Los Angeles Congestion Reduction Demonstration ExpressLanes Program: National Evaluation Report

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Final Report — August 31, 2015

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16. Abstract

This document presents the final report on the national evaluation of the Los Angeles Congestion Reduction Demonstration (LA CRD) ExpressLanes Program under the United States Department of Transportation (U.S. DOT) CRD Program. The LA CRD projects focus on reducing congestion by employing strategies consisting of combinations of Tolling, Transit, Telecommuting/TDM, and Technology, also known as the 4Ts. Tolling (pricing) strategies include converting high occupancy vehicle (HOV) lanes on the two freeway corridors to variably-priced high-occupancy toll (HOT) lanes, adding a second HOT lane to portions of one corridor, and implementation of a downtown L.A. intelligent parking management system featuring demand-based pricing and real-time parking availability information. Transit improvements include increased bus service, transit station security improvements, expansion of two transit stations, creation of an El Monte Busway/Union Station connector, and the expansion of downtown L.A. transit signal priority. TDM strategies aim to establish 100 new registered vanpools. The national evaluation of the LA CRD projects was guided by the National Evaluation Framework, the LA CRD National Evaluation Plan, and individual test plans for various components. This report provides information on the use of the new LA CRD projects. Changes in travel speeds, travel times, trip-time reliability, and transit ridership are described. The air quality, energy, and safety impacts of the LA CRD projects are examined. Information on changes in unemployment rates and gasoline prices is also summarized.

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4Ts	Tolling, Transit, Telecommuting, and Technology
APC	Automated Passenger Counter
apps	Applications
ARB	Air Resources Board
AT-PZEV	Advanced Technology – Partial Zero Emission Vehicles
AVL	Automated Vehicle Location
AVO	Average Vehicle Occupancy
BCA	Benefit-Cost Analysis
BRT	Bus Rapid Transit
CAG	Corridor Advisory Group
Caltrans	California Department of Transportation
CCTV	Closed-Circuit Television
CHP	California Highway Patrol
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CRD	Congestion Reduction Demonstration
CTOC	California Toll Operators Committee
DBOM	Design-Build-Operate-Maintain
DMS	Dynamic Message Signs
DMV	Department of Motor Vehicles
EMFAC	Emissions Factors
EPA	Environmental Protection Agency
ETC	Electronic Toll Collection
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
GPS	Global Positioning System
HOT	High-Occupancy Toll
HOV	High-Occupancy Vehicle
HOV2+	High Occupancy Vehicle Lane allowing Travel by Vehicles with Two or more Occupants
HOV3+	High Occupancy Vehicle Lane allowing Travel by Vehicles with Three or more Occupants
I-10	Interstate-10

I-110	Interstate-110
ILEV	Inherently Low-Emission Vehicle
IPM	Intelligent Parking Management
ITS	Intelligent Transportation Systems
JPO	Joint Program Office
LA	Los Angeles
LADOT	Los Angeles Department of Transportation
LAX	Los Angeles International Airport
Metro	Los Angeles County Metropolitan Transportation Authority
Metrolink	The Southern California Regional Rail Authority
Mp	Mile Post
mph	Miles per Hour
MSA	Metropolitan Statistical Area
MUTCD	Manual of Uniform Traffic Control Devices
NEF	National Evaluation Framework
Non-Rev	Non-revenue
NOx	Nitrogen Oxides
PBP	Pay by Plate
PeMS	Caltrans Performance Measurement System
$PM_{2.5}$	Particulate Matter less than 2.5 Microns
RITA	Research and Innovative Technology Administration
ROG	Reactive Organic Gases
SCAG	Southern California Association of Governments
SOV	Single Occupant Vehicle
SULEV	Super Ultra-Low Emission Vehicle
SWITRS	Statewide Integrated Traffic Records System
TDM	Travel Demand Management
TG	Technology Groups
TMC	Traffic Management Centers
TPS	Transit Priority Signal
TRAC	Washington State Transportation Center
TRB	Transportation Research Board
TTI	Texas Transportation Institute
UPA	Urban Partnership Agreement
U.S. DOT	U.S. Department of Transportation
VMT	Vehicle Miles Traveled
VOC	Volatile Organic Compounds
VOT	Value of Time

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Executive Summary

This report presents the national evaluation of the Los Angeles (LA) Congestion Reduction Demonstration (CRD) projects under the U.S. Department of Transportation (U.S. DOT) CRD program. It summarizes information from the pre-deployment period and one full year of operation of the majority of LA CRD projects.

Background

In 2007, the U.S. DOT, in partnership with select metropolitan areas, initiated a program to demonstrate congestion reduction through the implementation of pricing activities (e.g., tolling) combined with necessary supporting elements. Six sites around the U.S. including LA, as well as Atlanta, Miami, Minneapolis, San Francisco, and Seattle, were selected through a competitive process to conduct either Urban Partnership Agreement (UPA) or CRD program improvements. The selected sites were awarded funding for implementing congestion reduction strategies based on four complementary strategies known as the 4Ts: Tolling, Transit, Telecommuting/Travel Demand Management (TDM), and Technology.

The U.S. DOT sponsored the UPA and CRD national evaluation, with the overall responsibility for the national evaluation assigned to the Intelligent Transportation Systems Joint Program Office (ITS JPO). In the Office of the Assistant Secretary for Research and Technology (formerly in the Research and Innovative Technology Administration [RITA]). Representatives from the Federal Highway Administration (FHWA) and the Federal Transit Administration (FTA) were actively involved in the national evaluation. The Battelle team was selected by the U.S. DOT to conduct the national evaluation through a competitive procurement process.

The purpose of the national evaluation was to assess the impacts of the UPA/CRD projects in a comprehensive and systematic manner across all sites. The national evaluation generated information and produced technology transfer materials to support deployment of the strategies in other metropolitan areas. The national evaluation also generated findings for use in future federal policy and program development related to mobility, congestion, and facility pricing. The Battelle team developed a National Evaluation Framework (NEF) to provide a foundation for evaluation of the UPA/CRD sites. The NEF was based on the 4T congestion reduction strategies and the questions that the U.S. DOT sought to answer through the evaluation. The NEF was used to develop the LA CRD National Evaluation Strategy, the LA CRD National Evaluation Plan, and ten Test Plans. These plans guided the LA CRD National Evaluation.

The Los Angeles CRD

The LA CRD, also known as the ExpressLanes Program was one of six sites funded by the U.S. DOT through the UPA and CRD programs to demonstrate congestion pricing and other supporting strategies.

The LA CRD ExpressLanes Program effort was led by the Los Angeles County Metropolitan Transportation Authority (Metro) in partnership with the California Department of Transportation (Caltrans). The CRD projects were implemented with the assistance of a number of supporting agencies including the Los Angeles Department of Transportation (LADOT); Gardena Municipal Bus Lines; Torrance Transit; the Southern California Regional Rail Authority (Metrolink); Foothill Transit; and the California Highway Patrol (CHP).

Despite substantial transportation investments, it is widely accepted that major elements of LA's transportation network are operating at or near capacity. By making an investment in the Interstate-10 (I-10) and Interstate-110 (I-110) corridors to convert existing high-occupancy vehicle (HOV) lanes to dynamically-priced high-occupancy toll (HOT) lanes, the CRD projects added peak period transportation capacity in the treatment corridors for single-occupant vehicles (SOVs). The program also provided funding for transit enhancements and ridesharing alternatives to vehicle travel to offer more transportation alternatives to travelers. These projects sought to examine public willingness to accept pricing as a way of moderating congestion and improving transportation facility utilization in the LA region.

The LA CRD projects were intended to reduce congestion, promote throughput, and enhance mobility in the I-10 and I-110 corridors, and in downtown LA. The centerpieces of the LA CRD were the HOT Lanes ("ExpressLanes") along the I-10 and I-110 freeways.[1] The ExpressLanes were intended to expand freeway capacity by permitting toll-paying vehicles that do not meet the carpool occupancy requirements to use remaining HOT lane capacity on the I-10 and I-110 freeways. The ExpressLanes were created by converting existing HOV lanes into HOT lanes on the I-10 and I-110. The ExpressLanes were not permitted to increase from the existing HOV occupancy requirements. During the demonstration period, all vehicles were required to pay to use the ExpressLanes with the exception of publicly or privately operated transit vehicles, motorcycles, emergency response vehicles responding to an emergency, and multiple-occupant private vehicles (three or more occupants on I-10 during peak hours, two or more all other times; and two or more occupants on I-110). Upon completion of the demonstration period (effective February 24, 2014), alternative fuel vehicles with white and green California Clean Air Stickers were allowed to travel toll-free irrespective of occupancy with a FasTrak® transponder. Tolls ranged from a minimum $0.25 per mile to a maximum $1.40 per mile depending on congestion levels. When travel speeds in the ExpressLanes fell below 45 mph for more than ten minutes, the ExpressLanes had reached capacity. At this point, the lanes reverted to HOV lanes and vehicles that did not meet the carpool occupancy requirements were not permitted to "buy" their way into the lanes. Qualifying Low-Income commuters received a $25 credit when they set up their account through the Equity Plan.[2]

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[1] ExpressLanes were created by converting existing HOV lanes into HOT lanes along the I-10 (from I-605 to Alameda Street) and along the I-110 (from 182nd Street to Adams Boulevard). In addition, a second HOT lane was created (via restriping; no loss of general purpose lanes occurred) on I-10 from I-605 to I-710.

[2] The Equity Plan, later re-named the Low-Income Assistance Plan, defineed low income commuters as Los Angeles residents with an annual household income (family of 3) of $39,060 or less (numbers based on 2013 income levels per the demonstration period).

Other LA CRD projects that were evaluated included transit improvements to increase the frequency of Metro bus rapid transit service through the acquisition of new clean fuel expansion buses and increased service, security upgrades, construction improvements along stations and park-and-ride lots, and implementation of transit priority signal (TPS) technology to facilitate ExpressLanes traffic movement where the I-110 enters downtown LA. Additionally, the intelligent parking management (IPM) ("LA Express Park™"), a variable and demand-based parking pricing system, was implemented to reduce traffic congestion, decrease air pollution, and improve transit efficiency by reducing parking search times. Lastly, ridesharing promotional efforts were conducted to increase the number of registered vanpools (the goal was 100 new registered vanpools on the I-10 and I-110 corridors).

The following points highlight the findings of the major elements of the CRD projects that were the focus of the national evaluation:

- **Tolling.** The ExpressLanes on the I-110 opened on November 10, 2012 and those on the I-10 opened on February 23, 2013. The number of trips on the ExpressLanes by all groups – self-declaring toll-free HOV2+s and HOV3+s, toll-paying HOV2+s and single occupant vehicles (SOVs), as well as vanpools, buses, motorcycles, and other non-revenue vehicles – increased over the course of the demonstration. A total of 210,367 FasTrak® accounts were opened during the 20-month period examined in the evaluation, with 261,230 transponders issued. The ExpressLanes provided choices to travelers in the I-10 and I-110 corridors. The growth in self-declaring HOV2+ and HOV3+ FasTrak® trips over the course of the demonstration and the survey results indicate that carpooling continues to be a viable option for travelers in the corridor, although Caltrans occupancy count observations suggest that carpooling overall decreased.

  The impacts on congestion on the I-10 and I-110 from the ExpressLanes were generally positive, with some mixed results, partly reflecting increased travel in the two corridors due to the improving economy. The employment rate grew by 3.1 percent during the study period, and Caltrans measured VMT increased on other highway facilities in the region, implying that the growth in VMT was not entirely due to the CRD project. Peak period, peak direction travel times on the I-10 increased slightly in the general purpose lanes in the morning, but declined slightly in the afternoon. Due primarily to the increase in capacity from adding an HOV lane in each direction, travel times on the I-10 ExpressLanes declined during both time periods. Travel times on the I-110 general purpose lanes increased slightly in the morning, but remained approximately the same in the afternoon. Travel times in the ExpressLanes increased in the morning, but remained the same in the afternoon. Travel time reliability, as measured by the 95th percentile travel time and the Buffer Index, improved on the I-10 ExpressLanes and general purpose lanes, but declined slightly on the I-110 ExpressLanes and general purpose lanes. Vehicle throughput increased on I-110 in both the morning and afternoon peak hours, peak direction of travel. Person throughput declined slightly in both the morning and afternoon peak hour. Vehicle and person throughput increased on I-10 in both the morning and afternoon peak hours, peak direction of travel. Travel speeds in the I-10 and I-110 ExpressLanes remained above the 45 mph target in all but a few time intervals on the I-110 during the morning and afternoon peak periods. Travel speeds in the I-10 and I-110 general purpose lanes declined in the morning peak period, but increased or remained the same in the afternoon peak period. Use of the I-10 and I-110 ExpressLanes continued to provide travel-time savings over the general purpose lanes in the 2014 post-deployment period.

One of the statements in the 2012 and 2014 survey of motorists was "Even if I do not wish to pay to use the ExpressLanes on a regular basis, it is good to have an option when I need to go somewhere fast." Approximately 67 percent of the respondents in 2012 and 58 percent in 2014 agreed with this statement. Support was higher among the I-10 users and among HOV users on both facilities.

The 2013 ExpressLanes FasTrak® Customer Satisfaction Survey included questions related to the perceived benefits of the ExpressLanes. Approximately 71 percent of the respondents selected time savings as the greatest benefit from using the ExpressLanes. In response to a question asking respondents to rate their overall experience to date with the ExpressLanes, 86 percent rated their experience as good to excellent. Approximately 81 percent of respondents reported they would recommend FasTrak® to their family and friends.

The results of the LA Express Park™ analysis indicate that the parking sensors, new parking meters, additional payment methods, and parking management system – coupled with policy changes enacted by the LA City Council – enabled the implementation of demand-based parking pricing and the parking guidance system in the downtown area. The time-of-day pricing resulted in more even distribution of parking space use, with more blocks experiencing 70 to 90 percent parking occupancy, and enhanced overall parking management.

- **Transit.** The LA CRD Program included multiple transit-related improvements, including the purchase of 59 new clean-fuel buses to enhance the Metro Silver Line, the Foothill Transit Silver Streak, as well as several other municipal bus routes. In downtown LA, TPS technology was installed at 15 intersections on Figueroa Street between Wilshire Boulevard and Adams Boulevard and at 5 intersections on Flower Street between Wilshire Boulevard and Olympic Boulevard. Ridership has significantly increased in both ExpressLanes corridors, including the Metro Silver Line bus service, Foothill Transit Silver Streak and Route 699, Gardena Lines 1X and 2, and Torrance Transit Line 4. There has been an increase in utilization of park and ride lots in both the I-10 and I-110 corridors. Data suggests that implementing variable tolls has had little or no negative impact to bus travel times on the I-110 ExpressLanes, and it has had a positive impact to bus travel times on the I-10 ExpressLanes. A survey of Silver Line riders showed statistically significant improvements in the ratings given by riders on the I-110 segment for frequency and hours of service.
- **TDM.** The rideshare, or TDM element, of the CRD projects was centered on a focused campaign to form new vanpools in the two ExpressLanes corridors. A total of 119 new vanpools were formed, exceeding the goal of forming at least 100 new vanpools in the first year after tolling. Employer outreach, incentives and direct marketing were effective methods of promoting alternatives to driving alone. The necessity for all users to have transponders created some confusion early on, but ongoing education by Metro was cited as very helpful. Employer outreach was crucial to both forming new vanpools and educating existing carpoolers and vanpoolers about how the ExpressLanes operate. Incentives, in the form of vanpool fare subsidies ($400) and the Carpool Loyalty Program, were also important to retain ridesharing arrangements, although the proportion of travelers aware of these incentives was relatively low. The results of available data related to mode shift and carpool behavior were inconclusive as to whether carpooling was unintentionally negatively impacted by tolling. Caltrans occupancy count observations such as those used in other CRD sites suggested that carpooling overall decreased

substantially after the opening of the ExpressLanes. Toll account data showed carpooling increased in the ExpressLanes after implementation. Two surveys, one of all travelers and one of transponder account holders, showed almost no change in carpooling. Methodological issues among all these data sources may call into question the ability to determine the answer to this question. As such, the issue of carpool impacts, as a direct result of tolling, was inconclusive in this case.

- **Technology.** Advanced technologies, e.g., ITS, played a significant role in almost all of the LA CRD projects, including the ExpressLanes tolling, switchable transponders, and variable pricing. Advanced parking technologies, including the parking occupancy sensors and the new parking meters, allowed the LADOT to implement demand-based parking pricing and the parking guidance system in the downtown Los Angeles area, and improved the Department's ability to enforce parking regulations.

The safety analysis was largely inconclusive due to a lack of sufficient crash data; however, no negative safety impacts were observed by CHP personnel as a result of the ExpressLanes. The environmental analysis pointed to an increase in air emissions and fuel consumption along the corridor after one year of tolling as a result of improved vehicle throughput on the I-10 and I-110. Non-technical success factors included strong political and agency leadership champions and a comprehensive outreach and communications campaign which garnered public acceptance.

The evaluation assumed that changes observed on the I-10 and I-110 were due to the CRD projects. This was not the preferred evaluation method. Using an urban planning model to model the impact of the LA CRD projects would have been preferable – with that model holding exogenous factors constant. Model results could be calibrated using empirical data collected on the freeways and the model could then estimate the impact of allowing SOVs on the HOV lanes for a toll. Given that modelling of the impacts was not possible, the next best option would have been to compare changes observed on the I-10 and I-110 to one or more control corridors. Any changes observed on the I-10 and I-110 relative to changes observed on the control corridor(s) could then be attributed to the LA CRD Projects. Unfortunately, the local partners indicated that there were no suitable control corridors. Therefore, the only option available was to measure the changes on the I-10 and I-110 and attribute those changes to the LA CRD projects. As mentioned, this was not the preferred method, and exogenous factors could (and likely did) cause some of these changes.

Overall, the LA CRD projects resulted in many positive outcomes. Tolling and parking technologies were successfully tested, resulting in broad user acceptance. Tolling helped to improve the efficiency of the ExpressLanes, helping to address congestion issues by increasing the effective capacity of the corridors. As such, tolling led to increased vehicle and person throughput. While some of the increased VMT that caused higher calculated emissions and fuel use costs may have been a result of a decrease in carpooling after the opening of the ExpressLanes, increased VMT occurred regionally on all freeway facilities as a result of an improving economy and could also have shifted from adjacent arterial routes. The LA CRD projects had a benefit-to-cost ratio of -0.48. However, all changes observed in this evaluation on the I-10 and I-110 were assumed to be due to the CRD projects despite significant data limitations, which may have caused negative impacts on emissions and fuel consumption to be overestimated, contributing to the negative BCA ratio.

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Chapter 1 Introduction

This report presents the national evaluation of the Los Angeles (LA) Congestion Reduction Demonstration (CRD) sponsored by the U.S. Department of Transportation (U.S. DOT) CRD program. LA was one of six locations selected by the U.S. DOT to implement a suite of strategies aimed at reducing congestion under the Urban Partnership Agreement (UPA) and CRD programs. A cross-cutting final report that documents the UPA/CRD programs at all six locations will be generated at the conclusion of the evaluation periods.

The LA CRD included projects focusing on the 4T congestion reduction strategies: tolling, transit, telecommuting/travel demand management (TDM), and technology in the Los Angeles metropolitan area. The U.S. DOT selected a team, led by Battelle, to conduct an independent evaluation of the UPA/CRD projects. This document presents the LA CRD National Evaluation Final Report developed by the Battelle team in cooperation with the LA CRD partners and the U.S. DOT. The report presents information from the pre- and post-deployment periods that encompass a full year following the transition from high-occupancy vehicle (HOV) lanes to high-occupancy toll (HOT) lanes on the Interstate-110 (I-110) and Interstate-10 (I-10) in November 10, 2012 and February 23, 2013, respectively.

This report is divided into five sections following this introduction. Chapter 2 summarizes the UPA and CRD programs. Chapter 3 highlights the LA CRD local agency partners and projects. Chapter 4 presents the national evaluation methodology and the data used in the evaluation. Chapter 5 describes the various impacts from the projects and the major findings from the evaluation. Chapter 6 highlights the overall conclusions from the national evaluation of the LA CRD projects. Appendix A through Appendix L present more detailed information on each of the analysis areas. Appendix M contains the hypotheses and questions guiding the LA CRD national evaluation.

The evaluation report is intended to serve the needs of a variety of readers. For a reader seeking an overall understanding of the strategies used in the LA CRD and the key findings about their effectiveness and impact, Chapters 3 and 6 will be most useful. Readers interested in specific types of transportation projects, such as transit, should consult the pertinent project descriptions in Chapter 3, along with the associated analysis in Chapter 5. For analysis of cross-cutting effects, such as equity and benefit-cost analysis (BCA), readers will find those results in Chapter 5. Readers interested in an in-depth understanding of the evaluation should consult the appendices, each of which focuses on a different aspect of the evaluation, along with previously-published evaluation planning documents.

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Chapter 2 The UPA/CRD Programs

The LA region was one of six sites awarded a grant by the U.S. DOT in 2007 and 2008 for implementation of congestion reduction strategies under the UPA and the CRD programs. The other areas were Atlanta, Miami, Minnesota, San Francisco, and Seattle. A set of coordinated strategies known as the 4Ts incorporated tolling, transit, telecommuting/TDM, and technology tailored to the needs of each site. The UPA and CRD programs sought to aggressively use these strategies to relieve congestion in urban areas and raise revenues to support needed transportation improvements.

The national evaluation assessed the impacts of the UPA and CRD projects in a comprehensive and systematic manner across all sites. The objective was to document the extent to which congestion reduction is realized from the 4T strategies and to identify the associated impacts and contributions of each strategy. The evaluation also sought to determine the contributions of non-technical success factors – outreach, political and community support, and institutional arrangements – to the success of the projects and the overall net benefits relative to costs. Detailed documentation of the national evaluation framework (NEF) and the evaluation planning documents specifically for the LA CRD can be found at http://ops.fhwa.dot.gov/congestionpricing/crd/agreements/la_eval.htm.

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Chapter 3 Los Angeles Congestion Reduction Demonstration

This chapter presents the LA CRD, describing the LA CRD partners, the transportation system and underlying congestion issues in the LA metropolitan area, specifically in the I-110 and I-10 corridors, and the LA CRD projects and deployment schedule.

The Los Angeles CRD Partners

The LA CRD partners consist of the Los Angeles County Metropolitan Transportation Authority (Metro) and the California Department of Transportation (Caltrans), District 7. Metro was the designated lead agency for the LA CRD project and was responsible for overseeing the policy, planning, and design of tolling and transit operations and serves as the coordinating body for all of the LA CRD local partners, including mobility partners (Foothill Transit, Gardena Municipal Bus Lines, Los Angeles Department of Transportation (LADOT), the Southern California Regional Rail Authority (Metrolink), and Torrance Transit) and enforcement partners (California Highway Patrol).

While Metro was in charge of the tolling operations for the ExpressLanes, it was implemented on facilities owned by Caltrans. Therefore, Caltrans maintained an oversight and advisory role during the planning and implementation stages of the LA CRD.

The Transportation System in Los Angeles County

The Los Angeles-Long Beach-Santa Ana metropolitan statistical area has nearly 13 million residents. Despite its reputation for urban sprawl, it has the second highest population density in the country, second only to the New York-New Jersey metroplex. Roughly 85 percent of the urbanized area falls within L.A. County, which covers more than 4,000 square miles and includes 88 cities plus several unincorporated areas.

The Los Angeles region includes major transportation facilities that are of regional and national significance including the Port of Los Angeles, the Port of Long Beach, and the Los Angeles International Airport (LAX). Los Angeles County's economy is ranked 15th worldwide. Its two ports combined rank fifth worldwide in the volume of cargo that they handle. The region has a complex transportation network of freeways and arterial roads; heavy and light rail; commuter rail; and bus service including bus rapid transit (BRT). LA's freeway system, including its network of HOV lanes, is the most extensive in the country. Public transportation is available throughout the region, with Metro being the largest transit provider. Metro buses serve an area of 1,433 square miles. Sixteen other municipal transit operators provide additional bus service in Los Angeles County.

The LA CRD projects relate to the I-10 and I-110 transportation corridors which move traffic to and from downtown Los Angeles, and also to downtown Los Angeles parking facilities. Table 3-1 describes key transportation facilities in these CRD project treatment areas. It should be noted that neither the I-10 nor I-110 corridors have light rail service. However, the Blue Line runs parallel to the I-110 at certain locations. Similarly, the Metrolink San Bernardino Line commuter rail service parallels the I-10 at certain locations along its route.

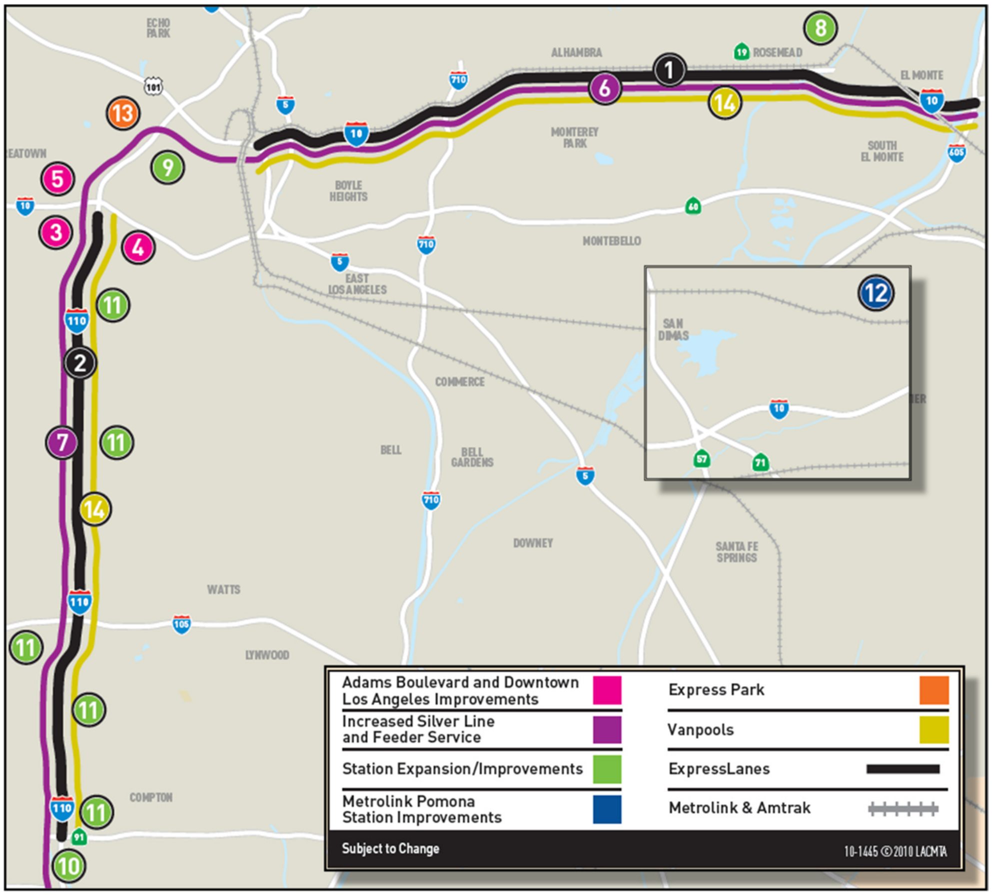
The LA region has consistently been ranked as one of the most congested urbanized areas in the country by the Texas A&M Transportation Institute (TTI). Peak-period traffic and major congestion on the roadway system extends from 6:00 to 10:00 a.m. in the morning and from 3:00 to 7:00 p.m. in the evening.

The following factors contribute to LA traffic congestion:

- A large and growing population and employment base
- Increasing trend toward urban sprawl development in the outer areas of the county, which limits the effectiveness of transit strategies while creating demand for additional roads and highly subsidized transit services
- The polycentric structure of the LA urban area that promotes travel in many different directions and impedes the provision of economical mass transit
- Rapid growth of freight movement traffic for all modes, particularly trucks transporting containers
- Disproportionate increase in the demand for travel relative to the growth in road capacity (i.e., vehicle miles of travel compared to road lane-miles)
- Increasing numbers of traffic incidents, especially along major freight corridors
- Historically low gasoline prices
- Insufficient funding resources to implement needed transportation investments in a timely manner
- The abundance of free or relatively inexpensive parking
- Competing transportation investment priorities, especially the need to reduce air pollution from transportation sources.

Despite enormous transportation investments, it is widely accepted that major elements of LA's transportation network are operating at or near capacity. By making an investment in the I-110 and I-10 corridors to convert existing HOV lanes to dynamically-priced HOT lanes, the CRD projects add peak period transportation capacity in the treatment corridors for SOVs. The program also provided funding for transit enhancements and ridesharing alternatives to vehicle travel to offer more transportation alternatives to travelers. These projects sought to examine public willingness to accept pricing as a way of moderating congestion and improving transportation facility utilization in the LA region.

The LA CRD projects were intended to reduce congestion, promote throughput, and enhance mobility in the I-10 and I-110 corridors, and in downtown LA. Figure 3-1 shows the location of the LA CRD (Metro ExpressLanes) Program projects and Figure 3-2 provides short summaries of the numbered projects on Figure 3-1.



Note: See Figure 3-2 for the explanation of each numbered project on this map.

Source: Derived from ExpressLanes project map.

Figure 3-1. LA CRD (ExpressLanes) Program Project Locations

EXPRESSLANES

1 **EXPRESSLANES ON THE I-10**: This project converted existing HOV lanes on the I-10 from Alameda Street/Union Station to the I-605 into ExpressLanes (44 lane-miles). The budget covered the toll technology, toll infrastructure, and operational improvements required to complete the conversion. This project also provided additional ExpressLanes capacity on the El Monte Busway between the I-710 and the I-605 through re-striping and buffer changes. No general purpose lanes were removed to create the additional ExpressLanes, one in each direction, between the I-710 and the I-605.

2 **EXPRESSLANES ON THE I-110:** This project converted existing HOV lanes on the I-110 from 182nd Street/Artesia Transit Center to Adams Boulevard into ExpressLanes (38 lane-miles). The budget covered the toll technology, toll infrastructure and operational improvements required to complete the conversion.

The ExpressLanes project was a one-year demonstration, which received permanent status in 2014. Buses, motorcycles, vanpools, and carpools that could previously use the HOV lanes were not charged a toll. General purpose lanes continued to remain toll-free. The following projects provided additional access and capacity to the I-10 and I-110 ExpressLanes to encourage movement of more people rather than more vehicles.

ADAMS BOULEVARD AND DOWNTOWN LOS ANGELES IMPROVEMENTS

3 **I-110 ADAMS/ FIGUEROA FLYOVER STUDY:** The Adams/Figueroa Flyover Study investigated how the construction of a new structure – connecting the I-110 northbound HOV lane off-ramp directly to Figueroa Street – could improve traffic flow at the end of the I-110 HOV lane.

4 **ADAMS BOULEVARD WIDENING:** Adams Boulevard was widened between the Harbor Freeway off-ramp and Flower Street – adding an additional westbound right-turn-only lane to the HOV bypass connecting to Figueroa Street. Restriping also added one extra lane to the HOV off-ramp approaching Adams Boulevard to increase capacity.

5 **TRANSIT PRIORITY SIGNALS IN LA:** This project installed bus signal priority technology on Figueroa Street between Wilshire Boulevard and Adams Boulevard (15 signals), and Flower Street between Wilshire Boulevard and Olympic Boulevard (5 signals) to enhance transit operations. It also extended the existing a.m. peak-period northbound bus-only lane on Figueroa Street between 23rd Street and 4th Street to cover the p.m. peak-period.

INCREASED SILVER LINE AND FEEDER SERVICE

6 **NEW BUSES FOR THE I-10 EL MONTE BUSWAY CORRIDOR:** Before adding ExpressLanes to the corridor, Metro and its transit partner – Foothill Transit –purchased 30 new buses and increased Silver Line and feeder service on the I-10 El Monte Busway, with a goal of providing service every three to seven minutes during rush hour.

7 **NEW BUSES FOR THE I-110 HARBOR TRANSITWAY CORRIDOR:** Before adding ExpressLanes to the corridor, Metro and its transit partners – Torrance Transit and Gardena Municipal Bus Lines – purchased 29 new buses to improve Silver Line and feeder service on the I-110 Transitway, with a goal of providing service every three to seven minutes during rush hour.

STATION EXPANSION/IMPROVEMENTS

8 **EL MONTE TRANSIT STATION EXPANSION:** The El Monte Station is the eastern terminus of the El Monte Busway, and the busiest bus terminal west of Chicago. Given that the El Monte Station is now also the eastern terminus of the ExpressLanes, expansion of the terminal was required to accommodate additional high-capacity buses, passenger parking, and bike lockers.

9 **PATSAOURAS PLAZA/UNION STATION CONNECTION:** A new Union Station stop was be created for the El Monte Busway, allowing direct access to the station's Patsaouras Transit Plaza. This eliminated long walks, operational delays and insufficient lighting and information displays that passengers had to contend with when transferring at Alameda Street to Metro's Red and Gold lines, Metrolink, and Amtrak.

10 **IMPROVED ARTESIA TRANSIT CENTER SECURITY:** Improvements at the largest transit center on the I-110 Harbor Transitway included bike lockers to promote non-motorized access and a law enforcement substation to assist with station security.

11 **I-110 HARBOR TRANSITWAY PARK & RIDE AND TRANSIT STATION IMPROVEMENTS:** Improvements to these facilities included enhanced signage, lighting, and security. Other benefits to customers included new bus stops under Slauson and Manchester stations for Lines 108/115 and improved signage and security for existing Harbor Transitway Park and Ride lots at Slauson, Manchester, Harbor Green Line, Rosecrans, Artesia, Carson, PCH, and Harbor/Beacon in San Pedro.

METROLINK POMONA STATION IMPROVEMENTS

12 **ADDITIONAL COMMUTER RAIL CAPACITY:** This station on Metrolink's San Bernardino Line underwent several improvements, including the addition of 143 new parking spaces and the expansion of platforms to accommodate longer eight-car trains.

LA EXPRESS PARK™

13 **DOWNTOWN PARKING MANAGEMENT:** This project used new parking technology to provide motorists alternative payment options and real-time parking availability information for nearly 13,000 on-street and off-street parking spaces in downtown LA. The information aided motorists in understanding their parking options and guided them to available parking spaces – eliminating the need to search for parking and reducing traffic congestion.

New parking meters were installed at approximately 5,500 on-street metered parking spaces in the downtown area. These meters were capable of charging motorists demand-based parking rates that change depending on the time of day and traffic congestion levels. They also provided alternative payment options, allowing motorists to pay for parking using their credit card or cell phone and to receive a text message when their paid parking time is about to expire.

VANPOOLS

14 **I-10/I-110 COMMUNITY-BASED VANPOOL FORMATION:** This program provided vanpool formation services to communities where ExpressLanes were implemented. This included a dedicated vanpool representative that actively trained community groups to form vanpools and provide support to ensure that vanpools were created and retained.

In addition to receiving the incentive of free access to the new ExpressLanes, vanpoolers along those corridors were also eligible for vanpool start-up assistance, which may cover the cost of driver and back-up driver training and exams, as well as special training on how best to keep existing vanpools together.

Source: Derived from ExpressLanes project map.

Figure 3-2. LA CRD (ExpressLanes) Program Project Descriptions

Tolling

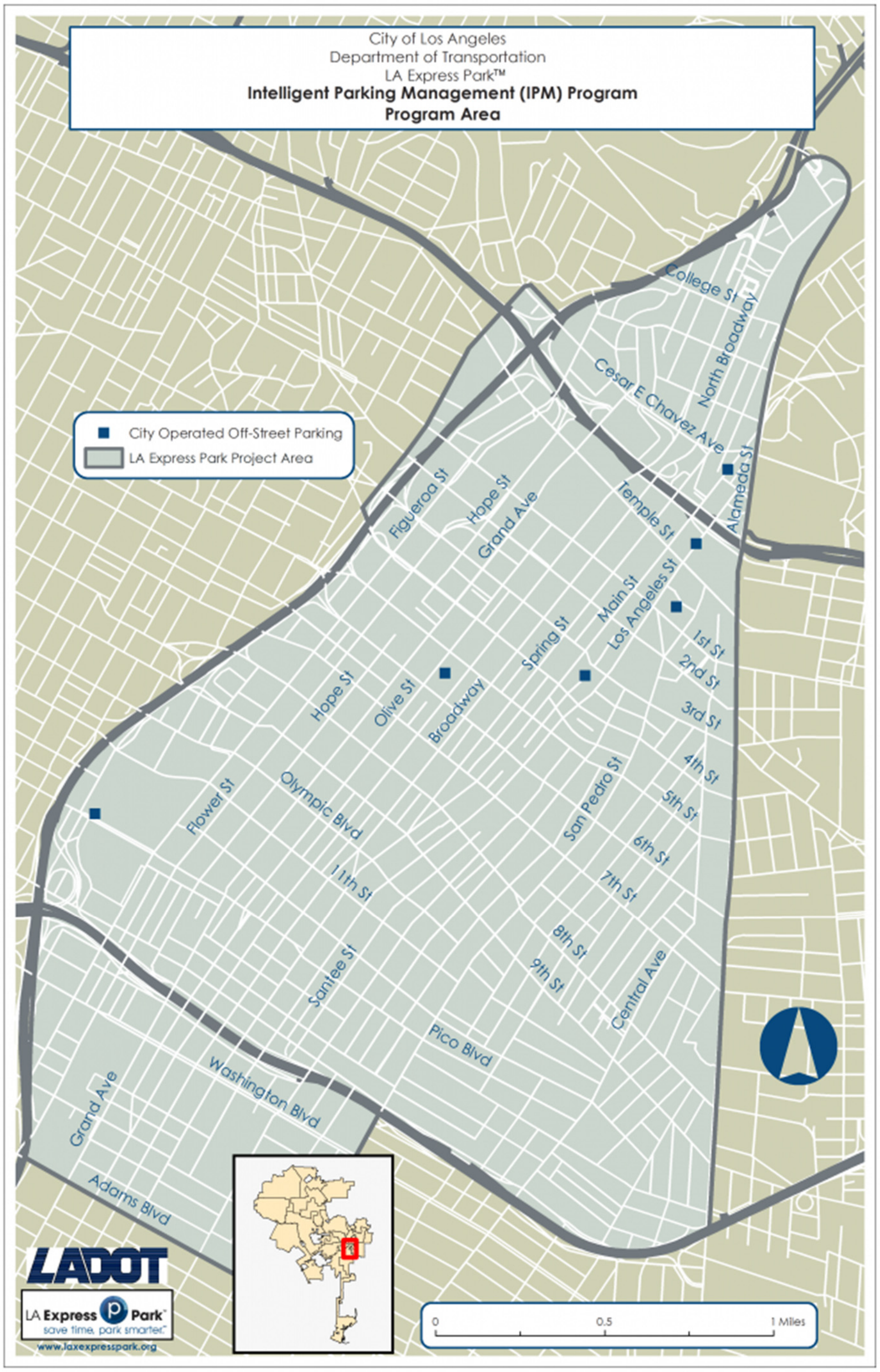
HOT lanes ("ExpressLanes") were intended to provide mobility options and choices to travelers using the I-110 and I-10 by permitting toll-paying vehicles that do not meet the carpool occupancy requirements to use the ExpressLanes by paying a fee. The ExpressLanes were created by converting existing HOV lanes into HOT lanes along the I-10 (from the I-605 to Alameda Street) and along the I-110 (from 182nd Street to Adams Boulevard). In addition, a second HOT lane was created via restriping with no loss of general purpose lanes on the I-10 from the I-605 to I-710. All vehicles pay to use the ExpressLanes with the exception of publicly or privately operated transit vehicles, motorcycles and multiple-occupant private vehicles (three or more occupants on the I-10 during peak hours, two or more all other times; and two or more occupants on the I-110), and non-revenue vehicles, such as emergency response vehicles responding to an emergency. Effective February 29, 2014, after the demonstration period ended, vehicles with white and green California Clean Air stickers were also allowed to travel toll-free irrespective of occupancy levels with a FasTrak® transponder. All tolls are collected electronically, requiring all vehicles entering the ExpressLanes to be equipped with a FasTrak® transponder. Vehicles satisfying the ExpressLanes occupancy requirements, and therefore eligible to use the lane free of charge, "self-declare" by setting a switch on their transponders. ExpressLanes enforcement was carried out manually through on-site law enforcement observation and automatically through photo-enforcement for vehicles traveling in the ExpressLanes without a transponder. Tolls ranged from a minimum $0.25 per mile to a maximum $1.40 per mile depending on congestion levels. When travel speeds in the ExpressLanes fell below 45 mph for more than ten minutes, the ExpressLanes had reached capacity. At this point, the HOT lanes reverted to HOV only and vehicles that did not meet the carpool occupancy requirements were not permitted to buy their way into the lanes. Qualifying low income commuters received a $25 credit when they set up their account through the Equity Plan.[3] Cash paying Equity Plan customers received a $25 waiver for the transponder deposit while credit card paying customers receive an additional $25 for pre-paid tolling. For all Equity Plan customers, the monthly account maintenance fee was waived.

The LA CRD Project also includes an additional priding component, intelligent parking management (IPM) (LA Express Park™). The LA Express Park™ project combined technology and demand-based pricing to provide an innovative parking management strategy in the 4.5 square mile area of downtown LA. The area encompasses all of downtown LA, including the Fashion District, South Park, Little Tokyo, the Historic District, and Chinatown and is bounded by the I-10, I-110, Alameda Street, and Adams Boulevard. This area is detailed in the following section.

Technology

LA Express Park™" consists of many innovative ITS strategies including a variable, demand-based parking pricing system coupled with a parking guidance system that includes real-time parking availability information. IPM was intended to reduce traffic congestion, reduce air pollution, and improve transit efficiency by reducing parking search times to achieve 10 to 30 percent parking availability for on-street parking. The LA Express Park™ system covers approximately 13,500 parking spaces owned or operated by the City of LA (about 6,000 on-street, metered spaces and about 7,500 off-street spaces in an area of downtown LA bounded by the I-10 and I-110 freeways, Alameda Street and Adams Boulevard as shown in Figure 3-3). LA Express Park™ meter capabilities include demand-based parking rates; alternate payment options (coins, credit card, smart phone, cell phone); and increased convenience (text messages when paid parking time is about to expire). Vehicle sensors placed in the on-street metered parking spaces provide real-time occupancy and parking duration information to users. Parking conditions and availability in off-street parking locations was determined using vehicle sensors, cordon counting systems, and/or advanced revenue control systems. The parking guidance component of the IPM provides information via a limited number of on-street dynamic message signs when not in use for active traffic management, an Internet web site, mobile phones using the regional 511 interactive voice response system, and smart phones.

[3] The Equity Plan, later re-named the Low-Income Assistance Plan, defines low income commuters as Los Angeles residents with an annual household income less than twice the Federal poverty level, e.g., in 2013, a family of 3 with an annual household income of $39,060 or less was eligible.



Source: LADOT – http://www.laexpresspark.org/about-la-expresspark/.

Figure 3-3. LA Express Park™ Project Area in Downtown LA

Transit

Over half of the overall CRD grant funds were allocated to transit improvements. These improvements included increasing the frequency of Metro bus rapid transit service and municipal feeder service. This was done through the acquisition of 59 new clean fuel expansion buses (30 buses in the I-10 El Monte Busway corridor and 29 buses in the I-110 Harbor Transitway corridor). Various security upgrades made to the Harbor Gateway Transit Center included better lighting, new security cameras, bicycle lockers, and a new LA County Sheriff's substation. The El Monte Transit Center was expanded to include reconstruction of the existing transit passenger terminal, additional surface parking, and a new administration facility. There was an expansion of the Pomona (North) Metrolink station which included 143 new parking spaces and extended platforms to accommodate additional rail cars for the San Bernardino Line. The improvements to Harbor Transitway Park and Ride lots and Transit Stations included enhanced signage, lighting, and closed-circuit television (CCTV) cameras for existing lots at Slauson, Manchester, Harbor Green Line, Rosecrans, and Harbor Gateway, as well as the relocation of bus stops for Lines 108 and 115 to the Slauson and Manchester Transitway stations. The 37th Street Station was also fitted with translucent and architectural sound attenuation panels to reduce noise levels for waiting customers on the Harbor Transitway. Transit priority signal (TPS) technology was implemented on Figueroa Street (15 signals between Wilshire Boulevard and Adams Boulevard) and Flower Street (5 signals between Wilshire Boulevard and Olympic Boulevard) in downtown LA. To facilitate ExpressLanes traffic movement where the I-110 enters downtown LA, Adams Boulevard was widened and the Adams Boulevard off-ramp was restriped, both providing an additional lane of capacity. Finally, although it was not part of the transit analysis, it is worth mentioning Metro's Transit Rewards Program. As frequent transit riders on the ExpressLanes, customers were presented the opportunity to earn toll credits on the ExpressLanes corridors. Using their registered TAP card, transit riders could earn a $5 toll credit by taking 32 one-way trips on qualifying transit lines during peak hours along the I-110 Harbor Transitway or I-10 El Monte Busway. The toll credits could only be used on ExpressLanes and were not valid on other toll roads. The Rewards Program was the first of its kind in the transit and toll industry.

Travel Demand Management

Ridesharing promotion efforts were conducted to increase the number of registered vanpools (with a goal of 100 new registered vanpools on the I-10 and I-110 corridors), and major employer-based ridesharing through the use of promotional methods including subsidies to travelers and vanpool operators and promotional outreach to major employers. In addition, an ExpressLanes Carpool Loyalty Program was developed, which incentivizes vanpool trips by offering monthly drawings for gift cards on each corridor. Vanpools were automatically entered into the drawing every time they used the ExpressLanes and the toll system detected their FasTrak® at the 2+ or 3+ setting.

LA CRD Project Deployment Schedule

Table 3-1 below provides an overview of each major CRD project along with its deployment date. All major CRD projects were deployed by the overall LA CRD post-deployment period end date of February 23, 2014. As noted earlier, this report provides an assessment of baseline data and various post-deployment findings based on available data for the analysis areas.

Table 3-1. LA CRD Project Deployment Schedule

LA CRD Project		Deployment Date
ExpressLanes	I-110	November 10, 2012
	I-10	February 23, 2013
LA Express Park™	Phase I	June 2012
	Phase II	August 2012
	Phase III	October 2013
Expanded Bus Service	Phase I	June 2011
	Phase II	July 2012
	Phase III	November 2012 (I-110); February 2013 (I-10)
Transit Signal Priority		November 2012
Ridesharing Promotions	Carpool Loyalty Program	November 2012 (I-110); February 2013 (I-10)
Vanpool Formation		October 2012

Secondary CRD projects include: parking expansion, lighting improvement, security upgrade, bus stop cutouts, transit center expansion, sound enclosure, and roadway widening.

Source: Data sourced from Metro.

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Chapter 4 National Evaluation Methodology and Data

This chapter highlights the national UPA/CRD evaluation methodology and the data used in conducting the LA CRD national evaluation. An overview of the national UPA/CRD evaluation methodology is presented first. The four objective questions posed by the U.S. DOT to guide the national evaluation are described, along with the associated analysis, followed by the major data sources used in the LA CRD national evaluation.

Four U.S. DOT Evaluation Questions

The national evaluation assessed the impacts of the UPA/CRD projects in a comprehensive and systematic manner across all sites. The Battelle team developed an NEF to provide a foundation for evaluation of the UPA/CRD sites. The NEF was based on the 4T congestion reduction strategies and the questions that the U.S. DOT sought to answer through the evaluation. The NEF defined the questions, analyses, measures of effectiveness, and associated data collection for the entire UPA/CRD evaluation. The framework was a key driver of the site-specific evaluation plans and test plans, and served as a touchstone throughout the project to ensure that national evaluation objectives were supported through the site-specific activities.

Table 4-1 presents the four U.S. DOT objective questions[4] and the analysis areas used in the LA CRD evaluation to address these questions. As noted in the table, the analysis focused on the overall reduction in congestion, the performance of the 4Ts, and associated impacts. Elements of the analysis are presented in Chapters 5 and 6. Appendix A through J presents detailed information on the 10 analysis areas. Appendix L summarizes information on changes potentially caused by exogenous factors.

[4] "Urban Partnership Agreement Demonstration Evaluation – Statement of Work," United States Department of Transportation, Federal Highway Administration; November 29, 2007.

Table 4-1. U.S. DOT Objective Questions and LA CRD Evaluation Analyses

U.S. DOT 4 Objective Questions	Evaluation Analyses
#1 – How much was congestion reduced?	Congestion
#2 – What are the associated impacts of the congestion reduction strategies?	**Strategy Performance**
	Strategy Performance: Tolling
	Strategy Performance: Transit
	Strategy Performance: Telecommuting/TDM
	Strategy Performance: Technology
	Associated Impacts
	Associated Impacts: Safety
	Associated Impacts: Equity
	Associated Impacts: Environmental
#3 – What are the non-technical success factors?	Non-Technical Success Factors
#4 – What is the overall cost and benefit of the strategies?	Benefit Cost Analysis

Source: Battelle.

Los Angeles CRD Evaluation Process and Data

The LA CRD evaluation involved several steps. Members of the national evaluation team worked closely with the local partners and U.S. DOT representatives on the following activities and products:

- Project kick-off conference call, site visit, and workshop;
- LA CRD National Evaluation Strategy;
- LA County CRD National Evaluation Plan;
- 10 LA CRD ExpressLanes Program test plans;
- Collection of one year of pre-deployment and one year of post-deployment data;
- Analysis of the collected data, surveys, and focus groups; and
- Two Interim LA CRD ExpressLanes Program National Evaluation Reports and a National Evaluation Findings Report.

A wide range of data was collected and analyzed as part of the LA CRD. Table 4-2 presents the data, the data sources, and related analysis areas used in the LA CRD national evaluation. Each appendix presents detailed descriptions of the data sources and the analysis techniques.

Members of the Battelle team worked with representatives from the LA CRD partnership agencies and the U.S. DOT on all aspects of the national evaluation. This team approach included the participation of local representatives throughout the process and the use of site visits, workshops, conference calls, and e-mails to ensure ongoing communication and coordination. The local agencies were responsible for data collection and conducting surveys, focus groups, and interviews. The Battelle team was responsible for analyzing the local data and survey results.

Table 4-2. LA CRD National Evaluation Data Sources

Data	Source	Evaluation Analyses
Travel Time Data	Caltrans	• Congestion Analysis • Equity Analysis • Environmental Analysis • Benefit Cost Analysis
Vehicle Occupancy Counts	Caltrans	• Congestion Analysis • Rideshare Analysis • Environmental Analysis
Toll Accounts and Transponders Data, Toll Transaction Data, Toll Rates Information, Revenue Data, and Closures to (SOVs)	Metro	• Tolling Analysis • Rideshare Analysis • Equity Analysis
Citations Data	California Highway Patrol (CHP)	• Tolling Analysis • Safety Analysis
Websites, Reports, Press Releases, and News and Media Coverage	Metro, LADOT	• Tolling Analysis • Technology Analysis • Equity Analysis • Non-Technical Success Factors Analysis
Transit Ridership Data, automated vehicle location (AVL) Data, Park and Ride Lot Counts	Metro	• Transit Analysis • Equity Analysis • Environmental Analysis • Benefit Cost Analysis
Vanpool Data	Metro	• Rideshare Analysis • Environmental Analysis
Socio-Economic Data	U.S. Census Bureau	• Equity Analysis
Emissions and Fuel Consumption Rates	California Air Resources Board	• Equity Analysis • Environmental Analysis • Benefit Cost Analysis
Traffic Sensor Data	Caltrans	• Environmental Analysis
UPA Partnership Documents and Outreach Materials	Metro	• Non-Technical Success Factors Analysis
Capital, Operating, and Maintenance Costs of CRD Projects	Metro, City of Los Angeles, City of Pomona, LADOT	• Benefit Cost Analysis

Table 4-2. LA CRD National Evaluation Data Sources (Continued)

Data	Source	Evaluation Analyses
Unemployment Rates – National, State, and Metro Area	U.S. Bureau of Labor Statistics	• Exogenous Factors
Gasoline Prices	U.S. Energy Information Administration	• Exogenous Factors
Major Road Construction Events	Caltrans	• Exogenous Factors
Non-CRD Transit Changes	Metro	• Exogenous Factors
I-10 and I-110 User Survey	Metro	• Congestion Analysis • Tolling Analysis • Rideshare Analysis • Equity Analysis • Non-Technical Success Factors Analysis
ExpressLanes FasTrak® Customer Satisfaction Surveys	Metro	• Congestion Analysis • Tolling Analysis • Rideshare Analysis • Equity Analysis • Non-Technical Success Factors Analysis
Personnel Interviews	LADOT, CHP	• Tolling Analysis • Technology Analysis • Safety Analysis • Equity Analysis
Stakeholder Interviews and Workshops	Hubert H. Humphrey School of Public Affairs	• Tolling Analysis • Technology Analysis • Non-Technical Success Factors Analysis
Silver Line Transit Survey	Metro	• Transit Analysis • Equity Analysis • Non-Technical Success Factors Analysis
Vanpooler Survey	Metro	• Rideshare Analysis
Employer Focus Group	Metro	• Rideshare Analysis
Equity Plan Survey	Metro	• Equity Analysis

Source: Battelle.

Chapter 5 Major Findings

This chapter highlights the major findings from the national evaluation of the LA CRD projects. The contextual changes occurring in the LA area during the evaluation period – including the decrease in the unemployment rate – are highlighted below. Following that, the LA CRD's use of the 4Ts – tolling, transit, telecommuting, and technology – are described. Information on changes from the pre- and post-deployment periods is also presented. Finally, a summary of the impacts of the LA CRD projects by the four U.S. DOT objective questions and 10 evaluation analyses is provided. The timing of CRD projects coming on-line and the evaluation period is presented in Table 5-1.

Table 5-1. LA CRD Project Dates

LA CRD Project		Deployment Date
ExpressLanes	I-110	November 10, 2012
	I-10	February 23, 2013
LA Express Park™	Phase I	June 2012
	Phase II	August 2012
	Phase III	October 2013
Expanded Bus Service	Phase I	June 2011
	Phase II	July 2012
	Phase III	November 2012 (I-110); February 2013 (I-10)
Transit Signal Priority		November 2012
Ridesharing Promotions	Carpool Loyalty Program	November 2012 (I-110); February 2013 (I-10)
Vanpool Formation		October 2012

Secondary CRD projects include: parking expansion, lighting improvement, security upgrade, bus stop cutouts, transit center expansion, sound enclosure, and roadway widening.

Source: Data sourced from Metro.

Contextual Changes During the Evaluation Period

The implementation of the LA CRD projects occurred after a spike in the unemployment rate in early 2010. The unemployment rate for the area counties and state generally decreased through both the pre- and post-deployment periods. The unemployment rate for the LA-Long Beach-Santa Ana Metropolitan Statistical Area in particular ranged from a high of 11.0 percent toward the beginning of the baseline period in January 2012 to a low of 7.9 percent toward the end of the post-deployment period in December 2013. These trends could have affected the CRD projects' effectiveness and be reflected in the observed travel patterns.

The price of a gallon of regular conventional gasoline experienced minor fluctuations during the pre-deployment to post-deployment periods, with a generally flat trend in cost. In the baseline period before the ExpressLanes opened on the I-110 in November 2012, the weekly average price ranged from $3.65 to $4.78. For the post-deployment period after the ExpressLanes opened on the I-10, gasoline prices were more volatile, but ranged between $3.63 and $4.39. These changes in gasoline prices likely had minimal influence on travel behavior and use of the LA CRD projects.

Construction on the I-10 could have also impacted conditions during the evaluation period. During the pre-deployment period, a project on the I-10 was undertaken to provide additional ExpressLanes capacity on the El Monte Busway between the I-710 and the I-605 through re-striping and buffer changes. Additionally, a major construction project to upgrade the I-10/I-605 interchange on the eastern boundary of the I-10 ExpressLanes corridor began in early 2013 and continued through the post-deployment period.

Use of the Los Angeles CRD Projects

The implementation and use of the LA CRD projects, along with their possible influence on the transportation system in the LA metropolitan area are highlighted in this section. The LA CRD projects represent a suite of strategies aimed at expanding mobility options for travelers in the I-110 and I-10 corridors by implementing tolling in HOV-facilities in an effort to provide additional mobility options and choices for travelers in vehicles not meeting the occupancy requirements, while maintaining travel time savings and trip-time reliability for buses, vanpools, and carpools. The local partners undertook the challenge of implementing tolling of an existing HOV-facility in order to better manage the transportation network. The following sections reveal how the strategies performed in achieving their objectives.

Tolling

The tolling components of the LA CRD included two projects – the ExpressLanes on the I-110 and I-10 and LA Express Park™ in downtown LA. The ExpressLanes, shown in Figure 5-1, were implemented by expanding and converting the existing HOV lanes on the I-110 and I-10 into HOT lanes. LA Express Park™ combined technology and demand-pricing into an innovative parking management strategy in a 4.5 square mile area of downtown LA. The analysis of the ExpressLanes is summarized first followed by the LA Express Park™ analysis.

I-110 and I-10 ExpressLanes

The user requirements on the I-110 and I-10 ExpressLanes reflect those in effect during the previous HOV operations, maintaining the same access for the different HOV user groups, while expanding the eligible users to include toll-paying vehicles that do not meet the carpool occupancy requirement. While the occupancy requirements were not changed, carpools and vanpools were required to register, obtain, and use FasTrak® transponders. This requirement added extra steps for using the former HOV lanes as a carpooler or vanpooler. The I-110 and I-10 ExpressLanes use an electronic toll data collection system that allow drivers to travel the lanes without stopping, although all drivers, including carpools, need a FasTrak® toll transponder to use the ExpressLanes.

During the one-year demonstration, vehicles with California Clean Air stickers were required to pay the appropriate toll if they did not meet the vehicle occupancy requirements. Effective February 29, 2014, after the demonstration period ended, vehicles with white and green California Clean Air stickers were allowed to travel toll-free irrespective of occupancy levels with a FasTrak® transponder. Use of the yellow California Clean Air stickers, which included hybrid vehicles, were allowed to lapse by the California Legislature on July 1, 2011, so these vehicles were not allowed to use the HOV lanes during either the pre- or post-deployment periods.

Source: Metro.

Figure 5-1. Image of the LA ExpressLanes

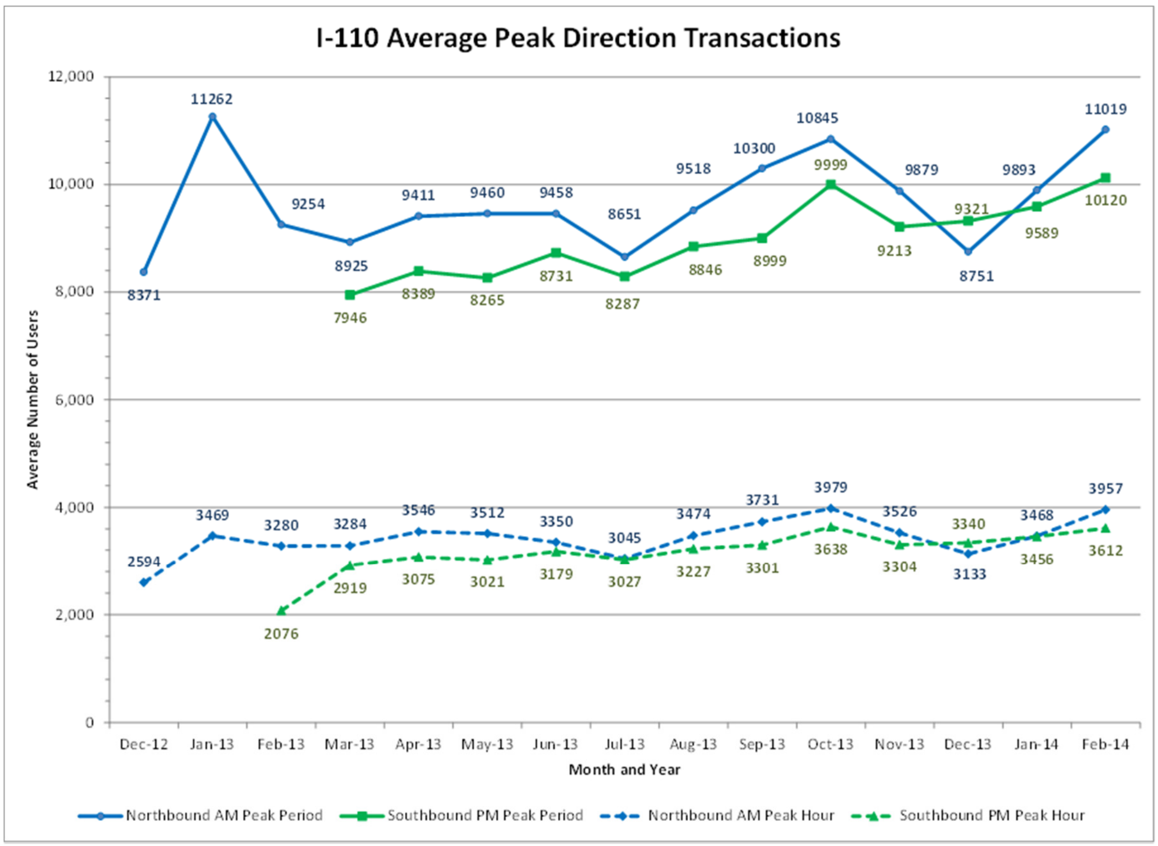
Metro provided the National Evaluation Team with the number of new FasTrak® accounts opened by type and transponders issued. A total of 210,367 accounts were opened during the 20-month period from July 2012 to February 2014, with 261,230 transponders issued. These figures exceed the goal of 100,000 transponders in circulation at the end of the demonstration period. In addition, existing FasTrak customers with non-switchable transponders issued by other California agencies requested switchable transponders, further exceeding the initial transponder goal and illustrating the use of the I-10 and I-110 ExpressLanes by motorists throughout the state. The month with the largest number of new accounts opened and transponders issued was November 2012, corresponding to the opening of the I-110 ExpressLanes, with a total of 25,383 accounts and 31,850 transponders. March 2013 was the second highest month for new accounts and transponders, reflecting the opening of the I-10 ExpressLanes in February 2013.

The ExpressLanes on the I-110 opened on November 10, 2012 and included two lanes in each direction of travel from the I-105 to Exposition Boulevard. The toll trip data from Metro examined for this analysis covers the period from December 2012 through February 2014 on the I-110 ExpressLanes. A grace period for violators was in effect for the first 60 days of operation on the I-110 ExpressLanes. Figure 5-2 presents the average total and tolled transactions during peak hours per month on the I-110 from December 2012 through February 2014. The morning peak hour was defined as 7:00 a.m. to 8:00 a.m. and the afternoon peak hour was defined as 5:00 p.m. to 6:00 p.m. The peak direction of travel on the I-110 is northbound into downtown LA in the morning and southbound in the afternoon.

The ExpressLanes on the I-10 opened on February 23, 2013. As part of the CRD, a second lane was added to the I-10 ExpressLanes from the I-605 to the I-710. The toll trip data from Metro examined for this analysis covers the period from February 2013 through February 2014 on the I-10 ExpressLanes. A grace period for violators was in effect for I-10 ExpressLanes for the first 60 days of operation. Figure 5-3 presents the average total and tolled transactions during peak hours per month on the I-10. The morning peak hour was also defined as 7:00 a.m. to 8:00 a.m. and the afternoon peak hour was defined as 5:00 p.m. to 6:00 p.m. The peak direction of travel on the I-10 is westbound into downtown LA in the morning and eastbound in the afternoon.

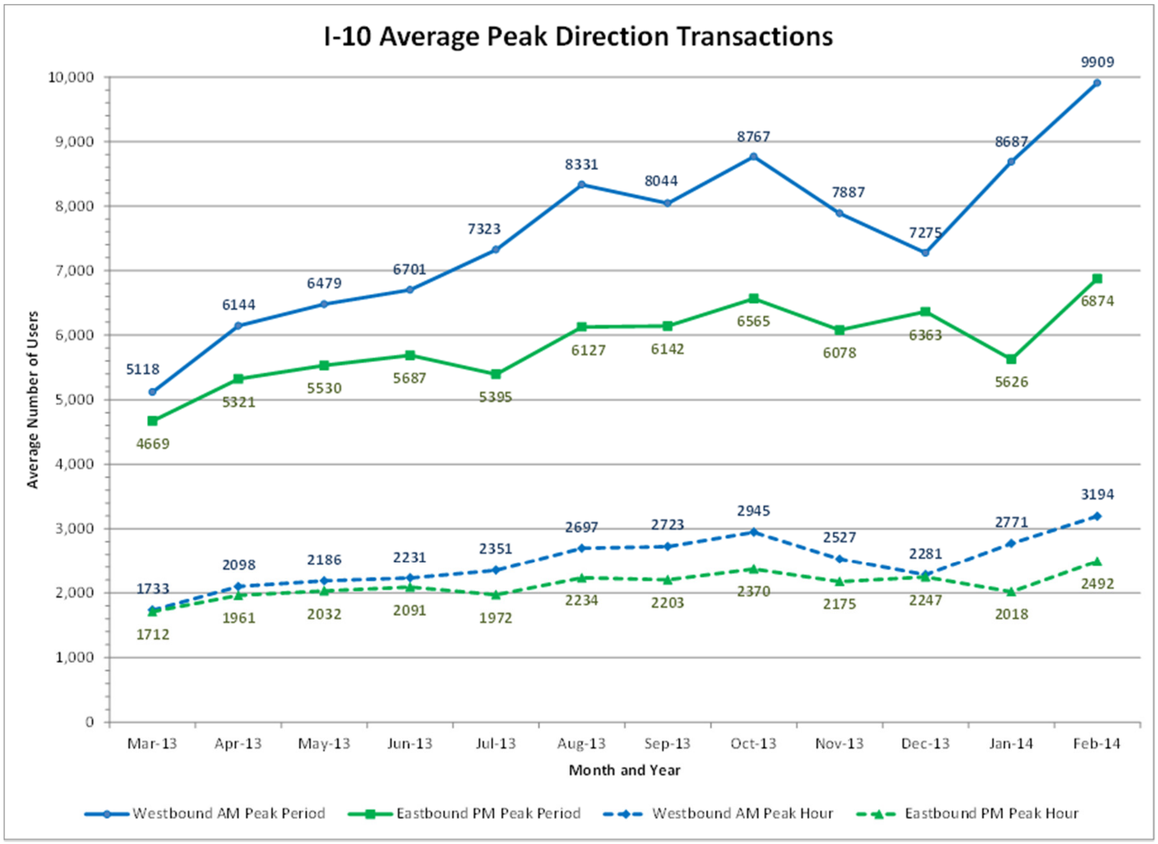
The figures show steady growth overall in the use of both facilities, with slightly lower averages during the holiday months, primarily July, August, November, and December. The figures indicate an overall increase in HOV2+ and HOV3+ toll trips, which represent self-declared 2+ and 3+ carpools, as well as buses, vanpools, motorcycles and non-revenue vehicles on the I-110 and the I-10 ExpressLanes, and increases in toll paying HOV2+ vehicles and SOVs.

These summaries highlight changes in toll transaction types over the course of the demonstration. The information presented does not represent a before-and-after assessment of changes in carpooling. Both Metro and Caltrans noted variances in the observed occupancy discussed in the congestion section and the self-declared occupancy from the transponder setting toll data. These differences, which focus on self-declared transponder settings indicating higher use levels than the visual occupancy data, continue to be examined in more detail by the agencies. The level of self-declaring HOV3+ FasTrak® trips was of interest given the national experience indicating the difficulty of forming and maintaining three person carpools. Self-declaring HOV2+ and HOV3+ vanpools, buses, motorcycles, and other non-revenue vehicles represented between 54 percent and 59 percent of the peak period and peak hour FasTrak® trips on the ExpressLanes during the demonstration.



Source: Data from Metro and graph developed by the Texas A&M Transportation Institute.

Figure 5-2. I-110 ExpressLanes Average Monthly Morning and Afternoon Peak Hour, Peak Direction, Total and Toll Trips



Source: Data from Metro and graph developed by the Texas A&M Transportation Institute.

Figure 5-3. I-10 ExpressLanes Average Monthly Morning and Afternoon Peak Hour, Peak Direction, Total and Toll Trips

As noted previously, vehicles with California Clean Air Stickers were required to pay the appropriate toll to use the ExpressLanes during the demonstration period if they did not meet the vehicle-occupancy requirements. These vehicles had previously been allowed to use the I-10 and I-110 HOV lanes without meeting the occupancy requirements. Effective February 29, 2014, after the demonstration period ended, vehicles with white and green California Clean Air stickers were allowed to travel toll-free irrespective of occupancy levels with a FasTrak® transponder. Although the Caltrans vehicle occupancy counts showed low levels of vehicles with these stickers, the toll-free use of the ExpressLanes could be expected to grow, as the California High-Occupancy Vehicle Lane Degradation Determination Report indicated that approximately 50 percent of the white and green stickers distributed as of December 31, 2013 were to residents in Los Angeles, Riverside, San Bernardino, and Orange Counties.[5]

[5] Caltrans, 2013 California High-Occupancy Vehicle Lane Degradation Determination Report, December 12, 2014.

The ExpressLanes were the first HOT operation in the country to offer a discount for low-income commuters, known as the "Equity Plan." Qualifying residents of LA County receive a $25 credit when they set up an account (proof of eligibility required). This credit can then be applied to either the transponder deposit or pre-paid toll deposit. The monthly $3 account maintenance fee is also waived. As of the end of February 2014, a total of 4,415 LA County households were enrolled in the equity plan, accounting for $110,375 in toll/transponder credits.

The National Evaluation Team examined the frequency of ExpressLanes used by different toll trip types on a monthly basis. Overall, the HOV toll trips represented a larger percentage of the frequent users, defined as one-to-two daily trips during the weekday, with SOVs representing a larger percentage of the infrequent users, defined as one-to-four trips a month.

The system records the number of minutes the ExpressLanes were closed to SOVs in the event that travel speeds were degraded below 45 miles per hour (mph) in the ExpressLanes. The ExpressLanes on the I-110 were closed to SOVs for approximately 36 hours in the 16 months of operation from November 2012 to February 2014. The I-10 ExpressLanes were closed to SOVs for approximately 12 hours for the 12-month period from February 2013 to February 2014.

Both electronic and manual visual enforcement were used on the I-110 and I-10 ExpressLanes. The FasTrak® system records vehicles without an active transponder. When a vehicle enters a HOT lane without a transponder it is considered to be in violation and the vehicle's license plate is recorded and identified. The toll system first reviews the database to determine if the license plate is assigned to an existing FasTrak® customer account or an authorized Non-Revenue account (i.e., publically and privately operated buses and emergency response vehicles). When the system determines that the license plate is not in the toll database, a violation notice is then sent to the address where the vehicle is registered. When such violations occur, the toll incurred plus the violation penalty are billed and mailed to the violator. During the demonstration period, a violator had 14 days to pay the toll and 30 days to pay the toll and violation penalty of $25. If the violator did not pay the toll and penalty within 30 days, they were billed an additional $30. The violation payment business rules changed after the demonstration period. The 14-day period to pay the toll-only no longer exists. To avoid paying the penalty, drivers must open a FasTrak® account. However, a 60-day grace period was in place at the beginning of the I-110 ExpressLanes and the I-10 ExpressLanes deployments. During this grace period, no violation penalties were assessed. If someone drove in the ExpressLanes without a FasTrak® transponder, they were only billed for the toll incurred.

The number of toll violation trips was highest during the initial months of operation on the I-110 and I-10 ExpressLanes. These months correspond to the grace period and reflect a typical ramp-up period for a toll facility. From March through December 2013, the number of violation toll trips recorded during the AM peak hour, peak direction on the I-10 ExpressLanes ranged from 140 toll trips to 224 toll trips, representing approximately 6 percent-to-7 percent of the total toll trips during that time period. Violation toll trips recorded on the I-110 ExpressLanes during the same time period ranged from 186 to 232, representing approximately 6 percent-to-7 percent of the total toll trips. Data from the 2011 Caltrans District 7 HOV Annual Report[6] provides an indication of the violation rates experienced during the pre-deployment period with HOV facility operations. In 2011, the morning peak-period violation rates recorded through the Caltrans visual observation counts was 12 percent on the I-10 (with a 3+ HOV requirement) and 2 percent on the I-110 (with a 2+ HOV requirement. The number of violators we 316 on I-10 and 128 on I-110.

The electronic toll collection system only addresses vehicles without a transponder or a non-active account. A combination of electronic monitoring and visual enforcement is used to address violations of the self-declared occupancy requirements. CHP officers provide extra enforcement on the I-10 and I-110 ExpressLanes during the morning and afternoon peak periods. The CHP officers are assisted by a beacon light, which indicates the transponder setting of vehicles passing a toll reader. The officers issue both verbal warnings and citations to drivers without valid transponders and drivers of vehicles without the number of occupants to meet the self-declared transponder setting. During the demonstration period, the monthly number of verbal warnings on the I-110 ExpressLanes ranged from 57 to 133, with the monthly number of citations ranging from 108 to 201. On the I-10 ExpressLanes, the monthly number of verbal warnings ranged from 77 to 164, and the number of citations ranged from 113 to 226.

Table 5-2 presents the monthly average posted toll and the maximum posted toll for the morning and the afternoon peak periods, in the peak direction of travel. The tolls are dynamically priced and updated every five minutes based on real-time traffic conditions in the ExpressLanes. The minimum toll rate was $0.25 per mile and the maximum was $1.40 per mile. Further, 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. The average tolls may be below the required 150 percent of the transit fare due to the influence of shorter trips outnumbering trips taken the full length of the corridor. On the I-110 ExpressLanes, both the monthly average posted tolls and the maximum posted tolls were higher in the morning peak period. The monthly average posted toll in the peak periods ranged between $3.31 and $7.63. The monthly maximum posted toll ranged between $3.95 and $14.55. On the I-10 ExpressLanes, the monthly average posted toll in the peak period, peak directions ranged from $4.25 to $5.46. The monthly average maximum toll during the same time period ranged from $4.25 to $9.05.

[6] Caltrans, 2011 HOV Annual Report, District 7, September 2012.

Table 5-2. I-110 and I-10 Monthly Average and Maximum Posted Tolls – Morning and Afternoon Peak Period, Peak Direction

Peak Period	Month	Average Posted Toll		Maximum Posted Toll	
		I-110	I-10	I-110	I-10
Morning (Northbound)	Nov 2012	$5.40	—	$10.85	—
	Dec 2012	$5.57	—	$10.55	—
	Jan 2013	$5.33	—	$10.10	—
	Feb 2013	$5.25	—	$8.00	—
	Mar 2013	$5.36	$4.25	$10.05	$7.20
	Apr 2013	$5.35	$4.48	$9.95	$7.00
	May 2013	$6.19	$4.70	$11.00	$7.00
	Jun 2013	$5.93	$4.68	$12.30	$7.00
	Jul 2013	$5.04	$4.54	$12.35	$7.20
	Aug 2013	$6.36	$4.92	$11.95	$7.25
	Sep 2013	$7.21	$5.10	$14.25	$9.05
	Oct 2013	$7.63	$5.20	$14.35	$8.30
	Nov 2013	$7.05	$4.90	$14.55	$8.00
	Dec 2013	$6.54	$4.75	$14.05	$7.30
	Jan 2014	$6.65	$4.87	$14.05	$7.30
	Feb 2014	$7.53	$5.18	$14.20	$6.80
Afternoon (Southbound)	Nov 2012	$4.65	—	$8.10	—
	Dec 2012	$4.79	—	$7.50	—
	Jan 2013	$4.59	—	$7.05	—
	Feb 2013	$4.73	—	$7.45	—
	Mar 2013	$4.27	$4.95	$6.15	$6.85
	Apr 2013	$4.02	$5.22	$4.85	$6.95
	May 2013	$4.02	$5.32	$4.95	$6.95
	Jun 2013	$3.81	$5.40	$5.55	$6.95
	Jul 2013	$3.33	$5.12	$4.95	$6.95
	Aug 2013	$3.84	$5.46	$5.15	$7.30
	Sep 2013	$3.42	$5.11	$5.30	$6.75
	Oct 2013	$3.50	$4.83	$4.65	$5.60
	Nov 2013	$3.35	$4.50	$5.10	$5.30
	Dec 2013	$3.41	$4.50	$3.95	$4.90
	Jan 2014	$3.31	$4.42	$4.25	$5.00
	Feb 2014	$3.45	$4.51	$3.95	$5.10

Source: Metro.

Table 5-3 presents the gross revenue from toll-paying vehicles not meeting the carpool occupancy requirements using the I-110 and I-10 ExpressLanes for the 16-month period from November 2012 through February 2014. The total gross revenues reported are from the electronic toll transactions only. Revenues from toll violations, violation penalties, and other fees are not included. The changes in revenues reflect the changes in use of the ExpressLanes described previously.

Table 5-3. Total Gross Revenue for I-110 and I-10 ExpressLanes*

	Gross Toll Revenue	
Month	**I-110**	**I-10**
2012		
November	$387,042	—
December	$885,316	—
2013		
January	$881,315	
February	$986,998	$33,179
March	$1,293,556	$535,166
April	$1,135,103	$562,575
May	$1,580,153	$785,134
June	$1,156,887	$618,309
July	$1,021,259	$623,845
August	$1,366,270	$809,733
September	$1,283,006	$809,907
October	$1,515,030	$890,516
November**	$658,666	$853,253
December**	$2,007,099	$762,976
2014		
January	$1,277,622	$792,798
February	$1,269,639	$841,594
Total	**$18,704,961**	**$8,918,985**

*The total gross revenues reported are from the electronic toll transactions only. Revenues from toll violations, violation penalties, and other fees are not included.

**A fiber cut in November 2013 delayed applying transaction revenue until December 2013.

Source: Metro.

The I-110 and I-10 ExpressLanes offered the potential for a faster and more reliable trip during the peak period. For purposes of the analysis, peak period was defined as 5:30 a.m. to 9:00 a.m. for the morning peak period and from 3:00 p.m. to 7:00 p.m. in the afternoon peak. Table 5-4 contains the results of a statistical comparison of pre- and both post-deployment average peak period travel times in the peak direction for the general purpose lanes and HOV/ExpressLanes on the I-10 and I-110.

Table 5-4. Statistical Comparison of Pre-and Post-Deployment Average Peak Period Travel Times for the I-10 and I-110 General Purpose and ExpressLanes

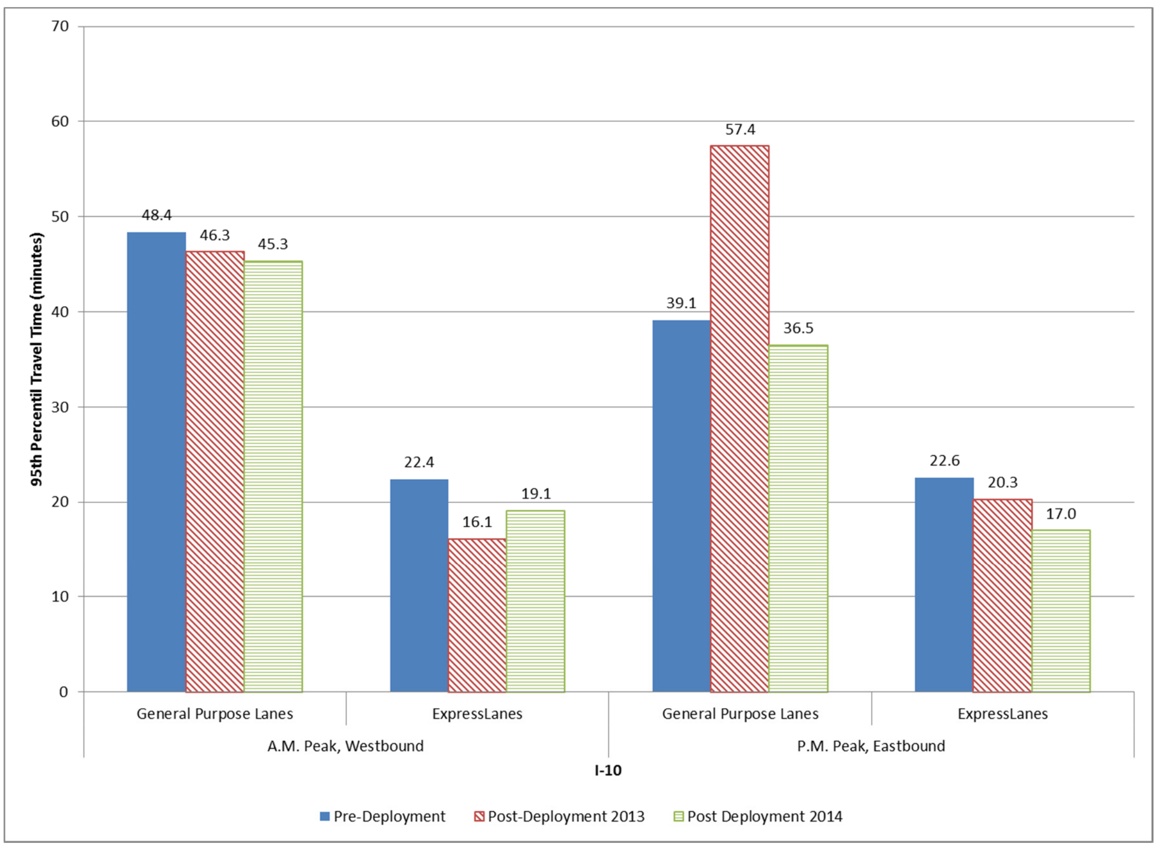
Route and Lane Type		Pre-Deployment Average Travel Time (mins)	Travel Time (minutes)			
			Post-Deployment Period	Average Travel Time (mins)	Difference	Statistically Significant?*
A.M. Peak						
I-10 Westbound	General Purpose Lanes	30.88	2013 Post-Deployment	28.99	-1.89	No
			2014 Post-Deployment	33.90	3.02	No
	Express-Lanes	15.96	2013 Post-Deployment	13.77	-2.18	Yes
			2014 Post-Deployment	15.08	-0.85	No
I-110 Northbound	General Purpose Lanes	27.09	2013 Post-Deployment	27.07	-0.02	No
			2014 Post-Deployment	30.39	3.29	No
	ExpressLanes	12.40	2013 Post-Deployment	14.29	1.90	Yes
			2014 Post-Deployment	18.99	6.60	Yes
P.M. Peak						
I-10 Eastbound	General Purpose Lanes	30.30	2013 Post-Deployment	34.61	4.31	Yes
			2014 Post-Deployment	26.16	-4.14	Yes
	ExpressLanes	18.14	2013 Post-Deployment	16.44	-1.69	Yes
			2014 Post-Deployment	14.98	-3.15	Yes
I-110 Southbound	General Purpose Lanes	18.45	2013 Post-Deployment	20.16	1.71	Yes
			2014 Post-Deployment	18.88	0.43	No
	ExpressLanes	10.75	2013 Post-Deployment	10.64	-0.11	No
			2014 Post-Deployment	11.00	0.25	No

*Values judged to be significantly significant at a 95 percent confidence level.

Source: Texas A&M Transportation Institute based on data provided by Caltrans.

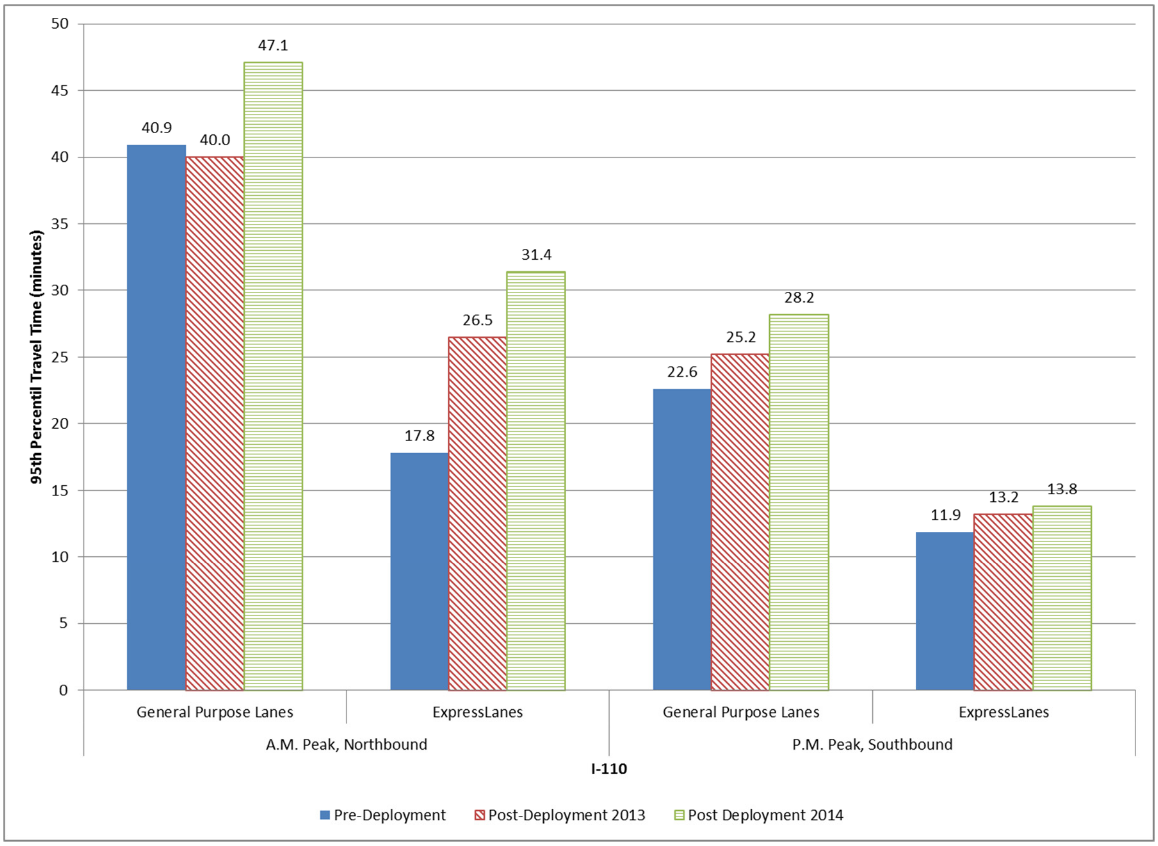
Peak period, peak direction travel times on the I-10 increased slightly in the general purpose lanes in the morning, but declined slightly in the afternoon. Travel times on the I-10 ExpressLanes declined during both time periods. Travel times on the I-110 general purpose lanes increased slightly in the morning, but remained approximately the same in the afternoon. Travel times in the ExpressLanes increased in the morning, but remained the same in the afternoon. While the results show that travel time in both the general purpose lanes and the ExpressLanes have increased slightly during the a.m. peak on the I-110, the ExpressLanes continue to provide a travel-time advantage over the general purpose lanes in the 2014 post-deployment period on both the I-10 and the I-110. The 2014 post-deployment time data, specifically, indicate that travel times are increasing in some time intervals on the I-10 and I-110 ExpressLanes and general purpose lanes in the morning peak period, but declining or remaining the same in the afternoon peak period. These increases in travel time may reflect the improving economy in the area.

Travel time reliability, as measured by the 95th percentile travel time, improved on the I-10 ExpressLanes and general purpose lanes, but declined slightly on the I-110 ExpressLanes and general purpose lanes in the post-deployment period, as depicted in Figure 5-4 and Figure 5-5, respectively. With the exception of I-110 in a portion of the morning peak period, it does not appear that allowing tolled vehicles to use the HOV/ExpressLanes has caused congestion to increase in the lanes during the peak hour. Travel times and travel speeds in the ExpressLanes during peak periods improved or remained the same in the 2014 post-deployment period.



Source: Texas A&M Transportation Institute from data provided by Caltrans.

Figure 5-4. Comparison of 95th Percentile Travel Times in the General Purpose and ExpressLanes for I-10 – Pre- and Post-Deployment



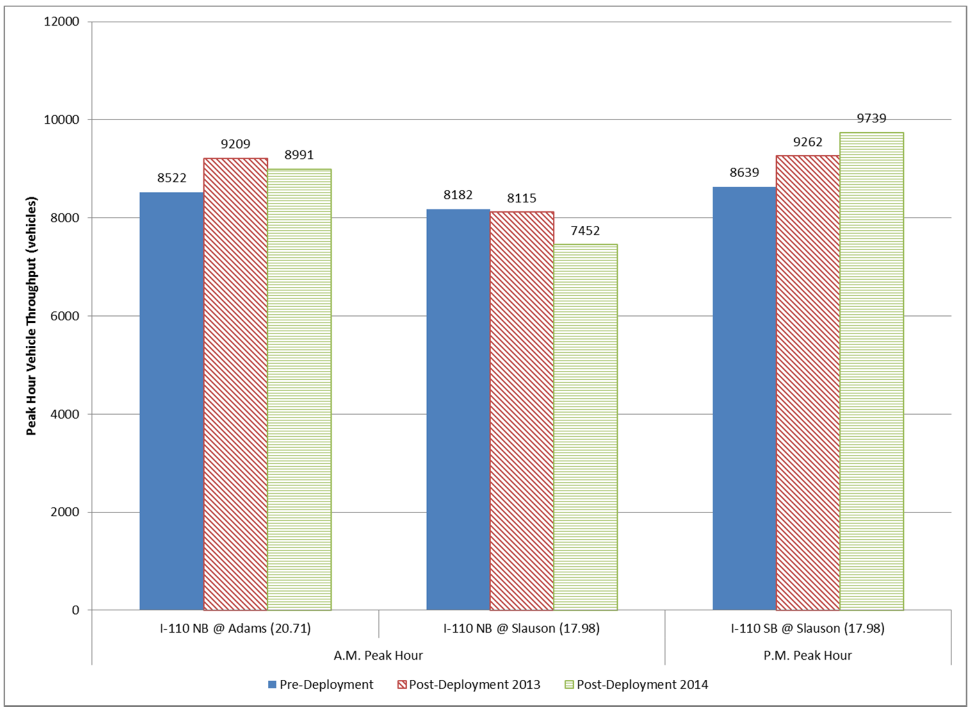
Source: Texas A&M Transportation Institute from data provided by Caltrans.

Figure 5-5. Comparison of 95th Percentile Travel Times in the General Purpose and ExpressLanes for I-110 – Pre- and Post-Deployment

Travel speeds in the I-10 and I-110 ExpressLanes remained above the 45 mph target in all but a few time intervals on the I-110 during the morning and afternoon peak periods. Travel speeds in the I-10 and I-110 general purpose lanes declined in the morning peak period, but increased or remained the same in the afternoon peak period.

Vehicle throughput increased on the I-110 in both the morning and afternoon peak hours, peak direction of travel, as shown in Figure 5-6, while person throughput declined slightly in the morning and increased in the afternoon. Vehicle and person throughput increased on the I-10 in both the morning and afternoon peak hours, peak direction of travel. Figure 5-7 shows the increase in vehicle throughput on the I-10.

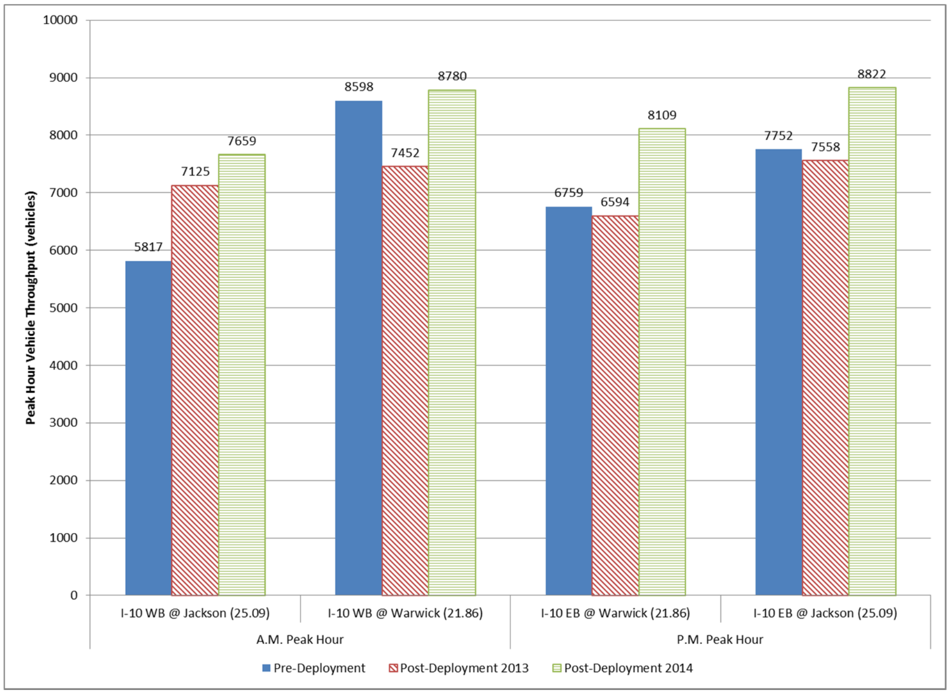
Person throughput can decrease while vehicle throughput increases if occupancies decrease. For example, if 3- or 4-person carpools change to 2-person carpools, or carpools change to SOVs, the facility can carry fewer people but more vehicles. Caltrans occupancy counts during the pre- and post-deployment periods indicate a decrease in vehicle occupancies.[7] It should be noted that data sources for determining vehicle throughput were not robust and these results rely on a very limited sampling of traffic flow from the corridor.



Source: Texas A&M Transportation Institute from data provided by Caltrans.

Figure 5-6. Comparison of Pre-and Post-Deployment of Vehicle Throughput on the I-110 at Selected Locations

[7] Caltrans occupancy counts are the standard of use in California unless more extensive data has been collected. A review of potential data sources to supplement the Caltrans counts showed that nothing more extensive was available.



Source: Texas A&M Transportation Institute from data provided by Caltrans.

Figure 5-7. Comparison of Pre-and Post-Deployment of Vehicle Throughput on the I-10 at Selected Locations

Another source of data to measure the impact of the CRD comes from Metro sponsored pre- and post-deployment surveys of motorists using the general purpose lanes and the HOV/ExpressLanes on the I-10 and I-110 freeways. These surveys and results are described in more detail in Appendix A – Congestion Analysis and Appendix B – Tolling Analysis. The results of this survey indicated some shifts in mode use, including becoming a toll paying solo driver and self-reported reductions in carpooling, vanpooling, or bus use. The results also indicated that 49 percent of the I-10 respondents and 47 percent of the I-110 respondents used the ExpressLanes at least once a week as a carpooler, vanpooler, or bus rider. Respondents were also asked to agree or disagree with positive and negative statements about the ExpressLanes, and the results indicate general support for the ExpressLanes, with HOV users expressing stronger support.

Metro also conducted customer satisfaction surveys of existing Metro ExpressLanes FasTrak® account holders in 2013 and 2014 during the post-deployment period. These surveys and results are described in more detail in Appendix A – Congestion Analysis and Appendix B – Tolling Analysis, but specific responses are summarized below.

- In 2013, slightly over half, 55 percent, self-identified as a carpooler (34 percent selected 2-person carpools and 21 percent selected carpools with more than 2 persons), while 43 percent self-identified as solo drivers, 1 percent self-identified as a vanpooler, and 1 percent self-selected as a motorcyclist.
- A total of 27 percent reported making no trips per week using the ExpressLanes on Monday through Friday in a typical week in 2013, 51 percent reported making 1-to-3 round trips and 22 percent reported making 4 or more round trips (16 percent reported 4-to-6 trips, 3 percent reported 7-to-9 trips, and 3 percent reported 10 or more trips).

- In regards to how frequently the respondent used the carpool/HOV lanes prior to the opening of the ExpressLanes, the responses in 2013 were split between 3-to-5 days a week, 18 percent; 1-to-2 days a week, 21 percent; twice a month, 21 percent; once a month, 21 percent; never, 13 percent; and other, 6 percent. Approximately 84 percent of the individuals reporting no use of the carpool/HOV lane self-identified as solo drivers in the second question. The remaining 16 percent self-identified as carpoolers, vanpoolers, and motorcyclists. These results indicate that existing carpools did continue to use the ExpressLanes after the HOV-to-HOT expansion and new toll paying solo drivers also use the lanes.
- In 2013, the primary reason that respondents obtained an ExpressLanes FasTrak® transponder was to commute to work at 47 percent, but 31 percent identified faster access to other freeways as the major reason. Most solo drivers reported getting a FasTrak® transponder for their commute, while more carpoolers favored faster access to other freeways. The vast majority, 81 percent, of frequent ExpressLanes users (4 or more round trips) reported commuting as their primary reason for obtaining a transponder.
- The majority of respondents, 71 percent, selected time savings as the greatest benefit of the ExpressLanes in 2013; followed by solo driver access, 19 percent; convenience, 6 percent, reliability, 1 percent; and other, 3 percent. The responses were similar across all self-reported modes, with the exception of solo driver access, which was selected by more solo drivers. The responses were also similar across the frequency of use groups.
- Most respondents, 86 percent, rated their overall experience in 2013 with the ExpressLanes as good or excellent, 11 percent gave an average rating, and 3 percent gave a poor rating. While the general responses were similar across all self-reporting modes, solo drivers had the highest percent of excellent rating and motorcyclists had the lowest. The responses were similar across the two facilities and across the different round trip user groups.
- In 2014, approximately 65 percent of respondents who drove alone before the ExpressLanes were implemented continued to make the same number of monthly one-way solo trips after the ExpressLanes were opened into 2014. Given that these individuals have ExpressLanes FasTrak® transponders, it was assumed that these trips are now being made in the ExpressLanes as a solo toll paying motorist, rather than in the general purpose freeway lanes. In addition, 22 percent of respondents reported a reduction in their drive-alone trip rates, while 12 percent reported an increase. Analysis indicated that most solo drivers who are driving less are carpooling more, and most solo drivers who are driving more are carpooling less. Also, 38 percent of the respondents who indicated they were carpooling more identified the main reason for this change as the desire for the travel-time savings provided by the ExpressLanes, without having to pay the toll.
- In 2014, the vast majority of vanpoolers – 99 percent, bus riders – 98 percent, and motorcyclists – 99 percent, reported no change in the number of trips before-and-after implementation of the ExpressLanes. As a result, a detailed analysis was not conducted on the respondents indicating vanpooling, taking the bus, and riding their motorcycles as their major mode. These trips would have been made in the I-10 and I-110 HOV lanes in the pre-deployment period and would continue to be made in the ExpressLanes in the post-deployment period.

LA Express Park™

The LA Express Park™ project combined technology and demand-based pricing to provide an innovative parking management strategy in the 4.5 square mile area in downtown LA. Key elements of the project included new parking meter technology, parking space vehicle sensors, an off-street occupancy system, a real-time parking guidance system, an integrated parking management system, and a public outreach program. The analysis of the LA Express Park™ project focused on the 6,300 on-street metered spaces. Xerox was selected by LADOT as the LA Express Park™ systems developer and integrator.

The new parking meter technology included pay stations serving multiple parking spaces in a block and single space meters. The new parking meters also expanded payment options to include not only cash, but also debit and credit cards, and payment via cell phones.[8] The meters provide real-time communication, allowing motorists to receive a notification when the time on a meter was about to expire. Individuals can pay for additional time using their cell phone. The parking meters are also capable of charging demand-based parking rates depending on the time-of-day and current occupancy.

Sensors were embedded in the pavement in approximately 6,000 on-street parking spaces to record parking space occupancy. The occupancy data was integrated with the parking meter data to support optimizing parking rates, time limits, and hours of operation. The integrated data were also used to enhance parking meter enforcement.

The parking management system provides a data warehouse for all transaction data. It stores and analyzes the parking transactions and occupancy data. The system performs advanced analyses to assist in setting parking rates, limits, and hours of operation. The data provided by the system helps LADOT optimize parking operations.

Elements of the parking guidance system include the LA Express Park™ website, third party cell phone applications (apps), third-party tailored websites, and dynamic message signs with parking availability at selected locations. The 511 telephone system was implemented in January 2014, after the period considered in this analysis. The additional dynamic message signs were deployed in July 2014, also after the period considered in this analysis.

A number of methods were used to inform local businesses, downtown workers and shoppers, and the public about the LA Express Park™ project. Brochures and window posters in local businesses provided key information about the LA Express Park™ project, including the project purpose, major elements, anticipated benefits, and the schedule. The project website presented similar information, along with videos highlighting various project features. Social media and presentations to different groups and organizations were also used. A Community Advisory Committee provided two-way communication, with members explaining the project to community leaders, business owners, employers, and the public. Members also obtained input from these groups, which they passed on to the project leaders.

[8] The number of pay-by-cell meters was reduced by approximately two-thirds of the downtown meters in March 2014 after the period examined in this analysis. According to the LADOT press release, pay-by-cell technology negatively affects the life of single-space meter batteries. The use of the pay-by-cell option at many meters did not remain high enough to justify the cost of maintaining the single-space meter batteries. The pay-by-cell option was continued at multi-space meters.

A number of policy changes were implemented in conjunction with the LA Express Park^{TM} project. These changes included extending paid parking hours from 6:00 p.m. to 8:00 p.m. in areas with sufficient demand and extending parking meter time limits from 1 hour to 2 or 4 hours. The use of demand-based pricing represents an additional policy change.

LA Express Park^{TM} was implemented in three phases. The first phase was initiated on May 21, 2012. Major elements of the three phases are highlighted below.

- Phase I – Base Hourly Rate, Initiated May 21 through July, 2012. Baseline data was used during this phase to interactively set the base hourly rates to influence demand toward the project goals. The parking payment hours were extended from 6:00 p.m. to 8:00 p.m. and the time limits were extended from 1 hour to 2 hours, or 4 hours in some areas.
- Phase II – Time-of-Day Pricing, August 2012 to the present. The experience from Phase I with parking levels during different times of the day was used to identify the morning and afternoon peak periods and set the parking rates by time-of-day. The following four time periods were selected from the analysis to optimize the parking system, while keeping it simple and understandable for users:
    - Monday – Friday Morning (8:00 a.m. – 11:00 a.m.)
    - Monday – Friday Mid-Day (11:00 a.m. – 4:00 p.m.)
    - Monday – Friday Evening (4:00 p.m. – 8:00 p.m.)
    - Saturday (all enforced hours)

  The actual parking rates for the time periods were displayed on the parking meter screen, the website, and the cell phone apps. The maximum rate per hour was also displayed. The parking meter also calculates the rate if someone was parking over different time periods. The time-of-day pricing was implemented incrementally in areas throughout the downtown over the course of the demonstration.

- Phase III – Adaptive Pricing, Initiated on Limited Basis in October 2013. It was initially anticipated that prices would be adjusted in real-time where demand fluctuated week-to-week. The analysis of Phase II conducted by Xerox and LADOT indicated that the time-of-day pricing continued to manage demand, however. As a result, the time-of-day pricing has continued, with some changes in the actual parking rates. Adaptive pricing has been implemented in a few blocks to test the concept.

The rates in October 2013 ranged from $.50 to $6.00 an hour. In some areas there was as much as a 50 percent variation from the original base rate. According to LADOT personnel, parking rate changes over the first year resulted in an overall decrease in average rates at 59 percent of parking meters in the area, a 29 percent increase in rates, and unchanged rates at 12 percent of the spaces. The overall average rate decreased by 11 percent. Generally, rate reductions resulted in increases in use and rate increases resulted in slightly lower use levels.

Overall, LA Express Park^{TM} was generally revenue neutral, according to LADOT personnel. Revenues did increase approximately 2.5 percent from June 2012 to September 2013, with the extended hours excluded. This slight increase was attributed to the overall slightly higher parking occupancy for spaces with increased parking rates, and higher overall occupancy rates resulting from the improving economy.

According to LADOT and Xerox, the changes in parking use over the first seven months of the project reflected more parking spaces occupied between 70 percent and 90 percent of the time, fewer parking spaces occupied over 90 percent of the time, and fewer parking spaces occupied less than 70 percent of the time. These changes reflect the desired outcome of the project.

LADOT and Xerox conducted intercept and online surveys to obtain feedback on different elements of the LA Express Park™ project from individuals parking in the downtown area. These surveys and results are described in more detail in Appendix B – Tolling Analysis, but specific responses are summarized below.

- In response to questions about parking behavior and time-of-day pricing, 24 percent of those surveyed knew that parking rates at some meters changed throughout the day. Slightly over 80 percent indicated they understood the parking rate table, but only 21 percent understood the "max rate" labels. A total of 76 percent of those surveyed reported that they would park in nearby lower-priced spaces once they were aware of their availability. Overall, 82 percent of those surveyed favored or were neutral about the use of time-of-day pricing, while 37 percent responded that it was the best way to solve parking problems.
- When asked to rank the importance of four factors from a pre-determined list when selecting a parking space (1 as least important and 4 as most important), online survey respondents identified proximity as most important (2.99 weighted average), followed by cost (2.50 weight average), availability (2.46 weighted average), and time (2.03 weighted average). Participants in the intercept surveys were asked to select all of the factors during the same time period that they felt were important. The percentage of respondents selecting the different factors were proximity, 64 percent; availability, 33 percent; cost, 19 percent; and time 7 percent.
- Approximately 20 percent of the online survey respondents and 31 percent of the intercept survey respondents indicated an awareness of the parking price changes. Approximately 20 percent of the online survey respondents and 24 percent of the intercept survey participants indicated an awareness of the time-of-day dynamic pricing in the pilot area. Approximately 11 percent of the online survey respondents and 25 percent of individuals responding to the intercept survey indicated they were aware of the mobile parking apps. Only 5 of the online survey respondents and 4 of the intercept survey respondents could name a mobile parking app, however.
- Results from the intercept survey indicated that 55 percent of respondents parked within one block of their destination. The mean number of blocks respondents indicated a willingness to walk to their destination was 3.07 blocks.
- Approximately 84 percent of the respondents to the online survey and 74 percent of the respondents to the intercept survey indicated a willingness to use lower-priced nearby parking. Respondents to both surveys were less likely to change behavior in response to time-of-day pricing. Approximately 48 percent of respondents to the online survey and 49 percent of respondents to the intercept survey indicated they were somewhat or extremely likely to change their parking behavior based on time-of-day pricing. Further, approximately 32 percent of the online survey respondents indicated they were unlikely to change their parking behavior in response to time-of-day pricing.

Transit

The LA CRD Program included multiple transit-related improvements. This was critical to allowing Metro to overcome the unique challenge of introducing tolling in HOV lanes already operating at full capacity. Metro successfully created additional capacity by expanding viable options to solo driving, including investing the majority of the CRD funding into transit improvements that were deployed a year before tolling operations. By the time tolling was deployed, the transit improvements had already cultivated increased ridership, showing that commuters recognized transit as a functional and reliable alternative.

First and foremost of the transit-related improvement was the purchase of 59 new clean-fuel buses to enhance the Metro Silver Line, the Foothill Transit Silver Streak, as well as several other municipal bus routes. In downtown LA, TPS technology was installed at 15 intersections on Figueroa Street between Wilshire Boulevard and Adams Boulevard and at 5 intersections on Flower Street between Wilshire Boulevard and Olympic Boulevard. Unless otherwise noted, the transit analysis relies on three separate three-month analysis periods in 2011, 2012, and 2013, which represent the period prior to any CRD funded improvements, the period after some of the CRD funded transit improvements were in place but prior to tolling, and the period after tolling began on the I-110 and I-10, respectively. The purpose of dividing the analysis into three periods was to be able to distinguish the impact of the new CRD-funded transit service on ridership from the impact of the tolls.

Changes in bus travel times on the ExpressLanes were examined using the automated vehicle location (AVL) systems of the Silver Line and Silver Streak buses. The data suggests that implementing variable tolls had little or no negative impact on bus travel times on the I-110 ExpressLanes, and it had a positive impact to bus travel times on the I-10 ExpressLanes. Travel times on the I-110 ExpressLanes were relatively flat except near of the end of the evaluation in September, October, and November 2013. Bus travel times on the I-10 ExpressLanes reveal a noticeable decrease in travel time. The Silver Line's average travel time on the I-110 ExpressLanes increased 6 percent in the morning peak period after tolling, which equated to less than a one minute increase. There was virtually no change in the afternoon peak period. On the I-10 ExpressLanes, bus travel time for the Silver Line decreased 4 percent in the morning peak period and 14 percent in the afternoon peak period. That 14 percent equated to a 2.6 minute travel time reduction. On the Silver Streak, the decrease was more pronounced. Travel time decreased 22 percent in the morning peak period and 17 percent in the afternoon peak period. This equated to a 4.7 minute and 3.8 minute reduction, respectively. Besides the variable tolls, a likely contributor to the stronger travel time reductions on I-10 was the fact that a second HOT lane was created via restriping with no loss of general purpose lanes on I-10 from I-605 to I-710. This means the I-10 ExpressLanes now have more capacity than they did as HOV lanes during the pre-deployment period.

The TPS on Figueroa Street and Flower Street was activated on November 9, 2012. Travel time data was collected for northbound travel on Figueroa Street and southbound travel on Flower Street before and after the introduction of TPS. The same end points were used for both directions. On Figueroa, the 12-month average pre-TPS was 6.0 minutes and 5.8 minutes post-TPS. On Flower Street, it was 7.5 minutes pre-TPS and 7.4 minutes post-TPS. Changes in travel time were so small as to not likely have been noticeable to riders.

Seven park and ride lots were monitored for the evaluation: five on the I-110, one on the I-10 at El Monte Station, and another at the Pomona Metrolink Station. With the exception of the Harbor Gateway lot, all have undergone changes in capacity in the last several years due to various construction activities. In absolute numbers, the El Monte Transit Center saw the largest increase in occupied spaces. There were 394 more spaces occupied in February 2014 than in February 2012.

At both the Harbor Gateway and Harbor Freeway Transit Centers, there were 48 more occupied spaces in February 2014 than in February 2012.

The most positive observation related to transit in the LA CRD evaluation has been an increase in ridership, as presented in Table 5-5. In the I-110 corridor where Metro added service to its Silver Line bus service, ridership increased 52 percent in the morning peak period and 41 percent in the afternoon peak period. This increase occurred after the new service was added but before tolling began. After tolling began, ridership increased another 29 percent in the morning peak period and another 25 percent in the afternoon peak period. In the I-10 corridor where Foothill Transit added service to the Silver Streak and Route 699, ridership increased also. Ridership on the Silver Streak increased 59 percent in the morning peak period and 15 percent in the afternoon peak period. Ridership on the Route 699 increased 53 percent in the afternoon peak period. Gardena Municipal Bus Lines and Torrance Transit also saw ridership increases in the I-110 corridor. Morning peak period ridership on the Gardena Line 1X increased 106 percent, and afternoon peak period ridership increased 123 percent. On the Torrance Transit Line 4, morning peak period ridership was 73 percent higher.

Table 5-5. Average Peak Period Ridership

		Morning Peak Period	Percent Change	Afternoon Peak Period	Percent Change
Silver Line (I-110 ExpressLanes)	Mar-May 2011	596		680	
	Mar-May 2012	907	52%	957	41%
	Mar-May 2013	1,175	29%	1,199	25%
Silver Line (I-10 ExpressLanes)	Mar-May 2011	1,434		1,528	
	Mar-May 2012	1,642	15%	1,629	7%
	Mar-May 2013	1,568	-5%	1,637	0%
Foothill Transit Silver Streak (I-10 ExpressLanes)	Mar-May 2012	505		681	
	Mar-May 2013	804	59%	783	15%
Foothill Transit Route 699 (I-10 ExpressLanes)	Mar-May 2012	484		271	
	Mar-May 2013	420	-13%	415	53%
Gardena Line 1X (I-110 ExpressLanes)	Mar-May 2012	124		151	
	Mar-May 2013	256	106%	338	123%
Gardena Line 2	Mar-May 2012	2,008		1,664	
	Mar-May 2013	2,059	3%	1,857	12%
Torrance Transit Line 4	Dec. 2012	51		76	
	Feb. 2014	88	73%	73	-4%

Source: Metro.

In a survey of Silver Line riders, there were statistically significant improvements in the ratings given by riders on the I-110 segment for frequency of service and hours of service. This was an important finding since Metro invested a large amount of CRD funds in improving service on the I-110 portion of the Silver Line. Sixty-five (65) percent of the Silver Line riders on I-110 segment and 57 percent riders on the I-10 segment said their travel time has been faster since tolling began. Thirty-two (32) percent of the new riders on the I-110 segment and 33 percent of the new riders on the I-10 segment said they used to drive alone before switching to transit. Among riders who began taking the Silver Line after tolling began, 37 percent of the riders on the I-110 segment and 34 percent of the riders on I-10 segment said the tolls influenced them to take the bus. In both corridors, 48 percent of Silver Line riders agreed to varying extents that tolling the I-110 and I-10 ExpressLanes improved their travel while 34 percent in both corridors were neutral. Prior to the first survey in 2011, Metro made several CRD grant funded safety-related improvements at the transit stations on I-110, however the surveys revealed no statistically significant change in user perceptions of safety by riders on the I-110 portion of the Silver Line.

Travel Demand Management (Ridesharing)

The rideshare, or TDM element, of the CRD projects was centered on a focused campaign to form new vanpools in the two ExpressLanes corridors. Additionally, Metro promoted commute alternatives as part of its employer outreach in the region for employees who commuted on the I-10 and/or I-110. As part of the CRD agreement, Metro set a target of forming at least 100 new vanpools in the two corridors. Marketing began in July 2012, four months before the opening of the ExpressLanes on I-110. Employers within the commuter-shed served by each facility were contacted by Metro with outreach materials. These materials were tailored for each corridor and highlighted the travel time reliability benefits offered by the ExpressLanes without having to pay a toll. The materials were distributed several months before and during the HOT conversions. The type of vanpools offered, and the subsidies associated with these vans, did not change from the normal, ongoing Metro vanpool program. However, marketing and outreach to employers, designed to identify and encourage potential vanpool groups among employees, was concentrated in the two CRD corridors. A total of 119 vanpools, using either or both the I-110 and I-10 ExpressLanes, were established from July 2012 through February 2014, surpassing the goal of 100 new vanpools. A total of 34 vanpools use the I-110 ExpressLanes, 79 use the I-10 ExpressLanes, and 6 use both.

A vanpooler survey was undertaken in order to gather additional data on their behavior and attitudes. Half of the vanpoolers in the two corridors switched from driving alone and another 12 percent shifted from carpooling to vanpooling. Thus, almost 2/3 of the vanpoolers (29 percent) represent a shift that reduces vehicle trips and improves person throughput. Almost a third, however, switched from bus, light rail (e.g., Gold Line, Blue Line) or Metrolink, representing an increase in vehicle trips. Other interesting findings from the vanpooler survey include:

- 40 percent have been only vanpooling for one year or less (indicative of the marketing push to form new vanpools).
- 57 percent of vanpoolers heard about the Metro Vanpool Program through their employer, indicative of the marketing made by Metro. Another 20 percent heard about the program via family/friends and another 12 percent heard about it from Metro itself (website, advertisements, etc.). Only 19 percent of vanpoolers had learned about the ExpressLanes project from their employer, with 23 percent hearing about them from Metro.
- Almost two-third of vanpoolers (61 percent) noted that their vans received a subsidy from Metro and 26 percent did not know. All vanpools received a subsidy from Metro. Fewer (49 percent) knew if their employer also provides a benefit to help pay for the vanpool fare.
- The most important factors in their decision to vanpool included: cost savings (91 percent), travel time reliability (80 percent), time savings (78 percent), and employer support (61 percent). The stated benefits of vanpooling mirrored these factors (cost and time savings, less wear and tear on their personal vehicle) but 89 percent also said that vanpooling reduces stress.
- The most important reasons for wanting to use the ExpressLanes included: saving time (77 percent), reducing fuel use (72 percent), faster trip (64 percent), no tolls for vanpools (64 percent), and less congestion (63 percent).
- Vanpoolers were generally favorable to the ExpressLanes concept, with almost half (48 percent) agreeing that they should be made permanent on the I-110/I-10 and just over half (52 percent) thinking that there should be more on other freeways in LA County.

Also, as part of its education campaign on the ExpressLanes project, Metro included ridesharing information. Part of this was necessitated by the fact that carpools desiring to use the ExpressLanes must have a FasTrak® transponder and valid account. The various means to promote ridesharing include: employer outreach, direct marketing to commuters, incentive programs, the Metro website and ExpressLanes page. The important role of employers was noted in the vanpooler survey responses as being important in informing commuters of the vanpool option and getting them into new ridesharing arrangements.

A focus group was held among the employee transportation coordinators (ETCs) from six large employers and one representative of smaller employers who have a significant proportion of commuters using I-110 or I-10 to explore the role of employers in promoting Metro rideshare initiatives.

Many of these employers purchased transponders for their vanpools to make it easier on vanpool groups. Four of the six coordinators said that they paid for or reimbursed their vanpools for the transponder. Most representatives said that there was a definite learning curve on the use of the transponders, frustration among commuters, and some voiced concern with getting useful information from ExpressLanes customer service.

A major response was that existing and new vanpools needed to acquire and maintain a transponder to use the ExpressLanes, whereas nothing was required to use the HOV lanes prior to tolling. Interestingly, many coordinators did not view the incentive as pivotal in forming new vans (noting that the subsidy did not change) while other cited the incentive as a big part of the appeal of the program.

Additionally, Metro implemented two critical programs to provide additional incentives and benefits to two user groups, one directly related to ridesharing – the Carpool Loyalty Program and the other related to transit riders – the Transit Rewards Program. The Carpool Loyalty Program automatically entered ExpressLanes FasTrak® account holders each time they used the lanes as a carpooler into monthly drawings for gift cards valued at $50. During the demonstration period, 520 gift cards were issued. The Transit Rewards Program allows frequent bus riders to earn toll credits for use on the ExpressLanes. Using their registered TAP card, riders earn a $5 toll credit by taking 32 one-way trips during the peak hours on the I-110 and I-10 ExpressLanes. The reward credits were not transferrable and expired after 90 days. During the demonstration period, 5,782 accounts were enrolled in the program, earning $12,870 in toll credits.

Four data sources were used to examine whether tolling had an unintended negative impact on carpooling: occupancy counts collected by Caltrans, tolling data assembled from Metro operational data, a before and after license plate survey, and a customer satisfaction survey among FasTrak® account holders in the two corridors.

The before and after occupancy data counts collected by Caltrans at locations on both the I-110 and I-10 showed a dramatic reduction in carpooling in both the HOT lanes and the general purpose lanes. In the I-10 ExpressLanes, the counts reveal that there were 37 percent fewer carpools in the morning peak hour and 50 percent in the afternoon peak hour. On the I-110, the counts showed a 61 percent drop in carpools in the morning period and a 51 percent drop in the afternoon period. Carpools here refers to vehicles with three or more occupants on the I-10 and two or more occupants on the I-110. The Caltrans count data was the only data available, and, as noted earlier, was the standard of use in California unless a more extensive source was available. After extensive review and discussion it was determined there were no other sources available. These data, as per the CRD test plans, were used to estimate changes in VMT and emissions. However, to further explore the impact on carpooling as the result of tolling, other data sources were explored, as summarized below.

The tolling data provided indicated an overall increase in HOV2+ and HOV3+ toll trips, which represent self-declared 2+ and 3+ carpools, as well as buses, vanpools, motorcycles and non-revenue vehicles on the I-110 and the I-10 ExpressLanes, and increases in toll paying HOV2+ vehicles and SOVs. The figures also indicate that self-declaring HOV2+ and HOV3+, vanpools, buses, motorcycles, and other non-revenue vehicles represented between 54 percent and 59 percent of the peak period and peak hour FasTrak® trips on the ExpressLanes during the demonstration. However, the extent of enforcement of tolling was unclear, and a 60-day grace period when no violation penalties were issued was in effect after the initiation of tolling on the I-110 and the I-10 ExpressLanes.

The before and after license plate survey provided some information on mode shift by asking how many times per week that respondents used various modes. These survey results indicated some shifts in mode use, including becoming a toll paying solo driver, and reductions in carpooling, vanpooling or bus use. The license plate survey revealed that the same proportion of travelers who used an alternative mode 5 days per week remained the same. It also showed that the proportion of travelers who make NO trips using commute alternatives actually rose (from 42 percent to 51 percent on I-10 and from 41 percent to 53 percent on I-110) and this revealed that about half of all travelers carpool, vanpool or ride the bus at least once per week.

Finally, the customer satisfaction survey included several questions about modal behavior before and after the advent of tolling and reasons for any changes. This survey involved toll account holders with 55 percent identifying themselves as carpoolers and 1 percent as vanpoolers. When asked to estimate how many monthly trips each made by mode before and after tolling was introduced, two-thirds responded that they make the same number of carpooling trips, with only 12 percent saying less carpooling trips and 22 percent stating more carpooling use. This would indicate that only a modest shift was made from carpooling to paid SOV use and that the majority of carpoolers maintained their behavior.

However, methodological issues complicate the ability to draw conclusions about the impact of tolling on carpooling. Given the fact that the various data sources related to carpool behavior reveal differing and even conflicting results, the impact of tolling on carpooling was inconclusive in the case of the LA CRD project. While occupancy data, and to a much lesser extent, the license plate survey show a reduction in carpooling in the two corridors after implementation of the ExpressLanes project, the customer satisfaction survey shows no change or even a slight increase in carpooling and the tolling data shows growth in carpooling after the ExpressLanes were opened. Therefore, observed carpool occupancy data was used to calculate VMT and emissions changes, but in addressing the issue of how tolling impacted carpooling, the total set of data sources render this question unanswerable.

Technology

Technology was an important element of the LA CRD, with intelligent transportation systems (ITS) incorporated into many of the projects to enable a wide variety of improvements. The technology analysis focuses on the components of the LA Express Park™ project. Unfortunately, comprehensive quantitative data was unavailable for inclusion in this evaluation and BCA. Technologies included the parking space vehicle sensors, the new parking meters, a real-time parking guidance system, a website, and an integrated parking management system. In addition, smart phone parking apps were developed using the real-time information from the City of LA Department of Transportation (LADOT). The technology analysis focused on the ITS technologies supporting the demand-based parking management and congestion-reducing objectives, not determining how well the technology performed.

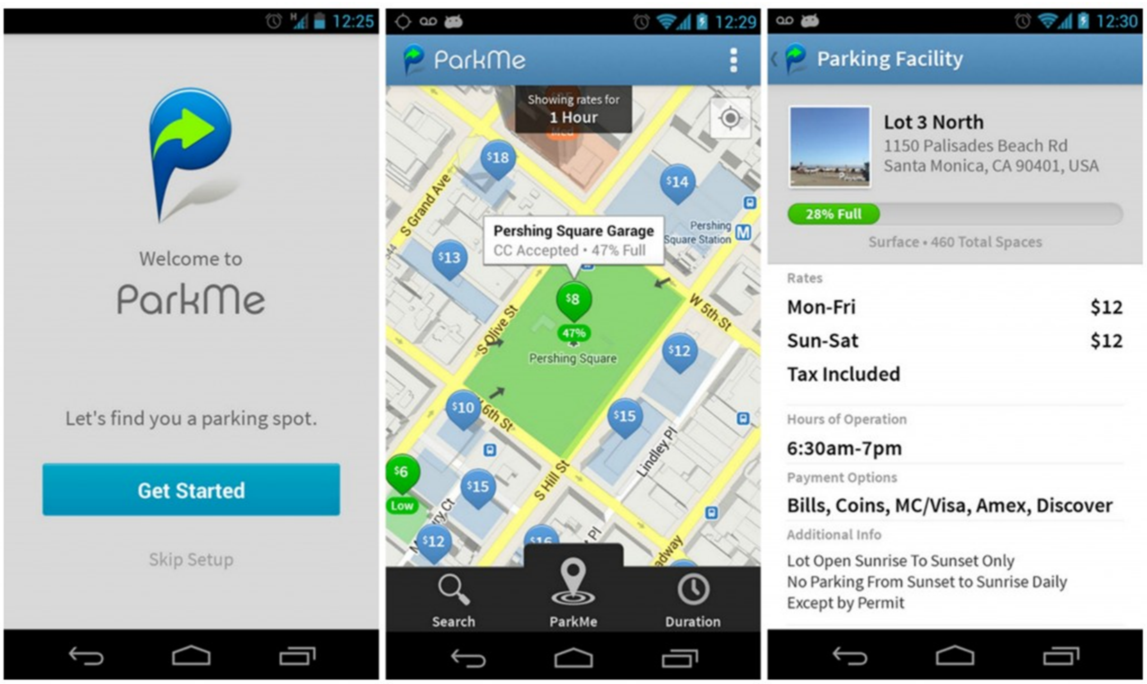
LA Express Park™ is an IPM system that relies on state-of-the-art parking sensor, parking meters, and parking guidance technologies, as well as advanced analytical capabilities. Vehicle sensors, shown in Table 5-9, were installed in the pavement of 6,300 on-street parking spaces in the project area. The parking sensors, which are battery operated and communicate through a wireless mesh network, provide the occupancy status of parking spaces in real-time. The new parking meters shown in Table 5-10 allow payment by cash, credit card, debit card, and smart phone. The parking meters also provide payment data to the parking management systems. The parking guidance system includes the LA Express Park™ website, third-party smart phone apps depicted in Table 5-11, third-party tailored website apps, and LA Express Park™ on-street dynamic message signs. The parking management system includes a data warehouse for all transaction data and provides parking management reports and dashboards for use by operations and enforcement personnel.

Source: Streetline.

Figure 5-8. LA Express Park™ In-Ground Parking Sensor

Source: LADOT.

Figure 5-9. LA Express Park™ Parking Meter



Source: Drippler.com (http://drippler.com/drip/featured-top-10-best-android-car-finderparking-apps).

Figure 5-10. ParkMe Smart Phone App

LADOT personnel indicated in the interviews and workshops conducted as part of the National Evaluation that the advanced parking technology, including the parking occupancy sensors and the parking meters, allowed the agency to implement demand-based parking pricing and the parking guidance system in the downtown pilot area. They noted that most of the system elements were implemented as anticipated, with the exception of the telephone information system and the additional dynamic message parking guidance signs.

LADOT and Xerox personnel noted that LA did not experience many of the technology issues with the parking sensors encountered in San Francisco. For example, LA did not have the underground interference with the wireless technology, which was a problem in San Francisco. LADOT and Xerox personnel reported that, in general, the parking sensors were operating well. They did note that the sensors require ongoing maintenance and repair, and that LADOT continues to explore alternative technologies for future applications.

LADOT and Xerox personnel also noted that parking meters were working well and were well received by the public. The ability to pay for parking using cash, credit cards, debit cards, and cellphones has been viewed positively by the public. They suggested that more people are paying for parking now, including possible paying for more time, because was it easier, rather than risking receiving a citation.

LADOT personnel suggested that the technology enabled the implementation of LA Express Park™, the demand-based pricing, and the parking guidance system. These components assisted in moving the parking rate setting to a demand-based approach rather than the long standing flat rate approach used in the city. It was noted that this focus on market-based demand represented a culture change.

Personnel from LADOT noted the issue of disabled parking permits during the interviews and workshops. California law allows drivers with a valid disabled parking permit to park for free at an on-street meter. According to LADOT, at least 10 percent of licensed drivers in the state have valid disabled parking permits. In addition, the use of fake disabled parking permits has previously been identified as a concern in LA. According to LADOT, the percentage of parking spaces occupied by vehicles with disabled parking was as high as 90 percent in portions of the downtown area.

As part of the parking enforcement effort in the LA Express Park™ area, occupancy data from the parking sensors and the payment data from the parking meters are combined to help identify potential violators. This situation requires a filtering of parking sensor and parking meter data. Without the free disabled parking, potential violators would be identified by combining sensor data indicating a parked vehicle with meter data indicating no payment. This approach may identify vehicles with disabled parking permits, however. LADOT personnel noted that dispatching enforcement officials to these locations wastes resources. While the filtering process may miss some vehicles without handicapped placards parking illegally without paying, LADOT personnel noted that this filtering system works well and has provided for more efficient and effective use of parking enforcement personnel.

Real-time information on parking availability and parking rates was provided to the public through a number of methods, including the LA Express Park™ website, third-party smart phone apps and website links, and dynamic message signs. The total number of hits per month on the LA Express Park™ website from March 2013 through November 2014 was approximately 60,600. In 2012, the number of hits were over 2,000 for all months. The number of hits increased to over 3,000 in 2014, approaching 4,000 by the end of the year, which represents a substantial monthly increase. These numbers appear low based on 6,000 parking spaces and the number of hits received by many popular websites. The increases in 2014 may represent increased awareness of the website, and subsequent use.

Intercept and online surveys were conducted in 2013 showed that approximately 11 percent of the online survey respondents and 25 percent of individuals responding to the intercept survey indicated they were aware of the mobile parking apps. Only 5 of the online survey respondents and 4 of the intercept survey respondents could name a mobile parking app, however.

Assessment of U.S. DOT Four Objective Questions

The four U.S. DOT objective questions and the 10 analysis areas used in the LA CRD evaluation were presented and discussed in Chapter 4 of this report. Appendices A though J present detailed information on the 10 analyses. This section summarizes the impacts by the hypotheses/questions for each of the 10 analysis areas.

Summary of Congestion Impacts

Table 5-6 summarizes the impacts for the 15 congestion-related hypotheses and questions. Overall, implementation of the ExpressLanes and the other CRD projects improved and maintained operations of the heavily traveled I-10 and I-110 corridors. The analysis results and support of the hypotheses vary by corridor, time-of-day, and direction of travel.

The hypothesis related to the impact of deploying the ExpressLanes on the I-10 and I-110 on travel times, travel speeds, trip-time reliability, and other related factors were generally supported. Peak period, peak direction travel times on the I-10 increased slightly in the general purpose lanes in the morning, but declined slightly in the afternoon. Travel times on the I-10 ExpressLanes declined during both time periods. Travel times on the I-110 general purpose lanes increased slightly in the morning, but remained approximately the same in the afternoon. Travel times in the I-110 ExpressLanes increased in the morning, but remained the same in the afternoon.

Travel time reliability, as measured by the 95^{th} percentile travel time and the Buffer Index, improved on the I-10 ExpressLanes and general purpose lanes, but worsened on the I-110 ExpressLanes and general purpose lanes in the post-deployment period. Vehicle throughput increased on the I-110 in both the morning and afternoon peak hours, peak direction of travel. Person throughput declined slightly in the morning, but increased in the afternoon. Vehicle and person throughput increased on the I-10 in both the morning and afternoon peak hours, peak direction of travel.

Travel speeds in the I-10 and I-110 ExpressLanes remained above the 45 mph target in all but a few time intervals on the I-110 during the morning and afternoon peak periods. Travel speeds in the I-10 and I-110 general purpose lanes declined in the morning peak period, but increased or remained the same in the afternoon peak period. The 2014 post-deployment time data indicate that travel times were increasing in some time intervals on the I-10 and I-110 ExpressLanes and general purpose lanes in the morning peak period, but declining or remaining the same in the afternoon peak period. The increases in travel time may reflect the improving economy in the area.

While the results show that travel time in both the general purpose lanes and the ExpressLanes have increased slightly during the a.m. peak on the I-110, the ExpressLanes continue to provide travel-time advantage over the general purpose lanes in the 2014 post-deployment period on both the I-10 and the I-110. Travel time reliability did decline slightly in the I-110 ExpressLanes. With the exception of the I-110 in a portion of the morning peak period, it does not appear that allowing tolled vehicles to use the HOV/ExpressLanes has caused congestion in the lanes. With the exception of the a.m. peak on the I-110, travel times and travel speeds in the ExpressLanes have improved or remained near pre-deployment levels. The I-110 ExpressLanes have experienced a significant increase in travel time in the post-deployment (2014) a.m. peak period.

The information needed to assess the final two hypotheses and four questions was not available. Data were not available on congestion levels on arterial streets paralleling the I-10 and I-110 corridors. Data on congestion levels in downtown Los Angeles were also not available. Thus, it was not possible to assess the hypotheses related to reducing congestion on arterial streets paralleling the I-10 and I-110 corridors and reducing congestion in downtown Los Angeles.

Questions on travelers' perceptions related to noticeable reductions in travel times, improvements in trip-time reliability, reductions in the duration of congested periods, and reductions in the length of peak congestion periods on the I-10 and I-110 were inadvertently left off the 2014 post-deployment survey of motorists in the corridors. While it was not possible to assess these questions, the 2012 and 2014 surveys of motorists using the I-10 and I-110 general purpose lanes and the ExpressLanes, and the 2013 ExpressLanes FasTrak® Customer Satisfaction Survey provide some insights on the perceptions of travelers on the benefits of the ExpressLanes. One of the statements in the 2012 and 2014 survey of motorists was "Even if I do not wish to pay to use the ExpressLanes on a regular basis, it is good to have an option when I need to go somewhere fast." Approximately 67 percent of the respondents in 2012 and 58 percent in 2014 agreed with this statement. Support was higher among I-10 users and among HOV users on both facilities.

The 2013 ExpressLanes FasTrak® Customer Satisfaction Survey included questions related to the perceived benefits of the ExpressLanes. Approximately 71 percent of the respondents selected time savings as the greatest benefit from using the ExpressLanes. In response to a question asking respondents to rate their overall experience to-date with the ExpressLanes, 86 percent rated their experience as good to excellent. Approximately 81 percent of respondents reported they would recommend FasTrak® to their family and friends.

Table 5-6. Summary of Impacts across Congestion Hypotheses

Hypotheses	Result	Evidence
Deployment of the ExpressLanes will reduce the travel time of users in the I-10 and I-110 corridors.	Somewhat Supported	Peak period, peak direction travel times on the I-10 increased slightly in the general purpose lanes in the morning and declined slightly in the afternoon. Travel times in the I-10 ExpressLanes declined during both time periods. Travel times in the I-110 general purpose lanes increased slightly in the morning and remained approximately the same in the afternoon, while travel times in the ExpressLanes increased in the morning and remained the same in the afternoon.
Deployment of the ExpressLanes will improve the reliability of user trips in the I-10 and I-110 corridors.	Somewhat Supported	Travel time reliability, as measured by the 95th percentile travel time and the Buffer Index, improved on the I-10 ExpressLanes and general purpose lanes, but declined on the I-110 ExpressLanes and general purpose lanes in the post-deployment period.
Deploying the ExpressLanes will result in more vehicles and persons served in the I-10 and I-110 corridors during peak periods.	Somewhat Supported	Vehicle throughput increased on the I-110 in both the morning and afternoon peak hours, peak direction of travel. Vehicle occupancy counts shows that the person throughput has decreased on the I-110 ExpressLanes during the a.m. and p.m. peak hours. Vehicle and person throughput increased on the I-10 in both the morning and afternoon peak hours, peak direction of travel.

Table 5-6. Summary of Impacts across Congestion Hypotheses (Continued)

Hypotheses	Result	Evidence
The ExpressLanes will regulate vehicular access to I-10 and I-110 and improve their operation.	Somewhat Supported	Travel speeds in the I-10 and I-110 ExpressLanes remained above 45 mph in all but a few time intervals on the I-110 during the morning and afternoon peak periods. On the I-10, average travel speeds ranged between 58 mph and 65 mph in the morning peak period and from 47 to 58 mph in the afternoon peak period. In the morning peak period, average travel speeds on the I-110 were slightly slower in the post deployment periods between 7:00 to 9:00; however, average travel speeds remained above 45 mph throughout the entire afternoon peak period. Travel speeds declined in the I-10 and I-110 general purpose lanes in the morning peak period, but increased or remained the same in the afternoon peak period.
The ExpressLanes pricing will maintain operating improvements on the I-10 and I-110 after the initial ramp up.	Somewhat Supported	The 2014 post-deployment travel time data suggest that the travels times in some intervals of the morning peak period are increasing in both the general purpose lanes and in the ExpressLanes on the I-10 and I-110. Travel times in the afternoon peak period continue to remain at the same level or have improved in the 2014 post-deployment period.
Relative travel times for HOV/HOT lanes versus general purpose lanes will either remain the same or (more likely) improve for HOV/HOT travelers as a result of the ExpressLanes.	Somewhat Supported	The ExpressLanes continue to provide a travel time advantage over the general purpose lanes in all time intervals. With the exception of the morning peak period on the I-110, the relative travel time advantage of using the ExpressLanes over the general purpose lanes increased in most intervals in both peak periods in both corridors.
The introduction of tolled traffic into the I-10 and I-110 ExpressLanes will not negatively impact HOV or transit traffic in terms of average travel times or travel reliability.	Somewhat Supported	On the I-10 ExpressLanes, travel time reliability improved by over 6 minutes in the morning peak period and by approximately 2 minutes in the afternoon peak period. On the I-110 ExpressLanes, the travel time reliability declined during some time intervals, but the ExpressLanes still provided a travel time advantage over the general purpose lanes.
Allowing tolled vehicles will not cause traffic congestion to increase in the ExpressLanes.	Somewhat Supported	With the exception of the I-110 during part of the morning peak period, allowing tolled vehicles to use the HOV/ExpressLanes has not caused congestion in the lanes. Travel times and speeds in the ExpressLanes remained the same or improved in the 2014 post-deployment period.
Because of latent demand in the I-10 and I-110 corridors, the ExpressLanes are not likely to impact traffic congestion on the general purpose lanes.	Supported	In the I-10 and I-110 corridors, travel speeds in the general purpose lanes declined in the morning peak period, but increased or remained the same in the afternoon peak period. The 2014 post-deployment time data indicate that travel times are increasing in some time intervals on the I-10 and I-110 ExpressLanes and general purpose lanes in the morning peak period, but declining or remaining the same in the afternoon peak period.

Table 5-6. Summary of Impacts across Congestion Hypotheses (Continued)

Hypotheses	Result	Evidence
Because of the ExpressLanes, congestion on the arterial streets paralleling the corridors will be reduced.	Unknown	Data were not available to assess the impacts of the ExpressLanes on parallel arterial streets in the I-10 and I-110 corridors. Thus, it was not possible to assess this hypothesis.
Will surveyed travelers perceive a noticeable reduction in travel times in the I-10 and I-110 corridors?	Unknown	A question on travelers' perception of a noticeable reduction in travel times on the I-10 and I-110 corridors was not included in the 2014 survey of motorists in the I-10 and I-110 corridors. Thus, it was not possible to assess this question.
Will surveyed travelers perceive a noticeable improvement in trip time reliability in the I-10 and I-110 corridors?	Unknown	A question on travelers' perception of a noticeable improvement in time reliability on the I-10 and I-110 corridors was not included in the 2014 survey of motorists in the I-10 and I-110 corridors. Thus, it was not possible to assess this question.
Will surveyed travelers perceive a noticeable reduction in the duration of congested periods in the I-10 and I-110 corridors?	Unknown	A question on travelers' perception of a noticeable reduction in the duration of congestion periods on the I-10 and I-110 corridors was not included in the 2014 survey of motorists in the I-10 and I-110 corridors. Thus, it was not possible to assess this question.
Will surveyed travelers perceive a noticeable reduction in the length of peak congestion periods in the I-10 and I-110 corridors?	Unknown	A question on travelers' perception of a noticeable reduction in the length of peak congestion periods on the I-10 and I-110 corridors was not included in the 2014 survey of motorists in the I-10 and I-110 corridors. Thus, it was not possible to assess this question.
Deployment of LA Express Park™ will reduce congestion in the downtown.	Unknown	Data were not available to assess the impacts of the LA Express Park™ project on congestion in downtown Los Angeles. Thus, it was not possible to assess this hypothesis.

Source: Texas A&M Transportation Institute.

Summary of Tolling Impacts

The results of the ExpressLanes analysis indicate that the number of new FasTrak® accounts and transponder sales exceeded the initial goal, and individuals continue to open new FasTrak® accounts and obtain switchable transponders. In addition, existing FasTrak® customers with non-switchable transponders issued by other California agencies requested switchable transponders, further exceeding the initial transponder goal and illustrating the use of the I-110 and I-10 ExpressLanes by motorists throughout the state. The number of trips on the ExpressLanes by all groups – self declaring toll-free HOV2+s and HOV3+s, toll-paying HOV2+s and SOVs, as well as vanpools, buses, motorcycles, and other non-revenue vehicles – increased over the course of the demonstration. The Equity Plan, the Carpool Loyalty Program, the Transit Rewards Program, and the Vanpool Program appear to be well received and well used by qualifying individuals. The ExpressLanes are providing choices to travelers in the I-110 and I-10 corridors. The growth in self-declaring HOV2+ and HOV3+ FasTrak® trips over the course of the demonstration and the survey results indicate that carpooling continues to be a viable option for travelers in the corridor. The level of self-declaring HOV3+ FasTrak® trips was of interest given the national experience highlighting the difficulty in forming and maintaining 3-person carpools.

The results of the LA Express Park™ analysis indicate that the parking sensors, new parking meters, additional payment methods, and parking management system – coupled with policy changes enacted by the LA City Council – enabled the implementation of demand-based parking pricing and the parking guidance system in the downtown area. The time-of-day pricing resulted in more even distribution of parking space use, with more blocks experiencing the targeted parking occupancy and enhanced parking management overall.

Table 5-7 summarizes the impacts across the five tolling hypotheses and questions. The results of the 2012 and 2014 surveys of users of the I-110 and I-10 general purpose lanes and HOV/ExpressLanes and the 2013 and 2014 ExpressLanes FasTrak® Customer Satisfaction Surveys support the first hypothesis. Some general purpose lane travelers did shift to the ExpressLanes, while many HOV lane users continued to carpool in the ExpressLanes.

Approximately 43 percent of the respondents to the 2013 ExpressLanes FasTrak® Customer Satisfaction Survey self-identified as solo drivers. Most of these individuals (84 percent) reported no use of the HOV lanes prior to the opening of the ExpressLanes. Results from the 2014 ExpressLanes FasTrak® Customer Satisfaction Survey indicated that 65 percent of the respondents who drove alone before the opening of the ExpressLanes (presumably in the general purpose freeway lanes) continued to make the same number of trips as toll-paying solo drivers after the ExpressLanes opened.

The results of the 2014 user survey indicated that 49 percent of the I-10 respondents and 47 percent of the I-110 respondents reported using the ExpressLanes as a carpooler, vanpooler, or bus rider at least once a month. On the I-10, 23 percent of respondents reported using these modes five times a week in 2014, which was the same percentage reported in 2012. On the I-110, 18 percent of respondents reported using these modes five times a week in 2014, a one percent increase over 2012. Further, 55 percent of respondents to the 2014 ExpressLanes FasTrak® Customer Satisfaction Survey self-identified as carpoolers.

The analysis indicates that the ExpressLanes had a positive impact on reducing HOV violation rates. Vehicles without FasTrak® transponders are detected electronically, but visual enforcement of vehicle occupancy levels is still needed for self-declaring carpools. The number of monthly citations issued by CHP to drivers of vehicles without the number of occupants to meet the self-declared transponder setting ranged from 113 to 226 on the I-10 and 108 to 201 on the I-110. These figures are below or in the same range as the pre-deployment violation rates from the Caltrans visual monitoring counts. In 2011, the morning peak period violation rates were 2 percent (128 violators) on the I-110 and 12 percent (316 violators) on the I-10.

The results from the Metro-sponsored 2012 and 2014 surveys of users of the I-110 and I-10 indicate that many travelers perceive that the tolling and transponders assist in reducing HOV violations, however. On the I-10, 64 percent of the survey respondents in 2012 agreed with the statement “the FasTrak® transponders will reduce illegal carpool lane usage,” compared to 62 percent in 2014. Agreement was higher among carpoolers at 69 percent, than non-HOV users at 54 percent in 2014. On the I-110, 55 percent of respondents agreed with the statement in 2012, compared to 54 percent in 2014. Agreement was slightly higher among HOV users at 56 percent than for non-HOV users at 52 percent.

According to analyses conducted by LADOT and Xerox, the changes in parking use over the first seven months of the project resulted in more parking spaces occupied between 70 percent and 90 percent of the time, fewer parking spaces occupied over 90 percent of the time, and fewer parking spaces occupied less than 70 percent of the time. These changes support the hypothesis that the LA Express Park™ project would result in parking occupancy of 70 to 90 percent of the parking spaces on each block throughout the day.

Although increasing parking revenues was not a goal of the LA Express Park™ project, LADOT personnel reported that parking revenues did increase by approximately 2.5 percent during Phase II of the project, with the extended parking hours excluded. LADOT personnel attributed the modest increase to more people paying for parking due to the expanded payment options, increased parking rates at well-utilized meters, and more people parking due to the improved economy. LADOT personnel noted that the parking revenues from all 37,000 metered spaces in the city, including those in the project area, is deposited into the Special Parking Revenue Fund. This fund is used for parking-related projects throughout the city. It will be used to fund future expansion of LA Express Park™ into Westwood and Hollywood, along with federal funds from the Value Pricing Pilot Program.

An extensive assessment of the impact of LA Express Park™ on retailers and businesses in the downtown area was not conducted as part of the National Evaluation. Comments from LADOT personnel indicated that no negative impacts on retailers and businesses were documented and that retailers and businesses benefited from the extended time limits implemented in some parts of the project area. LADOT personnel further pointed to the overall increase in city sales tax revenues, the increase in garbage tonnage in the Fashion District, and new economic development in the downtown area as indications that LA Express Park™ did not inhibit retail and business activity.

Table 5-7. Summary of Impacts across Tolling Hypotheses/Questions

Hypotheses/Questions	Result	Evidence
Some general purpose lane travelers will shift to the ExpressLanes, while HOV lane travelers will continue to use them after the conversion to HOT lanes.	Supported	Results of the 2012 and 2014 surveys of I-110 and I-10 users and the 2013 and 2014 FasTrak® Customer Satisfaction Surveys indicate that some individuals who formerly drove alone in the general purpose freeway lanes are now using the ExpressLanes as toll-paying solo drivers, while carpoolers, vanpoolers and bus riders who used the HOV lanes continued to use the ExpressLanes. Approximately 43 percent of the 201 ExpressLanes FasTrak® Customer Satisfaction Survey respondents self-identified as solo drivers. Most (84 percent) of these individuals reported no prior use of the HOV lanes. Results from the 2014 ExpressLane FasTrak® Customer Satisfaction Survey indicated that 65 percent of the respondents who drove alone before the opening of the ExpressLanes continued to make the same number of trips as toll-paying solo drivers after the ExpressLanes opened. The results of the 2014 user survey indicated that 49 percent of the I-10 respondents and 47 percent of the I-110 respondents reported using the ExpressLanes as a carpooler, vanpooler, or bus rider at least once a month. On the I-10, 23 percent of the respondents reported using these modes five times a week in 2012 and 2014. On the I-10, 18 percent of respondents reported using these modes in 2014, a one percent increase over 2012.
Implementing the ExpressLanes will reduce HOV violation rates.	Supported	Visual enforcement of vehicle occupancy levels for self-declaring carpools is still required. The monthly number of citations issued to drivers of vehicles without the number occupants to meet the self-declared transponder setting during the post-deployment period ranged from 113 to 226 on the I-10 and 108 to 201 on the I-110. The pre-deployment (2011) morning peak period violation rates were 2 percent (128 violators) on the I-110 and 12 percent (316 violators) on the I-10. In addition, users of the I-110 and I-10 perceive that the tolling system and transponders help reduce HOV violations. In a 2014 post-deployment survey of the I-110 and I-10 users, 62 percent of I-10 respondents and 54 percent of the I-110 users agreed with the statement “the FasTrak® transponders reduce illegal carpool lane usage.”
The LA Express Park™ project will result in the occupancy of 70 percent to 90 percent of the parking spaces on each block throughout the day.	Supported	LADOT and Xerox analyses indicate that over the initial seven months of the project the demand-responsive pricing resulted in more parking spaces being occupied 70 to 90 percent of the time, fewer parking spaces occupied over 90 percent of the time, and fewer parking spaces occupied less than 70 percent of the time.

Table 5-7. Summary of Impacts across Tolling Hypotheses/Questions (Continued)

Hypotheses/Questions	Result	Evidence
The LA Express Park™ project may increase parking revenues that can be used to fund system expansion in other high-demand areas.	Supported	Although increasing parking revenues was not a goal of the LA Express Park™ project, a slight increase of 2.5 percent in revenues was realized during Phase II of the project. The funds from the LA Express Park™ area are deposited into the Special Parking Revenue Fund, along with revenue from all city meters. Future expansion of LA Express Park™ into Westwood and Hollywood is being financed by a combination of funding from the Special Parking Revenue Fund and the federal Value Pricing Pilot Program.
How will the LA Express Park™ project affect retailers and similar businesses that rely on customers' ability to access their stores?	No Apparent Negative Impacts	There was no indication that the LA Express Park™ project and the implementation of demand-based parking pricing inhibited retail and business activity in the downtown area. Further, retailers and businesses benefited from the extended time limits implemented in some areas.

Source: Texas A&M Transportation Institute.

Summary of Transit Impacts

The most positive observation related to transit in the LA CRD evaluation has been increase in ridership. In the I-110 corridor where Metro added service to its Silver Line bus service, ridership increased 52 percent in the morning peak period and 41 percent in the afternoon peak period. This increase occurred after the new service was added but before tolling began. After tolling began, ridership increased another 29 percent in the morning peak period and another 25 percent in the afternoon peak period. In the I-10 corridor where Foothill Transit added service to the Silver Streak and Route 699, ridership increased also. Ridership on the Silver Streak increased 59 percent in the morning peak period and 15 percent in the afternoon peak period. Ridership on the Route 699 increased 53 percent in the afternoon peak period. Gardena Municipal Bus Lines and Torrance Transit also saw ridership increases in the I-110 corridor. Morning peak period ridership on the Gardena Line 1X increased 106 percent, and afternoon peak period ridership increased 123 percent. On the Torrance Transit Line 4, morning peak period ridership was 73 percent higher.

There has been an increase in utilization of park and ride lots in both the I-110 and I-10 corridors. February 2014 was the last month of data collection. At the El Monte Transit Center on the I-10, there were 394 more spaces occupied in February 2014 than there were in February 2012. At both the Harbor Gateway and Harbor Freeway Transit Centers on the I-110, there were 48 more occupied spaces in February 2014 than there were in February 2012.

The data suggests that implementing variable tolls has had little or no negative impact to bus travel times on the I-110 ExpressLanes, and it has had a positive impact to bus travel times on the I-10 ExpressLanes. On the I-110, the Silver Line's average travel time after tolls increased less than a minute in the morning and was virtually the same in the afternoon. On the I-10, the average travel time decreased 4 percent in the morning and 14 percent in the afternoon. That 14 percent reduction equated to a 2.6 minute reduction. The Silver Streak's average travel time on the I-110 decreased 22 percent in the morning and 17 percent in the afternoon. This amounted to a 4.7 minute and 3.8 minute reduction respectively.

In the survey of Silver Line riders, there were statistically significant improvements in the ratings given by riders on the I-110 segment for frequency of service and hours of service. This was an important finding since Metro invested a large amount of CRD funds to improving service on the I-110 portion of the Silver Line. Sixty-five (65) percent of the Silver Line riders on the I-110 segment and 57 percent riders on the I-10 segment said their travel time has been faster since tolling began. Thirty-two (32) percent of the new riders on the I-110 segment and 33 percent of the new riders on the I-10 segment said they used to drive alone before switching to transit. Among riders who began taking the Silver Line after tolling began, 37 percent of the riders on the I-110 segment and 34 percent of the riders on the I-10 segment said the tolls influenced them to take the bus. In both corridors, 48 percent of Silver Line riders agreed to varying extents that tolling the I-110 and I-10 ExpressLanes improved their travel while 34 percent in both corridors were neutral.

Table 5-8. Summary of Impacts across Transit Hypotheses

Hypotheses/Questions	Result	Evidence
CRD projects will enhance transit performance within CRD corridors through reduced travel times, increased service reliability, and increased service capacity	Mostly Supported	• Post-toll travel times for the Silver Line on the I-110 ExpressLanes stayed about the same. • Post-toll travel times for the Silver Line on the I-10 ExpressLanes were 4% longer (less than a minute) in the morning peak period and 14% shorter in afternoon peak period (2.6 minutes) • Post-toll travel times for the Silver Streak on the I-10 ExpressLanes were 22% shorter (4.7 minutes) in the morning peak period and 17% shorter (3.8 minutes) in the afternoon peak period. • There were no significant travel time improvements from the TPS on Figueroa and Flower Streets • In the survey of the I-110 Silver Line riders, the ratings for frequency of service and hours of service both improved and were statistically significant. • In the surveys, 65% of Silver Line riders on the I-110 and 57% of Silver Line riders on the I-10 said their travel time has been faster since tolling began.
User perceptions of security at transit stations/park-and-ride lots will be improved by CRD projects	Not supported	• There was no statistically significant change in user perceptions of safety by riders on the I-110 portion of the Silver Line. • Overall, riders rated their overall feeling of security as “Fair.”

Table 5-8. Summary of Impacts across Transit Hypotheses (Continued)

Hypotheses/Questions	Result	Evidence
CRD projects will increase ridership and facilitate a mode shift to transit within CRD corridors	Supported	• Ridership on the I-110 segment of the Silver Line increased 52% in the morning peak period and 41% in the afternoon peak period after CRD service was added; it increased another 29% in morning peak period and another 25% in the afternoon peak period after tolling. • Ridership on the Foothill Transit Silver Streak (I-10) increased 59% (morning peak) and 15% (afternoon peak) • Ridership on the Foothill Transit Route 699 dropped 13% in the morning peak but increased 53% in the afternoon peak. • Ridership on Gardena Line 1X increased 106% in the morning peak and 123% in the afternoon peak. Ridership on the Line 2 increased 3% in the morning peak and 12% in the afternoon peak. • Ridership on the Torrance Transit Line 4 increased 73% (morning peak). • Monthly boardings on the San Bernardino line of Metrolink were 6% higher in February 2014 than they were in December 2010 when the rail platforms were extended. • At the park-and-ride lot at the El Monte Transit Center, there were 394 more spaces occupied in February 2014 than there were in February 2012. At both the Harbor Gateway and Harbor Freeway Transit Centers, there were 48 more occupied spaces in February 2014 than there were in February 2012.
Increased ridership and mode shift to transit will contribute to increased person throughput, congestion mitigation, and transit cost-effectiveness within CRD corridors	Supported	• The increase in transit ridership supports this hypothesis. • Data from Appendix A – Congestion Analysis indicates increases in person throughput during some, but not all time periods examined.
What was the relative contribution of each CRD project element to increased ridership/ transit mode share/ person throughput?		• In the survey of Silver Line riders, 32% of the new riders on the I-110 segment and 33% of new riders on the I-10 segment said they used to drive alone. • Among riders who began taking the Silver Line after tolling began, 37% of the riders on the I-110 and 34% of the riders on I-10 said the tolls influenced them to take the bus. • In both corridors, 48% of Silver Line riders agreed to varying extents that tolling the I-110 and I-10 ExpressLanes improved their travel. 34% in both corridors were neutral.

Source: Center for Urban Transportation Research.

Summary of Ridesharing Impacts

The results of the rideshare analysis, conducted on the TDM element of the LA CRD project, indicate that the primary goal of forming at least 100 new vanpool was exceeded (119) and that employer outreach, incentives and direct marketing were effective ways in promoting alternatives to driving alone. Aggressive marketing of vanpools was started several months prior to the opening of the first ExpressLanes and formation continued throughout the project. Some 34 vanpools were formed on the I-110 and 79 formed on the I-10 (this may have been partially due to the 3+ requirement for free use of the lanes in the peak) with another six new vanpools using both facilities. While the necessity for all users to have transponders created some confusion early on, ongoing education by Metro was cited as very helpful.

Employer outreach was crucial to both forming new vanpools, but in assisting existing carpoolers and vanpoolers learn about the ExpressLanes. Incentives, in the form of vanpool fare subsidies ($400) and a Carpool Loyalty Program were also important to retain ridesharing arrangements, although the proportion of travelers aware of these incentives was relatively low.

Of great interest nationally, was the impact that HOV-to-HOT conversion might have on existing ridesharing levels. The idea behind HOT lanes is to sell under-utilized capacity in these lanes while maintaining the benefits of their use (time saving and reliability). The results of all the data related to mode shift and carpool behavior were inconclusive as to whether carpooling was unintentionally negatively impacted. Occupancy counts (observations) suggest that carpooling overall went down substantially after the opening of the ExpressLanes. Toll account data shows carpooling increased in the ExpressLanes after implementation. Two surveys, one of all travelers and one of transponder account holders, shows a different picture, of relatively no change in carpooling. However, methodological issues among all these data sources, may call into question the ability to inform this question. As such, the issue of the impact of tolling on carpooling was inconclusive in this case.

Table 5-9. Summary of Impacts across Rideshare Hypotheses/Questions

Hypotheses/Questions	Result	Evidence
CRD vanpool promotion will result in at least 100 new Metro-registered vanpools.	Supported	Operating data shows that over 100 (119) vanpools were formed in the two corridors from July 2012 to February 2014.
Which factors were most effective in promoting ridesharing?	Partially Supported	Employer outreach and direct marketing to individual commuters, coupled with ongoing rideshare incentives, were critical to forming the new vanpools and maintaining rideshare arrangements, but awareness of these incentives was relatively low.
Will CRD HOT and transit improvements lead to the unintended breakups of current carpools/vanpools?	Inconclusive	Conflicting data (occupancy counts, tolling data, and traveler surveys) do not allow for a definitive statement to be made about the impact of the projects on ridesharing. Occupancy counts reveal a decrease in carpools, yet toll transaction data shows increases in carpooling in the ExpressLanes and user survey results do not show a dramatic change in carpooling among current users.

Source: ESTC.

Summary of Technology Analysis

Table 5-10 summarizes the technology impacts for the three hypotheses. Based on the information provided by LADOT, individuals were accessing the LA Express Park™ website. The number of monthly hits has increased since March 2013, averaging close to 4,000 from July through November, 2014. These figures were modest, however, compared to the hits received by popular websites. The telephone information system was not in operation during the evaluation period. The number of people who have downloaded the third-party parking apps is not known, but the results from the intercept and online surveys indicated modest awareness of the cell phone parking apps.

LADOT personnel indicated that the parking sensors, parking meters, and parking management system facilitated the department's ability to implement demand-based pricing and the parking guidance system. They also noted that the policy changes allowing time-of-day pricing and the different rate levels approved by the LA City Council were key elements of implementing demand-based parking pricing.

LADOT personnel interviewed indicated that the parking sensors, parking meters, and parking management system improved the department's ability to enforce parking regulations. Matching the data from the sensors and the meters in the management system identifies expired meters. The system was also used to identify vehicles parked at a meter with no initial payment. These vehicles might have handicapped placards, which allow for free parking. Although the technology cannot address concerns with this policy, the information can be used to better manage enforcement personnel. In addition, LADOT personnel noted that the expanded payment options made it easier for people to pay for parking, increasing payment levels.

Table 5-10. Summary of Impacts across Technology Hypotheses

Hypotheses	Result	Evidence
Travelers will access the LA Express Park™ website and the telephone information system	Supported	Parking information was widely disseminated. Individuals were accessing the LA Express Park™ website. During 2014, the number of hits ranged from a low of 2,559 a month to a high of 3,963 a month.
LA Express Park™ will improve LADOT's ability to re-configure parking restrictions and rates	Supported	LADOT personnel interviewed indicated that the parking sensors, parking meters, expanded payment options, and the parking management system were key to implementing demand-based parking pricing. They also noted the importance of the policy changes approved by the LA City Council, which facilitated implementation of the demand-based parking pricing.
LA Express Park™ will improve LADOT's ability to enforce parking regulations	Supported	LADOT personnel interviewed perceived improvements in the agency's ability to enforce parking regulations in the LA Express Park™ area as a result of the technology. Further, the expanded payment options made it easier for people to pay for parking, rather than risk receiving a citation. The data provided by the sensors and the meters were matched in the parking management system to identify expired meters. The system was also used to identify meters with a parked vehicle and no initial payment, which might be vehicles with handicapped placards that were allowed to park for free.

Source: Texas A&M Transportation Institute.

Summary of Safety Impacts

Table 5-11 summarizes the safety impacts across the hypotheses. The analysis in this appendix presented inconclusive results on the safety impacts of the CRD projects, principally the I-110 and I-10 ExpressLanes. Citation data and perceptions of CHP personnel provided insight to safety impacts. No negative safety impacts were observed by CHP personnel as a result of the ExpressLanes. However, because crash data was unavailable for analysis, most hypotheses and questions of this analysis were inconclusive.

Table 5-11. Summary of Impacts across Safety Hypotheses

Hypotheses/Questions	Result	Evidence
The collective impacts of CRD improvements[9] will be safety neutral or safety positive.	Inconclusive	Crash data was not available to conduct a crash analysis. No positive or negative safety impacts were observed by CHP personnel.
The addition of transition zones will not increase incidents.	Not able to determine	Transition zones did not change from the pre-deployment period to the post-deployment period for either of the ExpressLanes corridors.
Will boundary jumping cause incidents?	Inconclusive	Although citations issued for boundary jumping more than doubled on both corridors from the pre-deployment to the post-deployment periods, the presence of dedicated ExpressLanes CHP personnel on the corridors in the post-deployment period may have caused this increase. It was not clear that the actual frequency of boundary jumping increased in the post-deployment period or that boundary jumping caused incidents.
Will HOT infrastructure changes affect the time needed to respond to or clear accidents?	Not able to determine	Data were not readily available to assess the potential impact of ExpressLanes infrastructure changes on the time needed to respond to or clear incidents.
Will adjusted enforcement procedures affect the number of incidents?	No perceived impact	CHP personnel did not perceive any change in the number of incidents as a result of adjusted enforcement procedures.

Source: Battelle.

Summary of Equity Analysis

Table 5-12 presents a summary of the equity analysis across the three questions. The first question examined the impact of the CRD programs on socioeconomic groups and geographic areas. Findings show that the number of FasTrak® accounts and Equity Plans[10] continued to grow throughout the post-deployment period. The analysis showed that users with an Equity Plan made more monthly trips in the ExpressLanes than overall ExpressLanes users, averaging 12.0 trips per month versus 10.4 trips per month for all users. However, almost 80 percent of trips taken by users

[9] Relevant CRD changes include narrower lanes on portions of the I-10 freeway, new signage, new HOT procedures, new enforcement procedures, and reduced congestion (i.e., faster flowing traffic).

[10] The Equity Plan was later re-named the Low-Income Assistance Plan.

with Equity Plans were toll-free trips (HOV3+ on the I-10 during peak periods, and HOV2+ on the I-10 for non-peak periods and the I-110 at all times). Overall, Equity Plans accounted for only 1.2 percent of tolled trips on the I-10 and I-110 ExpressLanes, but 3.7 percent of free trips. Overall, SOVs that used the ExpressLanes from November 2012 to February 2014 paid an average toll of $2.31, while an SOV with an Equity Plan paid an average toll of $1.91 in that same period, reflecting travelers tend to use the ExpressLanes when the toll was lower. Results from the Metro Equity Plan Survey showed that the credit from the Equity Plan was very important for over 82 percent of the respondents in making the decision to get a FasTrak® account to use the ExpressLanes. When examining the spatial distribution of FasTrak® accounts by ZIP code throughout the LA Metro area, it was revealed that higher percentages of Equity Plan accounts tend to correspond with areas having low median household incomes and high rates of poverty. In many cases, the areas with higher percentages of equity plans were in a lower income area where fewer individuals obtained a FasTrak® account.

The LA Express Park™ program has the potential to provide benefits to drivers traveling to downtown LA, as well as those who reside there. The average rate for all parking meters in the area has dropped from $1.95 per hour to $1.76 per hour, as a part of the effort to encourage parking in underutilized spaces. With a goal to increase the number of available on-street parking spaces to 10-30 percent per block, the number of cars searching for parking may decrease, which could improve traffic flow and benefit both drivers and transit users in downtown LA. Parking availability information was expected to guide drivers to available spots more quickly, thus reducing parking search time. The combination of parking availability information and lower parking rates in underutilized areas provides the opportunity for low-income users access to parking spaces at lower rates than prior to the deployment by identifying the underutilized locations with lowered rates.

The second question examined the environmental impacts on various socioeconomic groups. Census data shows that the population residing adjacent to the I-110 and I-10 ExpressLanes corridors have a much lower percentage of Whites; a higher percentage of Blacks or African-Americans, Asians and/or individuals identifying as Some Other Race; a higher percentage Hispanics or Latinos; and considerably lower median household income, relative to regional figures. Given the prevalence of minority and low-income households in geographic proximity to the ExpressLanes corridors, these populations were therefore disproportionately affected by air quality impacts from an environmental equity standpoint. Net emissions on the ExpressLanes corridors increased 6.1 percent to 82.1 percent, depending on the pollutant, as reported by the environmental analysis. These increased emissions result from an increase in VMT that may have resulted from traffic previously utilizing alternate routes, in which case any negative impact is likely overstated here.

The third question focused on reinvestment of generated revenues. Metro's policy for reinvestment of the ExpressLanes net toll revenues for diverse and multimodal projects promotes a positive, equitable impact. Equity across geographic areas was promoted by re-investing toll revenue only within the corridor from which the revenue was collected. Investments for pedestrian, transit, vanpool, and fare subsidy programs support equity for low-income users in the corridors. Highway improvements will likewise support drivers that utilize the ExpressLanes. Multimodal investments support all user groups within the corridors by enhancing the quality and quantity of transportation options available and reducing congestion in the corridors to further improve the travel experience. Further, multimodal investments also reduce adverse air quality impacts in the corridor, thereby promoting environmental equity. Given the information presented above, the Metro policy for re-investment of net toll revenues promotes equity. Revenue from LA Express Park™ will be used to expand the program into Westwood Village in Summer 2015 and Hollywood in 2016. Given the realization of the expected benefits of the initial LA Express Park™ program, this would seemingly promote equity for various user groups and the environment, while expanding the geographic area that derive benefits from the program.

Table 5-12. Summary of Impacts across Equity Hypotheses

Hypotheses/ Questions	Result	Evidence
What is the socio-economic and spatial distribution of the direct social effects of the CRD projects?	No Apparent Negative Impacts	Users with an Equity Plan made more monthly trips in the ExpressLanes (12.0) than overall users (10.4). Almost 80 percent of trips taken by users with Equity Plans were toll-free trips (HOV3+ for I-10 peak periods, and HOV2+ for I-10 non-peak periods and the I-110 at all times). Equity Plans accounted for only 1.2 percent of tolled trips but 3.7 percent of free trips. The Metro Equity Plan Survey showed the Equity Plan credit was very important for over 82 percent of respondents to get a FasTrak® account to use the ExpressLanes. FasTrak® accounts by ZIP code show higher percentages of Equity Plan accounts tend to correspond with areas having low median household incomes and high rates of poverty. Driving respondents to the Metro License Plate Survey expressed a less favorable attitude of the ExpressLanes regarding fairness toward user groups both by income and mode. LA Express Park™ was expected to benefit drivers and transit users with improved traffic flow and reduced parking search times in downtown LA. Parking availability information and lowered parking rates in some areas allows increased access to parking for low-income users.
Are there any differential environmental impacts on certain socio-economic groups?	Negative impacts likely	Net emissions on the ExpressLanes corridors increased 6.1 - 82 percent, where there is a much lower percentage of Whites; a higher percentage of Blacks or African-Americans, Asians and/or individuals identifying as Some Other Race; a higher percentage Hispanics or Latinos; and considerably lower median household income, relative to regional figures. It is not known if this increased traffic was utilizing alternate routes before, or if it was due to latent demand for use of the I-110 and I-10.
Will the potential HOT and IPM net revenues be reinvested in an equitable manner?	Supported	Metro policy for reinvestment of net toll revenues for diverse and multimodal projects promotes a positive, equitable impact that benefit all users. Geographic equity is promoted by re-investing toll revenue only within the corridor from which the revenue was collected. Highway improvements support drivers that utilize the ExpressLanes. Environmental equity is promoted by investments that reduce adverse air quality impacts in the corridor. LA Express Park™ program plans reinvestment to expand IPM to new areas. This will promote equity by extending the potential benefits of improved traffic flow and air quality to other areas

Source: Battelle.

Summary of Environmental Analysis

Vehicle throughput on the I-110 and I-10 improved, leading to an increase in air emissions and fuel consumption along the corridor, at least after one year of tolling. It is not known if this increased traffic was utilizing alternate routes before, or if it is due to latent demand for use of the I-10 and I-110, or the growing economy. It was likely a combination of these factors, along with the decrease in vehicle occupancies.[11] The carpool analysis based on Caltrans occupancy counts showed that some of the increase was due to a decrease in carpooling. There was no electronic or survey data on the use of alternate facilities to assess the reason for other changes. The Caltrans occupancy counts were the sole source of reliable data, as occupancy data from the tolling data could be influenced by a lack of enforcement, driver mistakes like forgetting to change the transponder from the carpool setting, and to the 60-day grace period for violations following the initiation of tolling on the ExpressLanes. If the travelers that contributed to increased throughput along the I-110 and I-10 had all previously been using alternate routes, it can be safely assumed that the net effect of this project would have decreased emissions. Switching a route to the I-110 or I-10 would be done only if it saved time, meaning that the switch involved a shorter distance, faster trip, and/or less stop and go. Because alternate routes of longer distance would mean more VMT, trips on those alternate routes would have increased emissions.

[11] Due to a drop in carpooling.

The net effect considering VMT and travel speeds in both lane types and peak periods was a 6.1-82.1 percent increase in emissions post deployment. This increase was slightly mitigated by the clean fuel buses (by about 1 percent overall). Most of the increase was due to increases in use of the ExpressLanes. During the morning peak emissions along the I-110 ExpressLanes increased by 5.7-22.3 percent depending on the pollutant. During the afternoon peak they rose by between 19.8-78.1 percent. In both cases, $PM_{2.5}$ was one of the extremes of the range. During the morning commute $PM_{2.5}$ changed the least of all the other pollutants (5.7 percent) and during the afternoon it changed the most (78.1 percent).

The I-110 general purpose lanes showed a mixture of increases and decreases. In the morning peak period NOx and $PM_{2.5}$ both decreased by a little over 8 percent and the remaining pollutants increased 6.4-10.4 percent. In the afternoon peak period, ROG and CO decreased slightly (1.3-3.3 percent). CO_2 increased by 0.4 percent, while NOx and $PM_{2.5}$ increased by over 16 percent.

Emissions for the I-10 changed substantially. Overall, considering the net effect of both lane types and times of day, there was a 26.1-82.1 percent increase in pollution depending on the pollutant. For example, ROG increased by 32.9 percent, NOx by 54.4 percent, CO by 26.1 percent, and fine particulate matter by 82.1 percent. All emission calculations utilized the same VMT value: the variations arise from differences in the emission factors at differing speeds. For scale, emissions of particulate matter range from the single digits to 12 pounds daily; ROG was in the 55-75 pounds range; NOx was in the 373-576 range; CO between 1,581 and 1,995; and CO_2 in the hundreds of thousands of pounds per day.

Looking at the results by direction and lane type, the increases in the general purpose lanes were 5.9 percent for the morning commute and range from 4.2-25.0 percent in the afternoon commute. The 25.0 percent increase was only for fine particulate matter; increases for the other pollutants ranged from 4.2-12.9 percent. The air pollution increases (on a percentage basis) on the ExpressLanes were more pronounced, especially during the 2 hours of the morning peak that were included in the count data where they range from 181.5-519.3 percent. During the afternoon peak hour the increases on the ExpressLanes were 67.5-151.6 percent.

Table 5-13. Summary of Impacts across Environmental Hypotheses

Questions	Result	Evidence
Average vehicle-related air emissions will decrease in the treatment corridors	Not supported	The ExpressLanes resulted in greater vehicle throughput. This increased VMT by a great enough factor to also increase emissions. On the I-110 net emissions increased by 6.1-21.4% depending on pollutant. On the I-10 the net effect was a 26.1-82.1% increase in emissions depending on the pollutant.
Average vehicle fuel economy will improve in the treatment corridors	Not supported	On the I-110 the combined morning and afternoon peak fuel consumption increased by 8.8% and on the I-10 by 36.7%. Fuel economy did not improve.
Average vehicle-related noise will decrease in the treatment corridors	Not evaluated	After the Los Angeles evaluation plan was completed, it was decided to not perform noise impact modeling or analysis due to a lack of original data and issues related to using the FHWA noise model.

Source: Earth Matters, Inc.

Summary of Non-Technical Success Factors

As highlighted in Table 5-14, people, process, structures, the media, and competencies all played supporting roles in the implementation, deployment, and operation of the LA CRD. The multi-organizational structure, with its specific roles and responsibilities supported the implementation, deployment, and operations of the CRD projects. A team of competent staff were able to lead the region through the implementation of a technologically complex project, albeit with some delays. While tolling is not new to California, converting HOV to HOT lanes was a first of its kind in LA County. The CRD program had already earned the support of local elected officials and local agency leadership as an appropriate strategy for the region, but it posed a challenge to the local partners in garnering public acceptance within a region famous for its car culture and severe traffic congestion. Along with significant transit improvements to the corridor, an extensive outreach and communications plan aided the local partners' ability to inform the public and cultivate users. The successful deployment of electronic tolling on the I-10 and I-110 has led to additional plans for tolling on other critical corridors in the region. Public reaction to the CRD projects has been generally positive.

Table 5-14. Summary of Impacts across Non-Technical Success Factors Hypotheses

Hypotheses/Questions	Results	Evidence
What role did factors related to these five areas play in the success of the deployment?		
1. People Sponsors, champions, policy entrepreneurs, neutral conveners, legislators	1. Effective	1. Strong political and agency leadership champions from outset. Executed a comprehensive outreach and communications campaign to garner public acceptance. Agency staff held technical expertise and project management skills needed to successfully implement the projects. Staff held their colleagues in high regard.
2. Process Forums (including stakeholder outreach), meetings, alignment of policy ideas with favorable politics and agreement on nature of the problem), legislative and Congressional engagements	2. Adequate	2. Some project delays occurred, including revising original project timeline, but were necessary for the successful deployment of electronic tolling.
3. Structures Networks, connections and partnerships, concentration of power & decision making authority, conflict mgt. mechanisms, communications strategies, supportive rules and procedures	3. Effective	3. As lead agency, Metro maintained a collaborative environment, conducting regular check-ins with all local partners and establishing an integrated project site during tolling implementation.
4. Media Media coverage, public education	4. Effective	4. Media kept the projects in the public eye and coverage tended to lean more neutral or positive, tempering negative opinions with detailed descriptions of the potential benefits to the overall system.
5. Competencies Cutting across the preceding areas: persuasion, getting grants, doing research, technical/technological competencies; ability to be policy entrepreneurs; knowing how to use markets	5. Effective	5. Agency staff held technical expertise and project management skills needed to successfully implement the projects. Staff held their colleagues in high regard.
Does the public support the CRD strategies as effective and appropriate ways to reduce congestion?	Mostly supported	Survey results general support for the ExpressLanes among I-110 and I-10 motorists, with HOV users expressing stronger support. Among FasTrak® account holders, 86 percent rated their experience as good or excellent. In both corridors, 48 percent of Silver Line riders agreed that tolling the I-110 and I-10 ExpressLanes improved their travel while 34 percent in both corridors were neutral.

Source: University of Minnesota.

Summary of Benefit Cost Analysis

It is important to note the deficiencies in this BCA that result from a lack of comprehensive data available to conduct a more thorough analysis. First, this evaluation assumes that changes observed on the I-10 and I-110 were due to the CRD projects. While other methods, such as an urban planning model able to hold exogenous factors constant, would have been preferable to measure impacts of the LA CRD projects, this was not feasible for various reasons. Additionally, no suitable control corridors were identified for LA to compare changes observed on the I-10 and I-110 with changes observed regionally. Therefore, changes on the I-10 and I-110 were measured and assumed to be attributed to the LA CRD projects – with the caveat that exogenous factors, such as a decreasing unemployment rate could have and likely did cause some of these changes. Additionally, data were not collected on arterials, which limits the understanding of VMT increases on the ExpressLanes corridors that may be due to latent demand. Finally, as discussed earlier, both Metro and Caltrans noted variances in the observed occupancy discussed in the congestion analysis and the self-declared occupancy from the transponder setting toll data. These differences, which focus on self-declared transponder settings indicating higher use levels than the visual occupancy data, continue to be examined in more detail by the agencies. While a number of assumptions made for this BCA were imperfect and likely undervalue the benefits of the ExpressLanes, this analysis was conducted in accordance with the methodology employed for all UPA/CRD sites, and detailed in the *Los Angeles Congestion Reduction Demonstration (Metro ExpressLanes) Program National Evaluation: Cost Benefit Analysis Test Plan* using the best data and information available.

The costs and benefits of the LA CRD projects are summarized as follows:

- Travel time savings: $20,198,158
- Increased emissions: -$14,938,606
- Increased auto fuel use: -$104,566,154
- TOTAL Benefits: -$99,306,603
- The cost of the CRD projects, in 2013 dollars, was $208,187,629.

This BCA examined the net societal costs and benefits of the LA CRD projects. As presented in Table 5-15, the benefit-to-cost ratio for the LA CRD projects was -0.48 and the net societal benefit was -$307,494,232. The analysis had several limitations and required numerous assumptions. For example vehicle operating costs included only increased fuel consumption for automobiles. The potential increase in vehicles with white and green clean air decals was not considered. All of the estimates were based on limited field data and projected those same changes will occur for 10 years into the future. The future year costs and benefits represented the best estimates available, but they are only estimates, and the actual costs and benefits could vary substantially.

Overall, the LA CRD projects resulted in many positive outcomes. Tolling and parking technologies were successfully tested, resulting in broad user acceptance. Tolling helped to improve the efficiency of the ExpressLanes, helping to address congestion issues by increasing the effective capacity of the corridors. As such, tolling led to increased vehicle and person throughput. Note that while some of the increased VMT that caused increased emissions and fuel use costs may have been a result of a decrease in carpooling after the opening of the ExpressLanes, the increased VMT could also have shifted from adjacent routes. Regardless, increased emissions and increased fuel use had a significant contribution that resulted in a negative Benefit-to-Cost Ratio.

Table 5-15. Summary of Impacts across BCA Hypotheses

Hypotheses/Questions	Result	Evidence	
What are the overall benefits, costs, and net benefits from the Los Angeles CRD projects?		Benefits:	-$99,306,603
		Costs:	$208,187,629
		Net Benefits:	-$307,494,232
		Benefit-to-cost ratio:	-0.48

Source: Texas A&M Transportation Institute.

Chapter 6 Summary and Conclusions

This report has presented the results from the national evaluation of the LA CRD projects. The report included a summary of the UPA and CRD programs, the LA CRD partners and projects, and the evaluation process and data. The major findings from the evaluation were presented. Appendix A through L contain more detailed descriptions of the 10 analysis areas. This section summarizes the major findings from the evaluation and presents overall conclusions on the LA CRD project.

Summary of Major Findings

Table 6-1 highlights the key findings from the national evaluation of the LA CRD projects based on the U.S. DOT's four objective questions.

Table 6-1. U.S. DOT Objective Questions and LA CRD Impacts

U.S. DOT 4 Objective Questions Evaluation Analyses
How much was congestion reduced?
Congestion. The impacts on congestion on I-10 and I-110 from the ExpressLanes were generally positive, with some mixed results, possibly reflecting increased travel in the two corridors due to the improving economy. Peak period, peak direction travel times on I-10 increased slightly in the general purpose lanes in the morning, but declined slightly in the afternoon. Travel times on the I-10 ExpressLanes declined during both time periods. Travel times on the I-110 general purpose lanes increased slightly in the morning, but remained approximately the same in the afternoon. Travel times in the I-110 ExpressLanes increased in the morning, but remained the same in the afternoon. Travel time reliability, as measured by the 95th percentile travel time and the Buffer Index, improved on the I-10 ExpressLanes and general purpose lanes, but declined slightly on the I-110 ExpressLanes and general purpose lanes. Vehicle throughput increased on I-110 in both the morning and afternoon peak hours, peak direction of travel. Person throughput declined slightly in the morning, but increased in the afternoon. Vehicle and person throughput increased on I-10 in both the morning and afternoon peak hours, peak direction of travel. Travel speeds in the I-10 and I-110 ExpressLanes remained above the 45 mph target in all but a few time intervals on the I-110 during the morning and afternoon peak periods. Travel speeds in the I-10 and I-110 general purpose lanes declined in the morning peak period, but increased or remained the same in the afternoon peak period. Use of the I-10 and I-110 ExpressLanes continued to provide travel-time savings over the general purpose lanes in the 2014 post-deployment period.
Tolling. The number of trips on the ExpressLanes by all groups – self declaring toll-free HOV2+s and HOV3+s, toll-paying HOV2+s and SOVs, as well as vanpools, buses, motorcycles, and other non-revenue vehicles – increased over the course of the demonstration. A total of 210,367 FasTrak® accounts were opened during the 20-month period examined in the evaluation, with 261,230 transponders issued. The ExpressLanes are providing choices to travelers in the I-110 and I-10 corridors. The growth in self-declaring HOV2+ and HOV3+ FasTrak® trips over the course of the demonstration and the survey results indicate that carpooling continues to be a viable option for travelers in the corridor.

Table 6-1. U.S. DOT Objective Questions and LA CRD Impacts (Continued)

U.S. DOT 4 Objective Questions Evaluation Analyses

Transit. Ridership has significantly increased in both ExpressLanes corridors, including the Metro Silver Line bus service, Foothill Transit Silver Streak and Route 699, Gardena Lines 1X and 2, and Torrance Transit Line 4. There has been an increase in utilization of park and ride lots in both the I-110 and I-10 corridors. Data suggests that implementing variable tolls has had little or no negative impact to bus travel times on the I-110 ExpressLanes, and it has had a positive impact to bus travel times on the I-10 ExpressLanes. A survey of Silver Line riders showed statistically significant improvements in the ratings given by riders on the I-110 segment for frequency of service and hours of service.

Ridesharing. A total of 119 new vanpools were formed, exceeding the goal of forming at least 100 new vanpools in the first year after tolling. Employer outreach, incentives, and direct marketing were effective ways in promoting alternatives to driving alone. The necessity for all users to have transponders created some confusion early on, but ongoing education by Metro was cited as very helpful. Employer outreach was crucial to forming new vanpools, and in assisting both existing carpoolers and vanpoolers learn about the ExpressLanes. Incentives, in the form of vanpool fare subsidies ($400) and a Carpool Loyalty Program were also important to retain ridesharing arrangements, although the proportion of travelers aware of these incentives was relatively low. The results of available data related to mode shift and carpool behavior were inconclusive as to whether carpooling was unintentionally negatively impacted. Occupancy counts observations suggest that carpooling overall went down substantially after the opening of the ExpressLanes. Toll account data shows carpooling increased in the ExpressLanes after implementation. Two surveys, one of all travelers and one of transponder account holders, show relatively no change in carpooling. Methodological issues among all these data sources may call into question the ability to inform this question. As such, the issue of carpool impacts was inconclusive in this case.

Technology. The advanced parking technologies, including the parking occupancy sensors and the new parking meters, allowed LADOT to implement demand-based parking pricing and the parking guidance system in the downtown LA area, and improved the Department's ability to enforce parking regulations. Policy changes enacted by the LA City Council also contributed to implementation of demand-based parking pricing.

What are the associated impacts of the congestion reduction strategies?

Safety. No negative safety impacts were observed by CHP personnel as a result of the ExpressLanes. However, because crash data was unavailable for analysis, the safety impact of the ExpressLanes was inconclusive.

Equity. The ExpressLanes were the first HOT lane operation to offer an Equity Plan for low-income commuters. Results from the Metro Equity Plan Survey showed that the credit from the Equity Plan was very important for over 82 percent of the respondents in making the decision to get a FasTrak® account to use the ExpressLanes. The LA Express Park™ program has the potential to provide benefits to drivers traveling to downtown LA, as well as those who reside there. The combination of parking availability information and lower parking rates in underutilized areas provides the opportunity for low-income users access to park at lower rates than prior to the deployment by identifying the underutilized locations with lowered rates. Given the prevalence of minority and low-income households in geographic proximity to the ExpressLanes corridors, these populations were therefore disproportionately affected by air quality impacts from an environmental equity standpoint. Metro's policy for reinvestment of the ExpressLanes net toll revenues for diverse and multimodal projects promotes a positive, equitable impact by re-investing toll revenue only within the corridor from which the revenue was collected for pedestrian, transit, vanpool, and fare subsidy programs, which support equity geographically and for low-income users in the corridors. Multimodal investments also reduce adverse air quality impacts in the corridor, thereby promoting environmental equity.

Table 6-1. U.S. DOT Objective Questions and LA CRD Impacts (Continued)

U.S. DOT 4 Objective Questions Evaluation Analyses

Environmental. Vehicle throughput on the I-110 and I-10 improved, leading to an increase in air emissions and fuel consumption along the corridor after one year of tolling. It was not known if this increased traffic was utilizing alternate routes before, or was due to latent demand for use of the I-10 and I-110. If increased throughput on the I-10 and I-110 had been using alternate routes it can be safely assumed that the net effect of this project was to decrease emissions. The growing economy may have had an impact, as the unemployment rate decreased from 10.8 percent to 8.1 percent over the pre- and post-deployment periods, which likely increased travel demand in the region. Caltrans statistics note observed increases in vehicle travel on all freeway facilities in the region. Thus, increases in air emissions attributable to the CRD projects may be overestimated.

Business Impacts. There was no indication that the LA Express Park™ project and the implementation of demand-based parking pricing inhibited retail and business activity in the downtown area. Further, retailers and businesses benefited from the extended time limits implemented in some areas.

What are the non-technical success factors?

Non-Technical Success Factors. The multi-organizational structure, with its specific roles and responsibilities supported the implementation, deployment, and operations of the CRD projects. A team of competent staff were able to lead the region through the implementation of a technologically complex project, albeit with some delays. While tolling is not new to California, converting HOV to HOT lanes was a first of its kind in LA County. The CRD program had already earned the support of local elected officials and local agency leadership as an appropriate strategy for the region, but it posed a challenge to the local partners in garnering public acceptance within a region famous for its car culture and severe traffic congestion. Along with significant transit improvements to the corridor, an extensive outreach and communications plan aided the local partners' ability to inform the public and cultivate users. The successful deployment of electronic tolling on the I-10 and I-110 has led to additional plans for tolling on other critical corridors in the region.

What is the overall cost and benefit of the strategies?

Benefit Cost Analysis. Overall, the LA CRD projects resulted in many positive outcomes. Tolling and parking technologies were successfully tested, resulting in broad user acceptance. Tolling helped to improve the efficiency of the ExpressLanes, helping to address congestion issues by increasing the effective capacity of the corridors. As such, tolling led to increased vehicle and person throughput. While some of the increased VMT that caused higher calculated emissions and fuel use costs may have been a result of a decrease in carpooling after the opening of the ExpressLanes, increased VMT occurred regionally on all freeway facilities as a result of an improving economy and could also have shifted from adjacent arterial routes. The LA CRD ExpressLanes projects in the I-10 and I-110 corridors had a benefit-to-cost ratio of -0.48. However, all changes observed in this evaluation on the I-10 and I-110 were assumed to be due to the CRD projects despite significant data limitations, which may have caused negative impacts on emissions and fuel consumption to be overestimated, contributing to the negative BCA ratio.

Source: Battelle.

Conclusions

The LA CRD projects were designed to demonstrate the effectiveness of innovative strategies for addressing congestion and to provide better mobility options for residents. This report documents the evaluation of the projects by the national evaluation team sponsored by U.S. DOT. The following conclusions can be drawn from the experience in deploying the CRD projects and in the use of the different projects:

- Metro overcame the unique challenge of introducing tolling in HOV lanes already operating at full capacity. Metro successfully created additional capacity by expanding viable options to solo driving, including vanpooling and investing the majority of the CRD funding into transit improvements that were deployed a year before tolling operations. By the time tolling was deployed, the transit improvements had already cultivated increased ridership, showing that commuters recognized transit as a functional and reliable alternative.
- The findings of this report were based on data ending in February 2014 and represented only one year of full operation of the ExpressLanes. Thus, some findings may have changed if examined over a longer period of time, during which both the local partners would gain more experience with operations in the corridor and travelers would have more time to modify their travel behavior.
- The LA CRD partners worked effectively as a team to plan and deliver the CRD projects in a coordinated fashion. A team of competent staff led the region through the implementation of a technologically-complex project, albeit with some delays.
- The CRD program posed a challenge to the local partners in garnering public acceptance within a region famous for its car culture and severe traffic congestion. While tolling is not new to California, converting HOV lanes to HOT lanes was a first of its kind in LA County. Along with significant transit improvements to the corridor, an extensive outreach and communications plan aided the local partners' ability to inform the public and cultivate users.
- Innovative programs can facilitate and encourage use of ExpressLanes and alternate modes. The Metro ExpressLanes program was the first HOT operation in the country to offer a discount for low-income commuters. Additionally, the Carpool Loyalty Program provides additional incentives and benefits to ExpressLanes carpoolers, while the Transit Rewards Program allows frequent bus riders to earn toll credits for use on the ExpressLanes.
- Special attention is required for recording data elements that are critical measures. Of great interest nationally, is the impact that HOV-to-HOT conversion might have on existing ridesharing levels. The idea behind HOT lanes is to sell under-utilized capacity in these lanes while maintaining the benefits of their use (time saving and reliability). However, the results of four data sources related to mode shift and carpool behavior were inconclusive as to whether carpooling was unintentionally negatively impacted.

- Additionally, although a robust dataset was provided by the local partners, the evaluation was limited in that the post-deployment lasted only a year. Some data that could provide greater insight, such as crash data, was unavailable. Assumptions made for imperfect data complicate the ability to draw definite conclusions, potentially exaggerating the actual impact (such as assumptions regarding ExpressLanes occupancy and traffic volumes, which significantly affects findings related to air quality and benefit-cost, for example).

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Appendix A. Congestion Analysis

This appendix analyzes the impacts of the ExpressLanes and other Los Angeles (LA) Congestion Reduction Demonstration (CRD) projects on congestion on the I-10 and I-110. The analysis examines the differences in traffic performance on the I-10 and I-110 general purpose lanes and the High Occupancy Vehicle (HOV)/ExpressLanes before and after deployment of the CRD projects. Information on changes in travel times, trip speeds, and peak hour vehicle and passenger throughput is presented. Information from surveys of motorists using the I-10 and I-110 HOV/ExpressLanes and general purpose lanes is also summarized.

The 11-mile ExpressLanes on the I-110 opened on November 10, 2012 and the 14-mile ExpressLanes on the I-10 opened on February 23, 2013. The I-110 ExpressLanes includes two lanes in each direction of travel from I-105 to Exposition Boulevard. As part of the CRD, a second lane was added to the I-10 ExpressLanes from I-605 to I-710. Construction related to freeway projects was underway on the I-10 during most of 2013. Appendix B – Tolling Analysis presents more information on implementation and operation of the ExpressLanes.

Table A-1 presents the 15 hypotheses and questions identified for the congestion analysis in the Los Angeles CRD National Evaluation Plan. Two of the hypotheses were listed in the tolling analysis, but are included here as they focus on congestion measures. All but one of the hypotheses focused on the I-10 and I-110 ExpressLanes. One hypothesis focused on the LA Express Park™ project.

The first hypothesis was that deployment of the ExpressLanes would reduce the travel time of users in the I-10 and I-110 corridors. The second hypothesis was that the ExpressLanes would improve the reliability of user trips. The third hypothesis was that deploying the ExpressLanes would result in more vehicles and more persons being served in the two corridors during the peak periods.

The two hypotheses initially listed in the tolling analysis were that the ExpressLanes would regulate vehicular access to the I-10 and I-110 and improve their operation, and that the ExpressLanes pricing would maintain operating improvements after the ramp up period. The next hypothesis is that the relative travel times for the HOV/High Occupancy Toll (HOT) lanes versus the general purpose lanes would remain the same or improve for HOV/HOT travelers after implementation of the ExpressLanes. The next hypothesis is that allowing tolled vehicles in the ExpressLanes would not negatively impact the average travel times or travel time reliability for HOVs. A related hypothesis is that tolled vehicles would not cause traffic congestion to increase in the ExpressLanes. The next hypothesis is that the ExpressLanes are not likely to impact traffic congestion in the general purpose lanes due to latent demand in the I-10 and I-110 corridors. The final ExpressLanes hypothesis is that congestion on parallel arterial streets in the I-10 and I-110 corridors would be reduced. The National Evaluation team was not able to analyze this hypothesis due to limited data on the operation of the parallel arterial streets.

Four questions focus on the perceptions of travelers in the corridors based on information obtained through surveys. The questions state that surveyed travelers would perceive a noticeable reduction in travel times, a noticeable improvement in trip-time reliability, a noticeable reduction in the duration of congested periods, and a noticeable reduction in the length of peak congestion periods in the I-10 and I-110 corridors. The National Evaluation team was not able to assess these questions as they were inadvertently left off the post-deployment surveys of motorists by Metro in the I-10 and I-110 corridors.

Table A-1. Los Angeles UPA Congestion Analysis Hypotheses/Questions

Hypotheses/Questions
• Deployment of the ExpressLanes will reduce the travel time of users in the I-10 and I-110 corridors.
• Deployment of the ExpressLanes will improve the reliability of user trips in the I-10 and I-110 corridors.
• Deploying the ExpressLanes will result in more vehicles and persons served in the I-10 and I-110 corridors during peak periods.
• The ExpressLanes will regulate vehicular access to I-10 and I-110 and improve their operation.
• The ExpressLanes pricing will maintain operating improvements on the I-10 and I-110 after the initial ramp up.
• Relative travel times for HOV/HOT lanes versus general purpose lanes will either remain the same or (more likely) improve for HOV/HOT travelers as a result of the ExpressLanes.
• The introduction of tolled traffic into the I-10 and I-110 ExpressLanes will not negatively impact HOV or transit traffic in terms of average travel times or travel reliability.
• Allowing tolled vehicles will not cause traffic congestion to increase in the ExpressLanes.
• Because of latent demand in the I-10 and I-110 corridors, the ExpressLanes are not likely to impact traffic congestion on the general purpose lanes.
• Because of the ExpressLanes, congestion the arterial streets paralleling the corridors will be reduced.
• Will surveyed travelers perceive a noticeable reduction in travel times in the I-10 and I-110 corridors?
• Will surveyed travelers perceive a noticeable improvement in trip time reliability in the I-10 and I-110 corridors?
• Will surveyed travelers perceive a noticeable reduction in the duration of congested periods in the I-10 and I-110 corridors?
• Will surveyed travelers perceive a noticeable reduction in the length of peak congestion periods in the I-10 and I-110 corridors?
• Deployment of LA Express Park™ will reduce congestion in the downtown.

Source: Battelle.

The final hypothesis is that the deployment of LA Express Park™ would reduce congestion in the downtown area. The National Evaluation team was not able to assess this hypothesis due to lack of information on congestion levels on downtown streets.

The remainder of this appendix is divided into six sections. The data sources used in the analysis are described in Section A.1. Changes in travel times and travel speeds on the I-10 and I-110 are examined in Section A.2. Changes in vehicle and person throughput on the I-10 and I-110 are analyzed in Section A.3. Results from the pre- and post-deployment surveys of motorists using the I-10 and I-110 HOV/ExpressLanes and general purpose lanes are highlighted in Section A.4. Results from the ExpressLanes FasTrak® Customer Satisfaction Surveys conducted in the fall of 2013 and August 2014 are highlighted in Section A.5. The appendix concludes with a summary of the congestion analysis hypotheses and questions in Section A.6.

A.1 Data Sources

Data from four sources were used in the congestion analysis. First, the California Department of Transportation (Caltrans) provided pre- and post-deployment travel time data for the I-10 and I-110 general purpose lanes and the HOV/ExpressLanes collected using the floating car technique. Second, Caltrans also provided pre- and post-deployment peak hour vehicle occupancy counts for the I-10 and I-110 HOV/ExpressLanes and the general purpose lanes. Third, Metro provided reports summarizing the 2012 and 2014 surveys of I-10 and I-110 motorists. Fourth, Metro also provided the report on the 2013 ExpressLanes FasTrak® Customer Satisfaction Survey and the data file for selected questions on carpooling from the August 2014 Customer Satisfaction Survey.

A.2 Changes in Travel Times and Speeds on the I-10 and I-110

A number of the congestion hypotheses focus on changes in travel times and travel speeds in the I-10 and I-110 HOV/ExpressLanes and the general purpose lanes. Travel time data were collected by Caltrans using a floating car method. This method involves driving a test vehicle as a “typical vehicle” through the I-10 and I-110 corridors. Travel speeds and vehicle position are recorded using a global positioning system (GPS) unit. Morning commute travel times were collected from 5:30 a.m. to 9:00 a.m. and afternoon commute travel times were collected from 3:00 p.m. to 7:00 p.m. Travel time runs were conducted on both the general purpose lanes and the HOV/ExpressLanes on the same day.

Table A-2 lists the days travel time runs were conducted on the I-10 and I-110 in the pre- and post-deployment periods. Data from the individual runs were aggregated across the entire peak period to provide a picture of corridor performance in the primary commuting periods. Data were also aggregated by 30-minute intervals within each primary commuting period to examine changes within the peak periods. Only travel time runs conducted on weekdays (Tuesday through Thursday) were included in this analysis.

Table A-2. Days Travel Times Runs were Conducted

Facility	Pre-Deployment	Post Deployment – 2013	Post-Deployment – 2014
I-10 EB	2/22/2012; 2/23/2012		2/11/2014; 2/13/2014; 3/11/2014
	5/15/2012; 6/6/2012	5/14/2013; 5/16/2013; 5/30/2013	
		10/1/2013; 10/3/2013; 10/22/2013; 10/24/3013	
I-10 WB	2/15/2012; 2/22/2012		2/11/2014; 2/13/2014; 3/11/2014
	5/15/2012; 6/6/2012	5/16/2013; 5/23/2013; 10/1/2013; 10/3/2013; 10/22/2013; 10/24/3013	
I-110 NB	2/8/2012; 2/9/2012	2/12/2013; 2/14/2013	2/25/2014; 2/26/2014; 3/13/2014
	5/9/2012; 5/10/2012	5/21/2013	
	6/7/2012	10/16/2013; 10/17/2013	
I-110 SB	2/8/2012; 2/9/2012	2/12/2013; 2/14/2013	2/25/2014; 2/26/2014; 3/13/2014
	5/9/2013; 5/10/2013	5/21/2013	
		10/16/2013; 10/17/2013	

Source: Caltrans.

As indicated in Table A-2, only a limited number of days and travel time runs were available from each evaluation period. The resulting data represent only a "snap shot" sampling of the conditions in the corridors at the time the data were collected. On any given day, travel conditions in either corridors can vary considerably, which may affect the travel times and travel speeds in the corridor, creating variability in the travel time performance.

In addition, factors external to the evaluation corridor (such as traffic incidents, weather, etc.) may influence travel conditions in the corridor (e.g., a traffic incident on I-710 may cause a shifting of demand either to or from the analyzed corridors). These factors, and the extent to which they impact operation of the I-10 or I-110, may not be known by the data collection crew at the time.

When the travel time data are aggregated in 30-minute intervals within the peak period, the number of samples in each time interval becomes very small. Statistical comparison of the average travel times by intervals within the peak periods may not be valid because of the limited sample sizes.

The months the travel time runs were conducted in the pre- and post-deployment periods do not match exactly. Pre-deployment travel time runs were conducted in February and May/June 2012 on the I-10 and I-110. Post deployment travel times runs were conducted on the I-110 in February, May, and October, 2013 and February/March 2014. Post-deployment travel time runs were completed on the I-10 in May and October, 2013, and February/March, 2014. Travel times in October 2012 were not sampled in the pre-deployment evaluation period; however. As a result, seasonal differences may exist in the data. Further, several days of data collection in the pre-deployment interval on the I-10 were close to a regional school holiday, which may have impacted traffic patterns on these days. Additionally, pre-deployment counts were performed five to eight months prior to the opening of the ExpressLanes, while the area economy was still rebounding and traffic increasing.

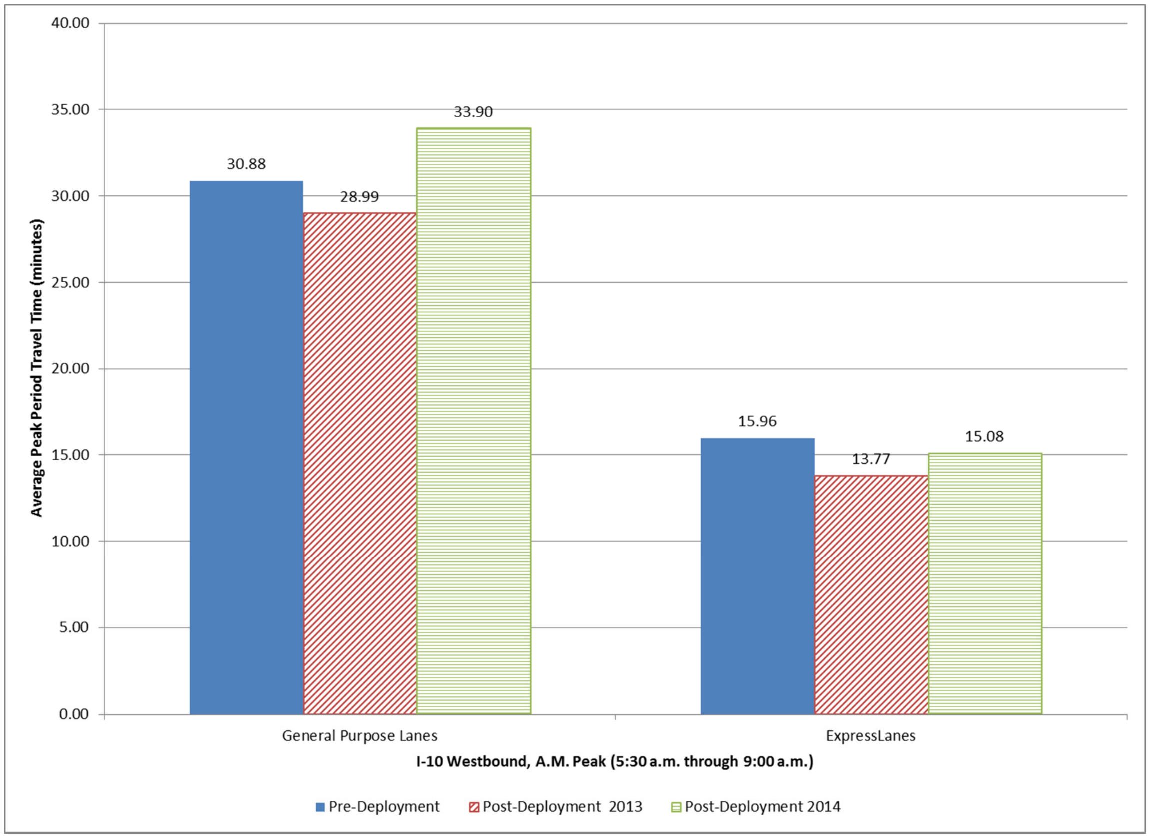
The travel time data were examined for three time periods – pre-deployment (2012), post-deployment (2013), and post-deployment (2014). The two post-deployment periods are provided to address the construction activities on the I-10, which were completed at the end of 2013, to allow for ramp-up periods on both facilities, and to provide comparable months in 2012 and 2014. The morning peak period used in the analysis was 5:30 a.m. to 9:00 a.m. and the afternoon peak period was 3:00 p.m. to 7:00 p.m. Information on the I-10 is presented first in this section, followed by the analysis of I-110.

A.2.1 I-10 Travel Times and Travel Speeds

A.2.1.1 I-10 Travel Times

Figure A-1 and Figure A-2 illustrate the average travel times for the peak period, peak direction of travel (westbound in the morning and eastbound in the afternoon) on the I-10 general purpose lanes and the HOV/ExpressLanes for the three evaluation periods: Table A-3 contains the results of a statistical comparison of pre- and both post-deployment average peak period travel times for both the general purpose lanes and HOV/ExpressLanes on the I-10. The statistical comparison was conducted using a 95 percent confidence level. It is important to note that these statistics are aggregated over the entire peak period – 5:30 a.m. to 9:00 a.m. for the morning peak period and from 3:00 p.m. to 7:00 p.m. in the afternoon peak period.

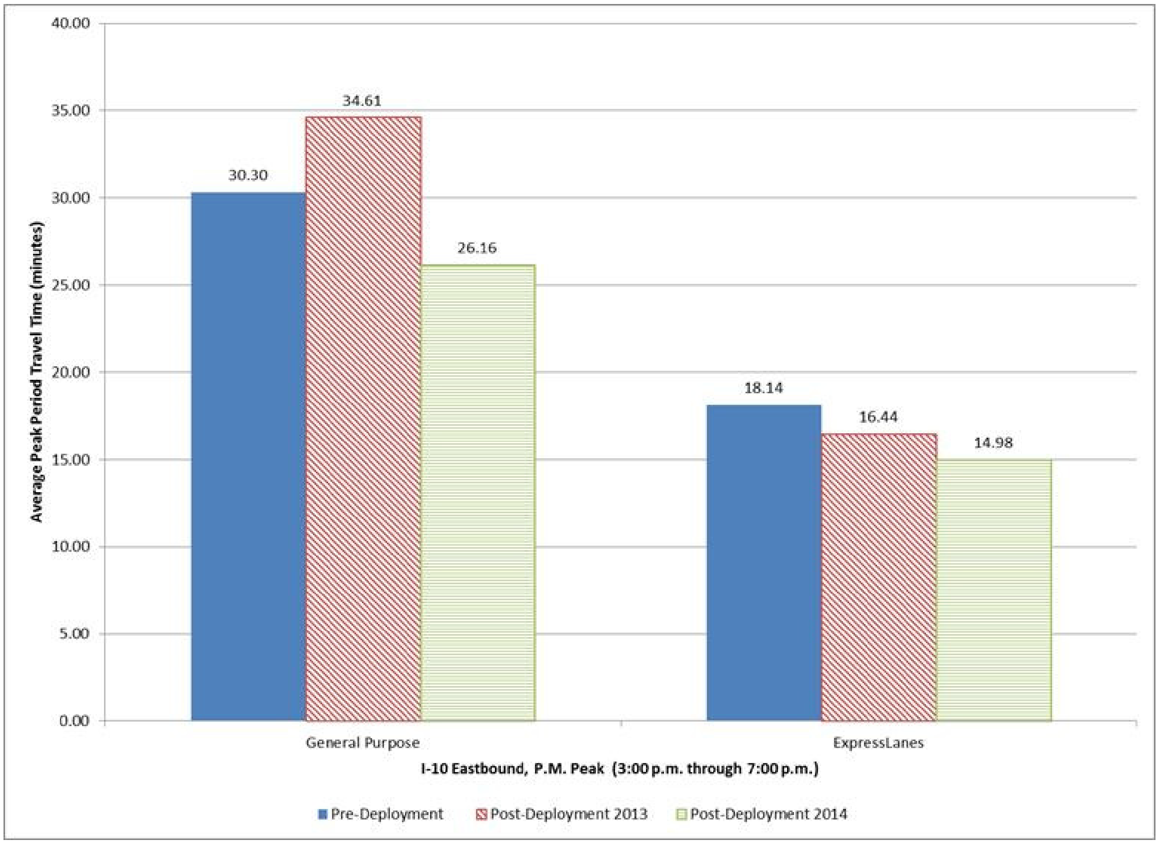
The results show different trends in the morning and afternoon peak periods. Figure A-1 illustrates that when aggregated over the entire morning peak period, travel times in both the general purpose lanes and the HOV/ExpressLanes showed a slight initial reduction after implementing the ExpressLanes, but increased slightly in the 2014 post-deployment period. The average travel times in the westbound general purpose lanes decreased from approximately 31 minutes to 29 minutes in 2013, and increased to approximately 34 minutes in 2014. The statistical analysis shows that no statistical difference existed between the post-deployment travel times compared to pre-deployment condition, however. The travel times in the westbound ExpressLanes during the morning peak period decreased by approximately 2 minutes – from approximately 16 minutes to 14 minutes – during the 2013 post-deployment period, but increased to approximately 15 minutes in 2014.



Source: Texas A&M Transportation Institute based on data provided by Caltrans.

Figure A-1. I-10 Morning Peak Period Travel Times (5:30 a.m. to 9:00 a.m.) in the General Purpose Lanes and HOV/ExpressLanes, Westbound

Figure A-2 presents the changes in average travel times in the I-10 general purpose lanes and the ExpressLanes for the afternoon peak period, peak direction of travel. The average travel times in the eastbound general purpose lanes increased by approximately 4 minutes during the 2013 post-deployment period. By early 2014, however, the average peak hour travel times were 4 minutes below the post-deployment times. The eastbound after peak period travel times in the ExpressLanes declined by approximately 1.5 minutes in the 2013 post-deployment period and by 3 minutes in early 2014. These changes in travel times in both general purpose lanes and the ExpressLanes were determined to be statistically different from pre-deployment conditions.



Source: Texas A&M Transportation Institute based on data provided by Caltrans.

Figure A-2. I-10 Afternoon Peak Period Travel Times (3:00 p.m. to 7:00 p.m.) in the General Purpose Lanes and ExpressLanes, Eastbound

Table A-3. Statistical Comparison of Pre-and Post-Deployment Average Peak Period Travel Times for I-10 General Purpose and ExpressLanes

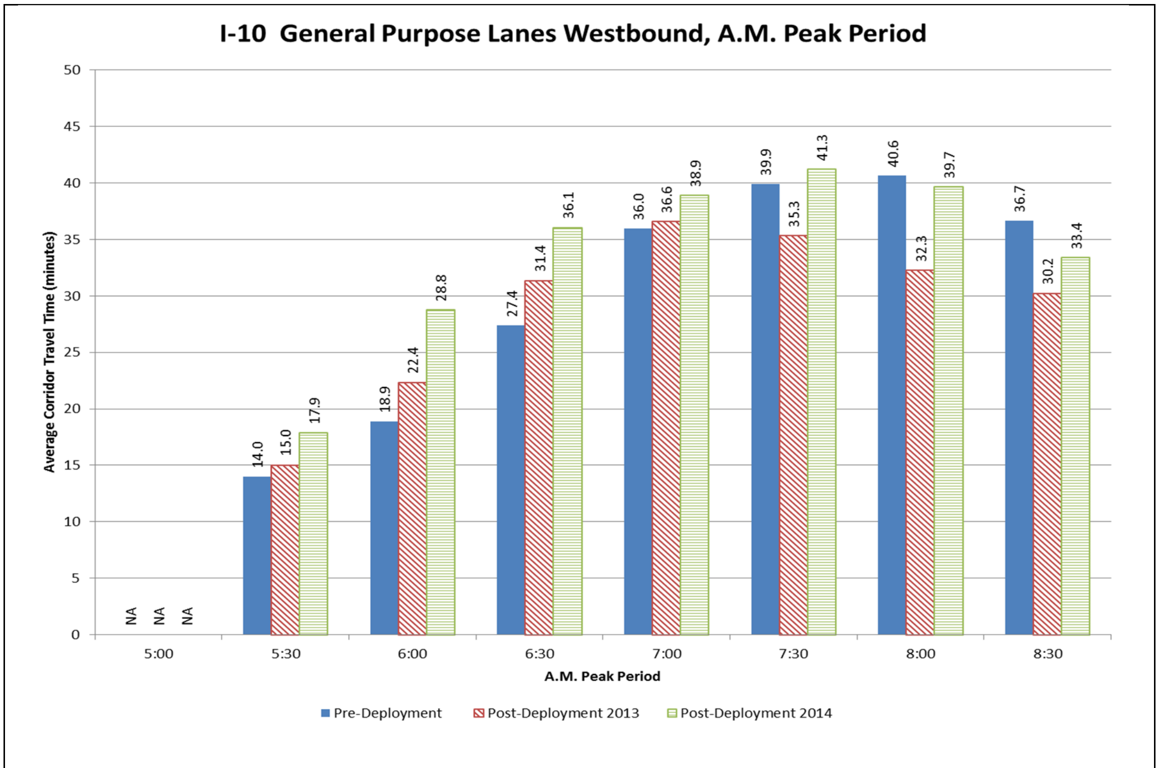
Lane Type	Pre-Deployment Average Travel Time (mins)	Travel Time (minutes)				
		Post-Deployment Period	Average Travel Time (mins)	Difference	p-Score	Statistically Significant?*
A.M. Peak						
General Purpose Lanes	30.88	2013 Post-Deployment	28.99	-1.89	0.3595	No
		2014 Post-Deployment	33.90	3.02	0.1029	No
Express-Lanes	15.96	2013 Post-Deployment	13.77	-2.18	0.0000	Yes
		2014 Post-Deployment	15.08	-0.85	0.0910	No
P.M. Peak						
General Purpose Lanes	30.30	2013 Post-Deployment	34.61	4.31	0.0146	Yes
		2014 Post-Deployment	26.16	-4.14	0.0013	Yes
Express-Lanes	18.14	2013 Post-Deployment	16.44	-1.69	0.0001	Yes
		2014 Post-Deployment	14.98	-3.15	<0.0001	Yes

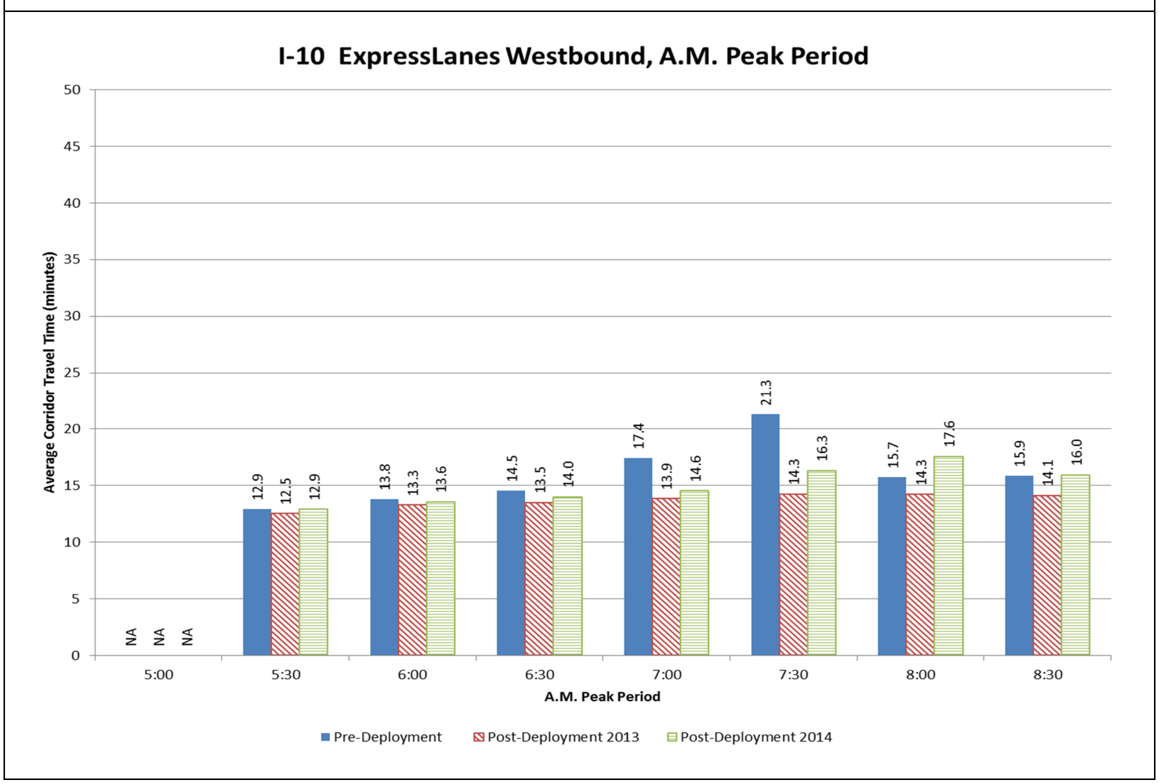
*Values judged to be significantly significant at a 95 percent confidence level.

Source: Texas A&M Transportation Institute based on data provided by Caltrans.

Figure A-3 presents the morning peak-period travel times in the I-10 general purpose lanes and the ExpressLanes by 30-minute intervals. Travel times increased slightly in the general purpose lanes in the post-deployment periods for the time intervals from 5:30 a.m. to 7:00 a.m. These increases ranged from approximately 0.5 minutes between 7:00 a.m. and 7:30 a.m. to 4 minutes from 6:00 a.m. to 7:00 a.m. After 7:30 a.m. travel times in the I-10 general purpose lanes decreased in the 2013 post-deployment period, with a decline of 5 to 8 minutes, but increased back to approximately the post-deployment level in the 2014 post-deployment period. These trends may reflect higher vehicle volumes due to the recovering economy.

As illustrated in Figure A-3, travel times in the I-10 ExpressLanes remained approximately the same for the 5:30 a.m. to 6:30 a.m. intervals, decreased in the 7:00 a.m. to 7:30 a.m. intervals, and increased slightly in the 8:00 a.m. to 8:30 a.m. intervals. These trends indicate that travel times remained relatively constant even with the addition of toll-paying solo drivers. This is most likely due to the addition of a second lane to the ExpressLanes.



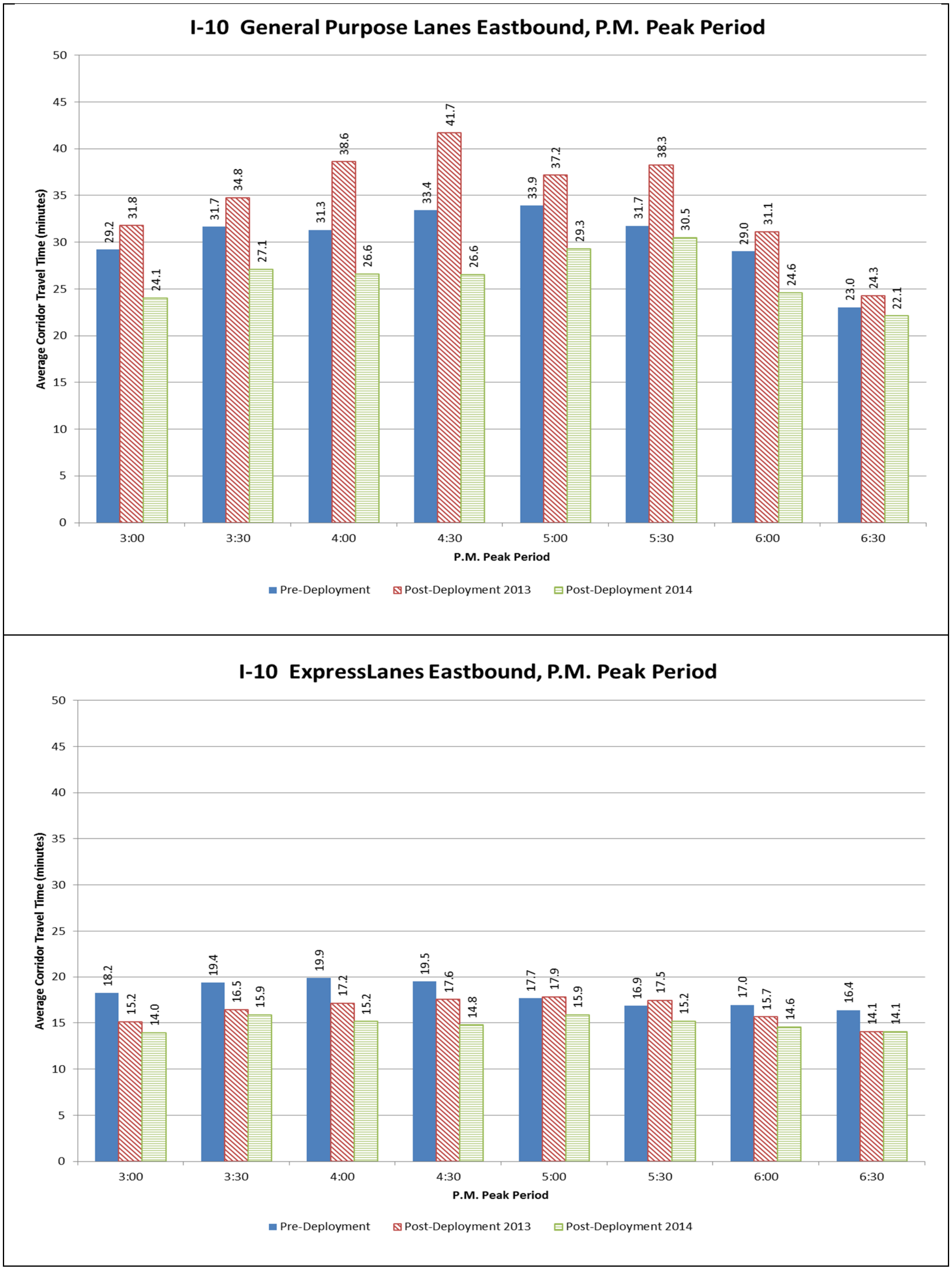


Source: Texas A&M Transportation Institute from data provided by Caltrans.

Figure A-3. Average Travel Times in the General Purpose Lanes and ExpressLanes on the I-10 Westbound by 30-minute Interval during the Morning Peak Period (5:30 a.m. to 9:00 a.m.)

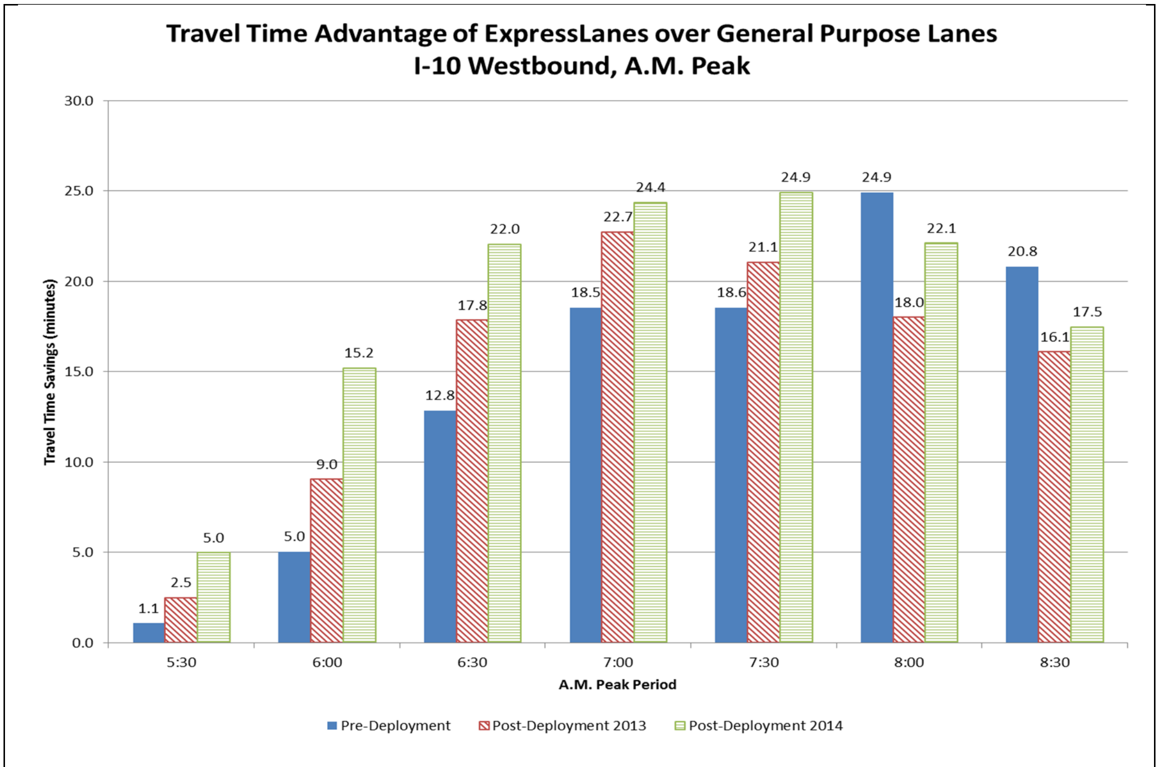
Figure A-4 presents the afternoon peak period, peak direction travel times in the I-10 general purpose lanes and ExpressLanes. In 2013, travel times in the general purpose lanes increased in every interval during the afternoon peak period. In 2014, however, travel times in the general purpose lanes were 1-to-5 minutes faster than pre-deployment conditions. The longer 2013 travel times may reflect the impact of construction activities occurring on the I-10. Travel times on the I-10 ExpressLanes declined or remained approximately the same over all the afternoon peak period intervals in the post-deployment periods. Between 3:00 p.m. and 5:00 p.m., travel times in the ExpressLanes were approximately 2 minutes faster in the 2013 post-deployment period and almost 4 minutes faster in the 2014 post-deployment period.

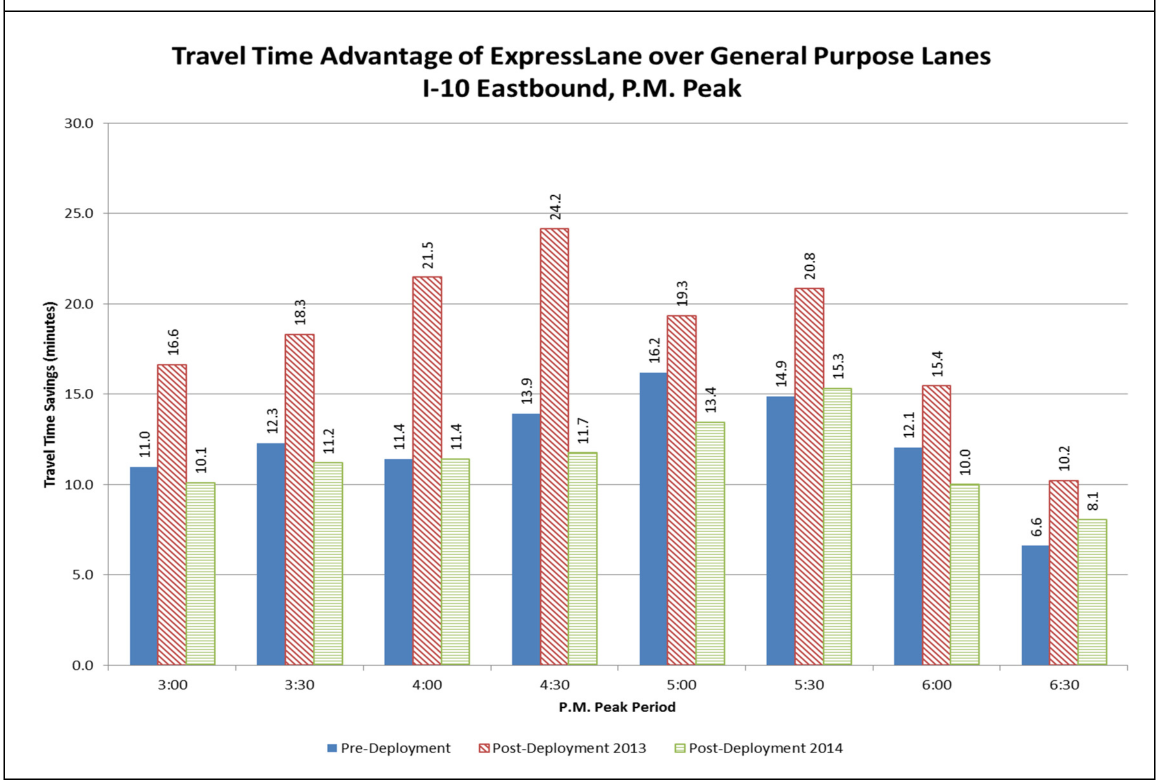
Figure A-5 illustrates the change in the travel time advantage of the I-10 ExpressLanes over the general purpose lanes. Travelers realized a greater travel time advantage by using the westbound ExpressLanes on the I-10 during most of the time intervals. From 5:00 a.m. to 8:00 a.m., ExpressLane users experienced between 2- to 5-minute improvements in travel time savings in 2013. In 2014, this advantage had increased to approximately 10 minutes. However, the relative travel time advantage of the ExpressLanes declined between 8:00 a.m. and 9:00 a.m. The travel time advantage for ExpressLane users increased by 5-to-10 minutes during all afternoon time intervals in 2013. In 2014, the travel time advantage for the ExpressLanes returned to near pre-deployment levels, however.



Source: Texas A&M Transportation Institute from data provided by Caltrans.

Figure A-4. Average Travel Times in the General Purpose Lanes and ExpressLanes on the I-10 Eastbound by 30-minute Intervals during the Afternoon Peak Period (3:00 p.m. to 7:00 p.m.)





Source: Texas A&M Transportation Institute from data provided by Caltrans.

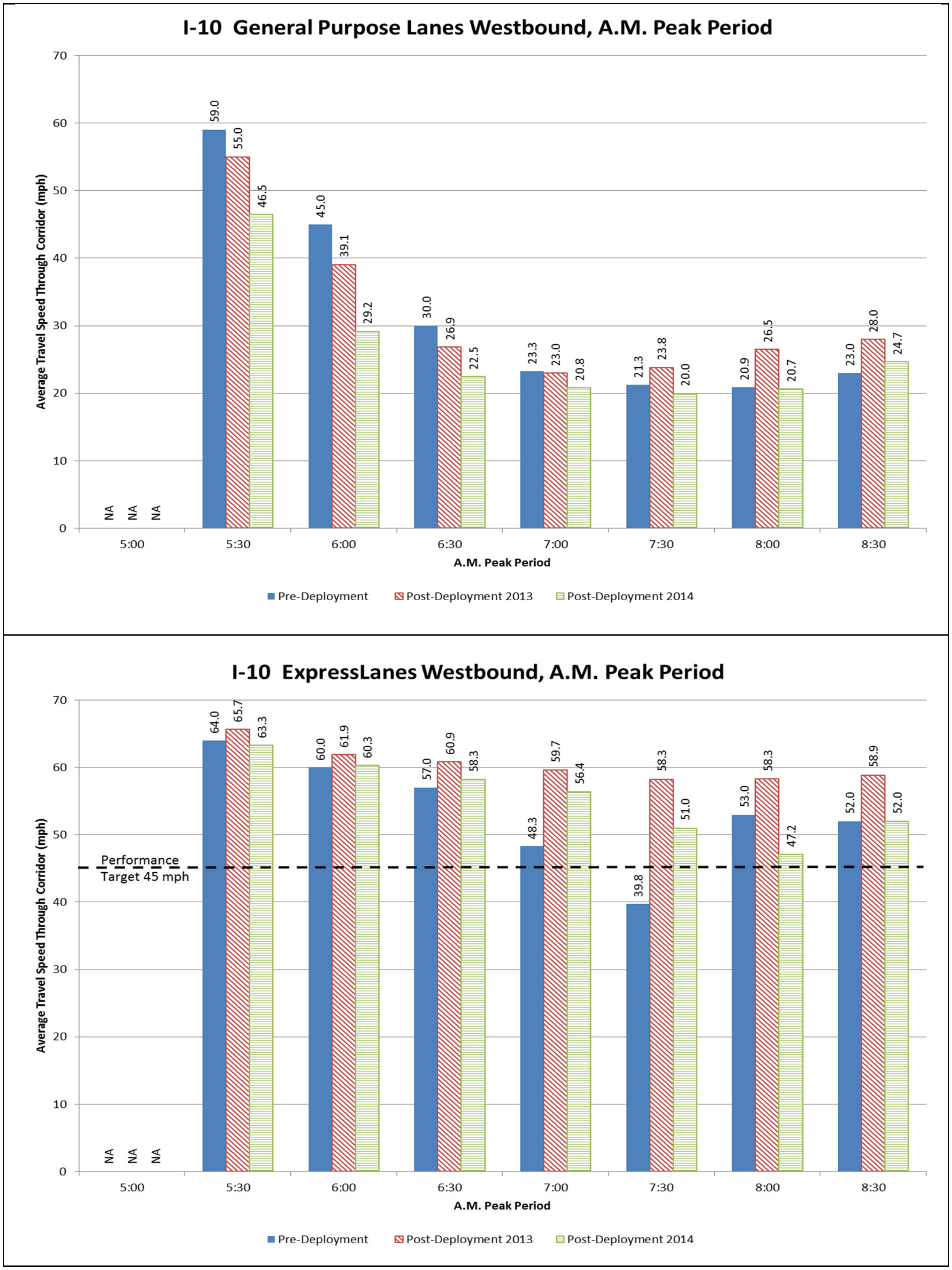
Figure A-5. Comparison of Pre- and Post-Deployment Travel Time Advantages of the ExpressLanes for the I-10 – Both Peak Periods

A.2.1.2 I-10 Travel Speeds

Figure A-6 presents the average travel speeds in the I-10 general purpose lanes and the ExpressLanes in the morning peak period, peak direction for the 30-minute intervals. Figure A-7 illustrates the same information for the afternoon peak period, peak direction of travel. The figures also note the 45 miles per hour (mph) performance metric for the ExpressLanes.

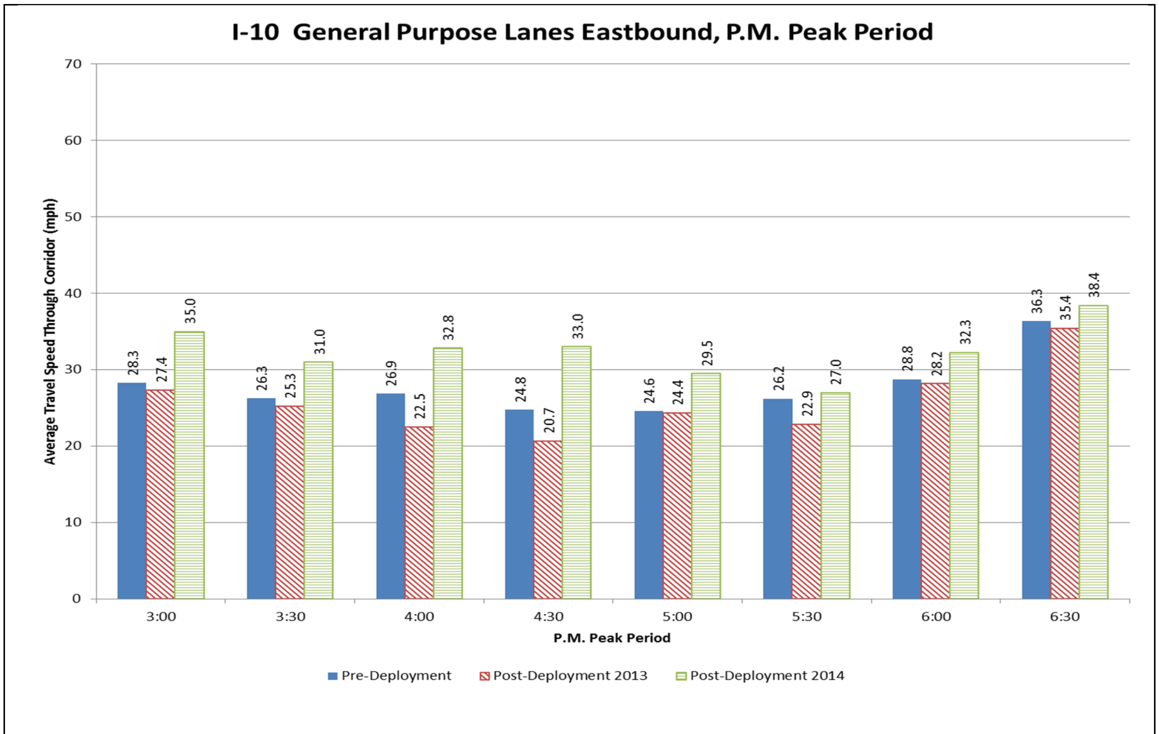
The average travel speeds in the I-10 general purpose lanes in the morning peak period westbound direction declined from 5:30 a.m. to 7:30 a.m. in the post-deployment periods, but increased slightly from 7:30 a.m. to 8:30 a.m. The average trip speeds in the I-10 ExpressLanes during the morning peak period, peak direction were above 55 mph throughout all time periods in the post-deployment evaluation periods. In the post-deployment period the average trip speeds in the westbound ExpressLanes experienced fluctuations, ranging from 64 mph to 39.8 mph. Average trip speeds fell below the 45 mph threshold between 7:30 a.m. to 8:30 a.m. in the pre-deployment period. In the post-deployment periods average trip speeds in the ExpressLanes ranged between 58 mph and 65 mph in the 2013 post-deployment period, but in 2014, trip speeds in the ExpressLanes returned to or above pre-deployment levels in all but the 8:00 a.m. to 8:30 a.m. interval. Travel speeds remained above the 45 mph threshold in all time intervals in the post-deployment periods.

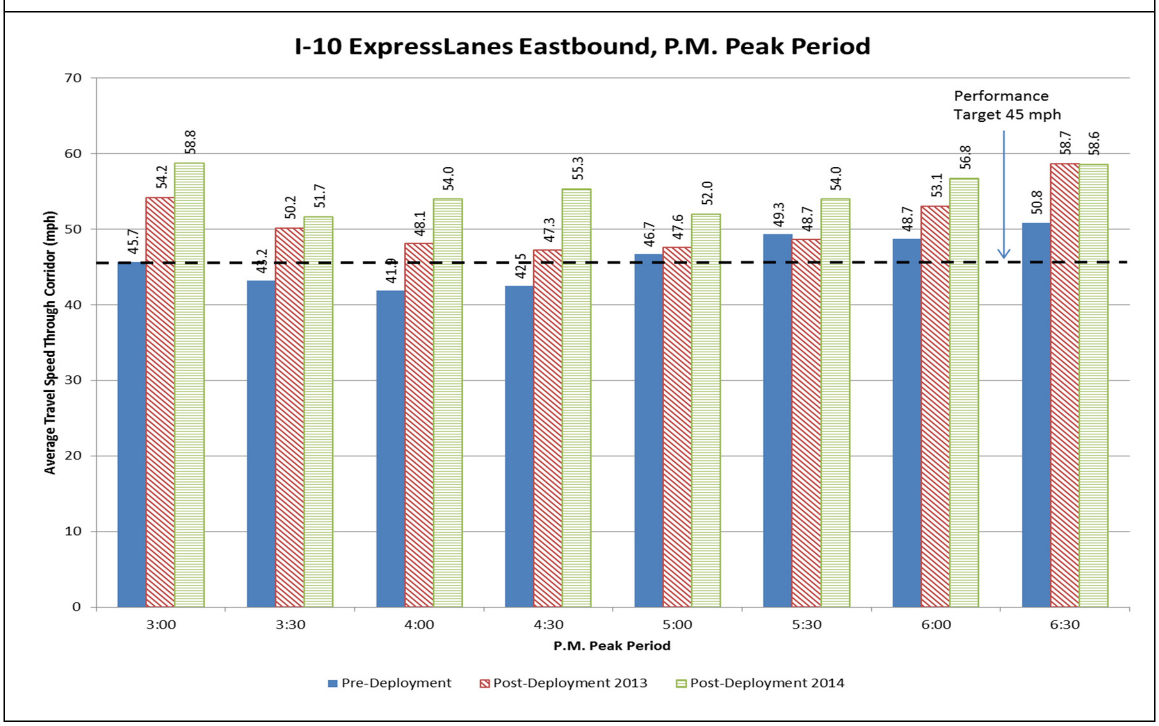
Travel speeds decreased in the general purpose lanes in the afternoon peak period, peak direction during the 2013 post-deployment period, but increased in the 2014 post-deployment period across all time intervals. The average travel times in the afternoon peak period, peak direction in the ExpressLanes increased across the intervals in the post-deployment periods. Travel speeds were below the 45 mph performance in some of the pre-deployment time intervals, while the travel speeds averaged above 50 mph in the 2014 post-deployment period.



Source: Texas A&M Transportation Institute from data provided by Caltrans.

Figure A-6. Pre- and Post-Deployment Average Travel Speeds in the General Purpose Lanes and ExpressLanes on the I-10 Westbound during the Morning Peak Period



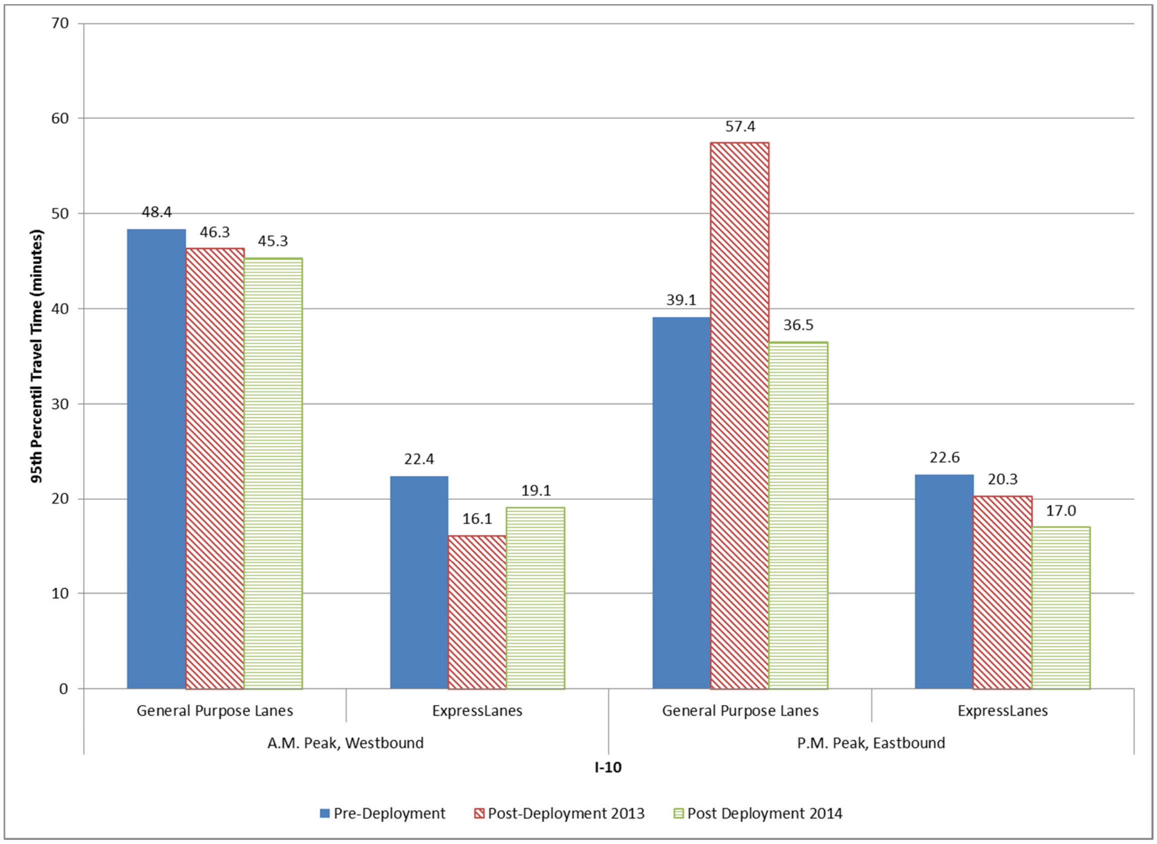


Source: Texas A&M Transportation Institute from data provided by Caltrans.

Figure A-7. Pre- and Post-Deployment Average Travel Speeds in the General Purpose Lanes and ExpressLanes on the I-10 Eastbound during the Afternoon Peak Period

A.2.1.3 I-10 Travel Time Reliability

The 95th percentile travel time and the Buffer Index are used as measures of corridor travel time reliability. Figure A-8 presents a comparison of the 95th percentile peak period travel times for the general purpose lanes and the ExpressLanes in the morning and afternoon peak periods, peak direction of travel. The 95th percentile travel times decreased in the 2014 post-deployment period for the general purpose lanes and the ExpressLanes. The 95th percentile travel time did increase in the general purpose lanes in the afternoon peak period and in the 2013 post-deployment period, but declined below the pre-deployment level in the 2014 post-deployment period.



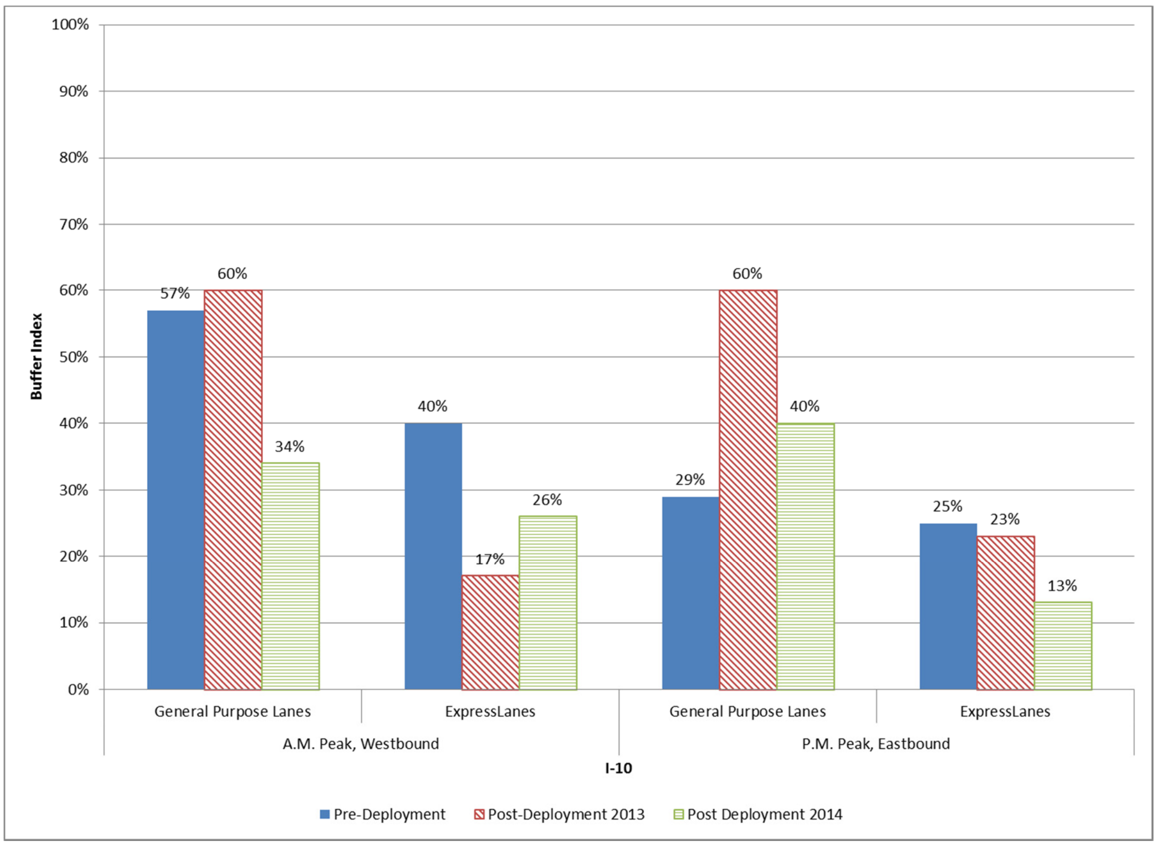
Source: Texas A&M Transportation Institute from data provided by Caltrans.

Figure A-8. Comparison of 95th Percentile Travel Times in the General Purpose and ExpressLanes for the I-10 – Pre- and Post-Deployment

The Buffer Index represents the extra time that travelers must add to their average travel time when planning trips to ensure an on-time arrival. It is the ratio of the difference between the 95th percentile travel time and the average travel time over the average travel time, expressed as a percentage. Increases in the Buffer Index between the pre- and post-deployment periods would imply that travel became less predictable following the deployment of the CRD improvements, while reductions in the Buffer Index would imply that commuters would need at allocate less additional time to their trip to ensure an on-time arrival.

As illustrated in Figure A-9, the Buffer Index for the I-10 general purpose lanes increased in both the morning and afternoon peak periods following the deployment of the CRD improvements. In 2013, the Buffer Index for the general purpose lanes increased by 3 percent in the morning peak period, and by 31 percent in the afternoon peak period. In 2014, however, the Buffer Index for the general purposes lanes declined by 32 percent in the morning peak period, but increased by 20 percent in the afternoon peak period over the pre-deployment levels. It appears that travel in the I-10 general purpose lanes became more consistent in 2014, partially due to completion of the I-10 widening project.

The Buffer Index for the ExpressLanes decreased by 23 percent in the morning peak period and by 3 percent in the afternoon peak period in the 2013 post-deployment period. In 2014, the Buffer Index for the ExpressLanes was 12 to 13 percent lower than pre-deployment levels for both peak periods, suggesting that the CRD projects resulted in an improvement in the travel time reliability in ExpressLanes.



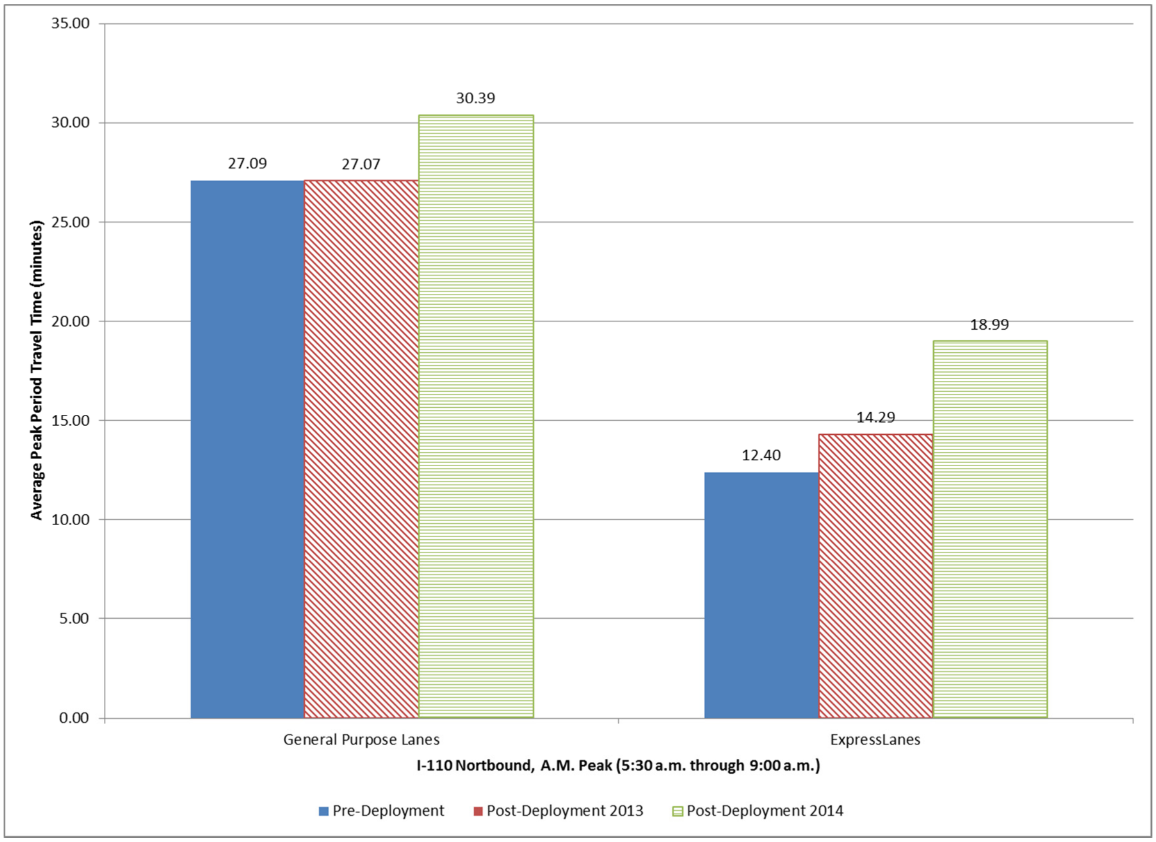
Source: Texas A&M Transportation Institute from data provided by Caltrans.

Figure A-9. Comparison of General Purpose and ExpressLanes Buffer Indices for the I-10 – Pre- and Post-Deployment

A.2.2 I-110 Travel Times and Travel Speeds

A.2.2.1 I-110 Travel Times

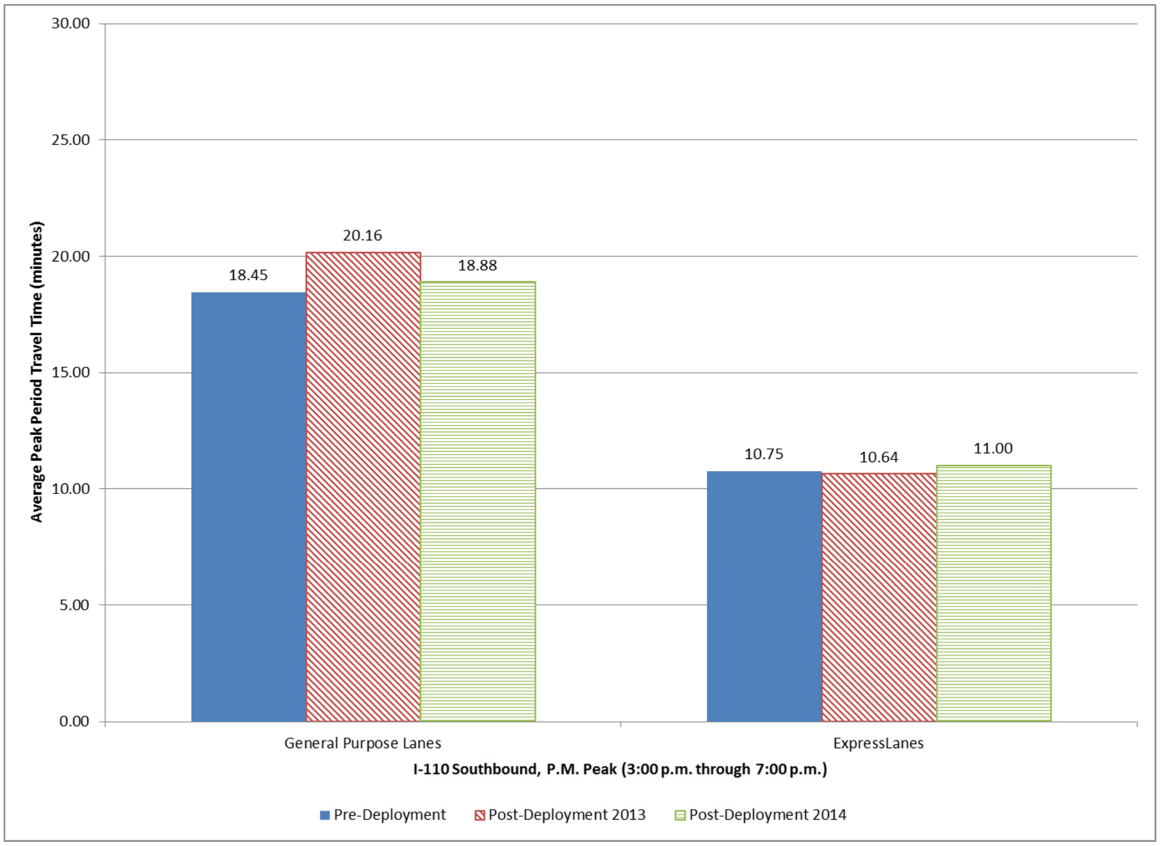
Figure A-10 presents the average travel times in the morning peak period for the I-110 general purpose lanes and the ExpressLanes in the peak direction of travel (northbound). Figure A-11 illustrates the same information for the afternoon peak direction of travel (southbound). Table A-4 presents a statistical comparison of the pre-deployment and post-deployment travel times for the I-110 general purpose lanes and ExpressLanes.



Source: Texas A&M Transportation Institute from data provided by Caltrans.

Figure A-10. I-110 Morning Peak Period Travel Times (5:30 a.m. to 9:00 a.m.) in the General Purpose Lanes and ExpressLanes, Westbound

Figure A-10 illustrates that travel times on the I-110 general purpose lanes in the morning peak period remained approximately the same between the pre-and 2013 post-deployment periods, averaging approximately 27 minutes, but increased to approximately 30 minutes in the 2014 post-deployment period. These changes were not statistically significant, however; because the general purpose lanes are more congested, the variance in the travel times tends to be greater. The average travel times in the I-110 ExpressLanes during the morning peak period increased from approximately 12 minutes to approximately 14 minutes in 2013, and to almost 19 minutes in 2014. Both of these increases were determined to be statistically significant at a 95 percent confidence level.



Source: Texas A&M Transportation Institute from data provided by Caltrans.

Figure A-11. I-110 Afternoon Peak Period Travel Times (3:00 p.m. to 7:00 p.m.) in the General Purpose Lanes and ExpressLanes

Figure A-11 presents the average travel times on the I-110 general purpose lanes and the ExpressLanes in the afternoon peak period, peak direction of travel. The average afternoon peak period travel times in the I-110 general purpose lanes increased from 18.5 minutes in the pre-deployment period to slightly over 20 minutes in the 2013 post-deployment period – a change of 1.5 minutes. In 2014, travel times in the general purpose lanes returned to the pre-deployment levels. The average afternoon peak period travel times in the ExpressLanes remained relatively constant at approximately 11 minutes over all three time periods. Only the 2013 and 2014 changes in the morning peak period travel times in the ExpressLanes and the 2013 change in afternoon peak period travel times in the general purpose lanes are statistically significant.

Figure A-12 compares pre- and post-deployment travel times on the I-110 general purpose lanes and ExpressLanes by 30-minute intervals for the morning peak period, peak direction of travel. Figure A-13 provides the same comparison for the afternoon peak period, peak direction of travel.

Table A-4. Statistical Comparison of Pre-and Post-Deployment Average Peak Period Travel Times for the I-110 General Purpose and ExpressLanes

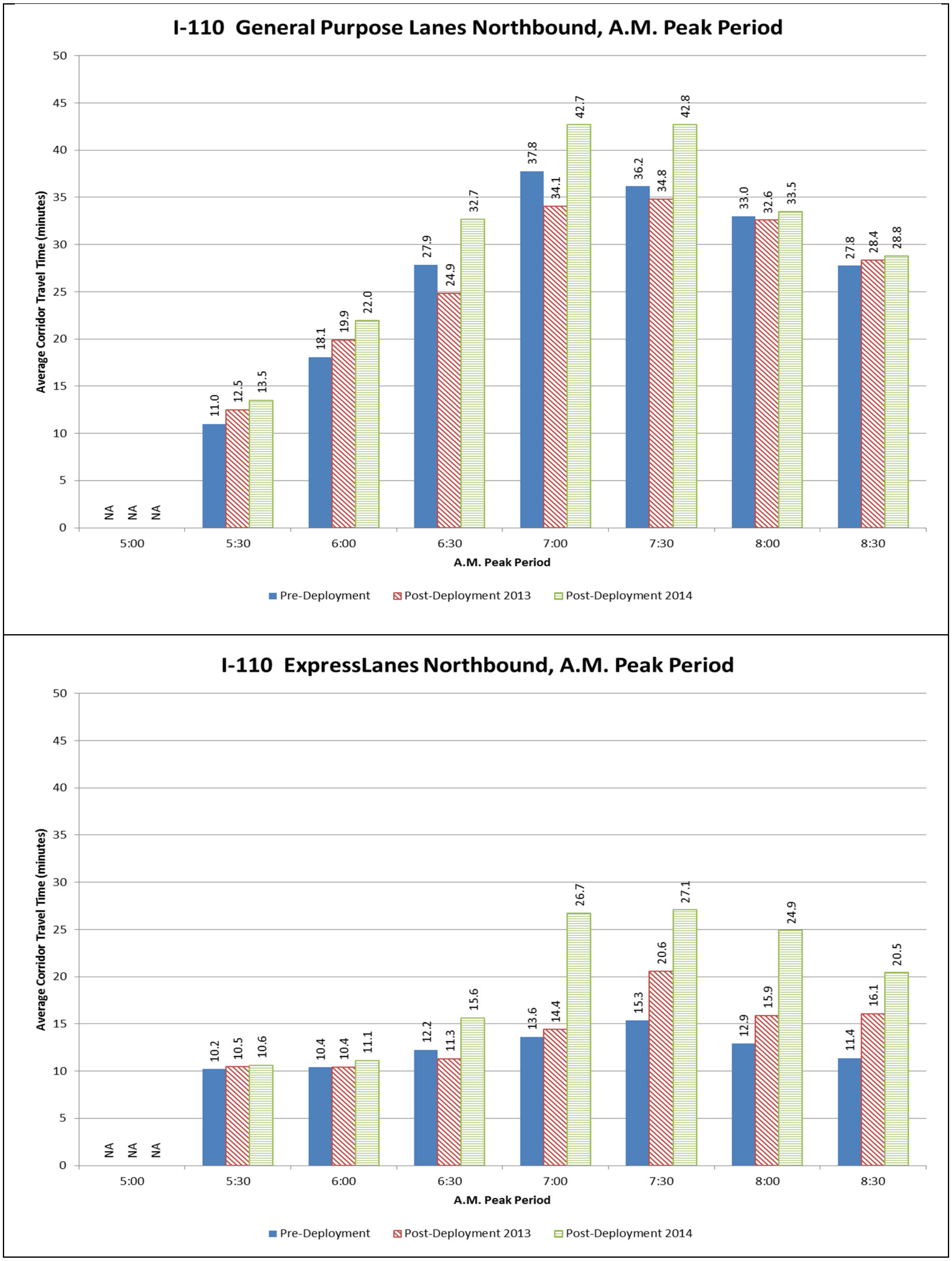
Lane Type	Pre-Deployment Average Travel Time (mins)	Travel Time (minutes)				
		Post Deployment Period	Average Travel Time (mins)	Difference	p-Score	Statistically Significant?*
A.M. Peak						
General Purpose Lanes	27.09	2013 Post-Deployment	27.07	-0.02	0.9913	No
		2014 Post-Deployment	30.39	3.29	0.0819	No
Express-Lanes	12.40	2013 Post-Deployment	14.29	1.90	0.0169	Yes
		2014 Post-Deployment	18.99	6.60	<0.0001	Yes
P.M. Peak						
General Purpose Lanes	18.45	2013 Post-Deployment	20.16	1.71	0.0012	Yes
		2014 Post-Deployment	18.88	0.43	0.2686	No
Express-Lanes	10.75	2013 Post-Deployment	10.64	-0.11	0.4383	No
		2014 Post-Deployment	11.00	0.25	0.1653	No

*Values judged to be significantly significant at a 95 percent confidence level.

Source: Texas A&M Transportation Institute based on data provided by Caltrans.

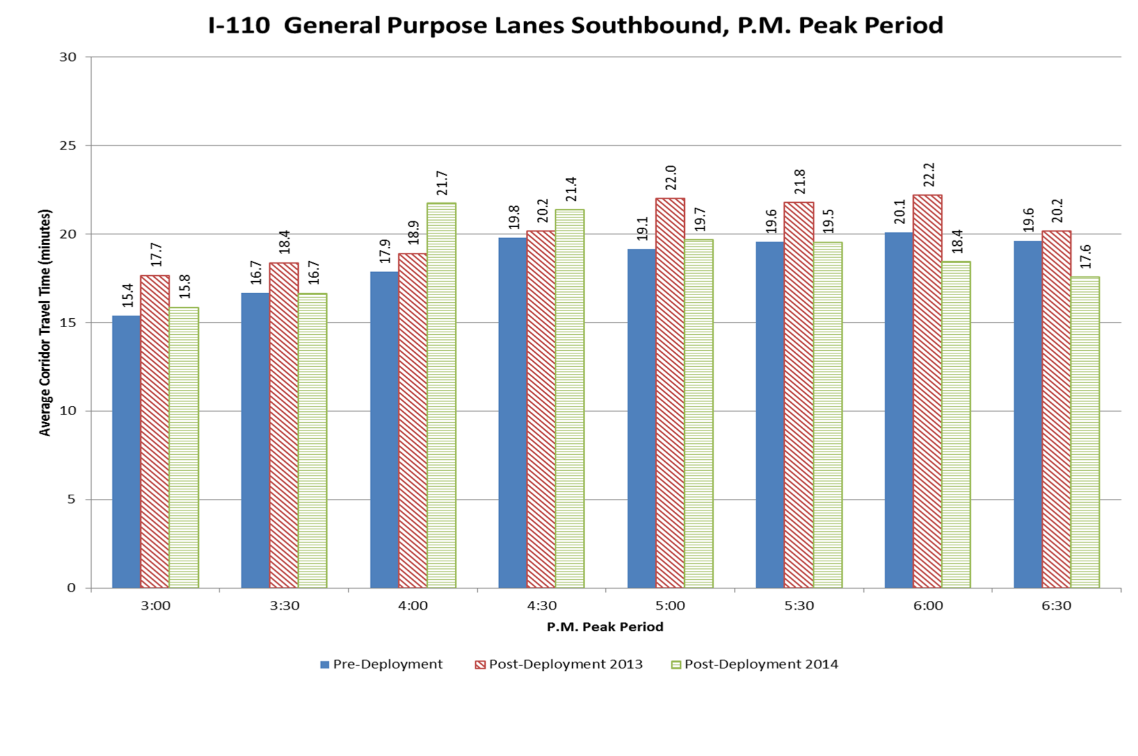
The average travel times in the general purpose lanes increased from the pre-deployment period to the 2014 post-deployment period for all time intervals, although there were slight declines in a few time intervals in the 2013 post-deployment period. Travel times in the general purpose lanes in the 2014 post-deployment period were 5 minutes longer than the pre-deployment period in the 7:00 a.m. and the 7:30 a.m. time intervals. The average travel times in the ExpressLanes remained close to pre-deployment levels until 7:00 a.m. Beginning at 7:00 a.m., the average ExpressLanes travel times increased between 3 and 5 minutes during the 2013 morning peak period. In 2014, travel times in the ExpressLanes increased nearly double the pre-deployment levels.

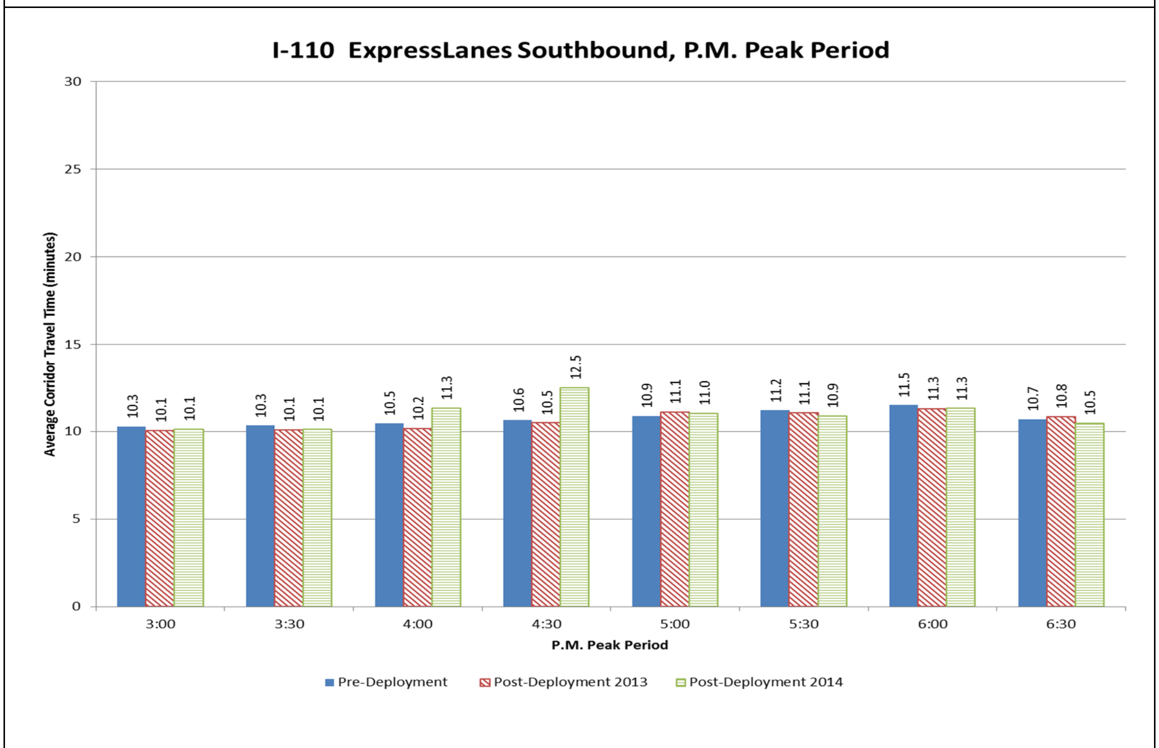
The average travel times on both the general purpose lanes and the ExpressLanes during the afternoon peak period remained relatively consistent between the pre-deployment and both post-deployment periods. The average travel times in the general purpose lanes and the ExpressLanes increased slightly during the 4:00 p.m. and the 4:30 p.m. time intervals.



Source: Texas A&M Transportation Institute from data provided by Caltrans.

Figure A-12. Average Travel Times on the I-110 Northbound by 30-minute Intervals during the Morning Peak Period (5:00 a.m. to 9:00 a.m.)

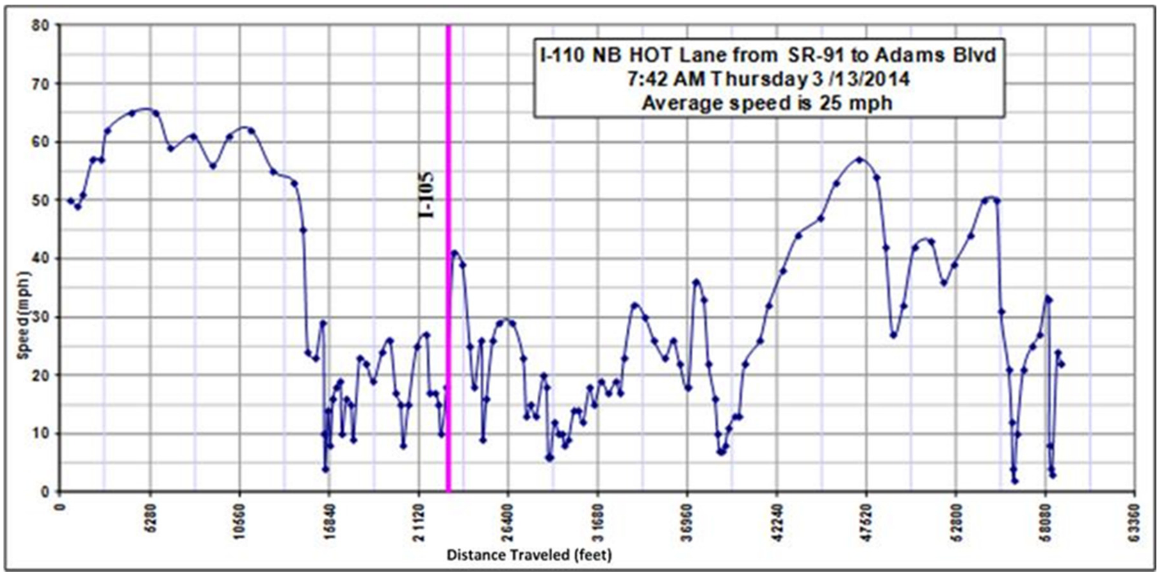




Source: Texas A&M Transportation Institute from data provided by Caltrans.

Figure A-13. Average Travel Times on the I-110 Southbound by 30-minute Intervals during the Afternoon Peak Period (3:00 p.m. to 7:00 p.m.)

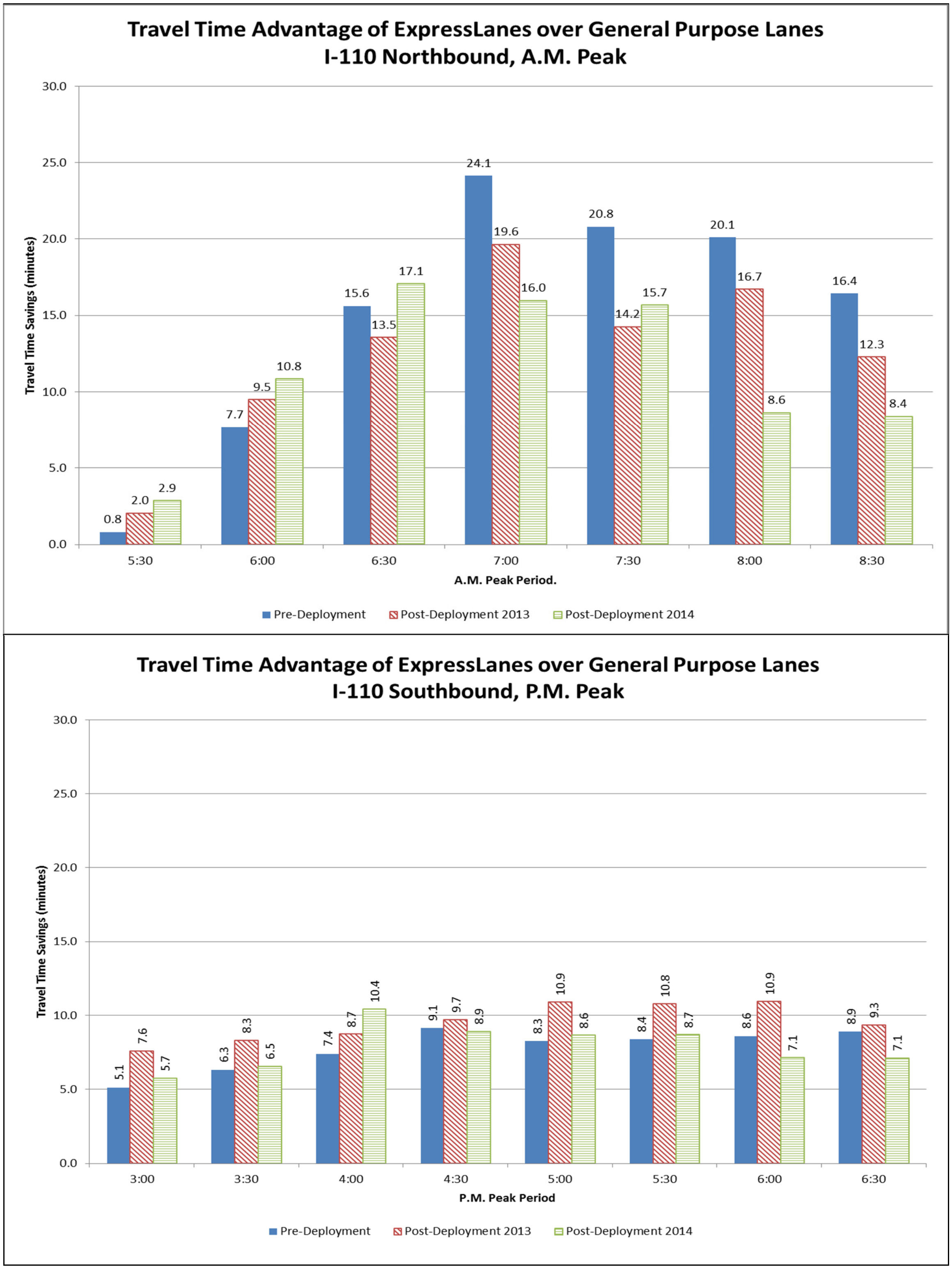
Figure A-14 illustrates a travel time profile for a single vehicle using the ExpressLanes on the I-110 in the morning peak period, peak direction of travel. The figure was generated by Caltrans by plotting the speed of the vehicle as it travels through the corridor. The direction of travel is from left to right with the left side representing SR 91 and the right end representing Adams Boulevard. A trip with a vehicle maintaining a consistent speed would appear as a straight line running left to right. Drops in speed are represented by sudden downward spikes in the speed profile. A trip which experiences large fluctuation in speed (as typically occurs in congestion) would appear as a jagged line, with numerous peaks and valleys. While the profile is indicative of only one trip on the ExpressLanes, it provides insight into locations where congestion is occurring on the facility. This profile indicates that this particular vehicle is encountering congestion approximately 1.5 miles upstream of the I-105 interchange and extending approximately 3 miles downstream of the I-105 interchange. This particular trip occurred at 7:42 a.m. which is consistent with where the largest increases in travel times are occurring in the ExpressLanes.



Source: Caltrans.

Figure A-14. Speed Profile of a Vehicle Traversing the I-110 CRD Corridor in the Northbound Direction during the Morning Peak Period

Figure A-15 illustrates the change in the relative travel time advantage of using the I-110 ExpressLanes over the general purpose lanes. The relative travel time advantage of using the ExpressLanes in the morning peak period declined between approximately 2 to 6 minutes over the time intervals in the 2013 post-deployment period. In the 2014 post-deployment period, the travel time advantage of using the ExpressLane in the morning peak period, while still positive, decreased 5-to-12 minutes lower than pre-deployment conditions. Even though ExpressLane users may have experienced a slight decrease in travel time advantage, ExpressLanes users still experience an advantage of between 8 and 16 minutes over general purpose lane users during the 2014 post-deployment period. In the afternoon peak period, ExpressLane users experienced a slight increase of approximately 2 minutes for all time intervals in the 2013 post-deployment period. In 2014 evaluation period, the travel time advantage of using the ExpressLanes in the afternoon peak period had returned to close pre-deployment levels, for most intervals, except 4:00 p.m., which experienced a 3-minute increase.



Source: Texas A&M Transportation Institute from data provided by Caltrans.

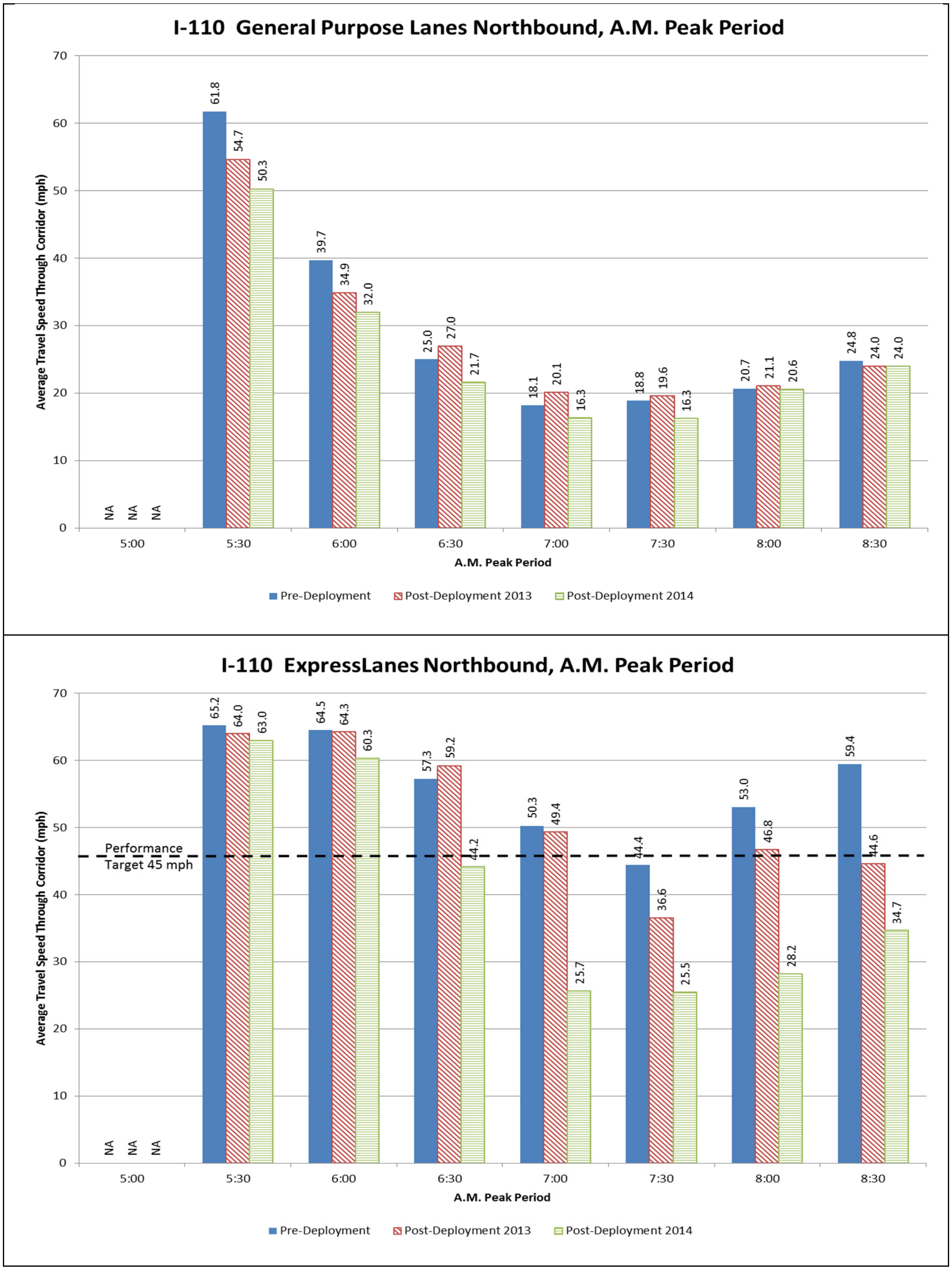
Figure A-15. Comparison of Pre- and Post-Deployment Travel Time Advantages of the ExpressLanes for the I-110 – Both Peak Periods

A.2.2.2 I-110 Travel Speeds

Figure A-16 presents the average travel speeds for the I-110 general purpose lanes and the ExpressLanes during the morning peak period, peak direction of travel. Travel speeds in the general purpose lanes experienced a decline from 5:30 a.m. to 7:30 a.m. from the pre-deployment period to the 2014 post-deployment period, with the largest declines in the 5:30 a.m. and 6:00 a.m. time intervals. The 8:00 a.m. and 8:30 a.m. time intervals remained relatively constant across all the evaluation periods.

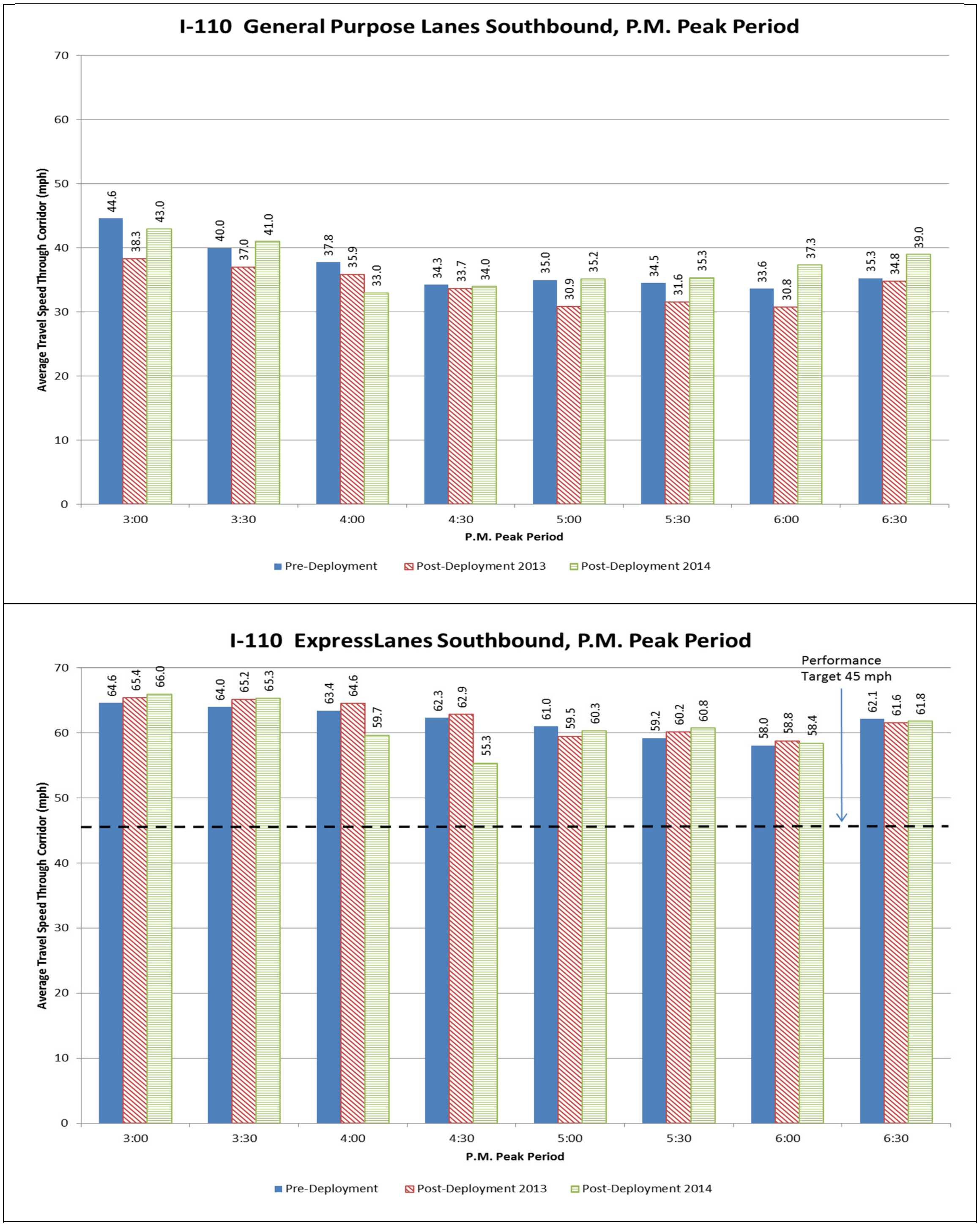
The average trips speeds in the ExpressLanes remained above the 45 mph threshold in all but one time interval (7:30 a.m. to 8:00 a.m.) in 2012. In the 2013 post-deployment period, the average trip speeds in the ExpressLanes remained the same or slightly higher for most of the morning peak period. Beginning at 7:30 a.m.; however, travel speeds averaged 8-to-10 mph slower compared to the pre-deployment condition. In 2014, the average trips speeds declined in the ExpressLanes in most intervals in the morning peak period, and averaged below 45 mph from 6:30 a.m. to 8:30 a.m. and below 30 mph between 7:00 a.m. to 8:30 a.m.

Figure A-17 illustrates the average travel speeds in both the I-110 general purpose lanes and ExpressLanes in the southbound direction during the afternoon peak period. The average trip speeds in the I-110 general purpose lanes remained relatively constant across all time intervals, averaging around 37 mph in the pre-deployment level and 34 mph in the 2013 post-deployment period. The figure shows that average trip speeds in the general purpose lanes were 2-to-3 mph slower in the 2013 post-deployment period, but returned to the pre-deployment level or above in the 2014 post-deployment period. The average travel speeds in the southbound ExpressLanes remained relatively constant across the three time periods, with trip speeds averaging approximately 62 mph in the pre- and post-deployment periods.



Source: Texas A&M Transportation Institute from data provided by Caltrans.

Figure A-16. Pre- and Post-Deployment Average Travel Speeds in the General Purpose Lanes and ExpressLanes on the I-110 Northbound during the Morning Peak Period



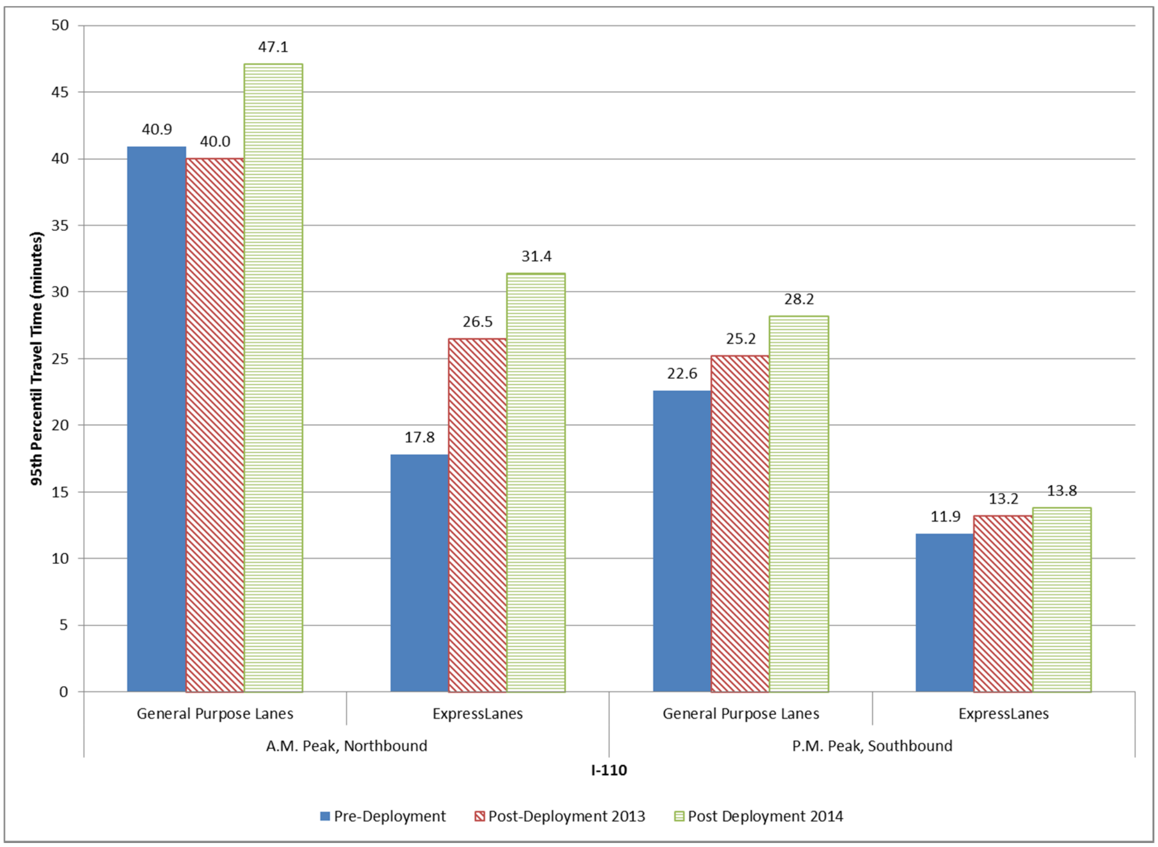
Source: Texas A&M Transportation Institute from data provided by Caltrans.

Figure A-17. Pre- and Post-Deployment Average Travel Speeds in the General Purpose Lanes and ExpressLanes on the I-110 Southbound during the Afternoon Peak Period

A.2.2.3 I-110 Travel Time Reliability

Figure A-18 presents the change in the 95 percentile travel time in the I-110 general purpose lanes and the ExpressLanes across the pre- and post-deployment periods. The 95th percentile travel times in the general purpose lanes declined by approximately 1 minute in the morning peak, but increased by approximately 2 minutes during the afternoon peak period during the 2013 post-deployment period. In 2014, the 95 percentile travel times in the general purpose lanes had increased by 7 minutes in the morning peak period and by almost 6 minutes in the afternoon peak period.

For the ExpressLanes, the 95th percentile travel times showed similar increases, especially in the morning peak period. During the 2013 post-deployment period, the 95th percentile travel times for the ExpressLanes increased by approximately 9 minutes in the morning peak period and by one minute in the afternoon peak period. In 2014, the 95th percentile travel time increased by approximately 13 minutes in the ExpressLanes in the morning peak period and by approximately 2 minutes in both the 2013 and 2014 post-deployment periods in the afternoon peak period.

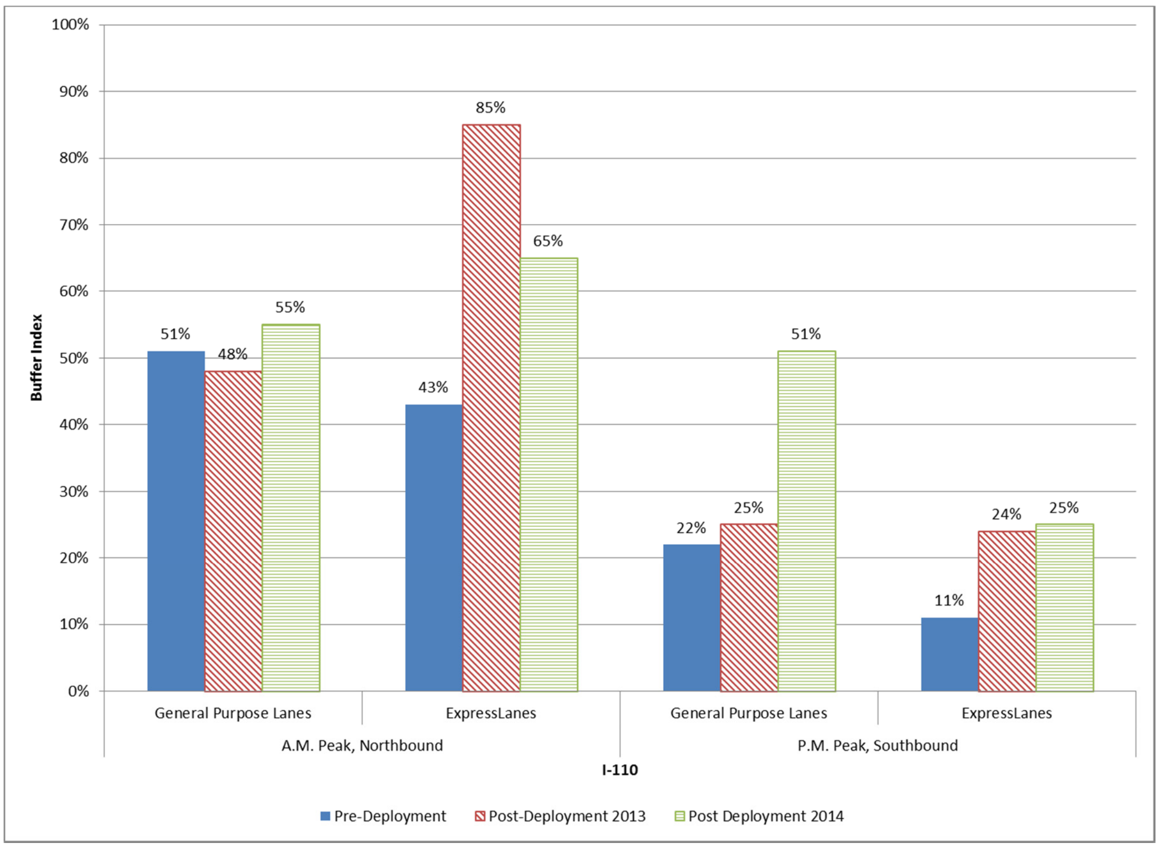


Source: Texas A&M Transportation Institute from data provided by Caltrans.

Figure A-18. Comparison of 95th Percentile Travel Times in the General Purpose and ExpressLanes for I-110 – Pre- and Post-Deployment

Figure A-19 illustrates the relative change in the Buffer Index for the I-110 general purpose lanes and the ExpressLanes in the peak periods, peak direction of travel. During the first year following the deployment of the CRD improvement, the Buffer Index in both peak periods remained close to their pre-deployment levels – meaning travel reliability in the general purpose lanes was not affected much by the CRD improvements. However, by 2014, the amount of extra time that travelers needed to allocate to ensure on time arrival during the both the morning and afternoon peak periods increased to approximately 50 percent. This suggests longer travel times in the general purpose lanes, particularly during the afternoon peak period, became less reliable in 2014 compared to pre-deployment conditions.

The Buffer Index for the ExpressLanes increased in both the morning and afternoon peaks periods. The northbound direction of travel in the ExpressLanes during the morning peak period experienced a 42 percent increase after the 2013 post-deployment period. In 2014, the Buffer Index for the ExpressLanes in the a.m. peak was still 22 percent higher than pre-deployment levels.



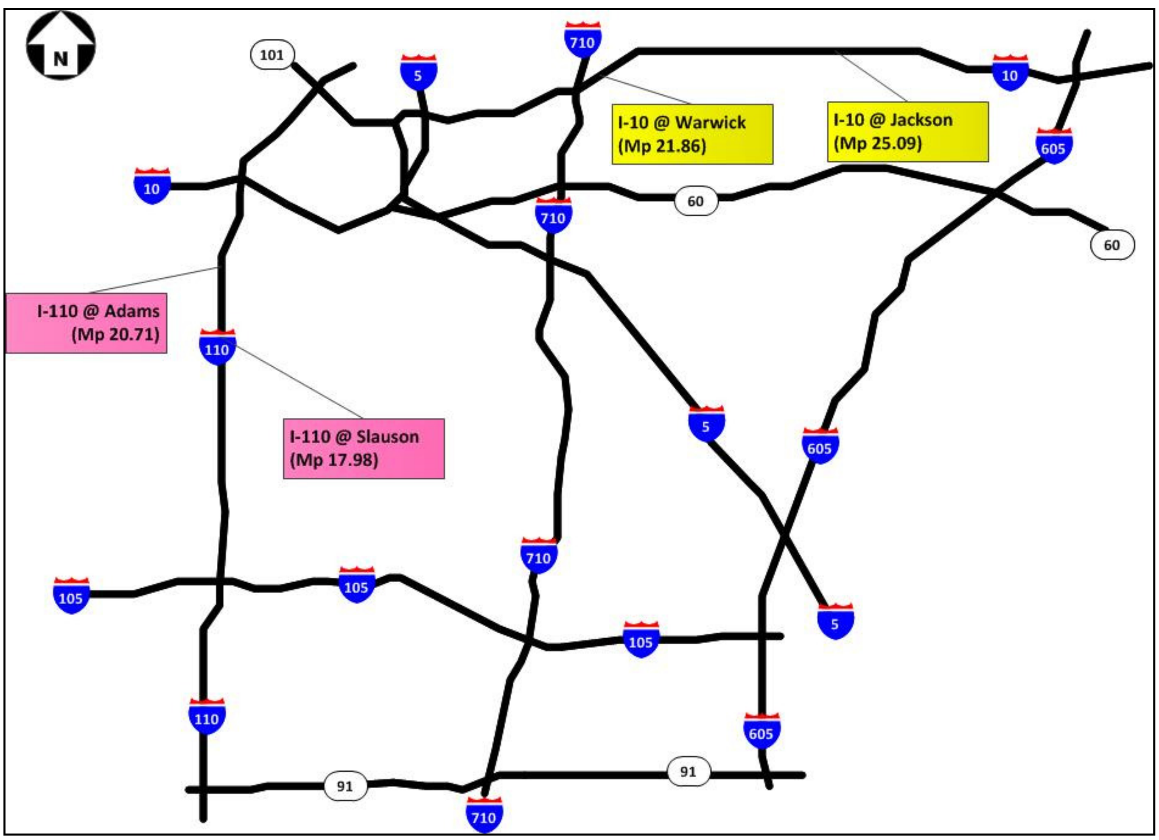
Source: Texas A&M Transportation Institute from data provided by Caltrans.

Figure A-19. Comparison of General Purpose and ExpressLanes Buffer Indices for the I-110 – Pre- and Post-Deployment

A.3 Changes in Vehicle and Person Throughput on the I-10 and I-110

Both vehicle and passenger throughput were also examined. The analysis was based on vehicle occupancy counts conducted by Caltrans. Vehicle occupancy data on both the I-10 and I-110 were collected using observers. Data collection personnel were positioned along the roadway (either overhead or adjacent to the roadway) so as to observe the number of occupants in each vehicle. Each vehicle was then categorized based on the number of occupants (single occupant vehicles, double-occupant vehicles, triple-occupant vehicles, etc.). Observed vehicles were placed into one of six different categories based on the number of occupants. Vanpools were designated as a 6+ occupant vehicle, while motorcycles were classified single-occupant vehicles. Buses were also categorized based on the estimated loading of the bus (full; ½-full, or ¼-full). Person throughput was calculated by multiplying the number of vehicles counted in each category by the occupancy requirement for each level in each category. The analysis focused only on peak hour vehicle and passenger throughput due to the difference in the time periods over the peak period in which data were collected in the pre- and post-deployment periods.

Figure A-20 shows the locations/mileposts (Mp) where Caltrans conducted their vehicle occupant studies. Table A-5 shows the dates of the Caltrans vehicle occupancy counts used in this analysis. As noted in Table A-5, occupancy counts were conducted on only one or two days during the different pre- and post-deployment periods. These limited observations need to be considered in reviewing the person throughput, as they may not reflect typical patterns in the corridor.



Source: Texas A&M Transportation Institute.

Figure A-20. Approximate Location of Caltrans Vehicle Occupancy Count Studies

Table A-5. Dates of Caltrans Vehicle Occupant Counts Used in CRD Throughput Analysis

Facility		Pre-Deployment	Post Deployment 2013	Post Deployment 2014
I-10 W	Warwick (Mp 21.86)	5/22/2012	6/4/2013	3/19/2014
	Jackson (Mp 25.09)	5/17/2012	5/02/2013 9/26/2013	3/4/2014 3/6/2014
I-110	Adams (Mp 20.71)	5/23/2012	2/27/2013 6/05/2013	2/19/2014
	Slauson (Mp 17.98)	5/16/2012 6/28/2012	2/26/2013 5/1/2013 10/18/2013	2/20/2014 3/5/2014

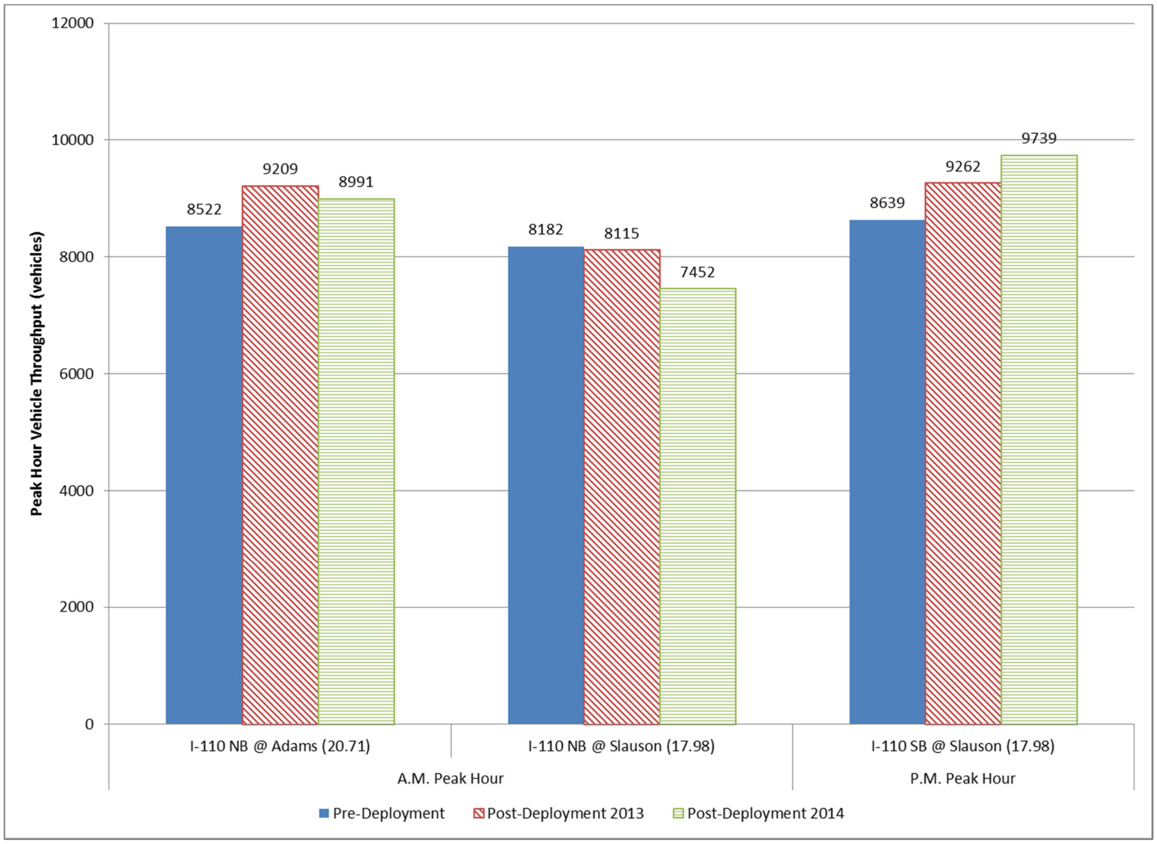
Source: Caltrans.

The pre-deployment data were collected six and nine months prior to the opening of the ExpressLanes. These data may not be representative of the seasonality of traffic nor changes due to improvements in the economy.

A.3.1 Vehicle Throughput

A number of Los Angeles CRD congestion hypotheses focus on vehicle throughput. Vehicle throughput is the number of vehicles that traverse a distance over a short period of time. Vehicle throughput diminishes as congestion forms. Data show that maximum vehicle throughput occurs when the freeway is operating with travel speeds ranging between 45 mph and 65 mph. For this study, vehicle throughput was computed using the vehicle occupant counts provided by Caltrans. Caltrans provided peak hour vehicle throughput counts for both the general purpose lanes and the ExpressLanes.

Figure A-21 shows the change in the peak hour vehicle throughput on the I-110 from the counts performed before and after the CRD improvements were implemented. The figure indicated mixed results in terms of average peak hour total vehicle throughput between the two post-deployment levels. In the morning, the total peak hour vehicle throughput on the I-110 near Adams Boulevard was 8 percent higher in 2013 and 5 percent higher in 2014, compared to pre-deployment level. At Slauson, average peak hour total vehicle throughput declined by approximately 9 percent in 2014 compared to pre-deployment levels.



Source: Texas A&M Transportation Institute from data provided by Caltrans.

Figure A-21. Comparison of Pre-and Post-Deployment of Vehicle Throughput on the I-110 at Selected Locations

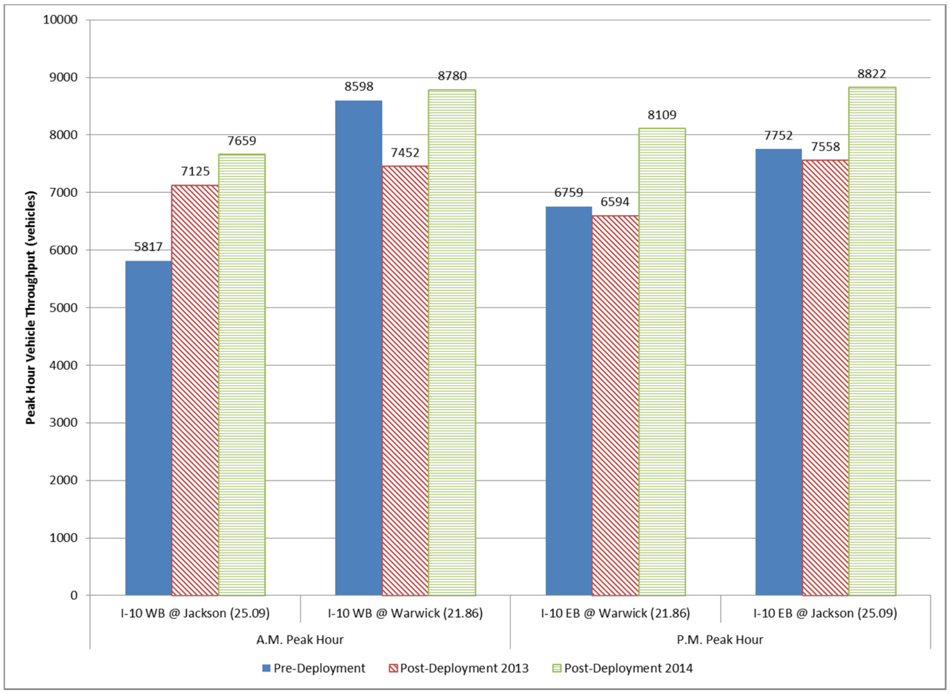
Table A-6 presents the changes in average vehicle throughput in the I-110 general purpose lanes and the ExpressLanes. The number of vehicles using the ExpressLanes during the morning peak period was generally 18-to-34 percent higher in both 2013 and 2014 compared to pre-deployment levels, while average vehicle throughput in the general purpose lanes dropped 15 percent and 8 percent during the same time interval. In the afternoon peak hour, the total vehicle throughput in the southbound direction increased in both the 2013 and 2014 post-deployment periods. The average vehicle throughput in the ExpressLanes remained near pre-deployment levels in 2013, but increased by nearly 27 percent by 2014. It should be noted that averages can have a tendency to skew data, particularly with a limited sample size (particularly with 1 to 3 counts in each evaluation period).

Table A-6. Change in Peak Hour Vehicle Throughput on the I-110 as a result of the LA CRD Improvements

Lane Type	Average Peak Hour Vehicle Throughput			Percent Change Between	
	Pre-Deployment	Post-Deployment 2013	Post-Deployment 2014	Pre and Post-Deployment 2013	Pre and Post-Deployment 2014
I-110 NB @ Adams (20.71) – A.M. Peak Hour					
GP Lanes	7,554	8,073	7,830	6.9%	3.7%
ExpressLane	968	1,136	1,161	17.4%	19.9%
Total	**8,522**	**9,209**	**8,991**	**8.1%**	**5.5%**
I-110 NB @ Slauson (17.98) – A.M. Peak Hour					
GP Lanes	5,818	4,920	4,143	-15.4%	-8.8%
ExpressLane	2,365	3,195	3,309	35.1%	39.9%
Total	**8,182**	**8,115**	**7,452**	**-0.8%**	**-8.9%**
I-110 SB @ Slauson (17.98) – P.M. Peak Hour					
GP Lanes	6,090	6,705	6,508	10.1%	6.9%
ExpressLane	2,549	2,557	3,232	0.3%	26.8%
Total	**8,639**	**9,262**	**9,739**	**7.2%**	**12.7%**

Source: Texas A&M Transportation Institute based on data provided by Caltrans.

Figure A-22 illustrates the change in the average peak hour total vehicle throughput on the I-10 over the three evaluation periods. In the morning peak hour, vehicle throughput increased 22 percent at one end of the corridor (at Jackson) but declined by 13 percent at the other end of the corridor (near Warwick). In 2014, the average morning peak hour total vehicle throughput had increased by 2 percent and 31 percent compared to pre-deployment levels. In the afternoon peak hour, average vehicle throughput declined by 2 percent in 2013 but increase by 13-to-20 percent in 2014. These changes in vehicle throughput were most likely impacted by the I-10 widening project ongoing during the evaluation period.



Source: Texas A&M Transportation Institute from data provided by Caltrans.

Figure A-22. Comparison of Pre-and Post-Deployment of Vehicle Throughput on the I-10 at Selected Locations

Table A-7 presents the change in peak hour vehicle throughput for the morning and afternoon peak hour for the I-10 general purpose and ExpressLanes. Vehicle throughput in the general purpose lanes declined slightly, but increased in the ExpressLanes.

Table A-7. Change in Peak Hour Vehicle Throughput on the I-10 as a result of the LA CRD Improvements

Lane Type	Average Peak Hour Vehicle Throughput			Percent Change Between	
	Pre-Deployment	Post-Deployment 2013	Post-Deployment 2014	Pre and Post-Deployment 2013	Pre and Post-Deployment 2014
I-10 WB @ Warwick (21.86) – A.M. Peak					
GP Lanes	7,720	5,675	6,405	-26.5%	-17.0%
ExpressLane	878	1,777	2,375	102.4%	170.5%
Total	8,598	7,452	**8,780**	**-13.3%**	**2.1%**
I-10 EB @ Warwick (21.86) – P.M. Peak					
GP Lanes	6,160	5,710	6965	-7.31%	13.1%
ExpressLane	599	884	1144	47.6%	91.0%
Total	6,759	6,594	**8,109**	**-2.4%**	**20.0%**
I-10 WB @ Jackson (25.09) – A.M. Peak					
GP Lanes	4,350	4,830	4545	11.0%	4.5%
ExpressLane	1,467	2,295	3114	56.4%	112.3%
Total	**5,817**	7,125	**7659**	**22.5%**	**31.7%**
I-10 WB @ Jackson (25.09) – P.M. Peak					
GP Lanes	6,780	5,940	6,803	-12.4%	0.3%
ExpressLane	972	1,618	2,019	66.4%	107.7
Total	**7,752**	7,558	**8,822**	**-2.5%**	**13.8%**

Source: Texas A&M Transportation Institute based on data provided by Caltrans.

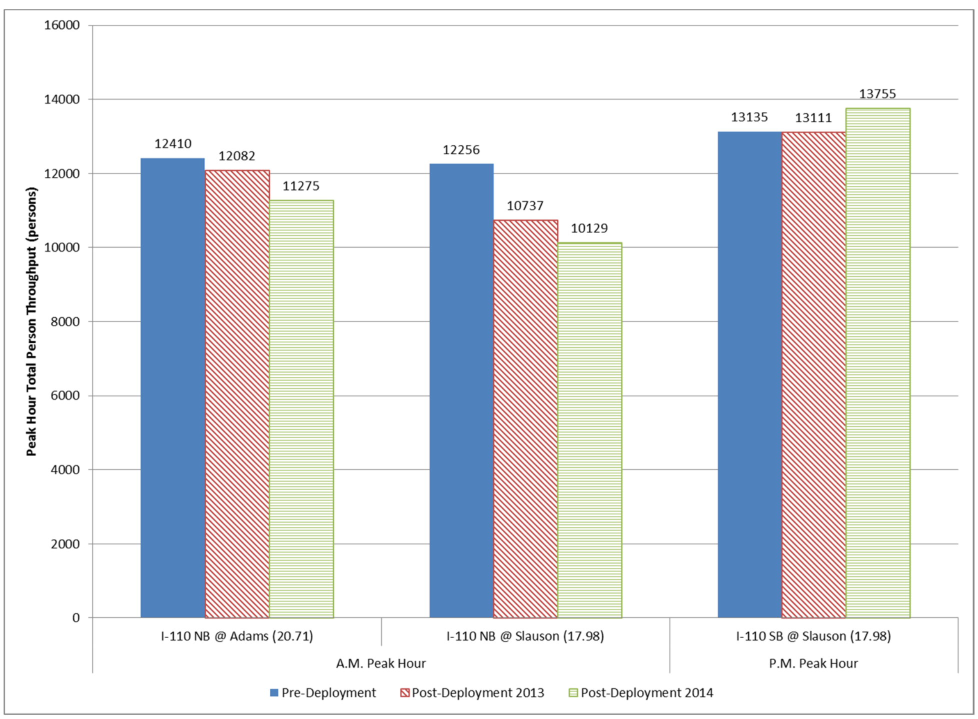
It should be noted that the vehicle occupancy counts were performed at a distance using manual observations. This approach has an unmeasured degree of inaccuracy based on comparisons to alternative methods of collecting occupancy data.

A.3.2 Person Throughput

Person throughput is a measure of how many people, on average, move through a segment of highway during a specified period. For this analysis, person throughput was computed using the Caltrans Occupancy Count data. Person throughput was computed by multiplying the number of occupants associated with each occupancy category by the number of vehicles observed in each occupancy category. In computing person throughput, Caltrans assumed that all designated vanpools contained a total of 6 occupants. Different levels of occupancies were assumed for different categories of buses – those bused designated as “1/4 full” were assumed to have 10 occupants, “½ full” buses were assumed to have 20 occupants, and “full” buses were assumed to have 40 occupants. Motorcycles were assumed to be single-occupant vehicles. As noted previously, the analysis of person throughput is based on an extremely limited number of vehicle occupancy counts performed in each evaluation period, and thus may not represent true trends for the corridors.

Figure A-23 and Table A-8 present the change in average peak hour person throughput in both the morning and afternoon peak hours on the I-110. The morning peak hour person throughput on the I-110 decreased by 328 persons at Adams and by 1,519 persons at Slauson in 2013. These changes equate to differences of 2.6 percent and 12 percent, respectively, at these locations. This reduction in average peak hour person throughput continued into 2014 – declining by 10 percent at Adams and by 17 percent at Slauson. The decline in average peak hour person throughput on the I-110 during the morning commute was attributed to increasing levels of congestion in the section of the I-105 and the Viaduct.

In the afternoon peak hours, changes in person throughput on the I-110 were examined at Slauson only. At this location, total person throughput the first year following deployment of the CRD improvements remained near pre-deployment levels. During 2013, the person throughput in the ExpressLanes decreased by 26.2 percent while person throughput in the general purpose lanes increased by almost 25 percent. In 2014, average person throughput in the southbound direction had increased by nearly 5 percent compared to pre-deployment conditions. Although still experiencing a reduction, the average person throughput in the ExpressLanes was only 10 percent below pre-deployment conditions.



Source: Texas A&M Transportation Institute based on data provided by Caltrans.

Figure A-23. Change in Total Peak Hour Person Throughput on the I-110 Pre- and Post-Deployment

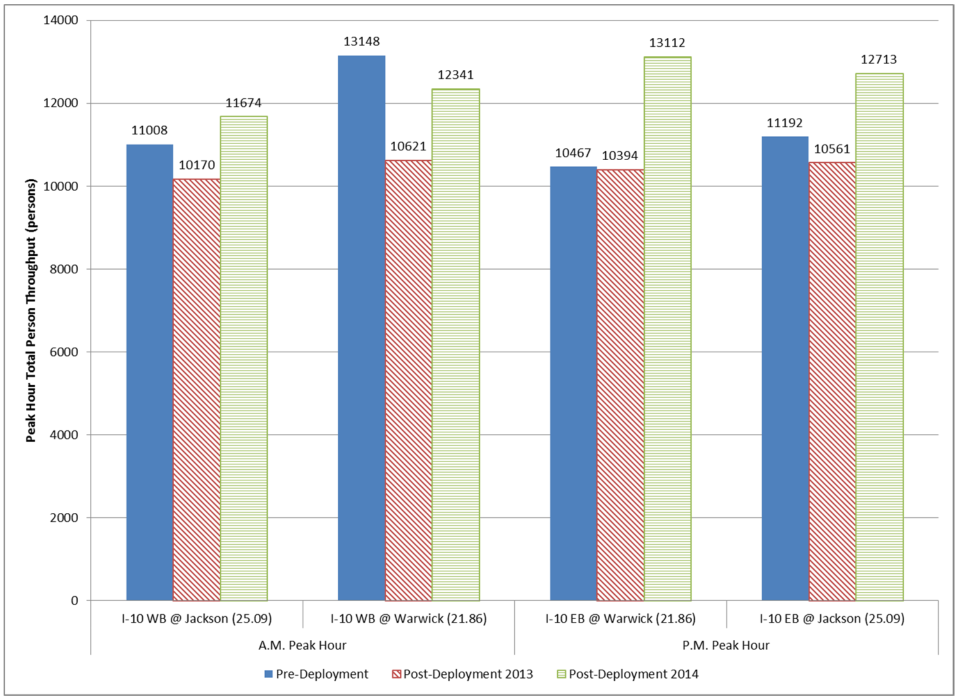
Table A-8. Change in General Purpose and ExpressLane Peak Hour Person Throughput at Select Locations on the I-110

Lane Type	Average Peak Hour Person Throughput			Percent Change Between	
	Pre-Deployment	Post-Deployment 2013	Post-Deployment 2014	Pre and Post-Deployment 2013	Pre and Post-Deployment 2014
I-110 NB @ Adams (20.71) – AM Peak Hour					
GP Lanes	9,498	9,480	8,772	-0.2%	-7.6%
ExpressLane	2,912	2,602	2,503	-10.7%	-14.0%
Total	**12,410**	**12,082**	**11,275**	**-2.6%**	**-9.1%**
I-110 NB @ Slauson (17.98) – AM Peak Hour					
GP Lanes	6,268	5,523	4,730	-11.9%	-24.5%
ExpressLane	5,989	5,214	5,399	-12.9%	-9.8%
Total	**12,256**	**10,737**	**10,129**	**-12.4%**	**-17.4%**
I-110 SB @ Slauson (17.98) – PM Peak Hour					
GP Lanes	6,688	8,353	7,978	24.9%	19.3%
ExpressLane	6,447	4,758	5,778	-26.2%	-10.4%
Total	**13,135**	**13,111**	**13,755**	**-0.2%**	**4.7%**

Source: Texas A&M Transportation Institute based on data provided by Caltrans.

Figure A-24 and Table A-9 present changes in the average peak hour person throughput at two locations – Warwick and Jackson – on the I-10 in the peak direction of travel for the morning and afternoon peak hours. In 2013, average peak hour person throughput in the A.M. peak declined by 8 and 19 percent at the two evaluation points in the corridor. This decline in person throughput was most likely attributable to a construction project that was ongoing during the first year after the deployment of the CRD improvements. In 2014, the average peak hour person throughput during the morning commute had increased by 6 percent.

In the afternoon peak hour, the average total person throughput remained approximately the same or decreased slightly during 2013, but increased in 2014 after the construction was completed. During the 2013 post-deployment period, the average total person throughput declined by less than 1 percent at Warwick and by almost 6 percent at Jackson. In 2014, after the construction was completed on the I-10, the average person throughput was higher at both locations. In 2014, the average person throughput in the ExpressLanes increased by approximately 30 percent during the afternoon peak hour, while the average person throughput in the general purpose lanes increased between 4 and 25 percent.



Source: Texas A&M Transportation Institute based on data provided by Caltrans.

Figure A-24. Change in Total Peak Hour Person Throughput on the I-10 Pre- and Post-Deployment

Table A-9. Change in General Purpose and ExpressLane Peak Hour Person Throughput at Select Locations on the I-10

Lane Type	Peak Hour Person Throughput			Percent Change Between	
	Pre-Deployment	Post-Deployment 2013	Post-Deployment 2014	Pre and Post-Deployment 2013	Pre and Post-Deployment 2014
I-10 WB @ Warwick (21.86) – AM Peak					
GP Lanes	8,390	6,335	6,890	-24.5%	-17.9%
ExpressLanes	4,758	4286	5,451	-9.9%	14.6%
Total	**13,148**	**10,621**	**12,341**	**-19.2%**	**-6.1%**
I-10 WB @ Jackson (25.09) – AM Peak					
GP Lanes	4,720	5,408	5,033	14.6%	6.6%
ExpressLanes	6,288	4,763	6,642	-24.3%	5.6%
Total	**11,008**	**10,170**	**11,674**	**-7.6%**	**6.1%**
I-10 EB @ Jackson (25.09) – PM Peak					
GP Lanes	7,650	7,150	7,968	-6.5%	4.2%
ExpressLanes	3,542	3,411	4,745	-3.7%	34.0%
Total	**11,192**	**10561**	**12,713**	**-5.6%**	**13.6%**
I-10EB @ Warwick (21.86) – PM Peak					
GP Lanes	7070	7015	8825	-0.78%	24.8%
ExpressLanes	3397	3379	4287	-0.53%	26.2%
Total	**10467**	**10394**	**13112**	**-0.7%**	**25.3%**

Source: Texas A&M Transportation Institute based on data provided by Caltrans.

It should be noted that the person throughput analysis is based on a limited sample size. These data may not provide an adequate representation of travel conditions in either of these corridors.

A.4 Pre- and Post-Deployment I-10 and I-110 Surveys

Metro sponsored pre- and post-deployment surveys[1] of motorists using the I-10 and I-110 freeways, including the general-purpose lanes and the HOV/ExpressLanes. The pre-deployment surveys were conducted in October and November of 2012, prior to the conversion of the HOV lanes to HOT lanes. The post-deployment survey was conducted in January and February 2014, 12-to-15 months after implementation of the ExpressLanes on the I-10 and I-110.

[1] ExpressLanes Public Education and Market Research Support – 2012 Pre-Implementation Survey License Plate Survey, Draft Report, Redhill Group, Inc., December 24, 2012. Metro ExpressLanes Post-Deployment License Plate Survey, Los Angeles County Metropolitan Authority, April 11, 2014.

Both surveys included questions on travel patterns, attitudes related to travel satisfaction, familiarity and support for the ExpressLanes, and demographic characteristics. The 2014 survey included updated and revised questions from the 2012 survey, reflecting the opening and operation of the ExpressLanes. Some questions in the 2012 survey, including those relating to perceptions of congestion and travel reliability, were not included in the 2014 survey, however. As a result of this oversight, the hypotheses and questions related to travelers' perception on changes in travel time reliability and congestion were not able to be analyzed.

Responses to general questions associated with travel on the facilities are presented first, followed by two questions related to perceptions of congestion and the benefits of the ExpressLanes. Questions of interest to the tolling, equity, and carpooling analysis are presented in those particular appendices. In addition, a more detailed description of the survey methodology is presented in Appendix B – Tolling Analysis.

- As could be expected, the results from the 2014 survey indicate that work trips dominated travel during the peak periods. Works trips accounted for 79 percent of the peak period trips on the I-10 and 74 percent on the I-110. As a result, 53 percent of the I-10 respondents and 56 percent of the I-110 respondents reported traveling on the freeways five days a week in 2014. Another 17 percent of the respondents on the I-10 and 16 percent of the respondents on the I-110 reported using the freeways three-to-four times a week during the peak periods. The survey results indicated some shifts in mode use, including becoming a toll paying solo driver and reductions in carpooling, vanpooling, or bus use. The results also indicated that 49 percent of the I-10 respondents and 47 percent of the I-110 respondents used the ExpressLanes at least once a week as a carpooler, vanpooler, or bus rider.

- The 2012 and 2014 surveys included positive and negative statements about the ExpressLanes. Respondents were asked to agree or disagree with the statements. The results indicated general support for the ExpressLanes, with HOV users expressing stronger support. One of the positive statements was "Even if I do not wish to pay to use the ExpressLanes on a regular basis, it is good to have as an option when I need to go somewhere fast." In the 2012 survey, 67 percent of all respondents on the I-10 and I-110 supported this statement. In the 2014 survey, support for this statement was lower at 58 percent. In 2014, response to the statement varied by facility and by HOV users and non-users. On the I-10, 69 percent of all respondents agreed with this statement in 2012, compared with 63 percent in 2014. Agreement was higher, at 81 percent, among HOV users than non-HOV users at 45 percent in 2014. On the I-110, 64 percent of all respondents agreed with the statement in 2012, compared to 53 percent in 2014. Agreement was higher among HOV users in 2014 at 63 percent than for non-HOV users at 43 percent.

- A second positive statement included in the 2012 and the 2014 surveys was "The ExpressLanes benefit all motorists by shifting traffic out of the regular lanes into the ExpressLanes when the ExpressLanes are not being fully used." In 2012, 55 percent of all I-10 and I-110 respondents supported this statement. Support was lower at 35 percent for this statement in the 2014 survey. Response to the statement in 2014 varied by facility and among HOV users and non-users. On the I-10, 57 percent of all respondents in 2012 agreed with the statement, compared to 50 percent in 2014. Agreement was higher, at 64 percent, among HOV users than non-users at 35 percent in 2014. On the I-110, 50 percent of all respondents agreed with the statement in 2012, compared to 40 percent in 2014. Support for the statement was higher, at 45 percent, among HOV users, than for non-HOV users at 35 percent in 2014.

A.5 ExpressLanes FasTrak® Customer Satisfaction Surveys

Metro conducted a customer satisfaction survey of existing Metro ExpressLanes FasTrak® account holders for a one week period from August 30-to-September 6, 2013. Invitations containing a link to the self-administered survey were emailed to all Metro ExpressLanes FasTrak® account holders with a valid email on file. Individuals who completed a survey were provided with a $10 toll credit. Approximately 153,000 FasTrak® account holders were sent emails with a link to the survey. A total of 28,870 surveys were completed, accounting for a response rate of approximately 19 percent.

No demographic data or other socio-economic status were included in the survey. Thus, it is not possible to ascertain to what degree the sample of respondents is representative of ExpressLanes travelers. Additionally, since the survey is of FasTrak® account holders, individuals who previously carpooled on the I-10 and I-110 HOV lanes but chose not to obtain a FasTrak® transponder would be excluded from the survey.

The survey included 14 questions on use of the ExpressLanes, communication methods, and customer satisfaction. Twelve of the questions were quantitative, closed-ended questions with preset responses. Two questions were open-ended allowing individuals to provide their own responses.

The survey questions addressing current use of the ExpressLanes, prior use of the carpool/HOV lanes, reasons for obtaining a FasTrak® transponder, and greatest benefit from the ExpressLanes are relevant to the congestion analysis and the tolling analysis. The responses to these questions are summarized in this section.

- The first question in the user profile section focused on the toll facility the respondent used the most. Users of the I-110 ExpressLanes represented 64 percent of the respondents, compared to 30 percent who reported primarily using the I-10 ExpressLanes. The remaining 6 percent reported using other toll facilities in Southern California.

- In the second question, respondents were asked to select a single category best describing themselves. Slightly over half, 55 percent, self-identified as a carpooler (34 percent selected 2-person carpools and 21 selected carpools with more than 2 persons), while 43 percent self-identified as solo drivers, 1 percent self-identified as a vanpooler, and 1 percent self-selected as a motorcyclist.

- The third user profile question asked how many round trips the respondent made using the ExpressLanes on Monday through Friday in a typical week. A total of 51 percent reported making 1-to-3 round trips per work week, 27 percent reported no trips, and 22 percent reported making 4 or more round trips (16 percent reported 4-to-6 trips, 3 percent reported 7-to-9 trips, and 3 percent reported 10 or more trips).

- The fourth user profile question asked how frequently the respondent used the carpool/HOV lanes prior to the opening of the ExpressLanes. The responses were split between 3-to-5 days a week, 18 percent; 1-to-2 days a week, 21 percent; twice a month, 21 percent; once a month, 21 percent; never, 13 percent; and other, 6 percent. Approximately 84 percent of the individuals reporting no use of the carpool/HOV lane self-identified as solo drivers in the second question. The remaining 16 percent self-identified as carpoolers, vanpoolers, and motorcyclists. These results indicate that existing carpools did continue to use the ExpressLanes after the HOV-to-HOT expansion and new toll paying solo drivers also use the lanes.

- One of the customer satisfaction questions focused on the primary reason for obtaining an ExpressLanes FasTrak® transponder. Work was the most frequently selected response at 47 percent, but 31 percent identified faster access to other freeways as the major reason. Other responses to the pre-identified responses were school, 3 percent; upgrade existing transponder to a switchable FasTrak® transponder, 2 percent; and other, 17 percent. In the other category, 3 percent of the total respondents reported faster commute/convenience as the motivating factor. The responses to this question were examined by corridor, mode of use, and number of round trips. Most solo drivers reported getting a FasTrak® transponder for work, while more carpoolers favored faster access to other freeways. The vast majority, 81 percent, of frequent ExpressLanes users (4 or more round trips) reported work as their primary reason for obtaining a transponder.

- Another customer satisfaction question addressed the greatest benefit of the ExpressLanes. The majority of respondents, 71 percent, selected time savings as the greatest benefit; followed by solo driver access, 19 percent; convenience, 6 percent; reliability, 1 percent; and other, 3 percent. The responses were similar across all self-reported modes, with the exception of solo driver access, which was selected by more solo drivers. The responses were also similar across the frequency of use groups.

- A further customer satisfaction survey question asked respondents to rate their overall experience to-date with the ExpressLanes. Most respondents, 86 percent, rated their experience as good or excellent, 11 percent gave an average rating, and 3 percent gave a poor rating. While the general responses were similar across all self-reporting mode, solo drivers had the highest percent of excellent rating and motorcyclists had the lowest. The responses were similar across the two facilities and across the different round trip user groups.

- The final customer satisfaction question asked if the respondent would recommend FasTrak® to their friends and family. The majority of respondents, 81 percent, answered yes, 17 percent answered maybe, and 3 percent answered no. The responses were similar across modes and the number of round trips. The one slight difference was that the percentage of solo driers reporting they would recommend FasTrak® to friends and family was slightly higher and percentage of motorcyclists was slightly lower.

The August 2014 FasTrak® customer satisfaction survey conducted by Metro included four questions to help identify possible changes in travel mode resulting from implementation of the ExpressLanes and factors influencing any changes. Respondents were asked to estimate the number of one-way trips they made monthly on the I-10 and I-110 by mode before-and-after implementation of the ExpressLanes. Individuals were also asked to select from a predetermined list the reasons they carpooled/vanpooled with less frequency or with more frequency after the ExpressLanes opened.

Metro provided the data file with the responses to these questions. A total of 30,727 responses were included in the file. Of this total, 1,068 individuals responded “not applicable” to the questions estimating the number of trips before-and-after implementation of the ExpressLanes. These responses were removed from the data file, resulting in 29,659 responses. No questions asking for demographic or socio-economic information on the survey respondents were provided. As a result, it is not possible to determine to what degree the sample of respondents is representative of ExpressLanes travelers.

Responses to the questions on the number of trips by mode before-and-after implementation of the ExpressLanes were analyzed to help identify possible changes in travel mode as a result of the ExpressLanes. Changes between driving alone and carpooling were of primary interest to address the tolling hypotheses, but are also important for the congestion analysis. For each respondent, the percent of drive alone trips and the percent of carpool trips before implementation of the ExpressLanes were calculated relative to the total number of before trips. The percent of drive alone trips and the percent of carpool trips after implementation of the ExpressLanes relative to the total number after trips was also calculated. The two rates were subtracted (after ExpressLanes opened – before ExpressLanes opened) to obtain the difference in the rate of drive alone and carpool trips.

A more detailed analysis of these questions is provided in Appendix B – Tolling Analysis. A few highlights related to the congestion analysis are summarized below.

- There was no change in the rate of carpooling for 66 percent of respondents. Approximately 22 percent of respondents experienced an increase in their rate of carpooling, with 10 percent experiencing an increase of over 75 percent. Approximately 12 percent experienced a decrease in their rate of carpooling, including 4 percent experiencing a decrease of 75 percent.

- Approximately 65 percent of respondents who drove alone before the ExpressLanes were implemented, continued to make the same number of monthly one-way solo trips after the ExpressLanes were opened. Given that these individuals have ExpressLanes FasTrak® transponders, it is assumed that these trips are now being made in the ExpressLanes as a solo toll paying motorist, rather than in the general purpose lanes. In addition, approximately 22 percent of respondents experienced a reduction in their drive-alone trip rates, while 13 percent experienced an increase. An analysis similar to the one described above for carpoolers indicated that most solo drivers who are driving less are carpooling more, and most solo drivers who are driving more are carpooling less. As discussed later in this section, 38 percent of the respondents who indicated they were carpooling more identified the main reason for this change as the desire for the travel-time savings provided by the ExpressLanes, without having to pay the toll.

- The vast majority of vanpoolers – 99 percent, bus riders – 98 percent, and motorcyclists – 99 percent, reported no change in the number of trips before-and-after implementation of the ExpressLanes. As a result, a detailed analysis was not conducted on the respondents indicating vanpooling, taking the bus, and riding their motorcycles as their major mode. These trips would have been made in the I-10 and I-110 HOV lanes in the pre-deployment period and would continue to be made in the ExpressLanes in the post-deployment period.

A.6 Findings of Congestion Impacts

Table A-10 summarizes the impacts for the 15 congestion-related hypotheses and questions. Overall, implementation of the ExpressLanes and the other CRD projects improved and maintained operations of the heavily traveled I-10 and I-110 corridors. The analysis results and support of the hypotheses vary by corridor, time-of-day, and direction of travel.

The hypothesis related to the impact of deploying the ExpressLanes on the I-10 and I-110 on travel times, travel speeds, trip-time reliability, and other related factors were generally supported. Peak period, peak direction travel times on the I-10 increased slightly in the general purpose lanes in the morning, but declined slightly in the afternoon. Travel times on the I-10 ExpressLanes declined during both time periods. Travel times on the I-110 general purpose lanes increased slightly in the morning, but remained approximately the same in the afternoon. Travel times in the ExpressLanes increased in the morning, but remained the same in the afternoon.

Travel time reliability, as measured by the 95th percentile travel time and the Buffer Index, improved on the I-10 ExpressLanes and general purpose lanes, but worsened on the I-110 ExpressLanes and general purpose lanes in the post-deployment period. Vehicle throughput increased on the I-110 in both the morning and afternoon peak hours, peak direction of travel. Person throughput declined slightly in the morning, but increased in the afternoon. Vehicle and person throughput increased on the I-10 in both the morning and afternoon peak hours, peak direction of travel.

Travel speeds in the I-10 and I-110 ExpressLanes remained above the 45 mph target in all but a few time intervals on the I-110 during the morning and afternoon peak periods. Travel speeds in the I-10 and I-110 general purpose lanes declined in the morning peak period, but increased or remained the same in the afternoon peak period. The 2014 post-deployment time data indicated that travel times are increasing in some time intervals on the I-10 and I-110 ExpressLanes and general purpose lanes in the morning peak period, but declining or remaining the same in the afternoon peak period. The increases in travel time may reflect the improving economy in the area.

Use of the I-10 and I-110 ExpressLanes continued to provide travel-time savings over the general purpose lanes in the 2014 post-deployment period. Travel time reliability did decline slightly in the I-110 ExpressLanes. With the exception of the I-110 in a portion of the morning peak period, it does not appear that allowing tolled vehicles to use the HOV/ExpressLanes has caused congestion in the lanes. Travel times and travel speeds in the ExpressLanes improved or remained the same in the 2014 post-deployment period.

The information needed to assess the final two hypotheses and four questions was not available. Data were not available on congestion levels on arterial streets paralleling the I-10 and I-110 corridors. Data on congestion levels in downtown Los Angeles were also not available. Thus, it was not possible to assess the hypotheses related to reducing congestion on arterial streets paralleling the I-10 and I-110 corridors and reducing congestion in downtown Los Angeles.

Questions on travelers' perceptions related to noticeable reductions in travel times, improvements in trip-time reliability, reductions in the duration of congested periods, and reductions in the length of peak congestion periods on the I-10 and I-110 were inadvertently left off the 2014 post-deployment survey of motorists in the corridors. While it was not possible to assess these questions, the 2012 and 2014 surveys of motorists using the I-10 and I-110 general purpose lanes and the ExpressLanes, and the 2013 ExpressLanes FasTrak® Customer Satisfaction Survey provided some insights on the perceptions of travelers on the benefits of the ExpressLanes. One of the statements in the 2012 and 2014 survey of motorists was "Even if I do not wish to pay to use the ExpressLanes on a regular basis, it is good to have an option when I need to go somewhere fast." Approximately 67 percent of the respondents in 2012 and 58 percent in 2014 agreed with this statement. Support was higher among I-10 users and among HOV users on both facilities.

The 2013 ExpressLanes FasTrak® Customer Satisfaction Survey included questions related to the perceived benefits of the ExpressLanes. Approximately 71 percent of the respondents selected time savings as the greatest benefit from using the ExpressLanes. In response to a question asking respondents to rate their overall experience to-date with the ExpressLanes, 86 percent rated their experience as good to excellent. Approximately 81 percent of respondents reported they would recommend FasTrak® to their family and friends.

Table A-10. Summary of Impacts across Congestion Hypotheses

Hypotheses	Result	Evidence
Deployment of the ExpressLanes will reduce the travel time of users in the I-10 and I-110 corridors.	Somewhat Supported	Peak period, peak direction travel times on the I-10 increased slightly in the general purpose lanes in the morning and declined slightly in the afternoon. Travel times in the I-10 ExpressLanes declined during both time periods. Travel times in the I-110 general purpose lanes increased slightly in the morning and remained approximately the same in the afternoon, while travel times in the ExpressLanes increased in the morning and remained the same in the afternoon.
Deployment of the ExpressLanes will improve the reliability of user trips in the I-10 and I-110 corridors.	Somewhat Supported	Travel time reliability, as measured by the 95th percentile travel time and the Buffer Index, improved on the I-10 ExpressLanes and general purpose lanes, but declined on the I-110 ExpressLanes and general purpose lanes in the post-deployment period.
Deploying the ExpressLanes will result in more vehicles and persons served in the I-10 and I-110 corridors during peak periods.	Somewhat Supported	Vehicle throughput increased on the I-110 in both the morning and afternoon peak hours, peak direction of travel. Vehicle occupancy counts show that the person throughput has decreased on the I-110 ExpressLanes during the a.m. and p.m. peak hours. Vehicle and person throughput increased on the I-10 in both the morning and afternoon peak hours, peak direction of travel.

Table A-10. Summary of Impacts across Congestion Hypotheses (Continued)

Hypotheses	Result	Evidence
The ExpressLanes will regulate vehicular access to I-10 and I-110 and improve their operation.	Somewhat Supported	Travel speeds in the I-10 and I-110 ExpressLanes remained above 45 mph in all but a few time intervals on the I-110 during the morning and afternoon peak periods. On the I-10, average travel speeds ranged between 58 mph and 65 mph in the morning peak period and from 47 to 58 mph in the afternoon peak period. In the morning peak period, average travel speeds on the I-110 were slightly slower in the post deployment periods between 7:00 to 9:00; however, average travel speeds remained above 45 mph throughout the entire afternoon peak period. Travel speeds declined in the I-10 and I-110 general purpose lanes in the morning peak period, but increased or remained the same in the afternoon peak period.
The ExpressLanes pricing will maintain operating improvements on the I-10 and I-110 after the initial ramp up.	Somewhat Supported	The 2014 post-deployment travel time data suggests that the travels times in some intervals of the morning peak period are increasing in both the general purpose lanes and in the ExpressLanes on the I-10 and I-110. Travel times in the afternoon peak period continue to remain at the same level or have improved in the 2014 post-deployment period.
Relative travel times for HOV/HOT lanes versus general purpose lanes will either remain the same or (more likely) improve for HOV/HOT travelers as a result of the ExpressLanes.	Somewhat Supported	The ExpressLanes continue to provide a travel time advantage over the general purpose lanes in all time intervals. With the exception of the morning peak period on the I-110, the relative travel time advantage of using the ExpressLanes over the general purpose lanes increased in most intervals in both peak periods in both corridors.
The introduction of tolled traffic into the I-10 and I-110 ExpressLanes will not negatively impact HOV or transit traffic in terms of average travel times or travel reliability.	Somewhat Supported	On the I-10 ExpressLanes, travel time reliability improved by over 6 minutes in the morning peak period and by approximately 2 minutes in the afternoon peak period. On the I-110 ExpressLanes, the travel time reliability declined during some time intervals, but the ExpressLanes still provided a travel time advantage over the general purpose lanes.
Allowing tolled vehicles will not cause traffic congestion to increase in the ExpressLanes.	Somewhat Supported	With the exception of the I-110 during part of the morning peak period, allowing tolled vehicles to use the HOV/ExpressLanes has not caused congestion in the lanes. Travel times and speeds in the ExpressLanes remained the same or improved in the 2014 post-deployment period.
Because of latent demand in the I-10 and I-110 corridors, the ExpressLanes are not likely to impact traffic congestion in the general purpose lanes.	Supported	In the I-10 and I-110 corridors, travel speeds in the general purpose lanes declined in the morning peak period, but increased or remained the same in the afternoon peak period. The 2014 post-deployment time data indicate that travel times are increasing in some time intervals on the I-10 and I-110 ExpressLanes and general purpose lanes in the morning peak period, but declining or remaining the same in the afternoon peak period.

Table A-10. Summary of Impacts across Congestion Hypotheses (Continued)

Hypotheses	Result	Evidence
Because of the ExpressLanes, congestion on the arterial streets paralleling the corridors will be reduced.	Unknown	Data were not available to assess the impacts of the ExpressLanes on parallel arterial streets in the I-10 and I-110 corridors. Thus, it is not possible to assess this hypothesis.
Will surveyed travelers perceive a noticeable reduction in travel times in the I-10 and I-110 corridors?	Unknown	A question on travelers' perception of a noticeable reduction in travel times on the I-10 and I-110 corridors was not included in the 2014 survey of motorists in the I-10 and I-110 corridors. Thus, it is not possible to assess this question.
Will surveyed travelers perceive a noticeable improvement in trip time reliability in the I-10 and I-110 corridors?	Unknown	A question on travelers' perception of a noticeable improvement in time reliability on the I-10 and I-110 corridors was not included in the 2014 survey of motorists in the I-10 and I-110 corridors. Thus, it is not possible to assess this question.
Will surveyed travelers perceive a noticeable reduction in the duration of congested periods in the I-10 and I-110 corridors?	Unknown	A question on travelers' perception of a noticeable reduction in the duration of congestion periods on the I-10 and I-110 corridors was not included in the 2014 survey of motorists in the I-10 and I-110 corridors. Thus, it is not possible to assess this question.
Will surveyed travelers perceive a noticeable reduction in the length of peak congestion periods in the I-10 and I-110 corridors?	Unknown	A question on travelers' perception of a noticeable reduction in the length of peak congestion periods on the I-10 and I-110 corridors was not included in the 2014 survey of motorists in the I-10 and I-110 corridors. Thus, it is not possible to assess this question.
Deployment of LA Express Park™ will reduce congestion in the downtown.	Unknown	Data were not available to assess the impacts of the LA Express Park™ project on congestion in downtown Los Angeles. Thus, it was not possible to assess this hypothesis.

Source: Texas A&M Transportation Institute.

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Appendix B. Tolling Analysis

This tolling analysis focuses on two of the Los Angeles (LA) Congestion Reduction Demonstration (CRD) projects – the ExpressLanes on the I-110 and I-10 and LA Express Park™ in downtown LA. The ExpressLanes were implemented by expanding and converting the existing high-occupancy vehicle (HOV) lanes on the I-110 and I-10 into high-occupancy toll (HOT) lanes. LA Express Park™ combined technology and demand-pricing into an innovative parking management strategy in a 4.5 square mile area of downtown LA. The analysis of the ExpressLanes is presented first followed by the LA Express Park™ analysis.

The Los Angeles County CRD National Evaluation Plan included six tolling hypotheses. Two tolling-related hypotheses were addressed in Appendix A – Congestion Analysis. These hypotheses were that the ExpressLanes would regulate vehicle access to the I-110 and I-10 and improve their operation, and that the I-110 and I-10 ExpressLanes pricing would maintain operating improvements after the initial ramp-up period.

Table B-1 presents the hypotheses for the tolling analysis presented in this appendix. Two hypotheses address the ExpressLanes and two hypotheses focus on LA Express Park™. The first hypothesis was that some general purpose lane travelers on the I-110 and I-10 would shift to the ExpressLanes, while travelers using the HOV lanes would continue to use them after the conversion to HOT lanes. The second hypothesis was that implementing the ExpressLanes would reduce HOV violation rates. The two hypotheses associated with LA Express Park™ were that the project would result in 70 to 90 percent of the parking spaces on each block being occupied throughout the day and that the project may increase parking revenues that could be used to fund system expansion in other high-demand areas. It is important to note that increasing parking revenues was not a goal of the LA Express Park™ project, however. In addition to these hypotheses, the one question from the business analysis addressing the potential effects of the LA Express Park™ project on businesses relying on customers' ability to access their stores is examined in the appendix.

Table B-1. Los Angeles CRD Tolling Analysis Hypotheses

Hypotheses/Questions
• Some general purpose lane travelers will shift to the ExpressLanes, while HOV lane travelers will continue to use them after the conversion to HOT lanes.
• Implementing the ExpressLanes will reduce HOV violation rates.
• The LA Express Park™ project will result in the occupancy of 70 percent to 90 percent of the parking spaces on each block throughout the day.
• The LA Express Park™ project may increase parking revenues that can be used to fund system expansion in other high-demand areas.
• How will the LA Express Park™ project affect retailers and similar businesses that rely on customers' ability to access their stores?

Source: Battelle.

The remainder of this appendix is divided into 14 sections. The data sources used in the analysis are described in Section B.1. The operating characteristics of the I-110 and I-10 ExpressLanes are summarized in Section B.2. Section B.3 examines the number of ExpressLanes accounts and transponders issued from July 2012 to February 2014. Toll transaction data and use of the I-110 and I-10 ExpressLanes are discussed in Section B.4. Enforcement of the ExpressLanes and HOV and HOT violation rates are described in Section B.5. Information on the I-110 and I-10 ExpressLanes toll rates is presented in Section B.6. ExpressLanes toll revenues are examined in Section B.7. Section B.8 summarizes the results from the pre- and post-deployment surveys of users of the I-110 and I-10 conducted in 2012 and 2014. Section B.9 examines the results from the 2013 and 2014 ExpressLanes FasTrak® customer satisfaction surveys. Section B.10 provides an overview of the LA Express Park™ project. Section B.11 reviews pre- and post-deployment parking rate changes. Section B.12 examines changes in parking space occupancy. Section B.13 presents the results of intercept and on-line surveys of individuals parking in downtown LA. The Appendix concludes with a summary of the tolling hypotheses in Section B.14.

B.1 Data Sources

Data from five sources were used in the ExpressLanes analysis. First, Metro provided data on new toll accounts opened and transponders issued from July 2012 to January 2014. Second, Metro also provided information on ExpressLanes transactions, the amount of time the ExpressLanes were closed to Single Occupant Vehicles (SOVs), toll rates, and gross toll revenue from November 2012 to December 2013. Third, the California Highway Patrol (CHP) provided information regarding citations issued on the ExpressLanes. Fourth, information from various Metro reports, press releases, and news articles were reviewed as part of this analysis. Fifth, Metro also provided reports summarizing the 2012 and the 2014 surveys of I-110 and I-10 users, the report on the 2013 FasTrak® customer satisfaction survey, and the data file for the questions on mode use before and after implementation of the ExpressLanes included in the August 2014 customer satisfaction survey.

Data from three sources were used in the LA Express Park™ analysis. First, information from the LA Express Park™ website, LA Department of Transportation (LADOT) press releases, and news articles were reviewed. Second, information from the pre- and post-deployment interviews with LADOT personnel and the workshops were examined. Third, papers written by LADOT and Xerox personnel for professional organizations and meetings were obtained and reviewed. LA Express Park™ data files were not analyzed due to limited resources.

B.2 I-110 and I-10 ExpressLanes Operating Characteristics

The ExpressLanes represent the first use of tolling in both corridors in LA County. The intent of the ExpressLanes was to provide additional mobility options and choices for travelers in vehicles not meeting the occupancy requirements, while maintaining travel time savings and trip-time reliability for buses, vanpools, and carpools. The 11-mile ExpressLanes on the I-110 opened on November 10, 2012 and the 14-mile ExpressLanes on the I-10 opened on February 23, 2013. The I-110 ExpressLanes included two lanes in each direction of travel from the I-105 to Exposition Blvd. As part of the CRD, a second lane was added to the I-10 ExpressLanes from the I-605 to the I-710.

The user requirements on the I-110 and I-10 ExpressLanes reflected those in effect during the previous HOV operations. The I-110 HOV lanes operated with a HOV2+ requirement 24 hours a day, 7 days a week (24/7). The I-110 ExpressLanes continue to provide toll-free HOV2+ access on a 24/7 basis, with vehicles not meeting the current carpool occupancy requirement allowed to use the lanes by paying the posted toll. The HOV lanes on the I-10 have had a variable-occupancy requirement since July 24, 2000. The I-10 HOV lanes were restricted to HOV3+ on weekdays from 5:00 a.m. to 9:00 a.m. and from 4:00 p.m. to 7:00 p.m. The lanes were open to HOV2+ use at all other times. The I-10 ExpressLanes allow HOV2+ to use the lanes during the HOV3+ restricted period by paying the posted toll, while continuing toll-free access at all other times. In addition, vehicles not meeting the carpool occupancy requirements can access the I-10 ExpressLanes at any time by paying the posted toll. Thus, the ExpressLanes on both freeways maintain the same access for the different HOV user groups, while expanding the eligible users to include toll-paying vehicles that do not meet the carpool occupancy requirement. While the occupancy requirements were not changed, carpools and vanpools were required to register, obtain, and use FasTrak® transponders. This requirement added extra steps for using the former HOV lanes as a carpooler or vanpooler and may have deterred use by these users.

During the one-year demonstration, vehicles with California Clean Air stickers were required to pay the appropriate toll if they did not meet the vehicle occupancy requirements. Effective February 29, 2014, at the end of the demonstration period, vehicles with white and green California Clean Air stickers were allowed to travel toll-free irrespective of occupancy levels with a FasTrak® transponder. Use of the yellow California Clean Air stickers, which included hybrid vehicles, were allowed to lapse by the California Legislature on July 1, 2011, so these vehicles were not allowed to use the HOV lanes during either the pre- or post-deployment periods.

The I-110 and I-10 ExpressLanes use FasTrak®, an electronic toll data collection system allowing drivers to travel through designated FasTrak®-only lanes without stopping. All drivers, including carpools, need a FasTrak® transponder to use the ExpressLanes. Motorcycles were initially required to obtain a transponder, but that requirement was removed in February 2013 due to software improvements by the toll system that enabled automatic identification of a motorcycle without a transponder. Alternative fuel vehicles with white and green California Clean Air stickers traveling as an SOV were charged a toll during the demonstration period. Effective February 24, 2014, these vehicles were allowed to travel toll-free irrespective of occupancy with a FasTrak® transponder.

Individuals must have a switchable FasTrak® transponder to travel as a toll-free carpool in the I-110 and I-10 ExpressLanes. Motorists set the transponder switch to the position corresponding with the number of occupants (1, 2, or 3+) before entering the lanes. In signing the FasTrak® Application and License Agreement, individuals agree to "accurately set the self-declaration switch to indicate the actual number of occupants in the vehicle prior to traveling on the ExpressLanes." They further agree to pay the single occupant toll rate if they fail to properly set the transponder to the accurate occupancy status prior to entering the ExpressLanes. Through the aid of enforcement beacon lights, dedicated CHP officers provided additional enforcement during the peak periods and issue citations to motorists who are found to have the self-declaration switch in the incorrect position.

The Carpool Loyalty Program and the Transit Rewards Program provide additional incentives and benefits to ExpressLanes carpoolers and bus riders. The Carpool Loyalty Program automatically enters ExpressLanes FasTrak® account holders using the lanes as a carpooler into monthly drawings for gift cards. During the demonstration period, 520 gift cards were issued. The Transit Rewards Program allows frequent bus riders to earn toll credits for use on the ExpressLanes.

Using their registered TAP card, riders earn a $5 toll credit by taking 32 one-way trips during the peak hours on the I-110 and I-10 ExpressLanes. The reward credits are not transferrable and expire after 90 days. During the demonstration period, 5,782 accounts were enrolled in the program, earning $12,870 in toll credits.

The Metro Vanpool Program offers up to a $400 monthly lease subsidy – not to exceed 50 percent of the lease costs – for commuter vanpools of 7 to 15 passengers that have a destination to a LA County worksite for which a completed program application and agreement has been submitted and approved by Metro. Vanpools are also enrolled in a Loyalty Program, providing the opportunity to earn gift cards. A total of 119 vanpools using either or both the I-110 and I-10 ExpressLanes, were established from July 2012 through February 2014, surpassing the goal of 100 new vanpools. A total of 34 vanpools use the I-110 ExpressLanes, 79 use the I-10 ExpressLanes, and six use both.

B.3 ExpressLanes Accounts and Transponders

Table B-2 presents the number of new FasTrak® accounts opened and transponders issued from July 2012 to February 2014. A total of 210,367 accounts were opened during the 20-month period, with 261,230 transponders issued. These figures exceed the goal of 100,000 transponders in circulation at the end of the demonstration period. In addition, demand on the ExpressLanes had a wide geographic reach as existing FasTrak customers with non-switchable transponders issued by other California agencies requested switchable transponders, further exceeding the initial transponder goal and illustrating the use of the I-10 and I-110 ExpressLanes by motorists throughout the state. The month with the largest number of new accounts opened and transponders issued was November 2012, corresponding to the opening of the I-110 ExpressLanes, with a total of 25,383 accounts and 31,850 transponders. March 2013 was the second highest month for new accounts and transponders, reflecting the opening of the I-10 ExpressLanes in February 2013. While the demand for new accounts and transponders has leveled off, it continues to remain stable.

Two types of FasTrak® accounts are available – personal accounts and business accounts. Personal accounts may have up to four transponders, while business accounts may have five or more transponders. Approximately 98 percent of the new accounts opened over the 20-month period were personal accounts and 2 percent were business accounts. Individuals can register for a transponder online, by mail, by telephone, at Metro service centers, and at participating retail outlets, which include Albertsons, Costco, and the AAA Automobile Club of Southern California. Initially, approximately 65 percent of all new accounts were opened at participating retail outlets, with 29 percent opened through the Metro website, 5 percent opened at walk-in centers, and 1 percent by mail and telephone. These percentages appear to have held constant over time.

The ExpressLanes is the first HOT operation in the country to offer a discount for low-income commuters, known as the “Equity Plan.” Qualifying residents of LA County receive a $25 credit when they set up an account (proof of eligibility required). This credit can then be applied to either the transponder deposit or pre-paid toll deposit. The monthly $3 account maintenance fee is waived. As of the end of February 2014, a total of 4,415 LA County households were enrolled in the equity plan, accounting for $110,375 in toll/transponder credits.

Table B-2. ExpressLanes – New FasTrak® Accounts Opened and Transponders Issued

	Accounts Opened			Transponders Issued
	Personal Accounts	Business Accounts	Total Accounts	
2012				
July	1,297	34	1,331	1,590
August	3,187	40	3,227	2,465
September	6,475	81	6,556	4,419
October	2,918	199	3,117	9,799
November	24,875	508	25,383	31,850
December	16,904	248	17,152	21,511
2013				
January	12,377	676	13,053	15,982
February	17,893	199	18,092	21,710
March	20,850	189	21,039	25,009
April	15,438	162	15,600	18,600
May	12,071	141	12,212	14,972
June	10,535	118	10,653	13,142
July	9,602	139	9,741	11,997
August	10,044	100	10,144	13,346
September	8,826	117	8,943	11,138
October	8,362	101	8,463	10,663
November	7,014	92	7,106	9,066
December	5,832	89	5,891	7,401
2014				
January	6,367	85	6,452	8,479
February	6,137	75	6,212	8,091
TOTAL	**207,004**	**3,363**	**210,367**	**261,230**

Source: Metro.

B.4 Toll Transactions and Use of the I-110 and I-10 ExpressLanes

Metro provided toll trip data on a regular basis over the course of the demonstration. The toll trip data examined for this report cover the period from December 2012 through February 2014 on the I-110 ExpressLanes and February 2013 through February 2014 on the I-10 ExpressLanes. A grace period for violators was in effect for the first 60 days of operation on the I-110 and I-10 ExpressLanes.

The trip data are compiled by first recording ExpressLanes transactions as either an electronic toll collection (ETC) transaction or a violation for each vehicle. The data are then processed through the back office to determine the source of the account posting. After posting, the trips are categorized as California Toll Operators Committee (CTOC), ETC, non-revenue (Non-Rev), pay by plate (PBP), and violation. An initial ETC transaction is posted as a CTOC, ETC, or Non-Rev transaction. A violation transaction will result in a CTOC, Non-Rev (those read by plate), PBP, or violation. The only Non-Rev account with a transponder is the Freeway Service Patrol. All other non-revenue transactions are processed by reading the plate and forming a trip, which is posted as a PBP trip. Publically and privately operated buses are not required to have a transponder. Transactions for these buses are initially read as lane violations, but then classified as a non-revenue trip during back office processing.

Toll trip data were examined in two ways. First, the total number of trips – including CTOC, ETC, Non-Rev, PBP, and violation – was reviewed. Second, the toll trip data were aggregated following the method Metro uses to summarize trips. This method presents single occupant, HOV2+, and HOV3+ categories. It allocates the Non-Rev transactions, which include public and private buses, to the 2+ category on the I-110 and the 3+ category on the I-10. The violations are not included in the summary as the number of occupants is not known.

The majority of trips in the HOV2+ and HOV3+ categories represent self-declared carpoolers. Enforcement of the toll and HOV requirements are discussed more extensively in Section B.5. The summary here is intended to highlight changes in toll transaction types over the course of the demonstration. The information presented does not represent a before-and-after assessment of changes in carpooling. Both Metro and Caltrans observed variances in the observed occupancy, as discussed in the Appendix A – Congestion Analysis and the self-declared occupancy from the transponder setting toll data. These differences, which focus on self-declared transponder settings indicating higher use levels than the visual occupancy data, are being examined in more detail by the agencies.

As noted previously, vehicles with California Clean Air Stickers were required to pay the appropriate toll to use the ExpressLanes during the demonstration period if they did not meet the vehicle-occupancy requirements. These vehicles had previously been allowed to use the I-10 and I-110 HOV lanes without meeting the occupancy requirements. Effective February 29, 2014, at the end of the demonstration period, vehicles with white and green California Clean Air stickers were allowed to travel toll-free irrespective of occupancy levels with a FasTrak® transponder. Although the Caltrans vehicle occupancy counts showed low levels of vehicles with these stickers, the toll-free use of the ExpressLanes could be expected to grow, as the California High-Occupancy Vehicle Lane Degradation Determination Report indicated that approximately

50 percent of the white and green stickers distributed as of December 31, 2013 were to residents in Los Angeles, Riverside, San Bernardino, and Orange Counties.[1]

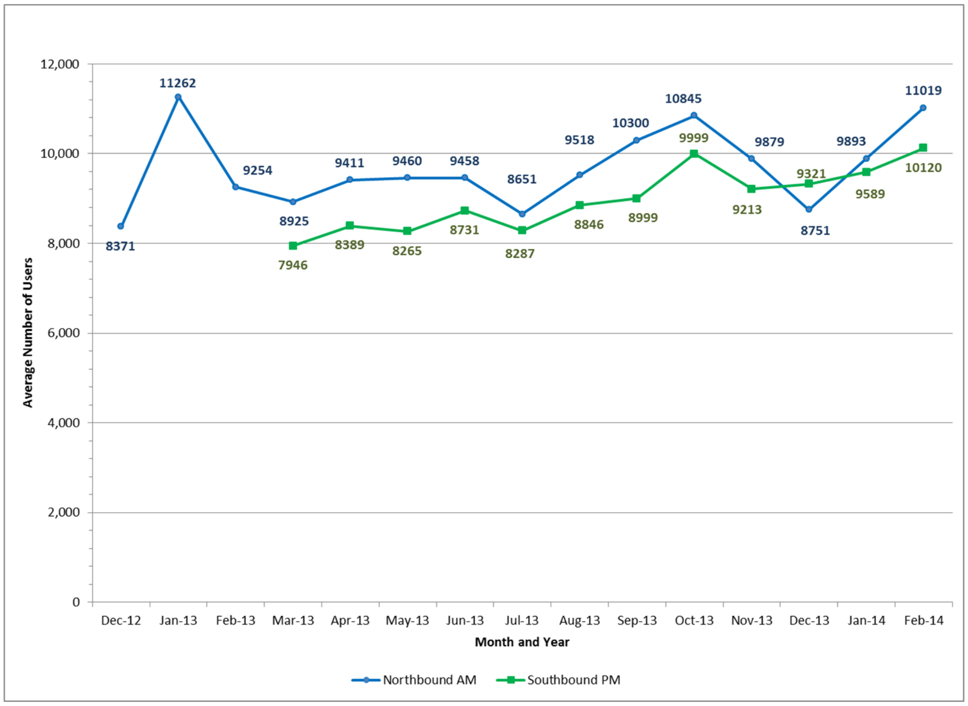
Use of the I-110 and I-10 ExpressLanes during the peak periods in the peak direction of travel was examined from the toll trip data provided by Metro. The morning peak period was defined as 5:00 a.m. to 9:00 a.m. (4 hours) and the afternoon peak period was defined as 4:00 p.m. to 7:00 p.m. (3 hours). The morning peak hour was defined as 7:00 a.m. to 8:00 a.m. and the afternoon peak hour was defined as 5:00 p.m. to 6:00 p.m. The peak direction of travel on the I-110 is northbound into downtown LA in the morning and southbound in the afternoon. The peak direction of travel on the I-10 is westbound into downtown LA in the morning and eastbound in the afternoon.

The data were aggregated into average daily peak period and peak hour transactions in the peak travel direction by month. The analysis presented here provides a general indication of trends in ExpressLanes use. Figure B-1 presents the I-110 ExpressLanes average morning and afternoon peak period use in the peak direction. Figure B-2 presents the same information for the I-10 ExpressLanes. In both cases, the morning peak period reflects a four-hour total and the afternoon peak period reflects a three-hour total. Figure B-3 and Figure B-4 present average monthly peak hour use by peak direction for the I-110 and I-10 ExpressLanes, respectively.

The figures show steady growth overall in the use of both facilities, with slightly lower averages during the holiday months, primarily July, August, November, and December. Figure B-3 and Figure B-4 also indicate slightly higher use levels during the morning peak hour than during the afternoon hour. This trend reflects the general pattern of more concentrated trip times in the morning and slightly more dispersed trip times in the afternoon.

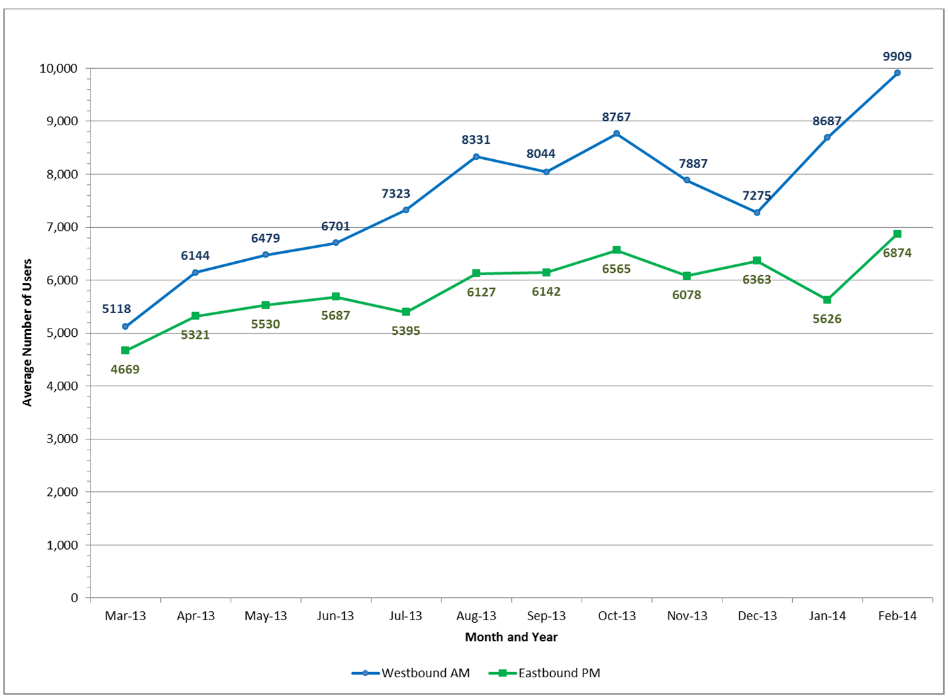
Figure B-5 and Figure B-6 present the average morning and afternoon peak period peak direction toll trips by type for the I-110 and I-10 ExpressLanes. Figure B-7 and Figure B-8 highlight the same information for the peak hour peak direction of travel. The figures show an overall increase in HOV2+ and HOV3+ toll trips, which represent self-declared 2+ and 3+ carpools, as well as buses, vanpools, motorcycles and non-revenue vehicles on the I-110 and I-10 ExpressLanes, and increases in toll paying HOV2+ vehicles and SOVs. The level of self-declaring HOV3+ FasTrak® trips is of interest given the national experience indicating the difficulty of forming and maintaining 3 person carpools. The figures also indicate that self-declaring HOV2+ and HOV3+, vanpools, buses, motorcycles, and other non-revenue vehicles represented between 54 percent and 59 percent of the peak period and peak hour FasTrak® trips on the ExpressLanes during the demonstration.

[1] Caltrans, 2013 California High-Occupancy Vehicle Lane Degradation Determination Report, December 12, 2014.



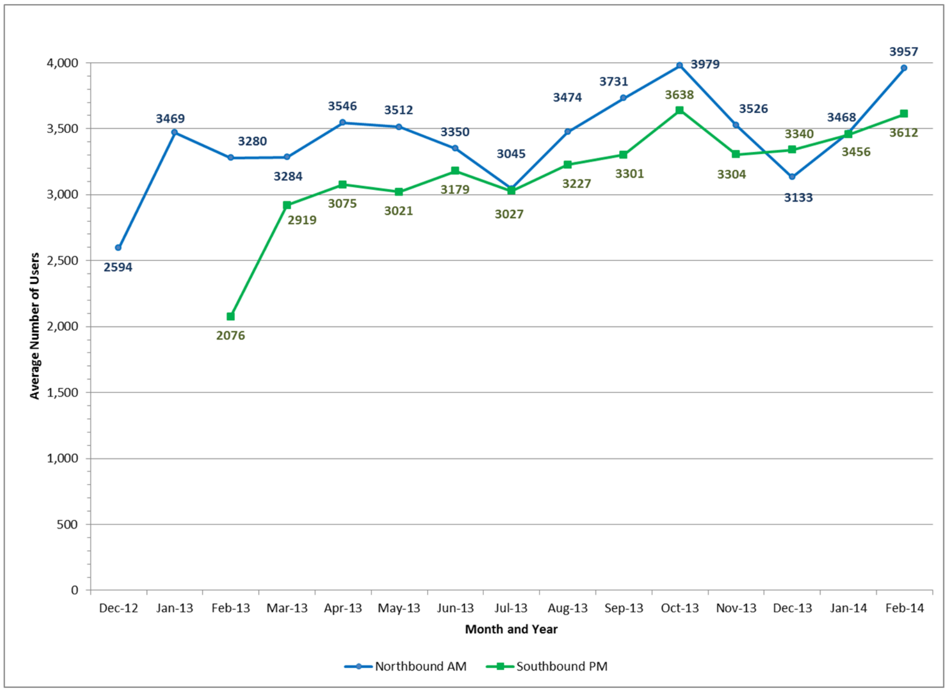
Source: Data from Metro and graph developed by the Texas A&M Transportation Institute.

Figure B-1. I-110 ExpressLanes Average Monthly Morning and Afternoon Peak Period, Peak Direction, Toll Trips



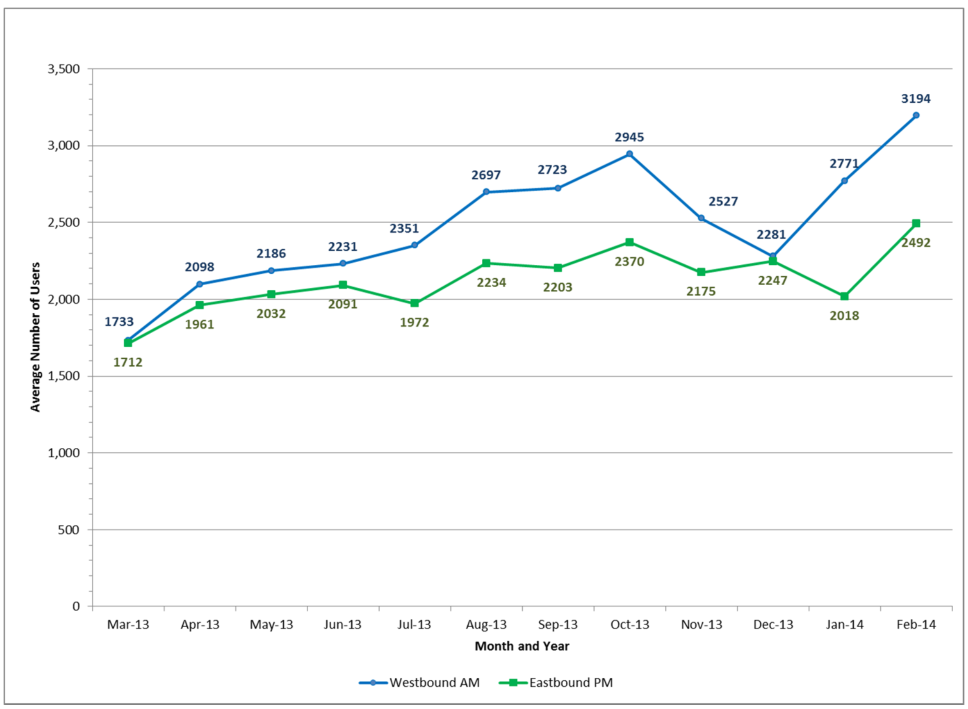
Source: Data from Metro and graph developed by the Texas A&M Transportation Institute.

Figure B-2. I-10 ExpressLanes Average Monthly Morning and Afternoon Peak Period, Peak Direction, Toll Trips



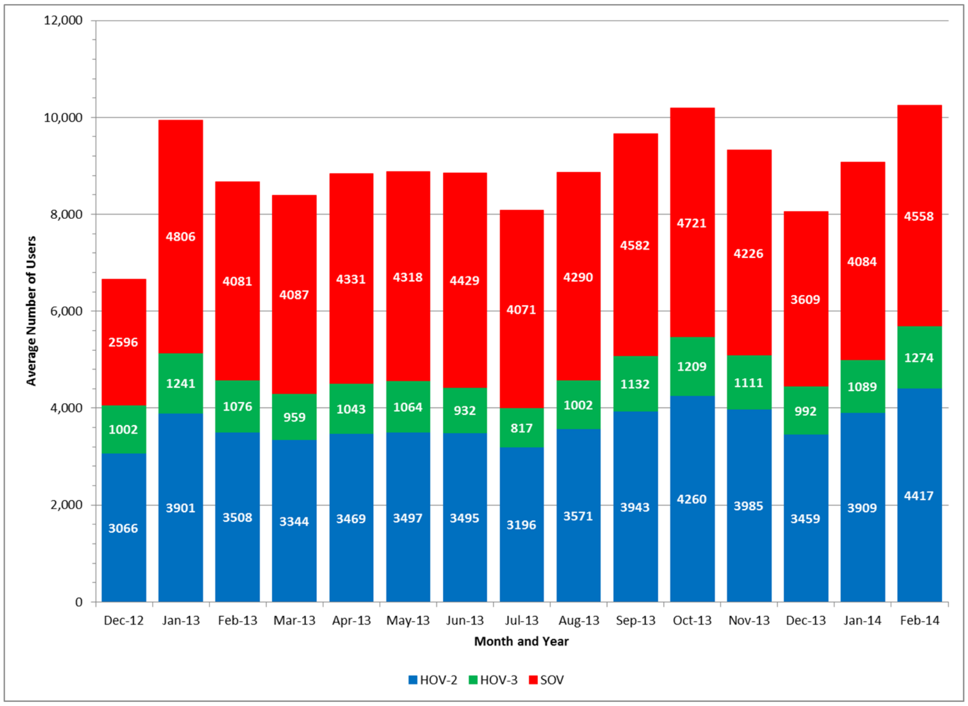
Source: Data from Metro and graph developed by the Texas A&M Transportation Institute.

Figure B-3. I-110 ExpressLanes Average Monthly Morning and Afternoon Peak Hour, Peak Direction, Toll Trips



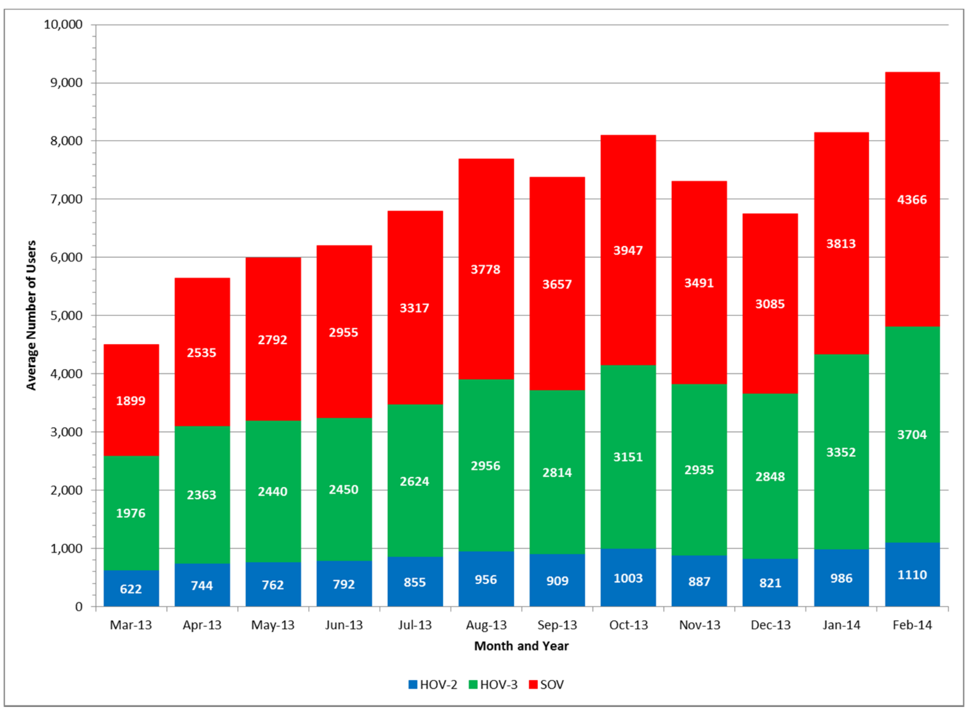
Source: Data from Metro and graph developed by the Texas A&M Transportation Institute.

Figure B-4. I-10 ExpressLanes Average Monthly Morning and Afternoon Peak Hour, Peak Direction, Toll Trips



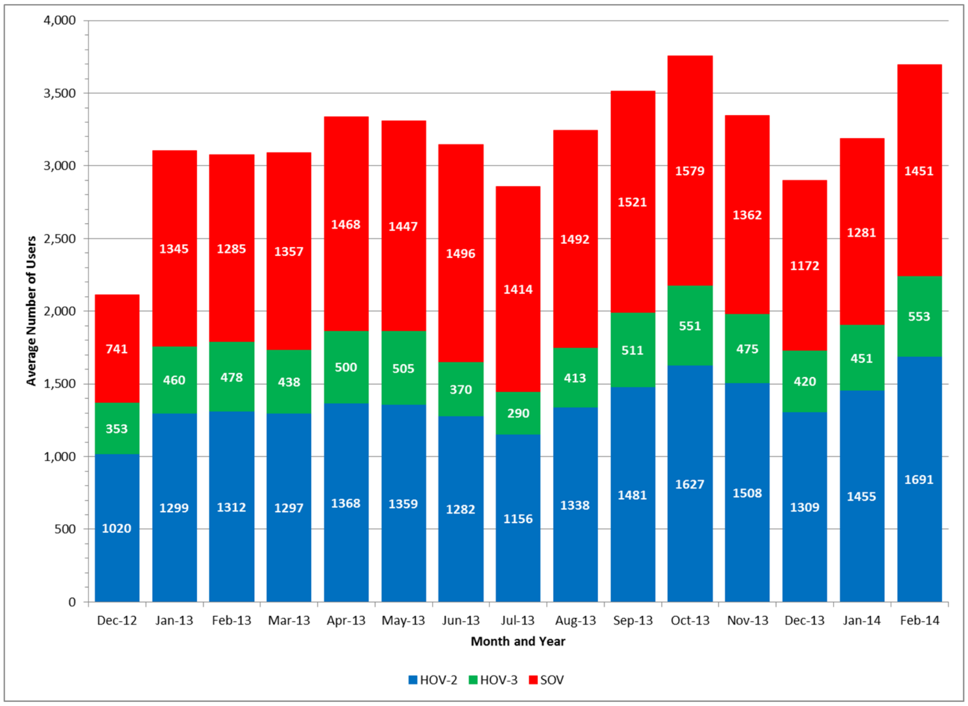
Source: Data from Metro and chart developed by the Texas A&M Transportation Institute.

Figure B-5. Average Monthly Morning Peak Period, Peak Direction, Toll Trips by Type – I-110 ExpressLanes



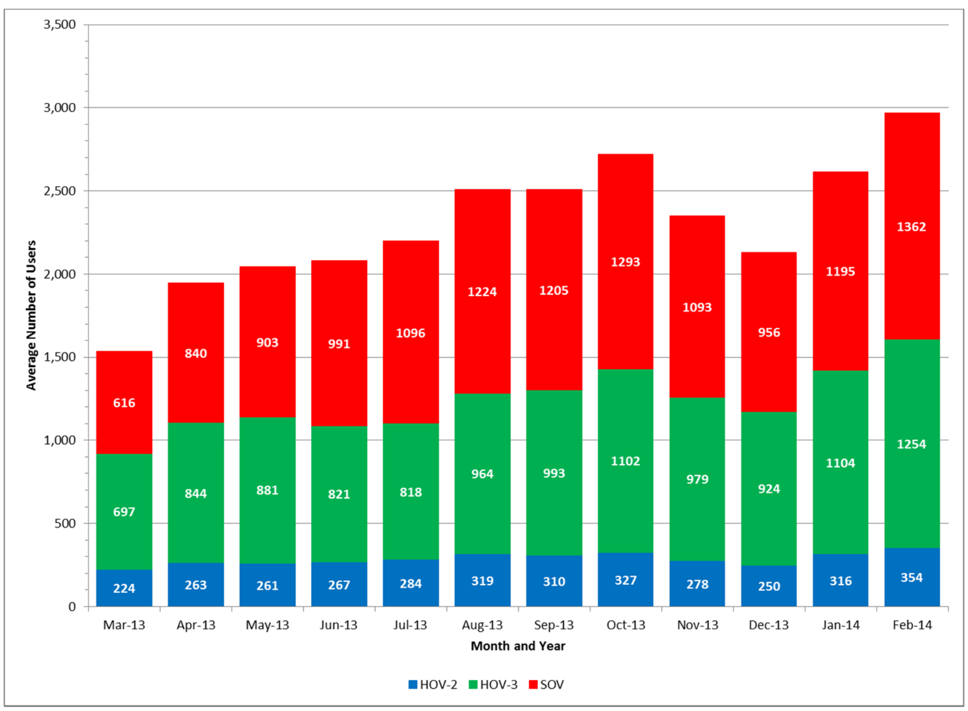
Source: Data from Metro and chart developed by the Texas A&M Transportation Institute.

Figure B-6. Average Monthly Morning Peak Period, Peak Direction, Toll Trips by Type – I-10 ExpressLanes



Source: Data from Metro and chart developed by the Texas A&M Transportation Institute.

Figure B-7. Average Monthly Morning Peak Hour, Peak Direction, Toll Trips by Type – I-110 ExpressLanes



Source: Data from Metro and chart developed by the Texas A&M Transportation Institute.

Figure B-8. Average Monthly, Morning Peak Hour, Peak Direction, Toll Trips by Type – I-10 ExpressLanes

The frequency of ExpressLanes use by different toll trip types on a monthly basis was also examined. Overall, the HOV toll trips represented a larger percentage of the frequent users, defined as one to two daily trips during the weekday, with SOVs representing a larger percentage of the infrequent users, defined as one to four trips a month.

Metro has the option to close the lanes to vehicles not meeting the carpool occupancy requirements in the event that travel speeds are degraded below 45 miles per hour (mph) in the ExpressLanes. As a part of the tolling algorithm calculation, once the speed threshold is reached, the system automatically posts the closure message on the Dynamic Message Signs (DMS). The criteria for returning to allowing SOVs is defined by a predictive density value based on current traffic performance, which projects the density to be below the “HOV only” threshold density. The current traffic performance projects that the density after a certain period will be below the “HOV only” threshold value and that the ExpressLanes will have the capacity to accommodate more vehicles.

The system records the number of minutes the ExpressLanes are closed to SOVs. The ExpressLanes on the I-110 were closed to SOVs for approximately 36 hours in the 16 months of operation from November 2012 to February 2014. September and October 2013 represented the months with the largest number of closed minutes on the I-110 ExpressLanes. In September, the I-110 ExpressLanes were closed to SOVs for 10 hours, or 1.4 percent of the total operating time, and for 5 hours in October, or 0.7 percent of the total operating time. The I-10 ExpressLanes were closed to SOVs for approximately 12 hours for the 12-month period from February 2013 to February 2014.

B.5 ExpressLanes Enforcement and Violations

Both electronic and manual visual enforcement are used on the I-110 and I-10 ExpressLanes. The FasTrak® system records vehicles without an active transponder. When a vehicle enters a HOT lane without a transponder it is considered to be in violation and the vehicle’s license plate is recorded and identified. The toll system first reviews the database to determine if the license plate is assigned to an existing FasTrak® customer account or an authorized Non-Revenue account (i.e., publically and privately operated buses and other vehicles). When the system determines that the license plate is not in the toll database a violation notice is then sent to the address where the vehicle is registered. When such violations occur, the toll incurred plus the violation penalty are billed and mailed to the violator. The violator then has 14 days to pay the toll and only 30 days to pay the toll and violation penalty of $25. If the violator does not pay the toll and penalty within 30 days, they are billed an additional $30. However, a 60-day grace period was in place at the beginning of the I-110 and I-10 ExpressLanes deployment. During this grace period, no violation penalties were assessed. If someone drove in the ExpressLanes without a FasTrak® transponder, they were only billed for the toll incurred.

The number of monthly toll violation trips recorded in the toll trip data were examined. The number of toll violation trips was highest during the initial months of operation on the I-110 and I-10 ExpressLanes. These months correspond to the grace period and reflect a typical ramp-up period for a toll facility. From March through December 2013, the number of violation toll trips recorded during the morning peak hour, peak direction on the I-10 ExpressLanes ranged from 140 toll trips to 224 toll trips, representing approximately 6 to 7 percent of the total toll trips during that time period. Violation toll trips recorded on the I-110 ExpressLanes during the same time period ranged from 186 to 232, representing approximately 6 to 7 percent of the total toll trips. As noted previously, violation notices are sent to the owners of these vehicles.

The electronic toll collection system only addresses vehicles without a transponder or a non-active account. A combination of electronic monitoring and visual enforcement is used to address violations of the self-declared occupancy requirements. CHP officers provide extra enforcement on the I-110 and I-10 ExpressLanes during the morning and afternoon peak periods. The CHP officers are assisted by a beacon light, which indicates the transponder setting of vehicles passing a toll reader. The officers issue both verbal warnings and citations to drivers without valid transponders and drivers of vehicles without the number of occupants to meet the self-declared transponder setting. During the demonstration period, the monthly number of verbal warnings on the I-110 ExpressLanes ranged from 57 to 133, with the monthly number of citations ranging from 108 to 201. On the I-10 ExpressLanes, the monthly number of verbal warnings ranged from 77 to 164, and the number of citations ranged from 113 to 226.

Data from the 2011 Caltrans District 7 HOV Annual Report[2] provide an indication of the violation rates experienced during the pre-deployment period with HOV facility operations. In 2011, the morning peak-period violation rates recorded through the Caltrans visual observation counts was 12 percent on the I-10 (with a 3+ HOV requirement) and 2 percent on the I-110 (with a 2+ HOV requirement). The number of violators was 316 on I-10 and 128 on I-110.

Perceptions of motorists using the ExpressLanes and the general purpose freeway lanes related to enforcement are discussed in Section B.8. The results from the before- and-after surveys indicate that both HOV users and motorists driving alone perceive that the FasTrak® transponders and the ExpressLanes support reducing HOV violations.

B.6 ExpressLanes Toll Rates

Table B-3 presents the monthly average posted toll and the maximum posted toll for the morning and the afternoon peak periods, in the peak direction of travel. The tolls are dynamically priced and updated every five minutes based on real-time traffic conditions in the ExpressLanes. The minimum toll rate is $0.25 per mile and the maximum is $1.40 per mile. Further, 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. The average tolls may be below the required 150 percent of the transit fare due to the influence of shorter trips outnumbering trips taken the full length of the corridor.

On the I-110 ExpressLanes, both the monthly average posted tolls and the maximum posted tolls were higher in the morning peak period. The lowest average posted toll in the morning peak period was $5.04 in July 2013 and the highest was $7.63 in October 2013. The lowest monthly maximum posted toll was $8.00 in February 2013 and the highest was $14.55 in November 2013. In the afternoon peak period, peak direction on the I-110 ExpressLanes, the lowest monthly average toll was $3.31 in January 2014 and the highest was $4.79 in December 2012. The lowest posted monthly maximum toll was $3.95 in December 2013 and February 2014, and the highest was $8.19 in November 2012.

On the I-10 ExpressLanes, the monthly average posted toll in the morning peak period, peak direction ranged from a low of $4.25 in March 2013 to a high of $5.20 in October 2013. The monthly average maximum toll during the same time period ranged from a low of $7.00 in April, May, and June 2013 to a high of $9.05 in September 2013. The lowest afternoon peak period, peak direction average monthly toll on the I-10 ExpressLanes was $4.42 in January 2014 and the

[2] Caltrans, 2011 HOV Annual Report, District 7, September 2012.

highest was $5.46 in August 2013. The lowest maximum posted toll on the I-10 ExpressLanes in the afternoon peak period, peak direction was $4.25 in January 2014 and the highest was $7.30 in August 2013.

Table B-3. I-110 and I-10 Monthly Average and Maximum Posted Tolls – Morning and Afternoon Peak Period, Peak Direction

Peak Period	Month	Average Posted Toll		Maximum Posted Toll	
		I-110	I-10	I-110	I-10
Morning (Northbound)	Nov 2012	$5.40	–	$10.85	–
	Dec 2012	$5.57	–	$10.55	–
	Jan 2013	$5.33	–	$10.10	–
	Feb 2013	$5.25	–	$8.00	–
	Mar 2013	$5.36	$4.25	$10.05	$7.20
	Apr 2013	$5.35	$4.48	$9.95	$7.00
	May 2013	$6.19	$4.70	$11.00	$7.00
	Jun 2013	$5.93	$4.68	$12.30	$7.00
	Jul 2013	$5.04	$4.54	$12.35	$7.20
	Aug 2013	$6.36	$4.92	$11.95	$7.25
	Sep 2013	$7.21	$5.10	$14.25	$9.05
	Oct 2013	$7.63	$5.20	$14.35	$8.30
	Nov 2013	$7.05	$4.90	$14.55	$8.00
	Dec 2013	$6.54	$4.75	$14.05	$7.30
	Jan 2014	$6.65	$4.87	$14.05	$7.30
	Feb 2014	$7.53	$5.18	$14.20	$6.80
Afternoon (Southbound)	Nov 2012	$4.65	–	$8.10	–
	Dec 2012	$4.79	–	$7.50	–
	Jan 2013	$4.59	–	$7.05	–
	Feb 2013	$4.73	–	$7.45	–
	Mar 2013	$4.27	$4.95	$6.15	$6.85
	Apr 2013	$4.02	$5.22	$4.85	$6.95
	May 2013	$4.02	$5.32	$4.95	$6.95
	Jun 2013	$3.81	$5.40	$5.55	$6.95
	Jul 2013	$3.33	$5.12	$4.95	$6.95
	Aug 2013	$3.84	$5.46	$5.15	$7.30
	Sep 2013	$3.42	$5.11	$5.30	$6.75
	Oct 2013	$3.50	$4.83	$4.65	$5.60
	Nov 2013	$3.35	$4.50	$5.10	$5.30
	Dec 2013	$3.41	$4.50	$3.95	$4.90
	Jan 2014	$3.31	$4.42	$4.25	$5.00
	Feb 2014	$3.45	$4.51	$3.95	$5.10

Source: Metro.

B.7 ExpressLanes Toll Revenues

Table B-4 presents the gross revenue from toll-paying vehicles not meeting the carpool occupancy requirements using the I-110 and I-10 ExpressLanes for the 16-month period from November 2012 through February 2014. The total gross revenues reported are from the electronic toll transactions only. Revenues from toll violations, violation penalties, and other fees are not included. The changes in revenues reflect the changes in use of the ExpressLanes described previously.

Table B-4. Total Gross Revenue for I-110 and I-10 ExpressLanes*

Month	Gross Toll Revenue	
	I-110	I-10
2012		
November	$387,042	–
December	$885,316	–
2013		
January	$881,315	
February	$986,998	$33,179
March	$1,293,556	$535,166
April	$1,135,103	$562,575
May	$1,580,153	$785,134
June	$1,156,887	$618,309
July	$1,021,259	$623,845
August	$1,366,270	$809,733
September	$1,283,006	$809,907
October	$1,515,030	$890,516
November**	$658,666	$853,253
December**	$2,007,099	$762,976
2014		
January	$1,277,622	$792,798
February	$1,269,639	$841,594
Total	**$18,704,961**	**$8,918,985**

*The total gross revenues reported are from the electronic toll transactions only. Revenues from toll violations, violation penalties, and other fees are not included.

**A fiber cut in November 2013 delayed applying transaction revenue until December 2013.

Source: Metro.

B.8 Pre- and Post-Deployment I-110 and I-10 User Surveys

Metro sponsored pre- and post-deployment surveys[3] of motorists using the I-110 and I-10 freeways, including the general purpose lanes and the HOV/ExpressLanes. The pre-deployment survey was conducted in October and November of 2012, prior to the expansion of the HOV lanes to HOT lanes, and the post-deployment survey was conducted in January and February 2014.

Both surveys used similar methodologies. License plates of vehicles on the I-110 and I-10 were filmed on Tuesday, June 26, 2012 from 6:00 a.m. to 6:00 p.m. Vehicles traveling in the HOV lanes and the general purpose lanes were included in the sample. The license plates were matched to the addresses of the registered vehicle owners through the California Department of Motor Vehicles (DMV) records. Only addresses, not names, were provided by the DMV. After deleting rental car companies and government agencies, a total of 7,391 addresses were available.

For both surveys, the mailing package included a cover letter and the questionnaire in both English and Spanish, and a postage-paid business reply envelope. For the 2014 survey, respondents had the option of completing the questionnaire online in addition to completing it by hand and returning it in the pre-paid envelope.

Both surveys included questions on travel patterns, travel satisfaction, familiarity on support for the ExpressLanes, and demographic characteristics. The 2014 survey included updated and revised questions from the 2012 survey, reflecting the opening and operation of the ExpressLanes. In addition, some questions from the 2012 survey were not included in the 2014 survey.

A total of 7,391 surveys were mailed in both 2012 and 2014. In 2012, 804 responses were received – 394 for I-10 users and 410 for I-110 users. For the 2012 survey, the results are accurate to ±3.7 percent at a 95 percent confidence interval. The results for each corridor can be considered accurate to ±5.1 percent at a 95 percent confidence interval. In 2014, 452 responses were received – 236 for I-10 users and 216 for I-110 users. The margin of error for the overall 2014 survey is 4.6 percent at a 95 percent confidence level. The responses individually for I-110 and I-10 have an associated error of 6.5 percent and 6.7 percent, respectively, at the 95 percent confidence interval.

For the 2012 survey, HOV users and general purpose lane motorists were determined based on the license plate video recordings of vehicles in the HOV lanes and the general purpose freeway lanes. Vehicles in the HOV lanes were identified as HOVs, while vehicles in the general purpose lanes were classified as single-occupant vehicles. Since the ExpressLanes include both HOVs and toll paying single-occupant vehicles, a different method was used with the 2014 survey. Individuals reporting using the ExpressLanes at least once per day a week as a carpooler, vanpooler, or bus rider were considered HOV users.

Responses to questions related to the tolling analysis are highlighted below. Questions of interest to the congestion, equity, and carpooling analysis are presented in the appendices.

[3] ExpressLanes Public Education and Market Research Support – 2012 Pre-Implementation Survey License Plate Survey. Draft Report, Redhill Group, Inc. December 24, 2012. Metro ExpressLanes Post-Deployment License Plate Survey. Los Angeles County Metropolitan Authority, April 11, 2014.

- Overall awareness of the ExpressLanes increased from 2012 to 2014. Motorists on the I-110 and I-10 indicating they were very familiar with the ExpressLanes increased from 25 percent in 2012 to 58 percent in 2014. Motorists responding that they had not heard of the ExpressLanes declined from 16 percent in 2012 to 7 percent in 2014. On the I-10, 55 percent of respondents reported they were very aware of the ExpressLanes in 2014, a major increase from the 13 percent responding they were very aware in 2012. On the I-110, 60 percent of the respondents reported they were very aware of the ExpressLanes in 2014, compared to 35 percent in 2012.

- The results from the 2014 survey indicate that work trips dominated travel during the peak period. Works trips accounted for 79 percent of the peak period trips on the I-10 and 74 percent on the I-110. As a result, 53 percent of the I-10 respondents and 56 percent of the I-110 respondents reported traveling on the freeways five days a week in 2014. Another 17 percent of the respondents on the I-110 and 16 percent of the respondents on the I-110 reported using the freeways three to four times a week.

- The survey results indicated some shifts in mode use, including becoming a toll paying solo driver and reductions in carpooling, vanpooling or bus use. The results indicated that 49 percent of the I-10 respondents and 47 percent of the I-110 respondents use the ExpressLanes at least once a week as a carpooler, vanpooler, or bus rider in 2014. The percent reporting using these modes five times a week was 23 percent on the I-10, which was the same as reported in 2012, and 18 percent on the I-110, a one percent increase over 2012. The percentage of respondents reporting no trips by those modes increased from 42 percent in 2012 to 51 percent in 2014 on the I-10 and from 41 percent in 2012 to 53 percent in 2014 on the I-110. On the I-10, 60 percent of the respondents reported never making toll trips on the ExpressLanes during the peak hours, compared to 40 percent reporting at least one toll trip a week, including 12 percent reporting five toll trips a week. On the I-110, 58 percent of the respondents reported making no peak-period toll trips a week on the ExpressLanes. Of the 42 percent responding they made at least one toll trip a week on the ExpressLanes, 15 percent reported using the ExpressLanes five times a week as a toll customer.

- The 2012 and 2014 survey included seven positive and three negative statements about the ExpressLanes. Respondents were asked to agree or disagree with the statements. The results indicated general support for the ExpressLanes, with HOV users expressing stronger support. One of the statements addressed the influence of the ExpressLanes on reducing HOV violations. The statement was "the FasTrak® transponders will reduce illegal carpool lane usage." On the I-10, 64 percent of all respondents agreed with this statement in 2012, compared with 62 percent in 2014. Agreement was higher, at 69 percent, among HOV users than non-HOV users at 54 percent in 2014. On the I-110, 55 percent of all respondents agreed with the statement in 2012, compared to 54 percent in 2014. Agreement was slightly higher among HOV users in 2014 at 56 percent than for non-HOV users at 52 percent.

- The 2012 survey included additional statements relating to reducing travel times, improving trip-time reliability, and reducing congestion. These statements were not included in the 2014 survey, however. Thus, it is not possible to assess the perspective of users on these attributes.

B.9 ExpressLanes FasTrak® Customer Satisfaction Surveys

Metro conducted a customer satisfaction survey of existing Metro ExpressLanes FasTrak® account holders for a one week period from August 30 to September 6, 2013. Invitations containing a link to the self-administered survey were emailed to all Metro ExpressLanes FasTrak® account holders with a valid email on file. Individuals who completed a survey were provided with a $10 toll credit. Metro provided the report documenting the survey results.[4]

Approximately 153,000 FasTrak® account holders were sent emails with a link to the survey. A total of 28,870 surveys were completed, accounting for a response rate of approximately 19 percent. No demographics or other socio-economic status was included in the survey. Thus, it is not possible to ascertain to what degree the sample of respondents is representative of ExpressLanes travelers. Additionally, since the survey is of FasTrak® account holders, individuals who previously carpooled on the I-110 and I-10 HOV lanes but chose not to obtain a FasTrak® transponder would be excluded from the survey.

The survey included 14 questions on use of the ExpressLanes, communication methods, and customer satisfaction. Twelve of the questions were quantitative closed-ended questions with preset responses. Two questions were open-ended allowing individuals to provide their own responses.

The survey questions addressing current use of the ExpressLanes are relevant to the tolling analysis. The responses to these questions are summarized in this section, along with a discussion of their relationship to the ExpressLanes analysis. A more detailed summary of the customer satisfaction questions is provided in Appendix A – Congestion Analysis to provide insight into users' perceptions of congestion.

- The first question in the user profile section focused on the toll facility the respondent used the most. Users of the I-110 ExpressLanes represented 64 percent of the respondents, compared to 30 percent who reported primarily using the I-10 ExpressLanes. The remaining 6 percent reported using other toll facilities in southern California.
- In the second question, respondents were asked to select a single category best describing themselves. Slightly over half, 55 percent, self-identified as a carpooler (34 percent selected 2 person carpools and 21 selected carpools with more than 2 persons), while 43 percent self-identified as solo drivers, 1 percent self-identified as a vanpooler, and 1 percent self-selected as a motorcyclist. The higher percentage of self-selected 2-person carpools may reflect the larger number of I-110 ExpressLanes users. The I-110 has a 2-person HOV requirement for non-tolled peak period trips, while the I-10 has a 3-person requirement for non-tolled trips during the peak periods.
- The third user profile question asked how many round trips the respondent made using the ExpressLanes on Monday through Friday in a typical week. A total of 51 percent reported making 1 to 3 round trips per work week, 27 percent reported no

[4] Customer Satisfaction Survey Analysis: Assessment of Metro ExpressLanes Users. Los Angeles County Metropolitan Transportation Authority, December 31, 2013.

trips, and 22 percent reported making 4 or more round trips (16 percent reported 4 to 6 trips, 3 percent reported 7 to 9 trips, and 3 percent reported 10 or more trips).

- The fourth user profile question asked how frequently the respondent used the carpool/HOV lanes prior to the opening of the ExpressLanes. The responses were split between 3 to 5 days a week, 18 percent; 1 to 2 days a week, 21 percent; twice a month, 21 percent; once a month, 21 percent; never, 13 percent; and other, 6 percent. Approximately 84 percent of the individuals reporting no use of the carpool/HOV lane self-identified as solo drivers in the second question. The remaining 16 percent self-identified as carpoolers, vanpoolers, and motorcyclists. These results indicate that existing carpools did continue to use the ExpressLanes after the HOV-to-HOT expansion and new toll paying solo drivers also use the lanes.

- The survey included four customer satisfaction questions. The responses to these questions are highlighted here and described in more detail in Appendix A – Congestion Analysis. Work was the most frequently selected response, at 47 percent, to a question on the primary reason for obtaining an ExpressLanes FasTrak® transponder. A total of 31 percent identified faster access to other freeways as the major reason. Other responses to the pre-identified responses were school, 3 percent; upgrade existing transponder to a switchable FasTrak® transponder, 2 percent; and other, 17 percent. In response to the second customer satisfaction question on the greatest benefit of the ExpressLanes, 71 percent selected time savings, followed by solo driver access, 19 percent; convenience, 6 percent; reliability, 1 percent; and other, 3 percent. When asked to rate their overall experience to-date with the ExpressLanes, 86 percent of respondents rated their experience as good or excellent, 11 percent gave an average rating, and 3 percent gave a poor rating. In response to the final customer satisfaction question, which asked if the respondent would recommend FasTrak® to their friends and family, 81 percent, answered yes, 17 percent answered maybe, and 3 percent answered no.

The August 2014 FasTrak® customer satisfaction survey conducted by Metro included four questions to help identify possible changes in travel mode resulting from implementation of the ExpressLanes and factors influencing any changes. Respondents were asked to estimate the number of one-way trips they made monthly on the I-110 and I-10 by mode before-and-after implementation of the ExpressLanes. Individuals were also asked to select from a predetermined list the reasons they carpooled/vanpooled with less frequency or with more frequency after the ExpressLanes opened.

Metro provided the data file with the responses to these questions. A total of 30,727 responses were included in the file. Of this total, 1,068 individuals responded "not applicable" to the questions estimating the number of trips before-and-after implementation of the ExpressLanes. These responses were removed from the data file, resulting in 29,659 responses. No questions asking for demographic or socio-economic information on the survey respondents were provided. As a result, it is not possible to determine to what degree the sample of respondents is representative of ExpressLanes travelers.

Responses to the questions on the number of trips by mode before-and-after implementation of the ExpressLanes were analyzed to help identify possible changes in travel mode as a result of the ExpressLanes. Changes between driving alone and carpooling were of primary interest to address the tolling hypotheses. For each respondent, the percent of drive alone trips and the percent of carpool trips before implementation of the ExpressLanes were calculated relative to the total number of before trips. The percent of drive alone trips and the percent of carpool trips after implementation of the ExpressLanes relative to the total number of after trips was also calculated. The two rates were subtracted (after ExpressLanes opened – before ExpressLanes opened) to obtain the difference in the rate of drive alone and carpool trips.

The following hypothetical example is provided to explain the methodology. A traveler reported taking 50 total trips per month before the ExpressLanes opened (40 carpooling and 10 driving alone) and 100 total trips per month (80 carpooling and 20 driving alone) after the ExpressLanes opened. In this example, 80 percent of the respondent's trips were made by carpool before the ExpressLanes were opened (40/50), and 80 percent were made by carpool after the ExpressLanes (80/100). Thus, the difference in rates would be zero, reflecting no change in mode.

Table B-5 presents the results of this analysis. It lists the number of respondents and the percent of respondents by different categories. Specifically, the table shows the differences in percentage of one-way trips per month relative to total monthly trips after the ExpressLanes opened versus before the ExpressLanes opened. The No Change category represents travelers with the same percentage of one-way trips by that mode, before and after the ExpressLanes were opened. The categories with positive percentages represent travelers who saw their rate of driving alone or carpooling increase, while the categories with negative percentages are travelers who saw their trip rates decrease. The results by mode and the factors influencing any changes are highlighted below.

- As shown in Table B-5, there was no change in the rate of carpooling for 66 percent of respondents. Approximately 22 percent of respondents experienced an increase in their rate of carpooling, with 10 percent experiencing an increase of over 75 percent. Approximately 12 percent experienced a decrease in their rate of carpooling, including 4 percent experiencing a decrease of 75 percent. A more detailed evaluation of the relationship between carpooling and drive-alone trips was conducted. The difference in the percentage category was compared to the corresponding change in drive-alone rates for that individual. As noted below, most of respondents who carpool less are now driving alone more and most respondents who are carpooling more are driving alone less.
    1. Of the 868 respondents who saw their rate of carpool trips drop by more than 75 percentage points, 91 percent saw their drive-alone rate increase by more than 75 percentage points.
    2. Of the 196 respondents who saw their rate of carpool trips drop between 50 and 75 percentage points, 91 percent saw their drive-alone rate increase by more than 50 percentage points.
    3. Of the 743 respondents who saw their rate of carpool trips drop between 25 and 50 percentage points, 96 percent saw their drive-alone rate increase by more than 25 percentage points.
    4. Of the 853 respondents who saw their rate of carpool trips drop between 0 and 25 percentage points, 96 percent saw their drive-alone rate increase.
    5. Of the 912 respondents who saw their rate of carpool trips increase between 0 and 25 percentage points, 92 percent saw their drive-alone rate decrease.
    6. Of the 827 respondents who saw their rate of carpool trips increase between 25 and 50 percentage points, 77 percent saw their drive-alone rate decrease by at least 25 percentage points.

7. Of the 811 respondents who saw their rate of carpool trips increase between 50 and 75 percentage points, 93 percent saw their drive-alone rate decrease by at least 50 percentage points.
8. Of the 2,101 respondents who saw their rate of carpool trips increase by more than 75 percentage points, 95 percent saw their drive-alone rate decrease by at least 75 percentage points.

- As presented in Table B-5, approximately 65 percent of respondents who drove alone before the ExpressLanes were implemented continued to make the same number of monthly one-way solo trips after the ExpressLanes were opened. Given that these individuals have ExpressLanes FasTrak® transponders, it is assumed that these trips are now being made in the ExpressLanes as a solo toll paying motorist, rather than in the general purpose freeway lanes. In addition, approximately 22 percent of respondents experienced a reduction in their drive-alone trip rates, while 13 percent experienced an increase. An analysis similar to the one described above for carpoolers indicated that most solo drivers who are driving less are carpooling more and most solo drivers who are driving more are carpooling less. As discussed later in this section, 38 percent of the respondents who indicated they were carpooling more identified the main reason for this change as the desire for the travel-time savings provided by the ExpressLanes, without having to pay the toll.

- The vast majority of vanpoolers – 99 percent, bus riders – 98 percent, and motorcyclists – 99 percent, reported no change in the number of trips before-and-after implementation of the ExpressLanes. As a result, a detailed analysis was not conducted on the respondents indicating vanpooling, taking the bus, and riding their motorcycles as their major mode. These trips would have been made in the I-110 and I-10 HOV lanes in the pre-deployment period and would continue to be made in the ExpressLanes in the post-deployment period.

- Respondents were asked to identify, from a pre-selected list, the most important reason they reduced or eliminated carpooling or vanpooling on the I-10 or I-110 from before the ExpressLanes opened. A total of 4,850 individuals, or 16 percent of the total respondents, selected a most important reason for reducing or eliminating carpooling or vanpooling trips. The two responses selected by the most respondents relate to factors not influenced by the ExpressLanes. "My job or home location has changed" was identified as the most important factor by 40 percent, followed by 17 percent selecting "my work schedule has changed." In addition, 3 percent selected "my carpooling partner(s) quit the carpool and I have not joined another carpool." Combining these three responses, the key factor influencing 60 percent of the 4,850 individuals reporting a reduction or elimination of carpooling or vanpooling was not related to the opening of the ExpressLanes. On the other hand, 16 percent selected the "I wanted a reduction in commute time" option and 15 percent selected the "it's more convenient to travel alone than to carpool" statement. Thus, 31 percent of the respondents reporting they reduced or eliminated carpooling or vanpooling appear to be influenced by the ability to receive the travel time convenience benefits of the ExpressLanes as a toll paying solo driver. Finally, 9 percent of the respondents appear to have switched from carpooling or vanpooling to riding the bus, as they selected the response "transit is more accessible or convenient now."

- Respondents were asked to identify the most important reason from a pre-selected list if they carpooled or vanpooled with the same or more frequency now than before the ExpressLanes were opened. More people responded to this question and selected a reason for increasing carpooling or vanpooling than those responding to the previous reducing or eliminating carpooling or vanpooling question. A total of 6,731 individuals or 23 percent of the total respondents selected a most important reason for maintaining or increasing carpooling or vanpooling. The two pre-determined responses selected most frequently by respondents were “it’s more convenient and/or saves me money, 42 percent, and “I wanted a reduction in commute time that the ExpressLanes provides, but didn’t want to pay the toll for driving alone,” 38 percent. These two factors relate to the benefits the ExpressLanes provide to carpoolers and vanpoolers with toll-free travel. The other two pre-determined reasons and response rates were “I wanted to be more environmentally friendly by having less cars on the road,” 13 percent, and “I like the company of my fellow passengers as opposed to driving alone,” 7 percent.

Table B-5. Distribution of the Difference in the Percentage of One-Way Trips per Month (Relative to Total Number of Respondent Trips per Month) by Mode of Travel

Travel Mode	Difference in Percentage of One-Way Trips per Month Relative to Total Monthly Trips (after ExpressLanes Opened Percentage – before ExpressLanes Opened Percentage)	Number of Respondents	Percent of Respondents
Drive Alone	Less than -75	2,106	9.78
	Between -75 and -50	356	1.65
	Between -50 and -25	1,117	5.19
	Between -25 and 0	1,063	4.94
	No Change	14,105	65.53
	Between 0 and 25	797	3.70
	Between 25 and 50	585	2.72
	Between 50 and 75	494	2.30
	Greater than 75	902	4.19
	Total	**21,525**	**100.00**
Carpool	Less than -75	868	4.03
	Between -75 and -50	196	0.91
	Between -50 and -25	743	3.45
	Between -25 and 0	853	3.96
	No Change	14,214	66.03
	Between 0 and 25	912	4.24
	Between 25 and 50	827	3.84
	Between 50 and 75	811	3.77
	Greater than 75	2,101	9.76
	Total	**21,525**	**100.00**

Source: Data provided by Metro and analysis conducted by Battelle.

B.10 LA Express Park™ Project Overview

The LA Express Park™ project combined technology and demand-based pricing to provide an innovative parking management strategy in the 4.5 square mile area of downtown LA illustrated in Figure B-9. The area encompasses all of downtown LA, including the Fashion District, South Park, Little Tokyo, Historic District, and Chinatown. Bounded by the I-10, I-110, Alameda Street, and Adams Boulevard, the area includes approximately 14,000 city-owned parking spaces – 6,300 on-street metered parking spaces and 7,700 off-street parking spaces in 9 city-owned facilities. Additional off-street parking spaces are available in private facilities.

Key elements of the project included new parking meter technology, parking space vehicle sensors, an off-street occupancy system, a real-time parking guidance system, an integrated parking management system, and a public outreach program. These elements are summarized below. The analysis of the LA Express Park™ project presented here focused on the 6,300 on-street metered spaces. Xerox was selected by LADOT as the LA Express Park™ systems developer and integrator. Appendix E – Technology Analysis contains more detailed LA Express Park™ technology components, described below.

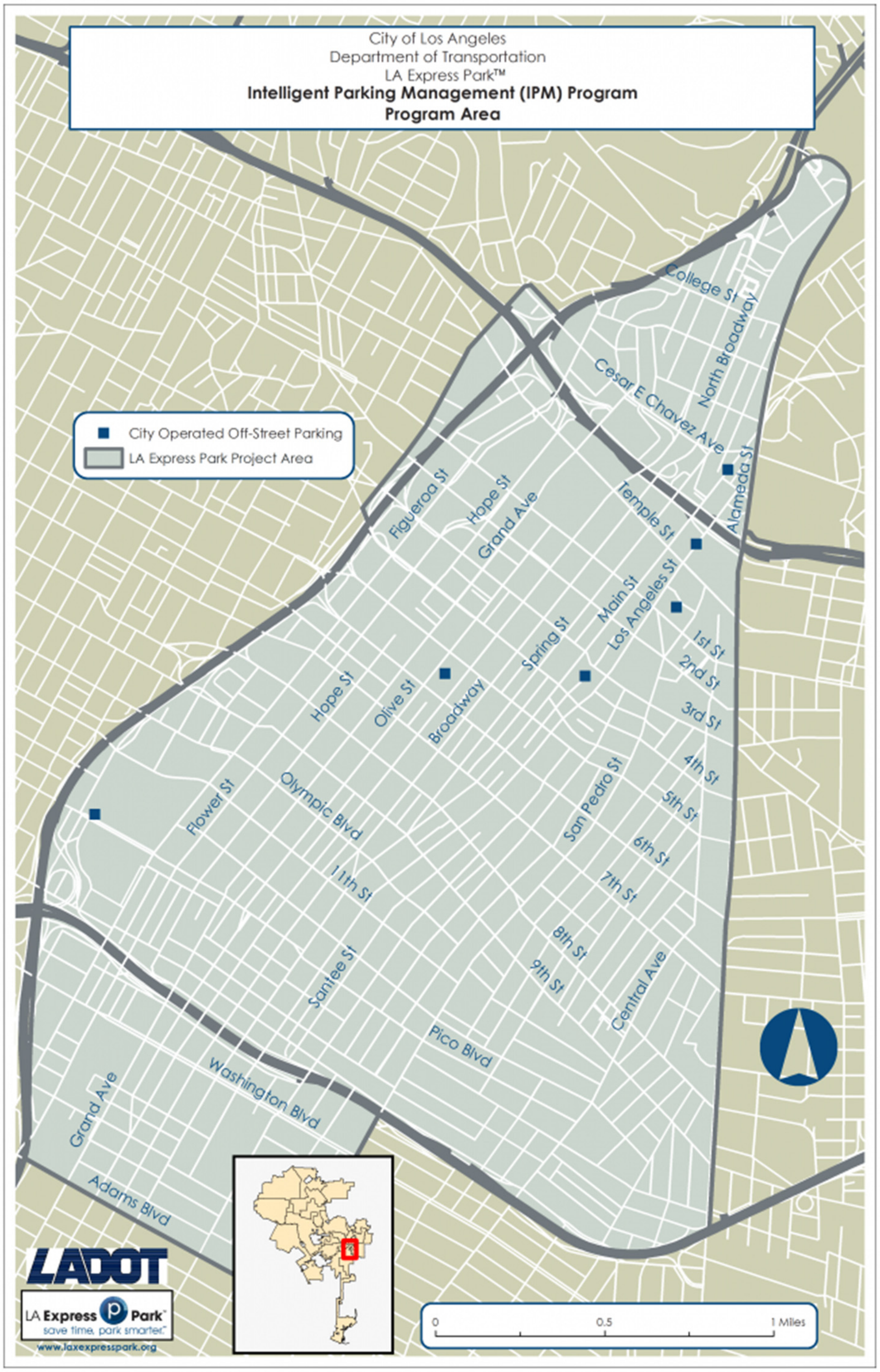
- New Parking Meter Technology – The new parking meter technology included pay stations serving multiple parking spaces in a block and single space meters. The new parking meters also expanded payment options to include not only cash, but also debit and credit cards, and cell phones.[5] The meters provided real-time communication, allowing motorists to receive a notification when the time on a meter is about to expire. Individuals could pay for additional time using their cell phone. The parking meters were also capable of charging demand-based parking rates depending on the time-of-day and current occupancy.

- On-Street Vehicle Sensors – Sensors were embedded in the pavement in approximately 6,000 on-street parking spaces to record parking space occupancy. The occupancy data are integrated with the parking meter data to support optimizing parking rates, time limits, and hours of operation. As discussed in Appendix E – Technology Analysis, the integrated data were also used to enhance parking meter enforcement.

- Parking Management System – The parking management system provides a data warehouse for all transaction data. It stored and analyzed the parking transactions and occupancy data. The system performed advanced analyses to assist in setting parking rates, limits, and hours of operation. The data provided by the system helped LADOT optimize parking operations.

- Parking Guidance System – Elements of the parking guidance system include the LA Express Park™ website, third party cell phone applications (apps), third-party tailored websites, and dynamic message signs with parking availability at selected locations. The 511 telephone system was implemented in January 2014, after the period considered in this analysis. The additional dynamic message signs were deployed in July 2014, also after the period considered in this analysis.

[5] The number of pay-by-cell meters was reduced by approximately two-thirds of the downtown meters in March 2014 after the period examined in this analysis. According to the LADOT press release, pay-by-cell technology negatively affects the life of single-space meter batteries. The use of the pay-by-cell option at many meters did not remain high enough to justify the cost of maintaining the single-space meter batteries. The pay-by-cell option was continued at multi-space meters.



Source: LADOT – http://www.laexpresspark.org/about-la-expresspark/.

Figure B-9. LA Express Park™ Project Area

- Public Outreach – A number of methods were used to inform local businesses, downtown workers and shoppers, and the public about the LA Express Park™ project. Brochures and window posters in local businesses provided key information about the LA Express Park™ project, including the project purpose, major elements, anticipated benefits, and the schedule. The project website presented similar information, along with videos highlighting various project features. Social media and presentations to different groups and organizations were also used. A Community Advisory Committee provided two-way communication, with members explaining the project to community leaders, business owners, employers, and the public. Members also obtained input from these groups, which they passed on to the project leaders.

A number of policy changes were implemented in conjunction with the LA Express Park™ project. These changes included extending paid parking hours from 6:00 p.m. to 8:00 p.m. in areas with sufficient demand and extending parking meter time limits from 1 hour to 2 hours, or 4 hours in some areas. The use of demand-based pricing represents an additional policy change.

B.11 Parking Rate Changes

LA Express Park™ was implemented in three phases. The first phase was initiated on May 21, 2012. Major elements of the three phases are highlighted below.

- Phase I – Base Hourly Rate, Initiated May 21 through July, 2012. Baseline data were used during this phase to interactively set the base hourly rates to influence demand toward the project goals. The parking payment hours were extended from 6:00 p.m. to 8:00 p.m. and the time limits were extended from 1 hour to 2 hours, or 4 hours in some areas.

- Phase II – Time-of-Day Pricing, August 2012 to the present. The experience from Phase I with parking levels during different times of the day was used to identify the morning and afternoon peak periods and set the parking rates by time-of-day. The following four time periods were selected from the analysis to optimize the parking system, while keeping it simple and understandable for users.

  - Monday – Friday Morning (8:00 a.m. – 11:00 a.m.)
  - Monday – Friday Mid-Day (11:00 a.m. – 4:00 p.m.)
  - Monday – Friday Afternoon (4:00 p.m. – 8:00 p.m.)
  - Saturday (all enforced hours)

  The actual parking rates for the time periods was displayed on the parking meter screen, the website, and the cell phone apps. The maximum rate per hour was also displayed. The parking meter also calculates the rate if someone is parking over different time periods. The time-of-day pricing was implemented incrementally in areas throughout the downtown over the course of the demonstration. In August 2012, the time-of-day pricing was introduced in Chinatown and part of the Fashion District. In October and December, it was extended to most of the Fashion District. In March 2013, portions of Little Tokyo and the Toy District were included, with more areas added through February 2014.

- Phase III – Adaptive Pricing, Initiated on Limited Basis in October 2013. It was initially anticipated that prices would be adjusted in real-time where demand fluctuated week to week. The analysis of Phase II conducted by Xerox and LADOT indicated that this was not necessary, as the time-of-day pricing was managing demand successfully. As a result, the time-of-day pricing has continued, with some changes in the actual parking rates. Adaptive pricing has been implemented in a few blocks to test the concept.

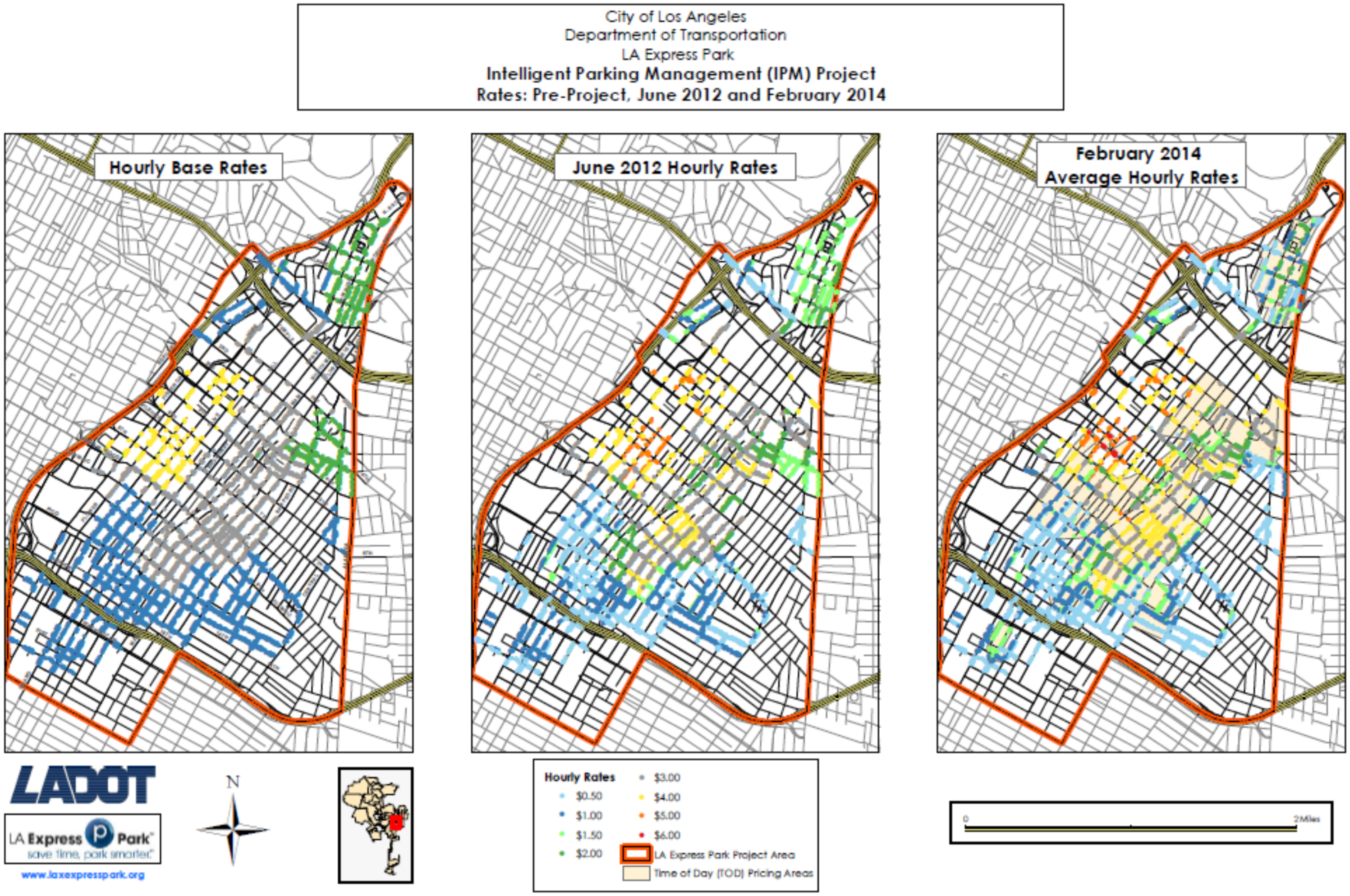
Figure B-10 presents the hourly base parking rates prior to implementation of LA Express Park™, the June 2012 base hour rates set to influence demand, and the February 2014 average hourly rates. The original base parking rates ranged from $1.00 to $4.00 per hour. The rates for demand-based pricing during the evaluation period were $0.50, $1.00, $1.50, $2.00, $3.00, $4.00, $5.00, and $6.00. LADOT had authority to change price by plus or minus 50 percent during the demonstration period. The pricing rates, which may vary by block face, are determined by the pricing algorithm.

There were eight rate changes during the time period from August 2012 to February 2014. Any changes in price were made on the first Monday of a month and were limited to one increment at a time. Data from the meters and sensors in the parking management system were analyzed using advanced algorithms to determine the fraction of time a block is over-utilized (with occupancy exceeding 90 percent) and under-utilized (with occupancy below 70 percent). The rates in October 2013 ranged from $.50 to $6.00 an hour. In some areas there was as much as a 50 percent variation from the original base rate.

According to LADOT personnel, parking rate changes over the first year resulted in an overall decrease in average rates at 59 percent of parking meters in the area, an increase in rates at 29 percent of meters, and unchanged rates at 12 percent of the spaces. The overall average rate decreased by 11 percent. They noted that in general, rate reductions resulted in increases in use and rate increases resulted in slightly lower use levels.

According to LADOT personnel, overall LA Express Park™ was close to revenue neutral. Revenues did increase approximately 2.5 percent from June 2012 to September 2013, with the extended hours excluded. This slight increase was attributed to the overall slightly higher parking rates in spaces with increased parking rates and higher overall occupancy rates resulting from the improving economy.

The LA City Council approved a change allowing LADOT to raise rates by as much as 100 percent of the base rate and to lower rates to $0.50 per hour. Based on this authority, LADOT implemented additional rate changes in February and May, 2014 after the post-deployment evaluation period.



Source: LADOT and Xerox.

Figure B-10. Changes in Hourly Parking Rates in Downtown LA

B.12 Parking Space Occupancy

Xerox and LADOT personnel examined parking occupancy over the course of the demonstration. The results of this analysis, as presented in papers prepared for the 2013 ITS World Congress and the 2014 Transportation Research Board (TRB) Annual meeting,[6] are summarized in this section. For the purpose of the analysis, Xerox and LADOT used the following three categories of occupancy levels.

- Congested Parking Spaces – Parking spaces with more than 90 percent occupancy for neighboring spaces.
- Just Right Parking – Parking spaces with 70 to 90 percent occupancy for neighboring spaces.
- Low Demand Parking – Parking spaces with less than 70 percent occupancy for neighboring spaces.

According to LADOT and Xerox, the changes in parking use over the first seven months of the project reflected more parking spaces occupied between 70 percent and 90 percent of the time, fewer parking spaces occupied over 90 percent of the time, and fewer parking spaces occupied less than 70 percent of the time. These changes reflect the desired outcome of the project. A gradual increase in occupancy occurred beginning in January 2013. Personnel from LADOT suggested that these increases reflect the improved economy in the area and new economic development occurring in the downtown area. They cited the 4 percent increase in sales tax revenues from 2012 to 2013 for LA and the increase in trash tonnage in the Fashion District from 2012 to 2013 as signs of the improving economy.

B.13 LA Express Park™ Intercept and Online Surveys

LADOT and Xerox conducted intercept and online surveys to obtain feedback on different elements of the LA Express Park™ project from individuals parking in the downtown area. Information on these surveys was documented in papers and PowerPoint presentations at conferences and meetings.[7]

Intercept surveys were conducted in July 2012 and February 2013 of individuals parking in the area. The major objective of the surveys was to assess individuals' awareness of LA Express Park™, the parking apps, and parking rates. A second objective was to gain insight into how drivers determine where to park. A total of 58 surveys were conducted in four areas within the Smart Park zone – the Fashion District, South Park, Little Tokyo, and the Historic District.

[6] "LA Express Park-Curbing Downtown Congestion through Intelligent Parking Management." Peer Ghent, Alex Pudlin, Eduardo Cardenas, Stephane Clinchant, Christopher Dance, and Onno Zoeter. Paper presented at the 21st ITS World Congress, Detroit, Michigan, September 2013. "Optimizing Performance Objectives for Congestion Pricing Parking Projects." Peer Ghent. Paper submitted for the 2015 TRB Annual Meeting.

[7] Understanding Dynamic Pricing for Parking in Los Angeles: Survey and Ethnographic Results." James Glasnapp, Hon lu Du, Christopher Dance, Stephane Clinchant, Alex Pudlin, Daniel Mitchell, and Onno Zoeter. LA Express Park: Intelligent Parking Management for Los Angeles. PowerPoint Presentation, National Parking Association 2013 Convention.

The results indicated a moderate awareness of Smart Park and its features. Overall awareness of LA Express Park™ and the parking apps increased from 11 percent of the individuals surveyed in July 2012 to 25 percent in February 2013. In July 2012, 21 percent were aware of recent price changes and 60 percent were aware of different prices on adjacent blocks. In February 2013, 30 percent of those surveyed were aware of recent price changes, but only 44 percent were aware of different prices on adjacent blocks.

The February 2013 survey included additional questions on parking behavior and time-of-day pricing. In response to these questions, 24 percent of those surveyed knew that parking rates at some meters changed throughout the day. Slightly over 80 percent indicated they understood the parking rate table, but only 21 percent understood the "max rate" labels. A total of 76 percent of those surveyed reported that they would park in nearby lower-priced spaces once they were aware of their availability. Overall, 82 percent of those surveyed favored or were neutral on the use of time-of-day pricing, and 37 percent responded that it was the best way to solve parking problems.

Additional intercept surveys were conducted in February and March 2013 with 73 individuals parking in four areas within the downtown zone. The areas selected included one block with relatively high parking rates and nearby blocks with lower rates. The survey questions focused on awareness of variable pricing, comprehension of different meter pricing stickers, and parking behavior. Individuals agreeing to participate in the survey received $20.

An online survey of individuals in LA was also conducted during the same time period by a market research firm to obtain additional insights on the understanding and acceptance of variable parking pricing. A total of 158 individuals participated in the online survey. The respondents represented a mix of ages, males and females, education levels, and annual incomes.

Both the intercept surveys and the online surveys included questions on the most important factors influencing the selection of a parking space. When asked to rank the importance of four factors from a pre-determined list when selecting a parking space (1 as least important and 4 as most important), online survey respondents identified proximity as most important (2.99 weighted average), followed by cost (2.50 weight average), availability (2.46 weighted average), and allowable time (2.03 weighted average). Participants in the intercept surveys were asked to select all of the factors during the same time period that they felt were important. The percentage of respondents selecting the different factors were proximity, 64 percent; availability, 33 percent; cost, 19 percent; and time, 7 percent. Participants also noted that a fear of having their vehicle towed and safety concerns were other important factors.

The survey also included questions on awareness of parking pricing changes, time-of-day dynamic pricing in downtown LA, and availability of cell phone parking apps. Responses to these questions indicated low awareness of these features. Approximately 20 percent of the online survey respondents and 31 percent of the intercept survey respondents indicated an awareness of the parking price changes. Approximately 20 percent of the online survey respondents and 24 percent of the intercept survey participants indicated an awareness of the time-of-day dynamic pricing in the pilot area. Approximately 11 percent of the online survey respondents and 25 percent of individuals responding to the intercept survey indicated they were aware of the mobile parking apps. Only 5 of the online survey respondents and 4 of the intercept survey respondents could name a mobile parking app, however.

Results from the intercept survey indicated that 55 percent of respondents parked within one block of their destination. The mean number of blocks respondents indicated a willingness to walk to their destination was 3.07 blocks.

Both surveys included questions about possible changes in behavior based on the availability of low-priced parking that was still nearby their destination (i.e., as an alternative to higher-priced parking) and time-of-day pricing. Approximately 84 percent of the respondents to the online survey and 74 percent of the respondents to the intercept survey indicated a willingness to use lower-priced parking that was still nearby. Respondents to both surveys were less likely to change behavior in response to time-of-day pricing. Approximately 48 percent of respondents to the online survey and 49 percent of respondents to the intercept survey indicated they were somewhat or extremely likely to change their parking behavior based on time-of-day pricing. Further, approximately 32 percent of the online survey respondents indicated they were unlikely to change their parking behavior in response to time-of-day pricing.

B.14 Summary of Tolling Analysis

The results of the ExpressLanes analysis indicate that the number of new FasTrak® accounts and transponder sales exceeded the initial goal, and individuals continue to open new FasTrak® accounts and obtain switchable transponders. The number of trips on the ExpressLanes by all groups – self declaring toll-free HOV2s+ and HOV3+s, toll-paying HOV2+s and SOVs, as well as vanpools, buses, motorcycles, and other non-revenue vehicles – increased over the course of the demonstration. The Equity Plan, the Carpool Loyalty Program, the Transit Rewards Program, and the Vanpool Program appear to be well received and well used by qualifying individuals. The ExpressLanes are providing choices to travelers in the I-110 and I-10 corridors. The growth in self-declaring HOV2+ and HOV3+ FasTrak® trips over the course of the demonstration and the survey results indicate that carpooling continues to be a viable option for travelers in the corridor. The level of self-declaring HOV3+ FasTrak® trips is of interest given the national experience highlighting the difficulty in forming and maintaining 3-person carpools.

The results of the LA Express Park™ analysis indicate that the parking sensors, new parking meters, additional payment methods, and parking management system – coupled with policy changes enacted by the LA City Council – enabled the implementation of demand-based parking pricing and the parking guidance system in the downtown area. The time-of-day pricing resulted in more even distribution of parking space use, with more blocks experiencing the targeted 70 to 90 percent parking occupancy, and enhanced overall parking management.

Table B-6 summarizes the impacts across the five tolling hypotheses and questions. The results of the 2012 and 2014 surveys of users of the I-110 and I-10 general purpose lanes and HOV/ExpressLanes and the 2013 and 2014 ExpressLanes FasTrak® Customer Satisfaction Surveys support the first hypothesis. Some general purpose lane travelers did shift to the ExpressLanes, while many HOV lane users continued to carpool in the ExpressLanes.

Approximately 43 percent of the respondents to the 2013 ExpressLanes FasTrak® Customer Satisfaction Survey self-identified as solo drivers. Most of these individuals (84 percent) reported no use of the HOV lanes prior to the opening of the ExpressLanes. Results from the 2014 ExpressLanes FasTrak® Customer Satisfaction Survey indicated that 65 percent of the respondents who drove alone before the opening of the ExpressLanes (presumably in the general purpose freeway lanes) continued to make the same number of trips as toll-paying solo drivers after the ExpressLanes opened.

The results of the 2014 user survey indicated that 49 percent of the I-10 respondents and 47 percent of the I-110 respondents reported using the ExpressLanes as a carpooler, vanpooler, or bus rider at least once a month. On the I-10, 23 percent of respondents reported using these modes five times a week in 2014, which was the same percentage reported in 2012. On the I-110, 18 percent of respondents reported using these modes five times a week in 2014, a one percent increase over 2012. Further, 55 percent of respondents to the 2014 ExpressLanes FasTrak® Customer Satisfaction Survey self-identified as carpoolers.

The analysis indicates that the impact of the ExpressLanes on reducing HOV violation rates was supportive. Vehicles without FasTrak® transponders are detected electronically, but visual enforcement of vehicle occupancy levels is still needed for self-declaring carpools. The number of monthly citations issued by CHP to drivers of vehicles without the number of occupants to meet the self-declared transponder setting ranged from 113 to 226 on the I-10 and 108 to 201 on the I-110. These figures are below or in the same range as the pre-deployment violation rates from the Caltrans visual monitoring counts. In 2011, the morning peak period violation rates were 12 percent (316 violators) on the I-10 and 2 percent (128 violators) on the I-110.

The results from the Metro-sponsored 2012 and 2014 surveys of users of the I-110 and I-10 indicate that many travelers perceive that the tolling and transponders assisted in reducing HOV violations, however. On the I-10, 64 percent of the survey respondents in 2012 agreed with the statement “the FasTrak® transponders will reduce illegal carpool lane usage,” compared to 62 percent in 2014. Agreement was higher among carpoolers at 69 percent, than non-HOV users at 54 percent in 2014. On the I-110, 55 percent of respondents agreed with the statement in 2012, compared to 54 percent in 2014. Agreement was slightly higher among HOV users at 56 percent than for non-HOV users at 52 percent.

According to analyses conducted by LADOT and Xerox, the changes in parking use over the first seven months of the project resulted in more parking spaces occupied between 70 percent and 90 percent of the time, fewer parking spaces occupied over 90 percent of the time, and fewer parking spaces occupied less than 70 percent of the time. These changes support the hypothesis that the LA Express Park™ project would result in parking occupancy of 70 to 90 percent of the parking spaces on each block throughout the day.

Although increasing parking revenues was not a goal of the LA Express Park™ project, LADOT personnel reported that parking revenues did increase by approximately 2.5 percent during Phase II of the project, with the extended parking hours excluded. LADOT personnel attributed the modest increase to more people paying for parking due to the expanded payment options, increased parking rates at well-utilized meters, and more people parking due to the improved economy. LADOT personnel noted that the parking revenues from all 37,000 metered spaces in the city, including those in the project area, is deposited into the Special Parking Revenue Fund. This fund is used for parking-related projects throughout the city. It will be used to fund future expansion of LA Express Park™ into Westwood and Hollywood, along with federal funds from the Value Pricing Pilot Program.

An extensive assessment of the impact of LA Express Park™ on retailers and businesses in the downtown area was not conducted as part of the National Evaluation. Comments from LADOT personnel indicated that no negative impacts on retailers and businesses were documented and that retailers and businesses benefited from the extended time limits implemented in some parts of the project area. LADOT personnel further pointed to the overall increase in city sales tax revenues, the increase in garbage tonnage in the Fashion District, and new economic development in the downtown area as indications that LA Express Park™ did not inhibit retail and business activity.

Table B-6. Summary of Impacts across Tolling Hypotheses/Questions

Hypotheses/Questions	Result	Evidence
Some general purpose lane travelers will shift to the ExpressLanes, while HOV lane travelers will continue to use them after the conversion to HOT lanes.	Supported	Results of the 2012 and 2014 surveys of I-110 and I-10 users and the 2013 and 2014 FasTrak® Customer Satisfaction Surveys indicate that some individuals who formerly drove alone in the general purpose freeway lanes are now using the ExpressLanes as toll-paying solo drivers, while carpoolers, vanpoolers and bus riders who used the HOV lanes continued to use the ExpressLanes. Approximately 43 percent of the 201 ExpressLanes FasTrak® Customer Satisfaction Survey respondents self-identified as solo drivers. Most (84 percent) of these individuals reported no prior use of the HOV lanes. Results from the 2014 ExpressLane FasTrak® Customer Satisfaction Survey indicated that 65 percent of the respondents who drove alone before the opening of the ExpressLanes continued to make the same number of trips as toll-paying solo drivers after the ExpressLanes opened. The results of the 2014 user survey indicated that 49 percent of the I-10 respondents and 47 percent of the I-110 respondents reported using the ExpressLanes as a carpooler, vanpooler, or bus rider at least once a month. On the I-10, 23 percent of the respondents reported using these modes five times a week in 2012 and 2014. On the I-10, 18 percent of respondents reported using these modes in 2014, a one percent increase over 2012.
Implementing the ExpressLanes will reduce HOV violation rates.	Supported	Visual enforcement of vehicle occupancy levels for self-declaring carpools is still required. The monthly number of citations issued to drivers of vehicles without the number occupants to meet the self-declared transponder setting during the post-deployment period ranged from 113 to 226 on the I-10 and 108 to 201 on the I-110. The pre-deployment (2011) morning peak period violation rates were 2 percent (128 violators) on the I-110 and 12 percent (316 violators) on the I-10, users of the I-110 and I-10 perceive that the tolling system and transponders help reduce HOV violations. In a 2014 post-deployment survey of the I-110 and I-10 users, 62 percent of I-10 respondents and 54 percent of the I-110 users agreed with the statement “the FasTrak® transponders reduce illegal carpool lane usage.”

Table B-6. Summary of Impacts across Tolling Hypotheses/Questions (Continued)

Hypotheses/Questions	Result	Evidence
The LA Express Park™ project will result in the occupancy of 70 percent to 90 percent of the parking spaces on each block throughout the day.	Supported	LADOT and Xerox analyses indicate that over the initial seven months of the project the demand-responsive pricing resulted in more parking spaces being occupied 70 to 90 percent of the time, fewer parking spaces occupied over 90 percent of the time, and fewer parking spaces occupied less than 70 percent of the time.
The LA Express Park™ project may increase parking revenues that can be used to fund system expansion in other high-demand areas.	Supported	Although increasing parking revenues was not a goal of the LA Express Park™ project, a slight increase of 2.5 percent in revenues was realized during Phase II of the project. The funds from the LA Express Park™ area are deposited into the Special Parking Revenue Fund, along with revenue from all city meters. Future expansion of LA Express Park™ into Westwood and Hollywood is being financed by a combination of funding from the Special Parking Revenue Fund and the federal Value Pricing Pilot Program.
How will the LA Express Park™ project affect retailers and similar businesses that rely on customers' ability to access their stores?	No Apparent Negative Impacts	There is no indication that the LA Express Park™ project and the implementation of demand-based parking pricing inhibited retail and business activity in the downtown area. Further, retailers and businesses benefited from the extended time limits implemented in some areas.

Source: Texas A&M Transportation Institute.

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Appendix C. Transit Analysis

The Los Angeles (LA) Congestion Reduction Demonstration (CRD) Program was intended to reduce congestion, promote throughput, and enhance mobility on the I-10 and I-110 corridors. The centerpiece was the creation of high-occupancy toll (HOT) lanes (ExpressLanes) in these corridors. However, the LA CRD included multiple transit-related improvements to increase the frequency and quality of Metro bus rapid transit service and support the goals of the CRD program. First and foremost was the purchase of 59 new clean-fuel buses to enhance the Metro Silver Line and the Foothill Transit Silver Streak, as well as several other municipal bus routes. The extra service was added in phases as shown in Table C-1.

Table C-1. CRD Funded Transit Service Changes

Effective Date	Agency	Service Change
June 2011	Metro	• Peak period headways of the I-110 portion of Silver Line changed from 30 minutes to 15 minutes.
June 2012	Metro	• Peak period headways of the I-110 portion of Silver Line changed from 15 minutes to 10 minutes.
October 2012	Gardena Municipal Bus Lines	• Peak period headway of Line 2 on the I-110 changed from 30 minutes to 15 minutes.
November 2012	Torrance Transit	• New Line 4 express bus created to go to downtown LA via the I-110 ExpressLanes
December 2012	Foothill Transit	• 13 morning peak period trips and 8 afternoon peak period trips added to the Silver Streak on the I-10. • 4 morning peak period and 14 afternoon peak period trips added to the Route 699 on the I-10.
June 2013	Metro	• Silver Line Saturday service headways on the I-110 changed from 40 minutes to 20 minutes and Sunday service headways changed from 60 minutes to 30 minutes.

Source: Metro.

The LA CRD included several other transit-related improvements, including security upgrades, construction improvements along stations, and park-and-ride lots, and implementation of transit priority signal (TPS) technology to facilitate ExpressLanes traffic movement where the I-110 enters downtown LA. TPS technology was installed in downtown LA at 15 intersections on Figueroa Street between Wilshire Blvd. and Adams Blvd. and at 5 intersections on Flower Street between Wilshire Blvd. and Olympic Blvd. The TPS was activated on November 9, 2012. Between August 2009 and November 2012, various safety-related upgrades were made at the Harbor Gateway Transit Center on I-110. These included better lighting, new security cameras, bicycle lockers, and a new LA County Sheriff substation. At the Pomona Metrolink Station, 143 new parking spaces were added in May 2010, and the passenger platform was lengthened in December 2010 to accommodate additional rail cars for the San Bernardino Line. Finally, the new and expanded El Monte Transit Center was opened to the public in October 2012.

Table C-2 presents the four hypotheses and one question for the LA CRD transit analysis. The first hypothesis states that the CRD projects listed in the above paragraph will enhance bus travel speeds, travel times, and reliability. The second hypothesis states that the safety-related upgrades at the Harbor Gateway Transit Center will lead to improved perceptions of safety by riders. The third and fourth hypotheses state that the CRD projects will facilitate increased ridership, a mode shift to transit, and a reduction in congestion. The last hypothesis is a question that seeks to quantify the extent to which the CRD projects contributed to increased ridership and reduced congestion.

Table C-2. Transit Hypotheses/Question

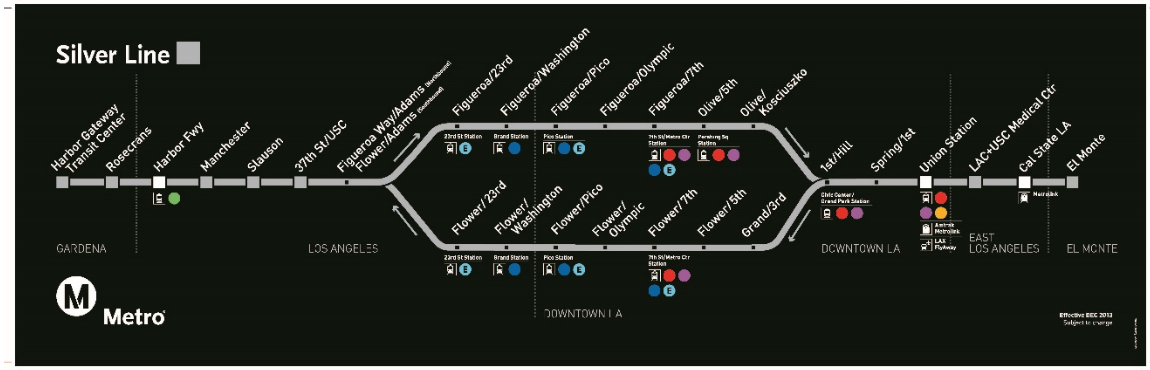
Hypotheses/Questions
• CRD projects will enhance transit performance within CRD corridors through reduced travel times, increased service reliability, and increased service capacity
• User perceptions of security at transit stations/park-and-ride lots will be improved by CRD projects
• CRD projects will increase ridership and facilitate a mode shift to transit within CRD corridors
• Increased ridership and mode shift to transit will contribute to increased person throughput, congestion mitigation, and transit cost-effectiveness within CRD corridors
• What was the relative contribution of each CRD project element to increased ridership/ transit mode share/ person throughput?

Source: Battelle.

The remainder of this appendix is divided into six sections. The data sources used in the analysis are presented in Section C.1. Information on bus travel times is presented in Section C.2. Park-and-ride lot usage data are provided in Section C.3. Changes in transit ridership are discussed in Section C.4. The results from the on-board rider surveys are presented in Section C.5. A summary of the impacts to transit from the CRD projects is in Section C.6.

C.1 Data Sources

All data for the transit analysis were provided by the LA County Metropolitan Transportation Authority (Metro). For ridership, the focus was on average daily peak period ridership in the peak direction. The peak periods were defined as 6:00 to 9:00 a.m. and 3:00 to 7:00 p.m. The peak direction on the I-110 is northbound in the morning and southbound in the afternoon. The peak direction on the I-10 is westbound in the morning and eastbound in the afternoon. Ridership on the I-110 was measured between the Harbor Gateway Transit Center on the south end and the 37th Street Station on the north end (this is the last station on the I-110 prior to downtown LA). Ridership on the I-10 was counted between El Monte Transit Station on the east end and Union Station on the west end. A schematic map of the stations on the I-110 and I-10 is shown in Figure C-1. The ridership figures were taken from automated passenger counter (APC) data, boardings in the morning and alightings in the afternoon.



Source: Metro.

Figure C-1. Silver Line Schematic Map

Bus travel times in the I-10 and I-110 ExpressLanes were derived from the automated vehicle location (AVL) system of the Metro Silver Line and the Foothill Transit Silver Streak. Bus travel times on the I-10 ExpressLanes were measured between El Monte and Union Stations. Bus travel times on the I-110 ExpressLanes were calculated between Harbor Gateway Transit Center and Slauson Station. Slauson Station was used instead of 37th Street Station on the I-110 because the buses had to bypass 37th Street Station from June 2010 to June 2011 due to construction for the Metro Expo rail line. Consequently, there was no AVL data for 37th Street. Park and ride lot occupancy data was also obtained from Metro.

Three on-board surveys of Silver Line riders were conducted. The first survey was conducted in June 2011 and was limited to the I-110 portion of the Silver Line. The second survey was conducted in October 2012 and included both the I-110 and I-10 Silver Line riders. Both the 2011 and 2012 surveys were pre-toll. The third and final survey was conducted in October 2013 to measure post-toll attitudes. In the 2011 survey, 401 surveys were collected, and the margin of error was ±4.8 percent at the 95 percent confidence level. In the 2012 survey, 593 surveys were collected, and the margin of error was ±3.9 percent at the 95 percent confidence level. In the 2013 survey, 809 surveys were collected, and the margin of error was ±3.4 percent.

Unless otherwise noted, this analysis relies on three separate three-month analysis periods. These were March to May 2011, March to May 2012, and March to May 2013. The same three months were used for comparative analysis in order to control for seasonal variation. This method is consistent with the method that was used in the transit analysis for the other UPA/CRD sites. March to May were chosen because no key CRD events occurred during this timeframe. Table C-3 shows how the three analysis periods situate in comparison to the CRD-funded improvements. The Baseline Analysis Period is the period prior to any CRD funded improvements. The Intermediate Analysis Period is the period after some of the CRD funded transit improvements were in place but prior to tolling. The Post-Toll Analysis Period is the period after the rest of the CRD funded transit improvements were in place and after tolling began on the I-110 and I-10. The purpose of dividing the analysis into three periods is to be able to distinguish the impact of the new CRD-funded transit service on ridership from the impact of the tolls.

Table C-3. Analysis Periods

Mar-May 2011	**Baseline Analysis Period**
June 2011	1st round of Silver Line service improvements
Mar-May 2012	**Intermediate Analysis Period**
June 2012	2nd round of Silver Line service improvements
Oct. 2012	Expanded El Monte Transit Center opens Gardena Transit improvements
Nov. 2012	I-110 ExpressLanes open Torrance Transit improvements
Dec. 2012	Foothill Transit improvements
Feb. 2013	I-10 ExpressLanes open
Mar-May 2013	**Post-Toll Analysis Period**

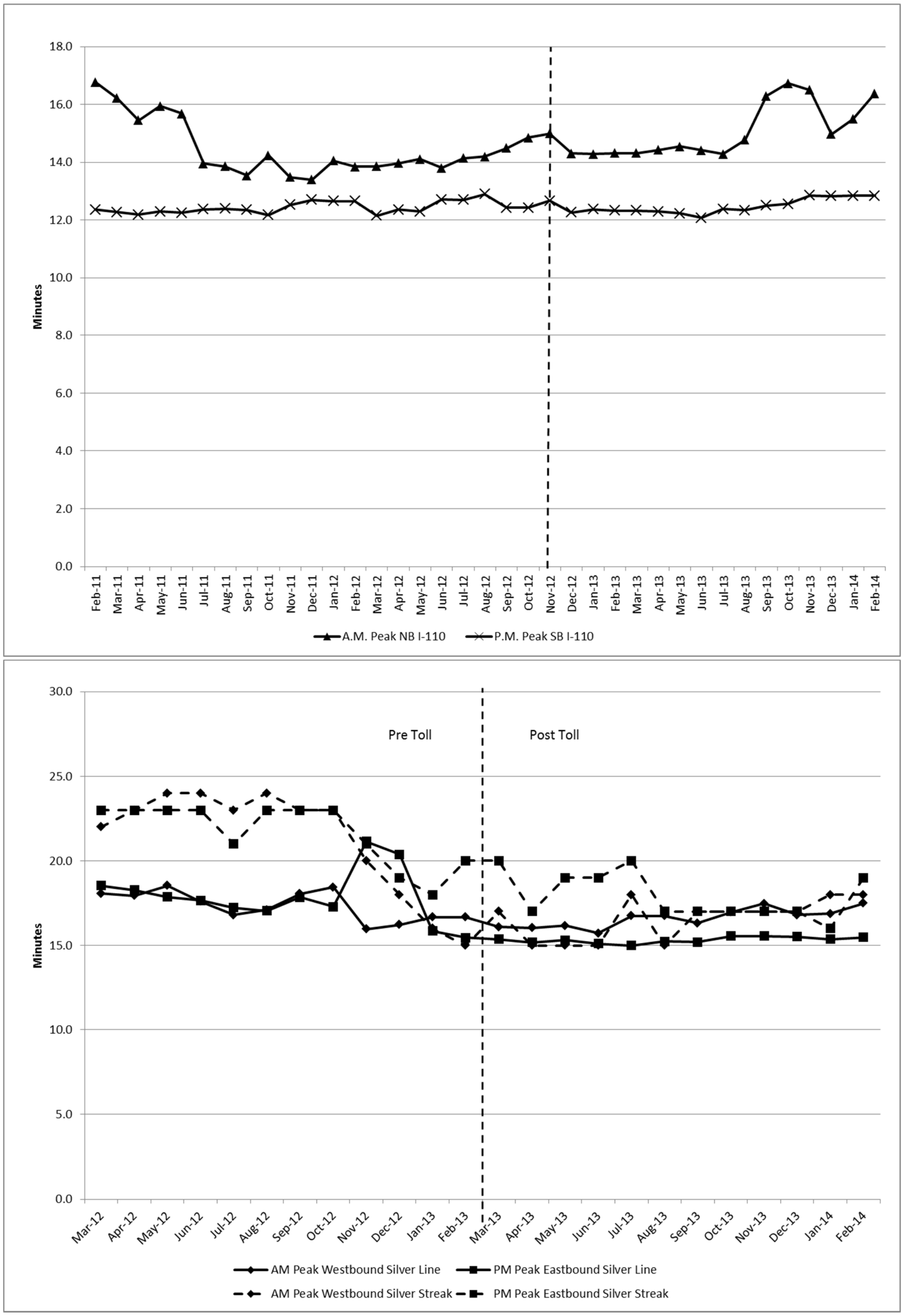
Source: Metro.

C.2 Bus Travel Time Data

C.2.1 ExpressLane Travel Times

Changes in bus travel times on the ExpressLanes were examined using the AVL systems of the Silver Line and Silver Streak buses. The data points were restricted to when the buses were in the ExpressLanes so as to isolate the impact of the latter on the former. AVL data for the year prior to tolling was compared to the year after tolling. The data suggests that implementing variable tolls has had little or no negative impact on bus travel times on the I-110 ExpressLanes, and it has had a positive impact to bus travel times on the I-10 ExpressLanes.

One can see from the top figure in Figure C-2 that the travel times on the I-110 ExpressLanes were relatively flat except near of the end of the evaluation in September, October, and November 2013. Bus travel times on the I-10 ExpressLanes, as shown in the bottom figure, reveal a noticeable decrease in travel time. A year of pre-toll travel time data was compared to a year of post-toll travel time data. The results for the I-110 ExpressLanes are shown in Table C-4, and the results for the I-10 ExpressLanes are shown in Table C-5. The Silver Line's average travel time on the I-110 ExpressLanes increased 6 percent in the morning peak period after tolling, which equated to less than a one minute increase. There was virtually no change in the afternoon peak period. On the I-10 ExpressLanes, bus travel time for the Silver Line decreased 4 percent in the morning peak period and 14 percent in the afternoon peak period. That 14 percent equated to a 2.6 minute travel time reduction. On the Silver Streak, the decrease was more pronounced. Travel time decreased 22 percent in the morning peak period and 17 percent in the afternoon peak period. This equated to a 4.7 minute and 3.8 minute reduction, respectively. Besides the variable tolls, a likely contributor to the stronger travel time reductions on the I-10 is the fact that a second HOT lane was created via restriping with no loss of general purpose lanes on the I-10 between the I-605 and I-710. This means the I-10 ExpressLanes have more capacity than the I-110 ExpressLanes.



Note: Top figure is Silver Line and bottom figure is Silver Line and Silver Streak

Source: Metro.

Figure C-2. Average Travel Times on the I-110 and I-10 ExpressLanes

Table C-4. Silver Line Average Travel Times on the I-110 ExpressLanes

	A.M. Peak Northbound	P.M. Peak Southbound
Pre-Toll	14.0 minutes	12.5 minutes
Post-Toll	14.8 minutes	12.4 minutes
Percent Change	6%	-1%

Pre-Toll = the 1-year average from Nov. 2011 to Oct. 2012

Post-Toll = the 1-year average from Nov. 2012 to Oct. 2013

Source: Metro.

Table C-5. Silver Line and Silver Streak Average Travel Times on the I-10 ExpressLanes

	Silver Line		Silver Streak	
	A.M. Peak Westbound	P.M. Peak Eastbound	A.M. Peak Westbound	P.M. Peak Eastbound
Pre-Toll	17.3 minutes	17.9 minutes	21.3 minutes	21.7 minutes
Post-Toll	16.6 minutes	15.3 minutes	16.6 minutes	17.9 minutes
Percent Change	-4%	-14%	-22%	-17%

Pre-Toll = the 1-year average from Mar. 2012 to Feb. 2013

Post-Toll = the 1-year average from Mar. 2013 to Feb. 2014

Source: Metro.

C.2.2 Transit Priority Signal (TPS) Travel Times

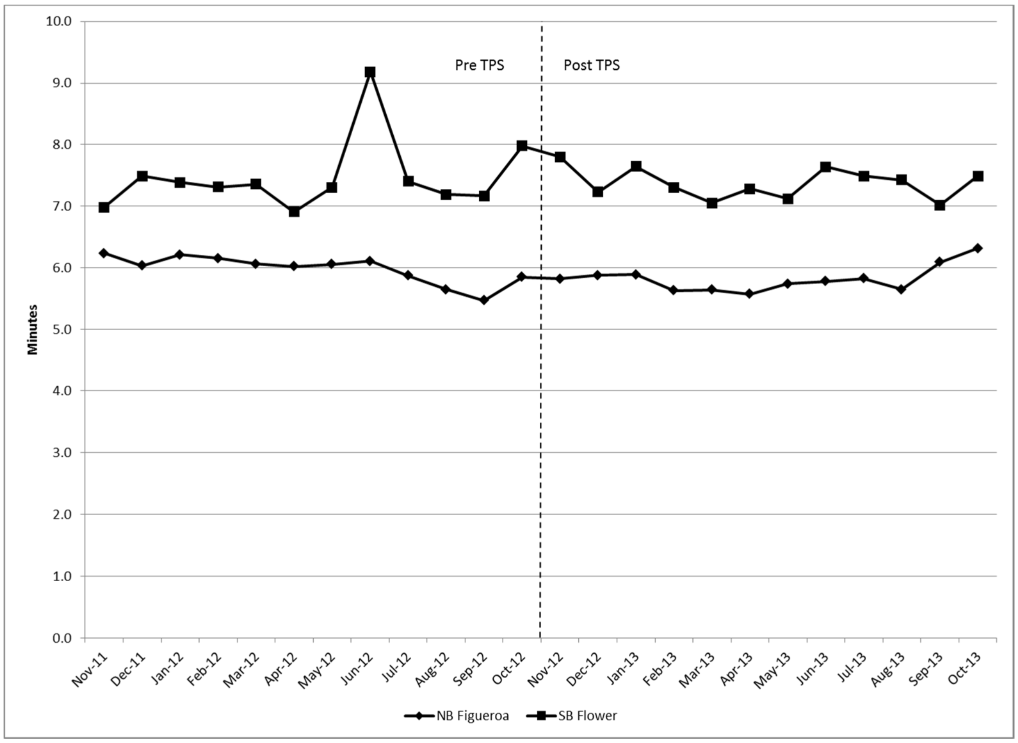
The TPS on Figueroa Street and Flower Street was activated on November 9, 2012. Travel time data was collected for northbound travel on Figueroa Street and southbound travel on Flower Street before and after the introduction of TPS. The same end points were used for both directions: Washington Boulevard and 7th Street (distance = 1.2 miles).

Table C-6 compares the 12-month averages for pre- and post-TPS. On Figueroa, the 12-month average pre-TPS was 6.0 minutes and 5.8 minutes post-TPS. On Flower Street, it was 7.5 minutes pre-TPS and 7.4 minutes post-TPS. Figure C-3 shows the monthly average travel times from November 2011 to October 2013. The changes in travel time are so small as to not likely have been noticeable to riders.

Table C-6. Silver Line Average TPS Travel Times

	A.M. Peak NB Figueroa	P.M. Peak SB Flower
Nov. 2011 – Oct. 2012 (pre-TPS)	6.0 min	7.5 min
Nov. 2012 – Oct. 2013 (post-TPS)	5.8 min	7.4 min

Source: Metro.



Source: Metro.

Figure C-3. Silver Line TPS Travel Times

C.3 Park-and-Ride Lot Use

Seven park and ride lots were monitored for the evaluation. Five of them were on the I-110 at: Harbor Gateway Transit Center, Rosecrans Station, Harbor Freeway Station, Manchester Station, and Slauson Station. The sixth lot was on the I-10 at El Monte Station. The seventh lot was the Pomona Metrolink Station.

All of the lots have undergone changes in capacity at different points of time in the last several years due to construction activities except for the Harbor Gateway lot. Table C-7 shows the vehicle counts at the seven lots for the month of February in 2012, 2013, and 2014 along with the figures for the percentage of occupied spaces.

In absolute numbers, the El Monte Transit Center saw the largest increase in occupied spaces. There were 394 more spaces occupied in February 2014 than there were in February 2012. At both the Harbor Gateway and Harbor Freeway Transit Centers, there were 48 more occupied spaces in February 2014 than there were in February 2012.

Table C-7. Park and Ride Lot Occupancy (vehicles counted)

	February 2012			February 2013			February 2014		
	Total Spaces	Spaces Occupied	Percent Occupied	Total Spaces	Spaces Occupied	Percent Occupied	Total Spaces	Spaces Occupied	Percent Occupied
Slauson	160	9	6%	160	9	6%	149	11	7%
Manchester	127	31	24%	127	34	27%	239	37	15%
Harbor Freeway	253	120	47%	253	138	55%	252	168	67%
Rosecrans	207	22	11%	185	31	17%	205	49	24%
Harbor Gateway	980	648	66%	823	691	84%	977	696	71%
El Monte	1,134	1,094	96%	1,419	1,196	84%	1,958	1,488	76%
Pomona Metrolink	372	317	85%	372	339	91%	337	325	96%

Source: Metro.

C.4 Transit Ridership Data

C.4.1 Silver Line

Table C-8 and Table C-9 show the average daily riders on the Silver Line on the I-110 and I-10, respectively. The figures are for peak period, peak direction. The peak periods were defined as 6:00 to 9:00 a.m. and 3:00 to 7:00 p.m. The peak directions on the I-110 are northbound in the morning and southbound in the afternoon. On the I-10, they are westbound in the morning and eastbound in the afternoon. On the I-110 segment, the number of average daily riders increased 52 percent in the morning peak period and 41 percent in the afternoon peak period after the first phase of CRD service was added. It increased another 29 percent in the morning peak period and another 25 percent in the afternoon peak period after the second phase of new service was added and after tolling began.

Table C-8. Silver Line Average Daily Riders (I-110 ExpressLanes)

	Morning Peak Period	Percent Change	Afternoon Peak Period	Percent Change
Mar-May 2011	596		680	
Mar-May 2012	907	52%	957	41%
Mar-May 2013	1,175	29%	1,199	25%

Source: Metro.

In contrast, Table C-9 shows that the number of average daily riders on the I-10 segment of the Silver Line increased by only 15 percent in the morning peak period and 7 percent in the afternoon peak period. It then dropped 5 percent in the morning peak period and stayed the same in the afternoon peak period. It should be pointed out that while the percentage changes on the I-110 segment of the Silver Line were larger, the I-10 segment carries a larger absolute number of riders. The main conclusion to draw from the I-110 data in Table C-8 is that the CRD-funded service improvements to the Silver Line had a greater impact on ridership than the tolls alone.

Table C-9. Silver Line Average Daily Riders (I-10 ExpressLanes)

	Morning Peak Period	Percent Change	Afternoon Peak Period	Percent Change
Mar-May 2011	1,434		1,528	
Mar-May 2012	1,642	15%	1,629	7%
Mar-May 2013	1,568	-5%	1,637	0%

Note: There were no service improvements to the I-10 of the Silver Line during the evaluation.

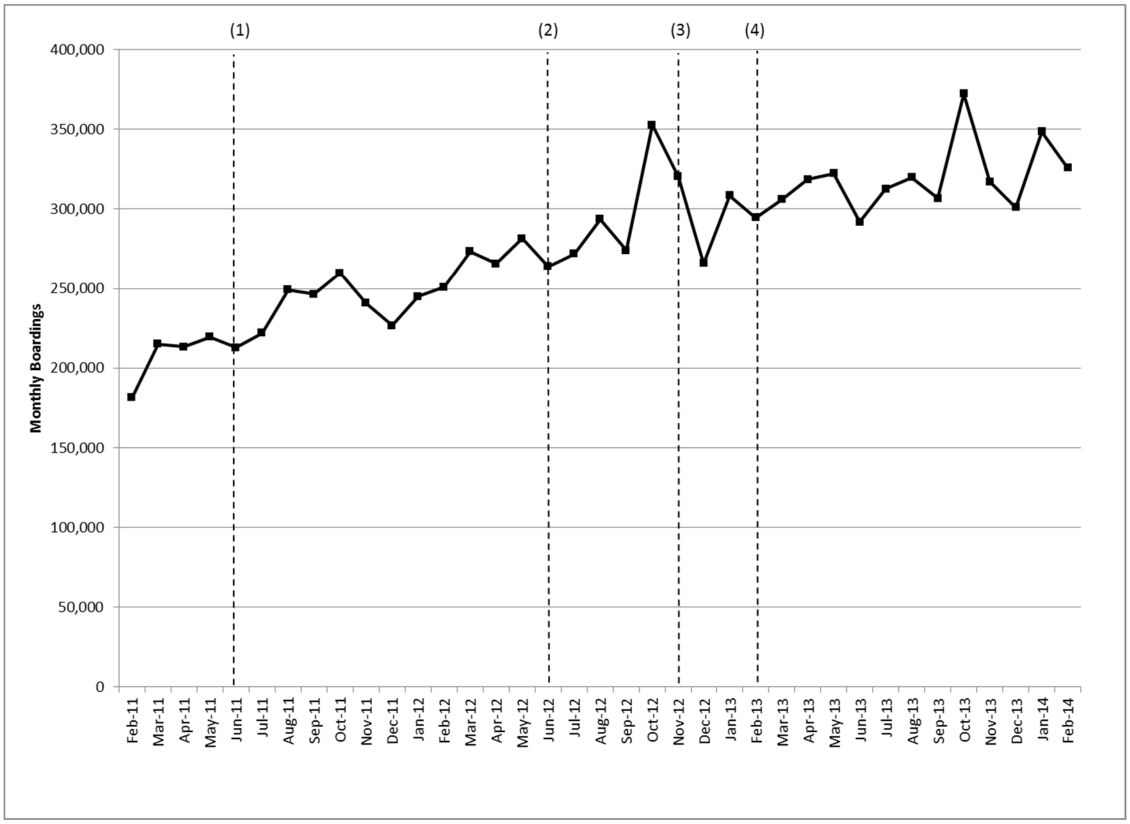
Source: Metro.

Ridership on the Silver Line was compared to Metro's system-wide ridership. The purpose was to examine whether the trend on the Silver Line was similar or different to what was occurring on the transit system as a whole. Table C-10 shows that monthly boardings on Metro, system-wide, was flat over the same time period that monthly boardings on the Silver Line was growing. The ridership growth on the Silver Line from February 2011 to February 2014 is shown in Figure C-4.

Table C-10. Monthly Boardings (Silver Line vs. Metro System-wide)

	Silver Line	Percent Change	Metro System-wide	Percent Change
Mar-May 2011	216,029		30,014,784	
Mar-May 2012	273,502	27%	29,724,628	-1%
Mar-May 2013	315,661	15%	30,057,352	1%

Source: Metro.



Notes: (1) June 2011, Peak period service on Silver Line increased from 30 to 15 minutes on I-110.

(2) June 2012, Peak period service on Silver Line increased from 15 to 10 minutes on I-110.

(3) November 2012, I-110 ExpressLanes open; tolling begins.

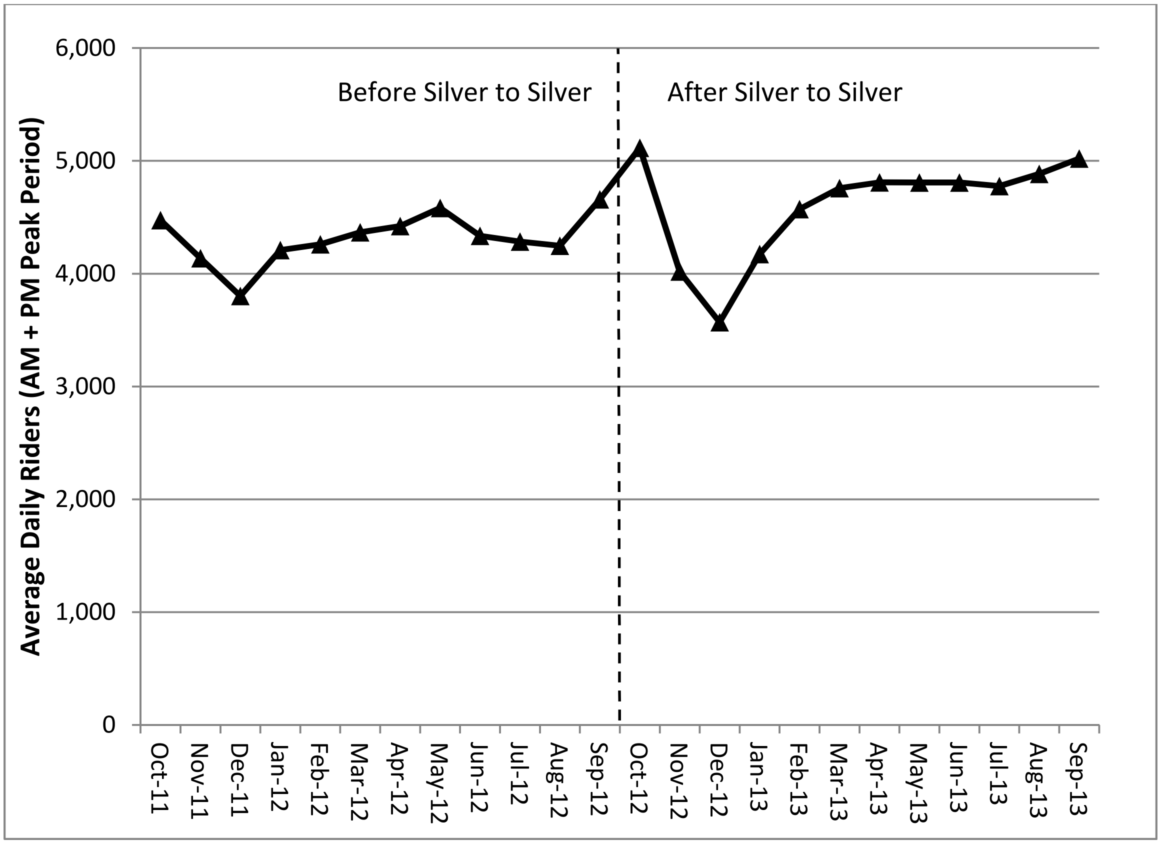
(4) February 2013, I-10 ExpressLanes open; tolling begins.

Source: Metro.

Figure C-4. Silver Line Monthly Boardings

C.4.2 Silver2Silver Program

The Silver2Silver Program began in October 2012 as a one-year demonstration project. It allowed riders of the Metro Silver Line and Foothill Transit Silver Streak to ride either route at the same fare. This resulted in a fare decrease for Silver Streak riders since previously the fare was substantially higher than the Silver Line. The purpose of the program was to maximize transit resources along the I-10 ExpressLanes. Although it is not part of the CRD, it has the potential to increase ridership in the I-10 corridor. Figure C-5 compares ridership for the one year before Silver2Silver (October 2011 to September 2012) to the one year after (October 2012 to September 2013). The ridership shown in the figure is for morning peak period plus afternoon peak period for the Silver Line and Silver Streak combined. There was a 7 percent increase in ridership.



Source: Metro.

Figure C-5. Silver2Silver Program Ridership

C.4.3 Foothill Transit

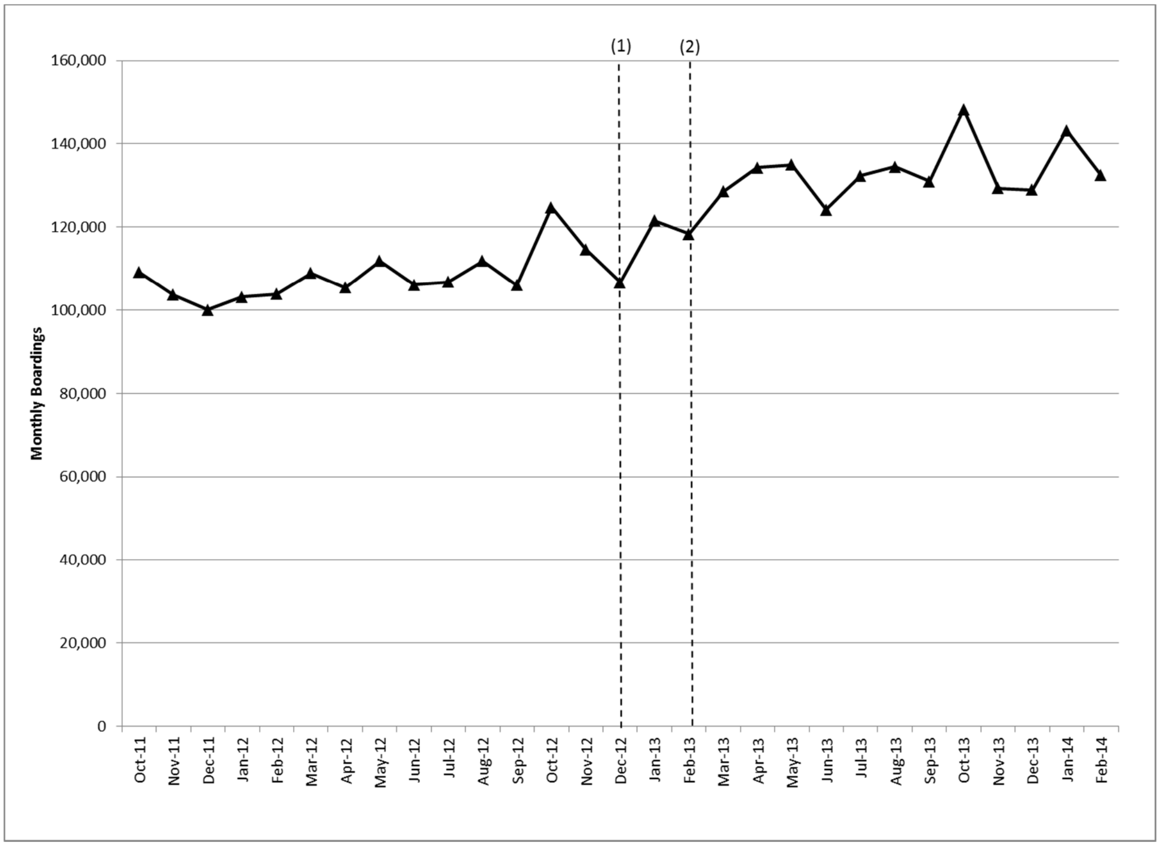
Foothill Transit received CRD funds to enhance service on the Silver Streak and the Route 699, both of which operate on the I-10 ExpressLanes. Unlike the Silver Line enhancements, which were phased in well before tolling, Foothill Transit introduced their CRD service enhancements just two months before tolling on I-10. The CRD service was added on December 16, 2012 and the I-10 ExpressLanes opened on February 23, 2013. Because the new service began so close to the start of tolls, it was difficult to parse how much of the change in ridership was due to each element. For the Silver Streak, CRD funds were used to add 13 more trips in the morning peak period and 8 more trips in the afternoon peak period. For the Route 699, CRD funds were used to add 4 additional trips in the morning peak period and 14 additional trips in the afternoon peak period.

As shown in Table C-11, average daily ridership on the Silver Streak increased 59 percent in the morning peak period and 15 percent in the afternoon peak period. It is unknown why there is such a difference in percentage growth between the morning and afternoon peak periods. It is possible that the Silver2Silver Program may have played a role. Some riders may take the Silver Streak into LA in the morning but make their return trip in the afternoon on the Silver Line. The overall trend in ridership on the Silver Streak is shown in Figure C-6.

Table C-11. Silver Streak Average Peak Period Ridership on I-10

	Morning Peak Period	Percent Change	Afternoon Peak Period	Percent Change
Mar-May 2012	505		681	
Mar-May 2013	804	59%	783	15%

Source: Metro.



Note: (1) December 2012, CRD service added.

(2) February 2013, I-110 ExpressLanes open, tolls begin.

Source: Metro.

Figure C-6. Silver Streak Monthly Boardings

As shown in Table C-12, average ridership on the Route 699 dropped by 13 percent in the morning peak period, but increased by 53 percent in the afternoon peak period. The drop in morning ridership may have been caused by riders using the Silver Streak for their morning commute but the Route 699 for their return trip in the afternoon (there is some overlap between the two routes). The Silver2Silver Program may have played a role also. Because the Silver2Silver Program reduced the fare on the Silver Streak, it would be more attractive to riders than the Route 699.

Table C-12. Route 699 Average Peak Period Ridership

	Morning Peak Period	Percent Change	Afternoon Peak Period	Percent Change
Mar-May 2012	484		271	
Mar-May 2013	420	-13%	415	53%

Source: Metro.

C.4.4 Gardena Municipal Bus Lines

Gardena Municipal received CRD funding to add two more buses to the Line 1X and Line 2. The Line 1X is an express bus service to downtown LA that runs every 30 minutes and uses the I-110 ExpressLanes. The Line 2 is a feeder service that connects with the Silver Line at the Harbor Freeway Transit Station. Its headways were increased from every 30 minutes to every 15 minutes. The CRD service was added in October 2012, one month prior to the opening of the I-110 ExpressLanes. Morning peak period ridership on the Line 1X increased 106 percent, and afternoon peak period ridership increased 123 percent. On the Line 2, morning peak period ridership increased 3 percent, and afternoon peak period ridership increased 12 percent. Because the start of new service was so close to the opening of the ExpressLanes, it is difficult to ascertain how much of the increase was due to each element.

Table C-13. Gardena Municipal Bus Lines Average Peak Period Ridership

		Morning Peak Period	Percent Change	Afternoon Peak Period	Percent Change
Gardena Line 1X	Mar-May 2012	124		151	
	Mar-May 2013	256	106%	338	123%
Gardena Line 2	Mar-May 2012	2,008		1,664	
	Mar-May 2013	2,059	3%	1,857	12%

Source: Metro.

C.4.5 Torrance Transit

At the end of November 2012, Torrance Transit began the new Line 4 with peak period express bus service from Torrance to downtown LA. The Line 4 replaced the Lines 1 and 2, which were truncated that same month so that they no longer travel to downtown LA. Since the Line 4 began after the I-110 ExpressLanes opened, it is not possible to compare ridership before and after tolls. What can be shown is how the Line 4 has performed since opening. As of February 2014, morning peak period ridership was 73 percent higher than it was in December 2012, the first month of operation. However, afternoon peak period ridership was 4 percent lower (see Table C-14). It is possible that the riders are taking the Line 4 into downtown LA in the morning but a different route home in the evening.

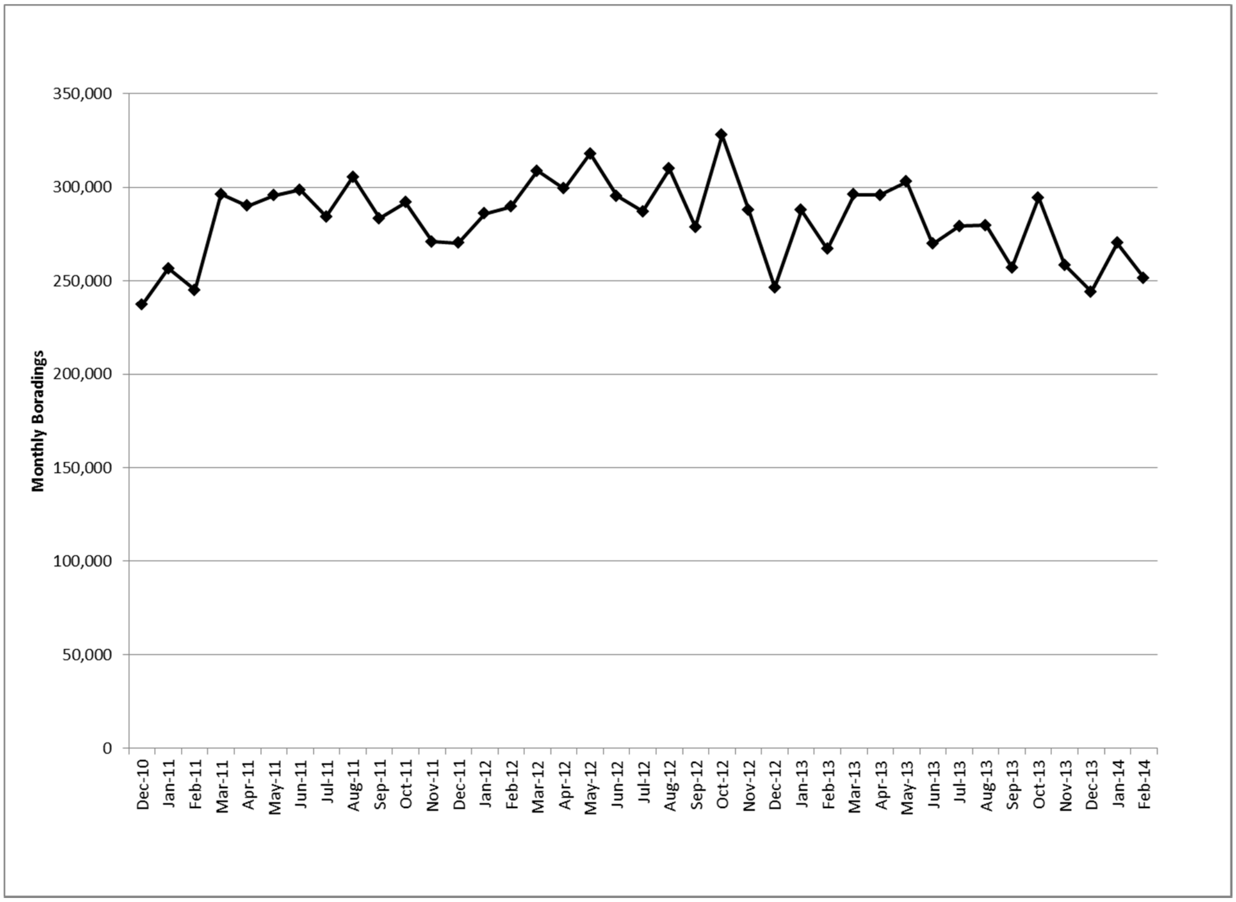
Table C-14. Torrance Line 4 Average Peak Period Riders

	Morning Peak Period	Percent Change	Afternoon Peak Period	Percent Change
Dec. 2012	51		76	
Feb. 2014	88	73%	73	-4%

Source: Metro.

C.4.6 Metrolink

In December 2010, the platform at the Pomona (North) Metrolink station was extended to accommodate additional rail cars for the San Bernardino Line. The monthly trend in ridership from December 2010 to February 2014 is shown in Figure C-7. As of February 2014, monthly boardings on the San Bernardino line were 6 percent higher than they were in December 2010.



Source: Metro.

Figure C-7. Metrolink San Bernardino Line Monthly Ridership

C.5 Silver Line Survey Results

Prior to the first survey in 2011, Metro made several CRD grant funded safety-related improvements at the transit stations on I-110. All three surveys (2011, 2012, and 2013) asked riders to rate several aspects of station safety. Table C-15 shows the changes in those ratings over the three years. The ratings are on a scale of 1 to 5 with 1 as the highest rating and 5 as the lowest. From 2011 to 2013, there were small degradations in the mean scores. An independent sample t-test revealed that none of the changes were statistically significant (i.e. the sig value was greater than 0.05). Overall, riders still rated the lighting at the stations as “Good” and their feeling of security as “Fair.”

Table C-15. Safety Ratings at Stations on the I-110

Station Feature	2011 Survey	2012 Survey	2013 Survey	Sig Value
Lighting in Stairwells	2.17	2.13	2.20	0.782
Lighting on Station Platforms	2.13	2.00	2.20	0.501
Lighting at Entrance to Station	2.13	2.07	2.21	0.443
Lighting in Elevators	2.25	2.24	2.38	0.285
Overall Feeling of Security	2.53	2.32	2.55	0.888

Scale: 1 = Very Good; 2 = Good; 3 = Fair; 4 = Poor; 5 = Very Poor

Scores are for I-110 stations only; responses from downtown and I-10 stations were filtered out.

Source: Metro.

Further analysis was done to see if the responses differed between new riders and seasoned riders. New riders were defined as those who were first time riders and those riding for less than a year. Table C-16 shows that the seasoned riders gave slightly better ratings than new riders on the lighting and their overall feeling of security. This could be because they are more aware of the changes that were made at the stations.

Table C-16. Safety Ratings at Stations on the I-110 (New vs. Seasoned Riders)

Station Feature	New Riders	Seasoned Riders
Lighting in Stairwells	2.27	2.18
Lighting on Station Platforms	2.30	2.13
Lighting at Entrance to Station	2.30	2.15
Lighting in Elevators	2.48	2.32
Overall Feeling of Security	2.66	2.51

Source: Metro.

In all three surveys, Silver Line riders were asked to rate various aspects of the service. Table C-17 shows the ratings from the three surveys for riders on the I-110 and also whether the change in rating from 2011 to 2013 was statistically significant. The ratings for frequency of service and hours of service both improved and were statistically significant. The rating for frequency of service improved from 2.14 to 1.90, and the rating for hours of service changed from 2.01 to 1.77. This survey finding is very relevant since a large portion of the CRD funds were used to reduce the headways on the I-110 portion of the Silver Line from every 30 minutes to every 10 minutes. The ratings for availability of seats and availability of parking both changed for the worse, and both changes were statistically significant. The rating for availability of seats degraded from 1.92 to 2.47, and the rating for parking availability degraded from 1.76 to 2.00. The drop in rating for these two categories may have been caused by the large increase in ridership on the I-110 portion of the Silver Line. In this case, the Silver Line may be a victim of its own success. Metro has plans to increase service.

Table C-17. I-110 Silver Line Customer Satisfaction Ratings

Service Aspect	2011 Survey	2012 Survey	2013 Survey	Sig Value*
On time performance	1.78	1.70	1.88	0.214
Travel time	1.63	1.64	1.74	0.147
Hours of service	2.01	1.85	1.77	**0.004***
Frequency of service	2.14	1.94	1.90	**0.008***
Wait time at station/stop	2.14	1.99	2.10	0.642
Value of service for the price	2.05	1.87	2.11	0.520
Availability of seats	1.92	2.18	2.47	**0.000***
Parking availability at the Park n Ride lots	1.76	1.96	2.00	**0.005***
Ability to connect with other transit service	1.76	1.75	1.77	0.933
Overall satisfaction with this bus service	1.79	1.77	1.81	0.734

Scale: 1 = Very Good; 2 = Good; 3 = Fair; 4 = Poor; 5 = Very Poor

*Values in bold are statistically significant at the 95 percent confidence level.

An independent sample T test was performed comparing 2011 (baseline) to 2013.

Source: Metro.

Table C-18 shows the ratings given by Silver Line riders on the I-10 portion of the route. Since the 2011 survey was only conducted on the I-110 portion, the results for I-10 are limited to 2012 and 2013. There were slight degradations in ratings for nine of the ten categories although the degradations were statistically significant for only three of the categories (travel time, ability to connect with other services, and overall satisfaction with the bus service). The rating for travel time degraded from 1.52 to 1.76. The rating for ability to connect to other services degraded from 1.64 to 1.84. The rating for overall satisfaction degraded from 1.63 to 1.80. It is important to point out though that the ratings still fall within the category of "Good".

Table C-18. I-10 Silver Line Customer Satisfaction Ratings

Service Aspect	2012 Survey	2013 Survey	Sig Value*
On time performance	1.61	1.76	0.051
Travel time	1.52	1.76	**0.003***
Hours of service	1.67	1.82	0.076
Frequency of service	1.71	1.82	0.202
Wait time at station/stop	1.89	2.03	0.169
Value of service for the price	1.96	2.07	0.294
Availability of seats	2.33	2.41	0.484
Parking availability at the Park n Ride lots	2.31	2.15	0.148
Ability to connect with other transit service	1.64	1.84	**0.022***
Overall satisfaction with this bus service	1.63	1.80	**0.030***

Scale: 1 = Very Good; 2 = Good; 3 = Fair; 4 = Poor; 5 = Very Poor

*Values in bold are statistically significant at the 95 percent confidence level.

An independent sample T test was performed comparing 2012 and 2013.

Source: Metro.

For both the I-110 and I-10, it is important to point out that the surveys did not reveal a statistically significant improvement in customer satisfaction related to bus travel time. Although the rating still falls within the range of "good", it is important for policy makers to know that the conversion of the carpool lanes into tolled ExpressLanes did not cause a positive change in bus rider satisfaction with travel time.

The surveys asked riders how long they have been riding the Silver Line. Table C-19 shows the results broken down by corridor. The percentage distribution was fairly similar with the exception that a higher percentage of Silver Line riders on the I-10 have been riding for more than five years.

Table C-19. How long have you been riding this bus route?

Response	I-110 Riders		I-10 Riders	
First time riding	19	7%	10	3%
Less than 6 months	53	19%	63	20%
6 months to 1 year	53	19%	53	17%
1-5 years	104	38%	105	34%
More than 5 years	43	16%	78	25%

Source: Metro.

Riders were asked how they made their trip before they began taking the Silver Line. The results in Table C-20 are limited to new riders, which are defined as first time riders and those riding for less than a year. The reason why the results are limited to new riders is to show how the CRD (both the new transit service and the lane conversions to tolled ExpressLanes) has influenced mode choice. About a third of the new riders in both corridors previously drove alone. Only a small percentage carpooled before taking the Silver Line.

Table C-20. How did you make this trip before you began riding this route?

Response	I-110 Riders		I-10 Riders	
Always made this trip by bus	32	26%	39	33%
Carpooled	10	8%	6	5%
Other (specify)	12	10%	13	11%
Drove alone	39	32%	39	33%
Rode another bus	30	24%	23	19%

Note: Responses are for new riders only.

Source: Metro.

Riders were asked whether they began riding the Silver Line before or after tolling. Table C-21 shows that a greater percentage of the I-110 riders began riding after tolling began (41 percent on the I-110 versus 28 percent on the I-10). A follow-up question asked whether the conversion of the carpool lanes into tolled ExpressLanes influenced their decision to ride the bus. The responses shown in Table C-22 are limited to riders who began riding the Silver Line after tolling began. This is similar to how the question was analyzed in the other UPA/CRD evaluations. The logic here is that riders who began riding before tolls began had already made up their minds and therefore could not have been influenced by the tolls. The results show that among these “post toll” riders, a little more than one third of them said the lane conversion influenced their decision to take transit (37 percent on the I-110 and 34 percent on the I-10).

Table C-21. Did you begin riding this bus before or after tolling began?

Response	I-110 Riders		I-10 Riders	
Before tolling started	148	59%	202	72%
After tolling started	101	41%	78	28%

Source: Metro.

Table C-22. Did the ExpressLanes influence you to ride this bus?

Response	I-110 Riders		I-10 Riders	
No	60	63%	46	66%
Yes	35	37%	24	34%

Note: Responses are limited to riders who said they started riding after tolls began.

Source: Metro.

The survey asked riders how their travel time now compared to before tolling began. Table C-23 shows that in both corridors, the majority of riders felt their travel time decreased since tolling began (65 percent on the I-110 and 57 percent on the I-10). Furthermore, one third of riders in both corridors said their travel time decreased by 30 minutes or more. Two discrepancies need to be addressed. First, there was a discrepancy between riders' perception of travel time savings and the AVL travel times reported earlier in Table C-4 and Table C-5. The Silver Line's average travel time on the I-110 ExpressLanes increased 6 percent in the morning peak period after tolling, which equated to less than a one minute increase. There was virtually no change in the afternoon peak period. On the I-10 ExpressLanes, bus travel time for the Silver Line decreased 4 percent in the morning peak period and 14 percent in the afternoon peak period. That 14 percent equated to a 2.6 minute travel time reduction. It is possible that riders were basing their perception of travel time savings on the entire length of their trip and not just one portion on the ExpressLanes. Second, there is a discrepancy between riders' perception of travel time and their level of satisfaction with travel time. While the majority of riders reported travel time savings after tolls, the customer satisfaction rating for travel time dropped. A closer look at the data revealed that 680 riders answered the survey question related to customer satisfaction, but only 506 answered the travel time savings question. The survey questionnaire was worded in such a way that a rider was prompted to answer the travel times savings question only if he/she had answered the previous question which asked whether the conversion of the I-110 and I-10 carpool lanes influenced them to take the bus. In retrospect, the question on travel time change should have been asked of all riders.

Table C-23. How does your travel time now compare to before tolls?

Response	I-110 Riders		I-10 Riders	
30 minutes faster or more	58	31%	61	29%
15-29 minutes faster	37	20%	31	15%
5-14 minutes faster	16	9%	18	9%
1-4 minutes faster	9	5%	8	4%
About the same	39	21%	63	30%
1-4 minutes slower	4	2%	2	1%
5-14 minutes slower	8	4%	12	6%
15-29 minutes slower	5	3%	6	3%
30 minutes slower or more	10	5%	8	4%

Source: Metro.

The survey included two questions about attitudes toward the tolls. Riders were asked whether they thought the ExpressLanes had improved their travel and whether they thought the tolls were unfair to people on limited incomes. The results of the former question are shown in Table C-24 and the results of the latter in Table C-25. In both corridors, 48 percent of the riders agreed to varying extents that tolling the I-110 and I-10 ExpressLanes has improved their travel. Another 34 percent in both corridors were neutral. A smaller, though not unsubstantial, percentage (19 percent) disagreed to varying extents that tolling the ExpressLanes improved their travel. Whether these 19 percent meant that tolling the ExpressLanes has made no difference or made it worse is unknown. In regards to the issue of equity, slightly more than half agreed to varying extents that the tolls on the I-110 and I-10 are unfair to people on limited incomes. In the I-110 corridor, it was 54 percent. In the I-10 corridor, it was 55 percent. About a third of the respondents in each corridor were neutral.

Table C-24. Tolling the I-110 and I-10 ExpressLanes has Improved my Travel

Response	I-110 Riders		I-10 Riders	
Strongly Agree	74	30%	79	27%
Agree	45	18%	62	21%
Neutral	84	34%	99	34%
Disagree	23	9%	24	8%
Strongly Disagree	24	10%	31	11%

Source: Metro.

Table C-25. Tolls on the I-110 and I-10 ExpressLanes are Unfair to People on Limited Incomes

Response	I-110 Riders		I-10 Riders	
Strongly Agree	85	36%	84	31%
Agree	43	18%	66	24%
Neutral	80	34%	84	31%
Disagree	15	6%	13	5%
Strongly Disagree	13	6%	27	10%

Source: Metro.

Table C-26 compares the demographics of Silver Line riders in the two corridors. In both corridors, slightly more than half are female. I-110 riders tend to be younger than I-10 riders. African-Americans and Hispanics comprise a larger percentage of the riders on the I-110 than I-10. In regards to income, 61 percent of riders on I-110 and 58 percent of riders on the I-10 have annual household incomes less than $35,000 a year. These riders qualify for the Metro Express Lane Equity Plan, which is described in greater detail in the next section of the report. In both corridors, less than half of the riders have access to an automobile for their trip (48 percent of the I-110 riders and 43 percent of the I-10 riders).

Table C-26. Demographics of Silver Line Riders

Response	I-110 Riders		I-10 Riders	
Gender				
Male	119	47%	136	48%
Female	132	53%	150	52%
Age				
Under 18	10	4%	12	4%
18-24	87	33%	84	27%
25-34	44	17%	56	18%
35-44	43	17%	57	18%
45-54	44	17%	45	15%
55-64	23	9%	36	12%
65 or over	9	3%	20	6%
Racial/Ethnic Background				
African American/Black	73	37%	33	14%
Asian	33	17%	60	26%
American Indian/Alaskan Native	11	6%	12	5%
Caucasian/White	32	16%	48	21%
Other	49	25%	76	33%
Hispanic/Latino				
Yes	136	55%	120	42%
No	111	45%	167	58%
Annual Household Income				
Less than $10,000	67	33%	58	23%
$10,000 to $24,999	37	18%	64	26%
$25,000 to $34,999	20	10%	22	9%
$35,000 to $49,999	28	14%	25	10%
$50,000 to $74,999	21	10%	27	11%
$75,000 to $99,999	16	8%	19	8%
$100,000 to $149,999	5	2%	22	9%
$150,000 to $199,999	5	2%	6	2%
$200,000 to $249,999	1	0%	2	1%
$250,000 or more	3	1%	4	2%
Access to an Automobile				
No	139	52%	172	57%
Yes	126	48%	132	43%

Source: Metro.

C.6 Summary Transit Impacts

The most positive observation related to transit in the LA CRD evaluation has been an increase in ridership. In the I-110 corridor where Metro added service to its Silver Line bus service, ridership increased 52 percent in the morning peak period and 41 percent in the afternoon peak period. This increase occurred after the new service was added but before tolling began. After tolling began, ridership increased another 29 percent in the morning peak period and another 25 percent in the afternoon peak period. In the I-10 corridor, where Foothill Transit added service to the Silver Streak and Route 699, ridership also increased. Ridership on the Silver Streak increased 59 percent in the morning peak period and 15 percent in the afternoon peak period. Ridership on the Route 699 increased 53 percent in the afternoon peak period. Gardena Municipal Bus Lines and Torrance Transit also saw ridership increases in the I-110 corridor. Morning peak period ridership on the Gardena Line 1X increased 106 percent, and afternoon peak period ridership increased 123 percent. On the Torrance Transit Line 4, morning peak period ridership was 73 percent higher.

There has been an increase in utilization of park and ride lots in both the I-110 and I-10 corridors. February 2014 was the last month of data collection. At the El Monte Transit Center on the I-10, there were 394 more spaces occupied in February 2014 than there were in February 2012. At both the Harbor Gateway and Harbor Freeway Transit Centers on the I-110, there were 48 more occupied spaces in February 2014 than there were in February 2012.

The data suggests that implementing variable tolls has had little or no negative impact to bus travel times on the I-110 ExpressLanes, and it has had a positive impact to bus travel times on the I-10 ExpressLanes. On the I-110, the Silver Line’s average travel time after tolls increased less than a minute in the morning and stayed virtually the same in the afternoon. On the I-10, the average travel time decreased 4 percent in the morning and 14 percent in the afternoon. That 14 percent reduction equated to a 2.6 minute reduction. The Silver Streak’s average travel time on the I-110 decreased 22 percent in the morning and 17 percent in the afternoon. This amounted to a 4.7 minute and 3.8 minute reduction respectively.

In the survey of Silver Line riders, there were statistically significant improvements in the ratings given by riders on the I-110 segment for frequency of service and hours of service. This is an important finding since Metro invested a large amount of CRD funds to improving service on the I-110 portion of the Silver Line. Sixty-five (65) percent of the Silver Line riders on the I-110 segment and 57 percent of riders on the I-10 segment said their travel time has been faster since tolling began. Thirty-two (32) percent of the new riders on the I-110 segment and 33 percent of the new riders on the I-10 segment said they used to drive alone before switching to transit. Among riders who began taking the Silver Line after tolling began, 37 percent of the riders on the I-110 segment and 34 percent of the riders on the I-10 segment said the tolls influenced them to take the bus. In both corridors, 48 percent of Silver Line riders agreed to varying extents that tolling the I-110 and I-10 ExpressLanes improved their travel while 34 percent in both corridors were neutral.

Table C-27. Summary of Transit Impacts across Hypotheses

Hypotheses/Questions	Result	Evidence
CRD projects will enhance transit performance within CRD corridors through reduced travel times, increased service reliability, and increased service capacity	Mostly Supported	• Post-toll travel times for the Silver Line on the I-110 ExpressLanes stayed about the same. • Post-toll travel times for the Silver Line on the I-10 ExpressLanes were 4% longer (less than a minute) in the morning peak period and 14% shorter in afternoon peak period (2.6 minutes). • Post-toll travel times for the Silver Streak on the I-10 ExpressLanes were 22% shorter (4.7 minutes) in the morning peak period and 17% shorter (3.8 minutes) in the afternoon peak period. • There were no significant travel time improvements from the transit priority signals on Figueroa and Flower Streets • In the survey of the I-110 Silver Line riders, the ratings for frequency of service and hours of service both improved and were statistically significant. • In the surveys, 65% of Silver Line riders on the I-110 and 57% of Silver Line riders on the I-10 said their travel time has been faster since tolling began.
User perceptions of security at transit stations/park-and-ride lots will be improved by CRD projects	Not supported	• There was no statistically significant change in user perceptions of safety by riders on the I-110 portion of the Silver Line. • Overall, riders rated their overall feeling of security as “Fair.”
CRD projects will increase ridership and facilitate a mode shift to transit within CRD corridors	Supported	• Ridership on the I-110 segment of the Silver Line increased 52% in the morning peak period and 41% in the afternoon peak period after CRD service was added; it increased another 29 % in morning peak period and another 25% in the afternoon peak period after tolling. • Ridership on the Foothill Transit Silver Streak (I-10) increased 59% (morning peak) and 15% (afternoon peak). • Ridership on the Foothill Transit Route 699 dropped 13% in the morning peak but increased 53% in the afternoon peak. • Ridership on the Gardena Line 1X increased 106% in the morning peak and 123% in the afternoon peak. Ridership on the Line 2 increased 3% in the morning peak and 12% in the afternoon peak. • Ridership on the Torrance Transit Line 4 increased 73% (morning peak). • Monthly boardings on the San Bernardino line of Metrolink were 6% higher in February 2014 than they were in December 2010 when the rail platforms were extended. • At the park-and-ride lot at the El Monte Transit Center, there were 394 more spaces occupied in February 2014 than there were in February 2012. At both the Harbor Gateway and Harbor Freeway Transit Centers, there were 48 more occupied spaces in February 2014 than there were in February 2012.

Table C-27. Summary of Transit Impacts across Hypotheses (Continued)

Hypotheses/Questions	Result	Evidence
Increased ridership and mode shift to transit will contribute to increased person throughput, congestion mitigation, and transit cost-effectiveness within CRD corridors	Not Supported	• Total person throughput on the I-110 in the northbound direction during the morning peak hour decreased 12.4% (data is from Appendix A – Congestion Analysis). • Person throughput on I-10 decreased in the morning commute but increased in the evening commute (from Appendix A – Congestion Analysis).
What was the relative contribution of each CRD project element to increased ridership/ transit mode share/ person throughput?		• In the survey of Silver Line riders, 32% of the new riders on the I-110 segment and 33% of new riders on the I-10 segment said they used to drive alone. • Among riders who began taking the Silver Line after tolling began, 37% of the riders on the I-110 and 34% of the riders on I-10 said the tolls influenced them to take the bus. • In both corridors, 48% of Silver Line riders agreed to varying extents that tolling the I-110 and I-10 ExpressLanes improved their travel. 34% in both corridors were neutral.

Source: Center for Urban Transportation Research.

Appendix D. Rideshare Analysis

This rideshare analysis focused on the Transportation Demand Management (TDM) aspects of the Los Angeles (LA) Congestion Reduction Demonstration (CRD) projects. The core elements of the CRD projects were the ExpressLanes on the I-110 and I-10 and LA Express Park™ in downtown LA. The ExpressLanes were implemented by expanding and converting the existing high-occupancy vehicle (HOV) lanes on the I-110 and I-10 into high-occupancy toll (HOT) lanes. LA Express Park™ combined technology and demand-pricing into an innovative parking management strategy in a 4.5 square mile area of downtown LA.

The LA Country CRD National Evaluation Plan included three rideshare hypotheses. Table D-1 presents the hypotheses for the rideshare analysis presented in this appendix. The first hypothesis focuses on whether a key target was met as contained in the project agreement, the formation of 100 vanpools to help maintain ridesharing in the ExpressLanes. The second hypothesis attempts to assess what was most effective in promoting ridesharing, in terms of incentives, information, outreach, etc. Finally, the third hypothesis inquires about the potential impact of the CRD projects on carpooling, as tolling and transit could have the unintended impact of breaking up existing carpools and vanpools. Based on the data reviewed and analyzed in this appendix, a summary of impacts, presented as evidence to support the hypotheses and answer the critical questions are presented.

Table D-1. Los Angeles CRD Rideshare Analysis Hypotheses

Hypotheses/Questions
• CRD vanpool promotion will result in at least 100 new Metro-registered vanpools.
• Which factors were most effective in promoting ridesharing?
• Will CRD HOT and transit improvements lead to the unintended breakups of current carpools/vanpools?

Source: Battelle.

The remainder of this appendix is divided into five sections. The data sources used in the analysis are described in Section D.1. A description of the rideshare element of the CRD projects is provided in Section D.2. The analysis of vanpool formation and promotion are presented in Section D.3. The analysis of CRD project impacts on ridesharing are included in Section D.4. The impacts of tolling on carpooling are examined in Section D.5. This appendix concludes with a summary of the rideshare hypotheses/questions in Section D.6.

D.1 Data Sources

Three primary data sources comprise the information to assess the first two hypotheses/questions. First, the Los Angeles Metropolitan Transportation Authority (Metro) provided quarterly vanpool formation data on new vanpools formed in each CRD corridor from July 2012 until February 2014. For each corridor (and for vanpools that used both freeways), Metro reported new vanpools formed (routes) and the corresponding number of riders (boardings), miles (revenue miles driven), and hours (revenue hours). Second, a vanpooler survey was distributed to all vanpools operating in the I-110 and I-10 corridors in February 2014. The National Evaluation team assisted Metro with the development of the survey instrument and surveying protocol. The purpose of the survey was to collect data on vanpooler behavior and attitudes. The survey was provided to all vanpool drivers and was distributed by the drivers to all passengers. The total usable responses received were 186 vanpoolers. An incentive was provided for the prompt return of survey forms. Third, an employer focus group was administered among employee transportation coordinators at a sample of employers whose employees commuted in the CRD corridors. Coordinators from six large employers participated, in addition to a consultant who represents smaller employers. The focus group was held on March 5, 2014 and followed a set moderator guide that had been developed by Metro with the assistance of the National Evaluation team. The analysis of these data sources is provided in Section D.3.

Additionally, information was received as to the utilization of the Carpool Loyalty program, but as the program was static (making 40 awards per month), no additional data is reported. Also, historical data on the number of Metro vanpools in service since the program's inception in 2008 was provided by Metro staff during the pre-deployment data collection phase.

Finally, to assess whether the ExpressLanes had the unintended impact of breaking-up ridesharing arrangements as a result of the new SOV toll and transit options, a number of data sources were examined, which are described in more detail in other analyses. Vehicle occupancy counts, as described in Appendix A – Congestion Analysis, are directly observed data. Toll transaction data, as detailed in Appendix B – Tolling Analysis, are from the tolling system itself and show the proportion of transponder users driving alone, versus ridesharing in 2-person or 3+ person carpool and vanpools. This data was recorded from the transponder and requires the driver to indicate the correct occupancy. Finally, the pre- and post-deployment I-110 and I-10 user surveys, and a FasTrak® customer satisfaction survey of transponder account holders, as described in more detail in Appendix B – Tolling Analysis, were used to assess travel behavior and mode shift.

The toll account application form inquired whether the traveler was currently carpooling; however, this data was determined to be too incomplete and inconsistent to use.

D.2 Rideshare Program Description

HOV users were still able to use the ExpressLanes for free (with the exception of 2+ carpools paying the toll during the peak period on the I-10 where the occupancy requirement was previously 3+). While free use of the lanes, travel time savings, and reliable travel times remains a significant incentive to carpooling and vanpooling, the CRD program also included a rideshare element to reinforce high occupancy trips while allowing solo drivers to pay a toll to use the lanes. HOV benefits are assured because if travel times fall below 45 mph, the lanes are restricted to HOV only. The benefits of the ExpressLanes for carpooling are cited on the Metro website[1] to include toll exemption, new lane miles of the I-10, better enforcement to reduce cheating, improved flexibility on the I-110 and a "Loyalty" program.

[1] See: www.metroexpresslanes.net.

The rideshare, or TDM element, of the CRD projects was centered on a focused campaign to form new vanpools in the two ExpressLane corridors. Additionally, Metro promoted commute alternatives as part of its employer outreach in the region for employees who commuted on the I-10 and/or I-110. As part of the CRD agreement, Metro set a target of forming at least 100 new vanpools in the two corridors. Marketing began in July 2012, four months before the opening of the ExpressLanes on the I-110. Employers within the commuter-shed served by each facility were contacted by Metro with outreach materials. These materials were tailored for each corridor and highlighted the travel time reliability benefits offered by the ExpressLanes without having to pay a toll. The materials were distributed several months before and during the HOT conversions. The type of vanpools offered, and the Metro subsidies associated with these vans, did not change from the normal, ongoing Metro vanpool program. However, marketing and outreach to employers, designed to identify and encourage potential vanpool groups among employees, was concentrated in the two CRD corridors.

Also, as part of its education campaign on the ExpressLanes project, Metro included ridesharing information. Part of this is necessitated by the fact that carpools desiring to use the ExpressLanes must have a FasTrak® transponder and valid account. One marketing slogan on the Metro ExpressLanes website states: *More choices for solo drivers. More rewards for carpoolers. More transit service. It's about time.*

Finally, Metro implemented two critical incentive programs. One was directly related to ridesharing – the Carpool Loyalty Program, and the other related to transit riders – the Transit Rewards Program. The Carpool Loyalty Program awards transponder owners when they travel in the ExpressLanes as a two- or three-person carpool (including vanpools). Each time the transponder is read in the “2” or “3+” setting, the account holder is entered into a monthly drawing for a gift card (valued at $50).

D.3 Vanpool Formation and Rideshare Promotion

As part of the CRD agreement, Metro focused its TDM element on vanpooling and set an objective of forming at least 100 new vanpools in the two ExpressLanes corridors during the post-deployment period. Table D-2 shows the number of new vanpools formed by quarter from July 2012 (pre-deployment marketing) until the end of February 2014 (the end of the post-deployment period).

Table D-2. Vanpool Formation by Quarter

Quarter	(Q1) July - Sep 2012	(Q2) Oct - Dec 2012	(Q3) Jan - Mar 2013	(Q4) April - June 2013	(Q5) July - Sept 2013	(Q6) Oct - Dec 2013	(Q7)* Jan - Feb 2014	Total
I-110								
New Routes	2	5	6	4	3	4	10	34
Boardings**	218	1,452	1,546	593	559	729	2,196	7,293
Miles	1,334	7,405	10,384	3,988	5,383	4,921	13,667	47,082
Hours	44	173	232	104	107	124	352	1,136
I-10								
New Routes	19	15	6	16	7	9	7	79
Boardings	4,542	3,923	1,723	3,909	1,751	2,051	1,532	19,431
Miles	44,629	26,980	14,769	36,241	14,290	18,589	13,749	169,247
Hours	946	658	307	759	327	436	316	3,749
I-110 and I-10								
New Routes	1	3	1	0	0	1	0	6
Boardings	189	744	262	0	0	152	0	1,347
Miles	1330	4515	2866	0	0	1,120	0	9,831
Hours	31	101	50	0	0	28	0	210
TOTAL New Vanpools	**22**	**23**	**13**	**20**	**10**	**14**	**17**	**119**

*represents final two months of post-deployment evaluation period

**refers to unlinked passenger trips (i.e., people getting on the vehicle)

Source: Metro.

As shown, Metro met and exceeded its objective by forming 119 new vanpools in the two corridors in the four months leading up to the opening of the first ExpressLane and then during the post-deployment period ending February 2014 on the I-10 corridor. Thirty-four vanpools were formed in the I-110 corridor, 79 vanpools in the I-10 corridor and six vanpools that used both corridors

Historically, the Metro vanpool program had been growing by about 100 vanpools per year, as shown in Table D-3, since its inception in 2007. Metro did not collect data on which corridor the vanpools used prior to the CRD project in 2012. Therefore, only a comparison of regional historical data was possible. Although regional FY07 data is currently unavailable, data from FY08 through FY12 show that vanpooling has continued to grow, almost doubling in the number of registered vanpools prior to 2013, with 615 vanpools in FY08 and 1,162 vanpools in FY12. Additionally, revenue miles more than doubled between FY08 and FY12, from 13,065,208 miles to 26,283,468 miles (vanpool revenue miles are collected as part of National Transit Database reporting). Passenger trips almost doubled from 1.8 million rides in FY08 to 3.4 million in FY12.

Table D-3. Metro Vanpool Program System-Wide Service Statistics*

	FY2008	FY2009	FY2010	FY2011	FY2012	Change 2008 - 2012
Routes	615	806	907	1,059	1,162	+89%
Revenue Miles	13,065,208	17,949,029	20,581,653	23,420,380	26,283,468	+101%
Boardings	1,804,235	2,487,304	2,725,105	2,995,193	3,355,746	+86%

*Fiscal Year runs July to June (e.g., FY08 runs from July 2008 – June 2009).

Note: FY2007 data was unavailable.

Source: Metro.

In the two ExpressLanes corridors, as shown in Table D-4, there were a total of 118 vanpools operating the in the quarter prior to the start of targeted marketing. The additional of 119 new vanpools; however, does equate to a doubling of usage because vanpooling (like all ridesharing) is rather fluid with vanpool groups disbanding and new vanpools forming on a regular basis.

Table D-4. Vanpool Usage by Corridor (Prior to Vanpool Promotion)

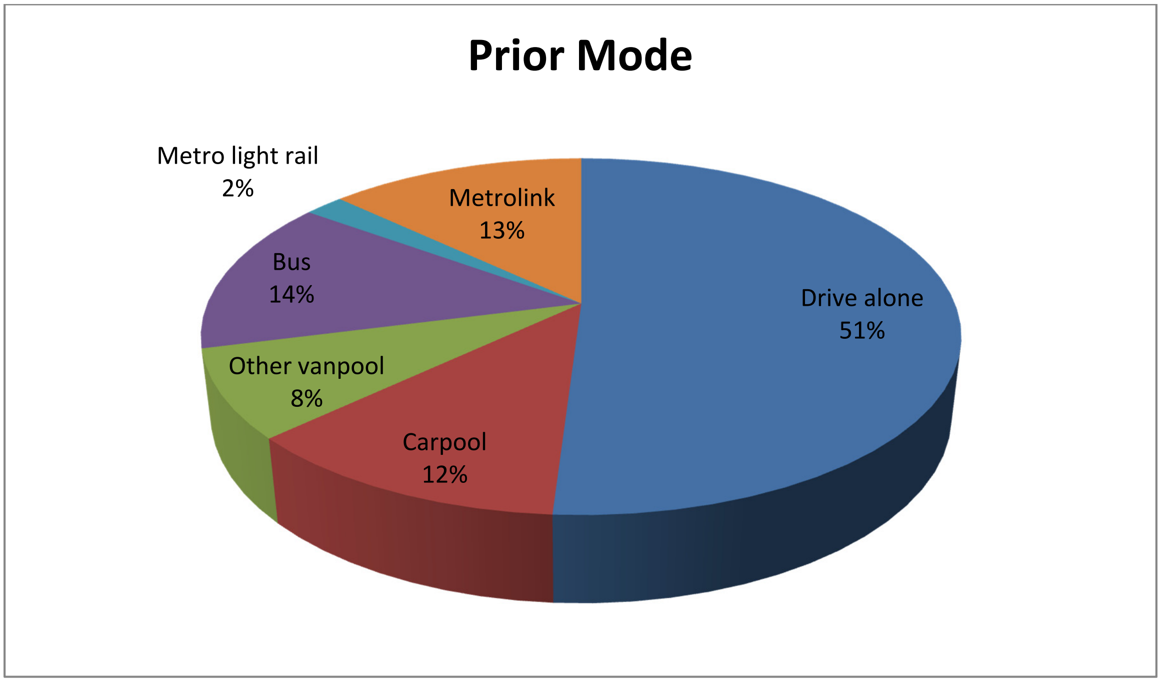
	FY2011		
	Quarter 2 (Oct – Dec 2011)	**Quarter 3 (Jan – Mar 2012)**	**Quarter 4 (April – June 2012)**
I-110 Usage Only	33	36	40
I-10 Usage Only	57	58	62
Usage of I-110 and I-10	13	14	16
Totals	**103**	**108**	**118**

Source: Metro.

In conclusion, Metro exceeded its goal of forming at least 100 new vanpools in the two corridors by creating 119 new vanpools. This growth is equal to the county-wide growth in vanpooling based in the previous five years' experience and is equal to the number of vanpools operating on the two facilities prior to the ExpressLanes project opening and specialized vanpool marketing effort.

Additionally, a vanpooler survey was undertaken in order to gather additional data on their behavior and attitudes. Of central interest was the previous mode of vanpoolers to assess the effectiveness of the program in encouraging a mode shift to higher occupancy modes and thus supporting improvements in vehicle throughput. The vanpooler survey, distributed among all vanpools operating in the I-110 and I-10 corridors was conducted in the last month of the post-deployment period (February 2014).

As shown in Figure D-1, half of the vanpoolers in the two corridors switched from driving alone and another 12 percent shifted from carpooling to vanpooling. Thus, 29 percent of the vanpoolers represent a shift that reduces vehicle trips and improves person throughput. Almost a third, however, switched from bus, light rail (e.g., Gold Line, Blue Line) or Metrolink, representing an increase in vehicle trips.



Source: ESTC with data from Metro.

Figure D-1. Prior Mode of Vanpooler

Some other interesting findings from the vanpooler survey include:

- 40 percent have been only vanpooling for one year or less (indicative of the marketing push to form new vanpools).
- 57 percent of vanpoolers heard about the Metro Vanpool Program through their employer, indicative of the marketing made by Metro. Another 20 percent heard about the program via family/friends and another 12 percent heard about it from Metro itself (website, advertisements, etc.). Only 19 percent of vanpoolers had learned about the ExpressLane project from their employer, with 23 percent hearing about vanpools from Metro.
- 61 percent of vanpoolers noted that their vans received a subsidy from Metro and 26 percent did not know. All vanpools received a subsidy from Metro. Fewer (49 percent) knew if their employer also provides a benefit to help pay for the vanpool fare.
- The most important factors in their decision to vanpool included: cost savings (91 percent), travel time reliability (80 percent), time savings (78 percent) and employer support (61 percent). The stated benefits of vanpooling mirrored these factors (cost and time savings, less wear and tear on their personal vehicle) but 89 percent also said that vanpooling reduces stress.

- The most important reasons for wanting to use the ExpressLanes included: saving time (77 percent), reducing fuel use (72 percent), faster trip (64 percent), no tolls for vanpools (64 percent), and less congestion (63 percent).
- Vanpoolers were generally favorable to the ExpressLane concept, with almost half (48 percent) agreeing that they should be made permanent on the I-110/I-10 and just over half (52 percent) thinking that there should be more on other freeways in LA County.

D.4 Rideshare Promotion

The second rideshare analysis question inquires about effective factors to promote ridesharing. The various means to promote ridesharing include: employer outreach, direct marketing to commuters, incentive programs, the Metro website and ExpressLanes page. The role of employers was noted in the vanpooler survey responses as being important in informing commuters of the vanpool option and getting them into new ridesharing arrangements.

In order to explore the role of employers in promoting Metro rideshare initiatives, a focus group was held among the employee transportation coordinators (ETCs) from six large employers and one representative of smaller employers whose have a significant proportion of commuters using the I-110 or I-10. The six employers included:

1. City of LA (16,000 employees, 95 vanpools);
2. UCLA (35,000 employees, 160 vanpools);
3. Cedar Sinai (10,000 employees, 28 vanpools);
4. Northrup Grumman (15,000 employees, 75 vanpools);
5. NASA Jet Propulsion Lab (5,000 employees, 70 vanpools);
6. LA World Airports (35,000 employees, 69 vanpools).

The coordinators were well versed in the ExpressLanes and several provided information to employees through newsletter and other avenues, using Metro materials and events. Metro provided brochures and invited coordinators to meetings and workshops on the project and the vanpool program.

Many employers purchased transponders for their vanpools to make it easier on vanpool groups. Four of the six coordinators said that they paid for or reimbursed their vanpools for the transponder. Metro had a mobile van that visited worksites to allow employers and employees to sign-up and purchase transponders. However, most representatives said that there was a definite learning curve on the use of the transponders, frustration among commuters, and some voiced concern with getting useful information from ExpressLanes customer service.

One area that the ETCs expressed some concern was the amount of paperwork required of the vanpool drivers to receive the $400 per month Metro subsidy. A second area was the fact that existing and new vanpools needed to get and maintain a transponder to use the ExpressLanes, whereas nothing was required to use the HOV lanes prior to tolling. Interestingly, many coordinators did not view the incentive as pivotal in forming new vans (noting that the subsidy did not change) while other cited the incentive as a big part of the appeal of the program.

The focus group summary concluded:

Overall, coordinators are happy with the Metro Vanpool Program, outside of some small bumps early on in the program. They find the incentives help in attracting commuters to form vanpools and there is ample information for them to provide to their employees. ETCs felt that Metro did a very good job getting out into the community and promoting/educating potential users.

One finding from the focus group was that employer outreach was an effective means of promoting the ridesharing, particularly the vanpool program in concert with ExpressLanes promotion.

The other source of rideshare data came from the Metro Carpool Loyalty Program. As stated earlier in the rideshare program description above, the Carpool Loyalty Program awards transponder owners when they travel in the ExpressLanes as a two- or three-person carpool (including vanpools). Each time the transponder is read in the "2" or "3+" setting, the account holder is entered into a monthly drawing for gift cards (valued at $50). Ten gift cards are awarded monthly to four groupings, HOV2+ – I-10, HOV3+ – I-10, HOV2+ – I-110 and HOV3+ – I-110, for a total of 40 awarded per month. The rewards started in November 2012 on the I-110 corridor and in March 2013 on I-10. The Carpool Loyalty Program (as with the Vanpool Program) continues today.

D.5 Tolling Impacts to Ridesharing

Additionally, four data sources, as reported and analyzed in other appendices, were deemed cogent to the question of whether the tolling project had an unintended negative impact on carpooling. These included: occupancy counts collected by Caltrans, tolling data assembled from Metro operational data, and two special evaluation surveys: a before and after license plate survey and a customer satisfaction survey among FasTrak® account holders in the two corridors.

The occupancy data was collected by Caltrans at several locations on both the I-110 and I-10 (albeit data was somewhat inconsistent between the two facilities), and included one or two days of "before" counts and several days of "after" data. The occupancy data is described in more detail in Appendix A – Congestion Analysis and is used in Appendix H – Environmental Analysis. The counts showed a dramatic reduction in carpooling in both the ExpressLanes and the general purpose lanes. In the I-10 ExpressLanes, the counts revealed that there were 37 percent fewer carpools in the morning peak hour and 50 percent in the afternoon peak hour (at Jackson). On the I-110, the counts showed a 61 percent drop in carpools in the morning peak hour and a 51 percent drop in the afternoon peak hour. The occupancy counts, being the only consistent source of observed before and after data, were used to estimate VMT and emissions changes. Unfortunately, the limitations of this data source restrict the analysis and findings.

Tolling data provided an indication of the growth in carpool use once tolling was implemented. As reported in Appendix B – Tolling Analysis, the level of carpool use increased during the demonstration period. Toll figures show an overall increase in HOV2+ and HOV3+ toll trips, which represent self-declared 2+ and 3+ carpools, as well as buses, vanpools, motorcycles and exempt vehicles on the I-110 and the I-10 ExpressLanes, and increases in toll paying HOV2+ vehicles and SOVs. Figures also indicate that self-declaring HOV2+ and HOV3+, vanpools, buses, motorcycles, and other exempt vehicles represented between 54 percent and 59 percent of the peak period and peak hour FasTrak® trips on the ExpressLanes during the demonstration.

While not showing any comparison to the "before" case, the tolling data does show that both paid SOV travelers, as well as high occupancy travelers, grew so that they were not, according to tolling data, a large shift away from carpooling during the post-deployment period.

As reported in Appendix B – Tolling Analysis, the pre- and post-deployment I-110 and I-10 user surveys provided some information on mode shift by asking how many times per week that respondents used various modes. The survey results indicated some shifts in mode use, including becoming a toll paying solo driver and reductions in carpooling, vanpooling or bus use. This survey revealed that the same proportion of travelers who used an alternative mode 5 days per week remained the same. It also showed that the proportion of travelers who make no trips using commute alternatives actually rose (from 42 percent to 51 percent on the I-10, and from 41 percent to 53 percent on the I-110). It also revealed that about half of all travelers carpool, vanpool or ride the bus at least once per week.

Finally, the FasTrak® customer satisfaction survey included several questions as to modal behavior before and after the advent of tolling and reasons for any changes. Again, as detailed in Appendix B – the Tolling Analysis, this survey involved toll account holders with 55 percent identifying themselves as carpoolers and 1 percent as vanpoolers. When asked to estimate how many monthly trips by mode that each made before and after tolling was introduced, two-thirds responded that they make the same number of carpooling trips, with only 12 percent saying less carpooling trips and 22 percent stating more carpooling use. This would indicate that only a modest shift was made from carpooling to paid SOV use and that the majority of carpoolers maintained their behavior. The findings are also counter to the occupancy counts, which show a dramatic reduction in carpooling. These results indicate that existing carpoolers did continue to use the ExpressLanes after the HOV-to-HOT conversion.

However, methodological issues complicate the ability to draw conclusions about the impact of tolling on carpooling. They are summarized here:

- A panel survey of carpoolers was not conducted for this LA CRD project and, as such, changes in carpooling need to be deduced from other data.
- Carpooling status from the transponder application form was not adequate for evaluation purposes.
- The occupancy data was very limited, with only one day as the before case for most of the data. This may have impacted the very significant changes in carpooling reported. Also, a significant proportion (19 percent-35 percent) of transponder users may have “mis-set” their transponders to HOV 2 or HOV 3 when actually driving alone.
- Tolling data shows changes in the volume of carpooling relative to solo driving since tolling began, but does not provide any comparison to before tolling.
- In the case of the pre- and post-deployment I-110 and I-10 user survey, differences in methodology and the identification of carpoolers in the before and after surveys could have influenced the results and the ability to accurately assess changes in carpooling. All users of the HOV lanes were categorized as carpoolers (with none from the general purpose lanes) in the before survey, whereas those in the ExpressLanes reporting carpooling at least one day per week were categorized as carpoolers in the after survey.
- Finally, the FasTrak® customer satisfaction survey was conducted among transponder account holders and would have missed those who carpooled before the HOT conversion and then decided not to obtain a transponder. While this is likely a small proportion, it means that this survey did not truly represent all carpoolers that were doing so before tolling. It was also a retrospective survey asking respondents to estimate monthly trip making levels before and after implementation of tolling.

Therefore, given the fact that the various data sources, related to carpool behavior, reveal differing and even conflicting results, the impact of tolling on carpooling is inconclusive in the case of the LA CRD project. While occupancy data, and to a much lesser extent, the pre- and post-deployment I-110 and I-10 user survey show a reduction in carpooling in the two corridors after implementation of the ExpressLanes project, the customer satisfaction survey shows no change or even a slight increase in carpooling and the tolling data shows growth in carpooling after the ExpressLanes were opened.

D.6 Summary of Rideshare Analysis

The results of the rideshare analysis, conducted on the TDM element of the LA CRD project, indicate that the primary goal of forming at least 100 new vanpool was exceeded (119) and that employer outreach, incentives and direct marketing were effective ways in promoting alternatives to driving alone. Aggressive marketing of vanpools was started several months prior to the opening of the first ExpressLanes and formation continued throughout the project. Some 34 vanpools were formed on the I-110 and 79 formed on the I-10 (this may have been partially due to the 3+ requirement for free use of the lanes in the peak) with another six new vanpools using both facilities. While the necessity for all users to have transponders created some confusion early on, ongoing education by Metro was cited as very helpful.

Employer outreach was crucial to both forming new vanpools and in educating existing carpoolers and vanpoolers about the ExpressLanes. Incentives, in the form of vanpool fare subsidies ($400) and a Carpool Loyalty Program were also important to retain ridesharing arrangements, although the proportion of travelers aware of these incentives was relatively low.

Of great interest nationally, is the impact that HOV-to-HOT conversion might have on existing ridesharing levels. The idea behind HOT lanes is to sell under-utilized capacity in these lanes while maintaining the benefits of their use (time saving and reliability). The results of all the data related to mode shift and carpool behavior are inconclusive as to whether carpooling was unintentionally negatively impacted. Occupancy counts (observations) suggested that carpooling overall decreased substantially after the opening of the ExpressLanes. Toll account data shows carpooling increased in the ExpressLanes after implementation. Two surveys, one of all travelers and one of transponder account holders, showed a different picture, of relatively no change in carpooling. However, methodological issues among all these data sources, may call into question the ability to inform this question. As such, the issue of the impact of tolling on carpooling is inconclusive in this case.

Table D-5. Summary of Impacts across Rideshare Hypotheses/Questions

Hypotheses/Questions	Result	Evidence
CRD vanpool promotion will result in at least 100 new Metro-registered vanpools.	Supported	Operating data shows that over 100 (119) vanpools were formed in the two corridors from July 2012 to February 2014.
Which factors were most effective in promoting ridesharing?	Partially Supported	Employer outreach and direct marketing to individual commuters, coupled with ongoing rideshare incentives, were critical to forming the new vanpools and maintaining rideshare arrangements.
Will CRD HOT and transit improvements lead to the unintended breakups of current carpools/vanpools?	Inconclusive	Conflicting data (occupancy counts, tolling data, and traveler surveys) do not allow for a definitive statement to be made about the impact of the projects on ridesharing. Occupancy counts reveal a decrease in carpools, yet toll transaction data shows increases in carpooling in the ExpressLanes and user survey results do not show a dramatic change in carpooling among current users.

Source: ESTC.

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Appendix E. Technology Analysis

Technology was an important element of the Los Angeles (LA) Congestion Reduction Demonstration (CRD) projects. Intelligent transportation systems (ITS) were incorporated in many of the LA CRD projects, enabling a wide variety of improvements. The technology analysis focused on the components of the LA Express Park™ project. Technologies included the parking space vehicle sensors, the new parking meters, a real-time parking guidance system, a website, and an integrated parking management system. In addition, smart phone parking apps were developed using the real-time information from the Los Angeles Department of Transportation (LADOT). The technology analysis focused on the ITS technologies supporting the demand-based parking management and congestion-reducing objectives, not determining how well the technology performed.

Table E-1 presents the three hypotheses for assessing the LA CRD technology elements included in the LA CRD National Evaluation Plan. The first hypothesis is that travelers will access the LA Express Park™ website and the telephone information system. The second hypothesis is that LA Express Park™ will improve LADOT's ability to re-configure parking restrictions and rates. The third hypothesis is that LA Express Park™ will improve LADOT's ability to enforce parking regulations. Related to the first hypothesis, the anticipated 511 information system was not operational in the time period included in this analysis. As a result, this analysis only examines use of the LA Express Park™ website.

Table E-1. Los Angeles CRD Technology Analysis Hypotheses

Hypotheses
• Travelers will access the LA Express Park™ website and the telephone information system
• LA Express Park™ will improve LADOT's ability to re-configure parking restrictions and rates
• LA Express Park™ will improve LADOT's ability to enforce parking regulations

Source: Battelle.

The remainder of this appendix is divided into six sections. The data sources used in the analysis are described in Section E.1. Section E.2 highlights the technology components of LA Express Park™. Section E.3 summarizes the results of interviews with representatives from the LADOT Parking Meters Division on the impacts of the parking sensors and the parking meters on enabling demand-based parking pricing and on enforcement. Information from the pre- and post-deployment workshops, which included LADOT personnel, is also presented. Section E.4 examines use of the parking sensors and new meters to aid in parking enforcement. Section E.5 reviews use of the LA Express Park™ website. The appendix concludes with a summary of the technology analysis hypotheses in Section E.6.

E.1 Data Sources

The data used in the technology analysis came primarily from five sources. First, information and available press releases contained in the LA Express Park^{TM} website, the LADOT website, and the smart phone parking application (app) websites were reviewed. Second, the pre- and post-deployment interviews and workshops with LADOT personnel provided perspectives on the contribution of the advanced parking technology to improve LADOT's ability to implement and operate demand-based parking pricing and parking guidance. The interviews and the workshop are both discussed more extensively in Appendix H – Non-Technical Success Factors Analysis. Third, a telephone interview was conducted with LADOT personnel in May 2014 to obtain additional information on the project concepts and technologies. Follow-up telephone calls and emails with LADOT and Xerox staff were used to clarify information and obtain updated information. Fourth, information on parking enforcement, including field observations and intercept surveys, was obtained from papers prepared by LADOT and Xerox staff for professional meetings and conferences. Fifth, information on use of the LA Express Park^{TM} website was obtained from LADOT through Xerox.

E.2 LA Express Park^{TM} Technology

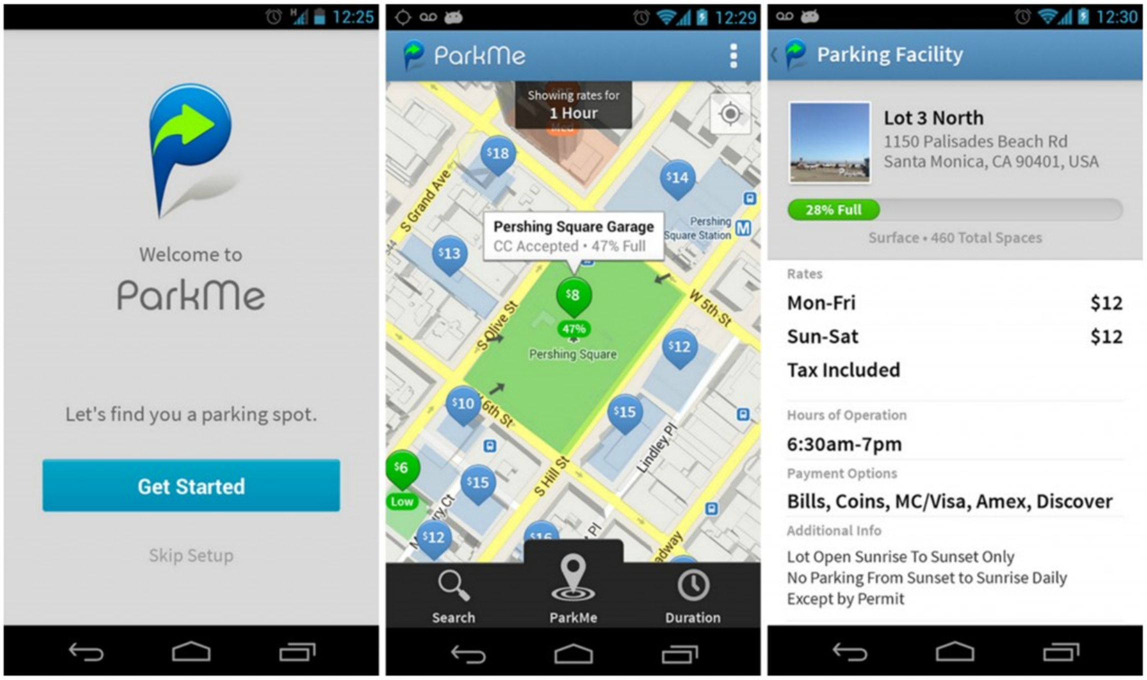
LA Express Park is an integrated parking management system that relies on state-of-the-art parking sensors, parking meters, and parking guidance technologies, as well as advanced analytical capabilities. Vehicle sensors (Figure E-1) were installed in the pavement of 6,300 on-street parking spaces in the project area. The parking sensors, which are battery operated and communicate through a wireless mesh network, provide the occupancy status of parking spaces in real-time. The new parking meters (Figure E-2) operate wirelessly and allow payment by cash, credit card, debit card, and smart phone. The parking meters also provided payment data to the parking management systems. The parking guidance system included the LA Express Park^{TM} website, third-party smart phone apps (Figure E-3), third-party tailored website apps (Figure E-4), and LA Express Park^{TM} on-street dynamic message signs (Figure E-5). The parking management system included a data warehouse for all transaction data and provided parking management reports and dashboards (Figure E-6) for use by operations and enforcement personnel.

Source: Streetline.

Figure E-1. LA Express Park™ In-Ground Parking Sensor

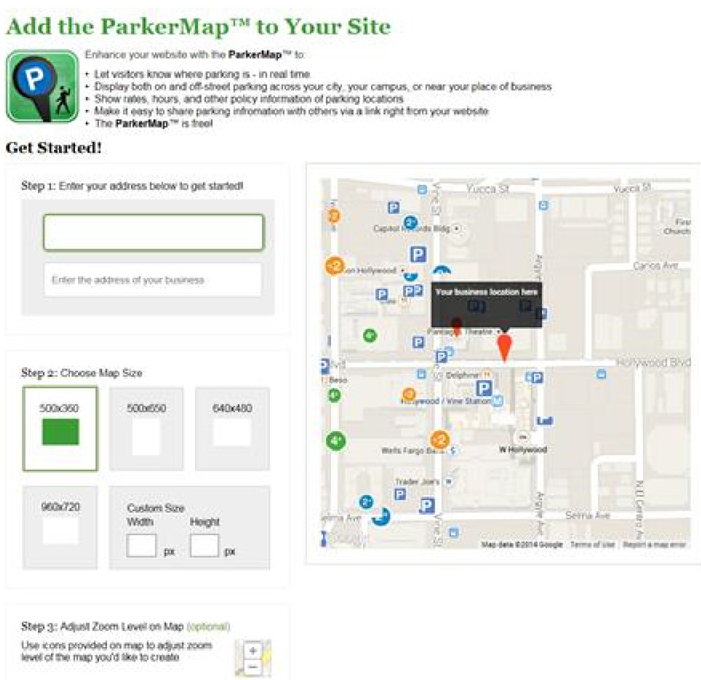
Source: LADOT.

Figure E-2. LA Express Park™ Parking Meter



Source: Drippler.com (http://drippler.com/drip/featured-top-10-best-android-car-finderparking-apps).

Figure E-3. ParkMe Smart Phone App



Source: ParkerMap Website (http://www.theparkerapp.com/parkermap/).

Figure E-4. ParkerMap Website Link

Source: LADOT.

Figure E-5. LA Express Park™ Dynamic Message Sign

Source: LADOT.

Figure E-6. LA Express Park™ Dashboard

E.3 Perceptions of Los Angeles Department of Transportation Personnel

As part of the national evaluation, interviews and workshops with representatives from the local partnership agencies were conducted, first in the fall of 2012 and again in the winter of 2014. The purpose of the interviews and workshops was to gain additional insights into the institutional arrangements, partnerships, outreach methods, and other activities contributing to planning, deploying, and operating the LA CRD projects. The local partners also provided their thoughts and ideas on project elements, implementation challenges, and lessons learned.

The pre- and post-deployment interviews were conducted with the LA Express Park™ project manager. The project manager also participated in both workshops. Questions in the pre- and post-deployment interviews and workshops focused on a number of topics, including the advanced parking system technologies and implementing demand-based parking pricing, parking enforcement, and revenue generation. In addition, LADOT and Xerox personnel provided additional information on the parking management system to members of the National Evaluation team in follow-up telephone calls and emails.

LADOT personnel indicated that the advanced parking technology, including the parking occupancy sensors and the parking meters, allowed the agency to implement demand-based parking pricing and the parking guidance system in the downtown pilot area. They noted that most of the system elements were implemented as anticipated, with the exception of the telephone information system and the additional dynamic message parking guidance signs.

LADOT and Xerox personnel noted that LA did not experience many of the technology issues with the parking sensors encountered in San Francisco. For example, LA did not have the underground interference with the wireless technology, which was a problem in San Francisco. LADOT and Xerox personnel reported that, in general, the parking sensors were operating well. They did note that the sensors require ongoing maintenance and repair, and that LADOT continues to explore alternative technologies for future applications.

LADOT and Xerox personnel also noted that parking meters were working well and were well received by the public. The ability to pay for parking using cash, credit cards, debit cards, and cellphones has been viewed positively by the public. They suggested that more people are paying for parking now, including possibly paying for more time, because is it easier, rather than risking receiving a citation.

LADOT personnel suggested that the technology enabled the implementation of LA Express Park™, the demand-based pricing, and the parking guidance system. These components assisted in moving the parking rate setting to a demand-based approach rather than the long standing flat rate approach used in the city. It was noted that this focus on market-based demand represented a culture change. It was further suggested that, like San Francisco, the technology and the ability to deliver the innovative project established credibility for LADOT locally and brought national attention.

E.4 Parking Meter Enforcement

Personnel from LADOT noted the issue of disabled parking permits during the interviews and workshops. California law allows drivers with a valid disabled parking permit to park for free at an on-street meter. According to LADOT, at least 10 percent of licensed drivers in the state have valid disabled parking permits. In addition, the use of fake disabled parking permits has previously been identified as a concern in LA. According to LADOT, the percentage of parking spaces occupied by vehicles with disabled parking is as high as 90 percent in portions of the downtown area.

Personnel from LADOT and Xerox indicated that this issue was examined through field studies, ethnographic observations, and intercept surveys of individuals parking in the area. The results of these activities and enforcement approaches to address the identified concerns were documented in papers[1] summarized in this section.

[1] "Understanding Dynamic Pricing for Parking in Los Angeles: Survey and Ethnographic Results." James Glasnapp, Hon lu Du, Christopher Dance, Stephane Clinchant, Alex Pudlin, Daniel Mitchell, and Onno Zoeter. "Optimizing Performance Objectives for Congestion Pricing Parking Projects." Peer Ghent. Paper submitted for the 2015 TRB Annual Meeting.

Xerox personnel conducted ethnographic observations of handicapped parking placard use in the demonstration area. A first field observation evolved out of an intercept survey conducted of individuals parking in the area. Observation of the 21 parking spaces on South Olive Street at 7th Street indicated that most spaces were occupied by vehicles with handicapped parking placards.

The parking spaces were monitored for two days – March 20 and 21, 2013. The number of parking vehicles with handicapped placards was recorded at four times each day. The results indicated that at any given time during the day, approximately 75 percent of the parking spaces were occupied by vehicles displaying handicapped placards. The number of parking spaces occupied by vehicles with a handicapped placard peaked during the middle of the day when approximately 91 percent of the available spaces were occupied by vehicles displaying handicapped placards.

The field observers recorded that when these spots opened up, paying customers typically replaced the park-for-free handicapped placard users. The field observers also noted that many drivers of vehicles with handicapped placards walked to their destinations without any noticeable physical disability or special condition.

A second field observation monitored nine blocks with high handicapped placard use identified by the LA parking enforcement officers. In this case, the parking spaces were monitored at least once. Different parking restrictions are in effect on opposite sides of the street in four of the nine blocks. This field observation found that the use of handicapped placard use was higher on the side of the street with fewer parking restrictions. On one block, vehicles with handicapped placards occupied 60 percent of the spaces on the side of the street with parking available from 8:00 a.m. to 8:00 p.m. No vehicles with handicapped placards were parked on the side of the street with parking available only from 9:00 a.m. to 3:00 p.m.

Data from the parking sensors and the parking meters are also used as part of the guided parking enforcement effort to help address these issues. This effort built on activities initiated prior to the LA Express Park™ project, including the development and testing of a smart phone enforcement app in the Hollywood area of LA. The app helped identify potential violations and tracked enforcement activities in real-time. According to the LADOT, the initial test improved the effectiveness of enforcement in Hollywood.

As part of the parking enforcement effort in the LA Express Park™ area, occupancy data from the parking sensors and the payment data from the parking meters are combined to help identify potential violators. This situation requires a filtering of parking sensor and parking meter data. Without the free disabled parking, potential violators would be identified by combining sensor data indicating a parked vehicle with meter data indicating no payment. This approach may identify vehicles with disabled parking permits; however, which are allowed to park without paying. LADOT personnel noted that dispatching enforcement officials to these locations wastes resources. The filtering process entails identifying vehicles with no initial payment. While the filtering process may miss some vehicles without handicapped placards parking illegally without paying, LADOT personnel noted that this filtering system works well and has provided for more efficient and effective use of parking enforcement personnel.

E.5 Parking Guidance Technology Usage

As noted previously, real-time information on parking availability and parking rates was provided to the public through a number of methods, including the LA Express Park™ website, third-party smart phone apps and website links, and dynamic message signs. Information on the use of these technologies available to the National Evaluation team included use of the LA Express Park™ website and responses to the intercept and online surveys conducted by Xerox.

Table E-2 presents the number of hits per month on the LA Express Park™ website from March 2013 through November 2014. In 2012, the number of hits was over 2,000 for all months. The number of hits increased to over 3,000 in 2014, approaching 4,000 by the end of the year. These numbers appear low based on 6,000 parking spaces and the number of hits received by many popular websites. The increases in 2014 may represent increased awareness of the website, and subsequent use.

Table E-2. Monthly Use of the LA Express Park™ Web Page*

Month	2013	2014
January		2,730
February		2,591
March	3,037	2,559
April	2,604	2,922
May	2,586	3,375
June	2,386	2,978
July	2,384	3,709
August	2,394	3,380
September	2,165	3,963
October	2,633	3,800
November	2,451	3,770
December	2,209	
Totals By Year	**24,849**	**35,777**
Grand Total		**60,626**

* Number of website hits per month.

Source: LADOT.

As discussed in Appendix B – Tolling Analyses, intercept surveys were conducted in February and March 2013 with 73 individuals parking in four areas within the downtown zone. An online survey of 158 individuals in LA was also conducted during the same time period by a market research firm to obtain additional insights on the understanding and acceptance of dynamic parking pricing. The results of both surveys are documented in a paper prepared by Xerox personnel.[2] Approximately 11 percent of the online survey respondents and 25 percent of individuals responding to the intercept survey indicated they were aware of the mobile parking apps. Only 5 of the online survey respondents and 4 of the intercept survey respondents could name a mobile parking app, however.

E.6 Summary of Technology Impacts

Table E-3 summarizes the technology impacts for the three hypotheses. Based on the information provided by LADOT, individuals are accessing the LA Express Park™ website. The number of monthly hits has increased since March 2013, averaging close to 4,000 from July through November, 2014. These figures are modest, however, compared to the hits received by popular websites. The telephone information system was not in operation during the evaluation period. The number of people who have downloaded the third-party parking apps is not known, but the results from the intercept and online surveys indicated modest awareness of the cell phone parking apps.

LADOT personnel indicated that the parking sensors, parking meters, and parking management system facilitated the department's ability to implement demand-based pricing and the parking guidance system. They also noted that the policy changes allowing time-of-day pricing and the different rate levels approved by the LA City Council were key elements of implementing demand-based parking pricing.

LADOT personnel interviewed indicated that the parking sensors, parking meters, and parking management system improved the department's ability to enforce parking regulations. Matching the data from the sensors and the meters in the management system identifies expired meters. The system was also used to identify vehicles parked at a meter with no initial payment. These vehicles might have handicapped placards, which allow for free parking. Although the technology cannot address concerns with this policy, the information can be used to better manage enforcement personnel. In addition, LADOT personnel noted that the expanded payment options made it easier for people to pay for parking, increasing payment levels.

[2] Understanding Dynamic Pricing for Parking in Los Angeles: Survey and Ethnographic Results." James Glasnapp, Hon Iu Du, Christopher Dance, Stephane Clinchant, Alex Pudlin, Daniel Mitchell, and Onno Zoeter.

Table E-3. Summary of Impacts across Technology Hypotheses

Hypotheses	Result	Evidence
Travelers will access the LA Express Park^{TM} website and the telephone information system	Supported	Parking information was widely disseminated. Individuals are accessing the LA Express Park^{TM} website. During 2014, the number of hits ranged from a low of 2,559 a month to a high of 3,963 a month.
LA Express Park^{TM} will improve LADOT's ability to re-configure parking restrictions and rates	Supported	LADOT personnel interviewed indicated that the parking sensors, parking meters, expanded payment options, and the parking management system were key to implementing demand-based parking pricing. They also noted the importance of the policy changes approved by the LA City Council, which facilitated implementation of the demand-based parking pricing.
LA Express Park^{TM} will improve LADOT's ability to enforce parking regulations	Supported	LADOT personnel interviewed perceived improvements in the agency's ability to enforce parking regulations in the LA Express Park^{TM} area as a result of the technology. Further, the expanded payment options made it easier for people to pay for parking, rather than risk receiving a citation. The data provided by the sensors and the meters were matched in the parking management system to identify expired meters. The system was also used to identify meters with a parked vehicle and no initial payment, which might be vehicles with handicapped placards that are allowed to park for free.

Source: Texas A&M Transportation Institute.

Appendix F. Safety Analysis

This appendix contains the safety-related analysis of the Los Angeles Congestion Reduction Demonstration (CRD) projects. Table F-1 presents the three safety hypotheses. The first hypothesis was that the collective impacts of the CRD improvements would be safety neutral or safety positive. The second hypothesis focused on whether the addition of transition zones would increase incidents. The third hypothesis examined if boundary jumping would cause incidents. The fourth hypothesis asked if HOT infrastructure changes would affect incident response time or the time to clear incidents. The fifth hypothesis focused on whether adjusted enforcement procedures would affect the number of incidents.

Table F-1. CRD Safety Analysis Hypotheses

Hypotheses/Questions
• The collective impacts of CRD improvements[1] will be safety neutral or safety positive.
• The addition of transition zones will not increase incidents.
• Will boundary jumping cause incidents?
• Will HOT infrastructure changes affect the time needed to respond to or clear accidents?
• Will adjusted enforcement procedures affect the number of incidents?

Source: Battelle.

The remainder of this appendix is divided into three sections. The data sources used in the safety analysis are presented next in Section F.1. Section F.2 presents safety-related information including enforcement and safety perceptions of the CRD Program Team. Section F.3 presents a summary of the safety analysis in relation to the hypotheses.

F.1   Data Sources

Two data sources were used in the safety analysis. First, California Highway Patrol (CHP) citation records were used to examine the number of boundary jumping and occupancy violations. Second, the summary of CRD Program Team Meetings was examined. The potential limitations with some of these data sources are discussed in the relevant sections. Data from the CHP Statewide Integrated Traffic Records System (SWITRS) was originally to be used to identify the number, type, and severity of crashes for a crash analysis. However, delays in the entry of crash data into SWITRS made this data unavailable in time to be included in this evaluation.

[1] Relevant CRD changes include narrower lanes on portions of the I-10 freeway, new signage, new HOT procedures, new enforcement procedures, and reduced congestion (i.e., faster flowing traffic).

F.2 Potential Safety Implications of the UPA Projects

This section presents safety-related information on the implications of the ExpressLanes on the I-110 and the I-10. Information on the number of citations issued for unlawfully entering or exiting the High Occupancy Vehicles (HOV) lanes in the pre-deployment period and ExpressLanes in the post-deployment period by crossing the double line is discussed in F.2.1.

F.2.1 Manual Enforcement Violations

There was no physical barrier separating the I-110 or the I-10 ExpressLanes from the general purpose lanes in the evaluation period. Rather, a double white line separated the ExpressLanes from the adjacent general purpose lanes. This was a change from the pre-deployment period when a double yellow line separated the HOV lanes from the adjacent general purpose lanes. The change in color from yellow to white was made on the ExpressLanes corridors to conform to Federal standards in the Manual of Uniform Traffic Control Devices (MUTCD), although other HOV lanes throughout the region still use a double yellow line as separation from the general purpose lanes. The change in color from yellow to white may have caused confusion to motorists in the post-deployment period by giving the impression that crossing the double white line was acceptable when in fact it was not.

Citations for crossing the double lines (i.e., boundary jumping) in either the pre-deployment or post-deployment periods could be issued by CHP law enforcement personnel, if a vehicle was pulled over. It should be noted that CHP dedicated a specific ExpressLanes patrol after the deployment of the ExpressLanes in the I-110 and I-10 corridors, whereas only CHP officers on routine patrol in the corridors issued citations during the pre-deployment period.

The citations issued by CHP during enforcement activities on the general purpose lanes and ExpressLanes for the I-110 and the I-10 for the evaluation period for each corridor is presented in Table F-2. The data were provided by CHP. The total number of manual vehicle code violations issued by CHP, increased in both corridors from the pre-deployment period to the post-deployment period. Vehicle code violations also includes citations such as speeding, tinted windows, and no brake lights. The number of double solid line violations more than doubled for both corridors, increasing by about 4 percent of the total manual vehicle code violations issued in the corridors.

Although the number of occupancy violations decreased significantly in the post-deployment period, the overall number of toll and transponder violations issued in the post-deployment period more than made up for this decrease. Toll and transponder violations can include citations issued for refusal to pay the toll and failure to possess or display a transponder at the toll gantry, for example. The type of citation issued is at the discretion of the CHP officer; more than one citation may apply to a given scenario even though only one citation is typically issued.

Table F-2. Citations Issued by CHP in the Evaluation Period

Citation Type	I-110		I-10	
	Pre-Deployment 11/1/11 - 10/31/12	Post-Deployment 11/1/12 - 10/31/13	Pre-Deployment 2/1/12 - 1/31/13	Post-Deployment 2/1/13 - 1/31/14
Double Solid Lines Violations	569	1183	873	2401
Toll and Transponder Violations	n/a	1211	n/a	2118
Occupancy Violations*	706	397	708	264
All Other Vehicle Code Violations	10737	11599	6055	10436
Total	**12012**	**14390**	**7636**	**15219**

*These represent citations issued for misrepresenting the number of occupants in the vehicle.

Source: Battelle from data provided by CHP.

F.2.2 Safety Perceptions of Involved Agencies

In lieu of conducting formal interviews as initially proposed in the LA CRD Survey Test, Metro conducted a series of ten CRD Program Team Meetings throughout the evaluation period that included varying representatives of Metro, CHP, LADOT, Caltrans, Torrance Transit, and Foothill Transit to document lessons learned, areas for improvement, and what was working well. Information from the CRD Program Team Meetings were generally insufficient to test the hypotheses of this safety analysis, as the meetings focused more on general project status and usage statistics.

The experience and perception of a CHP officer familiar with the operations of the ExpressLanes corridor provides valuable input to the safety analysis. Overall, the conversion of the HOV lanes to ExpressLanes was perceived to have no impact on safety. Specifically, the ExpressLanes were not believed to have any impact on the number, type, or severity of incidents that occurred during the evaluation period. Additionally, changes in enforcement procedures are not believed to have any negative impact on safety in the ExpressLanes corridors. In fact, it is possible that the presence of added, dedicated enforcement had a positive impact on safety, although this is not known.

F.3 Summary of Safety Impacts

Table F-3 summarizes the safety impacts across the hypotheses. The analysis in this appendix presented inconclusive results on the safety impacts of the CRD projects, principally the I-110 and I-10 ExpressLanes. Citation data and perceptions of CHP personnel provided insight to safety impacts. No negative safety impacts were observed by CHP personnel as a result of the ExpressLanes. However, because crash data was unavailable for analysis, most hypotheses and questions of this analysis are inconclusive.

Table F-3. Summary of Impacts across Hypotheses

Hypotheses/Questions	Result	Evidence
The collective impacts of CRD improvements[2] will be safety neutral or safety positive.	Inconclusive	Crash data was not available to conduct a crash analysis. No positive or negative safety impacts were observed by CHP personnel.
The addition of transition zones will not increase incidents.	Not able to determine	Transition zones did not change from the pre-deployment period to the post-deployment period for either of the ExpressLanes corridors.
Will boundary jumping cause incidents?	Inconclusive	Although citations issued for boundary jumping more than doubled on both corridors from the pre-deployment to the post-deployment periods, the presence of dedicated ExpressLanes CHP personnel on the corridors in the post-deployment period may have caused this increase. It is not clear that the actual frequency of boundary jumping increased in the post-deployment period or that boundary jumping caused incidents.
Will HOT infrastructure changes affect the time needed to respond to or clear accidents?	Not able to determine	Data were not readily available to assess the potential impact of ExpressLanes infrastructure changes on the time needed to respond to or clear incidents.
Will adjusted enforcement procedures affect the number of incidents?	No perceived impact	CHP personnel did not perceive any change in the number of incidents as a result of adjusted enforcement procedures.

Source: Battelle.

[2] Relevant CRD changes include narrower lanes on portions of the I-10 freeway, new signage, new HOT procedures, new enforcement procedures, and reduced congestion (i.e., faster flowing traffic).

Appendix G. Equity Analysis

This analysis examines potential equity concerns associated with the Los Angeles (LA) Congestion Reduction Demonstration (CRD) projects. It assesses whether the positive or negative effects of the ExpressLanes and other CRD projects fall disproportionately on different user groups, as well as different geographic areas.

Equity is of particular concern for the CRD projects because the ExpressLanes corridors and LA Express Park™ areas are adjacent to low income areas with high rates of poverty. Experience with pricing projects throughout the country indicates that perceptions of fairness, or equity, could be a key factor in the acceptance of transportation projects especially those involving the introduction of pricing.

Table G-1 presents the three questions in the equity analysis. The first question focused on the potential impacts of the CRD projects to socioeconomic groups and how users from different geographic areas in the region were affected. The second question looked at the distribution of environmental impacts on socio-economic groups. The third question focused on the equitable reinvestment of revenues generated by the ExpressLanes and LA Express Park™.

Table G-1. Equity Analysis Questions

Hypotheses/Questions
• What is the socio-economic and spatial distribution of the direct social effects of the CRD projects? • Are there any differential environmental impacts on certain socio-economic groups? • Will the potential HOT and Integrated Parking Management (IPM) net revenues be reinvested in an equitable manner?

Source: Battelle.

The remainder of the appendix is divided into six sections. Section G.1 describes the data sources used in the equity analysis. Section G.2 presents the analysis of potential equity impacts to the different user groups by mode. Analysis of geographic equity is presented in Section G.3. Section G.4 examines the air quality impacts from the LA CRD projects. Section G.5 discusses the planned reinvestment of potential revenues from the ExpressLanes tolls and LA Express Park™ parking revenue. The appendix concludes with a summary of the potential equity impacts in Section G.6.

G.1 Data Sources

The equity analysis drew on data from several other analyses in the national evaluation. Travel times were obtained from Appendix A – Congestion Analysis and Appendix C – Transit Analysis. Findings regarding toll rates, tolling transactions, FasTrak® accounts, and Equity Plans[1] in this analysis comes from Metro and Appendix B – Tolling Analysis. Appendix C – Transit Analysis also provided results of the Silver Line transit rider survey. Metro also provided results from the Equity Plan Survey that was

[1] The Equity Plan was later re-named the Low-Income Assistance Plan

conducted in December 2013.[2] Appendix H – Environmental Analysis provided findings on air quality. Information on LA Express Park™ were gathered from an interview with the project manager from the LA Department of Transportation (LADOT) and the program website at laexpresspark.org. These data were supplemented with socio-economic data from the U.S. Census Bureau. Findings from the Metro ExpressLanes Post-Deployment I-10 and I-110 User Surveys[3,4] and ExpressLanes FasTrak® Customer Satisfaction Surveys, described in Appendix A – Congestion Analysis, were also used.

G.2 Potential Equity Impact on User Groups

The evaluation examined the potential variation of benefits and costs experienced by different users of the I-110 and I-10 before and after the implementation of the ExpressLanes. Anticipating travel improvements as a result of the ExpressLane project, especially the cars and buses using the HOT lanes, it was reasonable to expect that some users might benefit more. At the same time, for those paying a toll, travel costs could be higher.

Data for assessing the equity impacts on user groups included average travel time drawn from Appendix A – Congestion Analysis and Appendix C – Transit Analysis, and average toll rates from Appendix B – Tolling Analysis. Data on FasTrak® accounts, Equity Plans, and the number of tolled and free HOV trips on the I-10 and I-110 ExpressLanes were provided by Metro. The perceptions of equity or fairness of tolling on the I-110 and the I-10 are presented below based on questions included in the pre- and post-deployment I-10 and I-110 user survey as described in Appendix A – Congestion Analysis, and the Silver Line transit rider survey, described in Appendix C – Transit Analysis.

The potential equity impacts of the LA Express Park™ program on drivers and transit users is also presented below.

G.2.1 General Purpose Lanes and ExpressLanes Drivers

The congestion analysis presents changes in travel time from the pre-deployment period to the post-deployment period. The congestion analysis shows changes in peak period travel times on the I-110 general purpose lanes between -0.02 to 3.29 minutes, compared with a change of -0.11 and 6.60 minutes in the I-110 ExpressLanes. Peak period travel times on the I-10 general purpose lanes changed between -1.89 and 4.31 minutes, with changes between -3.15 and -0.85 minutes in the I-10 ExpressLanes. Generally, general purpose lane users and HOV users who remained in the same user group from the pre-deployment period to the post-deployment period experienced no major change.

Users receiving the greatest potential benefit from the ExpressLanes are single-occupant vehicle drivers that did not meet the HOV occupancy requirements in the pre-deployment period, but can now pay a toll to ride in the ExpressLanes. According to the congestion analysis, these users saw an average peak period travel time savings of 16.06 and 14.59 minutes on the I-10 and 10.45 and 7.63 minutes on the I-110 for the morning and afternoon peak periods, respectively. Of course, these users also paid a toll of $0.25 to $1.40 per mile. This could result in a total toll of $3.50 to $19.60 for the 14-mile I-10 corridor or $2.75 to $15.40 for the 11-mile I-110 corridor. This user group reflects an

[2] Metro. *Metro ExpressLanes Equity Plan Survey Analysis.* (2014).

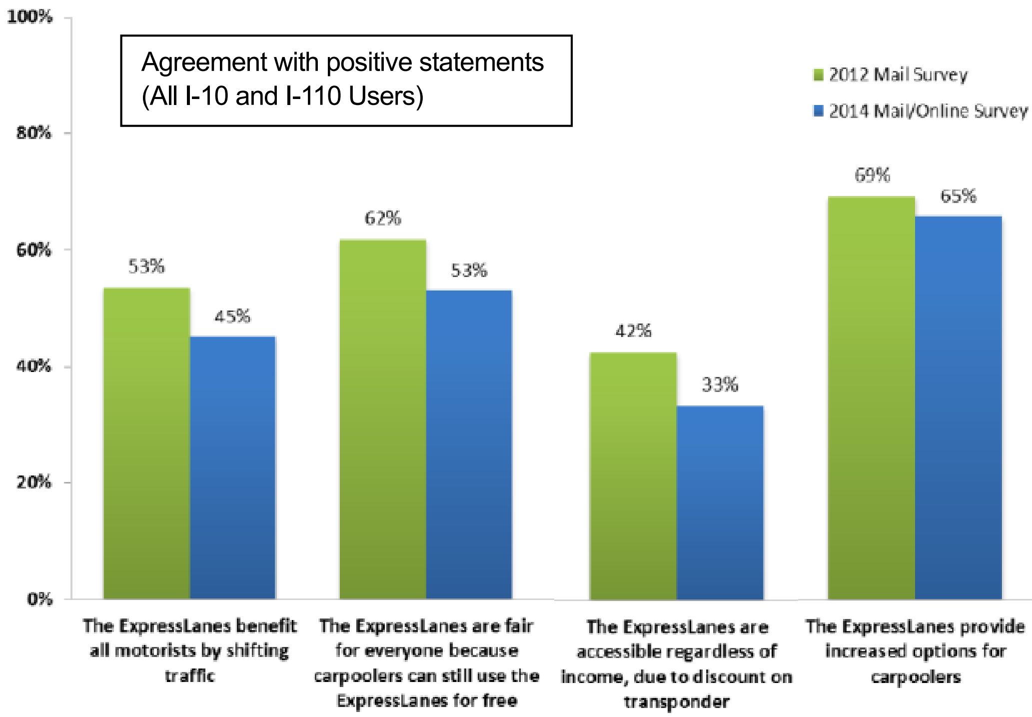
[3] Metro. *ExpressLanes Public Education and Market Research Support, 2012 Pre-Implementation Survey License Plate Study.* (2012).

[4] Metro. *Metro ExpressLanes Post-Deployment License Plate Survey.* (2014).

objective of the ExpressLanes, which is to provide an additional travel choice to I-10 and I-110 users, regardless of income.

Additionally, Metro conducted pre- and post-deployment I-10 and I-110 user surveys in late 2012 prior to the ExpressLanes opening and again in January/February 2014 in the post-deployment period, as described in Appendix A – Congestion Analysis. These surveys capture the opinions of both general purpose lane and HOV lane or ExpressLanes users. Several questions from this survey are relevant to the Equity Analysis.

Figure G-1 below shows the decrease in user agreement with positive statements about the ExpressLanes from 2012 to 2014. In regards to equity, 9 percent fewer driver respondents believe that the ExpressLanes are fair for everyone since carpoolers may still use them for free, and 9 percent fewer respondents agree that the ExpressLanes are accessible regardless of income due to the Equity Plan discount on the FasTrak® transponder. Additionally, 8 percent fewer driving respondents agree that the ExpressLanes benefit all motorists by shifting traffic, while 4 percent fewer respondents agree that ExpressLanes provide increased options for carpoolers.

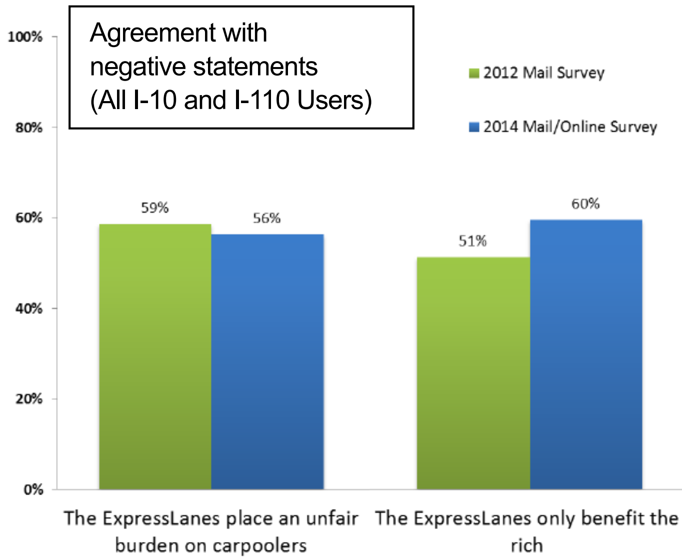


Source: Metro.

Figure G-1. Driver Agreement with Positive Statements about the ExpressLanes

Figure G-2 below shows the change in user agreement with negative statements about the ExpressLanes from 2012 to 2014. In regards to equity, 9 percent more driver respondents believe that the ExpressLanes only benefit the rich. However, a modest 3 percent fewer respondents believe that the ExpressLanes place an unfair burden on carpoolers.

Note that changes in user responses between 2012 and 2014 may be due to perception of the ExpressLanes versus experience.



Source: Metro.

Figure G-2. Driver Agreement with Negative Statements about the ExpressLanes

Finally, Metro conducted a customer satisfaction survey of existing Metro ExpressLanes FasTrak® account holders in 2013 that is described in more detail in Appendix A – Congestion Analysis. The greatest benefit of the ExpressLanes was travel time savings for most respondents (71 percent); followed by solo driver access (19 percent); convenience (6 percent); reliability (1 percent); and other (3 percent). The responses were similar across all self-reported modes, with the exception of solo driver access, which was selected by more solo drivers. The responses were also similar across the frequency of user groups.

A second question asked respondents to rate their overall experience to-date with the ExpressLanes. Most respondents (86 percent) rated their experience as good or excellent, 11 percent gave an average rating, and 3 percent gave a poor rating. While the general responses were similar across all self-reporting modes, solo drivers had the highest percent of excellent rating and motorcyclists had the lowest. The responses were similar across the two facilities and across the different round trip user groups.

G.2.2 Equity Plan Usage by Low-Income Drivers

The ExpressLanes is the first HOT lane operation to offer an Equity Plan for low-income commuters. Note that the Equity Plan was later re-named the Low-Income Assistance Plan. Eligibility requirements are that the applicant be a Los Angeles County resident with an annual household income at or below two times the Federal poverty level (i.e., a total of $39,060 in 2013). Qualifying residents received a $25 credit when they set up an account, which could be applied to either the transponder deposit or pre-paid toll deposit. The monthly $3 account maintenance fee was also waived. As of the end of February 2014, a total of 4,415 Los Angeles County households were enrolled in the equity plan, accounting for $110,375 in toll/transponder credits. These individuals paid the same toll rates as other users. This program helped to enable lower-income, single-occupant vehicle users to take advantage of the travel time savings offered by the ExpressLanes.

Data on FasTrak® accounts, Equity Plans, and the number of tolled and HOV2+ trips on the I-110 and I-10 ExpressLanes were provided by Metro for November 2012 through February 2014. Table G-2 presents a side-by-side comparison of Equity Plans versus all FasTrak® accounts regarding the number of accounts, total and average monthly single-occupant and HOV2+ trips, and the average amount paid for tolled trips. The number of FasTrak® accounts and Equity Plans continued to grow throughout the time period, as noted in the first two rows of Table G-2, with Equity Plans representing over 2 percent of total FasTrak® accounts. Average values presented in Table G-2 are based on the trip totals for each month divided by the number of accounts in that month, in order to account for the growing number of FasTrak® accounts.

The analysis shows that the average user with an Equity Plan made more monthly trips in the ExpressLanes, averaging 12.0 trips per month versus 10.4 trips per month for all users. Almost 80 percent of trips taken by users with Equity Plans were toll-free trips (HOV3+ on the I-10 during peak periods, and HOV2+ on the I-10 for non-peak periods and the I-110 at all times), although Equity Plan users paid for an average of 2.3 tolled trips per month from November 2012 to February 2014. Overall, 55 percent of ExpressLanes trips were free trips by HOV2+ users, with the remaining 44 percent of ExpressLanes trips being tolled single-occupant vehicles. The average user made almost twice the number of tolled ExpressLanes trips as an Equity Plan user, but only about 60 percent as many HOV2+ trips as users with Equity Plans. Overall, Equity Plans accounted for only 1.2 percent of tolled trips on the I-10 and I-110 ExpressLanes, but 3.7 percent of free trips. Finally, single-occupant vehicles that made 10.4 million paid trips on the I-10 and I-110 ExpressLanes from November 2012 to February 2014, paying an average toll of $2.31, while a single occupant vehicle with an Equity Plan paid an average toll of $1.91 in that same period.

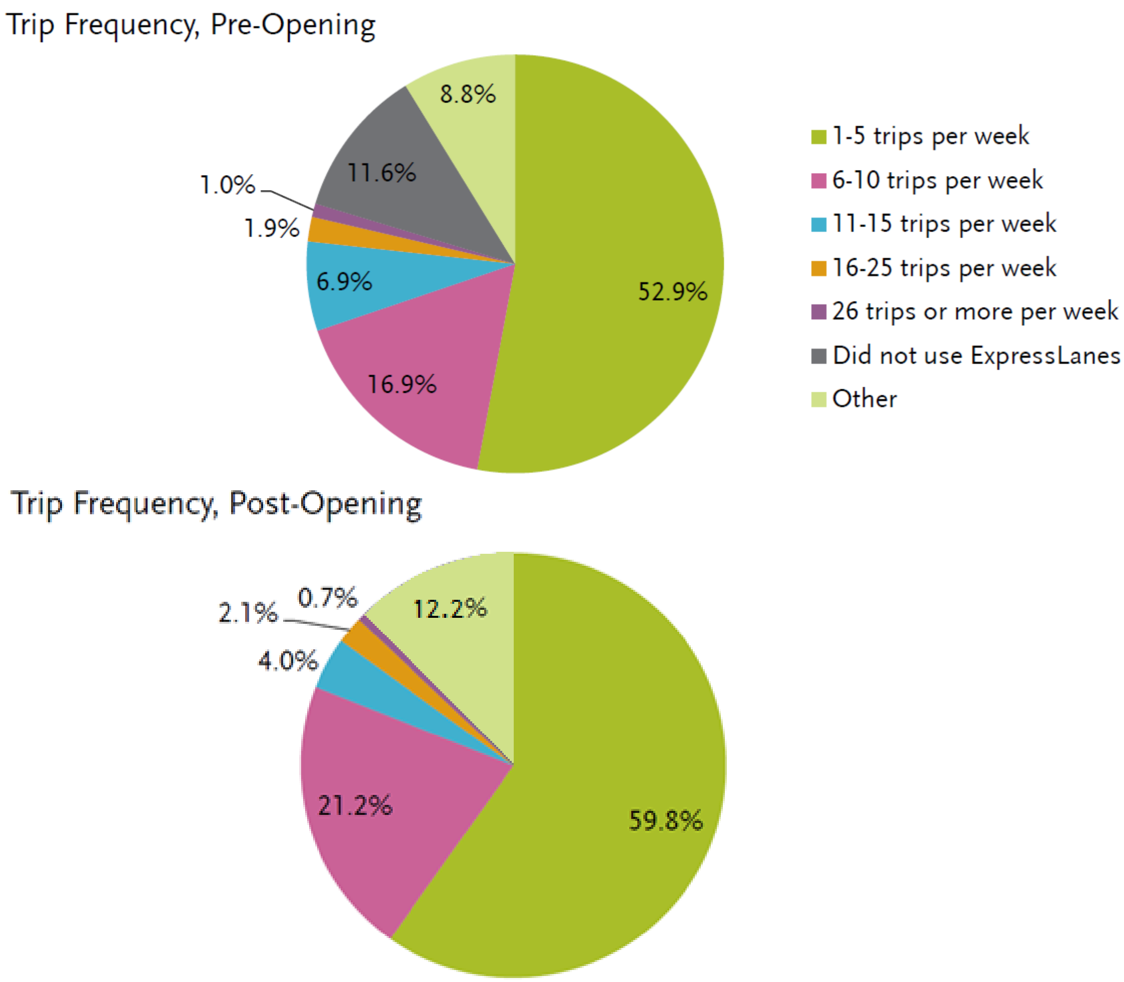
Table G-2. ExpressLanes Trips by ExpressLanes Account Holders on the I-10 and I-110 for November 2012-December 2013

	ExpressLanes FasTrak® Accounts* (including Equity Plans)	Equity Plans Only	
		Number	Percent of Total
Total Number of Accounts* (11/2012)	39,614	1020	2.6%
Total Number of Accounts* (through 2/2014)	210,365	4408	2.1%
Number of Tolled ExpressLanes Trips*	10,404,395	120,656	1.2%
Number of Free ExpressLanes Trips* (HOV3+ on I-10 for peak periods, and HOV2+ on I-10 for non-peak periods and I-110 at all times)	12,909,363	478,849	3.7%
Combined Tolled and Free ExpressLanes Trips*	23,313,758	599,505	2.6%
Average Tolled ExpressLanes Trips per Account per month*	4.6	2.3	50.8%
Average Free ExpressLanes Trips per Account per month* (HOV3+ on I-10 for peak periods, and HOV2+ on I-10 for non-peak periods and I-110 at all times)	5.8	9.7	166.5%
Average Combined Tolled and Free ExpressLanes Trips per Account per month*	10.4	12.0	115.5%
Average Amount Paid for a Tolled Trip*	$2.31	$1.91	82.7%

* Values include only ExpressLanes account holders and their trips on the ExpressLanes.

Source: Data from Metro.

The Metro ExpressLanes Equity Plan Survey was sent to all Equity Plan account holders in December 2013. A total of 580 completed survey responses were received for a 17.4 percent return rate. The survey showed that the credit from the Equity Plan was very important for over 82 percent of the respondents in making the decision to get a FasTrak® account to use the ExpressLanes. The reported number of trips taken before and after the opening of the ExpressLanes are shown in Figure G-3 below. Finally, 87.7 percent of survey respondents reported an excellent or good experience with the ExpressLanes.



Source: Metro.

Figure G-3. The Reported Number of Trips taken by Equity Plan Users on the ExpressLanes in the Pre-deployment and Post-deployment Periods

G.2.3 Drivers to Downtown Los Angeles

The LA Express Park™ program has the potential to provide benefits to drivers traveling to downtown LA. A goal of the program is to encourage parking in spaces on blocks that are underutilized. According to the LA Express Park™ website, "Prior to the start of the program the average rate for all parking meters in the program area was $1.95 per hour. The most recent average rate obtained in the program area was $1.76 per hour."

Additionally, an LA Express Park™ goal was to increase the number of available on-street parking spaces to 10-30 percent per block. This was expected to reduce the number of cars searching for parking. At the same time, parking availability information was expected to guide drivers to available spots more quickly. This was expected to improve traffic flow and reduce parking search time, which would benefit drivers. Unfortunately, data to analyze traffic flow improvements was unavailable.

From an equity perspective, the LA Express Park™ program parking availability guidance was disseminated in a variety of ways to ensure access to information for all users. Specifically, real-time parking availability and/or rate information was available on a number of smart phone applications, street-side signs, by calling 511, and on the website. Also, while payment options have been increased to include credit card payment capability, the meters still accepted coins.

The combination of parking availability information and lower parking rates in underutilized areas provides the opportunity for low-income users access to park at lower rates than prior to the deployment by identifying the underutilized locations with lowered rates.

G.2.4 Transit

Transit users on the ExpressLanes corridors benefitted from 59 new buses, enhanced transit service, a remodeled station, and safety improvements as a result of the CRD. Findings from Appendix C – Transit Analysis, show that peak Silver Line bus travel times on the I-110 increased by 0.8 minutes during the morning peak period, but decreased by 0.1 minutes in the afternoon peak period after the ExpressLanes became operational. On the I-10 corridor, the Silver Streak and Silver Line buses experienced decreases of 0.7 to 4.7 minutes after the ExpressLanes became operational. Thus, transit users who remained in the same user group from the pre-deployment period to the post-deployment period experienced no major travel time change from the implementation of the ExpressLanes.

The Silver Line transit rider survey, discussed in more detail in Appendix C – Transit Analysis, included two questions about attitudes toward the tolls. Riders were asked whether they thought the ExpressLanes have improved their travel and whether they thought the tolls were unfair to people with limited incomes. For the former question, 48 percent of the riders in both corridors agreed to varying extents that tolling the I-110 and I-10 ExpressLanes had improved their travel. Another 34 percent in both corridors were neutral. A smaller, though not unsubstantial, percentage (19 percent) disagreed to varying extents that tolling the ExpressLanes improved their travel. Whether these 19 percent meant that tolling the ExpressLanes has made no difference or made it worse is unknown. Regarding equity, slightly more than half of respondents to the Silver Line transit rider survey agreed to varying extents that the tolls on the I-110 (54 percent) and I-10 (55 percent) are unfair to people on limited incomes. About a third of the respondents in each corridor were neutral.

Additionally, the LA Express Park™ program had a goal to increase the number of available on-street parking spaces to be 10 to 30 percent per block, which may reduce the number of cars on roadways searching for parking spaces. Parking availability information may also be used to guide drivers to available spots more quickly. If the number of vehicles searching for parking is reduced, traffic flow on the streets within the LA Express Park™ area may improve, which would be a benefit to transit users.

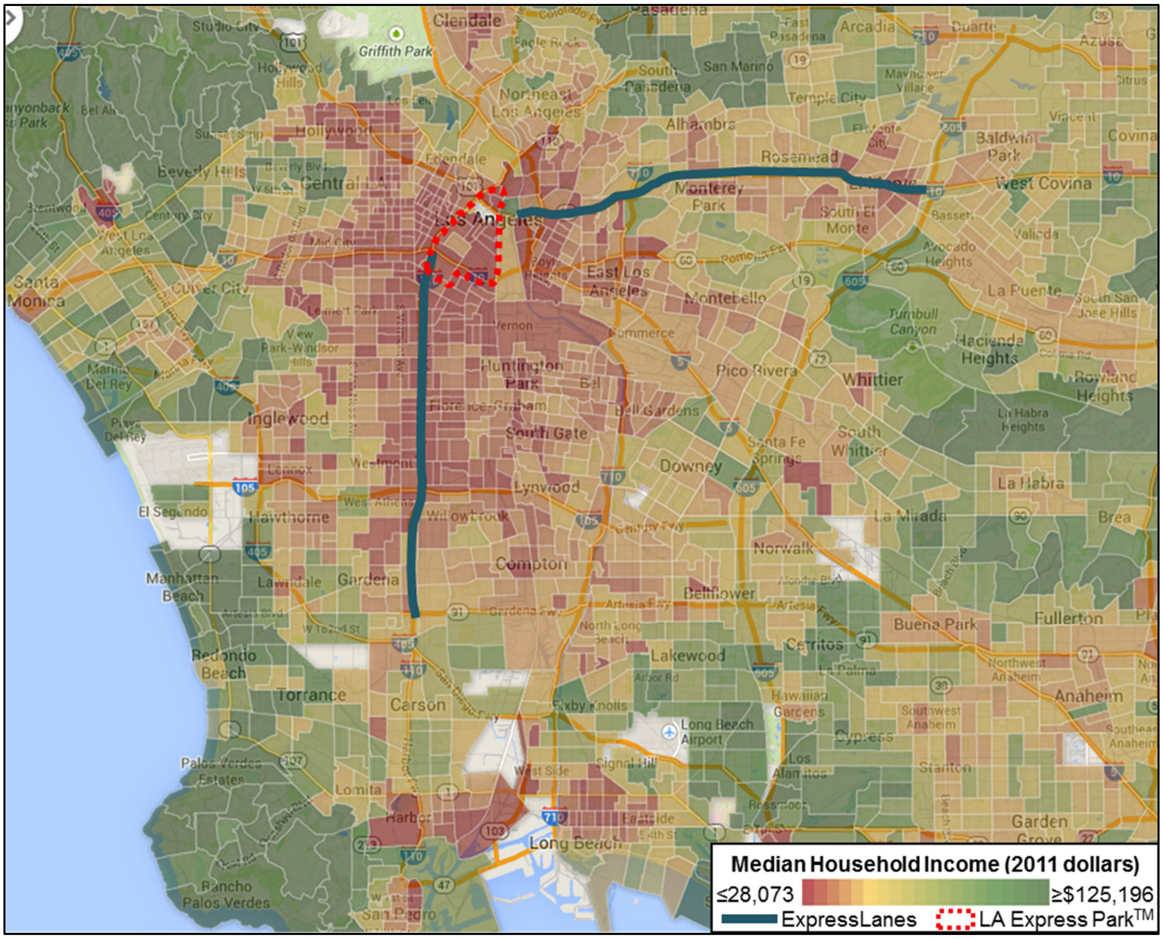
G.3 Potential Equity Impacts by Geographic Areas

Analysis of geographic equity sought to understand whether the impacts of the ExpressLanes, positive or negative, varied according to locations and, consequently, to the people living in those locations. Of course, the ExpressLanes program itself was designed to improve travel in a specific geographic area—the I-10 and I-110 corridors—and thus the question could be reframed to assess variation in impacts within parts of the corridor and elsewhere.

Potential impacts by geographic areas were assessed by examining the geographic attributes of users of the ExpressLanes. The transit analysis includes more details about new routes and ridership in the ExpressLanes corridors. Figure G-4 and Figure G-5 serve to illustrate the relatively low median household income and high rates of poverty present in the ExpressLanes corridors. As a result, many households in the ExpressLanes corridors also do not own a private vehicle.

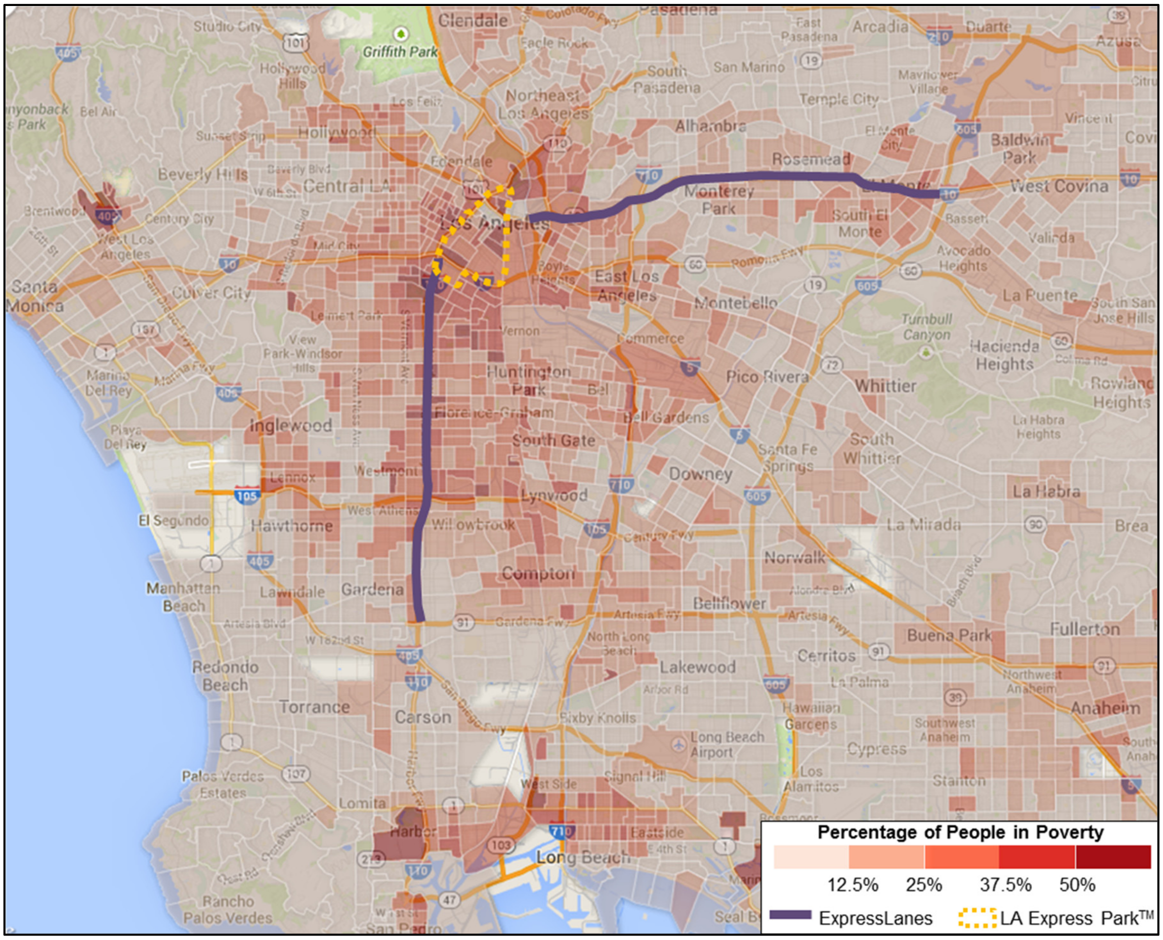
The spatial distribution of FasTrak® accounts through February 2014 by ZIP code throughout the LA metro area is depicted in Figure G-6. This map shows a very large number of FasTrak® account holders to the southwest of the I-110 ExpressLanes corridor, with over 2000 accounts in most ZIP codes. A large number of FasTrak® account holders are also present immediately north of the I-10 ExpressLanes corridor, with 500-2000 accounts in most ZIP codes there, as well as several ZIP codes with over 2000 accounts east of the I-10 ExpressLanes corridor. The number of FasTrak® accounts shown in Figure G-6 tends to be lower for areas that correspond to the areas having low median household incomes and high rates of poverty in Figure G-4 and Figure G-5, which might be expected given lower rates of car ownership in those areas. However, as might be expected, there also appears to be a high correlation between proximity to the ExpressLanes and the concentration of FasTrak® accounts. Thus, the observed distribution of accounts may not necessarily be driven primarily by income.

Figure G-7 is a map showing the spatial distribution of Equity Plan users through February 2014 as a percentage of the total FasTrak® account holders by ZIP code. Closer examination reveals that higher percentages of Equity Plan accounts in Figure G-7 tend to correspond with areas having low median household incomes and high rates of poverty in Figure G-4 and Figure G-5. In many cases, the areas with higher percentages of equity plans are in a lower income area where fewer individuals obtained a FasTrak® account.



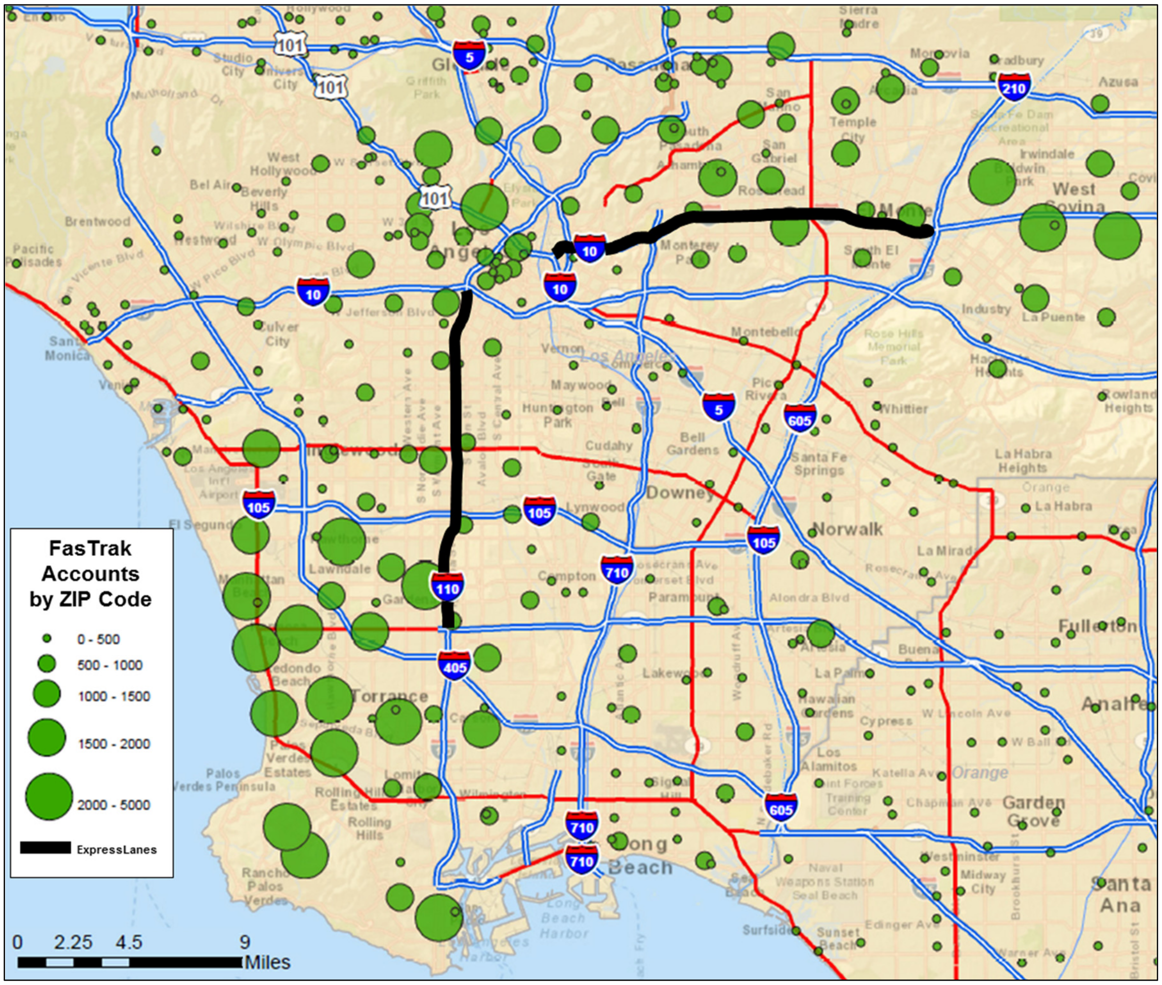
Source: Battelle with information from U.S. Census and Google Maps.

Figure G-4. Median Household Income by Census Tract in Areas Surrounding the ExpressLanes Corridors



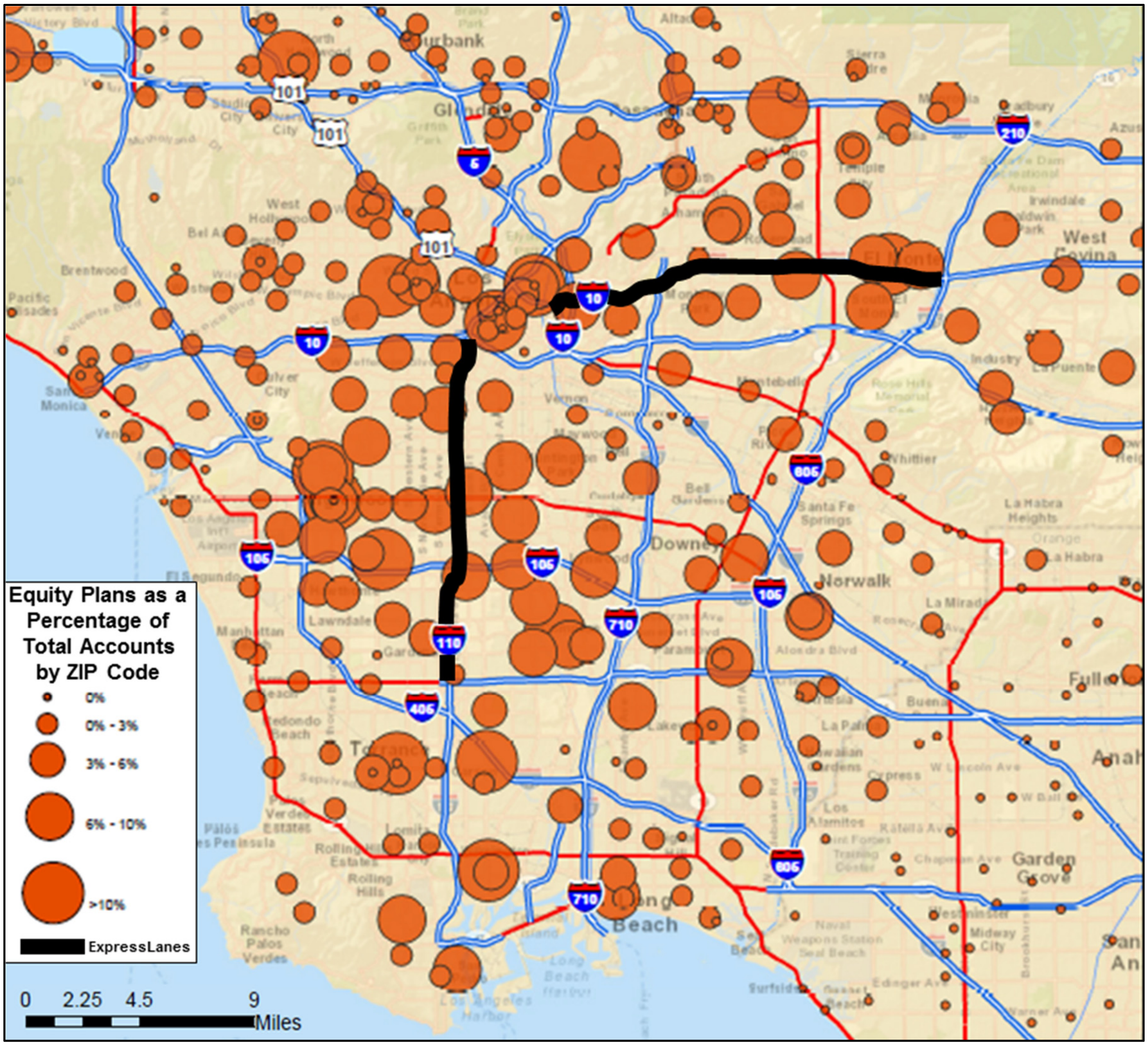
Source: Battelle with information from U.S. Census and Google Maps.

Figure G-5. Percentage of People Living in Poverty by Census Tract in Areas Surrounding the ExpressLanes Corridors



Source: Battelle with information from Metro, Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN, TomTom.

Figure G-6. Number of ExpressLanes FasTrak® Accounts by ZIP Code



Source: Battelle with information from Metro, Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN, TomTom.

Figure G-7. Percentage of Equity Plan FasTrak® Accounts by ZIP Code

Table G-3 shows cities with the highest numbers of ExpressLanes FasTrak® accounts and Equity Plans through February 2014. The cities are organized by the highest percentage of FasTrak® accounts that are Equity Plans. Any city that has more than 1500 total FasTrak® accounts, 50 Equity Plans, or 3.0 percent of FasTrak® accounts that are Equity Plans is presented in the table, with the top 10 for each category shown in **bold**. Los Angeles has the highest number of FasTrak® accounts and Equity Plans, at 43,028 and 1431 accounts, respectively. At the east end of the I-10 ExpressLanes corridor, 10.6 percent of FasTrak® accounts in South El Monte are Equity Plans, which is the highest percentage for any city. Overall, as of February 2014, Equity Plans account for 4408, i.e., 2.1 percent of the total 210,365 FasTrak® accounts that were opened in the ExpressLanes corridor.

Table G-3. Cities with the Highest Number of ExpressLanes FasTrak® Accounts, FasTrak® Equity Plans, and Percentage of ExpressLanes FasTrak® Accounts that are Equity Plans

City	Total ExpressLanes FasTrak® Accounts	FasTrak® Equity Plans	Percent FasTrak® Accounts that are Equity Plans
SOUTH EL MONTE	502	53	**10.6%**
COMPTON	1670	**119**	**7.1%**
ROSEMEAD	1722	**119**	**6.9%**
LYNWOOD	569	37	**6.5%**
EL MONTE	2141	**137**	**6.4%**
INGLEWOOD	2259	110	**4.9%**
SOUTH GATE	500	24	**4.8%**
BALDWIN PARK	2192	104	**4.7%**
PARAMOUNT	384	18	**4.7%**
LA PUENTE	1966	87	**4.4%**
RESEDA	139	6	4.3%
WILMINGTON	727	31	4.3%
HAWTHORNE	2988	**118**	3.9%
GARDENA	**3945**	**154**	3.9%
MONTEREY PARK	1463	56	3.8%
CARSON	3081	**117**	3.8%
TEMPLE CITY	1326	48	3.6%
NORWALK	705	25	3.5%
LOS ANGELES	**43082**	**1431**	3.3%
HACIENDA HEIGHTS	607	20	3.3%
ALHAMBRA	2443	74	3.0%
SAN GABRIEL	2419	65	2.7%
WEST COVINA	**5396**	**122**	2.3%
SAN PEDRO	**3489**	77	2.2%
LONG BEACH	**6463**	**134**	2.1%
TORRANCE	**9869**	**202**	2.0%
COVINA	3377	67	2.0%
ARCADIA	2717	31	1.1%
GLENDALE	**4451**	46	1.0%
RANCHO PALOS VERDES	3451	34	1.0%

Table G-3. Cities with the Highest Number of ExpressLanes FasTrak® Accounts, FasTrak® Equity Plans, and Percentage of ExpressLanes FasTrak® Accounts that are Equity Plans (Continued)

City	Total ExpressLanes FasTrak® Accounts	FasTrak® Equity Plans	Percent FasTrak® Accounts that are Equity Plans
REDONDO BEACH	**6331**	62	1.0%
PASADENA	**5911**	46	0.8%
MANHATTAN BEACH	**5023**	16	0.3%
HERMOSA BEACH	2360	2	0.1%
RANCHO CUCAMONGA	2247	0	0.0%
SUBTOTAL: SELECTED LA AREA CITIES	137915	3793	2.8%
OTHER LA AREA CITIES	66945	615	0.9%
OTHER CALIFORNIA	4572	0	0.0%
OTHER US	933	0	0.0%
GRAND TOTAL	210365	4408	2.1%

Source: Battelle with data from Metro.

The LA Express Park™ program was implemented in a 4.5 square mile area of downtown LA with 6,000 on-street metered spaces and 7,500 off-street public parking spaces in city operated facilities. Figure G-4 and Figure G-5 serve to illustrate the relatively low median household income and high rates of poverty present in the LA Express Park™ area. As a result, many households in the area may not own a private vehicle. However, the program could offer potential benefits to residents in the area. In addition to potential benefits to drivers and transit users by improved traffic flow that were mentioned above, the LA Express Park™ program is expected to reduce air pollution in the area, which could benefit local residents.

G.4 Potential Air Quality Impacts by Geographic Area and Socio-Economic Groups

The environmental analysis reported in Appendix H showed a net emissions increase on both the I-110 and I-10 corridors following the implementation of the ExpressLanes. Note that it is possible that air quality impacts might not be constant over the entire corridor if changes in traffic volumes and speed varied by road segment. In the environmental analysis, vehicle miles traveled (VMT) served as a proxy for air quality impacts since emissions are a function of miles traveled. Speed is also a key factor, and was used to determine the appropriate speed based emissions factors to apply for each facility, lane type, and time period.

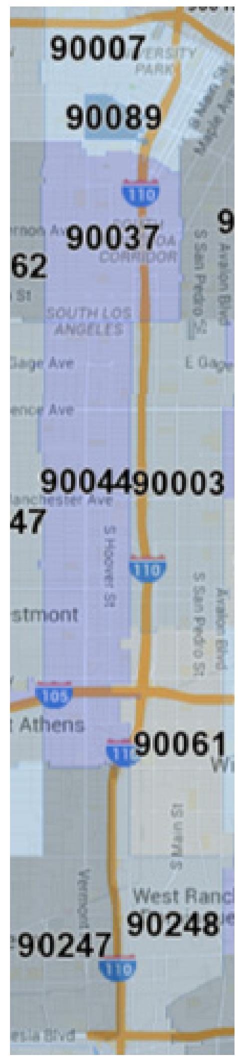
Census data on socio-demographic characteristics of communities adjacent to the corridor were used to assess the impact of air quality changes on the population. Specifically, were the impacted populations in each corridor minority or lower income groups? To make this determination, ZIP codes associated with the I-110 and I-10 corridors were identified and the census data for those ZIP codes were examined.

Figure G-8 and Figure G-9 show the ZIP codes through which the I-110 and I-10 ExpressLanes corridors run. Where a corridor forms the boundary between ZIP code areas, both ZIP codes were included.

The VMT for the I-110 corridor, including both general purpose lanes and ExpressLanes, increased during all peak periods in both directions between 6.40 and 8.72 percent, with the exception of the southbound afternoon peak period, which saw a 3.11 percent decrease. Emissions (including reactive organic gases [ROG], nitrous oxides [NOx], carbon monoxide [CO], fine particulate matter [$PM_{2.5}$], and carbon dioxide [CO_2]) increased between 6.1 and 21.4 percent during both morning and afternoon peak periods in each direction and including both general purpose lanes and ExpressLanes on the I-110, as shown in Table G-4. The I-110 corridor traverses or is adjacent to seven ZIP codes: 90003, 90007, 90037, 90044, 90061, 90247, and 90248.

On the other hand, the VMT for the I-10 corridor, including both general purpose and ExpressLanes, increased for morning and afternoon peak periods by a total of 26.8 percent. Emissions increased between 26.1 and 82.1 percent during both morning and afternoon peak periods in each direction and including both general purpose lanes and ExpressLanes on the I-10, as shown in Table G-4. The I-10 corridor traverses or is adjacent to 11 ZIP codes: 90032, 90033, 90063, 91731, 91732, 91754, 91755, 91770, 91776, 91801, and 91803.

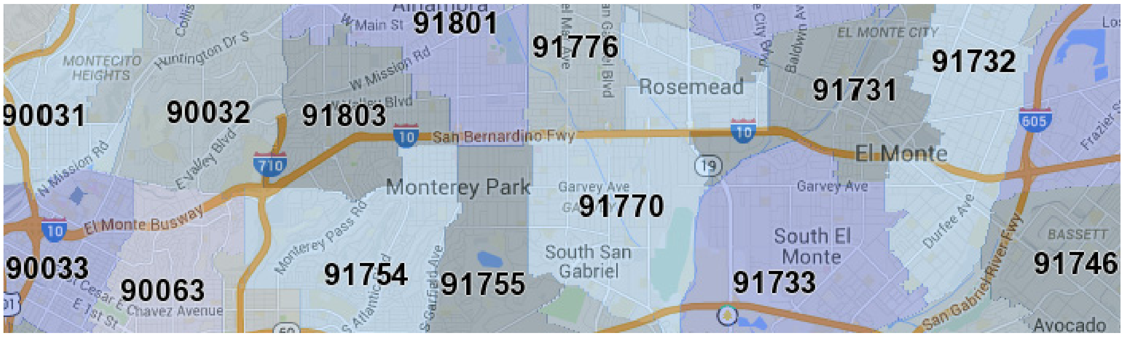
Note that the increases in VMT reported are likely not solely attributable to the ExpressLanes. For instance, the growing economy may have had an impact on this increased VMT. The unemployment rate[5] decreased from 10.8 percent to 8.1 percent over the pre- and post-deployment periods, which likely increased travel demand in the region. Caltrans statistics also note that there were observed increases in vehicle travel on all freeway facilities in the region. Thus, while increased VMT had negative impacts on air quality, there is a reasonable possibility that these impacts would have occurred even without the CRD projects.



Source: unitedstateszipcode.org.

Figure G-8. ZIP Codes and Communities Adjacent to the I-110 ExpressLanes Corridor

[5] Monthly Unemployment Rate, Not Seasonally-Adjusted for the Los Angeles-Long Beach-Santa Ana Metropolitan Statistical Area. Source: U.S. Bureau of Labor Statistics. http://www.bls.gov/lau/data.htm



Source: unitedstateszipcode.org.

Figure G-9. ZIP Codes and Communities Adjacent to the I-10 ExpressLanes Corridor

Table G-4. Pre- and Post-Deployment Change in Emissions on the I-110 and I-10 Corridors in the a.m. and p.m. Peak Periods

Corridor	Emissions, Percent Increase				
	ROG	NOx	CO	$PM_{2.5}$	CO_2
I-110	7.8%	13.8%	6.1%	21.4%	7.5%
I-10	32.9%	54.4%	26.1%	82.1%	33.9%

Source: Battelle.

Table G-5 presents socio-economic characteristics of the population for the ZIP codes associated with the I-110 ExpressLanes corridor. Relative to the Los Angeles-Long Beach-Anaheim Metropolitan Statistical Area (MSA), the population of the seven ZIP codes had a much lower percentage of Whites, and a higher percentage of Blacks or African-Americans and individuals identifying as Some Other Race, as well as a higher percentage Hispanics or Latinos. The median household income was considerably lower among the seven ZIP codes, averaging $34,136, relative to the regional figure of $60,252.

Table G-6 presents socio-economic characteristics of the population for the ZIP codes associated with the I-110 ExpressLanes corridor. Relative to the Los Angeles-Long Beach-Anaheim MSA, the population of the eleven ZIP codes had a much lower percentage of Whites and Blacks or African-Americans, and a higher percentage of Asians and individuals identifying as Some Other Race, as well as a higher percentage of Hispanics or Latinos. The median household income was lower for all the eleven ZIP codes, averaging $43,462, relative to the regional figure of $60,252.

Given the prevalence of minority and low-income households in geographic proximity to the ExpressLanes corridors, these populations were therefore disproportionately affected by air quality impacts from an environmental equity standpoint. Net emissions on the I-110 increased by 6.1 percent to 21.4 percent depending on pollutant. On the I-10, the net effect was a 26 percent to 82 percent increase in emissions depending on the pollutant. It is not known if this increased traffic was utilizing alternate routes before, or if it is due to latent demand for use of the I-110 and I-10. If the new vehicles on the I-110 and I-10 had been using alternate routes, the net effect of this project would be decreased emissions. Because switching a route to the I-110 or I-10 would likely be done only if it saved time, the switch would involve a shorter distance and/or a faster trip. Alternate routes of longer distance would mean more VMT and increased emissions. Since alternate routes would likely involve speeds in a range where emission factors are higher than those observed for the I-110 and I-10, the change in speeds, even with VMT being the same would tend to result in higher emissions.

Table G-5. Socio-economic Characteristics of Population by ZIP Codes Adjacent to the I-110 CRD Corridor

Socio-Economic Characteristics	LA-Long Beach-Anaheim MSA	ZIP Codes Adjacent to the I-110 ExpressLanes Corridor							
		Average	90003	90007	90037	90044	90061	90247	90248
Total population	12,945,252	343,448	66,200	43,173	61,845	87,590	27,457	47,361	9,822
Male	49.3%	48.4%	48.9%	49.7%	49.2%	47.7%	46.7%	46.7%	50.1%
Female	50.7%	51.6%	51.1%	50.3%	50.8%	52.3%	53.3%	53.3%	49.9%
Age									
Under 20	27.0%	31.3%	39.4%	26.8%	34.2%	34.3%	36.6%	26.4%	21.7%
20-44	36.9%	37.7%	36.6%	54.0%	39.8%	35.7%	35.6%	34.6%	27.9%
45-64	24.8%	21.2%	18.1%	13.6%	19.5%	21.9%	19.7%	25.8%	30.0%
65 years and over	11.4%	9.7%	5.9%	5.7%	6.4%	8.0%	8.0%	13.2%	20.4%
Median age (years)	35.4	31.1	26.2	23.7	28.9	29.8	27.7	36.1	45.2
Race									
White	55.5%	27.7%	27.2%	34.0%	17.5%	25.7%	38.0%	21.7%	29.5%
Black or African American	6.8%	23.3%	25.7%	9.9%	20.2%	37.3%	36.5%	18.9%	14.6%
American Indian and Alaska Native	0.5%	0.5%	0.8%	0.4%	0.3%	0.2%	0.5%	0.4%	1.0%
Asian	14.9%	11.1%	0.2%	17.1%	0.8%	0.8%	0.0%	26.9%	31.8%
Native Hawaiian and Other Pacific Islander	0.3%	0.2%	0.1%	0.3%	0.0%	0.2%	0.0%	1.0%	0.1%
Some other race	18.3%	34.4%	44.7%	35.4%	59.5%	33.3%	22.8%	27.8%	17.6%
Two or more races	3.6%	2.7%	1.5%	2.8%	1.7%	2.5%	2.1%	3.2%	5.3%

Table G-5. Socio-economic Characteristics of Population by ZIP Codes Adjacent to the I-110 CRD Corridor (Continued)

Socio-Economic Characteristics	LA-Long Beach-Anaheim MSA	ZIP Codes Adjacent to the I-110 ExpressLanes Corridor							
		Average	90003	90007	90037	90044	90061	90247	90248
Hispanic or Latino									
Hispanic or Latino (of any race)	44.6%	58.5%	73.1%	52.7%	76.6%	59.7%	62.4%	45.3%	39.9%
Not Hispanic or Latino	55.4%	41.5%	26.9%	47.3%	23.4%	40.3%	37.6%	54.7%	60.1%
Employment Status									
Population 16 years and over	10,223,746	256,303	45,451	36,953	45,291	63,841	19,389	37,151	8,227
Civilian labor force	65.3%	59.0%	58.5%	53.3%	62.4%	58.3%	58.1%	64.5%	57.7%
Employed	58.1%	50.5%	49.2%	46.0%	52.3%	50.1%	47.6%	57.3%	50.7%
Unemployed	7.1%	8.5%	9.4%	7.3%	10.1%	8.2%	10.5%	7.2%	6.9%
Household Income and Benefits in 2013 inflation-adjusted dollars									
Total households	4,225,895	96,022	15,989	11,385	16,187	25,671	7,191	16,201	3,398
Less than $25,000	21.1%	39.7%	44.3%	53.9%	46.1%	44.1%	37.9%	29.5%	21.8%
$25,000 to $49,999	21.4%	27.4%	29.0%	21.8%	30.2%	28.0%	30.2%	26.5%	26.4%
$50,000 to $99,999	29.0%	23.7%	21.7%	17.7%	17.8%	20.8%	26.2%	29.7%	32.1%
$100,000 or more	28.6%	9.2%	5.1%	6.8%	6.0%	7.1%	5.6%	14.3%	19.8%
Median household income ($)	60,252	34,136	29,686	22,420	26,796	29,870	33,476	44,693	52,013

Source: Battelle based on 2009 - 2013 American Community Survey 5-Year Estimates.

Table G-6. Socio-economic Characteristics of Population by ZIP Codes Adjacent to the I-10 CRD Corridor

Socio-Economic Characteristics	LA-Long Beach-Anaheim MSA	ZIP Codes Adjacent to the I-10 CRD Corridor											
		Average	90032	90033	90063	91731	91732	91754	91755	91770	91776	91801	91803
Total population	12,945,252	303,846	47,784	49,049	54,160	29,744	62,548	33,616	26,945	62,489	37,246	54,176	29,591
Male	49.3%	49.7%	49.0%	50.0%	50.3%	52.9%	49.4%	49.0%	47.4%	48.3%	48.7%	48.3%	48.2%
Female	50.7%	50.3%	51.0%	50.0%	49.7%	47.1%	50.6%	51.0%	52.6%	51.7%	51.3%	51.7%	51.8%
Age													
Under 20 years	27.0%	27.2%	28.1%	34.7%	33.0%	27.0%	29.1%	21.7%	16.6%	22.6%	19.9%	20.4%	20.9%
20-44 years	36.9%	36.8%	39.1%	36.9%	38.8%	37.5%	38.4%	33.9%	33.1%	34.2%	35.9%	37.8%	36.1%
45-64 years	24.8%	23.3%	22.1%	19.8%	19.1%	23.2%	22.5%	25.7%	30.4%	28.1%	31.0%	28.0%	27.3%
65 years and over	11.4%	12.8%	10.7%	8.7%	8.9%	12.3%	10.1%	18.7%	19.9%	15.0%	13.2%	14.0%	15.7%
Median age (years)	35.4	35.0	32.6	28.3	29.7	34.8	33.1	41.2	45.2	40.0	41.3	39.1	40.6
Race													
White	55.5%	39.6%	56.2%	51.2%	45.1%	43.4%	43.4%	19.6%	18.0%	24.2%	16.8%	26.5%	27.5%
Black or African American	6.8%	0.8%	1.9%	1.4%	0.4%	0.4%	0.7%	0.5%	0.5%	0.4%	0.8%	1.6%	1.2%
American Indian and Alaska Native	0.5%	0.4%	0.9%	0.7%	0.4%	0.4%	0.2%	0.1%	0.3%	0.6%	0.3%	0.2%	0.4%
Asian	14.9%	29.0%	11.1%	5.5%	1.1%	28.7%	27.8%	60.2%	68.7%	59.9%	66.6%	51.8%	52.3%
Native Hawaiian and Other Pacific Islander	0.3%	0.2%	0.1%	0.2%	0.1%	0.0%	0.2%	0.6%	0.2%	0.6%	0.3%	0.1%	0.1%
Some other race	18.3%	28.0%	27.7%	39.4%	51.4%	25.9%	26.0%	16.4%	9.2%	12.1%	13.5%	16.9%	15.6%
Two or more races	3.6%	2.0%	2.1%	1.6%	1.4%	1.2%	1.7%	2.7%	3.1%	2.1%	1.8%	2.8%	2.8%

Table G-6. Socio-economic Characteristics of Population by ZIP Codes Adjacent to the I-10 CRD Corridor (Continued)

Socio-Economic Characteristics	LA-Long Beach-Anaheim MSA	ZIP Codes Adjacent to the I-10 CRD Corridor											
		Average	90032	90033	90063	91731	91732	91754	91755	91770	91776	91801	91803
Hispanic or Latino													
Hispanic or Latino (of any race)	44.6%	65.6%	81.1%	91.2%	97.4%	66.2%	65.5%	32.9%	24.8%	33.7%	24.6%	34.1%	36.3%
Not Hispanic or Latino	55.4%	34.4%	18.9%	8.8%	2.6%	33.8%	34.5%	67.1%	75.2%	66.3%	75.4%	65.9%	63.7%
Employment Status													
Population 16 years and over	10,223,746	237,527	37,659	36,458	40,439	23,412	48,396	27,613	23,550	51,497	31,588	45,739	24,692
In civilian labor force	65.3%	60.3%	63.4%	59.8%	61.5%	59.8%	61.2%	57.2%	58.9%	58.5%	61.8%	64.4%	62.9%
Employed	58.1%	51.5%	52.6%	49.1%	52.1%	50.4%	52.1%	52.1%	51.9%	50.8%	57.2%	59.4%	58.4%
Unemployed	7.1%	8.8%	10.9%	10.7%	9.4%	9.4%	9.0%	5.0%	7.0%	7.6%	4.6%	5.0%	4.5%
Household Income and Benefits in 2013 inflation-adjusted dollars													
Total households	4,225,895	81,582	12,898	12,812	13,435	8,181	15,460	10,512	8,284	16,691	11,541	19,455	9,894
Less than $25,000	21.1%	30.4%	24.7%	45.4%	34.5%	33.1%	27.5%	23.0%	24.9%	24.3%	23.5%	24.0%	20.4%
$25,000 to $49,999	21.4%	26.8%	29.1%	27.4%	28.6%	30.0%	29.8%	21.4%	21.0%	28.1%	28.0%	23.0%	24.3%
$50,000 to $99,999	29.0%	28.0%	31.5%	21.0%	27.7%	27.1%	28.2%	29.2%	31.1%	30.2%	29.5%	31.6%	29.7%
$100,000 or more	28.6%	14.8%	14.5%	6.3%	9.2%	9.9%	14.4%	26.4%	23.0%	17.3%	18.9%	21.3%	25.6%
Median household income ($)	60,252	43,462	46,508	28,005	38,441	36,614	42,465	57,630	54,569	47,373	47,368	53,027	55,659

Source: Battelle based on 2009 – 2013 American Community Survey 5-Year Estimates.

G.5 Impact of Planned Re-investment of Potential Revenues

One measure of equity is how revenues collected by the tolling and pricing system were used. For example, were revenues collected from the ExpressLanes applied to other transportation modes or facilities, or were these revenues used to subsidize certain ExpressLanes user groups?

Metro's policy for reinvestment of ExpressLanes revenue is stated in a report entitled "Congestion Reduction Demonstration Program Net Toll Revenue Reinvestment Guidelines for the Pilot Period." Gross toll revenues from the ExpressLanes are first used to pay for maintenance, administration, and operation of the HOT lanes, including marketing, toll collection, and enforcement. 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 3 to 5 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, Gardena Line 1, and Torrance Transit Line 4. Net revenue remaining after these allocations is to be devoted to a combination of transit, system connectivity/active transportation, and highway improvements as presented in Table G-7.

This policy for allocating net toll revenues for diverse and multimodal projects promotes a positive, equitable impact. Equity across geographic areas is promoted by re-investing toll revenue only within the corridor from which the revenue was collected. Investments in pedestrian, transit, vanpool, and fare subsidy programs support equity for low-income users in the corridors. Highway improvements likewise support all users of the ExpressLanes, including drivers and transit users. Multimodal investments support all user groups within the corridors by enhancing the quality and quantity of transportation options available and reducing congestion in the corridors to further improve the travel experience. Further, multimodal investments also reduce adverse air quality impacts in the corridor, thereby promoting environmental equity. In conclusion, given these considerations, the Metro policy for re-investment of net toll revenues promotes equity.

Revenue from LA Express Park™ will be used to expand the program into Westwood Village in Summer 2014 and Hollywood in 2015. The LA Express Park™ website notes that revenue generation was not a consideration in the decision to deploy the program. Given the realization of the expected benefits of the initial LA Express Park™ program, this would seemingly promote environmental equity and equity for various user groups, while expanding the geographic area that derive benefits from the program.

Table G-7. Metro Reinvestment Targets for Toll Revenue Remaining after Allocations to Transit Service and a Reserve Fund

	Baseline Target for Allocation	Select Examples
Transit Uses	40%	• Increased levels of service and/or increased service span • Fare subsidy programs • Purchase of new bus and commuter rail vehicles • Metro transit corridor projects serving ExpressLanes corridors
System Connectivity/ Active Transportation	40%	• First/last mile connections to transit facilities, focusing on multimodal elements that might support 3rd party solutions like car-share or bike-share • Complete streets projects that emphasize multimodalism • Bicycle infrastructure such as bicycle lanes and secured bicycle parking facilities • Pedestrian enhancements such as on/off-ramp safety improvements, street crossings, and ADA-compliance improvements • Bus station improvements such as enhanced bus shelters and real-time arrival information • Rideshare/Vanpool programs • Park-n-Ride facility improvements including restrooms, lighting, and security
Highway Improvements	20%	• ITS improvements to manage demand • On/off-ramp improvements to reduce the incidence of vehicle collisions with bicycle and pedestrians • Expanded freeway service patrol • Extension of the ExpressLanes corridors

Source: Metro, "Congestion Reduction Demonstration Program Net Toll Revenue Reinvestment Guidelines for the Pilot Period."

G.6 Summary of Equity Analysis

Table G-8 presents a summary of the equity analysis across the three questions. The first question examined the impact of the CRD programs on socioeconomic groups and geographic areas. Findings show that the number of FasTrak® accounts and Equity Plans continued to grow throughout the post-deployment period. The analysis showed that users with an Equity Plan made more monthly trips in the ExpressLanes than overall ExpressLanes users, averaging 12.0 trips per month versus 10.4 trips per month for all users. However, almost 80 percent of trips taken by users with Equity Plans were toll-free trips (HOV3+ on the I-10 during peak periods, and HOV2+ on the I-10 for non-peak periods and the I-110 at all times). In total, Equity Plans accounted for only 1.2 percent of tolled trips on the I-10 and I-110 ExpressLanes, but 3.7 percent of free trips. Overall, SOVs that used the ExpressLanes from November 2012 to February 2014 paid an average toll of $2.31, while an SOV with an Equity Plan paid an average toll of $1.91 in that same period, reflecting that travelers tend to use the ExpressLanes when the toll is lower. Results from the Metro Equity Plan Survey showed that the credit from the Equity Plan was very important for over 82 percent of the respondents in making the decision to get a FasTrak® account to use the ExpressLanes. When examining the spatial distribution of FasTrak® accounts by ZIP code throughout the LA Metro area, it was revealed that higher percentages of Equity Plan accounts tend to correspond with areas having low median household incomes and high rates of poverty. In many cases, the areas with higher percentages of equity plans were in a lower income area where fewer individuals obtained a FasTrak® account.

The LA Express Park™ program has the potential to provide benefits to drivers traveling to downtown LA, as well as those who reside there. The average rate for all parking meters in the area has dropped from $1.95 per hour to $1.76 per hour, as a part of the effort to encourage parking in underutilized spaces. With a goal to increase the number of available on-street parking spaces to 10-30 percent per block, the number of cars searching for parking may decrease, which could improve traffic flow and benefit both drivers and transit users in downtown LA. Parking availability information is expected to guide drivers to available spots more quickly, thus reducing parking search time. The combination of parking availability information and lower parking rates in underutilized areas provides the opportunity for low-income users access to park at lower rates than prior to the deployment by identifying the underutilized locations with lower rates.

The second question examined the environmental impacts on various socioeconomic groups. Census data showed that the population residing adjacent to the I-110 and I-10 ExpressLanes corridors had a much lower percentage of Whites; a higher percentage of Blacks or African-Americans, Asians and/or individuals identifying as Some Other Race; a higher percentage Hispanics or Latinos; and considerably lower median household income, relative to regional figures. Given the prevalence of minority and low-income households in geographic proximity to the ExpressLanes corridors, these populations were therefore disproportionately affected by air quality impacts from an environmental equity standpoint. Net emissions on the ExpressLanes corridors increased 6.1 percent to - 82.1 percent, depending on the pollutant, as reported by the environmental analysis. These increased emissions resulted from an increase in VMT that may have resulted from increased traffic previously utilizing alternate routes before, or if it is due to latent demand for use of the I-110 and I-10 in which case any negative impact is likely overstated here.

The third question focused on reinvestment of generated revenues. Metro's policy for reinvestment of the ExpressLanes net toll revenues for diverse and multimodal projects promotes a positive, equitable impact. Equity across geographic areas is promoted by re-investing toll revenue only within the corridor from which the revenue was collected. Investments for pedestrian, transit, vanpool, and fare subsidy programs support equity for low-income users in the corridors. Highway improvements will likewise support drivers that utilize the ExpressLanes. Multimodal investments support all user groups within the corridors by enhancing the quality and quantity of transportation options available and reducing congestion in the corridors to further improve the travel experience. Further, multimodal investments also reduce adverse air quality impacts in the corridor, thereby promoting environmental equity. Given these considerations, the Metro policy for re-investment of net toll revenues promotes equity. Revenue from LA Express Park™ will be used to expand the program into Westwood Village in Summer 2015 and Hollywood in 2016. Given the realization of the expected benefits of the initial LA Express Park™ program, this would seemingly promote equity for various user groups and the environment, while expanding the geographic area that derive benefits from the program.

Table G-8. Summary of Equity Impacts across Hypotheses

Hypotheses/ Questions	Result	Evidence
What is the socio-economic and spatial distribution of the direct social effects of the CRD projects?	No Apparent Negative Impacts	Users with an Equity Plan made more monthly trips in the ExpressLanes (12.0) than overall users (10.4). Almost 80% of trips taken by users with Equity Plans were toll-free trips (HOV3+ for I-10 peak periods, and HOV2+ for I-10 non-peak periods and the I-110 at all times). Equity Plans accounted for only 1.2% of tolled trips but 3.7% of free trips. The Metro Equity Plan Survey showed the Equity Plan credit was very important for over 82% of respondents to get a FasTrak® account to use the ExpressLanes. FasTrak® accounts by ZIP code show higher percentages of Equity Plan accounts tend to correspond with areas having low median household incomes and high rates of poverty. Driving respondents to the Metro License Plate Survey expressed a less favorable attitude of the ExpressLanes regarding fairness toward user groups both by income and mode. LA Express Park™ is expected to benefit drivers and transit users with improved traffic flow and reduced parking search times in downtown LA. Parking availability information and lowered parking rates in some areas allows increased access to parking for low-income users.
Are there any differential environmental impacts on certain socio-economic groups?	Negative impacts likely	Net emissions on the ExpressLanes corridors increased 6.1 - 82%, where there is a much lower percentage of Whites; a higher percentage of Blacks or African-Americans, Asians and/or individuals identifying as Some Other Race; a higher percentage Hispanics or Latinos; and considerably lower median household income, relative to regional figures. It is not known if this increased traffic was utilizing alternate routes before, or if it is due to latent demand for use of the I-110 and I-10.
Will the potential HOT and IPM net revenues be reinvested in an equitable manner?	Supported	Metro policy for reinvestment of net toll revenues for diverse and multimodal projects promotes a positive, equitable impact that benefit all users. Geographic equity is promoted by re-investing toll revenue only within the corridor from which the revenue was collected. Highway improvements support drivers that utilize the ExpressLanes. Environmental equity is promoted by investments that reduce adverse air quality impacts in the corridor. LA Express Park™ program plans reinvestment to expand IPM to new areas. This will promote equity by extending the potential benefits of improved traffic flow and air quality to other areas

Source: Battelle.

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Appendix H. Environmental Analysis

Appendix H presents the environmental analysis of the Los Angeles (LA) Congestion Reduction Demonstration (CRD). It focuses on the air quality impacts and energy consumption of the I-110 and I-10 ExpressLanes projects.

The environmental analysis assesses the impacts of changes in vehicle throughput and speeds along the affected portions of the I-110 and I-10. The changes in the number of vehicles using the facilities were quantified using sensor-based measurements of vehicle traffic for the I-110, count data for the I-10, and floating car data for speeds for both facilities. All data were collected by Caltrans (California Department of Transportation). No data were available with which to assess changes on alternate facilities such as surface streets, arterials, or other freeways. Although a recommendation to collect this data were made at the inception of the project it was determined that there were insufficient resources to do so. These changes may have been substantial, based on the results seen along the I-110 and I-10. In addition to the use of alternate routes, it appears the growing economy may have had an impact. The unemployment rate[1] decreased from 10.8 percent to 8.1 percent over the pre- and post-deployment periods, which likely increased travel demand in the region. Caltrans statistics do note that there were observed increases in vehicle travel on all freeway facilities in the region.

Increases in transit and vanpool use are evaluated qualitatively as quantifying mode shift impacts would constitute double counting of traffic-related impacts. The impacts of the LA Express Park™ Intelligent Parking Management (IPM), another portion of the CRD program, are not evaluated, as agreed to in 2011 since no data are available with which to perform an environmental assessment.[2]

Table H-1. Environmental Analysis Questions

Hypotheses/Questions
• Average vehicle-related air emissions will decrease in the treatment corridors
• Vehicle fuel use will improve in the treatment corridors
• Average vehicle-related noise will decrease in the treatment corridors

Source: Battelle.

This appendix explores and quantifies the extent to which the above hypotheses are fulfilled. First, a description of the data sources used in the analysis is provided in Section H.1. Section H.2 includes a summary of the data as used in the analysis, such as tables showing vehicle miles of travel along the I-110 and I-10 in the pre- and post-deployment periods. A description of the methodology to determine the environmental and energy effects is provided next in Section H.3. Results of the analysis are presented in Section H.4. A summary of the analysis with respect to the hypotheses presented in Table H-1 concludes this appendix in Section H.5.

[1] Monthly Unemployment Rate, Not Seasonally-Adjusted for the Los Angeles-Long Beach-Santa Ana Metropolitan Statistical Area. Source: U.S. Bureau of Labor Statistics. http://www.bls.gov/lau/data.htm

[2] The San Francisco UPA instituted an intelligent parking management program, and a 25 percent reduction in VMT was attributed to increased parking availability and less cruising for parking spots.

H.1 Data Sources

This section presents a description of the data sources and a summary of the data. Data sources include traffic data from Caltrans that provide VMT and speeds along the I-110 and I-10 in the pre- and post-deployment periods during the morning and afternoon peak periods. Emission factors and fuel consumption rates come from the California Air Resources Board (ARB) Emissions Factors (EMFAC) model. The emission factors provide rates of emissions of air pollutants of interest in the LA area. The emission factors (rates of emissions in grams per mile of travel) are used together with the amount and speed of travel to estimate emissions, and fuel consumption rates are used with the amount and speed of travel to estimate fuel consumption. It should be noted that the EMFAC model utilizes detailed data on the local fleet mix in LA County, such as the model year distribution and vehicle type (e.g., passenger car, ILEV, motorcycle, line haul truck) to calculate the fleetwide emission factors. Transit ridership, carpool, and vanpool data are also used from Appendix C – Transit Analysis and Appendix D – Rideshare Analysis.

H.1.1 Traffic Data

Traffic data include freeway sensor data and Caltrans count data that were used to develop the pre- and post-deployment VMT and speed estimates that are the basis for estimating environmental effects along the I-110 and I-10 from traffic changes. Transit ridership, carpool, and vanpool data are also used as supplementary sources of information that provide additional qualitative information on the environmental effects. Quantification of emissions from alternate routes, increased transit, vanpooling, and the parking management program would require data collection that was not feasible for this study.

Because the only detailed source of VMT available for the CRD projects in the LA area are for the I-110 and I-10, this analysis is based only upon this data. As noted in the Environmental Test Plan, additional data on alternate facilities would be helpful to interpret changes on the I-110 or I-10, however no sources of such data that included pre- and post-deployment were available. Therefore the results are applicable to the I-10 and I-110 alone. The air pollutant emission and fuel consumption changes are attributable to the I-10 and I-110, but not completely attributable to the CRD projects as a whole.

<u>Caltrans Performance Measurement System (PeMS) Data</u>

Sensor data were collected from the Caltrans Performance Measurement System (PeMS). PeMS is a consolidated database of information collected via Caltrans loop detectors from traffic management centers (TMCs) throughout California. PeMS data for the I-110 and I-10 were examined. About 82-100 percent of PeMS data for the I-10 ExpressLanes was missing due to construction related sensor outages, and therefore could not be used in the analysis. The data for the I-110 were fairly complete and were therefore used as presented in the PeMS database of VMT. To be consistent with the count data used in the Congestion Analysis and in the Environmental Analysis for the I-10, May 2012 and May 2013 PeMS data were used to quantify the pre- and post-deployment traffic along the I-110. Traffic levels along the I-10 were quantified using the more limited count data, consistent with the Congestion Analysis.

PeMS data are available as hourly average values for VMT at each segment of highway covered by the sensors. For the I-110, there are 14 sensors placed approximately every mile for the ExpressLanes and 23 sensors placed approximately every ½ mile for the general purpose lanes. The data are available as hourly averages for each month. For example, a May 2012 dataset includes hourly data for each segment and lane type that represents the average of the hourly observations for May. The hourly average VMT values for May 2012 and May 2013 were used in the Environmental Analysis. May 2012 represents the pre-deployment period (deployment began five months later, in November 2012) and May 2013 represents the post-deployment period, occurring six months after deployment began.

PeMS provided VMT for each segment of each lane type for each hour. The values for 5:00 a.m. to 9:00 a.m. in the Northbound direction represent the morning peak period and the values for 3:00 p.m. to 7:00 p.m. in the Southbound direction represent the afternoon peak period. Speed data for these periods were drawn from Caltrans count data described below.

PeMS data were available for the I-10 but only as estimates. The amount of missing data observations for the estimates was listed by Caltrans as 100 percent. Therefore, Caltrans occupancy counts had to be utilized for the I-10.

<u>Occupancy Counts</u>

For the I-10, vehicle throughput was computed and described in more detail in Appendix A – Congestion Analysis using vehicle occupant counts provided by Caltrans and Metro. Because the I-10 was affected so strongly by construction, the post deployment period used in this analysis is March 2014, which is about one year after initiation of tolling. The availability of this data allowed for more certainty than the results represented post tolling and represented use of the facilities after adjustments to the new lanes and procedures had been made by users. It should be noted that the count data are for specific days and only part of the peak period and therefore represents a snapshot on those particular days. The VMT levels are about 50 percent of those recorded on the I-110. However, the I-110 PeMS data include all four hours of data for each peak period whereas the count data include two hours for the morning and one hour for the afternoon peak period. If points along the post-deployment period are examined, it can be seen that use of the ExpressLanes grows substantially over time. The Environmental Analysis of the I-10 is based on one of these points. Other points would likely provide the same direction of results (VMT increases along the corridor in both ExpressLanes and general purpose lanes) but different percentage changes.

This data are not as complete as the PeMS data but were the only reliable source available. Note that other CRD sites used occupancy count data as well. Count data are a standard way to estimate VMT in California when more detailed data are not available.

<u>Speeds</u>

Speeds were obtained with a floating car method. This method involves driving a test vehicle as a “typical vehicle” through the evaluation corridor. Travel speeds and vehicle position were recorded using a GPS unit. Morning commute travel times were collected from 5:30 a.m. to 9:00 a.m. and afternoon commute travel times were collected from 3:00 p.m. to 7:00 p.m. Travel time runs were collected on both the general purpose lanes and the ExpressLanes on the same day. The recorded speeds were used both in Appendix A - Congestion Analysis and in this Environmental Analysis and are presented later in this appendix.

<u>Transit, Carpooling, and Vanpooling Data</u>

Data on transit, carpooling, and vanpooling were provided from Metro and is presented in Appendix C – Transit Analysis, and Appendix D – Rideshare Analysis. However, available data are not sufficient for a quantitative assessment except for the 59 clean fueled transit buses. EMFAC2011 was used to estimate urban bus emission factors for diesel and clean fueled buses. Data on ridership, new vanpools and carpool retainment suggested that the environment was improved by the CRD transit projects, which showed significant increases in ridership and ridesharing efforts that added 119 new vanpools. They also suggested that there was less carpooling along the ExpressLanes, which was expected from the outset.

Regarding environmental and energy benefits, in a survey of vanpoolers, 77 percent said that reduced emissions were an important benefit of the ExpressLanes and 87 percent said that reduced fuel use was an important benefit.

H.1.2 Emission Factors

The Environmental Analysis examined changes in emissions of air pollutants such as ozone precursors (reactive organic gases, or ROG, and nitrogen oxides, or NOx), fine particulate matter, carbon monoxide, and greenhouse gases.

The motor vehicle emission factors used for this analysis are composite factors representing the entire fleet operating in the South Coast region in 2012. The composite factors were developed by developing weighted average emission rates for all the various combinations of vehicle type, age, fuel, and technology type. The weights were based on the amount of travel in the region by each vehicle type. For example, a typical 4-door passenger car emits much less than a diesel bus, and also represents more of the travel in the region than buses.

The motor vehicle emission factors were modeled using the EMFAC2011 model[3], which is the latest installment of the EMFAC series of models. EMFAC is the California ARB tool for estimating emissions from on-road vehicles and is the Environmental Protection Agency (EPA) approved method for doing so in California.[4] The model was used to estimate emission factors for the South Coast Air Basin for 2012.

EMFAC estimates emission factors for the fleet of motor vehicles operating on roads in the LA area, based on the age and type of vehicle, weight class and fuel type (i.e., gas, diesel, or electric). The number of vehicles in each class is based on an analysis of California Department of Motor Vehicles (DMV) registration data. These vary by calendar year and geographic area, so the make-up of the vehicle fleet was dependent on the calendar year and geographic area.

EMFAC models emission factors and vehicle activity data for every model year from 1965 through 2035 (2012 is the latest model year in this analysis) and then weighs the factors by the proportion of the fleet represented by each year. Within each vehicle class, the model year is represented by a combination of technology groups (TGs). For example, the earliest model year for passenger cars (1965) consisted of a non-catalyst gasoline-fueled technology group (TG-1) and a diesel-fueled technology group (TG-170).

EMFAC output for emission rates is expressed as rates (grams per mile, and grams per hour) for numerous vehicle classes. Passenger vehicles rates are modeled for four classes of light duty cars (catalytic and non-catalytic, gas and diesel) and four classes of light trucks (same divisions as for cars).

The national evaluation team developed a weighted average of emission factors based on the amount of the fleet represented by each vehicle type and fuel type, and the fraction of travel for each. The predominant vehicle was a gas fueled passenger car, but diesel fueled trucks, hybrid, full electric, alternatively fueled cars, trucks, buses, 18-wheelers, and others were also represented.

[3] Model runs were made by the national evaluation team using the online version of the model.

[4] In other areas of the U.S. the EPA requires use of the MOVEs model.

Table H-2 presents the passenger vehicle emission rates used in the analysis. ROG represents reactive organic compounds; CO is carbon monoxide; NOx is nitrogen oxides; CO_2 is carbon dioxide, a principal greenhouse gas, and $PM_{2.5}$ are fine particle matter less than 25 microns in width. $PM_{2.5}$ emission rates are for running exhaust emissions. Additional $PM_{2.5}$ is created by aerosols of other compounds that come out of tailpipes but this “secondary” formation is not expressed as a rate; it’s a much more complex process requiring complex air quality models in order to predict it. This analysis focused on the direct $PM_{2.5}$ emissions.

ROG and NOx are the primary precursors to ozone, the compound which, at breathing zone level, can damage the lungs and respiratory system. CO can be dangerous or even fatal when inhaled in large concentrations, and $PM_{2.5}$ also has significant health consequences. CO_2, as a principal component of greenhouse gases, does not cause direct health effects, but is the most commonly used metric for the concept of a carbon footprint.

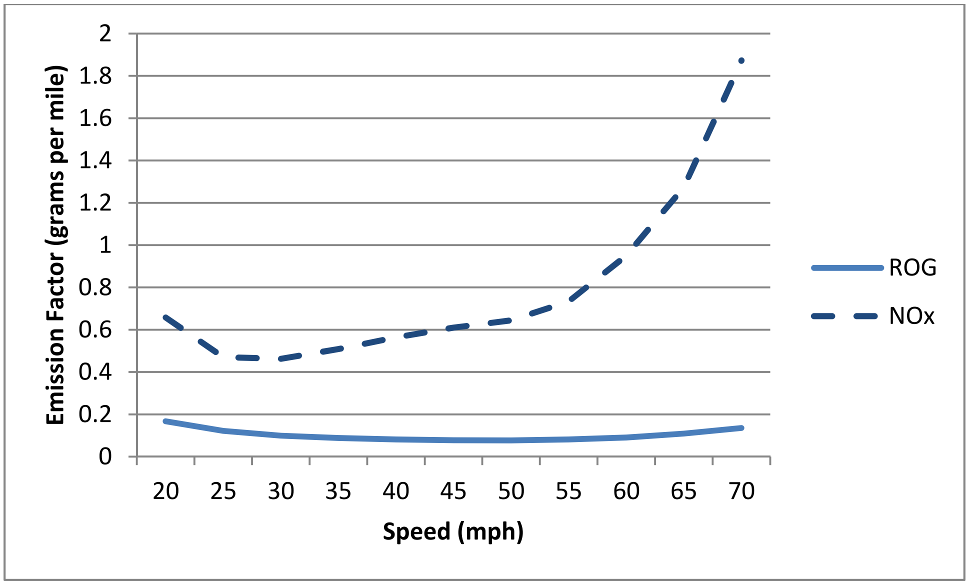
Table H-2. Weighted Composite Emission Factors (grams per mile)[5] and fuel consumption (gallons per mile) used in LA CRD Analysis of the I-110 and I-10 ExpressLane Projects

Speed	ROG	NOx	CO	$PM_{2.5}$	CO_2	Average Fuel Economy (gallons/mile)
20	0.167	0.658	3.353	0.016	683.0	12.8
25	0.122	0.471	2.951	0.009	556.1	14.9
30	0.099	0.463	2.664	0.009	484.6	16.7
35	0.088	0.509	2.454	0.009	445.5	18.0
40	0.081	0.564	2.306	0.010	425.6	18.6
45	0.077	0.611	2.208	0.012	418.7	19.0
50	0.077	0.644	2.149	0.014	421.6	18.5
55	0.081	0.735	2.149	0.017	442.7	17.3
60	0.090	0.951	2.091	0.025	478.6	15.7
65	0.109	1.274	2.193	0.039	546.5	12.8
70	0.136	1.873	2.341	0.061	629.3	12.8

Source: Earth Matters, Inc. based on EMFAC2011 model run for South Coast.

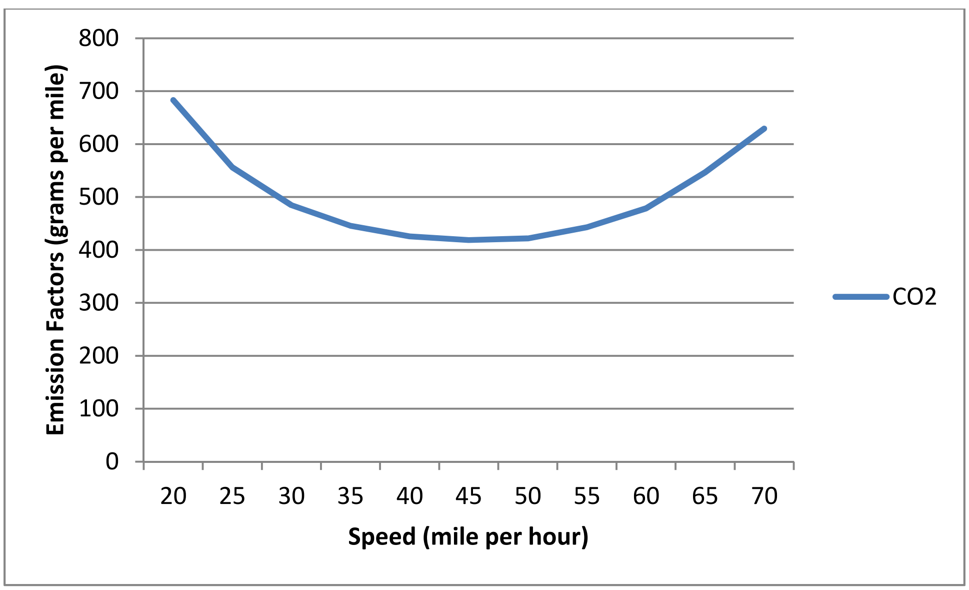
As shown in Figure H-1 and Figure H-2, the emission factors are highest for 20 mph (they are higher for lower speeds, but lower average speeds are not reported in the Caltrans data presented in Table H-7 and Table H-8). They drop through 45 or 50 mph and then begin rising again. Within some ranges, VMT could increase in the post-deployment period but emissions could decrease if the after speeds involved lower emission factors than the pre-deployment.

[5] Emission factors were weighted by the VMT included in the EMFAC2011 model for each vehicle class, fuel type, and technology type to arrive at a composite rate across all vehicles in the South Coast fleet.



Source: Earth Matters, Inc. based on EMFAC 2011 model for South Coast.

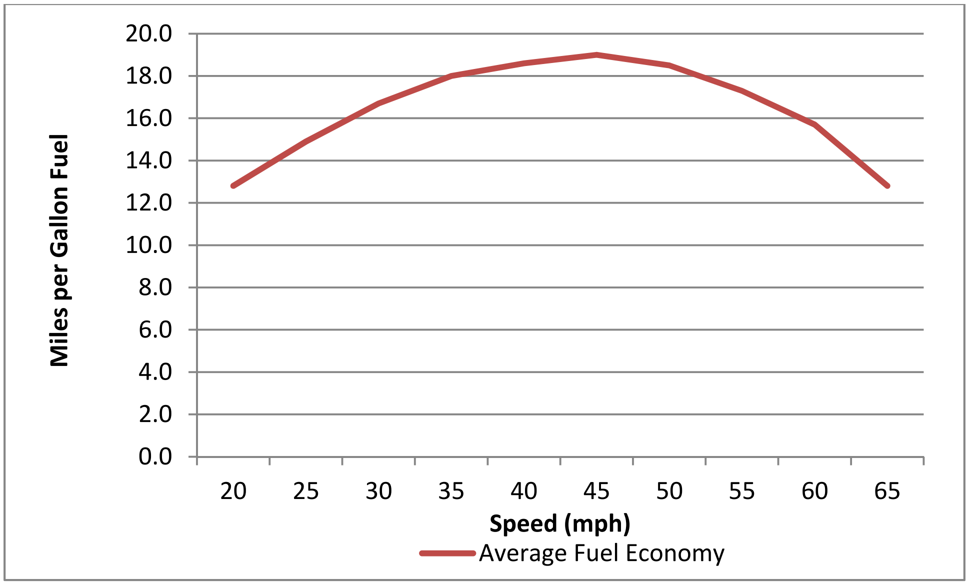
Figure H-1. Ozone Precursor Emission Factors by Observed I-10 and I-110 Speeds



Source: Earth Matters, Inc. based on EMFAC 2011 model for South Coast.

Figure H-2. CO_2 Emission Factors by Speed

Fuel economy by speed is also used in this analysis to evaluate the effects of the changes in speeds and traffic volumes on the I-110 and I-10. Figure H-3 below presents the fuel economy by speed modeled with the EMFAC2011 model. The fuel economies were weighted in a similar manner as emission factors in order to consider all vehicle types and weight each by the proportionate amount of travel represented by each. Similar to emission factors, fuel economy is best at speeds of approximately 50 mph and progressively worsens at lower or higher speeds.

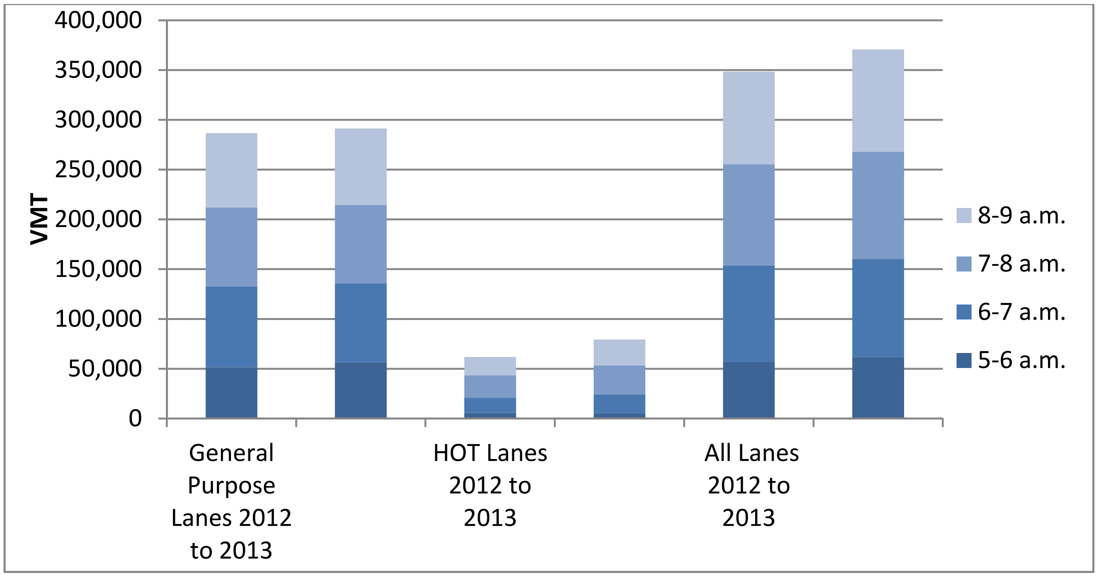


Source: Earth Matters, Inc. based on EMFC2011 run for South Coast Air Basin, 2012.

Figure H-3. Average Fuel Economy by Speed

H.2 Traffic Data Summary

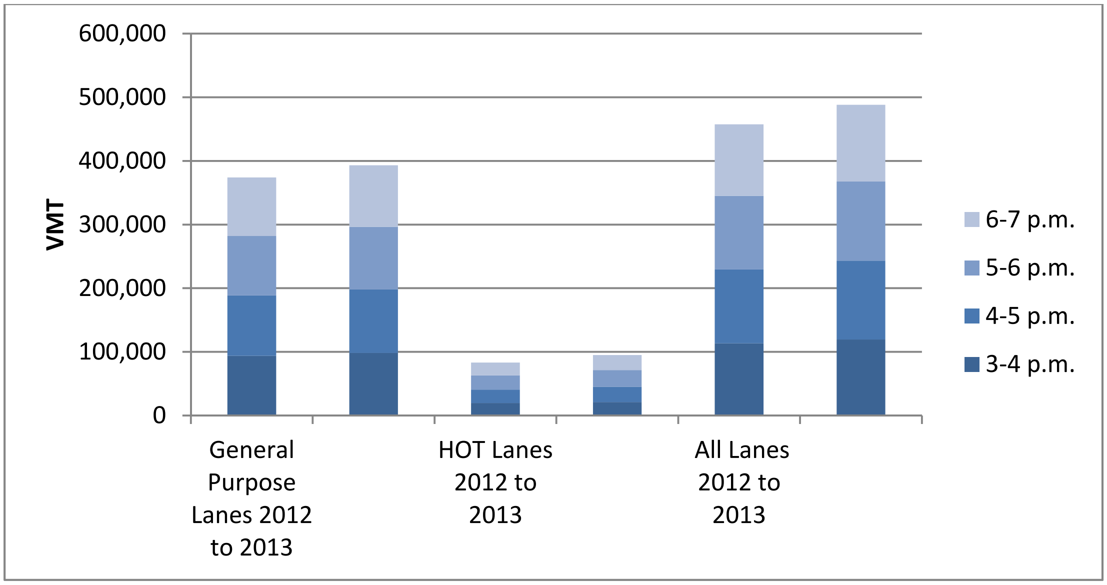
The PeMS data for the I-110 and the Caltrans count data for the I-10 are presented below in Figure H-4 and Figure H-5 and in Table H-2 through Table H-6. As described above, the data are much more detailed for the I-110 than for the I-10 because of the availability of the sensor data for the I-110. In some figures, the term "HOT Lanes" is used to describe ExpressLanes. This abbreviation is adopted at times for simplicity. The figures are presented to provide a general sense for the direction and size of changes; the tables show the actual values that were used in the environmental analysis.



Source: Earth Matters, Inc. based on Caltrans PeMS Data.

Figure H-4. VMT on the I-110 North during Morning Peak Period

A large increase in the I-110 ExpressLanes and a smaller increase in the general purpose lanes is evident in the figures, and also that the dominant period during the morning peak period is 6:00-8:00 a.m., with less travel occurring from 5:00-6:00 a.m. and 8:00-9:00 a.m. During the afternoon peak period the same pattern can be observed; an increase in the traffic on the ExpressLanes and the general purpose lanes. However the increases are of a smaller scale. Also the distribution of travel between hours of the peak period is more even than during the morning. These facts are more evident in Table H-2 and Table H-3 below.



Source: Earth Matters, Inc. based on Caltrans PeMS Data.

Figure H-5. VMT along I-110 South during Afternoon Peak Period

Table H-2 and Table H-3 present VMT along the I-110 during the peak periods for the peak directions (the morning peak is northbound and the afternoon peak is southbound). Table H-3 and Table H-4 present travel in the peak periods along the non-peak direction. This information is provided as a point of comparison between the pre- and post-deployment periods although the direction of travel is not in the peak flow direction.

Table H-3. Hourly and Peak Total VMT along the I-110 North, Morning Peak Period

Lane Type	Year	5-6 a.m.	6-7 a.m.	7-8 a.m.	8-9 a.m.	Total	Percent Change (2012 – 2013)
General Purpose Lanes	**2012**	51,498	81,426	79,092	74,569	286,585.5	1.66%
	2013	56,350	79,515	78,746	76,730	291,339.9	
ExpressLanes	**2012**	5,748	15,195	22,509	18,343	61,795.2	28.39%
	2013	5,043	19,360	29,080	25,857	79,339.7	
All Lanes	**2012**	57,246	96,622	101,601	92,912	348,380.7	6.40%
	2013	61,393	98,875	107,826	102,586	370,679.7	

Source: Earth Matters, Inc. based on Caltrans PeMS Data.

There are generally increases for each lane type throughout the morning peak period along the I-110 northbound apart from a small drop from 5:00 a.m. to 6:00 a.m. in the ExpressLanes. Overall, the ExpressLanes show a substantial increase in use between the pre- and post-deployment periods of 28.4 percent. The net effect for the morning peak period including both the ExpressLanes and the general purpose lanes is a 6.4 percent increase in VMT along the affected part of the I-110 corridor. The non-peak morning traffic in the Southbound direction presented in Table H-4 show a slightly smaller growth of 9 percent overall.

Table H-4. Hourly and Peak Total VMT along the I-110 Southbound, Afternoon Peak Period

	Year	3-4 p.m.	4-5 p.m.	5-6 p.m.	6-7 p.m.	Total	Percent Change (2012 to 2013)
General Purpose Lanes	2012	93,862	94,986	93,282	91,928	374,059	5.08%
	2013	98,268	99,782	98,390	96,625	393,064	
ExpressLanes	2012	19,655	21,136	22,272	20,278	83,341	14.19%
	2013	21,186	24,145	26,037	23,802	95,169	
All Lanes	2012	113,517	116,122	115,554	112,207	457,400	6.74%
	2013	119,454	123,927	124,426	120,427	488,234	

Source: Earth Matters, Inc. based on Caltrans PeMS Data.

There are increases in VMT along both the general purpose and the ExpressLanes for every hour of the afternoon peak period along the I-110 southbound. Similar to the morning peak, the percentage increases are larger for the ExpressLanes than for the general purpose lanes. However, the morning peak period showed a much larger percentage increase in ExpressLane use than the afternoon peak. The afternoon peak period increase is about 14 percent and the net effect for the southbound direction considering both the ExpressLanes and the general purpose lanes is 6.7 percent. For comparison, travel in the non-peak directions is also provided. The afternoon peak travel in the northbound direction shows a decrease of 3 percent.

Table H-5. VMT along the I-110 Southbound, Morning Peak Period

		5-6 a.m.	6-7 a.m.	7-8 a.m.	8-9 a.m.	Total	Percent Change (2012 - 2013)
Main Lanes	2012	56,434	85,273	99,994	91,717	333,418	8.39%
	2013	65,476	94,695	104,756	96,459	361,387	
Express Lanes	2012	7,048	12,607	16,050	13,310	49,015	10.99%
	2013	7,115	13,041	18,413	15,832	54,402	
All Lanes	2012	63,482	97,880	116,044	105,027	382,433	8.72%
	2013	72,591	107,736	123,170	112,292	415,789	

Source: Earth Matters, Inc. based on Caltrans PeMS Data.

There are VMT increases for both the general purpose and the ExpressLanes for all hours of the morning peak period along the I-110 southbound.

Table H-6. VMT along the I-110 Northbound, Afternoon Peak

		3-4 p.m.	4-5 p.m.	5-6 p.m.	6-7 p.m.	Total	Percent Change (2012 - 2013)
General Purpose Lanes	2012	79,731	82,129	81,794	74,065	317,719	0.15%
	2013	80,728	82,526	81,933	73,955	319,142	
Express Lanes	2012	16,590	17,742	18,758	16,671	69,761	-16.26%
	2013	12,517	13,797	15,048	13,961	55,324	
All Lanes	2012	96,321	99,871	100,552	90,737	387,479	-3.11%
	2013	93,245	96,323	96,981	87,916	374,465	

Source: Earth Matters, Inc. based on Caltrans PeMS Data.

As noted earlier, 82-100 percent of PeMS data for the I-10 ExpressLanes were missing due to construction related sensor outages, and therefore could not be used in the analysis. Instead Caltrans count data were used, as presented in Appendix A – Congestion Analysis. The count data included the number of vehicles in each lane type, as well as a count of the occupancies. In order to determine VMT the average of the two segment observations of vehicles was applied to the 14 miles of the I-10 affected by the conversion to ExpressLanes. The 14 miles included nine miles consisting of two Express Lanes and five miles consisting of one Express Lane. The measured counts were adjusted for the five-mile section.

Vehicle and person throughput recorded in the Caltrans counts was also presented in Appendix A – Congestion Analysis, which presents for examples of the post-deployment count days. Of necessity, this analysis utilizes only one pre- and one post-deployment set of counts. May 2012 represents pre-deployment, consistent with the I-110 analysis, and March 2014 represents about 12 months after tolling operations began. The use of this period allows for adjustments to tolling and the completion of construction to occur. The estimated VMT based on the throughputs calculated from the Caltrans count data is presented below in Table H-7.

Table H-7. VMT Estimates for the I-10 Express and Main Lanes Based on Caltrans Count Data for Morning 2-hour peak and Afternoon 1-hour peak

	ExpressLanes		Percent Change	Main Lanes		Percent Change	Total		Percent Change
	Pre	Post		Pre	Post		Pre	Post	
Westbound (Morning Peak)	24,863	71,820	+188.9%	163,408	173,110	+5.9%	188,271	244,930	+30.1%
Eastbound (Afternoon Peak)	17,917	31,282	+74.6%	90,580	97,020	+7.1%	108,497	128,302	+18.3%
Total Daily Peak Counts[6]	**42,780**	**106,110**	**+148.0%**	**253,988**	**270,130**	**+6.4%**	**296,768**	**376,240**	**+26.8%**

Source: Earth Matters, Inc. based on Caltrans Count Data.

The VMT along the I-10 recorded in the count data is a little less than half of that recorded on the I-110[7] but the percentage changes are much more dramatic than for the I-110, specifically for the ExpressLanes. There was a near doubling of VMT in the ExpressLanes during the morning peak period and a 75 percent increase in the afternoon peak period. Summing the ExpressLanes totals for both peak periods shows a 148 percent increase.

The general purpose lanes show a more modest increase of 6 to 7 percent, with a daily total peak increase of 6.4 percent. Summing both lane types, the net effect is a 30.1 percent increase in the morning peak and an 18.3 percent increase in the afternoon peak, for a 26.8 percent total increase considering the morning and afternoon peaks for both the ExpressLanes and general purpose lanes together.

[6] 2 hours of the morning peak and one hour of the afternoon peak.

[7] This is because data for the I-110 are for each of the entire 4 hour peak periods while the data for the I-10 are only for two hours of the a.m. peak and one hour of the afternoon peak.

Speed observations for the two highways were described in the second interim technical memo, Congestion and Tolling Analyses[8]. The speeds reported there are used in this analysis to select the appropriate emission factor for each time period, lane type, and highway. Table H-8 and Table H-9 list the pre- and post-deployment speeds used in the Environmental Analysis.

Table H-8. Average Peak Period Trip Speeds by Lane Type on the I-110

Average Trip Speeds -- I-110																
	Morning Commute Period (a.m.) -- Northbound															
	General Purpose Lanes								ExpressLanes							
Year	5:00	5:30	6:00	6:30	7:00	7:30	8:00	8:30	5:00	5:30	6:00	6:30	7:00	7:30	8:00	8:30
Pre- Deployment	NA	62	40	25	18	19	21	25	NA	65	65	57	50	44	53	59
Post- Deployment	NA	55	35	27	20	20	21	24	NA	64	59	49	37	47	47	45
	Afternoon Commute Period (p.m.) -- Southbound															
	General Purpose Lanes								ExpressLanes							
Year	3:00	3:30	4:00	4:30	5:00	5:30	6:00	6:30	3:00	3:30	4:00	4:30	5:00	5:30	6:00	6:30
Pre- Deployment	45	40	38	34	35	35	34	35	65	64	63	62	61	59	58	62
Post- Deployment	38	37	36	34	31	32	31	35	65	65	65	63	60	60	59	62

Source: Texas Transportation Institute based on data provided by Caltrans.

Table H-9. Average Peak Period Trip Speeds by Lane Type on the I-10

Average Trip Speeds -- I-10																
	Morning Commute Period (a.m.) -- Westbound															
	General Purpose Lanes								ExpressLanes							
Year	5:00	5:30	6:00	6:30	7:00	7:30	8:00	8:30	5:00	5:30	6:00	6:30	7:00	7:30	8:00	8:30
Pre- Deployment	NA	59	45	30	23	21	21	23	NA	64	60	57	48	40	53	52
Post- Deployment	NA	55	39	27	23	24	27	28	NA	66	62	61	60	58	58	59
	Afternoon Commute Period (p.m.) -- Eastbound															
	General Purpose Lanes								ExpressLanes							
Year	3:00	3:30	4:00	4:30	5:00	5:30	6:00	6:30	3:00	3:30	4:00	4:30	5:00	5:30	6:00	6:30
Pre- Deployment	28	26	27	25	25	26	29	36	46	44	41	43	47	49	49	51
Post- Deployment	27	25	23	21	24	23	28	35	54	50	48	47	48	49	53	59

Source: Texas Transportation Institute based on data provided by Caltrans.

The speeds reported above were used to determine the appropriate speed based emissions factor to apply for each facility, lane type, and time period. More information on emissions factors is included in the section below. This speed data shows improvements in the ExpressLanes and some degradation in the general purpose lanes. Taken together with the significantly greater throughput along the facilities, the changes in speed seem to indicate greater efficiency.

[8] Los Angeles Congestion Reduction Demonstration (LA CRD) ExpressLanes Program National Evaluation: Technical Memorandum on Congestion, Tolling, Transit, and Equity Results April 11, 2014.

H.3 Air Quality and Energy Analysis Methodology

The methodology is straightforward. The Environmental Analysis is largely focused on preparation of the data for use in the analysis, as described above in Section H.2.

The emissions calculations for changes in vehicle throughput and travel time along the I-110 and I-10 are made by multiplying the motor vehicle emission factors in grams per mile by the number of miles travelled along the I-110 and I-10 where the ExpressLanes were added. The speed of travel while cruising was used to select the appropriate emission factor for that speed. The fuel consumption calculations multiply VMT by the appropriate fuel economy for the appropriate speed.

The emission factors by speed were prepared as described above, running the EMFAC2011 model for 2012 for all speeds, vehicle ages, and types, and then weighting the resulting emission and fuel consumption factors by the proportion of VMT represented by each vehicle type. These weighted emission and fuel consumption factors were summarized in Section H.2.

The average speed of travel for each lane type, time of day, and direction of travel is used to select the appropriate emission and fuel consumption factors for that lane type, time of day, and direction of travel. The emission factors are then multiplied by the VMT for each lane type, etc. in order to estimate total pounds of emissions per time period.

The sensor data for the I-110 were available in VMT expressed as monthly averages per hour of the day for each of over 20 roadway segments for each lane type (ExpressLanes and general purpose lanes). The peak hours (6:00 a.m. to 10:00 a.m. and 3:00 p.m. to 7:00 p.m.) by lane type were summed across the segments to estimate total VMT along the ExpressLane corridor in each direction. These summarized VMT values were combined with the appropriate speeds reported by Caltrans and then used in the emission calculations for the I-110.

Since minimal sensor data were available for the I-10, the analysis utilized the Caltrans count data. The vehicle counts by lane type, time of day and direction were multiplied by the length of the affected segment (14 miles) to estimate VMT for the corridor on the ExpressLanes and on the general purpose lanes. As noted in Section H.2, the count data were only available for 2 hours of the morning peak period and one hour of the afternoon peak period. Therefore the resulting VMT and associated emission and fuel consumption estimates only represent those time periods rather than the entire morning and afternoon peak period that was available for the I-110.

Emissions of the ozone precursors NOx and ROG (Reactive Organic Gases), carbon monoxide, fine particulate matter, and CO_2 (predominant greenhouse gas) were estimated using the appropriate VMT for each lane type and speed for a given peak period and direction of flow.

Emission estimates for LA Express Park™ or changes in vanpooling, carpooling, and transit use were not made due to a lack of sufficient data. An emissions calculation for the 59 new clean fueled transit buses is included after emissions for the I-10 and I-110 are presented.

H.4 Findings from the Air Quality and Energy Analysis

The air quality and fuel consumption findings directly relate to the VMT changes: VMT increased substantially and therefore so did emissions and fuel consumption. As noted in Section H.2, net VMT (including all time periods and lane types) increased by 6.6 percent on the I-110 and by 30.5 percent on the I-10. Fuel economy did not improve either, even though speeds did. Speeds improved often in ranges that cause fuel economy to decrease. Therefore average fuel economy on the I-10 decreased from 18.4 to 17.6 mpg and from 17.9 to 17.5 mpg on I-110. These represent a 4.5 percent decrease on the I-10 and a 2.1 percent decrease on the I-110.

Because emissions are estimated at the speed of travel, the emissions changes do not follow the VMT changes in lockstep. Some percentage emissions increases were lower than the VMT increases and some were higher, depending on the emission factors for the speed of travel in the pre- and post-deployment periods.

A qualitative analysis for carpooling suggests that a substantial proportion of the increased VMT along the affected corridor is due to a drop in carpooling. The drop in the number of vehicles with carpoolers (for example 2772 for morning commute on the I-110 and 411 for the I-10 morning commute) is large enough to account for more than 50 percent of the VMT along the I-110 ExpressLanes and about 10 percent of the overall VMT along the I-110 considering both lane types (for peak periods). The I-10 reduction in carpooling would represent approximately 20 percent of ExpressLane VMT. In order to make this comparison, the change in carpool vehicles was multiplied by the total length of the corridor to roughly estimate VMT.

A qualitative analysis for vanpooling suggests that vanpooling improved emissions. 80 new vans with seating capacity of 733 people were added. If these vans made only 1 round trip per day along the corridor this would reduce VMT by over 10,000 miles.

Table H-10 on the following page presents pre- and post-deployment emissions along the I-110.

Table H-10. Pre- and Post-Deployment Emissions (Pounds) on the I-110 in the Peak Periods

Direction	Lane Type	ROG	NOx	CO	$PM_{2.5}$	CO_2
Northbound (Morning Peak)	Express, Pre	11.03	100.04	292.51	2.31	60,257.1
	Express, Post	13.46	112.54	375.55	2.45	73,677.6
	Percent Increase	22.1%	12.5%	28.4%	5.7%	22.3%
	GP, Pre	51.13	356.02	1,455.65	6.31	268,658.1
	GP, Post	56.47	326.63	1,574.78	5.78	285,885.3
	Percent Increase	10.4%	-8.3%	8.2%	-8.5%	6.4%
	Express + GP, Pre	62.16	456.07	1,748.16	8.63	328,915.2
	Express + GP, Post	69.93	439.18	1,950.33	8.22	359,562.9
	Percent Increase	12.5%	-3.7%	11.6%	-4.7%	9.3%
Southbound (Afternoon Peak)	Express, Pre	16.52	174.58	383.85	4.59	87,857.0
	Express, Post	22.85	267.06	459.70	8.18	114,559.4
	Percent Increase	38.3%	53.0%	19.8%	78.1%	30.4%
	GP, Pre	72.50	419.37	2,021.90	7.42	367,055.9
	GP, Post	70.13	488.30	1,996.49	8.66	368,476.2
	Percent Increase	-3.3%	16.4%	-1.3%	16.8%	0.4%
	Express + GP, Pre	89.03	593.95	2,405.74	12.00	454,912.9
	Express + GP, Post	92.98	755.36	2,456.20	16.83	483,035.6
	Percent Increase	4.4%	27.2%	2.1%	40.2%	6.2%
Total Morning and Afternoon Peaks	Pre	151.18	1,050.02	4,153.90	20.63	783,828.1
	Post	162.90	1,194.54	4,406.52	25.06	842,598.6
	Percent Increase	7.8%	13.8%	6.1%	21.4%	7.5%

Source: Earth Matters, Inc.

The pollutant changes vary depending on the amount of change in the emission factors per change in speed from pre- to post-deployment. As Table H-10 shows, there are even cases where some pollutants increase while others decrease.

The net effect considering both lane types and peak periods is a 6.1-21.4 percent increase in emissions post deployment. Most of the increase is due to increases in use of the ExpressLanes. During the morning peak, emissions along the I-110 ExpressLanes increased by 5.7-22.3 percent depending on the pollutant. During the afternoon peak they rose by 19.8-78.1 percent. In both cases $PM_{2.5}$ was one of the extremes of the range. During the morning commute $PM_{2.5}$ changed the least of all the other pollutants (5.7 percent) and during the afternoon it changed the most (78.1 percent).

The I-110 general purpose lanes show a mixture of increases and decreases. In the morning peak period NOx and $PM_{2.5}$ both decreased by a little over 8 percent and the remaining pollutants increased 6.4-10.4 percent. In the afternoon peak period, ROG and CO decreased slightly (1.3-3.3 percent). CO_2 increased by 0.4 percent, while NOx and $PM_{2.5}$ increased by over 16 percent.

Table H-11. Pre- and Post-Deployment Emissions (Pounds) on the I-10 in the Peak Periods

Direction	Lane Type	ROG	NOx	CO	$PM_{2.5}$	CO_2
Westbound (Morning Peak)	Express, Pre	5.13	40.74	147.21	0.80	27,915
	Express, Post	17.84	188.48	414.41	4.95	94,853
	Percent increase	247.5%	362.7%	181.5%	519.3%	239.8%
	GP, Pre	31.67	183.20	883.27	3.24	160,349
	GP, Post	33.55	194.08	935.71	3.43	169,869
	Percent increase	5.9%	5.9%	5.9%	5.9%	5.9%
Totals for Westbound	Express + GP, Pre	36.8	223.9	1,030.5	4.0	188,263
	Express + GP, Post	51.4	382.6	1,350.1	8.4	264,722
	Percent Increase	39.6%	70.8%	31.0%	107.6%	40.6%
Eastbound (Afternoon Peak)	Express, Pre	3.89	27.10	110.79	0.48	20,448
	Express, Post	6.65	55.61	185.55	1.21	36,402
	Percent increase	70.8%	105.2%	67.5%	151.6%	78.0%
	GP, Pre	15.36	121.90	440.53	2.39	83,537
	GP, Post	16.45	137.62	459.24	2.99	90,096
	Percent increase	7.1%	12.9%	4.2%	25.0%	7.9%
Totals for Eastbound	Express + GP, Pre	19.3	149.0	551.3	2.9	103,985
	Express + GP, Post	23.1	193.2	644.8	4.2	126,499
	Percent Increase	20.0%	29.7%	17.0%	46.1%	21.7%
Total Morning and Afternoon Peaks	Pre	56.1	372.9	1,581.8	6.9	292,247.8
	Post	74.5	575.8	1,994.9	12.6	391,221.0
	Percent Increase	32.9%	54.4%	26.1%	82.1%	33.9%

Source: Earth Matters, Inc.

Emissions for the I-10 change substantially. Overall, considering the net effect of both lane types and times of day there is 26.1-82.1 percent increase in pollution depending on the pollutant. For example, ROG increases by 32.9 percent, NOx by 54.4 percent, CO by 26.1 percent, and fine particulate matter by 82.1 percent. All emissions calculations utilize the same VMT value: the variations arise from differences in the emission factors at differing speeds. For scale, emissions of particulate matter range from the single digits to 12 pounds daily; ROG is the in 55-75 pounds range; NOx is the 373-576 range; CO between 1,581 and 1,995; and CO_2 in the hundreds of thousands of pounds per day.

Looking at the results by direction and lane type we can see that the increases in the main lanes are 5.9 percent for the morning commute and range from 4.2-25.0 percent in the afternoon commute. The 25.0 percent increase is only for fine particulate matter; increases for the other pollutants range from 4.2-12.9 percent. The air pollution increases (on a percentage basis) on the ExpressLanes are more pronounced, especially during the 2 hours of the morning peak that were included in the count data where they range from 181.5-519.3 percent. During the afternoon peak hour the increases on the ExpressLanes are 67.5-151.6 percent.

Energy use was evaluated by estimating changes in fuel consumption for the two highways in each direction, for both lane types. Table H-12 on the following page presents fuel consumption in the pre- and post-deployment peak periods.

Table H-12. Fuel Consumption in the Pre- and Post-Deployment Periods along the I-110 and I-10

	Fuel Consumption (gallons) I-110		Fuel Consumption (gallons): I-10	
	Northbound I-110 (morning peak)	**Southbound I-110 (afternoon peak)**	**Westbound I-10 (morning peak)**	**Eastbound I-10 (afternoon peak)**
Express Pre	3,572.0	5,308.4	1,593.1	1,172.7
Express Post	4,288.6	7,435.1	5,731.1	2,118.9
Increase	20.06%	40.06%	259.75%	80.69%
GP Pre	15,407.8	20,781.1	9,078.2	4,767.4
GP Post	16,185.6	21,132.5	9,617.2	5,244.3
Increase	5.05%	1.69%	5.94%	10.00%
Total Peak Period Pre	18,979.8	26,089.4	10,671.3	5,940.1
Total Peak Period Post	20,474.2	28,567.6	15,348.3	7,363.2
Increase	7.87%	9.50%	43.83%	23.96%
Total Daily During Peak Periods: Pre		45,069.2		16,611.3
Total Daily During Peak Periods: Post		49,041.8		22,711.5
Increase		8.81%		36.72%

Source: Earth Matters, Inc.

Daily fuel consumption increases in a similar manner as vehicular travel. On the I-110 the combined morning and afternoon peak fuel consumption increases by 8.8 percent and on the I-10 by 36.7 percent. This overall result is strongly affected by the large increase in fuel consumption for the ExpressLanes: 80.7 percent in the afternoon and 259.8 percent in the morning for the I-10. The I-110 ExpressLanes show a 20.1 percent (morning) to 40.1 percent (afternoon) fuel use increase. Fuel use on general purpose lanes increased by 1.7-5.1 percent for the I-110 and 6.0-10.0 percent for the I-10.

An additional analysis was made of the emissions reductions due to the 59 new clean fueled transit buses. On the I-10, 30 new clean fuel buses were added, and 29 were added on the I-110. Emission factors to represent the diesel buses that were replaced were modeled using the EMFAC model for calendar year 2012. Diesel urban bus emission factors for the South Coast Air Basin were used. Clean fuel bus factors were modeled using a 2035 gas-fueled bus fleet. VMT was based on the lengths of the I-10 and I-110 corridors, assuming the buses made one round trip per peak period. Table H-13 below summarizes the impacts.

Table H-13. Emissions Impacts of 59 New Clean Fueled Transit Buses

	Diesel Bus Emission Factors	Clean Bus Emission Factors	Diesel Bus Emissions* (pounds)	Clean Bus Emissions* (pounds)	Overall Emissions Change (pounds)	Emissions Change on I-10 (pounds)	Emissions Change on I-110 (pounds)
ROG	0.67	0.83	2.9	3.6	-0.7	-0.3	-0.4
CO	3.19	4.05	13.7	17.3	-3.7	-1.5	-2.2
NO_x	17	1.57	72.8	6.8	66.0	26.4	39.6
CO_2	2625.0	744	11,228.5	3,182.5	8,046.0	3,218.4	4,827.6
$PM_{2.5}$	0.3	0.0005	1.3	0.0	1.3	0.5	0.8

Source: Earth Matters, Inc.

H.5 Summary of Environmental Analysis

In summary, vehicle throughput on the I-110 and I-10 improved, leading to an increase in air emissions and fuel consumption along the corridor, at least after one year of tolling. It is not known if this increased traffic was utilizing alternate routes before, or if it is due to latent demand for use of the I-10 and I-110 or the growing economy. It was likely a combination of these factors, along with the decrease in vehicle occupancies.[9] The qualitative carpool analysis showed that some of the increase was due to a decrease in carpooling. There was no electronic or survey data on use of alternate facilities to assess the reason for the remaining changes. If the increased throughput along the I-110 and I-10 had all been using alternate routes it could be safely assumed that the net effect of this project was to decrease emissions. Switching a route to the I-110 or I-10 would be done only if it saved time, meaning that the switch involved a shorter distance and/or a faster trip. Because alternate routes of longer distance would mean more VMT this would increase emissions. Since they would likely involve speeds in the range where emission factors are higher than observed for the I-110 and I-10 the change in speeds, even with VMT being the same would tend to result in higher emissions.

[9] Due to a drop in carpooling

The net effect considering both lane types and peak periods is a 6.1-82.1 percent increase in emissions post deployment. This increase was slightly mitigated by the clean fueled buses (by about 1 percent overall). Most of the increase is due to increases in use of the ExpressLanes. During the morning, peak emissions along the I-110 ExpressLanes increased by 5.7-22.3 percent depending on the pollutant. During the afternoon peak they rose by between 19.8-78.1 percent. In both cases, $PM_{2.5}$ was one of the extremes of the range. During the morning commute $PM_{2.5}$ changed the least of all the other pollutants (5.7 percent) and during the afternoon it changed the most (78.1 percent).

The I-110 general purpose lanes show a mixture of increases and decreases. In the morning peak period NOx and $PM_{2.5}$ both decrease by a little over 8 percent and the remaining pollutants increase 6.4-10.4 percent. In the afternoon peak period, ROG and CO decrease slightly (1.3-3.3 percent). CO_2 increases by 0.4 percent, while NOx and $PM_{2.5}$ increase by over 16 percent.

Emissions for the I-10 change substantially. Overall, considering the net effect of both lane types and times of day there is 26.1-82.1 percent increase in pollution depending on the pollutant. For example, ROG increases by 32.9 percent, NOx by 54.4 percent, CO by 26.1 percent, and fine particulate matter by 82.1 percent. All emission calculations utilize the same VMT value: the variations arise from differences in the emission factors at differing speeds. For scale, emissions of particulate matter range from the single digits to 12 pounds daily; ROG is the in 55-75 pounds range; NOx is the 373-576 range; CO between 1,581 and 1,995; and CO_2 in the hundreds of thousands of pounds per day.

Looking at the results by direction and lane type we can see that the increases in the main lanes are 5.9 percent for the morning commute and range from 4.2-25.0 percent in the afternoon commute. The 25.0 percent increase is only for fine particulate matter; increases for the other pollutants range from 4.2-12.9 percent. The air pollution increases (on a percentage basis) on the ExpressLanes are more pronounced, especially during the 2 hours of the morning peak that were included in the count data where they range from 181.5-519.3 percent. During the afternoon peak hour the increases on the ExpressLanes were 67.5-151.6 percent.

Table H-4. Summary of Impacts across Questions

Questions	Result	Evidence
Average vehicle-related air emissions will decrease in the treatment corridors	Not supported	The ExpressLanes resulted in greater vehicle throughput. This increased VMT by a great enough factor to also increase emissions. On the I-110 net emissions increased by 6.1-21.4% depending on pollutant. On the I-10 the net effect is a 26.1-82.1% increase in emissions depending on the pollutant.
Average vehicle fuel economy will improve in the treatment corridors	Not supported	On the I-110 the combined morning and afternoon peak fuel consumption increased by 8.8% and on the I-10 by 36.7%. Fuel economy did not improve.
Average vehicle-related noise will decrease in the treatment corridors	Not evaluated	After the Los Angeles evaluation plan was completed, it was decided to not perform noise impact modeling or analysis due to a lack of original data and issues related to using the FHWA noise model.

Source: Earth Matters, Inc.

Appendix I. Non-Technical Success Factors Analysis

This analysis examines the non-technical success factors associated with the Los Angeles (LA) Congestion Reduction Demonstration Program (CRD). These non-technical success factors include outreach activities, media coverage, political and community support, and the institutional arrangements used to manage and guide implementation of the LA CRD. Information on the non-technical success factors is of benefit to the U.S. DOT, state departments of transportation, MPOs, and local communities interested in planning and deploying similar projects.

Table I-1 presents the questions, measures of effectiveness, and data sources associated with the analysis of the non-technical success factors. The first question guiding this analysis focuses on understanding how a wide range of variables influenced the success of the LA CRD project deployments. The variables are grouped into five major categories: (1) people, (2) process, (3) structures, (4) media, and (5) competencies. The second question focuses on examining public support for the LA CRD projects and whether the public viewed the CRD projects as effective and appropriate ways to reduce congestion.

Table I-1. Non-Technical Success Factors Analysis Approach

Hypotheses/Questions
What role did factors related to these five areas play in the success of the deployment? 1. People Sponsors, champions, policy entrepreneurs, neutral conveners, legislators 2. Process Forums (including stakeholder outreach), meetings, alignment of policy ideas with favorable politics and agreement on nature of the problem), legislative and Congressional engagements 3. Structures Networks, connections and partnerships, concentration of power & decision making authority, conflict mgt. mechanisms, communications strategies, supportive rules and procedures 4. Media Media coverage, public education 5. Competencies Cutting across the preceding areas: persuasion, getting grants, doing research, technical/technological competencies; ability to be policy entrepreneurs; knowing how to use markets
Does the public support the CRD strategies as effective and appropriate ways to reduce congestion?

Source: Battelle.

This appendix is divided into seven sections: the data sources used in the analysis are described in Section I.1. Information on the multi-agency organizational structure of the LA CRD is presented in Section I.2 followed by a discussion of the communications and outreach activities in Section I.3 and a content analysis of news media coverage of the LA CRD in Section I.4. The major themes from the interviews and workshops with the local partners are presented in Section I.5 and results from questions measuring public perception of the LA CRD are summarized in Section I.6. In conclusion, a summary of the LA CRD non-technical success factors is presented in Section I.7.

I.1 Data Sources

A variety of data sources were used in the non-technical success factors analysis. First, two rounds of interviews and workshops were conducted by the National Evaluation team with representatives of the local partners. Second, news media coverage of the LA CRD projects collected by Metro were reviewed and analyzed. Third, LA CRD partners shared with the National Evaluation team formal partnership documents and outreach materials and activities for examination and analysis. Fourth, Metro provided findings from the pre- and post-deployment I-10 and I-110 user surveys, FasTrak® customer satisfaction survey, and Silver Line transit rider survey. Fifth, reports and presentations by LADOT and Xerox personnel about LA Express Park™ intercept and online surveys were reviewed. Finally, findings from the Silver Line transit rider survey, ExpressLanes Post-Deployment I-10 and I-110 User Surveys, and ExpressLanes FasTrak® Customer Satisfaction Surveys, were provided by Metro.

I.2 LA CRD Multi-Agency Organizational Structure

The LA CRD partners consist of the Los Angeles County Metropolitan Transportation Authority (Metro) and the California Department of Transportation (Caltrans), District 7. Metro was the designated lead agency for the LA CRD project and was responsible for overseeing the policy, planning, and design of tolling and transit operations, and served as the coordinating body for all of the LA CRD local partners, including mobility partners (Foothill Transit, Gardena Transit, Los Angeles Department of Transportation (LADOT), Metrolink, and Torrance Transit) and enforcement partners (California Highway Patrol).

While Metro was in charge of the tolling operations for the ExpressLanes, it is being implemented on facilities owned by Caltrans. Therefore, Caltrans maintained an oversight and advisory role during the planning and implementation stages of the LA CRD and continues in a data management role during the post-deployment period.

I.3 Public Information and Outreach Activities

The following section describes the outreach approach and activities employed by the local partners as evidenced through the outreach materials and activities shared with the National Evaluation team and through the interviews and workshops with local partners. The section concludes with reflections from the local partners on both the challenges and lessons learned associated with implementing a communications and outreach plan for the LA CRD.

Lead Agency Roles and Responsibilities. As lead agency of the LA CRD projects, Metro was responsible for planning and executing the outreach and communications plan for the LA CRD. This included building legislative support at the beginning of the projects to pass the necessary legislation that would grant tolling authority in LA County and developing a marketing plan for the sale and distribution of the FasTrak® toll account.

Purpose and Approach to Outreach and Marketing Communication. In interviews, local partners emphasized that implementing a tolling project in LA County was not without controversy, even with the support of the Metro Board, because of the proclivity of commuters to choose cars over other commute choices like transit and carpooling. Historically, LA residents have maintained a low tolerance for change when it comes to their highway systems; in fact, interviewees referred to a 1970s general purpose lane conversion to HOV that still remained fresh in commuters' minds. The HOV was shut down and converted back to general purpose shortly after opening, revealing an unwillingness on the part of users to wait for possible longer-term impacts of the HOV facility on commuter behavior.

Given this historical context and pervading car culture, state legislators demanded constituent engagement and buy-in if they were going to provide the necessary legislative authority for tolling. In response, Metro developed a grassroots approach to its communications and outreach with the purpose of creating transparent communications and building a reputation for a willingness to share information on the LA CRD at any time with anyone. This included establishing an outreach policy in which Metro never turned down an opportunity to conduct a public meeting or presentation.

Outreach Activities. Given this commitment to transparency and availability, Metro led an outreach campaign that targeted specific stakeholders using a variety of methods and venues. During the period between receiving the grant in April 2008 and the end of the first year of tolling on the I-10 in February 2014, Metro had conducted a total of 640 briefings and events on the LA CRD, including 303 stakeholder briefings and 95 legislative briefings.

Metro also developed Corridor Advisory Groups (CAG), which met 20 times over the course of the LA CRD planning, implementation, and post-deployment periods. The CAG served as citizen advisors to the CRD and provided insight and recommendations on both messaging and helping shape some of the elements and features of the LA CRD projects. A complete list of communications and outreach methods used by Metro is found below:

In-person Activities

- One-on-one/small group meetings between Metro staff and key stakeholders, including:
    - local, state, and federal elected officials and members of their staff
    - representatives of the business community (e.g., chambers of commerce, business roundtables)
    - local transportation councils and commissions
    - neighborhood organizations
- Public hearings
- Press briefings and media events
- Information tables at shopping centers and events along the corridors
- Metro ExpressLanes Mobile Van events
- Community workshops
- Technical and Corridor Advisory Group meetings

Print and Online Communications

- Live web chats
- Press releases
- Construction notices
- Fact sheets and brochures
- Websites (www.metroexpresslanes.net, www.metro.net/projects/expresslanes, www.laexpresspark.org)
- The Source – Metro's transportation blog
- Social media (Facebook, Twitter, YouTube)

Key Messages. The primary message of the outreach and communications was on creating commuter choice on the I-110 and I-10 corridors. Metro faced a unique challenge in these corridors. In developing the ExpressLanes, Metro was not utilizing unused capacity in the existing carpool lanes, but rather, they were introducing tolling in HOV lanes already operating at full capacity. For tolling to work, Metro needed to create additional capacity by motivating commuters to choose alternative modes like transit. As one interviewee stated, "We had to create the capacity in order to sell it." This could only be achieved by creating a family of services for the commuter that included both car and transit options.

This meant Metro's messaging had to go beyond just informing commuters of the new tolling option on the ExpressLanes to marketing a set of commuting options.

Figure I-1 is an example of print materials created by Metro that provide an overview of the ExpressLanes system. The four quadrants on the right-hand side of the page give equal space to each of four methods commuters can access on the I-10 and I-110 corridors, including the benefits of each option.

Source: Metro.

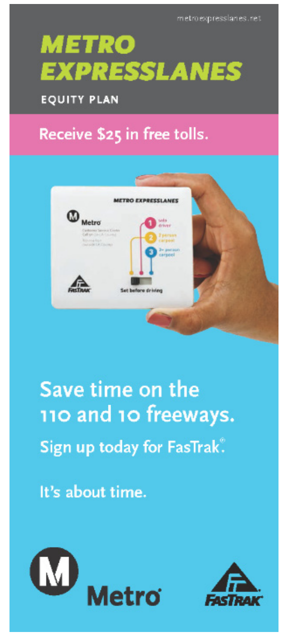
Figure I-1. Overview of Metro ExpressLanes

Figure I-2 illustrates how Metro envisioned the benefits of the ExpressLanes for various types of commuters. Interviewees indicated the value of market research to understanding the impacts the LA CRD would have on commuters. This understanding was critical to Metro's ability to market and 'sell' commuting choices. Metro was aware that if it did not understand the public's needs and interests, then it would not succeed in creating the extra capacity necessary for the ExpressLanes to have an impact on congestion in the region.

Source: Metro.

Figure I-2. Description of Customer Benefits

One example of how Metro listened to the needs of its customers was the development of the ExpressLanes Equity Plan. Figure I-3 is an image from a print handout describing the Equity Plan to potential FasTrak® users. The Equity Plan was developed in response to concerns raised by residents along the corridor that many potential ExpressLanes customers would be unable to afford the toll rate and monthly transponder fee. Based on eligibility determined by income and household size, commuters can access toll credits and a waived monthly transponder fee by enrolling in the Equity Plan. At the time of the second phase of stakeholder interviews one-year post-deployment on the I-10, Metro had enrolled almost five thousand households.



Source: Metro.

Figure I-3. Metro ExpressLanes Equity Plan Brochure

Lessons Learned. Metro took a proactive approach to learning from others who have implemented variable priced tolling by pursuing opportunities to incorporate lessons learned from the other UPA/CRD program sites. By learning from other sites who implemented high-occupancy toll (HOT) lanes before them, representatives from Metro came to understand the critical need to engage stakeholders, and remain willing to adapt and respond to their needs.

Interviewees also provided lessons learned in implementing a communications and outreach strategy for the LA CRD. Of particular note in these reflections was the recognition that high-level project staff must be directly involved in outreach activities to communicate the technical nature of the project and respond to the controversial aspects of tolling. In other words, communications and outreach must be a critical part of the project and program managers must collaborate with communications and government affairs staff to develop a coordinated outreach strategy.

Another important lesson learned was the realization that the role of the LA CRD extended beyond building and deploying a tolling facility, rather, the agency must design transportation enhancements that meet the needs of the public, with a customer service orientation. This became particularly evident when managing the tolling call center. Interviewees expressed regret that they did not maintain more control over the call center because they understood only after the fact the critical role the call center plays with the customer experience.

Interviewees highlighted carpoolers as a customer base with whom Metro may have missed opportunities to more fully engage. ExpressLanes requires transponders for all users, including carpoolers. Some interviewees described this change as negative for carpoolers. As one interviewee stated, "The carpoolers were really mad, actually. They really did not like this project because they felt like it was taking something free away from them." This statement revealed that carpoolers see themselves as distinct and established users of the HOV lanes. Requiring carpoolers to obtain transponders to use the ExpressLanes may have actually turned them off from using the lanes. Interviewees shared anecdotal evidence that carpoolers—especially the casual carpooler who only occasionally uses the HOV lane for evening, or weekend, travel—were uninterested, and even unwilling, to utilize the ExpressLanes because of the cost to purchase and maintain a transponder. While there is no definitive evidence of the impact this may have had on the ExpressLanes, interviewees speculated this may have lead to more congested general purpose lanes. At the very least, the ExpressLanes required a change in behavior for carpoolers and some interviewees questioned whether this was a group that may have needed additional outreach from Metro.

As lead agency of the LA CRD, Metro was responsible for the outreach activities and communications for the CRD. Implementing tolling in LA County required communicating a significant paradigm shift in how users can travel on the I-10 and I-110. Metro was tasked with not only informing the public of tolling, but also receiving stakeholder feedback and implementing a persuasive campaign to change driver behavior. Public acceptance was a critical factor to Metro in deciding whether the tolling demonstration would continue beyond the pilot period. The continuation of tolling beyond the pilot period also required the approval of the state legislature. Based on the pilot, the state legislature passed a bill to continue tolling after the pilot period.

I.4 News Media Content Analysis

The following section describes the content analysis of news media for the period that spans planning through the one-year post-deployment period of the LA CRD in order to understand the nature and occurrences of media coverage and its potential role in both providing information as well as shaping public opinion.

Methods. The National Evaluation team limited the selection of news media coverage to articles related to the LA CRD projects and initially tracked both broadcast and print media coverage. Media coverage was tracked from the first occurrence beginning in June 2007 through February 2014, one year after the ExpressLanes on the I-10 went live. News media coverage was gathered by Metro and supplemented by the National Evaluation team using LexisNexus and ProQuest News. A total of 709 individual pieces of news media coverage were collected during this period and all news media coverage was sorted into the following five categories:

- Mainstream: Included coverage from the major neighborhood, university, local, regional, national, and international news media outlets.
  - A subset of mainstream media was identified as "neighborhood" media, covering those aimed at specific neighborhoods within distinct communities such as downtown LA and university student bodies.
- Blogs: Included coverage created and/or disseminated by private, or organization-affiliated, blogs.
- Targeted Educational: Included newsletters from organizations not directly related to the project but aimed at promoting knowledge about transit or the LA region.
- Op-Ed: Included coverage in mainstream newspaper outlets from the Opinion and Editorial section. Authors typically include editorial staff from the newspaper or guest writers who are members of the readership community as well as letters to the editor.
- Industry Publications: Included coverage from national, non-peer reviewed publications from the transportation industry, and also included those aimed at other specific industries such as technology, business, government, and travel.

Due to the volume of media coverage and resource constraints in the National Evaluation, in-depth content analysis was limited to a 10 percent stratified simple random sample of English language print articles. Broadcasts were not included in the in-depth analysis due to variation in the quality of transcripts available. Additionally, while the Chinese language media had translations available, the Spanish language coverage did not and was therefore excluded from the content analysis. This resulted in a sampling frame of 460 instances of news media.

The news media sample was stratified twice, by media type and then by year. Within each media type, a proportional amount of media was chosen from each year of the study to be represented in the sample. Table I-2 shows the sample distribution by media type and year. The total sample is slightly more than 10 percent (52 individual news pieces out of 460 total) to accommodate instances in which the sample amount would have been zero, but was rounded up to one in order to include at least one news media piece in the final sample. A random number generator was used to collect the stratified sample.

Table I-2. Ten Percent Stratified Sample of Los Angeles News Media

By media type and year

	Mainstream			Blog			Targeted Educational		
Year	Total	Percent by Year	Sample	Total	Percent by Year	Sample	Total	Percent by Year	Sample
2007	16	6%	1	0	0%	0	0	0%	0
2008	10	4%	1	0	0%	0	0	0%	0
2009	12	5%	1	4	5%	*1	0	0%	0
2010	6	2%	1	6	7%	1	0	0%	0
2011	23	9%	2	20	24%	2	1	2%	*1
2012	102	42%	11	35	43%	3	26	54%	3
2013	81	32%	8	17	21%	2	20	42%	2
2014	2	0%	*1	0	0%	0	1	2%	*1
Total	**252**	**100%**	**26**	**82**	**100%**	**9**	**48**	**100%**	**7**

	Op-Ed			Industry Publication			Total		
Year	Total	Percent by Year	Sample	Total	Percent by Year	Sample	Articles in Sample Frame	Percent by Year	Articles in Sample
2007	4	9%	*1	0	0%	0	20	4%	2
2008	3	6%	*1	0	0%	0	13	3%	2
2009	6	13%	1	0	0%	0	22	5%	3
2010	2	4%	*1	0	0%	0	14	3%	3
2011	6	13%	1	4	21%	*1	54	12%	7
2012	13	28%	1	8	42%	1	192	42%	19
2013	13	28%	1	7	37%	1	142	31%	14
2014	0	0%	0	0	0%	0	3	1%	2
Total	**47**	**101%**	**7**	**19**	**100%**	**3**	**460**	**100%**	**52**

*Oversampled

Total percentages may not equal 100 percent due to rounding.

Source: University of Minnesota.

The content analysis of the sampled news media coverage involved first analyzing the news content by organizing the articles into positive, negative, balanced, and neutral categories. By categorizing the articles, an assessment was made to determine whether the media was shaping opinion in a certain attitudinal direction (the assumption being that news media both informs and influences its readership). A definition of each category is as follows:

- Positive: The coverage presents an overwhelmingly positive case for the LA CRD project(s), typically giving detailed information about the benefits of the project. Sources and quotations come from only a positive perspective.
- Negative: The coverage presents an overwhelmingly negative case for the LA CRD project(s), typically giving detailed information about the risks of the project. Sources and quotations come from a negative perspective, or are put into a negative context.
- Balanced: The coverage presents a balanced story of both the potential benefits and risks of the LA CRD project(s). Sources and quotations may come from positive and negative perspectives and the author does not give a final verdict on whether the project is a net positive or negative.
- Neutral: The coverage presents information simply to inform the reading audience of some phenomenon or event without a particular viewpoint.

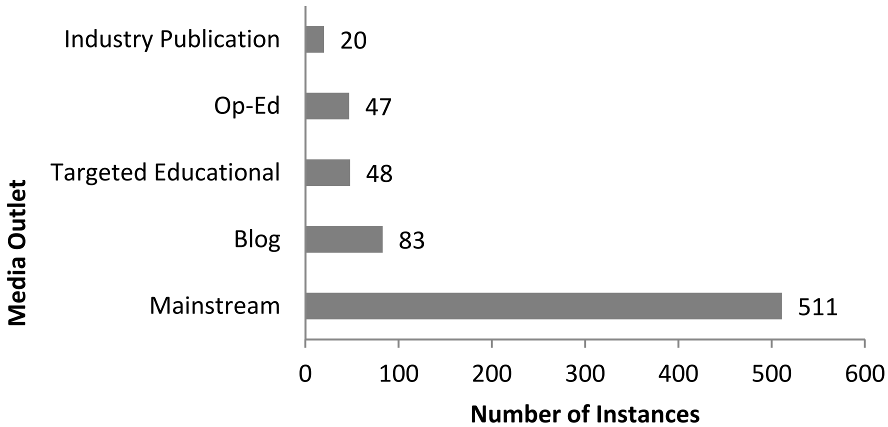
Next, the major themes and categories of ideas that arose from the topics in the news media coverage were identified by reading each sampled media item and coding for common themes using NVivo software.[1]

Findings. Coverage of the project was quite extensive, with about 34 percent of instances from broadcast media and the remaining 66 percent consisting of print and online written media sources. Media sources included major national media outlets such as The New York Times, The Huffington Post, USA Today, and The Los Angeles Times, although the majority of coverage was featured in local media outlets or the local affiliates of the major national media corporations. In part due to the substantial broadcast coverage of the LA CRD, coverage by mainstream media outlets far outnumbered the other categories, constituting 72 percent of all instances (Figure I-4). About 5 percent of the 709 recorded media instances were Chinese (27) or Spanish (8) language articles or broadcasts. The remaining 674 were English.

While mainstream and op-ed media covered the entire duration of development through evaluation, Figure I-5 shows that other outlets did not begin their coverage until later phases of the projects. The targeted educational and industry publications were highly concentrated, limited to implementation and evaluation phases.

[1] NVivo 10, a computer assisted qualitative data analysis software (CAQDAS), was used to conduct an in-depth content analysis of key themes of the news media coverage sample. Microsoft Excel was used to conduct a descriptive coding analysis of all news media coverage.

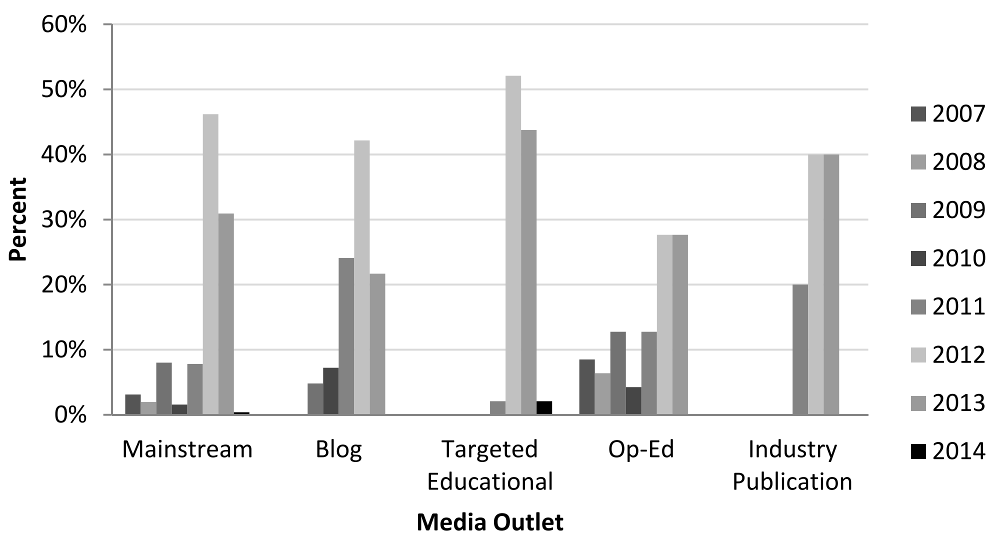
Total number of media instances by media outlet



Source: University of Minnesota.

Figure I-4. Mainstream Media Dominated Coverage

Yearly Distribution of Media Coverage by Outlet, 2007-2014, Percent

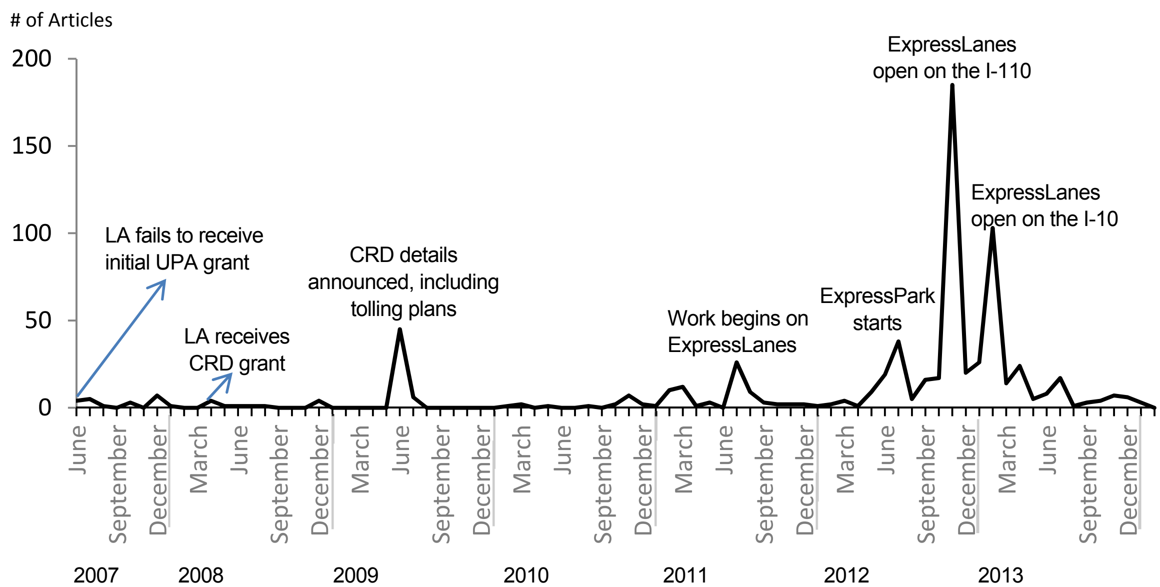


Source: University of Minnesota.

Figure I-5. All Media Outlets Concentrated Coverage 2011-2014

The distribution of media coverage, shown in Figure I-6, was tracked from planning through the one-year post-deployment period. Peaks in coverage coincided with major milestones of the LA CRD, with the largest spikes occurring when the ExpressLanes opened on the I-110 and I-10. A substantial peak also occurred with the announcement of the reworked plan for implementation, as the media and public reacted to the planned introduction of tolling in LA County for the first time.

Media coverage over time, June 2007 through February 2014

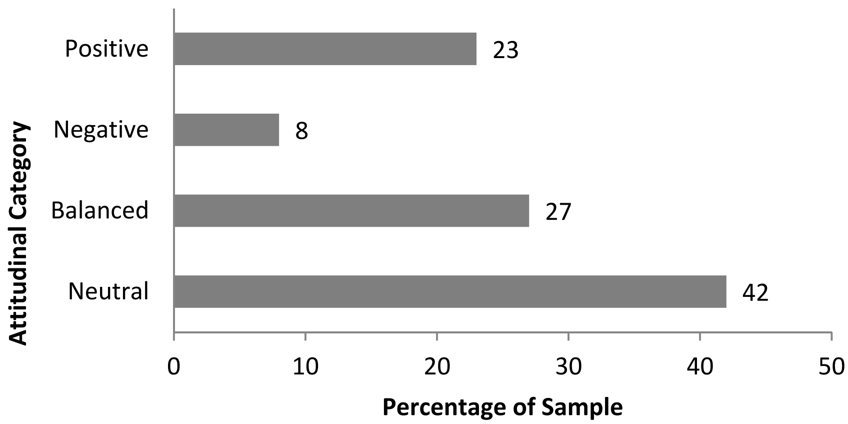


Source: University of Minnesota.

Figure I-6. Media Coverage Coincides with UPA Events

Through the in-depth analysis of the sample, it is clear that balanced (14 articles) and neutral (22 articles) media coverage made up the majority of instances, showing large amounts of public interest in the project developments, but a less decided public opinion on the subject. Positive reporting (12 articles) also substantially outweighed negative reporting (4 articles). Figure I-7 shows the breakdown of the sample by attitudinal category.

Attitudes of media coverage, percentage of sample

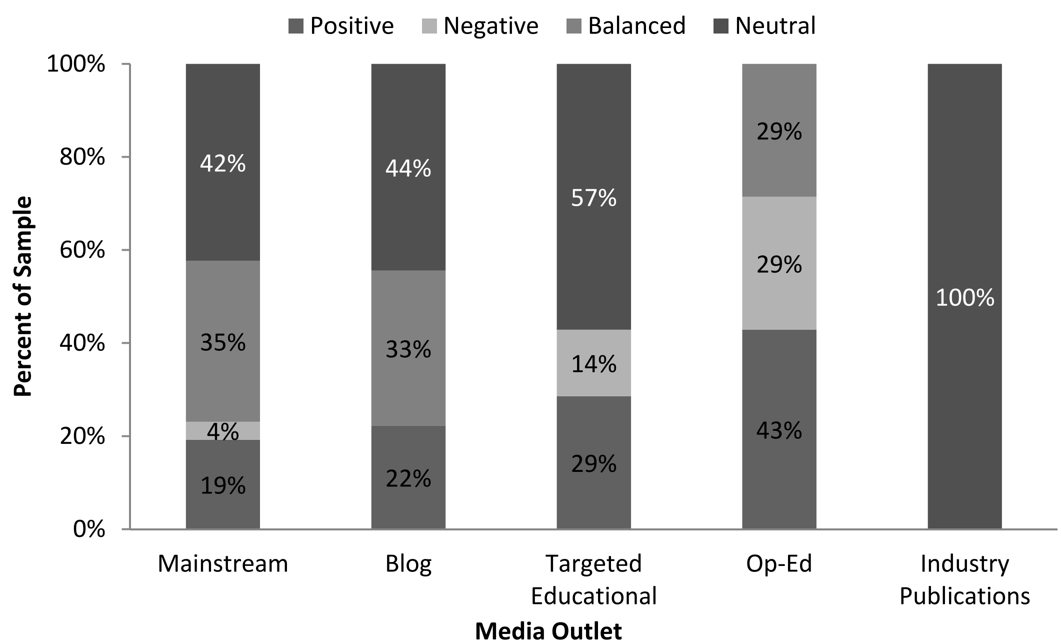


Source: University of Minnesota.

Figure I-7. Media Coverage was Predominantly Objective

While most media outlets reported a variety of attitudinal biases, there are a couple of categories of note that are displayed in Figure I-8. Unsurprisingly, op-eds contained no neutral reporting, though there were some balanced pieces in addition to those with a strong point of view. On the other hand, industry publications from the sample were entirely neutral in their portrayal of the LA CRD projects.

Attitudinal category of media coverage by outlet, percentage of sample

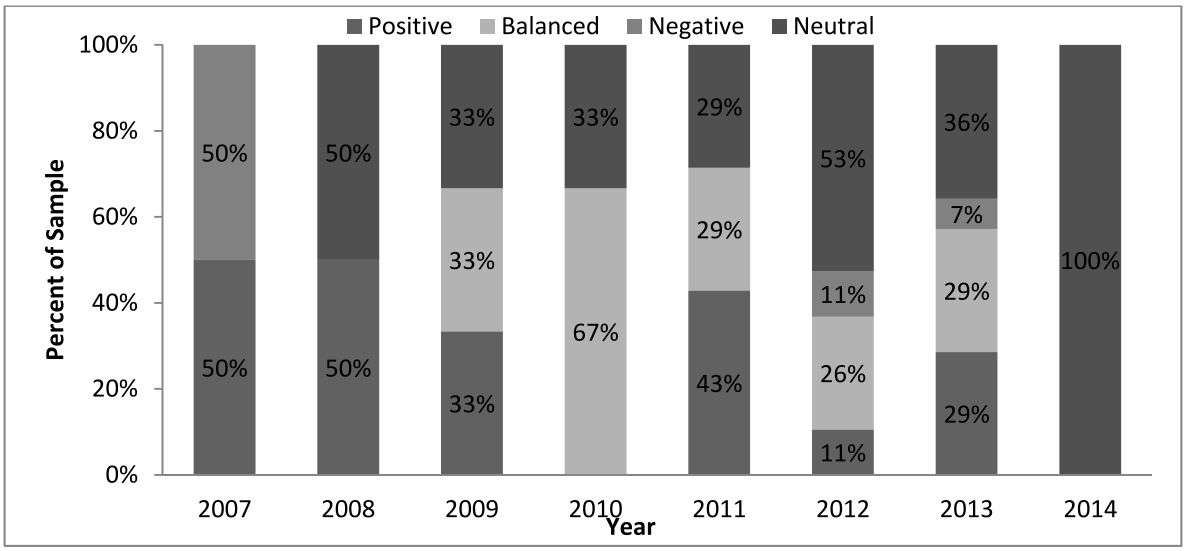


Source: University of Minnesota.

Figure I-8. Reporting Attitudes Vary by Media Outlet

Figure I-9 shows that the coverage of the LA CRD was overwhelmingly positive or non-biased. The negative articles cited a number of objections to the UPA projects, most specifically the ExpressLanes. Concerns about creating “Lexus lanes” and a two-tiered transportation system were the most common, though other critiques included double taxation, effectively punishing carpoolers by slowing their lanes, and the need to move towards more public transit rather than modified highways. While many articles mentioned such issues, they rarely adopted these viewpoints and more often explored the debate surrounding the projects. One possible explanation for this is that while LA County residents may not have been thrilled about the idea of putting tolls on their “freeways,” traffic congestion in the area is so bad and options so limited that the public has generally accepted the need to try new ways of addressing it.

Attitudinal category of media coverage by year, percentage of sample



Source: University of Minnesota.

Figure I-9. Media Reported a Variety of Attitudes through the Duration of the Project

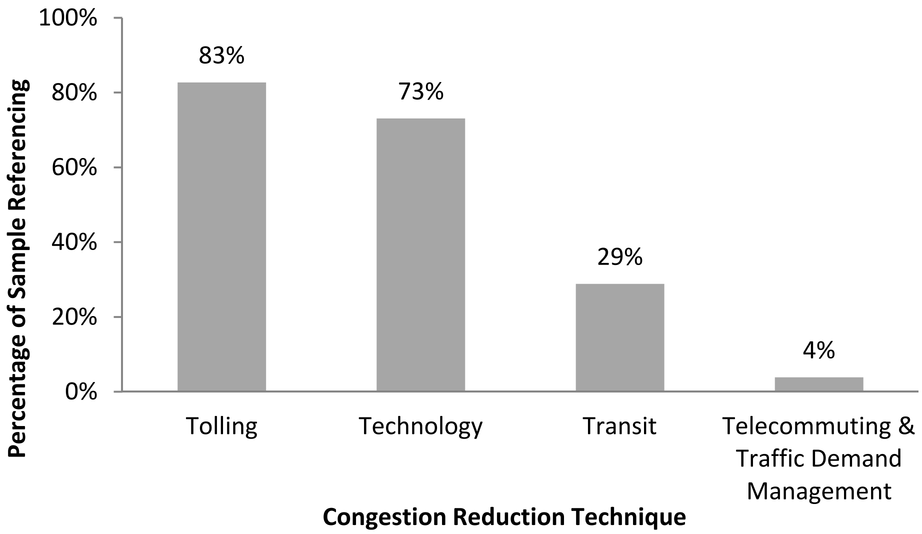
Another possible explanation for the lack of negative reporting is that people who held those opinions expressed them in different ways that were not featured as frequently in the media at large. Critics of these projects may have used other methods to voice their concerns, such as attending question and answer events in person, conducting direct correspondence with project leaders and public officials, or participating in online discussion forums that were not captured by a news media analysis.

Furthermore, the sample produced more negative headlines than overall negative articles. This underscores the idea that criticism is often more eye-catching for readers than more balanced interpretations, even when journalistic non-bias is maintained throughout the remainder of the article.

Positive coverage focused on themes of creating more equitable taxation for infrastructure than the gas tax, the improvement of driving conditions for all drivers by offering more choice, the large public uptake of transponders, and generally improved commute times and traffic flows.

The majority of coverage focused on the tolling and technology aspects of the LA CRD (Figure I-10). These were often referenced within the same articles, with many discussing the use of transponders or cameras for enforcement. LA Express Park™ was also featured frequently in technology discussions. The coverage of transit issues was limited to mentioning the purchase of high-occupancy buses, the renovations of the El Monte Bus Terminal, or a general sentiment that increasing appealing transit options is needed in addition to highway renovation. Telecommuting and traffic demand management were almost never mentioned in media coverage.

Media coverage of the "4Ts" of the UPA, by percent of sample referencing each



Source: University of Minnesota.

Figure I-10. Tolling & Technology were the Most Prominent Components of the LA CRD

The following section further discusses key topics and themes that emerged from the sample.

- **Controversy Surrounded the Projects:** The CRD projects were steeped in criticisms from various sides from inception through implementation, but rather than asserting one side or the other, the media acknowledged and explored the divergent opinions. In general, accounts turned out to be quite balanced or slightly positive. Tolling itself is controversial because of LA's historic and cultural aversion to it, but in the end it seems as though many are willing to try it in order to alleviate congestion.

  "Without taking sides, this discussion is one worthy of merit… but one likely to produce little consensus as our traffic pushes us to think outside of the box with respect to freeway transportation policy and cost-effective construction."[2]

[2] Ken Alpern, CitywatchLA. "Dueling Answers to Freeway Congestion." March 15, 2011.

- **<u>Equity Issues Surrounding Tolling</u>:** One theme that came up consistently was the issue of inequality in requiring payment to use faster lanes. Critics asserted that the toll lanes, or "Lexus lanes," create a two-tiered transportation system – a major issue in an already stratified society. Requiring payment to use the lanes in the form of tolls and transponders puts a burden on the working poor that can exclude them from their use. However, some recognized Metro's steps to lessen this burden through reducing transponder fees for low-income families. These critiques about tolling equity met with opposition from those who argued that a pay-for-use fee system like tolling actually reduces the burden on the poor more than a gas tax does, the other common funding mechanism for highway maintenance. Still others argue that equity is promoted through creating more choice for drivers. Another counter argument that emerged was that as more people move into the toll lanes, the general purpose lanes will speed up as well, benefiting all highway users.

  "A common complaint about toll lanes is that they may create a two-tiered commuting experience, one for those who can afford to pay for faster travel times and another for everyone else. It's "a tax that affects the poorer people more than the wealthy… I'm OK, but there are people who can't afford it," said Jim Gardner, a 72-year-old retired doctor from the Palos Verdes Peninsula. He bought a transponder because he uses the 110 Freeway once each week to carpool to the San Gabriel Mountains for hiking trips. Though he too was buying a transponder, San Pedro attorney Leslie Walker Van Antwerp III said the toll lanes seemed "undemocratic." Shoup, the UCLA professor, discounted such concerns. Low-income motorists will pay less for transponders, he said, and overall congestion should be reduced by the toll lanes. And toll lanes tend to gain in popularity once they are operating, officials argue. "Once we all get used to it, what once seemed unthinkable will seem indispensable," Shoup said. "I think just about everybody will gain from this.""[3]

[3] Ari Bloomekatz. Los Angeles Times. "LA County enters era of freeway toll lanes." November 9, 2012.

- **<u>Technology</u>:** Technology was a major component of the media coverage regarding the LA CRD. Media focusing on LA Express Park™ almost always highlighted the technological aspects: sensors to track parking space occupancy, apps for finding spots, and a centrally monitored pricing variation scheme. The ExpressLanes coverage also featured technology to a large extent, especially once tolling plans that required a transponder were announced. Much of the coverage was neutral, simply informing readers how tolling would be conducted, how the lanes would be enforced, and how signs would notify drivers of the variable pricing as well. Experts touted technology as one of the keys to successful implementation in both LA and other places that use automated tolling. The majority of coverage of technology, though, consisted of explanations to drivers of how the new systems would work and what to expect.

  "To access ExpressLanes on the 10 and 110, car owners will need to purchase a "FasTrak®" responder that will automatically deduct the toll cost from a credit card connected to the responder. An owner can list as many cars as he or she wants on the transponder. Each time the vehicle passes underneath a toll collection site, the account is debited to pay the toll. If the vehicle does not have a transponder or if a transponder is not detected at the Toll Plaza, a camera photographs the vehicle and its license plate for processing. If the license plate is registered as belonging to a FasTrak® user, the account is debited only the toll charge, and no penalty is charged. If there is no FasTrack® account, the owner of the vehicle is charged for using the lane and issued a ticket."[4]

- **<u>Effects on Carpoolers</u>:** One theme that surfaced periodically was the effects of converting the existing HOV lanes to HOT lanes. The people using the HOV lanes were portrayed as those who have complied with calls to carpool, but were then being punished by having lanes slowed down by those who had not. Requiring carpoolers to register and purchase transponders was also a concern, and was viewed as discouraging more general, impromptu carpooling.

  "My problem with the toll lanes on the 10 and 110 freeways is that they prevent the "casual carpooler" from using them. I used to seek out friends for occasional trips downtown so I could use the carpool lanes, which is now impossible because I have little need for a FasTrak® transponder. It would be very interesting to learn about how many such drivers are forced to use the free lanes because transponders are now required to access the tollways, or how many people just don't bother carpooling because they can't access the lanes at all."[5]

[4] Damien Newton. LA Streetsblog. "ExpressLanes Transponders, Coming to a Store Near You… and to the AAA! (Updated 11:30)." May 11, 2011.

[5] Todd Koerner. Los Angeles Times. "Letters: Give the 110 toll lane more time." April 13, 2013.

- **<u>Receiving Federal Funding for the Congestion Reduction Demonstration</u>:** A relatively large part of the sample (about 38 percent) made reference to the fact that the CRD funds came from the federal government. The prevalence of the federal funds being mentioned in articles is also likely a result of California's budgetary troubles; when the state is not allocating money to infrastructure at levels necessary to maintain roads, the fact that it is coming from the federal government is in fact newsworthy. However, it was often mentioned as a kind of justification for congestion pricing, a jarring change of freeway usage for LA County residents. Conveying the stipulation of tolling by the federal government can be a way for local authorities to mitigate risk and help hedge negative public opinion.

  > *"The federal government has offered Los Angeles County $213 million to convert carpool lanes to special, congestion-pricing toll lanes on three freeways, according to county government documents... The federal funding, however, would come to LA County only if local and state transportation officials agreed to the changes, which are highly controversial in the region, where most motorists expect "free" freeways."*[6]

- **<u>Culture of Free Freeways</u>:** The idea that freeways should be free came up as a theme frequently, particularly with regards to LA County as having a culture which supports this idea. This deep-held belief may have helped lead to further discussion of alternatives such as transit improvements or expanding carpool lanes. It also reflects the idea that roads have already been paid for and the public should not have to be taxed twice for them, even if the fact is that roads require more on-going maintenance.

  > *"East Coasters have dealt with toll roads for as long as there have been highways in America. West Coasters, and especially Californians – not so much. In fact, until recent decades, not at all. We'll pay a bridge toll without too much protest, especially if the span is a spectacular one – though, in case you haven't crossed it lately, the Golden Gate is up to $6 a pop. But surface routes? No way. Especially not in the county, Los Angeles, that prides itself as being the heart of American car culture. We like to imagine, at least, that we put the "free" in "freeway" at the same time we invented the beast. We know deep down in our fuel injectors that we pay for the roadways one way or another, even if we never drive on a particular one, and that doing so directly – throwing bills into the gaping maw of a booth, or having a FastTrak® device attached to our windshields – may make some economic sense. And yet still we resist what we view as a foreign scheme precisely for that reason – it's not been part of our mobile way of life."*[7]

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[6] Steve Hymon. Los Angeles Times. "U.S. offers funds for toll lanes; MTA will weigh congestion pricing on parts of 10 and 210, but fees to use freeways remain controversial." April 24, 2008.

[7] San Gabriel Valley Tribune. "Our View: Taking the free from our freeways." November 6, 2010.

- **<u>The Public's Biggest Concern is Commute Times</u>:** LA travelers are frustrated with gridlock both on the roads and in the institutions which should be working to address it. While the implementing agencies of the CRD are measuring person throughput, average driving speeds, and revenue generation as indicators of success, what the public actually cares about is whether or not their own commutes have improved. In the end, this is how the projects will be deemed successful or not.

  > *"Snoberger has been making his commute from Glendale to just south of downtown for 30 years, 20 miles each way. He's not happy about the fact that it takes him longer now than ever before. "It was bad, but it was bearable bad. Now it's bad, unbearable bad," he said. A big part of his commute is the 110 Freeway where the new, experimental Metro ExpressLanes have been put into place. "We've converted the carpool lanes to ExpressLanes," said Stephanie Wiggins with Metro. "The way it works is every vehicle that's going to use those ExpressLanes needs to have a FasTrak® transponder." In other words, starting last November, you can't use the carpool lanes unless you have a transponder. To get the device require an initial $40 deposit. Snoberger thinks that has pushed people out of the carpool lanes and into the regular lanes, where he usually is. "When we're sitting in traffic, and we're bumper-to-bumper with somebody, and the two lanes that are next to us here, there will be a car going by every five seconds," he said. Eyewitness News observed traffic on three separate mornings during rush hour. The ExpressLanes were barely used. "That's every day, every stinking day," Snoberger said."*[8]

- **<u>Revenue was Seldom a Topic of Media Coverage</u>:** Apart from extensive discussion of the rates charged to individual drivers, revenue generated by the toll lanes came up infrequently as a topic in the media coverage. When it was discussed, it was usually done so in the broader discussion of how tolling works across the country, and not looking at the situation specifically in LA County. Because tolling is often viewed as merely a revenue source for the government, it is unusual that this was not a more common theme. The idea that people resented paying the government more was mentioned, but it was not viewed as being the purpose of creating toll lanes.

[8] David Ono. KABC 7 Los Angeles News. "Metro ExpressLanes: Can they work in LA?" February 14, 2013.

I.5 Interviews and Workshops with Local Partners

The following section provides an analysis of the interviews and workshops conducted with representatives from the LA CRD local partners. The purpose of the interviews and workshops was to gain additional insights into the institutional arrangements, partnerships, outreach methods, and other activities contributing to planning, deploying, and operating the LA CRD projects.

Two rounds of in-depth interviews were conducted by the National Evaluation team with agency personnel involved in the LA CRD projects. The first round of interviews occurred in fall 2012 prior to tolling deployment and the second round in winter 2014, 11-12 months after tolling deployment of the I-10 ExpressLanes.

Interviewees were identified by the National Evaluation team with input from the LA CRD local partners. Once interviewing began, interviewees were asked for additional recommendations of other stakeholders to interview. Table I-3 identifies the number of individuals from different agencies and organizations participating in the interviews and workshops.

Interviews were conducted one-on-one over the phone using questions developed by the National Evaluation team with input from local partners and federal agency representatives. The questions were included in the *Los Angeles Congestion Reduction Demonstration (Metro ExpressLanes) Program Survey, Interviews, and Workshops Test Plan*.[9] Interviews lasted between 30 and 90 minutes. In most interviews, two members of the National Evaluation team were present. One individual led the interview, asking the questions and taking notes. The second individual took notes using a laptop computer. All interviews were audio recorded to produce a verbatim transcript. Interview transcripts were stored, organized, and analyzed using NVivo, a qualitative data analysis software. The software provides document coding and tracking capabilities based on key words and other characteristics.

[9] Burt, M. et al. Los Angeles Congestion Reduction Demonstration (Metro ExpressLanes) Program National Evaluation: Surveys, Interviews, and Workshops Test Plan. Publication Number FHWA-JPO-12-TBD, September 5, 2012.

Table I-3. Stakeholders Interviewed and Workshop Participants

Organization	Number of Participants			
	First Round Stakeholder Interviews	Second Round Stakeholder Interviews	First Round Stakeholder Workshop	Second Round Stakeholder Workshop
Metro	8	6	6	4
Caltrans	3	2	1	2
LADOT	1	1	1	1
CA State Assembly	1	0	0	0
LA World Airport	0	1	1	1
California Highway Patrol	0	1	0	0
FHWA	0	1	1	1
FTA	0	1	0	1
Total	**13**	**13**	**10**	**10**

Source: University of Minnesota.

After each round of interviews, the National Evaluation team convened a workshop where all of the individuals interviewed were invited, as well as other agency representatives. In addition, U.S. DOT personnel managing the LA CRD National Evaluation and other National Evaluation team members were in attendance. Both workshops were held in LA, the first in October 2012 and the second in March 2014.

The purpose of the workshop was to follow-up on the individual interviews by discussing the common themes that emerged and to draw lessons learned. To facilitate discussion during the workshop, the common themes from the interviews were summarized and presented. Workshop participants were encouraged to provide additional comments, including highlighting new points or by clarifying or reinforcing the identified themes and topics presented by the National Evaluation team.

The following are key topics and themes that emerged from the two rounds of interviews and workshops:

- **Understanding your context and maintaining a willingness to compromise is critical to implementing innovative traffic management solutions.** Interviewees were quick to point out that the car culture of LA posed a serious barrier to public acceptance of tolling and transit mode shift. As one interviewee stated, “Well, there’s a lot of challenges…from just acceptance of tolling here in LA. That’s kind of a huge one because LA is the capital of the freeway, emphasis on ‘free’.” In some ways, local political and agency leadership in the region were ahead of the public on tolling acceptance; and therefore, Metro had to figure out how to bring the public up to a level of understanding and acceptance that would satisfy state-level elected officials who were responsible for granting tolling authority. This was achieved, in part, by compromising and not raising the HOV occupancy levels on the ExpressLanes. But maintaining existing HOV occupancy levels presented a unique challenge for the local partners because unlike typical HOV to HOT conversions that harness the extra capacity of underused HOV lanes, in LA these lanes were already operating at or above capacity, leaving the local partners to grapple with finding other ways to create capacity for toll-paying users.

- **Congestion reduction requires a systems approach to moving people, which is a significant paradigm shift for highway operations.** Interviewees recognized there is a synergy to bundling together these separate projects that ends up creating a cleaner strategy for congestion reduction in the region. For example, to encourage mode shift behavior, incentives across modes were created (e.g., carpool loyalty plan, toll credits for transit users). But, bringing these separate projects together under one program requires that the people representing the various agencies involved check their territorial differences at the door. In other words, interviewees agreed that for this strategy to work there could be no modal competition in a multi-modal project. Interviewees commented that as an agency, Metro was recognized as a willing collaborator and as the agency lead for the CRD, Metro fostered and maintained a collaborative approach among the CRD partners. Interviewees also acknowledged how much personalities mattered in their ability to collaborate. Beyond experience and know-how, the personalities of those involved were frequently mentioned as critical to the CRD's success. Interviewees revealed that collaborating was not easy, but the quality of the relationships among the local partners paved the way for successful implementation and deployment of the LA CRD.
- **Implementing innovative traffic management solutions disrupts typical processes and challenges established practices.** Although working together was not new for Metro and Caltrans, the CRD had new elements and unique challenges that necessitated establishing new ways of working together. As lead agency, Metro was in charge of implementing and operating tolling, including procuring a first-ever Design-Build-Operate-Maintain (DBOM) contract, but it had to do this on a Caltrans-owned facility. Interviewees frequently mentioned that this raised issues between the two agencies over ownership and risk of the LA CRD program. This dynamic fostered territorial behaviors between the agencies, but interviewees credited the project management leadership at Metro and frequent communication among the local partners as critical to mitigating the tension. Many interviewees credited the integrated project site during the implementation stage as a mechanism for agency and contractor representatives to communicate and resolve issues on-the-spot. The accelerated timeline also required a different pace, often resulting in doing things out of order or faster than usual. Additionally, interviewees noted that a DBOM contract created a complicated dynamic in which the project owners had to maintain continual involvement with the contractor throughout the process. As one interviewee described it, "We've set up an integrated project office where, basically, any issue that arises during the course of the day, the people are right there, located all together, to resolve it. So it's a very critical component of the success of this project, this integrated project arrangement and the contractor occupies half of the compound. So if there's any issues, you just go across to the contractor trailer offices and resolve it right there."

- **There is no respite between pre- and post-deployment on a tolling project.** At the post-deployment stage of the CRD, interviewees reflected that introducing tolling into a region has actually meant that they are now running a business where customer satisfaction rules. As one interviewee put it, "This will be won or lost on customer satisfaction." Some interviewees expressed apprehension over whether this was an appropriate role for a public agency or if the public sector was even prepared for this kind of role. To facilitate this transition, Metro maintained the same leadership team into the post-deployment phase, never fully turning operations over to the contractor. This was done, in part, as recognition that Metro is now running a business and that control over the customer experience must remain in-house. Interviewees revealed this was a new way for Metro to operate post-deployment and they have begun to institutionalize the practice in new projects.
- **Publicly this is a tolling project, but financially it is a transit project.** One might say that to stand any chance at successfully reducing congestion in urban areas, highway users need a viable alternative to driving alone during peak hours. For the CRD program, transit is one of these viable alternatives; and in the case of the LA CRD, from a budget standpoint, transit was the focus even if the external communications and image of the CRD program emphasized tolling on the ExpressLanes. By investing the majority of the CRD funding into transit improvements—including streamlining routes and dramatically improving the aesthetic and security of the transit lines—and by deploying these investments a year in advance of tolling operations, the local partners were laying the groundwork for a viable alternative to solo driving. By the time tolling was a reality for LA drivers, the transit improvements had already cultivated increased ridership showing that commuters recognized transit as a functional and reliable alternative.
- **Federal funding allowed for local innovation at the cutting edge of technology.** It may seem obvious that the influx of federal grant money served as a catalyst to pursue innovative, high-tech solutions to traffic congestion, but interviewees still acknowledged that without the CRD funding, the imagined solutions of the local partners may have never come to fruition. In the case of the LA Express Park™ project, the City of LA had already been exploring the idea of demand-based parking pricing as a method to better distribute scarce parking in downtown LA, and thereby reduce the traffic congestion caused by cars circulating in search of parking. With this high-tech solution already in mind, when the CRD funding came along, LA Express Park™ was easily integrated into the CRD program's systemwide approach to reducing congestion in the region.
- **Defining success is a complex endeavor.** Interviewees were asked about what they thought constituted success for the LA CRD, but this question only ended up raising additional questions as to who actually owns the success when there may be different motivations and goals behind each local partner's involvement. While success may have multiple definitions, interviewees acknowledged that success is ultimately about the continuation of the CRD program beyond the demonstration period. However, this decision was ultimately in the hands of elected officials (i.e., LA City Council for LA Express Park™, Metro Board for ExpressLanes) who would use the results of the CRD during the demonstration period to inform their decisions. Interviewees recounted the difficulties among the local partners in agreeing on the results of the LA CRD during the pilot period due to difficulties in obtaining accurate counts for calculating person throughput in the corridors. The local partners also

grappled with the tension between how the program has exceeded expectations on the number of transponders sold with the belief that there are now too many carpools in the general purpose lanes that is causing congestion in the general purpose lanes and underuse of the ExpressLanes.

The following are lessons learned shared by interviewees and workshop attendees about their experiences planning, implementing and deploying the LA CRD projects.

- Securing buy-in from middle managers was critical to implementation. Going into the CRD, Metro had secured champions from top-level agency leadership, but their ability to overcome the day-to-day challenges of implementing the CRD rested with staff at the middle management level. Without project champions at this level, delays and barriers were regular issues.
- Implementing tolling on a live facility presented many challenges. Since the ExpressLanes were an HOV conversion, all construction and subsequent system testing had to occur on a facility that was in daily use. Interviewees expressed this as a lesson learned insofar as recommending that others create a realistic project timeline that recognizes that project delays are likely to occur due to the nature of implementing on a live facility.
- Interviewees overwhelmingly agreed that the LA CRD was successful due to strong project management leadership that remained consistent from project beginning to end. For Metro especially, the LA CRD required not just collaboration with external partners, but also a new way of working within the Metro organization. The CRD represents the first time staff remained on the same project from beginning to end and is now being incorporated into future project management.
- The LA CRD partners took a proactive approach to learning as much as possible from other tolling projects across the country. Interviewees explained that by being last to implement among the UPA/CRD sites meant they learned from others' experiences. Interviewees encouraged others to really take the time in the planning stage of a project to adapt and incorporate the lessons learned from other deploying agencies to avoid repeating the same mistakes.

I.6 Public Reaction to the CRD Projects

Metro conducted three different surveys that are valuable for assessing the public reaction to the CRD projects. First, Metro sponsored pre- and post-deployment surveys of motorists using the I-10 and I-110 freeways, including the general-purpose lanes and the HOV/ExpressLanes, as described in Appendix A – Congestion Analysis. Respondents were asked to agree or disagree with positive and negative statements about the ExpressLanes in the post-deployment period. The results indicate general support for the ExpressLanes, with HOV users expressing stronger support. One of the positive statements was "Even if I do not wish to pay to use the ExpressLanes on a regular basis, it is good to have as an option when I need to go somewhere fast." In the 2012 survey, 67 percent of all respondents on the I-10 and I-110 supported this statement. In the 2014 survey, support for this statement was lower at 58 percent. In 2014, response to the statement varied by facility and by HOV users and non-users. On the I-10, 69 percent of all respondents agreed with this statement in 2012, compared with 63 percent in 2014. Agreement was higher, at 81 percent, among HOV users than non-HOV users at 45 percent in 2014. On the I-110, 64 percent of all respondents agreed with the statement in 2012, compared to 53 percent in 2014. Agreement was higher among HOV users in

2014 at 63 percent than for non-HOV users at 43 percent. A second positive statement included in the post-deployment surveys was "The ExpressLanes benefit all motorists by shifting traffic out of the regular lanes into the ExpressLanes when the ExpressLanes are not being fully used." In 2012, 55 percent of all I-10 and I-110 respondents supported this statement. Support was lower at 35 percent for this statement in the 2014 survey. Response to the statement in 2014 varied by facility and among HOV users and non-users. On the I-10, 57 percent of all respondents in 2012 agreed with the statement, compared to 50 percent in 2014. Agreement was higher, at 64 percent, among HOV users than non-users at 35 percent in 2014. On the I-110, 50 percent of all respondents agreed with the statement in 2012, compared to 40 percent in 2014. Support for the statement was higher, at 45 percent, among HOV users, than for non-HOV users at 35 percent in 2014.

Second, Metro also conducted a customer satisfaction survey of existing Metro ExpressLanes FasTrak® account holders in 2013 that is described in more detail in Appendix A – Congestion Analysis. A customer satisfaction survey question asked respondents to rate their overall experience to-date with the ExpressLanes. Most respondents, 86 percent, rated their experience as good or excellent, 11 percent gave an average rating, and 3 percent gave a poor rating. While the general responses were similar across all self-reporting mode, solo drivers had the highest percent of excellent rating and motorcyclists had the lowest. The responses were similar across the two facilities and across the different round trip user groups.

Finally, as reported in Appendix C – Transit Analysis, Metro conducted three Silver Line transit rider surveys. Table I-4 shows the ratings from the three surveys for riders on the I-110 and also whether the change in rating from 2011 to 2013 was statistically significant. The ratings for frequency of service and hours of service both improved and were statistically significant. The rating for frequency of service improved from 2.14 to 1.90, and the rating for hours of service changed from 2.01 to 1.77. This survey finding is very relevant since a large portion of the CRD funds were used to reduce the headways on the I-110 portion of the Silver Line from every 30 minutes to every 10 minutes. The ratings for availability of seats and availability of parking both changed for the worse, and both changes were statistically significant. The rating for availability of seats degraded from 1.92 to 2.47, and the rating for parking availability degraded from 1.76 to 2.00. The drop in rating for these two categories may have been caused by the large increase in ridership on the I-110 portion of the Silver Line. In this case, the Silver Line may be a victim of its own success. Metro has plans to increase service.

Table I-4. I-110 Silver Line Customer Satisfaction Ratings

Service Aspect	2011 Survey	2012 Survey	2013 Survey	Sig Value*
On time performance	1.78	1.70	1.88	0.214
Travel time	1.63	1.64	1.74	0.147
Hours of service	2.01	1.85	1.77	**0.004***
Frequency of service	2.14	1.94	1.90	**0.008***
Wait time at station/stop	2.14	1.99	2.10	0.642
Value of service for the price	2.05	1.87	2.11	0.520
Availability of seats	1.92	2.18	2.47	**0.000***
Parking availability at the Park n Ride lots	1.76	1.96	2.00	**0.005***
Ability to connect with other transit service	1.76	1.75	1.77	0.933
Overall satisfaction with this bus service	1.79	1.77	1.81	0.734

Scale: 1 = Very Good; 2 = Good; 3 = Fair; 4 = Poor; 5 = Very Poor

*Values in bold are statistically significant at the 95 percent confidence level.

An independent sample T test was performed comparing 2011 (baseline) to 2013.

Source: Metro.

Table I-5 shows the ratings given by Silver Line riders on the I-10 portion of the route. Since the 2011 survey was only conducted on the I-110 portion, the results for I-10 are limited to 2012 and 2013. There were slight degradations in ratings for nine of the ten categories although the degradations were statistically significant for only three of the categories (travel time, ability to connect with other services, and overall satisfaction with the bus service). The rating for travel time degraded from 1.52 to 1.76. The rating for ability to connect to other services degraded from 1.64 to 1.84. The rating for overall satisfaction degraded from 1.63 to 1.80. It is important to point out though that the ratings still fall within the category of “Good”.

Table I-5. I-10 Silver Line Customer Satisfaction Ratings

Service Aspect	2012 Survey	2013 Survey	Sig Value*
On time performance	1.61	1.76	0.051
Travel time	1.52	1.76	**0.003***
Hours of service	1.67	1.82	0.076
Frequency of service	1.71	1.82	0.202
Wait time at station/stop	1.89	2.03	0.169
Value of service for the price	1.96	2.07	0.294
Availability of seats	2.33	2.41	0.484
Parking availability at the Park n Ride lots	2.31	2.15	0.148
Ability to connect with other transit service	1.64	1.84	**0.022***
Overall satisfaction with this bus service	1.63	1.80	**0.030***

Scale: 1 = Very Good; 2 = Good; 3 = Fair; 4 = Poor; 5 = Very Poor

*Values in bold are statistically significant at the 95 percent confidence level.

An independent sample T test was performed comparing 2012 and 2013.

Source: Metro.

The Silver Line transit rider survey also asked riders whether they thought the ExpressLanes have improved their travel. In both corridors, 48 percent of the riders agreed to varying extents that tolling the I-110 and I-10 ExpressLanes has improved their travel. Another 34 percent in both corridors were neutral. A smaller though not unsubstantial percentage (19 percent) disagreed to varying extents that tolling the ExpressLanes improved their travel. Whether these 19 percent meant that tolling the ExpressLanes has made no difference or made it worse is unknown.

I.7 Summary of Non-Technical Success Factors

As highlighted in Table I-6, people, process, multi-organizational structures, the media, and competencies all played supporting roles in the implementation, deployment, and operations of the LA CRD projects. The multi-organizational structure, with its specific roles and responsibilities supported the implementation, deployment, and operations of the CRD projects. A team of competent staff were able to lead the region through the implementation of a technologically complex project, albeit with some delays. While tolling is not new to California, converting HOV to HOT lanes was a first of its kind in LA County. The CRD program had already earned the support of local elected officials and local agency leadership as an appropriate strategy for the region, but it posed a challenge to the local partners in garnering public acceptance within a region famous for its car culture and severe traffic congestion. Along with significant transit improvements to the corridor, an extensive outreach and communications plan aided the local partners’ ability to inform the public and cultivate users. The successful deployment of electronic tolling on the I-10 and I-110 has led to additional plans for tolling on other critical corridors in the region. Public reaction to the CRD projects has been generally positive.

Table I-6. Non-Technical Success Factors

Hypotheses/Questions	Results	Evidence
What role did factors related to these five areas play in the success of the deployment?		
1. <u>People</u> Sponsors, champions, policy entrepreneurs, neutral conveners, legislators	1. Effective	1. Strong political and agency leadership champions from outset. Executed a comprehensive outreach and communications campaign to garner public acceptance. Agency staff held technical expertise and project management skills needed to successfully implement the projects. Staff held their colleagues in high regard.
2. <u>Process</u> Forums (including stakeholder outreach), meetings, alignment of policy ideas with favorable politics and agreement on nature of the problem), legislative and Congressional engagements	2. Adequate	2. Some project delays occurred, including revising original project timeline, but were necessary for the successful deployment of electronic tolling.
3. <u>Structures</u> Networks, connections and partnerships, concentration of power & decision making authority, conflict mgt. mechanisms, communications strategies, supportive rules and procedures	3. Effective	3. As lead agency, Metro maintained a collaborative environment, conducting regular check-ins with all local partners and establishing an integrated project site during tolling implementation.
4. <u>Media</u> Media coverage, public education	4. Effective	4. Media kept the projects in the public eye and coverage tended to lean more neutral or positive, tempering negative opinions with detailed descriptions of the potential benefits to the overall system.
5. <u>Competencies</u> Cutting across the preceding areas: persuasion, getting grants, doing research, technical/technological competencies; ability to be policy entrepreneurs; knowing how to use markets	5. Effective	5. Agency staff held technical expertise and project management skills needed to successfully implement the projects. Staff held their colleagues in high regard.
Does the public support the CRD strategies as effective and appropriate ways to reduce congestion?	Mostly supported	Survey results general support for the ExpressLanes among I-110 and I-10 motorists, with HOV users expressing stronger support. Among FasTrak® account holders, 86 percent rated their experience as good or excellent. In both corridors, 48 percent of Silver Line riders agreed that tolling the I-110 and I-10 ExpressLanes improved their travel while 34 percent in both corridors were neutral.

Source: University of Minnesota.

Appendix J. Benefit Cost Analysis

The purpose of the benefit cost analysis (BCA) was to quantify and monetize the societal benefits and costs of implementing the Los Angeles (LA) Congestion Reduction Demonstration (CRD) projects. The net benefit from the CRD projects, which was the difference between the total benefits and the total costs, indicated the net societal benefit of this public investment. As presented in Table J-1, the BCA focused on quantifying the overall benefits, costs, and net benefits from the LA CRD projects. The term cost benefit analysis (CBA) was used in the LA CRD test plan. The use of BCA has become the commonly accepted term in the transportation community and was used in this appendix.

Table J-1. Question for the BCA

Question
What are the overall benefits, costs, and net benefits from the Los Angeles CRD projects?

Source: Battelle.

The timeframe used for the BCA encompasses the planning, implementation, and ten years of post-deployment operation. This approach included all costs of the LA CRD projects focusing on the I-110 and I-10 ExpressLanes, transit improvements, ridesharing, and travel demand management (TDM) strategies from the planning stages to 10-years post-implementation and all benefits of the projects for a 10-year period after implementation. Within this evaluation time frame, the BCA estimated and compared the total benefits and costs between two scenarios – with and without the implementation of the LA CRD projects.

The LA Express Park™ project in downtown LA was not included in the BCA due to lack of data on the benefits from the project. Three other projects – the Patsaouras Plaza connector, the Pomona Metrolink Station improvements, and the transit signal prioritization in downtown LA – were also not included in the BCA as they were not associated with the ExpressLanes and no data were collected to evaluate them. In addition, since the Adams Flyover was not constructed, it was not included in the analysis.

The remainder of this appendix includes four sections. The LA CRD projects included in the BCA along with the data sources used in the BCA are presented in Section J.1. Cost information on the LA CRD projects included iYesn the BCA is presented in Section J.2. The estimation of benefits from the projects is described in Section J.3. The appendix concludes with a summary of the analysis in Section J.4.

J.1 Los Angeles CRD Projects and Data Sources

The LA CRD projects focused on reducing traffic congestion on the I-110 and I-10 through converting the existing high-occupancy vehicle (HOV) lanes to high-occupancy toll (HOT) lanes, increasing transit service, and promoting ridesharing. A second focus was on implementing market-based parking pricing in downtown LA. The LA CRD projects included in the BCA are described in this section. The projects not included in the BCA are also noted.

The ExpressLanes on the I-110 and I-10, which were implemented by converting the existing HOV lanes to HOT lanes, were included in the BCA. The Adams flyover was not included since it was not completed. The transit improvements included in the BCA were increased frequency of Metro bus rapid transit service through the acquisition of 59 new clean fuel buses (30 buses in the I-10 El Monte Busway corridor and 29 buses in the I-110 Harbor Transitway corridor) and increased service along the I-110 and I-10 corridors. Various security upgrades were made to the Harbor Gateway Transit Center and bicycle lockers were added. The El Monte Transit Center was expanded, doubling its size to accommodate additional high capacity buses, passenger parking, and a bicycle station. Improvements were made to the Harbor Transitway Park-and-Ride lots and Transit Stations to enhance signage, lighting, and security. The 37th Street Station was fitted with translucent and architectural sound attenuation panels to reduce noise levels for waiting customers on the Harbor Transitway.

Ridesharing and TDM strategies were promoted to maintain existing carpools, develop new carpools, and increase the number of registered vanpools. Promotional methods included subsidies to travelers and vanpool operators and promotional outreach to major employers. In addition, a Metro ExpressLanes Carpool Loyalty Program was developed and implemented.

Transit projects not included in the BCA were the Pomona Metrolink Station improvements, the transit signal priority on Figueroa Street and Flower Street in downtown LA, and the Patsaouras Transit Plaza in the downtown area. These projects did not impact use of the ExpressLanes and were not examined in the national evaluation.

The LA Express Park™ project was not included in the BCA due to the lack of data on the benefits. LA Express Park™ is an integrated parking management system that relies on state-of-the-art parking sensors, new parking meters, parking guidance technologies, and advanced analytical capabilities to implement market-based parking pricing in downtown LA. The project covers a 4.5 square mile area in downtown LA and includes 6,300 on-street metered parking spaces and 7,700 off-street parking spaces in nine city-owned facilities.

Data on the capital, operation, and maintenance costs of the projects listed above were obtained from Metro, the City of LA, the City of Pomona and the LA Department of Transportation (LADOT). Tolling began November 10, 2012 on the I-110 and on February 23, 2013 on the I-10. Most of the transit related projects were completed prior to that time. Therefore, the BCA uses January 1, 2013 as the start of the 10-year timeframe for estimation of benefits. To convert any future year costs to year 2013 dollars,[1] a real discount rate of 7 percent per year was used based on federal guidance.[2] Information on 10-year projections of benefits in travel-time savings were obtained by empirical measurement of travel time (see Appendix A – Congestion Analysis for motor vehicle travel time and Appendix C –

[1] This BCA uses January 1, 2013 as the start of the 10-year timeframe for estimation of benefits.

[2] Office of Management and Budget guidance (http://www.whitehouse.gov/omb/assets/a94/a094.pdf (page 9)) and current FHWA guidance (Federal Register, Vol. 75, No. 104, p. 30476)).

Transit Analysis for transit travel time). Emissions reductions were obtained from analysis of observed travel volumes and speed, and were calculated as shown in Appendix H – Environmental Analysis. Appendix H also includes the calculations of the changes in vehicle operating costs through changes in fuel usage.

It is important to note the deficiencies in this BCA that result from a lack of comprehensive data available to conduct a more thorough analysis. First, this evaluation assumes that changes observed on the I-10 and I-110 were due to the CRD projects. While other methods, such as an urban planning model which hold exogenous factors constant, would have been preferable to measure impacts of the LA CRD projects, this was not feasible for various reasons. Additionally, no suitable control corridors were identified for LA to compare changes observed on the I-10 and I-110 with changes observed regionally. Therefore, changes on the I-10 and I-110 were measured and assumed to be attributed to the LA CRD projects – with the caveat that exogenous factors, such as a decreasing unemployment rate could have and likely did cause some of these changes. Additionally, data were not collected on arterials, which limits the understanding of VMT increases on the ExpressLanes corridors that may be due to latent demand. Finally, as discussed earlier, both Metro and Caltrans noted variances in the observed occupancy discussed in the congestion analysis and the self-declared occupancy from the transponder setting toll data. These differences, which focus on self-declared transponder settings indicating higher use levels than the visual occupancy data, continue to be examined in more detail by the agencies. While a number of assumptions made for this BCA are imperfect and likely undervalue the benefits of the ExpressLanes, this analysis was conducted in accordance with the methodology employed for all UPA/CRD sites, and detailed in the *Los Angeles Congestion Reduction Demonstration (Metro ExpressLanes) Program National Evaluation: Cost Benefit Analysis Test Plan* using the best data and information available.

J.2 LA CRD Projects – Costs

Table J-2 presents the planning, design, acquisition, and construction costs for the projects included in the BCA. The costs are provided in 2013 dollars.[3] Most costs are directly from the quarterly progress reports prepared by LA Metro.

Table J-2. Los Angeles CRD Project Planning, Design, Acquisition, and Construction Costs

CRD Project Component	Planning, Design, Acquisition, and Construction Costs (2013 dollars)
Transit Facility Improvements	
El Monte Transit Center Expansion (CP 202286*)	$12,896,746
Harbor Transitway Improvements (SP 202287)	$3,838,355
Bike Lockers (CP 210115)	$101,012
New Buses	
41 buses for El Monte and Harbor Transitway Corridors (CP 201059)	$27,214,617
12 buses for Foothill Transit	$7,500,000
4 buses for Torrance Transit	$2,800,000
2 buses for Gardena Municipal Bus Lines	$1,200,000
Carpooling and Ridesharing	$400,000
I-110 and I-10 HOT Lanes (CP 210120)	$106,762,152
TOTAL	**$162,712,882**

Source: Texas A&M Transportation Institute.

* Note: these costs are directly from the *March 2014 Quarterly Project Status Report on the ExpressLanes* by Metro. The project numbers in parentheses refer to numbers in that report.

[3] The cost of the El Monte Transit Center Expansion was adjusted to reflect the distribution of use of that facility. All travelers using the El Monte Transit Center benefit from its expansion, but this BCA only examines the benefits that accrued to travelers on the I-10 and I-110 ExpressLanes. Therefore, only a portion of the costs of the expansion were included in this BCA. An average of 1790 buses use this transit center daily and 384 of those use the ExpressLanes (21.5 percent). Therefore, only 21.5 percent of the transit center's costs are included.

As outlined in the LA CRD National Evaluation Plan[4], a 10-year post-deployment timeframe was used for the BCA since many aspects of the projects were technology- or pricing-related. Both technology and pricing systems have relatively short life spans. Thus, only expenditures prior to December 31, 2022 incurred as a result of implementing the CRD projects were considered. In addition, only the marginal costs associated with the CRD projects were included in the cost data to the extent possible, e.g., the additional cost of a HOT lane versus the cost of an HOV lane. Note that the I-110 and I-10 HOT lanes costs listed above include total costs of equipment, as well as pavement and restriping (the individual costs were not available). This full amount is included because it would not have been spent if the HOV lanes had not been converted to HOT lanes. The BCA timeframe began with the first expenses incurred and ends in December 2022, after 10 years of operations. The LA CRD projects with useful lives longer than 10 years, such as new buses and the ExpressLanes, were accounted for by reducing the cost of that item by their salvage value in year 10.

Operating and maintaining the projects over the BCA timeframe of 10 years requires additional funding. To address costs incurred in years after 2013, those costs were adjusted to a common year using a discount rate of 7 percent. Therefore, determining the costs of the CRD projects was more difficult than simply assuming that the costs total $210 million. The information in Table J-3 and the narrative below provide details on the cost estimate of the LA CRD projects in 2013 dollars for the purpose of the BCA. Note that the operation and maintenance costs for the transit facilities (primarily El Monte) were adjusted to reflect the portion of El Monte transit users who use the ExpressLanes (21.5 percent).

Table J-3. Los Angeles CRD Project Operation, Maintenance and Reinvestment Costs

CRD Project Component	Operation, Maintenance and Reinvestment Costs (2013 dollars)
Transit Facilities	
METRO	$364,693 (to date) + $2,740,751 (future)
City of Pomona	unknown
New Buses (Metro, Foothill, Torrance, and Gardena Municipal Bus Lines)	$19,567,046 (to date) + $43,813,804 (future)
I-110 and I-10 HOT Lanes	$4,400,000 (to date) + $80,000,000 (future)
TOTAL	**$150,886,293**

Source: Texas A&M Transportation Institute.

In January of 2023 some of the items listed above will still have value, which is known as salvage value. The salvage value will be subtracted from the total cost above ($162,712,882) to determine the net cost over the 10 year BCA timeframe. For the physical infrastructure (I-110 and I-10 HOT lanes) Minnesota's BCA guidance[5] provided the following formula to obtain the salvage value:

[4] LA CRD National Evaluation Plan, FHWA-JPO, January 13, 2010. Available at https://www.metroexpresslanes.net/en/about/performance-measures-national-evaluation-plan.pdf

[5] Minnesota Department of Transportation, "Benefit-Cost Analysis for Transportation Projects," available at http://www.dot.state.mn.us/planning/program/benefitcost.html. Accessed July 12, 2012.

$$\text{Salvage Value} = \frac{(1+r)^n \times \left[\left(\frac{(1+r)^L - 1}{r(1+r)^L}\right) - \left(\frac{(1+r)^n - 1}{r(1+r)^n}\right)\right]}{\left(\frac{(1+r)^L - 1}{r(1+r)^L}\right)}$$

Where r = the discount rate (0.07)

n = number of years in the analysis period (10)

L = useful life of the asset

This same guidance suggests the useful life of surface (pavement) is 25 years, sub-base and base are 40 years, and major structures such as a park and ride garage have a useful life of 60 years. For the HOT lanes, a conservative (low end) life of 25 years was chosen, since the available value for costs also included some equipment costs. The same lifespan was selected for the improvements at the transit facilities. The salvage value percentage after 10 years of something with a 25 year life was:

$$\text{Salvage Value} = \frac{(1+0.07)^{10} \times \left[\left(\frac{(1+0.07)^{25} - 1}{0.07 \times (1+0.07)^{25}}\right) - \left(\frac{(1+0.07)^{10} - 1}{0.07 \times (1+0.07)^{10}}\right)\right]}{\left(\frac{(1+0.07)^{25} - 1}{0.07 \times (1+0.07)^{25}}\right)} = \frac{1.97 \times (11.65 - 7.02)}{11.65} = 0.782 = 78.2\%$$

The salvage value of the HOT lanes was 78.2 percent of the initial cost of the I-110 and I-10 ExpressLanes. This amounts to a salvage value of $83,440,474. Similarly, the salvage value of the transit facility improvements is 78.2 percent of their initial cost. This amounts to a salvage value of $13,158,345.

In addition, the new buses purchased for the project will have some value at the end of the evaluation period. The buses were assumed to have a useful life of 12 years. Using the equation above, salvage value at the end of year 10 for the buses will be 22.8 percent of their original purchase price. This amounts to $8,812,728.

Therefore, the resulting 10-year costs from the LA CRD projects were $162,712,882 + $150,886,293 - $83,440,474 - $13,158,345 - $8,812,728 = $208,187,629.

J.3 Los Angeles CRD Projects – Benefits

The benefits of the LA CRD projects were similar to benefits from many transportation infrastructure projects and the calculation methodology followed standard practice as provided by the Transportation Research Board (TRB) committee on transportation economics[6] and the Federal Highway Administration (FHWA).[7] This section highlights how the benefits were calculated for the CRD projects.

[6] http://bca.transportationeconomics.org/

[7] Federal Highway Administration, TIGER BCA Resource Guide, http://www.dot.gov/sites/dot.dev/files/docs/USDOT%20BCA%20Guidance.pdf

The preferred option to estimate the impacts, and therefore benefits, of the CRD projects was to use Metro's Travel Forecasting Model. Unfortunately, the model was unable to estimate the impacts of the LA CRD projects. Therefore, this analysis relies on empirical data collected in LA by the local partners and through the California Department of Transportation (Caltrans). This includes changes in travel times and vehicle occupancies (Appendix A – Congestion Analysis), transit travel times (Appendix C – Transit Analysis), and emissions and vehicle operating costs (Appendix H – Environmental Analysis). All of these changes were measured in the year before and after the implementation of the projects and those results were assumed to remain constant over the 10-year timeframe of the BCA. Benefits (or costs) associated with a change in the number of crashes due to the CRD projects are not included.

J.3.1 Benefits – Travel Time Savings

For most transportation projects the largest societal benefits are a result of the travel time savings gained through reduced congestion. The travel time savings from the LA CRD were measured in the field during the evaluation period. The data were developed from roadway sensors and travel time runs. Additional details regarding the data are available in Appendix A – Congestion Analysis.

The amount of time saved by travelers was converted to monetary benefits based on FHWA guidance[8] and local values of time[9] (see Table J-4). The local values of time were developed from a traveler survey of I-110 and I-10 travelers in 2009. The value of time for each vehicle in the year 2009 ranged from $6.50 per hour for non-work travel by low income individuals to $14.00 per hour for work travel for high income individuals. The value of time increased as the number of travelers per vehicle and their household income increased, except work trips, where no difference was found for increasing occupancy. The following data was taken from a survey of I-110 and I-10 travelers, and was used to develop an average value of time for this BCA:

- 55 percent of trips were work related travel, 45 percent non-work.
- The distribution of travelers in each household income category was as follows:
  - 32.4 percent low income ($0 to $50,000)
  - 26.5 percent medium income ($50,001 to $95,000)
  - 23.2 percent medium-high income ($95,001 to $125,000)
  - 17.9 percent high income (over $125,000).

For the general purpose lanes it was necessary to estimate the percentage of single-occupant vehicles (SOVs) and carpools. Based on vehicle occupancy counts it was assumed the traffic stream consisted of 88 percent SOV, 10 percent HOV2+, 2 percent HOV3+. These values yield an average vehicle occupancy (AVO) very similar to empirical data from vehicle occupancy counts. This resulted in a value of time for the general purpose lanes of $9.22 per hour. As noted in Appendix A-Congestion Analysis, occupancy counts were conducted on only one or two days during the pre- and post-deployment periods. These limited observations need to be taken into consideration when reviewing these findings, as they may not reflect typical patterns in the corridor.

[8] Federal Highway Administration, http://ostpxweb.dot.gov/policy/reports/vot_guidance_092811c.pdf, Table 4

[9] Parsons Brinckerhoff, Congestion Pricing Operating Plan for Los Angeles County: Stated Preference Survey Design and Analysis. Los Angeles County Metropolitan Transportation Authority, 2010. Table 3-10.

Table J-4. Local Values of Time

Group	Income Level	Value of Time ($/Hour)	
		Work Trips	Non-Work
SOV	Low	9.2	6.5
	Medium	9.2	7.9
	Upper Middle	10.1	8.6
	High	14	9.2
HOV2+	Low	9.2	7.1
	Medium	9.2	8.7
	Upper Middle	10.1	9.5
	High	14	10.2
HOV3+	Low	9.2	7.8
	Medium	9.2	9.5
	Upper Middle	10.1	10.4
	High	14	11.2

Source: Parsons Brinckerhoff (8).

The value of time in the HOV/ExpressLanes was broken into a SOV value of time and an HOV value of time since data on the number of HOVs and SOVs were available. Otherwise, the HOV lanes had the same distribution of travelers across trip purpose and household incomes. The resulting values of time were $9.17 per hour for SOVs and $9.57 per hour for HOVs.

These values of time were adjusted to 2013 based on the changes in the average household income in LA.[10] Note that 2013 data were not available and so household income for 2013 was assumed to be the same as in 2012. Between 2009 and 2012 (assuming 2013 is the same as 2012) median household incomes declined by 8.6 percent ($62,650 to $57,271) in this area. Therefore, the 2013 values of time were 8.6 percent lower than those 2009 values shown above. The 2013 values of time were therefore $8.43/hour for all general purpose lane vehicles, $8.39/hour for SOVs in the ExpressLanes and $8.75/hour for HOVs in the ExpressLanes. The 2013 values were adjusted for future values of time by increasing them by 1.6 percent per year for expected increases in incomes (prior to applying the discount rate) as outlined in the FHWA value of time guidance document.[11]

Travel times on the I-110 and I-10 freeways, in both the general purpose lanes and ExpressLanes, for pre- and post-deployment periods of the LA CRD projects, were obtained from Appendix A – Congestion Analysis. These values are summarized in Table J-5 and Table J-6.

[10] http://www.deptofnumbers.com/income/california/los-angeles/

[11] Federal Highway Administration, http://ostpxweb.dot.gov/policy/reports/vot_guidance_092811c.pdf.

Table J-5. Travel Times on the I-10

Direction of Travel	Time of Day	General Purpose Lanes		ExpressLanes	
		Before CRD Projects	With CRD Projects*	Before CRD Projects	With CRD Projects*
Westbound	5:30 a.m.	14.0	17.9	12.9	12.9
	6:00 a.m.	18.9	28.8	13.8	13.6
	6:30 a.m.	27.4	36.1	14.5	14.0
	7:00 a.m.	36.0	38.9	17.0	14.6
	7:30 a.m.	39.9	41.3	21.3	16.3
	8:00 a.m.	40.6	39.7	15.7	17.6
	8:30 a.m.	36.7	33.4	15.9	16.0
Eastbound	3:00 p.m.	29.2	24.1	18.2	14.0
	3:30 p.m.	31.7	27.1	19.4	15.9
	4:00 p.m.	31.3	26.6	19.9	14.8
	4:30 p.m.	33.4	26.6	19.5	14.8
	5:00 p.m.	33.9	29.3	17.7	15.9
	5:30 p.m.	31.7	30.5	16.9	15.2
	6:00 p.m.	29.0	24.6	17.0	14.6
	6:30 p.m.	23.0	22.1	16.4	14.1

*Travel time data collected in January and February 2014, following completion of the adjacent construction project.

Source: Texas A&M Transportation Institute.

Table J-6. Travel Times on the I-110

Direction of Travel	Time of Day	General Purpose Lanes		ExpressLanes	
		Before CRD Projects	With CRD Projects	Before CRD Projects	With CRD Projects
Northbound	5:30 a.m.	11.0	12.5	10.2	10.5
	6:00 a.m.	18.1	19.9	10.4	10.4
	6:30 a.m.	27.9	24.9	12.2	11.3
	7:00 a.m.	37.8	34.1	13.6	14.4
	7:30 a.m.	36.2	34.8	15.3	20.6
	8:00 a.m.	33.0	32.6	12.9	15.9
	8:30 a.m.	27.8	28.4	11.4	16.1
Southbound	3:00 p.m.	15.4	17.7	10.3	10.1
	3:30 p.m.	16.7	18.4	10.3	10.1
	4:00 p.m.	17.9	18.9	10.5	10.2
	4:30 p.m.	19.8	20.2	10.6	10.5
	5:00 p.m.	19.1	22.0	10.9	11.1
	5:30 p.m.	19.6	21.8	11.2	11.1
	6:00 p.m.	20.1	22.2	11.5	11.3
	6:30 p.m.	19.6	20.2	10.7	10.8

Source: Texas A&M Transportation Institute.

Next, the number of vehicles using the general purpose lanes and ExpressLanes were obtained from the occupancy counts, also included in Appendix A – Congestion Analysis. These occupancy counts were taken in multiple locations at multiple points in time. To develop an average value for each freeway, the counts below were averaged. The resulting number of vehicles is shown in Table J-7 and Table J-8.

Traffic Counts:

- I-10
  - In both the Eastbound and Westbound directions
    - Pre-Deployment
      - Average of 5/17/2012 count at Jackson plus 5/22/2012 count at Warwick
    - Post-Deployment
      - Average of 3/4/2014 and 3/6/2014 counts at Jackson plus 3/19/2014 count at Warwick

- I-110
  - Northbound
    - Pre-Deployment
      - Average of 5/16/2012 and 6/28/2012 counts at Slauson. Then take that result and average it with 5/23/2012 count at Adams.
    - Post-Deployment
      - Average of 2/27/2013 and 6/5/2013 counts at Adams. Average of 2/26/2013 and 5/1/2013 and 10/8/2013 counts at Slauson. Then take the average of those two results.
  - Southbound
    - Pre-Deployment
      - Average of 5/16/2012 and 6/28/2012 counts at Slauson.
    - Post-Deployment
      - Average of 2/26/2013 and 5/1/2013 and 10/8/2013 counts at Slauson.

Table J-7. Number of Vehicles on the I-10

Direction	Time of Day	General Purpose Lanes		ExpressLanes			
		Existing Vehicles (Pre-Deployment)	New Vehicles (change Post versus Pre-Deployment)	Existing SOVs	Existing HOVs	New SOVs in 2014	New HOVs in 2014
Eastbound	3:00 – 3:30 p.m.			24	348	2	219
	3:30 – 4:00 p.m.			24	348	2	219
	4:00 – 4:30 p.m.						
	4:30 – 5:00 p.m.	3235	207	64	307	-34	216
	5:00 – 5:30 p.m.	3235	207	64	307	-34	216
	5:30 – 6:00 p.m.						
	6:00 – 6:30 p.m.						
Westbound	6:30 – 7:00 a.m.	2018	350	122	431	1036	-362
	7:00 – 7:30 a.m.	3018	-280	97	456	936	-375
	7:30 – 8:00 a.m.	3018	-280	97	456	936	-375
	8:00 – 8:30 a.m.	2018	350	122	431	1036	-362

Source: Texas A&M Transportation Institute.

Table J-8. Number of Vehicles on the I-110

Direction	Time of Day	General Purpose Lanes		ExpressLanes			
		Existing Vehicles (Pre-Deployment)	New Vehicles (change Post versus Pre-Deployment)	Existing SOVs	Existing HOVs	New SOVs	New HOVs
Southbound	3:30 – 4:00 p.m.			70	1101	821	-612
	4:00 – 4:30 p.m.			70	1101	821	-612
	4:30 – 5:00 p.m.	3045	308	74	1205	747	-744
	5:00 – 5:30 p.m.	3045	308	74	1205	747	-744
Northbound	6:30 – 7:00 a.m.			36	729	692	-437
	7:00 – 7:30 a.m.	3343	-95	37	785	698	-449
	7:30 – 8:00 a.m.	3343	-95	37	785	698	-449
	8:00 – 8:30 a.m.	3343	-95	36	729	692	-437

Source: Texas A&M Transportation Institute.

From Table J-9 and Table J-10 it is clear that not all of the peak period traffic is accounted for in this analysis. Only the vehicles shown in the above tables were used in the value of travel time savings. Therefore, it is likely that these results underestimate the total travel time savings. The 'existing vehicles' are assumed to experience the change in travel time (pre- versus post-deployment) on that lane at that time of day. For a positive number of 'new vehicles', these vehicles are assumed to experience an average of one-half the travel time savings when there are travel time savings. This assumes that these new vehicles are coming from alternatives that ranged from being much slower to being almost as fast as the pre-deployment conditions. When travel time increased on the lanes, the new vehicles were assumed to have 0 travel time benefits. Also, when there was a decrease in HOVs on the ExpressLanes combined with an increase in SOVs on that lane it was assumed the new SOVs were originally HOVs on the HOV lane.

Given all of the above, the travel time benefits for the I-10 were $5,981 per day and for the I-110 were -$481 per day. The negative values on the I-110 stem from increases in peak period travel times on the general purpose lanes and little change in travel times on the ExpressLanes. Assuming 250 days per year that the lanes offer these travel time benefits we find a total travel time benefit in 2013 of $1,374,933 in year 2013 dollars. Adjusting that up by 1.6 percent per year for increases in income, and then assuming a discount rate of 7 percent to adjust future dollars to the year 2013, we obtain a total benefit from travel time savings of $11,012,083 (see Table J-8).

Table J-9. LA CRD Automobile Travel Time Benefits

Year	I-10	I-110	TOTAL	TOTAL (2013 dollars)
2013	$1,495,274	-$120,342	$1,374,933	$1,374,933
2014	$1,519,199	-$122,267	$1,396,932	$1,305,543
2015	$1,543,506	-$124,223	$1,419,282	$1,239,656
2016	$1,568,202	-$126,211	$1,441,991	$1,177,094
2017	$1,593,293	-$128,230	$1,465,063	$1,117,689
2018	$1,618,786	-$130,282	$1,488,504	$1,061,283
2019	$1,644,686	-$132,367	$1,512,320	$1,007,723
2020	$1,671,001	-$134,484	$1,536,517	$956,866
2021	$1,697,737	-$136,636	$1,561,101	$908,575
2022	$1,724,901	-$138,822	$1,586,079	$862,722
TOTALS				**$11,012,083**

Source: Texas A&M Transportation Institute.

Next, the value of travel time saved by transit riders on ExpressLanes was estimated. First, the value of time for a transit rider was estimated in a similar manner to that of an automobile driver using data from the same stated preference survey[8] used to determine automobile driver's values of time. For transit riders, the values of time were not calculated in the Parsons Brinkerhoff report. Therefore, the process to calculate those values is briefly outlined here.

Table 3-9 in the Stated Preference Survey Design and Analysis report[8] contains the coefficients of a logit model built to estimate the mode choice of travelers. These coefficients indicate the relative values travelers place on travel attributes such as their travel time, toll cost and bus fare. Comparing the value travelers place on their time versus a toll or bus fare allows us to estimate their value of time. In the case of a low-income transit traveler on a work trip, their coefficient of travel time was -0.0948 per minute and the coefficient for bus fare was -0.00556 per cent. Dividing the coefficient of travel time by the coefficient of bus fare, and adjusting to dollars per hour, yields a value of time of $10.23/hour. The survey also had different coefficients for non-work travel and an adjustment factor for higher income individuals. Using these data, the values of time for transit travelers were calculated (see Table J-10).

Table J-10. Values of Time for Transit Travelers

Household Income	Trip Purpose	
	Work	Non-Work
Low (< $50,000/year)	$10.23/hr	$3.70/hr
Medium ($50,000/year to $95,000/year)	$10.23/hr	$3.70/hr
Upper-Middle ($95,000/year to $125,000/year)	$11.22/hr	$4.06/hr
High(>$125,000/year)	$15.46/hr	$4.33/hr

Source: Texas A&M Transportation Institute.

The percentage of transit travelers belonging to each category in Table J-9 was needed prior to determining a value of time applicable to all riders. For consistency, the same data used for automobile travelers were used for transit riders. Using these assumptions the transit rider value of time was $8.02/hour in 2009. Adjusting this to a 2013 value required it to be reduced by 8.6 percent due to the declining household incomes. Thus, the 2013 value of time for transit riders was $7.33 per hour.

Next, the travel time for the buses on the I-110 and I-10, both pre-deployment and post-deployment, was obtained from Metro using data from the Silver Line and Silver Streak buses. Metro measures the travel time of the Silver Line and Silver Streak buses using automated vehicle location (AVL) systems. The average weekday, peak period, travel times were used for this analysis. These values are reproduced here in Table J-11. The travel times for the I-10 were based on average travel times from January and February 2012 for pre-deployment and from January and February 2014 for post-deployment. The travel times for the I-110 were based on average travel times from March 2012 to February 2013 for pre-deployment and from March 2013 to February 2014 for post-deployment. The two timeframes differ due to the adjacent construction impacting traffic on the I-10 during 2013. Next, it was necessary to determine the average number of riders on the bus routes during these times of days for the same periods. These were calculated using data supplied by Metro and are shown in Table J-10. Note that AM and PM peak period ridership was not available for lines 485 and 487/489 so ridership in both peak time periods were assumed to be 20 percent of total daily ridership based on other routes. In several cases, data was only available for the total number of daily riders, but the routes only ran during peak hours. In those cases it was assumed that 50 percent of total daily riders were in the AM peak period and 50 percent in the PM peak period.

Table J-11. Travel Times and Ridership for Buses on the ExpressLanes

Bus Route	Time of Day and Direction	Travel Time (min)		Average Daily Ridership During Selected Peak Period	
		Pre-Deployment	Post-Deployment	Pre-Deployment	Post-Deployment
I-110 Silver Line	AM Peak (Northbound)	14.0	14.8	912	1161
I-110 Silver Line	PM Peak (Southbound)	12.5	12.4	969	1195
450	AM Peak	As above for the Silver Line		351	352
450	PM Peak	“		429	477
550	AM Peak	“		202	172
550	PM Peak	“		228	221
Gardena	AM Peak	“		255	255
Gardena	PM Peak	“		371	353
Torrance	AM Peak	“		687	915
Torrance	PM Peak	“		767	1036
Dodger Express	AM Peak	“		0	0
Dodger Express	PM Peak	“		167	188
448	AM Peak	“		277	254
448	PM Peak	“		277	254
438*	AM Peak	8.4	8.9	362	404
438*	PM Peak	7.5	7.4	362	404
I-10 Silver Line	AM Peak (Westbound)	17.3	17.2	1560	1657
I-10 Silver Line	PM Peak (Eastbound)	18.3	15.4	1601	1665
I-10 Silver Streak	AM Peak (Westbound)	22.5	18.0	388	806
I-10 Silver Streak	PM Peak (Eastbound)	24.0	17.5	687	844
485	AM Peak	As above for the Silver Streak		312	311
485	PM Peak	“		312	311
FH 481	AM Peak	“		140	126
FH 481	PM Peak	“		140	126
FH 493	AM Peak	“		371	363
FH 493	PM Peak	“		371	363
FH 497	AM Peak	“		212	234
FH 497	PM Peak	“		212	234
FH 498	AM Peak	“		513	491

Table J-11. Travel Times and Ridership for Buses on the ExpressLanes (Continued)

Bus Route	Time of Day and Direction	Travel Time (min)		Average Daily Ridership During Selected Peak Period	
		Pre-Deployment	Post-Deployment	Pre-Deployment	Post-Deployment
FH 498	PM Peak	“		513	491
FH 499	AM Peak	“		337	333
FH 499	PM Peak	“		333	333
FH 699**	AM Peak	11.25	9.0	474	394
FH 699**	PM Peak	12.0	8.75	306	401
487/489**	AM Peak	11.25	9.0	799	789
487/489**	PM Peak	12.0	8.75	799	789

Source: Texas A&M Transportation Institute. * Used 60% of the travel time for the I-110 Silver Line since these buses run only on 60% of I-110 ExpressLanes ** Used 50% of the travel time for the I-10 Silver Streak since these buses run only on half of I-10 Express lanes. FH = Foothill Transit

As with travel time savings for motor vehicles, it was assumed that the existing (pre-deployment) transit riders experience the full benefits (or costs) from the reduced (or increased) travel times. New transit riders (the increase in ridership post-deployment) benefit half as much. These benefits were assumed to occur a total of 250 days per year. In the case where ridership increased along with travel times, it was assumed that the new transit riders experienced no change in travel time from their previous route / mode. Using these assumptions, and the data from Table J-10, transit riders experienced a savings of 626 person-hours per day. This equates to 156,539 person-hours per year or a value of time of $1,146,943 in 2013. Over a ten year period, including a 1.6 percent annual increase in value of time and a 7 percent discount rate, this equates to a travel time benefit of $9,186,074 over the 10-year life of the BCA.

There were no data on the travel time saved by trucks (if any) so the total for automobile drivers plus transit riders calculated above was the total used for the CRD projects. This total is $11,012,083 + $9,186,074= $20,198,158.

J.3.2 Benefits – Emissions

The shift in vehicles between the different lanes, plus shifts of travelers between modes has the potential to change the amount of emissions from vehicles. These emissions are harmful to humans and the environment and as such, a reduction or increase in emissions would result in a societal benefits or costs. The change in emissions due to the LA CRD projects was calculated in Appendix H – Environmental Analysis. These included only changes during the peak hours of travel, as listed in Table J-12, during work days (assumed to be 250 per year) for both the general purpose lanes and ExpressLanes. The changes in emissions were derived from actual travel speeds and volumes observed along the I-110 and I-10 corridor in both the general purpose lanes and ExpressLanes. Changes in emissions due to the CRD projects during other days and times would be negligible.

Note that the values shown here, in Table J-12, are slightly different from those found in Appendix H. The changes include:

1. Data for the I-10 was collected in the nine-mile segment which was expanded from one HOV lane in each direction of travel to two HOT lanes in each direction by restriping the existing cross-section. These data were originally applied to the full 14-miles of the ExpressLanes, including the five-mile section which remained one lane in the HOV to HOT expansion. As a result, the input data from the environmental analysis used in the BCA may overestimate the increases in emissions and fuel attributed to the I-10 ExpressLanes. The Battelle team estimated that this would have an overall impact of reducing the VMT shown in the environmental analysis and Table J-12 by 1.2 percent and thus reduce fuel used and emissions produced by approximately 1.2 percent.
2. The use of 59 new clean fuel buses was expected to have the following impact on the emissions values:

   - NOx emissions decrease by 1 percent
   - PM2.5 emissions decrease by 3 percent
   - CO2 emissions decrease by 0.2 percent
   - ROG emissions increase by .3 percent
   - CO emissions increase by 0.06 percent

Table J-12. Change in Emissions

	Time of day	Change in Emissions (pounds per day) for:				
		ROG (VOC)	NOx	CO	$PM_{2.5}$	CO_2
I-110	AM Peak (Northbound, 5 am to 9 am)	7.70	-16.52	200.96	-0.39	30219
I-110	PM Peak (Southbound, 3 pm to 7 pm)	3.91	157.86	50.16	4.63	27729
I-10	AM Peak (Westbound, 6:30 am to 8:30 am)	14.47	155.21	317.68	4.22	75389
I-10	PM Peak (Eastbound, 4:30 pm to 5:30 pm)	3.77	43.23	92.94	1.25	22199
TOTAL	Pounds per Day	29.8	339.8	661.7	9.7	155535.0
TOTAL	Pounds per Year	7462.2	84944.2	165433.9	2423.7	38883748.1
TOTAL	Tons per Year	3.73	42.47	82.72	1.21	19441.87

Source: Texas A&M Transportation Institute.

These changes in emissions were used throughout the 10-year timeframe of the BCA. The current year value of the societal benefit from reduced pollution was derived from the U.S. Environmental Protection Agency (EPA) estimates of the value of health and welfare-related damages (incurred or avoided) and are recommended for use in current FHWA guidance.[12] The values were found in the report Final Regulatory Impact Analysis: Corporate Average Fuel Economy for MY 2011 Passenger Cars and Light Trucks[13] and are shown in Table J-13.

Table J-13. Values of Reduced Emissions (in 2007 Dollars)

Pollutant	Cost in 2009	Cost in 2015	Cost in 2020
VOC	$1,700 per ton	$1,200 per ton	$1,300 per ton
CO_2	$21 per metric ton	$24 per metric ton	$26 per metric ton
NO_X	$4,000 per ton	$4,900 per ton	$5,300 per ton
$PM_{2.5}$	$168,000 per ton	$270,000 per ton	$290,000 per ton

Source: Texas A&M Transportation Institute
http://www.nhtsa.gov/DOT/NHTSA/Rulemaking/Rules/Associated%20Files/CAFE_Final_Rule_MY2011_FRIA.pdf

Future year values were taken from the Highway Economic Requirements System documentation[14] and are also shown in Table J-13. This reference does not provide a value per ton of CO, and, therefore, CO was not included in the calculation.

The values in Table J-12 were interpolated (assuming a linear change in values per year) to obtain the monetary benefit of the four pollutants in each year from 2013 to 2022. Multiplying these values by the amount of pollution reduced (Table J-11), then adjusting the 2007 dollars to 2013 dollars using a discount rate of 7 percent, resulted in a total cost of $71,728 from VOC, $3,237,312 from NO_x, $6,608,163 from CO_2, and $5,021,403 from PM2.5. Combining the costs of these individual emissions resulted in a total environmental cost of $14,938,606. As noted previously, these costs may be slightly overestimated due to using data from the nine-mile, two-lane section on the I-10 for the complete 14-mile ExpressLanes. Note that it is not known if these increased emissions result from traffic that was utilizing alternate routes before, or if it is due to latent demand for use of the I-10 and I-110 or the growing economy, as the unemployment rate decreased from 10.8 percent to 8.1 percent over the pre- and post-deployment periods, which likely increased travel demand in the region. Caltrans statistics do note that there were observed increases in vehicle travel on all freeway facilities in the region.

[12] Federal Register, Vol. 75, No. 104, p. 30479

[13] Office of Regulatory Analysis and Evaluation, National Center for Statistics and Analysis, National Highway Transportation Safety Administration, March 2009 (http://www.nhtsa.gov/DOT/NHTSA/Rulemaking/Rules/Associated%20Files/CAFE_Final_Rule_MY2011_FRIA.pdf, Table VIII-5, page VIII-60).

[14] Highway Economic Requirements System, Federal Highway Administration http://www.fhwa.dot.gov/infrastructure/asstmgmt/hersdoc.cfm.

J.3.3 Benefits – Fuel

A reduction in congestion had the potential to change the operating cost of vehicles. Conversely, an increase in vehicle miles of travel (VMT), could increase the total operating costs of vehicles. For example, if a carpool were to break-up and use two vehicles instead of one. These operating costs are comprised of items such as maintenance, wear and tear on a vehicle, fuel use, and other factors due to reduced congestion, a smoother driving cycle, or increased VMT. The change in fuel use is often the largest change from a monetary perspective. For this analysis, the change in fuel use was the only vehicle operating cost calculated since it was the only data available.

The change in fuel use for automobiles was calculated in Appendix H – Environmental Analysis. A summary of those results is shown in Table J-14. Note that these changes are only for the peak period – as with the travel time savings and the emission savings. Also note that these changes are assumed to remain constant over the ten year timeframe of the BCA. In this case, an increase in fuel use was reported, which resulted in a negative benefit.

These numbers may be high due to applying the data from the nine-mile, two-lane section of the I-10 to the full 14-miles of ExpressLanes. It also does not account for possible changes in vehicle fuel efficiency and the use of low emission and energy efficient vehicles. California law allows vehicles meeting California's super ultra-low emission vehicle (SULEV) standard for exhaust emission and the federal inherently low-emission vehicle (ILEV) standard, and certain advanced technology – partial zero emission vehicles (AT-PZEV) to obtain white clean air vehicle decals. Vehicles meeting California's enhanced AT-PZEV requirements may obtain green clean air vehicle decals. Owners of vehicles with white and green clean air decals may use the ExpressLanes without meeting the occupancy requirements or paying a toll.

Table J-14. Change in Fuel Use

Time of Day		Change in Fuel Use (gallons) for:	
		GPLs	ELs
I-110	AM Peak (Northbound, 5 am to 9 am)	777.80	716.60
I-110	PM Peak (Southbound, 3 pm to 7 pm)	351.40	2,126.70
I-10	AM Peak (Westbound, 6:30 am to 8:30 am)	539.00	4,138.00
I-10	PM Peak (Eastbound, 4:30 pm to 5:30 pm)	476.90	946.20
TOTAL	Gallons per Day	2,145.10	7,927.50
TOTAL	Gallons per Year	536,275	1,981,875
TOTAL	Gallons per Year	2,518,150	

Source: Texas A&M Transportation Institute.

The cost of fuel (including taxes) for 2013 was obtained from the U.S. Energy Information Administration and was for all grades of gasoline for an entire year for LA.[15] Taxes of 18.4 cents (federal) and 49.8 cents (State of California plus local taxes[16]) on gasoline were then removed from that amount and the result is shown in Table J-15. The estimated cost of fuel (minus taxes) for future years was obtained from Final Regulatory Impact Analysis: Corporate Average Fuel Economy for MY 2011 Passenger Cars and Light Trucks.[17] Table J-15 also presents actual and estimated future year gas prices based on the CAFE document, which includes both automobiles and trucks. The total costs from increased fuel used were $105,836,188 (2013 dollars). Note that it is not known if this increased fuel use results from traffic utilizing alternate routes in the pre-deployment period, or if it is due to latent demand for use of the I-10 and I-110 or the growing economy, as the unemployment rate decreased from 10.8 percent to 8.1 percent over the pre- and post-deployment periods, which likely increased travel demand in the region. Caltrans statistics do note that there were observed increases in vehicle travel on all freeway facilities in the region.

[15] U.S. Energy Information Administration, http://www.eia.gov/dnav/pet/pet_pri_gnd_dcus_y05la_a.htm

[16] http://www.api.org/oil-and-natural-gas-overview/industry-economics/fuel-taxes/gasoline-tax

[17] Office of Regulatory Analysis and Evaluation, National Center for Statistics and Analysis, National Highway Transportation Safety Administration, March 2009. (http://www.nhtsa.gov/DOT/NHTSA/Rulemaking/Rules/Associated%20Files/CAFE_Final_Rule_MY2011_FRIA.pdf) Table VIII-4.

Table J-15. Gasoline Costs

Year	Actual Gasoline Price Excluding Taxes	Actual Gasoline Price Excluding Taxes Adjusted to 2013 $/gallon	Gas Used (Gallons)	Costs (2013 $)
2013	3.312 (2013 $/gallon)	3.312	2,518,150	8,340,113
Year	**Forecast Gasoline Price Excluding Taxes in 2007 $/gallon**	**Forecast Gasoline Price Excluding Taxes Adjusted to 2013 $/gallon**		
2014	2.668	4.004	$2,518,150	$10,082,543
2015	2.688	4.034	$2,518,150	$10,158,124
2016	2.736	4.106	$2,518,150	$10,339,519
2017	2.801	4.204	$2,518,150	$10,585,159
2018	2.846	4.271	$2,518,150	$10,755,217
2019	2.909	4.366	$2,518,150	$10,993,298
2020	2.975	4.465	$2,518,150	$11,242,716
2021	3.066	4.601	$2,518,150	$11,586,611
2022	3.11	4.667	$2,518,150	$11,752,889
		TOTALS	**$25,181,500**	**$105,836,188**
		ADJUSTED TOTAL (-1.2%)		**$104,566,144**

Source: Texas A&M Transportation Institute.

As with the emissions, the final value is reduced by 1.2 percent to account for the data coming from the 2-lane portion of the ExpressLanes. Thus the total impact from the change in fuel use was –$104,566,154.

J.4 Summary of BCA

The costs and benefits of the LA CRD projects are summarized as follows:

- Travel time savings: $20,198,158
- Increased emissions: -$14,938,606
- Increased auto fuel use: -$104,566,154
- TOTAL Benefits: -$99,306,603
- The cost of the CRD projects, in 2013 dollars, was $208,187,629.

This BCA examined the net societal costs and benefits of the LA CRD projects. As presented in Table J-16, the benefit-to-cost ratio for the LA CRD projects was -0.48 and the net societal benefit was -$307,494,232. The analysis had several limitations and required numerous assumptions. For example vehicle operating costs included only increased fuel consumption for automobiles. The potential increase in vehicles with white and green clean air decals was not considered. The data from the nine-mile, two-lane section of the I-10 was applied to the full 14-miles of ExpressLanes. Data on possible reduction in fuel used by buses were not available. All of the estimates were based on limited field data and projected those same changes will occur for 10 years into the future. The future year costs and benefits represented the best estimates available, but they are only estimates, and the actual costs and benefits could vary substantially.

There are significant deficiencies in this BCA that result from a lack of comprehensive data available to conduct a more thorough analysis. First, this evaluation assumes that all changes observed on the I-10 and I-110 were due to the CRD projects. The data collection and study design do not address the issue of attributing changes to the ExpressLanes, but simply report the data as collected per the LA CRD test plans. Exogenous factors, such as a decreasing unemployment rate, were observed and likely contributed to increasing VMT on the ExpressLanes corridors. However, these relative impacts cannot be isolated given the lack of suitable control corridors to compare changes observed on the I-10 and I-110 with changes observed regionally. Additionally, with no arterial data available, it cannot be ascertained whether increased VMT on the ExpressLanes are new trips or shifted trips, which has a major impact on calculated changes in emissions and fuel use that are used in this analysis. While a number of assumptions made for this BCA are imperfect and likely undervalue the benefits of the ExpressLanes, this analysis was conducted in accordance with the methodology employed for all UPA/CRD sites, and detailed in the Los Angeles Congestion Reduction Demonstration (Metro ExpressLanes) Program National Evaluation: Cost Benefit Analysis Test Plan using the best data and information available.

Overall, the LA CRD projects resulted in many positive outcomes. Tolling and parking technologies were successfully tested, resulting in broad user acceptance. Tolling helped to improve the efficiency of the ExpressLanes, helping to address congestion issues by increasing the effective capacity of the corridors. As such, tolling led to increased vehicle and person throughput. Note that while some of the increased VMT that caused increased emissions and fuel use costs may have been a result of a decrease in carpooling after the opening of the ExpressLanes, the increased VMT could also have shifted from adjacent routes. Regardless, increased emissions and increased fuel use had a significant contribution that resulted in a negative Benefit-to-Cost Ratio.

Table J-16. Question for the BCA

Hypotheses/Questions	Result	Evidence	
What are the overall benefits, costs, and net benefits from the Los Angeles CRD projects?		Benefits:	-$99,306,603
		Costs:	$208,187,629
		Net Benefits:	-$307,494,232
		Benefit-to-cost ratio:	-0.48

Source: Texas A&M Transportation Institute.

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Appendix K. Exogenous Factors

The effectiveness of the CRD strategies might have been influenced by factors external to the projects themselves. To account for these factors, the National Evaluation team monitored exogenous factors throughout the pre- and post-deployment periods. The post-deployment period varied for the I-110 and the I-10 corridors, including one-year of data following the opening of the I-110 ExpressLanes in November 2012 and the I-10 ExpressLanes in February 2013. The external factors being considered in the LA CRD projects include: unemployment rates, gasoline prices, atypical travel conditions,[1] and non-CRD transportation system changes. Information in this appendix provided a resource for use in the other analysis areas.

This appendix is divided into three sections. Unemployment rates in the Los Angeles metropolitan area and the state declined over the course of the evaluation period, and are described in Section K.1. Gasoline prices, which have fluctuated over the course of deploying the CRD projects, are discussed in Section K.2. A list of non-CRD transportation system changes are presented in Section K.3.

K.1 Unemployment Rates

Unemployment rates were monitored throughout the evaluation period as the change in the number of people traveling to and from work influences traffic levels and bus ridership. The recession began before most of the Los Angeles CRD projects became operational, and began to subside during the course of the evaluation period. Information on unemployment rates was used to help examine the potential effects of the economic downturn on the CRD projects in the different analyses.

The U.S. Bureau of Labor Statistics tracks historic unemployment data at the metropolitan and state levels. The information is available through the U.S. Bureau of Labor Statistics website. For the Los Angeles CRD national evaluation, annual and monthly unemployment statistics were monitored for the state (which are seasonally-adjusted) and the Los Angeles-Long Beach-Santa Ana metropolitan statistical area (which are not seasonally-adjusted). The not seasonally-adjusted unemployment rate was used for the metropolitan area, as it was the only data available from the Bureau of Labor Statistics at the regional level. Data from 2001 to February 2014 were examined.

Table K-1 presents the annual average not seasonally adjusted unemployment rates for 2001 through 2014 for the Los Angeles-Long Beach-Santa Ana metropolitan statistical area alongside the California and United States unemployment rates for the same period from the U.S. Bureau of Labor Statistics. As shown in Table K-1, the annual not seasonally-adjusted unemployment rate for the Los Angeles-Long Beach-Santa Ana metropolitan statistical area increased from a range of 4.4 to 6.9 percent during 2001 to 2008 to a high of 11.8 percent in 2010, and declining to 9.0 percent in 2013 and to 8.2 percent through early 2014.

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[1] The LA area experiences more than 3,000 special events per year including major sports and entertainment events, police actions, film shootings, etc. However, only a fraction of these will affect either of the treatment corridors or downtown LA. Thus, frequently recurring events, such as LA Dodgers baseball games, will not be included as special events.

Table K-1. Los Angeles Area, California, and United States Annual Average Unemployment Rate

Year	Annual Average Unemployment Rate, Not Seasonally Adjusted		
	Los Angeles-Long Beach-Santa Ana Metropolitan Statistical Area	California	United States
2001	5.3	5.4	4.7
2002	6.3	6.7	5.8
2003	6.4	6.8	6.0
2004	6.0	6.2	5.5
2005	5.0	5.4	5.1
2006	4.4	4.9	4.6
2007	4.8	5.4	4.6
2008	6.9	7.2	5.8
2009	10.9	11.3	9.3
2010	11.8	12.4	9.6
2011	11.4	11.8	9.0
2012	10.1	10.5	8.1
2013	9.0	9.0	7.4
2014*	8.2	8.5	7.0

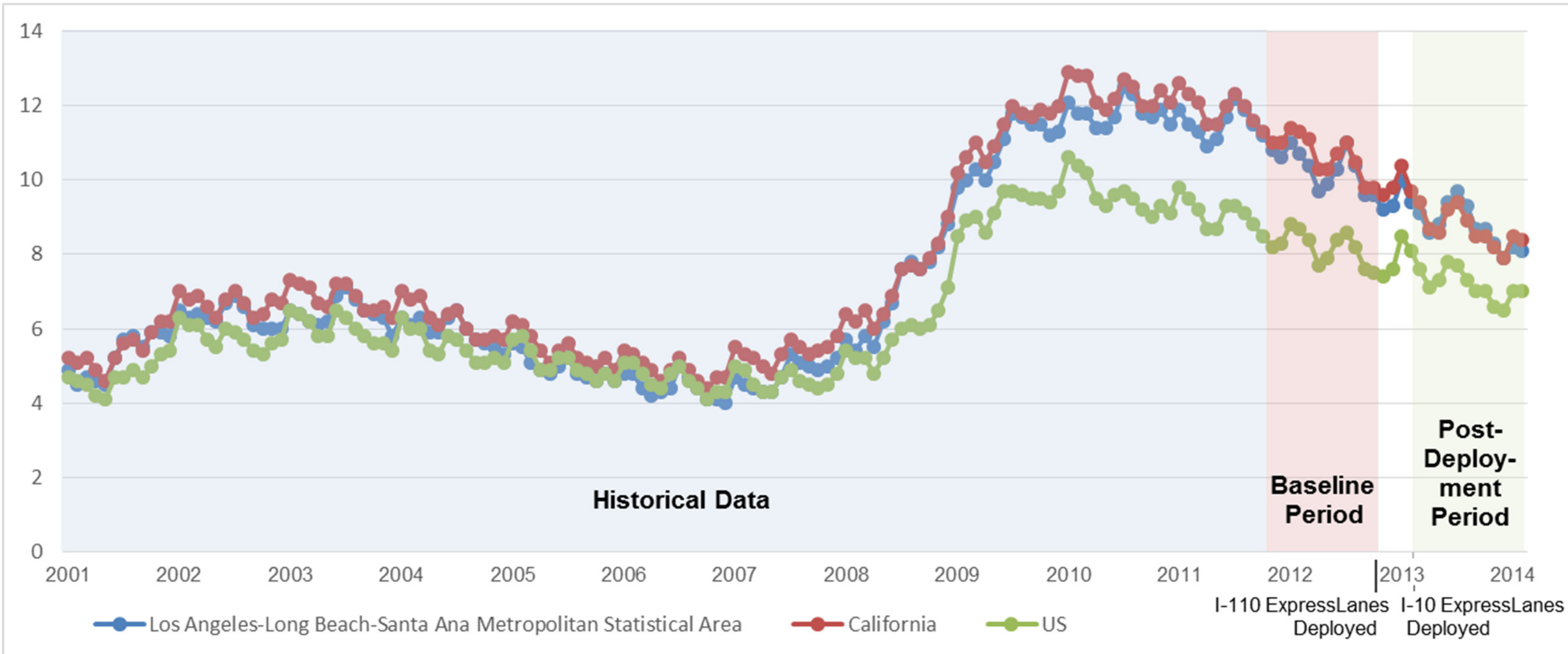
*Note: Average for January-February, 2014.

Source: U.S. Bureau of Labor Statistics. http://www.bls.gov/lau/data.htm, http://data.bls.gov/timeseries/LASST060000000000003.

Figure K-1 shows the monthly Los Angeles-Long Beach-Santa Ana metropolitan statistical area, California, and United States not seasonally adjusted unemployment rates for 2001 through February 2014. Table K-2 contains the monthly Los Angeles-Long Beach-Santa Ana metropolitan statistical area not seasonally adjusted unemployment rates for November 2011 through February 2014, which captures a one-year baseline period prior to the opening of the I-110 ExpressLanes in November 2012. This is presented alongside the California state not seasonally-adjusted unemployment rates for the same period from the U.S. Bureau of Labor Statistics for November 2011 through February 2014.

The unemployment rate for the Los Angeles-Long Beach-Santa Ana metropolitan statistical area was stable during the pre-deployment and post-deployment periods from November 2011 through February 2014, with a slow decreasing trend as shown in Figure K-1. The unemployment rate averaged 11.4 percent in 2011 (with a range of 10.7 percent to 12.2 percent) and 10.1 percent in 2012 (with a range of 9.2 percent to 11.0 percent). The unemployment rate was 9.2 percent in November 2012 at the beginning of revenue operations for the I-110 ExpressLanes, and 9.4 percent in February 2013 at the beginning of revenue operations for the I-10 ExpressLanes. The unemployment rate continued to trend lower into the post-deployment period with the 2013 average at 8.9 percent (with a range of 7.9 percent to 10.0 percent), and an average of 8.1 percent by February 2014.

The monthly and annual unemployment rates for the Los Angeles-Long Beach-Santa Ana metropolitan statistical area, California, and the United States tend to follow similar trends throughout the time periods presented in Table K-1 and Table K-2.



Source: U.S. Bureau of Labor Statistics. http://www.bls.gov/lau/data.htm.

Figure K-1. Los Angeles-Long Beach-Santa Ana Metropolitan Statistical Area, California, and United States, Not-Seasonally-Adjusted Unemployment Rate – 2001 through February 2014

Table K-2. Monthly Unemployment Rate, Not Seasonally-Adjusted

		Unemployment Rate, Not Seasonally Adjusted		
Year	Month	Los Angeles-Long Beach-Santa Ana Metropolitan Statistical Area	California	United States
2011	November	10.8	11.0	8.2
	December	10.6	11.0	8.3
2012	January	11.0	11.4	8.8
	February	10.7	11.3	8.7
	March	10.4	11.1	8.4
	April	9.7	10.3	7.7
	May	9.9	10.3	7.9
	June	10.3	10.7	8.4
	July	11.0	11.0	8.6
	August	10.4	10.5	8.2
	September	9.6	9.8	7.6
	October	9.6	9.8	7.5
	November	9.2	9.6	7.4
	December	9.3	9.8	7.6
2013	January	10.0	10.4	8.5
	February	9.4	9.7	8.1
	March	9.1	9.4	7.6
	April	8.6	8.7	7.1
	May	8.8	8.6	7.3
	June	9.4	9.2	7.8
	July	9.7	9.4	7.7
	August	9.3	8.9	7.3
	September	8.7	8.5	7.0
	October	8.7	8.5	7.0
	November	8.3	8.2	6.6
	December	7.9	7.9	6.5
2014	January	8.2	8.5	7.0
	February	8.1	8.4	7.0

Source: U.S. Bureau of Labor Statistics. http://www.bls.gov/lau/data.htm.

K.2 Gasoline Prices

Table K-3. Los Angeles Monthly Retail Gasoline Prices

Year	Month	Average Weekly Retail Gasoline Price
2011	November	$3.90
	December	$3.70
2012	January	$3.83
	February	$4.11
	March	$4.48
	April	$4.35
	May	$4.41
	June	$4.15
	July	$3.86
	August	$4.16
	September	$4.23
	October	$4.51
	November	$3.93
	December	$3.69
2013	January	$3.77
	February	$4.27
	March	$4.30
	April	$4.08
	May	$4.09
	June	$4.10
	July	$4.13
	August	$3.96
	September	$4.03
	October	$3.84
	November	$3.66
	December	$3.71
2014	January	$3.71
	February	$3.80

Source: U.S. Energy Information Administration; http://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=EMM_EPM0_PTE_Y05LA_DPG&f=W.

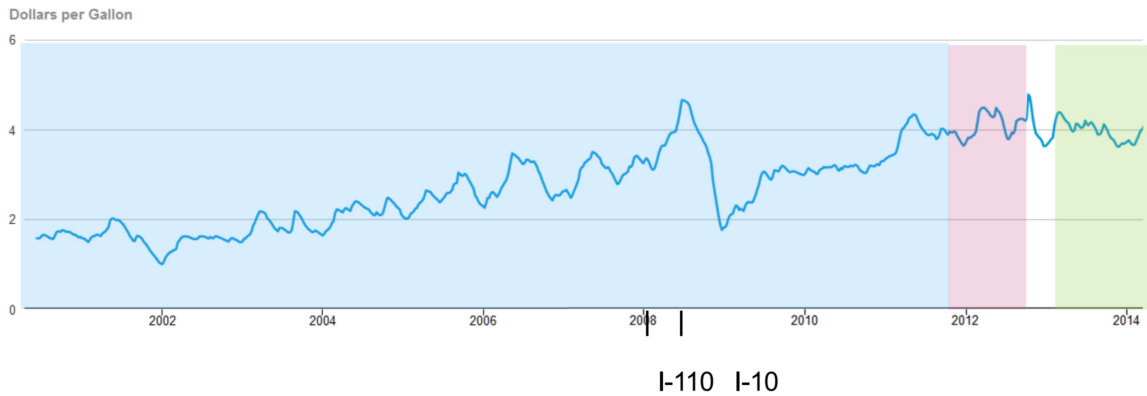
Gasoline prices were monitored by the national evaluation team as changes in price might influence the demand for travel, which in turn could influence vehicles miles of travel (VMT) and total trips. Increases in gasoline might also influence commuters who typically drive alone to carpool, take transit, or telecommute.

The U.S. Energy Information Administration monitors gasoline prices by selected regions, including the Los Angeles metropolitan area. Data on weekly and monthly retail gasoline prices for various grades since 2000 were available online on the Energy Information Administration website. Table K-3 presents the monthly average retail gasoline prices in the region from the Energy Information Administration website. Figure K-2 shows a time series of the weekly average retail price of a gallon of gasoline in Los Angeles from 2000 through February 2014 from the Energy Information Administration.

During the evaluation period gasoline prices reached a high of $4.51 per gallon in October 2012, as shown in Table K-3. The major decline in gasoline prices in late 2008 reflected the decline in world crude oil prices, which dropped from a then high of $147 per barrel in July to $40 per barrel in December 2008. The price of gasoline bottomed out at $1.77 in December 2008. In the pre-deployment period one year before the I-110 ExpressLanes opened in November 2012, the price increased from $3.65 the week of December 19, 2011 to a peak of $4.78 the week of October 8, 2012. After the I-110 ExpressLanes opened in November 2012 and before the I-10 ExpressLanes opened in February 2013, gas prices hit a low of $3.64 the week of December 24, 2012, before increasing to a peak of $4.39 the week of February 25, 2013. After the I-10 ExpressLanes opened, the price remained stable, fluctuating between $3.63 and $4.39 from February 25, 2013 through February 2014, with a price of $3.94 at the end of the post-deployment period the last week of February 2014.

The team found that throughout the evaluation period, gasoline prices experienced minor fluctuations with generally flat trend in cost (as shown in Figure K-2). In 2012, the average weekly price of gas was $4.13 (with a range of $3.64 to $4.78), in 2013 it was $3.99 (with a range of $3.63 to $4.39), and in the first two months of 2014 it was $3.76 (with a range of $3.66 to $3.94).[2]

[2] Weekly average price of a gallon of conventional retail gasoline (an average of all grades and formulations) in Los Angeles as recorded by the U.S. Energy Information Administration. For more information see: http://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=EMM_EPM0_PTE_Y05LA_DPG&f=W.



Source: U.S. Energy Information Administration
http://www.eia.gov/oil_gas/petroleum/data_publications/wrgp/mogas_history.html

Figure K-2. Los Angeles Historic Average Gas Price Chart – 2001 to February 2014

K.3 Non-CRD Transportation System Changes

A major construction project to upgrade the I-10/I-605 interchange on the eastern boundary of the I-10 ExpressLanes corridor may have impacted conditions during the evaluation period.[3] This project began in early 2013 and continued through the post-deployment period, with an expected completion in 2015. Caltrans expected construction closures during the project, although the majority of work was to take place during evening hours.

[3] For additional information, see: http://www.dot.ca.gov/dist07/sync/cpimages/file/Connector%20fact%20sheet%2010%2011%202013(1).pdf and http://www.dot.ca.gov/dist07/sync/cpimages/file/I%2010%20I%20605%20Interchange%20Improvement%20FAQ%20%20112013.pdf.

Table K-4 and Table K-5 below present non-CRD transit changes for the Silver Line and Metrolink San Bernadino Line.

Table K-4. Silver Line Non-UPA Transportation System Changes Log

12/2009	Service begins, bus assignments split between D9 & D18
12/2009	Service begins on Long Term Detour via 39th St. to Figueroa due to Expo Line construction
6/2010	Travel time added for schedule adherence
9/2010	Service begins operating at adjacent El Monte Temporary Station during new station construction
12/2010	Long Term Detour cancelled, buses begin operating via 37th St. Station & Adams Blvd; buses begin running out of D9 only
12/2009 through Post-Deployment Period	Selected Late Night Closures – El Monte Busway closed which resulted in detouring via local streets to serve Cal State LA; LAC + USC not served during this time
2/2011	Selected Late Night Closures – Harbor Transitway closed which resulted in detouring via Figueroa between Harbor Gateway Transit Center & downtown LA
March 2011-	Selected Late Night Closures – Harbor Transitway Closed which resulted in detouring via Figueroa between Harbor Gateway Transit Center & downtown LA. Weekend night closures occurred for the El Monte Busway.
5/2011	Harbor Transitway closed which resulted in detouring via Figueroa between Harbor Gateway Transit Center & downtown LA
6/2011	From June 1-10, 2011, the Harbor Transitway had night closures which resulted in detouring via Figueroa between Harbor Gateway Transit Center & downtown LA and bus stations were not served on freeway platform.
8/2011	Beginning 9/7/2011 through 9/2012 all stations along the Harbor Transitway are closed from 10:00 pm – 6:00 am every night due to Metro ExpressLanes construction. An alternate shuttle runs along Figueroa St. from 4:00 am - 6:00 am every day. No freeway platforms are served during the closure period.
9/2011	Beginning 9/26/2011 through 9/2012, the El Monte Busway will be closed every night from 10:00 pm - 5 am (westbound) and 10:00 pm - 6:00 am (eastbound) due to Metro ExpressLanes construction. During this time, LAC+USC Medical Center Station and Cal State LA Station will not be served. Passengers are suggested to take Line 70 or Metrolink.
6/2012	Weekday rush hour service increased resulting in entire line operating a peak hour frequency of 4 1/2 min between El Monte and Downtown LA and frequency of 8 1/2 min (from 5 min and 10 min, respectively).
9-12/2012	Saturday USC football gamedays at the Coliseum will feature additional service for pre and post-game movement, serving 37th St/USC Transitway Station. Traffic related delays expected during these occurrences.

Table K-4. Silver Line Non-UPA Transportation System Changes Log (Continued)

10/2012	New El Monte Station grand opening. Temporary bus terminal closed. Silver to Silver promotional fare program begins (pass reciprocity and lower cash fare on Foothill may shift some riders from Silver Line to Silver Streak). Restroom construction at Artesia TC.
12/2012	Temporary bus terminal converted back to public parking lot. (437 parking spaces)
(Spring) 2013	Bollards installed on all Harbor Transitway platforms. Sound proofing installed on 37th Street Station.
(Summer) 2013	Rebranding of Artesia Transit Center to Harbor Gateway Transit Center, including: new signage, landscaping, improved customer information and public restrooms.
6/2013	Late night service to CSULA and USC Medical Center resumes. Late night weekend service connected to Metro I-105 Green Line station.
12/2013.	Weekday service on I-110 will increase during AM and PM peak periods to 4-5 minute headways.

Source: Metro.

Table K-5. Metrolink San Bernadino Line Non-UPA Transportation System Changes Log

4/1/2011	Beginning on 4/1, after the Dodger's first home game, Antelope Valley and San Bernardino line trains will depart Union Station at 11 p.m. Ticket Packages for a Dodger ticket and Metrolink roundtrip ticket will start at $20.
5/2011	• Beginning on 5/1, San Bernardino Line train schedules will change to connect with a train at Union Station arriving at the Burbank Airport in time for 7 a.m. airport departures. • Effective 5/9, San Bernardino Line will add four new trains and two new peak hour express trains that have a trip time of sixty minutes from San Bernardino to Union Station.
7/2011	• Effective 7/1, Southern Californians can buy a weekend pass to ride unlimited Metrolink trains for only $10. Unlimited weekend riding was added for monthly pass holders at no additional cost. • New 10 percent student discount added to one-way and roundtrip ticket. • New 7-Day Pass will be good seven consecutive days from purchase between a set origination and destination. • The 10-trip Ticket will be discontinued sometime in the fall of 2011. A significant amount of lost revenue is attributed to this type of ticket due to a failure to validate, resulting in fare evasion.
11/2011	• San Bernardino Line closed in the evening Wednesday, 11/2 between Fontana and Rancho Cucamonga due to a freight train derailment. • Due to an annual track maintenance project, Metrolink train service will be limited on the San Bernardino Line on November 5-6, 12-13 and 19-20.
12/2011	• The 60 Freeway was closed in both directions due to a tanker explosion, resulting in traffic being diverted to the I-10 and public transportation.
1/2012	Schedule changes went into effect 1/9 to coordinate with Amtrak's schedule changes and improve reliability. San Bernardino Line – Monday thru Friday Service. • Train 319 and 331 will arrive later into Los Angeles • Train 333, 337 and 387 times have changed out of San Bernardino • Train 330, 32, 334 times have changed out of Los Angeles
8/31 – 9/30/2012 – LA County Fair Special Service	Take the San Bernardino Line to the special Fairplex Station that drops you off right at the fair. A free shuttle will take you to the Yellow Gate to begin your fair adventure.
10/2012	• New train schedules effective 10/1/2012 • 10/17/2012 – reconstructed platform and three new tracks completed at Union Station
11/2012	Metrolink trains will not run on Thanksgiving day. $10 Weekend passes will be valid between 7 p.m. on Wednesday through Sunday, 11/25.
12/2012	Metrolink will operate a Sunday schedule on the San Bernardino and Antelope Valley lines on Christmas Day, Tuesday, 12/25.

Table K-5. Metrolink San Bernadino Line Non-UPA Transportation System Changes Log (Continued)

1/1/2013	Metrolink will operate a modified schedule on New Year's Day, Tuesday, 1/1, to allow people to attend the 2013 Tournament of Roses Parade® celebrations in Pasadena. The first train on Metrolink's San Bernardino Line will operate a modified Sunday schedule, departing Riverside- Downtown at 5:30 a.m. and San Bernardino at 6:05 a.m. making all station stops. Train 349 will arrive at L.A. Union Station at 7:35 a.m.
2/2013	Metrolink passengers will have the opportunity to travel to the 114th annual Golden Dragon Parade on Saturday, 2/16. After arriving at Los Angeles Union Station, riders can transfer with no additional charge to the Metro Gold Line Chinatown Station for the 1 p.m. event.
3/2013	Metrolink will provide service to the Auto Club 400 on Sunday, 3/24 at Auto Club Speedway. Metrolink train tickets to the Auto Club 400 are only $19 for one (1) round trip train ticket. Metrolink will operate three trains originating from Oxnard, Lancaster and Oceanside with limited stops in between for faster service.
4/2013	• On Monday, 4/22, Metrolink will implement a schedule change to four weekday trains and one weekend train: o San Bernadino line 383 will complete its weekday route at Union Station 2 minutes later. • Metrolink will employ all 17 of its Bike Cars in time for CicLAvia on Sunday, 4/21. Metrolink will add multiple Bike Cars on its San Bernardino, Orange and Antelope Valley Lines. Metrolink is modifying its regular Bike Car schedule, moving the special cars to different train sets. • On 4/22, Metrolink passengers can now add a $7 LAX flyaway ticket to their Metrolink ticket.
5/2013	• Metrolink will celebrate Bike to Work Day on Thursday, 5/16, by offering free train rides to Southern California commuters who bring their bicycles on board Metrolink trains. • There will be limited Metrolink service on Memorial Day, Monday, 5/27.
6/2013	• Metrolink launched TAP-enabled fare tickets • The Bob Hope Airport-Hollywood Way Metrolink Station opened on 6/21.
7/2013	• On 7/1, Metrolink will increase systemwide fares by 5 percent. The $10 Weekend Pass will become a $10 Weekend Day Pass. • Metrolink service will not operate on Thursday, 7/4, with the exception of two round-trip trains on the Antelope Valley Line. • Metrolink has partnered with the City of Thousand Oaks Transit to provide convenient weekday round-trip shuttle service to the Metrolink Moorpark Station from the Thousand Oaks Transportation Center, The Oaks Shopping Center and California Lutheran University. Service starts 7/15, and will run 6 round trips during peak AM and PM periods.
8/2013	Metrolink will provide direct service to the LA County Fair on Saturdays and Sundays, from 8/31 through September. The San Bernardino Line will add a stop at the Pomona Fairplex.

Table K-5. Metrolink San Bernadino Line Non-UPA Transportation System Changes Log (Continued)

9/2013	• Metrolink will suspend service on Monday, 9/2 in observance of Labor Day, with the exception of two round-trip trains on the Antelope Valley Line. • Effective 9/20, Metrolink will make adjustments to its schedule to reflect current operating conditions and future Positive Train Control operating requirements: o Trains 300, 305 and 383 have been adjusted in response to customer input. o Train 309 will arrive at LA Union Station later, while trains 311 and 315 will depart San Bernardino earlier. • Train 357 will depart San Bernardino earlier to connect to the AV line.
12/2013	Metrolink will operate a Sunday schedule on the San Bernardino and Antelope Valley lines on Christmas Day, Wednesday, 12/25, and operate a modified schedule on New Year's Day, Wednesday, 1/1, which will allow people to attend the 2014 Tournament of Roses Parade® in Pasadena.
1/2014	The move of Big Boy No. 4014 will create a service disruption to Metrolink's San Bernardino Line as crews move the massive locomotive from temporary tracks at the Fairplex onto the main line. The final two trains on Saturday night (379 and 378) along with the first four trains Sunday morning (351, 354, 356 and 357) will be affected.

Source: Metro.

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Appendix L. Compilation of Hypotheses/Questions for the LA CRD National Evaluation

Evaluation Analysis	Hypothesis/ Question No.	Hypothesis/Question
Congestion	LACong-1	Deployment of the CRD improvements will reduce the travel time of users in the I-10 and I-110 corridors.
	LACong-2	Deployment of the CRD improvements will improve the reliability of user trips in the I-10 and I-110 corridors.
	LACong-3	Deployment of the Downtown LA Intelligent Parking Management Project will reduce congestion in the downtown.
	LACong-4	Deploying the CRD improvements will result in more vehicles and persons served in the I-10 and I-110 corridors during peak periods.
	LACong-5	Will surveyed travelers perceive a noticeable reduction in travel times in the treatment corridors?
	LACong-6	Will surveyed travelers perceive a noticeable improvement in trip-time reliability in the treatment corridors?
	LACong-7	Will surveyed travelers perceive a noticeable reduction in the duration of congested periods in the treatment corridors?
	LACong-8	Will surveyed travelers perceive a noticeable reduction in the length of peak congestion periods in the treatment corridors?
	LACong-9	Relative travel times for HOV/HOT lanes vs. general purpose lanes will either remain the same or (more likely) improve for HOV/HOT travelers as a result of the CRD deployments.
	LACong-10	The introduction of tolled SOV traffic into the HOT lanes in the deployment corridors will not negatively impact HOV or transit traffic in terms of average travel times or travel reliability.
	LACong-11	The CRD deployment will not cause traffic congestion to increase in the HOV/HOT lanes.
	LACong-12	Because of latent demand in the deployment corridors, the CRD deployments are not likely to impact in traffic congestion on the general purpose lanes.
	LACong-13	Because of the CRD deployments, congestion on the arterials streets paralleling the corridors will be reduced.

Evaluation Analysis	Hypothesis/ Question No.	Hypothesis/Question
Tolling	LATolling-1	The HOT lanes will regulate vehicular access to the I-10 and I-110 and improve their operation.
	LATolling-2	Some general-purpose lane travelers will shift to the HOT lanes, while HOV lane travelers will continue to use them after they are converted to HOT.
	LATolling-3	After ramp-up, the HOT lanes on I-10 and I-110 pricing maintains operating improvements on I-10 and I-110 after the initial ramp-up period.
	LATolling-4	The downtown IPM project will result in 70-90% of the parking spaces on each block occupied throughout the day.
	LATolling-5	The downtown IPM project may increase parking revenues that can be used to fund system expansion in other high-demand areas.
	LA Tolling-6	Implementing the HOT lanes will reduce the HOV violation rate.
Transit	LATransit-1	CRD projects will enhance transit performance within CRD corridors through reduced travel times, increased service reliability, and increased service capacity.
	LATransit-2	User perceptions of security at transit stations/park-and-ride lots will be improved by CRD projects.
	LATransit-3	CRD projects will increase ridership and facilitate a mode shift to transit within CRD corridors.
	LATransit-4	Increased ridership and mode shift to transit will contribute to increased person throughput, congestion mitigation, and transit cost-effectiveness within CRD corridors.
	LATransit-5	What was the relative contribution of each CRD project element to increased ridership/ transit mode share/person throughput?
Ridesharing	LARideshare-1	CRD vanpool promotion will result in at least 100 new Metro-registered vanpools.
	LARideshare-2	Which factors were most effective in promoting ridesharing?
	LARideshare-3	Will CRD HOT and transit improvements lead to unintended breakups of current carpools/vanpools?
Technology	LATech-1	Travelers will access the IPM website and telephone information system.
	LATech-2	IPM will improve LADOT’s ability to reconfigure parking restrictions and rates.
	LATech-3	IPM will improve LADOT’s ability to enforce parking regulations.

Evaluation Analysis	Hypothesis/ Question No.	Hypothesis/Question
Safety	LASafety-1	The collective impacts of CRD improvements[1] will be safety neutral or safety positive.
	LASafety-2	The addition of transition zones will not increase incidents.
	LASafety-3	Will boundary jumping cause incidents?
	LASafety-4	Will HOT infrastructure changes affect the time needed to respond to or clear accidents?
	LASafety-5	Will adjusted enforcement procedures affect the number of incidents?
Equity	LAEquity-1	What is the socio-economic and spatial distribution of the direct social effects of the CRD projects?
	LAEquity-2	Are there any differential environmental impacts on certain socio-economic groups?
	LAEquity-3	Will the potential HOT and IPM net revenues be reinvested in an equitable manner?
Environmental	LAEnvironmental-1	Vehicle-related air emissions will decrease in the treatment corridors.
	LAEnvironmental-2	Vehicle-related fuel consumption will decrease in the treatment corridors.
Business Impacts	LABus-Imp-1	How will the downtown IPM project affect retailers and similar businesses that rely on customers' ability to access their stores?

[1] Relevant CRD changes include narrower lanes on portions of the I-10 freeway, new signage, new HOT procedures, new enforcement procedures, and reduced congestion (i.e., faster flowing traffic).

Evaluation Analysis	Hypothesis/ Question No.	Hypothesis/Question
Non-Technical Success	LANon-Tech-1	What role did factors related to these five areas play in the success of the deployment? 1. People: Sponsors, champions, policy entrepreneurs, neutral conveners, legislators 2. Process: Forums (including stakeholder outreach), meetings, alignment of policy ideas with favorable politics and agreement on nature of the problem), legislative and Congressional engagements 3. Structures: Networks, connections and partnerships, concentration of power & decision making authority, conflict mgt. mechanisms, communications strategies, supportive rules and procedures 4. Media: Media coverage, public education Competencies: Cutting across the preceding areas: persuasion, getting grants, doing research, technical/technological competencies; ability to be policy entrepreneurs; knowing how to use markets
	LANon-Tech-2	Does the public support the CRD strategies as effective and appropriate ways to reduce congestion?
Cost Benefit	LACostBenefit-1	Will the LA CRD (Metro ExpressLanes) Program projects have a net societal benefit?

Source: Battelle.

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