MTC EXPRESS LANES
Concept of Operations

July 1, 2015

METROPOLITAN TRANSPORTATION COMMISSION

In collaboration with:

ALAMEDA County Transportation Commission

CHP

Caltrans

CONTRA COSTA transportation authority

U.S. Department of Transportation Federal Highway Administration

STA Solano Transportation Authority

VTA

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Revision History:

Revision	Date	Description
0	23 May 13	Initial Release
1	01 July 15	Includes the addition of the Contra Costa I-680 North (CC-680N) project, the classification of the bridge approaches as future projects to be developed, signage and other design updates to reflect current designs, and updates to reflect current terminology and wording to be consistent with business requirements.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

AADT	Average annual daily traffic
AASHTO	American Association of State Highway and Transportation Officials
AET	All Electronic Tolling
Alameda CTC	Alameda County Transportation Commission
ALPR	Automatic License Plate Recognition
ATCAS	Advanced Toll Collection and Accounting System
ATM	Active Traffic Management
ATMS	Advanced Transportation Management System
AVD/AVC	Automatic Vehicle Detection/Automatic Vehicle Classification
AVI	Automatic Vehicle Identification
BAIFA	Bay Area Infrastructure Financing Authority
BART	Bay Area Rapid Transit
BATA	Bay Area Toll Authority
BAVU	Bay Area Video Upgrade
CAD	Computer-Aided Dispatch
CBP	Call Box Program
CCCTA	Central Costa County Transit Authority
CCTA	Contra Costa Transportation Authority
CCTV	Close-Circuit Television
CHP	California Highway Patrol
CMA	Congestion Management Agency
CSC	Customer Service Center
CTC	California Transportation Commission
CTFA	California Transportation Financing Authority
CTOC	California Toll Operators Committee
DMV	Department of Motor Vehicles
DVAS	Digital Video Auditing System
ESC	Executive Steering Committee
ETC	Electronic Toll Collection
FAST	Fairfield/Suisun Transit
FasTrak®	Electronic toll collection system used in California
FCC	Federal Communications Commission
FHWA	Federal Highway Administration
FPI	Freeway Performance Initiative
FSP	Freeway Service Patrol
GHz	Gigahertz
GPS	Global Positioning System
HDM	Highway Design Manual
HOT	High-occupancy/toll
HOV	High-occupancy vehicle
HOV 2	Vehicles with two occupants
HOV 2+	Vehicles with two or more occupants

HOV 3+	Vehicles with three or more occupants
ICM	Integrated Corridor Management
ISO	International Organization for Standardization
ITE	Institute of Transportation Engineers
ITS	Intelligent Transportation System
LA Metro	Los Angeles County Metropolitan Transportation Authority
LAVTA	Livermore Amador Valley Transit Authority
MAP-21	Moving Ahead for Progress in the 21st Century
MHz	Megahertz
MLIP	Managed Lanes Implementation Plan
MOMS	Maintenance Online Management System
MOU	Memorandum of Understanding
MPH	Miles-per-hour
MTC	Metropolitan Transportation Commission
MUTCD	Manual on Uniform Traffic Control Devices
NB	Northbound
NEMA	National Electrical Manufacturers Association
OBU	On-board Unit
OCR	Optical Character Recognition
ORT	Open Road Tolling
PeMS	Performance Measurement System
PII	Personal Identifiable Information
RCSC	Regional Customer Service Center
RF	Radio Frequency
RFID	Radio Frequency Identification
RTP	Regional Transportation Plan
SAFE	Service Authority for Freeways and Expressways
SANDAG	San Diego Association of Governments
SB	Southbound
SOV	Single occupant vehicle
STA	Solano Transportation Authority
SR	State Route
Sunol JPA	Sunol Smart Carpool Lane Joint Powers Authority
TIP	Transportation Improvement Program
TMC	Traffic Management Center
TOPD	Traffic Operations Policy Directive
TWG	Technical Working Group
UPS	Uninterruptable Power Supply
VES	Violation Enforcement System
VPH	Vehicles-per-hour
VTA	Santa Clara Valley Transportation Agency
WestCAT	West Contra Costa Transit Authority

CHAPTER 1 INTRODUCTION

1.1 PURPOSE OF DOCUMENT AND INTENDED AUDIENCE

This Concept of Operations is intended to describe how the express lanes being implemented by the Metropolitan Transportation Commission (MTC)[1], referred to as MTC Express Lanes, will operate from a user perspective and to set the framework for the design and operational characteristics of the express lane system. As such, this document serves as a bridge between the needs and expectations of the express lane user and the technical specifications to be developed for the toll system. The express lane system includes the hardware and software that will be procured to implement and operate the express lanes.

This Concept of Operations does not specify detailed design requirements of the express lane system. Instead, this document is meant to describe the desired operational characteristics of the MTC Express Lanes that get translated into detailed design requirements. This document also preserves flexibility to account for policy and design characteristics that are not yet fully defined or that may evolve in the future.

The July 1, 2015 update to the Concept of Operations reflects decisions made following the initial May 23, 2014 release. Updates include the addition of the Contra Costa I-680 North (CC-680N) project, the classification of the bridge approaches as future projects to be developed, signage and other design updates to reflect current designs, and updates to reflect current terminology and wording to be consistent with business requirements.

1.2 BACKGROUND

1.2.1 EXPRESS LANES DEFINED

Express lanes, also commonly referred to as high-occupancy/toll (HOT) lanes, function as high-occupancy vehicle (HOV) lanes that allow vehicles not meeting eligibility requirements to pay a toll to travel in the lane. Eligibility requirements to use HOV lanes typically include HOV occupancy restrictions and vehicle type (e.g., motorcycles and low-emission vehicles). The first express lane project was implemented on State Route (SR) 91 in Orange County in 1995 and the concept has since gained substantial national recognition as an effective strategy to improve the efficiency and reliability of HOV lanes and has been implemented and planned in multiple locations around the U.S.

Express lanes maintain toll-exempt travel for buses, HOVs and other toll-exempt vehicles designated to use the lanes (e.g., motorcycles), and charge a toll for other passenger vehicles that

[1] In April of 2013, MTC entered into a cooperative agreement with the Bay Area Infrastructure Financing Authority (BAIFA) through which MTC delegated authority to BAIFA to develop and operate the eventual 270-mile Bay Area Express Lanes. BAIFA is a joint powers authority of MTC and the Bay Area Toll Authority (BATA); see Chapter 5 for more information. For simplicity, and since most readers are more familiar with MTC, this Concept of Operations refers to MTC as the entity responsible for the development and operation of the express lanes. This is consistent with the CTC action that granted express lane eligibility to MTC.

choose to use the lane. Express lane tolls are collected electronically via electronic toll collection (ETC) systems and typically vary based on the level of congestion to ensure that a high level of service is maintained in the express lane. As traffic in the express lane increases, the toll rate also increases to limit the number of people entering the lane. Toll rates decrease when traffic in the lane decreases to incentivize more vehicles to use the existing capacity in the lane. Shifting vehicles from congested general purpose lanes to utilize excess capacity in the express lane benefits general purpose lane flow without sacrificing free-flow operations in the express lane.

1.2.2 ENABLING LEGISLATION

In October of 2011, the California Transportation Commission (CTC) found MTC eligible to develop and operate a 270-mile network of express lanes, consistent with California Streets and Highways Code Section 149.7. These lanes, referred to as MTC Express Lanes, include portions of Interstates 80, 880 and 680 as well as the Dumbarton and San Mateo-Hayward Bridge approaches (see orange outlined corridors in Figure 1-1). The network includes conversion of approximately 150 lane-miles of existing HOV lanes to express lanes and construction of 120 lane-miles of new express lanes. The gap in the network on I-880 through Oakland represents a segment with very constrained right-of-way where express lanes are not proposed in the near-term.

In addition to the MTC Express Lanes, there are other express lane projects in operation or under development in Alameda and Santa Clara counties. These express lanes are authorized under Sections 149.5 and 149.6 of the California Streets and Highways Code. The Sunol Smart Carpool Lane Joint Powers Authority (JPA), consisting of members from the Alameda County Transportation Commission (Alameda CTC) and the Santa Clara Valley Transportation Authority (VTA), oversees the operation of the Bay Area's first express lane on Interstate 680 southbound (I-680 SB) over the Sunol Grade. The Alameda CTC also has authority to operate express lanes on the I-580 corridor in Alameda County. The VTA separately operates an express lane at the interchange of I-880 and SR-237 and has authority to operate express lanes on a second corridor in Santa Clara County. Work is underway by these agencies to open additional express lanes in the 2015 to 2020 timeframe, which include the SR-237 extension, I-580, SR-85 and US-101, and I-680 northbound over the Sunol Grade. These previously authorized express lanes are highlighted in red and green in Figure 1-1. Together, the MTC, ACTC and VTA express lanes are referred to as 'Bay Area Express Lanes'.

FIGURE 1-1: BAY AREA EXPRESS LANES (PLANNED AND OPERATIONAL)

1.2.3 GEOGRAPHICAL LIMITS AND PHASING

This Concept of Operations applies only to MTC Express Lanes, which includes the following corridors:

- I-80 between San Francisco/Oakland Bay Bridge and Solano/Yolo County Line (130 lane-miles), including westbound approaches (I-80, I-880 and I-580) to the San Francisco-Oakland Bay Bridge that carry vehicles to the Bay Bridge metering lights
- I-680 between I-80 and Contra Costa/Alameda County Line (77 lane-miles)
- I-880 between Hegenberger Road and State Route 237 (53 lane-miles)
- SR-84 WB from I-880 to Dumbarton Bridge Toll Plaza (3 lane-miles)
- SR-92 WB from I-880 to San Mateo-Hayward Bridge Toll Plaza (3 lane-miles)

The Bay Area Infrastructure Financing Authority's (BAIFA) phasing strategy from the start has been to use available funding to open as much of the 270-mile network as it can while seeking opportunities to get additional projects shelf-ready should additional funding become available for construction. As the program has matured, staff has revisited the prioritization in the 2011 application to the California Transportation Commission, in which all 150 miles of HOV lane conversions (Tier 1) were assumed to precede implementation of new lanes (Tiers 2 and 3). It is possible to offer significant mobility relief by completing some gap closure projects on I-680 in Contra Costa County and I-80 in Solano concurrently, or in close succession, with conversions in these corridors and on I-880 in Alameda County. MTC is currently working with partner agencies to implement the following projects (shown in yellow callouts in Figure 1-2):

- I-680 Contra Costa South Conversion (CC-680S)
    - I-680 northbound (NB) in Contra Costa County between Alcosta Boulevard and Livorna Road and I-680 SB between Rudgear Road and Alcosta Boulevard (i.e., CC-680 Southern Segment).
- I-680 Contra Costa North Conversion and Widening (CC-680N)
    - I-680 NB in Contra Costa County between SR-242 and Marina Vista Avenue (i.e., CC-680 Northern Segment – Northbound Conversion) and I-680 SB between Marina Vista Avenue and Rudgear Road (i.e., CC-680 Northern Segment – Southbound Conversion and Southbound HOV Completion). The Contra Costa Transportation Authority (CCTA) is leading civil project delivery for these projects.
- I-880 Alameda Conversion (ALA-880)
    - I-880 NB in Alameda and Santa Clara counties between Dixon Landing Road and Lewelling Boulevard and I-880 SB between Hegenberger Road and Dixon Landing Road
- I-80 Solano West Conversion (I-80 West) and I-80 Solano East Widening (I-80 East)
    - I-80 West includes conversion of the existing HOV lane in the eastbound (EB) and westbound (WB) directions of I-80 in Solano County between Red Top Road and Air Base Parkway. I-80 East includes the addition of a new lane in each direction between Air Base Parkway and I-505. The Solano Transportation Authority (STA) is leading the civil project delivery for these project.

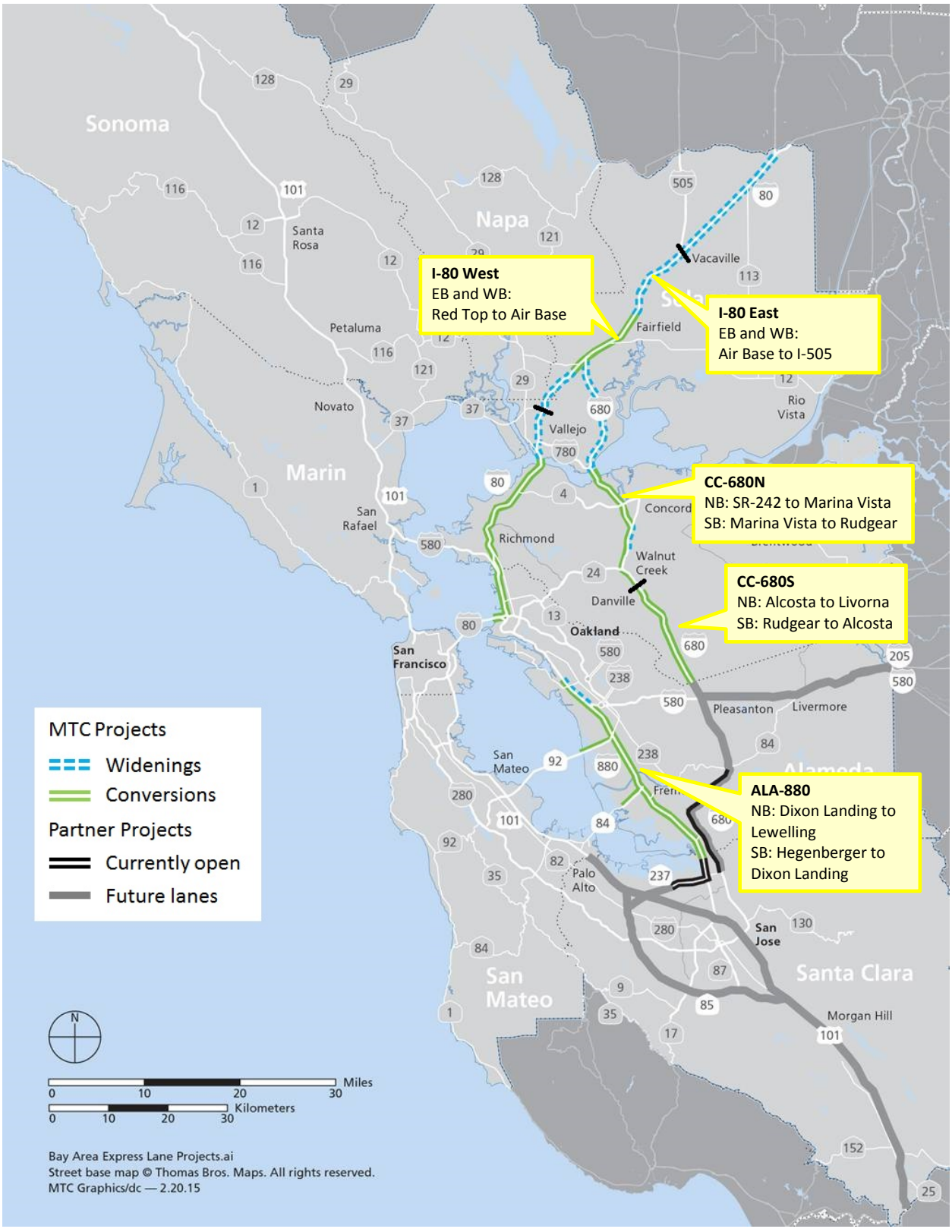


FIGURE 1-2: MTC PROJECTS UNDER DEVELOPMENT

Future MTC Express Lane projects to be developed are shown in blue in Figure 1-2 and are described below in Table 1-1.

TABLE 1-1: FUTURE EXPRESS LANE PROJECTS TO BE DEVELOPED

County	Route	Geographical Limits	Lane-Miles
Conversions			
ALA/CC	I-80	Carquinez Bridge to Bay Bridge	38
ALA	Bay Bridge	I-80, I-580 and I-880 approaches to HOV lanes	3
ALA	SR-84	I-880 to Dumbarton Bridge Toll Plaza*	3
ALA	SR-92	I-880 to San Mateo-Hayward Bridge Toll Plaza*	3
Gap Closures, Extensions and Interchanges			
ALA	I-880NB	Marina Boulevard to Lewelling Boulevard	5
CC	I-680NB	SR-242 to N. Main Street	3
SOL	I-80	Carquinez Bridge to SR-37	10
SOL	I-80	SR-37 to Red Top Road	11
SOL	I-80	I-505 to Yolo County Line*	33
SOL	I-680	I-80 to Benicia-Martinez Bridge	22
SOL	I-80/I-680	Interchange direct connectors	6

* Environmental phase fully funded and underway

1.3 REGIONAL GOALS AND OBJECTIVES

1.3.1 EXPRESS LANES OBJECTIVES

Objectives of the MTC Express Lanes include:

1. Create a network of HOV lanes to encourage carpools, vanpools and express buses;
2. Make the best use of HOV lane capacity;
3. Provide reliable travel times for solo drivers; and
4. Better manage all lanes to keep traffic moving

1.3.2 CONSISTENCY WITHIN BAY AREA AND CALIFORNIA

This Concept of Operations has been developed in collaboration with Caltrans, Congestion Management Agencies (CMAs), California Highway Patrol (CHP) and Federal Highway Administration (FHWA) with a primary goal of establishing maximum feasible consistency of practice for all express lanes in the Bay Area. The involved CMAs include ACTC, CCTA, STA and VTA. An operations-focused Technical Working Group (TWG) and Executive Steering Committee (ESC) were instituted, including representatives from the agencies mentioned above to discuss and

provide feedback on the topics included in this Concept of Operations. Individual meetings with Caltrans and the CHP were also held.

Although the ultimate Bay Area regional express lane network will include express lanes that are currently being planned, implemented and operated by various agencies, the goal is to present a seamless network to users. This requires a large degree of collaboration to maximize consistency in terms of design treatments and operational policies. A Public Information Working Group (PIWG) with members from each of the operating agencies has been established for the purpose of ensuring consistency in public messaging and outreach. In addition, the TWG and ESC will continue to be forums for discussion and collaboration as MTC and other agencies move forward with express lane implementation and operation.

To maintain consistency and interoperability with other express lane and toll facilities in California, tolls on MTC Express Lanes will be collected electronically according to specifications detailed in California Code of Regulations, Title 21, or any other specification that may be adopted by the time the MTC Express Lanes system requirements are finalized.

1.4 ORGANIZATION OF THE REPORT

This document includes the following chapters:

- **Chapter 2 – Current Characteristics**: Describes the geographical limits and current physical and operating characteristics of express lane corridors.
- **Chapter 3 – Facility Design**: Describes typical cross-section, access, striping, signing, enforcement and other considerations related to physical design of express lane facilities.
- **Chapter 4 – Operating Concept**: Describes how the express lanes will operate, including guidelines for use of the lane by toll-exempt and toll-paying vehicles. Also includes considerations for hours of operation, HOV occupancy requirement, pricing and integration with other projects such as Integrated Corridor Management (ICM).
- **Chapter 5 – Roles and Responsibilities**: Describes the areas of responsibility related to express lane operations and the roles of each of the stakeholders.
- **Chapter 6 – Technical Requirements**: Describes the various hardware and software elements of the toll system.
- **Chapter 7 – Express Lane Operations**: Describes how express lanes will be operated, including enforcement, incident management, performance monitoring and day-to-day operations.
- **Chapter 8 – Motorist and Operator Perspective**: Describes how the express lanes will operate from the perspective of the motorist and operators.

1.5 PLANNED FUTURE REVISIONS TO THIS DOCUMENT

The MTC Express Lanes will be built out in phases. Consequently, it is envisioned that this Concept of Operations will be updated as appropriate to account for the incorporation of future express lanes and evolving policies or operations. The flow chart presented in Figure 1-3 portrays how future express lane corridors could be incorporated into the Concept of Operations.

MTC is undertaking the development of a Managed Lanes Implementation Plan (MLIP) to develop a comprehensive assessment and plan of action for the entire existing, planned, and future managed

lanes system in the Bay Area. The MLIP is expected to be completed in 2016. Results from the Plan may be applicable to this Concept of Operations.

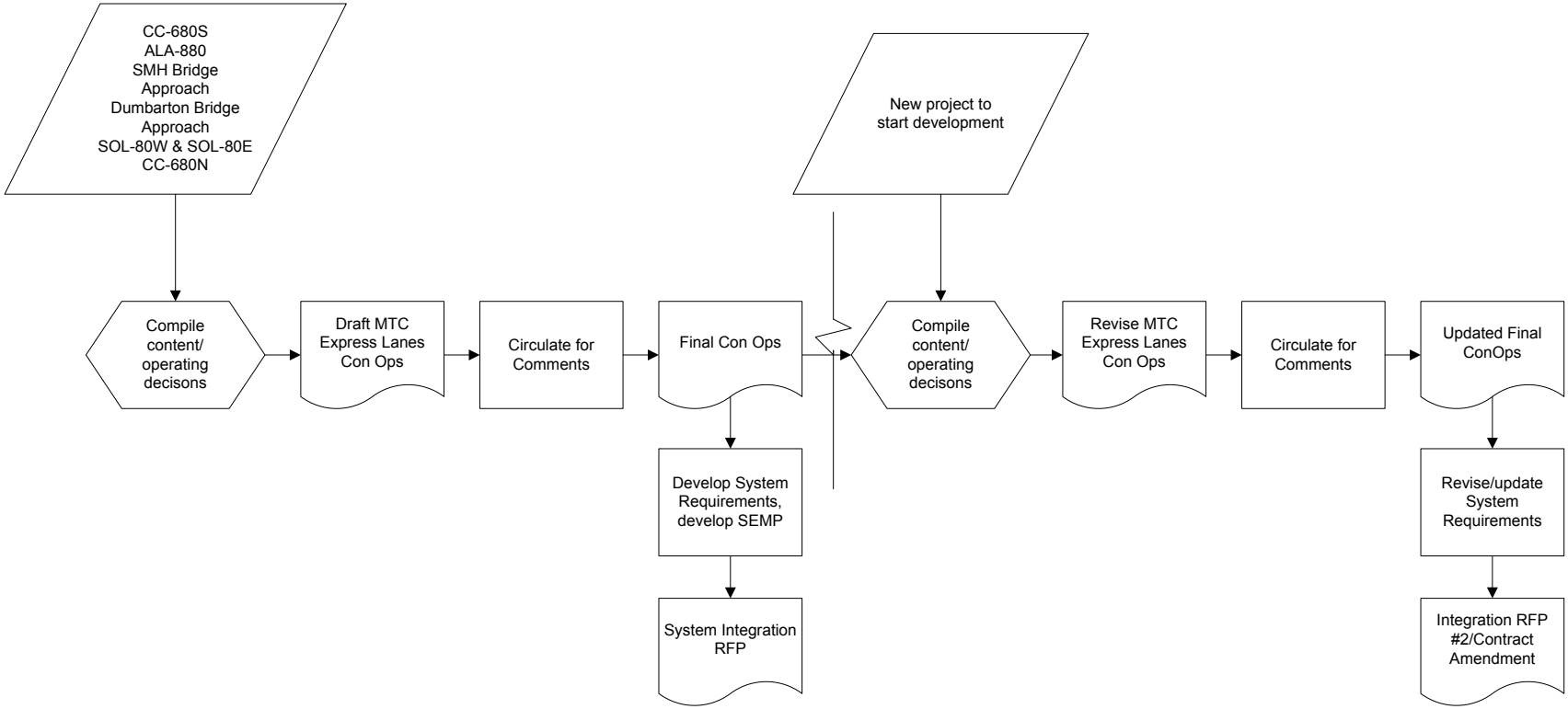


FIGURE 1-3: CONCEPT OF OPERATIONS UPDATE PROCESS FLOWCHART

CHAPTER 2 CURRENT CHARACTERISTICS

This chapter is divided into two sections to differentiate between projects under development and future projects. Current physical and operational characteristics are presented for projects under development in the first section. Future projects to be developed are listed in the second section.

2.1 PROJECTS UNDER DEVELOPMENT

This section describes the existing physical and operational characteristics of the projects under development as summarized below in Table 2-1.

TABLE 2-1: PROJECT CHARACTERISTICS FOR PROJECTS UNDER DEVELOPMENT

Corridor	County	Project Limits	HOV Lane Characteristics	
			Operating Hours	HOV Occupancy Requirement
I-680 South (CC-680S)	Contra Costa	Rudgear Road (SB)/Livorna Road(NB) to Alcosta Boulevard	5-9 a.m. and 3-7 p.m.	HOV 2+
I-680 North (CC-680N)	Contra Costa	Marina Vista Avenue to Rudgear Road (SB)/SR-242 (NB)	5-9 a.m. and 3-7 p.m.	HOV 2+
I-880 (ALA-880)	Alameda	Hegenberger Road (SB)/Lewelling Boulevard (NB) to Dixon Landing Road	5-9 a.m. and 3-7 p.m.	HOV 2+
I-80 West (I-80 West)	Solano	Red Top Road to Airbase Parkway	5-10 a.m. and 3-7 p.m.	HOV 2+
I-80 East (I-80 East)*	Solano	Airbase Parkway to I-505	N/A	N/A

* Environmental phase fully funded and underway

2.1.1 I-680 CONTRA COSTA SOUTH (CC-680S)

2.1.1.1 GENERAL CHARACTERISTICS

The I-680 corridor in southern Contra Costa County serves as a north-south route connecting the cities of Walnut Creek, San Ramon and the Town of Danville. The corridor runs through the urbanized San Ramon Valley with residential, industrial and commercial development on both sides. At the southern end, the I-680 corridor connects with I-580 in Alameda County, which serves as an important route for access between the Bay Area and the Central Valley. The corridor also provides access to the Bishop Ranch Office Park in San Ramon, a major commuter destination. In general, the corridor is eight lanes with one HOV lane and three general purpose lanes in each direction and has 10-foot inside shoulders for a majority of its length.

2.1.1.2 PROJECT LIMITS AND DESCRIPTION

The I-680 Contra Costa South (CC-680S) project includes conversion of existing HOV lanes to express lanes on the northbound segment of I-680 between Alcosta Boulevard and Livorna Road (11.2 miles) and on the southbound segment between Alcosta Boulevard and Rudgear Road (12.5 miles) through the San Ramon Valley in Contra Costa County (see Figure 2-1). HOV lanes also exist on the northern segment of I-680 in Contra Costa County north of Walnut Creek; these are also being converted to express lanes as part of the I-680 Contra Costa North (CC-680N) project (described in Section 2.1.2). However, there is a gap in the northbound and southbound HOV lanes through Walnut Creek. There are plans to extend the express lane through Walnut Creek to close the gap in the southbound direction. There are plans to shorten the gap in the northbound direction by extending the lane from its current southern terminus at SR-242 to North Main Street as a future express lanes project.

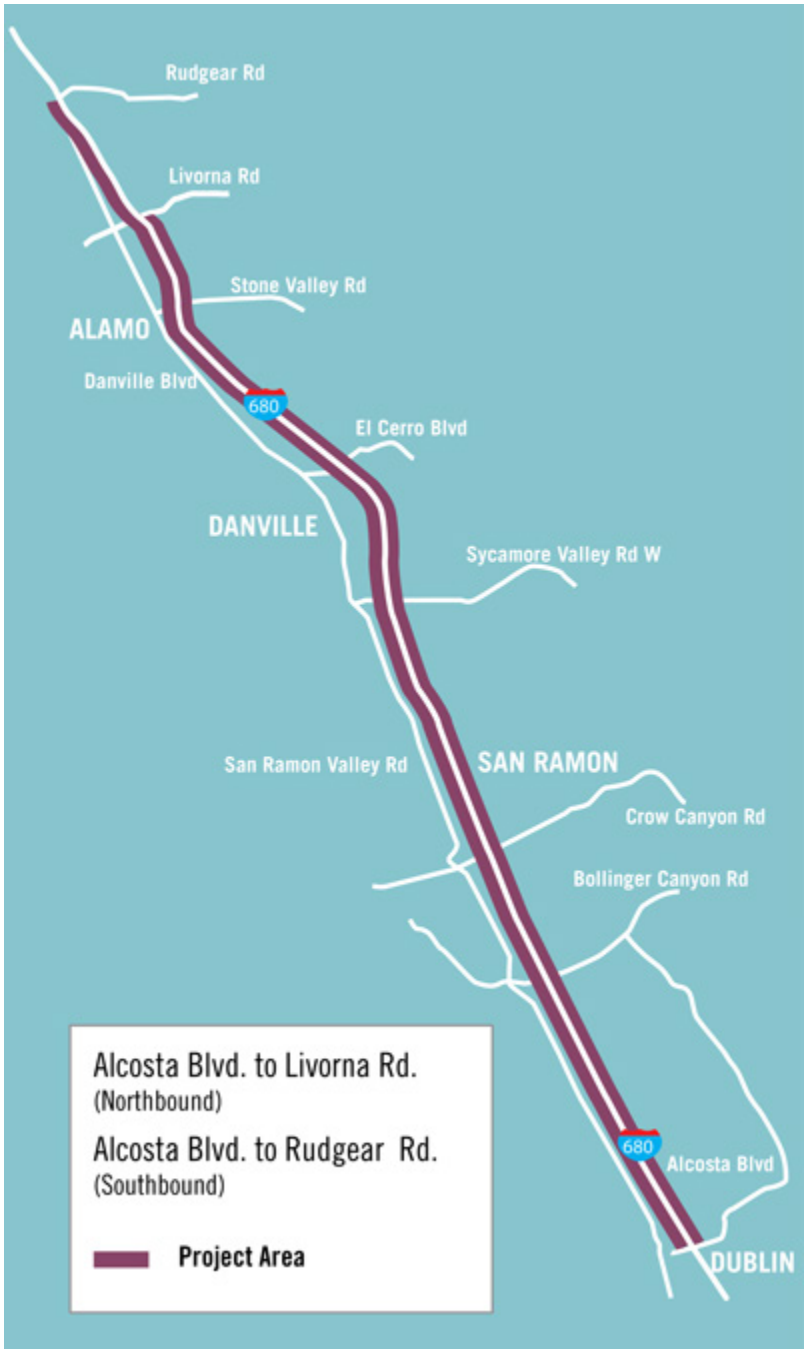


FIGURE 2-1: CC-680S PROJECT LIMITS

Within the project limits, the I-680 typical cross-section consists of three general purpose lanes and one HOV lane in each direction. The segment serves a total of nine interchanges in the northbound and southbound directions. The 2011 Caltrans Ramp Metering Design Plan shows that ramp meters are partially constructed or planned (subject to agreement) on all ramps within the project segment.

The construction of HOV Direct Access Ramps (DAR's) in the vicinity of Norris Canyon Road in the city of San Ramon is currently being evaluated. The connectors would provide a direct connection for buses and carpools using the I-680 HOV lanes to a major business park.

2.1.1.3 CURRENT HOV OPERATING POLICY

HOV lanes on I-680 operate during weekday peak periods and serve as general purpose lanes during all other times. Current peak period hours of operation are defined as 5 a.m. to 9 a.m. and 3 p.m. to 7 p.m. Access to the HOV lanes on I-680 is unrestricted along the entire length.

HOV lane eligibility requirements on I-680 require two or more passengers in a vehicle during peak periods. Other eligible vehicles include buses, motorcycles and SOVs that meet specified emissions standards with DMV issued decals. Vehicles pulling a trailer and large trucks with more than two axles are not permitted to use HOV lanes.

2.1.1.4 TRAFFIC CHARACTERISTICS

Travel time and traffic volume data were collected in April of 2012 for the I-680 corridor between Stoneridge Drive and Treat Boulevard/Geary Road. Table 2-2 compares the average travel times by hour during the peak periods for travel in the general purpose lanes versus travel in the HOV lanes. Drivers traveling in the northbound direction experience the longest travel times during the afternoon peak and drivers traveling in the southbound direction experience the longest travel times during the morning peak. These are also the periods during which the HOV lanes provide the greatest travel time savings. For example, a driver traveling northbound using the HOV lane between 5 p.m. and 6 p.m. saves about 10 minutes compared with traveling in the general purpose lanes.

The most congested hour during the morning peak period is from 8 a.m. to 9 a.m. in both the northbound and southbound directions. In the afternoon peak period, the most congested hour occurs from 5 p.m. to 6 p.m. in both directions.

TABLE 2-2: CC-680S AVERAGE TRAVEL TIMES[1]

	Time Period	Average Travel Time (minutes)		
		Using GP Lanes	Using HOV lane	HOV lane travel time savings
Northbound	**Morning Peak Period**			
	5 a.m. - 6 a.m.	17.6	17.4	0.2
	6 a.m. - 7 a.m.	17.4	17.4	0.0
	7 a.m. - 8 a.m.	19.7	17.9	2.8
	8 a.m. - 9 a.m.	23.2	18.4	4.8
	Afternoon Peak Period			
	3 p.m. - 4 p.m.	20.7	19.1	1.6
	4 p.m. - 5 p.m.	29.3	24.4	4.9
	5 p.m. - 6 p.m.	35.7	25.5	10.2
	6 p.m. - 7 p.m.	23.1	19.5	3.6
Southbound	**Morning Peak Period**			
	5 a.m. - 6 a.m.	16.8	16.8	0.0
	6 a.m. - 7 a.m.	18.4	17.8	0.6
	7 a.m. - 8 a.m.	25.0	21.7	3.3
	8 a.m. - 9 a.m.	29.6	24.2	5.4
	Afternoon Peak Period			
	3 p.m. - 4 p.m.	18.1	17.5	0.6
	4 p.m. - 5 p.m.	21.8	19.9	1.9
	5 p.m. - 6 p.m.	25.2	21.9	3.3
	6 p.m. - 7 p.m.	18.4	17.8	0.6

Note: Travel time is measured between Stoneridge Drive and Treat Boulevard. HOV lane travel times include travel in the general purpose lanes where no HOV lanes exist.

Average travel speeds and HOV lane traffic volumes during the most congested hours in the northbound direction are shown in Figure 2-2 through Figure 2-4 As shown in Figure 2-2, congestion during the morning peak hour in the northbound direction causes speeds in the general purpose lanes to drop below 30 mph between Crow Canyon Road and El Cerro Boulevard. Congestion is more severe and widespread in the afternoon peak hour, as shown in Figure 2-3. Average speeds in the HOV lanes are maintained above 45 mph throughout the corridor during both peak periods. HOV lane traffic volumes, shown in Figure 2-4, do not go above 1400 vph indicating that excess capacity exists in the HOV lanes during the peak periods.

[1] MTC Express Lane Phase I Project – Weekday Data Collection Results for Interstate 680. Metropolitan Transportation Commission. September 28, 2012.

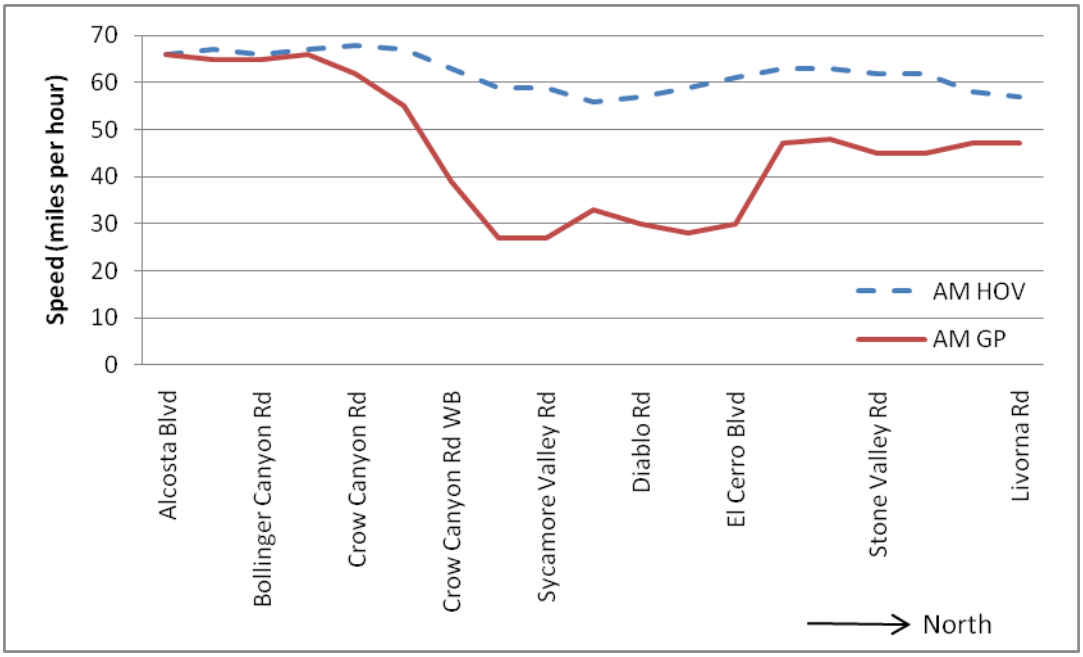


FIGURE 2-2: CC-680S NORTHBOUND A.M. PEAK HOUR (8 A.M. TO 9 A.M.) AVERAGE SPEEDS[1]

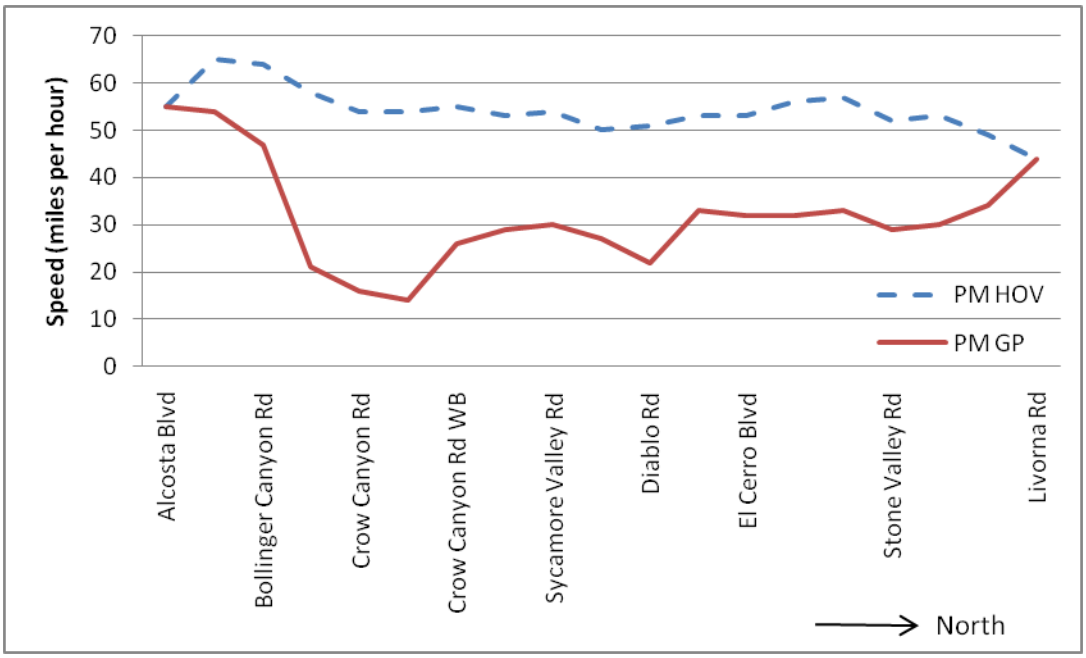
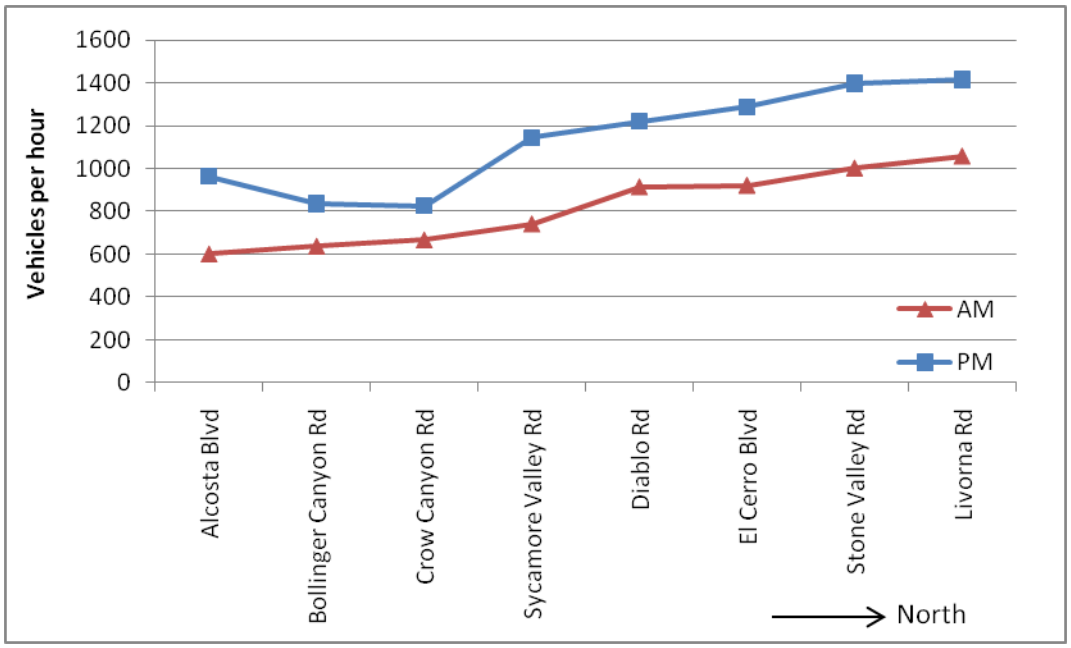


FIGURE 2-3: CC-680S NORTHBOUND P.M. PEAK HOUR (5 P.M. TO 6 P.M.) AVERAGE SPEEDS[1]

[1] MTC Express Lane Phase I Project – Weekday Data Collection Results for Interstate 680. Metropolitan Transportation Commission. September 28, 2012.



Note: Volumes shown include all vehicles traveling in the HOV lane, including motorcycles, hybrid vehicles and single-occupant violators

FIGURE 2-4: CC-680S NORTHBOUND A.M. PEAK HOUR (8 A.M. TO 9 A.M.) AND P.M. PEAK HOUR (5 P.M. TO 6 P.M.) AVERAGE HOV TRAFFIC VOLUMES[1]

Average travel speeds and HOV lane volumes for the southbound direction of I-680 are shown in Figure 2-5 through Figure 2-7. During the peak hour, average speeds in the general purpose lanes tend to be low (15-20 mph) around Rudgear Road and generally improve as drivers travel south along the corridor. Average speeds in the southbound HOV lane follow a similar trend of increasing from north to south, but speeds are maintained above 45 mph at all times. Average HOV volumes, shown in Figure 2-7, do not go above 1100 vph and are lowest south of Sycamore Valley Road.

[1] MTC Express Lane Phase I Project – Weekday Data Collection Results for Interstate 680. Metropolitan Transportation Commission. September 28, 2012.

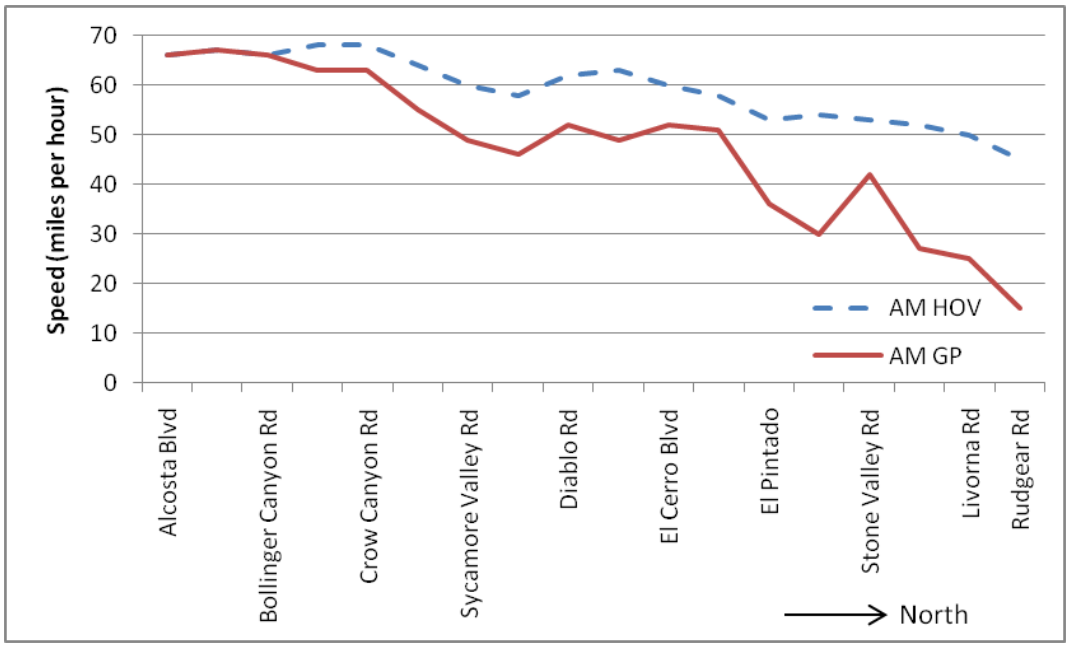


FIGURE 2-5: CC-680S SOUTHBOUND A.M. PEAK HOUR (8 A.M. TO 9 A.M.) AVERAGE SPEEDS[1]

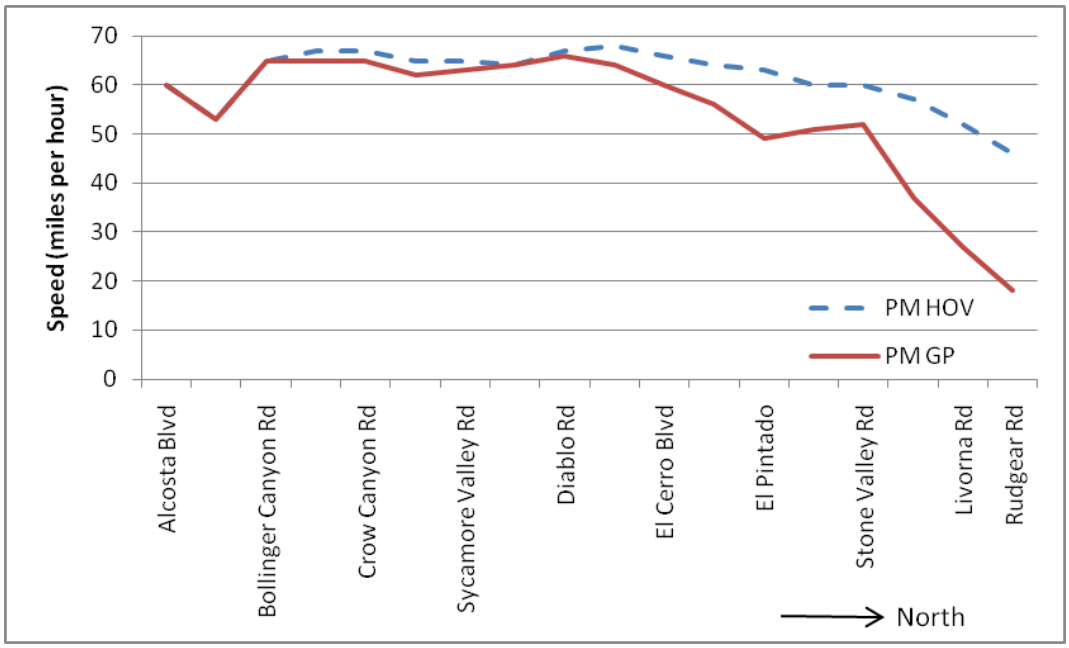
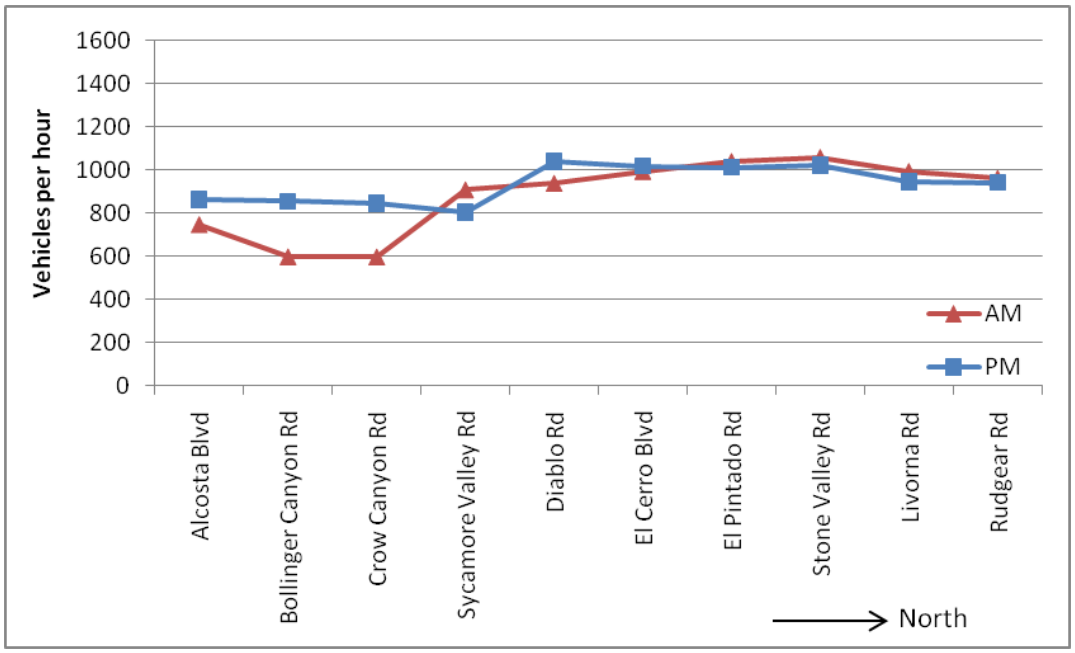


FIGURE 2-6: CC-680S SOUTHBOUND P.M. PEAK HOUR (5 P.M. TO 6 P.M.) AVERAGE SPEEDS[1]

[1] MTC Express Lane Phase I Project – Weekday Data Collection Results for Interstate 680. Metropolitan Transportation Commission. September 28, 2012.



Note: Volumes shown include all vehicles traveling in the HOV lane, including motorcycles, hybrid vehicles and single-occupant violators

FIGURE 2-7: CC-680S SOUTHBOUND A.M. PEAK HOUR (8 A.M. TO 9 A.M.) AND P.M. PEAK HOUR (5 P.M. TO 6 P.M.) AVERAGE HOV LANE TRAFFIC VOLUMES[1]

2.1.1.5 TRANSIT

A list of express bus routes utilizing the I-680 project segment are shown in Table 2-3. The main transit service provider on I-680 within the project limits is County Connection, operated by the Central Contra Costa Transit Authority (CCCTA). County Connection routes connect Dublin/Pleasanton with downtown Pleasant Hill as well as several locations in between. The Livermore Amador Valley Transit Authority (LAVTA) also operates an express bus service as part of WHEELS that uses the I-680 project segment and connects the Dublin BART station with the Pleasant Hill and Walnut Creek BART stations. The Bishop Ranch office park in San Ramon also provides express shuttle service to and from BART.

TABLE 2-3: TRANSIT SERVICE ON CC-680S CORRIDOR

Transit Operator	**Route**
County Connection	92X: Walnut Creek to Pleasanton ACE Train Station
	95X: Walnut Creek BART to San Ramon Transit Center
	96X: Walnut Creek BART to San Ramon Transit Center
	97X: San Ramon Transit Center to Dublin BART
WHEELS	70X: Dublin BART to Pleasant Hill BART

[1] MTC Express Lane Phase I Project – Weekday Data Collection Results for Interstate 680. Metropolitan Transportation Commission. September 28, 2012.

2.1.1.6 PARK AND RIDE

Table 2-4 lists the four park and ride lots along I-680 within the project limits.

TABLE 2-4: CC-680S PARK AND RIDE LOTS

Address	**City**
Sycamore Valley Road & Camino Ramon	Danville
Bollinger Canyon Road & I-680	San Ramon
Camino Ramon & Executive Parkway	San Ramon
Rudgear Road & I-680	Walnut Creek

2.1.2 CONTRA COSTA I-680 NORTH (CC-680N)

2.1.2.1 GENERAL CHARACTERISTICS

The I-680 corridor in northern Contra Costa County serves as a north-south route connecting the cities of Martinez, Concord, Pleasant Hill and Walnut Creek and feeds into the Benicia-Martinez Bridge. The corridor crosses two heavily traveled east-west commute corridors including SR-4 and SR-24. The area surrounding the corridor is urbanized with residential and commercial development south of SR-4 and primarily industrial development north of SR-4. The corridor is characterized by three to six lanes in each direction, multiple curves and constrained inside shoulders.

2.1.2.2 PROJECT LIMITS AND DESCRIPTION

The CC-680N project includes conversion of existing HOV lanes to express lanes on the northbound segment of I-680 between SR-242 and Marina Vista Avenue (4.3 miles) and on the southbound segment between Marina Vista Avenue and Treat Boulevard (7.3 miles). In addition, a new lane will be added, through a separately funded and environmentally cleared project called the Southbound HOV Gap Closure, in the southbound direction between Treat Boulevard and Rudgear Road (4.1 miles) to close the gap that currently exists. The project limits are illustrated in Figure 2-8. When completed, the project will connect to express lanes in southern Contra Costa County, creating continuous express lanes on I-680 through Contra Costa County with the exception of a three mile gap in the northbound direction through Walnut Creek.

FIGURE 2-8: CC-680N PROJECT LIMITS

2.1.2.3 CURRENT HOV OPERATING POLICY

HOV lanes on I-680 operate during weekday peak periods and serve as general purpose lanes during all other times. Current peak period hours of operation are defined as 5 a.m. to 9 a.m. and 3 p.m. to 7 p.m. Access to the HOV lanes on I-680 is unrestricted along the entire length.

HOV lane eligibility requirements on I-680 require two or more passengers in a vehicle during peak periods. Other eligible vehicles include buses, motorcycles and SOVs that meet specified emissions standards with DMV issued decals. Vehicles pulling a trailer and large trucks with more than two axles are not permitted to use HOV lanes.

2.1.2.4 TRAFFIC CHARACTERISTICS

Existing traffic conditions will be described in the Existing Conditions Report to be developed as part of the environmental clearance process for the CC-680N project.

2.1.2.5 TRANSIT

A list of express bus routes utilizing the CC-680N project segment are shown in Table 2-5. The main transit service provider on CC-680N is County Connection, operated by CCCTA. County Connection routes connect from the Walnut Creek BART station to Pleasanton, San Ramon and Martinez. Soltrans and WHEELS also operate express buses that use the corridor.

TABLE 2-5: TRANSIT SERVICE ON CC-680N

Transit Operator	**Route**
County Connection	92X: Walnut Creek to Pleasanton ACE Train Station
	95X: Walnut Creek BART to San Ramon Transit Center
	96X: Walnut Creek BART to San Ramon Transit Center
	98X: San Ramon Transit Center to Dublin BART
Soltrans	76: Vallejo to Diablo Valley College
	78: Vallejo to Walnut Creek BART
WHEELS	70X: Dublin BART to Pleasant Hill BART

2.1.2.6 PARK AND RIDE

Table 2-6 lists the three park and ride lots within the CC-680N project limits.

TABLE 2-6: CC-680N PARK AND RIDE LOTS

Address	**City**
Pacheco Boulevard & Blum Road	Martinez
Treat Boulevard & Oak Road	Pleasant Hill
Rudgear Road & I-680	Walnut Creek

2.1.3 I-880 ALAMEDA (ALA-880)

2.1.3.1 GENERAL CHARACTERISTICS

The I-880 corridor, shown in Figure 2-9, is an approximately 42-mile, north-south route that runs through Alameda and Santa Clara Counties in the East Bay. The corridor connects the San Francisco-Oakland Bay Bridge with the South Bay and serves the Port of Oakland, Oakland International Airport and Mineta San Jose International Airport. As such, the I-880 corridor is a key international trade corridor and has the highest truck volume of any corridor in the region. This urban corridor also serves as a commuter link between Silicon Valley and the East Bay, and serves transbay traffic from three bridges: the Bay Bridge, the San Mateo-Hayward Bridge and the Dumbarton Bridge.

FIGURE 2-9: ALA-880 PROJECT LIMITS

2.1.3.2 PROJECT LIMITS AND DESCRIPTION

As shown in Figure 2-9, this project includes conversion of HOV lanes to express lanes on I-880 SB between Hegenberger Road in Oakland and Dixon Landing Road in Milpitas (27.5 miles) and on I-880 NB between Dixon Landing Road and Lewelling Boulevard in San Leandro (22.3 miles).

Southbound HOV lanes currently begin at Marina Boulevard, but construction is underway on a three-mile northward extension of the southbound HOV lane so that it begins at Hegenberger Road. The project limits assume that construction of this extension will be completed in time for conversion to express lanes. At the southern end of the I-880 project limits, the I-880 HOV lanes connect to the express lanes being operated by VTA. The VTA express lanes opened to traffic on March 20, 2012 and operate between Dixon Landing Road on I-880 and Lawrence Expressway on SR-237 in Santa Clara County.

Within the project limits, the I-880 typical cross-section varies between eight and ten lanes with auxiliary lanes provided in some locations. The southbound segment of I-880 between Hegenberger Road and Dixon Landing Road includes 23 interchanges and the northbound segment from Lewelling Boulevard to Dixon Landing Road includes 17 interchanges, resulting in an average interchange spacing of approximately 1.2 to 1.3 miles. All of the freeway on-ramps within this segment are metered although not all are operational. Many of the metered ramps include HOV bypass lanes that allow HOVs to enter the freeway at a faster metered rate.

The I-880 Integrated Corridor Management (ICM) project is a planned project within the limits of the ALA-880 express lanes. A concept of operations for the I-880 ICM project was developed for the Federal Highway Administration (FHWA) in 2008, defining a number of Intelligent Transportation Systems (ITS) strategies to enhance safety, efficiency and mobility for the I-880 corridor. Building on the initial concept of operations, a prioritized list of ICM strategies was developed for the I-880 corridor in 2012. These strategies include comparative travel times, alternate routes, real-time parking information and adaptive ramp metering. Additionally, the I-880 ICM project identified the need for the development of operational procedures for express lane management during incidents.

As part of the I-880 ICM project, a coordinated freeway and arterial incident management strategy was identified for rapid deployment within the northern segment of the I-880 corridor. To manage traffic that naturally diverts from the freeway due to incidents on I-880, the arterial incident management project will install ITS equipment on arterial streets along the I-880 corridor in the cities of Oakland and San Leandro. The I-880 ICM North Alameda Segment is approximately 12 miles long, between Davis Street in San Leandro and the junction with I-80 in Oakland (Bay Bridge distribution structure). Construction for the I-880 ICM project is scheduled to begin in late 2015 and be completed by late 2016.

Other projects that are planned within the express lane project limits include a Caltrans project to replace the median barrier, a Freeway Performance Initiative (FPI) project and a paving project. Express lane construction activities will need to be coordinated with each of these projects.

2.1.3.3 CURRENT HOV OPERATING POLICY

Like all HOV lanes in the Bay Area, the HOV lanes on I-880 operate only during weekday peak periods and serve as general purpose lanes during all other times. Peak periods on I-880 HOV lanes are defined as 5 a.m. to 9 a.m. and 3 p.m. to 7 p.m. Access to the HOV lanes on I-880 is unrestricted along the entire length.

HOV lane eligibility requirements on I-880 require two or more passengers in a vehicle during peak periods. Other eligible vehicles include buses, motorcycles and single-occupant vehicles that meet specified emissions standards. The Department of Motor Vehicles (DMV) issues green and white decals to vehicles that meet the specified emission standards, which allow drivers of these vehicles

to use HOV lanes without having two or more vehicle occupants. Any vehicle pulling a trailer and large trucks with more than two axles are not permitted to use HOV lanes.

2.1.3.4 CURRENT EXPRESS LANE OPERATING POLICY

The SR-237/I-880 express lane direct connectors opened to traffic on March 20, 2012, allowing single-occupant vehicles (SOVs) to use the direct connectors for a toll. When the express lane opened, the morning peak period hours of operation were extended by one hour to 5 a.m. to 10 a.m. in the southbound-to-westbound direction to accommodate heavy traffic volumes during the 9 a.m. to 10 a.m. hour. On southbound I-880, signing designates the start of the express lane at Dixon Landing Road (see Figure 2-10) and access to the lane is restricted approximately one mile downstream using double white solid striping. Access to the express lane is also restricted in the northbound direction for a distance of approximately one-half mile after the direct connector touches down. Signs designate the end of the northbound express lane at Dixon Landing Road, at which point all single-occupant, toll-paying vehicles are required to have exited the lane. Similar signs are in place on westbound SR-237 where the express lane terminates at Lawrence Expressway.

The operating concept for the I-880 express lanes to be operated by MTC differs from the current operating policy on the SR-237/I-880 express lane direct connectors. These differences in operating policy are described in Chapter 4 along with the need for coordination among MTC and VTA to ensure seamless operations between the two projects.

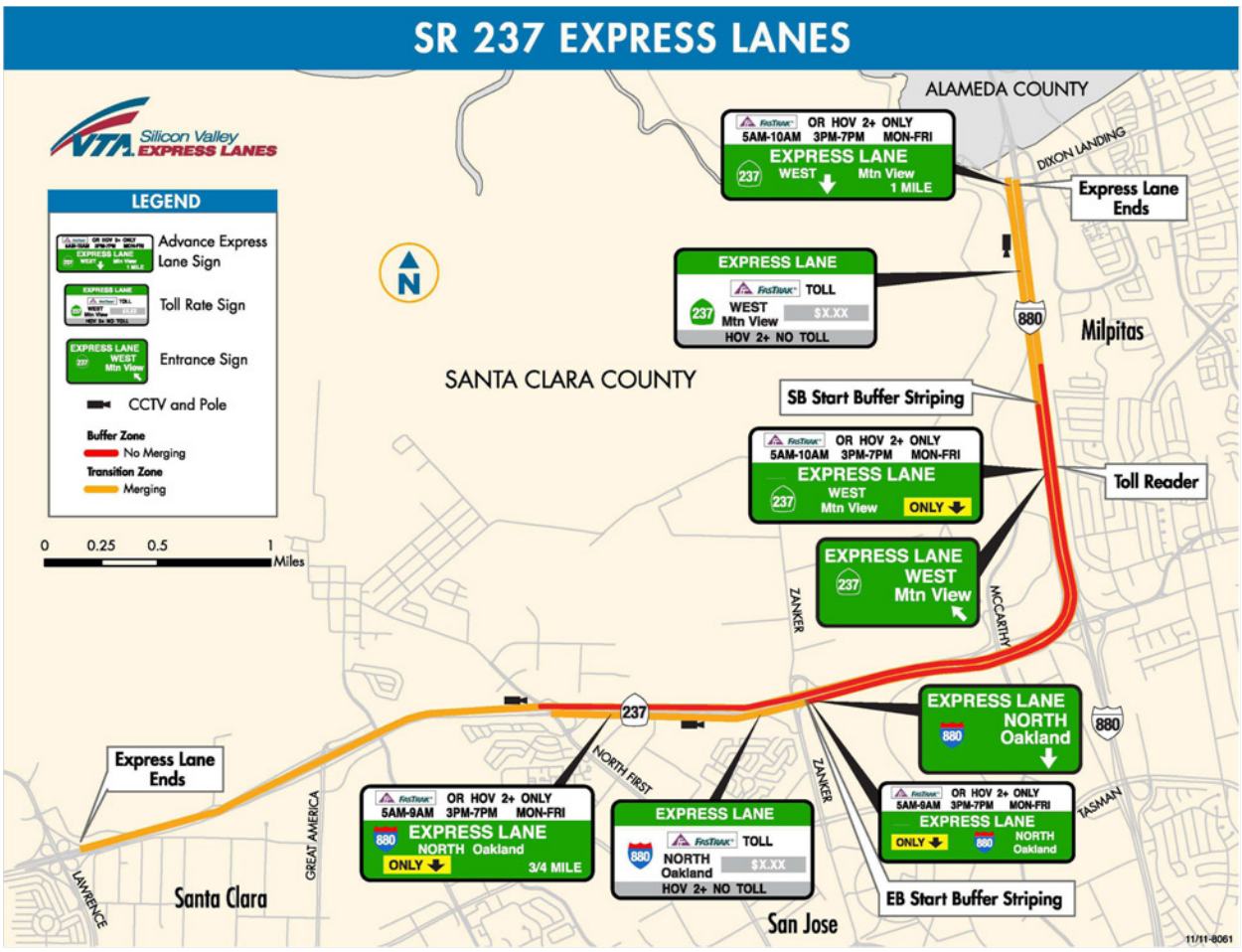


FIGURE 2-10: SR-237/I-880 EXPRESS LANE PROJECT MAP

2.1.3.5 TRAFFIC CHARACTERISTICS

Travel time and traffic volume data were collected for the I-880 corridor in April of 2012 to support the Project Approval/Environmental Document (PA/ED) effort for the I-880 express lanes project. Table 2-7 compares the average travel times by hour during the morning and afternoon peak periods for travel in the HOV lanes and the general purpose lanes. As shown, the longest travel times are experienced during the afternoon peak period in the northbound direction and during the morning peak period in the southbound direction. These are also the time periods during which the HOV lanes provide the greatest travel time savings. For example, a driver traveling southbound on the I-880 corridor using HOV lanes during 8 a.m. to 9 a.m. saves about 22 minutes on average compared to traveling in the general purpose lanes.

The most congested hour during the morning peak period is from 8 a.m. to 9 a.m. in both the northbound and southbound directions. In the afternoon peak period, the most congested hour occurs from 6 p.m. to 7 p.m. in the northbound direction and from 5 p.m. to 6 p.m. in the southbound direction.

TABLE 2-7: ALA-880 AVERAGE TRAVEL TIMES[1]

	Time Period	Average Travel Time (minutes)		
		Using GP Lanes	Using HOV lane	HOV lane travel time savings
Northbound	**Morning Peak Period**			
	5 a.m. - 6 a.m.	27.7	26.9	0.8
	6 a.m. - 7 a.m.	28.5	27.2	1.3
	7 a.m. - 8 a.m.	30.9	28.6	2.3
	8 a.m. - 9 a.m.	33.8	30.1	3.7
	Afternoon Peak Period			
	3 p.m. - 4 p.m.	37.3	30.7	6.6
	4 p.m. - 5 p.m.	42.9	33.5	9.4
	5 p.m. - 6 p.m.	44.1	36.7	7.4
	6 p.m. - 7 p.m.	44.3	40.9	3.4
Southbound	**Morning Peak Period**			
	5 a.m. - 6 a.m.	28.5	27.1	1.4
	6 a.m. - 7 a.m.	33.8	28.5	5.3
	7 a.m. - 8 a.m.	49.9	34.8	15.1
	8 a.m. - 9 a.m.	57.6	35.3	22.3
	Afternoon Peak Period			
	3 p.m. - 4 p.m.	30.1	28.0	2.1
	4 p.m. - 5 p.m.	33.9	30.0	3.9
	5 p.m. - 6 p.m.	37.8	32.1	5.7
	6 p.m. - 7 p.m.	31.5	29.0	2.5

Note: Travel time is measured between Montague Expressway and 66th Avenue. HOV lane travel times include travel in the general purpose lanes where no HOV lanes exist.

Average travel speeds and traffic volumes for the peak hours, identified from the largest travel times above, are shown in Figure 2-11 through Figure 2-13 for the northbound direction of the I-880 corridor. These figures reveal that the northbound HOV lane generally provides higher speeds compared with the general purpose lanes, although speeds in the HOV lane during the p.m. peak hour are more variable and on occasion fall below the federally mandated 45 mph threshold in some spot locations.

The HOV volumes shown in Figure 2-13 represent all vehicles traveling in the HOV lane during the 8 a.m. to 9 a.m. period, including motorcycles, hybrids and violators. Data from the Caltrans District 4 2010 Bay Area HOV Lanes Report suggests that violation rates are as high as 10 percent on some Bay Area corridors. The presence of these violators may account for volumes in the HOV lane being above the operating capacity and may cause speeds to drop. The incorporation of access restrictions where needed for operational and/or safety reasons and an automated violation

[1] MTC Express Lane Phase I Project – Weekday Data Collection Results for Interstate 880. Metropolitan Transportation Commission. September 28, 2012.

enforcement system upon conversion to express lanes is likely to deter many violators from using the lanes, which would free up capacity and improve operating speeds in the lanes.

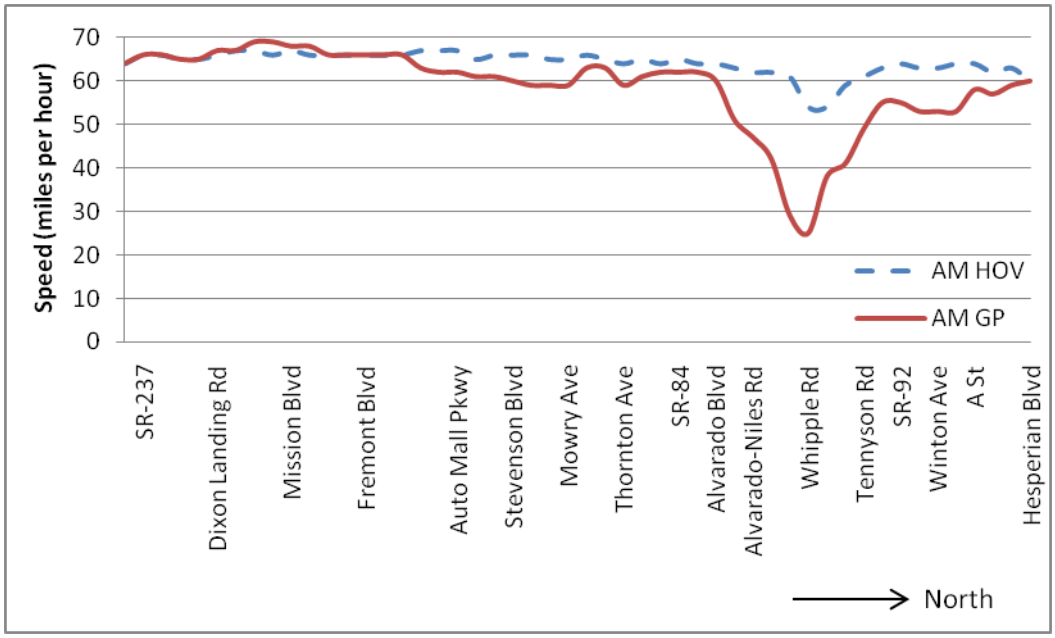


FIGURE 2-11: ALA-880 NORTHBOUND A.M. PEAK HOUR (8 A.M. TO 9 A.M.) AVERAGE SPEEDS[1]

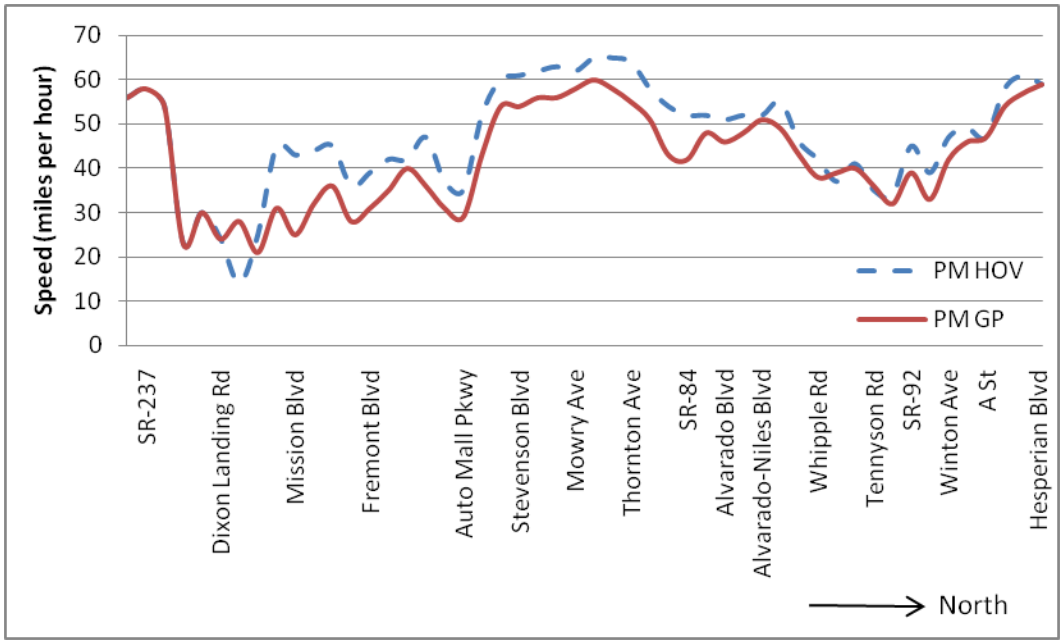
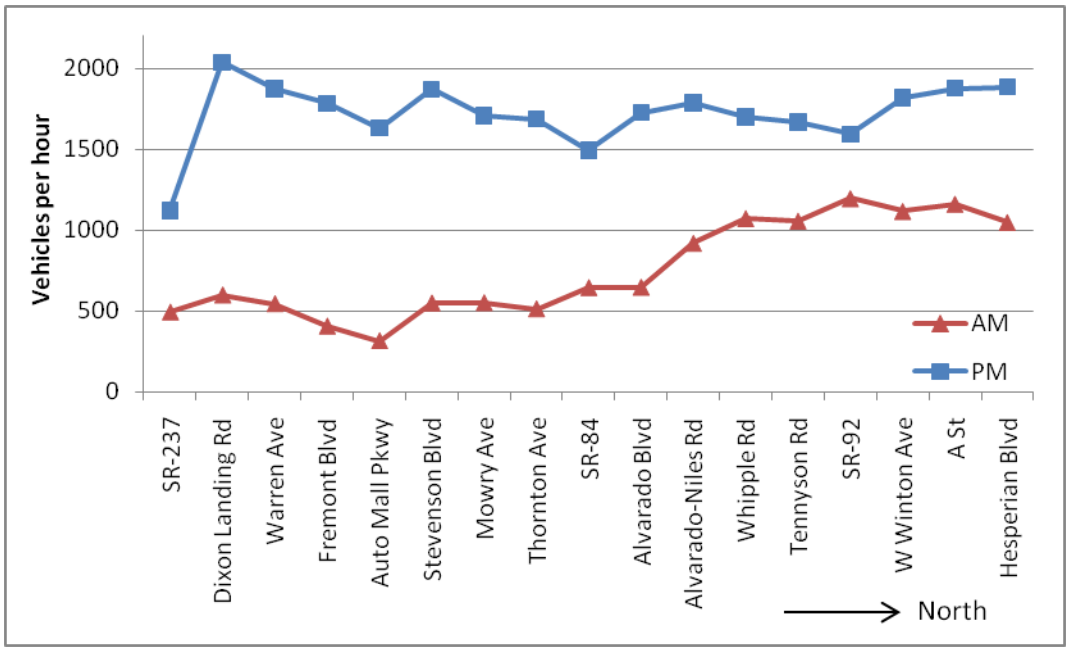


FIGURE 2-12: ALA-880 NORTHBOUND P.M. PEAK HOUR (6 P.M. TO 7 P.M.) AVERAGE SPEEDS[1]

[1] MTC Express Lane Phase I Project – Weekday Data Collection Results for Interstate 880. Metropolitan Transportation Commission. September 28, 2012.



Note: Volumes shown include all vehicles traveling in the HOV lane, including motorcycles, hybrid vehicles and single-occupant violators

FIGURE 2-13: ALA-880 NORTHBOUND A.M. PEAK HOUR (8 A.M. TO 9A.M.) AND P.M. PEAK HOUR (6 P.M. TO 7 P.M.) AVERAGE HOV LANE VOLUMES[1]

Average speeds and traffic volumes for the southbound direction of I-880 are presented in Figure 2-14 through Figure 2-16. As shown, speeds in the HOV lane during the a.m. and p.m. peak hours are generally maintained at or above the 45 mph threshold even as speeds in the general purpose lanes during the a.m. peak hour fall to as low as 15 mph. Traffic volumes in the HOV lane, shown in Figure 2-16, approach the operating capacity between Tennyson Road and Hesperian Boulevard during the p.m. peak hour. However, the southbound HOV lane generally operates at below 1500 vph along most of its length during the peak hours.

[1] MTC Express Lane Phase I Project – Weekday Data Collection Results for Interstate 880. Metropolitan Transportation Commission. September 28, 2012.

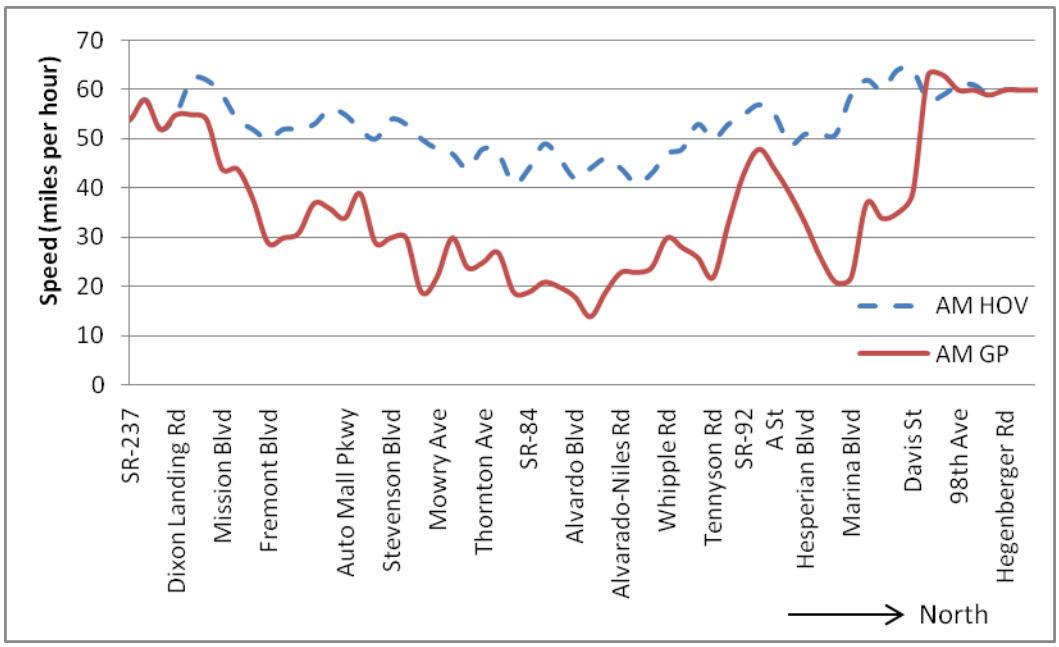


FIGURE 2-14: ALA-880 SOUTHBOUND A.M. PEAK HOUR (8 A.M. TO 9 A.M.) AVERAGE SPEEDS[1]

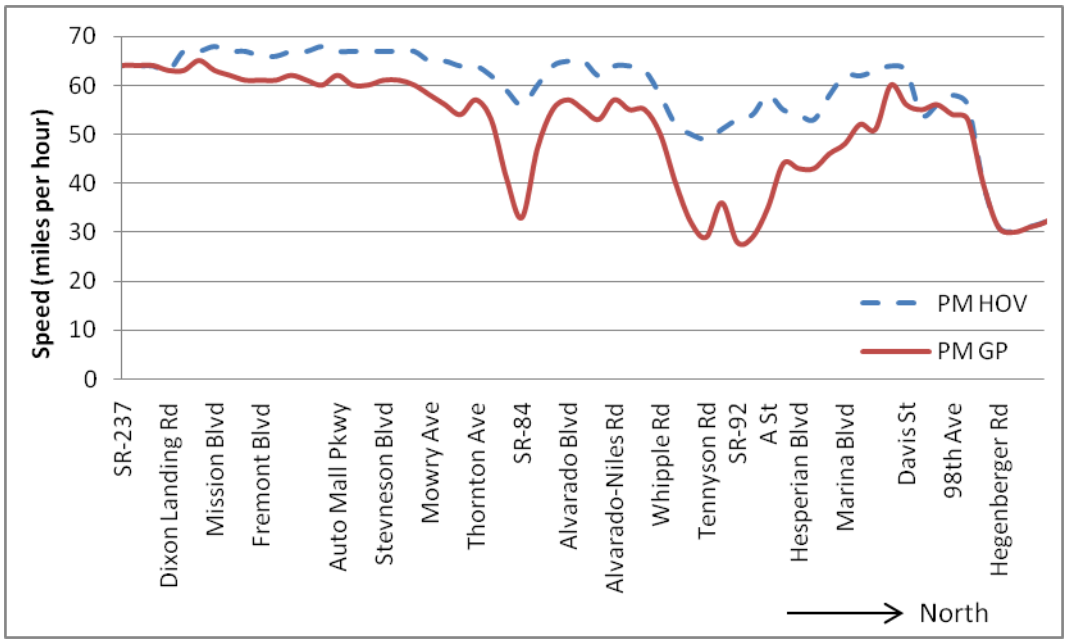
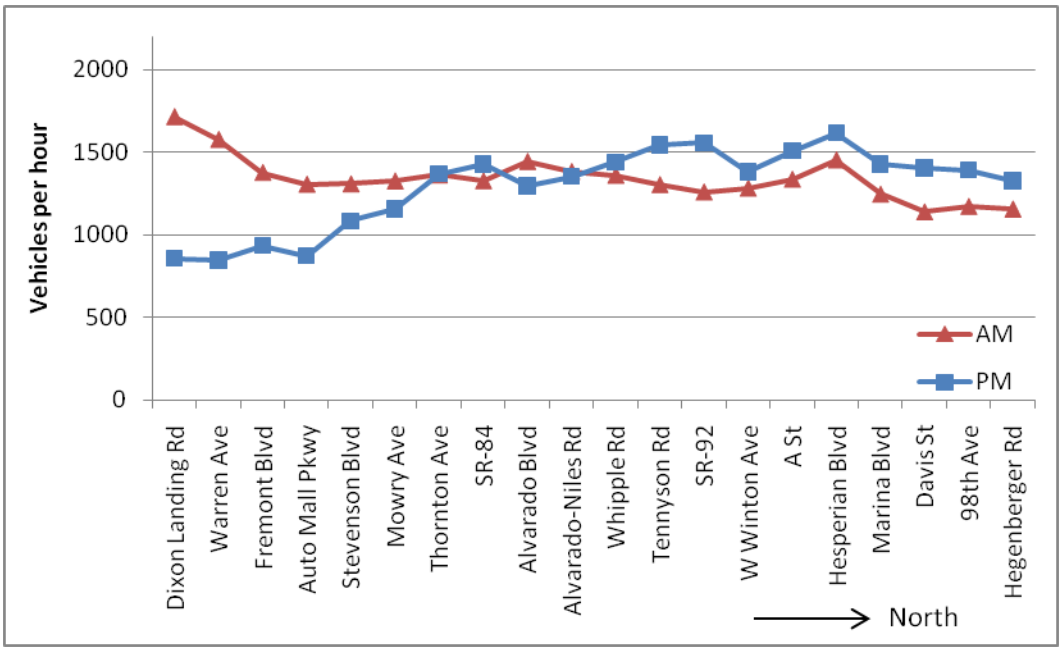


FIGURE 2-15: ALA-880 SOUTHBOUND P.M. PEAK HOUR (5 P.M. TO 6 P.M.) AVERAGE SPEEDS[1]

[1] MTC Express Lane Phase I Project – Weekday Data Collection Results for Interstate 880. Metropolitan Transportation Commission. September 28, 2012.



Note: Volumes shown include all vehicles traveling in the HOV lane, including motorcycles, hybrid vehicles and single-occupant violators

FIGURE 2-16: ALA-880 SOUTHBOUND A.M. PEAK HOUR (8 A.M. TO 9 A.M.) AND P.M. PEAK HOUR (5 P.M. TO 6 P.M.) AVERAGE HOV TRAFFIC VOLUMES[1]

2.1.3.6 TRANSIT

The I-880 corridor serves regional bus service provided by Alameda-Contra Costa Transit (AC Transit) and VTA, as summarized in Table 2-8. AC Transit routes provide transbay service between various locations in the East Bay and downtown San Francisco via the Bay Bridge. VTA routes connect the Fremont BART station to transit centers in Sunnyvale and San Jose and to Mission College in Santa Clara.

TABLE 2-8: TRANSIT SERVICE ON ALA-880 CORRIDOR

Transit Operator	Route
AC-Transit	S: South Hayward to San Francisco
	SA: San Lorenzo to San Francisco
	SB: Newark to San Francisco
	OX: Harbor Bay/Alameda to San Francisco
	O: Alameda to San Francisco
	W: West Alameda to San Francisco
VTA	120: Fremont BART to Lockheed Martin Transit Center
	140: Fremont BART to Mission College
	181: Fremont BART to San Jose Diridon Transit Center

[1] MTC Express Lane Phase I Project – Weekday Data Collection Results for Interstate 880. Metropolitan Transportation Commission. September 28, 2012.

2.1.3.7 PARK AND RIDE

Table 2-9 lists the park and ride lots located along the I-880 corridor within the project limits.

TABLE 2-9: ALA-880 PARK AND RIDE LOTS

Address	**City**
Union City Boulevard & Horner Street	Union City
Ardenwood Boulevard & SR-84	Fremont

2.1.4 I-80 SOLANO WEST AND EAST SEGMENTS (I-80 WEST AND I-80 EAST)

2.1.4.1 GENERAL CHARACTERISTICS

The I-80 corridor in Solano County connects the Cities of Vacaville and Fairfield and provides connections to two major north-south routes including I-505 on the eastern end and I-680 on the western end. The corridor is heavily traveled by commuters on weekdays and on weekends serves as a recreational gateway to destinations outside of the Bay Area, including Lake Tahoe and Reno, Nevada.

2.1.4.2 PROJECT LIMITS AND DESCRIPTION

The I-80 project in Solano County will likely be constructed in two segments (see Figure 2-17). The first segment, referred to as I-80 West, includes conversion of HOV lanes to express lanes on I-80 between Red Top Road and Airbase Parkway in Fairfield, CA. I-80 West is approximately nine miles long and serves a total of ten interchanges, making for an average interchange spacing of less than one mile. Within this segment, the typical cross-section consists of four general purpose lanes plus one HOV lane in each direction, with the exception of the portion between I-680 and SR-12 East which has five general purpose lanes and one HOV lane in each direction.

The second segment, referred to as I-80 East, includes widening to add an express lane in each direction between Air Base Parkway in Fairfield and I-505 in Vacaville. I-80 East is approximately eleven miles long and serves a total of eleven interchanges. The typical cross sections consists of four general purpose lanes in each direction and an inside shoulder that varies from four to ten feet.

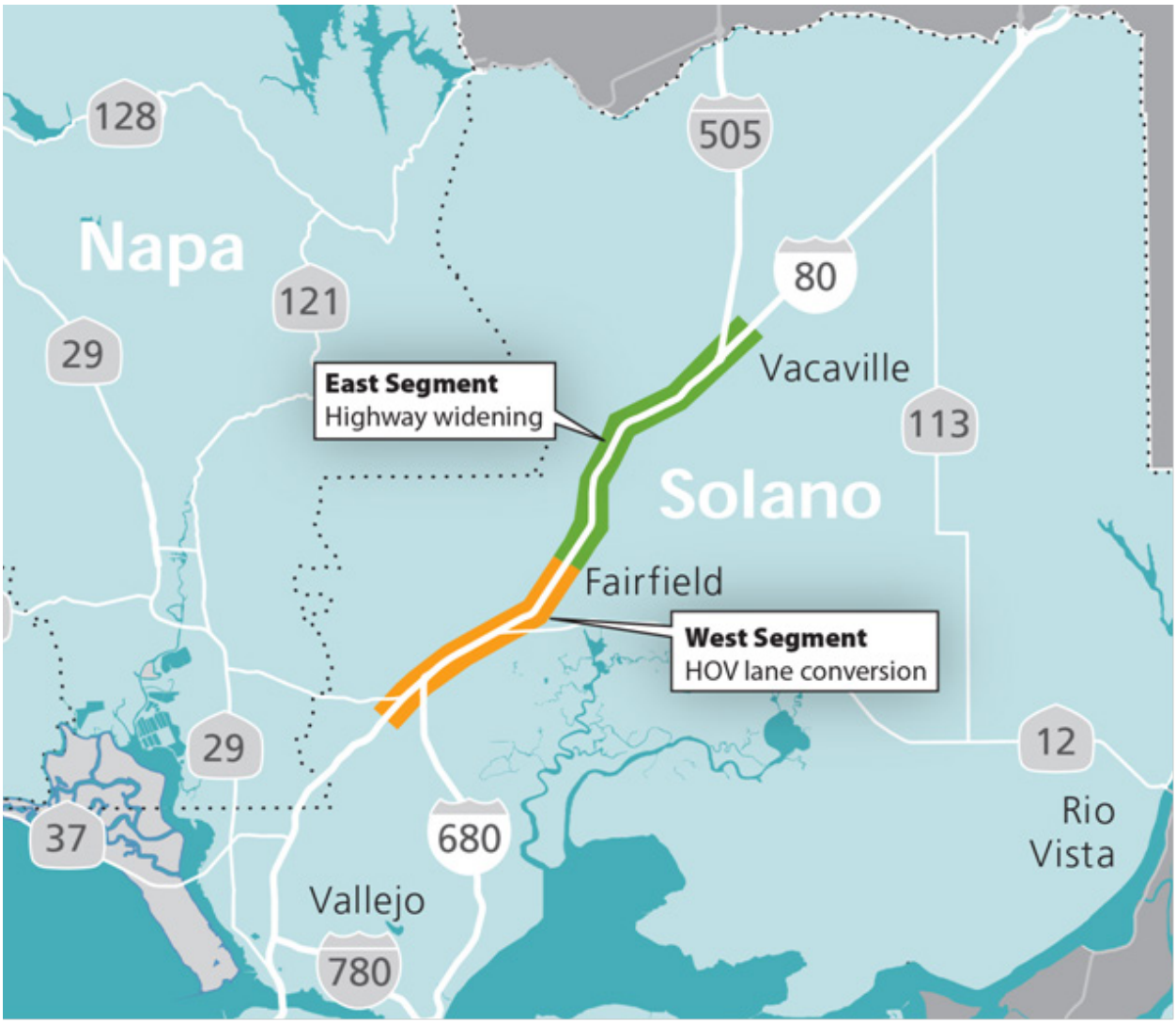


FIGURE 2-17: I-80 WEST SEGMENT AND EAST SEGMENT PROJECT LIMITS

2.1.4.3 CURRENT HOV OPERATING POLICY

HOV lanes on the segment of I-80 between Red Top Road and Airbase parkway were opened to traffic in 2009. Operating hours for the HOV lanes are 5 a.m. to 10 a.m. and 3 p.m. to 7 p.m. During all other times, the lanes serve as general purpose lanes.

HOV lane eligibility requirements on I-80 require two or more passengers in a vehicle during peak periods. Other eligible vehicles include buses, motorcycles and SOVs that meet specified emissions standards.

2.1.4.4 TRAFFIC CHARACTERISTICS

The I-80 corridor through Vacaville and Fairfield is heavily traveled by commuters and freight traffic during weekdays. On weekends, the corridor serves as a gateway for recreational traffic traveling to the Sierra Nevada Mountains and other destinations outside of the Bay Area.

Traffic volume data collected for the Solano County I-80 Express Lane Project are shown in Figure 2-18 and Figure 2-19. Weekday traffic volumes are heaviest during the p.m. peak period in the eastbound direction and during the a.m. period in the westbound direction, reflecting the typical commute pattern representative of vehicles heading towards San Francisco and Oakland in the morning and returning home in the afternoon. These figures also show that weekend traffic volumes are significant. In the westbound direction, Sunday peak period volumes are nearly as high as weekday peak volumes, due to recreational traffic.

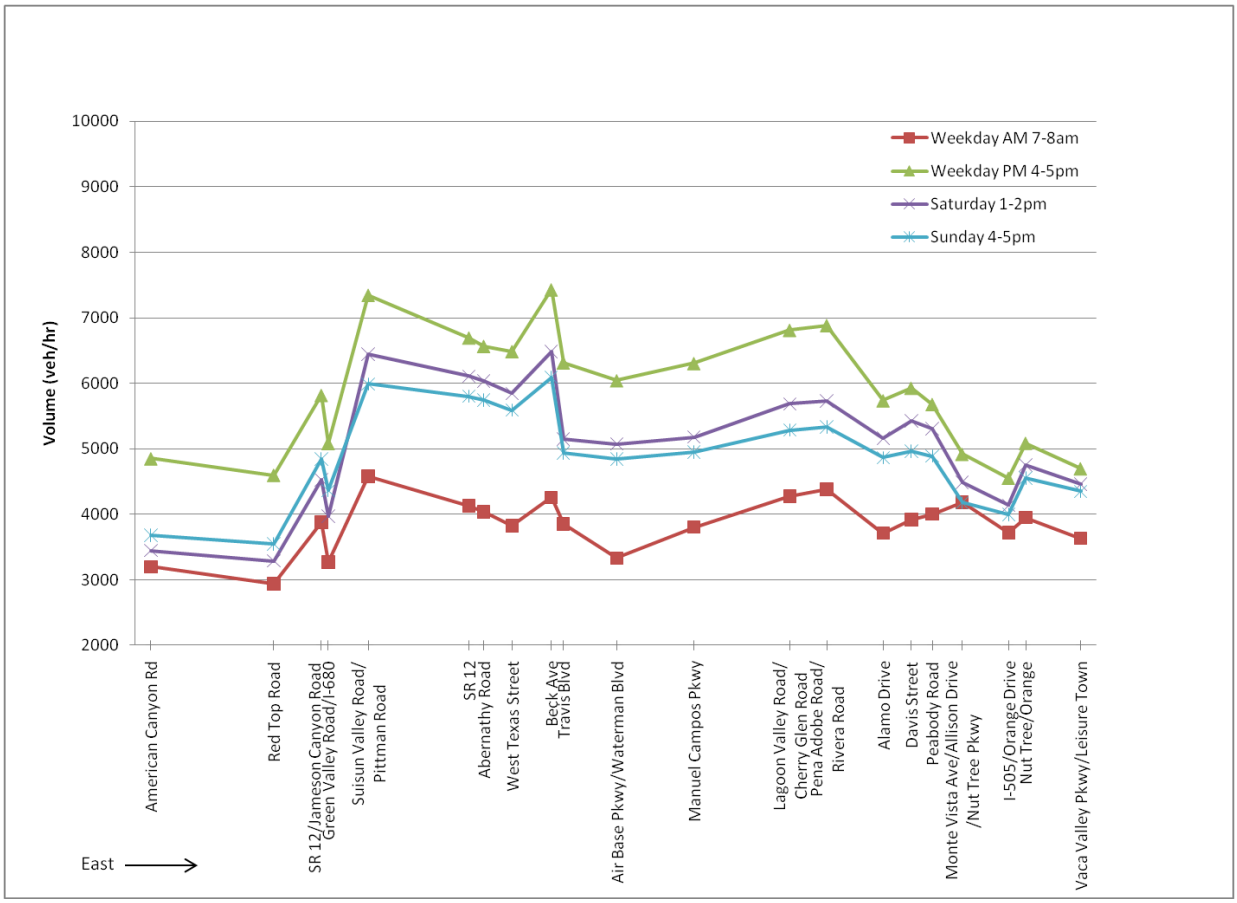


FIGURE 2-18: EASTBOUND I-80 WEEKDAY AND WEEKEND PEAK TRAFFIC VOLUMES[1]

[1] I-80 Express Lanes Project Existing Conditions Report. Solano Transportation Authority. September 28, 2012.

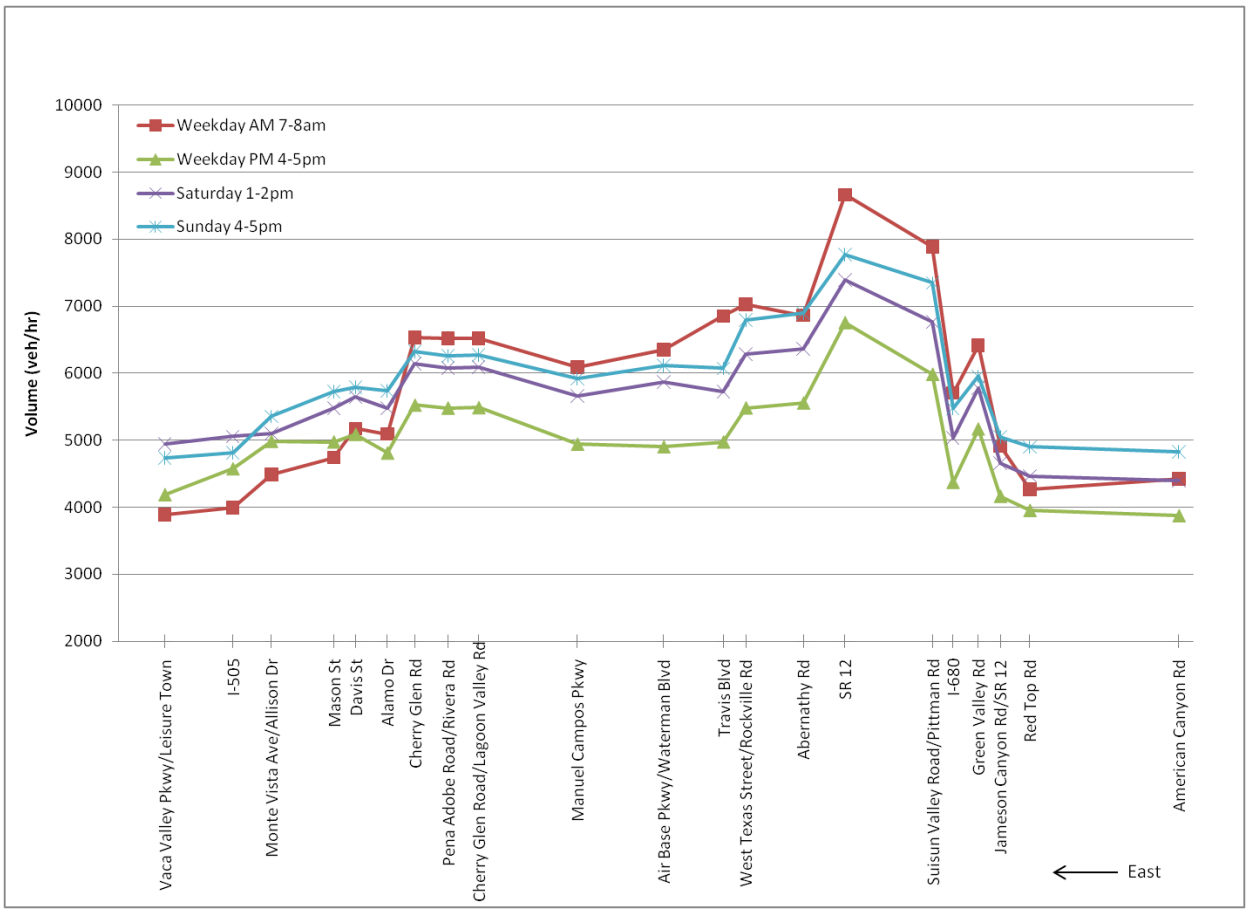


FIGURE 2-19: WESTBOUND I-80 WEEKDAY AND WEEKEND PEAK TRAFFIC VOLUMES[1]

Peak hour HOV volumes from the Caltrans District 4 2010 Bay Area HOV Lanes report indicate that substantial unutilized capacity exists in the HOV lanes, as shown in Table 2-10[2].

TABLE 2-10: PEAK HOUR HOV VOLUMES ON I-80 (2010)[2]

Direction	Segment	Average HOV Volumes (vph)	
		AM Peak	PM Peak
Westbound	Airbase Parkway to Red Top Road	347	235
Eastbound	Red Top Road to Airbase Parkway	191	495

Note: HOV Volumes include all vehicles in the HOV lane, including motorcycles, hybrids and violators.

2.1.4.5 TRANSIT

There are four transit operators providing intercity bus service on the I-80 corridor between Fairfield and Vacaville, as shown in Table 2-11. These include Fairfield/Suisun Transit (FAST), Delta Breeze, Yolobus and Soltrans.

[1] I-80 Express Lanes Project Existing Conditions Report. Solano Transportation Authority. September 28, 2012.

[2] 2010 Bay Area HOV Lanes: Volumes, Occupancies and Violation Rates for Freeway High Occupancy Vehicle Lanes in the San Francisco Bay Area. California Department of Transportation, District 4, Office of Highway Operations.

TABLE 2-11: TRANSIT SERVICE ON I-80 CORRIDOR

Transit Operator	Route
FAST	20: Vacaville to Fairfield
	30: Fairfield to Sacramento
	40: Vacaville to Walnut Creek BART
	90: Fairfield to El Cerrito del Norte BART
Delta Breeze	50: Rio Vista to Fairfield
	52: Rio Vista to Pittsburgh/Bay Point BART
YoloBus	220: UC Davis to Vacaville
Soltrans	85: Vallejo to Fairfield

2.1.4.6 PARK AND RIDE

There are seven park and ride lots located along the I-80 project limits, shown in Table 2-12.

TABLE 2-12: I-80 PARK AND RIDE LOTS

Address	City
Red Top Road & I-80	Fairfield
Green Valley Road & I-80	Fairfield
Fairfield Transportation Center Near West Texas & I-80	Fairfield
Cliffside Drive & I-80	Vacaville
Davis Street (north) & Hickory Ln	Vacaville
Davis Street (south) & I-80	Vacaville
Allison Drive & Ulatis	Vacaville

2.2 FUTURE CORRIDORS TO BE DEVELOPED

Table 2-13 below lists the remaining express lane projects to be developed in the MTC network. As development begins on a project, a project description similar to those shown in the previous sections will be added to this chapter.

TABLE 2-13: PROJECT CHARACTERISTICS FOR FUTURE PROJECTS

County	Corridor	Project Limits	HOV Lane Characteristics	
			Operating Hours	HOV Occupancy Requirement
ALA/CC	I-80	Carquinez Bridge to Bay Bridge	5-10 a.m. and 3-7 p.m.	HOV 3+
ALA	Bay Bridge	I-80, I-580 and I-880 approaches to HOV lanes	5-9 a.m. and 3-7 p.m.	HOV 3+
ALA	SR-84	I-880 to Dumbarton Bridge Toll Plaza*	5-10 a.m. and 3-7 p.m.	HOV 2+
ALA	SR-92	I-880 to San Mateo-Hayward Bridge Toll Plaza*	5-10 a.m. and 3-7 p.m.	HOV 2+
ALA	I-880NB	Hegenberger Road to Lewelling Boulevard	N/A	
CC	I-680	SR-242 to North Main Street	N/A	
SOL	I-80	Carquinez Bridge to SR-37	N/A	
SOL	I-80	SR-37 to Red Top Road	N/A	
SOL	I-80	I-505 to Yolo County Line	N/A	
SOL	I-680	I-80 to Benicia-Martinez Bridge	N/A	
SOL	I-80/ I-680	Interchange direct connectors	N/A	

* Environmental phase fully funded and underway

Early work was undertaken to study the characteristics of the bridge approaches. This information is included in Appendix A and will be updated when development of the bridge approaches resumes.

CHAPTER 3 FACILITY DESIGN

This chapter highlights preliminary geometric and signing standards that will be applied to the design of MTC Express Lanes. The concepts provided in this chapter do not represent final design decisions. Instead, they are intended to promote clarity and consistency for both users and operators throughout the MTC Express Lanes. As the engineering for the express lane projects advances, there may be refinements or changes to the design.

The following sections describe the preliminary design approach being applied to MTC Express Lanes including CC-680S, CC-680N, ALA-880 and I-80 in Solano County.

3.1 CURRENT INVENTORY

The existing HOV lanes in the Bay Area operate as concurrent flow lanes which are located on the inside freeway lane in the same direction of travel and not physically separated from the adjacent general purpose lanes. Overhead and median barrier-mounted signs and the diamond symbol pavement marking are used to designate the HOV lanes from the general purpose lanes. In addition, the corridors and bridge approaches have all the components of a freeway system, including existing signs, sign gantries and striping that will need to be evaluated during design of the express lanes.

3.2 DESIGN STANDARDS

The express lanes will be implemented on Caltrans facilities and therefore will need to be designed in accordance with all applicable Caltrans standards. The final highway design will be approved by Caltrans and may also require FHWA approval. The following design standards and guidance documents will be referenced during the design process:

- Caltrans Highway Design Manual (HDM)
- Caltrans Standard Plans and Standard Specifications
- Caltrans High-Occupancy Vehicle Guidelines
- California Manual on Uniform Traffic Control Devices (MUTCD)
- Caltrans Traffic Operations Policy Directive (TOPD) 11-02
- Caltrans Headquarters is currently updating the state's existing HOV Guidelines and other general policies to include in the new HOV/Express Lane Policy Guidance. At the time this document was drafted, these guidelines were not yet published. However, efforts are ongoing to coordinate with headquarters staff to ensure this project is consistent with the proposed guidelines.
- Caltrans encroachment policies and guidance.
- Caltrans safety guidelines.
- All other current Caltrans standards, policies and procedures applicable to the project.

3.3 TYPICAL SECTION

All MTC Express Lanes are proposed to be concurrent flow, single-lane express lanes. The existing condition provides limited ability to expand the freeway cross-section, and the ultimate design will

be influenced by this limitation. Where reductions in the standards for cross-sectional elements are determined necessary and justified and approved by Caltrans, the HOV Guidelines provide a priority listing of where the reductions should be made. The ranges of widths for various elements of the freeway cross-section from the Caltrans Highway Design Manual and the HOV Guidelines are listed below in Table 3-1.

TABLE 3-1: FREEWAY CROSS-SECTION ELEMENTS

	Unrestricted Access	**Restricted Zone**
Left Side Offset	10 feet (standard) 2 feet *	10 feet (standard) 2 feet *
Lane Widths	14 feet (desirable) 12 feet (standard) 11 feet *	14 feet (desirable) 12 feet (standard) 11 feet *
Express Lane Buffer Width	0 feet	4 feet (desirable) 2 feet *
Right Side Shoulders	10 feet	10 feet

*Subject to Caltrans approval

3.4 ACCESS AND STRIPING

Current guidance specified in Caltrans' Traffic Operations Policy Directive (TOPD) 11-02 issued in April of 2011 suggests consideration of two types of access treatments for managed lanes as described below:

1. Limited access design – Access to/from the express lane is provided at designated locations, typically through at-grade access openings that can serve ingress, egress, or combined ingress and egress. Physical barriers or striping separates the express lane from the adjacent general purpose lanes between access locations.
2. Continuous access design – Access to/from the express lane is not restricted to designated locations. Instead, vehicles are able to enter and exit the express lane at any point.

The access configuration for MTC Express Lanes will most likely be a combination of the two access treatments specified above. The goal of the MTC express lane access configuration will be to preserve the flexibility inherent in the design of the existing continuous access HOV system to the extent possible, while at the same time ensuring that safety and operational considerations are addressed. The requirements related to weaving distance and minimum access openings specified in the TOPD for limited access design pose a challenge for implementation in settings with closely spaced interchanges particularly in corridors that have narrow shoulders and/or reduced width travel lanes. Therefore, it is expected that MTC Express Lanes may have long stretches of unrestricted access where traffic and safety analyses do not reveal adverse impacts to operations or safety. In this document, the term "more open access" is used to recognize that some express lanes corridors will allow ingress and egress at most locations but there will be some areas of restricted access. Other corridors may have longer stretches of limited access if needed for safety or operational reasons. Figure 3-1 below illustrates a preliminary access concept for ALA-880 with a combination of limited and continuous access.

FIGURE 3-1: EXAMPLE OF PRELIMINARY EXPRESS LANES ACCESS

The California MUTCD requires a broken single 8-inch wide white lane line to designate stretches of unrestricted access to an express lane. Areas of restricted access are designated using a solid

double stripe white pavement marking. The use of a diamond marking, as seen in HOV lanes, will not be used to designate express lanes; instead, a white pavement marking consisting of the words "EXPRS LANE" will be used.

In addition to operational and safety considerations, the placement of access restrictions must also consider transit routes. Buses require longer weaving distances to reach the express lane from a freeway on-ramp and to reach an off-ramp from the express lane. Locations of park and ride lots should also be considered when placing access restrictions.

3.5 SIGNING

The MUTCD provides prescriptive sign and lane marking requirements for toll roads (i.e. facilities where all users are required to pay a toll) and for managed lanes (e.g., express lanes). The MUTCD express lane requirements are for limited access facilities, including requirements for signing at the beginning and end of an express lane facility and for intermediate access locations. The MUTCD does not provide guidance with respect to the type and frequency of signs to employ for continuous access express lanes, although it does include signing practices for continuous access HOV lanes that could be applicable to express lanes. Signing requirements for toll roads, including requirements for the depiction of pictographs for electronic toll collection accounts, are also applicable to express lanes.

In order to develop a preliminary signing concept for a more open access design, a series of workshops was held with MTC, Caltrans (District 4 and Headquarters), the CMAs, CHP and FHWA. These workshops provided a forum to discuss assumptions related to the types and frequency of signs that would be necessary. Imposing an access restriction after a long stretch of unrestricted access was a main topic of discussion, since this transition to restricted access required unique signing to ensure that users are alerted about upcoming access restrictions. Since the workshops, final sign plans have been developed for CC-680S and preliminary design plans, which are subject to change, have been developed for ALA-880. The signing considerations discussed in this chapter are based on these designs and take into account Caltrans sign mounting details and requirements for median barrier replacement.

The proposed signing treatments are discussed in the following sections for the start of an express lane, intermediate access locations (where ingress/egress is allowed between stretches of restricted access), areas of unrestricted access, transition from unrestricted to restricted access and vice versa, terminus of an express lane, and transition from an express lane to a HOV lane. Signing concepts for individual corridors will need to take into account the existing inventory of signs within the express lane limits.

The signs described in the following sections assume that all vehicles are required to have a FasTrak® account. Eligible toll-exempt vehicles will be required to carry a switchable toll tag to travel in the express lanes without paying a toll. The switchable toll tags will be branded and marketed as "FasTrak® Flex" as described in Chapter 4. A statewide logo for the FasTrak® Flex toll tags was developed to include on express lanes signage.

3.5.1 SIGNS DESIGNATING THE BEGINNING OF AN EXPRESS LANE

Signing for the start of an express lane includes advance overhead signs to let drivers know that they are approaching an express lane, the price to travel in the express lane, the FasTrak® account requirement and the hours of operation.

Overhead-mounted express lane signs in advance of the express lane entrance will be used to inform drivers that they are approaching the start of an express lane (see Figure 3-2). These signs will also indicate that a FasTrak® account is required for vehicles to use the lane.

FIGURE 3-2: EXAMPLE EXPRESS LANE ENTRANCE GUIDE SIGN

Pricing signs will be overhead-mounted and display the toll to travel to downstream locations (see Figure 3-3). In accordance with the guidance provided in the MUTCD, pricing signs will display no more than two downstream locations. Changeable message elements will be used to display the toll amount in effect at any given time. As discussed in Chapter 4, the destinations shown on pricing signs will correspond to the termini of pricing zones. Pricing signs will include a third dynamic message display element below the destinations for the purpose of displaying express lane messages as appropriate. This display may be used to indicate the requirement for carpools to carry a FasTrak® Flex toll tag or other key messages as needed. The pricing signs will also be located at intermediate access locations and at strategic locations within unrestricted access segments as described in the following section.

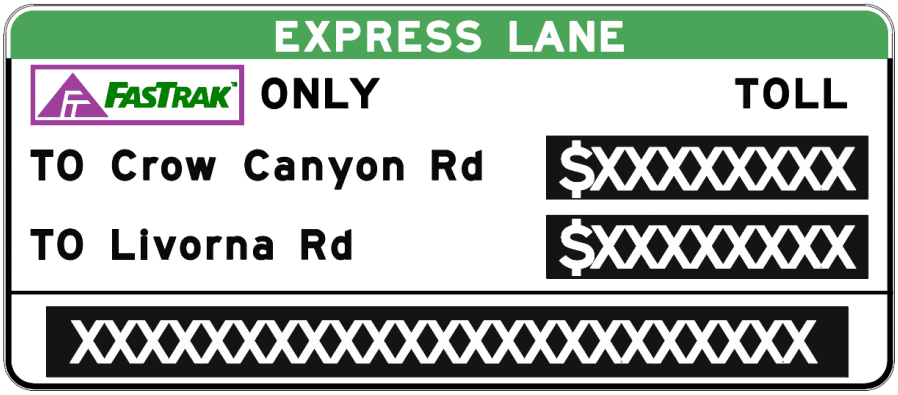


FIGURE 3-3: EXAMPLE EXPRESS LANE PRICING SIGN

3.5.2 SIGNS TO BE PLACED AT REGULAR INTERVALS WITHIN UNRESTRICTED ACCESS SEGMENTS

Along segments where there are few or no access restrictions, overhead regulatory signs will be located at regular intervals to clearly designate the express lane and display the HOV eligibility requirement, hours of operation and the FasTrak® account requirement for all vehicles in the lane (see Figure 3-4). These signs may need to allow for easy modifications in the event that the HOV eligibility requirement or the hours of operation change in the future.

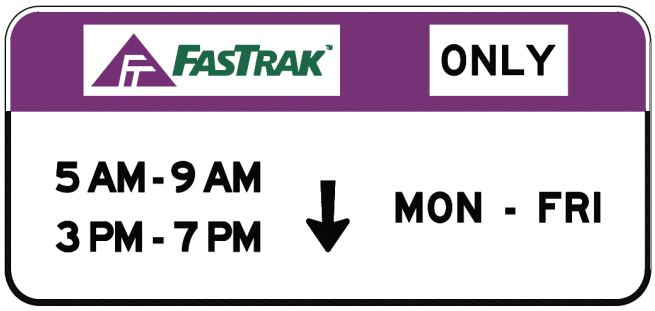


FIGURE 3-4: EXAMPLE EXPRESS LANE OVERHEAD REGULATORY SIGN

In addition to the overhead regulatory signs, pricing signs will be strategically placed downstream of on-ramps with large traffic volumes so that drivers have an opportunity to see the toll rate before being detected at a toll point and at locations with recurring congestion where drivers are likely to make a decision to enter the express lane. The spacing between pricing signs will vary based on the characteristics of different corridors (i.e., interchange spacing, bottleneck locations and access restrictions), but the average spacing is expected to be no more than two miles along segments with no access restrictions.

Barrier-mounted signs will be placed at regular intervals to reinforce the requirement for all vehicles to have a FasTrak® account and for eligible vehicles to carry a FasTrak® Flex toll tag. This sign is depicted below in Figure 3-5.

FIGURE 3-5: EXAMPLES EXPRESS LANE
BARRIER-MOUNTED SIGN

3.5.3 SIGNS FOR INTERMEDIATE ACCESS WITHIN RESTRICTED SEGMENT

In advance of locations where access to/from the express lane is provided within a restricted access segment, overhead signs will be placed to inform drivers in the general purpose lanes of the upcoming opportunity to enter the express lane. Like the sign in Figure 3-2 they will include the FasTrak® account requirement and tell drivers how far ahead the express lane access is.

If the break in the express lane access restriction is short (i.e., the express lane access restriction will begin again after satisfying the minimum requirements in the TOPD), then signs will be needed to inform drivers in the express lane of the local exits that are served by the express lane intermediate access point. These local exit signs (see Figure 3-6) should list all downstream exits that are not directly accessible from the express lane due to access restrictions, thereby informing drivers wishing to access one of the locations shown that they need to exit the express lane.

FIGURE 3-6: EXAMPLE EXPRESS LANE LOCAL EXIT SIGNS FOR INTERMEDIATE ACCESS

3.5.4 SIGNS DESIGNATING BEGINNING OF A RESTRICTED SEGMENT

In locations where express lanes transition from unrestricted access to restricted access, it will be necessary to inform drivers of the impending change in access type. In addition to the local exit signs shown in Figure 3-6, additional signs shown in Figure 3-7 will inform drivers that they will no longer be able to freely exit the express lane ahead. These signs will be installed at regular intervals within a restricted segment to reinforce the access restriction.

FIGURE 3-7: EXAMPLE EXPRESS LANE SIGNS INDICATING UPCOMING ACCESS RESTRICTION

There may be instances when drivers entering the freeway are able to access the express lane before a restricted access segment begins, but are not able to see the sequence of signs advising of the upcoming restrictions and the interchanges they cannot access. In this instance, it may be necessary to locate signs along the freeway on-ramp to alert motorists of the restricted access.

3.5.5 SIGNS DESIGNATING THE END OF AN EXPRESS LANE

A sequence of signs beginning one-half mile upstream of the terminus of an express lane will be used in accordance with the MUTCD to indicate that the express lane is ending. For an express lane that transitions to an HOV lane, a sequence of post-mounted signs instructing all non-HOV vehicles to exit will be installed (see Figure 3-8). These signs will also indicate the HOV eligibility requirement and the hours of operation for the HOV lane.

FIGURE 3-8: EXAMPLE SIGNS INDICATING END OF EXPRESS LANE

3.6 TOLL POINTS

The locations of toll points, which consist of toll tag readers and Automatic License Plate Recognition (ALPR) cameras, are important for operations as well as enforcement. There is a concern that toll evaders may try to weave in and out of the lane to avoid the toll points in areas where access is not restricted. This concern can be minimized with careful consideration of both the frequency and placement of toll points. Initial toll sites will be identified based on operational needs and areas of restriction. The assumption is that toll zones will be more frequent in areas of open access and less frequent in areas of restricted access. They may be strategically placed downstream of major interchanges and at locations where bottlenecks are known to occur regularly. The exact spacing of the toll points will be determined during design and should provide redundancy if a toll point malfunctions so that the toll system can function without all toll points operational at all times. In segments with unrestricted access, toll points will generally be placed at intervals that are no greater than 1.5 miles apart.

3.7 OBSERVATION AREAS

Observation areas are wider median areas where CHP can observe express lane patrons to ensure compliance with express lane eligibility requirements. Observation areas differ from enforcement areas in that a vehicle cannot be pulled over into an observation area. Observation areas will be strategically located to allow CHP to easily view enforcement beacons, as described in Chapter 7.

In lessons learned from existing projects, CHP has noted that observation areas have been "fit in" to the express lane and are unusable by CHP, particularly for CHP's new fleet of SUV cruisers. CHP has

also expressed a preference for observation areas to be elevated to provide a better viewing angle into vehicles, and to have long, gradual run-offs to allow their cruisers to easily accelerate to full speed. As a result, Caltrans, in consultation with Bay Area Express Lanes operators and the CHP, has developed a prototypical layout for CHP observations areas located in the freeway median. This design provides positive barrier protection, an 18" raised platform for the CHP vehicle and a set of FasTrak® status beacons. From this protected vantage point, a CHP officer can view the number of passengers within higher profile vehicles along with the status of their FasTrak® tag. In the event that an enforcement action is needed, the design provides for sufficient acceleration prior to a safe merge into the lane.

Discussions with CHP will continue to inform decisions related to the design of enforcement provisions for express lanes.

3.8 LIGHTING

During the development of the traffic safety analyses for the projects under development, Caltrans provided specific direction on how and where additional highway lighting will be applied on continuous access express lanes and MTC agreed to the requirements. Additional overhead lighting will be placed in the following locations:

- For 1,000 feet prior to the entrance and 1,000 feet beyond the termination of the express lane;
- For 2,000 feet in the vicinity of a toll zone change (including 1,000 feet prior to and 1,000 feet following a toll zone change);
- Mounted above pricing signs;
- At CHP observation areas (2 lights in each direction).

Specific lighting requirements are subject to change based on future agreements between Caltrans and MTC.

CHAPTER 4 OPERATING CONCEPT

This chapter describes how MTC Express Lanes will operate. As defined in Chapter 1, express lanes allow vehicles that do not meet HOV lane eligibility requirements to use the lane when paying a variably priced toll. The following sections describe how HOVs and toll-paying vehicles will use MTC Express Lanes and how the express lanes will be priced to ensure that performance meets State and Federal requirements. This chapter also describes how MTC Express Lanes will interface with other California express lane systems and with other operational projects such as ramp metering and ICM.

4.1 EXPRESS LANE OPERATING REQUIREMENTS

There are federal and state regulations governing the operation of express lanes. Section 166(d) of the United States Code requires agencies operating HOV lanes that allow tolled vehicles or low emission vehicles to annually certify that the lanes are not degraded. Degradation is defined as a facility that does not meet a minimum average operating speed of 45 miles-per-hour (mph) 90 percent of the time over a consecutive 180-day period during morning or evening weekday peak hour periods. The maximum traffic flow rate at which this speed can be reliably maintained on Bay Area HOV lanes is commonly assumed to be approximately 1650 vehicles per hour (vph), referred to herein as the operating capacity of the HOV lanes. The California Streets and Highway Code states that express lanes must maintain Level of Service (LOS) C, unless Caltrans makes an exception to accept a threshold of LOS D.

4.2 PAYMENT SCENARIOS

All MTC Express Lane customers will be required to have a FasTrak® account. Toll-exempt vehicles will be required to carry a FasTrak® Flex toll tag toggled to an appropriate toll-exempt setting as described in Section 4.3.1.1. This scenario allows the toll system to automatically distinguish between toll-paying and toll-exempt vehicles and for ALPR cameras to capture license plate images of any vehicle not carrying a toll tag for automatic toll violation processing.

4.2.1 EVALUATION OF SCENARIOS

Several payment option scenarios were evaluated for MTC Express Lanes as shown in Table 4-1. Pay-by-plate account scenarios were included in the evaluation due to the Golden Gate Bridge Highway and Transportation District's (GGBHTD) approval of license plate accounts for toll payment. For customer service and consistency reasons, the Bay Area Toll Authority (BATA) honors GGBHTD pay-by-plate accounts on the state-owned bridges and may eventually offer pay-by-plate as an option for BATA customers. Therefore, pay-by-plate options were evaluated in Scenarios 4 through 7. These scenarios consider different permutations of toll payment options and methods for eligible toll-exempt vehicles to be recognized by the toll system, which are further described in the sections that follow. The detailed evaluations for each of the seven scenarios are provided in Appendix B, which shows how each scenario was evaluated against a set of criteria including cost, enforcement, policy, reliability, bandwidth requirements and revenue impacts. As the most preferred scenario that allows the possibility of pay-by-plate, Scenario 5 is assumed for

the purposes of this document. Throughout this document, the term "FasTrak® account" is used to refer to both toll tag and pay-by-plate accounts.

TABLE 4-1: OPERATING SCENARIOS EVALUATED FOR MTC EXPRESS LANES

Scenario	Payment options for toll-paying vehicles			Payment options for toll-free vehicles			
	Standard FasTrak® toll tag	FasTrak® Flex toll tag	Pay-by-plate account	Standard FasTrak® toll tag with carpool registration	FasTrak® Flex toll tag	Pay-by-plate account	No toll tag or account requirement
1 (Existing Bay Area Express Lanes)	✓						✓
2	✓			✓			
3	✓	✓			✓		
4	✓		✓	✓			
5	✓	✓	✓		✓		
6	✓		✓	✓		✓	
7	✓	✓	✓		✓	✓	

4.3 VEHICLE ELIGIBILITY FOR EXPRESS LANE USE

The MTC Express Lanes toll system will automatically distinguish between toll-exempt and toll-paying vehicles based on use of standard or FasTrak® Flex toll tags. Toll-exempt vehicles include two-axle vehicles that meet the HOV eligibility requirements or are otherwise allowed to use existing HOV lanes. Toll-paying vehicles include all other two-axle vehicles with a registered account. Sections 22348 and 22406 of the California Vehicle Code restrict vehicles such as those pulling trailers, large trucks and other vehicles subject to a 55 mph speed limit to the rightmost lanes of traffic, thereby precluding them from using HOV and express lanes regardless of vehicle occupancy. The distinction between toll-exempt and toll-paying vehicles is further described below.

4.3.1 TOLL-EXEMPT VEHICLES

Vehicles eligible for toll-exempt travel on the express lanes include all vehicles that are currently eligible to travel in existing HOV lanes, including:

- Vehicles with the requisite number of occupants, as determined by Caltrans. For the initial project segments described in this Concept of Operations, current HOV lane occupancy requirements are:
  - I-680 in Contra Costa County: 2 or more occupants (HOV 2+)
  - I-880 in Alameda and Santa Clara counties: HOV 2+
  - I-80 in Solano County: HOV 2+

- Other vehicles permitted by statute
  - Motorcycles

- Vehicles that meet specified emission standards with Department of Motor Vehicles (DMV) issued decals (Assembly Bill No. 1721 approved on Sept 21, 2014 provides the option to charge these vehicles a reduced toll on express lanes; MTC plans to explore this option in more detail)
- Emergency and other exempted vehicles
- Two-seat vehicles with two persons on an HOV 3+ facility

4.3.1.1 DECLARATION OF TOLL-EXEMPT STATUS

The MTC Express Lanes toll system will recognize vehicles that declare their eligibility for toll-exempt travel. Enforcement officers will be alerted to the presence of vehicles that declare as being eligible for toll-exempt travel as described in Chapter 7.

Eligible toll-exempt vehicles will be required to declare their exempt status via the use of a FasTrak® Flex toll tag (see Figure 4-1). A feasibility study undertaken by BATA in 2010 found switchable toll tags to be feasible and cost-effective. The Los Angeles County Metropolitan Transportation Authority (LA Metro) began distributing switchable toll tags for use on I-10 and I-110 express lanes in November of 2012. The I-495 express lanes outside of Washington DC also use a switchable tag, referred to as E-ZPass® Flex™.

FIGURE 4-1: FASTRAK® FLEX SWITCHABLE TOLL TAG

A switchable toll tag allows users to declare their eligibility status to the toll system using a switching mechanism located on the face of the toll tag. Indicators and labeling on the switch correspond to the number of vehicle occupants (1, 2, or 3+). The switchable toll tag transmits a unique identification number to the toll reader corresponding to the switch setting, in accordance with procedures as established by the California Toll Operations Committee (CTOC). The toll system is then able to apply the appropriate facility toll (or lack of a toll) according to the declared eligibility status. Motorcycles, eligible low-emission vehicles with DMV-issued decals and two-seat vehicles with two occupants will need to be instructed to set their toll tag in a HOV setting when

traveling without the requisite number of vehicle occupants in order to travel toll-exempt in the express lanes.

Legislation enacted in September of 2014 amended the California Streets and Highways Code to allow ACTC, VTA, the San Diego Association of Governments (SANDAG) and MTC to require HOVs to carry a switchable toll tag on express lanes for law enforcement purposes.

The current standard FasTrak® toll tags in use throughout California, including the external toll tags mounted on license plate frames, will still be able to be used by toll-paying vehicles on MTC Express Lanes, but these toll tags cannot be used to identify toll-exempt vehicles. Vehicles with metallic windshields that cannot find a place on the windshield where the express lane system can read a FasTrak® transponder will need to use a bumper-mounted transponder and will therefore not be able to travel toll-exempt on the express lanes. This is consistent with LA Metro's policy regarding the use of externally mounted toll tags.

4.3.2 TOLL-PAYING VEHICLES

Vehicles required to pay a toll on MTC Express Lanes include all two-axle vehicles that do not meet the requisite HOV occupancy requirement in effect and are not one of the other vehicle types eligible to use HOV lanes without paying a toll. The method by which the toll is calculated and displayed to drivers is described in Section 4.6.

4.3.2.1 TOLL PAYMENT

Tolls on MTC Express Lanes will be collected electronically according to specifications detailed in California Code of Regulations, Title 21, or any other specification that may be adopted by the time that MTC Express Lanes are implemented, including a pay-by-plate account option. For vehicles that do not self-declare a toll-exempt status, the prevailing toll will automatically be debited from the prepaid account associated with the toll tag or license plate detected by the toll system. A license plate image is captured at every toll point. If the license plate image is successfully matched to a FasTrak® account, then the toll amount will be applied to the user's account. The functionality to charge a higher toll for image-based transactions will be maintained by the toll system, but will not be charged initially. If there is no account associated with the license plate, then the license plate will be matched to the address of the vehicle's registered owner for issuance of a violation notice and a bill to collect the toll payment. MTC plans to adopt an express lane toll violation policy consistent with BATA's toll bridge violation policy to allow for the assessment of violation penalties on top of the toll payment itself.

4.4 HOV OCCUPANCY REQUIREMENT

In the future, as HOV demand increases and as the express lanes begin to connect corridors with different HOV occupancy requirements, there may be a need to change the HOV occupancy requirements on some segments to maintain efficient operations and consistency throughout the network. Much of the existing HOV system in the Bay Area is already degraded according to the federal definition[1]. In the near term, the degradation may be addressed with added striping to

[1] Title 23 of the United State Code defines a "degraded facility" as one where vehicles fail to "maintain a minimum average operating speed 90 percent of the time over a consecutive 180-day period during morning or evening weekday peak hour periods (or both)."

restrict access where operational conditions warrant and added enforcement to reduce the number of violators, but long term mitigation strategies will need to be applied at a system-wide level. The current federal transportation bill, Moving Ahead for Progress in the 21st Century (MAP-21), identifies ways to bring a facility that falls below the minimum operating threshold into compliance, which include increasing the HOV occupancy requirement, varying tolls to reduce demand, discontinuing allowance for non-HOVs (California law that allows low emission vehicles to use the HOV lanes will sunset on January 1, 2019), or increasing capacity by adding lanes.

The evolution of HOV demand on facilities operating at HOV 2+ is illustrated by the graphic in Figure 4-2. Without adding additional capacity, it may become necessary on some corridors to increase from a HOV 2+ to a HOV 3+ occupancy requirement as HOV demand grows over time to keep traffic volumes below the critical operating threshold. As described in Chapter 2, this critical operating threshold is typically assumed to be approximately 1650 vehicles per hour, which is considered to be the maximum traffic volume at which reliable free-flow travel can be maintained in the HOV lane. An increase in the HOV occupancy requirement would be warranted to maintain traffic volumes below the critical operating threshold as traffic demand grows in the HOV lane. Because there are typically far fewer vehicles with three or more occupants, this could result in significant underutilization. In addition, vehicles that were formerly able to use the lane may now have to travel in the congested general purpose lanes. The conversion of HOV lanes to express lanes allows the unutilized capacity in the HOV lanes to be occupied by toll paying vehicles (including HOV-2), as illustrated in Figure 4-3. As the express lanes continue to be built out and become more connected, it may be desirable to have a consistent HOV definition, which might also warrant the changing of HOV occupancy requirements on some segments.

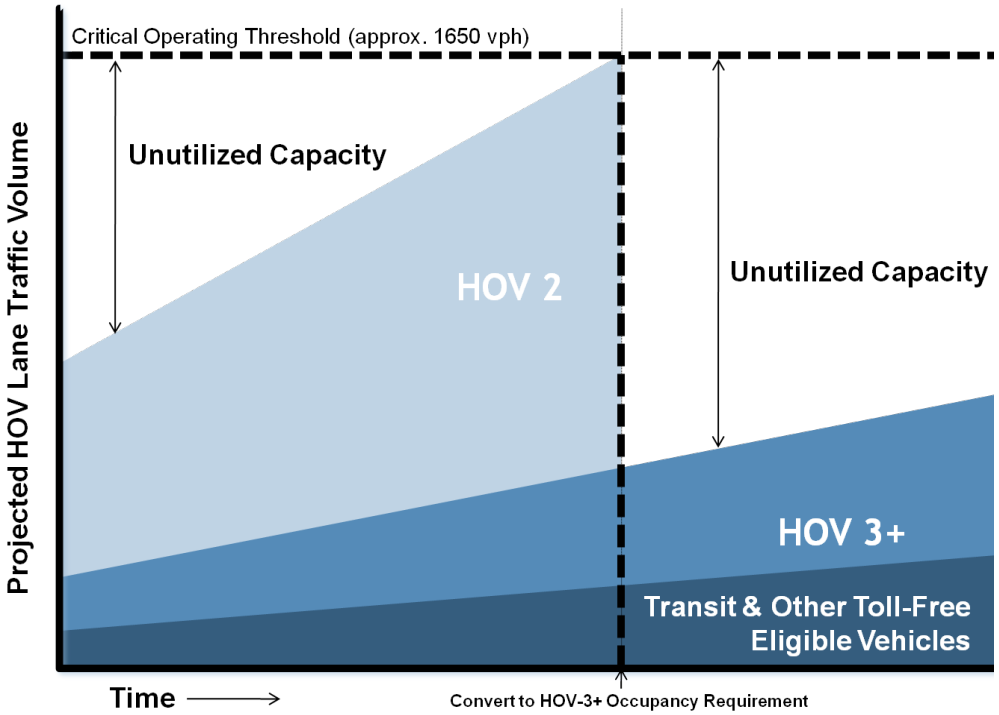
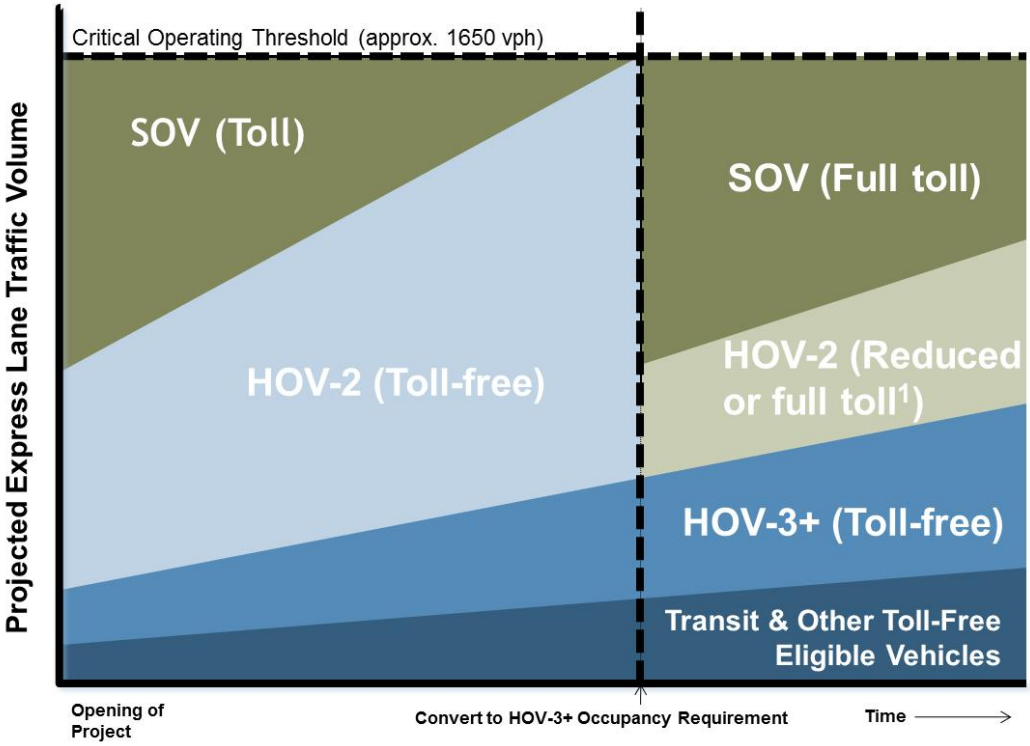


FIGURE 4-2: EVOLUTION OF AN HOV LANE



[1]Assembly Bill No. 1721 approved on Sept 21, 2014 provides the option to charge clean air vehicles a reduced toll on express lanes

FIGURE 4-3: EVOLUTION OF AN EXPRESS LANE

As described in Chapter 5, changes to the HOV occupancy requirement are evaluated by the HOV Committee, which is an informal committee chaired by Caltrans with representatives from MTC and CHP. Any increase in the HOV occupancy requirement will need to be supported by an analysis of the operational impacts and consider the possibility of negative perception by the motoring public. With the implementation of express lanes, any operational impacts associated with an increase in the HOV occupancy requirement (i.e., shifting vehicles into the general purpose lanes) could be mitigated with pricing to ensure appropriate utilization of the express lane.

The toll system must be able to recognize HOV occupancy requirements that will initially be different among corridors and have the ability to change as warranted by increases in HOV demand and/or the desire to maintain consistency throughout the network. Depending on the nature of future HOV demand, it may be desirable to increase HOV occupancy requirements to HOV 3+ during the peak of the peak periods only when HOV demand is highest, as is done on the I-10 corridor in Los Angeles. In this scenario, HOV 2 vehicles could be charged a reduced toll or the full toll depending on business requirements implemented by MTC.

4.5 HOURS OF OPERATION

Express lane hours of operation define the time periods for which eligibility restrictions are in effect. Bay Area HOV lanes currently operate during the morning and evening peak periods only and serve as general purpose lanes during all other times. One exception is the existing I-680SB express lane which operates from 5 a.m. to 8 p.m. on weekdays and serves as a general purpose

lane during all other times. Enabling statute specifies that Bay Area express lanes can only operate during hours that the lanes are restricted to use by HOVs. Therefore, express lane hours of operation must be concurrent with and no longer than the hours for which a HOV restriction is in effect unless there are changes to state law.

Table 4-2 below shows existing HOV hours of operation for the MTC projects under development. The HOV operating hours for the morning peak period are longer by one hour on I-80 West as compared to the other projects. Modifications to HOV hours of operation may be recommended in cases where there are significant operational or mobility benefits or where there is a desire for consistency among segments that directly connect. For example, the ALA-880 project will directly connect to the existing SR-237/I-880 express lanes, which currently operate for an extended hour during the morning peak period (5-10 a.m. on SR-237/I-880 as compared to 5-9 a.m. on ALA-880). Also, as the express lanes continue to be built out and become more connected, it may be desirable to have uniform hours of operation.

TABLE 4-2: CURRENT HOV HOURS OF OPERATION FOR PROJECTS UNDER DEVELOPMENT

Project	Current HOV Hours of Operation
CC-680S	M-F, 5-9 a.m. and 3-7 p.m.
ALA-880	M-F, 5-9 a.m. and 3-7 p.m.
I-80 West	M-F, 5-10 a.m. and 3-7 p.m.
CC-680N	M-F, 5-9 a.m. and 3-7 p.m.

Operational conditions, traffic forecasts and the desire for consistency and efficiency will inform decisions related to hours of operation for subsequent phases of the MTC Express Lanes build-out. The MTC toll system will need to be flexible and allow for hours of operation that may differ among segments in the near-term, and also allow for hours of operation to be extended in the future.

4.6 PRICING

Variable pricing will serve as the principal mechanism for regulating access to MTC Express Lanes for vehicles that do not meet toll-exempt eligibility requirements. The primary goal of pricing will be to ensure efficient operations and to meet the federally mandated requirement (Title 23, Section 166 of the U.S. Code) of maintaining a minimum average speed of 45 mph in the express lane most of the time and state requirements to maintain LOS C or LOS D (Sections 149.1 and 149.5 of Streets and Highways Code). Tolls will be collected electronically using FasTrak® accounts. The following subsections describe more specifically how pricing on MTC Express Lanes will work.

4.6.1 DYNAMIC PRICING

MTC Express Lanes will incorporate dynamic pricing, which allows toll rates to vary according to real-time traffic conditions. Using vehicle detection equipment in the express lanes, with supplemental information provided by detection equipment in the general purpose lanes, the MTC Express Lanes toll system will be able to increase and decrease the toll rate to ensure that conditions in the express lane meet performance standards and that any excess capacity in the express lane is appropriately utilized. When speeds in the express lane decrease, the toll rate increases to discourage additional vehicles from entering the lane. The toll rate decreases when

speeds in the express lane increase to encourage general purpose lane vehicles to use the lane during periods of lower demand. Express lane operators will have the ability to override the dynamic pricing during incidents, lane closures or otherwise as appropriate.

Time-of-day pricing, which changes toll rates according to a fixed schedule, has been implemented on other express lane projects on an interim basis, so as to collect data for the dynamic pricing algorithm in advance of its operation. This, in turn, allows the dynamic pricing system to operate more consistently than adapting the algorithm within the initial weeks of opening. The MTC Express Lanes toll system may initially use time-of-day pricing to calibrate its dynamic pricing algorithm.

4.6.1.1 MINIMUM AND MAXIMUM TOLL RATES

MTC may decide to implement a minimum and/or a maximum toll rate. Minimum toll rates are typically set to ensure that the value of the express lane is maintained at all times, even when demand is low, and to ensure that the cost to operate the lane during periods of low demand is justified by the amount of toll revenue collected. Maximum toll rates are set to cap the toll at a certain level to balance the public's perception of value with the performance of the lane.

If a maximum toll rate were established, and the volume in the express lane approached the critical operating threshold where the maximum toll rate was reached, the toll system would close the lane to new toll-paying vehicles. This would be accomplished by displaying a message such as "HOV ONLY" on the pricing signs to indicate that only eligible toll-exempt vehicles are allowed to use the express lane. Business requirements to be developed by MTC would include rules for toll-paying vehicles in the event that the express lane reverts to HOV-only operations, including toll-paying vehicles that already happen to be in the express lane when it switches to HOV-only mode. Enforcement procedures during HOV-only operations would also be established.

If implemented, the minimum and maximum toll rates would need to be evaluated and adjusted periodically to ensure that conditions in the express lanes are being maintained to meet the federal and state requirements. They would also need to be revisited and adjusted as the build-out of the MTC Express Lanes provides longer distances of uninterrupted travel in the express lanes to ensure that the ability to effectively manage demand is not constrained by pre-determined toll rates.

4.6.2 ZONE AND SEGMENT-BASED PRICING

Due to the extensive length of the corridors within the MTC Express Lanes, it will be necessary to divide the corridors into smaller pieces ("zones"), to ensure that the applied toll rate is able to effectively manage demand. A single toll rate applied over a long corridor will not be able to manage demand efficiently since varying traffic conditions over the length of the corridor could warrant lower or higher toll rates on some portions of the corridor, even though these rates may not be justified on other portions of the corridor. The concept of zone-based pricing applies a separate toll rate to each defined zone along the corridor according to traffic conditions within that zone. In this way, zones with higher levels of congestion could experience higher toll rates without causing toll rates to unnecessarily increase in other zones where demand does not justify such an increase.

The toll rate in effect for each defined zone will be charged to any vehicle entering the express lane within the limits of the zone regardless of how far the vehicle travels in the zone, or how many toll

points the vehicle passes under while in the zone. This type of pricing strategy is thought to be beneficial from a revenue leakage viewpoint since vehicles only need to be detected once within a zone to be charged the full zone toll. This strategy may also be a potential disincentive to any drivers that would be otherwise tempted to weave in and out of the lane to avoid toll payment. Vehicles will also be locked into the zone toll when passing under the first toll point within the zone and will not have to pay a higher toll if the toll rate were to increase while traveling between toll points within a zone. Again, this may provide a disincentive to weaving in and out of the lane.

The beginning and end of pricing zones will be based on logical termini determined via analysis of traffic patterns along the corridor. Ideally, traffic volume characteristics within the limits of a zone should not vary drastically and bottleneck locations should be captured within a single zone. With these criteria applied, it is assumed that the length of zones will vary between approximately three and five miles, although specific conditions may warrant zones of different lengths. The length of a zone will also be constrained by the fact that the zone toll will need to effectively manage demand along the entire length of the zone.

Although the toll rate for a particular zone will be primarily determined based on traffic conditions within that zone, the toll system will have the ability to take into consideration the traffic conditions in adjacent zones when calculating the toll rate for a zone. This allows the toll system to increase the toll rate upstream of a zone experiencing heavy congestion to ensure that the express lane within the zone does not become over-utilized.

On longer corridors, zones may be grouped together to form "segments." Like zones, users will be locked into segment prices upon entering and being detected at a toll point in any zone within a segment. The concept of zones and segments is illustrated below in Figure 4-4. As shown, there are three zones, each with three toll points, and two segments. As described above, a vehicle will be charged the full zone toll regardless of how many toll points the vehicle travels through. This means that a vehicle that travels through Toll Point 1 and Toll Point 2, but not Toll Point 3, will pay the full toll for Zone 1. And because vehicles are locked into the zone toll after passing under the first toll point in the zone, a vehicle that travels through Toll Point 1 would not pay a higher toll if the Zone 1 toll were to increase by the time the vehicle reached Toll Point 2. The concept of a segment allows the toll system to lock vehicles into toll rates for multiple zones. In Figure 4-4, a vehicle that travels through Toll Point 1 would be locked into the toll rate in effect at the time for Zone 1 and Zone 2 because both of these zones are within Segment 1, even if the toll for Zone 2 were to increase before the vehicle reaches Toll Point 4. The process of communicating zone and segment tolls to users is described in the next section.

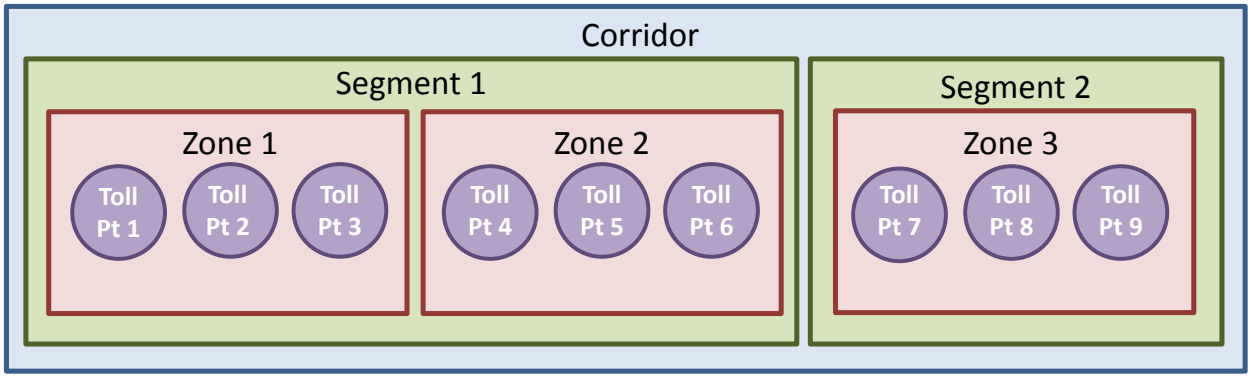


FIGURE 4-4: EXAMPLE TOLL ZONES AND SEGMENTS

4.6.3 COMMUNICATING TOLL RATES AND DESTINATIONS TO DRIVERS

As described in Chapter 3, toll rates will be communicated to drivers using destination-based pricing signs incorporating changeable message elements as specified in the MUTCD. The destination(s) shown on these signs will correspond to the termini of pricing zones. The first destination will correspond to the terminus of the current pricing zone and the second destination will correspond with a destination that is two or more pricing zones downstream to give users a sense of the cost to travel longer distances in the express lanes and hopefully encourage longer distance travel and minimize frequent weaving in and out of the lane.

The MTC Express Lanes pricing concept is illustrated in Figure 4-5. The graphic shows a portion of a hypothetical corridor with three zones. The top price on the first sign shows the toll to travel in the orange zone, which terminates at Destination 1, and the second price shows the cumulative toll to travel through the orange, blue and purple zones to Destination 3. The combination of Zones 1, 2 and 3 is a segment. Drivers entering the express lane upon seeing the first sign would be locked into both prices displayed upon being detected at the toll point immediately following the pricing sign. In the scenario depicted in Figure 4-5, a driver traveling to Destination 1 would pay $1.50 and a driver traveling all the way to Destination 3 would pay $4.50, even if the tolls were to increase while the driver was traveling in the lane. A driver entering the express lane upon seeing the first sign and traveling to Destination 2 would know that the toll was somewhere between $1.50 and $4.50, but they would not know the exact price of their trip at the time the trip was made. The second sign shown in Figure 4-4 is similar in concept to the first sign as it shows the price to travel in the zone that it precedes and the cumulative price to travel to the end of the segment. The third sign precedes the zone terminating at the end of the segment and therefore only shows one price since the end of the zone and the end of the segment are the same.

Another option for destination-based pricing signs is to display the toll to travel to the end of the facility. However, this scenario is not advisable for longer corridors as it may become difficult to effectively manage demand along the corridor when locking vehicles into a price early in their trip.

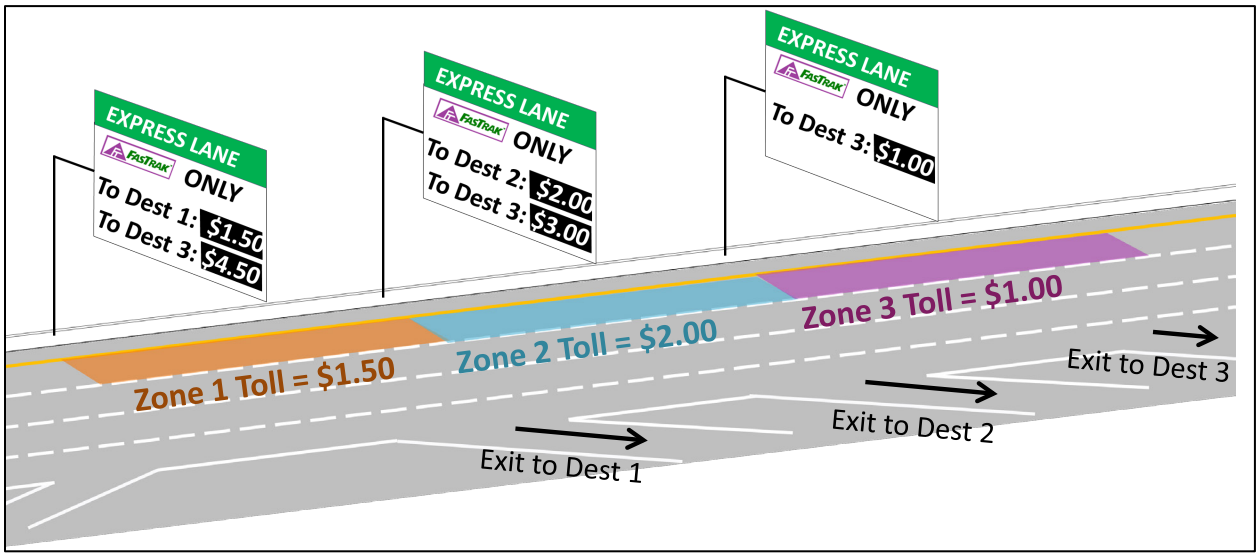


FIGURE 4-5: ZONE-BASED PRICING EXAMPLE

As described above in Section 4.6.1.1, in the event a maximum toll rate is established and reached, the express lanes may close to toll-paying vehicles. This would be communicated to drivers by displaying a message such as "HOV ONLY" next to the destination on pricing signs instead of a price, indicating that toll-exempt vehicles are the only vehicles permitted to travel in the express lane. Outside of the express lane hours of operation or during incidents, a message such as "OPEN TO ALL" or "NO TOLL" will be displayed next to the destinations on pricing signs. This will inform drivers that the express lanes are permitted to be used by all vehicles without paying a toll, except those vehicles never allowed to be in the lane per the vehicle code.

4.6.4 CONSISTENCY IN PRICING AMONG CORRIDORS

In order to promote familiarity with express lane operations and to avoid driver confusion, a consistent pricing policy will be applied for all MTC Express Lanes. This will be accomplished by applying zone-based pricing to all MTC Express Lanes. This will simplify public outreach and allow education materials to focus on the following:

- Corridors are segmented into zones for the purposes of tolling.
- Each zone has its own toll rate that changes based on traffic conditions.
- Priced destination signs show toll rates to one or two downstream destinations.
- Tolls shown on the same priced destination signs are not additive (i.e., the price to the furthest downstream location is inclusive of the price to the end of the current zone).
- The price to travel within a zone is independent of the distance traveled in the zone, or where the driver enters the zone.
- Once a vehicle enters a zone, the price is fixed, even if the price in the zone subsequently changes after the vehicle entered.

Although the existing express lanes on southbound I-680 and SR-237/I-880 are not described as employing zone-based pricing, the points made above are consistent with the user experience on either of these two facilities.

4.7 BUSINESS REQUIREMENTS

The MTC Express Lanes business requirements are a list of the rules that govern the use and operation of the express lanes, building upon the concepts outlined in this Concept of Operations. As such, they are used to inform the development of the technical requirements for the toll system and the standard operating procedures for express lane operators. Example business requirements include requiring all toll-exempt vehicles to carry a FasTrak® Flex toll tag and guaranteeing that customers will be locked into the price displayed on the pricing sign immediately preceding the toll point at which they are first detected. The business requirements that have been developed for MTC Express Lanes are stored in a separate document and include the following topics:

- Using the Express Lanes
- Express Lane Operations
- Express Lane Pricing
- Trip Building
- Regional Customer Service Center (RCSC) System Processing
- Customer Contact and Support
- Financial & Accounting Operations

The business requirements will be a living document throughout the development of the toll system and will be updated as appropriate.

4.8 OPERATIONAL INTERFACES WITH OTHER PROJECTS AND SYSTEMS

There are several projects and Intelligent Transportation System (ITS) deployments with which MTC Express Lanes will need to interface. The technical requirements that need to be considered to achieve these interfaces are described in Chapter 6. The following sections describe how MTC Express Lanes will operate in combination with adjacent projects and systems.

4.8.1 OTHER BAY AREA EXPRESS LANES

MTC Express Lanes will interface with express lanes that are being developed and operated by other agencies. The express lane project under development on the I-880 corridor will directly connect to the SR-237/I-880 express lanes operated by VTA, and MTC Express Lanes on the I-680 corridor will operate in close proximity to the I-680SB express lane operated by ACTC. In addition, there are other express lane projects currently under development by VTA (SR-85 and US-101) and ACTC (I-580 and I-680NB). Some of these projects are expected to be in operation within the same timeframe as MTC Express Lanes.

The goal is for all express lanes in the Bay Area to form a network that allows users to travel seamlessly between express lanes operated by different agencies. This will require consistency in many operating policies, the most important of which include:

- Use of toll tags and eligibility declaration: Standard toll tags currently used throughout the Bay Area will be recognized by the MTC Express Lanes toll system for toll-paying vehicles, but cannot be used by eligible vehicles for toll-exempt travel. Similarly, switchable toll tags used on MTC Express Lanes will be recognized on all toll facilities in California as long as they are set in the single occupancy position. All eligible toll-exempt vehicles traveling on

MTC Express Lanes will be required to carry a FasTrak® Flex toll tag set in HOV mode to avoid being charged a toll. This is different from the current policy on SR-237/I-880 and I-680SB express lanes where users are required to shield their toll tags by placing them in Mylar bags when traveling in the express lanes as an eligible toll-exempt vehicle in order to avoid being charged a toll. Any vehicle traveling on MTC Express Lanes without a properly displayed toll tag or one stored in a mylar bag will trigger an automated response by the toll system to charge a toll to an account using a picture of the vehicle's license plate, or to issue a toll violation in the event that the license plate is not matched to an account. Therefore, it is essential that the toll-exempt declaration policy for all Bay Area Express Lanes be consistent to allow users to travel seamlessly. Bay Area Express Lane operators are in agreement and have a plan so that switchable toll tags will be recognized on all express lanes in the region.

- Hours of operation: Although hours of operation on existing HOV lanes in the Bay Area differ, it may be desirable for the hours of operation to be consistent once express lanes start to become connected. For example, the hours of operation for the SR-237/I-880 express lanes operated by VTA and MTC Express Lanes on I-880 may need to be made consistent if users are expected to be able to make an uninterrupted trip along both facilities at all times of the day.
- Eligibility requirement: Similar to hours of operation, consistency in the HOV occupancy requirements may be necessary to provide seamless travel when express lanes directly connect to one another.

There are other functional areas where consistency of practice is desired to promote a seamless express lane network in the Bay Area, including signage and other design treatments, business requirements and customer service.

4.8.2 TRANSITION FROM EXPRESS LANE TO HOV LANE

Another interface that will occur at the SR-237/I-880 interchange, and will occur at other locations throughout the MTC network as future phases of express lanes are implemented, is the transition from express lanes to HOV lanes. The ALA-880 express lane will transition to an HOV lane in the southbound direction south of the SR-237 interchange. Appropriate signage will be deployed to direct non-eligible HOV vehicles out of the lane as the express lane transitions to a HOV lane, as is currently done on the northern and western segments of the SR-237/I-880 express lanes. Traffic operational analysis will inform decisions about the location and length of the transition area to ensure that exiting express lane vehicles do not adversely impact general purpose lane traffic.

4.8.3 RAMP METERING

Experience has shown that ramp metering in combination with express lanes can result in a noticeable improvement to freeway operations. The ability for ramp metering to reduce the rate of freeway incidents is not only beneficial for general purpose lane operations, but also reduces the likelihood that express lane operations are interrupted during an incident.

Ramp metering is currently deployed or planned along the I-880 and I-680 corridors where MTC Express Lanes will be implemented. In addition, the FPI plans to add additional ramp meters to the I-880, SR-84 and SR-92 corridors. The HOV bypass lanes at ramp meters will continue to operate

only for eligible HOV vehicles after the implementation of express lanes. Implementation of adaptive ramp metering is planned as part of the I-880 & I-80 ICM projects described below.

4.8.4 INTEGRATED CORRIDOR MANAGEMENT (ICM)

As described in Chapter 2, ICM projects will be implemented on I-80 (referred to as the I-80 SMART Corridor Project) and I-880. The operations of these projects will need to be consistent with express lane operations and vice versa. For the I-80 SMART Corridor Project, which includes the installation of advisory speed signs and lane control signals on overhead gantries, some of these operational consistencies include:

- Operating speed: Advisory speeds should not adversely impact the minimum operating speed of express lanes.
- Lane closures: Dynamic message signs deployed as part of the I-80 SMART Corridor Project and express lane signage need to display consistent messages when there is an express lane closure.
- Lane designation: Overhead signs deployed as part of the I-80 SMART Corridor Project to designate lane operations should properly reflect the current operation of the express lane (i.e., refer to the lane as express lane when tolling is in effect or as HOV when the lane is at capacity.)
- Alternate routing: When traffic is routed from San Pablo Avenue to the I-80 corridor, the express lanes operator should be notified.
- Incident detection: When incidents are detected by the express lanes or the I-80 SMART Corridor Project, the other system should be alerted.

CHAPTER 5 ROLES AND RESPONSIBILITIES

5.1 ROLES AND RESPONSIBILITIES OVERVIEW

The implementation, operation and maintenance of MTC Express Lanes will require collaboration among multiple public agencies. This chapter describes the stakeholder agencies and their roles as they relate to the express lanes to be operated by MTC. State law requires MTC to contract with BATA, CHP and Caltrans for certain services and pay for those services with toll revenue. This Concept of Operations does not draw any conclusions or make recommendations on financial responsibilities beyond those required in state law.

5.2 METROPOLITAN TRANSPORTATION COMMISSION (MTC)

MTC is the transportation planning, coordinating and financing agency for the nine-county San Francisco Bay Area. MTC's work is guided by a 19-member policy board and performed by a staff of some 210 persons headquartered at the Joseph P. Bort MetroCenter in Oakland. MTC is currently planning a move to a new facility at 375 Beale Street in San Francisco in 2015.

MTC is eligible to develop and operate 270 lane-miles of express lanes, based on action by the CTC in 2011. As the agency that sought express lane authority from the CTC, MTC's express lane roles include:

- Design, implement, operate and own the toll system.
- Oversee daily operations of the express lanes.
- Establish toll policy.
- Operate and administer the MTC Express Lanes.
- Maintain toll equipment.
- Monitor and report on express lane performance.
- Provide enforcement tools to the CHP.
- Perform marketing and public outreach for the express lanes.
- Protect personal identifiable information (PII).

In addition, MTC performs other roles that support express lane deployment and operation:

- In partnership with Caltrans and CHP, operates the regional traveler information system, 511, including:
    - Data collection and dissemination; and,
    - Operation of the Traveler Information Center (511 Operations Center).
- Operates the Regional Rideshare Program to support carpool and vanpool formation and perform employer outreach. The Regional Rideshare Program may be leveraged to perform outreach so that the transition for carpools and vanpools upon conversion of HOV lanes to express lanes is as seamless and understandable as possible.
- Works in collaboration with Caltrans on the Freeway Performance Initiative (FPI) to design, install and implement ramp metering and traffic operations systems.

- Coordinates the Regional Traffic Incident Management Program with Caltrans, CHP, and incident response personnel to enhance traffic incident detection, verification, mitigation, response and clearance.
- Works with Caltrans, CHP and local agencies to implement ICM strategies to actively manage freeway, arterial, transit and parking systems within a corridor and optimize operations under various scenarios.
- Administers the Service Authority for Freeways and Expressways (SAFE). MTC SAFE works in conjunction with CHP and Caltrans to implement various motorist aid programs, which include:
    - Freeway Service Patrol (FSP): The FSP is a fleet of roving tow trucks that operate Monday through Friday during peak commute hours and all day in pre-designated freeway construction zones. FSP drivers clear accidents, assist motorists and remove debris from freeways.
    - Call Box Program (CBP): The CBP provides approximately 2,200 yellow roadside call boxes for motorists in need and operates a 24-hour call answering center.
- Prepares and approves the Regional Transportation Plan (RTP) and Transportation Improvement Program (TIP), which reflect express lane phasing and funding.
- Coordinates with other express lane operators in the region to provide a complete express lane network that is seamless to users.
- Conducts air quality planning and conformity analysis.
- Manages federal, state and regional matching funds for HOV and express lanes.
- Is developing a Managed Lanes Implementation Plan (MLIP), which may establish a regional framework for considering changes to express lane policies such as hours of operation and HOV occupancy requirements.
- Builds, operates and maintains Backhaul communications infrastructure utilized to transport express lane data between express lanes corridors, host sites, operation centers, and RCSC.

MTC delegated express lane authority to the Bay Area Infrastructure Financing Authority (BAIFA) in April of 2013, which is discussed in Section 5.4.

5.3 BAY AREA TOLL AUTHORITY (BATA)

BATA was created by the California Legislature in 1997 to administer the bridge tolls on the San Francisco Bay Area's seven state-owned toll bridges. The statute that created BATA established that BATA would operate using MTC's staff and governing board. On January 1, 1998, BATA assumed toll operations from the State Department of Transportation. In August 2005, the California Legislature expanded BATA's responsibilities to include administration of all toll revenue and joint oversight of the toll bridge construction program with Caltrans and the CTC. Caltrans owns and operates the state-owned bridges.

BATA's express lane roles include:

- Operate the Regional Customer Service Center (RCSC) including:
    - Manage FasTrak® customer accounts, protect PII, and provide general customer service.
    - Collect express lane tolls from FasTrak® customer accounts based upon trip transaction records from express lane operators.

- Reverse tolls in the event that express lane operating conditions are impacted during an incident.
- Issue toll violation notices.
- Track, inventory, and distribute FasTrak® toll tags to customer service outlets.
- Operate, support and maintain FasTrak® back office operations (e.g., trip records, revenue and account information).
- Provide marketing of the express lanes along with other FasTrak® marketing.
- Administer and distribute toll revenue to the express lanes agencies.
- Establish interface with credit and debit card processing and banking services.
- Establish interface with DMV for processing license plate reads and matching with registered vehicle owner.

In addition, BATA performs other roles that support express lane deployment and operation:

- Implement and maintain toll systems at the bridges.
- Operate and maintain changeable message signs at the bridges.
- Administer toll revenue generated by the region's seven state-owned toll bridges, including any express lane operations at the bridge approaches and toll plazas.

5.4 BAY AREA INFRASTRUCTURE FINANCING AUTHORITY (BAIFA)

BAIFA is a joint exercise of powers agency formed by MTC and BATA to plan, develop, operate and finance transportation and related projects, including express lanes. On April 24, 2013 MTC entered into a cooperative agreement with BAIFA through which MTC delegated authority to BAIFA to develop and operate the 270-mile MTC Express Lanes. In addition to assuming MTC's express lane responsibilities shown in Section 5.2, BAIFA's express lane responsibilities also include financing of the express lanes.

5.5 CALTRANS

Caltrans manages more than 50,000 miles of California's highway and freeway lanes, provides inter-city rail services, permits more than 400 public-use airports and special-use hospital heliports, and works with local agencies to implement transportation projects. As owner of the state highway system, Caltrans has a large role in express lane development and implementation.

Caltrans' express lane roles include:

- Review and approve all design and operation plans, including construction and maintenance activities within state right-of-way.
- Monitor the operation of the freeway and initiate corrective actions when needed to ensure motorist safety.
- Operate the Traffic Management Center (TMC). Through the TMC, coordinate with express lane operators, and when applicable, request override of the express lane toll display messages when an event occurs that warrants an override.
- Control regional Advanced Transportation Management System (ATMS).
- Maintain all roadway elements of the express lanes, other than the toll collection equipment, unless MTC hires a contractor for this purpose. If MTC contracts with Caltrans for a higher level of maintenance (e.g., more frequent sweeping), MTC will reimburse

Caltrans for these services. A Maintenance Agreement with Caltrans will be executed prior to approval for construction.
- Monitor the performance of HOV lanes.
- Own and maintain the Freeway Performance Measurement System (PeMS).
- Maintain the Title 21 requirements consistent with statutory instructions.
- Support CHP in incident management.

5.6 CALIFORNIA HIGHWAY PATROL (CHP)

CHP is the law enforcement agency that has patrol jurisdiction over all California highways and serves as the state police. CHP's express lane roles include:

- Perform on-site enforcement of express lane eligibility (i.e., HOV and low emission vehicle) requirements with MTC-provided tools.
- Enforce buffer crossing violations in express lanes.
- Lead coordination and implementation of response functions related to incidents or other disruptions on the express lanes and general purpose lanes. CHP will communicate to the toll system operator when incidents require the use of express lanes to divert traffic.
- Provide lane closure enforcement for installation and maintenance activities when required by policy, contract or agreement.
- Enforce motor vehicle violations.

5.7 CONGESTION MANAGEMENT AGENCIES (CMAs)

CMAs were formed in 1990 with the passage of Proposition 111, which doubled the state gas tax and specified among other things that each county designate a county-wide body to put programs in place to keep traffic levels manageable. The Bay Area Express Lanes span four counties: Alameda, Contra Costa, Solano and Santa Clara counties; however, the MTC Express Lanes is predominantly located in three of these: Alameda, Contra Costa and Solano counties. Alameda and Santa Clara counties have separate statutory authority to implement and operate express lanes on certain corridors within their counties. It is the desire of all stakeholders to have a network of express lanes that functions seamlessly for the customer throughout the Bay Area. An operations-focused staff-level Technical Working Group (TWG), staff-level Public Information Working Group (PIWG) and Executive Steering Committee (ESC, consisting of chief executive officers of each organization), including members of the CMAs discussed below, were instituted to promote collaboration and information sharing. These groups have been the main source for feedback on the recommendations in this concept of operations and how they should be explained to the public.

CMA express lane roles include:

- Participate in the TWG, PIWG and ESC.
- Participate jointly with MTC, CHP and Caltrans in the planning and delivery of express lane improvements for the MTC Express Lanes within their respective counties. The CMA may act as the lead for one or more phases of delivery (environmental, design, advertise and award or construction) for the civil component of the express lanes. Except where noted below, the leads for specific phases have yet to be determined.
- For express lanes that are owned and operated by a CMA, coordinate operations and business requirements with those of the MTC Express Lanes.

5.7.1 ALAMEDA COUNTY TRANSPORTATION COMMISSION (ALAMEDA CTC)

The Alameda CTC is the CMA for Alameda County and coordinates countywide transportation planning efforts; programs local, regional, state and federal funding; and delivers projects and programs including those approved by voters in Alameda County transportation expenditure plans. The Alameda CTC is a joint powers authority governed by a 22-member Board of Directors comprised of elected officials from each of the 14 cities in Alameda County, all five members of the Alameda County Board of Supervisors, and elected representatives from AC Transit and BART.

The Alameda CTC is the administering agency for the I-580 express lanes, which are currently under development. The Alameda CTC is a member of the I-680 Sunol Smart Carpool Lane Joint Powers Authority (I-680 Sunol JPA), which is the owner and operator for the I-680SB express lane, which is currently in operation, and the I-680NB express lane, which is under development. The Alameda CTC performs day-to-day management of the I-680 express lane projects.

5.7.2 CONTRA COSTA TRANSPORTATION AUTHORITY (CCTA)

CCTA is a public agency formed by Contra Costa voters in 1988 to manage the county's transportation sales tax program and to do countywide transportation planning. CCTA is also the county's designated CMA, responsible for putting programs in place to keep traffic levels manageable. CCTA is the sponsor and implementing agency responsible for preparing project approval, environmental and engineering documentation for civil construction of the CC-680N express lanes in northern Contra Costa County, which are part of the MTC Express Lanes. MTC will be the owner-operator of the CC-680N express lanes.

5.7.3 SOLANO TRANSPORTATION AUTHORITY (STA)

STA is the CMA for Solano County and is responsible for countywide transportation planning, programming transportation funds, managing and providing transportation programs and services, delivering transportation projects, and setting transportation priorities. STA is the sponsor and implementing agency responsible for preparing project approval, environmental and engineering documentation for civil construction of the Solano I-80 express lanes between Red Top Road and I-505, which are a part of the MTC Express Lanes. MTC will be the owner-operator of the I-80 express lanes.

5.7.4 SANTA CLARA VALLEY TRANSPORTATION AUTHORITY (VTA)

VTA is a special purpose district that provides transit service and serves as the CMA for Santa Clara County. VTA provides bus, light rail, and paratransit services, as well as participates as a funding partner in regional rail service including Caltrain, Capital Corridor, and the Altamont Corridor Express. As the county's congestion management agency, VTA is responsible for countywide transportation planning, including congestion management, design and construction of specific highway, pedestrian, and bicycle improvement projects, as well as promotion of transit oriented development.

VTA is the administering agency of an existing express lane on the SR-237/I-880 direct connector, which opened on March 20, 2012. Other express lane projects being implemented by VTA include

an extension of the express lane on SR-237 as well as express lanes on SR-85 and US-101. VTA is a member of the I-680 Sunol JPA, which is the owner and operator for the I-680SB express lane.

5.8 FEDERAL HIGHWAY ADMINISTRATION (FHWA)

FHWA is the agency within the U.S. Department of Transportation that supports State and local governments in the planning, design and construction of the National Highway System via the Federal Aid Highway Program and provides financial resources and technical assistance for a coordinated program of public roads that service the transportation needs of Federal and Indian lands via the Federal Lands Highway Program. FHWA maintains project level approval for projects that are deemed as High Profile projects, which include major ITS projects. FHWA has designated all express lane projects as High Profile projects.

FHWA's express lane roles include:

- Review and approve improvements and lane operations on Federal Aid Highway Routes.
- Provide lessons learned and recommended best practices
- Provide oversight and review of the project as outlined in the agreement among FHWA, Caltrans and MTC.
- Approve Concept of Operations and Systems Engineering Management Plan (SEMP).

5.9 TRANSIT

There are numerous transit agencies as noted in Chapter 2 that are currently operating along the existing corridors. They will continue to operate transit in the express lanes and therefore will provide input on bus operations and access needs.

5.10 CALIFORNIA TOLL OPERATORS COMMITTEE (CTOC)

CTOC is a collaborative organization composed of California's toll facility operators/owners. CTOC is the primary resource for interoperability and coordination among tolling facilities, and education and advocacy regarding tolling in California. CTOC members communicate regularly on issues of interoperability, technology, operating policies, customer service, the legislative, administrative and regulatory framework for tolling, and other issues affecting tolling in California.

CTOC's express lane role includes:

- Responsible for setting interoperability guidelines for California toll operators consistent with Title 21. One of the requirements set forth in the most recent Federal Surface Transportation Authorization, titled Moving Ahead for Progress in the 21st Century (MAP-21), calls for national interoperability among toll systems. It is envisioned that CTOC will be the body to discuss and implement changes to conform to this requirement.

5.11 SYSTEM INTEGRATOR

The system integrator will be contracted by MTC to design, implement and maintain the toll collection system.

5.12 OTHER

5.12.1 CALIFORNIA TRANSPORTATION FINANCE AUTHORITY (CTFA)

CTFA is authorized to issue revenue bonds to finance transportation projects and to grant approval to a project sponsor to issue revenue bonds for a specific project. The CTFA may also grant approval to a project sponsor to collect tolls as part of the financing plans to repay revenue bonds for a specific project.

CTFA's express lane role includes:

- Assist with financing mechanisms, in the event MTC seeks CTFA approval of MTC's issuance authority for the MTC Express Lanes. This is not anticipated for the Phase 1 corridors.

5.12.2 CALIFORNIA TRANSPORTATION COMMISSION (CTC)

CTC is responsible for the programming and allocation of funds for the construction of highway, passenger rail and transit improvements throughout California. The CTC also advises and assists the Secretary of the California State Transportation Agency and the Legislature in formulating and evaluating state policies and plans for California's transportation programs. The CTC is also an active participant in the initiation and development of State and Federal legislation that seeks to secure financial stability for the State's transportation needs.

CTC's express lane roles include:

- Found MTC eligible to implement and operate the MTC Express Lanes in 2011.
- Review and approve public-private partnerships involving any aspect of the Bay Area Express Lanes (per Senate Bill No. 4 passed in 2009).
- Approve programming of state funds, if used to fund the MTC Express Lanes.

5.12.3 HOV COMMITTEE

The HOV Committee is a mutually agreed upon group of three representatives from MTC, Caltrans and CHP to enable better coordination and communication between the partnering agencies involved with the aspects of implementing and operating HOV lanes. The California Vehicle Code (CVC) Section 21655.5 gives Caltrans the authority to designate exclusive or preferential use of a lane by HOV's based on a competent engineering estimate of the safety, congestion and highway capacity. Additionally, CVC 21655.6 requires that Caltrans obtain the approval of the transportation planning agency (i.e., MTC) before implementing preferential lanes. The HOV Committee reviews requests to modify the hours of operation and eligibility requirements on HOV lanes in the Bay Area. Any request made must be accompanied by justification showing that the change will not have adverse operational impacts.

5.12.4 BAY AREA INCIDENT MANAGEMENT TASK FORCE (IMTF)

The Bay Area IMTF is an interagency committee formed in 2002 and comprised of chaired by Caltrans with cooperation from CHP, MTC and first responder agencies. The goal of the IMTF is to

improve responder safety and to promote safe and quick clearance of freeway incidents. The IMTF meets monthly to discuss challenges and solutions for responding to traffic incidents.

5.12.5 TRANSPORTATION CORRIDOR AGENCIES (TCA)

TCA are two joint powers authorities formed by the California Legislature in 1986 to plan, finance, construct and operate Orange County's 67-mile public toll road system. As the holder of the trademark to the FasTrak® name and logo, any use of the FasTrak® logo and brand must be approved by TCA. In addition, TCA will be the holder of the FasTrak® Flex name and logo once its registration application is approved.

5.13 EXISTING AGREEMENTS

The stakeholders and groups referenced above have been working together on a variety of projects throughout the region, including the express lanes. Existing agreements between stakeholders, which are pertinent to express lanes, include:

- Standard operating procedures for incident management on the State Highway System between CHP and Caltrans
- Enforcement agreements between I-680 Sunol JPA and CHP and between VTA and CHP
- Toll collection and RCSC operations between the Alameda CTC and BATA and between VTA and BATA
- Express lane agreements between I-680 Sunol JPA and Caltrans and between VTA and Caltrans
- Toll agreements between Caltrans and FHWA for the I-680 and SR-237/I-880 express lanes and Bay Area toll bridges, including the Dumbarton and San Mateo-Hayward bridges.
- Cooperative agreements between Caltrans and BAIFA or various CMAs for environmental and design.

Future express lane agreements needed for MTC Express Lanes:

- Enforcement agreement between BAIFA and CHP
- Toll collection and RCSC operations between BAIFA and BATA
- Operations and maintenance agreements between BAIFA and Caltrans, including maintenance of the backhaul communications network and back-up toll operations from the TMC.
- Cooperative agreement for fiber optic communications between BAIFA and BART
- Possible agreements among or between BAIFA, Caltrans and CMAs addressing project responsibilities for delivery of civil projects
- Possible Memorandums of Understanding (MOUs) between BAIFA and VTA or the Alameda CTC on business requirements and interoperability
- Possible agreements between BAIFA and CMAs on the use of express lane toll revenue
- Cooperative agreements between Caltrans and BAIFA or various CMAs for environmental and design
- Cooperative agreements between Caltrans and BAIFA or various CMAs for construction

CHAPTER 6 TECHNICAL REQUIREMENTS

6.1 SYSTEM ARCHITECTURE

MTC Express Lanes will require a system of equipment, software and communication links to control the facility. The base of all these components come from the traditional tolling industry and either replicate the infrastructure used for single point tolling or have slight modifications to function in an open road tolling (ORT) scenario. Similar systems have already been deployed in the Bay Area and a similar architecture will be used for this project with adjustments made based on lessons learned and/or advances in technology.

MTC has a Regional ITS Architecture that includes express lanes as shown below in Figure 6-1. The conceptual system architecture is depicted in Figure 6-2 and includes the lane equipment, the central systems and the interfacing systems. The architecture is meant to be descriptive and does not dictate final design; rather, it is intended to provide a conceptual operating idea. A description of these components follows.

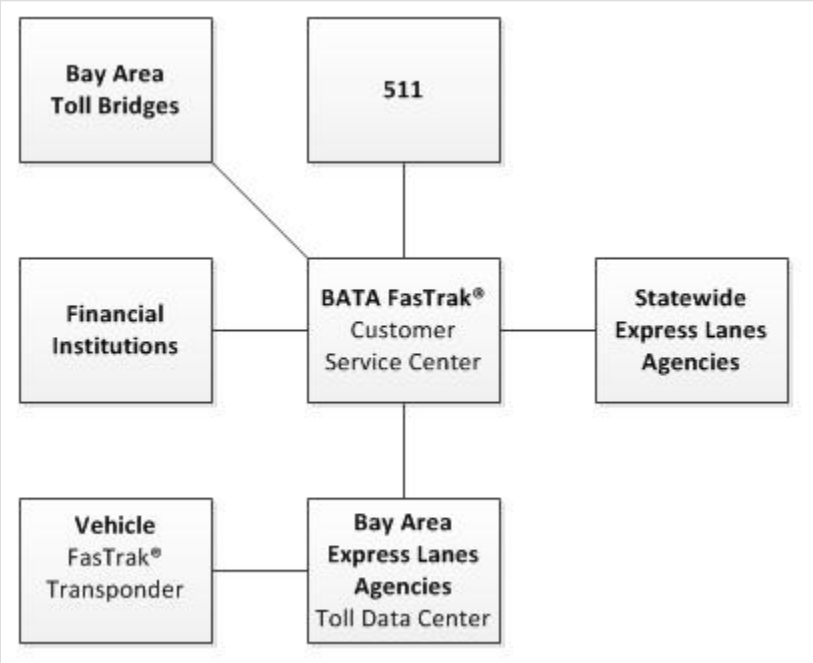


FIGURE 6-1: REGIONAL ARCHITECTURE[1]

[1] Bay Area ITS Architecture 2011 Update. Metropolitan Transportation Commission. April 23, 2012

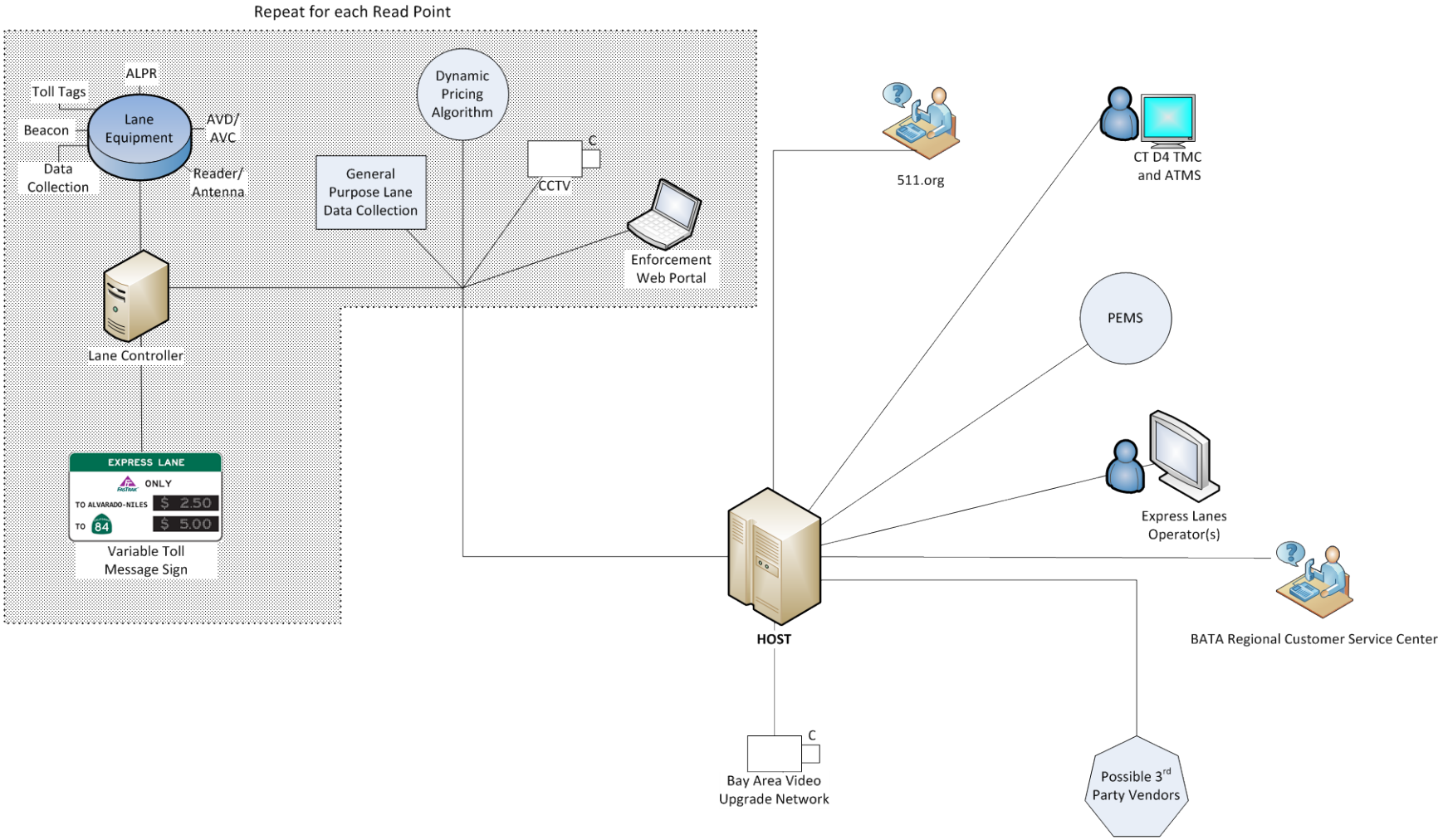


FIGURE 6-2: EXPRESS LANE SYSTEM CONCEPTUAL ARCHITECTURE

6.1.1 AUTOMATED VEHICHLE IDENTIFICATION (AVI)

The AVI equipment is the physical equipment used to identify an individual vehicle for tolling. At the heart of the AVI system are the antennae, toll tag reader and toll tag.

6.1.1.1 FASTRAK® READER/ANTENNA

The AVI antennae will be mounted on overhead structures and will be connected to readers mounted on the sign posts. The antennae will emit a radio signal that prompts toll tags in vehicles underneath the antennae to communicate their unique toll tag identification number. The toll tag identification is used to recognize whether the tag is set to toll or toll-exempt mode, and if set to toll mode is used to match the vehicle to an account for processing of the toll. A sample toll point is depicted below in Figure 6-3.

The reader and toll tag are based on Radio Frequency Identification (RFID) technology. In California, the RFID is mandated by Title 21 Specification to communicate using a frequency of 915 megahertz (MHz). Title 21 legislation was established to ensure that ETC systems implemented in the State of California are interoperable with current and future ETC systems in the State. Across the United States there are a variety of different protocols for tolling, including ISO 18000-6C sticker tags. For this reason a dual reader capable of reading both Title 21 and 6C will be used for deployment to assist in interoperability and be ready if there were to be a change to Title 21 specifications.

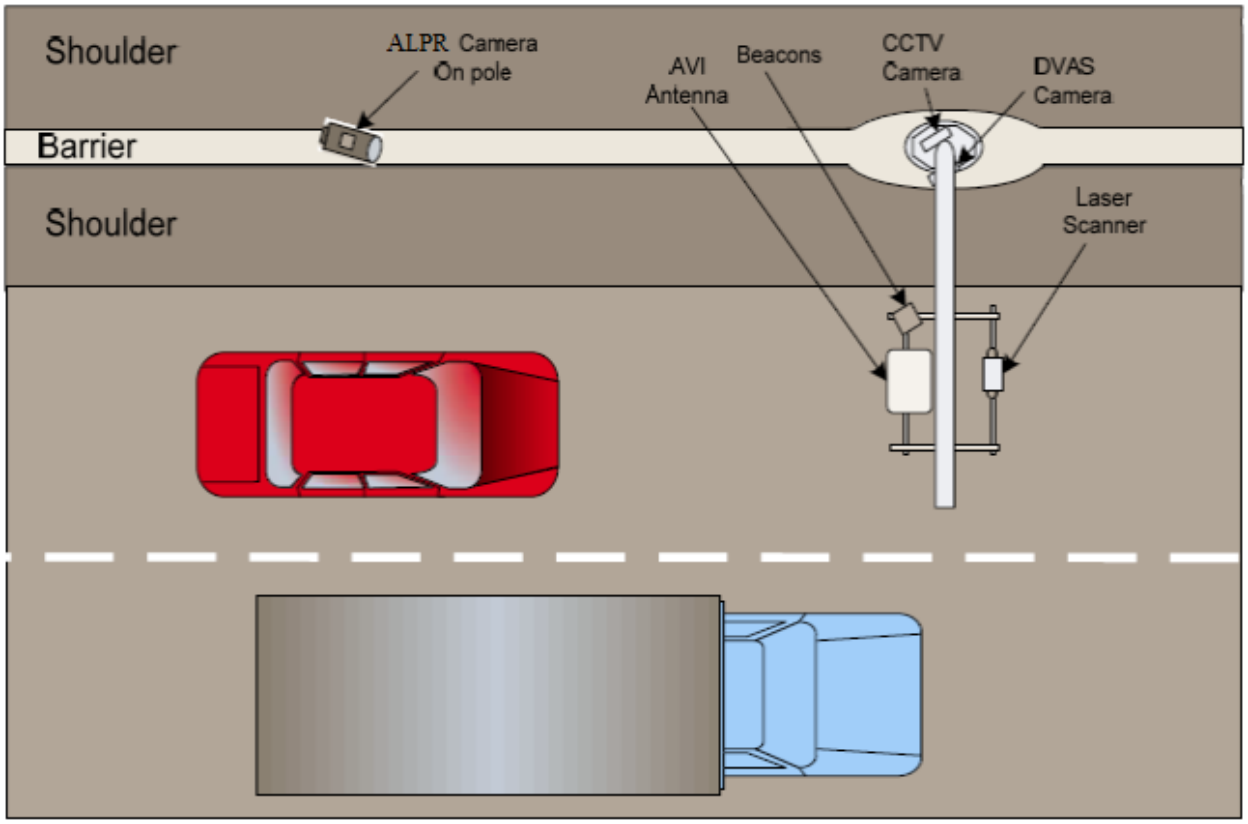


FIGURE 6-3: EXAMPLE TOLL READ POINT

6.1.1.2 AUTOMATED VEHICLE DETECTION AND AUTOMATIC VEHICHLE CLASSIFACATION

Automatic Vehicle Detection and Automated Vehicle Classification (AVD/AVC) is placed in conjunction with the AVI systems and uses a laser to trigger a message to the AVI system when a vehicle is detected at the toll point.

6.1.1.3 TOLL TAGS/TRANSPONDERS

The express lane toll tags will be Title 21 compliant and are commonly referred to as FasTrak® tags in the San Francisco Bay Area. FasTrak® tags are battery operated and user installed on the inside front windshield of the vehicle behind the rear view mirror. They communicate a unique tag identification number to the reader via the antenna. The existing inventory of standard tags will work on MTC Express Lanes, but a switchable toll tag, as described in Chapter 4, will be required for eligible toll-exempt vehicles. In the Bay Area, it has become common to keep the tag elsewhere in the car (glove compartment, center console, inside Mylar bag) and pull it out as the driver passes through the tolling facility. To improve the read rates, tags should be properly mounted on the windshield as directed.

There is a subset of high-end vehicles with windshields that interfere with the ability of tag readers to read a toll tag. These vehicles are issued toll tags that are mounted to the license plate. As described in Chapter 4, these externally mounted toll tags cannot be used to travel as an eligible toll-exempt vehicle.

Toll tags may or may not emit a beep when going through a toll point.

6.1.2 LANE CONTROLLERS

The lane controller is the component of the toll collection system that manages and automates the real-time control of lane equipment and receives data from in-lane equipment, systems and sub-systems. They will be housed in roadside cabinets on the outside shoulder and will communicate to all devices in the field and the toll system host, and record transactions. The toll system integrator will provide communications connections between lane equipment in the median and the lane controllers.

6.1.3 HOST

The host is the central database and processor for the express lanes toll system. It receives data from the lane controllers and performs a function referred to as trip building to assemble the lane transactions into trip transactions that are sent to the RCSC. The host also supports monitoring and maintenance of the equipment and includes the functionality to assign toll rates and determine pricing. To provide redundancy, there will be a primary host located at the Benicia-Martinez Toll Plaza building and a secondary host located at MTC's new headquarters at 375 Beale Street in San Francisco. The backhaul communications network, discussed in Section 6.3, will provide communications between the lane controllers, the primary and secondary hosts and the TMC.

6.1.4 VARIABLE TOLL MESSAGE SIGN

Variable Toll Message Signs (VTMS) will be located throughout the express lane corridors to communicate toll rates to drivers. These signs will consist of dynamic message panels installed

within a static sign panel. The dynamic message panels include a series of LED lights capable of displaying alphanumeric characters and will be sized to display the needed character height and message size according to the standards and guidelines in the MUTCD. Typically, these signs display the toll to travel to specific destinations, but they could also display messages related to the status of the lane. Example messages include "HOV ONLY," "CLOSED," or "ACCESS ¼ MILE." The messages will be automatically controlled by the host. They will also be capable of manual overrides by express lane operators for incident management or other operational reasons. In order to visibly ensure the price shown on the sign is accurate, cameras may be placed within view of the signs. An example pricing sign is shown in Figure 6-4 below.

FIGURE 6-4: EXAMPLE I-680SB EXPRESS LANE PRICING SIGN

6.1.5 BEACONS

Beacons will be strategically placed in the proximity of selected toll zones and will alert officers to the presence of vehicles self-declaring as an eligible toll-exempt user. The beacon will illuminate when a declared toll-exempt vehicle passes through the toll point. There are two types of beacons, a directional beacon placed at the CHP observation areas and beacons mounted on the structures from which the toll readers are hung. The directional beacons at CHP observation areas will be positioned to be visible from the rear-view mirror of parked CHP vehicles. The beacons mounted on the toll reader structures will be visible upstream and will allow CHP to do roaming enforcement, as described in Chapter 7.

6.1.6 DATA COLLECTION

There is a need for data collection of vehicle speed and traffic volumes in both the express lane and the general purpose lanes using traffic monitoring sensors. This is needed for input into the dynamic pricing algorithm as well as monitoring the overall performance of the corridor. The express lanes may require more frequent spacing of data collection infrastructure than the general purpose lanes. Data collection can be achieved through multiple technologies including in-pavement loops, side-fire microwave sensors, or in-pavement magnetic sensors.

PeMS is the data fusion system for all traffic monitoring in the state, owned and maintained by Caltrans. It takes in data from over 25,000 detectors to provide real time and historical traffic information on both the general purpose and HOV lanes in the state. The existing inventory of roadway sensors in the corridors is part of the PeMS system and can be used for monitoring the

express lanes and general purpose lanes. In addition, data collected by detection equipment deployed for MTC Express Lanes will be shared with PeMS. Data from PeMS will not be used for the speed input into the dynamic pricing algorithm due to latency and downtime issues within the PeMS system.

6.1.7 ENFORCEMENT TOOLS

CHP needs tools to enforce HOV occupancy requirements in the field. Handheld FasTrak® readers are mobile devices that query a toll tag for an account number and confirm the declaration status for the last transaction recorded from the toll zone. These readers have been used on the I-680 and SR-237/I-880 express lanes. They are mobile and wireless, allowing them to be used by motorcycle CHP officers as well as to be easily moved between standard patrol vehicles. Despite these features, handhelds are not a preferred tool for enforcement by CHP because they are bulky and require officers to hold them, which is viewed as a safety issue when approaching a vehicle, especially in the dark. An alternate enforcement tool preferred by CHP is a web portal that allows officers to access toll tag transaction information through their on-board mobile computers or via central dispatch. CHP has expressed a preference for a single web portal interface for all Bay Area Express Lanes. Enforcement tools are further described in Chapter 7.

6.1.8 AUTOMATIC LICENSE PLATE RECOGNITION (ALPR)

ALPR cameras will be used to capture images of vehicle license plates for any vehicle passing through a toll point. Optical character recognition (OCR) software is then used to automatically distinguish the actual plate characters. ALPR is not 100% accurate and typically some portion of the license plate images will have to be manually read by an operator. OCR can be used in combination with the emerging "fingerprinting" technology to enhance the accuracy of the system. Vehicle fingerprinting technology attempts to match various characteristics in the captured images, including the license plate and the image of the vehicle itself.

6.1.9 CLOSED CIRCUIT TELEVISION (CCTV) CAMERAS

CCTV cameras will be strategically placed in the corridor to monitor the express lanes, the toll equipment, and the general purpose lanes. The cameras deployed as part of the express lanes will be primarily used for express lane operations, and will be integrated with the Caltrans video distribution system. Operator priority can be set so express lane operators always have the highest status for operation of the express lane cameras. There is currently no plan to record the video feeds.

The cameras will be placed on roadside poles and are sometimes placed on mast arms attached to the gantries. The cameras will have pan, tilt and zoom capabilities to allow the express lane operators and possibly the TMC to monitor the freeway and incidents.

6.1.10 MAINTENANCE ONLINE MANAGEMENT SYSTEM (MOMS)

The express lanes will have multiple components integrated to make one complete system. It will be important to monitor all the hardware and software components for errors, failures or any inconsistencies. The industry uses a Maintenance Online Management System (MOMS) to monitor

all the components and to send an alert when there is an error. MOMS can be set up to send emails, texts or pages to IT staff, the system integrator or whoever is responsible for repairing the problem.

6.1.11 DIGITAL VIDEO AUDITING SYSTEM (DVAS)

In order to support auditing and to troubleshoot and diagnose performance issues and other systemic problems in the express lanes, a Digital Video Auditing System (DVAS) with video and data audit capability will be used to conduct independent performance audits. The DVAS system will be integrated into the host and/or to mobile DVASs that can be used to audit the system and diagnose system problems.

6.1.12 EXPRESS LANE OPERATIONS

The express lanes will have operators to monitor the system and to coordinate with Caltrans, CHP and other agencies. The operators will have workstations that interface with the toll system and provide the ability to monitor the operations of the express lanes and override the dynamic pricing algorithm if conditions warrant. The new headquarters for MTC at 375 Beale Street in San Francisco will serve as the primary location for toll operations; the Caltrans District 4 TMC will serve as a back-up location.

6.1.13 REGIONAL CUSTOMER SERVICE CENTER (RCSC)

The RCSC is a one-stop shop for the seven Bay Area State-owned bridges, the Golden Gate Bridge and the express lanes to maintain FasTrak® accounts and provide customer service. The RCSC is operated by BATA and will be responsible for the following express lanes tasks:

- Toll tag distribution
- Sending tag status file to the Central Processing System
- Receiving trip-based data from the Central Processing System
- Receiving images from the Central Processing System for violation processing
- Account Management
- Customer Service

The RCSC Contractor, with assistance from Alameda County Transportation Commission and MTC, will develop a new Interface Control Document which will specify the communication protocol for the Bay Area's Express Lanes to send and receive data to/from the RCSC.

6.2 OTHER INTERFACES

There are multiple other systems with which the express lanes may interface for improved operations. Descriptions of some of these potential system interfaces are below.

6.2.1 ADVANCED TRANSPORTATION MANAGEMENT SYSTEM (ATMS)

Caltrans District 4 owns and operates the ATMS which is an integrated ITS platform for monitoring and managing the transportation network from the TMC. Currently, express lane operators on I-680 and SR-237/I-880 manually notify the Caltrans District 4 TMC of an incident over the phone. Caltrans then enters the incident into their ATMS. The ATMS is also the software that will be used

to manage the I-80 SMART Corridor Project described in Chapter 4. There are no plans for MTC Express Lanes to interface with the ATMS in the near term.

6.2.2 BAY AREA VIDEO UPGRADE (BAVU) SYSTEM

The BAVU system provides control and monitoring of CCTV cameras on Bay Area freeways from the TMC. Camera feeds from CCTV cameras installed for MTC Express Lanes may be shared with TMC operators through the BAVU system.

6.2.3 COMPUTER AIDED DISPATCH (CAD)

The CAD is a computerized listing of all incidents within California. The CAD is maintained by the CHP and provides real-time information regarding incidents. The public CAD is a package of the primary CAD with elements eliminated for safety and/or privacy considerations. The public CAD is utilized by transportation information organizations including 511 and TV and radio stations. The public CAD is a subset of the media CAD and is distributed at http://cad.chp.ca.gov. There is currently an interface between the CAD and Caltrans' ATMS, which is not being used. Express lane operators will have access to the media CAD.

6.2.4 EXPRESS LANE WEB PORTAL AND WEBSITE

BayAreaExpressLanes.org will serve as the primary portal site for the public to access information about express lanes in the San Francisco Bay Area. It will be branded with the Bay Area Express Lanes identity. It will contain universal information about express lanes and how to use them, a map of current and planned express lanes, and other high-level content. The portal site is managed by MTC with input from the Express Lanes Public Information Working Group (PIWG).

From this portal site, visitors will be directed to the websites of individual express lane operators (Alameda CTC, MTC and VTA), Bay Area FasTrak® and other partners for more detailed and/or lane specific information. MTC has developed MTCExpressLanes.org for this purpose.

6.2.5 NEW ADVANCED TOLL COLLECTION AND ACCOUNTING SYSTEM (ATCAS II)

ATCAS II is the toll system in use on the seven Bay Area bridges overseen by BATA. This system is able to discern between the different switch settings of the FasTrak® Flex toll tags. However, the ATCAS II system will need to be modified when the HOV approaches to any of the bridges are converted to express lanes so that the toll system will properly charge SOV vehicles a full bridge toll.

6.2.6 PERFORMANCE MEASUREMENT SYSTEM (PEMS)

PeMS is a freeway performance measurement system for the state of California. Traffic data is collected in real-time from over 39,000 individual detectors that span the freeway system across major metropolitan areas throughout the state. PeMS also provides over ten years of archived data for analysis. MTC Express Lanes will share traffic speeds, volumes, toll sign information and anonymized trip data with PeMS.

6.2.7 511.ORG

The Bay Area traveler information website (www.511.org) and phone service is the regional source for information on transit, traffic, ridesharing and bicycling, and is owned and operated by MTC. MTC Express Lanes will send traffic speeds, volumes and toll sign information to 511, and 511 operators will have access to express lane camera feeds through BAVU. Currently, 511 does not display information on the status of existing express lanes, but may in the future.

6.3 BACKHAUL COMMUNICATIONS

The backhaul communications network will provide a telecommunications backbone to facilitate real-time communications from each of the express lanes corridors to the express lanes host sites, express lanes operation centers and the RCSC. The backhaul network will consist of fiber optic cable to be installed along I-680 and I-880, partner agency fiber from BART and Silicon Valley ITS, and AT&T high-speed leased-line telecommunication services (see Figure 6-5). The leased-line services will provide the primary telecommunication path for the I-80 West express lanes as well as redundant paths for the CC-680S and ALA-880 express lanes. The network will be used to communicate between the toll system lane controllers, the primary and secondary host sites, and the primary and secondary operations sites.

In addition, the backhaul communications network will support broader regional traffic management communications needs, including connections to existing Caltrans Traffic Operations Systems (TOS) elements on I-680 and I-880 and future connections to TMS systems.

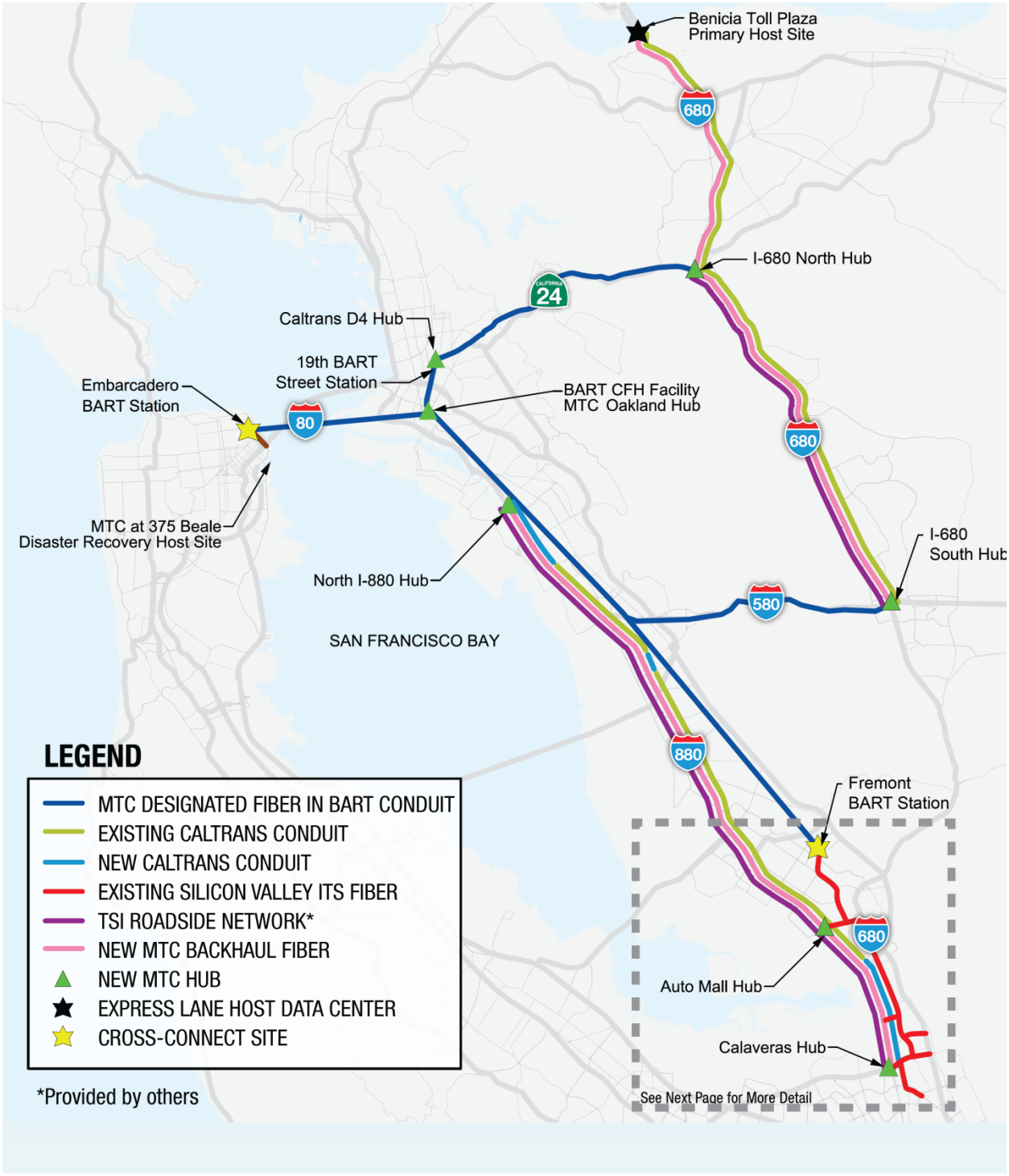


FIGURE 6-5 BACKHAUL NETWORK

6.4 DYNAMIC PRICING ALGORITHM

As described in Chapter 4, there will be zone-based pricing that will be dynamically set to manage the demand of traffic in the express lanes. An algorithm will be developed to determine the price in

each zone at any given time. The pricing algorithm will have the capability to set a minimum toll and a maximum toll, if desired. The algorithm will use current speeds, volumes and density on the express lanes and general purpose lanes to calculate the price. The price will be updated at a reasonable time interval so travelers are not seeing a constantly changing price and the price will only vary by no more than a designated amount. Although the algorithm will be automated, it will need to be monitored to ensure it is effectively responding to operating conditions. After a period of performance, the algorithm and the designated interval of pricing change may need to be refined. The toll algorithm will need to provide for the ability for operators to manually override by changing the toll or reverting to HOV-Only mode when conditions warrant (e.g., for incident management and routine maintenance). The system will need to adjust for the time it takes a vehicle to travel from a pricing sign to a toll point to ensure each customer is charged the price shown on the sign when that vehicle entered the express lane. For example, a vehicle may drive under a pricing sign, but the toll may change by the time the vehicle reaches a downstream toll zone. In this case, the toll system would apply the toll that the driver saw on the pricing sign.

6.5 AUTOMATED OCCUPANCY DETECTION

There are two emerging technologies to detect and communicate the number of occupants in a vehicle. The first is infrared cameras capable of detecting the number of people in a vehicle. The second is interrogation to the vehicle on-board unit (OBU) to get occupancy based on seat detectors in the vehicle. OBU's are used in newer vehicles to control airbag operations, seat belt warnings and other functions.

Fully automated enforcement has not been deployed to date in any express lanes and there are a number of obstacles that must be overcome, including validity in court, privacy concerns and accuracy. Even though automated occupancy detection may not be used for violations, it may provide helpful information to CHP even if not entirely accurate.

Automated occupancy detection is an experimental market and, in order to determine its applicability and reliability, a technology demonstration from multiple vendors could be set up to see the latest in the industry. SANDAG and some other express lane operators are also looking at automated occupancy detection, and this project can learn from their findings. MTC is working with a vendor to test its passenger detection system and plans to stay informed of other technology demonstrations in this field.

6.6 RADIO FREQUENCY INTERFERENCE

The AVI system relies on radio frequency (RF) communication at a frequency of 915 megahertz. Radio frequency is notorious for bouncing, reflecting and causing general interference issues. The Federal Communications Commission (FCC) requires a license for anybody operating RF in this band to help control interference issues. Prior to any deployment, a radio frequency survey will be performed, along each corridor at the toll zones, to determine any potential conflicts. Periodic radio frequency interference surveys may also need to be performed once the lane is operational to maintain toll system integrity. Conflicts can affect the physical placement of toll points and can influence the selection of the ultimate communications technology to be employed.

6.7 PRESERVE FLEXIBILITY FOR FUTURE TECHNOLOGIES

In order to design and build a system ready for traffic in 2016, the technologies will need to be determined shortly after the adoption of this Concept of Operations. Although the Title 21 standard will continue to be used to read toll tags in the near term, dual protocol toll tag readers are being installed that are capable of reading toll tags using the ISO 18000-6C and Title 21 standards. Under new federal requirements, national interoperability will be required by 2016. The standards for national interoperability have yet to be determined, and each tolling agency will have to make adjustments as details emerge. Caltrans is responsible for maintaining the California Title 21 specification for electronic toll collection. Any changes to Title 21 would have an effect statewide and require support from CTOC.

6.8 NATIONAL TRANSPORTATION COMMUNICATIONS FOR ITS PROTOCOL (NTCIP)

The National Transportation Communications for ITS Protocol (NTCIP) is a family of standards being jointly developed by the American Association of State Highway and Transportation Officials (AASHTO), the Institute of Transportation Engineers (ITE), and the National Electrical Manufacturers Association (NEMA). These standards should be used in the selection of hardware, infrastructure and software to ensure greater interoperability and adherence to national standards.

6.9 INTEROPERABILITY WITH ALAMEDA AND SANTA CLARA PROJECTS

Currently, there are two operational express lanes in the Bay Area, SR-237/I-880 (VTA) and I-680 SB (Alameda CTC). Although there is no plan to operate these express lanes from the same software platform, there may be a need in the future for these systems to share information with one another. In the meantime, Bay Area Express Lanes operators are in agreement and have a plan in place so that switchable toll tags will work seamlessly on all express lanes.

6.10 EQUIPMENT LIFECYCLE AND SPARES

All equipment has a natural lifecycle that will need to be planned for, typically assumed to be 10 years in the tolling industry. There are components that can have a shorter lifecycle (e.g. network switch, monitors) and will need to be replaced more frequently. There is also a technology lifecycle that should be accounted for in the 5-10 year range. Routine maintenance and preventative replacements will help to ensure unplanned outages. The lifecycle of all equipment should be planned for and properly financed ahead of time. Spare parts should be acquired and on hand to keep the system running in case of a failure. Ten percent is a typical spare parts quantity used.

6.11 FAILURE SCENARIOS

The express lane system will be designed with all potential failure scenarios accounted for with redundancy, failover plans, or other mechanisms to minimize downtime. Potential failures include loss of power to a toll point, physical damage to a roadside cabinet or interruptions in third party communication service. There will be physical redundancies, battery backup and duplication of

storage to ensure transactions are never lost. The maintainer of the systems will have pre-designated response times to failures and alert systems to notify of outages.

6.12 SYSTEM REDUNDANCY, BACKUP AND SECURITY

It is important that there be redundancy with critical pieces of equipment and that all data is backed up on a routine basis to minimize revenue loss in the event of equipment failures, communications losses, theft or destruction from an accident. An Uninterruptible Power Supply (UPS) should be deployed for battery back up in the case of power failure. In order to prevent theft, lockable pullboxes and cabinets should be utilized. The system and network also need to be designed to protect against hacking and to keep personal identifiable information secure. Reliability of the revenue stream is important to maintain the financial integrity of the express lanes to cover operations and maintenance costs and to meet obligations to bondholders, if any.

CHAPTER 7 EXPRESS LANE OPERATIONS

This chapter describes how MTC Express Lanes will be operated in terms of enforcement, incident management, performance monitoring and day-to-day operations.

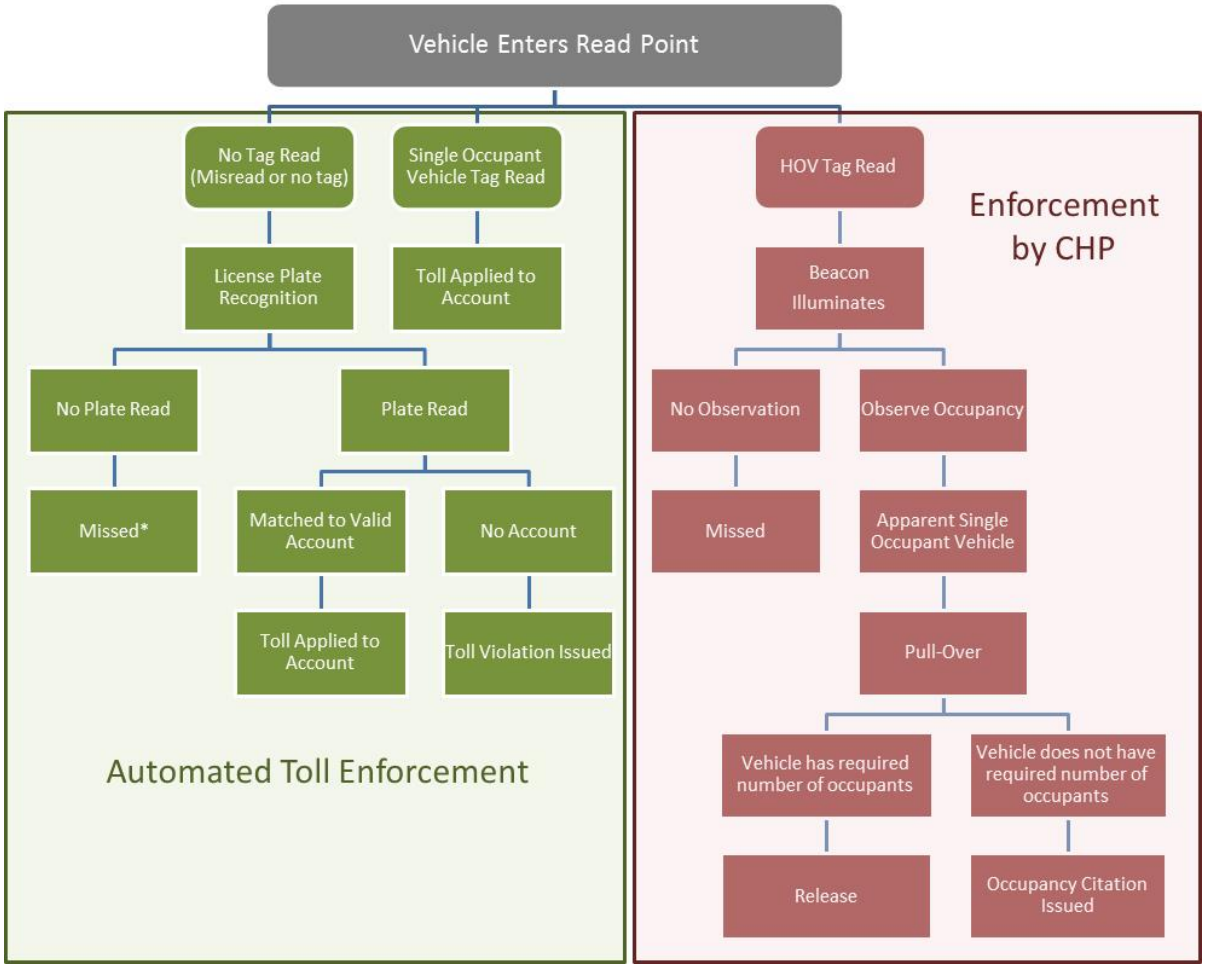
7.1 ENFORCEMENT

Enforcement of MTC Express Lanes is critical to maintain an acceptable level of operational performance and system integrity. Enforcement efforts will be a combination of visual enforcement by CHP officers along with automated toll system enforcement strategies to ensure that vehicles using the express lanes follow adopted toll policies and pertinent vehicle codes regarding payment of tolls, eligibility to travel toll-exempt and legal ingress/egress.

7.1.1 TYPES OF VIOLATIONS

For the purposes of express lane enforcement in this document, violations are classified into three types: (1) toll violations, (2) eligibility violations and (3) buffer crossing violations. Enforcement of other California Vehicle Code violations such as speeding are not addressed.

As described in Chapter 4, the requirement for vehicles to self-declare their toll-exempt status will allow the toll system to automate the toll violation process through use of the ALPR system. The CHP will enforce eligibility violations, including violation of the HOV occupancy requirements for toll-exempt travel, and buffer-crossing violations. The flowchart shown in Figure 7-1 illustrates how automated toll system enforcement will work in conjunction with manual enforcement by CHP officers. As shown, CHP officers would be expected to visually observe vehicles for eligibility violations when alerted by an enforcement beacon, which is triggered when a vehicle passes a toll point with a switchable toll tag set in a toll-exempt setting. Vehicles without a valid toll tag read will be handled via ALPR to match the transaction to an account or issue a toll violation. CHP will not be alerted to the presence of a vehicle with no toll tag read since the toll system will automatically enforce this situation. In addition, it would be ineffective to alert CHP to a vehicle with no toll tag read because, given MTC's anticipated toll polices that allow pay-by-plate accounts, California Vehicle Code Section 23302(d) would not allow CHP to pull the vehicle over based on this information alone. To support the ALPR system, CHP will play an important role in making sure all vehicles in the express lane have a license plate.



**CHP will be relied upon to cite vehicles without properly mounted license plates in the express lanes.*

FIGURE 7-1: EXPRESS LANE ENFORCEMENT PROTOCOL

7.1.1.1 ELIGIBILITY VIOLATIONS

The CHP will be responsible for enforcing the eligibility requirement for the express lanes. Eligible toll-exempt vehicles will be required to declare their eligibility status using a switchable toll tag, as described in Chapter 4. CHP have expressed concern that switchable toll tags could be a driver distraction. To alleviate some of these concerns, drivers will be instructed to set their switchable toll tag before making their trip. Once the toll tag is set, a driver would have no need to change the switch setting. Enforcement tools described in the following sections will allow CHP officers to determine what setting switchable toll tags were set in (SOV vs. HOV) when a vehicle was detected at a toll point.

Enforcement beacons will be installed at toll points and in close proximity to CHP observation areas throughout the corridor. The beacons will display a distinct light color to indicate that a self-declared toll-exempt vehicle has passed through the toll zone. The CHP will monitor the beacons, and when alerted, will visually inspect the vehicle to ensure that it meets eligibility requirements (i.e., whether the vehicle has the required number of vehicle occupants or meets other toll-exempt requirements). Users who commit a violation will be issued a citation by the CHP for violating the HOV policy for the facility.

The beacons at CHP observation areas will be positioned to face towards the rear of parked CHP vehicles so that an officer can see the beacon and associate it with vehicles passing by (see Figure 7-2).

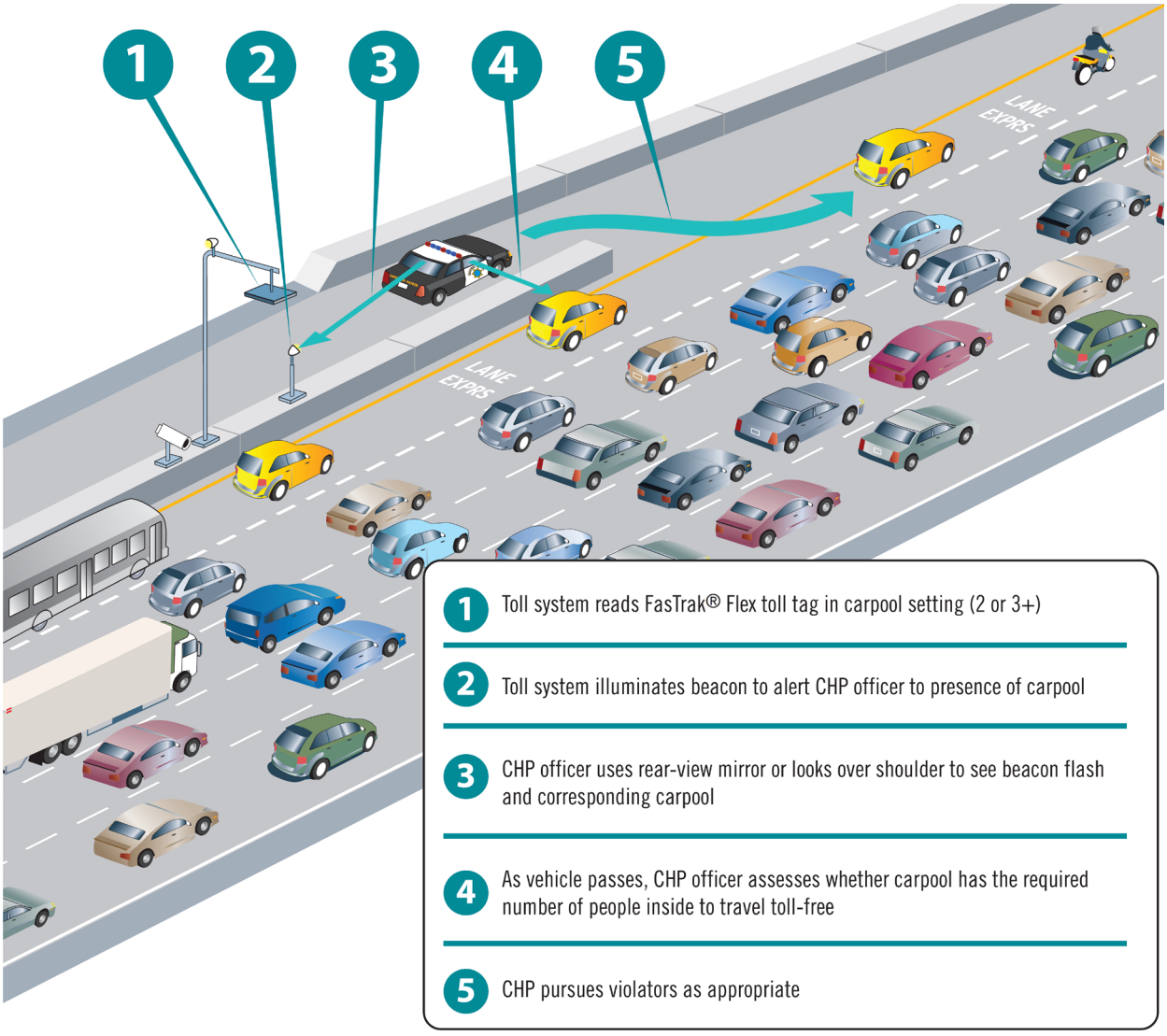


FIGURE 7-2: ENFORCEMENT BEACONS AT CHP OBSERVATION AREAS

Similar enforcement beacons mounted on toll point gantries will be visible to patrolling officers upstream of the beacon. These beacons will allow CHP officers to enforce the eligibility requirement while traveling along the corridor.

In addition to the beacons, mobile computers already in CHP vehicles will have access to a web portal that draws upon the express lane host system to provide a toll tag's declaration status when a vehicle is pulled over. CHP officers will be able to query the toll tag declaration status detected at the last toll point by typing in the toll tag identification number affixed to the toll tag. Later, officers will be able to retrieve information to support citations in a court of law.

Handheld FasTrak® readers are wireless devices that can assist CHP officers in verifying the declaration status of vehicles that are pulled over by providing officers information about the last transaction recorded. Handheld readers that have been provided to CHP officers for enforcement of the two existing Bay Area express lanes are underutilized. This is due to the lack of interoperability between facilities, the size of the readers which makes them cumbersome to carry, and the need for officers to keep their hands free when approaching a vehicle for safety reasons. For these reasons, the enforcement of MTC Express Lanes will not include the use of handheld readers.

7.1.1.2 TOLL VIOLATIONS

Toll violation enforcement will be accomplished through the use of ALPR. The ALPR cameras will take a picture of the license plate of all vehicles that pass through a toll point. The license plate image will then be used to associate the transaction(s) with a valid account or to issue a toll violation to users without an established account. Business requirements will be implemented to define protocol for first-time violators and vehicles with malfunctioning toll tags.

ALPR cameras will be installed at every toll point. The primary components of the ALPR subsystem are a camera, a light source, and an image processor. Cameras and lights will be mounted a short distance upstream of the toll reader to capture the rear license plate for each vehicle. The transaction record (image with or without a tag read) will be transmitted by the lane controller to the host for handling. All images, including those that cannot successfully be processed by OCR, will be indexed to the corresponding transaction record. The system will protect PII in accordance with the agency's PII policy.

The use of full color cameras allows the ALPR system to recognize vanity and specialty plates currently used that are not standard seven character license plates. A feature on these plates and its color (emblem, a shape, etc.) can be used as a starting point in recognizing the characters position on the plate.

7.1.2 BUFFER CROSSING VIOLATIONS

The CHP will be responsible for enforcing the ingress and egress restrictions for the express lanes. As described in Chapter 3, portions of the express lanes will be separated from the general purpose lanes by a solid double-striped pavement marking. Legal access into and out of the lane in these areas will be restricted to designated access points. Vehicles that illegally enter or exit the facility will be subject to a vehicle code violation citation from the CHP.

7.1.3 OFFICER OBSERVATION

CHP enforcement on MTC Express Lanes will be primarily on a contracted overtime basis and can be categorized as stationary enforcement from a designated observation area or as a moving patrol. Enforcement may be targeted during peak periods when violations are most problematic.

For stationary enforcement, the officers park on the shoulder or in designated observation areas where they can observe an enforcement beacon and have a clear view of the vehicles to determine eligibility. As noted in Section 3.7, observation areas are to be designed to provide a high level of officer safety as well as ease of access and ability to accelerate. Stationary enforcement is one way

for officers to enforce adherence to eligibility requirements, but this strategy severely limits the area that an officer can see to enforce ingress/egress violations.

Patrols that are moving with the flow of traffic are the more practical method for enforcing illegal weaving in and out of the express lane as the officers will have a greater view of the corridor than what can be seen from the stationary observation points. They can also target specific vehicles to confirm their toll tag setting matches the number of occupants while driving in the express lane corridor.

The periodic deployment of a high presence of CHP officers (2-3 times the normal amount of officers patrolling a corridor) has proven successful on existing Bay Area express lane facilities. This strategy provides several advantages:

- Able to provide higher level of CHP coverage and presence throughout the corridor.
- Provides more flexibility to move officers between stationary and moving patrols as needed
- Allows officers to work in teams where one officer identifies a violator and radios to a partner who writes the citation
- High profile presence acts as a deterrent

Due to costs and other difficulties associated with deploying additional officers on overtime, this approach will be used strategically. This strategy can be more effectively employed when targeted during time periods and in locations where violations are most problematic. It may also be desirable to have a high presence of CHP enforcement when express lanes are first opened to establish compliance. The enforcement agreement between MTC and CHP will specify the desired level of enforcement.

7.2 INCIDENT MANAGEMENT

The partnering agencies involved in the operations of the express lanes, including BATA, MTC, CMAs, Caltrans and the CHP, will need to have a clear understanding of roles and responsibilities regarding incident management to maintain express lane operations. Procedures for clearing of the incident and operations of the express lane during the incident will be documented in an incident management plan prior to the opening of the facility. It is assumed that the current process in place for the management of incidents by the CHP and Caltrans will continue per the existing CHP-Caltrans Joint Operational Policy Statement.

Incident management will be coordinated among the express lane operations staff, the TMC operators, the CHP and the FSP. The Bay Area Incident Management Task Force, which includes each of these agencies as members, could serve as a forum to facilitate coordination. In the event that express lanes are used to divert traffic during an incident, or if an incident causes conditions in the express lanes to deteriorate, the express lane operator must be notified in accordance with the incident management plan. The express lanes pricing signs will display a message such as "NO TOLL" and no toll will be charged when there is an incident affecting the express lane. There may be instances when the RCSC is required to reverse transactions that are recorded during the time of the incident, too.

7.2.1 TRANSPORTATION MANAGEMENT CENTER (TMC)

The Caltrans TMC is staffed by Caltrans operations staff as well as representatives from the CHP. The TMC includes the District Communications Center (i.e., the radio room), which is staffed by Caltrans maintenance. The TMC serves as the command center for traffic operations and coordination of activities associated with incident management. The TMC will coordinate with CHP officers on the scene of the incident and assist in the dispatch of Caltrans maintenance resources, emergency vehicle response and FSP as required. MTC Express Lanes operators will monitor the lanes and coordinate with Caltrans TMC and CHP during an incident.

7.2.2 CALIFORNIA HIGHWAY PATROL (CHP)

During an incident, the highest-ranking CHP officer is the on-scene incident commander. The CHP incident commander is responsible for traffic control and coordination of the incident. Information about the incident is relayed via CHP's Computer Aided Dispatch (CAD). In addition to the incident commander, a CHP officer assigned to manage the CHP's TMC staff is responsible for the CHP procedures for incident communications between CHP dispatch, officers at the scene of the incident and the TMC.

The operating procedures developed for MTC Express Lanes will include use of CHP's public CAD, which is a package of the primary CAD with elements eliminated for safety and/or privacy considerations.

7.2.3 FREEWAY SERVICE PATROL (FSP)

As described in Chapter 5, FSP drivers patrol the Bay Area freeways during hours of peak congestion, providing response to incidents including clearing of debris, towing and minor auto repairs. Each of the major freeways in the Bay Area has a predetermined schedule and allocation of FSP resources based on historical data regarding the average number of incidents for the corridor. The existing FSP resources for each of the express lane corridors will be reviewed on a case-by-case basis to determine the adequacy to address the operational needs of the express lanes. Additional FSP resources will be contracted if necessary.

7.3 PERFORMANCE MONITORING AND REPORTING

Operational goals will be established for the MTC Express Lanes and will form the basis for a performance monitoring program. The attainment of these goals will be quantified using various performance measures. The establishment of performance measures will ensure that express lane operations are ideally managed in response to varying traffic conditions. The performance measures will also drive the monitoring and associated data collection needs that are necessary to track adherence to goals. These performance measures could be used to reflect conditions in the express lanes, general purpose lanes or across all lanes.

The performance measures established for the MTC operated express lanes will be regularly reported to various stakeholders. These reports may include traffic performance, toll system performance, financial and customer service information. Performance measures can be presented in a way that display trends over time to allow for monthly, quarterly and annual comparisons.

Some of this reporting is required by statute. Additional reporting will be necessary to brief BAIFA Commissioners, report to the public and respond to media inquiries. Reporting needs are classified into the following types and described in more detail below:

- Statutory performance reporting
    - Section 149.7 of the Streets and Highways Code requires that the California Transportation Commission submit an annual report to the Legislature on the progress and operation of express lanes.
    - Section 166 of Title 23 of the United States Code requires submittal of an annual report to document express lane operations impacts where HOV lanes have been converted to express lanes.
- Before and After Comparison
    - Section 149.5 of the Streets and Highways Code requires the submittal of a report to the Legislature on the effects of the express lanes no later than three years after the express lanes begin revenue service. MTC plans to collect traffic operations data and other information prior to construction for each express lane corridor to compare with data collected after the express lanes are in operation.
- Monthly performance reporting
    - MTC staff will produce monthly performance reports for presentation to executives and commissioners. The types of data to be included in the reports will be readily available from the toll system.
- Less frequent performance reporting
    - Some performance measures may not be reported on a monthly basis due to the nature of the data to be used (e.g., customer feedback and data from multiple sources that requires compilation).
- Active monitoring and reporting during first few months of operations
    - There may be a need for more frequent monitoring and reporting when an express lane corridor first opens to ensure that the express lane pricing algorithm is functioning properly and that there are no adverse traffic impacts.

7.4 DAY-TO-DAY OPERATIONS

MTC Express Lanes will be operated from a toll operations center located at 375 Beale Street in San Francisco, which is the location of the new regional government facility including MTC's offices. Express lane operators will have workstations to monitor CCTV camera feeds and toll system operational status and will have the ability to react to toll system issues and incidents. Operators will also have the ability to fine-tune the operations of the express lane (e.g., manually change the toll rates).

A back-up toll operations center will be located at the Caltrans District 4 TMC.

CHAPTER 8 MOTORIST AND OPERATOR PERSPECTIVE

8.1 INTRODUCTION

This chapter describes users' and operators' perspectives through operational scenarios for MTC Express Lanes. The operational scenarios fall into four categories with one or two scenarios in each category. The categories and scenarios are listed below.

Customer-focused scenarios:

- Becoming a customer and managing my account
- Using the express lanes

Customer service center scenarios

- Account activity
- Violation processing

Field-based scenarios

- Enforcement
- Incident response

Operator scenarios

- Incident response

8.2 CUSTOMER-FOCUSED SCENARIOS

8.2.1 BECOMING A CUSTOMER/MANAGING ACCOUNT

Becoming a customer of the MTC Express Lanes requires being or becoming a FasTrak® customer. Only electronic toll collection will be in place for the express lanes as opposed to the toll bridges where cash payment is still accepted. A person purchases a toll tag, registers the tag, and then properly mounts the tag on his or her vehicle, usually on the windshield. As discussed in Chapter 4, all MTC Express Lane customers will be required to have a FasTrak® account. To be recognized as a toll-exempt vehicle, drivers will be required to carry a FasTrak® Flex toll tag set in an HOV setting. Part of the purchase of the toll tag price becomes the initial balance available for tolls. As part of the registration process, a customer can link a credit card to their FasTrak® account or opt to pay cash to replenish the account.

The RCSC is responsible for toll tag distribution and account initiation and management. The RCSC is the primary contact between the customer and toll system. Once an account is established, customers can securely manage their accounts to:

- Update their user account information (such as credit card information and password).
- Track account activity.
- Update account type.
- Link one or more license plate numbers to the account. (If a tag is not read when a vehicle passes through a toll zone, a camera image of the vehicle's license plate is captured. If the

license plate is linked to a valid account, the toll is deducted from the account and no violation is issued.)

Once an account has been established, the customer can use the express lane system, as described in the next section.

8.2.2 USING THE EXPRESS LANES

There are two ways to use the express lane system, either as a toll-exempt vehicle or as a toll payer. For both sets of customers, using the express lanes will be somewhat different from using the existing HOV lanes or toll bridge facilities in the Bay Area. Before making a trip, carpoolers and other toll-exempt users will need to obtain a FasTrak® Flex toll tag and "declare" their toll exempt status by setting the switch on the device to the appropriate position. Carpoolers will simply select the position of the switch on the FasTrak® Flex toll tag that corresponds to the total number of people in the car. Other toll-exempt vehicles (e.g., motorcycles) will be instructed to set their tag in an HOV setting. The system will recognize the declaration and handle the account as follows:

- If the switch on the FasTrak® Flex toll tag is set to indicate that there are enough people in the vehicle to qualify for toll-exempt travel, no toll will be charged to the account. Motorcycles, eligible low-emission vehicles with DMV-issued decals and two-seat vehicles with two occupants will also need to set their toll tag in a HOV setting for toll-exempt travel in the express lanes.
- If the switch on the FasTrak® Flex toll tag is set to indicate that there are not enough people in the car to qualify for toll-exempt travel, or the vehicle is carrying a standard FasTrak® toll tag, the prevailing toll will be charged if the vehicle enters an express lane. The toll will be charged based on the number of toll "zones" a motorist passes through and how congested the facility is. The express lane facilities will be broken into toll zones with logical termini to effectively manage the demand. It is estimated that the toll zones will be approximately 3-5 miles in length. In order to dissuade motorists from weaving in and out of the express lanes, motorists will be charged a toll for each express lane zone they travel into or through, regardless of the distance they travel within that zone.

If a driver will never travel in the express lanes as a carpool, a standard FasTrak® toll tag can be used and their account will always be debited the prevailing toll amount whenever traveling in the express lanes. However, these users will not be able to shield their toll tag in a mylar bag as a way of declaring their toll-exempt status, as is currently done on the operating express lanes in the Bay Area.

Overhead signs will display the toll amount to given destinations. The destination(s) will correspond to the termini of toll zones and will be based on an analysis of traffic patterns within the corridor. The driver will not be charged more than the toll that is displayed for the current zone and the major destination as displayed on the pricing sign upon entering the lane, even if the price increases after entering the lane. Generally speaking, either one or two destinations will be displayed on a given sign. A driver could choose to not enter the express lane in the first zone and then enter further downstream. Or, a driver could enter the first zone and then exit the express lane before entering the second zone. In either case, the driver would only be charged for the zone(s) traveled in and for the toll(s) displayed when first entering.

The toll prices will be set to safely maximize system performance. The primary benefit that the express lanes provide is a reliable trip for carpools or for people who wish to pay for the benefit. It is critical that the pricing is set to assure that reliable trip. In the event that the speed drops below 45 mph in the express lane, the price to use the lane would either become increasingly expensive to discourage SOVs from entering until the lane returns to more normal operating conditions or the lane would revert to HOV-only mode. For the latter, the pricing signs would display "HOV ONLY" and SOVs would no longer be permitted to enter the lane. Business requirements to be developed by MTC would establish policies for toll-paying vehicles that are already in the express lane when if it reverts to HOV-only mode.

Based on the price displayed on the toll signs during operating hours, motorists will decide whether to enter the express lane or not. Drivers can enter/exit the express lanes at any location except those where the express lane is separated from the general purpose lanes by a double solid line. If the choice is to enter, the FasTrak® toll tag or license plate is read by field equipment (toll tag reader or ALPR camera). This information is transmitted to the host where it is assembled into a complete record of the entire trip on the express lanes via trip building for eventual submission of a trip transaction to the FasTrak® customer service center where the tolls are charged to the appropriate accounts.

As discussed in Chapter 4, the express lanes will operate during the same hours as the HOV lanes. During other times of day, motorists will be able to use the lanes without paying a toll or being in a carpool.

The graphic below in Figure 8-1 illustrates how signage and striping will be used to communicate the express lane requirements to motorists.

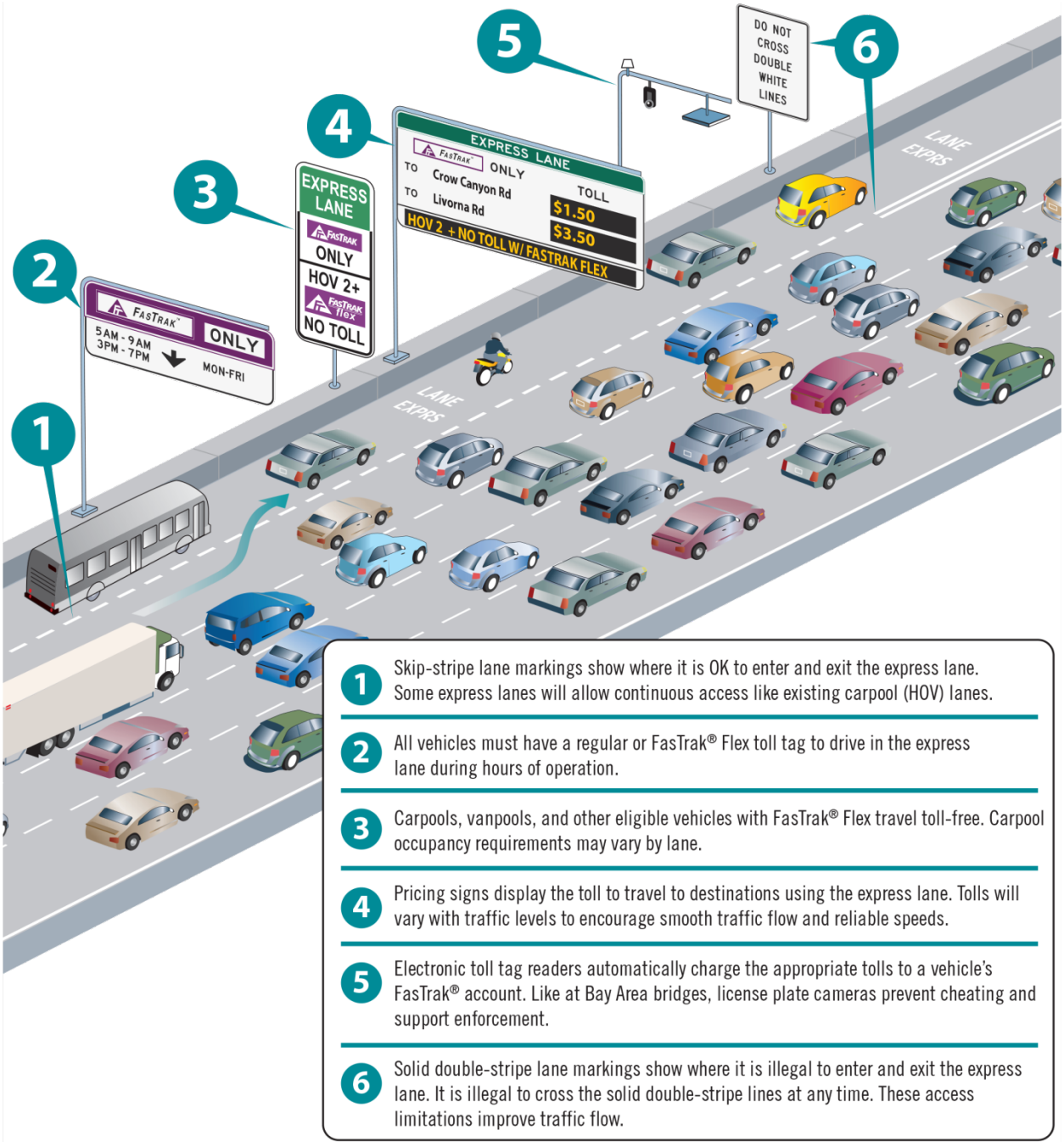


FIGURE 8-1: HOW EXPRESS LANES WORK

8.3 CUSTOMER SERVICE CENTER SCENARIOS

8.3.1 ACCOUNT ACTIVITY

Staff at the RCSC manage all FasTrak® customer accounts and provide general customer service. The RCSC collects express lane tolls from customer accounts based on trip transaction records from

individual express lane systems. The RCSC also maintains account records for each FasTrak® account. The records at the RCSC allow customers to track their account activity.

The systems and staff at the RCSC also monitor account activity. As the balance in the account drops below a certain threshold, the system either automatically charges a set amount to the account holder's credit card to replenish the account or sends a notice to the account holder indicating that it is time to replenish funds using cash or a check.

8.3.2 TOLL VIOLATIONS PROCESSING

A toll violation occurs when a vehicle passes through a toll zone but does not have a valid FasTrak® account. Toll violation enforcement is primarily an automated task. The field detection system will capture images of all vehicle license plates. If there is no toll tag detected, the license plate images will be compiled into a trip before being sent to the RCSC for toll payment processing. At the RCSC, the license number will be cross-checked against valid accounts. If the plate is associated with a valid account, the account is charged the toll at the time of the transaction. If the plate is not associated with a valid account, a toll violation will be issued to the registered owner of the vehicle although the driver of the vehicle is ultimately responsible for payment according to statute. If the amount goes unpaid a notification will be referred to DMV to withhold vehicle registration until the amount is paid.

The violation will be processed in the same manner as any FasTrak® toll violation. A violation notice is sent to the vehicle's registered owner within 21 days of the toll violation. The first notice requests payment for the toll amount and an additional $25 penalty. Depending on business requirements to be developed by MTC, the penalty may be waived for first time violators that sign up for a FasTrak® account, as is currently done for first time violators at the bridges. Violation history will be kept on record. If the registered owner fails to respond to the instructions on the first notice, a second notice will be sent for the toll amount plus a $70 penalty ($25 penalty plus $45 late penalty). Failure to respond to the second notice will result in additional penalties and fees and could lead to withholding the vehicle registration. Instructions for contesting a violation are provided on the violation notice.

8.4 FIELD PERSONNEL SCENARIOS

8.4.1 ENFORCEMENT & CHP-ISSUED VIOLATIONS

An eligibility violation occurs when the driver of a vehicle declares that there is the requisite number of people in the vehicle, but there is not. Eligibility violations cannot be automated cost-effectively with today's technology. CHP officers in the field will be required to enforce vehicle eligibility requirements. When a vehicle passes through a toll point or past an enforcement observation area in the express lane with a FasTrak® Flex toll tag switched to the carpool position, a beacon will be triggered. Beacons will be located on gantries with toll tag readers and on posts at CHP observation areas. Beacons will be lights that display a specific color or flash combination to indicate that a tag switched to the carpool designation has passed through the toll point. Depending on the location, beacons will be visible to officers upstream or downstream of the toll point. A stationary or roving officer that sees the beacon activated can observe the vehicle to determine if it meets the eligibility requirements. If it does not, the officer can stop the vehicle and issue a citation.

Another type of express lane violation is violating the ingress and egress restrictions of the express lane. These restrictions will also be enforced in the field by CHP officers. The majority of the express lanes will be separated from the general purpose lanes by a single dashed line, indicating that vehicles can freely enter or exit the express lane. However, some portions of the express lanes will be separated from the general purpose lanes by a solid double-striped line or 'buffer'. Vehicles are not permitted to cross into or out of the express lane when they are separated from the general purpose lanes by a solid striped buffer. If a vehicle crosses the buffer, it is a violation and CHP can cite the driver.

CHP will also be relied upon to enforce vehicles traveling in the express lanes without rear license plates.

8.4.2 INCIDENT RESPONSE

Incidents in the express lane jeopardize the performance of the lane and need to be cleared as quickly as possible. When a major incident occurs in the general purpose lanes, the express lane may be the only viable alternative to get around the incident. In either case, responding to and managing the incident becomes key in the overall operation of the express lanes.

After an incident occurs and is reported, action can be taken. Coordination among the agencies with capabilities and authority is key to effective incident management in general and is even more important when dealing with incidents involving express lanes because of the additional agencies involved and the potential revenue implications. Incident management in a corridor with express lanes will likely be handled in much the same way as incidents in these corridors today. The freeway corridors with express lanes are critical transportation lifelines and responding to incidents is given a very high priority. The primary difference with the express lanes is that the express lanes can be dynamically managed. Toll rates can be adjusted to manage express lane performance during incidents. The express lanes may even be able to be used to rush incident response vehicles and first responders to the scene. Incident management will be coordinated through the express lane toll operations center, Caltrans' TMC, the CHP and the FSP. The highest ranking CHP officer is the on-scene incident commander who is responsible for traffic control. The CHP incident commander will make the ultimate on-site decisions about how to respond to and manage the incident. All decisions affecting the operation of the express lanes will be communicated to the express lane operator.

FSP is key to quick and effective incident management and clearance. In the Bay area, FSP is implemented and managed by the MTC SAFE, Caltrans and the CHP. FSP drivers patrol the Bay Area freeways during hours of peak congestion, providing response to incidents including clearing of debris, towing and minor auto repairs. The roving patrols will respond to incidents and help to clear a majority of the incidents that might affect the express lanes.

When an incident occurs in the express lane that causes the performance of the express lane to degrade below an acceptable threshold, the tolls paid by those affected by the incident may be reversed at MTC's discretion.

8.5 OPERATOR SCENARIOS

Express lane operators at the 375 Beale toll operations center will have workstations that display current operating conditions and live camera feeds. The workstations will be connected to the toll system host via the backhaul communications network allowing the operators to access real-time toll rates, travel speeds, traffic volumes and other indicators of the performance of the toll system. In addition, the operators will have access to CHP's public CAD and 511. The workstations will display a graphical user interface for the operators to navigate and quickly access different forms of information. In addition, operators will coordinate with CHP and Caltrans staff at the TMC when there are incidents to make sure that toll signs display appropriate messages. The express lane operator may need to reverse or adjust tolls when there are incidents that affect express lane performance as deemed necessary by MTC.

APPENDIX A - BRIDGE APPROACHES

The following sections contain information specific to the approaches to the Bay Bridge, the San Mateo-Hayward Bridge and the Dumbarton Bridge.

A.1. TOLL PLAZA OPERATIONAL IMPROVEMENTS EVALUATION

BATA is undertaking an evaluation of the operational status of the seven state-owned toll bridges to make recommendations for improvement. The evaluation will analyze the impacts of implementing all electronic tolling (AET) with the overall goals of reducing toll collection and operational costs, decreasing congestion and travel times through the toll plazas, and improving customer convenience, motorist safety and air quality. The evaluation will develop implementation plans for each of the bridges and is scheduled to be completed by 2017. The results of the evaluation have the potential to affect the bridge approaches for future express lanes implementation.

A.2. CURRENT CHARACTERISTICS

A.2.1. BAY BRIDGE APPROACHES

A.2.1.1. GENERAL CHARACTERISTICS

There are four approaches to designated HOV lanes at the Bay Bridge Toll Plaza that are being evaluated for potential conversion to express lanes. The study limits for these approaches, including I-80, I-580, I-880 and West Grand Avenue, are shown in Figure A-1. Each of these approaches feeds into one of the four lanes at the Bay Bridge toll plaza that operate as designated HOV lanes during peak periods that carry vehicles to the Bay Bridge metering lights. There are a total of 20 lanes that pass through the Bay Bridge toll plaza. The left-side HOV lanes are designated as Lanes 1 and 2 and the right-side HOV lanes are designated as Lanes 19 and 20 (see Figure A-2 and Figure A-3). All other lanes operate as cash/FasTrak® lanes, allowing vehicles to pay the bridge toll with cash or with a FasTrak® toll tag, or as FasTrak® only lanes. The lane designation is indicated using changeable message signs mounted at the toll plaza.

Metering lights, located downstream of the toll plaza, meter all vehicles in Lanes 3 through 18 when the bridge is approaching capacity. While meters are present in HOV lanes 1 and 2, they are not turned on during peak periods to prevent queuing in those lanes, as well as to provide an incentive for carpooling. The current metering algorithm uses the flow in the general purpose lanes and is adjusted based on the volume of vehicles being loaded onto the bridge through the HOV lanes. FasTrak® only lanes are metered at a faster rate than cash/FasTrak® lanes.

FIGURE A-1: STUDY LIMITS FOR BAY BRIDGE HOV APPROACHES

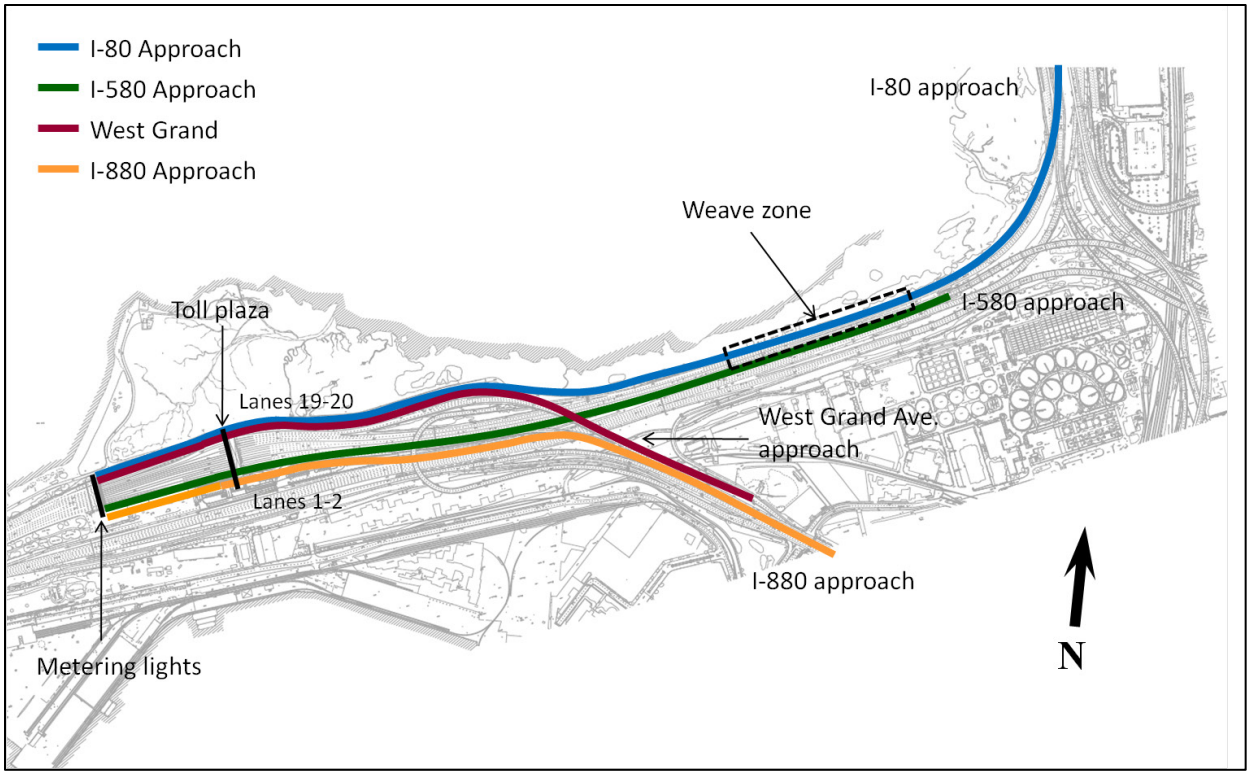


FIGURE A-2: APPROACHES TO BAY BRIDGE TOLL PLAZA HOV LANES

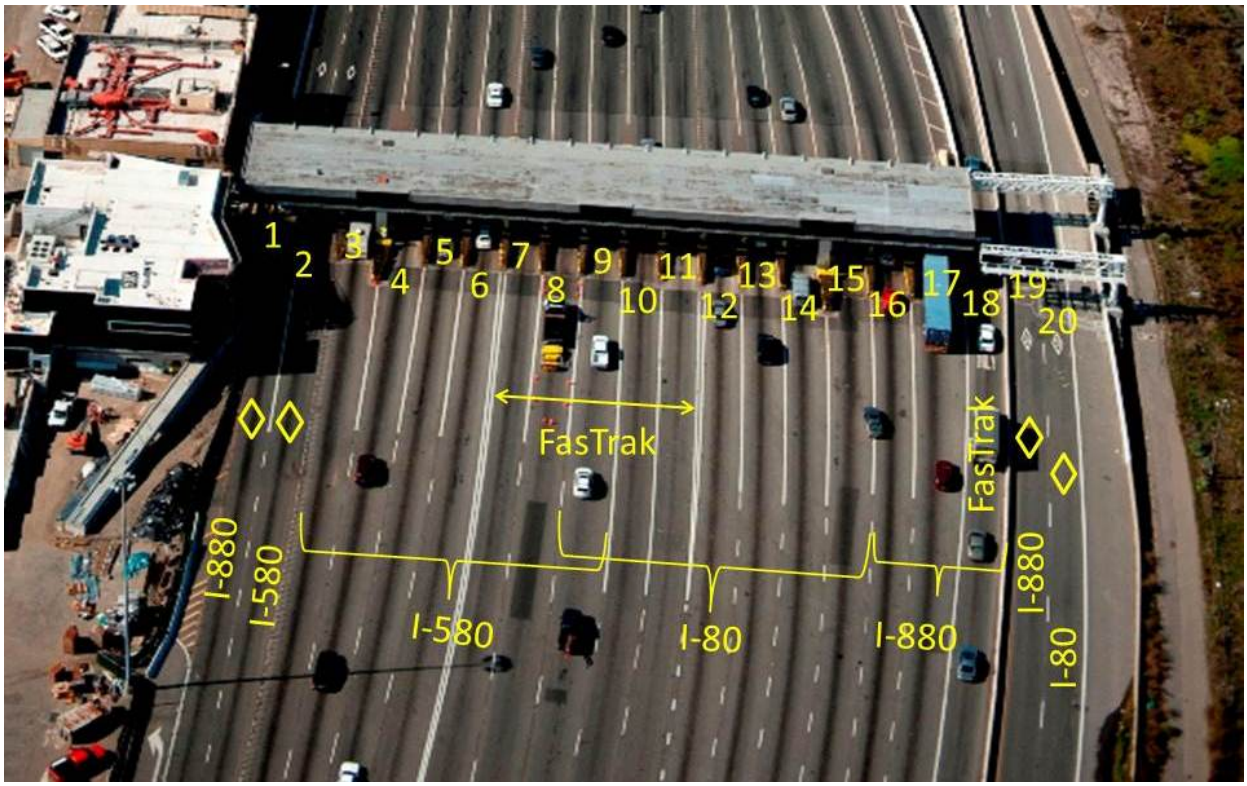


FIGURE A-3: BAY BRIDGE TOLL PLAZA LANE DESIGNATION

A.2.1.2. CURRENT HOV OPERATING POLICY

When in operation during peak periods, defined as 5 a.m. to 10 a.m. and 3 p.m. to 7 p.m., the designated HOV lanes at the toll plaza charge vehicles a reduced bridge toll (see Table A-1 for bridge toll rates) and allow vehicles to bypass the metering lights, providing a monetary and time-saving incentive. Vehicles eligible for the reduced bridge toll include 2-axle vehicles with three or more occupants, motorcycles, inherently low emission vehicles with DMV issued decals and 2-axle vehicles with two occupants in vehicles designated by the manufacturer to carry no more than two occupants. Eligible vehicles must use the designated HOV lanes at the toll plaza to be charged the reduced bridge toll and must carry a FasTrak® toll tag. Commute buses and vanpools are eligible for toll-exempt travel across the bridge at all times in designated lanes. During off-peak periods, Lanes 1 and 2 operate as cash/FasTrak® lanes, and Lanes 19 and 20 operate as bus-only lanes. The approaches to these lanes are described in further detail below.

TABLE A-1: BAY BRIDGE TOLL RATES

<table>
<tr><th></th><th>Day/Time</th><th>Toll Rate</th></tr>
<tr><td rowspan="3">2-axle vehicles</td><td rowspan="2">Mon-Fri
5 a.m. – 10 a.m.
3 p.m. – 7 p.m.</td><td>Three or more occupants*:
$2.50</td></tr>
<tr><td>Fewer than three occupants*:
$6.00</td></tr>
<tr><td>Mon-Fri
10 a.m. – 3 p.m.
7 p.m. – 5 a.m.</td><td>$4.00</td></tr>
<tr><td>Saturday – Sunday</td><td>$5.00</td></tr>
<tr><td>Commute buses and vanpools</td><td>All times</td><td>Toll-exempt</td></tr>
</table>

*Inherently-low-emission vehicles (ILEVs) with DMV-issued decals, 2-axle vehicles carrying two persons that are designated by the manufacturer to be occupied by no more than two persons and motorcycles are also eligible for reduced rate of $2.50 during peak periods. Discounted passage for HOV users is recognized only in designated lanes at the toll plaza.

A.2.1.3. I-80 HOV APPROACH PROJECT LIMITS

The I-80 approach is approximately 2 miles in length when measured from the entrance near Powell Street to the Bay Bridge metering lights. The approach connects the HOV lane on westbound I-80 to Lane 20 at the toll plaza (shown in blue in Figure A-2). Part of the I-80 approach consists of a grade-separated flyover ramp that carries traffic traveling in the I-80 westbound HOV lane over the general purpose lanes to the rightmost lane approaching the toll plaza.

Access to the right-side HOV lane at the downstream end of the flyover is currently unrestricted. This allows eligible vehicles that enter I-80 at the Powell Street on-ramp, and are therefore unable to access the HOV flyover, to use Lanes 19 and 20. The configuration of the downstream end of the flyover allows vehicles that use the HOV flyover ramp during off-peak period to access the cash/FasTrak® lanes and for buses entering I-80 at Powell Street to access Lanes 19 and 20, which operate as bus-only lanes during off-peak periods.

The I-80 Integrated Corridor Mobility (ICM) project will install ITS and Active Traffic Management (ATM) technologies along the I-80 corridor from the Carquinez Bridge to the I-80/I-580/I-880 interchange as well as improvements to San Pablo Avenue. The goal of the I-80 ICM project is to

enhance freeway operations and safety along the corridor by maintaining optimum traffic flow. This will be accomplished via the use of strategies such as advisory speeds, lane control, adaptive ramp metering and vehicle detection. Advisory speeds, lane control signals and variable message signs will be installed on sign structures that span all lanes of traffic at approximately one-half mile intervals. The current schedule assumes that the I-80 ICM construction will be completed by 2015.

A.2.1.4. I-880 HOV APPROACH PROJECT LIMITS

The I-880 HOV approach is approximately 1.8 miles when measured from its entrance near 14th Street to the metering lights. The approach provides a connection for HOVs traveling northbound on I-880 to access the left-side HOV lane at the toll plaza (Lane 1). Part of the approach consists of a grade-separated connector ramp that carries all I-880NB traffic destined for the Bay Bridge. The leftmost lane of this connector carries HOV vehicles into Lane 1 at the toll plaza.

During off-peak periods, the HOV approach is open to all vehicles and Lane 1 at the toll plaza serves as a cash/FasTrak® lane.

A.2.1.5. I-580 HOV APPROACH PROJECT LIMITS

The I-580 HOV approach begins downstream of the direct connector ramp carrying westbound traffic on I-580 to the Bay Bridge. The approach is approximately 1.2 miles when measured from its start to the metering lights. Vehicles traveling westbound on I-580 are able to access the HOV lane, which immediately starts on the left hand side as vehicles come off of the connector ramp. Access to the lane is unrestricted for its entire length, although it is separated from the adjacent lane with a single solid white stripe. The I-880 approach meets the I-580 approach about ¼ mile before the toll plaza and the two lanes travel side by side and feed into Lanes 1 (I-880) and 2 (I-580) at the toll plaza. Approximately 450 feet upstream of the toll plaza, access to Lanes 1 and 2 are restricted by flexible pylons to prevent last minute weaving into and out of the faster moving HOV lanes.

A.2.1.6. WEST GRAND AVENUE HOV APPROACH PROJECT LIMITS

The West Grand Avenue on-ramp connects with the I-880 ramp carrying vehicles traveling northbound on I-880 destined for the Bay Bridge. Vehicles entering at West Grand Avenue are placed into the rightmost lane of the ramp that provides access to Lane 19 at the toll plaza. This lane operates as a bus-only lane during off-peak periods.

A.2.1.7. TRAFFIC CHARACTERISTICS

Traffic volumes at the Bay Bridge Toll Plaza are typically highest during the morning weekday peak periods, although Friday afternoon peak periods and mid-day periods on weekends also regularly experience high traffic volumes. Average weekday traffic volumes for HOV lanes at the Bay Bridge Toll Plaza reported for the month of March 2012 are shown below in Figure A-4.

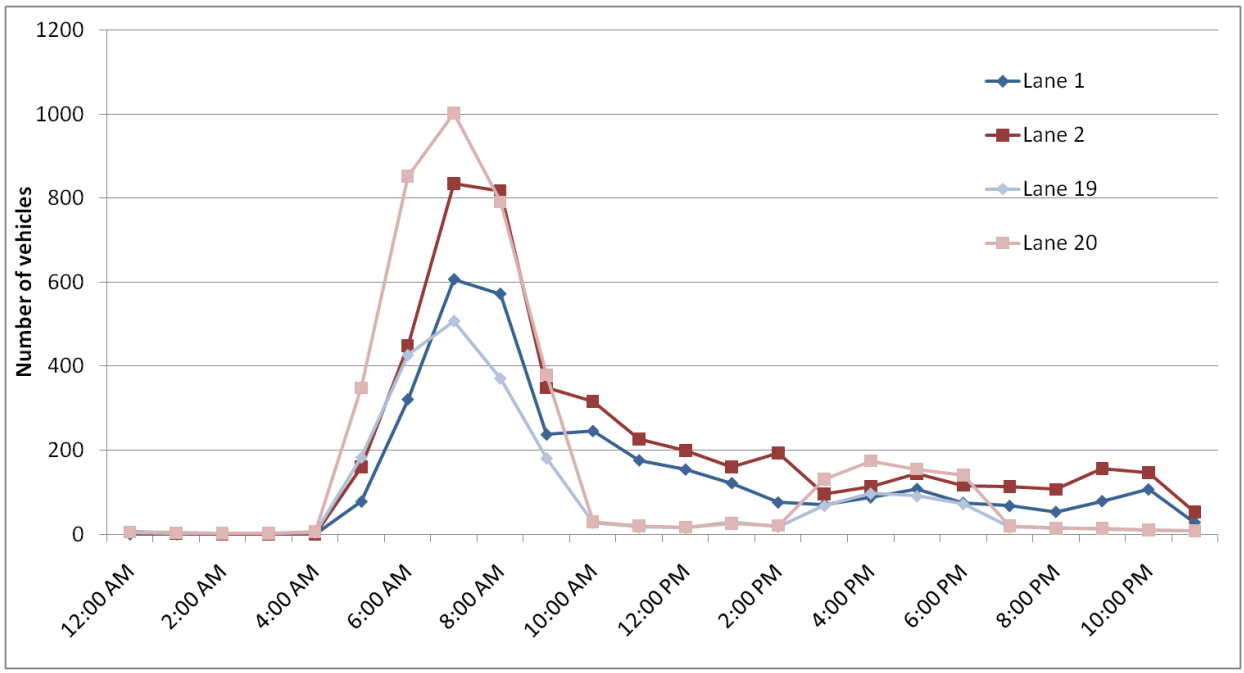


FIGURE A-4: AVERAGE WEEKDAY (MON-THUR) TRAFFIC VOLUMES AT BAY BRIDGE TOLL PLAZA HOV LANES (AVERAGED FOR MARCH 2012)[1]

A.2.1.8. TRANSIT

Transbay transit routes utilizing the Bay Bridge are summarized below in Table A-2. AC Transit currently operates 27 routes over the Bay Bridge that provide connections between downtown San Francisco and various locations in the East Bay. In addition, the Western Contra Costa Transit Authority (WestCAT) provides express transbay service between Hercules and San Francisco via its Lynx service. Amtrak also provides bus service between San Francisco and its Emeryville train station.

[1] Data provided by Bay Area Toll Authority. March 2012.

TABLE A-2: TRANSBAY TRANSIT ROUTES OVER THE BAY BRIDGE

Transit Operator	Route: Origin	HOV Approach Used
AC-Transit	B: Oakland	I-580
	C: Piedmont	I-580
	CB: Oakland	I-580
	E: Oakland	I-580
	F: Berkeley	I-80
	FS: Berkeley	I-80
	G: El Cerrito	I-80
	H: Richmond	I-80
	J: Berkeley	I-80
	L: San Pablo	I-80
	LA: Richmond	I-80
	LC: Richmond	I-80
	NL: Oakland	West Grand
	NX: Oakland	I-580
	NX1: Oakland	I-580
	NX2: Oakland	I-580
	NX3: San Leandro	I-580
	NX4: Castro Valley	I-580
	O: Oakland	I-880
	OX: Alameda	I-880
	P: Piedmont	I-580
	S: Hayward	I-880
	SB: Newark	I-880
	V: Oakland	I-580
	W: Alameda	I-880
	Z: Albany	I-80
	800: Richmond	I-80
WestCAT	Lynx: Hercules	I-80
Amtrak	Thruway: Emeryville	I-80

A.2.1.9. PARK AND RIDE

There are no park and ride lots along the Bay Bridge approaches within the project limits. However, park and ride lots along the I-880, I-80, I-580 and Route 24 corridors serve travelers crossing the Bay Bridge.

A.2.2. SR-84 DUMBARTON BRIDGE APPROACH

A.2.2.1. GENERAL CHARACTERISTICS

The segment of westbound SR-84 from I-880 to the Dumbarton Bridge Toll Plaza consists of two general purpose lanes and one HOV lane. The HOV lane begins on the I-880 southbound off-ramp and extends approximately 2.8 miles to the toll plaza (see Figure A-5 below). Vehicles exiting from southbound I-880 are directed into the HOV lane as they approach the intersection with SR-84. The lane is separated by a solid white line for most of its length to indicate that it feeds into a designated HOV/FasTrak® lane at the toll plaza.

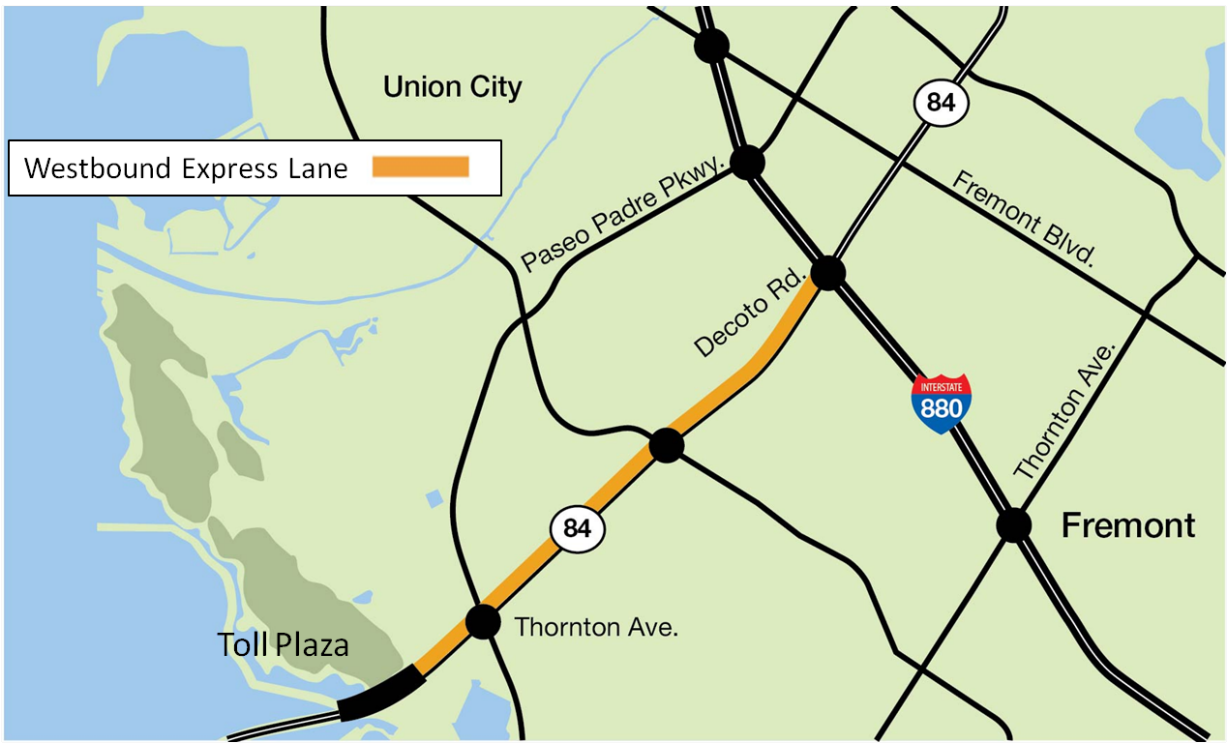


FIGURE A-5: SR-84 DUMBARTON BRIDGE APPROACH

A.2.2.2. CURRENT HOV OPERATING POLICY

The Dumbarton Bridge HOV lane approach operates during weekday peak periods, defined as 5 a.m. to 10 a.m. and 3 p.m. to 7 p.m. The lane is open to FasTrak® only during all other times. Overhead changeable message signs indicate when the lane is open for HOV versus FasTrak® vehicles. The operating hours for the HOV lane on SR-84 differ from the operating hours on I-880 HOV lanes, which operate from 5 a.m. to 9 a.m. and 3 p.m. to 7 p.m.

HOV lane eligibility requirements on SR-84 require two or more passengers in a vehicle during peak periods. Other eligible vehicles include buses, motorcycles and SOVs that meet specified emissions standards with DMV issued decals. When in operation, the approach feeds into a designated HOV lane at the bridge toll plaza that charges vehicles a reduced bridge toll ($2.50 for eligible vehicles).

A.2.2.3. TRAFFIC CHARACTERISTICS

Westbound traffic volumes are heaviest on SR-84 approaching the Dumbarton Bridge during the AM peak period. Average annual daily traffic (AADT) volumes on both directions of SR-84 are shown below in Figure A-6.

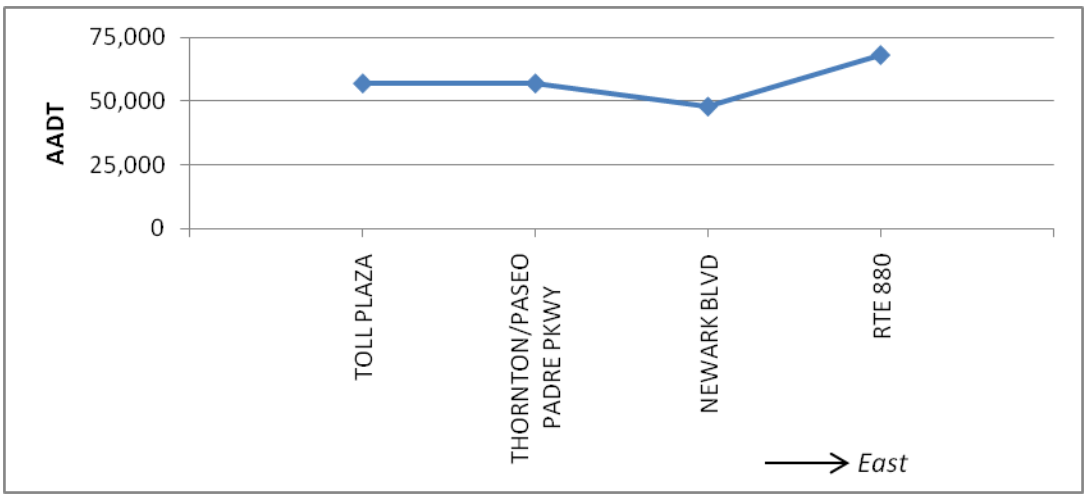


FIGURE A-6: AADT ON SR-84[1]

Average peak hour HOV lane traffic volumes on westbound SR-84 from the Caltrans District 4 2010 Bay Area HOV Lanes report are reported as 944 vehicles in the AM peak period and 290 vehicles in evening peak period[2].

A.2.2.4. TRANSIT

The Dumbarton Express bus service is administered by AC Transit and offers transbay service via the Dumbarton Bridge serving the cities of Menlo Park, Newark, Palo Alto and Union City. Dumbarton Express operates two bus lines between the Union City BART station and the Palo Alto Caltrain Station. In addition to the Dumbarton Express, AC Transit operates two routes between the East Bay and San Mateo/Santa Clara Counties via the Dumbarton Bridge. All transbay bus routes across the Dumbarton Bridge are listed below in Table A-3.

TABLE A-3: TRANSBAY TRANSIT ROUTES OVER THE DUMBARTON BRIDGE

Transit Operator	**Route**
Dumbarton Express	DB: Union City BART to Palo Alto
	DB1: Union City BART to Palo Alto
AC Transit	DA: Newark to Redwood City
	U: Fremont BART to Stanford University

A.2.2.5. PARK AND RIDE

There is one park and ride lot located along the SR-84 Dumbarton Bridge Approach, listed in Table A-4. Park and ride lots in the I-880 corridor also serve travelers crossing the Dumbarton Bridge.

[1] Traffic and Vehicle Data Systems Unit, 2011 Traffic Volumes on California State Highway System. California Department of Transportation, Traffic Operations Division. http://www.dot.ca.gov/hq/traffops/saferesr/trafdata/2011all/index.html

[2] 2010 Bay Area HOV Lanes: Volumes, Occupancies and Violation Rates for Freeway High Occupancy Vehicle Lanes in the San Francisco Bay Area. California Department of Transportation, District 4, Office of Highway Operations.

TABLE A-4: SR-84 DUMBARTON BRIDGE APPROACH PARK AND RIDE LOT

Address	City
Ardenwood Boulevard & SR-84	Fremont

A.2.3. SR-92 SAN MATEO-HAYWARD BRIDGE APPROACH

A.2.3.1. GENERAL CHARACTERISTICS

The segment of westbound SR-92 from Hesperian Boulevard to the San Mateo-Hayward Bridge Toll Plaza consists of three general purpose lanes and one HOV lane. The HOV lane begins just downstream of the Hesperian Boulevard interchange and extends approximately 3.2 miles to the toll plaza (see Figure A-7 below). The HOV lane on SR-92 is unrestricted along its entire length to allow vehicles entering SR-92 downstream of the Hesperian Boulevard interchange to access the lane.

FIGURE A-7: SR-92 SAN MATEO-HAYWARD BRIDGE APPROACH

A.2.3.2. CURRENT HOV OPERATING POLICY

The San Mateo-Hayward Bridge HOV lane approach operates during weekday peak periods, defined as 5 a.m. - 10 a.m. and 3 p.m. – 7 p.m. The lane is open to all vehicles during all other times. Like the SR-84 HOV lane, the operating hours for the SR-92 HOV lane differ from the operating hours on I-880 HOV lanes, which operate from 5 a.m. - 9 a.m. and 3 p.m. - 7p.m.

HOV lane eligibility requirements on SR-92 require two or more passengers in a vehicle during peak periods. Other eligible vehicles include buses, motorcycles and SOVs that meet specified emissions standards with DMV issued decals. When in operation, the approach feeds into a

designated HOV lane at the bridge toll plaza that charges vehicles a reduced bridge toll ($2.50 for eligible vehicles and $5.00 for other autos).

A.2.3.3. TRAFFIC CHARACTERISTICS

Like the approach to the Dumbarton Bridge, westbound traffic volumes are heaviest on SR-92 during the AM peak period. AADT volumes on both directions of SR-92 are shown below in Figure A-8.

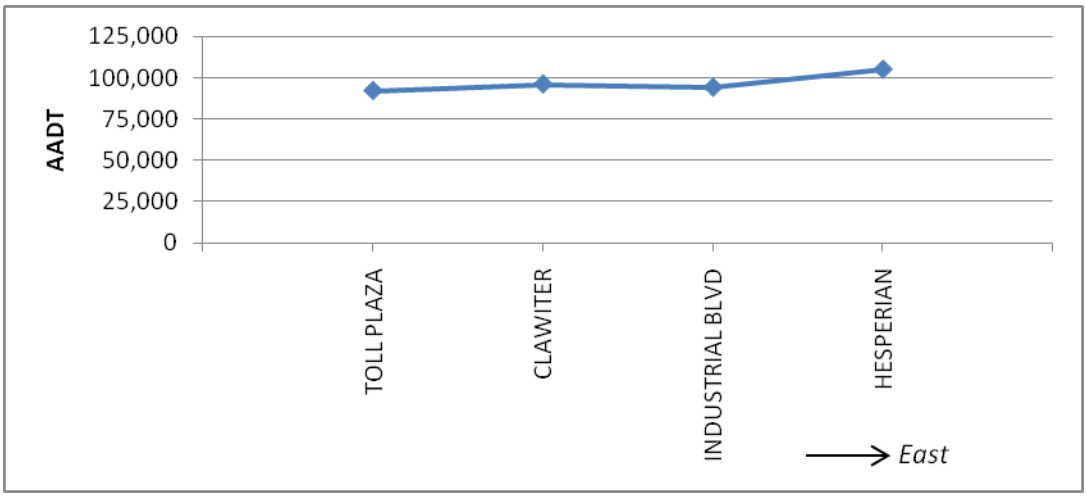


FIGURE A-8: AADT ON SR-92[1]

Average peak hour HOV lane traffic volumes on westbound SR-92 from the 2010 Caltrans HOV Lane Report are reported as 1056 vehicles in the AM peak period and 422 vehicles in evening peak period[2].

A.2.3.4. TRANSIT

AC Transit's Route M provides express transbay service from the Hayward BART station to the Hillsdale Shopping Center in the city of San Mateo via the San Mateo-Hayward Bridge.

A.2.3.5. PARK AND RIDE

There are no park and ride lots along the SR-92 San Mateo-Hayward Bridge approach. However, park and ride lots along the I-880 corridor serve travelers crossing the San Mateo-Hayward Bridge.

A.3. DESIGN CONSIDERATIONS FOR BRIDGE APPROACHES

The bridge approaches are configured differently than the express lane corridors. They are shorter in length and act more like "chutes" than corridors. Although the same design standards will be applied, it is anticipated that each bridge approach may have only one toll zone (or two maximum)

[1] Traffic and Vehicle Data Systems Unit, 2011 Traffic Volumes on California State Highway System. California Department of Transportation, Traffic Operations Division. http://www.dot.ca.gov/hq/traffops/saferesr/trafdata/2011all/index.html

[2] 2010 Bay Area HOV Lanes: Volumes, Occupancies and Violation Rates for Freeway High Occupancy Vehicle Lanes in the San Francisco Bay Area. California Department of Transportation, District 4, Office of Highway Operations.

and will be more restricted in terms of access. The bridge approaches will also have more existing signage that must be taken into account. As described in Chapter 4, signs at the bridge approaches will have to clearly distinguish the express lane toll from the bridge toll, or show a combined toll[1]. With the exception of the I-80 approach to the Bay Bridge discussed below, the other bridge approaches do not have unique design issues.

At the Bay Bridge, there is a weave zone where the I-80 general purpose lanes meet the HOV flyover ramp. This weave zone, shown in Figure A-9, is currently needed to allow buses that are not able to access the HOV flyover ramp to access the right-side HOV approach lanes at the toll plaza, which allow commute buses and registered vanpools to travel toll-exempt over the bridge at all times. Buses that are not able to access the HOV flyover currently include AC Transit and Amtrak buses that enter the freeway at Powell Street. This access will need to be preserved for transit upon conversion to express lanes.

Lanes 19 and 20 historically did not have tolling equipment, requiring the lanes to revert to bus only operations during non-HOV hours since there was no ability to collect a toll. Recently, tolling equipment was installed to collect tolls from HOVs.

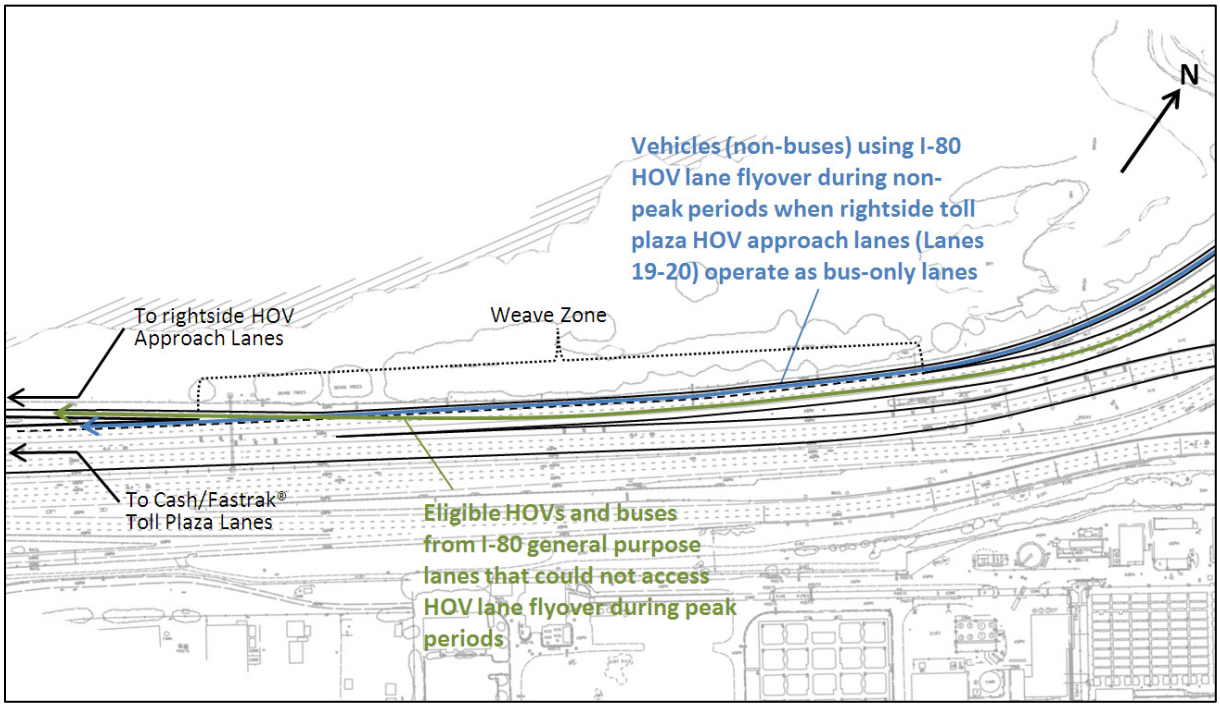


FIGURE A-9: BAY BRIDGE APPROACH WEAVE ZONE WHERE I-80 HOV FLYOVER MEETS I-80 GENERAL PURPOSE LANES

[1] Currently, the CMSs on the Bay Bridge approaches do not show the toll rates. They only indicate what lane type it is (e.g., Carpool, FasTrak® Only, or Cash/FasTrak®).

A.4. OPERATIONAL CONSIDERATIONS FOR BRIDGE APPROACHES

There are several operational considerations which are unique to the three HOV approaches at the Bay Bridge (I-80/I-580/I-880), San Mateo-Hayward Bridge (SR-92) and Dumbarton Bridge (SR-84). These are described in the following sections.

A.4.1. OVERVIEW OF EXPRESS LANE OPERATIONS AT THE BRIDGE APPROACHES

The bridge approaches currently allow eligible vehicles to pay a reduced toll rate to cross the bridges in designated HOV lanes and, during HOV hours, to bypass queues that form in the general purpose lanes at the bridge toll plazas. Upon conversion of the bridge HOV lanes to express lanes, any vehicles not meeting the HOV eligibility requirements will be charged the full bridge toll. Vehicles meeting HOV eligibility requirements will only be charged the effective carpool bridge toll. Commute buses and 11 to 15 passenger vanpools will continue to be able to be toll-exempt. These toll-exempt vehicles will need to carry a non-revenue FasTrak® toll tag as is done currently.

Dynamic message signs will inform drivers of the toll to use the express lane bridge approaches. The signs could convey the combined toll (including the bridge toll and the express lane toll as a consolidated toll) or just the express lane toll (not including the bridge toll). The unique configuration of the various approaches to the Bay Bridge may require multiple pricing signs to inform drivers of the express lane toll. The pricing signs for the I-80 and I-880 approaches to the Bay Bridge will be located along the I-80 and I-880 corridors in advance of the grade-separated HOV flyover ramp. There will also be signing as appropriate for the I-580 and West Grand Avenue approaches to the Bay Bridge. Pricing signs for the San Mateo-Hayward and Dumbarton bridge approaches will be located along the SR-92 and SR-84 corridors, respectively, in advance of the HOV lane at the toll plaza. Alternatively, the express lane tolls for SR-92 and SR-84 could be displayed on pricing signs on the I-880 corridor in advance of the SR-92 and SR-84 exits. The express lane toll applied may vary dynamically based on real-time traffic conditions or may vary according to a fixed time-of-day schedule. There may be a desire to operate all three of the bridge approach express lanes in a consistent fashion, which would necessitate the express lane pricing scheme to be consistent among the bridge approaches.

A.4.2. METERING LIGHTS

Metering lights at the Bay Bridge are intended to regulate traffic flow onto the bridge when the bridge is at or near operating capacity. The current algorithm for the metering rate is adjusted based on the volume of vehicles being loaded onto the bridge through the HOV approach lanes, which are not metered. FasTrak® only lanes are metered at a faster rate than cash/FasTrak® lanes. Increasing the volume of vehicles using the HOV approach lanes and bypassing the metering lights would cause the algorithm to meter the other lanes at a slower rate. This could potentially result in longer queue formations in these other lanes at the bridge approach. These impacts, along with the constraints set by the capacity of the bridge and the operation of the metering lights, will affect operation of the express lanes. Express lane tolls at the bridge approaches will be set to ensure that the downstream capacity of the bridges is not exceeded as a result of increased traffic volume through the HOV approach lanes at the toll plazas.

Metering lights are installed at the Dumbarton and San Mateo-Hayward bridges, but are currently not used. Results of future traffic analyses will inform whether activation of the metering lights at these bridges will be needed upon conversion to express lanes.

A.4.3. REVENUE CONSIDERATIONS

If express lanes at the bridge approaches are to operate outside of the currently defined peak periods, then the hours during which HOV bridge toll rates are offered will need to also be expanded so that the HOV hours are concurrent with the express lane hours, provided that such expansion does not adversely impact bridge operations as described in the previous section. As described in Chapter 2, the HOV approach lanes at the bridge approaches allow eligible vehicles to pay a reduced bridge toll rate during the morning and evening peak periods when the lanes are in operation. An expansion of the hours for which the HOV approaches are in operation could result in reduced bridge toll revenue collected by BATA since eligible vehicles would qualify for a reduced bridge toll rate during longer periods of the day. This loss of bridge toll revenue would have to be quantified and offset by an equal portion of the amount collected from express lane operations. In the end, any express lane strategy operated at the bridge approaches would be implemented so as not to negatively affect net BATA bridge toll revenue.

Another option to allow express lanes at the bridge approaches to operate outside of the currently defined peak periods without permitting eligible vehicles to qualify for a reduced bridge toll is to operate the express lanes outside of the peak periods and only allow toll paying vehicles in the lane. This option may require changes to state law, which currently specifies that express lanes must operate during the hours that the HOV eligibility requirement is in effect.

APPENDIX B – PAYMENT AND DECLARATION SCENARIOS

MTC Express Lanes - Scenario comparison for Pay-by-plate

		Current Bay Area Express Lanes	No Pay-by-Plate Option		Pay-by-Plate Option for SOVs Only - HOV to Carry Tag		Pay-by-Plate Option for All	
		Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7
Payment method/ Declaration	SOV	Regular Tag	Regular Tag	Regular Tag or Switchable Tag	Regular Tag or Pay-by-Plate	Regular Tag, Switchable Tag or Pay-by-Plate	Regular Tag or Pay-by-Plate	Regular Tag, Switchable Tag or Pay-by-Plate
	HOV	No tag needed	Regular Tag - Carpool Registration	Switchable Tag	Regular Tag - Carpool Registration	Switchable Tag	Regular Tag - Carpool Registration, or Pay-by-Plate - Carpool Registration	Switchable Tag, or Pay-by-Plate - Carpool Registration
Capital Cost		Low - No LPR	Medium - LPR cost	High - LPR cost + switchable tags	Medium - LPR cost	High - LPR cost + switchable tags	Medium - LPR cost	High - LPR cost + switchable tags
Operating Cost		Low - No license plate image processing	Medium - License plate image processing when no or malfunctioning tag.	Medium - License plate image processing when no or malfunctioning tag.	High - Requires plate reads of SOVs and violators. Possible surcharge to pay by plate accounts to offset operating cost.	High - Requires plate reads of SOVs and violators. Possible surcharge to pay by plate accounts to offset operating cost.	Highest - Requires plate reads of SOVs, HOVs and violators. Possible surcharge to pay by plate accounts to offset operating cost.	Highest - Requires plate reads of SOVs, HOVs and violators. Possible surcharge to pay by plate accounts to offset operating cost.
Impact to HOVs		Carpools shield tag if in vehicle. For the bridge approached Carpoolers would need to shield for the EL, and then unshield for the toll plaza.	Carpools must carry a tag and register.	Carpools must carry a switchable tag.	Carpools must carry a tag and register tag number.	Carpools must carry switchable tag.	Carpools must register tag number (if they have one) or license plate.	If not using switchable tag, carpools must register license plate.
Enforcement		No ability for automated toll enforcement since no LPR. Beacon alerts CHP to vehicles with no tag read. CHP performs visual check to confirm HOV occupancy status.	LPR to capture tagless vehicles who will receive violation in the mail. Beacon to identify HOVs for CHP visual confirmation of occupancy. (see Reliability)	LPR to capture tagless vehicles who will violation I the mail. Beacon to identify HOVs for CHP visual confirmation of occupancy.	LPR to capture tagless vehicles or vehicles without a Pay-by-Plate account who will receive bill by mail for payment. Beacon to identify HOVs for CHP visual confirmation of occupancy. (see Reliability)	LPR to capture tagless vehicles or vehicles without a Pay-by-Plate account who will receive bill by mail for payment. Beacon to identify HOVs for CHP visual confirmation of occupancy.	LPR to capture vehicles without a tag. For HOVs with a tag, a beacon will identify HOVs for CHP visual confirmation of occupancy. For HOVs with no tag, a beacon will not work [insufficient time for the system to process the LP number, confirm carpool registration and illuminate the beacon]. Instead, CHP will use mobile LPRs to identify HOVs for visual confirmation of occupancy.	LPR to capture vehicles without a tag. For HOVs with a tag, a beacon will identify HOVs for CHP visual confirmation of occupancy. For HOVs with no tag, a beacon will not work [insufficient time for the system to process the LP number, confirm carpool registration and illuminate the beacon]. Instead, CHP will use mobile LPRs to identify HOVs for visual confirmation of occupancy.
Policy/Statutory Change Needed		No	Yes - State law requires HOV to have unrestricted access.	Yes - State law requires HOV to have unrestricted access.	Yes - State law requires HOV to have unrestricted access. BATA/BAIFA has to allow Pay-by-Plate accounts.	Yes - State law requires HOV to have unrestricted access. BATA/BAIFA has to allow Pay-by-Plate accounts.	Yes - State law requires HOV to have unrestricted access. BATA/BAIFA has to allow Pay-by-Plate accounts.	Yes - State law requires HOV to have unrestricted access. BATA/BAIFA has to allow Pay-by-Plate accounts.
System Reliability		Medium-Low -The beacons are used to indicate when a valid transponder read does not occur. This causes vehicles to be pulled over unnecessarily by CHP.	Medium - Potential issues because field devices would have to get updates from the system continuously to reflect carpool registration in real-time and show HOV status on beacons.	High - No reliance on HOV occupancy status data being pushed to field devices since switchable tags are used.	Medium - Potential issues with carpool registration because field devices would have to get updates from the system continuously to reflect carpool registration in real-time and show HOV status on beacons.	High - No reliance on HOV occupancy status data being pushed to field devices since switchable tags are used.	Low - Potential issues with carpool registration, especially by license plate, and the use of a beacon for enforcement. The field (beacons/mobile LPRs) would have to get updates from the system continuously, then match with license plate instantly to show HOV status via beacon.	Low - Potential issues with license plate carpool registration and the use of a beacon for enforcement. The field (beacons/mobile LPRs) would have to get updates from the system continuously then match with license plate instantly to show HOV status via beacon.
Bandwidth Requirements		Low	Medium - License plate image captured for all vehicles without a tag	Medium - License plate image captured for all vehicles without a tag	Medium/High - Increased number of license plate images associated with SOVs with Pay-by-Plate accounts	Medium/High - Increased number of license plate images associated with SOVs with Pay-by-Plate accounts	High - Potential for large number of license plate images associated with SOV and HOV Pay-by-Plate accounts	High - Potential for large number of license plate images associated with SOV and HOV Pay-by-Plate accounts
Revenue Loss		High - No LPR for automated toll violation enforcement	Minimal - LPR allows automated toll violation enforcement of cars without a tag.	Minimal - LPR allows automated toll violation enforcement of cars without a tag.	Medium - Leakage associated with plate accounts (misreads, out of state)	Medium - Leakage associated with plate accounts (misreads, out of state)	Medium - Leakage associated with plate accounts (misreads, out of state)	Medium - Leakage associated with plate accounts (misreads, out of state)
Examples		-I-680SB & SR-237/I-880 (Bay Area) -I-15 (Utah), -I-15 (San Diego), -I-10 (Houston), -I-394 and I-35W (Minneapolis) -SR-167 (Washington)	-I-95 (Miami) - HOVs receive a decal when they register and must shield their toll tag. -I-85 (Atlanta) - HOVs must obtain a PeachPass tag and register 15 minutes prior to using lanes.	-I-10 and I-110 (Los Angeles) -I-495 (Virginia)	-I-25 (Denver) - HOVs not required to carry a tag and use designated lanes at toll zones	-Proposed for future express lanes in Seattle		
Overall Rank (1 is preferred, 4 is least preferred)		The analysis concluded that it is prudent to include pay by plate capabilities within our system design. However, when/if pay-by-plate is available to express lane users will depend on the outcome of the new Golden Gate Bridge program. As such, it does not make sense to rank scenarios that do not allow pay-by-plate.			2	1	4	3