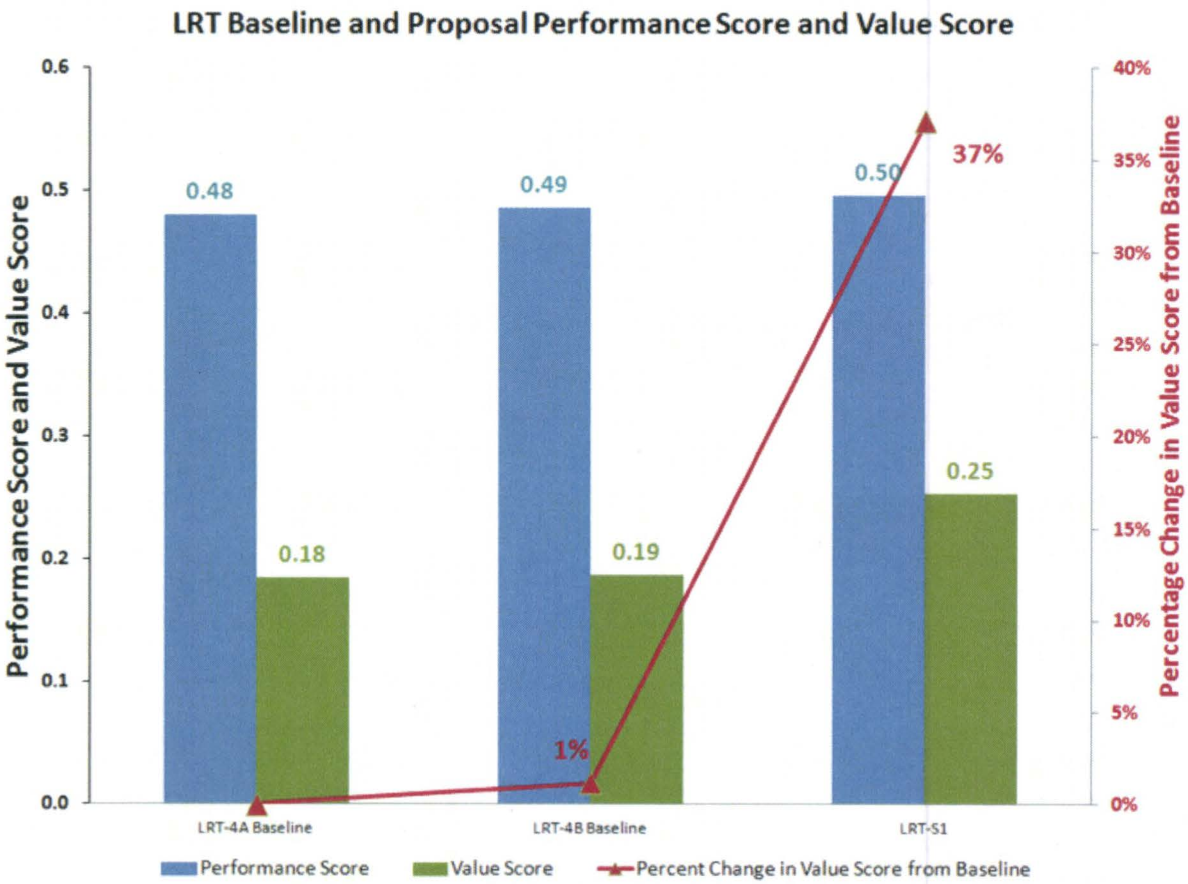


Exhibit 3. Benefit and Cost Performance



VA STRATEGY NO. FT-S1

Strategy Title: Single-Bore Tunnel with Demand Constrained by Variable Toll (FT1) Combined with Car-Only Freeway Tunnel at 46.5 Feet Inside Diameter

Initial Cost Savings:	$2,788,000,000
Future Cost Savings:	$0
Net LCC Savings:	$2,788,000,000
Change in Schedule:	Potential Reduction
Performance Change:	+ 19%
Value Change:	+175 %

Description of Baseline Concept: The baseline proposal provides twin-bore tunnels, each bore carrying two levels of traffic with two lanes on each level. Cut-and-cover tunnels are provided at each end through the portals. The easterly tunnel carries northbound traffic; the westerly tunnel carries southbound traffic. The tunnels' capacity would accommodate the 2035 forecast demand and carry standard truck traffic.

Description of VA Strategy Concept: Proposal FT-S1 would combine Alternatives FT1 and FT2; the details are summarized here, not repeated.

As discussed under proposal FT1, FT-S1 would construct a single-bore tunnel with two levels, each with two lanes, northbound travel on the lower deck, and southbound travel on the upper deck. As with proposal FT2, the tunnel would be restricted for use by cars only; trucks could not be physically accommodated and so would be banned. Correspondingly, the diameter of the tunnel could be reduced. FT2 considers two diameters: Scenario 1 proposes a 48-foot diameter; Scenario 2 proposes a 46.6-foot diameter. The cut-and-cover sections would be reduced accordingly in order to provide two lanes in each direction except near the portals, where they would widen to three lanes in each direction to accommodate weaving on the approaches to I-10 on the south, and to I-210/SR 134 on the north.

A variable toll system would be implemented to limit traffic demand to correspond to the lower capacity that a single bore would provide compared to two bores. Tolls would be set to reduce demand to the maximum capacity of the toll section. As a variation of this proposal, a proportion of the toll profits could subsidize bus and transit service in the area.

Advantages:

- Cost reductions approaching 50 percent; commensurate savings on financing costs.
- Lower initial environmental impact due to reduced construction impacts.
- Lesser impacts on I-210 north and east of the project.
- Lower air quality emissions from traffic using the tunnel.
- Traffic need not be split in two separate tunnels at the north and south portals.
- Saves requirement for pedestrian and vehicular crossovers.
- Reduced tunnel diameter significantly reduces cost.
- Smaller-diameter tunnel boring machine (TBM) bore is beneficial for control of settlements and impacts.
- Reduced fire size for ventilation/fire life safety (FLS) design, which will reduce costs further.

- A car-only tunnel cannot attract any freight traffic from the Ports.
- A car-only tunnel is more compatible with Fastrack express lanes.

Disadvantages: There are also some disadvantages, but most could be considered as challenges that can be addressed during project development:

- Does not meet the Caltrans Highway Design Manual (HDM) guideline that new facilities should accommodate future travel demand 20 years after completion of the project; the remaining traffic that cannot be accommodated in the tunnel will remain on the surface street system or use other routes.
- A portion of current cut-through traffic will remain on surface streets.
- All local truck traffic that would otherwise use the tunnel will remain on surface streets.
- Loss of economy-of-scale from constructing second bore concurrently or in immediate sequence with first bore.
- The long-range construction of a future second bore would be challenging due to reduced available right-of-way (ROW) at the north and south portals.
- Potential for drivers to find the tunnel claustrophobic (mitigated in A86 tunnel by use of color and light. See FT2 Discussion section for more detail on A86 tunnel).
- Reduced flexibility as the tunnel will not be able to accommodate trucks or buses.
- Special low-clearance maintenance and emergency response vehicles would be required.
- Special low-clearance buses would be required if transit usage is proposed in the tunnel.

Discussion: A single-tunnel car-only option has several short-term advantages:

- Cost of construction would approach half that of constructing two bores that could accommodate trucks.
- Lower construction costs would reduce initial capital outlays, making the project more financially viable.
- With lower costs associated with single-bore car-only construction, the project might recover a greater proportion of costs from toll revenue.

Construction-related environmental impacts of single-bore construction would initially be lower than impacts associated with construction of two tunnels. For example, spoils generated by tunnel digging would also be approximately half that of a two-tunnel option, thus reducing the impact of spoils disposal/relocation as well as traffic congestion and air pollution from spoils transport. Other environmental impacts associated with worker trips to the construction site would be reduced by approximately half. Air pollutants emitted from the tunnel should be reduced.

Strategy Title: Single-Bore Tunnel with Demand Constrained by Variable Toll (FT1) Combined with Car-Only Freeway Tunnel at 46.5 Feet Inside Diameter

The reduction in tunnel diameter that results from adopting a car-only tunnel produces significant cost savings:

- Smaller TBM with reduced purchase cost
- Less spoil to be removed and disposed of
- Smaller-diameter tunnel segments will reduce hoop load
- Reduced road deck spans and traffic loads potentially resulting in thinner deck slabs

Along with marginally higher progress rates, a smaller-diameter TBM may also facilitate control of ground loss and associated ground movements, thereby limiting potential for impacts to existing utilities and structures. The smaller diameter may also reduce the number of subsurface easements required, due to a narrower ROW. However, these benefits are not guaranteed to materialize.

Furthermore, if trucks are excluded from the tunnel, the design fire size could be reduced from the current 100 megawatt (MW) fire to 30 MW or less for a car fire. A car-only tunnel would reduce required cross-sectional areas for supply and exhaust air significantly; this reduction would, in turn, bring down costs associated with the ventilation and FLs equipment requirements and operational costs. However, due to time constraints, these savings have not been evaluated as part of the VA study.

A car-only tunnel also may be more attractive to local communities, particularly those at the northern end of the proposed tunnel alignment who may be concerned that a full-scale freeway tunnel would encourage trucks carrying freight from the Ports to pass through Pasadena and La Canada. A car-only tunnel would ameliorate this concern instantly.

With the baseline proposal, northbound vehicles entering the south portal just north of I-10 must select a lane (and thus a tunnel level) far ahead of time, based on their ultimate plans to travel west on SR 134, east on I-210, or west (north) on I-210 at the freeway junction nearly 5 miles away. This early decision requirement could create confusion for motorists who have just navigated the I-10/I-710 interchange. Similarly, southbound motorists entering the north portal must select their next destination—continuing south on I-710, or traveling east or west on I-10—long before they reach the interchange. This requirement for pre-segregating the traffic flows contributes to the need to replace several local overcrossings on the north SR 710 stub in Pasadena.

The single-tunnel car-only option does not require splitting traffic at the tunnel entrance based on ultimate destination; northbound and southbound vehicles are each on their own levels. Because there would be only one level of traffic in each direction, drivers would not need to commit to an ultimate destination until they approached the interchanges at the north and south end of the project, consistent with standard motorist expectations; confusion regarding early lane selection would not be a factor. The existing local service overcrossings at Del Mar Boulevard, Green Street, Colorado Boulevard, and Union Street may be salvageable.[1]

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1 The VA team understands that there may be more than one reason to replace one or all of these bridges. The next phase of design should readdress these proposed. If the bridges can be salvaged, then additional savings over $40 million would result, and construction traffic delays would be reduced.

Reduced maintenance cost is another long-range advantage: less infrastructure means less maintenance.

The single- tunnel car-only option has several drawbacks, both short-term and long-term. While constructing just a single bore might cut immediate costs, the demand already exists for both bores, and the cost of constructing the second bore will only increase with time. The long-term costs associated with constructing a second bore well into the future could negate any short-term savings, and economies-of-scale would be lost.[2]

Constructing one tunnel that excludes trucks does not reduce travel demand and does not adequately address that demand. Diverted traffic, particularly trucks, would continue to burden local arterials.

FT2 discussed a number of disadvantages to the car-only aspect of the proposal, such as the potential for the tunnel to be claustrophobic for some drivers, and the costs of special low-clearance maintenance and emergency response vehicles. But the height issue can be mitigated, and the cost of low-clearance maintenance and emergency response vehicles would be negligible compared with the potential cost savings over time.

Technical Review Comments:

- The traffic and revenue study should assess the potential for vehicular traffic and truck traffic to be diverted to city streets.
- This alternative is clearly technically feasible; however, the design team should perform further due diligence on the reduction in tunnel diameter that is possible if the tunnel accommodates only cars.
- The design team should also evaluate the impact of a car-only option on the ventilation design, which could become considerable less onerous in car-only conditions, but this potential should be quantified by analysis.
- Implementation of the second bore could be very difficult logistically.

Project Management Considerations: None.

Discussion of Schedule Impacts: Depending on the construction schedule assumptions, construction time could be reduced.

Discussion of Risk Impacts: In general, this VA strategy is expected to mitigate risks, at least partially, particularly those associated with the following:

- The full two-bore all-vehicular design may not be affordable.
- Accidents within the tunnel, resulting fire size, and associated emergency response would be reduced.

[2] If the first bore is limited to cars only, separate consideration would need to be given to allowing trucks in the second bore at such time as it is built. While this would be feasible, the north and south portal approaches would require a different design than currently proposed.

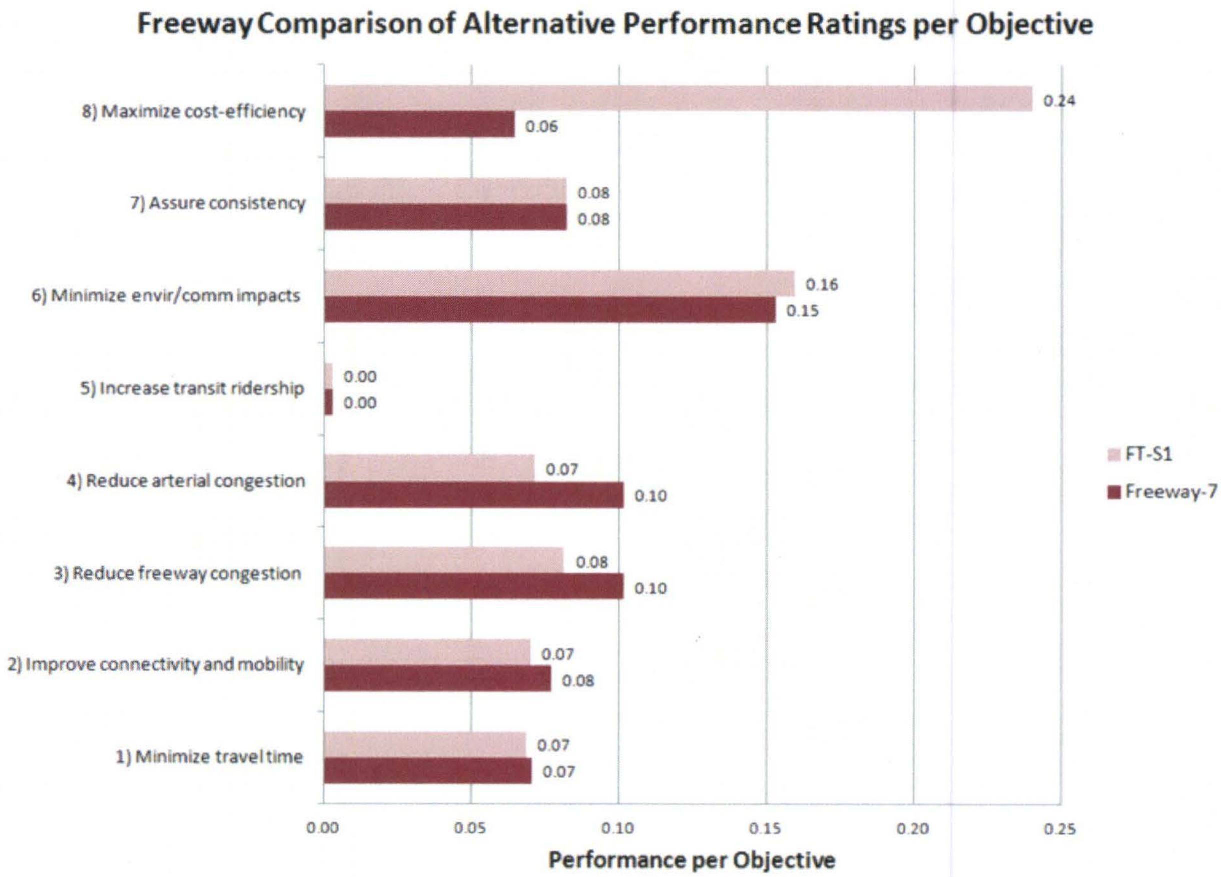
- Potential for ground movement induced by tunneling and associated impacts to structures and utilities would be reduced.
- Public fears that a freeway tunnel that accommodated trucks would encourage freight traffic from the Ports to pass through Pasadena and La Canada would be allayed.

Adopting a single-bore car-only tunnel may give rise to the following risks:

- Mobilizing opposition from the trucking and goods movement industries
- Drawing fire from interest groups opposed to toll roads
- Low-income interests that believe that toll roads are elitist
- Alienating current project supporters who believe that tolling the system would reduce the project benefits

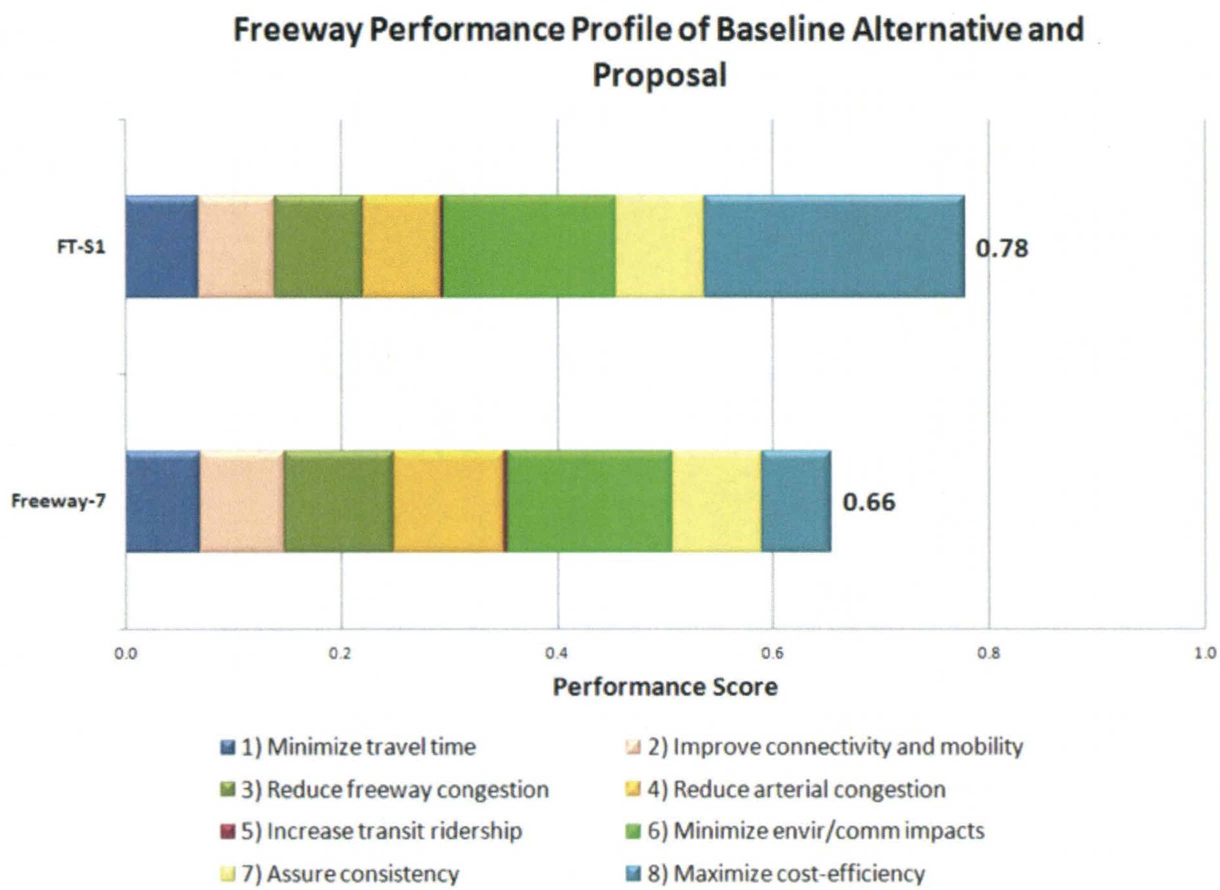
Strategy Title: Single-Bore Tunnel with Demand Constrained by Variable Toll (FT1) Combined with Car-Only Freeway Tunnel at 46.5 Feet Inside Diameter

Exhibit 1. Performance Ratings



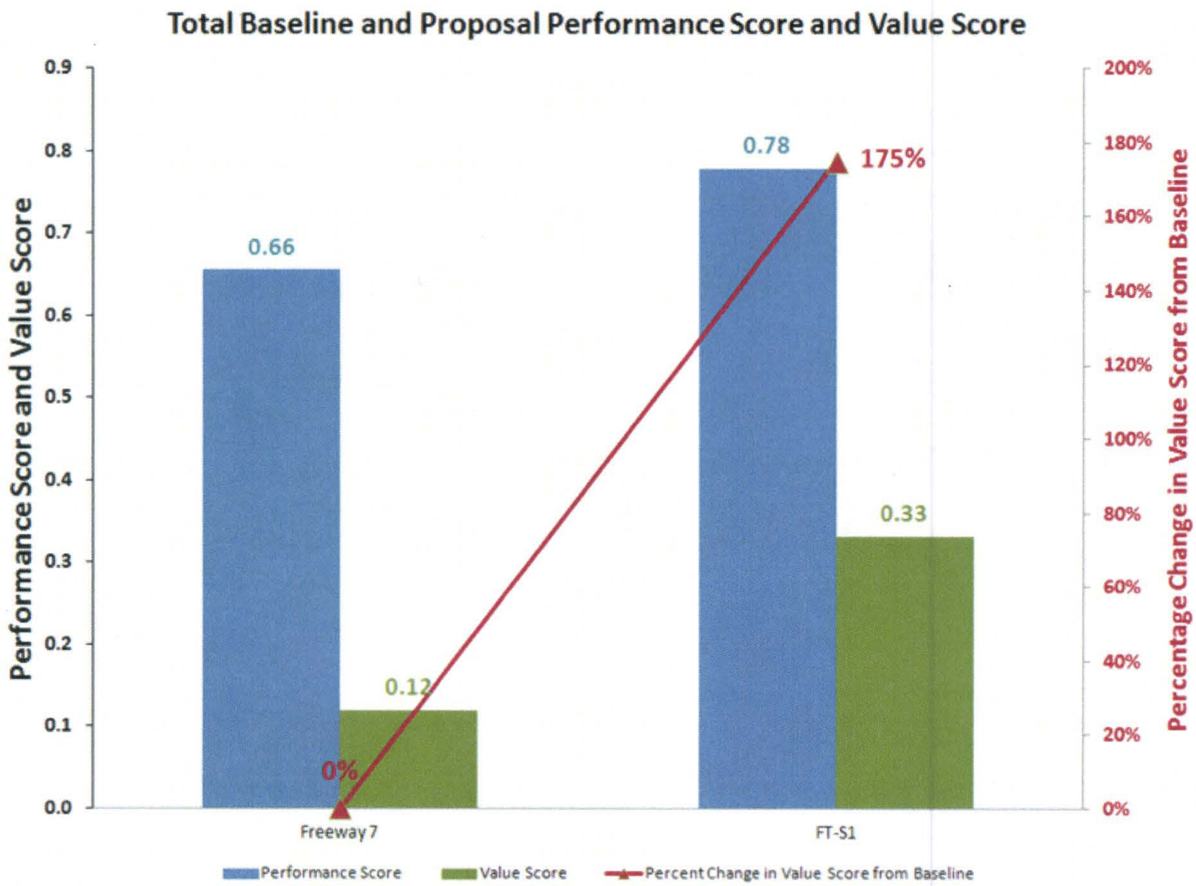
Strategy Title: Single-Bore Tunnel with Demand Constrained by Variable Toll (FT1) Combined with Car-Only Freeway Tunnel at 46.5 Feet Inside Diameter

Exhibit 2. Performance Profile



Strategy Title: Single-Bore Tunnel with Demand Constrained by Variable Toll (FT1) Combined with Car-Only Freeway Tunnel at 46.5 Feet Inside Diameter

Exhibit 3. Benefit and Cost Performance



Strategy Title: Single-Bore Tunnel with Demand Constrained by Variable Toll (FT1) Combined with Car-Only Freeway Tunnel at 46.5 Feet Inside Diameter

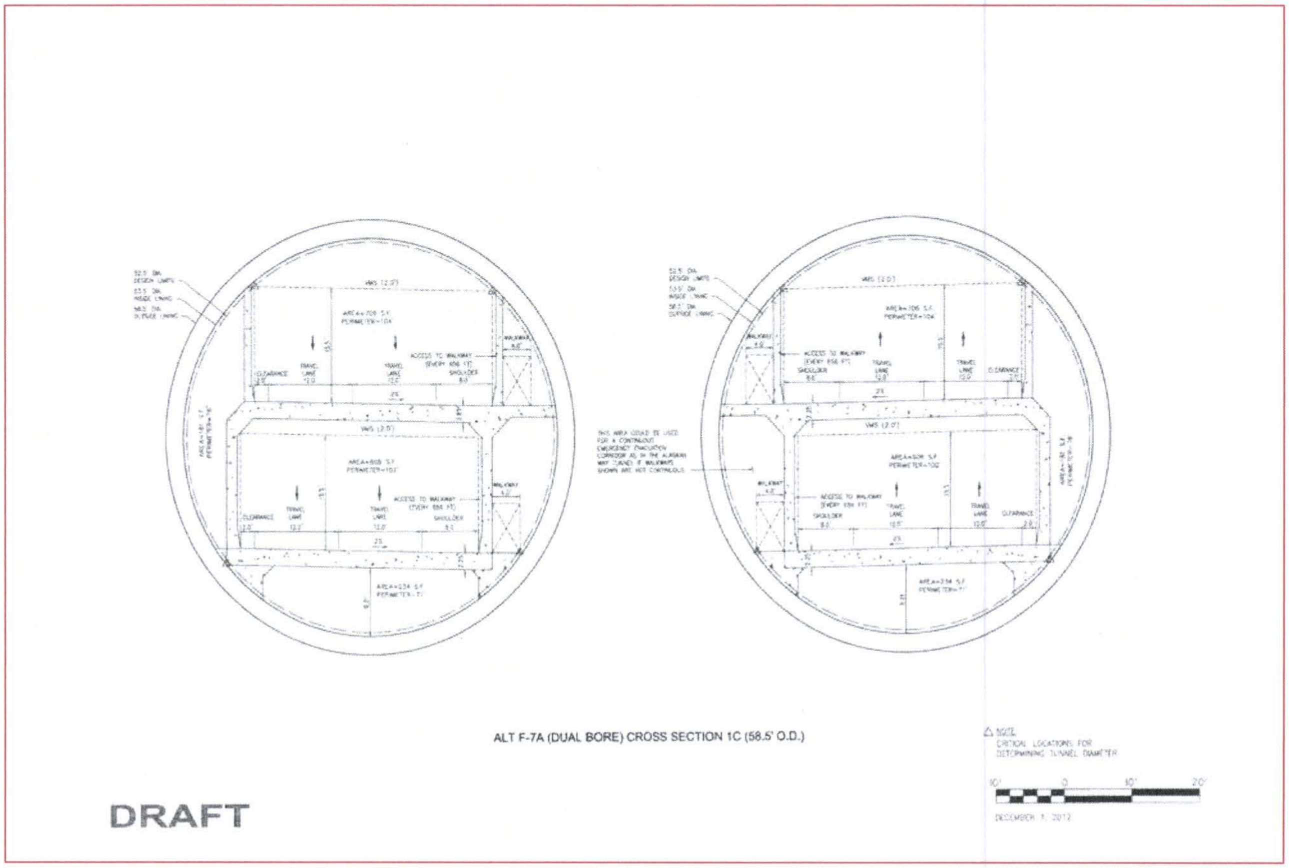
Exhibit 4. Performance Assessment

Performance Attributes (Objectives) Evaluation

Objectives	Comment (Influence of the VA Proposal upon the Objective)	Rating (VA Proposal "Improves Performance" or "No Change" or "Reduces Performance")
Minimize travel time	For drivers who pay toll, objective will be met. Trucks and drivers who do not pay toll will still face greater travel times.	Reduces performance but may make project financially viable.
Improve connectivity and mobility	For drivers who pay toll, objective will be met. Trucks and drivers who do not pay toll will still face greater travel times.	Reduces performance but may make project financially viable.
Reduce congestion on freeway system	Proportionately less reduction in freeway congestion. Does not improve truck congestion	Reduces performance but may make project financially viable.
Reduce congestion on local street system	For passenger vehicles that pay toll, objective will be met. For trucks and vehicles that do not pay the toll, performance objectives will not be met.	Reduces performance but may make project financially and politically viable.
Increase transit ridership	Residual unmet demand could be a candidate for transit. If tolls are used to subsidize transit, then transit usage could increase.	Potential to increase performance through enhanced transit as subsidized by tolls.
Minimize environmental and community impacts related to transportation	Reduced construction air quality emissions, slight increase in long-term emissions. Trucks remain on existing routes. Imposition of tolls could lead to environmental justice concerns; higher tolls could mean additional concerns.	Potential to increase performance through transit subsidy from tolls.
Assure consistency with regional plans and strategies	Generally consistent.	No change.
Maximize cost efficiency of public investments	Highly efficient as high-value customers are captured at a premium price.	Increased performance.

Strategy Title: Single-Bore Tunnel with Demand Constrained by Variable Toll (FT1) Combined with Car-Only Freeway Tunnel at 46.5 Feet Inside Diameter

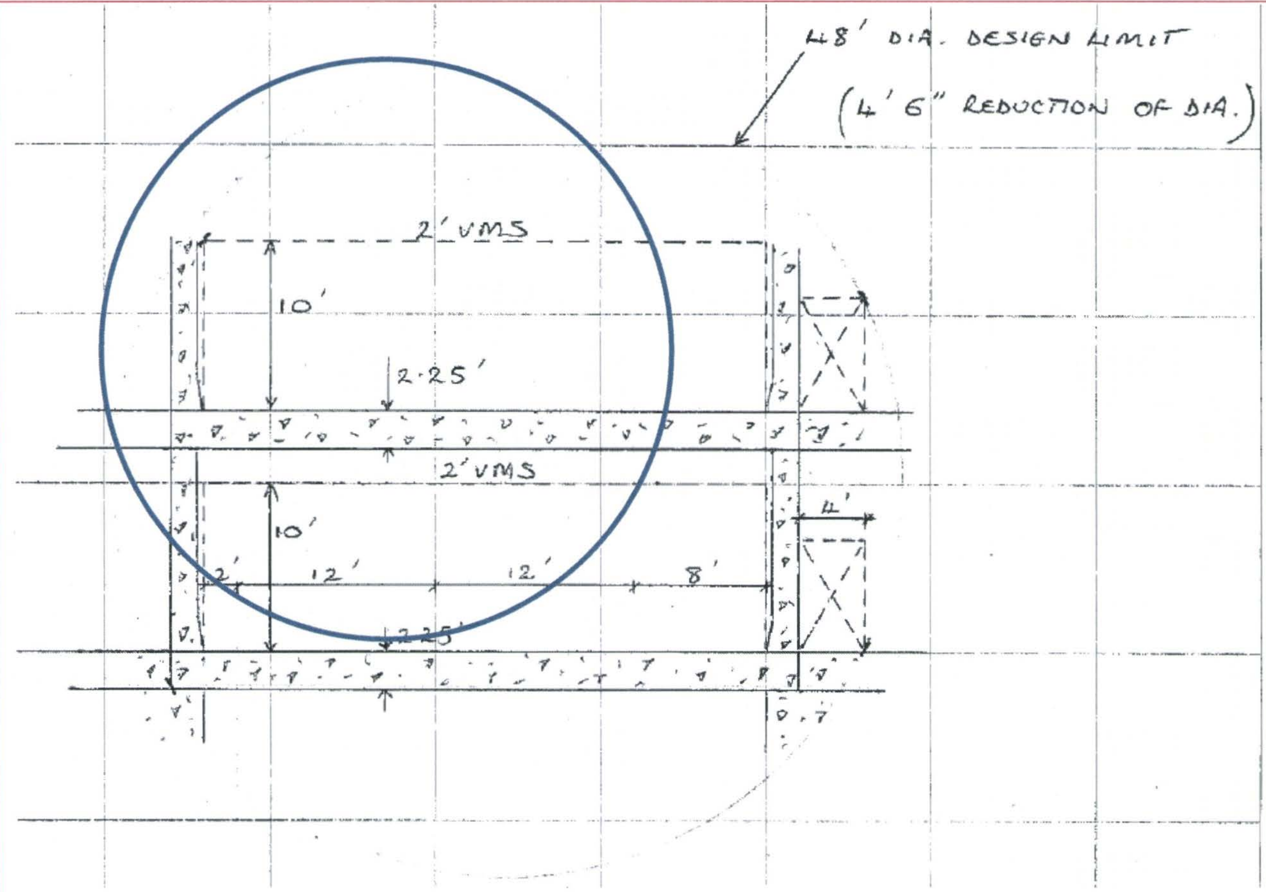
Exhibit 5. Baseline Concept Sketch



VA STRATEGY NO. FT-S1

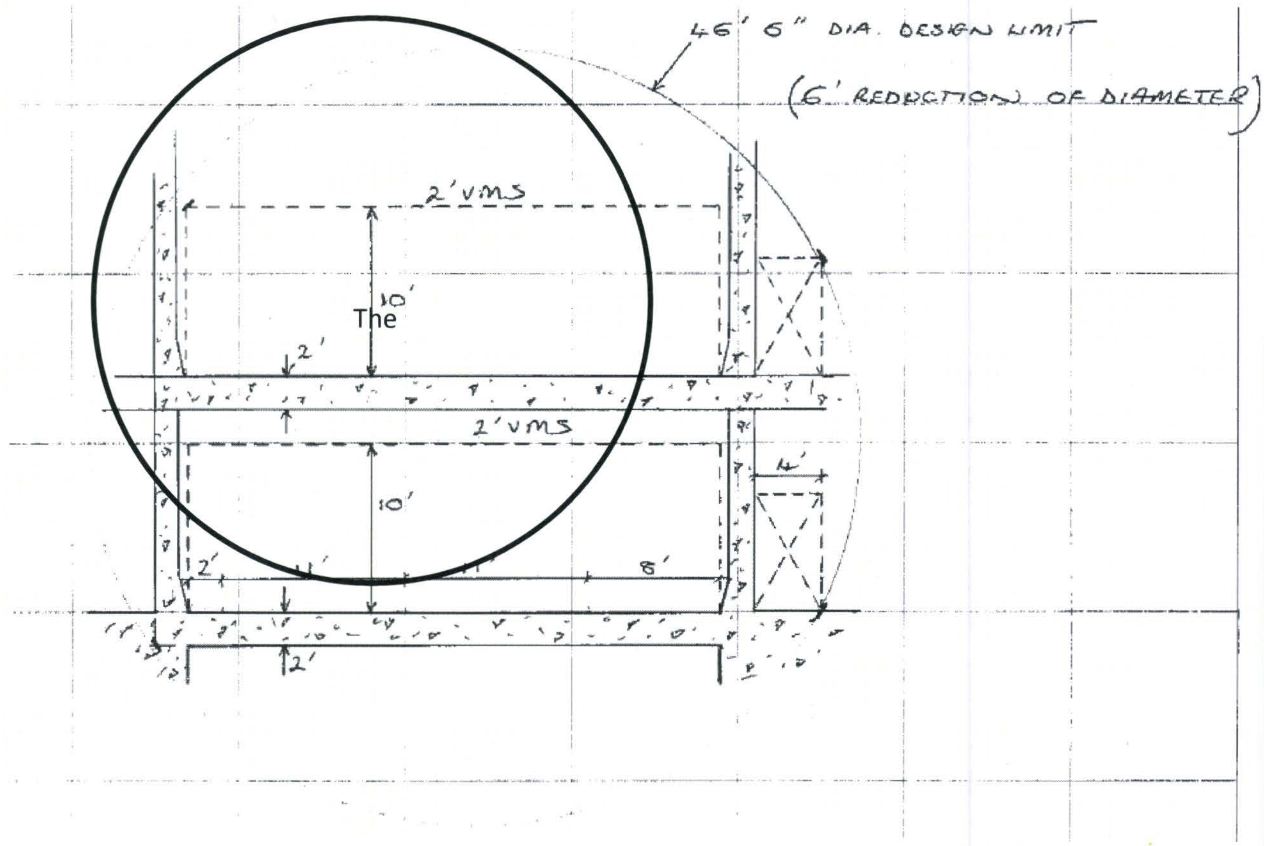
Strategy Title: Single-Bore Tunnel with Demand Constrained by Variable Toll (FT1) Combined with Car-Only Freeway Tunnel at 46.5 Feet Inside Diameter

Exhibit 6. VA Strategy Concept Sketch, Scenario 1



Scenario 1 – Car-only tunnel with 12-foot lane widths with 10-foot vertical traffic clearance

Exhibit 7. VA Proposal Concept Sketch, Scenario 2



Scenario 2 – Car-only tunnel with 11-foot lane widths with 10-foot vertical traffic clearance

VA STRATEGY NO. FT-S1

Strategy Title: Single-Bore Tunnel with Demand Constrained by Variable Toll (FT1) Combined with Car-Only Freeway Tunnel at 46.5 Feet Inside Diameter

Assumptions and Calculations: The capital cost analyses in FT1 and FT2 are not repeated here. The full cost savings from FT1 would apply to FT-S1. The discussion of FT2 already includes an analysis of a single-bore option; that analysis concludes that savings would be reduced by 50 percent. Thus, the total cost savings for Strategy FT-S1 would include the following:

FT1 Capital Cost Savings	$2,496,000,000
FT2 Capital Cost Savings (Scenario 2), 50%	$292,115,000
Total FT-S1 Capital Cost Savings	**$2,788,115,000**
Baseline Cost	$5,425,000,000
Percentage Reduction	**49%**

Life-Cycle Cost Estimates: The VA team did not provide future cost calculations for this strategy because it was not felt that significant differences in future costs between the VA strategy and the Baseline Alternative could be quantified or computed at this conceptual phase of design. The future cost difference for this VA strategy is therefore zero, and the Net Life Cycle Cost as shown in the cost summary at the top of this strategy is the same as the Initial Cost Saving (or Premium if a negative value is shown in parentheses).

VA ALTERNATIVE NO. BRT-A1

Alternative Title: Addition of BRT with Enhanced Technology to Freeway Tunnel Alternative

Base Cost Estimate:	($181,000,000)
Change in Schedule:	None
Performance Change:	+36 %
Value Change:	+152 %

Description of Baseline Concept: The baseline concept is based on Alternative F-7 and is assumed to consist of a freeway with twin-bore tunnels, with each bore carrying two levels of traffic and two lanes on each level. Cut-and-cover tunnels are provided at each end through the portals. The easterly tunnel carries northbound traffic; the westerly tunnel carries southbound traffic. The tunnels would provide enough capacity to accommodate the 2035 forecast demand.

Under the proposed system, traffic entering the northbound tunnel would need to segregate by ultimate destination at the I-210/SR-134 interchange prior to entering the tunnel. The lower deck would access only I-210 west (north toward La Canada/Flintridge), while the upper deck would access I-210 east and SR-134 west. Motorists would need to make the choice of ultimate destination prior upon entering the northbound tunnel at Valley Boulevard.

Alternative BRT-6 would provide BRT service between Atlantic Boulevard at Whittier Boulevard and Pasadena City College (PCC) and the California Institute of Technology (Caltech) in Pasadena. BRT vehicles would travel along Atlantic Boulevard to Huntington Drive, and then travel briefly west along Huntington Drive to Fair Oaks Avenue, before traveling north along Fair Oaks Avenue into Pasadena.

In Pasadena, the BRT vehicles would travel along Colorado Boulevard, making a loop to PCC and Caltech via Hill Avenue, California Boulevard, and Lake Avenue. The total length of the route would be 13.8 miles. Alternative BRT-6 would operate in a combination of exclusive bus lanes and mixed-flow lanes. The exclusive lanes would generally be adjacent to the curb. Other Metro routes that share part of the alignment would also be able to use these lanes. The exclusive lanes would be created generally in existing right-of-way (ROW) through a variety of methods, including restriping the roadway; prohibiting on-street parking; and narrowing medians, planted parkways, and sidewalks. No property acquisition would be required for Alternative BRT-6. In some areas, exclusive lanes could not be provided without substantial ROW acquisition. In these areas, the buses would share existing lanes with other traffic.

Description of VA Alternative Concept: The VA alternative calls for the incorporation of Alternative BRT-6 with any freeway tunnel proposal or alternative. This packaging of alternatives would allow regional cut-through traffic to use the freeway tunnel, thus staying off the local roadways in the study area, but would also provide additional mobility options to those with origins and destinations in the study area, who do not have such direct access to the tunnel. Bus stops would be placed at approximately ½-mile intervals, at major activity centers and cross streets.

The effectiveness of the BRT 6A alternative would be improved with the addition of select, relatively low-cost passenger information system and Intelligent Transportation Systems (ITS) technologies. The key components are:

- Passenger Information System: Real-time information displayed via light-emitting diode (LED) and liquid crystal display (LCD) signs at each BRT stop. Could also be accessible via a Web site or cell phone application. Passengers are better able to manage the amount of time spent waiting at the BRT stop.

- Transit Signal Priority: Priority provided for BRT vehicles along the study corridor. Improves BRT travel time and schedule reliability.
- Advanced Fare Payment: Transit riders pay their fare before boarding the bus via a smart card reader, cell phone, or credit card. Metro plans to implement a similar system along Wilshire Boulevard.
- Other technology applications: There are a variety of other technology applications that could be cost-effectively applied if also used elsewhere in the Metro system. These include remote security monitoring and integral real-time optimization of the corridor operation. These are not included in the cost estimate provided below.

The provision of real-time information and advanced fare payment collection reduces the dwell time by the BRT vehicle at the BRT stops. Transit riders, who have already paid their fares, are queued up and ready to board when the vehicle arrives. This allows for boarding through all bus doors, not just the front door. The BRT bus driver is also freed up to assist any passengers who need help boarding the bus.

These systems also provide the opportunity for additional amenities to the transit rider, which makes taking the BRT bus even more attractive. Information such as local weather, event updates, and community activities can be provided to make waiting time more pleasant. Emergency information also can be disseminated more quickly and reliably to the traveling public.

Advantages:

- Travel and mobility are improved for regional through trips as well as trips with origins and destinations in the study area.
- Real-time information provided at the BRT stations also could be made available remotely via Web sites and mobile phones.
- Provision of traffic signal priority for BRT buses would reduce vehicle travel times and improve travel time reliability.
- Advanced fare collection systems would result in less dwell time for the BRT buses by reducing the need for the bus driver to collect the fares on-board the bus, and allowing boarding through all doors.

Disadvantages:

- There would be an increase in construction costs and vehicle purchase costs.
- Additional enforcement needs for advanced fare collection systems would be needed.

Discussion: Strategies such as traffic signal priority, remote security monitoring, and integrated real-time corridor operation reduce BRT travel times and increase schedule reliability by allowing the buses to traverse the corridor according to their planned schedule. Both recurring and non-recurring congestion are responded to much more quickly.

The provision of real-time information and advanced fare payment collection reduces the dwell time by the BRT vehicle at the BRT stops. Transit riders are queued up and ready to board when the vehicle arrives, and already have the fare paid. This allows for boarding through all bus doors, not just the front door. The BRT bus driver is also freed up to assist any passengers who need help boarding the bus.

These systems also provide the opportunity for additional amenities to the transit rider, which makes taking the BRT bus even more attractive. Information such as local weather, event updates, and community activities can be provided to make waiting time more pleasant. Emergency information also can be disseminated more quickly and reliably to the traveling public.

Technical Review Comments: This VA alternative demonstrates that BRT is a moderate-cost alternative when compared to other transportation modes. However, it must be kept in mind that this overall alternative is comprised also of a bored-tunnel freeway facility, and the capital costs of each mode must be considered together for the total investment.

Project Management Considerations: (---)

Discussion of Schedule Impacts: No impacts anticipated to schedule.

Discussion of Risk Impacts: Traffic signal priority would be maintained by the local jurisdiction. An agreement would be needed to ensure ongoing priority for BRT vehicles.

Exhibit 1. Performance Ratings

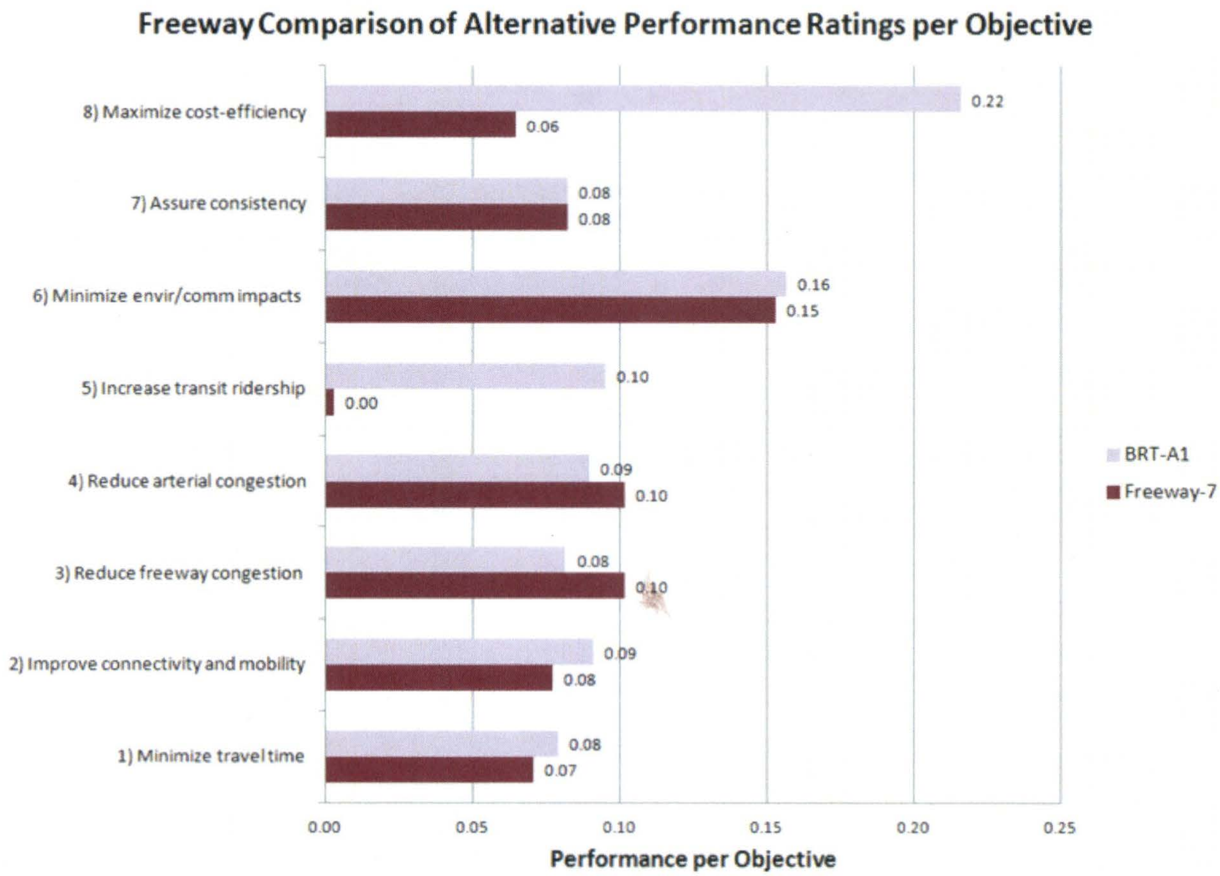


Exhibit 2. Performance Profile

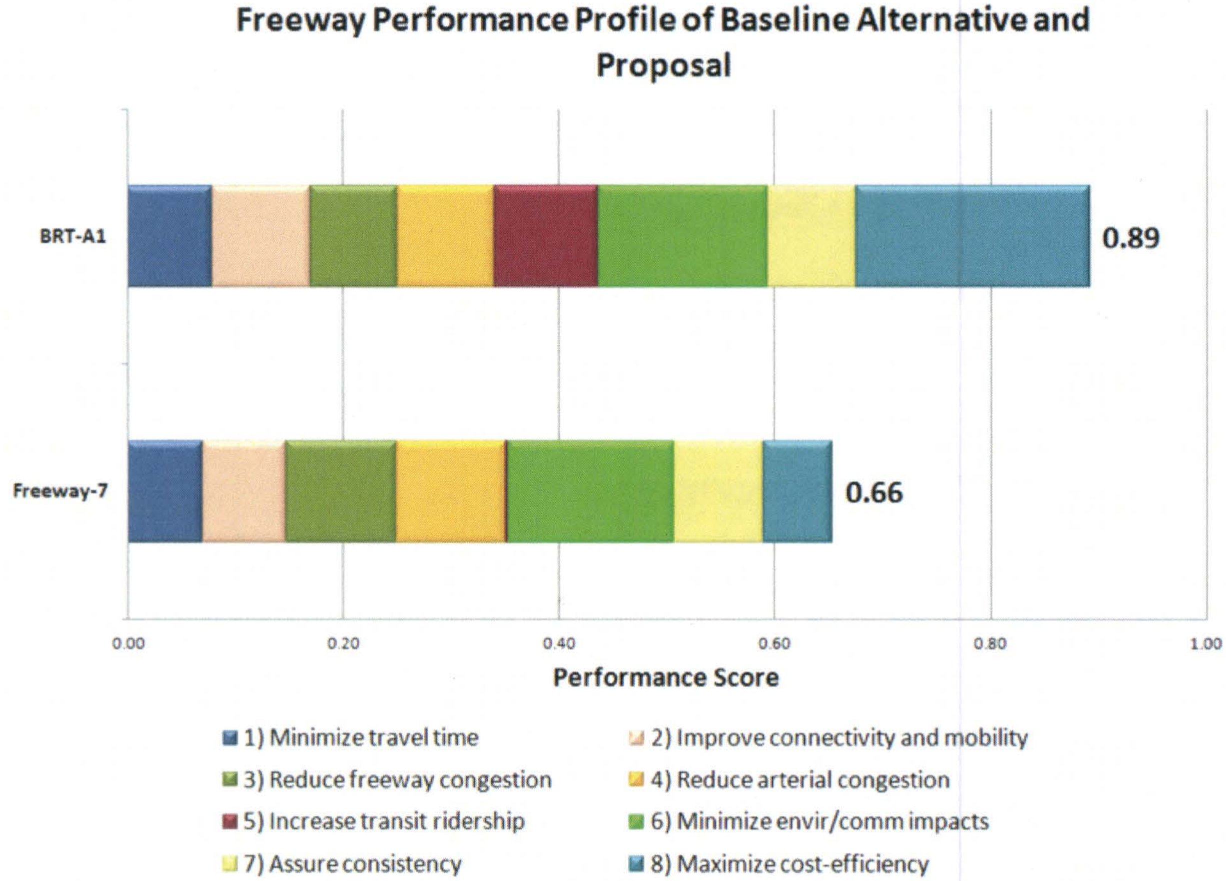


Exhibit 3. Benefit and Cost Performance

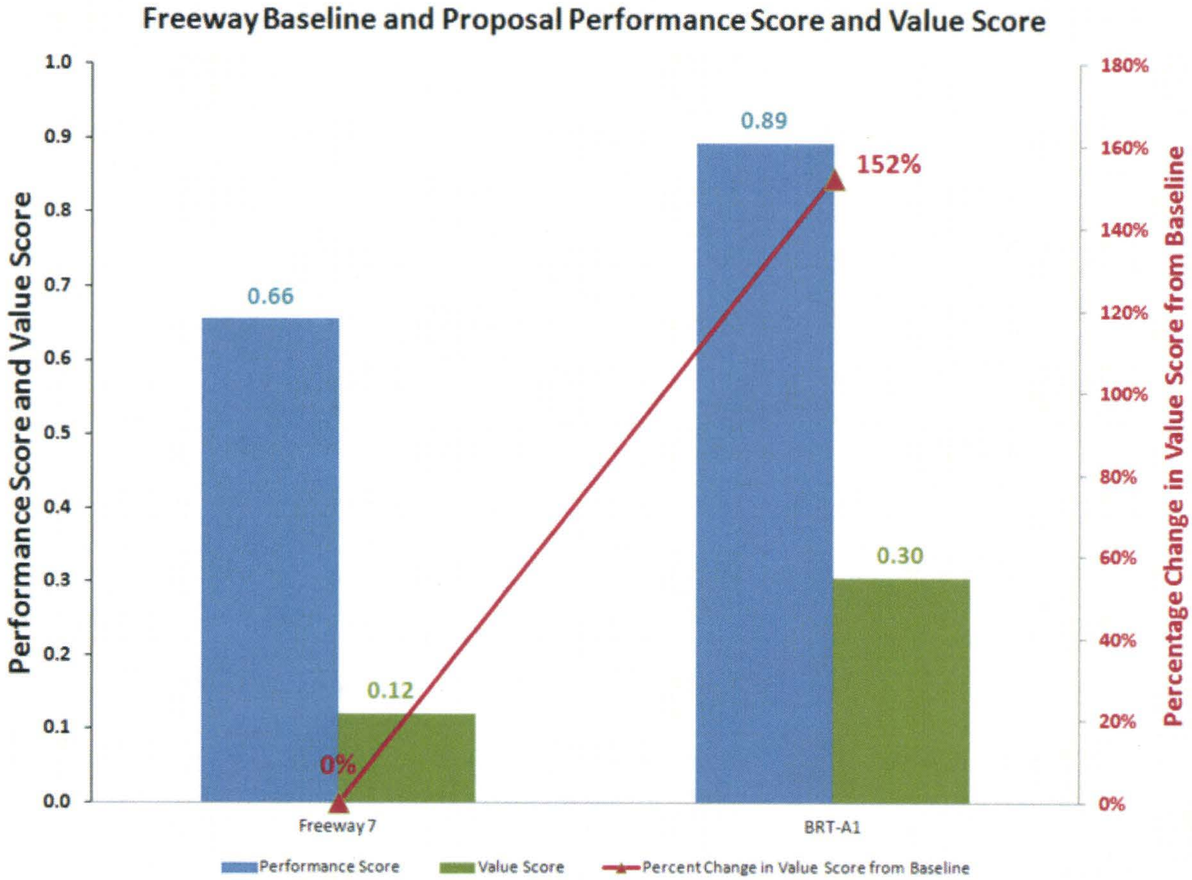


Exhibit 4. Performance Assessment

Performance Attributes (Objectives) Evaluation

Objectives	**Comment** **(Influence of the VA Alternative upon the Objective)**	**Rating** **(VA Alternative "Improves Performance" or "No Change" or "Reduces Performance")**
Minimize Travel Time	Advance technologies reduce dwell time and speeds travel through signalized intersections, resulting in shorter travel times.	Improves performance
Improve Connectivity and Mobility	Addition of BRT provides additional mobility and connectivity opportunities.	Improves performance
Reduce Congestion on Freeway System		No change
Reduce Congestion on Local Street System	Provision of traffic signal priority could impact mixed-flow operations at signalized intersections.	Reduces performance
Increase Transit Ridership	The system becomes more reliable, faster, thus potentially attracting higher ridership.	Improves performance
Minimize Environmental and Community Impacts Related to Transportation	Increased transit ridership would improve air quality and reduce noise impacts from single-occupancy vehicles (SOVs).	Improves performance
Assure Consistency with Regional Plans and Strategies	Regional plans and strategies promote increasing mobility, reducing congestion, and increasing transit use within the area.	Improves performance
Maximize Cost Efficiency of Public Investments	The advanced technologies increase mobility with minimal implementation and operating costs.	Improves performance

Exhibit 5. Baseline Concept Sketch (BRT6A Alternative)

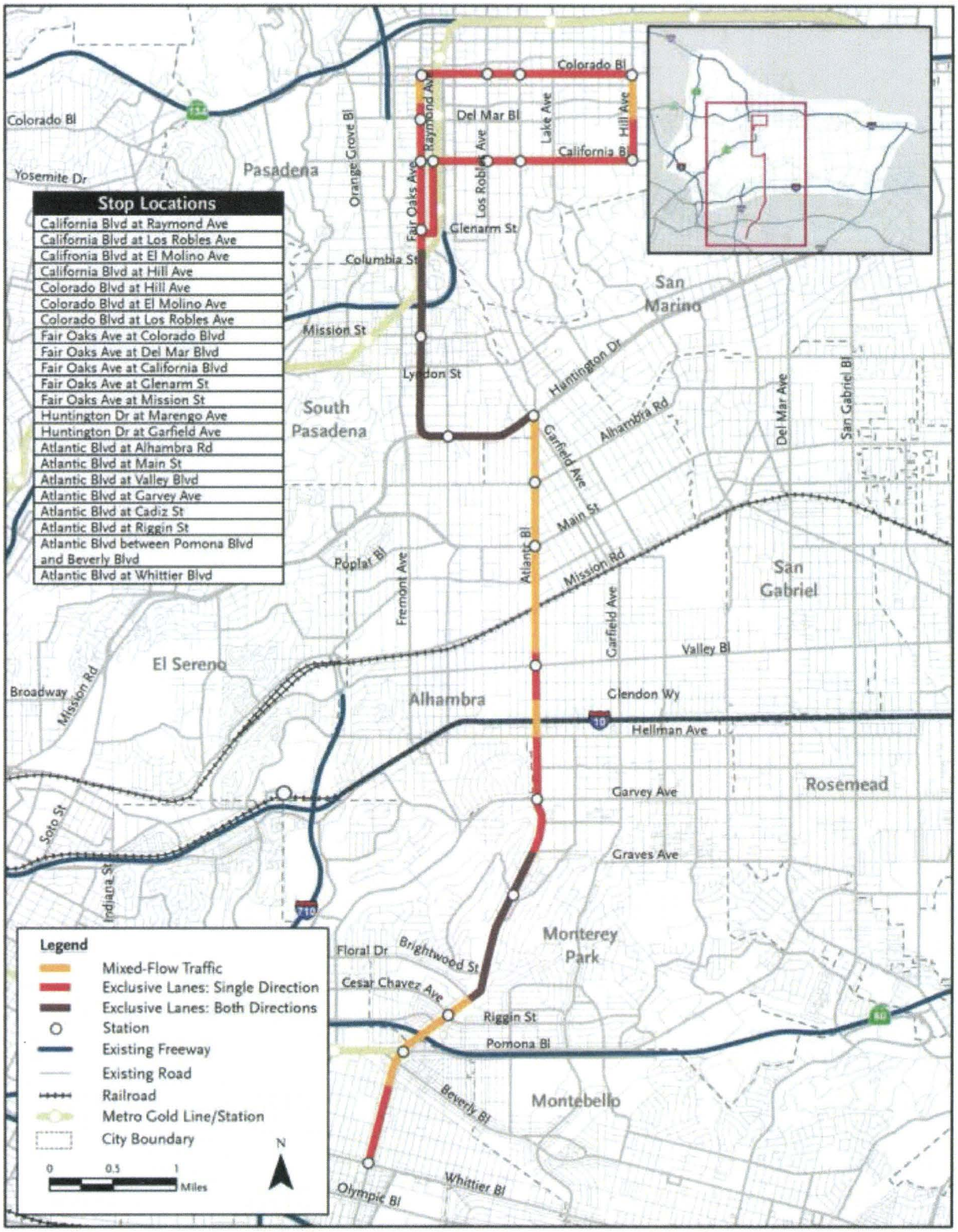
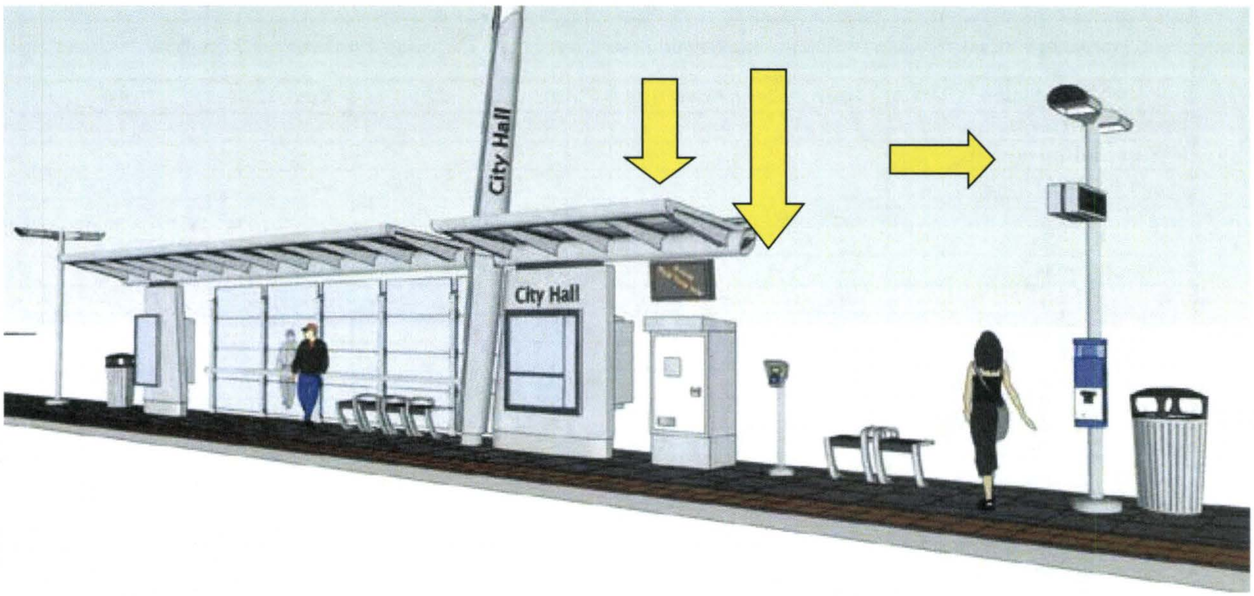


Exhibit 6. Examples of Real-Time Information Signs

Real Time Information: LED Signs

Real Time Information: LCD Signs

Exhibit 7. Example Application of Real-Time Information and Off-Board Fare Collection



VA ALTERNATIVE NO. BRT-A1

Alternative Title: Addition of BRT with Enhanced Technology to Freeway Tunnel Alternative

Exhibit 8. Initial Cost Estimates

INITIAL COSTS								ALT. NO. BRT 4
CONSTRUCTION ELEMENT		*BASELINE CONCEPT*			*VA PROPOSAL CONCEPT*			
Description	**Unit**	**Qty**	**Cost/Unit**	**Total**	**Qty**	**Cost/Unit**	**Total**	
ROADWAY ITEMS								
BRT Base Alternative								
Assumed Cost	ea			$ -	100,000,000	$ 1	$ 100,000,000	
	ea			$ -		$ -	$ -	
				$ -			$ -	
Technology Elements								
TSP	ea			$ -	0	$ -	$ -	
LED Real Time Info Signs	ea			$ -	33	$ 10,800	$ 356,400	
LCD Monitor for RTI	ea			$ -	33	$ 9,800	$ 323,400	
				$ -			$ -	
Off-Board Fare Collection								
Smart Card Readers	ea			$ -	33	$ 1,682	$ 55,506	
				$ -			$ -	
ROADWAY SUBTOTAL				$ -			*$ 100,735,306*	
ROADWAY MARK-UP	*79.6%*			$ -			*$ 80,185,304*	
ROADWAY TOTAL				$ -			*$ 180,920,610*	
ENVIRONMENTAL MITIGATION ITEMS								
				$ -			$ -	
				$ -			$ -	
CAPITAL OUTLAY SUPPORT ITEMS								
Reengineering and Redesign				$ -			$ -	
Project Engineering				$ -			$ -	
TOTAL		$ -			$ 180,920,610			
TOTAL (Rounded)		$0			$180,920,000			
						Base Savings	**($180,920,000)**	

Life-Cycle Cost Estimates: The VA team did not provide future cost calculations for this alternative because it was not felt that this new Alternative could be quantified or computed at this conceptual phase of design. The future cost for this VA alternative is therefore zero.

VA ALTERNATIVE NO. BRT-A1

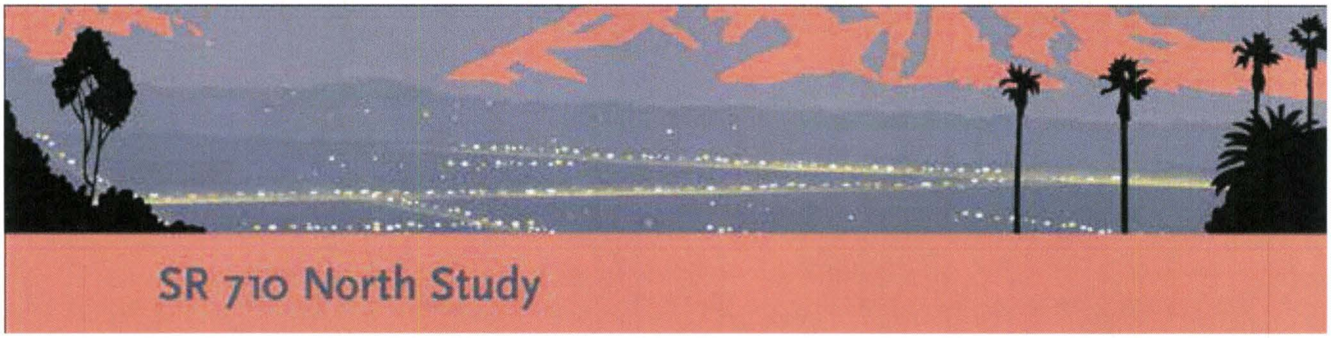
Alternative Title: Addition of BRT with Enhanced Technology to Freeway Tunnel Alternative

Assumptions and Calculations:

- BRT 6A Alternative
  - $100 M assumed, based on cost observations provided separately.
- Traffic Signal Priority
  - No additional cost. Metro is planning to implement traffic signal priority in this area as a separate project.
- Real-Time Information
  - 1 LED sign and 1 LCD monitor at BRT stop and in each direction of travel (33)
    - $10,800 per LCD sign
    - $9800 per LED monitor
- Off-Board Fare Collection
  - Smart card readers (one for each direction of travel per BRT stop: 33)
    - $1,682 per smart card reader = $55,506
- Assume software is not an incremental cost to project

Project Information

TBG0416130431 23SCO



Project Information

3. PROJECT INFORMATION

FINAL

BACKGROUND

The SR 710 North Study is the culmination of a long history of efforts to address north-south mobility in the western San Gabriel Valley and east and northeast Los Angeles. The history of the planning efforts dates back to 1933 when Legislative Route 167, later renamed SR 7, was defined to run from San Pedro east to Long Beach and north to the vicinity of Monterey Park. The majority of this route has been constructed and incorporated into the Interstate Highway System as I-710. In 1959, the proposed northern limits of SR 7 were extended to the planned Foothill Freeway (now I-210). Over the years, planning efforts continued to address community and agency concerns, eventually leading to the issuance of a ROD in 1998 by the Federal Highway Administration (FHWA) for a surface freeway. After litigation initiated by some of the affected communities, FHWA rescinded the ROD in 2003, citing changes in project circumstances such as funding uncertainty and the opening of the Metro Gold Line to Pasadena, and requiring a more thorough evaluation of the feasibility of a bored tunnel.

In 2006, Metro and Caltrans conducted two tunnel feasibility assessments, the Route 710 Tunnel Technical Feasibility Assessment Report (Parsons Brinckerhoff, June 7, 2006) and the Final Geotechnical Summary Report, SR 710 Tunnel Technical Study (CH2M HILL, April 2010), to evaluate the feasibility of constructing a tunnel to complete the planned SR 710 freeway route that would lessen the potential impacts associated with a surface route. The studies found that a tunnel would be a viable solution and would warrant more detailed evaluation. In November 2008, Measure R (a half-cent sales tax dedicated to transportation projects in Los Angeles County) was approved by a two-thirds majority of county voters. Included in the Measure R plan is the commitment of $780 million to improve the connection between the SR 710 and I-210 freeways.

In March 2011, Caltrans published a Notice of Intent (NOI) under NEPA and a Notice of Preparation (NOP) under CEQA to initiate the environmental review process for the "State Route 710 North Gap Closure" project. The environmental review process began with the "SR 710 Conversations" outreach effort, led by Metro, including 21 pre-scoping and scoping meetings throughout the study area in March and April of 2011. Metro also initiated the "State Route 710 Gap Closure Transit Profile Study" to gather transit service and patronage data, and to assess current and future transit travel markets within the study area.

PROJECT DESCRIPTION

A wide range of possible transportation alternatives was identified based on past studies and comments received during the "SR 710 Conversations" from stakeholders including elected officials, city and agency staff, and the community. The resulting options were evaluated and refined through a sequential screening process to identify the alternatives that best meet the purpose and need of the study.

The initial screening of the alternatives identified in the preliminary screening step evaluated the preliminary set of alternatives based on the eight project objectives described in the AA Report. Twelve alternatives resulted from the initial screening.

In the secondary screening, the performance of the 12 alternatives from the initial screening (based on the eight project objectives) was evaluated using 42 performance measures. Table ES-4 in the AA summarizes the performance of each of the alternatives on the five objectives related to the project need. Table ES-6 in the AA summarizes the performance of each of the alternatives on the three objectives related to environmental, planning, and cost concerns.

The No Build Alternative and the TSM/TDM Alternative are required to be evaluated in the PA/ED phase. Therefore, they should be evaluated further.

Among the BRT Alternatives, the measures for the objectives related to transportation system performance were similar to one another, with Alternative BRT-1 performing slightly better at reducing transit travel times, but Alternatives BRT-6 and BRT-6A performing slightly better at increasing access to high-frequency transit service and increasing north-south transit patronage. Therefore, performance on the transportation objectives does not clearly favor one alternative over the others. However, Alternatives BRT-6 and BRT-6A could be implemented with no ROW acquisition and would also have a smaller potential impact on sensitive habitat. Therefore, Alternative BRT-6, along with the design variation Alternative BRT-6A, should be evaluated further in the PA/ED phase.

Among the LRT Alternatives, the measures for the objectives related to transportation system performance were similar to one another. However, on the measures for the objectives related to environmental and other concerns, Alternative LRT-6 was clearly inferior to Alternatives LRT-4A, LRT-4B, and LRT-4D. Alternative LRT-6 would require the acquisition of hundreds of properties, impact more historic period properties, and impact more community facilities. Similarly, compared to Alternatives LRT-4A and LRT-4B, Alternative LRT-4D would have greater property impacts. Therefore, Alternatives LRT-4A and LRT-4B should be evaluated further in the PA/ED phase.

Among the Freeway Tunnel Alternatives, Alternatives F-6 and F-7 are superior to Alternatives F-2 and F-5 on the measures for the objectives related to the transportation system performance. Alternatives F-6 and F-7 each performed best on either minimizing travel times or improving connectivity and mobility, and both performed best on the objective of reducing congestion on local streets. The performance on the objectives related to environmental and other concerns distinguished Alternatives F-6 and F-7 from one another. Alternative F-7 would require only a small number of property acquisitions (fewer than 10), compared to the over 400 required for Alternative F-6 in addition to properties that Caltrans already owns. Alternative F-7 would also impact fewer historic period properties and community facilities. Therefore, Alternative F-7 should be evaluated further in the PA/ED phase.

None of the highway alternatives performed well on the measures for objectives related to transportation system performance. They also performed poorly on the measures for objectives related to environmental and other concerns, especially Alternative H-2. Therefore, neither of the highway alternatives should be evaluated further in the PA/ED phase.

In the PA/ED phase, alternatives will be refined first to avoid and then to minimize potential impacts to the extent possible. Where impacts cannot be avoided or minimized, feasible mitigation measures will be identified to reduce impacts.

Additional refinements of alternatives that should be investigated in the PA/ED phase include the following:

- The No Build Alternative should be updated to reflect the financially constrained project list in the 2012 RTP/SCS. This plan was adopted by SCAG after the initiation of the AA, but it would be appropriate to update the No Build Alternative in the PA/ED phase to be consistent with the newly adopted plan. The ridership and travel demand forecasting in the PA/ED phase will be based on the 2012 RTP/SCS.
- The TSM/TDM Alternative was found to have potential ROW impacts, primarily resulting from the spot intersection and roadway segment improvements included in the alternative. These spot improvements should be refined in coordination with the local jurisdictions to maximize the benefits of the alternative and minimize its impacts. In addition, these improvements should be refined to identify opportunities to create "complete streets" that enhance the pedestrian and bicycle environment and to ensure that they do not detract from it. The other components of the TSM/TDM Alternative should also be reviewed and refined to look for additional opportunities to improve the performance of the alternative.
- Alternative BRT-6, like all of the BRT Alternatives, would displace a large amount of on-street parking. Therefore, refinements should be considered to its design, alignment, and/or operational characteristics to minimize the impact to on-street parking. Refinements should also be considered to maximize ridership and productivity (passengers per bus).
- Alternative LRT-4A/B station locations should be refined to maximize ridership, minimize property impacts, and to facilitate transfers to the Metro Gold Line at its northern and southern termini.
- Alternative LRT-4A/B could be combined with enhanced bus service, including feeder routes to its stations.

PROJECT DESIGN EXCEPTIONS

Mandatory Design Exceptions

- None.

Advisory Design Exceptions

- None.

INFORMATION PROVIDED TO THE VA TEAM

The following project documents were provided to the VA Team for their use during the VA Study. Copies of these documents are provided in Appendix A.

- Pre-Study VA Agenda
- Draft VA Study Agenda
- Overview Presentation
- VA Surface Group Idea List
- VA Tunnel Group Idea List
- VA Briefing Presentation
- ROD (May 4, 1998)
- SR 710 North Study TAC Comments (January 18, 2012)

PROJECT DRAWINGS

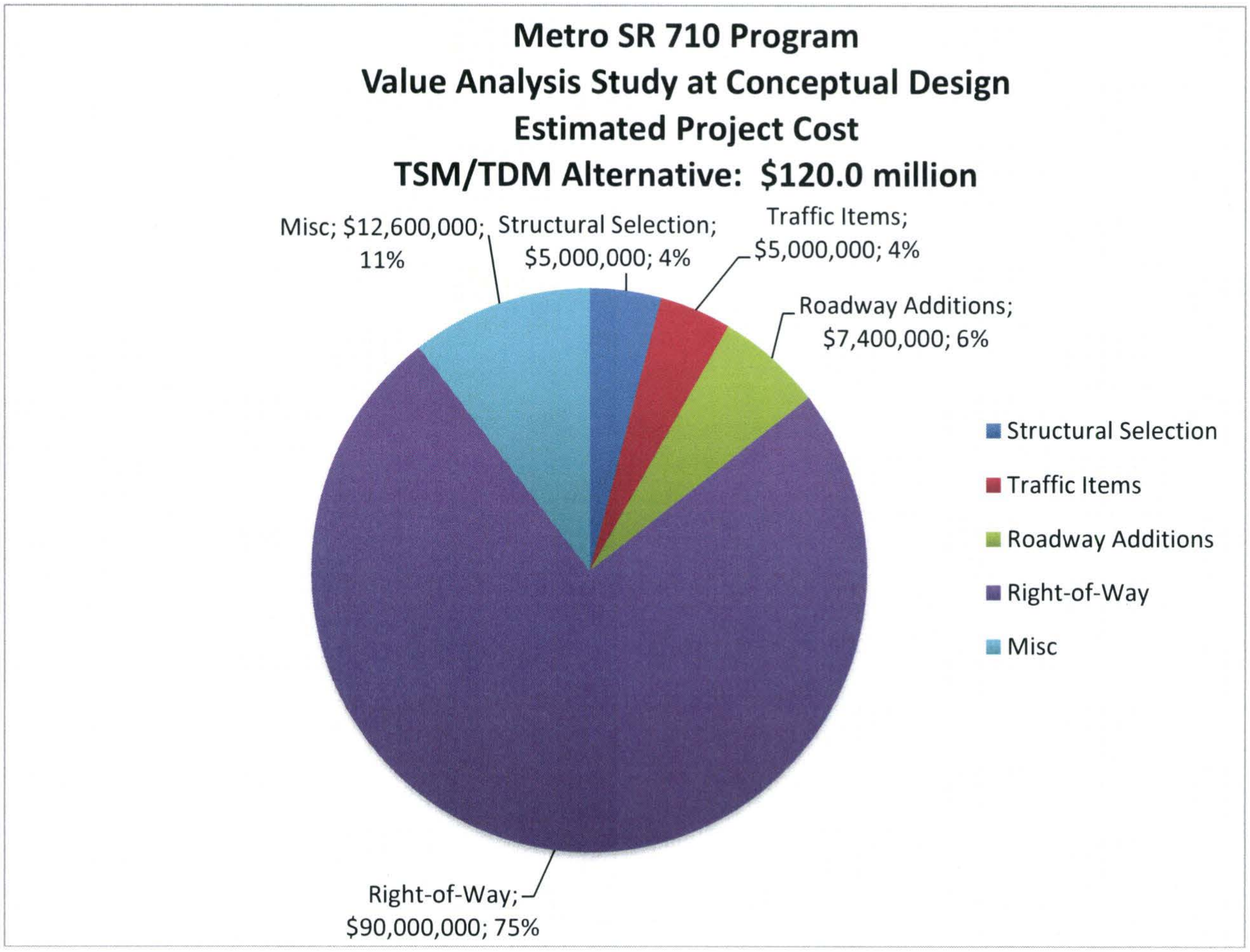
The following project drawings were provided to the VA Team for their use during the study:

- Alternative BRT-6 (full-size exhibit)
- Draft Alternative LRT-4A/4B (full-size exhibit)
- Freeway Tunnel Dual Bore Alternative (full-size exhibit)
- State Route 710 Study: Parks (large-format map)
- State Route 710 Study: Historic Districts (large-format map)
- State Route 710 Study: Biological Resources (large-format map)

PROJECT COST ESTIMATE

The project cost estimate that was used as the baseline for the VA Study is the original cost estimate in the AA Report. The cost models shown herein are also shown in the Project Analysis section of this VA Study Report. The entire cost estimate for the alternatives is not provided here due to its large size, but the cost estimate can be found in the AA Report.

Exhibit 3-1



Metro SR 710 Program
Value Analysis Study at Conceptual Design
Estimated Project Cost
TSM/TDM Alternative: $120.0 million
Misc; $12,600,000; 11%
Structural Selection; $5,000,000; 4%
Traffic Items; $5,000,000; 4%
Roadway Additions; $7,400,000; 6%
Right-of-Way; $90,000,000; 75%
Structural Selection
Traffic Items
Roadway Additions
Right-of-Way
Misc

Exhibit 3-2

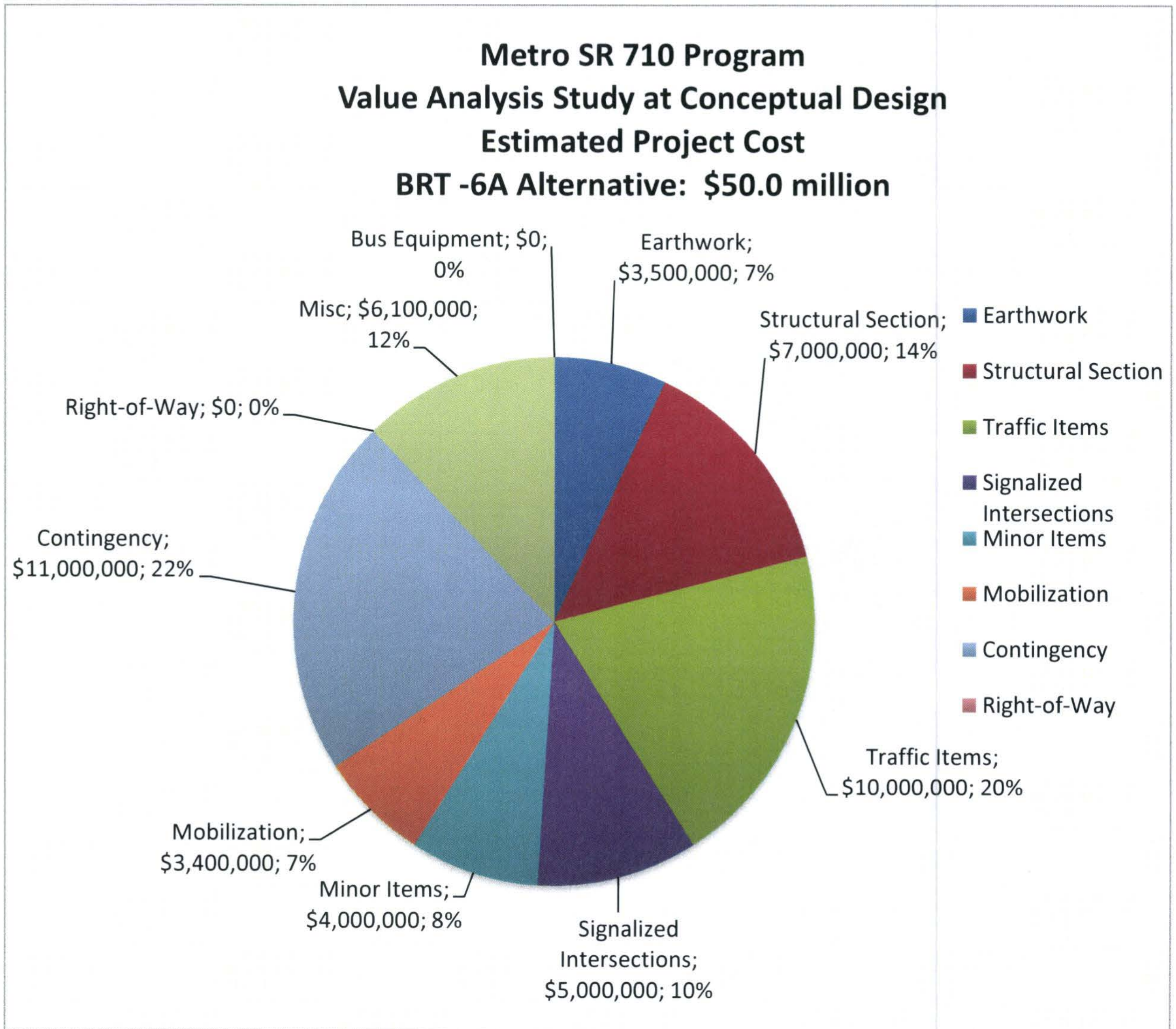

Metro SR 710 Program
Value Analysis Study at Conceptual Design
Estimated Project Cost
BRT -6A Alternative: $50.0 million
Bus Equipment; $0; 0%
Earthwork; $3,500,000; 7%
Misc; $6,100,000; 12%
Structural Section; $7,000,000; 14%
Right-of-Way; $0; 0%
Contingency; $11,000,000; 22%
Traffic Items; $10,000,000; 20%
Mobilization; $3,400,000; 7%
Minor Items; $4,000,000; 8%
Signalized Intersections; $5,000,000; 10%
Earthwork
Structural Section
Traffic Items
Signalized Intersections
Minor Items
Mobilization
Contingency
Right-of-Way

Exhibit 3-3

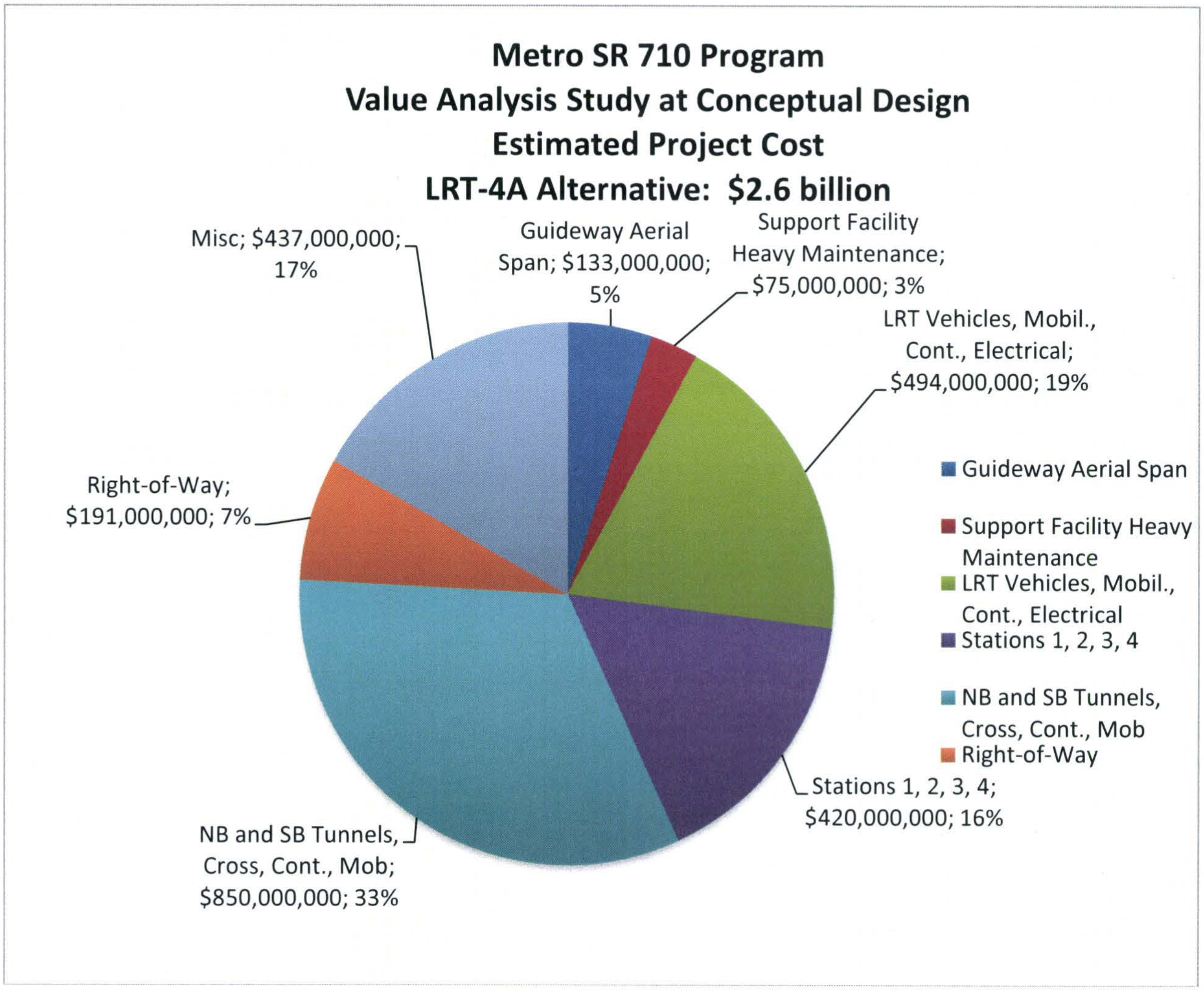
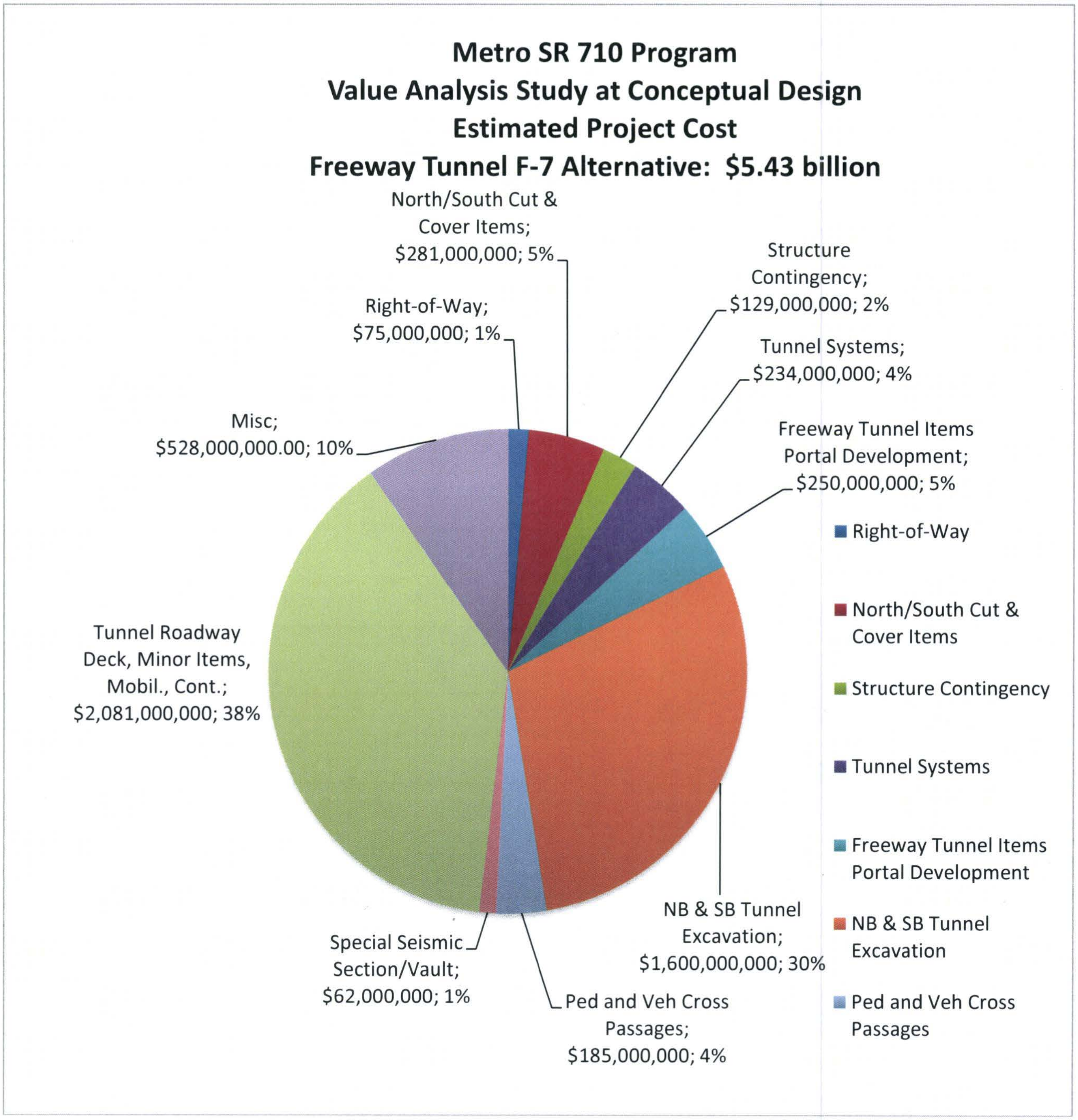
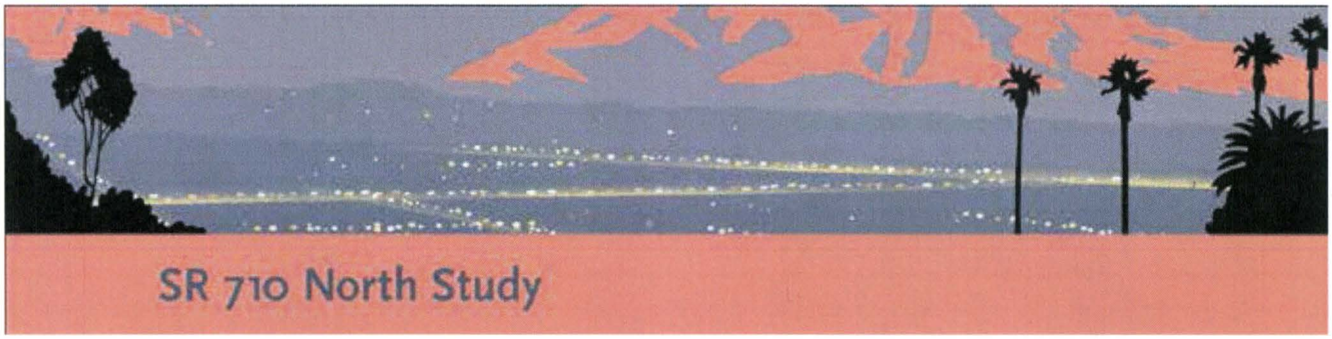

Metro SR 710 Program
Value Analysis Study at Conceptual Design
Estimated Project Cost
LRT-4A Alternative: $2.6 billion
Misc; $437,000,000; 17%
Guideway Aerial Span; $133,000,000; 5%
Support Facility Heavy Maintenance; $75,000,000; 3%
LRT Vehicles, Mobil., Cont., Electrical; $494,000,000; 19%
Right-of-Way; $191,000,000; 7%
Stations 1, 2, 3, 4; $420,000,000; 16%
NB and SB Tunnels, Cross, Cont., Mob; $850,000,000; 33%
Guideway Aerial Span
Support Facility Heavy Maintenance
LRT Vehicles, Mobil., Cont., Electrical
Stations 1, 2, 3, 4
NB and SB Tunnels, Cross, Cont., Mob
Right-of-Way

Exhibit 3-4


Metro SR 710 Program
Value Analysis Study at Conceptual Design
Estimated Project Cost
Freeway Tunnel F-7 Alternative: $5.43 billion
North/South Cut & Cover Items; $281,000,000; 5%
Structure Contingency; $129,000,000; 2%
Right-of-Way; $75,000,000; 1%
Tunnel Systems; $234,000,000; 4%
Misc; $528,000,000.00; 10%
Freeway Tunnel Items Portal Development; $250,000,000; 5%
Tunnel Roadway Deck, Minor Items, Mobil., Cont.; $2,081,000,000; 38%
NB & SB Tunnel Excavation; $1,600,000,000; 30%
Special Seismic Section/Vault; $62,000,000; 1%
Ped and Veh Cross Passages; $185,000,000; 4%
Right-of-Way
North/South Cut & Cover Items
Structure Contingency
Tunnel Systems
Freeway Tunnel Items Portal Development
NB & SB Tunnel Excavation
Ped and Veh Cross Passages

Project Analysis



Project Analysis

4. PROJECT ANALYSIS

SUMMARY OF ANALYSIS

The following analysis tools were used to study the project:

- Key Project Factors
- Cost Model
- Function Analysis
- Value Metrics

KEY PROJECT FACTORS

The first day of the VA Study typically includes meetings with the project stakeholders and a site visit. Summarized below are the key project issues and site visit observations identified during these sessions.

Project Issues (Stakeholders)

1. Lack of regional north-to-south and south-to-north connections results in cut-through traffic on local arterial streets, further exacerbating local congestion.
2. High levels of congestion on surface streets and freeways in the study area results in increased costs and travel time for individuals and businesses. Also results in more pollution and degradation of the quality of life.
3. Inadequate regional transit service in this densely populated area would benefit from regional transit connections to improve livability and air quality.
4. Availability of funding could limit implementation of alternatives, with costs for additional ROW and escalation increasing over time.
5. High level of public scrutiny on potential impacts from all alternatives. Consensus needed to implement the project.

VA Team Project Issues and/or Site Visit Observations

Site Visit Observation

- The existing SR 710 stub near the Alternative F-7 south portal location seems very limited in terms of space for construction. It was very difficult to navigate a large tour bus in this area.
- During the tour on the first day of the VA Study, the team noticed much congested traffic at 2:00 p.m. on a Monday through Atlantic Boulevard.
- The area just northeast of where I-110 cross Fair Oaks may provide some potential for a BRT station. There are many stores and restaurants here, which would make it an ideal place for a station.

COST MODEL

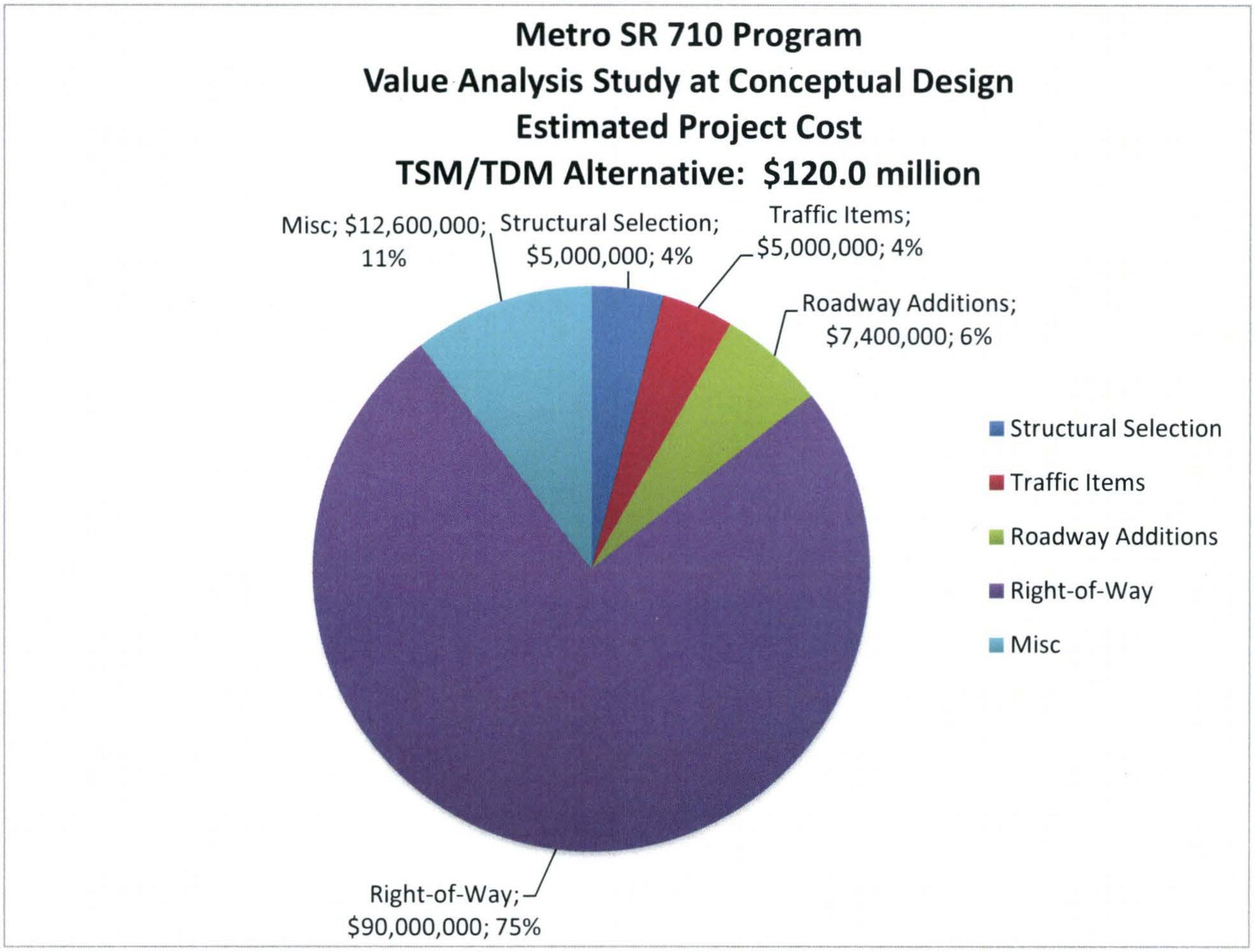
The VA Team Leader prepared a cost model from the cost estimate in the AA Report. The model is organized to identify major construction elements, the current estimated cost, and the percent of total project cost for the significant cost items.

The cost model clearly showed the cost drivers for the project and was used to guide the VA Team during the VA Study.

The following conclusions were noted by the VA Team regarding the project costs:

- The cost estimate is very general and contains many high-level cost placeholders for various project items.
- Construction is the major driver for the BRT, LRT, and Freeway Tunnel Alternatives.
- ROW acquisition is the major driver for the TSM/TDM Alternative.

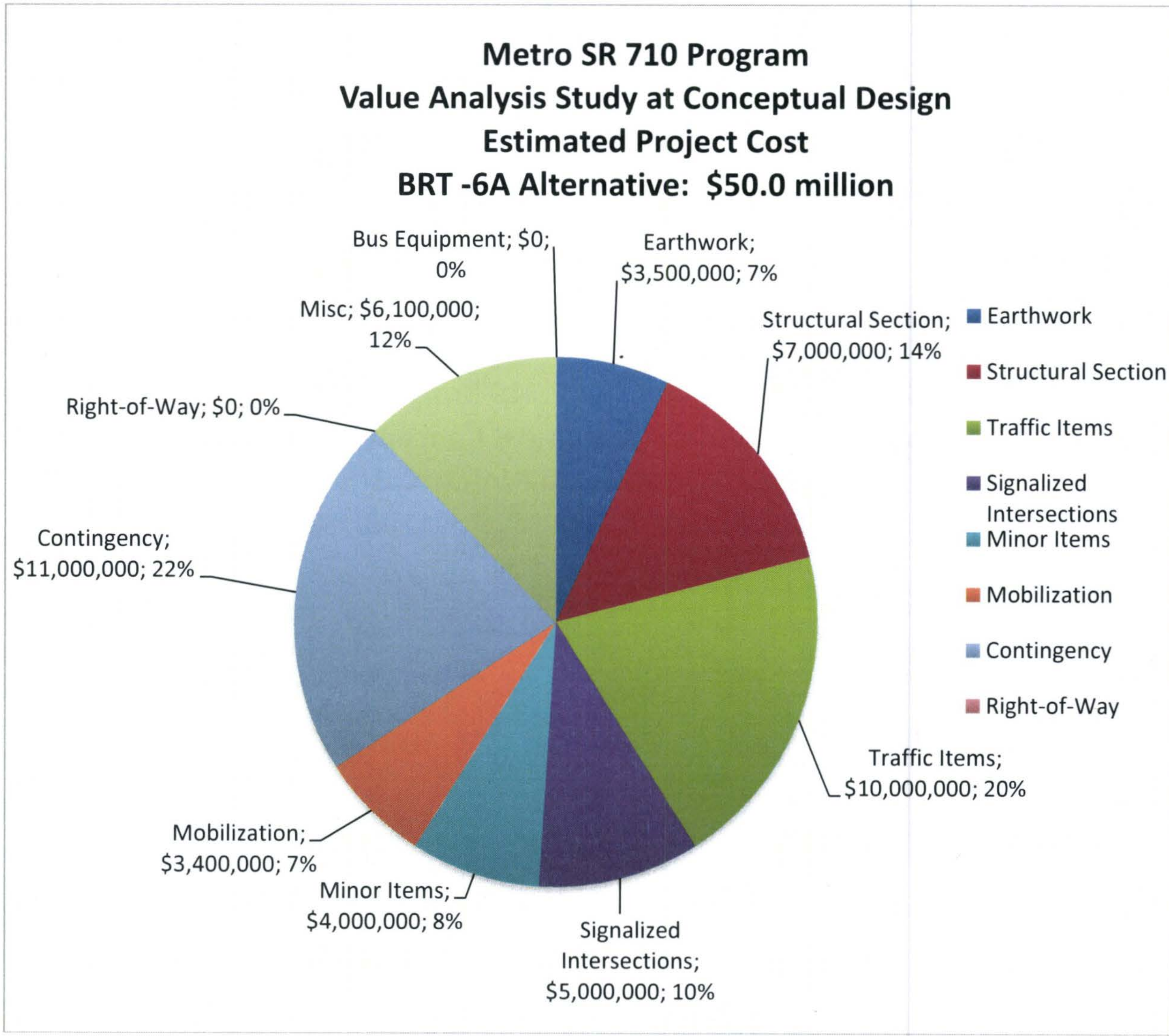
Exhibit 4-1



TSM/TDM Alternative Cost Model – VA Team conclusions:

- ROW acquisition is the major driver for the TSM/TDM Alternative.
- A big part of the cost for this TSM/TDM Alternative is portioned for miscellaneous items, including contingency.

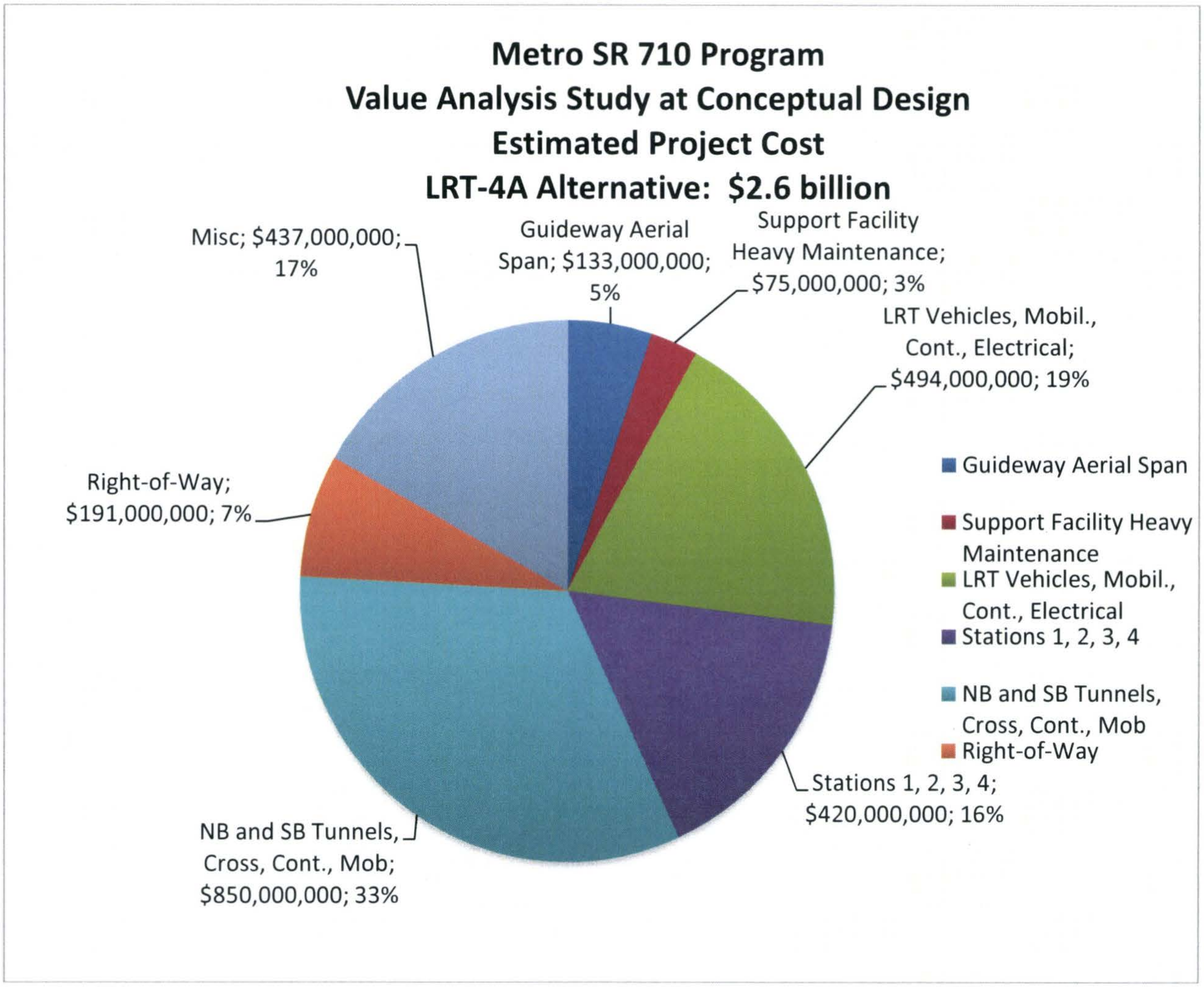
Exhibit 4-2



BRT-6A Alternative Cost Model – VA Team conclusions:

- The cost estimate is very general and contains many high-level cost placeholders for various project items.
- Contingency and traffic items are the major drivers for the BRT-6A Alternative.
- Structural sections are another major driver for the BRT-6A Alternative cost.

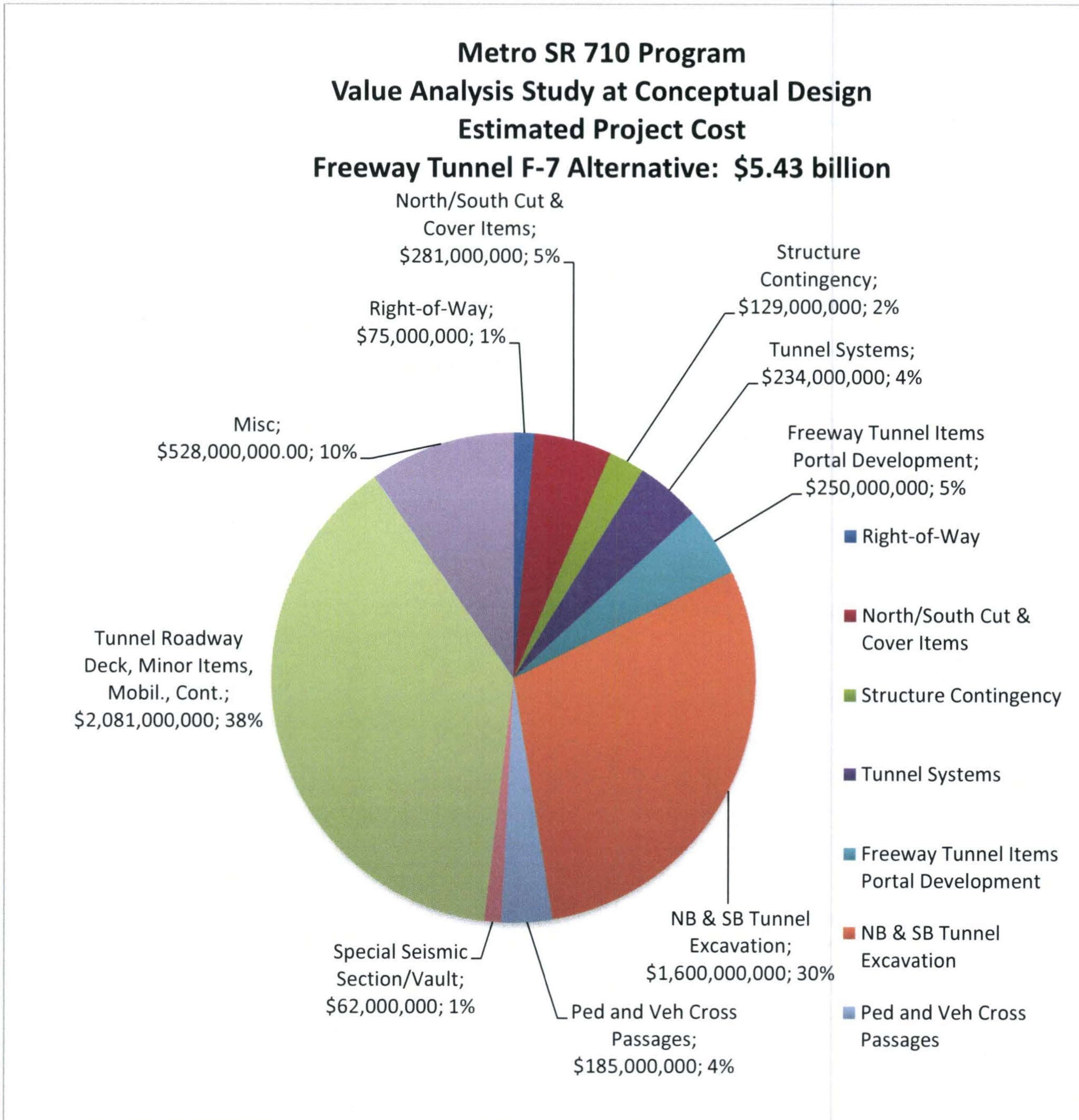
Exhibit 4-3



LRT-4A Alternative Cost Model – VA Team conclusions:

- Tunnels and other items associated with tunnel construction are the major drivers for the LRT-4A Alternative.
- LRT vehicles and their associated items are another major driver for the cost of this alternative.
- The overall costs for the stations would be worth noting as a major driver as well.

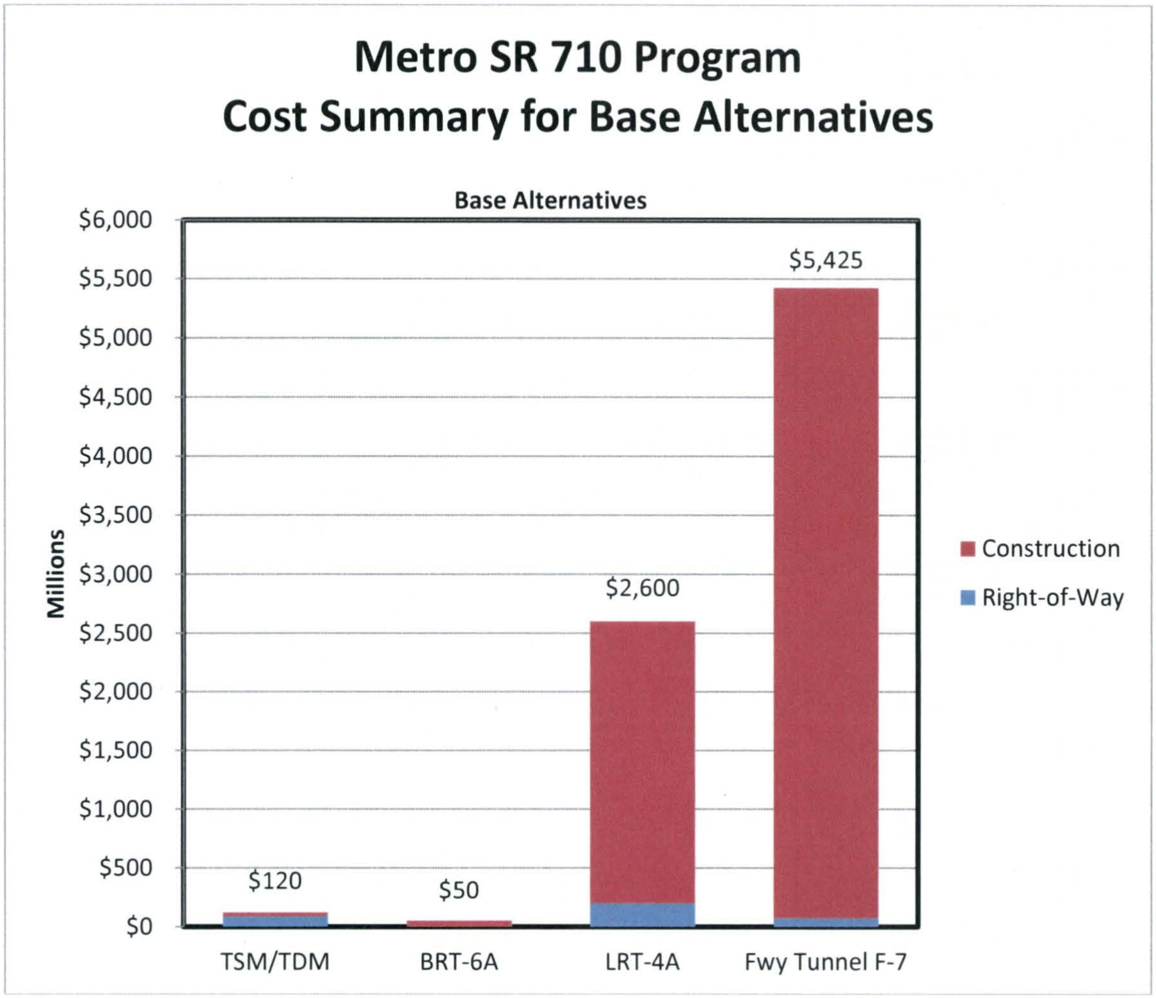
Exhibit 4-4



F-7 Alternative Cost Model – VA Team conclusions:

- Tunnels, roadway deck, and other items associated with tunnel construction are the major drivers for the F-7 Alternative.
- Excavation is the other major driver for the F-7 Alternative. Looking into methods to reduce excavation would be beneficial for this alternative.

Exhibit 4-5



The following conclusions were noted by the VA Team regarding the project costs:

- The cost estimate is very general and contains many high-level cost placeholders for various project items.
- Construction is the major driver for the BRT, LRT, and Freeway Tunnel Alternatives.
- ROW acquisition is the major driver for the TSM/TDM Alternative.

FUNCTION ANALYSIS

During the Function Analysis Phase, the VA Team identified functions for each of the major project components of the SR 710 North Study. This exercise is helpful in bringing the VA Team to a more complete level of understanding of the project goals, drivers, and purpose.

Functions are described in simple verb-noun definitions (along with occasional adjectives and descriptive statements), and are intended to help clarify the scope of the project for the purposes of VA analysis. Functions of a project can be categorized as Higher-Order (H) functions, Basic (B) functions, Secondary (S) functions, and All-the-Time (A) functions.

Higher-Order (H) functions describe the overall purpose of the project, but are not viewed to be within the specific scope of the VA Study. These are the high-ideals of the project, which all basic functions of the SR 710 North Study project are intended to support. The basic and secondary functions themselves are within the purview of the VA Team to review for possible alternatives representing an economy to the project. Basic (B) functions describe the most important elements of the project. Secondary (S) functions describe meaningful, yet secondary elements of the project that need to be accommodated to deliver the project, but do not themselves represent a primary purpose for implementing the project. In many projects, the costs devoted to accomplishing secondary functions are often higher than they really need to be; therefore, secondary functions receive much scrutiny in a VA Study along with basic functions. All-the-Time (A) functions describe meaningful objectives that a project should strive to meet.

High-cost areas of the project where opportunities for VA savings exist can be found primarily in basic and secondary functions. That is why the VA Team spends time identifying project functions. Alternatives are evaluated that can meet the intended function without compromise to quality or the function itself. For example, if a lot of money is being spent on the secondary function "Reuse Material," (meaning full-depth reclamation) then it is incumbent on the VA Team to explore other technically feasible and lower-cost alternatives to this function.

The functions generated by the VA Team are identified below, along with the designators as to the type of function they represent.

Table 4-1. Random Function Determination from Functional Analysis Phase of the VA Study

Function Type[1]	Function	No Build	TSM/TDM	BRT	LRT	Freeway Tunnel with TSM/TDM
	From BRT/LRT Group					
A	Preserve community identity	Y	Y	Y	Y	Y
A	Provide transit safety/security	N/A	Y	Y	Y	Y
A	Accommodate emergency access	N/A	Y	Y	Y	Y
A	Maintain worker safety	N/A	Y	Y	Y	Y
B	Improve north-south mobility	No	Y	Y	Y	Y
B	Improve north-south connectivity	No	Y	Y	Y	Y
B	Reduce local congestion	No	Y	Y	Y	Y
B	Reduce travel times	No	Y	Y	Y	Y
A	Minimize property/historical/ cultural impacts	Y	Y	Y	Y	Y

Table 4-1. Random Function Determination from Functional Analysis Phase of the VA Study

Function Type[1]	Function	No Build	TSM/TDM	BRT	LRT	Freeway Tunnel with TSM/TDM
B	Increase transit ridership/mode split	No	Y	Y	Y	Y
B	Transport people	No	Y	Y	Y	Y
B	Maximize project cost-effectiveness	N/A	Y	Y	Y	Y
B	Encourage active transportation	No	Y	Y	Y	Y
H	Access employment/ education centers	No	Y	Y	Y	Y
H	Promote economy	No	Y	Y	Y	Y
H	Improve livability	No	Y	Y	Y	Y
A	Reduce emissions	No	Y	Y	Y	Y
S	Reduce cut-through traffic on local streets	No	No	Y	Y	Y
S	Increase transit reliability	No	Y	Y	Y	Y
S	Provide transportation options/alternatives	No	Y	Y	Y	Y
S	Build community support/consensus	No	Y	Y	Y	Y
S	Improve regional transit connectivity; direct linkages, interlining, feeder buses	No	Y	Y	Y	Y
S	Increase connections to regional freeway system	No	No	No	No	Y

[1] H = Higher-Order Functions; B = Basic Functions; S = Secondary Functions; and A = All-the-Time Functions

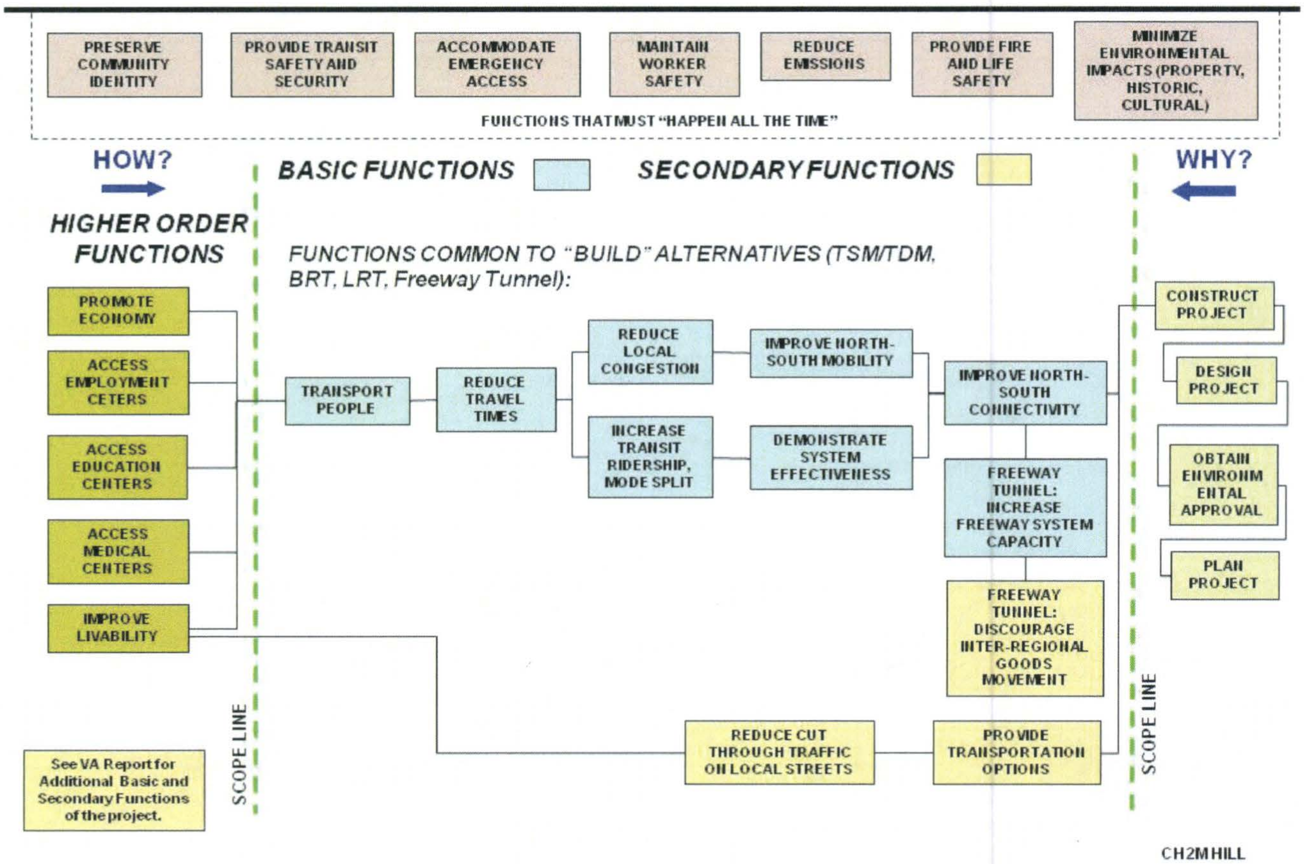
FAST DIAGRAM

The VA Team arranged the functions into a "Function Analysis System Technique" (FAST) diagram. The following FAST diagram links the Basic and Higher-Order functions into "How-Why" relationships for the SR 710 North Study.

Exhibit 4-6

FUNCTION ANALYSIS SYSTEM TECHNIQUE (FAST) DIAGRAM

METRO SR-710 PROGRAM



DECISION SCIENCE APPLICATION

Decision Science is the application of structure, process, and tools to assist with the collection of data, evaluation of performance, and communication of tradeoffs among alternatives. Application of Decision Science supports the decision makers in reaching a conclusion.

For the VA, Decision Science adds another set of data to showcase the performance of the proposals against the original alternatives and the relative performance against each other.

Decisions Science Elements and Associated Benefits for SR 710

For the SR 710 VA Study, Decision Science has been applied in the assessment of the VA Team proposals for three specific reasons.

1. **Application of the Caltrans VA Methodology**

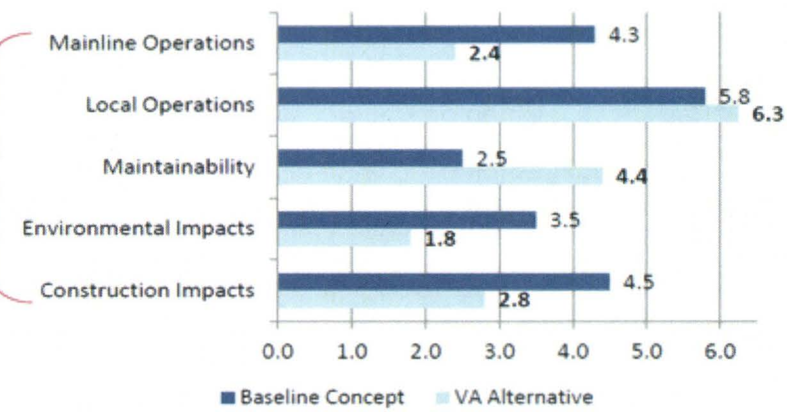
   Caltrans has a very robust VA methodology that applies a well thought-out and applicable Decision Science application. The instructions from the Caltrans VA Analysis Team Member Guide demonstrate the application and the Decision Science results that are expected as part of the development and presentation of proposal performance and comparison. This exact methodology was applied to the SR 710 VA Study. The only difference is in the details of the performance criteria (explained below).

Exhibit 4-7

Comparison of Performance

These performance attributes will be identified either prior to the study or during the Information Phase of the VA study.

The chart to the right – which depicts the differences in performance ratings between the Baseline Concept and the Alternative Concept – will be created by the VA Team Leader.



Performance Assessment

Performance Attribute	Rationale for Change in Performance
Mainline Operations	*How will the alternative impact each of the various performance attributes?* Is performance better or worse? Explain why. At times, this information is captured from discussions during group Idea Evaluation; elaborate on this information.
Maintainability	Is performance better or worse? Explain why.
Environmental Impacts	Is performance better or worse? Explain why.
Construction Impacts	Is performance better or worse? Explain why.

2. Continuity of Decision Process

The SR 710 Study AA has taken advantage of Decision Science methodology – establishing and applying performance criteria. This methodology was very successful in moving through the analysis and screening of alternatives.

This AA also has the advantage of being applied with insight and guidance from the public. The Technical Advisory Committee (TAC) was created with the purpose of providing technical input to Metro, Caltrans, and the project team. The TAC met eight times during the AA process. A Stakeholder Outreach Advisory Committee was also created at the direction of the Metro Board, and was briefed on the progress of the SR 710 Study. The success of this AA screening process and the validation that took place with the advisory committees during the AA process should be continued, as best as possible, in the VA Study. Applying Decision Science methods in the VA would continue the application of these same criteria to maintain continuity in the decision process.

In particular, demonstrating continuity from the AA to the VA Study should include the application of the AA objectives set:

1. Minimize travel time.
2. Improve connectivity and mobility.
3. Reduce congestion on freeway system.
4. Reduce congestion on local street system.
5. Increase transit ridership.
6. Minimize environmental and community impacts related to transportation.
7. Assure consistency with regional plans and strategies.
8. Maximize cost-efficiency of public investments.

3. Communication of VA Results

The high public scrutiny of this project requires clear communication of each step of the process. Displaying the ideas and evaluation of performance will be imperative for the VA process. In particular, the clear comparison of performance of the baseline alternatives with the VA Team proposals and the tradeoffs related to performance are important to demonstrate. The Decision Science methodology supports the production of information to display these tradeoffs.

4. Transition to Compare Across Modes

The AA showcased performance of each mode; comparing across modes will be part of the PA/ED process. The VA Study is not in any way suggesting a preferred alternate either within modes or across modes. However, applying the performance criteria from the AA with Decision Science process and tools in the VA will demonstrate comparable mode performance.

PRESENTATION OF DECISION SCIENCE RESULTS WITHIN EACH PROPOSAL

Each VA proposal is compared against the performance of the baseline alternative of the mode family. This comparison is done against the eight objectives that were formulated in the AA. The first step in this process was a verbal description of the performance change within each individual objective by the VA Team.

Comparison of Performance

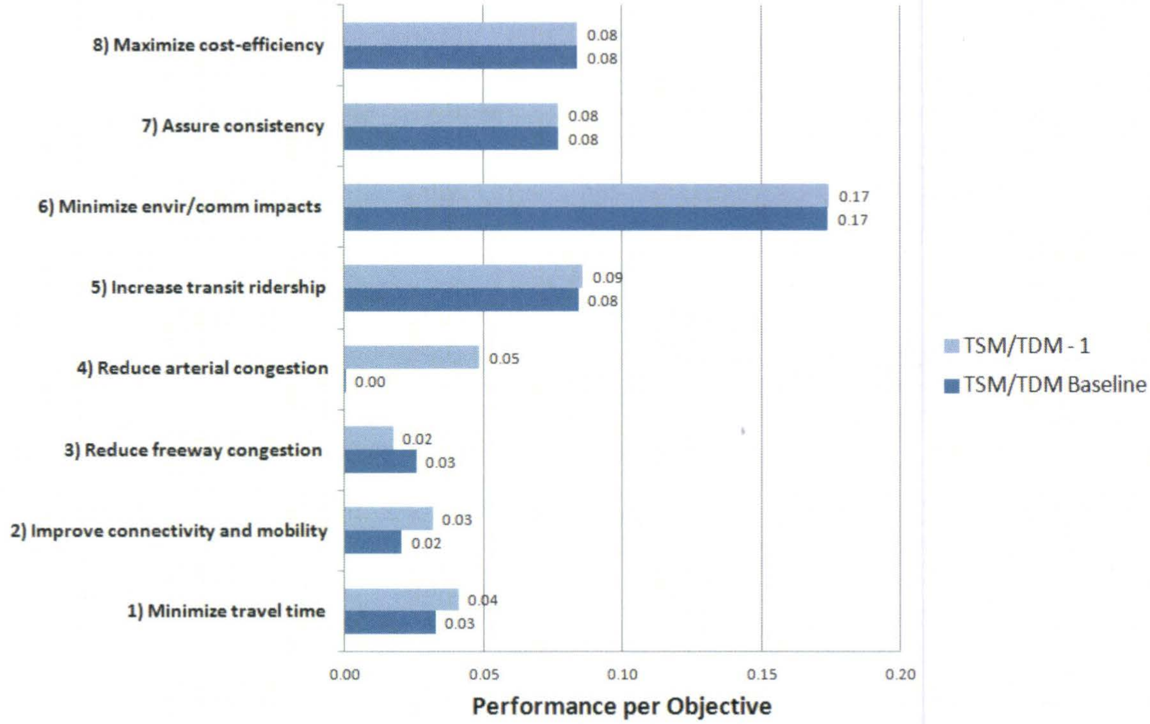
Performance Attributes (Objectives) Evaluation

Objectives	Comment (Influence of the VA Proposal upon the Objective)	Rating: "Improves Performance" or "No Change" or "Reduces Performance"
Minimize Travel Time	The proposal would minimize travel times for HOV 2+ and for transit within the corridor.	Improves performance
Improve Connectivity and Mobility	Mobility will be improved by encouraging carpooling.	Improves performance
Reduce Congestion on Freeway System	This proposal as a TSM/TDM stand-alone alternative would potentially result in increased congestion on the freeway system if existing cut-through traffic switches to freeway options instead of local roads.	Reduces performance
Reduce Congestion on Local Street System	The proposal would reduce congestion by discouraging cut-through traffic on north-south local street corridors.	Improves performance
Increase Transit Ridership	By allowing transit to use restricted lane, transit travel times and reliability would potentially improve, resulting in increased transit ridership.	Improves performance
Minimize Environmental and Community Impacts Related to Transportation	Reducing the number of trips on local streets (by allowing only HOV 2+ during peak hours) will result in better air quality and less noise impacts.	Improves performance
Assure Consistency with Regional Plans and Strategies	Regional plans and strategies promote increasing mobility, reducing congestion, and increasing transit use within the area.	Improves performance
Maximize Cost Efficiency of Public Investments	This proposal increases mobility with minimal implementation and operating costs.	Improves performance

The next step was the performance rating against the objectives with the performance measures within the objectives from the AA. An example of this comparison is below.

Exhibit 4-8

TSM\TDM Comparison of Alternative Performance Ratings per Objective



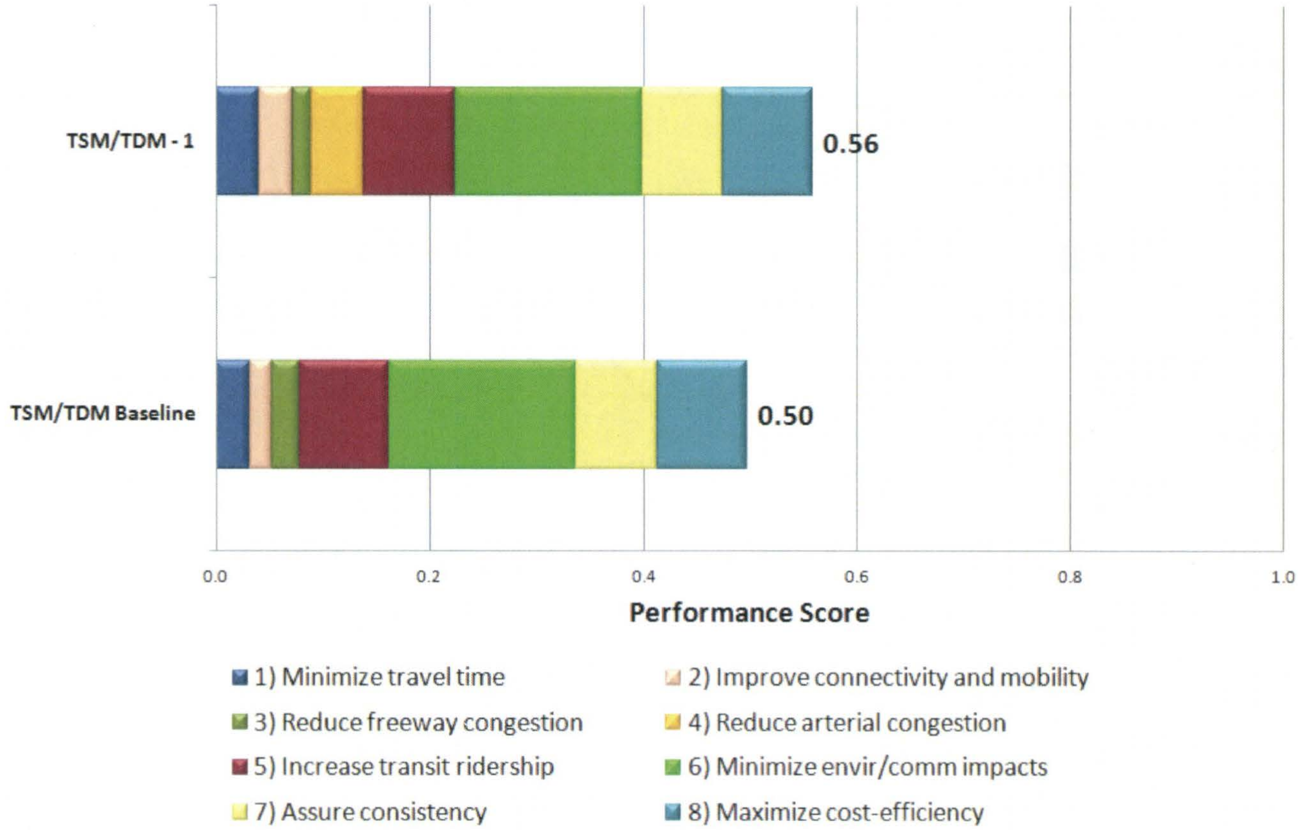
The baseline TSM/TDM Alternative performance was determined as part of the AA. The number and the colored bar that represents that number for each objective is the relative performance of the alternative against the criteria set within the objective. For example, the baseline alternative has a 0.03 performance score for the "Minimize travel time" objective. In comparison, the VA Team, using the same criteria set, rated the performance of the TSM/TDM Proposal No. 1 as slightly better in performance with a relative performance score of 0.04. Note that all of the VA Team performance ratings are subjective. On the other hand, the TSM/TDM Proposal No. 1 performs slightly worse than the baseline in Objective 3, "Reduce freeway congestion." This demonstrates the relative tradeoff of performance of the baseline alternative with the proposed alternative.

Please note that the VA Team had the benefit of the detailed performance ratings of the baseline alternatives, but relied on professional judgment of how the proposed alternatives would perform.

The addition of the individual performance among the eight objectives produces a total relative performance score.

Exhibit 4-9

TSM\TDM Performance Profile of Baseline Alternative and Proposal



For TSM/TDM Proposal No. 1, its total relative performance is slightly better than the baseline. The size of the colored bar represents the performance of each individual objective from the previous graph. The total score at the end of the stacked bar represents the total relative performance.

However, this relative benefit performance calculation is just one view of the proposed alternative. The cost savings or additional cost associated with the proposed alternative should also be taken into consideration. The impression of costs relative to benefit will provide an additional view of trade-offs:

Does the proposal reduce cost AND have the improved performance?

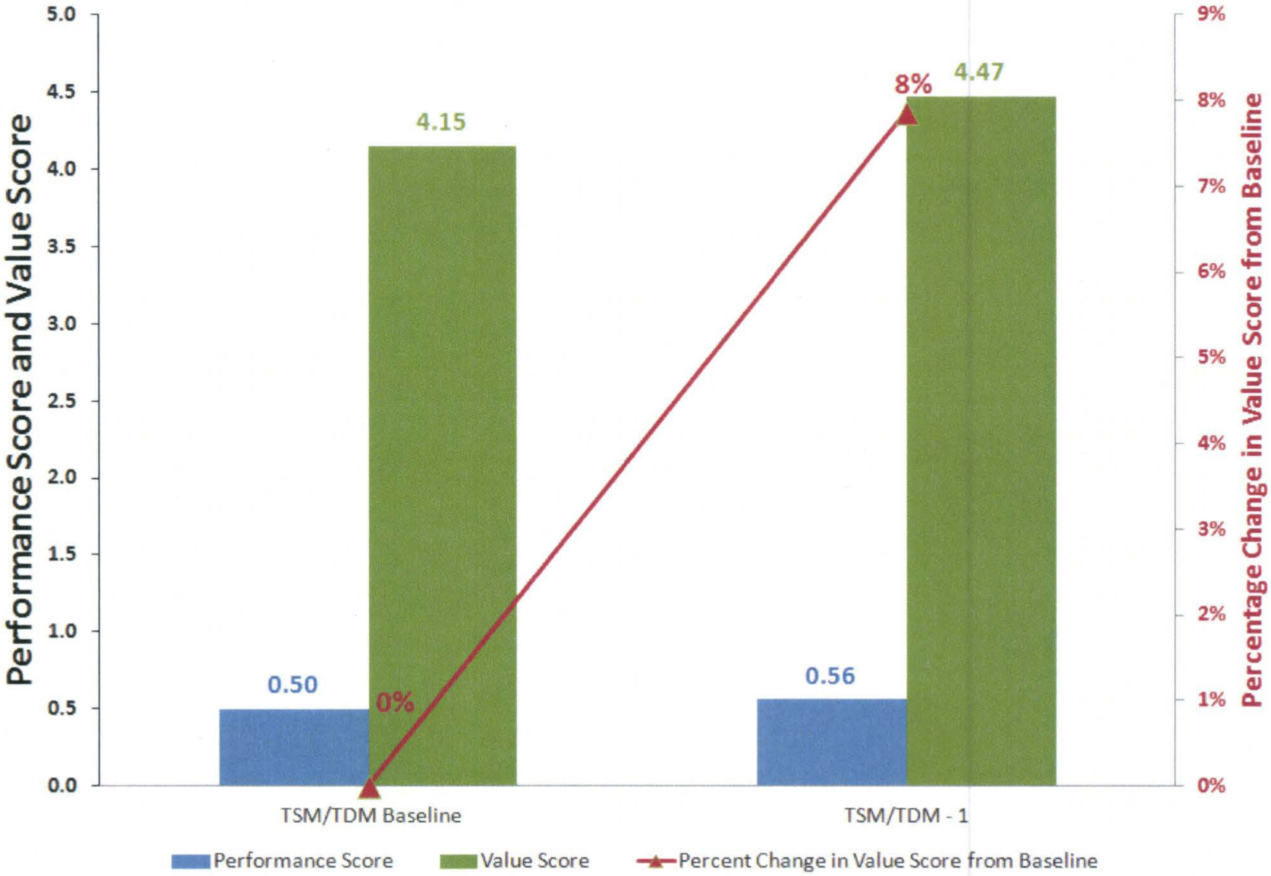
Is the increase in cost offset by an increase in performance?

Is a decrease in performance also offset with a decrease in cost?

The graph below demonstrates the benefit/cost tradeoff.

Exhibit 4-10

TSM/TDM Baseline and Proposal Performance Score and Value Score



The blue bar represents the performance score from the previous graph. The green bar represents the performance score divided by cost ratio – the higher the better. The red points and trend line showcase the increase (or decrease) in the performance/cost ratio, or value score, of the proposal relative to the benefit/cost ratio of the baseline alternative.

All four of these tables/graphs present an impression of performance and tradeoffs associated with the individual VA Team proposals.

VALUE METRICS

The Value Metrics process is an integral part of the Caltrans VA Process. This process provides the cornerstone of the VA process by providing a systematic and structured means of considering the relationship of a project's performance and cost as they relate to value. Project performance must be properly defined and agreed upon by the stakeholders at the beginning of the VA Study. The performance attributes and requirements developed are then used throughout the study to identify, evaluate, and document proposals.

In conjunction with the VA Team, the Project Stakeholders identified and defined the performance attributes and requirements, and then developed a rating scale to measure performance.

Performance requirements represent essential, nondiscretionary aspects of project performance. Performance attributes represent those aspects of a project's scope and schedule that may possess a range of potential values.

The original (baseline) design concept is first evaluated relative to each of the performance attributes based on a 0 to 10 rating scale. A "0" represents performance that is unacceptable while a "10" represents the highest desired level of performance. Typically, a standard comparative scale is used that measures all VA proposals against the baseline design concept. In this case, the baseline concept is rated in the middle of the scale as a "5". Once the attributes have been rated by the PDT, the relative importance of each attribute in meeting the project's purpose and need is determined using the paired comparison method. This process yields relative weightings that are used as modifiers in rating the relative performance of the original design concept.

As the VA Team develops proposals, the performance of each is rated against the original design concept. Changes in performance are always based on the overall impact to the total project. Once performance and cost data have been developed by the VA Team, the net change in value of the VA proposals can be compared to the original design concept. The resulting Value Matrix provides a summary of these changes and allows a way for the PDT to assess the potential impact of the VA proposals on total project value.

The PDT is asked to validate the performance measures and rationale at the Implementation Meeting. The rationale for the numerical rating change for each proposal in each set is developed. The Value Matrix shows the numerical change for each performance measure and proposal set. The Total Performance is calculated by multiplying the attribute weight by the performance rating for each performance measure of either the original concept or VA set.

The following pages summarize the results of the Value Metrics process for this VA Study:

- Performance Requirements
- Performance Attributes and Scales

Defining Performance Requirements

Performance requirements represent essential, nondiscretionary aspects of project performance. Any concept either developed during the project design process or during the course of the VA Study that fails to meet the basic objectives of the project, therefore, cannot be considered as a valid solution. For example, a concept that did not meet a performance requirement for a key project milestone could not be considered further as an acceptable design solution. Concepts that do not meet a performance requirement cannot be considered further in the Value Metrics process unless such shortcomings are addressed through the VA process in the form of VA proposals. It should be noted that in some cases, performance requirements may also represent the minimum acceptable level of a performance attribute. (Performance attributes are discussed in depth in the following section.)

The following performance requirements were selected for this project:

Performance Requirement	Definition
Highway Design Standards	Any deviation from the Caltrans Highway Design Manual (HDM) must be approvable by the District's Design Reviewer.
Structural Design Standards	Any structure on the project must comply with current seismic design standards and meet the Load Resistance Design Factor.
Environmental Review Process	Any concept or design modification considered must comply with state and federal environmental law and be compatible with the environmental review process.
Minimize travel time	This includes point-to-point travel time – vehicular; point-to-point travel time – transit; reduction in VHT; and percentage of travel on managed facilities.
Improve connectivity and mobility	This includes new interchanges/transit connections, jobs reachable within fixed time, transit boardings, arterial volumes, and freeway throughput.
Reduce congestion on freeway system	This includes facility miles operating at LOS F1 or worse, facility miles operating at LOS E or F0, and VMT on congested freeway segments.
Reduce congestion on local street system	This includes percent of intersections with congested approaches, average v/c on arterials, VMT on arterials, arterial cut-through percentage, and north-south travel on arterials.
Increase transit ridership	This includes increase in transit ridership, percent of population and employment within 1/4 mile of transit, and transit mode share.
Minimize environmental and community impacts related to transportation.	This includes property acquisitions, residential or business acquisitions, recreational/community sites impacted, archeological sites impacted, properties over 45 years old impacted, significant historic resources impacted, increase in noise exposure, increase in MSATs, increase in regional criteria pollutants, increase in GHG emissions, hazardous waste sites impacted, visual intrusion in communities, scenic corridors impacted, natural environment areas of high paleontological sensitivity impacted, exposure to adverse geotechnical conditions, sensitive habitats impacted, and drainages impacted.
Assure consistency with regional plans and strategies objective.	This includes consistency with RTP/SCS goals, consistency with Measure R goals, and consistency with Metro LRTP goals.
Maximize the cost-efficiency of public investments	This includes construction and ROW costs, available funding, and technical feasibility.

Defining Performance Attributes and Scales

Prior to beginning the VA Study, the VA Team Leader met with project stakeholders to discuss project performance. The following performance attributes were identified as being of critical importance in meeting the project's purpose and need. The following scales were used to evaluate the performance of the proposal concepts relative to the baseline concept.

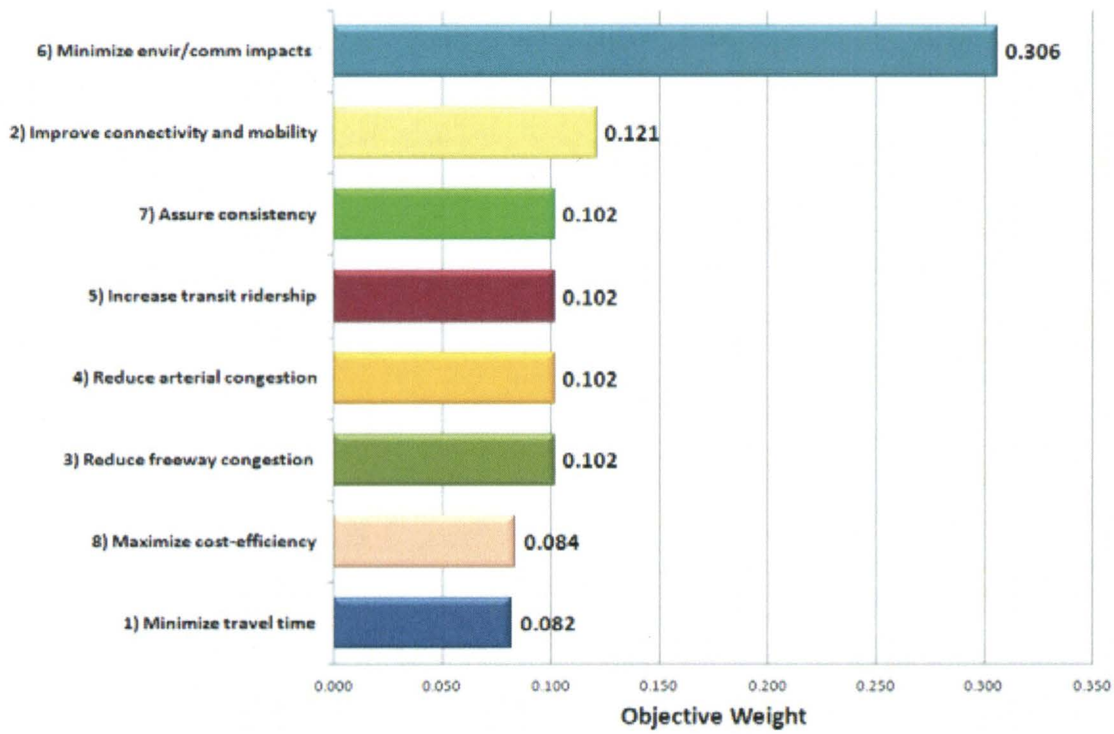
Rating	Minimize Travel Time	Connectivity and Mobility	Freeway Congestion	Arterial Congestion	Transit Ridership	Environmental and Community Impacts	Consistency with Regional Plans and Strategies	Maximize Cost Efficiency of Public Investments
Improves Performance	Proposal concept is preferred. Proposal concept performance improves from baseline concept performance.							
No Change	Baseline concept is equally preferred to baseline concept.							
Reduces Performance	Baseline concept is preferred. Proposal concept performance reduces from baseline concept performance.							

Performance Attribute Prioritization

The team systematically prioritized the performance attributes to determine their relative importance in meeting the purpose and need of the project.

Exhibit 4-11

Objective Weights, Average of all Factor Focus Group Values



Measure Performance of Baseline

The baseline of each mode type was determined first to produce the benchmark from which the proposals were judged. These baseline performance and value scores were generated from the performance ratings of the AA Report.

Exhibit 4-12

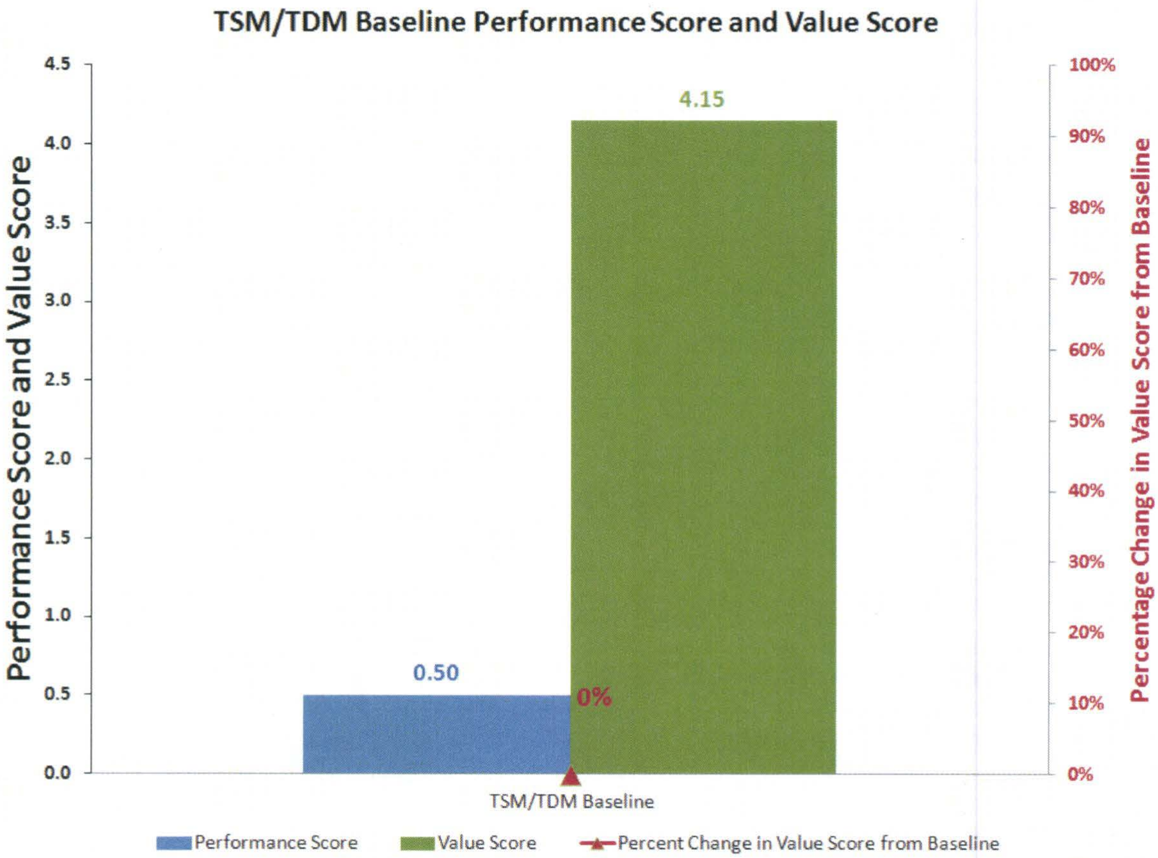


Exhibit 4-13

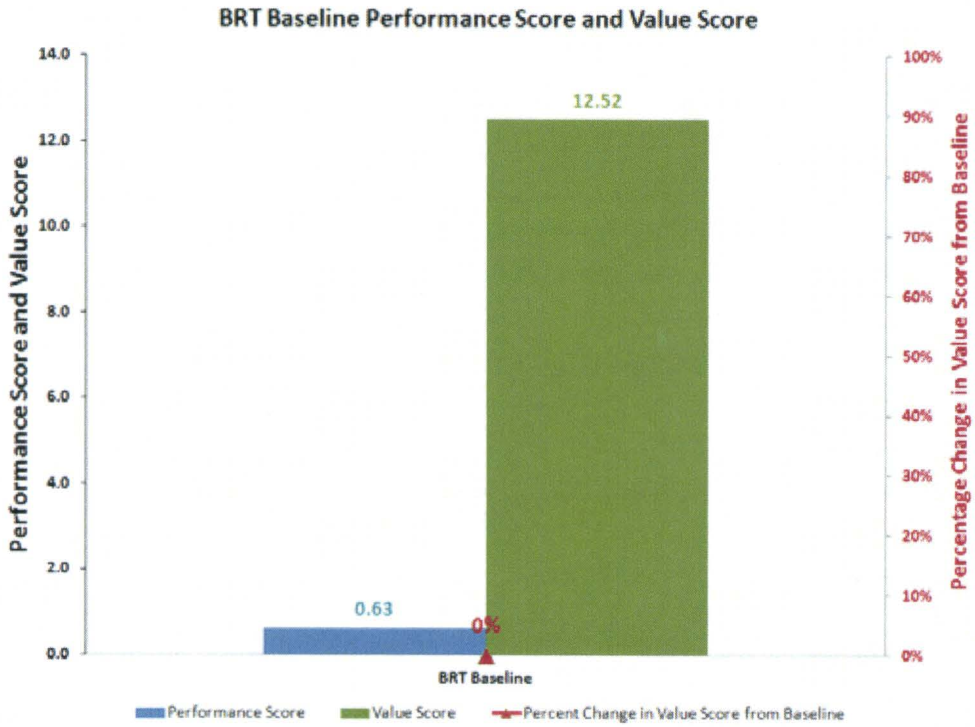


Exhibit 4-14

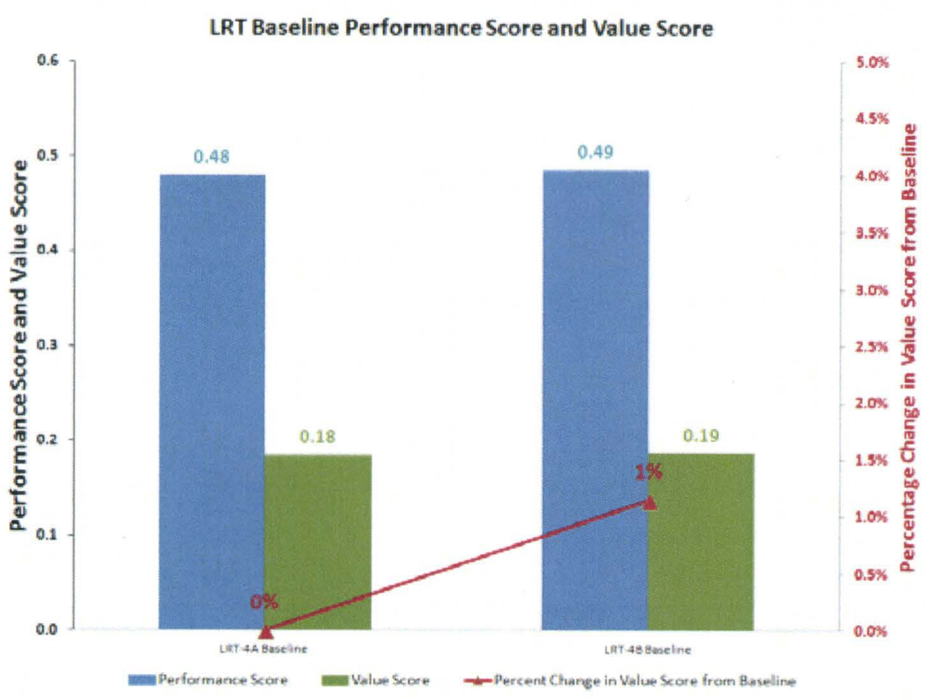
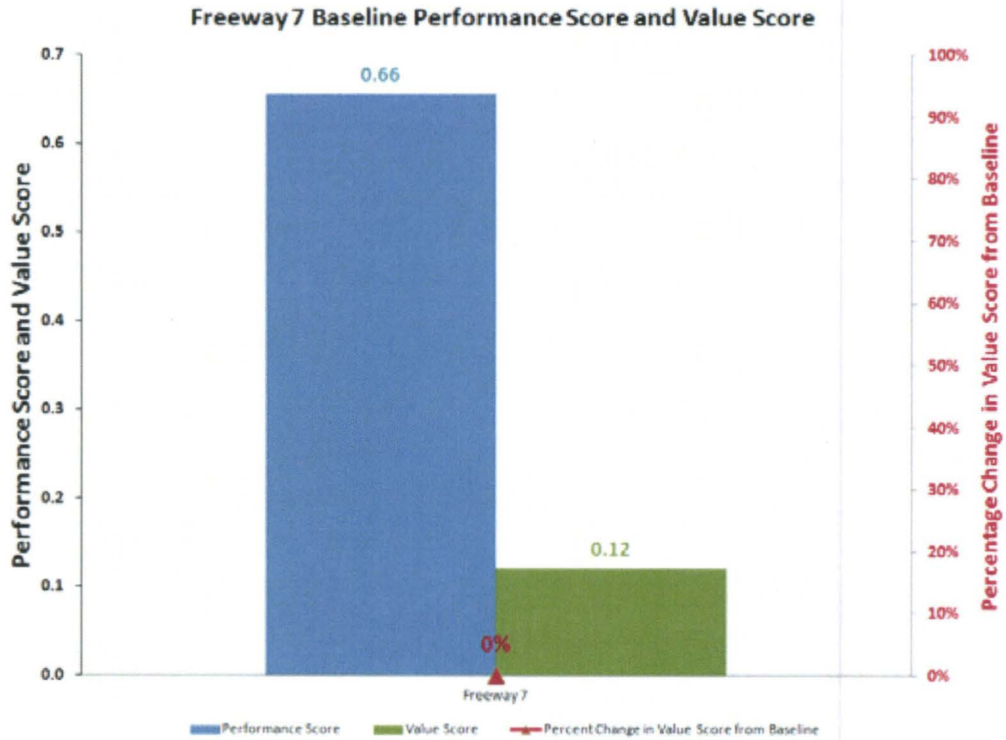


Exhibit 4-15



Measure Performance of Design Options

Design options were not part of this assessment.

Measure Performance of VA Proposals

The performance of the VA proposals is summarized in Table 4-2 below (same as Table 2-1 in Section 2 of this document), and captured in the summary graphics of Exhibits 4-16 to 4-19.

Table 4-2. Summary of VA Proposals

Proposal No. and Description	Initial Cost Savings	LCC Savings	Change in Schedule	Performance Change	Value Change
TSM1. Peak-Direction HOV Lane on Fremont Avenue and Fair Oaks Avenue During Peak Periods	($5,150,000)	(---)	None	+12 %	+8%
BRT1. BRT Enhanced Technology – Guided BRT Operation Combined with Passenger Information System and ITS Technologies	($7,160,000)	(---)	None	+2 %	-12%
BRT2. Multimodal Transportation Centers for BRT Alternative Combined with Single Bored Freeway Tunnel with Managed Lanes (FT1)	($111,000,000)	(---)	Increase	+27 %	-61%
BRT3. Streetcar along Alternative BRT-6A Alignment	$1,700,000,000	(---)	Increase	+24 %, +22 %	+257% +253%
LRT1. LRT-4A Alignment on I-710 Median	$29,400,000	(---)	Decrease	0 %, -1 %	+2%, 0%
LRT2. Valley Boulevard Overcrossing of LRT	$71,000,000	$94,100,000	None	0 %, -1 %	+3%, +2%
LRT3. Terminate LRT-4A Alignment at Gold Line North of Arroyo Seco Parkway	$540,000,000	$660,000,000	(---)	+3 %, +2 %	+30% +29%
LRT4. LRT At-Grade Between Mission Road and Fair Oaks Avenue	$896,000,000	$801,000,000	Decrease	-9 %, -10 %	+38%, +37%

Table 4-2. Summary of VA Proposals

Proposal No. and Description	Initial Cost Savings	LCC Savings	Change in Schedule	Performance Change	Value Change
LRT5. Hybrid LRT-4A/ LRT-6 Alternative to Provide At-Grade LRT Along Atlantic Boulevard	$576,000,000	$215,000,000	None	-13 %, -14 %	+12%, +10%
LRT6. Shortened Tunnel per LRT-4A Alternative – Mission Street Option	$262,000,000	$320,000,000	None	+3 %, +2 %	+15%, +13%
FT1. Single-Bore Tunnel with Demand Constrained by Variable Toll	$2,500,000,000	(---)	Decrease	+15%	+113%
FT2. Car-Only Freeway Tunnel at 46.5-foot ID vs. 52.5-foot ID	$584,000,000	(---)	None	-37 %	-30%
FT3. Raise the Profile at the North Portal by 40 feet, Retaining the Same Cover as the Base Design	$198,000,000	(---)	Decrease	0%	+4%
FT4. Additional SR 710 Access Located at the North Project Terminus	($47,000,000)	(---)	(---)	+30 %	+29%
FT5. Relocate South Portal to North of Mission Road	$369,000,000	(---)	Decrease	-26%	-19%
FT6. Precast Elements for Tunnel Roadway Decks and Interior Walls	$35,700,000	(---)	Decrease	-1%	0%
FT7. Covered Depressed Freeway with a Landscaped Area for "At-Grade Section"	$116,000,000	(---)	None	+3%	+1%

Table 4-2. Summary of VA Proposals

Proposal No. and Description	Initial Cost Savings	LCC Savings	Change in Schedule	Performance Change	Value Change
FT8. Move to PPP Model of Delivery	$1,070,000	(---)	(---)	+33%	+33%
FT9. Utilize "Early Contractor Involvement" Into the Project Delivery Options of the Corridor	$500,000	(---)	(---)	+1%	+1%
FT10. Networkwide Congestion Management by Vehicle Speed Control	($47,900,000)	($1,420,000)	None	+15%	+14%

Note: Because the cost data depicted above represent savings, a number in parentheses represents a cost increase.

Exhibit 4-16

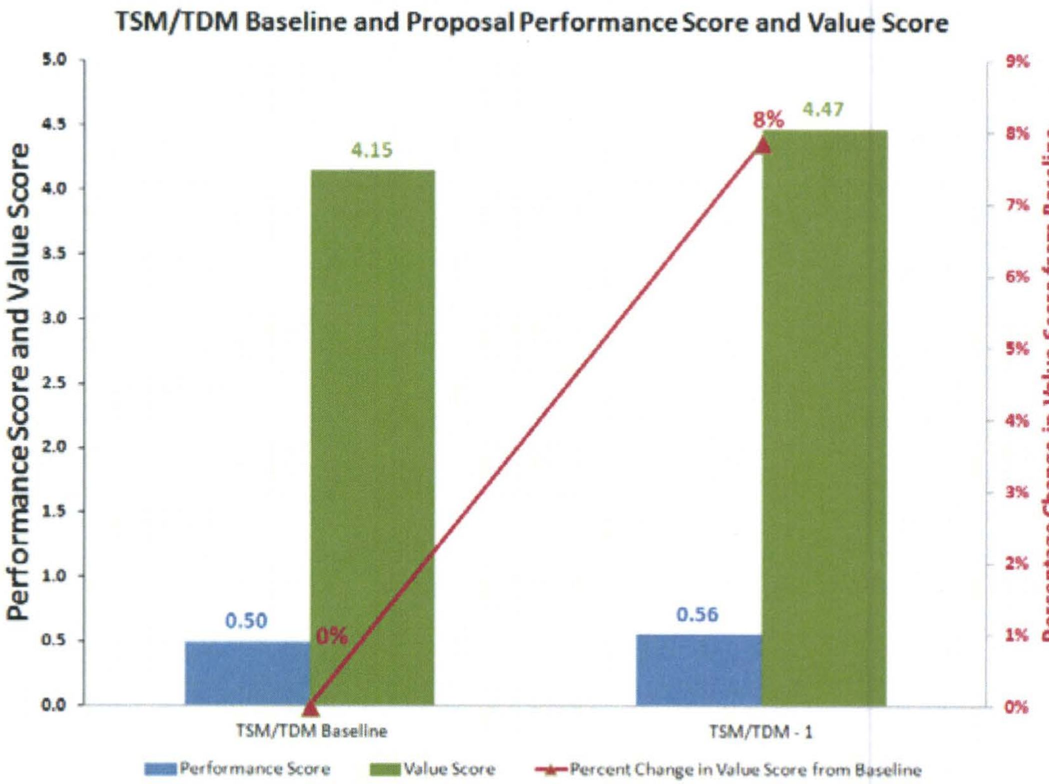


Exhibit 4-17

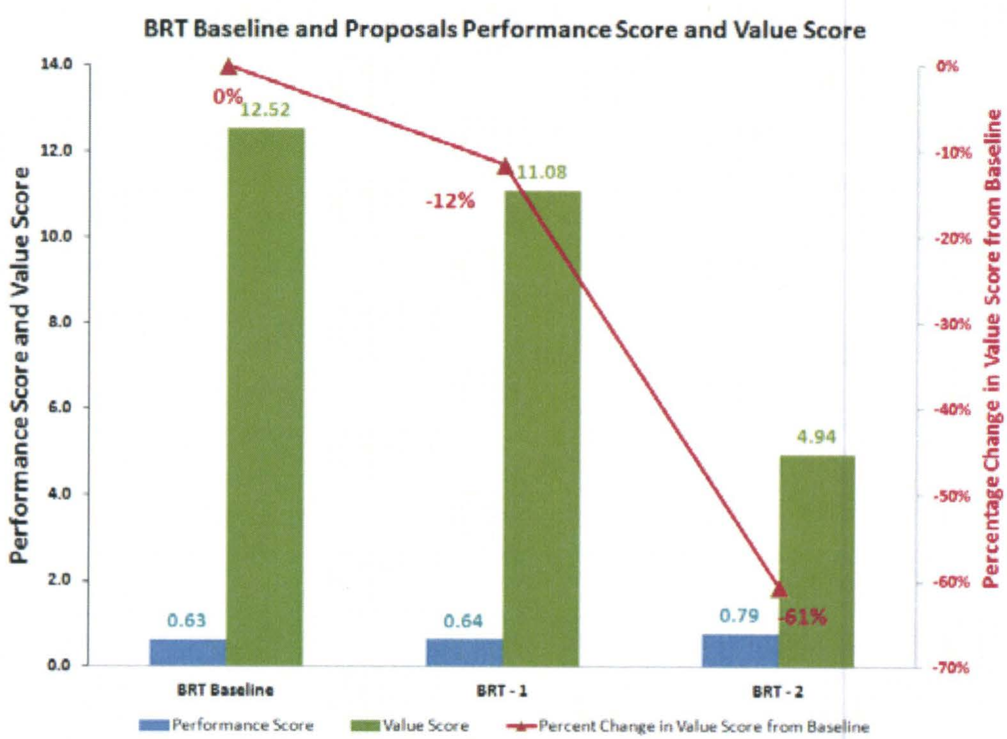


Exhibit 4-18

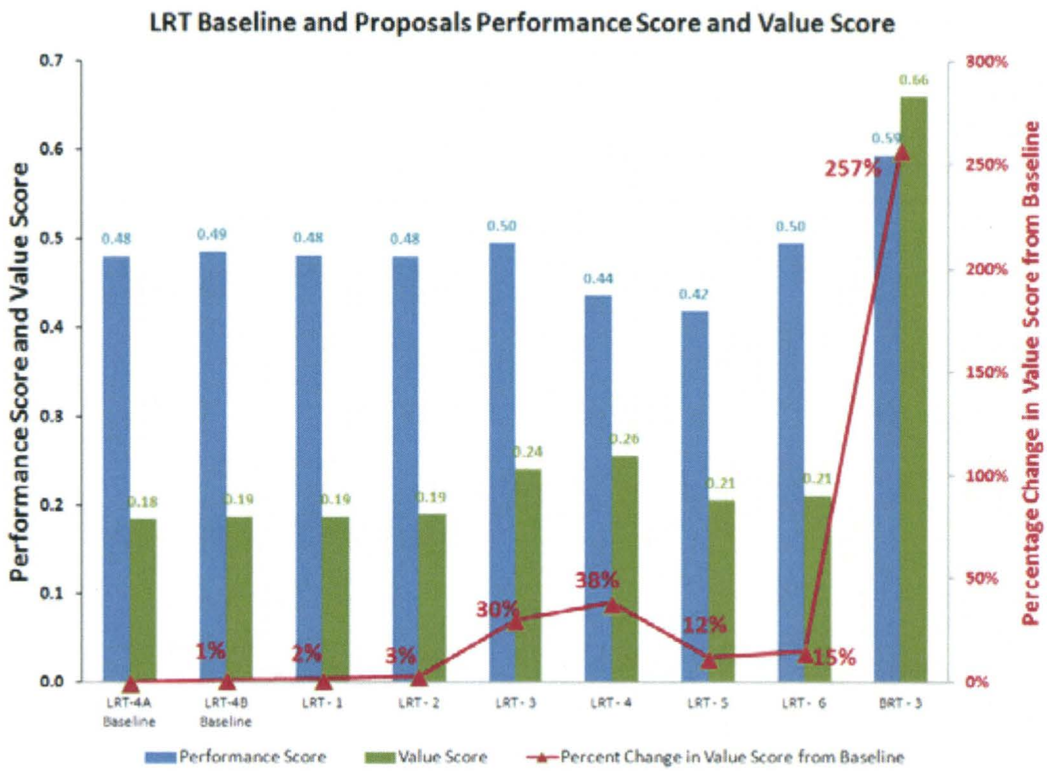
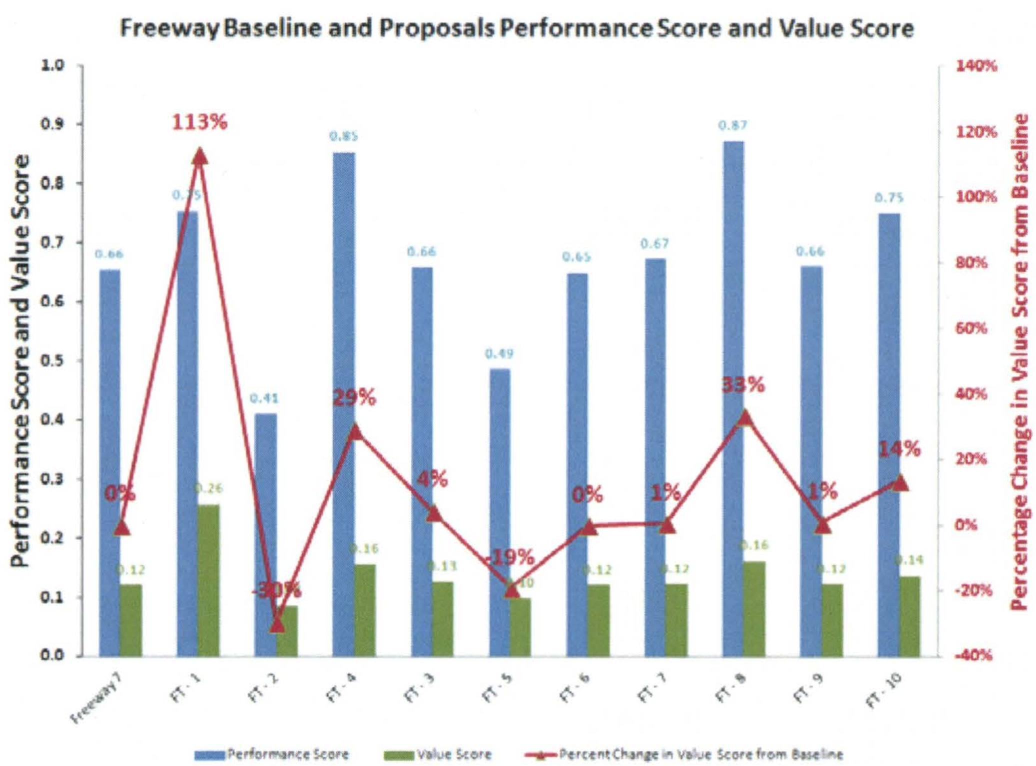


Exhibit 4-19



Define VA Strategies

Strategy Description	Initial Cost Savings	LCC Savings	Change in Schedule	Change in Performance
VA Strategy LRT-S1. LRT-4A Alignment on I-710 Median, Valley Boulevard Overcrossing of LRT, and LRT-4A Alignment Terminus at Gold Line North of SR 110. Proposal Nos. LRT1, LRT2, and LRT3	$640,000,000	$784,000,000	Reduces Schedule	+3 %, +2 %
Recommended VA Strategy VA Strategy FT-S1. Single-Bore Tunnel with Demand Constrained by Variable Toll (FT1) Combined with Car-Only Freeway Tunnel at 46.5-foot Inside Diameter Proposal Nos. FT1 and FT2	$2,788,000,000	$0	Potential Reduction	+19%

Note: Because the cost data depicted above represent savings, a number in parentheses represents a cost increase.

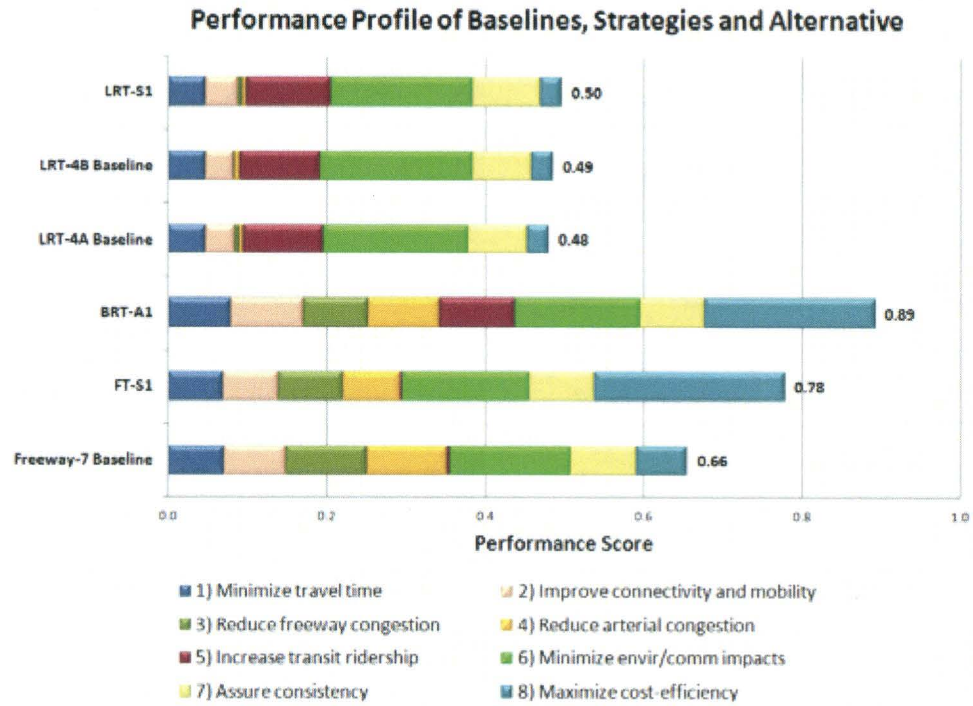
Define VA Design Alternative

Strategy Description	Base Cost	Change in Schedule	Change in Performance
VA Alternative BRT-A1. Addition of BRT with Enhanced Technology to Freeway Tunnel Alternative Proposal Nos. FT1 and BRT-6A	($181,000,000)	None	+36 %

Note: Because the cost data depicted above represent savings, a number in parentheses represents a cost increase.

Comparison of Performance – Baseline Concept, VA Strategies, and VA Alternative

Exhibit 4-20



Rating Rationale for VA Strategies

LRT-S1 – LRT-4A Alignment on I-710 Median, Valley Boulevard Overcrossing of LRT, and LRT-4A Alignment Terminus at Gold Line North of SR 110

Performance Attribute	Rating	Rationale for Rating
Minimize Travel Time	No change	No significant change.
Improve Connectivity and Mobility	No change	No significant change.
Reduce Freeway Congestion	Improves performance	The performance for Strategy LRT-S1 does not show significant change in comparison to LRT-4A baseline, but does show slight improvement in comparison to LRT-4B baseline. The increase of transit ridership would reduce the number of people driving on the freeway.
Reduce Arterial Congestion	No change	No significant change.
Increase Transit Ridership	Improves performance	The performance for this strategy shows slight improvement from the baseline concept. The opportunity for a multimodal transit facility at the north terminal site would increase transit ridership.
Minimize Environmental and Community Impacts	Reduces performance	The performance for this strategy does not show significant change from the LRT-4A baseline, but shows a slight decrease in performance in comparison to the LRT-4B baseline due to the additional ROW acquisition required in LRT2 and LRT3.
Assure Consistency	Improves performance	The performance for this strategy shows slight improvement from the baseline concept. LRT3 eliminates duplicative South Pasadena Station.
Maximize Cost-Efficiency	No change	No significant change.

FT-S1 – Single-Bore Tunnel with Demand Constrained by Variable Toll (FT1) Combined with Car-Only Freeway Tunnel at 45.5-foot Inside Diameter

Performance Attribute	Rating	Rationale for Rating
Minimize Travel Time	No change	No significant change.
Improve Connectivity and Mobility	Reduces performance	The performance for this strategy shows slight reduction in performance from the baseline concept. For drivers who pay toll, objective will be met. Trucks and drivers who do not pay toll will still face greater travel times.
Reduce Freeway Congestion	Improves performance	The performance for this strategy shows slight improvement from the baseline concept. This strategy proportionally reduces freeway congestion, but does not improve truck congestion.
Reduce Arterial Congestion	Reduces performance	The performance for this strategy shows slight reduction in performance from the baseline concept. Objective will be met for passenger vehicles that pay toll, but will not be met for trucks and vehicles that do not pay toll.
Increase Transit Ridership	No change	No significant change.
Minimize Environmental and Community Impacts	Improves performance	The performance for this strategy shows slight improvement through transit subsidy from tolls. This strategy reduces construction air quality emissions, but slightly increases long-term emissions. Trucks remain on existing routes. Imposition of tolls could lead to environmental justice concerns; higher tolls could mean additional concerns.
Assure Consistency	No change	No significant change.
Maximize Cost-Efficiency	Improves performance	The performance for this strategy shows major improvement from the baseline concept. Highly efficient as high-value customers are captured at a premium price.

BRT-A1 – Addition of BRT with Enhanced Technology to Freeway Tunnel Alternative

Performance Attribute	Rating	Rationale for Rating
Minimize Travel Time	Improves performance	The performance for this strategy shows slight improvement. Advance technologies reduce dwell time and speeds travel through signalized intersections, resulting in shorter travel times.
Improve Connectivity and Mobility	Improves performance	The performance for this strategy shows slight improvement. Addition of BRT provides additional mobility and connectivity opportunities.
Reduce Freeway Congestion	Reduces performance	This strategy provides a slight decrease in performance from the baseline concept.
Reduce Arterial Congestion	Reduces performance	This strategy provides a slight decrease in performance from the baseline concept. Provision of traffic signal priority could impact mixed-flow operations at signalized intersections.
Increase Transit Ridership	Improves performance	This alternative provides a slight increase in performance compared to the baseline concept. The system becomes more reliable, faster, thus potentially attracting higher ridership.
Minimize Environmental and Community Impacts	Improves performance	This alternative provides a slight increase in performance compared to the baseline concept. Increased transit ridership would improve air quality and reduce noise impacts from single-occupancy vehicles.
Assure Consistency	No change	No significant change.
Maximize Cost-Efficiency	Improves performance	This alternative provides a major increase in performance compared to the baseline concept. The advanced technologies increase mobility with minimal implementation and operating costs.

Compare Value

Table 4-3 shows the cost and value score comparison of the VA strategies, the VA alternative, and their respective baseline alternatives in equal measure. The value score is the reflection of how well the individual alternative performs; the higher the number, the better performing it is relative to the compilation of the criteria. For example, BRT-A1 has a value score of 0.30 relative to the Freeway-7 baseline value score of 0.12.

Table 4-3. Comparison of Value Score

Strategies	Cost	Value Score
F-7 Baseline	$5.4 billion	0.12
BRT-A1	$181 million	0.30
FT-S1	$2.8 billion	0.33
LRT-4A Baseline	$2.6 billion	0.18
LRT-4B Baseline	$2.4 billion	0.19
LRT-S1	$640 million	0.25

Value Matrix

The following Value Matrix permits comparison of the two competing strategies and the new alternative by organizing the data developed for the performance attributes into a matrix format in order to yield value indices. The matrix is essential for understanding the relationship of cost, performance, and value of the project baseline and VA concepts.

Exhibit 4-21

Comparison of Strategies and Alternative Performance Ratings per Objective

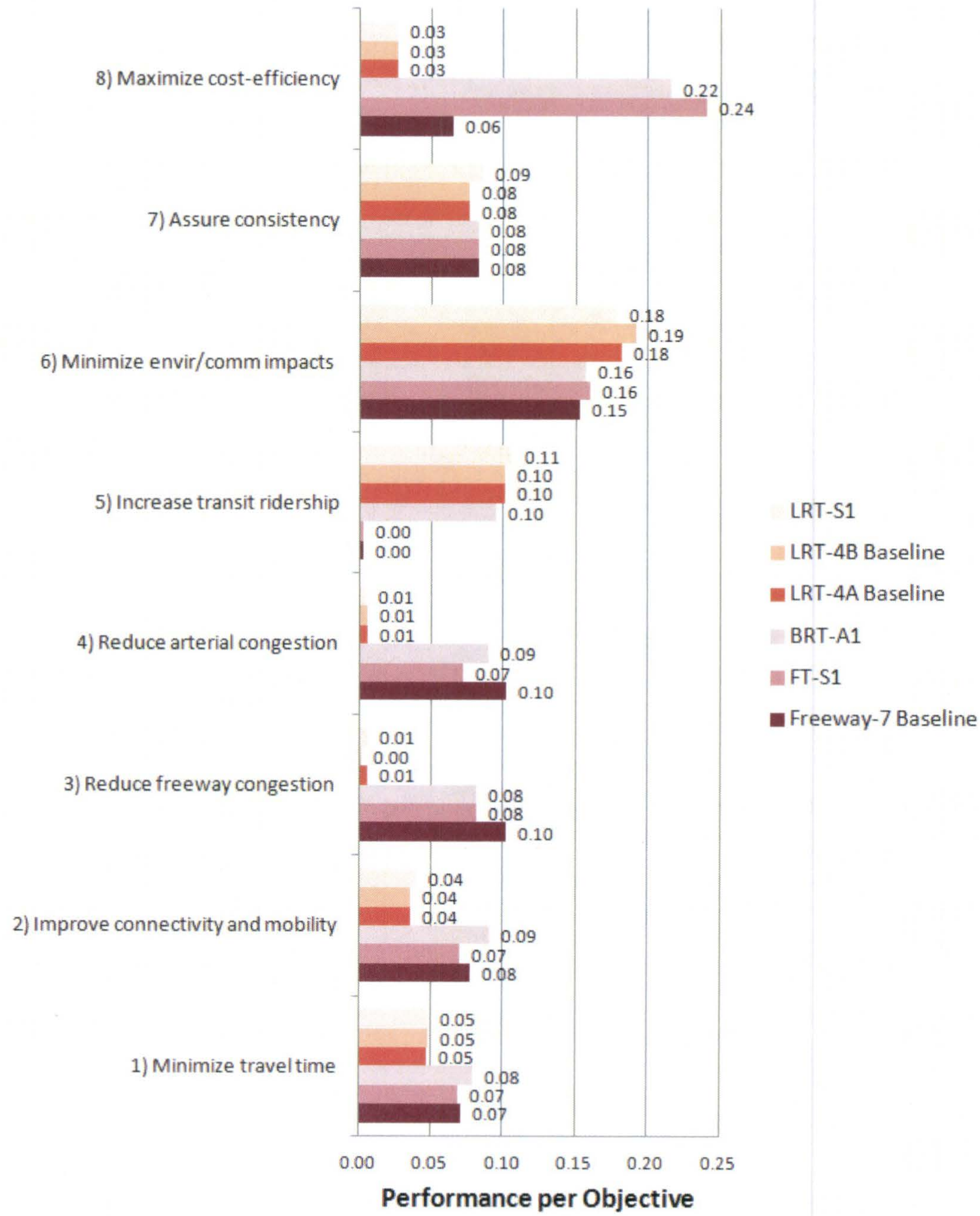
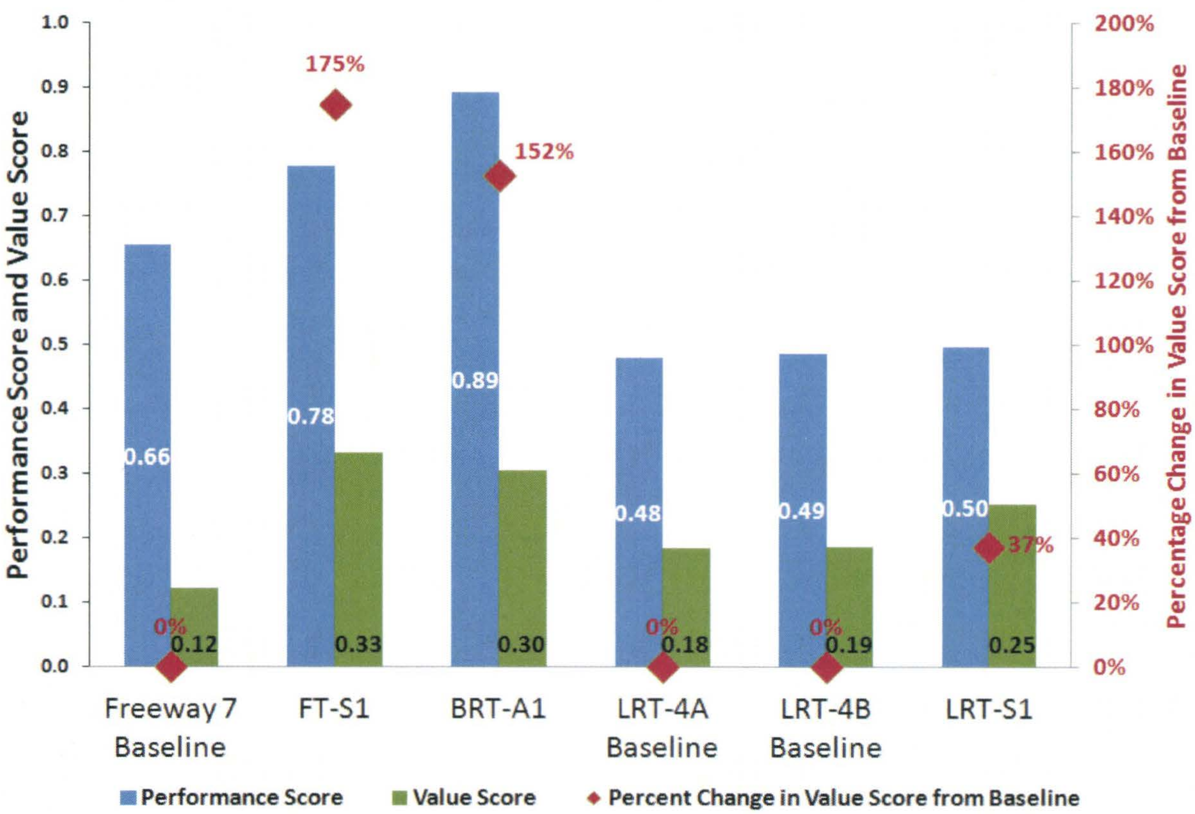


Table 4-4. Value Matrix

Concept	Performance Score	Change in Performance	Value Score (P/C)	Change in Value
F-7 Baseline	0.66	(---)	0.12	(---)
BRT-A1	0.89	+36%	0.30	+152%
FT-S1	0.78	+19%	0.33	-175%
LRT-4A Baseline	0.48	(---)	0.18	(---)
LRT-4B Baseline	0.49	(---)	0.19	(---)
LRT-S1	0.50	+3%, +2%	0.25	+37%, +36%

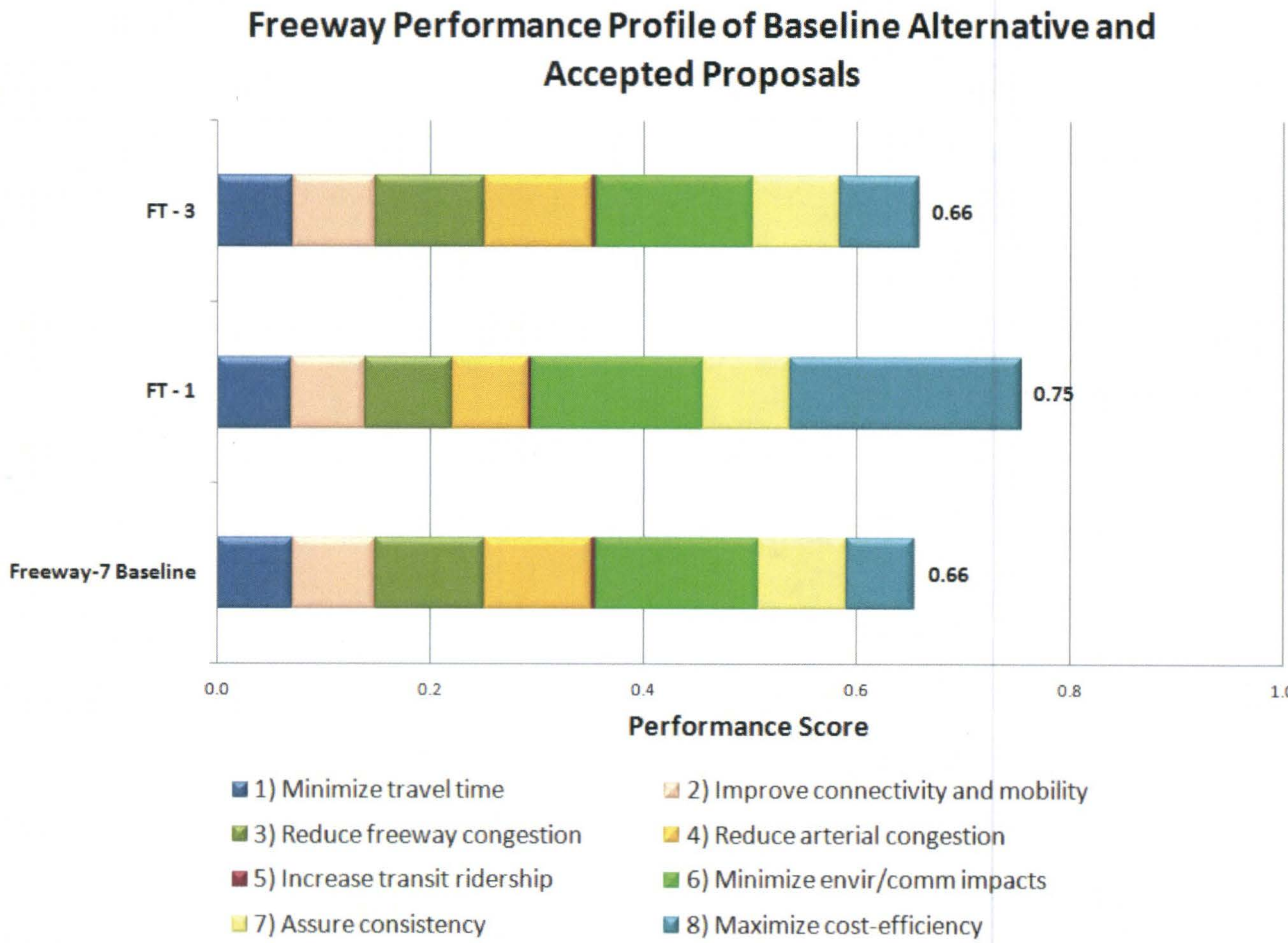
Exhibit 4-22

Strategies and Alternatives Performance Score and Value Score



Comparison of Performance – Baseline Concept and Accepted VA Proposals

Exhibit 4-23



Rating Rationale for Accepted VA Proposals

FT1 – Single-Bore Tunnel with Demand Constrained by Variable Toll

Performance Attribute	Rating	Rationale for Rating
Minimize Travel Time	No change	No significant change.
Improve Connectivity and Mobility	Reduces performance	The performance for this proposal shows a slight reduction in performance from the baseline concept. For drivers who pay a toll, the objective will be met. Trucks and drivers who do not pay a toll will still face greater travel times.
Reduce Freeway Congestion	Reduces performance	The performance for this proposal shows a slight reduction from the baseline concept. This proposal proportionally reduces freeway congestion, but does not improve truck congestion.
Reduce Arterial Congestion	Reduces performance	The performance for this proposal shows a slight reduction in performance from the baseline concept. The objective will be met for passenger vehicles that pay a toll, but will not be met for trucks and vehicles that do not pay a toll.
Increase Transit Ridership	No change	No significant change.
Minimize Environmental and Community Impacts	Improves performance	The performance for this proposal shows a slight improvement through transit subsidy from tolls. This proposal reduces construction air quality emissions, but slightly increases long-term emissions. Trucks remain on existing routes. Imposition of tolls could lead to environmental justice concerns; higher tolls could mean additional concerns.
Assure Consistency	No change	No significant change.
Maximize Cost-Efficiency	Improves performance	The performance for this proposal shows a major improvement from the baseline concept. It is highly efficient as high-value customers are captured at a premium price.

FT-3 – Raise the Profile at the North Portal by 40 feet Retaining the Same Cover as the Base Design

Performance Attribute	Rating	Rationale for Rating
Minimize Travel Time	No change	No significant change.
Improve Connectivity and Mobility	No change	No significant change.
Reduce Freeway Congestion	No change	No significant change.
Reduce Arterial Congestion	No change	No significant change.
Increase Transit Ridership	No change	No significant change.
Minimize Environmental and Community Impacts	No change	No significant change.
Assure Consistency	No change	No significant change.
Maximize Cost-Efficiency	Improves performance	The performance for this proposal shows a slight improvement from the baseline concept due to the reduction in construction costs.

Compare Value

Table 4-5 shows the cost and value score comparison of the Accepted VA Proposals.

Table 4-5. Comparison of Value Score

Strategies	Cost	Score
F-7 Baseline	$5.4 billion	0.12
FT1	$2.9 billion	0.26
FT3	$5.2 billion	0.13

Value Matrix

The following Value Matrix permits comparison of the two accepted proposals by organizing the data developed for the performance attributes into a matrix format in order to yield value indices. The matrix is essential for understanding the relationship of cost, performance, and value of the project baseline and VA concepts.

Exhibit 4-24

Freeway Comparison of Alternative Performance Ratings per Objective for Accepted Proprosals

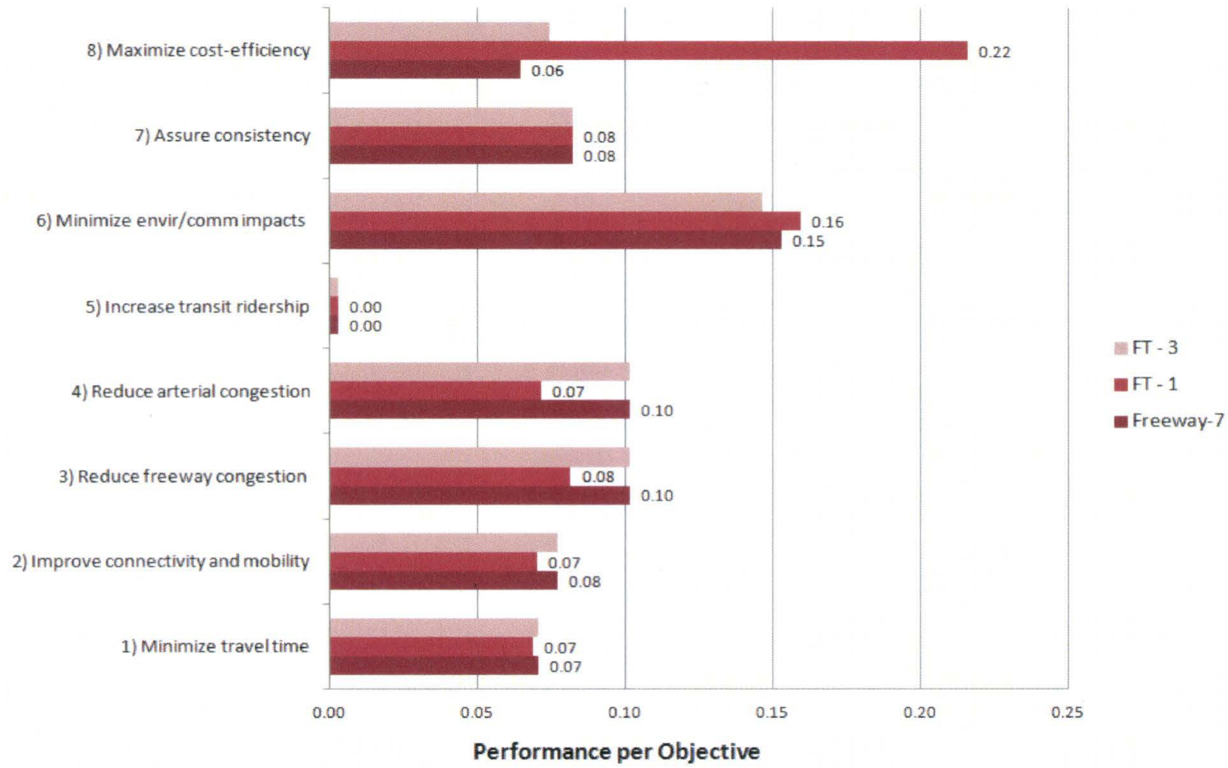


Table 4-6. Value Matrix

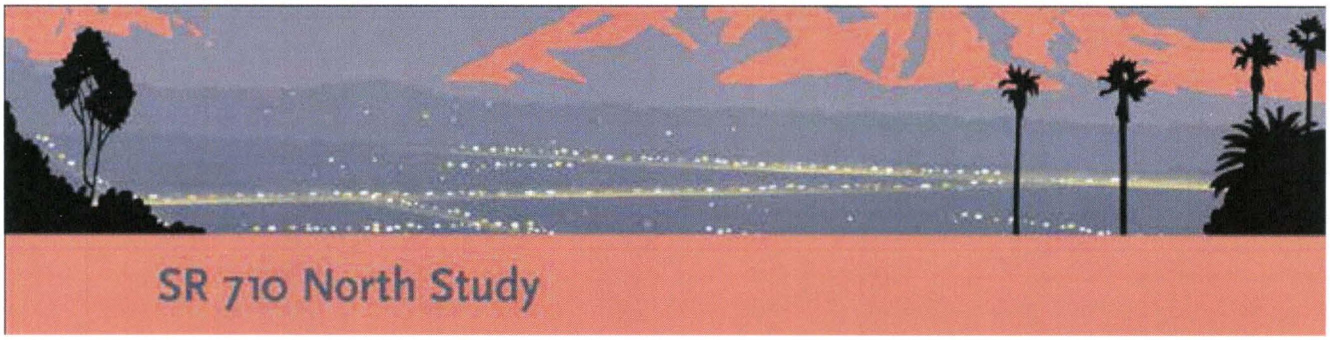
Concept	Performance Score	Change in Performance	Value Score (P/C)	Change in Value
F-7 Baseline	0.66	(---)	0.12	(---)
FT1	0.75	+15%	0.26	+113%
FT3	0.66	0%	0.13	+4%

RISK ANALYSIS

A risk analysis was not performed because it was outside the scope of this VA Study.

Idea Evaluation

TBG041613043123SCO



Idea Evaluation

5. IDEA EVALUATION

PERFORMANCE ATTRIBUTES

The following key performance attributes for this project were used to assist the VA Team in evaluating the ideas:

1. Minimize travel time.
2. Improve connectivity and mobility.
3. Reduce freeway congestion.
4. Reduce arterial congestion.
5. Increase transit ridership.
6. Minimize environmental and community impacts related to transportation.
7. Assure consistency with regional plans and strategies.
8. Maximize the cost-efficiency of public investments.

EVALUATION PROCESS

The VA Team, as a group, generated and evaluated ideas on how to perform the various functions. The idea list was grouped by function or major project element. The VA Team, as a group, evaluates each idea with respect to the functional requirements of the project. Each idea is evaluated against specific criteria established by the VA Team and stakeholders. Advantages and disadvantages of each idea are recorded. The potential impact on project cost is established last, and a relative impact noted.

IDEA EVALUATION TABLE

All of the ideas generated during the creative phase using brainstorming techniques were recorded on the Idea Evaluation Table (see Table 5-1, included at the end of this section). These ideas were discussed with Metro, Caltrans, and the Design Team during the middle of the first week of the VA Study to determine which ideas should be pursued by the VA Team and which should be failed.

LRT, BRT, TSM, TDM Group – Team Focus Questions and Answers

1. **What is the problem we are about to discuss?**
    a. Lack of regional north-south connections.
    b. High levels of congestion on surface streets and freeways in the study area.
    c. Inadequate regional transit service.
    d. Availability of funding and color of money.
    e. Highly developed, urban area with historic features/buildings and strong community identity.
    f. High level of public awareness of the project and historic alternatives.

2. **Why do we consider this a problem?**
    a. Concentration of urban environment at the north and south ends of the study area.
    b. Congestion results in increased costs in dollar and travel time for individuals and businesses. Also results in more pollution and a degradation of the quality of life.
    c. Dense populated areas within and outside study area that would benefit from regional transit connections. Provide an alternative to driving alone.
    d. Options can be limited by available funding. Given constraints, range of solutions can be high cost. Dollars available for freeways cannot necessarily be used for other modes.
    e. Limits options for alternatives and introduces concerns such as ROW constraints.
    f. There will be a high level of public scrutiny on potential impacts from all options.
3. **Why do we believe a solution is necessary?**
    a. Results in cut-through traffic on local arterials and streets, further exacerbating the local congestion.
    b. Improve quality of life and environmental impacts, such as air quality.
    c. Providing more transit options would assist in relieving congestion and would provide mobility options to residents. Potential transit-dependent population would have greater access to jobs.
    d. Funding needed to build project. With time, this issue can increase.
    e. Awareness that the most effective solutions will minimize ROW impacts.
    f. Consensus needed to implement project.
4. **What are the highest cost components of the project?**
    a. TSM/TDM would require significant ROW take.
    b. LRT, BRT, and FT Alternatives' cost is mostly driven by construction rather than ROW.
5. **What are the highest risk issues associated with the project?**
    a. Funding availability.
    b. Color of money (source of funding and what it can be used for).
    c. Community opposition.
    d. Consistent political support.
    e. Technology being used for tunnel bores.
    f. Actual traffic levels and ridership lower than projected.
    g. Achieving potential revenue goals.
    h. Construction costs higher than anticipated.
    i. ROW impacts identified during design phase are greater than anticipated.
6. **What are the expected outcomes from the VA Study?**
    a. Explore cost-effective solutions within each alternative that would deliver the project function.
    b. Combinations of alternatives that have not been developed before.

7. **What options are available to build up the existing alternatives and/or reduce their limitations as outlined in the AA?**
    a. Include managed lanes, and reduce freeway tunnels to one. Could be a phased approach to implementing a second tunnel in the future.
    b. Include managed lanes without reducing the capacity of the alternative.
    c. Incorporating TSM/TDM Alternative with other alternatives.
    d. Include transit options with the Freeway Tunnel Alternative.
    e. Street car option could allow surface street operation and use of the BRT alignment, which would result in higher transit ridership. Would be a lower cost option, not requiring a tunnel.
    f. Freeway north portal, cut-and-cover area could offer an opportunity.
    g. Multimodal center near north freeway portal, and future LRT/BRT station. Would allow use of multiple mode and options that can vary by day. Can carpool using the managed lanes or use transit. Could vary by direction of travel.
    h. Reduce amount of tunneling for freeway.
    i. Are there portions of the highway alternatives that can be combined with other alternatives, without significant ROW impacts?
    j. Review exclusive BRT lanes. Can some be reduced and result in cost savings, without impacting ridership?
    k. Assuming regional through trips are addressed in another part of the ultimate alternative, can reduce mixed-flow capacity on selected arterials and provide this capacity to additional BRT exclusive lanes. Would provide transit options and reduce costs due to ROW and streetscape/landscaping.
    l. Focus on improvements that would increase transit ridership.
        i. Such as a park-and-ride near I-10, if there is travel demand from south to north. Need to know if there is travel demand in this direction with destinations that would be served in the study area.
        ii. Make sure light rail option is safe and secure, attractive to new riders.
    m. Look for opportunities for community input and community improvements. Where they can claim ownership for the project and have a vested interest.
        i. North freeway portal/ cut-and-cover area. Could be an open space/ recreation space/ development area. Connect neighborhoods on both sides of the existing freeway. Let public have input on priorities and design.
        ii. Ability to have local residents purchase Caltrans-owned properties that they currently occupy.
    n. Build up existing transit alternatives by encouraging TODs. Maintain visibility of LRT/BRT station.

Freeway Tunnel Group Problem Statements

1. **What is the problem?**
   a. A significant lack of mobility involving "All-Modes" coupled with urban congestion throughout a regional area.
   b. Highway system connectivity is missing and this increases local street bypass traffic.
   c. Multiple adverse impacts to the communities caused by construction.
   d. Finance feasibility of the project related to the tunneling alternative (Whole-Life cost). Including the costs associated with the capital investments of the TBMs, removal of tunnel excavation materials, tunnel ventilation, air quality, and long-term maintenance.
   e. Is the method proposed for the tunnel construction the most feasible means?
   f. Numerous potential project show-stoppers for a Freeway Tunnel Alternative.
   g. The freeway dual-tunnel is driving the costs of the project that may ultimately make the project unattainable.
   h. The unknown timeframe of the project and the effects of changes in environmental policy, laws, regulations, legislation, and political views; in addition to engineering and construction technologies coupled with advances in transportation modes.
   i. Seismic considerations for the freeway tunnel and the know faults in the project vicinity.
   j. Addressing the aspects of life-safety of the Freeway Tunnel Alternative.

2. **Why do we consider this a problem?**
   a. Overall regional congestion adversely impacting travel times, urban congestion, safety, and environmental elements, such as air quality.
   b. The lack of connectivity between freeways increases urban congestion by promoting cut-through traffic.
   c. Issues related to construction noise, air quality, and the effects of disposing the excess tunnel material will be a problem.
   d. The ability for the project to actually be attainable from a funding standpoint. If the costs are out of line, then both public and private funding mechanisms may not be attainable and would be a show-stopper for the project. The unique items related to the tunnel can make significant cost swings in the overall project total.
   e. The capital investment in the TBMs is a significant part of the project costs. Could a cut-and-cover option be just as feasible even with the additional impacts to ROW? Could a more traditional method tunnel excavation be utilized recognizing the difference in schedules between the two methods?
   f. The complexity of the project both from an environmental, public, political, financial feasibility, and other initial project development elements could cause show-stoppers that would kill the project.
   g. A key challenge with the project will be the financial feasibility; alternatives that are viewed as unattainable could create a show-stopper both from a political and public standpoint.

h. The unknown project timeframe makes addressing changes in environmental policy, laws, regulations, legislation, and political views a very high risk item that could be a potential show-stopper, major delay, or setback, or increase overall costs. The unknown timeframe affects planning for the most viable technologies to develop the project along with the ultimate uses.
i. Seismic considerations and the known fault would increase projects risks resulting in increased costs and safety concerns.
j. Addressing the life-safety for the freeway tunnel based on regulations including appropriate fire and rescue measures coupled with the overall public perception would be a key consideration affecting initial capital investment and long-term maintenance expenditures.

3. **Why do we believe a solution is necessary?**
   a. The problem will only get worse and degrade the overall area.
   b. Need to minimize cut-through movements.
   c. Construction impacts provide one more opportunity for outside groups to object to the project and that could pose delays or stoppage.
   d. An attainable project budget will help in promoting the feasibility to complete the project. The ability to identify funding methods both public and private is vital.
   e. To provide backup for justification of tunneling construction methods and comparison of the relative differences in costs, ROW, and environmental impacts.
   f. The upfront planning of the Project Development is essential for moving the project forward and avoiding show-stoppers including planning for legislation, revenue streams, political support, and minimizing effects as viewed by the public.
   g. The Freeway Tunnel Alternative should consider a single-tunnel option to potentially provide a more financial viability option.
   h. A better-defined project timeframe allows for better planning and designing for known environmental policy, laws, regulations, legislation, and political views with a goal of reducing the risks of these items creating a show-stopper, major delays, or setbacks ultimately increasing overall costs.
   i. The seismic consideration should be addressed to better quantify the risks and define appropriate solutions.
   j. The infrastructure necessary for life-safety will be a key driver in the size of the freeway tunnel and other appurtenances affecting the overall capital investment and LCC of the alternative.

4. **What are the highest risks issues associated with the project?**

For the Freeway Tunnel Alternatives, the high-risk issues identified were broken into four development phases of the project as listed below. Each phase has a number of potential risks that may occur during this process.

5. **Potential risks associated with the initial Project Development (PA/ED):**
    a. Environmental (State Historic Preservation Office [SHPO]) – Potential stoppage or major delays in the project related to the environmental process especially related to SHPO.
    b. NEPA Legal Sufficiency – Potential show-stopper if legal sufficiency cannot be achieved through the environmental documentation process. This project will be highly contested and significant legal challenges are anticipated.
    c. Fiscally Attainable Solution (Project Costing + Funding) – Potential show-stopper if viable funding sources are not defined as part of the project development.
    d. Defining Funding Sources (Federal, State, PPP) – Confirmation that these potential funding sources are viable and achievable as part of the initial development.
    e. Legislation (Plus or Minus) – The current political climate is in opposition of the project. Potential future legislation could be proposed to stop the project or cause major delays.
    f. No Champion for the Project – Without a champion from the community, business, or other private industry, gaining positive political support would be difficult.
    g. Permitting with a Variety of Municipalities – Allows opportunities for municipalities to influence their objectives that may be opposite of the project.
    h. Delivery Method Selection (DBB, DB, PPP) – An unknown delivery method will hamper the effectiveness of planning the project, thereby affecting schedule and development costs.
    i. Staging Area and Addition of ROW for Construction Activities.

6. **Potential risks associated with development of the design (PS&E):**
    a. Geotechnical Data (major work task) – Being able to better quantify geological conditions either lessens or increases risks to the owner and contractors.
    b. Utilities (portal areas) – Based on the current portal locations, this should be a minimal risk item but still needs to be addressed.
    c. Permitting – Local agencies could still delay the project through restrictive permitting processes.
    d. Hazardous Materials – potential where the cut-and-cover tunnels are located.
    e. ROW and Easements (securing the underground easement) – This still may require going through condemnation on multiple properties to go through the easement process.
    f. Changes to Regulations during the Progression of the Work (FLS and other code changes) – These changes add risks to increase costs and potential delays.
    g. Terrorism Considerations for Safety – Potential to increase risks and costs associated with emergency response to such an event.
    h. Potential Contract Packaging (Multiple Projects) – There could be either opportunities or risks associated with having one large project or breaking the project into packages.

7. **Advertising (Bidders)**
    a. Qualified Bidders – International Contractors – Attracting Firms – The ability to attract qualified firms and to develop a creative bidding environment is a risk due to the size and nature of the project combined with the high-profile controversial nature of the project.

b. Global Considerations will be involved from a Bidder Perspective – Depending on the overall global market conditions and other large projects being constructed during the time period of this project, global considerations could significantly swing bid prices to complete the work or limit the competition.
c. Previous Owner Effects Actually Could Decrease the Number of Qualified bidders – Based on previous experience with California contracting, potential bidders may pass on the opportunity due to owner's terms and conditions in combination with regulatory laws, design, and construction standards.
d. Unit Costs; Inflation, Labor Costs, Material Costs, and Interest Rates – The specific time of the advertisement and market conditions can cause major differences in costing.
e. Owner Terms and conditions – Could limit the number of bidders.
f. Improved Legislation to Enhance Terms and Conditions for Contractors – This could be a potential to reduce risks by addressing some of the industry concerns prior to advertisement.

8. **Construction**
   a. Differing ground conditions can significantly affect tunnel construction.
   b. Test commissioning for ventilation system may affect schedule.
   c. Work site logistics – Adverse effects related to construction, including noise, access, air, vibrations, traffic, damage to historic properties, equipment type (potential gases impact), and other items can be a major construction cost.
   d. Large staging areas will be required and the impacts associated with such areas. For example, the precast facilities for the tunnel lining will require a notable area for construction and storage.
   e. Access to the site, especially related to hauling of excavated tunnel material from the site.
   f. Material supply and cost appreciation at the time of construction. There could be notable swings in costs due to available material supplies.
   g. TBM machine and power for operations of the TBM. Major power demands are required to operate the TBM machinery on other projects; notable lead time was necessary to acquire the power source.
   h. Ongoing continued public negativity resulting in potential stoppage or delays of work activities ultimately increasing final construction costs.
   i. The means for retrieval of TDM or abandon the TDM is a cost consideration for the project.

Table 5-1. Idea Evaluation Table

Pass = P, and Priority 1, 2, 3; or Consideration, Cons.	Fail = F	Initial Cost Savings, C1, C2, C3; or Cons.	Future O&M Savings, OM+ savings, OM- (increase)	Compliance with Transp. System Performance Measures, TS1, TS2, TS3	Overall Ability to Implement	Assigned To	Brainstorm Idea	Owner and Design Team's Initial Responses from Mid-Week Distribution of VA Idea List
No Build Alternative								
Cons.						Surface	Focus on incentives to increase ridership on the Gold Line.	OK to comment.
TSM, TDM Alternative								
P2		C+	Neutral	1	2	Surface	Introduce HOV 2+ and bus restrictions on Atlantic for one lane in each direction in order to improve mobility and reduce congestion. Minor increased cost for striping and enforcement. Key advantage is a reduction in traffic congestion. This proposal should be considered in conjunction with another BRT or LRT proposal. Single drivers might be opposed. Nearby residential might be opposed. Idea would improve mobility overall. Convert one lane of the BRT corridor for exclusive use of transit. Reduces the capacity for cars because the freeway will accommodate the cars. Provides improved service for BRT. Reduces ROW cost, parking impacts, and streetscape impacts. Also consider the possibility of a reversible lane for peak periods. Examine BRT exclusive bus lanes to determine if they contribute toward operations. If not, then put the BRT in mixed flow.	Consider in conjunction with a BRT or LRT Alternative.
TBD		C+	OM-	3	2	Surface	Consider expanded use of traffic calming to reduce or eliminate through traffic. Idea can be considered at a future time. Discuss with Caltrans and Metro.	

Table 5-1. Idea Evaluation Table

Pass = P, and Priority 1, 2, 3; or Consideration, Cons.	Fail = F	Initial Cost Savings, C1, C2, C3; or Cons.	Future O&M Savings, OM+ savings, OM- (increase)	Compliance with Transp. System Performance Measures, TS1, TS2, TS3	Overall Ability to Implement	Assigned To	Brainstorm Idea	Owner and Design Team's Initial Responses from Mid-Week Distribution of VA Idea List
BRT Alternative								
P1		C+	OM-	1	1	Surface	Hybrid system of guided BRT with paint on the road guiding the buses, versus standard BRT. At stops, there is a system of advising passengers of when the next bus will arrive. Complete passenger information system. Technology is improving and would be integrated, such as paying for bus pass with cell phone or credit card. Real-time optimization of the corridor. Metro plans to implement this along Wilshire Boulevard. Review which elements of this may already be in the base alternative. Would be an enhancement. Working well in New York for commuters, but consider environmental justice issues.	This idea is not yet part of the base BRT design, but is being considered as a refinement. OK to propose idea.
P1		1	OM+	1	1	Tunnel	Multimodal center near north freeway corridor, and BRT or LRT station, for parking. People can park and car pool. Use managed lanes (toll system based on occupancy) in the tunnel. Tolls vary based on demand in the tunnel. Encourage a shift in transportation mode from autos to BRT/LRT. This idea needs to be in conjunction with a Freeway Tunnel or LRT Alternative. Could be a significant cost saving to the Freeway Tunnel design. Multimodal provides option of paying to drive through the tunnel, or park and take BRT or LRT. Parking garages could be located over the cut-and-cover sections at both north and south portals. Savings comes from a single-bore tunnel versus two bores. Review continued extent of cut-through traffic as a possible disadvantage. Keeps option open for a future second tunnel.	OK to pursue.

Table 5-1. Idea Evaluation Table

Pass = P, and Priority 1, 2, 3; or Consideration, Cons.	Fail = F	Initial Cost Savings, C1, C2, C3; or Cons.	Future O&M Savings, OM+ savings, OM- (increase)	Compliance with Transp. System Performance Measures, TS1, TS2, TS3	Overall Ability to Implement	Assigned To	Brainstorm Idea	Owner and Design Team's Initial Responses from Mid-Week Distribution of VA Idea List
	F						Convert Atlantic to exclusive BRT transit both directions, and move passenger vehicles to Garfield. Idea is to provide two exclusive lanes for BRT (one in each direction) along Atlantic. Affects businesses along the route, medical facilities along Atlantic, and Alhambra central business district. Would face community opposition.	OK to fail.
P1		C2	OM+	1	2		Operate streetcars in mixed traffic along the BRT alignment. Will cost more than BRT Alternative, but less expensive than LRT Alternative. Would require overhead lines for traction power, creating potential community concern. Consider future O&M requirements.	OK to calculate.
Cons.						Surface	Include a roundabout at Huntington and Atlantic for the BRT option, and TSM/TDM. Concern with ROW cost. Does not benefit the overall system as a stand-alone proposal.	
	F						Electrically power the buses with overhead lines as a streetcar system. Similar to an LRT system. Rubber tired system. Metro does not have electric buses. Would be a significant issue with the community due to aesthetics of the overhead power lines. There are other options for Metro to use other green technologies versus electric with overhead lines. Could apply to a depressed freeway idea with a lane for electric buses or in the tunnel with an electric lane but not a bus only lane.	OK to fail.

Table 5-1. Idea Evaluation Table

Pass = P, and Priority 1, 2, 3; or Consideration, Cons.	Fail = F	Initial Cost Savings, C1, C2, C3; or Cons.	Future O&M Savings, OM+ savings, OM- (increase)	Compliance with Transp. System Performance Measures, TS1, TS2, TS3	Overall Ability to Implement	Assigned To	Brainstorm Idea	Owner and Design Team's Initial Responses from Mid-Week Distribution of VA Idea List
Cons.						Surface	Continue the BRT route as a regional route for greater regional connectivity. Intent is to capture greater ridership. The focus in this region is LRT, so the BRT idea would work against the regional transportation plan, but could work as an interim measure if funding is limited. Metro's long-term goal is for a rail system. Orange Line is a popular BRT route with exclusive ROW.	OK as consideration.
Cons.						Surface	Encourage transit oriented development, and maintain visibility of stations to attract ridership. Metro has approximately 30 projects in general. P3 opportunities with apartments, retail, and education. Could be considered with or without the tunnel option. Metro has active P3 developments in other areas. Applies to BRT and LRT stations.	OK to pursue.
	F	Increase	Increase	1	3		On Atlantic where we could not have two exclusive lanes, place the BRT in a cut-and-cover tunnel where the system cannot get two exclusive BRT lanes. Could have community opposition during construction of cut-and-cover, but could be done if phased properly. Would have additional utility impacts. This would be a backup consideration only if there is not space on the surface. Would cost less to purchase ROW than to build a cut-and-cover tunnel.	OK to fail.

Table 5-1. Idea Evaluation Table

Pass = P, and Priority 1, 2, 3; or Consideration, Cons.	Fail = F	Initial Cost Savings, C1, C2, C3; or Cons.	Future O&M Savings, OM+ savings, OM- (increase)	Compliance with Transp. System Performance Measures, TS1, TS2, TS3	Overall Ability to Implement	Assigned To	Brainstorm Idea	Owner and Design Team's Initial Responses from Mid-Week Distribution of VA Idea List
	F						Extend the BRT north from Long Beach at I-710/ SR 710 connecting from SR 60 freeway to I-210 by connecting to alternative technology such as catenary (no emissions) truck lanes. Run electric buses down these lanes. Beyond the scope of the current project, but should be considered as part of long-term planning. Could create a concern of encouraging goods movement through the study area. If BRT option prevails, then the community would not want to promote goods movement through the area.	OK to fail.
	F						Smaller, approximately 30-foot bore, for tunnel with one lane in each direction dedicated to transit. Add intermediate stations, such as at Huntington. Idea is to convert the tunnel to BRT exclusive lanes. Consider NFPA requirements for egress, possibly along the tunnel route. Complicates FLS, areas of refuge, fire doors, existing, etc. Increases cost for BRT Alternative. BRT does not solve the problem of moving traffic through the study area. If it is to be a transit tunnel, then LRT makes more sense than BRT.	OK to fail.

Table 5-1. Idea Evaluation Table

Pass = P, and Priority 1, 2, 3; or Consideration, Cons.	Fail = F	Initial Cost Savings, C1, C2, C3; or Cons.	Future O&M Savings, OM+ savings, OM- (increase)	Compliance with Transp. System Performance Measures, TS1, TS2, TS3	Overall Ability to Implement	Assigned To	Brainstorm Idea	Owner and Design Team's Initial Responses from Mid-Week Distribution of VA Idea List
LRT Alternative								
P1		C2	OM+	Y	2	Surface	Place the LRT track at-grade in the median along the south section of SR 710, widening to the outside as required, with a pedestrian bridge from the at-grade station to Cal State LA. Cost of widening more than offset by cost of elevated structures of current alignment.	
	F	C2	OM-	Y	3	Surface	Design BRT tunnel for conversion to LRT when funding allows. Will be issues in future during construction with BRT in operation. Cost savings may not justify investment for future.	
P1		C1	OM+	Y	1	Surface	Reconstruct Valley Boulevard to fly over the project; consolidates maintenance facility site, moves portal to north of Mission, and shortens tunnel section. May also apply to Freeway Tunnel option.	OK to explore. Consider geometric constraints. Consider RR.
	F	C3	OM+	Y	3	Surface	Instead of underground stations for the LRT, have shallower stations open to the air, simplifying FLS issues; reduces cost of elevators/escalators or requires only Americans with Disabilities Act (ADA) ramp. Station area requires ROW acquisition outside of roadway.	
	F					Surface	Open cut the light rail at Fremont to decrease the depth of the tunnel and make it more of a box versus the two circular bores. Requires changing tunneling methods in the middle of the alignment.	

Table 5-1. Idea Evaluation Table

Pass = P, and Priority 1, 2, 3; or Consideration, Cons.	Fail = F	Initial Cost Savings, C1, C2, C3; or Cons.	Future O&M Savings, OM+ savings, OM- (increase)	Compliance with Transp. System Performance Measures, TS1, TS2, TS3	Overall Ability to Implement	Assigned To	Brainstorm Idea	Owner and Design Team's Initial Responses from Mid-Week Distribution of VA Idea List
	F					Surface	Use elevated section for the entire alignment of the LRT. Likely environmental issues; may have been considered previously.	
P1		C1	OM+	Y	2	Surface	Instead of terminating at Fillmore Station at the north end (mostly commercial properties), shorten the alignment along Raymond and terminate in the vicinity of Railroad Avenue and the existing Gold Line in order to reduce parallel tracks. Shortening the north terminus of alignment has merit; explore feasible connection point via at-grade station site that could serve both lines (consider possibly closing existing Fillmore Station, but retain parking).	
	F					Surface	Stop the LRT short at Huntington Station, and run BRT north on the proposed BRT alignment. Requires transfer between two modes of transportation with limited destinations on shortened BRT.	
Cons.						Surface	For LRT at north-south termini, promote municipal and private bus feeder or circulator service bus at peak hours for access to employment centers.	
						Surface	Change the alignment from Cal State LA to Alhambra, to still allow the tunnel option at a future time. ***Proposal not clear; not evaluated.***	

Table 5-1. Idea Evaluation Table

Pass = P, and Priority 1, 2, 3; or Consideration, Cons.	Fail = F	Initial Cost Savings, C1, C2, C3; or Cons.	Future O&M Savings, OM+ savings, OM- (increase)	Compliance with Transp. System Performance Measures, TS1, TS2, TS3	Overall Ability to Implement	Assigned To	Brainstorm Idea	Owner and Design Team's Initial Responses from Mid-Week Distribution of VA Idea List
P2		C1	OM+	2	2	Surface	Modify LRT alignment to reduce tunneling by flying over UPRR and Mission, running along Sheffield Avenue (at-grade or underground, without relocating residents), then elevating over southbound lanes of Huntington to median. Strong environmental justice issue.	Consider environmental justice issues at El Sereno. Review AA Report for discussion. This idea had been considered before (Alt 4C).
P2		C1	OM+	Y	3	Surface	Eliminate tunnel by using LRT-4D for the south section to Mission, traveling at-grade to Atlantic, and then follow LRT-6 alignment to north terminus. May be additional ROW acquisition and strong community opposition.	
Freeway Tunnel with TSM, TDM Components								
P1		C1	OM-	Less Capacity	2	Tunnel	Single-bore tunnel, with two lanes each direction, demand controlled with dynamic pricing. Explore long-term scenario of three lanes in each direction in a single-bore, but technology is not there yet.	Major Cost Savings
P2		C+	Some	Design Except	2	Tunnel	Add 1 to 2 feet to bore to provide 11-foot outside shoulder and allow right shoulder use during peak periods.	Allows three lanes in peak
P3		C+	OM+	New **Idea**	1	Tunnel	Introduce wider area VMS for variable speed enforcement for congestion management.	Generally good idea
F						Tunnel	Depressed freeway with side slopes and landscape areas to close the SR 710 gap, versus bored freeway tunnel. Eliminated due to community opposition.	

Table 5-1. Idea Evaluation Table

Pass = P, and Priority 1, 2, 3; or Consideration, Cons.	Fail = F	Initial Cost Savings, C1, C2, C3; or Cons.	Future O&M Savings, OM+ savings, OM- (increase)	Compliance with Transp. System Performance Measures, TS1, TS2, TS3	Overall Ability to Implement	Assigned To	Brainstorm Idea	Owner and Design Team's Initial Responses from Mid-Week Distribution of VA Idea List
P		C2	n/a	n/a	2	Tunnel	P3 project with a pre-development agreement with the P3 concession team helping with the selection of the Preferred Alternative, without pre-selecting an alternative. Address this approach within the NEPA/CEQA process. Keep the competitive tension in the selection process, versus sole source negotiations. Consider a hybrid process with early involvement, but still bidding the project to obtain best value.	OK to explore. Address community participation when decision is made about tunnel versus BRT or LRT or combination of both. Could say the project is P3 in general without pre-determining selected alternative.
P		C2	n/a	n/a	2	Tunnel	Bring a contractor on board early for construction advice. Obtain high-level input from tunneling contractor, for example. Contractor may not be able to bid later. Keep competitive process going.	
P		C3	OM-	n/a	?	Tunnel	Make the tunnel shallower to reduce the length of the tunnel.	Engineers need to evaluate
P		C1	OM-	n/a	1	Tunnel	Freeway goes over Valley, Railroad, and Mission, then enter tunnel.	Salvages existing grading
See Above						Tunnel	Extend the cut-and-cover where possible.	See above
P		C1	OM-	n/a	2	Tunnel	Use cut-and-cover for all/part of Mission/ Huntington segment; start TBM tunnel at Huntington; move and relocate historic homes in this segment.	
P		C+	OM+	OK	1	Tunnel	Add lane in each cut-and-cover south of Huntington southbound-on/northbound-off.	
See Above						Tunnel	Extend southbound cut-and-cover at north end as far as possible.	

Table 5-1. Idea Evaluation Table

Pass = P, and Priority 1, 2, 3; or Consideration, Cons.	Fail = F	Initial Cost Savings, C1, C2, C3; or Cons.	Future O&M Savings, OM+ savings, OM- (increase)	Compliance with Transp. System Performance Measures, TS1, TS2, TS3	Overall Ability to Implement	Assigned To	Brainstorm Idea	Owner and Design Team's Initial Responses from Mid-Week Distribution of VA Idea List
P		C+	OM+	n/a	2	Tunnel	Consider a mid-point shaft for TBM access during construction for the Freeway Tunnel option, and as a permanent maintenance shaft in the completed project. Shaft will be built in the middle of two bored tunnels.	Consider neighborhood concerns of air quality. This is a significant concern. Plan in the base design is to run the TBMs from both ends to middle, then abandon TBMs underground. Four TBMs required. Could consider maintenance access at mid-point.
F						Tunnel	Use one tunnel with bi-directional movements to accommodate peak demands. Reversible lanes.	Should be studied further; may not make sense with directional split.
						Tunnel	Make the tunnel for cars only. Consider cumulative benefits from reduced cost through reduced bore diameter, simplified FLS systems. Could have low-rider (height) buses and EMS and response vehicles.	Take into account emergency response.
See Above						Tunnel	Consider a point of ingress/egress at Huntington Drive to access the tunnel in the mid-point of the tunnel. Would require the profile of the tunnel to be shallower.	
F						Tunnel	Single tunnel, two-level, with BRT on one level, and general traffic managed in other level in the peak direction, reversible.	

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Pass = P, and Priority 1, 2, 3; or Consideration, Cons.	Fail = F	Initial Cost Savings, C1, C2, C3; or Cons.	Future O&M Savings, OM+ savings, OM- (increase)	Compliance with Transp. System Performance Measures, TS1, TS2, TS3	Overall Ability to Implement	Assigned To	Brainstorm Idea	Owner and Design Team's Initial Responses from Mid-Week Distribution of VA Idea List
F						Tunnel	Keep two tunnels, during peak periods one managed level with express HOV lanes. Incorporate BRT on local street.	
See Above						Tunnel	Shorten the distance between portals for the Freeway Tunnel.	
P		C+	OM+	n/a	2	Tunnel	Provide means of emergency escape mid-point in the tunnel.	
Cons						Tunnel	Develop low clearance bus fleet to allow a smaller-diameter bore for the tunnel.	
F						Tunnel	Construct an elevated freeway versus a tunnel to reduce ROW take.	Absolute nonstarter with neighborhoods
See above						Tunnel	Make freeway more affordable by providing more cut-and-cover and surface roadways, versus deep bored tunnel.	
F						Tunnel	At the area of the Raymond fault, make the freeway a surface freeway, versus bored tunnel.	
See Above						Tunnel	Offer the Caltrans-owned property for sale for future development. Make the freeway cut-and-cover through these areas. Then develop the property. Refer to the Roberti Bill.	
F						Tunnel	Have the advertising agency purchase the TBM versus the contractor.	Could be looked at later.
F						Tunnel	Convert the pedestrian path in tunnel as a bike path as well as walking path. Be clear that pedestrian path is also emergency access path.	ADA, sidewalk not wide enough
P		C2	OM-	n/a		Tunnel	Reduce the footprint of the portal cut-and-cover area by maximizing gradient, or minimizing separation and cover to tunnels.	Engineers need to evaluate

Table 5-1. Idea Evaluation Table

Pass = P, and Priority 1, 2, 3; or Consideration, Cons.	Fail = F	Initial Cost Savings, C1, C2, C3; or Cons.	Future O&M Savings, OM+ savings, OM- (increase)	Compliance with Transp. System Performance Measures, TS1, TS2, TS3	Overall Ability to Implement	Assigned To	Brainstorm Idea	Owner and Design Team's Initial Responses from Mid-Week Distribution of VA Idea List
P		C2		n/a	2	Tunnel	Keep the tunnel footprint the same on the north side. Adjust the grades of the tunnel enough to avoid having to build another bridge versus having to replace the Del Mar bridge. Provide on-/off-ramps in Del Mar/210 segment (braided).	
P		C+	OM+	n/a	1	Tunnel	For north freeway portal cut-and-cover area in post-construction, make this a recreational space or amenity opportunity to reconnect neighborhoods that had been separated by the SR 710 years ago. Can help with community participation.	
F						Tunnel	Oval tunnel to maximize use of space and minimize wasted space.	Not practical
Do not Understand						Tunnel	Tunnel portals with conventional mining techniques to rapidly move cut-and-cover to a horizontal mode. Sequential excavation. Reduces the length of the tunnel, and reduces the length of the cut-and-cover.	
Cons						Tunnel	Maximize the use of the express lane/managed lane concept by placing direct connections to the El Monte Busway (I-10 Express Lanes) and connections to potential I-210 Express Lanes.	
See above						Tunnel	Adjust portal location further south in north end of project to provide further access to Del Mar.	
P1		3	1	1	2	Tunnel	Eliminate or minimize cross passages in the Freeway Tunnel. Could save as much as $200 million. Very difficult to build from a mining/risk perspective. Review with fire marshal. Note that a single-bore tunnel would not have the cross passages.	Discussion of cross passage spacing. Design team already considering reductions that are not reflected yet in estimates.

Table 5-1. Idea Evaluation Table

Pass = P, and Priority 1, 2, 3; or Consideration, Cons.	Fail = F	Initial Cost Savings, C1, C2, C3; or Cons.	Future O&M Savings, OM+ savings, OM- (increase)	Compliance with Transp. System Performance Measures, TS1, TS2, TS3	Overall Ability to Implement	Assigned To	Brainstorm Idea	Owner and Design Team's Initial Responses from Mid-Week Distribution of VA Idea List
F						Tunnel	Allow only green vehicles, electrical or hybrid, within the tunnel to reduce air scrubbing requirements.	
See above						Tunnel	Introduce wider area VMS for variable speed enforcement for congestion management.	
F						Tunnel	Have two tunnels versus one with northern tunnel stopping north of SR 110, and one stopping south of SR 110, with direct connects to SR 110.	
Cons						Tunnel	Change the law to reduce ROW compensation cost for placing a tunnel underneath properties.	
						Tunnel	Phase the project with first phase from south end to Huntington. Then north from Huntington to Arroyo Seco as a second phase. Then from Arroyo Seco to the northern limit of the project at Del Mar. Contractors can sell the TBM from one contractor to the next.	
See above						Tunnel	Provide one bore first along the full length, with the second bore some years later.	
F						Tunnel	Eliminate the access to SR 710 from Valley Boulevard.	
See above						Tunnel	Push the south Portal as far north as the existing Caltrans ownership allows, and shallow cut-and-cover up to that portal in order to return the surface property to the local community for improvement/development.	OK to explore. Caltrans owns property to Huntington. Ok to look at N and S sections.
F						Tunnel	Make portions of the highway as surface highway where existing Caltrans ownerships will allow.	

Table 5-1. Idea Evaluation Table

Pass = P, and Priority 1, 2, 3; or Consideration, Cons.	Fail = F	Initial Cost Savings, C1, C2, C3; or Cons.	Future O&M Savings, OM+ savings, OM- (increase)	Compliance with Transp. System Performance Measures, TS1, TS2, TS3	Overall Ability to Implement	Assigned To	Brainstorm Idea	Owner and Design Team's Initial Responses from Mid-Week Distribution of VA Idea List
F						Tunnel	Take a portion of the funding to be devoted to the project, such as $1 billion, and distribute it to the community in the form of improvements, in order to develop a surface freeway.	
						Tunnel	Phased implementation to develop the first tunnel for cars, then in the future a second bore for truck traffic.	
P		C2	OM-	n/a	1	Tunnel	Utilize more precast elements for the interior of the tunnel section to speed construction and minimize staging area.	
Cons						Tunnel	Address construction staging constraints for dealing with precast components, removal of earth from the bore, etc.	
Cons						Tunnel	During PA/ED and PS&E phase, attempt to find areas for use of the spoils from the project.	
Cons						Tunnel	Address access through communities for transport of spoils.	
Cons						Tunnel	Contact the Port Authority to find out if they could utilize the spoils.	
See above						Tunnel	Maximize the use of the existing SR 710 stubs, north and south, versus more extensive reconstruction. Would affect the profile of the tunnel.	
See above						Tunnel	Partial access to Huntington or SR 110, which may reduce the necessary ROW takes in these areas.	

Table 5-1. Idea Evaluation Table

Pass = P, and Priority 1, 2, 3; or Consideration, Cons.	Fail = F	Initial Cost Savings, C1, C2, C3; or Cons.	Future O&M Savings, OM+ savings, OM- (increase)	Compliance with Transp. System Performance Measures, TS1, TS2, TS3	Overall Ability to Implement	Assigned To	Brainstorm Idea	Owner and Design Team's Initial Responses from Mid-Week Distribution of VA Idea List
							General comments: Be cautious with respect to reducing the tunnel bore, particularly the width. This will be a long tunnel. Consider FLS.	
							Consider how environmental justice deals with tolling. Arguments from perspective of relieving congestion in an urban area, which improves livability. Also, lower-paid workers may not be able to afford the tolls.	
							Directional lanes can be valid, but address operational management issues.	

Notes:
This is the VA Team's list of ideas from the Creative Phase of the VA study. VA team members will use this information within the templates for VA Proposals and Considerations. The text will change as the proposals and considerations are developed. In the subjective ratings, a rating of 1 means high priority, 2 means moderate priority, 3 means lower priority. In Column A, a "P" for "Pass" means the idea is planned to be developed in the VA Proposal template for cost saving ideas. P1 means it is a high priority for calculation, P2 moderate priority, and P3 lower priority, in consideration of not only cost-saving potential (Col. C); but also future O&M cost savings; compliance with transportation system performance measures; and overall ability to implement. For the very approximate range of cost savings (Col. C), rating of C1 means potentially greater than 10 percent in savings for the alternative; C2 means from 5 to 10 percent savings, and C3 means less than 5 percent in savings. "Cons." in Col. A means it is a general consideration compared to a cost-saving proposal. An "F" in Column B means the idea is Failed due to an evident disadvantage or fatal flaw.

Idea List from Creative and Analysis Phases of the VA Study, March 11-14, 2013; Paul Johnson, CVS, Dan Speicher, and VA Team Members, SR 710 VA Study

Value Analysis Process

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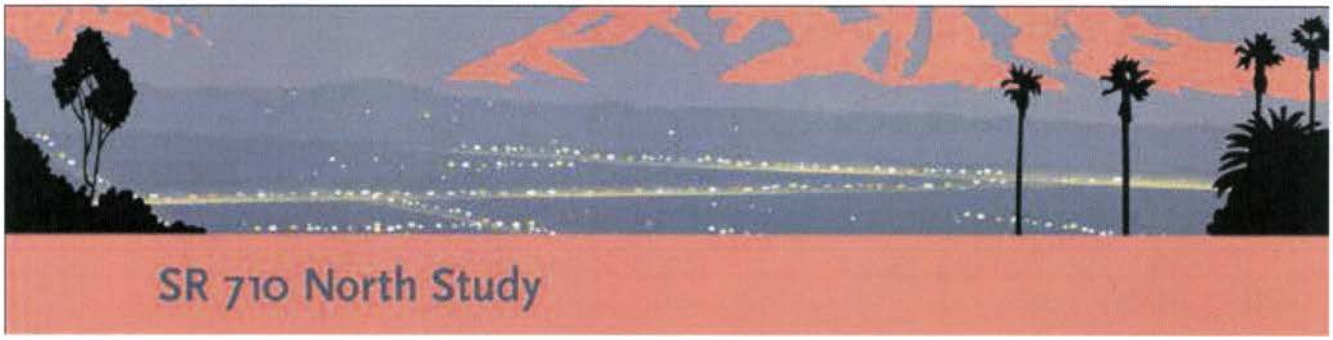

Value Analysis Process

6. VALUE ANALYSIS PROCESS

The Caltrans VA process involves 16 activities needed to accomplish a VA Study, organized into three parts: Pre-study, VA Study, and Report. Integral to the Caltrans VA process is the Value Metrics process. Value Metrics offers the cornerstone of the Caltrans VA process by providing a systematic and structured means of considering the relationship of a project's performance and cost as they relate to value.

Value Analysis has traditionally been perceived as an effective means for reducing project costs. This paradigm only addresses one part of the value equation, often at the expense of the role that VA can play with regard to improving project performance. Project costs are fairly easy to quantify and compare; performance is not.

Project performance must be properly defined and concurred by the stakeholders at the beginning of the VA Study. The performance attributes and requirements developed are then used throughout the study to identify, evaluate, and document proposals. This process, Value Metrics, emphasizes the interrelationship between cost and performance and can be quantified and compared in terms of how they contribute to overall value.

Value Metrics provides a standardized means of identifying, defining, evaluating, and measuring performance. Once this has been achieved, and costs for all VA proposals have been developed, measuring value is straightforward.

Value Metrics can improve VA studies by:

- Building consensus among project stakeholders (especially those holding conflicting views)
- Developing a better understanding of a project's goals and objectives as they relate to purpose and need
- Developing a baseline understanding of how the project is meeting performance goals and objectives
- Identifying areas where project performance can be improved through the VA process
- Developing a better understanding of the effect of a proposal concept on project performance
- Developing a deeper understanding of the relationship between performance and cost in determining value
- Using value as the basis for selecting the best project or design concept

The following provides an overview of the Caltrans approach to VA. The Caltrans VA Study Activity Chart at the end of this narrative identifies the steps in each activity, which are detailed as follows.

PRE-STUDY

Meaningful and measurable results are directly related to the pre-study work performed. Depending on the type of study, all or part of the following information needs to be determined during the pre-study phase:

- Clear definition of the current situation and study objectives
- Identification of Study Team members
- Identification of project stakeholders
- Definition of how stakeholders are impacted by the project
- Identification of key issues and concerns
- Identification of project performance requirements and attributes
- Status of project cost estimate
- Project data gathered to be distributed to VA Team

In preparation for the VA Study, the team leader confers with owners and stakeholders to outline the VA process, initiate data gathering, refine project scope and objectives, structure the scope and team members and technical specialists, and finalize study plans. Specific deliverables are provided. Following the initial planning meeting, the team leader reviews the data collected for the project and develops a cost model. The team leader also consults with the technical specialists to prepare them for the VA Study.

VA STUDY

The VA Job Plan guides the VA Team in their search to enhance value in the project or process. Caltrans follows a seven-phase VA Job Plan:

1. Information Phase
2. Function Phase
3. Speculation Phase
4. Evaluation Phase
5. Development Phase
6. Presentation Phase
7. Implementation Phase

Information Phase

At the beginning of the VA Study, the design team presents a more detailed review of the design and the various systems. This includes an overview of the project and its various requirements, which further enhances the VA Team's knowledge and understanding of the project. The project team also responds to questions posed by the VA Team.

The performance requirements and attributes of the project are discussed, and the performance of the baseline concept is evaluated.

Function Phase

Key to the VA process is the function analysis techniques used during the Function Phase. Analyzing the functional requirements of a project is essential to assuring an owner that the project has been designed to meet the stated criteria and its purpose and need. The analysis of these functions in terms of cost, performance, time, and risk is a primary element in a VA Study, and is used to develop proposals. This procedure is beneficial to the VA Team, as it forces the participants to think in terms of functions and their relative value in meeting the purpose and need of the project. This facilitates a deeper understanding of the project.

Speculation Phase

The Speculation Phase involves identifying and listing creative ideas. During this phase, the VA Team participates in a brainstorming session to identify as many means as possible to provide the necessary project functions. Judgment of the ideas is not permitted in order to generate a broad range of ideas.

The idea list includes all of the ideas suggested during the study. These ideas should be reviewed further by the project team, since they may contain ideas that are worthy of further evaluation and may be used as the design develops. These ideas could also help stimulate additional ideas by others.

Evaluation Phase

The purpose of the Evaluation Phase is to systematically assess the potential impacts of ideas generated during the Speculation Phase relative to their potential for value improvement. Each idea is evaluated in terms of its potential impact to performance, cost, time, and risk. Once each idea is fully evaluated, it is given a total rating number. This is based on a scale of 1 to 7, as indicated by the following rating index:

7 = Major Value Improvement 6 = Moderate Value Improvement 5 = Minor Value Improvement 4 = Possible Value Improvement	These ratings represent the subjective opinion of the VA Team regarding the potential benefits of the concepts in order to prioritize them for development.
3 = Minor Value Degradation	Concept results in a minor cost or performance improvement at the expense of the other.
2 = Moderate Value Degradation	Concept reduces cost but creates an unacceptable degradation to performance.
1 = Major Value Degradation	Concept is not technically feasible or does not meet project purpose and need.

Ideas rated 4 to 7 are developed further; those found to have the greatest potential for value improvement are documented in the VA proposals section of this report. A more refined definition of what a 4 to 7 rating is (Major Value Improvement, etc.) will be developed by the team leader and team for each study. The rationale for why ideas were rated highly but not developed as proposals is documented in the Idea Evaluation section of the report.

Development Phase

During the Development Phase, the highly rated ideas are expanded and developed into VA proposals. The development process considers the impact to performance, cost, time, and risk of the proposal concepts relative to the baseline concept. This analysis is prepared as appropriate for each proposal, and the information may include a performance assessment, initial cost and LCC comparisons, schedule analysis, and an assessment of risk. Each proposal describes the baseline concept and proposed changes and includes a technical discussion. Sketches and calculations are also prepared for each proposal as appropriate.

Presentation Phase

The VA Study concludes with a preliminary presentation of the VA Team's assessment of the project and VA proposals. The presentation provides an opportunity for the owner, project team, and stakeholders to review the proposals and develop an understanding of the rationale behind them.

Implementation Phase

After the stakeholders have had an opportunity to review the proposals identified by the VA Team, the team leader conducts an implementation meeting to discuss the proposals and resolve appropriate action for each VA proposal. If necessary, any other VA report edits requested by the representatives are also made by the VA Team leader and a final report is issued.

This implementation meeting helps to ensure that savings or process improvements are not lost due to lack of communication, and that those VA proposals that are accepted are properly integrated into the project design.

VA REPORT

Preliminary Report

Following the completion of the VA Study, the team leader compiles the information developed during the VA Study into the *Preliminary Value Analysis Study Report*. This report, documenting viable proposals, is provided to the customer within the timeframe requested (usually within 2 weeks). The preliminary report also contains a VA Study Summary Report – Preliminary Findings, designed to highlight critical elements of the VA Study, including detailed documentation of VA proposals, in a concise manner for the use of parties without the opportunity to review the report in its entirety. More details can be found in the complete preliminary report, which consists of the following documentation: Executive Summary, VA Proposals, Project Information, Project Analysis, Idea Evaluation, and VA Process.

Written Report – VA Implementation Action Memorandum

If the disposition of all VA proposals cannot be determined at the Implementation Meeting, then a VA Implementation Action Memorandum is submitted. This memorandum states which proposals are accepted, which are rejected (and the rationale for rejection), and which VA proposals are conditionally accepted with further study required. For these proposals, the memorandum states what action must be completed so that a decision can be made as to the disposition of this VA proposal, when that action is expected to be completed, and who is responsible for completing the action. If all VA proposals are either accepted or rejected, then this memorandum is not required.

Written Report – Final Report

Once all VA proposals have been either accepted or rejected, the team leader updates the *Preliminary Value Analysis Study Report* to show the final results of the study in a *Final Value Analysis Study Report*. In addition, a Value Analysis Study Summary Report (VASSR) is sent to Caltrans HQ to permit easy documentation into the Caltrans Annual Report to FHWA.

The Caltrans VA Study Activity Chart below describes each activity. Following the Activity Chart is the VA Study Agenda for this project.

CALTRANS VA STUDY ACTIVITY CHART

PREPARATION		**INITIATE STUDY** ➢ Identify study project ➢ Identify study roles and responsibilities ➢ Define study goals ➢ Select team leader ➢ Prepare draft Study Charter 1	**ORGANIZE STUDY** ➢ Conduct Pre-Study Meeting ➢ Select team members ➢ Identify stakeholders, decision makers, and technical reviewers ➢ Identify data collection ➢ Select study dates ➢ Determine study logistics ➢ Update VA Study Charter ➢ Identify and define performance requirements 2	**PREPARE DATA** ➢ Collect and distribute data ➢ Develop construction cost models ➢ Develop highway user benefit / LCC model (if required) 3	
VA STUDY	Segment 1	**INFORM TEAM** ➢ Review study activities and confirm reviewers ➢ Present design concept ➢ Present stakeholders' interests ➢ Review project issues and objectives ➢ Rate performance of baseline concept ➢ Visit project site 4	**ANALYZE FUNCTIONS** ➢ Analyze project data ➢ Expand project functions ➢ Prepare FAST diagram ➢ Determine functional cost drivers and performance 5	**CREATE IDEAS** ➢ Focus on functions ➢ List all ideas ➢ Apply creativity and innovation techniques (group and individual) 6	**EVALUATE IDEAS** ➢ Apply key performance attributes to rate idea ➢ List advantages and disadvantages ➢ Consider cost impacts ➢ Rank all ideas ➢ Assign proposals for development 7
	Segment 2	**DEVELOP PROPOSALS** ➢ Develop proposal concepts ➢ Prepare sketches and calculations ➢ Measure performance ➢ Estimate costs, LCC benefits/costs 8	**CRITIQUE PROPOSALS** ➢ VA Proposals Technical Review ➢ VA Proposals Team Consensus Review ➢ Identify mutually exclusive groups of proposals ➢ Identify VA strategies ➢ Validate performance 9	**PRESENT PROPOSALS*** ➢ Present findings ➢ Document feedback ➢ Confirm pending reviews ➢ Prepare preliminary report **Interim presentation of study findings* 10	
	Segment 3	**ASSESS PROPOSALS**** ➢ Review Preliminary Report ➢ Assess proposals for project acceptance ➢ Prepare draft implementation dispositions ***Activities performed by PDT, Technical Reviewers, and Stakeholders* 11	**RESOLVE PROPOSALS** ➢ Review implementation dispositions ➢ Resolve implementation actions with decision-makers and stakeholders ➢ Edit proposals ➢ Revisit rejected proposals, if needed 12	**PRESENT RESULTS*** ➢ Present results ➢ Obtain management approval on implemented proposals ➢ Summarize performance, cost, and value improvements **Final presentation of study results* 13	
REPORT		**DOCUMENT STUDY** ➢ Document process and study findings ➢ Distribute Preliminary VA Study Report ➢ Distribute electronic report to HQ VA Branch ➢ Conduct Implementation Meeting 14	**VA IMPLEMENTATION ACTION MEMO** *(If Conditionally Accepted Proposals exist)* ➢ Publish memo to document action plan to complete study ➢ Resolve Conditionally Accepted Proposals 15	**PUBLISH RESULTS** ➢ Document process and study results ➢ Incorporate all comments and implementation actions ➢ Distribute Final VA Study Report ➢ Distribute electronic report to HQ VA Branch ➢ Update VASSR ➢ Provide HQ the Final VA Study Report in PDF format 16	*Note: The dashed boxes indicate steps that **may** not be required in some VA Studies.*

Day 1 – Monday, March, 11, Caltrans, 100 S. Main Street, Los Angeles

Kick-Off Meeting

8:00 **SAFETY MOMENT, AND INTRODUCTIONS** Introductions and roles on the project

8:15 **OVERVIEW OF STUDY AGENDA AND VA PROCESS/ DECISION SCIENCE APPLICATION**
– Paul Johnson, CVS - VA Team Leader and Dan Speicher

8:40 **METRO and CALTRANS OVERVIEW**

Metro Perspectives

- Project objectives
- What Metro and Caltrans would like from the VA/DS Study
- Project Funding/Constraints
- Scheduling Requirements
- Stakeholder Concerns

Caltrans Perspective

- Caltrans expectation
- Design Objectives
- Historic Consideration
- General Comments
- Next steps in the Project Analysis/Environmental Documentation process

9:00 **DESIGN TEAM PRESENTATION** – by Yoga Chandran/CH2M HILL and design team

(Including Q/A for each topic, may be arranged by alternative rather than individual subject area)

- Overview of Project - Yoga Chandran
- Purpose and need – Deborah Pracilio
  Range of Alternatives considered, including final alternatives - Yoga Chandran
- Discussion of each alternative, include design considerations, refinements, ROW, and cost. Also highlight high cost items, CAD information – Tom Ionta, Steve Greene, Vincent Chio
  - No Build
  - TSM/TDM
  - LRT
  - BRT
  - Freeway Tunnel
- Tunnel design considerations – Steve Dubnewych and Bernhard Hoepperger
  - Tunnel cross-section and features
  - FLS and ventilation components
- Seismic and geotechnical evaluations, including faulting –Eldon Gath
- Environmental considerations for each alternative – Deborah Pracilio
- Traffic Study Results – Loren Bloomberg
- Community concerns – Yoga Chandran
- General Schedule – Yoga Chandran

11:15 **ALTERNATIVES ANALYSIS** – Dan Speicher, Loren Bloomberg, Steve Greene

- Alternative Analysis Process
- Evaluation Criteria and results
- Alternatives considered and removed
- Performance limitations of alternatives (areas that present the best opportunity for improvement)

12:00 Lunch

1:00 **DRIVE AND TOUR OF PROJECT SITE**

Several representatives from the Owner/Program Manager, and Design team, are requested to guide the VA Team members on a tour of the facility. CH2M HILL (Yoga Chandran) is requested to provide a van or vans and driver(s). CH2M HILL VA staff are requested to bring their own safety equipment (orange reflective vests, and safety glasses). VA Team members are requested to wear suitable business casual clothing and sturdy shoes for the tour.

5:00 Adjourn

Day 2 – Tuesday, March, 12, Caltrans, 100 S. Main Street, Los Angeles

8:00 **FURTHER REVIEW OF DESIGN INFORMATION**

9:00 **TEAM FOCUS QUESTIONS AND ANSWERS**

- What is the problem we are about to discuss?
- Why do we consider this a problem?
- Why do we believe a solution is necessary?
- What are the highest cost components of the project?
- What are the highest risk issues associated with the project?
- What are the expected outcomes from the VA Study?
- What options are available to build up the existing alternatives and/or reducing their limitations as outlined in the Alternatives Analysis (AA)?

10:00 Break

10:15 **FUNCTIONAL ANALYSIS**

- Identify significant project functions with opportunities for cost reduction or functional enhancement
- Alternative Analysis criteria application
- FAST Diagram

12:00 Lunch

1:00 **APPLICATION OF EXISTING AND CREATION OF NEW CRITERIA**

- Agree on application of Alternatives Analysis criteria
- Generate new criteria

2:30 **BRAINSTORMING**

- Generate alternative solutions to current designs
- Generate new designs
- Validation of design elements

5:00 Adjourn

Day 3 – Wednesday, March, 13, Caltrans, 100 S. Main Street, Los Angeles

8:00 **PERFORMANCE OF ALTERNATIVE SOLUTIONS**

Screening of Concepts

- Weighting of criteria
- Performance rating of options
- Key Advantages and Disadvantages of Each Alternative
- Are there any Fatal Flaws that Preclude an Alternative?
- Are there other Alternatives that should be considered?
- LOS Considerations
- Safety Considerations
- Showcase improvements to performance baseline from the Alternatives Analysis

10:00 ***Mid-Study Briefing with Caltrans HQ Staff, and Metro, and CH2M HILL Design Representative (Yoga Chandran)***

- Review of Proposals being considered for development by the VA Team
- Indication of Proposal Priority
- Drop any Proposals that are deemed unworkable from the outset, so that the VA Team remains focused on proposals that are of interest to Caltrans and Metro with the potential for consideration

12:00 Lunch

1:00 **REFINEMENT OF PROMISING ALTERNATIVE SOLUTIONS**

- Point Values as Indicators for Relative Comparisons
- Determine Top Concepts, and Refine as Necessary
- LOS Considerations
- Point Values as Indicators for Relative Comparisons
- Determine Top Concepts, and Refine as Necessary
- LOS Considerations

5:00 Adjourn

Day 4 – Thursday, March, 14, Caltrans, 100 S. Main Street, Los Angeles

8:00 **RANKING OF ALTERNATIVES**

- Characterization of improvements to existing alternatives
- Characterization of performance of all potential alternatives, including new alternatives
- Rank improvements and display tradeoffs

10:00 Break

10:15 **BEGIN WRITE-UPS, ECONOMIC CALCULATIONS, SKETCHES FOR COST PROPOSALS, DECISION SCIENCE GRAPHICS**

FORMAT OF MATERIALS FOR PRESENTATIONS

12:00 Lunch

1:00 **ACTIONS AND ASSIGNMENTS**

Actions and assignments during study break from March 15 through March 22.

2:00 Adjourn

Day 5 – Monday, March, 25, Caltrans, 100 S. Main Street, Los Angeles

8:00 **CONTINUE WRITE-UPS, ECONOMIC CALCULATIONS, SKETCHES FOR COST PROPOSALS, DECISION SCIENCE GRAPHICS**

DISCUSSIONS OF DRAFT MATERIAL

- Review of:
  - Advancements of existing alternatives
  - New alternatives
  - Cost saving strategies
  - Performance against evaluation criteria
  - Presentation materials

5:00 Adjourn

Day 6 – Tuesday, March, 26, Caltrans, 100 S. Main Street, Los Angeles

8:00 **WRITE-UPS, ECONOMIC CALCULATIONS, SKETCHES FOR COST PROPOSALS, DECISION SCIENCE GRAPHICS**

PREPARE EXECUTIVE SUMMARY PRESENTATION

5:00 Adjourn

Day 7 – Wednesday, March, 27, Caltrans, 100 S. Main Street, Los Angeles

8:00 **COMPLETE WRITE-UPS, AND CROSS CHECK PROPOSALS; COMPLETE PREPARATIONS OF THE EXECUTIVE SUMMARY PRESENTATION**

Participants: VA Team only

Location: CH2M HILL downtown Los Angeles office (see address above)

- Show Consequence Table for performance of alternatives (both existing and new alternatives)
- Show contributions by category- as a means to communicate results
- Display value/cost tradeoffs graphic
- Showcase how results of VA assist with the movement toward decisions of alternatives in PA/ED

10:00 **EXECUTIVE SUMMARY PRESENTATION TO METRO, CALTRANS, AND CH2M HILL DESIGN TEAM**
(This Presentation will conclude the Value Analysis Study.)

The Preliminary VA Report will be prepared within 10 working days following the VA Study. It will be distributed to Metro, Caltrans, CH2M HILL Design Team, Agency and VA participants both in hard copy and electronic PDF format.

12:00 Adjourn the VA Study

VA STUDY MEETING ATTENDEES

VA Team Members

2013 March												
11	12	13	14	25	26	27	Name	Position/Role	Organization	Telephone		E-mail
X	X	X	X	X	X	X	Paul Johnson	VA Team Leader	CH2M HILL	208-383-6299	208-890-8203	Paul.johnson@ch2m.com
X	X	X	X	X	X	X	Dan Speicher	Decision Analysis	CH2M HILL	425-233-3054	425-785-2352	Dan.speicher@ch2m.com
X	X			X	X	X	Deborah Dagang	BRT Expert	CH2M HILL	210-587-7591	510-867-7572	Deborah.dagang@ch2m.com
X	X	X	X	X	X	X	Don Anderson	Geotechnical	CH2M HILL	425-233-3418		Donald.anderson@ch2m.com
X	X	X	X	X	X	X	Gustavo Ceballos	Transportation Planning	CH2M HILL	703-376-5143		Gustavo.ceballos@ch2m.com
X	X	X	X	X	X	X	Andrew Leong	LRT Expert	CH2M HILL	720-286-1249		Andy.leong@ch2m.com
X	X	X	X	X	X	X	Charles Nicholas	Financial Expert	CH2M HILL	646-644-7589		Charles.nicholas@ch2m.com
				X	X	X	Rick Hults	Cost Estimating	CH2M HILL	510-251-2888 x37736	925-348-5743	Rick.hults@ch2m.com
X	X	X	X	X	X	X	Brian Bellfi	Alternative Project Delivery	CH2M HILL	303-771-0952 x65328		Brian.bellfi@ch2m.com
X	X	X	X	X	X	X	Kim Nokes	Roadway Design	CH2M HILL	208-383-6451		Kim.nokes@ch2m.com
X	X	X	X	X	X	X	Mark Johnson	Highway Tunnel Design	CH2M HILL	212-688-3990		Mark.johnson@ch2m.com
X	X	X	X	X	X	X	Cesar Tiscareno	Assistant VA Facilitator	CH2M HILL	214-228-8244		Cesar.tiscareno@gmail.com
X	X	X	X	X	X	X	Randy Anderson	HQ Structure Design	Caltrans	916-227-4488		Randy.anderson@dot.ca.gov
X	X	X	X	X	X	X	Andrew Ponzi	Structure Construction	Caltrans	310-751-0365	858-205-4342	Andrew.ponzi@dot.ca.gov
X	X	X	X	X	X	X	Duke Nguyen	Assistant VA Coordinator	Caltrans	213-897-4195		Duke.nguyen@dot.ca.gov
X	X	X	X	X	X	X	Derek Sim	Structure Construction	Caltrans	626-572-6700		Derek.sim@dot.ca.gov
X	X	X	X	X	X	X	Lourdes Ortega	Environmental Planning	Caltrans	213-897-9572		Lourdes.ortega@dot.ca.gov
X							Mine Struhl	Environmental	Caltrans	213-897-5446		mine.struhl@dot.ca.gov
X	X	X	X	X	X	X	Shiva Karimi	Geotech Studies	Caltrans			Shiva.karimi@dot.ca.gov
X	X	X	X	X	X		Jeff Yang	Structure Maintenance and Inspection	Caltrans			Jeff.yang@dot.ca.gov

11	12	13	14	25	26	27	Name	Position/Role	Organization	Telephone	E-mail
X		X				X	Cris Liban	Environmental	Metro	213-922-2471	libane@metro.net
X						X	Geoff Martin	Tunnel Design	Metro		geomar@usc.edu
X	X	X		X		X	Matthew Crow	Tunnel Design/Construction	Metro		crowm@metro.net
X						X	Harvey Parker	Tunnel Design	Metro		harveyparker@compuserve.com
						X	Edward Cording	Tunnel Design	Metro		cordingconsult@gmail.com
X	X	X	X	X	X	X	Lyn Calerdine	Environmental	LSA	760-416-2075	Lyn.calerdine@lsa-assoc.com

Agency/Consultant Team

2013 March											
11	12	13	14	25	26	27	Name	Position/Role	Organization	Telephone	E-mail
X		X				X	Lilly Acuna	Project Assistant	CH2M HILL	213-228-8250	lilly.acuna@ch2m.com
X						X	Loren Bloomberg	Traffic Lead	CH2M HILL	714-435-6020	loren.bloomberg@ch2m.com
X		X				X	Yoga Chandran	Project Manager	CH2M HILL	714-435-6111	yoga.chandran@ch2m.com
X						X	Vincent Chio	Project Engineer	CH2M HILL	213-228-8223	vincent.chio@ch2m.com
						X	Garrett Damrath	Environmental Engineer	Caltrans	213-897-9016	Garrett.damrath@dot.ca.gov
X						X	Steve Dubnewych	Tunnel Design	Jacobs Associates	626-737-6521	dubnewych@jacobssf.com
X							Eldon Gath	Geology/Faulting	Earth Consultants International	714-412-2653	gath@earthconsultants.com
X							Jatindur Gaur		Caltrans		Jatinder.gaur@dot.ca.gov
X		X				X	Cleave Govan	Environmental Lead	Metro	213-922-3034	govanc@metro.net
X						X	Steve Greene	Transit Lead	AECOM	213-330-7182	Steve.greene@aecom.com
X						X	Derek Higa	Design Manager	Caltrans	213-897-0394	Derek.higa@dot.ca.gov
X						X	Bernhard Hoepperger	Tunnel Systems	ILF	703-501-5443	Bernhard.hoepperger@ilf.com
X							Tom Ionta	Engineering Lead	CH2M HILL	714-435-6238	Thomas.ionta@ch2m.com
X		X				X	Ainsley Kung	Design	Caltrans	213-897-6791	Ainsley.kung@dot.ca.gov
X						X	Deborah Pracilio	Environmental Studies	LSA	949-553-0666	Deborah.pracilio@lsa-assoc.com
						X	Jason Roach	Environmental	Caltrans	213-897-0357	Jason.roach@dot.ca.gov
X						X	Abdi Saghafi	Corridor Manager	Caltrans	213-897-9810	Abdi.saghafi@dot.ca.gov

X		X					Michelle Smith	Project Manager	Metro	213-922-3057	smithmi@metro.net
X							Albert Andraos	D7 VA Coordinator	Caltrans	213-897-4921	Albert.a.andraos@dot.ca.gov
X							Josue Yambo	Traffic Engineer	FHWA	213-894-5351	Josue.yambo@dot.gov
X							Chris Newman	State Program Team Leader	FHWA	213-894-4468	Christopher.newman@dot.gov
X							John Ehsan	Geotech	Caltrans	916-201-0127	John.ehsan@dot.ca.gov
		X				X	Karl Dreher		Caltrans		Karl.dreher@dot.ca.gov
		X					Brian Frazer		Caltrans		Brian.frazer@dot.ca.gov
							Lynda Bybee		Metro		bybeel@metro.net
						X	Doug Failing		Metro		failingd@metro.net
						X	Susan Gilmore	Outreach	Metro		gilmores@metro.net
						X	Vincent Gonzalez	Outreach	Metro		gonzalezv@metro.net
						X	Helen Ortiz-Gilstrap		Metro		ortiz-gilstraph@metro.net
						X	Frank Quon		Metro		quonf@metro.net
							Shirley Choate		Caltrans		shirley_choate@dot.ca.gov
						X	Aziz Elattar		Caltrans		aziz_elattar@dot.ca.gov
							Don Fogle		Caltrans		don_fogle@dot.ca.gov
							Dan Freeman		Caltrans		Dan_freeman@dot.ca.gov
							Kimberly Gamble		Caltrans		Kimberly_gamble@dot.ca.gov
							Ron Kosinski		Caltrans		Ron.kosinski@dot.ca.gov
							Lindy Lee-Lovell		Caltrans		Lindy_lee-lovel@dot.ca.gov
							Herby Lissade		Caltrans		Herby_lissade@dot.ca.gov
						X	Gregg Magaziner		Caltrans		Gregg_magaziner@dot.ca.gov
							Michael Miles		Caltrans		Michael.miles@dot.ca.gov
							Andrew Nierenberg		Caltrans		Andrew_P_Nierenberg@dot.ca.gov
							Lauren Wonder		Caltrans		Lauren_wonder@dot.ca.gov
							Melissa De La Peña	Project Report Lead	CH2M HILL	213-228-8232	Melissa.delapena@ch2m.com
		X					Kaz Kayoda		Caltrans		Kaz.kayoda@dot.ca.gov
						X	Ravee Raveendra	Geotech	CH2M HILL	714-435-6248	Ravee.raveendra@ch2m.com
						X	Ryan Meza	Roadway Engineer	CH2M HILL	714-435-6231	Ryan.meza@ch2m.com

X	Ryan Mitry	Roadway Engineer	CH2M HILL	714-435-6337	Ryan.mitry@ch2m.com
X	Kristopher Barker	Geotech	Caltrans	213-620-2334	Kristopher_barker@dot.ca.gov
X	Bernhard Parth	Engineering	ILF		bernhard.parth@ilf.com
X	Chris Joe	Intern/Highway Prog.	Metro	213-922-4848	joec@metro.net
X	Robert Stewart	QA/QC	VMS, Inc.	503-224-1415	rob@vms-inc.com
X	Joe Sawtelle	QA/QC for Metro	Tran Systems	714-708-6881	jwsaqtelle@transystem.com
X	Wayne Brown	Public Outreach	MBI Media	626-967-1510	wbrown@mbimedia.com
X	Anne Kollefor	Public Outreach	Consensus Inc.	213-802-1755	Anne.kellefer@consensusinc.com
X	Ellen Isaach	Metro Communications	Metro	213-922-2488	isaache@metro.net
X	Scott Page	Metro Service Planning	Metro	213-922-1228	pages@metro.net
X	Sam Hout		CH2M HILL	949-374-2553	Sam.hout@ch2m.com
X	Bardia Nezhati		CH2M HILL	702-445-2307	Bardia.nezhati@ch2m.com
X	Jay McRae		CH2M HILL	503-804-6939	Jay.mcrae@ch2m.com
X	Elaheh Yadegar		Caltrans		elaheh.yadegar@dot.ca.gov

Appendix A
VA Study Attachments

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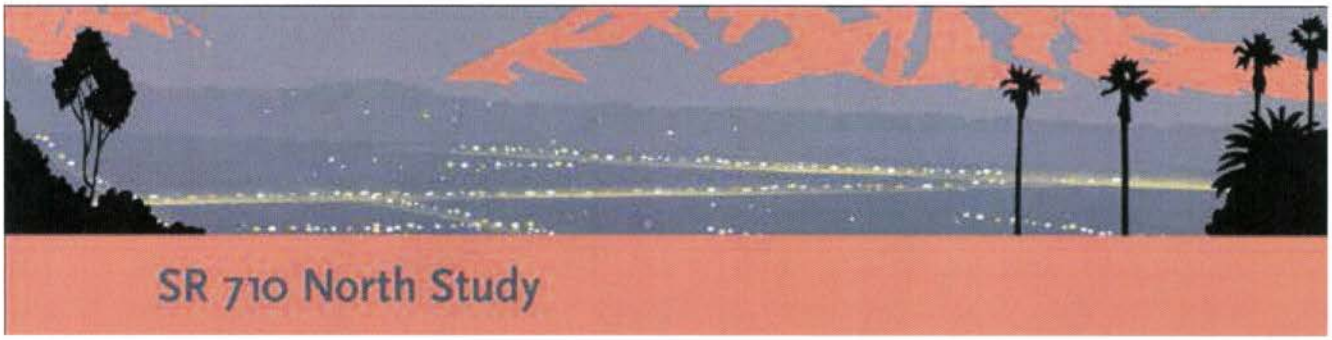

Appendix A
VA Study Attachments

APPENDIX A. VA STUDY ATTACHMENTS

The following items are included in this appendix:

- Pre-Study Agenda and Coordination Information for Value Analysis Study of SR 710
- Agenda and Coordination Information for Value Analysis Study
- Value Analysis Overview – PowerPoint Presentation
- Executive Summary Presentation Value Analysis Study – PowerPoint Presentation

Pre-Study Agenda and Coordination Information for Value Analysis Study of SR710

February 20, 2013

Metro and Caltrans

Meeting Location and Time

Metro Building in Benefits Conference Room on the 21st Floor.

Meeting Date, Time: Wednesday, February 20, 2013, 1:00 p.m. to 2:30 p.m.

Attendees:

VA Team Leader, CH2M HILL Program and Design Representative, LA Metro, Caltrans (Not the full Value Analysis Team)

Yoga Chandran, Program Manager, CH2M HILL
Paul Johnson, Value Analysis Team Leader, CH2M HILL
Michelle Smith, Metro
Derek Higa, Caltrans
Abdi Saghafi, Caltrans
Gaur Jatinder, Caltrans
Damrath Garrett, Caltrans
Jason Roach, Caltrans
Thomas Ionta, CH2M HILL
Tim Bevan, CH2M HILL
Ainsley Kung, Caltrans
Lilly Acuna, CH2M HILL

Planning Value Analysis Study

Participants: VA Team Leader, CH2M HILL Program/Design, LA Metro, Caltrans Representatives

- Introductions

- Review of the planned VA Study Agenda

- Confirm Focus of Study, Expected Outcomes, Goals from VA Study, Deliverables

- Schedule of the VA Study

- Confirm Study Participants, Times of Attendance

- Discuss all materials needed and who will assemble, and any further preparations necessary prior to the study, possibly including:

1. Financial Review: Toll Revenue Study and Bonding Capacity
2. Project Scope Review
3. NEPA and Design Document Comparative Review
4. Project Delivery Method Review
5. Independent Cost Estimate
6. Project Schedule Review

Agenda and Coordination Information for Value Analysis Study

Revised March 6, 2013

Metro SR 710 Program

Metro and Caltrans

Orientation Meeting and Site Tour Date: Monday, March 11, 2013
Continuing VA Study Dates: Tuesday, March 12 through Thursday, March 14, 2013 and Monday, March 25 through Wednesday, March 27, 2013

Executive Summary Presentation on Wednesday, March 27, 10:00 a.m. to 12:00 p.m.

Study Locations

VA Session 1 (March 11 - March 14) for VA Orientation Meeting, and Days 1-4 of the VA Study:
Caltrans Building, 100 South Main Street, Los Angeles, CA

VA Session 2 (March 25 - March 27) for Days 5-7 of the VA Study, and the VA Executive Summary Presentation on Day 7:
Metro at One Gateway Plaza (Union Station), Los Angeles, in the Mulholland Conference Room

Introduction and Project Description

This scope of work describes the services to be provided by CH2M HILL, Inc. (CH2M) to facilitate a Value Analysis (VA) study on the SR 710 Program in Los Angeles, for Metro and Caltrans.

Refer to the State Route 710 Study, Alternatives Analysis Report, December 2012, for a description of the project, and the five short-listed alternatives, including:

- The No Build Alternative
- The TSM/TDM Alternative
- Alternative BRT-6, with possible refinements
- Alternative LRT-4A/B, with possible refinements
- Alternative F-7, with possible refinements

Metro and Caltrans desire that an independent VA study be conducted in order to assess the project's functions and costs, and to outline functional and cost-saving strategies for each of the four build alternatives that can be considered for implementation at this time. It will not be the focus of the VA study to recommend a specific alternative from the five short-listed alternatives. The selection of a final alternative will be facilitated in a different setting involving multiple stakeholders.

Value Analysis Study Goals and Methodology

The general mission of the VA study is to provide Metro and Caltrans with recommendations for improved value solutions, where possible, for meeting the transportation goals of the project, for any of the four "build" alternatives that may be selected through subsequent evaluation by the project team. The VA Team will provide recommendations that seek to minimize total initial and life-cycle cost, and will also address functional improvements, where possible. P3 delivery alternatives will be evaluated on a preliminary basis. CH2M will lead the VA Team, consisting of CH2M HILL multi-disciplinary staff assigned to the study as identified herein, and Metro and Caltrans representatives, as appropriate.

VA Study Participants

- VA Team Leader/Facilitator – Paul Johnson, CVS, CH2M HILL; Office: (208) 383-6299; cell: (208) 890-8203; paul.johnson@ch2m.com
- Decision Analysis: Dan Speicher
- Roadway Design: Kim Nokes
- Geotechnical: Don Anderson
- Highway Tunnel Design: Mark Johnson
- Highway Tunnel Ventilation: Baljinder Bassi (Mark Johnson will coordinate ventilation issues with Baljinder) *((Baljinder is not available for VA Session 1, but he will coordinate offline with Mark Johnson for tunnel issues the week of March 18. Then Baljinder and Mark will return for VA Session 2 on March 25-27.)*
- LRT Expert: Andrew Leong
- Financial Expert: Charles Nicholas
- Alternative Project Delivery: Brian Bellfi
- Transportation Planning: Gustavo Ceballos
- Environmental: Lyn Calerdine
- Cost Estimating: Rick Hults *(Rick will not attend Session 1, but Rick will be available by email. Rick will participate in VA Session 2 on March 25-27)*
- BRT Expert: Deborah Dagang
- Assistant VA Facilitator: Cesar Tiscareño

- **Metro Participants:**
- Environmental: Cris Liban *(Cris will attend March 12/13 and March 26/27)*
- Tunnel Design/Construction: Matthew Crow *(Full time)*
- Tunnel Design: Edward Cording *(Will attend March 27)*
- Tunnel Design: Geoff Martin *(Might attend March 11; Will attend March 27)*
- Tunnel Design: Harvey Parker *(Might attend March 11; Will attend March 27)*

- **Caltrans Participants:**
- Structure Construction: Andrew Ponzi *(Full time)*
- HQ Structure Design: Randy Anderson *(Full time)*
- Geotech Studies: Shiva Karimi *(Full time)*
- Structure Maintenance and Inspection: Jeff Yang *(Full time)*
- Assistant VA Coordinator: Duke Nguyen *(Full time)*
- Environmental: Mine Struhl *(Full time Session 1)*
- Environmental: Lourdes Ortega *(Full time Session 2)*
- Structure Construction Technical Resource: Ken Bocchicchio

- Structure Construction Technical Resource: Thomas P. Grey
- Structure Construction Technical Resource: Peter Strykers
- Structure Maintenance and Inspection Technical Resource: Pete Whitfield
- P3 Program Technical Resource: Nizar Melehani
- Design Technical Resource: Karl Dreher
- R/W Technical Resource: Zoltan Elo
- R/W Technical Resource: Wayne Lee
- Air Quality Technical Resource: Andrew Yoon
- Geotech Studies Technical Resource: John Ehsan
- HQ Structures Design Technical Resource: Moe Amini
- FHWA Technical Resource: Josue Yambo
- FHWA Technical Resource: Chris Newman
- FHWA Technical Resource Backup: Cesar Perez

Administrative support for the VA Study will be provided by Lilly Acuña, phone (213) 228-8250, from CH2M HILL's Los Angeles office. This will be a part-time effort during the study sessions to assist with study logistics when necessary.

Metro and Caltrans Agency Managers

Additional Metro and Caltrans representatives involved in the project may attend the orientation meeting on March 11, and VA Executive Summary presentation on March 27.

Design Team

The planning/preliminary design consultant to Metro is CH2M HILL. The planning team will be represented by Yoga Chandran and team who have been requested by Metro and Caltrans to present the project history and design information to the VA Team at the Orientation Meeting on the first day of the VA study – March 11, 2013. Yoga Chandran and team are also requested to attend the VA Executive Summary presentation on March 27, 2013.

Metro and Caltrans VA Coordinators

Metro and Caltrans VA representatives:
Metro: Michelle Smith – Project Manager
Caltrans: Abdi Saghafi - Corridor Manager, with input from Derek Higa, or Jatinder Gaur

These Metro and Caltans staff will attend the VA Orientation Meeting on March 11, and the VA Executive Summary Presentation on March 27, 2013 - the last day of the VA study.

Additional Metro or Caltrans Attendees

At the Owner's discretion, additional Metro or Caltrans representatives involved in the project may attend the VA Orientation Meeting, site tour, and VA Executive Summary presentation.

Pre-Study Information Gathering

The CH2M HILL VA Team Leader will coordinate with the Metro and Caltrans VA manager and CH2M HILL to request compilation of pertinent project design information for the VA study.

The VA Team Leader will confirm that sufficient copies of existing design documentation will be available to the VA Team during the week of the study. Pertinent documentation includes, but is not limited to: alternatives evaluations, design drawings, specifications, cost estimates, environmental documents, schedules, budgets, soils reports, the bridge construction options report, and other information that describes existing conditions, the final design, and interfaces with adjacent projects (current or future).

A subset of pertinent design information has been reproduced by CH2M HILL and sent to VA Team members for their review prior to the VA study.

Materials and Equipment for VA Study Support

Lilly Acuña is requested to bring an In-Focus projector and screen in order to accommodate PowerPoint or other presentations by CH2M HILL at the VA Orientation Meeting on March 11, and the VA Executive Summary presentation on March 27.

The Caltrans office will have a projector for laptop connections, a projection screen, a printer and copier, and office supplies needed for the VA study.

Metro, Caltrans and other agency staff who are participating full time on the VA study are requested to each bring a laptop computer with Word and Excel software, and e-mail capability, for use during the VA study. (Note: Laptops are not needed on March 11, but will be needed for the remainder of the study.)

All VA study participants are requested to bring their own reference books beginning on March 12 (or have them available at a nearby office). Reference books include any resource that may be needed for VA study calculations, such as tunnel design guidelines, cost estimating references, green book, and other transportation design guidelines. If you need help arranging a laptop or other reference materials, please contact Yoga Chandran or Lilly Acuña in advance of the VA study.

VA Study Agenda

Monday, March 11

Phase 1 – Information

Participants: All VA team members, Metro, Caltrans CH2M HILL design representatives beginning at 8:00 a.m.

Location: Caltrans, 100 S. Main Street, Los Angeles

8:00 a.m. to 8:15 a.m. *All participants, including the owner and design team and the VA Team should plan on arriving at 8:00 a.m.*	**SAFETY MOMENT, AND INTRODUCTIONS** Introductions and roles on the project
8:15 a.m. to 8:40 a.m.	**OVERVIEW OF STUDY AGENDA AND VA PROCESS/ DECISION SCIENCE APPLICATION** – Paul Johnson, CVS - VA Team Leader and Dan Speicher

8:40 a.m. to 9:00 a.m.	**METRO and CALTRANS OVERVIEW** **Metro Perspectives** • Project objectives • What Metro and Caltrans would like from the VA/DS Study • Project Funding/Constraints • Scheduling Requirements • Stakeholder Concerns **Caltrans Perspective** • Caltrans expectation • Design Objectives • Historic Consideration • General Comments • Next steps in the Project Analysis/Environmental Documentation process
9:00 a.m. to 11:15 a.m.	**DESIGN TEAM PRESENTATION** – by Yoga Chandran/CH2M HILL and design team *(Including Q/A for each topic, may be arranged by alternative rather than individual subject area)* • Overview of Project - Yoga Chandran • Purpose and need – Deborah Pracilio Range of Alternatives considered, including final alternatives - Yoga Chandran • Discussion of each alternative, include design considerations, refinements, right-of-way, and cost. Also highlight high cost items, CAD information – Tom Ionta, Steve Greene, Vincent Chio ➢ No-Build ➢ TSM/TDM ➢ LRT ➢ BRT ➢ Freeway Tunnel • Tunnel design considerations – Steve Dubnewych and Bernhard Hoepperger ➢ Tunnel cross-section and features ➢ FLS and ventilation components • Seismic and geotechnical evaluations, including faulting – Eldon Gath • Environmental considerations for each alternative – Deborah Pracilio • Traffic Study Results – Loren Bloomberg • Community concerns – Yoga Chandran • General Schedule – Yoga Chandran

11:15 a.m. to 12:00 p.m.	**ALTERNATIVES ANALYSIS –** Dan Speicher, Loren Bloomberg, Steve Greene • Alternative Analysis Process • Evaluation Criteria and results • Alternatives considered and removed • Performance limitations of alternatives (areas that present the best opportunity for improvement)
12:00 p.m. to 1:00 p.m.	**LUNCH BREAK**
1:00 p.m. to 5:00 p.m.	**DRIVE AND TOUR OF PROJECT SITE** Several representatives from the Owner/Program Manager, and Design team, are requested to guide the VA Team members on a tour of the facility. CH2M HILL (Yoga Chandran) is requested to provide a van or vans and driver(s). CH2M HILL VA staff are requested to bring their own safety equipment (orange reflective vests, and safety glasses). VA Team members are requested to wear suitable business casual clothing and sturdy shoes for the tour.

VALUE ANALYSIS STUDY

Tuesday, March 12

Phase 1 – Information – Continued

Participants: VA Team only

Location: Caltrans office in downtown Los Angeles office (see address above)

8:00 a.m. to 9:00 a.m.	**FURTHER REVIEW OF DESIGN INFORMATION**
9:00 a.m. to 10:00 a.m. *Break, 10:00 a.m. to 10:15 a.m.*	**TEAM FOCUS QUESTIONS AND ANSWERS** • What is the problem we are about to discuss? • Why do we consider this a problem? • Why do we believe a solution is necessary? • What are the highest cost components of the project? • What are the highest risk issues associated with the project? • What are the expected outcomes from the VA study? • What options are available to build up the existing alternatives and/or reducing their limitations as outlined in the Alternatives Analysis?
10:15 a.m. to 12:00 p.m.	**FUNCTIONAL ANALYSIS** • Identify significant project functions with opportunities for cost reduction or functional enhancement • Alternative Analysis criteria application • FAST Diagram
12:00 p.m. to 1:00 p.m.	**LUNCH BREAK**

Phase 2 – Creative

1:00 p.m. to 2:30 p.m.	**APPLICATION OF EXISTING AND CREATION OF NEW CRITERIA** • Agree on application of Alternatives Analysis criteria • Generate new criteria
2:30 p.m. to 5:00 p.m.	**BRAINSTORMING** • Generate alternative solutions to current designs • Generate new designs • Validation of design elements

Wednesday, March 13	*Phase 3 – Analysis* **Participants:** VA Team only **Location:** Caltrans downtown Los Angeles office (see address above)
8:00 a.m. to 12:00 p.m. *Lunch break 12:00 p.m. to 1:00 p.m.*	**PERFORMANCE OF ALTERNATIVE SOLUTIONS** Screening of Concepts • Weighting of criteria • Performance rating of options • Key Advantages and Disadvantages of Each Alternative • Are there any Fatal Flaws that Preclude an Alternative? • Are there other Alternatives that should be considered? • LOS Considerations • Safety Considerations • Showcase improvements to performance baseline from the Alternatives Analysis
1:00 p.m. to 5:00 p.m.	**REFINEMENT OF PROMISING ALTERNATIVE SOLUTIONS** • Point Values as Indicators for Relative Comparisons • Determine Top Concepts, and Refine as Necessary • LOS Considerations • Point Values as Indicators for Relative Comparisons • Determine Top Concepts, and Refine as Necessary • LOS Considerations
3:00 p.m. to 4:00 p.m. or another time this afternoon (March 13th) that is convenient for Caltrans and Metro. This meeting could also take place on Thursday morning, March 14th.	***Mid-Study Briefing with Caltrans HQ Staff, and Metro, and CH2M HILL Design Representative (Yoga Chandran)*** • Review of Proposals being considered for development by the VA Team • Indication of Proposal Priority • Drop any Proposals that are deemed unworkable from the outset, so that the VA Team remains focused on proposals that are of interest to Caltrans and Metro with the potential for consideration

Thursday, March 14 — *Phase 4 – Results Development*

Participants: VA Team only

Location: Caltrans downtown Los Angeles office (see address above)

8:00 a.m. to 10:00 a.m. *Break, 10:00 a.m. to 10:15 a.m.*	**RANKING OF ALTERNATIVES** • Characterization of improvements to existing alternatives • Characterization of performance of all potential alternatives, including new alternatives • Rank improvements and display tradeoffs
10:15 a.m. to 1:00 p.m. *Lunch Break, 12:00 p.m. to 12:45 p.m.*	**BEGIN WRITE-UPS, ECONOMIC CALCULATIONS, SKETCHES FOR COST PROPOSALS, DECISION SCIENCE GRAPHICS** **FORMAT OF MATERIALS FOR PRESENTATIONS**
1:00 p.m. to 2:00 p.m.	**ACTIONS AND ASSIGNMENTS** Actions and assignments during study break from March 15 through March 22.
2:00 p.m.	**Adjourn Session 1**

Monday, March 25 — *Phase 4 – Development (continued)*

Participants: VA Team only

Location: Metro at One Gateway Plaza (Union Station), Los Angeles, in the Mulholland Conference Room

8:00 a.m. to 5:00 p.m.	**CONTINUE WRITE-UPS, ECONOMIC CALCULATIONS, SKETCHES FOR COST PROPOSALS, DECISION SCIENCE GRAPHICS** **DISCUSSIONS OF DRAFT MATERIAL** Review of: • Advancements of existing alternatives • New alternatives • Cost saving strategies • Performance against evaluation criteria • Presentation materials

Tuesday, March 26	*Phase 4 – Development (continued)* **Participants:** VA Team only **Location:** Metro at One Gateway Plaza (Union Station), Los Angeles, in the Mulholland Conference Room
8:00 a.m. to 5:00 p.m.	**WRITE-UPS, ECONOMIC CALCULATIONS, SKETCHES FOR COST PROPOSALS, DECISION SCIENCE GRAPHICS** **PREPARE EXECUTIVE SUMMARY PRESENTATION**

Wednesday, March 27	*Phase 4 – Development (continued)* **Participants:** VA Team only **Location:** Metro at One Gateway Plaza (Union Station), Los Angeles, in the Mulholland Conference Room
8:00 a.m. to 10:00 a.m.	**COMPLETE WRITE-UPS, AND CROSS CHECK PROPOSALS; COMPLETE PREPARATIONS OF THE EXECUTIVE SUMMARY PRESENTATION** **Participants:** VA Team only **Location:** CH2M HILL downtown Los Angeles office (see address above) • Show Consequence Table for performance of alternatives (both existing and new alternatives) • Show contributions by category- as a means to communicate results • Display value/cost tradeoffs graphic • Showcase how results of VA assist with the movement toward decisions of alternatives in PA/ED

Wednesday, March 27	***Phase 5 – Presentation*** **Participants:** Metro, Caltrans, and Agency Managers, FHWA, CH2M HILL and all VE Team members **Location:** Metro at One Gateway Plaza (Union Station), Los Angeles, in the Mulholland Conference Room
10:00 a.m. to 12:00 p.m.	**EXECUTIVE SUMMARY PRESENTATION TO METRO, CALTRANS, AND CH2M HILL DESIGN TEAM** (This Presentation will conclude the Value Analysis Study.) The Preliminary VA Report will be prepared within 10 working days following the VA study. It will be distributed to Metro, Caltrans, CH2M HILL Design Team, Agency and VA participants both in hard copy and electronic PDF format.
12:00 p.m.	**Adjourn the VA Study**

Follow-up	***Phase 6 – Implementation***
	The Implementation Phase will be subsequent to the VA Study, following Metro's, Caltrans', CH2M HILL's, and other participants' review of the Preliminary VA Report. CH2M HILL suggests that a conference call be held with appropriate Metro, Caltrans and CH2M HILL design team members to determine acceptance, rejection, or modification of the VA proposals for incorporation into the design as appropriate. CH2M HILL will follow-up with a Final VA Report summarizing the final disposition of the VA proposals. Ten copies and an electronic PDF copy of the Final VE Report will then be sent to Metro and Caltrans within 2 weeks of receipt of the final dispositions of the VA proposals and observations.

Value Analysis Overview

Metro SR710 Program

Metro and Caltrans

VA Study: Session 1: March 11-14, 2013
Session 2: March 25-27, 2013

Paul Johnson, CVS
Dan Speicher, Decision Analysis

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OVERVIEW

- Value Analysis (VA), or Value Engineering (VE) History
- Why Use VA (synonymous with VE)
- When to Use VA
- Concept Level vs. Mid-Design VA/VE
- VA Methodology
  - What, How, When, and Why
- VA Focus on SR710 Project
  - Objectives from the VA Study
  - Ground Rules

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Value Engineering History

- 1945 GE assigns L. D. Miles to reduce costs
- 1947-52 L. D. Miles developed and proved function techniques
- 1955 Navy adds VE Incentive Clause in contracts
- 1959 Society of American Value Engineers founded
- 1964 Corps of Engineers applies VE to construction
- 1969 NASA starts formal VE studies
- 1970 DOT uses VE Incentive Clause
- 1988 OMB issues Circular A-131
- 1991 DOE Order 4010.1
  - Replaced by DOE Order 430.1A (1998) and O 413.3 (2000)
- Canadian Society of Value Analysis (CSVA) Founded in early 1990's
  1996 Public Law 104-106 (all Federal Agencies)
- 2004 DOE Policy 413.2
- SAVE – The Value Society; www.value-eng.org

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What Value Engineering Is

- A systematic problem-solving method
- Multidisciplinary VE team
- Structured process: Typically a 5-day (40-hour) study
- Conducted on capital improvement projects to save money <u>without compromising function</u>
- And to <u>enhance function</u> within the Owner's budget
- VE usually pays for itself on projects over $5 million
- Requirement to conduct VE on DOT Highway projects over $50 million involving federal funding (or for Bridges over $40 million)
- VE Process is applied to Capital Improvement Projects: Transportation, Water, Wastewater, Military, Public Sector Buildings

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Value Engineering Balances Cost, Reliability, and Performance Issues

Value Engineering is a proven management technique that uses a systematic approach to identify the best functional balance between the cost, reliability and performance of a product or project to meet the owner's objectives.

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Why Use Value Engineering?

- **Focus on essential functions not systems or procedures**
- **Embraces creativity and out of the box thinking**
- **Uses life-cycle cost analysis for decision making**
- **Provides an organized framework for alternative development**
- **Consistently achieves the desired results (from 5:1 to 50:1 ROI)**

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The Value Equation

$$V = F/C$$

Where V = Value from the Owner's Eyes

F = Function

C = Cost

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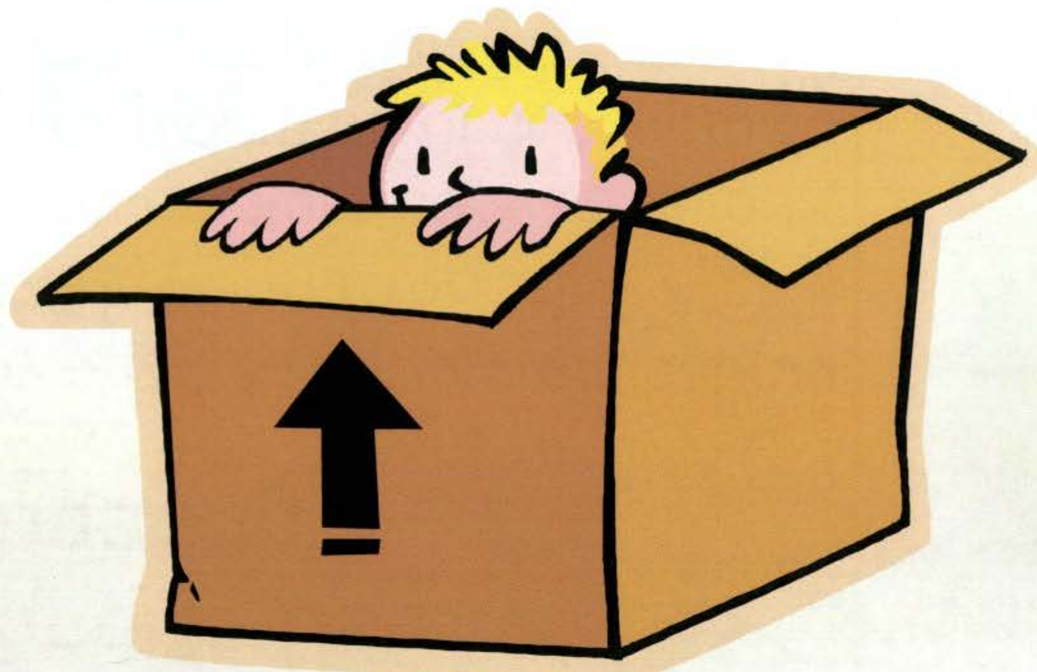
VE Is A Structured Team Approach Focused On Function(s) And Thinking Outside The Box



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The Best Time to Use Value Engineering

- Early on in any project (i.e., pre-conceptual or earlier (Value Planning)
- Validated cost savings are best achieved between 80% development of conceptual and 20% development of definitive design
- VE can also be applied during construction, and during process, operation, and maintenance cycles

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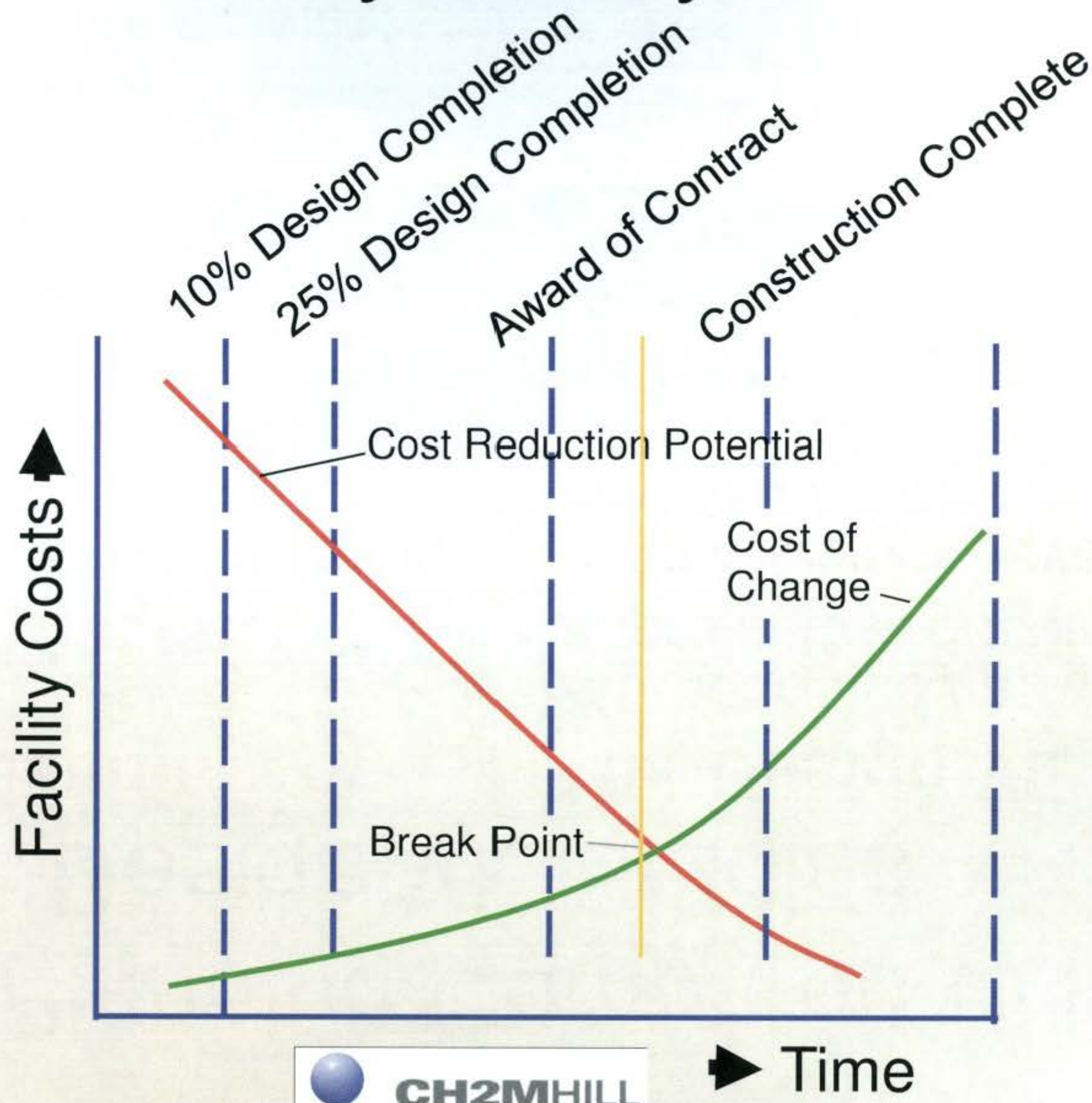
Opportunities for Savings in Facility Life Cycle



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Value Planning Compared to Mid-Design VE Studies

Value Planning, or Concept-Level VE (Value Analysis)

- Abbreviated or full study, pre-design
- Many concepts considered
- VE Team includes key project stakeholders
- Goal is to select preferred concept
- Design continues with fewer challenges
- Mid-design VE follows

Mid-Design VE

- 40-hour study at approx. 40% design
- Eng & Owner have selected a design
- VE focus is normally on cost savings
- Functional enhancement proposals possible without major change to project geometry

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How VE Handles Cost

- There is always a better way to do anything.
- The secret is to understand functions…
- And then determine the best value!

Best value does <u>not</u> mean "cost cutting."

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Value Engineering Employs Six Steps

- **Information**
- **Creative**
- **Analysis**
- **Development**
- **Presentation**
- **Implementation**

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VE Process Diagram

Value Engineering Process Diagram

Pre-Workshop Activities

- Determine Objectives
- Identify VE Team
- Prepare Agenda
- Distribute Orientation Memo
- Review Documents
- Analyze Costs

Workshop Activities

Information Phase	Creative Phase	Analysis Phase	Development Phase	Presentation Phase
↓	↓	↓	↓	↓
Understand Project and Functions	Generate Ideas for Improved Value	Rate Best Alternatives	Perform Analysis and Cost Estimate	Explain Ideas and Rationale

Post-Workshop Activities

→ Evaluate Recommendations → Document Results → Implement Changes

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Pre-Study Phase

- Solidify customer needs and success criteria
  - Interview PM and key team members
- Define the problem(s) to be solved
- Gather information on project design, cost, schedule, status, and lessons learned to-date
- Define specific VE study scope, objectives and deliverables
- Identify the appropriate team member skills to match the objectives and deliverables
- Solidify workshop schedule and logistics
- Conduct team briefing prior to the workshop

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The Information Phase Is Important!

If I were given an hour to solve a problem on which my life depended, I would spend:

40 minutes studying it
15 minutes reviewing it
5 minutes solving it

Albert Einstein

Answers the Questions:

- **How does it work today?**
- **Who does what?**
- **What does that cost?**
- **What's the problem to be solved?**

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Function Analysis Phase

- Function is defined as a two word statement:

"Active Verb/Measurable Noun"

- Identify and classify functions
- Develop function, worth, and cost models
  - Function Analysis System Technique Diagramming
    - Applies intuitive logic to test functions
    - Identifies dependence between functions
    - Creates common language for team

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Function Analysis System Technique

FAST Diagramming

- Developed in 1964 by Charles W. Bytheway
- Applies intuitive logic to test functions
- Displays functions in a diagram or model form
- Identifies dependence between functions
- Creates common language for team
- Tests validity of functions
- No "correct" FAST model -- team consensus

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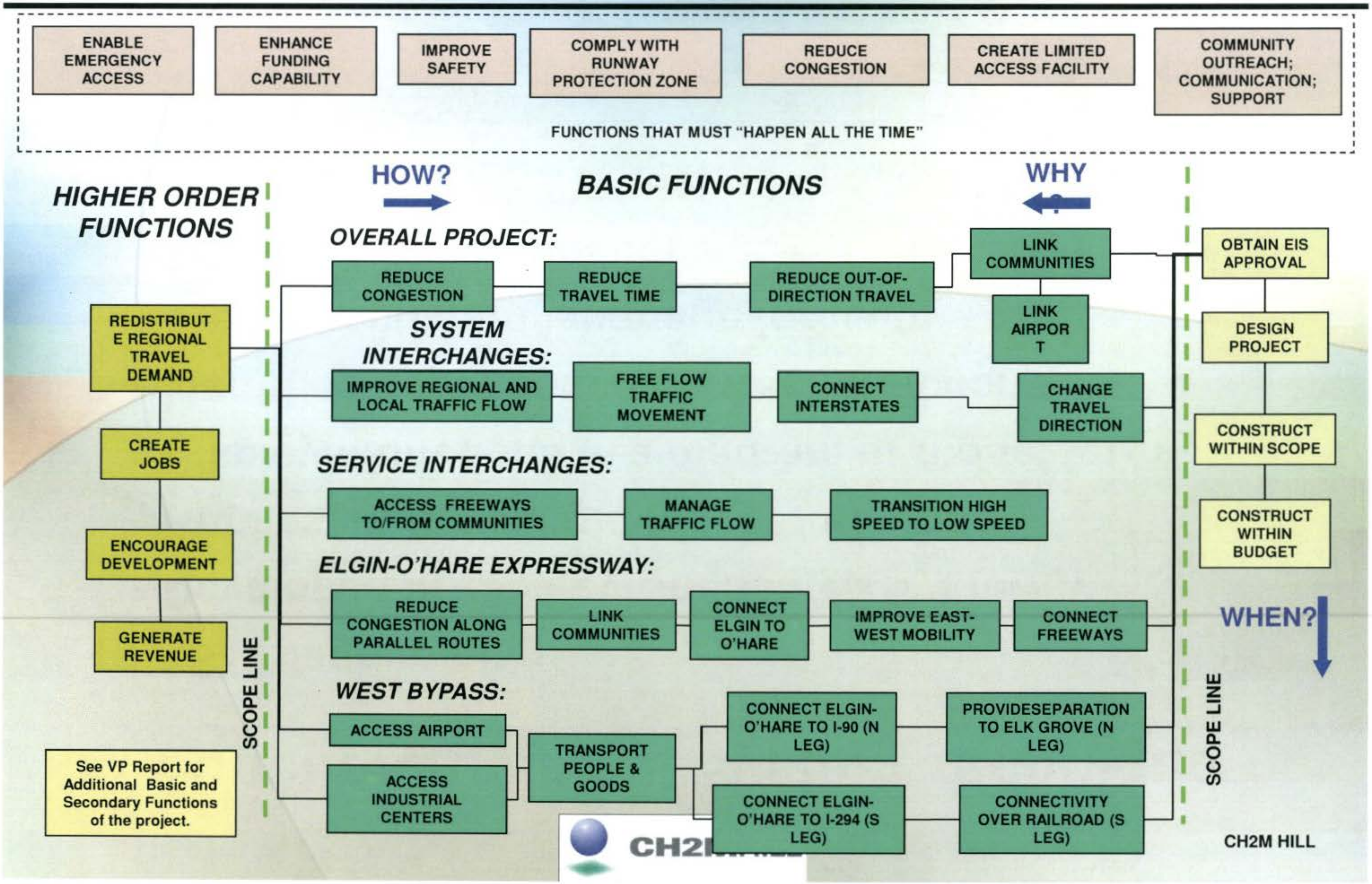
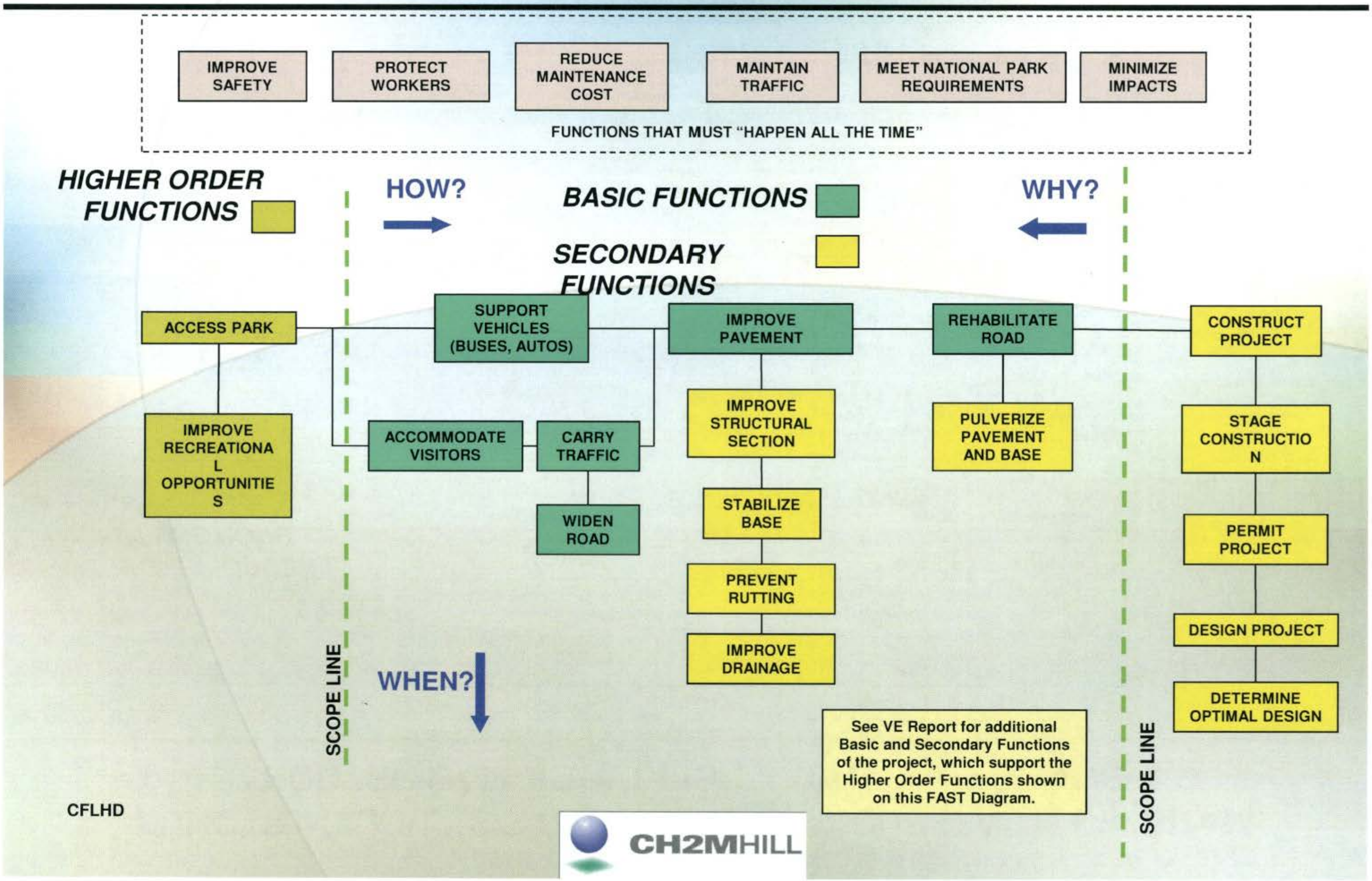
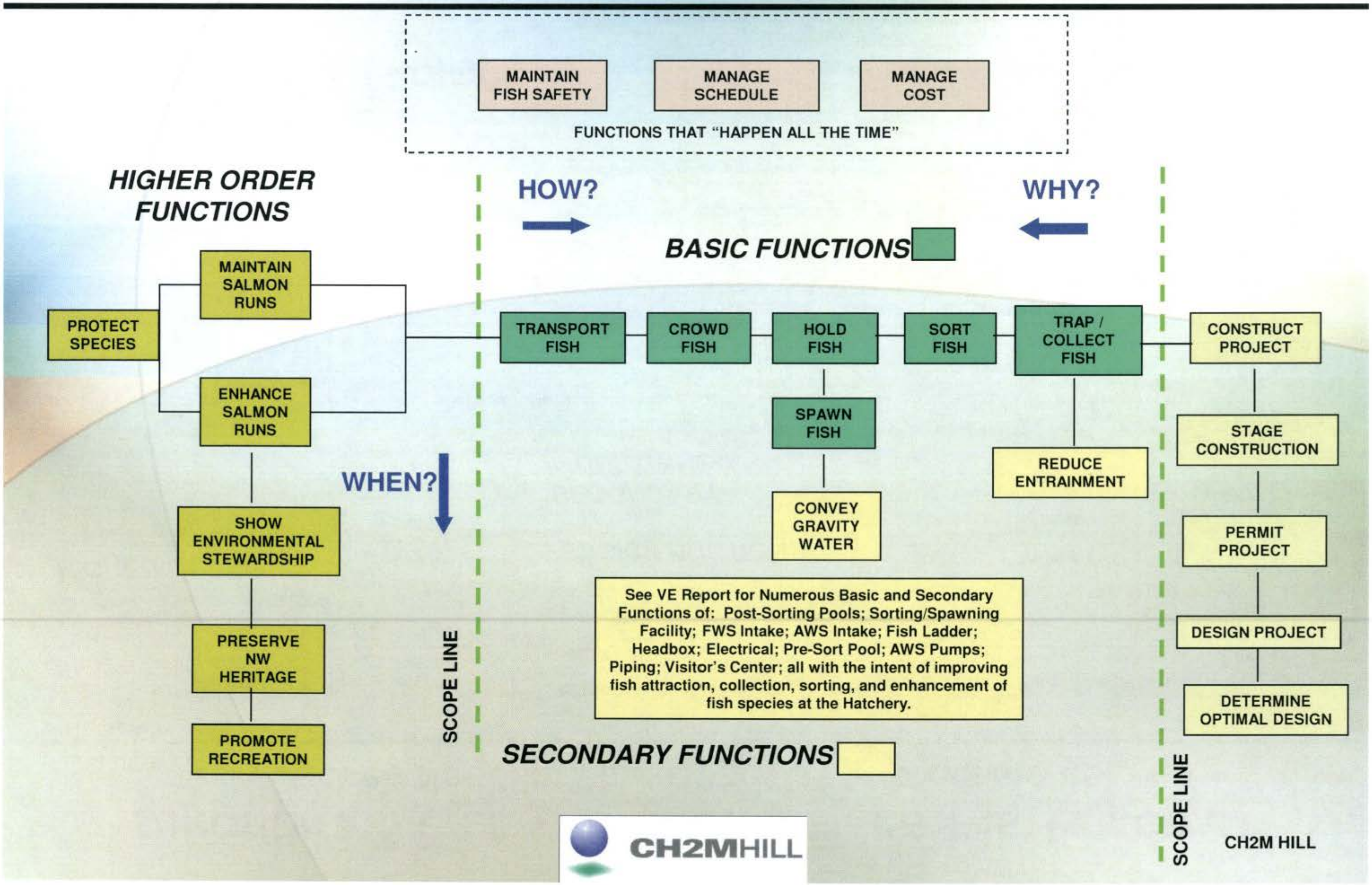
FUNCTION ANALYSIS SYSTEM TECHNIQUE (FAST) DIAGRAM
Elgin-O'Hare West Bypass, Initial Build Project



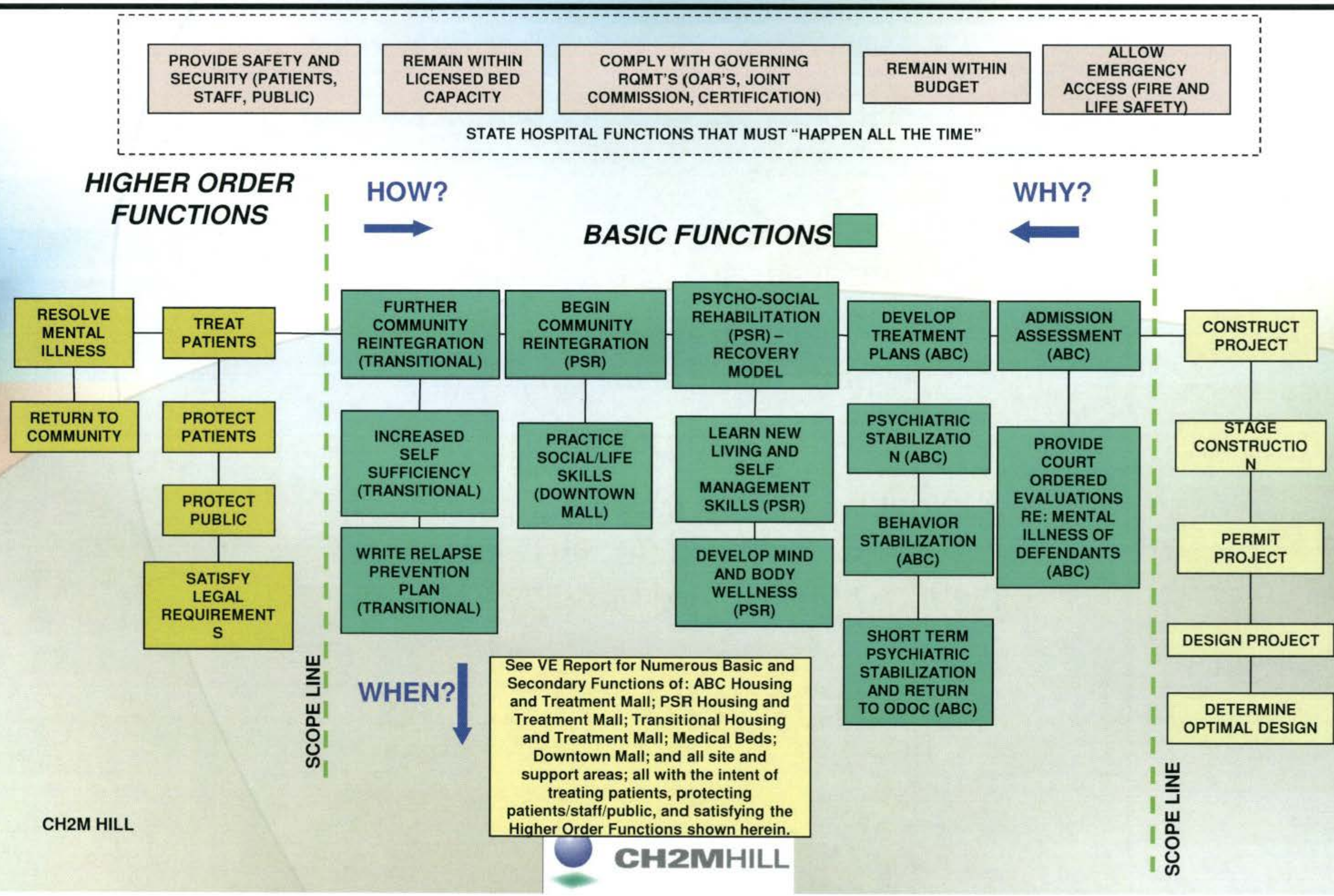
FUNCTION ANALYSIS SYSTEM TECHNIQUE (FAST) DIAGRAM
Arches National Park Roadway Improvements



FUNCTION ANALYSIS SYSTEM TECHNIQUE (FAST) DIAGRAM
FOSTER DAM ADULT FISH FACILITY UPGRADE



FUNCTION ANALYSIS SYSTEM TECHNIQUE (FAST) DIAGRAM
OREGON STATE HOSPITAL, JUNCTION CITY SITE



PARETO PRINCIPLE

Developed by Vilfredo Pareto and Dr. Joe Juran
The "80-20" Rule
Separates Vital Few From Trivial Many

Examples

80% of the costs are incurred by
20% of the functions

80% of the time is spent on
20% of the functions

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CREATIVE PHASE

- Select functions to brainstorm
- Follow brainstorming rules
  - Defer judgment
  - Generate many ideas -- Quantity not Quality
  - Freewheeling
  - Listen/improve on other's ideas (hitchhike)
  - Don't criticize/evaluate (yours or others)
  - Encourage participation
  - Record all ideas
- Brainstorm functions
- Identify other ways to perform the function

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EVALUATION PHASE

Evaluation is accomplished in 2-3 rounds:

- Eliminate possible, but improbable
- Group similar ideas
- Identify lowest cost ideas
- Develop/Use Criteria
  - Paired comparison
- Rank and rate ideas
  - Weighted criteria
- Select best ideas for development

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DEVELOPMENT PHASE

- Initiate and facilitate changes
- Anticipate roadblocks
- Conduct cost benefit analysis
- Develop implementation plan
- Prepare final proposals
- Promote recommendations

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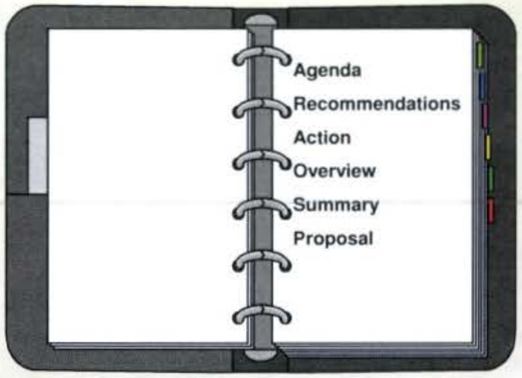
PRESENTATION PHASE

- Present results and obtain approval to proceed
  - Brief overview of VE process
  - Present recommended proposals to management
  - Solicit input/enhancements and approval to proceed



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Post-Study Phase

- Issue Formal Report
  - News you can use
- Implement Changes and Monitor Status
  - Complete change documentation, as appropriate
  - Procure resources, as appropriate
  - Track until completion
- Feedback: Incorporate Lessons Learned

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What Makes VE Unique?

Interdisciplinary Team
+
Job Plan
+
Function/Fast
+
Documentation
+
Facilitation

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Decision Science Defined

- **Decision Science is the application of structure, process, and tools to assist with the collection of data, evaluation of performance, and communication of tradeoffs among alternatives. Application of Decision Science supports the decisions makers in reaching a conclusion.**
- **All of us have been through decision science applications**

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Decision Science will support the VA in three ways - #1

- *Continuity of Decision process*
- **The Alternatives Analysis has taken advantage of Decision Science methodology – establishing and applying performance criteria. Applying Decision Science methods in the Value Analysis (VA) would continue the application of these same criteria to maintain continuity in the decision process.**
- **Benefits:**
  - **Clear application of the Advisory Group's criteria**
  - **Continuity of decision making process into the PA/ED Phase**

Decision Science will support the VA in three ways - #2

- ***Transition to Compare Across Modes***
- **The Alternatives Analysis showcased performance of each mode, comparing across modes will be part of the PA/ED process. Applying the performance criteria from the Alternatives Analysis with Decision Science process and tools in the VA will demonstrate comparable mode performance.**
- **Benefit:**
  - **Application of performance criteria in comparing across modes**

Element of Need	Objective	No Build	TSM/TDM	BRT-1	BRT-6	BRT-6A	LRT-4A	LRT-4B	LRT-4D	LRT-6	F-2	F-5	F-6	F-7	H-2	H-6
Regional Transportation System	1: Minimize travel time	1	2	3	2	2	3	3	3	3	4	3	4	5	1	2
	2: Improve connectivity and mobility	1	1	1	2	2	2	2	2	2	3	4	5	4	2	2
Freeway system in study area	3: Reduce congestion on freeway system	1	2	1	1	1	1	1	1	1	6	5	7	5	4	3
Local Street system in study area	4: Reduce congestion on local street system	1	1	1	1	1	1	1	1	1	4	5	6	6	1	2
Transit system in study area	5: Increase transit ridership	1	4	6	6	6	7	7	7	7	1	1	1	1	1	1

Decision Science will support the VA in three ways - #3

- ***Communication of VA Results***
- **The high public scrutiny of this project requires clear communication of each step of the process. Displaying the ideas, evaluation, and tradeoffs of performance will be imperative for the VA process.**
- **Benefits:**
  - **Support structure in communication of VA results**
  - **Demonstration of tradeoffs in alternatives' performance improvement and cost reductions**

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Decision Science is not a separate process

- **Rather, Decision Science is a compliment to the VA process. Structuring of Decision Science elements is embedded in the already established VA process and associated workshop agendas.**
- **Need your help!**

Concept-Level VE Study Results

- **Elgin-O'Hare West Bypass, IDOT**
  - **$2.5 Billion (Phase I) highway and interchange program to link communities west of O'Hare Airport**
  - **Multi-disciplinary IDOT/CH2M HILL Value Planning team**
  - **$120 million accepted cost saving; 5% of estimated cost; ROI 1200-to-1**

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Concept-Level VE Study Results

- **Boulder City Bypass, US-93 Realignment Phase 1, NDOT**
  - **$170 Million highway realignment and interchange**
  - **Multi-disciplinary NDOT/CH2M HILL Value Analysis team**
  - **5 concepts brought to VA study**
  - **2 concepts developed during VA study**
  - **Concept 6 from VA study refined and recommended**
  - **$35 million accepted cost saving; 21% of estimated cost; ROI 1400-to-1; with functional enhancements!**

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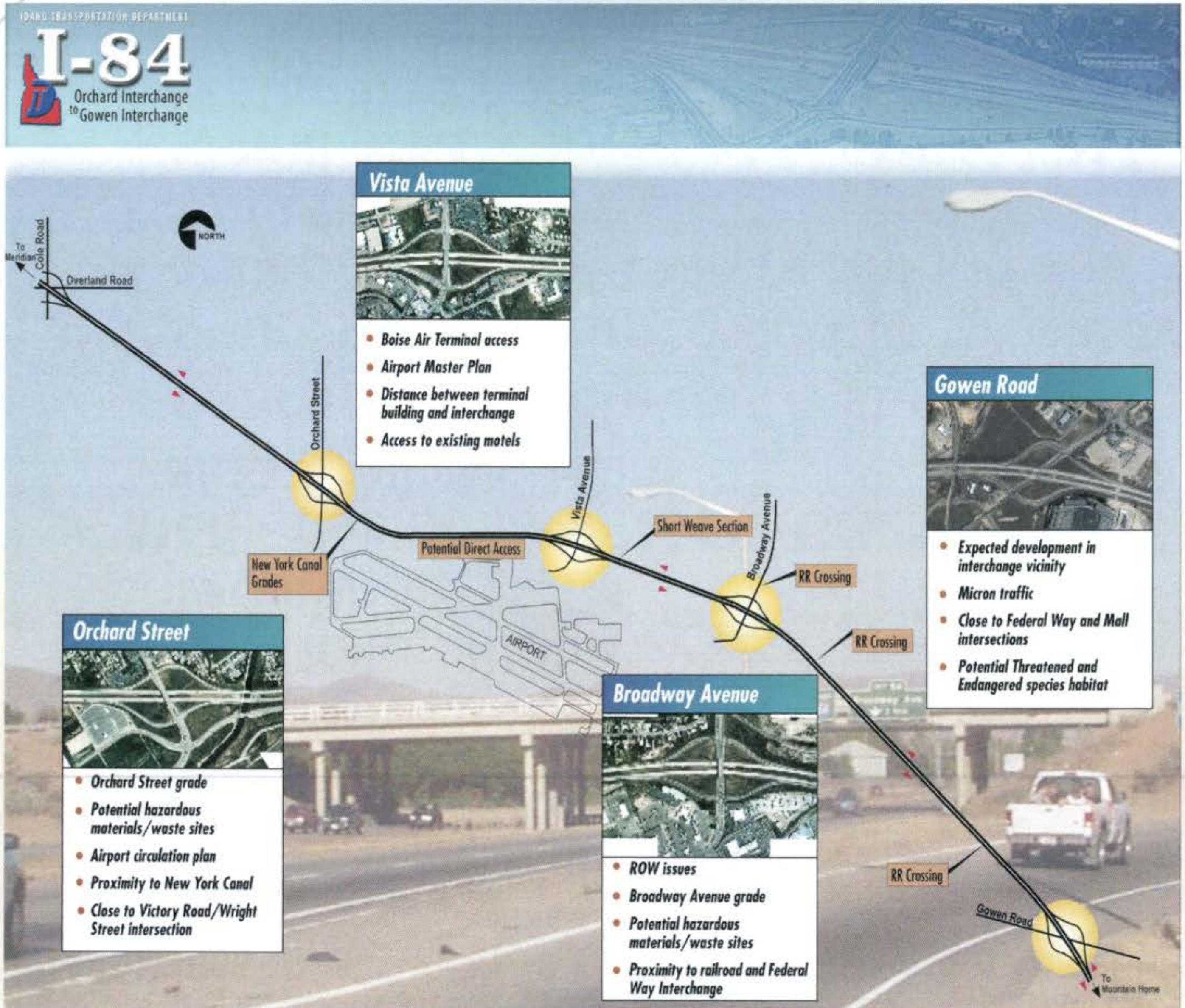
Interstate 84 Through Boise, ID



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Existing Vista Interchange

Vista Avenue

- *Boise Air Terminal access*
- *Airport Master Plan*
- *Distance between terminal building and interchange*
- *Access to existing motels*

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Existing Vista Interchange

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Vista Interchange Alt. B - Single Point Urban IC

Key Disciplines on I-84 CLVE Study

- ITD, FHWA Mgt. & Area Engineer (5)
- Interchange Geometry
- Bridge Design (2)
- Traffic Planner
- Drainage, Cost Estimating
- VE Team Leader
- Roadway Design (2)
- Construction (2)
- Right-of-Way
- Environmental (2)
- Operations
- Intelligent Transportation Systems

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Topics Addressed in I-84 CLVE Study

- **Reconstruction and widening of highway mainline**
- **Bridge structural systems**
- **Arterial road reconstruction**
- **Right-of-way impacts**
- **Construction staging and traffic control**
- **ITS applications**

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Mid-Design VE Study Results

Dworshak Fish Hatchery

- **$12.4 million to renovate hatchery's WWTP and improve effluent quality prior to discharge into river, to meet NPDES requirements**
- **Accepted Savings: $3 million through consolidation of plant processes, and electrical distribution**
- **In-house VE study**
- **Reasons for success:**
  - **Complex project with piecemeal additions over time presented an opportunity for a unique solution**
  - **Mutual respect between Design and VE team members**

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Mid-Design VE Study Results

Oregon State Hospital – Junction City Site

- $169 million estimate vs. $100 million budget
- Traditional VE could only hope to reduce project cost by perhaps $25 million without impacting function (bed space)
- VE study convinced owner to change bed type (transitional), keeping higher security patients at Salem; thus allowing non-hospital level construction at Junction City and saving upwards of $70 million to keep the project in budget

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VE Focus on SR710Project

- Evaluation of:
  - The No Build Alternative
  - The TSM/TDM Alternative
  - Alternative BRT-6, with possible refinements
  - Alternative LRT-4A/B, with possible refinements
  - Alternative F-7, with possible refinements
- Explore Functional and Cost Savings Strategies within Each Alternative
- Leave the Door Open to a New Alternative (if not previously explored and dismissed)
- It is Not the Purpose to Recommend a Preferred Alternative
- Recommendations in a Defendable Document

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Executive Summary Presentation
Value Analysis Study
SR 710 North Study

March 27, 2013

Presented at Metro Headquarters, Los Angeles, CA

CH2M HILL & Consultant VA Team Members

Study Date: March 11-14, and March 25-27, 2013

Metro

1

Value Analysis Site Visit, March 11, 2013 Proposed BRT Alt Route heading North on Atlantic Blvd, approaching SR 60

Metro

2

Value Analysis Site Visit, March 11, 2013 Proposed BRT Alt Route heading North on Atlantic Blvd, approaching I-10

Metro

3

Value Analysis Site Visit, March 11, 2013 Proposed BRT Alt Route heading North on Atlantic Blvd, approaching Main Street

Metro

4

Value Analysis Site Visit,
March 11, 2013
Proposed BRT Alt Route heading North on Atlantic Blvd, turning Left onto Huntington Drive

Metro

5

Value Analysis Site Visit,
March 11, 2013
Proposed BRT or LRT Route heading North on Fair Oaks Ave

Metro

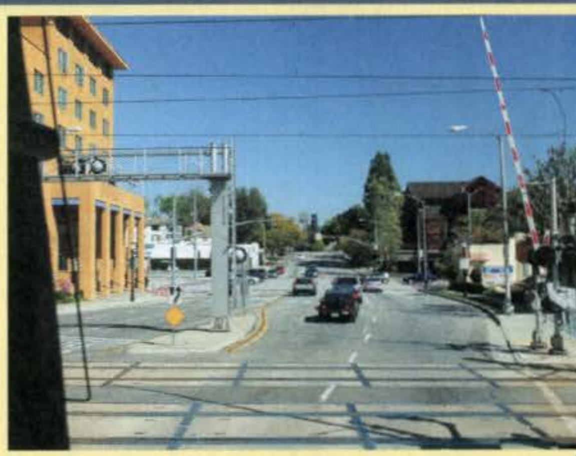
6

**Value Analysis Site Visit,
March 11, 2013
Proposed BRT or LRT Route heading North on Fair Oaks Ave at Arroyo Seco Pkwy (Location of the Raymond Fault)**

Metro

7

**Value Analysis Site Visit,
March 11, 2013
Proposed BRT Alt Route heading East on Del Mar Blvd at Raymond Ave**



Metro

8

Value Analysis Site Visit, March 11, 2013 Proposed BRT Alt Route turning Left (North) on Hill Ave from Del Mar Blvd

Metro

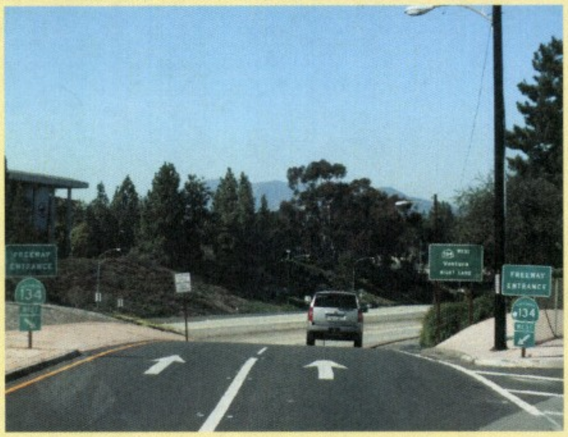
9

Value Analysis Site Visit, March 11, 2013 Proposed BRT Alt Route turning Left (South) on Lake Ave from Colorado Blvd)

Metro

10

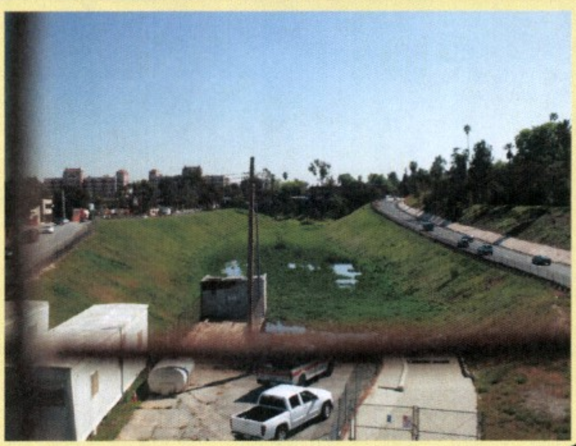
Value Analysis Site Visit, March 11, 2013 Proposed Freeway Tunnel Route Near North Portal at SR 134



Metro

11

Value Analysis Site Visit, March 11, 2013 Proposed Freeway Tunnel Route At North Portal, Looking South, at S Terminus of SR 210



Metro

12

Value Analysis Site Visit, March 11, 2013 Proposed Freeway Tunnel Route At North Portal of SR710, Looking North across Del Mar Ave, to SR 210

Metro

13

Value Analysis Site Visit, March 11, 2013 Proposed BRT or LRT Route heading South on Fair Oaks Ave

Metro

14

Value Analysis Site Visit, March 11, 2013 Proposed BRT or LRT Route heading South on Fair Oaks Ave Approaching Arroyo Seco Parkway

Metro

Caltrans

15

Value Analysis Site Visit, March 11, 2013 Proposed BRT or LRT Route turning Left (South) on Fremont Ave from Huntington Drive

Metro

Caltrans

16

Value Analysis Site Visit, March 11, 2013 Proposed LRT Route heading South on Fremont Ave at Main St

Metro

Caltrans

17

Value Analysis Site Visit, March 11, 2013 Proposed LRT Route heading South on Fremont Ave at Alhambra Crossing, Approaching Mission Rd

Metro

Caltrans

18

Value Analysis Site Visit, March 11, 2013 Proposed SR 710 Freeway Tunnel South Portal Location, at W Valley Blvd

Metro

Caltrans

19

Value Analysis Site Visit, March 11, 2013 Proposed SR 710 Freeway Tunnel South Portal Location, at W Valley Blvd

Metro

Caltrans

20

Value Analysis Site Visit, March 11, 2013 Heading South on SR 710 Approaching SR 60 (Route of Proposed Elevated LRT)

Metro

21

Value Analysis Site Visit, March 11, 2013 Proposed LRT Route Heading South on Monterey Pass Rd at Cesar Chavez Ave

Metro

22

OVERVIEW

- Value Analysis (VA) Focus on Metro SR-710 Program
- VA Team, Owner and Design Team
- Why VA is Used
- VA Methodology
- VA Study Recommendations
  - Proposals
  - Decision Analysis Approach
  - Design Suggestions
- Follow-up Tasks
  - VA Reports
  - Proposal Dispositions – by Metro, Caltrans, CH2M HILL Design Team
- Questions/Comments

Metro

Caltrans

23

Value Analysis Team, Metro Representatives

- Matthew Crow, Tunnel Design/Construction
- *Chris Leban, Environmental
- *Geoff Martin, Tunnel Design
- *Harvey Parker, Tunnel Design

* Part Time Representative

Metro

Caltrans

24

Value Analysis Team, Caltrans Representatives

- Randy Anderson, HQ Structure Design
- Shiva Karimi, Geotechnical
- Duke Nguyen, Assistant VA Coordinator
- Andrew Ponzi, Structure Construction
- Jeff Yang, Structure Maintenance and Inspection
- Mine Struhl, Environmental
- Lourdes Ortega, Environmental
- Derek Sim, Construction

Metro

25

Value Analysis Team, CH2M HILL and Consultant Representatives

- Paul Johnson, VA Team Leader, CH2M HILL
- Dan Speicher, Decision Analysis Specialist, CH2M HILL
- Don Anderson, Geotechnical, CH2M HILL
- Brian Bellfi, Alternative Project Delivery, CH2M HILL
- Gustavo Ceballos, Transportation Planning, CH2M HILL
- Lyn Calerdine, Environmental, LSA
- Deborah Dagang, BRT Expert, CH2M HILL
- Mark Johnson, Highway Tunnel Design, CH2M HILL
- Andrew Leong, LRT Expert, CH2M HILL
- Charles Nicholas, Financial Analysis, CH2M HILL
- Kim Nokes, Roadway Design, CH2M HILL
- Cesar Tiscareno, Assistant VA Facilitator, CH2M HILL
- Rick Hults, Cost Estimating, CH2M HILL

Metro

26

Agency Representatives attending VA Orientation Meeting on March 11

- Michelle Smith, Project Manager, Metro
- Abdi Saghafi, Corridor Manager, Caltrans
- **Jatinder Gaur, Project Manager, Caltrans
- Derek Higa, Design Manager, Caltrans
- Cleave Govan, Environmental Lead, Metro
- Garrett Damrath, Environmental Manager, Caltrans
- Albert Andraos, D7 VA Coordination, Caltrans
- Josue Yambo, Traffic Engineer, FHWA
- Chris Newman, State Project Team Leader, FHWA
- John Ehsan, Geotechnical, Caltrans
- Ainsley Kung, Design, Caltrans
- Jason Roach, Environmental, Caltrans

** Project Representative (not at meeting)

Metro

27

Design Representatives attending VA Orientation Meeting on March 11

- Yoga Chandran, Project Manager, CH2M HILL
- Loren Bloomberg, Traffic Lead, CH2M HILL
- Vincent Chio, Project Engineer, CH2M HILL
- Steve Dubnewych, Tunnel Design, Jacobs
- Eldon Gath, Geology/Faulting, Earth Consultants Int'l
- Steve Greene, Transit Lead, AECOM
- Bernhard Hoepperger, Tunnel Systems, ILF
- Tom Ionta, Engineering Lead, CH2M HILL
- Deborah Pracillo, Environmental Studies, LSA
- Lilly Acuna, Project Assistant, CH2M HILL

Metro

28

Why Use Value Analysis?

- Focus on essential functions not systems or procedures
- Embraces creativity and out of the box thinking
- Uses initial and life-cycle cost analysis for decision making
- Provides an organized framework for alternative development
- Consistently achieves the desired results (from 5:1 to 50:1 ROI) when implemented at early-to-mid design phase

Metro

Caltrans

29

The Optimal Time to Use Value Analysis

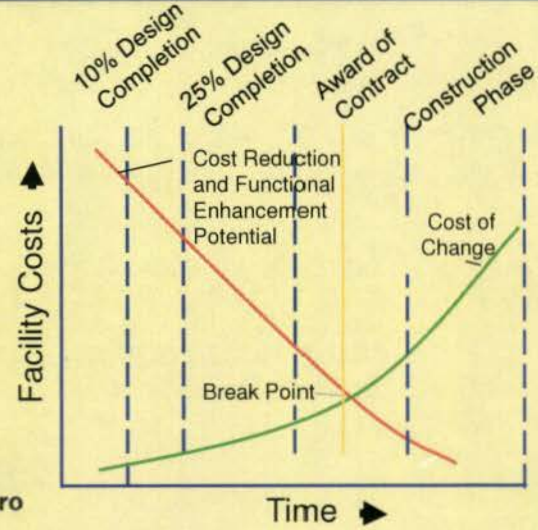
- Early on in a project design phase (or by the conclusion of the Preliminary Engineering Phase for a highway or bridge design)
- Cost savings and functional enhancements are best achieved at conceptual design
- Value Analysis (VA) is applied at preliminary design or earlier
- Traditional Value Engineering (VE) is applied not later than mid-design

Metro

Caltrans

30

Opportunities for Savings in Facility Life Cycle



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The VA Job Plan: A Structured Six-Phase Approach

- Pre-Study Workshop (February 20)
- VA Session 1: (4 Days, March 11 – 14)
  1. Information Phase
  2. Function Analysis Phase
  3. Creative Phase
  4. Evaluation Phase (Mid-Study Briefing, March 13)
- Study Break (Week of March 18)
- VA Session 2: (3 Days, March 25 – 27)
  5. Development Phase
  6. Presentation Phase (March 27)

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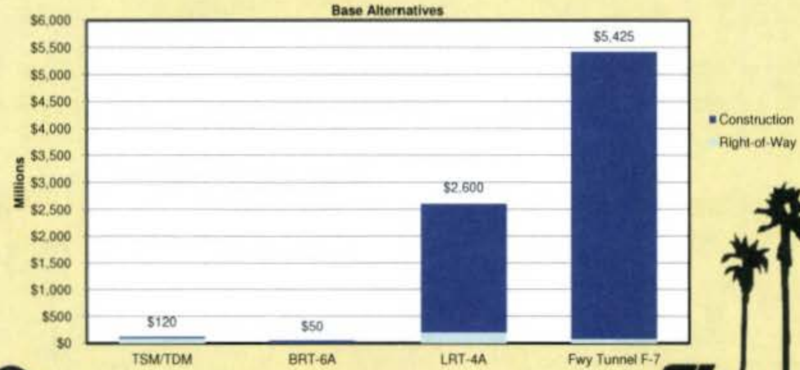
Cost Model

Metro SR 710 Program
Cost Summary for Base Alternatives



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Team Focus QA

VA Team's Discussion of Key Project Issues

- Lack of regional N-S connections results in cut-through traffic on local arterial streets, further exacerbating local congestion.
- High levels of congestion on surface streets and freeways in the study area results in increased costs and travel time for individuals and businesses. Also results in more pollution and a degradation of the quality of life.
- Inadequate regional transit service in this densely populated area would benefit from regional transit connections, to improve livability and air quality.
- Availability of funding could limit implementation of alternatives, with costs for additional right of way and escalation increasing over time.
- High level of public scrutiny on potential impacts from all alternatives. Consensus needed to implement the project.

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Team Focus QA

What are the highest risk issues associated with the project?

- Funding availability
- Sources of funding and how that funding can be used
- Potential for community opposition
- Consistent political support needed
- Technology being used for tunnel bores
- Actual traffic levels and ridership lower than projected
- Achieving potential revenue goals
- Construction costs higher than anticipated
- Right of way impacts identified during design phase possibly being greater than anticipated

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Team Focus QA

What are the expected outcomes from the SR 710 VA study?

- Increase the value of the project by looking for opportunities to increase the functionality of the project within the same or similar budget for each Build Alternative.
- Try to identify opportunities for cost savings, within each Build Alternative, that fully respect the functionality and commitments on the project.
- Review combinations of alternatives that may not have been developed before.
- Use Decision Analysis with criteria consistent with earlier alternatives evaluations to help support the VA proposals within the context of an Alternative.
- VA Reporting using Caltrans formats.

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VA Study Recommendations: New Build Alternative

- Project Delivery Proposals
- TSM/TDM Proposals
- BRT Proposals
- LRT Proposals
- Freeway Tunnel Proposals
- New Build Alternatives:
  - Streetcar System
  - Streetcar System with Single Bore Freeway Tunnel, or any Freeway Tunnel Alternatives
  - BRT Combined with Single Bore Freeway Tunnel, or any Freeway Tunnel Alternatives

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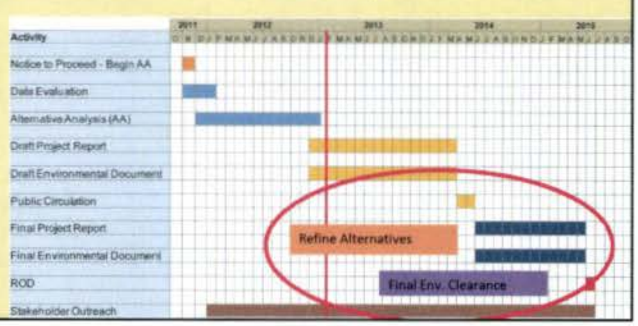
P3 Delivery, Freeway Tunnel Proposal FT8 – P3 Delivery, Commit as Soon As Possible

<u>Advantages</u>

+ Potential to Fill Funding Gap
+ Captures Industry Innovations
+ Offers Specific Means & Methods Input and Approach to Combining Financially Reasonable Alternatives
+ Will **NOT** Impact NEPA/CEQA

<u>Disadvantages</u>

- Requires Higher Level of Expertise to Develop Procurement Doc's
- Loss of Public Control
- Cost Competitiveness



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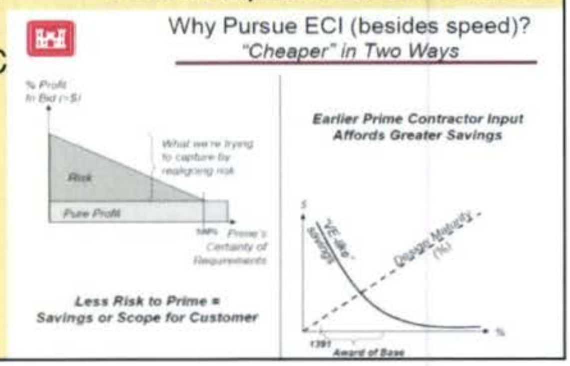
Freeway Tunnel Proposal FT9 – Early Contractor Input

Advantages

+ Captures Industry Feedback
+ Lowers Risk Pricing
+ Agreed upon Risk Allocations
+ Fosters Contractor-Owner Communications
+ Considerations for CM/GC and DB Delivery Options

Disadvantages

- Limits Construction Input to just 1 Contractor
- Option could eliminate 1 Bidder
- Cost Competitiveness Concern



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TSM Proposal TSM1 - Peak Direction Arterial HOV Lane

Advantages

- Reduces cut through traffic
- Less congested for buses
- Increases mobility
- Relatively low cost

Disadvantages

- On-street parking impacts
- Potential increase in non-HOV congestion
- Enforcement Required

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TSM Proposals TSM1 - Peak Direction Arterial HOV Lane

Typical Cross Sections

- Fremont Ave. at W. Commonwealth (looking North)

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BRT Proposal BRT1 - Enhanced Technology

Advantages	Disadvantages
Increase Reliability	Less Routing Flexibility
Reduce Travel Times	Enforcement Required
Improve Passenger Amenities	Increase Cost $7.2 million

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LRT Proposal LRT1 - LRT on median of I-710

Place the LRT track at the south section along median of SR-710, with the bridge to Cal State LA.

Advantages

- Reduce ~0.6 miles elevated light rail track
- Improve LRT operation
- Less structural maintenance
- Lower seismic risk
- Less Fire Hazard from hillside
- Improve emergency access

Disadvantages

- Requires freeway widening
- Reconstruct shoulder structural roadway
- Construct bridge over I-710/I-10 IC
- Conflict with median columns at IC

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LRT Proposal LRT2 - Valley Blvd over LRT Alignment, and Maintenance Facility

- Consolidates MSF Site
- Reduces Bored Tunnel
- Yard Tracks same Level
- Reduces Material to be Exported
- Valley Blvd on Structure
- Minor ROW Impacts to abutting Properties

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LRT Proposal LRT3 - Shorten North Terminus to Arroyo Seco and Fair Oaks

- Reduces bored tunnel by one mile
- Deletes S Pasadena Station and Parking

- EOL Station at Fair Oaks and Arroyo Seco site
- Multi-modal Facility for #260 bus and Oaklawn park-n-ride and Park-n-ride
- Opportunity for new Gold Gold Line station

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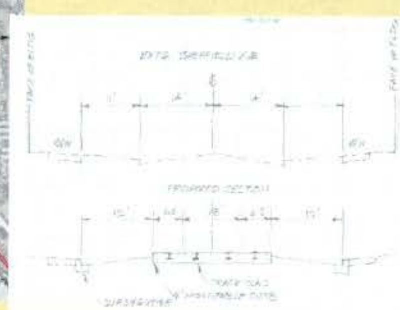
LRT Proposal LRT4 - At-Grade Alignment between Mission Rd and Fair Oaks



+ At-Grade less Cost than Tunnel
+ Utilize Caltrans ROW w/o Relocating Residents

+ Station near Huntington Dr
+ Optional Single Track along Sheffield
- Environmental Justice
- Section 4(f)

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LRT Proposal LRT4 - At-Grade Alignment between Mission Rd and Fair Oaks

Photo from Hillsboro, OR

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LRT Proposal LRT5 – Omit LRT Tunnel and Provide LRT at Grade along Atlantic to Fillmore LRT Station

- Advantages
  - ✓ Eliminates all tunnel sections (↓ $$$)
  - ✓ Takes advantage of SR-710 right-of-way
  - ✓ Highly visible alignment
  - ✓ Connects to Gold Line termini
  - ✓ Provides local service on Atlantic Blvd.
- Disadvantages
  - ✓ Requires numerous property takes
  - ✓ Disruption during construction
  - ✓ Slow transit time
  - ✓ At-grade street crossing of LRT
  - ✓ Little community support

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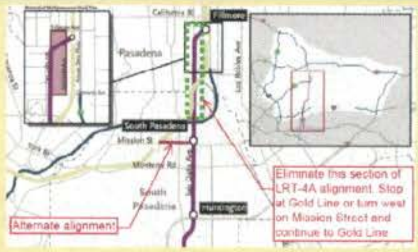
LRT Proposal LRT6 – Shortened Tunnel, Mission St.

- Advantages
  - ✓ Shortens tunnel length by nearly 1 mile
  - ✓ Eliminates overlap between LRT-4A and Gold Line
  - ✓ Connects to existing Gold Line station at Mission Street
- Disadvantages
  - ✓ Need easement along Mission Street
  - ✓ May need additional parking structure
  - ✓ Alignment goes under existing single-story building



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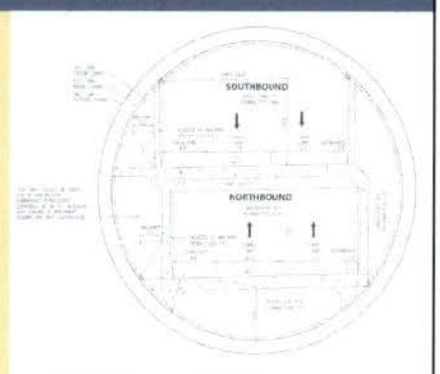
Freeway Tunnel Proposal FT1 - Single Bore Tunnel with Demand Based Tolling

Proposal FT-1: Express Tunnel

- Two Lanes in Each Direction, Stacked in Single Tunnel.
- Variable Toll Depending on Real Time Demand, like I-10, I-110, SR-91 Express Lanes
- Major Cost Savings $2,496,000 (45%)



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Freeway Tunnel Proposal FT1 - Single Bore Tunnel with Demand Based Tolling

- Much more likely to be financeable
- Reduced Environmental Impacts During Construction
- Potential to run a Profit – Dedicate some profits to improved local transit
- Does not preclude later construction of Second Bore
- Potentially Combine with Truck Restriction

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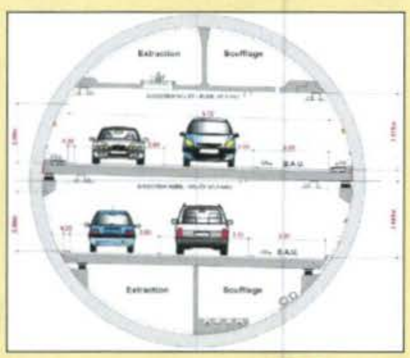
Freeway Tunnel Proposal FT2 - Car-Only Freeway Tunnel at 46.5 ft. ID vs. 52.5 ft. ID (both tunnels)

Car-only tunnel:

- Enables vertical clearance to be reduced
- Precedent with Paris A86 Tunnel which is Operational
  - 8.4ft vertical clearance (incl. VMS)
  - 9.8ft traffic lanes + 8.2ft shoulder
  - 34.1ft ID tunnel
- Two scenarios evaluated:
  - Both 10ft vertical clearance + 2ft VMS
  - Scenario 1 – 12ft lane width
  - Scenario 2 – 11 ft lane width



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Freeway Tunnel Proposal FT2 - Car-Only Freeway Tunnel at 46.5 ft. ID vs. 52.5 ft. ID (both tunnels)

- Scenario 1
  - 4.5ft reduction in ID
  - $474M cost reduction
- Scenario 2
  - 6ft reduction in ID
  - $584M cost reduction

Advantages

- (+) Potential benefit for settlement due to smaller TBM
- (+) reduced design fire size (<30MW)
- (+) Will not attract freight trucks through the tunnel

Disadvantages

- (-) Low clearance maintenance/response vehicles required
- (-) Some drivers may find the tunnel claustrophobic

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Freeway Tunnel Proposal FT3 - Single Bore Tunnel Combined with Car Only

- Combine FT-1 (Single Bore) with FT-2 (Car Only)
- One Truck = 3 Cars
- Precludes Port Traffic from using I-210
  - A significant community concern
- Total Savings: $2,788,115,000 (51%)

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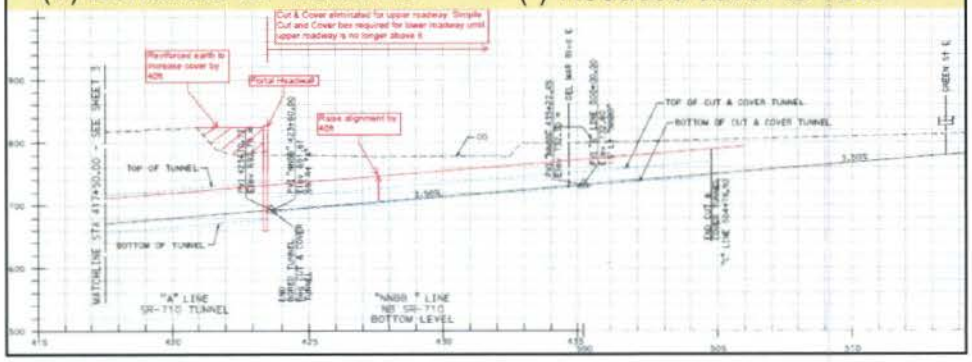
Freeway Tunnel Proposal FT3 - Raise the Profile at the North Portal by 40 ft. Retaining the Same Cover as the Base Design

Advantages	Disadvantages
(+) Cost Savings:$198 million	(-) Sequoyah school:
(+) Eliminates C&C Tunnel	Increased noise
(+) Existing bridges remain	Reduced air quality
(+) Beneficial for Vent/FLS	(-) Reduced cover to TBM



FREEWAY TUNNEL Proposal FT4 - Additional SR 710 Access Located at the North Project Terminus

Kim Nokes

Advantages	Disadvantages
(+) Additional SR-710 Access	(-) Local Street Congestion
(+) Improves Connectivity	(-) Environmental
(+) Freeway Congestion	(-) Cost Increase: $47 million

Freeway Tunnel Proposal FT5 – Relocate Southern Portal One Half Mile North to Reduce Cost

- Make best use of existing southern SR-710 stub
- Tunnel costs 6-10 times that of standard freeway
- Elevated freeway from Valley to Mission
- Freeway descends to grade at Concord

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Freeway Tunnel Proposal FT5 – Relocate Southern Portal One Half Mile North to Reduce Cost

- Tunnel Portal north of Mission,
- Requires Approx. 50 residential removals (Caltrans owns) and five businesses.
- Full interchanges at Valley/Mission (reduced congestion)
- Approximately $500 Million cost savings

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Combination of Freeway Tunnel Proposals FT1, FT2, FT3, FT5

- FT1 – Single Bore Tunnel
- FT2 – Car Only Tunnel
- FT3 – North Portal, and FT5 – South Portal, Savings reduced 50% with single bore tunnel
- **Total Potential Savings $3.1 Billion (58%)**

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Freeway Tunnel Proposal FT6 – Precast Roadway Decks within Tunnel Interior

Advantages

- (+) Reduces Const. Schedule
- (+) Revenue generation quicker
- (+) Reduces Project Costs
- (+) Utilize Same Casting Plant
- (+) Initial Cost Savings: $36 million

Disadvantages

- (-) May require larger staging area
- (-) Full moment connections are difficult
- (-) Transport/handling may be challenging

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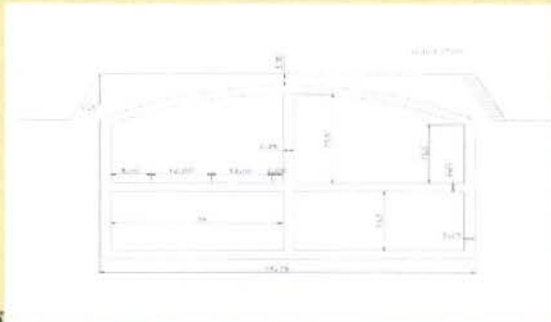
Freeway Tunnel Proposal FT7 - Covered Depressed Freeway with a Landscaped Area for "At-Grade Section"

Advantages

- (+) Minimizes Noise Transfer
- (+) Reduces Impact on Air Quality
- (+) Enhances the Quality of Urban Environment

Disadvantages

- (-) Cost of Structural Section
- (-) Footprint of Embankment Fill



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BRT Proposal BRT2 - Multimodal Transportation Centers

Advantages

- Encourage alternate mode use
- Enhances F1 tunnel option
- Reduce arterial congestion

Disadvantages

- Reroute BRT alignment
- ROW impacts
- Increase Cost $111 million

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BRT Proposal BRT2 - Multimodal Transportation Centers

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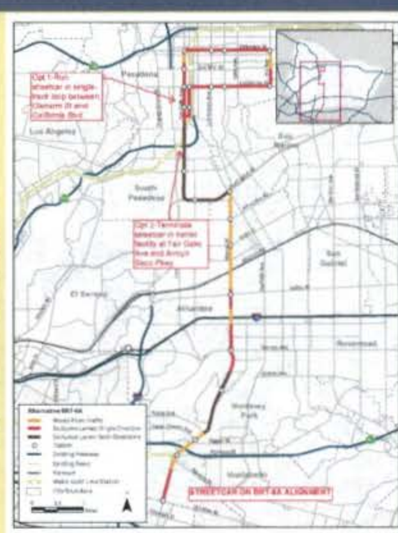
Streetcar Proposal BRT3 - Streetcar on BRT-6A Alignment

- Spacing of Stops like BRT
- Less costly than LRT
- Complements Gold Line

- Requires MSF and ROW
- Visual impact of OH Power



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VA Study Recommendations: Decision Analysis

- Ensure application of the CALTRANS VA methodology
- Display benefits and benefit/cost performance of proposals, in addition to cost savings
- Used to display tradeoffs and move toward recommendations

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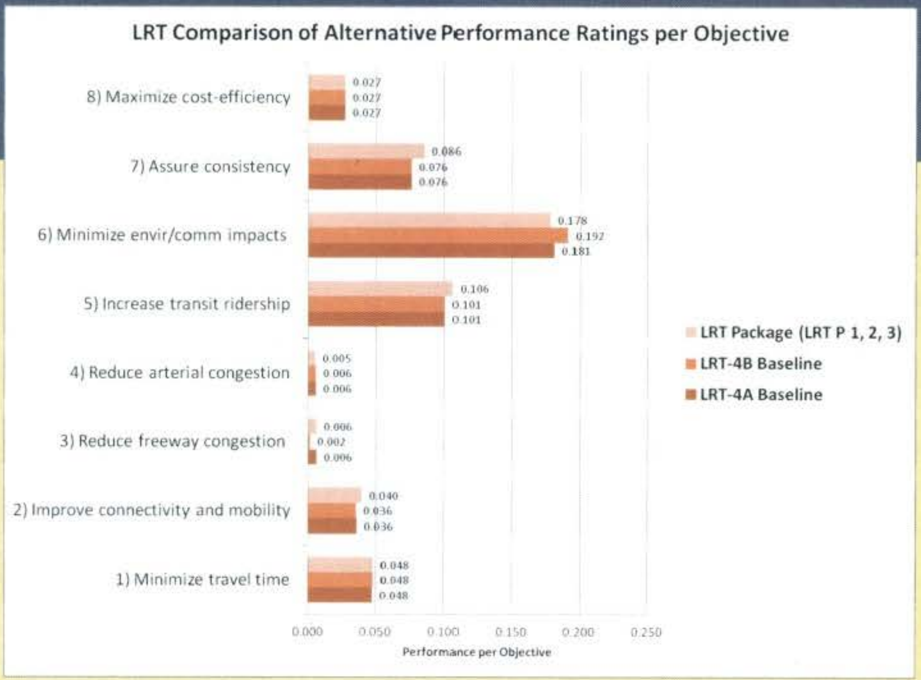

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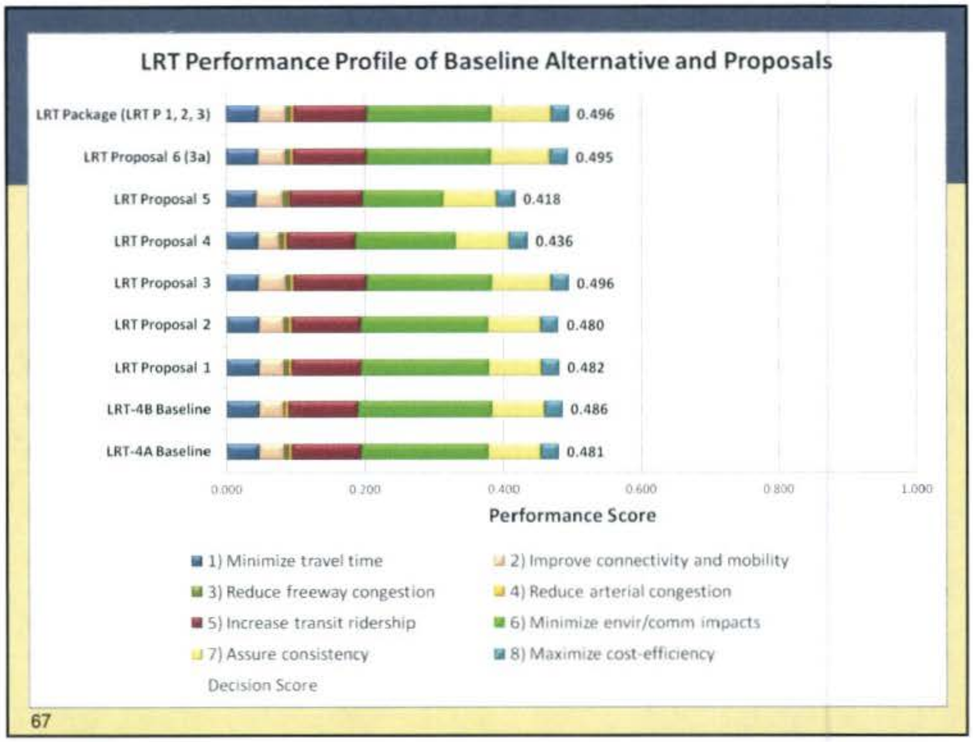
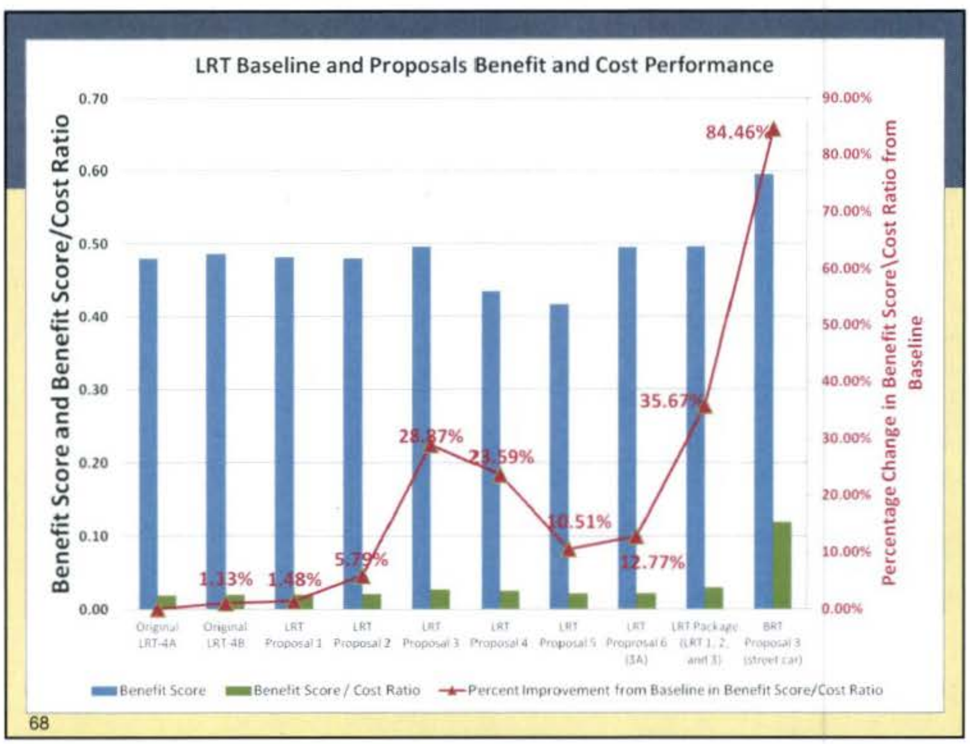

LRT Performance Profile of Baseline Alternative and Proposals
LRT Package (LRT P 1, 2, 3)
LRT Proposal 6 (3a)
LRT Proposal 5
LRT Proposal 4
LRT Proposal 3
LRT Proposal 2
LRT Proposal 1
LRT-4B Baseline
LRT-4A Baseline
0.496
0.495
0.418
0.436
0.496
0.480
0.482
0.486
0.481
0.000
0.200
0.400
0.600
0.800
1.000
Performance Score
1) Minimize travel time
2) Improve connectivity and mobility
3) Reduce freeway congestion
4) Reduce arterial congestion
5) Increase transit ridership
6) Minimize envir/comm impacts
7) Assure consistency
8) Maximize cost-efficiency
Decision Score
67


LRT Baseline and Proposals Benefit and Cost Performance
Benefit Score and Benefit Score/Cost Ratio
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
Percentage Change in Benefit Score\Cost Ratio from Baseline
90.00%
80.00%
70.00%
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
0.00%
84.46%
35.67%
28.37%
23.59%
10.51%
12.77%
5.79%
1.13%
1.48%
Original LRT-4A
Original LRT-4B
LRT Proposal 1
LRT Proposal 2
LRT Proposal 3
LRT Proposal 4
LRT Proposal 5
LRT Proprosal 6 (3A)
LRT Package (LRT 1, 2, and 3)
BRT Proposal 3 (street car)
Benefit Score
Benefit Score / Cost Ratio
Percent Improvement from Baseline in Benefit Score/Cost Ratio
68

VA Implementation Phase (Follow-up Tasks)

- Distribute Draft VA Report for Initial Review by Management Team within 2 weeks (by April 10)
- Metro, Caltrans, CH2M HILL Review of Draft VA Report (1 week, by April 17)
- Distribute Preliminary VA Report (1.5 weeks, by, April 26)
- Metro and Caltrans, with input from FHWA, provide Dispositions in consultation with Design Team (Implementation Meeting) to Complete the final VA Process
- Distribute Final VA Report

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Conclusion

- Q/A
- Thanks for the opportunity for CH2M HILL to work with Metro and Caltrans on the VA study for this very important project!

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