Los Angeles Congestion Reduction Demonstration (Metro ExpressLanes) Program

National Evaluation: Safety Data Test Plan

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16. Abstract

This report presents the Safety Data Test Plan for the national evaluation of the Los Angeles County Congestion Reduction Demonstration (CRD) under the United States Department of Transportation (U.S. DOT) Urban Partnership Agreement (UPA) Program. The Los Angeles County CRD projects focus on reducing congestion by employing strategies consisting of combinations of tolling, transit, telecommuting/travel demand management (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. This Safety Data Test Plan is one of ten test plans being developed. The other nine test plans consist of the following: traffic; tolling; transit; ridesharing; content analysis; environmental; surveys, interviews and workshops; cost-benefit; and exogenous factors. Each test plan is based on the Los Angeles County CRD National Evaluation Plan. This test plan describes the safety data sources, data availability, and possible risks associated with the data. The methods for analyzing the safety data are discussed. The schedule and responsibility for collecting, analyzing, and reporting the safety data are presented.

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LIST OF ABBREVIATIONS

4Ts	Tolling, Transit, Telecommuting, and Technology
ATCS	Adaptive Traffic Control System
ATMS	Advanced Transportation Management System
AXDB	Caltrans Accident Database
Caltrans	California Department of Transportation
CHP	California Highway Patrol
CRD	Congestion Reduction Demonstration
ExpressLanes	Component of LA CRD, pilot converted HOT lanes
ExpressPark	Component of LA CRD, pilot LA parking management system
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
HOT	High-occupancy tolling
HOV	High-occupancy vehicle
I-10	Interstate 10 (El Monte Busway between Alameda St and I-605)
I-110	Interstate 110 (Harbor Transitway between Adams Blvd and Harbor Gateway Transit Center)
IPM	Intelligent Parking Management
L.A.	Los Angeles
LA CRD	Los Angeles Congestion Reduction Demonstration
LADOT	Los Angeles Department of Transportation
Metro	Los Angeles County Metropolitan Transportation Authority
Metrolink	Southern California Regional Rail Authority
MOE	Measure of effectiveness
SBCCOG	South Bay Cities Council of Governments
SCAG	Southern California Association of Governments
SGVCOG	San Gabriel Valley Council of Governments
SWITRS	Statewide Integrated Traffic Records System
TASAS	Traffic Accident Surveillance and Analysis System
TDM	Travel demand management
UPA	Urban Partnership Agreement
U.S. DOT	U.S. Department of Transportation
VMT	Vehicle miles traveled

1.0 INTRODUCTION

This report presents the test plan for collecting and analyzing information that will be used in the "safety" portion of the United States Department of Transportation (U.S. DOT) evaluation of the LA CRD (Metro ExpressLanes) Program. The LA CRD (Metro ExpressLanes) Program is one of several large field deployments around the United States that are receiving U.S. DOT funding and which are intended to demonstrate congestion pricing and supporting strategies. The LA CRD (Metro ExpressLanes) Program national evaluation will address the four primary U.S. DOT evaluation questions shown in Table 1-1.

Table 1-1. U.S. DOT National Evaluation "Objective Questions"

Objective Question #1	How much was congestion reduced in the area impacted by the implementation of the tolling, transit, technology, and telecommuting strategies? It is anticipated that congestion reduction could be measured by one of the following measures, and will vary by site and implementation strategy: • reductions in vehicle trips made during peak/congested periods; • reductions in travel times during peak/congested periods; • reductions in congestion delay during peak/congested periods; and • reductions in the duration of congested periods.
Objective Question #2	What are the associated impacts of implementing the congestion reduction strategies? It is anticipated that impacts will vary by site and that the following measures may be used: • increases in facility throughput during peak/congested periods; • increases in transit ridership during peak/congested periods; • modal shifts to transit and carpools/vanpools; • traveler behavior change (e.g., shifts in time of travel, mode, route, destination, or forgoing trips); • operational impacts on parallel systems/routes; • equity impacts; • environmental impacts; • impacts on goods movement; and • effects on businesses.
Objective Question #3	What are the non-technical success factors with respect to the impacts of outreach, political and community support, and institutional arrangements implemented to manage and guide the implementation?
Objective Question #4	What are the overall costs and benefits of the deployed set of strategies?

Source: "Urban Partnership Agreement Demonstration Evaluation – Statement of Work," United States Department of Transportation, Federal Highway Administration, November 2007.

The questions shown in Table 1-1 will be addressed by carrying out the following 11 "evaluation analyses" described in the LA CRD (Metro ExpressLanes) Program National Evaluation Plan[1]: tolling, technology, transit, travel demand management (TDM), congestion, equity, environment, business impacts, non-technical success factors, cost benefit and content analysis. Each of these 11 analyses relies upon various evaluation measures of effectiveness.

[1] Los Angeles County Congestion Reduction Demonstration National Evaluation Plan, January 13, 2010, U.S. DOT.

"Test plans" are the evaluation planning documents that describe how specific data will be collected and processed to yield the evaluation measures of effectiveness required for the various analyses. Whereas evaluation analyses are categorized according to related evaluation questions or types of impacts, for example all equity-related impacts are addressed in the equity analysis, test plans are categorized according to common data types or sources. For example, the "Traffic System Data Test Plan" collects and processes all of the traffic data required for the national evaluation. There are a total of ten test plans for the LA CRD (Metro ExpressLanes) Program national evaluation. In addition to this Safety Data Test Plan, there are test plans focusing on the following types of data: traffic; tolling; ridesharing; content analysis; environmental; transit; surveys, interviews, and workshops; cost benefit; and exogenous factors.

The relationship between test plans and evaluation analyses is discussed in Section 1.2. In short, analyses describe the evaluation questions and hypotheses to be investigated and the test plans describe how the data and measures of effectiveness needed to support the evaluation will be collected and processed. Most test plans collect data and provide measures of effectiveness that will be used in multiple analyses and most analyses rely upon data and measures developed through several different test plans.

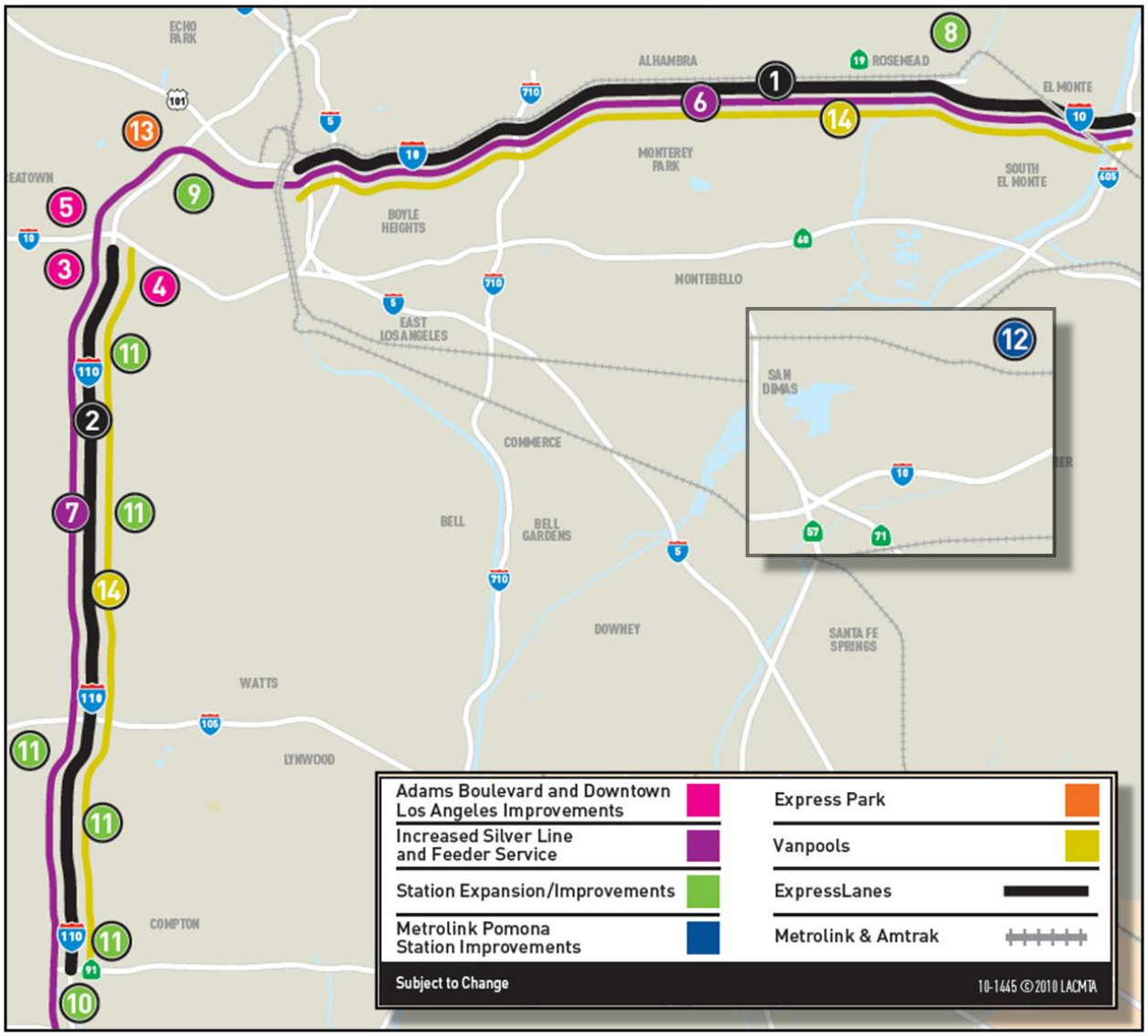
The remainder of this introduction chapter identifies the LA CRD (Metro ExpressLanes) Program deployments and elaborates on the relationship between test plans and evaluation analyses. The remainder of the report is divided into three sections. Chapter 2.0 presents the data sources, availability, and risks associated with data collected through this Safety Data Test Plan. Chapter 3.0 discusses how the safety data will be conducted and used in the national evaluation. Chapter 4.0 presents the schedule and responsibilities for conducting the safety data test plan.

1.1 The LA CRD (Metro ExpressLanes) Program Projects

The LA CRD (Metro ExpressLanes) Program was selected by the U.S. DOT as an Urban Partner to implement projects aimed at reducing congestion based on four complementary strategies known as the 4Ts: Tolling, Transit, Telecommuting/TDM, and Technology. Under contract to the U.S. DOT, a national evaluation team led by Battelle is assessing the impacts of the projects in a comprehensive and systematic manner in Los Angeles (L.A.) County and other sites. The national evaluation will generate information and produce technology transfer materials to support deployment of the strategies in other metropolitan areas. The national evaluation will also generate findings for use in future Federal policy and program development related to mobility, congestion, and facility pricing.

The LA CRD (Metro ExpressLanes) Program effort is led by the Los Angeles County Metropolitan Transportation Authority (Metro). The CRD projects are being implemented with the assistance of a number of supporting agencies especially the California Department of Transportation (Caltrans); and the Los Angeles Department of Transportation (LADOT). Other participating agencies include the Southern California Association of Governments (SCAG); the San Gabriel Valley Council of Governments (SGVCOG); the South Bay Cities Council of Governments (SBCCOG); the Southern California Regional Rail Authority (Metrolink); Foothill Transit; the California Highway Patrol (CHP); and the Los Angeles County Sheriff's Department. The LA CRD (Metro ExpressLanes) Program projects are intended to reduce

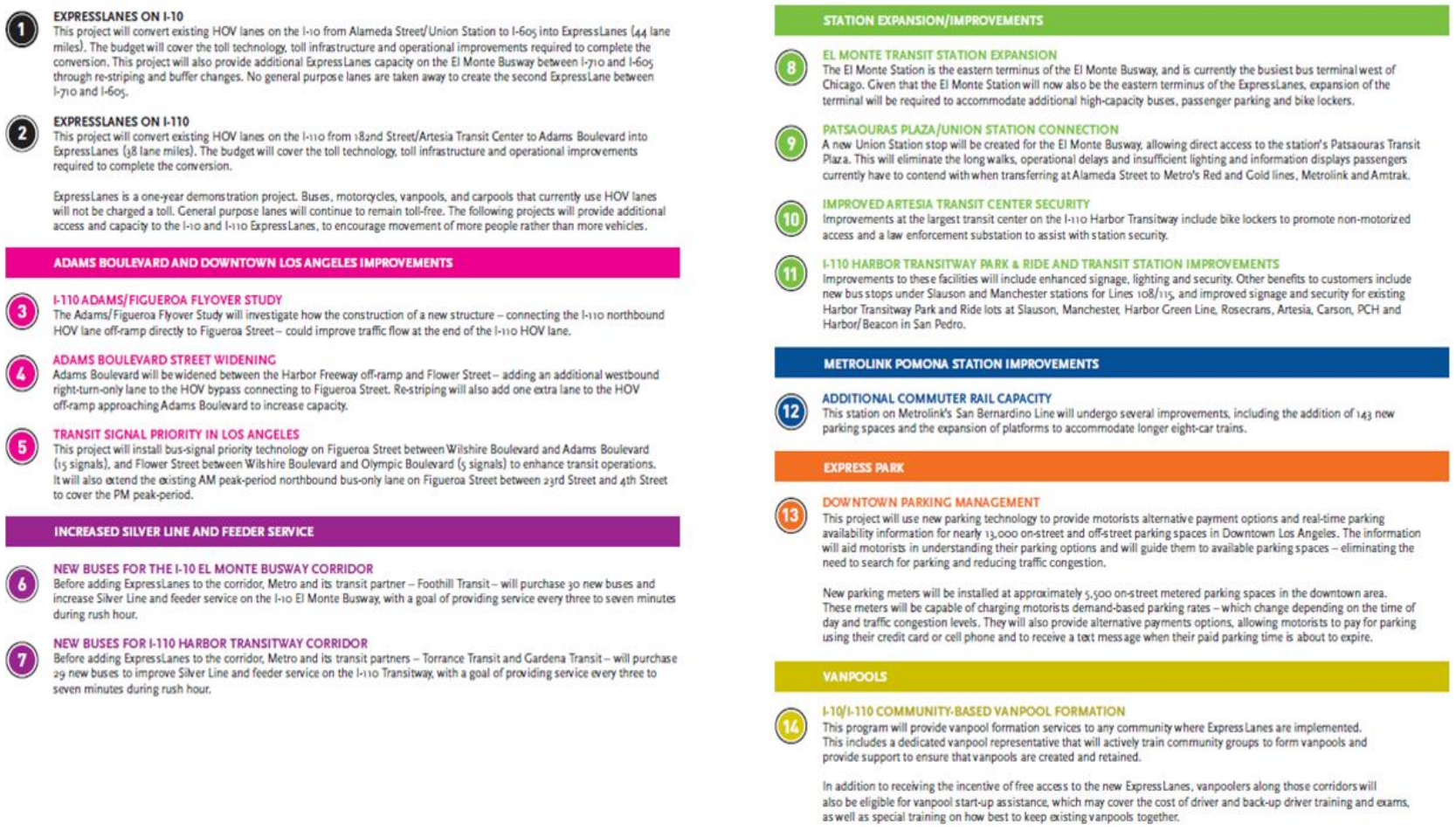
congestion, promote throughput, and enhance mobility in the Interstate-10 (I-10) and Interstate-110 (I-110) corridors, and in downtown Los Angeles. Figure 1-1 shows the location of the LA CRD (Metro ExpressLanes) Program projects and Figure 1-2 provides short summaries of the numbered projects on Figure 1-1.



Source: Derived from Metro ExpressLanes project map

Note: See Figure 1-2 for the explanation of each numbered project on this map.

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



1 EXPRESSLANES ON I-10
This project will convert existing HOV lanes on the I-10 from Alameda Street/Union Station to I-605 into ExpressLanes (44 lane miles). The budget will cover the toll technology, toll infrastructure and operational improvements required to complete the conversion. This project will also provide additional ExpressLanes capacity on the El Monte Busway between I-710 and I-605 through re-striping and buffer changes. No general purpose lanes are taken away to create the second ExpressLane between I-710 and I-605.

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

ExpressLanes is a one-year demonstration project. Buses, motorcycles, vanpools, and carpools that currently use HOV lanes will not be charged a toll. General purpose lanes will continue to remain toll-free. The following projects will provide 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 will investigate 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 STREET WIDENING
Adams Boulevard will be 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. Re-striping will also add one extra lane to the HOV off-ramp approaching Adams Boulevard to increase capacity.

5 TRANSIT SIGNAL PRIORITY IN LOS ANGELES
This project will install 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 will also extend the existing AM peak-period northbound bus-only lane on Figueroa Street between 23rd Street and 4th Street to cover the PM 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 – will purchase 30 new buses and increase 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 I-110 HARBOR TRANSITWAY CORRIDOR
Before adding ExpressLanes to the corridor, Metro and its transit partners – Torrance Transit and Gardena Transit – will purchase 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 is currently the busiest bus terminal west of Chicago. Given that the El Monte Station will now also be the eastern terminus of the ExpressLanes, expansion of the terminal will be required to accommodate additional high-capacity buses, passenger parking and bike lockers.

9 PATSAOURAS PLAZA/UNION STATION CONNECTION
A new Union Station stop will be created for the El Monte Busway, allowing direct access to the station's Patsaouras Transit Plaza. This will eliminate the long walks, operational delays and insufficient lighting and information displays passengers currently have 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 include 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 will include enhanced signage, lighting and security. Other benefits to customers include 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 will undergo several improvements, including the addition of 143 new parking spaces and the expansion of platforms to accommodate longer eight-car trains.

EXPRESS PARK

13 DOWNTOWN PARKING MANAGEMENT
This project will use 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 Los Angeles. The information will aid motorists in understanding their parking options and will guide them to available parking spaces – eliminating the need to search for parking and reducing traffic congestion.

New parking meters will be installed at approximately 5,500 on-street metered parking spaces in the downtown area. These meters will be capable of charging motorists demand-based parking rates – which change depending on the time of day and traffic congestion levels. They will also provide alternative payments 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 will provide vanpool formation services to any community where ExpressLanes are implemented. This includes a dedicated vanpool representative that will actively train community groups to form vanpools and provide support to ensure that vanpools are created and retained.

In addition to receiving the incentive of free access to the new ExpressLanes, vanpoolers along those corridors will also be 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 Metro ExpressLanes project map.

Figure 1-2. LA CRD (Metro ExpressLanes) Program Project Descriptions

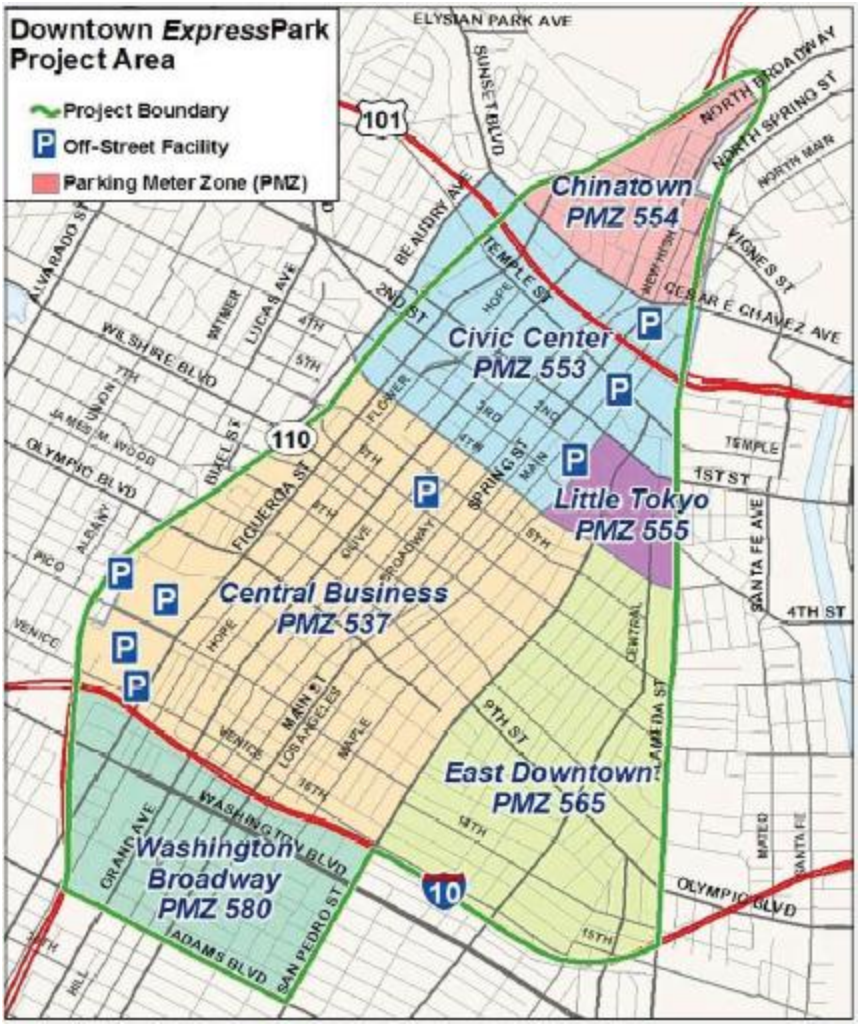
The U.S. DOT is allocating $210.6 million in Federal grant funding for the LAC CRD projects, drawn from the Federal Transit Administration (FTA) 5309 Bus and Bus Facilities Program. The LAC CRD projects consist of the following:

- **Transit Improvements** to increase the frequency of Metro bus rapid transit service 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) and increased service: to one bus every seven minutes along the I-10 corridor and to one bus every ten minutes along the I-110 corridor. Various security upgrades will be made to the Harbor Gateway Transit Center (better lighting, new security cameras, bicycle lockers and a new L.A. County Sheriff's substation). Expansion of the El Monte Transit Center includes reconstruction of the existing transit passenger terminal, additional surface parking, and a new administration facility. A new El Monte Busway stop will be created at Union Station that will allow for direct pedestrian access to Union Station's Patsaouras Transit Plaza and thus promote transfers to/from the El Monte Busway and other transit services. Expansion of the Pomona (North) Metrolink station includes 143 new parking spaces and extended platforms to accommodate additional rail cars for the San Bernadino Line. Improvements to Harbor Transitway Park-and-Ride lots and Transit Stations include enhanced signage, lighting, and closed-circuit television cameras for existing lots at Slauson, Manchester, Harbor Green Line, Rosecrans, and Harbor Gatway as well as the relocation of bus stops for Lines 108 and 115 to the Slauson and Manchester Transitway stations. The 37th Street Station will also be fitted with translucent and architectural sound attenuation panels to reduce noise levels for waiting customers on the Harbor Transitway. Implementation of transit signal priority technology on Figueroa Street (15 signals between Wilshire Boulevard and Adams Boulevard) and Flower Street (5 signals between Wilshire Boulevard and Olympic Boulevard) in downtown Los Angeles. Lastly, to facilitate HOT traffic movement where the I-110 freeway enters downtown Los Angeles, Adams Boulevard will be widened and the Adams Boulevard off ramp will be restriped, both providing an additional lane of high occupancy vehicle (HOV) capacity.
- **High Occupancy Toll (HOT) Lanes** ("ExpressLanes") to expand freeway capacity by permitting toll-paying, single occupancy vehicles or those that do not meet the carpool occupancy requirement to use slack, HOT lane capacity on the I-10 and I-110 freeways. ExpressLanes will be 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 will be created (via restriping; no loss of general purpose lanes will occur) on I-10 from I-605 to I-710 where there is no slack HOV lane capacity during peak periods. All vehicles will pay to use the HOT lanes with the exception of transit vehicles, motorcycles and multiple-occupant private vehicles (three or more occupants on I-10 during peak hours, two or more all other times; two or more occupants on I-110). All tolls will be collected electronically, requiring all vehicles entering HOT lanes to be equipped with a transponder. Vehicles satisfying the ExpressLane occupancy requirements and therefore eligible to use the lane free of charge will "self declare" by setting a switch on their transponders. ExpressLane enforcement will be carried out manually through on-site law enforcement observation. Tolls will range from a minimum $0.25 per mile to a maximum $1.40 per mile depending on

congestion levels. When travel speeds in the HOT lanes fall below 45 mph for more than ten minutes, the ExpressLanes have reached capacity. At this point, the lanes will revert to HOV lanes and vehicles that do not meet the carpool occupancy requirements will not be permitted to "buy" their way into the lanes. Low income commuters[2] will receive cost reductions through the Equity Account Discount, consisting of a $25 discount for toll account set-up and waiver of the $3 non-usage maintenance fee.

- **Intelligent Parking Management (IPM)** ("ExpressPark") consists of a variable, demand-based parking pricing system coupled with a parking guidance system that will include real-time parking availability information. The IPM is intended to reduce traffic congestion, reduce air pollution, and improve transit efficiency by reducing parking search times by achieving 10 to 30 percent parking availability for on-street parking. The ExpressPark system will cover approximately 13,500 City of Los Angeles-owned or operated parking spaces (about 6,000 on-street, metered spaces and about 7,500 off-street spaces in an area of downtown Los Angeles bounded by the I-10 and I-110 freeways, Alameda Street and Adams Boulevard. The project area is shown in Figure 1-3. ExpressPark meter capabilities include demand-based parking rates based on time of day and length of stay; 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. Parking conditions and availability in off-street parking locations will be determined using vehicle sensors, cordon counting systems and/or advanced revenue control systems. The parking guidance component of the IPM will provide 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 Metro's 511 interactive voice response system, smart phones and, pending industry support, in-vehicle navigation systems.
- **Ridesharing Promotion (travel demand management)** to increase the number of registered vanpools (with a goal of 100 new 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.

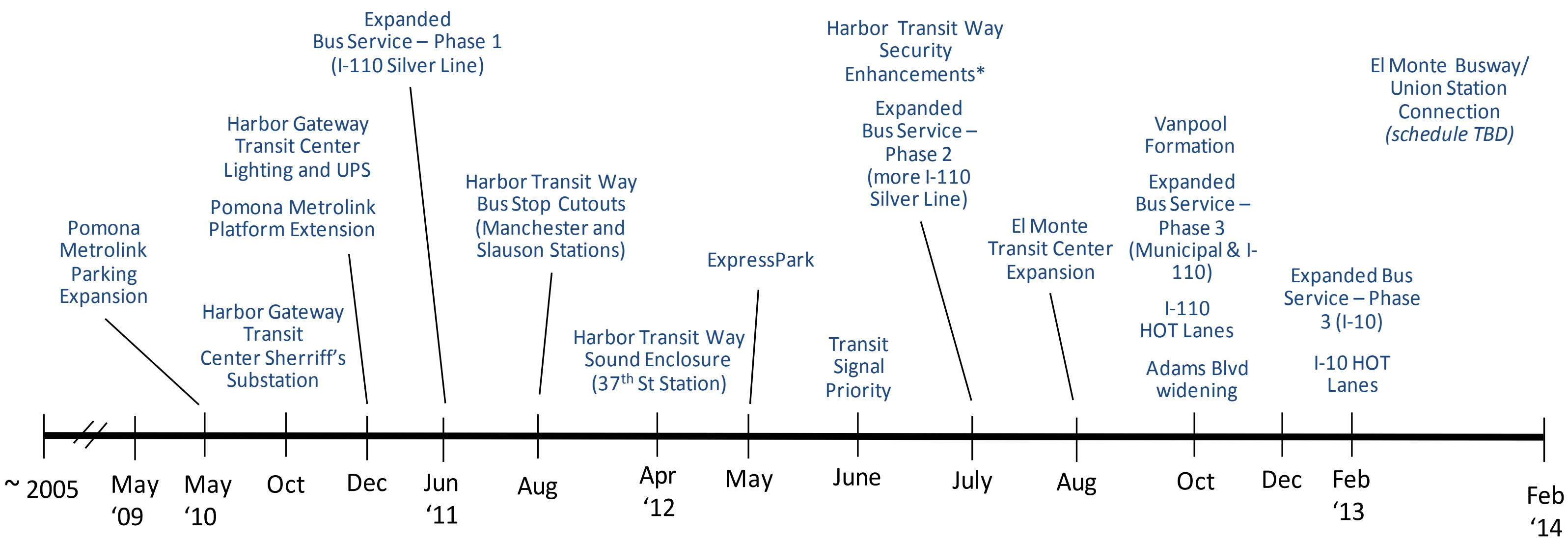
[2] The Equity Account Discount defines low income commuters as Los Angeles residents with an annual household income (family of 3) of $35,000 or less.



Source: Derived from "ExpressPark Intelligent Parking Management: Downtown" Los Angeles Department of Transportation Pamphlet http://ladot.lacity.org/pdf/PDF217.pdf

Figure 1-3. ExpressPark Project Area

Schedule for the LA CRD (Metro ExpressLanes) Program Projects. As shown in Figure 1-4, the LA CRD (Metro ExpressLanes) Program projects will become operational in a phased manner. Tolling on I-110 is scheduled to begin in October 2012, and tolling on I-10—the last project to be completed—is scheduled to begin in February 2013. Most of the LA CRD (Metro ExpressLanes) Program projects will be coming on line in advance of I-110 and I-10 tolling. One project will come on line after tolling begins on the I-10.



Stations: Slauson, Manchester, Harbor Green Line, Rosecrans, Harbor Gateway

Source: Based on information provided by Metro; March 2012.

Figure 1-4. LA CRD (Metro ExpressLanes) Program Project Completion ("Go Live") Schedule

1.2 LA CRD (Metro ExpressLanes) Program National Evaluation Plan and the Use of Data from the Safety Data Test Plan

Table 1-2 shows which of the various LA CRD (Metro ExpressLanes) Program test plans will contribute data to each of the evaluation analyses. The "flow" between test plans is "one way" in the sense that test plans feed data and measures to the analyses rather than the reverse. The solid circles show where data from a given test plan constitutes a major input to an analysis; the open circles show where data from a given test plan constitutes a supporting input to an analysis. As shown in Table 1-2, the Safety Data Test Plan provides major input to the Safety and Cost-Benefit Analyses and supporting input to the Congestion and Equity Analyses.

Within a test plan, data are grouped by type into various data elements. Table 1-3 lists the LA CRD (Metro ExpressLanes) Program safety data elements and, by associating those elements with the measures of effectiveness and the hypotheses/questions from the related evaluation analyses, summarizes why these data are important.

Table 1-2. Relationships Among Test Plans and Evaluation Analyses

LA CRD (Metro ExpressLanes) Program Test Plans	Evaluation Analyses										
	Tolling	Technology	Transit	Travel Demand Management (TDM)*	Congestion	Safety	Environmental	Equity	Business Impact	Non-Technical Factors	Cost-Benefit
Traffic System Data Test Plan	●		○		●	●	●	○			●
Tolling Test Plan	●	●			○			○	○		●
Transit System Data Test Plan			●		○						○
Ridesharing Test Plan				●				○			○
Safety Data Test Plan					○	●		○			●
Environmental Data Test Plan							●	○			○
Surveys, Interviews, Workshops Test Plan	●	●	●	●	○	○	○	●	●	●	○
Content Test Plan										●	
Cost Benefit Test Plan											●
Exogenous Factors Test Plan	○	○	○	○	○	○	○	○	○	○	

Source: Battelle, April 2012.

● — Test Plan Data Constitutes a Major Input to the Evaluation Analysis

○ — Test Plan Data Constitutes a Supporting Input to the Evaluation Analysis

* The only Travel Demand Management (TDM) element included in the LA CRD are those related to ridesharing and therefore what is called the TDM Analysis in the evaluation plan documents for some of the other UPA and CRD sites is referred to as the Ridesharing Analysis in the LA CRD evaluation documents.

Table 1-3. Safety Data Test Plan Data Elements Used in Testing Evaluation Hypotheses / Questions

LA CRD (Metro ExpressLanes) Program Data Element	LA CRD (Metro ExpressLanes) Program Measure of Effectiveness	LA CRD (Metro ExpressLanes) Program Hypotheses/Questions*
1. Total safety incidents 2. Type of safety incidents 3. Severity of safety incidents	• Change in incidents per vehicle miles traveled (VMT) in treatment corridors comparable to the before change condition	(LA Safety-1) The collective impacts of CRD improvements will be safety neutral or safety positive
4. Total safety incidents near HOT transition zones 5. Frequency of HOT transition zone violations	• Few if any safety events involving HOT transitions** • Few if any citations for transition zone violations**	(LA Safety-2) The addition of transition zones will not increase incidents
6. Total safety incidents in HOT buffer zones 7. Frequency of HOT buffer zone violations for boundary jumping	• Few if any safety incidents attributable to boundary jumping** • Few if any citations for boundary jumping**	(LA Safety-3) Will boundary jumping cause incidents?
8. CHP accident logs (response time)	• Change in average accident response time in treatment corridors is comparable to that occurring on similar routes in the region • Change in accident clearance times in treatment corridors is comparable to that occurring on similar routes in the region	(LA Safety-4) Will the additional law enforcement presence (associated with speed and toll enforcement) coupled with enhancement of the dedicated tow truck vehicle removal services associated with the CRD impact incident response and/or clearance time?

Source: Battelle, April 2012.

*The full set of Los Angeles CRD evaluation hypotheses/questions, including those related to safety data which are identified in this table, are listed in Appendix B.

**This assumes that the HOT lanes will—in contrast with the current HOV lanes—identify only specific areas where vehicles may enter or exit the HOT lanes, i.e., "transition zones" with the remaining areas (i.e., "buffer zones") prohibiting ingress and egress.

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2.0 DATA SOURCES, AVAILABILITY, AND RISKS

This chapter identifies the sources for the safety data and discusses the availability of the data, as well as any potential risks associated with collecting and processing them for use in the evaluation. The safety data discussed in this test plan focuses on crash and incident data associated with the conversion to HOT lanes of the El Monte Busway and I-10 HOV lanes (I-605 to Alameda St.) and the I-110 Harbor Transitway HOV lanes (Harbor Gateway Transit Center to Adams Blvd.). Safety analysis for these and the other LA CRD (Metro ExpressLanes) Program projects will also be qualitatively conducted through personnel interviews, which are collected through the Surveys, Interviews, and Workshops Test Plan.

The primary interest of this safety analysis is whether infrastructural and procedural changes associated with the HOT lanes will (1) create safety problems at HOT lane entry points and transition zones or (2) whether the changes provide safety benefits or result in the emergence of new types of safety events (e.g., incidents involving buffer violation to evade tolls). Crash and incident rates prior to HOT lane corridor changes will be evaluated against collision and volume data occurring after changes have been put into effect for the HOT lane corridors. In addition, pre- and post-data will be compared with crash rates on other area urban freeways.

2.1 Data Sources

Three types of data are required for the safety evaluation including: crash records, incident reports, and citation records. The information that will be gleaned from this safety data includes:

- Locations of safety incidents attributable to buffer violations;
- Descriptions of the basic facts of safety incidents; and
- Indications of incident type and severity.

The Safety Data Test Plan uses several sources of data, which include the California Highway Patrol (CHP) Statewide Integrated Traffic Records System (SWITRS), the Caltrans Traffic Accident Surveillance and Analysis System Accident Database (TASAS AXDB), and CHP citation records. The data from these sources is described next, along with the advantages and limitations of each database. Table 2-1 details the data needs for the LA CRD (Metro ExpressLanes) Program and lists location, granularity, frequency, time period, and responsible agency for each data element.

Table 2-1. Summary of Data Needs for LA CRD (Metro ExpressLanes) Program

Data Element	Location	Data Granularity	Data Collection Timing		Data Reporting Frequency	Data Source
			Pre-Deployment	Post-Deployment		
1. Total safety incidents	HOT and comparison HOV corridors* (I-405, I-210, I-605)	Individual crash or incident record	11/2009-10/2012 [I-110] 3/2010-2/2013 [I-10]	11/2012-10/2013 [I-110] 3/2013-2/2014 [I-10]	Annual	SWITRS
2. Type of safety incidents	HOT and comparison HOV corridors* (I-405, I-210, I-605)	Individual crash or incident record	11/2009-10/2012 [I-110] 3/2010-2/2013 [I-10]	11/2012-10/2013 [I-110] 3/2013-2/2014 [I-10]	Annual	SWITRS
3. Severity of safety incidents	HOT and comparison HOV corridors* (I-405, I-210, I-605)	Individual crash or incident record	11/2009-10/2012 [I-110] 3/2010-2/2013 [I-10]	11/2012-10/2013 [I-110] 3/2013-2/2014 [I-10]	Annual	SWITRS
4. Total safety incidents near HOT transition zones	HOT lane transition zones	Individual crash or incident record	N/A	11/2012-10/2013 [I-110] 3/2013-2/2014 [I-10]	Once at end of data collection	TASAS AXDB
5. Frequency of HOT transition zone violations	HOT lane transition zones	Individual citation record	N/A	11/2012-10/2013 [I-110] 3/2013-2/2014 [I-10]	Once at end of data collection	CHP citation records
6. Total safety incidents near HOT buffer zones	HOT lane buffer zones	Individual crash or incident record	N/A	11/2012-10/2013 [I-110] 3/2013-2/2014 [I-10]	Once at end of data collection	TASAS AXDB
7. Frequency of HOT buffer zone violations for boundary jumping	HOT lane buffer zones	Individual citation record	N/A	11/2012-10/2013 [I-110] 3/2013-2/2014 [I-10]	Once at end of data collection	CHP citation records
8. CHP accident logs (clearance and response time)	HOT lane corridors	Individual crash or incident record	11/2009-10/2012 [I-110] 3/2010-2/2013 [I-10]	11/2012-10/2013 [I-110] 3/2013-2/2014 [I-10]	Once at end of data collection	CHP accident logs

Source: Battelle, April 2012.

* The objective here is not to find "matched" control corridors per se but to simply compare CRD corridor crash statistics with other freeway corridors (or segments) in an attempt to understand the influence of non-CRD, regional factors on crashes.

Statewide Integrated Traffic Records System. California developed the "Statewide Integrated Traffic Records System" (SWITRS) as a repository for Traffic Collision Reports, which are the basic element of raw accident data collected in the state. SWITRS is maintained by CHP. SWITRS holds data for all fatal and injury motor vehicle traffic crashes. In addition, data relating to a large proportion of the reported property damage-only crashes also reside in SWITRS. The evaluation expects SWITRS to contain records of all fatal and injury crashes occurring in the I-10 and I-110 corridors on both freeways and arteries. However, there may be a lag of six to nine months between the date of crashes and the appearance of relevant data in SWITRS. Table 2-2 details elements of raw data available for SWITRS records, a sample of which is exhibited in Appendix A.

Table 2-2. Relevant SWITRS Data Elements

Report Type	Applicability
Collisions and Victims by Motor Vehicle Involved	Total collisions, fatal collisions, injury collision data for non-collision, other motor vehicle
Collisions and Victims by Primary Collision Factor	Unsafe lane change
Countywide Total Collision Report	Analysis to determine overall CRD changes effect on collision rate (specifically injury and fatality collisions)

Source: Derived from available SWITRS records, accessed April 2012.

Traffic Accident Surveillance and Analysis System Accident Database. Caltrans developed the Traffic Accident Surveillance and Analysis System (TASAS) to summarize and analyze SWITRS data. SWITRS are transferred to Caltrans where they are post-processed and inserted into Caltrans own accident database (AXDB). AXDB contains ten historical years of crash data plus data for the most recent year. The individual records in the AXDB contain two basic types of data, those describing crashes themselves and those describing the parties involved in the crash. The national evaluation is only interested in the first set of data elements which include:

- Location
- Severity
- Environmental Features
- Collision Type
- Time and Date
- Primary Collision Factor
- Roadway Conditions
- Number of Involved Vehicles.

The location data in AXDB records refers to highway kilometer posts, ramps, intersections, or other transportation facility elements. The AXDB is used by Caltrans to map and identify high crash locations that merit potential safety improvements.

California Highway Patrol Citation Records. The CHP maintains a record of all citations issued that includes information regarding the nature of the traffic violation, e.g., HOT lane buffer zone violation, as well as general location information of the infraction. For the evaluation, Caltrans will obtain relevant citation information by route as it pertains to buffer zone and transition zone violations.

2.2 Data Availability

The evaluation does not foresee any major obstacles to gaining access to the required data, although there will be a six to nine month delay between the occurrence of safety events and the availability of data in the SWITRS, TASAS, and CHP citation record repositories describing these events.

It is possible that the location information in these repositories may not be as precise as desired for the evaluation and the causal information recorded for low severity events is likely to be minimal. The national evaluation team recognizes these data limitations. Information obtained through the Surveys, Interviews, and Workshops Test Plan from interviews with law enforcement and professional drivers who travel in the I-10 and I-110 corridors may help to fill gaps left by the data in the incident databases.

California law states that data contained in raw accident reports is for the confidential use of the CHP, Caltrans, and local authorities with jurisdiction over relevant highways. The evaluation does not expect to gain access to raw incident data, and SWITRS and TASAS are expected to meet the evaluation needs. If necessary, however, due to any major concerns, the evaluation team will need Caltrans to summarize supplemental incident data needed by the evaluation at a level consistent with the confidentiality requirements of California law.

As noted in Table 2-1, basic crash statistics (number, type, severity and rate) for the CRD corridors will be compared to comparable statistics for other regional HOV freeway corridors, i.e., I-405, I-210, and/or I-605. These three corridors have been suggested by Caltrans keeping in mind that the objective is not to have a matched, formal "control corridor"—indeed, the local partners indicated during the Evaluation Plan development that no such corridors exist—but rather simply to have other freeway corridors where the comparison may shed some light on the possible influence of non-CRD related, regional influences on the observed CRD corridor safety statistics. It is the evaluation team's understanding that there is no periodic, e.g., annual, regional freeway safety analysis performed that would readily provide such comparison statistics and, therefore, that these statistics will need to be computed by the evaluation team using raw crash data provided by the local partners. Given the significant effort associated with that data collection and analysis, it will only be possible to make comparisons to two other freeway corridors or segments.

2.3 Potential Risks

There are inherent limitations and risks associated with the use of traffic crash and incident databases and safety-related analyses. Table 2-3 identifies the risks and limitations and potential mitigations for each.

Table 2-3. Potential Risks and Limitations of Safety Data

Risk or Limitation	Mitigation
Crash and incident data are recorded by personnel at the scene. As a result, the accuracy of the data depends on individuals providing accurate and complete information.	Although it does not fully mitigate this risk, qualitative feedback from CHP personnel (collected through interviews described in the Surveys, Interviews and Workshops Test Plan) regarding their overall perceptions of the nature of any post-CRD changes in crashes may be useful.
Even when accurate and complete information is recorded, the exact cause(s) of a crash or incident may not be apparent or known. For example, a crash in the HOT lane may be the result of driver actions in the general-purpose freeway lanes or visa-versa.	None identified.
Crash data in SWITRS or TASAS does not always note the lane that an incident takes place. Thus, it may be unknown whether an incident on the corridor takes place in the right shoulder or the HOT lane.	The evaluation team will work with other available data, such as the Advanced Transportation Management System (ATMS) logs, which may note the lanes affected by a collision and help to HOT lane-related crashes, as deemed necessary.
There is a lag time with the availability of data from some of the databases. Less than a year of post-deployment safety data may be available.	The evaluation team will work with available data, to make seasonal or other adjustments if appropriate, and in the final report note cautions to be taken in interpretation of the findings.
Fully examining the safety improvements of projects takes longer than the one-year post-deployment period available for analyzing the Los Angeles County CRD project.	Compare I-110 and I-10 data and historical trends. In the final report note cautions to be taken in interpretation of the findings.

Source: Battelle, April 2012.

Given budget and time considerations, there are no cost effective approaches for addressing all of these risks. The use of the multiple databases in this test plan, along with examining overall crash data from the area as a reference point will help address some of the risks. The national evaluation team will analyze the available safety data, but fully exploring the safety impacts of the LA CRD (Metro ExpressLanes) Program projects may require a long-term analysis beyond the scope of the national evaluation. Thus, the potential impact on the evaluation of the data risks is that the safety analysis may not provide conclusive findings regarding the LA CRD projects. Nevertheless, participating agencies will be able to use the evaluation protocol to continue to monitor and analyze crash and incident data in the future, which will provide a longer-term perspective on the safety impacts of the LA CRD projects.

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3.0 DATA ANALYSIS

It is the understanding of the national evaluation team that the safety analysis is important to identify any unexpected adverse safety effects, although not as high of a priority for resources as, for example, the congestion analysis, since the LA CRD (Metro ExpressLanes) Program projects are not specifically designed to improve safety. This safety analysis will include both before/after comparison of general crash and incident data as well as after-only analysis of the safety of HOT lane access control features. The data will be used to assess the measure of effectiveness (MOE) in the safety and technology analyses and to estimate the safety cost savings from the LA CRD projects for the cost benefit analysis.

Members of the Battelle team will conduct a visual inspection of the data to identify any outliers or suspect data. Any data concerns identified will be checked with Caltrans and the appropriate action will be taken.

Additionally, the evaluation team will utilize a data log maintained by the local partners for Section 166 compliance requirements within the HOT lane agreement. This data will be gathered through the Exogenous Factors Test Plan, and include information regarding incidents in both the Metro ExpressLanes and general purpose lanes in the I-10 and I-110 corridors, in both directions. This should include all incidents, including crashes and law enforcement activities that result in the closure of one or more lanes for any time period, as reported by California Highway Patrol and/or Caltrans. Although this log is not expected to be comprehensive enough to supplant any data elements collected with this test plan, it may be used to supplement collected data.

This analysis includes both quantitative and qualitative data, each of which are described below.

3.1 Quantitative Data Analysis

The quantitative data analysis will include both pre- vs. post-deployment as well as some post-deployment only analysis (pertaining to HOT lane ingress and egress) crash, incident, and citation data for the HOT corridors to assess the effects of the LA CRD project on corridor safety. MOEs described under the safety analysis will be computed. These are concerned with the frequency, type, cause, time, and location of safety incidents in the treatment corridors with special regard to the features of the LA CRD project infrastructure (HOT buffer zones, etc.) which might be a factor in crashes.

Examples of the measures and analysis to be used in examining the safety data are highlighted below. Appropriate statistical measures, such as testing for significance, will be applied.

- Total numbers of crashes. The total number of crashes on the El Monte Busway/I-10 and I-110 corridors will be compared before and after deployment.
- Spatial configuration of crashes. The location or spatial configuration of crashes on the various facilities will also be analyzed pre- and post-deployment. This analysis will assist in determining any changes in the number of crashes on the HOT corridors versus other HOV freeway corridors.

- Types and severity of crashes. The types and the severity of crashes will be examined pre- and post-deployment based on available data. This analysis will assess potential changes in the nature of crashes, and the resulting severity, based on the LA CRD project.
- Crashes per 1,000 VMT. This analysis will compare pre- and post-deployment crashes per 1,000 VMT, based on available data from the traffic data test plan. This measure normalizes crash rates to account for either increases or decreases in VMT.
- Frequency of buffer and transition zone violations and crashes. The number of safety incidents and citations for illegally crossing into and out of the HOT lanes will be assessed in the post-deployment period.

Judgments about the causal relationship between crashes and incidents will be made based on a detailed understanding of the LA CRD deployments and operational strategies coupled with all available data on crash and incident cause or contributing factors. Although the specific number of crashes will be considered, most conclusions related to LA CRD causality will be based on crash rates so that the impact of varying traffic volumes are controlled. There are no specific control corridors or control area for the LA CRD project. However, CRD corridor crash statistics (total number, types and severity and rates) will be compared with data on other LA HOV freeway corridors, i.e., I-405, I-210, and/or I-605, thereby aiding the understanding of what portion of any observed nominal change in CRD corridor crash rates may be attributable to other, non-CRD factors impacting the region.

A variety of multivariate techniques will be used to incorporate exogenous factors into the safety analysis. Descriptive analytic tools, such as histograms and scatter plots, will be produced to identify patterns in the data. Standard statistical measures, such as t-tests, F-tests, and Chi-Square tests, will help identify statistically significant variations in the data. Multivariate regression analysis, Poisson transformations, and correlations will also be used where warranted.

One of the major challenges related to safety data is that given the year-over-year variability in collisions and incidents, one year is a very short period of time upon which to base judgments about post-deployment safety impacts. Collection and analysis of historic collision and incident data in order to determine long-term trends is one method that will be used to control for short-term variability on the pre-deployment side of the before-after safety impacts assessment. Also, if, as expected, less than a full year of post-deployment data is available due to the lag in the availability of data from CHP SWITRS, that data will be extrapolated to create a full one-year comparison with the baseline data, while accounting for seasonal changes.

Another factor that must be taken into account for before/after comparative analysis is the additional HOT lane being constructed on I-10 between I-610 and I-705. This, in addition to just the conversion from a HOV lane to a HOT lane, has the potential to impact safety and will be noted in the analysis.

The safety analysis will compare and contrast the following metrics from SWITRS, TASAS AXDB, CHP citation records, and CHP accident log to determine whether there was a significant change within a 5% margin of error before and after deployment. The period of time studied will focus on a micro and macro scale, i.e., the initial 3 months immediately following a significant change (such as the conversion to a HOT lane) with the previous year's same three month time

period as well as the macro scale of 6-12 months data post-change to 6-12 months data pre-change.

1. Total Collisions
    a. With respect to Total Collisions
    b. With respect to Unsafe Lane Change
2. Fatal Collisions
    a. With respect to Total Collisions
    b. With respect to Unsafe Lane Change
3. Injury Collisions
    a. With respect to Total Collisions
    b. With respect to Unsafe Lane Change
4. Location of Collision – ascertain the rates of accidents based on traffic volumes in the HOV lanes, HOV Lane Transition Zone, and HOV Lane Buffer area and compare to the post change of an HOT Lanes, HOT Lane Transition Zone and HOT Lane Buffer Area; check with CHP interview responses.
    a. HOV/HOT Lanes
    b. HOV/HOT Lane Transition Zone
    c. HOV/HOT Lane Buffer Area
5. CHP response time

3.2 Qualitative Data Analysis

Qualitative data gathered as a part of the Surveys, Interviews, and Workshops Test Plan will also be used in the safety analysis to supplement quantitative data. Specifically, a post-deployment interview with CHP personnel will ask about their perception of safety events, citations, and whether a significant number of incidents is attributable to transition zones or boundary jumping. This information will provide additional perspective to the quantitative results pertaining to four of the five safety analysis hypotheses. The fifth and final safety hypothesis (LA-Safety5), "Will adjusted enforcement procedures affect the number of incidents?" will be evaluated solely upon the CHP interview data since it attempts to directly link enforcement strategy changes with safety outcomes.

Additionally, the frequency of buffer and transition zone violations and crashes will be examined. Because the number of safety incidents and citations for illegally crossing into and out of the HOT lanes will be assessed in the post-deployment period only, the evaluation team will be unable to use firm quantitative analysis to make observations.

Generally speaking, the qualitative safety data is not expected to provide definitive conclusions related to the safety impacts of the CRD deployment; the quantitative analysis will carry most of that burden. However, the qualitative data is expected to provide additional useful perspective.

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4.0 SCHEDULE AND RESPONSIBILITY

The collection schedule for safety data is summarized in Table 4-1. These data are routinely collected and archived by the local partners. The national evaluation team will be responsible for analysis of the data and reporting of the findings.

Table 4-1. Safety Data Collection Schedule

Project Element	Dates
Baseline Data*	11/2009-10/2012 [I-110] 3/2010-2/2013 [I-10]
One-Year Post-Deployment Data	11/2012-10/2013 [I-110] 3/2013-2/2014 [I-10]

Source: Battelle, April 2012.

*Includes two years of "historic data" plus the single "pre-deployment" year immediately prior to HOT lane operations.

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APPENDIX A – SAMPLE OF SWITRS COLLISION DATA RECORDS

CASE_ID	3989688	4062972	4078490	4078498	4079582	4080824
ACCIDENT_YEAR	2009	2009	2009	2009	2009	2009
PROC_DATE	20100114	20090916	20091109	20091109	20100107	20100121
JURIS	9590	9580	9530	9530	9590	9590
COLLISION_DATE	20090101	20090101	20090101	20090101	20090101	20090101
COLLISION_TIME	514	1719	720	721	135	215
OFFICER_ID	18040	18710	15126	15126	18345	17965
REPORTING_DISTRICT						
DAY_OF_WEEK	4	4	4	4	4	4
CHP_SHIFT	3	2	1	1	3	3
POPULATION	7	7	7	7	7	7
CNTY_CITY_LOC	1942	1942	1942	1942	1942	1942
SPECIAL_COND	0	0	0	0	0	0
BEAT_TYPE	1	1	1	1	1	1
CHP_BEAT_TYPE	1	2	1	1	1	1
CITY_DIVISION_LAPD						
CHP_BEAT_CLASS	2	2	2	2	2	2
BEAT_NUMBER	50	102	110	110	60	52
PRIMARY_RD	RT 110	RT 101	RT 110	RT 110	RT 10	RT 110
SECONDARY_RD	SLAUSON AV	BALBOA BL	RT 91	RT 91	LA SALLE AV	11TH ST
DISTANCE	780	200	528	528	96	200
DIRECTION	S	S	S	S	E	N
INTERSECTION	N	N	N	N	N	N
WEATHER_1	E	A	B	B	E	B
WEATHER_2	-	-	E	E	-	-
STATE_HWY_IND	Y	Y	Y	Y	Y	Y
CALTRANS_COUNTY	LA	LA	LA	LA	LA	LA
CALTRANS_DISTRICT	7	7	7	7	7	7
STATE_ROUTE	110	101	91	91	10	110
ROUTE_SUFFIX	-	-	-	-	-	-
POSTMILE_PREFIX	-	-	-	-	R	-
POSTMILE	17.82	19.18	6.298	6.298	13.06	22.06
LOCATION_TYPE	H	H	R	R	H	H
RAMP_INTERSECTION	-	-	2	2	-	-
SIDE_OF_HWY	N	N	E	E	E	N
TOW_AWAY	N	Y	N	N	Y	Y
COLLISION_SEVERITY	0	0	0	0	2	3
NUMBER_KILLED	0	0	0	0	0	0
NUMBER_INJURED	0	0	0	0	5	1
PARTY_COUNT	2	2	1	1	1	1

PRIMARY_COLL_FACTOR	A	A	A	A	A	A
PCF_CODE_OF_VIOL	-	-	-	-	-	-
PCF_VIOL_CATEGORY	3	7	3	3	8	1
PCF_VIOLATION	22350	21658	22350	22350	22107	23152
PCF_VIOL_SUBSECTION		A				A
HIT_AND_RUN	N	M	N	N	N	N
TYPE_OF_COLLISION	C	B	E	E	F	E
MVIW	C	C	I	I	I	I
PED_ACTION	A	A	A	A	A	A
ROAD_SURFACE	A	A	B	B	A	A
ROAD_COND_1	H	H	H	H	H	H
ROAD_COND_2	-	-	-	-	-	-
LIGHTING	C	B	A	A	C	C
CONTROL_DEVICE	D	D	D	D	D	D
CHP_ROAD_TYPE	1	1	1	1	1	1
PEDESTRIAN_ACCIDENT						
BICYCLE_ACCIDENT						
MOTORCYCLE_ACCIDENT						
TRUCK_ACCIDENT						
NOT_PRIVATE_PROPERTY	Y	Y	Y	Y	Y	Y
ALCOHOL_INVOLVED						Y
STWD_VEHTYPE_AT_FAULT	I	-	A	A	A	A
CHP_VEHTYPE_AT_FAULT	20	-	1	1	7	1
COUNT_SEVERE_INJ	0	0	0	0	1	0
COUNT_VISIBLE_INJ	0	0	0	0	4	1
COUNT_COMPLAINT_PAIN	0	0	0	0	0	0
COUNT_PED_KILLED	0	0	0	0	0	0
COUNT_PED_INJURED	0	0	0	0	0	0
COUNT_BICYCLIST_KILLED	0	0	0	0	0	0
COUNT_BICYCLIST_INJURED	0	0	0	0	0	0
COUNT_MC_KILLED	0	0	0	0	0	0
COUNT_MC_INJURED	0	0	0	0	0	0
PRIMARY_RAMP	-	-	TO	TO	-	-
SECONDARY_RAMP	-	-	-	-	-	-
LATITUDE		34.17029	33.8717	33.87177		
LONGITUDE		118.5008	118.28562	118.28545		

Source: Derived from available SWITRS records, accessed April 2012.

APPENDIX B – HYPOTHESIS/QUESTIONS FROM THE L.A. COUNTY CRD NATIONAL EVALUATION PLAN

Evaluation Analysis	Hypothesis/ Question Number	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 Number	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 Number	Hypothesis/Question
Safety	LASafety-1	The collective impacts of CRD improvements[3] 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 the additional law enforcement presence (associated with speed and toll enforcement) coupled with enhancement of the dedicated tow truck vehicle removal services associated with the CRD impact incident response and/or clearance time?
	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?
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 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
	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, April 2012.

[3] 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).

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