express Travel Choices Study

SCAG Region Value Pricing Project—
Regional Express Lane Network
Pre-Implementation Assistance

REGIONAL CONCEPT OF OPERATIONS (TECHNICAL REPORT)

PREPARED FOR:

SCAG
INNOVATING FOR A BETTER TOMORROW

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Disclosure Statement:

This document is reflective of discussions and policies at the time of development. As such, some of the elements and priorities discussed in this document may have changed since the document was prepared. The project priorities in this document do not necessarily represent the official positions of the partner agencies. Continuing updates to this document are expected as the region's express lanes program matures and projects become operational.

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2+	Two or more persons per vehicle
3+	Three or more persons per vehicle
AASHTO	American Association of State Highway and Transportation Officials
AB	Assembly Bill
ACTC	Alameda County Transportation Commission
AT PZEV	Advanced Technology Partial-Zero Emission Vehicles
ATMS	Advanced Transportation Management Systems
AVI	Automatic Vehicle Identification
AVTA	Antelope Valley Transit Authority
BAIFA	Bay Area Infrastructure Financing Authority
BATA	Bay Area Toll Authority
BNSF	Burlington Northern and Santa Fe (Railway)
BOT	Build-Operate-Transfer
Caltrans	California Department of Transportation
CANbus	Controller Area Network Bus
CaMUTCD	California Manual on Uniform Traffic Control Devices
CAPS	Customer Assistance Patrol Specialist
CARB	California Air Resources Board
CAV	Clean Air Vehicle
CCR	California Code of Regulations
CCTV	Closed Circuit Television
CDOT	Colorado Department of Transportation
CEQA	California Environmental Quality Act
CFTA	California Transportation Finance Authority
CHP	California Highway Patrol
ConOps	Concept of Operations
CMAs	Congestion Management Agencies
CMS	Changeable Message Sign(s)
CMS	Corridor Management System
CRD	Congestion Reduction Demonstration

CSC	Customer Service Center
CTC	California Transportation Commission
CTCs	County Transportation Commissions
CTOC	California Toll Operators Committee
CV	Connected Vehicle(s)
DB	Design-Build
DBB	Design-Bid-Build
DBF	Design-Build-Finance
DBFOM	Design-Build-Finance-Operate-Maintain
DBOM	Design-Build-Operate-Maintain
DD	Deputy Directive
DIB	Design Information Bulletin
DMS	Dynamic Message Sign(s)
DMV	Department of Motor Vehicles
DSRC	Dedicated Short Range Communication
EA	Environmental Assessment
EB	Eastbound
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
EJ	Environmental Justice
ETC	Electronic Toll Collection
FAST	Fixing America's Surface Transportation (Act)
FDOT	Florida Department of Transportation
FHWA	FHWA
FONSI	Finding of No Significant Impact
FSP	Freeway Service Patrol
FTA	Federal Transit Authority
FY	Fiscal Year
GAO	Governmental Accountability Office
GDOT	Georgia Department of Transportation
GHG	Greenhouse Gas(es)
GGHTD	Golden Gate Bridge Highway and Transportation District
GPS	Global Positioning System

GTrans	Gardena Transit
HDM	Highway Design Manual
HOT	High Occupancy Toll
HOV	High Occupancy Vehicle(s)
I- (or IH-)	Interstate Highway
IC	Imperial County
ID	Identification
ILEV	Inherently Low Emission Vehicle(s)
IR	Infrared
IS	Initial Study
ITS	Intelligent Transportation Systems
IVR	Interactive Voice Response
JPA	Joint Powers Authority
LA	Los Angeles
LAC	Los Angeles County
LADOT	City of Los Angeles Department of Transportation
LASAFE	Los Angeles County Service Authority for Freeway Emergencies
LAWA	Los Angeles World Airports
LED	Light Emitting Diode
LFPWG	Local Funding Partners Working Group
LOS	Level of Service
LPR	License Plate Recognition
LRTP	Long Range Transportation Plan
MAP-21	Moving Ahead for Progress in the 21st Century (Act)
Metro	Los Angeles County Metropolitan Transportation Authority
MHz	Megahertz
MnDOT	Minnesota Department of Transportation
MOMS	Maintenance and Operations Management System
MOU	Memorandum of Understanding
MPO	Metropolitan Planning Organization
MTC	Metropolitan Transportation Commission
MTS	Metropolitan Transit System
MUTCD	Manual on Uniform Traffic Control Devices

NB	Northbound
NCHRP	National Cooperative Highway Research Program
ND	Negative Declaration
NEPA	National Environmental Policy Act
O&M	Operations and Maintenance
OBU	On-Board Unit
OC	Orange County
OCR	Optical Character Recognition
OCTA	Orange County Transportation Authority
OCTAM	Orange County Transportation Analysis Model
ODOT	Oregon Department of Transportation
ORT	Open Road Tolling
P3 (or PPP)	Public-Private Partnership
PABs	Private Activity Bonds
PA&ED	Project Approval and Environmental Document
PDS	Project Development Support
PeMS	Performance Monitoring System
PPP	Public Private Partnership
PSR	Project Study Report
PTZ	Pan, Tilt and Zoom
RapidTOM	Rapid Toll Optimization Model
RC	Riverside County
RCTC	Riverside County Transportation Commission
RFID	Radio Frequency Identification
ROD	Record of Decision
RPMT	Regional Project Management Team
RTA	Riverside Transit Agency
RTDM	Regional Travel Demand Model
RTP	Regional Transportation Plan
SAFETEA-LU	Safe, Accountable, Flexible and Efficient Transportation Equity Act: A Legacy for Users
SANDAG	San Diego Association of Government
SB	San Bernardino
SBC	San Bernardino County

SB	Senate Bill
SB	Southbound
SBCTA	San Bernardino County Transportation Authority
SBX	South Bay Expressway
SCAG	Southern California Association of Governments
SCS	Sustainable Communities Strategy
SD	San Diego
SEMP	Systems Engineering Management Plan
SHPO	State Historic Preservation Office
SIB	State Infrastructure Bank
SOV	Single Occupant Vehicle(s)
SR	State Route
SRTP	Short Range Transportation Plan
SULEV	Super Ultra-Low Emission Vehicle(s)
T&R	Traffic and Revenue
TAP	Transit Access Pass
TCA	Transportation Corridor Agencies
TIFIA	Transportation Innovation Finance Innovation Act
TIGER	Transportation Investment Generating Economic Recovery
TMC	Transportation Management Center(s)
TOPD	Traffic Operations Policy Directive
TRB	Transportation Research Board
TTI	Texas Transportation Institute
TxDOT	Texas Department of Transportation
UDOT	Utah Department of Transportation
ULEV	Ultra-Low Emission Vehicle(s)
UPA	Urban Partnership Agreement
U.S.C.	United States Code
USDOT	United States Department of Transportation
V2I	Vehicle to Infrastructure
V2V	Vehicle to Vehicle
VC	Ventura County
VCTC	Ventura County Transportation Commission

VDS	Vehicle Detection System(s)
VISTA	Ventura Intercity Transit Service Authority
VMS	Variable Message Sign(s)
VMT	Vehicle Miles Traveled
VPP	Value Pricing Program
VTA	Santa Clara Valley Transportation Authority
WB	Westbound
WSDOT	Washington State Department of Transportation
§	Section

1.0 INTRODUCTION

1.1 Purpose of Document and Intended Audience

This Regional Express Lane Network Concept of Operations (ConOps) is intended to describe how express lane facilities being implemented, planned or proposed by the region's County Transportation Commissions (CTCs) and/or California Department of Transportation (Caltrans) districts in the Southern California Association of Governments (SCAG) region, referred to collectively as the regional express lane network, will operate from a user perspective and to set the framework for the design and operational characteristics of the express lane system. The purpose of the ConOps is to provide a blueprint for a regional express lane network that integrates individual express lane facilities into a regional system with consistent or compatible operating, design, and policy rules. The results of this study also helped refine the recommendations for a regional express lane network for inclusion into the adopted *SCAG 2016-2040 Regional Transportation Plan / Sustainable Communities Strategy* (2016 RTP/SCS), adopted April 7, 2016. Further updates of the ConOps are anticipated for the development of the 2020 RTP/SCS. The RTP/SCS is a long-range visioning plan that balances future mobility and housing needs with economic, environmental and public health goals.

This ConOps 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 by the respective operating agency. The express lane system includes the hardware and software that will be procured to implement and operate the express lanes. As the first document developed as part of the systems engineering process, this ConOps does not specify detailed design requirements of the express lane system. Instead, this document is meant to describe the desired operational characteristics of the regional express lane network for future translation into detailed design requirements. This document establishes a framework for the implementation of a network of express lane facilities encompassing a high level of uniformity from the customer facing perspective. Although the document recommendations reflect a consensus of the various agencies responsible for delivering and operating express lanes in the SCAG region based on engagement and active participation throughout the study process, it is not intended to limit the ability of individual agencies to implement specific policies and measures to meet specific local needs. The document is intended to preserve flexibility to account for policy and design characteristics that are not yet fully defined or that may evolve in the future. It is important to note that the design guidance outlined in this document should not be construed as providing standards for individual design issues that must be resolved as individual projects are developed. Design standards will be governed by prevailing Caltrans and federal guidance.

1.2 Background

In January 2013, SCAG's *Express Travel Choices Study Phase I* was completed as part of the region's efforts to gain better understanding of travel behavioral impacts from pricing. Supplementing the efforts were additional pre-implementation funds obtained through Caltrans, the Los Angeles County Metropolitan Transportation Authority (Metro), and other transportation partners in the region, which were applied towards conducting

demonstration projects on I-10 and I-110, as well as planning for other value pricing projects. The previous findings from the Phase I study indicated that congestion pricing strategies can have a beneficial impact on Southern California's mobility.

As a follow up to the original *Express Travel Choices Study*, an additional grant application for the pre-implementation plan phase was submitted by Caltrans, in partnership with SCAG and Metro, and funds were obtained through the Federal Highway Administration's (FHWA) Value Pricing Pilot (VPP) Program in response to the Federal Register notice dated October 19, 2010. The overall objective of the VPP Program is for the FHWA to support state and local governments or other public authorities to establish local VPP programs and to gather information about the role that various types of value pricing methods can play in improving the efficiency of transportation systems and in dealing with congestion, air pollution, energy consumption, and other problems related to automobile use in congested areas.

This express lanes study represents one of the two contracts for the *SCAG Regional Value Pricing Project—Express Travel Choices Study (Phase II)*, which was released by SCAG and funded by the FHWA's VPP Program grant, along with local match funds from Metro, the Orange County Transportation Authority (OCTA), the Riverside County Transportation Commission (RCTC), and the San Bernardino County Transportation Authority (SBCTA). The two separate contracts are: (1) Cordon / Area Pricing Pre-Implementation Assistance; and (2) Regional Express Lane Network Pre-Implementation Assistance.

Under the first contract, the Cordon / Area Pricing Pre-Implementation Assistance project will define specific cordon / area pricing alternatives and the potential pricing and operating rules necessary for consistency with a regional system of express lanes. The Cordon / Area Pricing Pre-Implementation Assistance project is not being conducted as part of the express lanes study and therefore the findings and recommendations of that project are not discussed in this report.

The focus of the second contract, the Regional Express Lane Network Pre-Implementation Assistance, was to develop a ConOps for a regional network of express lanes that addresses the operating, design, and policy issues of a regional system. This regional ConOps document presents the findings and recommendations of the Regional Express Lane Network Pre-Implementation Assistance project.

Although the pre-implementation work was broken into these two project categories, the goal was to develop an integrated, regional value pricing system. This regional express lane network project is expected to provide a valuable addition to the national dialogue on congestion management strategies. The project's key activities included:

- Building on previous corridor planning efforts to define a regional network of express lanes;
- Evaluating the performance of regional network alternatives;

- Defining consistent technology, interoperability and policy requirements across express lane corridors (considering different vehicle occupancy and pricing considerations);
- Developing a regional investment / financial plan, as may be appropriate;
- Assessing institutional and governance arrangements for administering pricing (including toll collection, enforcement, debt issuance, and operational issues) across multiple agencies; and
- Developing a ConOps for a regional network.

1.3 Express Lanes Defined

Express lanes, also commonly referred to as high-occupancy toll (HOT) lanes, are dedicated lanes on the highway where demand is managed by restricting access to certain eligible high occupancy vehicles (HOV) and allowing vehicles not meeting the eligibility requirements to pay a toll to travel in the lanes. HOV eligibility requirements typically include occupancy restrictions and vehicle type (e.g., motorcycles and low-emission vehicles). The first express lane project was implemented on State Route 91 (SR-91) in Orange County in 1995 and the concept has since gained 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-free or discounted travel for buses, HOVs, and other vehicles designated as being eligible to use the lanes, and charge a toll for other passenger vehicles that 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 higher level of service (LOS) is maintained in the express lane. As traffic in the express lanes (and sometimes the adjacent general-purpose lanes) increases, the toll rates also increase as a disincentive to limit the number of vehicles entering the lanes. Toll rates decrease when traffic in the lanes 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 lanes benefits general-purpose lanes flow while maintaining free-flow operations in the express lanes.

1.4 Enabling Legislation

Assembly Bill (AB) 194 (Frazier), which was signed by Governor Brown on October 9, 2015, authorizes a regional transportation agency or Caltrans to apply to the California Transportation Commission (CTC) to develop HOT lanes and other toll facilities, as specified, without a deadline for HOT lane applications or a limitation on the number of facilities that may be approved. AB 194 removes the limit on the number of projects that can be constructed under Streets and Highways Code Section 149.7, and it streamlines the project development process by making the decision to allow a toll facility an administrative rather than a legislative decision.

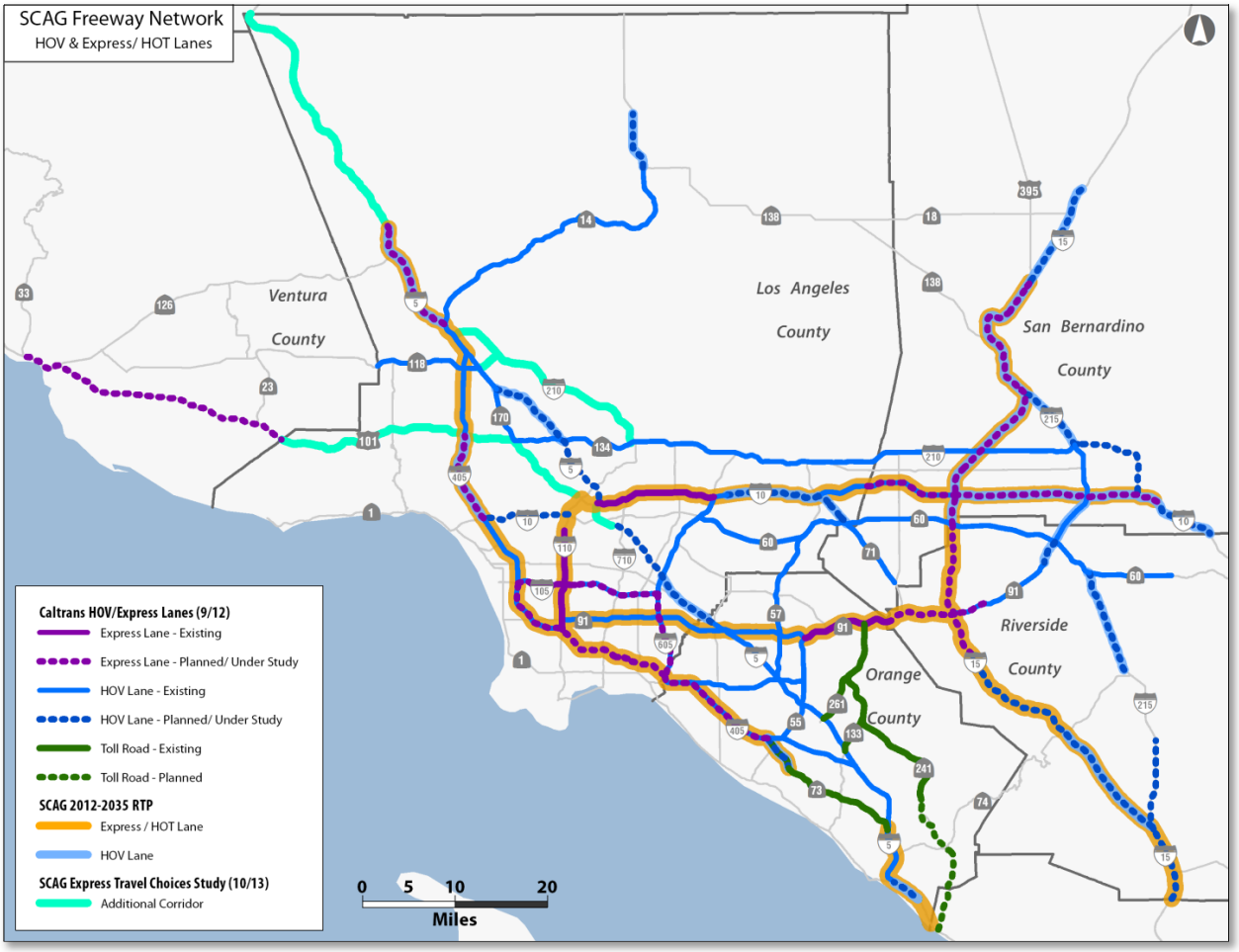
Another opportunity to expand the authorization to operate tolled facilities is to amend California's public-private partnership (P3) statute to extend (or remove) the sunset date for lease agreements with private entities.

To avoid piecemeal applications to the CTC, SCAG, Caltrans and the CTCs could seek CTC approval of a regional network of express lanes, as was done by the Metropolitan Transportation Commission (MTC) in the San Francisco Bay Area. For further discussion on federal and state tolling authorizations, see Chapter 4.

1.5 Project Area

The SCAG region consists of six counties (Imperial, Los Angeles, Orange, Riverside, San Bernardino, and Ventura) with an aggregate highway and arterial system of 67,000 lane-miles that serves 62 million trips each weekday. According to SCAG's Regional Travel Demand Model (RTDM), nine out of every ten trips rely either entirely or in part on the highway and arterial system. The project area is the entire SCAG region, although candidate corridors for the express lane network were primarily located in the urban core area of Los Angeles and Orange counties along with the denser, more congested corridors of Riverside and San Bernardino counties. Imperial and Ventura counties as well as the less dense portions of Riverside and San Bernardino counties do not have the traffic congestion warranted for express lane implementation at this time. Figure 1-1 depicts the existing and planned HOV and express lanes in the SCAG region inventoried at the start of this study.

Figure 1-1: SCAG Region Existing and Planned HOV and Express Lanes



Source: SCAG; Caltrans; WSP | Parsons Brinckerhoff

1.6 Regional Goals and Objectives

Defining regional express lanes goals and objectives represents a critical first step in the process of evaluating the effectiveness of existing facility investments and determining the feasibility of future network expansions or enhancements. Policies based on a defined vision, and set of goals and objectives, can provide direction for determining when an express lane facility or network should be considered for implementation, how it should be operated, and how effective the facility or network performs over time. Policies typically establish guidelines and thresholds for use in identifying the need for express lane facilities and measuring system performance.

Table 1-1 summarizes the goals and objectives for the regional express lane network, which were developed based on input and dialog received from the SCAG Regional Project Management Team:

Table 1-1: Regional Express Lane Network Goals and Objectives

Goals	Objectives
Improve Mobility and Reliability	▪ Reduce travel times and improve travel time reliability for customer and non-customer ▪ Manage travel demand and traffic congestion ▪ Maximize the performance of existing system infrastructure ▪ Maximize the use of technology management ▪ Provide mobility options and choices ▪ Improve transit service options, efficiency and reliability ▪ Improve system connectivity ▪ Increase person throughput
Improve Environmental Quality	▪ Provide air quality benefits ▪ Enhance quality of life ▪ Reduce greenhouse gas emissions ▪ Take into account neighborhood concerns
Improve Safety	▪ Preserve and enhance safety of the user
Provide Financial Sustainability and Accelerate Delivery	▪ Leverage existing revenue sources and assets ▪ Access new or alternative revenue sources ▪ Accelerate project delivery to complete the system ▪ Support ongoing operations and maintenance ▪ Support transit service provision ▪ Plan future investments
Generate Public and Political Support	▪ Support public outreach ▪ Publicize system benefits to the customer and non-customer ▪ Identify and foster champions ▪ Facilitate equitable distribution of costs whereby users pay for what they use

1.7 Consistency within the SCAG Region and California

This ConOps has been developed in collaboration with Caltrans, the CTCs, the Transportation Corridors Agencies (TCA), and FHWA with the primary goal of establishing maximum feasible consistency of practice for all express lanes in the SCAG region. The involved CTCs included Metro, OCTA, RCTC, SBCTA, and the Ventura County Transportation Commission (VCTC). A Local Funding Partners Working Group (LFPWG) comprised of the CTCs, and a Regional Project Management Team (RPMT) comprised of the CTCs, Caltrans headquarters, Caltrans Districts 7, 8, and 12, and FHWA were instituted to provide technical and policy feedback on the topics included in this ConOps. Individual meetings with Caltrans, FHWA and other stakeholder agencies were also held throughout the study effort, which began in April 2013.

Although the ultimate 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 consistency in terms of design treatments and operational policies. The LFPWG and the RPMT will continue to be forums for discussion and collaboration as the implementing 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 SCAG region express lanes will be collected electronically per specifications detailed in California Code of Regulations (CCR), Title 21, or any other specification that may be subsequently adopted.

1.8 Organization of the Report

Like all ConOps documents, this ConOps report is intended to be a "living document" and updated as new express lane projects are contemplated in the region and become operational, and as new technologies or other changing conditions emerge. This document includes the following chapters:

Chapter 1 – Introduction: Details the purpose and need, background, study area, and organization of the report.

Chapter 2 – Current HOV and Express Lane Facilities Characteristics: Describes the geographical limits and current physical and operating characteristics of HOV and express lanes in the SCAG region, as well as summarizes current and ongoing express lane projects.

Chapter 3 – Future Express Lane Facilities Characteristics: Describes future geographic boundaries in the SCAG region for express lanes and some possibilities for physical and operating characteristics of future express lanes networks in the region.

Chapter 4 – Federal and State Tolling Authorization: Describes the statutory requirements and legislative authorizations for tolling at the federal and state levels.

Chapter 5 – Facility Design: Describes typical cross-section, access, striping, signing, toll zone layout, enforcement, and other considerations related to physical design of express lane facilities.

Chapter 6 – Operating Concept: Describes how the express lanes in the SCAG region should operate, including guidelines for use of the lanes by eligible HOVs and toll-paying vehicles. Also, includes considerations for hours of operation, vehicle eligibility, pricing mechanisms, tolling schemes, and equity considerations.

Chapter 7 – Roles and Responsibilities: Describes the areas of responsibility related to express lane operations and the assumed roles of each of the stakeholders.

Chapter 8 – Technical Requirements: Describes the various hardware and software elements of the ETC system.

Chapter 9 – Enforcement and Incident Management: Describes how express lanes will be enforced and how they will operate during highway incidents.

Chapter 10 – Performance Measurement and Evaluation: Details various performance metrics to be measured for express lanes. The selected performance metrics should be in alignment with the regional goals and objectives of the regional express lane network.

Chapter 11 – Express Lane Network Delivery and Governance Options: Compares existing express lanes across California that are owned / operated by individual government agencies versus Joint Powers Authorities (JPA). This chapter also looks at procurement options for implementation of express lanes.

Chapter 12 – Transit Integration: Reviews transit service on existing express lanes in the SCAG region; discusses three best practices for express bus service on express lanes; details lessons learned; explores opportunities for future express bus services on express lanes in the SCAG region; and provides recommendations for increased express bus service on the regional express lane network.

Chapter 13 – Policy Recommendation Summary: Provides an abbreviated summary of recommended express lane facility design, operating concept, performance measurement and evaluation, delivery and governance, and transit integration policy recommendations.

Chapter 14 – References: Provides the list of references and studies that were reviewed or supported the findings and recommendations in this report.

Chapter 15 – Appendices: Provides additional detail that support the analysis and recommendations made in this report, including the copies of adopted agency toll policies, detailed performance maps, corridor profiles, initial screening results, and the financial feasibility assessment.

2.0 CURRENT REGIONAL HOV AND EXPRESS LANE NETWORK

2.1 Introduction

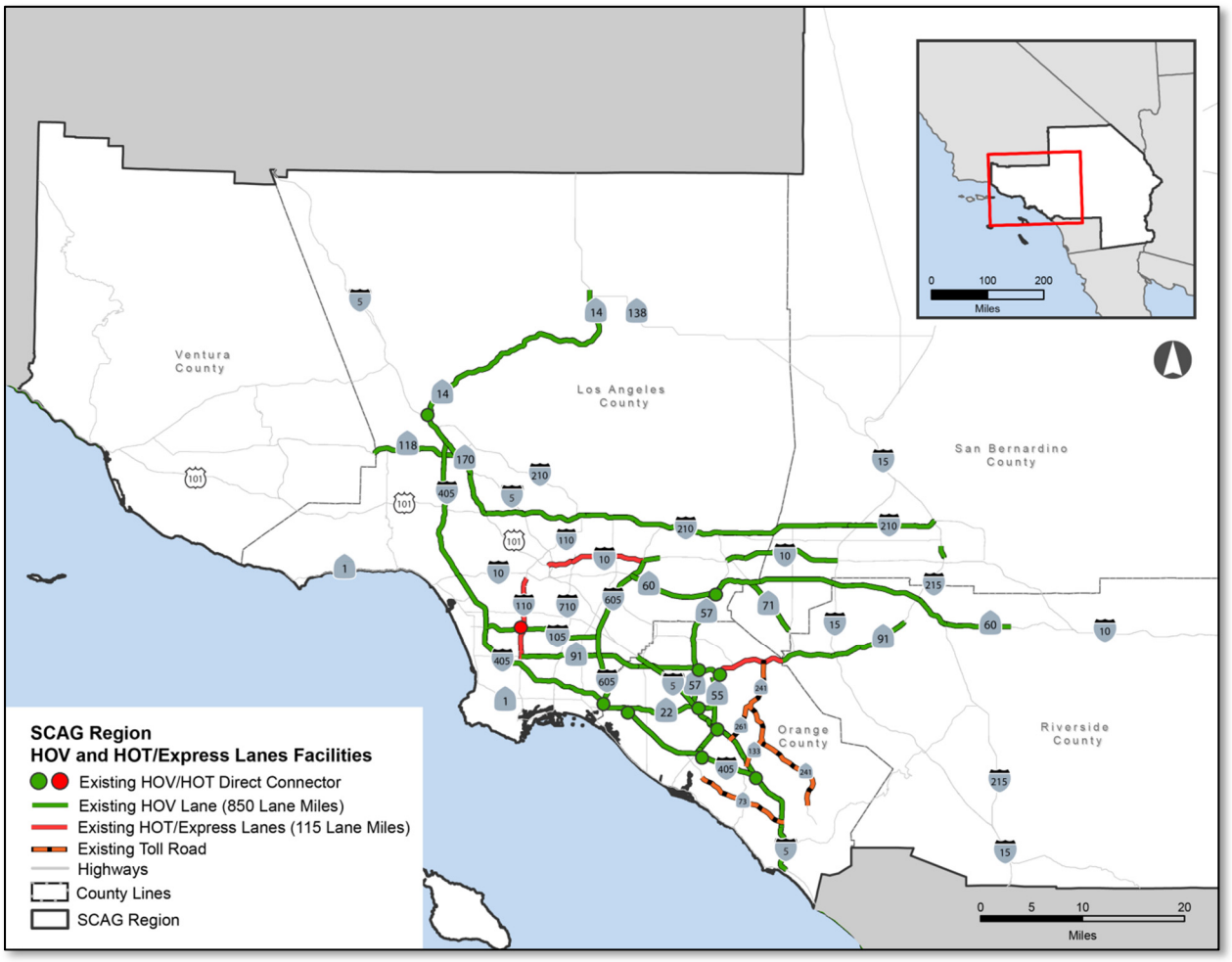
The SCAG region extends across six counties (Imperial, Los Angeles, Orange, Riverside, San Bernardino, and Ventura) and has an aggregate population of over 18 million people, which represents 49 percent of California's populace. With such a large population base and associated housing and employment needs, providing an effective transportation network in the SCAG region is critical to regional competitiveness, economic prosperity, and quality of life. The SCAG region is home to one of the most robust and extensive managed lane networks in the country currently comprised of approximately 852 lane-miles of operating HOV facilities and 115 lane-miles of express lanes. The network continues to grow with the planned construction of both HOV and express lanes.

The managed lane system enhances regional mobility by providing a variety of transportation options including access to express lanes for paying non-HOV motorists and improved transit service and facilities along both HOV and express lane corridors. Figure 2-1 shows the existing HOV and express lane facilities within the SCAG region. This chapter of the ConOps report documents the existing conditions of HOV and express lane facilities in the SCAG region, and inventories funded HOV and express lane improvements that are currently planned or programmed in the region. This section concludes with an overview of recently completed and ongoing express lane related studies within the SCAG region.

2.2 Existing HOV and Express Lane Facilities in SCAG Region

HOV lanes in the SCAG region generally operate with a minimum occupancy requirement of two or more (2+) persons per vehicle, except for the I-10 in Los Angeles, which requires three or more (3+) persons per vehicle during peak periods and HOV-2+ at other times. The following vehicle types are exempted from the occupancy requirement: motorcycles, buses (designated by the operating agency), vanpools (designated by the operating agency), and certain plug-in hybrid, alternative fuel and clean-air (Inherently Low Emissions Vehicles (ILEV) / Ultra Low Emissions Vehicles (ULEV) / Super Ultra Low Emissions Vehicles (SULEV)) vehicles. Most of the HOV lanes in Southern California are separated from other lanes by a buffer zone and operate on an HOV basis, 24-hours a day, and seven days a week. Table 2-1 through Table 2-4 summarizes the HOV lanes-miles by highway corridor in the Caltrans districts encompassing the SCAG region.

Figure 2-1: Existing HOV and Express Lane Facilities in SCAG Region



Source: WSP | Parsons Brinckerhoff

Table 2-1: Summary of High-Occupancy Vehicle (HOV) Lanes (2013)

District	Region	Length (Lane-Miles)		
		Existing	Under Construction	Programmed or Proposed
7	Los Angeles County and Ventura County	453.2	50.7	80.5
8	Riverside County and San Bernardino County	177.5	18.2	240.8
12	Orange County	222.1	4.5	28.0
Total		**852.8**	**73.4**	**349.3**

Source: Caltrans HOV Inventory (March 2013)

Table 2-2: Existing HOV Lane Facilities in Caltrans District 7 (Los Angeles and Ventura Counties)

District	County	Route	From	To	Centerline Miles	Lane Miles	Occupancy Policy	Hours of Operation
7	Los Angeles	5	SR-118	SR-14	6.1	11.4	2+	24 Hr
7	Los Angeles	10	I-605	Puente Ave	2.2	4.1	2+	24 Hr
			SR-57	San Bernardino County Line	5.9	11.3	2+	24 Hr
7	Los Angeles	14	I-5	Avenue P-8	36.7	72.8	2+	NB: 3:00–7:00 PM M–F SB: 5:00–9:00 AM M–F
7	Los Angeles	57	Orange County Line	SR-60	5.5	10.9	2+	24 Hr
7	Los Angeles	60	I-605	San Bernardino County Line	18.7	35.4	2+	24 Hr
7	Los Angeles	91	I-110	Orange County Line	14.2	26.4	2+	24 Hr
7	Los Angeles / Ventura	101	Santa Barbara County Line	Mussel Shoals	5.3	10.6	2+	24 Hr
7	Los Angeles	105	I-405	Studebaker Rd	16.3	32.0	2+	24 Hr
7	Los Angeles / Ventura	118	I-5	Rocky Peak Rd	11.3	21.7	2+	24 Hr
7	Los Angeles	134	US-101	I-210	12.6	24.2	2+	24 Hr
7	Los Angeles	170	US-101 / SR-134	I-5	5.9	11.6	2+	24 Hr
7	Los Angeles	210	SR-134	San Bernardino County Line	27.2	54.4	2+	24 Hr
7	Los Angeles	405	Orange County Line	I-5	47.8	86.7	2+	24 Hr
7	Los Angeles	605	Orange County Line	I-10	19.9	39.7	2+	24 Hr

Source: Caltrans HOV Inventory (March 2013)

Table 2-3: Existing HOV Lane Facilities in Caltrans District 8 (Riverside and San Bernardino Counties)

District	County	Route	From	To	Centerline Miles	Lane Miles	Occupancy Policy	Hours of Operation
8	San Bernardino	10	Los Angeles County Line	Haven Ave	8.5	16.8	2+	24 Hr
8	Riverside / San Bernardino	60	Los Angeles County Line	I-215/SR-91	22.2	44.4	2+	West of I-215: 24 Hr East of I-215: 6:00–10:00 AM & 3:00–7:00 PM
			East Jct I-215	Redlands Blvd	7.0	13.9	2+	6:00-10:00 AM 3:00-7:00 PM
8	San Bernardino	71	Riverside County Line	Los Angeles County Line	7.3	14.4	2+	24 Hr
8	Riverside	91	Orange County Line	E. Adams St	17.4	33.7	2+	24 Hr
8	San Bernardino	210	Los Angeles County Line	I-215	21.5	42.9	2+	24 Hr
8	Riverside / San Bernardino	215	Box Springs Rd	SR-60/SR-91	4.5	8.9	2+	24 Hr

Source: Caltrans HOV Inventory (March 2013)

Table 2-4: Existing HOV Lane Facilities in Caltrans District 12 (Orange County)

District	County	Route	From	To	Centerline Miles	Lane Miles	Occupancy Policy	Hours of Operation
12	Orange	5	SR-1 PCH	Artesia Blvd	38.3	76.3	2+	24 Hr
12	Orange	22	SR-55	Valley View St	10.5	20.8	2+	24 Hr
12	Orange	55	I-405	0.4 mile south of Lincoln Ave	10.7	21.0	2+	24 Hr
12	Orange	57	I-5 / SR-22	Los Angeles County Line	12.2	24.2	2+	24 Hr
12	Orange	91	Los Angeles County Line	Riverdale Ave	11.8	23.6	2+	24 Hr
12	Orange	405	I-5	Los Angeles County Line	24.4	52.7	2+	24 Hr
12	Orange	605	I-405	Los Angeles County Line	2.5	3.5	2+	24 Hr

Source: Caltrans HOV Inventory (March 2013)

As part of the region's congestion management strategy, several express lane projects have been implemented to improve highway operational efficiency and maximize corridor throughput. However, these facilities operate with different requirements and toll structures. Currently, Los Angeles County has the most extensive express lane system in the region with nearly 75-lane miles operating along I-10 and I-110. Orange County operates an additional 40-lane miles of express lanes along SR-91 with additional lanes currently being developed along I-405. San Bernardino and Riverside counties did not have any operating express lanes prior to 2017, but RCTC opened an extension of the 91 Express Lanes in 2017 and is developing additional lanes along I-15, while SBCTA is developing plans for express lane projects on I-10 and I-15. Table 2-5 through Table 2-7 provide additional information on existing (as of 2013), and planned express lanes for the different Caltrans districts in the SCAG region.

Table 2-5: Express Lanes in SCAG Region (2013)

District	Region	Length (Lane-Miles)		
		Existing	Under Construction	Programmed or Proposed
7	Los Angeles County / Ventura County	74.4	0.0	184.9
8	Riverside County / San Bernardino County	0.0	0.0	379.1
12	Orange County	40.2	0.0	114.5
Total		**114.6**	**0.0**	**678.5**

Source: Caltrans HOV Inventory (March 2013)

Table 2-6: Existing Express Lanes Facilities in Caltrans District 7 (Los Angeles and Ventura Counties)

District	County	Route	Direction	Begin Post Mile	End Post Mile	Description	Length (Lane-Miles)	Occupancy Requirement for Toll-Free Passage	Hours of Operation
7	Los Angeles	110	NB	10.51	19.78	Artesia Transit Center to Adams Blvd	17.6	2+	24 Hr
7	Los Angeles	110	SB	20.2	10.51	Flower St to Artesia Transit Center	17.7	2+	24 Hr
7	Los Angeles	10	EB	16.97	27.89	Alameda St to Baldwin Ave	16.5	3+ 5:00-9:00 AM M-F 3+ 4:00-7:00 PM M-F 2+ All Other Times	24 Hr
7	Los Angeles	10	EB	27.96	30.84	Baldwin Ave to I-605	2.9	3+ 5:00-9:00 AM M-F 3+ 4:00-7:00 PM M-F 2+ All Other Times	24 Hr
7	Los Angeles	10	WB	30.69	27.72	I-605 to Baldwin Ave	3.0	3+ 5:00-9:00 AM M-F 3+ 4:00-7:00 PM M-F 2+ All Other Times	24 Hr
7	Los Angeles	10	WB	27.65	16.97	Baldwin Ave to Alameda St	16.7	3+ 5:00-9:00 AM M-F 3+ 4:00-7:00 PM M-F 2+ All Other Times	24 Hr
DISTRICT 7 TOTAL LANE-MILES EXISTING							**74.4**		

Source: Caltrans HOV Inventory (March 2013)

Table 2-7: Existing Express Lanes Facilities in Caltrans District 12 (Orange County)

District	County	Route	Direction	Begin Post Mile	End Post Mile	Description	Length (Lane-Miles)	Occupancy Requirement for Toll-Free Passage	Hours of Operation
12	Orange	91	EB	8.65	R18.90	Santa Ana River to Riverside County Line	20.9	3+ (Pay discounted toll M-F 4:00-6:00 PM)	24 Hr
12	Orange	91	WB	R18.75	8.59	Riverside County Line to Santa Ana River	19.3	3+	24 Hr
DISTRICT 12 TOTAL LANE-MILES EXISTING							40.2		

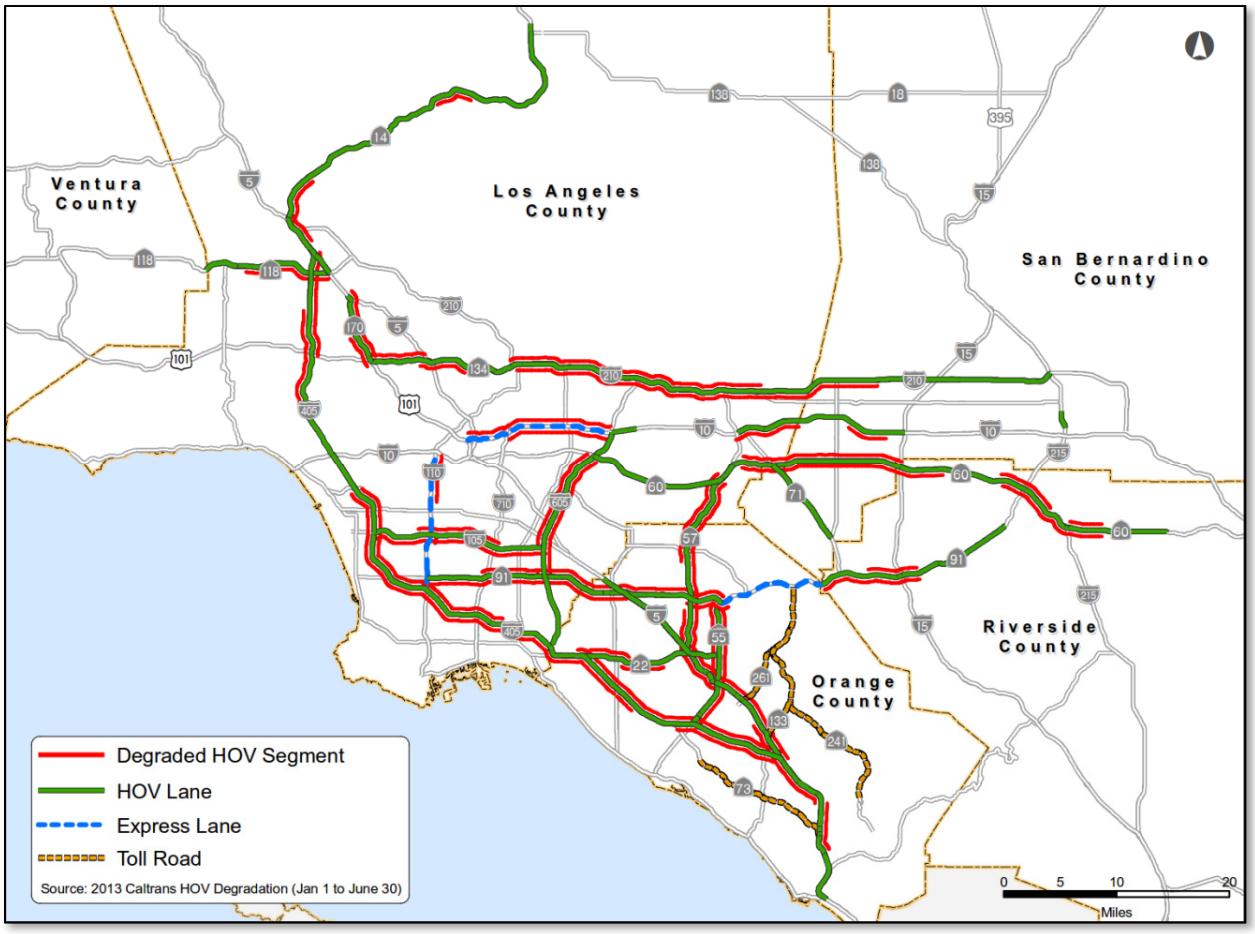
Source: Caltrans HOV Inventory (March 2013)

2.2.1 Existing HOV Degradation

The Caltrans *2013 California High-Occupancy Vehicle Lane Degradation Determination Report* documents the operational conditions of the HOV facilities in the state and identifies HOV facilities that are considered degraded, as defined by federal standards in Section (§) 166 of Title 23, U.S. Code (U.S.C.). Under federal law, HOV facilities are considered degraded when the average speed during the peak periods falls below 45 mph for 10 percent or more of the time over a consecutive 180-day period. In other words, average peak-period HOV traffic speeds cannot drop below 45 mph in any given segment for more than a total of about 15 hours each month. If the lanes are considered degraded, then the state (Caltrans) must either limit or discontinue the use of the lane by exempted vehicles or take other actions that will bring the operational performance up to the federal standard within 180 days of being designated as degraded.

As shown in Figure 2-2, significant portions of the HOV lane network are considered degraded in the SCAG region in 2013. A similar degradation pattern was also shown in the 2014 *California High-Occupancy Vehicle Lane Degradation Determination Report.* The causes of degradation can be attributed to various factors including demand levels that exceed capacity, on-going construction activities, operational conflict between HOV and GP lanes, the friction effects of GP lane congestion, the termination of HOV lanes, the lack of HOV to HOV direct connector ramps, and high truck volumes.

Figure 2-2: SCAG Region HOV Degradation

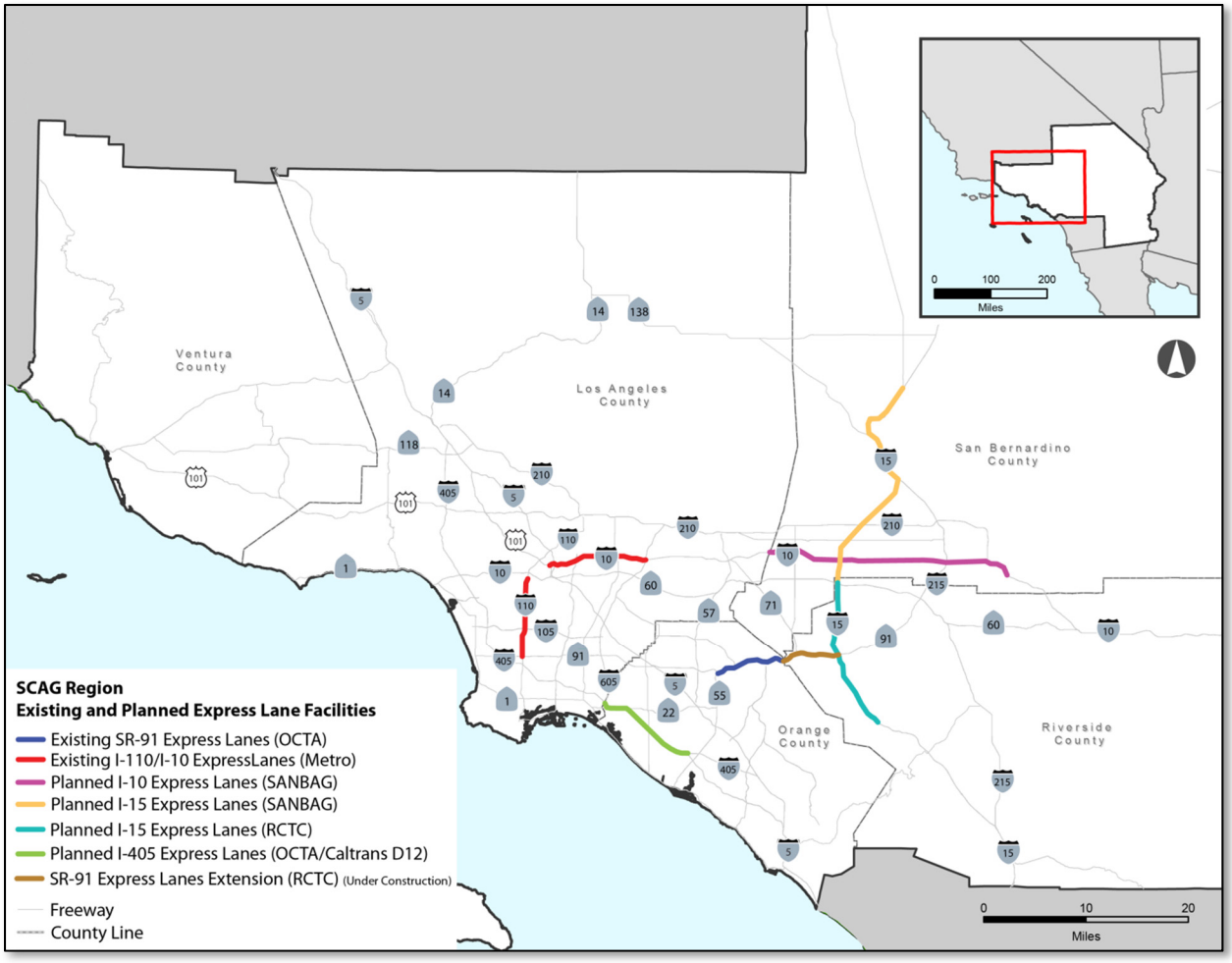


Source: Caltrans HOV Degradation Report (2013)

2.3 Planned and Proposed Express Lanes in SCAG Region

Due in part to the success of the Metro I-110 / I-10 ExpressLanes program, and the 91 Express Lanes in Orange County, Metro, OCTA, RCTC, SBCTA, and Caltrans are actively planning for the implementation of express lanes on other corridors throughout the SCAG region. Figure 2-3 illustrates the locations of existing and currently planned and programmed express lane facilities in the region. Below is a summary of those projects that are further along in the development process.

Figure 2-3: Existing and Planned / Programmed HOV and Express Lane Facilities in SCAG Region



Source: WSP | Parsons Brinckerhoff

2.3.1 San Bernardino County Transportation Authority I-10 and I-15 Express Lanes

SBCTA is currently advancing plans for two major express lane expansion projects on I-10 and I-15 in San Bernardino County. A major regional east-west highway corridor, I-10 is heavily used by travelers between Los Angeles and San Bernardino counties, and is also a primary east-west truck route between Southern California and the rest of the nation. Currently, I-10 operates at capacity for many hours of the day, conditions are expected to worsen significantly during the coming years if capacity is not added. The proposed I-10 Corridor Project consists of adding lane(s) and providing improvements along all or a portion of the existing 35-mile segment of I-10 from approximately two miles west of the Los Angeles / San Bernardino County line in the City of Pomona to Ford Street in the City of Redlands. Three alternatives are being studied in the environmental documents: (1) no build; (2) HOV lanes; and (3) Express lanes.

The proposed I-15 Corridor Project would widen a 33-mile stretch of I-15 from Cantu Galleano Ranch Road in Riverside County to US-395 in the City of Hesperia. As a major regional north-south highway corridor, I-15 is used heavily by commuters and recreational travelers. It is also an important goods-movement corridor, linking Southern California and Las Vegas, Nevada, the U.S. Mountain West and Plains, and providing onward access to central Canada. I-15 also facilitates east-west movement within the U.S. with its connections to I-40 and I-70. Currently, I-15 also operates at capacity for several hours of the day, and conditions will deteriorate further if new capacity is not added. SBCTA's Strategic Plan and 10-Year Delivery Plan financial analysis concluded that traditional funds will not be adequate to pay for the expansion of I-15 without leveraging an additional source of funding such as toll revenue. As a result, HOV lanes are not being considered as an alternative for the I-15.

In October 2014, SBCTA released a preliminary ConOps report, which evaluated the feasibility of implementing express lanes along the I-10 and I-15 corridors. Both projects would provide two express lanes in each direction and they would be separated from the general-purpose lanes by a two-foot wide buffer with two solid white lane markings and possibly the use of traffic channelizers. The toll would vary dynamically based on prevailing traffic volumes and speeds, and HOV3+ vehicles would be able to use the lanes for free or for a discounted toll.

On December 4, 2013, SBCTA's Board voted to complete the Project Approval and Environmental Document (PA&ED) stage for the I-10 HOV and express lanes alternatives and initiate the PA&ED for the I-15 from Cantu Galleano to SR-210. The Environmental Impact Report (EIR) / Environmental Impact Statement (EIS) for the I-10 Corridor Project was approved in July 2017. In early 2018, the I-15 Corridor Project is expected to enter public review and comment period for the Draft Environmental Document.

2.3.2 Riverside County Transportation Commission 91 Express Lanes Extension

In early 2014, RCTC began construction on an eight-mile extension of the 91 Express Lanes into Riverside County. The project includes express lanes, regular lanes, auxiliary lanes, and direct express lane connectors. Improvements were also made to interchanges, ramps, and surface streets along the SR-91 corridor. The project was completed in 2017.

The project includes two new express lanes in both directions from the existing OCTA 91 Express Lanes to and from the I-15 in Corona, replacing the existing single carpool lanes in each direction. In addition, a single tolled express lane was added to I-15 in both directions starting and ending south of Magnolia Avenue. Direct express lanes connectors were built between eastbound SR-91 and southbound I-15 and between northbound I-15 and westbound SR-91.

There is a seamless transition between the 91 Express Lanes in Orange County and the new 91 Express Lanes in Riverside County. Existing transponder owners do not need to establish a new account with RCTC or change their existing account to use the new lanes in Riverside County. Both sections of the 91 Express Lanes operate using the same account structure, account fee schedule format, and customer service systems. Like the Orange County system, Riverside County toll collection is electronic, with no toll booths needed. Separate tolls are charged for each county segment, offering drivers a choice of using the Riverside County toll lanes, the Orange County toll lanes, or both. Vehicles with HOV 3+ and a transponder are able to use the 91 Express Lanes toll-free or at reduced rates, depending on the direction of travel, time of day and day of the week.

2.3.3 Riverside County Transportation Commission I-15 Express Lanes

RCTC is also planning to construct express lanes along I-15. The project would include two tolled express lanes in each direction between the I-15 / Cajalco Road interchange and the I-15 / SR-60 interchange. All proposed improvements are anticipated to be constructed within the existing right of way, with the majority of the improvements occurring within the existing I-15 median. The project is estimated to cost $471 million. RCTC is proceeding with a design-build process to expedite delivery of the project and minimize construction costs. Project construction is anticipated to begin in summer 2018 with the express lanes slated to open in 2020.

2.3.4 Orange County I-405 Improvement Project Express Lanes

OCTA, in cooperation with Caltrans, is proposing to widen the I-405 between SR-73 and I-605 to provide one additional general-purpose lane and a new express lane in each direction. The new express lane combined with the conversion of the existing carpool lanes will provide two express lanes in both directions. The I-405 Improvement Project is partially funded by $1.1 billion from Measure M, the half-cent transportation sales tax measure in Orange County. Funding for the express lanes will come mostly from toll financing repaid from tolls paid by those who choose to use the express lanes facility. Caltrans is also contributing $90 million to build the express lanes. The overall I-405 Improvement Project is estimated to cost $1.9 billion.

A design-build contract was awarded in November 2016. Project construction is started in early 2018 with the express lanes slated to open in 2023.

2.4 Other Completed or Ongoing Express Lanes Related Studies

In addition to those express lanes projects mentioned above that have advanced into the construction, design or environmental phase, there have been several other current and recent planning studies that are considering express lanes. Table 2-8 lists the recently completed and ongoing express lanes studies within the SCAG region.

Table 2-8: Express Lane Related Studies in the SCAG Region

Study	Route / Corridor	Type of Study	Completion / Status
Metro I-405 Sepulveda Pass Level II Traffic and Revenue Study	I-405	Level II Traffic & Revenue	Ongoing
Metro I-5 North Traffic and Revenue Study	I-5	Traffic & Revenue	Ongoing
Metro I-105 ExpressLanes PAED	I-105	PAED	Ongoing
Metro I-605 Corridor Improvement Project[1]	I-605	PAED	Ongoing
SBCTA I-10 and I-15 Express Lane Concept of Operations	I-10 / I-15	Concept of Operations	Completed
RCTC I-15 Express Lanes Concept of Operations	I-15	Concept of Operations	Completed
Caltrans District 12 Orange County Managed Lanes Feasibility Study	Orange County	Master Plan	Completed January 2017
Caltrans System Plan for Managed Lanes on State Highways	Statewide	Master Plan	Completed October 2016
VCTC US-101 HOT Lanes Financial Feasibility Study	US-101	Feasibility	Completed September 2014
Metro I-405 Freeway (OC Line to LAX) HOV to HOT Conversion Feasibility Study	I-405	Concept of Operations	Completed June 2014
Metro I-405 Sepulveda Pass Corridor Supplemental Traffic and Revenue Study	I-405	Level I Traffic & Revenue	Completed in October 2013
Metro I-405 Sepulveda Pass Corridor System Planning Study	I-405	Planning	Completed in November 2012
RCTC SR-91 Project System Engineering Management Plan (SEMP) Section 2 Concept of Operations	SR-91	Concept of Operations	Completed June 2012
Metro 2015 Los Angeles County HOV to HOT Conversion Technical Feasibility Report	Regional	Feasibility	Completed in November 2010

Source: WSP | Parsons Brinckerhoff

[1] As part of the EIR/EIS, express lanes are included as an alternative.

3.0 FUTURE NETWORK CHARACTERISTICS

This chapter describes the two-phase corridor screening and phasing analysis with an initial screening of the existing and planned HOV facilities on the regional highway network that assessed the levels of HOV degradation, HOV utilization, constructability, and ease of implementation. The initial corridor screening resulted in a smaller screening network that was subjected to more detailed evaluation. In addition to highway corridors with existing or planned HOV facilities, this network also includes a small number of highway segments without planned HOV lanes in order to create a contiguous network.

3.1 Regional Express Lanes Network

The screening process utilized planning-level traffic and revenue (T&R) forecasts that were prepared for the years 2020 and 2035 for RTP/SCS Baseline Composite Express Lane Network (i.e., Composite Network). The Composite Network assumed that the existing regional highway network will be in place, together with fully funded and committed baseline transportation improvements in the approved SCAG 2012 RTP/SCS that are possible to implement with the revenues generated by the continuation of current gas tax policies. The Composite Network also assumed that all existing and planned HOV facilities will be converted to express lanes operations and that select gap closure express lane improvements will be in place by Year 2035. For purposes of comparison and generating annual T&R forecasts over a financing horizon, all HOV lane scenarios have been modeled for both 2020 and 2035 for the Composite Network.

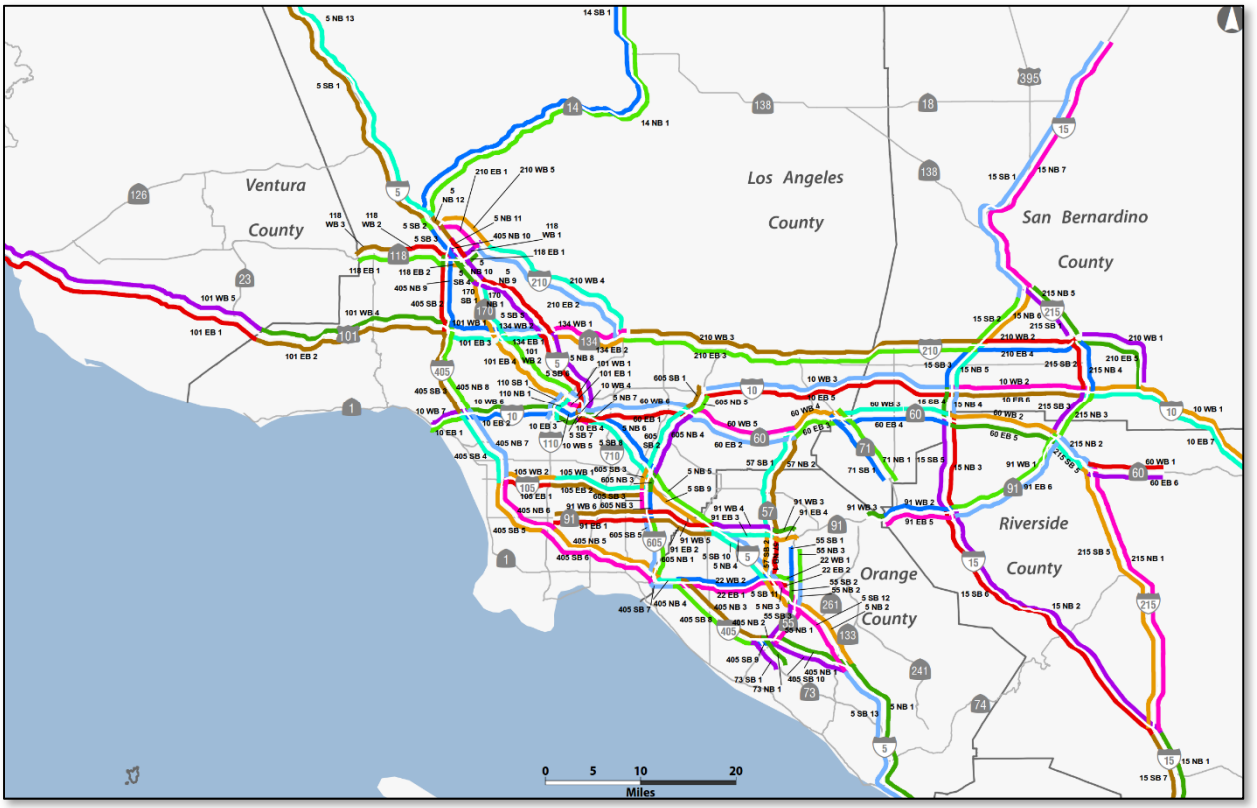
To facilitate the evaluation, the screening network was subdivided into 204 individual, directional roadway segments as shown in Figure 3-1. The termini for the roadway segments are located at county borders or at connections with other major highway facilities where potential variations in traffic volumes, roadway cross sections, and travel characteristics occur. It should be noted that segments where express lane projects have already been programmed were not included as part of the screening analysis, as they have been subject to detailed project specific traffic analysis and financial planning, and have already advanced in project development.

3.1.1 Model Scenarios

The travel demand model results for each scenario have been post-processed using ECONorthwest's Rapid Toll Optimization Model (RapidTOM©) to determine how motorists would respond to tolling and alternative vehicle occupancy requirements on the express lanes. Separate traffic and revenue forecasts have been prepared assuming a 2+ and 3+ occupancy requirement for receiving an HOV toll exemption. The two different exemption occupancy rates have been modeled for two separate tolling objectives. One objective assumed that toll rates will vary dynamically to maximize toll revenues (Revenue Maximization), which essentially minimizes delay in the express lanes only. The other objective assumed that toll rates would vary dynamically at lower overall levels of traffic delay to minimize corridor travel costs (Cost Minimization). By utilizing somewhat lower toll rates, the

latter objective results in higher utilization of the express lanes, which helps to maximize congestion relief for both the express lanes and the general-purpose lanes.

Figure 3-1: SCAG Region Express Lane Analysis Segments



Source: WSP | Parsons Brinckerhoff

3.2 Evaluation Approach and Methodology

The evaluation resulted in an initial optimized and prioritized network by reviewing the performance of the general-purpose lanes and the express lanes on each highway segment based on a series of three mobility metrics, as well as a single financial feasibility metric. The evaluation utilizes data from the T&R forecasts, together with planning level construction cost estimates that have been prepared for each of the highway segments.

The analysis was conducted using individual evaluation metrics calculated and arrayed in a spreadsheet database. The results of the individual screening assessments were grouped into quintiles ranked one to five based on their performance, with a higher number indicating superior performance. An overall mobility score was calculated by averaging the three individual mobility metric scores. In a final calculation, a composite performance score was determined by calculating the average of the composite mobility score and the single

financial feasibility score for each analysis segment. The results of the evaluation are reported both numerically and using shaded Harvey Balls[2]. The results were also used to generate color coded maps showing the performance of the analysis segments on the same five-point scale. The individual screening metrics are described in greater detail below.

3.2.1 Mobility Screening

The mobility screening measure was determined based on three criteria used to gauge the positive impact an express lane could have on a motorist's mobility and trip reliability. The mobility screening metrics are General-Purpose Lane Peak Period Average Speeds, Managed Lane Person Throughput, and User Costs as Value of Time.

3.2.1.1 General-Purpose Lanes Peak Period Average Speeds

Given that the majority of vehicles operating on the Composite Network will utilize the general-purpose lanes, vehicle operating speeds on the general-purpose lanes are important measures of traffic performance. The screening process compared peak period speeds on the general-purpose lanes for the different express lane alternatives to the all HOV scenario, with the difference being reported as the measurable score. General-purpose lane speeds were reported in the following manner in the screening process:

- AM and PM peak periods
- Weighted by volume and distance on each analysis segment
- 2035 express lanes compared to 2035 non-tolled (HOV conditions), both with an HOV 3+ occupancy requirement

3.2.1.2 Express Lanes Person Throughput

The contribution that express lanes make to reducing congestion is to provide access to available managed lane roadway capacity to non-HOV motorists. This eases congestion on the general-purpose lanes by better balancing traffic across the entire highway corridor, and using variably priced tolls set in real time manages demand to prevent traffic conditions on the express lanes from deteriorating below an acceptable level. Express lane utilization was captured in this evaluation using person throughput. Person throughput was determined using vehicle volumes and average occupancies by vehicle type. Average vehicle occupancies are a product of the SCAG Regional Travel Demand Model. Since RapidTOM outputs were not fed back into the regional mode choice or trip distribution models for the purposes of this screening evaluation, the throughput for a segment inclusive of both the express lanes and the general-purpose lanes remains constant across alternate toll policy runs of RapidTOM. However, the person throughput for express lanes and general-purpose lanes changes individually based on alternative, and can be reported by segment. For the purposes of this evaluation, person throughput was reported using the following parameters:

[2] A form of ideograms similar to those used by Consumer Reports™ magazine to rank the features of various products

- 24 hour values
- Managed lanes only
- No weighting
- 2035 express lanes compared to 2035 non-tolled (HOV conditions)
- HOV 3+ occupancy requirement

3.2.1.3 User Costs as Value of Time

The third mobility screening metric was an aggregate calculation prepared in RapidTOM to monetize the travel time savings gained by motorists using highway corridors with express lanes. This metric was calculated by tracking the vehicle hours of travel on the managed lanes corridors. Each vehicle was assigned a value of time that is derived from a distribution of time values that reflect vehicle occupancy and vehicle type. The value was calculated for vehicles in both the express lanes and the general-purpose lanes. This sum of user costs as value of time is reported as the recordable screening value. User costs as value of time were reported in the following manner as part of the screening process:

- 24 hour values
- Aggregated for all travel lanes
- No weighting
- 2035 express lanes compared to 2035 non-tolled (HOV conditions)
- HOV 3+ occupancy requirement

3.2.2 Financial Feasibility Screening

The financial feasibility screening assessment utilized a calculation that compares the sum of estimated segment toll revenues in 2020 and 2035, less a toll operating cost allowance factor and the cost of converting each segment to express lane operation. The results of the calculation are expressed in discounted present values. The formula developed for the screening relies on available model output and cost data, and was fashioned to emulate the more detailed financial feasibility analysis of the preferred express lanes network for Los Angeles, Orange, Riverside, and San Bernardino counties. The financial screening calculation uses the following inputs and assumptions:

- Capital cost estimates, revenues, and operating cost factors are assumed to be expressed in constant 2014 dollars

- Segment capital costs for express lanes conversion are in 2014 dollars (discounted from a nominal assumed construction year of 2019 to a 2014 present value)

- The real discount rate for discounting future amounts in time already expressed in constant 2014 (uninflated) dollars was assumed to be 3 percent

- Segment express lane length in miles

- 2020 daily volume of toll-paying traffic by segment
- 2035 daily volume of toll-paying traffic by segment
- 2020 daily potential gross toll revenue by segment, in 2014 dollars (discounted from 2020 to 2014)
- 2035 daily potential gross toll revenue by segment, in 2014 dollars (discounted from 2035 to 2014). A combined toll collection operating cost factor or allowance was assumed to be $0.10 per toll transaction plus $0.02 per segment mile per toll paying vehicle by segment

The formula for the financial feasibility assessment screening measure is shown in Figure 3-2 and explained further below.

Figure 3-2: Financial Feasibility Assessment Formula

$$\frac{\left[\frac{2020\_DailyRevenue-(2020\_DailyTrnsns\times(\$0.10+HOT\_Length\times\$0.02))}{(1+Real\_Discount\_Rate)^{(2020-2014)}}\right]+\left[\frac{2035\_DailyRevenue-(2035\_DailyTrnsns\times(\$0.10+HOT\_Length\times\$0.02))}{(1+Real\_Discount\_Rate)^{(2035-2014)}}\right]}{\frac{(Capital\_Cost\_2014\$s/1000)}{(1+Real\_Discount\_Rate)^{(2019-2014)}}}$$

The numerator of the equation first deducts the toll collection operating cost allowance factor from gross daily revenues to provide an adjusted revenue value for both 2020 and 2035. The intent was to provide a more realistic measure of net daily cash flow, recognizing that this effort precedes the preparation of more detailed operating cost estimates. These two future year adjusted daily revenue amounts, expressed in constant 2014 dollars, were then discounted to present values in 2014. The two figures are then added to provide the numerator of the financial screening measure for each segment.

The denominator of the equation calculates the present value of the estimated HOV to express lane conversion construction cost for each segment, expressed in thousands of 2014 dollars and discounted from the nominal assumed year of construction (2019).

The resulting financial feasibility assessment screening measure or ratio was then indexed such that the average value was equal to 1.0. This measure does not have a specific meaning, but can be thought of as a proxy for cost-effectiveness. A negative numerator, and thus, a negative overall measure value suggests that the given segment is not likely to be self-supporting. That is, it is not likely to generate sufficient revenues to cover its operating costs. However, a positive value does not necessarily mean that the segment is sustainable; other factors including revenue leakage, rate of revenue growth, and facility O&M costs also contribute to the segment's financial feasibility. The financial feasibility calculation captures three important underlying financial considerations:

- Future gross revenue in 2035 is worth less (has a lower present value) than opening year revenue in 2020. This reflects the fact that the sooner gross revenue materializes, the better it will support financing or pay-go for capital investments, and thus, the higher the scoring.

- An adjusted revenue figure as a proxy for net revenue is a stronger evaluation measure than gross revenue. For example, if there are two segments with equal gross revenues, then the segment with lower volumes and/or a shorter distance should result in lower toll collection operating costs as well as facility maintenance costs (volume and distance serve as proxies for toll collection and operations and maintenance (O&M) cost factors), and thus a higher feasibility score.

- Between two segments with equal adjusted revenue numerator values, the one with the lower express lane capital conversion cost will score higher.

As with the mobility screening, the resulting financial feasibility scores were divided into quintiles, with each segment receiving a score of one to five depending upon where it falls within the overall range. The inputs for the financial feasibility assessment were taken from two sources: the 2020 and 2035 traffic and revenue forecasts generated by RapidTOM and the capital construction cost estimates that have been prepared for each analysis segment. The cost estimates were generated using generic indicative per-linear-foot centerline construction unit costs for five cross-section types which have been identified based on visual inspections of each of the 204 highway segments included in the screening process.

3.2.3 Averaging the Revenue Maximization and Revenue Minimization Results

The Revenue Maximization and Cost Minimization scenarios represent the bounds in the range of dynamic pricing operations that can be used to either maximize express lane revenue generation, or maximize overall corridor time savings and minimizing the costs associated with travel delay. As such, these scenarios represent bookends in the range of average toll rates that would be likely to be charged in a dynamic pricing scheme in order to maintain acceptable traffic service conditions on the express lanes. However, it is likely that the actual toll levels charged on the regional express lane network will fall somewhere in the middle of that range in order to achieve a balance of both revenue generation and travel delay reduction. Given that the two pricing objectives yield different mobility and financial feasibility outcomes, the performance of the segments has been determined by averaging the results of the two objectives for each of the evaluation metrics. In addition, the results of directional segment pairs were averaged to determine a single score for each segment regardless of travel direction. For example, a segment with a westbound performance score of "2" and eastbound performance of "4" would have an averaged segment score of "3" for each metric.

3.3 Regional Express Lane Network Evaluation Results

The detailed results of the screening evaluation are presented in **Appendix K** of this report. The appendix provides the numeric output from each of the four screening calculations and then arrays those results into quintiles. These scores were then used to generate maps showing the performance of the 204 analysis segments comprising the SCAG Composite Network. The maps use the following colors to indicate the scores the different segments achieved:

- 5—Dark Green
- 4—Light Green
- 3—Yellow
- 2—Orange
- 1—Red

Some of the SCAG Composite Network segments contain future express lane projects already programmed for implementation by the CTCs. Therefore, for purposes of this analysis, programmed express lane segments were not considered as part of the screening exercise, and are not scored in the performance maps or screening matrix. However, the programmed express lane corridors are considered in network phasing recommendations and are listed below:

- SBCTA's I-10 Express Lanes from Los Angeles County line to Ford Street
- SBCTA's I-15 Express Lanes from Cantu Galleano Ranch Road to US-395
- RCTC 91 Express Lanes Extension from Orange County Line to I-15 (completed in 2017)
- RCTC I-15 Express Lanes Project from Cajalco Road to SR-60
- OCTA / Caltrans District 12 I-405 Express Lanes from SR-73 to I-605

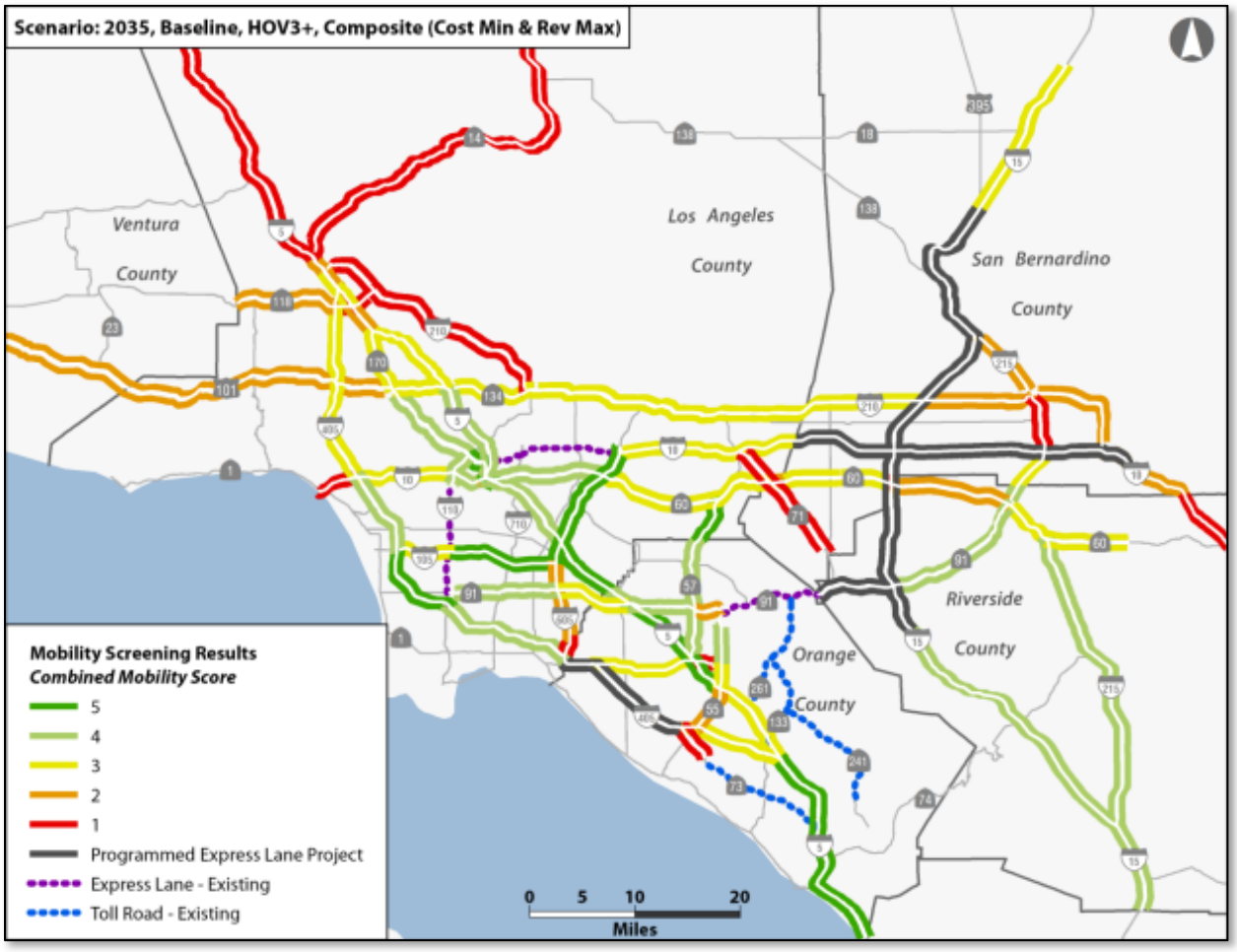
3.3.1 Mobility and Reliability Screening Results

The performance maps contained in **Appendix J** document the performance of the average of the Revenue Minimization and Revenue Maximization scenarios for each of the three mobility evaluation metrics.

Figure 3-3 presents the composite mobility score for HOV 3+ Cost Minimization and Revenue Maximization Scenarios, which represents the average of the individual mobility metrics:

- Change in Peak Period General-Purpose Lane Speeds
- Change in 24-hour Managed Person Throughput
- User Costs as Value of Time

Figure 3-3: Composite Mobility Scores (Cost Minimization and Revenue Maximization Scenarios)



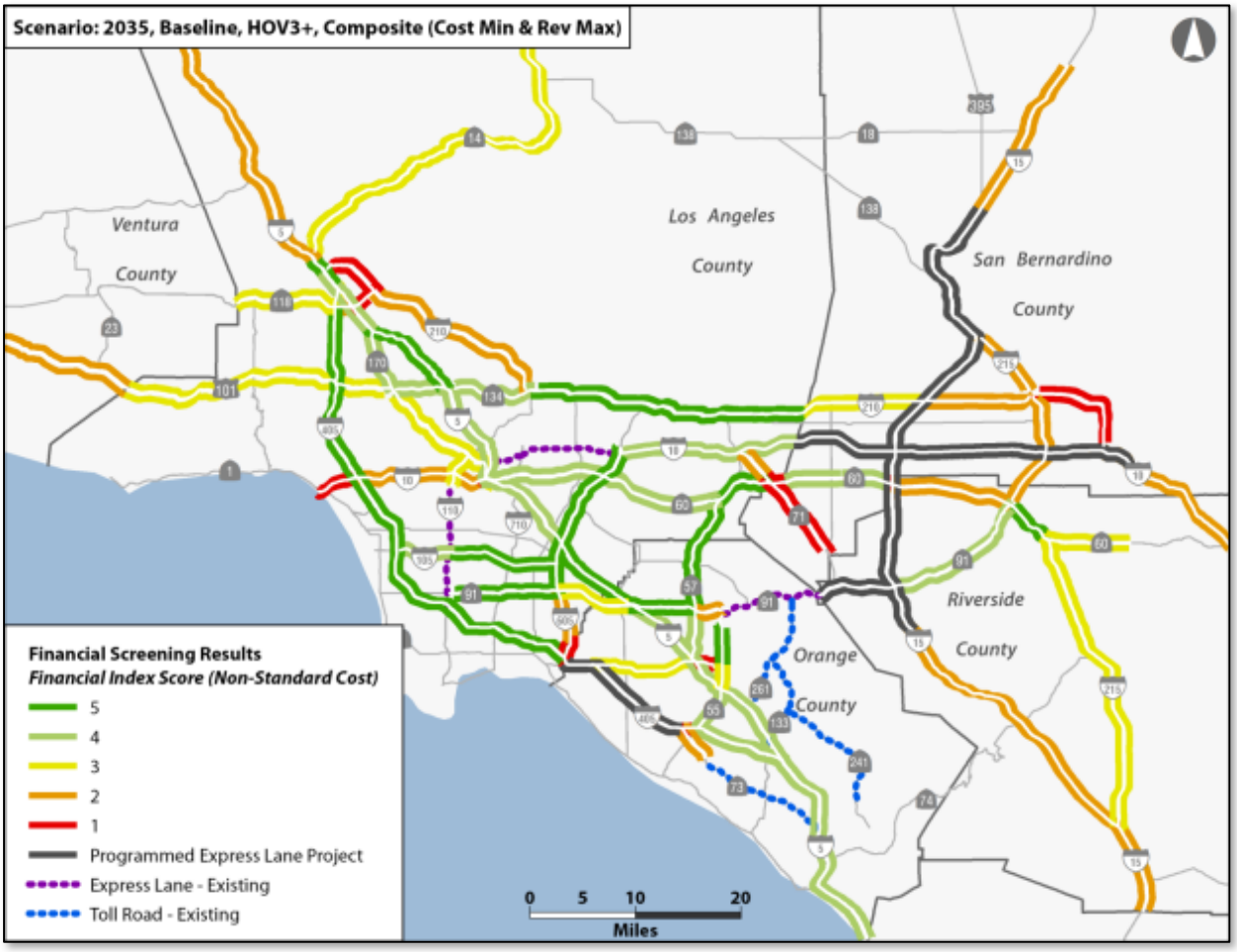
Source: WSP | Parsons Brinckerhoff

Figure 3-3 demonstrates that the corridors demonstrating the strongest mobility performance tend to be located in the central and southeastern portion of Los Angeles County, as well as Orange County.

3.3.2 Financial Feasibility Screening Results

The results of the composite financial feasibility screening analysis for the Cost Minimization and Revenue Maximization pricing objectives are shown in Figure 3-4. Many of the express lane segments in Los Angeles County demonstrated the potential for stronger financial performance compared with segments in other counties in the SCAG region.

Figure 3-4: Composite Financial Feasibility Scores
(Cost Minimization and Revenue Maximization Scenarios)



Source: WSP | Parsons Brinckerhoff

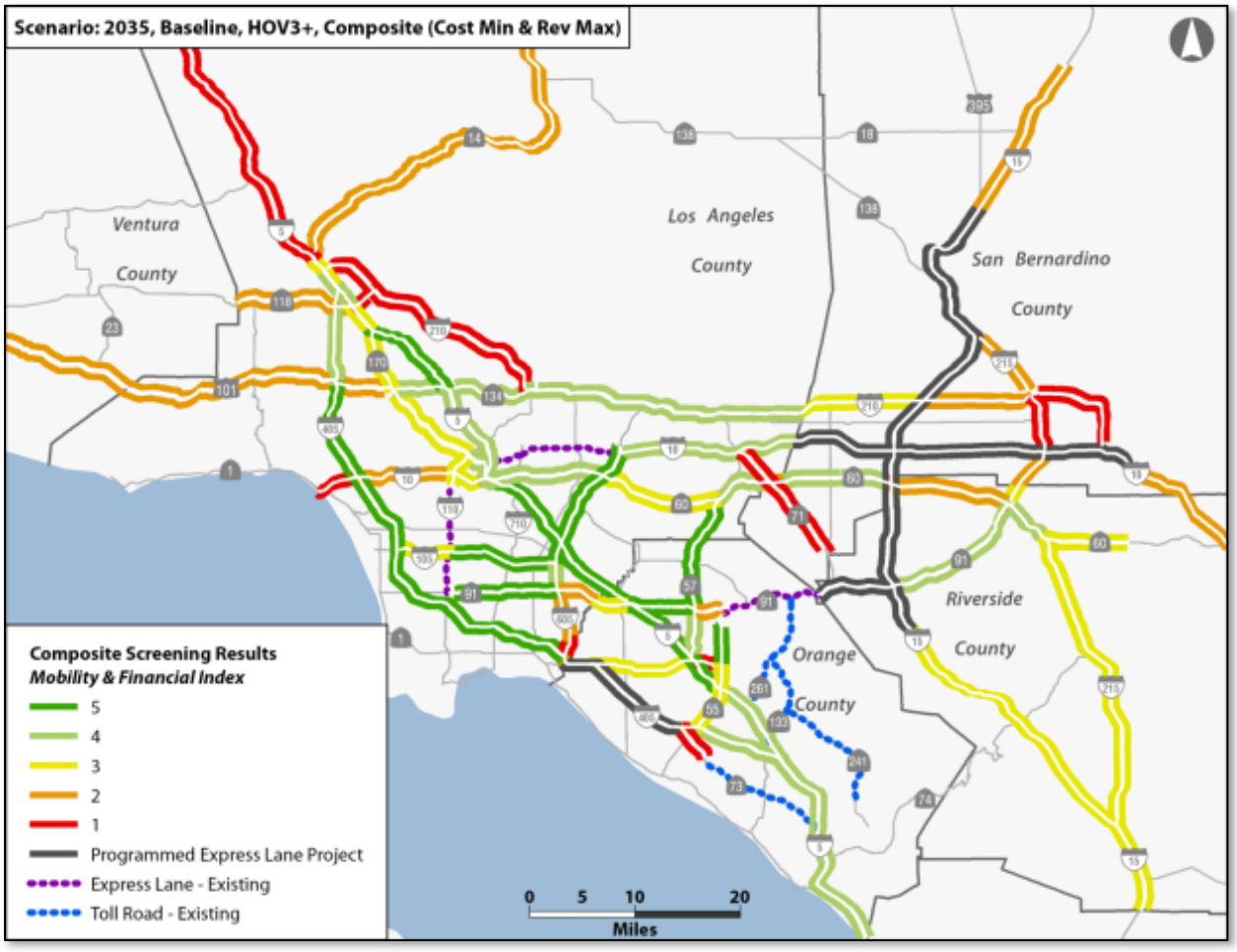
3.3.3 Composite Mobility and Financial Screening Results

The screening analysis concluded by averaging the results of the composite mobility and financial feasibility screening results into a single overall performance score. As with the other components of the screening process, the performance of the SCAG Composite Network analysis segments were broken into quintiles, with the highest performing segments gaining a score of "5," the subsequent quintile a score of "4," and so on.

The results of the composite mobility and financial screening exercise are presented in Figure 3-5. Consistent with the individual mobility and financial feasibility screening scores, highway corridors in the southern and western portions of Los Angeles County and northern Orange County tended to outperform those in northern Los Angeles County, as well as segment on the periphery of the Composite Network in Ventura, San Bernardino, and Riverside counties.

Together these segments would be expected to form the core of a future express lane network in the SCAG region. Once operational, they would generate toll revenues that would cover a significant portion of their own implementation costs and also provide additional revenue that could be used to implement additional express lanes implementation throughout the region if such an approach were to be used.

Figure 3-5: Composite Mobility and Financial Screening Results



Source: WSP | Parsons Brinckerhoff

3.4 Regional Express Lane Network Phasing Recommendations

Once the screening process was completed, the next step was to recommend the phasing of the different express lane conversion projects. This was a two-step process where preliminary recommendations were made based solely on the output of the screening calculations and final modified recommendations reflected input from SCAG partner agencies.

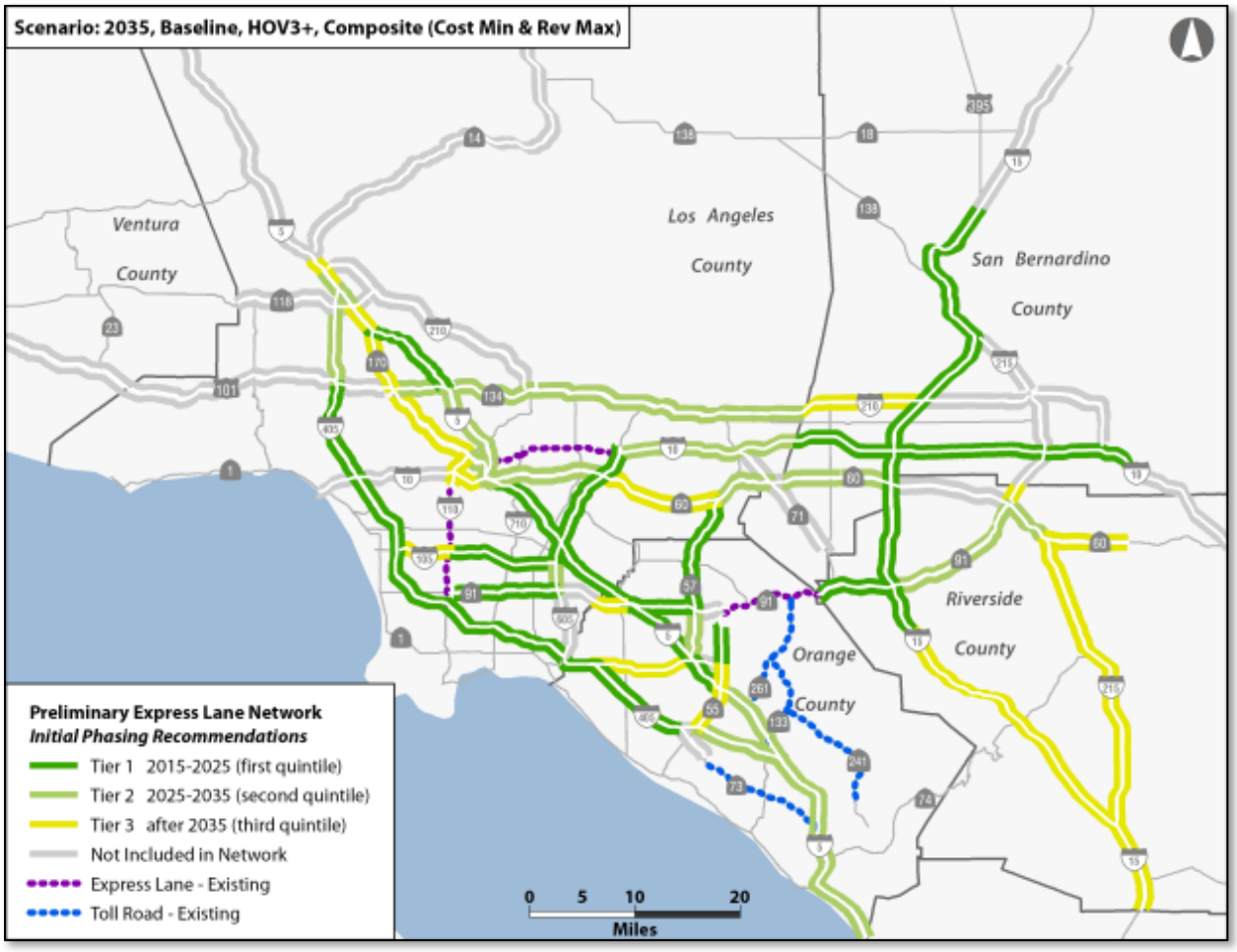
3.4.1 Preliminary Preferred Express Lane Network and Phasing Recommendations

In order to begin the process of identifying a preferred express lane network, the two lowest performing quintiles of individual segments were eliminated from consideration, and the top three performing quintiles were retained. Recognizing that the implementation of the express lane network will require substantial investment and time to gain environmental approvals and complete highway widening in some corridors, it was assumed that the network will be implemented in three phases over a 30-year period. Therefore, as a starting point for considering the phasing of a potential regional express lane network, it was assumed that the individual segments would be implemented in three nominally ten-year tiers as follows:

- Tier 1 — near-term (within 5-10 years) — first quintile segments
- Tier 2 — mid-term (within 15 years) — second quintile segments
- Tier 3 — longer-term (within 25 years) — third quintile segments

The segments that achieved a score of 5, 4, or 3, as well as express lane projects already programmed for implementation, represent a preliminary preferred express lane network and initial phasing. These segments are shown in Figure 3-6. Programmed express lane projects are included as part of the Tier 1 implementation.

Figure 3-6: Preliminary Preferred Express Lane Network—Initial Phasing



Source: WSP | Parsons Brinckerhoff

3.4.2 Modified Phasing Recommendations

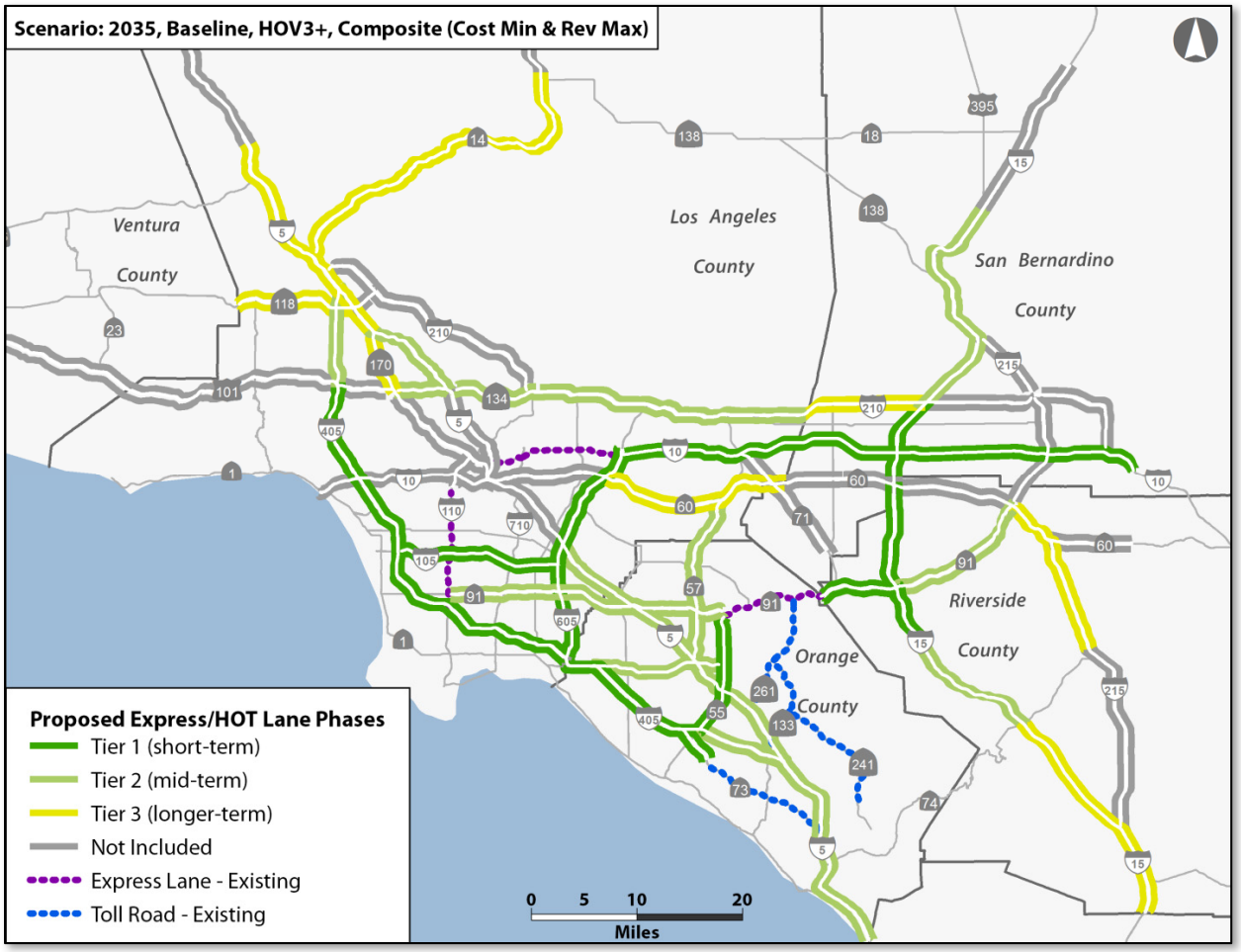
The preliminary preferred express lane network and initial phasing described in section 3.4.1 represents the culmination of the corridor screening exercise. However, the identification of the preferred express lane network involved a number of steps and included issues beyond the mobility and financial performance of the individual segments included in the network. These other more qualitative factors considered as part of the evaluation process included:

- Connectivity with other express lane corridors to ensure a contiguous network
- Transit Benefits
- Geographic equity throughout the SCAG region
- Inclusion in the RTP/SCS
- Implementation Capacity

In addition, the preliminary preferred express lane network was shared with SCAG partner agencies for comment as part of the study outreach process. These partner agencies included Caltrans and the CTCs. As part of these coordination efforts, partner agencies brought to light their own plans for express lane implementation within their respective jurisdictions, potential implementation difficulties, as well as other highway improvement work plans, and programmed projects that may affect the phasing of express lane projects as the basis for reconciling the preliminary recommendations and confirming the preferred express lane network phasing.

As a result of these considerations and discussions with partner agencies, the preliminary preferred express lane network was modified to shift the implementation phase of some segments, add segments previously not included, or remove them from consideration entirely. This modified network represents the preferred express lane network and proposed phasing, and is shown in Figure 3-7.

Figure 3-7: Preferred Express Lane Network—Proposed Phasing



Source: WSP | Parsons Brinckerhoff

The network represented in Figure 3-7 is similar to the preliminary preferred express lane network with some notable differences. The modifications include the removal of analysis segments requiring new construction to providing a connection to downtown Los Angeles, prioritization of several segments in northern Orange County, and inclusion of corridors in northern Los Angeles County previously removed from consideration. The segments included in the preferred express lane network are listed below by proposed implementation phase.

Near-Term (First Phase)—Tier 1 Segments (within 5-10 years):

- I-10 from I-605 to Los Angeles County (LAC) / San Bernardino County (SBC) Line
- I-10 from LAC / SBC Line to Ford Street
- I-15 from Cajalco Road to SR-60 (under construction; scheduled for completion in 2020)
- I-15 from Cantu Galleano Ranch Road to I-210
- I-105 from I-405 to I-110
- I-105 from I-110 to I-605
- I-405 from SR-55 to SR-73
- I-405 from SR-73 to I-605 (under construction; scheduled for completion in 2023)
- I-405 from I-605 to LAC / Orange County (OC) Line
- I-405 from LAC / OC Line to I-110
- I-405 from I-110 to I-105
- I-405 from I-105 to I-10
- I-405 from I-10 to US-101
- I-605 from I-405 to LAC / OC Line
- I-605 from LAC / OC Line to SR-91
- I-605 from SR-91 to I-105
- I-605 from I-105 to I-5
- I-605 from I-5 to SR-60
- I-605 from SR-60 to I-10
- SR-55 from I-405 to I-5
- SR-55 from I-5 to SR-22
- SR-55 from SR-22 to SR-91
- SR-73 from University Drive to I-405
- SR-91 Riverside County (RC) / OC Line to I-15 (construction completed March 2017)

Mid-Term (Second Phase)—Tier 2 Segments (within 15 years):

- I-5 from OC / San Diego County (SDC) Line to I-405
- I-5 from I-405 to SR-55
- I-5 from SR-55 to SR-57 to
- I-5 from SR-57 to SR-91
- I-5 from the SR-91 to LAC / OC Line
- I-5 from LAC / OC Line to I-605
- I-5 from SR-134 to SR-170

- I-15 from SR-74 to Cajalco Road
- I-15 from I-210 to US-395
- I-210 from SR-134 to the LAC / SBC Line
- I-405 from I-5 to SR-55
- I-405 from US-101 to I-5
- SR-22 from SR-57 to SR-55
- SR-22 from I-405 to SR-57
- SR-57 from I-5 to SR-91
- SR-57 from SR-91 to LAC / OC Line
- SR-57 from LAC / OC Line to SR-60
- SR-91 from I-110 to I-605
- SR-91 from I-605 to LAC / OC Line
- SR-91 from LAC / OC Line to I-5
- SR-91 from I-5 to SR-57
- SR-91 from SR-57 to SR-55
- SR-91 from I-15 to SR-60
- SR-134 from SR-170 to I-5
- SR-134 from I-5 to I-210

Longer Term (Third Phase)—Tier 3 Segments (within 25 years):

- I-5 from SR-170 to SR-118
- I-5 from SR 118 to SR-14
- I-5 from SR-14 to Parker Road
- I-15 from the OC / SDC Line to SR-74
- I-210 from the LAC / SBC Line to I-15
- I-215 from SR-74 to SR-91
- SR-14 from I-5 to SR-138
- SR-60 from I-605 to SR-57
- SR-60 from SR-57 to SR-71
- SR-60 from SR-71 to LAC / SBC Line
- SR-118 from the LAC / Ventura County (VC) Line to I-405
- SR-118 from I-405 to I-5
- SR-170 from SR-134 to I-5

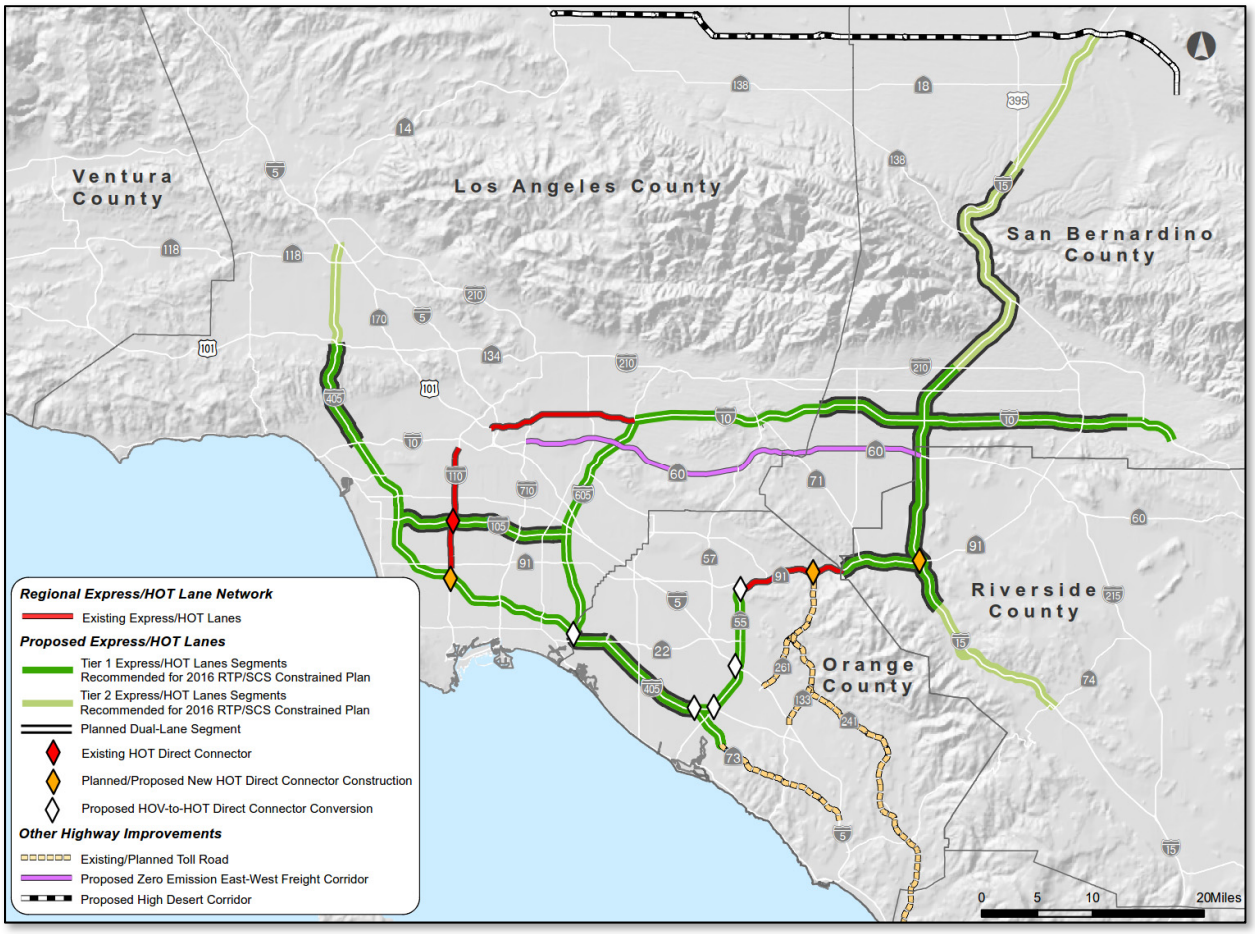
3.5 Regional Express Lane Network Implementation Phasing Plan

Based on the modified phasing recommendations and subsequent discussions with SCAG, the RPMT, the LFPWG, and Caltrans, it was determined that the regional express lane network be categorized, according to those projects that would be recommended in the fiscally constrained portion of the 2016 RTP/SCS; and those projects recommended for the unconstrained portion of the 2016 RTP/SCS.

3.5.1 Recommended Network for 2016 RTP/SCS Constrained Plan

Figure 3-8 shows the recommended regional express lane network for inclusion as part of the fiscally constrained portion of the 2016 RTP/SCS. Table 3-1 provides a listing of the projects by county and by tier. The projects include all of the Tier 1 projects noted above and a few select Tier 2 projects. These projects represent all the near-term and a few mid-term projects. Most are considered priority corridors in terms of inter-county travel. The constrained plan recommendations are also comprised of projects that are either programmed or have had an initial feasibility completed or underway. The constrained plan recommendation was subsequently endorsed by the SCAG Transportation Committee at the meeting held on October 8, 2015.

Figure 3-8: Recommended Network of Express Lanes for 2016 RTP/SCS Constrained Plan



Source: WSP | Parsons Brinckerhoff

Table 3-1: List of Recommended Express Lane Projects for 2016 RTP/SCS Constrained Plan

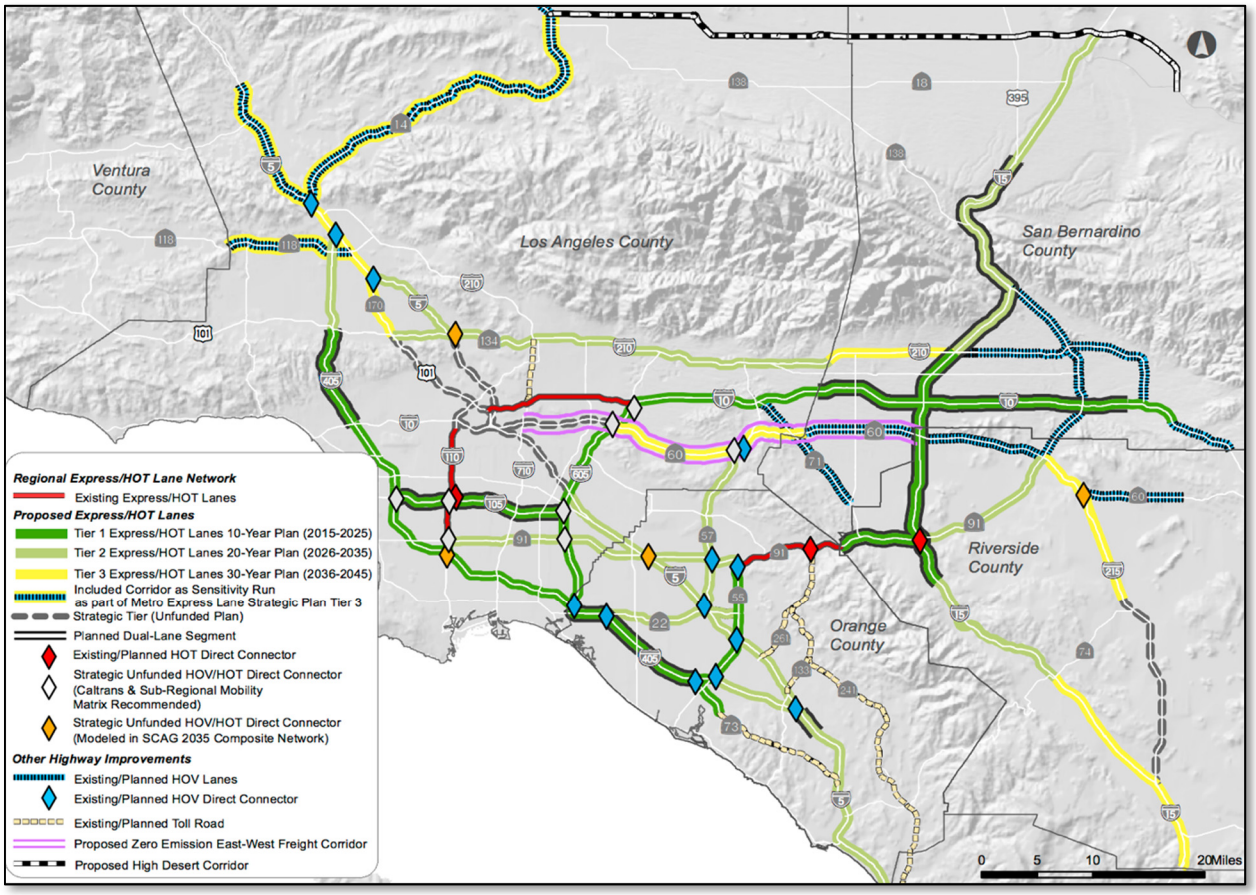
County	Tier	Route	From	To	Description
Los Angeles	1	I-10	I-605	LAC / SBC Line	Convert existing HOV lane to single express lane in each direction
Los Angeles	1	I-105**	I-405	I-110	Convert existing HOV lane and add one new express lane in each direction; potentially dual express lanes in each direction
Los Angeles	1	I-105**	I-110	I-605	Convert existing HOV lane and add one new express lane in each direction
Los Angeles	3	I-110*	SR-91	I-405	Construct single express lane in each direction and build new HOV / HOT direct connector SB I-110 to SB I-405 and vice versa
Los Angeles	1	I-405	LAC / OC Line	I-10	Convert existing HOV lane to single express lane in each direction
Los Angeles	1	I-405**	I-10	US-101	Convert existing HOV lane and add one new express lane in each direction
Los Angeles	2	I-405	US-101	I-5	Convert existing HOV lane to single express lane in each direction
Los Angeles	1	I-605	LAC / OC Line	I-10	Convert existing HOV lane to single express lane in each direction
Orange	1	SR-55	I-405	SR-91	Convert existing HOV lane to single express lane in each direction
Orange	1	SR-73	University Drive	I-405	Convert future HOV lanes to single express lane in each direction
Orange	1	I-405	SR-55	SR-73	Convert existing HOV lane to single express lane in each direction
Orange	1	I-405	SR-73	I-605	Programmed as add one GP lane in each direction and convert existing HOV lane and add new express lane in each direction
Orange	1	I-405	I-605	LAC/OC Line	Convert existing HOV lane to single express lane in each direction
Orange	1	I-605	I-405	LAC/OC Line	Convert existing HOV lane to single express lane in each direction
San Bernardino	1	I-10	LAC / SBC Line	Ford Street	Programmed as convert existing HOV lane and add new express lane in each direction from LAC / SBC Line to Haven Avenue; Haven Avenue to SR-210 add two new express lanes each direction, SR-210 to Ford Street add one new express lane in each direction
San Bernardino	1 & 2	I-15	Cantu Galleanu	US-395	Programmed as dual express lanes in each direction
San Bernardino	2	I-15	HDC	US-395	Convert future HOV lanes to single express lane in each direction
Riverside	1	I-15	Cajalco Road	SR-60	Programmed as dual express lanes in each direction
Riverside	2	I-15	SR-74	Cajalco Road	Build new single express lanes in each direction
Riverside	1	SR-91	OC / RC Line	I-15	Recently completed construction of dual express lanes in each direction

Notes: *I-110 Extension and 110 / 405 direct connector added after network-level traffic and revenue modeling was completed.
**Proposed as dual-lane express lane segments after network-level traffic and revenue modeling was completed.

3.5.2 Recommended Network for 2016 RTP/SCS Unconstrained Plan

Figure 3-9 shows the recommended regional express lane network for inclusion as part of the unconstrained portion of 2016 RTP/SCS. Table 3-2 provides a listing of the projects by county and by tier. The projects include all of the balance of the Tier 2 and Tier 3 projects noted above. These projects represent mostly mid-term to longer-term projects that require further study.

Figure 3-9: Recommended Network of Express Lanes for 2016 RTP/SCS Unconstrained Plan



Source: WSP | Parsons Brinckerhoff

Table 3-2: List of Recommended Express Lane Projects for 2016 RTP/SCS Unconstrained Plan

County	Tier	Route	From	To	Description
Los Angeles	2	I-5	SR-134	SR-170	Convert future HOV lane to single express lane in each direction
Los Angeles	2	I-5	LAC / OC Line	I-605	Convert future HOV lane and add one new express lane in each direction
Los Angeles	2	SR-91	I-110	I-605	Construct single express lane in each direction and build new HOV / HOT direct connector SB I-110 to SB I-405 and vice versa
Los Angeles	2	SR-91	I-605	LAC / OC Line	Convert existing HOV lane to single express lane in each direction
Los Angeles	2	SR-134	SR-170	I-210	Convert existing HOV lane to single express lane in each direction
Los Angeles	2	I-210	SR-134	LAC / SB Line	Convert existing HOV lane to single express lane in each direction
Orange	2	I-5	SR-57	LAC / OC Line	Convert existing HOV lane to single express lane in each direction
Orange	2	I-5**	SR-55	SR-57	Convert existing HOV lane to single express lane in each direction; dual express lanes between SR-57 and SR-55
Orange	2	I-5	I-405	SR-55	Convert existing HOV lane and add one new express lane in each direction
Orange	2	I-5**	OC / SDC Line	I-405	Convert existing HOV lane to single express lane in each direction; dual express lanes between I-405 and Alicia Pkwy
Orange	2	SR-22	I-405	SR-55	Convert existing HOV lane to single express lane in each direction
Los Angeles	2	SR-57	LAC / OC Line	SR-60	Convert existing HOV lane to single express lane in each direction
Orange	2	SR-57	I-5	LAC / OC Line	Convert existing HOV lane to single express lane in each direction
Orange	2	SR-91	LAC / OC Line	SR-55	Convert existing HOV lane to single express lane in each direction
Orange	2	I-405	I-5	SR-55	Convert existing HOV lane to single express lane in each direction
Riverside	2	I-15	SR-74	Cajalco Road	Construction new single express lane in each direction
Riverside	2	SR-91	I-15	SR-60	Convert future HOV lane to single express lane in each direction
Los Angeles	3	I-5	SR-170	SR-14	Convert existing HOV lane to single express lane in each direction
Los Angeles	3	I-5	SR-14	Parker Road	Convert future HOV lane to single express lane in each direction
Los Angeles	3	SR-14	I-5	SR-138	Convert existing HOV lane to single express lane in each direction
Los Angeles	3	SR-118	LAC / VC Line	I-5	Convert existing HOV lane to single express lane in each direction
Los Angeles	3	SR-170	SR-134	I-5	Convert existing HOV lane to single express lane in each direction
San Bernardino	3	I-210	LAC / SBC Line	I-15	Convert existing HOV lane to single express lane in each direction
Riverside	3	I-15	RC / SDC Line	SR-74	Construct new single express lane in each direction
Riverside	3	I-215	SR-74	SR-91	Construct new single express lane in each direction

Notes: *I-110 Extension and 110 / 405 direct connector added for consideration post traffic and revenue modeling.
**Possible dual lane express lane configuration on partial or full segment length.

4.0 FEDERAL AND STATE TOLLING AUTHORIZATION

4.1 Federal Express Lane Authorization

Historically, federal law generally prohibited the imposition of tolls by states on federally funded facilities.[3] Under the *Safe, Accountable, Flexible and Efficient Transportation Equity Act: A Legacy for Users* (SAFETEA-LU) Congress enabled several exceptions to the general prohibition. In the *Moving Ahead for Progress in the 21st Century Act* (MAP-21) passed on June 29, 2012, Congress expanded the exceptions for construction of new tolling capacity, but did little to expand existing toll pilot programs. On December 4, 2015, President Obama signed the *Fixing America's Surface Transportation* (FAST) *Act*, a five-year authorization of surface transportation programs, which made some significant changes with respect to tolling, especially as it relates to express lanes.

4.1.1 Section 129 General Tolling Program

23 U.S.C § 129 General Tolling Program allows tolling on new highways and new lanes added to existing highways and on the reconstruction or replacement of bridges, tunnels and existing toll facilities.[4] MAP-21 expanded the authority states have to implement new toll capacity on Interstate highways under 23 U.S.C. § 129, by allowing new capacity tolling on existing non-tolled highways as-of-right without additional federal authorizations provided the number of toll-free lanes after construction is not less than the number of toll-free lanes before construction.[5] Tolling agreements are not required for the construction of new capacity as requirements previously included in the tolling agreements are codified in the statute.[6]

Section 1411(a) of FAST Act struck Section 129(a)(4) in its entirety. 23 U.S.C. § 129(a)(4)(A) previously allowed for tolling of vehicles, excluding HOVs, subject to certain requirements, such as consultation with an affected Metropolitan Planning Organization (MPO) concerning placement and amount of tolls, automatic toll collection, and established policies and procedures for managing demand and enforcing sanctions for violations. 23 U.S.C. § 129(a)(4)(B) expressly provided for the ability to implement a toll structure based on vehicle class. The effects of eliminating § 129(a)(4) altogether appear to be twofold. On the one hand, it has eliminated the administrative burden on an agency looking to implement a toll facility thereby opening up more opportunity for tolled facilities. On the other hand, eliminating § 129(a)(4)(B) potentially means that agencies no longer have the opportunity to charge different toll rates for different classes of vehicles. As codified, the statute does not expressly prohibit differential toll structures and therefore the argument exists that such strategies will continue to be permissible. Another item to note is that by eliminating § 129(a)(4)(a), which provided the toll exemption for HOVs, agencies now have the opportunity to toll HOVs.

[3] 23 U.S.C. § 301.
[4] 23 U.S.C. § 129.
[5] 23 U.S.C. § 129(a)(1)(B) and (C).
[6] Id.

4.1.2 Section 166 HOV / HOT Lanes

Under 23 U.S.C. § 166, existing HOV lanes may be converted to HOT lanes, subject to certain requirements. States must demonstrate that the existing HOV facility is not degraded, and that the presence of tolled vehicles will not result in degradation.[7] The FAST Act amended § 166 to add subparagraph (g) which requires an agency to consult with the MPO on toll placement and amount for HOT lanes on Interstate facilities within the applicable metropolitan planning area. Automatic toll collection systems must be implemented on such projects, and toll revenue from such facilities is subject to the requirements of 23 U.S.C. § 129(a)(3).[8]

Facilities tolled pursuant to § 166 are subject to ongoing annual reporting documenting conditions on the converted lanes.[9] The FAST Act amended Section 166 to allow waivers of sanctions for degraded HOV operation under certain conditions including in part that the agency is meeting the conditions under § 166(d)(1)(D) and is making a good faith effort to improve performance.[10]

Other amendments to § 166 under the FAST Act include:

- § 166(b)(3)(C) is amended to enable privately-owned buses servicing the public to utilize toll facilities under the same rates, terms and conditions as other public transportation vehicles where such are allowed to use HOV lanes.[11]
- § 166 amended throughout to replace "state agency" with "public authority" recognizing that the operator of HOV / HOT lanes is not necessarily a state department of transportation.[12]
- § 166(b)(5) amended to allow alternative fuel vehicles and plug-in vehicles to use HOV lanes subject to the public authority establishing procedures for enforcing the restrictions of such use.[13]

4.2 State Legislative Authorization

Table 4-1 provides a summary of the existing state statutes authorizing tolling for current express lane projects in the SCAG region as well as spending state legislation.

[7] 23 U.S.C. § 166(d)(1).
[8] 23 U.S.C. § 166(b)(4)(B) and 23 U.S.C. § 166(c).
[9] 23 U.S.C. § 166(d)(1).
[10] 23 U.S.C. § 166(d)(1)(F).
[11] Pub. Law 114-094 § 1411(b)
[12] Pub. Law 114-094 § 1411(b)
[13] Pub. Law 114-094 § 1411(b)

Table 4-1: Current Statutes and Pending Legislation for SCAG Region Express Lanes

Project	Existing Statutes	Recently Passed Legislation
Metro I-110 / I-10 Express Lanes	Streets & Highways Code § 149.9	N/A
OCTA SR-91 Express Lanes	Streets & Highways Code § 143 Public Utilities Code § 130240 Public Utilities Code § 130244 Public Utilities Code §130245	N/A
RCTC SR-91 Express Lanes	Public Utilities Code § 130240 Public Utilities Code § 130244 Public Utilities Code § 130245	N/A
RCTC I-15 Express Lanes	Streets & Highways Code § 149.7 Streets & Highways Code § 149.8	AB 194 (2015)
SBCTA I-10 Express Lanes	N/A	AB 194 and AB 914 (2015)
SBCTA I-15 Express Lanes	N/A	AB 194 and AB 914 (2015)
OCTA I-405 Express Lanes	N/A	AB 194 (2015)

4.2.1 Existing Statewide Authorizing Legislation

State law grants Caltrans the authority to regulate franchises, licenses, or the privilege to construct or operate toll bridges or roads in the state.[14] Legislative authorization to operate toll facilities was historically granted on a facility-by-facility basis and accomplished by direct authorization to develop and operate an express lane or authorization to engage a private partner in the development of a project.

In 2006, the Legislature passed AB 1467 to allow regional transportation agencies[15], in cooperation with Caltrans, to develop and operate HOT lane projects.[16] AB 1467 required application to CTC and limited the number of projects to four, with two projects in Southern California and two projects in Northern California.[17] In 2011, the CTC found MTC eligible to develop and operate 285 miles of express lanes, consistent with California Streets and Highways Code § 149.7. This included the conversion of approximately 150 miles of existing HOV lanes and the construction of 120 miles of new express lanes across multiple highway corridors. No applications were able to be approved under this statute on or after January 1, 2012.[18]

AB 798, signed into law on October 11, 2009, removed the requirement that the CTC forward HOT applications to the Legislature for approval, but did not substantively change the other restrictions under § 149.7 (c), which

[14] Sts. & Hy. Code, §30800-30813.

[15] See Sts. & Hy. Code § 149.7. "Regional transportation agency" is statutorily defined to mean a transportation planning agency, a county transportation commission, any other local or regional transportation entity that is designated by statute as a regional transportation agency. Sts. & Hy. Code, § 143.

[16] Sts. & Hy. Code, § 149.7(a).

[17] Sts. & Hy. Code, § 149.7(c).

[18] Sts. & Hy. Code, § 149.7(e).

limited the number of projects and established the January 1, 2012 sunset date for approval of applications effectively meaning that any new HOT projects would require specific legislative authorization.

AB 194, signed into law on October 9, 2015, amended Streets and Highways Code § 149.7 to authorize regional transportation agencies and Caltrans to build and operate HOT lanes or other toll facilities without limit, subject to review and approval by the CTC. AB 194 also removed the January 1, 2012 deadline for applications to develop and operate HOT lane projects.[19]

4.2.2 Metro I-110 / I-10 Express Lanes Authorization

Metro was granted specific legislative authority to implement express lanes on I-10 and I-110.[20] In 2014, Senate Bill (SB) 1298 removed the sunset date on Metro's authority and extended the program indefinitely.[21] The new law contains additional requirements for agreements between Metro, Caltrans and the California Highway Patrol (CHP) to identify respective roles and responsibilities and procedures for law enforcement.[22] Costs incurred by state agencies in the implementation or operation of the program and maintenance of the facilities in connection with the program shall be reimbursed from toll revenues.[23] Remaining revenue must be used in the I-10 and I-110 corridors for planning and construction costs of HOV facilities and improvement of transit services.[24] SB 1298 also authorized Metro to issue bonds to finance costs necessary to implement the program and to finance expenditures payable from the revenues generated from the program.[25]

4.2.3 RCTC I-15 Express Lanes Authorization

RCTC was granted legislative authority to develop and operate a HOT lane facility on I-15 under the provision of AB 768.[26] The I-15 Express Lanes project is one of the two HOT lane projects in Southern California authorized by Streets and Highways Code § 149.7, and upon approval by the CTC was codified in Streets and Highways Code § 149.8 by AB 1954.[27] To finance the costs of the HOT lane facilities, RCTC is authorized to issue bonds.[28] Revenue generated from the facility must first be used to cover costs for capital outlay, O&M (including toll enforcement), repair and rehabilitation, indebtedness (and related financing costs), reserves, and administrative costs, which are limited to three percent of toll revenues.[29]

[19] AB 194 (2015).
[20] See Sts. & Hy. Code, § 149.9.
[21] SB 1298 (2014) http://www.dot.ca.gov/hq/innovfinance/public-private-partnerships/ab_1467_bill_20060519_chaptered.pdf
[22] Sts. & Hy. Code § 149.9(b)(1).
[23] *Id*.
[24] Sts. & Hy. Code, § 149.9(b)(2).
[25] Sts. & Hy. Code, § 149.9(h).
[26] Sts. & Hy. Code, § 149.8.
[27] AB 1954 (2008). In 2009, AB 798 deleted the requirement for the CTC to forward the Section 149.7 applications for the four authorized facilities to the Legislature for approval or rejection.
[28] Sts. & Hy. Code, § 149.8(c)(3).
[29] Sts. & Hy. Code, 149.8(c)(1).

Excess toll revenues may be used for transit service or other operational or capacity improvements designed to reduce congestion on I-15.[30]

4.2.4 OCTA / RCTC 91 Express Lanes Authorization

In 1989, AB 680 added § 143 to the Streets and Highways Code[31] to allow for four privately funded demonstration transportation projects. The 91 Express Lanes on SR-91 in Orange County, which opened in 1995, was authorized under AB 680.[32] OCTA was expressly granted authority to collect tolls on SR-91 between I-15 in Riverside County and SR-55 in Orange County.[33] Prior to imposing tolls on SR-91 in Riverside County, OCTA was required to obtain approval from the Riverside County Board of Supervisors, RCTC, and the SR-91 advisory committee.[34] In 2008, SB 1316 authorized OCTA to relinquish its rights relative to SR-91 in Riverside County to RCTC, legally separating the segments of the SR-91 franchise and effectively allowing RCTC to proceed with planning and design for the extension of the 91 Express Lanes into Riverside County.[35] RCTC was granted broad authority to impose tolls, user fees, or other charges for use of the 91 Express Lanes in Riverside County for 50 years following the opening of the facility for public use.[36] In accordance with SB 1316, RCTC has entered into an agreement with OCTA providing for coordination of the respective toll facilities to be operated by each entity.[37]

4.2.5 SBCTA I-10 / I-15 Express Lanes Authorization

AB 914 authorizes SBCTA, by virtue of their role as the county transportation commission for San Bernardino County, to conduct, administer, and operate a value-pricing program on I-10 and I-15 in San Bernardino County.[38] SBCTA is required to enter into cooperative agreements with Metro and/or RCTC to the extent the facilities extend into such respective counties and connect to, or are near similar toll facilities.[39] The proposed provisions are similar to other tolled facilities in California.[40] SBCTA is allowed to issue bonds to finance project related costs, and is required to use toll revenues for the benefit of the respective corridors and enter into agreements with Caltrans and CHP to provide for reimbursements from toll revenues for costs incurred in connection with implementation or operation of the program.[41] AB 914 limits administrative costs to up to three percent of toll revenues,[42] and expressly provides that it does not authorize the conversion of any existing non-

[30] Sts. & Hy. Code, 149.8(c)(2). These improvements could be anywhere along the SR 15 corridor, as the statute does not limit these projects to the HOT facility.
[31] Section 143 of the Streets and Highways Code has since been amended to allow for public-private partnerships.
[32] A second project authorized in the region was for SR 57 in Orange County, which was ultimately never constructed.
[33] Pub. Util. Code, § 130240 et seq. (2007)
[34] *Id*.
[35] Pub. Util. Code § 130240(k).
[36] Pub. Util. Code § 130244(c)(6)
[37] Public Utilities Code § 130240(l).
[38] AB 914 (2015),http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160AB914.
[39] *Id*.
[40] See Sts. & Hy. Code §§ 149.1, 149.4, 149.5 and 149.6.
[41] AB 914 (2015),http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160AB914.
[42] *Id*.

toll or non-user fee lanes to be converted into HOT lanes[43] although it does allow the conversion of HOV lanes to HOT lanes.[44] On October 9, 2015, Governor Brown signed AB 914 into law with the provisions of the bill taking effect on or before January 1, 2016.

4.2.6 Assembly Bill 194

As discussed in Section 4.2.1, prior to 2016, state law limited the number of HOT facilities that can be approved under Streets and Highways Code § 149.7 to four projects and prohibited the CTC from approving applications after January 1, 2012.[45] Introduced during the 2015-2016 regular session, AB 194 amended § 149.7, to authorize regional transportation agencies and Caltrans to build and operate HOT lanes or other toll facilities without limit, subject to review and approval by the CTC, and removed the January 1, 2012 deadline for applications.[46]

This bill makes the authorization of a toll lane or toll road an administrative determination by the CTC, rather than the legislative decision. Piecemeal legislation would no longer be required. The CTC is required to develop guidelines for development and operation of toll facilities to be applied across the board for projects authorized under § 149.7.[47] Removing the limitations on the number of facilities and deleting the application deadline enables more regional transportation agencies the opportunity to implement tolled facilities. Furthermore, giving CTC administrative power to authorize toll facilities streamlines the process and potentially expedites the approval process. On October 9, 2015, Governor Brown signed AB 194 into law with the provisions of the bill taking effect on or before January 1, 2016.

4.3 Other State Legislative and Regulatory Considerations

There are other legislative and regulatory considerations that will apply in some manner to the development and operation of a regional express lane network in Southern California. They are described below in further detail.

4.3.1 User Fees

The distinction between fees (including tolls) and taxes is important because typically the imposition of a new tax or a tax increase requires legislative and/or voter approval, while an agency can set a fee administratively, with the appropriate statutory authority. To be considered a fee rather than a tax, a nexus relationship needs to exist between the collection of revenue and the use of that revenue. For example, the collection of tolls should be related to paying for the capital expenses and/or O&M of the tolled facility or the broader system of tolled facilities and related transportation infrastructure.

[43] *Id*.
[44] *Id*.
[45] Sts. & Hy. Code § 149.7.
[46] AB 194 (2015).
[47] *Id*.

Existing enabling legislation for projects in California specifically addresses the use of revenues generated from the facilities. By statute, toll revenues generated by the I-10 and I-110 ExpressLanes must be used to reimburse state agencies such as Caltrans and CHP, for costs incurred in connection with implementation or operation of the program, as well as maintenance of state highway system facilities in connection with the program.[48] Remaining revenue must be used in the corridor from which the revenue was generated for preconstruction, construction, and other related costs of HOV facilities, transportation improvements, and improvement of transit service.[49] Similarly, toll revenues from the 91 Express Lanes are to be used for capital and operating expenses of the toll lanes, including debt service, with excess revenues available for transportation purposes related to SR-91.[50] For projects receiving funding issued as part of the California Transportation Financing Authority Act, toll revenues must be used to pay debt service, operations, and maintenance over the life of the bonds and incorporate life-cycle costs for the project, including rehabilitation.[51] Lease agreements entered into pursuant to California's public-private partnership authority must require toll revenues to be applied to payment of capital outlay costs, costs associated with operation and administration of the facility, reimbursement of state agencies for costs of service to develop and maintain the facility, and a reasonable return on investment for the private partner.[52]

In 2011, MTC received approval from the CTC to develop and implement 285 miles of express lanes on I-80, I-680, I-880, SR-92 and SR-84 (referred to as the Express Lane Facility) pursuant to § 149.7 of the Streets and Highways Code.[53] The Bay Area express lanes network includes not only the express lane facility, but also express lanes programs on I-680 and I-580 authorized by Streets and Highways Code § 149.5.[54] Consistent with applicable statutes, revenues generated from the Bay Area express lanes network would be used for direct expenses related to operation, maintenance, construction and administration with administrative costs not to exceed three percent of total revenues.[55] MTC will invest remaining revenues within the Bay Area express lanes network for transportation improvements and services, including, but not limited to, costs related to HOV and transit projects pursuant to an adopted expenditure plan.[56]

Generally speaking, the use of toll revenues is consistent across most projects throughout California. If SCAG and the regional partners want to develop a regional network of express lanes, flexibility to use revenues for improvements within the entire network, regardless of corridor, would be critical. Provided the use of revenues

[48] Sts. & Hy. Code § 149.9(b)(1).

[49] Sts. & Hy. Code § 149.9(b)(2).

[50] Pub. Util. Code §§ 130240(e) and 130244(c).

[51] Gov. Code § 64112(d) and 64112(e).

[52] Sts. & Hy. Code § 143(j)(1).

[53] Projects authorized under Section 149.7 must be consistent with Sections 149, 149.1, 149.3, 149.4, 149.5, and 149.6, which generally require that revenue generated from facilities be available for direct expenses related to the operation, maintenance, construction, and administration of the program with program-related planning and administrative expenses not to exceed three percent of revenues. Requirements related to remaining revenues generally require the administering agency to adopt an expenditure plan outlining the use of such revenues.

[54] MTC Hot Lanes Application, http://www.catc.ca.gov/programs/HOTLanes/MTC_HOT_Lanes_app.pdf.

[55] *Id*.

[56] *Id*.

is consistent with approved programs, use of toll revenues derived from operating a regional network of facilities for completing improvements within that regional network would likely be allowable.

4.3.2 Rate Setting

Caltrans is authorized to set or modify toll rates on toll bridges or toll roads.[57] The various pieces of California legislation authorizing specific facilities typically provide the regional transportation agency the authority to set rates on the respective facility.[58] The enabling legislation for the I-10 and I-110 ExpressLanes gives Metro broad authority to set toll rates, but requires a public hearing to be held prior to setting or increasing the toll.[59] RCTC has legislative authority to set toll rates on SR-91[60] and I-15,[61] subject to a minimum 30 day public review and comment period prior to adoption of the initial schedule and any subsequent changes.[62]

The California Transportation Finance Authority Act limits toll rates to the expected cost of paying debt service on bonds, funding reserves, operation, maintenance, repair and rehabilitation, and providing transportation improvements in the corridor, unless the toll rates are used as a congestion management mechanism.[63] Toll rates on facilities developed as part of a public-private partnership shall be established in the lease agreement and any proposed increase in those rates shall be approved by the appropriate public entity, subject to at least one public hearing conducted at a location near the proposed or existing facility.[64]

For the most part, regional transportation agencies have broad authority to set toll schedules. This allows them to set toll rates in accordance with the goals and policies of the respective project. It is anticipated that any new legislation authorizing tolls would have similar language with respect to retaining flexibility for rate setting. Pursuant to AB 194, the sponsoring agency of a tolled facility shall be responsible for establishing, collecting, and administering tolls, and may include discounts and premiums for the use of the toll facility.

4.3.3 High-Occupancy Vehicle Lanes

Caltrans is responsible for maintaining operations for HOV lanes, which includes the authority to make operational changes (including occupancy) provided they are compliant with federal and state regulations.[65] Caltrans is expressly authorized to construct new HOV lanes on existing highways subject to conducting

[57] Sts. & Hy. Code §30802-30803
[58] *See* Sts. & Hy. Code §§ 149.1, 149.8. and 149.9.
[59] Sts. & Hy. Code § 149.9(7).
[60] Pub. Util. Code § 130244(c)(1).
[61] Sts. & Hy. Code § 149.8(c)(1).
[62] See Sts. & Hy. Code § 149.8(d) and Pub. Util. Code § 130244(c)(7).
[63] Gov. Code, § 64112(g).
[64] Sts. & Hy. Code § 143(j)(2).
[65] Veh. Code § 21655.5 gives Caltrans the ability to designate HOV lanes on state highways.

competent engineering estimates of the effect of HOV lanes on safety, congestion and highway capacity.[66] Signs notifying motorists of vehicle occupancy levels and hours of HOV usage are required to be posted.[67] Emergency vehicles (responding to a qualifying event), motorcycles, mass transit, and paratransit vehicles are exempt from access requirements.[68] Vehicles designed for a maximum of two people are generally prohibited from accessing HOV lanes that require three or more persons per vehicle.[69] To the extent proposed express lane facilities in the SCAG region incorporate specific provisions to accommodate and incentivize HOV use, the construction and operation of HOV facilities will need to be developed pursuant to federal and state regulations relating to HOV lanes.

4.3.4 Clean Air Vehicles

The California Vehicle Code allows qualifying ILEV and Advanced Technology Partial-Zero Emission Vehicles (AT PZEV) with the appropriate decals issued by the Department of Motor Vehicles (DMV) to use HOV lanes regardless of occupancy. [70] Decals remain valid until January 1, 2019 or until federal authorization expires.[71] There is no limit on the number of decals issued to ILEVs.[72] In 2015, AB 95 increased the number of decals available for AT PZEVs from 40,000 to 85,000.[73] The California Air Resources Board (CARB) maintains the list of eligible vehicles for these programs.[74] In the absence of any legislative changes or specific provisions of project specific authorizing legislation, express lanes developed within the SCAG region will be required to treat ILEV and AT PZEV with "Access OK" decals as eligible HOV's, regardless of occupancy, until January 1, 2019.

4.3.5 Toll Evasion Violation

California Vehicle Code § 40254 allows for detection of toll evasion by "automated devices, visual observation, or otherwise." Metro uses a combination of visual monitoring by CHP vehicles, photo enforcement, and an ETC system to discover toll violations. Photo enforcement is also used on the San Joaquin Hills, Foothill and Eastern Toll Roads in Orange County, as well as the 91 Express Lanes.

Toll violations are civil infractions.[75] Existing law allows fines for noncompliance (and unpaid user fees) to be collected through an administrative process.[76] Toll evasion penalties collected accordance with § 40254, including all administrative and process service fees, as well as costs related to debt collection, are deposited

[66] Sts. & Hy. Code § 149.
[67] Veh. Code § 21655.5
[68] *Id*.
[69] http://www.dot.ca.gov/hq/traffops/systemops/hov/hov_sys/
[70] Veh. Code §§ 5205.5 and 21655.9.
[71] Veh. Code § 5205.5(j). The Director of Transportation may also make a determination that federal law does not authorize the state to allow vehicles described in the statute to use HOV lanes regardless of vehicle occupancy. Veh. Code § 5205.5(i).
[72] http://www.arb.ca.gov/msprog/carpool/carpool.htm
[73] Veh. Code § 5205.5(f).
[74] Veh. Code § 5205.5(d).
[75] Veh. Code § 40250(a).
[76] Veh. Code § 40255.

into the account of the entity (public or private) authorized to collect tolls.[77] The statute does not make a distinction between whether the penalty is collected administratively or as a result of a judicial process. As such the entity authorized to collect the toll would receive the collected penalty regardless.

Citations issued by CHP officers for non-compliance with express lanes operating rules a typically issued under Vehicle Code § 21655.5. Penalties for citations issued under § 21655.5[78] are distributed to state, county and judicial jurisdictions in accordance with state statutes[79] and the Uniform Bail and Penalty Schedule as published by the Judicial Council of California.[80]

4.3.6 Data Privacy

The use of ETC systems may raise public concern related to a citizen's privacy interests. The public is often uneasy with providing personal information that may allow a government agency to track them or may subject them to unwanted solicitations.

In 2010, privacy protections were codified into statute and extended to all transportation agencies that have, or may acquire electronic data-collection technologies.[81] For purposes of this statute, "transportation agency" means Caltrans, the Bay Area Toll Authority (BATA), any entity operating a toll bridge, toll lane, or toll highway, or any entity under contract with any of these entities.[82] The law prohibits selling or providing personally identifiable information obtained through ETC systems,[83] which includes transponders, license plate recognition (LPR) systems, or other electronic mediums.[84] This prohibition does not:

- Include law enforcement efforts pursuant to a search warrant or with good cause when conducting criminal or traffic collision investigation; [85]
- Prohibit a transportation agency from performing financial and accounting functions required to operate and manage toll facilities;[86]
- Prohibit a transportation agency from communicating exclusively about its transportation related projects and services to subscribers;[87] or

[77] Veh. Code § 40251. That portion of the penalty collected attributable to issuance of the violation by CHP is given to the city or county where the violation occurred. *Id*.
[78] Veh. Code § 42001.11
[79] Veh. Code Division 18 Chapter 2, § 42200 et seq.
[80] Cal. Rules of Court, rule 4.102
[81] Sts. & Hy. Code § 31490 et seq.
[82] Sts. & Hy. Code § 31490(l).
[83] Sts. & Hy. Code § 31490(a).
[84] Sts. & Hy. Code § 31490(m).
[85] Sts. & Hy. Code § 31490(e).
[86] Sts. & Hy. Code § 31490(i).
[87] Sts. & Hy. Code § 31490(j).

- Prohibit a transportation agency from sharing data with another transportation agency solely to comply with interoperability specifications and standards regarding electronic toll collection devices and technologies.[88]

It should be noted that this statute does not require the sharing of information for any of these purposes, it simply does not prohibit it.

Other major provisions of the statute include the following:

- Establishment of a data retention time period;[89]
- Requiring a transportation agency to develop a privacy policy and to post that policy on its website;[90] and
- Allows for civil remedies for drivers whose personal information is released to recover damages, reasonable costs and attorney's fees.[91]

The depth and breadth of this law is an indication that the state takes the privacy issue seriously. Because any public agency or private party employed to operate an electronic toll collection system on any future express lanes would be considered a "transportation agency" under the statute, they would be subject to these requirements and restrictions related to the use of personal information collected through such system.

4.3.7 Interoperability

MAP-21 requires that all highway toll facilities constructed with federal funds implement technologies or business practices that provide for nationwide operability.[92] AB 493 amended Streets and Highways Code § 27565 to allow toll facility operators in the state to implement technologies or business to comply with federal requirements.[93]

Prior to AB 493, existing law prohibited transportation agencies from selling or otherwise providing personally identifiable information about their subscribers, with some minor exceptions such as for law enforcement purposes or to comply with the state's interoperability efforts.[94] It did not allow California toll operators to share information with out-of-state agencies. AB 493 makes narrow exceptions to existing privacy protections, by allowing operators of toll facilities on federal-aid highways to share information, but expressly limits the information to license plate number, transponder identification (ID) number, date and time of transaction, and identity of the agency operating the toll facility, with other toll facility operators.[95] As part of an interoperability

[88] Sts. & Hy. Code § 31490(h).
[89] Sts. & Hy. Code §§ 31490(c)-(d).
[90] Sts. & Hy. Code § 31490(b).
[91] Sts. & Hy. Code § 31490(p).
[92] 23 U.S.C. § 1512.
[93] Sts. & Hy. Code § 27565.
[94] SB 168 (2010).
[95] Sts. & Hy. Code § 27565(e).

program, existing law would allow SCAG region transportation agencies to share limited information with other states that may be useful for enforcing out of state toll violations.

Streets and Highways Code § 27565 establishes the requirement for Caltrans to develop and adopt functional specifications and standards for an automatic vehicle identification (AVI) system to be used on toll facilities throughout the California.[96] The Compatibility Specifications for Automatic Vehicle Identification Equipment developed in response to the requirements of § 27565 are codified in § 1700 of Title 21 of the California Code of Regulations[97], and outline the detailed specifications for all ETC systems installed in the state to ensure interoperability (commonly referred to as the Title 21 protocol). Although California has had interoperability with ETC throughout the state since the adoption of the Title 21 protocol in 1992, California is the only state that currently utilizes the specification as currently defined. Streets and Highways Code § 27565 was amended subsequent to the enactment of MAP-21 to facilitate implementation of technologies and business practices by California operators of toll facilities on the federal-aid highway system to comply with the national interoperability requirement.[98] In response to the provisions of MAP-21 and § 27565, the California Toll Operators Committee (CTOC) is currently working on revising the Title 21 protocol to contribute to achieving national ETC interoperability.

FasTrak® is the branding used for Title 21 compliant ETC systems throughout California. The FasTrak brand name and logo, which are registered trademarks of TCA, is typically displayed on in-vehicle devices, signage and marketing materials related to the Title 21 compliant ETC system. Additional details related to Title 21 compliant ETC equipment and the FasTrak branding are provided in Chapter 8.

4.3.8 Imposition of Fines

The use of penalties and fines to enforce the use of express lanes or HOV lanes is accepted practice. The California Constitution prohibits the imposition of excessive fines.[99] Where fines are legislatively established, they are subject to review under a principle of proportionality standard—whether the amount of the fine bears some relationship to the gravity of the offense it is designed to punish.[100] Where fines are set administratively as a quasi-legislative function, the agency is presumed to have promulgated a reasonable rule and the challenger has the burden of demonstrating that the fine was set arbitrarily and capriciously.[101]

[96] Sts. & Hy. Code § 27565(a)

[97] CCR. § 1700

[98] Sts. & Hy. Code § 27565(e).

[99] Cal. Const. art. 1, § 17.

[100] *U.S. v. Bajakajian*, 524 U.S. 321, 327-328, 334, 336 (1998) (citing *Austin v. U.S.*, 509 U.S. 602, 609-610 (1993).

[101] *Yamaha Corp. of America v. State Bd. of Equalization*, 78 Cal.Rptr.2d 1, 6 (1998) (citing *Wallace Berrie & Co. v. State Bd. of Equalization*, 40 Cal.3d 60, 65 (1985) (in reviewing the legality of a regulation adopted pursuant to a delegation of legislative power, the judicial inquiry is confined to the question whether the it is arbitrary, capricious or without reasonable rational basis)).

In California, the legislature has set a limit on the schedule of toll evasion penalties on a per annum basis.[102] Because this is a legislative function, the amount of these penalties would be reviewed using the principle of proportionality. With respect to traffic violations related to a vehicle's entrance into or exit from an HOV lane, the Judicial Council of California is responsible for setting the fines and maintaining the penalty schedule.[103] As an administrative agency asserting its quasi-legislative authority, any rule promulgated would be presumed reasonable by a court.

Enforcement of toll evasion and HOV use appears to be well established in California and the implementation of an express lane network in the SCAG region is unlikely to be met with any enforcement issues that have not been previously encountered in the state.

[102] California Vehicle Code § 40258.

[103] Cal. Const. Art. VI § 6 grants the authority to the Judicial Council to adopt rules for court administration and rules of practice and procedure that are not inconsistent with statute. Ca. Rule of Court, rule 4.102, The Uniform Bail and Penalty Schedule, applies to occupancy violations of Vehicle Code Section 21655.5(b).

5.0 FACILITY DESIGN

The geometric design of individual express lane facilities will differ throughout the Southern California network based upon prevailing conditions and local desires. However, as the network involves interconnected facilities comprising one cohesive regional network, an understanding of express lanes design in the broad context is equally as important as the local context. The purpose of this chapter is to provide a basic understanding of geometric design and signing practices for a regional express lanes network in Southern California, so that individual projects within specific corridors may avoid inconsistencies and incompatibilities that could impact user experience. While this chapter provides design guidance and best practices for building the regional express lane network, it should not be construed as providing standards for individual design issues that must be resolved. Design standards will be governed by prevailing Caltrans and federal guidance.

5.1 Design Standards

Caltrans and FHWA highway design guidelines have been adopted to meet express lanes requirements and should be followed to the best extent possible. Whenever physical barriers to incorporating standards are encountered, approved design exceptions will be necessary. As express lanes are often implemented in highly constrained, urban environments, their design may require adaptations based on the physical circumstances and limitations of a particular highway corridor.

Design of express lanes in Southern California needs to conform to the applicable existing manuals, guidelines and design standards. Most express lanes in Southern California will be implemented on Caltrans facilities; therefore, FHWA and Caltrans standards will guide the design and approval of Final Highway plans. The express lane design must comply with the following design standards and guidance documents:

- Caltrans *Highway Design Manual* (HDM), 6th Edition May 2012
- Caltrans *Standard Plans and Standard Specifications* 2010
- Caltrans *High-Occupancy Vehicle Guidelines* 2003
- *California Manual on Uniform Traffic Control Devices* (CaMUTCD), November 2014
- Caltrans *Traffic Operations Policy Directive* (TOPD) *11-02*, 2011
- FHWA *Manual on Uniform Traffic Control Devices* (MUTCD) 2009 Edition Revision 2, May 2012
- FHWA *Priced Managed Lane Guide* 2012
- Caltrans *Encroachment Policies and Guidance* 2013
- Caltrans *Design Information Bulletin* (DIB) *78-03*
- Caltrans *Project Development Procedures Manual* 2013
- American Association of State Highway and Transportation Officials (AASHTO): *A Policy on Geometric Design of Highways and Streets* (commonly referred to as Green Book), 6th Edition, 2011
- National Cooperative Highway Research Program (NCHRP) 15-49 *Guidelines for Implementing Managed Lanes*, publication pending 2016
- Additional applicable Caltrans standards, policies and procedures as it relates to the project

As project developers implement individual facilities, the established design standards together with this ConOps for the SCAG regional express lanes will inform project design. Local agencies will likely have slightly differing objectives for express lanes facilities in their jurisdictions, and these differences may need to be reflected in the design of the regional network. For this reason, critical design criteria will inform whether a deviation from the established guidance is warranted. Key principles in considering deviations from the design guidance include:

- **Safety**. Deviations from design guidance should either have no change from or improve upon the perceived safety for express lanes and general-purpose travelers.
- **Operations**. Deviations should be oriented towards enhancing express lane operations and performance, and/or making necessary express lanes maintenance easier and safer.
- **Customer Understanding**. Deviations should maintain consistency and customer understanding of use within and between facilities, particularly as they affect adjacent and connecting segments.

5.2 Typical Section

The physical configuration of express lanes is driven by the location and design environment of the corridors within which express lanes will be deployed. Express lane improvements either involve adding capacity to existing highway corridors or converting existing HOV lanes to express lane operations. The construction of express lanes also involves utility coordination and potential relocation, the installation of drainage systems, earthwork, paving, the construction of ramps, overpasses and bridges, and the addition of appropriate ETC, vehicle detection and traffic monitoring equipment as well as signage and striping. Right-of-way acquisition may be necessary for roadway widening in some cases. However, this may not necessarily be required for the conversion of an existing HOV lane to express lane operation. In addition, express lane projects could be expected to involve modifications to existing structures, signs, and barriers.

As plans are refined for each individual corridor, design exceptions to mandatory and advisory design standards will be identified. Where existing facilities were built to non-standard widths and lane configurations, they are assumed to be maintained under the express lane conversion, provided the consideration for safety, operations, and customer understanding can likewise be maintained. The Caltrans DIB 78-03 Design Checklist provides a guide for documenting non-standard features and explaining why the non-standard feature may be retained or why improvements may be needed to achieve full standards. Once sufficient justification has been provided, a Fact Sheet for Design Exceptions for Caltrans review and approval is prepared and the Design Exception Approval Process, per Caltrans *Project Development Procedures Manual* Chapter 21, is followed.

5.2.1 Typical Section Recommendation

The regional project partners emphasize that full standard shoulder and buffer design is desirable on express lanes to reduce crash rates and improve speed differentials. Caltrans typical section provides guidance and should be maintained to the best extent possible.

Typical Section:
Emphasize full standard shoulder and buffer design to help reduce crash rates and friction due to speed differential between lanes.

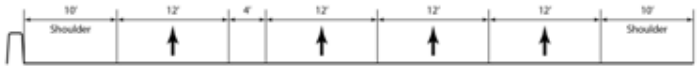
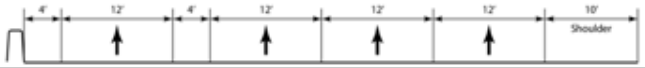
The typical express lanes full standard roadway section is defined by the Caltrans 2003 HOV Guidelines, and summarized in Table 5-1:

Table 5-1: Typical Cross Section Standards Affecting Express Lanes
Adapted from Caltrans 2003 HOV Guidelines

Cross Section Element	Standard
Lane Width	12 feet
Shoulder Width	10 feet preferable; 2 feet minimum
Separation Width	4 feet
Sight Distance	Standard stopping sight distance
Safety Considerations	Crash attenuation for exposed barrier ends, transition treatments, adequate access opening lengths

This typical configuration may be reduced per Caltrans HOV Guidelines. As an example, Figure 5-1 shows a configuration of a single express lane with three general-purpose lanes. The example shows a desired full standard cross section, together with preferred strategies to reduce the roadway cross section. Deviations from mandatory standards are subject to Caltrans' Design Exception Approval Process.

Figure 5-1: Typical Cross Section Width Reduction Priorities

Recommended Sequence	Cross-Section Design Change	Overall Effect
Desired		
First	Reduce left shoulder to 4 ft.	
Second	Reduce express lane width to 11 ft.	
Third	Reduce leftmost general-purpose lanes to 11 ft. Try to retain the rightmost lane at 12 ft.	
Fourth	Reduce buffer (2 ft.)	
Fifth	Reduce right shoulder to 8 ft.	
Sixth	Reduce left offset to 2 ft.	

5.3 Separation Treatments

During congested periods of the day, express lanes typically operate at higher speeds than adjacent general-purpose lanes. Given the speed differential and potential impact upon operations and safety, effective strategies for separating express lanes from the general-purpose lanes are important. The earlier a preference for separation treatment can be made, the earlier decisions regarding access and design tradeoffs (if necessary) can be made. The choice in separation design will also play a large role in operational feasibility, affordability, and overall constructability. Separation treatments may also have important lifecycle impacts upon maintenance, safety, enforcement, and incident management.

The design of most single-lane express lanes and all dual-lane express lanes provides separation from general-purpose lanes through the use of a combination of painted buffers, traffic channelizers, and/or concrete barriers. In addition, some operators have implemented a more open, continuous access design on primarily single-lane facilities using either a broken or solid lane line for lane separation. These options are addressed in more detail below.

5.3.1 Painted Line / Buffer Separation

Most existing HOV lanes in Southern California employ painted line or painted buffer pavement markings to delineate HOV lanes or express lanes from the parallel general-purpose lanes. The 2009 MUTCD updated

pavement markings guidance for barrier-separated and buffer-separated managed lanes. As a result, commonly used markings in California were no longer in compliance with MUTCD standards, including the use of yellow stripes in the buffer—a notable feature of HOV lane markings in California over the past few decades. Today, physical barriers and striping should comply with the guidance found in MUTCD Chapters 3D (Markings for Preferential Lanes) and 3E (Markings for Toll Plazas), which stipulate:

- Prohibited access is indicated by two sets of wide solid double white lines and buffer width of four feet or greater, with white chevron markings if buffer space is wider than four feet (Figure 5-2).
- Permitted (open or continuous) access is indicated by a wide broken single white lane line within the allocated buffer space where crossing the buffer space is permitted (Figure 5-3).

Figure 5-2: Pavement Striping for Buffer Separated Express Lanes, MUTCD Chapter 3D, Figure 3D-2, Sheet 1, 2009

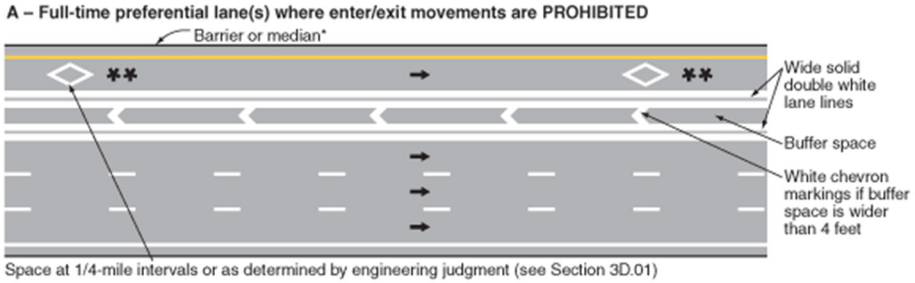
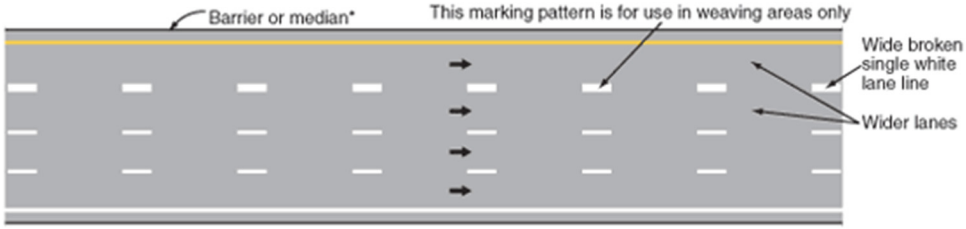


Figure 5-3: Pavement Striping for Open Access Express Lanes, MUTCD Chapter 3D, Figure 3D-2, Sheet 2, 2009



5.3.2 Channelizers / Delineators

Traffic channelizers—also known as delineators, pylons or tubular markers—may be used to delineate express lanes, improve driver comfort to operate with a speed differential, and reduce buffer crossing violations. The channelizers are placed at frequent intervals in the buffer area to create a perceived physical barrier to actively discourage motorists from moving in or out of the express lanes in undesignated areas. The first operational express lanes facility, the 91 Express Lanes in Orange County, has continually operated with channelizers since December 1995. Per the 2009 MUTCD revised in May 2012, channelizers are 36 inches in height with white

posts, and reflectors shall conform to the pavement markings. The posts may be surface mounted or anchored below the surface. The spacing of the channelizers depends on speed and traffic volumes and they should be centered within the striped buffer area so that the installation and replacement of the posts does not affect other pavement markings.

The width of the buffer where the channelizers are located effects friction between the express lanes and the general-purpose lanes. On I-95 in Miami and SR-91 in Orange County, the 4-foot buffer (split evenly between express lanes and the general-purpose lanes) separates traffic and preserves better speeds in the express lanes. However, illegal buffer crossings and vehicle strikes occur regularly, requiring an estimated 30 to 50 percent of the channelizers to be replaced on an annual basis. By comparison, the 16-foot buffer on the I-10 facility in Houston (split evenly) provides substantial separation of traffic ensuring minimal illegal crossings and the effective elimination of vehicle strikes of the channelizers. In essence, the I-10 facility has adopted the footprint of a barrier separated facility, but using channelizers that would enable configuration changes in the future, including expanding lane capacity.

5.3.3 Concrete Barrier Separation

Despite significantly higher capital and right-of-way requirements, concrete barriers continue to be used to separate some express lanes. They are more likely to be deployed on projects that integrate P3 and large scale corridor reconstruction that are funded in part by toll revenues. Barrier separation is preferred with:

- Express lanes with oncoming traffic between the express lanes and adjacent general-purpose lanes, such as contra-flow or reversible segments.
- Concurrent lanes treatments with high speed differential between the express lanes and the general-purpose lanes.
- Either concurrent or reversible lanes where risk of revenue leakage and/or performance degradation must be minimized to the best extent possible.

Concrete barriers may be mounted on the pavement (precast units) or cast-in-place. Either approach requires about two feet of width for the barrier plus sight distance and drainage space on either side. Typically, these requirements are accommodated within the 10-foot emergency breakdown shoulders for the express and general-purpose lanes, making the total required shoulder area about 22 feet in typical design settings. This is approximately 14 to 20 feet greater than other separation treatments described in this section. Additional width is needed at access points, as barrier openings require attenuation when exposed to oncoming traffic.

Positive Separation:
Establish specific parameters for the use of positive separation with barrier or channelizers where it is desirable to address specific design considerations.

Unlike cast barriers, moveable barriers provide an additional operational flexibility while maintaining the benefits of cast barriers. These special barriers are most useful for corridors with a clear peak directionality, such

as the I-15 Express Lanes in San Diego County. However, they also require on-going O&M expenditure requirements.

5.3.4 Separation Comparisons

All the separation treatments described above are in active use across the United States and also, in Southern California. Furthermore, all express lanes operators generally report that they are satisfied with their chosen systems of lane separation treatment. Each separation option offers particular advantages and disadvantages, as noted in Table 5-2.

Table 5-2: Advantages / Disadvantages of Separation Types

Separation	Advantages	Disadvantages
Painted Line / Buffer	▪ Lowest capital and ongoing maintenance costs ▪ Flexibility of operational options ▪ Flexibility for roadway reconfiguration ▪ Diversion for incident management ▪ Allows easy access to emergency vehicles	▪ Required enforcement of buffer crossings ▪ Lower reliability of performance due to friction and buffer crossings ▪ Greater risk of revenue leakage
Channelizer / Delineator	▪ Lower capital and ROW costs ▪ Flexibility for roadway reconfiguration ▪ Ease of diversion for incident management (channelizers can be driven over or removed) ▪ Allows easy access to emergency vehicles ▪ Reduces risk for buffer crossings ▪ Reduces risk for revenue leakage	▪ Highest ongoing maintenance expenses ▪ Closure of lanes to replace channelizers ▪ Lateral alignment of vehicle within express lanes due to presence of channelizers ▪ Limited access to left-side shoulder ▪ Buffer crossings are still possible potentially affecting performance
Concrete Barrier	▪ Lower maintenance costs than channelizers ▪ Highest speed differentials ▪ No buffer crossings ▪ Minimal risk for revenue leakage ▪ Easier to maintain performance	▪ Highest capital and ROW costs ▪ Higher drainage costs ▪ High cost for access treatments ▪ More difficult incident management ▪ Inflexibility for operational changes

5.3.5 Separation Treatment Recommendation

Multiple factors are involved in the selection of the most appropriate separation treatment. Each project will have differing goals, objectives, market characteristics, funding considerations, and field conditions. Therefore, the choice of separation treatment is dependent on the specifics of individual projects and the context of the regional concept of operations.

Separation Treatment:
Within the parameters of existing guidance, retain flexibility for implementing agencies to determine the lane separation treatment that best meets the objectives and needs of the specific project.

5.4 Access Treatment

The options for regulating express lane access are related in part to the separation treatment used on the facility. As such, access is a secondary consideration to separation. Southern California HOV and express lanes feature a combination of separation treatments, with the most prominent being painted buffers. Developing a regional express lane network requires considering how existing HOV designs can be optimized for express lane travelers, and how different express lane designs can be integrated at points of convergence.

Caltrans' TOPD 11-02 suggests two types of express lane access treatments, limited access design, and continuous access design. As limited access comes in multiple forms, this ConOps splits limited access into two distinct types—direct connector ramps and at-grade weaves. Limited access treatments provide the ability to regulate where vehicles enter and exit express lane facilities. When properly located and designed, limited access offers a safe means of accommodating access movements while minimizing operational impacts. However, limited access does diminish access to the express lanes from general-purpose lanes that feed them and they may alter existing traffic patterns. Future changes in traffic patterns may introduce the need to revisit limited access treatments on the express lanes. Continuous access addresses these concerns by maximizing the ability for customers to enter and exit the facility at any point, just as with movements between adjacent general-purpose lanes. Several different express lane access treatments are described in greater detail below.

5.4.1 Limited Access - Direct Connector Ramps

Direct connector ramps in the form of median drop ramps from overpasses or direct highway-to-highway connections provide direct ingress and egress to and from express lanes. This access approach is most commonly associated with barrier and/or channelizer separation designs, as they do not require cross-facility weaving to enter the express lanes. In fact, direct connector ramps are primarily used to minimize weaving movements. As a result, direct connector ramps provide greater efficiency, safety and capacity, while greatly reducing the operational impacts of weaving and merging movements. The design of direct connector ramps should follow AASHTO Green Book design standards for highway entrance / exit ramps. Caltrans provides additional guidance in TOPD 11-02 stating, "Drop ramps and direct connectors should be considered where substantial congestion in the general-purpose lanes exists or is expected and there is a significant local demand for access to or from the [express] lanes."

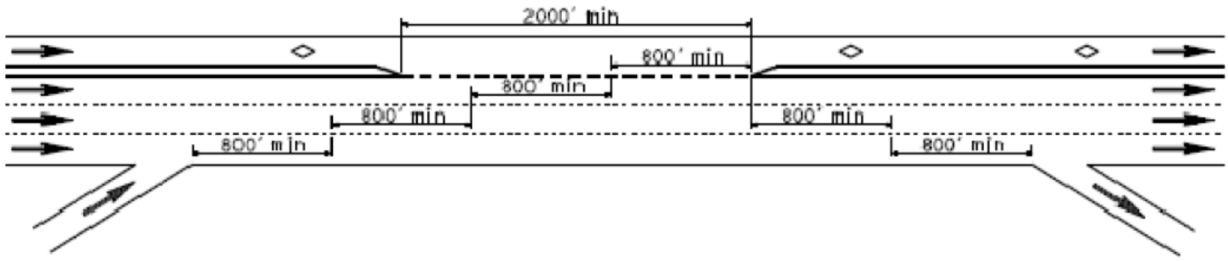
Due to the design requirements for barrier-separation between opposing flows, 50-mph design speeds, and sufficient speed-change, merge, and diverge lengths, the provision of direct connectors involves substantial right of way and represents a significantly higher capital cost. For these reasons, high ramp traffic volumes are typically necessary to warrant their construction, although safety considerations, especially associated with the provision of transit services, may also warrant consideration of direct connector ramps.

5.4.2 Limited Access - At-Grade Weaves

In most settings, limited-access express lanes are reached via designated at-grade ingress and egress locations. Physical barriers and/or striping within the buffer space separate the express lanes from general-purpose lanes between access points, so the design of the at-grade weaves is critical to maintaining operational functionality on both the express and general-purpose lanes. As described below, there are three common approaches for providing at-graded openings:

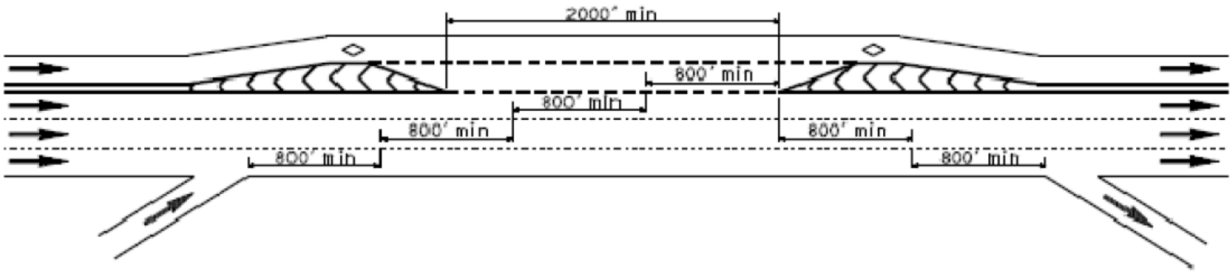
- *Weave Zones*, as described in Caltrans TOPD 11-02, provide combined ingress and egress with short breaks to the physical barriers or striping at designated locations, with the minimum distances shown in Figure 5-4. Weave zones are generally used only on buffer separated facilities.

Figure 5-4: Weaving Zone Access Design, Caltrans TOPD 11-02, 2011



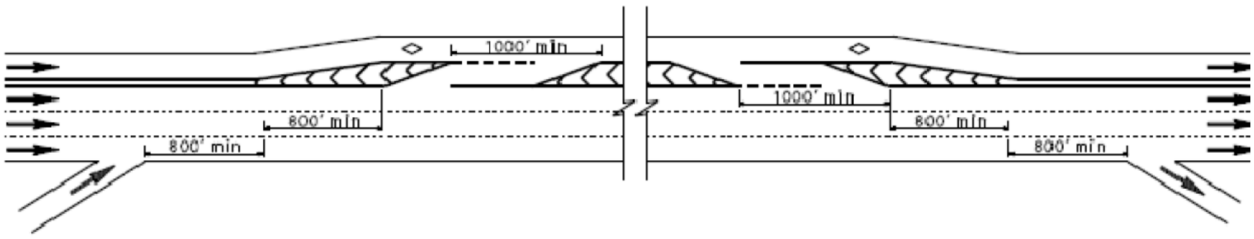
- *Weave Lanes* are similar to weave zones in that they accommodate both ingress and egress movements. However, ingress and egress movements are facilitated by a change lane that isolates the weaving from both the express and general-purpose lanes, thereby reducing the potential for unstable flow due to speed differential between the express lanes and general-purpose lanes and the associated acceleration and deceleration of merging traffic. Weave lanes, as illustrated in Figure 5-5, may be used with any type of separation treatment. It should be noted that some jurisdictions have observed general-purpose drivers using the weave lane as a queue jump without having the intent to enter the express lanes requiring specific considerations for the use of these treatments, especially in very heavily congested corridors where there is a greater incentive for queue jumping.

Figure 5-5: Weave Lane Access Design, Caltrans TOPD 11-02, 2011



- *Merge Lanes*—also known as slip ramps—provide dedicated and separated ingress and egress to the express lanes, as shown in Figure 5-6. The merge lanes provide drivers the opportunity to adjust their speeds to match the lane they are merging into. This further reduces the potential for unstable traffic flows, as conflicts are avoided in the access lane. Separating the ingress and egress movements with merge lanes also reduces the potential for general-purpose drivers to utilize the lane as a queue jump without having the intent to enter the express lanes.

Figure 5-6: Merge Lanes Access Design, Caltrans TOPD 11-02, 2011



5.4.3 Continuous Access Design

More recently, continuous access design has been increasingly used for HOV lanes in Caltrans Districts 8 and 12. Continuous access design permits vehicles to enter the express lanes at any point, provided that such movements conforms to moving vehicle guidance and safety requirements. Continuous access on express lanes remains relatively rare, with only I-35W in Minneapolis and SR 167 in Seattle currently using this access method. With continuous access there are no designated ingress / egress locations. These facilities should be striped in accordance with MUTCD Chapter 3B, Pavement and Curb Markings.

5.4.4 Access Comparisons

Table 5-3 highlights the comparative advantages and disadvantages for each access type described above.

Table 5-3: Advantages / Disadvantages of Access Types

Separation	Advantages	Disadvantages
Direct Connectors	▪ Independent toll zone capability ▪ Speed control ▪ Higher vehicle throughput ▪ Significantly reduces toll evasion ▪ Eliminates friction from weaving traffic	▪ High cost / more right of way ▪ Requires accommodation on arterials ▪ Increased infrastructure maintenance ▪ Local jurisdictions opposing distance between access points
At-Grade Weave	▪ Transition lanes may be accommodated with restriping ▪ Reduces toll evasion ▪ Enables access control	▪ Concentrates weaves at access zones ▪ Potential higher crash rates ▪ Enforcement of access violations ▪ Local jurisdictions opposing distance between access points
Continuous Access	▪ Lowest cost ▪ Reduces weave concentrations ▪ Lowest crash rates ▪ Greatest market flexibility	▪ Greatest potential revenue leakage ▪ Highest manual enforcement costs ▪ May complicate signing ▪ May complicate toll structure

Given the high cost of constructing new direct connector ramps, regional express lane plans should focus on the differences between continuous access and at-grade weave access treatments. Table 5-4 highlights the most frequently cited factors including, driver interaction, safety concerns, and pricing strategy.

Table 5-4: Issues of Access Types

Issue	Continuous Access Design	At-Grade Weave Design
Driver Interaction	▪ Driver familiarity with lane merging ▪ Reduces public education requirement ▪ May complicate signing for driver notification of toll rates	▪ Consolidates public outreach and education messaging for how to use the region's express lanes ▪ May increase frequency and/or severity of illegal crossings ▪ Requires modeling for proper location of access breaks
Safety	▪ Lower crash rates than at-grade ▪ Reduces the concentration of weaves ▪ Limited adoption in express lanes ▪ No ability to concentrate access where desired ▪ Potential for increased weaving at toll zones to evade detection	▪ Locate access where safe and desirable ▪ Reduced potential for weaving at toll zones ▪ Increases concentration of traffic at weave points ▪ Higher crash rates at access points
Pricing Strategy	▪ Complicates toll rate communication ▪ Complicates toll rate lock-in ▪ Per mile pricing may work as users control length of use, but also requires user calculation of total length + toll rate ▪ Destination pricing could confuse drivers who may anticipate entering and exiting in between their origin and final destination ▪ Drivers may attempt to exit at inopportune times to avoid tolls	▪ Simplifies pricing of origins and destinations, which can reduce driver confusion ▪ Permits segment-based pricing, which is the most common pricing system in operation ▪ Limited opportunity to optimize pricing for bottlenecks and other constraints

5.4.5 Access Treatment Recommendation

SCAG's LFPWG and the RPMT both reviewed access treatment options and indicated a preference for maintaining limited access design where currently utilized. Specific recommendations include:

- Existing and planned direct connector ramps are preferred for highway-to-highway movements with dominant directionality for the express lanes.
- Merge lanes are the default treatment for at-grade express lane access in order to improve operations and safety. Combined weave lanes are a secondary preference.

Access Treatment-Limited Access: Maintain limited access design where it is currently utilized for HOV lanes, and utilize separated merge lanes or combined weave lanes to improve operations and safety at access locations.

- Weave zones may be used in segments with minimal entering or exiting traffic volumes and moderate levels of general-purpose lane traffic.

- Continuous access may be used on those HOV lanes that currently feature continuous access. The operator will evaluate the use of continuous access in the express lane setting, with additional limited access locations identified and striped to improve safety and operations management at a strategic locations. Toll collection infrastructure should be installed at a maximum spacing of one-mile within continuous access segments, and segment-based pricing should be used to minimize the potential for queue jumping and toll evasion.

Access Treatment-Continuous Access: Evaluate the use of continuous access on a corridor basis to be utilized strategically for enhancing safety and operations, and use a maximum one-mile spacing of toll readers and segment based pricing in continuous access locations to minimize toll evasion.

5.5 Express Lanes Signage

The signing requirements for express lanes in the SCAG region shall comply with the 2014 CaMUTCD. The purpose of the CaMUTCD is to provide uniformity in the design, placement, and use of signs, signals and pavement markings to reduce driver confusion and promote safety and operational efficiency. The 2014 CaMUTCD also provides specific guidance on signage at the beginning, end and intermediate access locations of express lane facilities in California. Express lane operators within the SCAG region will also be responsible for the provision of regulatory signs, including HOV definition and occupancy requirements, transponder guidance and requirements, and warnings about the crossing of double lines.

Guide signs for express lanes shall be developed in accordance with Chapter 2F, Toll Road Signs and 2G, Preferential and Managed Lane Signs of the CaMUTCD. Chapter 2G designates use of the ETC system pictogram (the FasTrak logo) and purple as a new color for signs providing information specifically related to requirements for ETC. Purple as a background color shall be used only when the information associated with the ETC system is displayed on that portion of the sign. The signs described in this section assume that all vehicles in express lanes are required to be equipped with a valid Title 21 compliant ETC (FasTrak) transponder and that pay-by-plate options are not deployed as a primary toll collection option (which would require different sign standards, as any vehicle could access the lane).

Figure 5-7 illustrates examples of the placement of the FasTrak logo and purple background coloring on entrance signs to Southern California express lanes, including those used on the I-110 ExpressLanes in Los Angeles, which comply with the current CaMUTCD requirements. In contrast, the 91 Express Lanes, which opened in 1995 prior to the purple color and other express lane signage guidance adopted in the 2009 MUTCD, uses white header on the guide signs. Renderings of guide signs for express lane entrances are shown in Figure 5-8 from the CaMUTCD 2014 Edition.

Figure 5-7: Express Lane Entrance Signs in Southern California

I-110 ExpressLanes, Los Angeles County

91 Express Lanes, Orange County

Figure 5-8: Entrance to Express Lane, CaMUTCD 2014

Overhead-mounted pricing signs display the toll amount to a given downstream location and convey any HOV requirements and incentives, if applicable. In accordance with the guidance in the CaMUTCD, pricing signs should display the current toll to no more than two downstream destinations. Variable message technology should be used to indicate toll rates that vary by time of day or in response to changing traffic conditions. These signs will also specify that the vehicle must be equipped with a valid Fastrak transponder as a requirement to use the facility. Pricing signs can use a combination of static and changeable elements, as illustrated in Figure 5-9 or be fully variable, as depicted in Figure 5-10. Each type of sign has its advantages and disadvantages. Static signs are generally less expensive and can provide independent connectivity options when two operators may need to display pricing information (which may be important at jurisdictional boundaries, where the express lanes cross operational jurisdictions). By comparison, full changeable message signs (CMS) provide flexibility to change messaging without fabricating a new sign. They are particularly helpful in providing information on traffic incidents, but are more costly to deploy and are can be less easily readable compared to static signs. Static

express lane signs are used in San Diego and the Bay Area, but they are not currently used on express lanes in the SCAG region.

Figure 5-9: Example Combination Static / Changeable Pricing Signs for Express Lanes, CaMUTCD 2014

Figure 5-10: Example Full Changeable Message Signs for Express Lanes in the SCAG Region

I-110 ExpressLanes, Los Angeles County

91 Express Lanes, Orange County

Guidance on the standard components of express lane signage, including progression, information, and sequencing, are provided in the 2014 CaMUTCD and should be followed for all express lane projects. Typically, per CaMUTCD criteria, a minimum of five (5) express lane overhead signs should be placed in advance of access points to provide motorists with advance notification and adequate warning of upcoming entrance locations.

The first advance warning sign for the express lane entrance is placed two miles ahead of the initial entry point. Sequences of guide signs for the intermediate entry and terminus of restricted access express lanes are similar to the signs for the initial entry point, but location and type of guide signs will vary based on access points, in accordance with the CaMUTCD.

5.5.1 Express Lanes Signage Recommendation

The LFPWG and the RPMT have not identified a regional preference for static signs or full CMS. Therefore, the choice signage type will depend upon local preferences, environmental considerations, and required design approvals.

Signage:
Signage consistent with CaMUTCD is preferred. The signage developed for Metro ExpressLanes provides a template for future express lanes in the region with the use of full CMS providing greater flexibility to adjust toll messaging over time. For continuous access, signs will designate the start of the pricing segment(s) thereby also serving to designate the start of the statutory enforcement area.

5.6 Toll Collection Zones

Toll collection zones will be installed at appropriate locations on the express lanes, in accordance with the separation and access strategy identified for each facility.

5.6.1 Toll Zone Systems

Systems that will be incorporated within the toll collection zone include:

- ETC which enables motorists to pay tolls without cash. These systems include a lane controller, AVI systems for interfacing with transponders, automatic vehicle classification systems for identifying vehicles via sensors, and video enforcement systems for imaging license plates.

- Intelligent Transportation Systems (ITS) technology which is used to monitor travel conditions and communicate information to motorists. These systems include CMS, pricing information signs, closed circuit television (CCTV) systems, and traffic volume / speed monitoring systems.

The ITS and toll collection equipment is vital to the operation of express lanes to optimize traffic flow and overall system performance. A toll collection zone is the location on the roadway where the toll is collected electronically and violation enforcement occurs. Each toll collection zone will have a set of equipment to read transponders, collect data, activate enforcement equipment, capture images as needed, and transmit information to the central toll system (i.e., the toll operators back office). Each toll zone requires power and communications to an adjacent local control cabinet.

The roadside elements of the video enforcement system will consist of a camera mounted to the overhead structures and a lighting assembly to provide proper illumination in varying daylight and weather conditions. The camera is triggered and images are captured of every vehicle's rear license plate. The light assembly is typically either a set of high intensity light emitting diode (LED) strobes or always-on lights that can operate in the visible or infra-red spectrums, and are typically angled to stay out of the customer's line of sight. If visible, the light assembly can also dim during the night to minimize glare.

5.6.2 Special Design Requirements for Declaration Lanes at Toll Collection Zones

There are three primary strategies for distinguishing toll-free / discounted toll and tolled express lane traffic: declaration lanes, switchable transponders, and pre-registration. Declaration lanes are used on the 91 Express Lanes in Orange County, and are being constructed on the extension of the 91 Express Lanes into Riverside County which will open in 2017. Declaration lane solutions require eligible HOVs and other exempted vehicles to travel through tolling points on a designated lane which is reserved for eligible vehicles only. These vehicles are charged an appropriate discounted or zero-value toll, and the vehicle occupancy may be confirmed by enforcement personnel via visual observation. Vehicles without transponders are considered violators—the same as if they traveled through the main toll lanes without a transponder. Declaration lanes require additional right-of-way to accommodate an additional lane that is separated from toll lanes at tolling points, as well as enforcement areas and appropriate tapers, as shown in Figure 5-11.

Figure 5-11: Declaration Lane on 91 Express Lanes in Orange County

5.7 Enforcement Provisions

Express lanes require effective enforcement policies and programs to operate successfully. Enforcement of vehicle occupancy requirements is critical to protecting eligible vehicles' travel time savings and safety. Visible and effective enforcement promotes fairness and maintains the integrity of the facility to help gain acceptance among users and nonusers.

As express lanes cater to a wider array of users through pricing, enforcement is made more complicated. Among the greatest challenges in implementing express lanes is identifying qualified carpool vehicles for toll-free or discounted use on the facility. Persistent violation problems can breed disregard for enforcement and result in

a significant loss of toll revenue on the express lanes, as well as increase corridor congestion. The consequences of unchecked violators resulting from enforcement challenges affect not only mobility but also revenue.

Enforcement beacons or character displays may be installed at each toll zone, and triggered to display a message when a valid transponder is declared as an eligible HOV in a passing vehicle. This would provide a visual cue to an enforcement officer that the passing vehicle declared as an HOV. It is important to note that the type and location of a beacon may be heavily influenced by the availability of an enforcement area, and that the enforcement beacons should display a message that is intuitive to enforcement personnel. Metro will be experimenting with new beacons along the I-10 ExpressLanes that display an LED numeric number to represent the transponder setting, instead of blue and white flashing beacon lights that are currently used.

As California moves toward complying with national interoperability requirements which could potentially include the adoption of International Standards Organization (ISO) 18000 6c transponders, the currently available ISO 18000 6c switchable transponders display the transponder's status on the device itself which is visible to enforcement personnel observing the front windshield. If this device type is adopted within California, it may eliminate the need for beacons, providing enforcement personnel with a quick means of assessing transponder status and vehicle occupancy without moving focus from the vehicle, as shown in Figure 5-12.

Figure 5-12: ISO 18000 6c Switchable Transponders with Color Coded Status Indication

Source: Colorado Department of Transportation (CDOT)

CHP observation areas for the express lanes should be provided in toll zones, including a wide left shoulder for use by CHP personnel. CHP personnel could subsequently observe express lane users to ensure compliance with the express lane eligibility requirements and normal traffic enforcement. Compliance is supported within the observation area by allowing CHP to view enforcement beacons, transponder status, and/or vehicle occupancy safely. Observation areas should be designed in accordance with the Caltrans HOV Guidelines. These guidelines

are intended to maintain safe conditions. With the presence of CHP personnel, the goal is to discourage violators from accessing the express lanes. Experience on the I-110 and I-10 ExpressLanes has indicated that toll and HOV violation rates are greatly reduced when CHP is actively conducting enforcement activities within the corridor, emphasizing the importance of active enforcement to deter violations and improve compliance using express lanes.

With either switchable transponders or declaration lanes, the express lane concept requires drivers to self-declare the number of occupants in their vehicle and relies upon enforcement officers to visually verify that vehicles are in compliance. Emerging technologies provide options for automated vehicle occupancy detection primarily using imaging and recognition of human occupants in the vehicle. Although such systems have yet to be permanently deployed for express lane occupancy enforcement purposes, the results of recent testing have shown the potential for such systems to support and enhance current enforcement efforts by CHP. Automated enforcement systems may be useful as an additional secondary tool for enforcement personnel, but not a replacement for pursuit and apprehension of willful violators of HOV policies as the primary means of enforcement. In particular, CHP may use the system to screen vehicle occupancy at the toll collection point allowing officers to focus enforcement efforts by pursuing vehicles that the detection system has identified as a potential violator. Additionally, the automated enforcement system could be used to recognize repeated suspected violators on the facility, especially when coupled with toll collection data, to identify when these violators are likely to use the facility. Furthermore, the systems can be used for soft enforcement, either as a psychological warning (e.g., advance signs stating, Notice: Enforcement Cameras in Use) or as a letter to suspected violators articulating suspicion of violation. Ultimately, in the foreseeable future these systems are only a supplement to the required physical, in-field presence by CHP. It is also important to note that there currently is no legislation is California enabling HOV violation to be enforced based on automated occupancy detection.

5.8 Current State of the Practice

Table 5-5 identifies the facility design treatments currently in use or planned for express lane projects in the SCAG region.

Table 5-5: Express Lane Design Treatments in the SCAG Region

Topic	Metro		OCTA		RCTC		SBCTA	
	I-10	I-110	SR-91	I-405*	SR-91	I-15*	I-10*	I-15*
Lane Separation	Barrier / Striped	Barrier / Striped	Channel -lizer	TBD	Channel -lizer	TBD	Striped Buffer	Striped Buffer
Access Treatment	Limited Access	Limited Access	Limited Access	TBD	Limited Access	Limited Access	Limited Access	Limited Access
Single / Dual Lane Configuration	Dual	Dual	Dual	Dual	Dual	Dual	Dual	Dual
HOV Declaration Lane	No	No	Yes	TBD	Yes	TBD	No	No
CA MUTCD	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: * Future or proposed express lanes

6.0 OPERATING CONCEPT

Implementing express lanes in Southern California will require a long-term commitment to actively manage traffic operations within the lanes to maintain and optimize performance. While some aspects of operations overlap with the maintenance of the state highway system, the operations of express lanes are more acutely associated with optimizing travel time reliability and travel speed benefits for express lane users. As such, express lanes require different operating policies from the general-purpose lanes, including eligibility, pricing, in-vehicle equipment requirements, and proactive intervention. This policy foundation is addressed in this chapter of the ConOps. Discussions of system requirements are provided in subsequent chapters.

At a minimum, express lane operational policies must meet the following federal requirements:

- A program for enrolling customers
- Automatically collecting tolls from customers
- Enforcing violations
- Varying the toll rate to manage demand
- Measuring, monitoring, and reporting achievement of performance standards

This chapter addresses these components and discusses them in the Southern California regional context.

6.1 Electronic Toll Collection Concept

The preferred tolling concept for the regional express lane network includes policies agreed upon by the Southern California partner agencies. This section explores the various policy preferences related to the regional express lane ETC concept. It should be noted that while these policies reflect the consensus recommendation of the LFPWG and RPMT, unique corridor characteristics and specific local needs may necessitate that individual projects implement operating policies that differ from the preferred ETC concept for the overall regional express lane network.

- **All Cashless Tolling:** Tolls shall be collected electronically at highway speeds from vehicles equipped with a FasTrak transponder. There will be no toll booths or other stop-and-pay mechanisms.

- **All Vehicles Have Transponders:** All vehicles using the express lanes, regardless of occupancy or other eligibility criteria, will be required to have transponders. Vehicles without a transponder will have an image of their license plate captured and an invoice or violation notice will be sent to the registered owner of the vehicle.

- **Self-Declaration:** Express lane customers who desire discounted or toll-free travel, as available, will need to self-declare based upon vehicle eligibility. The use of switchable transponders will be usable throughout the region for this purpose; although, some corridors may have additional declaration requirements.

- **Variable Pricing:** The amount charged to express lane payers will vary based upon predicted (time of day) or current (dynamic) traffic conditions, cumulatively assessed based upon the number of tolled segments traveled.

- **Differential Payment Classes:** Regardless of the actual toll rates in effect at any given time, there may be two or three payment classes in effect—full toll, discounted toll, and/or no toll. For example, the toll rate may vary based on occupancy within the vehicle, classification of the vehicle, toll collection method (electronic transponder or license plate capture), or other forms of delineation.

6.1.1 All Cashless Tolling

ETC technology enables the use of variably priced tolls as a tool to manage highway traffic flows and volume based on time of day, prevailing traffic conditions, vehicle occupancy and travel demand. Together with advanced traffic management and traveler information systems, transportation agencies now have a set of enhanced tools for more effective and dynamic traffic management. Exclusive use of ETC is essential on express lanes because of the inherent travel delay and congestion associated with manual toll collection. ETC systems utilize AVI technology to detect the unique ID of all vehicles passing toll collection points. LPR with optical character recognition (OCR) technology further enhance the capabilities of capturing toll payments (and violations) from vehicles traversing the express lanes. These technologies are further discussed in Technical Requirements under Chapter 8.0.

Electronic Toll Collection:
All express lane facilities in the region will utilize FasTrak ETC systems compliant with CCR Title 21 (or superseding regulations) and CTOC guidelines.

To maintain consistency and interoperability with other express lanes and toll facilities in California, tolls on the regional express lane network will be collected electronically according to specifications detailed in California CCR Title 21, or any other specification that may be enacted to supersede Title 21. All express lane facilities in the SCAG region will also be fully compliant with CTOC's interoperability guidelines.

6.1.2 All Vehicles Have Transponders

As the preferred primary means for tolling and enforcement, drivers will be required to have a CTOC-compliant radio frequency identification (RFID) transponder in order to use the express lanes. Each transponder will be coded with a unique ID number that is linked to a valid ETC account with a CTOC member agency and the account will be debited for the toll amount due when the transponder is read at a tolling point.

Mandatory Transponders:
Mandatory use of RFID transponders is recommended as the primary means for tolling and enforcement. Video license plate capture should only be used as a secondary mechanism for enforcement and tolling.

CTOC is coordinating closely with the International Bridge Turnpike and Tunnel Association (IBTTA) in its work to vet and establish a national ETC interoperability standard and a corresponding transponder protocol in accordance with the interoperability requirements established in MAP-21. As this process and available technology evolves,

transponder protocols and ETC requirements in California may change as the express lane network is completed, including the potential for transponders registered with non-CTOC member agencies to be utilized on toll facilities within the SCAG region. Regardless of what the exact transponder requirements are when any given express lane facility opens, the transponder requirements will be consistent with current CTOC and national standards.

As a secondary means of enforcement and tolling, vehicles without a transponder will have an image of their license plate captured and an invoice or violation notice will be sent to the registered owner if the vehicle information is not linked to an active CTOC account in good standing. This is a common method to provide access to a broader base of customers who do not have transponders. However, video capture and associated LPR typically has a higher cost associated with the image processing and verification, and due to the inherent limitations of OCR technology, especially related to varying weather and lighting conditions, and the accuracy of reading a wide variety of vanity and out of state plates. Where video tolling is desired as a secondary means of tolling, a toll premium could be charged to those using video tolling, relative to the toll with a transponder, to offset the additional cost. The rate of this toll premium would be determined at the discretion of the responsible agency in accordance with the provision of California statutes regarding the setting of fees.

6.1.3 Self-Declaration

As the regional express lane network is developed, Southern California partner agencies will face additional enforcement requirements compared to those required for enforcing the HOV system. Providing sufficient personnel to enforce both occupancy and toll evasion across all facilities may be expensive. Whereas automated occupancy verification is not yet ready for deployment for primary enforcement purposes, current technologies can likely help with focusing manual enforcement efforts on likely occupancy violators and identifying behavioral patterns of likely recurrent violators. Furthermore, automated toll payment enforcement for toll violators is ready and can be deployed. Altogether, these options provide opportunities for self-declaration of occupancy to aid automated tolling and enforcement solutions. There are two primary mechanisms for self-declaration currently used in Southern California: declaration lanes and switchable transponders. A third mechanism, pre-registration of eligibility, is only used on a limited basis in the SCAG region for establishing toll-exempt accounts for transit vehicles, emergency vehicles, and other official use vehicles, etc.

6.1.3.1 Declaration Lanes

As there is no commercially reliable method for automatically detecting the number of vehicular occupants as a primary means of occupancy verification, the enforcement of express lane facilities falls upon visual inspection by law enforcement officers. On many of the initial express lanes where right-of-way was not an overriding issue, including as implemented on SR-91, vehicles that complied with occupancy requirements (and permitted toll-free or discounted toll use) are physically separated from toll-paying vehicles in toll zones (as shown on SR-91, Figure 6-1). Enforcement personnel only verify the occupancies of vehicles in the declaration lane, while any toll evasions in the toll lane(s) are captured by LPR technologies and enforced through established business rules.

This method reduces the total number of users that enforcement personnel must positively verify for system compliance. Although there are advantages to physically separating HOV from non-HOV users in toll zones, this strategy requires significant amounts of right-of-way not only for the separation but also for enforcement detention and citation. In Southern California, many potential express lane corridors have physical constraints that present challenges to implementation and enforcement. In addition, separate lanes for each vehicle class could increase weaving either side of toll-zones, leading to increased potential for congestion and crashes.

Figure 6-1: Declaration on 91 Express Lanes in Orange County

6.1.3.2 Switchable Transponders

This method provides a technological option for the driver to declare carpool status from in the vehicle through the use of a switchable transponder, as implemented on I-10 and I-110 in Los Angeles as well as in the Bay Area, Colorado, Virginia, and Washington. Additional strategies, such as carpool registration and photo-based toll collection and enforcement can be used in this method. As used in Los Angeles, switchable transponders allow the customer to self-declare his or her occupancy status on the transponder itself.

Switchable Transponders:
Switchable tags eliminate the need for physical declaration lanes or the use of HOV registration programs, and they allow maximum flexibility to changing occupancy and pricing policies over time, such as the increase to HOV 3+ and discounting tolling for HOV 2 in the future.

One type of switchable transponder uses a binary mechanism (toll or no-toll), such as that used by Virginia (Figure 6-2a). The transponder currently utilized by Metro transmits multiple ID codes in order to associate the correct toll for a vehicle based upon its occupancy status (Figure 6-2b). These ID codes can be associated with an SOV, HOV 2, and HOV 3+ setting directly on the transponder. For compliant HOVs, the user declares the vehicle's status on the transponder (e.g., switching the tag to HOV 2 or HOV 3+), and the appropriate toll rate (including zero dollars) would be charged. If the same vehicle is being operated without the required occupancy, the driver is required to declare

appropriately on the transponder and the correct toll would be charged. If no transponder is present (or if it is malfunctioning), LPR would be used as a secondary means of enforcement and tolling to ensure full toll payment from the user (regardless of vehicle class or occupancy status). Additional information regarding transponders is provided in Section 8.3.1.

Figure 6-2: Switchable Transponders, E-ZPass Flex (a) and Metro FasTrak (b)

It should be noted that on August 21, 2015, Transport Technologies LLC filed a Complaint for Patent Infringement against Metro for their use of a switchable transponder for express lanes vehicle occupancy self-declaration. The complaint claims that the US Patent Office issued a patent to Transport Technologies on or about December 27, 2005 for "a system that allows a claim by a registrant as to the number of occupants traveling in a vehicle over a section of highway with a high occupancy vehicle incentive program in place to be transmitted. The registrant is identified by a registrant identifier. The claim about occupancy is optionally visually displayed as the vehicle traverses the highway. The ID of the registrant making the claim is captured by a plurality of reading devices along the highway and transferred to a central processing system. That system determines if a qualified ride-sharing event has occurred, and if so it will then provide for distribution of the program incentives to the registered individual(s)." The complaint claims that "Metro, through its operations of the ExpressLanes, has infringed and continues to infringe…patent by using the inventions claimed therein." At the time of this writing, the status of this complaint remains as pending and it is unclear as to the outcome and the ramifications of this filing and subsequent findings on the use of switchable transponders in conjunction with express lanes projects.

6.1.4 Pricing Models

Multiple mechanisms exist for pricing an express lane facility. The two most relevant to Southern California, time-of-day (static variable) pricing and dynamic pricing, are described below.

Pricing Models:
Various methods of variable, and segment or zone based pricing can co-exist. Changes in business rules can effect utilization and compliance, and interface with the public must appear uniform.

6.1.4.1 Time of Day Pricing

Static variable pricing according to a set time of day schedule is actively used on the SR-91 (Orange County)[104], all Denver area priced managed lanes (I-25, US 36, and I-70), and all Houston area express lane facilities (IH-10, IH-45, US 290, and US 59). This structure has generally been shown to produce nominally higher rates of net revenue, potentially due to the economics of pricing for slightly higher marginal values of time savings necessary to account for fluctuations in travel demand over time. To be most effective, this form of variable pricing requires both a high degree of variability by time of day and day of the week, and a system for altering toll rates over time.

With time of day pricing, tolls vary according to a fixed schedule, with different prices charged based on direction of travel, day of the week, and hour of the day. The rates are determined based on actual observed travel conditions in the corridor, and vary according to anticipated demand and congestion. The performance of express lane facilities using time of day pricing should be evaluated on a regular basis to ensure that free flow conditions are being maintained in the express lanes. If travel conditions on the express lanes deteriorates in a given time period, then the rates should be increased. Similarly, rates can also be lowered when the express lanes are found to have excess capacity that is not being used effectively.

On the 91 Express Lanes, performance is monitored daily and evaluated every three months. Based on the results of this evaluation, rates are adjusted if over- or under-utilization is detected during two subsequent three-month monitoring periods. Surveys have found that customers using the 91 Express Lanes like the price certainty and predictability associated with time of day pricing.

6.1.4.2 Dynamic Pricing

Dynamic pricing is used on most California express lanes, including I-10 and I-110 (Los Angeles County), I-15 (San Diego County), I-580 and I-680 (Alameda County), and I-880 / SR-237 (Santa Clara County). Dynamic pricing utilizes toll rates that vary in real time based on actual travel conditions observed in the corridor. Real time traffic data is obtained using vehicle detection devices capable of determining values such as traffic volume and speed in real time. A tolling algorithm then uses these values to determine changes in traffic conditions and to calculate the appropriate toll to charge. The toll can be raised or lowered in response to traffic conditions as appropriate to influence express lane operations. If speeds in the express lanes (and/or the adjacent general-purpose lanes)

[104] Static variable pricing is also proposed to be used on the 91 Express Lanes in Riverside County when they open in 2017.

decrease, tolls are increased to discourage additional vehicles from entering the lane. When speeds in the express lanes (and/or the adjacent general-purpose lanes) increase, the toll rate decreases to encourage more paying motorists to use the lanes. Toll rates are adjusted in regular intervals which may be as frequent as every five minutes. Express lane operators also have the ability to override the dynamic pricing systems during incidents, lane closures or special events.

With dynamic pricing, there is greater variability in use, which is reflected in revenue generation. While dynamic pricing requires real time monitoring and response capability, the pricing structure must be sufficiently robust to account for variations in markets, geospatial access, and demand over time.

6.1.5 Differential Payment Classes

The applicable price for access can vary for different users. Discounts or exemptions may be applied for achievement of occupancy standards (e.g., HOV 2+, HOV 3+, etc.), vehicle type (e.g., ILEV, ULEV, SULEV, motorcycle, bus, etc.), vehicle classification (e.g., passenger vehicle, truck, etc.), or other criteria. Furthermore, pricing differentiation can be associated with the individual account. One method of responding to equity concerns is to apply toll discounts in a manner similar to discounting utility rates for disadvantaged households. Although policy drives the application of price differentiation, technology determines the ability to actually accomplish the categorization of users. The ability to differentiate by user is dependent upon a system for segmenting users.

Differential payment classes can be distinguished using self-declaration or pre-registration. As described previously, self-declaration requires HOVs or those users that meet other qualifying criteria to self-declare using a designated lane or switchable transponder in order to receive an exemption or discount. Pre-registration provides the opportunity for declaration at the user account level. This can be accomplished either by registration of eligibility on a per-trip or permanent basis (as is done for carpools on I-85 in Atlanta and I-95 in Miami), or by the establishment of differential accounts (e.g., establishing a non-revenue account class, as is often done for transit providers, emergency services, roadside assistance, etc.).

6.1.6 Toll Collection Recommendations

The Southern California partner agencies have agreed to utilize CTOC-approved technologies for exclusive use of ETC in express lane facilities. Mandatory use of FasTrak transponders is preferred as a primary means for tolling and enforcement. Violation enforcement will be conducted by LPR for those vehicles not equipped with valid FasTrak transponders. Video-based tolling is recommended only as a secondary means of toll collection, if chosen as a local option, due to the higher costs associated with the image processing and verification, and due to the inherent limitations of OCR.

By default, express lanes will utilize switchable transponders as the primary means of self-declaration, promoting regional consistency. Southern California partner agencies may choose to utilize additional lane-based declaration as augmentation to switchable transponders. Additionally, express lane operators may use

either time of day or dynamic pricing systems, as individual corridors warrant from established T&R studies. However, signage and other means of communication to travelers would make the choice of variable pricing much more transparent.

6.2 Occupancy Policy and Tolling Exemptions for Express Lane Use

6.2.1 Toll-Free / Toll Discounts for High Occupancy Vehicles

Caltrans has the responsibility of maintaining operations for the state's HOV lanes, which includes the authority to make operational changes (including occupancy requirements) provided they are compliant with federal and state regulations. As described previously in Chapter 4.0, multiple sections of California law pertain to HOV policies on express lanes. State authorization legislation provides the authority for the operating agency to set rates and HOV policies on the respective facilities. In particular, § 5205.5 of the California Vehicle Code provides Caltrans with the ability to remove toll-free access to certain vehicle classifications if it is found that toll-free use is negatively impacting the ability to maintain a LOS C or better on the HOV lanes or LOS D or better on express lanes in accordance with § 149 of the California Streets and Highways Code. Additionally, § 64112 of the California Government Code permits CTCs and Caltrans to propose new express lanes throughout California (including HOV lane conversion), provided they meet the general requirements of § 149. As such, the state law permits each agency to manage and maintain appropriate HOV policies for their facilities.

For Southern California, the expressed desire is to maintain jurisdictional primacy over immediate HOV access decisions. As such, the primary options for Southern California partner agencies to consider regarding HOV policy are as follows:

1. **Maintain HOV 2+ toll-free or discounted toll policy on current HOV 2+ lanes**. This policy only opens available capacity to toll payers, while maintaining toll-free or discounted use for HOV 2+, similar to policies currently in place on I-110 in Los Angeles and I-15 in San Diego. This policy yields minimal available capacity for express lanes toll paying customers in peak periods, and will be unviable on certain corridors due to demand exceeding supply.
2. **Adopt HOV 3+ toll-free or discounted toll during peak periods; maintain HOV 2+ during off-peak periods.** This solution mirrors the current deployment on the Metro I-10 ExpressLanes. This policy may create customer confusion, due to different peak versus non-peak policies, and may potentially yield lower available capacity for express lanes toll payer use during off-peak periods than the remaining two options.
3. **Adopt full-time HOV 3+ toll-free or discounted toll policy.** This policy provides a 24-hour HOV 3+ policy, whereby any HOV 3+ vehicle is provided toll-free or discounted access to the express lanes at any time. SOV and HOV 2 are always charged a full toll. This policy is not currently found in California, and is inconsistent with existing HOV 2+ lane policies, but has been adopted on express lanes in Florida, Georgia and Virginia.

4. **Adopt HOV 3+ toll-free during off-peak periods; full or discounted tolls would be charged to HOV 3+ during peak periods.** This policy reflects that of SR-91 in Orange County, as discounted tolls are applied on HOV-3+ in the eastbound direction at certain times of the days and days of the week.

Express lane development in Southern California point towards a hybrid approach to accommodating HOV's on the network. Whereas legacy HOV lanes are largely HOV 2+, the express lanes currently in operations and those being developed have generally converged upon an HOV 3+ policy for discount and/or toll-free service. Although in some cases, the HOV policy is explicitly to make the project financially viable, in most cases it is necessary for traffic management purposes and the ability to continue to provide a reliable, quality, low-delay facility for transit and all customers.

Occupancy Requirements:
HOV Occupancy determinations should be made based on agency goals for mobility and revenue, and the performance of managed lanes to ensure they do not become degraded. HOV occupancy requirements should also be informed by travel demand modeling to determine HOV demand on a corridor and regional level.

6.2.1.1 HOV Exemption Recommendations

Vehicles that are eligible to utilize HOV lanes in accordance with applicable federal or state statutes will generally be allowed toll-free or discounted toll access to express lanes. These vehicles include carpools and vanpools carrying the required number of occupants, emergency vehicles (responding to a qualifying event), mass transit buses, motorcycles, and paratransit vehicles. In terms of HOV use of express lanes in the SCAG region, HOV 3+ toll-free or discounted tolls during peak periods; maintain HOV 2+ during off-peak periods (Option 2 above) is recommended as the default condition for facilities involving the conversion of existing HOV 2+ lanes to express lane operations, while a full-time HOV 3+ toll-free or discounted toll policy is recommended for facilities involving new construction. This combination of policy options best achieves the balance of maintaining HOV occupancy requirements on existing facilities for a majority of the day, restoring peak period performance on degraded facilities, improving overall corridor throughput, and preserving high-quality capacity for multi-occupant vehicles. A higher level of occupancy requirements (Option 4) is permitted wherever the implementing and/or operating agency determines a peak period HOV-3+ full or discounted toll policy is necessary to maximize corridor performance or desirable to enhance revenue generation.

6.2.2 Toll-Free / Discounts for Alternative Fuel Vehicles

Those vehicles that are eligible under state statute to utilize HOV lanes are typically allowed toll-free access to express lanes. The California Vehicle Code allows qualifying ILEV, which are primarily zero-emission vehicles and certain alternative fuel vehicles, with Access OK decals issued by the Department of Motor Vehicles, to use HOV lanes.[105] There is no limit on the number of these white-colored decals (Figure 6-3) issued to ILEVs, and the decals are valid until January 1, 2019, as amended by AB 266.[106] In addition, vehicles that meet California's AT PZEV

[105] California Vehicle Code § 5205.5
[106] http://www.arb.ca.gov/msprog/carpool/carpool.htm

standard, which are generally plug-in hybrid vehicles, are eligible for green-colored decals. These green-colored decals are available to the first 85,000 applicants that meet the AT PZEV requirement and are valid until January 1, 2019, as amended by AB 95. CARB maintains the list of eligible vehicles for these programs. Federal FAST Act legislation extends authorization allowing qualifying low-emission and energy-efficient vehicles HOV access through 2025.

Figure 6-3: Example Access OK Identifier Decal

23 U.S.C. § 166(b)(4) provides specific authority allowing vehicles not meeting the occupancy limitations to operate on HOV lanes, including eligible low-emissions and hybrid vehicles. However, 23 U.S.C. § 166 also requires that states must annually certify that HOV facilities, including those converted to express lanes, continue to meet minimum operational performance requirements. As part of this certification, states must provide a clear demonstration that the presence of tolled and/or low emission and hybrid vehicles have not caused the facility to become degraded. States are required to mitigate any degradation within 180 days by increasing HOV lanes occupancy, varying tolls on non-HOVs, discontinuing non-HOV use or increasing HOV lanes capacity. Failure to bring a facility into compliance within 180 days may result in the imposition of sanctions such as withholding federal funds or project approvals, until the performance of such facility is no longer degraded. Consistent with the performance provision of 23 U.S.C. § 166, California Vehicle Code §5205.5 (d) provides for the Department of Transportation to remove individual HOV lanes, or portions of those lanes, during periods of peak congestion from the low emissions and hybrid vehicles access provisions of §5205.5 (a), "following a finding that the lane, or portion thereof, exceeds a LOS C", and "the operation or projected operation of the vehicles described in §5205.5 (a) in these lanes, or portions thereof, will significantly increase congestion."

6.2.2.1 Clean Air Vehicle Exemption Recommendations

The continuing use of HOV lanes by qualifying low emission vehicles regardless of the number of occupants, as well as toll-free use of express lanes by the same vehicles clearly has consequences to the performance of the lanes and contributes to degraded conditions. The 2013 California High-Occupancy Vehicle Lane Degradation Determination Report further documents that over half the lane miles of the HOV lanes in Caltrans District 7 were considered to be degraded in accordance with 23 U.S.C. § 166 during the same time period, with slightly less than half of the HOV lane miles in the SCAG region having the same finding. AB 1721 in 2014 enabled express lane operators to charge white and green decaled vehicles discounted tolls. However, to maximize the person movement potential of HOV lanes, to ensure demand for the lanes can be better

Clean Air Vehicle Exemptions:
In accordance with federal and state performance requirements, enhanced AT PZEV and ILEV should no longer be permitted to use express lanes during peak periods without the necessary minimum number of occupants or payment of the relevant toll to ensure demand can be appropriately managed and degradation of lanes can be mitigated.

managed long-term, and to comply with the HOV lane degradation provisions of 23 U.S.C. § 166 and California Vehicle Code §5205.5 (d), it is necessary that enhanced AT PZEV and ILEV no longer be permitted to use express lanes without the necessary minimum number of occupants or payment of the relevant toll.

The Southern California partner agencies recommended, in accordance with 23 U.S.C. § 166 and California Vehicle Code §5205.5 (d), to discontinue HOV lane access and toll-free express lane use by ILEV and enhanced AT PZEV without the required minimum number of vehicle occupants during peak periods based on the findings of performance measurements conducted by Caltrans. When degraded conditions are observed in more than 40 percent of express lane miles in the region during an off-peak period, express lane access for ILEV and enhanced AT PZEV without the required minimum number of vehicle occupants should be discontinued for the corresponding off peak period. Recognizing the existing high level of utilization on many regional HOV lanes, especially during peak periods, and the extent of the current level of express lane degradation in the region, discontinuing HOV and express lane use by ILEV and enhanced AT PZEV should be applied consistently across the region to minimize the potential for driver confusion due to inconsistencies between corridors.

6.3 Hours of Operation

Given the high utilization rates on the 700-mile HOV and express lane network in the six-county SCAG region (excluding Imperial County), all HOV and express lane facilities in Los Angeles, Orange, San Bernardino, Riverside and Ventura counties operate 24 hours a day, seven days a week, with the exception of SR-14 between Santa Clarita and Palmdale and SR-60 from Day Street to Redlands Boulevard in Moreno Valley. Given this important precedent and continued heavy demand for express lanes throughout the day, all express lane facilities will continue to operate 24 hours a day, seven days a week.

It is important to note, however, that changes in certain operational requirements including occupancy rates may be needed during peak periods, as articulated in Section 6.2. Additional travel demand analysis conducted as a component of project development will be completed to determine if increased peak period occupancy rates may be needed on other corridors in the SCAG project area. Furthermore, traffic performance will be monitored on an on-going basis for all operational facilities and partner agencies will take appropriate actions to return performance of any facilities for which average peak period travel speeds fall below the 45 mph minimum speed threshold prescribed in 23 U.S.C. § 166.

6.3.1 Hours of Operation Recommendations

The Southern California partner agencies agreed that all express lane facilities will operate 24 hours a day, seven days a week.

Hours of Operations:
Express lanes facilities will operate 24 hours a day, seven days a week.

6.4 Tolling System Policies

6.4.1 Pricing Models

Different variable pricing models have been used on express lane projects in Southern California and throughout the U.S., including time of day static variable pricing and dynamic pricing. In addition, tolls may be charged at the facility level where the same toll is applied regardless of where a given motorist accesses the facility. Longer facilities are often broken down into a series of toll zones, each of which has a different cost. In some cases, groups of toll zones may be aggregated into toll segments where motorists are provided with a guaranteed price for all the toll zones in the segment when they first enter the segment, as is the case on the existing Metro ExpressLanes. These mechanisms are discussed in Section 6.1.4, whereby allowance is provided for either pricing model with a preference for segment-based price calculation.

6.4.2 Maximum and Minimum Toll Rates

Whereas time of day pricing yields definitive low and high tolls, dynamically priced express lane facilities often use maximum and minimum toll rate caps to provide context for the management of the system. Minimum toll rates ensure that some level of revenue is collected from toll paying customers during periods of low demand, offsetting operations costs. Maximum toll rate caps prevent toll rates from reaching levels that could cause negative public reaction. If volumes in the express lanes continue to increase after the maximum toll rate is reached, the toll system can close access to the lanes to all paying vehicles, leaving the lanes to operate in an HOV only mode until demand is reduced and the system has returned to a manageable state. This approach is currently utilized by Metro on the existing I-10 and I-110 ExpressLanes.

If used, minimum and maximum toll rates should be evaluated and adjusted periodically to account for changes in the value of time savings to drivers along with other economic factors to ensure that speeds in the express lanes are being maintained above the minimum 45 mph threshold. Similarly, toll rates should also be adjusted as the regional express lane network is expanded and longer distances of uninterrupted express lane travel are available affecting drivers' willingness to pay different amounts.

6.4.2.1 Toll Rate Recommendations

Minimum and maximum toll rates may be established on dynamically priced facilities. However, minimum and maximum toll rates should be established with careful consideration to ensure they do not inadvertently restrict the ability to use pricing to manage demand. Furthermore, the function of the network should not be constrained by pre-determined minimum and maximum toll rates that were originally put in place for smaller individual corridors.

Toll Rates:
Minimum and maximum toll rates may be established, but should be carefully considered to ensure they do not constrain the ability adequately manage performance in express lanes.

6.4.3 Segment-Based and Zone-Based Pricing

In longer corridors, express lanes are often divided into smaller toll segments and/or zones. Segment-based and/or zone based pricing is used because a single toll rate is not capable of managing demand across the entire corridor, as varying conditions could warrant lower or higher toll rates on certain portions. For the purposes of the SCAG regional express lane network, the following definitions of segment, zone and corridor are used:

- *Segment* is the portion of the express lanes between adjacent access points;
- *Zone* is a pre-specified group of contiguous express lanes segments[107];
- *Corridor* is the overall extent of the express lane facility.

6.4.3.1 Segment-Based Pricing

Segment-based pricing applies a separate toll rate to each defined segment along the corridor based on traffic conditions within that segment. In this way, segments with higher levels of congestion will have higher toll rates, but without causing unnecessary increases in other segments where demand does not justify them. The prevailing toll rate for each defined segment is charged to any vehicle detected in the express lanes within the limits of the segment.

The beginning and end points of pricing segments are usually defined by the contiguous access points for a limited access facility, or proximate interchanges with other highways or major streets for a continuous access facility. Ideally, traffic volume characteristics within a given segment should not vary drastically. Bottleneck locations should be captured within a single segment. The length of most toll segments varies from two to four miles, although specific conditions may warrant segments of different lengths. The length of a segment will also be constrained by the fact that demand will need to be effectively managed along the entire length of the segment.

Multiple segments can be aggregated into a pricing zone or corridor for the purposes of communicating and guaranteeing toll rates to customers for multiple destinations. I-10 and I-110 ExpressLanes in Los Angeles County both apply segment-based pricing whereby the toll is calculated for each toll segment and aggregated for the respective corridors allowing driver to pay for only the segment(s) they used while also allowing them to see the prevailing toll to traverse the entire length of the corridor.

Although the toll rate for a particular segment is determined based on traffic conditions within the segment, toll systems should incorporate the ability to take traffic conditions in adjacent segments into consideration when calculating the toll rate for a segment. This allows the toll system to increase the toll rate upstream of a segment

[107] Zone is also used in the context of toll zone to describe the point within a pricing segment where the ETC equipment is installed on the express lanes to detect those vehicles using the lane as the basis for charging a toll.

experiencing heavy congestion to ensure that the express lanes within the segment do not become over-utilized.

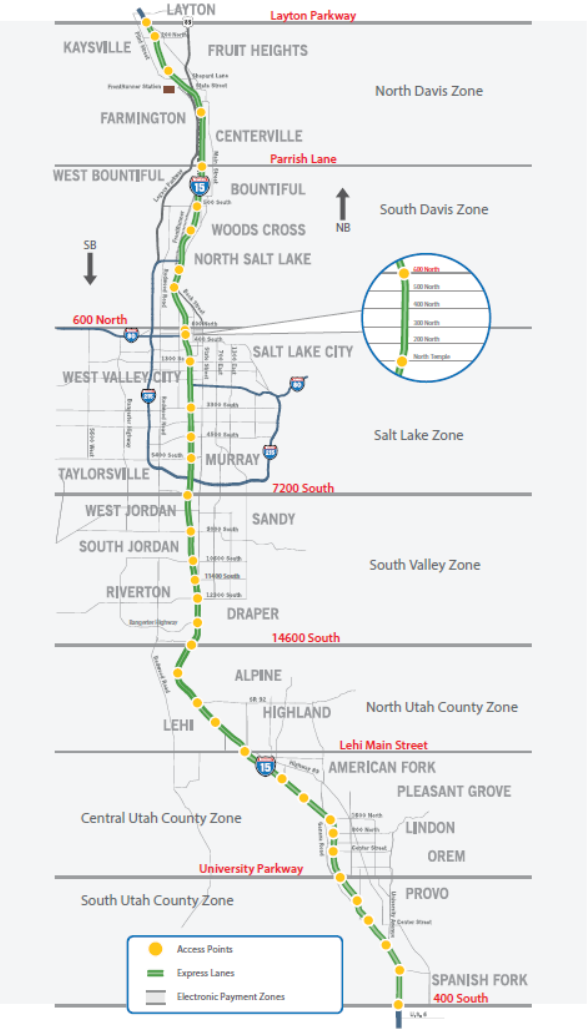
6.4.3.2 Pricing by Zone

Toll zones may similarly be defined by highway ingress and egress points, by minimum or maximum distance thresholds, or by spatial relation to an important decision point or common destination. From the system perspective, zone pricing permits separation of zones with differential travel demands or operational needs so that they can be properly managed through the application of independent tolls being charged for each respective zone. For example, a zone in a highly congested corridor section may be managed for performance objectives whereas a zone in a lightly and/or infrequently congested area may be managed for revenue generation.

A zone-based pricing structure is used to break up guaranteed pricing in longer express lane corridors. As express lane corridors get extended, guaranteeing pricing from too far away can inhibit the ability to manage traffic farther downstream as demand increases over time because the driver may have already locked in an earlier lower toll rate. The approach is being used by the Utah Department of Transportation (UDOT) for the I-15 Express Lanes in Salt Lake City, and is proposed to be used by the Florida Department of Transportation (FDOT) as it extends the Express Lanes along I-95 in Miami.

For the I-15 Express Lanes in Salt Lake City, toll rates are calculated for seven separate toll zones each comprised of multiple segments along the 72-mile corridor. The tolls are charges independently for each zone, regardless of how many segments are traveled within the zone, requiring drivers to reassess their desire to use the lanes at the start of each zone. Drivers traveling along multiple zones on I-15 Express Lanes in Salt Lake City will incur separate tolls for each zone they use with the tolls accumulating as they proceed from one zone to the next to determine their total trip cost. Figure 6-4 illustrates the zone structure utilized for pricing the I-15 Express Lanes in the Salt Lake City area.

Figure 6-4: I-15 Express Lanes Zone Map

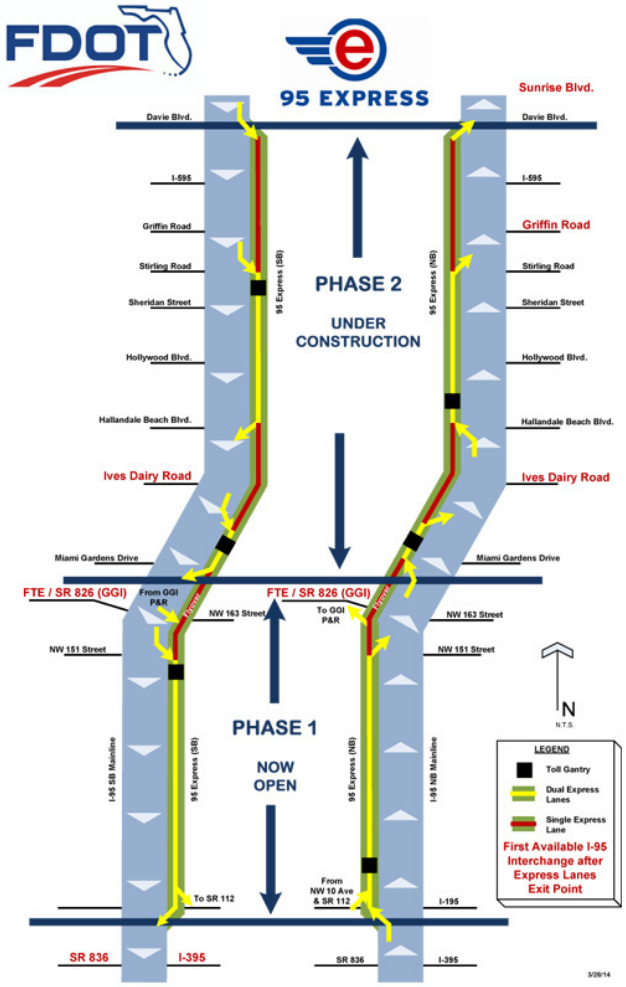


Source: UDOT

With the opening of Phase 2 of the 95 Express Lanes, the facility will incorporate two separate pricing zones, each comprised of multiple pricing segments. Drivers entering the facility will be shown toll rates for travel to the end of each of the segments within the first pricing zone guaranteeing their rate up to that point. As drivers transition from the first zone to the second zone, the toll rate for travel to the end of each of the segments in the second zone will be displayed requiring drivers to reassess their willingness to pay to stay in the lanes. This approach creates a decision point between zones allowing the operating agency to better manage demand within the respective zones. Figure 6-5 illustrates the proposed zone structure for the 95 Express Lanes in Miami in anticipation of Phase 2 opening in the summer of 2016.

Zone-based pricing can also be used to reduce the incentive to weave in and out of the express lane to avoid a toll collection point if the zone incorporates multiple pricing segments and the prevailing toll rate is charged for any use of the pricing zone regardless of how many tolling points or pricing segments the vehicle was observed using. This approach is being proposed by SBCTA for use on the I-10 and I-15 Express Lanes currently being developed for San Bernardino County.

Figure 6-5: 95 Express Lanes Zone Map



Source: FDOT

6.4.3.3 Pricing Model Recommendations

> ***Pricing Models:***
> ***Various methods of pricing can co-exist. In determining pricing zones, facility travel sheds, interconnectivity, and logical termini should be evaluated.***

Southern California partner agencies agree to analyze travel sheds and trip patterns for extended segments and/or zones or multiple facilities to develop pricing models that serve the majority of users, likely using proximity to highway to highway interchanges (where trips tend to disperse) as decision points for network users. Noting that on a network there is often an imbalance in the demand for different trip destinations at the points of divergence, demand balancing at these points may require upstream differential pricing and increases in directional capacity.

6.4.4 Communicating Toll Rates to Motorists

Customers are advised of the prevailing toll rate upstream of entry points via CMS in accordance with guidance found in the MUTCD and CaMUTCD. The prevailing price a customer sees when making a choice to use the lane is locked in once they enter for the destinations signed (and all points in between). To do so, the tolling system design opens a customer transaction at the first toll point, but does not process the completed trip transaction until the vehicle passes final tolling gantries and the transaction is closed.

6.4.4.1 Communicating Toll Rates Recommendations

Information on toll rate pricing structure should be communicated to drivers through destination-based pricing signs incorporating changeable message elements as specified in the MUTCD and CaMUTCD. The destinations shown on the signs should include nearby and farther destinations determined by the facility travel shed, interconnectivity with other corridors, logical termini and major destinations, and the corresponding segment- and/or zone-based pricing structure. The pricing indicated for each destination shown should be locked in at the time the vehicle is first detected using the express lanes within the respective pricing zone to effectively provide a toll rate guarantee. For longer corridors encompassing multiple distinct travel sheds, pricing zones should be divided at logical termini to provide an appropriate decision point to communicate new toll rates for destinations in the subsequent zone thereby allowing drivers to reassess continuing in the lanes or exiting, accordingly. Where multiple pricing zones are utilized to represent distinct travel sheds or multiple logical termini, progressive overlapping of destinations in subsequent zones should not occur on signage to avoid establishing an expectation of a toll rate guarantee beyond the current zone (in other words, destinations on signage should only include those destinations guaranteed pricing within the particular zone). Regardless of the specified destinations or established termini, communication with motorists must appear uniform to minimize the potential for confusion.

6.5 Toll Collection Business Rules

As plans for the regional express lane network are refined, it will be necessary to develop a set of business rules that describe how the various situations that arise in the day-to-day operation of the express lanes should be handled by the toll system operator back office accounting and customer service center. Given the nature of the network, this will inevitably involve multiple partner agencies. For example, a toll collection business rule will be required to describe how to handle a customer that unintentionally entered the express lanes and was charged a toll, but disputes the toll charged. Business rules can be unique to a specific facility. However, one option for this particular rule would be to allow customers one free unintentional trip as a mitigation action and then send them a letter informing them how they can register for an account and that they would be responsible for paying for all future trips and any related fines.

6.5.1 Business Rules Recommendations

> ***Business Rules:***
> ***Each operator will develop business rules specific to the goals and objectives of the particular facility, and consistent with the characteristics of their organizational and facility operations structure.***

Each operator will have different business rules for each facility. The combined business rules will be a living document that will be completed as the express lane system is developed allowing project stakeholders to vet, refine and agree upon the different policies that will be needed to operate the express lane system. The partner agencies acknowledge that changes in business rules on the part of one operator may affect utilization of the express lane network and compliance with federal and state requirements.

6.5.2 Use of Toll Revenue

While the regional express lane network will generate toll revenue, in accordance with state statutes these revenues must be prioritized to cover the costs involved in constructing, operating and maintaining the network. Within the region, excess revenue is oriented towards completing the network, as well as other projects within operating corridors.

6.5.2.1 Toll Revenue Allocation

The most fundamental input into policies on the use of toll revenues is determining whether they will apply region-wide, within individual counties, groups of projects, or individual projects. Given the different institutional structures and toll policies within the SCAG counties, it is likely that a number of parallel policies will need to be put into place in order to guide the development of an express lanes network that is as expansive as envisioned in the SCAG region.

Toll revenue allocation policies will need to take into account differences in legal policies governing the implementation of toll facilities by partner agencies. For example, it is a policy requirement that all toll facilities in Orange County are self-financed, relying on toll revenues alone. Other revenue sources such as local or county sales tax measures may not be used to finance toll roads in Orange County. This policy drives the development and design of toll facilities in Orange County, as they must be financed on a stand-alone, limited recourse basis. This requires a careful balance between the design of the toll facilities and the revenues they will generate. Projects must be sized so that they can be financed by the expected toll proceeds within the terms and conditions specified by the covenants underlying the toll revenue bonds used to finance them. While certain enhancements or expansions may be attractive from other public policy perspectives, they are not possible if they increase capital construction costs to the point where a toll project is no longer financeable on the resulting toll revenues alone.

Some express lanes on the network will involve the conversion of existing HOV facilities and require relatively minor capital improvements whereas others will involve the reconstruction of entire highway corridors where there may be improvements to, or expansion of, the general-purpose lanes to accompany new express lanes. This may require developing unique toll allocation policies for more complex projects.

Express lane toll revenues are likely to be collected by a number of toll operators within the region and then credited to the agency responsible for operating the facility or facilities that the user accessed through the CTOC clearinghouse. Toll proceeds will be used to cover the cost of operating the express lane network and to pay for constructing the network. In the event that there are additional revenues available after these costs have been paid, a policy decision will need to be made on how the remaining revenue, if there is any, would be used. One guiding example could be the net toll reinvestment policy followed by Metro, which governs the Metro ExpressLanes on I-10 and I-110. The Metro policy states that toll revenues must first be used to pay for maintenance, administration, and operation of the ExpressLanes. All remaining revenue must be used in the respective corridor from which it was collected to provide a direct congestion reduction benefit, including transit active transportation, and highway improvements.

In a system as extensive as the envisioned Southern California express lane network, some express lane segments will generate excess revenues, some will break even, and others will operate at a deficit. One likely approach to this situation would be to use the excess revenues from those facilities generating a profit to cover the income gap of those segments operating at a deficit but necessary to ensure system continuity. Based on the current structure of the CTCs and Caltrans districts, this revenue sharing could be expected to occur inherently at a county or district level, but could also be considered, based on interagency cooperation and agreement, to occur at a subregional or regional level. Revenue sharing would likely occur only if there are excess revenues after all deficits have been covered, with excess revenues potentially being used to cover express lane network expansion and other transportation related improvements or programs within the express lane corridor(s), as agreed upon by the Southern California partner agencies and in accordance with state and federal legislative requirements. However, it is not known if the system would actually generate any excess revenues. Therefore, while it is prudent to agree on policies to manage this possibility, the regional partner agencies should not assume that this outcome will actually occur.

6.5.2.2 Toll Revenue Allocation Recommendations

Revenue Allocation:
Identify and prioritize operational expenses for primary allocation of revenues. Secondary use of revenue could include transit or HOV within the corridor.

Inter-county coordination is critical for facilities that cross county lines. In particular, implementing agencies should coordinate to assess the exchange or sharing of excess revenues on a project basis where facilities meet at the county line and there are demonstrable benefits to the respective agencies. The implementing agencies will identify and prioritize operational expenses in order to demonstrate revenue allocation in accordance with Streets and Highways Code § 149.2 and § 149.9. Primary use of revenues will include maintenance, operation and enforcement of the facility generating the revenues, while secondary use of revenue could include transit service or HOV development in corridor. Implementing agencies should explicitly identify whether incentives and equity mitigation is a fundamental part of operations (primary expense) or associated with transit services or HOV expansion (secondary expense).

6.6 Current State of the Practice

Table 6-1 provides a summary of operational policies currently in use or planned on express lane projects in the SCAG region.

Table 6-1: Express Lane Operational Policies in the SCAG Region

Topic	Metro		OCTA		RCTC		SBCTA	
	I-10	I-110	SR-91	I-405*	SR-91*	I-15*	I-10*	I-15*
Hours of Operation	24/7	24/7	24/7	24/7	24/7	24/7	24/7	24/7
Pricing Scheme	Dynamic	Dynamic	Schedule	Schedule	Schedule	Dynamic	Dynamic	Dynamic
Pricing Interval	Per Segment	Per Segment	Per Corridor	TBD	Per Corridor	Per Segment	Per Zone	Per Zone
License Plate Tolling	Secondary	Secondary	Secondary	TBD	Secondary	Secondary	Yes	Yes
Switchable Transponders for Occupancy	Yes	Yes	No	TBD	No	Yes	Yes	Yes
Adopted Title 21 or any subsequent CTOC standard	Yes	Yes	Yes	TBD	Yes	Yes	Yes	Yes
Carpool Definition	HOV3+ pk / HOV2+ off-pk	HOV2+	HOV3+	TBD	HOV3+	HOV3+	HOV3+	HOV3+
Clean Air Vehicles*	Free	Free	Free	TBD	Free	Discounted	Free or discounted	Free or discounted

Note: * CAV exemption expires 2019

6.7 Interfaces with Other Projects and Systems

There are several projects and ITS deployments within the SCAG region that the regional express lane network will need to interface with. Whereas the technical requirements that need to be considered to achieve these interfaces are described in Chapter 8.0, the following narrative describes the effects of these interfaces upon the SCAG express lane network operations in concept.

The goal is for all express lanes in the region to ultimately form a seamless network that allows users to travel between express lanes operated by different agencies while maintaining a familiar look and feel. The policies and practices identified as part of this ConOps help achieve this goal by promoting a consistency and coordination of experience for the end users. Besides user consistency, it will be necessary for the individual corridor toll systems to communicate with each other to ensure that the operating conditions on one express lane facility does not adversely affect conditions on other facilities. For example, an express lane that closes to non-HOV vehicles when demand approaches the critical operating threshold could affect the information being provided to upstream facilities operated by a different agency. The same is true if an express lane is closed to all vehicles during an incident. As discussed earlier, there may also be a need for express lane pricing algorithms to be coordinated to ensure that demand is managed efficiently.

6.7.1 Network Recommendations

Regional Network Coordination:
The implementation of a regional express lane network requires collaboration and coordination across multiple agencies. The partner agencies should meet regularly to coordinate on issues of regional significance.

The implementation and operation of the regional express lane network will require the collaboration of multiple public agencies. The structure for partner agency collaboration and coordination as part of the development of this ConOps provides an appropriate forum for continued collaboration and coordination. The partner agencies should continue to meet and coordinate regularly to resolve issues related to the regional express lane network and to provide assurance for the performance of the network on whole.

6.8 Framework for Analysis of Social Equity and Environmental Justice

To be successful, SCAG and its regional partners will have to engage the Southern California community in an open, transparent, and inclusive process for evaluating the potential social equity and environmental justice (EJ) concerns associated with the regional express lane network. As interest in pricing alternatives on highways has grown, so too has concern that pricing proposals may be unfair to some drivers or population groups such as the transit-dependent or low-income. A key reason for public reluctance toward acceptance of roadway pricing can be the failure to address equity concerns adequately. Despite the many social and economic benefits of road pricing, educating the public on the value of tolling requires a careful analysis of the distribution of costs and benefits across different socioeconomic groups, especially where the impacts may be felt by a large and diverse number of people.

6.8.1 Non-Discrimination and Environmental Justice

An equity evaluation should include the framework laid out by the federal government and the state of California regarding various regulations and guidelines to prevent discrimination against EJ communities. In addition, SCAG can rely on the overarching mission documented in the adopted 2012 RTP/SCS to guide the equity analysis:

> *It is SCAG's role to ensure that when transportation decisions are made, low-income and minority communities have ample opportunity to participate in the decision-making process and that they receive an equitable distribution of benefits and not a disproportionate share of burdens.*

6.8.2 SCAG Regional Transportation Plan Equity Analysis

In the previously adopted 2012 RTP/SCS, SCAG identified 11 performance measures to analyze existing social and environmental equity in the region and to address disadvantaged population groups. Several of these measures are specifically relevant to the current regional express lane network study: (1) distribution of travel

time savings and travel distance reductions; (2) accessibility to employment and services; and (3) environmental impacts along highways and highly traveled corridors.

Travel behavior varies by race, ethnicity, gender, age, health condition, household size and composition, income level, place of residence, and other factors. In addition to the direct toll charges, requirements such as deposits or down payments to obtain a transponder, the need for a credit card or checking account to set up a payment account, or minimum balance requirements may make it harder for people to access the system. Language barriers or other difficulties in comprehension may also discourage some travelers from using the system. While it is not possible to detail all the possible impacts that the present proposal might have on different groups of people with regard to the categories previously stated, the equity assessment that is ultimately implemented should be prepared to take them into consideration.

6.8.3 Applying Equity Principles / Best Practices to Tolled Facilities

Many congestion pricing proposals have encountered substantial public resistance and even intense opposition. In general, tolling opponents have raised a number of objections including: (1) drivers are paying for what has traditionally been free; (2) drivers are paying twice for same facilities (gasoline taxes plus tolls); and (3) there are disproportionate distributions of costs / benefits.

Tolling is generally rated more equitable where it is used to finance new express lane facilities such as the 91 Express Lanes in Orange County[108]. But it should be noted that pricing also addresses some of the added costs of congestion that are being imposed on all motorists from overuse during peak periods by collecting fees from at least some drivers. Since the regional express lane network may consist of both new express lanes and HOV lane conversions, attention should be paid to justifying the need for tolling (demand management, paying for repairs, replacement, etc.) as well as defining and providing information to the public on alternative financing mechanisms to assure the public that the costs imposed are being fairly apportioned according to various equity criteria. It is important to note that all highway users (even low-income) may benefit indirectly from the additional road capacity as those willing to pay to enter the express lanes will not be competing for space on the existing general-purpose lanes.

A survey of drivers on the 91 Express Lanes in Orange County found that households earning below $50,000 annually used the lanes about as often as those earning $200,000 or more. Another study showed that 19 percent of peak period users had household incomes below $40,000 and only 21 percent above $100,000[109]. A study of the I-15 Express Lanes in San Diego County found strong support among all income levels[110].

Still, one of the most frequent criticisms of express lanes is that they primarily benefit high-income drivers who can afford to pay a toll for premium travel while low-income drivers are forced to ride on the more congested

[108] Schweitzer and Taylor, 2008
[109] Sullivan, 2000
[110] Zmud and Arce, 2008

general-purpose lanes or take other routes. The impression that express lanes are really just so called Lexus lanes is a powerful impediment to achieving public acceptance for these pricing mechanisms, even if other finance mechanisms such as sales and fuels taxes are more regressive.

While express lanes utilization (and user costs) generally increases with income, as shown by studies of the Minnesota I-394 project and the 91 Express Lanes[111], it should be noted that voluntary tolls can still be considered regressive since it takes a higher proportion of income from low income households that use priced facilities, though the amount can vary depending on "geographic context and the choices available to low-income motorists"[112].

Regarding best practices, the San Francisco Bay Bridge project has offered lifeline credits for low-income motorists to counter the costs of tolls to cross the span between Oakland and San Francisco. In Southern California, Metro offers low-income residents of Los Angeles County a per-household account set-up fee waiver equal to the cost of the required transponder, about $25, for accounts related to the I-110 and I-10 ExpressLanes. Metro has also addressed the needs of transit riders along the two express lane corridors by offering frequent transit riders (many of whom are low-income) a $5 toll credit for using a Transit Access Pass (TAP) card on certain routes more than a set minimum of times each month. As demonstrated with these cases, concerns over high toll prices have been addressed by offering certain drivers discounts or rebates, special promotions, or other cost reducing measures.

6.8.4 Recommendations for Designing an Equity Process

Equity Analysis:
An ongoing process for analyzing equity implications should be undertaken for every express lanes project to understand the effects on all potential users and to determine appropriate strategies to ameliorate equity impacts and concerns over time.

The main objective in undertaking an equity analysis should be to understand how the proposal will affect specific EJ communities and how it can be made fairer for all. It should involve looking at both short term and long term impacts, and build in flexibility to respond if and when conditions may change. Experience has shown that public engagement is crucial in addressing concerns about and building public support for road pricing proposals. Most problems surrounding public acceptance of controversial new policies such as tolling often stem from the perception that participation will have no impact on outcomes, since project decisions have already been made and equity concerns are only an afterthought. The community should be engaged in a process that provides a wide-ranging, meaningful public dialogue about the proposed network, how it will be financed, how the revenues will be collected and spent, what the equity impacts may be, and how any negative consequences can be minimized and mitigated. As done with the 2012 RTP/SCS, SCAG and its partner agencies can draw on its list of key

[111] Pattenson, 2007; Supernak et al., 2002; Sullivan 2000
[112] Schweitzer, 2009, p. 2

stakeholder individuals and organizations, including local community advocates, environmental groups and unions to develop specific outreach strategies to EJ communities.

The direct costs of the project will be borne primarily by those who pay the tolls to access the express lanes. The focus of the equity assessment should be on determining whether these costs fall disproportionately on particular groups (both as total costs and as a percentage of household income) and if that is fair reasonable in light of the ability to pay, benefits received, or costs imposed principles. Some equity categories that an implementing operating agency should consider while undertaking an EJ analysis with regard to proposed express lanes include:

***Individual / Group Equity*:** Depending on the financing plan some individuals could be worse off to the extent they pay gasoline or sales taxes and the revenue collected is spent to fund express lanes that they will not use rather than some other services. The evaluation should consider how sources of funding may impact different groups and whether any imbalance can be mitigated by changing the way that any revenues from tolling are spent.

***Modal Equity*:** The evaluation should also consider the distribution of indirect costs and other non-economic factors, like whether current carpoolers may be diverted onto the general-purpose lanes and if non-express lane users may experience more traffic congestion, and which groups change their travel modes or trip-making behavior.

Geographic Equity: Noise, air quality and traffic impacts on local communities and neighborhoods should also be evaluated. Additional potential impacts could include changes in land use patterns that might take place due to changes in accessibility or local traffic patterns affecting residents and businesses in low-income or disadvantaged areas.

Most congestion pricing studies assume travelers can assign some monetary value to the time saved from avoiding delays caused by congestion. Even low-income drivers may place a high value on saving time, especially if they must get to work on time or risk losing employment, and may be more willing to incur toll charges, at least some of the time. While higher income individuals generally place a greater value on the time saved from avoiding congestion and will find it easier to bear the additional cost and thus gain the most benefits, the fact that any driver will have the option to use the tolled lanes in situations when the value of time saved exceeds the toll charged, indicates that even low-income drivers may benefit. Additionally, all drivers in the corridor, irrespective of their income level, may benefit from travel time savings in the general-purpose lanes as a result of other drivers moving from the general-purpose lanes to the express lanes. In short, having an express lane option available could be one sign that low income drivers will be better off if the project is implemented.

Additional policies that could increase the chances that low-income and other drivers will take advantage of that opportunity could include: (1) giving exemption, discounts, subsidies, or rebates to encourage express lanes use; (2) offering credits for alternative transportation services, and (3) allowing different methods for toll payment.

The key question will be whether the program has been designed to achieve an equitable distribution of the costs and benefits that have been identified. The equity assessment process should also consider whether there are other travel alternatives for those who may not drive or have access to an automobile, but might benefit from more express bus service or other transit improvements such as vanpools in the corridor or within the region more generally.

Equity considerations will not end when an express lane project is approved or even completed. Since it is impossible to foresee all the possible impacts, it is important to put in place procedures to monitor the express lane program on an ongoing basis. Performance measures should be established and information regularly collected to identify any issues that may arise. The touchstone of a successful equity evaluation process should be whether there is general consensus that the proposal together with any accompanying transportation enhancements improve mobility and accessibility for all populations without disproportionately disadvantaging or harming EJ communities.

7.0 ROLES AND RESPONSIBILITIES

The County Transportation Commissions Act was enacted in 1976 ultimately leading to the creation of the CTCs in each of the regional express lane network study area counties.[113] In establishing the CTCs, the legislature recognized public demand for efficient transportation infrastructure and the need for coordinated planning and policy to accomplish necessary improvements.[114] The CTCs in the five-county SCAG regional express lane network study area include:

- Metro
- OCTA
- RCTC
- SBCTA
- VCTC

The CTCs were also designated as Congestion Management Agencies (CMAs) in 1990 with the passage of Proposition 111 which doubled the state motor fuel tax and required that each county designate a county-wide body to implement programs to keep traffic conditions manageable.[115]

To date, the CTCs, in partnership with Caltrans and FHWA, have taken the lead in implementing all operational express lane facilities in the region and in conducting feasibility, environmental clearance, and design efforts for future express lane projects. It is assumed that the CTC's, as well as Caltrans, will serve in this role and oversee the construction of new express lane projects within the SCAG region. However, certain functions such as toll collection, back office accounting operations, and customer service may be consolidated and centralized.

With express lane corridors extending across county lines, county officials may decide to establish JPAs to oversee the implementation and operation of those projects. Corridors crossing county lines where express lanes are being considered in this study include:

Los Angeles—Orange

- I-5
- I-405
- SR-57
- SR-91

[113] Cal. Pub. Util. Code §130000
[114] Cal. Pub. Util. Code §130001
[115] The Traffic Congestion Relief And Spending Limitation Act Of 1990, California Proposition 111 (1990)

Los Angeles—San Bernardino

- I-10
- I-210
- SR-60
- SR-71

Los Angeles—Ventura

- US-101

Riverside—San Bernardino

- I-10
- I-15
- I-215

Riverside—San Diego

- I-15

Orange—San Diego

- I-5

7.1 Los Angeles County Metropolitan Transportation Authority (Metro)

Branded as Metro, the Los Angeles County Metropolitan Transportation Authority is the state-chartered regional transportation planning agency and public transportation operating agency for Los Angeles County. Metro was formed in 1993 through the merger of the Southern California Rapid Transit District and the Los Angeles County Transportation Commission. It is responsible for transportation planning, policy, and funding programs in Los Angeles County and it is also the county's primary transit provider. The agency operates the third-largest public transportation system in the United States with over 2,000 buses and nearly 90 miles of rail transit lines.

Metro operates the I-10 and I-110 ExpressLanes and is also studying the possible conversion of HOV lanes in other highway corridors in Los Angeles County to express lane operation. It has partnered with Caltrans and other mobility partners in developing the I-10 and I-110 ExpressLanes. The agency is also currently undertaking a T&R study for express lanes option on I-405 from I-10 to US 101, and is coordinating with Caltrans to undertake T&R, ConOps and PA&ED for potential express lanes conversion and expansion of the existing HOV lanes along I-105 from I-405 to I-605.

7.2 Orange County Transportation Authority (OCTA)

OCTA is the primary transportation agency in Orange County. It was formed in 1991 through the consolidation of seven separate transportation agencies. OCTA is responsible for formulating transportation policy and funding priorities in Orange County and for all transportation planning activities. OCTA operates bus service in Orange County and also administers the M2 local sales tax measure. In 2003, OCTA took over the operation of the 91 Express Lanes.

More recently, Caltrans and OCTA studied three options for adding managed lanes to a 16-mile section of I-405 between SR-73 and I-605 as part of an EIR / EIS. OCTA's Board of Directors subsequently approved adding one new general-purpose lane in each direction of I-405 with funding for this project being provided through Measure M. The Board also approved a cooperative strategy for Caltrans District 12 to lead the implementation of two express lanes in each direction of I-405 from SR-73 to I-605 incorporating the existing HOV lanes and direct connectors that opened in 2014. In approving the cooperative strategy for implementing the express lanes along I-405, the OCTA Board reiterated the position that all toll facilities in the county must pay for themselves, dictating that no Measure M sales tax revenue can be used to construct the I-405 Express Lanes facility. The I-405 Express Lanes project is expected to be funded by a combination of state and federal funds, as well as toll-backed financing.

OCTA also coordinates closely with RCTC with the extension of the 91 Express Lanes into Riverside County.

7.3 Riverside County Transportation Commission (RCTC)

RCTC was created by the California legislature in 1976. The agency plans and implements transportation and transit improvement projects in Riverside County. Unlike Los Angeles and Orange counties, RCTC does not provide transit services in Riverside County. The Riverside Transit Agency (RTA), which was established as a JPA in 1975, is the transit provider for the western portion of Riverside County. One of RCTC's primary responsibilities is administering Measure A which is a half-cent sales tax funding highway, local street and transit project throughout Riverside County. RCTC also allocates all state and federal transportation funding in Riverside County.

RCTC completed the 91 Express Lanes extension eight miles eastward from the Orange County Line to the I-15 interchange in 2017. The project converted the existing HOV lanes to express lanes operation and added a second express lane in each direction. The project also added one general-purpose lane in each direction from SR-71 to I-15 and made improvements to bridges and interchanges, including the addition of auxiliary or merge lanes for improved access. Direct connectors to / from the express lanes to I-15 south of SR-91 were also included.

The new 91 Express Lanes use the same ETC system, toll operator, and congestion pricing scheme as the existing 91 Express Lanes in Orange County. HOV 3+ use the express lanes for free or at a discount depending on the

time and day of use. The extension project features static variable pricing similar to that on the existing 91 Express Lanes. Toll rates will be adjusted quarterly based on express lane toll volumes.

Although the existing 91 Express Lanes and the 91 Corridor Improvement Project are two separate projects with their own independent financing, they provide a seamless experience to customers. The two express lane facilities share the same branding and customers receive one consolidated toll charge per trip. However, the back office accounting system track tolls accruing in each of the two counties precisely and disburse toll proceeds to the two counties accordingly. OCTA and RCTC established a joint advisory board to negotiate and agree on a set of business procedures that will achieve the goal of seamless operations.

The SR-91 extension provides a model of the type of collaboration that is necessary when implementing an express lanes project that extends across county lines. The project has required the execution of a total of 17 interagency agreements between RCTC and nine other entities ranging from FHWA to local utility companies. These agreements are discussed in greater detail in Section 7.9 of this document.

RCTC is also proceeding with the implementation of express lanes along I-15. The project will result in the construction of one to two express lanes in each direction of I-15 between SR-60 near the San Bernardino County Line and Cajalco Road. The express lanes are proposed to be constructed in the existing I-15 median and are planned to open in 2020.

A Notice of Intent to Adopt a MND / EA related to the I-15 Express Lanes project was circulated in July 2015 with comments received through August 28, 2015. A ND / FONSI is anticipated to be published in the spring of 2016. In anticipation of the environmental approval, RCTC has entered into a Design Build Cooperative Agreement with Caltrans delineating responsibilities for oversight and construction inspection services. In December 2015, RCTC initiated procurement for Toll Systems Integration and Operation services for the I-15 Express Lanes. RCTC is currently preparing for a Design-Build (DB) procurement for the project with the intent of awarding a contract in 2017 to coincide with the financial close.

7.4 San Bernardino County Transportation Authority (SBCTA)

SBCTA is the council of governments and transportation planning agency for San Bernardino County. SBCTA is responsible for cooperative regional planning and furthering an efficient multi-modal transportation system countywide. As the County Transportation Commission, SBCTA supports highway construction projects, regional and local road improvements, train and bus transportation, railroad crossings, call boxes, ridesharing, congestion management efforts and long-term planning studies. SBCTA administers Measure I, the half-cent transportation sales tax approved by county voters in 1989 and renewed in 2004 to extend to 2040. While SBCTA allocates funding for transit in San Bernardino County, transit services are provided by six local transit agencies. SBCTA was established in 1973, when the County of San Bernardino approved a JPA to create the organization as a Council of Government in 1973 and has taken on additional transportation functions throughout its 43-year history.

The Environmental Impact Report (EIR) / Environmental Impact Statement (EIS) for the I-10 Corridor Project was approved in July 2017. The project is expected to be completed in two phases, with a segment west of I-15 entering service in mid-2022 and the end of construction anticipated in mid-2024.

In early 2018, the I-15 Corridor Project is expected to enter public review and comment period for the Draft Environmental Document. The project is expected to be completed in multiple phases, with an initial phase between Cantu-Galleano Road and Duncan Canyon Road entering service in 2024, a second phase between SR-210 and I-215 entering service in 2026, a third phase between I-215 and US-395 entering service in 2030, and a fourth phase between US-395 and the High Desert Corridor entering service in 2034.

SBCTA has also established an Express Lanes Ad Hoc Committee to review draft tolling policy, investigate technical issues, and monitor costs and schedule for the I-10 and I-15 express lane projects.

7.5 Ventura County Transportation Commission (VCTC)

VCTC is the public sector transportation planning body for Ventura County. VCTC oversees highway, bus, aviation, rail and bicycle activity, and controls the use of government funds for transportation projects in Ventura County. The commission was created by California State Legislature in 1988 and began operation in 1989 when it assumed the transportation responsibilities of the Ventura County Association of Governments.

In January 2014, VCTC began a two-phase study to assess the feasibility of adding express lanes along a 28-mile segment of US-101 HOV lanes between the Los Angeles County line and Highway 33 in Ventura County. In September 2014, members of the VCTC Board opted not to proceed with the second phase of the study because of the high costs of building the project and limited toll revenues. The projects estimated cost ranged from $1.6 billion if built to full Caltrans standards to $700 million with design exceptions. Toll revenues over 30 years were only projected at $128 million. As the only county in the five-county study area without a half cent sales tax dedicated to transportation needs, Ventura County's ability to embark upon a project of this magnitude is limited.

7.6 Southern California Association of Governments (SCAG)

Founded in 1965, SCAG is a JPA under California state law, established as an association of local governments and agencies that voluntarily convene as a forum to address regional issues. Under federal law, SCAG is designated as the MPO for the six county Southern California region, and under state law SCAG is designated as a Regional Transportation Planning Agency and a Council of Governments.

The SCAG region encompasses six counties (Imperial, Los Angeles, Orange, Riverside, San Bernardino and Ventura) and 191 cities in an area covering more than 38,000 square miles. The agency develops the long-range regional transportation plan including sustainable communities' strategy and growth forecast components, the regional transportation improvement program, the regional housing needs allocation, and a portion of the South Coast Air Quality management plan.

In addition to the six counties and 191 cities that make up SCAG's region, there are six CTCs (including the Imperial County Transportation Commission, in addition to the five described previously in this section) that hold the primary responsibility for programming and implementing transportation projects, programs and services in their respective counties. Additionally, SCAG bylaws provide for representation of Native American tribes and Air Districts in the region on the Regional Council and Policy Committees.

SCAG is not an implementing or operating agency and will not play a lead role in the development of express lane facilities in Southern California. However, as an MPO it is responsible for encouraging regional coordination among the counties as they advance planning and design efforts for express lane projects. SCAG's primary vehicle for developing a regional vision for express lanes in Southern California is the regional express lane network component of the SCAG Region Value Pricing Project and its subsequent inclusion in the RTP/SCS. Moving forward, SCAG will continue to be a partner agency with the different CTCs as they advance their express lane projects. This will enable SCAG to share its detailed knowledge of express lane project development throughout the region, and ensure individual project sponsors are aware of the express lane policy decisions agreed upon by regional stakeholders.

7.7 California Department of Transportation (Caltrans)

Caltrans manages more than 50,000 miles of California's highway and highway 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 lanes roles include:

- Reviewing and approving all environmental documentation, design and operation plans relating to construction and maintenance activities within state right-of-way.
- Monitoring the operation of the highway and initiating corrective actions when needed to ensure motorist safety.
- Operating a Transportation Management Center (TMC) in each of the Caltrans Districts. Through the TMCs, request override of the express lane toll display messages by the toll system operator when an event occurs that warrants an override.
- Controlling regional Advanced Transportation Management Systems (ATMS).
- Maintaining all roadway elements of the express lanes, other than the toll collection equipment, unless any of the express lane project sponsors hire a contractor for this purpose. If a project sponsor contracts with Caltrans for a higher level of maintenance (e.g., more frequent sweeping), it will reimburse Caltrans

for these services. A Maintenance Agreement with Caltrans will be executed prior to approval for construction for individual express lane projects.

- Monitoring the performance of HOV lanes.
- Owning and maintaining the Highway Performance Monitoring System (PeMS).
- Maintaining Title 21 requirements consistent with statutory instructions.
- Supporting CHP in incident management.

In 2009, Caltrans published the California HOV / Express Lane Business Plan to establish a framework to "lead the state to easily implement more flexible and effective system management strategies for HOV and express lanes". A key aspect of the Business Plan was a focus on "those aspects of HOV and express lane development and operations that can and should be addressed at a state level to increase California's ability to manage congestion with HOV and express lanes". In part, the Business Plan emphasized Caltrans desire to take in a more prominent role in leading the development and implementation of express lane projects within the state.

In March 2011, Caltrans issued TOPD 11-02 titled *High Occupancy Vehicle Guidelines for Planning, Design, and Operations*. TOPD 11-02 offers supplemental guidance for the planning, design and implementation of HOV and express lane projects on state highways in California. The provisions of TOPD 11-02 have subsequently influenced the planning, design and implementation of all managed lane projects currently being developed, particularly related to the design considerations for lane separation and access, engineering study requirements, and performance evaluation.

In May 2015, Caltrans issued *Deputy Directive* (DD) *43-R1* on Managed Lane Facilities, which requires each district which operates or plans to operate managed lanes to develop a managed lane system plan in cooperation with regional agencies. The directive also outlines the following provisions for priced managed lane facilities:

- Tolls shall be collected electronically as a means to manage demand
- Toll revenues shall first be used for facility debt service, capital expenses, maintenance, and operations including CHP enforcement activities
- Excess toll revenues shall be used towards the improvement or preservation of safety, operations, or travel reliability for any mode or travel option in the corridor from which the toll was collected, unless otherwise dictated by state requirements
- A toll revenue expenditure plan, concept of operations, incident management plan, and enforcement plan shall be created during the development or operation of each facility by the responsible agency

Caltrans District 12 is currently undertaking a Managed Lanes Network Study for Orange County. This study will evaluate the feasibility of a proposed express lane system in Orange County. Travel demand analysis is being conducted for the year 2040 using the Orange County Transportation Analysis Model (OCTAM) to test various occupancy strategies. The study will also prepare planning level T&R forecasts which will be used to assess financial feasibility and prioritize the implementation of routes and segments based on demand, performance and cost-effectiveness. Caltrans has partnered with the following agencies in undertaking the study: CHP, OCTA, Metro, SCAG, RCTC, TCA, FHWA, the San Diego Association of Governments (SANDAG), and local jurisdictions.

7.8 Federal Highway Administration (FHWA)

FHWA is the agency within the U.S. Department of Transportation (USDOT) 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 due to the integration of ITS elements such as ETC.

FHWA's express lanes roles include:

- Reviewing and approving improvements and lane operations on Federal Aid Highway Routes.
- Facilitating research and the exchange of information on lessons learned and recommended best practices.
- Providing oversight and review of individual projects.
- Approving ConOps and Systems Engineering Management Plans (SEMP) for all ITS projects.

7.9 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:

- Performing on-site enforcement of express lane eligibility (i.e., HOV, Access OK) requirements with the support of local agency provided tools.
- Enforcing buffer crossing violations in express lanes.
- Leading 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 and to the customer service center (CSC) when incidents require the use of express lanes to divert traffic.

- Providing lane closure enforcement for installation and maintenance activities when required by policy, contract or agreement.

- Enforcing motor vehicle violations.

Project sponsors will need to negotiate agreements with CHP for their enforcement of individual corridors. In many cases, project sponsors opt to pay CHP to implement enhanced enforcement in express lane corridors. It is expected that each of the operating agencies in the SCAG regional express lane network study area will negotiate their own agreements with CHP and that those agreements will be amended as new express lane facilities open to service.

7.10 System Integrators

In California, toll facilities are operated by various agencies and special-purpose districts. Concerned that they would each introduce different, incompatible ETC systems, the California State Legislature passed SB 1523 in 1990, requiring Caltrans to develop a statewide specification that all these toll agencies were required to meet. Three years later, TCA opened the Foothill Toll Road in Orange County, implementing the statewide ETC system for the first time, and branding it as FasTrak. Although TCA holds the registered trademark for the FasTrak name and logo, the brand is now ubiquitous to all Title 21 compliant ETC systems within California. The state continues to delegate the responsibility of selling and maintaining FasTrak accounts to the different toll agencies.

The sponsors of express lane projects in Southern California will likely need to retain the services of a system integrator to design, install and operate toll collection systems on their managed lanes. System integrators provide two main functions: designing and installing the required toll collection and communication equipment in the lanes, and operating the back office accounting and CSC. When a project sponsor implements its first toll project, it typically retains a system integrator to install the necessary equipment and operate the back office and CSC for a designated period of time—often up to five years. When implementing subsequent toll projects, the sponsor could have a different system integrator install ETC equipment in the lanes, but it is typically advisable to have a single back office and CSC covering all of its toll facilities.

There are currently three different private sector toll system integrators operating ETC systems within the five county SCAG regional express lane network study area[116]. They include:

[116] SANDAG also has two separate back office operations for the I-15 Express Lanes and the South Bay Expressway in San Diego County although they are currently exploring options to consolidate these operations

- TransCore, which operates the toll collection system on the San Joaquin Hills and Foothill / Eastern transportation corridors for the TCA in Orange County
- Cofiroute, which operates the toll collection system on the 91 Express Lanes for OCTA
- Xerox which operates the toll collection systems on the I-10 and I-110 ExpressLanes for Metro

It is likely that Metro and OCTA will use their current back office operation to process tolls on any new express lane facilities built in Los Angeles County and Orange County, respectively. Riverside County and Orange County have also agreed to have Cofiroute fulfill the system integrator role on the extension of the 91 Express Lanes into Riverside County to ensure seamless consistency with the existing 91 Express Lanes operations. However, it is currently RCTC's intent to retain its own system integrator and establish its own back office operation for subsequent express lane facilities in Riverside County, including those currently being planned along I-15. SBCTA is also currently exploring options for a system integrator and back office for express lanes in San Bernardino County, including considerations for coordinating back office functions with TCA.

Rather than keeping their separate system integrators, the CTCs could opt to consolidate certain aspects of their operations to use a smaller number of integrators or even a single entity to operate all express lanes in the region. While this would achieve certain efficiencies, it could also introduce challenges, as the different CTCs are likely to have different operational policies and toll structures on their facilities. However, if toll structures, hours of operation, and eligibility requirements are relatively consistent across the region, as is envisioned in the Bay Area Express Lane network, then the argument for having a smaller number of system integrators is compelling. Current plans in the Bay Area, for example, call for BATA to collect tolls on all express lane facilities to be implemented by MTC.

Given that separate back office operations are currently in place in several Southern California counties, it is likely the respective agencies will continue use of these separate back offices in the short to medium term. However, as older systems are replaced and as existing equipment is replaced, there may be opportunities to consolidate. Regardless of the number of system integrators operating express lanes facilities in the SCAG region, all of them will need to use FasTrak and be compatible with CTOC standards and the national transponder protocol that is currently under development, as required by MAP-21.

7.11 Other Stakeholders

7.11.1 Transportation Corridor Agencies (TCA)

TCA are two JPAs formed by the California legislature in 1986 to plan, finance, construct and operate Orange County's 67-mile public toll road system. Fifty-one miles of the system are complete, including the SR-73, SR-133, SR-241 and SR-261 Toll Roads. Elected officials from surrounding cities and county supervisorial districts are appointed to serve on each agency's board of directors. Public oversight ensures that the interests of local communities and drivers are served and that TCA continues to meet the region's growing need for congestion-

free transportation alternatives. TCA was the first operator of the FasTrak ETC system in California and holds the registered trademark to the FasTrak name and logo that is used to brand all ETC systems within the state of California. Each agency implementing an express lane project will need to execute or modify existing license agreements with TCA to use the FasTrak name and logo. The performance of the TCA toll road network has directly supported the performance of the adjacent 91 Express Lanes, and has the potential to benefit any new express lane facility planned in the region. For these reasons, it is essential that close coordination with TCA continues to ensure compatibility and mutual benefit between the toll road network and future express lane facilities.

7.11.2 California Toll Operators Committee (CTOC)

CTOC is a collaborative organization of California's toll facility operators and owners, primarily concerned with developing protocols and resolving issues related to ETC interoperability. CTOC's current members include:

- BATA
- Caltrans
- TCA
- Golden Gate Bridge Highway and Transportation District (GGBHTD)
- Metro
- OCTA
- RCTC
- SBCTA
- SANDAG
- Santa Clara Valley Transportation Authority (VTA)
- Sunol SMART Carpool Lane JPA

CTOC's members have a standing conference call every other month to discuss current tolling issues. CTOC is coordinating closely with the IBTTA in its work to vet and establish a national ETC interoperability standard. It also coordinates with the Alliance for Toll Interoperability which has been established by IBTTA as a hub for sharing license plate and transponder data.

CTOC provides the clearinghouse for all toll operators within the state of California to exchange transaction and account information for all toll systems using FasTrak. This clearinghouse function allows the individual operators to reconcile toll charges for the use of their respective facilities by account holders belonging to other member agencies. In doing so, the clearinghouse provides the forum for member agencies to comply with statewide tolling interoperability requirements.

CTOC has also established the FasTrak Flex brand for electronic toll collection systems within California that utilize self-declaration of vehicle occupancy using a switchable transponder.

7.11.3 California Transportation Finance Authority (CTFA)

The CTFA was created within the State Treasurer's office in 2009. CTFA is authorized to issue revenue bonds to finance transportation projects and to grant approval to a project sponsor to issue revenue bonds for transportation improvements. CTFA may also provide grant approval to a project sponsor to collect tolls as part of the financing plans to repay revenue bonds for specific projects. CTFA provides local transportation agencies a greater ability to sell bonds backed by non-general fund monies in the municipal bond market. CTFA may issue or approve debt on behalf of the CTCs to help finance the different projects comprising the regional express lane network.

7.11.4 California Transportation Commission (CTC)

The CTC was established in 1978 by AB 402 with the intent of providing a single, unified California transportation policy. The CTC replaced and assumed the responsibilities of four independent bodies: The California Highway Commission, the State Transportation Board, the State Aeronautics Board, and the California Toll Bridge Authority.

The CTC includes eleven voting members and two non-voting ex-officio members. Of the eleven voting members, nine are appointed by the Governor, one is appointed by the Senate Rules Committee, and one is appointed by the Speaker of the Assembly. The two ex-officio non-voting members are appointed from the State Senate and Assembly, usually the respective chairs of the transportation policy committee in each house.

The 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 Business, Transportation and Housing Agency (or successor 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.

The CTC's involvement with the SCAG regional express lane network is expected to include:

- Finding CTCs eligible to implement and operate express lane projects
- Reviewing and approving any P3 arrangements that might be used on express lane projects
- Approving the programing of any state funds, if used to fund express lanes

7.12 Express Lane Agreements

A wide variety of agreements are needed in order to gain permissions and formalize the business procedures that must be in place in order to operate an express lane facility. Project sponsors will need to coordinate with all stakeholder agencies in order to determine the number and type of agreements needed. Projects involving

the conversion of an existing HOV facility to express lane operation will require a §166 Memorandum of Understanding (MOU) with FHWA. Maintenance agreements will also be needed with Caltrans, as will agreements on construction access and design approval. Individual project sponsors will also need to negotiate agreements on information sharing with other toll operators in California. They will also need to enter agreements with CHP regarding enforcement on the express lane facilities.

7.12.1 91 Express Lanes Extension

The most comprehensive set of existing express lane agreements developed to date in Southern California involve the extension of the 91 Express Lanes into Riverside County. The extension benefits current users of the 91 Express Lanes, most of whom live in Riverside County. However, OCTA, which operates the existing express lanes segment, and RCTC, which implemented the extension, wanted to make sure that their customers experience a seamless facility.

In order to achieve that vision, the two agencies negotiated on how they would interact with customers once the expanded facility was completed. They have entered into two primary agreements: the first is a Cooperative Agreement between OCTA and RCTC that sets for the procedures on how the two agencies will oversee the DB contract to construct the extension and then O&M the new and existing segments as a single express lane facility. This agreement took approximately three years to complete to address design, construction and startup requirements for the extension. The second is a tripartite agreement between OCTA, RCTC and Cofiroute—the current private sector toll system operator of the operational segment of the 91 Express Lanes in Orange County—outlining how Cofiroute will operate the combined facility, and the roles, responsibilities, scope and costs that each of the three entities will be responsible for. The tripartite agreement took one-and-a-half years to negotiate. OCTA and RCTC created an advisory body comprised of five members from each of the two counties to negotiate construction activities, closures, account procedures, maintenance fees and the sharing of revenues, all of which is memorialized in a ConOps document.

As an example of the types of agreements necessary to successfully implement an express lanes project, RCTC has executed a total of 17 interagency agreements with OCTA and nine other entities to govern the implementation and operation of the 91 Express Lanes Extension. These various agreements are listed below:

FHWA

1. FHWA / Caltrans / RCTC High Profile Project Agreement (FHWA Major Project agreement)
2. FHWA / Caltrans / RCTC Section 129 Tolling Agreement (federal tolling authority)
3. USDOT / FHWA / RCTC Transportation Investment Finance Innovation Act (TIFIA) Loan Agreement

Caltrans

1. Caltrans / RCTC Environmental Phase Cooperative Agreement

2. Caltrans / RCTC Design-Build Phase Cooperative Agreement (roles, responsibilities, cost allocation, Caltrans oversight / inspection / etc.)
3. Caltrans / RCTC Toll Facility Agreement (long-term Operations & Maintenance phase)
4. Caltrans / RCTC Toll Facility Maintenance Agreement (future agreement to contract for specific, routine maintenance services)

OCTA

1. Orange County Transportation Authority / RCTC Cooperative Agreement (agreement between both agencies to jointly operate and maintain a single express lane facility, also design-build phase)
2. Orange County Transportation Authority / RCTC / Cofiroute USA (three-party O&M agreement to share the existing operator, roles, responsibilities, scope, costs)
3. Orange County Public Works Right of Entry

CHP

1. RCTC / CHP Toll Facility Police Services Agreement (future agreement to contract for violation enforcement services)

TCA

1. TCA / RCTC License Agreement (use of TCA's trademarked FasTrak logo for RCTC's toll facilities)

City of Corona

1. City of Corona / RCTC Cooperative Agreement (agreement for all phases of work)

Riverside County

1. Riverside County / RCTC Cooperative Agreement (agreement for all phases of work)
2. Freeway Agreement (between Caltrans / Corona but RCTC serves as the coordinator / facilitator)

Railroad/Utility

1. RCTC / Burlington Northern and Santa Fe (BNSF) Railroad Agreements
2. RCTC / Utility Company Agreements

7.12.2 Future Express Lane Agreements

The exact number of agreements needed for the different express lane facilities to be built as part of the regional express lane network will be driven by their level of institutional complexity, with those extending across county lines, like the 91 Express Lanes Extension, being the most challenging. There may be opportunities to address some issues by modifying existing agreements, and it may be possible to use standardized agreement templates in certain cases. The ongoing collaboration and coordination among the CTCs, Caltrans, FHWA, CHP and all other express lane stakeholder organizations will be extremely helpful in navigating the express lane implementation process and identifying the specific agreements that will be needed in the region as new express lane facilities enter service. This coordination has been mandated as part of AB 194, which requires a regional transportation agency to consult with every local transportation authority and every CMA whose jurisdiction includes the proposed express lane facility. It also enables a local transportation authority or CMA the ability to enter into agreements and act as a lead agency for express lane project development, engineering, financial studies, and environmental documentation. DD 43-R1 also instructs Caltrans, CTCs, and other stakeholders to enter into agreements that define roles, responsibilities, requirements, and use of revenue related to maintenance and operation of managed lanes.

8.0 TECHNICAL REQUIREMENTS

8.1 Introduction to Toll Collection

The regional express lane network will require a variety of equipment, software, and communications infrastructure to operate the various required tolling facilities across Southern California. This infrastructure allows for the pricing of a highway to enable the capability to better manage traffic flow and LOS based on time of day and travel demand. Combining this capability with ATMS and traveler information systems greatly expands the tool box for more effective management of the overall regional transportation network. In all of its forms, ETC consists of the following four primary components:

- **Collecting the toll**—although historically toll collection involved a direct cash transfer at a toll booth, ETC for express lane purposes requires a transfer of data via electronic technology with actual money changing hands through other means. Regardless, it is necessary to ensure the correct toll is collected, and that toll avoidance and user fraud is discouraged.

- **Setting the toll rate**—the toll rate must be determined and the fees clearly conveyed to the user. Traditionally, tolls are fixed amounts based upon vehicle characteristics such as number of axles. Tolls can be assessed at a point on the road or based upon the distance traveled. Advances in traffic conditions monitoring now allow toll rates to vary based on the level of congestion and the number of vehicle occupants which is critical to the use of pricing as a congestion management tool as is the case with express lanes.

- **Enforcement against violations**—While most users will pay the required toll to use the express lanes, some will try to evade payment. Like any business, toll collection enterprises must identify, quantify and mitigate these potential losses. The primary goal of enforcement is to ensure that there is an acceptable level of compliance and enforcement efforts are fair and consistent.

- **Management and accounting**—toll collection, audit, accounting, maintenance, security, customer service and enforcement must be managed, with a full accounting of all revenue and costs associated with the operation.

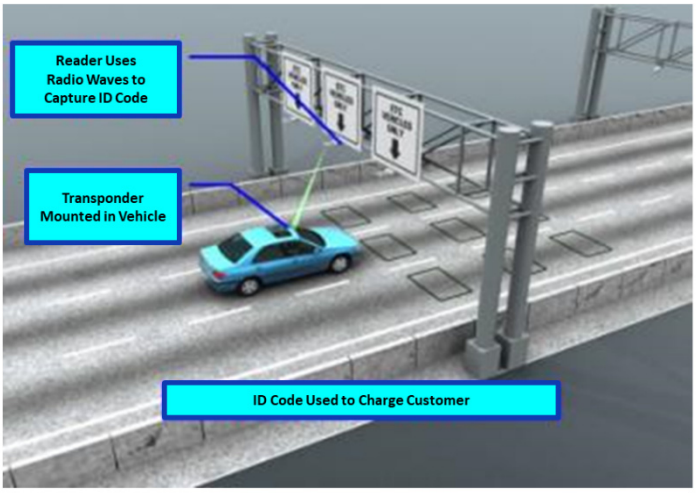
Technology, coupled with agency business rules, is a principal enabler of all four components of toll collection related to express lanes. The following sections describe these components and the underlying technologies utilized for express lane operations, including tolling, in more detail.

8.1.1 Collecting the Toll

Historically, the most common approach for collecting tolls was to have the driver stop and pay cash to a toll collector at a tollbooth. The development of ETC technology has progressed to allow Open Road Tolling (ORT) which eliminates the need to stop and pay a toll and is widely being deployed as the preferred mechanism for

collecting highway tolls. ORT technology is fundamental to the concept of express lanes which uses pricing as a demand management tool. The concept of ORT is illustrated in Figure 8-1.

Figure 8-1: Automatic Vehicle Identification Technology for Open Road Tolling



ORT depends on the ability to identify every vehicle that passes a tolling point at normal highway operating speeds, effectively eliminating the need for any delay to the traveler to allow for payment of the toll. The mechanics for implementing this process varies and are discussed in more detail later in this chapter, but the underlying concept is that infrastructure installed along the roadway identifies a vehicle that is commonly linked to a preregistered account, and the account is subsequently automatically debited for the amount of the toll. Alternatively, the registered owner of the vehicle is identified through vehicle registration databases and is notified via postal mail to provide payment of the toll(s).

8.1.2 Setting the Toll Rate

The concept behind setting rates for express lane tolls is to maximize the productivity of the facility by managing vehicle demand to maintain a desired minimum travel speed. For express lane facilities that integrate HOV considerations, the pricing is structured to sell any available excess capacity to non-HOV or otherwise ineligible users (like SOV). Therefore, traffic conditions must be monitored in real time to ensure that travel speeds are being maintained and that there is excess capacity available to sell at a given time. This information is used to set the toll rate for the additional drivers who wish to use the lanes. The rate is dynamically set at a level to attract or discourage toll paying drivers from entering the facility. The implications of this type of operation require that (1) information of real time traffic conditions will be needed to determine the toll; and (2) toll paying drivers will need to be notified of the toll rate at a point before they enter the express lanes.

A key consideration of express lane tolling is whether toll paying users will be charged one rate no matter where they enter the facility or a rate based upon which part of the facility they traveled on. Most of the initial express lane facilities have only one entrance and exit which makes the first approach the only practical approach. For example, the existing 91 Express Lanes in Orange County currently only have one entrance and exit so the published toll rate represents the full cost to travel the facility. The toll is charged by reading a transponder as the vehicle passes through a single toll collection point located approximately midway along the facility. In contrast, many newer express lanes provide multiple opportunities for drivers to enter and exit the facility. For example, Metro's I-110 and I-10 ExpressLanes incorporate multiple ingress and egress points requiring charging of the toll based on the segments traveled. This is accomplished by reading transponders at each ingress point

and forming these individual reads into a trip for which the user is charged. Typically, business rules allow for the toll rate for the entire trip to be locked in based on the prevailing toll rate at the time the vehicle was detected at its initial point of ingress, or when the vehicle is detected at a subsequent decision point as it transitions from one toll facility or toll segment(s) to another.

Vehicle classification is also typically a factor in setting the toll rate for an express lanes. In the SCAG region, classification is done both for vehicle type and occupancy. For example, Metro currently charges a toll based on vehicle occupancy. Separate categories are selectable on the transponder for SOV, HOV 2 and HOV 3+. Vehicle types such as transit buses and motorcycles are excluded from toll charges as well as alternative fuel vehicles with an appropriate California DMV Access OK decal issued in accordance with state law. Unlike buses and motorcycles, alternative fuel vehicles traveling on the Metro operated corridors must have a transponder but drivers of these qualifying vehicles are currently permitted to select HOV 3+ irrespective of the actual vehicle occupancy.

8.1.3 Enforcement

The introduction of ETC without gates and toll collectors has resulted in the deployment of supplemental technology to automatically identify toll evaders and demand the payment of the required tolls. The primary goal of enforcement is to ensure that there is an acceptable level of compliance, and enforcement efforts are considered to be fair and consistent.

8.1.4 Management and Accounting

Any type of regional express lane network will require operators or operations staff to monitor the system and to coordinate with other local agencies such as Caltrans and CHP, as well as reconciling account validity and toll collection with other tolling agencies within the state (and potentially nationally in order to comply with federal toll reciprocity requirements). The operators will have workstations that interface with the toll system and provide the ability to monitor the operations of the express lanes, override toll pricing if conditions in the express or general-purpose lane are warranted, and coordinate with Freeway Service Patrol (FSP) and CHP during incident situations. These systems also typically automate the regular retrieval of toll account status information from a central clearing house in order to ensure drivers having valid accounts with other agencies are correctly charged a toll and the toll is subsequently transmitted to the facility operator.

The technology-based infrastructure used to implement express lanes operations has multiple components integrated to make one complete system. It is important to monitor all the hardware and software components for errors, failures or any inconsistencies. The industry uses the broad term of Maintenance Online Management System (MOMS) for the technology infrastructure that monitors all the components and sends an alert when there is an error. In the context of a regional system, there could potentially be several individual MOMS' for various tolling implementations that would be sending status and error data to a central back office or appropriate maintenance agency.

8.2 Roadside Equipment

Implementation of a regional express lane network will require the design, installation, and O&M of a variety of technologies and communications infrastructure in the field. This field infrastructure is where the fundamental toll collection process happens within the context of the associated agency business rules.

Figure 8-2: Lane Controller Cabinet

8.2.1 Lane Controller

The lane controller manages and automates the real time control of the various equipment in the lane. The controller receives data from in-lane equipment, systems and sub-systems, and forwards the information to the host controller that is part of the back office systems typically housed at a TMC or other operational facility. The lane controller is often housed in roadside cabinets or dedicated roadside equipment shelters. The controllers will store updated account status files, communicate between all devices in the field and the host controller, and record transactions. Given that this device is in effect the front line with respect to actually collecting and processing toll transactions based on agency business rules, additional considerations for power and communications redundancy is important. Figure 8-2 shows a typical lane controller cabinet.

8.2.2 Automatic Vehicle Identification (AVI)

AVI is used to identify individual vehicles for purposes of tolling. Within the SCAG region, two different ETC technologies have been deployed: a RFID based reader and transponder system; and LPR systems.

8.2.2.1 Radio Frequency Identification (RFID)

RFID reader and transponder based ETC systems are made up of an antenna, reader, and in-vehicle transponder (also commonly referred to as a toll tag). In California, these systems are collective branded as FasTrak, and they must be developed to be compliant with Title 21, as described previously. The antenna typically will be mounted on an overhead gantry or mast arm and connected to the reader which can be collocated on the gantry or housed in a lane side cabinet. The antenna will emit a radio signal forming a read zone beneath the gantry. As a vehicle enters the read zone, the toll tag in the vehicle will be activated by the signal being transmitted by the antenna, and will reflect back the unique ID number associated with the tag and a corresponding pre-established toll account. The ID number is then sent to a centralized computer accounting system where the customer's account is debited for the amount of the toll. Tolls for exempted vehicle classes such as HOVs, vanpools, buses, or emergency response vehicles are set at zero or appropriately discounted. A Metro ExpressLanes read zone with a FasTrak sign, antennas and reader is shown in Figure 8-3.

Figure 8-3: Example Electronic Toll Collection Read Zone

The communication process for the exchange of information between the reader and the transponder is called Dedicated Short Range Communication (DSRC). As discussed previously, all ETC systems in California are required to comply with Title 21 which currently specifies the DSRC protocol to communicate using a frequency of 915 megahertz (MHz). All tolling agencies in the state currently comply with the Title 21 ETC requirements, including Metro, OCTA, and TCA.

As stated previously, federal legislation now requires establishing national interoperability of all ETC systems. In California, CTOC is currently working on revising the Title 21 protocol to contribute to achieving national ETC interoperability. Additionally, CTOC members also participate in IBTTA and other national forums to advance efforts to comply with the interoperability provision of MAP-21. As the push to achieve national interoperability continues, the SCAG partner agencies may wish to consider the use of multi-protocol readers and transponders in Southern California which allow these devices to communicate using other DSRC protocols in additional to the Title 21 protocol.

8.2.2.2 License Plate Recognition (LPR)

LPR is used both as an AVI system and primary tolling mechanism, as well as an enforcement technology within the SCAG region. As shown in the example in Figure 8-4, the system consists of a camera mounted to an overhead structure and a lighting assembly to provide proper illumination in varying daylight, glare and weather conditions. Metro and OCTA currently utilize LPR systems for enforcement purposes in cases when a vehicle's toll tag is not detected, read correctly or is determined to be invalid as it passes through a read zone. Upon detection of a vehicle without a valid transponder, the camera is triggered and an image(s) is captured of the vehicle's rear license plate. The light assembly is typically either a set of high intensity filtered or unfiltered LED strobes, infrared (IR), or always-on visible lights angled to stay out of the customer's line of sight. The light assembly can be designed to dim during the night to minimize glare with the data it receives from a light sensor.

Figure 8-4: Example License Plate Recognition Camera and Illumination Equipment

Once images are captured they are scanned by OCR software which locates and deciphers each license plate character. Any plates that are not recognizable by the OCR software within a predefined level of accuracy are sent for human review and verification. This information is used to charge the accounts of customers who have registered vehicles in advance. For vehicles that are not registered, this license plate number is used to determine the owner's name and address through searching vehicle registration records. The registered owner of the vehicle is either sent an invoice for the toll or issued a violation notice. The specific process including the type of notice sent depends on the business rules used on the express lane facility.

TCA has recently implemented a pay by plate option for drivers using the toll roads in Orange County without a FasTrak transponder. For those drivers, the LPR system is the primary toll collection system as opposed to an enforcement tool. Several express lanes and toll facilities in the U.S. also utilize LPR to provide a pay by plate option for toll collection. Due to the substantially higher operation, verification and accounting costs associated with the use of LPR as a primary toll collection option, most agencies using this option charge a higher toll for pay by plate compared to the toll charged to those using a transponder on the same facility. Figure 8-5 illustrates the differential toll rates for transponder (Good to Go!) and pay by plate (pay by mail) ETC options on the SR-520 Floating Bridge near Seattle.

Figure 8-5: Example Differential Toll Rate Sign

Source: Washington State Department of Transportation (WSDOT)

8.2.3 Vehicle Detection Systems (VDS)

VDS are placed in conjunction with the AVI systems and serves to trigger a message to the AVI system when a vehicle enters the read zone. Additional detection deployed along express lanes and the general-purpose lanes also enable the capability to monitor the performance of traffic in the corridor and to use the data received to determine the toll rate necessary to manage demand. Typical VDS can consist of inductive loops embedded in the pavement, a microwave or radar sensor, an overhead or roadside point detection device, a treadle, or a self-contained in-pavement sensor.

Within the SCAG region, inductive loops have been the preferred detection technology. Loops are installed in the pavement and are used to detect the presence of vehicles over the loop (commonly referred to as lane occupancy), the number of vehicles passing over the loop during a given period of time (commonly referred to as traffic count or lane volume), the size and/or type of each vehicle passing over the loop (commonly referred

to as vehicle classification) and the speed of each vehicle passing over the loop. Loops are a series of wires that are installed in small cuts in pavement that are sealed after the wire is placed and connected by cables to a roadside cabinet. The inductive loops act as antennas that measure the change in magnetic field to determine trigger points and vehicle characteristics. Loops work in diverse weather conditions and are accurate for detecting vehicles when the loops are not damaged or receiving interference from other sources. Due to the fact that loops are installed in-pavement, they can be damaged over time as heavy vehicles pass over them. Loop damage often occurs with asphalt paved surfaces due to movement in the asphaltic cement surface, and less so when loops are installed in roadways with a concrete cement surface. Although loops suffer the possibility of being damaged, they have been shown to be reliable to enable detection and obtain speed, volume and/or lane occupancy statistics at the tolling points when they are properly maintained.

Microwave or radar sensors differ from loops in that they are primarily used to detect vehicle speed across multiple lanes. The units are typically mounted on a pole perpendicular to traffic making them far less intrusive and easier to maintain than devices installed within the pavement. These sensors work in diverse weather conditions and can detect speed and classify vehicles across multiple lanes and often for both directions of a highway (dependent on total lane count and width). Microwave or radar sensors, however, are subject to problems of occlusion which occurs when a large vehicle like a truck blocks the detection of a smaller vehicle traveling beside it. These devices can also experience echo when the waves are reflected off of hard surfaces like pavements and barriers. Microwaves and radar sensors are not typically used as trigger points for toll gantries as the technology does not provide the accuracy required to trigger transponder reads and LPR cameras. The diminished accuracy of these devices also means they are typically not preferred for collecting traffic performance data to support the determination of toll rates in express lanes.

In contrast to microwave sensors, point detection devices, such as overhead laser scanners, can be used for trigger points for toll gantries. Laser scanners are mounted overhead of vehicles for each lane and use a laser curtain to detect vehicles. This laser curtain can detect vehicle presence, speed and size. This technology does have issues with poor environmental conditions (such as heavy fog, rain, dust or snow) that block or scatter the laser curtain.

Roadside point detection devices provide another alternative for detecting the speed, volume, classification and lane occupancy using a combination of a transmitter that projects a matrix of infra-red light beams and a receiver that detects the beams and the duration of breaks in the beams. The devices are non-intrusive to the pavement being mounted on either side of the roadway a few inches above the level of the pavement so that the light beams can pass beneath the passing vehicles. As a vehicle passes, the light beams are broken temporarily as they get blocked by the wheels. The receiver detects and records the series of breaks in the matrix of light beams allowing the speed of the vehicle and the wheel configuration for each vehicle across the roadway to be calculated. Roadside point detection devices are highly accurate for determining speed, volume, classification and lane occupancy and are used for automated speed enforcement in some jurisdictions. Roadside point detection devices are subject to vehicle occlusion, although the effects from vehicle occlusion are very limited

requiring adjacent vehicles to have very similar speeds, tire size and axle configuration to affect detection. These devices can also be affected by occlusion in extreme weather conditions such as heavy snow accumulation blocking the light beams.

Treadles are in pavement devices that detect vehicles by measuring weight as vehicle tires roll over the device. Treadles must be installed along the full width of the lane and are more complex to install than loops in that a greater portion of the roadway must be cut away to implant the treadle in the pavement. These devices work well in all weather conditions and are a reliable solution for trigger point detection; however, they provide inconsistent speed data.

Self-contained in-pavement sensors (sometimes referred to as pucks or studs) provide a detection solution that can measure speed and volume. These sensors are typically magnetometers installed in the pavement at predefined intervals in each lane. Units are embedded in the pavement and can typically operate for up to 5 years without the need for maintenance or external power. In pavement units communicate wirelessly to access points installed on poles. The units perform well under most environmental conditions and are not susceptible to damage by heavy vehicles or normal pavement movement (although some states have experienced issues with these devices due to salt penetration associated with snow removal). The data is very accurate for speed, volume and lane occupancy but the technology is not accurate enough for trigger points. The Metro I-110 and I-10 ExpressLanes use in-pavement sensors for speed and lane occupancy detection outside of the toll points to support traffic monitoring and the dynamic pricing algorithm.

8.2.4 Enforcement Beacons

Enforcement signals are strategically placed in the proximity of selected toll zones and will alert officers to the presence of vehicles without a valid transponder, drivers self-declaring as an eligible toll-free user and/or the occupancy declared by the driver. Enforcement signals are linked to the lane controller and will illuminate according to set parameters when vehicle passes through the tolling point. An enforcement signal can take the form of a colored light or array of lights (as depicted to the left of the illuminator in Figure 8-4), or an LED alpha-numeric display. Metro will be experimenting with LED numerical occupancy displays to aid enforcement by the CHP on the I-10 ExpressLanes. The color of the enforcement signal lights should not be red or amber, as those colors tend to be used to alert drivers to stop or slow down. Enforcement signals that are visible upstream and downstream can be used to allow officers to do roaming enforcement although design consideration should be made for how the officers can observe these signals. Specifically, the signals should be placed such that they can be easily observed as they traverse the corridor or from a specific enforcement pull out area.

8.2.5 Automated Occupancy Enforcement

Automated occupancy enforcement uses technology to detect the occupancy within a passing vehicle to aid enforcement of express lanes that require drivers to declare their occupancy such as the Metro I-10 and I-110 ExpressLanes and the 91 Express Lanes. Automated occupancy enforcement has improved over the years with two technologies showing promise as a viable option for detecting the number of occupants in a vehicle. The

two emerging technologies either use IR cameras or a vehicle on-board unit (OBU). Even with the emergence of these two technologies, a fully automated occupancy enforcement system has not been deployed on any express lane outside of pilot deployments as there are a number of obstacles that must be overcome, including legal validity for enforcement purposes, privacy concerns and accuracy. Even though automated occupancy detection may not yet be suitable for automatically enforcing violations, it may be helpful in current forms for law enforcement officers in the field to identify likely violators, as well as tolling agencies to gather information about drivers who demonstrate a pattern of repeatedly setting their occupancy incorrectly.

Infrared camera based systems use at least two cameras to detect occupancy. One camera is mounted overhead and captures images through the windshield of each vehicle. The second camera is mounted to the side of the lane to capture images of the back seat area of each vehicle. Software is then used to analyze the images to detect the number of occupants within a vehicle.

The second technology uses an OBU to capture and/or verify information provided by in-vehicle systems such as airbag and seat belt detectors, or dashboard cameras in equipped vehicles. For this system to work, each vehicle needs an OBU to be installed using a custom hardwired solution that connects to the vehicle Controller Area Network bus (CANbus). As equipped vehicles use the express lanes, the OBU reports the occupancy wirelessly to the toll point to declare the occupancy of the vehicle.

Automated occupancy 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 Metro have previously worked with Xerox to conduct a demonstration of automated occupancy detection systems, and Metro is currently coordinating with Xerox to implement a pilot deployment of the technology. SCAG and regional express lanes operators should analyze the results of automated occupancy pilot deployments and learn from their findings, along with considering the potential to partner with system developers to conduct demonstrations on existing express lane facilities in the SCAG region.

Additionally, the emergence of Connected Vehicle (CV) technologies, which integrate OBU that allow vehicle to vehicle (V2V) as well as vehicle to infrastructure (V2I) communications using DSRC, offers the potential for ETC systems to access in-vehicle sensor information to help verify occupancy. As CV technologies further evolve, regional express lane operators should contemplate integration of roadside equipment to make use of the data being made available, as well as the potential for communicating information related to current traffic conditions and toll rates back to the vehicle.

8.2.6 Changeable Message Signs (CMS)

CMS (also referred to a Variable Message Signs (VMS) or Dynamic Message Signs (DMS)) are a widely deployed tool in Southern California to support traffic management and traveler information functions. For tolling operations, CMS are typically located throughout the corridor to communicate the toll and travel time information to drivers. CMS can be a static sign, with a small section that is electronically changeable or a full

matrix sign that can be used to display custom messages. Examples of each CMS option were previously illustrated in Figures 5-9 and 5-10.

The customizable CMS include a series of LED lights capable of displaying alpha-numeric characters. CMS 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 can also display messages on the status of the lane or travel times. Example messages include "HOV ONLY," "LANE CLOSED," or "ACCESS 1 MILE." The messages can be automatically controlled by the host controller or overridden manually by the TMC for incident management or other operational reasons. In order to visibly ensure the price shown on the sign is accurate, a fixed camera is typically located with a view of the sign. These cameras can take an image capture every time the pricing changes to keep a record of verification of the displayed toll rate if a customer disputes a price. CMS deployed to support tolling typically serve as support for pricing or traveler information.

8.2.7 Closed Circuit Television (CCTV) Cameras

CCTV cameras are placed strategically in the corridor to provide visual imagery of the toll lanes, the toll equipment, and the general-purpose lanes to allow the operators to monitor the highway travel conditions and to look for incidents. Cameras can be fixed to show only certain areas of the express lanes or can be provided with full pan, tilt and zoom (PTZ) capabilities to allow operators to control and view multiple areas of the lanes. The cameras deployed as part of the express lanes will be primarily used for toll lane operations, including LPR, CMS verification and traffic monitoring, but can be integrated with the various Caltrans district TMC and associated video distribution systems. When sharing system cameras, operator priority can be set so toll operators always have the highest status for operation of the toll lane cameras.

8.3 In-Vehicle Equipment

Implementation of a regional express lane network will require some level of in-vehicle equipment. The obvious equipment will be a transponder, often referred to as a toll tag, but there are emerging technologies such as smart phone applications and hardware associated with the FHWA CV initiative that could potentially influence future decisions.

8.3.1 Transponder

Transponders, like the ones previously shown in Figure 6-2**,** are RFID devices used in ETC systems to identify account holders as they drive through a tolling point. Transponders are battery operated and user installed on the inside front windshield of the vehicle typically near the rear view mirror. They communicate a unique tag ID number to the reader via the antenna at the toll point. FasTrak is the branding used for the Title 21 compliant RFID reader and transponder-based ETC systems used in California.

FasTrak transponders have evolved from simply allowing the ETC system to verify a device ID to allowing the ability to declare vehicle occupancy using a switch on the device. With the opening of the I-580 Express Lanes in the Bay Area in 2015, switchable transponders used in California are now being branded by CTOC as FasTrak Flex. Figure 8-6 provides an example of the FasTrak Flex branded transponder now used by BATA.

Figure 8-6: Example FasTrak Flex Branded Switchable Transponder

Source: BATA

Switchable transponders allow drivers to declare the number of occupants inside the vehicle—a feature that is often required in express lane applications. The transponders are often configurable by the system to emit a beep when being read at a tolling point. The beep is a way of communicating a successful transaction to the driver. This is helpful since ORT does not have the traditional status signs that toll booths have to indicate toll paid, low balance, or no toll paid. The system can also be set to not emit a beep, if desired. This could be helpful if the desire is to obscure the location of toll readers from the traveling public, making it more difficult to intentionally avoid readers or if reader density is so high that frequent beeping might be an irritation to drivers.

The Metro ExpressLanes employ switchable self-declaration FasTrak transponders. These hard cased transponders have a sliding switch to allow drivers to self-declare their occupancy status as one of the following: SOV, HOV 2, or HOV 3+. As mentioned in previous sections, this allows the toll system to charge the appropriate toll according to the declared occupancy. The switchable toll tag offers an advantage for drivers who sometimes use the express lanes as a tolled SOV and other times as an eligible HOV. In addition to providing the ability for users to self-declare their vehicle eligibility status, the switchable toll tag can be a useful tool in monitoring and tracking vehicle occupancy in the express lanes.

As discussed previously, Metro's current use of a switchable transponder for vehicle occupancy declaration as part of their ExpressLanes operations is currently the subject of a patent infringement complaint. It is unclear at this time as to the outcome and effects of this complaint on the use of switchable transponders in conjunction with express lane projects.

8.3.1.1 Statewide and National System Interoperability

Nationwide ETC interoperability is a program, which when implemented, will provide a system where customers have the choice of opting in and are able to pay tolls on any participating toll facility in the country using a single account. The immediate goal of nationwide interoperability is to allow customers with a valid pre-paid toll account to use any toll facility. The plan does not include un-registered toll customers.

Interoperability is now required by Congress due to the use of different tolling technologies throughout the country. Certain regions have already begun to develop interoperable systems by adopting the same, similar or

multi-protocol tolling technologies. These are done to serve customer needs as a region. As an example, Title 21 has provided for ETC interoperability under the FasTrak brand for multiple toll agencies throughout California. Similarly, E-ZPass® is an association of 27 toll agencies in 16 mid-western and northeastern U.S. states that operates interoperable ETC across an extensive system of toll roads, bridges and tunnels as well as express lane facilities.

Interoperability is required by the MAP-21 legislation. This establishes a four-year deadline for all toll facilities on federal-aid highways to implement technologies or business practices that provide for the interoperability of ETC programs. With this requirement, most of the toll facilities in California will need to adapt to allow customers the choice to use a single tolling account nationwide.

Toll system interoperability within California is coordinated by the CTOC as initially required by SB 1523. As discussed previously, this committee is a collaborative organization composed of all California toll facility operators and owners. In addition to interoperability, CTOC also serves to coordinate technology, operating policies, legislative and regulatory framework for California. Account holders using any transponder issued by CTOC member agencies can use their transponder on any toll facility in California. However, only switchable transponders will allow drivers to declare occupancy on express lane corridors or other toll facilities that charge tolls based on occupancy. For example, a non-switchable transponder from OCTA can be used on the Metro I-110 ExpressLanes, but the system will charge the account according to the prevailing single occupant rate regardless of the number of people in the vehicle or if the vehicle is a qualifying ILEV or AT PZEV.

8.3.2 In-Vehicle Navigation / Computer Systems

In-vehicle navigation or computer systems have become prevalent in many new vehicles in the fleet. These systems typically include a screen displaying current location, information regarding the status of the vehicle, or appropriate entertainment content or hands-free communications information. More recent systems include integrated cellular communications capabilities enabling location and vehicle status information to be communicated with responders if the vehicle reports it has been in a collision. This enhanced communications system allows for a more feature-rich map interface enabling dynamic point-of-interest information to be provided to drivers, including traffic conditions and weather information.

These systems have become a key point for manufacturers to differentiate themselves to their customers but the systems and the capabilities vary dramatically between the different makers and models, and is a key area of research by the USDOT. In fact, the Port of Long Beach has a pilot project sponsored in part by USDOT where in-vehicle navigation units are being used to route trucks around congestion in real time. Continued research and development will establish base level capabilities and protocols to enable V2V and V2I applications under the CV initiative. There are a number of potential applications of CV for the operations of a regional express lanes network. These include:

- *In-vehicle navigation systems*—the in vehicle system could communicate with an RFID transponder or other device so that users would no longer need to mount a tag in their vehicle. The in-vehicle system could also detect the number of occupants using the seat belt warning, air bag activation or other systems to self-declare the vehicle occupancy, as appropriate, to the toll point.

- *Real time pricing*—as a user enters an express lane, the current toll rate could be displayed on the car's navigation unit and then updated as the user traverses the corridor.

- *Traveler information*—the in-vehicle system could show the travel time associated with the express lane compared to the general-purpose lanes, as well as the current pricing. These systems could also display incident related information or alert the driver that an entrance or exit to the express lane is approaching.

These applications remain emerging technologies, but the speed in which the various manufacturers are iterating on these technologies would indicate that these systems will be available in some form by the time a considerable portion of the regional express lane network is in place. The ETC systems deployed on the express lanes should be able to support and interact with these technologies as they become more mature, and they are likely to enhance customer experience on the express lanes.

8.3.3 Mobile Devices

The proliferation of smartphones, tablets and other mobile devices has greatly affected a number of industries. In the context of managing and operating toll and express lane operations, these devices are of particular interest for many operators and technology providers. Currently, much of the discussion regarding mobile devices centers on account management, transponder replacement and occupancy declaration. It is important to note that with any of these possibilities, effective strategies are needed to mitigate against driver distraction and ensure that local distracted driver laws are not breached.

Figure 8-7: Example Mobile Application for Electronic Toll Collections

Source: WSDOT

Several companies that have developed mobile applications to replace a toll tag in the car. For example, GeoToll® has integrated ISO 18000 6C tag protocols into the Android phone platform allowing the phone itself to act as the transponder. The company has conducted a demonstration for the Washington State Department of Transportation (WSDOT) and has shown that their application can be used within the deployed tolling infrastructure with a comparable level of accuracy to RFID tags. The GeoToll system, as demonstrated, consisted

of an omnidirectional antenna and processor using a 6C chip embedded in a rubber sleeve that wrapped around a Samsung Galaxy™ S3 smart phone allowing the application software loaded on the phone to detect and transmit to the toll system antenna. GeoToll has announced it is working on developing an app that will allow the system to handle all the electronic tolling protocols in use in North America. Concerns for standardizing on these types of emerging applications currently exist due to phone compatibility, communications to the back office, occupancy declaration, and enforcement challenges.

Occupancy declaration via smart phones is also being tested on tolling facilities on TX-183-A and the US-290 Manor Expressway in Austin, Texas where the Carma ridesharing application is being used to obtain toll credits. The Carma application locates ridesharing partners for drivers who have registered their toll tag with the service. As the driver picks up other riders who have registered with Carma and uses these toll facilities the driver receives a toll credit through the Carma application.

Figure 8-8: Example Mobile Application for Express Lanes Account Management

Source: GDOT

Account management can also be accommodated in different ways on smartphones. The first is to create a mobile device compatible and responsive website that may be viewed on devices with multiple screen sizes and mobile browsers. Customers would be able to use the standard web address to access their account with limited software development costs. The second would be to create a custom smartphone application to create a defined user experience for multiple smartphone platforms. This solution is the most complex as an application will need to be coded for the major smart phone platforms allowing for multiple screen sizes, operating systems and device specifications. Although agencies like the Georgia Department of Transportation (GDOT) have developed a mobile application, the PeachPass®—shown in Figure 8-8—to support carpool registration and account management features, the use of mobile applications is still emerging for express lane purposes.

8.3.3.1 Global Positioning System (GPS)

Global Positioning System (GPS) based technologies require considerably less infrastructure in the field to implement. Each vehicle is provided an OBU that obtains satellite time stamped location coordinates and periodically records the vehicle's movements. At regular intervals, this information is transmitted along with the vehicle ID using cellular based technologies or deployed wireless readers. The most often cited location for deployment of GPS based tolling technology is in Germany, where it is used to specifically support a distance based toll on trucks and heavy commercial vehicles. More recently, the Oregon Department of Transportation (ODOT) has tested the use of GPS based systems in conjunction with the development of mileage based user fees as an alternative to collecting motor fuel taxes. Singapore has recently embarked on a program to

implement GPS based tolling technologies to upgrade the cordon pricing program utilized within the country. Proponents of this technology cite the lack of need for extensive roadside infrastructure. However, concerns over privacy, GPS accuracy / availability and the need for deployment of an OBU for each user have limited the use of this tolling technology to date.

8.4 Customer Service Center (CSC) & Back Office

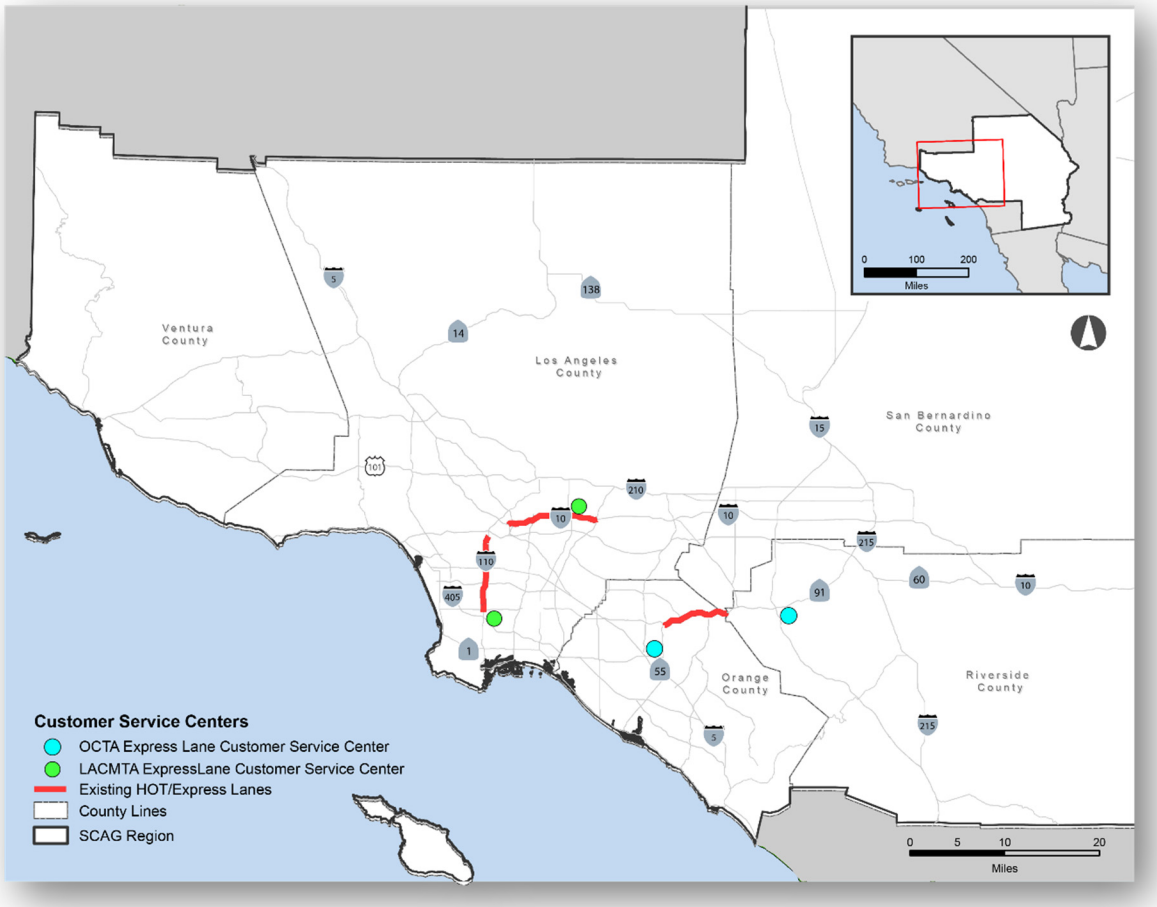
For the tolling entities within the SCAG region, various CSCs provide public facing services and the ability to process tolling transactions for their customers. A typical CSC includes face to face customer services as well as phone and web based customer interactions. These facilities typically house the hardware and software infrastructure that make up the back office systems needed to process the tolling information transmitted from toll points in the field. The back office systems also provide the core account and tolling management services and are responsible for charging, tracking account balances and providing information to both customers and the service center. The Metro ExpressLanes CSC in El Monte, shown in Figure 8-9, is an example of such a facility.

Figure 8-9: Metro ExpressLanes Customer Service Center located at the El Monte Transit Center

Currently, each operating tolling agency in the SCAG region maintains its own customer service center and back office facility, although OCTA and RCTC have executed an agreement to consolidate CSC and back office functions for the 91 Express Lanes following the completion of the 91 Express Lanes extension project in Riverside County. One potential mechanism to increase regional efficiency would be to establish a regional CSC and back office operation that could provide a consistent customer experience and a central facility to process toll transactions from participating agencies in the SCAG region. This approach has been used in the Bay Area to provide a one-stop shop for the seven Caltrans-owned Bay Area toll bridges, the Golden Gate Bridge and the expanding MTC express lanes network, all of which use one consolidated CSC operated by BATA.

Implementation of a regional CSC and back office systems would require an interface for the different tolling systems to utilize data from the field infrastructure. This integration would allow for a consistent user experience and gain efficiencies for the participating agencies with a single entity providing transaction, account management, and enforcement functions. Figure 8-10 shows the existing customer service centers for express lane facilities currently operating in the SCAG region.

Figure 8-10: Express Lanes Customer Service Center Locations



Source: WSP | Parsons Brinckerhoff

Regardless of the scope of any particular CSC, the Corridor Management System (CMS) and Account Management are typically managed or maintained at these facilities. The CMS and Account Management function, along with their key components, are described in more detail in the follow sections.

8.4.1 Corridor Management System (CMS)

The corridor management system (CMS) is made up of the various component systems required to support pricing and ETC in an express lane corridor. CMS collects data from the field infrastructure and processes that information in accordance with the operating agency business rules for pricing and traffic performance to generate and post toll rates, charge the correct tolls to customers, and operate the express lanes.

The following components are key elements of the CMS.

8.4.1.1 Host Controller

The host controller is the central server that stores the system database, communicates with the lane controller, detection systems, CCTV and other field devices, and processes the incoming data streams. The host controller assigns the transactions to accounts and processes violations. It also applies and processes all the pricing and traffic performance related business rules, lane transactions and trip transaction data to support the dynamic pricing algorithm, trip building functions, and revenue and operational reporting for the toll system.

8.4.1.2 Detection Interface

Detecting real time traffic conditions is an essential element of operating an express lane corridor. Detection information is used to set toll rates within the corridor itself and to provide data to measure corridor performance over time. The detection interface provides the linkage between the detection devices located in the field, and the host controller. Data collected in the field is transmitted to the host controller via the detection interface as the basis for determining the appropriate toll rate, and to charge the correct toll to customers based on their observed use of the facility.

8.4.1.3 Trip Assembly

Trip assembly is required when there are multiple tolling points on a corridor that allow drivers to use one or more segments of the toll road to complete their journey. If drivers only pass one toll point, then the transaction process is straight forward since the toll is only for that one segment. When a driver passes through two or more consecutive toll segments, a trip assembly process must be used to accurately determine the correct toll according to the established business rules. For example, on a dynamically priced toll facility that requires pricing for segments to be determined when the driver enters the first tolling point, the system must assemble the trip at the prevailing toll rate when the driver passed the first tolling point even if the price changed after the driver passes subsequent tolling points. The trip assembly process must recognize and construct the correct trip based on transponder and/or LPR information.

8.4.1.4 Dynamic / Manual Pricing Interface

As described in Section 6.1.4, pricing models for express lane facilities in the SCAG region generally falling into one of two approaches: time of day (static variable) or dynamic pricing. Time of day pricing applies a predetermined pricing schedule that varies the toll rate depending on the time, day of the week, direction of travel, and holiday status. Rate adjustments for time of day tolling are often completed at quarterly or annual scheduled intervals. Dynamically priced toll facilities will vary the segment toll rates in real time based on defined business rules typically associated with the travel demand or traffic performance in the corridor.

Both of these pricing models can charge a toll on a per mile, segment / zone, trip or classification basis. A per-mile toll charges drivers for every mile traveled in a corridor. Segment- or zone-based tolling charges drivers a

fixed price for the segment or zone that has been traversed as typically defined by entry and exit points along a corridor. Trip-based tolling determines charges by how many times a driver uses a corridor or is determined based on the total number of segments or zones that a driver passes through. Lastly, classification based pricing determines the correct charge based on vehicle type, vehicle classification, occupancy status and/or other defining characteristics. Various combinations of these toll charging methods are employed for express lanes.

With dynamically priced facilities, a pricing algorithm is used to determine the toll rate for each segment at any given time according to the business rules. The pricing algorithm typically calculates the toll per mile basis for each segment and multiplies the per mile rate by the length of the segment to establish the published segment rate. The pricing algorithm often has the capability to set a minimum toll and a maximum toll and typically takes into account the current volume, speed and/or density of traffic in the express lanes (and/or the adjacent general-purpose lanes) to calculate the price. For example, Metro's I-110 and I-10 ExpressLanes operate with a dynamic pricing model that discourages SOVs from entering the lanes if traffic density in the lane increases and speed begins to decrease to 45 mph. Under such conditions, the toll rate for those segments increases until the traffic density decreases and speeds in the lanes increase. If the speed falls below 45 mph for a set period, the dynamic pricing model reverts the lanes to HOV only status to reduce demand and preserve traffic flow for transit and eligible HOV users.

Toll rates on facilities with dynamic pricing are generally updated at frequent intervals of every five minutes or so, which means that motorists do not see a constant change in price. In addition, pricing algorithm parameters can be set so that the price will only vary by a designated minimum amount. Although algorithms are automated, they should be continuously monitored to ensure they are responding effectively to operating conditions. Operators also have the ability to override dynamic pricing algorithms when conditions warrant, such as for incident management, and routine maintenance.

8.4.1.5 Maintenance Online Management System

Most toll operators use MOMS to monitor all the components of the facility and can be programmed to send an alert when there is a system or device issue. The MOMS monitors all hardware, network and software components for errors, failures or any inconstancies. MOMS can be set up to send emails, texts or other alerts to maintenance staff, the system integrator or whoever is responsible for remedying the problem.

In addition to monitoring issues, MOMS can be used for reporting and routine maintenance scheduling. Reports can be generated to show system up-time, time to respond to issues, and the time required to fix issues. In terms of maintenance scheduling, MOMS can track when maintenance should be performed, when it was performed and what items were fixed by maintenance crews.

Lastly, MOMS can be used to store asset information such as asset tags assigned to equipment, spare equipment inventory and item procurement information. This adds accountability for all the equipment installed or stored and it ensures that spare parts are available.

8.4.2 Account Management

The CSC and back office system also must support all aspects of account management for express lane customers. More specifically, account management activities include:

- Maintenance of the toll accounts through a dedicated website and Interactive Voice Response (IVR) telephone system as well as manned CSC counter and telephone services. Each platform allows the customer to perform all related cost account services such as account sign-up, payment modification, account statement, and vehicle information modification as well as many other toll facility related account services.

- Most ETC accounts are automatically linked to credit or debit cards so tolls can be paid automatically. Payments by check are often accepted either via the U.S. postal service or in person at CSC. Cash payments are often accepted at the CSC, a service that is important for customers without bank or credit card accounts. In the future, there is the potential for cash toll account holders to be able to use toll vending machines to check their account status and add value using cash at various locations.

- Oversight of any equity or discount programs to ensure that accounts are correctly verified users and are not abusing the program.

- Financial accounting including the processing and reconciliation of all customer payments, fees and credits and reconciliation of fees and revenues against system transaction records for each express lane facility.

- Coordination with third-party retail partners for the distribution of transponders and for the pre-payment of tolls.

Additional details related to key specific express lane account management functions are provided in the following sections.

8.4.2.1 Violations Management

Violation processing includes the full life cycle of violations, reviewing and verification of OCR results for LPR, obtaining names and addresses of vehicle owners from the DMV, printing and mailing notices, processing payments, reconciling financials, and administering appeals. Performance measures for these functions would include the accuracy of reviewed images and notices, the timeliness of invoicing and payment processing, and the timeliness of vehicle owner identification.

8.4.2.2 Transponder Management

Transponder account management including account openings and closures; filling transponder orders; maintaining an inventory of all transponders; assessing fees; applying credits; processing customer statements;

and notifying customers of account irregularities, such as transponder failures or the expiration of bank or credit cards used for automatic payments.

8.4.3 Regional Consolidated Back Office System

As with the CSC, a regional consolidated back office system would generate efficiencies for express lane operators in the SCAG region. A regional consolidated back office system could be responsible for tracking toll transactions, account management, violation management, maintenance systems and transponder distribution for participating agencies. This integration would allow for a more consistent customer experience and gain efficiencies for each tolling agency in addition to possible economies of scale that may potentially lower the costs associated with processing toll transactions. The following are a list of some advantages and disadvantages of a Regional Consolidated Back Office System:

Advantages:

- Economies of scale to lower per transaction costs
- Single management center to oversee multiple toll corridors
- Possibility for 24-hour corridor monitoring
- Single point of contact for customer service and account management
- Possibility for consolidated and consistent business rules
- New tolling agencies or facilities have reduced startup costs

Disadvantages:

- Integration of existing tolling agency systems could be complex
- Possibility of separate business rules for different agencies adds to system complexity
- Added complexity when implementing new features or services
- System disruptions will affect all operators in the region
- Possible financial reconciliation challenges due to multi-agency interactions

The San Francisco Bay Area consolidated CSC merged the CSCs previously operated by BATA, GGBHTD and Caltrans into a single regional CSC in 2005. This created an improved customer experience with a single source for customer service account management and a single entity to perform violations processing. During the first phase, the contracted tolling vendor operated the separate existing service centers. The second phase merged operations, developed joint business rules, combined customer databases, and created a new public website to allow customers to maintain their accounts. Following the creation of the consolidated CSC, BATA has grown and is now managed by six partner agencies which are the MTC, GGBHTD, Caltrans, VTA, Alameda County Transportation Commission (ACTC) and Bay Area Infrastructure Financing Authority (BAIFA).

8.5 Transportation Management Initiatives

This section discusses how a regional express lanes network would interact with other regional transportation initiatives to provide the best value to the travelling public.

8.5.1 Regional Traveler Information Integration

The Southern California Traveler Information System known as go511 is operated by the Los Angeles County Service Authority for Freeway Emergencies (LASAFE), which serves the five counties of Los Angeles, Ventura, Orange, San Bernardino, and Riverside. The service provides regional traveler information to the traveling public including information on traffic conditions, transit services, and within Los Angeles County, information on the Metro ExpressLanes. The go511 IVR telephone system currently acts as the portal for callers inquiring about the Metro ExpressLanes. When a user selects ExpressLanes, the IVR transfers the caller to a separate IVR and call center operated by the ExpressLanes contractor. This is the current extent of the integration between the systems.

Previous sections discussed opportunities for express lanes to relay information to the traveling public via mobile devices or in-vehicle navigation systems. Additional consideration should be given to how the traveling public could interact with 511 or other similar systems. For example, in the Bay Area, the regional traveler information system makes use of the RFID transponder infrastructure to anonymously generate travel time and speed data for 511. Tag readers have been installed along major corridors to read tags allowing the calculation of speeds and travel times. These tag reads could be made both on express lanes and general-purpose lanes. These reads would not be a done for the purposes of tolling but for traveler information only. The associated readers would be configured so that they would not generate audible indications to the motorist through in-vehicle transponders. As additional transponders are deployed throughout the SCAG region to support a regional express lane network, this method of field data collection could become a viable alternative to in-pavement vehicle detection sensors. This method will also help with corridors under construction or when the in pavement sensors have been removed or damaged. Portable transponder readers could also be set up to provide accurate travel time data as needs arise or change. Information on travel conditions could be disseminated to the public by third-party traffic data providers (e.g. Inrix® or Google) to allow drivers to make informed choices on whether to use or avoid construction areas.

The region would benefit from increased integration of these different systems, including express lanes into 511. Traffic data, CCTV feeds, and travel time information from CMS could all be disseminated to the public through the 511 system.

8.5.2 Regional Advanced Transportation Management System (ATMS) Integration

Caltrans owns and operates a regional ATMS which is an integrated platform for monitoring and managing the transportation network from their TMCs. There is an opportunity to interface express lane operations with the Caltrans ATMS. The two systems could share incident and speed data plus CMS status and CCTV video with appropriate usage rights and permissions. As noted in the previous discussion regarding traveler information, deployment of additional tag readers in the region could be used to augment the detection capabilities on the highway network. Integration of the express lanes back office operations with Caltrans TMCs should also be considered to garner the efficiencies of collocating express lane and highway operations staff as well as the CHP in a central facility to manage the transportation network in a more coordinated. The goal is to provide coordination for incident and event management, closures and traffic analysis.

Transit agencies in the SCAG region have deployed or are planning to deploy individual ATMSs. Similar to TMC's, transit management centers use ATMS to manage transit service operations. These centers should also share information with other similar programs. With the large vehicle fleet, transit operators often know of incidents and can provide first person information about the nature of incidents to provide to the express lanes and TMC operators. In turn the ATMS system could benefit from speed data of the express lane corridors to augment bus data for real time bus travel times.

8.5.3 Freeway Service Patrol (FSP) Integration

FSP and other similar roadway response or motorists aid services provide courtesy roadside assistance to reduce traffic congestion by managing traffic incidents along with the CHP, Caltrans and local agencies. These services are often the front line support to clear minor incidents and should be directly integrated with express lane operations. Service trucks should be exempted from incurring tolls on the express lanes, recognizing that many vehicles are owned by private sector companies who are under contract to cover certain express lane corridors. Integration can be as simple as having operators call one another to report and clear incident or more complex by integrating systems to track and assign service vehicles to incidents.

8.5.4 Connected Vehicle (CV)

The CV effort is still in the nascent stages even though significant planning has taken place over the past decade. This technology has begun to gain traction with agencies vying for federal funding to deploy pilot projects with anticipated completion dates of 2020. Earlier sections of this ConOps have touched on how CV technologies could be used to enhance express lane operations.

- Congestion management
    - Vehicle smoothing (optimal vehicle spacing, speed, braking)
    - Incident detection
    - Planned navigation information
    - Vehicle speeds

- Vehicle occupancy detection
- In vehicle payment systems (instead of transponders)
- In vehicle display of pricing, CMS messages, incident notification, next entrance / exit

8.5.5 Cordon and Area Pricing Support

Cordon and area pricing systems levy charges to enter congested activity centers. The goal is to reduce traffic congestion within these typically heavily congested core areas and the roadways that provide access to them by shifting trips to other modes, times of day, routes, and destinations. Several Asian and European cities have implemented these successful area pricing schemes that ease regional congestion with nominal effects on local business. These systems have been implemented with either RFID transponders (e.g., Singapore) or LPR technology (e.g., London). GPS technologies could also be used to collect the fee, as is currently proposed as part of the updating of the system in Singapore.

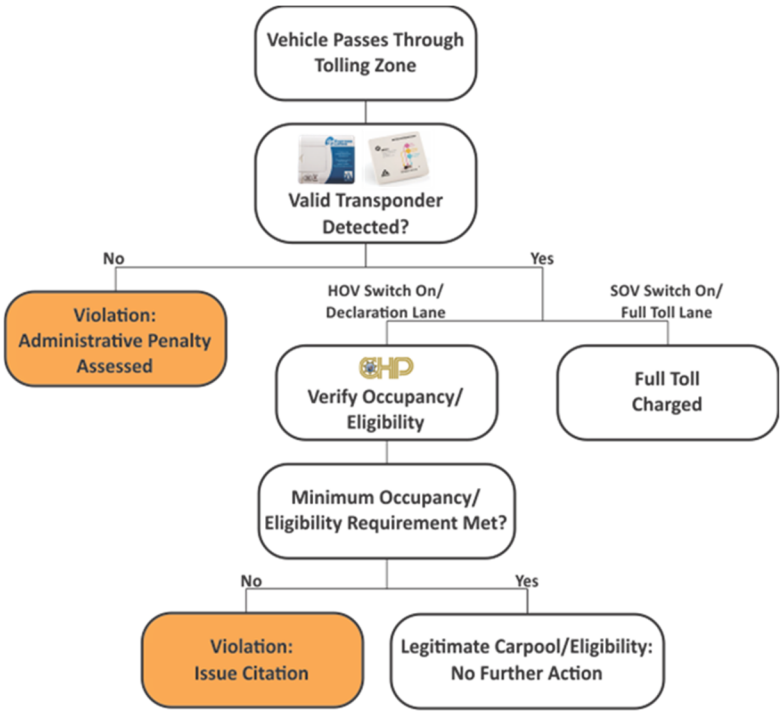
SCAG has been studying the possible use of cordon pricing within Los Angeles County. Doing so would require an interface between the cordon and area pricing, and other tolled facilities in the region. Details would need to be flushed on how a cordon or area pricing policy would interface with existing express lanes to ensure that appropriate business rules were developed together with an understanding of the effects of area pricing on the demand and revenue generation potential for express lanes. This is most important when express lane corridors pass through or end in a pricing zone. Business rules and signage would need to be consistent to provide a seamless experience for drivers. In addition, interoperability or singular toll consolidator would be helpful in financial reconciliation handled by the back office accounting systems.

9.0 ENFORCEMENT AND INCIDENT MANAGEMENT

Effective enforcement and incident management are essential in ensuring that express lanes operate at the intended level of performance. Enforcement of vehicle occupancy and/or toll payment requirements is critical to protecting eligible users' travel time savings and safety. Visible and effective enforcement promotes fairness and maintains the integrity of the facility to help gain acceptance among users and non-users.

Enforcement facilities and technologies are addressed in Chapters 5.0 and 8.0, respectively. Figure 9-1 illustrates a typical enforcement process after a vehicle passes through an express lane tolling zone under a universal switchable transponder approach. A violation occurs if a vehicle is not equipped with a valid transponder, or if motorist declares his or her vehicle as an HOV when it does not meet minimum occupancy or eligibility requirements.

Figure 9-1: Typical Express Lanes Enforcement Process



Incident management requires coordination between the partnering agencies involved in the operations of express lane facilities. Incident management on the I-10 and I-110 ExpressLanes is coordinated between Caltrans District 7, Metro and CHP, while that on 91 Express Lanes involves interfaces between Caltrans District 12, OCTA, and CHP.

9.1 Types of Violations

For the purpose of express lanes enforcement, violations are classified into three types: (1) Eligibility Violations; (2) Toll Violations; and (3) Buffer Crossing Violations. The following sub-sections detail the types of violations and general enforcement practices within the SCAG region.

9.1.1 Eligibility Violations

Vehicle eligibility policies established by the operating agency will determine toll exemptions and/or toll discounts on individual express lanes facilities. Vehicles that do not meet the eligibility requirements will be required to pay the toll in order to drive in the express lanes. Currently, technologies for fully automated

enforcement of vehicle occupancy are still experimental and will likely not be available for large-scale implementation in the near future, therefore the enforcement of eligibility violations are conducted by CHP through visual inspection in conjunction with supporting technologies.

9.1.1.1 Metro I-10 and I-110 ExpressLanes

All vehicles, except motorcycles, travelling in the I-10 and I-110 ExpressLanes are required to have a FasTrak transponder associated with a valid FasTrak account. For those using a switchable transponder, prior to making the trip on the I-10 and I-110 ExpressLanes, users are required to declare their eligibility status by manually toggling the transponder slide switch according to the correct vehicle occupancy. For vehicles displaying a valid DMV issued Access OK decal, a switchable transponder is required and the transponder needs to be set to HOV-3+ in order to drive toll-free in the ExpressLanes. Along the I-110 / I-10 ExpressLanes, enforcement beacons are installed at tolling zones and in close proximity to CHP observation areas throughout the corridor. Beacon lights are located near CHP observation areas to allow CHP officers to clearly associate vehicles with the beacon lights. The observation areas provide a location for CHP officers to park and observe vehicles in the ExpressLanes. The enforcement beacons will be triggered, displaying a distinct light color, when a self-declared toll-free vehicle passes through the toll zone. CHP officers will enforce the eligibility violations by monitoring the beacons and visually inspecting the vehicles to ensure that they meet the eligibility requirements.

9.1.1.2 OCTA 91 Express Lanes

Similar to the Metro ExpressLanes, all vehicles driving on the 91 Express Lanes facility are required to have a FasTrak transponder mounted in the vehicles and associated with a valid FasTrak account. However, the 91 Express Lanes operates with a different self-declaration method. Instead of requiring a switchable transponder, toll-free or toll-discounted vehicles (such as HOV 3+, ILEV, AT PZEV, motorcycles, disabled plates and disabled veterans) are required to utilize a declaration lane while driving through the toll collection zone. This allows CHP officers to focus on HOV 3+ vehicles in a dedicated lane without having to observe every passing vehicle in the 91 Express Lanes. However, as discussed in earlier chapters, HOV declaration lanes require additional right-of-way. Similar to the Metro ExpressLanes, CHP is contracted for their enforcement services. CHP officers will monitor the facilities from three specific enforcement areas, as well as along the corridor, and visually inspect the vehicles utilizing the declaration lane to verify eligibility.

9.1.2 Toll Violations

In corridors where use of transponders is mandatory for all vehicles, toll violation enforcement is typically accomplished through the use of LPR systems. The LPR cameras will take a picture of the license plate of any vehicle that passes through a toll zone without a properly mounted toll tag. 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.

In corridors where the use of transponders is not mandatory for all vehicles, the effectiveness of LPR is diminished as the system is not able to automatically distinguish between eligible vehicles that are exempt from the requirement to carry a transponder and violators without a valid transponder. In these cases, declaration lanes or pre-registration of exempt vehicles may be necessary to reconcile eligible vehicles from violators in conjunction with the use of LPR for toll violations. Alternatively, visual enforcement by CHP would be required to determine toll violations. It should be noted that HOV pre-registration has been utilized in other states, and could be further explored as an option in Southern California to ease the burden of enforcement of HOV occupancy.

9.1.3 Buffer Crossing Violations

As described in Chapter 5, express lanes are typically separated from the general-purpose lanes by painted buffers, traffic channelizers, or barriers. Painted buffers and traffic channelizers allow for higher chances of physical crossings of vehicles between the express lanes and the general-purpose lanes. Therefore the enforcement of buffer crossing violations is required on express lane facilities using these separation treatments. The CHP is responsible for enforcing the ingress and egress restrictions for express lanes. Vehicles that enter or exit the facility illegally will be subjected to a citation from the CHP.

9.2 Enforcement Roles and Responsibilities

The toll operator is responsible for enforcing toll violations using the LPR system. The CHP is tasked with enforcing vehicle occupancy rates, express lane eligibility requirements and moving violations, including illegal entry into express lanes.

The Caltrans TMC is the command center for traffic operations along the highway system. Caltrans and CHP work together to coordinate 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.

For incident management along the Metro ExpressLanes, funding is provided for FSP to provide dedicated tow trucks for incident management in the ExpressLanes. This service is separate from FSP patrols serving the general-purpose lanes.

Along the SR-91 Express Lanes, there are 35 cameras located along the 10-mile corridor to monitor traffic and safety conditions. Once incidents are identified, a Customer Assistance Patrol Specialist (CAPS) is dispatched to provide assistance. In addition, CAPS also patrols the 91 Express Lanes corridor Monday through Friday between the hours of 5 AM and 9 PM, and during peak hours on weekends.

10.0 PERFORMANCE MEASUREMENT AND EVALUATION

Performance measurement and evaluation for congestion pricing projects accomplishes three important and interrelated purposes:

- To ensure that congestion pricing projects are functioning as efficiently as possible and to make adjustments to operational policies as needed;
- To quantify and validate the different benefits these facilities deliver; and
- To document the successful application of congestion of pricing in support of their expanded use.

The first step in the implementation of a congestion pricing project is the completion of planning studies, which ideally includes a preliminary identification of performance measurements. These performance measurements will demonstrate the extent to which the project meets its goals and objectives, and addresses public and other stakeholder concerns. The regional goals and objectives for the SCAG regional express lane network are set forth in Table 1-1. Monitoring performance will help in managing the regional express lane network towards the achievement of these goals.

Performance monitoring efforts should be commenced at least one year prior to the start of construction in any proposed express lane corridor to establish a base line or control for subsequent comparison of facility performance, and should be ongoing while a project is in operations. Performance monitoring should cover the operations within the express lanes as well as the operations in the adjacent general-purpose lanes and should also integrate transit services operating within the corridor.

Performance Measurement:
Performance on all regional express lanes should be continuously monitored for compliance with federal standards, to address state requirements, and to confirm local and regional performance objectives.

In addition to state legislative requirements for monitoring and reporting the performance of express lanes, federal law requires the establishment of a performance monitoring, evaluation and reporting program that provides for continuous monitoring, assessment, and reporting of express lane impacts on facilities where HOV lanes have been converted to express lanes. Caltrans, Metro and OCTA currently share the responsibility to fulfill this obligation to report on the performance of the existing HOV and express lanes operations in the SCAG region. While federal law requires the submittal of an annual performance report, to ensure efficient management of express lanes in response to changing traffic conditions and to communicate with local stakeholders and the public, monthly or quarterly reporting of key measures is recommended as well.

10.1 Compliance with Performance Standards

State agencies must annually certify that operational performance monitoring programs and enforcement programs are in place. The federal performance standard applies to the SCAG region because the state of California allows low-emission vehicles in all HOV lanes, as discussed above on occupancy requirements. If a

degraded condition has been identified by the performance monitoring, then the state has 180 days in which to bring the operational performance of the lane into compliance with federal law.

If the HOV facility is degraded, MAP-21 identifies ways to bring the facility into compliance, such as:

- **Enhancing enforcement on the facility.** If the HOV / express lane suffers from ineligible users that are degrading performance, the operating agency should immediately enhance enforcement in order to reduce the volume of users who do not meet minimum eligibility.

- **Change occupancy requirements.** This condition primarily involves a change in operations from HOV 2+ to HOV 3+ eligibility to use the HOV lane. Express lanes provide the opportunity to use a combination of occupancy change and the introduction of tolling to sell any available capacity following the occupancy change.

- **Apply variable pricing.** If the express lane performance degradation is due to toll rates which are lower than prevailing market forces would yield, then the toll rates must be increased to restore performance.

- **Alter the toll rate structure.** This can be conducted with a change in occupancy or a change in toll rates, whereby different user classifications have different toll rates applied.

- **Alter access or charge tolls for ILEV / AT PZEV.** This may become an important consideration by the end of the decade if Access OK decal vehicles yield disproportionate use of the express lanes.

If the state fails to act, and a degraded condition is still found 180 days, MAP-21 identifies sanctions. However, it should be noted the law is written broadly to allow other treatments and flexibility in time to act. FAST Act introduced an addition provision that allows FHWA, upon request of a public authority, to grant a waiver for compliance requirements in certain instances if: (1) the waiver is in the best interest of the traveling public; (2) the public authority is meeting the conditions under 23 U.S.C. 166(d)(1)(D); and (3) the public authority is making a good faith effort to improve performance of the facility.[117]

10.2 Monitoring

10.2.1 Establishing Performance Measurement Programs

A performance monitoring team should be brought together to formulate plans to evaluate and measure the performance of the project. The team should identify the universe of issues that potentially require tracking and rationalize them with the overall goals established for the regional express lanes network and the funds available to support the performance monitoring program. According to the *NCHRP Guidelines for Evaluation and*

[117] 23 U.S.C. 166(d)(1)

Performance Measurement of Congestion Pricing Projects[118], as different measures are discussed, the monitoring team should consider the following issues:

- How is the measure collected—with real time detection equipment, regular counts or surveys, or one-time surveys?
- Is the data already collected, or would a new effort be needed to do so?
- Which agency is best places to collect the data?
- What is the cost of collecting the data?
- Should the data be collected internally or by an outside vendor or contractor?
- What is the benefit of having the data?
- How would the data be used?
- What level of resources is available to support collecting the data?
- Are cooperating agencies able to provide data within their existing budgets or would they require additional funding to be able to do so?
- Will construction activities or other externalities be likely to skew or otherwise influence the data collected during the baseline period, and, if so, how should this be reconciled?

By considering these issues, the monitoring team develops an understanding of which potential measures will deliver essential information, and which of them do not necessarily provide the same level of utility.

While scheduling specifics will differ from project to project, it is be best for project sponsors to complete their performance monitoring plans two years prior to the opening of the project. Ideally, baseline data collection should extend for at least one full year prior to the start of construction on the express lane facility so that recurring patterns are well documented and the quantity of data is robust enough to make comparisons with those collected after operations begin. Comprehensive baseline data documenting conditions prior to the opening of the facility is essential to determine the incremental effects of pricing once it becomes operational.

10.2.2 Suggested Performance Metrics

Once the project goals and areas with performance specifications are identified, individual performance metrics to be used in the performance monitoring plan are established. The optimal set of metrics enables the project sponsor to have a clear understanding of how well the project is performing and to what extent it is meeting its various goals and standards without being overly costly or requiring an inordinate amount of staff or contractor time to collect. It is good practice while establishing performance metrics to consider how the data for each

[118] Perez, Benjamin Gerry, Reno Giordano, and Heidi Stamm. *Evaluation and Performance Measurement of Congestion Pricing Projects*. Vol. 694. Transportation Research Board, 2011, pp 19.

metric will be collected, the frequency of collection, the ease of collection and overall cost. No single set of performance metrics should be incorporated into a performance monitoring program. Rather, the project sponsor should tailor the performance metrics to align with the regional express lane network goals, community concerns, agency needs, project configuration and operational policies, and the resources available for monitoring the facilities.

The following table lists various suggested performance measures and level of detail for reporting, such as by general-purpose, HOV and express lanes, or by time of day. The performance measures for the network will need to be developed in greater detail and reviewed among the project partners.

Table 10-1: Express Lane Performance Measures

Performance Measures	Level of Reporting
Traffic Operations & Safety Performance	
Vehicle Throughput	GP & HOV / HOT lanes; a.m. peak, p.m. peak, off-peak, daily, annual
Speeds	GP & HOV / HOT lanes; a.m. peak, p.m. peak, off-peak
Corridor Mode Share	SOV, HOV, bus, rail, ride share, exempted vehicles
Person Throughput	GP & HOV / HOT lanes; a.m. peak, p.m. peak, off-peak, daily, annual
Accident Rates	GP & HOV / HOT lanes
Transit Performance	
Corridor Transit Ridership—bus and rail	a.m. peak, p.m. peak, off-peak, daily, annual
Park-and-Ride Utilization (bus and rail)	lot counts
On-Time Performance	travel time / on time / excess wait
In Service Transit Travel Speeds	speeds / average speeds
Vanpool Utilization	ridership / boardings
Public Acceptance	
General Public Opinion	by income group, HOT users, transit riders, solo drivers
Enforcement	
Toll Evasion Rate	traffic stops / responses
HOV Violations	violations / citations / fines
Revenue and Electronic Toll Collection System	
Number of FasTrak accounts	
FasTrak transponders issued	
Number of transactions	by time of day, a.m. peak, p.m. peak, off-peak, daily, weekly, monthly and annual
Toll revenue receipts	revenues and toll rates by time of day, a.m. peak, p.m. peak, off-peak, daily, weekly, monthly and annual
Toll Collection Costs as % of Toll Receipts	
Accuracy of Transactions	
Greenhouse Gas Emission	
Corridor-Specific Daily VMT and VHT	by vehicle type, including transit
Vehicle Fleet Composition	

10.2.3 Data Collection Systems

Caltrans maintains PeMS which is an online database that provides real time and historical traffic data collected from detectors placed on state highways, as well as other Caltrans and partner agency data sets. Caltrans reports data on HOV lanes separate from general-purpose lanes. The reliability of the detectors that provide the data inputs to PeMS has historically been a problem with substantial numbers of these devices not working at any given point in time. This tends to hamper data collection and evaluation efforts to monitor the performance of state highways. For this reason, specific attention should be given to prioritizing the installation and maintenance of detection devices in express lanes corridors to support performance monitoring efforts.

Tolling systems serve as an important source of data. Discrepancies in data between existing state monitoring systems and tolling systems are not unusual among express lane systems, and so decisions on using appropriate redundant data sources may be required. As express lanes are typically variably priced based on changing demand, data for short durations (i.e. 5 minutes and 15 minutes data) will be important to analyze in addition to aggregate values like daily averages.

10.2.4 Performance Reporting

Performance reporting can occur at various levels depending on the underlying requirement for reporting and/or the audience being served. The following sections highlight various levels of reporting that may be appropriate for the regional express lane network.

10.2.4.1 Statewide

Reporting systems for HOV and express lanes will be partly driven by legislation. To comply with federal reporting requirements under 23 U.S.C. § 166, Caltrans published *the 2013 California High-Occupancy Vehicle Lane Degradation Determination Report* and the associated *California High-Occupancy Vehicle Lane Degradation Action Plan*. The reports identify degraded segments of HOV lanes statewide, including Southern California, in two 180-day reporting periods in 2013. These segments are categorized into the severity of degradation and potential causes of degradation and remediation strategies are identified.

10.2.4.2 SCAG Region

In the SCAG region, Caltrans District 7, which includes Los Angeles and Ventura counties, published the *2011 HOV Annual Report* which summarizes HOV operations in the district that year. Additional data is available from District 12 (Orange County) and District 8 (San Bernardino and Riverside counties) through PeMS as well as manual counts. The *2011 HOV Annual Report* includes information on peak hour volumes with vehicle occupancy, violation rates, and average daily traffic on the respective HOV facilities in Los Angeles and Ventura counties.

10.2.4.3 Metro I-110 and I-10 ExpressLanes

SB 1422, which authorized the Metro ExpressLanes demonstration project, required Metro and the U.S. Department of Transportation, which provided funding, to report to the Legislature on the demonstration project on December 31, 2014. Metro published a preliminary report on express lane performance in July 2013 based on 6 months of operations on the I-110 and 2 months of operation on the I-10. The report included data on express lane speeds and usage by occupancy. Metro published the official performance evaluation report after more than 12 months of operation on both facilities. SB 1422 required the report to include a summary of the demonstration program, a survey of its users, the impact on carpoolers, revenues generated, how transit service or alternative modes of transportation were impacted, any potential effect on traffic congestion in the HOV lane and in the neighboring lanes, the number of toll paying vehicles that utilized the express lanes, any potential reductions in the greenhouse gas emissions that are attributable to congestion reduction resulting from the express lane demonstration project, and a description of the mitigation measures on the affected communities and commuters in this demonstration program.

In addition, USDOT published the *Los Angeles County Congestion Reduction Demonstration National Evaluation Plan* for the Metro ExpressLanes in 2010. It presents the national framework for evaluating Urban Partnership Agreement (UPA) / Congestion Reduction Demonstration (CRD) projects around the nation and specific measures for evaluating the Metro ExpressLanes.

10.2.4.4 OCTA 91 Express Lanes

OCTA publishes an annual financial report that highlights the financial state of the 91 Express Lanes Fund in accordance with accounting principles accepted in the U.S., including the design, implementation and maintenance of internal corridor relevant to the report. The *91 Express Lanes Fiscal Year* (FY) *2013-14 Annual Report* presents the following significant accounting measures:

- Cash and investments
    - Cash and cash equivalents
    - Restricted cash and investments
    - Receivables
    - Other Assets
    - Integrated Assess—Toll Facilities
    - Deferred Outflow / Inflow or resources
    - Risk management

- Capital Assess
    - Improvements
    - Equipment, furniture and fixtures
    - Computer hardware and software
    - Transponders
- Service Concession Arrangements—Toll Facilities Franchise
- Bonds Payables
- Commitments and Contingencies

In addition, OCTA conducts a survey every three years to develop an up-to-date understanding of how 91 Express Lanes customers are using the 91 Express Lanes. The *91 Express Lanes 2014 Customer Satisfaction Survey* report presents a statistically reliable understanding of 91 Express Lanes customer's satisfaction, priorities, concerns and experience of the facility and OCTA's management. The customer survey provides information on:

- Customer's frequency and time of use, trip purposes and origins and destinations
- Relative importance that customers place on specific performance standards when traveling on the 91 Express Lanes
- Measure the customer's overall satisfaction with their experience, and how they feel the 91 Express Lanes is meeting specific standards
- Measure customers' perceptions of OCTA's management
- Identify customer's current exposure to OCTA's communications, and preference on future communications

The report serves to inform the OCTA Board and staff when making strategic decision on planning, service delivery, setting toll charge and identifying effective marketing strategies.

11.0 EXPRESS LANE NETWORK DELIVERY AND GOVERNANCE OPTIONS

The first few express lanes in California were procured by individual regional or county agencies. JPAs have been formed to implement recent express lanes projects in the San Francisco Bay Area spanning multiple counties. Either of these models could be used in the SCAG region.

11.1 Individually Governed and Procured

The individual method of governance is appropriate for projects that remain within the implementing agency's boundaries and where revenue sources may include local sales taxes. Governance does not, however, dictate project delivery, as individual agencies have employed different procurement strategies for express lanes. SANDAG in San Diego County and VTA in Santa Clara County have each employed the traditional Design-Bid-Build (DBB) method of procurement for the I-15 Express Lanes and SR 237 / I-880 Express Lanes, respectively. The projects are both beneficiaries of local sales tax measures. Metro has employed the Design-Build-Operate-Maintain (DBOM) method for the I-10 and I-110 ExpressLanes in Los Angeles County. Additionally, the 91 Express Lanes were originally procured by Caltrans as a Design-Build-Finance-Operate-Maintain (DBFOM) concession.[119] In 2002, the OCTA purchased the project from the private toll operator.

11.2 Joint Powers Authority (JPA)

California law provides agencies the ability to exercise joint powers under the *Joint Exercise of Powers Act*.[120] The two JPAs that have been established for the construction of express lanes in California are described below.

Interagency Collaboration:
Consider the use of a JPA for interconnected projects crossing multiple jurisdictions. Use the JPA framework to establish parameters for cost and revenue sharing, and performance assessment to accomplish common goals.

11.2.1 Sunol Smart Carpool Lane Joint Powers Authority

California AB 2032, passed and signed into law in 2004, authorized the Sunol Smart Carpool Lane Joint Powers Authority, ACTC and VTA, to implement the I-680 Express Lanes.[121] The legislation authorizes the administering agency to issue bonds to finance construction payable by express lane toll revenues. Also known as the I-680 Express Lanes Authority, it comprises five elected officials, four voting members from Alameda County and one voting member is from Santa Clara County, based on each county's share of road miles in the corridor. Administrative functions for the JPA are performed on a contract basis by the ACTC. Funding for the express lanes includes local sales tax revenues.

[119] http://www.dot.ca.gov/hq/paffairs/about/toll/rt91.htm
[120] Government Code § 6500-6536
[121] California Streets and Highways Code § 149.5

11.2.2 Bay Area Infrastructure Financing Authority (BAIFA)

In 2011, the CTC determined the MTC eligible to develop and operate 270 miles of express lanes, consistent with California Streets and Highways Code § 149.7. In April 2013, MTC entered into a cooperative agreement with the BAIFA through which MTC delegated authority to BAIFA to develop and operate the planned 270-mile regional express lane network. BAIFA is a JPA established through an agreement with MTC and BATA. It assumes responsibility for a variety of policy decisions ranging from deciding which projects get built first to setting toll rates. The members of the governing board of BAIFA include the chair of MTC, the chair of the BATA Oversight Committee, a non-voting commissioner from the State of California's Business, Transportation and Housing Agency, and three commissioners representing the counties through which the planned HOT / express lanes primarily reside—Alameda, Contra Costa, and Solano counties.

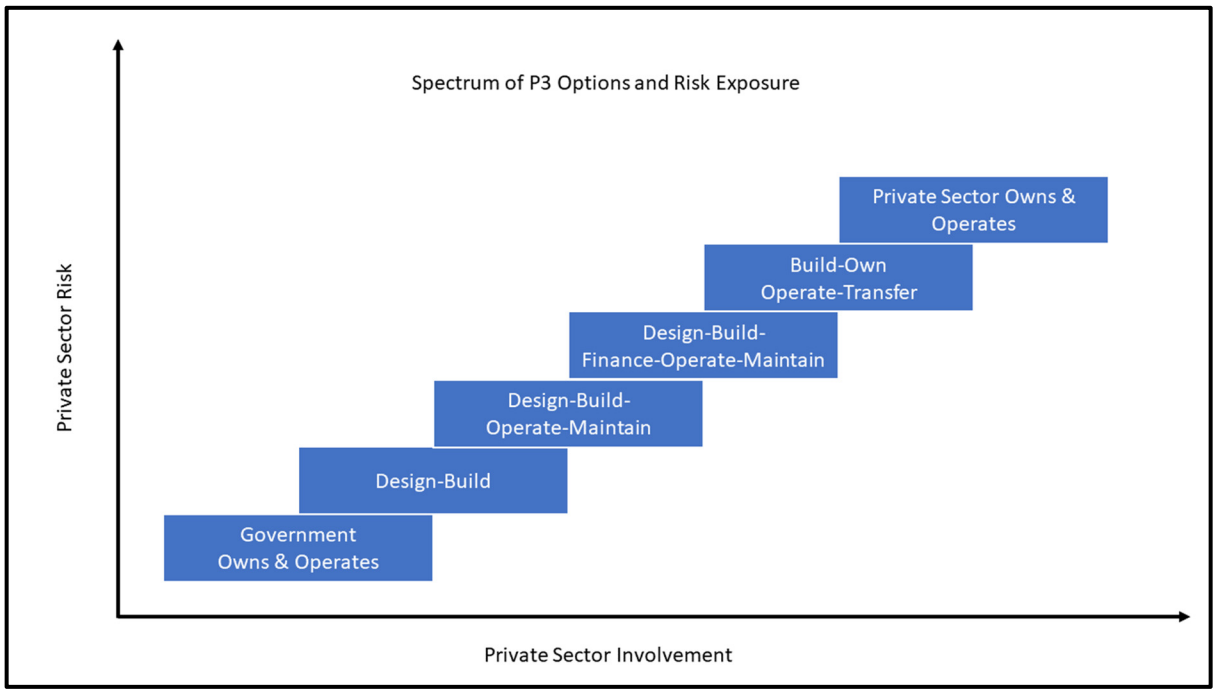
11.3 Procurement Options

There are a variety of innovative procurement options that transportation owners are using around the United States to implement transportation improvement programs, including express lanes projects. Many of these approaches are also considered P3 arrangements as they allow for greater private-sector participation and responsibility in the design, delivery, financing, operation and/or maintenance of transportation improvements. These delivery options are a departure from the traditional DBB approach described in the following section.

As shown in Figure 11-1, project delivery approaches range from DBB (where the government agency completes the design, construction and operation of the project in-house or under separate contracts), DB procurements (where design and construction services are grouped into a single, fixed-price procurement), to concessions (where a private investor / operator is responsible for financing, designing, constructing, operating and maintaining new toll highway projects). In certain cases, P3 projects may also involve transferring the operation of existing highway facilities to private-sector operators who are also obligated to make capital improvements to the facilities. The project delivery approaches most often utilized for express lanes projects are described in greater detail below.[122]

[122] The following descriptions are based largely on SHRP2 C12, The Effect of Public-Private Partnerships and Non-Traditional Procurement Processes on Highway Planning, Environmental Review, and Collaborative Decision Making, Task 3—Technical Report, Parsons Brinckerhoff, March 2011.

Figure 11-1: Project Delivery Options



11.3.1 Government Owns and Operates (Design-Bid-Build)

DBB is the traditional project delivery method where the government owner fully funds the project, and completes the design process, either in-house or under one contract, then awards a separate contract to a construction contractor to build projects, and thereafter retains responsibility for owning and operating the facility. The government owner is responsible for the details of the design and warrants the quality of the construction documents to the construction contractor.[123] As a result, the government owner assumes the risks of any errors or omissions encountered during construction that are not included in the design.

11.3.2 Design-Build (DB)

DB is a project-delivery method that combines two usually separate services into a single contract. With design-build procurements, owners execute a single, fixed-fee contract for engineering services as well as construction. With DB delivery, the design-builder assumes responsibility for the majority of the design work and all construction activities, together with the risks associated with providing these services for a fixed fee. When using DB delivery, the owners retain responsibility for financing, O&M the project. However, the private-sector design-builder assumes a significant portion of the risk of construction cost overruns. While the DB procurement

[123] NCHRP Synthesis 402, *Construction Manager-at-Risk Project Delivery for Highway Programs*

process has been prevalent in private-sector work for some time, over the past ten years it has gained acceptance among many public-sector transportation-infrastructure owners.

DB delivery offers a number of benefits to public agencies developing transportation improvements. It allows completion to be accelerated because design and construction work can proceed concurrently. Opportunities for creative design solutions and the ability to align the project design with construction techniques and equipment also provide the potential to accelerate implementation timeframes and may result in overall cost savings. Shifting the risk of design defects to the private sector eliminates one of the most common causes of construction claims, creating greater upfront cost certainty for the public sponsor. The potential for owners to realize such benefits is greatest with more complex projects.

The enactment of SB 4 (SBX2 4), passed by the California Legislature and signed into law in 2009, allows Caltrans and CTCs to enter into P3 agreements until January 1, 2017.[124] Caltrans is currently limited to utilize DB on up to only ten projects on the state highway system until January 1, 2024. There is no limit on the number of DB projects that CTCs can develop on the state highway system, provided the agency enters into a cooperative agreement with Caltrans. CTCs can also utilize DB for expressways that are not part of the state highway system provided the project is being developed with an expenditure plan approved by voters as of January 1, 2014.[125] RCTC, authorized by the CTC, utilized DB procurement for the SR-91 Corridor Improvements Project. As described previously, the project completed construction in 2017 and widened the corridor to add two express lanes in each direction.

A variation of DB is design-build-finance (DBF) whereby the design-builder also provides private capital to accelerate the implementation of a project in advance of the availability of public funds dedicated to the project. In this case, the private sector design-builder agrees to provide all or some of the construction financing and to be repaid through either milestone or completion payments made by the project sponsor. These arrangements are typically short term and extend no longer than the duration of the construction period. While DBF procurements transfer design and construction risk to the private partner, they do not transfer ongoing O&M risks and do not generate greater efficiencies than DB procurements. The primary benefit of DBF arrangements is that they provide project sponsors with short-term gap financing.

11.3.3 Design-Build-Operate-Maintain (DBOM)

DBOM combines the design and construction responsibilities of DB procurements with the ongoing O&M of the resultant facility. These services are provided by a private-sector contractor through a single contract, with financing provided by the public sector agency. The advantage of DBOM procurements is that by combining these services, the private partner has an incentive to use cost-saving, life-cycle costing principles to align the design of the project with long-term maintenance activities. This delivery approach is used by highway operators

[124] California Streets and Highways Code § 143
[125] Public Contract Code §6820

around the world and is common in the transit sector. DBOM is known by several terms, including turnkey procurement and build-operate-transfer (BOT).

DBOM is a particularly relevant method for express lanes implementation where public agency funds are available to complete the project. DBOM procurements integrate the ongoing O&M responsibilities inherently associated with express lane projects into a single contracting mechanism thereby simplifying the procurement process for the project sponsor. The implementation of Metro's I-10 and I-110 ExpressLanes is an example of a DBOM procurement for express lanes projects, with the majority of the financing for the project being derived from a USDOT grant.

11.3.4 Design-Build-Finance-Operate Maintain (DBFOM)

DBFOM procurements are also commonly referred to as concessions. With DBFOM procurements, the private partner assumes responsibilities for designing, building, financing, operating and maintaining highway improvements for a designated period of time. In exchange, the private-sector partner has the right to collect all or a portion of the revenues generated by the facility during the concession period. Conversely, the public agency sponsoring the project may agree to make availability payments to the private-sector partner during the concession period, and retain any toll revenues generated. There is a great variety in DBFOM structures and the degree to which financial responsibilities are actually transferred to the private sector; however, DBFOM projects are either partly or wholly financed by debt backed by project revenues. With DBFOM projects, future revenues are leveraged to issue bonds or other debt that provide funds for capital and project development costs. With real toll concessions, project revenues are often supplemented by public-sector grants in the form of money or contributions in kind, such as right-of-way or complementary construction projects.

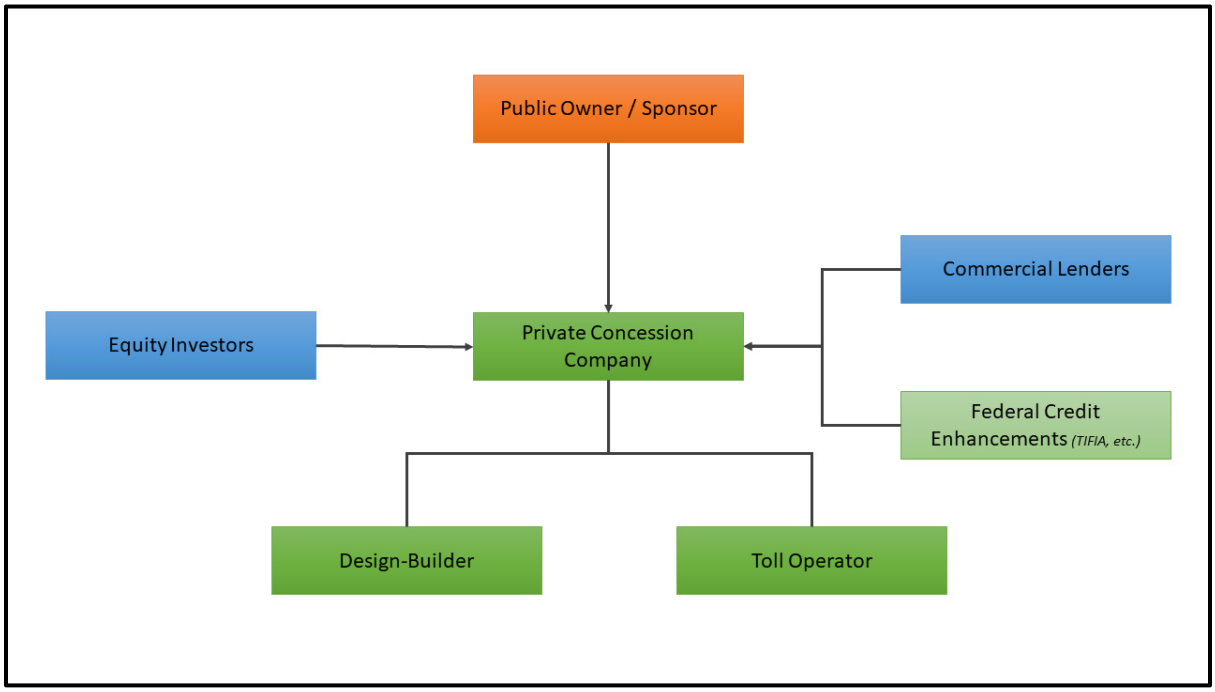
Most recent DBFOM concession projects in the U.S.—particularly those with a high implementation costs—have been financed using a combination of toll revenues, government grants, private debt, and private-investor equity. These transactions are often further enhanced by financial mechanisms such as TIFIA funding and private activity bonds (PABs). These federal tools encourage the use of toll financing and P3s by providing flexible repayment terms, and potentially more favorable interest rates when compared to the private capital market. Together, these mechanisms help public agencies sponsoring real toll projects by allowing their private investment partners to help mitigate the risk associated with these transactions.

DBFOM concessions often extend for 25 to 50 years or more, and are awarded through competitive procurements. With the DBFOM approach, the public sponsor retains ownership of the highway assets and stipulates performance thresholds, maintenance protocols and specific improvements to be made over the concession period, thereby ensuring that the assets are properly operated and maintained during the term of the concession, and returned in good condition. DBFOM concessions are often attractive to public transportation agencies, as they can provide access to new sources of equity and financing, and deliver similar schedule and cost-efficiency benefits to DBOM projects.

The structure of a typical DBFOM concession is shown in Figure 11-2. The agency sponsoring the project could be a state department of transportation, MPO, transit agencies, public benefit corporation, toll highway authority or other state, regional and local agencies. The project sponsor awards the DBFOM procurement to a private limited-liability concession company which is usually comprised of a group of firms who have agreed to partner in the development of the project and to invest their own equity in the concession company. The concession company then leverages future revenues it will receive for operating the highway facility and raises debt to cover the cost of implementing from the municipal finance and commercial credit markets. In many cases these traditional sources of finance may be supplemented by federal credit tools including PABs, the TIFIA program, § 129 loans, or state infrastructure bank (SIB) loans. With its financing in place, the concession company would then enter into a fixed-priced DB contract to implement the project and a separate O&M contract to collect tolls and maintain the project. These contracts may be awarded to subsidiaries of the firms which formed the concession company. The potential for revenue generation associated with express lane projects makes DBFOM the desirable procurement approach for many recently completed express lane projects.

The 91 Express Lanes in Orange County is an example of a project that was originally procured as a DBFOM project. It has since been purchased by OCTA. The I-495 Capital Beltway Express Lanes project in Virginia is an example of DBFOM concession procurement model for a more recently completed express lanes project.

Figure 11-2: Typical DBFOM Concession Structure



11.4 Project Delivery Recommendations

Project Delivery:
Evaluate the full range of available delivery options to enhance the overall value of the project.

Implementing agencies shall decide on the most appropriate project delivery approach at the project planning level based on the specific needs of the project. The wide variety of available procurement methods provide options for the implementing agencies to achieve schedule and cost-efficiency benefits, simply and consolidate contracting requirements, and gain access to alternative sources of financing.

12.0 TRANSIT INTEGRATION

12.1 Introduction

Metropolitan areas around the country have recently started integrating express lanes into their regional transportation networks. Express lanes create a valuable opportunity for transit agencies to expand express bus service[126], enhancing regional transit options. When managed through variable pricing to maintain a minimum LOS, express lanes create efficient and reliable transit corridors from previously congested highways. In fact, several of the earliest examples of express lanes projects in the United States were first developed as fully-dedicated busways in the 1960s and 1970s (i.e., IH-10 in Houston and I-10 in Los Angeles), later evolved into carpool lanes, and now operate as express lanes. Operating express bus service on express lanes offers several key benefits:

- **Shorter Travel Times**. By maintaining minimum travel speeds, travel time is reduced compared to general-purpose lanes and HOV lanes, which can become congested.
- **Improved Travel Time Reliability**. Similarly, by maintaining minimum travel speeds and avoiding unpredictable congestion, travel times become more reliable and on-time performance is improved.
- **Lower Operating Costs.** Decreasing travel times and improving reliability translates into a cost savings for transit operators, who no longer need to account for uncertainty in the schedule.
- **Increased Person Throughput**. Express bus service operating on express lanes moves more people in fewer vehicles than private automobiles, increasing the person throughput on the facilities, which is often one of the stated goals of express lane programs.
- **Encourages Carpooling and Transit Use**: Transit buses and eligible HOV users benefit from both travel time savings as well as toll-free (or discounted) use of the express lanes, which can be effective at attracting new carpool and transit riders. Additional increases in transit ridership can be accomplished when express bus services are improved or expanded in conjunction with express lane development and operation.
- **New Revenue Source**. The express lane toll revenue provides a potential new funding source for transit service enhancements along the corridor.

[126] In the context of express lanes, express bus service commonly refers to public transit bus services that operate in part along the highway with limited stops to provide higher travel speeds and expedited travel times between more distant origin and destination points.

- **Addresses Equity Concerns.** By using express lane revenue to enhance transit service along the corridor, it is also possible to address some of the frequently raised equity concerns surrounding toll lanes.

- **Builds Public Support.** Incorporating high quality transit on express lanes can help sell an otherwise controversial project. Expanding transit can help in battling the Lexus lanes misconception.

For these reasons, many transit agencies have introduced express bus service on express lanes. The performance of the transit service depends on a number of design and policy factors, such as location of access points, fare policies, and revenue distribution policies. Incorporating these design and policy considerations in the express lane program requires extensive coordination early in the project development between the tolling agency or authority and the transit agency.

This chapter of the ConOps provides an overview of express lane projects with frequent transit service and the lessons learned from these services. This discussion is followed by an overview of the existing SCAG region express bus services and a discussion to identify corridors where future transit services may benefit the most from the introduction of express lanes. The chapter concludes with policy recommendations.

12.2 Review of Transit Service on Existing Express Lanes

Most express lane facilities include a transit component. The *Journal of Public Transportation* published an article in November 2014 entitled *HOT for Transit? Transit's Experience of High-Occupancy Toll Lanes*, which provides an overview of the current state of transit integration with express lanes facilities. The article surveyed twelve operating express lanes facilities in the United States:

- 91 Express Lanes in Orange County
- I-15 Express Lanes in San Diego
- IH-10 Katy Freeway Managed Lanes in Houston
- US-290 Northwest Highway QuickRide in Houston
- I-394 MnPASS Express Lanes in Minneapolis
- I-15 Express Lanes in Salt Lake City
- I-25 Express Lanes in Denver
- SR-167 HOT Lanes in Seattle
- I-95 Express in Miami
- I-35W MnPASS Express Lanes in Minneapolis
- I-680 Sunol Express Lanes in the Bay Area
- I-85 Express Lanes in Atlanta

In addition to these 12 facilities, this section provides a summary of the recently completed I-10 and I-110 ExpressLanes in Los Angeles County. It should be noted that because much of the following data was taken from previously published reports and articles, some of the information may be outdated or inherits inconsistencies for comparison purposes.

Table 12-1 provides an overview of some of the key characteristics of express bus services provided on express lanes facilities. Because express lanes are long, linear facilities that cross multiple jurisdictions, multiple transit agencies often operate service on a single facility. Several of the surveyed facilities have up to four different transit operators running services on a single express lane. For example, in Los Angeles County, Metro and Foothill Transit operate frequent express bus service on the I-10 ExpressLanes; and Metro, Gardena Transit (GTrans), Torrance Transit, and the City of Los Angeles Department of Transportation (LADOT) operate frequent express bus service on the I-110 ExpressLanes. Coordinating the services among different operators can be challenging, but coordinated schedules and marketing materials can markedly improve the overall customer experience.

Table 12-1: Bus Service on Express Lanes

Region	Corridor	Median or Shoulder Running	Operators	Weekday Bus			Fares		Park-and-Ride Lots
				Routes	Vehicle Trips	Vehicle Trips / Routes	Highest	Lowest	
Orange County	SR-91	Median	2	2	39	20	$4.50	$3.00	0
San Diego	I-15	Median	1	6	141	24	$5.00	$2.50	12
Houston	I-10	Median	1	6	391	65	$4.50	$1.25	2
Houston	US-290	Median	1	4	236	59	$4.50	$3.25	4
Minneapolis	I-395	Median	4	38	548	14	$3.00	$1.75	5
Salt Lake City	I-15	Median	1	12	76	6	$5.00	$5.00	5
Denver	I-25	Median	1	12	434	36	$5.00	$4.00	0
Seattle	SR-167	Median	2	2	88	44	$4.00	$2.50	5
Miami	I-95	Median	2	4	259	65	$2.35	$2.35	0
Minneapolis	I-35W	Median	4	26	495	19	$3.00	$1.75	5
Bay Area	I-680	Median	1	1	30	30	$4.00	$4.00	1
Atlanta	I-85	Median	2	8	133	17	$4.00	$3.00	2
Los Angeles	I-10	Median	2	11	732	73	$4.90	$2.45	1
Los Angeles	I-110	Median	4	7	459	66	$3.75	$1.00	5

Source: Newmark, 2014; WSP | Parsons Brinckerhoff, 2015

The number of different routes and frequency of service provided along the express lanes varies greatly. Of the express lanes surveyed in the 2014 study, the number of routes range from one route on the I-680 Sunol Express Lanes to 38 routes on the Minneapolis I-394 MnPASS Express Lanes. However, a higher number of routes do not necessarily correspond with a higher number of trips. For example, the 95 Express in Miami is only served by four routes, but 259 total transit vehicle trips are made on the express lanes each day. In contrast, the I-15 Express Lanes in Salt Lake City are served by 12 routes, but only 76 transit vehicle trips are made each day on the express lanes. These variations reflect different approaches to service planning. With fewer routes, the routes do not branch into the surrounding communities, but rather provide frequent service along the express lanes. With more routes, service tends to branch off the express lanes to directly serve the surrounding communities. Transit operators must decide whether to run more frequent service on a few trunk routes or spread the service across a greater number of routes with less frequent service on each route.

Express bus service fares range from $1.00 for some routes in Los Angeles to $5.00 in several cities. Express lanes provide an opportunity to brand express bus routes as premium service, justifying slightly higher fares. Several transit agencies, including LADOT, have implemented a variable pricing system where fares are dependent on distance or zones. This structure allows agencies to charge higher fares for longer-distance trips on the express lanes.

Park-and-ride lots are located along many express lane facilities. Table 12-1 includes a summary of park-and-ride lots located within a half-mile of the express lanes. Park-and-ride lots provide an opportunity for transit riders to drive and transfer to express bus service along the express lanes. These lots are particularly useful where express bus service operates on express lanes and does not enter into the community. Ideally, direct access ramps provide a connection between the park-and-ride lots and the express lanes so buses do not have to cross over general-purpose lanes.

The number of average weekday riders varies from a low of 150 riders on the Orange County 91 Express Lanes to a high of 14,840 riders on the Denver I-25 Express Lanes. In Orange County, the 91 Express Lanes connect Riverside and Orange counties, both of which have decentralized patterns of development with no single central business district, which differs from the development patterns in those areas with higher ridership, such as Denver or Minneapolis. These areas also have a developed transit network to complement the express bus service. The 91 Express Lanes is also paralleled by highly utilized commuter rail line which connects suburban communities in Riverside County with major employment centers in Orange and Los Angeles counties, also potentially affecting express bus ridership in the corridor.

12.3 Current State of the Practice

In order to better understand how different transit agencies have integrated express bus service with express lanes, three cases are presented below: Los Angeles I-110 and I-10 ExpressLanes, Miami 95 Express, and San Diego I-15 Express Lanes.

12.3.1 Los Angeles I-110 and I-10 ExpressLanes: Federal Grant Expands Transit Service Frequency

From its inception, transit has been considered a key component of the Los Angeles I-110 and I-10 ExpressLanes. Providing high-quality transit service is the key to meeting the ExpressLanes stated goal of moving more people—not more vehicles. The Metro ExpressLanes opened on the I-110 Harbor Freeway, between Adams Boulevard and SR-91, on November 10, 2012 providing toll-free access to transit vehicles and HOV 2+ at all times. The ExpressLanes opened on I-10 San Bernardino Freeway between Alameda Street and I-605 on February 23, 2013 providing toll-free access to transit vehicles and HOV 3+ during peak periods and transit vehicles and HOV 2+ during off-peak periods. As of June 2014, the combined annual transit ridership on the I-110 and I-10 ExpressLanes exceeded 15 million riders per year.

Metro used a sizable portion of the $210.6 million federal CRD grant to expand transit services on the express lanes. In addition to converting existing carpool lanes to express lanes, the federal grant funded 59 new clean fuel buses, security and lighting improvements at transit stations, new bike lockers, reconstruction of the El

Monte Transit Center, and expanded transit signal priority in downtown Los Angeles. The enhanced transit service on the two corridors is summarized below in Table 12-2.

Table 12-2: Transit Service Changes on Metro ExpressLanes

Effective Date	Agency	Service Change
June 2011	Metro	Peak period headways of I-110 portion of Silver Line changed from 30 minutes to 15 minutes
June 2012	Metro	Peak period headways of I-110 portion of Silver Line changed from 15 minutes to 10 minutes
October 2012	GTrans	Peak period headways of Line 2 changed from 30 minutes to 15 minutes
October 2012	Torrance Transit	New Line 4 express bus created to go to downtown LA via I-110 ExpressLanes
December 2012	Foothill Transit	13 morning peak period trips and 8 afternoon peak period trips added to the Silver Streak on I-10 4 morning peak period and 14 afternoon peak period trips added to the Route 699 on I-10
June 2013	Metro	Silver Line Saturday service headways on I-110 changed from 40 minutes to 20 minutes and Sunday service headways changed from 60 minutes to 30 minutes.
December 2015	Metro	New Silver Line express service created makes limited stops during the weekday morning and afternoon rush hours between San Pedro, downtown LA and El Monte via I-110 and I-10 ExpressLanes

Source: USDOT, 2014. Los Angeles Congestion Reduction Demonstration (LA CRD) ExpressLanes Program; *National Evaluation: Technical Memorandum on Congestion, Tolling, Transit, and Equity Results*.

The Metro Silver Line, a 26-mile express bus line operated by Metro, is the most frequent transit service on the I-110 and I-10 ExpressLanes. The Silver Line runs from the El Monte Transit Center in the east, along various streets in downtown Los Angeles, and south to San Pedro. Along the I-10 and I-110 ExpressLanes, the Silver Line stations are located in the highway median or adjacent to the express lanes with direct access for passengers provided to the street level from the highway level. The Silver Line buses pull directly off the ExpressLanes into the Silver Line stop. Other express bus service operating along the ExpressLanes use the same in-line highway stations.

The Silver Line began running in January 2010 on the HOV lanes, two years before the ExpressLanes opened. As summarized in Table 12-2, Silver Line headways have continuously increased with service now running every five minutes on the I-110 during peak periods. Since 2010, the Silver Line ridership has increased 103 percent. However, much of the ridership gains took place when service was first added in 2011 and 2012, prior to the opening of the ExpressLanes, suggesting that the improved service frequency had a greater impact on ridership than the operation of the toll lanes. In a survey of Silver Line passengers, the majority felt that their travel time has been faster since tolling began on the ExpressLanes. The same survey showed that a little more than one third of new riders stated that the ExpressLanes conversion influenced their decision to start taking transit and one third of new riders said they drove alone prior to the increased service on the Silver Line. Along both the I-10 and I-110 ExpressLanes, 48 percent of Silver Line riders agreed that the tolling has improved their travel.

The Metro Board's revenue policy is that all gross toll revenues from the ExpressLanes are first used to pay for maintenance, administration, and operation of the express lanes. All remaining revenue that is produced must be used in the respective corridor from which it was collected to provide a direct benefit for reducing congestion. A reserve fund sets aside three to five percent of revenues to cover unexpected costs on the ExpressLanes. A direct allocation of revenue supports the incremental transit service that was implemented to support the deployment of the ExpressLanes, which includes the Metro Silver Line, Foothill Silver Streak, Foothill Route 699, GTrans Line 1, and Torrance Transit Line 4. Any remaining net revenue is devoted to a combination of transit, system connectivity, active transportation, and highway improvements.

12.3.2 Miami 95 Express: Bus Rapid Transit Integral to Express Lane Success

Similar to Los Angeles, Miami received federal funding through the CRD Program to alleviate traffic congestion on the I-95 corridor between I-595 in Broward County and I-395 in Miami-Dade County. The project replaced the existing single HOV lane in each direction with express lanes, added an additional express lane, and enhanced transit and travel demand management services along the corridor. The HOV occupancy requirement was also increased from HOV 2+ to HOV 3+ with carpoolers subsequently required to enroll in a rigorous vehicle registration program to qualify for toll-free travel. The corridor was already served by a single express bus route—Route 95X—with service into downtown Miami. Phase 1A, which included enhancements to Route 95X, began in December 2008, and Phase 1B began in January 2010. Phase 2B included new Miami-Dade Transit and Broward County Transit express buses, providing non-stop service from Broward County to downtown Miami. In addition, park-and-ride lot capacity was increased by 535 spaces and transit signal priority was provided at 50 intersections along Hollywood / Pines Boulevard and Broward Boulevard.

The conversion of HOV lanes to express lanes improved the transit performance along the corridor. Average travel times for the initial 7 mile segment of the express lanes decreased from 25 minutes to 8 minutes and average speeds increased from 18 mph to 57 mph. The increased speeds and reduced travel times allowed Miami-Dade Transit to reduce the scheduled travel time for Route 95X from 32 minutes to 22 minutes northbound and 15 minutes southbound. The on-time performance improved from 76 percent on-time in 2008 to 81 percent on-time in 2010.

Between 2008 and 2010, average weekday ridership along the 95 Express Lanes increased 57 percent. Although some of this increase was due to the addition of three new lines, ridership on 95X alone increased by 13 percent. On Route 95X, boardings per revenue mile increased 51 percent between 2008 and 2010. Person throughput from transit alone increased 23 percent in the AM peak period southbound and 36 percent in the PM period northbound. Based on on-board survey results, 53 percent of new riders stated that the opening of the express lanes influenced their decision to use transit. Of the new riders, 45 percent used to take another form of transit, such as Tri-Rail and Metrorail and 38 percent used to drive alone.

In its review of the project, the Federal Transit Administration (FTA) concluded: (1) The 95 Express Bus Service has benefitted from the implementation of the HOV to express lanes conversion in the areas of travel time and

on-time performance; (2) the 95 Express Bus Service has attracted choice riders and seen an increase in ridership despite rising unemployment in Miami-Dade County; (3) the transit surveys revealed that the UPA Project did influence people's decision to use the 95 Express Bus Service; (4) the decreases seen in average vehicle occupancy and transit mode share in the I-95 Express Lanes are due to the influx of toll paying SOVs; and (5) the 95 Express Bus Service contributed to increased total person throughput in the express lanes while HOV 2 and 3+ person throughput dropped in these lanes.

12.3.3 San Diego I-15 Express Lanes: Transit Need Spurs Express Lanes

In January 2012, SANDAG and Caltrans completed a $1.4 billion expansion of I-15 including replacement of the prior dual lane reversible express lanes with a four-lane facility featuring a moveable median barrier. The project also included the completion of direct access ramps from the express lanes to transit park-and-ride facilities along the 20-mile corridor that extends from SR-78 in Escondido to SR-163 in San Diego.

The I-15 Express Lanes are located in the center of I-15 with 20 access points and five direct access ramps. As envisioned, an integral part of the express lanes is the Rapid bus service, a new high-frequency express bus system that runs from Escondido to Downtown San Diego. The Rapid service expands the previous Premium Express system that had been operating on the express lanes during peak-hour commutes. The five Rapid routes are all operated by Metropolitan Transit System (MTS) and funded by TransNet, a regional half-cent sales tax for transportation improvements administered by SANDAG. SANDAG operates the I-15 Express Lanes while Caltrans maintains the entire highway corridor. The Rapid service opened in June 2014 and cost approximately $276 million.

Direct access ramps connect park-and-ride lots and transit stations with the express lanes, which allows buses to enter the lanes without crossing the general-purpose lanes. In addition to the five transit stations connected by direct access ramps, there will be two centerline highway level transit stations as part of the future planned Rapid bus service extension. The Rapid includes transit signal priority, real time arrival signage, enhanced passenger shelters, and fewer stops. 29 new buses were acquired for Rapid service. Rapid fares range from $2.50 to $5.00. Headways and hours vary between the five different Rapid routes with some operating at frequent headways all day and others just operating in peak periods.

12.4 Lessons Learned

The review of existing facilities provides a valuable set of lessons learned from both a physical design perspective as well as a policy approach. In order to integrate transit successfully, the express lanes facilities must be designed to efficiently move buses. However, the majority of the HOV lane facilities contemplated for conversion to express lanes were originally designed as HOV lanes. Beyond the physical design considerations, there are numerous policy considerations that can influence the success of transit on a corridor. While there are numerous examples where transit has played an integral role in express lanes, there is debate about how much of the success is due to improved conditions as opposed to increased revenue for transit services.

12.4.1 Physical Design Considerations

Many of the physical design considerations for integrating bus service for express lanes are similar to those for HOV lanes, which have well-established design criteria. Based on the review of existing facilities, the following considerations should be taken into account in the planning and design of transit service on express lanes[127]:

- **Maintain Minimum Level of Service**—if managed properly, pricing levels should maintain a minimum LOS on express lanes at all times. This is a characteristic of express lanes not shared with HOV lanes and a benefit for transit operators. However, if prices are constrained, the express lanes could become congested, degrading transit service. Appropriate pricing policies are of particular importance when converting existing HOV lanes to express lanes to ensure that expanded access does not degrade speeds and transit service. In addition to LOS on the facility, it is also important to monitor the LOS at ingress and egress point to avoid conflicts with merging and diverging vehicles.
- **Provide Direct Access / Drop Ramps**—many express lanes are located in the center of the highway, limiting ingress and egress, and requiring weaving across multiple lanes to enter to or exit from the highway. Where high frequency bus service is anticipated, designing for the express lanes should include consideration for direct access ramps to avoid the need for transit vehicles to cross multiple general-purpose lanes, which can be particularly challenging for unwieldy buses. Any proposed direct ingress and egress locations should be taken into consideration in developing routing along the express lanes. Shoulder-running express lanes provide more flexibility for ingress and egress locations.
- **Limit Reversible Lanes—**some express lanes are designed to be reversible, so that the traffic direction changes with peak traffic flow. While these reversible lanes can work well in areas where peak traffic flow demand is tidal, they can present challenges for transit service. Fully reversible lanes prevent return or reverse commute buses from following the same path. Providing a different return path can compromise reliability of service and confuse passengers.
- **Provide Park-and-Ride Lots with Direct Access Ramps**—most express lanes have at least one park-and-ride lot within a mile of the facility. In several cases, the revenue from express lane facilities has been used to fund construction of new park-and-ride lots, expanding access to transit. When locating park-and-ride lots, access to the express lanes is an important consideration. Ideally, buses would have direct access from the park-and-ride lots to the express lanes, which may be a challenge along facilities with existing park-and-ride lots.
- **Determine Whether Stations will be In-Line or Off-Line—**the *Caltrans 2003 HOV Guidelines* establishes clear definitions of in-line and off-line transit stations. In-line stations are contiguous to the express lane facility and serve pedestrian passengers and feeder transit lines, as well as transfers with other routes on the facility. Benefits of in-line stations include right of way savings, eliminating the need for ramp

[127] Newmark, 2014

construction, and time savings. Drawbacks include noise and air pollution for the passenger, longer walking distances, increase in transfers, and expensive handicap access.

In an in-line station, a passing lane is required for through traffic. The platform could be in the center of the lanes or to the side. Center platforms provide less width, provide for easy transfers and are less expensive. However, buses generally load on the right side, which is a challenge for center platform stations. Off-line stations are not contiguous with the express lanes, but are close enough to receive direct bus service. They are often located at park-and-ride lots, large employment centers, or a major transit center. Off-line stations require either a direct connector ramp or a drop-ramp and also result in longer travel times. Off-line stations provide better pedestrian access than an in-line station.

Figure 12-1 to Figure 12-4 include three photographs (Los Angeles, Miami, and Minneapolis) and one illustration (San Diego) of express buses operations on express lanes around the U.S.

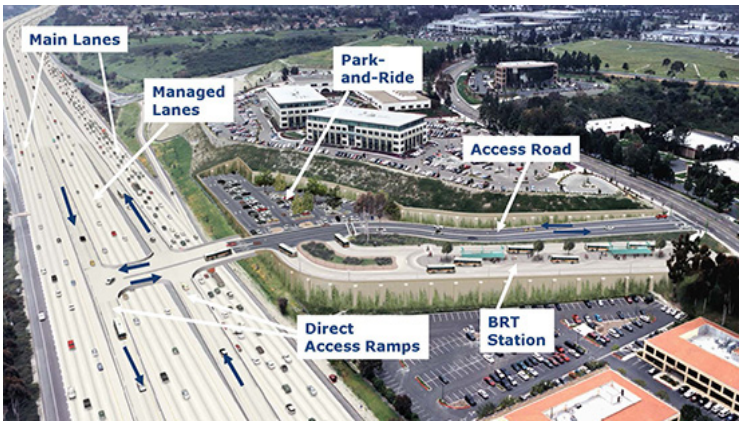
Figure 12-1: In-Line 37th Street & USC Metro Silver Line Station, I-110, Los Angeles

Source: Wikimedia Commons, Metro96, 2013

Figure 12-2: 95X Express Bus, I-95, Miami

Source: FDOT

Figure 12-3: Direct Access Ramps, I-15, San Diego



Source: SANDAG

Figure 12-4: Express Lanes, I-35W, Minneapolis

Source: Minnesota Department of Transportation (MnDOT)

12.4.2 Policy Considerations

Each express lane project has a unique set of policies in place that influences how well transit is integrated in a particular corridor. Among the most critical policies is determining pricing levels of the express lanes and distributing revenue. For example, if the express lanes were initially conceived as a means to fund transit, the policies are likely to reflect that intent by dedicating a portion of express lane revenue to transit service. Establishing a set of policies that improves transit service and capacity is also often essential in building public support for often controversial toll lane projects and helps to neutralize the concept of Lexus lanes. The following key policy considerations relate to transit integration into express lanes[128]:

- **Coordinate Multiple Transit Operators—**as shown in Table 12-1, it is not uncommon to have multiple transit agencies operating service on a single express lane facility. Transit vehicles are typically allowed to utilize the express lanes without paying a toll. Ideally, the express lane transit operators would coordinate all service on a facility and market the service clearly to the public. Some facility operators, such as 95 Express in Miami, provide uniform branding of services regardless of transit agency.

- **Dissuade Shifts to Driving—**one of the potential unintended consequences of converting HOV lanes to express lanes is that some existing transit riders may decide to start paying to drive alone in the express lanes. Some transit agencies have addressed this concern by pricing the express facilities at a minimum rate that is at least as much as the transit fare so there is never an out of pocket price advantage for solo driving. For example, in Los Angeles, tolls in the morning and afternoon peak periods for the full trip on the ExpressLanes must be at least 1.5 times the Metro Bus Rapid Transit fare of $2.45.

- **Set Fares to Reflect Service—**express buses operating in express lanes often provide a superior LOS, allowing transit agencies to justify higher fares on these routes. Many transit agencies have established distance based fares applied to express bus service operating in express lanes facilities.

- **Consider Shifts from Parallel Transit Service—**in evaluating transit ridership gains on express lane facilities, it is important to consider whether the riders are new to transit or if they are existing transit riders who are shifting from parallel routes. It is recommended that agencies conduct a rigorous before and after evaluation, which includes ridership surveys on surrounding routes.

- **Capitalize on Express Lanes Media as a Transit Marketing Opportunity—**since express lane facilities are still a relatively new concept, they often receive a great deal of free media attention during the planning, construction, and opening. Savvy transit agencies can capitalize on this media attention to market both existing as well as new transit service in the corridor.

- **Establish Strong Brand Recognition**—introducing new bus service along express lanes provides an opportunity for transit agencies to brand a premium transit service. Marketing the service as different

[128] Newmark, 2014

from traditional transit service (i.e., Metro Silver Line) may appeal to new riders and may allow agencies to charge a higher fare for express routes.

- **Institute Revenue Transfer Policies—**perhaps one of the most critical policies to establish is determining how toll revenues will be used. In order to transfer toll revenues to fund transit operations, legislation often must be adopted that specifies how any revenue is to be distributed.

- **Leverage Federal Funding Opportunities—**federal programs, such as the VPP Program, have provided initial funding for the development of several express lanes initiatives.

- **Establish Transit Rewards Program—**the Metro ExpressLanes was the first express lanes project to establish a transit rewards program, which was intended to incentivize transit use along the corridors as well as to address equity concerns. The program provides toll credits for regular transit passengers.

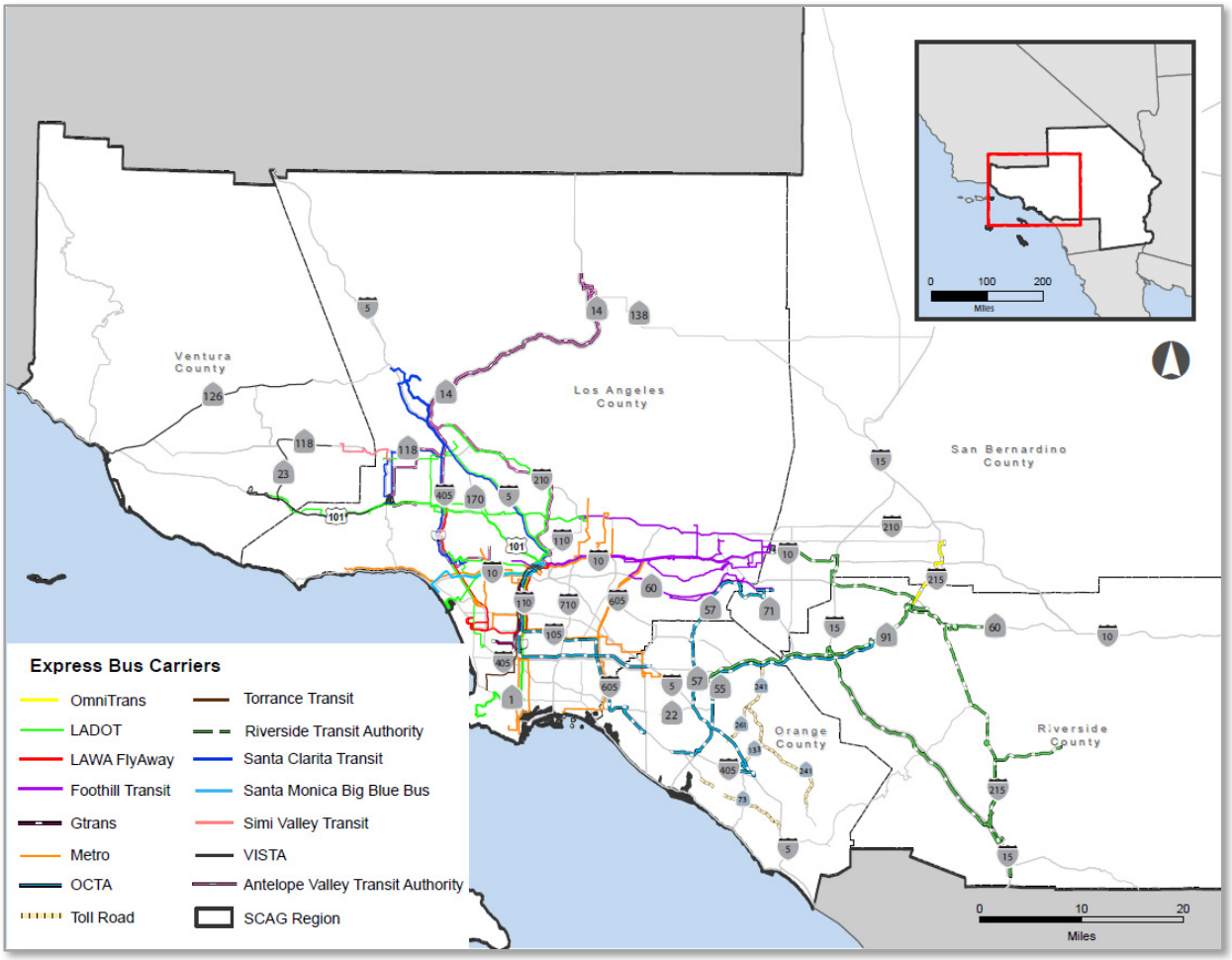
- **Adopt Interoperable Fare System**—interoperability between different tolling facilities is being increasingly commonplace. However, in order to establish a transit rewards program, tolling accounts must also be interoperable with transit accounts. If multiple agencies are involved in the operations of the toll lanes and transit service, this will require close interagency coordination.

12.5 Opportunities for Future Express Bus Service in the SCAG Region

The SCAG region is well served in the urban core by express bus services operating on the region's highways. However, much of the existing and future express bus service is concentrated around regional activity centers, such as downtown Los Angeles, and the cities of Orange, Corona, and San Bernardino. The highways surrounding these regional centers are often subject to bottlenecks and heavy traffic congestion, especially during peak commuting times. Although much of the current service operates on the existing HOV lanes network, where present, even these lanes can become heavily congested, making the travel times unreliable. Establishing a network of express lanes with express bus service feeding into the regional centers would improve transit travel time reliability.

Figure 12-5 depicts the express bus service routes by transit agency and identifies existing and future HOV and express lanes. As shown, thirteen different agencies currently operate express bus services in the region (Antelope Valley Transit Authority (AVTA), LADOT, Foothill Transit, GTrans, Torrance Transit, Metro, OCTA, OmniTrans, RTA, Santa Clarita Transit, Santa Monica Big Blue Bus, Simi Valley Transit, and Ventura Intercity Transit Service Authority (VISTA)). In addition, the Los Angeles World Airports (LAWA) operates LAX FlyAway® buses offering convenient regularly scheduled round-trips, seven days a week, between each terminal at LAX to / from: Van Nuys, Union Station, Westwood, Santa Monica Hollywood, Orange Line and Long Beach. Several segments of the highways are served by multiple transit operators, such as I-405 over the Sepulveda Pass, I-110 south of downtown Los Angeles, I-5 north of downtown Los Angeles, I-10 east of downtown Los Angeles, and I-210 east of Pasadena.

Figure 12-5: Current Express Bus Service in SCAG Region by Agency



Source: SCAG; WSP | Parsons Brinckerhoff

As part of the SBCTA I-10 Express Lanes, SBCTA is working with OmniTrans to integrate express lane service into the facility. Omnitrans currently runs Express Bus Route 290 along the I-10 corridor. This highway express bus route runs along I-10 and connects the downtown San Bernardino Transit Center with Arrowhead Regional Medical Center, Ontario Mills, and the Montclair Transit Center. Once the I-10 Express Lanes are built, Route 290 would be able to use approximately 24 miles of the HOV or Express Lanes on I-10, resulting in a reduced travel time of approximately 50 percent compared to local bus services. The route is designed to maximize transfer potential to Foothill Transit's Silver Streak in Montclair, Metrolink trains, and other Omnitrans route for better connectivity regionally.

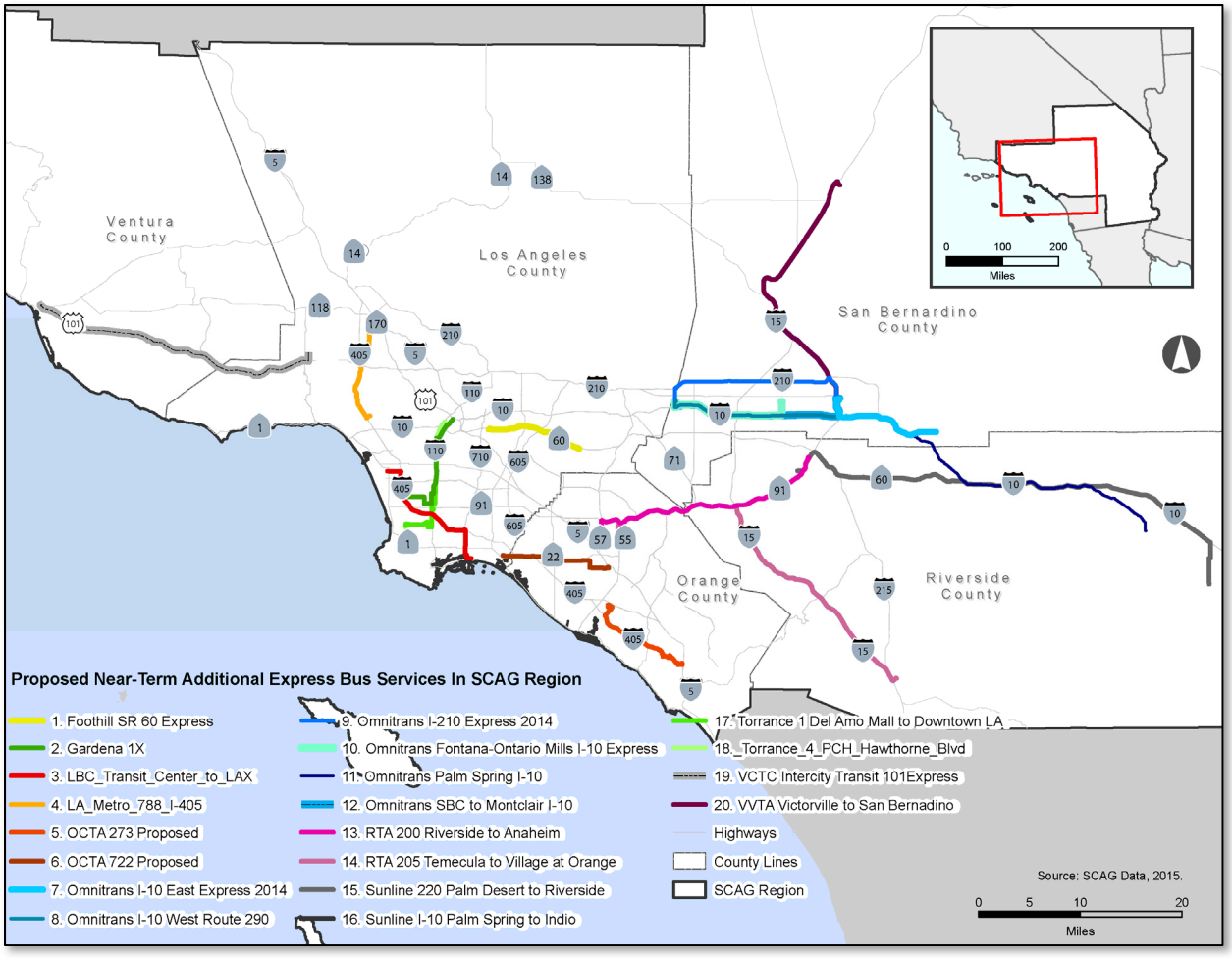
Omnitrans is also considering several locations along I-10 that may be suitable for implementing key bus stop locations, allowing greater transit connectivity and opportunities to accommodate trip transfers for existing and future customers. Preliminary engineering concept plans are being reviewed with SBCTA, Caltrans and

Omnitrans that implement bus stop locations along interchange ramps at Mountain Avenue and Sierra Avenue to accommodate trip transfers between the express bus line and primary local bus routes. These bus stops appear feasible for implementation, lie within the project footprint, and will continue to be further developed to finalize the preliminary design of the bus stops at these locations.

Of the existing or future HOV and express lanes identified in Figure 12-5, most are already served by express bus service. However, there are some segments of the I-405, I-5, I-210, I-10, I-15, SR-22, SR-91, and SR-60 that are identified to have HOV and express lanes, but are not currently served by express bus service. Most of these segments do not directly serve a major regional center, so express bus service may not be justified.

Figure 12-6 and Table 12-3 and show future / expanded express bus service by agency according to SCAG. Most of the new service or augmentation of current express service is in heavily traveled, relatively densely developed corridors. Further study is necessary to determine whether expanding express bus service along corridors with sparse current service and lower density development is warranted.

Figure 12-6: Future / Expanded Express Bus Routes in SCAG Region by Agency



Source: SCAG; WSP | Parsons Brinckerhoff

Table 12-3: Future / Expanded Express Bus Service in SCAG Region by Agency

Operator	Line	Future Express Bus Corridors/ Terminals	Highway Facilities	AM Headway	Midday Headway	PM Headway	Evening Headway	Implement New / Expanded Service
Foothill	SR 60 Express	SR-60 between Atlantic Gold Line Station and Puente Hills Mall	HOV Lane	15	30	15	60	2020
GTrans	1X	Gardena to downtown LA	Express Lane	30	60	30	60	2040
LBT	LAX	San Diego Fwy Express between LB Transit Mall and LAX	Express Lane	30	60	30	60	2040
Metro	788	Arleta/Van Nuys/Westwood/LAX	Express Lane	20	30	20	30	2040
OCTA	273	SR-73 from Laguna Niguel/Mission Viejo Metrolink to South Coast Plaza	Toll Road	30	N/A	30	No Service	2040
OCTA	722	SR-22 from Santa Ana from Santa Ana Reg. Trans. Ctr. to Cal State Long Beach	HOV Lane	30	60	30	No Service	2040
Omnitrans	I-10 East	Yucaipa/Redlands to San Bernardino Transit Center via I-10	Express Lane	30	60	30	60	2040
Omnitrans	I-10 West	San Bernardino Transit Center to Montclair TransCenter via I-10	Express Lane	30	60	30	60	2018
Omnitrans	I-210	San Bernardino Transit Center to Montclair TransCenter via I-210	HOV Lane	30	60	30	60	2040
Omnitrans	Ontario Mills	Ontario Mills Mall to Montclair TransCenter via I-10	Express Lane	30	60	30	60	2040
Omnitrans	PS	San Bernardino Transit Center to Palm Springs	Express Lane /Mixed Flow	30	60	30	60	2040
Omnitrans	TBD	San Bernardino Transit Center to downtown Montclair	Express Lane	30	60	30	60	2040
RTA	200	Downtown Riverside to ARTIC	Express Lane	30	60	30	No Service	2017
RTA	205	Temecula to Village at Orange	Express Lane	30	60	30	No Service	2017
SunLine	220	Palm Desert to downtown Riverside	Mixed Flow	30	60	30	60	2040
SunLine	I-10	Palm Springs to Indio via I-10	Mixed Flow	30	60	30	60	2040
Torrance	1	Del Amo Mall to downtown L.A.	Express Lane	30	60	30	60	2040
Torrance	4	PCH and Hawthorne to downtown L.A.	Express Lane	30	60	30	60	2040
VISTA	101 Express	Ventura to Warner Center	HOV Lane	30	60	30	60	2040
VVTA	SBTC	Victorville to San Bernardino Transit Center—El Cajon Express	Express Lane	30	60	30	60	2040

Source: SCAG Transit Network, received Aug. 2015

12.6 Transit Integration Recommendations

Transit Integration:
Integrate transit considerations into the planning, design and operation for future express lanes to accommodate transit services, where appropriate, to maximize the effectiveness of the lanes.

As the SCAG region looks to expand the regional express lane network, the expansion of high quality bus service should be integrated into the decision making process. The success of the transit service on the I-110 and I-10 ExpressLanes demonstrates that express lanes can benefit not only solo drivers and HOVs, but also transit riders. The ability to provide more frequent and reliable service has the potential to change how transit is viewed and used. Implementing agencies should keep in mind the following recommendations as the regional express lane network advances.

1. **Integrate transit planning into the early planning process.** If providing transit on the express lanes is a priority, it is critical to engage with the transit operators early to understand their physical infrastructure needs and service requirements, such as geometric considerations, direct access ramps, and park-and-ride facilities.

2. **Identify express bus routes that connect regional centers.** Develop a comprehensive understanding of corridor travel patterns to determine where express bus service would be most efficient. Express bus service on express lanes is best suited for long-distance commuting trips. The SCAG region would benefit from express bus service that connects suburban outlying communities to downtown Los Angeles, central Orange County, northwestern Riverside County, and western San Bernardino County.

3. **Establish clear revenue spending plans**. The operating agency for the express lanes should adopt policies that clearly specify how express lane revenue will be distributed. Transit service operations should be a consideration in the project financial planning and revenue distribution, where appropriate.

4. **Identify lead agency to coordinate and market express bus service.** Transit service is most successful when the service provided by various operators is well coordinated and marketed as one unified program. This also provides an opportunity for transit service to rebrand itself as part of the innovative express lanes.

5. **Pursue federal and state funding opportunities.** Incorporating express bus service on express lanes opens up new federal and state funding opportunities for transit and multimodal projects, which express lanes may not qualify for on its own, including Transportation Investment Generating Economic Recovery (TIGER) grants, Small Starts grants and Cap and Trade funding.

6. **Adopt an interoperable toll and fare collection system.** Establishing toll and fare collection systems that link to the same account results in not only improved convenience for passengers, but also allows for the implementation of transit incentives, such as those available Metro TAP and ExpressLanes customers.

13.0 POLICY RECOMMENDATION SUMMARY

Table 13-1 provides an abbreviated summary of recommended express lane facility design, operating concept, performance measurement and evaluation, delivery and governance, and transit integration policy recommendations outlined as part of this document. The table is intended as a quick reference of policy recommendations, but should not be considered a comprehensive synopsis of the guidance of this document.

Table 13-1: Policy Recommendation Summary

Policy	Recommendation
Facility Design	
Typical Section	▪ Emphasize full standard shoulder and buffer design to reduce crashes and friction
Separation Treatment	▪ Retain flexibility for implementing agencies to allow treatment that best meets the needs of a specific project, within parameters of existing guidance
Access Treatment	▪ Maintain limited access design where it is currently utilized for HOV lanes, and utilize separated merge lanes or combined weave lanes for operations and safety ▪ Evaluate use of continuous access on a strategic corridor basis for enhancing safety and operations, with maximum one-mile spacing of toll readers to minimize toll evasion
Express Lane Signage	▪ Signage consistent with CaMUTCD is preferred ▪ Signage developed for Metro ExpressLanes provides regional template for CTCs ▪ Signage for continuous access should designate the start of pricing segments to designate start of statutory enforcement area
Operating Concept	
Toll Collection	▪ Mandatory use of RFID transponders in preferred as the primary means for tolling and enforcement ▪ Violation enforcement will be conducted by LPR for those vehicles not equipped with transponders ▪ Video-based tolling is recommended only as a secondary means of toll collection
HOV Occupancy / Exemption	▪ HOV occupancy policy should be based on agency goals for mobility and revenue, and managed lanes performance to avoid lane degradation ▪ HOV 3+ toll-free or discounted during peak periods, and HOV 2+ during off-peak periods is recommended where HOV 2+ lanes are to be converted to express lanes ▪ Full-time HOV 3+ toll-free or discounted policy is recommended for express lanes involving new construction
Clean Air Vehicle Exemptions	▪ Clean air vehicles should no longer be permitted to use express lanes during peak periods without meeting occupancy requirements or toll payment in accordance with federal and state performance requirements
Hours of Operations	▪ Express lane facilities will operate 24 hours a day, seven days a week
Toll Rate	▪ Minimum and maximum toll rates may be established, but should be carefully considered to ensure they do not constrain the lane performance
Pricing Model	▪ Variable pricing using a segment or zone based model is recommended ▪ Facility travel sheds, interconnectivity, and logical termini should be evaluated when determining pricing segments or zones

Policy	Recommendation
Toll Communication	▪ Toll rate pricing structure should be communicated to drivers through destination-based CMS, showing near and farther destinations ▪ Visual communications would act as a toll rate guarantee, where the price is locked in once a driver enters a specific segment or zone
Business Rules	▪ Each operator will develop business rules specific to the goals and objectives of the particular facility, and consistent with characteristics of existing operations structure
Revenue Allocation	▪ Identify and prioritize operational expenses for primary allocation of revenues, with transit or HOV within the corridor as a secondary use of revenue
Network	▪ Implementation of a regional express lanes network requires collaboration and coordination across multiple agencies, requiring partnering organizations to meet regularly to coordinate on issues of regional significance
Equity Process	▪ An ongoing process for analyzing equity implications should be undertaken for every express lane project to understand the effects on all potential uses, and to determine appropriate strategies to mitigate equity impacts and concerns over time
Performance Measurement and Evaluation	
Performance Measurement	▪ Performance on all regional express lanes should be continuously monitored to ensure compliance with federal standards, state requirements, and local goals and objectives
Network Delivery and Governance Options	
Network Governance	▪ Use of JPA should be considered for interconnected projects crossing multiple jurisdictions, to establish parameters for cost and revenue sharing and performance assessment
Transit Integration	
Transit	▪ Maximize effectiveness of express lanes by integrating transit considerations into the planning, design, and operation of facilities to accommodate transit

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15.0 APPENDICES

Appendix A:	Existing Corridor Conditions Profiles
Appendix B:	Social Justice and Environmental Equity Framework
Appendix C:	Caltrans Deputy Directive (DD-43-R1)
Appendix D:	Adopted Toll Policy for LA Metro I-110 / I-10 ExpressLanes
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