ATLANTA
CONGESTION REDUCTION DEMONSTRATION
NATIONAL EVALUATION PLAN

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ATLANTA
CONGESTION REDUCTION DEMONSTRATION
NATIONAL EVALUATION PLAN

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16. Abstract

This report provides an analytic framework for evaluating the Atlanta Congestion Reduction Demonstration (CRD) under the United States Department of Transportation (U.S. DOT) Urban Partnership Agreement (UPA) and CRD Programs. The Atlanta CRD projects include the conversion of lanes for high occupancy vehicle with a minimum of two occupants (HOV2+) on approximately16-miles of I-85 to high occupancy toll (HOT)/HOV3+ lanes along with expansion and enhancement of transit service in that corridor, including new and expanded park-and-ride lots. The Atlanta CRD national evaluation plan identifies major questions to be answered through the evaluation, the evaluation analyses to be used to address those questions, and the data needed for the analyses. It also outlines the test plans that will be used to collect and analyze the required data. The evaluation plan is based on the National Evaluation Framework (NEF) prepared for the U.S. DOT. Four objective questions that were posed by U.S. DOT serve as a starting point for the NEF and Atlanta Evaluation Plan. These questions are how much congestion was reduced; what contributed to the reduction and what were the associated impacts; what lessons were learned about non-technical factors for success; and what were the overall cost and benefit of the congestion reduction strategies. The four objective questions were translated into twelve evaluation analyses, which in turn consist of hypotheses and questions, measures of effectiveness (MOEs), and data required for the MOEs. This document presents the plan for evaluating the Atlanta CRD projects.

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LIST OF ABBREVIATIONS

4Ts	Tolling, Transit, Telecommuting, and Technology
AADT	Annual average daily traffic
AFV	Alternative fuel vehicle
ALPR	Automatic license plate reader
ARC	Atlanta Regional Commission
AVI	Automatic vehicle identification
AVL	Automatic vehicle location
AVO	Average vehicle occupancy
CAC	Clean Air Campaign
CBA	Cost benefit analysis
CID	Community Improvement District
COTM	Contract Officer Technical Manager
CO2	Carbon dioxide
CRD	Congestion Reduction Demonstration
CTE	Center for Transportation and the Environment
CT-RAMP	Coordinated Travel Regional Activity-Based Modeling Platform
CUTR	Center for Urban Transportation Research
CVO	Commercial vehicle operator
DOE	Department of Environment
DPS	Department of Public Safety
EA	Environmental Analysis
EPD	Environmental Protection Division
FARS	Fatality Analysis Reporting System
FHWA	Federal Highway Administration
GDOT	Georgia Department of Transportation
Georgia Tech	Georgia Institute of Technology
GFI	General Fares Industry
GRTA	Georgia Regional Transportation Authority
HC	hydrocarbon
HERO	Highway Emergency Response Operators
HOT	High occupancy toll

HOV	High occupancy vehicle
ITS JPO	Intelligent Transportation Systems Joint Program Office
LOS	Level of service
MARTA	Metropolitan Atlanta Rapid Transit Authority
MOE	Measure of effectiveness
NEF	National Evaluation Framework
NO_x	Nitrogen oxide
PM	Particulate matter
PMT	Person miles traveled
PT	Person throughput
PTI	Planning time index
RFID	Radio frequency identification
RITA	Research and Innovative Technology Administration
ROG	Reactive organic gas
SIP	State implementation plan
SRTA	State Road and Tollway Authority
STARS	State Traffic and Reporting Statistics
TCM	Transportation control measures
TDM	Travel demand management
TMC	Traffic Management Center
TTI	Texas Transportation Institute
UPA	Urban Partnership Agreement
U.S. DOT	United States Department of Transportation
VOC	Volatile organic compounds
VMT	Vehicle miles traveled
VT	Vehicle trips

EXECUTIVE SUMMARY

This report provides an analytical framework for evaluating the Atlanta Congestion Reduction Demonstration (CRD) under the United States Department of Transportation (U.S. DOT) Urban Partnership Agreement (UPA) and CRD program. It identifies the hypotheses to be tested and questions to be answered in the evaluation, the evaluation analyses and measures of effectiveness, and the data needed to conduct the analyses.

Background

In 2006, the U.S. DOT, in partnership with metropolitan areas, initiated a program to explore reducing traffic congestion through the implementation of pricing activities combined with necessary supporting elements. This program was instituted through the UPAs and the CRDs. Within each program, multiple sites around the U.S., including Atlanta, were selected through a competitive process. The selected sites were awarded funding for implementation of congestion reduction strategies. The applicants' proposals for congestion reduction were based on four complementary strategies known as the 4Ts: Tolling, Transit, Telecommuting, which includes additional travel demand management (TDM) strategies, and Technology.

The UPA/CRD national evaluation is sponsored by the U.S. DOT. The Research and Innovative Technology Administration (RITA) Intelligent Transportation Systems Joint Program Office (ITS JPO) is responsible for the overall conduct of the national evaluation. Representatives from the modal agencies are 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 is to assess the impacts of the UPA/CRD projects in a comprehensive and systematic manner across all sites. The national evaluation will gather information and produce technology transfer materials to support deployment of the strategies in other metropolitan areas. The national evaluation will also generate findings for consideration 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 at multiple sites. The NEF is based on the 4Ts congestion reduction strategies and the questions that the U.S. DOT seeks to answer through the evaluation.

The Atlanta CRD

The Atlanta CRD partnership is led by three public agencies—the Georgia Department of Transportation (GDOT), the Georgia Regional Transportation Authority (GRTA), and the State Road and Tollway Authority (SRTA). Other partners include Atlanta Regional Commission (ARC), Georgia Department of Public Safety, Metropolitan Atlanta Rapid Transit Authority (MARTA), Gwinnett County Government, Clean Air Campaign (CAC), and Georgia Institute of Technology (Georgia Tech).

The CRD projects that are the subject of the national evaluation include:

HOT Lanes on I-85. As the first phase of a regional integrated system of congestion-priced lanes, the existing HOV lanes will be converted to dynamically-priced high occupancy toll (HOT) lanes on approximately 16 miles of I-85 from I-285 in DeKalb County to Old Peachtree Road in Gwinnett County, as depicted in Figure ES-1. The current HOV2+ lanes will be changed to HOV3+ and require registration to use the lanes. Vehicles with less than three occupants will have the option to use the HOV3+ lane by paying a toll. Toll-exempt vehicles include HOV3+, motorcycles, and alternative fuel vehicles (but not hybrids). Tolling will occur 24 hours a day and seven days a week. GDOT is responsible for the construction in the HOV to HOT conversion. SRTA will operate the tolling portion of the system.

Georgia DOT, Presentation at Public Hearing Open House, November 12, 2009.

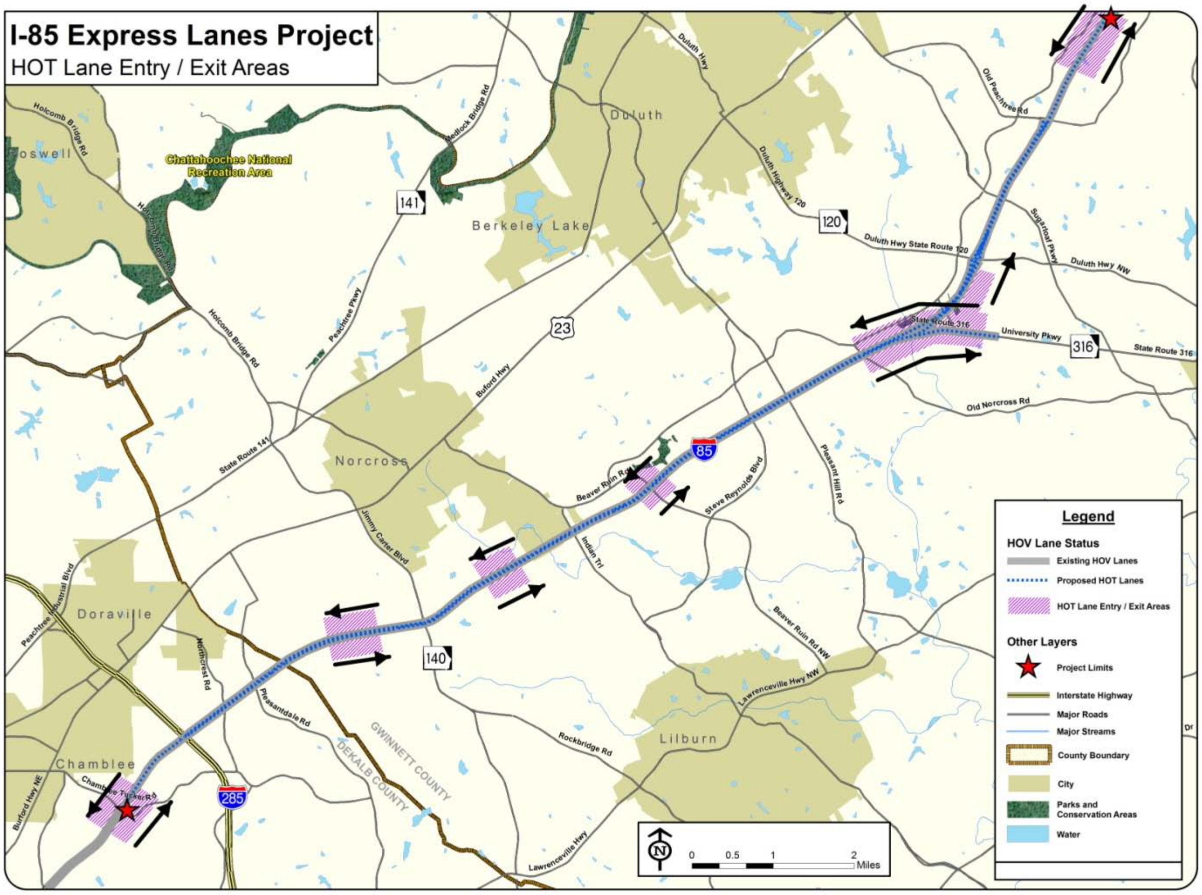

Figure ES-1. I-85 HOV to HOT Conversion Project

Transit Enhancements. A total of 36 new CRD-funded buses will be added to the commuter bus fleet on the I-85 corridor, with 20 buses added in 2010 and 16 more in 2011. The expanded fleet will enable five new routes to operate on the corridor, the first of which began in August of 2010. GRTA will purchase the buses. GRTA is also responsible for the construction of the park-and-ride lots in the corridor. These include three new lots—Mall of Georgia, Hamilton Mill, and Cedars Lane—and one expanded lot at I-985/GA 20. Due to the construction schedule, the evaluation will not include Cedars Lane lot. In addition to three CRD-funded park and ride lots, the evaluation will include two other lots that are not funded by the CRD but could be impacted. These include Discover Mills and Indian Trail Park and Ride Lots.

Automated Enforcement Systems. Radio frequency identification (RFID) readers will read transponders, and cameras will collect images of vehicle occupancy and vehicle license plates. This information will be used to identify toll violators. Mobile automatic license plate reader (ALPR) camera systems will be installed in enforcement vehicles to aid in occupancy verification of registered vehicles using the HOT lane. Enforcement officials will be provided with an audible or visual alert if a license plate doesn't match the database of registered HOT users. Officers will upload a list of occupancy violations written during a shift to the HOT lane back-office system.

Carpooling Outreach. Public outreach to encourage alternative mode use will be part of Clean Air Campaign's on-going efforts to promote travel alternatives to single occupant vehicles. Important to the HOV to HOT lane conversion, Clean Air Campaign will contact 2-person carpools to help them transition to 3-person carpools and will use existing incentive programs.

Evaluation Analyses and Test Plans

The national evaluation of the Atlanta CRD projects addresses the 12 analysis areas outlined in the NEF: congestion, tolling, transit, TDM, technology, safety, equity, environmental, goods movement, business impact, non-technical success factors, and cost-benefit. Analyses describe the evaluation questions and hypotheses to be investigated, which in turn are supported by a series of "test plans." 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 12 analysis areas. 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. 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.

There are a total of ten test plans for the Atlanta CRD national evaluation. Table ES-1 presents the relationship among the analysis areas and the test plans. 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.

One of the analysis areas, the tolling analysis, is presented below in Table ES-2 as an example of the approach used throughout the Atlanta CRD National Evaluation Plan. The HOT lanes on I-85 are expected to have positive outcomes on travel in the corridor, such as travel time reliability, increased throughput, and reduced congestion. HOT lanes could also contribute to mode shift. Table ES-2 illustrates the hypotheses and questions, measures of effectiveness, and data for the tolling analysis.

The first hypothesis is that the HOT lanes will increase vehicular throughput in the corridor and improve travel reliability during the peak periods. The effect of variable tolling will be measured by the change in vehicle usage and travel-time reliability in the new HOT lanes. The second related hypothesis addresses specific change in usage as a result of the HOV-to-HOT conversion. Changes in usage will be measured by vehicle occupancy, person throughput, vehicle user groups, shifts of two-person carpools (in terms of mode, route and time of travel), and formation of casual carpools (also known as "slugging") due to the new HOV3+ requirement. Data needed to assess these measures of effectiveness include traffic data, toll system data, and surveys and observations of users.

Plans for collecting and analyzing data pertaining to these hypotheses and all other evaluation hypotheses will be detailed in a series of test plan documents. The ten preliminary test plans for the Atlanta CRD evaluation are included in this evaluation plan document. Responsibility for collecting the data described in the preliminary test plans will reside with the Atlanta CRD partners. The national evaluation team will provide guidance to the partners on data collection and will be responsible for analyzing all the data and reporting the results.

Table ES-1. Relationship among Test Plans and Evaluation Analyses

Atlanta CRD Test Plans	Congestion Analysis	Tolling Analysis	Transit Analysis	TDM Analysis	Technology Analysis	Safety Analysis	Equity Analysis	Environmental Analysis	Goods Movement Analysis	Business Impact Analysis	Non-Technical Success Factors Analysis	Cost Benefit Analysis
Traffic System Data Test Plan	●	●			○	○	○	●	●			○
Tolling Data Test Plan		●			○		○	○	●	○		○
Transit System Data Test Plan	○	○	●				○	○				○
TDM Data Test Plan	○			●			○	○		○		○
Safety Data Test Plan					●	●						○
Surveys and Interviews Test Plan	○	○	●	●		○	●	○	○	○	●	○
Environmental Data Test Plan							○	●				○
Content Analysis Test Plan											●	
Cost Benefit Analysis Test Plan												●
Exogenous Factors Test Plan	○	○	○	○	○	○	○	○	○	○	○	○

● — Major Input ○ — Supporting Input

Table ES-2. Illustrative Excerpt from the Tolling Analysis Approach

Hypotheses/Questions	Measures of Effectiveness	Data
▪ The HOT lanes will increase vehicular throughput on I-85 HOV/HOT and improve travel reliability	▪ Change in vehicle throughput (number of vehicles) on I-85 HOV/HOT ▪ Change in buffer time ▪ Change in planning time index ▪ Change in travel time variance (or standard deviation)	▪ Traffic volumes by time-of-day, location/segment, and lane type ▪ Toll transactions by time of day and location ▪ Average link speeds ▪ 95^{th} percentile link speed ▪ Free flow speed ▪ Link Lengths
▪ What changes in usage will occur as a result of the conversion of the 2+ HOV lanes to 3+ HOT lanes?	▪ Change in average vehicle occupancy in HOV/HOT lanes and general-purpose lanes ▪ Change in person throughput (number of persons) on I-85 HOV/HOT ▪ Change in the number of vehicles on I-85 HOV/HOT lanes by user groups, such as toll/non-toll, carpools, etc. ▪ Modal shift by current 2-person carpools in I-85 HOV lanes (to HOV3+, SOV, paying HOV2, transit) ▪ Temporal and spatial shifts by current 2-person carpools using the I-85 HOV lanes ▪ Observations of casual carpools formation	▪ Vehicle occupancy ▪ Traffic volumes by time-of-day, location/segment, and lane type ▪ Toll transactions by type of account and/or toll status ▪ Surveys of current 2-person carpools ▪ Observed location of slugging (park-and-ride) ▪ Observations of casual carpools formed at park-and-ride facilities
▪ How much will travelers utilize the I-85 HOV/HOT toll system?	▪ Patterns of usage of the I-85 HOV/HOT toll system by accounts, transactions and evasion: • Account activity by month • Number of daily and monthly transactions by direction and time period • Frequency of use • Peak hour and peak period trips by toll status • Peak period violation rate (%) ▪ Use of general purpose lanes by vehicles with transponders	▪ Number of toll accounts ▪ Number of toll transactions by account type and/or toll status ▪ Number of toll transactions by location (HOT lane or general purpose lanes) ▪ Number of toll evasions by type
▪ Variable pricing the I-85 HOV/HOT lanes will regulate vehicular access so as to improve the operation of the lanes.	▪ Price elasticity of demand (change in transactions in response to change in toll charged)	▪ Toll transactions by time of day ▪ Toll price by time of day

1.0 INTRODUCTION

The U.S. Department of Transportation (U.S. DOT) awarded grants in 2007 and 2008 to six metropolitan areas for implementation of congestion reduction strategies under the Urban Partnership Agreement (UPA) and Congestion Reduction Demonstration (CRD) programs. Atlanta was one of the sites selected for CRD funding. Based on a competitive procurement process, the U.S. DOT also selected the Battelle team to conduct the national evaluations of the UPA/CRD projects. This document presents the Atlanta CRD National Evaluation Plan developed by the Battelle team, in cooperation with the Atlanta CRD partners and the U.S. DOT. This introduction section describes U.S. DOT's congestion reduction programs and the strategies being implemented at the various sites.

The remainder of this report is divided into four sections. Chapter 2.0 discusses the Atlanta CRD. An overview of the transportation system in the Atlanta metropolitan area is presented first, followed by a description of the Atlanta CRD partners and the CRD projects, funding, and deployment schedule. Chapter 3.0 provides an overview of the national evaluation organizational structure, the national evaluation process and framework, the U.S. DOT guiding questions and evaluation analyses, and the Atlanta CRD evaluation process. Chapter 4.0 presents the Atlanta CRD evaluation plan. The chapter discusses 12 evaluation analyses and describes the preliminary evaluation test plans. The report concludes with a discussion of the next steps in the Atlanta national evaluation process.

1.1 U.S. DOT Program to Reduce Congestion

Transportation system congestion is a significant threat to the economic prosperity and quality of life in the U.S. Whether it takes the form of trucks stalled in traffic, cargo stuck at overwhelmed seaports, or airplanes stuck on the tarmac, congestion costs the nation an estimated $200 billion a year.[1] Traffic congestion in major metropolitan areas is a key part of this problem. In 2007, congestion caused urban Americans to travel 4.2 billion hours more and to purchase an extra 2.8 billion gallons of fuel. The value of time spent and out-of-pocket fuel costs represented a total congestion cost of $87.2 billion—an increase of more than 50 percent from a decade ago.[2] Congestion affects the quality of life in America by robbing time that could be spent socializing with families and friends, participating in civic life, and pursuing recreational activities. As indicated in Figure 1-1, which reflects conditions in 14 of the nation's largest urban areas representing 54 percent of the population, the total hours of traffic delay grew approximately 340 percent from 1982 to 2007 and the miles traveled under extreme congestion more than tripled, from 8 percent to 28 percent.

[1] American Association of State Highway and Transportation Officials. "Transportation, Invest in Our Future: The Freight Challenge." May 2007, pg. 4. Attributed to Norman Mineta, former Secretary of Transportation.

[2] David Schrank and Tim Lomax, "Urban Mobility Report 2009." Texas Transportation Institute, The Texas A&M University System, July 2009.

1.2 Urban Partnership Agreement/Congestion Reduction Demonstration Program Overview

U.S. DOT entered into agreements with cities, pursuant to their commitment to implement "broad congestion pricing." In December 2006, the U.S. DOT issued a Federal Register Notice soliciting cities to apply for Urban Partnership status by April 30, 2007. For the cities that were selected, this Urban Partnership status would confer priority for available Federal discretionary funds of approximately $1 billion across about a dozen programs. The applicants' proposals for congestion reduction were to be based on four complementary strategies known as the 4Ts: Tolling, Transit, Telecommuting, which includes additional travel demand management (TDM) strategies (such as car and van pool promotion), and Technology.

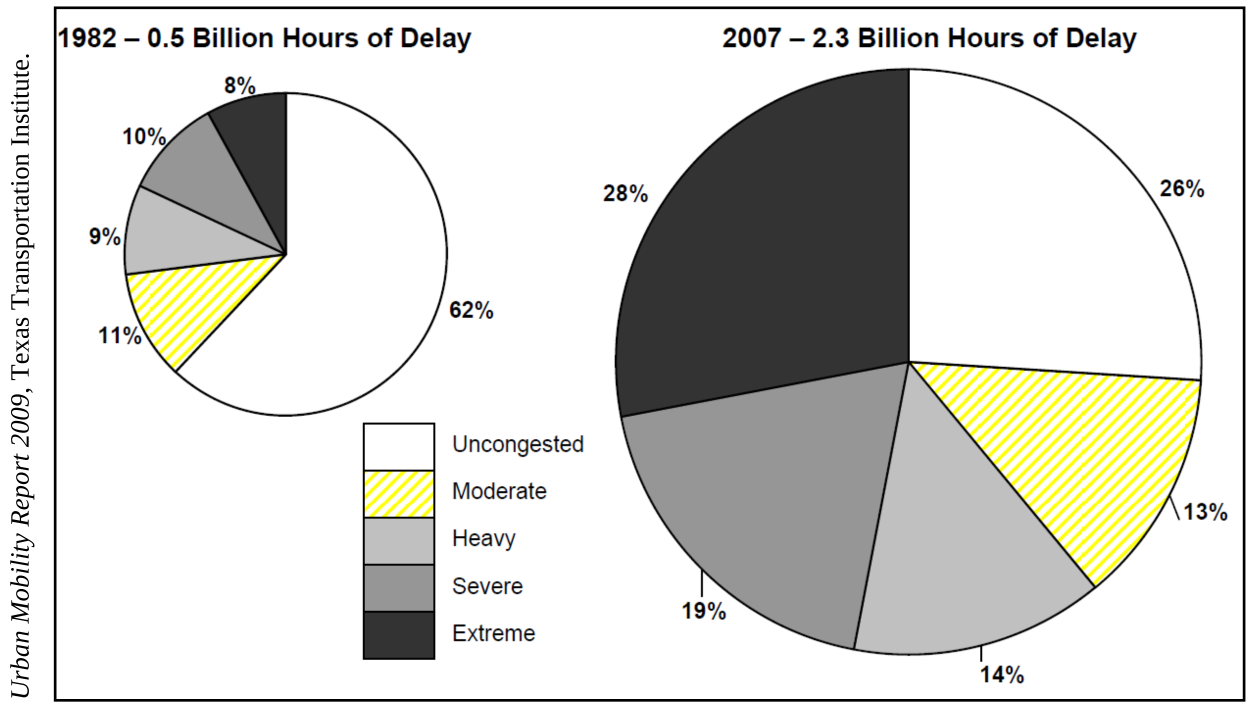

Figure 1-1. Percentage of Vehicle Miles Traveled by Congestion Level in Very Large Urban Areas, 1982 versus 2007

In August 2007, the selection of five urban partners was announced—Miami, Minnesota, New York City, San Francisco, and Seattle—along with a total of $853 million in federal discretionary grants for these partners. On April 7, 2008, the New York State Assembly declined to take a formal vote to provide needed legislative authority to implement the proposed New York City congestion-pricing project. The U.S. DOT announced that the UPA funds previously targeted for New York would be made available to other areas for implementing congestion pricing and supporting strategies.

In 2007, the U.S. DOT announced a follow-up to the UPA Program, called the Congestion Reduction Demonstration Program. The November 13, 2007, Federal Register notice set a December 31, 2007, deadline for applications. Subsequently, the U.S. DOT announced a

$210.6 million CRD award to the City of Los Angeles and a $153 million award to the City of Chicago. Chicago was subsequently removed from the program when deadlines for pricing legislation were not met. Atlanta was selected to receive $110 million in Federal funding under the CRD Program in November 2008.

A wide range of strategies and projects are being implemented at the UPA/CRD sites using the 4Ts. Table 1-1 highlights the strategies being deployed at the various UPA/CRD sites. The Atlanta CRD projects focus on the I-85 corridor. Projects include congestion pricing in the form of variable tolling on one HOT lane in both directions, additional express commuter bus service, new or expanded park-and-ride lots, and promotion of carpooling through employer-based programs.

Table 1-1. Summary of UPA/CRD Strategies by Site

UPA/CRD Strategies	Site					
	MN	SF	Sea	Mia	LA	Atl
Convert high-occupancy vehicle (HOV) lanes to dynamically priced high-occupancy tolling (HOT) lanes and/or new HOT lanes	X			X	X	X
Priced dynamic shoulder lanes	X					
Variably priced parking and/or loading zones		X			X	
Variably priced roadways or bridges (all lanes)			X			
Increase park-and-ride capacity (expand existing or add new)	X		X	X	X	X
Expand or enhance bus service	X		X	X		X
Implement new, or expand existing, Bus Rapid Transit	X			X	X	X
Transit on special runningways (e.g., contraflow lanes, shoulders)	X			X		
New and/or enhanced transit stops/stations	X		X	X	X	X
Transit traveler information systems (bus arrival times, parking availability)	X	X	X			
Transit lane keeping/lane guidance	X					
Transit traffic signal priority	X			X	X	
Arterial street traffic signal improvements to improve transit travel times	X					
Ferry service improvements		X	X			
Improved transit travel forecasting techniques		X				
Pedestrian improvements				X	X	
"Results Only Work Environment" employer-based techniques	X					
Work to increase use of telecommuting	X	X	X	X		
Work to increase flexible scheduling	X		X	X		
Work to increase alternative commute programs, including car and van pools	X	X	X	X	X	X
Vehicle infrastructure integration test bed		X				
Active traffic management	X		X			
Regional multi-modal traveler information (e.g., 511)	X	X	X			
Freeway management (ramp meters, travel time signs, enhanced monitoring)	X			X		
Enhanced traffic signal operations	X					
Parking management system		X			X	
Integrated electronic payment for parking and transit		X				
Automated enforcement of toll violations						X

2.0 ATLANTA CONGESTION REDUCTION DEMONSTRATION

This chapter describes the Atlanta CRD. An overview of the transportation system in the Atlanta region is provided first. The Atlanta CRD partners and the local organizational structure are highlighted next. Finally, the Atlanta CRD projects, funding, and deployment schedule are described.

2.1 The Transportation System and Congestion in Atlanta

The Atlanta region has experienced rapid growth this past decade with an average of more than 77,000 new residents each year since 2000. The ten-county Atlanta region is now home to 4.1 million persons, larger than the population of 24 states according to the 2008 Census estimates. The economic slowdown, while having a significant effect, has not managed to stall the growth. The region added 24,770 new residents in 2009, which is the slowest growth year of the decade.

The population in Atlanta is served by a transportation infrastructure in the region comprising of over 350 miles of interstate in the 10-county area, six public transportation providers,[3] and a network of HOV lanes. The 44-miles of HOV are on five interstate corridors, which have one HOV lane in each direction for a total of approximately 90 lane miles.

The population growth and employment patterns have resulted in the second highest percent increase of vehicle miles traveled (VMT) from 1990 to 2003 (66%) and highest VMT per capita (~28 miles) compared to similar regions (Dallas, Houston, Phoenix, and Washington DC),[4] Texas Transportation Institute estimated the annual congestion delay for the Atlanta metropolitan area was 135 million person hours in 2007 with the total cost of congestion close to $2.9 billion.[5] The current highway infrastructure (including the HOV lanes) is heavily traveled and experiences a high intensity, duration and extent of congestion. Figure 2-1 shows the travel time index (a measure quantifying the degree of congestion, in terms of travel time, that a traveler experiences compared to free-flow conditions) for the major interstate segments in the Atlanta region for an hour during the a.m. peak. The I-75 corridor, the I-85 corridor, and GA 400 all experience significant congestion during the a.m. peak and the situation reverses direction in the p.m. peak. Existing HOV Lanes on I-75 and I-85 operate at level of service (LOS) F at various segments during rush hours.

[3] These providers are MARTA, Cherokee Area Transportation Services (CATS), Cobb Community Transit (CCT), C-Tran (Clayton Transit), Gwinnett County Transit (GCT) and GRTA Xpress (Georgia Regional Transportation Authority).

[4] Georgia's HOV to HOT System Proposal, Draft Submission to USDOT, August 26, 2008.

[5] Texas Transportation Institute, 2009 Urban Mobility Report, Performance Measure Summary – Atlanta, GA.

Note: The Travel Time Index is expressed as the ratio of the average travel time in a given period and the free-flow travel time.
The Travel Time Index for GA 400 is based on 2004 data.

Georgia Regional Transportation Authority, 2009 Transportation MAP Report, accessible at http://www.grta.org/PDF_Files/2009_Transportation_MAP_Report.pdf

Figure 2-1. Travel Time Index in Atlanta, 2008

2.2 The Atlanta CRD Local Partners

The Atlanta CRD partnership is led by three public agencies—the Georgia Department of Transportation (GDOT), the Georgia Regional Transportation Authority (GRTA), and the State Road and Tollway Authority (SRTA). Other partners include Atlanta Regional Commission (ARC), Georgia Department of Public Safety, Metropolitan Atlanta Rapid Transit Authority (MARTA), Gwinnett County Government, Clean Air Campaign, and Georgia Institute of Technology (Georgia Tech). Figure 2-2 presents the organizational structure of the CRD partnership.

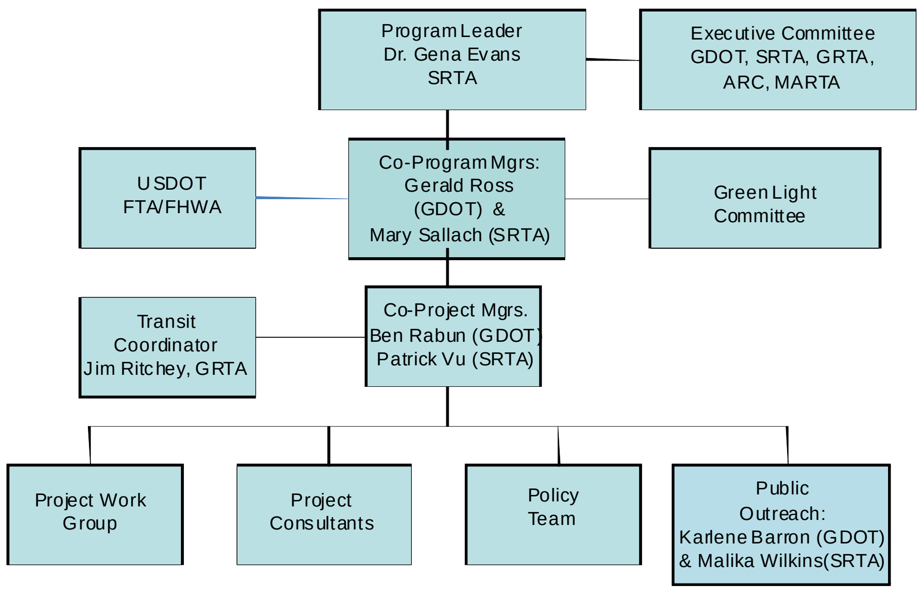

Figure 2-2. Atlanta CRD Team

Georgia DOT's role in the CRD reflects its statewide responsibility for planning, constructing, maintaining, and improving the state's roads and bridges. They are responsible for all construction needed for the HOV to HOT conversion on I-85 and in the on-going infrastructure maintenance and operation of all lanes in the demonstration corridor.

GRTA is the state agency responsible for improving Georgia's mobility, air quality, and land-use practices. In that capacity GRTA operates Xpress, a public transportation service in partnership with twelve counties in metropolitan Atlanta. In the CRD, GRTA is responsible for acquiring 36 buses to provide additional service on the I-85 corridor and for construction of new and expanded park-and-ride lots. GRTA is working in concert with Gwinnett County Transit which operates express bus transportation service in the corridor.

SRTA's role in the CRD is as the toll operator of the HOT lanes, reflecting their responsibility throughout Georgia to operate toll roads. They will establish the variable toll rates, select electronic toll technology, market the HOT service to travelers, and manage tolling operations.

2.3 Atlanta CRD Projects and Deployment Schedules

The Atlanta CRD partners have as a long-term regional goal an integrated system of congestion-priced lanes, enhanced transit service, and advanced technology on 49-miles of I-75, I-85, and I-20. In recognition of that goal, U.S. DOT provided $110 million in CRD funding to establish the first phase of that network on approximately 16 miles of I-85 from I-285 to Old Peachtree Road.

Table 2-1 shows the project components. Each of these projects are discussed below.

Table 2-1. Atlanta CRD Projects

Project
Congestion-priced Lanes
HOV to HOT conversion on I-85 as Phase 1
Transit Projects
Purchase of 36 commuter buses
Construction or expansion of 4 park-and-ride lots
Technology Projects
Automated enforcement through a controlled gantry system and in-vehicle technology
Carpooling
Clean Air Campaign outreach to promote 3+ carpools

HOT Lanes on I-85. As the first phase of a regional integrated system of congestion-priced lanes, the existing HOV lanes will be converted to dynamically-priced high occupancy toll lanes on approximately 16 miles of I-85 from I-285 in DeKalb County to Old Peachtree Road in Gwinnett County, as depicted in Figure 2-3. The occupancy requirement for the current HOV2+ lanes will be changed to HOV3+ along with registration to use the lanes. Registered toll-exempt vehicles include HOV3+, motorcycles, alternative fuel vehicles (AFV) with GA AFV license plates (but not hybrids), transit, and emergency vehicles. The lanes will operate with seven entry and exit points in the northbound direction and six in the southbound direction. Tolling will occur 24 hours a day and seven days a week in four southbound sections and five northbound sections. GDOT is responsible for the construction in the HOV to HOT conversion. SRTA will operate the tolling portion of the system.

Georgia DOT, Presentation at Public Hearing Open House, November 12, 2009.

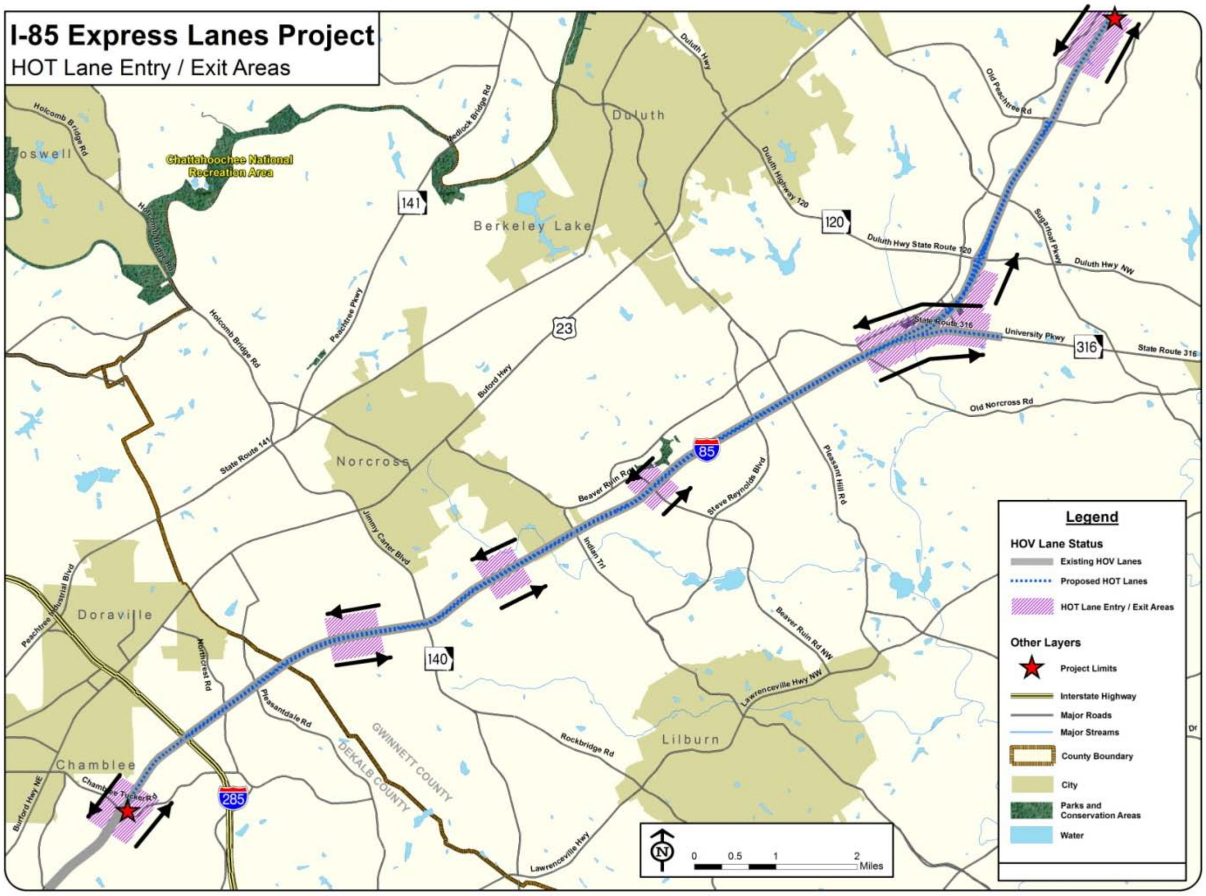

Figure 2-3. I-85 HOV to HOT Conversion Project

Transit Enhancements. A total of 36 new buses will be added to the commuter bus fleet on the I-85 corridor, with 20 buses added in 2010 and 16 more in 2011. The expanded fleet will enable five new routes to operate on the corridor, the first of which began in August of 2010. GRTA will purchase the buses. GRTA is also responsible for the park-and-ride lots added with CRD funding. These include three new lots—Mall of Georgia, Hamilton Mill, and Cedars Lane—and one expanded lot at I-985/GA 20. Due to a construction schedule substantially later than the other three lots, the Cedars Lane lot will not be included in the evaluation. The Mall of Georgia lot opened first in August of 2010 with the addition of 750 leased spaces until the permanent lot is open at that location. The other lots will add 2134 more spaces and will open in 2011. In addition to the three (excluding Cedars Lane) CRD-funded park and ride lots, the evaluation will include two other lots that are not funded by the CRD but could be impacted. These include Discover Mills and Indian Trail Park and Ride Lots. Figure 2-4 illustrates the location of the transit enhancements.

Georgia DOT. Presentation at Public Hearing Open House. November 12. 2009.

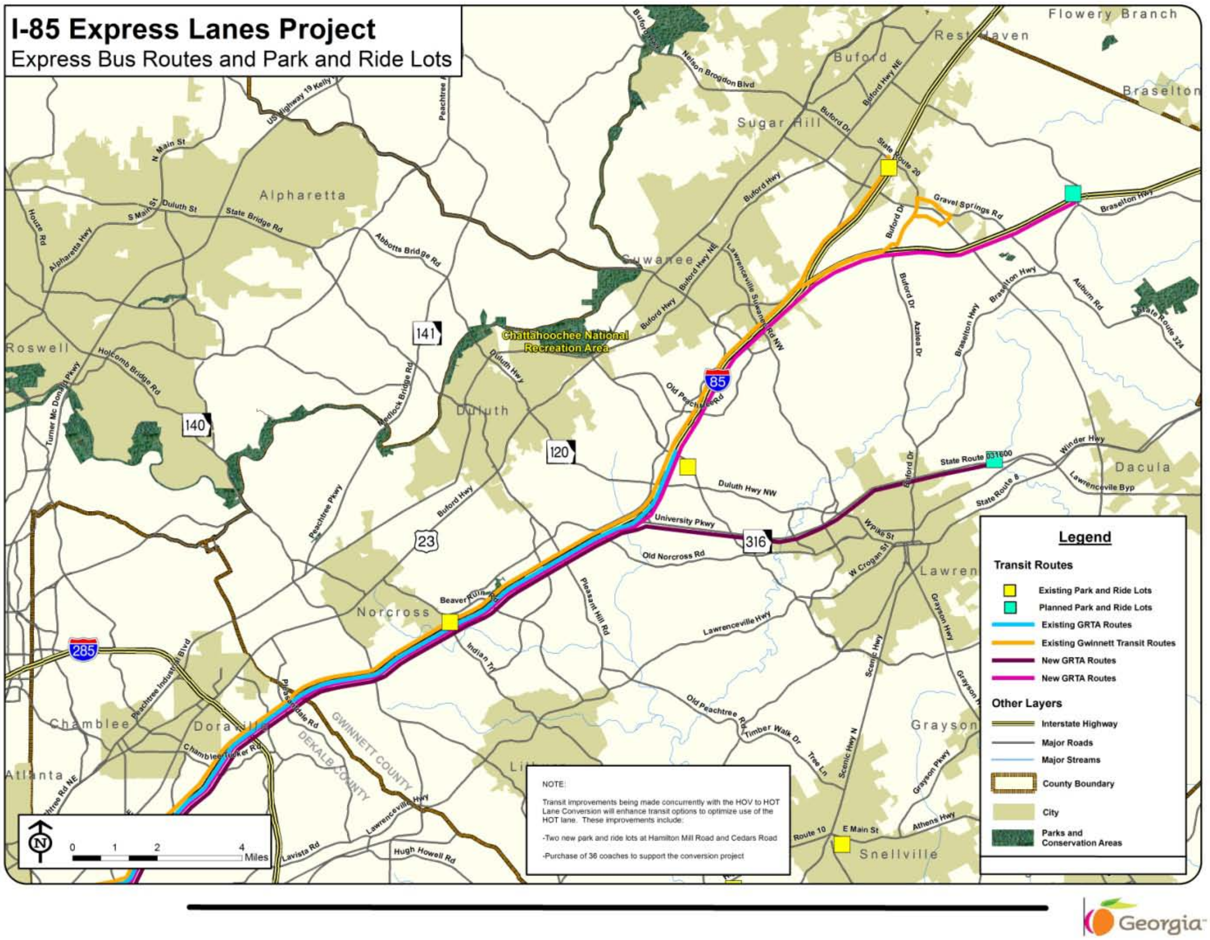

Figure 2-4. Location of Transit Enhancements

Automated Enforcement Systems. A controlled access gantry system will consist of approximately 35 overhead gantries or existing structures placed in the median. Readers equipped radio frequency identification (RFID) will read transponders, and cameras will collect images of vehicle license plates. This information will be used to identify toll violators. Mobile automatic license plate readers (ALPR) camera systems installed in enforcement vehicles will aid police officers with visual occupancy verification of vehicles using the HOT lane. Enforcement officials will be provided with an audible or visual alert, if a license plate matches the database of registered HOV3+ users to prompt a visual inspection for vehicle occupancy compliance. Officers will upload a list of occupancy violations written during a shift to the HOT lane back-office system. Figure 2-5 illustrates some of the enforcement technology.

State Road and Tollway Authority. Used with permission.

Figure 2-5. Automatic License Plate Reader Laptop and Camera Installed in Patrol Vehicles

Carpooling Outreach. Public outreach to encourage alternative mode use will be part of Clean Air Campaign's (CAC) on-going efforts to promote travel alternatives to single occupant vehicles. Important to the HOV to HOT lane conversion, CAC will contact 2-person carpools to help them transition to 3-person carpools and will use existing incentive programs.

Schedule for the CRD Projects. Table 2-2 presents the dates at which each of the Atlanta CRD projects that are part of the national evaluation are expected to be in operation.

Table 2-2. CRD Project Schedules

Projects	Operational Date
HOT Lanes on I-85	Summer 2011
36 New Commuter Buses	Spring 2010 – Dec. 2011
5 New Bus Routes	August 2010 – January 2012
Park-and-Ride Lot: Mall of Georgia	August 2010
Park-and-Ride Lot: I-985/GA 20	July 2011
Park-and-Ride Lot: Hamilton Mill	July 2011
Park-and-Ride Lot: Cedars Rd.	April 2012
Automated Enforcement	Summer 2011
Carpooling Outreach	On-going

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3.0 NATIONAL EVALUATION OVERVIEW

This chapter summarizes how the national evaluation of the UPA/CRD sites is being organized and carried out and identifies the steps in the Atlanta CRD evaluation process.

3.1 National Evaluation Organizational Structure

The evaluation of the UPA/CRD national evaluation is sponsored by the U.S. DOT. The Intelligent Transportation Systems Joint Program Office (ITS JPO) of the Research and Innovative Technology Administration (RITA) is responsible for the overall conduct of the national evaluation. Representatives from the modal agencies within U.S. DOT are actively involved in the national evaluation.

Members of the Battelle evaluation team include:

- Battelle Memorial Institute – Prime;
- Texas Transportation Institute (TTI), The Texas A&M University System;
- Center for Urban Transportation Research (CUTR), University of South Florida;
- Hubert H. Humphrey Institute of Public Policy and Center for Transportation Studies, University of Minnesota;
- Eric Schreffler, ESTC; and
- Susan Shaheen and Caroline Rodier, University of California, Berkeley.

As highlighted in Figure 3-1, the Battelle team is organized around the individual UPA/CRD sites. A site leader is assigned to each site, along with specific Battelle team members. The site teams are also able to draw on the resources of 4T experts and evaluation specialists.

The purpose of the national evaluation is to assess the impacts of the UPA/CRD projects in a comprehensive and systematic manner across all sites. The national evaluation will gather information and produce technology transfer materials to support deployment of the strategies in other metropolitan areas. The national evaluation will also generate findings for consideration in future Federal policy and program development related to mobility, congestion, and facility pricing.

The focus of the national evaluation is on assessing the congestion reduction realized from the 4T strategies and the associated impacts and contributions of each strategy. The non-technical success factors, including outreach, political and community support, institutional arrangements, and technology will also be documented. Finally, the overall cost benefit analysis of the deployed projects will be examined.

Members of the Battelle team are working with representatives from the local partner agencies and the U.S. DOT on all aspects of the national evaluation. This team approach includes 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 are responsible for data collection, including conducting surveys and interviews. The Battelle team is responsible for providing the local partners direction on the needed data, formats and collection methods and for analyzing resulting data and reporting results.

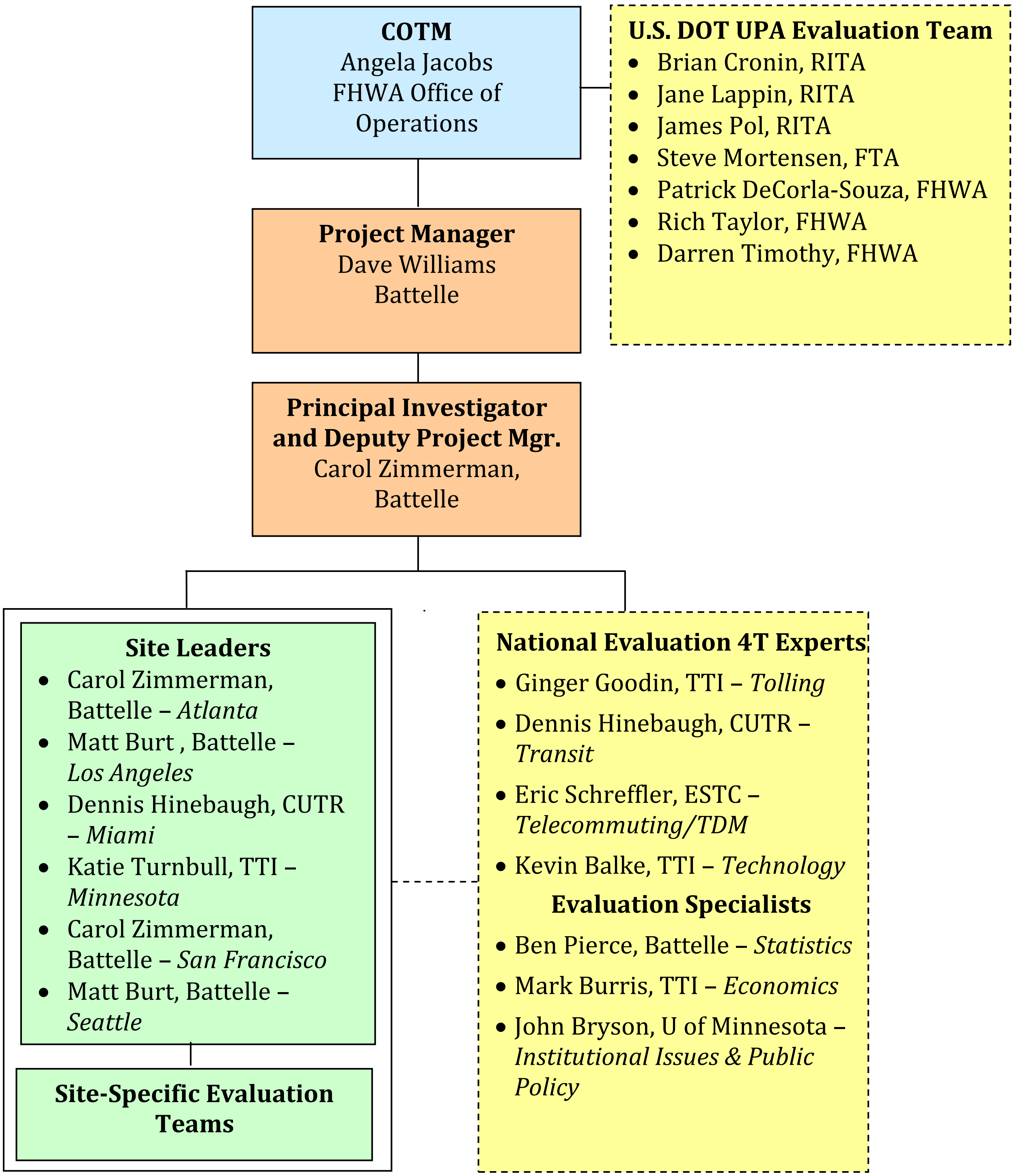

Figure 3-1. Battelle Team Organizational Structure

3.2 National Evaluation Process and Framework

The Battelle team developed a National Evaluation Framework (NEF) to provide a foundation for evaluation of the UPA/CRD sites. The NEF is based on the 4Ts congestion reduction strategies and the questions that the U.S. DOT seeks to answer through the evaluation. The NEF is essential because it defines the questions, analyses, measures of effectiveness, and associated data collection for the entire UPA/CRD evaluation. As illustrated in Figure 3-2, the framework is a key driver of the site-specific evaluation plans and test plans and will serve as a touchstone throughout the project to ensure that national evaluation objectives are being supported through the site-specific activities.

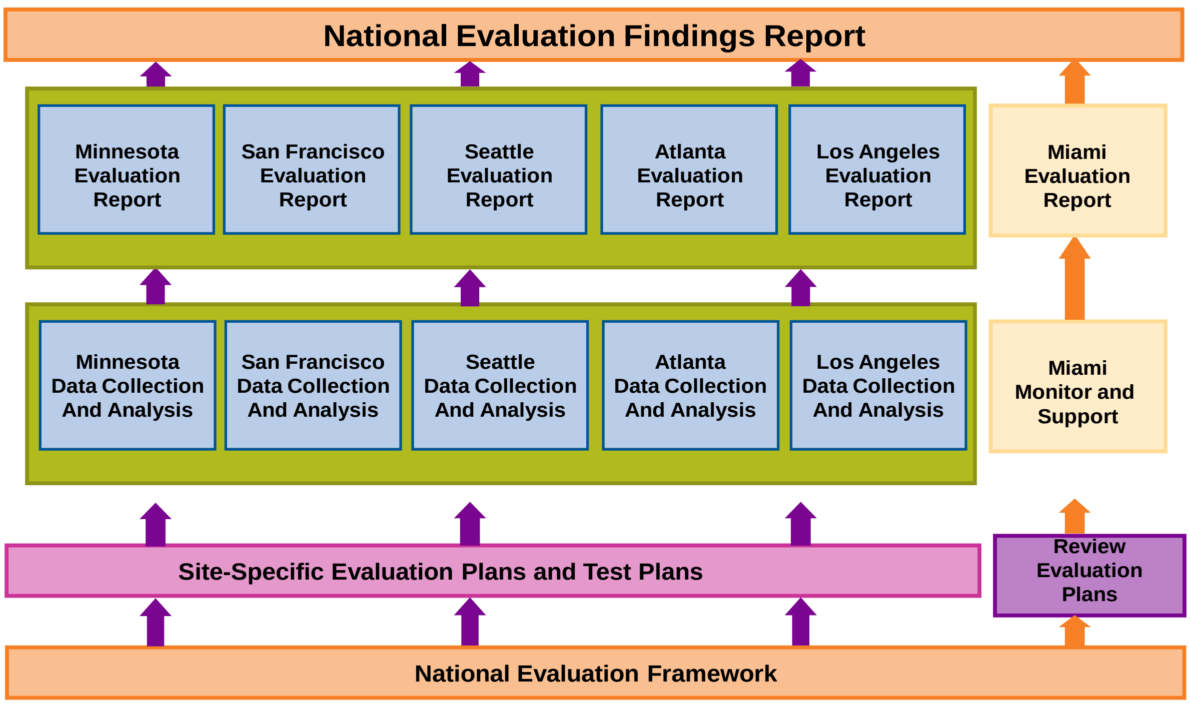

Figure 3-2. The National Evaluation Framework in Relation to Other Evaluation Activities

The evaluation of each UPA/CRD site will involve several steps. With the exception of Miami, where the national evaluation team is serving in a limited role of review and support to the local partners, the national evaluation team will work closely with the local partners to perform the following activities and provide the following products:

- a site-specific strategy guided by the NEF;
- a site-specific evaluation plan that describes the strategy and provides a high-level view of all the test plans needed, the roles and responsibilities, and the schedule;
- multiple site-specific test plans that provide complete details on how the data collection and analysis activity will be implemented;

- monitoring of site's collection of one year of pre-deployment and one year of post-deployment data;[6]
- analysis of the collected data; and
- site-specific evaluation reports and a National Evaluation Findings Report.

The NEF provides guidance to the local sites in designing and deploying their projects, such as by identifying the need to build in data collection mechanisms if such infrastructure does not already exist. To measure the impact of the congestion strategies, it is essential to collect both the "before" and "after" data for many of the measures of effectiveness identified in the NEF. Also important is establishing as many common measures as possible that can be used at all of the sites to enable comparison of findings across the sites. For example, a core set of standardized questions and response categories for traveler surveys that have been used at other UPA/CRD sites will be incorporated in surveys in Atlanta as much as possible. Questions may need to be tailored or added to reflect the specific congestion strategies and local context for Atlanta, such as road names or transit lines, but striving for comparability among sites will be a goal of the evaluation.

A traditional "before and after" study is the recommended analysis approach for quantifying the extent to which the strategies affect congestion in the UPA/CRD sites. In the "before," or baseline condition, data for measures of effectiveness will be collected before the deployments become operational. For the "after" or post-deployment period, the same data will be collected to examine the effects of the strategies. The analysis approach will track how the performance measures changed over time (trend analysis) and examine the degree to which they changed between the "before" and "after" periods. Whenever possible, field-measured data will be used to generate the measures of effectiveness.

3.3 Mapping of U.S. DOT Four Questions to 12 Analyses

Table 3-1 shows the four "Objective Questions" that U.S. DOT has directed the national evaluation team to address.[7] The analyses present what must be studied to answer the four objective questions. Table 3-2 identifies the 12 evaluation analyses described in the National Evaluation Framework and shows how they relate to the four objective questions. These 12 analyses form the basis of the evaluation plans at the UPA/CRD sites, including Atlanta.

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[6] While one-year each of pre- and post-deployment data are desirable, the operational data for specific projects within the overall evaluation schedule may result in more or less than a year's data being collected either pre- or post-deployment.

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

Table 3-1. 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?

Table 3-2. U.S. DOT Objective Questions vs. Evaluation Analyses

U.S. DOT 4 Objective Questions	Evaluation Analyses
#1 – How much was congestion reduced?	#1 – Congestion
#2 – What are the associated impacts of the congestion reduction strategies?	**Strategy Performance** #2 – Strategy Performance: Tolling #3 – Strategy Performance: Transit #4 – Strategy Performance: Telecommuting/TDM #5 – Strategy Performance: Technology **Associated Impacts** #6 – Associated Impacts: Safety #7 – Associated Impacts: Equity #8 – Associated Impacts: Environmental #9 – Associated Impacts: Goods Movement #10 – Associated Impacts: Business Impacts
#3 – What are the non-technical success factors?	#11 – Non-Technical Success Factors
#4 – What is the overall cost and benefit of the strategies?	#12 – Cost-Benefit Analysis

The analyses associated with Objective Question #2 are of two types. The first four analyses focus on the performance of the deployed strategies associated with each of the 4Ts. These analyses will examine the specific impacts of each deployed project/strategy, and, to the extent possible, associate the performance of specific strategies with any changes in congestion. The second type of analysis associated with Objective Question #2 focuses on specific types of impacts, e.g., “equity” and “environmental.”

The 12 evaluation analyses were further elaborated into one or more hypotheses for testing. In some cases, where the analysis is not guided by a hypothesis, per se, such as the analysis of the non-technical success factors, specific questions are stated rather than hypotheses. Next, measures of effectiveness (MOEs) were identified for each hypothesis, and then required data for each MOE.[8]

3.4 Atlanta CRD National Evaluation Process

Figure 3-3 presents the Atlanta CRD national evaluation team. The team includes the Contract Officer Technical Manager (COTM) who serves as the U.S. DOT national evaluation leader, the U.S. DOT evaluation team, the U.S. DOT points of contact for the site, and the Battelle team. The national evaluation team works with representatives from the Atlanta partners, shown previously in Section 2, in development of the CRD evaluation for Atlanta.

[8] The hypotheses, measures of effectiveness and data presented in the National Evaluation Framework can be found at http://www.itsdocs.fhwa.dot.gov/JPODOCS/REPTS_TE/14446.htm.

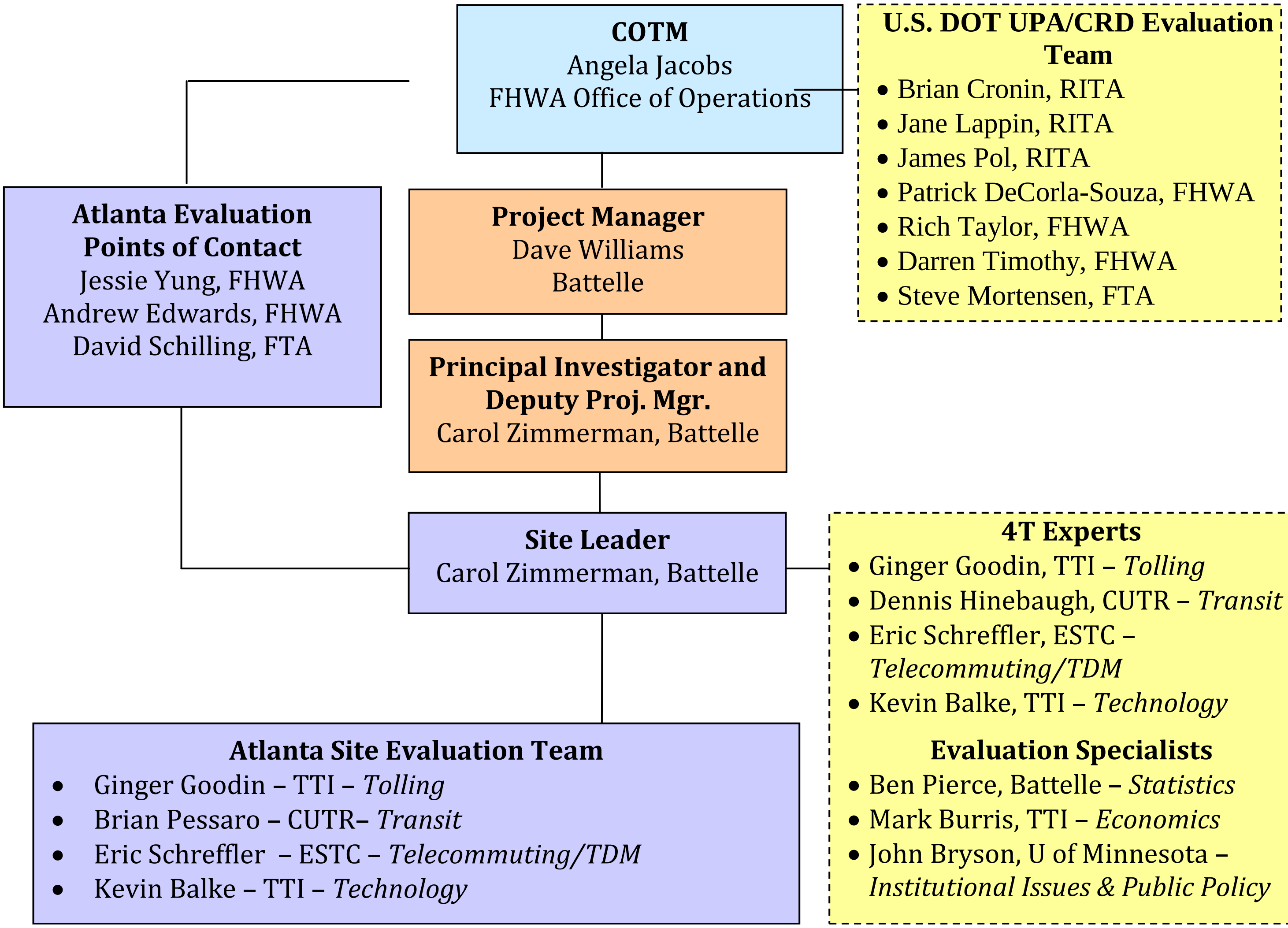

Figure 3-3. Atlanta CRD National Evaluation Team

Figure 3-4 presents the process for developing and conducting the national evaluation of the Atlanta CRD projects. The major steps are briefly discussed following the figure.

Figure 3-4. Atlanta CRD National Evaluation Process

Kick-Off Conference Call. The kick-off conference call, held on November 17, 2009, introduced the Atlanta partners, the U.S. DOT representatives, and the Battelle team members. The Atlanta CRD projects and deployment schedule were discussed, and the national evaluation approach and activities were presented. A PowerPoint presentation and various handouts were distributed prior to the conference call.

Site Visit and Workshop. Members of the U.S. DOT evaluation team and the Battelle team convened with the Atlanta partners in Atlanta on December 1 and 2, 2009. The first day was used by the partners to brief the evaluation team on the CRD projects and provide a tour of the I-85 corridor where the CRD projects were to be deployed. A day-long evaluation workshop was held on the second day. Members of the U.S. DOT, Battelle, and local agency teams discussed potential evaluation strategies, including analyses, hypotheses, data needs, and schedule. A PowerPoint presentation containing the preliminary evaluation strategy, analysis, data needs, and other information was distributed prior to the workshop. A summary of the workshop discussion was prepared and distributed to participants after the workshop.

Atlanta CRD National Evaluation Strategy. The Atlanta CRD national evaluation strategy was revised based on the discussions at the workshop in December 2009. The Atlanta CRD evaluation strategy included the hypotheses and questions, measures of effectiveness, and data needs for the analysis areas. The strategy also included a preliminary pre- and post-deployment data collection schedule, possible issues associated with the evaluation, and approaches for addressing exogenous factors. The Atlanta CRD national evaluation strategy was presented in a PowerPoint presentation, which was distributed to representatives of the U.S. DOT team and the Atlanta partners and a conference call was held on February 1, 2010 to review and discuss the evaluation strategy. There was agreement among all parties on the Atlanta CRD evaluation strategy, and formal approval from the U.S. DOT was subsequently received to proceed with development of the Atlanta CRD national evaluation plan.

Atlanta CRD National Evaluation Plan. This document constitutes the Atlanta CRD national evaluation plan. The report provides a background to the U.S. DOT UPA/CRD, describes the Atlanta CRD projects, and presents the Atlanta CRD evaluation plan and preliminary test plans. A draft was distributed for review by U.S. DOT and Atlanta CRD partners, and this final plan was based on all subsequent comments and discussions about the evaluation plan. The document will guide the overall conduct of the Atlanta CRD national evaluation.

Atlanta CRD National Evaluation Test Plans. Based on approval from the U.S. DOT and the Atlanta partners, the national evaluation team will proceed with developing separate, more detailed test plans for each type of data needed for the evaluation, i.e., traffic, transit, etc. The preliminary test plans contained in the evaluation plan provide the basis for the more fully-developed test plans. Between September and November 2010 the individual test plans will be developed, reviewed with representatives from the U.S. DOT and local partnership agencies, and finalized.

Pre-Deployment Data Collection. Upon approval of the Atlanta CRD evaluation individual test plans, data collection activities for the pre-deployment period will be initiated. The general strategy is to collect one full year of baseline data, although when historic, archived data are available and helpful in establishing long-term trends and the influence of exogenous factors (such as gas prices), they will be utilized. As discussed in chapter 2, several of the Atlanta CRD transit projects are scheduled to become operational in 2010 a year or more before the HOT lanes become operational. Therefore, pre-deployment data collection will be phased and begin with data already collected by the partners starting in the August 2009 and will extend through July 2011 up to the start of the HOT lanes.

Post-Deployment Data Collection. Collection of post-deployment data of the Atlanta CRD projects will begin projects become operational. For the HOT lanes the post-deployment data will begin in the summer of 2011. Transit projects will be phased in over 2010 and 2011, and thus, post-deployment data will begin when each transit project begins operations. Therefore, the post-deployment data collection period stretches from August 2010, with relevant data collection already taking place by the local partners, through July of 2012.

Analysis and Evaluation Reports. Analysis of baseline data will begin once all of the data have been collected. Analysis of early (e.g., the first several months of) post-deployment data will begin shortly after the beginning of post-deployment data collection in late-2011.
A technical memorandum on evaluation early results, based on four or five months of post-deployment data, will be completed in the winter of 2011/12. The final evaluation report will be completed by December 2012.

4.0 ATLANTA CRD NATIONAL EVALUATION PLAN

This chapter presents the Atlanta CRD National Evaluation Plan. This material is presented in major subsections. The first of these sections, 4.1 Evaluation Analyses, discusses the potential benefits, costs, and impacts of the UPA projects; the planned approach to measuring those effects; the kinds of data needed to perform this work; and the planned analytic approach. The second section, 4.2 Preliminary Evaluation Test Plans, summarizes in somewhat more detail data sources and analysis methods. Once this evaluation plan has been finalized, the full detail on data collection and analyses will be presented through a set of separate test plan documents.

The relationship between evaluation analyses and test plans is discussed further in Section 4.2. 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.

4.1 Evaluation Analyses

The proposed approach to twelve evaluation analyses is presented in this section. The analyses address the following areas:

1. Congestion
2. Tolling
3. Transit
4. Travel Demand Management
5. Technology
6. Safety
7. Equity
8. Environment
9. Goods Movement
10. Business Impacts
11. Non-Technical Success Factors
12. Cost-Benefit.

For each of these analyses, key hypotheses and questions to be addressed are presented. The hypotheses describe the results that the CRD projects are expected to produce, including benefits such as throughput improvements, congestion reduction, expanded traveler choices, improved mobility, and related outcomes. In a few cases, unwanted side-effects of the CRD investments are hypothesized. For each hypothesis and question, measures of effectiveness (MOEs) are presented. These are measurable aspects of the deployment effects that relate to the evaluation hypotheses and questions.

Each analysis discussion includes a table which summarizes the hypotheses/questions being asked, relevant MOEs, and the data required to compute those MOEs. Accompanying text discusses key aspects of the planned analytic approach and related matters.

4.1.1 Congestion Analysis

The congestion analysis is intended to assess the extent to which overall congestion was reduced in the I-85 corridor by conversion of the HOV lane on I-85 to HOT operations and the changes in transit service. Following the evaluation principles outlined in NCHRP *Guide to Effective Freeway Performance Measurement*,[9] the congestion analysis will examine the effects of the deployment of all the CRD improvements using the following performance measures:

- Travel time and travel speeds,
- Travel time reliability and variability,
- Spatial and temporal extent of congestion,
- Vehicle and person throughput, and
- Users perceptions of congestion on I-85.

Travel Time and Travel Speeds

The congestion analysis will specifically evaluate the effects of deploying the CRD improvements on travel time and average travel speeds for both the general purpose lanes and the high occupancy lane on I-85. Table 4-1 summarizes the hypotheses, measures of effectiveness, and data needs associated with this portion of the congestion analysis.

Travel time is the average time consumed by vehicles traversing a fixed distance, defined by specific origins and destinations. In their NAVIGATOR website, GDOT provides real-time and historical travel times on many of the major commuting corridors in the Atlanta area, including I-85. GDOT has established standard segments for reporting travel times on I-85. The national evaluation will focus its analysis on the following three segments on I-85:

- Between SR 316 and Indian Trail Rd. (Waypoint 8 to Waypoint 7)
- Between Indian Trail and I-285 (Waypoint 7 to Waypoint 6) , and
- Between I-285 and Clairmont Rd. (Waypoint 6 to Waypoint 5).

While the last travel time segment is beyond the scope of the CRD deployment, it is included in the evaluation to capture potential carry-over effects of the HOV lane conversion on operations in this segment. Travel times will be examined in both the general purpose lanes and the HOV/HOT lanes and in both directions during peak and off-peak periods.

[9] **Margiotta, Richard, et al.** Guide to Effective Freeway Performance Measurment: Final Report and Guidebook. [Online] NCHRP Web-Only Document 97, August 2006. [Cited: March 24, 2010.] http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_w97.pdf.

Table 4-1. Congestion Analysis Approach: Travel Time and Travel Speed

Hypothesis/Question	Measure of Effectiveness	Data
Converting the I-85 HOV lanes to HOT operations will improve travel time and average travel speeds on both the general purpose and high occupancy lanes on I-85	▪ Percent change in average, median, and 95th percentile travel time ▪ Actual and percent change in average travel speeds in general purpose and HOV/HOT lanes during peak and off-peak periods ▪ Percent change in travel time index in general purpose and HOV/HOT lanes	▪ Segment travel times ▪ Average link speeds ▪ Free-flow speed[a] ▪ Link length[b]
Converting the I-85 HOV lanes to HOT operations will improve travel time and average travel speeds on both the general purpose and high occupancy lanes on I-85	▪ Percent change in average, median, and 95th percentile ▪ travel time ▪ Percent change in average travel speeds in general purpose and HOV/HOT lanes during peak and off-peak periods ▪ Percent change in travel time index in general purpose and HOV/HOT lanes	▪ Segment travel times ▪ Average link speeds ▪ Free flow speed ▪ Link length[a]

[a] NCHRP *Guide to Effective Freeway Measurement* defines free-flow speed as "the speed at which vehicles would travel under very light volumes (only a few vehicles on the road, traveling unimpeded by other vehicles)." The Guide recommends that "the free-flow speed should be set at the lower of 1)85th percentile speed that occurs under low-volume conditions, or 2) the speed limit."

[b] For the purposes of this study, "link length" is defined as the distance between detector stations. It is typically used to reflect the "zone of influence" of a traffic sensor and is generally the length that is one-half the distance to the nearest upstream and downstream sensor. A "segment" is defined to be a collection of contiguous links. Therefore the length of a segment is the sum total of the link lengths for the links included in a segment.

In addition to examining the effects of the improvements on travel times, an assessment will be made of the impact of converting the HOV lane to HOT operations on average link speeds on I-85. GDOT has installed traffic sensors approximately every 1/3 mile. These sensors are used to obtain average link speeds in both directions of I-85. Average link speed represents the average speed of all vehicles passing over the detectors at each detector station, and, while link speed and travel time are highly correlated, average link speed provides an instantaneous "snapshot" of travel conditions at a specific point on the freeway. High link speeds imply that a particular section of freeway is operating well, while low link speeds on a freeway imply that a particular section of freeway is congested. A link is defined as the section of roadway between two successive detector stations. Link speed is an important measure in determining the spatial and temporal extent of congestion (discussed below).

Travel time index is another measure of congestion that will be used to assess the impacts of CRD improvements on corridor travel times. Travel time index is the ratio of the average travel time during peak periods to the travel time during off-peak periods when travel times are considered free-flow. Free-flow travel time for a freeway segment is defined as the 15th percentile travel time during traditional off-peak times (i.e., incident-free weekdays between 9 a.m. and 4 p.m., and between 7 p.m., and 10 p.m.). Travel time index will be used to assess how much more time a trip takes during the peak periods as opposed to the same trip if it occurred during non-peak travel periods. As an example, a travel time index of 1.20 means that a trip during the peak period takes 20 percent longer than the same trip during off-peak periods. Because travel time index is a ratio of travel times and it eliminates the effects of different corridor lengths, the travel time index will be useful in comparing the different UPA/CRD sites.

Travel Time Reliability

Another potential effect of converting the HOV lane to HOT operations will be to improve the travel time reliability. According to NCHRP *Guide to Effective Freeway Performance Measurement*, travel time reliability is defined as "the level of consistency in travel conditions over time and is measured by describing the distribution of travel times that occur over a substantial period of time." Travel time reliability is often synonymous with travel time predictability. Travelers often adjust their travel behaviors and expectations to accommodate expected levels of congestions. When unexpected congestion or changes in service are encountered, travelers are frustrated, and their satisfaction with the performance of the transportation system may decrease. NCHRP's *Guide to Effective Freeway Performance Measurement* recommends two measures of effectiveness for travel time reliability:

- Buffer time, and
- Planning index time.

Buffer time is the amount of *extra* time that travelers in a corridor need to allot to ensure that they arrive on time at their destination. It is computed as the difference between the 95th percentile travel time and the average travel time during a particular period of travel, expressed as a percentage of the normal travel time. For example, a buffer time of 40 percent in the a.m. peak means that in order to guarantee an on-time arrival during his or her morning commute, a traveler would have to allow an additional 40 percent more time for the trip than it would take on average. This would be equivalent to allocating an extra 8 minutes in buffer time for a peak period trip that typically takes 20 minutes to complete. Smaller buffer times imply that there is very little variability in the average trip time and that, on average, very little extra time has to be allotted to the normal travel time to guarantee arrival on time. A high buffer times implies that travel times are highly variable and travelers need to allot more time to account for this variability to guarantee on time arrival.

Like buffer time, the planning time index (PTI) is a measure of the extra amount of time that travelers need to allot to a trip during a specific period. However, instead of comparing the trip time to the average travel time during that peak, PTI compares trips that occur in the peak period to the same trip if it were to occur during non-peak (or free-flow) periods. PTI uses the 95th percentile travel time and is intended to show how much extra time a traveler needs to allot to his or her trip during the peak period compared to non-peak conditions to guarantee on-time arrival. For example, a PTI of 1.60 for the a.m. peak means that a traveler would need to allocate an additional 60 percent more time to make the trip during the a.m. peak compared to making the same trip during the off-peak to ensure on-time arrival.

For the purposes of the national evaluation, travel time reliability will be examined on both the general purpose lanes and the HOT lanes on the segment of I-85 between SR 316 and I-285. Both directions of travel will be compared in both peak periods. Table 4-2 shows the hypotheses and related measures of effectiveness that will be used to evaluate travel time reliability impacts.

Table 4-2. Congestion Analysis Approach: Travel Time Reliability

Hypothesis/Question	Measure of Effectiveness	Data
Converting the I-85 HOV lanes to HOT operations will improve travel time reliability and reduce variability on both the general purpose and high occupancy lanes on I-85	▪ Change in buffer time ▪ Change in planning time index	▪ Average link speeds ▪ 95^{th} percentile link speed ▪ Free flow speed ▪ Link Lengths

In addition to examining these measures of reliability, the national evaluation team will also examine travel time variability in both the general purpose and HOV/HOT lanes. Potential sources of travel time variability include the following:

- Incidents – any event (such as a collision, vehicle breakdown, or debris in the road) that disrupts the normal flow of traffic, whether the event occurs on the shoulder or in the main travel lanes.
- Work zones – construction and maintenance activities.
- Weather – the full range of events that impact visibility and roadway surface conditions – from obscuring visibility due to fog/snow/rain to slick pavements due to rain, snow and ice.
- Special events – any event that dramatically changes travel demands or travel patterns in the vicinity of the event.

The evaluation team will examine how travel time in both the general purpose and the HOV/HOT lanes changes as a result of the CRD deployments when these events occur.

Throughput

Changes in vehicular and person throughput will be examined to assess the extent to which congestion was reduced by deploying the CRD improvements in the I-85 corridor. According the NCHRP's *Guide to Effective Freeway Performance Measurement*, throughput is a fundamental measure of freeway performance. Throughput is a measure of the number of users "served" by the transportation system. The congestion analysis focuses on how deploying the UPA/CRD projects changed the throughput in the I-85 corridor. Using throughput as a measure of effectiveness in evaluating the impacts of the UPA/CRD deployments allows the evaluation team to determine if more vehicles and/or persons are "served" as a result of the deployment, even though travel times or travel time reliability has not changed.

Two types of throughput will be used in this assessment: vehicle throughput and person throughput. Vehicle throughput (VT) will be determined by measuring the number of vehicles using both the general purpose and the HOV/HOT lanes in the I-85 corridor. Person throughput (PT) is the total number of persons "served" by different transportation modes utilizing the corridor. PT is estimated by multiplying vehicle throughput for different vehicle classes by the average number of occupants per vehicles in each vehicle class. PT changes will be estimated by summing the following:

- PT changes attributed to CRD transit improvements, and
- PT changes due to converting the I-85 HOV lane to HOT operations.

Screenlines, imaginary lines across the highway that correspond to the GDOT detector stations (as shown in GDOT's State Traffic and Reporting Statistics [STARS] system)[10] will be established in the corridor, and traffic volume data will be used to derive vehicle throughput measures. Vehicle occupancy data are needed to assess changes in person throughput. Changes in both peak period as well as average daily VT will be assessed in the congestion analysis. PT will only be assessed in the peak periods.

VMT and person-miles traveled (PMT) will also be used by the national evaluation team in the congestion analysis. VMT is the product of the number of vehicles traveling over the length of the facility (i.e., VT) times the length of the facility. PMT is computed by taking the product of the person throughput times the length of the facility. The congestion analysis will examine how VMT and PMT changed before and after the deployment of the CRD improvements.

Table 4-3 shows the hypotheses, measures of effectiveness, and data needed for investigating the effects of the Atlanta CRD improvements on throughput.

Table 4-3. Congestion Analysis Approach: Vehicle and Person Throughput

Hypothesis/Question	Measure of Effectiveness	Data
Deploying the CRD improvements will result in more vehicles and persons being served on I-85	▪ Percent change in daily and peak period VT ▪ Percent change in PT during peak periods ▪ Percent change in the total peak period VMT in the corridor ▪ Percent change in the total daily VMT in the corridor ▪ Percent change in the peak period PMT in the corridor	▪ Traffic counts by vehicle class ▪ Average vehicle occupancy by vehicle class and lane ▪ Link length

[10] Georgia Department of Transportation. Georgia's State Traffic and Report Statistics (STARS), http://www.dot.state.ga.us/statistics/stars/Pages/default.aspx.

Spatial and Temporal Extent of Congestion

Frequently, travel time and travel time reliability do not capture how long or how far a freeway is congested. NCHRP *Guide to Effective Freeway Performance Measurements* recommends that temporal and spatial measures of congestion also be used to assess freeway performance. The spatial extent of congestion will be measured as a percentage of I-85 VMT, between I-285 to Old Peachtree Road, where the average speed is less than a predefined threshold. Likewise, the temporal extent of congestion can be measured by determining the percent of day where the average speed is less than a defined threshold. NCHRP *Guide to Effective Freeway Performance Measurements* suggests that two thresholds be used in an analysis: less than 45 mph and less than 30 mph. However, a locally set threshold could also be used for this analysis.

Table 4-4 lists the hypotheses, measures of effectiveness, and data requirements associated with the analysis that will be performed on the spatial and temporal extent of congestion.

Table 4-4. Congestion Analysis Approach: Spatial and Temporal Extent of Congestion

Hypothesis/Question	Measure of Effectiveness	Data
Implementing the CRD improvements in the I-85 corridor will reduce the spatial and temporal extent of congestion	▪ Change in the number of general purpose and HOV/HOT lane-miles operating at less than 45 mph. ▪ Change in the number of general purpose and HOV/HOT lane-miles operating at less than 30 mph. ▪ Change in the number of hours per day that the general purpose and HOV/HOT lanes are operating at less than 45 mph. ▪ Change in the number of hours per day that the general purpose and HOV/HOT lanes are operating at less than 30 mph.	▪ Average travel speeds ▪ Link lengths[11]

Users' Perceptions

The congestion analysis will investigate the degree to which travelers experienced changes in their travel based on a before/after travel diary and a companion opinion survey with the same travelers to assess their perceptions of congestion change before and after the deployment of the CRD improvements. Understanding reported changes in travel by I-85 users and their perceptions of the effectiveness of the various strategies at reducing congestion provides valuable insight into users' acceptance of future deployments of congestion reduction strategies in other areas. Table 4-5 lists the hypothesis, measures of effectiveness, and data requirements for assessing user perceptions of effectiveness of the CRD deployments on reducing congestion. The data for this analysis will be collected through a household travel panel survey.[12]

[11] For the purposes of this study, a "link" is defined as section of freeway between two detector stations in the same direction of travel. It is typically used to reflect the "zone of influence" of a traffic sensor and is generally the length that is one-half the distance to the nearest upstream and downstream sensor.

[12] The household travel panel survey mentioned through this document refers to a survey administered by the Volpe National Transportation Systems Center, part of the Research and Innovative Technology Administration within

Table 4-5. Congestion Analysis Approach: User Perceptions

Hypothesis/Question	Measure of Effectiveness	Data
As a result of the CRD improvements, the perception of travelers is that congestion has been reduced in the I-85 corridor.	▪ Percentage of respondents reporting a reduction in travel time ▪ Percentage of respondents reporting an improvement in travel reliability ▪ Percentage of respondents reporting a reduction in the duration of congestion ▪ Percentage of respondents reporting a reduction in the extent of congestion	▪ Household travel panel survey data, including – Reported travel behavior – Perceptions of congestion and travel reliability

4.1.2 Tolling Analysis

The tolling analysis focuses on the effects of the I-85 HOT lanes on travel behavior, vehicular throughput and traffic congestion on I-85. Table 4-6 presents the hypotheses/ questions, measures of effectiveness, and data for the tolling analysis. The tolling analysis is closely related to the congestion, transit and TDM analyses, which include examining changes in travel mode.

The first hypothesis is that the HOT lanes will increase vehicular throughput in the corridor and improve travel reliability during the peak periods. The introduction of variable pricing, HOV3+ occupancy requirements and mandatory toll registration will change the operational characteristics of the HOV lanes. The effect of variable tolling will be measured by the change in vehicle usage and travel-time reliability in the new HOT lanes. The second related hypothesis addresses specific change in usage as a result of the HOV-to-HOT conversion. Changes in usage will be measured by vehicle occupancy, person throughput, vehicle user groups, shifts of two-person carpools (in terms of mode, route and time of travel), and formation of casual carpools (also known as "slugging") due to the new HOV3+ requirement. A third hypothesis relates to how travelers utilize the toll system by account types and level of toll evasion. The fourth hypothesis relates to the impact of pricing to regulate use of the lanes by measuring the relationship between toll pricing and lane utilization. Data needed to assess these measures of effectiveness include traffic data, toll system data, and surveys and observations of users.

U.S. DOT. The panel survey is described further in this document within section 4.2.6 Survey and Interview Test Plan.

Table 4-6. Tolling Analysis Approach

Hypotheses/Questions	Measures of Effectiveness	Data
▪ The HOT lanes will increase vehicular throughput on I-85 HOV/HOT and improve travel reliability	▪ Change in vehicle throughput (number of vehicles) on I-85 HOV/HOT ▪ Change in buffer time ▪ Change in planning time index ▪ Change in travel time variance (or standard deviation)	▪ Traffic volumes by time-of-day, location/segment, and lane type ▪ Toll transactions by time of day and location ▪ Average link speeds ▪ 95^{th} percentile link speed ▪ Free flow speed ▪ Link Lengths
▪ What changes in usage will occur as a result of the conversion of the 2+ HOV lanes to 3+ HOT lanes?	▪ Change in average vehicle occupancy in HOV/HOT lanes and general-purpose lanes ▪ Change in person throughput (number of persons) on I-85 HOV/HOT ▪ Change in the number of vehicles by user group on I-85 HOV/HOT lanes ▪ Modal shift by current 2-person carpools in I-85 HOV lanes (to HOV3+, SOV, paying HOV2, transit) ▪ Temporal and spatial shifts by current 2-person carpools using the I-85 HOV lanes ▪ Observations of casual carpools formation	▪ Vehicle occupancy ▪ Traffic volumes by time-of-day, location/segment, and lane type ▪ Toll transactions by type of account and/or toll status ▪ Surveys of current 2-person carpools ▪ Observed location of slugging (park-and-ride) ▪ Observations of casual carpools formed at park-and-ride facilities
▪ How much will travelers utilize the I-85 HOV/HOT toll system?	▪ Patterns of usage of the I-85 HOV/HOT toll system by accounts, transactions and evasion: • Account activity by month • Number of daily and monthly transactions by direction and time period • Frequency of use • Peak hour and peak period trips by toll status • Peak period violation rate (%) ▪ Use of general purpose lanes by vehicles with transponders	▪ Number of toll accounts ▪ Number of toll transactions by account type and/or toll status ▪ Number of toll transactions by location (HOT lane or general purpose lanes) ▪ Number of toll evasions by type
▪ Variable pricing the I-85 HOV/HOT lanes will regulate vehicular access so as to improve the operation of the lanes.	▪ Price elasticity of demand (change in transactions in response to change in toll charged)	▪ Toll transactions by time of day ▪ Toll price by time of day

4.1.3 Transit Analysis

Transit is a key element of the Atlanta CRD. The Atlanta CRD transit projects focus on making riding the bus in the I-85 corridor more attractive and convenient by adding transit service with premium coach buses and by adding park-and-ride lot capacity. Mode shift may result from current automobile drivers changing to riding the bus, from increased transit use among existing riders, and from new travelers in the corridor selecting transit. Thus, a key transit evaluation issue is the identification and measurement of mode shift. In theory, a mode shift to transit should then facilitate higher transit ridership, reduced levels of traffic congestion, more efficient use of existing road capacity, and potentially higher levels of person throughput.

Table 4-7 presents the hypotheses, measures of effectiveness, and data for the transit analysis. The first hypothesis relates to improved transit performance in the I-85 corridor provided by the HOT lanes and expanded park-and-ride lot capacity. The measures of effectiveness include actual and percent changes in bus travel speeds, bus travel times, bus service reliability, bus service capacity, and park-and-ride lot capacity.

The second and third hypotheses relate to increasing transit ridership, influencing mode shifts, and reducing congestion on I-85 that will result from adding capacity at new and existing park-and-ride lots and adding new transit service. The measures of effectiveness include actual and percent changes in transit ridership, transit mode share, and park-and-ride lot utilization.

The last hypothesis relates to the relative contribution of each of the transit strategies to mode shift and congestion reduction. There are a number of factors contributing to possible mode shift, including increased vehicle travel cost in response to tolling, decreased transit travel time, increased transit reliability, improved transit infrastructure, increased service quantity, and increased capacity at park-and-ride lots, in addition to exogenous extraneous factors such as high gasoline prices. If mode shift to transit does occur, it is important to be able to understand why, and to relate the resultant mode shift to specific Atlanta CRD project elements to the extent possible. This will require consideration of transit data sources, supplemented by survey information of bus riders.

Table 4-7. Transit Analysis Approach

Hypotheses/Questions	Measures of Effectiveness	Data
▪ Atlanta CRD project will enhance transit performance in the I-85 corridor	▪ Actual and % change in average bus travel speeds ▪ Actual and % change in average bus travel times ▪ Actual and % change in service reliability (schedule adherence/on-time performance) ▪ Actual and % change in service capacity ▪ Actual and % change in park-and-ride lot capacity	▪ Transit travel-speed data ▪ Transit travel-time data ▪ Transit travel time reliability and schedule adherence data ▪ Transit service characteristics data ▪ Park-and-ride lot capacity data
▪ Atlanta CRD project will increase ridership and facilitate a mode shift to transit within the I-85 corridor	▪ Actual and % change in transit ridership ▪ Transit mode share (person throughput by mode) ▪ Actual and % change in park-and-ride lot utilization	▪ Transit ridership data ▪ Household travel panel survey data ▪ Transit on-board survey data ▪ Park-and-ride lot utilization data
▪ Increased ridership / mode shift to transit will contribute to congestion mitigation within the I-85 corridor	▪ Actual and % change in transit ridership ▪ Transit mode share (person throughput by mode) ▪ Actual and % change in park-and-ride lot utilization ▪ Transit customer satisfaction	▪ Transit ridership data ▪ Household travel panel survey data ▪ Transit on-board survey data ▪ Park-and-ride lot utilization data
▪ What was the relative contribution of each Atlanta CRD project element to increased ridership and/or mode shift to transit within the I-85 corridor?	▪ All of the above, supplemented by effectiveness measures from other aspects of the evaluation	▪ All of the above, supplemented by data from other aspects of the evaluation

4.1.4 TDM Analysis

The TDM element of the Atlanta CRD focuses on outreach and supportive TDM measures for the I-85 HOT lane project. The principal organization responsible for TDM outreach in the corridor is the Clean Air Campaign. The CAC works with employers and commuters to encourage alternative mode use (carpool, vanpool, transit, telecommuting, compressed work weeks and bicycle/walk) with the aim of reducing VMT and emissions. The CAC provides TDM outreach in areas not served by local transportation management associations, such as those serving the Perimeter, Emory University or the Buckhead area. In addition to employer outreach and information provision, the CAC operates one of the most comprehensive and successful rideshare incentive programs in the U.S. Drive-alone commuters willing to switch to an alternative mode are eligible for a cash incentive for up to three months. More salient to the CRD project and HOT lane policies, the CAC provides a Carpool Reward program for carpools with three or more occupants (a $40 gas card per month for 3-person carpools and $60 per month for 4+ carpools).

The CAC is planning to educate client employers and registered alternative mode users about the HOT lane project and extol the benefits of 3+ carpooling (free use of HOT lanes, reliable travel times and carpool reward incentives). This will be the principal TDM element of the CRD project. No additional or special services or incentives are planned in conjunction with the CRD project. However, CAC will commit staff and educational resources to the corridor as demand warrants. CAC will work with other CRD partners to promote alternative modes and encourage those who switch modes as a result of the HOT lane project to register with the CAC to be eligible for incentives. CAC will educate its client worksites, most of whom have employees who commute on I-85, about the HOT lane project and the related benefits of using alternative modes, including express bus service.

The Atlanta TDM evaluation will seek to assess the impact of the CAC's regular outreach and incentives on the use of commute alternatives in the I-85 corridor. Key hypotheses, performance measures and data sources are outlined in Table 4-8. For example, any increases in registered commuters will be documented during the deployment period and the influence of the CRD project on these increases will be assessed. This will help generate key performance measures such as mode shift and VMT reduction. These findings will be corroborated with changes in average vehicle occupancy (AVO) on I-85 and changes in overall volumes.

Table 4-8. TDM Analysis Approach

Hypotheses/Questions	Measures of Effectiveness	Data
▪ Promotion of commute alternatives removes trips and VMT from I-85 ▪ CAC incentives support formation of 3+ carpools and vanpools on I-85 ▪ What was the relative contribution of the Atlanta CRD TDM initiatives on reducing I-85 vehicle trips/VMT?	▪ Increase in vehicle occupancy on I-85 (HOT lanes) ▪ Number of new registered carpools and vanpools ▪ Number of commuters reschedule or eliminate trips ▪ Mode shift to 3+ carpool and vanpool ▪ Numbers of vehicle trips and vehicle miles traveled reduced on I-85 (and estimated contribution of TDM) ▪ Number of employers who request information on HOT lane project and commute options	▪ CAC registered commuters and their mode choices ▪ Before/after carpooler survey ▪ Household travel panel survey ▪ Car and vanpool vehicle occupancy counts ▪ Vanpool statistics ▪ CAC client employer statistics ▪ Trip lengths of car and vanpoolers

In addition to client employer and commuter registration data, a before and after survey will be conducted with carpoolers in the CAC registration database. A similar survey was conducted in early 2009 as part of market research activities for the HOT lane concept and will be repeated during the pre-deployment CRD period. A second survey will be conducted during the post-deployment phase to assess changes in commute behavior of previous carpooler, and new carpool registrants can be surveyed to assess prior mode, reason for switching, and the role of the HOT lane project therein. Mode shift and other behavioral and attitudinal indicators will also be gleaned from the household travel panel survey.

There are two other evaluation issues related to carpooling that are being included within the tolling analysis. First, the requirement for two-person carpools to pay a toll may have an impact on carpool formation rates. It could contribute to the formation of 3+ carpools; it could result in 2-person carpools switching to the general lanes, or it could cause the break-up of some carpools. This dynamic will be explored in the tolling analysis. Likewise, the offer of free use of the HOT lanes to 3+ carpools may result in casual carpooling. Registered carpool drivers could seek riders at park-and-ride or other locations at end of the toll lanes to form daily 3+ carpools. Again, this potential phenomenon will be assessed as part of the tolling analysis and included in the tolling data test plan.

4.1.5 Technology Analysis

Although ITS technologies underlie many of the CRD enhancements, the technology analysis will focus on a unique technological application—the use of automated enforcement systems and their contributions to the level of enforcement in the corridor. In converting HOV 2+ to HOT 3+, local partners were concerned about the following types of violations:

- Use by unregistered carpools,
- Vehicle occupancy requirement violations, and
- Vehicles moving in and out of the HOT lane between access points (i.e., crossing "double-white line" buffer zone).

To address these issues, automated enforcement will use technologies throughout the corridor in conjunction with the controlled access gantry system. This system will use confirmation gantries and automated video enforcement technologies (cameras) between the toll paying gantries to assist with the enforcement activities.

Access to the HOT lanes is restricted to registered users only. To enforce this requirement, all vehicles must be equipped with a transponder, and to receive a transponder, a user has to pre-register to use the HOT lane. Automated license plate reading technology will be deployed to assist with the enforcement. License plate reads will be compared to the registration database to ensure that vehicles are authorized to use the lane. If an unregistered vehicle is detected, the owner of the vehicle will be issued a toll violation notice automatically. The number and rate of toll violation notices issued in the corridor will be tracked. Of particular interest to the national evaluation is how the frequency of violations changes over time after the automated enforcement systems have been installed.

Under the current concept of operation, vehicles with three or more passengers will not be required to pay a toll – only those passenger vehicles with one and two occupants. Other toll exempt vehicles include Alternative Fuel Vehicle with valid Georgia AVF license plates, motorcycles, over-the-road buses, and emergency vehicles. For a carpooler to qualify as a toll exempt user, carpoolers must self-declare their HOV status, either prior to beginning their trip or at the time that their original registration. It is the user's responsibility to change their occupant status before entering the HOT system by contacting the HOT service center. Enforcement personnel will be equipped with mobile automated license plate recognition devices that will allow them to verify the declared occupancy status of vehicles in the HOT lanes. The devices will receive direct updates from the SRTA back office via a wireless communication system, allowing the officer to immediately determine if the vehicle is registered as a non-toll user. The enforcement activities will be targeted to catch those users who fail to meet the occupancy requirements. Current peak period HOV violation rates in the Atlanta area range between 11 and 12 percent.

The final enforcement issue of concern for the local partners is associated with maintaining the integrity of the lane as an HOV/HOT lane. Because no physical barrier exists separating the HOV/HOT lane from the general purpose lanes (other than a double white stripe and a small buffer space), the local partners are concerned about potential violators moving in and out of the HOV/HOT lane between established access points. The proposed design of the gantry controlled access system is intended to assist with detecting vehicles moving in and out of the HOV/HOT lane between toll collection stations and automatically issue toll violation notices.

The technology analysis is not intended to be an assessment of the technology itself – rather, the technology assessment is intended to assess if the automated enforcement systems reduced the level and types of violations that occur in the HOV/HOT lane. Table 4-9 summarizes the hypotheses, measures of effectiveness, and data needs associated with this portion of the technology analysis.

In addition to collecting quantitative information on enforcement activities, interviews with SRTA and enforcement personnel will be conducted. The objective will be to obtain their impressions of the effectiveness of the automated enforcement approaches used in this deployment and to discuss issues and lessons learned associated with using automated enforcement techniques in this situation.

Table 4-9. Technology Analysis Approach: Enforcement

Hypothesis/Question	Measure of Effectiveness	Data
Using advanced technology to enhance enforcement will reduce the rate and type of violators in the corridor	▪ Number of citations issued for unregistered users ▪ Number of citations issued for violating passenger occupancy requirements ▪ Number of citation issued for "crossing double white" (i.e., entry/exit at non-gantry locations) ▪ Total number of citations ▪ Citations per VMT	▪ Number of citation by type ▪ Traffic volumes/ vehicle-miles travel

4.1.6 Safety Analysis

Table 4-10 summarizes the planned approach to evaluating the I-85 CRD project's safety impacts. While the projects are designed with safety in mind, unintended safety impacts could result from the conversion of the HOV lanes to HOT lanes. Reduced congestion in the HOV lanes may lead to faster-flowing traffic and a higher risk of severe collisions. New lane markings and signage at the entrances to the HOT lanes may present potential safety concerns. It is possible that drivers may be confused by new HOT lane use requirements and new enforcement procedures. Some drivers may illegally engage in "boundary jumping" to avoid paying HOT tolls, which could lead to accidents. On the other hand, the project improvements and the new enforcement technology are expected to reduce buffer-related incidents and violations and provide a positive contribution to safety in the corridor compared with current conditions.

Table 4-10. Safety Analysis Approach

Hypotheses/Questions	Measures of Effectiveness	Data
The collective impacts of CRD improvements will be safety neutral or safety positive	▪ Change in incidents per VMT in treatment corridors	▪ Frequency, type, and severity of safety incidents on treatment and control corridor freeways and arteries ▪ VMT
Gantry-controlled access technology will reduce buffer-related incidents and buffer violations	▪ Safety incidents attributable to buffer violation ▪ Citations for buffer violation ▪ Corridor operating personnel's perceptions of incidents attributable to buffer violations	▪ Frequency of safety incidents involving buffer violation ▪ Frequency of citations for buffer violation ▪ Surveys/interviews with enforcement personnel, freeway service patrol operators, operations staff, and bus operators
Tolling strategies that entail unfamiliar signage will not adversely affect highway safety	▪ Change in the perception of safety by service patrol operators, state patrol officers, medical first responders, and bus operators ▪ Changes in the perception of safety by travelers	▪ Surveys/interviews with enforcement personnel, freeway service patrol operators, medical first responders and bus operators

While the preceding safety impacts are not expected to be large, they still merit careful examination. Four kinds of data will be required to do this. These include VMT data for affected freeways and arteries, since VMT is a primary measure of risk exposure; safety incident data (frequency, type, and severity) that can be used to quantify the numbers of accidents occurring before and after HOT deployment; the subjective observations of the law enforcement personnel, service personnel, and professional drivers whose serve and travel in the treatment corridors; and perceptions of safety by travelers as collected through surveys.

4.1.7 Equity Analysis

This analysis will examine potential equity issues associated with the Atlanta CRD project. Experience with HOT lanes projects and other toll facilities throughout the country indicate that perceptions of fairness, or equity, may be a factor in the acceptance of proposed pricing projects. Equity may also be a concern in the spatial distribution of services and infrastructure. Equity issues are important to assess because the impacts – both positive and negative – may contribute to public opinion and the effects upon various population groups.

The Atlanta CRD partner agencies have already conducted one form of equity analysis as part of the required Environmental Analysis (EA) to fulfill environmental justice requirements. The purpose of the equity analysis within the national evaluation is not to compare findings with that projected in the EA, but to assess equity issues using observed and derived data at the end of the deployment period.

As presented in Table 4-11, equity will be examined in four ways. First, the direct social effects from the Atlanta CRD HOT lane project, on various user groups will be examined. These social effects may include tolls paid, travel-time savings, and adaptation costs. The second hypothesis addresses the spatial distribution of aggregate out-of-pocket and inconvenience costs, and travel time and mobility benefits. Third, possible differential environmental impacts on certain socio-economic groups will be examined. This question addresses possible environmental justice issues. Finally, the reinvestment of revenues from tolling on the I-85 HOT lanes and how this reinvestment impacts various user groups will be examined.

4.1.8 Environmental Analysis

This analysis will assess the impacts the I-85 HOT lanes on mode shift, vehicle and person throughput, increased speeds, reductions in idling, increases in transit ridership, and new telecommuters on the environment. This environmental analysis addresses air quality and energy impacts. The Atlanta CRD partners have already conducted an air quality analysis as part of an environmental assessment of substituting the HOT lane project for HOV improvements as a transportation control measures (TCM) in the state implementation plan (SIP).[13] The national evaluation does not intend to compare the findings of this environmental analysis, which will be based on observed VMT and speed changes, to that the effects modeled for the TCM analysis.

[13] TCM substitution analysis adopted on November 5, 2009 by EPA concurrence letter.

Table 4-11. Equity Analysis Approach

Hypotheses/Questions	Measures of Effectiveness	Data
▪ What are the direct social effects (travel times, tolls, adaptation costs) for various transportation system user groups from tolling and other CRD strategies? ▪ What is the spatial distribution of aggregate out-of-pocket and inconvenience costs, and travel-time and mobility benefits?	▪ Socio-economic and geographic distribution of benefits and impacts - Tolls and adaptation costs - Changes in travel time and trip distance - Total transportation cost ▪ Public perception of the individualized equity impacts of pricing	▪ Reported travel behavior changes from household travel panel survey ▪ Regional travel cost averages ▪ Perceived impact of congestion strategies on special populations from household travel panel survey ▪ Toll payment methods ▪ Toll transaction/usage by income levels ▪ Customer account data ▪ Traffic and transit data ▪ Transit ridership data ▪ Carpool and vanpool data ▪ Regional socio-economic data
▪ Are there any differential environmental impacts on certain socio-economic groups?	▪ Socio-economic and geographic distribution of environmental benefits and impacts	▪ Air quality impacts from the environmental analysis
▪ How does reinvestment of HOT revenues impact various transportation system users?	▪ Spatial distribution of revenue reinvestment (short- and long-run)	▪ Agency records on revenue and reinvestment ▪ Expectations of agency officials (interviews)

Table 4-12 lists the hypotheses and questions for the environmental analysis. The focus will be on air quality as it relates to changes in travel behavior. Air quality benefits are often cited as a positive impact from pricing, transit, telecommuting, and some technology projects. The second hypothesis involves the potential for energy savings from mode shifts and changes in freeway operating conditions.

Table 4-12. Environmental Analysis Approach

Hypotheses/Questions	Measures of Effectiveness	Data
▪ What are the impacts of the HOT lane project in the I-85 corridor on air quality?	▪ Change in estimated emissions	▪ VMT and speed changes from congestion analysis ▪ Emission factors ▪ Travelers' reported mode shift ▪ VMT reduction from mode shift ▪ Observed data for changes in fleet composition
▪ What are the impacts on energy consumption?	▪ Changes in estimated fuel consumption	▪ VMT changes from congestion analysis ▪ Fuel efficiency factors

Observed changes in VMT and speeds for the I-85 corridor will be based on the data from the congestion analysis. The Georgia Environmental Protection Division (EPD) of the Department of Natural Resources will use MOBILE6.2 to produce emission rates for speeds from 3 mph to 65 mph. The appropriate emission factor (ozone precursors, nitrogen oxides, fine particulate matter, and carbon dioxide) will be applied by the national evaluators to the VMT on a link-by-link basis, based on the observed congested speed of the link. The results will also be aggregated to a corridor total. As an additional means to quantify emission changes resulting from the CRD strategies, mode shift findings may be used to estimate VMT reductions associated with shifts from lower to higher occupancy modes and for travelers who telecommute or respond to enhanced TDM programs and, thus, eliminate travel and VMT in the corridor. These VMT reductions will be applied to the emission factors developed for the modeled VMT and speed change results by ARC. While not a complete picture of emission reductions, because it does not account for changes in speeds, the mode shift/VMT analysis provides a good secondary source that is also observed, sheds light on the *relative contribution* of mode shift to overall VMT change (based on the congestion analysis) and allows for adjustment to corridor VMT levels based solely on observed volumes multiplied by the length of the project corridor.

The impacts of the CRD project on energy consumption will be examined using VMT data from the congestion analysis. The energy savings from reductions in VMT will be estimated using fuel efficiency factors.

4.1.9 Goods Movement Analysis

The Atlanta CRD projects do not focus specifically on goods movement in the I-85 corridor or in the metropolitan area as a whole. However, given the economic importance of goods movement to the Atlanta region, understanding the impacts of the Atlanta CRD projects on this sector is important. While vehicles with more than six wheels (with the exception of over-the-road buses or emergency vehicles) and multi-unit vehicles are prohibited from using the HOT lane facilities, the reduction of congestion on the general purpose lanes of I-85 could reduce travel times for commercial vehicle operators (CVOs), allowing faster movement of long-haul semi-trucks and vehicles used for short-haul delivery and by service providers.

Also, some commercial operators with light-duty trucks (such as package deliveries and service vehicles) may realize further travel-time savings and trip-time reliability through use of the HOT lanes. The tolls associated with HOT lanes represent an added cost of doing business for such commercial entities, which must be weighed against the potential gains made in travel time.

Table 4-13 presents the goods movement analysis approach. The first hypothesis is that commercial vehicles on I-85 general-purpose freeway lanes will realize travel-time savings due to the overall reduction in congestion resulting from the deployment of the CRD projects. The measure of effectiveness for this hypothesis is the change in travel times in the general purpose freeway lanes pre- and post-deployment. While a majority of the truck traffic in the area is during off-peak hours when congestion might not be a factor, the evaluation will strive to capture any changes in truck travel times or in percentage of trucks during peak hours due to the CRD projects.

Table 4-13. Goods Movement Analysis Approach

Hypotheses/Questions	Measures of Effectiveness	Data
Commercial vehicle operators (CVOs) will experience reduced travel time by reduced congestion on general purpose lanes	Percent change in travel time in general purpose lanes	▪ Travel time by vehicle types in general purpose lanes
Operators with light-duty trucks will prefer to use HOT lanes to general purpose lanes for faster travel times	Correlation of tolls paid by operators of light-duty trucks with travel time on HOT lanes	▪ Toll transaction data (number by vehicle type, usage, revenue data) ▪ Travel time in HOT lane
Operators delivering goods will perceive the net benefit of tolling strategies (e.g., benefits such as faster service and greater customer satisfaction outweigh higher operating costs due to tolls)	Perceived advantages and disadvantages of tolling among operators	▪ Surveys/interviews with operators of delivery/small commercial vehicles
Operators report changing operational decisions due to use of HOT (e.g., changing delivery times)	Operational changes reported by operators who use HOT lanes	▪ Changes in truck travel times during peak hours ▪ Changes in truck percentages during peak hours ▪ Surveys/interviews with operators of delivery/small commercial vehicles

The second hypothesis looks at the trends in usage of HOT lanes by commercial operators. The measure of effectiveness for this hypothesis is the correlations in the trends in tolls paid by operators of light duty trucks and the travel times on HOT lanes. The third and fourth hypothesis relate to the perceptions of operators on the HOT lanes and tolling specifically on the perceived advantages, disadvantages of tolling, and the ability to make operational changes due to the CRD projects.

4.1.10 Business Impacts Analysis

This analysis will examine the effects of I-85 HOT lanes and the transit and TDM improvements on employers and businesses. For example, implementation of HOT lanes may result in an improved commute trip leading to employee satisfaction and retention. New and expanded bus services may result in improved employee satisfaction with commuting options. The ability to use an HOT lane may improve the efficiency of transportation-dependent business like taxi operators and couriers).

Table 4-14 presents the hypothesis/questions, measures of effectiveness, and data for the business impact analysis. The first question focuses on the impacts of the CRD projects on employers, including employee satisfaction with commute trips, perceived productivity, employer retention/hiring, and changes in the cost of doing business. Measures of effectiveness and data related to this question address changes in employees' and employers' perceptions of these elements as measured by surveys, interviews, or focus groups with various classes of employers and employment centers in areas targeted for congestion reduction (including private and public sectors and nonprofits). Representatives from the Perimeter and Gwinnett Community Improvement Districts will be targeted for interviews to address these evaluation questions.

Table 4-14. Business Impacts Analysis Approach

Hypotheses/Questions	Measures of Effectiveness	Data
▪ What is the impact of the strategies on employers? e.g., ▪ Employee satisfaction with commute (HOT, transit) ▪ Increased employment-shed to downtown/mid-town Atlanta	▪ Change in perceptions and satisfaction with commute trip (by all modes) ▪ Increase in workers within 45 minutes of downtown and other employment centers	▪ Perceptions of CRD impacts from sample of affected employers and employees
▪ What is the impact of the strategies on businesses that rely on customers accessing their stores, such as retail and similar establishments?	▪ Change in perceived (by businesses in CID) impact of congestion strategies on business volume, day/week patterns of business	▪ Perceptions of CRD impacts by occupants/representatives of Gwinnett and Perimeter Community Improvement Districts
▪ How are businesses that are particularly impacted by transportation costs affected (e.g., taxis, couriers, distributors, tradesmen)?	▪ Change in perception of transportation costs and benefits for transportation-related businesses ▪ Level of usage of HOT lanes by transportation-sensitive businesses	▪ Perceptions of CRD impacts from a sample of business managers of transportation-related services

The second question presented in that table examines possible impacts on downtown businesses that rely on customers accessing their stores, such as retail establishments. The measures of effectiveness focus on reported changes in store traffic, sales, and shopping frequency as gathered through opinions of retail business representatives especially in the Perimeter and Gwinnett Community Improvement Districts (CID), and sales tax receipts in the affected CIDs.

The third question relates to the specific impacts of the CRD projects on businesses that are transportation-based or highly transportation-sensitive such as taxis and delivery services. The related measure of effectiveness is the change in perception of these service firms obtained in interviews with business owners and managers of transportation-sensitive businesses.

4.1.11 Non-Technical Success Factors Analysis

This analysis will collect lessons learned about non-technical success factors from the Atlanta CRD. These non-technical success factors include outreach, political and community support, and the institutional arrangements used to manage and guide implementation of the Atlanta CRD projects. Information on the non-technical success factors is of benefit to the U.S. DOT, state departments of transportation, metropolitan planning organizations (MPOs), and local communities interested in planning and deploying similar projects.

Table 4-15 presents the questions, measures of effectiveness and data sources associated with the analysis of the non-technical success factors. The first hypothesis/question focuses on understanding how a wide range of variables influence the success of the Atlanta CRD project deployments. The variables have been grouped into five major categories: (1) people, (2) process, (3) structures, (4) media, and (5) competencies. The categorization scheme emerged from the Hubert H. Humphrey Institute of Public Affairs' recent study of the Minnesota UPA process leading up to that site's UPA award by U.S. DOT.[14]

Table 4-15. Non-Technical Success Factors Analysis Approach

Hypotheses/Questions	Measures of Effectiveness	Data
▪ What role did factors related to these five areas play in the success of the deployment? 1. People (sponsors, champions, policy entrepreneurs, neutral conveners) 2. Process (forums [including stakeholder outreach], meetings, alignment of policy ideas with favorable politics and agreement on nature of the problem) 3. Structures (networks, connections and partnerships, concentration of power and decision-making authority, conflict-management mechanisms, communications strategies, supportive rules and procedures) 4. Media (media coverage, public education) 5. Competencies (cutting across the preceding areas: persuasion, getting grants, conducting research, technical/technological competencies; ability to be policy entrepreneurs; knowing how to use markets)	▪ Observations from CRD participants	▪ One-on-one interviews followed by group workshops: – End of planning and implementation phase – End of CRD one-year operational evaluation period
	▪ Partnership documents (e.g., memoranda of understanding)	▪ CRD partners' documents
	▪ Outreach materials (press releases, brochures, websites, etc.)	▪ CRD partners' outreach materials
	▪ Radio, TV and newspaper coverage	▪ Internet-based tracking of media coverage ▪ CRD partners' files
▪ Does the public support the UPA strategies as effective and appropriate ways to reduce congestion?	▪ Public opinion	▪ Survey of general public about the CRD project (if available) ▪ Comments at public forums

[14] John M. Bryson, Barbara C. Crosby, Melissa M. Stone, J. Clare Mortensen (2008). "Collaboration in Fighting Traffic Congestion: A Study of Minnesota's Urban Partnership Agreement." Report no. CTS 08-25, University of Minnesota ITS Institute. December.
http://www.its.umn.edu/Publications/ResearchReports/reportdetail.html?id=1714

As indicated in Table 4-15 this analysis relies heavily on information provided by the Atlanta CRD partners. Input from the Atlanta CRD partners will be collected using the formal mechanisms shown in Table 4-15, which includes rounds of interviews followed by a group workshop addressing the non-technical success factors. Additionally, information will be gleaned informally through observation and interaction with the Atlanta CRD partners over the course of the demonstration, as well as an examination of formal partnership documents, outreach material, and media coverage. The second question guiding this analysis focuses on public opinion regarding the Atlanta CRD project. Does the public view the CRD projects as effective and appropriate ways to reduce congestion? Public opinion data, if available, and information from the stakeholder interviews will be used.

4.1.12 Cost Benefit Analysis

The purpose of the cost benefit analysis (CBA) is to quantify and monetize the potential costs and benefits that may be incurred from implementing the Atlanta CRD projects. The net benefit from the CRD projects, which is the difference between the total benefits and the total costs, will indicate the potential returns from the public investment. The cost benefit analysis plays an important role in determining the feasibility of transportation projects because the results from the analysis are easily understood and acknowledged.

The cost benefit analysis will be performed using a 10-year time frame (the 10 years following implementation of the Atlanta CRD projects). Within this evaluation time frame, the cost benefit analysis will estimate and compare annual benefits and costs between two scenarios—(1) with the Atlanta CRD projects implemented (reality) and (2) if the Atlanta CRD projects had not been implemented (base case scenario).

The CRD projects focus on reducing congestion in the I-85 corridor, and the expected benefits include travel-time savings, vehicle operating cost savings, and increases in travel time reliability. These savings will be determined on an aggregate scale using output from Atlanta's regional planning model and results from other CRD data collection efforts. The cumulative amount of travel time savings, reduced emissions and reduced vehicle operating costs will be determined and then converted to monetary units. On the cost side, the capital costs of the CRD projects will be included, as will operating and maintenance costs, and replacement and reinvestment costs for technology components, such as new tolling and enforcement systems. For communities, the potential benefits include reduction in emissions.

The cost benefit analysis for the Atlanta CRD projects depends on several types of data. These data sources include the travel forecasts from the regional travel demand model, the data collected from surveys, and the project investment or the expenditures of the local government agencies.

To examine the impacts of certain parameters on the net benefits calculated in the cost benefit analysis, a sensitivity analysis may be conducted if warranted. Vehicle operating cost savings, for instance, are one of the major benefits that will be experienced by drivers and freight transportation. The calculation of the vehicle operating cost savings depends on fuel price, which has been volatile in recent years. Because forecasting the future movement of fuel price is beyond the scope of the Atlanta CRD evaluation, a sensitivity analysis will be utilized to examine the impacts of fuel price and the net benefit generated from the cost benefits analysis.

Table 4-16 summarizes the key hypothesis/question that will be addressed by the cost benefit analysis and the main data components that will be calculated in the analysis.

Table 4-16. Cost Benefit Analysis Approach

Hypotheses/ Questions	Data
▪ What is the net benefit (benefits minus costs) of the Atlanta CRD projects?	▪ Much data will come from other analyses and test plans (traffic, safety, etc.) ▪ Cost data include: – Capital costs – Operation and maintenance costs – Replacement and re-investment costs ▪ Benefits data include: – Travel time savings – Improvement in travel reliability – Vehicle operating cost savings – Safety cost savings – Reduction in emissions

4.2 Preliminary Evaluation Test Plans

Individual test plans will be developed and used to collect and analyze the data needed to assess the hypothesis in the 12 evaluation analyses presented in Section 4.1. The 10 test plans for the Atlanta CRD are:

- Traffic System Data Test Plan
- Tolling Data Test Plan
- Transit System Data Test Plan
- TDM Data Test Plan
- Safety Data Test Plan
- Surveys and Interviews Test Plan
- Environmental Data Test Plan
- Content Analysis Test Plan
- Cost Benefit Analysis Test Plan
- Exogenous Factors Test Plan.

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.

Table 4-17 shows which of the various 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. Table 4-18 presents the more specific data needed for each of the 12 evaluation analyses that will be included in the test plans. Figure 4-1 shows the schedule for data collection.

The remainder of this section summarizes the key elements of each of the 10 test plans. Preliminary information on the data sources, data availability, data analysis, and the data collection schedule and responsibilities is presented. The more detailed test plans will be developed as the next step in the evaluation process.

4.2.1 Traffic System Data Test Plan

Traffic system data will be used to support a number of analyses, including the congestion, technology, transit, telecommuting, safety, environmental, equity, and cost benefit analyses. The primary traffic system data elements that are needed for these analyses include the following:

- link speed,
- segment travel time,
- link volume, and
- average number of occupants per vehicle.

For the purpose of this study, a "link" is defined as the portion of roadway between detector stations and typically reflects the "zone of influence" of a traffic sensor. As such, a link is generally one-half the distance to the nearest upstream and downstream sensor. A "segment" is defined to be a collection of contiguous links. Traffic network links will be aggregated into segments to reflect the various tolling segments to be using on I-85. It is expected that each travel segment will contain at least one GDOT traffic sensor station.

Table 4-17. Relationships Among Test Plans and Evaluation Analyses

Atlanta CRD Test Plans	Congestion Analysis	Tolling Analysis	Transit Analysis	TDM Analysis	Technology Analysis	Safety Analysis	Equity Analysis	Environmental Analysis	Goods Movement Analysis	Business Impact Analysis	Non-Technical Success Factors Analysis	Cost Benefit Analysis
Traffic System Data Test Plan	●	●			○	○	○	●	●			○
Tolling Data Test Plan		●			○		○	○	●	○		○
Transit System Data Test Plan	○	○	●				○	○				○
TDM Data Test Plan	○			●			○	○		○		○
Safety Data Test Plan					●	●						○
Surveys and Interviews Test Plan	○	○	●	●		○	●	○	○	○	●	○
Environmental Data Test Plan							○	●				○
Content Analysis Test Plan											●	
Cost Benefit Analysis Test Plan												●
Exogenous Factors Test Plan	○	○	○	○	○	○	○	○	○	○	○	○

● — Major Input ○ — Supporting Input

Table 4-18. Data for the Evaluation Analyses

Evaluation Data	Congestion	Tolling	Transit	TDM	Technology	Safety	Equity	Environmental	Goods Movement	Business Impacts	Non-Technical Success Factors	Cost Benefit
<u>Traffic Data</u>												
Travel times	X	X					X		X			X
Travel speeds	X						X	X				
Link length	X				X	X		X				
Traffic counts/volumes	X	X			X	X		X				
Vehicle occupancy	X	X										
<u>Tolling Data</u>												
Toll transactions		X					X		X	X		
Toll accounts		X					X			X		
Toll evasions		X										
Toll price		X										
Toll revenues												X
<u>Transit Data</u>												
Travel speed			X									
Travel time			X									
Schedule adherence			X									
Service characteristics (frequency, revenue and vehicle miles)			X									
Park-and-ride lot capacity			X									
Park-and-ride lot utilization			X									
Ridership							X					
<u>Car and Vanpooling Data</u>												
Location of slugging		X										
Casual carpool counts at park-and-ride lots		X										
Clean Air Campaign registered commuters' data				X			X					
Clean Air Campaign employer data				X								
Vanpool data				X			X					
<u>Safety and Enforcement Data</u>												
Citations by type and location					X	X						
Safety incidents by type and location						X						X
Highway Emergency Response Operators (HERO) dispatch logs	X											

Table 4-18. Data for the Evaluation Analyses (Continued)

Evaluation Data	Congestion	Tolling	Transit	TDM	Technology	Safety	Equity	Environmental	Goods Movement	Business Impacts	Non-Technical Success Factors	Cost Benefit
<u>Surveys/Interviews: Transportation Experience and Opinion Data</u>												
Traveler behavior	X	X	X	X				X				
Traveler costs							X					X
Public/travelers' perceptions	X		X				X				X	
Enforcement personnel, freeway service patrol operators, TMC operations staff, and bus operators						X						
Stakeholders experience and opinions							X	X			X	
Operators of delivery, small commercial vehicles, and other transportation-related businesses									X	X		
Employer, employees, Community Improvement Groups, retailers										X		
<u>Agency Data</u>												
Agency cost data												X
Transportation model forecasts												X
Toll revenue reinvestment							X					
Regional socio-economic data							X					
Air quality emissions factors								X				
Vehicle fuel use factors								X				
Stakeholder documents											X	
Stakeholder outreach materials											X	
<u>Media Coverage/Public and Political Outreach Information</u>											X	

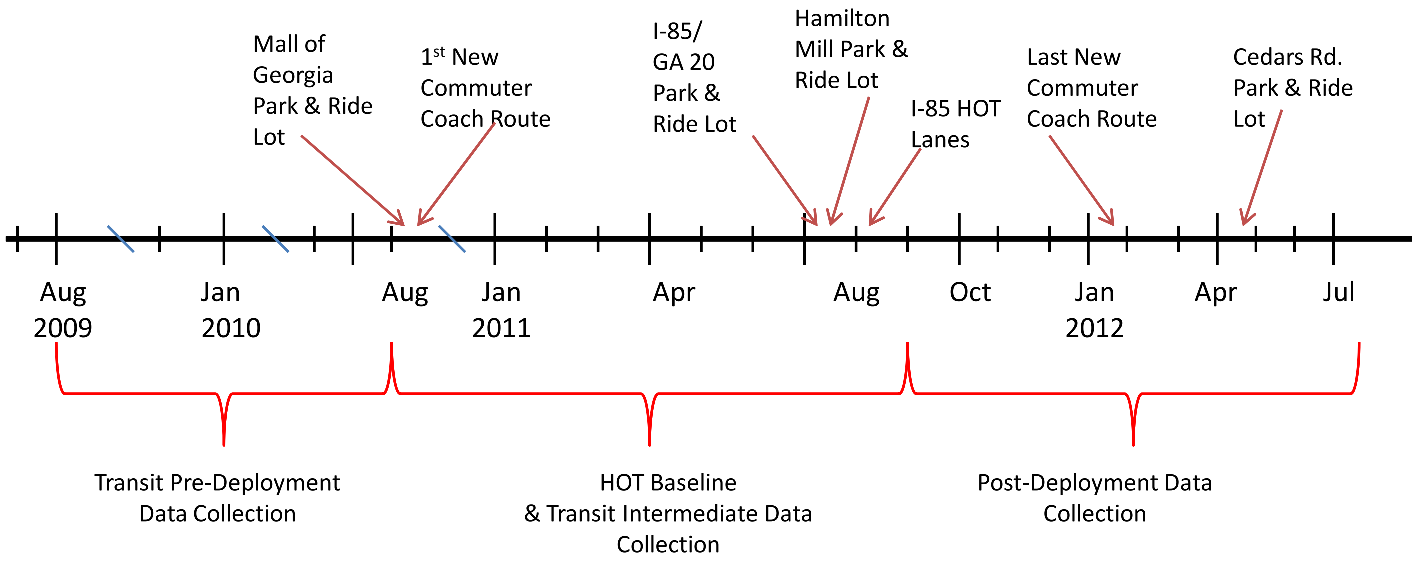

Figure 4-1. Atlanta CRD Projects Deployment and Evaluation Data Collection Schedule

Data Sources

GDOT Atlanta Traffic Management Center (TMC). Archived traffic sensor data are available through GDOT's Navigator System. Detectors are installed to measure speed, volume, and occupancy in each travel lane of the freeway, including the HOV/HOT lane. These sensors provide traffic measures every 20 seconds 24 hours per day, 7 days per week. Traffic sensors have been installed approximately every 1/3 of mile along most of the major interstates around Atlanta. GDOT uses the data from these sensors to manage the freeway sections and to drive their traveler information displays, such as the Navigator Real-time Traffic Map and the Navigator Trip Times display. These data are also used to compute travel times on major roadways in the Atlanta area, include I-85. The evaluation team will use speed data from detector stations to compute link and segment travel times for both the general purpose and HOV/HOT lanes. Loop volume data at or near screen line locations shown in Figure 4-2 will be used in the throughput analysis.

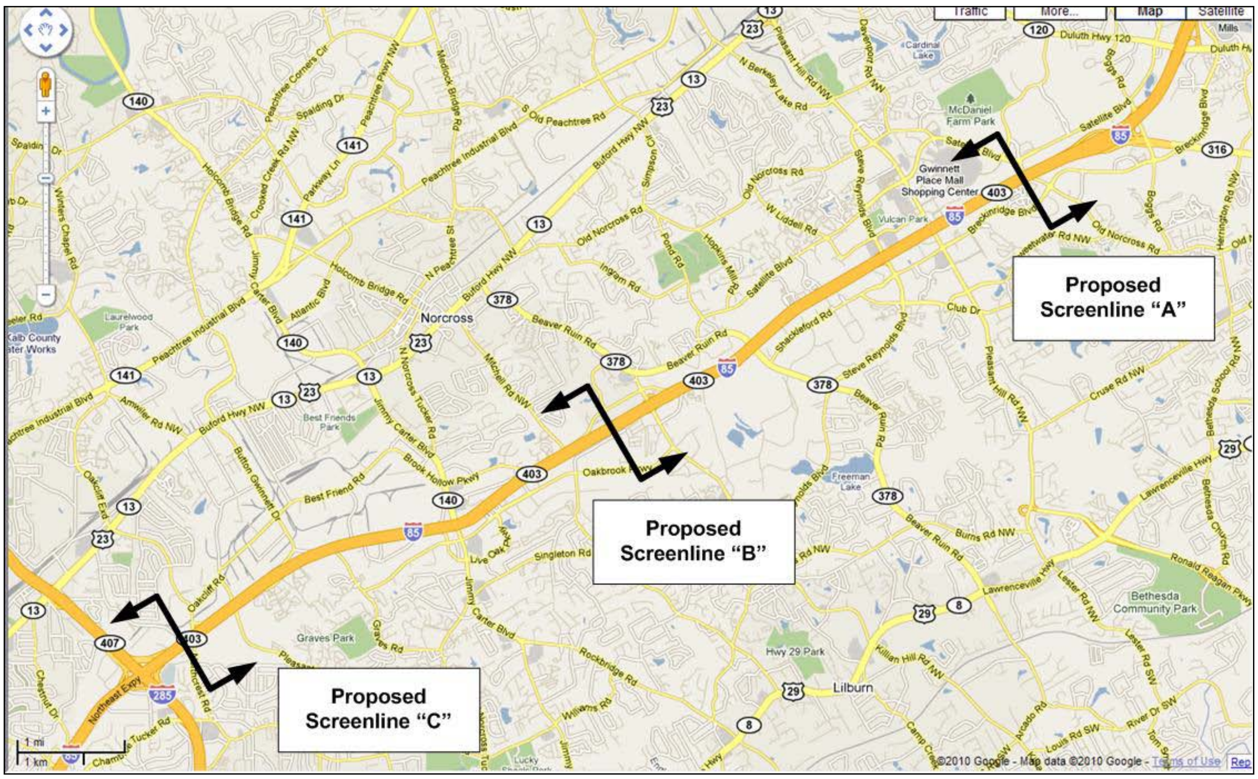

Figure 4-2. Potential Screenline Locations for the UPA Traffic System Data Test Plan

TMC operator logs will also be used to identify when an incident impacts travel conditions in the study area. It is assumed that the operator logs contain information that can be used to determine the time at which an incident occurred, the time at which an incident cleared the travel lanes, and the types of traffic responses (message posted on dynamic message signs, changes in ramp metering strategies, etc.) were implemented to manage traffic during these incident conditions.

GDOT's State Traffic and Report Statistics. Georgia DOT's STARS system provides annual average daily traffic (AADT) counts collected from permanent and portable traffic collection devices throughout the state for every segment of Georgia's State Highway System. The evaluation team will use the STARS system to extract AADT counts and estimates for trends in areas other than the I-85 corridor that can be used as a type of control to assess the potential impact of exogenous factors.

HERO Dispatch Logs. GDOT also operates an incident response patrol in the Atlanta area called Highway Emergency Response Operators (HEROs). HEROs units patrol sections of the Atlanta-area freeways to assist in clearing incidents and stalled vehicles from the travel lanes and provide help to stranded motorists with minor mechanical problems. They provide assistance from 5:30 a.m. to 9 p.m. Monday through Friday, and from 7:30 a.m. to 9 p.m. Saturday and Sunday. HERO patrols are dispatched through the TMC. Information from the logs will be used to identify when travel conditions in the study corridor are impacted by incident conditions.

Special Studies – Vehicle Occupancy Counts. Vehicle-occupancy counts are needed for the national evaluation to measure changes in person throughput in the corridor. Special counts will need to be performed to count the number of vehicles in each of the following categories:

- passenger vehicles that have one occupant
- passenger vehicles that have two occupants
- passenger vehicles that have three occupants
- passenger vehicles that have four (or more occupants)
- vanpools
- transit agency vehicles
- school buses, airport shuttles, or private buses
- two-axle trucks such as delivery vehicles
- three-axle trucks
- motorcycles

These counts should be conducted in 15-minute intervals in each direction for the each study period. Vehicle occupancy counts are needed in both directions of travel in both the general purpose lanes as well as the HOV/HOT lane. Preferably, occupancy counts will be performed in the same month(s) in the before and after periods.

Data Analyses

The traffic system data will be used to compare how travel conditions in each direction of I-85 change as a result of converting the HOV lane to HOT operations. A before-and-after analysis approach will be used to provide this comparison. The "before" conditions represents how I-85 operates with an HOV and the "after" condition represents how I-85 operates with the HOV lane converted to HOT operations. The analysis will focus on peak period operations using the a.m. inbound direction of flow and the outbound p.m. direction of flow. For the purposes of this study, the a.m. peak period is defined to be from 6:00 to 10:00 a.m., while the p.m. peak is defined to be from 3:00 to 7:00 p.m.

Data Collection Schedule and Responsibilities

Table 4-19 provides a high-level data collection and analysis schedule of the traffic data used in the national evaluation. GDOT currently has systems in place that routinely collect and archive traffic sensor data as well as incident dispatch and response logs; therefore, the evaluation team does not anticipate the need for a special study to collect this type of operational data.

Table 4-19. Analysis Time Frames for Traffic System Data

Data Source	Time Frames		
	Historical	Pre-Deployment	Post-Deployment
GDOT Traffic Management Center Data		✓	✓
GDOT's State Traffic and Report Statistics	✓	✓	✓
HERO Dispatch Logs		✓	✓
Special Studies – Vehicle Occupancy Counts		✓	✓

Special studies, however, need to be performed to collect average vehicle occupancy counts. At a minimum, these counts will be required at least once during the "before" and once during the "after" study periods at each of the three screenline locations. Ideally, the counts should be for an entire peak period; however, average vehicle occupancy counts should be performed during the peak hours of both the a.m. and p.m. peak periods. Average occupancy counts should be performed during months reflecting typical driving conditions and avoid holidays and vacation periods that alter the typical traffic flow.

4.2.2 Tolling Data Test Plan

Data Sources

The tolling data test plan focuses on data from the SRTA toll collection system for I-85. Data will be utilized in the tolling, environmental, equity, goods movement, and cost benefit analyses.

Key data elements that will be collected from the toll system database include the number of transponders purchased and activated, the home zip code of transponder purchasers, transaction data, revenue data, violation data, and other related system and user data. More detail on the toll system data is presented below. Additional information needed for the tolling analysis will be obtained from the traffic system data test plan.

SRTA has previously operated the GA 400 facility using the brand "Cruise Card" for all electronic tolling. The new toll system for the I-85 HOT lanes is being branded as "PeachPass." The specific approach for interoperability has yet to be determined. The goal is to for customers to have one transponder, one bill, and one account within a seamless system, using either transponder or video technologies with back office accommodations to provide interoperability between the two facilities.

SRTA has undertaken a dual procurement process to supply, install and maintain an all-electronic tolling solution that supports the tolling requirements for the I-85 HOT lanes.
A vendor has been procured to supply the automatic vehicle identification (AVI) transponders and readers under an open protocol, non-proprietary solicitation. SRTA selected 6c RFID equipment to enable interoperability among multiple vendors' equipment and to ensure a simpler and more cost-effective path to future technology upgrades.

A second contract is being negotiated for toll system integration, which will include back office operations, customer service operations, hosting, lane equipment and maintenance. This vendor will operate the toll system database from which much of the data for the CRD evaluation will come.

Motorists will be required to register to use the HOT lanes and to pay the toll through establishing a transponder-based account. A license plate-based registration approach may be introduced after the I-85 project is operational. Motorists who have not pre-registered by one of these two methods and who use the HOT lanes will be considered in violation, receiving a violation notice that includes the toll amount and other fees. Motorists will also be able to pay for their toll transactions through a number of methods, including by mail, on the Internet, by telephone, and in person at a retail distribution location.

There are several vehicle groups that qualify for non-revenue status (such as emergency vehicles) or toll exemptions, including motorcycles, alternative fuel vehicles, and vehicles with three or more occupants. Motorists must choose their "primary mode" as toll or non-toll, and may change their status at least 15 minutes in advance of their trip on the HOT lanes. For example, a transponder-equipped vehicle that operates mostly as a 3-person carpool, and chooses "non-toll" as its primary mode, may operate as a single-occupant vehicle in the lanes by notifying the customer service center at least 15 minutes before the trip on the HOT lane.
By doing so, they are properly tolled for the trip.

The tolling database will be able to provide data on the date, time, toll charge, and transponder identification numbers. The following provide examples of the type of information that will be obtained from the database on a monthly basis for use in the tolling and other analyses:

- number of toll accounts
- number of toll transactions by account time
- toll transactions by time of day and location
- toll transactions by type of account
- number of toll evasions
- toll price by time of day
- number of toll accounts in the I-85 catchment area and associated cost to users;
- user home zip code and frequency of use;
- transponder penetration rates in targeted geographic communities;
- average toll;
- highest toll;
- revenues by time period; and
- other appropriate data.

Data Analysis

The data obtained from the toll system database will be used to examine measures of effectiveness contained in the tolling, environmental, equity, goods movement, and cost benefit analyses. Examples of measures of effectiveness include:

- For the tolling analysis, calculate price elasticities to assess the effectiveness of pricing for managing vehicular throughput on the I-85 HOV/HOT lanes;
- For the equity analysis, examine the geographic distribution of the HOT users by zip codes and the income level associated with those zip codes. Also, determine how the revenues generated from tolling I-85 are used and the impact on low-income and other populations; and
- Toll transaction data will be used in combination with the sensor data from the traffic data test plan and the number of buses from the transit data test plan to estimate the vehicle mix (tolled vehicles, carpools, and buses) using the HOT lanes. This analysis will compare historical and pre-deployment data on the number of carpools with current estimates of carpool use from the toll transaction analysis.

Data Collection Schedule and Responsibilities

Tolling data collection will begin after opening of the I-85 toll system in the summer of 2011. Data collection will continue for one full year of post-deployment operation. There is a possibility of obtaining transaction data collected during the pre-tolling test period when the tolling system is in place but not yet charging tolls. The test-period data would offer opportunities to determine how individual travelers change their behavior with the initiation of tolls (e.g., shift in time of travel). SRTA will be responsible for providing the tolling data in an electronic format on a regular basis. The national evaluation team will be responsible for working with the local partners to specify data formats and collection protocols and analyzing the data for the various measures of effectiveness for the national evaluation.

4.2.3 Transit System Data Test Plan

Data Sources

The transit system data test plan will be used primarily in the transit and cost-benefit analyses. It also supports the congestion, tolling, environmental, and equity analyses. The CRD transit projects focus directly on adding bus service and park-and-ride lot capacity in the I-85 corridor. Specifically, the CRD is funding the purchase of 36 commuter coach buses for the creation of five new express routes, the construction and/or lease of three new park-and-ride lots, and the expansion of one existing park-and-ride lot. The five express routes will begin at staggered intervals between August 2010 and January 2012. Indirectly, it is hoped that the HOV to HOT conversion will lead to improved end-to-end travel times and on-time performance.

To evaluate these benefits, the transit system data test plan will rely on five data sources from GRTA: bus ridership data, park-and-ride lot utilization data, bus travel-time data, bus on-time performance data, and published bus schedule information. In addition to these data sources, basic information on transit service characteristics will be documented pre- and post-deployment. Examples of these characteristics include the routes in the corridors, the number of runs per route and headways, and vehicle assignments. The evaluation team members will work with GRTA personnel to record this information pre- and post-deployment.

GRTA Bus Ridership Data. GRTA collects daily ridership data two ways. One is through passenger counts recorded by the bus driver. The other is through a reconciliation of smart card data (i.e., Breeze Card) and the revenue collected by the General Fares Industry (GFI) farebox. Ridership data will be collected throughout the evaluation period and aggregated into a monthly average weekday ridership figure. Figures will be needed for the peak directions in the a.m. and p.m. peak periods and for all day. Ridership data will be obtained both for the new express service as well as the existing express routes, which include the routes 101, 102, 103, 410, and 412.

Park-and-Ride Lot Utilization. The locations and scheduled opening dates of the park-and-ride lots funded by the CRD are shown in Table 4-20.

Table 4-20. Park-and-Ride Lot Opening Schedule

Location	Opening Date
Mall of Georgia (new)	August 2010
I-985/GA 20 (expansion)	July 2011
Hamilton Mill (new)	July 2011
Cedars Rd. (new)	April 2012

In addition, there are two other park and ride lots, which although not funded by the CRD, are on the I-85 corridor and will be monitored. They are the Discover Mills and Indian Trail park-and-ride lots.

Prior to the Atlanta CRD, GRTA did not conduct park-and-ride lot counts on a regular annual basis. Based on conversations with GRTA, the evaluation team has learned that there are some limited pre-deployment park-and-ride lot counts for the I-985/GA 20 and Discover Mills park-and-ride lots. For the CRD evaluation, the evaluation team recommends that GRTA conduct five park-and-ride lot counts starting in the fall of 2010. This would result in three counts conducted during the intermediate transit analysis phase and two counts in the post-deployment phase.

The park-and-ride lot counts can also serve as a monitor of casual carpool (i.e., slugging) formation that may take place at the park-and-ride lots as a result of the HOV3+ requirement to avoid tolls in the HOT lane. Though casual carpooling is not officially part of the CRD project, staff performing the park and ride lot counts will note any obvious formation of casual carpooling.

Bus Travel Time Data. It is anticipated that the HOV to HOT conversion on I-85 lanes will result in reduced travel times and increased travel speeds. Since the express buses in the I-85 corridor are not equipped with an automatic vehicle location (AVL) system, GRTA has designed a “travel time report card” to be used by the bus drivers to record departure and arrival times. From the report card data, it should be possible to derive average bus running times. It may be possible to use the travel time report card to calculate average bus speeds if the distance between the start and end points is known. However, it may be necessary to use other means such as a floating car technique. The bus travel time data will need to be collected for the six CRD funded routes as well as for the five existing bus routes on I-85.

Bus On-time Performance Data. The on-time performance standard used by GRTA and Gwinnett County is greater than 10 minutes. That is to say, a bus is considered late if it arrives at its destination more than 10 minutes past its scheduled arrival time. For the intermediate and post-deployment phases, average on-time performance data will be derived from the travel time report cards. Based on conversations with GRTA and the contracted bus operator, Veolia, the evaluation team has learned that pre-deployment on-time performance data is not readily available. Veolia does have the raw data of recorded departure and arrival times going back to 2008. However, the monthly on-time performance figures that they reported to GRTA and Gwinnett County excluded late performance that was due to traffic congestion or other events beyond Veolia's control. Since the CRD evaluation needs to capture all late time performance, a true pre-deployment baseline will still need to be established. One possible method would be to extract a random sample of trip reports from Veolia from the pre-deployment period. Regardless, it will be important that the method be the same or similar to the method used to calculate on-time performance for the intermediate and post-deployment periods. The evaluation team will work closely with GRTA, Gwinnett County, and Veolia to establish a methodology.

Published Schedule Data. The final information source for the transit test plan is the published schedules for the routes affected by the CRD projects. The published schedule information represents what riders actually see as a result of the CRD projects. The published schedules for buses operating in the I-85 corridor will be documented before-and-after deployment of the CRD projects to assess changes in bus running times.

Data Availability

As Table 4-21 illustrates, pre- and post-deployment data is available for most of the transit system data sources. Obviously, before data is not available for new park-and-ride lots and new transit routes.

Table 4-21. Transit System Data Availability

Data Source	Pre-Deployment Data	Intermediate and Post-Deployment Data
Transit Ridership Data	Yes	Yes
Park-and-Ride Lot Utilization Surveys	Some	Yes
Bus Travel Time Data	Yes	Yes
Bus On-Time Performance Data	Yes*	Yes
Published Schedule Data	Yes	Yes

** The raw data is available, but it will need to be re-aggregated.*

Data Analysis

It is envisioned that data will be delivered by GRTA to the national evaluation team via email, typically in MS Excel spreadsheet format. The data will be quality-checked for outliers, missing information, or other irregularities, and any issues will be resolved with the agency providing the data.

The transit test plan will focus on comparing pre-deployment data with intermediate and post-deployment data. The data will be used for the measures of effectiveness presented in the transit analysis and other related analyses. Table 4-22 matches the measures of effectiveness to the various data sources.

Table 4-22. Transit Data Analysis

Measures of Effectiveness (MOE)	Data					
	Ridership	Service Characteristics	Park-and-Ride Lot Counts	Travel Time	Reliability	Survey*
Avg. weekday ridership (boardings)	■					
Transit mode share (%)	■					■
Revenue hours/mile		■				
Passengers/revenue hour	■	■				
P&R utilization factor			■			
End-to-end travel times		■		■		
Average travel speed (mph)				■		
On-time performance (%)					■	
User perceptions / customer satisfaction						■
User demographics						■
Mode use / travel behavior characteristics	■	■	■	■	■	■

*Transit survey data discussed in the section on the Survey and Interviews Data Test Plan.

Data Collection Schedule and Responsibility

The specific timing of transit data collection will be identified in the full test plan document and will reflect the local partners' final deployment timeline. Because the first of the CRD funded transit service began in August 2010, well before the anticipated HOT lane opening in 2011, the transit analysis will be divided into the three phases shown in Table 4-23.

Table 4-23. Phases for Transit Analysis

Phase	From	To
Pre-deployment	August 2009	July 2010
Intermediate	August 2010	July 2011
Post-deployment	August 2011	July 2012

The local partners will be responsible for data collection and the national evaluation team will be responsible for analysis and reporting. All of the transit data with the exception of park-and-ride utilization will be collected continuously. The park-and-ride utilization data will be collected at the times recommended earlier. Ideally, GRTA will provide the evaluation team updated figures (e.g., average monthly ridership, average running times) on a monthly basis. The evaluation team will work with GRTA to develop a transit data template for recording all of the pertinent data.

4.2.4 TDM Data Test Plan

The TDM data test plan will be used primarily for the TDM analysis. It also supports the congestion, environmental, equity, business impacts, and cost benefit analyses. The principal organization involved in TDM activities as part of the CRD project is the Clean Air Campaign, and their role in the CRD HOT lane project is the promotion of 3+ person carpools through information to commuters and employers, cash incentives to new carpoolers, and a rewards program for those who remain in 3+ carpools.

The evaluation will assess the extent to which the CAC program directly contributes to changes in vehicle occupancy levels in the corridor. The CAC will provide data related to the use and effectiveness of their program services to the local partners and the national evaluation team. The TDM Data Test Plan will cover the evaluation of CAC program activities. The evaluation of mode shifts to carpooling, transit, vanpooling, telecommuting, etc., will be covered in other test plans, including those dealing with tolling, traffic data, transit, and surveys. Carpool formation dynamics, beyond that resulting from CAC efforts, will be captured in the tolling analysis in terms of changes in vehicle occupancy due to the toll (including break-up of 2-person carpools, the creation of 3-person carpools not influenced by CAC, and any casual carpooling that might be generated by the toll). The full TDM Data Test Plan will be developed in close cooperation with CAC, as the details of the TDM element of the CRD have not been thoroughly documented in project materials to date. The CAC will be the primary organization responsible for providing TDM data to the national evaluation team.

Data Sources

The specific sources of data for the TDM analysis will include:

- CAC commuter registration records (cash for commuters and carpool rewards records)
- CAC client employer outreach records
- Vanpool formation and operational records

Mode shift data, used to corroborate and complement the TDM analysis will be covered in other test plans (as noted) and will include:

- Carpool formation dynamics data (from Tolling Data Test Plan)
- Before and after carpooler survey of registered carpools (from Survey and Interviews Test Plan)
- Vehicle occupancy data (from Traffic System Data Test Plan)
- Transit ridership and mode shift data (from Transit System Data Test Plan)
- Traveler panel survey (from Surveys and Interviews Test Plan)
- Trip length factors (for VMT calculations) from regional modeling (Cost-Benefit Analysis Test Plan)

Data Availability

It is anticipated that the data needed to assess the impacts of the CAC TDM activities on commuters in the I-85 corridor will be readily available from the CAC. Baseline and post-deployment data will be assembled for the TDM evaluation. Data on commuter use of CAC program incentives and information will be collected as part of normal monitoring and reporting activities undertaken by CAC.

It is anticipated that the CAC (working with other CRD partners) will compile the registration data for carpoolers utilizing the I-85 corridor as well as client employers with destination on or near I-85. Likewise, registered vanpooler statistics will be compiled by the CAC. The summary registrant data will then be forwarded to the national evaluation team for analysis and inclusion in the Atlanta CRD evaluation report.

It is also anticipated that CAC‘s carpool registrant database will be used for carpooler surveys similar to the one fielded in early 2009 as part of CRD market research. The Atlanta partners will field the surveys in the spring of 2011 prior to the HOT opening and in the spring of 2012 during the post-deployment phase. The survey is discussed further in section 4.2.6.

Data Analysis

The analysis of CAC data will consistent of two primary parts. First, the effectiveness of CAC program activities in forming and maintaining 3+ carpools and vanpools, which will be able to use the HOT lanes for free. The second part of the analysis will involve use of the carpooler survey to understand the factors that influence carpoolers' commute behavior, including changes in occupancy and influence of the CAC program incentives. Mode shift analysis, conducted as part of the tolling and transit analyses, will also be summarized with the TDM analysis to corroborate the findings from the CAC data.

Data Collection Schedule and Responsibilities

The Clean Air Campaign will be the primary source of TDM data. CAC commuter and employer data will be assembled for the pre- and post-deployment periods as well.

The Battelle team is responsible for management of the national evaluation, coordinating with local partners (GDOT, SRTA, GRTA, and CAC), providing technical assistance to local partners as appropriate. For this test plan the Battelle team will analyze the data provided by CAC and report the findings in the Atlanta CRD evaluation report and other documents of the national evaluation.

4.2.5 Safety Data Test Plan

The data acquired under the Safety Data Test Plan will primarily be used for the safety and technology analyses, but it will also be used as an input to the cost-benefit analysis. The primary interest is in whether infrastructural and procedural changes associated with the HOT lanes create safety problems at HOT lane entry points and transition zones, and 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). The changes will also be compared with the safety experience on the I-75 control corridor.

Four types of safety data are required by the evaluation: crash records, incident reports, citations for buffer violation, and personnel interviews. The interview data requirements are covered under the Surveys and Interviews Test Plan. This current section discusses required, safety violation and incident report data, including:

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

Data Sources

GDOT Crash Reporting Unit. Crash data can be obtained from the GDOT Crash Reporting Unit, which has images of all available crash reports back to 2000. The Georgia FARS (Fatality Analysis Reporting System) Office is also located within the GDOT Crash Reporting Unit. All law enforcement agencies are required to submit their Georgia Uniform Motor Vehicle Accident Reports to the GDOT Crash Reporting Unit. Motor vehicle accident reports include information such as severity, type of crash, crash diagram, crash location, lighting conditions, and surface conditions.

GDOT Atlanta Traffic Management Center (TMC). Archived incident data are available through the Atlanta TMC. Data are recorded over a 24-hour period at 20-second intervals. The apparent advantage of the GDOT TMC incident data source for the national evaluation is that they are expected to provide information needed to better understand the impact of any change in crashes that may occur as a result of the CRD project. That is, while the crash data can show changes in the number of crashes, the incident data can help show the impact of those changes. To date, no specific disadvantages of the incident data have been identified. As the data is examined in greater detail as part of the development of the full, detailed Safety Test Plan document, disadvantages such as the lag time for these data sources will be specified and their impact on the evaluation identified.

Department of Public Safety (DPS) Motor Carrier Compliance Division. The Georgia DPS is the agency responsible for enforcing the HOV lanes and issuing citations on buffer violations. Other public safety agencies such as the Georgia State Patrol or other local police may have citation data, but the primary source is the DPS.

Data Availability

All crash reports are processed within 45-60 days of the crash. An additional step of geo-locating each crash can add 45-60 days to availability, but GDOT is in the process of implementing a system for electronic transmission of crash reports, so that additional time may be significantly reduced over the next year. Incident data are available from the TMC with minimal lag time.

No major obstacles to gaining access to the required data are foreseen, although there may be up to a 120-day delay between the occurrence of safety events and the availability of data describing these events.

It is possible that the locational data 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. The information obtained from interviews with law enforcement, service patrol personnel, and from professional drivers who travel in the I-85 corridor may help to fill gaps left by the data in the incident databases.

Data Analyses

The evaluation will compare pre- and post-deployment crash, incident and citation data for the I-85 and I-75 corridors to assess the effects of the CRD project on corridor safety. Measures of effectiveness 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 CRD project infrastructure (HOT lane transition zones and buffers, narrowed lanes, etc.) which might be a factor in crashes.

The quantitative information derived from the preceding analyses will be augmented with the information gathered through interviews. The interview data will help to illuminate causal and locational details which may be difficult or impossible to obtain from the quantitative accident data alone. The data acquired under this Safety Data Test Plan are also expected to be used as an input to the cost-benefit analysis and in analysis of the traffic data in the congestion analysis.

Data Collection Schedule and Responsibility

The collection schedule for safety analysis data are summarized in Table 4-24. These data are routinely collected and archived by GDOT. One year of pre- and post-deployment data related to the operation of the HOT lanes will be collected. In addition, the national evaluation will also use 3-5 years of historical data to assess long-term trends. The Atlanta partners will be responsible for providing the safety data, and no special data collection effort will be required to support the evaluation. The national evaluation team will be responsible for analysis of the data and reporting of the findings.

Table 4-24. Safety Data Collection Schedule

Data Source	Historical	Pre-Deployment	Post-Deployment
GDOT Crash Reporting Unit	✔	✔	✔
Atlanta TMC Incident Database	✔	✔	✔
DPS Citations	Not Needed	✔	✔

4.2.6 Surveys and Interviews Test Plan

Data Sources and Availability

The Surveys and Interviews Test Plan contributes to almost every analysis in the Atlanta CRD evaluation. Surveys and interviews are critical for obtaining information needed to assess the influence of the Atlanta CRD projects on changes in travel behavior and perceptions. Possible behavior changes include shifting travel modes, frequency of trips, route, and changing time-of-travel. While traffic counts and bus ridership data are important, the only way to ascertain if people have changed their travel mode or made other changes as a result of the CRD projects (as opposed to other factors) is to ask them. Surveys and interviews also provide information about individuals' perceptions of different strategies and projects, the ease or difficulty of using technologies and services, and concerns about equity.

This test plan outlines the survey- and interview-related CRD evaluation data needs. Planning and conducting special surveys can be costly and so the national evaluation team has, aided by the Atlanta partners, inventoried existing data sets and planned surveys for possible use in the CRD evaluation. The recommended approach includes identification of existing and planned local partner data and data collection that may be used in the CRD evaluation. It also identifies the additional CRD-specific surveys and interviews needed to fully evaluate the Atlanta deployment.

Table 4-25 presents the information needed from various populations and summarizes the recommended approach. A total of seven population groups and the associated information needed for the evaluation are identified.

Table 4-25. Recommended Survey and Interviews

Population Group/ Information Needed	Recommended Approach	
	Baseline	**Post-Deployment**
General Public. General public's expectations and reaction to the Atlanta CRD projects with respect to reducing congestion, equity of pricing, and environmental quality.	▪ GDOT Managed Lane Survey ▪ SRTA 2008 HOT Concept Focus Groups	▪ Survey or focus groups if available
I-85 Travelers. Reported impact of HOT pricing on travel on the I-85 corridor in terms of frequency, mode, origin-destination, etc. Perception of the impact of the Atlanta CRD strategies on reducing congestion, equity of pricing, and environmental quality.	▪ Volpe Household Traveler Panel Survey ▪ SRTA/CAC 2009 On-line Survey of Carpoolers ▪ CTE Surveys in 2010: Regional Commuter Survey, Commuter Reward Survey, and Vanpool Survey ▪ 2011 Survey of Carpoolers	▪ Volpe Household Travel Panel Survey ▪ 2012 Survey of Carpoolers
Transit Riders. I-85 corridor transit riders' origin-to-destination travel times, access to/from transit, prior mode, reason for using transit, specific type of fare paid (monthly, discounted, etc.), perception of UPA transit improvements and congestion, perception of equity of pricing, impact of tolling on shopping behavior, and origin-destination.	▪ GRTA Annual "Xpress" Bus Survey in March 2010	▪ GRTA Annual "Xpress" Bus Survey in spring 2011 and spring 2012
Enforcement Personnel, Freeway Service Patrol Operators, and Bus Operations. Perception of impact of CRD technology on safety.	▪ No baseline data needed (analysis is post-deployment only)	▪ CRD interviews needed
Operators of Goods Delivery Vehicles. Perception of impact of tolling on their business and operational decisions.	▪ No baseline data needed (analysis is post-deployment only)	▪ CRD survey or interviews needed
Employers and Employees. Perception of the impact of CRD projects on their business.	▪ No baseline data needed (analysis is post-deployment only)	▪ CRD survey, interviews, or focus groups needed
Partnership Agency Representatives and Other Key Stakeholders. Information on perception of factors influencing the success of the Atlanta CRD partnership, project benefits, and lessons learned.	▪ CRD interviews and workshops needed	▪ CRD interviews and workshops needed

The sections that follow briefly discuss each survey or interview to be used, first presenting the existing or planned local partner data to be utilized and then identifying the CRD-specific method that is recommended. Details on questions and survey protocols (recruitment, sampling method, etc.) will be presented in the full test plan documents and will include consultation with the local partners.

Use of Atlanta Partners' Relevant Existing and Planned Surveys

GDOT Managed Lane Survey. This survey was conducted by Georgia State University as part of its program of annual surveys for GDOT on policy topics. Between September 24 and October 30 of 2007 a random-digit dialing telephone survey of 2000 residents in 18 counties was conducted to assess driving behavior and opinions pertinent to managed lanes. Questions covered such topics as traffic congestion, HOT3+, tolling, and travel reliability. This survey will provide some regional baseline data on public opinions related to the CRD projects.

Center for Transportation and the Environment (CTE) Regional Commute Survey. CTE is a non-profit organization in Atlanta that performs evaluation and measurement of TDM for GDOT. One survey they conduct is with commuters to assess attitudes and awareness of commute options. This regional telephone survey will 4000 households is being fielded during the summer of 2010. The last one was conducted in 2006, and it will be conducted again during 2013 or 2014. This is a regional survey of the 20-county non-attainment area, of which only about 200 Gwinnett and DeKalb County commuters in the I-85 CRD study area will be sampled. Some of the results may be provide some potentially useful regional perspective but the questions are not specific to the CRD strategies nor is the I-85 sample statistically sufficient.

Center for Transportation and the Environment Commuter Rewards Survey. CTE conducts TDM programmatic surveys for GDOT. A survey of the Commuter Rewards program being fielded in the summer of 2010 will be based on a regional sample, including a subset of registered carpoolers. CTE anticipates a sample of 1600, the size of the last survey in 2006. The next survey (post-2010) has not been scheduled. The focus of the survey is to assess three programs: Cash for Commuters, Commuter Prizes, and Carpool Rewards. To assist the CRD evaluation, CTE has added a question in the 2010 survey asking the commuters if they commute on the I-85 CRD study area. Depending upon the number traveling the corridor, the results may provide some useful baseline data. However, there are no questions specific to the CRD strategies.

Center for Transportation and the Environment Vanpool Survey. CTE surveys vanpoolers for GDOT. Questionnaires are sent to vanpool vendors, who in turn give them to drivers for distribution to riders. In 2006, 3000 surveys were distributed and about 900 responses were received (30% response rate). Questions include, among other data, trip distance and mode for accessing the van pool. The 2010 survey is being fielded during the summer. There was no opportunity to include a question about travel on the I-85 CRD corridor.

SRTA HOT Concept Focus Groups. Six ninety-minute focus groups were conducted in November 6 and 7, 2008 with carpoolers and non-carpoolers across the Atlanta region. The groups consisted of approximately 60 participants with at least 2 transit riders in each group. The focus groups findings were used in development of the PeachPass marketing approach. Discussion included likes and dislikes about HOT, HOV2 to HOV3 conversion, the potential impact of HOT on congestion, environmental benefit, fairness, and ideas about branding and preferred communication of information. Although qualitative data, some of the focus group findings may provide useful perspective for the national evaluation when used in conjunction with data from other sources.

SRTA/CAC HOT On-Line Survey. In March and April of 2009 2,405 carpoolers in the I-85 corridor were contacted by e-mail using the carpooler database of the Clean Air Campaign. 731 persons (about 30%) responded and answered questions about their travel in the I-85 corridor and attitudes towards HOV use, transit and tolls.

Needed Surveys and Interviews

Volpe Household Travel Panel Survey (Baseline and Post-Deployment). The Volpe Center, a unit of U.S. DOT's Research and Innovative Technology Administration, plans to conduct a before-and-after household survey in Atlanta and Seattle in support of the UPA/CRD evaluation to assess behavioral response to congestion pricing. This survey will fill the need for a CRD-specific survey. In Atlanta, the survey will focus on current users of the I-85 facility as well as users of alternate routes (i.e., Buford Highway/GA-3/US-23). A panel survey of all members of the household will be conducted, so that the same households will be part of both the before and after surveys approximately one year apart. With a target sample of 1500 households at the end of the post-deployment survey, with most of the sample to include drivers and carpool/vanpool riders, who will be identified using a random sample of license plate numbers captured during peak and shoulder periods of the day. 200 of the 1500 households will be transit riders recruited onboard routes in the corridor. Household members will complete a 2-day diary for all trips plus additional survey questions on attitudes and demographics. Most respondents will complete the survey online, although there will also be a toll-free telephone option. The baseline survey in Atlanta will occur between March and May of 2011 and the post deployment survey will occur in those months in 2012.

Carpooler Survey (Baseline & Post-Deployment). The Atlanta partners will conduct new surveys of carpoolers in the I-85 corridor to assess the impact of HOT on the carpool formation and use. It will be similar to the 2009 SRTA/CAC carpooler survey and rely on the CAC database of registered carpoolers in the I-85 corridor (2405 in 2009) who will be contacted by e-mail in the spring of 2011. A response rate of 30% is anticipated based on the 2009 response. Another survey will be conducted in the spring of 2012. Due to the movement of persons in and out of the registration list, cross-sectional rather than a panel survey will be conducted.

Transit Riders Survey (Baseline & Post-Deployment). Transit rider survey data will provide information both on transit rider perceptions as well as report travel behaviors before and after CRD deployment. The surveys are critical to understanding how and why transit riders' attitudes and/or travel behavior have been impacted and by which specific CRD projects.

While the Vole household traveler panel survey will include transit riders in its sample, another source is the annual customer satisfaction survey of express ("Xpress") bus users conducted by GRTA. The most recent was in March 2010 which will provide baseline data. The national evaluation team was able to coordinate with GRTA to add some CRD-related questions to the survey instrument in 2010. The survey covers all express routes in the 12-county metropolitan Atlanta area, not just those on the I-85 corridor. In order for there to be a statistically significant number of responses from I-85 express bus riders, it will be important that GRTA oversample the five existing and six new transit routes in the I-85 corridor. The next survey of Xpress bus users is scheduled for the spring of 2011, and this will serve as the intermediate phase of the evaluation when the Xpress buses are in operation but before the HOT lanes. The survey in the spring of 2012 will serve as the post-deployment phase. Both surveys should incorporate CRD questions and oversampling for I-85 express bus riders. Volpe will coordinate with GRTA on the two separate survey efforts.

Interviews with Enforcement Personnel, Freeway Service Patrol Operators, and Bus Operators. The objective of these interviews is to gather data on the perceived impact of CRD technology on safety and enforcement efforts. These interviews will collect information from public agency personnel who are in a position to observe firsthand the potential safety impacts of Atlanta CRD projects and the implication of safety changes on traffic congestion. Specifically, these personnel will be questioned regarding any perceived changes in crash frequency, crash severity and the time required to clear incidents and the relationship between any such changes and the new roadway signage or traffic patterns related to the HOT lanes. Enforcement personnel will also be asked about their experience using the in-vehicle enforcement equipment. These interviews will be needed in the post-deployment period only.

Survey or Interviews with Operators of Goods Delivery Vehicles. The introduction of HOT lanes on I-85 may affect the efficiency of goods movement in the corridor, and, thus, it is important to understand the impact of tolling on delivery businesses and their operational decisions. Operators of delivery vehicles will be interviewed, probably by phone, in the post-deployment period regarding the impact of tolling on goods movement, including route selection, travel time, and timing of their trips. Direct observation of traffic flows or use of existing traffic cameras or leveraging business contact lists or relationships with industry associations are all possibilities for selecting interviewees.

Surveys, Interviews, or Focus Groups with Employers. Interviews with major employers will document perceptions of the impact of the Atlanta CRD strategies on employee satisfaction, productivity, retention/hiring, the cost of doing business, and their business volume/success. These interviews will also collect information on the number of employees opting to participate in car and van pooling programs in the I-85 corridor. Employers representing various classes of organizations will be interviewed, including private, public and non-profit organizations. Employers will be selected from the Clean Air Campaign database of employers, based on their likelihood of having employees that commute in the I-85 corridor. These interviews will be needed only in the post-deployment period.

Interviews with Partnership Agency Representatives and Other Key Stakeholders (Baseline and Post- Deployment). Members of the national evaluation team will conduct one-on-one interviews with representatives of organizations that play an important role in planning, deploying and/or operating the CRD projects. This will include those organizations instrumental in the institutional, technical or public outreach aspects of the CRD projects. As the full test plan is developed the national evaluation team will work with the local partners to further specify interviewees. Two rounds of interviews will be conducted, one each near the end of the baseline and post-deployment periods. Each round of interviews will include a group workshop to discuss lessons learned.

Data Analysis

A variety of data analysis techniques will be used to analyze the wide range of survey and interview data, with techniques varying according to the type of data and the intended use of the resulting measures of effectiveness in the various evaluation analyses. In the case of interviews, key points from each interview will be compiled, summarized and discussed, and areas of agreement, disagreement and recurring themes cutting across multiple interviews will also be identified.

Survey analysis will begin with checking the data for anomalies, outliers, or other data peculiarities and to prepare the data, including applying any necessary weighting to adjust for selection bias, unequal response rates in various strata, etc. Descriptive statistics will be prepared to characterize outcomes of interest such as the percentage of respondents reporting mode shift as a result of pricing or characterization of travel behavior by geographic area or trip purpose.

Data Collection Schedule and Responsibilities

The Volpe Center will be responsible for the household travel panel survey. The Atlanta local partners will be responsible for collecting the rest of the data in this test plan with the exception of interviews with the partnership agencies and other key stakeholders, which will be conducted by the national evaluation team. The national evaluation team will, through the full Surveys and Interviews Test Plan document to be developed, provide the local partners specific guidance and recommendations on the key aspects of methodology, including specific information to be collected.

Baseline surveys should be conducted shortly before the HOT lanes go into operation during the summer of 2011. In the case of the on-board transit surveys conducted by GRTA, the baseline survey was conducted in March 2009.

Post-deployment surveys and interviews should occur six to twelve months after all the Atlanta CRD projects are operational to provide sufficient time for travelers to become fully accustomed to the new system. Since the new express buses will be deployed in two phases, GRTA's post-deployment on-board transit surveys will occur in two phases as well in the spring of 2011 and 2012.

4.2.7 Environmental Data Test Plan

The Environmental Data Test Plan will generate data to be used primarily in the environmental analysis. Results will also be used in the equity and cost benefit analyses. Observed changes in VMT and speeds for the I-85 corridor and relevant parallel routes, based on data developed as part of the congestion analysis, will be the primary original data to be used in the environmental analysis. This will be augmented with air quality emission factors that will be applied to changes in miles traveled and average speeds.

Data Sources

EPD will use its regional travel forecasting modeling capabilities and MOBILE6.2 to generate emission factors for speeds from 3 mph to 65 mph. The following factors will be generated to assess the air quality and energy impacts:

- Emission factors by speed for ozone precursors (reactive organic gas [ROG], hydrocarbon [HC], or volatile organic compounds [VOC] and nitrogen oxide [NO_x]), greenhouse gas (CO2) and fine particulate matter (PM) from MOBILE6.2, supplemented with national default factors;
- Fuel consumption factors from MOBILE6.2, supplemented with national default factors;

Traffic, survey, and transit data will also be used as generated from other test plans (as noted):

- VMT and speeds (from Traffic System Data Test Plan)
- Mode shift data (from the Survey, Transit and TDM Test Plans)

Data Availability

Emission and fuel consumption factors will be generated by ARC using the MOBILE6.2 emissions model. Emission model runs are a routine activity performed by the air quality modeling staff at EPD.

Data Analysis

The environmental analysis will utilize VMT and speed analysis data from the congestion analysis and apply emission and fuel consumption factors provided by EPD. Mode shift analyses from the transit, tolling and TDM analyses will also be used to assess additional VMT reductions (and therefore emissions and energy) not picked up in the congestion analysis, and the emission and fuel consumption factors will be applied. This will provide for changes in pollutants generated and energy consumed in the corridor.

In order to estimate the spatial and temporal impacts on emissions and energy, the appropriate emission rate will be applied to the VMT on a link-by-link basis, based on the average speed on the link by time of day. The results will also be aggregated to a corridor total. Mode shift analysis results will also be used to assess secondary sources of VMT changes.

Data Collection Schedule and Responsibilities

EPD is responsible for providing the emission and fuel consumption factors as outputs of runs of the MOBILE6.2 model. Battelle team members will confer with staff from EPD on running the emissions models and obtain the emission factors for the pre- and post-deployment periods in the summer of 2012. The schedules for the collection of data generated through other test plans are detailed elsewhere in this document.

4.2.8 Content Analysis Test Plan

Data Sources

The content analysis test plan focuses on collecting and analyzing information on the Atlanta CRD outreach activities, Atlanta CRD partner documents, and Atlanta CRD-related media coverage. The information collected and analyzed in this test plan will be used in the non-technical success factors analysis.

Three primary data sources will be used in this test plan, including:

Outreach Materials/Activities. To the extent possible, all outreach materials related to the Atlanta CRD project that are created and distributed by partner agencies (or any marketing/communications contractors) will be archived and given by the Atlanta CRD partner agencies to the national evaluation team in electronic format during both baseline and post-deployment periods. In addition, any outreach activities conducted by the partner agencies and any marketing/communications contractors will be logged and reported by the Atlanta CRD partner agencies to the national evaluation team during these same periods.

Partnership Documents. To the extent possible, all Atlanta CRD partnership documents will be archived and given by the Atlanta CRD partner agencies to the national evaluation team in electronic format during the baseline stage. Partnership documents include the original partnership agreement as well as communications among partners during the proposal development and project implementation stage (i.e., baseline).

Media Coverage. From its first occurrence, all local, regional, and national media coverage of the Atlanta CRD project will be archived and given by the Atlanta CRD partner agencies to the national evaluation team in electronic format during both baseline and post-deployment periods.

Data Availability

The consulting firm, SRF Consulting, Inc., has archived the majority of collateral and marketing materials, including press releases. The project website hosted on the Georgia Department of Transportation's website contains documentation of public outreach materials, including press releases, project-related newsletters, and public hearings. The national evaluation team is in communication with SRTA on securing partnership documents. Media coverage will be collected and stored by the national evaluation team.

Data Analysis

The content analysis is guided by the overall evaluation framework for non-technical success factors. Using this framework, the content analysis is directed by two key questions:

1. What did the partners do to try to make their CRD projects successful?; and
2. What were the keys to success and what are the associated lessons learned that will be useful to U.S.DOT and other state and local transportation agencies?

The analysis will assess public reaction to the CRD project, chronicle project hurdles and challenges, and evaluate the methods used to overcome the hurdles and challenges. The analysis will also examine the role the media plays as both a intermediary of conveying information to the public as well as a shaper of public opinion. In addition, the analysis will assess whether and how there was a coherent marketing and communications plan for the CRD project and will explore the dynamics of collaboration through partnership documents.

Members of the national evaluation team will store, organize and analyze all outreach materials/activities, partnership documents, and media coverage data using NVivo, a qualitative data analysis software.[15]

A descriptive analysis will be used for the outreach materials/activities and partnership documents. This will involve a detailed description for each data element that answers the following questions:

1. What was done?
2. When did it happen?
3. What form did it take?

Coding will be used for media coverage to identify common themes emerging from the media, such as public reactions to the CRD project, challenges facing the project, and outcomes or goals of the project.

Data Collection Schedule and Responsibilities

The Atlanta CRD local partners are responsible for providing data for the content analysis to the national evaluation team. To supplement the local partners' collection of media coverage, the Battelle team has registered with Google Alerts using Atlanta CRD search terms. Members of the Battelle team will continue to monitor Google Alerts over the course of the baseline and post-deployment periods. Team members have also requested being added to agency lists for press releases and information relating to the Atlanta CRD projects.

The anticipated opening of the HOT lanes is the summer of 2011, which marks the end of the baseline and start of the post-deployment period. One year of baseline and one year of post-deployment data need to be collected. However, the content analysis data collection needs to extend to the start of the CRD project to ensure that all pertinent material is captured. Thus, for the purposes of the evaluation, the baseline period will begin with the November 21, 2008 teaming agreement between U.S. DOT and the Atlanta partners and the proposal upon which it was based.

4.2.9 Cost Benefit Analysis Test Plan

Data Sources

This test plan focuses on obtaining and analyzing data for the cost benefit analysis, including the costs of the various Atlanta CRD projects and the intended resulting benefits, including improvements in travel conditions on highways, transit services, and the environment. The cost benefit analysis test plan will use three major sources of data. The first source is the detailed costs associated with the CRD project. These data will be provided by GDOT, GRTA, SRTA,

[15] More information on the NVivo software can be found at http://www.qsrinternational.com. The full version of the Content Analysis Test Plan will provide additional detail how NVivo will be used in the national evaluation.

and any other agencies expending funds on CRD activities. A second source of data is forecasts of travel from the region's transportation model. Data collected through other test plans and evaluation analyses (e.g., congestion, and environment) comprise the third data source.

Cost Data from Participating Agencies. Cost data will be obtained from GDOT, GRTA, SRTA, and any other agencies making CRD project expenditures. Data include the capital costs associated with various projects, the operating and maintenance costs, and the replacement and re-investment costs. Where investments are intended to support the region's planned expansion to a regionwide HOT system, the portion of costs attributable to the I-85 CRD will be determined. The following examples are some but not all of the cost categories needed for this test plan.

- Capital investment costs
  - Equipment and installation of gantries for tolling system
  - Automated enforcement technologies
  - Transit expansion, including purchase of 36 new buses
  - Park-and-ride lot additions and expansion
- Operating and maintenance costs
  - Operating and maintaining tolling system
  - Operating and maintaining expanded transit services
  - Compliance costs for enforcing the toll facility
- Replacement and re-investment costs.
  - Replacing and/or updating computer hardware and software for tolling system
  - Replacing and/or updating equipment for automated enforcement system

Travel Demand Forecasting Model Data. The ARC regional travel demand model will be used to generate 10-year forecasts of travel in the region resulting from the CRD strategies. The model was used to support the proposal for the HOV to HOT conversion in the Atlanta partners' 2007 proposal that resulted in the award of CRD funding. For the cost benefit analysis, the evaluation will need model outputs of travel scenarios with and without the CRD projects and before and 10 years after the deployments.

The ARC travel demand model utilizes a traditional four-step trip-based aggregate modeling process consisting of trip generation, trip distribution, mode choice, and trip assignment for the 20-county area.[16] However, beginning in 2010, a dual-track method is being used by ARC that will maintain the 4-step trip-based model and the implementation of an activity-based disaggregate modeling process based on CT-RAMP (Coordinated Travel Regional Activity-Based Modeling Platform). The advantage of the CT-RAMP for modeling travel behavior in the Atlanta region is that it has improved sensitivity to highway pricing compared to the traditional model, and it can more readily deal with congestion reduction strategies such as telecommuting, compressed work week, flexible work hours, and teleshopping.[17]

[16] The Travel Forecasting Model Set for the Atlanta Region, 2008 Documentation. Atlanta Regional Commission, Updated November 2008.

[17] Activity-Based Travel Model Specifications: Coordinated Travel Regional Activity-Based Modeling Platform (CT-RAMP) for the Atlanta Region. Atlanta Regional Commission, Updated March 2009.

The ARC model is capable of generating a variety of measures on a per-person or aggregate level that will be useful for the cost-benefit analysis. These include measures of travel time and travel delay as well as estimated costs of travel based on passenger and commercial vehicle travel, wages and fuel cost.

Other Atlanta CRD Test Plans. Another important source of data for the cost benefit analysis is other test plans. The data from each test plan will be used to compare the scenarios before and after the CRD projects are implemented. The following are examples of the data from other test plans that will be used in the cost benefit analysis:

- Reduction in travel time from the Traffic System Data Test Plan;
- Reduction in transit travel time from the Transit System Data Test Plan;
- Transit fares paid by the people who switch from driving to riding the bus from the traveler survey in the Survey and Interview Test Plan;
- Changes in safety conditions from the Safety Data Test Plan; and
- Improvement in air quality and fuel usage from the Environmental Data Test Plan.

Data Availability

It is anticipated that agency cost data will be available from GDOT, SRTA, and GRTA and other partnering agencies records. ARC has agreed to run the travel demand model to produce forecasts for the national evaluation. Other needed data for the cost benefit analysis will be obtained from other test plans.

Data Analysis

As noted previously, ARC's regional travel forecast model will be used to estimate the benefits related to congestion reduction resulting from the CRD projects. The cost benefit analysis will be performed using a 10-year time frame. This time frame includes the first year after implementation of the CRD projects and again nine years into the future, for a total 10-year period after implementation of the projects. Within this evaluation time frame, the cost benefit analysis will estimate and compare annual benefits and costs between two scenarios—before implementation of the Atlanta CRD projects and after implementation of the Atlanta CRD projects.

Data Collection Schedule and Responsibilities

The cost benefit analysis will be initiated prior to deployment of the Atlanta CRD projects. The analysis will be completed after all the CRD projects are in operation. The local partners will be responsible for providing the cost information relevant to the CRD projects that each agency is deploying. ARC will run the regional travel model to provide forecasts based on collaboration with the national evaluation team about the inputs and the outputs needed. Members of the national evaluation team will perform the cost benefit analysis based on data from the various sources.

It is anticipated that the national evaluation team will work with the ARC staff running the regional travel model to perform test runs during the post-deployment operation phase of the CRD projects. Test runs will help identify any modeling issues that need to be resolved before the final modeling is performed. Once the modeling data and all the other data from this test plan are available following the post-deployment data collection, the cost benefit analysis will be performed.

4.2.10 Exogenous Factors Test Plan

The exogenous factors test plan will be used to monitor elements un-related to the Atlanta CRD demonstration that may influence travel in the I-85 corridor and the use of the various project elements, and changes in travel modes and telecommuting. The data obtained in the exogenous factor test plan supports all of the analysis areas. The overall approach for control and monitor for exogenous factors in the Atlanta CRD relies on six overlapping techniques which will be used in various combinations depending upon the analysis area:

1. **Use of a Control Group.** The evaluation will identify a control group or a sample of highway and transit facilities and services located outside of the expected CRD impact corridor—and, therefore, assumed to be mostly or entirely unaffected by the CRD projects—as a "control group."
2. **Relying on Traveler Surveys.** Surveys of travelers will probe for the influence of both CRD projects and exogenous factors on their pre- vs. post-deployment travel behavior. For example, the motivations for mode shift will include questions about construction, or fares in addition to CRD elements like tolling or transit improvements.
3. **Isolating Non-Typical Travel Condition Data.** Identifying the specific time periods and locations within the expected CRD impact area where traffic incidents, special events and/or adverse weather conditions may have significantly influenced evaluation MOEs (e.g., traffic volumes, transit ridership) and eliminating and/or separately analyzing evaluation data associated with those locations and periods.
4. **Documenting the impacts of Non-CRD Transportation System Changes.** Documenting non-CRD related transportation projects or policies such as regional transit fare increases during the evaluation period.
5. **Documenting the Economic Conditions.** Document changes in employment levels and gasoline prices throughout the evaluation period.
6. **Looking at Historic CRD Corridor Data.** Document the long-term trends (three to five years before CRD deployment) in key evaluation MOEs such as traffic volumes and transit ridership within the expected CRD impact area.

Anticipated Data Sources

The exogenous test plan will exclusively focus on collection of data on:

- Fuel prices,
- Major changes in regional employment,
- Roadway construction, and
- Control corridors.

Other data required to account and manage for exogenous factors come from various test plans including the survey test plan, safety data test plan, traffic system data test plan, and transit system data test plan. For example, non-CRD related transportation system changes such as transit fare increases, tolling rates, changes in operating philosophy will be captured in transit and traffic system test plans. Traffic incident data will be captured through the safety and traffic test plans. Similarly, traveler surveys will be used to understand impacts of exogenous factors on the motivations to travel.

The details related to exogenous factors data will be determined through the development of the full test plan document. The following describe data sources under consideration for each of the data elements mentioned in the bullets above.

U.S. Department of Energy (DOE) Gasoline Prices. The U.S. DOE monitors gasoline prices. Historical data on the weekly price of retail gasoline for various grades has been available online since 2000. Data will be monitored over the course of the CRD evaluation. Various commercial Internet sites that provide Atlanta region gas prices will also be consulted.

ARC and Georgia Department of Labor Employment Data. Data will be examined from 2000 to the conclusion of the CRD evaluation. Two major sources of data will be monitored as part of this data collection. ARC has employment data available for the CRD region on their website (http://www.atlantaregional.com/info-center/arc-region/employment-data/employmentdata) including historical data from 2000. For state-level trends of employment the Georgia Department of Labor statistics on employment will also be collected for the CRD region.

Non-CRD Roadway Construction. The evaluation will work with the local partners to identify the schedule and the impacts of road construction that may influence travel patterns, bus routes, and other factors. This information will be monitored over the course of the evaluation.

Non-typical Weather Conditions and Special Events. Information from the Georgia Navigator will be used to identify major weather conditions and special events that may influence normal travel patterns, bus routes, and other factors. Information available from the Navigator system will be monitored over the course of the evaluation.

Control Corridors. Monitoring various travel and traffic MOEs of interest on one or more control corridors provides a method for assessing how much of any observed I-85 changes could have been expected without the CRD. In discussions to date, the local partners have indicated that there are few, if any, good control corridor candidates, “good” candidates being those without corridor-specific major construction or other corridor-specific influences that make them poor indicators of the influence of more general exogenous factors (like economic conditions) on travel. As the full test plan is developed the issue of control corridors will be revisited and finalized including the types of data required for each control facility. In some cases, these issues may be resolved in various other test plans. For example, if the traffic system test plan requires volumes and speeds on control facilities for the evaluation, the data and the control corridor will be described in the traffic system test plan.

Data Availability

Historical, pre-deployment, and post-deployment data are available for unemployment rates and gasoline prices. Historical and pre-deployment data on other exogenous factors are limited, but post-deployment data will be available on all of the elements in the test plan.

Data Analysis

The factors included in this test plan will be used as comparison checks in all of the analysis areas. The information on the exogenous factors will assist in identifying elements that may influence and explain changes in travel patterns, traffic conditions, and mode changes in the I-85 corridor.

Data Collection Schedule and Responsibilities

Table 4-26 presents the anticipated data collection schedule for the exogenous factors test plan. As noted, historical data and pre-deployment data are available for some factors, while post-deployment data are available for all factors. The responsibility for collecting data will reside with the local partners. In most cases, the evaluation will adjust to utilize whatever data is normally collected, although in a few cases—such as construction, weather/incidents/events, and/or transportation system changes record keeping—if the standard archived information is very incomplete it is hoped that the local partners can find low-cost ways to preserve more detailed and comprehensive data for the evaluation.

Table 4-26. Exogenous Factors Data Collection Schedule

Data Source	Historical Data	Pre-Deployment Data	Post-Deployment Data
Employment Data	✔	✔	✔
Gasoline Prices	✔	✔	✔
Non-CRD Roadway Construction	Not Needed	Some	✔
Non-typical Weather Conditions and Special Events	Not Needed	Some	✔
Control Corridors	Not Needed	Some	✔

5.0 NEXT STEPS

The next steps in the Atlanta CRD national evaluation are highlighted below.

- Detailed test plans will be developed based on this final Atlanta CRD National Evaluation Plan. It is anticipated that the test plans will be completed by November 2010.
- Baseline data collection will be initiated along with the development of the test plans.
- Members of the Battelle team will continue to monitor the deployment status of the Atlanta CRD projects and will provide assistance with elements of the evaluation as requested.
- Members of the Battelle team will continue to coordinate with other UPA/CRD sites and share experiences and "lessons learned."

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