

Contra Costa I-680 (North) Northbound Design Alternative Assessment

Contra Costa County, California
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Prepared for:
Metropolitan Transportation Commission
Contra Costa Transportation Authority

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1. EXECUTIVE SUMMARY

The Metropolitan Transportation Commission (MTC), in cooperation with the Contra Costa Transportation Authority (CCTA) initiated the I-680 (North) Northbound (NB) Design Alternative Assessment (DAA) to identify and evaluate a range of alternatives between Livorna Road and State Route (SR) 242 that would address the existing I-680 northbound managed lane gap, improve traffic operations and relieve congestion on northbound I-680 in Contra Costa County.

The scope of the DAA includes the identification and development of geometric concepts, operational analysis and feasibility assessment of selected alternatives. A Technical Advisory Committee (TAC) consisting of MTC, CCTA, and local officials was formed in October 2015 to provide input and guide the DAA Team on the identification and feasibility of geometric concepts and traffic analysis alternatives. The goal of the DAA is to identify a set of feasible alternatives that can be included for further study in the next project delivery phase of a future northbound I-680 project.

Geometric Improvement Concepts

Working with the TAC, a wide range of solutions were considered to address the I-680 northbound gap, including several operational improvement strategies that would complement the managed lane operation and provide additional congestion relief benefits.

The TAC eliminated design concepts based on the following criteria:

- Substantial design constraints/issues related to meeting the standards presented in the *California Highway Design Manual*
- Significant right-of-way (ROW) constraints
- TAC consensus, based on projected volume forecasts, that the concept would not meet the primary project objectives to improve managed lane connectivity or traffic operations

Once the concepts were evaluated based on the criteria, the TAC determined how to arrange the remaining concepts into alternatives for traffic analysis.

Traffic Analysis Alternatives

A total of ten alternatives (including No Build) were studied as part of this evaluation under year 2020 conditions. Due to design constraints along the corridor only two of the ten alternatives (Alternatives 8 and 9) would provide a continuous managed lane (eliminate the gap). Six of the alternatives would reduce the length of the gap (Alternatives 3, 4, 5, 6, 6A, and 7). Two alternatives (Alternative 1 and 2) would maintain the existing gap. **Table E-1** presents an overview of the key features and assumptions for each alternative. A schematic of each of the evaluated alternatives is presented in Appendix A.

Table E-1: Traffic Analysis Alternatives

Alternative	Title	Key Features And Assumptions
1	No Build	This is the baseline alternative. Assumes that by year 2020 the northbound I-680 Express Lane is operational on the southern end of the study corridor. The managed lanes gap is about 7.5 miles.
2	Adaptive Ramp Metering	This alternative assumes adaptive ramp metering. This is also included as part of Alternatives 3 through 9.
3	Express Lane: GP Lane Conversion with Transit and Park & Ride Investments	This alternative converts a General Purpose (GP) Lane to an Express Lane. This alternative assumes a 20% mode shift from SOV to HOV and transit, as a result of an expanded Express Lane system and future corridor investments in transit and park-n-ride facilities with shuttle service to BART stations. This alternative also assumes a policy change for the HOV Lane from 2+ persons to 3+ persons and an increase in HOV occupancy from an average of about 2.2 persons under existing conditions to 4.0 persons. The managed lanes gap would be shortened from 7.5 miles to less than one mile.
4	Express Lane: GP Lane Conversion Plus C-D System with Transit and Park & Ride Investments	This alternative is similar to Alternative 3 but also provides a Collector-Distributor (C-D) road system to service the North Main Street off-ramp, North Main Street on-ramp, and Treat Boulevard off-ramp to eliminate mainline weaving and capacity issues at this location. This alternative also assumes the 20% mode shift from SOV to HOV and transit, as well as the HOV occupancy change included in Alternative 3. The managed lanes gap would be shortened from 7.5 miles to less than one mile.
5	Express Lane Extension and GP Lane Widening	This alternative provides outside widening on both the north side and south side of the SR 24 interchange to increase the length of the Express Lane and reduce the existing gap. The managed lanes gap would be shortened from 7.5 miles to less than one mile.

6	Express Lane Extension and GP Lane Widening Plus C-D System	This alternative is similar to Alternative 5 except it also provides a C-D road system to eliminate the mainline weaving between the North Main Street on-ramp and Treat Boulevard off-ramp. The managed lanes gap would be shortened from 7.5 miles to less than one mile.
6A	Express Lane: GP Lane Conversion and GP Lane Widening Plus C-D System	This scenario is similar to Alternative 6 except it does not include a managed lane extension from N. Main St to SR 242 and only includes an express lane conversion from Livorna Rd to SR 24. The managed lanes gap would be shorten from 7.5 miles to about 4.5 miles. This alternative would be an initial phase of Alternative 6.
7	Express Lane Extension and GP Lane Widening Plus C-D System and Ygnacio I/C Reconfiguration	This alternative is similar to Alternative 6 except it does not include the mainline widening between Olympic Boulevard and Ygnacio Boulevard and instead reconfigures the Ygnacio Boulevard off-ramp. The managed lanes gap would be shortened from 7.5 miles to less than one mile.
8	Contra-Flow Plus Express Lane Extension and GP Lane Widening	This alternative provides a contra flow lane (by using the southbound express lane during the PM peak) to provide a continuous Express Lane with no gap.
9	SR 24 and Ygnacio I/C Reconfiguration Plus Express Lane Extension and GP Lane Widening	This alternative would reconfigure the I-680/SR 24 interchange (SR 24 would join I-680 on the right hand side as opposed to the left-side) to provide a continuous Express Lane with no gap.

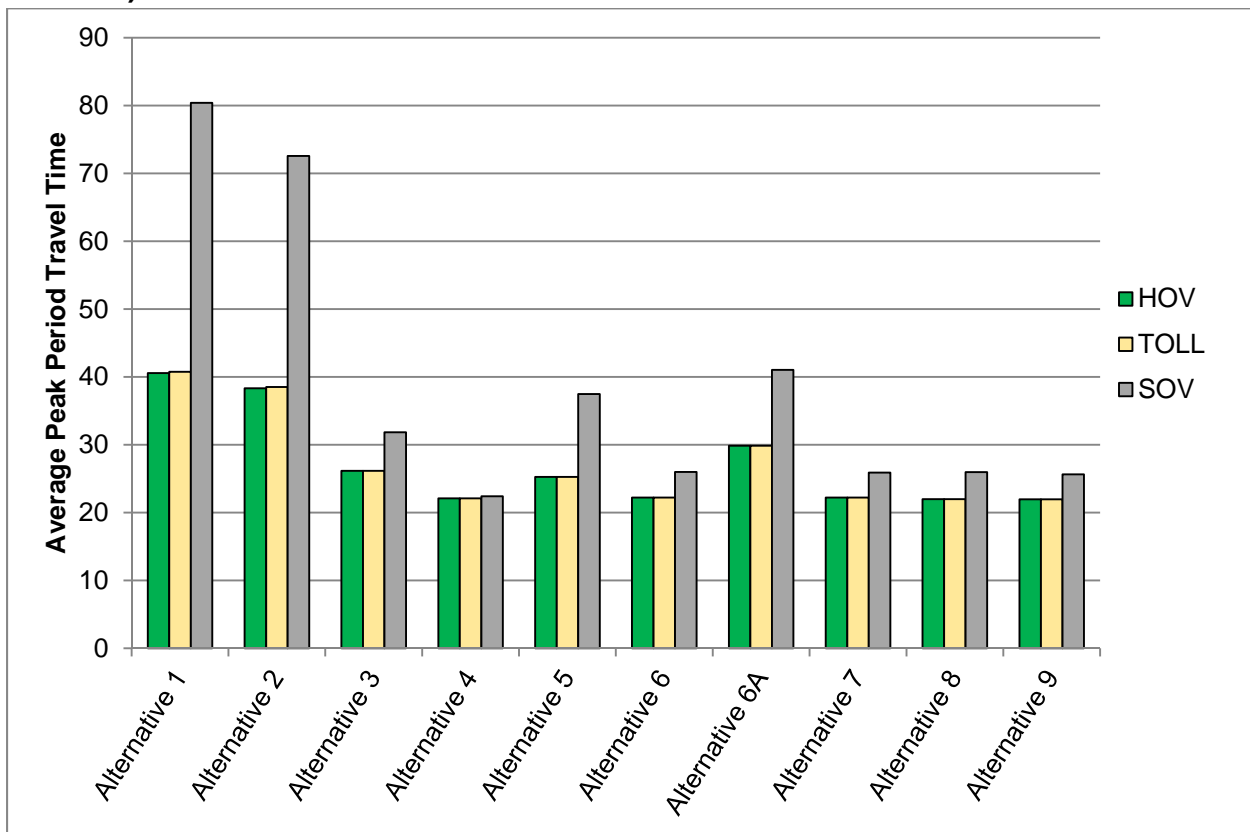
Traffic Operational Analysis Findings

Exhibit E-1 presents the average peak period travel time by mode (HOV, Toll, and SOV) and alternative. Northbound I-680 travel time is measured for drivers traveling between I-580 and State Route 4 (SR 4), a distance of approximately 23 miles. Under Alternative 1 the HOV and tolled vehicles average peak period travel time would be about 41 minutes while the SOV

average peak period travel time would be about 80 minutes in year 2020. The free-flow travel time (average speed of 65 mph) is about 21 minutes. All of the alternatives are anticipated to reduce average peak period travel times for all modes of travel compared to Alternative 1.

The greatest reduction to HOV/TOLL travel times would be provided under Alternatives 4, 6, 7, 8, and 9 where the average peak period travel time would be reduced to 22 minutes. The largest reduction to SOV travel times would be provided under Alternative 4. Alternative 4 would improve traffic operations via the C-D road system at one of the major existing bottlenecks on northbound I-680 (North Main Street on-ramp to Treat Boulevard off-ramp). Alternative 4 also assumes an overall 20% reduction in vehicle demand compared to Alternative 1 as a result of mode shift (SOV to HOV and transit) and future corridor investments in transit and park-n-ride facilities that will increase the overall average HOV occupancy on the corridor (from about 2.2 under Alternative 1 conditions to 4.0). Alternative 3 also assumed a similar 20% reduction in vehicle demand compared to Alternative 1. As a result, travel times under Alternative 3 for all modes would be reduced compared to Alternative 1. Alternatives 6, 6A, 7, 8, and 9 would also provide a substantial reduction to travel times. The reduction in travel times under these alternatives is primarily attributed to operational and capacity improvements along corridor. Alternative 2, ramp metering alone, would provide the least reduction to travel times.

EXHIBIT E-1: Average Peak Period Travel Times by Mode of Travel (3:00 PM to 7:00 PM)



Conclusion and Recommendations

This DAA memo discusses the process the TAC has taken to determine and evaluate geometric improvement concepts and develop alternatives for traffic analysis. A summary of the assessment used to determine the recommended alternatives for the next phase of study is provided below.

Table E-2 shows the studied alternatives and the associated benefit-cost ratio based on estimated average construction costs and an operational benefit factor based on the traffic analysis results.

Table E-2: Alternative Benefit - Cost Ratios

ALTERNATIVE	AVERAGE COST* (MILLIONS \$)	OPERATIONAL BENEFIT FACTOR	BENEFIT- COST RATIO	BENEFIT- COST RANK
Alternative 2	17.5	240	13.7	1
Alternative 3	90	790	8.8	2
Alternative 4	144	999	6.9	3
Alternative 6A	112.5	760	6.8	4
Alternative 8	240	970	4.0	5
Alternative 5	230	870	3.8	6
Alternative 6	275	970	3.5	7
Alternative 7	375	970	2.6	8
Alternative 9	800	970	1.2	9

* Costs shown are construction estimates only and do not include support costs

The benefit/cost analysis is summarized as follows:

- **Alternative 2** has the highest benefit-cost ratio as a result of a modest operational benefit but with a substantially lower cost compared to the other alternatives. Some key conclusions are :
 - This alternative is included in all the other studied alternatives, except Alternative 1.
 - Adaptive ramp metering if desired can be separated and delivered as an initial delivery project for NB I-680.

- **Alternatives 4, 6 and 8** all provide similar substantial operational benefits for NB I-680 under a different set of key assumptions and/or geometric improvement concepts:
 - Alternative 4 assumes a 20% mode shift (SOV to HOV and transit, through investments in transit and park & ride services) with the GP Lane Conversion

Design Concept C (North Main to SR 242). It has a lower cost compared to Alternatives 6 and 8.

- Alternatives 4 and 6 both include a C-D Road (North Main to Treat).
 - Alternative 6 and 8 include the Managed Lane Extension (North Main to SR 242).
 - Alternative 8 includes a Contra Flow Lane and has a lower cost than Alternative 9 (the other alternative that closely the gap completely).
 - Based on these findings and comparison to the other remaining alternatives these three alternatives are ideal for further study.
- **Alternative 3** can be considered a subset (or an initial phase) of Alternative 4 as it also assumes a 20% mode shift and includes the same geometric improvement concepts except the C-D Road (North Main to Treat). Some key conclusions for Alternative 3 compared to Alternative 4
 - Alternative 3 has a higher benefit-cost ratio than Alternative 4.
 - Although Alternative 3 has a higher benefit-cost ratio, Alternative 4 is better suited for further study as an analysis can be performed with and without the C-D Road and effectively evaluate Alternative 3 and 4.
 - **Alternatives 5 and 6A** can be considered subsets (or an initial phases) of Alternative 6 due to the following:
 - Alternative 5 includes all of the geometric improvement concepts as Alternative 6 except the C-D Road (North Main to Treat).
 - Alternative 6A includes all of the geometric improvement concepts as Alternative 6 except the Managed Lane Extension (North Main to SR 242).
 - Alternative 6 is better suited for further study vs. Alternatives 5 and 6A as Alternative 6 can be evaluated with and without the C-D road and Managed Lane Extension and effectively evaluate Alternatives 5, 6A, and 6.
 - **Alternatives 8 and 9** provide improvements that close the I-680 NB managed lane gap:
 - Alternative 8 is better suited for further study compared to Alternative 9 as it fully meets the project objective (closing the gap in the managed lane) at a lower cost.
 - Alternative 9 has the lowest benefit-cost ratio, highest cost, and substantial risks and challenges that make this alternative not suitable for further study.
 - **Alternatives 7 and 9** have the lowest benefit-cost ratios along with several risks that include:
 - Significant project delivery risks and construction challenges.
 - Alternatives 7 and 9 are not ideal alternatives to be carried through for further study due to the costs, risks and approval challenges.

RECOMMENDED ALTERNATIVES

This DAA recommends three proposed alternatives be studied and compared to the No Build alternative to identify the preferred alternative during the next project delivery phase:

- No Build
- **Alternative 4** - GP Lane Conversion Plus C-D System with Transit and Park & Ride Investments
- **Alternative 6** - Express Lane Extension and GP Lane Widening Plus C-D System
- **Alternative 8** - Contra-Flow Plus Express Lane Extension and GP Lane Widening

2. INTRODUCTION

The Metropolitan Transportation Commission (MTC), in cooperation with the Contra Costa Transportation Authority (CCTA) initiated the I-680 (North) Northbound (NB) Design Alternative Assessment (DAA) to identify and evaluate a range of alternatives between Livorna Road and State Route (SR) 242 that would address the existing I-680 NB managed lane gap, improve traffic operations and relieve congestion on northbound I-680 in Contra Costa County.

The scope of the DAA includes the identification and development of geometric concepts, operational analysis and feasibility assessment of selected alternatives. A Technical Advisory Committee (TAC) consisting of MTC, CCTA, and local officials was formed in October 2015 to provide input and guide the DAA Team on the identification and feasibility of geometric concepts and traffic analysis alternatives. The goal of the DAA is to identify a set of feasible alternatives that can be included for further study in the next project delivery phase of a future northbound I-680 project.

This technical memorandum, the **Design Alternative Assessment Memo**, summarizes the assessment of the **Geometric Improvement Concepts** and **Traffic Analysis Alternatives** developed during this study and provides a recommendation of project alternatives to be carried to the next phase for project delivery.

3. BACKGROUND

I-680 Corridor

I-680 is a six- to ten-lane major north-south freeway connecting the Bay Area with I-80 and I-580 for travel to and from the Central Valley and Sacramento metropolitan area. Within the Bay Area, I-680 passes through Santa Clara, Alameda, Contra Costa, and Solano counties. I-680 is functionally classified as an Urban Principle Arterial-Interstate Freeway and is considered a Lifeline Highway route along the entire length of the interstate freeway. The study segment of I-680 is heavily traveled as it is utilized by commuters, recreational travelers, and public transit services.

I-680 Managed Lanes System

Managed lanes include both High Occupancy Vehicle (HOV) lanes and express lanes. HOV lanes are provided on several sections of I-680 within Contra Costa County from the Benicia-Martinez Bridge in the north to Alcosta Boulevard in the south. These lanes are open to only HOV (carpool) eligible vehicles on weekdays between the hours of 5:00 AM to 9:00 AM and 3:00 PM to 7:00 PM. Express lanes, also known as High Occupancy Toll (HOT) lanes, are either planned or currently under construction on I-680 in Contra Costa County. Express lanes

are HOV lanes that are free to carpools, buses, motorcycles, and other eligible vehicles, and available to single occupant vehicles (SOV) that choose to pay a toll.

There will be a continuous express lane in Contra Costa County on I-680 in the southbound direction from the Marina Vista Avenue interchange to the Alcosta Boulevard interchange (approximately 30 miles) within the next five years. This express lane will provide increased operational flexibility to respond to southbound traffic demand growth and enhance southbound mobility. The southbound express lane is part of the Metropolitan Transportation Commission's vision to eventually provide 550 miles of express lane network in the Bay Area.

In the northbound direction there is an HOV lane in the southern part of the county between Alcosta Boulevard and Livorna Road (southern managed lane) which is currently being converted to an express lane, and an HOV lane in the northern part of the county from SR242 to about 1-mile south of Benicia-Martinez bridge toll plaza (northern managed lane). There is a 7.5 mile gap between these managed lane segments which diminishes the effectiveness of the northbound managed lane. The purpose of this study is to identify and evaluate improvements to I-680 in this gap.

The northbound gap in the Contra Costa County I-680 Managed Lanes is shown in **Figure 3-1**.

Figure 3-1: Contra Costa County I-680 Managed Lanes



Problems, Deficiencies, Constraints:

As identified in MTC’s 2014 Bay Area Congested Segments, traffic during the northbound I-680 PM peak period between Crow Canyon Road and Treat Boulevard has been ranked as the fifth worst commute corridor in the San Francisco Bay Area. There are two primary bottlenecks between the Livorna Road on-ramp and Rudgear Road off-ramp and between the North Main Street (Lawrence Way) on-ramp and Treat Boulevard off-ramp. These bottlenecks result in congestion between 3:30 PM and 7 PM and vehicle queues in excess of 12 miles.

At the heart of the northbound congestion near the City of Walnut Creek, a three-lane freeway ramp connector from SR 24 eastbound connects with I-680 northbound from the left-hand side in the median. Immediately north of the ramp connector, elevated tracks for the Bay Area Rapid Transit (BART) cross I-680 resulting in several structural columns in the median and the outside shoulder of northbound I-680. These two elements create significant design constraints that make it challenging to widen the mainline to create a continuous northbound express lane through the existing managed lane gap.

4. GEOMETRIC CONCEPTS DEVELOPMENT

In collaboration with the TAC, a wide range of solutions were considered to close the northbound gap, including several operational improvement strategies that would complement the managed lanes and provide additional congestion relief benefits. Concepts and findings were presented by the Project Team and explored with the TAC over a series of five meetings held between October 2015 and March 2016. The Project Team and TAC members are shown in **Table 4-1**.

Table 4-1: Project Team and Technical Advisory Committee Members

Name	Title	Representing
Technical Advisory Committee		
Jerry Fahy	Division Manager, Transportation Engineering	Contra Costa County Public Works Department
Steve Waymire	City Engineer	City of Walnut Creek
Ross Chittenden	Deputy Executive Director, Projects	CCTA
Susan Miller	Director, Projects	CCTA
Leo Scott	I-680 N. Express Lane Project Manager	CCTA/ Gray-Bowen-Scott
Ashley Nguyen	Principal	MTC
Andrew Dillard	Transportation Manager	City of Danville
Project Study Team		
Kevin Chen	Project Manager	MTC
Mike Kerns	Traffic Manager	MTC
Eddie Barrios	Project Manager	Fehr & Peers
Rob Rees	Traffic Advisor	Fehr & Peers
Brian Stewart	Engineering Lead	HDR
Carl Haack	Design Manager	HDR

Table 4-2 and 4-3 presents the geometric improvement concepts that were investigated with the TAC and identifies those that were eliminated prior to the traffic analysis for one or more of the following reasons:

1. Substantial design issues or constraints and the ability to satisfy *California Highway Design Manual* standards
2. Significant right-of-way (R/W) impacts

3. TAC / Team consensus, based on projected volume forecasts, that the concept would not meet the primary project objectives to improve managed lane connectivity or traffic operations

Table 4-2: Evaluated Geometric Improvement Concepts

ID	Title	Description
A	Adaptive Ramp Metering	Adaptive ramp metering installed and activated at all on-ramps except EB SR 24 to NB I-680
B	General Purpose (GP) Lane Conversion (South)	Convert GP Lane (#1 lane) to express lane from Livorna Road On-Ramp to Ygnacio Valley off-ramp.
C	General Purpose (GP) Lane Conversion (North)	Convert GP lane (#1 lane) to express lane from North Main Street Overcrossing (O/C) to the start of planned express lane north of SR 242.
D	Contra Flow Lane (south of SR 24 to North Main St. O/C)	Near the northbound Rudgear Road on-ramp the northbound express lane would transition to the southbound I-680 express lane and operate as a contraflow lane roughly between the Rudgear on-ramp and North Main Street off-ramp. The southbound I-680 express lane would be inoperable between the North Main Street and Rudgear Road interchanges during the operation of the contra flow lane.
F1	Collector-Distributor (C-D) Road (North Main Street/Treat Boulevard Area)	Provide a C-D road to service the North Main Street off-ramp, North Main Street on-ramp, and Treat Boulevard off-ramp. The C-D road is intended to address the existing bottleneck between the North Main Street on-ramp and Treat Boulevard off-ramp by moving weaving traffic from the mainline to the C-D road.
J	Outside Widening Livorna Road to Rudgear Road	Widen the mainline on the outside to provide a new lane from the Livorna Road on-ramp to the Rudgear Road on-ramp. With the widening a 5 th lane would be provided from the Livorna Road on-ramp to the Olympic/SR 24 off-ramp.
K	Outside Widening Olympic Boulevard to Ygnacio Valley Road	Widen the mainline on the outside from the Olympic/SR 24 off-ramp to the Olympic Boulevard on-ramp. With the widening a 4 th lane would be provided from the Olympic/SR 24 off-ramp to the Ygnacio Valley Road off-ramp.
M1	Extend the Managed Lane from SR 242 South to North Main Street O/C (Plus)	Extend the northern planned managed lane (including new lane from SR 242 to North Main OC Geometric ID "L") to the south an additional 1,950 feet south of the North Main Street on-ramp.
N	SR 24/I-680 Interchange reconfiguration (Swap SR 24 and I-680 lanes including Ygnacio Boulevard off-ramp reconfiguration)	Reconfigure the SR 24/I-680 interchange such that eastbound SR 24 would join northbound I-680 on the right side instead of the left side. Provide a new direct connector to the Ygnacio Boulevard off-ramp from the existing northbound to westbound SR 24 flyover (the existing off-ramp from northbound I-680 to the Ygnacio Boulevard would be closed).

ID	Title	Description
O	Ygnacio Boulevard Off-Ramp Reconfiguration	Provide a new direct connector to the Ygnacio Boulevard off-ramp from the existing northbound I-680 to westbound SR 24 flyover (the existing off-ramp from northbound I-680 to the Ygnacio Boulevard off-ramp would be closed).
X	NB I-680 - Express Lane Infrastructure	Provide Express Lane infrastructure (civil and TSI components) for I-680 northbound from Livorna Road to 1-mile south of the Benicia Bridge Toll Plaza (12 Miles)

Table 4-3: Eliminated Geometric Improvement Concepts

ID	Title	Description
E	Tunnel	Construct a tunnel underneath the I-680/SR 24 interchange to allow a continuous express lane through the interchange. Preliminary geometric review of the tunnel concept indicates that grades may need to be as high as 15%. <u>Due to the significant design issues associated with the concept, it was not progressed into the traffic analysis.</u>
F2	Braided Ramps (North Main Street/Treat Boulevard Area)	Provide braided ramps as an alternative to the C-D system. (F1). <u>Due to the similar operational improvements and the significant increased cost compared with the C-D Road Concept (F1), this concept was not progressed into the traffic analysis.</u>
G	North Main Street (Lawrence Way) On-Ramp Direct Connector	Provide a direct express lane connector to the median on northbound I-680 from Lawrence Way on-ramp (North Main St). It was determined that the direct connector would effectively prohibit the extension of the express lane to the south of the North Main Street and beginning the express lane at this location would not be effective in addressing the existing bottleneck between the North Main Street on-ramp and Treat Boulevard off-ramp. <u>Due to these concerns the concept was not progressed into the traffic analysis.</u>
H	Permanent Northbound Express Lane on the Southbound Roadbed	Use the southbound roadbed (primarily southbound shoulder) to provide a northbound express lane. Currently (2016), there is sufficient shoulder width to consider this concept; however, the southbound HOV Completion project (to be completed by year 2020) will utilize the majority of the southbound shoulder to close the existing southbound HOV lane gap. <u>The concept was not progressed into traffic analysis.</u>
I	Shoulder Running Lane	Use the existing right-side shoulder to provide the necessary roadway width for a northbound express lane. Further review of this concept revealed that there are geometric, grade, and operational design challenges at each off- and on-ramp. Most of the constraints are in the vicinity of the SR 24 interchange. A shoulder running lane between I-580 and SR 24 for buses was evaluated as part of a CCTA effort entitled <i>I-680 Transit Investment/Congestion Relief Options Study</i> . <u>The concept was not progressed into the traffic analysis.</u>

ID	Title	Description
L	Extend the Managed Lane from SR 242 South to North Main Street O/C	This improvement is presented in the March 2007 Caltrans PSR. Further analysis of this concept by CCTA in 2014 revealed that the proposed start of the express lane would not allow sufficient distance for northbound drivers to transition from the general purpose lanes to the managed lane prior to reaching the bottleneck between the North Main Street on-ramp and Treat Boulevard off-ramp. Thus, minimal operational benefit would be achieved. The 2014 analysis indicated that the managed lane would need to start at least 1,500 feet prior to the North Main Street on-ramp to provide a substantive operational benefit (Concept M1 includes the additional 1,500 feet). <u>Due to these findings the concept was not progressed into the traffic analysis.</u>
M2	Extend the Managed Lane from SR 242 South to SR 24	Extend the northern managed lane to the south to about 4,860 feet south of the North Main Street on-ramp. <u>Due to substantial ROW and design constraints the concept was not progressed into the traffic analysis.</u>

5. GEOMETRIC CONCEPTS EVALUATION

The design team evaluated each of the improvement concepts that were identified by the TAC to be progressed into the next phase of the study. The team performed a design evaluation of each of the concepts including considerations for construction costs, R/W impacts, design feasibility and constructability. Safety considerations were also noted in association with each concept's required exceptions to design standards from the California Highway Design Manual (HDM).

Design Evaluation Criteria

Cost Range: Costs shown include capital construction costs for each of the geometric improvement concepts. Project development costs (including design and oversight), Environmental Mitigation and R/W costs are not included in the estimates. General quantities were prepared for the major work items including pavement widening, structure widening, retaining walls, sound walls and signing and striping. Lump sum estimates of work were prepared for grading and drainage, traffic handling and various miscellaneous construction items based off the size and scale of the overall construction work required for each of the concepts. The capital cost range includes a cost confidence factor and constructability factor as discussed below.

Cost Confidence: A cost confidence factor has been applied to account for uncertainty in construction cost due to complexity, constructability and uncertainty in the construction work associated with each geometric improvement concept. The cost confidence factor has been applied to the construction estimate values. A high cost confidence factor applies a 0% to 20%

cost range above the base estimate, a medium cost confidence factor is 20% to 40%, and a low cost confidence factor applies 40% to 60% range above the base estimate.

R/W Impact: R/W impacts have been evaluated for each of the geometric improvement concepts. A high impact value assumes that there is significant R/W acquisition required to construct the improvement concept that would substantially affect the project cost and delivery schedule. A medium impact value assumes there is some R/W acquisition required for construction but the affect is relatively lower to the project cost and delivery schedule. A low impact value assumes there is no R/W acquisition required for construction of the improvement concept. R/W impacts were based on design and R/W information available at the time of this study.

Design Feasibility: This factor is based on the magnitude, type and likelihood of obtaining the necessary exceptions to the HDM design standards associated with each geometric improvement concept. A high design feasibility value assumes low risk with approval of design exceptions. A low feasibility value is used when there are high risks associated with design approval from Caltrans.

Constructability: The constructability factor is used to account for the overall complexity of the construction involved for each design improvement concepts. A high constructability value is assigned to the concepts where the construction work is typical for highway construction, provides adequate work areas and would require little impact to existing traffic. A low value is assigned when the construction work is very complex, requires significant impacts to traffic and the work area is highly constrained.

Table 5-1 summarizes the evaluation of each geometric improvement concept and includes additional considerations associated with each improvement concept.

Table 5-1: Summary of Geometric Concepts Evaluation

ID	Cost Range	Cost Confidence	R/W Impact	Design Feasibility	Constructability
Adaptive Ramp Metering					
A	\$15M to \$20M	High	Med	High	High
Design Summary	Seven (7) of the I-680 northbound on-ramps will have TOS elements installed for ramp metering. Design Exceptions: If R/W can not be acquired at certain ramps to accommodate HOV by-pass lanes a Caltrans policy exception would be required to install the ramp metering improvements without a HOV by-pass lane.				
Considerations	R/W: R/W may be required for the addition of HOV by-pass lanes at certain ramp locations. Constructability: The proposed work is straight forward and would require some temporary closures of the on-ramps. That work can be done at night with detours. Safety: There should be little concern with safety for this concept as long as the design meets current standards.				

ID	Cost Range	Cost Confidence	R/W Impact	Design Feasibility	Constructability
General Purpose (GP) Lane Conversion (South)					
B	\$900K to \$1.1M	High	Low	High	High
Design Summary	Converting a general purpose (GP) lane into a managed lane is relatively non-complex. Work mainly includes re-striping and signing. There are about 3.9 miles of GP lane conversion along I-680 assumed for this concept (south of the SR 24 Interchange). Costs do not include express lane system costs. Design Exceptions: Although it is assumed there are no new design exceptions required for this design concept, implementation of an express lane may require a striped 2-foot wide buffer along the limits, potentially requiring new design exceptions to reduce shoulder width or lane width to accommodate the buffer. Conversion of a GP lane would require policy approval from FHWA and Caltrans.				
Considerations	R/W: It is assumed that no new R/W would be required for this concept and use of the existing pavement width would be utilized. Constructability: Construction work is straight forward and would require re-striping on I-680 to be performed during night time hours. Safety: There should be little concern with safety for this concept, provided the design meets current standards.				
General Purpose (GP) Lane Conversion (North)					
C	\$900K to \$1.1M	High	Low	High	High
Design Summary	Converting a general purpose (GP) lane into a managed lane is relatively non-complex. Work mainly includes re-striping and signing. There are about 3.3 miles of GP lane conversion along I-680 assumed for this concept (north of the SR 24 Interchange). Costs do not include express lane system costs. Design Exceptions: Although it is assumed there are no new design exceptions required for this design concept, implementation of an express lane may require a striped 2-foot wide buffer along the limits, potentially requiring new design exceptions to reduce shoulder width or lane width to accommodate the buffer. Conversion of a GP lane would require policy approval from FHWA and Caltrans.				
Considerations	R/W: It is assumed that no new R/W would be required for this concept and use of the existing pavement width would be utilized. Constructability: Construction work is non-complex and would require re-striping on I-680 to be performed during night time hours. Safety: Safety concerns are low for this concept, provided the design meets current standards. There is a proposed left lane drop after the SR 24 merge and before the start of the managed lane. This proposed lane drop feature should be evaluated in the next phase of project design. Lane Conversion: This improvement assumes a GP lane drop before the start of the converted managed lane near N. Main St. During the next phase of design a direct GP lane to managed lane facility should be considered without a lane drop. Advanced signing can be installed per MUTCD to address the transition without a lane drop. The two options should be discussed with Caltrans and considered in the Traffic Operations Analysis during the next phase of design.				

ID	Cost Range	Cost Confidence	R/W Impact	Design Feasibility	Constructability
Contra Flow Lane (south of SR 24 to North Main St. O/C)					
D	\$20M to \$25M	Med	Low	Low	High
Design Summary	<p>The Contra Flow Lane concept provides just over 2 miles of an I-680 northbound managed lane along the southbound travel way section. It requires a left exit to access the lane south of SR 24 and a merge section back to northbound I-680 near N. Main Street. The north merge location would require a left side lane drop along the southbound direction of travel while the contra flow lane is operational in the PM peak period. The concept would also require the use of a movable barrier system to protect the contra flow lane traffic during operations. The movable barrier system would include a "zipper" truck and a location to house and store the truck while not in use. The cost estimate assumes the costs for the movable barrier system and truck. There would be an on-going cost of about \$400K/year for operations and maintenance of the system. Design Exceptions: There are several design exceptions required for this concept. Reduction of the southbound left shoulder width would be required to store the moveable barrier while not in operation (shoulder reduction of 2-feet). During operations there would be design exceptions associated with the travel lane widths (11-feet) and the proposed shoulder widths along the movable barrier limits (0-2-foot shoulders). This concept would also require a left side lane drop along southbound I-680 during contra flow lane operation.</p>				
Considerations	<p>R/W: It is assumed that no new R/W would be required for this concept and the existing pavement width would be utilized. Constructability: Construction work is non-complex and would require work to the median barrier for the northbound/southbound merge sections on I-680 to be performed during night time hours. Consideration of the overhead express lane signs would be required to allow for dual direction operation and could present issues with the tolling system design. Safety: Due to multiple new design exceptions, a southbound left side lane drop and introduction of a new managed lane concept to California, the safety considerations are high. Approval would be required from Caltrans and FHWA to implement the contra flow lane. A proposed 50 MPH speed limit for the contra flow lane should be discussed with Caltrans design and safety in PA/ED.</p>				

ID	Cost Range	Cost Confidence	R/W Impact	Design Feasibility	Constructability
Collector-Distributor (C-D) Road (North Main Street/Treat Boulevard Area)					
F1	\$47M to \$58M	Med	Med	Med	Med
Design Summary	<p>The collector -distributor (C-D) road concept would provide a C-D system from the N. Main off-ramp to the Treat Blvd. on-ramp. The concept provides a two lane off-ramp at N. Main St, a three lane C-D roadway section between the Lawrence Way on-ramp and the Treat Blvd. off-ramp and a 1-lane on-ramp onto I-680 at the location of the current truck scale on-ramp. A 4,700-foot long retaining wall structure would be required along the outside of the proposed pavement widening to reduce R/W impacts and conflicts with BART. Structure widening would be required at the Contra Costa Canal bridge as well as the potential to addition of sound barriers along the outside of the C-D road on top of the proposed retaining structure. This concept would require the closure of the northbound CHP truck scale facility. A high speed Weigh-In-Motion (WIM) and Bypass system is assumed in the cost estimate to mitigate the closure of the Truck Scale Facility. Also \$5M to \$10M in costs has been included to mitigate operational conflicts with the City of Walnut Creek Maintenance Facility (see R/W impact below). Design Exceptions: There would be no new major design exceptions associated with this concept. There is a design constraint at the location of the N. Main St overcrossing structure that would require a design exception for left shoulder width and a special barrier design to protect the existing structure columns in order to maximize the travel way width for the proposed two lane off-ramp.</p>				
Considerations	<p>R/W: This concept would require R/W acquisition on two parcels (0.1 to 0.2 AC). On the City of Walnut Creek parcel, there would be potential impacts to the existing set-back of the building structure. There would be a small R/W acquisition required from the BART property that doesn't appear to impact the BART line or setbacks. Additional design exceptions could be proposed to reduce the R/W impact at this location. Constructability: Although most of the construction work would be off of the I-680 mainline, this concept would temporarily impact the N. Main Street off-ramp, Lawrence Way on-ramp and Treat Blvd off-ramp. It is highly likely that temporary closures of these ramps would be required to complete the work and could be done over a 3-day weekend closure. Night time closure would also be required to complete the majority of the work. The proposed widening work encroaches onto city property and requires a retaining structure to be constructed along the existing R/W line of Caltrans and the BART parcel. The construction work would require coordination with BART for work in or near (25 feet) of BART operating right-of-way and could increase the duration of the construction phase. Safety: Other than construction phase considerations there should be minimal concern with the safety of this concept provided the design meets current standards and the merge section along the C-D road does not present any operational issues.</p>				

ID	Cost Range	Cost Confidence	R/W Impact	Design Feasibility	Constructability
Outside Widening Livorna Road to Rudgear Road					
J	\$25M to \$30M	High	Low	High	High
Design Summary	This concept would provide a 2-mile long additional northbound lane from the Livorna Road on-ramp to the existing auxiliary lane between the Rudgear Road on-ramp and the South Main Street off-ramp. This concept would provide a 5th lane from the Livorna Road on-ramp to the Olympic Blvd. off-ramp. It would require about 8,100-feet (25 to 35-foot max height) of retaining structures along the outside pavement widening limits. The concept would also require structure widening of the Rudgear Road Undercrossing (UC) structure. Design Exceptions: There are no new design exceptions assumed for this design concept.				
Considerations	<p>R/W: It is assumed that no new R/W would be required for this concept and the proposed outside retaining wall would minimize R/W impacts. Constructability: Construction work would require outside pavement widening and most of the work could be done without major impacts to existing traffic. The concept would require structure widening of the Rudgear Road UC and would temporarily impact local traffic on Rudgear Road to complete the work. The proposed retaining wall would likely be a soil nail type to allow for fewer impacts during construction. The overall wall height of the proposed retaining structure would need to be investigated to determine the best wall type along the proposed limits. Safety: There should be minimal concern with safety for this concept provided the design meets current standards. During the construction phase, protection of local traffic along Rudgear Road would need to be considered to accommodate the structure widening.</p>				
Outside Widening Olympic Boulevard to Ygnacio Valley Road					
K	\$6.5M to \$8.0M	High	Low	High	High
Design Summary	This concept would provide a 0.6-mile long additional lane from the SR 24 off-ramp to the Olympic Blvd on-ramp. This concept would provide a 4th lane from SR 24 off-ramp to the Ygnacio Valley Blvd off-ramp. It would require outside structure widening of the Olympic Blvd UC and Mount Diablo UC structures. The work would also include minor re-alignment of the Olympic Blvd on and off ramps. Design Exceptions: There are no new design exceptions assumed for this design concept.				

ID	Cost Range	Cost Confidence	R/W Impact	Design Feasibility	Constructability
Considerations	<p>R/W: It is assumed that no new R/W would be required for this concept.</p> <p>Constructability: Construction work would require outside pavement widening and most of the work could be done without major impacts to existing traffic. The concept would require structure widening of the Olympic and Mount Diablo UCs and would temporarily impact local traffic on these roads to complete the work.</p> <p>Safety: There should be minimal concern with safety with this concept provided the design meets current standards. During the construction phase, protection of local traffic along Olympic and Mount Diablo Blvd would need to be considered to accommodate the structure widening.</p>				
Extend the Managed Lane from SR 242 South to North Main Street O/C (Plus)					
M1	\$140M to \$160M	Med	Med	Med	Low
Design Summary	<p>This concept would extend the northbound I-680 managed lane from SR 242 to south of the N. Main St Overcrossing structure (4 miles). It would require significant re-striping, outside pavement widening, structure widening, and retaining wall and sound wall replacement. The NB Truck Scales would also be rebuilt to accommodate the widening work. Structure work would include replacement of the I-680/SR 242 separation structure, and widening of the Contra Costa Canal Bridge and the Monument Blvd Undercrossing structure. Caltrans has studied the majority of this concept under a Project Study Report (PSR) previously approved. Design Exceptions: There are no new design exceptions required for this design concept north of N. Main St; the proposed features provide standard sight distance, lane width and shoulder widths. Extending the new lane south of the N. Main St Overcrossing would require nonstandard shoulder and lane widths.</p>				
Considerations	<p>R/W: This concept would require new R/W acquisitions from two parcels (0.3 AC) to allow room to widen I-680 and realign Buskirk Ave. Also, significant utility relocation work would be required for this design concept. Constructability: Construction work would require structure replacement and structure widening, outside pavement widening, sound wall and retaining wall construction. The majority of this work would be performed during night time hours. Reconstruction of the Truck Scale facility and Buskirk Ave would require additional traffic control and detours. Safety: There are safety considerations that will need to be considered during the review and approval of the project in the PA/ED phase. There are also several safety considerations for the construction phase including overhead structure replacement at SR 242.</p>				

ID	Cost Range	Cost Confidence	R/W Impact	Design Feasibility	Constructability
SR 24/I-680 Interchange reconfiguration (Swap SR 24 and I-680 lanes including Ygnacio Boulevard off-ramp reconfiguration)					
N	\$500M to \$600M	Low	High	Low	Low
Design Summary	<p>This concept would realign the EB SR24 connector on-ramp to the right side (outside) of the I-680 travel way. This re-alignment would allow for an additional northbound managed lane to be constructed closing the existing managed lane gap through the SR 24/I-680 Interchange location. The design work would be significant and very complex. Major demolition work would be required with significant pavement widening and reconstruction. The concept would include about 7,600 of reconstructed concrete barrier, about 6,900-feet of reconstructed retaining walls (16 to 35 -feet in height), reconstruction of three major structures (SR24 WB Connector, SR 24 EB Connector and SR 24/Ygnacio Valley ramp), a new aerial structure for the I-680 Ygnacio Valley Blvd off-ramp (re-aligned to diverge off of the SR24 WB off-ramp connector) and outside structure widening of Ygnacio Valley UC and Parkside UC structures. Design Exceptions: Left and right shoulder width design exceptions would be required along I-680 at the existing BART and Trinity Ave OC structure columns (approximately 4-foot shoulder widths).</p>				
Considerations	<p>R/W: This concept would require significant R/W acquisition on 16-parcels (about 1.0 AC total). The concept would result in impacts to 13 existing building structures within the acquired parcels and one parking lot area. The amount of R/W acquisition could increase if the remaining parcel size is determined to be unusable during the R/W appraisal evaluation process. Constructability: There are numerous concerns regarding the constructability of this design concept. The work is very complex and the added need to maintain existing traffic flows on I-680 and SR 24 may potentially make this concept unfeasible to construct. Significant detail is needed to determine the constructability and feasibility of this concept if it moves forward into a PA/ED phase for implementation. Safety: Due to the complex nature of this design concept various safety considerations should be reviewed during the PA/ED phase; construction phase safety is likely to be the biggest concern.</p>				

ID	Cost Range	Cost Confidence	R/W Impact	Design Feasibility	Constructability
Ygnacio Boulevard Off- Ramp Reconfiguration					
O	\$90M to \$100M	Low	High	Med	Low
Design Summary	<p>This concept would add a new aerial structure to serve the I-680 northbound traffic to Ygnacio Valley Blvd via the existing SR 24 WB connector structure. Widening of the existing SR 24 WB connector would be required to provide a three lane diverging connector configuration from northbound I-680. The concept would re-route Ygnacio Valley Blvd users to the SR 24 off-ramp then to an exit ramp. The concept would also close the existing I-680 off-ramp to Ygnacio Blvd. The concept would require a 1,100-foot retaining wall along the approach to Ygnacio Valley Blvd. This design concept is also included under design concept N (SR 24/680 Interchange reconfiguration). Design Exceptions: There are no new design exceptions assumed for this design concept.</p>				
Considerations	<p>R/W: This concept would require significant R/W acquisition on nine parcels (about 0.7 AC total). This concept would result in impacts to seven existing building structures within the acquired parcels. The amount of R/W acquisition could increase if the remaining parcel size is determined to be unusable during the R/W appraisal evaluation process. Constructability: If adequate R/W is acquired to provide for ample construction room, the construction work for this concept could be done without major concerns. Work would be required over Olympic and Mount Diablo Blvd impacting local traffic. Safety: Due to the complex nature of this design concept various safety considerations should be reviewed during the PA/ED phase; construction phase safety is likely to be the biggest concern.</p>				
NB I-680 - Express Lane Infrastructure					
X	\$18M to \$24M	High	Low	High	High
Design Summary	<p>This concept would provide the addition of express lane infrastructure on I-680 northbound from Livorna Road to the Benicia Bridge Toll Plaza (12 miles). Costs include all civil and Toll System Integration (TSI) construction components. There are no backhaul costs assumed (MTC Backhaul system will already have been installed in the corridor). Design Exceptions: New design exceptions for this concept would include reduction of median shoulder widths for sign and gantry structures and lane widths for the installation of a striped 2-foot wide buffer (if required).</p>				

ID	Cost Range	Cost Confidence	R/W Impact	Design Feasibility	Constructability
Considerations	<p>R/W: It is assumed that no new R/W will be required for this concept.</p> <p>Constructability: Construction work would mostly be performed at night and within the median of I-680 and along the outside shoulder areas. Temporary lane closures would be necessary to complete the work along with the potential for temporary lane shifts to provide an adequate working area in the median of I-680. Safety: Due to the complex nature of this design concept with respect to traffic operations and weaving (buffer determination), several safety considerations would be reviewed during the PA/ED phase of the project and will be identified in the Traffic Safety Analysis Report (TSAR).</p>				

6. ALTERNATIVES RECOMMENDED FOR TRAFFIC STUDY

Table 6-1 presents the traffic analysis alternatives that were evaluated in the second phase of this DAA study. The traffic analysis alternatives were developed based on combinations of the various geometric concepts presented above.

A total of ten alternatives (including No Build) were studied as part of this evaluation under year 2020 conditions. Due to design constraints along the corridor only two of the ten alternatives (Alternatives 8 and 9) would provide a continuous managed lane (eliminate the gap). Six of the alternatives would reduce the length of the gap (Alternatives 3, 4, 5, 6, 6A, and 7). Two alternatives (Alternative 1 and 2) would maintain the existing gap.

Table 6-1: Traffic Analysis Alternatives

Alternative	Title	Key Features And Assumptions
1	No Build	This is the baseline alternative. Assumes that by year 2020 the northbound I-680 Express Lane is operational on the southern end of the study corridor. The managed lanes gap is about 7.5 miles.
2	Adaptive Ramp Metering	This alternative assumes adaptive ramp metering. This is also included as part of Alternatives 3 through 9.
3	Express Lane: GP Lane Conversion with Transit and Park & Ride Investments	This alternative converts a General Purpose (GP) Lane to an Express Lane. This alternative assumes a 20% mode shift from SOV to HOV and transit, as a result of an expanded Express Lane system and future corridor investments in transit and park-n-ride facilities with

		<p>shuttle service to BART stations. This alternative also assumes a policy change for the HOV Lane from 2+ persons to 3+ persons and an increase in HOV occupancy from an average of about 2.2 persons under existing conditions to 4.0 persons. The managed lanes gap would be shortened from 7.5 miles to less than one mile.</p>
4	<p>Express Lane: GP Lane Conversion Plus C-D System with Transit and Park & Ride Investments</p>	<p>This alternative is similar to Alternative 3 but also provides a Collector-Distributor (C-D) road system to service the North Main Street off-ramp, North Main Street on-ramp, and Treat Boulevard off-ramp to eliminate mainline weaving and capacity issues at this location. This alternative also assumes the 20% mode shift from SOV to HOV and transit, as well as the HOV occupancy change included in Alternative 3. The managed lanes gap would be shortened from 7.5 miles to less than one mile.</p>
5	<p>Express Lane Extension and GP Lane Widening</p>	<p>This alternative provides outside widening on both the north side and south side of the SR 24 interchange to increase the length of the Express Lane and reduce the existing gap. The managed lanes gap would be shortened from 7.5 miles to less than one mile.</p>
6	<p>Express Lane Extension and GP Lane Widening Plus C-D System</p>	<p>This alternative is similar to Alternative 5 except it also provides a C-D road system to eliminate the mainline weaving between the North Main Street on-ramp and Treat Boulevard off-ramp. The managed lanes gap would be shortened from 7.5 miles to less than one mile.</p>
6A	<p>Express Lane: GP Lane Conversion and GP Lane Widening Plus C-D System</p>	<p>This scenario is similar to Alternative 6 except it does not include a managed lane extension from N. Main St to SR 242 and only includes an express lane conversion from Livorna Rd to SR 24. The managed lanes gap would be shorten from 7.5 miles to about 4.5 miles. This alternative would be an initial phase of Alternative 6.</p>

7	Express Lane Extension and GP Lane Widening Plus C-D System and Ygnacio I/C Reconfiguration	This alternative is similar to Alternative 6 except it does not include the mainline widening between Olympic Boulevard and Ygnacio Boulevard and instead reconfigures the Ygnacio Boulevard off-ramp. The managed lanes gap would be shortened from 7.5 miles to less than one mile.
8	Contra-Flow Plus Express Lane Extension and GP Lane Widening	This alternative provides a contra flow lane (by using the southbound express lane during the PM peak) to provide a continuous Express Lane with no gap.
9	SR 24 and Ygnacio I/C Reconfiguration Plus Express Lane Extension and GP Lane Widening	This alternative would reconfigure the I-680/SR 24 interchange (SR 24 would join I-680 on the right hand side as opposed to the left-side) to provide a continuous Express Lane with no gap.

7. TRAFFIC FORECAST AND OPERATIONS ANALYSIS

DATA COLLECTION

Existing Demand Volumes and Travel Speeds

The existing PM peak period demand volumes (3 PM to 7 PM) for northbound I-680 from Bollinger Canyon Road to Concord Avenue are presented in Appendix D. The existing demand volumes were based on data from the I-680 North Express Lane Conversion and I-680 South Express Lane Conversion projects, and a PEMS traffic count (March/April 2015) south of the Bollinger Canyon Road interchange.

Northbound I-680 travel speed data for the study corridor was obtained from the INRIX database. INRIX provides a traffic flow archive with the capability to access speeds reported at the segment level for specific days and times of day. INRIX data are gathered from a variety of sources, including in-vehicle GPS systems, mobile smart phones, and roadway sensors. INRIX provides a much larger data set than could be collected performing travel-time surveys utilizing the floating-car method and therefore is more comprehensive. INRIX speed data for April/May 2015 was used to establish a typical weekday condition. The observed INRIX speed data for the corridor is presented in Appendix B.

Existing Northbound I-680 Bottleneck Locations and Queue Observations

Bottleneck locations and queue length estimates for the 2015 PM peak period were determined primarily from field observations and INRIX speed data.

HOV LANE

No bottlenecks or queuing were consistently observed on the HOV Lane. However, between the Crow Canyon Road and Livorna Road interchanges the HOV Lane does experience a speed reduction between 4:00 PM and 6:30 PM as a result of congestion on the adjacent General Purpose Lanes. Slowing in the northern end of the HOV Lane was also observed as vehicles approach queues in the General Purpose Lanes extending from a bottleneck between the Lawrence Way on-ramp and Treat Boulevard Off-ramp.

GENERAL PURPOSE LANES

Table 7-1 summarizes the bottleneck and queuing observations on northbound I-680 during the 2015 weekday PM study period. Four bottlenecks develop on northbound I-680 during the PM study period. The bottlenecks for northbound I-680 during the PM study period are:

- Between the El Pintado Road on-ramp and Stone Valley Road off-ramp
- Between the Livorna Road on-ramp and Rudgear Road off-ramp
- Between the Ygnacio Valley Road off-ramp and North Main Street off-ramp
- Between the North Main Street on-ramp and Treat Boulevard off-ramp

Table 7-1: NB I-680 General Purpose Lane Bottlenecks – PM Study Period

Time Period	Bottleneck Location	Controlling or Hidden Bottleneck	Causes of Bottleneck	Approximate Queue Length and Location of End of Queue
3 to 3:30 PM	Between the Livorna on-ramp and Rudgear off-ramp	Controlling	Lane utilization imbalance & uphill grade	0.8 miles (Stone Valley on-ramp)
3:30 to 4 PM	Between the North Main on-ramp and Treat off-ramp	Controlling	High mainline and on-ramp/off-ramp weaving volume	3.0 miles (Rudgear Road on-ramp)
	Between the Ygnacio Valley off-ramp and North Main Street off-ramp	Hidden	Hidden within the congestion of N. Main St. bottleneck	n/a
	Between the Livorna on-ramp and Rudgear off-ramp	Controlling	Lane utilization imbalance & uphill grade	1.3 miles (Stone Valley off-ramp)
	Between the El Pintado on-ramp and Stone Valley off-ramp	Controlling	High mainline volumes & uphill grade	2.4 miles (Sycamore Valley off-ramp)
4 to 4:30 PM	Between the North Main on-	Controlling	High mainline and	9.4 miles (Sycamore

Table 7-1: NB I-680 General Purpose Lane Bottlenecks – PM Study Period

Time Period	Bottleneck Location	Controlling or Hidden Bottleneck	Causes of Bottleneck	Approximate Queue Length and Location of End of Queue
	ramp and Treat off-ramp		on-ramp/off-ramp weaving volume	Valley off-ramp)
	Between the Ygnacio Valley off-ramp and North Main Street off-ramp	Hidden	Hidden within the congestion of N. Main St. bottleneck	n/a
	Between the Livorna on-ramp and Rudgear off-ramp	Hidden	Hidden within the congestion of N. Main St. bottleneck	n/a
	Between the El Pintado on-ramp and Stone Valley off-ramp	Hidden	Hidden within the congestion of N. Main St. bottleneck	n/a
4:30 to 5 PM	Between the North Main on-ramp and Treat off-ramp	Controlling	High mainline and on-ramp/off-ramp weaving volume	11.4 miles (Crow Canyon WB on-ramp)
	Between the Ygnacio Valley off-ramp and North Main Street off-ramp	Hidden	Hidden within the congestion of N. Main St. bottleneck	n/a
	Between the Livorna on-ramp and Rudgear off-ramp	Hidden	Hidden within the congestion of N. Main St. bottleneck	n/a
	Between the El Pintado on-ramp and Stone Valley off-ramp	Hidden	Hidden within the congestion of N. Main St. bottleneck	n/a
5 to 5:30 PM	Between the North Main on-ramp and Treat off-ramp	Controlling	High mainline and on-ramp/off-ramp weaving volume	11.4 miles (Crow Canyon WB on-ramp)
	Between the Ygnacio Valley off-ramp and North Main Street off-ramp	Hidden	Hidden within the congestion of N. Main St. bottleneck	n/a
	Between the Livorna on-ramp and Rudgear off-ramp	Hidden	Hidden within the congestion of N. Main St. bottleneck	n/a
	Between the El Pintado on-ramp and Stone Valley off-ramp	Hidden	Hidden within the congestion of N. Main St. bottleneck	n/a
5:30 to 6 PM	Between the North Main on-ramp and Treat off-ramp	Controlling	High mainline and on-ramp/off-ramp weaving volume	11.4 miles (Crow Canyon WB on-ramp)
	Between the Ygnacio Valley off-ramp and North Main Street off-ramp	Hidden	Hidden within the congestion of N. Main St. bottleneck	n/a
	Between the Livorna on-ramp and Rudgear off-ramp	Hidden	Hidden within the congestion of N. Main St. bottleneck	n/a
	Between the El Pintado on-ramp and Stone Valley off-ramp	Hidden	Hidden within the congestion of N. Main St. bottleneck	n/a

Table 7-1: NB I-680 General Purpose Lane Bottlenecks – PM Study Period

Time Period	Bottleneck Location	Controlling or Hidden Bottleneck	Causes of Bottleneck	Approximate Queue Length and Location of End of Queue
6 to 6:30 PM	Between the North Main on-ramp and Treat off-ramp	Controlling	High mainline and on-ramp/off-ramp weaving volume	9.4 miles (Sycamore Valley off-ramp)
	Between the Ygnacio Valley off-ramp and North Main Street off-ramp	Hidden	Hidden within the congestion of N. Main St. bottleneck	n/a
	Between the Livorna on-ramp and Rudgear off-ramp	Hidden	Hidden within the congestion of N. Main St. bottleneck	n/a
	Between the El Pintado on-ramp and Stone Valley off-ramp	Hidden	Hidden within the congestion of N. Main St. bottleneck	n/a
6:30 to 7 PM	Between the Ygnacio Valley off-ramp and North Main Street off-ramp	Controlling	Lane utilization and mainline lane drop	2.7 miles (Rudgear on-ramp)

VISSIM MODEL DEVELOPMENT

The VISSIM microsimulation model developed as part of the I-680 North Express Lane Conversion and I-680 South Express Lane Conversion projects were updated reflect year 2015 traffic conditions. The existing (2015) observed and modeled speed contour maps for the General Purpose Lanes on northbound I-680 are presented in Appendix B. Bottleneck locations, congestion duration, maximum queues, and travel times were replicated adequately in the updated VISSIM model.

Table 7-2 presents the observed versus modeled travel time. In general, the simulated travel times are more conservative than the observed travel times.

Table 7-2: Observed versus Modeled Travel Time on Northbound I-680¹

PM Peak Period	Observed (2015) Travel Time (minutes)	Modeled Travel Time (minutes)	% Difference
3:00-3:30	22.6	22.5	-0.2%
3:30-4:00	32.3	40.2	24.5%
4:00-4:30	39.2	48.3	23.0%
4:30-5:00	49.8	48.6	-2.4%
5:00-5:30	57.0	52.7	-7.6%
5:30-6:00	55.5	51.2	-7.7%
6:00-6:30	36.1	41.6	15.3%
6:30-7:00	23.2	25.5	9.8%

¹ Limits are from the Alcosta Boulevard on-ramp to the SR 4 off-ramp.
Source: Fehr & Peers and INRIX, 2015.

EXISTING NETWORK MEASURES OF EFFECTIVENESS

Several Measures of Effectiveness (MOEs) computed with the VISSIM models are being used to quantify traffic operations for the project study area. Network MOEs are presented for the four-hour study period to provide a better understanding of overall traffic operations during the study period. Note that some MOEs (such as vehicle miles of travel) are presented for all origin/destination pairs while others (such as average travel time) are presented for just travel through the corridor between two discreet points. A distinction is made because some MOEs are most meaningful when the delays and traffic volumes from all on-ramps and off-ramps are considered while others are most meaningful when comparing only travel through the entire corridor on the freeway as experienced by users. The network MOEs can be particularly useful when comparing project alternatives by demonstrating the aggregate benefits of the project beyond a single peak hour. **Table 7-3** presents the existing network MOEs.

All Origin-Destination Pairs

- **Vehicle Miles of Travel (VMT) & Person Miles of Travel (PMT)** – is a measure of the total vehicle (person) throughput of the study area taking into consideration the actual volume served versus the demand and the trip lengths.
- **Vehicle Hours of Delay (VHD) & Person Hours of Delay (PHD)** – is a measure of the total delay incurred by all vehicles (persons) during the study period due to congestion.

Travel Through the Corridor

- **Average Travel Time** – is a measure of the time taken by all vehicles (on average) to travel through the network i.e., between two discreet points during the study period. The travel time calculation considers the average delay, vehicle queues, and friction caused by merging vehicles.
- **Average Travel Speed** – is a measure of vehicle speeds in the network that travel between two discreet points during the study period. This measure depends both on the posted speed for a given link and the level of congestion.

Lane-Mile Duration Index

The lane-mile duration index is another useful MOE when comparing alternatives especially if the location of the bottlenecks will differ among the alternatives. The lane-mile duration index is determined by summing the product of congested lane-miles and congestion duration for segments of roadway. For the purposes of this study a modified version of the lane-mile duration index will be used as follows¹:

$$\text{Modified Lane-Mile Duration Index} = (\text{Congested miles} * \text{Congestion Duration}) / (\text{Total miles} * 4 \text{ Hours})$$

¹ This calculation includes only the congested miles and does not include the number of lanes provided segment by segment.

The modified lane-mile duration index will provide results between 0 and 1.0 and will be useful in determining how overall congestion changes from one alternative to the next. A value of 0 indicates that no roadway segments on northbound I-680 between I-580 and SR 4 are congested (speeds less than 35 mph) while a value of 1.0 would indicate that every roadway segment on northbound I-680 is congested for the entire four hour peak period. Therefore, a lower index value would indicate less overall congestion.

Table 7-3: Existing NB I-680 PM Study Period Network Measures of Effectiveness

Measure	Value
All Origin-Destination Pairs	
Vehicle Miles of Travel (VMT)	769,225
Person Miles of Travel (PMT)	919,517
Vehicle Hours of Delay (VHD) in hours	359
Person Hours of Delay (PHD) in hours	408
Travel Through the Corridor (I-580 to SR 4)	
Average Travel Time (minutes): SOV	43.1
Average Travel Speed (mph): SOV	32
Average Travel Time (minutes): HOV	32.0
Average Travel Speed (mph): HOV	43
Modified Lane-Mile Duration Index	0.35

Notes

All origin-destination pairs consider all on- and off-ramps in the study network

Travel through the corridor includes only those vehicles that travel between the I-580 on-ramp and SR 4 off-ramp.

Delay is calculated relative to 65 mph on freeways.

Source: Fehr & Peers, 2016

EXPRESS LANE ASSUMPTIONS AND TRAFFIC DEMAND FORECASTS

Year 2020 Roadway Network Assumptions

The roadway network assumptions for each of the alternatives were presented earlier in Table 6-1 in this study. The Express Lane operational assumptions are:

- Alternative 1 and 2 – The Express Lane is operational in the southern part of the study corridor (Alcosta Boulevard to Livorna Road). Express lane operations are not provided in the northern part of the study corridor (north of SR 242).
- Alternatives 3 through 9 – Existing HOV lanes and proposed managed lanes within the study corridor will operate as Express Lanes.

Year 2020 Traffic Demand Forecasts

The traffic demand forecasts for each of the alternatives are presented in Appendix B. The traffic demand forecasts are generally the same for Alternatives 1, 2, 5, 6, 6A, 7, 8, and 9.

The traffic demand forecasts for Alternatives 3 and 4 differ from the other alternatives due to a 20% mode shift assumption (SOV to HOV). The overall vehicle demand volumes for Alternative

3 and 4 are lower (about 20% lower) than the other alternatives due to implementation of these alternatives with future corridor investments in transit that increase the overall average vehicle occupancy along the corridor and park-n-ride facilities with shuttle service to BART stations. It is estimated that about 103 northbound bus trips with an average occupancy of 60 passengers per bus during the PM peak period would be necessary to achieve the 20% vehicle demand reduction. Alternatives 3 and 4 also assume a policy change on vehicle occupancy for the HOV Lane from 2 persons to 3+ persons to gain free access to the Express Lane. In general, Alternatives 3 and 4 assume that the HOV occupancy will increase from an average of 2.2 persons under existing conditions to an average of 4.0 persons. While the vehicle demand forecasts may be different between the alternatives the same person demand is assumed for each of the alternatives.

2020 Corridor Operations

This section summarizes the corridor operations analysis for year 2020 applying the calibrated/validated VISSIM micro-simulation model developed under Existing Conditions. The speed contour maps for each of the alternatives are presented in Appendix D. **EXHIBIT 7-** presents the modified lane-mile duration index by alternative.

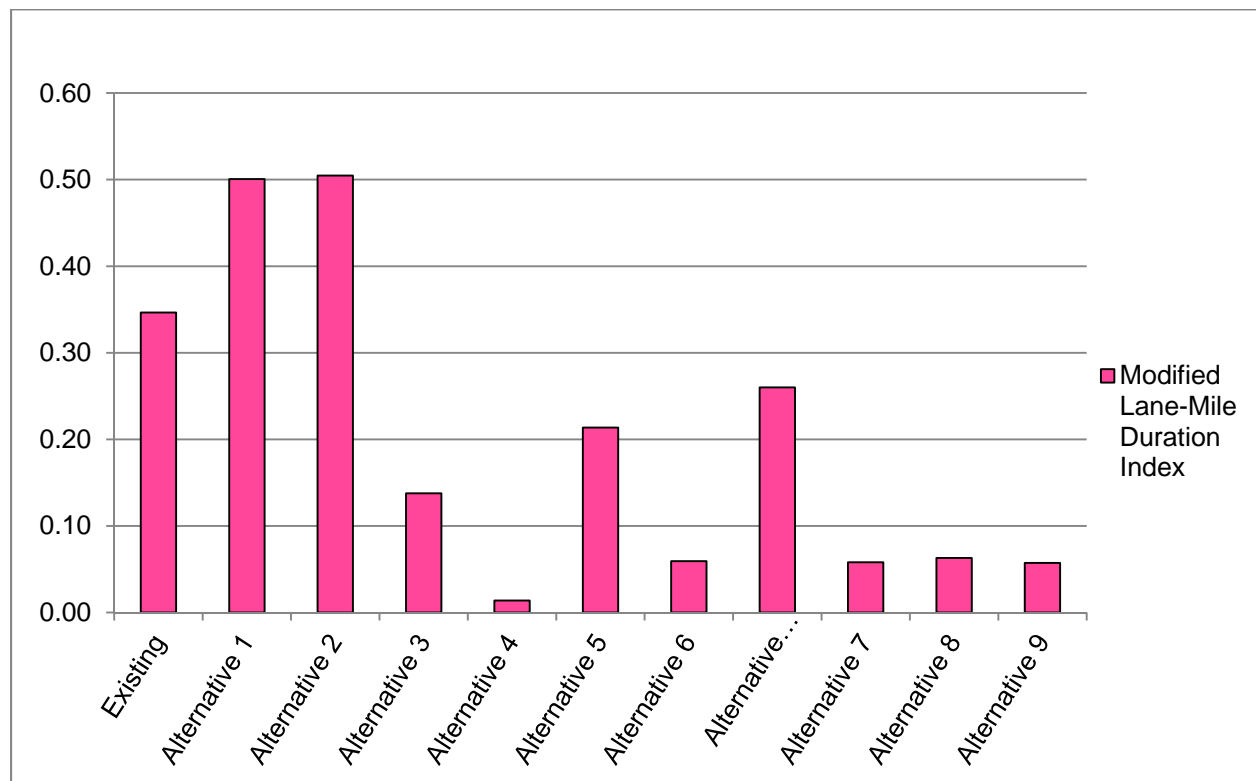


EXHIBIT 7-1: Modified Lane-Mile Duration Index

Bottleneck and Queue Characteristics

ALTERNATIVE 1

Under Alternative 1 conditions (year 2020 baseline) the overall congestion is anticipated to worsen compared to existing conditions. The modified lane-mile duration index is anticipated to increase from 0.35 to 0.50. Under Alternative 1 conditions, the following controlling bottlenecks would remain:

- Between the Livorna Road on-ramp and Rudgear Road off-ramp (controlling between 3:00 PM and 4:00 PM)
- Between the Ygnacio Valley Road off-ramp and North Main Street off-ramp (controlling between 3:00 PM and 3:30 PM and 6:30 PM to 7:00 PM)
- Between the North Main Street on-ramp and Treat Boulevard off-ramp (controlling between 3:30 PM and 6:30 PM)

Under Alternative 1 conditions the existing controlling bottleneck between the El Pintado Road on-ramp and Stone Valley Road off-ramp would no longer be a controlling bottleneck as it will be hidden within the congestion of downstream bottlenecks.

Under existing conditions the bottleneck between the Ygnacio Valley Road off-ramp and North Main Street off-ramp is present under one time period (6:30 PM to 7:00 PM) and under Alternative 1 conditions this bottleneck will be present under two time periods (between 3:00 PM and 3:30 PM and 6:30 PM to 7:00 PM). The bottleneck is a result of the mainline lane drop at the North Main Street off-ramp. Less than 400 vehicles per hour are served at the North Main Street off-ramp resulting in low utilization of the outside lane at the ramp exit. Based on the traffic analysis model, vehicles on the outside lane heading past the North Main Street off-ramp wait to move to the General Purpose Lanes until after the Ygnacio Valley Road off-ramp resulting in last minute lane changes that contribute to the bottleneck formation.

Under existing conditions the cumulative effect of the controlling bottlenecks resulted in a maximum queue that extended to about the Crow Canyon Road diagonal on-ramp. By year 2020, the cumulative effect of the controlling bottlenecks will result in a maximum vehicle queue that extends to about the Alcosta Boulevard off-ramp. This represents a queue length increase of about 4.6 miles compared to existing conditions.

Due to the projected traffic growth a new controlling bottleneck is anticipated to form between the Contra Costa Boulevard off-ramp and Monument Boulevard off-ramp from 5:30 PM to 6:30 PM. The bottleneck is a result of the mainline lane drop at the Monument Boulevard off-ramp. Less than 400 vehicles per hour are served at the Monument Boulevard off-ramp resulting in low utilization of the outside lane at the ramp exit. Based on the traffic analysis model, vehicles on the outside lane (auxiliary lane) heading past the Monument Boulevard off-ramp wait to move to the General Purpose Lanes until after the Contra Cost Boulevard off-ramp resulting in last minute lane changes that contribute to the bottleneck formation and lower vehicle speeds.

Typical speeds through a bottleneck are between 35 mph and 55 mph, the vehicle speeds at this bottleneck are anticipated to be between 20 mph and 30 mph. The queue from this bottleneck is anticipated to extend to about the Oak Road on-ramp (0.60 miles).

ALTERNATIVE 2

The modified lane-mile duration index is anticipated to remain unchanged under Alternative 2 compared to Alternative 1. Alternative 2 is expected to have the same controlling bottleneck locations as Alternative 1. The additional vehicle throughput as a result of ramp metering at the bottleneck between the North Main Street on-ramp and Treat Boulevard off-ramp results in the following when compared to Alternative 1:

- Overall higher congested speeds (lower delay) south of the North Main Street on-ramp bottleneck. The higher speeds are a result of the ramp meters that break up the platoons of vehicles entering the freeway and results in smoother traffic flow at the on-ramps. Compared to Alternative 1, Alternative 2 would result in a travel time reduction for vehicles traveling through the corridor. Alternative 2 would result in a maximum travel time savings of about 14 minutes.
- Due to ramp metering, the throughput of the bottleneck north of the North Main Street on-ramp will increase and, as a result, increase traffic demand for the bottleneck between the Contra Costa Boulevard off-ramp and the Monument Boulevard off-ramp. Consequently, the bottleneck duration will increase from 1 hour to 2 hours and the maximum vehicle queue will grow from the Oak Road on-ramp to the truck scales on-ramp (increase of about 0.4 miles).

ALTERNATIVE 3

The modified lane-mile duration index is anticipated to decrease from 0.5 under Alternative 1 to 0.14 under Alternative 3. This represents a substantial reduction in overall congestion. The reduction in congestion is primarily attributed to the reduced vehicle demand assumed under Alternative 3. Under Alternative 3 there are three controlling bottlenecks and they are:

- Between the El Pintado Road on-ramp and Stone Valley Road off-ramp (controlling between 3:30 PM and 4:00 PM)
- Between the Livorna Road on-ramp and Rudgear Road off-ramp (controlling between 3:30 PM and 4:00 PM)
- Between the North Main Street off-ramp and North Main Street on-ramp (location of General Purpose Lane conversion to Managed Lane; controlling between 3:00 PM and 7:00 PM)

Under Alternative 3 the major bottleneck would be between the North Main Street off-ramp and North Main Street on-ramp where the number of General Purpose Lanes would be reduced from five to four to allow for the restriping of the left most General Purpose Lane to a Managed Lane. The queue from this bottleneck would extend through the upstream bottleneck between the Livorna Road on-ramp and Rudgear Road off-ramp and result in maximum queues extending to the Livorna Road off-ramp (4.8 miles). The maximum vehicle queue from the El Pintado Road bottleneck would extend to about the El Cerro Road on-ramp (0.5 miles).

The Alternative 3 analysis assumes that a General Purpose Lane is dropped (left side lane drop) prior to restriping one of the General Purpose Lanes to a Managed Lane. The 2014 California Manual of Uniform Traffic Control Devices (CA MUTCD) provides guidance on how a General Purpose Lane could feed directly into a managed lane through proper signing and striping and should be considered in future studies of this alternative. A General Purpose Lane feeding directly into a managed lane would avoid a left side lane drop and would provide a higher vehicle throughput. It is likely that both the congestion duration and maximum queue length would be reduced at the North Main Street off-ramp to North Main Street on-ramp bottleneck if the General Purpose Lane was designed to feed directly into the managed lane.

ALTERNATIVE 4

The modified lane-mile duration index is estimated to be 0.01 under Alternative 4. This indicates that almost all of the congestion present under Alternative 1 would be eliminated under Alternative 4. The reduction in congestion is partially attributed to the reduced vehicle demand assumed under Alternative 4. Alternative 4 provides a C-D road system to service the North Main Street off-ramp, North Main Street on-ramp, and Treat Boulevard off-ramp. The C-D road system is intended to address the existing bottleneck between the North Main Street on-ramp and Treat Boulevard off-ramp by moving weaving traffic from the mainline to the C-D road system. Other operational benefits of the C-D road system that improve traffic operations are:

- Reduces the mainline vehicle demand between the North Main Street off-ramp and North Main Street on-ramp
- Improves the lane utilization approaching the North Main Street off-ramp; thereby, increasing the mainline throughput at this location.

Under Alternative 4 there are three controlling bottlenecks and they include:

- Between the El Pintado Road on-ramp and Stone Valley Road off-ramp (controlling between 3:30 PM and 4:00 PM)
- Between the Livorna Road on-ramp and Rudgear Road off-ramp (controlling between 3:30 PM and 4:00 PM)
- Between the SR 242 off-ramp and Express Lane add about 900 feet south of the Willow Pass Road off-ramp (controlling between 4:30 PM and 5:30 PM)

The maximum vehicle queue from the El Pintado Road bottleneck would extend to about the El Cerro Road on-ramp (0.5 miles). The maximum vehicle queue from the Livorna Road bottleneck would extend to the Livorna Road off-ramp (0.3 miles). The bottleneck between the SR 242 off-ramp and Express Lane add would develop as a result of reducing the number of General Purpose Lanes from three to two at this location to provide the Managed Lane. The queue from this bottleneck would extend to the Monument Boulevard on-ramp (0.68 miles).

ALTERNATIVE 5

The modified lane-mile duration index is anticipated to decrease from 0.5 under Alternative 1 to 0.21 under Alternative 5. This represents a substantial reduction in overall congestion. Alternative 5 would eliminate three of the four controlling bottlenecks present under Alternative 1. Under this alternative the outside roadway widening north of the Livorna Road on-ramp would help eliminate the bottleneck between the Livorna Road on-ramp and Rudgear Road off-ramp. The extension of the northern managed lane to the south to about 1,950 prior to the North Main Street on-ramp would increase the capacity between the North Main Street on-ramp and the Treat Boulevard off-ramp and eliminate the following two other bottlenecks present under Alternative 1:

- Between the North Main Street on-ramp and Treat Boulevard off-ramp
- Between the Contra Costa Boulevard off-ramp and Monument Boulevard off-ramp

The only remaining controlling bottleneck from Alternative 1 is between the Ygnacio Valley Road off-ramp and North Main Street off-ramp (controlling between 3 PM and 7:00 PM). The elimination of the Alternative 1 bottlenecks would reduce queuing south of the SR 24 interchange and, as a result, a new controlling bottleneck, hidden under Alternative 1 conditions, would be revealed between the El Pintado Road on-ramp and Stone Valley Road off-ramp (controlling between 3:30 PM and 6:00 PM).

The vehicle speeds between Ygnacio Valley Road off-ramp and North Main Street off-ramp are anticipated to be between 20 mph and 25 mph (lower than the typical speeds through a bottleneck). This is a location where there is low lane utilization, due to the mainline lane drop at the North Main Street off-ramp and less than 400 vehicles per hour using the off-ramp. Based on the traffic analysis model, vehicles on the outside lane heading past the North Main Street off-ramp wait to move to the General Purpose Lanes until after the Ygnacio Valley Road off-ramp resulting in last minute lane changes that contribute to the bottleneck formation and lower vehicle speeds.

Overall, the congestion under Alternative 5 would be substantially less than Alternative 1 as a result of eliminating three of the four controlling bottlenecks. The maximum vehicle queue from the El Pintado Road bottleneck would extend to about the Sycamore Valley off-ramp (2.4 miles) while the maximum vehicle queue from the Ygnacio Valley Road bottleneck would extend to about the Stone Valley Road on-ramp (5.0 miles).

ALTERNATIVE 6

Under Alternative 6 the modified lane-mile duration index would decrease from 0.5 under Alternative 1 to 0.06. This represents a substantial reduction in overall congestion. Alternative 6 includes the same improvements as Alternative 5 and as a result would eliminate the same bottlenecks Alternative 1. Similar to Alternative 5 the only remaining controlling bottleneck from Alternative 1 is between the Ygnacio Valley Road off-ramp and North Main Street off-ramp (controlling between 3 PM and 7:00 PM). However, the reduced queuing south of the SR 24

interchange associated with this alternative again reveals a new controlling bottleneck, that had been hidden in queues from downstream bottlenecks under Alternative 1 conditions, between the El Pintado Road on-ramp and Stone Valley Road off-ramp (controlling between 3:30 PM and 6:00 PM).

Alternative 6 also includes the C-D roadway system which improves the lane utilization approaching the North Main Street off-ramp and as a result would substantially reduce the vehicle queues associated with the Ygnacio Valley Road off-ramp to North Main Street off-ramp bottleneck. The maximum vehicle queue from this bottleneck would extend to about the Olympic Boulevard on-ramp (0.2 miles). The maximum vehicle queue from the El Pintado Road bottleneck would extend to about the Sycamore Valley off-ramp (2.4 miles). Overall, the congestion under Alternative 6 would be substantially less than Alternative 1 as a result of eliminating three of the four controlling bottlenecks and substantially reducing the congestion approaching the Ygnacio Valley Road bottleneck.

ALTERNATIVE 6A

Under Alternative 6A the modified lane-mile duration index would decrease from 0.5 under Alternative 1 to 0.26. This represents a substantial reduction in overall congestion. Alternative 6A includes the same improvements as Alternative 6, except the extension of the northern managed lane south from SR 242 to the North Main Street interchange. The following controlling bottlenecks would develop under Alternative 6A:

- Between the El Pintado Road on-ramp and Stone Valley Road off-ramp (controlling between 3:30 PM and 5:30 PM)
- Between the Ygnacio Valley Road off-ramp and North Main Street off-ramp (controlling between 3:00 PM and 3:30 PM)
- Between the Buskirk on-ramp and Oak Road on-ramp (controlling between 3:30 PM and 4:00 PM)
- Between the Contra Costa Boulevard off-ramp to Monument Boulevard off-ramp (controlling between 3:30 PM and 7:00 PM)

The primary difference between Alternative 6A and 6 is the controlling bottleneck between the Contra Costa Boulevard off-ramp and Monument Boulevard off-ramp that is anticipated under Alternative 6A. This is the result of not extending the northern managed lane to the south. Under Alternative 6A the queue from this bottleneck would extend through the upstream bottleneck at the El Pintado Road on-ramp at times during the peak period.

ALTERNATIVE 7

Under Alternative 7 the modified lane-mile duration index would decrease from 0.5 under Alternative 1 to 0.06. This represents a substantial reduction in overall congestion. Alternative 7 would close the existing Ygnacio Valley Road off-ramp and provide access to Ygnacio Valley Road via the SR 24 off-ramp. This design would reduce traffic demand for freeway sections

immediately north of the SR 24 off-ramp and, as a result, eliminate the need for widening between the SR 24 off-ramp and Olympic on-ramp (as in Alternative 6). Analysis results for this alternative indicate that bottleneck locations, congestion duration and queue lengths would be nearly identical to those for Alternative 6.

ALTERNATIVE 8

Under Alternative 8 the modified lane-mile duration index would decrease from 0.5 under Alternative 1 to 0.06. This represents a substantial reduction in overall congestion. Alternative 8 would eliminate the gap in the managed lane system by providing a contra flow lane near the I-680/SR 24 interchange area to provide a continuous northbound Express Lane. This alternative would eliminate the following three controlling bottlenecks present under Alternative 1 conditions:

- Between the Livorna Road on-ramp and Rudgear Road off-ramp
- Between the Ygnacio Valley Road off-ramp and North Main Street off-ramp
- Between the Contra Costa Boulevard off-ramp and Monument Boulevard off-ramp

The only remaining controlling bottleneck from Alternative 1 is between the North Main Street on-ramp and Treat Boulevard off-ramp (between 3:30 PM and 4:00 PM). Similar to other alternatives which reduce queuing south of the SR 24 interchange, this alternative reveals a new controlling bottleneck between the El Pintado Road on-ramp and Stone Valley Road off-ramp (controlling between 3:30 PM and 6:00 PM).

The maximum vehicle queue from the El Pintado Road bottleneck would extend to about the Sycamore Valley Road off-ramp (2.4 miles) and the maximum vehicle queue from the North Main Street bottleneck would extend to about the Ygnacio Valley Road on-ramp (1.1 miles). Overall, the congestion under Alternative 8 would be substantially less than Alternative 1 as a result of eliminating three of the four controlling bottlenecks and substantially reducing the congestion at the North Main Street on-ramp to Treat Boulevard off-ramp bottleneck.

A major drawback of this alternative is that the I-680 southbound Express Lane would be inoperable between the North Main Street and Rudgear Road interchanges so that the lane can be used as the northbound Express Lane. Some preliminary volume to capacity analysis was performed for the southbound I-680 direction to determine the potential impact of reducing the capacity for southbound traffic. The preliminary analysis indicates that within the contra-flow lane freeway section southbound traffic for year 2020 will not result in any new bottlenecks. As a result, no substantial change in congestion length or duration is anticipated for southbound traffic.

ALTERNATIVE 9

Under Alternative 9 the modified lane-mile duration index would decrease from 0.5 under Alternative 1 to 0.06. This represents a substantial reduction in overall congestion. Alternative 9 would reconfigure the I-680/SR 24 interchange to help eliminate the gap in the managed lane

system and provide a continuous northbound Express Lane. This alternative would provide about the same northbound capacity as Alternative 8 and as a result the analysis results are nearly identical to Alternative 8. This alternative would eliminate the following three controlling bottlenecks present under Alternative 1 conditions:

- Between the Livorna Road on-ramp and Rudgear Road off-ramp
- Between the Ygnacio Valley Road off-ramp and North Main Street off-ramp
- Between the Contra Costa Boulevard off-ramp and Monument Boulevard off-ramp

The only remaining controlling bottleneck from Alternative 1 is between the North Main Street on-ramp and Treat Boulevard off-ramp (between 3:30 PM and 4:00 PM). Similar to other alternatives this alternative reveals a new controlling bottleneck between the El Pintado Road on-ramp and Stone Valley Road off-ramp (controlling between 3:30 PM and 6:00 PM) as a result of eliminating several downstream controlling bottlenecks and reducing queues south of SR 24.

The maximum vehicle queue from the El Pintado Road bottleneck would extend to about the Sycamore Valley off-ramp (2.4 miles) and the maximum vehicle queue from the North Main Street bottleneck would extend to about the Ygnacio Valley Road on-ramp (1.1 miles). Overall, the congestion under Alternative 9 would be substantially less than Alternative 1 as a result of eliminating three of the four controlling bottlenecks and substantially reducing the congestion at the North Main Street on-ramp to Treat Boulevard off-ramp bottleneck.

NETWORK MEASURES OF EFFECTIVENESS

Table 7-4 presents the network measures of effectiveness for all of the alternatives in year 2020. The percent change for Alternatives 2 through 9 compared to Alternative 1 is presented in parenthesis.² The most informative MOEs with respect to comparing the alternatives are vehicle and person hours of delay and travel time. All of the alternatives reduce the vehicle and person hours of delay and reduce travel times (increase travel speeds) compared to Alternative 1.

EXHIBIT 7- presents a comparison of vehicle and person hours of by alternative. **EXHIBIT 7-** presents a travel time comparison for SOVs by alternative while **EXHIBIT 7-** presents a travel time comparison for HOVs by alternative.

² Note that while a comparison is made for VMT between Alternatives 3 and 4 with Alternative 1 it is not truly a direct comparison as Alternatives 3 and 4 have substantially lower demand volumes than Alternative 1.

Table 7-4: Year 2020 Northbound I-680 PM Study Period Network Measures of Effectiveness

Measure	Alternative									
<i>All Origin-Destination Pairs</i>	1	2	3	4	5	6	6A	7	8	9
Vehicle Miles of Travel (VMT)	764,371	776,818 (2%)	632,370 (-17%)	644,044 (-16%)	803,961 (5%)	806,257 (5%)	799,298 (5%)	805,146 (5%)	806,333 (5%)	805,233 (5%)
Person Miles of Travel (PMT)	907,985	922,965 (2%)	962,995 (6%)	963,800 (6%)	958,526 (6%)	963,619 (6%)	953,770 (5%)	962,261 (6%)	963,746 (6%)	962,354 (6%)
Vehicle Hours of Delay (VHD) in hours	2,253	1,706 (-24%)	471 (-79%)	9 (-99%)	302 (-87%)	72 (-97%)	555 (-75%)	71 (-97%)	69 (-97%)	68 (-97%)
Person Hours of Delay (PHD) in hours	2,460	1,859 (-24%)	510 (-79%)	11 (-99%)	316 (-87%)	76 (-97%)	595 (-76%)	75 (-97%)	71 (-97%)	71 (-97%)
<i>Travel Through the Corridor (I-580 to SR 4)</i>										
Average Travel Time (minutes): SOV	80.4	72.6 (-10%)	31.8 (-60%)	22.4 (-72%)	37.5 (-53%)	26.0 (-68%)	41.1 (-49%)	25.9 (-68%)	26.0 (-68%)	25.6 (-68%)
Average Travel Speed (mph): SOV	17.0	18.8 (11%)	42.9 (153%)	61.0 (259%)	36.4 (114%)	52.5 (209%)	33.3 (96%)	52.7 (210%)	52.6 (210%)	53.3 (214%)
Average Travel Time (minutes): HOV	40.6	38.3 (-6%)	26.2 (-36%)	22.1 (-46%)	25.3 (-38%)	22.2 (-45%)	29.9 (-26%)	22.2 (-45%)	22.0 (-46%)	22.0 (-46%)
Average Travel Speed (mph): HOV	33.7	35.6 (6%)	52.2 (55%)	61.8 (84%)	54.0 (61%)	61.4 (83%)	45.7 (36%)	61.5 (83%)	62.1 (84%)	62.1 (85%)

Notes:

1. Alternatives 3 and 4 assume a 20% reduction in vehicle demand as a result of mode shift.
2. Results presented in parenthesis show the percent change for the alternative compared to Alternative 1.

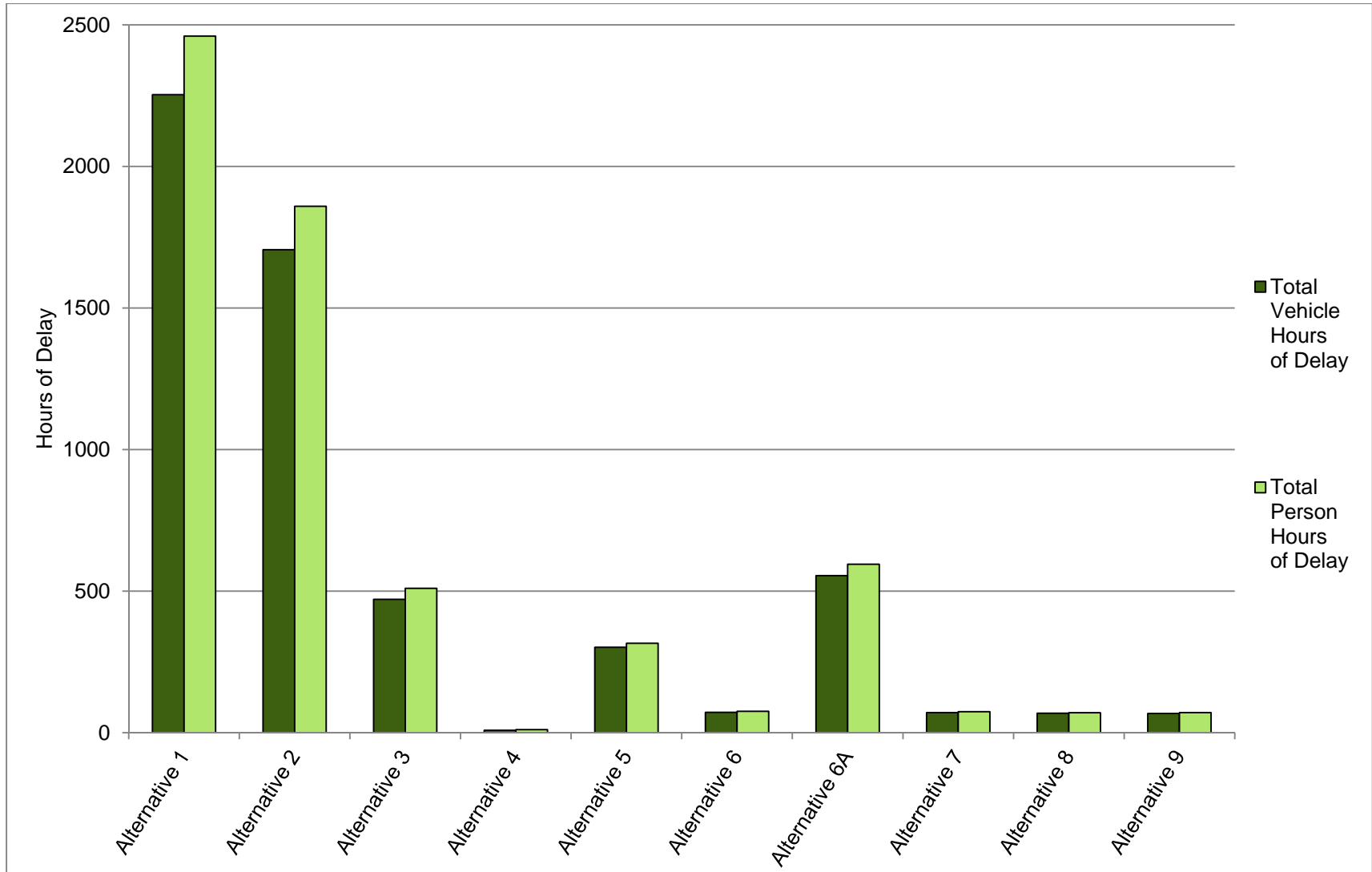


EXHIBIT 7-2: Northbound I-680 Vehicle and Person Hours of Delay by Alternative

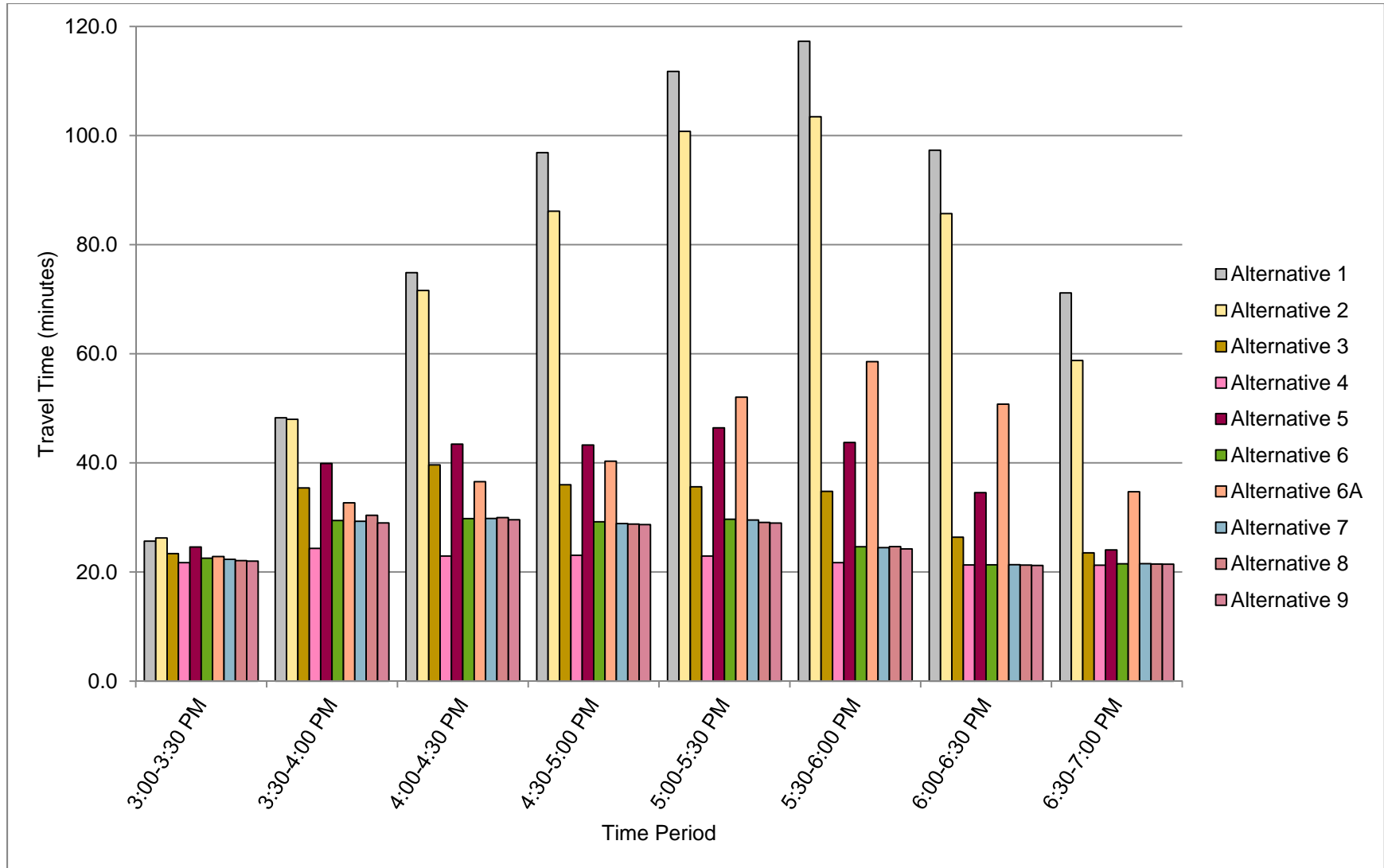


EXHIBIT 7-3: Northbound I-680 SOV Travel Time by Alternative

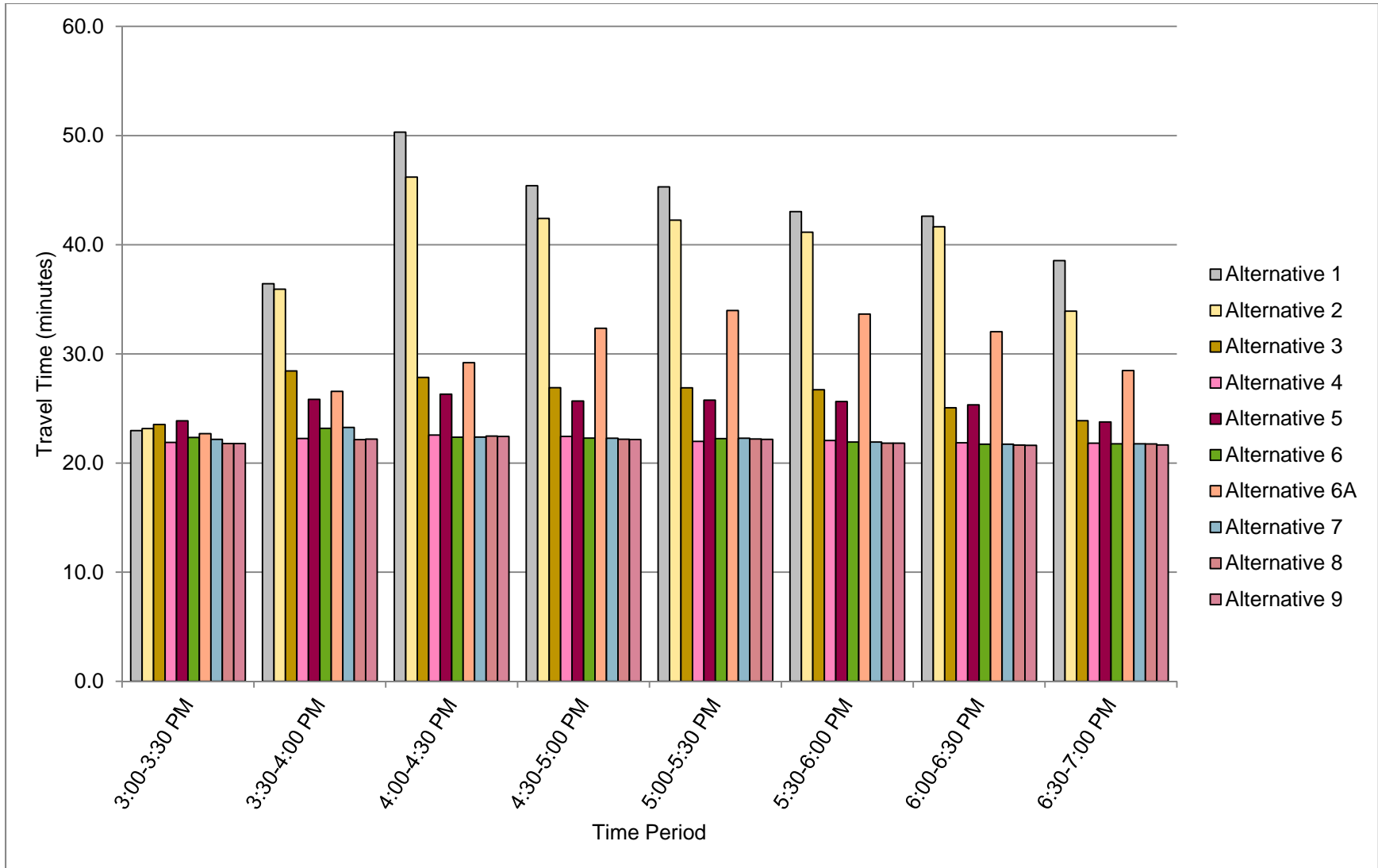


EXHIBIT 7-4: Northbound I-680 HOV Travel Time by Alternative

ALTERNATIVE 1

Existing network measures of effectiveness were presented in **Table 7-3** while year 2020 network measures of effectiveness are presented in **Table 7-4**. Increased corridor traffic demand between 2015 and 2020 will result in Alternative 1 vehicle hours of delay growing from 359 to 2,253 (528% increase) while the person hours of delay will grow from 408 to 2,460 (503% increase). The average SOV travel time will grow from 43.1 minutes under existing conditions to 80.4 minutes (87% increase) while the average HOV travel time will grow from 32.0 minutes under existing conditions to 40.6 minutes (27% increase).

ALTERNATIVE 2

Alternative 2 (with implementation of adaptive ramp metering) would reduce vehicle and person hours of delay by about 24% compared to Alternative 1. SOV and HOV average travel times are also anticipated to improve under Alternative 2 (10% reduction for SOVs and 6% reduction for HOVs).

ALTERNATIVE 3

Alternative 3 would reduce vehicle and person hours of delay compared to Alternative 1 (79% reduction for VHD and PHD). SOV and HOV average travel times are also anticipated to improve under Alternative 3 (60% reduction for SOVs and 36% reduction for HOVs).

As discussed earlier, the Alternative 3 analysis assumes that a General Purpose Lane is dropped (left side lane drop) prior to restriping one of the General Purpose Lanes to a managed lane. It is anticipated that the lane drop would result in increased congestion (VHD and PHD) on eastbound SR 24 including the freeway connector when compared to Alternative 1 and the other alternatives. The left side lane drop would effectively reduce the number of eastbound SR 24 lanes that merge with northbound I-680 from three to two. The increased congestion on the SR 24 freeway connector is the reason why the VHD and PHD is higher for Alternative 3 than other alternatives that have a higher the travel time on northbound I-680 compared to Alternative 3. As discussed earlier, future studies that include this alternative should consider a design that has the General Purpose Lane feeding directly into the managed lane. This would reduce the congestion on eastbound SR 24.

ALTERNATIVE 4

Alternative 4 would reduce vehicle and person hours of delay compared to Alternative 1 (99% reduction for VHD and PHD). SOV and HOV average travel times are also anticipated to improve under Alternative 4 (72% reduction for SOVs and 46% reduction for HOVs).

ALTERNATIVE 5

Alternative 5 would reduce vehicle and person hours of delay compared to Alternative 1 (87% reduction for VHD and PHD). SOV and HOV average travel times are also anticipated to improve under Alternative 5 (53% reduction for SOVs and 38% reduction for HOVs).

ALTERNATIVE 6

Alternative 6 would reduce vehicle and person hours of delay compared to Alternative 1 (36% reduction for VHD and 39% reduction for PHD). SOV and HOV average travel times are also anticipated to improve under Alternative 6 (68% reduction for SOVs and 45% reduction for HOVs).

ALTERNATIVE 7

Alternative 7 would reduce vehicle and person hours of delay compared to Alternative 1 (97% reduction for both VHD and PHD). SOV and HOV average travel times are also anticipated to improve under Alternative 7 (68% reduction for SOVs and 45% reduction for HOVs).

ALTERNATIVE 8

Alternative 8 would reduce vehicle and person hours of delay compared to Alternative 1 (97% reduction for both VHD and PHD). SOV and HOV average travel times are also anticipated to improve under Alternative 8 (68% reduction for SOVs and 46% reduction for HOVs).

ALTERNATIVE 9

Alternative 9 would reduce vehicle and person hours of delay compared to Alternative 1 (97% reduction for both VHD and PHD). SOV and HOV average travel times are also anticipated to improve under Alternative 9 (68% reduction for SOVs and 46% reduction for HOVs).

8. DESIGN ALTERNATIVE ASSESSMENT

A total of ten alternatives (including No Build) were studied as part of this evaluation under year 2020 conditions. Due to design constraints along the corridor only two of the ten alternatives (Alternatives 8 and 9) would provide a continuous managed lane (eliminate the gap). Six of the alternatives would reduce the length of the gap (Alternatives 3, 4, 5, 6, 6A, and 7). Two alternatives (Alternative 1 and 2) would maintain the existing gap. The DAA team has evaluated construction costs, operational improvements and associated risks for the proposed alternatives. The assessment of the proposed alternatives is provided below.

Table 8-1 ranks the studied traffic analysis alternatives by overall operational benefit for I-680 NB congestion relief. The table includes the key geometric features associated with each alternative to illustrate common and unique features of each alternative for comparison purposes.

Table 8-1: Operational Improvement Ranking of Studied Alternatives

RANK	ALTERNATIVE	DESIGN CONCEPTS	KEY DESIGN ELEMENT	COST RANGE*
1	Alternative 4	A, B, C, F1, X	C-D Road w/ GP Conversion (Mode Shift)	\$85M - \$105M
2	Alternative 6	A, B, F1, J, K, M1, X	C-D Road w/ Lane Extension	\$250M - \$300M
	Alternative 8	A, B, D, J, M1, X	Contra Flow w/ Lane Extension	\$220M - \$260M
	Alternative 7	A, B, F1, J, M1, O, X	Ygnacio Off-Ramp Configuration	\$350M - \$400M
	Alternative 9	A, B, J, K, M1, N, X	I680/ SR24 Interchange Reconfiguration	\$700M - \$900M
6	Alternative 5	A, B, J, K, M1, X	Lane Extension	\$210M - \$250M
7	Alternative 3	A, B, C, X	GP Conversion (Mode Shift)	\$35M - \$47M
8	Alternative 6A	A, B, F1, J, K, X	C-D Road	\$100M - \$125M
9	Alternative 2	A	Ramp Metering	\$15M - \$20M
10	Alternative 1	-	-	No Build

* Costs shown are construction estimates only and do not include support costs

Table 8-2 shows the studied alternatives and the associated benefit-cost ratio based on estimated average construction costs and an operational benefit factor based on the traffic analysis results.

Table 8-2: Alternative Cost-Benefit Ratios

ALTERNATIVE	AVERAGE COST* (MILLIONS \$)	OPERATIONAL BENEFIT FACTOR	BENEFIT- COST RATIO	BENEFIT- COST RANK
Alternative 2	17.5	240	13.7	1
Alternative 3	90	790	8.8	2
Alternative 4	144	999	6.9	3
Alternative 6A	112.5	760	6.8	4
Alternative 8	240	970	4.0	5
Alternative 5	230	870	3.8	6
Alternative 6	275	970	3.5	7
Alternative 7	375	970	2.6	8
Alternative 9	800	970	1.2	9

* Costs shown are construction estimates only and do not include support costs

9. CONCLUSION AND RECOMENDATIONS

Based on the results presented in Section 8 the following conclusions can be made:

- **Alternative 2** has the highest benefit-cost ratio as a result of a modest operational benefit but with a substantially lower cost compared to the other alternatives. Some key conclusions are :
 - This alternative is included in all the other studied alternatives, except Alternative 1.
 - Adaptive ramp metering if desired can be separated and delivered as an initial delivery project for NB I-680.
- **Alternatives 4, 6 and 8** all provide similar substantial operational benefits for NB I-680 under a different set of key assumptions and/or geometric improvement concepts:
 - Alternative 4 assumes a 20% mode shift (SOV to HOV and transit, through investments in transit and park & ride services) with the GP Lane Conversion Design Concept C (North Main to SR 242). It has a lower cost compared to Alternatives 6 and 8.

- Alternatives 4 and 6 both include a C-D Road (North Main to Treat).
 - Alternative 6 and 8 include the Managed Lane Extension (North Main to SR 242).
 - Alternative 8 includes a Contra Flow Lane and has a lower cost than Alternative 9 (the other alternative that closely the gap completely).
 - Based on these findings and comparison to the other remaining alternatives these three alternatives are ideal for further study.
- **Alternative 3** can be considered a subset (or an initial phase) of Alternative 4 as it also assumes a 20% mode shift and includes the same geometric improvement concepts except the C-D Road (North Main to Treat). Some key conclusions for Alternative 3 compared to Alternative 4
 - Alternative 3 has a higher benefit-cost ratio than Alternative 4.
 - Although Alternative 3 has a higher benefit-cost ratio, Alternative 4 is better suited for further study as an analysis can be performed with and without the C-D Road and effectively evaluate Alternative 3 and 4.
- **Alternatives 5 and 6A** can be considered subsets (or an initial phases) of Alternative 6 due to the following:
 - Alternative 5 includes all of the geometric improvement concepts as Alternative 6 except the C-D Road (North Main to Treat).
 - Alternative 6A includes all of the geometric improvement concepts as Alternative 6 except the Managed Lane Extension (North Main to SR 242).
 - Alternative 6 is better suited for further study vs. Alternatives 5 and 6A as Alternative 6 can be evaluated with and without the C-D road and Managed Lane Extension and effectively evaluate Alternatives 5, 6A, and 6.
- **Alternatives 8 and 9** provide improvements that close the I-680 NB managed lane gap:
 - Alternative 8 is better suited for further study compared to Alternative 9 as it fully meets the project objective (closing the gap in the managed lane) at a lower cost.
 - Alternative 9 has the lowest benefit-cost ratio, highest cost, and substantial risks and challenges that make this alternative not suitable for further study.
- **Alternatives 7 and 9** have the lowest benefit-cost ratios along with several risks that include:
 - Significant project delivery risks and construction challenges.
 - Alternatives 7 and 9 are not ideal alternatives to be carried through for further study due to the costs, risks and approval challenges.

RECOMMENDED ALTERNATIVES

This DAA recommends three proposed alternatives be studied and compared to the No Build alternative to identify the preferred alternative during the next project delivery phase:






- No Build
- **Alternative 4** - GP Lane Conversion Plus C-D System with Transit and Park & Ride Investments
- **Alternative 6** - Express Lane Extension and GP Lane Widening Plus C-D System
Alternative 8 - Contra-Flow Plus Express Lane Extension and GP Lane Widening

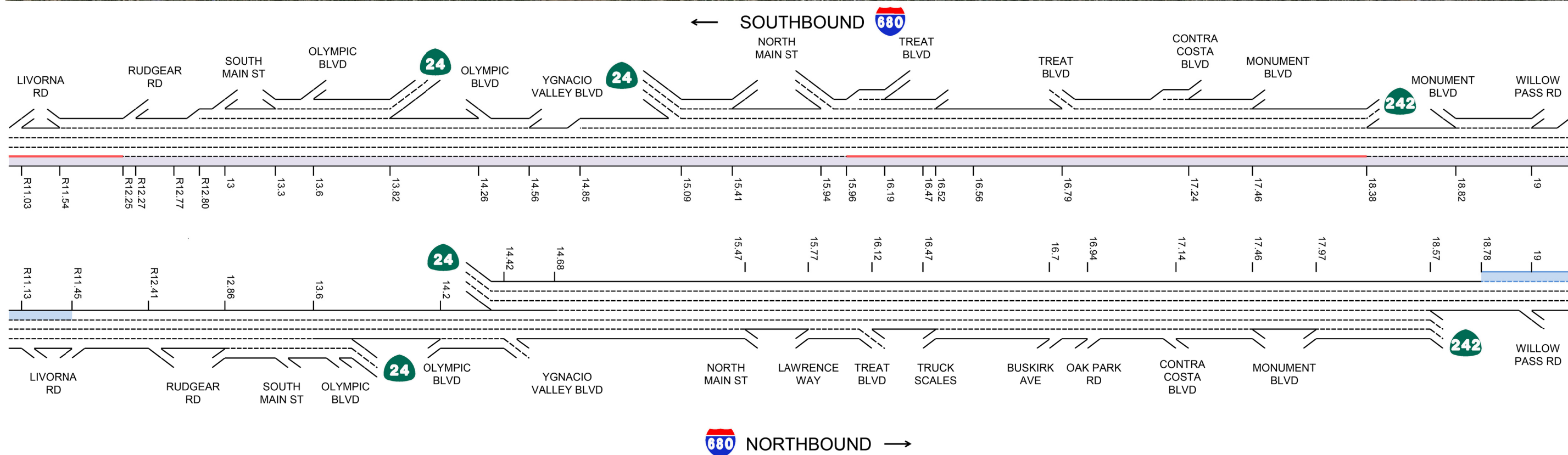
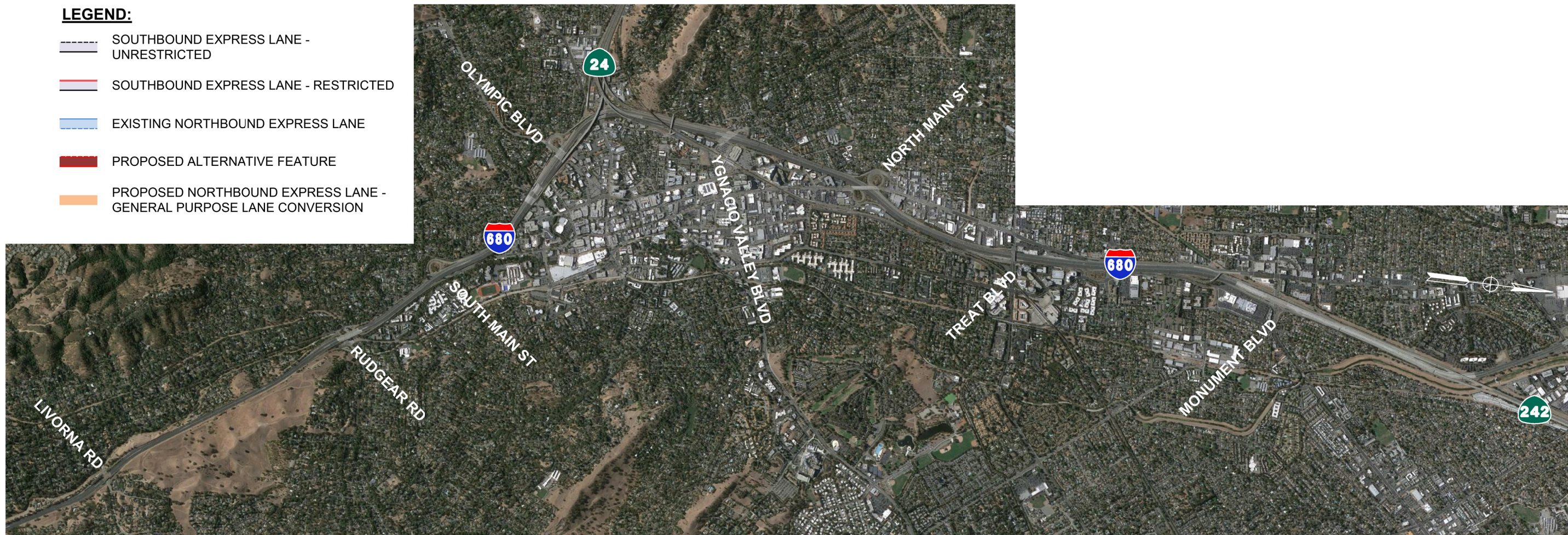
OTHER CONSIDERATIONS

- **Alternative 6** can serve as the baseline proposed alternative for the next phase:
 - Alternative 6 has the largest impact footprint of the three proposed alternatives and includes almost all the associated environmental impacts of Alternatives 4 and 8.
 - Alternative 6 can be evaluated for separate optional future phases of construction.
 - Alternative 6A can be an initial construction phase and later include Design Concept of M1, Managed Lane Extension (North Main to SR 242) as a future construction phase to produce Alternative 6.
 - Design Concept C, GP Lane Conversion Design (North Main to SR 242), included in Alternative 4 can be considered as a future construction phase.
 - Alternative 6 includes more typical highway improvements compared with Alternatives 4 and 8 with less project approval risks.
- **Alternative 8** is comparable to Alternative 6 for construction cost and operational benefit and is the only recommended alternative that closes the I-680 NB gap.
- **Alternative 4** provides the highest operational benefits and lowest cost with the highest benefit-cost ratio of the three recommended alternatives.
- The GP Lane conversion element (Concept C) of **Alternative 4** and Contra Flow Lane element (Concept D) of **Alternative 8** should be vetted early during the next phase to identify delivery feasibility and Caltrans Approval as well as consider other associated project risks.

APPENDIX A – Alternative Lane Diagrams

LEGEND:

-  SOUTHBOUND EXPRESS LANE - UNRESTRICTED
-  SOUTHBOUND EXPRESS LANE - RESTRICTED
-  EXISTING NORTHBOUND EXPRESS LANE
-  PROPOSED ALTERNATIVE FEATURE
-  PROPOSED NORTHBOUND EXPRESS LANE - GENERAL PURPOSE LANE CONVERSION








No Build

**I-680 NORTHBOUND
DESIGN ALTERNATIVE ANALYSIS
ALTERNATIVE 1**

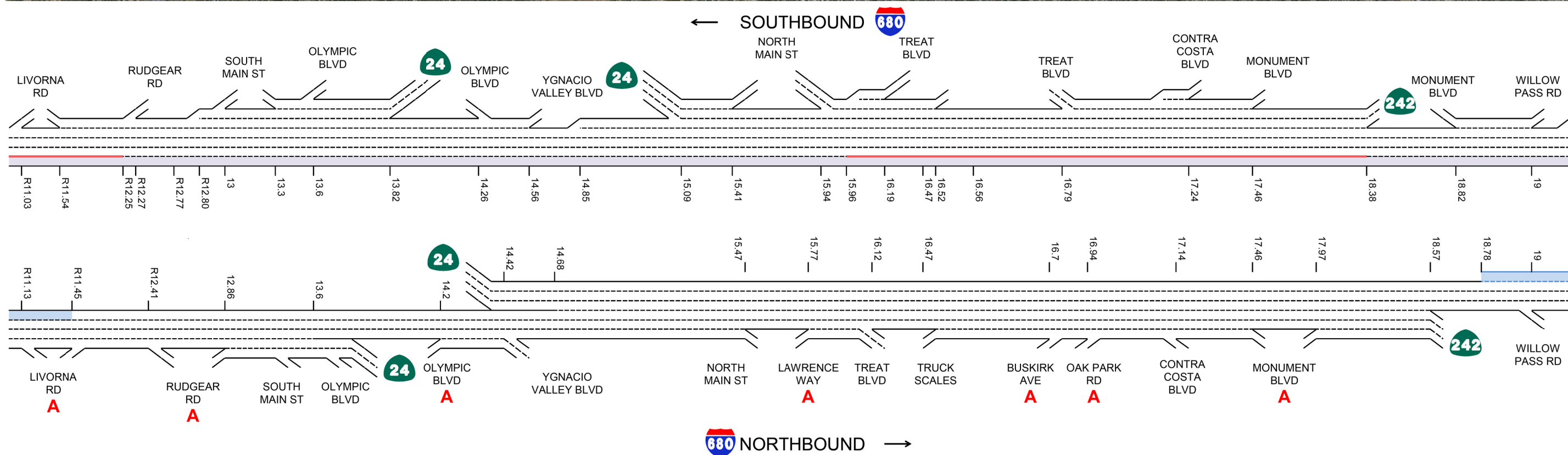
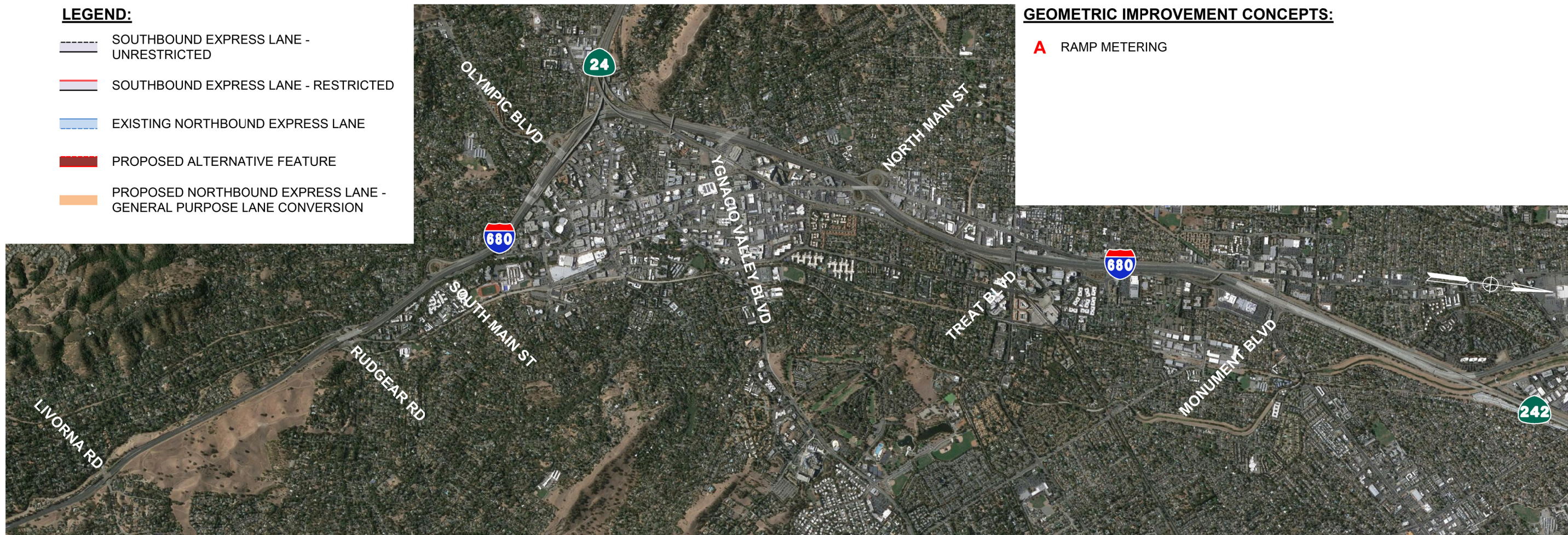
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DATE	6/10/2016
SCALE	NO SCALE

LEGEND:

-  SOUTHBOUND EXPRESS LANE - UNRESTRICTED
-  SOUTHBOUND EXPRESS LANE - RESTRICTED
-  EXISTING NORTHBOUND EXPRESS LANE
-  PROPOSED ALTERNATIVE FEATURE
-  PROPOSED NORTHBOUND EXPRESS LANE - GENERAL PURPOSE LANE CONVERSION

GEOMETRIC IMPROVEMENT CONCEPTS:

-  RAMP METERING



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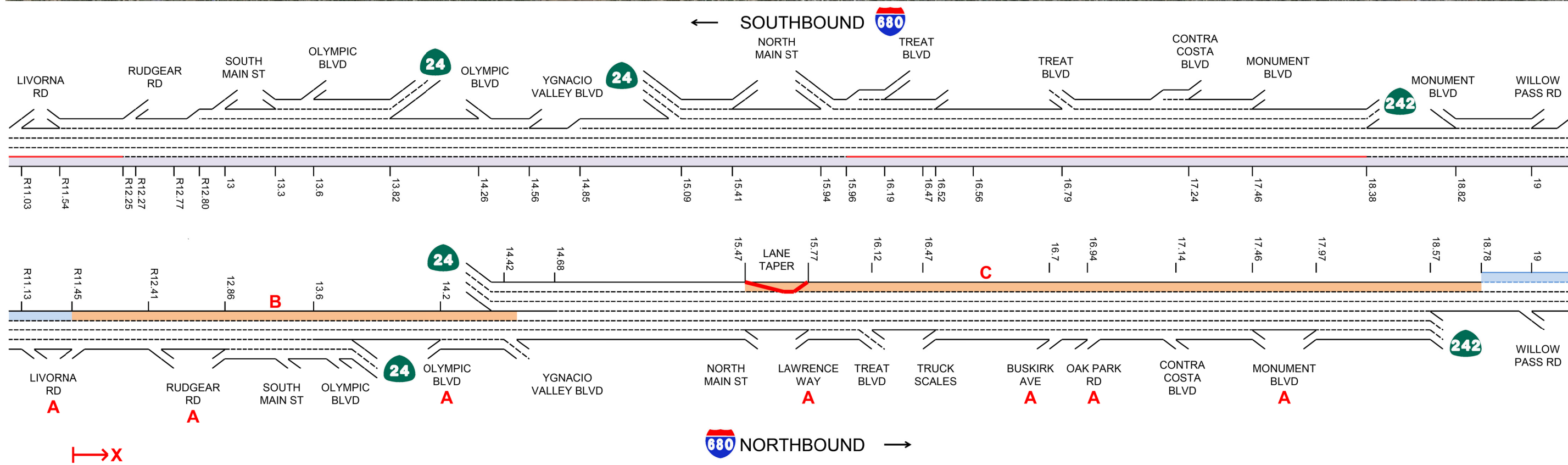
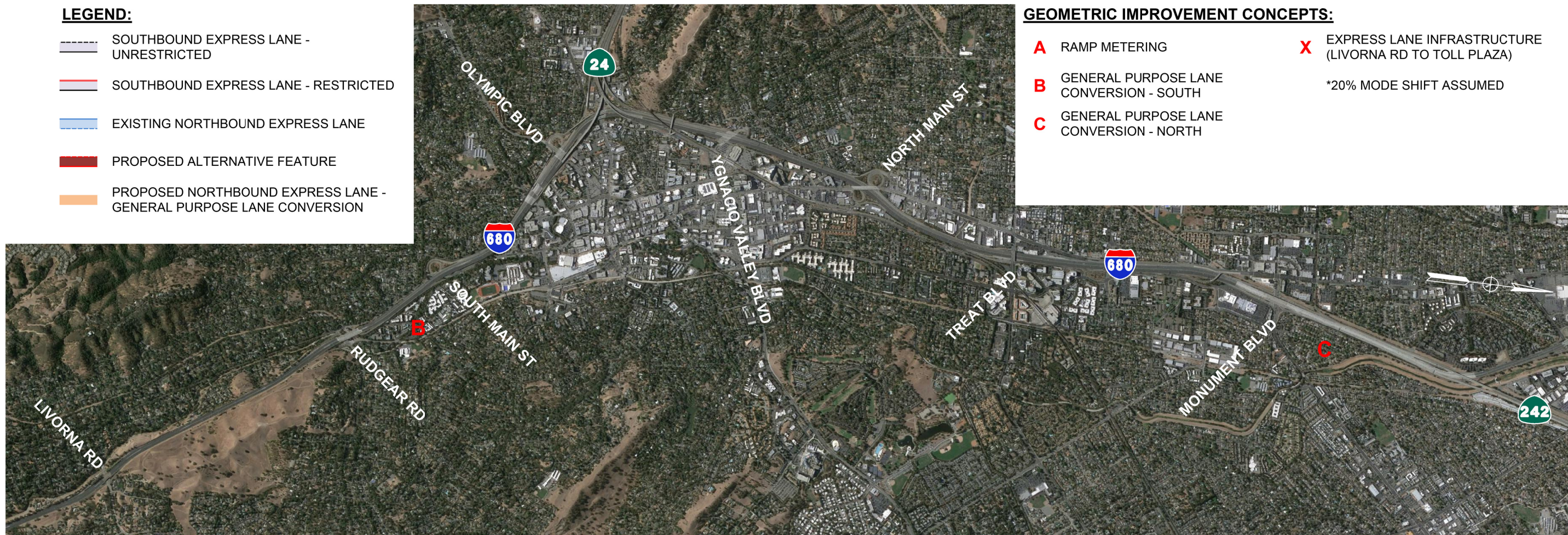
Ramp Metering
 Capital Construction Cost Range: \$15M to \$20M
 (Costs shown are construction estimates only and do not include R/W or support costs)

LEGEND:

- SOUTHBOUND EXPRESS LANE - UNRESTRICTED
- SOUTHBOUND EXPRESS LANE - RESTRICTED
- EXISTING NORTHBOUND EXPRESS LANE
- PROPOSED ALTERNATIVE FEATURE
- PROPOSED NORTHBOUND EXPRESS LANE - GENERAL PURPOSE LANE CONVERSION






GEOMETRIC IMPROVEMENT CONCEPTS:

- A** RAMP METERING
 - B** GENERAL PURPOSE LANE CONVERSION - SOUTH
 - C** GENERAL PURPOSE LANE CONVERSION - NORTH
 - X** EXPRESS LANE INFRASTRUCTURE (LIVORNA RD TO TOLL PLAZA)
- *20% MODE SHIFT ASSUMED



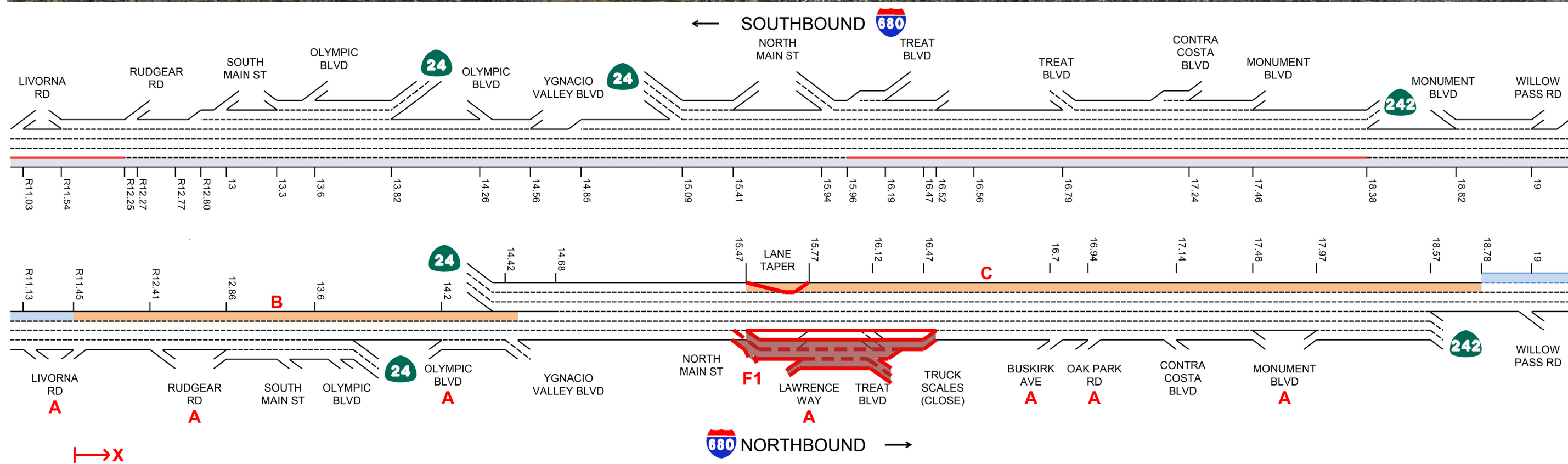
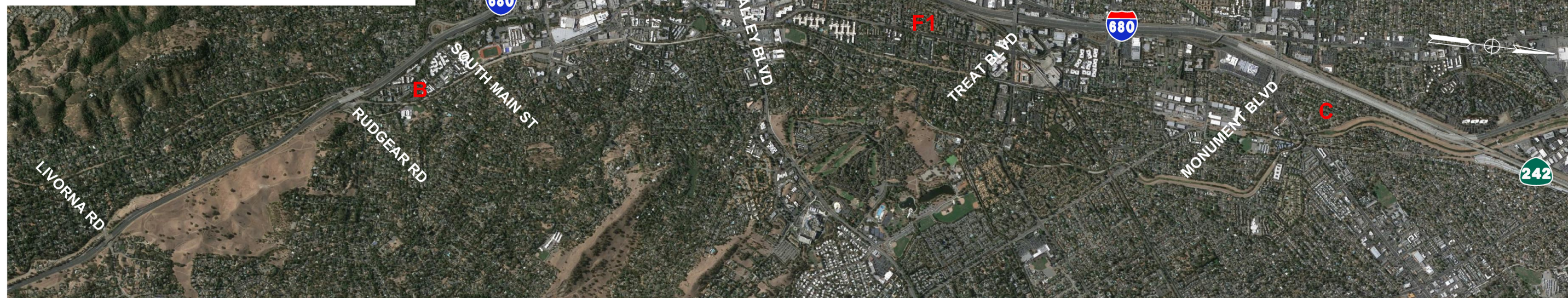
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LEGEND:

-  SOUTHBOUND EXPRESS LANE - UNRESTRICTED
-  SOUTHBOUND EXPRESS LANE - RESTRICTED
-  EXISTING NORTHBOUND EXPRESS LANE
-  PROPOSED ALTERNATIVE FEATURE
-  PROPOSED NORTHBOUND EXPRESS LANE - GENERAL PURPOSE LANE CONVERSION

GEOMETRIC IMPROVEMENT CONCEPTS:

- A** RAMP METERING
 - B** GENERAL PURPOSE LANE CONVERSION - SOUTH
 - C** GENERAL PURPOSE LANE CONVERSION - NORTH
 - F1** COLLECTOR DISTRIBUTOR ROAD (w/ WIM AND BYPASS SYSTEM)
 - X** EXPRESS LANE INFRASTRUCTURE (LIVORNA RD TO TOLL PLAZA)
- *20% MODE SHIFT ASSUMED



Express Lane GP Lane Conversion Plus C-D System

Capital Construction Cost Range: \$135M to \$155M

(Costs shown are construction estimates only and do not include R/W or support costs)

*Includes Mode Shift costs of \$50M








**I-680 NORTHBOUND
DESIGN ALTERNATIVE ANALYSIS
ALTERNATIVE 4**

SHEET 4 OF 9
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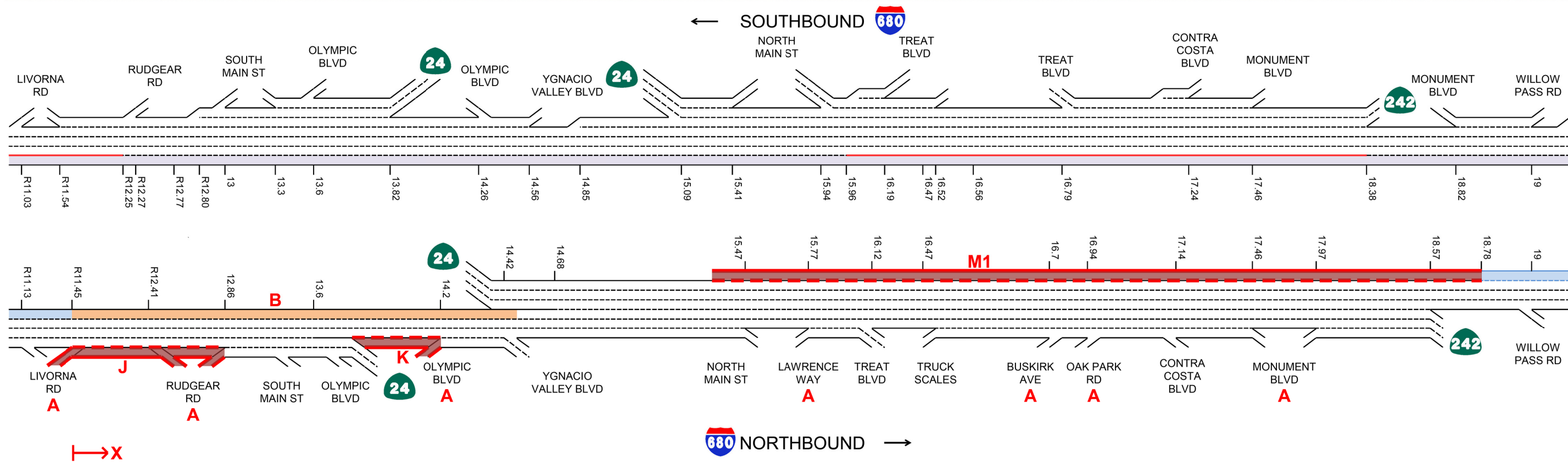
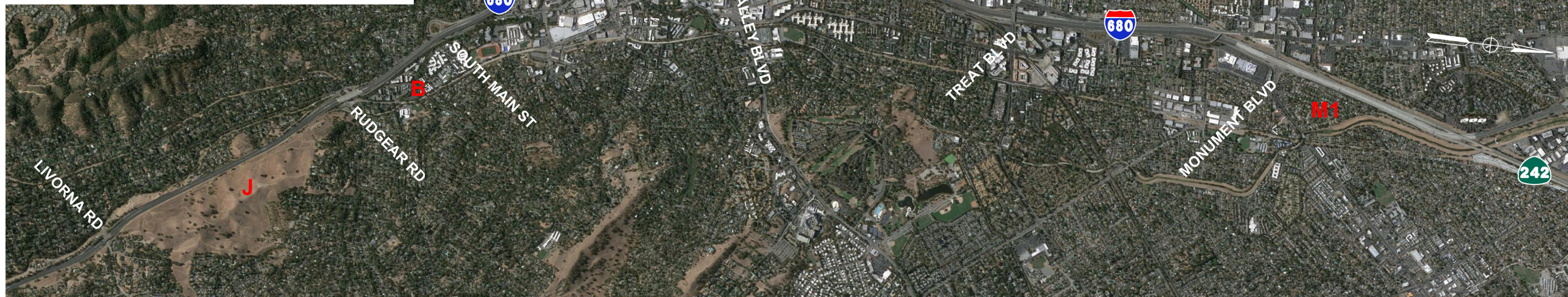
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LEGEND:

-  SOUTHBOUND EXPRESS LANE - UNRESTRICTED
-  SOUTHBOUND EXPRESS LANE - RESTRICTED
-  EXISTING NORTHBOUND EXPRESS LANE
-  PROPOSED ALTERNATIVE FEATURE
-  PROPOSED NORTHBOUND EXPRESS LANE - GENERAL PURPOSE LANE CONVERSION






GEOMETRIC IMPROVEMENT CONCEPTS:

- A** RAMP METERING
- B** GENERAL PURPOSE LANE CONVERSION - SOUTH
- J** LANE ADDITION - LIVORNA RD TO RUDGEAR RD
- K** LANE ADDITION - SR24 TO OLYMPIC BLVD
- M1** EXTEND EXPRESS LANE FROM SR242 TO NORTH MAIN ST
- X** EXPRESS LANE INFRASTRUCTURE (LIVORNA RD TO TOLL PLAZA)



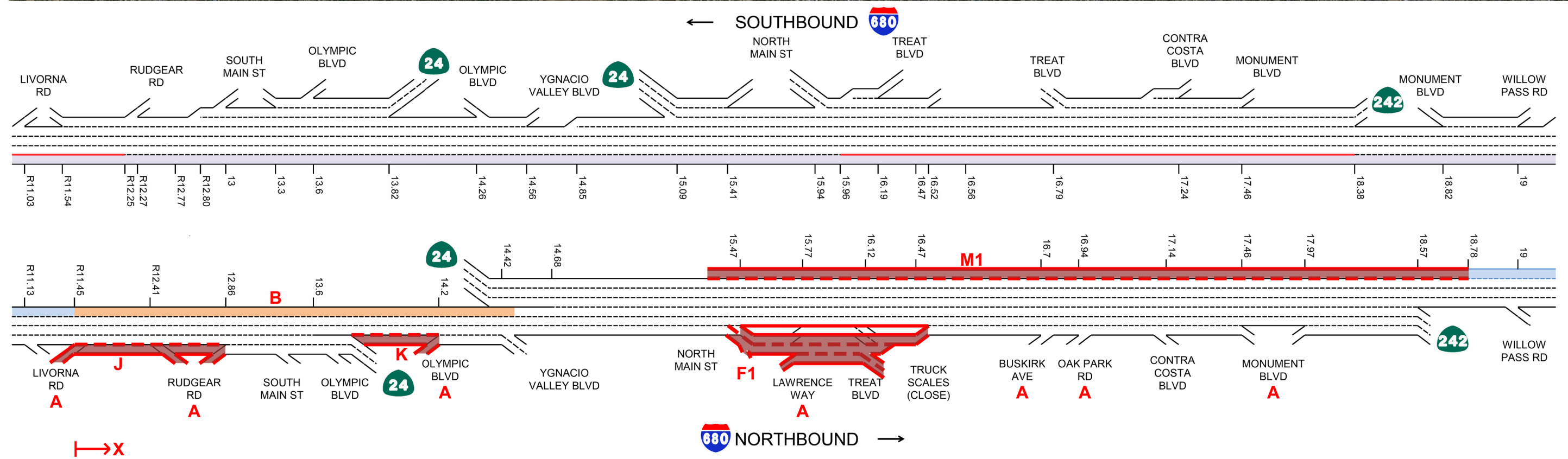
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LEGEND:

-  SOUTHBOUND EXPRESS LANE - UNRESTRICTED
-  SOUTHBOUND EXPRESS LANE - RESTRICTED
-  EXISTING NORTHBOUND EXPRESS LANE
-  PROPOSED ALTERNATIVE FEATURE
-  PROPOSED NORTHBOUND EXPRESS LANE - GENERAL PURPOSE LANE CONVERSION

GEOMETRIC IMPROVEMENT CONCEPTS:

- A** RAMP METERING
- B** GENERAL PURPOSE LANE CONVERSION - SOUTH
- F1** COLLECTOR DISTRIBUTOR ROAD (w/ WIM AND BYPASS SYSTEM)
- J** LANE ADDITION - LIVORNA RD TO RUDGEAR RD
- K** LANE ADDITION - SR24 TO OLYMPIC BLVD
- M1** EXTEND EXPRESS LANE FROM SR242 TO NORTH MAIN ST
- X** EXPRESS LANE INFRASTRUCTURE (LIVORNA RD TO TOLL PLAZA)



Express Lane Extension and GP Lane Widening Plus C-D System

Capital Construction Cost Range: \$250M to \$300M

(Costs shown are construction estimates only and do not include R/W or support costs)

I-680 NORTHBOUND
DESIGN ALTERNATIVE ANALYSIS
ALTERNATIVE 6

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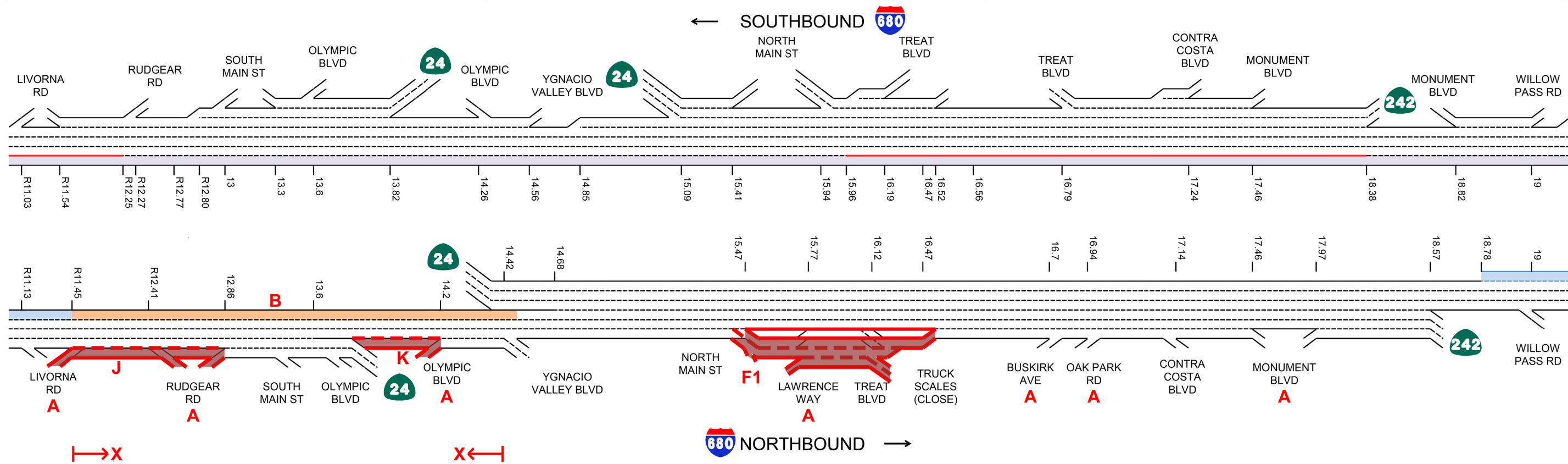
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- EXISTING NORTHBOUND EXPRESS LANE
- PROPOSED ALTERNATIVE FEATURE
- PROPOSED NORTHBOUND EXPRESS LANE - GENERAL PURPOSE LANE CONVERSION






GEOMETRIC IMPROVEMENT CONCEPTS:

- A** RAMP METERING
- B** GENERAL PURPOSE LANE CONVERSION - SOUTH
- F1** COLLECTOR DISTRIBUTOR ROAD (w/ WIM AND BYPASS SYSTEM)
- J** LANE ADDITION - LIVORNA RD TO RUDGEAR RD
- K** LANE ADDITION - SR24 TO OLYMPIC BLVD
- X** EXPRESS LANE INFRASTRUCTURE (LIVORNA RD TO SR 24)



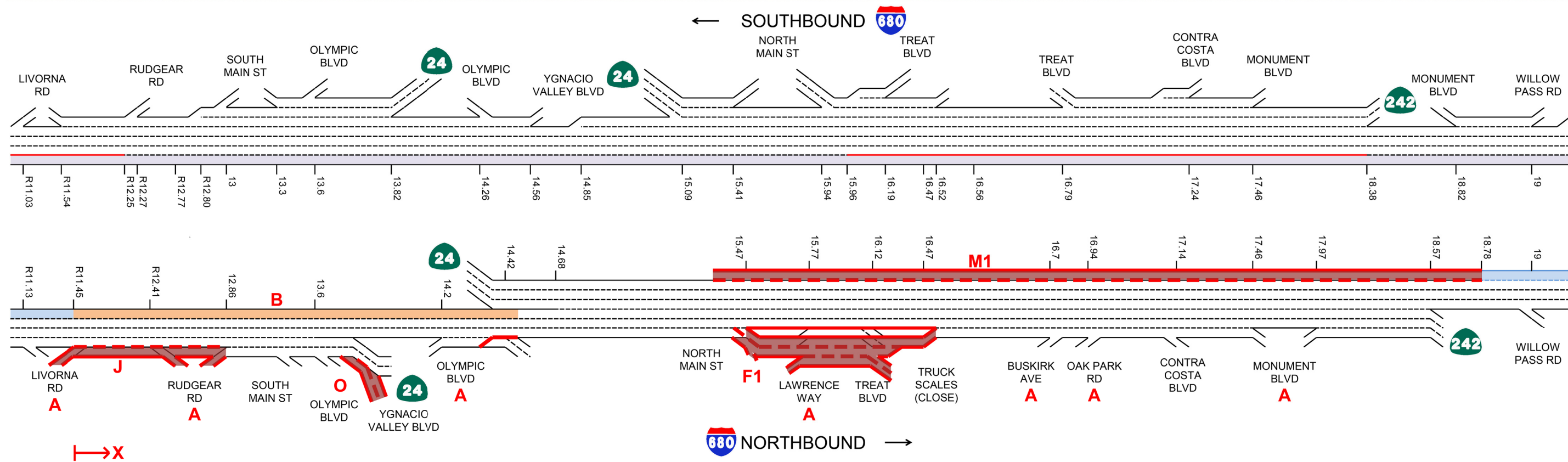
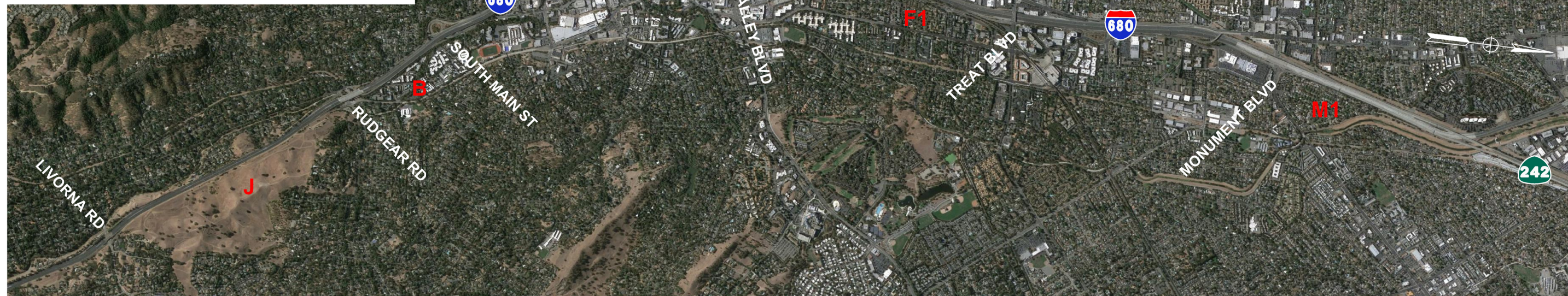
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LEGEND:

-  SOUTHBOUND EXPRESS LANE - UNRESTRICTED
-  SOUTHBOUND EXPRESS LANE - RESTRICTED
-  EXISTING NORTHBOUND EXPRESS LANE
-  PROPOSED ALTERNATIVE FEATURE
-  PROPOSED NORTHBOUND EXPRESS LANE - GENERAL PURPOSE LANE CONVERSION






GEOMETRIC IMPROVEMENT CONCEPTS:

- A** RAMP METERING
- B** GENERAL PURPOSE LANE CONVERSION - SOUTH
- F1** COLLECTOR DISTRIBUTOR ROAD (w/ WIM AND BYPASS SYSTEM)
- J** LANE ADDITION - LIVORNA RD TO RUDGEAR RD
- M1** EXTEND EXPRESS LANE FROM SR242 TO NORTH MAIN ST
- O** YGNACIO OFF RAMP RECONFIGURATION
- X** EXPRESS LANE INFRASTRUCTURE (LIVORNA RD TO TOLL PLAZA)



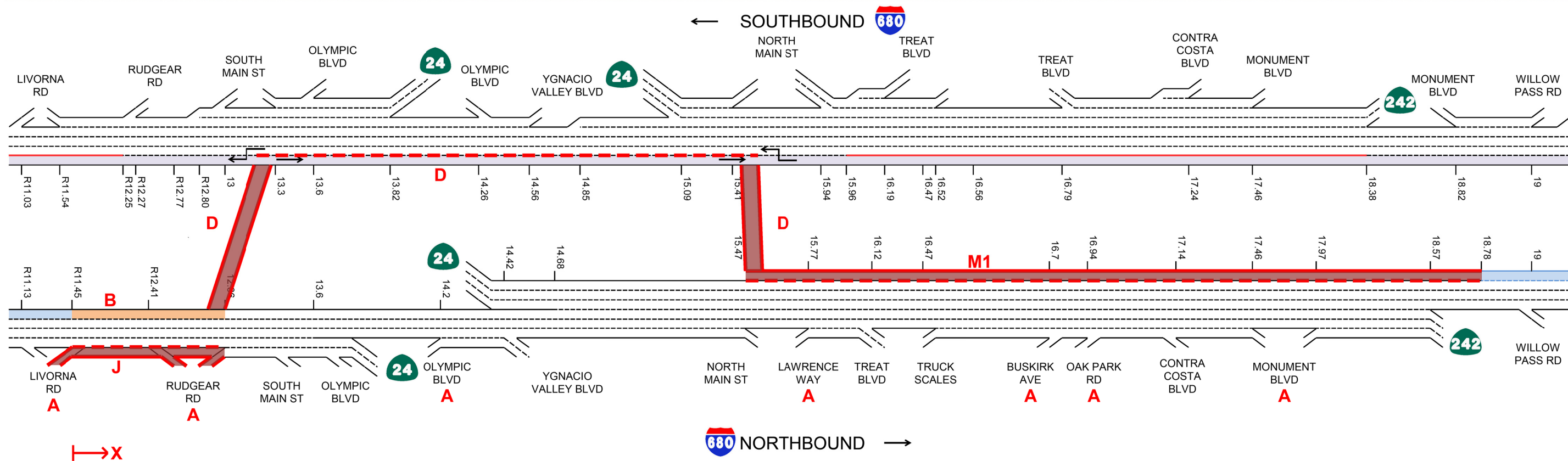
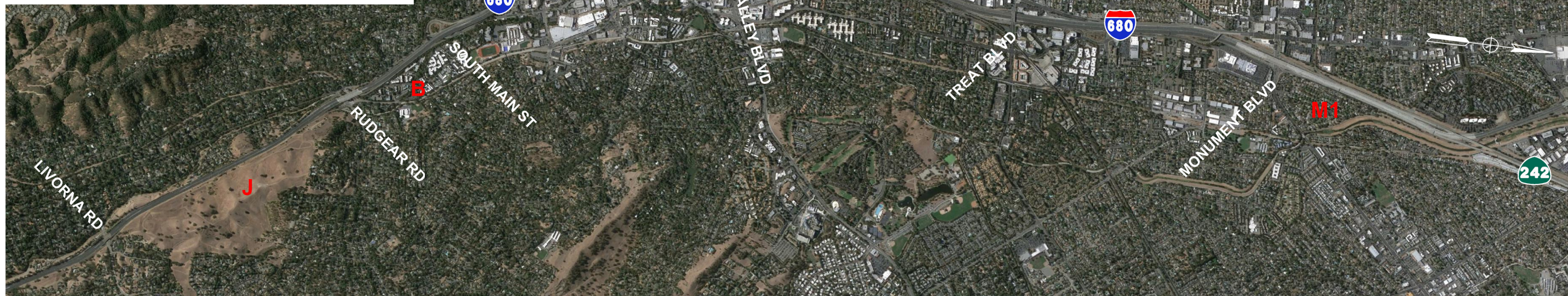
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LEGEND:

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-  SOUTHBOUND EXPRESS LANE - RESTRICTED
-  EXISTING NORTHBOUND EXPRESS LANE
-  PROPOSED ALTERNATIVE FEATURE
-  PROPOSED NORTHBOUND EXPRESS LANE - GENERAL PURPOSE LANE CONVERSION

GEOMETRIC IMPROVEMENT CONCEPTS:

- A** RAMP METERING
- B** GENERAL PURPOSE LANE CONVERSION - SOUTH
- D** CONTRA-FLOW LANE
- J** LANE ADDITION - LIVORNA RD TO RUDGEAR RD
- M1** EXTEND EXPRESS LANE FROM SR242 TO NORTH MAIN ST
- X** EXPRESS LANE INFRASTRUCTURE (LIVORNA RD TO TOLL PLAZA)



Contra Flow Plus Express Lane Extension and GP Lane Widening






Capital Construction Cost Range: \$220M to \$260M
 Contra Flow O & M: \$400K per year

(Costs shown are construction estimates only and do not include R/W or support costs)

**I-680 NORTHBOUND
 DESIGN ALTERNATIVE ANALYSIS
 ALTERNATIVE 8**

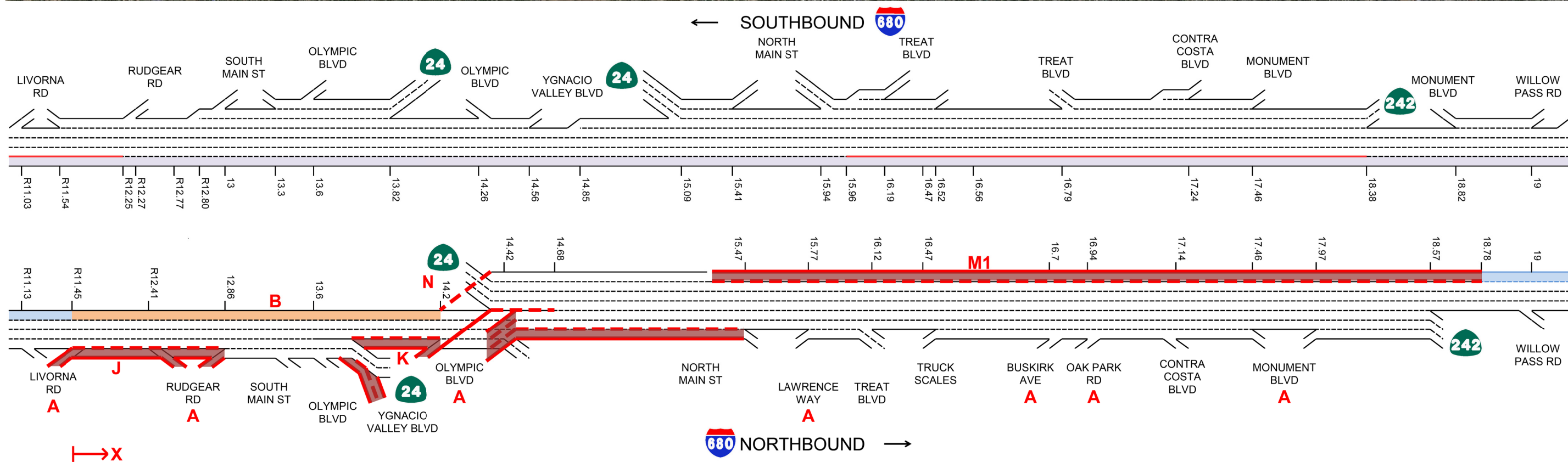
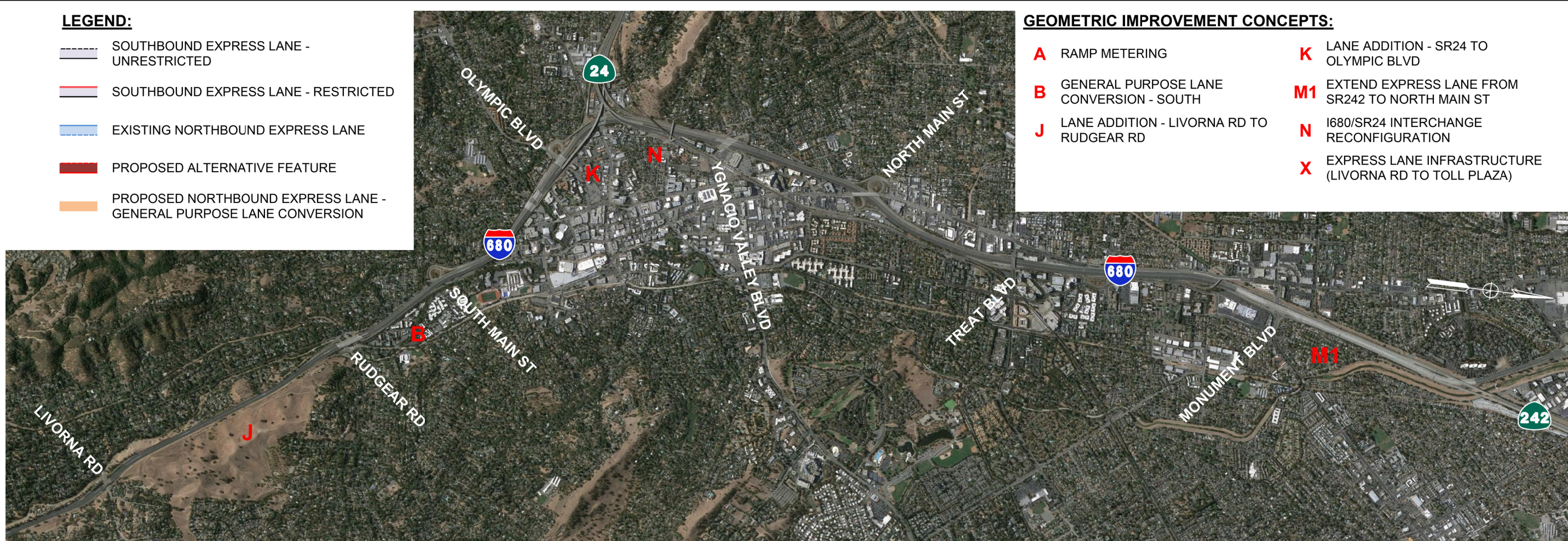
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LEGEND:

-  SOUTHBOUND EXPRESS LANE - UNRESTRICTED
-  SOUTHBOUND EXPRESS LANE - RESTRICTED
-  EXISTING NORTHBOUND EXPRESS LANE
-  PROPOSED ALTERNATIVE FEATURE
-  PROPOSED NORTHBOUND EXPRESS LANE - GENERAL PURPOSE LANE CONVERSION

GEOMETRIC IMPROVEMENT CONCEPTS:

- A** RAMP METERING
- B** GENERAL PURPOSE LANE CONVERSION - SOUTH
- J** LANE ADDITION - LIVORNA RD TO RUDGEAR RD
- K** LANE ADDITION - SR24 TO OLYMPIC BLVD
- M1** EXTEND EXPRESS LANE FROM SR242 TO NORTH MAIN ST
- N** I680/SR24 INTERCHANGE RECONFIGURATION
- X** EXPRESS LANE INFRASTRUCTURE (LIVORNA RD TO TOLL PLAZA)



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APPENDIX B – Traffic Analysis Data

EXISTING PM PEAK PERIOD
DEMAND VOLUMES

Location	2015 (Existing) Total Demand Volumes				2015 (Existing) HOV Demand Volumes				2015 (Existing) SOV Demand Volumes			
	3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM
Mainline: NB I-680 south of Bollinger	6,021	5,931	6,027	5,660	705	860	835	729	5,316	5,071	5,192	4,931
Bollinger Off-Ramp	1,032	1,096	1,781	1,114	168	213	188	147	864	883	1,593	967
Mainline	4,989	4,835	4,246	4,546	537	647	647	582	4,452	4,188	3,599	3,964
Bollinger Loop On	291	241	204	243	58	57	53	60	233	184	151	183
Mainline	5,280	5,076	4,450	4,789	595	704	700	642	4,685	4,372	3,750	4,147
Bollinger Diagonal On	861	980	819	749	166	189	124	112	695	791	695	637
Mainline	6,141	6,056	5,269	5,538	761	893	824	754	5,380	5,163	4,445	4,784
Crow Canyon Off-Ramp	1,317	1,094	1,771	1,240	109	132	125	86	1,208	962	1,646	1,154
Mainline	4,824	4,962	3,498	4,298	652	761	699	668	4,172	4,201	2,799	3,630
Crow Canyon Loop On	646	760	679	575	132	173	171	148	514	587	508	427
Mainline	5,470	5,722	4,177	4,873	784	934	870	816	4,686	4,788	3,307	4,057
Crow Canyon Diagonal On	963	1,059	1,007	723	193	241	270	180	770	818	737	543
Mainline	6,433	6,781	5,184	5,596	977	1,175	1,140	996	5,456	5,606	4,044	4,600
Sycamore Off-Ramp	581	795	489	678	163	169	150	168	418	626	339	510
Mainline	5,852	5,986	4,695	4,918	814	1,006	990	828	5,038	4,980	3,705	4,090
Sycamore On	1,121	1,052	1,021	948	257	247	227	205	864	805	794	743
Mainline	6,973	7,038	5,716	5,866	1,071	1,253	1,217	1,033	5,902	5,785	4,499	4,833
Diablo Valley Off-Ramp	724	728	647	679	79	78	51	41	645	650	596	638
Mainline	6,249	6,310	5,069	5,187	992	1,175	1,166	992	5,257	5,135	3,903	4,195
Diablo Valley Loop On	320	227	251	212	64	54	66	51	256	173	185	161
Mainline	6,569	6,537	5,320	5,399	1,056	1,229	1,232	1,043	5,513	5,308	4,088	4,356
Diablo Valley Diagonal On	166	210	202	164	34	50	52	41	132	160	150	123
Mainline	6,735	6,747	5,522	5,563	1,090	1,279	1,284	1,084	5,645	5,468	4,238	4,479
El Cerro Off-Ramp	426	487	441	441	42	50	31	24	384	437	410	417
Mainline	6,309	6,260	5,081	5,122	1,048	1,229	1,253	1,060	5,261	5,031	3,828	4,062
El Cerro On	664	409	450	372	114	121	119	91	550	288	331	281
Mainline	6,973	6,669	5,531	5,494	1,162	1,350	1,372	1,151	5,811	5,319	4,159	4,343
El Pintado On	125	96	85	59	26	24	23	15	99	72	62	44
Mainline	7,098	6,765	5,616	5,553	1,188	1,374	1,395	1,166	5,910	5,391	4,221	4,387
Stone Valley Diagonal Off	180	191	184	144	25	33	34	26	155	158	150	118
Mainline	6,918	6,574	5,432	5,409	1,163	1,341	1,361	1,140	5,755	5,233	4,071	4,269
Stone Valley Loop Off	300	228	211	185	41	39	35	28	259	189	176	157
Mainline	6,618	6,346	5,221	5,224	1,122	1,302	1,326	1,112	5,496	5,044	3,895	4,112
Stone Valley On	583	530	491	436	87	91	88	70	496	439	403	366
Mainline	7,201	6,876	5,712	5,660	1,209	1,393	1,414	1,182	5,992	5,483	4,298	4,478

Location	2015 (Existing) Total Demand Volumes				2015 (Existing) HOV Demand Volumes				2015 (Existing) SOV Demand Volumes			
	3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM
Livorna Off	244	204	235	223	34	34	40	37	210	170	195	186
Mainline	6,957	6,672	5,477	5,437	1,175	1,359	1,374	1,145	5,782	5,313	4,103	4,292
Livorna On	413	255	232	195	52	49	47	38	361	206	185	157
Mainline	7,370	6,927	5,709	5,632	1,227	1,408	1,421	1,183	6,143	5,519	4,288	4,449
Rudgear Off	552	477	481	466	63	84	99	81	489	393	382	385
Mainline	6,818	6,450	5,228	5,166	1,164	1,324	1,322	1,102	5,654	5,126	3,906	4,064
Rudgear On	435	474	516	430	66	82	95	72	369	392	421	358
Mainline	7,253	6,924	5,744	5,596	1,230	1,406	1,417	1,174	6,023	5,518	4,327	4,422
S. Main Off	460	341	285	301	62	61	67	62	398	280	218	239
Mainline	6,793	6,583	5,459	5,295	1,168	1,345	1,350	1,112	5,625	5,238	4,109	4,183
Olympic Off	559	920	811	753	60	128	147	92	499	792	664	661
Mainline	6,234	5,663	4,648	4,542	1,108	1,217	1,203	1,020	5,126	4,446	3,445	3,522
SR 24 Off	1,394	1,354	1,177	1,302	179	241	248	206	1,215	1,113	929	1,096
Mainline	4,840	4,309	3,471	3,240	929	976	955	814	3,911	3,333	2,516	2,426
Olympic On	1,290	1,081	1,446	1,024	179	224	242	162	1,111	857	1,204	862
Mainline	6,130	5,390	4,917	4,264	1,108	1,200	1,197	976	5,022	4,190	3,720	3,288
Ygnacio Valley Off	810	843	662	698	118	137	134	136	692	706	528	562
Mainline	5,320	4,547	4,255	3,566	990	1,063	1,063	840	4,330	3,484	3,192	2,726
SR 24 On	4,949	5,378	5,494	4,502	471	512	479	425	4,478	4,866	5,015	4,077
Mainline	10,269	9,925	9,749	8,068	1,461	1,575	1,542	1,265	8,808	8,350	8,207	6,803
N. Main Off	352	327	324	317	54	57	57	49	298	270	267	268
Mainline	9,917	9,598	9,425	7,751	1,407	1,518	1,485	1,216	8,510	8,080	7,940	6,535
Lawrence On	1,432	1,348	1,043	1,103	216	235	184	189	1,216	1,113	859	914
Mainline	11,349	10,946	10,468	8,854	1,623	1,753	1,669	1,405	9,726	9,193	8,799	7,449
Treat Off	1,641	1,391	1,423	1,545	256	244	246	237	1,385	1,147	1,177	1,308
Mainline	9,708	9,555	9,045	7,309	1,367	1,509	1,423	1,168	8,341	8,046	7,622	6,141
Truck Scales On	2	3	6	7	0	0	0	0	2	3	6	7
Mainline	9,710	9,558	9,051	7,316	1,367	1,509	1,423	1,168	8,343	8,049	7,628	6,148
Buskirk On	942	1,268	1,297	927	184	209	252	217	758	1,059	1,045	710
Mainline	10,652	10,826	10,348	8,243	1,551	1,718	1,675	1,385	9,101	9,108	8,673	6,858
Oak On	441	519	688	552	87	102	135	117	354	417	553	435
Mainline	11,093	11,345	11,036	8,795	1,638	1,820	1,810	1,502	9,455	9,525	9,226	7,293
Contra Costa Off	669	630	781	639	97	100	123	102	572	530	658	537
Mainline	10,424	10,715	10,255	8,156	1,541	1,720	1,687	1,400	8,883	8,995	8,568	6,756
Monument Off	935	899	786	614	143	147	134	111	792	752	652	503

Location	2015 (Existing) Total Demand Volumes				2015 (Existing) HOV Demand Volumes				2015 (Existing) SOV Demand Volumes			
	3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM
Mainline	9,489	9,816	9,469	7,542	1,398	1,573	1,553	1,289	8,091	8,243	7,916	6,253
Monument On	1,123	1,179	1,363	1,085	219	229	261	266	904	950	1,102	819
Mainline	10,612	10,995	10,832	8,627	1,617	1,802	1,814	1,555	8,995	9,193	9,018	7,072
SR 242 Off	5,316	5,357	5,289	4,282	795	875	876	755	4,521	4,482	4,413	3,527
Mainline	5,296	5,638	5,543	4,345	822	927	938	800	4,474	4,711	4,605	3,545
Willow Pass Off	1,087	1,022	923	878	177	172	162	172	910	850	761	706
Mainline	4,209	4,616	4,620	3,467	645	755	776	628	3,564	3,861	3,844	2,839
Willow Pass On	878	966	1,140	962	171	189	222	238	707	777	918	724
Mainline	5,087	5,582	5,760	4,429	816	944	998	866	4,271	4,638	4,762	3,563
Burnett Off	662	649	603	533	108	110	106	104	554	539	497	429
Mainline	4,425	4,933	5,157	3,896	708	834	892	762	3,717	4,099	4,265	3,134
Burnett On	558	584	624	516	100	104	111	92	458	480	513	424
Mainline	4,983	5,517	5,781	4,412	808	938	1,003	854	4,175	4,579	4,778	3,558
Concord On	338	377	430	332	114	101	88	90	224	276	342	242
Mainline: NB I-680 north of Concord	5,321	5,894	6,211	4,744	922	1,039	1,091	944	4,399	4,855	5,120	3,800

Note: Trucks are included in the SOV demand volume.

APRIL/MAY 2015 OBSERVED INRIX SPEED DATA AND
MODELED SPEED CONTOUR MAPS

OBSERVED (2015) AND MODELED SPEED CONTOUR MAPS

PM Peak	Observed (General Purpose Lanes Only)																																									
	On-Ramp from Alcosta	NB Off-Ramp to Bollinger Canyon	Between On-Ramps from Bollinger Canyon	NB Off-Ramp to Crow Canyon	EB-NB On-Ramp from Crow Canyon	WB-NB On-Ramp from Crow Canyon	NB Off-Ramp to Sycamore Valley	NB On-Ramp from Sycamore Valley	NB Off-Ramp to Diablo	EB-NB On-Ramp from Diablo	NB Off-Ramp to El Cerro	NB On-Ramp from El Cerro	NB On-Ramp from El Pintado	NB Off-Ramp to Stone Valley	NB On-Ramp to Stone Valley	NB On-Ramp from Stone Valley	NB Off-Ramp to Livorna	NB On-Ramp from Livorna	NB Off-Ramp to Rudgear	NB On-Ramp from Rudgear	Off-Ramp to S Main	SR-24 Off-ramp	Hill Side On Ramp	Ygnacio Valley Off-ramp	Main St NB Off-Ramp	Main St On_Ramp	Treat Blvd Off-Ramp	Truck Scales On	Treat Blvd On	Oak Park On	Contra Costa Blvd Off	Monument Blvd Off	Monument Blvd On	SR 242 Off	Lane Add	Willow Pass Rd off	Willow Pass On	Burnett Ave Off	Burnett Ave On	Concord Ave on		
3:00-3:30	68	68	68	68	68	68	63	61	59	58	56	55	56	41	41	30	31	49	59	59	52	44	42	42	42	46	55	55	59	59	61	60	61	62	62	65	67	67	67	65		
3:30-4:00	67	68	68	66	66	52	30	28	25	22	21	28	41	34	34	31	31	47	45	34	16	16	23	22	29	43	55	55	57	57	58	59	61	63	63	65	66	67	67	66		
4:00-4:30	67	68	67	66	66	37	17	15	16	17	19	23	33	26	26	25	25	33	27	21	13	15	19	22	26	36	49	49	51	51	55	57	57	60	60	64	66	66	66	64		
4:30-5:00	68	68	66	64	64	23	12	12	12	12	12	15	20	17	17	18	18	26	23	17	11	12	18	21	25	33	45	45	47	47	51	54	56	61	61	64	66	66	66	65		
5:00-5:30	68	68	68	64	64	22	8	7	9	9	9	11	17	17	17	17	17	27	23	17	10	9	18	22	26	31	40	40	41	41	44	50	52	59	59	63	66	65	64	63		
5:30-6:00	68	68	68	67	67	35	8	8	9	8	7	10	19	18	18	21	19	26	23	19	9	11	17	19	24	31	38	38	40	40	42	49	53	60	60	65	68	67	67	65		
6:00-6:30	68	69	69	70	70	56	26	23	20	19	16	20	33	34	34	30	27	35	28	21	12	17	21	22	27	39	51	51	53	53	56	57	58	61	61	65	68	68	68	67		
6:30-7:00	68	70	69	70	70	72	71	69	60	52	52	52	60	61	61	59	53	53	40	33	26	28	34	34	37	49	57	57	59	59	60	61	62	64	64	67	68	67	68	67		
	Modeled (General Purpose Lanes Only)																																									
3:00-3:30	63	63	63	64	63	64	64	63	63	63	64	56	55	64	48	26	16	54	63	64	63	62	51	46	47	50	59	62	62	65	64	62	63	64	64	65	65	65	65	63		
3:30-4:00	64	64	63	64	64	56	22	16	16	13	14	15	43	33	27	22	16	54	59	29	14	10	11	15	26	45	53	55	51	64	64	62	60	64	63	64	63	64	65	65	64	63
4:00-4:30	64	65	64	65	64	43	11	10	13	11	13	13	25	22	19	20	17	28	15	13	11	12	13	17	30	46	56	53	46	64	64	61	59	63	63	65	65	65	65	65	63	
4:30-5:00	63	64	64	64	63	29	11	10	13	10	12	12	23	22	19	20	17	31	17	15	12	13	13	19	32	45	55	53	45	64	64	61	60	63	63	64	64	65	64	61		
5:00-5:30	64	65	65	65	64	16	11	10	12	10	12	12	22	20	18	19	16	33	16	14	12	12	15	21	32	44	54	52	45	64	64	57	50	63	63	64	64	64	64	64	61	
5:30-6:00	63	65	65	66	65	25	10	9	12	10	12	12	23	24	19	20	16	33	15	13	11	12	14	20	34	43	43	50	45	64	64	60	54	63	63	64	64	64	64	64	61	
6:00-6:30	65	66	66	66	66	65	29	24	25	16	17	15	25	22	19	20	16	18	16	15	12	14	14	20	35	44	45	51	45	63	64	60	59	63	63	64	64	64	64	64	62	
6:30-7:00	63	64	63	64	64	64	64	64	64	64	64	64	60	63	58	47	36	53	43	31	20	20	22	27	44	51	58	55	48	64	64	62	61	64	64	65	65	65	65	65	64	

YEAR 2020 TRAFFIC DEMAND FORECASTS

ALTERNATIVE 1, 2, 5, 8	2020 Total Demand Volumes				2020 HOV Demand Volumes				2020 SOV Demand Volumes			
	Location	3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM
Mainline: NB I-680 south of Bollinger	6,322	6,228	6,328	5,943	740	903	877	765	5,582	5,325	5,451	5,178
Bollinger Off-Ramp	1,084	1,151	1,870	1,170	176	224	197	154	908	927	1,673	1,016
Mainline	5,238	5,077	4,458	4,773	564	679	680	611	4,674	4,398	3,778	4,162
Bollinger Loop On	306	253	214	255	61	60	56	63	245	193	158	192
Mainline	5,544	5,330	4,672	5,028	625	739	736	674	4,919	4,591	3,936	4,354
Bollinger Diagonal On	904	1,029	860	786	174	198	130	118	730	831	730	668
Mainline	6,448	6,359	5,532	5,814	799	937	866	792	5,649	5,422	4,666	5,022
Crow Canyon Off-Ramp	1,383	1,149	1,860	1,302	114	139	131	90	1,269	1,010	1,729	1,212
Mainline	5,065	5,210	3,672	4,512	685	798	735	702	4,380	4,412	2,937	3,810
Crow Canyon Loop On	678	798	713	604	139	182	180	155	539	616	533	449
Mainline	5,743	6,008	4,385	5,116	824	980	915	857	4,919	5,028	3,470	4,259
Crow Canyon Diagonal On	1,011	1,112	1,057	759	203	253	284	189	808	859	773	570
Mainline	6,754	7,120	5,442	5,875	1,027	1,233	1,199	1,046	5,727	5,887	4,243	4,829
Sycamore Off-Ramp	610	835	513	712	171	177	158	176	439	658	355	536
Mainline	6,144	6,285	4,929	5,163	856	1,056	1,041	870	5,288	5,229	3,888	4,293
Sycamore On	1,177	1,105	1,072	995	270	259	238	215	907	846	834	780
Mainline	7,321	7,390	6,001	6,158	1,126	1,315	1,279	1,085	6,195	6,075	4,722	5,073
Diablo Valley Off-Ramp	760	764	679	713	83	82	54	43	677	682	625	670
Mainline	6,561	6,626	5,322	5,445	1,043	1,233	1,225	1,042	5,518	5,393	4,097	4,403
Diablo Valley Loop On	336	238	264	223	67	57	69	54	269	181	195	169
Mainline	6,897	6,864	5,586	5,668	1,110	1,290	1,294	1,096	5,787	5,574	4,292	4,572
Diablo Valley Diagonal On	174	221	212	172	36	53	55	43	138	168	157	129
Mainline	7,071	7,085	5,798	5,840	1,146	1,343	1,349	1,139	5,925	5,742	4,449	4,701
El Cerro Off-Ramp	447	511	463	463	44	53	33	25	403	458	430	438
Mainline	6,624	6,574	5,335	5,377	1,102	1,290	1,316	1,114	5,522	5,284	4,019	4,263
El Cerro On	697	429	473	391	120	127	125	96	577	302	348	295
Mainline	7,321	7,003	5,808	5,768	1,222	1,417	1,441	1,210	6,099	5,586	4,367	4,558
El Pintado On	131	101	89	62	27	25	24	16	104	76	65	46
Mainline	7,452	7,104	5,897	5,830	1,249	1,442	1,465	1,226	6,203	5,662	4,432	4,604
Stone Valley Diagonal Off	189	201	193	151	26	35	36	27	163	166	157	124
Mainline	7,263	6,903	5,704	5,679	1,223	1,407	1,429	1,199	6,040	5,496	4,275	4,480
Stone Valley Loop Off	315	239	222	194	43	41	37	29	272	198	185	165
Mainline	6,948	6,664	5,482	5,485	1,180	1,366	1,392	1,170	5,768	5,298	4,090	4,315
Stone Valley On	612	557	516	458	91	96	92	74	521	461	424	384
Mainline	7,560	7,221	5,998	5,943	1,271	1,462	1,484	1,244	6,289	5,759	4,514	4,699

ALTERNATIVE 1, 2, 5, 8 Location	2020 Total Demand Volumes				2020 HOV Demand Volumes				2020 SOV Demand Volumes			
	3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM
Livorna Off	256	214	247	234	36	36	42	39	220	178	205	195
Mainline	7,304	7,007	5,751	5,709	1,235	1,426	1,442	1,205	6,069	5,581	4,309	4,504
Livorna On	434	268	244	205	55	51	49	40	379	217	195	165
Mainline	7,738	7,275	5,995	5,914	1,290	1,477	1,491	1,245	6,448	5,798	4,504	4,669
Rudgear Off	580	501	505	489	66	88	104	85	514	413	401	404
Mainline	7,158	6,774	5,490	5,425	1,224	1,389	1,387	1,160	5,934	5,385	4,103	4,265
Rudgear On	457	498	542	452	69	86	100	76	388	412	442	376
Mainline	7,615	7,272	6,032	5,877	1,293	1,475	1,487	1,236	6,322	5,797	4,545	4,641
S. Main Off	483	358	299	316	65	64	70	65	418	294	229	251
Mainline	7,132	6,914	5,733	5,561	1,228	1,411	1,417	1,171	5,904	5,503	4,316	4,390
Olympic Off	587	966	852	791	63	134	154	97	524	832	698	694
Mainline	6,545	5,948	4,881	4,770	1,165	1,277	1,263	1,074	5,380	4,671	3,618	3,696
SR 24 Off	1,464	1,422	1,236	1,367	188	253	260	216	1,276	1,169	976	1,151
Mainline	5,081	4,526	3,645	3,403	977	1,024	1,003	858	4,104	3,502	2,642	2,545
Olympic On	1,355	1,135	1,518	1,075	188	235	254	170	1,167	900	1,264	905
Mainline	6,436	5,661	5,163	4,478	1,165	1,259	1,257	1,028	5,271	4,402	3,906	3,450
Ygnacio Valley Off	851	885	695	733	124	144	141	143	727	741	554	590
Mainline	5,585	4,776	4,468	3,745	1,041	1,115	1,116	885	4,544	3,661	3,352	2,860
SR 24 On	5,196	5,647	5,769	4,727	495	538	503	446	4,701	5,109	5,266	4,281
Mainline	10,781	10,423	10,237	8,472	1,536	1,653	1,619	1,331	9,245	8,770	8,618	7,141
N. Main Off	370	343	340	333	57	60	60	51	313	283	280	282
Mainline	10,411	10,080	9,897	8,139	1,479	1,593	1,559	1,280	8,932	8,487	8,338	6,859
Lawrence On	1,504	1,415	1,095	1,158	227	247	193	198	1,277	1,168	902	960
Mainline	11,915	11,495	10,992	9,297	1,706	1,840	1,752	1,478	10,209	9,655	9,240	7,819
Treat Off	1,723	1,461	1,494	1,622	269	256	258	249	1,454	1,205	1,236	1,373
Mainline	10,192	10,034	9,498	7,675	1,437	1,584	1,494	1,229	8,755	8,450	8,004	6,446
Truck Scales On	2	5	6	7	0	0	0	0	2	5	6	7
Mainline	10,194	10,039	9,504	7,682	1,437	1,584	1,494	1,229	8,757	8,455	8,010	6,453
Buskirk On	989	1,331	1,362	973	193	219	265	228	796	1,112	1,097	745
Mainline	11,183	11,370	10,866	8,655	1,630	1,803	1,759	1,457	9,553	9,567	9,107	7,198
Oak On	463	545	722	580	91	107	142	123	372	438	580	457
Mainline	11,646	11,915	11,588	9,235	1,721	1,910	1,901	1,580	9,925	10,005	9,687	7,655
Contra Costa Off	702	662	820	671	102	105	129	107	600	557	691	564
Mainline	10,944	11,253	10,768	8,564	1,619	1,805	1,772	1,473	9,325	9,448	8,996	7,091
Monument Off	982	944	825	645	150	154	141	117	832	790	684	528

ALTERNATIVE 1, 2, 5, 8 Location	2020 Total Demand Volumes				2020 HOV Demand Volumes				2020 SOV Demand Volumes			
	3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM
Mainline	9,962	10,309	9,943	7,919	1,469	1,651	1,631	1,356	8,493	8,658	8,312	6,563
Monument On	1,179	1,238	1,431	1,139	230	240	274	279	949	998	1,157	860
Mainline	11,141	11,547	11,374	9,058	1,699	1,891	1,905	1,635	9,442	9,656	9,469	7,423
SR 242 Off	5,582	5,625	5,553	4,496	835	919	920	793	4,747	4,706	4,633	3,703
Mainline	5,559	5,922	5,821	4,562	864	972	985	842	4,695	4,950	4,836	3,720
Willow Pass Off	1,141	1,073	969	922	186	181	170	181	955	892	799	741
Mainline	4,418	4,849	4,852	3,640	678	791	815	661	3,740	4,058	4,037	2,979
Willow Pass On	922	1,014	1,197	1,010	180	198	233	250	742	816	964	760
Mainline	5,340	5,863	6,049	4,650	858	989	1,048	911	4,482	4,874	5,001	3,739
Burnett Off	695	681	633	560	113	116	111	109	582	565	522	451
Mainline	4,645	5,182	5,416	4,090	745	873	937	802	3,900	4,309	4,479	3,288
Burnett On	586	613	655	542	105	109	117	97	481	504	538	445
Mainline	5,231	5,795	6,071	4,632	850	982	1,054	899	4,381	4,813	5,017	3,733
Concord On	355	396	452	349	120	106	92	95	235	290	360	254
Mainline: NB I-680 north of Concord	5,586	6,191	6,523	4,981	970	1,088	1,146	994	4,616	5,103	5,377	3,987

Note: Trucks are included in the SOV demand volume.

ALTERNATIVE 3 Location	2020 Total Demand Volumes				2020 HOV Demand Volumes				2020 SOV Demand Volumes			
	3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM
Mainline: NB I-680 south of Bollinger	4,962	4,877	4,954	4,663	678	823	803	696	4,283	4,052	4,153	3,967
Bollinger Off-Ramp	867	921	1,496	936	141	179	158	123	726	742	1,338	813
Mainline	4,095	3,956	3,458	3,727	537	644	645	573	3,557	3,310	2,815	3,154
Bollinger Loop On	241	200	170	199	50	49	46	51	191	151	124	148
Mainline	4,336	4,156	3,628	3,926	587	693	691	624	3,748	3,461	2,939	3,302
Bollinger Diagonal On	711	811	676	620	141	160	106	96	570	651	570	524
Mainline	5,047	4,967	4,304	4,546	728	853	797	720	4,318	4,112	3,509	3,826
Crow Canyon Off-Ramp	1,106	919	1,488	1,042	91	111	105	72	1,015	808	1,383	970
Mainline	3,941	4,048	2,816	3,504	637	742	692	648	3,303	3,304	2,126	2,856
Crow Canyon Loop On	535	625	558	474	113	147	146	126	422	478	412	348
Mainline	4,476	4,673	3,374	3,978	750	889	838	774	3,725	3,782	2,538	3,204
Crow Canyon Diagonal On	788	872	827	586	164	204	229	153	624	668	598	434
Mainline	5,264	5,545	4,201	4,564	914	1,093	1,067	927	4,349	4,450	3,136	3,638
Sycamore Off-Ramp	488	668	410	570	137	142	126	141	351	526	284	429
Mainline	4,776	4,877	3,791	3,994	777	951	941	786	3,998	3,924	2,852	3,209
Sycamore On	942	884	858	796	216	207	190	172	726	677	667	624
Mainline	5,718	5,761	4,649	4,790	993	1,158	1,131	958	4,724	4,601	3,519	3,833
Diablo Valley Off-Ramp	608	611	543	570	66	66	43	34	542	546	500	536
Mainline	5,110	5,150	4,106	4,220	927	1,092	1,088	924	4,182	4,055	3,019	3,297
Diablo Valley Loop On	269	190	211	178	54	46	55	43	215	145	156	135
Mainline	5,379	5,340	4,317	4,398	981	1,138	1,143	967	4,397	4,200	3,175	3,432
Diablo Valley Diagonal On	139	177	170	138	29	42	44	34	110	134	126	103
Mainline	5,518	5,517	4,487	4,536	1,010	1,180	1,187	1,001	4,507	4,334	3,301	3,535
El Cerro Off-Ramp	358	409	370	370	35	42	26	20	322	366	344	350
Mainline	5,160	5,108	4,117	4,166	975	1,138	1,161	981	4,185	3,968	2,957	3,185
El Cerro On	558	343	378	313	96	102	100	77	462	242	278	236
Mainline	5,718	5,451	4,495	4,479	1,071	1,240	1,261	1,058	4,647	4,210	3,235	3,421
El Pintado On	105	81	71	50	22	20	19	13	83	61	52	37
Mainline	5,823	5,532	4,566	4,529	1,093	1,260	1,280	1,071	4,730	4,271	3,287	3,458
Stone Valley Diagonal Off	151	161	154	121	21	28	29	22	130	133	126	99
Mainline	5,672	5,371	4,412	4,408	1,072	1,232	1,251	1,049	4,600	4,138	3,161	3,359
Stone Valley Loop Off	252	191	178	155	34	33	30	23	218	158	148	132
Mainline	5,420	5,180	4,234	4,253	1,038	1,199	1,221	1,026	4,382	3,980	3,013	3,227
Stone Valley On	490	446	413	366	73	77	74	59	417	369	339	307
Mainline	5,910	5,626	4,647	4,619	1,111	1,276	1,295	1,085	4,799	4,349	3,352	3,534

ALTERNATIVE 3 Location	2020 Total Demand Volumes				2020 HOV Demand Volumes				2020 SOV Demand Volumes			
	3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM
Livorna Off	205	171	198	187	29	29	34	31	176	142	164	156
Mainline	5,705	5,455	4,449	4,432	1,082	1,247	1,261	1,054	4,623	4,207	3,188	3,378
Livorna On	347	214	195	164	44	41	39	32	303	174	156	132
Mainline	6,052	5,669	4,644	4,596	1,126	1,288	1,300	1,086	4,926	4,381	3,344	3,510
Rudgear Off	464	401	404	391	53	70	83	68	411	330	321	323
Mainline	5,588	5,268	4,240	4,205	1,073	1,218	1,217	1,018	4,515	4,051	3,023	3,187
Rudgear On	366	398	434	362	55	69	80	61	310	330	354	301
Mainline	5,954	5,666	4,674	4,567	1,128	1,287	1,297	1,079	4,825	4,381	3,377	3,488
S. Main Off	386	286	239	253	52	51	56	52	334	235	183	201
Mainline	5,568	5,380	4,435	4,314	1,076	1,236	1,241	1,027	4,491	4,146	3,194	3,287
Olympic Off	470	773	682	633	50	107	123	78	419	666	558	555
Mainline	5,098	4,607	3,753	3,681	1,026	1,129	1,118	949	4,072	3,480	2,636	2,732
SR 24 Off	1,171	1,138	989	1,094	150	202	208	173	1,021	935	781	921
Mainline	3,927	3,469	2,764	2,587	876	927	910	776	3,051	2,545	1,855	1,811
Olympic On	1,084	908	1,214	860	150	188	203	136	934	720	1,011	724
Mainline	5,011	4,377	3,978	3,447	1,026	1,115	1,113	912	3,985	3,265	2,866	2,535
Ygnacio Valley Off	637	662	511	542	105	121	118	120	532	542	393	422
Mainline	4,374	3,715	3,467	2,905	921	994	995	792	3,453	2,723	2,473	2,113
SR 24 On	4,157	4,518	4,615	3,782	396	430	402	357	3,761	4,087	4,213	3,425
Mainline	8,531	8,233	8,082	6,687	1,317	1,424	1,397	1,149	7,214	6,810	6,686	5,538
N. Main Off	296	274	272	266	46	48	48	41	250	226	224	226
Mainline	8,235	7,959	7,810	6,421	1,271	1,376	1,349	1,108	6,964	6,584	6,462	5,312
Lawrence On	1,203	1,132	876	926	182	198	154	158	1,022	934	722	768
Mainline	9,438	9,091	8,686	7,347	1,453	1,574	1,503	1,266	7,986	7,518	7,184	6,080
Treat Off	1,378	1,169	1,195	1,298	215	205	206	199	1,163	964	989	1,098
Mainline	8,060	7,922	7,491	6,049	1,238	1,369	1,297	1,067	6,823	6,554	6,195	4,982
Truck Scales On	2	4	5	6	0	0	0	0	2	4	5	6
Mainline	8,062	7,926	7,496	6,055	1,238	1,369	1,297	1,067	6,825	6,558	6,200	4,988
Buskirk On	791	1,065	1,090	778	154	175	212	182	637	890	878	596
Mainline	8,853	8,991	8,586	6,833	1,392	1,544	1,509	1,249	7,462	7,448	7,078	5,584
Oak On	370	436	578	464	73	86	114	98	298	350	464	366
Mainline	9,223	9,427	9,164	7,297	1,465	1,630	1,623	1,347	7,760	7,798	7,542	5,950
Contra Costa Off	562	530	656	537	82	84	103	86	480	446	553	451
Mainline	8,661	8,897	8,508	6,760	1,383	1,546	1,520	1,261	7,280	7,352	6,989	5,499
Monument Off	786	755	660	516	120	123	113	94	666	632	547	422

ALTERNATIVE 3 Location	2020 Total Demand Volumes				2020 HOV Demand Volumes				2020 SOV Demand Volumes			
	3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM
Mainline	7,875	8,142	7,848	6,244	1,263	1,423	1,407	1,167	6,614	6,720	6,442	5,077
Monument On	943	990	1,145	911	184	192	219	223	759	798	926	688
Mainline	8,818	9,132	8,993	7,155	1,447	1,615	1,626	1,390	7,373	7,518	7,368	5,765
SR 242 Off	4,466	4,500	4,442	3,597	668	735	736	634	3,798	3,765	3,706	2,962
Mainline	4,352	4,632	4,551	3,558	779	880	890	756	3,575	3,753	3,662	2,803
Willow Pass Off	913	858	775	738	149	145	136	145	764	714	639	593
Mainline	3,439	3,774	3,776	2,820	630	735	754	611	2,811	3,039	3,023	2,210
Willow Pass On	738	811	958	808	144	158	186	200	594	653	771	608
Mainline	4,177	4,585	4,734	3,628	774	893	940	811	3,405	3,692	3,794	2,818
Burnett Off	556	545	506	448	90	93	89	87	466	452	418	361
Mainline	3,621	4,040	4,228	3,180	684	800	851	724	2,939	3,240	3,376	2,457
Burnett On	469	490	524	434	84	87	94	78	385	403	430	356
Mainline	4,090	4,530	4,752	3,614	768	887	945	802	3,324	3,643	3,806	2,813
Concord On	284	317	362	279	96	85	74	76	188	232	288	203
Mainline: NB I-680 north of Concord	4,374	4,847	5,114	3,893	864	972	1,019	878	3,512	3,875	4,094	3,016

Note: Trucks are included in the SOV demand volume.

ALTERNATIVE 4 Location	2020 Total Demand Volumes				2020 HOV Demand Volumes				2020 SOV Demand Volumes			
	3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM
Mainline: NB I-680 south of Bollinger	5,006	4,927	5,006	4,705	634	773	753	654	4,371	4,153	4,255	4,051
Bollinger Off-Ramp	867	921	1,496	936	141	179	158	123	726	742	1,338	813
Mainline	4,139	4,006	3,510	3,769	493	594	595	531	3,645	3,411	2,917	3,238
Bollinger Loop On	241	200	170	199	50	49	46	51	191	151	124	148
Mainline	4,380	4,206	3,680	3,968	543	643	641	582	3,836	3,562	3,041	3,386
Bollinger Diagonal On	711	811	676	620	141	160	106	96	570	651	570	524
Mainline	5,091	5,017	4,356	4,588	684	803	747	678	4,406	4,213	3,611	3,910
Crow Canyon Off-Ramp	1,106	919	1,488	1,042	91	111	105	72	1,015	808	1,383	970
Mainline	3,985	4,098	2,868	3,546	593	692	642	606	3,391	3,405	2,228	2,940
Crow Canyon Loop On	535	625	558	474	113	147	146	126	422	478	412	348
Mainline	4,520	4,723	3,426	4,020	706	839	788	732	3,813	3,883	2,640	3,288
Crow Canyon Diagonal On	788	872	827	586	164	204	229	153	624	668	598	434
Mainline	5,308	5,595	4,253	4,606	870	1,043	1,017	885	4,437	4,551	3,238	3,722
Sycamore Off-Ramp	488	668	410	570	137	142	126	141	351	526	284	429
Mainline	4,820	4,927	3,843	4,036	733	901	891	744	4,086	4,025	2,954	3,293
Sycamore On	942	884	858	796	216	207	190	172	726	677	667	624
Mainline	5,762	5,811	4,701	4,832	949	1,108	1,081	916	4,812	4,702	3,621	3,917
Diablo Valley Off-Ramp	608	611	543	570	66	66	43	34	542	546	500	536
Mainline	5,154	5,200	4,158	4,262	883	1,042	1,038	882	4,270	4,156	3,121	3,381
Diablo Valley Loop On	269	190	211	178	54	46	55	43	215	145	156	135
Mainline	5,423	5,390	4,369	4,440	937	1,088	1,093	925	4,485	4,301	3,277	3,516
Diablo Valley Diagonal On	139	177	170	138	29	42	44	34	110	134	126	103
Mainline	5,562	5,567	4,539	4,578	966	1,130	1,137	959	4,595	4,435	3,403	3,619
El Cerro Off-Ramp	358	409	370	370	35	42	26	20	322	366	344	350
Mainline	5,204	5,158	4,169	4,208	931	1,088	1,111	939	4,273	4,069	3,059	3,269
El Cerro On	558	343	378	313	96	102	100	77	462	242	278	236
Mainline	5,762	5,501	4,547	4,521	1,027	1,190	1,211	1,016	4,735	4,311	3,337	3,505
El Pintado On	105	81	71	50	22	20	19	13	83	61	52	37
Mainline	5,867	5,582	4,618	4,571	1,049	1,210	1,230	1,029	4,818	4,372	3,389	3,542
Stone Valley Diagonal Off	151	161	154	121	21	28	29	22	130	133	126	99
Mainline	5,716	5,421	4,464	4,450	1,028	1,182	1,201	1,007	4,688	4,239	3,263	3,443
Stone Valley Loop Off	252	191	178	155	34	33	30	23	218	158	148	132
Mainline	5,464	5,230	4,286	4,295	994	1,149	1,171	984	4,470	4,081	3,115	3,311
Stone Valley On	490	446	413	366	73	77	74	59	417	369	339	307
Mainline	5,954	5,676	4,699	4,661	1,067	1,226	1,245	1,043	4,887	4,450	3,454	3,618

ALTERNATIVE 4 Location	2020 Total Demand Volumes				2020 HOV Demand Volumes				2020 SOV Demand Volumes			
	3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM
Livorna Off	205	171	198	187	29	29	34	31	176	142	164	156
Mainline	5,749	5,505	4,501	4,474	1,038	1,197	1,211	1,012	4,711	4,308	3,290	3,462
Livorna On	347	214	195	164	44	41	39	32	303	174	156	132
Mainline	6,096	5,719	4,696	4,638	1,082	1,238	1,250	1,044	5,014	4,482	3,446	3,594
Rudgear Off	464	401	404	391	53	70	83	68	411	330	321	323
Mainline	5,632	5,318	4,292	4,247	1,029	1,168	1,167	976	4,603	4,152	3,125	3,271
Rudgear On	366	398	434	362	55	69	80	61	310	330	354	301
Mainline	5,998	5,716	4,726	4,609	1,084	1,237	1,247	1,037	4,913	4,482	3,479	3,572
S. Main Off	386	286	239	253	52	51	56	52	334	235	183	201
Mainline	5,612	5,430	4,487	4,356	1,032	1,186	1,191	985	4,579	4,247	3,296	3,371
Olympic Off	470	773	682	633	50	107	123	78	419	666	558	555
Mainline	5,142	4,657	3,805	3,723	982	1,079	1,068	907	4,160	3,581	2,738	2,816
SR 24 Off	1,171	1,138	989	1,094	150	202	208	173	1,021	935	781	921
Mainline	3,971	3,519	2,816	2,629	832	877	860	734	3,139	2,646	1,957	1,895
Olympic On	1,084	908	1,214	860	150	188	203	136	934	720	1,011	724
Mainline	5,055	4,427	4,030	3,489	982	1,065	1,063	870	4,073	3,366	2,968	2,619
Ygnacio Valley Off	637	662	511	542	105	121	118	120	532	542	393	422
Mainline	4,418	3,765	3,519	2,947	877	944	945	750	3,541	2,824	2,575	2,197
SR 24 On	4,157	4,518	4,615	3,782	396	430	402	357	3,761	4,087	4,213	3,425
Mainline	8,575	8,283	8,134	6,729	1,273	1,374	1,347	1,107	7,302	6,911	6,788	5,622
N. Main Off/Treat Off	1,673	1,439	1,462	1,558	261	253	254	240	1,412	1,186	1,208	1,318
Mainline	6,902	6,844	6,672	5,171	1,012	1,121	1,093	867	5,890	5,725	5,580	4,304
Lawrence On	1,203	1,132	876	926	182	198	154	158	1,022	934	722	768
Mainline	8,105	7,976	7,548	6,097	1,194	1,319	1,247	1,025	6,912	6,659	6,302	5,072
Treat Off (Closed)	0	0	0	0	0	0	0	0	0	0	0	0
Mainline	8,105	7,976	7,548	6,097	1,194	1,319	1,247	1,025	6,912	6,659	6,302	5,072
Truck Scales On (Closed)	0	0	0	0	0	0	0	0	0	0	0	0
Mainline	8,105	7,976	7,548	6,097	1,194	1,319	1,247	1,025	6,912	6,659	6,302	5,072
Buskirk On	791	1,065	1,090	778	154	175	212	182	637	890	878	596
Mainline	8,896	9,041	8,638	6,875	1,348	1,494	1,459	1,207	7,549	7,549	7,180	5,668
Oak On	370	436	578	464	73	86	114	98	298	350	464	366
Mainline	9,266	9,477	9,216	7,339	1,421	1,580	1,573	1,305	7,847	7,899	7,644	6,034
Contra Costa Off	562	530	656	537	82	84	103	86	480	446	553	451
Mainline	8,704	8,947	8,560	6,802	1,339	1,496	1,470	1,219	7,367	7,453	7,091	5,583
Monument Off	786	755	660	516	120	123	113	94	666	632	547	422

ALTERNATIVE 4 Location	2020 Total Demand Volumes				2020 HOV Demand Volumes				2020 SOV Demand Volumes			
	3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM
Mainline	7,918	8,192	7,900	6,286	1,219	1,373	1,357	1,125	6,701	6,821	6,544	5,161
Monument On	943	990	1,145	911	184	192	219	223	759	798	926	688
Mainline	8,861	9,182	9,045	7,197	1,403	1,565	1,576	1,348	7,460	7,619	7,470	5,849
SR 242 Off	4,466	4,500	4,442	3,597	668	735	736	634	3,798	3,765	3,706	2,962
Mainline	4,395	4,682	4,603	3,600	735	830	840	714	3,662	3,854	3,764	2,887
Willow Pass Off	913	858	775	738	149	145	136	145	764	714	639	593
Mainline	3,482	3,824	3,828	2,862	586	685	704	569	2,898	3,140	3,125	2,294
Willow Pass On	738	811	958	808	144	158	186	200	594	653	771	608
Mainline	4,220	4,635	4,786	3,670	730	843	890	769	3,492	3,793	3,896	2,902
Burnett Off	556	545	506	448	90	93	89	87	466	452	418	361
Mainline	3,664	4,090	4,280	3,222	640	750	801	682	3,026	3,341	3,478	2,541
Burnett On	469	490	524	434	84	87	94	78	385	403	430	356
Mainline	4,133	4,580	4,804	3,656	724	837	895	760	3,411	3,744	3,908	2,897
Concord On	284	317	362	279	96	85	74	76	188	232	288	203
Mainline: NB I-680 north of Concord	4,417	4,897	5,166	3,935	820	922	969	836	3,599	3,976	4,196	3,100

Note: Trucks are included in the SOV demand volume.

ALTERNATIVE 6, 6A	2020 Total Demand Volumes				2020 HOV Demand Volumes				2020 SOV Demand Volumes			
	Location	3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM
Mainline: NB I-680 south of Bollinger	6,322	6,228	6,328	5,943	740	903	877	765	5,582	5,325	5,451	5,178
Bollinger Off-Ramp	1,084	1,151	1,870	1,170	176	224	197	154	908	927	1,673	1,016
Mainline	5,238	5,077	4,458	4,773	564	679	680	611	4,674	4,398	3,778	4,162
Bollinger Loop On	306	253	214	255	61	60	56	63	245	193	158	192
Mainline	5,544	5,330	4,672	5,028	625	739	736	674	4,919	4,591	3,936	4,354
Bollinger Diagonal On	904	1,029	860	786	174	198	130	118	730	831	730	668
Mainline	6,448	6,359	5,532	5,814	799	937	866	792	5,649	5,422	4,666	5,022
Crow Canyon Off-Ramp	1,383	1,149	1,860	1,302	114	139	131	90	1,269	1,010	1,729	1,212
Mainline	5,065	5,210	3,672	4,512	685	798	735	702	4,380	4,412	2,937	3,810
Crow Canyon Loop On	678	798	713	604	139	182	180	155	539	616	533	449
Mainline	5,743	6,008	4,385	5,116	824	980	915	857	4,919	5,028	3,470	4,259
Crow Canyon Diagonal On	1,011	1,112	1,057	759	203	253	284	189	808	859	773	570
Mainline	6,754	7,120	5,442	5,875	1,027	1,233	1,199	1,046	5,727	5,887	4,243	4,829
Sycamore Off-Ramp	610	835	513	712	171	177	158	176	439	658	355	536
Mainline	6,144	6,285	4,929	5,163	856	1,056	1,041	870	5,288	5,229	3,888	4,293
Sycamore On	1,177	1,105	1,072	995	270	259	238	215	907	846	834	780
Mainline	7,321	7,390	6,001	6,158	1,126	1,315	1,279	1,085	6,195	6,075	4,722	5,073
Diablo Valley Off-Ramp	760	764	679	713	83	82	54	43	677	682	625	670
Mainline	6,561	6,626	5,322	5,445	1,043	1,233	1,225	1,042	5,518	5,393	4,097	4,403
Diablo Valley Loop On	336	238	264	223	67	57	69	54	269	181	195	169
Mainline	6,897	6,864	5,586	5,668	1,110	1,290	1,294	1,096	5,787	5,574	4,292	4,572
Diablo Valley Diagonal On	174	221	212	172	36	53	55	43	138	168	157	129
Mainline	7,071	7,085	5,798	5,840	1,146	1,343	1,349	1,139	5,925	5,742	4,449	4,701
El Cerro Off-Ramp	447	511	463	463	44	53	33	25	403	458	430	438
Mainline	6,624	6,574	5,335	5,377	1,102	1,290	1,316	1,114	5,522	5,284	4,019	4,263
El Cerro On	697	429	473	391	120	127	125	96	577	302	348	295
Mainline	7,321	7,003	5,808	5,768	1,222	1,417	1,441	1,210	6,099	5,586	4,367	4,558
El Pintado On	131	101	89	62	27	25	24	16	104	76	65	46
Mainline	7,452	7,104	5,897	5,830	1,249	1,442	1,465	1,226	6,203	5,662	4,432	4,604
Stone Valley Diagonal Off	189	201	193	151	26	35	36	27	163	166	157	124
Mainline	7,263	6,903	5,704	5,679	1,223	1,407	1,429	1,199	6,040	5,496	4,275	4,480
Stone Valley Loop Off	315	239	222	194	43	41	37	29	272	198	185	165
Mainline	6,948	6,664	5,482	5,485	1,180	1,366	1,392	1,170	5,768	5,298	4,090	4,315
Stone Valley On	612	557	516	458	91	96	92	74	521	461	424	384
Mainline	7,560	7,221	5,998	5,943	1,271	1,462	1,484	1,244	6,289	5,759	4,514	4,699

ALTERNATIVE 6, 6A Location	2020 Total Demand Volumes				2020 HOV Demand Volumes				2020 SOV Demand Volumes			
	3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM
Livorna Off	256	214	247	234	36	36	42	39	220	178	205	195
Mainline	7,304	7,007	5,751	5,709	1,235	1,426	1,442	1,205	6,069	5,581	4,309	4,504
Livorna On	434	268	244	205	55	51	49	40	379	217	195	165
Mainline	7,738	7,275	5,995	5,914	1,290	1,477	1,491	1,245	6,448	5,798	4,504	4,669
Rudgear Off	580	501	505	489	66	88	104	85	514	413	401	404
Mainline	7,158	6,774	5,490	5,425	1,224	1,389	1,387	1,160	5,934	5,385	4,103	4,265
Rudgear On	457	498	542	452	69	86	100	76	388	412	442	376
Mainline	7,615	7,272	6,032	5,877	1,293	1,475	1,487	1,236	6,322	5,797	4,545	4,641
S. Main Off	483	358	299	316	65	64	70	65	418	294	229	251
Mainline	7,132	6,914	5,733	5,561	1,228	1,411	1,417	1,171	5,904	5,503	4,316	4,390
Olympic Off	587	966	852	791	63	134	154	97	524	832	698	694
Mainline	6,545	5,948	4,881	4,770	1,165	1,277	1,263	1,074	5,380	4,671	3,618	3,696
SR 24 Off	1,464	1,422	1,236	1,367	188	253	260	216	1,276	1,169	976	1,151
Mainline	5,081	4,526	3,645	3,403	977	1,024	1,003	858	4,104	3,502	2,642	2,545
Olympic On	1,355	1,135	1,518	1,075	188	235	254	170	1,167	900	1,264	905
Mainline	6,436	5,661	5,163	4,478	1,165	1,259	1,257	1,028	5,271	4,402	3,906	3,450
Ygnacio Valley Off	851	885	695	733	124	144	141	143	727	741	554	590
Mainline	5,585	4,776	4,468	3,745	1,041	1,115	1,116	885	4,544	3,661	3,352	2,860
SR 24 On	5,196	5,647	5,769	4,727	495	538	503	446	4,701	5,109	5,266	4,281
Mainline	10,781	10,423	10,237	8,472	1,536	1,653	1,619	1,331	9,245	8,770	8,618	7,141
N. Main Off/Treat Off	2,091	1,799	1,828	1,948	326	316	318	300	1,765	1,483	1,510	1,648
Mainline	8,690	8,624	8,409	6,524	1,210	1,337	1,301	1,031	7,480	7,287	7,108	5,493
Lawrence On	1,504	1,415	1,095	1,158	227	247	193	198	1,277	1,168	902	960
Mainline	10,194	10,039	9,504	7,682	1,437	1,584	1,494	1,229	8,757	8,455	8,010	6,453
Treat Off (Closed)	0	0	0	0	0	0	0	0	0	0	0	0
Mainline	10,194	10,039	9,504	7,682	1,437	1,584	1,494	1,229	8,757	8,455	8,010	6,453
Truck Scales On (Closed)	0	0	0	0	0	0	0	0	0	0	0	0
Mainline	10,194	10,039	9,504	7,682	1,437	1,584	1,494	1,229	8,757	8,455	8,010	6,453
Buskirk On	989	1,331	1,362	973	193	219	265	228	796	1,112	1,097	745
Mainline	11,183	11,370	10,866	8,655	1,630	1,803	1,759	1,457	9,553	9,567	9,107	7,198
Oak On	463	545	722	580	91	107	142	123	372	438	580	457
Mainline	11,646	11,915	11,588	9,235	1,721	1,910	1,901	1,580	9,925	10,005	9,687	7,655
Contra Costa Off	702	662	820	671	102	105	129	107	600	557	691	564
Mainline	10,944	11,253	10,768	8,564	1,619	1,805	1,772	1,473	9,325	9,448	8,996	7,091
Monument Off	982	944	825	645	150	154	141	117	832	790	684	528

ALTERNATIVE 6, 6A Location	2020 Total Demand Volumes				2020 HOV Demand Volumes				2020 SOV Demand Volumes			
	3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM
Mainline	9,962	10,309	9,943	7,919	1,469	1,651	1,631	1,356	8,493	8,658	8,312	6,563
Monument On	1,179	1,238	1,431	1,139	230	240	274	279	949	998	1,157	860
Mainline	11,141	11,547	11,374	9,058	1,699	1,891	1,905	1,635	9,442	9,656	9,469	7,423
SR 242 Off	5,582	5,625	5,553	4,496	835	919	920	793	4,747	4,706	4,633	3,703
Mainline	5,559	5,922	5,821	4,562	864	972	985	842	4,695	4,950	4,836	3,720
Willow Pass Off	1,141	1,073	969	922	186	181	170	181	955	892	799	741
Mainline	4,418	4,849	4,852	3,640	678	791	815	661	3,740	4,058	4,037	2,979
Willow Pass On	922	1,014	1,197	1,010	180	198	233	250	742	816	964	760
Mainline	5,340	5,863	6,049	4,650	858	989	1,048	911	4,482	4,874	5,001	3,739
Burnett Off	695	681	633	560	113	116	111	109	582	565	522	451
Mainline	4,645	5,182	5,416	4,090	745	873	937	802	3,900	4,309	4,479	3,288
Burnett On	586	613	655	542	105	109	117	97	481	504	538	445
Mainline	5,231	5,795	6,071	4,632	850	982	1,054	899	4,381	4,813	5,017	3,733
Concord On	355	396	452	349	120	106	92	95	235	290	360	254
Mainline: NB I-680 north of Concord	5,586	6,191	6,523	4,981	970	1,088	1,146	994	4,616	5,103	5,377	3,987

Note: Trucks are included in the SOV demand volume.

ALTERNATIVE 7 Location	2020 Total Demand Volumes				2020 HOV Demand Volumes				2020 SOV Demand Volumes			
	3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM
Mainline: NB I-680 south of Bollinger	6,322	6,228	6,328	5,943	740	903	877	765	5,582	5,325	5,451	5,178
Bollinger Off-Ramp	1,084	1,151	1,870	1,170	176	224	197	154	908	927	1,673	1,016
Mainline	5,238	5,077	4,458	4,773	564	679	680	611	4,674	4,398	3,778	4,162
Bollinger Loop On	306	253	214	255	61	60	56	63	245	193	158	192
Mainline	5,544	5,330	4,672	5,028	625	739	736	674	4,919	4,591	3,936	4,354
Bollinger Diagonal On	904	1,029	860	786	174	198	130	118	730	831	730	668
Mainline	6,448	6,359	5,532	5,814	799	937	866	792	5,649	5,422	4,666	5,022
Crow Canyon Off-Ramp	1,383	1,149	1,860	1,302	114	139	131	90	1,269	1,010	1,729	1,212
Mainline	5,065	5,210	3,672	4,512	685	798	735	702	4,380	4,412	2,937	3,810
Crow Canyon Loop On	678	798	713	604	139	182	180	155	539	616	533	449
Mainline	5,743	6,008	4,385	5,116	824	980	915	857	4,919	5,028	3,470	4,259
Crow Canyon Diagonal On	1,011	1,112	1,057	759	203	253	284	189	808	859	773	570
Mainline	6,754	7,120	5,442	5,875	1,027	1,233	1,199	1,046	5,727	5,887	4,243	4,829
Sycamore Off-Ramp	610	835	513	712	171	177	158	176	439	658	355	536
Mainline	6,144	6,285	4,929	5,163	856	1,056	1,041	870	5,288	5,229	3,888	4,293
Sycamore On	1,177	1,105	1,072	995	270	259	238	215	907	846	834	780
Mainline	7,321	7,390	6,001	6,158	1,126	1,315	1,279	1,085	6,195	6,075	4,722	5,073
Diablo Valley Off-Ramp	760	764	679	713	83	82	54	43	677	682	625	670
Mainline	6,561	6,626	5,322	5,445	1,043	1,233	1,225	1,042	5,518	5,393	4,097	4,403
Diablo Valley Loop On	336	238	264	223	67	57	69	54	269	181	195	169
Mainline	6,897	6,864	5,586	5,668	1,110	1,290	1,294	1,096	5,787	5,574	4,292	4,572
Diablo Valley Diagonal On	174	221	212	172	36	53	55	43	138	168	157	129
Mainline	7,071	7,085	5,798	5,840	1,146	1,343	1,349	1,139	5,925	5,742	4,449	4,701
El Cerro Off-Ramp	447	511	463	463	44	53	33	25	403	458	430	438
Mainline	6,624	6,574	5,335	5,377	1,102	1,290	1,316	1,114	5,522	5,284	4,019	4,263
El Cerro On	697	429	473	391	120	127	125	96	577	302	348	295
Mainline	7,321	7,003	5,808	5,768	1,222	1,417	1,441	1,210	6,099	5,586	4,367	4,558
El Pintado On	131	101	89	62	27	25	24	16	104	76	65	46
Mainline	7,452	7,104	5,897	5,830	1,249	1,442	1,465	1,226	6,203	5,662	4,432	4,604
Stone Valley Diagonal Off	189	201	193	151	26	35	36	27	163	166	157	124
Mainline	7,263	6,903	5,704	5,679	1,223	1,407	1,429	1,199	6,040	5,496	4,275	4,480
Stone Valley Loop Off	315	239	222	194	43	41	37	29	272	198	185	165
Mainline	6,948	6,664	5,482	5,485	1,180	1,366	1,392	1,170	5,768	5,298	4,090	4,315
Stone Valley On	612	557	516	458	91	96	92	74	521	461	424	384
Mainline	7,560	7,221	5,998	5,943	1,271	1,462	1,484	1,244	6,289	5,759	4,514	4,699

ALTERNATIVE 7 Location	2020 Total Demand Volumes				2020 HOV Demand Volumes				2020 SOV Demand Volumes			
	3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM
Livorna Off	256	214	247	234	36	36	42	39	220	178	205	195
Mainline	7,304	7,007	5,751	5,709	1,235	1,426	1,442	1,205	6,069	5,581	4,309	4,504
Livorna On	434	268	244	205	55	51	49	40	379	217	195	165
Mainline	7,738	7,275	5,995	5,914	1,290	1,477	1,491	1,245	6,448	5,798	4,504	4,669
Rudgear Off	580	501	505	489	66	88	104	85	514	413	401	404
Mainline	7,158	6,774	5,490	5,425	1,224	1,389	1,387	1,160	5,934	5,385	4,103	4,265
Rudgear On	457	498	542	452	69	86	100	76	388	412	442	376
Mainline	7,615	7,272	6,032	5,877	1,293	1,475	1,487	1,236	6,322	5,797	4,545	4,641
S. Main Off	483	358	299	316	65	64	70	65	418	294	229	251
Mainline	7,132	6,914	5,733	5,561	1,228	1,411	1,417	1,171	5,904	5,503	4,316	4,390
Olympic Off	587	966	852	791	63	134	154	97	524	832	698	694
Mainline	6,545	5,948	4,881	4,770	1,165	1,277	1,263	1,074	5,380	4,671	3,618	3,696
SR 24 Off/Ygnacio Valley Off	2,315	2,307	1,931	2,100	312	397	401	359	2,003	1,910	1,530	1,741
Mainline	4,230	3,641	2,950	2,670	853	880	862	715	3,377	2,761	2,088	1,955
Olympic On	1,355	1,135	1,518	1,075	188	235	254	170	1,167	900	1,264	905
Mainline	5,585	4,776	4,468	3,745	1,041	1,115	1,116	885	4,544	3,661	3,352	2,860
Ygnacio Valley Off (Closed)	0	0	0	0	0	0	0	0	0	0	0	0
Mainline	5,585	4,776	4,468	3,745	1,041	1,115	1,116	885	4,544	3,661	3,352	2,860
SR 24 On	5,196	5,647	5,769	4,727	495	538	503	446	4,701	5,109	5,266	4,281
Mainline	10,781	10,423	10,237	8,472	1,536	1,653	1,619	1,331	9,245	8,770	8,618	7,141
N. Main Off/Treat Off	2,091	1,799	1,828	1,948	326	316	318	300	1,765	1,483	1,510	1,648
Mainline	8,690	8,624	8,409	6,524	1,210	1,337	1,301	1,031	7,480	7,287	7,108	5,493
Lawrence On	1,504	1,415	1,095	1,158	227	247	193	198	1,277	1,168	902	960
Mainline	10,194	10,039	9,504	7,682	1,437	1,584	1,494	1,229	8,757	8,455	8,010	6,453
Treat Off (Closed)	0	0	0	0	0	0	0	0	0	0	0	0
Mainline	10,194	10,039	9,504	7,682	1,437	1,584	1,494	1,229	8,757	8,455	8,010	6,453
Truck Scales On (Closed)	0	0	0	0	0	0	0	0	0	0	0	0
Mainline	10,194	10,039	9,504	7,682	1,437	1,584	1,494	1,229	8,757	8,455	8,010	6,453
Buskirk On	989	1,331	1,362	973	193	219	265	228	796	1,112	1,097	745
Mainline	11,183	11,370	10,866	8,655	1,630	1,803	1,759	1,457	9,553	9,567	9,107	7,198
Oak On	463	545	722	580	91	107	142	123	372	438	580	457
Mainline	11,646	11,915	11,588	9,235	1,721	1,910	1,901	1,580	9,925	10,005	9,687	7,655
Contra Costa Off	702	662	820	671	102	105	129	107	600	557	691	564
Mainline	10,944	11,253	10,768	8,564	1,619	1,805	1,772	1,473	9,325	9,448	8,996	7,091
Monument Off	982	944	825	645	150	154	141	117	832	790	684	528

ALTERNATIVE 7 Location	2020 Total Demand Volumes				2020 HOV Demand Volumes				2020 SOV Demand Volumes			
	3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM
Mainline	9,962	10,309	9,943	7,919	1,469	1,651	1,631	1,356	8,493	8,658	8,312	6,563
Monument On	1,179	1,238	1,431	1,139	230	240	274	279	949	998	1,157	860
Mainline	11,141	11,547	11,374	9,058	1,699	1,891	1,905	1,635	9,442	9,656	9,469	7,423
SR 242 Off	5,582	5,625	5,553	4,496	835	919	920	793	4,747	4,706	4,633	3,703
Mainline	5,559	5,922	5,821	4,562	864	972	985	842	4,695	4,950	4,836	3,720
Willow Pass Off	1,141	1,073	969	922	186	181	170	181	955	892	799	741
Mainline	4,418	4,849	4,852	3,640	678	791	815	661	3,740	4,058	4,037	2,979
Willow Pass On	922	1,014	1,197	1,010	180	198	233	250	742	816	964	760
Mainline	5,340	5,863	6,049	4,650	858	989	1,048	911	4,482	4,874	5,001	3,739
Burnett Off	695	681	633	560	113	116	111	109	582	565	522	451
Mainline	4,645	5,182	5,416	4,090	745	873	937	802	3,900	4,309	4,479	3,288
Burnett On	586	613	655	542	105	109	117	97	481	504	538	445
Mainline	5,231	5,795	6,071	4,632	850	982	1,054	899	4,381	4,813	5,017	3,733
Concord On	355	396	452	349	120	106	92	95	235	290	360	254
Mainline: NB I-680 north of Concord	5,586	6,191	6,523	4,981	970	1,088	1,146	994	4,616	5,103	5,377	3,987

Note: Trucks are included in the SOV demand volume.

ALTERNATIVE 9 Location	2020 Total Demand Volumes				2020 HOV Demand Volumes				2020 SOV Demand Volumes			
	3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM
Mainline: NB I-680 south of Bollinger	6,322	6,228	6,328	5,943	740	903	877	765	5,582	5,325	5,451	5,178
Bollinger Off-Ramp	1,084	1,151	1,870	1,170	176	224	197	154	908	927	1,673	1,016
Mainline	5,238	5,077	4,458	4,773	564	679	680	611	4,674	4,398	3,778	4,162
Bollinger Loop On	306	253	214	255	61	60	56	63	245	193	158	192
Mainline	5,544	5,330	4,672	5,028	625	739	736	674	4,919	4,591	3,936	4,354
Bollinger Diagonal On	904	1,029	860	786	174	198	130	118	730	831	730	668
Mainline	6,448	6,359	5,532	5,814	799	937	866	792	5,649	5,422	4,666	5,022
Crow Canyon Off-Ramp	1,383	1,149	1,860	1,302	114	139	131	90	1,269	1,010	1,729	1,212
Mainline	5,065	5,210	3,672	4,512	685	798	735	702	4,380	4,412	2,937	3,810
Crow Canyon Loop On	678	798	713	604	139	182	180	155	539	616	533	449
Mainline	5,743	6,008	4,385	5,116	824	980	915	857	4,919	5,028	3,470	4,259
Crow Canyon Diagonal On	1,011	1,112	1,057	759	203	253	284	189	808	859	773	570
Mainline	6,754	7,120	5,442	5,875	1,027	1,233	1,199	1,046	5,727	5,887	4,243	4,829
Sycamore Off-Ramp	610	835	513	712	171	177	158	176	439	658	355	536
Mainline	6,144	6,285	4,929	5,163	856	1,056	1,041	870	5,288	5,229	3,888	4,293
Sycamore On	1,177	1,105	1,072	995	270	259	238	215	907	846	834	780
Mainline	7,321	7,390	6,001	6,158	1,126	1,315	1,279	1,085	6,195	6,075	4,722	5,073
Diablo Valley Off-Ramp	760	764	679	713	83	82	54	43	677	682	625	670
Mainline	6,561	6,626	5,322	5,445	1,043	1,233	1,225	1,042	5,518	5,393	4,097	4,403
Diablo Valley Loop On	336	238	264	223	67	57	69	54	269	181	195	169
Mainline	6,897	6,864	5,586	5,668	1,110	1,290	1,294	1,096	5,787	5,574	4,292	4,572
Diablo Valley Diagonal On	174	221	212	172	36	53	55	43	138	168	157	129
Mainline	7,071	7,085	5,798	5,840	1,146	1,343	1,349	1,139	5,925	5,742	4,449	4,701
El Cerro Off-Ramp	447	511	463	463	44	53	33	25	403	458	430	438
Mainline	6,624	6,574	5,335	5,377	1,102	1,290	1,316	1,114	5,522	5,284	4,019	4,263
El Cerro On	697	429	473	391	120	127	125	96	577	302	348	295
Mainline	7,321	7,003	5,808	5,768	1,222	1,417	1,441	1,210	6,099	5,586	4,367	4,558
El Pintado On	131	101	89	62	27	25	24	16	104	76	65	46
Mainline	7,452	7,104	5,897	5,830	1,249	1,442	1,465	1,226	6,203	5,662	4,432	4,604
Stone Valley Diagonal Off	189	201	193	151	26	35	36	27	163	166	157	124
Mainline	7,263	6,903	5,704	5,679	1,223	1,407	1,429	1,199	6,040	5,496	4,275	4,480
Stone Valley Loop Off	315	239	222	194	43	41	37	29	272	198	185	165
Mainline	6,948	6,664	5,482	5,485	1,180	1,366	1,392	1,170	5,768	5,298	4,090	4,315
Stone Valley On	612	557	516	458	91	96	92	74	521	461	424	384
Mainline	7,560	7,221	5,998	5,943	1,271	1,462	1,484	1,244	6,289	5,759	4,514	4,699

ALTERNATIVE 9 Location	2020 Total Demand Volumes				2020 HOV Demand Volumes				2020 SOV Demand Volumes			
	3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM
Livorna Off	256	214	247	234	36	36	42	39	220	178	205	195
Mainline	7,304	7,007	5,751	5,709	1,235	1,426	1,442	1,205	6,069	5,581	4,309	4,504
Livorna On	434	268	244	205	55	51	49	40	379	217	195	165
Mainline	7,738	7,275	5,995	5,914	1,290	1,477	1,491	1,245	6,448	5,798	4,504	4,669
Rudgear Off	580	501	505	489	66	88	104	85	514	413	401	404
Mainline	7,158	6,774	5,490	5,425	1,224	1,389	1,387	1,160	5,934	5,385	4,103	4,265
Rudgear On	457	498	542	452	69	86	100	76	388	412	442	376
Mainline	7,615	7,272	6,032	5,877	1,293	1,475	1,487	1,236	6,322	5,797	4,545	4,641
S. Main Off	483	358	299	316	65	64	70	65	418	294	229	251
Mainline	7,132	6,914	5,733	5,561	1,228	1,411	1,417	1,171	5,904	5,503	4,316	4,390
Olympic Off	587	966	852	791	63	134	154	97	524	832	698	694
Mainline	6,545	5,948	4,881	4,770	1,165	1,277	1,263	1,074	5,380	4,671	3,618	3,696
SR 24 Off/Ygnacio Valley Off	2,315	2,307	1,931	2,100	312	397	401	359	2,003	1,910	1,530	1,741
Mainline	4,230	3,641	2,950	2,670	853	880	862	715	3,377	2,761	2,088	1,955
Olympic On	1,355	1,135	1,518	1,075	188	235	254	170	1,167	900	1,264	905
Mainline	5,585	4,776	4,468	3,745	1,041	1,115	1,116	885	4,544	3,661	3,352	2,860
Ygnacio Valley Off (Closed)	0	0	0	0	0	0	0	0	0	0	0	0
Mainline	5,585	4,776	4,468	3,745	1,041	1,115	1,116	885	4,544	3,661	3,352	2,860
SR 24 On	5,196	5,647	5,769	4,727	495	538	503	446	4,701	5,109	5,266	4,281
Mainline	10,781	10,423	10,237	8,472	1,536	1,653	1,619	1,331	9,245	8,770	8,618	7,141
N. Main Off	370	343	340	333	57	60	60	51	313	283	280	282
Mainline	10,411	10,080	9,897	8,139	1,479	1,593	1,559	1,280	8,932	8,487	8,338	6,859
Lawrence On	1,504	1,415	1,095	1,158	227	247	193	198	1,277	1,168	902	960
Mainline	11,915	11,495	10,992	9,297	1,706	1,840	1,752	1,478	10,209	9,655	9,240	7,819
Treat Off	1,723	1,461	1,494	1,622	269	256	258	249	1,454	1,205	1,236	1,373
Mainline	10,192	10,034	9,498	7,675	1,437	1,584	1,494	1,229	8,755	8,450	8,004	6,446
Truck Scales On	2	5	6	7	0	0	0	0	2	5	6	7
Mainline	10,194	10,039	9,504	7,682	1,437	1,584	1,494	1,229	8,757	8,455	8,010	6,453
Buskirk On	989	1,331	1,362	973	193	219	265	228	796	1,112	1,097	745
Mainline	11,183	11,370	10,866	8,655	1,630	1,803	1,759	1,457	9,553	9,567	9,107	7,198
Oak On	463	545	722	580	91	107	142	123	372	438	580	457
Mainline	11,646	11,915	11,588	9,235	1,721	1,910	1,901	1,580	9,925	10,005	9,687	7,655
Contra Costa Off	702	662	820	671	102	105	129	107	600	557	691	564
Mainline	10,944	11,253	10,768	8,564	1,619	1,805	1,772	1,473	9,325	9,448	8,996	7,091
Monument Off	982	944	825	645	150	154	141	117	832	790	684	528

ALTERNATIVE 9 Location	2020 Total Demand Volumes				2020 HOV Demand Volumes				2020 SOV Demand Volumes			
	3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM
Mainline	9,962	10,309	9,943	7,919	1,469	1,651	1,631	1,356	8,493	8,658	8,312	6,563
Monument On	1,179	1,238	1,431	1,139	230	240	274	279	949	998	1,157	860
Mainline	11,141	11,547	11,374	9,058	1,699	1,891	1,905	1,635	9,442	9,656	9,469	7,423
SR 242 Off	5,582	5,625	5,553	4,496	835	919	920	793	4,747	4,706	4,633	3,703
Mainline	5,559	5,922	5,821	4,562	864	972	985	842	4,695	4,950	4,836	3,720
Willow Pass Off	1,141	1,073	969	922	186	181	170	181	955	892	799	741
Mainline	4,418	4,849	4,852	3,640	678	791	815	661	3,740	4,058	4,037	2,979
Willow Pass On	922	1,014	1,197	1,010	180	198	233	250	742	816	964	760
Mainline	5,340	5,863	6,049	4,650	858	989	1,048	911	4,482	4,874	5,001	3,739
Burnett Off	695	681	633	560	113	116	111	109	582	565	522	451
Mainline	4,645	5,182	5,416	4,090	745	873	937	802	3,900	4,309	4,479	3,288
Burnett On	586	613	655	542	105	109	117	97	481	504	538	445
Mainline	5,231	5,795	6,071	4,632	850	982	1,054	899	4,381	4,813	5,017	3,733
Concord On	355	396	452	349	120	106	92	95	235	290	360	254
Mainline: NB I-680 north of Concord	5,586	6,191	6,523	4,981	970	1,088	1,146	994	4,616	5,103	5,377	3,987

Note: Trucks are included in the SOV demand volume.

YEAR 2020 SPEED CONTOUR MAPS FOR ALTERNATIVES

APPENDIX C – Cost Estimates

SUMMARY OF ALTERNATIVE COSTS

ALT	A		B		C		C2	D		F1		J		K		M1		N		O		X		ESTIMATED LOW	ESTIMATED HIGH	USE LOW	USE HIGH
	LOW	HIGH	LOW	HIGH	LOW	HIGH		LOW	HIGH	LOW	HIGH	LOW	HIGH	LOW	HIGH	LOW	HIGH	LOW	HIGH	LOW	HIGH	LOW	HIGH				
1																							\$0	\$0	\$0	\$0	
2	\$15,000,000	\$20,000,000																					\$15,000,000	\$20,000,000	\$15,000,000	\$20,000,000	
3	\$15,000,000	\$20,000,000	\$900,000	\$1,100,000	\$900,000	\$1,100,000	\$49,200,000														\$18,000,000	\$24,000,000	\$84,000,000	\$95,400,000	\$84,000,000	\$96,000,000	
4	\$15,000,000	\$20,000,000	\$900,000	\$1,100,000	\$900,000	\$1,100,000	\$49,200,000			\$47,000,000	\$58,000,000										\$18,000,000	\$24,000,000	\$131,000,000	\$153,400,000	\$135,000,000	\$155,000,000	
5	\$15,000,000	\$20,000,000	\$900,000	\$1,100,000								\$25,000,000	\$30,000,000	\$6,500,000	\$8,000,000	\$140,000,000	\$160,000,000				\$18,000,000	\$24,000,000	\$205,400,000	\$243,100,000	\$210,000,000	\$250,000,000	
6	\$15,000,000	\$20,000,000	\$900,000	\$1,100,000						\$47,000,000	\$58,000,000	\$25,000,000	\$30,000,000	\$6,500,000	\$8,000,000	\$140,000,000	\$160,000,000				\$18,000,000	\$24,000,000	\$252,400,000	\$301,100,000	\$250,000,000	\$300,000,000	
6A	\$15,000,000	\$20,000,000	\$900,000	\$1,100,000						\$47,000,000	\$58,000,000	\$25,000,000	\$30,000,000	\$6,500,000	\$8,000,000						\$5,940,000	\$7,920,000	\$100,340,000	\$125,020,000	\$100,000,000	\$125,000,000	
7	\$15,000,000	\$20,000,000	\$900,000	\$1,100,000						\$47,000,000	\$58,000,000	\$25,000,000	\$30,000,000			\$140,000,000	\$160,000,000			\$90,000,000	\$100,000,000	\$18,000,000	\$24,000,000	\$335,900,000	\$393,100,000	\$350,000,000	\$400,000,000
8	\$15,000,000	\$20,000,000	\$900,000	\$1,100,000				\$20,000,000	\$25,000,000			\$25,000,000	\$30,000,000			\$140,000,000	\$160,000,000				\$18,000,000	\$24,000,000	\$218,900,000	\$260,100,000	\$220,000,000	\$260,000,000	
9	\$15,000,000	\$20,000,000	\$900,000	\$1,100,000								\$25,000,000	\$30,000,000	\$6,500,000	\$8,000,000	\$140,000,000	\$160,000,000	\$500,000,000	\$600,000,000			\$18,000,000	\$24,000,000	\$705,400,000	\$843,100,000	\$700,000,000	\$900,000,000

*C2 - Mode Shift Investment (see attached estimate)
 Costs shown are construction estimates only and do no include R/W, Support Costs or O&M

DESIGN CONCEPTS - ESTIMATE OF CONSTRUCTION COSTS			CONCEPT A		CONCEPT B		CONCEPT C		CONCEPT D		CONCEPT F1		CONCEPT J	
Unit	Unit Price		Quantity	Unit Cost	Quantity	Unit Cost	Quantity	Unit Cost	Quantity	Unit Cost	Quantity	Unit Cost	Quantity	Unit Cost
Section 1: Earthwork														
Roadway Excavation	LS	\$100,000.00		\$0		\$0		\$0	2	\$200,000	3	\$300,000	2	\$200,000
Imported Borrow	LS	\$100,000.00		\$0		\$0		\$0		\$0	4	\$400,000		\$0
Export	LS	\$100,000.00		\$0		\$0		\$0		\$0		\$0	1	\$100,000
Clearing and Grubbing	AC	\$50,000	2	\$100,000		\$0		\$0		\$0	3	\$150,000	1	\$50,000
Contaminated Soil Excavation				\$0		\$0		\$0		\$0		\$0		\$0
(Type Y-1) (ADL)	CY			\$0		\$0		\$0		\$0		\$0		\$0
(Type Y-2) (ADL)	LS	\$50,000.00	1	\$50,000		\$0		\$0		\$0	2	\$100,000	2	\$100,000
(Type Z-2) (ADL)	CY			\$0		\$0		\$0		\$0		\$0		\$0
Develop Water Supply	LS	\$25,000	1	\$25,000	1	\$25,000	1	\$25,000	1	\$25,000	1	\$25,000	1	\$25,000
Topsoil Reapplication	LS			\$0		\$0		\$0		\$0		\$0		\$0
Stepped Slopes and Slope Rounding				\$0		\$0		\$0		\$0		\$0		\$0
(Contour Grading)	LS			\$0		\$0		\$0		\$0		\$0		\$0
Subtotal Earthwork				\$175,000		\$25,000		\$25,000		\$225,000		\$975,000		\$475,000
Section 2: Pavement Structural Section														
HMA (Open Graded)	Ton	\$180		\$0		\$0		\$0		\$0		\$0		\$0
HMA (Type A)	Ton	\$120		\$0		\$0		\$0		\$0		\$0		\$0
Cement Treated Base	CY	\$160		\$0		\$0		\$0		\$0		\$0		\$0
Class 4 Aggregate Subbase	CY	\$36		\$0		\$0		\$0		\$0		\$0		\$0
Class 2 Aggregate Base	CY	\$0		\$0		\$0		\$0		\$0		\$0		\$0
Treated Permeable Base	CY	\$140		\$0		\$0		\$0		\$0		\$0		\$0
Subgrade Enhancement Fabric	SOYD			\$0		\$0		\$0		\$0		\$0		\$0
Cold Plane Asphalt Concrete	SOYD			\$0		\$0		\$0		\$0		\$0		\$0
Edge Drain	LF	\$20.00		\$0		\$0		\$0		\$0		\$0		\$0
Pavement Lump Sum	SOFT	\$15		\$0		\$0		\$0	31700	\$475,500	384000	\$5,760,000	208000	\$3,120,000
Subtotal Structural Section				\$0		\$0		\$0		\$475,500		\$5,760,000		\$3,120,000
Section 3: Drainage														
Large Drainage Facilities	LS	\$500,000		\$0		\$0		\$0		\$0	1	\$500,000		\$0
Storm Drains (Median Inlets)	LS	\$50,000		\$0		\$0		\$0	3	\$150,000	3	\$150,000	3	\$150,000
Project Drainage				\$0		\$0		\$0		\$0		\$0		\$0
(X-Drains, overside, etc.)	LS			\$0		\$0		\$0		\$0		\$0		\$0
Hydromodification	LS	\$200,000		\$0		\$0		\$0		\$0	1	\$200,000	1	\$200,000
Subtotal Drainage				\$0		\$0		\$0		\$150,000		\$850,000		\$350,000
Section 4: Specialty Items														
Retaining Walls	SF	\$115		\$0		\$0		\$0		\$0	56400	\$6,486,000	71280	\$8,197,200
Noise Barriers	LS	\$250,000		\$0		\$0		\$0		\$0	2	\$500,000		\$0
Concrete Barriers	LF	\$300		\$0		\$0		\$0	10000	\$3,000,000	4800	\$1,440,000		\$0
Movable Barrier System	LS	\$5,200,000		\$0		\$0		\$0	1	\$5,200,000		\$0		\$0
Water Pollution Control	LS	\$50,000		\$0		\$0		\$0	3	\$150,000	4	\$200,000	2	\$100,000
Hazardous Waste Investigation and/or Mitigation Work				\$0		\$0		\$0		\$0		\$0		\$0
Environmental Mitigation	LS	\$50,000		\$0		\$0		\$0		\$0	1	\$50,000	1	\$50,000
Resident Engineer Office Space	LS			\$0		\$0		\$0		\$0		\$0		\$0
Removal Items	LS	\$50,000	2	\$100,000	2	\$100,000	2	\$100,000	3	\$150,000	6	\$300,000	1	\$50,000
Subtotal Specialty Items				\$100,000		\$100,000		\$100,000		\$8,500,000		\$8,976,000		\$8,397,200
Section 5: Traffic Items														
Highway Lighting	LS	\$100,000		\$0		\$0		\$0	2	\$200,000	3	\$300,000	3	\$300,000
Traffic Delineation Items	LF	\$6		\$0	18000	\$108,000	17500	\$105,000	2100	\$12,600	28500	\$171,000		\$0
Traffic Signals	EA	\$0		\$0		\$0		\$0		\$0		\$0		\$0
Overhead Signs	EA	\$150,000		\$0		\$0		\$0	3	\$450,000	3	\$450,000	3	\$450,000
Roadside Signs (Median Mounted)	LS	\$100,000		\$0	1	\$100,000	1	\$100,000		\$0		\$0		\$0
Traffic Control Systems	LS	\$100,000	1	\$100,000	2	\$200,000	2	\$200,000	2	\$200,000	2	\$200,000	2	\$200,000
Transportation Management Plan	LS			\$0		\$0		\$0		\$0		\$0		\$0
Toll System Infrastructure	LS	\$4,200,000		\$0		\$0		\$0		\$0		\$0		\$0
Subtotal Traffic Items				\$100,000		\$408,000		\$405,000		\$862,600		\$1,121,000		\$950,000
Section 6: Planting and Irrigation														
Highway Planting	AC			\$0		\$0		\$0		\$0		\$0		\$0
Replacement Planting	LS	\$100,000		\$0		\$0		\$0		\$0		\$0		\$0
Irrigation Modification	LS			\$0		\$0		\$0		\$0		\$0		\$0
Relocate Existing Irrigation Facilities	LS	\$25,000		\$0		\$0		\$0		\$0		\$0		\$0
Irrigation Crossovers	LS	\$25,000		\$0		\$0		\$0		\$0		\$0		\$0
Subtotal Planting and Irrigation				\$0		\$0		\$0		\$0		\$0		\$0
Section 7: Roadside Management and Safety														
Vegetation Control Treatments	SOYD			\$0		\$0		\$0		\$0		\$0		\$0
Gore Area Pavement	SOFT			\$0		\$0		\$0		\$0		\$0		\$0
Pavement Beyond Gore Area	LS	\$50,000.00		\$0		\$0		\$0		\$0		\$0		\$0
Miscellaneous Paving	LS			\$0		\$0		\$0		\$0		\$0		\$0
Erosion Control	LS	\$250,000		\$0		\$0		\$0		\$0	1	\$250,000	1	\$250,000
Slope Protection	LS	\$50,000		\$0		\$0		\$0		\$0	1	\$50,000	1	\$50,000
Side Slopes/Embankment Slopes	LS			\$0		\$0		\$0		\$0		\$0		\$0
Maintenance Vehicle Pullouts	EA	\$15,000		\$0		\$0		\$0		\$0	3	\$45,000		\$0
Off-freeway Access (gates, stairways, etc.)				\$0		\$0		\$0		\$0		\$0		\$0
Roadside Facilities	EA	\$11,100		\$0		\$0		\$0		\$0		\$0		\$0
High Speed WIM				\$0		\$0		\$0		\$0		\$0		\$0
Relocating roadside facilities	LS	\$2,000,000		\$0		\$0		\$0		\$0	1	\$2,000,000		\$0
(TOS & Ramp Metering)	LS	\$60,000	1	\$10,000,000		\$0		\$0	1	\$60,000	3	\$180,000	3	\$180,000
CHP Enforcement Area	LS	\$603,400		\$0		\$0		\$0		\$0		\$0		\$0
Subtotal Roadside Management and Safety				\$10,000,000		\$0		\$0		\$60,000		\$2,525,000		\$480,000
TOTAL SECTIONS 1-7				\$10,375,000		\$533,000		\$530,000		\$10,273,100		\$20,207,000		\$13,772,200

DESIGN CONCEPTS - ESTIMATE OF CONSTRUCTION COSTS			CONCEPT A		CONCEPT B		CONCEPT C		CONCEPT D		CONCEPT F1		CONCEPT J	
Unit	Unit Price		Quantity	Unit Cost	Quantity	Unit Cost	Quantity	Unit Cost	Quantity	Unit Cost	Quantity	Unit Cost	Quantity	Unit Cost
Section 8: Minor Items														
Subtotal Sections 1-7			10%	\$10,375,000	10%	\$533,000	10%	\$530,000	10%	\$10,273,100	10%	\$20,207,000	10%	\$13,772,200
TOTAL MINOR ITEMS				\$1,037,500		\$53,300		\$53,000		\$1,027,310		\$2,020,700		\$1,377,220
Section 9: Roadway Mobilization														
Subtotal Sections 1-8			10%	\$11,412,500	10%	\$586,300	10%	\$583,000	10%	\$11,300,410	10%	\$22,227,700	10%	\$15,149,420
TOTAL ROADWAY MOBILIZATION				\$1,141,250		\$58,630		\$58,300		\$1,130,041		\$2,222,770		\$1,514,942
Section 10: Roadway Additions														
Subtotal Sections 1-8			10%	\$11,412,500	10%	\$586,300	10%	\$583,000	10%	\$11,300,410	10%	\$22,227,700	10%	\$15,149,420
Supplemental Work				\$1,141,250		\$58,630		\$58,300		\$1,130,041		\$2,222,770		\$1,514,942
Subtotal Sections 1-8			20%	\$11,412,500	20%	\$586,300	20%	\$583,000	20%	\$11,300,410	20%	\$22,227,700	20%	\$15,149,420
Contingencies				\$2,282,500		\$117,260		\$116,600		\$2,260,082		\$4,445,540		\$3,029,884
TOTAL ROADWAY ADDITIONS				\$3,423,750		\$175,890		\$174,900		\$3,390,123		\$6,668,310		\$4,544,826
Section 11: Agency Furnished Materials														
Transportation Management Plan			LS	\$25,000	1	\$25,000	1	\$25,000	2	\$50,000	1	\$25,000	1	\$25,000
Resident Engineer Office Space			LS	\$25,000	1	\$25,000	1	\$25,000	1	\$25,000	1	\$25,000	1	\$25,000
TOTAL AGENCY FURNISHED MATERIALS				\$50,000		\$50,000		\$50,000		\$75,000		\$50,000		\$50,000
TOTAL ROADWAY ITEMS <i>(Subtotal Sections 1 thru 11)</i>				\$16,027,500		\$870,820		\$866,200		\$15,895,574		\$31,168,780		\$21,259,188
Section 12: Structures														
1	SQFT	\$300		\$0		\$0		\$0		\$0		\$0		\$0
2	SQFT	\$350		\$0		\$0		\$0		\$0	9000	\$3,150,000	7400	\$2,590,000
3	SQFT			\$0		\$0		\$0		\$0		\$0		\$0
4	SQFT			\$0		\$0		\$0		\$0		\$0		\$0
5	SQFT			\$0		\$0		\$0		\$0		\$0		\$0
6	SQFT			\$0		\$0		\$0		\$0		\$0		\$0
7	SQFT			\$0		\$0		\$0		\$0		\$0		\$0
8	SQFT			\$0		\$0		\$0		\$0		\$0		\$0
TOTAL STRUCTURES ITEMS				\$0		\$0		\$0		\$0		\$3,150,000		\$2,590,000
Section 13: Cost Confidence Factor														
LOW			0%	\$0	0%	\$0	0%	\$0	20%	\$3,179,115	20%	\$6,863,756	0%	\$0
HIGH			20%	\$3,205,500	20%	\$174,164	20%	\$173,240	40%	\$6,358,230	40%	\$13,727,512	20%	\$4,769,838
TOTAL COST WITH ADJUSTMENT - LOW				\$16,027,500		\$870,820		\$866,200		\$19,074,689		\$41,182,536		\$23,849,188
TOTAL COST WITH ADJUSTMENT - HIGH <i>(Subtotal Sections 1 thru 13)</i>				\$19,233,000		\$1,044,984		\$1,039,440		\$22,253,804		\$48,046,292		\$28,619,026
Use				\$15,000,000		\$900,000		\$900,000		\$20,000,000		\$5,000,000		\$25,000,000
				\$20,000,000		\$1,100,000		\$1,100,000		\$25,000,000		\$8,000,000		\$30,000,000
WC Parcel												\$5,000,000		
WC Parcel												\$10,000,000		

DESIGN CONCEPTS - ESTIMATE OF CONSTRUCTION COSTS			CONCEPT K		CONCEPT N		CONCEPT MI		CONCEPT O		CONCEPT X	
	Unit	Unit Price	Quantity	Unit Cost	Quantity	Unit Cost	Quantity	Unit Cost	Quantity	Unit Cost	Quantity	Unit Cost
Section 1: Earthwork												
Roadway Excavation	LS	\$100,000.00	1	\$100,000	30	\$3,000,000		\$0	5	\$500,000		
Imported Borrow	LS	\$100,000.00		\$0	10	\$1,000,000		\$0	5	\$500,000		
Export	LS	\$100,000.00	1	\$100,000	10	\$1,000,000		\$0	2	\$200,000		
Clearing and Grubbing	AC	\$50,000	1	\$50,000	2	\$100,000		\$0	2	\$100,000		
Contaminated Soil Excavation (Type Y-1) (ADL)	CY			\$0		\$0		\$0		\$0		
(Type Y-2) (ADL)	LS	\$50,000.00	1	\$50,000	10	\$500,000		\$0	2	\$100,000		
(Type Z-2) (ADL)	CY			\$0		\$0		\$0		\$0		
Develop Water Supply	LS	\$25,000	1	\$25,000	2	\$50,000		\$0		\$0		
Topsoil Reapplication	LS			\$0		\$0		\$0		\$0		
Stepped Slopes and Slope Rounding (Contour Grading)	LS			\$0		\$0		\$0		\$0		
Subtotal Earthwork				\$325,000		\$5,650,000		\$0		\$1,400,000		
Section 2: Pavement Structural Section												
HMA (Open Graded)	Ton	\$180		\$0		\$0		\$0		\$0		
HMA (Type A)	Ton	\$120		\$0		\$0		\$0		\$0		
Cement Treated Base	CY	\$160		\$0		\$0		\$0		\$0		
Class 4 Aggregate Subbase	CY	\$36		\$0		\$0		\$0		\$0		
Class 2 Aggregate Base	CY			\$0		\$0		\$0		\$0		
Treated Permeable Base	CY	\$140		\$0		\$0		\$0		\$0		
Subgrade Enhancement Fabric	SQYD			\$0		\$0		\$0		\$0		
Cold Plane Asphalt Concrete	SQYD			\$0		\$0		\$0		\$0		
Edge Drain	LF	\$20.00		\$0		\$0		\$0		\$0		
Pavement Lump Sum	SQFT	\$15	71800	\$1,077,000	313000	\$4,695,000		\$0	87000	\$1,305,000		
Subtotal Structural Section				\$1,077,000		\$4,695,000		\$0		\$1,305,000		
Section 3: Drainage												
Large Drainage Facilities	LS	\$500,000		\$0	5	\$2,500,000		\$0	2	\$1,000,000		
Storm Drains (Median Inlets)	LS	\$50,000	3	\$150,000	25	\$1,250,000		\$0	10	\$500,000		
Project Drainage (X-Drains, overside, etc.)	LS			\$0		\$0		\$0		\$0		
Hydromodification	LS	\$200,000	1	\$200,000	5	\$1,000,000		\$0	2	\$400,000		
Subtotal Drainage				\$350,000		\$4,750,000		\$0		\$1,900,000		
Section 4: Specialty Items												
Retaining Walls	SF	\$115		\$0	172500	\$19,837,500		\$0	11000	\$1,265,000		
Noise Barriers	LS	\$250,000		\$0	5	\$1,250,000		\$0		\$0		
Concrete Barriers	LF	\$300	1000	\$300,000	6400	\$1,920,000		\$0	1000	\$300,000		
Movable Barrier System	LS	\$5,200,000		\$0		\$0		\$0		\$0		
Water Pollution Control	LS	\$50,000	2	\$100,000	10	\$500,000		\$0	5	\$250,000		
Hazardous Waste Investigation and/or Mitigation Work	LS	\$50,000	1	\$50,000	3	\$150,000		\$0	1	\$50,000		
Environmental Mitigation	LS			\$0		\$0		\$0		\$0		
Resident Engineer Office Space	LS			\$0		\$0		\$0		\$0		
Removal Items	LS	\$50,000	1	\$50,000	600	\$30,000,000		\$0	50	\$2,500,000		
Subtotal Specialty Items				\$500,000		\$53,657,500		\$0		\$4,365,000		
Section 5: Traffic Items												
Highway Lighting	LS	\$100,000	2	\$200,000	20	\$2,000,000		\$0	5	\$500,000		
Traffic Delineation Items	LF	\$6		\$0	104000	\$624,000		\$0	25000	\$150,000		
Traffic Signals	EA			\$0		\$0		\$0		\$0		
Overhead Signs	EA	\$150,000	2	\$300,000	25	\$3,750,000		\$0	5	\$750,000		
Roadside Signs (Median Mounted)	LS	\$100,000		\$0		\$0		\$0		\$0		
Traffic Control Systems	LS	\$100,000	2	\$200,000	200	\$20,000,000		\$0	20	\$2,000,000		
Transportation Management Plan	LS			\$0		\$0		\$0		\$0		
Toll System Infrastructure	LS	\$4,200,000		\$0		\$0		\$0		\$0		
Subtotal Traffic Items				\$700,000		\$26,374,000		\$0		\$3,400,000		
Section 6: Planting and Irrigation												
Highway Planting	AC			\$0		\$0		\$0		\$0		
Replacement Planting	LS	\$100,000		\$0		\$0		\$0		\$0		
Irrigation Modification	LS			\$0		\$0		\$0		\$0		
Relocate Existing Irrigation Facilities	LS	\$25,000		\$0		\$0		\$0		\$0		
Irrigation Crossovers	LS	\$25,000		\$0		\$0		\$0		\$0		
Subtotal Planting and Irrigation				\$0		\$0		\$0		\$0		
Section 7: Roadside Management and Safety												
Vegetation Control Treatments	SOYD			\$0		\$0		\$0		\$0		
Gore Area Pavement	SQFT			\$0		\$0		\$0		\$0		
Pavement Beyond Gore Area	LS	\$50,000.00		\$0		\$0		\$0		\$0		
Miscellaneous Paving	LS			\$0		\$0		\$0		\$0		
Erosion Control	LS	\$250,000	1	\$250,000	10	\$2,500,000		\$0	5	\$1,250,000		
Slope Protection	LS	\$50,000	1	\$50,000	10	\$500,000		\$0	5	\$250,000		
Side Slopes/Embankment Slopes	LS			\$0		\$0		\$0		\$0		
Maintenance Vehicle Pullouts	EA	\$15,000		\$0		\$0		\$0		\$0		
Off-freeway Access (gates, stairways, etc.)	EA	\$11,100		\$0		\$0		\$0		\$0		
Roadside Facilities				\$0		\$0		\$0		\$0		
High Speed WDM	LS	\$2,000,000		\$0		\$0		\$0		\$0		
Relocating roadside facilities (TOS & Ramp Metering)	LS	\$60,000	2	\$120,000	10	\$600,000		\$0	4	\$240,000		
CHP Enforcement Area	LS	\$603,400		\$0		\$0		\$0		\$0		
Subtotal Roadside Management and Safety				\$420,000		\$3,600,000		\$0		\$1,740,000		
TOTAL SECTIONS 1-7				\$3,372,000		\$98,726,500		\$36,000,000 <small>(from Caltrans PSR)</small>		\$14,110,000		

DESIGN CONCEPTS - ESTIMATE OF CONSTRUCTION COSTS			CONCEPT K		CONCEPT N		CONCEPT MI		CONCEPT O		CONCEPT X	
	Unit	Unit Price	Quantity	Unit Cost	Quantity	Unit Cost	Quantity	Unit Cost	Quantity	Unit Cost	Quantity	Unit Cost
Section 8: Minor Items												
	Subtotal Sections 1-7		10%	\$3,372,000	40%	\$98,726,500	10%	\$36,000,000	10%	\$14,110,000		
	TOTAL MINOR ITEMS			\$337,200		\$39,490,600		\$3,600,000		\$1,411,000		
Section 9: Roadway Mobilization												
	Subtotal Sections 1-8		10%	\$3,709,200	15%	\$138,217,100	10%	\$39,600,000	10%	\$15,521,000		
	TOTAL ROADWAY MOBILIZATION			\$370,920		\$20,732,565		\$3,960,000		\$1,552,100		
Section 10: Roadway Additions												
	Subtotal Sections 1-8		10%	\$3,709,200	40%	\$138,217,100	10%	\$39,600,000	10%	\$15,521,000		
	Supplemental Work			\$370,920		\$55,286,840		\$3,960,000		\$1,552,100		
	Subtotal Sections 1-8		20%	\$3,709,200	30%	\$138,217,100	20%	\$39,600,000	20%	\$15,521,000		
	Contingencies			\$741,840		\$41,465,130		\$7,920,000		\$3,104,200		
	TOTAL ROADWAY ADDITIONS			\$1,112,760		\$96,751,970		\$11,880,000		\$4,656,300		
Section 11: Agency Furnished Materials												
	Transportation Management Plan	LS		\$25,000	1	\$25,000	50	\$1,250,000	1	\$25,000	1	\$25,000
	Resident Engineer Office Space	LS		\$25,000	1	\$25,000	10	\$250,000	1	\$25,000	1	\$25,000
	TOTAL AGENCY FURNISHED MATERIALS			\$50,000		\$1,500,000		\$50,000		\$50,000		
	TOTAL ROADWAY ITEMS <i>(Subtotal Sections 1 thru 11)</i>			\$5,242,880		\$257,201,635		\$55,490,000		\$21,779,400		
Section 12: Structures												
1	SQFT	\$300		\$0	300000	\$90,000,000		\$0	133000	\$39,900,000		
2	SQFT	\$350	3700	\$1,295,000		\$0		\$0		\$0		\$0
3	SQFT			\$0		\$0		\$0		\$0		\$0
4	SQFT			\$0		\$0		\$0		\$0		\$0
5	SQFT			\$0		\$0		\$0		\$0		\$0
6	SQFT			\$0		\$0		\$0		\$0		\$0
7	SQFT			\$0		\$0		\$0		\$0		\$0
8	SQFT			\$0		\$0		\$0		\$0		\$0
	TOTAL STRUCTURES ITEMS			\$1,295,000		\$90,000,000		\$61,000,000		\$39,900,000		
Section 13: Cost Confidence Factor												
	LOW		0%	\$0	40%	\$138,880,654	20%	\$23,298,000	40%	\$24,671,760		
	HIGH		20%	\$1,307,576	60%	\$208,320,981	40%	\$46,596,000	60%	\$37,007,640		
	TOTAL COST WITH ADJUSTMENT - LOW			\$6,537,880		\$486,082,289		\$139,788,000		\$86,351,160		
	TOTAL COST WITH ADJUSTMENT - HIGH <i>(Subtotal Sections 1 thru 13)</i>			\$7,845,456		\$555,522,616		\$163,086,000		\$98,687,040		
	Use			\$6,500,000		\$500,000,000		\$140,000,000		\$90,000,000		
				\$8,000,000		\$600,000,000		\$160,000,000		\$100,000,000		
												\$1.5M/ Mile for 12miles \$2.0M/ Mile for 12miles \$18,000,000 \$24,000,000

CC 680 DAA GP Lane Conversion Alternatives (Alt 3 and 4)

Cost for Express Buses

Bus Seating Capacity - Assume 60 passengers per bus

- Mixed fleet of regular full size bus and double decker (50/50)
- Regular bus seating capacity: 57
- Double decker seating capacity: 80
- Average seating capacity: 68
- Assume < 90% occupancy: 60 passengers per bus

New Buses required: 42 buses

- 64 to 103 total for the peak period, let's be conservative and use the higher number 103 for cost estimates.
- Hourly distribution of buses required (3 to 7 PM): $28+27+26+22 = 103$
- Assume time required for a round trip for buses: 90 minutes
- New Buses required: $28+27/2 = 42$ buses
 - o 21 double decker
 - o 21 regular full size bus

Capital Cost for New Buses: \$29.4M

- Double decker: $21 \times \$800k = \$16.8M$
- Regular full size: $21 \times \$600 = \$12.6M$

Annual O&M for Buses: \$ 8.4M

- Unit cost for O&M: \$175/hr
- 4 hours for AM and 4 hour for PM
- 42 buses
- 260 days/year
- $175 \times (4+4) \times 42 \times 260 = \$15.3 M$
- Assume 45% fare box recovery: \$8.4 M

Cost for Park-and-Ride

Parking spaces: 3,300

- 50% of SOV reduction
- Potential expanded services from UBER/LYFT and other on-demand mobility may help reduce the need for park and ride, as those services would be provided from door-to-door

Capital Cost for parking: \$19.8M

- \$6k per space, assumed surface lot, and does not include land cost

Annual O&M for parking: \$ 528k

- \$800 per space, includes a full time security guard
- Assume 80% of O&M recovery from parking fees
- $\$800 \times 3,300 \times 20\% = \$528k$

Ca I 680 Walnut Creek #1603-0017B

March 4th 2016

Carlton Haack
HDR
2379 Gateway Oaks Drive, Suite 200
Sacramento,
California 95833-4239

Via email carlton.haack@hdrinc.com

Project: Ca I 680 Walnut Creek

Dear Carl,

Attached please find our budget quotation for the Walnut Creek I 680 project. Prices will be adjusted and reflect increased costs that LTSSS experiences. For planning purposes please use an inflation factor of 3% per year.

This proposal has capital costs for the system of \$5,198,000 for the barrier and one machine. Installation costs are likely another \$8-10 per foot or \$80-110,000 and could be accomplished in less than a week at night.

I have outlined a budget for operations costs at the end of the quote.

Concrete Reactive Tension System (CRTS 18") Barrier (Purchase)

The total project as planned is currently 11,088 ft (2.1 miles) in one direction. Changes in Qty of plus or minus 10% will not affect the unit price.

All external steel shall be stainless steel or hot dipped galvanized in accordance with ASTM, A 123. The barriers do not include reflectors or striping.

18" CRTS system (TL-4) \$320.00 /Ft.

Variable Length Barrier - VLB

VLB units will be substituted one for one for CRTS barrier pieces and will be charged at the same unit price as concrete CRTS units. Lindsay will provide the correct number of VLB's based on the final deployment drawings.



Boston Class Barrier Transfer Machine (Purchase)

1 EA. Machine per Specification MS 110610 Rev 7 \$1,650,000.00 EA

Training – provided as part of the sales price

Lindsay will provide the following training prior to installation and for the first year of operation.

- Onsite installation oversight and training during initial barrier replacement.
- Full applications engineering support
- Live roadway training with operators for 1-2 weeks as necessary
- Maintenance training for mechanics
- During the remaining warranty period, our representative will visit the job periodically, but at least quarterly and provide a written report for management outlining system conditions and concerns if any.

The cost for this training is included with the purchase of the system.

Taxes:

This quotation is exclusive of federal taxes, which the parties agree are the responsibility of the buyer unless an exemption letter is provided.

Delivery:

All barriers and VLB's shall be manufactured or made available at casting yard within 100 miles of the project site. Buyer takes legal ownership and full risk of loss at the casting site after inspection and acceptance.

Said Products shall then be considered delivered to the Buyer on the basis of Ex-Works Seller's premises (ICC Incoterms 2010) upon the earlier of: (i) Buyer's inspection and written acceptance of the identified Products, or (ii) the date occurring 30 days after Seller's notice of inspection is sent and the Buyer has failed to perform an inspection and send written notice of acceptance or rejection within such time frame.

Delivery timelines:

Barrier and VLB's: All barriers will take up to 6 months to deliver
Machine: Would take about 9 months to deliver

Operations:

As Byron and I stated in our meeting LTSSS would be willing to operate the system for Caltrans or whichever entity is responsible for procurement and operations. Very preliminary estimates for the full cost including labor and parts would be between \$350,000 and \$425,000 per year. The size of the proposed system is similar to the one in Washington DC and public bids are consistent with our calculations. There are many variables that need to be clarified but that estimate should be reasonable for this early stage.

Cordially,

Lindsay Transportation Solutions Sales & Service LLC

A handwritten signature in black ink that reads "Chris Sanders". The signature is written in a cursive, flowing style.

Chris Sanders
Senior Vice president

Jeff Shewmaker - LTS
Byron West -LTS

APPENDIX D – DAA TAC Meeting Minutes

DRAFT MEETING MINUTES

Contra Costa Northbound I-680 Design Alternative Assessment Kick-Off Meeting

October 26, 2015

2:00 – 4:00pm

CCTA Offices – 2999 Oak Road, Suite 100, Walnut Creek, CA

Action Items: see underlined italic text

1. Welcome & Introduction

- a. Self-Introduction
- b. Roles & Responsibilities

2. Project Background

a. Project Background and Recent Studies

- i. Discussion of future projects on the 680 corridor
 1. I-680 North Express Lanes Conversion – Currently in PAED & Design
 - a. Southbound conversion of existing HOV lane. Construction will include widening to close the gap in the HOV lane from Treat Boulevard to Rudgear Road.
 - b. Leo Scott noted that this project no longer includes the conversion of the existing NB HOV lane from SR 242 to the Benicia Bridge
 2. I-680 South Express Lane Conversion - Under Construction
 - a. Conversion of existing HOV lanes from Alcosta Road to Livorna Road.
 3. I-680 Northbound Planned HOV/Express Lane – PSR (Caltrans 2007)
 - a. Extension of the NB HOV lane from N. Main overcrossing to SR 242
 - b. Leo Scott stated that this project could not be assumed as an existing condition of this study because he is concerned with the geometrics included in the PSR.
 - i. HDR to review PSR to identify any red flag geometric issues.

b. Purpose of this study:

- i. Desired end product for MTC/CCTA is to include the alternatives from this study in a PAED effort for the northbound HOV gap closure.
- ii. Also want to include in the Plan Bay Area 2040.

3. Traffic Conditions

a. Available Data and Traffic Models

- i. Eddie Barrios discussed the existing traffic through the corridor, including discussion of increasing traffic pattern within the last two years.
 1. Bottlenecks caused by combination of traffic demand over capacity, weaving, and geometry (grade at Livorna Rd.).
- ii. Two bottlenecks identified
 1. Livorna Rd.
 - a. Eddie stated that the bottleneck is exacerbated by the grade approaching Livorna.
 - b. Steve Waymire indicated that it was also an issue with weaving that influences the bottleneck.

- c. Eddie stated that recent data shows the bottleneck at Livorna Rd. has shortened in the last two years extending to Crow Canyon Rd. instead of Bollinger Canyon Rd as previously. It is believed this is due to the recently constructed auxiliary lanes in that area.
 2. North Main St./Treat Blvd.
 - a. This is the controlling bottleneck. Recent data showed that the queue from this bottleneck spills back to overlap with the Livorna bottleneck causing queuing to Crow Canyon.
 3. Data suggests that traffic around Monument Blvd. is close to capacity.
- iii. Walnut Creek has seen a 6% growth in traffic since 2005

b. Study Approach

- i. Traffic analysis evaluation should be done at a corridor level to assessment system effects.
- ii. Rob stated that from previous projects, the greatest benefit to traffic operations will be achieved if the HOV/Express Lane can be carried through all bottlenecks
- iii. Steve indicated that he wants a fresh look and 'outside the box' solutions, i.e. interchange closures, moving structure columns, tunnels, etc.
- iv. Ashley Nguyen asked what year the traffic analysis would analyze.
 1. Eddie stated that they had planned to analyze 2040 to serve an eventual PSR/PDS.
 2. The group thought that traffic would be so congested by 2040 that it would be difficult to compare any improvements between the alternatives.
 3. *Group decided that the more appropriate approach would be to analyze 2020.*

4. Alternative Development Brainstorm

a. Alternatives identified in RFP

- i. Conversion of General Purpose lane into an Express Lane:
 1. Kevin stated that this this alternative needs to be assessed per MTC's policy.
 2. Eddie stated that this would likely be feasible for short segments or in combination with other strategies to reduce congestion on the general purpose lanes.
- ii. Contra-Flow:
 1. Brian Stewart explained that the northbound express lane would travel on the southbound roadway (in the southbound express lane) during the PM peak. The contra-flow lane would extend through the 24 interchange.
 - a. Rob stated that the southbound express lane does show benefits in the PM peak period. Eddie stated that the analysis would need to include improvements to the southbound roadway to offset any negative impacts to PM traffic.
 2. The barrier for northbound operation could be either moveable or fixed.
 - a. Group indicated that the fixed barrier would create an issue during the AM peak when the southbound express lane is in operation as continuous through the 24 interchange.

- b. Susan and Leo indicated concern for storing a moveable barrier in the left shoulder at the pinch points at the BART and SR24 columns with less than 1' shoulders.
 3. Group had a brief discussion of ingress and egress points.
 4. The group had a positive reaction and wanted to pursue the concept further.
 - iii. Adaptive Ramp Metering:
 1. Eddie stated that it had not yet been determined what type of analysis would be conducted on this alternative.
 2. Steve indicated concern over "adaptive" ramp metering and its affects on the local roadway network.
 3. Jerry Fahy indicated that they have similar concerns over the current ramp metering on SR 4.
 - iv. Collector Distributor Road: Sheena Patel stated the concept would provide a two lane off ramp for N. Main/Treat prior to the N. Main OC, one lane would peel off to the N. Main loop, the other would run parallel to the highway as a C-D road. Lawrence on ramp would tie into the C-D road, Treat off would exit, and the C-D road would re-enter 680 just beyond the existing truck scales.
 1. Identified as a way of helping to relieve the Main/Treat bottleneck due to weaving.
 2. Mike Kerns indicated that given the ramp volumes (on and off) a one or two lane collector distributor could be overly congested.
 3. Steve expressed that the city would be willing to work with the project on resulting impacts to Corps yard.
 - v. HOV Direct Connector from Lawrence on ramp:
 1. Lawrence Way is a heavily congested on ramp in the PM providing access from downtown Walnut Creek.
 2. Eddie questioned whether the ramp had enough HOV volume to justify the cost of the structure.
 - a. Susan reminded the group that it would be an express lane allowing tolled vehicles to access as well which would reduce congestion on Lawrence Way.
 3. Brian brought up concerns about how the touchdown would interact with a contra-flow lane or even an extension of the HOV lane south of N. Main.
 4. Group thought that the concept should be reviewed at a high level to determine whether or not it could be eliminated.
 - vi. Removal of Truck Scale: Removal of truck scale at Treat Blvd. is thought to be beneficial if coupled with other alternatives due to the additional width it would provide for widening and/or collector distributor options.
 1. Susan Miller mentioned that in previous meetings between CCTA and CHP, CHP expressed that they need the truck scales at Treat Blvd. to remain open. Using weigh-in-motion (WIM) technology as a possible replacement is a potential solution to reduce the overall footprint.
 - vii. Widening: Sheena mentioned that there is potential to widen between Livorna on-ramp to S. Main off-ramp in order to extend the limits of the existing Express Lane. It would require a tall retaining wall.

1. This extension would help address the bottleneck at Livorna but could push more traffic into the N. Main bottleneck and reducing the overall system effectiveness.
2. The group thought the alternative could also be used in combination with other alternatives like the contra-flow lane.

b. Other Alternatives:

- i. Kevin Chen presented an alternative concept with braided ramps at Lawrence on ramp and Treat off ramp.
 1. Lawrence on ramp would go under Treat off so that the grade changes could be minimized.
 2. Group agreed that this alternative was worth moving forward.
- ii. Susan suggested a tunnel option to connect HOV lanes through the SR 24 interchange. Group discussed that the most likely entrance to the tunnel would be just after Mt. Diablo Blvd. and the exit would be north of the Trinity OC support columns.
 1. *HDR to review concept.*
- iii. Relocating/redesigning columns (SR 24, BART, Trinity Ave) to allow for additional width for various alternatives. Steve asked whether we were willing to assume this as a constraint not worth pursuing.
 1. Group decided that the structure constraints at the SR24 interchange would need to be evaluated at a very high level and mentioned with a brief discussion indicating why they were not pursued.
- iv. Susan mentioned shoulder running as an alternative, either in the median or outside shoulder.
 1. Caltrans has been reluctant to allow it on the outside shoulder because of interference with on ramps. In this corridor, the outside shoulder is the only option since there is little to no inside shoulder.
 2. *Group agreed to assess the shoulder running lane at a high level.*

5. Opportunities, Constraints, Fatal Flaws

6. Action Items & Next Steps

7. Project Schedule

8. Future TAC Meetings

DRAFT MEETING MINUTES**Contra Costa Northbound I-680 Design Alternative Assessment Meeting #2****November 17, 2015****3:15 – 5:00 pm****CCTA Offices – 2999 Oak Road, Suite 100, Walnut Creek, CA*****Action Items: see underlined italic text*****1. Introductions****2. Recap of Project Objectives**

- a. Kevin provided a summary of the project objectives
 - i. Find innovative ways to create a northbound express lane
 - ii. Alleviate congestion on northbound I-680
 - iii. Express lane on its own may not be sufficient to alleviate congestion and the team should consider other improvements to improve traffic operations. Other improvements currently under consideration include such things as C-D road and braided ramps system and auxiliary lanes.
- b. Goal of this meeting is review the alternative concepts that have been discussed to date and offer an opportunity for the team to comment.
- c. After the concepts are further along an evaluation criteria matrix will be developed and will be used to weigh the pros/cons of the alternatives.

3. Review Draft Alternatives Concepts

- a. Sheena presented the alternatives currently under consideration
 - i. Year 2020 Baseline Conditions: This represents the expected condition by year 2020. It includes a continuous southbound I-680 express lane with two locations providing restrictive access. In the northbound direction an express lane will be provided south of Livorna. The current northbound HOV lane north of SR 242 is proposed to remain an HOV lane.
 - ii. Alternative 1 – Contra Flow Lane: This alternative would convert a GP lane from the Livorna on-ramp to Rudgear on-ramp to an express lane. To help offset the potential loss of capacity from the conversion the alternative would also widen the mainline on the outside from the Livorna on-ramp to the Rudgear on-ramp to provide a new GP lane. Near the northbound Rudgear on-ramp the northbound express lane would transition to the southbound I-680 express lane and operate as a contraflow lane roughly between the Rudgear on-ramp and N. Main Street Off-Ramp. The southbound I-680 express lane would be inoperable between the N. Main Street and Rudgear interchange during the operation of the contra flow lane. The existing HOV lane currently provided north of SR 242 would be extended to the N. Main Street off-ramp and converted to an express lane; thereby, providing the opportunity for a continuous northbound express lane from county line to county line. The team discussed the potential issues associated with how southbound traffic would transition in and out of the southbound express lane during the operation of the contra flow lane and how this could be potentially be designed. Another issue that was raised was the loss of capacity in the southbound direction as a result of taking a lane away and the potential to substantially worsen southbound traffic operations. The team requested that a high level capacity analysis be performed to determine the potential impacts to

southbound traffic operations. *Fehr & Peers with assistance from MTC to determine the potential impacts to southbound I-680.*

- iii. Alternative 2 – Tunnel Concept: This alternative is similar to the contra flow concept except it would construct a tunnel underneath the I-680/SR 24 interchange instead of using the I-680 southbound roadbed. Initial review of the tunnel concept indicates that grades may need to be as high as 15% to keep the tunnel as compact as possible. To provide a tunnel with grades more consistent with HDM guidance the tunnel would require tunneling over 60 feet below ground conditions due to existing structures. HDR indicated that as a side note the cost of the tunnel was comparable to reconstructing the I-680/SR 24 interchange. As such HDR began to look at a concept that involved reconstruction assuming the team was in support. The team indicated that they were interested in hearing HDR's thoughts on reconstructing the I-680/SR 24 interchange. A decision was made to discuss this concept after the team went through the alternatives currently under consideration. Based on the information provided by HDR on the tunnel concept and team feedback it was determined that this concept should not be explored further but should be documented in the final report with a discussion about the concept and decision of why it was decided not to explore further. *HDR to provide write up in the Design Alternative Assessment Memorandum.*
- iv. Alternative 3 – Conversion of General Purpose Lane: This alternative would convert a GP lane from the Livorna on-ramp to the Olympic off-ramp to an express lane. To help offset the potential loss of capacity from the conversion the alternative would also widen the mainline on the outside from the Livorna on-ramp to the Rudgear on-ramp to provide a new GP lane. The existing HOV lane currently provided north of SR 242 would be extended to the N. Main Street off-ramp and converted to an express lane. With this alternative a gap in the express lane system would still remain between Olympic and Main Street. The team discussed that this is currently the most straightforward alternative and perhaps easiest to implement; however, the major drawback is that a gap in the northbound express lane system would remain, although the gap would be shorter.
- v. Alternative 3a – General Purpose Conversion with a Collector-Distributor (C-D) Road System: This alternative is the same as Alternative 3 except it would also provide a C-D road system to service the N. Main Street off-ramp, Lawrence Way on-ramp and Treat Boulevard off-ramp. A section of the C-D road would require three lanes to accommodate the high traffic demand volumes. The C-D road system is intended to address the existing bottleneck between the Lawrence Way on-ramp and Treat Boulevard off-ramp by moving weaving traffic between Lawrence on and Treat off from the mainline to the C-D system. The goal is to reduce congestion at this location such that northbound express lane users can easily weave over from the center lane approaching SR 24 to the left hand side. This alternative would require the relocation of the truck scales and have potential impacts to the Corps yard.

- vi. Alternative 3b – General Purpose Conversion with Braided Ramps: This alternative is the same as Alternative 3a except that instead of provided a C-D road system to address weaving traffic the Lawrence on-ramp and Treat off-ramp would be braided.
- vii. Alternative 3c – General Purpose Conversion with Direct Lawrence Way Connector: This alternative is the same as Alternative 3 on the south side of SR 24. Unlike Alternative 3, the existing HOV lane north of SR 242 would only be extended to about the Treat Boulevard off-ramp to allow for a direct HOV/express lane connector from Lawrence Way to the northbound express lane. Two key items were discussed regarding this alternative: 1) the direct connector would effectively prohibit the ability for the express lane to be extended further south in the future; and 2) the start of the express lane (i.e. around the Treat Boulevard off-ramp) would not be very effective in addressing the existing bottleneck between the Lawrence Way on-ramp and Treat Boulevard off-ramp. Based on the discussion it was determined that this concept should not be explored further but should be documented in the final report with a discussion about the concept and decision of why it was decided not to explore further. HDR to provide write up in the Design Alternative Assessment Memorandum.
- viii. “Ross New Concept” – Sheena indicated that she did her best to interpret the schematic provided by Ross and that she would reach out to him to confirm her understanding was correct. The concept is similar to the contraflow lane concept except that this alternative would not use the southbound express lane but instead use the southbound median shoulder. Sheena indicated that although it seems that today there is an opportunity to use the shoulder unfortunately there would not be much a shoulder left after the Southbound HOV Gap Closure project is implemented as that project is using the existing shoulder as part of its design. HDR to confirm with Ross that their understanding of his concept is accurate.
- ix. I-680/SR 24 Interchange Reconstruction Alternative – This was a new alternative brought up by HDR after their review of the existing constraint locations and very preliminary cost ranges for some of the alternatives under consideration. The general idea of the alternative would be to reconfigure the interchange such that SR 24 comes in from right hand side as opposed to the left hand side. This can potentially provide increased opportunities for a continuous express lane. HDR sketched out conceptually in front of the group how this would work and what the constraints were. The team indicated that they would like HDR to develop this concept further to potentially include as one of the alternatives for evaluation. As part of developing this concept further the team also asked HDR to look into the feasibility of providing an additional lane from the SR 24 off ramp to the Olympic Boulevard on-ramp. HDR to develop this alternative further and look into the feasibility of providing an additional lane from the SR 24 off ramp to the Olympic Boulevard on-ramp. HDR would also look into the constructability of this concept in terms of staging.

4. Next Steps

- a. Next meeting to occur the second/third week of December.

DRAFT MEETING MINUTES**Contra Costa Northbound I-680 Design Alternative Assessment Meeting #3****December 14, 2015****3:00 – 5:00 pm****CCTA Offices – 2999 Oak Road, Suite 100, Walnut Creek, CA****Action Items: see underlined italic text****1. Introductions and Recap**

- a. Kevin indicated that the minutes for the last meeting had been sent to team members and if there were any comments or feedback to send it to him.
- b. Kevin indicated that the primary focus of today's meeting was to review the project alternatives that have been discussed to date including the concept developed by Ross. Present the proposed evaluation criteria and matrix. Finally, provide an update on the traffic analysis.

2. Evaluation Criteria/Matrix

- a. Carl and Brian went down the list of the alternatives in the evaluation criteria/matrix and provided the group a brief description of the various concepts still under consideration. (Note: detailed descriptions of the concepts and schematics of the alternatives were provided as part of the minutes from the last meeting).
- b. Brian gave a brief summary of HDR's meeting with Ross to discuss his concept. The concept entails using the southbound roadbed (primarily southbound shoulder) to provide a northbound express lane. Currently, there appears to be sufficient shoulder width to potentially consider this concept; however, the southbound express lanes gap closure project (to be completed by year 2020) will utilize the majority of the SB shoulder. After discussion it was concluded that this concept would be dropped from further consideration as part of this study but would be documented in the final report.
- c. Brian provided additional information regarding the new concept of reconfiguring the I-680/SR 24 interchange such that SR 24 eastbound would join I-680 northbound on the right side instead of the left side, permitting a continuous express lane on the left (#1 lane) for NB I-680. HDR concluded that this concept was feasible but would likely have a high construction cost. The team decided that this concept warranted further consideration as part of this study. For this alternative, traffic analysis would be conducted as a first step. Then, depending on the level of potential traffic operational benefits, the team would decide whether to perform additional design and cost estimation work.
- d. Ashley informed the group that it's MTC's policy to evaluate a general purpose lane to express lane conversion scenario. This alternative would include a lane conversion for both north and south of the SR 24 interchange, to the extent that it's feasible.
- e. HDR guided the team through some of the constraints associated with extending the northern express lane to the south past the Main Street O/C. In particular, the retaining wall adjacent to the Marriott Hotel presents the major design/construction challenge. CCTA asked HDR to break their investigation of extending the express lane into two sets of design assumptions. The first set of assumptions could include design exceptions that

they feel could be potentially acceptable to Caltrans and use the existing roadway bed and right-of-way, while the second set assumptions could include modifications to the retaining wall or reduced lane widths. HDR to investigate further the constraints associated with extending the northern express lane.

- f. The team spent some time discussing the importance of pulling the express lane further south past the North Main Street O/C which is the location where the Caltrans PSR assumed the HOV lane would start. Fehr & Peers informed the team that the operational benefit of the express lane through the bottleneck between the Lawrence On and Treat Off could only be achieved if northbound vehicles had sufficient distance to transition from the general purpose lane to the express lane prior to the Lawrence on-ramp gore point. Based on previous analysis performed by Fehr & Peers for CCTA, it appears that the HOV lane should start at about 1,500 feet south of the North Main Street O/C. The further south it starts the greater the operational benefit of the express lane.
- g. Brian walked through the opportunities and constraints on the southern portion of the corridor in terms of widening for express lanes (between Livorna Road on-ramp and SR 24 on-ramp). As part of the discussion, he introduced the idea of reconfiguration the Ygnacio off-ramp, to be combined with the SR 24 off-ramp with a new connector to Ygnacio.

3. Traffic Analysis Update

- a. Kevin and Eddie provided an update on the traffic analysis. The VISSIM model has been updated to reflect year 2015 conditions. Also, year 2020 No Build forecasts had been developed by assuming a 1% per year growth rate.
- b. Kevin informed the group that this study should consider mode shift as a result of the build alternatives providing an improved HOV lane system. The group spent some time discussing the specifics and how mode shift would be considered in the traffic analysis and documentation. Eddie raised the question of whether or not this topic could be deferred to PA/ED. Ashley indicated that MTC was very interested in beginning the conversation now in this study as she was concerned that if it was deferred to PA/ED that a “business as usual” approach in PA/ED would not properly address mode shift.
- c. The group also discussed about the potential for additional mode shift that could be achieved with further investments to enhance express bus services, park and ride lots, etc. These strategies would help reduce the overall vehicle trip demands on the corridor which serving the same number of persons more efficiently.
- d. Due to time constraints it was determined to continue the discussion on mode shift assumptions for project alternatives at the next meeting.

4. Next Meeting

- a. The next meeting is being planned for the 3rd or 4th week in January 2016. Kevin will send out a survey to the group to confirm a date that works for everyone.

DRAFT MEETING MINUTES**Contra Costa Northbound I-680 Design Alternative Assessment Meeting #3****January 25, 2015 2:00 PM****CCTA Offices – 2999 Oak Road, Suite 100, Walnut Creek, CA****Action Items: see underlined italic text****1. Introductions and Recap**

Kevin provided a recap of the project activities to date, and indicated that the minutes of the last meeting had been sent to team members. He also asked that any comments or feedback be sent to him.

2. Traffic Analysis Update

- a. Eddie provided an update of the traffic analysis effort. The 2020 No Build analysis, which indicates that traffic congestion will worsen by 2020 when compared to existing conditions: freeway queue length will be longer and travel times increase.
- b. The group discussed mode shift assumptions for Alternatives 3 and 4 and agreed to assume that a mode shift to more carpoolers and transit riders would occur under these two scenarios.

3. Geometric Concepts, Design Updates and Traffic Analysis Scenarios Matrix,

- a. Carol and Brian provided an update of the design analysis efforts.
- b. A handout was distributed to the group that provided a detailed list of design elements discussed to date, and a matrix of traffic analysis scenarios which combined various elements.
- c. The group discussed and agreed on 9 scenarios to be carried forward for traffic analyses.
- d. The group agreed that detailed design of ramp meters will not be included as part of this DAA effort.
- e. For the C-D road design element, Brian will try to tighten the radius at off- and on-ramp to avoid encroaching the on the corp yard.
- f. For alternative 8 (contra flow lane), Brian will evaluate potential design speeds other than those for the existing mainline.

4. Next Meeting

- a. The next meeting is being planned for mid-March, 2016.

DRAFT MEETING MINUTES**Contra Costa Northbound I-680 Design Alternative Assessment Meeting****March 17, 2016****9:00 am – 12:00 pm****CCTA Offices – 2999 Oak Road, Suite 100, Walnut Creek, CA****Action Items: see underlined italic text****1. Introductions and Recap**

Kevin provided a project overview and shared the agenda. He indicated that the primary goal of the meeting was to share the technical analysis results.

2. Draft Alternative Evaluation Results

- a. Carl provided several handouts that presented the proposed alternatives. Each of the graphics for the alternatives included the geometric improvement concepts that it includes and a cost range.
- b. Alternative 2 – Eddie discussed some of the benefits of Alternative 2 (Ramp Metering) and Brian shared some information regarding the geometry and assumptions used to develop capital construction cost range estimates. Team feedback was that the ramp meter construction costs may be on the low side and the team agreed to increase them. HDR to adjust ramp meter construction costs to \$15M to \$20M range (Geometric Improvement Concept A). The reasons for the likely higher costs were to potentially provide HOV bypass lane per ramp metering design standards and ROW acquisitions.
- c. Alternative 3 – Eddie provided some information regarding the mode shift assumptions under this alternative. One of the major assumptions was the overall reduction of vehicle demand by 20%. Toshi provided additional insight into the assumptions. In particular, that one of the objectives of this alternative was to find the necessary vehicle demand reduction that would result in this alternative providing a similar benefit to other alternatives. With an understanding of how much of a vehicle demand reduction was necessary they can begin to find multimodal strategies to achieve the reduction. Eddie indicated that Alternative 3 showed a substantial benefit over the baseline alternative – Alternative 1. Given the benefit of Alternative 3 is largely due to the 20% reduction in vehicle demand the team requested that this information be clear in the documentation. Steve noted that the group should be prepared to respond to the questions: what will the freeway conditions be like without the mode shift in this alternative.

Fehr & Peers to add notes to report that Alternative 3 needs to be implemented in coordination with other transit improvements and add notes where the mode shift was applied. HDR to add note to alternative exhibits indicating a 20% reduction to vehicle demand that reflects mode shift.

In the Draft DAA report, discussions will be added regarding the combined effort between this study, and CCTA's recently completed "I-680 Transit Investment/Congestion Relief Options Study" into an overall plan for encouraging a mode shift.

Brian provided some additional information regarding the geometry for Alternative 3 regarding the general purpose lane drop to HOV lane start at the Main Street interchange. The team discussed the need to clarify the current assumptions and future design considerations. Brian indicated that the current MUTCD supports a general purpose lane feeding an Express Lane directly without tapers (i.e. without a GP lane drop before HOV lane start). Leo indicated that Caltrans' initial preference is likely to see a lane drop before the HOV lane add. Eddie added that the traffic analysis was done with a lane drop before the HOV lane start. For the purposes of moving forward it was decided that this document should keep the GP lane drop before the HOV lane start but identify the need to consider and evaluate the benefits of having a GP lane feeding directly into an Express Lane. Ross mentioned that in the next phase, the project could consider adding a lane on the SR 24 connector prior to touch down at 680.

HDR to add modify Alternative 3 exhibit to show general purpose lane drop before HOV lane start. Fehr & Peers to acknowledge in report the need to consider a GP lane feeding directly into the HOV lane in future studies and the likely benefits of this design. Fehr & Peers to also clarify in the MOE Table that the results shown in "()" are compared to Alternative 1 (No Build).

- d. Alternative 4 – Eddie presented the analysis results and assumptions for this alternative. Similar to Alternative 3 one of the major assumptions was the overall reduction of vehicle demand by 20%. Eddie indicated that Alternative 4 showed the most benefit over the baseline alternative. A new bottleneck developed under this alternative on northbound I-680 just after SR 242. This is because under current conditions there are three general purpose lanes at this location and under Alternative 4 there would be 1 express lane and two general purpose lanes resulting in an overall lower capacity. A suggestion to eliminate this bottleneck was to take one of the mandatory SR 242 exit lanes and make it an optional exit so that 3 GP lanes were provided to SR 242 and 3 GP lanes were provided to northbound I-680. It was determined that Alternative 4 would remain as is but that future studies could consider additional improvements.

Ross indicated that since this alternative provided the most benefit it would be worthwhile to approximate and document how many buses would be needed to realize a 20% vehicle demand reduction. Fehr & Peers and MTC to estimate this value, and potential costs associated with it.

The team discussed that the C-D system assumed under this alternative was a big factor in the achieving the benefit. Brian indicated that the truck scales would need to be modified to accommodate the C-D system. The team asked HDR to further clarify the cost implications of modifying the trucks scales. HDR to do the following: 1) Include weigh in motion in cost range; 2) add costs for mitigation of removing the truck scales; 3) add costs of about \$5M to \$10M to City of WC (impact to yard).

Brian provided additional clarification regarding the proposed HOV to Express lane conversion north of SR 242. He indicated that these costs were not currently included under any of the alternatives. He indicated that this would be corrected. HDR to the following: 1) Create a new Geometric Improvement Concept "X" to denote the express lane conversion and include it under Alternatives 3 through 9; 2) include cost of about \$1.5 to \$2M per lane mile for 12 miles; 3) document the assumptions of the cost estimate such as no backhaul, no support costs, etc.

- e. Alternative 5 – Eddie presented the analysis results and assumptions for this alternative. This alternative does not assume any mode shift. Eddie indicated that Alternative 5 showed a substantial benefit over the baseline alternative.

Brian indicated that the cost was based on “narrow” solution and that extending the northern HOV lane to the south would require a design exception due to sight distance and the design speed would likely need to be around 45 mph. Brian asked the team if the cost should include the cost to fix the curve at SR 242 and avoid the sight distance issue. The team said yes. HDR to adjust costs for Express Lane extension from SR 242 (M1) to include higher costs from PSR (SR 242 Structure Replacement to fix design exception). Cost about an extra \$100M.

Given the projected high cost of structure replacement Susan asked HDR to look into a cost saving option. HDR to look into the feasibility of SR 242 exit lane option to help correct curve design exception.

- f. Alternative 6 – Eddie presented the analysis results and assumptions for this alternative. This alternative does not assume any mode shift and is very similar to Alternative 5 except that in addition to the Express Lane Extension (M1) it also includes the C-D roadway system. The Express Lane Extension in combination with the C-D roadway system would eliminate almost all of the congestion north of SR 24.

Given the potential difficulty and high cost involved in implementing the Express Lane Extension south of SR-242, a new alternative (Alternative 6A) was discussed as a potential phasing strategy for Alternative 6. This alternative would be identical to Alternative 6 but it would not include the Express Lane Extension (M1). The results from Alternative 6A could potentially be used to determine the need for the inclusion of the Express Lane Extension in Alternative 6. Fehr & Peers to evaluate new Alternative 6A.

- g. Alternative 7 – Eddie presented the analysis results and assumptions for this alternative. This alternative does not assume any mode shift. The traffic analysis results of Alternative 7 are nearly identical to Alternative 6. Brian pointed out that the cost of Alternative 7 was substantially higher than Alternative 6.
- h. Alternative 8 – Eddie highlighted that Alternative 8, the contra flow lane alternative, was the first of two alternatives that provided a continuous express lane. The traffic analysis results of Alternative 8 are nearly identical to Alternative 6 and 7. Ross asked what the potential traffic issues might be for the southbound direction. Mike responded that based on his analysis there would be no near-term issues as the southbound bottleneck that develops at Livorna would continue to be the controlling bottleneck. Potential impacts on the southbound operations be unlikely until after Year 2030. However, in the future there potential issues might be expected as traffic demand continues to grow, but that queues from the Livorna bottleneck would extend through them before they had a chance to develop and overall there would not be any additional impact to southbound traffic. Brian pointed out that the current cost range does not include yearly O&M costs. The team asked HDR to include O&M costs to provide a more complete picture of costs and a better apples to apples cost comparison with the other alternatives. HDR to add year

O&M costs to Alternative 8. HDR will also need design speeds for the contra flow lane (likely at 50 mph).

- i. Alternative 9 – Eddie highlighted that Alternative 9, the reconfiguration of the I-680/SR 24 interchange, was the second alternative to provide a continuous express lane. The traffic analysis results of Alternative 9 are nearly identical to Alternatives 6, 7, and 8. Brian pointed out that the estimate cost for this alternative was significantly higher than the other alternatives.
- j. The team discussed that strictly from a cost to benefit ratio that Alternative 7 and 9 should not be carried further in future studies. HDR to document this recommendation in the Design Alternatives Assessment (DAA) Report.
- k. Toshi indicated that while only Alternative 3 and 4 explicitly consider mode shift that the team should look for strategies and resources to encourage mode shift for all alternatives. The team agreed. HDR to provide guidance on how the concepts presented in the DAA report can work together with transit improvements along the corridor to better frame the next steps of these efforts.



Contra Costa Northbound I-680 Design Alternative Assessment

Technical Advisory Committee (TAC) Meeting
May 11, 2016, 2:00 PM
CCTA Offices
2999 Oak Road, Suite 100, Walnut Creek, CA

Meeting Summary

1. Introductions

2. Power Point Presentation

a. Project Background and Purpose

- Kevin thanked the team members for completing the Draft DAA and for the close collaboration.
- Kevin indicated that the success of the project was in part due to leveraging available data and traffic models.
- Kevin indicated that this project really included out of the box ideas and concepts in addition to traditional capacity increasing alternatives.
- Kevin identified the project purpose to address the 7.5 mile gap in the northbound I-680 managed lane to reduce congestion and increase person & vehicle throughput.

b. Traffic Analysis Results - Alternative 6A

- Eddie presented Alternative 6A which is a new alternative and was based as a potential first phase to Alternative 6. It is similar to Alternative 6 except it does not include the southern extension of the northern managed lane.
- Based on the traffic analysis a bottleneck would develop between Monument off-ramp and Monument on-ramp at the mainline lane drop location. The queue from this bottleneck would extend upstream through the El Pintado bottleneck.
- Based on vehicle and person hours of delay Alternative 6A would operate worse than Alternative 6 but substantially better than Alternatives 1 and 2.

c. Benefit Cost Analysis

- Brian provided a summary of the benefit cost evaluation that was used to rank the alternatives based on performance and cost. The ranking (from best to worst)
 - Alternative 2
 - Alternative 3
 - Alternative 4
 - Alternative 6A
 - Alternative 8
 - Alternative 5
 - Alternative 6
 - Alternative 7

- Alternative 9
- Eddie and Kevin added that this benefit cost analysis was not the typical analysis that is commonly done by Caltrans as part of their analysis but rather a more simplified version to get a sense of which alternatives could provide the biggest bang for the buck.

d. Recommended Alternatives for Further Consideration

- Brian presented the team's current alternatives that are recommended to be studied further:
 - Alternative 4
 - Alternative 6
 - Alternative 8
 - Alternative 2
- Brian indicated that other alternatives could be initial phases of these alternatives. For example, Alternative 3 could be an initial phase of Alternative 4. Alternative 5 and 6A could be initial phases of Alternative 6
- Of the alternatives studied, only Alternative 7 and Alternative 9 were not recommended for further study. This is due to the challenges they will present in design and getting Caltrans concurrence. Furthermore, these two alternatives ranked last in the benefit to cost evaluation.
- Susan asked about the Caltrans factor. In particular, which alternatives are likely to give Caltrans more concern than others. The team discussed the unique elements of each of the Alternatives that would definitely require close coordination with Caltrans. Ultimately, Alternative 6 was viewed as the most traditional alternative that Caltrans is familiar with and would likely cause the least concern. Alternative 8 was identified as likely causing Caltrans the most concern due to its very unique design features and potential safety concerns. Since Alternative 8 is the only recommended alternative that fully closes the gap, the team determined that it warranted further study in the next project phase where a more detailed evaluation would occur.

e. Project Next Steps

- Carl indicated that a potential next step could be a PSR/PDS to help keep the project going. Based on his experience, the DAA includes the majority of the elements required in the PSR/PDS and the only new element that would be needed would be a PEAR (Preliminary Environmental Analysis Report)
- The team acknowledged that further discussion was needed with Caltrans to better understand the next steps in project development including PSR/PDS and PA/ED.

f. Questions?

3. Action Items & Next Steps

- The Draft DAA is ready for team review. We are looking for comments within two weeks (by May 25).
- Final DAA will be provided in June.

APPENDIX E – List of Design Exceptions

SUMMARY OF MAJOR DESIGN EXCEPTIONS

ALT	DESIGN CONCEPT	DESIGN EXCEPTION*
1	No Build	NA
2	A	Ramp Metering Policy Exception - <i>For HOV By-Pass Lanes</i>
3	A+B+C+X	Ramp Metering Policy Exception, Left Shoulder Width, Lane Width - <i>For Ramp Metering, Express Lane signs and buffer</i>
4	A+B+C+F1+X	Ramp Metering Policy Exception, Left Shoulder Width, Lane Width - <i>For Ramp Metering, Express Lane signs and buffer & at the N. Main St Overcrossing (C-D Road Off-Ramp)</i>
5	A+B+J+K+M1+X	Ramp Metering Policy Exception, Left Shoulder Width, Lane Width - <i>For Ramp Metering, Express Lane signs and buffer & along managed lane extension(N. Main to SR 242)</i>
6	A+B+F1+J+K+M1+X	Ramp Metering Policy Exception, Left Shoulder Width, Lane Width - <i>For Ramp Metering, Express Lane signs and buffer, at the N. Main St Overcrossing (C-D Road Off-Ramp) & along managed lane extension(N. Main to SR 242)</i>
6A	A+B+F1+J+K+X	Ramp Metering Policy Exception, Left Shoulder Width, Lane Width - <i>For Ramp Metering, Express Lane signs and buffer & at the N. Main St Overcrossing (C-D Road Off-Ramp)</i>
7	A+B+F1+J+M1+O+X	Ramp Metering Policy Exception, Left Shoulder Width, Lane Width - <i>For Ramp Metering, Express Lane signs and buffer, at the N. Main St Overcrossing (C-D Road Off-Ramp) & along managed lane extension(N. Main to SR 242)</i>
8	A+B+D+J+M1+X	Ramp Metering Policy Exception, Left Shoulder Width, Right Shoulder Width, Lane Width - <i>For Ramp Metering, Express Lane signs and buffer, along the Contra Flow Lane (SR 24 to N. Main) & along managed lane extension(N. Main to SR 242)</i>
9	A+B+J+K+M1+N+X	Ramp Metering Policy Exception, Left Shoulder Width, Right Shoulder Width, Lane Width - <i>For Ramp Metering, Express Lane signs and buffer, along managed lane extension(N. Main to SR 242) & at the I-680/ SR24 Interchange columns</i>

* A complete list of Caltrans Design Exceptions should be identified in the next phase of design