I-80 Integrated Corridor Mobility (ICM)

Corridor System Management Plan

Final

Prepared by

DKS Associates
TRANSPORTATION SOLUTIONS

September 30, 2010

I-80 Integrated Corridor Mobility (ICM) Corridor System Management Plan

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Corridor System Management Plan

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Interstate 80 Integrated Corridor Mobility Project

Corridor System Management Plan

FINAL

By

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September 30, 2010

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1 INTRODUCTION

1.1 Purpose and Needs of CSMP

A Corridor System Management Plan (CSMP) is a document and an associated set of analytical tools and performance monitoring systems designed to optimize performance of a major transportation corridor. A transportation corridor is not limited to the highway but encompasses all transportation components such as major local parallel arterials, local road intersections, ramps and ramp meters, signal controls, transit.

The ultimate purpose of the CSMP is to serve as a tool for efficiently and effectively optimizing the safety, mobility, productivity and reliability of the existing system. The CSMP allows the State, regional agencies, and local jurisdictions to manage and operate the transportation corridor to maintain a high level of sustained productivity and reliability based on the assessment and evaluation of performance measures. The CSMP assesses current performance, identifies causal factors for congestion and proposes the best currently feasible mix of improvements, strategies, and actions to optimize corridor performance.

The CSMP approach is consistent with the goals and objectives of the Governor's Strategic Growth Plan. The objectives of the plan are to decrease congestion, improve travel time and safety. Key elements of the strategy are illustrated in **Figure 1-1** .

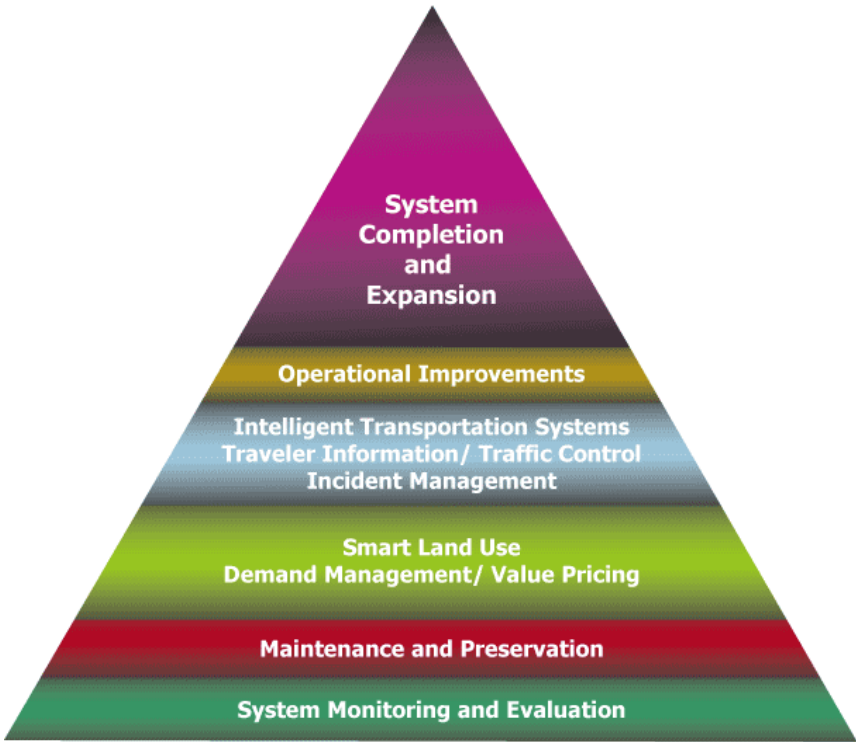


Figure 1-1 Key Strategic Elements of Strategic Growth Plan

The foundation of transportation system management, which is the base of the pyramid, is system monitoring and evaluation. It is critical to understand what is occurring on the transportation network so that the value of any investment decision made at a higher level in the pyramid is not limited. The next layers up the pyramid are focused on making the best use of existing resource and reducing the demand for new transportation facilities.

The CSMP is also consistent with the Regional Transportation Plan (RTP), city and county general plans, and multi-modal plans. In addition, with goals of improving mobility on the state highway system to more optimum speeds to reduce vehicle emission, and providing viable transportation alternatives and accessibility across modes to encourage transit and bicycling and decrease single occupant auto use, the CSMP will assist in fulfilling the goals of recently enacted legislation such as Assembly Bill 32 that addressed air quality and green house gas emissions and Senate Bill 375 that addressed the land use.

1.2 The I-80 CSMP corridor

The study corridor covers the Interstate 80 (I-80) freeway segment between the San Francisco Bay Bridge in Alameda County and the Carquinez Bridge in Contra Costa County, and includes ramps, roadway connectors, parallel arterials, and transit services. **Figure 1-2** provides a graphical overview of the corridor study limits.

I-80 is a major east-west freeway connecting San Francisco and Sacramento, passing through Alameda County and Contra Costa County. The I-80 corridor has ranked as the most congested corridor in the entire San Francisco Bay Area during the last six years, with traffic volumes reaching 288,000 vehicles per day and over 7,000 hours of delay daily. For more than forty years, congestion has been present in the I-80 corridor. Even after past major investments in freeway capacity, segments of the corridor remain congested for up to ten hours a day. Currently, the demand on the freeway exceeds the roadway capacity, causing unreliable travel times, erratic operating speeds, breakdowns, as well as diversion to the local arterials. The congestion on the roadway network contributes to an increase in incidents, including rear-end accidents on both the freeway and local arterials. The frequency of incidents also contributes to delays for transit services operating along the corridor. The combined effect of the incidents and the congestion hinders efficient response times and creates potential for additional secondary incidents.

Building additional freeway capacity is not feasible for the I-80 corridor due to the right of way, financial, environmental, and political constraints. The I-80 ICM project instead focuses on the Advanced Traffic Management (ATM) elements such as speed harmonization, end of queue warning, ramp metering, and traveler information.

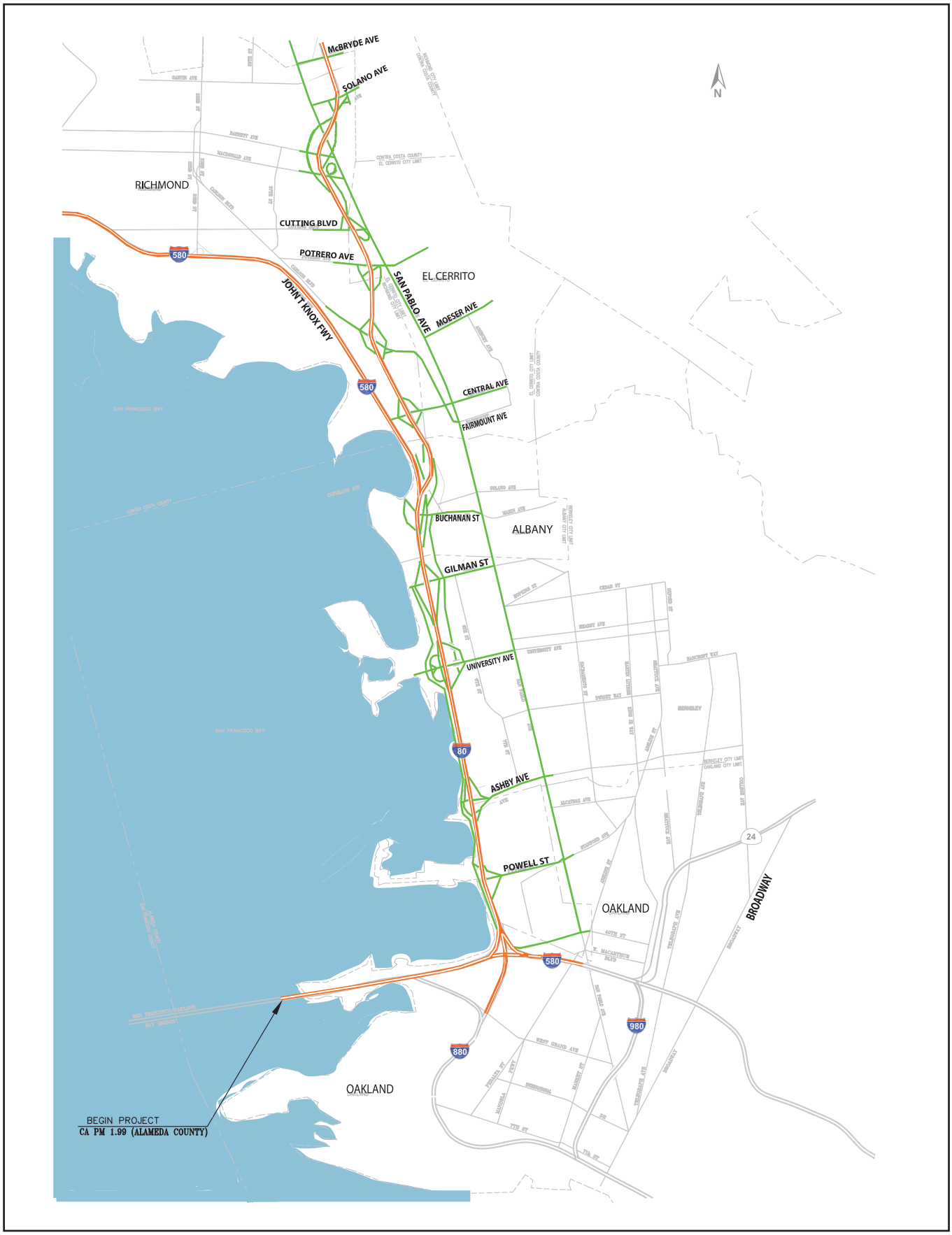


Figure 1-2 Study Corridor Limit

Figure 1-2 Study Corridor Limit (Continued)

1.3 Corridor Team

The preparation and implementation of a CSMP requires coordination with local agencies, MTC, CMA, and Caltrans.

Project Team:

- Alameda County Congestion Management Agency
- DKS Associates
- Kimley-Horn and Associates, Inc

The technical team worked with the stakeholders to define the corridor, to assess the corridor performance, and to identify bottlenecks and causality.

Agency Participants:

- Alameda County Congestion Management Agency, West Contra Costa Transportation Advisory Committee, Contra Costa Transportation Authority, Water Emergency Transportation Authority, Contra Costa County.
- Metropolitan Transportation Commission.
- Caltrans District 4
- California Highway Patrol.
- Federal Highway Administration.
- Federal Transit Administration, AC Transit, WestCAT Transit, BART, Amtrak.
- City of Albany, Berkeley, El Cerrito, Emeryville, Hercules, Pinole, Richmond, Oakland, and San Pablo.

The stakeholder teams deal with modal interactions, connectivity with local arterial network, and assistance with data collection.

1.4 Evaluation Framework

The modeling activities conducted for the I-80 CSMP involved a combination of applying travel demand models and micro-simulation models. Travel demand models were used to generate projections of base and future demands and generate seed origin-destination (OD) trip matrices for the micro-simulation models. The forecast years included 2005, 2015, and 2035. Micro-simulation models were used to conduct detailed operational analysis for various alternatives under 2015 demand conditions. The micro-simulation modeling process also included development and calibration of existing condition models. The modeling approach used for both the demand forecasting and the operational analysis are described further in the following subsections.

1.4.1 Forecasting Approach

Because of the bi-county nature of the study corridor, the forecasting approach involved starting with the current ACCMA model, but enhancing it to better reflect land use conditions within Contra Costa County, as well current year (2008) network conditions. Land use data from the CCTA model were used to refine the ACCMA model for areas along the corridor within Contra Costa County.

To support the operational analysis and micro-simulation modeling, a subarea extraction from the regional model was undertaken resulting in a "I-80 ICM/CSMP Corridor" model with a network matching that used for the micro-simulation. As part of the extraction process, AM and PM peak hour OD trip tables for the corridor were generated.

1.4.2 Operational Analysis Approach

Detailed operational analysis of alternatives was conducted only for the 2015 forecast year, as agreed by the stakeholders, because a simulation model is not suitable for a long range planning of which the forecasted growth would likely overload the micro-simulation model making the comparison among alternatives difficult to be realistically determined. Paramics, a microscopic traffic simulation software package, was used in this study. The base-year models were developed and calibrated to the 2008 traffic condition as illustrated in **Figure 1-3.** A sound methodology based on the forecasted traffic growth from the regional travel demand models was used to develop the 2015 simulation models as illustrated in **Figure 1-4.**

Simulation models were developed for both the AM peak period (6:00 to 10:00 AM) and the PM peak period (2:00 to 7:00 PM). The simulation model network was illustrated previously in Figure 1-2, which covers the 21-mile segment of I-80 between the Bay Bridge Toll Plaza in Oakland and the Carquinez Bridge in Crockett. The network includes all the interchanges and freeway-to-freeway connectors along I-80, the major alternative parallel arterial (San Pablo Avenue), the roadway connectors between I-80 and San Pablo Avenue, and selected local intersections.

The base-year simulation AM and PM peak period models were calibrated to the existing conditions (2008), followed the standard of practice presented in *Traffic Analysis Toolbox Volume III: Guidelines for Applying Traffic Micro-simulation Modeling Software* (July 2004) developed by the Federal Highway Administration (FHWA). More details about the simulation calibration can be found in the *I-80 ICM Project Traffic Operations Analysis Report (Appendix A).*

Once the base-year simulation models were calibrated, the model network was revised to reflect a set of network improvements assumed for 2015. The model demand, which is represented by hourly O-D trip tables, was also revised to reflect the forecasted growth available from the regional

travel demand models. Several Build alternatives were also tested to reflect different combinations of the proposed I-80 ICM strategies including ramp metering, variable speed limits (VSL), and lane management control. More detailed explanation of these strategies can be found in the *Traffic Operations Analysis Report (Appendix A).*

The 2015 simulation models were also used to test a number of interim/intermediate-term improvement scenarios. The interim improvement scenarios model the 2015 demand but with network changes to reflect some of the projects that might be implemented in between the years 2015 and 2035.

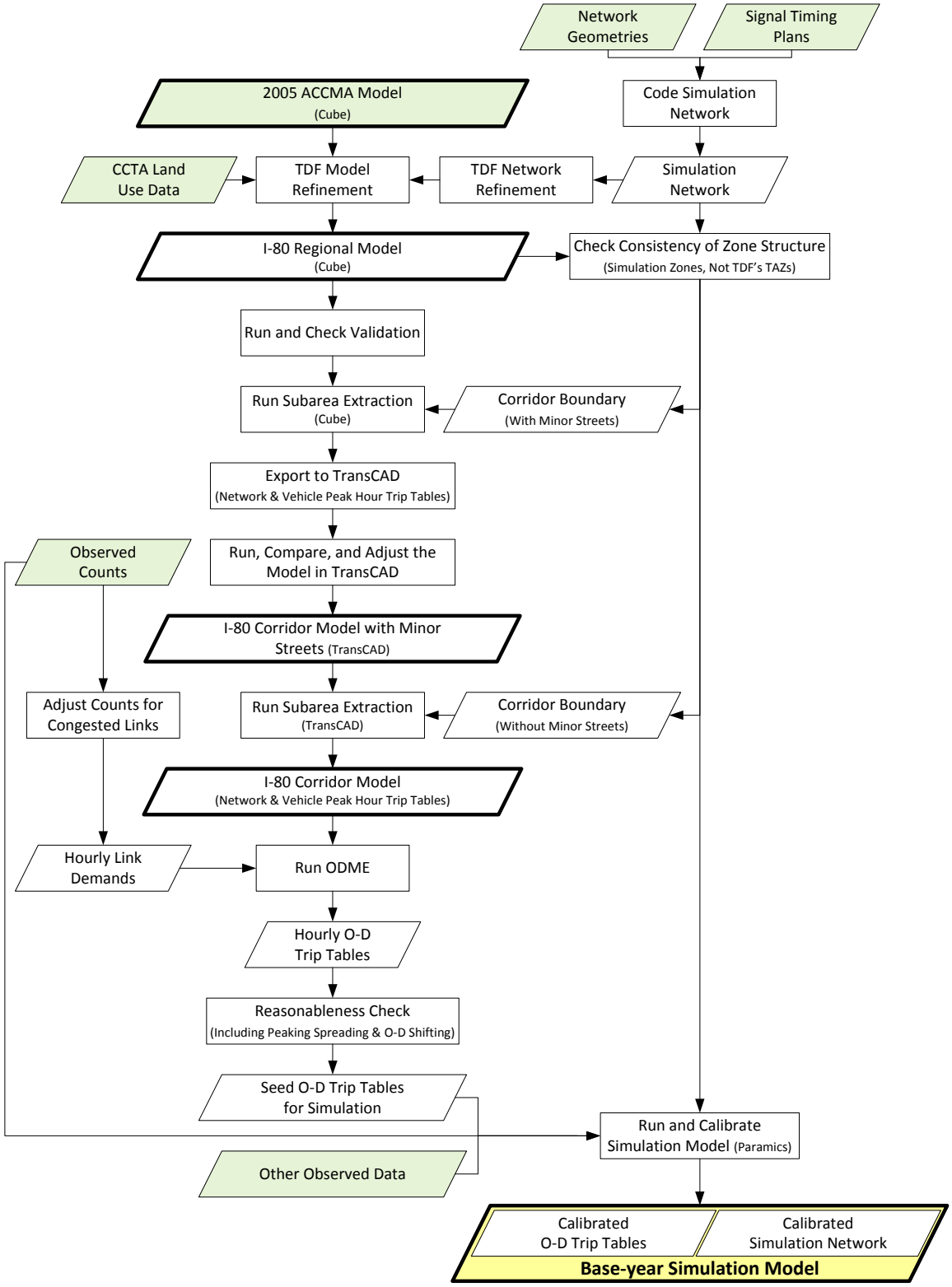


Figure 1-3 Development of Base-Year Simulation Model

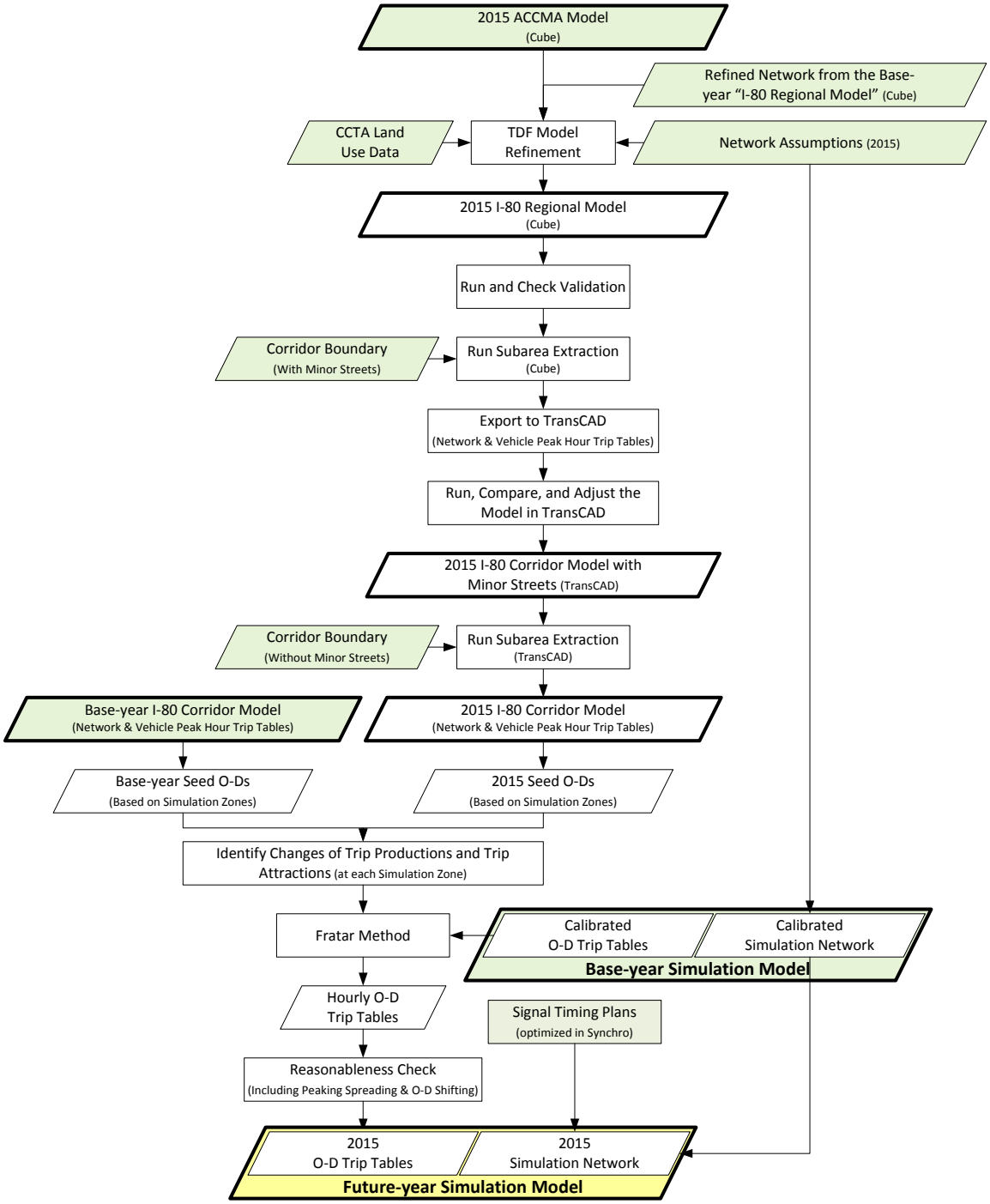


Figure 1-4 Development of Future-Year Simulation Model

2 EXISTING CONDITIONS

2.1 Corridor Description

2.1.1 Freeway

I-80 is a major east-west directional freeway connecting San Francisco and Sacramento, passing through Alameda County and Contra Costa County. In general, I-80 has three mixed-flow lanes between the Carquinez Bridge and Interstate 580 (I-580 in Albany) and five mixed-flow lanes between I-580 (Albany) and Powell Street (Emeryville). Several freeway segments include an auxiliary lane between an on-ramp and the immediate downstream off-ramp. The segment of I-80 from the Bay Bridge to the Carquinez Bridge is approximately 20 miles in length.

High Occupancy Vehicle (HOV) lanes are available in this corridor for three or more people per vehicle during the hours of 5:00 AM to 10:00 AM and 3:00 PM to 7:00 PM. **Table 2-1** lists the existing HOV lanes on I-80 within the study corridor. There are a total of 35.7 HOV lane miles available on I-80, and there is a plan to add another 4.7 lane miles to the eastbound I-80 from west of State Route 4 (SR-4) to the Carquinez Bridge, as indicated in the Caltrans *2007 Bay Area HOV Lanes Report*.

Table 2-1 Existing HOV Lane along the I-80 Corridor

Direction	Route	Limits	Lane-miles	Minimum Occupancy	Periods
Westbound	CC-80	SR-29 to SR-4	4.9	3+	5-10 AM, 3-7 PM
Westbound	CC-80	SR-4 to Alameda County Line	10.1	3+	5-10 AM, 3-7 PM
Westbound	ALA-80	Contra Costa County Line to I-880 Viaduct	4.2	3+	5-10 AM, 3-7 PM
Westbound	ALA-80	Bay Bridge Toll Plaza	1.1	3+	5-10 AM, 3-7 PM
Eastbound	ALA-80	I-880 Viaduct to Ala/CC County Line	5.8	3+	5-10 AM, 3-7 PM
Eastbound	CC-80	Ala/CC County Line to SR-4	9.5	3+	5-10 AM, 3-7 PM
Eastbound	SOL-80	Carquinez Bridge Toll Plaza	0.1	3+	5-10 AM, 3-7 PM

Note: There is a plan to extend the HOV lane on I-80E from West of SR-4 to the Carquinez Bridge (EA#26372K: $45 million, 4.' lane-miles)

Source: Caltrans 2007 Bay Area HOV Lanes Report

Within the designated corridor limits, there are two freeway-to-freeway junctions and twenty-four (24) full or partial local interchanges along I-80. The configuration of these interchanges varies, although most diamond or partial cloverleaf. Because the I-80 ICM project includes ramp metering, on-ramps are of particular importance. As listed in **Table 2-2**, there are 52 on-ramps (26 in each direction) along the study segment of I-80 that provide access from local arterials or other freeways onto I-80, including HOV-only center median on-ramps at Richmond Parkway (Pinole) and Cutting Boulevard (Richmond), Most of the on-ramps are in a diamond configuration that allow access to the freeway from both directions of the cross streets. There are some locations where loop ramps are utilized to serve only one direction of cross street traffic (e.g., eastbound Cutting Boulevard on-ramp to eastbound I-80).

Table 2-2 I-80 On-ramps Within Study Corridor

Westbound	Eastbound
Pomona St on-ramp	WB I-580 merge (at right)
Cummings Skyway on-ramp	NB I-880 merge (at left)
Willow Ave on-ramp	Powell St on-ramp
WB Route 4 on-ramp	WB Ashby Ave on-ramp
Pinole Valley Rd on-ramp	WB University Ave on-ramp
Appian Way on-ramp	Gilman St on-ramp
Richmond Pkwy on-ramp	Buchanan St on-ramp
Richmond Pkwy HOV on-ramp (at left)	Central Ave on-ramp
WB Hilltop Dr on-ramp	Carlson Blvd on-ramp
EB Hilltop Dr on-ramp	EB Cutting Blvd on-ramp
El Portal Dr on-ramp	WB Cutting Blvd on-ramp
San Pablo Dam Rd on-ramp	Cutting Blvd HOV on-ramp (at left)
Solano Ave on-ramp	San Pablo Ave on-ramp
Barrett Ave on-ramp	San Pablo Dam Rd on-ramp
Potrero Ave on-ramp	El Portal Dr on-ramp
Carlson Blvd on-ramp	EB Hilltop Dr on-ramp
Central Ave on-ramp	WB Hilltop Dr on-ramp
EB I-580 merge (at right)	EB Richmond Pkwy on-ramp
Buchanan St on-ramp	WB Richmond Pkwy on-ramp
Gilman St on-ramp	EB Appian Way on-ramp
WB University Ave on-ramp	WB Appian Way on-ramp
WB Ashby Ave on-ramp	Pinole Valley Rd on-ramp
Frontage Rd on-ramp	Route 4 on-ramp
Powell St on-ramps	Willow Ave on-ramp
WB I-580 merge (at left)	Cummings Skwy on-ramp
NB I-880 merge (at right and HOV merge at left)	Pomona St on-ramp

2.1.2 Arterials

San Pablo Avenue is the primary north-south alternative arterial to the I-80 corridor, running parallel to I-80 from Crockett (the northern end of the corridor) to Oakland (the southern end of the corridor). It is a north-south directional roadway with one or two through lanes per direction. Other study corridor arterials serve as secondary alternative routes (localized) or connectors between I-80 on-ramps and off-ramps, and transit facilities on San Pablo Avenue. These roadways also typically have one or two through lanes per direction.

Table 2-3 lists segments of the parallel arterials within the study corridor in the north-south direction (most segments are sections of San Pablo Avenue). Roadway connectors between these parallel arterials and I-80 ramps are listed in **Table 2-4.**

Table 2-3 Parallel Arterial Segments within the Study Corridor

Parallel Arterial	From	To
San Pablo Ave	Pomona St	Cummings Skyway
San Pablo Ave/ Parker Ave	Cummings Skyway	Willow Ave
San Pablo Ave	Willow Ave	Route 4/John Muir Pkwy
San Pablo Ave	Route 4/John Muir Pkwy	Pinole Valley Rd
San Pablo Ave	Pinole Valley Rd	Appian Way
Fitzgerald Dr	Appian Way	Richmond Parkway
San Pablo Ave	Appian Way	Richmond Parkway
San Pablo Ave	Richmond Pkwy	Hilltop Dr
San Pablo Ave	Hilltop Dr	El Portal Dr
El Portal Dr	San Pablo Dam Rd	El Portal Dr on-ramp to I-80W
San Pablo Ave	El Portal Dr	San Pablo Dam Rd
San Pablo Dam Rd	El Portal Dr	San Pablo Ave
San Pablo Ave	San Pablo Dam Rd	McBryde Ave
San Pablo Ave	McBryde Ave	Barrett Ave
Swans Way	San Pablo Ave	Barrett Ave
San Pablo Ave	Barrett Ave	Cutting Blvd
San Pablo Ave	Cutting Blvd	Potrero Ave
San Pablo Ave	Potrero Ave	Central Ave
Carlson Blvd	I-80	Central Ave
San Pablo Ave	Central Ave	Buchanan St
San Pablo Ave	Buchanan St	Gilman St
W. Frontage Rd	Gilman St	Powell St
Eastshore Hwy	Buchanan St	University Ave
San Pablo Ave	Gilman St	University Ave
San Pablo Ave	University Ave	Ashby Ave
San Pablo Ave	Ashby Ave	Powell St
San Pablo Ave	Powell St	W. MacArthur Blvd

Table 2-4 Roadway Connectors within the Study Corridor

Roadway Connector	From	To
Cummings Skyway	San Pablo Ave	I-80
Willow Ave	San Pablo Ave	I-80
Route 4/John Muir Pkwy	San Pablo Ave	I-80
Pinole Valley Rd	San Pablo Ave	I-80
Appian Way	San Pablo Ave	I-80
Richmond Pkwy	San Pablo Ave	I-80
Hilltop Drive	San Pablo Ave	I-80
El Portal Dr	San Pablo Ave	San Pablo Dam Rd
McBryde	San Pablo Ave	I-80
Solano Ave	San Pablo Ave	I-80
Barrett Ave	I-80	San Pablo Ave
MacDonald Ave	I-80	San Pablo Ave
Cutting Blvd	I-80	San Pablo Ave
Potrero Ave	I-80	San Pablo Ave
Central Ave	I-80	San Pablo Ave
Buchanan St	I-80	San Pablo Ave
Gilman St	W. Frontage Rd	San Pablo Ave
University Ave	W. Frontage Rd	San Pablo Ave
Ashby Ave	W. Frontage Rd	San Pablo Ave
Powell St	W. Frontage Rd	San Pablo Ave

2.1.3 Transit

Various transit agencies provide service along the project corridor. **Table 2-5** summarizes each transit operator, type of transit service, and service limits within the corridor. There are currently no existing ferry stops within the corridor limit. However, the Vallejo BayLink Ferry provides ferry services from Vallejo Ferry Building to San Francisco Ferry Building and the Oakland/Alameda Ferry provides ferry services from Oakland Jack London Square to San Francisco Ferry Building. These ferry services parallel all or part of the project corridor.

Table 2-5 Transit Services

Transit Operator	Type of Transit Service	Service Limits within Corridor
Bay Area Rapid Transit (BART)	Rail	Between Richmond and San Francisco
Amtrak/Capitol Corridor	Rail	Between Sacramento and San Jose via I-80 corridor through Richmond, Berkeley, Emeryville, Oakland, and San Francisco (via Amtrak bus)
Fairfield-Suisun Transit	Express bus connections to BART	Between Fairfield and El Cerrito del Norte BART station along Interstate 80
Vallejo Transit	Express bus connections to BART	Between Vallejo and El Cerrito del Norte BART station along Interstate 80
WestCAT	Express bus connections to BART	Between Martinez, Hercules and the El Cerrito del Norte BART station along Interstate 80
Golden Gate Transit	Express bus connections to BART	Between San Rafael and El Cerrito del Norte BART station along Cutting Boulevard.
Vallejo BayLink	Transbay express bus service to San Francisco	Between Vallejo Ferry Building and San Francisco Ferry Building along Interstate 80
AC Transit	Transbay express bus service to San Francisco	Between various east bay locations (neighborhoods and park-and-ride lots) and San Francisco along Interstate 80
WestCAT Lynx	Transbay express bus service to San Francisco	Between Hercules Transit Center and San Francisco Transbay Terminal along Interstate 80
AC Transit	Rapid Bus and Local Service	Along San Pablo Avenue between Richmond and Oakland

Rail Transit Service

Bay Area Rapid Transit (BART) is a major rail service within the study corridor. The 5 system lines and 43 stations are presented in Figure 2-1. BART operates Monday through Friday from 4:00 AM to midnight; Saturdays from 6:00 AM to midnight; and, Sundays from 8:00 AM to midnight. Service may extend beyond midnight depending on the station coordination of the last running train. The Richmond-Millbrae and Richmond-Fremont BART lines, running parallel to the I-80 corridor have the average travel time of 69 minutes and 61 minutes, respectively. Train headways are 15 minutes during weekdays and headways are 20 minutes during weekends for both Richmond lines. Seating capacity varies between cars; however, total capacity including standing

passengers can reach up to 150. Detailed information including frequencies and connections to bus services is presented in **Appendix A.**

In addition to BART, Amtrak also provides rail service within the corridor. There are four Amtrak stations within the study corridor: Richmond, Berkeley, Emeryville, and Oakland-Jack London Square. The Richmond station has a platform with shelter and fixed service hours; however, there is no ticket office and checked baggage service available. The Berkeley station has only a platform without shelter. There is no fixed service hour, no ticket office, and no checked baggage service at this location. Access to the Berkeley station is limited to arrival and departure times. The Emeryville and Oakland-Jack London Square stations are full service stations with fixed service hours, ticket office, checked baggage hours, and waiting rooms. Amtrak also provides service to San Francisco via a bus connection between Emeryville Station to Caltrans Station, Moscone Center, Civic Center, San Francisco Shopping Center, Fisherman's Wharf, Ferry Building, and Financial District.

Source: www.bart.gov

Figure 2-1 BART System

Bus Service

The Western Contra Costa Transit Authority (WestCAT) and the Alameda-Contra Costa Transit District (AC Transit) are the two main transit agencies providing bus services in the study corridor. **Table 2-6** and **Table 2-7** summarize major bus service routes in the study corridor operated by these agencies. WestCAT bus routes provide services in the northern section of the study corridor connecting Hercules Transit Center with the Richmond Transit Center and El Cerrito del Norte BART station. In **Table 2-6,** route JX, J, JPX and 30Z are the rapid bus routes provided by WestCAT. The rapid bus line used leading-edge technology and unique on-street improvements to reduce the travel time.

In contrast, AC Transit bus routes provide services in the southern section of the I-80 corridor connecting downtown Oakland to both San Francisco Transbay Center and Richmond Transit Center. In **Table 2-7,** route 72R is a rapid bus line provided by AC Transit. Line 72R runs from Contra Costa College in downtown San Pablo to downtown Oakland along San Pablo Ave., and on to Jack London Square along Broadway. It runs during the weekday only from 6 am to 7 am and headway is 12 minutes.

It is important to note that bus routes connecting to/from a BART station have significant ridership. BART is a crucial transit alternative in the study corridor and many travelers use bus transit services to connect to the BART system. Detailed information on each bus service route within the study corridor is provided in **Appendix B**.

Table 2-6 Major WestCAT Bus Service Routes

Provider	Route	From	To	2007 Ridership
WestCAT	JX	Hercules Transit Center	El Cerrito del Norte BART Station	121,655
WestCAT	J	Hercules Transit Center	El Cerrito del Norte BART Station	456,114
WestCAT	JPX	Hercules Transit Center	El Cerrito del Norte BART Station	74,251
WestCAT	30Z	El Cerrito del Norte BART Station	Downtown Martinez	68,151
WestCAT	C3	Hercules Transit Center	Pinole-Contra Costa College	52,075
WestCAT	LYNX	Rodeo/Hercules	San Francisco Transbay Terminal	124,071
WestCAT	10	Hercules Transit Center	Gem Street	29,449
WestCAT	11	Hercules Transit Center	Rodeo/Hercules	98,263
WestCAT	12	Hercules Transit Center	Redwood Street	38,990
WestCAT	13	Hercules Transit Center	Coronado	57,350
WestCAT	14	Hercules Transit Center	Pheasant Drive, Sparrow Drive, Falcon Way, and Refugio Valley Road	48,405
WestCAT	15	Hercules Transit Center	North Shore Business Park, Rodeo	52,388
WestCAT	16	Richmond Parkway Transit Center	Pinole Valley Area	93,690
WestCAT	17	Richmond Parkway Transit Center	Del Monte Shopping Center	10,771
WestCAT	18	Tara Hills	Richmond Parkway Transit Center/Hilltop Mall	15,864
WestCAT	19	Hercules Transit Center	Hilltop Mall	59,400

Table 2-7 Major AC Transit Bus Service Routes within I-80 Corridor

Provider	Route	From	To	2007 Ridership
AC Transit	L	San Francisco Transbay	Princeton Plaza Shopping Center	175,695
AC Transit	7	Rockridge BART	Berkeley BART/El Cerrito Del Norte BART	467,690
AC Transit	70	Contra Costa College	Richmond BART	400,248
AC Transit	71	El Cerrito Del Norte BART	Richmond BART/Richmond Parkway Transit Center	389,721
AC Transit	72/ 72M	Oakland 14th St/Broadway Ave	El Cerrito Del Norte BART/Richmond BART/Castro Street	2,730,143
AC Transit	72R	Jack London Square	Contra Costa College	1,733,490
AC Transit	74	Hall Ave& Marina Way	Richmond BART/Orinda BART	426,438
AC Transit	76	Richmond Parkway Transit Center	Richmond BART/El Cerrito Del Norte BART	687,745
AC Transit	376	El Cerrito Del Norte BART	Richmond BART/Pinole Business Park	70,752

In the I-80 corridor, WestCAT transit route J and AC transit routes 76 and 376 are designated as lifeline transit routes. MTC embarked on the Lifeline Transportation Program to address the mobility and accessibility needs of low-income individuals and families. It was implemented locally by the nine Bay Area county congestion management agencies. The Lifeline Transportation Program funds a variety transportation projects throughout the region to benefit low-income people and communities. These projects are intended to address locally prioritized transportation gaps and barriers with new or expanded service, or improved transportation choice, which provide low-income people and communities a “lifeline” to assessing employment, services, and other activities that are considered essential to daily life.

Parking Facilities

Park-and-Ride spaces discussed in this section includes all the spaces available from both Park-and-ride and multi-modal facilities. Park-and-ride facilities allow travelers to park their cars to use transit or carpool with others. **Table 2-8** summarizes the park-and-ride spaces within the study corridor including location, available spaces, and possible transit route connection options. The park-and-ride spaces are sorted by their locations from north to south. Park and ride lots in Hercules (Willow Avenue and I-80) and Richmond (Richmond Parkway and I-80) are owned by Caltrans. Caltrans has a unique set up for Richmond Parkway Transit Center, where they owns the ROW and has a maintenance agreement for AC Transit to operate the facility. **Figure 2-2** illustrates the locations of park and ride facilities in the corridor.

Table 2-8 Parking Facilities (including Park & Ride lots)

City	Location	Owner/ Operator	Spaces	Transit Operators	Connection to Transit Routes	Non-transit Riders Allowed
Hercules	Willow Ave and I-80	Caltrans	170	WestCAT	J, C-3, JX, 30Z, JPX, LYNX, 10,11,12,13,14,15,19	Yes
Hercules	Hercules Transit Center	BART	422	WestCAT	C-3, JX,30Z, JPX, LYNX,J, 10,11,12,13,14,15,19	Yes
Richmond	Richmond Pkwy and I-80	Caltrans/AC Transit	182	WestCAT	17	Yes
				AC Transit	LA, LC, 70,71,76,376,670	Yes
Richmond	Hilltop Dr and I-80	Caltrans	135	AC Transit	LA, LC, J,18, 71, 76, 670, 672,676	Yes
San Pablo	San Pablo Ave near Church Ln	City of San Pablo	156	AC Transit	LC, L, 72R, 72, 76	Yes
Richmond	Richmond Station Bart Station	BART	626	BART	Richmond-Fremont/Daly City	No
				AC Transit	Routes 71, 72, 72 M, 74, 76, 376;	
				GG Transit	Golden Gate Transit route 42	
El Cerrito	El Cerrito del Norte Bart Station	BART	2159	BART	Richmond-Fremont/Daly City	No
				AC Transit	Routes 7, 71, 72, 72M, 72R, 76, 376, L.	
				GG Transit	Golden Gate Transit routes 40, 42	
				WestCAT	Routes 30Z, J, JL, JPX, JR, JX.	
El Cerrito	El Cerrito Plaza Bart Station	BART	747	BART	Richmond-Fremont/Daly City	No
				AC Transit	Routes 19, 72,72M,79,G.	
Berkeley	North Berkeley Bart Station	BART	792	BART	Richmond-Fremont/Daly City	No
				AC Transit	Routes 19, 88	
Berkeley	Ashby Bart Station	BART	602	BART	AC Transit routes 9, 15, 18	No
Oakland	MacArthur Bart Station	BART	621	BART	Richmond-Fremont/Daly City	No
				AC Transit	Routes 1, 1R, 12, 14, 15, 18, 57	
Oakland	Grand Ave and Lake Park	City of Oakland	165	AC Transit	NX1,B,NL, NX, 12,13,57,653,657,658,680,688,689,805	No
Oakland	Linden St and 7th St	Caltrans	180	AC Transit	19,62,800	No
Oakland	West Oakland Bart Station	BART	439	BART	San Francisco-Richmond/Pittsburg/Pleasanton/Fremont	No
				AC Transit	Routes 13, 19, 62	

Source: http://rideshare.511.org/511maps/ and 2008 list of Caltrans owned P&R Facilities

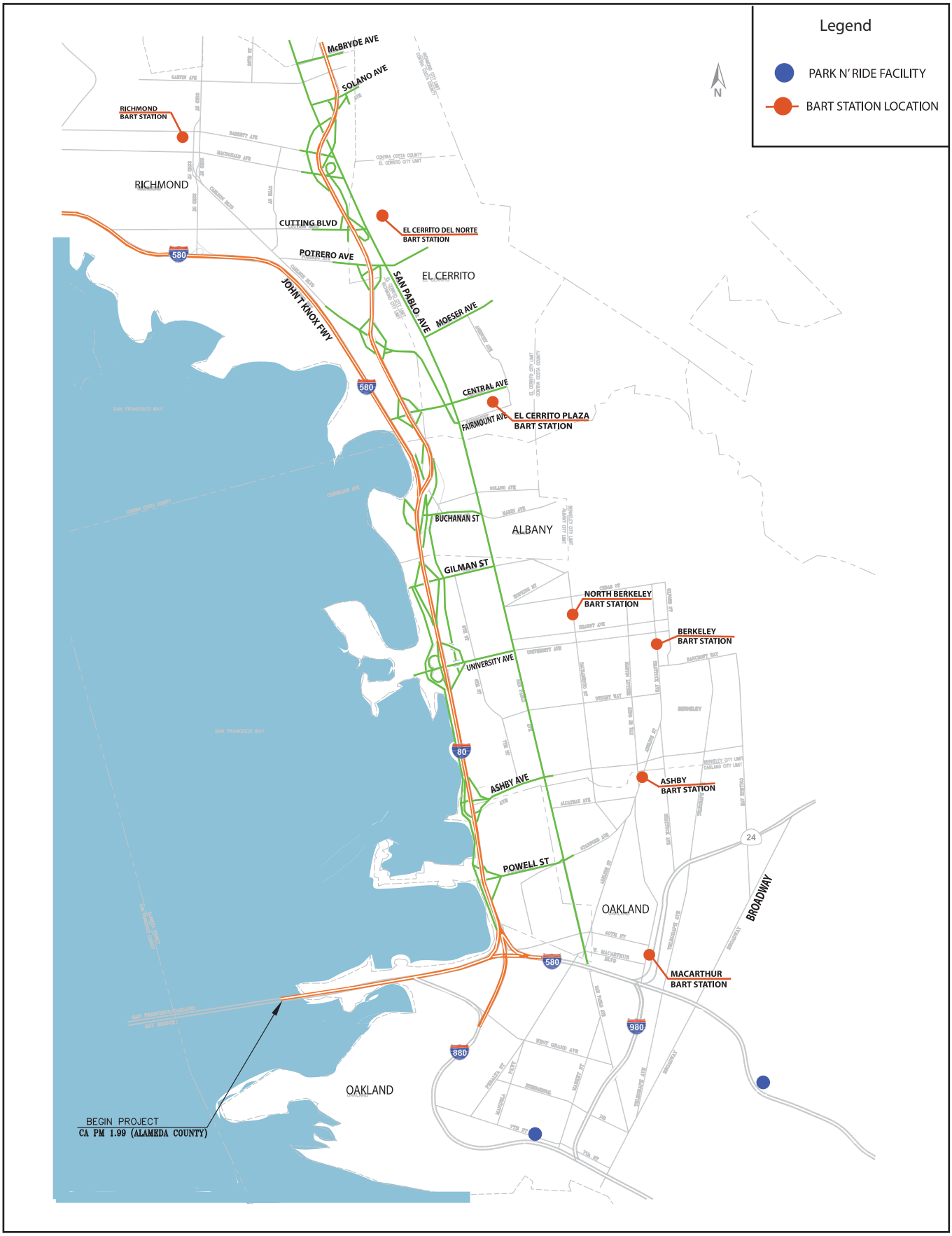


Figure 2-2 Park and Ride Facilities in the Corridor

Figure 2-2 Park and Ride Facilities in the Corridor (Continued)

2.1.4 Freight Movement Trends

Bay Area Trade Pattern

Goods movement is critical to the Bay Area's transportation and economic systems. Goods movements in the Bay Area can be thought of as serving three primary markets or functions: local distribution/pick-up/delivery and service markets long-haul domestic trade markets; and international trade. Measured in terms of tonnage, approximately 46 percent of goods move into, out of or within the Bay Area have both an origin and destination within the region, and much of this local goods movement is putting consumer goods on the shelves of retails stores or in offices and service businesses throughout the region.

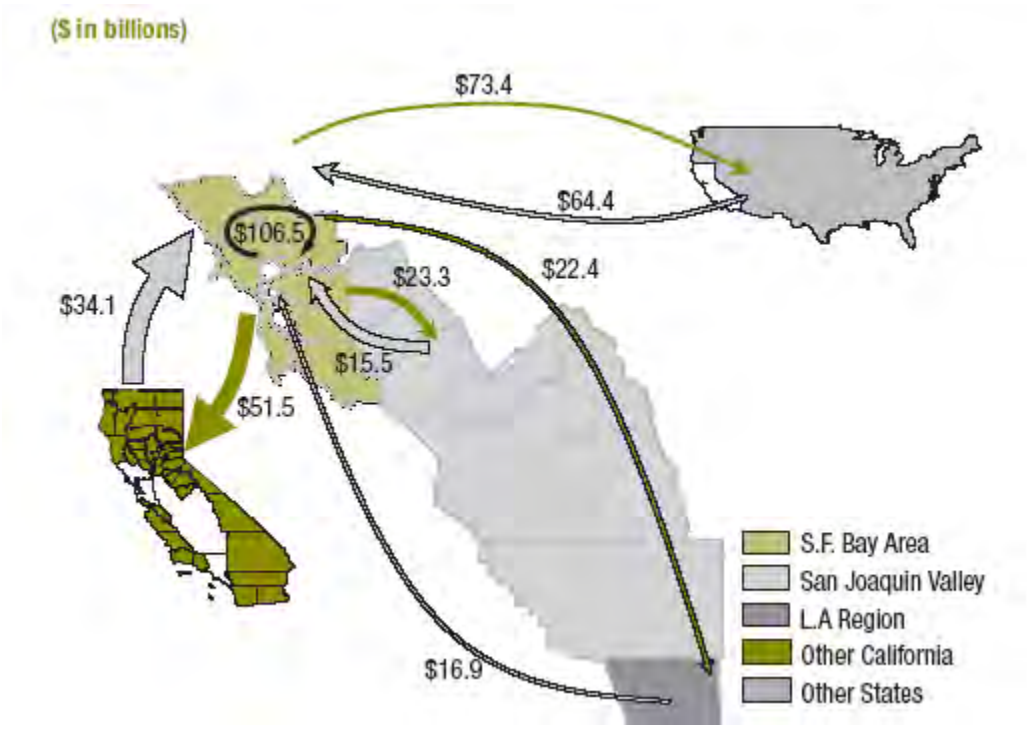


Figure 2-3 Bay Area Trading Pattern

Sources: Regional Goods Movement Study for the San Francisco Bay Area, Final Summary Report, December 2004, MTC.

As shown in **Figure 2-3**, in terms of dollar value, the largest share of the Bay Area's domestic trade stays within the California, with approximately 66 percent of goods moved within California, of which 39 percent moved within the Bay Area.

The fastest-growing segment of goods movement and a major component of the Bay Area economy is international trade. Between 1993 and 1999, the value of exports from the region increased by almost 50 percent based on the U.S. Department of Commerce, 2000. The port of Oakland is one of the few West Coast ports where export container volumes exceeded import volumes.

Freight Movement by Highway

In term of volume, more than 80 percent of the goods movement in the Bay Area involves trucking in several major corridors: Interstates 80, 580, and 880, and U.S Highway 101[1]. The I-880 corridor carries the highest volume of truck traffic in the region and among the highest of any highway in the state while the I-80 carries the third-highest truck volume in the region, serving primarily as a connector to the transcontinental truck network.

All the major truck corridors within the region face growing levels of recurrent congestion that affect goods movement costs. Trucks contribute to this congestion in these corridors because they use more capacity per vehicle than autos do. In the past, this was less of a problem than it is today because the trucks could avoid the periods of peak congestion because most of their pickups and deliveries occur during business hours. Since the peak periods have spread out and trucking business have been pushed to the outer Bay Area, it is more difficult for trucks to avoid peak periods of congestion.

Freight Movement by Other Modes

Rail carries the next largest fraction of Bay Area goods after trucking. Oakland is the center of the Bay Area rail network and the Union Pacific line to Roseville and the Burlington Northern and Santa Fe line to Stockton are the two major rail routes in the Bay Area. The Bay Area is a net consumer of goods by rail, with inbound tonnage more than twice that of outbound. Contra Costa and Alameda counties are the largest origins and destinations for Bay Area rail traffic.

Bay Area maritime cargo includes containerized cargo at Oakland and San Francisco, bulk cargoes at San Francisco, Richmond, Redwood City, and Benicia, and crude petroleum products, raw sugar and bay sand handled at various private terminals around the bay.

Air cargo is the fastest-growing mode of the Bay Area goods-movement system. Air Cargo volume is forecast to triple from 1998 to 2020, with 125 percent increase in all-cargo flights based on the Regional Goods Movement Study for the San Francisco Bay Area, Final Summary Report, Dec 2004, MTC.

2.1.5 Major Trip Generators

This section discusses land uses that are major trip generators and attractors within the study corridor.

Powell Street Emeryville Shopping District

With an area of 800 acres (1.25 square miles) the Powell Street Shopping District consists of variety of major retail stores like IKEA, and outdoor shopping mall located on Bay Street slightly east of I-80 and north of I-580. Bay Street Emeryville is a mixed urban neighborhood consisting of retail, residential apartment units, restaurants and movie theaters. Bay Street Emeryville offers over 1,900 parking spaces in multi-level structured facilities and surface lots.

Golden Gate Fields

The Golden Gate Fields facility is located on 181 acres (0.3 square miles) near the Buchanan Street exit, just west of I-80, with a one-mile dirt track for horse racing. In addition to holding

[1] Adopted from the Regional Goods Movement Study for the San Francisco Bay Are, Final Summary Report, Dec 2004, MTC.

approximately 1,350 horses, there is a main grandstand with seating for up to 9,000 visitors and a clubhouse with seating for 4,500 visitors. Parking is available for 8,500 cars on racing days. Within the year, there are approximately 105 racing days.

University of California Berkeley

The flagship campus of the University of California (UC) is located at the end of University Avenue, approximately two miles east of I-80 has an enrollment of 35,409 students and 2,028 faculty members among the 130 academic departments. As one of the largest universities in California, this public university has numerous intercollegiate athletic teams that compete throughout the year. During the fall, the university's football team brings as many as 80,000 spectators per game from the Bay Area to Berkeley's Memorial Stadium on the east side of campus.

Richmond Hilltop Shopping Area

The Hilltop Mall covering 64 acres (0.1 square miles) is located approximately 0.5 miles off the Hilltop Drive exit from I-80. Opening in 1976, this two-level mall has 140 stores, including a wide variety of retail stores and restaurants. Along Fitzgerald Drive, there is an 80-acre (0.12 square miles) plaza containing a wide range of retail, restaurant, and fast food venues. The plaza is also easily accessible off the Richmond Parkway exit.

Port of Oakland

Even though the Port of Oakland is located outside of the corridor limit (approximately two miles south of the corridor limit), it contributes significant truck traffic to I-80. The Port of Oakland is one of the largest maritime facilities in the Bay Area and it continues to grow and plans to capture a larger share of west coast maritime activities. It has ten container terminals and two intermodal rail facilities serving the Oakland Waterfront. The port of Oakland occupied 19 miles of waterfront in the San Francisco Bay, with about 900 acres devoted to maritime activities and 2600 acres devoted to aviation activities. The seaport ranks within the top 5 in the nation for containerized traffic.

2.1.6 Existing ITS Infrastructure

Existing roadway ITS elements within the I-80 study limits include both freeway mainline and ramp loop detectors, microwave vehicle detection systems (MVDS), changeable message signs (CMS), extinguishable message signs (EMS), closed circuit television cameras, Highway Advisory Radio (HAR), associated roadside equipment, Caltrans' Traffic Operations System, and FasTrak. Other ITS elements include bus arrival system, automatic vehicle location (AVL) system fro transit vehicles, and TravInfo. **Table 2-9** provides a summary inventory of the roadway ITS elements in the I-80 Corridor. Loop detector stations are equally distributed throughout the study corridor. There are 52 existing loop detector stations on the I-80 eastbound and 53 existing loop detector stations on the I-80 westbound. Many of the existing elements included in the Regional Architecture[3] are relevant to the I-80 study corridor and each element was evaluated to determine how they fit within the system concept of the I-80 ICM project. Additional details about existing ITS infrastructure and the regional ITS architecture can be found in the **Appendix E** .

[3] San Francisco Bay Area Regional ITS Plan, MTC, June, 2004.
http://www.mtc.ca.gov/planning/ITS/Index.htm

Table 2-9 Infrastructure Inventory

	ITS devices	Count
1	I-80 mainline and ramp loop detectors	105
2	Microwave vehicle detection systems (MVDS) on arterials	19
3	Changeable message signs on I-80 mainline	5
4	Highway advisory radio (HAR) antennas along I-80	3
5	Extinguishable message signs (EMS)	5
6	Closed-circuits television (CCTV) cameras along I-80 mainline	24
7	Closed-circuits television (CCTV) cameras along arterial	88

2.1.7 Environmental Issues

The I-80 corridor between the Bay Bridge and Carquinez Bridge encompasses numerous sensitive environmental resources. In addition to localized conditions or situations that may result in a significant adverse environmental impacts (e.g., noise and vibration, hazardous materials, etc.), the following environmental issues may be present throughout the corridor:

- Air quality: the San Francisco Bay Area Air Basin is not in attainment of state and/or federal ambient air quality standards for particulate matter.
- Biological resources: non-native grasslands in Contra Costa County and salt marsh areas in Alameda County provide habitat for several state- and federally-listed plant and wildlife species.
- Cultural resources: the corridor contains sediments, particularly in valleys and riverbanks, that are considered sensitive and may contain previously undocumented archaeological deposits.
- Traffic: the corridor, and I-80 in particular, currently experiences significant peak hour traffic congestion.
- Visual resources: portions of the corridor, particularly in the Emeryville Crescent area, have views of San Francisco Bay that are considered sensitive for motorists and others in the area.
- Permitting: portions of the alignment, particularly within the Emeryville Crescent area, are under the jurisdiction of the Bay Conservation and Development Corporation (BCDC). This state agency is charged with issuing or denying permit applications for work within their jurisdiction. Also, the corridor includes several creeks and other wetland features that may be within the jurisdiction of the US Army Corps of Engineers, the California Department of Fish and Game, and the Regional Water Quality Control Board.

2.2 Corridor Performance

Understanding the corridor-wide performance is the foundation for developing a Corridor System Management Plan (CSMP). This section discusses the corridor-wide performance measures to assess the operations of the I-80 corridor. In addition to traffic counts, floating car travel time runs and field observations conducted specifically for the I-80 ICM Project, numerous existing data and information sources were utilized in conducting this assessment of corridor performance. These sources included:

- Performance Measurement System (PeMS) database
- Caltrans Traffic Census data
- ACCMA travel demand model
- 2006 American Community Survey
- Caltrans Highway Congestion Monitoring Program (HICOMP) report
- Traffic Accident Surveillance and Analysis System (TASAS) database maintained by Caltrans
- Caltrans 2007 Bay Area HOV Lanes Report
- Caltrans Pavement Condition Reporting (PCR) System
- San Pablo Corridor Regional Signal Timing Program (RSTP) Project report
- 2008 BART Station Profile Study
- WestCAT and AC Transit schedules and ridership data
- Caltrans and MTC Tach run data
- Aerial photos

Figure 2-4 Existing Bi-Directional AADT

Source : Caltrans Data, 2008

2.2.1 Travel Demand Characteristics

Corridor Traffic Volume

Figure 2-4 provides a flow diagram of the bi-directional annual average daily traffic (AADT) on I-80 for 2008 from Caltrans traffic counts. The single highest traffic count of 288,000 vehicles per day (vpd) occurs between Powell Street and the I-80/I-880/I-580 split. East of the I-80/I-580 (east)/I-880 junction, there are two locations within the corridor where major changes in daily traffic occur: at I-580 (West) where volume changes by 94,000 vpd and at SR 4 where volume changes by 56,000 vpd.

Figure 2-5 provides westbound ramp volume and select mainline freeway information in the I-80 corridor for the AM peak hour (2008). The highest on-ramp volume of 3,000 vph is added to the corridor from I-580. Other high-volume on-ramp locations in the AM peak hour include SR 4 (2,000 vph), Pinole Valley Road (1,200 vph), Appian Way (1,220 vph), and San Pablo Dam Road (1,100 vph). The I-580/I-880 off-ramps experience the highest off-ramp volume of 5,700 vph. Other high-volume off-ramp locations include Richmond Parkway (1,760 vph), Cutting Boulevard (1,300 vph), and Gilman Street (1,490 vph).

Similar information for eastbound I-80 in the PM peak hour is provided in **Figure 2-6.** The highest entering volumes are from northbound I-880 (2,300 vph) and westbound I-580 (3,100 vph). Other high-volume on-ramp locations in the PM peak hour include Powell Street (950 vph), Barrett Avenue (1,350 vph), and eastbound Richmond parkway (1,400 vph). In addition to I-580-West (3,700 vph), high-volume off-ramp locations include Powell Street (1,700 vph), Hilltop Drive (1,150 vph), and SR-4 (2,400 vph).

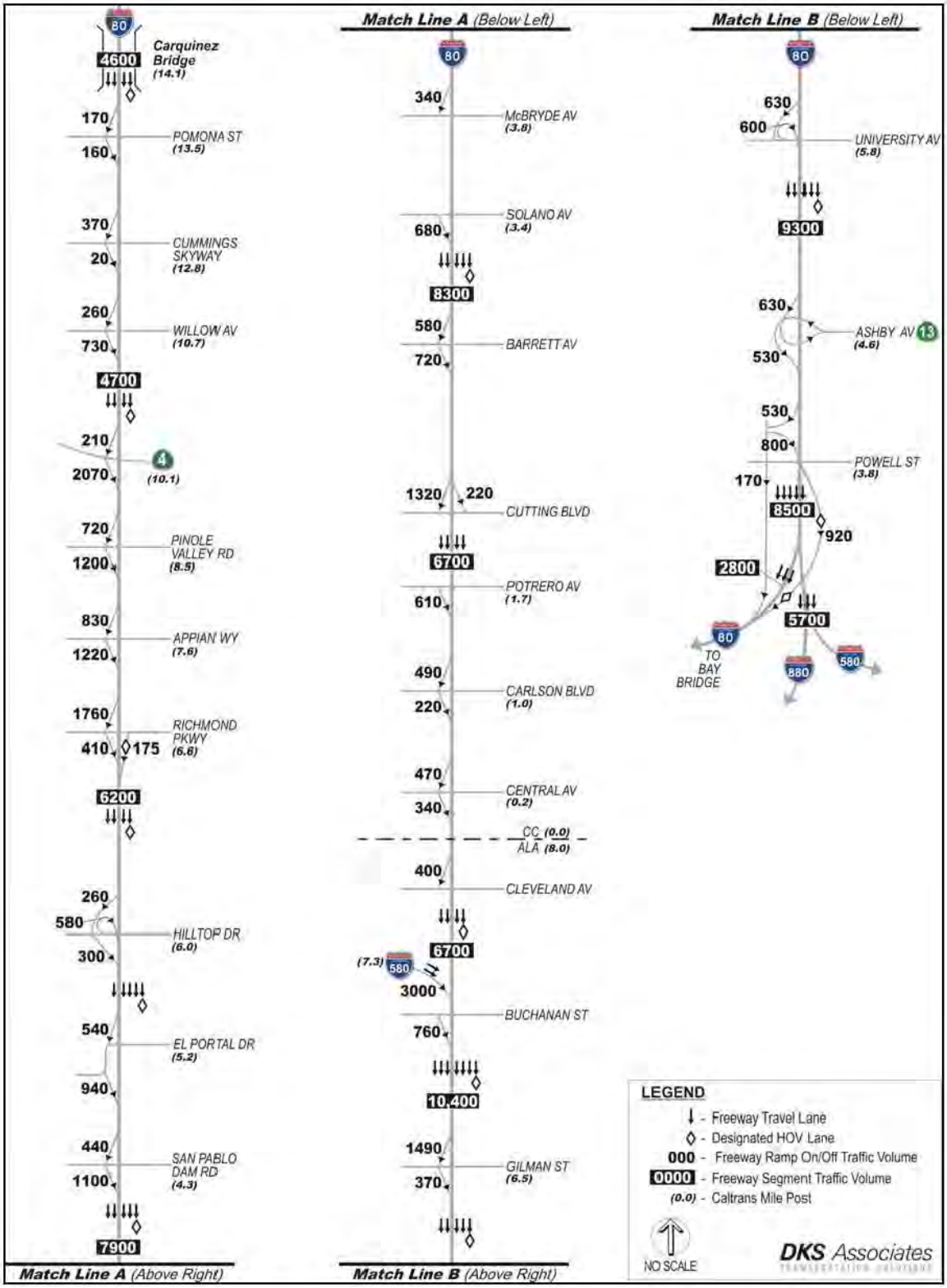


Figure 2-5 Existing Peak Hour Mainline and Ramp Volumes (WB AM Peak)

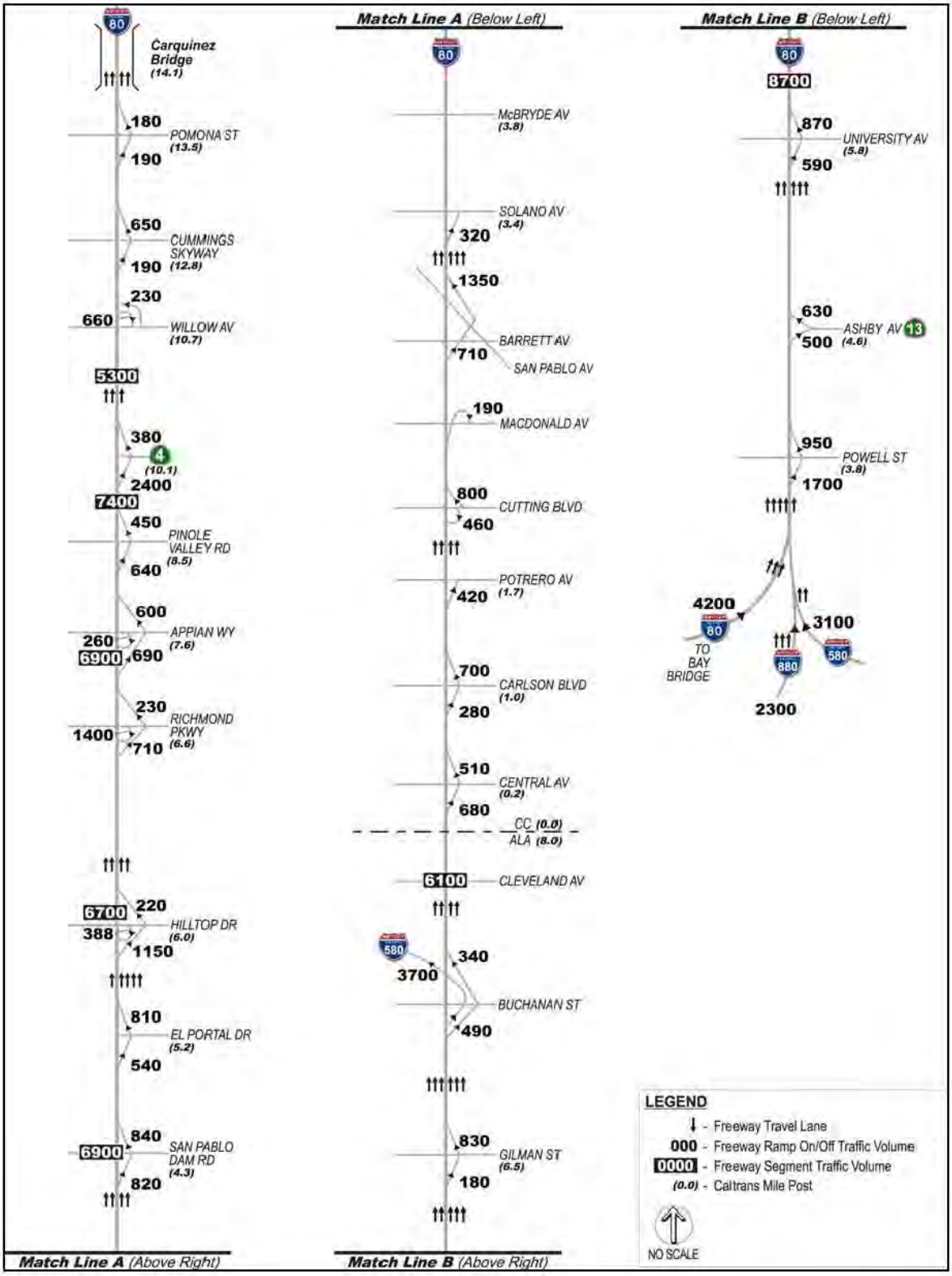
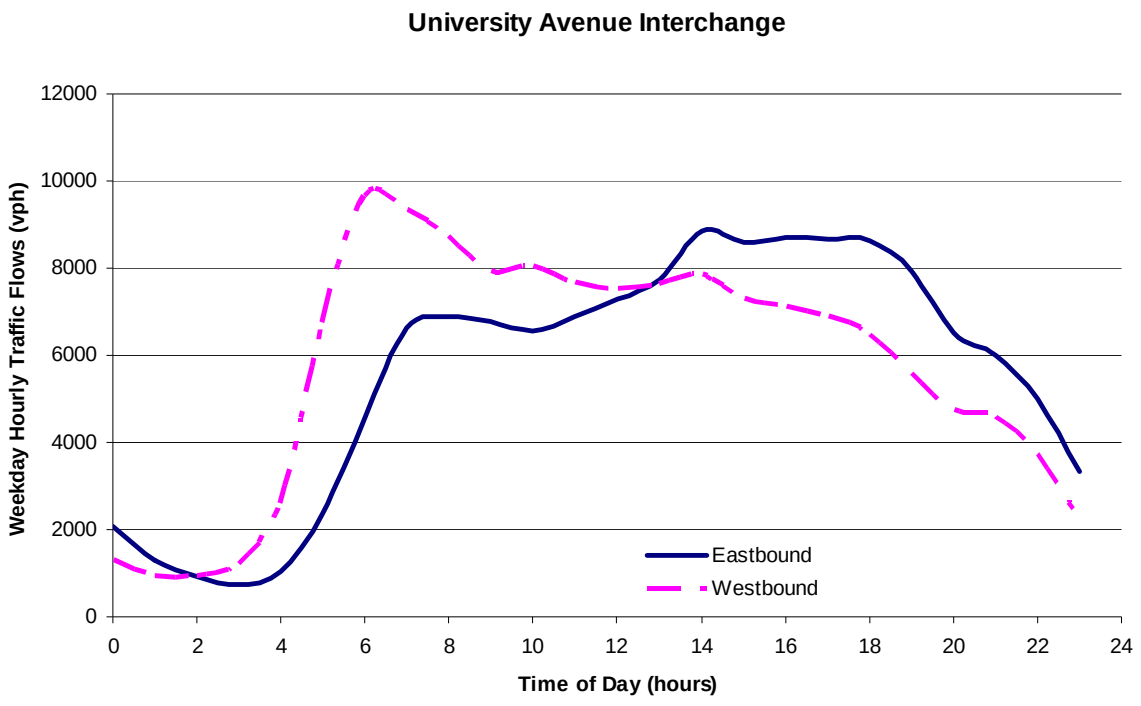


Figure 2-6 Existing Peak Hour Mainline and Ramp Volumes (EB PM Peak)

Traffic Peaking Patterns

Figure 2-7 and **Figure 2-8** consist of graphs at key locations that illustrate the variation in directional traffic volumes throughout the day based on Caltrans Census data between the years 2002-2004. In general, key findings from this data include:

- The directional peak in the morning is westbound.
- The directional peak in the evening is eastbound.
- In the eastbound direction, the percentage of traffic in the PM peak period varies between 18% and 23% of daily traffic.
- In the westbound direction, the percentage of traffic in the AM peak period varies between 35% and 43% of daily traffic.
- In the AM peak period, the directional split on I-80 is typically 40% eastbound, 60% westbound.
- In the PM peak period, the directional split on I-80 is typically 55% eastbound, 45% westbound.
- The peak hour volume ranges from 7% to 9% of the daily volume.



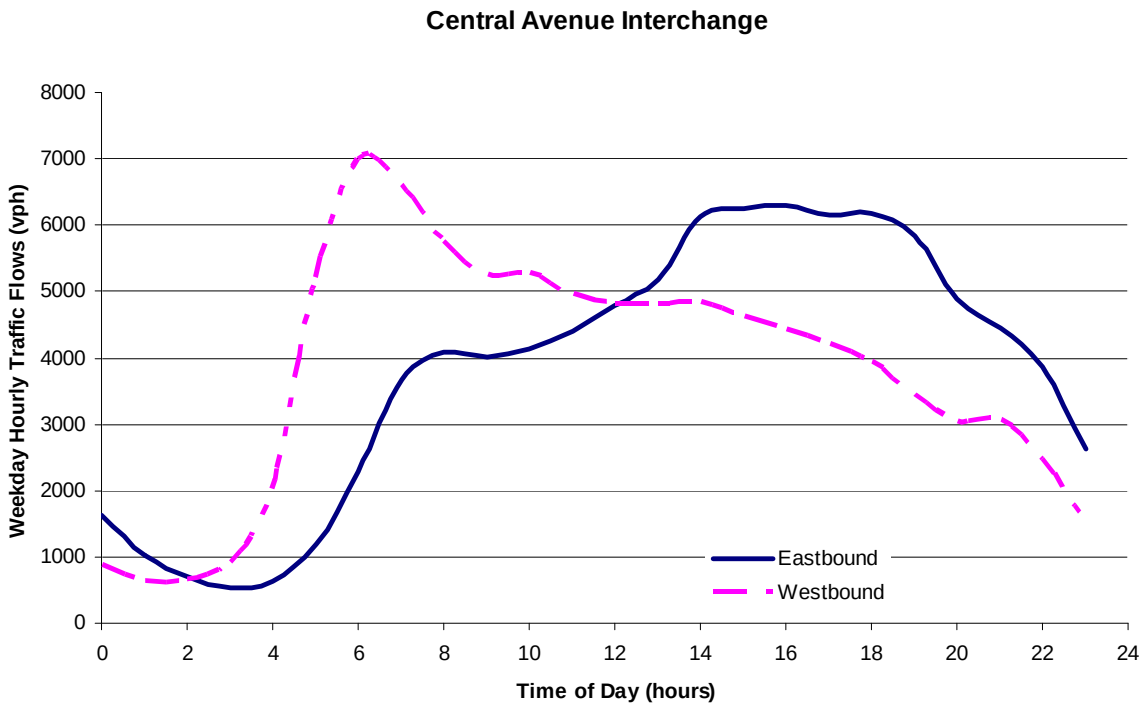
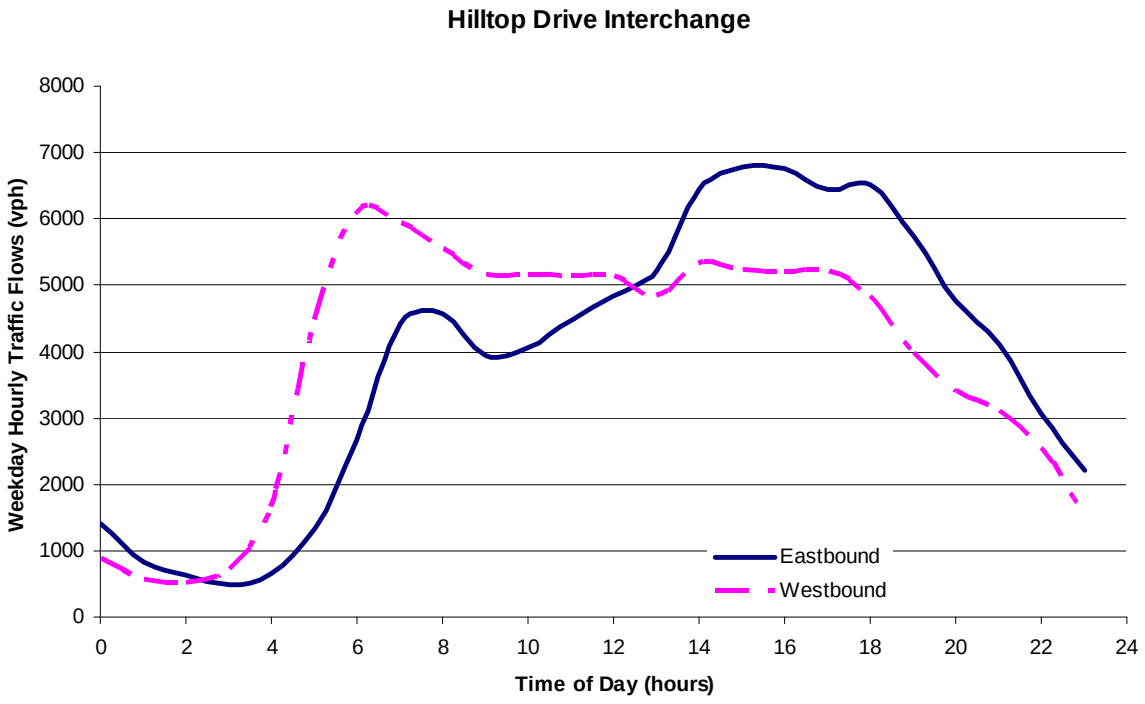


Figure 2-7 I-80 Weekday Hourly Volume Variation



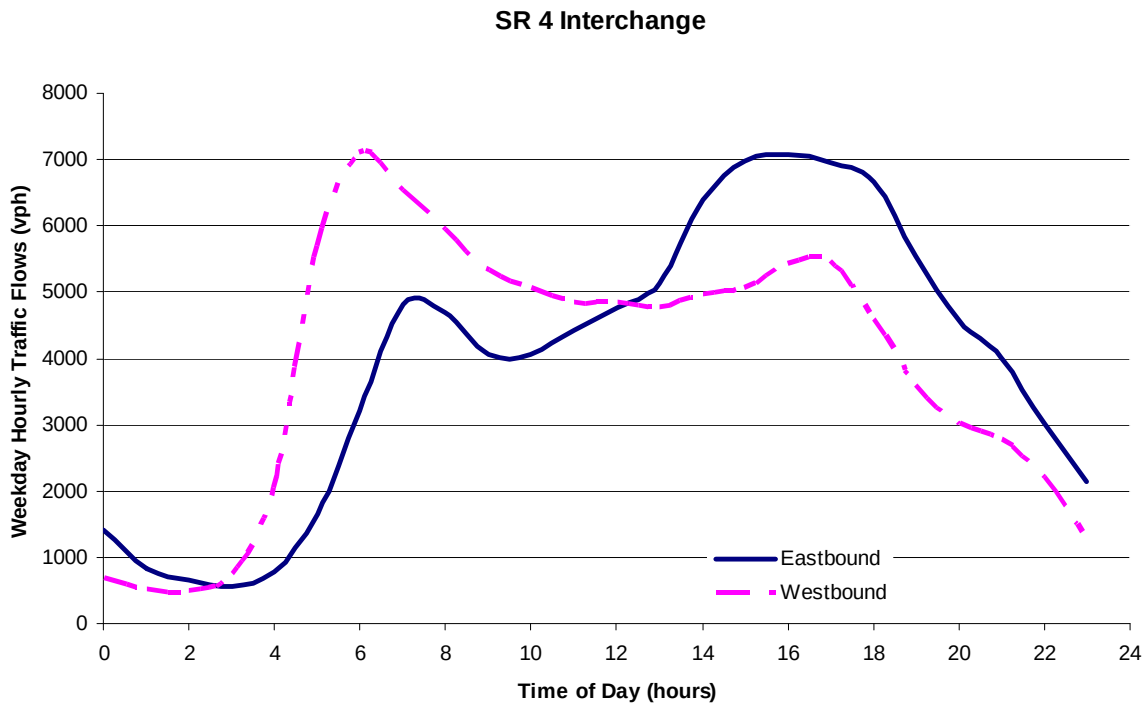


Figure 2-8 I-80 Weekday Hourly Volume Variation (Continued)

Trip Origin-Destination Patterns

Figure 2-9 and **Figure 2-10** highlight the origin and destination of traffic using I-80 in the existing AM peak hour and PM peak hour respectively. These figures were developed using select link results from the existing travel demand model.

Figure 2-9 presents origin-destination results for two select link locations in the westbound direction during the AM peak hour. The first part of the figure (figure to the right) shows the distribution of trip destinations for vehicles that pass through the Carquinez Bridge, while the second part (figure to the left) shows the distribution of trip originations that pass through I-80 west of Powell Street. Key findings include:

- Over 55% of the trips that use the Carquinez Bridge in the AM peak hour westbound continue west to the I-80/I-880/I-580 split. In total this represents a little over one full lane of capacity in terms of demand.
- Vehicle trips that use I-80 west of Powell Street during the AM peak hour originate in roughly equal distributions from four areas. These four areas include: Albany/Berkeley/Emeryville, I-580, Richmond to Rodeo, and east of the Carquinez Bridge.

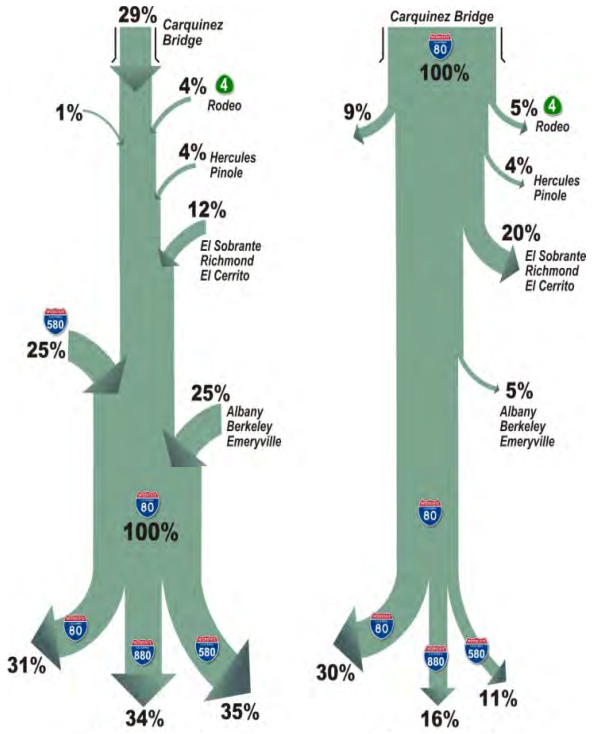


Figure 2-9 Origin Destination Data for WB I-80 Existing AM Peak Hour

Figure 2-10 provides similar information for eastbound I-80 in the existing PM peak hour. The figure to the left shows the distribution of trip destinations of vehicles originating from eastbound I-80 at Powell Street. The figure to the right shows the distribution of trip originations of vehicles that travel through Carquinez Bridge. Key findings include:

- Trip destinations of vehicles originating from eastbound I-80 at Powell Street in the PM peak hour are roughly equally distributed to four areas: Albany/Berkeley/Emeryville, I-580, Richmond to Rodeo, and east of the Carquinez Bridge.
- Over 40% of the trips that use the Carquinez Bridge eastbound in the PM peak hour travel the entire corridor.

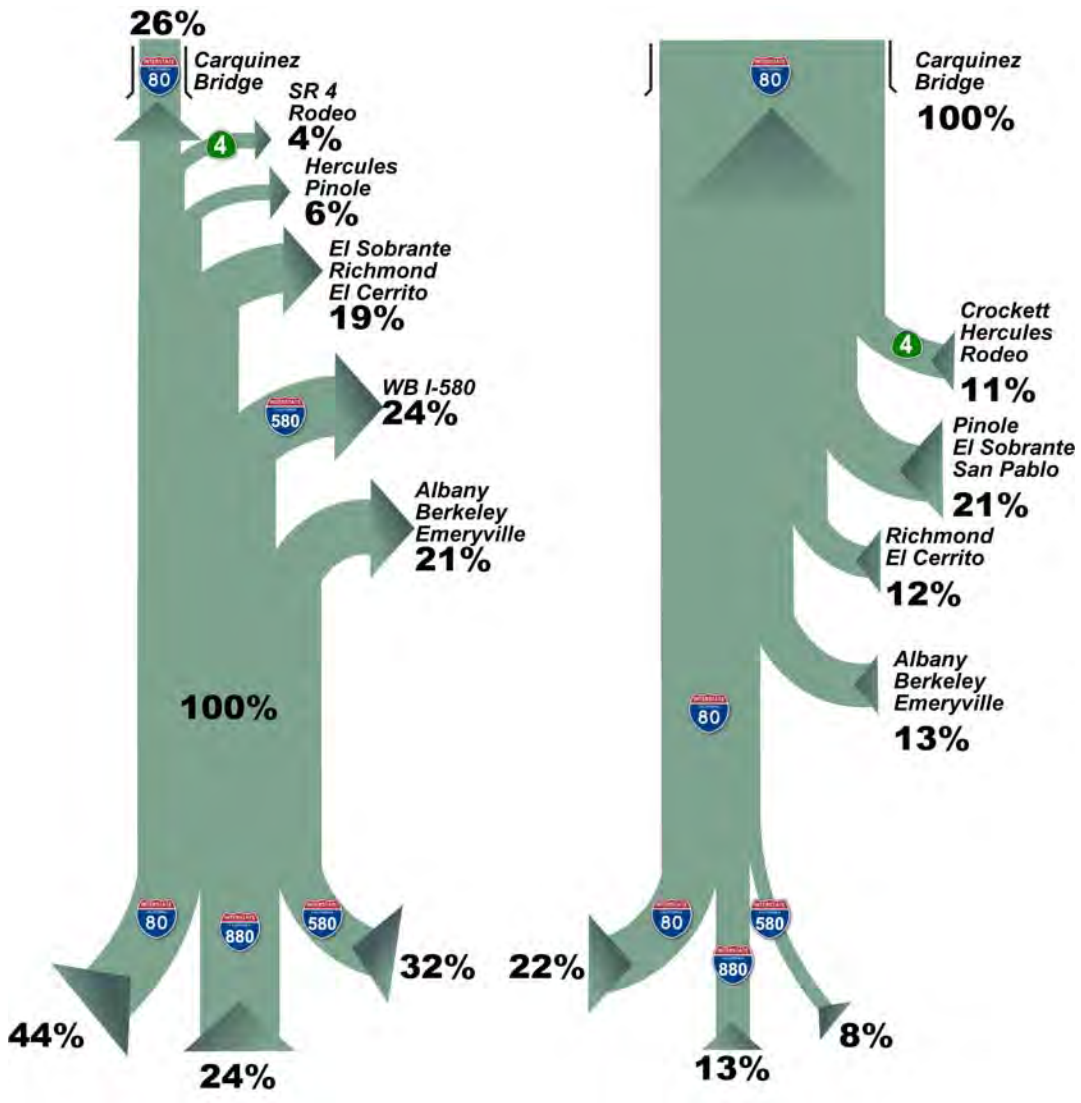


Figure 2-10 Origin Destination Data for EB I-80 Existing PM Peak Hour

Truck Traffic

The percentage of trucks along I-80 within the study corridor is summarized in **Table 2-10.** The trucks along I-80, range from two to five percent of the total daily vehicle traffic. The highest truck volumes and percentages are observed just east (north) of the I-80/I-580/I-880 maze, with truck volumes and percentage dropping dramatically at the Bay Bridge. This pattern reflects the high volume of traffic associated with the connections to I-580 and , more importantly, I-880 that provides access to the Port of Oakland.

Based on the San Pablo Corridor Regional Signal Timing Program (RSTP) Project, trucks represent about two percent of the total vehicle traffic on San Pablo Avenue.

Table 2-10 Truck Percentages along the I-80 Corridor

Postmile	Leg	Description	Truck AADT	% Truck of Total Vehicles	% Truck by Axle			
					2	3	4	5+
ALA1.989	A	Bay Bridge Toll Plaza	6,325	2.5	45	7	3	45
ALA2.802	B	Oakland, Junction I-580E	3,593	1.8	46	7	4	43
ALA2.802	A	Oakland, Junction I-580E	8,056	2.7	42	9	4	45
ALA3.786	A	Emeryville, Powell Street	13,364	4.8	38	9	4	50
ALA4.582	B	Berkeley, Junction SR-13E	13,420	4.8	35	10	4	51
ALA4.582	A	Berkeley, Junction SR-13E	12,879	4.8	38	9	4	49
CC2.04	B	Richmond, Junction SR-123S	5,888	3.2	35	11	4	50
CC2.04	A	Richmond, Junction SR-123S	6,688	3.2	35	10	4	52
CC2.961	B	Richmond, San Pablo Avenue	6,674	3.2	35	8	5	53
CC2.961	A	Richmond, San Pablo Avenue	7,633	3.6	34	7	4	56
CC5.983	B	Richmond, Hilltop Drive	8,040	4.0	37	10	3	50
CC7.597	O	Pinole, Appian Way	8,478	4.4	31	8	3	59
CC7.597	B	Pinole, Appian Way	8,109	4.2	32	7	4	58
CC10.059	B	Hercules, Junction SR-4E	8,556	4.6	34	7	4	55
CC10.059	A	Hercules, Junction SR-4E	7,169	5.4	28	8	2	62
CC14.139	B	Carquinez Bridge	6,200	5.0	28	8	3	61

Note: Leg A = ahead leg, Leg B = back leg, Leg O = traffic volume is equal for the back and ahead legs

Source: 2007 Annual Average Daily Truck Traffic on the California State Highway System, Compiled by Traffic Data Branch, Division of Traffic Operations (published in September, 2008)

Mode Choice Characteristics

The data presented in this section is derived from the 2006 American Community Survey (ACS). Mode split for means of transportation to work for cities along the I-80 Corridor is illustrated in **Table 2-11.** Single occupancy vehicle use is prevalent at 73.5 percent in Vallejo and at 71 percent in Hercules, which is in the northern area of the study corridor. In contrast, transit use is higher in the southern areas such as Albany, Berkeley, Emeryville, and Oakland.

Table 2-11 Mode Split

Cities	SOV%	Rideshare%	Transit%	Bike %	Walk%	Other Means%	Work at home %
Vallejo	73.5	16.1	3.2	0.3	1.5	1.8	3.7
Richmond-San Pablo	59.0	17.4	15.1	0.8	1.0	1.5	5.2
El Cerrito-Hercules	71.0	13.2	10.1	0.2	1.5	0.6	3.4
Berkeley-Albany	44.6	6.3	19.0	6.5	14.5	0.9	8.3
West-North-Oakland-Emeryville	51.9	10.2	19.7	3.8	7.2	1.6	5.6
Oakland Hills-Piedmont	61.6	11.5	15.1	1.9	3.5	0.9	5.5
East Oakland	58.3	13.4	14.6	0.1	4.0	3.7	5.9

Source: 2006 American Community Survey

According to this survey, the HOV percentage in the Bay Area was approximately 10.2 percent in 2007, down from 12.9% in 2000. The HOV percentage in Alameda County was approximately the same with the Bay Area while the HOV percentage was 11.5% in Contra Costa County.

2.2.2 Freeway Performance

This section summarizes the findings along with the methodologies and assumptions used to measure the performance of I-80 corridor. The performance measures used to quantify the freeway performance include:

- Mobility: quantifies traffic congestion in terms of vehicular delays
- Reliability: measures predictability of freeway travel times within the corridor
- Safety: evaluates accident rates in comparison to statewide average accident rates
- Productivity: gauges freeway's loss in efficiency due to traffic congestion

Mobility

Mobility describes the ease of movement of people and freight in the corridor. Travel time and delay are interrelated primary measures to quantify mobility. Travel time is defined as is the amount of time for a vehicle to traverse between two points along a corridor. Delay, on the other hand, is defined as the difference between the observed travel time and the expected travel time under a specified traffic condition such as 35 mph, which Caltrans uses to define congested

conditions for freeways. Therefore, the delay relative to 35 mph is used in this study, and is reported as vehicle-hours of delay. Rather than reporting the delay for individual vehicles, the total delay incurred by all travelers over a period or day is most often reported. Delay information is shown in this section to describe mobility issue. Travel time information will be shown along with its variation to describe the reliability issue in the next section.

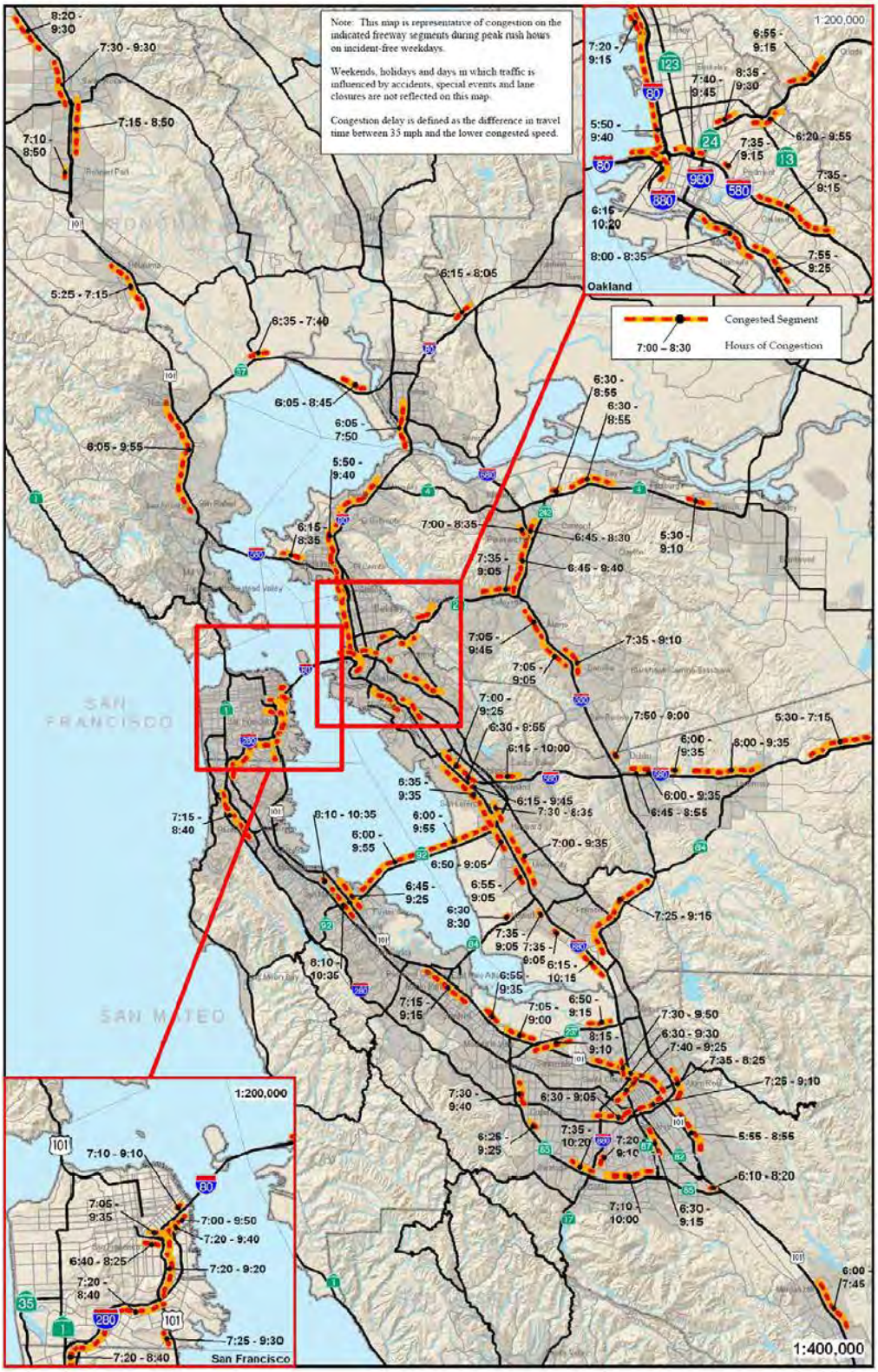
Caltrans Highway Congestion Monitoring Program (HICOMP) is one of most accepted sources for information regarding the overall mobility of a corridor. The annual HICOMP report identifies the location and duration of congestion delay on freeways. HICOMP defines recurrent congestion as a condition lasting for 15 minutes or longer where travel demand exceeds freeway capacity and vehicular speeds are 35 miles per hour (mph) or less. **Figure 2-11** and **Figure 2-12**, extracted from the 2007 HICOMP report, show the hours of congestion on Bay Area freeways during the AM and PM Peak Periods. HICOMP reports describe I-80 as the most congested corridor in the Bay Area for many years, particularly in the westbound direction, between SR 4 in Contra Costa County and the Bay Bridge during the AM peak period. During the AM peak period, westbound (or southbound) is the peak direction and during the PM peak period, the peak direction is eastbound (or northbound).

Vehicle Hours of Delay

The PeMS database was also a data source used to compute freeway delay (measured as vehicle of hours of delay) along I-80 eastbound and I-80 westbound. Continuous data from the PeMS detectors were processed and aggregated to provide delay information by day of week, and by time of day.

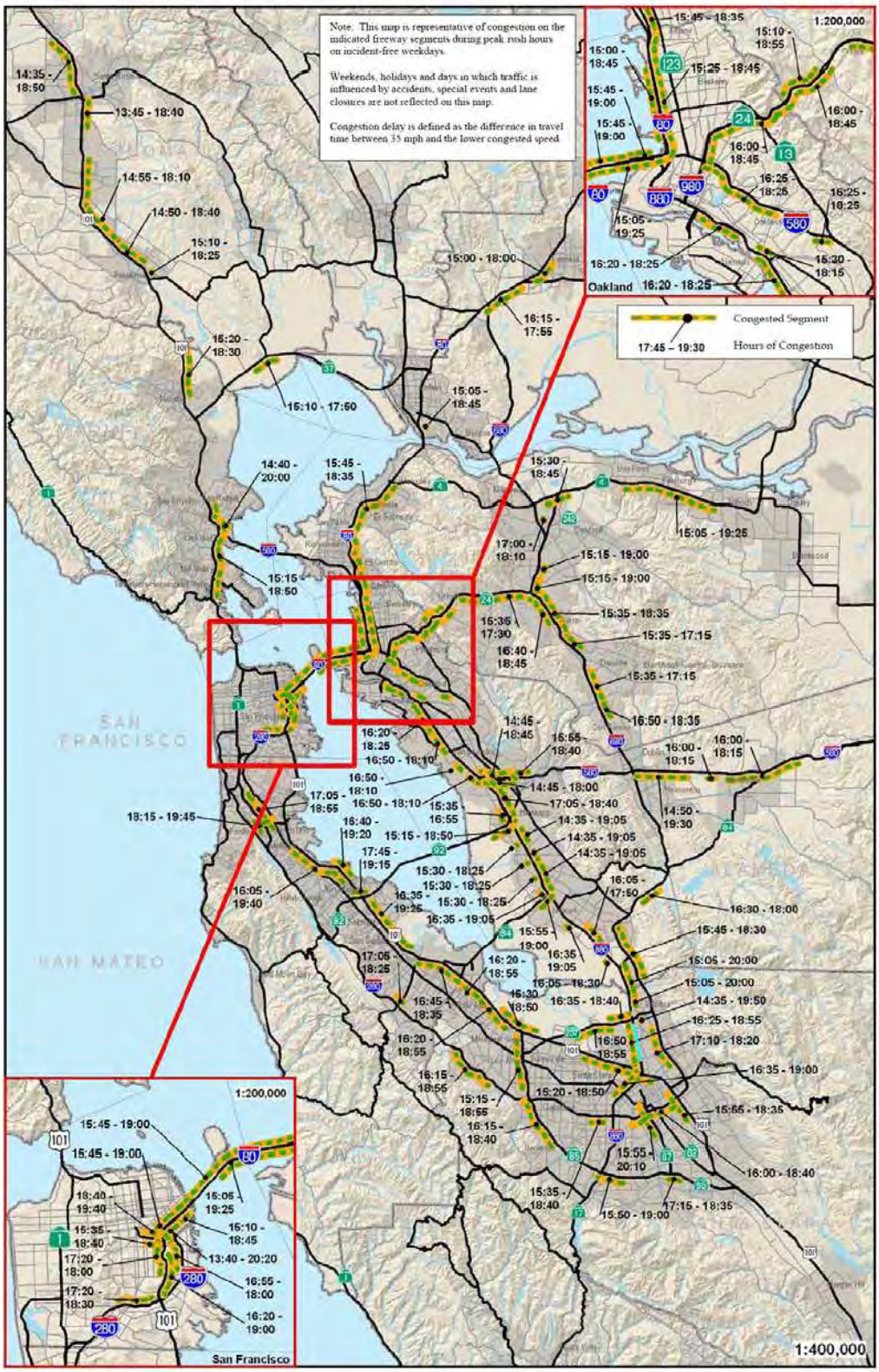
Figure 2-13 shows average daily delay by day of week. The minimum, mean (average), and maximum delays of each day are shown in the plot, as well as the corresponding values in the unit of vehicle-hours relative to the congested speed of 35 mph as discussed earlier. The figure indicates that the mobility along the corridor on Sundays is good (less delay and less fluctuation).

Figure 2-14 shows the data aggregated by time of day for a typical workday (Tuesday to Thursday). Three-year trends are identified for I-80 eastbound and I-80 westbound, separately. The figure indicates that corridor mobility has slightly improved from 2006 to 2008, not only in terms of magnitude of delay but also in terms of variation. The peak delay in 2008 occurs during the AM period between 6:00 AM and 10:00 AM in the westbound direction and the peak delay occurs during the PM peak period between 2:00 PM and 7:00 PM.



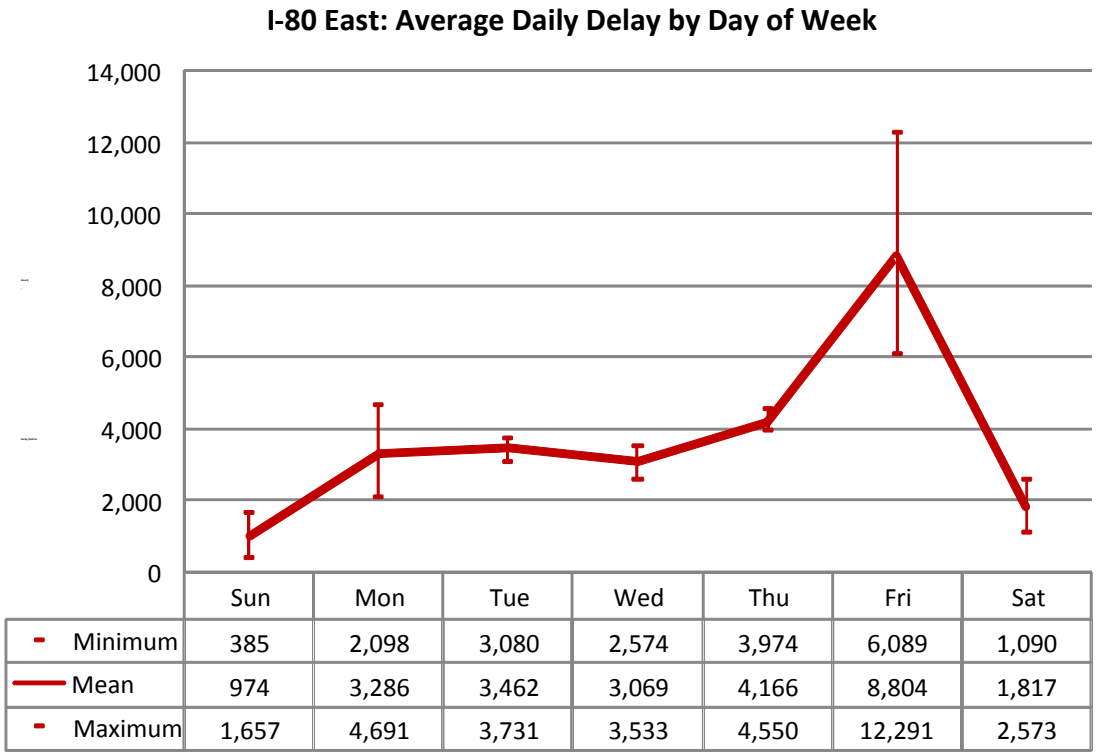
Source: HICOMP (2007)

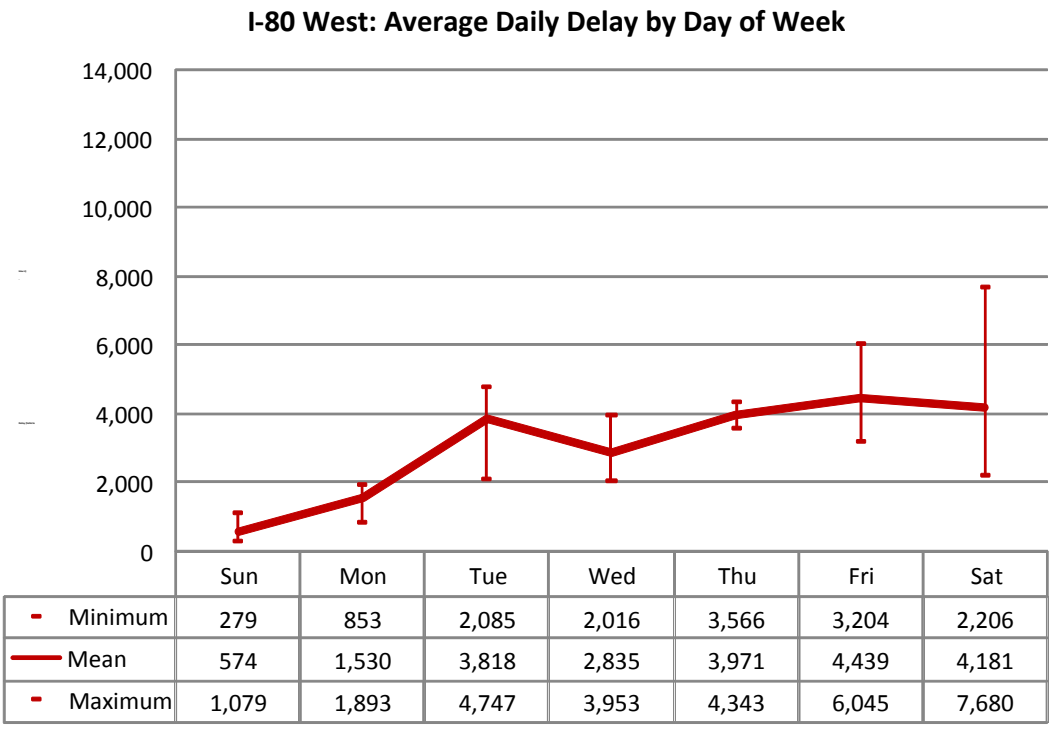
Figure 2-11 Congested Freeways – Existing AM Peak



Source: HICOMP (2007)

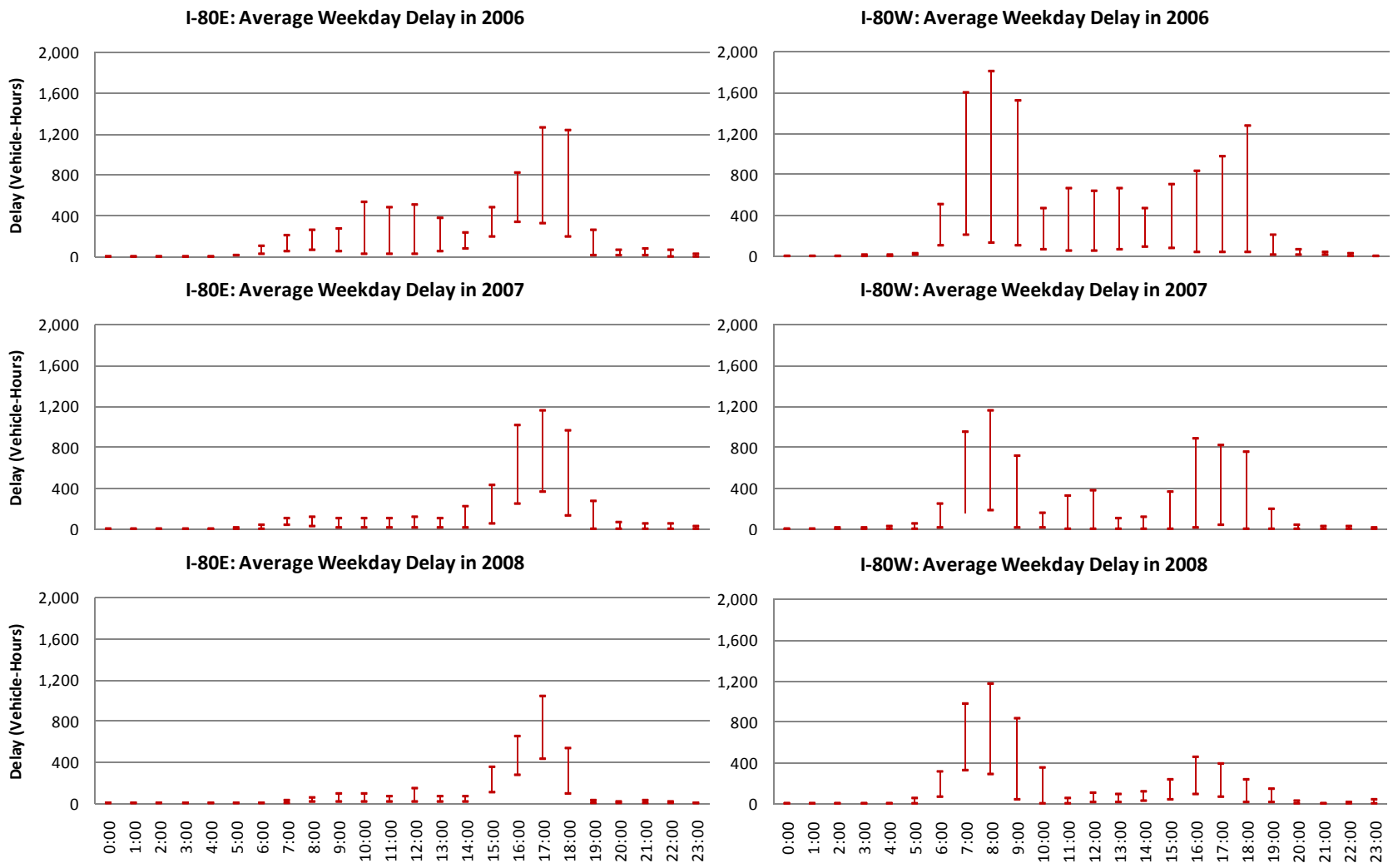
Figure 2-12 Congested Freeways – Existing PM Peak





Source: PeMS Database (March 30 – April 19, 2008)

Figure 2-13 Average Daily Delay by Day of Week



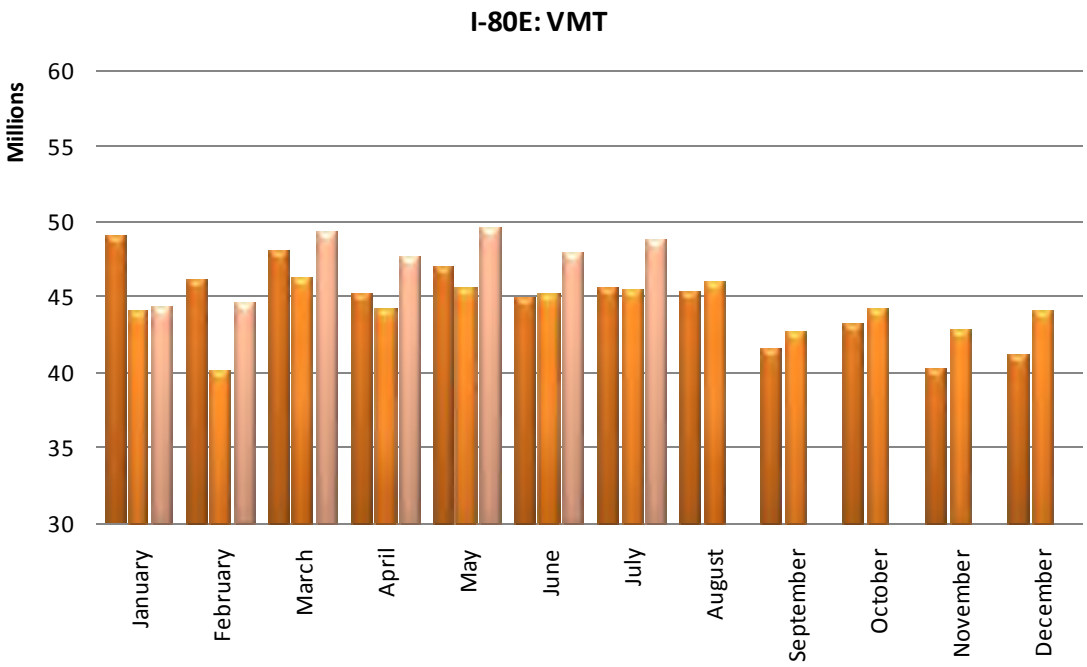
Source: PeMS Database (March 30 – April 19; Tuesday to Thursday)

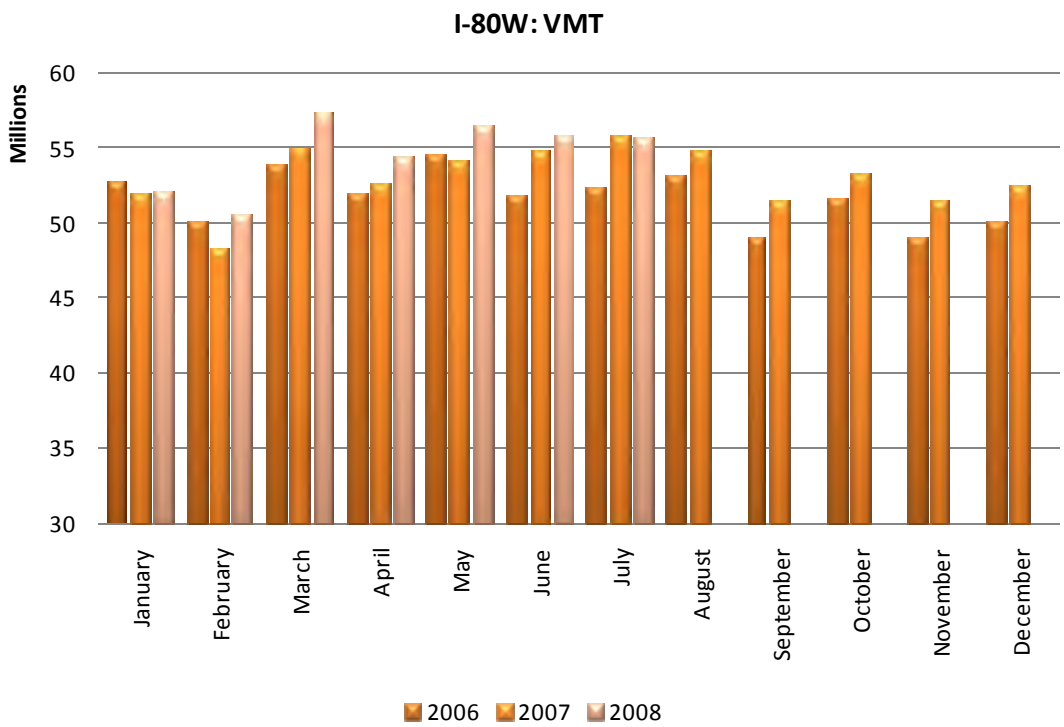
Figure 2-14 Average Weekday Delay by Time of Day

Vehicle-Miles Traveled (VMT)

Vehicle-miles traveled (VMT) is a key measurement used for highway planning and management. VMT measures roadway usage, which is not weighted by the time that travelers are required to spend on using a set of roadway segments. Along with other data, VMT is often used in estimating congestion, air quality, and potential gas-tax revenues, as well as providing a general measure of the level of the economic activity.

Figure 2-15 illustrates VMT along I-80 within the study corridor by month, obtained from the PeMS database for the period covering January 2006 to July 2008. Each bar represents the total VMT for each month in each year. It can be seen that I-80 westbound serves more traffic than I-80 eastbound. Overall, I-80 westbound experienced 17% higher VMT than I-80 eastbound. I-80 westbound serves on the average of 53 million vehicle-miles per month, compared to an average of 45 million vehicle-miles served by I-80 eastbound. In terms of year-to-year trends, VMT on I-80 generally increased from year 2006 to year 2008. The peak travel months are generally between March and August.



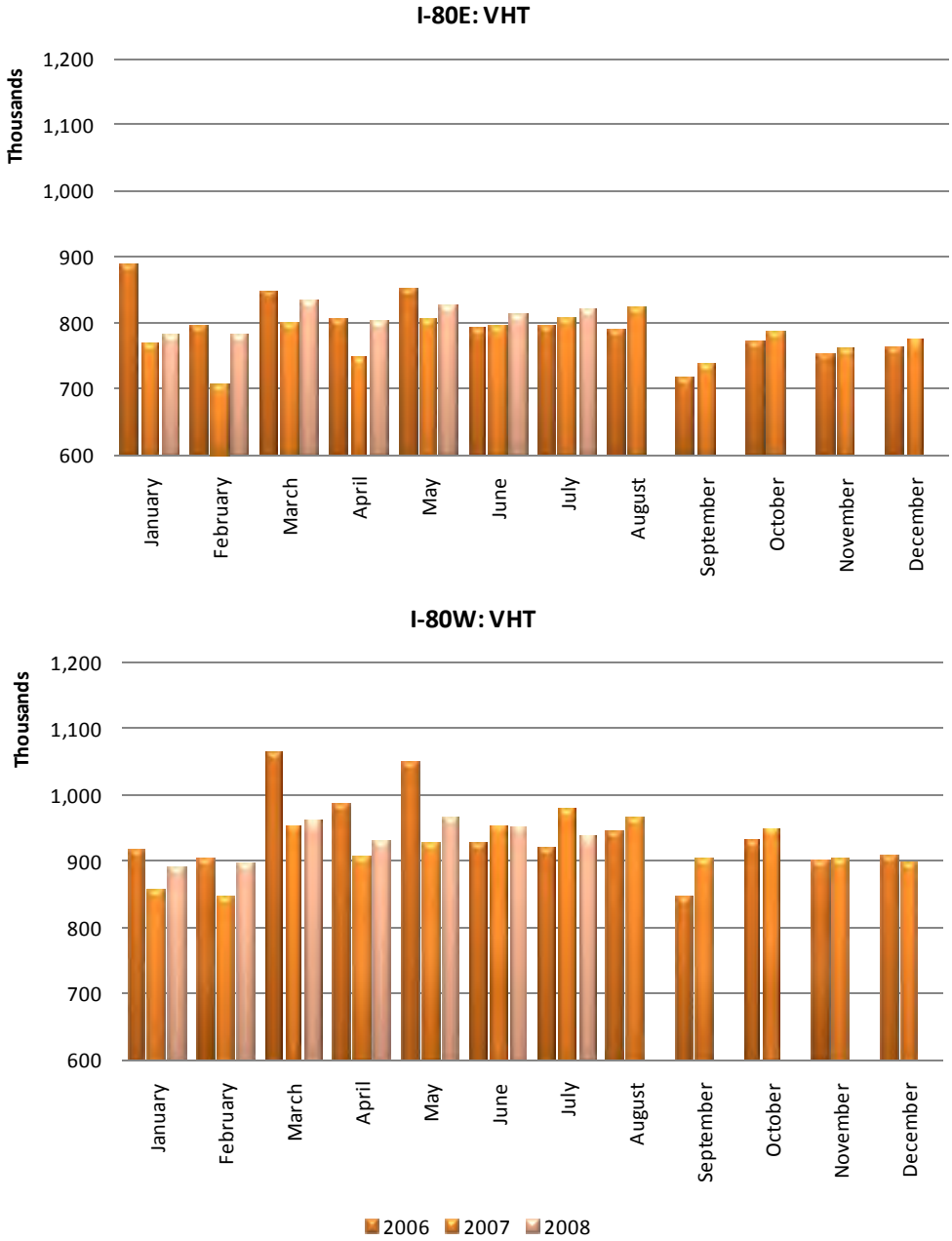


Source: PeMS Database (January, 2006 – July, 2008)

Figure 2-15 Vehicle-Miles Traveled (VMT)

Vehicle-Hours Traveled (VHT)

Vehicle-hours traveled (VHT) is another key measurement used for highway planning and management. It is calculated as a product of traffic volume and travel time on each freeway segment. **Figure 2-16** illustrates the monthly VHT on I-80 obtained from the PeMS database for the period between January 2006 and July 2008. Similar to VMT, the VHT experienced on I-80 westbound is approximately 18% higher compared to VHT experienced on I-80 eastbound. The peak travel months are March and August.



Source: PeMS Database (January, 2006 – July, 2008)

Figure 2-16 Vehicle-Hours Traveled (VHT)

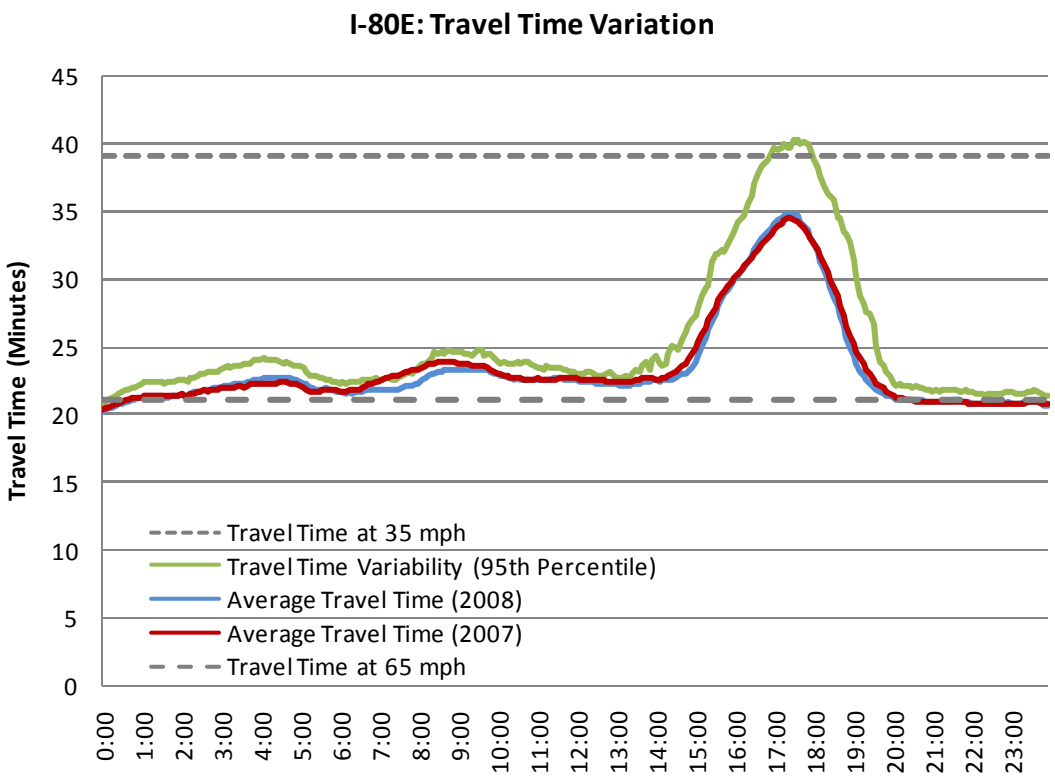
Reliability

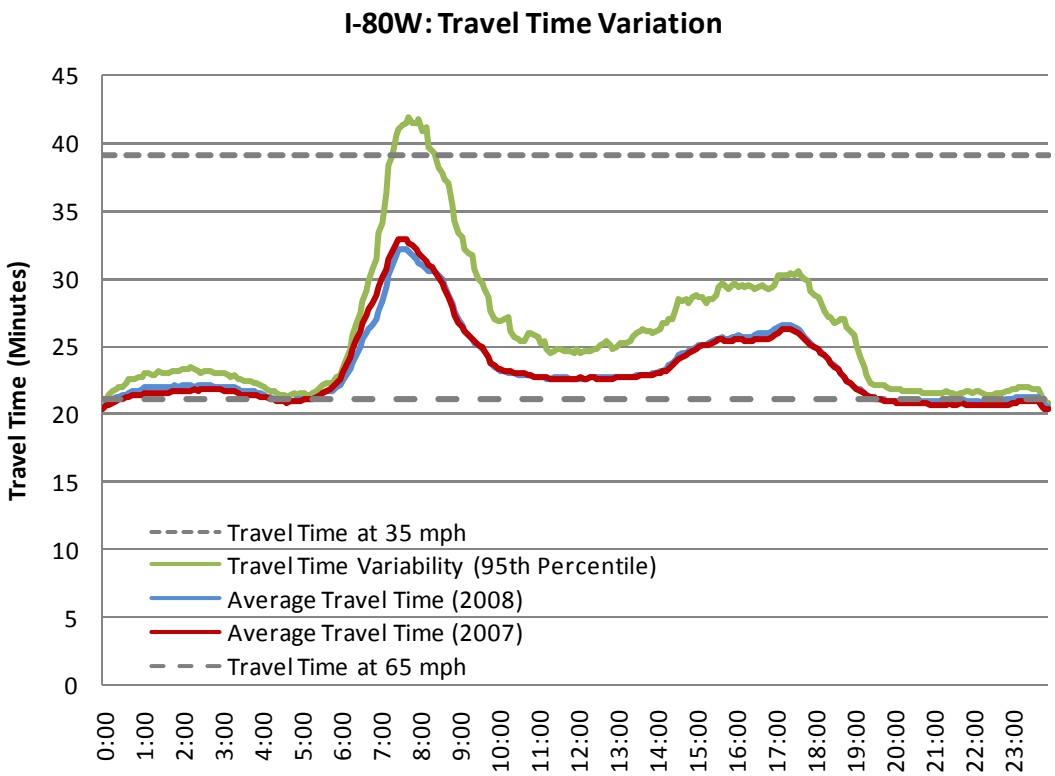
Unlike mobility, reliability focuses on the day-to-day variation of travel time. Continuous travel time data from the PeMS database was used to assess the reliability of travel times along the entire I-80 study corridor between the City of Oakland and the City of Vallejo. The data was used to compute the average and 95th percentile weekday (Tuesday to Thursday) travel times. The difference between the average and the 95th percentile travel times provides an indication of the day-to-day variation and reliability in travel time along the corridor. These results are presented in **Figure 2-17.** For reference, the expected travel times at constant speeds of 65 mph (21 minutes) and 35 mph (39 minutes) are also illustrated.

As illustrated in the figure, the travel time of I-80 eastbound is more reliable than that of I-80 westbound as the average travel time is closer to the 95th percentile for a greater portion of the day. Even during the peaks, travel times for I-80 eastbound are more reliable. For example, to travel on I-80 westbound around 7:30 AM, it takes on average about 33 minutes. However, travelers must allow for the trip to take 43 minutes (10 additional minutes) to account for extra congestion that they may face if they want to have 95% chance of arriving on-time. For I-80 eastbound, the corresponding numbers at 5:30 PM are an average travel time of 35 minutes and a 95th percentile time of 40 minutes meaning an allowance of 5 additional minutes.

The figure shows that travel times for I-80 eastbound remain relatively constant for a good portion of the day, but increase significantly from 2:00 PM to 7:00 PM, with the peak around 5:00 PM. In the westbound direction, travel times increase not only during the AM peak (5:00 AM to 9:00 AM), but also to a lesser degree during the PM peak period. The peak travel time occurs around 7:00 AM.

Finally, **Figure 2-17** also shows the average travel times for both 2007 and 2008. In general, travel times show little change between the two years.





Source: PeMS Database (January 1 – October 31, 2008; Tuesday to Thursday)

Figure 2-17 Travel Time Variation by Time of Day

Safety

Accident Data from TASAS Database

The Traffic Accident Surveillance and Analysis System (TASAS) database maintained by Caltrans is a collection of auto accident data which complies with federal law requiring statistical analyses of auto accidents for the purpose of reducing the occurrence of collisions. The components of the system include Accident Data Base (AXDB) and a TASAS Selective Accident Retrieval (TSAR) query system.

Accident rate, defined as accidents per million vehicle-miles, is a safety performance measure of a highway corridor. **Table 2-12** summarizes the accident rate by segment for the study portion of I-80 between November 2004 and October 2007. The limits of each segment are illustrated in **Figure 2-18**. The figure shows the segments from the Bay Bridge Toll Plaza to the merge from I-580 (segments 1 and 2 in Table 2-12) are critical segments in terms of safety. Segment 1 has an accident rate of 2.06, compared to the state-wide average accident rate of 1.32. Segment 2 has an accident rate of 2.18, compared to the state-wide average accident rate of 1.22.

In addition to the information provided in **Table 2-12,** the TASAS database also indicates that I-80 in the westbound direction experiences more accidents than the eastbound direction. Among the 926 accidents in Segment 1, 716 occurred in the westbound direction. Among 2,270 accidents in segment 2, 1,407 happened on I-80W.

Table 2-12 Accident Rate by Segment

Segment	Limits	Number of Accidents	Accident Rate	State-wide Average Accident Rate
1	ALA PM 1.990 – ALA PM 3.513	926	2.06	1.32
2	ALA PM 3.513 – ALA PM R6.936	2,270	2.18	1.22
3	ALA PM R6.936 – CC PM 4.063	1,077	0.97	1.19
4	CC PM 4.063 – CC PM 9.250	1,290	1.18	1.00
5	CC PM 9.250 – CC PM 14.138	722	0.99	1.03

Note: "Accident Rate" is the number of accidents per million vehicle-miles. "State-wide Average Accident Rate" is the average accident rate for California freeway segments in areas and with similar geometrics.
Source: TASAS Database (November 1, 2004 – October 31, 2007)

Figure 2-18 Segment from TASAS Accident Analysis

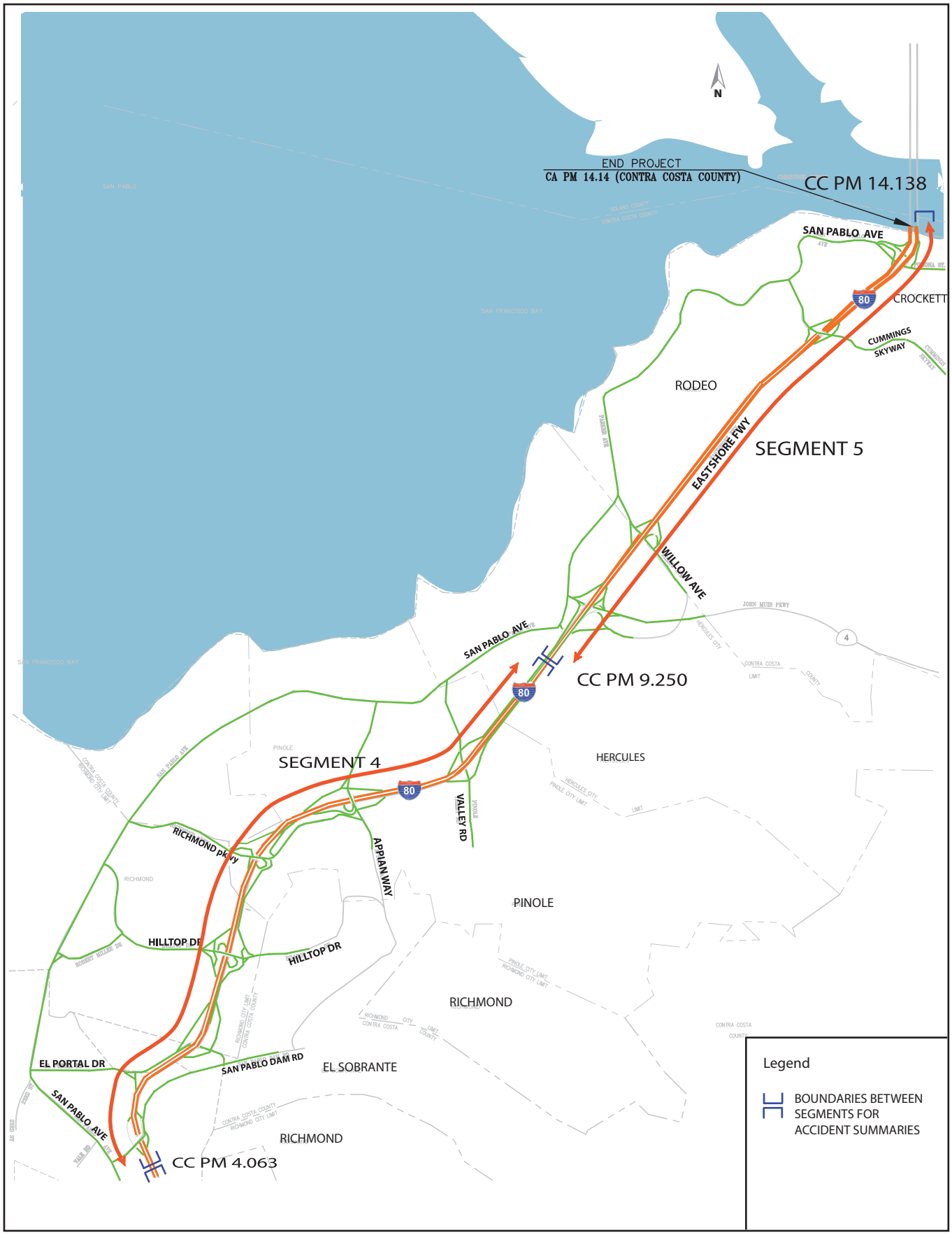


Figure 2-18 Segment from TASAS Accident Analysis (Continued)

Continuous Risk Profiles from TASAS Database

Continuous Risk Profile (CRP) analysis is an alternative way of assessing the accident data from the TASAS database. A CRP represents the number of accidents recorded in a moving window of the freeway, compared to a reference base rate. The resulting profile plots highlight locations that have a high risk of incidents, and filter out the "noise" related to inaccuracies in coding exact location. The CRP methodology was developed by the Traffic Safety Center at the University of California at Berkeley in collaboration with the California Department of Transportation.

The results of the CRP analysis for eastbound and westbound I-80 within the study corridor are illustrated in **Figure 2-19** and **Figure 2-20** respectively. This figure shows the trends between the years of 2004 to 2006. The magnitude of the y-axis indicates the number of accidents per year per mile. Spikes or peaks in the chart indicate where greater risks for collisions are present. Consistent with the TASAS results presented previously, the I-80 segment between the Bay Bridge Toll Plaza and the merge from I-580 has the highest risk in terms of collisions (it also have the longest duration of congestion within the corridor). Additionally, in the eastbound direction, the segment between San Pablo Dam Road and SR 4 has a relatively higher risk of collisions compared to other segments in the corridor.

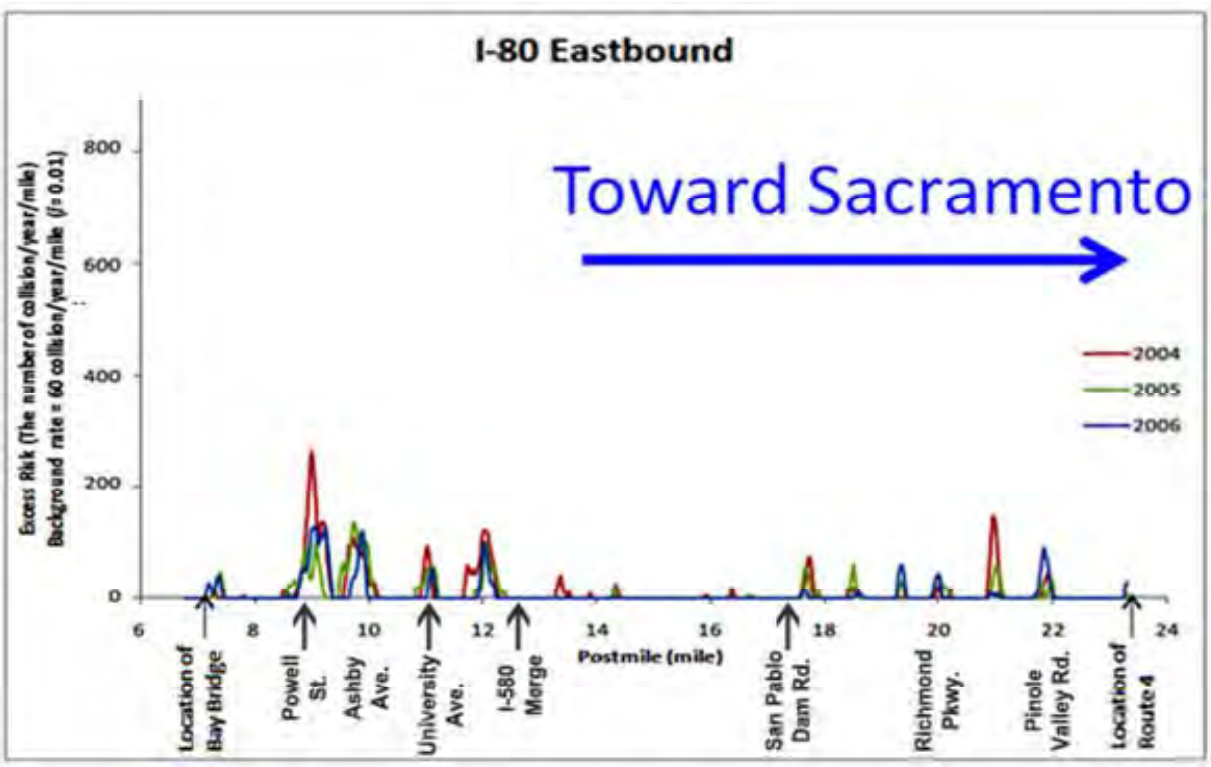


Figure 2-19 Eastbound I-80 Continuous Risk Profile

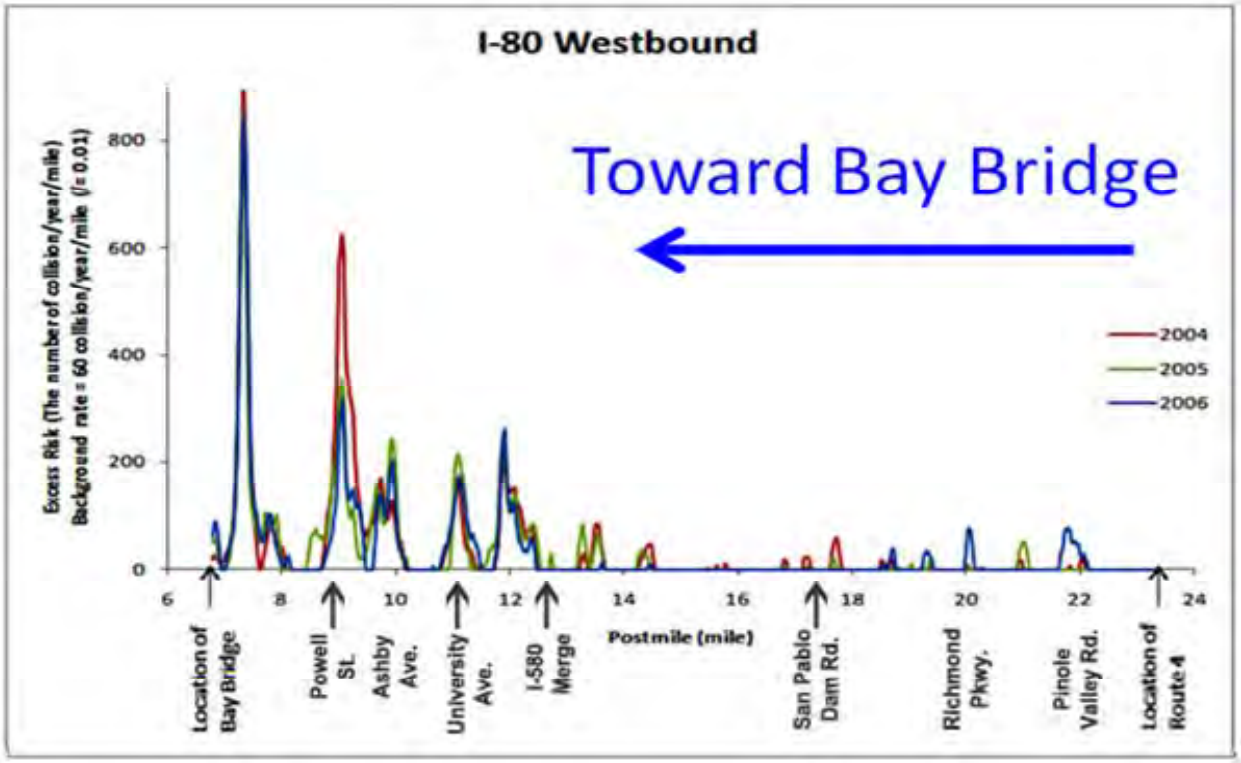
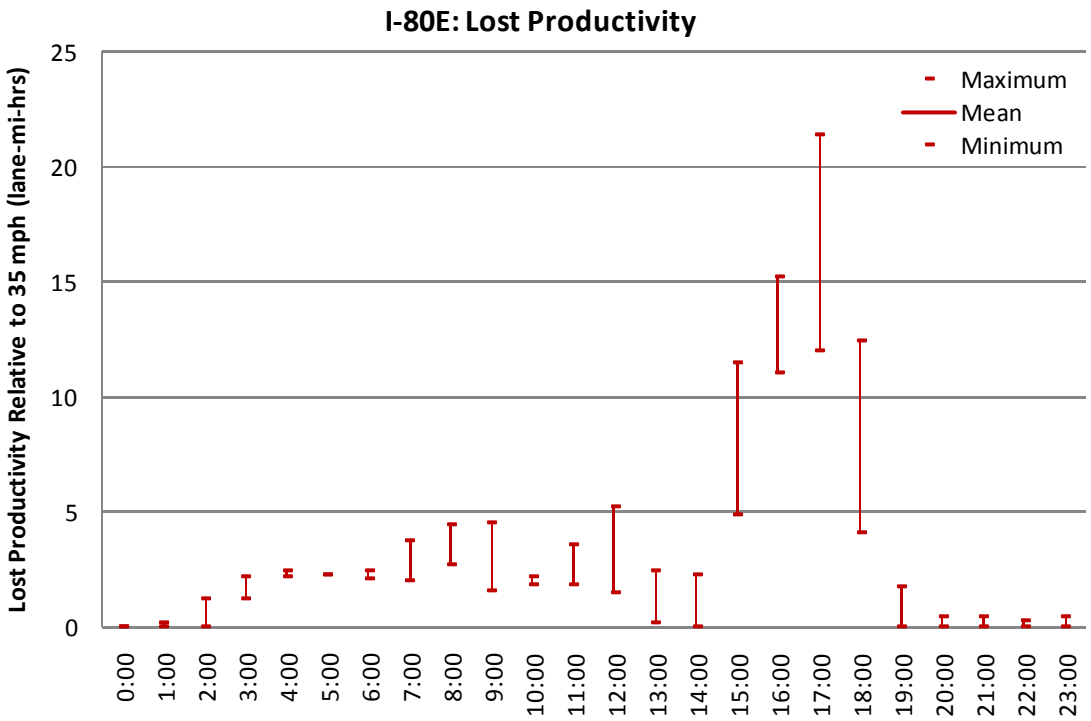


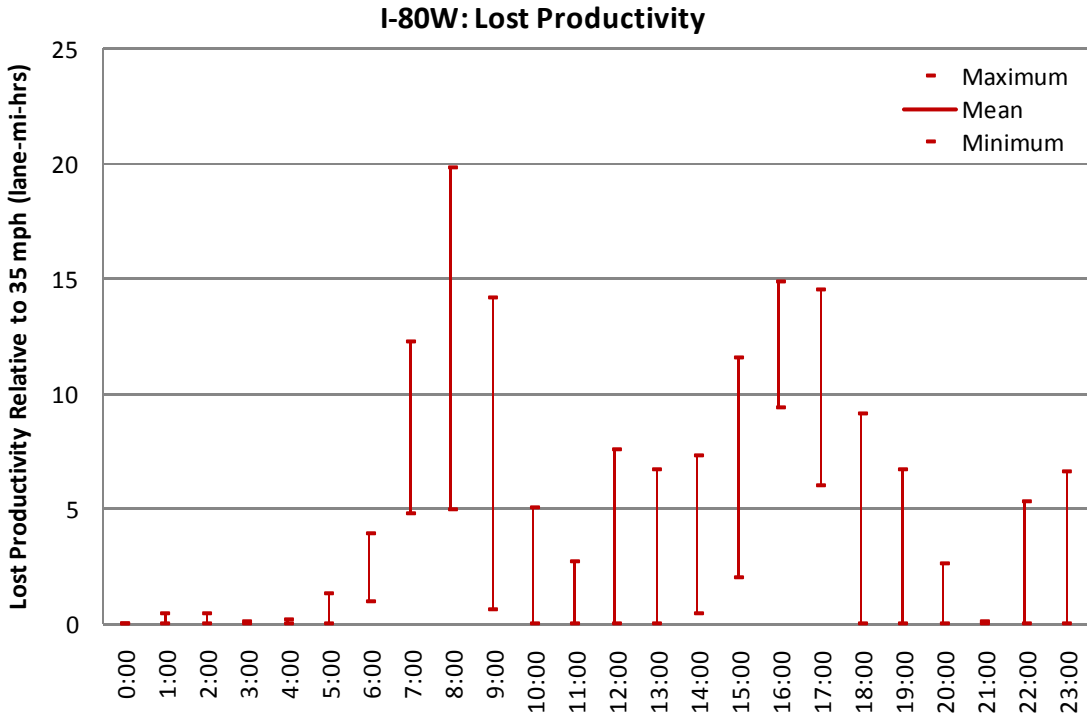
Figure 2-20 Westbound I-80 Continuous Risk Profile

Productivity

Productivity is a system efficiency measure. It is generally defined as the ratio of output per unit of input. In the case of transportation, the output is the amount of vehicles served and the input is the capacity of the roadway. One way to measure the productivity is to measure the actual volume and divide it by the capacity of roadways. Even though this approach is quite straightforward, it is not commonly used and not available from the PeMS database. Alternatively, the productivity lost can be converted to equivalent lost lane-miles, which is used in PeMS. These lost lane-miles represent a theoretical level of capacity that would have to be added in order to achieve maximum productivity. For example, losing six lane-miles implies that adding a new lane along a six mile section of freeway would improve productivity.

The PeMS database was used to measure productivity in this study. PeMS defines productivity as a measure of the equivalent lane miles lost due to the freeway operating in congestion instead of at peak efficiency. The lost productivity relative to the efficient speed of 35 mph is reported in **Figure 2-21,** in the unit of lanes-miles-hours. The minimum, mean, and maximum values of lost productivity are reported for each hour. Based on the figure, a significant amount of lost productivity occurs on I-80 eastbound during the PM peak period between 2:00 PM and 7:00 PM, and on I-80 westbound during both the AM peak (5:00 AM to 11:00 AM) and PM peak periods (3:00 to 7:00 PM).





Source: PeMS Database (March 30 – April 19, 2008; Tuesday to Thursday)

Figure 2-21 Lost Productivity by Time of Day

High Occupancy Vehicle Lane Performance

Table 2-13 summarizes the high occupancy vehicle (HOV) lane performance at eight observation locations along I-80 during the AM and PM peak hours. **Figure 2-22** shows the HOV lane performance averaged over the Bay Area. The performance of HOV lanes in the study corridor is better than the average HOV lane performance in the Bay Area in terms of both the percentage of HOV, and percentage of people in the HOV lanes, especially during the AM peak hour.

In addition, the Bay Area Toll Authority (BATA) provides incentives for carpooling by providing exclusive HOV lanes and free access during peak periods to the seven state-owned toll bridges: Antioch Bridge, Benicia-Martinez Bridge, Carquinez Bridge, Dumbarton Bridge, Richmond-San Rafael Bridge, San Francisco-Oakland Bay Bridge, and San Mateo-Hayward Bridge. However, beginning on July 1, 2010 free access to San Francisco Bay Bridge will end for HOV users. Among these seven bridges, two bridges are within the I-80 study corridor (the San Francisco-Oakland Bay Bridge and the Carquinez Bridge). The HOV lane performance at these two bridges shows that incentives contribute to the high percentage of carpooling within the I-80 study corridor, especially at the Bay Bridge Toll Plaza during the AM peak hour. Approximately 37% of all vehicles and 63% of all persons at these bridges use carpool lanes (compared to the Bay Area average of 17% vehicles and 30% of all persons using carpool lanes).

2.2.3 Pavement Preservation

Preservation may be assessed in terms of distressed lane miles and International Roughness Index (IRI). Distressed lane miles were used to distinguish among pavement segments that require only preventive maintenance at relatively low costs and segments that require major rehabilitation or replacement are considered to be distressed. In contrast, IRI distinguish between smooth-riding and rough-riding pavement based on measuring the up and down movement of a vehicle over pavement. When such movement is measured to be 95 inches per mile or less, the pavement is considered good or smooth-riding. When movements are between 95 and 170 inches per miles, the pavement is considered acceptable. Measurements above 170 inches per mile reflect unacceptable or rough-riding conditions.

The assessment presented in this report utilized data from the Caltrans Pavement Condition Reporting (PCR) System. PCR (version 3) is used in this study, which contains 2007 pavement inventory data. The analysis using this data was conducted for the segment of I-80 from the Bay Bridge Toll Plaza to the Carquinez Bridge (Alameda postmile 1.990 to 8.036 and Contra Costa postmile 0.000 to 14.138).

This analysis suggests that there are 61.918 distressed lane miles (17.495 in Alameda County and 44.423 in Contra Costa County) on I-80 within the study corridor. In addition, from the IRI, three percent of the I-80 mainline is considered to have good pavement conditions (IRI $\leq$ 95). Ninety percent of the I-80 mainline is considered to have acceptable pavement conditions and seven percent is un-acceptable. Detailed locations of the distressed segments are provided in **Appendix D**, including begin postmile, end postmile, length, pavement type, direction, lane miles of the distressed segment (triggered lane miles), and short description of the predominant type of distress.

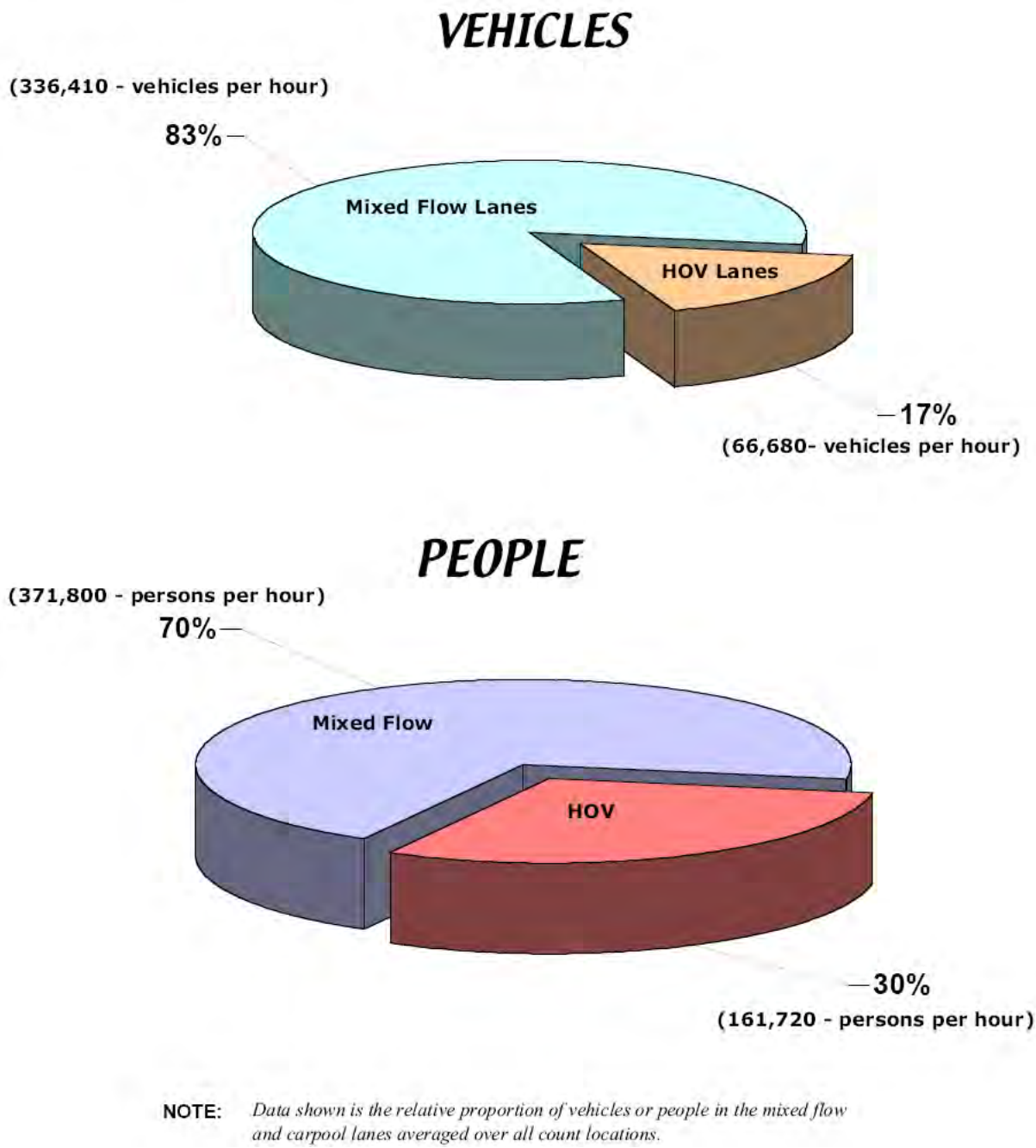
Table 2-13 HOV Lane Performance at Observation Locations within the I-80 Corridor

Route	Direction	Location	# of Non-HOV Lanes	AM Peak Hour						PM Peak Hour					
				HOV (vph)	Violation Rate	% of All Vehicles		% of All Persons		HOV (vph)	Violation Rate	% of All Vehicles		% of All Persons	
						HOVL	Non-HOVL	HOVL	Non-HOVL			HOVL	Non-HOVL	HOVL	Non-HOVL
ALA-80	Westbound	Bay Bridge Toll Plaza (4 HOVL)	18	3,669	6.5%	37%	63%	63%	37%	961	7.8%	14%	86%	30%	70%
ALA-80	Westbound	Contra Costa County Line to Powell St	4	1,757	11.1%	20%	80%	37%	63%	N/A	N/A	N/A	N/A	N/A	N/A
ALA-80	Eastbound	I-880 Viaduct to Contra Costa County Line	4	N/A	N/A	N/A	N/A	N/A	N/A	1,259	7.9%	15%	85%	34%	66%
ALA-80	Westbound	HOV Flyover Ramp	0	1,483	11.3%	100%	0%	100%	0%	387	10.9%	100%	0%	100%	0%
ALA-880	Northbound	16th St to Bay Bridge Toll Plaza	2	703	12.6%	38%	62%	60%	40%	N/A	N/A	N/A	N/A	N/A	N/A
CC-80	Westbound	Solano County to Alameda County Line	3	1,476	10.6%	25%	75%	46%	54%	N/A	N/A	N/A	N/A	N/A	N/A
CC-80	Eastbound	Alameda County Line to SR-4	3	N/A	N/A	N/A	N/A	N/A	N/A	877	2.0%	13%	87%	34%	66%
SOL-80	Eastbound	Carquinez Bridge Toll Plaza	11	N/A	N/A	N/A	N/A	N/A	N/A	959	10.1%	20%	80%	41%	59%

Notes: All locations have 1 HOV lane, except the Bay Bridge Toll Plaza which had 4 in 2007.

Lane configurations at the Bay Bridge and Carquinez Bridge toll plazas have been changed recently.

Source: Caltrans 2007 Bay Area HOV Lanes Report.



Source: Caltrans 2007 Bay Area HOV Lanes Report

Figure 2-22 HOV Lane Performance Averaged over the Bay Area

2.2.4 Arterial Performance

Arterial Travel Time

As part of the San Pablo Corridor Regional Signal Timing Program (RTSP) Project, travel time information on several arterial segments was compiled. For the RTSP project, San Pablo Ave was broken into three sections: (1) Northern - Willow Ave to Robert Miller Drive, (2) Central - Rivers Street to Monroe Street, and (3) Southern - Gilman Street to 17th Street/Clay Street. Travel times for selected arterials in the study corridor are summarized in Figure 2-13 by segment, period, and direction. For example, it takes an average of 13 minutes and 7 seconds to travel northbound on San Pablo Avenue, from Willow Avenue to Robert Miller Drive. This travel time with an average speed of 27.8 mph includes 3 minutes and 23 seconds of stop delay with an average of 7.3 stops. Based on the data presented in **Table 2-14,** San Pablo Avenue, which is the major parallel arterial to I-80, experiences higher stop delay in the afternoon period than the morning period for both northbound and southbound directions, especially in the central and southern sections. The central and southern sections experience higher stop delay than the northern section of San Pablo Avenue.

Table 2-14 Arterial Travel Time

Period	Direction	Average Travel Time (min:sec)	Average Stop Delay (min:sec)	Average Stops (Times)	Average Speed (mph)
San Pablo Avenue (Northern Section) - Willow Avenue to Robert Miller Drive - 32,095 feet					
AM	NB	13:07	3:23	7.3	27.8
	SB	13:58	4:04	8.9	26.1
PM	NB	13:54	4:10	8.9	26.2
	SB	13:38	3:45	8.9	26.7
San Pablo Avenue (Central Section) - Rivers Street to Monroe Street - 35,730 feet					
AM	NB	17:59	5:19	10.3	22.6
	SB	20:34	7:19	12.5	19.7
PM	NB	24:21	10:26	14.8	16.8
	SB	22:43	8:30	14.4	17.9
San Pablo Avenue (Southern Section) - Gilman Street to 17th Street/Clay Street - 27,695 feet					
AM	NB	16:14	5:36	10.6	19.4
	SB	15:12	4:33	10.1	20.7
PM	NB	20:03	8:33	14.0	15.7
	SB	17:38	6:29	13.0	17.9
Appian Way - San Pablo Avenue to Fitzgerald Drive - 5,000 feet					
AM	NB	2:08	0:26	1.8	26.6
	SB	3:30	1:48	3.2	16.2
PM	NB	2:14	0:29	1.5	25.5
	SB	3:23	1:39	2.8	16.8
Buchanan Street - I-80 WB Ramps to I-80 EB Ramps - 510 feet					
AM	EB	0:19	0:05	0.4	18.3
	WB	0:14	0:05	0.3	25.6
PM	EB	0:18	0:04	0.3	19.1
	WB	0:16	0:06	0.4	21.3

Table 2-14 Arterial Travel Time (cont.)

Period	Direction	Average Travel Time (min:sec)	Average Stop Delay (min:sec)	Average Stops (Times)	Average Speed (mph)
Central Avenue - I-80 WB Ramps to San Pablo Avenue - 2,455 feet					
AM	EB	2:21	1:22	1.7	11.9
	WB	1:46	0:49	2.2	15.9
PM	EB	2:20	1:15	2.2	12.0
	WB	1:55	0:54	1.7	14.6
Cutting Boulevard - I-80 WB Ramps to San Pablo Avenue - 1,055 feet					
AM	EB	0:56	0:36	1.0	12.9
	WB	0:38	0:14	1.0	19.0
PM	EB	1:08	0:46	1.0	10.6
	WB	0:52	0:29	1.5	14.0
Marin Avenue - San Pablo Avenue to Peralta Avenue - 3,920 feet					
AM	EB	2:53	1:15	2.1	15.4
	WB	2:55	1:26	2.1	15.2
PM	EB	2:41	1:06	2.2	16.6
	WB	3:04	1:09	1.6	14.6
Pinole Valley Road - San Pablo Avenue to I-80 EB Ramps - 4,070 feet					
AM	NB	3:03	1:13	2.4	15.1
	SB	3:11	1:30	2.4	14.5
PM	NB	2:20	0:36	2.1	19.8
	SB	2:24	0:43	1.7	19.3
Richmond Parkway - San Pablo Avenue to I-80 EB Ramps- 6,130 feet					
AM	EB	2:26	0:34	1.1	28.6
	WB	3:12	1:22	1.6	21.8
PM	EB	2:46	0:53	1.6	25.1
	WB	3:05	1:23	1.8	22.6
San Pablo Dam Road - San Pablo Avenue to I-80 EB Ramps - 1,645 feet					
AM	EB	2:28	1:44	1.6	7.6
	WB	1:07	0:24	0.8	16.7
PM	EB	2:12	1:25	1.7	8.5
	WB	1:30	0:47	1.7	12.5

Source: San Pablo Corridor Regional Signal Timing Program Project (2007)

Arterials Accident Summary

As part of the San Pablo Corridor Regional Signal Timing Program Project, accident records on arterials were compiled using the data from the Cities of Oakland and Berkeley. This data includes the collision history from September 30, 2002 to September 30, 2005, and is summarized **Table 2-15.** The number of collisions was low at a majority of the intersections (relative to the roadway volumes). Intersections that experienced a higher number of collisions included San Pablo Avenue/Ashby Avenue, San Pablo Avenue/Addison Street, San Pablo Avenue/University Avenue, San Pablo Avenue/Cedar Street, Ashby Avenue/7th Street, University Avenue/6th Street. The primary collision types for these intersections are rear-end, broadside, and sideswipe.

Table 2-15 Arterials Accident Summary

Intersection	Total # of Collisions	Primary Collision Types	Primary Collision Direction(s)
San Pablo Avenue & 17th Street	6	Rear-End (2)	EB
		Sideswipe (3)	Varies
		Auto/ Ped (1)	NB
San Pablo Avenue & 19th Street	2	Rear-End (1)	WB
		Sideswipe (1)	
San Pablo Avenue & 20th Street	4	Broadside (2)	SB
		Sideswipe (2)	Varies
San Pablo Avenue & Martin Luther King Way / Castro Street	1	Sideswipe (1)	SB
San Pablo Avenue & Castro Street	9	Rear-End (5)	Varies
		Sideswipe (3)	Varies
		Broadside (1)	NB
San Pablo Avenue & Grand Avenue	21	Rear-End (4)	Varies
		Broadside (10)	Varies
		Head-On (1)	SB
		Auto/ Ped (4)	Varies
		Auto/ Bike (2)	Varies
San Pablo Avenue & 25th Street	9	Rear-End (4)	Varies
		Broadside (2)	Varies
		Sideswipe (1)	SB
		Head-On (2)	SB
San Pablo Avenue & 27th Street	7	Rear-End (2)	SB
		Broadside (1)	WB
		Sideswipe (1)	WB
		Auto/ Ped (1)	NB
		Auto/ Bike (2)	Varies
San Pablo Avenue & 30th Street	6	Rear-End (4)	Varies
		Head-On (2)	Varies
San Pablo Avenue & 31st Street	8	Rear-End (3)	Varies
		Broadside (3)	Varies
		Head-On (1)	WB
		Other (1)	N/A
San Pablo Avenue & Market Street	6	Rear-End (4)	Varies
		Head-On (2)	Varies
San Pablo Avenue & 35th Street	21	Rear-End (6)	Varies
		Broadside (5)	Varies

Table 2-15 Arterials Accident Summary (cont.)

Intersection	Total # of Collisions	Primary Collision Types	Primary Collision Direction(s)
		Sideswipe (6)	Varies
		Head-On (2)	Varies
		Hit Object (1)	SB
		Auto/ Bike (1)	SB
San Pablo Avenue & 36th Street	7	Broadside (4)	Varies
		Sideswipe (3)	Varies
San Pablo Avenue & Stanford Avenue	9	Rear-End (6)	Varies
		Broadside (1)	NB
		Sideswipe (2)	EB
San Pablo Avenue & 63rd Street	8	Rear-End (2)	NB
		Sideswipe (1)	WB
		Head-On (2)	Varies
		Hit Object (2)	WB
		Auto/ Ped (1)	NB
San Pablo Avenue & Alcatraz Avenue	8	Rear-End (3)	Varies
		Broadside (1)	NB
		Sideswipe (2)	Varies
		Head-On (1)	NB
		Auto/ Bike (1)	SB
San Pablo Avenue & West Street (N)	9	Rear-End (4)	Varies
		Broadside (2)	NB
		Sideswipe (1)	SB
		Head-On (2)	SB
San Pablo Avenue & Ashby Avenue	71	Rear-End (23)	Varies
		Broadside (20)	Varies
		Sideswipe (15)	Varies
		Head-On (3)	Varies
		Hit Object (5)	Varies
		Auto/ Ped (3)	Varies
		Auto/ Bike (1)	SB
		Not Stated (1)	SB
San Pablo Avenue & Grayson Street	11	Rear-End (5)	Varies
		Broadside (1)	SB
		Sideswipe (4)	Varies
		Head-On (1)	SB
San Pablo Avenue & Dwight Way	27	Rear-End (12)	Varies
		Broadside (6)	Varies
		Sideswipe (5)	Varies
		Hit Object (1)	SB
		Auto/ Ped (2)	Varies
		Auto/ Bike (1)	WB

Table 2-15 Arterials Accident Summary (cont.)

Intersection	Total # of Collisions	Primary Collision Types	Primary Collision Direction(s)
San Pablo Avenue & Allston Way	26	Rear-End (7)	Varies
		Broadside (7)	Varies
		Sideswipe (3)	Varies
		Head-On (2)	Varies
		Hit Object (2)	Varies
		Auto/ Ped (3)	Varies
		Auto/ Bike (1)	EB
		Not Stated (1)	N/A
San Pablo Avenue & Addison Street	30	Rear-End (10)	Varies
		Broadside (4)	Varies
		Sideswipe (12)	Varies
		Head-On (1)	NB
		Auto/ Ped (2)	Varies
		Other (1)	NB
San Pablo Avenue & University Avenue	56	Rear-End (30)	Varies
		Broadside (7)	Varies
		Sideswipe (10)	Varies
		Head-On (1)	EB
		Hit Object (3)	Varies
		Auto/ Ped (3)	Varies
		Auto/ Bike (2)	WB
San Pablo Avenue & Delaware Street	17	Rear-End (7)	Varies
		Broadside (2)	EB
		Sideswipe (5)	Varies
		Auto/ Ped (2)	SB
		Other (1)	NB
San Pablo Avenue & Cedar Street	36	Rear-End (3)	Varies
		Broadside (17)	Varies
		Sideswipe (11)	Varies
		Head-On (3)	Varies
		Auto/ Ped (1)	EB
		Not Stated (1)	WB
San Pablo Avenue & Gilman Street	28	Rear-End (10)	Varies
		Broadside (6)	Varies
		Sideswipe (7)	Varies
		Head-On (1)	Varies
		Hit Object (1)	EB
		Auto/ Ped (2)	NB
		Other (1)	NB
7th Street & Potter Street	11	Rear-End (4)	Varies
		Broadside (5)	Varies
		Sideswipe (2)	SB

Table 2-15 Arterials Accident Summary (cont.)

Intersection	Total # of Collisions	Primary Collision Types	Primary Collision Direction(s)
Ashby Avenue & 9th Street	6	Broadside (1)	EB
		Sideswipe (2)	Varies
		Hit Object (3)	Varies
Ashby Avenue & 7th Street	29	Rear-End (8)	Varies
		Broadside (6)	EB
		Sideswipe (9)	Varies
		Hit Object (3)	Varies
		Other (3)	Varies
University Avenue/ 9th Street	28	Rear-End (11)	Varies
		Broadside (10)	Varies
		Sideswipe (5)	Varies
		Head-On (2)	EB
		Hit Object (3)	Varies
University Avenue/ 6th Street	55	Rear-End (15)	Varies
		Broadside (11)	Varies
		Sideswipe (18)	Varies
		Hit Object (4)	Varies
		Auto/ Ped (3)	Varies
		Auto/ Bike (1)	WB
		Other (3)	Varies

Source: San Pablo Corridor Regional Signal Timing Program Project (2007)

Intersection Level of Service

Intersection level of service (LOS) and average delay for key intersections within the study corridor are summarized in **Table 2-16**. Consistent with the arterial travel time reported in the last section, level of service and delay are worse in the afternoon peak period than the morning peak period. Severe congestion (LOS = F) can be found at the following intersections: San Pablo Avenue & East Shore Boulevard/ Hill Street (PM), San Pablo Avenue & University Avenue (PM), San Pablo Avenue & Dwight Way (PM), 7th Street & Potter Street (PM), Ashby Avenue & 7th Street (PM), and San Pablo Dam Road & I-80 eastbound ramp (both AM and PM).

Table 2-16 Intersection Level of Service

Intersection	AM Peak Hour		PM Peak Hour	
	LOS	Delay (sec)	LOS	Delay (sec)
San Pablo Avenue & Willow Avenue	B	15.7	B	15.0
San Pablo Avenue & Victoria Crescent	B	10.4	B	10.4
San Pablo Avenue & Route 4 / John Muir Parkway	C	30.4	D	43.7
San Pablo Avenue & Transit Center	A	5.4	A	5.3
San Pablo Avenue & Sycamore Avenue	C	33.9	C	27.6

Table 2-16 Intersection Level of Service (cont.)

Intersection	AM Peak Hour		PM Peak Hour	
	LOS	Delay (sec)	LOS	Delay (sec)
San Pablo Avenue & Hercules Avenue	C	24.6	C	22.1
San Pablo Avenue & John Street	A	1.3	A	1.2
San Pablo Avenue & Pinole Valley Road	B	12.8	B	12.0
San Pablo Avenue & Fernandez Avenue	A	3.7	A	6.7
San Pablo Avenue & Tennent Avenue	B	12.3	A	9.3
San Pablo Avenue & Oak Ridge Lane	A	6.0	A	5.0
San Pablo Avenue & Appian Way	B	15.0	C	26.6
San Pablo Avenue & Sunnyview Drive	B	10.8	B	12.1
San Pablo Avenue & Pinole Shores Drive	B	19.4	B	14.3
San Pablo Avenue & Del Monte Drive / Belmont Way	B	18.7	B	19.4
San Pablo Avenue & Tara Hills Drive	B	15.6	B	11.3
San Pablo Avenue & Shamrock Drive	C	27.5	B	12.8
San Pablo Avenue & Crestwood Drive	A	8.6	A	8.1
San Pablo Avenue & Kay Road	A	5.5	B	16.0
San Pablo Avenue & Richmond Parkway	D	36.7	C	34.4
San Pablo Avenue & Hilltop Drive	C	28.7	C	34.7
San Pablo Avenue & Robert Miller Drive	B	18.9	C	20.9
San Pablo Avenue & Rivers Street	C	31.8	C	20.3
San Pablo Avenue & Rumrill Blvd / College Lane	B	10.6	C	32.7
San Pablo Avenue & El Portal Drive / Broadway	C	21.2	C	25.7
San Pablo Avenue & Bank Lane	A	6.2	B	10.0
San Pablo Avenue & 23rd Street	D	48.1	D	36.8
San Pablo Avenue & Van Ness Street	A	6.9	A	8.8
San Pablo Avenue & Church Lane	C	34.9	C	33.7
San Pablo Avenue & Vale Road	D	40.8	C	26.7
San Pablo Avenue & San Pablo Dam Road	C	21.1	C	29.6
San Pablo Avenue & Food Max	A	4.4	A	9.7
San Pablo Avenue & Rheem Avenue	B	17.3	B	18.5
San Pablo Avenue & McBryde Avenue	C	22.4	C	26.0
San Pablo Avenue & Esmond Avenue	A	4.2	A	2.9
San Pablo Avenue & Garvin Avenue	A	6.9	A	7.0
San Pablo Avenue & Solano Avenue	A	7.0	A	6.2
San Pablo Avenue/ Clinton Avenue	A	4.2	A	8.5
San Pablo Avenue & Sierra Pedestrian Crossing	A	1.7	A	1.6

Table 2-16 Intersection Level of Service (cont.)

Intersection	AM Peak Hour		PM Peak Hour	
	LOS	Delay (sec)	LOS	Delay (sec)
San Pablo Avenue & I-80 NB Ramps / Roosevelt Avenue	A	7.3	B	13.1
San Pablo Avenue & Barrett Avenue	C	27.7	C	33.4
San Pablo Avenue & MacDonald Avenue	A	8.1	B	12.6
San Pablo Avenue & Home Depot / Conlon Avenue	B	11.2	B	14.7
San Pablo Avenue & Knott Avenue	B	10.7	B	11.9
San Pablo Avenue & Cutting Boulevard	C	31.7	C	30.1
San Pablo Avenue & East Shore Blvd./ Hill Street	D	48.1	F	110.7
San Pablo Avenue & Potrero Avenue	C	26.6	C	28.3
San Pablo Avenue & Bayview Avenue/ Manila Avenue	B	11.3	B	12.3
San Pablo Avenue & Schmidt Lane	A	9.8	A	7.8
San Pablo Avenue & Moeser Lane	C	27.4	B	13.5
San Pablo Avenue & Stockton Avenue	C	24.1	B	19.3
San Pablo Avenue & Central Avenue	D	35.4	D	39.4
San Pablo Avenue & Fairmount Avenue	B	19.8	C	21.8
San Pablo Avenue & Carlson Boulevard	B	14.2	C	23.8
San Pablo Avenue & Brighton Avenue	B	13.4	B	12.7
San Pablo Avenue & Clay Street	A	2.1	A	5.8
San Pablo Avenue & Washington Avenue	A	9.8	A	8.2
San Pablo Avenue & Solano Avenue	C	30.9	C	28.2
San Pablo Avenue & Buchanan Street	A	8.9	A	5.6
San Pablo Avenue & Marin Avenue	D	43.2	D	51.4
San Pablo Avenue & Monroe Street	B	12.0	A	8.0
San Pablo Avenue & Gilman Street	C	27.7	C	27.7
San Pablo Avenue & Cedar Street	B	18.2	C	33.3
San Pablo Avenue & Delaware Street	B	14.5	B	18.5
San Pablo Avenue & University Avenue	D	39.8	F	147.1
San Pablo Avenue & Addison Street	A	6.7	A	8.6
San Pablo Avenue & Allston Way	A	8.5	A	9.2
San Pablo Avenue & Dwight Way	C	29.2	F	117.6
San Pablo Avenue & Grayson Street	A	8.2	B	10.8
San Pablo Avenue & Ashby Avenue	C	28.2	D	37.9
San Pablo Avenue & Alcatraz Avenue	C	22.6	E	76.6
San Pablo Avenue & 63rd Street	A	8.4	A	6.4
San Pablo Avenue & Stanford Avenue	C	29.9	D	39.9

Table 2-16 Intersection Level of Service (cont.)

Intersection	AM Peak Hour		PM Peak Hour	
	LOS	Delay (sec)	LOS	Delay (sec)
San Pablo Avenue & 53rd Street	B	12.1	A	9.8
San Pablo Avenue & 47th Street	A	6.2	A	4.7
San Pablo Avenue & 45th Street	A	4.4	A	5.0
San Pablo Avenue & Park Avenue	B	14.7	B	11.2
San Pablo Avenue & 40th Street	C	32.1	D	43.0
San Pablo Avenue & Adeline Street / MacArthur Boulevard	B	12.5	B	12.3
San Pablo Avenue & 36th Street	B	14.0	B	10.9
San Pablo Avenue & 35th Street	C	22.2	D	44.3
San Pablo Avenue & 30th Street / Market Street	A	11.8	B	11.1
San Pablo Avenue & 27th Street	B	11.8	A	7.8
San Pablo Avenue & 25th Street	A	7.7	A	7.4
San Pablo Avenue & Grand Avenue	B	14.4	B	17.2
San Pablo Avenue & Castro Street / MLK, Jr Blvd	B	14.1	B	15.2
San Pablo Avenue & 20th Street	B	15.9	B	19.5
San Pablo Avenue & 19th Street	A	8.6	B	15.1
San Pablo Avenue & 17th Street	B	16.9	C	23.5
Appian Way & Fitzgerald Drive	D	43.0	D	39.3
Appian Way & I-80 EB Ramps	A	9.5	B	16.0
Appian Way & I-80 WB Ramps	D	35.4	C	21.2
Appian Way & Tara Hills Drive	D	36.8	C	24.7
Appian Way & Mann Drive	B	13.1	A	8.1
7th Street & Potter Street	C	20.8	F	81.5
Ashby Avenue & 9th Street	A	2.8	A	3.6
Ashby Avenue & 7th Street	D	44.1	F	172.6
Buchanan Street & I-80 EB	A	4.8	A	8.1
Buchanan Street & I-80 WB	C	22.2	B	15.9
Central Avenue & Carlson Boulevard	C	20.9	C	21.7
Central Avenue & San Luis Street/Pierce Street	A	9.6	C	24.9
Central Avenue & I-80 EB Ramps	B	11.1	C	32.7
Central Avenue & I-80 WB Ramps	B	29.9	B	18.9
Cutting Boulevard & I-80 HOV Ramp	D	38.8	A	8.0
Cutting Boulevard & I-80 WB Ramp	B	11.2	A	9.6
Marin Avenue & Peralta Avenue	B	14.4	B	16.9
Marin Avenue & Santa Fe Avenue	C	24.2	B	19.6

Table 2-16 Intersection Level of Service (cont.)

Intersection	AM Peak Hour		PM Peak Hour	
	LOS	Delay (sec)	LOS	Delay (sec)
Marin Avenue & Masonic Avenue	B	19.5	C	26.1
Pinole Valley Road & I-80 EB Ramps	D	39.8	E	56.4
Pinole Valley Road & I-80 WB Ramps	C	23.5	B	12.9
Pinole Valley Road & Henry Avenue	B	15.3	B	16.8
Pinole Valley Road & Ellerhorst Street	C	24.1	B	19.9
Potrero Avenue & I-80 EB Ramps	B	12.1	A	9.7
Richmond Parkway & Lakeside Drive	B	12.1	B	15.3
Richmond Parkway & Hilltop Bayview Apts	A	8.5	B	14.3
Richmond Parkway & Blume Drive/ I-80 WB Off-EB On Ramps	C	27.3	D	53.2
Richmond Parkway & I-80 WB On-Ramp	A	4.3	A	6.1
Richmond Parkway & I-80 EB Off-Ramp	E	11.6	C	23.4
Rumrill Boulevard & roadway Avenue	C	31.5	C	28.2
San Pablo Dam Road & Contra Costa Avenue	A	8.4	B	11.9
San Pablo Dam Road & Ventura Avenue	B	11.3	C	22.5
San Pablo Dam Road & I-80 WB Ramp	E	57.4	E	63.8
San Pablo Dam Road & I-80 EB Ramp	F	122.4	F	118.2
University Avenue & 9th Street	A	9.9	B	11.1
University Avenue & 6th Street	E	58.8	D	49.7

2.2.5 Transit performance

Rail Transit Service

Based on the Statistical Summary of Bay Area Transit Operators Report, prepared by the Metropolitan Transportation Commission (MTC) in March 2008, BART average daily ridership has been more than 300,000 since 2002. The average ridership has increased approximately 4% from 2006 to 2007.

Average weekday ridership and other basic information such as absolute number of home origin trips and access mode share for each station are summarized in **Table 2-17.** Except Downtown Berkeley Station, all stations in the study corridor have substantial trips from home origin trips. Downtown Berkeley station has the least home origin trips because of the high number of non-home based trips coming from work and school.

Nearly half of those coming from home, travel to BART by car and 30% of those home origins travel to the BART stations by "walk only" mode. Taking bus/transit to BART is highest at El Cerrito del Norte (22%) and bicycling to BART is highest at Ashby (12%).

Table 2-17 Station Ridership

Station	Average weekday ridership	Home origins	% Home origins	Travel mode to the station			
				Walk only	Bus/Transit	Bicycle	Drive
Ashby	4,797	3,293	69%	57%	1%	12%	30%
Downtown Berkeley	11,929	2,837	24%	71%	9%	10%	10%
El Cerrito del Norte	7,788	6,613	85%	13%	22%	3%	62%
El Cerrito Plaza	4,420	3,533	80%	43%	1%	6%	50%
MacArthur	7,802	4,398	56%	35%	15%	8%	42%
North Berkeley	3,714	2,962	80%	43%	1%	8%	48%
Richmond	3,680	2,686	73%	24%	21%	2%	53%
Rockridge	4,842	3,456	71%	37%	3%	5%	55%
West Oakland	5,355	4,134	77%	16%	1%	5%	78%

Source: 2008 Bart Station Profile Study

Bus Service

Table 2-18 presents the average weekday ridership, headway during the peak and off-peak periods, average travel time, and vehicle capacity for each WestCAT bus route. Because the maximum load is not available for each WestCAT bus route, it cannot be concluded if there is capacity constraint on any WestCAT bus routes.

Table 2-18 WestCAT Bus Performance

Route	Average Weekday Ridership	Peak Frequency (Min)	Off-Peak Frequency (Min)	Average Travel Time (min)	Seating Capacity
JX	373	15	----	15	43
J	1,220	30	60	31	43
JPX	363	15	60	23	39
30Z	260	30	60	68	39
C3	177	60	60	25	39
Lynx	510	20	----	40	57
10	149	40	40	26	39
11	308	40	40	38	39
12	186	40	40	27	39
15	153	40	40	30	39
16	292	30	30	54	39
17	18	70	70	32	39
18	30	70	70	30	39

Source: WestCAT transit

Table 2-19 presents the average weekday ridership, headway during the peak and off-peak periods, maximum load, average travel time, and vehicle capacity for each AC Transit bus route. Maximum load during AM and PM peaks are the average of all the maximum loads recorded from 6:00 am to 10 am and 2:00 pm to 7:00 pm. Average travel time is based on the route schedule not the actual travel time. The maximum loads during both peak periods are smaller than seated capacity of assigned bus for each route. Thus, there is no capacity constraint on any AC bus routes within the study corridor.

Table 2-19 AC Transit Bus Performance

Route	Average Weekday Ridership	Peak Frequency (min)	Off-Peak Frequency (min)	Maximum Load		Average Travel Time (min)	Typical Vehicle Assignment (Effective December 2008)
				AM peak	PM peak		
L	704	10-20	n/a	27	24	66	MCI 45-foot highway cruiser, seats 57
LA	726	10-20	120	15	21	49	MCI 45-foot highway cruiser, seats 57
7	2,460	20	30	18	23	46	NABI 40-foot, seats 40
70	1,368	30	30	12	13	59	Van Hool 40-foot, seats 32
71	1,486	30	30	14	16	50	NABI 40-foot, seats 40
72	3,821	30	30	20	22	79	Van Hool 60-foot artic, seats 47
72M	3,815	30	30	20	22	76	Van Hool 60-foot artic, seats 47
72R	6,969	12	12	22	21	46	Van Hool 40-foot, seats 32
74	1,327	30	30	14	12	68	Van Hool 40-foot, seats 32
76	2,162	30	30	17	20	60	NABI 40-foot, seats 40

Source: AC transit

2.2.6 Bottlenecks

A bottleneck is defined as a freeway segment where the travel demand is greater than the roadway capacity. Both demand (i.e., the number of vehicles that *wants to* pass through a bottleneck during a specific period of time) and supply (i.e., the number of vehicles that *can* pass a bottleneck during a specific period of time) contribute to congestion upstream of a bottleneck. For example, a lane drop (capacity reduction) could cause a bottleneck when the demand to pass this lane drop location is high enough. Once there is sufficient demand, the bottleneck becomes active, causing congestion upstream of this location.

The bottlenecks identified in this section were derived from multiple information sources. This was done in recognition that conditions dynamically vary from day-to-day and hour-by-hour, and that most sources provide only a snapshot of a specific time period. In this study, information from the following sources was used to identify bottlenecks:

- Tach run data from DKS (2008)
- Traffic speed from PeMS
- Aerial photos
- Field observations

Bottlenecks along I-80 eastbound and I-80 westbound are summarized in the following sections. Each bottleneck is identified in terms of potential causes, approximate length, and approximate duration.

I-80 Eastbound Bottlenecks and Causalities

AM Peak Period

During the AM peak period, there is one queue in the eastbound direction for one-half of a mile between University Avenue on-ramp and Gilman Street/ WB 580. **Table 2-19** details this queue.

Table 2-19 AM Eastbound Bottlenecks and Queues

Bottleneck Location	Reason	Queue Length (Postmile)	Duration
WB 580 off-ramp	High off-ramp volume at WB 580 results in heavy weaving traffic between the on-ramp from University Avenue and the off-ramp to Gilman Street /WB 580	12.8 to 12.3	7:00 AM to 9:00 AM

The queue starting at WB 580 off-ramp is due to high off-ramp traffic at WB 580, which creates heavy weaving traffic between the on-ramp from University Avenue and the off-ramp to Gilman St/ WB 580. The queue typically occurs between 7:00 AM and 9:00 AM, as shown in **Figure 2-23**.

Figure 2-23 Eastbound I-80 from University Ave to Gilman St/ WB 580

PM Peak Period

For the PM period, there are four queues in the eastbound direction ranging between 5.3 miles and 1.8 miles as shown in **Table 2-20.**

Table 2-20 PM Eastbound Bottlenecks and Queues

Bottleneck Location	Reason	Queue Length (Postmile)	Duration
1.Pinole Valley Road /SR 4	Between Pinole Valley Rd on-ramp and SR 4 off-ramp due to on-ramps volumes and weaving between on-ramp from Pinole Valley Rd and off ramp to SR ; and the lane drop from 4 to 3 lanes on the EB I-80 mainline.	22.0 to 16.7	4:00 PM to 6:30 PM
Appian Way*	Downstream of two on-ramps from Appian Way (within 0.20 miles of each other serving northbound and southbound traffic) due to mainline plus on-ramp traffic.	21.0 to 20.2	4:00 PM to 6:30 PM
2. San Pablo Ave	Downstream of San Pablo Avenue on-ramp due to mainline plus on-ramp traffic and sharp curve near the San Pablo Avenue interchange	16.7 to 14.6	3:15 PM to 7:00 PM
3. Carlson Boulevard	Downstream of Carlson Boulevard on-ramp due to mainline plus on-ramp demand and access point density (interchange is 0.50 miles from I-580 and serves as an access point for travel between I-580 and I-80).	14.5 to 12.7	3:30 PM to 7: 15 PM
4. Gilman/I-580	High volumes at the off-ramp to WB 58-. Short weaving distance between the University Avenue on-ramp and the Gilman Street/WB 580 off-ramp; heavy traffic (this bottleneck area serves the highest volume of traffic of I-80E)	12.8 to 10.8	3:00 PM to 7:45 PM

* Embedded bottleneck – refers to a bottleneck hidden with the queue of a downstream bottleneck.

The first queue begins at SR4 interchange and extends 5.3 miles to the Pinole Valley Road/Appian Way. The queue typically occurs between 4:00 PM and 6:30 PM. **Figure 2-24** and **Figure 2-25** show the segment of I-80 eastbound at Pinole Valley Road and Appian Way, respectively.

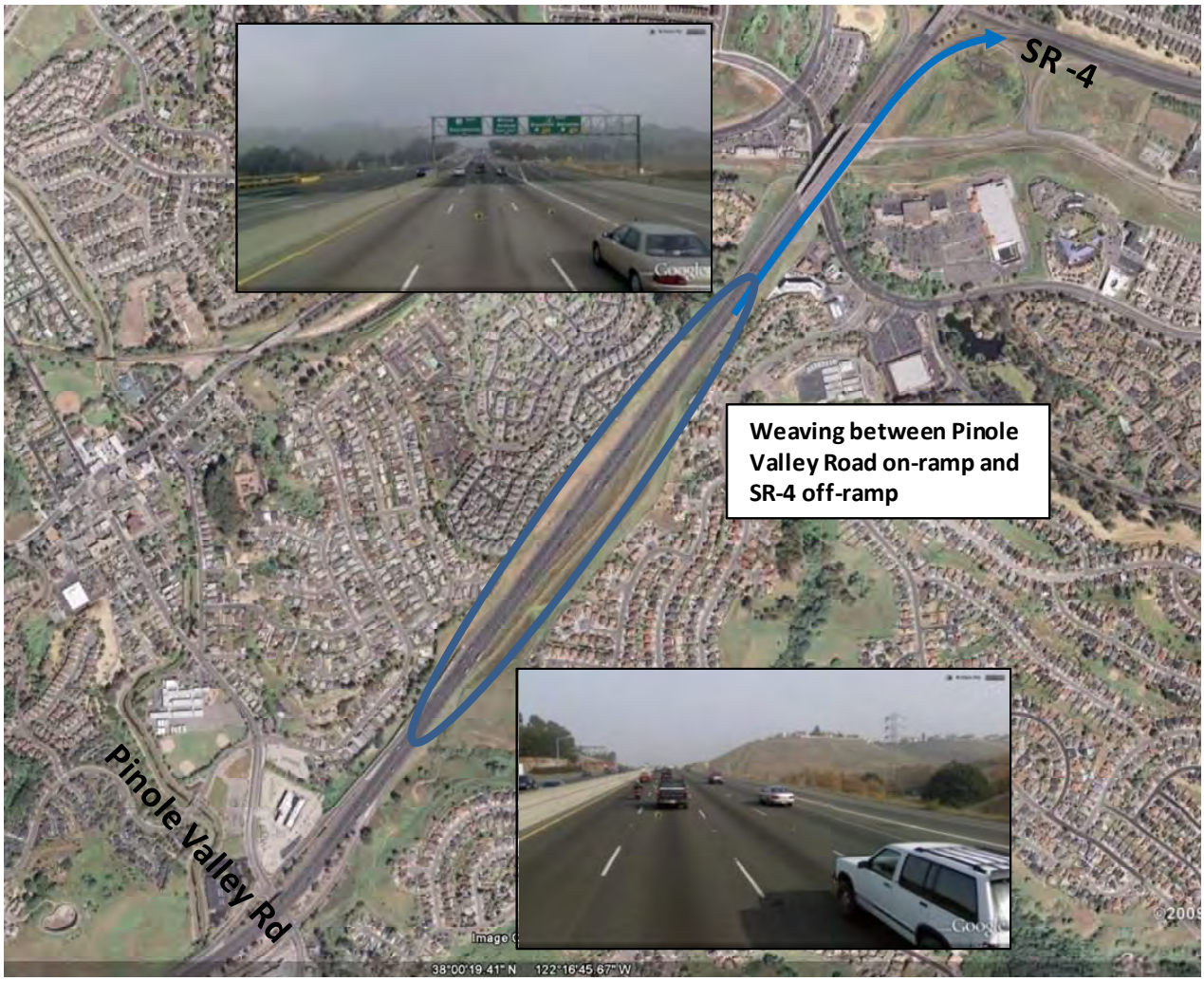


Figure 2-24 Eastbound I-80 from Pinole Valley Rd to SR 4

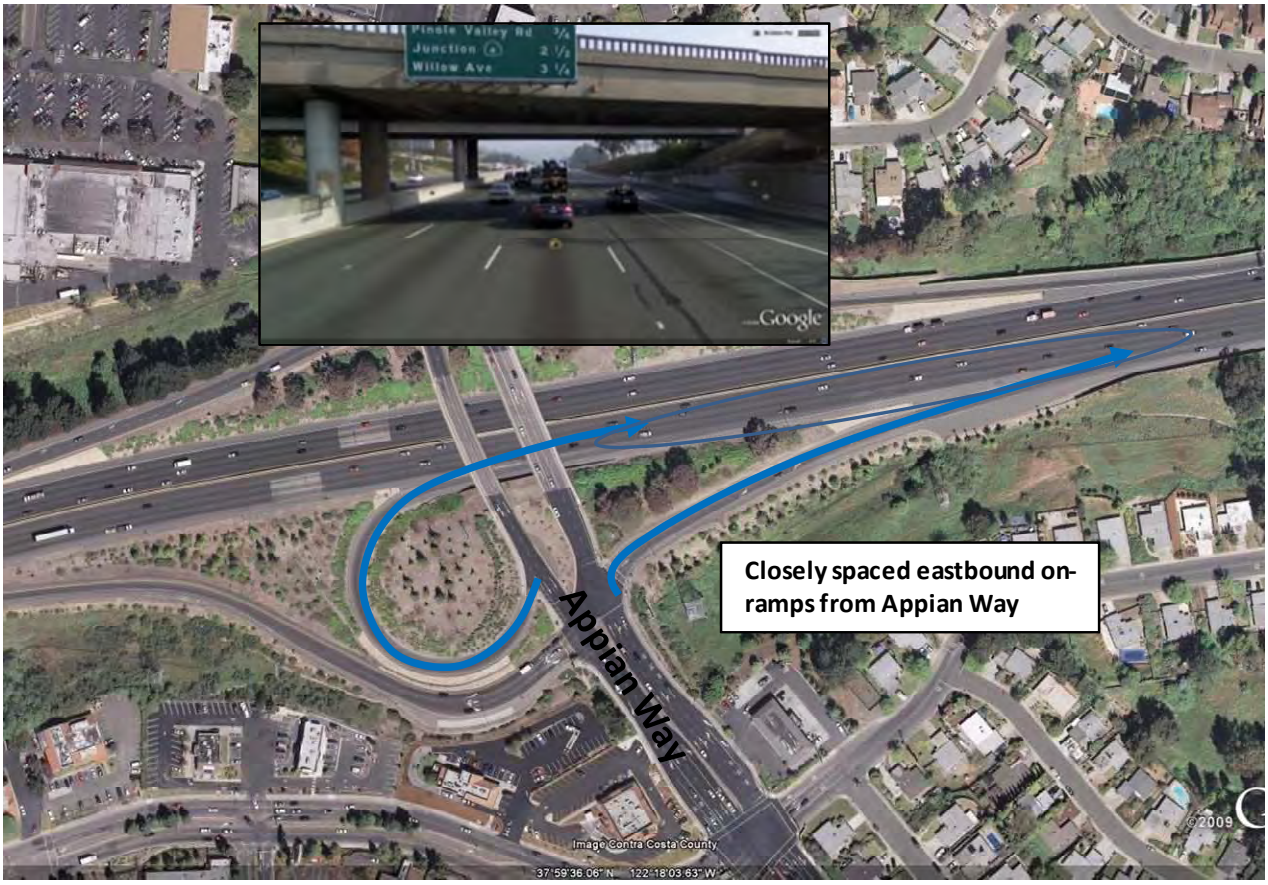


Figure 2-25 Eastbound I-80 at Appian Way

Another queue occurs between Carlson Boulevard and San Pablo Avenue with a length of approximately 2.1 miles. The queue occurring between 3:15 PM and 7:00 PM is due to on-ramp traffic merging with mainline traffic in addition to a sharp curve near the San Pablo Avenue interchange. **Figure 2-26** shows the segment of eastbound I-80 at San Pablo Avenue.

Figure 2-26 Eastbound I-80 at San Pablo Ave

Another 1.8 mile long queue also typically occurs between Buchanan Street and Carlson Boulevard. As shown in **Figure 2-27** the cause of this queue is due to on-ramp traffic from Carlson Boulevard merging with mainline traffic in addition to the interchange proximity to I-580. This queue generally occurs between 3:30 PM and 7:15 PM. **Figure 2-27** shows the segment of eastbound I-80.

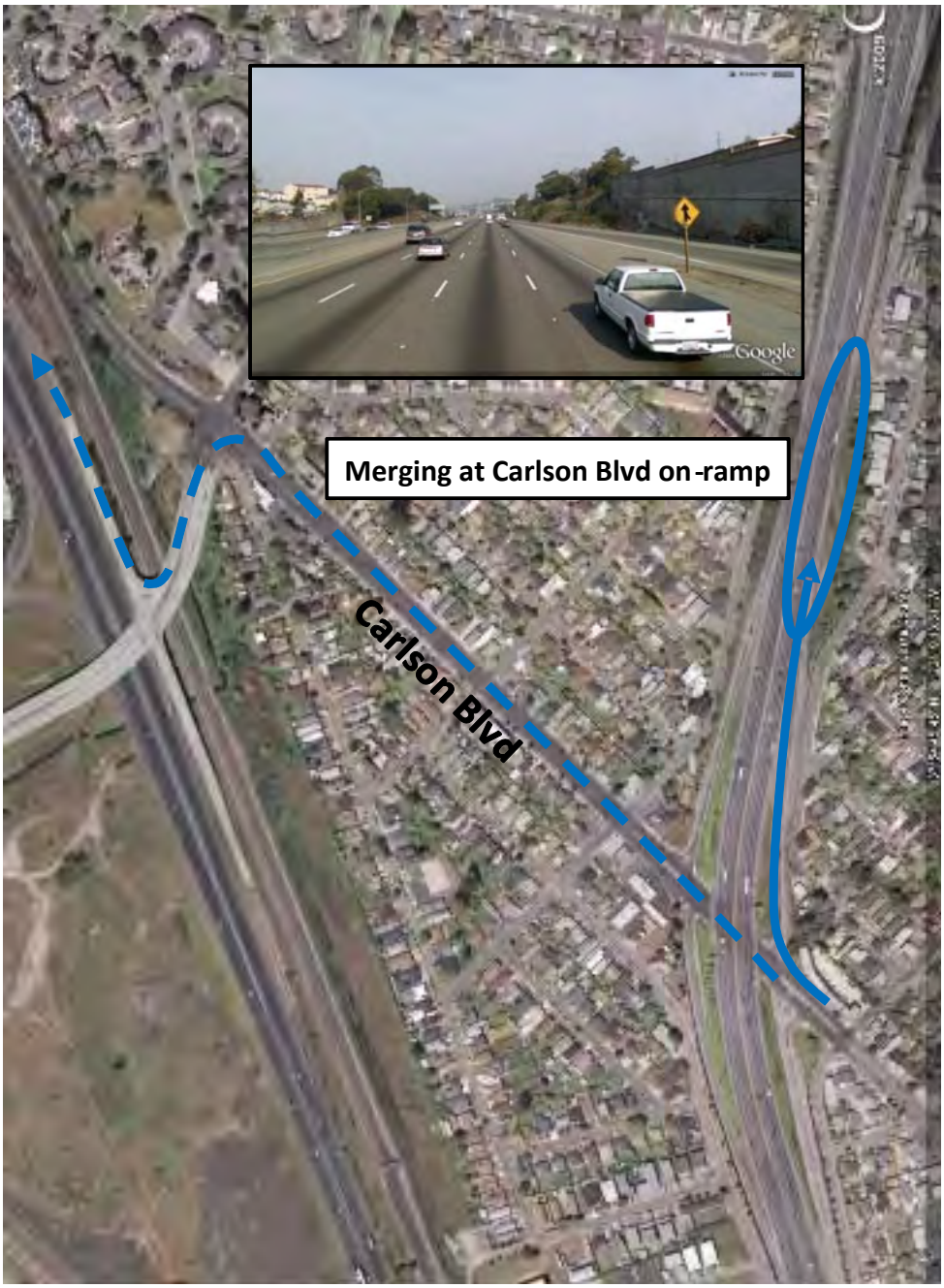


Figure 2-27 Eastbound I-80 at Carlson Blvd

The fourth queue in the eastbound direction during the PM period occurs for a length of 2 miles between University Avenue and Gilman/I-580. This queue, which occurs between 3:00 PM – 7:45 PM is likely a result of the short weaving distance between the University Avenue on-ramp and the Gilman Street/ WB 580 off-ramps and high off-ramp volume to WB 580, as shown in **Figure 2-28.**

Figure 2-28 Eastbound I-80 at University Ave

I-80 Westbound Bottlenecks and Causalities

AM Peak Period

In the westbound direction during the AM period, three queues occur as summarized **Table 2-21**.

Table 2-21 AM Westbound Bottlenecks and Queues

Bottleneck Location	Reason	Queue Length (Postmile)	Duration
Pinole Valley/Appian Way	Downstream of Appian Way on-ramp due to mainline plus on-ramp traffic.	21.0 to 23.0	6:45 AM to 8:30 AM
San Pablo Dam Road	Downstream of San Pablo Dam Road on-ramp due to mainline plus on-ramp traffic, short weave between the on-ramp from Sam Pablo Dan Road to McBryde Ave, and sharp curve in the roadway east of the San Pablo Dam Road interchange	17.9 to 23.0	6:45 AM to 9:00 AM
I-580/Gilman Street	Downstream of Gilman Street on-ramp due to the mainline plus on-ramp traffic and short weave between the on-ramp at Buchanan Street and the off-ramp at Gilman Street.	11.9 to 15.4	6:45 AM to 9:45 AM
Powell Street	Downstream of Powell street due mainline plus on-ramp traffic.	9.3 to 11.2	7:00 AM to 9:30 AM
Bay Bridge Toll Plaza	High volumes, lane changing disruption, and stops at Toll Plaza	6.6 to 7.7	6:00 AM to 10:00 AM

The first queue on westbound direction occurs between 6:45 AM and 9:00 AM for a length of 5.1 miles between San Pablo Dam Road and Sycamore Avenue. **Figure 2-29** shows westbound I-80 between San Pablo Dam and McBryde Ave. The bottleneck is due to the on-ramp traffic at San Pablo Dam Road merging with mainline traffic in addition to the close proximity of San Pablo Dam Road on-ramp and McBryde avenue off-ramp. One embedded bottleneck occurs at Appian Way and is due to the on-ramp traffic merging with mainline traffic.

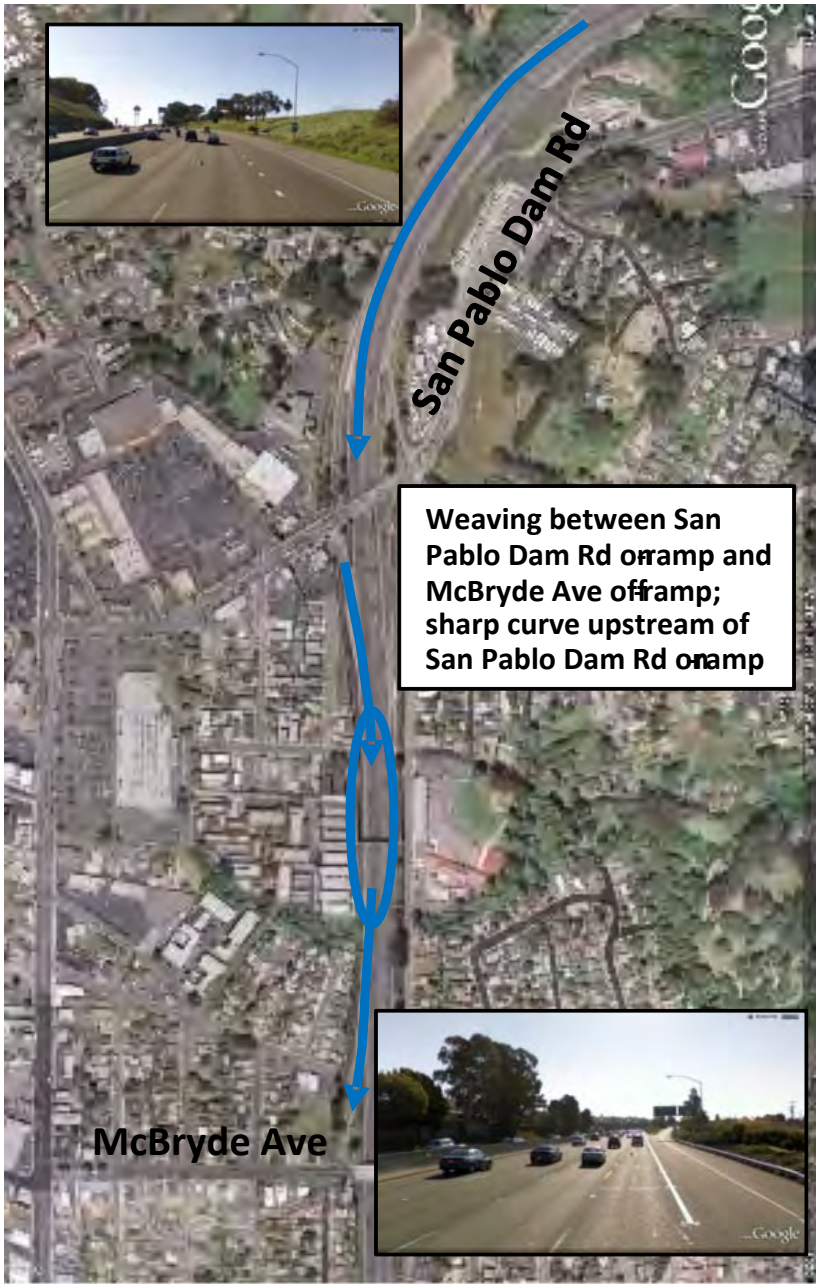


Figure 2-29 Westbound I-80 from San Pablo Dam to McBryde

The second bottleneck occurs between Cutting Boulevard and Gilman Street for a length of 3.5 miles between 6:45 AM and 9:45 AM. The bottleneck is due to Gilman Street on-ramp traffic merging with mainline traffic in addition to vehicular weaving between the on-ramp at Buchanan Street and the off-ramp at Gilman Street approximately 0.20 miles away, as shown in **Figure 2-30.**

Figure 2-30 Westbound I-80 at Gilman St

The third bottleneck is observed at Powell Street, which occurs from 7:00 AM to 9:30 AM. The bottleneck is due to Powell Street on-ramp traffic merging with mainline traffic in addition to vehicular weaving to the Bay Bridge and I-580/I-880, as shown in **Figure 2-31**.

Figure 2-31 Westbound I-80 at Powell St

PM Peak Period

In the westbound direction during the PM period, a queue is observed near the I-80/I-580/I-880 diverge and would result in a 3.0 mile long queue to Gilman Street. The queue occurs between 2:30 PM and 7:15 PM and is due to traffic from the I-80, I-580, and I-880 traveling along this stretch of I-80, which has many major merging and diverging points in close proximity. **Table 2-22** details the PM Westbound Bottlenecks and Queues.

Table 2-22 PM Westbound Bottlenecks and Queues

Bottleneck Location	Reason	Queue Length (Postmile)	Duration
I-80/I-580/I-880 Diverge	Heavy traffic to the I-580E/I-880S split (unlike the AM peak, there is no backup from the Bay Bridge Toll Plaza contributing to congestion in this area); many major merging and diverging points close to each other in the vicinity of this complex interchange.	8.95 to 11.95	2:30 PM to 7:15 PM
Bay Bridge Toll Plaza	High volumes, lane changing disruption, and stops at Toll Plaza	6.6 to 7.4	2:00 PM to 7:00 PM

3 CONGESTION MITIGATION STRATEGIES & IMPROVEMENTS

3.1 Candidate Strategies and Constraints

The I-80 corridor currently ranks as the most congested corridor in the entire San Francisco Bay Area. Existing traffic demand on I-80 exceeds capacity on several segments during both peak periods. The congestion on the freeway causes traffic queues to back up onto on-ramps and the local arterial network increasing the overall system congestion. In the future years, without congestion mitigation strategies and improvements, traffic conditions in the I-80 corridor are expected to worsen. The regional travel demand models forecast significant traffic growth of 10% during the AM peak and 6% during the PM peak by 2015.

The most direct approach for mitigating these impacts, and to improve mobility and travel time reliability within the corridor, is to add or expand freeway capacity by adding lanes. However, while some localized improvements may be possible, the potential for significant capacity expansion is constrained physically (constrained on both sides by water and development) and institutionally. The majority of stakeholders, including local agencies along the corridor, do not support roadway widening due to the:

- High cost associated with right of way acquisition, roadway construction and roadway operation and maintenance.
- Significant environmental impacts associated with the roadway construction and roadway operation and maintenance.
- Potential for the increased capacity to lead to an increase in vehicle demands using the corridor.

Given this limitation, and the magnitude of projected growth, it is expected that some of the demand will shift to other times (expand the peak period) and some forecasted trips will not occur. However, it is still expected that the demand will grow beyond what the baseline roadway system, plus minor improvements, can accommodate. Therefore there is a need to focus on strategies that:

- Maximize the efficiency of the existing roadway system.
- Encourage increased use of other modes.
- Reduce the occurrence and impact of incidents.
- Reduce or manage peak period vehicle travel demand.

The types of strategies that can be applied in the I-80 corridor to address existing and forecasted deficiencies include: Freeway and Arterial Geometric Improvements, Freeway and Arterial Management and Operations Improvements, Transit Improvements, Non-Motorized Mode Improvements, Demand Management Strategies, Traveler Information Improvements, Goods Movement Policies, ITS Improvements. In reality, a combination of these improvements and strategies is likely necessary. An overview of these types of strategies is provided below.

3.2 Roadway Geometric Improvements

As noted above, due to the physical and institutional constraints major capacity expansion is unlikely, but smaller improvements are possible that may address some deficiencies. Potential freeway improvements include auxiliary lanes, ramp modifications and ramp intersection modifications. Surface streets improvements could include adding new roadways that can help relieve I-80, especially in the eastern end of the corridor where higher growth is projected in future years. Potential improvements may also include the widening of existing roadway and intersections.

3.3 System Management Improvements

The primary objective of System Management improvements is to get maximum benefit out of the existing system. Examples of System Management improvements or strategies include ramp metering, managed lanes, shoulder use, variable speed limit signs, congestion pricing, traffic signal improvements, freeway/ramp/surface street signal coordination, incident management, and reversible lane strategies.

The proposed I-80 ICM Project is focused on the implementation of several System Management strategies, plus systems that can support the implementation of additional or expanded strategies in the future. The project also includes integration with the East Bay SMART Corridors Program (a joint Alameda and Contra Costa County ITS program) and the Caltrans District 4 Transportation Management Center (TMC).

Table 3-1 summarizes the benefits associated with various system management strategies and identifies whether the strategies are currently included in the I-80 ICM Project. All the system management strategies listed in Table 3-1 were considered in the I-80 ICM Concept of Operations. Some of the strategies were not included in the I-80 ICM project due to funding, timing and institutional constraints. The strategies that were not included in the I-80 ICM project can be considered as possible future improvements.

Table 3-1 System Management Strategies and Benefits

System Management Strategy	Increased throughput	Increased capacity	Decrease in primary accidents	Decrease in secondary accidents	Decrease in incident sensitivity	More uniform speeds	Decreased headways	More uniform driver behavior	Increased trip reliability	Delay onset of freeway breakdown	Reduction in traffic noise	Reduction in emissions	Reduction in fuel consumption	Included in the I-80 ICM project?
Variable Advisory Speel Limit (VASL)	●		●	●	●	●	●	●	●	●	●	●	●	Yes
Automated speed enforcement			●		●	●		●	●			●	●	No
Freeway shoulder use	●	●							●	●				No
Dynamic lane markings	●	●							●					No
Dynamic merge control	●	●	●			●			●	●	●	●	●	No
Junction control	●		●			●		●	●	●		●	●	No
Construction site management	●	●							●		●	●	●	Yes
Adaptive ramp metering	●		●	●		●			●	●		●	●	Yes
Dynamic rerouting	●		●	●				●	●			●	●	Yes
Traffic signal synchronization	●					●	●		●		●	●	●	Yes
Centralized traffic signal management	●				●	●	●		●		●	●	●	Yes
Improved incident response	●			●	●	●	●							Yes
Reversible lanes	●													No
High Occupancy Vehicle Lanes	●					●	●		●		●	●	●	Yes
Express Lanes	●					●	●		●	●	●	●	●	No

Source: DKS Associates, 2010

3.4 Transit Improvements

There are currently a number of transit services and facilities in the corridor. Current services include various bus services (local, express, Rapid Bus), BART, Amtrak/Capitol Corridor rail. Transit facilties include BART and Amtrak stations, Hercules Transit Center, and numerous park-and-ride lots.

The travel demand forecasts suggest that transit demand will increase by 20% by the year 2015, and more than double by 2035. Even with this growth, auto travel demand is also expected to grow leading to more severe congestion in the corridor. To accommodate the forecasted growth and, ideally, promote even greater transit mode share to help reduce congestion on the roadway network, improvements to the transit system will be necessary. Improvements may include enhancing or expanding the existing services and facilities, implementing new services, and constructing new facilities. Other improvements include supporting strategies such as transit signal priority (TSP) and transit/HOV lanes that facilitate the flow of transit vehicles on the roadway network. A critical component of these improvements will be the provision of parking at transit centers, rail stations and park-and-ride facilities. Potential transit-related improvements within the I-80 corridor include:

- New ferry service
- Enhancements to Capitol corridor rail service
- BART improvements – extend line, add in-fill stations, increase frequency, add parking capacity
- Enhance or expand bus services
- Construct new transit centers and park-and-ride lots
- Improve transit traveler information systems

3.5 Non-Motorized Mode Improvements

Non-motorized mode of travel can be a complement or alternative to both auto and transit modes. The I-80 freeway corridor exceeds the maximum trip length for bicycle trips and pedestrian travel. Non-motorized travel is more appropriate for short trips and may reduce surface street traffic. The Alameda County Bicycle Plan and Contra Costa Countywide Bicycle and Pedestrian Plan identify numerous improvement projects for non-motorized mode network.

One specific area for potential improvement is the integration of bicycle travel and transit. In general, bicycles are allowed on BART only during non-peak hours. Provision of exclusive bicycle cars on BART or reserving some room on regular BART car during peak periods should be considered. Improving bicycle parking, providing more bicycle lockers at BART stations might encourage people to take bicycles to BART stations. This might reduce the parking demand at BART stations and reduce short trips on surface streets.

Potential pedestrian travel improvements within the I-80 corridor include:

- Install pedestrian count-down signals,
- Improve sidewalk conditions, construct mid-block lighted crossings
- Develop pedestrian, transit stop and streetscape improvements along San Pablo Avenue
- Improve pedestrian access and safety along transit access routes.
- Close the Bay Trail gaps

Potential bicycle travel improvements include:

- Construct Class I bicycle trails
- Improve bike detection in the corridor.
- Provide exclusive right-of-way for bikes wherever feasible to enhance bike safety.
- Provide more room for bikes on BART.
- Increase the availability of bike lockers and bike parking at BART stations.

3.6 Demand Management Strategies

Federal Highway Administration recognizes that managing demand can no longer stop at encouraging travelers to change their travel mode from driving alone to choosing a carpool, public transit, or other commute alternative. Managing demand today is about providing all travelers, regardless of whether they drive alone, with choices of location, route, and time, not just mode of travel.

The contemporary concept of travel demand management encompasses broader set of transportation goals due to need to manage demand in multiple situations and conditions as well as the influence of information and the technologies to deliver it. Real-time travel information evaluations show that – armed with real-time travel information – a significant number of travelers alter their original route, departure-time, and even mode choices, reducing the demand for already congested facilities and maximizing the use of underutilized alternatives.[4]

All the other strategies listed in this chapter are methods to manage traffic demand. The I-80 corridor has no right of way to increase capacity to the roadway network. Therefore, it is more critical to pay attention to the strategies to shift the demand to other modes, to non-peak hours and possible means to reduce the demand.

The possible strategies for the I-80 corridor include:

- Worksite flextime: Allows employees to set their own arrival and departure time to/from work within established time boundaries agreed to by their employer. In congested areas like I-80 corridor, it may encourage employees to avoid the most congested travel times, reducing the demand on roadway and/or transit systems during peak-demand periods.
- Telecommuting: Telework programs and policies at the worksite from structured, formally-implemented telework programs and policies to more informal telework arrangements established between individual employees and their direct supervisors.

[4] FHWA, Office of Operations, Overview of Travel Demand Management Program

- Transit-Oriented and Pedestrian Oriented Design: Focusing a mix of land uses, such as employment, housing, restaurants, services, retail and more in well designed, pedestrian friendly and/or near transit connections can reduce demand for vehicle travel and reduce trip distances.
- Live Near Work Incentive Programs: Live near work programs provide incentives for employees to live near their place of employment. Examples include down payment assistance, location efficient mortgages and rent subsidies. By providing housing close to employment, this program can lower the costs of commuting, lessen the pressure on infrastructure, and generate more pedestrian traffic in business districts.
- Live Near Transit Mortgage Incentives: Live near transit programs offer mortgage incentives to encourage residential location near transit facilities. The programs recognize that household transportation expenses can be lower for residences well served by public transportation, and allow homebuyers to use these transportation savings as additional borrower income in qualifying for a home mortgage

These options are well recognized by stakeholder agencies in the corridor and are being pursued to the extent feasible. This CSMP recognizes that these strategies are important to the long term success toward maintaining mobility and increasing efficiency in the the corridor.

3.7 Traveler Information

Providing travel information is one of the potential strategies to mitigate traffic congestion in the I-80 corridor. **Figure 3-1** illustrates the effects of traveler information on trip making decisions. Also illustrated in **Figure 3-2**, traveler information has impacts to travelers in avoiding congestion, reducing uncertainty and stress, saving time, and improving travel safety.

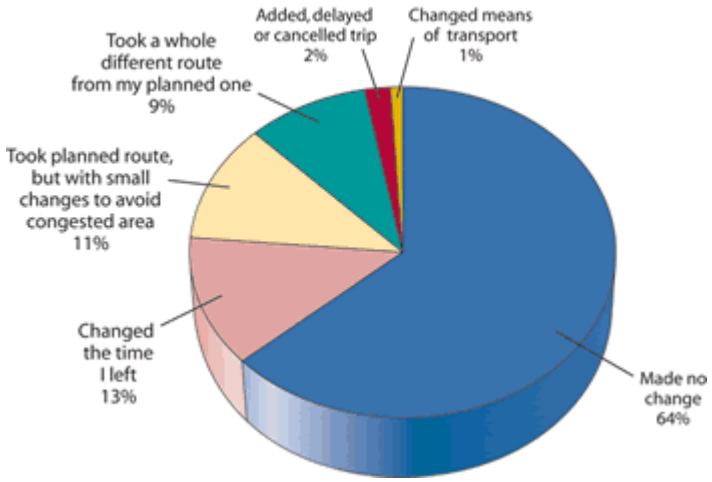


Figure 3-1 Effect of Traveler Information on Travel

Source: *Managing Demand through Travel Information Services*, FHWA

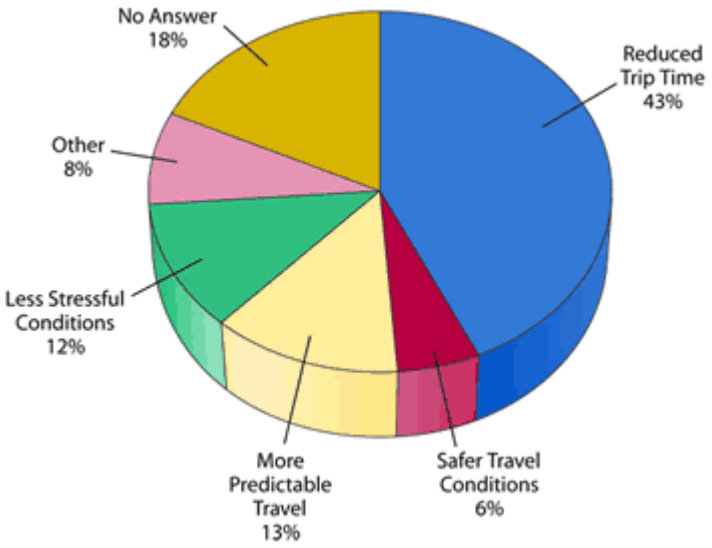


Figure 3-2 Benefits of Traveler Information

Source: *Managing Demand through Travel Information Services*, FHWA

Currently, traveler information on I-80 corridor is provided via Changeable Message Signs (CMS), Highway Advisory Radio (HAR), telephone and the internet. CMS and HAR systems are used to provide real time information and directions to the driver, plus they are used to advise about upcoming events. These systems are controlled from Caltrans District 4 Transportation Management Center. The internet is used to provide more detailed information to the public. The primary method of sharing information on the Internet and the telephone is via the Bay Area 511 system. The 511 system receives real time information from detectors, Closed-Circuit Television (CCTV) cameras and from some management applications. This information helps travelers make more-informed decisions in selecting departure times, destinations, and routes in addition to modes of transportation.

The I-80 ICM project will provide more ITS devices to monitor traffic conditons, and disseminate the information to travelers in the near-term. In the longer-term, potential improvements include extending the capability of traveler information to emerging personalized devices and in vehicle navigation system, and providing devices at bus transit and rail stations to disseminate the traveler and transit information.

3.8 Goods Movement Policies

Trucks and other heavy vehicles use I-80 to move goods within the Bay Area to and from northern and southern California, and points beyond. The Port of Oakland and other important industrial and commercial facilities are located along the corridor or are linked by the I-80 freeway. During the peak periods, heavy truck traffic can consume road capacity which contributes to congestion.

Because of the importance of efficient freight movement to the economy, the needs of this group will be factored into the solution; moreover, the solution must be consistent with the Bay Area

goods movement strategies while still allowing the corridor to meet its congestion and safety goals. Improving the commercial vehicle operators' safety, efficiency, mobility and travel times are the most important goals for this group of users. Some of the possible solutions are explained below.

3.8.1 Roadway Time of Day Restrictions

Due to the severe congestion on I-80 freeway during morning and afternoon peak period, commercial vehicles can be restricted to use the road network at the busies hour at the most congested sections of the freeway. Some trucks can choose not be restricted by this rule by paying a certain fee and obtain a special sticker/license for driving during the rush hour. The institutional issues and the fee will need to be studied in more detail to make this solution feasible.

3.8.2 Lane Restrictions

Because trucks and passenger cars have significantly difference operation pattern, when possible trucks should be separated from passenger vehicles. For I-80, the following options can be considered:

- Exclusive lanes – Designate a lane for exclusive truck use. Passenger cars cannot use the truck lane while truck can only use the truck lane.
- Suggested exclusive lane – Truck can only use the designated truck lane while passenger cars do not have restriction
- Mixed lane— only trucks are allowed to use the designated truck lane, and only passenger cars are allowed to use the designated passenger car lane. The other lane in the middle can be used by both truck and passenger cars.

The selection of the lane designation options will need to be calculated with special benefit/cost model with input of truck volume, passenger car volume, highway characterizes, and incident history.

3.8.3 Remote Transfer Sites

Remote transfer sites can be considered where commercial vehicles can hold until traffic conditions and conditions at port are favorable for load transfer.

4 NEAR-TERM (2015) CONDITIONS

4.1 Travel Demand Trends

The following sections summarize the 2015 growth trends in the I-80 Corridor.

4.1.1 Land Use

As shown in **Table 4-1**, 995,512 households are expected to be present in these two counties by 2015 for a 9.3% increase from 2005. For the I-80 corridor, households would increase 7.0% from 113,407 in 2005 to 121,382 in 2015.

As can be seen in **Table 4-2**, employment in Alameda and Contra Costa Counties would increase 14.7% between 2005 and 2015 rising from 1,123,521 to 1,289,161. Within the I-80 corridor, 2005 employment is 126,335 and would increase by 14.4% to 144,530 by 2015.

Table 4-1 Household Growth

County	2005	2015	% Growth
Alameda	545,250	591,494	8.5%
Contra Costa	365,193	404,018	10.6%
Total	910,443	995,512	9.3%
I-80 Corridor	**113,407**	**121,382**	**7.0%**

Source:
ACCMA Travel Demand Model – network update 2008
CCTA Travel Demand Model – perennial model update 2007

Table 4-2 Employment Growth

County	2005	2015	% Growth
Alameda	735,460	850,586	15.7%
Contra Costa	388,061	438,575	13.0%
Total	1,123,521	1,289,161	14.7%
I-80 Corridor	**126,335**	**144,530**	**14.4%**

Source:
ACCMA Travel Demand Model – network update 2008
CCTA Travel Demand Model – perennial model update 2007

4.1.2 Freeway Demands

As shown in **Table 4-3**, I-80 peak hour demand is forecasted to increase between 3% and 27% during the AM peak hour and between 2% and 14% during the PM peak hour between 2005 and 2015.

Table 4-3 Mainline Demands

Mainline Location	Existing (2005) Demand		Future (2015) Demand		Growth (%)	
	AM Peak Hour	PM Peak Hour	AM Peak Hour	PM Peak Hour	AM Peak Hour	PM Peak Hour
I-80 Eastbound						
Between University Ave and Gilman St	7,072	9,371	8,095	9,560	14%	2%
Between San Pablo Dam off and on ramps	3,335	5,892	4,185	6,113	25%	4%
Between Pinole Valley Rd and SR 4	3,290	7,446	4,177	8,202	27%	10%
I-80 Westbound						
Between SR 4 and Pinole Valley Rd	8,138	4,056	8,918	4,620	10%	14%
Between San Pablo Dam off and on ramps	6,190	4,921	6,362	5,377	3%	9%
Between Gilman St and University Ave	8,928	7,611	9,375	8,427	5%	11%

Source:
I-80 ICM Regional Model (modified version of ACCMA Travel Demand Model)

As shown in **Table 4-4,** total freeway demand within the corridor, defined as the total vehicle demand that uses a section of Interstate 80 within the study corridor, is forecasted to increase by 17.5% during the AM peak hour and 8.7% during the PM peak hour by 2015. This includes vehicle trips with an origin and/or destination within the corridor and through trips where both the origin and destination of the trips exist outside the corridor.

Table 4-4 I-80 Corridor Freeway Demand (Vehicle Trips)

Peak Hour	Existing (2005)	Future (2015)	Growth (%)
AM	**135,909**	**159,739**	**17.5%**
PM	**160,621**	**174,626**	**8.7%**

Source:
I-80 ICM Regional Model (modified version of ACCMA Travel Demand Model)

4.1.3 Arterial Demands

As demand along the I-80 corridor increases, it is expected that demand along San Pablo Avenue will increase as well since it is the main parallel arterial to the I-80 study corridor. As indicated in **Table 4-5,** between the existing year and 2015, maximum arterial demand increase is expected

to reach 71% between McBryde Avenue and San Pablo Dam in the AM peak hour and 141% between San Pablo Dam and McBryde Avenue during the PM peak hour.

Table 4-5 Arterial Demands

San Pablo Ave Location	Existing (2005) Demand		Future (2015) Demand		Growth (%)	
	AM Peak Hour	PM Peak Hour	AM Peak Hour	PM Peak Hour	AM Peak Hour	PM Peak Hour
Between University Ave and Gilman St	932	1,839	1,495	1,875	60%	2%
Between McBryde Ave and San Pablo Dam	474	1,179	810	1,443	71%	22%
Between Pinole Valley Rd and SR 4	257	2,014	293	2,160	14%	7%
Between SR 4 and Pinole Valley Rd	1,965	257	2,126	333	8%	30%
Between San Pablo Dam and McBryde Ave	971	199	1,083	478	12%	141%
Between Gilman St and University Ave	1,936	1,379	1,873	1,861	-3%	35%

Source:
I-80 ICM Regional Model (modified version of ACCMA Travel Demand Model)

4.1.4 Mode Choice

Mode choice demands have been compiled from the regional travel demand model for 2005 and 2015 and are summarized in **Table 4-6.** In 2015, travel demand within the I-80 corridor for each mode is projected to increase generally at rates greater than those for the region as a whole. Drive alone will increase by 12.9%, rideshare with two people will increase by 14.7%, rideshare with three or more people will increase by 15.5%, truck use will increase by 16.5%, and transit use will increase by 20.2% when compared to 2005 conditions.

Table 4-6 Daily Mode Choice Demands

Regional Person Trips			
Mode	**Existing (2005)**	**Future (2015)**	**Growth (%)**
Drive Alone	11,948,017	13,179,025	10.3%
Share 2	3,791,658	4,185,363	10.4%
Share 3+	2,889,006	3,196,210	10.6%
Truck	3,586,692	3,865,527	7.8%
Transit	1,021,585	1,261,703	23.5%
I-80 Corridor[1] Person Trips			
Mode	**Existing (2005)**	**Future (2015)**	**Growth (%)**
Drive Alone	742,938	838,436	12.9%
Share 2	225,447	258,600	14.7%
Share 3+	162,172	187,324	15.5%
Truck	125,493	146,172	16.5%
Transit	178,969	215,104	20.2%

Note: 1. All trips traveling within the corridor, including through trips (both trips ends outside the corridor).
Source: I-80 ICM Regional Model (modified version of ACCMA Travel Demand Model)

4.1.5 Transit Ridership

According to the travel demand model, transit demand is expected increase at a higher rate than other modes of transportation for 2015. The corresponding increase in transit use within the I-80 corridor is detailed in **Table 4-7.** Between 2005 and 2015, daily transit ridership is expected to increase by 17.2%.

Table 4-7 I-80 Corridor Daily Transit Ridership Growth[1]

Transit Provider	2005 Daily Ridership	2015 Daily Ridership	Growth (%)
BART	37,981	44,140	16.2%
Amtrak	759	1,206	58.9%
AC Transit	92,708	109,949	18.6%
WestCAT	9,848	10,080	2.4%
Ferry	3,139	3,510	11.8%
Other	8,630	10,452	21.1%
Total Corridor	**153,065**	**179,337**	**17.2%**

Note: 1. Combines boardings and alightings within Corridor. Includes transfer but does not include through trips (both trips ends outside the corridor).
Source: I-80 ICM Regional Model (modified version of ACCMA Travel Demand Model)

4.2 Mobility Trends

This section presents the trends in baseline mobility for three different levels of aggregation:

1. The I-80 Study Corridor: This consists of city streets, county roads, and state highways within the study area.
2. I-80 Freeway Mainline Only.
3. San Pablo Avenue only: San Pablo Avenue represents the primary alternate arterial route throughout a majority of the study corridor.

Mobility is measured in terms of vehicle miles traveled (VMT), vehicle hours traveled (VHT), and vehicle hours of delay (VHD) as defined within the travel demand model.

4.2.1 I-80 Study Corridor

Table 4-8 shows the trends in baseline mobility for the entire I-80 Corridor network (freeways, state highways, local streets). In 2015, the I-80 corridor's VMT increases by approximately 13% and 11% during the respective AM and PM peak hours while the VHT increases by approximately 20% and 18% during the respective AM and PM peak hours.

Table 4-8 I-80 Corridor Baseline Mobility Trends

Performance Measure	Existing (2005)	Future (2015)	Change (%)
AM Peak Hour			
Vehicle Miles Travel	493,883	555,725	13%
Vehicle Hours Travel	14,377	17,295	20%
PM Peak Hour			
Vehicle Miles Travel	532,934	589,893	11%
Vehicle Hours Travel	16,974	20,107	18%

Source:
I-80 ICM Regional Model (modified version of ACCMA Travel Demand Model)

4.2.2 I-80 Freeway Mainline

Table 4-9, Table 4-10 and **Table 4-11** show the trends in baseline mobility for the I-80 Freeway Mainline within the study corridor.

In 2015, between Carquinez Bridge and SR 4, the AM eastbound is expected to have the highest increase in traffic. As shown in **Table 4-9**, VMT in this segment increases approximately 32% while the VHT increases by 34% compared to 2005.

Table 4-9 Performance Trends: Between Carquinez Bridge and SR 4

Performance Measure		Existing (2005)	Future (2015)
AM Eastbound	Vehicle Miles of Travel	10,882	14,392
	Vehicle Hours of Travel	174	234
	Vehicle Hours of Delay	1	5
	Average Vehicle Speed	62	61
PM Eastbound	Vehicle Miles of Travel	26,649	28,679
	Vehicle Hours of Travel	1,105	1,190
	Vehicle Hours of Delay	673	726
	Average Vehicle Speed	24	24
AM Westbound	Vehicle Miles of Travel	29,343	32,182
	Vehicle Hours of Travel	1,050	1,085
	Vehicle Hours of Delay	598	590
	Average Vehicle Speed	28	30
PM Westbound	Vehicle Miles of Travel	13,564	15,703
	Vehicle Hours of Travel	211	247
	Vehicle Hours of Delay	3	6
	Average Vehicle Speed	64	64

Source:
I-80 ICM Regional Model (modified version of ACCMA Travel Demand Model)

For I-80 between SR 4 and Central Avenue, the AM eastbound segment experiences the highest VMT increase of 24% and a VHT increase of 34% when comparing the 2015 and existing conditions, as shown in **Table 4-10**.

Table 4-10 I-80 Performance Trends: Between SR 4 and Central Avenue

Performance Measure		Existing (2005)	Future (2015)
AM Eastbound	Vehicle Miles of Travel	34,708	42,899
	Vehicle Hours of Travel	582	782
	Vehicle Hours of Delay	23	91
	Average Vehicle Speed	60	55
PM Eastbound	Vehicle Miles of Travel	66,255	69,560
	Vehicle Hours of Travel	2,057	2,414
	Vehicle Hours of Delay	995	1,300
	Average Vehicle Speed	32	29
AM Westbound	Vehicle Miles of Travel	69,162	73,117
	Vehicle Hours of Travel	2,088	2,527
	Vehicle Hours of Delay	978	1,356
	Average Vehicle Speed	33	29
PM Westbound	Vehicle Miles of Travel	46,653	50,777
	Vehicle Hours of Travel	922	1,068
	Vehicle Hours of Delay	168	248
	Average Vehicle Speed	51	48

Source:
I-80 ICM Regional Model (modified version of ACCMA Travel Demand Model)

Between Central Avenue and the Bay Bridge, the AM eastbound segment would experience the highest increase in VMT (14%) and VHT (43%), as shown in **Table 4-11**.

Table 4-11 I-80 Performance Trends: Between Central Avenue and the Bay Bridge

Performance Measure		Existing (2005)	Future (2015)
AM Eastbound	Vehicle Miles of Travel	32,808	37,317
	Vehicle Hours of Travel	748	1,068
	Vehicle Hours of Delay	201	446
	Average Vehicle Speed	44	35
PM Eastbound	Vehicle Miles of Travel	42,269	42,901
	Vehicle Hours of Travel	1,395	1,476
	Vehicle Hours of Delay	690	760
	Average Vehicle Speed	30	29
AM Westbound	Vehicle Miles of Travel	42,907	44,194
	Vehicle Hours of Travel	1,279	1,438
	Vehicle Hours of Delay	560	696
	Average Vehicle Speed	34	31
PM Westbound	Vehicle Miles of Travel	35,250	38,872
	Vehicle Hours of Travel	821	1,106
	Vehicle Hours of Delay	227	449
	Average Vehicle Speed	43	35

Source:
I-80 ICM Regional Model (modified version of ACCMA Travel Demand Model)

4.2.3 San Pablo Avenue

Table 4-12, Table 4-13, and **Table 4-14** show the trends in baseline mobility for San Pablo Avenue from between the Carquinez Bridge and the Bay Bridge.

Between 2005 and 2015, the highest increase in VMT between the Carquinez Bridge and SR 4 would occur during the AM peak hour in the eastbound direction. As shown in **Table 4-12**, the VMT would increase from 256 to 310 for an increase of 21% with a VHT increase of 29%.

Table 4-12 San Pablo Avenue Performance Trends: Between Carquinez Bridge and SR 4

Performance Measure		Existing (2005)	Future (2015)
AM Eastbound	Vehicle Miles of Travel	256	310
	Vehicle Hours of Travel	7	9
	Vehicle Hours of Delay	0	0
	Average Vehicle Speed	35	35
PM Eastbound	Vehicle Miles of Travel	1,531	1,758
	Vehicle Hours of Travel	44	50
	Vehicle Hours of Delay	0	0
	Average Vehicle Speed	35	35
AM Westbound	Vehicle Miles of Travel	3,394	3,711
	Vehicle Hours of Travel	99	108
	Vehicle Hours of Delay	0	0
	Average Vehicle Speed	34	34
PM Westbound	Vehicle Miles of Travel	297	319
	Vehicle Hours of Travel	9	9
	Vehicle Hours of Delay	0	0
	Average Vehicle Speed	35	35
Source:			
I-80 ICM Regional Model (modified version of ACCMA Travel Demand Model)			

Between SR 4 and Central Avenue, the highest increase in VMT from 2005 to 2015 is expected to occur during the PM peak hour in the westbound direction. The VMT would increase by 38% while the VHT would increase by 41%, as shown in **Table 4-13**.

Table 4-13 San Pablo Avenue Performance Trends: Between SR 4 and Central Avenue

Performance Measure		Existing (2005)	Future (2015)
AM Eastbound	Vehicle Miles of Travel	3,852	4,757
	Vehicle Hours of Travel	110	137
	Vehicle Hours of Delay	0	0
	Average Vehicle Speed	35	35
PM Eastbound	Vehicle Miles of Travel	15,338	16,396
	Vehicle Hours of Travel	603	959
	Vehicle Hours of Delay	150	471
	Average Vehicle Speed	25	17
AM Westbound	Vehicle Miles of Travel	16,040	16,423
	Vehicle Hours of Travel	592	876
	Vehicle Hours of Delay	109	385
	Average Vehicle Speed	27	19
PM Westbound	Vehicle Miles of Travel	4,271	5,903
	Vehicle Hours of Travel	125	176
	Vehicle Hours of Delay	0	0
	Average Vehicle Speed	34	33
Source:			
I-80 ICM Regional Model (modified version of ACCMA Travel Demand Model)			

For the segment between Central Avenue and the Bay Bridge, the largest increase in VMT from 2005 to 2015 would occur during the AM peak period in the eastbound direction. As shown in **Table 4-14**, the VMT would increase by 75% and the VHT is forecasted to increase by 118%.

Table 4-14 San Pablo Avenue Performance Trends: Central Avenue to Bay Bridge

Performance Measure		Existing (2005)	Future (2015)
AM Eastbound	Vehicle Miles of Travel	3,935	6,883
	Vehicle Hours of Travel	131	285
	Vehicle Hours of Delay	0	48
	Average Vehicle Speed	30	24
PM Eastbound	Vehicle Miles of Travel	8,222	8,592
	Vehicle Hours of Travel	315	358
	Vehicle Hours of Delay	16	42
	Average Vehicle Speed	26	24
AM Westbound	Vehicle Miles of Travel	7,985	8,167
	Vehicle Hours of Travel	514	324
	Vehicle Hours of Delay	224	33
	Average Vehicle Speed	16	25
PM Westbound	Vehicle Miles of Travel	6,721	8,594
	Vehicle Hours of Travel	226	317
	Vehicle Hours of Delay	0	13
	Average Vehicle Speed	30	27

Source:
I-80 ICM Regional Model (modified version of ACCMA Travel Demand Model)

4.2.4 Freeway Safety Trends

A tool to forecast collision rates within the I-80 corridor does not exist. A simple, but often-used, approach is to assume that collision rates will remain at existing levels and that the number of collisions will increase on par with the forecasted increase in VMT. Between the existing year and 2015, VMT is expected to increase by 9% resulting in a similar 9% increase in collisions along the I-80 study corridor. The resulting numbers of collisions by segment are presented in **Table 4-15**.

Table 4-15 Collisions on I-80 Study Corridor

Segment	Limits	Number of Collisions	
		Existing	2015
1	Bay Bridge Toll Plaza/Powell	926	1,012
2	Powell/Buchanan-580	2,270	2,480
3	580-Buchanan/San Pablo Dam Road	1,077	1,177
4	San Pablo Dam Road/SR 4	1,290	1,409
5	SR 4/Carquinez Bridge	722	789

Source: DKS Associates, 2010

4.3 Potential Improvements

Given the time typically needed to define, design, get environmental clearance, and get funding, there is limited opportunity to implement new projects by 2015. The current economic conditions further limit the potential for new projects to be implemented in this timeframe. Thus, the list of potential roadway-related improvements has been limited to those already in the pipeline.

4.3.1 Baseline Improvement Project

A review of planning/programming documents plus the travel demand models revealed a single major capital improvement project along the I-80 corridor that is assumed to be completed by 2015 (see **Table 4-16**). This project is currently under construction.

Table 4-16 2015 Baseline Capital Improvement Projects

Model Year	Project	Description
2015	I-80 Eastbound HOV lane	Construct EB HOV lane on I-80 from where existing HOV lanes end to Crockett interchange.

Source:
ACCMA Travel Demand Model – network update 2008
CCTA Travel Demand Model – perennial model update 2007

With respect to transit, no significant service or capital improvements were assumed for the near-term baseline condition. This assumption is reflective of the current funding situation that has lead to service reductions in many areas.

4.3.2 I-80 ICM Project Improvements

The I-80 Integrated Corridor Mobility (ICM) Project focuses on the implementation of several System Management strategies, and incorporates elements that address all of the objectives related to system efficiency, alternative mode use, incident reduction, and demand reduction. The project uses State-of-the-Practice Intelligent Transportation System (ITS) technologies to enhance the effectiveness of the existing transportation network, including the I-80 freeway, parallel arterials and transit system in Alameda and Contra Costa Counties.

This $91.7 million project is primarily funded with Corridor Mobility Improvement Account (CMIA) funds

for freeway elements and Traffic Light Synchronization Program (TLSP) funds for arterial and transit-related improvements. Local funds are also programmed for this project.

The proposed I-80 ICM project components or sub-systems are listed in **Table 4-17.**

Table 4-17 I-80 ICM Project System Components

System Component	Element	Purpose
Freeway Management System	Adaptive Ramp Metering; Variable Advisory Speed Limits/Signs; Changeable Message Signs; Lane Management/Use Signs; Highway Advisory Radio; Travel Time Information; Traffic Monitoring (CCTV System)	End of queue warning, optimize flow of traffic, reduce delay, decrease accidents, merge control, decrease arterial spillover, and improve safety
Incident Management System	Incident Response plan; Lane Management; End-of-the-queue warning; Vehicle detection system; Speed Harmonization (SH); Diversion management	Decrease number of accidents, decrease incident response time, and decrease incident recovery time
Arterial Management System	Controller upgrades; Signal Interconnect; Emergency Vehicle Preemption; Transit Signal Priority; Trailblazer Signs; Traffic Monitoring (CCTV, detectors); TMC for local jurisdictions; Incident response timing plans	Optimize traffic flow on arterials, maximize coordination
Transit Management System	Ramp meters with HOV preferential lanes; Transit Signal Priority; Transit/traffic traveler information at BART stations	Improve travel time reliability, reduce travel time, encourage mode shift
Traveler Information System	Changeable Message Signs; Highway Advisory Radio; 511 enhancement/Personalized 511 System; SMART Corridor ATIS enhancement; Comparative Travel Times; Parking Information System	Enhanced traveler information for all users Minimize diversion during incident
Traffic Surveillance and Monitoring System	CCTV cameras, vehicle detection system	Traffic Monitoring to support other systems

Source: DKS Associates, 2010

With respect to the I-80 freeway, the core ICM elements include adaptive ramp metering, variable advisory speed limits (VASL) and lane management. These core elements are the subject of an on-going project development process that includes preparation of a *Project Study Report*

(including *Traffic Operations Analysis Report*) *(see Appendix A), Ramp Metering Plan, Concept of Operations, System Requirements*, and design documents. As currently proposed, only ramp metering will be utilized during recurrent congestion conditions, while all three elements (ramp metering, VASL and Lane Management) will be utilized under incident conditions. The application of these core elements is further described below.

Ramp Metering – Under the I-80 ICM project, it is proposed all local interchange on-ramps in both the westbound and eastbound directions between the Bay Bridge Toll Plaza and the Carquinez Bridge be metered, except as follows:

- Richmond Parkway direct HOV connector to WB80;
- Cutting Blvd direct HOV connector to EB80; and
- Eastbound Pomona on-ramp to the Carquinez Bridge.

Metering of the freeway-to-freeway connector ramps from State Route (SR-4) is proposed in the project, but metering of the freeway-to-freeway connector ramps at I-80/580/880 and eastbound I-580 to westbound I-80 is not included.

It is anticipated that Ramp Metering will be used under both recurring and incident conditions during the weekday AM and PM peak periods. With respect to the ramp meter control strategy, it is proposed that a coordinated, corridor-wide adaptive ramp metering program would be implemented, but that initially it is anticipated that the ramp metering control algorithm for I-80 would be based on the existing Caltrans Traffic Operations System (TOS) v2.1.1 program used throughout the Bay Area. Specific details, such as those of which ramps are active and their metering rate at any given time, are subject to the prevailing conditions at that time.

It should be noted that most of the on-ramps in the corridor have been configured and at least partially-equipped to accommodate ramp metering as part of previous projects. The I-80 ICM Project includes configuring and equipping the remaining ramps, installing the remaining equipment on those ramps that are currently only partially-equipped, and, in a few instances, modifying current layouts. Reflective of funding constraints, a limited set of geometric improvements are proposed as part of the I-80 ICM Project. In most cases, these improvements involve only minor physical changes, and emphasize striping and signing improvements. Other physical improvements to the ramps are beyond the resources of this project.

Variable Advisory Speed Limits - Variable advisory speed limits (VASL) involve the use of electronic signs, Variable Advisory Speed Signs (VASSs), along the freeway that provide speed limit information with the limits varying depending on downstream conditions. VASL can be used in two ways: to promote corridor speed harmonization and to provide “end-of-queue” warning. It is proposed that Variable Advisory Speed Signs (VASSs) be deployed in both directions of the entire length of the corridor. More specifically, equipment will be installed as follows:

- Signs will be placed at freeway entrance(s) into the project area to inform motorists that they are entering an "active traffic management zone";

- VASSs will be installed at the following locations:

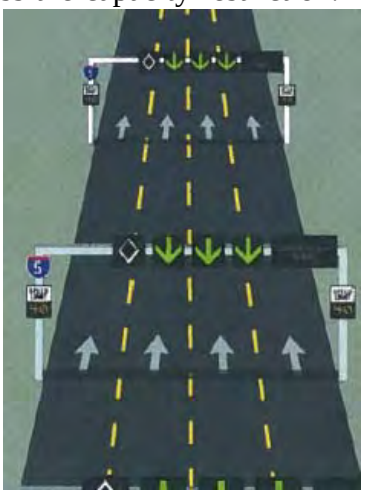
    1. Downstream of on-ramps on the right shoulder. The minimum spacing of each pair of signs is one per interchange or every two miles, whichever is less;

    2. Signs will be installed on both left and right columns of all gantries with spacing about 0.5 mile intervals.

A central algorithm would adjust the advisory speed for discrete sections of the corridor, based on criteria to be developed in cooperation with Caltrans, CHP, MTC, and local stakeholders. Once VASL equipment is deployed along a freeway, it can be used for either or both of the purposes described above.

In the case of VASL, the initial functionality would be that of end-of-queue warning in response to freeway incidents, primarily as a means to reduce speeds approaching unexpected stopped or slow traffic. However, in order to gain the full benefits of VASL strategies for congestion relief under both recurrent and incident-related congestion conditions, the infrastructure and all other necessary elements of VASL will be installed allowing full implementation of active traffic management in the future. To this end, Variable Advisory Speed Signs (VASSs) be deployed in both directions of the entire length of the corridor. The VASS infrastructure will allow incremental and future expansion of VASL strategies, upon gained knowledge and demonstrated effectiveness, to other operating scenarios that may benefit from speed harmonization.

Lane Management –_Lane management utilizes overhead sign structures to provide motorist information regarding lane condition changes. When a lane blockage or closure occurs, the overhead Lane Usage Signs (LUSs) are able to convey to motorist the exact lane condition miles in advance allowing for more efficient lane changes or paths to address the capacity restriction. The LUSs will display colored symbolic or text information for each lane, facilitating clearer communication of approaching conditions to drivers and dynamic lane management as needed for incident management or planned highway work.



As currently proposed for the I-80 ICM project, LUSs will be installed at approximately 0.5-mile intervals (or one set between two interchanges) in the westbound direction at the western end of the corridor between Cutting Blvd. and the I-80 Maze. Priority is given to this segment of the corridor, as it is the portion of the project area with the most congestion and higher incident rates. LUSs will be hung over each lane on 10 to 12 separate gantries. Every third gantry will hold a CMS along with the LUSs.

4.3.3 ITS Improvements

Intelligent Transportation System (ITS) is used typically for traffic management, incident management, and collecting and disseminating traveler information. The corridor does not have a full ITS deployment, but it does include some field elements such as detection, CCTV cameras, highway advisory radio (HAR) and changeable message signs (CMS).

As part of the I-80 ICM project a considerable amount of additional ITS equipment will be deployed within the corridor. This equipment will include: ramp meters, VASSs, LUSs, vehicle detection stations, CCTV cameras, CMSs, HAR, and transit signal priority.

Caltrans District 4 Deployment Approach

Caltrans District 4 has established the following approach for positioning ITS field elements along the I-80 freeway corridor for the I-80 ICM project.

- Ramp Metering Stations: Caltrans District 4 recently completed a Ramp Meter Development Plan (RMDP) which identifies specific ramp meter deployment locations. Caltrans plans to meter all freeway on-ramps in the I-80 corridor. Freeway to freeway metering in the I-80 corridor needs to be studied further to determine the feasibility of implementation.
- Traffic Monitoring Stations: On the freeway mainline, the detectors will be placed at regular intervals in support of the existing Freeway Performance Measurement System (PeMS) detection system. Loop detectors will be placed at the on-ramps as per the requirements of the adaptive ramp metering algorithm.
- CCTV Cameras: Color CCTV cameras, both fixed and Pan/Tilt/Zoom (PTZ) will be located along the freeway. These cameras will be placed at strategic locations to assist Caltrans District 4 and local agencies to monitor and manage traffic, incidents and events. The cameras will be mounted either on sign structures or on standalone poles. All the on-ramps will have video monitoring.
- Changeable Message Sign (CMS): Considered at decision points upstream of freeway-to-freeway interchanges and to support active traffic management strategies. CMS may provide information such as warning and alerts, travel time on freeways and on transit, available parking information, port information for commercial vehicles and comparative travel times between different modes.
- Highway Advisory Radio: Spaced at 4.5 mile intervals that will provide full coverage of the highway. Changeable message signs are deployed at locations within the HAR transmitter's operating range.
- Center to Center communication between Caltrans TMC and the TMC's for local jurisdictions to facilitate inter-agency information sharing, coordination and system operation.

4.4 Evaluation

4.4.1 Approach

A detailed evaluation of the I-80 ICM project was performed as part of the *I-80 ICM Project Traffic Operations Analysis Report (see Appendix A)* using a Paramics micro-simulation model. This included the analysis of several ICM build alternatives representing combinations of the core ICM elements (ramp metering, VASL/corridor speed harmonization, and lane management) for comparison to 2015 No Build conditions. Analyses were conducted for the 2015 AM and PM weekday peak periods under both recurring and incident (non-recurring) conditions.

The results of the alternatives analysis, in addition with other design and institutional considerations, were used to refine the ramp meter designs at a number of locations, and define how the different core elements would be used (at least initially) under recurring and incident conditions, as described in the previous section. As currently proposed, only ramp metering will be utilized during recurrent congestion conditions, while all three elements will be utilized under incident conditions. The results presented in the following section reflect this final recommended ICM Project design.

4.4.2 Expected Benefits of the Project

Under recurring conditions, the proposed I-80 ICM Project application is projected to provide significant operational benefits to freeway operations, especially in the westbound direction, and an overall benefit to operations in the corridor. While the freeway benefits would be partially offset by increased delay at the on-ramps and the arterial approaches, the ICM Project is projected to still yield an overall reduction in network delay during both the AM and PM peak periods. The ICM Project is expected to have a generally minimal impact on trips originating within Contra Costa or Alameda Counties. A sampling of such trips indicates that in most cases ramp meter delay is offset by mainline speed improvement resulting in negligible change in overall travel time. Another important benefit of the ICM Project is the potential reduction in accident rates. By improving freeway and network-wide performance, the ICM Project can also produce greenhouse benefits in the form of reduced emissions and fuel consumption.

The 2015 AM and PM peak period system performance results, as measured by vehicle hours of delay and average speeds, are summarized in **Table 4-18** and **Table 4-19** respectively. These tables compare the 2015 No Build with a 2015 Build – ICM Project alternative consisting of the final ramp metering plan. In the AM peak period, the recommended project produces a significant improvement to freeway operation with a 26% reduction in freeway delay and a 7% increase in average speed compared to the No Build alternative. During the PM peak, the ramp refinements incorparated into the final proposed ICM Project design help improve the efficiency of the ramp meter operations and eliminate the need to allow all-green intervals at three eastbound ramps. The net result is a 9% reduction in network delay and 11% reduction in freeway delay compared to No Build alternative.

Table 4-18 2015 Recurring Conditions System Performance (AM Peak Period)

Facility Type	No-Build	Build (ICM Project)	Change (%)
Vehicle Hours of Delay (Hours)			
Network Wide[1]	13,365	12,290	-8%
Freeway[2]	6,899	5,090	-26%
Ramp	702	1,170	67%
Arterial	5,764	6,027	5%
Average Speed (mph)			
Network Wide	32.9	33.6	2%
Freeway	41.0	43.9	7%
Ramp	20.9	15.2	-27%
Arterial	17.6	17.2	-2%

Note: 1. Network Wide includes all links in Paramics model
2. Includes I-80, portions of I-580 and I-880, plus freeway-to-freeway connectors
Source: DKS Associates, 2010

Table 4-19 2015 Recurring Conditions System Performance (PM Peak Period)

Facility Type	No-Build	Build (ICM Project)	Change (%)
Vehicle Hours of Delay (Hours)			
Network Wide[1]	36,400	33,288	-9%
Freeway[2]	24,400	21,687	-11%
Ramp	1,300	1,514	16%
Arterial	10,600	10,074	-5%
Average Speed (mph)			
Network Wide	23.2	24.5	6%
Freeway	26.5	28.4	7%
Ramp	17.8	16.0	-10%
Arterial	16.1	16.7	-4%

Note: 1. Network Wide includes all links in Paramics model
2. Includes I-80, portions of I-580 and I-880, plus freeway-to-freeway connectors
Source: DKS Associates, 2010

Additional findings from the analysis of recurring conditions indicate that with the final set of ramp meter designs, the recommended ICM Project:

- decreases the hours of delay on westbound I-80 by 24% during the AM and 28% during the PM peak periods.
- increases speeds on westbound I-80 by 10% during the AM peak, and by 22% during the PM peak.
- provides only modest benefit in the eastbound direction during the PM peak period due to the congestion pattern (the primary congested segment is located at the start of the corridor) and the all-green operation at a few on-ramps.

- shifts some delay to the on-ramps and arterials, but would still yield an overall reduction in network hours of delay of 8% during the AM and 9% during the PM peak.
- produces average meter delays of about 30 seconds per vehicle during both the AM peak and PM peak.
- generates additional delays of over 1 minute and queue spillback onto local streets at a limited number of locations. In these cases, modifications can be made to the ramp metering rates and/or meter designs to mitigate or minimize these ramp delays and arterial impacts.
- is expected to have a generally minimal impact on trips originating within Contra Costa or Alameda Counties and destined for the points beyond the corridor boundaries during the AM peak period. Journey travel times for a broad sample of such trips indicate that in most cases ramp meter delay is offset by mainline speed improvement resulting in negligible change in overall travel time.
- will provide a benefit during the PM peak period to those trips destined for points within Contra Costa or Alameda Counties through improved freeway travel times.
- will not result in significant diversion of trips from the freeway to parallel routes such as San Pablo Avenue, but can keep traffic on the freeway by discouraging drivers from hopping off the freeway and back on.
- will have an insignificant or minor impact to the arterial network as a whole and San Pablo Avenue, in particular, with respect to hours of delay and average speeds.
- offers potentially significant safety benefits by reducing accident rates. The benefits of an accident rate reduction include a lower number of injuries and fatalities, a decrease in property damage costs, and a reduction in non-recurring delay.
- can produce greenhouse benefits in the form of reduced emissions and fuel consumption as a result of reduced congestion and smoother flow.

The analysis conducted as part of the *I-80 ICM Project Traffic Operations Analysis Report (see Appendix A)* indicates that the proposed combination of ICM strategies (Ramp Metering, VASL, and Lane Management) as part of a Full Incident Management alternative is projected to provide significant operational and safety benefits under non-recurring conditions. Under incident conditions, the analysis suggests that the combination of the three ICM strategies (Ramp Metering + VASL + Lane Management) as part of a Full Incident Management alternative yields significant benefit. While the exact benefits of the proposed full Incident Management alternative will vary depending upon the location, duration, and severity of the incident, this combination of ICM elements was found to yield significant reductions in hours of delay on westbound I-80 and network-wide under a range of incident scenarios.

In the case of the sample accident tested, the analysis indicated that this combination of ICM elements provided the following benefits:

- westbound I-80 hours of delay reduced by 12%;

- within segment from Central to the 580/880 Split, hours of delay reduced by 19%; and
- flow at the incident locations increases by 5%.

The proposed ICM strategies can also provide further benefit by reducing the potential for both primary and secondary incidents. Depending on the extent and combination of strategies deployed on the I-80 corridor, the potential safety benefits include not only a decrease in primary incidents, but also a decrease in secondary incidents. Furthermore, by improving freeway and arterial operations during incidents, it is expected that proposed ICM strategies, particularly when implemented together, will produce significant benefits in terms of reduced emissions and fuel consumption. Greater detail regarding the projected benefits and impacts of the I-80 ICM Project under non-recurring conditions is provided in the *I-80 ICM Project Traffic Operations Analysis Report.*

4.4.3 Expected Return on Investment

When determining return on investment for the I-80 ICM Project two items need to be considered – estimated cost of the system and the benefits that could be accrued as a result of the system. Potential benefits may include annual savings due to a reduction in Vehicle Hours of Delay (VHD), accidents, auto demand, and unnecessary circulation.

The expected savings, costs and return on investment for the I-80 ICM Project are summarized in **Table 4-20**. The expected savings are broken down according to different project elements and conditons: CMIA-funded Freeway ATM elements – recurring conditons, Freeway ATM elements – non-recurring (incident) conditions, and TLSP-funded Arterial and Transit elements. For the Freeway ATM element, delay savings were derived from the operational analysis as described in the previous section. These savings were then monetized using an assumed value of time derived from the Caltrans Life Cycle Benefit/Cost Analysis Model. Additional savings associated with a reduction in secondary accidents was also derived from the Caltrans Life Cycle Benefit/Cost Analysis Model. For the Arterial and Transit elements, the savings presented reflect those reported in the TLSP grant application.

Under recurring conditions, the Freeway ATM elements (in this case, specifically the adaptive ramp metering and TOS components) are expected to generate delay savings of 4200 vehicle hours per weekday when comparing the 2015 AM and PM build conditions to 2015 no-build conditions. Assuming 1.5 persons/vehicle and an average value of time of $11.30/hour, the expected annual savings could equal approximately $18.1 million.

For non-recurring conditons, the Freeway ATM elements (adaptive ramp metering, TOS, VASS, and LUS) are expected to generate delay savings of 240 vehicle hours per weekday incident. Assuming 200 incident per year, 1.5 persons/vehicle and an average value of time of $11.30/hour, the expected annual delay savings could equal approximately $885,000. in addition, these elements are expected to reduce the occurrence of secondary accidentsgenerating additional annual savings of $5.7 million.

The Arterial and Transit elements are expected to generate savings associated with signal synchronization delay reductions, improved safety, transit mode shift, incident management, parking management, and traveler information. The total estimated annual savings are just over $37.3 million.

When combined, the total expected savings generated by the I-80 ICM are $61.94 million. Based on a total cost of $91.7 million, this yields a project Return on Investment of approximately 1.5 years.

Table 4-20 I-80 ICM Project Return on Investment

Savings	
Freeway ATM (Ramp Metering & TOS) – Recurring Conditions	
Average Delay Savings per Weekday (Vehicle Hours)	4200 (1)
Number of Non-holiday Weekdays/Year	250
Average Vehicle Occupancy Rate	1.5 (2)
Average Value of Travel Time/Person	$11.30/hr (3)
Expected Annual Savings– Freeway ATM (Recurring)	$18,112,500
Freeway ATM (Ramp Metering, TOS, VASS, LUS) – Non-Recurring Conditions	
Average Delay Savings/Incident (Vehicle Hours)	240 (4)
Number of AM/PM Peak Period Incident Days/Year	200
Average Vehicle Occupancy Rate	1.5 (2)
Average Value of Travel Time/Person	$11.30/hr (3)
Total Annual Savings – Delay Reduction	$814,000
Total Annual Savings – Accident Costs (5)	$5,700,000
Expected Annual Savings – Freeway ATM (Non-recurring)	$6,514,000
TLSP – Arterial & Transit Elements (6)	
Signal Synchronization Delay Savings	$8,145,000
Safety Savings	$16,090,000
Transit Mode Shift Savings	$5,601,000
Incident Management Savings	$3,443,000
Parking Management Savings	$885,000
Traveler Information Savings	$3,154,000
Expected Annual Savings – Arterial + Transit	$37,320,000
Total Combined I-80 ICM Program	
Total Annual Savings	$61,940,000
Estimated Cost	$91,700,000
Return On Investment	1.5 years (7)

Notes:
1 –Network Delay Savings - 2015 AM & PM Conditions
2 –Source – 2007 Caltrans HOV Lane Report
3 - Source – California Life-Cycle Benefit/Cost Analysis Model (weighted Avg .– Auto +Truck)
4 – Average reduction (5 Percent) for the lowest incident scenarios. For WB I-80 only.
5 – Source – California Life-Cycle Benefit/Cost Analysis and Model Results, assuming 10% reduction in secondary accidents.
6 – Benefits presented in the TLSP Application
7 - Assuming declining benefits from 100% to 50% during 20-year life cycle

4.4.4 Operations and Maintenance Issues

As primarily a system management project, on-going operations and maintenance (O&M) considerations are critical to the I-80 ICM Project. These considerations include not only O&M costs, but also the roles and responsiblities of the various stakeholder agencies. These considerations are addressed in the *I-80 ICM Project Operations and Maintenance Plan*. The O&M Plan describes the activities and funding required for effective operation and maintenance of the I-80 ICM system. The plan includes a description of project resources, partner responsibilities, policies, and procedures. In addition to the O&M Plan, it is expected that specific roles and responsibilities will be documented as part of a series of memoranda of understanding (MOUs) covering each of the involved agencies or jurisdictions.

5 INTERMEDIATE TERM IMPROVEMENTS

5.1 Potential Improvements

As noted in the previous chapter, the I-80 ICM Project along with the extension of the eastbound HOV lane on I-80 are expected to provide significant operational and safety benefits on I-80 in the near-term (2015) timeframe. However, significant congestion affecting the freeway, ramps and arterials is projected to remain. Furthermore, continued growth in traffic demand will only worsen traffic conditions in the I-80 corridor.

This chapter examines a number of potential intermediate term roadway improvements defined as those that could be implemented in the next five to ten years. These intermediate term improvements include a number of operational and low or moderate cost capital improvements. It is important to note that these intermediate term improvements are not intended to fully eliminate congestion in the I-80. Given the physical, institutional and funding constraints that exist, doing so is not practical or feasible, especially in an intermediate term timeframe.

Some of the potential improvements studied are concepts that have previously been proposed as part of other efforts. Others were defined based on an assessment of freeway, ramp and arterial bottlenecks observed in the 2015 Build – ICM simulation models. A detailed review of these models revealed several projected problem locations including several on-and-off-ramps, interchanges, mainline merging and weaving areas, and arterials under 2015 demands. These findings, plus design considerations, were used to define a set of potential ramps, interchanges, mainline, and arterial geometric improvements.

Three potential intermediate term improvement scenarios were examined. The first two involve singular, operational improvements intended to address mainline operations on I-80, while the third includes a package of freeway, ramp and arterial capital improvements. In each case, the scenarios build upon the I-80 ICM project improvements recommended for the corridor. These scenarios examined are summarized in in **Table 5-1** and are further described below.

Intermediate Term Improvement Scenario 1 – I-580 Connector Metering (AM Peak Only)

This scenario combines the I-80 ICM Project with metering of the I-580E to I-80W connector. Even prior to completion of the *I-80 ICM Project Traffic Operations Analysis Report*, questions were raised regarding the feasibility and impact of also metering the freeway-to-freeway connector

joining I-580 eastbound to I-80 westbound. This issue was raised, in part, due to concerns that in the area close to the junction, notably at Central Avenue, the metering of on-ramps to I-80 would lead to the diversion of trips over to I-580.

For this scenario, it was assumed that the meter limit line would be located near the Central interchange providing for 3 general purpose lanes. This scenario was evaluated under recurring congestion (no incident) conditions during the AM peak period only because it represents the peak period for the westbound direction.

Table 5-1 Intermediate Term Improvement Scenarios

Improvement Type	Location	Intermediate Term Improvement Scenario		
		1	2	3
System Management	Westbound 80: Meter the EB I-580 connector near the Central Avenue interchange; provide 3 GP lanes	X		
Mainline Modifications	Westbound 80: restripe WB 80 to 580/880 connector to 4 lanes (currently three)		X	X
Ramp Modifications	***Add GP lanes:***			
	• WB SR 4: reconstruct bridge to allow for 3rd GP lane and moving meter limit line downstream			X
	• WB Buchanan Street: widen to add 2nd general purpose lane			X
	Add Storage/widen:			
	• WB Richmond off-ramp: add 2nd Thru lane			X
	• WB Central off-ramp: add 3rd lane			X
	• WB Gilman off-ramp: add 3rd lane			X
	• EB Powell off-ramp: add 4th lane			X
	• EB San Pablo Dam Road off-ramp: add 4th lane			X
Interchange Improvements	• Powell Street: modify Powell/frontage intersection - Allow westbound left turn and southbound through to use westbound I-80/Bay Bridge on-ramp			X
Auxiliary Lanes	• WB San Pablo Dam Road on-ramp to San Pablo Avenue off-ramp – extend current aux lane between San Pablo Dam Rd and Edwards/McBryde Ave			X
	• WB Potrero Avenue on-ramp to Carlson Boulevard off-ramp			X
	• EB Ashby Avenue on-ramp to University Avenue off-ramp			X
	• EB San Pablo Ave on-ramp to San Pablo Dam Road off-ramp – extend current aux lane			X
	• EB San Pablo Dam Road on-ramp to El Portal Drive off-ramp			X
Arterial Geometric Improvements	• SB San Pablo Avenue at Richmond Parkway – widen to provide 2nd LT bay			X
	• SB San Pablo Avenue at San Pablo Dam Road – extend LT bay			X

Intermediate Term Improvement Scenario 2 – I-80/I-580/I-880 Split Re-Striping

This scenario combines the I-80 ICM Project with the re-striping of westbound I-80 approaching the split to I-580/I-880 in order to provide for four lanes (from the current three) to I-580/I-880. The intent of this improvement is to ideally improve the flow of traffic to I-580 and I-880, and thus reduce the bottleneck in the segment approaching the Split. This scenario was evaluated under recurring congestion (no incident) conditions during both AM and PM peak periods.

Intermediate Term Improvement Scenario 3 – Capital Improvements

This scenario combines the I-80 ICM Project with the re-striping of westbound I-80 approaching the split to I-580/I-880 (per Scenario 2) and a package of additional roadway capital improvements as listed. The improvements include:

- The widening of two on-ramps to provide for additional ramp meter capacity in order to reduce meter-related queuing;
- The widening of five off-ramps to provide additional capacity at the terminal intersection and storage as a means of reducing or eliminating queue spillback onto the mainline;
- Modification of the Powell Street interchange to provide direct access for westbound and southbound traffic to the Bay Bridge diagonal on-ramp;
- Auxiliary lanes on I-80 at various high-volume locations; and
- Turn bay improvements at two locations along southbound San Pablo Avenue intended to increase capacity and reduce or eliminate queue spillback into the through lanes.

This scenario was evaluated under recurring congestion (no incident) conditions during both AM and PM peak periods.

5.2 Evaluation

5.2.1 Approach

The intermediate term improvement scenarios were tested using the 2015 Build Paramics models. For each scenario, the model network was modified accordingly, but the demand inputs (trip tables) were not changed. While it is unlikely that all of these improvements could be completed by 2015, it was felt that this approach would provide for a reasonable assessment of the potential benefits and impacts given the uncertainty related to the potential timing and demand forecasts. The scenarios were tested under recurring (non-incident) conditions only.

5.2.2 Expected Benefits

The expected system benefits of the intermediate term improvement scenarios are presented in **Table 5-2** and **Table 5-3,** for AM and PM peak periods, respectively. They are presented along with the results of the 2015 No-Build and 2015 Build – ICM alternatives described in the previous chapter. The percentage change from the 2015 No-Build scenario are also presented to facilitate comparison. Note that the Intermediate Term Scenario 1 – I-580 Connector Metering

was tested for the AM peak period only, therefore, its results are shown in **Table 5-2**, but not in **Table 5-3.**

Table 5-2 Intermediate Term Improvement System Performance (AM Peak Period)

Facility Type	No-Build	2015 Build - ICM	Intermediate Scenario 1 – I-580 Connector Metering	Intermediate Scenario 2 – 580/880 Split Re-Striping	Intermediate Scenario 3 – Capital Improvements
Vehicle Hours of Delay (Hours)					
Network Wide[1]	13,360	12,280 (-8%)	12560 (-6%)	14,860 (11%)	11,440 (-14%)
Freeway[2]	6,900	5,090 (-26%)	5840 (-15%)	7,590 (10%)	5,100 (-26%)
Ramp	700	1,170 (67%)	1,060 (51%)	1190 (70%)	970 (38%)
Arterial	5,760	6,030 (5%)	5,660 (-2%)	6,080 (6%)	5,370 (-7%)
Average Speed (mph)					
Network Wide	32.9	33.6 (2%)	33.3 (1%)	31.4 (6%)	34.9 (6%)
Freeway	41.0	43.9 (7%)	43.0 (5%)	39.6 (10%)	45.0 (10%)
Ramp	20.9	15.2 (-27%)	18.0 (-14%)	15.1 (-19%)	17.0 (-19%)
Arterial	17.6	17.2 (-2%)	17.0 (-3%)	17.1 (2%)	18.0 (2%)

Note: 1. Network Wide includes all links in Paramics model

2. Includes I-80, portions of I-580 and I-880, plus freeway-to-freeway connectors

Source: DKS Associates, 2010

Table 5-3 Intermediate Term Improvement System Performance (PM Peak Period)

Facility Type	No-Build	2015 Build - ICM	Intermediate Scenario 2 – 580/880 Split Re-Striping	Intermediate Scenario 3 – Capital Improvements
Vehicle Hours of Delay (Hours)				
Network Wide[1]	36,400	33,290 (-9%)	37,450 (3%)	32,230 (-11%)
Freeway[2]	24,400	21,690 (-11%)	25,040 (3%)	20,290 (-17%)
Ramp	1,300	1,510 (16%)	1,730 (33%)	1,270 (-3%)
Arterial	10,600	10,090 (-5%)	10,680 (1%)	10,670 (1%)
Average Speed (mph)				
Network Wide	23.2	24.5 (6%)	22.8 (-2%)	25.0 (8%)
Freeway	26.5	28.4 (7%)	26.1 (-2%)	29.5 (11%)
Ramp	17.8	16.0 (-10%)	14.4 (-19%)	18.0 (1%)
Arterial	16.1	16.7 (-4%)	16.2 (1%)	16.2 (1%)

Note: 1. Network Wide includes all links in Paramics model

2. Includes I-80, portions of I-580 and I-880, plus freeway-to-freeway connectors

Source: DKS Associates, 2010

Intermediate Term Improvement Scenario 1 – I-580 Connector Metering (AM Peak Period)

As shown in Table 5-2, the metering of the I-580 connector to westbound I-80 is projected to produce a 6% reduction in network-wide vehicle hours of delay compared to 2015 No-Build (from 13,360 hours to 12,560 hours). This reduction is not as great as that achieved under the 2015 Build – ICM scenario. More notable, however, is how the delay is distributed across the network.

In comparison to the 2015 Build – ICM scenario, the metering of I-580 connector further manages the entry of vehicles onto I-80 westbound leading to improved operations and less congestion on I-80. This, in turn, lowers the likelihood of queues spilling back from the mainline onto ramps and arterials. Additionally, this can allow for less restrictive metering at the local on-ramps. As a result, I-80 westbound, ramp and arterial delays are lower under Intermediate Term Scenario 1 – 580 Connector Metering compared to the 2015 Build – ICM scenario. These delay reductions, however, are offset by increased delay on the eastbound I-580 freeway segment. Similar findings are also shown in term of average speed in **Table 5-2.** It is important to note that the model does not take into account the ramp and arterial delay on approaches to I-580.

These results do not occur simply due to the controlled release of vehicles from the connector, but from the fact that the assumed I-580 ramp meter capacity is below the demand on this connector. During the AM peak period, the forecasted hourly demands range from approximately 2400 to 3100 vph. The theoretical maximum metering rate for the three general purpose lanes is 900 vphpl, or 2700 vph combined. The simulation model results even suggest a lower practical maximum flow rate at the meter of 2300 to 2400 vph. Assuming the meter remains in operation throughout the AM peak period, this yields a maximum flow through the meter that is below the forecasted demand in all hours.

As a result of this meter constraint, the volume of traffic entering from I-580 under this scenario is approximately 15% lower than that for the No Build and Build – ICM alternatives over the 4-hour peak period. In turn, this meter capacity constraint results in the build-up of a significant queue on eastbound I-580 that continues to grow throughout the peak period. Because demands are projected to exceed the practical meter capacity in all four hours of the AM peak period, this queue will begin forming at the start of the period, and will continue to grow through to the end. At this time, the queue is estimated to extend over 4 miles.

Intermediate Term Improvement Scenario 2 – I-580/I-880 Split Re-Striping

As shown in both **Table 5-2** and **Table 5-3**, the re-striping of westbound I-80 approaching the split to I-580/I-880 appears to produce additional delay during both peak periods. During the AM peak period, this scenario yields an 11% increase in the vehicle hours of delay for the network as a whole, and a 10% increase in freeway delay compared to No Build. In the PM peak period, delay increases by 3% both network-wide and on the freeway. This represents an even greater increase in delay relative to the 2015 Build – ICM Project alternative.

This increased delay is generally associated with the additional weaving required to access the lanes for eastbound I-580, especially for those coming on at the Powell on-ramp. This traffic must now get completely across 4 lanes of traffic rather than just 3. This additional “turbulence” results in a worsening of conditions approaching the split.

The impact of this condition is reflected not only in the hours of delay but also the traffic flow achieved through this segment and congestion patterns on westbound I-80. For example, AM peak hour traffic flows in the segment just west of the Powell Street on-ramp decrease from approximately 9000 vehicles under both the No Build and Build – ICM Project alternatives, to 8400 vehicles in the peak hour for the Re-Striping scenario. Under the Build – ICM Project alternative with the existing configuration, queues from the bottlenecks in this area are projected to extend back to about the I-580 junction in Albany during the AM peak period. With the modified configuration, the queue extends beyond the Central interchange.

Intermediate Term Improvement Scenario 3 – Capital Improvements

The package of improvements included as Intermediate Term Improvement Scenario 3 provide for the greatest benefit in terms of network delay reduction. Compared to the No Build alternative, this scenario yields a reduction of approximately 1900 vehicles hours of delay (14%) during the AM peak period, and approximately 4200 hours (11%) during the PM peak period.

This represents a reduction of 840 and 1060 hours of delay during the AM and PM peak periods, respectively, compared to the Build – ICM project alternative. As part of this, the Intermediate Term Improvement Scenario 3 produces reduced ramp (-200 hours) and arterial (-660 hours) delay, and essentially the same freeway delay during the AM peak period. During the PM peak, this scenario yields a reduction in freeway (-1400 hours) and ramp (-240) delay, but an increase in arterial delay (+580 hours). In relating these results to the individual improvements included in this scenario, it is important to recognize that most improvements can have mixed impacts. For example, an improvement that addresses an off-ramp bottleneck can reduce delay on the ramp and upstream on the mainline, but in releasing more traffic can result in increased delay downstream on the arterials.

It should be also noted that these benefits are achieved despite the fact that this package of improvements includes the re-striping of westbound I-80 approaching the split to I-580/I-880 that, as described under Scenario 2, appears to produce additional delay during both peak periods. The disbenefit of the re-striping is offset primarily by improved operations elsewhere along I-80 resulting from the implementation of the auxiliary lanes and off-ramp modifications. In some locations, the auxiliary lanes result in the higher segment link volumes (up to 400 vph) and higher operating speeds. The off-ramp modifications provide additional capacity at the terminal intersection, as well as storage, leading to the elimination or reduction in the spillback of queues onto the mainline. This, in turn, contributes to a reduction in both freeway and ramp delay.

The disbenefit from the re-striping of the split is also partially offset by the modification of the Powell interchange that reduces the volumes of traffic using the Powell on-ramp upstream of the split. However, the interchange modification also generates additional arterial delay, notably during the PM peak, due to queuing in the eastbound left turn lane to the Powell diagonal on-ramp.

The on-ramp widening at SR 4 and Buchanan reduce delays at these ramps and on the approach roads. At the same time, these improvements result in an increase in the volume of traffic on westbound I-80 (approximately 900 vehicles during the AM peak) that can lead to increased congestion and delay downstream.

On San Pablo Avenue, the southbound left-turn bay improvements at Richmond Parkway and at San Pablo Dam Road help eliminate the spillback of queues associated with heavy left turn

volumes at these locations. This results in improved operation at these two intersections and a reduction in vehicle hours of delay on the arterial, especially during the AM peak period.

5.2.3 Recommendations for Further Study

While the results indicate feasibility of the proposed intermediate term improvements, further study is needed. Two further studies are recommended: (a) I-580E Corridor Metering Plan that not only further examines the possible metering of the I-580E connector to I-80W, but also metering all on-ramps on I-580 eastbound segment from Richmond Bridge to I-80/I-580 merge and (b) I-580/I-80/SR-24 Maze Area Design Plan. These studies should expand the simulation corridor limit to cover a broader area to account for queues and congestion outside of the current corridor limit. Also, estimating cost in addition to benefit in monetary values would be very helpful to decision-makers to compare scenarios and prioritize capital investment.

6 LONG-TERM (2035) CONDITIONS

6.1 Travel Demand Trend

The following sections summarize the 2035 travel demand growth trends in the I-80 Corridor. These trends are based on the inputs to and outputs from the I-80 Corridor travel demand model (see Chapter 1 for description), and compare the 2005 model base year to the 2035 model horizon year..

6.1.1 Land Use

As shown in **Table 6-1,** 1,169,369 households are expected to be present in these two counties by 2035 for a 28.4% increase from 2005. Within the I-80 corridor, the number of households is projected to increase 20.9% from 113,407 in 2005 to 137,154 in 2035.

As can be seen in **Table 6-2**, employment in Alameda and Contra Costa Counties is projected to increase 49.5% between 2005 and 2035 rising from 1,123,521 to 1,679,458. Within the I-80 corridor, 2005 employment is 126,335 and would increase by 44.8% to 182,942 by 2035.

Table 6-1 Household Growth

County	2005	2035	% Growth
Alameda	545,250	697,366	27.9%
Contra Costa	365,193	472,003	29.2%
Total	910,443	1,169,369	28.4%
I-80 Corridor	**113,407**	**137,154**	**20.9%**

Table 6-2 Employment Growth

County	2005	2035	% Growth
Alameda	735,460	1,110,956	51.1%
Contra Costa	388,061	568,502	46.5%
Total	1,123,521	1,679,458	49.5%
I-80 Corridor	**126,335**	**182,942**	**44.8%**

6.1.2 Freeway Demands

As shown in **Table 6-3**, peak hour demand on I-80 is forecasted to increase between 21% and 67% for the AM peak hour and between 16% and 35% for the PM peak hour between 2005 and 2035.

Table 6-3 Mainline Demands

Mainline Location	2005 Demand		2035 Demand		Growth (%)	
	AM Peak Hour	PM Peak Hour	AM Peak Hour	PM Peak Hour	AM Peak Hour	PM Peak Hour
I-80 Eastbound						
Between University Ave and Gilman St	7,072	9,371	8,529	11,313	21%	21%
Between San Pablo Dam off and on ramps	3,335	5,892	4,844	6,838	45%	16%
Between Pinole Valley Rd and SR 4	3,290	7,446	5,478	10,016	67%	35%
I-80 Westbound						
Between SR 4 and Pinole Valley Rd	8,138	4,056	10,897	5,450	34%	34%
Between San Pablo Dam off and on ramps	6,190	4,921	7,477	5,776	21%	17%
Between Gilman St and University Ave	8,928	7,611	11,226	8,942	26%	17%

Source:
I-80 ICM Regional Model (modified version of ACCMA Travel Demand Model

As shown in **Table 6-4**, total freeway demand within the corridor, defined as the total vehicle demand that uses a section of Interstate 80 within the study corridor, is forecasted to increase by 51.9% during the AM peak hour and 47.4% during the PM peak hour by 2035. This includes vehicle trips with an origin and/or destination within the corridor and through trips where both the origin and destination of the trips exist outside the corridor.

Table 6-4 I-80 Corridor Freeway Demand (Vehicle Trips)

Peak Hour	2005	2035	Growth (%)
AM	135,909	206,463	51.9%
PM	160,621	236,686	47.4%

Source:
I-80 ICM Regional Model (modified version of ACCMA Travel Demand Model)

6.1.3 Arterial Demands

As demand along the I-80 corridor increases, it is expected that demand along San Pablo Avenue will increase as well since it is the main parallel arterial to the I-80 study corridor. As detailed in **Table 6-5**, between 2005 and 2035, peak hour demands along San Pablo Avenue are expected to

increase by as much as 284% between Pinole Valley Road and SR 4 in the AM peak hour and 306% between San Pablo Dam Rd and McBryde Avenue during the PM peak hour.

Table 6-5 Arterial Demands

San Pablo Ave Location	2005 Demand		2035 Demand		Growth (%)	
	AM Peak Hour	PM Peak Hour	AM Peak Hour	PM Peak Hour	AM Peak Hour	PM Peak Hour
Between University Ave and Gilman St	932	1,839	1,668	1,883	79%	2%
Between McBryde Ave and San Pablo Dam	474	1,179	1,075	1,860	127%	58%
Between Pinole Valley Rd and SR 4	257	2,014	987	2,237	284%	11%
Between SR 4 and Pinole Valley Rd	1,965	257	2,592	964	32%	276%
Between San Pablo Dam and McBryde Ave	971	199	1,553	805	60%	306%
Between Gilman St and University Ave	1,936	1,379	1,915	1,902	-1%	38%

Source:
I-80 ICM Regional Model (modified version of ACCMA Travel Demand Model)

6.1.4 Mode Choice

The 2005 and 2035 daily person trips by mode within the region a whole and within the I-80 corridor have been compiled from the regional travel demand model for 2005 and 2035 and are summarized in **Table 6-6.** By 2035, travel demand within the I-80 corridor for each mode is projected to increase at rates greater than those for the region as a whole. Drive alone trips are projected to increase by 47.6%, rideshare with two people by 57.0%, rideshare with three or more people by 67.1%, truck tripsby 56.7%, and transit use by almost 100% when compared to 2005 conditions.

Table 6-6 Daily Mode Choice Demands

Regional Person Trips			
Mode	**2005**	**2035**	**Growth (%)**
Drive Alone	11,948,017	17,018,399	42.4%
Share 2	3,791,658	5,309,254	40.0%
Share 3+	2,889,006	3,649,624	26.3%
Truck	3,586,692	5,201,064	45.0%
Transit	1,021,585	1,781,284	74.4%
I-80 Corridor[1] Person Trips			
Mode	**2005**	**2035**	**Growth (%)**
Drive Alone	742,938	1,096,661	47.6%
Share 2	225,447	354,047	57.0%
Share 3+	162,172	270,989	67.1%
Truck	125,493	196,619	56.7%
Transit	178,969	357,761	99.9%

Note: 1. All trips traveling within the corridor, including through trips (both trips ends outside the corridor).
Source: I-80 ICM Regional Model (modified version of ACCMA Travel Demand Model)

6.1.5 Transit Ridership

As mentioned in the previous section, transit demand is expected to increase at a higher rate than other modes of transportation for 2035. The corresponding increase in transit use within the I-80 corridor is detailed in **Table 6-7**. Between 2005 and 2035, daily transit ridership is expected to increase by 60.9%

Table 6-7 I-80 Corridor Daily Transit Ridership Growth[1]

Transit Provider	2005 Daily Ridership	2035 Daily Ridership	Growth (%)
BART	37,981	78,754	107.4%
Amtrak	759	3,102	308.7%
AC Transit	92,708	128,447	38.6%
WestCAT	9,848	15,591	58.3%
Ferry	3,139	6,924	120.6%
Other	8,630	13,465	56.0%
Total Corridor	**153,065**	**246,283**	**60.9%**

Note: 1. Combines boardings and alightings within Corridor. Includes transfer but does not include through trips (both trips ends outside the corridor).
Source: I-80 ICM Regional Model (modified version of ACCMA Travel Demand Model)

6.2 Mobility Trends

This section presents the trends in baseline mobility for three different levels of aggregation:

1. The I-80 Study Corridor: This consists of all city streets, county roads, and state highways within the study area that are included in the travel demand model.
2. I-80 Freeway Mainline Only.
3. San Pablo Avenue only: San Pablo Avenue represents the primary alternate arterial route throughout a majority of the study corridor.

Mobility is measured in terms of vehicle miles traveled (VMT), vehicle hours traveled (VHT), and vehicle hours of delay (VHD) as defined within the travel demand model.

6.2.1 I-80 Study Corridor

Table 6-8 shows the trends in baseline mobility for the entire I-80 Corridor network (freeways, state highways, local streets). By 2035, VMT within the I-80 corridor is projected to increase by approximately 37% during the AM peak hour and 32% during the PM peak hour. Over this same period, VHT is projected to increase by approximately 109% and 77% during the AM and PM peak hours respectively. The much increase in VHT indicates that as demand increases, the level of congestion can be expected to increase significantly, resulting in higher travel time, lower speeds and increased delays.

Table 6-8 I-80 Corridor Baseline Mobility Trends

Performance Measure	2005	2035	Growth (%)
AM Peak Hour			
Vehicle Miles Travel	493,883	678,656	37%
Vehicle Hours Travel	14,377	29,998	109%
PM Peak Hour			
Vehicle Miles Travel	532,934	705,857	32%
Vehicle Hours Travel	16,974	30,037	77%

Source:
I-80 ICM Regional Model (modified version of ACCMA Travel Demand Model)

6.2.2 I-80 Freeway Mainline

Table 6-9, **Table 6-10**, and **Table 6-11** show the trends in baseline mobility for different segments of the I-80 Freeway Mainline within the study corridor.

For the segment between Carquinez Bridge and SR 4, the highest increase in traffic demand is expected to occur the eastbound direction during the AM peak hour. As shown in **Table 6-9**, VMT in the eastbound direction increases approximately 90% in the AM peak while the VHT increases by 124% compared to 2005.

Table 6-9 I-80 Freeway Performance Trends: Between Carquinez Bridge and SR 4

Performance Measure		2005	2035
AM Eastbound	Vehicle Miles of Travel	10,882	20,637
	Vehicle Hours of Travel	174	714
	Vehicle Hours of Delay	1	380
	Average Vehicle Speed	62	29
PM Eastbound	Vehicle Miles of Travel	26,649	32,455
	Vehicle Hours of Travel	1,105	1,824
	Vehicle Hours of Delay	673	1,298
	Average Vehicle Speed	24	18
AM Westbound	Vehicle Miles of Travel	29,343	38,652
	Vehicle Hours of Travel	1,050	2,350
	Vehicle Hours of Delay	598	1,756
	Average Vehicle Speed	28	16
PM Westbound	Vehicle Miles of Travel	13,564	20,146
	Vehicle Hours of Travel	211	342
	Vehicle Hours of Delay	3	32
	Average Vehicle Speed	64	59

Source:
I-80 ICM Regional Model (modified version of ACCMA Travel Demand Model)

Similarly, the I-80 segment between SR 4 and Central Avenue also experiences the highest VMT increase (51%) and VHT increase (almost 100%) in the eastbound direction during the AM peak, as shown in **Table 6-10**,

Table 6-10 I-80 Freeway Performance Trends: Between SR 4 and Central Avenue

Performance Measure		2005	2035
AM Eastbound	Vehicle Miles of Travel	34,708	52,511
	Vehicle Hours of Travel	582	1,162
	Vehicle Hours of Delay	23	319
	Average Vehicle Speed	60	45
PM Eastbound	Vehicle Miles of Travel	66,255	80,947
	Vehicle Hours of Travel	2,057	3,800
	Vehicle Hours of Delay	995	2,504
	Average Vehicle Speed	32	21
AM Westbound	Vehicle Miles of Travel	69,162	83,775
	Vehicle Hours of Travel	2,088	4,562
	Vehicle Hours of Delay	978	3,221
	Average Vehicle Speed	33	18
PM Westbound	Vehicle Miles of Travel	46,653	55,919
	Vehicle Hours of Travel	922	1,300
	Vehicle Hours of Delay	168	399
	Average Vehicle Speed	51	43

Source:
I-80 ICM Regional Model (modified version of ACCMA Travel Demand Model)

As shown in **Table 6-11**, the highest increase in VMT (21%) and VHT (101%) for the segment between Central Avenue and the Bay Bridge is projected for the westbound direction during the AM peak.

Table 6-11 I-80 Freeway Performance Trends: Between Central Avenue and the Bay Bridge

Performance Measure		2005	2035
AM Eastbound	Vehicle Miles of Travel	32,808	37,020
	Vehicle Hours of Travel	748	1,213
	Vehicle Hours of Delay	201	596
	Average Vehicle Speed	44	31
PM Eastbound	Vehicle Miles of Travel	42,269	47,896
	Vehicle Hours of Travel	1,395	2,592
	Vehicle Hours of Delay	690	1,793
	Average Vehicle Speed	30	18
AM Westbound	Vehicle Miles of Travel	42,907	51,717
	Vehicle Hours of Travel	1,279	2,567
	Vehicle Hours of Delay	560	1,698
	Average Vehicle Speed	34	20
PM Westbound	Vehicle Miles of Travel	35,250	41,174
	Vehicle Hours of Travel	821	1,375
	Vehicle Hours of Delay	227	678
	Average Vehicle Speed	43	30

Source:
I-80 ICM Regional Model (modified version of ACCMA Travel Demand Model)

6.2.3 San Pablo Avenue

Table 6-12, Table 6-13, and **Table 6-14** show the trends in baseline mobility for different segments of San Pablo Avenue from between the Carquinez Bridge and the Bay Bridge.

Between 2005 and 2035, the highest increase in VHT for the segment between the Carquinez Bridge and SR 4 would occur during the AM peak hour in the westbound direction. As shown in **Table 6-12**, the VMT in this case is projected to increase from 3,394 to 5,096 for an increase of 50% with a VHT increase of 187%.

Table 6-12 San Pablo Avenue Performance Trends: Carquinez Bridge to SR 4

Performance Measure		2005	2035
AM Northbound	Vehicle Miles of Travel	256	611
	Vehicle Hours of Travel	7	17
	Vehicle Hours of Delay	0	0
	Average Vehicle Speed	35	35
PM Northbound	Vehicle Miles of Travel	1,531	2,886
	Vehicle Hours of Travel	44	84
	Vehicle Hours of Delay	0	0
	Average Vehicle Speed	35	35
AM Southbound	Vehicle Miles of Travel	3,394	5,096
	Vehicle Hours of Travel	99	284
	Vehicle Hours of Delay	0	125
	Average Vehicle Speed	34	18
PM Southbound	Vehicle Miles of Travel	297	437
	Vehicle Hours of Travel	9	13
	Vehicle Hours of Delay	0	0
	Average Vehicle Speed	35	35
Source: I-80 ICM Regional Model (modified version of ACCMA Travel Demand Model)			

As shown in **Table 6-13**, the highest increase in VMT for the segment between SR 4 and Central Avenue is expected to occur during the PM peak hour in the westbound direction. The VMT would increase by 136% while the VHT would increase by 138%.

Table 6-13 San Pablo Avenue Performance Trends: SR 4 to Central Avenue

Performance Measure		2005	2035
AM Northbound	Vehicle Miles of Travel	3,852	8,305
	Vehicle Hours of Travel	110	235
	Vehicle Hours of Delay	0	0
	Average Vehicle Speed	35	35
PM Northbound	Vehicle Miles of Travel	15,338	17,607
	Vehicle Hours of Travel	603	1,053
	Vehicle Hours of Delay	150	520
	Average Vehicle Speed	25	17
AM Southbound	Vehicle Miles of Travel	16,040	17,531
	Vehicle Hours of Travel	592	1,155
	Vehicle Hours of Delay	109	623
	Average Vehicle Speed	27	15
PM Southbound	Vehicle Miles of Travel	4,271	10,081
	Vehicle Hours of Travel	125	298
	Vehicle Hours of Delay	0	0
	Average Vehicle Speed	34	34
Source: I-80 ICM Regional Model (modified version of ACCMA Travel Demand Model)			

For the segment of San Pablo Avenue between Central Avenue and the Bay Bridge from 2005 to 2035, the largest increase in VMT would occur during the AM peak period in the eastbound direction. As shown in **Table 6-14**, VMT would increase by 113% and the VHT is forecasted to increase by 318%.

Table 6-14 San Pablo Avenue Performance Trends: Central Avenue to Bay Bridge

Performance Measure		2005	2035
AM Northbound	Vehicle Miles of Travel	3,935	8,366
	Vehicle Hours of Travel	131	547
	Vehicle Hours of Delay	0	252
	Average Vehicle Speed	30	15
PM Northbound	Vehicle Miles of Travel	8,222	9,860
	Vehicle Hours of Travel	315	651
	Vehicle Hours of Delay	16	274
	Average Vehicle Speed	26	15
AM Southbound	Vehicle Miles of Travel	7,985	9,567
	Vehicle Hours of Travel	514	717
	Vehicle Hours of Delay	224	358
	Average Vehicle Speed	16	13
PM Southbound	Vehicle Miles of Travel	6,721	9,443
	Vehicle Hours of Travel	226	475
	Vehicle Hours of Delay	0	127
	Average Vehicle Speed	30	20

Source: I-80 ICM Regional Model (modified version of ACCMA Travel Demand Model)

6.2.4 Freeway Safety Trends

A tool to forecast collision rates within the I-80 corridor does not exist. A simple, but often-used, approach is to assume that collision rates will remain at existing levels and that the number of collisions will increase on par with the forecasted increase in VMT. Between the existing year and 2035, VMT is expected to increase by 34% resulting in a similar 34% increase in collisions along the I-80 study corridor. The resulting numbers of collisions by segment are presented in **Table 6-15.**

Table 6-15 Collisions on I-80 Study Corridor

Segment	Limits	Number of Collisions	
		Existing	2035
1	Bay Bridge Toll Plaza/Powell	926	1,241
3	580-Buchanan/San Pablo Dam Road	1,077	1,443
4	San Pablo Dam Road/SR 4	1,290	1,729
5	SR 4/Carquinez Bridge	722	968

Source: DKS Associates, 2010

6.3 Potential Improvements

By 2035, demands on some segments of I-80 in the study corridor are forecasted to increase by up to 60%. With this level of growth, conditions along I-80 are expected to worsen considerably. This will result in not only the increased severity of congestion associated with existing bottlenecks, but also congestion occurring in more areas and in the off-peak direction. Conditions on the arterials in the corridor are also expected to worsen.

As noted previously, major capacity expansion along I-80 is unlikely due to physical and institutional constraints. Given this limitation, and the magnitude of projected growth, plans for the corridor must include a combination of more localized improvements plus strategies that further maximize the efficiency of the existing roadway system, reduce the occurrence and impact of incidents, encourage increased use of other modes, and reduce or manage peak period vehicle travel demand. The types of strategies can be applied in the I-80 corridor to address existing and forecasted deficiencies include: Freeway and Arterial Geometric Improvements, Freeway and Arterial Management and Operations Improvements, Transit Improvements, Non-Motorized Mode Improvements, Demand Management Strategies, Traveler Information Improvements, Goods Movement Policies, ITS Improvements.

6.3.1 Baseline Improvements

The future year travel demand trend forecasts were developed using the I-80 travel demand model described in Chapter 1. That model is based primarily on the ACCMA model and includes a number of assumed roadway and transit network improvements within the region for 2035. In the I-80 CSMP study area, only a single improvement that may most affect corridor travel demand was included in the model and is listed in **Table 6-16.**

Table 6-16 2035 I-80 Corridor Baseline Improvements

Model Year	Project	Description
2035	Telegraph/International Bus Rapid Transit	Bus rapid transit corridor from San Leandro BART to UC Berkeley.

Source:
ACCMA Travel Demand Model – network update 2008
CCTA Travel Demand Model – perennial model update 2007

6.3.2 Roadway Geometric Improvements

Due to the physical and institutional constraints major capacity expansion is unlikely, but smaller improvements are possible that may address some deficiencies. Potential freeway improvements include auxiliary lanes, ramp modifications and ramp intersection modifications. Surface streets improvements could include adding new roadways in the eastern end of the corridor where higher growth is projected in future years. Potential improvements may also include the widening of existing roadway and intersections.

Potential longer-term roadway geometric improvement projects, as derived from existing planning and programming documents, plus the results from the 2015 traffic analysis simulation results and 2035 travel demand forecasts, include the following:

Ramp Modifications:
• San Pablo Avenue: Reconfigure eastbound on-ramp to increase storage length. • SR 4: Construct direct connectors between westbound I-80 and eastbound SR 4 • Cutting Boulevard: Construct new connector ramps to the Del Norte BART station • Cumming Skyway: Modify westbound on-ramp to provide a second general-purpose lane or an HOV lane • Solano Avenue: Modify westbound on-ramp to provide a second general-purpose lane
Interchange Improvements:
• Pinole Valley Road: Provide a right turn lane on eastbound on-ramp and bus turnout/shelter on westbound ramp • SR 4: Construct direct connectors between westbound I-80 and eastbound SR 4 • El Portal Drive: Upgrade and improve • Cutting Boulevard: Construct new connector ramps to the Del Norte BART station • Hilltop Drive: Upgrade and improve
Mainline auxiliary lanes:
• Hilltop Drive on-ramp to Richmond Parkway off-ramp in the eastbound direction

6.3.3 System Management Improvements

The primary objective of System Management improvements is to get maximum benefit out of the existing system. Examples of System Management improvements or strategies include ramp metering, managed lanes, shoulder use, variable speed limit signs, congestion pricing, traffic signal improvements, freeway/ramp/surface street signal coordination, incident management, and reversible lane control.

The proposed I-80 ICM Project is focused on the implementation of several System Management strategies, plus systems that can support the implementation of additional or expanded strategies in the future. The project also includes integration with the East Bay SMART Corridors Program (a joint Alameda and Contra Costa County ITS program) and the Caltrans District 4 Transportation Management Center (TMC). However, some System Management strategies were not included in the I-80 ICM project due to funding, timing and institutional constraints. The strategies that were not included in the I-80 ICM project can be considered as possible future improvements.

The following system management projects and strategies are recommended for future consideration in the I-80 corridor:

Freeway Management
• Cummings Skyway to Cutting Boulevard: Shoulder utilization in the westbound direction for incident management and transit vehicles • Corridor-wide: Freeway shoulder use to add additional capacity during periods of congestion and /or during an incident • Corridor-wide: Implement lane management in eastbound direction for non-recurring conditions • Corridor-wide: Convert HOV lanes to Express Lanes

Arterial Management
• Carlson Boulevard: Signalize I-80 ramp intersections • San Pablo Avenue: Extend SMART Corridor throughout entire study area • Corridor-wide: Enhance/implement freeway/ramp meter/surface street signal coordination • Regularly update signal timing plans

6.3.4 Transit Improvements

The travel demand forecasts suggest that transit demand will increase by 20% by the year 2015, and more than double by 2035. Even with this growth, auto travel demand is also expected to grow leading to more severe congestion in the corridor. There are currently a number of transit and facilities in the corridor. To accommodate the forecasted growth and, ideally, promote even greater transit mode share to help reduce congestion on the roadway network, improvements to the transit system will be necessary.

Several transit improvements are already included in the programmed/planned projects in the corridor. Potential long term transit improvements within the I-80 CSMP corridor include:

Ferry:
• Provide service between Berkeley/Albany and San Francisco • Provide service between Richmond and San Francisco • Provide service between Hercules and San Francisco
Rail:
• Hercules: Construct Capitol Corridor train station
BART:
• Berkeley: Improve Ashby Station to support Ed Roberts Campus and future TOD • Richmond: Provide transportation improvements on the east side of the Richmond Station to accommodate TOD • El Cerrito: Provide real-time transit information displays • El Cerrito Del Norte: Provide transportation improvement to support TOD • System-wide: Provide additional or new parking capacity • Extend to Richmond Hilltop and Hercules
Bus
• Northern Alameda County: Improve AC transit facilities including new operating system • Expand WestCAT service including purchase of vehicles • Install WestCAT-furnished real-time transit information displays • Purchase new express buses for I-80 express service to be provided by AC transit, Vallejo Transit, and WestCAT • Expand Bus Rapid Transit from Richmond Parkway Transit Center to Hercules
Transit Centers
• New Hercules Transit Center, including relocation of park and ride facility and construction of express bus facilities • Construct Phase 2 of Hercules Inter-modal Station • Expand Richmond Parkway Transit Center
Other Measures
• Expand/add park-and-ride facilities

6.3.5 Non-Motorized Mode Improvements

Non-motorized mode of travel is an alternative to both auto and transit modes. The I-80 freeway corridor exceeds the maximum trip length for bicycle trips and pedestrian travel. Non-motorized travel is more appropriate for short trips and may reduce surface street traffic. Proposed non-motorized mode improvements within the I-80 corridor include:

Pedestrian
• Richmond: Install pedestrian count-down signals, improve sidewalk conditions, construct mid-block lighted crossings, and landscape Nevin Avenue, Barrett Ave & other areas • El Cerrito: Develop pedestrian, transit stop and streetscape improvements along San Pablo Avenue • Improve pedestrian access and safety for transit access routes. • Close the Bay Trail gaps along Richmond Parkway between Pennsylvania Avenue and Gertude Avenue, north of Freethy Blvd to Payne Drive, from Payne to Cypress, and from Pinole Shores to Parker Ave
Bicycle
• Richmond: Construct Class I Bicycle Trail from Carlson Blvd to I-80 along abandoned railroad property and Richmond-Ohlone Greenway Gap Closure was currently designed. • Improve bike detection in the corridor at signalized intersections. • Provide exclusive right-of-way for bikes wherever feasible to enhance bike safety. • Provide more room for bikes on BART. This will facilitate in the extension of hours that bike riders can use BART services and reduce the parking demand at BART stations. • Increase the availability of bike lockers and bike parking at BART stations.
Other
• Berkeley: Improve Ashby/I-80 interchange/Aquatic Park Access streetscape, bicycle, and pedestrian facilities

6.3.6 Demand Management Strategies

Federal Highway Administration (FHWA) recognizes that managing demand can no longer stop at encouraging travelers to change their travel mode from driving alone to choosing a carpool, public transit, or other commute alternative. Managing demand today is about providing all travelers, regardless of whether they drive alone, with choices of location, route, and time, not just mode of travel.

The contemporary concept of travel demand management encompasses broader set of transportation goals due to need to manage demand in multiple situations and conditions as well as the influence of information and the technologies to deliver it.

The I-80 corridor has no right of way to increase capacity to the roadway network. Therefore, it is more critical to pay attention to the strategies to shift the demand to other modes, to non-peak hours and possible means to reduce the demand.

The possible strategies for the I-80 corridor include:

- Worksite flextime allows employees to set their own arrival and departure time to/from work – within established time boundaries agreed to by their employer. In congested areas like I-80 corridor, it may encourage employees to avoid the most congested travel times, reducing the demand on roadway and/or transit systems during peak-demand periods.

- Telecommuting: Telework programs and policies at the worksite from structured, formally-implemented telework programs and policies to more informal telework arrangements established between individual employees and their direct supervisors.
- Transit-Oriented and Pedestrian Oriented Design: Focusing a mix of land uses, such as employment, housing, restaurants, services, retail and more in well designed, pedestrian friendly and/or near transit connections can reduce demand for vehicle travel and reduce trip distances.
- Live Near Work Incentive Programs: Live near work programs provide incentives for employees to live near their place of employment. Examples include down payment assistance, location efficient mortgages and rent subsidies. By providing housing close to employment, this program can lower the costs of commuting, lessen the pressure on infrastructure, and generate more pedestrian traffic in business districts.
- Live Near Transit Mortgage Incentives: Live near transit programs offer mortgage incentives to encourage residential location near transit facilities. The programs recognize that household transportation expenses can be lower for residences well served by public transportation, and allow homebuyers to use these transportation savings as additional borrower income in qualifying for a home mortgage.
- Casual Carpool Sites: "casual car pools" or "ad hoc car pools" are informal car pools that form when drivers and passengers meet without specific prior arrangement at designated locations.

These options are well recognized by stakeholder agencies in the corridor and they are already pursuing to the extent feasible.

6.3.7 Traveler Information

Currently, traveler information on I-80 corridor is provided via Changeable Message Signs (CMS), Highway Advisory Radios (HAR), telephone and the internet. CMS and HAR systems are used to provide real time information and directions to the driver, plus they are used to advise about upcoming events. These systems are controlled from Caltrans District 4 Transportation Management Center. The internet is used to provide more detailed information to the public. The primary method of sharing information on the Internet and the telephone is via the Bay Area 511 system. The 511 system receives real time information from detectors, Closed-Circuit Television (CCTV) cameras and from some management applications. This information is then analyzed and used to display meaningful, up to the minute information.

The I-80 ICM project will provide more ITS devices to disseminate the information to travelers in the near-term. The long-term recommendations for the I-80 corridor is to extend the capability of traveler information to emerging personalized devices and in-vehicle navigation system to influence traveling choices in selecting departure times, destinations, and routes in addition to modes of transportation. Necessary devices will be provided at bus transit and rail stations to disseminate the traveler and transit information.

6.3.8 Goods Movement Policies

Trucks and other heavy vehicles use I-80 to move goods within the Bay Area to and from northern and southern California, and points beyond. The Port of Oakland and other important industrial and commercial facilities are located along the corridor or are linked by the I-80 freeway. During the peak periods, heavy truck traffic can consume road capacity which contributes significantly to congestion.

Because of the importance of efficient freight movement to the economy, the needs of this group will be factored into the solution; moreover, the solution must be consistent with the Bay Area goods movements' strategies while still allowing the corridor to meet its congestion and safety goals. Improving the commercial vehicle operators' safety, efficiency, mobility and travel times are the most important goals for this group of users. Some possible solutions are described below.

Roadway Time of Day Restrictions

Due to the severe congestion on I-80 freeway during morning and afternoon peak period, commercial vehicles can be restricted to use the road network at some busy hours at some congested sections of the freeway. Trucks can choose not to be restricted by paying a certain fee to obtain a special sticker/license for driving during the restricted hour. The institutional issues and the fee should be studied in more details to make this solution feasible.

Lane Restrictions

Because trucks and passenger cars are significantly different in term of performance and operation pattern, when possible trucks should be separated from passenger vehicles. For I-80, the following options can be considered:

- Exclusive lanes--designate lanes exclusively for truck use. Passenger cars are not allowed using the truck lanes while trucks can only use the truck lanes.
- Suggested exclusive lanes--trucks can only use the designated truck lane while passenger cars do not have restriction.
- Mixed lane--only trucks are allowed to use the designated truck lanes, and only passenger cars are allowed to use the designated passenger car lanes. The other lanes in the middle can be used by both trucks and passenger cars.

The selection of the lane designation options should be studied in more details with a benefit/cost model that accounts for truck volumes, passenger car volumes, highway characteristics, and incident history.

Remote Transfer Sites

Remote transfer sites can be considered where the commercial vehicles can hold the load until the traffic conditions on road and conditions at port are favorable for load transfer.

6.4 Evaluation

6.4.1 Approach

Because the projected 2035 demands so greatly exceed capacity, it was recognized early on that the microsimulation models would not produce reasonable or reliable results under such oversaturated conditions. Furthermore, given the constraints on major freeway capacity expansion, the emphasis of this evaluation was placed on strategies to reduce automobile travel demand in the corridor.

The approach taken was one of using the 2035 "I-80 Corridor" travel demand model to perform a high-level assessment of long-term auto demand reduction strategies such as transit-related improvements, Sustainable Community Strategies (SCS) and demand management strategies. Many of these strategies involve policy decisions related to land use and demand management requirements, and offer considerable amount of flexibility and uncertainty in how they may be implemented. Transit improvements, particularly those related to service levels, are also subject to significant flexibility and uncertainty. In recognition of this, the approach did not involve the modeling of specific improvements, but rather involved reductions in auto trips within the model.

The modeling approach first involved identifying those zones and origin-destination (O/D) pairs likely to be impacted by the implementation of these strategies within the corridor. It was assumed that the strategies would only impact trips that travel within or through the I-80 study corridor. For SCS/demand management strategies, adjustments were applied as follows:

- For the AM peak period: if the trip's destination is in the I-80 corridor then reduce the vehicle trips by an agreed percentage.
- For the PM peak period: if the trip's origin is in the I-80 corridor then reduce the vehicle trips by an agreed percentage.

Because potential transit-related improvements are expected to provide better mode choices and reduce auto dependency in the corridor, it was assumed that these improvements may impact both trips within the corridor, as well as those travelling through the study area. A select-link analysis was performed to identify the origin-destination pairs that use either I-80 or San Pablo Avenue. The resulting "user" matrices became the selection set eligible for transit improvement-related trip reductions in the I-80 corridor.

The second step was to then reduce the auto trips associated with those zones or O/D pairs by a pre-determined percentage. For the purposes of this effort, two trip reduction scenarios were tested: 3% and 10%. These percentages are somewhat arbitrary but were intended to reflect reasonable reduction levels. Additionally, in the case of transit-related improvements, a planning level reasonableness check of the corridor-wide gains in transit ridership was performed by comparing the reductions in the vehicle trip tables to year 2035 corridor transit ridership forecasts to make sure that the transit ridership gains are in a realistic or attainable range.

The adjusted trip tables were then re-assigned within the travel demand model. Each scenario was then compared to the base model to determine the impact on travel (VMT, VHT, VHD, average freeway speed) within the I-80 study corridor.

It should be noted that the trip reduction processes explained above were not applied to truck trips. Only vehicle trips (drive-alone, two-person carpool, and three+ person carpool) were considered for trip reduction.

6.4.2 Expected Benefits

Table 6-17 shows the projected reduction in I-80 corridor freeway demands in term of vehicle trips for the two auto trip reduction scenarios, which confirms the methodology used to reduce the number of vehicle trips by 3% and 10%.

Table 6-17 Trip Reduction Scenario Freeway Demand Trends (Vehicle Trips)

Peak Hour	Future 2035 Baseline	Future 2035 3% TDM-Transit	Future 2035 10% TDM-Transit
AM	206,463	201,038 (-2.6%)	186,509 (-9.7%)
PM	236,686	230,528 (-2.6%)	214,205 (-9.5%)

Source:
I-80 ICM Regional Model (modified version of ACCMA Travel Demand Model)

As a result of the trip reductions, the travel demand model projected changes in VMT, VHT, and average vehicle speed within the I-80 study corridor as summarized in **Table 6-18**. It can be seen that the percent reductions of VMT are almost the same as the percent reduction of I-80 corridor freeway demand. However, the percent reduction in VHT is almost twice as much. For example, for the AM peak hour, the 3% reduction of vehicle trips causing by TDM and Transit improvement contributes to 3% reduction in VMT and 7% reduction in VHT. Consistent with this, average vehicle speeds increase as a result of TDM and Transit improvement.

Table 6-18 Trip Reduction Scenario Corridor Mobility Trends

Performance Measure	Future 2035 Baseline	Future 2035 3% TDM-Transit	Future 2035 10% TDM-Transit
AM Peak Hour			
Vehicle Miles Travel	678,656	657,292 (-3%)	627,140 (-8%)
Vehicle Hours Travel	29,998	27,993 (-7%)	25,384 (-15%)
Average Vehicle Speed	22.6	23.5 (4%)	24.7 (9%)
PM Peak Hour			
Vehicle Miles Travel	705,857	688,930 (-2%)	651,299 (-8%)
Vehicle Hours Travel	30,037	29,811 (-1%)	25,654 (-15%)
Average Vehicle Speed	23.5	23.1 (-2%)	25.4 (8%)

Source:
I-80 ICM Regional Model (modified version of ACCMA Travel Demand Model)

It is interesting to highlight that, when comparing the VMT and VHT for the trip reduction scenarios reported in **Table 6-18** with the existing condition values reported in **Table 6-8**, it can be seen that in the year 2035, even assuming a 10% reduction in number of vehicle trips, the estimated VMT and VHT are still much greater than the existing conditions. For example, the 2005 VMT during the AM peak hour is 493,883; comparing to 627,140 of the 2035 VMT with 10% reduction in vehicle trips. That means 27% increase in VMT which results in 77% increase in VHT (14,377 vs. 25,384).

In addition to the change in VMT, VHT, and average vehicle speed aggregated for the whole I-80 corridor, the expected benefits of the 3% and 10% reduction in vehicle trips were also estimated by freeway/arterial directional traffic. **Table 6-19** to **Table 6-21** are the disaggregated results of the I-80 freeway in the following three segments: (1) between Carquinez Bridge and SR 4, (2) between SR 4 and Central Avenue, and (3) between Central Avenue and the Bay Bridge, respectively from North to South. Similarly, the results of the parallel arterial (San Pablo Avenue) are reported in **Table 6-22** to **Table 6-24.**

It can be seen that the freeway segments are slightly improved, relative to improvement on the parallel arterial, as a result of the 3% and 10% reductions in vehicle trips. For example, on I-80 AM Eastbound between Carquinez Bridge and SR 4, VMT decreases by 5% (from 20,637 to 19,671) and 6% (from 20,637 to 19,485) for the 3% and 10% TDM-Transit scenarios, respectively. These numbers are much lower than 19% (from 611 to 492) and 25% (from 611 to 461) VMT reductions projected for San Pablo Avenue AM northbound between Carquinez Bridge and SR 4. This finding can be explained by a hypothesis that while the TDM and transit improvements reduce the total number of trips, some drivers would shift from San Pablo Avenue to using I-80.

The hypothesis was confirmed by comparison between **Table 6-25** and **Table 6-26**. **Table 6-25** summarizes mainline demands (vph) at some selected locations on I-80 freeway. These numbers can be compared with arterial demands at corresponding locations on San Pablo Avenue as summarized in **Table 6-26.** For example, on AM Eastbound between Pinole Valley Road and SR 4 (which is a part of the segment between Carquinez Bridge and SR 4), the I-80 freeway demands decrease 2% (from 5,478 to 5,370) and 4% (from 5,478 to 5,280) in the 3% and 10% TDM-Transit scenarios, respectively. These numbers are much lower than the corresponding 12% (from 987 to 865) and 25% (from 987 to 737) reductions in arterial demand.

This analysis shows that 2035 scenarios that involve more aggressive transit and TDM improvements can lead to improved conditons (lower dealys, higher average speed) on the roadways in the corridor. However, these benefits will be more heavily weighted towards the arterials rather than the freeway. Furthermore, even with a 10% reduction in auto trips, demands on some freeway mainline segments are still forecasted to increase up to 60% over existing conditions meaning that congestion levels can be expected to increase significantly. In addition, a 10% reduction in auto trips equates to a 65% increase in corridor transit ridership and would require significant additional transit capacity. Additional improvements and strategies are needed to manage congestion in the corridor.

Table 6-19 Trip Reduction Scenario I-80 Performance Trends: Between Carquinez Bridge and SR 4

Performance Measure		Future 2035 Baseline	Future 2035 3% TDM-Transit	Future 2035 10% TDM-Transit
AM Eastbound	Vehicle Miles of Travel	20,637	19,671	19,485
	Vehicle Hours of Travel	714	652	643
	Vehicle Hours of Delay	380	334	328
	Average Vehicle Speed	29	30	30
PM Eastbound	Vehicle Miles of Travel	32,455	31,932	31,009
	Vehicle Hours of Travel	1,824	1,729	1,589
	Vehicle Hours of Delay	1,298	1,212	1,087
	Average Vehicle Speed	18	18	20
AM Westbound	Vehicle Miles of Travel	38,652	38,674	37,285
	Vehicle Hours of Travel	2,350	1,947	1,751
	Vehicle Hours of Delay	1,756	1,352	1,178
	Average Vehicle Speed	16	20	21
PM Westbound	Vehicle Miles of Travel	20,146	19,372	19,087
	Vehicle Hours of Travel	342	322	315
	Vehicle Hours of Delay	32	24	22
	Average Vehicle Speed	59	60	61

Source: I-80 ICM Regional Model (modified version of ACCMA Travel Demand Model)

Table 6-20 Trip Reduction Scenario I-80 Performance Trends: Between SR 4 and Central Avenue

Performance Measure		Future 2035 Baseline	Future 2035 3% TDM-Transit	Future 2035 10% TDM-Transit
AM Eastbound	Vehicle Miles of Travel	52,511	52,064	50,837
	Vehicle Hours of Travel	1,162	1,122	1,056
	Vehicle Hours of Delay	319	285	240
	Average Vehicle Speed	45	46	48
PM Eastbound	Vehicle Miles of Travel	80,947	80,205	78,261
	Vehicle Hours of Travel	3,800	3,569	3,099
	Vehicle Hours of Delay	2,504	2,285	1,846
	Average Vehicle Speed	21	22	25
AM Westbound	Vehicle Miles of Travel	83,775	85,905	82,535
	Vehicle Hours of Travel	4,562	4,634	3,773
	Vehicle Hours of Delay	3,221	3,259	2,452
	Average Vehicle Speed	18	19	22
PM Westbound	Vehicle Miles of Travel	55,919	55,141	53,855
	Vehicle Hours of Travel	1,300	1,264	1,185
	Vehicle Hours of Delay	399	375	317
	Average Vehicle Speed	43	44	45

Source: I-80 ICM Regional Model (modified version of ACCMA Travel Demand Model)

Table 6-21 Trip Reduction Scenario I-80 Performance Trends: Between Central Avenue and the Bay Bridge

Performance Measure		Future 2035 Baseline	Future 2035 3% TDM-Transit	Future 2035 10% TDM-Transit
AM Eastbound	Vehicle Miles of Travel	37,020	36,986	35,556
	Vehicle Hours of Travel	1,213	1,180	1,023
	Vehicle Hours of Delay	596	563	430
	Average Vehicle Speed	31	31	35
PM Eastbound	Vehicle Miles of Travel	47,896	47,368	45,852
	Vehicle Hours of Travel	2,592	2,388	1,983
	Vehicle Hours of Delay	1,793	1,598	1,217
	Average Vehicle Speed	18	20	23
AM Westbound	Vehicle Miles of Travel	51,717	51,899	50,537
	Vehicle Hours of Travel	2,567	2,364	2,087
	Vehicle Hours of Delay	1,698	1,492	1,239
	Average Vehicle Speed	20	22	24
PM Westbound	Vehicle Miles of Travel	41,174	39,769	38,090
	Vehicle Hours of Travel	1,375	1,202	1,041
	Vehicle Hours of Delay	678	529	397
	Average Vehicle Speed	30	33	37

Source: I-80 ICM Regional Model (modified version of ACCMA Travel Demand Model)

Table 6-22 Trip Reduction Scenario San Pablo Avenue Performance Trends: Between Carquinez Bridge and SR 4

Performance Measure		Future 2035 Baseline	Future 2035 3% TDM-Transit	Future 2035 10% TDM-Transit
AM Northbound	Vehicle Miles of Travel	611	492	461
	Vehicle Hours of Travel	17	14	13
	Vehicle Hours of Delay	0	0	0
	Average Vehicle Speed	35	35	35
PM Northbound	Vehicle Miles of Travel	2,886	2,766	2,243
	Vehicle Hours of Travel	84	80	65
	Vehicle Hours of Delay	0	0	0
	Average Vehicle Speed	35	35	35
AM Southbound	Vehicle Miles of Travel	5,096	4,605	4,834
	Vehicle Hours of Travel	284	139	173
	Vehicle Hours of Delay	125	0	25
	Average Vehicle Speed	18	33	28
PM Southbound	Vehicle Miles of Travel	437	443	408
	Vehicle Hours of Travel	13	13	12
	Vehicle Hours of Delay	0	0	0
	Average Vehicle Speed	35	35	35

Source: I-80 ICM Regional Model (modified version of ACCMA Travel Demand Model)

Table 6-23 Trip Reduction Scenario San Pablo Avenue Performance Trends: Between SR 4 and Central Avenue

Performance Measure		Future 2035 Baseline	Future 2035 3% TDM-Transit	Future 2035 10% TDM-Transit
AM Northbound	Vehicle Miles of Travel	8,305	7,270	5,875
	Vehicle Hours of Travel	235	206	165
	Vehicle Hours of Delay	0	0	0
	Average Vehicle Speed	35	35	36
PM Northbound	Vehicle Miles of Travel	17,607	17,610	7,289
	Vehicle Hours of Travel	1,053	1,006	204
	Vehicle Hours of Delay	520	473	0
	Average Vehicle Speed	17	18	36
AM Southbound	Vehicle Miles of Travel	17,531	17,695	17,778
	Vehicle Hours of Travel	1,155	1,007	1,044
	Vehicle Hours of Delay	623	467	500
	Average Vehicle Speed	15	18	17
PM Southbound	Vehicle Miles of Travel	10,081	8,982	6,973
	Vehicle Hours of Travel	298	265	205
	Vehicle Hours of Delay	0	0	0
	Average Vehicle Speed	34	34	34

Source: I-80 ICM Regional Model (modified version of ACCMA Travel Demand Model)

Table 6-24 Trip Reduction Scenario San Pablo Avenue Performance Trends: Between Central Avenue and the Bay Bridge

Performance Measure		Future 2035 Baseline	Future 2035 3% TDM-Transit	Future 2035 10% TDM-Transit
AM Northbound	Vehicle Miles of Travel	8,366	7,332	6,207
	Vehicle Hours of Travel	547	263	213
	Vehicle Hours of Delay	252	11	0
	Average Vehicle Speed	15	28	29
PM Northbound	Vehicle Miles of Travel	9,860	9,917	9,592
	Vehicle Hours of Travel	651	819	520
	Vehicle Hours of Delay	274	437	165
	Average Vehicle Speed	15	12	18
AM Southbound	Vehicle Miles of Travel	9,567	9,342	9,371
	Vehicle Hours of Travel	717	372	533
	Vehicle Hours of Delay	358	35	184
	Average Vehicle Speed	13	25	18
PM Southbound	Vehicle Miles of Travel	9,443	9,304	8,805
	Vehicle Hours of Travel	475	430	341
	Vehicle Hours of Delay	127	91	27
	Average Vehicle Speed	20	22	26

Source: I-80 ICM Regional Model (modified version of ACCMA Travel Demand Model)

Table 6-25 Trip Reduction Scenario Freeway Mainline Demand Trends

Mainline Location	Future 2035 Baseline		Future 2035 3% TDM-Transit		Future 2035 10% TDM-Transit	
	AM Peak Hour	PM Peak Hour	AM Peak Hour	PM Peak Hour	AM Peak Hour	PM Peak Hour
I-80 Eastbound						
Between University Ave and Gilman St	8,529	11,313	8,479 (-1%)	11,184 (-1%)	8,363 (-2%)	10,675 (-6%)
Between San Pablo Dam off and on ramps	4,844	6,838	4,822 (0%)	6,789 (-1%)	4,747 (-2%)	6,773 (-1%)
Between Pinole Valley Rd and SR 4	5,478	10,016	5,370 (-2%)	9,850 (-2%)	5,280 (-4%)	9,468 (-5%)
I-80 Westbound						
Between SR 4 and Pinole Valley Rd	10,897	5,450	10,839 (-1%)	5,371 (-1%)	10,462 (-4%)	5,285 (-3%)
Between San Pablo Dam off and on ramps	7,477	5,776	7,606 (2%)	5,696 (-1%)	7,245 (-3%)	5,506 (-5%)
Between Gilman St and University Ave	11,226	8,942	11,267 (0%)	8,691 (-3%)	10,919 (-3%)	8,327 (-7%)

Source: I-80 ICM Regional Model (modified version of ACCMA Travel Demand Model

Table 6-26 Trip Reduction Scenario Arterial Demand Trendss

San Pablo Avenue Location	Future 2035 Baseline		Future 2035 3% TDM-Transit		Future 2035 10% TDM-Transit	
	AM Peak Hour	PM Peak Hour	AM Peak Hour	PM Peak Hour	AM Peak Hour	PM Peak Hour
Northbound/Eastbound						
Between University Ave and Gilman St	1,668	1,883	1,647 (1%)	1,876 (0%)	1,337 (20%)	1,822 (3%)
Between McBryde Ave and San Pablo Dam	1,075	1,860	1,045 (3%)	1,811 (3%)	882 (18%)	1,614 (13%)
Between Pinole Valley Rd and SR 4	987	2,237	865 (12%)	2,213 (1%)	737 (25%)	2,169 (3%)
Southbound/Westbound						
Between SR 4 and Pinole Valley Rd	2,592	964	2,554 (1%)	814 (16%)	2,509 (3%)	622 (36%)
Between San Pablo Dam and McBryde Ave	1,553	805	1,177 (24%)	740 (8%)	1,345 (13%)	535 (34%)
Between Gilman St and University Ave	1,915	1,902	1,872 (2%)	1,911 (0%)	1,924 (0%)	1,895 (0%)

Source: I-80 ICM Regional Model (modified version of ACCMA Travel Demand Model

7 IMPLEMENTATION PLAN

This chapter presents the draft timeline for implementing the proposed projects and strategies identified in the previous chapter. For the purposes of this CSMP, near-term is defined as 0 to 5 years (2010 to 2015), intermediate term is defined as 5 to 10 years (2015 to 2020), and long-term is defined as 10 to 25 years (2020 to 2035). The near-term, intermediate term and long term strategies are shown in . It is important to note that because of the time needed to plan, build consensus, design, get environmental clearance, fund and build projects, many of those identified fall into the intermediate or long-term timeframe.

7.1 Near-Term

Those projects and strategies recommended for implementation in the near-term include those that have secured funding, obtained environmental clearance, are under design, or do not require significant physical work or funding.

Based on these criteria, the recommended near-term improvements include construction of the eastbound I-80 HOV lane from SR 4 to the Carquinez Bridge and implementation of the I-80 ICM Project. As noted previously, the I-80 ICM Project a number of system management (both freeway and arterial) and transit improvements.

In addition to the two projects identified above, it is recommended that the following activites be pursued in the near-term:

- establish an I-80 Corridor Management Committee,
- conduct a before-and-after study of the I-80 ICM Project,
- develop corridor wide land use policies,
- conduct a Maze Study,
- conduct an I-580 Ramp Metering Study,
- analyze effectiveness of the individual intermediate term projects identified in the CSMP, and
- analyze weekend conditions.

The objective of these last five activities is to further assess potential intermediate and long-term improvements and strategies for the corridor.

7.2 Intermediate Term

The improvements recommended for intermediate term implementation are generally those which have support and require minor or moderate physical work or funding, but have not acquired funding and require environmental clearance or design. Proposed projects include expanded or enhanced deployment of ICM capabilities within the corridor, minor to moderate geometric improvements to both the freeway and arterial network, improved connectors between roadways, signalization of un-signalized interchange intersections, and an increase in public transit service.

Other efforts recommended for the intermediate term include improving the reliability of automatic data collection systems, and undertaking studies needed to facilitate the implementation

of long-term improvements and strategies. Specific studies include those related to BART extensions and multimodal access improvements, analysis of Commercial Vehicle policies to reduce peak hour traffic, and an assessment of the benefits of converting the HOV Lanes to Express Lanes.

7.3 Long-Term

As noted previously, major capacity expansion along I-80 is unlikely due to physical and institutional constraints. Given this limitation, and the magnitude of projected growth, plans for the corridor must include an combination of more localized improvements plus strategies that further maximize the efficiency of the existing roadway system, reduce the occurrence and impact of incidents, encourage increased use of other modes, and reduce or manage peak period vehicle travel demand.

In general, longer-term projects include those requiring more significant physical work and thus funding, and those that require considerable consensus-building and may face more significant institutional issues.

Key projects include major public transportation expansion, additional roadway capacity, revised goods movement strategies, and large-scale ITS improvements. The latter may include the implementation of full ATM strategies within the corridor including new technologies such as Intellidrive.

The long term improvements presented in **Table 7-1** represent a financially unconstrained listing of potential improvements. An analysis of these individual improvements was not conducted as part of this CSMP. Thus, further study of these improvements, individually or as packages, is required.

While these improvements are identified as being long term, it is important to recognize that the exact timing of any future improvement is dependent upon several factors including actual future conditons and funding levels

Table 7-1 I-80 CSMP Recommended Project Implementation Timeline

Proposed Projects		Implementation Timeframe[1]			Comments
		Near-Term (2010-2015)	Intermediate-Term (2015-2020)	Long-Term (2020-2035)	
Roadway Geometric Improvements					
Freeway Geometric Improvements	*Ramp Modifications:*				
	• WB SR4: reconstruct bridge to allow for 3rd GP lane and moving meter limit line downstream				
	• WB Buchanan Street: widen to add 2nd GP lane				
	• WB Richmond off-ramp: add 2nd thru lane		X		
	• WB Central off-ramp: add 3rd lane				
	• WB Gilman off-ramp: add 3rd lane	X			
	• EB San Pablo Dam Road off-ramp: add 4th lane				
	• Powell Street: Widen eastbound off-ramp	X			
	Interchange Improvements:				
	• Powell Street: Allow westbound left turn and southbound through for the westbound off-ramp	X X			Further study of WB left turn required
	• Gilman Street: Convert interchange to roundabout	X			PSR underway
	• Central Avenue: a) redirect I-80 WB on-ramp traffic to I-580 during weekend peaks, and b) Improve signalized intersection spacing by connecting Pierce St to San Mateo St, and relocating the traffic signal at Pierce to San Mateo intersection	X X X X	X		Planned project – being studied by CCTA
	• Pinole Valley Road: Provide WB right turn lane and EB left-turn lane to eastbound on-ramp; add bus turnout/shelter on westbound ramp				
	• San Pablo Dam Road Interchange: Upgrade and improve; includes modifications at El Portal and McBride				Planned project – Environmental document approved
	• Cutting Boulevard: Construct new connector ramps to the Del Norte BART station	X		X	
	• SR 4: Construct direct connectors between westbound I-80 and eastbound SR 4	X		X	

Table 7-1 I-80 CSMP Recommended Project Implementation Timeline (cont.)

Proposed Projects		Implementation Timeframe[1]			Comments
		Near-Term (2010-2015)	Intermediate-Term (2015-2020)	Long-Term (2020-2035)	
Roadway Geometric Improvements (cont.)					
	Mainline auxiliary lanes:				
	• WB San Pablo Dam Road on-ramp to San Pablo Avenue off-ramp – extend current aux lane between San Pablo Dam Road and Edwards/McBryde Av				Coordinate with SPDR I/C improvements
	• WB Potrero on-ramp to Carlson off-ramp		X		
	• EB Ashby on-ramp to University off-ramp				
	• EB San Pablo Ave on-ramp to San Pablo Dam Road off-ramp – extend current aux lane	X			
	• EB San Pablo Dam Road on-ramp to El Portal off-ramp				
	• EB Hilltop off-ramp to Richmond Parkway on-ramp			X	
	Other:	X			
	• Westbound 80: Re-stripe SB 80 to 880 connector to 4 lanes (currently three)	X			Further study recommended
	• Corridor-wide: Convert HOV lanes to Express lanes	X		X	
Arterial Geometric Improvements	• SB San Pablo Avenue at Richmond Parkway – widen to provide 2nd LT bay				
	• SB San Pablo Avenue at San Pablo Dam Road – extend LT bay	X			
	• Carlson Boulevard: Reconstruction and restriping to add a 6' median from Tehama Avenue to San Jose Avenue	X			Underway
	• Central Hercules: Improve and expand arterials for express bus and rail transit facilities to support transit-oriented development	X X		X	
	• San Pablo Avenue at University Avenue, Cutting Boulevard, Richmond Parkway, and Roosevelt Avenue: Arterial widening where are necessary			X	

Table 7-1 I-80 CSMP Recommended Project Implementation Timeline (cont.)

Proposed Projects		Implementation Timeframe[1]			Comments
		Near-Term (2010-2015)	Intermediate-Term (2015-2020)	Long-Term (2020-2035)	
System Management and Operational Improvements					
Freeway Management	• Corridor-wide: I-80 ICM Project-Freeway Elements (adaptive ramp metering, VASS, LUS)	X			
	• Corridor-wide: connector metering at I-580 eastbound interchange				Further study recommended
	• Corridor-wide: Implement lane management in eastbound direction for non-recurring conditions			X	
	• Cummings Skyway to Cutting Boulevard: Shoulder utilization in the westbound direction for incident management and transit vehicles	X		X	
	• Corridor-wide: Freeway shoulder use to add additional capacity during periods of congestion and /or during an incident			X	
	• Corridor-wide: Implement Congestion Pricing			X	
Arterial Management	• I-80 ICM Project-Arterial Elements	X			
	• Carlson Boulevard: Signalize I-80 ramp intersections				
	• Gilman Street: Signalize I-80 ramp intersections				
	• San Pablo Avenue: Extend SMART Corridor		X		
	• Corridor-wide: enhance/implement freeway/ramp meter/surface street signal coordination			X	
	• Update signal timing plans	X X		X	Should be on a regular basis
Transit Improvements					
	Ferry:	X			
	• Provide service between Berkeley/Albany and San Francisco	X		X	
	• Provide service between Richmond and San Francisco			X	
	• Provide service between Hercules and San Francisco			X	
	Rail:				
	• Hercules: Construct Capitol Corridor train station	X		X	

X

Table 7-1 I-80 CSMP Recommended Project Implementation Timeline (cont.)

Proposed Projects		Implementation Timeframe[1]			Comments
		Near-Term (2010-2015)	Intermediate-Term (2015-2020)	Long-Term (2020-2035)	
Transit Improvements (cont.)					
	BART:				
	• Berkeley: Improve Ashby Station to support Ed Roberts Campus and future TOD			X	
	• Richmond: Provide transportation improvements on the east side of the Richmond Station to accommodate TOD			X	
	• El Cerrito: Provide real-time transit information displays			X	
	• System-wide: Provide additional or new parking capacity			X	
	• Extend to Richmond Hilltop and Hercules			X	
	• Additional infill stations to fill in gaps between the existing stations			X	
	Bus				
	• Northern Alameda County: Improve AC transit facilities including new operating system			X	
	• Expand WestCAT service including purchase of vehicles			X	
	• Install WestCAT-furnished real-time transit information displays			X	
	• Purchase new express buses for I-80 express service to be provided by AC transit, Vallejo Transit, and WestCAT			X	
	• Expand Bus Rapid Transit from Richmond Parkway Transit Center to Hercules			X	
	• Bus Transit connections between new ferry terminals			X	
	Transit Centers				
	• Relocate and expand Hercules Transit Center, including relocation of park and ride facility and construction of express bus facilities			X	
	• Construct Phase 2 of Hercules Inter-modal Station			X	
	Other Measures				
	• I-80 ICM Project-Transit elements	X			

Table 7-1 I-80 CSMP Recommended Project Implementation Timeline (cont.)

Proposed Projects		Implementation Timeframe[1]			Comments
		Near-Term (2010-2015)	Intermediate-Term (2015-2020)	Long-Term (2020-2035)	
Non-Motorized Mode Improvements					
	Pedestrian				
	• Richmond: Install pedestrian count-down signals, improve sidewalk conditions, construct mid-block lighted crossings, and landscape Nevin Avenue, Barrett Ave & other areas			X	
	• El Cerrito: Develop pedestrian, transit stop and streetscape improvements along San Pablo Avenue			X	
	• Improve pedestrian access and safety for transit access routes.			X	
	• Close the Bay Trail gaps along Richmond Parkway between Pennsylvania Avenue and Gertude Avenue, north of Freethy Blvd to Payne Drive, from Payne to Cypress, and from Pinole Shores to Parker Ave			X	
	Bicycle				
	• Richmond: Construct Class I Bicycle Trail from Carlson Blvd to I-80 along abandoned railroad property			X	
	• Improve bike detection in the corridor.			X	
	• Provide exclusive right-of-way for bikes wherever feasible to enhance bike safety.			X	
	• Provide more room for bikes on BART. This will facilitate in the extension of hours that bike riders can use BART services and reduce the parking demand at BART stations.			X	
	• Increase the availability of bike lockers and bike parking at BART stations.			X	
	Other				
	• Berkeley: Improve Ashby/I-80 interchange/Aquatic Park Access streetscaping, bicycle, and pedestrian facilities			X	

Table 7-1 I-80 CSMP Recommended Project Implementation Timeline (cont.)

Proposed Projects		Implementation Timeframe[1]			Comments
		Near-Term (2010-2015)	Intermediate-Term (2015-2020)	Long-Term (2020-2035)	
Demand Management/Land Use Strategies					
	• Implement the Transit Commute Benefits Promotion to encourage the region-wide ridesharing	X	X	X	
	• Encourage public and private agencies to implement flex work schedules to give more travel choices for the employees	X	X	X	
	• Incentive programs to agencies, that encourage carpool and non-auto travel modes	X	X	X	
	• Encourage transit-oriented development (TOD) around BART stations and other transit centers	X	X	X	
	• Promote urban infill development	X	X	X	
Traveler Information Improvements					
	• I-80 ICM Project – CMS and Highway Advisory Radio	X			
	• Extend traveler information dissemination to in vehicle navigation systems and other personalized devices			X	
Goods Movement Strategies					
	• Cummings Skyway Truck Climbing Lane Extension: Extend truck climbing lane in the eastbound direction to allow faster moving vehicles to safely pass slow moving trucks climbing existing 10% grade	X		X	
	• N. Richmond Truck Route: Extension of Soto Street from Market Avenue to Parr Boulevard			X	
	• Dynamic Truck restrictions in conjunction with queue warning			X	
	• Coordinate with commercial vehicle information source to support I-80 ICM Commercial Vehicle Operations System			X	
	• Signage to designate truck routes and time of day restrictions			X	
	• Construct satellite freight consolidation facility			X	

Table 7-1 I-80 CSMP Recommended Project Implementation Timeline (cont.)

Proposed Projects		Implementation Timeframe[1]			Comments
		Near-Term (2010-2015)	Intermediate-Term (2015-2020)	Long-Term (2020-2035)	
ITS Improvements					
	• Additional Connector metering			X	
	• Expand existing surveillance and monitoring			X	
	• Install additional Changeable Message Signs (CMSs)			X	
	• Install additional Highway Advisory Radio (HAR) transmitters			X	

Note:

1: It is important to recognize that the exact timing of any future improvement is dependent upon several factors including actual future conditons and funding levels. These factors may push some intermediate term improvements beyond 2020. At the same time, some long term improvements, notably lower-cost pedestrian and bicycle improvements, may proceed before 2020.

X

X

X

X

Appendix A
I-80 ICM Project Traffic Operations Analysis Report

Appendix B
BART Services

Station	BART Line	From	To	Frequency	Connection to Bus Services
Ashby	Orange	Richmond	Fremont	NB from 4:45 AM to 1:00 AM with 15-minute to 20-minute headway, SB from 4:27 AM to 12:30 AM with 15-minute to 20-minute headway	AC Transit routes 9,15,18, and the regional All Nighter
	Red	Richmond	Millbrae		
Downtown Berkeley	Orange	Richmond	Fremont	NB from 4:48 AM to 12:51 AM with 15-minute to 20-minute headway, SB from 4:25 AM to 12:30 AM with 15-minute to 20-minute headway	AC Transit routes 1,1R,7,9,15,18,19,51,52L,65,67,79, 800
	Red	Richmond	Millbrae		
El Cerrito del Norte	Orange	Richmond	Fremont	NB from 4:57 AM to 1:00 AM with 15-minute to 20-minute headway, SB from 4:16 AM to 12:30 AM with 15-minute to 20-minute headway	AC Transit routes L,7,71,72,72M, 72R,76, and 376 WestCAT routes 30Z, J, JL, JPX, JR, JX, and the regional All Nighter Golden Gate Transit routes 40 and 42 Fairfield-Suisun route 90
	Red	Richmond	Millbrae		
El Cerrito Plaza	Orange	Richmond	Fremont	NB from 4:54 AM to 12:57 AM with 15-minute to 20-minute headway, SB from 4:19 AM to 12:23 AM with 15-minute to 20-minute headway	AC Transit routes G,19, 72, 72M,79, and regional All Nighter
	Red	Richmond	Millbrae		
MacArthur	Orange	Richmond	Fremont	NB from 4:42 AM to 12:45 AM with 15-minute headway, SB from 4:31 AM to 12:45 AM with 15-minute headway. The yellow line has 5-minute to 20-minute headway in both NB and SB directions.	AC Transit routes 1, 1R,12,14,15,18,57, and All Nighter
	Red	Richmond	Millbrae		
	Yellow	Pittsburg/ Bay Point	SFO		
North Berkeley	Orange	Richmond	Fremont	NB from 4:50 AM to 12:54 AM with 15-minute to 20-minute headway, SB from 4:22 AM to 12:26 AM with 15-minute to 20-minute headway	AC Transit routes 19,88, and regional All Nighter
	Red	Richmond	Millbrae		
Richmond	Orange	Richmond	Fremont	SB from 4:12 AM to 12:16 AM with 15-minute to 20-minute headway	AC Transit routes 71,72, 72M, 74,76, and 376 Golden Gate Transit route 42 Regional All Nighter
	Red	Richmond	Millbrae		
Rockridge	Yellow	Pittsburg/ Bay Point	SFO	NB from 4:45 AM to 12:48 AM with 5-minute to 20-minute headway, SB from 4:34 AM to 12:32 AM with 5-minute to 20-minute headway	AC Transit routes 7,51,59,851, and regional All Nighter
West Oakland	Yellow	Pittsburg/ Bay Point	SFO	NB from 4:33 AM to 12:32 AM with 15-minute headway, SB from 4:39 AM to 12:53 AM with 15-minute headway The yellow line has 5-minute to 20-minute headway in both NB and SB directions.	AC Transit routes 13,19,62, and regional All Nighter
	Green	Fremont	Daly City		
	Red	Richmond	Millbrae		
	Blue	Dublin/ Pleasanton	Millbrae		

Appendix C
Bus Service

Provider	Route	From	To	Portion where I-80 is used	Service Description	2007 Ridership
WestCAT	JX	Hercules Transit Center	El Cerrito del Norte BART Station	I-80 from Cutting Blvd to Sycamore Ave	Weekdays, from 5:25 AM to 8:41 AM and from 3:41 PM to 7:57 PM with 15-minute headway.	121,655
WestCAT	J	Hercules Transit Center	El Cerrito del Norte BART Station	I-80 from Cutting Blvd to Sycamore Ave	Weekdays, from 4:47 AM to 12:30 AM with 15-minute headway during the peak hour and 30-minute headway during the off-peak.	456,114
WestCAT	JPX	Hercules Transit Center	El Cerrito del Norte BART Station	I-80 from Cutting Blvd to Sycamore Ave	Weekdays, from 6:00 AM to 8:00 PM with 30-minute headway during the peak period and 60-minute headway during the off peak.	74,251
WestCAT	30Z	El Cerrito del Norte BART Station	downtown Martinez	I-80 from Cutting Blvd to SR 4	Weekdays, from 6:00 AM to 8:13 PM with 30-minute headway during the peak hour and one-hour headway during the off-peak.	68,151
WestCAT	C3	Hercules Transit Center	Pinole-Contra Costa College	This route does not run on I-80	Weekdays, from 7:25 AM to 10:15 PM with 60-minute headway	52,075
WestCAT	LYNX	Rodeo/Hercules	San Francisco Transbay Terminal	I-80 from Bay Bridge to Willow Ave	Weekdays, from 5:00 AM to 8:20 AM and from 3:30 PM to 7:45 PM with 15-minute headway.	124,071
WestCAT	10	Hercules Transit Center	Gem Street	This route does not run on I-80	Weekdays, from 5:47 AM to 7:27 PM with 30-minute headway	29,449
WestCAT	11	Hercules Transit Center	Rodeo/Hercules	This route does not run on I-80	Weekdays, from 5:46 AM to 9:57 PM with 30-minute headway throughout the day.	98,263
WestCAT	12	Hercules Transit Center	Redwood Street	This route does not run on I-80	Weekdays, from 5:30 AM to 7:30 PM with 30-minute headway throughout the day,	38,990
WestCAT	13	Hercules Transit Center	Coronado	This route does not run on I-80	Weekdays, from 5:50 AM to 7:30 PM with 30-minute headway during peak hours and one–hour headway during the off peak.	57,350
WestCAT	14	Hercules Transit Center	Pheasant Drive, Sparrow Drive, Falcon Way, and Refugio Valley Road	This route does not run on I-80	Weekdays only, from 5:50 AM to 7:30 PM with 30-minute headway.	48,405
WestCAT	15	Hercules Transit Center	North Shore Business Park, Rodeo	This route does not run on I-80	Weekdays, from 5:40 AM to 9:08 PM with 30–minute headway.	52,388
WestCAT	16	Richmond Parkway Transit Center	Pinole Valley Area	This route does not run on I-80	Weekdays, from 5:29 AM to 8:48 PM with 30-minute headway	93,690

Provider	Route	From	To	Portion where I-80 is used	Service Description	2007 Ridership
WestCAT	17	Richmond Parkway Transit Center	Del Monte Shopping Center	This route does not run on I-80	Weekdays, from 6:20 AM to 7:11 PM with 60-minute headway	10,771
WestCAT	18	Tara Hills	Richmond Parkway Transit Center/Hilltop Mall	This route does not run on I-80	Weekdays, from 6:00 AM to 7:50 PM with 70-minute headway.	15,864
WestCAT	19	Hercules Transit Center	Hilltop Mall	This route does not run on I-80	Weekdays, from 6:15 AM to 6:45 PM with 30-minute headway and on Saturday from 8:35 AM to 7:10 PM with 40-minute headway.	59,400
AC Transit	L	San Francisco Transbay	Princeton Plaza Shopping Center	From Bay Bridge to Buchanan St.	Weekdays, from 5:20 AM to 8:15 AM on the westbound with 25-minute headway and from 3:10 PM to 9:00 PM on the eastbound with 15-minute headway.	175,695
AC Transit	7	Rockridge BART	Berkeley BART /El Cerrito Del Norte BART	This route does not run on I-80	Weekdays, from 6:22 AM to 8:55 PM with 20-minute headway during the peak hour and 30-minute headway during the off-peak. Weekends, from 8:00 AM to 8:00 PM with 60-minute headway	467,690
AC Transit	70	Contra Costa College	Richmond BART	This route does not run on I-80	Weekdays, from 5:41AM to 11:11 PM with 30-minute headway. Weekends, from 5:55 AM to 10:55 PM with 60-minute headway.	400,248
AC Transit	71	El Cerrito Del Norte BART	Richmond BART/ Richmond Parkway Transit Center	This route does not run on I-80	Weekdays, from 5:16 AM to 7:42 PM with 30-minute headway. Weekends, from 6:12 AM to 8:27 PM with 60-minute headway.	389,721
AC Transit	72/72M	Oakland 14th St/Broadway	El Cerrito Del Norte BART/Richmond BART/Castro Street	This route does not run on I-80	Weekdays, from 5:00 AM to 7:42 PM with 15-minute headway. Weekends, from 6:12 AM to 8:27 PM with 60-minute headway.	2,730,143
AC Transit	72R	Jack London Square	Contra Costa College	This route does not run on I-80	Weekdays only, from 6:00 am to 7:20 pm with 12-minute headway.	1,733,490
AC Transit	74	Hall Ave& Marina Way	Richmond BART/ Orinda BART	This route does not run on I-80	Weekdays, from 5:42 AM to 11:20 PM with 30-minute headway. Weekends, from 7:50 AM to 5:20 PM with 30-minute headway on the northbound and 60-	426,438

Provider	Route	From	To	Portion where I-80 is used	Service Description	2007 Ridership
					minute headway on the southbound.	
AC Transit	76	Richmond Parkway Transit Center	Richmond BART/ El Cerrito Del Norte BART	This route does not run on I-80	Weekdays, from 6:34 AM to 8:13 PM with 30-minute headway. Weekends from 7:50 AM to 5:20 PM with 30-minute headway on the northbound and 30-minute headway on the southbound.	687,745
AC Transit	376	El Cerrito Del Norte BART	Richmond BART/Pinole Business Park	This route does not run on I-80	Evening only, from 8:20 PM to 2:19 AM with 30-minute headway.	70,752

DKS Associates
TRANSPORTATION SOLUTIONS

Appendix D
Preservation Data

County	Begin PM	End PM	Length	Pave Type	Direction	Triggered Lane Miles	Defect	IRI
ALA	1.763	2.255	0.492	Flexible	Right Roadbed Only	0.984	HIGH ABC	110
ALA	1.763	2.255	0.492	Flexible	Left Roadbed Only	0.984	FINE RAVEL	168
ALA	2.255	2.657	0.402	Flexible	Right Roadbed Only	0.804	HIGH ABC	123
ALA	2.255	2.657	0.402	Flexible	Left Roadbed Only	0.804	FINE RAVEL	135
ALA	2.657	2.801	0.144	Flexible	Right Roadbed Only	0.000	GOOD CONDITION	89
ALA	2.657	2.801	0.144	Flexible	Left Roadbed Only	0.288	FINE RAVEL	146
ALA	2.801	3.391	0.590	Flexible	Right Roadbed Only	0.000	GOOD CONDITION	127
ALA	2.801	3.391	0.590	Flexible	Left Roadbed Only	1.180	FINE RAVEL	173
ALA	3.391	3.451	0.060	Flexible	Right Roadbed Only	0.000	GOOD CONDITION	134
ALA	3.391	3.451	0.060	Flexible	Left Roadbed Only	0.120	FINE	149
ALA	3.451	3.513	0.062	Flexible	Right Roadbed Only	0.000	NO DISTRESS OBSERVED	144
ALA	3.451	3.513	0.062	Flexible	Left Roadbed Only	0.124	FINE RAVEL	118
ALA	3.513	3.517	0.004	Bridge	Right Roadbed Only	0.000	N/A Bridge	N/A
ALA	3.513	3.517	0.004	Bridge	Left Roadbed Only	0.000	N/A Bridge	N/A
ALA	3.517	3.576	0.059	Flexible	Right Roadbed Only	0.000	GOOD CONDITION	128
ALA	3.517	3.576	0.059	Flexible	Left Roadbed Only	0.118	FINE RAVEL	124
ALA	3.576	3.721	0.145	Flexible	Right Roadbed Only	0.000	GOOD CONDITION	145
ALA	3.576	3.721	0.145	Flexible	Left Roadbed Only	0.290	FINE RAVEL	136
ALA	3.721	3.786	0.065	Flexible	Right Roadbed Only	0.000	GOOD CONDITION	153
ALA	3.721	3.786	0.065	Flexible	Left Roadbed Only	0.130	FINE RAVEL	151
ALA	3.786	3.844	0.058	Bridge	Right Roadbed Only	0.000	N/A Bridge	132
ALA	3.786	3.844	0.058	Bridge	Left Roadbed Only	0.000	N/A Bridge	119
ALA	3.844	3.955	0.111	Flexible	Right Roadbed Only	0.000	GOOD CONDITION	120
ALA	3.844	3.955	0.111	Flexible	Left Roadbed Only	0.222	FINE RAVEL	127
ALA	3.955	3.959	0.004	Bridge	Right Roadbed Only	0.000	N/A Bridge	N/A
ALA	3.955	3.959	0.004	Bridge	Left Roadbed Only	0.000	N/A Bridge	N/A
ALA	3.959	3.990	0.031	Flexible	Right Roadbed Only	0.000	GOOD CONDITION	83
ALA	3.959	3.990	0.031	Flexible	Left Roadbed Only	0.062	FINE RAVEL	N/A
ALA	3.990	4.310	0.325	Flexible	Right Roadbed Only	0.000	GOOD CONDITION	121
ALA	3.990	4.315	0.325	Flexible	Left Roadbed Only	0.650	FINE RAVEL	156
ALA	4.315	4.410	0.095	Flexible	Right Roadbed Only	0.000	GOOD CONDITION	123
ALA	4.315	4.410	0.095	Flexible	Left Roadbed Only	0.285	RIDE	334
ALA	4.410	5.490	1.080	Flexible	Right Roadbed Only	0.000	GOOD CONDITION	123
ALA	4.410	5.490	1.080	Flexible	Left Roadbed Only	2.160	FINE RAVEL	131
ALA	5.490	5.836	0.346	Flexible	Right Roadbed Only	0.000	GOOD CONDITION	133
ALA	5.490	5.836	0.346	Flexible	Left Roadbed Only	0.692	HIGH ABC	183
ALA	5.836	6.190	0.354	Flexible	Right Roadbed Only	0.708	ALL A, NO B, OPEN CRKS	166
ALA	5.836	6.190	0.354	Flexible	Left Roadbed Only	0.708	HIGH ABC	128
ALA	6.190	6.620	0.430	Flexible	Right Roadbed Only	0.860	ALL A, NO B, OPEN CRKS	143
ALA	6.190	6.620	0.430	Flexible	Left Roadbed Only	0.860	HIGH ABC	125

County	Begin PM	End PM	Length	Pave Type	Direction	Triggered Lane Miles	Defect	IRI
ALA	6.620	6.679	0.059	Bridge	Right Roadbed Only	0.000	N/A Bridge	236
ALA	6.620	6.679	0.059	Bridge	Left Roadbed Only	0.000	N/A Bridge	205
ALA	6.679	6.899	0.220	Flexible	Right Roadbed Only	0.440	ALL A, NO B, OPEN CRKS	113
ALA	6.679	6.899	0.220	Flexible	Left Roadbed Only	0.000	GOOD CONDITION	103
ALA	6.899	7.032	0.133	Flexible	Right Roadbed Only	0.266	ALL A, NO B, OPEN CRKS	98
ALA	6.899	7.032	0.133	Flexible	Left Roadbed Only	0.000	GOOD CONDITION	86
ALA	7.032	7.136	0.104	Flexible	Right Roadbed Only	0.208	FINE RAVEL	103
ALA	7.032	7.136	0.104	Flexible	Left Roadbed Only	0.000	GOOD CONDITION	142
ALA	7.136	7.771	0.635	Flexible	Right Roadbed Only	1.270	FINE RAVEL	115
ALA	7.136	7.771	0.635	Flexible	Left Roadbed Only	1.270	FINE RAVEL	157
ALA	7.784	7.999	0.215	Flexible	Right Roadbed Only	0.430	FINE RAVEL	110
ALA	7.784	7.999	0.215	Flexible	Left Roadbed Only	0.430	FINE RAVEL	115
ALA	7.999	8.036	0.037	Flexible	Right Roadbed Only	0.074	FINE RAVEL	N/A
ALA	7.999	8.036	0.037	Flexible	Left Roadbed Only	0.074	FINE RAVEL	N/A
CC	0.000	0.002	0.002	Flexible	Right Roadbed Only	0.004	FINE RAVEL	112
CC	0.000	0.002	0.002	Flexible	Left Roadbed Only	0.004	FINE RAVEL	159
CC	0.002	0.008	0.006	Bridge	Right Roadbed Only	0.000	N/A Bridge	N/A
CC	0.002	0.008	0.006	Bridge	Left Roadbed Only	0.000	N/A Bridge	148
CC	0.008	0.216	0.208	Flexible	Right Roadbed Only	0.416	FINE RAVEL	154
CC	0.008	0.216	0.208	Flexible	Left Roadbed Only	0.416	FINE RAVEL	134
CC	0.216	0.254	0.038	Flexible	Right Roadbed Only	0.076	FINE RAVEL	N/A
CC	0.216	0.254	0.038	Bridge	Left Roadbed Only	0.000	N/A Bridge	185
CC	0.254	1.067	0.813	Flexible	Right Roadbed Only	1.626	FINE RAVEL	116
CC	0.254	1.067	0.813	Flexible	Left Roadbed Only	1.626	FINE RAVEL	119
CC	1.067	1.467	0.400	Flexible	Right Roadbed Only	0.800	FINE RAVEL	106
CC	1.067	1.467	0.400	Flexible	Left Roadbed Only	0.800	FINE RAVEL	121
CC	1.467	1.671	0.204	Flexible	Right Roadbed Only	0.408	FINE RAVEL	157
CC	1.467	1.671	0.204	Flexible	Left Roadbed Only	0.408	FINE RAVEL	162
CC	1.671	1.717	0.046	Bridge	Right Roadbed Only	0.000	N/A Bridge	171
CC	1.671	1.717	0.046	Bridge	Left Roadbed Only	0.000	N/A Bridge	145
CC	1.717	2.040	0.323	Flexible	Right Roadbed Only	0.646	FINE RAVEL	130
CC	1.717	2.040	0.323	Flexible	Left Roadbed Only	0.646	FINE RAVEL	135
CC	2.040	2.076	0.036	Bridge	Right Roadbed Only	0.000	N/A Bridge	N/A
CC	2.040	2.076	0.036	Flexible	Left Roadbed Only	0.072	FINE RAVEL	N/A
CC	2.076	2.527	0.450	Flexible	Right Roadbed Only	0.902	FINE RAVEL	119
CC	2.076	2.527	0.450	Flexible	Left Roadbed Only	0.902	FINE RAVEL	106
CC	2.527	2.532	0.005	Bridge	Right Roadbed Only	0.000	N/A Bridge	N/A
CC	2.527	2.532	0.005	Flexible	Left Roadbed Only	0.010	FINE RAVEL	N/A
CC	2.532	2.567	0.035	Flexible	Right Roadbed Only	0.070	FINE RAVEL	N/A
CC	2.532	2.567	0.035	Flexible	Left Roadbed Only	0.070	FINE RAVEL	N/A
CC	2.567	2.619	0.052	Flexible	Right Roadbed Only	0.052	RIDE	232

County	Begin PM	End PM	Length	Pave Type	Direction	Triggered Lane Miles	Defect	IRI
CC	2.567	2.619	0.052	Flexible	Left Roadbed Only	0.052	RIDE	252
CC	2.619	2.643	0.024	Bridge	Right Roadbed Only	0.000	N/A Bridge	N/A
CC	2.619	2.643	0.024	Bridge	Left Roadbed Only	0.000	N/A Bridge	193
CC	2.643	2.822	0.179	Flexible	Right Roadbed Only	0.358	FINE RAVEL	168
CC	2.643	2.822	0.179	Flexible	Left Roadbed Only	0.358	FINE RAVEL	179
CC	2.822	2.853	0.031	Bridge	Right Roadbed Only	0.000	N/A Bridge	N/A
CC	2.822	2.853	0.031	Bridge	Left Roadbed Only	0.000	N/A Bridge	186
CC	2.853	2.961	0.108	Flexible	Right Roadbed Only	0.108	RIDE	264
CC	2.853	2.961	0.108	Flexible	Left Roadbed Only	0.108	RIDE	239
CC	2.961	2.989	0.028	Bridge	Right Roadbed Only	0.000	N/A Bridge	N/A
CC	2.961	2.989	0.028	Bridge	Left Roadbed Only	0.000	N/A Bridge	N/A
CC	2.989	3.067	0.078	Flexible	Right Roadbed Only	0.156	FINE RAVEL	117
CC	2.989	3.067	0.078	Flexible	Left Roadbed Only	0.156	FINE RAVEL	124
CC	3.067	4.067	1.000	Flexible	Right Roadbed Only	0.000	GOOD CONDITION	110
CC	3.067	4.067	1.000	Flexible	Left Roadbed Only	2.000	FINE RAVEL	122
CC	4.067	4.667	0.600	Flexible	Right Roadbed Only	0.000	GOOD CONDITION	114
CC	4.067	4.667	0.600	Flexible	Left Roadbed Only	1.200	FINE RAVEL	154
CC	4.667	5.246	0.579	Flexible	Right Roadbed Only	1.158	FINE RAVEL	122
CC	4.667	5.246	0.579	Flexible	Left Roadbed Only	1.158	FINE RAVEL	151
CC	5.246	5.276	0.030	Bridge	Right Roadbed Only	0.000	N/A Bridge	N/A
CC	5.246	5.276	0.030	Bridge	Left Roadbed Only	0.000	N/A Bridge	N/A
CC	5.276	5.567	0.291	Flexible	Right Roadbed Only	0.582	FINE RAVEL	123
CC	5.276	5.567	0.291	Flexible	Left Roadbed Only	0.582	FINE RAVEL	125
CC	5.567	6.262	0.695	Flexible	Right Roadbed Only	1.390	FINE RAVEL	102
CC	5.567	6.262	0.695	Flexible	Left Roadbed Only	1.390	FINE RAVEL	149
CC	6.262	6.264	0.002	Flexible	Right Roadbed Only	0.004	FINE RAVEL	N/A
CC	6.262	6.264	0.002	Flexible	Left Roadbed Only	0.004	FINE RAVEL	N/A
CC	6.264	6.267	0.003	Flexible	Right Roadbed Only	0.006	FINE RAVEL	N/A
CC	6.264	6.267	0.003	Flexible	Left Roadbed Only	0.006	FINE RAVEL	N/A
CC	6.267	6.725	0.458	Flexible	Right Roadbed Only	0.916	FINE RAVEL	130
CC	6.267	6.725	0.458	Flexible	Left Roadbed Only	0.916	FINE RAVEL	151
CC	6.725	7.067	0.342	Flexible	Right Roadbed Only	0.684	FINE RAVEL	112
CC	6.725	7.067	0.342	Flexible	Left Roadbed Only	0.684	FINE RAVEL	120
CC	7.067	7.158	0.091	Flexible	Right Roadbed Only	0.182	FINE RAVEL	212
CC	7.067	7.158	0.091	Flexible	Left Roadbed Only	0.182	FINE RAVEL	128
CC	7.158	7.767	0.609	Flexible	Right Roadbed Only	1.218	FINE RAVEL	129
CC	7.158	7.767	0.609	Flexible	Left Roadbed Only	1.218	FINE RAVEL	140
CC	7.767	8.508	0.741	Flexible	Right Roadbed Only	0.741	MISC. UNSEALED CRACKS	135
CC	7.767	8.508	0.741	Flexible	Left Roadbed Only	1.482	FINE RAVEL	145
CC	8.508	8.530	0.022	Bridge	Right Roadbed Only	0.000	N/A Bridge	N/A
CC	8.508	8.530	0.022	Bridge	Left Roadbed Only	0.000	N/A Bridge	N/A
CC	8.530	8.567	0.037	Flexible	Right Roadbed Only	0.037	MISC. UNSEALED	N/A

County	Begin PM	End PM	Length	Pave Type	Direction	Triggered Lane Miles	Defect	IRI
							CRACKS	
CC	8.530	8.567	0.037	Flexible	Left Roadbed Only	0.074	FINE RAVEL	156
CC	8.567	9.122	0.555	Flexible	Right Roadbed Only	0.555	MISC. UNSEALED CRACKS	134
CC	8.567	9.122	0.555	Flexible	Left Roadbed Only	0.555	MOD ABC & PAT	140
CC	9.122	9.267	0.145	Flexible	Right Roadbed Only	0.145	MISC. UNSEALED CRACKS	90
CC	9.122	9.267	0.145	Flexible	Left Roadbed Only	0.145	MOD ABC & PAT	103
CC	9.267	9.712	0.445	Flexible	Right Roadbed Only	0.890	FINE RAVEL	116
CC	9.267	9.712	0.445	Flexible	Left Roadbed Only	0.445	MOD ABC & PAT	116
CC	9.712	9.847	0.135	Bridge	Right Roadbed Only	0.000	N/A Bridge	134
CC	9.712	9.847	0.135	Bridge	Left Roadbed Only	0.000	N/A Bridge	147
CC	9.847	9.848	0.001	Bridge	Right Roadbed Only	0.000	N/A Bridge	N/A
CC	9.847	9.848	0.001	Bridge	Left Roadbed Only	0.000	N/A Bridge	N/A
CC	9.848	10.046	0.198	Flexible	Right Roadbed Only	0.396	FINE RAVEL	148
CC	9.848	10.046	0.198	Flexible	Left Roadbed Only	0.396	MOD ABC & PAT	246
CC	10.046	10.101	0.055	Bridge	Right Roadbed Only	0.000	N/A Bridge	266
CC	10.046	10.101	0.055	Bridge	Left Roadbed Only	0.000	N/A Bridge	N/A
CC	10.101	10.685	0.584	Flexible	Right Roadbed Only	1.168	FINE RAVEL	128
CC	10.101	10.685	0.584	Rigid	Left Roadbed Only	0.000	UNSEALED CRACKS OR	157
CC	10.685	10.701	0.016	Bridge	Right Roadbed Only	0.000	N/A Bridge	166
CC	10.685	10.701	0.016	Bridge	Left Roadbed Only	0.000	N/A Bridge	N/A
CC	10.701	10.717	0.016	Bridge	Right Roadbed Only	0.000	N/A Bridge	N/A
CC	10.701	10.717	0.016	Bridge	Left Roadbed Only	0.000	N/A Bridge	N/A
CC	10.717	10.725	0.008	Rigid	Right Roadbed Only	0.016	THIRD ST. CRKNG	N/A
CC	10.717	10.725	0.008	Rigid	Left Roadbed Only	0.016	SLAB CRACKING	N/A
CC	10.725	10.729	0.004	Bridge	Right Roadbed Only	0.000	N/A Bridge	148
CC	10.725	10.729	0.004	Bridge	Left Roadbed Only	0.000	N/A Bridge	132
CC	10.729	11.667	0.938	Rigid	Right Roadbed Only	1.876	THIRD ST. CRKNG	N/A
CC	10.729	11.667	0.938	Rigid	Left Roadbed Only	1.876	SLAB CRACKING	N/A
CC	11.667	11.697	0.030	Rigid	Right Roadbed Only	0.060	SLAB CRACKING	N/A
CC	11.667	11.697	0.030	Rigid	Left Roadbed Only	0.060	SLAB CRACKING	N/A
CC	11.697	11.703	0.006	Bridge	Right Roadbed Only	0.000	N/A Bridge	87
CC	11.697	11.703	0.006	Bridge	Left Roadbed Only	0.000	N/A Bridge	106
CC	11.703	12.131	0.428	Rigid	Right Roadbed Only	0.856	SLAB CRACKING	69
CC	11.703	12.131	0.428	Rigid	Left Roadbed Only	0.856	SLAB CRACKING	146
CC	12.131	12.140	0.009	Bridge	Right Roadbed Only	0.000	N/A Bridge	97
CC	12.131	12.140	0.009	Bridge	Left Roadbed Only	0.000	N/A Bridge	94
CC	12.140	12.667	0.527	Rigid	Right Roadbed Only	1.054	SLAB CRACKING	N/A
CC	12.140	12.667	0.527	Rigid	Left Roadbed Only	1.054	SLAB CRACKING	N/A
CC	12.667	12.729	0.062	Rigid	Right Roadbed Only	0.062	THIRD ST. CRKNG	113
CC	12.667	12.729	0.062	Rigid	Left Roadbed Only	0.124	SLAB CRACKING	136

County	Begin PM	End PM	Length	Pave Type	Direction	Triggered Lane Miles	Defect	IRI
CC	12.729	13.015	0.286	Rigid	Right Roadbed Only	0.286	THIRD ST. CRKNG	154
CC	12.729	13.015	0.286	Rigid	Left Roadbed Only	0.572	SLAB CRACKING	132
CC	13.015	13.489	0.474	Flexible	Right Roadbed Only	0.948	MISC. UNSEALED CRACKS	176
CC	13.015	13.489	0.474	Rigid	Left Roadbed Only	0.948	SLAB CRACKING	126
CC	13.489	14.139	0.650	Bridge	Right Roadbed Only	0.000	N/A Bridge	N/A
CC	13.489	14.139	0.650	Bridge	Left Roadbed Only	0.000	N/A Bridge	N/A
County	Begin PM	End PM	Length	Pave Type	Direction	Triggered Lane Miles	Defect	IRI
ALA	1.763	2.255	0.492	Flexible	Right Roadbed Only	0.984	HIGH ABC	110
ALA	1.763	2.255	0.492	Flexible	Left Roadbed Only	0.984	FINE RAVEL	168
ALA	2.255	2.657	0.402	Flexible	Right Roadbed Only	0.804	HIGH ABC	123
ALA	2.255	2.657	0.402	Flexible	Left Roadbed Only	0.804	FINE RAVEL	135
ALA	2.657	2.801	0.144	Flexible	Right Roadbed Only	0.000	GOOD CONDITION	89
ALA	2.657	2.801	0.144	Flexible	Left Roadbed Only	0.288	FINE RAVEL	146
ALA	2.801	3.391	0.590	Flexible	Right Roadbed Only	0.000	GOOD CONDITION	127
ALA	2.801	3.391	0.590	Flexible	Left Roadbed Only	1.180	FINE RAVEL	173
ALA	3.391	3.451	0.060	Flexible	Right Roadbed Only	0.000	GOOD CONDITION	134
ALA	3.391	3.451	0.060	Flexible	Left Roadbed Only	0.120	FINE	149
ALA	3.451	3.513	0.062	Flexible	Right Roadbed Only	0.000	NO DISTRESS OBSERVED	144
ALA	3.451	3.513	0.062	Flexible	Left Roadbed Only	0.124	FINE RAVEL	118
ALA	3.513	3.517	0.004	Bridge	Right Roadbed Only	0.000	N/A Bridge	N/A
ALA	3.513	3.517	0.004	Bridge	Left Roadbed Only	0.000	N/A Bridge	N/A
ALA	3.517	3.576	0.059	Flexible	Right Roadbed Only	0.000	GOOD CONDITION	128
ALA	3.517	3.576	0.059	Flexible	Left Roadbed Only	0.118	FINE RAVEL	124
ALA	3.576	3.721	0.145	Flexible	Right Roadbed Only	0.000	GOOD CONDITION	145
ALA	3.576	3.721	0.145	Flexible	Left Roadbed Only	0.290	FINE RAVEL	136
ALA	3.721	3.786	0.065	Flexible	Right Roadbed Only	0.000	GOOD CONDITION	153
ALA	3.721	3.786	0.065	Flexible	Left Roadbed Only	0.130	FINE RAVEL	151
ALA	3.786	3.844	0.058	Bridge	Right Roadbed Only	0.000	N/A Bridge	132
ALA	3.786	3.844	0.058	Bridge	Left Roadbed Only	0.000	N/A Bridge	119
ALA	3.844	3.955	0.111	Flexible	Right Roadbed Only	0.000	GOOD CONDITION	120
ALA	3.844	3.955	0.111	Flexible	Left Roadbed Only	0.222	FINE RAVEL	127
ALA	3.955	3.959	0.004	Bridge	Right Roadbed Only	0.000	N/A Bridge	N/A
ALA	3.955	3.959	0.004	Bridge	Left Roadbed Only	0.000	N/A Bridge	N/A
ALA	3.959	3.990	0.031	Flexible	Right Roadbed Only	0.000	GOOD CONDITION	83
ALA	3.959	3.990	0.031	Flexible	Left Roadbed Only	0.062	FINE RAVEL	N/A
ALA	3.990	4.310	0.325	Flexible	Right Roadbed Only	0.000	GOOD CONDITION	121
ALA	3.990	4.315	0.325	Flexible	Left Roadbed Only	0.650	FINE RAVEL	156
ALA	4.315	4.410	0.095	Flexible	Right Roadbed Only	0.000	GOOD CONDITION	123
ALA	4.315	4.410	0.095	Flexible	Left Roadbed Only	0.285	RIDE	334

County	Begin PM	End PM	Length	Pave Type	Direction	Triggered Lane Miles	Defect	IRI
ALA	4.410	5.490	1.080	Flexible	Right Roadbed Only	0.000	GOOD CONDITION	123
ALA	4.410	5.490	1.080	Flexible	Left Roadbed Only	2.160	FINE RAVEL	131
ALA	5.490	5.836	0.346	Flexible	Right Roadbed Only	0.000	GOOD CONDITION	133
ALA	5.490	5.836	0.346	Flexible	Left Roadbed Only	0.692	HIGH ABC	183
ALA	5.836	6.190	0.354	Flexible	Right Roadbed Only	0.708	ALL A, NO B, OPEN CRKS	166
ALA	5.836	6.190	0.354	Flexible	Left Roadbed Only	0.708	HIGH ABC	128
ALA	6.190	6.620	0.430	Flexible	Right Roadbed Only	0.860	ALL A, NO B, OPEN CRKS	143
ALA	6.190	6.620	0.430	Flexible	Left Roadbed Only	0.860	HIGH ABC	125
ALA	6.620	6.679	0.059	Bridge	Right Roadbed Only	0.000	N/A Bridge	236
ALA	6.620	6.679	0.059	Bridge	Left Roadbed Only	0.000	N/A Bridge	205
ALA	6.679	6.899	0.220	Flexible	Right Roadbed Only	0.440	ALL A, NO B, OPEN CRKS	113
ALA	6.679	6.899	0.220	Flexible	Left Roadbed Only	0.000	GOOD CONDITION	103
ALA	6.899	7.032	0.133	Flexible	Right Roadbed Only	0.266	ALL A, NO B, OPEN CRKS	98
ALA	6.899	7.032	0.133	Flexible	Left Roadbed Only	0.000	GOOD CONDITION	86
ALA	7.032	7.136	0.104	Flexible	Right Roadbed Only	0.208	FINE RAVEL	103
ALA	7.032	7.136	0.104	Flexible	Left Roadbed Only	0.000	GOOD CONDITION	142
ALA	7.136	7.771	0.635	Flexible	Right Roadbed Only	1.270	FINE RAVEL	115
ALA	7.136	7.771	0.635	Flexible	Left Roadbed Only	1.270	FINE RAVEL	157
ALA	7.784	7.999	0.215	Flexible	Right Roadbed Only	0.430	FINE RAVEL	110
ALA	7.784	7.999	0.215	Flexible	Left Roadbed Only	0.430	FINE RAVEL	115
ALA	7.999	8.036	0.037	Flexible	Right Roadbed Only	0.074	FINE RAVEL	N/A
ALA	7.999	8.036	0.037	Flexible	Left Roadbed Only	0.074	FINE RAVEL	N/A
CC	0.000	0.002	0.002	Flexible	Right Roadbed Only	0.004	FINE RAVEL	112
CC	0.000	0.002	0.002	Flexible	Left Roadbed Only	0.004	FINE RAVEL	159
CC	0.002	0.008	0.006	Bridge	Right Roadbed Only	0.000	N/A Bridge	N/A
CC	0.002	0.008	0.006	Bridge	Left Roadbed Only	0.000	N/A Bridge	148
CC	0.008	0.216	0.208	Flexible	Right Roadbed Only	0.416	FINE RAVEL	154
CC	0.008	0.216	0.208	Flexible	Left Roadbed Only	0.416	FINE RAVEL	134
CC	0.216	0.254	0.038	Flexible	Right Roadbed Only	0.076	FINE RAVEL	N/A
CC	0.216	0.254	0.038	Bridge	Left Roadbed Only	0.000	N/A Bridge	185
CC	0.254	1.067	0.813	Flexible	Right Roadbed Only	1.626	FINE RAVEL	116
CC	0.254	1.067	0.813	Flexible	Left Roadbed Only	1.626	FINE RAVEL	119
CC	1.067	1.467	0.400	Flexible	Right Roadbed Only	0.800	FINE RAVEL	106
CC	1.067	1.467	0.400	Flexible	Left Roadbed Only	0.800	FINE RAVEL	121
CC	1.467	1.671	0.204	Flexible	Right Roadbed Only	0.408	FINE RAVEL	157
CC	1.467	1.671	0.204	Flexible	Left Roadbed Only	0.408	FINE RAVEL	162
CC	1.671	1.717	0.046	Bridge	Right Roadbed Only	0.000	N/A Bridge	171
CC	1.671	1.717	0.046	Bridge	Left Roadbed Only	0.000	N/A Bridge	145
CC	1.717	2.040	0.323	Flexible	Right Roadbed Only	0.646	FINE RAVEL	130

County	Begin PM	End PM	Length	Pave Type	Direction	Triggered Lane Miles	Defect	IRI
CC	1.717	2.040	0.323	Flexible	Left Roadbed Only	0.646	FINE RAVEL	135
CC	2.040	2.076	0.036	Bridge	Right Roadbed Only	0.000	N/A Bridge	N/A
CC	2.040	2.076	0.036	Flexible	Left Roadbed Only	0.072	FINE RAVEL	N/A
CC	2.076	2.527	0.450	Flexible	Right Roadbed Only	0.902	FINE RAVEL	119
CC	2.076	2.527	0.450	Flexible	Left Roadbed Only	0.902	FINE RAVEL	106
CC	2.527	2.532	0.005	Bridge	Right Roadbed Only	0.000	N/A Bridge	N/A
CC	2.527	2.532	0.005	Flexible	Left Roadbed Only	0.010	FINE RAVEL	N/A
CC	2.532	2.567	0.035	Flexible	Right Roadbed Only	0.070	FINE RAVEL	N/A
CC	2.532	2.567	0.035	Flexible	Left Roadbed Only	0.070	FINE RAVEL	N/A
CC	2.567	2.619	0.052	Flexible	Right Roadbed Only	0.052	RIDE	232
CC	2.567	2.619	0.052	Flexible	Left Roadbed Only	0.052	RIDE	252
CC	2.619	2.643	0.024	Bridge	Right Roadbed Only	0.000	N/A Bridge	N/A
CC	2.619	2.643	0.024	Bridge	Left Roadbed Only	0.000	N/A Bridge	193
CC	2.643	2.822	0.179	Flexible	Right Roadbed Only	0.358	FINE RAVEL	168
CC	2.643	2.822	0.179	Flexible	Left Roadbed Only	0.358	FINE RAVEL	179
CC	2.822	2.853	0.031	Bridge	Right Roadbed Only	0.000	N/A Bridge	N/A
CC	2.822	2.853	0.031	Bridge	Left Roadbed Only	0.000	N/A Bridge	186
CC	2.853	2.961	0.108	Flexible	Right Roadbed Only	0.108	RIDE	264
CC	2.853	2.961	0.108	Flexible	Left Roadbed Only	0.108	RIDE	239
CC	2.961	2.989	0.028	Bridge	Right Roadbed Only	0.000	N/A Bridge	N/A
CC	2.961	2.989	0.028	Bridge	Left Roadbed Only	0.000	N/A Bridge	N/A
CC	2.989	3.067	0.078	Flexible	Right Roadbed Only	0.156	FINE RAVEL	117
CC	2.989	3.067	0.078	Flexible	Left Roadbed Only	0.156	FINE RAVEL	124
CC	3.067	4.067	1.000	Flexible	Right Roadbed Only	0.000	GOOD CONDITION	110
CC	3.067	4.067	1.000	Flexible	Left Roadbed Only	2.000	FINE RAVEL	122
CC	4.067	4.667	0.600	Flexible	Right Roadbed Only	0.000	GOOD CONDITION	114
CC	4.067	4.667	0.600	Flexible	Left Roadbed Only	1.200	FINE RAVEL	154
CC	4.667	5.246	0.579	Flexible	Right Roadbed Only	1.158	FINE RAVEL	122
CC	4.667	5.246	0.579	Flexible	Left Roadbed Only	1.158	FINE RAVEL	151
CC	5.246	5.276	0.030	Bridge	Right Roadbed Only	0.000	N/A Bridge	N/A
CC	5.246	5.276	0.030	Bridge	Left Roadbed Only	0.000	N/A Bridge	N/A
CC	5.276	5.567	0.291	Flexible	Right Roadbed Only	0.582	FINE RAVEL	123
CC	5.276	5.567	0.291	Flexible	Left Roadbed Only	0.582	FINE RAVEL	125
CC	5.567	6.262	0.695	Flexible	Right Roadbed Only	1.390	FINE RAVEL	102
CC	5.567	6.262	0.695	Flexible	Left Roadbed Only	1.390	FINE RAVEL	149
CC	6.262	6.264	0.002	Flexible	Right Roadbed Only	0.004	FINE RAVEL	N/A
CC	6.262	6.264	0.002	Flexible	Left Roadbed Only	0.004	FINE RAVEL	N/A
CC	6.264	6.267	0.003	Flexible	Right Roadbed Only	0.006	FINE RAVEL	N/A
CC	6.264	6.267	0.003	Flexible	Left Roadbed Only	0.006	FINE RAVEL	N/A
CC	6.267	6.725	0.458	Flexible	Right Roadbed Only	0.916	FINE RAVEL	130
CC	6.267	6.725	0.458	Flexible	Left Roadbed Only	0.916	FINE RAVEL	151
CC	6.725	7.067	0.342	Flexible	Right Roadbed Only	0.684	FINE RAVEL	112

County	Begin PM	End PM	Length	Pave Type	Direction	Triggered Lane Miles	Defect	IRI
CC	6.725	7.067	0.342	Flexible	Left Roadbed Only	0.684	FINE RAVEL	120
CC	7.067	7.158	0.091	Flexible	Right Roadbed Only	0.182	FINE RAVEL	212
CC	7.067	7.158	0.091	Flexible	Left Roadbed Only	0.182	FINE RAVEL	128
CC	7.158	7.767	0.609	Flexible	Right Roadbed Only	1.218	FINE RAVEL	129
CC	7.158	7.767	0.609	Flexible	Left Roadbed Only	1.218	FINE RAVEL	140
CC	7.767	8.508	0.741	Flexible	Right Roadbed Only	0.741	MISC. UNSEALED CRACKS	135
CC	7.767	8.508	0.741	Flexible	Left Roadbed Only	1.482	FINE RAVEL	145
CC	8.508	8.530	0.022	Bridge	Right Roadbed Only	0.000	N/A Bridge	N/A
CC	8.508	8.530	0.022	Bridge	Left Roadbed Only	0.000	N/A Bridge	N/A
CC	8.530	8.567	0.037	Flexible	Right Roadbed Only	0.037	MISC. UNSEALED CRACKS	N/A
CC	8.530	8.567	0.037	Flexible	Left Roadbed Only	0.074	FINE RAVEL	156
CC	8.567	9.122	0.555	Flexible	Right Roadbed Only	0.555	MISC. UNSEALED CRACKS	134
CC	8.567	9.122	0.555	Flexible	Left Roadbed Only	0.555	MOD ABC & PAT	140
CC	9.122	9.267	0.145	Flexible	Right Roadbed Only	0.145	MISC. UNSEALED CRACKS	90
CC	9.122	9.267	0.145	Flexible	Left Roadbed Only	0.145	MOD ABC & PAT	103
CC	9.267	9.712	0.445	Flexible	Right Roadbed Only	0.890	FINE RAVEL	116
CC	9.267	9.712	0.445	Flexible	Left Roadbed Only	0.445	MOD ABC & PAT	116
CC	9.712	9.847	0.135	Bridge	Right Roadbed Only	0.000	N/A Bridge	134
CC	9.712	9.847	0.135	Bridge	Left Roadbed Only	0.000	N/A Bridge	147
CC	9.847	9.848	0.001	Bridge	Right Roadbed Only	0.000	N/A Bridge	N/A
CC	9.847	9.848	0.001	Bridge	Left Roadbed Only	0.000	N/A Bridge	N/A
CC	9.848	10.046	0.198	Flexible	Right Roadbed Only	0.396	FINE RAVEL	148
CC	9.848	10.046	0.198	Flexible	Left Roadbed Only	0.396	MOD ABC & PAT	246
CC	10.046	10.101	0.055	Bridge	Right Roadbed Only	0.000	N/A Bridge	266
CC	10.046	10.101	0.055	Bridge	Left Roadbed Only	0.000	N/A Bridge	N/A
CC	10.101	10.685	0.584	Flexible	Right Roadbed Only	1.168	FINE RAVEL	128
CC	10.101	10.685	0.584	Rigid	Left Roadbed Only	0.000	UNSEALED CRACKS OR	157
CC	10.685	10.701	0.016	Bridge	Right Roadbed Only	0.000	N/A Bridge	166
CC	10.685	10.701	0.016	Bridge	Left Roadbed Only	0.000	N/A Bridge	N/A
CC	10.701	10.717	0.016	Bridge	Right Roadbed Only	0.000	N/A Bridge	N/A
CC	10.701	10.717	0.016	Bridge	Left Roadbed Only	0.000	N/A Bridge	N/A
CC	10.717	10.725	0.008	Rigid	Right Roadbed Only	0.016	THIRD ST. CRKNG	N/A
CC	10.717	10.725	0.008	Rigid	Left Roadbed Only	0.016	SLAB CRACKING	N/A
CC	10.725	10.729	0.004	Bridge	Right Roadbed Only	0.000	N/A Bridge	148
CC	10.725	10.729	0.004	Bridge	Left Roadbed Only	0.000	N/A Bridge	132
CC	10.729	11.667	0.938	Rigid	Right Roadbed Only	1.876	THIRD ST. CRKNG	N/A
CC	10.729	11.667	0.938	Rigid	Left Roadbed Only	1.876	SLAB CRACKING	N/A
CC	11.667	11.697	0.030	Rigid	Right Roadbed Only	0.060	SLAB CRACKING	N/A

County	Begin PM	End PM	Length	Pave Type	Direction	Triggered Lane Miles	Defect	IRI
CC	11.667	11.697	0.030	Rigid	Left Roadbed Only	0.060	SLAB CRACKING	N/A
CC	11.697	11.703	0.006	Bridge	Right Roadbed Only	0.000	N/A Bridge	87
CC	11.697	11.703	0.006	Bridge	Left Roadbed Only	0.000	N/A Bridge	106
CC	11.703	12.131	0.428	Rigid	Right Roadbed Only	0.856	SLAB CRACKING	69
CC	11.703	12.131	0.428	Rigid	Left Roadbed Only	0.856	SLAB CRACKING	146
CC	12.131	12.140	0.009	Bridge	Right Roadbed Only	0.000	N/A Bridge	97
CC	12.131	12.140	0.009	Bridge	Left Roadbed Only	0.000	N/A Bridge	94
CC	12.140	12.667	0.527	Rigid	Right Roadbed Only	1.054	SLAB CRACKING	N/A
CC	12.140	12.667	0.527	Rigid	Left Roadbed Only	1.054	SLAB CRACKING	N/A
CC	12.667	12.729	0.062	Rigid	Right Roadbed Only	0.062	THIRD ST. CRKNG	113
CC	12.667	12.729	0.062	Rigid	Left Roadbed Only	0.124	SLAB CRACKING	136
CC	12.729	13.015	0.286	Rigid	Right Roadbed Only	0.286	THIRD ST. CRKNG	154
CC	12.729	13.015	0.286	Rigid	Left Roadbed Only	0.572	SLAB CRACKING	132
CC	13.015	13.489	0.474	Flexible	Right Roadbed Only	0.948	MISC. UNSEALED CRACKS	176
CC	13.015	13.489	0.474	Rigid	Left Roadbed Only	0.948	SLAB CRACKING	126
CC	13.489	14.139	0.650	Bridge	Right Roadbed Only	0.000	N/A Bridge	N/A
CC	13.489	14.139	0.650	Bridge	Left Roadbed Only	0.000	N/A Bridge	N/A

DKS Associates
TRANSPORTATION SOLUTIONS

Appendix E

ITS Inventory

Existing Field Elements

Loop Detections

Currently, there are 105 existing loop detector stations on I-80 with 52 deployed in the eastbound and 53 in the westbound lanes. Initially, these detector stations will be used for monitoring and managing the freeway mainline traffic during I-80 project construction as part of Traffic Operation System (TOS) and will be part of the detection system after the overall completion of the I-80 ICM project for freeway monitoring purposes. All of the loop detectors are in jurisdiction of Caltrans District 4. All of the loop detectors are directly connected to Caltrans District 4 Regional Traffic Management Center (TMC).

Table E1 and Table E2 include the list of the existing loop detectors on I-80 Westbound and Eastbound lanes, respectively.

Table E1: Existing loop detectors on I-80 WB

Item	Location	CA MP[5]
1	Inside T2, south Tower West leg	13.91
2	San Pablo Ave. on ramp to WB 80	13.48
3	Cummings Pkwy on ramp to EB 80	12.76
4	Cumming SKWY on ramp to WB 80	12.66
5	600 ' west of Refinery Rd UC	12.00
6	EB 80@ Willow Ave	11.78
7	California St / Spring	11.71
8	East of Carlson Blvd	11.30
9	Rodeo (Willow Ave)	10.90
10	Rte EB4 To Rte EB80 on ramp	10.04
11	Sycamore Ave.& Rte 4, Between, On ramp & WB	09.95
12	West of Sycamore	09.91
13	3000' west of SR4 Near Call Box 9.7	09.70
14	1/4 mile East of Pinole Valley Rd	09.20
15	Pinole Valley Road on ramp	08.59
16	Pinole Valley Rd	08.47
17	Appian Way	07.62
18	West of Appian Way	07.60
19	1000' West of Appian Way	07.29
20	East of Richmond Pkwy	06.89
21	East of Richmond Pkwy	06.61
22	1000' W of Richmond Pkwy	06.27
23	Hilltop EB Diag near CB 6.2	06.20
24	Just W of Hilltop Dr.	05.94

[5] California (CA) Mile-Post (MP)

Item	Location	CA MP[5]
25	W of Hill Top Dr. off ramp	05.69
26	East of El Portal Dr	05.50
27	West of El Portal Drive	05.21
28	El portal Dr.	04.82
29	800' E of San Pablo Dam Road	04.53
30	West of San Pablo Dam Rd	04.20
31	600' W of San Pablo Dam Rd. behind Soundwall	04.06
32	On Amador st W of Mc Bryde Ave	03.75
33	West of Solano Ave O/C	03.41
34	100 ft East of San Pablo Ave	02.97
35	200 ft West of Barrett Ave	02.62
36	just east of Cutting Blvd	02.05
37	just West of Cutting Blvd	02.00
38	West of Potrero Ave	01.54
39	East of Carlson Ave	01.12
40	West of Carlson Blvd	00.91
41	West of Panama Ave	00.51
42	East of Central Ave	00.44
43	West of Central Ave	00.23
44	W of Central Ave.@ beginning of ramp	00.06
45	Cleavland Ave off ramp	06.74
46	200' West of Buchanan	07.26
47	Gilman St.	06.64
48	Gilman St	06.60
49	1000 feet West of Powell	03.64
50	80/880 W to SF Bay Bridge, Carpool bypass	02.66
51	WB maritime / Grand Ave., Radio station Exit	02.42
52	WB maritime / Grand Ave., Radio station Exit	02.41
53	Base of the Bay Bridge	01.38

Table E2: Existing loop detectors on I-80 EB

Item	Location	CA MP
1	San Pablo Ave. on ramp to WB 80	13.48
2	Cummings Pkway onramp to EB 80	12.76
3	Cumming SKWY on ramp to WB 80	12.66
4	600 ' west of Refinery Rd UC	12.00
5	EB 80@ Willow Ave	11.78
6	Rte EB4 To Rte EB80 on ramp	10.04

Item	Location	CA MP
7	Sycamore Ave.& Rte 4, Between, On ramp & WB	09.95
8	West of Sycamore	09.91
9	3000' west of SR4 Near Call Box 9.7	09.70
10	1/4 mile East of Pinole Valley Rd	09.20
11	Pinole Valley Road	08.59
12	Pinole Valley Rd	08.47
13	Appian Way	07.62
14	Appian Way	07.61
15	1000' West of Appian Way	07.29
16	East of Richmond Pkwy	06.89
17	West of Richmond Pkway	06.57
18	1000' W of Richmond Pkwy	06.27
19	Hilltop EB Diag near CB 6.2	06.20
20	Just W of Hilltop Dr.	05.94
21	W of Hill Top Dr. off ramp	05.69
22	East of El Portal Dr	05.50
23	West of El Portal Drive	05.21
24	800' E of San Pablo Dam Road	04.53
25	East of San Pablo Dam Rd.	04.30
26	West of San Pablo Dam Rd	04.20
27	600' W of San Pablo Dam Rd. behind Soundwall	04.06
28	On Amador st W of Mc Bryde Ave	03.75
29	West of Solano Ave O/C	03.41
30	100 ft East of San Pablo Ave	02.97
31	200 ft West of Barrett Ave	02.62
32	just east of Cutting Blvd	02.05
33	just West of Cutting Blvd	02.00
34	West of Potrero Ave	01.54
35	East of Carlson Blvd	01.13
36	East of Carlson Ave	01.12
37	West of Carlson Blvd	00.91
38	West of Panama Ave	00.51
39	East of Central Ave	00.44
40	W of Central Ave.@ beginning of ramp	00.06
41	East of Buchanan	07.35
42	200' West of Buchanan	07.26
43	Gilman St.	06.64
44	Gilman St	06.60
45	1000 feet West of Powell	03.63

Item	Location	CA MP
46	Outside substation	03.17
47	Outside substation	03.17
48	80 / 580 split	02.62
49	80 / 580 split	02.62
50	West Grand Ave & Maritime St. off ramp	02.32
51	West Grand Ave & Maritime St. off ramp	02.32
52	Base of the Bay Bridge	01.38

MVDS

On the arterial streets such as San Pablo Avenue, there are multiple detection technologies such as loop detectors, video detectors and Microwave Vehicle Detection Systems (MVDS). Loop detectors and video detectors are typically connected to traffic signal controllers and used for signal control and actuation. They will be described separately in Traffic Signal Controller Section.

Currently, there are some existing MVDS devices within the project area on San Pablo Avenue and some of the cross streets connecting I-80 and San Pablo Avenue. The MVDS devices are in jurisdiction of ACCMA and directly connected to East Bay SMART Corridors. Table E3 includes the list of existing MVDS detectors located on arterials within the project area.

Table E3: Existing MVDS on Arterial Streets

Item	Location	ID
1	Ashby Ave : 7th St	SC-D033
2	Buchanan St : S of Fillmore St	SC-D039
3	Central : Belmont	SC-D041
4	Gilman St : 4th St	SC-D037
5	Richmond Pkwy : W of I-80 off-ramp	SC-D049
6	San Pablo : Tulare Ave	SC-D008
7	San Pablo Ave : 54th St	SC-D031
8	San Pablo Ave : 67th St	SC-D032
9	San Pablo Ave : Bancroft Way	SC-D034
10	San Pablo Ave : Blake St	SC-D044
11	San Pablo Ave : Eire Dr	SC-D050
12	San Pablo Ave : Jones St	SC-D036
13	San Pablo Ave : Monroe St	SC-D055
14	San Pablo Ave : N of 21st St	SC-D022
15	San Pablo Ave : N of Carlson Blvd	SC-D017
16	San Pablo Ave : S of Richmond Pkwy	SC-D048
17	San Pablo Ave : Tsushima St	SC-D051
18	University : 5th St	SC-D038

Item	Location	ID
19	West Grand Ave : Campbell St	SC-D052

CMS

Currently, there are three existing Model-500 Changeable Message Signs (CMS) on I-80 westbound and two on the Eastbound. Table E4 includes the list of existing CMS(s) on I-80 corridor.

Table E4: Existing CMS on I-80 Corridor

Item	Location	ID	Jurisdiction	
1	I-80 WB N of Ashby Ave.	CM070	Caltrans	District 4
2	I-80 EB 2200F W of Gilman St. OC	CM078	Caltrans	District 4
3	I-80 WB E of Appian Way	CM090	Caltrans	District 4
4	I-80 EB E of Willow Ave. UC	CM050	Caltrans	District 4
5	I-80 WB W of Carquinez Bridge	CM091	Caltrans	District 4

The location of existing CMS signs are also provided in the PS&E packages developed for other projects.

HAR

Highway Advisory Radio (HAR) is a means of providing traffic information via an AM radio channel to travelers. Upstream of the HAR transmitter, travelers will be instructed by Extinguishable Message Signs (EMS) signs to tune their vehicle radio to a specific frequency. Information is typically relayed to the other users by a pre-recorded message, although live messages can also be broadcast.

Currently there are three existing HAR sites within the project limit. Controller equipment at two out of three HAR sites is analog while the other one has a digital transmitter and controller. There will be a module upgrade required to the two analog HAR sites for frequency synchronization. In addition new DMS signs will replace the existing EMS sites. Table E5 includes the list of existing HAR on I-80 corridor.

Table E5: Existing HAR on I-80 Corridor

Item	Location	ID	Jurisdiction	
1	I-80 EB W of Ashby Ave off ramp	HR001	Caltrans	District 4
2	I-80 WB San Pablo Dam Road	HR012	Caltrans	District 4
3	I-80 WB at Toll Plaza	HR048	Caltrans	District 4

All three locations are operational and have a FCC license for broadcasting radio voice messages using radio frequency of 840 AM. HAR transmitters have two types: analog and digital. Caltrans's current central control system is able to support both types and systems; but the digital series of

transmitters are required for new installations. HAR sites must communicate with Caltrans District 4 RTMC via Asymmetrical Digital Subscriber Line (ADSL) or General Packet Radio System (GPRS) technologies. Fixed HAR systems with digital transmitters are capable of covering a 4-8 mile radius.

EMS

Currently there are five existing Extinguishable Message Signs (EMS) along the I-80 that need to be replaced. Table E6 includes the list of existing EMS signs on I-80 corridor. EMS operate much the same way as Changeable Message Signs, but the message is a fixed message built into the sign panel. The signs usually flash the fixed message such as "Tune Radio AM 840".

Table E6: Existing EMS on I-80 Corridor

Item	Location	ID	Jurisdiction	
1	I-80 EB E of Central Ave On Ramp	FM022	Caltrans	District 4
2	I-80 WB E of San Pablo Dam Rd.	FM023	Caltrans	District 4
3	I-80 EB W of Hilltop Dr.	FM024	Caltrans	District 4
4	I-80 EB E of Willow Ave.	FM025	Caltrans	District 4
5	I-80 EB 580/80/880 IC	FM089	Caltrans	District 4

The EMS has a controller (Quixote HIS RC200 AM Receiver), which listens to the HAR messages broadcasted by a specific radio frequency. Previously the EMS became operational whenever the HAR site broadcast a message. The concept was changed to be able to control eastbound and westbound signs separately through use of single or double beeps broadcasted over the air. The commands were being entered by phone touch tones. The FCC doesn't allow beep messages to be broadcasted on the licensed AM frequency radio. Caltrans is evaluating changing all of the EMS signs with VMS signs that can be fully manageable using NTCIP 1203 and used for multiple purposes. Alternatively EMS units will be used in conjunction with Quixote HIS BT Cellular modules or IP600 Ethernet modules to communicate with District 4 HAR Server using wireless or wired links respectively.

CCTV

There are 24 CCTV PTZ cameras connected to Caltrans District 4 which will be used for freeway monitoring. Fourteen CCTV cameras are located on the westbound lanes and ten are on the eastbound. Table E7 includes the list of existing CCTVs on I-80 Corridor.

Table E7: Existing CCTV on I-80 Freeway

Item	Location	ID
1	I-80 EB WOF POWELL ST	TV106
2	I-80 WB AT POWELL ST.	TV107
3	I-80 EB JWO ASHBY AVE	TV516
4	I-80 WB AT ASHBY AVE	TV121

Item	Location	ID
5	I-80 WB AT UNIVERSITY AVE	TV514
6	I-80 WB AT GILMAN ST	TV515
7	I-80 WB AT CENTRAL AVE	TV502
8	I-80 WB CARLSON BL OFR	TV503
9	I-80 EB JWO CUTTING BL	TV504
10	I-80 EB AT SOLANO AVE	TV506
11	I-80 WB WOF BARRETT AV	TV505
12	I-80 WB JEO SAN PABLO DAM RD	TV507
13	I-80 EB JEO EL PORTAL DR	TV510
14	I-80 EB JWO HILLTOP DR	TV509
15	I-80 EB JEO HILLTOP DR	TV508
16	I-80 WB JEO APPIAN WAY	TV512
17	I-80 EB AT PINOLE VALLEY RD	TV511
18	I-80 EB AT WB4 TO EB 80	TV969
19	I-80 WB JEO WILLOW AVE	TV513
20	I-80 WB AT CALIFORNIA ST	TV978
21	I-80 WB JWO CUMMINGS SKWY	TV970
22	I-80 EB JEO CUMMINGS PKWY	TV971
23	I-80 WB JWO NEW BRIDGE	TV972
24	I-80 WB AT SOUTH TOWER	TV973

There are 88 CCTV cameras in the project area located along the arterials. These cameras are currently connected to the East Bay SMART Corridors program data center. Table E8 includes the list of existing arterial CCTV cameras and their general direction of view.

Table E8: Existing CCTV on Arterial Streets

Item	Group ID	Location	Camera Direction
1	SC-C101W	San Pablo Ave and John Muir Pkwy	West
2	SC-C101S	San Pablo Ave and John Muir Pkwy	South
3	SC-C101N	San Pablo Ave and John Muir Pkwy	North
4	SC-C101E	San Pablo Ave and John Muir Pkwy	East
5	SC-C102N	San Pablo Ave and Richmond Pkwy	North
6	SC-C102E	San Pablo Ave and Richmond Pkwy	East
7	SC-C102W	San Pablo Ave and Richmond Pkwy	West
8	SC-C102S	San Pablo Ave and Richmond Pkwy	South
9	SC-C103W	San Pablo Ave and Church Ln	West
10	SC-C103S	San Pablo Ave and Church Ln	South
11	SC-C103N	San Pablo Ave and Church Ln	North

Item	Group ID	Location	Camera Direction
12	SC-C103E	San Pablo Ave and Church Ln	East
13	SC-C104W	San Pablo Ave and San Pablo Dam Rd	West
14	SC-C104E	San Pablo Ave and San Pablo Dam Rd	East
15	SC-C104N	San Pablo Ave and San Pablo Dam Rd	North
16	SC-C104S	San Pablo Ave and San Pablo Dam Rd	South
17	SC-C105N	San Pablo Dam Rd and SB I-80 Ramps	North
18	SC-C105E	San Pablo Dam Rd and SB I-80 Ramps	East
19	SC-C105W	San Pablo Dam Rd and SB I-80 Ramps	West
20	SC-C105S	San Pablo Dam Rd and SB I-80 Ramps	South
21	SC-C106E	San Pablo Ave and MacDonald Ave	East
22	SC-C106N	San Pablo Ave and MacDonald Ave	North
23	SC-C106W	San Pablo Ave and MacDonald Ave	West
24	SC-C106S	San Pablo Ave and MacDonald Ave	South
25	SC-C107E	San Pablo Ave and Cutting Blvd	East
26	SC-C107N	San Pablo Ave and Cutting Blvd	North
27	SC-C107S	San Pablo Ave and Cutting Blvd	South
28	SC-C107W	San Pablo Ave and Cutting Blvd	West
29	SC-C108W	San Pablo Ave and Potrero Ave	West
30	SC-C108S	San Pablo Ave and Potrero Ave	South
31	SC-C108N	San Pablo Ave and Potrero Ave	North
32	SC-C108E	San Pablo Ave and Potrero Ave	East
33	SC-C109E	San Pablo Ave and Central Ave	East
34	SC-C109N	San Pablo Ave and Central Ave	North
35	SC-C109S	San Pablo Ave and Central Ave	South
36	SC-C109W	San Pablo Ave and Central Ave	West
37	SC-C110E	Central Ave and NB I-80 Ramps	East
38	SC-C110N	Central Ave and NB I-80 Ramps	North
39	SC-C110S	Central Ave and NB I-80 Ramps	South
40	SC-C110W	Central Ave and NB I-80 Ramps	West
41	SC-C111W	San Pablo Ave and Buchanan St	West
42	SC-C111S	San Pablo Ave and Buchanan St	South
43	SC-C111N	San Pablo Ave and Buchanan St	North
44	SC-C111E	San Pablo Ave and Buchanan St	East
45	SC-C112N	Buchanan St and NB I-80 Ramps	North
46	SC-C112S	Buchanan St and NB I-80 Ramps	South
47	SC-C112E	Buchanan St and NB I-80 Ramps	East
48	SC-C112W	Buchanan St and NB I-80 Ramps	West
49	SC-C113W	San Pablo Ave and Gilman St	West

Item	Group ID	Location	Camera Direction
50	SC-C113E	San Pablo Ave and Gilman St	East
51	SC-C113S	San Pablo Ave and Gilman St	South
52	SC-C113N	San Pablo Ave and Gilman St	North
53	SC-C114E	San Pablo Ave and University Ave	East
54	SC-C114N	San Pablo Ave and University Ave	North
55	SC-C114S	San Pablo Ave and University Ave	South
56	SC-C114W	San Pablo Ave and University Ave	West
57	SC-C115N	University Ave and 6th St	North
58	SC-C115E	University Ave and 6th St	East
59	SC-C115W	University Ave and 6th St	West
60	SC-C115S	University Ave and 6th St	South
61	SC-C116E	San Pablo Ave and Ashby Ave	East
62	SC-C116N	San Pablo Ave and Ashby Ave	North
63	SC-C116S	San Pablo Ave and Ashby Ave	South
64	SC-C116W	San Pablo Ave and Ashby Ave	West
65	SC-C117E	Ashby Ave and 7th St	East
66	SC-C117N	Ashby Ave and 7th St	North
67	SC-C117S	Ashby Ave and 7th St	South
68	SC-C117W	Ashby Ave and 7th St	West
69	SC-C118N	Powell St and Christie Ave	North
70	SC-C118E	Powell St and Christie Ave	East
71	SC-C118W	Powell St and Christie Ave	West
72	SC-C118S	Powell St and Christie Ave	South
73	SC-C119W	San Pablo Ave and Stanford Ave	West
74	SC-C119S	San Pablo Ave and Stanford Ave	South
75	SC-C119N	San Pablo Ave and Stanford Ave	North
76	SC-C119E	San Pablo Ave and Stanford Ave	East
77	SC-C120E	San Pablo Ave and 40th St	East
78	SC-C120N	San Pablo Ave and 40th St	North
79	SC-C120S	San Pablo Ave and 40th St	South
80	SC-C120W	San Pablo Ave and 40th St	West
81	SC-C121W	W Grand Ave and Mandela Pkwy	West
82	SC-C121S	W Grand Ave and Mandela Pkwy	South
83	SC-C121N	W Grand Ave and Mandela Pkwy	North
84	SC-C121E	W Grand Ave and Mandela Pkwy	East
85	SC-C122E	San Pablo Ave and W Grand Ave	East
86	SC-C122N	San Pablo Ave and W Grand Ave	North
87	SC-C122S	San Pablo Ave and W Grand Ave	South

Item	Group ID	Location	Camera Direction
88	SC-C122W	San Pablo Ave and W Grand Ave	West

Traffic Signal Controllers (TSC)

Arterial traffic signals are owned and operated by cities and several local stakeholders. All locations are equipped with Model-170 traffic controllers and are capable of communicating with existing Bi-Trans QuicNet traffic control system installed in each city's Traffic Management Center (TMC).

This project will upgrade several local agencies' Bi-Trans central application to the more current version and upgrade some of controllers to Model-2070. Most of existing controllers will require firmware upgrade and will not be replaced.

This project is not upgrading signal loop detections.

Existing signal controllers are typically equipped with 3M's Opticom TSP / EVP receivers.

Table E9 includes a list of existing intersections with equipped with controllers.

Table E9: Existing Traffic Signal Controller on I-80 Corridor

Item	Location	Jurisdiction	
1	San Pablo Ave @ Willow Ave	Contra Costa County	Contra Costa County
2	San Pablo Ave @ Cummings Skyway	Contra Costa County	Contra Costa County
3	San Pablo Av @ John Muir Pkwy (Rte 4)	Contra Costa County	City of Hercules
4	San Pablo Av @ Transit Center	Contra Costa County	City of Hercules
5	San Pablo Av @ Sycamore Av	Contra Costa County	City of Hercules
6	San Pablo Av @ Hercules Av	Contra Costa County	City of Hercules
7	San Pablo Av @ Pinole Valley Rd	Contra Costa County	City of Pinole
8	San Pablo Av @ Tennent Av	Contra Costa County	City of Pinole
9	San Pablo Av @ Oak Ridge Rd	Contra Costa County	City of Pinole
10	San Pablo Av @ Appian Way	Contra Costa County	City of Pinole
11	San Pablo Av @ Sunnyview Dr	Contra Costa County	City of Pinole
12	San Pablo Av @ Pinole Shores Dr	Contra Costa County	City of Pinole
13	San Pablo Av @ Del Monte Dr/Belmont Way	Contra Costa County	City of Pinole
14	San Pablo Av @ Tara Hills Dr	Contra Costa County	City of Pinole
15	San Pablo Av @ Shamrock Dr	Contra Costa County	City of Pinole
16	San Pablo Av @ Crestwood Dr	Contra Costa County	City of Pinole
17	San Pablo Av @ Kay Rd	Contra Costa County	City of Pinole
18	San Pablo Av @ Richmond Pkwy	Contra Costa County	City of Pinole
19	San Pablo Av @ Hilltop Dr	Contra Costa County	City of Richmond
20	San Pablo Av @ Robert Miller Dr	Contra Costa County	City of Richmond

Item	Location	Jurisdiction	
21	San Pablo Av @ Rivers St	Contra Costa County	City of San Pablo
22	San Pablo Av @ Rumrill Blvd/College Ln	Contra Costa County	City of San Pablo
23	San Pablo Av @ Broadway Av/El Portal Dr	Contra Costa County	City of San Pablo
24	San Pablo Av @ Bank Ln	Contra Costa County	City of San Pablo
25	San Pablo Av @ 23rd St/Road 20	Contra Costa County	City of San Pablo
26	San Pablo Av @ Van Ness St	Contra Costa County	City of San Pablo
27	San Pablo Av @ Church Ln	Contra Costa County	City of San Pablo
28	San Pablo Av @ Vale Rd	Contra Costa County	City of San Pablo
29	San Pablo Av @ San Pablo Dam Rd	Contra Costa County	City of San Pablo
30	San Pablo Av @ Food Max	Contra Costa County	City of San Pablo
31	San Pablo Av @ Rheem Av	Contra Costa County	City of San Pablo
32	San Pablo Av @ McBryde Av	Contra Costa County	City of Richmond
33	San Pablo Av @ Esmond Av	Contra Costa County	City of Richmond
34	San Pablo Av @ Garvin Av	Contra Costa County	City of Richmond
35	San Pablo Av @ Solano Av	Contra Costa County	City of Richmond
36	San Pablo Av @ Clinton Av	Contra Costa County	City of Richmond
37	San Pablo Av @ Barrett Av	Contra Costa County	City of Richmond
38	San Pablo Av @ MacDonald Av	Contra Costa County	City of Richmond
39	San Pablo Av @ Cutting Blvd	Caltrans	District 4
40	San Pablo Av @ Eastshore Blvd/Hill St	Caltrans	District 4
41	San Pablo Av @ Potrero Av	Caltrans	District 4
42	San Pablo Av @ Bayview Av/Manila Av	Caltrans	District 4
43	San Pablo Av @ Schmidt Dr	Caltrans	District 4
44	San Pablo Av @ Moeser Ln	Caltrans	District 4
45	San Pablo Av @ Stockton Av	Caltrans	District 4
46	San Pablo Av @ Central Av	Caltrans	District 4
47	San Pablo Av @ Fairmont Av	Caltrans	District 4
48	San Pablo Av @ Carlson Blvd	Caltrans	District 4
49	San Pablo Av @ Brighton Av	Caltrans	District 4
50	San Pablo Av @ Clay St	Caltrans	District 4
51	San Pablo Av @ Washington Av	Caltrans	District 4
52	San Pablo Av @ Solano Av	Caltrans	District 4
53	San Pablo Av @ Buchanan St	Caltrans	District 4
54	San Pablo Av @ Marin Av	Caltrans	District 4
55	San Pablo Av @ Monroe St	Caltrans	District 4
56	San Pablo Av @ Gilman St	Alameda County	City of Berkeley
57	San Pablo Av @ Cedar St	Alameda County	City of Berkeley
58	San Pablo Av @ Delaware St	Alameda County	City of Berkeley

Item	Location	Jurisdiction	
59	San Pablo Av @ University Av	Alameda County	City of Berkeley
60	San Pablo Av @ Addison St	Alameda County	City of Berkeley
61	San Pablo Av @ Allston Way	Alameda County	City of Berkeley
62	San Pablo Av @ Dwight Way	Alameda County	City of Berkeley
63	San Pablo Av @ Grayson St	Alameda County	City of Berkeley
64	San Pablo Av @ Ashby Av	Alameda County	City of Berkeley
65	San Pablo Av @ Alcatraz Av	Alameda County	City of Oakland
66	San Pablo Av @ 63rd St	Alameda County	City of Oakland
67	San Pablo Av @ Stanford Av	Alameda County	City of Oakland
68	San Pablo Av @ 53rd St	Caltrans	District 4
69	San Pablo Av @ 47th St	Caltrans	District 4
70	San Pablo Av @ 45th St	Caltrans	District 4
71	San Pablo Av @ Park Av	Caltrans	District 4
72	San Pablo Av @ 40th St	Caltrans	District 4
73	San Pablo Av @ Adeline St	Caltrans	District 4
74	San Pablo Av @ 36th St	Alameda County	City of Oakland
75	San Pablo Av @ 35th St	Alameda County	City of Oakland
76	San Pablo Av @ 30th St/Market St/31st St	Alameda County	City of Oakland
77	San Pablo Av @ 27th St	Alameda County	City of Oakland
78	San Pablo Av @ 25th St	Alameda County	City of Oakland
79	San Pablo Av @ W. Grand Av	Alameda County	City of Oakland
80	San Pablo Av @ Castro St/M.L.K. Jr. Way	Alameda County	City of Oakland
81	San Pablo Av @ 20th St/ M.L.K. Jr. Way	Alameda County	City of Oakland
82	San Pablo Av @ 19th St	Alameda County	City of Oakland
83	San Pablo Av @ 17th St	Alameda County	City of Oakland
84	Appian Way @ Mann Dr	Contra Costa County	City of Pinole
85	Appian Way @ Tara Hills Dr	Contra Costa County	City of Pinole
86	Appian Way @ I-80 WB	Contra Costa County	City of Pinole
87	Appian Way @ I-80 EB	Contra Costa County	City of Pinole
88	Appian Way @ Fitzgerald	Contra Costa County	City of Pinole
89	Ashby Ave @ 7th St	Alameda County	City of Berkeley
90	Ashby Ave @ 9th St	Alameda County	City of Berkeley
91	Ashby 7th St @ Potter St	Alameda County	City of Berkeley
92	Buchanan St @ Jackson St	Alameda County	City of Albany
93	Buchanan St @ I-80 WB	Alameda County	City of Albany
94	Buchanan St @ I-80 EB	Alameda County	City of Albany
95	Carlson Blvd @ Huntington Ave	Contra Costa County	City of Richmond
96	Central Avenue @ I-80 WB	Contra Costa County	City of Richmond

Item	Location	Jurisdiction	
97	Central Avenue @ I-80 EB	Contra Costa County	City of Richmond
98	Central Avenue @ San Luis St/Pierce St	Contra Costa County	City of Richmond
99	Central Avenue @ Carlson Blvd	Contra Costa County	City of El Cerrito
100	Cutting Blvd @ I-80 WB	Contra Costa County	City of Richmond
101	Cutting Blvd @ I-80 HOV	Contra Costa County	City of Richmond
102	El Portal Dr @ Road 20	Contra Costa County	City of San Pablo
103	El Portal Dr @ Rollingwood Dr	Contra Costa County	City of San Pablo
104	El Portal Dr @ Fordham St	Contra Costa County	City of San Pablo
105	El Portal Dr @ Glenlock St	Contra Costa County	City of San Pablo
106	El Portal Dr @ I-80 (west)	Contra Costa County	City of San Pablo
107	El Portal Dr @ I-80 (east)	Contra Costa County	City of San Pablo
108	Gilman St @ 8th St	Alameda County	City of Berkeley
109	Gilman St @ 6th St	Alameda County	City of Berkeley
110	Hilltop Dr @ I-80 (west)	Contra Costa County	City of San Pablo
111	Hilltop Dr @ I-80 (east)	Contra Costa County	City of San Pablo
112	Hilltop Dr @ Blume Dr	Contra Costa County	City of Richmond
113	Hilltop Dr @ Research Dr	Contra Costa County	City of Richmond
114	Hilltop Dr @ Hillview Dr	Contra Costa County	City of Richmond
115	Hilltop Dr @ Robert Miller Dr	Contra Costa County	City of Richmond
116	Hilltop Dr @ Shane Dr	Contra Costa County	City of Richmond
117	Pinole Valley Rd @ Ellerhorst Ave	Contra Costa County	City of Pinole
118	Pinole Valley Rd @ Henry Ave	Contra Costa County	City of Pinole
119	Pinole Valley Rd @ I-80 WB	Contra Costa County	City of Pinole
120	Pinole Valley Rd @ I-80 EB	Contra Costa County	City of Pinole
121	Potrero Ave @ I-80 EB	Contra Costa County	City of El Cerrito
122	Powell St @ Beaudry	Alameda County	City of Emeryville
123	Powell St @ Hollis St	Alameda County	City of Emeryville
124	Powell St @ Christie Ave	Alameda County	City of Emeryville
125	Powell St @ I-80	Alameda County	City of Emeryville
126	Powell St @ Frontage	Alameda County	City of Emeryville
127	Richmond Pkwy @ I-80 EB	Contra Costa County	City of Pinole
128	Richmond Pkwy @ I-80 HOV	Contra Costa County	City of Pinole
129	Richmond Pkwy @ I-80 (west)	Contra Costa County	City of San Pablo
130	Richmond Pkwy @Bella Vista (entrance)	Contra Costa County	City of San Pablo
131	Richmond Pkwy @ Lakeside Dr	Contra Costa County	City of Richmond
132	San Pablo Dam Rd @ I-80 (east)	Contra Costa County	City of San Pablo
133	San Pablo Dan Rd @ I-80 (west)	Contra Costa County	City of San Pablo

Item	Location	Jurisdiction	
134	San Pablo Dam Rd @ Ventura Ave	Contra Costa County	City of San Pablo
135	San Pablo Dam Rd @ Contra Costa Ave	Contra Costa County	City of San Pablo
136	University Ave @ 6th St	Alameda County	City of Berkeley
137	University Ave @ 9th St	Alameda County	City of Berkeley
138	Willow Ave @ Hawthorne Dr	Contra Costa County	City of Hercules
139	Willow Ave @ I-80 (West)	Contra Costa County	City of Hercules
140	Willow Ave @ I-80 (East)	Contra Costa County	City of Hercules
141	W. Grand Ave / Broadway	Alameda County	City of Oakland
142	W. Grand Ave / Webster St	Alameda County	City of Oakland
143	W. Grand Ave / Valdez St	Alameda County	City of Oakland
144	W. Grand Ave / Bay Place	Alameda County	City of Oakland
145	W. Grand Ave / Park View Terrace	Alameda County	City of Oakland
146	W. Grand Ave / Perkins St	Alameda County	City of Oakland
147	W. Grand Ave / Staten Ave	Alameda County	City of Oakland
148	W. Grand Ave / Euclid Ave	Alameda County	City of Oakland
149	W. Grand Ave / El Embarcadero	Alameda County	City of Oakland
150	W. Grand Ave / MacArthur Blvd	Alameda County	City of Oakland
151	W. Grand Ave / Lake Park Ave	Alameda County	City of Oakland
152	W. Grand Ave/Market St	Alameda County	City of Oakland
153	W. Grand Ave/Adeline St	Alameda County	City of Oakland
154	W. Grand Ave/Poplar	Alameda County	City of Oakland
155	W. Grand Ave/Mandela Pkwy	Alameda County	City of Oakland