SEATTLE-LAKE WASHINGTON CORRIDOR URBAN PARTNERSHIP AGREEMENT NATIONAL EVALUATION PLAN

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SEATTLE-LAKE WASHINGTON CORRIDOR URBAN PARTNERSHIP AGREEMENT NATIONAL EVALUATION PLAN

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16. Abstract

This report provides an analytical framework for evaluating the Seattle/Lake Washington Corridor (LWC) Urban Partnership Agreement (UPA) under the United States Department of Transportation (U.S. DOT) UPA Program. The Seattle/LWC UPA projects focus on reducing congestion by employing strategies consisting of combinations of tolling, transit, telecommuting/travel demand management, and technology, also known as the 4 Ts. The Seattle/LWC national evaluation plan identifies the 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 Seattle/LWC UPA national evaluation is based on the National Evaluation Framework prepared for the U.S. DOT. Four objective questions posed by U.S. DOT serve as a starting point for the national and Seattle/LWC 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 Seattle/LWC UPA projects.

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TABLE OF CONTENTS

TABLE OF CONTENTS (CONTINUED)

List of Tables

TABLE OF CONTENTS (CONTINUED)

Page

List of Tables (Continued)

List of Figures

LIST OF ABBREVIATIONS

4Ts	Tolling, Transit, Telecommuting, and Technology
APC	Automatic passenger counter
ASTM	American Society for Testing Materials
ATM	Active traffic management
AVL	Automatic vehicle location
AVO	Average vehicle occupancy
BFI	Boeing Field/King County International Airport
CAD	Computer aided dispatch
CBA	Cost and benefit analysis
CRD	Congestion Reduction Demonstration
CSC	Customer Service Center
CTR	Commute Trip Reduction
CTS	Center for Transportation Studies
CUTR	Center for Urban Transportation Research
CVISN	Commercial Vehicle Information Systems and Networks
CVO	Commercial vehicle operator
DOE	U.S. Department of Energy
DVAS	Digital Video Audit System
EJ	Environmental justice
FHWA	Federal Highway Administration
FMAS	Facility Management and Administration System
FTA	Federal Transit Administration
GTEC	Growth and Transportation Efficiency Center
HOT	High-occupancy tolling
HOV	High-occupancy vehicle
HOV 2+	High-occupancy vehicle containing two or more travelers
HOV 3+	High-occupancy vehicle containing three or more travelers
IRT	Incident Response Teams
ITS	Intelligent transportation systems
ITS JPO	Intelligent Transportation Systems Joint Program Office

LIST OF ABBREVIATIONS (CONTINUED)

LWC	Lake Washington Corridor
MOE	Measure of effectiveness
MOVES	Motor Vehicle Emission Simulator
NEF	National Evaluation Framework
P&R	Park-and-ride
PMT	Person-miles traveled
PSRC	Puget Sound Regional Council
PT	Person throughput
RFP	Request for Proposal
RITA	Research and Innovative Technology Administration
RTCS	Roadside Toll Collection System
SOV	Single-occupant vehicle
SPT	Service Planning Tool
TCI	Transit Competitiveness Index
TCS	Toll Collection System
TDM	Travel demand management
TMC	Traffic Management Center
TRIPS	Transportation Information Planning Support
TSMC	Traffic Systems Management Center
TTI	Texas Transportation Institute
UPA	Urban Partnership Agreement
U.S. DOT	U.S. Department of Transportation
VMT	Vehicle miles traveled
VT	Vehicle trips
WITS	WSDOT Incident Response Tracking System
WSDOT	Washington State Department of Transportation

EXECUTIVE SUMMARY

This report provides an analytical framework for evaluating the Seattle/Lake Washington Corridor (LWC) Urban Partnership Agreement (UPA) under the United States Department of Transportation (U.S. DOT) UPA program. It identifies the hypothesis and questions to be tested and answered in the evaluation, the evaluation analyses and measures of effectiveness, and the data needed to conduct the analysis.

The evaluation plan identified in this document will be carried out in partnership between the Seattle/Lake Washington Corridor UPA local partners and a national evaluation team retained by the U.S. DOT. The national evaluation team is responsible for developing the evaluation plan in coordination with the local partners, including specifying required data, analyzing data, and reporting results. The local partners are responsible for coordinating with the national evaluation team on evaluation plans and for collecting the necessary evaluation data.

Background

In 2006, the U.S. DOT, in partnership with metropolitan areas, initiated a program to explore reducing congestion through the implementation of pricing activities combined with necessary supporting elements. This program was instituted through the UPAs and the Congestion Reduction Demonstrations (CRDs). Within each program, multiple sites around the U.S., including Seattle, 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 evaluation of 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 generate information and produce technology transfer materials to support deployment of the strategies in other metropolitan areas. The national evaluation will also generate findings for use in future federal policy and program development related to mobility, congestion, and facility pricing. The 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 Seattle/LWC UPA

The Seattle/LWC UPA partners are the Washington State Department of Transportation (WSDOT), King County, and the Puget Sound Regional Council (PSRC). The Seattle/LWC projects are intended to reduce congestion on SR 520 between Interstate 405 and Interstate 5, a heavily-traveled east-west commuter route across Lake Washington. The lake separates downtown Seattle and coastal points to the south from eastside communities like Redmond and Bellevue. The location of SR 520 is shown in Figure ES-1.

The U.S. DOT is allocating $154.5 million in Federal grant funding for the Seattle/LWC projects, drawn from Federal Highway Administration (FHWA), Federal Transit Administration (FTA) and RITA funding programs. The Seattle/LWC UPA projects consist of the following:

Washington State Department of Transportation, "SR 520 Variable Tolling Project Environmental Assessment," March 2009.

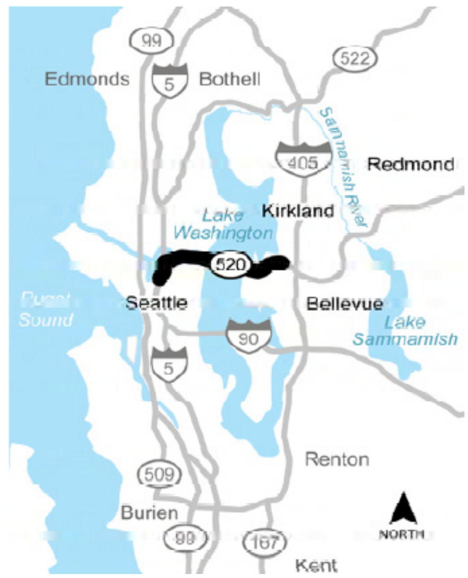

Figure ES-1. SR 520 Location

- **Variable tolling** on all lanes of SR 520 between I-405 and I-5.
- **Active Traffic Management** (ATM) on SR 520 and I-90—the major freeway alternate route located about three miles south of SR 520—including lane control, dynamic message and advisory speed limit signage to alert drivers to delays and direct travel away from incident-blocked lanes.
- **Travel time signs** to provide travelers headed toward Seattle with real-time travel time estimates for SR 520 and alternate routes.
- **Enhanced bus service on SR 520** adding 90 one-way peak period trips and including purchase of 45 new buses.
- **Improvements to transit stops/stations** including improvements to two park-and-ride lots, one of them part of a broader transit oriented development (TOD), and real-time information displays at stops/stations.
- **Various travel demand management strategies** funded locally such as employer-based strategies to promote ridesharing or telecommuting.
- **Regional ferry boat improvements** which will not be evaluated because they are not expected to impact SR 520 corridor travel.

The local partners' latest deployment schedule (from the September 2009 Term Sheet revision[1]) calls for almost all of the UPA projects, specifically the following, to be operational no later than June 30, 2011: SR 520 tolling, enhanced bus service, transit real-time information signs and passenger facilities, real-time multi-modal traveler information, and active traffic management. One UPA project was completed much earlier, the Redmond Park-and-Ride/Transit Oriented Development (P&R/TOD) which became operational on June 30, 2009, and one project, the Kirkland park-and-ride lot, will be completed much later (too late to be included in this evaluation), by October 15, 2014.

Evaluation Analyses and Test Plans

The national evaluation of the Seattle/LWC UPA projects focuses on 10 of the 12 analysis areas outlined in the NEF. The Goods Movement and Business Impacts analyses from the NEF will not be performed in Seattle because no significant impacts in those areas are intended or expected. Plans for collecting and analyzing the data to support the 10 analyses are described in 10 test plans. Table ES-1 presents the relationship among the analysis areas and the test plans. The transit analysis area and the transit system data test plan are summarized below to provide an example of the approach used in the Seattle/LWC UPA National Evaluation Plan.

Transit is a key element of the Seattle/LWC UPA. The UPA transit projects focus on making riding the bus in the SR 520 corridor more attractive and convenient by reducing bus travel times on SR 520, increasing trip-time reliability, adding service on SR 520, expanding park-and-ride lot capacity, and providing enhanced traveler information. Table ES-2 presents two of the several transit hypotheses and the related measures of effectiveness, and data.

The first hypothesis and associated measures of effectiveness relate to the increased travel speeds of buses using the SR 520 bridge, the travel-time savings, improved trip-time reliability and enhanced capacity resulting from the variable tolling of SR 520 (which is intended to reduce congestion) and the addition of new transit service. The second hypothesis relates to increasing transit ridership and increasing transit share of total corridor trips. These benefits are intended to result from the improved travel times, added capacity and other improvements assessed in the first hypothesis.

These two examples from the transit analysis typify two prongs of the three-pronged strategy utilized throughout the evaluation. The first prong of that strategy features measuring the "end result" transportation metrics like, in the case of transit, ridership and corridor mode split. The second prong measures changes in variables intended to facilitate the change in the end result metrics—in this transit example this would include transit travel times and transit capacity. The third prong of that strategy (not featured in this specific example which focuses only on the first two transit hypotheses) consists of surveying travelers. Travelers will be surveyed to determine perceptions of the effectiveness and equity of the UPA projects, and—critical to linking causes (specific UPA projects) to observed effects (e.g., changes in ridership)—reported travel behavior changes in response to specific UPA projects.

[1] "Amended and Restated Urban Partnership Agreement by and between U.S. Department of Transportation and its Seattle-Area Urban Partner," United States Department of Transportation, September 30, 2009.

Plans for collecting and analyzing data pertaining to these two transit hypotheses and all other evaluation hypotheses will be detailed in a series of test plan documents. In the case of transit, data will be collected from a variety of sources including King County Metro's automatic vehicle location (for bus travel times and reliability data) and automated passenger counter (for ridership data) systems and on-board surveys of Metro riders.

Responsibility for collecting evaluation data resides with the Seattle/LWC UPA partners. The evaluation team will provide guidance to partners on data collection and is responsible for analyzing all of the data and reporting results.

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

Seattle UPA Test Plans	Evaluation Analysis: Congestion Analysis	Tolling Analysis	Transit Analysis	Telecommuting / TDM Analysis	Technology Analysis	Safety Analysis	Environmental Analysis	Equity Analysis	Non-Technical Factors Analysis	Cost Benefit Analysis
Traffic System Data Test Plan	●	○	○	○	●	○	●	○		●
Tolling Test Plan		●					○	○		●
Transit System Data Test Plan	○	○	●	○	●	○	○	○		●
Telecommuting Data Test Plan	○			●			○	○		○
Safety Test Plan						●				●
Surveys, Interviews & Workshops 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 Transit Analysis Approach

Hypotheses/Questions	Measures of Effectiveness	Data
• Seattle/LWC UPA projects will enhance transit performance in the SR 520 corridor through reduced travel times, increased reliability, and increased capacity	• Actual and % change in bus travel speeds • Actual and % change in bus travel times • Actual and % change in service reliability (schedule adherence/on-time performance) • Actual and % change in service capacity	• Transit travel-speed data • Transit travel-time data • Transit-reliability and schedule adherence data • Transit service characteristics data
• Seattle/LWC UPA projects will facilitate an increase in ridership and a mode shift to transit on the SR 520 corridor	• Actual and % change in transit ridership • Transit mode share (person throughput by mode) for the entire UPA corridor (SR 520 and alternate routes) • Transit mode share for the Redmond P&R/TOD (mode of access used by TOD residents and business patrons) and, as a point of reference, mode shares of comparable non-TOD developments • Actual and % change in park-and-ride lot utilization	• Transit ridership data • Traveler survey data • Park-and-ride lot utilization data

Next Steps

The next step in the Seattle/LWC UPA National Evaluation is to develop the last, and most detailed, in the series of evaluation planning products, the detailed test plans. After that, collection of baseline data will be initiated. It is anticipated that the draft test plans will be developed in November or December 2009. The results of the Seattle/LWC UPA national evaluation are expected in mid-2012.

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. The Seattle/Lake Washington Corridor (LWC) UPA, focusing on the SR 520 corridor was one of the selected sites. Based on a competitive procurement process, the U.S. DOT also selected the Battelle team to conduct the national evaluations of the UPA projects. This document presents the Seattle/LWC UPA National Evaluation Plan developed by the Battelle team, in cooperation with the Seattle/LWC UPA partners and the U.S. DOT.

The evaluation plan identified in this document will be carried out in partnership between the Seattle/Lake Washington Corridor UPA local partners and a national evaluation team retained by the U.S. DOT. The national evaluation team is responsible for developing the evaluation plan in coordination with the local partners, including specifying required data, analyzing data, and reporting results. The local partners are responsible for coordinating with the national evaluation team on evaluation plans and for collecting the necessary evaluation data.

This introduction section describes U.S. DOT's congestion reduction programs and the strategies being implemented at the various sites. The organization of this report is also presented.

1.1 U.S. DOT Program to Reduce Congestion

Transportation system congestion is a significant threat to the economic prosperity and way 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. 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 over the previous decade[2]. Congestion affects the quality of life in America by robbing time that could be spent with families and friends, in participation in civic life, and in 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.

1.1.1 Urban Partnership Agreement/Congestion Reduction Demonstration Program Overview

U.S. DOT entered into UPAs 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

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

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, and Technology.

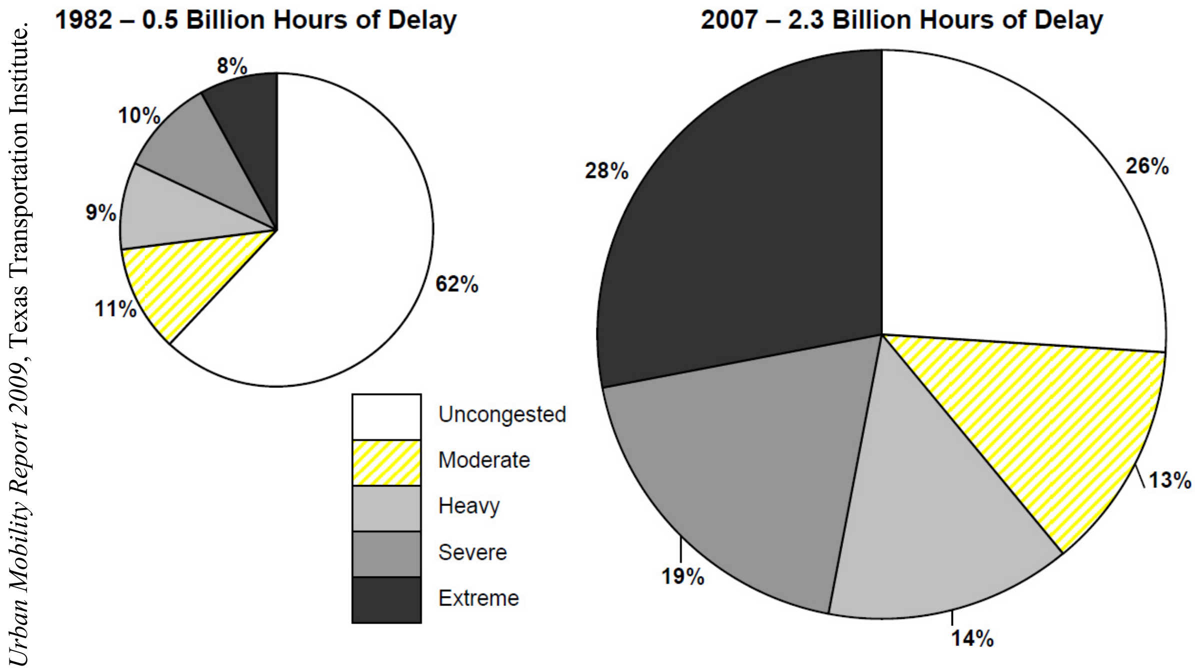

Figure 1-1. Percentage of Vehicle Miles Traveled by Congestion Level in Very Large Urban Areas, 1982 versus 2007

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 Initiative. The November 13, 2007, Federal Register notice set a December 31, 2007, deadline for applications. Subsequently, the U.S. DOT announced a total of $263 million in federal discretionary grants for Los Angeles and Atlanta. Chicago had been awarded funds at one point but was later removed from the program when deadlines for pricing legislation were not met.

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 Seattle/LWC UPA projects focus on the SR 520 corridor. Projects include congestion pricing in the form of variable tolling on all lanes of SR 520, Active Traffic Management (ATM) on SR 520 and the parallel Interstate 90, travel time signs, enhanced bus service, enhanced park-and-ride lots (including one that is a part of a transit oriented development), transit stop/station improvements including real-time traveler information, a range of travel demand management program strategies (e.g., employer-based programs), and regional ferry enhancements.

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

UPA/CRD Strategies	Site				
	MN	SF	Sea	Mia	LA
Convert HOV lanes to dynamically priced high-occupancy tolling (HOT) lanes and/or new HOT lanes	X			X	X
Priced dynamic shoulder lanes	X				
Variably priced parking and/or loading zones		X			X
Variably priced roadways or bridges (partial cordon)			X		
Increase park-and-ride capacity (expand existing or add new)	X		X	X	X
Transit-oriented development			X		
Expand or enhance bus service	X		X	X	X
Implement new, or expand existing, Bus Rapid Transit	X			X	
Transit on special runningways (e.g., contraflow lanes, shoulders)	X			X	
New and/or enhanced transit stops/stations	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
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

The U.S. DOT selected a national evaluation contractor through a competitive procurement process to assess the effectiveness of the various UPA/CRD strategies. The Battelle team was selected to conduct the national evaluation. The team has been working with representatives from the U.S. DOT and the UPA/CRD sites to develop and conduct the evaluation process. This report was prepared by members of the Battelle team working in cooperation with the Seattle/LWC UPA partners and representatives from the U.S. DOT.

1.2 Organization of this Report

The remainder of this report is divided into four sections. Chapter 2.0 discusses the Seattle/LWC UPA. An overview of the transportation system in the Seattle metropolitan area is presented first, followed by a description of the Seattle/LWC UPA partners and the UPA 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 Seattle/LWC UPA evaluation process. Chapter 4.0 presents the Seattle/LWC UPA evaluation plan. The chapter discusses the 10 evaluation analyses and describes the preliminary evaluation test plans. The report concludes with a discussion of the next steps in the Seattle/LWC UPA national evaluation process.

2.0 SEATTLE/LWC URBAN PARTNERSHIP AGREEMENT

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

2.1 The Transportation System and Congestion in the Seattle Urban Area

Congestion levels in the Puget Sound area continue to increase. According to WSDOT's *Managing and Reducing Congestion in Puget Sound Performance Audit Report,*[3] over 40 percent of the traffic traveling in either the a.m. or p.m. peak periods is travelling below 45 mph. The reports also states that 49 to 79 percent of the commuters in the Puget Sound area (depending upon the route) drive alone. TTI's *Urban Mobility Report*[4] ranks Seattle 18th nationally in terms of total delay and 19th in terms of delay per peak traveler, based on 2005 data. The report also estimates that 57 percent of the lane-miles in the Seattle area are congested, up from 47 percent the previous year.

Both SR 520 and I-90, which cross Lake Washington, represent two of the major east-west commuting corridors in the Seattle Area, linking communities east of Lake Washington (such as Bellevue, Redmond, and Issaquah) with downtown Seattle. Downtown Seattle remains the region's major center of population and employment, supporting approximately 500,000 jobs annually. Over the past 40 years, the population of Seattle has remained relatively constant, increasing from 467,591 in 1960 to 563,374 in 2000. Over the same time period, however, the Eastside communities have experienced tremendous growth, primarily supported by the SR 520 floating bridge and I-90 bridge structures. Between 1960 and 1970, the population of the Eastside more than tripled, growing from 24,184 to 84,287. From 1970 to 2000, the population of the Eastside has essentially doubled again. The 2000 Census placed the population of the Eastside at 161,967. Even more substantial has been the growth of employment in the Eastside. Today, SR 520 and I-405 corridors support some of the major high-tech businesses, bringing thousands of workers to the Eastside. As a result, the morning commute from Seattle to Eastside is just as important to the region's economic vitality and the morning commute as the commute from the eastside to Seattle.[5]

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[3] *Washington State Department of Transportation Managing and Reducing Congestion in Puget Sound Performance Audit.* Prepared by Talbot, Korvola, and Warwick for the Washington State Auditor. October 2007. Available at http://www.wsdot.wa.gov/NR/rdonlyres/6CC095B5-2B01-4B5B-B2D7-9F773268F80D/0/ar1000006.pdf. Accessed May 27, 2009.

[4] D. Schrank and T. Lomax. *The 2007 Urban Mobility Report*. Texas Transportation Institute, The Texas A&M University System, September 2007. Available at http://tti.tamu.edu/documents/mobility_report_2007_wappx.pdf. Accessed May 27, 2009.

[5] *SR 520 Bridge Replacement and HOV Project: Draft Environmental Impact Statement*. Report No. FHWA-WA-EIS-O6-02-D. Washington State Department of Transportation. August 18, 2006. Available at http://www.wsdot.wa.gov/projects/sr520bridge/DraftEIS.htm. Accessed June 11, 2009.

The following additional information on SR 520 is excerpted from WSDOT's Request for Proposals for the SR 520 Toll Collection System:

> "SR 520 currently consists of two lanes eastbound and two lanes westbound, with the exception of a third HOV lane that starts west of I-405 and ends just before the eastern terminus of the SR 520 Bridge…The three major access points to the SR 520 Corridor are the I-5, I-405, and SR 908/Bellevue Way NE interchanges.
>
> …The SR 520 Bridge opened to traffic in 1963 and was initially designed for a capacity of 65,000 vehicles per day, although it currently carries approximately 110,000 vehicles per day. Moreover, about seven times the number of vehicles cross the SR 520 Bridge than when it opened in 1963, and the traffic demand in both directions often exceeds the capacity during rush hours. Traffic on SR 520 grew steadily between the years 1975 and 2000, but has leveled off since then.
>
> SR 520 traffic volumes have been relatively balanced in both directions since the late 1980s. Since 1993, however, peak morning traffic volumes have been slightly higher eastbound, and peak afternoon traffic volumes have been slightly higher westbound.
>
> Travel times are not reliable on SR 520 due to traffic volume, incidents, weather, and special events, all which negatively affect congestion. Furthermore, congestion on this east-west corridor negatively affects the two major north-south corridors in the region (I-5 and I-405), as well as local arterials. As with most corridors, however, demand is not consistent throughout the day, which results in periods when the bridge is not being used to its capacity."[6]

Several agencies provide transit services throughout the entire Puget Sound area, but the two service providers that have the greatest ridership in the Lake Washington area are King County Metro Transit and Sound Transit. Metro Transit is one of the area's largest public transit providers, serving more than 1.8 million residents in King County. Through its more than 1300-vehicle fleet, Metro Transit services an annual ridership of 118 million passengers within a 2,134 square mile area. Metro Transit's fleet includes standard and articulated coaches, electronic trolleys, dual-powered buses, hybrid diesel-electric buses, and streetcars. Metro Transit also operates the largest publicly-owned vanpool program in the country, with about 1,000 vans.

Sound Transit is the other major transit provider in the corridor. Created in 1996, Sound Transit provides regional express bus, commuter rail, and light rail services between major commuting destinations in the region. Sound Transit operates a total of 25 express bus routes with 7 routes directly utilizing either SR 520, I-90, and SR 522.

According to the Congestion Report, one possible reason why eastbound trips out of Seattle did not change between 2005 and 2007 was the dramatic change in transit ridership. Sound Transit bus routes heading eastbound out of Seattle experienced a ridership increase of approximately 23 percent between 2005 and 2007. Similarly, King County Metro experienced a 12 percent increase in ridership on the eastbound services.

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[6] *Request for Proposal ACQ-2009-0530-RFP, Supply, Install, Maintain a Toll Collection System, Appendix 2—Project Description*, WSDOT, July 15, 2009

The Seattle/Lake Washington UPA projects discussed in Section 2.2 represent one of the many efforts being pursued in the Puget Sound area to fight the growth of congestion. Other initiatives include expansion of bus, light rail, and ferry services, integrated corridor management on I-5, use of innovative traffic management and traffic control procedures, improvement in travel demand and telecommuting services, and the elimination of capacity bottlenecks.

2.2 The Seattle/LWC UPA Local Partners

The Seattle/LWC local UPA partners consist of the Washington State Department of Transportation (WSDOT), the Puget Sound Regional Council (PSRC); and King County, Washington. These partners are coordinating planning, implementation and/or operation of various UPA projects with a number of other local agencies such as the City of Seattle and Sound Transit.

WSDOT is responsible for the overall project schedule and financial management, coordinating project activities and reporting to Federal agencies. WSDOT is leading the SR 520 bridge variable tolling, real-time travel time signage, and SR 520/I-90 active traffic management projects.

King County operates the Metro transit service, which comprises the majority of the transit service in the SR 520 corridor. King County is leading the Seattle/LWC UPA bus transit projects, consisting of enhanced bus service along SR 520 and real-time information signs at transit stations, and expansion of two existing park-and-ride facilities.

The Puget Sound Regional Council is the Metropolitan Planning Organization for the Seattle urban area including King, Pierce, Snohomish and Kitsap Counties. PSRC is leading the telecommuting/travel demand management projects which are part of the UPA but are being implemented without Federal UPA funds.

Figure 2-1 presents the Seattle/LWC UPA team. The three Seattle/LWC UPA local partner agencies (WSDOT, PSRC and King County) coordinate their UPA activities with U.S. DOT headquarters in Washington, D.C., the Federal Highway Administration Washington State Division, and with the Federal Transit Administration Region 10 office in Seattle.

“UPA Program Management Plan,” Washington State Department of Transportation, April 2008.

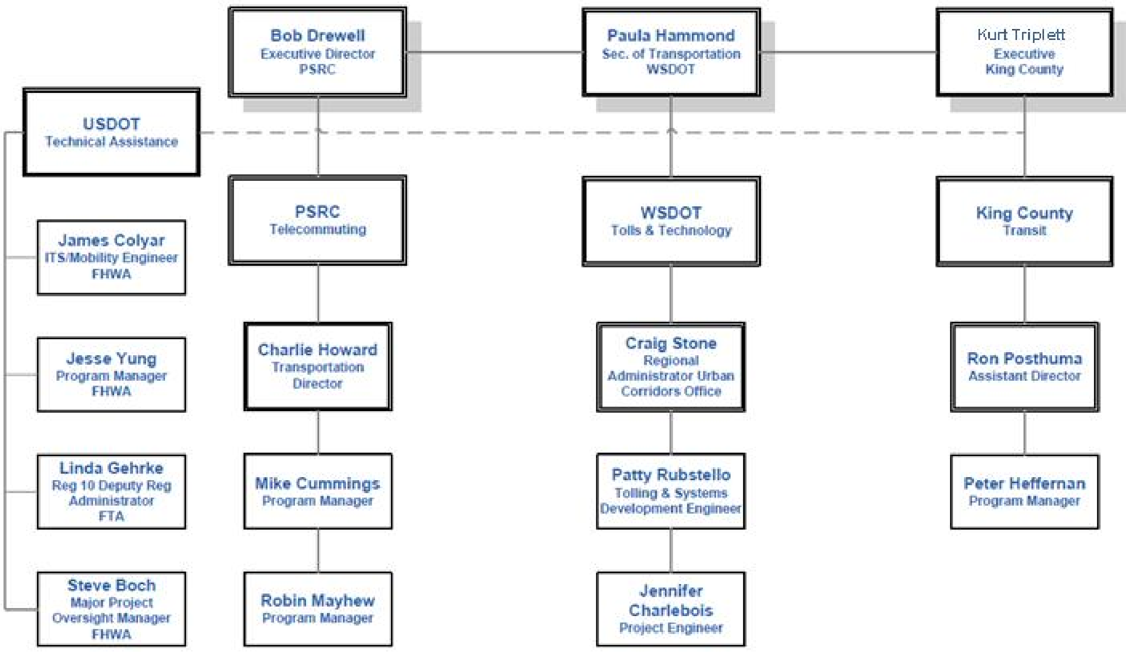

Figure 2-1. Seattle/LWC UPA Team

2.3 Seattle/LWC UPA Projects and Deployment Schedules

The Seattle/LWC UPA projects are intended primarily to reduce congestion—improve average travel speeds while increasing the person throughput—on SR 520 between I-405 to the east and I-5 to the west. SR 520 interchanges with I-5, the major north-south route in and out of downtown Seattle, about three miles north of the Seattle central business district. The centerpiece of that approximately 6-mile segment is the approximately 1.4-mile long SR 520 (officially, the “Governor Albert D. Rosellini Bridge—Evergreen Point”) floating bridge across Lake Washington. Interstate 90 parallels SR 520, about three miles to the south, between I-405 and I-5 and constitutes a primary alternate route. Figure 2-2 shows the location of SR 520.

Washington State Department of Transportation, “SR 520 Variable Tolling Project Environmental Assessment,” March 2009.

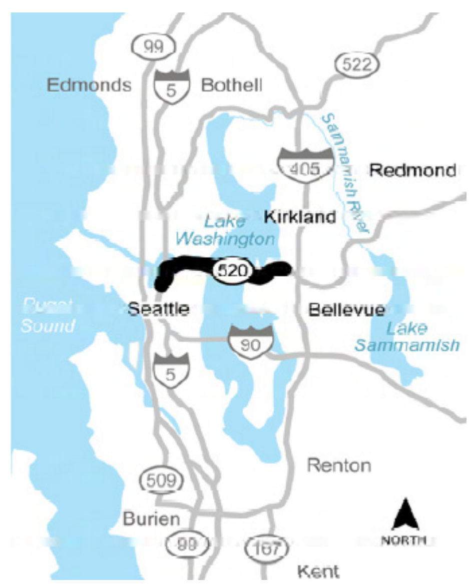

Figure 2-2. SR 520 Location

Bi-directional, all-lane variable tolls on all lanes of SR 520 constitute the congestion pricing component of the Seattle/LWC UPA and are supported by transit, technology and travel demand management projects. Table 2-1 is adapted from the September 30, 2009 amended and restated Urban Partnership Agreement Term Sheet[7] and summarizes the Federally-funded Seattle/LWC UPA projects. Additional information on those as well as the locally-funded travel demand management projects follow Table 2-1. Figure 2-3 shows the locations of the WSDOT UPA tolling and technology projects and Figure 2-4 shows the location of the UPA transit projects.

Table 2-1, which quotes project description language directly from the latest term sheet, shows that vehicles with 3 or more passengers will pay discounted tolls or no tolls. However, that issue in general as well as any specific approaches to high occupancy vehicles are still being considered by the local partners and U.S. DOT. Although this evaluation plan includes vehicle occupancy and other data collection relevant to HOV-related inquiries, it does not necessarily contain all of the HOV-related evaluation activities that may be needed, depending on the final approach taken by the local partners. When the local partners and U.S. DOT have resolved this issue the evaluation approach will be adjusted as necessary and reflected in the test plans.

Table 2-1. Seattle/LWC UPA Projects and Funding

Project	Federal Funding
Tolling (Congestion Pricing) Projects	
• **Variable pricing on SR 520.** The Urban Partner will implement variable pricing (based on the level of demand) on all through lanes of SR 520 between I-5 and I-405 and, to the extent necessary to maintain free flow traffic in the through-lanes, on all collectors and distributors for SR 520 between I-5 and I-405. The Urban Partner will provide discounted or free access for vehicles with 3+ occupants.	$63.0M
Transit Projects	
• **Enhanced bus service along SR 520.** The Urban Partner will expand transit capacity along SR 520 by adding 90 one-way peak period trips on core and other supporting bus routes operated by King County Metro and Sound Transit. • **New transit improvements along SR 520 corridor.** The Urban Partner will construct transit facilities to include stops/stations/terminals, expansion of existing park-n-ride lots, and the provision of real time information signs at transit stations to support the tolling of SR 520.	$41.0M
• **Improvements to regional ferry service.** The Urban Partner will carry out a number of projects to improve regional ferry boat service, as described in applications filed for funding under FHWA's Ferry Boat Discretionary Program.	$27.4M
Technology Projects	
• **Real-time multi-modal traveler information.** The Urban Partner will use intelligent transportation system ("ITS") technology to provide real-time traveler information (including current toll rates) for SR 520 and the Lake Washington corridor. Dynamic message signage prior to traveler decision points will provide opportunities for re-routing in order to access alternate travel routes (I-90, I-405, I-5). • **SR 520 active traffic management.** The Urban Partner will implement technology to provide active traffic management of the Lake Washington Corridor (SR 520, I-90, I-5 and I-405).	$23.1M

U.S. DOT – Seattle/LWC Urban Partnership Agreement, Amended and Restated, September 30, 2009.

[7] "Amended and Restated Urban Partnership Agreement by and between U.S. Department of Transportation and its Seattle-Area Urban Partner," United States Department of Transportation, September 30, 2009.

The Seattle/LWC local partners and U.S. DOT have agreed that since the regional ferry services are not expected to significantly impact traffic conditions in the SR 520 corridor the ferry projects will not be included in the national evaluation.

Figure 2-3. Seattle/LWC UPA Tolling and Technology Projects

Washington State Department of Transportation, WSDOT Projects website, "Lake Washington Congestion Management Projects," http://www.wsdot.wa.gov/Projects/LkWaMgt/UPAmap.htm, July 4, 2009.

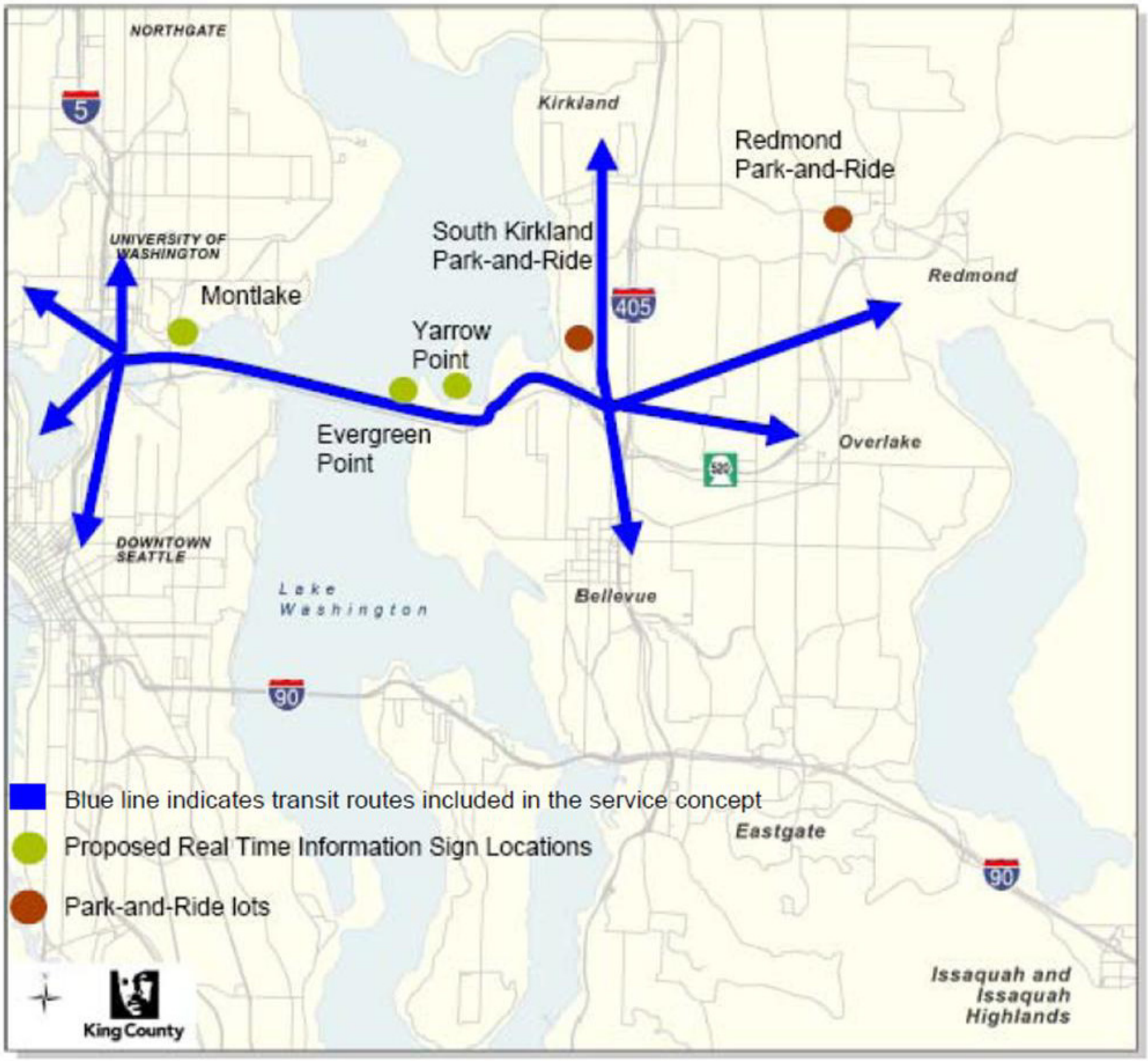

Figure 2-4. Seattle/LWC UPA Transit Projects

SR 520 Variable Tolls

The following information on the SR 520 toll system is excerpted from the WSDOT Toll Collection System Request for Proposals (June 15, 2009):

> "When open to tolling, motorists will be charged a toll to cross the SR 520 Bridge in both directions. The toll rates, including any discounts for **High Occupancy Vehicle (HOV)** use, will be determined later in 2009 or in 2010 by the Washington State Transportation Commission but will depend upon the time of day (i.e., variable tolling), the type of vehicle (i.e., vehicle classification), and possibly the occupancy of the vehicle (e.g., **Single-occupant Vehicle [SOV]**, high-occupancy vehicle containing two or more travelers [HOV 2+], and high-occupancy vehicle containing three or more travelers [HOV 3+]). WSDOT will communicate the toll rates to the public via Internet, static and dynamic message signs and various public education and outreach efforts.

> The toll collection system (TCS) will automatically identify and classify each vehicle traveling in both directions at a single location on the highway, capture the **Transponder** identification number (if any) and license plate image and number of each vehicle, build a **Toll Transaction**, and send this information to WSDOT's **Customer Service Center** (**CSC**) back office for processing and collection. No toll booths will be provided; therefore, motorists will not be required to stop to pay. Motorists can pay by either 1) establishing a pre-paid, Transponder-based ***Good To Go!*™** customer account with WSDOT from which tolls can be debited, or 2) paying (pre-pay or post-pay) for each Toll Transaction through a number of methods, including by mail, on the web, over the phone, or in person at one of three customer service storefronts. Doing so will allow vehicles to travel through the corridor at highway speeds without stopping to pay a toll.
>
> WSDOT expects that, in time, most users of the SR 520 Bridge will pay using a *Good To Go!*™ customer account; however, a significant amount of users will not have *Good To Go!*™ accounts or Transponders and therefore must be identified by the TCS via their license plates. This information will be used by the WSDOT CSC back office to match Toll Transactions with customer pre-payments or bill customers for post-payment. WSDOT, through its CSC provider, will handle Toll Transactions received from all **State** toll facilities, including the Tacoma Narrows Bridge, the SR 167 **HOT** Lanes, and the new SR 520 toll lanes (i.e., the TCS).
>
> It is anticipated that the toll rate structure of the SR 520 toll lanes will encourage motorists to either shift their travel times from the peak periods into less congested periods or to shift their travel mode from single occupant vehicles to either HOV or transit. Some motorists may also elect to cancel or consolidate some or all of their trips or to take an alternate route altogether. Over time, travel patterns may change significantly from opening day scenarios due to various factors, including tolling, and the TCS is expected to be able to accommodate these changing conditions. Although toll rates have not yet been established, they would likely vary based on historical traffic demand, with higher toll rates during peak travel periods and lower toll rates during off peak travel periods. The toll rates may be adjusted several times a year to accommodate seasonal demand and from year to year as travel patterns change."[8]

The SR 520 tolling is planned to utilize a single toll collection point located on the far eastern portion of the bridge span. Figure 2-5 shows the proposed tolling point location.

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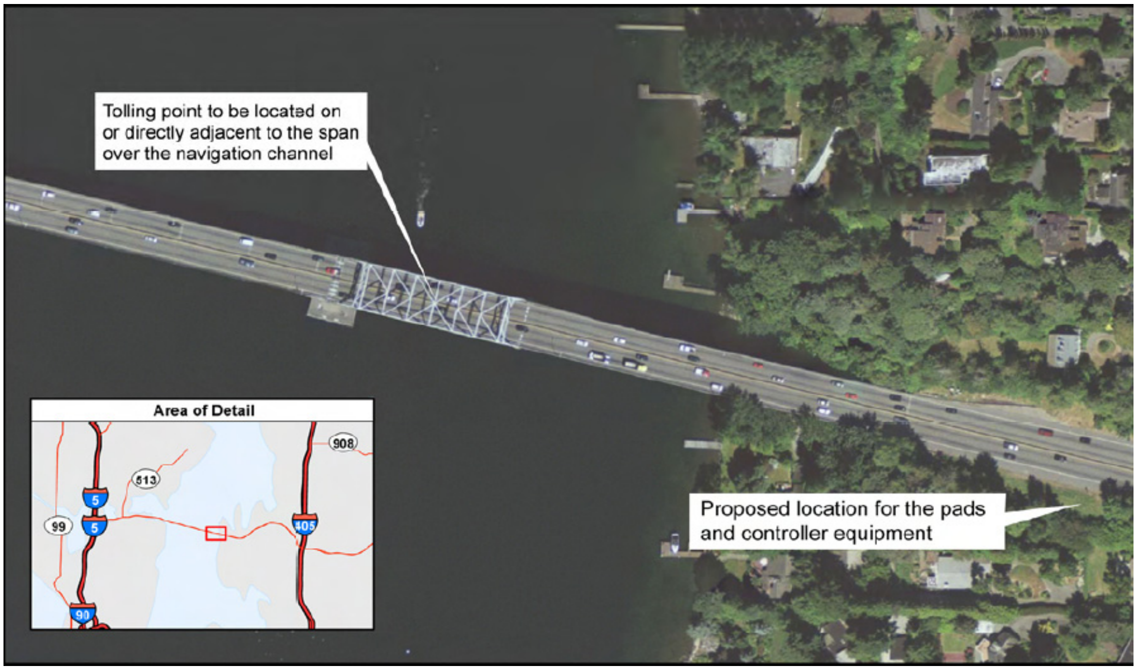
[8] "Request for Proposal ACQ-2009-0530-RFP - Supply, Install, Maintain a Toll Collection System, Appendix 2 – Project Description," Washington State Department of Transportation, June 15, 2009.



“SR 520 Variable Tolling Project Environmental Assessment,” Washington State Department of Transportation, March 2009.

Figure 2-5. Proposed Tolling Point Location

Transit Projects

Bus service along SR 520 will be expanded by adding 90 one-way peak period trips on bus routes operated by King County Metro and Sound Transit. Service expansion will include purchasing 45 new buses. The new bus service is focusing in particular on the reverse commute direction, e.g., west to east in the AM and east to west in the p.m., building upon existing all-day, two-way services and peak commuter routes currently provided by Metro and Sound Transit.

Two park-and-ride lots are being modified, the South Kirkland lot located at the I-405/SR 520 interchange and the Redmond lot located farther east. At both locations, existing surface lots are being replaced by new parking garages. The Kirkland location will not be complete until after the UPA evaluation data collection has been completed and so it will not be included in the evaluation. The Redmond park-and-ride lot changes are a critical part of a larger redevelopment of the Redmond station that includes a new transit center and a transit oriented development (TOD) project. Converting the existing surface lot to garage parking (with no change in the total number of spaces) made room for the addition of a 6-story mixed use building containing 322 apartments and 12,000 square feet of commercial space. In conjunction with this project a new transit center is being developed adjacent to the parcel. The transit center features new passenger amenities and loading facilities. Collectively, these projects are intended to increase ridership on the SR 520 corridor due to better passenger facilities and ridership from the TOD project.

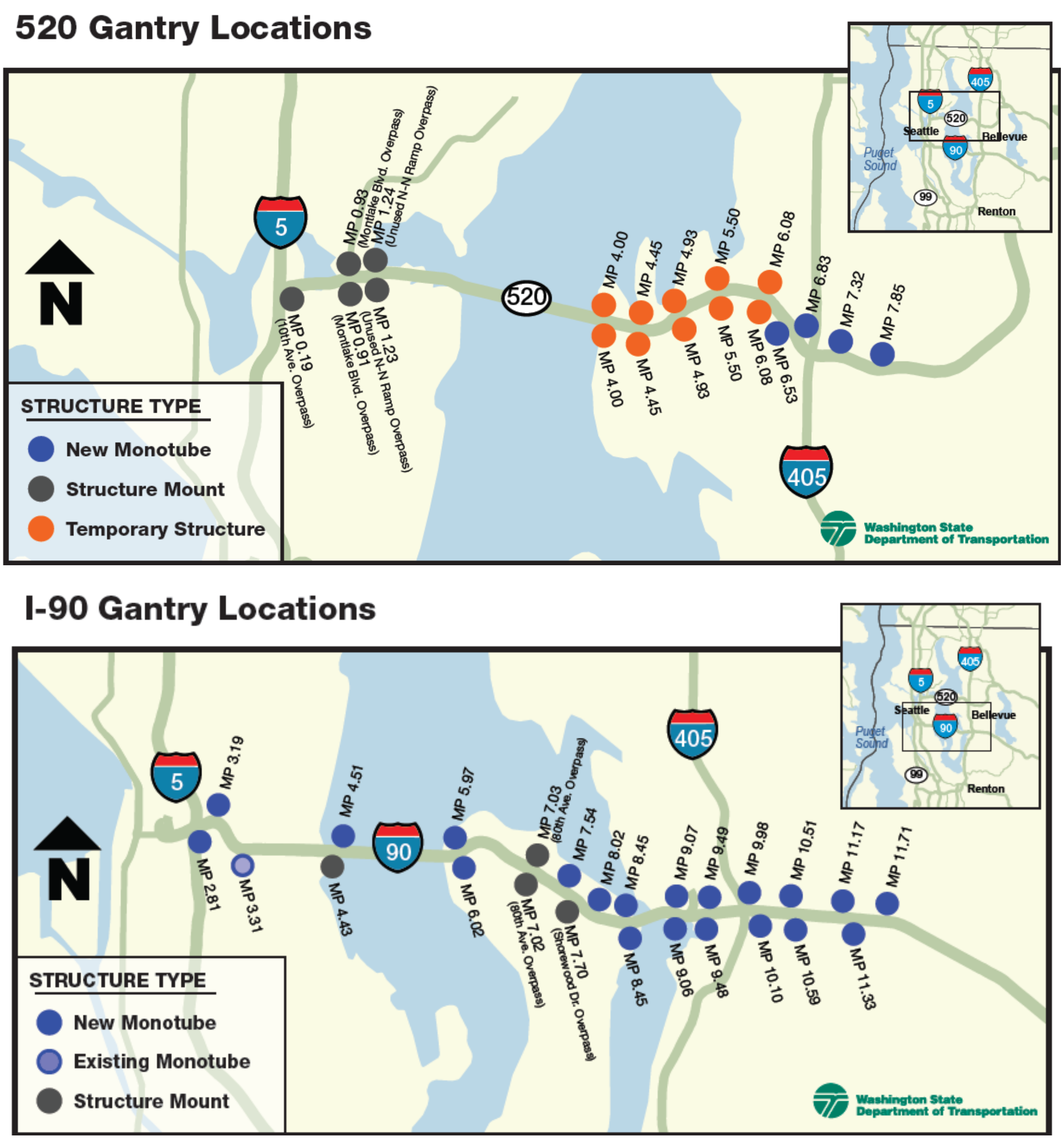
Other transit improvements include new bus shelters and new real-time information at bus shelters/stations, both at locations to be determined.

Technology Projects

Advanced technologies, e.g., Intelligent Transportation Systems, play a significant role in almost all of the Seattle/LWC UPA projects. In addition to the pervasive, enabling role for technology throughout the deployment, there are two specific technology projects being implemented. The first project is the Active Traffic Management (ATM) system that will be installed on SR 520 and I-90 (an ATM is also being installed on I-5 although it is not included in the UPA). The system will consist of a series of electronic speed-limit, lane status, and mini-dynamic message signs over each lane on the SR 520 and I-90 bridges over Lake Washington. Figures 2-6 show the planned SR 520 and I-90 ATM gantry locations. Figure 2-7 shows a visualization of the gantries. The depiction in Figure 2-7 is of a two-cycle message gantry where temporary traffic control begins, showing how displays used for advisory speeds (bottom image) would convert to lane control displays.

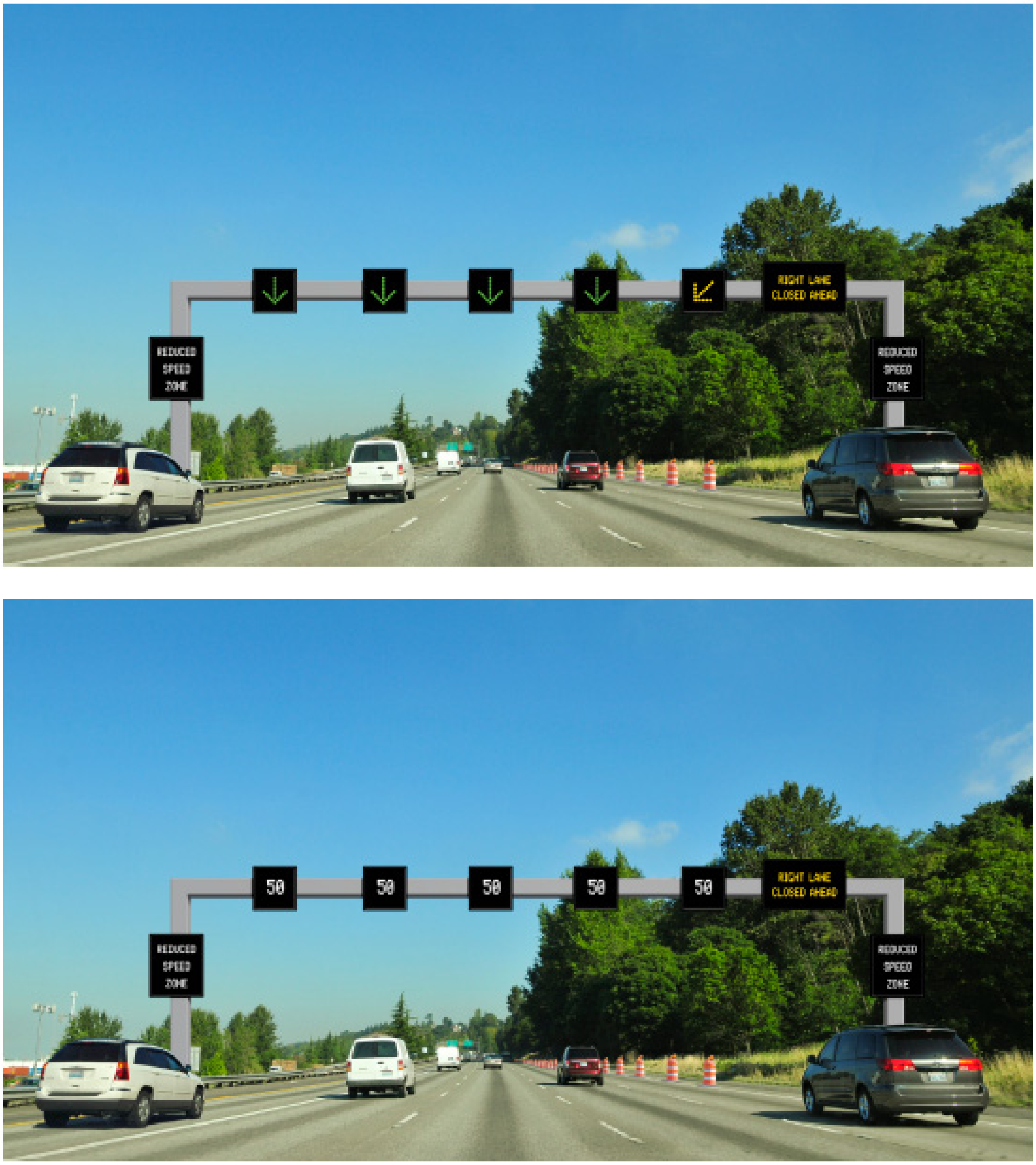
The second type of UPA technology project is real-time, multi-modal traveler information. The project identified to date in this area consist of several new travel time signs in the SR 520 corridor. WSDOT will use the signs to provide up-to-the-minute, comparative travel times (e.g., for alternate routes) for travel to Seattle. The signs are intended to reduce collisions, as well as the congestion caused by collisions, by warning drivers of slow-moving traffic ahead. The information is also intended to signal drivers to use alternative routes. Signs will be installed at three locations (locations are shown in the previous Figure 2-3):

- Westbound SR 520, one mile east of I-405
- Southbound I-405 at the NE 72nd Place overpass, 1.3 miles north of the SR 520
- Westbound SR 522 at the SR 202 overpass, one mile east of the I-405 northbound exit.



Washington State Department of Transportation, "Pre-Ad Boards, Revised," February 2009.

Figure 2-6. UPA ATM Gantry Locations



Washington State Department of Transportation, "Pre-Ad Boards, Revised," February 2009.

Figure 2-7. Visualization of UPA ATM Signs

Figure 2-8 shows two possible designs for the UPA travel time signs.

Washington State Department of Transportation, WSDOT Projects website, "New travel time signs for Lake Washington corridors," http://www.wsdot.wa.gov/Projects/LkWaMgt/TravelTime/Map.htm, July 4, 2009.

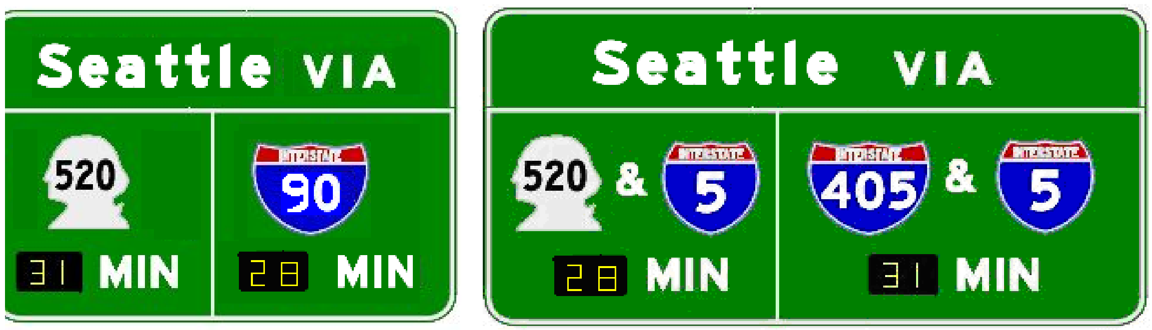


Figure 2-8. Possible Travel Time Sign Designs

Travel Demand Management Projects

There are no travel demand management projects that are funded through the UPA. However, the Seattle/LWC UPA partners are considering options for enhancing a wide range of regional travel demand management strategies which, in the SR 520 corridor, are intended to complement the UPA projects. Further, through a related but non-UPA exercise (the local partners' "Travel Demand Target Setting" study), the SR 520 corridor is being used by the local partners as a test case for applying TDM strategies to achieve specific, pre-defined traffic reduction targets on major highway corridors. Most of the TDM strategies under consideration consist of expanding or enhancing existing programs. The specific TDM strategies to be implemented have not been identified yet and therefore the evaluation plans presented in this document are high level. As specific TDM strategies and targets are identified more specific evaluation approaches will be developed and reflected in the Telecommuting/TDM Test Plan.

Potential TDM strategies under consideration by the Seattle/LWC UPA partners include:

- Growth and Transportation Efficiency Center (GTEC) – Continued funding to existing or new centers in the SR 520 corridor ("centers" are designated geographic areas within growing urban regions where WSDOT is working with partners on economic development, transportation efficiency, and land use changes). GTEC provides a framework for establishing goals and creating strong partnerships between local government, the business community, and transit agencies. GTEC programs reach out beyond the major employers under the CTR program to smaller employers, students and residents. The program also provides a mechanism for local governments to tie their land use policies, including parking management, concurrency requirements, and development standards, to trip reduction goals.
- Parking Management Programs – Employer incentives to reduce or eliminate employee parking subsidies.
- Parking Supply – New or expanded park-and-ride lots.
- Travel Alternatives Promotion – Including using the existing Commute Trip Reduction (CTR), King County Metro InMotion, Rideshareonline.com, vanpools, and ORCA/Smart Card (regional integrated fare payment cards).
- Land Use – New activities that could include HOV or transit supportive land use decisions, guidance to local government and developers and possible bonuses for developments meeting standards, or employer bus pass requirements.
- Employer Based Strategies – Enhancing or expanding the existing CTR, Redmond Trip Reduction Incentive Program, Transportation Management Program and University of Washington UPASS.
- Carsharing – Expanding carsharing (e.g., "Zipcars") locations.
- Data Collection and Performance Management – Building on the existing tools and processes used for the CTR and GTEC commuter surveys and the new daily trip log that will be offered by the new Rideshareonline to measure the effectiveness of SR 520 TDM strategies.

Table 2-2 presents the deployment timeline for the various Seattle/LWC UPA projects (ferry service, which will not be evaluated, is not shown). Most of the projects, including the tolling and enhanced transit service, are scheduled to become operational no later than June 30, 2011 and potentially as early as November 1, 2010. WSDOT is allowing prospective toll system contractors to propose their own delivery date within this 8-month window (November 2010 to June 30, 2011) and is providing an incentive for completion earlier within this window. Given this current uncertainty, the schedule-related discussions in this evaluation plan leave the exact timing of evaluation activities unspecified. The full test plan documents to be developed in the next few months will refine the data collection schedule once the specific deployment dates are provided by WSDOT. One project, the Redmond P&R/TOD is already operational. The South Kirkland park-and-ride lot expansion will not become operational in time to be considered in the UPA national evaluation. A schedule for travel demand management projects has not yet been identified.

Table 2-2. UPA Project Schedules

Projects	Operational Date
Redmond Park-and-Ride/Transit Oriented Development	June 30, 2009
Variable Pricing on SR 520	June 30, 2011
Enhanced Bus Service on SR 520	
Transit Real-time Information Signs	
Travel Time Signs (and any other real-time multi-modal information)	
SR 520 Active Traffic Management	
I-90 Active Traffic Management	
South Kirkland Park-and-Ride Lot Expansion	October 15, 2014
Travel Demand Management	Existing programs are on-going; timing of specific enhancements supporting the UPA is to be determined

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3.0 NATIONAL EVALUATION OVERVIEW

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

3.1 National Evaluation Organizational Structure

The evaluation of the UPA/CRD national evaluation is sponsored by the U.S. DOT. The RITA 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. Members of the Battelle 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 (CTS), University of Minnesota;
- Wilber Smith Associates;
- 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 generate information and produce technology transfer materials to support deployment of the strategies in other metropolitan areas. The national evaluation will also generate findings for use in future federal policy and program development related to mobility, congestion, and facility pricing.

The 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.

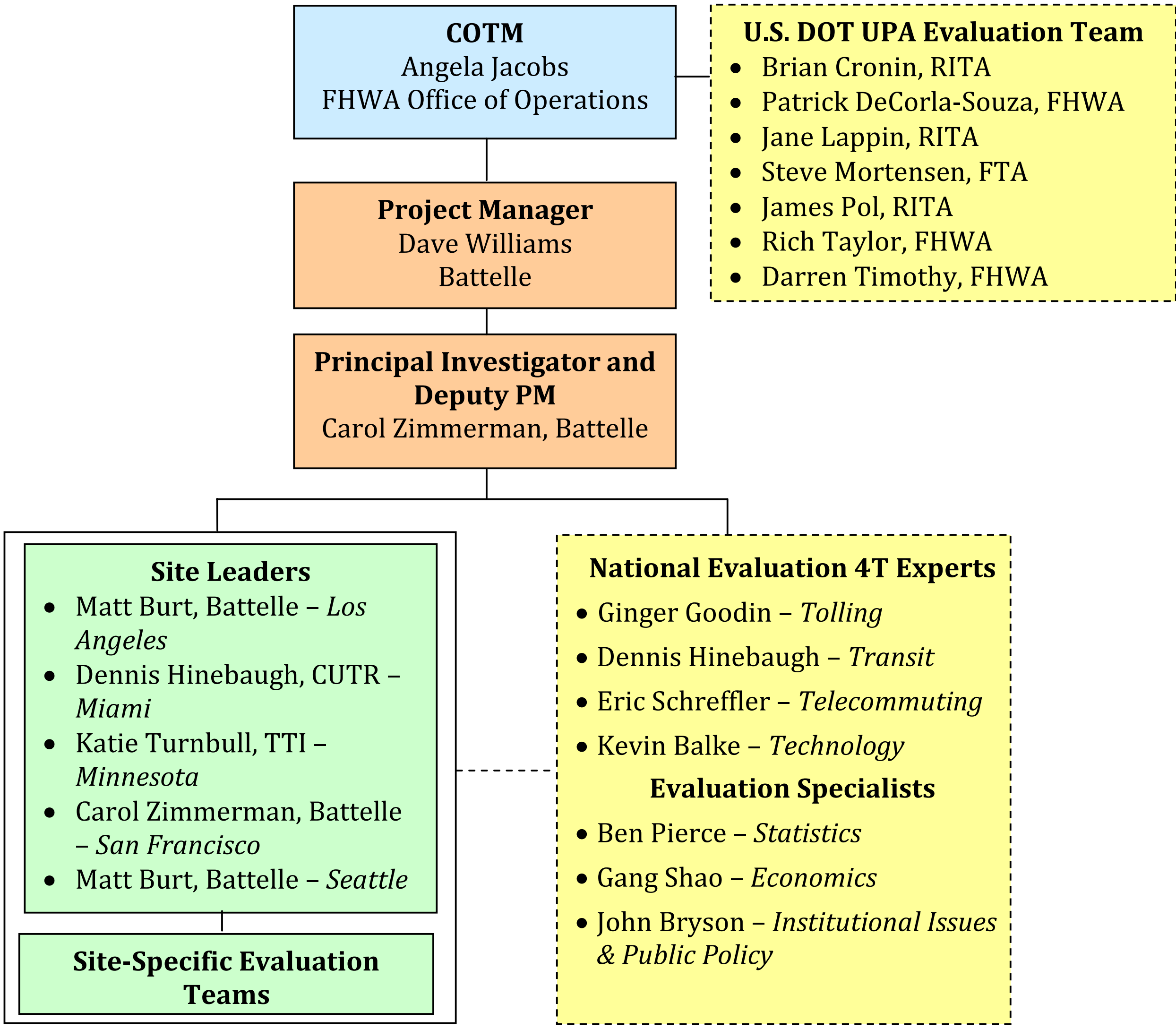

Figure 3-1. Battelle Team Organizational Structure

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.

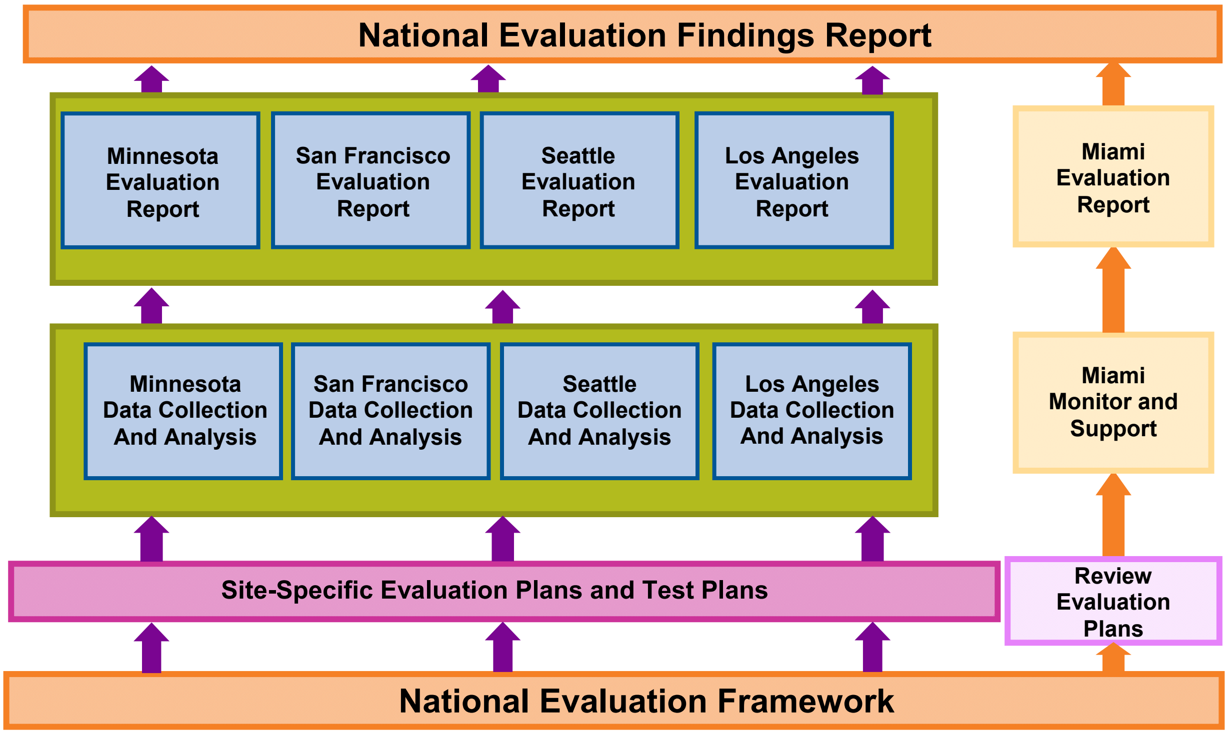

Figure 3-2. The National Evaluation Framework in Relation to Other Evaluation Activities

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;
- collection of one year of pre-deployment and one year of post-deployment data;
- 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 will be prepared. Questions may need to be tailored or added to reflect the specific congestion strategies and local context for each site, 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, measures of effectiveness will be collected before the deployments become operational. For the "after," or post-deployment period, the same measures 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 U.S. DOT Four Questions and Mapping to 12 Analyses

Table 3-1 shows the four "Objective Questions" that U.S. DOT has directed the national evaluation team to address.[9] 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 related to the four objective questions. These analyses from the NEF form the basis of the evaluation plans at the UPA/CRD sites, including Seattle/LWC.

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?

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

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: Business Impacts
#3 – What are the non-technical success factors?	#10 – Non-Technical Success Factors
#4 – What is the overall cost and benefit of the strategies?	#11 – 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.

3.4 Seattle/LWC UPA National Evaluation Process

Figure 3-3 presents the Seattle/LWC UPA national evaluation team. The team includes U.S. DOT National Evaluation leader, the COTM, the U.S. DOT evaluation team, the FHWA point of contact, and the Battelle team. Representatives from the partnership agencies are involved in development of the UPA national evaluation.

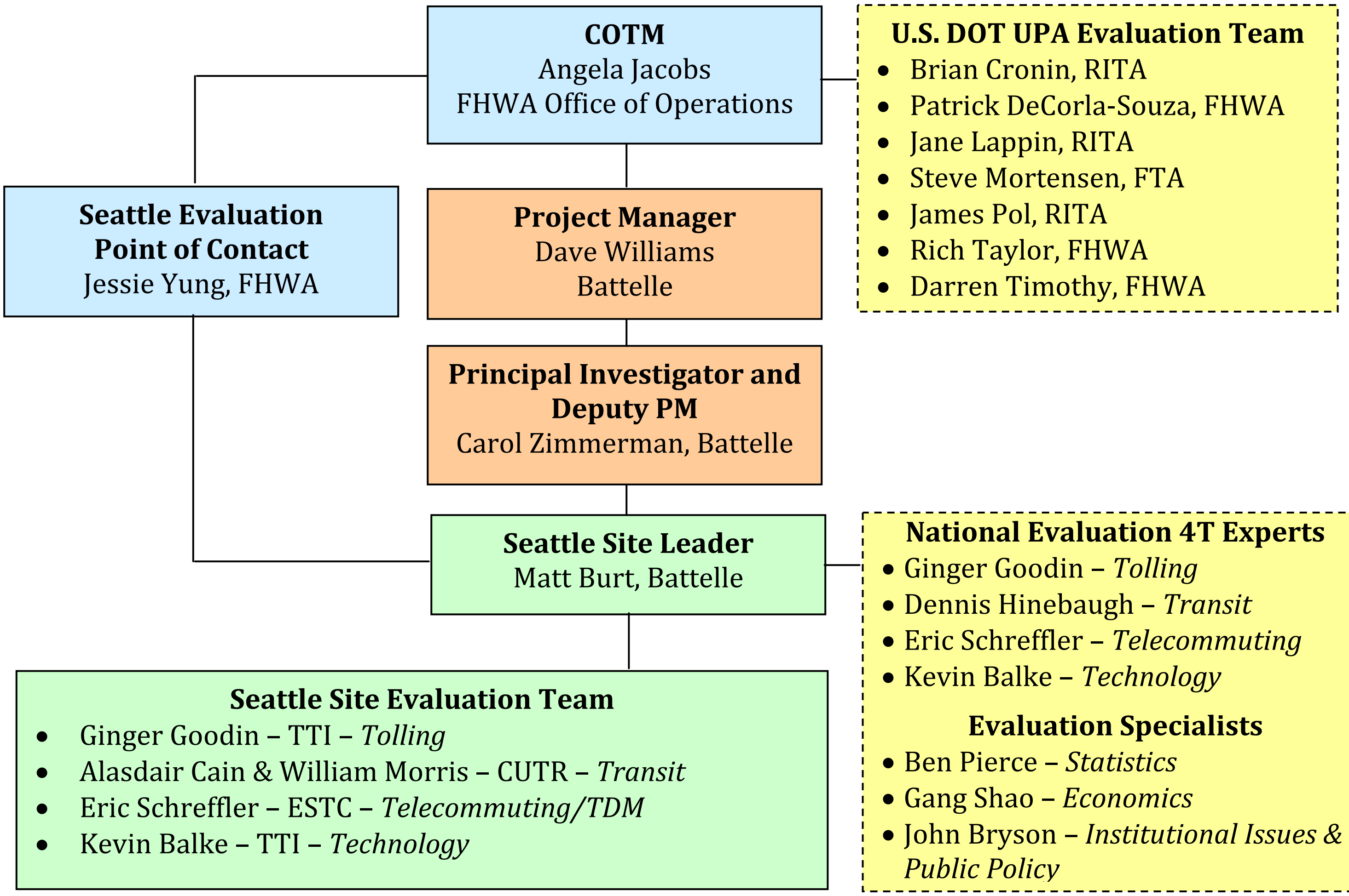

Figure 3-3. Seattle/LWC UPA National Evaluation Team

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

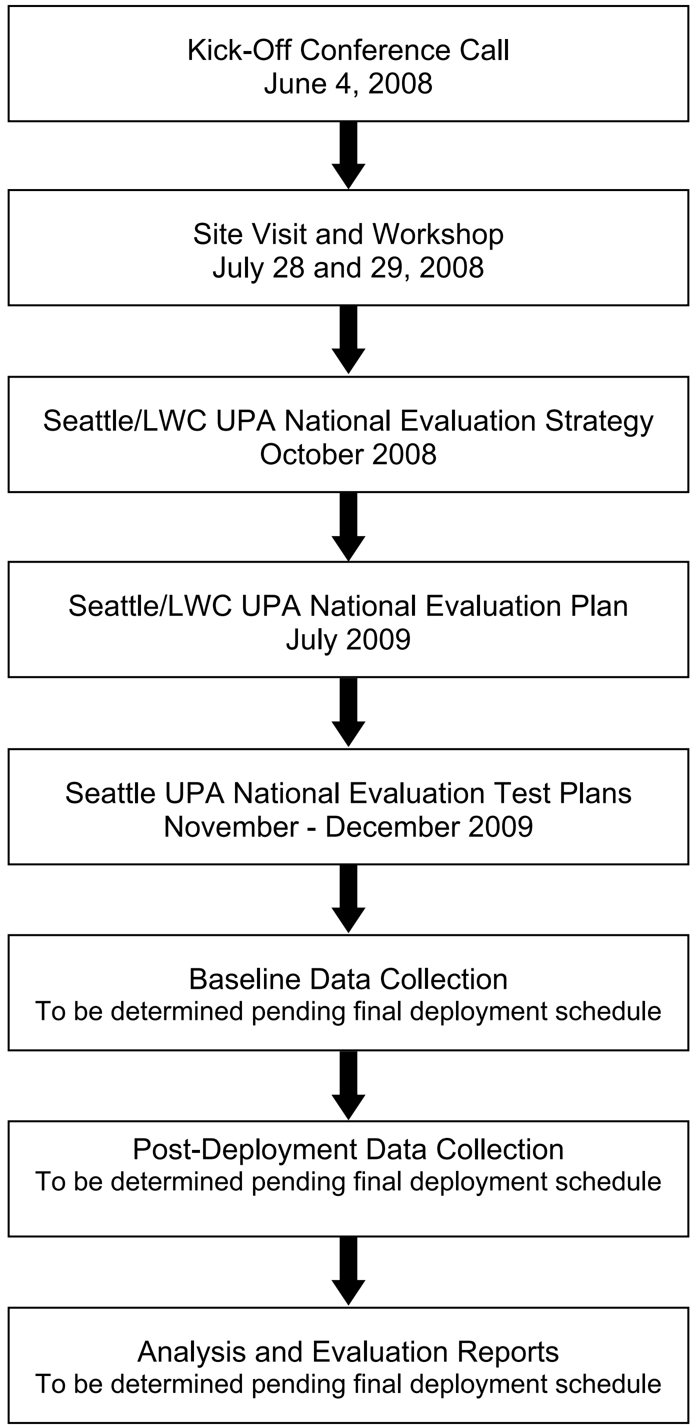

Figure 3-4. Seattle/LWC UPA National Evaluation Process

Kick-Off Conference Call. The kick-off conference telephone call, held on June 4, 2008, introduced the Seattle/LWC partners, the U.S. DOT representatives, and the Battelle team members. The Seattle/LWC UPA 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 in Seattle on July 28 and 29, 2008. King County Metro provided bus a tour of the SR 520 corridor on July 28 that included representatives of U.S. DOT, the Battelle team, and the local partners. A day-long evaluation workshop was held on July 29. 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.

Seattle/LWC UPA National Evaluation Strategy. The Seattle/LWC UPA national evaluation strategy was revised based on the discussion at the workshop and the completion of the National Evaluation Framework. The Seattle/LWC UPA evaluation strategy included the hypotheses/ questions, measures of effectiveness, and data needs for each of the 12 analyses. 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 Seattle/LWC UPA national evaluation strategy was presented in a PowerPoint presentation, which was distributed to representatives of the U.S. DOT team and the Seattle partners on September 18, 2008. A conference call was held on October 7 to review and discuss the evaluation strategy. There was agreement among all parties on the Seattle/LWC UPA evaluation strategy and formal approval from the U.S. DOT was subsequently received to proceed with development of the Seattle/LWC UPA national evaluation plan.

Seattle/LWC UPA National Evaluation Plan. This document constitutes the Seattle/LWC UPA national evaluation plan. The report provides a background to the U.S. DOT UPA, describes the Seattle/LWC UPA projects, and presents the Seattle/LWC UPA evaluation plan and preliminary test plans. The draft report was distributed in July 2009 and reviewed with U.S. DOT and Seattle/LWC UPA partners during an on-site meeting or conference call. The plan has been finalized based on comments and discussions at the meeting or conference call. The document will guide the overall conduct of the Seattle/LWC UPA national evaluation.

Seattle/LWC UPA National Evaluation Test Plans. Based on approval from the U.S. DOT, the Battelle Seattle/LWC UPA evaluation team will proceed with developing separate, more detailed test plans for each type of data need for the evaluation, e.g., traffic, safety, etc. The preliminary test plans contained in the evaluation plan provide the basis for the more fully-developed test plans. In November and December 2009 the individual test plans will be developed, and reviewed with representatives from the U.S. DOT and local partnership agencies.

Baseline Data Collection. Based on approval of the Seattle/LWC UPA 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. The specific timing of baseline data collection will be identified in the full test plan documents to be developed in November and December 2009. By that time, WSDOT expects to know the specific estimated operational date for the SR 520 tolling and other major UPA projects. (Currently the WSDOT schedule calls for these projects to be operational as early as November 1, 2010 but not later than June 30, 2011). One project, the Redmond P&R/TOD, became operational June 30, 2009 and so the data collection timeline associated with that project is different.

Post-Deployment Data Collection. The general strategy is to collect one full year of post-deployment data. As with the baseline data collection, the final timing of post-deployment data collection will be identified in the full test plan documents after WSDOT has specified a final deployment schedule. Post-deployment data collection will begin sometime between November 2010 and July 2011 depending on the local partners' final deployment schedule.

Analysis and Evaluation Reports. Analysis of baseline data will begin once all of the data has been collected, sometime between November 2010 and July 2011 depending on the local partners' final deployment schedules . Analysis of early (e.g., the first several months of) post-deployment data will begin shortly after the beginning of post-deployment data collection. A technical memorandum on evaluation early results, based on four or five months of post-deployment data will be completed mid-way through the one-year post-deployment period. The final evaluation report is expected to be completed by approximately February 2012.

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4.0 SEATTLE/LWC NATIONAL UPA EVALUATION PLAN

This chapter presents the Seattle/LWC UPA 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 Evaluation team's 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.

4.1 Evaluation Analyses

The proposed approach to eleven evaluation analyses is presented in this section. These analyses address:

1. Congestion
2. Tolling
3. Transit
4. Telecommuting/Travel Demand Management (TDM)
5. Technology
6. Safety
7. Equity
8. Environment
9. Non-Technical Success Factors
10. Cost Benefit.

The Seattle/LWC UPA evaluation excludes two of the 12 analyses included in the National Evaluation Framework, "Goods Movement" and "Business Impacts," because the local partners do not expect significant impacts in those areas and wish to focus limited evaluation resources on other, more critical, evaluation areas.

For each of the 10 Seattle/LWC UPA evaluation analyses, key hypotheses and questions to be addressed are presented. The hypotheses describe the results that the UPA 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 UPA investments are hypothesized. For each hypothesis and question, *measures of effectiveness* (MOEs) are presented. These are measurable aspects of the Seattle/LWC deployment effects that speak 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.

The latest Term Sheet between the local partners and U.S. DOT (September 30, 2009), shows that vehicles with 3 or more passengers will pay discounted tolls or no tolls on SR 520. However, that issue in general as well as any specific approaches to high occupancy vehicles are still being considered by the local partners and U.S. DOT. Although this evaluation plan includes vehicle occupancy and other data collection relevant to HOV-related inquiries, it does not necessarily contain all of the HOV-related evaluation activities that may be needed, depending on the final approach taken by the local partners. When the local partners and U.S. DOT have resolved this issue the evaluation approach will be adjusted as necessary and reflected in the test plans.

4.1.1 Congestion Analysis

The Seattle/LWC local partners and the U.S. DOT are currently negotiating revisions in the UPA agreement ("term sheet") related to the specific congestion reduction targets of the UPA deployment. The development of this Congestion Analysis has been informed by the September 30, 2009 version of the Term Sheet that includes the following congestion reduction objective: implement variable pricing (based on the level of demand) on SR 520 between I-5 and I-405 to the extent necessary to maintain free flow traffic in the through-lanes, on all collectors and distributors for SR 520 between I-5 and I-405.

The purpose of the congestion analysis is to assess the extent to which the UPA projects collectively were able to achieve this objective or whatever similar final congestion reduction objectives may be identified. Following the evaluation principles outlined in NCHRP *Guide to Effective Freeway Performance Measurement,* the congestion analysis is designed to assess the following impacts of the Seattle/LWC UPA deployment on SR 520 and alternate routes:

- Travel time and travel speed
- Travel time reliability and variability
- Spatial and temporal extent of congestion
- Vehicle and person throughput
- Users' perceptions of congestion on SR 520 and the adjacent alternate routes.

Travel Time and Travel Speed

The congestion analysis will specifically evaluate the cumulative effect of all the UPA projects on travel time and travel speed on SR 520 and other parallel facilities. Table 4-1 summarizes the hypotheses, measures of effectiveness and data associated with this portion of the congestion analysis.

For the purposes of the Seattle/LWC UPA evaluation, both travel time and travel speed will be used in the congestion analysis—travel time permits comparisons across all the UPA deployment sites, whereas travel speed is the local performance objective. Travel time and travel speed are closely related and will be derived from WSDOT traffic detector data.

Travel time is the average time consumed by vehicles traversing a fixed distance, defined by a specific origin and destination. On their website,[10] WSDOT provides real-time travel time on

[10] Seattle Area Travel Times. Washington State Department of Transportation. Available at http://www.wsdot.wa.gov/traffic/seattle/traveltimes. Accessed May 26, 2009.

typical commuter routes in the Seattle region. These same origin-destination pairs will be used in this analysis.

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

Hypothesis/Question	Measures of Effectiveness	Data
Deploying the UPA projects reduced travel times and increased speeds on SR 520 over Lake Washington (between I-5 and I-405)	• Percent change in average travel speeds • Percent change in average, median, and 95th percentile travel times • Percent change in travel time delay[1] • Percent change in travel time index	• Average link speeds • Segment travel times • Free flow speed • Link length[2]
Deploying the UPA projects did not increase travel times or decrease speeds of these nearby facilities: • I-90 general purpose lanes (between I-5 and I-405) • I-90 Express Lanes • I-90 (between Issaquah/MP 19.41 and I-405) • SR 522 (between I-405 and I-5) • I-5 (between SR 522 and I-405) • I-405 (between SR 167 and SR 522) • SR 520 (between SR 202 and I-405)	• Percent change in average travel speeds • Percent change in average, median, and 95th percentile travel times • Percent change in travel time delay • Percent change in travel time index	• Average link speeds • Segment travel times • Free flow speed • Link length

[1] Travel time delay is not among the standard set of congestion measures used in the national evaluation at the various UPA and CRD sites but has been included here at the request of WSDOT, for whom this is a standard performance measure. Delay is defined as the extra time it takes a driver to traverse a desired travel segment or complete a desired trip. WSDOT calculates and reports delay in two different ways: 1) Actual travel time versus travel times at posted speeds, and 2) Actual travel time versus travel time at maximum flow speeds. WSDOT expresses both measures as the sum of vehicle delay (in hours) across an average twenty-four hour day.

[2] 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 sum total of the link lengths for the links included in a segment.

Because travel time is highly dependent on the distance being traversed by travelers and to facilitate comparisons across multiple UPA sites, the evaluation team will also use change in the Travel Time Index to compare the effectiveness of the improvements. The Travel Time Index is the ratio of the average peak travel time to an off-peak (or free-flow) travel time. Free-flow travel time for each roadway section will be determined from the WSDOT detector data. It will be 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.). The Travel Time Index can be used to assess how much more time a trip takes during the peak period compared to the same trip if it occurred during non-peak travel times. 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 times. Travel Time Index is a ratio of travel times and therefore it eliminates the effects of different corridor lengths.

Travel Time Reliability

Another possible effect of the Seattle/LWC projects will be to improve the travel time reliability of SR 520 travelers. Travelers often adjust their travel behaviors and expectation to accommodate expected levels of congestion. When unexpected congestion or changes in service are encountered, travelers are frustrated and their satisfaction with the performance of the transportation system decreases. Therefore, in evaluation of transportation systems, reliability is commonly used to describe the level of consistency in transportation service for mode, trip, route, or corridor and to describe the quality of service from the traveler's perspective.[11]

NCHRP's *Guide to Effective Freeway Performance Measurement*[12] recommends the following as measures of travel time reliability:

- Buffer time
- Planning Time Index

Buffer Time is the amount of *extra* time that travelers in a corridor need to leave to ensure that they arrive on-time at their destination for most trips. For the purposes of the UPA Evaluation, the buffer time will be defined as the difference between the 95th percentile travel time and the average travel time, normalized by the average travel time. Therefore, if the buffer index is 40 percent, this means that in order to arrive on-time 95 percent of the time, a traveler should budget an additional 8 minutes of buffer time for a trip that, on average, takes 20-minutes.

Like Buffer Time, the Planning Time Index is a measure of the extra amount of time that most travelers need to allot for a trip during a specific period. However, unlike Buffer Time, the Planning Time Index compares trips that occur in the peak period to trips under off-peak (or free flow) conditions. The Planning Time Index is the 95th percentile of the Travel Time Index. As an example, a Planning Time Index of 1.60 for the a.m. peak would mean that, to ensure an on-time arrival 95 percent of the time, a traveler would need to allocate an additional 60 percent more time to make that trip in the a.m. peak compared to making that same trip during off-peak conditions.

Table 4-2 shows the hypotheses and related measures of effectiveness that will be used to evaluate travel time reliability impacts.

[11] T. Lomax, D. Shrank, S. Turner, and R. Margiotta. *Selecting Travel Reliability Measures*. May 2003. Available at http://tti.tamu.edu/documents/474360-1.pdf. Accessed May 26, 2009.

[12] R. Margiotta, T. Lomax, M. Hallenbeck, S. Turner, A. Skabardonis, C. Ferrell, and B. Eisele. NCHRP Web-only Document 97: "Guide to Effective Freeway Performance Measurement: Final Report and Guidebook." August 2006. Available at http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_w97.pdf.

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

Hypothesis/Question	Measures of Effectiveness	Data
Deploying the UPA projects improved travel time reliability on SR 520 over Lake Washington (between I-5 and I-405)	• Percent change in Buffer Index • Percent change in Planning Time Index	• Average link speeds • 95th percentile link speed • Free Flow Speed
Deploying the UPA projects did not decrease travel time reliability of nearby facilities, namely: • I-90 general purpose lanes (between I-5 and I-405) • I-90 Express Lanes • I-90 (between Issaquah/MP 19.41 and I-405) • SR 522 (between I-405 and I-5) • I-5 (between SR 522 and I-405) • I-405 (between SR 167 and SR 522) • SR 520 (between SR 202 and I-405)	• Percent change in Buffer Index • Percent change in Planning Time Index	• Average link speeds • 95th percentile link speed • Free flow speed

In addition to examining travel time reliability measures, the congestion analysis will also examine how different events caused travel time to vary in the corridor. Potential sources of travel time variability include the following:

- Incidents—collisions, vehicle breakdowns and debris that disrupt the normal flow of traffic, whether the event occurs on a shoulder or in the main travel lanes.
- Work Zones—construction or maintenance activity.
- Weather—the full range of vision-affecting events—from obscured visibility due to fog/snow/rain to bright, sunshine in driver's eyes—as well as roadway surface conditions that affect driver behavior.
- Special Events—causing dramatically different travel patterns or volumes in the vicinity of the event.
- Service Disruption—significant changes or disruptions in transit services using the facilities.

Facility and corridor level travel time measures will be examined to determine if the variability in travel time during these events was improved as a result of deploying the UPA improvements.

Throughput

Changes in vehicular and person throughput will be examined to assess the extent to which congestion was reduced. According to 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 transportation system. The congestion analysis focuses on how deploying the UPA projects in the SR 520 corridor changed the throughput in the systems (roadways and transit) serving commuters over Lake Washington. The basic premise for using throughput as a performance measure is that the UPA projects reduced congestion in the corridor because more vehicles and/or persons were "serviced" after the improvements, even if the travel time or travel time reliability performance measures show no change.

Table 4-3 shows the hypotheses, measures and performance and data needed for investigating the effects of the Seattle/LWC UPA projects on throughput.

Vehicle throughput (VT) will be determined by counting the number of vehicles using SR 520 and other alternate routes around Lake Washington. Vehicle throughput will be derived from WSDOT's Traffic System Management detector station data. The roadway segments on which vehicle throughput will be assessed include the following:

- SR 520 (between I-5 and I-405)
- SR 520 (between Issaquah/MP 19.41 and I-405)
- I-90 (between I-5 and I-405) – both general purpose and express lanes
- I-90 (between SR 202 and I-405)
- SR 522 (between I-405 and I-5)
- I-5 (between SR 522 and I-405)
- I-405 (between SR 167 and SR 522).

Person throughput (PT) will also be used to assess the degree to which the UPA projects impacted congestion on the SR 520 corridor. Person throughput is the total number of persons "served" by the different modes of travel that utilize the SR 520 corridor. For the Seattle/LWC UPA projects, the total person throughput can be estimated by summing the following:

- PT changes attributed to transit projects
- PT changes attributed to TDM projects
- PT changes attributed to SR 520 tolling
- PT changes attributed to the technology projects.

PT will be estimated by multiplying the VT for different vehicle classes by the average number of occupants per vehicles per class.

Vehicle-miles traveled (VMT) and Person-miles traveled (PMT) will also be computed. VMT is the product of the number of vehicles traveling over a length of facility (VT) by the length of the facility, while PMT is the product of the number of persons using a facility (PT) by the length of that facility.

Table 4-3. Congestion Analysis Approach: Throughput

Hypothesis/Question	Measures of Effectiveness	Data
Total Corridor Throughput of the roadways around and over Lake Washington remained the same or increased as a result of the Seattle/LWC projects	• Percent change in total vehicle corridor throughput, daily and in peak periods • Percent change in total person travel, daily and in peak periods • Percent change in total peak period VMT in corridor • Percent change in total daily VMT in corridor • Percent change in peak period PMT in corridor • Percent change in total daily PMT in corridor	• Traffic counts (by vehicle class) • Average number of occupants (by vehicle class) • Link length
Vehicle and person throughput on SR 520 remained the same or increased as a result of the Seattle/LWC projects	• Percent change in vehicle throughput on SR 520, daily and in peak periods • Percent change in person travel on SR 520, daily and in peak periods • Percent change in peak period and Daily VMT on SR 520 • Percent change in peak period and Daily PMT SR 520	• Traffic counts (by vehicle class) • Average number of occupants (by vehicle class) • Link length
The Seattle/LWC UPA projects did not reduce the throughput on nearby facilities, namely: • I-90 general purpose lanes (between I-5 and I-405) • I-90 Express Lanes • I-90 (between Issaquah/MP 19.41 and I-405) • SR 522 (between I-405 and I-5) • I-5 (between SR 522 and I-405) • I-405 (between SR 167 and SR 522) • SR 520 (between SR 202 and I-405)	• Percent change in vehicle throughput on identified routes, daily and in peak periods • Percent change in person travel on identified routes, daily and in peak periods • Percent change in peak period and daily VMT on identified routes • Percent change in peak period and daily PMT on identified routes	• Traffic counts (by vehicle class) • Average number of occupants (by vehicle class) • Link length

Spatial and Temporal Extent of Congestion

The congestion analysis will examine both the spatial and temporal aspects of congestion impacts. From a temporal perspective, the analysis will examine the total number of hours per day and hours during the peak period during which SR 520 and the adjacent facilities operate at or below a specific speed threshold to be determined by the local partners and U.S. DOT. Speed on a facility can also vary through the length of the facility and, therefore, the congestion analysis will also look at the number of lane-miles on SR 520 and alternate routes where speeds are below a to-be-determined performance threshold.

Table 4-4 lists hypothesis, performance measures and data requirements associated with the spatial and temporal analysis of congestion impacts.

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

Hypothesis/Question	Measures of Effectiveness	Data
The UPA projects will improve averages speeds on SR 520 (to be consistently above a specific target speed to be agreed upon in advance by the local partners and U.S. DOT)	• Percent change in the number of hours per day and per peak period that SR 520 between I-5 and I-405 is operating at or below the agreed upon performance threshold • Percent change in the number of lane-miles on SR 520 between I-5 and I-405 that is operating at or below the agreed upon performance threshold	• Average travel speed on SR 520 by time of day and by link • Link length associated with detector station
The UPA projects did not increase the temporal or spatial extent of congestion on nearby facilities, namely: • I-90 general purpose lanes (between I-5 and I-405) • I-90 Express Lanes • I-90 (between Issaquah/MP 19.41 and I-405) • SR 522 (between I-405 and I-5) • I-5 (between SR 522 and I-405) • I-405 (between SR 167 and SR 522) • SR 520 (between SR 202 and I-405)	• Percent change in the number of hours (per day and per peak period) that alternate routes to SR 520 are operating in a "congested" mode as defined by the local partners and U.S. DOT • Percent change in the number of lane-miles that alternate routes to SR 520 are operating in a "congested" mode (as defined by the local partners and U.S. DOT), per day and per peak period	• Average travel speed on facilities listed by time of day and by link • Link length associated with detector station

Users' Perceptions

Table 4-5 lists the hypotheses, measures of effectiveness and data requirements associated the assessment of SR 520 corridor travelers' perceptions of congestion and the impact of the UPA projects.

Table 4-5. Congestion Analysis Approach: User's Perception

Hypothesis/Question	Measures of Effectiveness	Data
Travelers will perceive that congestion has been reduced in the SR 520 corridor	• Percentage of respondents citing an improvement in travel time on SR 520 • Percent of respondents citing an improvement in travel time reliability on SR 520 • Percent of respondents citing a reduction in the duration in congestion on SR 520 • Percent of respondents citing a reduction In the extent of congestion on SR 520	• Travelers' reported travel time • Travelers' reported trip-time reliability experienced • Travelers' reported duration of congestion experienced • Travelers' reported extend of congestion experienced
Travelers will not perceive that congestion increased on nearby facilities, namely: • I-90 general purpose lanes (between I-5 and I-405) • I-90 Express Lanes • I-90 (between Issaquah/MP 19.41 and I-405) • SR 522 (between I-405 and I-5) • I-5 (between SR 522 and I-405) • I-405 (between SR 167 and SR 522) • SR 520 (between SR 202 and I-405)	• Percentage of respondents citing an no increase in travel time on the alternate routes • Percent of respondents citing n decrease in travel time reliability on alternate routes • Percent of respondents citing a no increase in the duration in congestion on alternate routes • Percent of respondents citing a no increase In the extent of congestion on SR 520	• Travelers' reported travel time • Travelers' reported trip-time reliability experienced • Travelers' reported duration of congestion experienced • Travelers' reported extend of congestion experienced

4.1.2 Tolling Analysis

This analysis focuses on the affect of tolling SR 520 on travel behavior, vehicular and person throughput, and traffic congestion on SR 520. 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 and transit analyses, which include examining changes in traffic congestion and travel mode.

The first hypothesis is that variable tolling on SR 520 will regulate vehicular access so as to improve the operation of SR 520. The measures of effectiveness related to this hypothesis focus on increasing vehicle and person throughput, improving level-of-service and trip-time reliability, and traffic density. The second hypothesis relates to maintaining these gains from pricing over time. The measures of effectiveness for this hypothesis focus on trip-time reliability and other performance measures. Data needed to assess these measures of effectiveness include toll payment methods, toll transactions by time-of-day, and traffic volumes by time-of-day, location/segment, and lane type.

Table 4-6. Tolling Analysis Approach

Hypotheses/Questions	Measures of Effectiveness	Data
• Variable pricing SR 520 will regulate vehicular access so as to improve the operation of SR 520	• Change in vehicle throughput (number of vehicles) • Change in person throughput (vehicle occupants) • Change in level-of-service on SR 520 Bridge • Change in travel-time reliability on SR 520 Bridge • Change in traffic density on SR 520 Bridge	• Traffic volumes by time-of-day, location/segment, and lane type • Toll payment method • Toll transactions (payments) by time-of-day and method
• After ramp-up, the SR 520 Bridge pricing maintains operating improvements on SR 520	• Change in travel-time reliability on the tolled lanes, normalized over time • Days exceeding reliability and performance thresholds	• Time-series comparison of traffic volumes by time-of-day, location/segment, and lane type

4.1.3 Transit Analysis

This analysis examines the impact of the UPA transit projects: increased bus service on SR 520, new or enhanced stops/stations/terminals, the Redmond P&R/TOD, and real-time information signs at transit stations. Generally, the UPA transit projects focus on making transit services better able to accommodate travelers who may switch from driving to transit in order to avoid the new SR 520 tolls (e.g., through the additional transit service being added), or on facilitating such mode shifts by making transit a more attractive alternative. In the case of the Redmond P&R/TOD, locating apartments and business in convenient proximity to the transit station in conjunction with a new transit center featuring new passenger amenities and loading facilities is intended to shift travel to transit, contributing to congestion reduction in the UPA corridor and manifested by a higher transit mode share than found in similar traditional (non-TOD) developments.

Table 4-7 presents hypotheses, measures of effectiveness (MOE), and data needs for the transit analysis.

Table 4-7. Transit Analysis Approach

Hypotheses/Questions	Measures of Effectiveness	Data
• Seattle/LWC UPA projects will enhance transit performance in the SR 520 corridor through reduced travel times, increased reliability, and increased capacity	• 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	• Transit travel-speed data • Transit travel-time data • Transit-reliability and schedule adherence data • Transit service characteristics data
• Seattle/LWC UPA projects will facilitate an increase in ridership and a mode shift to transit on the SR 520 corridor	• Actual and % change in transit ridership • Transit mode share (person throughput by mode) for the entire UPA corridor (SR 520 and alternate routes) • Transit mode share for the Redmond P&R/TOD (mode of access used by TOD residents and business patrons) and, as a point of comparison, mode shares of comparable non-TOD developments • Actual and % change in park-and-ride lot utilization	• Transit ridership data • Traveler survey data • Park-and-ride lot capacity and utilization data • Existing regional mode share data for traditional developments (for comparison to Redmond)
• Mode shift to transit will result in reduced road congestion on the SR 520 corridor	• Actual and % change in transit ridership • Transit mode share (person throughput by mode) • Actual and % change in park-and-ride lot utilization • Customer satisfaction	• Transit ridership data • Traveler survey data • Park-and-ride lot utilization data
• What was the relative contribution of each Lake Washington UPA project element to increased ridership and mode shift to transit?	• 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

The first hypothesis relates to changes in transit service performance resulting from transit or other UPA projects. Measures of effectiveness include travel speeds, travel times, reliability (schedule adherence/on-time performance) and changes to service capacity.

The second hypothesis relates to the impact of the UPA projects on ridership and transit mode share, for both the UPA corridor overall as well at the Redmond P&R/TOD in particular. Transit mode share on the UPA corridors will be measured in terms of the proportion of person throughput carried by transit services. Transit mode share in the UPA corridor overall may increase through people switching to transit who previously travelled by private auto, by increased transit usage among existing transit users, or by a reduction in non-transit person throughout. Survey data will play a key role in assessing the ridership and mode share hypotheses, both in revealing the role of the UPA projects in any observed changes in ridership but also as the primary means for determining the mode share of the residents and business patrons of the Redmond TOD.

The third hypothesis relates to whether any observed changes in transit mode share impacts traffic congestion within the corridor, which will require coordination with other aspects of the evaluation. Other secondary impacts due to changes in transit mode share will also be assessed including potential vehicle overcrowding and impacts on public perceptions.

The last hypothesis relates to the relative contribution of each of the UPA project elements to transit mode shift and subsequent congestion reduction. There are a number of UPA-related factors contributing to possible mode shift, including increased vehicle travel cost (the SR 520 toll), decreased transit travel time, increased transit reliability, improved transit infrastructure, increased service quantity, as well as exogenous factors such as high gasoline prices. If mode shift to transit does occur, it is important to be able to understand why and, to the extent possible, to relate the resultant mode shift to specific project elements. This will require consideration of transit data sources including park-and-ride lot utilization and traveler survey data, supplemented by information from other evaluation analyses.

The local partners have not yet identified the specific plans, including locations, for the "enhanced stops/stations/terminals" or real-time information signs at stations. Analysis details related to these projects will be added once the specific plans are identified by the local partners. It is expected that, like the Redmond P&R/TOD, a focused analysis of stop-specific ridership data will be performed.

Transit routes of interest to this analysis consist of all corridor routes impacted by the UPA projects. This includes routes operated by King County Metro, Sound Transit, Community Transit, and Microsoft. As explained in the Transit System Data Test Plan, ***ridership*** data and ***transit service characteristics*** data will be needed for every route in the corridor in order to support the comprehensive, corridor-wide study of person throughput and mode share described in the Congestion Analysis. It will not be necessary, however, to collect transit ***performance*** data (travel times, reliability, and rider perceptions) from every single bus route in the corridor. Rather, data from a representative sample of routes will be sufficient.

4.1.4 Telecommuting/TDM Analysis

The telecommuting/TDM element of the Seattle Area/LWC UPA focuses on outreach and supportive TDM measures in the SR 520 corridor. The local partners have not yet identified their specific projects in this area. It is expected that the local partners will work with large employers within the corridor area, local Transportation Management Associations, downtown associations, State and local governments, and residential neighborhoods to increase the use of telecommuting, flexible scheduling, and employer-based alternative commute programs.

The main thrust of the Telecommuting/TDM activities is expected to focus primarily on enhancing existing programs within the UPA corridor in order to increase their effectiveness in addressing congestion in concert with the other UPA strategies. This might involve coordinated efforts within the corridor to promote telecommuting and alternative work scheduling, target marketing to partners in the corridor and enhanced employer-based incentives for inducing more commuting via transit, carpool, vanpool, bicycling and walking.

The local partners expect to identify their specific UPA corridor telecommuting/TDM strategies as well as a set of measures of effectiveness by approximately November 2009. Those details are being established in part through the local partners' "Travel Demand Target Setting" study now underway and expected to be completed in October 2009. The analysis approach summarized in Table 4-8 is a general, placeholder approach that is based on general expectations for telecommuting/TDM strategies. The final approach will be identified in the Telecommuting/TDM Test Plan document to be produced in November or December 2009.

Table 4-8. Telecommuting/TDM Analysis Approach

Hypotheses/Questions	Measures of Effectiveness	Data
• Promotion of commute alternatives and other options (mode, time) removes trips and VMT from SR 520 • What was the relative contribution of the various Seattle UPA Telecommuting/TDM initiatives on reducing SR 520 vehicle trips/VMT?	• Number of new ridesharers and telecommuters • Number of commuters who shift their travel times to off-peak hours • Number of commuters reschedule or eliminate trips • Numbers of vehicle trips and vehicle miles traveled reduced on SR 520 • Bicycle utilization	• Traveler surveys • Carpooler surveys • Employer interviews • Average trip lengths (for VMT calculations) • Bicycle counts
• Employees who use telecommuting as an alternative to commuting and their managers will perceive no reduction in the employees' productivity	• Perceptions about telecommuting experience	• Surveys of teleworkers and telemanagers

The final evaluation approach will also take into account a flexible carpooling project that the local partners are currently developing. If that project is considered to be part of the broader package of UPA or UPA-supporting telecommute/TDM projects, it will be fully included in the evaluation. If that project is considered a separate project, an exogenous influence, it will be monitored to aid in the isolation of UPA project impacts.

4.1.5 Technology Analysis

This analysis focuses on the impacts of two types of Seattle/LWC technology projects: 1) Three new dynamic message signs displaying travel times into Seattle for SR 520 and alternate routes and 2) Active Traffic Management Systems on SR 520 and I-90 consisting of lane control, mini-variable message, and advisory speed limit signs. Each technology project will be assessed individually; however, as these different projects are intended to work as a system, especially during incident conditions, it may be extremely difficult to separate the degree to which each technology deployment contributed to an overall reduction in congestion.

The variable messages signs will be used to provide travelers with comparative travel times between SR 520 and alternate routes in the Lake Washington Corridor. These signs will be placed upstream of decision points in the corridor and provide travelers with travel time information on alternate routes so that drivers can make informed route-choice decisions. The national evaluation will investigate whether providing comparative travel times significantly alters the distribution of traffic across SR 520 and alternate routes under both incident and non-incident conditions.

The Active Traffic Management (ATM) system to be installed on SR 520 and I-90 is designed to promote smoother traffic flow and better balance traffic demand on these two facilities. WSDOT's expects the ATM to reduce the number of congestion-causing incidents on these roadways. When incidents do occur in the corridor, WSDOT also expects the ATM systems to allow them to better manage traffic demands and capacities on these roadways, thereby, reducing the congestion impacts of incidents and reducing incident duration. The technology analysis will consider ATM impacts during incidents as well as during non-incident conditions.

Table 4-9 shows the hypotheses, measures of effectiveness, and data requirements that will be used in the technology analysis. As in the congestion analysis, the technology analysis will compare baseline and post-deployment conditions.

It is anticipated that all of the data needed to support this evaluation will come from the WSDOT Traffic Systems Management Center. Speed and volume information used to compute travel time and throughput will come from WSDOT archived detector station data. Dynamic message sign logs will be used to determine the content of the messages on the travel time and ATM message signs as well as the circumstances in which these messages were displayed. WSDOT operator incident and dispatching logs will be used to determine incident frequencies, durations, and severity.

Table 4-9. Technology Analysis Approach

Hypotheses	Measures of Effectiveness	Data
The travel time signs will promote a more even distribution of traffic between SR 520 and alternate routes (I-405 and SR 522)	• Change in the ratio of volumes among SR 520, I-90 and I-405 before and after the installation of the DMS signs.	• Traffic volumes • DMS message logs
Active Traffic Management will promote smoother traffic flow and better throughput on SR 520 and I-90 during non-incident conditions	• Change in the lane-by-lane variation in travel speed • Change in the number of lane-miles speeds at or above target speed • Change in non-incident throughput	• Average segment speeds • Average throughput
Active Traffic Management will reduce the number of congestion-causing collisions on SR 520 and on I-90.	• Change in the total number of congestion-causing collisions • Change in the rate of congestion-causing collisions	• Incident frequencies • Traffic volumes
Active Traffic Management in the Lake Washington Corridor will reduce the duration of congestion-causing incidents on SR 520 and I-90	• Change in average duration of incident closure • Change in the number of congestion-causing collisions requiring: ○ Lasting 90 mins or more in total duration ○ Lasting between 60-90 mins in total duration ○ Lasting between 30-60 mins in total duration ○ Lasting less than 30 mins in total duration • Change in ratio of average throughput during incident conditions to the average throughput during non-incident conditions	• Incident duration • Number of incidents by total duration • Average throughput during incident conditions • Average throughput during non-incident conditions • Timespace of when incident detected and when reported clear
Active Traffic Management will reduce the impact severity of congestion-causing incidents	• Change in average travel time during incident conditions • Change in Planning Index during incident conditions • Change in vehicle throughput during incident conditions • Change in number of congested links (speed < target speed) during incident conditions • Change in estimated maximum queue length	• Segment travel times • 95^{th} percentile travel times • Vehicular volumes • Average segment speed • Link length*

* = 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 sum total of the link lengths for the links included in a segment.

4.1.6 Safety Analysis

Two general types of safety implications are associated with the Seattle/LWC UPA projects. First, the Active Traffic Management elements to be deployed on SR 520 and I-90 are intended to reduce the number of crashes on those facilities. The intent is to reduce crashes by posting variable speed limits on the ATM gantry-mounted signs that will warn drivers of backups ahead and smooth out traffic as it approaches a lane block incident. WSDOT also intends to use the ATM signs to quickly close entire lanes and provide warning information to drivers before they reach slower traffic[13]. The second safety implication is that the introduction of the new signage related to tolling, ATM and travel times may impact safety in the first few weeks after deployment as drivers become accustomed to the new information and react to it by changing lanes and/or speeds.

Table 4-10 presents the safety hypotheses, MOEs and data for the safety analysis. MOEs focus on the percent change in crash rate by type and severity, the percent change in the average duration of incidents (ATM is expected to reduce the amount of incident-related congestion, thus speeding recovery to pre-incident traffic flow conditions), and the change in the perception of safety by enforcement, WSDOT Incident Response Team (IRT), and first response personnel, as well as bus operators. Data needed to assess these MOEs include the number of crashes by type and severity and the number and duration of incidents. Information on changes in the perception of safety will be obtained through surveys and interviews with IRT members, state patrol officers, medical first responders, and bus operators. The safety test plan summary presents additional information on the data sources and analysis techniques.

A number of issues may need consideration in assessing the safety impacts of the Seattle/LWC UPA projects. First is the possible influence of other factors such as the introduction of new non-UPA projects, construction, and major weather events. Second, it may be difficult to detect significant changes in safety impacts in the one-year post-deployment period, especially since the a multi-month lag in crash data availability means that the post-deployment period will include only about 10 months of data. Finally, it may not be possible to link the cause of a crash to a specific UPA project element. To the extent that these challenges compromise the ability to draw conclusions based strictly on quantitative data, the qualitative input from IRT members, state patrol officers, medical first responders, bus operators, and possible input from travelers themselves, may enhance the understanding of safety impacts of the Seattle UPA projects.

[13] (WSDOT, "SR 520 / I-90 - Active Traffic Management" website, http://www.wsdot.wa.gov/projects/lkwamgt/lkwaatm/).

Table 4-10. Safety Analysis Approach

Hypotheses/ Questions	Measures of Effectiveness	Data
• Active traffic management will reduce the number of primary and/or secondary crashes on SR 520 and I-90	• Percent change in crash rate by type and severity • Percent change in average incident duration	• Number, type, and severity of crashes • Traffic volumes (for calculating accident rates) • Number of incidents and incident duration • Safety records maintained by transit agencies • Surveys/interviews with WSDOT Incident Response Team members, state patrol officers, medical first responders, and bus operators
• Tolling, ATM and traveler information (e.g., travel time sign) strategies that entail unfamiliar signage and which may alter existing traffic flows will not adversely affect highway safety	• Percent change in crash rate by type and severity • Percent change in average incident duration • Change in the perception of safety by WSDOT Incident Response Team members, state patrol officers, medical first responders, and bus operators • Changes in the perception of safety by travelers	• Number, type, and severity of crashes • Number of incidents and incident duration • Surveys/interviews with WSDOT Incident Response Team members, state patrol officers, medical first responders, and bus operators • Survey of travelers

4.1.7 Equity Analysis

This analysis will examine potential equity issues associated with the various Seattle/LWC UPA projects. Experience with the SR 167 HOT lanes in the Seattle region and with other HOT and 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 Seattle/LWC UPA partner agencies are taking a number of actions to mitigate any potential equity concerns. For example, although many travelers are expected to use the SR 520 *Good to Go!* pre-paid, transponder-based account, several other payment options are being offered. These options include pre- or post-payment for each toll transaction by mail, over the Internet, by telephone, and in person at a customer service store. Outreach efforts, including those focused on limited-English-speaking populations, are also planned.

As presented in Table 4-11, equity will be examined in four ways. First, the direct social effects from the Seattle/LWC UPA projects, including tolling SR 520, 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 the SR 520 Bridge and how this reinvestment impacts various user groups will be examined.

Table 4-11. Equity Analysis Approach

Hypotheses/Questions	Measures of Effectiveness	Data
• What are the direct social effects (tolls paid, travel times, adaptation costs) for various transportation system user groups from tolling the SR 520 Bridge, transit, and other UPA strategies? • What is the spatial distribution of aggregate out-of-pocket and inconvenience costs, and travel time and mobility benefits?	• Change in travel costs due to tolls paid, transit fares, and adaptation costs by different user groups • Change in travel time and distance by user groups • Change in total transportation cost by user groups	• Travelers' reported cost of travel • Perceived impact of congestion strategies on special populations • Toll payment methods • Customer account data • Traffic and transit data • Transit ridership data • Regional socio-economic data
• Are there any differential environmental impacts on certain socio-economic groups?	• Socio-economic and geographic distribution of benefits and impacts	• Air quality modeling from the environmental analysis
• How does reinvestment of revenues from tolling SR 520 impact various transportation system users?	• Spatial distribution of revenue reinvestment	• Agency records on revenues and reinvestment • Expectations of agency officials

4.1.8 Environmental Analysis

This analysis will assess the impacts of mode shift, vehicle and person throughput, increased speeds, reductions in idling, increases in transit ridership, and new telecommuters on the environment. The environmental analysis addresses air quality and energy (fuel consumption).

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 refers to perceptions of the public and stakeholders as to the overall environmental impacts of the projects. The third hypothesis involves the potential for energy savings from mode shifts, changes in freeway operating conditions, and the use of alternative fuels.

The details of the air quality analysis are still being developed. At a high level, the approach will be to calculate emissions before and after the UPA deployment by multiplying observed, roadway link VMT (at specific speeds) by appropriate emission rates. U.S. DOT has requested that the evaluation utilize the EPA MOVES (Motor Vehicle Emission Simulator) model, which is capable of both producing emission factors and, when supplied with observed VMT, speed and other data, calculating emissions. The details of the air quality analysis approach will be worked out in partnership between U.S. DOT, the local partners, and the national evaluation team as the Environmental Test Plan is developed over the next few months.

The impacts of the UPA projects on energy consumption will be examined using VMT data from the congestion analysis. The energy savings from reductions in VMT will be estimated. The energy savings from the use of alternative fueled transit buses will also be estimated based on a comparison of fuel use by route mileage and VMT for the various types of buses.

Table 4-12. Environmental Analysis Approach

Hypotheses/Questions	Measures of Effectiveness	Data
• What are the impacts of the UPA strategies in the SR 520 corridor on air quality?	• Reductions in VMT	• VMT changes from traffic analysis and emissions factors • Travelers' reported mode shift • Travelers' reported access mode to new transit services • Operational data for changes in speed, fleet composition, etc.
• What are the impacts on perceptions of overall environmental quality?	• Perceived changes in environmental quality	• Users' and non-users' perceptions of environmental quality • Stakeholders' perceptions of environmental quality
• What are the impacts on energy consumption?	• VMT reduction	• Travel behavior changes identified in the congestion analysis

4.1.9 Non-Technical Success Factors Analysis

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

Table 4-13 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 Seattle/LWC UPA 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, which resulted in the successful award of the U.S. DOT UPA grant.

The second question guiding this analysis focuses on examining public support for the Seattle/LWC UPA projects as effective and appropriate ways to reduce congestion. As indicated in Table 4-13, this analysis relies heavily on information provided by the local partners. Input from the Seattle/LWC UPA partners will be collected using the formal mechanisms shown in Table 4-13, 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 Seattle/LWC UPA partners over the course of the demonstration.

4.1.10 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 Seattle/LWC UPA projects. The net benefit from the UPA 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. Within this evaluation time frame, the cost benefit analysis will estimate and compare annual benefits and costs between two scenarios—before and after implementation of the Seattle/LWC UPA projects.

Expected UPA project benefits include travel-time savings, vehicle operating cost savings, safety cost savings, and savings associated with improved travel time reliability. The increase in transit-related travel costs paid by those people who switch to riding transit may offset certain proportions of the benefits realized by vehicle usage on SR 520. On the cost side, the capital costs of the UPA projects will be included, as well as operating and maintenance costs, and replacement and reinvestment costs for technology components, such as toll facilities. For communities, the potential benefits include reduction in emissions.

Table 4-13. 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 UPA participants	• One-on-one interviews followed by group workshops: – End of planning and implementation phase – End of UPA one-year operational evaluation period
	• Partnership documents (e.g., Memoranda of Understanding)	• UPA partners' documents
	• Outreach materials (press releases, brochures, websites, etc.)	• UPA partners' outreach materials
	• Radio, TV and newspaper coverage	• Internet-based tracking of media coverage • UPA partners' files
• Does the public support the UPA strategies as effective and appropriate ways to reduce congestion?	• Public opinion	• Opinions of general public about the UPA projects and congestion

The cost benefit analysis utilizes several types of data. These data sources include forecasts of future travel, which are expected to come from the PSRC regional travel demand model, survey data, and the project investment or the expenditures from the U.S. DOT and the state and local government agencies.

To examine the impacts of certain parameters on the net benefits calculated in the cost benefits analysis, a sensitivity analysis will be conducted. Vehicle operating cost savings, for instance, are one of the major benefits that will be experienced by individual drivers and freight carriers. 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 out of scope of the Seattle/LWC UPA national evaluation, a sensitivity analysis will be utilized to examine the impacts of fuel price on vehicle operating cost savings and the net benefit generated from the cost benefits analysis.

Table 4-14 summarizes the key hypotheses/questions that will be addressed by the cost benefit analysis and the main data that will be used. Some of the important benefits realized from the project, such as improved comfort, reliability, simplicity, and other attributes related to improvements to transit services, will not be included in the cost benefit analysis because it will be impossible to monetize those benefits. However, those benefits will be summarized and reported as non-monetized benefits in the final evaluation report.

Table 4-14. Cost Benefit Analysis Approach

Hypotheses/ Questions	Data
• What is the net benefit (benefits minus costs) of the Seattle/ LWC UPA projects?	• Much data will come from other analyses and test plans (traffic, safety, etc.) • Cost data include: – Capital costs – Operation and maintenance costs – Compliance costs – Replacement and re-investment costs – Travel costs for people who switch from driving to taking transit or switch from non-tolled facilities to the tolled SR 520 bridge • Benefits data include: – Travel time savings – Vehicle operating cost savings – Safety cost savings – Improvement in travel reliability – Reduction in travel time and travel costs for telecommuters – Reduction in emissions and fuel costs

4.2 Preliminary Evaluation Test Plans

Individual test plans will be developed and conducted to collect and analyze the data needed to assess the hypothesis in the 10 evaluation analyses presented in Section 4.1. The 10 test plans for the Seattle/LWC UPA are:

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

Table 4-15 illustrates the relationship among the 10 test plans and the 11 evaluation analyses. The use of data from the various test plans in assessing the evaluation analyses – both as major input and as supporting input – is highlighted. Table 4-16 presents the more specific data need for each of the 11 evaluation analyses that will be included in the test plans.

Figure 4-1 summarizes the schedule for data collection. The local partners have indicated that these major projects may be operational anytime between November 1, 2010 and June 30, 2011. The specific schedule for the projects is expected to be determined in late 2009 and will be reflected in the full test plan documents to be developed by the national evaluation team.

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.

The latest Term Sheet between the local partners and U.S. DOT (September 30, 2009) shows that vehicles with 3 or more passengers will pay discounted tolls or no tolls. However, that issue in general as well as any specific approaches to high occupancy vehicles are still being considered by the local partners and U.S. DOT. Although this evaluation plan includes vehicle occupancy and other data collection relevant to HOV-related inquiries, it does not necessarily contain all of the HOV-related evaluation activities that may be needed, depending on the final approach taken by the local partners. When the local partners and U.S. DOT have resolved this issue the evaluation approach will be adjusted as necessary.

Table 4-15. Relationships Among Test Plans and Evaluation Analyses

Seattle UPA Test Plans	Evaluation Analysis									
	Congestion Analysis	Tolling Analysis	Transit Analysis	Telecommuting / TDM Analysis	Technology Analysis	Safety Analysis	Environmental Analysis	Equity Analysis	Non-Technical Factors Analysis	Cost Benefit Analysis
Traffic System Data Test Plan	●	○	○	○	●	○	●	○		●
Tolling Test Plan		●					○	○		●
Transit System Data Test Plan	○	○	●	○	●	○	○	○		●
Telecommuting Data Test Plan	○			●			○	○		○
Safety Test Plan						●				●
Surveys, Interviews & Workshops Test Plan	●	●	●	●	●	●	●	●	●	
Environmental Data Test Plan	○						●	○		●
Content Analysis Test Plan	○	○	○	○	○	○	○	○	●	
Cost Benefit Analysis Test Plan										●
Exogenous Factors Test Plan	○	○	○	○	○	○	○	○	○	○

● — Major Input ○ — Supporting Input

Table 4-16. Data for the Evaluation Analyses

Evaluation Data	Congestion	Tolling	Transit	Telecommuting/ TDM	Technology	Safety	Equity	Environmental	Non-Technical Success Factors	Cost Benefit
Traffic Data – Freeway										
Travel time	X	X			X		X	X		X
Travel speeds	X				X			X		
Volume	X	X			X	X		X		X
Occupants per vehicle		X	X		X					
Types of vehicles/fleet composition								X		X
Traffic Data – Arterial										
Volume	X	X			X					
Travel times	X				X					
Occupants per vehicle	X									
Types of vehicles/fleet composition	X									
Incident Data										
Number of incidents/crashes					X	X				X
Types of incidents/crashes					X	X				
Severity of crashes						X				X
Incident duration					X					
Incident response times					X	X				
Clearance times					X	X				
Transit Data										
Ridership	X	X	X							
Travel time			X				X			
Reliability and schedule adherence			X							
Fare rates										X
Service characteristics data			X							
Park-and-ride lot use			X							
Safety data						X				
Toll Data										
Transponder sales, revenues and transactions		X					X			X
Customer account data							X			

Table 4-16. Data for the Evaluation Analyses (Continued)

Evaluation Data	Congestion	Tolling	Transit	Telecommuting/ TDM	Technology	Safety	Equity	Environmental	Non-Technical Success Factors	Cost Benefit
Surveys/Interviews/Workshops: Transportation Experience and Opinion Data										
Traveler behavior	X	X	X	X			X	X		X
Traveler costs							X			X
Public/travelers' perceptions	X		X	X			X		X	
TDM travelers				X						
Employers				X						X
Commercial vehicle operators							X			
Agencies									X	
Enforcement officers, first responders, bus operators						X				
Agency Data										
Cost data										X
Transportation model outputs							X	X		X
Regional socio-economic data							X	X		
Air quality modeling data								X		X
Alternative vehicle fuel use								X		
Stakeholder documents									X	
Stakeholder outreach materials									X	
Media Coverage/Public and Political Outreach Information									X	

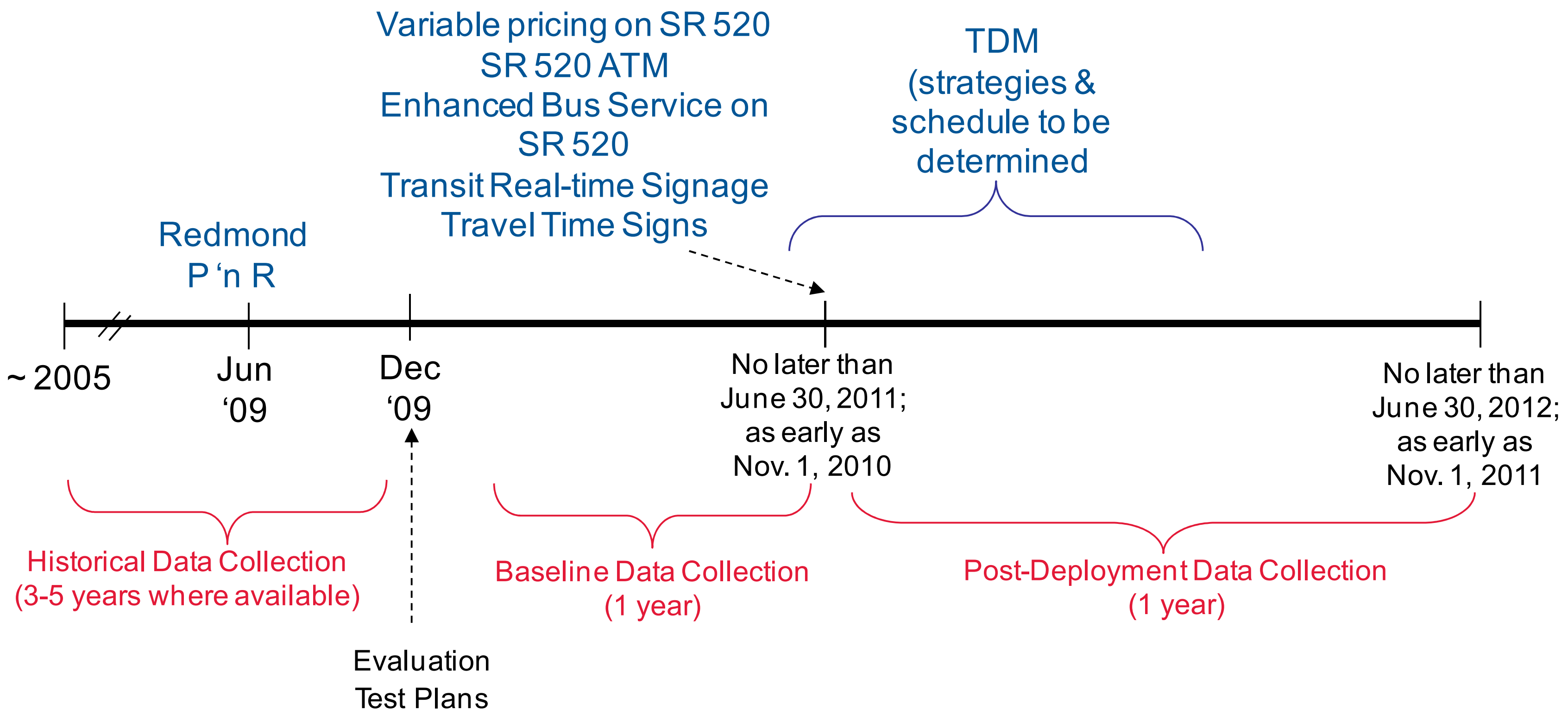


Figure 4-1. Seattle/LWC UPA Project Deployment Timeline and Evaluation Data Collection Timeline

Seattle/LWC Urban Partnership Agreement
Final National Evaluation Plan
November 4, 2009
Page 4-27

4.2.1 Traffic System Data Test Plan

Traffic signal system data will be used to support a number of analyses, including the congestion, technology, transit, telecommuting, safety, environmental, equity, goods movement, and cost benefit analyses. The primary data elements that will be obtained from using traffic system data include the following:

- Link speed
- Travel time
- Link volume
- Average vehicle occupancy

For the purposes of this study, a "link" is defined as the section 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. Therefore, the length of a segment is sum total of the link lengths for the links included in a segment.

Some of the measures of effectiveness developed in this test plan and used in the various analyses will require combining various discrete traffic data elements and, in some cases, adjusting for exogenous factors. For example, the congestion analysis requires average or typical VMT which will be derived using link volumes and lengths and adjusting as necessary for any exogenous factors such as weather or special events. This test plan focuses on the primary traffic system data elements; exogenous factors are addressed in a separate test plan.

Traffic system data are needed for the roadways listed in Table 4-17.

Table 4-17. Roadways for Which Traffic System Data Are Needed

Roadway	Limits
SR 520	• I-5 to I-405 • SR 202 (Redmond) to I-405
I-90	• I-5 to I-405 (General Purpose and Express Lanes) • I-405 to SR 202 (Issaquah)
I-405	• SR 522 to SR 520 • SR 520 to I-90 • I-90 to SR 900 (Renton)
I-5	• SR 522 to SR 520 • SR 520 to I-90 • I-90 to I-405
SR 522	• SR 524 (Maltby) to I-405 • I-405 to I-5
Bellevue Way	• I-90 to SR 520
Montlake Blvd NE (SR 513)	• SR 520 to NE 45th St.

It is envisioned that the traffic system data required to complete the analyses planned in the national evaluation will come from two general sources: (1) Automated sources, where the evaluation will take advantage of data that are already being collected and archived and which is continuous in nature (data will be available for each day) and, (2) Special studies, where data are, or will need to be, collected especially for the UPA evaluation and probably for only a sample time period, e.g., for a week. The automated data sources consist primarily of the technology systems and programs that WSDOT uses to manage and operate the freeway system. Each of the sources of data is discussed below.

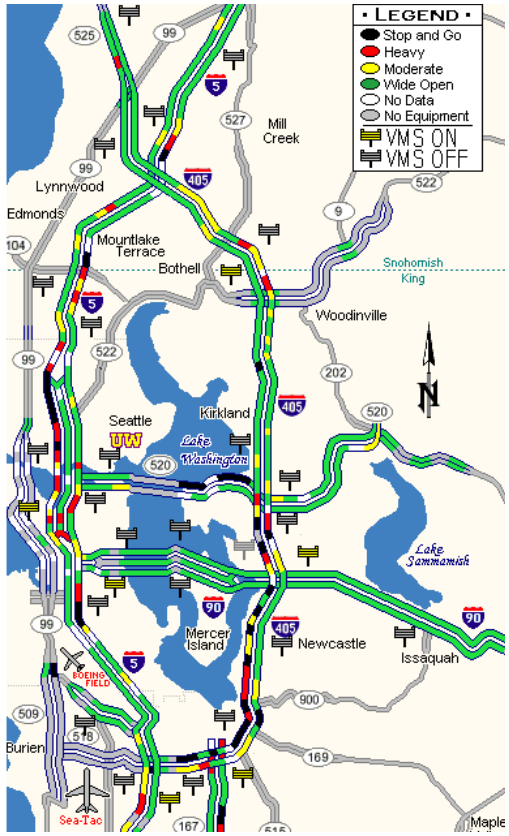
Data Sources – Automated

WSDOT Traffic Sensor Data. WSDOT has installed a network of traffic sensors on the freeways in the evaluation corridor. WSDOT uses two configurations for their freeway loop detectors: single loop detector and speed trap detectors. Single loop detectors allow volume and lane occupancy to be measured in each lane at each location. The speed trap configuration also collects volume and lane occupancy as well as measuring the average speed of traffic and limited vehicle type classifications. At a minimum, these traffic sensors record volume, lane occupancy, and speed (depending upon the detector configuration) every 20 seconds on a lane-by-lane basis. These traffic sensors are generally located in each lane, the HOV lanes, and entrance and exit ramps of measured facilities. The data from these sensors are communicated to the WSDOT's Northwest Region Traffic Systems Management Center, where it is used to generate travel time information for dissemination to the public and for use in making command and control decisions for traffic management purposes. WSDOT archives the traffic sensor data for research and evaluation purposes. These archives contain 5-min aggregation of the raw traffic sensor data.

WSDOT calculates travel times for common commuting origin-destination routes. Each route is divided into a number of sections (or links), with a traffic sensor station on each end. Using the traffic sensor data, speed is calculated for each link. That speed is then used to determine the travel time in that section (or link). The segment travel time is determined by summing the link travel times for all sections that define a route. It appears that travel time information may be retained by WSDOT to support historical comparison of segment travel times on the common commuter routes. If so, this information could potentially be used to support many of the UPA evaluation analyses.

As part of the UPA deployment effort, WSDOT plans to install vehicle license plate readers to collect travel time information on SR 522 (an arterial state highway) in the westbound direction only (i.e., toward downtown Seattle). The travel time information will be displayed on the travel time signs that are part of the UPA deployment. These sensors are scheduled to be installed summer of 2010 and could provide between about 3 and 10 months of baseline data depending on the local partners' final schedule for deploying the SR 520 tolling and other major UPA projects.

Dynamic Message Signs. WSDOT has deployed numerous dynamic message signs throughout the Puget Sound area. These signs are used to disseminate information about travel times, incident conditions, Amber Alerts, etc. in real time to motorists traveling on major freeways. The locations of DMS in the SR 520 corridor are shown in Figure 4-2. Additional DMS will be installed as part of this deployment effort for use in providing comparative travel times on SR 520 and I-90 between Seattle and Bellevue.



Washington State Department of Transportation, "Seattle Area Traffic," www.dot.wa.gov/traffic/seattle/.

Figure 4-2. Location of SR 520 DMS

As part of the technology evaluation, it will be important to know what information is being disseminated on theses signs. It is anticipated that WSDOT maintains logs showing how what messages are posted to which signs. These logs will be used to determine the percentage of time that signs are utilized performing different traffic management functions (e.g., disseminating travel time information, incident information, Amber Alerts, etc.).

Data Sources – Special Studies

SR 522 Eastbound Travel Times. WSDOT currently operates no traffic sensor stations on SR 522, a state-operated arterial roadway that is one of the alternate routes to SR 520 that will be important to this analysis. WSDOT has plans in place to implement license plate readers that will provide westbound SR 522 data only. Discussions are under way with WSDOT on the need to collect data in the eastbound direction and WSDOT has taken the action item to examine alternative data collection techniques. At this point, it is expected that the data will be available although the details are as yet unknown. Those details will be specified in the full Traffic System Data Test Plan document. There are a wide range of options for collection this data, including "floating car" runs or installing temporary or permanent traffic sensors. If floating car runs are used, an adequate number of sample runs would need to be performed to ensure that the data are statistically valid. Specially instrumented vehicles that utilize GPS could be employed to facilitate the collection of detailed travel time data. If found to be critical to the evaluation, such travel time studies would need to be performed quarterly or after the opening of each project phase or major deployment.

Arterial Street Volume Counts. Traffic volumes on several arterials that serve as or provide access to SR 520 alternate routes are needed to assess changes in vehicle and person throughput. These counts can be performed using either temporary or permanent traffic count installation. It is recommended that these volume counts be conducted at least quarterly and after the completion of any major deployment phase. It is recommended that WSDOT wait at least one month after the opening of a deployment phase before collecting volume counts to allow traffic patterns to stabilize.

Vehicle-Occupant Counts. Vehicle-occupant rates for various vehicle classes are needed to measure changes in person throughput in the corridor. Vehicle occupant rate is the average number of persons that occupy vehicles in each vehicle class of interest (e.g., transit, carpools, automobiles, etc.). While it is expected that vehicle occupancy for transit vehicles can be determined from passenger counts on transit vehicles—that is, transit vehicle occupancy is the same as ridership—it is expected that a special study will be needed to determine average number of occupants in non-transit SR 520 corridor travelers' vehicles.

The Washington State Transportation Research Center (TRAC) is responsible for collecting and maintaining data on the HOV system in the Seattle system. As part of this effort, TRAC periodically samples average vehicle occupancy information from both the general purpose lanes and HOV lanes from many of the roadways within the study area. These data are stored in a database maintained by TRAC and located at http://trac29.trac.washington.edu/hov/index.jsp. The data collected by TRAC include counts of the number of vehicles in the sampling period that contain one, two, three, and four or more occupants, as well as the number of public buses, other buses, and trucks with 2 and 3+ axles, and motorcycles. These volume counts are then used to compute the average vehicle occupancy during the sampling period. The national evaluation is working with WSDOT to determine whether the frequency (biennial) and coverage of the existing TRAC data collection effort will be satisfactory or whether supplemental data collection will be needed. The resolution of this issue will be captured in the full Traffic System Data Test Plan document.

Data Availability

It is anticipated that all the sources of traffic system data that existed in the corridor before the deployment of the UPA improvements will be available after the deployment. This includes lane-by-lane coverage of the automated traffic sensor equipment and the WSDOT RTSMC data logs. It is also anticipated that these systems will be maintained throughout the evaluation period and that no major gaps in the data will exist.

The evaluation team will download and archive traffic sensor and incident data from WSDOT every month. Downloaded data will go through a series of quality control checks to identify suspect or invalid data. WSDOT may be asked to perform periodic checks or to replace any traffic sensors that appear to have failed or that routinely provide faulty or erroneous data. Checked data will be processed at least quarterly and quarterly progress reports will be produced.

At a minimum, data needed from special studies should be collected quarterly or after the opening of a significant improvement in the quarter.

Data Analyses

Most of the traffic system data will be used to support before and after comparison of traffic conditions. Various UPA improvements will become operational at different times and therefore traffic sensor data will be analyzed as each deployment comes on line to attempt to isolate the impacts of each project or element.

Most of the evaluation analyses require peak period traffic system data. Peak period analyses will be performed as this is the time period when the UPA improvements are most likely to have a significant impact on congestion. For the purposes of this study, the a.m. peak period will be defined as 6:00 a.m. to 9:00 p.m. while p.m. peak period will be defined as 3:00 p.m. to 7:00 p.m.

Table 4-18 lists the traffic system data elements and analysis periods used in calculating the primary evaluation performance measures used in these analyses.

Table 4-18. Data Requirements for Computing Performance Measures Used in the National Evaluation Analyses

Evaluation Performance Measure	Analysis					Traffic Data Element				
	Congestion	Technology	Air Quality	Good Movement	Safety	Speed/ Travel Time	Volume	Link Length	Average Vehicle Occupancy	DMS Message Logs
Average, Median, and 95th Percentile Travel time	X	X	X			X		X		
Delay	X					X				
Travel Time Index	X					X		X		
Buffer Time	X					X		X		
Planning Time Index	X	X				X		X		
Total Vehicle Throughput	X	X		X			X			X
Total Passenger Throughput	X						X		X	
Vehicle Miles Traveled	X	X	X		X		X	X		
Person Miles Traveled	X						X	X	X	
# of Hours Congested	X					X				
# of Lane-Miles Congested	X					X		X		
Maximum Queue Length		X					X	X		

Data Collection Schedule and Responsibilities

The high-level data and analysis periods for each data source are summarized in Table 4-19. For the freeway performance data, historical, baseline and post-deployment will be collected. Information dissemination logs will be collected only in the post-deployment period because these devices will be operational only in the post-deployment effort. The details of the data collection report period (the intervals at which data will be transmitted from the local partners to the Battelle evaluation team) will be identified in the detailed test plan document.

Table 4-19. Data and Analysis Time Frames

Data Source	Time Frames		
	Historical	Pre-Deployment	Post-Deployment
WSDOT Traffic Sensor Data	✔	✔	✔
WSDOT Dynamic Message Sign Logs		✔	✔
WSDOT Incident Databases		✔	✔
WSDOT Construction and Maintenance Activities		✔	✔
Weather Information		✔	✔
Supplemental Volume Counts	✔	✔	✔
Truck Volume Counts	✔	✔	✔
Vehicle Occupancy Counts		✔	✔

4.2.2 Tolling Test Plan

Data Sources

The tolling data test plan focuses on data from the WSDOT Toll Collection System (TCS) on the SR 520 bridge. Data will be utilized in the tolling, environmental, equity, goods movement, and cost benefit analyses.

Key data elements that will be collected from the TCS 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 TCS data is presented below. Data from the Washington State Patrol on violations of the TCS and the SR 520 Bridge tolling operating requirements will also be obtained and analyzed. Additional information needed for the tolling analysis will be obtained from the traffic system data test plan.

TCS Database. WSDOT is in the process of procuring a vendor to supply, install, and maintain an all-electric tolling lane solution to support the tolling needs on the SR 520 bridge. As outlined in the Request for Proposal (RFP), the TCS will utilize the following technologies:

- WSDOT's *Good to Go!*™ eGO® Plus radio frequency identification toll tag;
- The American Society for Testing Materials (ASTM) v6 – Commercial Vehicle Information Systems and Networks (CVISN) toll tag; and
- For non-transponder users, image capature technologies.

WSDOT currently owns and operates two toll facilities in the Puget Sound Region; SR 16 at the Tacoma Narrows Bridge in Pierce County and the SR 167 HOT lanes in South King County. As part of the UPA, WSDOT will own and operate a cashless toll facility on the SR 520 Bridge and a statewide Customer Service Center (CSC). The RFP outlines the specific requirements and functionality of the TCS. A two-way, single-point, variable priced open road TCS will be provided. Motorists will be able to pay the toll through establishing a pre-paid, transponder based account. They will also be able to pre-or post-pay for each toll transaction through a number of methods, including by mail, on the Internet, by telephone, and in person at a customer service store.

The TCS includes two major elements – the Roadside Toll Collection System (RTCS) and the Facility Management and Administration System (FMAS). The RTCS includes the toll collection lane hardware and the Digital Video Audit System (DVAS). The FMAS consists of the central control systems and applications that facilitate operations, administration, reporting, and maintenance of the TCS. The FMAS will be located at WSDOT's existing Traffic Management Center (TMC).

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

- number of TCS transponders sold and activated in the SR 520 catchment area and associated cost to users;
- user home zip code and frequency of use;
- TCS transponder penetration rates in targeted geographic communities;
- individual transactions by time period;
- average toll;
- highest toll;
- revenues by time period;
- toll trips by hour;
- toll trips by day of the week;
- non-payment of tolls;
- total revenue generated; and
- other appropriate data.

Washington State Patrol. Information from the Washington State Patrol on the number of citations issued for violating the toll payment and operating requirements will also be obtained and evaluated.

Data Analysis

The data obtained from the SR 520 TCS database will be used to examine measures of effectiveness contained in the tolling, environmental, equity, goods movement, and cost benefit analyses. Examples of the information needs include:

- number of toll users;
- frequency of use;
- use by time of day;
- average toll by time periods;
- highest toll;
- revenue by time periods;
- total revenue;
- number of non-paying toll violators; and
- traffic density;
- TCS transponder purchases;
- zip codes of TCS transponder holders; and
- frequency of use by zip codes of transponder holders.

Examples of measures of effectiveness include:

- assess the effectiveness of pricing to manage vehicular throughput on SR 520;
- examine potential accessibility, affordability, and equity issues for targeted communities associated with tolling SR 520; and
- identify revenues generated from tolling SR 520 for other uses.

Data Collection Schedule and Responsibilities

It is recommended that monthly data collection begin after opening of the SR 520 toll system, currently expected to be sometime between November 1, 2010 and June 30, 2011. Data collection would continue for one full year of post-deployment data.

Battelle team members will work the WSDOT personnel to establish the data collection and analysis protocol. WSDOT will be responsible for provide the tolling data to Battelle in electronic formats on a monthly 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

The transit system data test plan will collect data to be used in many analyses, including transit, technology, cost benefit analyses, congestion, tolling, telecommuting, safety, environmental, and equity analyses. The local partners have not yet identified the specific plans, including locations, for the "enhanced stops/stations/terminals" or real-time information signs at stations. Data collection and analysis details related to these projects will be added once the specific plans are identified by the local partners. It is expected that, like the Redmond P&R/TOD, a focused analysis of stop-specific ridership data will be performed.

Data Sources

A wide range of transit data will be collected from a variety of sources as summarized below. Survey data—which indeed plays a very important role in the Transit Analysis—is not discussed here, but rather is included in the Surveys, Interviews and Workshops Test Plan.

Ridership Data. Ridership data is required for all UPA corridor transit routes in order to track ridership changes (overall and for specific routes especially impacted by certain UPA projects, such as routes serving the Redmond P&R/TOD and routes using the SR 520 bridge) and also to provide the person trip data needed for corridor wide total person throughput and mode share accounting included in the Congestion Analysis. King County Metro collects ridership data using automatic passenger counters (APCs) installed on approximately 12 percent of its fleet (including the services operated on behalf of Sound Transit) and circulated through the system to provide samples of ridership data for each route. The APC data will be supplemented by baseline and post-deployment ridership data from the other transit services operated in the UPA corridor: Community Transit, Sound Transit, and Microsoft. In addition, system-wide ridership data will be obtained to track regional ridership trends.

Transit Service Characteristics Data. Basic descriptive information for all UPA corridor transit routes is required, such as service span and frequency, fare structure, and revenue hours/miles so that temporal changes in service quantity on the UPA corridors can be monitored.

Park-and-Ride Lot Utilization. King County Metro collects park-and-ride lot utilization data on a monthly basis, which is then compiled into quarterly reports. We will use these data to aid in the interpretation of any changes in corridor transit ridership and mode share that may be observed. Utilization at the park-and-ride at the Redmond P&R/TOD will also be used as part of the assessment of specific impacts of the Redmond P&R/TOD project. We are aware that many of these lots are already operating at capacity and therefore utilization levels may not change.

Redmond TOD Residential and Business Occupancy Data. This data will be used in the analysis Redmond P&R/TOD analysis to aid in the interpretation of ridership, parking utilization and survey findings and to coordinate the timing of survey data collection (discussed in the Surveys, Interviews and Workshops Test plan). This data will be provided by the TOD developer and/or King County.

Transit Travel Time Data. These data will be utilized as part of the corridor-level analysis but will not be required for the Redmond P&R/TOD-specific aspects of the transit analysis. These data will be used to determine whether SR 520-tolling related congestion reduction or the new transit service result in reduced transit travel times. These data does not need to be collected for every UPA corridor transit route. Rather, a sample of data should be sufficient to gauge impacts. Because most UPA corridor routes are operated by King County Metro and because Metro is best equipped to provide large quantities of accurate data, these data will be sampled from Metro routes. Travel time data will be extracted from Metro's automatic vehicle location (AVL) system, which collects information from AVL units installed on 100 percent of its fleet. Where necessary existing data points will be interpolated to match specific UPA corridor boundaries. Baseline and post-deployment published schedule information will be used to cross-reference any observed changes in travel times.

Transit Reliability Data. These data will be utilized as part of the corridor-level analysis but will not be required for the Redmond P&R/TOD-specific aspects of the transit analysis. These data will be used to determine whether SR 520-tolling related congestion reduction or the new transit service result in improved transit reliability. Like the transit travel time data, reliability data—also known as on-time performance or schedule adherence data—will be collected from a sample of UPA corridor routes and, given that most routes are operated by Metro and Metro is able to provide the most extensive data, all of this data will come from Metro. The data will be extracted for the baseline and post-deployment periods from Metro's AVL system. An 'on time' service is defined as being between 1 minute early and 5 minutes late. Where necessary existing data points will be interpolated to match specific UPA corridor boundaries.

Data Availability

Table 4-20 summarizes, for each data source, the current understanding of baseline and post deployment data availability.

Table 4-20. Transit System Data Availability

Data	Baseline		Post-Deployment	
	KC Metro	ST/CT/MS*	KC Metro	ST/CT/MS
Ridership Data	Yes	Yes	Yes	Yes
Transit Service Characteristics Data	Yes	Yes	Yes	Yes
Park-and-Ride Lot Utilization Data	Yes	N/A	Yes	N/A
Transit Travel Time Data	Yes	N/A	Yes	N/A
Transit Reliability Data	Yes	N/A	Yes	N/A
Redmond TOD Residential and Business Occupancy Data	Yes	N/A	Yes	N/A

* KCM = King County Metro; ST = Sound Transit; CT = Community Transit; MS = Microsoft

Data Analysis

It is envisioned that data will be delivered by local transit agencies to the Battelle 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 national evaluation team will utilize these data to develop the various required MOEs. Ideally, the MOEs will be based on weekday average values that are computed on a monthly basis, though four-month (third of a year) averages may need be utilized in some cases due to sample size constraints. Table 4-21 shows the MOEs that will be developed from each data source.

The transit analysis will consider both cumulative, corridor-level impacts such as corridor mode share changes and total ridership gains, as well as more localized impacts influenced by specific UPA projects. For example, the Redmond P&R/TOD analysis will also consider ridership data, but it will focus on ridership at the Redmond station and the influence of the TOD on ridership.

Table 4-21. Transit Data Analysis

Measures of Effectiveness (MOE)	Transit Agencies*	Data					
		Ridership	Service Charac-teristics	Park-and-Ride Utilization	Travel Time	Reliability	Survey/ Other
Required for All Transit Agencies Providing Service in UPA Corridor							
Av. Weekday Ridership (boardings)	KCM, ST, CT, MS	✔					
Transit Mode Share (%)	KCM, ST, CT, MS	✔					
Revenue Hours/Miles (miles/hours)	KCM, ST, CT, MS		✔				
Passengers per Revenue Hour/Mile	KCM, ST, CT, MS	✔	✔				
Required only for King County Metro							
P&R Utilization Factor	KCM			✔			
Redmond TOD Mode Share	KCM	✔					✔
End-to-End Travel Time (s)	KCM		✔		✔		
Average Travel Speed (mph)	KCM				✔		
On-time Performance (%)	KCM					✔	
User Perceptions/ Customer Satisfaction	KCM						✔
User Demographics	KCM						✔
Mode Use/Travel Behavior Changes	KCM	✔	✔	✔	✔	✔	✔
Redmond TOD Vehicle Ownership Levels	KCM						✔
Redmond TOD Residential and Business Occupancy	KCM						✔

* ST = Sound Transit; CT = Community Transit; MS = Microsoft

Data Collection Schedule and Responsibilities

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. Currently, the local partners have indicated that, with the exception of the Redmond P&R/TOD which has already been implemented, the transit projects to be considered in the national evaluation will be implemented no later than June 30, 2011 and as early as November 1, 2010. Ridership, transit service characteristic, transit travel time and transit reliability data will be collected for one year prior to deployment and continuing through one year after deployment, a timeline that could start as early as November 2009 and run through as late as June 30, 2012 depending on the local partners' final deployment schedule. Data pertaining to the Redmond P&R/TOD, including ridership for routes serving the Redmond station, park-and-ride lot utilization, and TOD occupancy data will be collected for as far back as 2005, to reflect the much earlier implementation of this project.

All of the transit data with the exception of park-and-ride utilization is expected to be collected continuously. The park-and-ride utilization data will be collected monthly. The local partners will be responsible for data collection and the national evaluation team will be responsible for analysis and reporting.

For the "continuous" data sets, which includes APC ridership data, service characteristics data, travel time data, and reliability data, data will be sought from King County Metro at regular intervals, ideally providing a monthly average in each case, though four-month (third of a year) averages may be used in some cases due to sample size constraints. In addition, ridership data and service characteristics data will be sought from the other transit agencies operating in the defined study corridors (Community Transit, Sound Transit, and Microsoft).

4.2.4 Telecommuting/TDM Data Test Plan

The telecommuting/TDM data test plan will generate data to be used in the telecommuting/TDM, congestion, environmental, equity, and cost benefit analyses. It is not possible to summarize the Telecommuting/TDM Data Test Plan at this time because the local partners have not yet identified their specific UPA/UPA-supporting strategies in this area. Those strategies, as well as proposed measures of effectiveness, are expected to be indentified in November 2009. At that time, the specific evaluation approach will be developed and documented in the Telecommuting/TDM Test Plan.

The local partners are currently conducting a study which is expected to significantly shape their approach to telecommuting/TDM in the UPA corridor and, therefore, the evaluation approach. One thrust of the local partners' on-going is to develop measures of effectiveness for the UPA 520 corridor telecommuting/TDM strategies. The draft scope of work called for:

> *"…a performance measurement plan that could be deployed to monitor progress toward TDM targets on major highway corridors, using the draft TDM targets for the 520 corridor as a case study. The performance measurement plan should consider existing data collection activities, such as the Commute Trip Reduction survey and WSDOT traffic data. The plan must include a description of proposed data collection tools, frequencies of measurement, analysis methods, and reporting techniques that can produce statistically valid information at a level of accuracy to be determined by WSDOT. The plan outcomes must be directly measurable against the trip reduction targets and the plan must be applicable regardless of TDM strategy. The plan must estimate the costs of implementing the performance measurement plan. The plan must also propose an approach for creating a warehouse of TDM impacts as measured through the plan."*[14]

[14] WSDOT, "DRAFT Scope of Work, Development of Transportation Demand Management Corridor Targets, Using SR 520 as a Case Study." May 2009.

The remainder of this section summarizes a generic, illustrative Telecommuting/TDM Test Plan based on general expectations for what sorts of strategies the local partners will implement, the sorts of performance measures they identify, and what data sources may be available. The specific evaluation approach is expected to be articulated in the full Test Plan document in November or December 2009.

Data Sources

Data sources may include:

- Traveler surveys conducted for other analyses
- Employer Commute Trip Reduction (CTR) employment site survey data
- Participation data from specific TDM initiatives (e.g., vanpool empty seat subsidies)
- Transit utilization data (from transit test plan)
- Special surveys (e.g., telecommuters, vanpooler, etc.)

Responsibilities for the collection, compilation and distribution of the final data to be collected from various sources is will be determined pending resolution of the local partners' plans.

Data Availability

It is anticipated that the data needed to assess the impacts of the telecommuting and other TDM strategies on travel in the SR 520 corridor will be available from the Seattle/LWC local partners.

Data Analysis

It is anticipated that much and perhaps all of the analysis may be completed by the local partners as part of their own study of the effectiveness of the UPA corridor telecommuting/TDM strategies and that these results would be reported through the UPA evaluation. Needs for supplemental analysis for the national evaluation will be determined after the local partners present their specific strategies and performance measures. The national evaluation is most interested in changes in travel behavior and net person trip and VMT reduction on SR 520 and the main alternate routes (SR 522, I-90 and the portions of I-5 and I-405 between SR 522 and I-90). The national evaluation will attempt to assess the relative contribution of telecommuting and TDM strategies on overall evaluation questions, such as congestion relief, other impacts, and non-technical success factors.

Data Collection Schedule and Responsibilities

The local partners will be responsible for data collection. The national evaluation team is available to help guide data collection and will be responsible for any analysis above and beyond that performed by the local partners that may appear necessary to address national evaluation questions. The national evaluation team will report the results of the local partner and any national analyses. The detailed schedule for data collection will be identified in the full Test Plan document that will be prepared after the local partners have specified their telecommuting/TDM approach. Generally, and in keeping with the overall evaluation approach, one year of baseline and one year of post-deployment data will be collected.

4.2.5 Safety Test Plan

Data Sources

The safety test plan will be used primarily in the safety analysis and the cost benefit analysis. The safety test plan focuses on obtaining and analyzing crash data and incident response data for the roadway segments where the new travel time signs, ATM gantries and toll signs will be deployed. Table 4-22 lists those locations. This test plan also includes obtaining and examining information from the transit providers that operate bus service along these locations, which consists primarily of King County Metro but may also include Sound Transit, Community Transit, Pierce Transit, and Microsoft. Finalization of transit data sources will occur with the development of the full, detailed Safety Test Plan document.

Table 4-22. UPA Signage Locations

UPA Signage Type	Roadway	Location
Travel Time Signs	Westbound SR 520	One mile east of I-405
	Southbound I-405	At the NE 72nd Place overpass, 1.3 miles north of the SR 520
	Westbound SR 522	At the SR 202 overpass, one mile east of the I-405 northbound exit
ATM Gantries	SR 520	Various locations from MP 0.19 to the west (at the I-5 interchange) to MP 7.85 to the east (about one mile east of I-405)
	I-90	Various locations from MP 2.81 to the west (at I-5 interchange) to MP 11.71 to the east (about two miles east of I-405)
Toll Signs	I-5	North and south of the SR 520 and I-90 interchanges (locations to be verified with WSDOT)
	I-405	North and south of the SR 520 and I-90 interchanges (locations to be verified with WSDOT)
	SR 520	East of I-405

The safety test plan will use three sources of data. Crash data will come from the WSDOT Collision Data and Analysis Branch reports that utilize data from the WSDOT Transportation Information Planning Support System (TRIPS). Incident data will come from the WSDOT Traffic Office's Washington Incident Response Tracking System. Transit safety information will come each of the transit agencies that operate bus routes along the roadway locations shown in Table 4-22. The data available from these sources is described next, along with the advantages and limitations of each database.

WSDOT Collision Data and Analysis Branch Reports ("TRIPS System"). The data available from the Collision Data and Analysis Branch is derived from collision reports completed by law enforcement personnel and from citizen reports. Collision data for all locations of interest (all of which are state highways) are available from January 1, 1993 through the present, with a two-month lag (that is, an analysis done on July 1, 2009 could include data through April 30, 2009). Records for the years 1997 and 1998 are considered as “partial records.” “Partial records” has a two-fold meaning; 1) not all the records are available, and 2) the information available within the existing records is very limited.[15] A variety of standard and custom data reports are available. Available information for each collision includes:

- Location (mile post and direction of travel)
- Date and time
- Collision type (e.g., rear end)
- Contributing circumstance (e.g., following too closely)
- Severity (number of injuries, number of fatalities, number of vehicles involved)
- Vehicle types
- Roadway surface conditions (e.g., wet, dry)
- Lighting conditions (e.g., daylight, dusk)
- Accident report number
- Diagram analysis data
- Various cross-tabulations (e.g., severity by collision type)

The WSDOT Collision Data and Analysis Branch represents an excellent data source in that data is expected to be available for all locations, can be provided in a variety of formats and levels of granularity based on specific analysis needs, and includes data that can support a historic rather than merely one-year pre-deployment analysis. There are a few limitations associated with this data, the first being that the two-month data lag time will limit the post-deployment analysis to a ten month period rather than a full year. The second limitation is a function of the raw data, the accident reports, which feed the TRIPS database. Specifically, variations among individual personnel in specifying collision type and contributing circumstance may make it difficult to clearly discern changes in the specific types of collisions one may expect as a result of the new UPA signage, e.g., side swipes from drivers changing lanes or rear-end collisions from drivers slowing to read the signs or change lanes. A similar limitation is that the locations noted on the collision report are not always accurate enough to pinpoint locations and associate them with possible driver reactions to new UPA signage.

WSDOT Incident Databases. WSDOT compiles a variety of incident related information that will be examined for use in the evaluation. WSDOT compiles data from a variety of sources, including the WSDOT Incident Response Tracking System (WITS), the WSDOT Northwest Region Traffic Systems Management Center (TSMC) blocking incident log, and the Washington State Patrol’s computer aided dispatch (CAD) system. Data from various sources are utilized to compile reports such as those included in WSDOT’s “Gray Notebook” (the quarterly “Measures, Markers and Mileposts” performance and accountability report). Incident data from WSDOT sources that will be utilized for this evaluation include number of incidents by type, response times, and clearance times. One of the major primary sources that WSDOT utilizes in compiling incident data is the Incident Report forms completed by WSDOT Incident Response vehicle operators. Those reports, which feed the Incident Response Tracking System, include a variety of detailed information including:

[15] WSDOT Transportation Data Office, “Collision Data Report Samples,” http://www.wsdot.wa.gov/mapsdata/tdo/colli_data_report.htm, July 5, 2009.

- Date
- Location (route and milepost)
- Start of incident
- Time arrived
- Time all lanes opened
- Time cleared
- Detailed closure information (e.g., direction, number of lanes, specific lane group)
- Type of incident (severity, blocking disabled vehicle, etc.)
- Action taken (e.g., traffic control, cleared debris, etc.)

The apparent advantage of the WSDOT incident data sources 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 UPA projects. 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.

King County Metro and Other Transit Agency Logs. Transit agencies maintained data related to incidents represents another source of information that may help expand the understanding of the impact of UPA projects on crashes. Transit agency data is expected to include logs maintained by bus operators and/or information maintained by transit agency dispatch staff. It is not likely that transit data sources will reveal crashes or incidents not included in the WSDOT data sources described above, but if a transit vehicle is involved in any crashes that appear related to UPA signage, the transit data sources provide a means to more thoroughly explore the specifics of the incident.

Data Availability

With the exception of the aforementioned lag times (e.g., two months for crash data), the availability of required safety data is expected to be very good and sufficient to support an effective analysis. Table 4-23 presents the data sources and availability of before deployment data and after deployment safety data.

Table 4-23. Safety Test Plan Data Sources and Availability

Data Source	Before Deployment Data	After Deployment Data
WSDOT Collision Data and Analysis Branch Reports (TRIPS)	Yes[1]	Yes[2]
WSDOT Incident Databases	Yes[1]	Yes[2]
King County Metro and Other Transit Agency Logs	Yes[1]	Yes[2]

[1] Historic data, that is, data extending much farther than one year prior to UPA project deployment is available and is planned to be utilized in the evaluation.

[2] In some cases, the after data may not contain a full year of data given the data availability lag time.

Data Analysis

The safety test plan will focus on comparing before-deployment crash and incident data with after-deployment crash and incident data. The data will be used to assess the measures of effectiveness outlined in the safety analysis and other analyses. Examples of the measures include:

- total numbers of crashes;
- types and severity of crashes;
- crashes per 1,000 VMT;
- incident response time; and
- incident duration time.

Appropriate statistical tests will be utilized to determine whether pre- and post-deployments differences exist. Judgments about the causal relationship between crashes and incidents will be made based on a detailed understanding of the UPA deployments and operational strategies coupled with all available data on crash and incident cause/contributing factors. Although the specific number of crashes will be considered most conclusions related to UPA causality will be based on crash rates so that the impact of varying traffic volumes are controlled.

One of the major challenges related to safety data is that given the year-over-year variability in collisions and incidents, one year is a very short period of time upon which to base judgments about post-deployment safety impacts. Collection and analysis of historic collision and incident data in order to determine long-term trends is one method that will be used to control for short-term variability on the pre-deployment side of the before-after safety impacts assessment. Also, if, as expected, less than a full year of post-deployment data is available, that data will be adjusted for seasonality.

Data Collection Schedule and Responsibilities

The high-level data and analysis periods for each data source are summarized in Table 4-24. For the collision and incident data, historical, pre-deployment (the twelve months immediately preceding deployment), and post-deployment (the twelve months immediately following deployment) will be collected. Transit agency logs will be collected only in the post-deployment period because they will be used only to better understand the circumstances associated with collisions and incidents that may be related to the UPA deployment. The specific data collection time frames will be identified in the full Safety Test Plan document to be produced in November or December 2009.

Table 4-24. Data and Analysis Time Frames

Data Source	Time Frames		
	Historical	Pre-Deployment	Post-Deployment
WSDOT Collision Data and Analysis Branch Reports (TRIPS)	✔	✔	✔
WSDOT Incident Databases	✔	✔	✔
King County Metro and Other Transit Agency Logs			✔

4.2.6 Surveys, Interviews and Workshops Test Plan

Data Sources and Availability

Surveys, interviews and workshops are critical for obtaining information needed to assess the influence of the Seattle/LWC UPA projects on changes in travel behavior and perceptions. Possible behavior changes include shifting travel modes, paying to use the tolled SR 520 bridge, changing time-of-travel, and eliminating trips due to telecommuting. 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 UPA projects (as opposed to other factors) is to ask them. Surveys, interviews and workshops also provide information about individuals' perceptions of different strategies and projects, the ease or difficulty of using technologies and services, and concerns over safety or equity.

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

"Planned surveys and focus groups" is a moving target in so much as the local partners' plans in this area are becoming clear by degrees. The information presented here reflects the latest information available to the national evaluation team. The national evaluation team is, and will continue, to work closely with the local partners to identify planned surveys and interviews and assess opportunities for the evaluation. The full Surveys, Interviews and Workshops Test Plan document to be produced in November and December 2009 will include updated information.

Table 4-25 identifies the information needed from various populations and summarizes the recommended approach. A total of 13 population groups and the associated information needed for the evaluation are identified.

Table 4-25. Recommended Survey, Interviews and Workshops

Population Group/ Information Needed	Recommended Approach	
	Baseline	**Post-Deployment**
General Public. General public's expectations and reaction to the Seattle/LWC UPA projects related to reducing congestion, equity of pricing, and environmental quality and pre- and post-deployment.	• Previous surveys provide much, but not all, desired information but can suffice • No UPA- survey needed	• UPA survey needed • No planned local partner surveys yet identified for piggy-backing
Transit Riders. SR 520 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.	• UPA survey needed unless Metro can: ○ Schedule next survey for 2010 ○ Add UPA questions ○ Over-sample for SR 520 riders • Metro 2006 and 2007 surveys do not include enough SR 520 corridor riders	• UPA survey needed unless Metro can: ○ Schedule next survey for 2011 ○ Add UPA questions ○ Over-sample for SR 520 riders
Corridor Drivers (SR 520 bridge and alternate routes). Perception of the impact of the Seattle/LWC UPA strategies on reducing congestion (duration, extent, severity), safety, commute trip, travel behavior, trip length, travel time, travel time reliability, mode, origin-destination, route, frequency, perception of equity of pricing, impact of tolling on shopping behavior, and transit.	• UPA survey needed • 2006 PSRC Household Travel Survey does not include enough SR 520 corridor travelers	• UPA survey needed • Next PSRC survey (2015) is too late
Workers Changing to Telecommuting, Ride Sharing or Flexible Work Arrangements. Number of days using flexible work arrangements, prior mode of travel, trip length, O-D, change in travel time.	• No baseline data needed (analysis is post-deployment only)	• UPA survey needed (but could be combined with Corridor Drivers' Survey) • Employer Commute Trip Reduction data does not include all needed information (e.g., O-D, travel time)
Washington State Patrol, WSDOT Incident Response Team Members, First Responders, and Bus Operators. Perceptions of changes in crashes and the time required to clear incidents resulting from Seattle/LWC UPA projects.	• No baseline data needed (analysis is post-deployment only)	• UPA interviews needed • No planned local partner surveys yet identified for piggy-backing
Major Employers. Perception of impact of Seattle/LWC strategies on employee satisfaction, productivity, retention/hiring, cost of doing business, and their business.	• No baseline data needed (analysis is post-deployment only)	• UPA interviews needed unless we can piggy-back on Employee Commute Trip Reduction or other local surveys

Table 4-26. Recommended Survey, Interviews and Workshops (Continued)

Population Group/ Information Needed	Recommended Approach	
	Baseline	Post-Deployment
Redmond TOD Users. Influence of the Redmond TOD on travel behavior.	• No baseline data needed (analysis is post-deployment only)	• UPA survey needed (no local partner piggy-back opportunities identified to date)
Commercial Vehicle Operators. Perceptions of the impact of the SR 520 tolling on goods movement, including route selection, travel time, and timing of their trips.	• No baseline data needed (analysis is post-deployment only)	• UPA interviews needed • No planned local partner surveys yet identified for piggy-backing
Partnership Agency Representatives and Other Key Stakeholders. Information on perception of factors influencing the success of the Seattle UPA partnership, project benefits, and lessons learned.	• UPA interviews and workshops needed	• UPA interviews and workshops needed

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

Use of Seattle/LWC Partners' Existing and Planned Surveys

The information presented here on existing surveys is fairly comprehensive, although it may be further elaborated in the full Surveys, Interviews, and Workshops Test Plan document. The information presented here on planned surveys is incomplete because the local partners have not made and/or communicated all of their plans yet. The national evaluation team is working with the local partners now to identify survey and related plans and assess opportunities for the evaluation. Updated information on planned surveys will be included in the full test plan document.

WSDOT SR 520 Environmental Justice Survey (Regular & Transit)

WSDOT conducted two surveys of SR 520 bridge users in 2008 that will contribute very useful baseline (pre-deployment) traveler perception data for the UPA evaluation. Both surveys included both environmental justice (e.g., low income) and non-environmental justice stakeholders. The first survey, conducted by telephone, was fielded in October 2008 and assessed the likely impact of the SR 520 bridge toll and attitudes toward various tolling options. The second survey, a paper handout survey, assessed the same issues among transit users who cross the SR 520 bridge. These surveys are not ideal for UPA evaluation purposes, e.g., only SR 520 bridge travelers were surveyed whereas the UPA interest is in all corridor travelers' perceptions, but the value of conducting an additional baseline survey for the UPA national evaluation does not warrant the cost. Baseline data from these surveys that will be used in the UPA evaluation consist of the following:

- Perceptions of congestion on the SR 520 bridge
- Frequency of bridge crossing, time of day of trips, and mode
- Support for the UPA tolling scenario
- Expressed expectations for how the respondent may change their traveler behavior in response to the toll (e.g., mode, route, time, etc.)

WSDOT Environmental Justice and Regional Pricing Focus Groups

Two sets of focus groups were conducted in the 2007-2008 timeframe that will contribute useful baseline perception data to the UPA evaluation. One focus group was conducted by WSDOT and gauged the attitudes and perceptions of environmental justice (EJ) stakeholders regarding SR 520 tolling issues. That focus group was a precursor to the WS SR 520 environmental justice telephone and paper surveying described above. The second focus group included a general stakeholder population and considered attitudes about tolling in general. Data from these focus groups that will be used in the UPA evaluation consist of the following:

- Frequency of SR 520 bridge use, trip purpose and time of day
- Attitudes toward bridge replacement and traffic congestion
- Attitudes toward tolling the SR 520 bridge and toll rates
- Ability of tolling to reduce congestion on SR 520 bridge
- Support for SR 520 bridge tolling
- Expressed expectations for how the respondent may change their traveler behavior in response to the toll (e.g., mode, route, time, etc.)

WSDOT August 2009 Communications and Marketing Survey

This survey collects similar information as in the aforementioned WSDOT surveys, namely information on usage of the SR 520 bridge, reactions to various toll payment strategies, and various supporting rationales for tolling. This survey targeted current users of the SR 520 bridge and collected information from 800 respondents using a random sample phone survey.

WSDOT Fall 2009 SR 520 Traffic and Revenue Study Surveys

Two surveys are being conducted in the fall of 2009 in support of a WSDOT SR 520 traffic and revenue study that will yield a variety of information of interest to the evaluation. The first survey, the "O-D Pairs" survey collects travel pattern information (origin-destination and time of day) for a specific eastbound SR 520 bridge trip. This information will be used to calibrate a traffic model being used for the traffic and revenue study. The sample was collected via license plate readers on the SR 520 bridge, with a survey sent to every vehicle captured by the readers over a specific time frame. Surveys will be sent out to 40,000 people and WSDOT hopes to collect responses from 10,000 people. The other survey being conducted in support of the traffic and revenue study is referred to be WSDOT as the "stated preference" survey. The primary objective is to collect information on travelers' valuation of time. The sample is being drawn using the same license plate reader data collection as for the "O-D pairs" survey. WSDOT reports that they will solicit participation via an on-line request and then conduct surveys in person at "community survey stations. For this survey, WSDOT is aiming for 2,000 responses. WSDOT provided a draft of the survey questionnaire to the national evaluation team and is considering adding one of the additional questions requested by the national evaluation team.

King County 2007 Tolling Surveys

Much of the information from these two surveys is also available from the more recent WSDOT Environmental Justice Surveys described earlier, but the results from these surveys has been obtained and will be considered in the national evaluation. These surveys focused on perceptions of transportation problems, options for replacing the SR 520 bridge, and reactions to various tolling scenarios. The samples consisted of the general public (residents of King, Snohomish and Pierce Counties), with one survey including 501 interviews and the other 1,194 interviews. Both surveys were conducted by telephone.

Tolling Implementation Study Committee Telephone Survey

The Tolling Implementation Study Committee—the group named by the Washington State Legislature to study tolling options for the SR 520 corridor (including I-90) conducted a telephone survey of SR 520 and I-90 bridge users in November of 2008 that will contribute useful baseline data to the UPA evaluation. Information of use consists of the following:

- Perceptions of congestion on the bridges
- Frequency of bridge crossing, time of day of trips, and mode
- Support for UPA tolling scenarios
- Expressed expectations for how the respondent may change their traveler behavior in response to the toll (e.g., mode, route, time, etc.)

Needed Surveys and Interviews

General Public Survey (Post-Deployment)

This survey will gather input from travelers throughout the region—inside and outside the SR 520 corridor—on their perceptions of the SR 520 tolling and other UPA projects after they have been operational for some time. Telephone is a likely method for this survey. Data collection should be conducted near the end of the one-year post-deployment period.

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 UPA deployment. The surveys are critical to understanding how and why transit riders' attitudes and/or travel behavior have been impacted and by which specific UPA projects. Survey data should be collected only from Metro bus routes because most of the service that will most impacted by the UPA is operated by Metro and because it is simply impractical to conduct surveys on the several other transit services in the corridor.

Data from King County Metro's 2006 and 2007 region-wide rider surveys has been reviewed for possible use in the UPA evaluation but is expected to prove inadequate due to the small number of SR 520 corridor riders and other concerns. For these reasons, the national evaluation team has preliminarily identified a need to conduct UPA specific baseline and post-deployment transit rider surveys.

Corridor Drivers Survey (Baseline & Post Deployment)

These surveys will provide details on travel behavior in response to the UPA strategies as well as travelers' perception of the impact and value of the UPA project for addressing congestion issues. Surveys will reveal the perceived personal advantages and disadvantages of the UPA strategies to the traveler, such as improved travel time reliability, and the perceptions of the broader societal implications (e.g., equity, safety, and environment). Collecting information on travel behavior, including changes in travel patterns (e.g., different origins and or destinations, time of travel or route) and the reason for the change is essential for several reasons. This data will be very useful in differentiating the impact of the UPA from the influence of various exogenous factors and understanding traveler responses to specific UPA strategies.

There are several options for conducting a survey of corridor drivers, including cross-sectional and panel studies. Other methodological options pertain to the method of recruiting participants (e.g., license plate readers on corridor roads) and conducting the survey (e.g., telephone versus mail out/mail back). These methodological details will be addressed in the development of the full test plan document and in consultation with the local partners and U.S. DOT.

The use of PSRC's 2006 region-wide Household Activity Survey—which collected detailed trip-level information through travel diaries—was reviewed for potential use as the baseline data source for the UPA evaluation. As is the case with the Metro transit survey data, it appears that there are two few SR 520 corridor trips (about 300 round-trips as estimated by PSRC) to be of use in the UPA evaluation. The age of this data set and the potential that it may not reflect today's conditions is also a concern.

Surveys of Workers Changing to Telecommuting, Ridesharing or Flexible Work Arrangements (Post Deployment)

The objective of this survey is to assess the response to the UPA projects that promote car and van pooling and that encourage telecommuting and other flexible work arrangements. Due to the low incidence of the population of employees who are candidates for this survey, a broad-based sample like the survey of corridor drivers will not suffice. Special sources will need to be tapped, such as regional registration lists for vanpools and other potential sources such as large employers' lists of employees using car and van pools and telecommuting and other alternate work arrangements. Information sought would include number of days using flexible work arrangements, prior mode of travel, trip length, O-D, VMT, change in travel time, as well as satisfaction with the change in travel behavior and perceived advantages and disadvantages of the UPA projects on them and the region in general.

Interviews with Washington State Patrol, Freeway WSDOT Incident Response Team Members, First Responders and Bus Operators (Post-Deployment)

These interviews will collect information from public agency personnel who are in a position to observe firsthand the potential safety impacts of the Seattle/LWC UPA 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 UPA roadway signage (travel times, ATM variable speed and lane controls). These interviews will be needed in the post-deployment period only.

Interviews with Major Employers (Post-Deployment)

Interviews with major employers will document perceptions of the impact of Seattle/LWC 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 employer-based, UPA-related TDM programs. Employers representing various classes of organizations will be interviewed, including private, public and non-profit organizations. Employers will be selected that, based on their proximity and hours of operation, would likely have employees that commute in the SR 520 corridor. Selection of employers for interviewing will also take into account participation in UPA-related TDM programs. These interviews will be needed only in the post-deployment period.

Surveys of Redmond TOD Users (Post-Deployment)

Users of the Redmond transit oriented development, including residents of the apartments and patrons of the businesses that constitute the TOD, will be surveyed to assess the impact of the TOD on UPA corridor travel. Questions will fully explore prior (before moving to the apartments or before patronizing the businesses) and current (post-TOD deployment) travel behavior, including origins and destinations, trip types and frequencies, travel modes, perceptions of traffic congestion and mobility in general, and perceptions of the TOD, including its effectiveness in facilitating transit use. Questions will also be asked pertaining to auto ownership.

Interviews with Commercial Vehicle Operators (Post-Deployment)

Commercial vehicle operators will be interviewed, probably by phone, in the post-deployment period regarding the impact of the SR 520 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 existing commercial vehicle stakeholder contact lists or relationships with industry associations are all possibilities for selecting interviewees.

Partnership Agency Representatives and Other Key Stakeholders (Baseline & 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 UPA projects. This will include those organizations instrumental in the institutional, technical or public outreach aspects of the UPA, such as the SR 520 Tolling Implementation Committee. 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 measure of effectiveness in 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 that they switched from driving on SR 520 to transit as a result of the UPA deployment, as well as potential predictor variables such as the length of commute.

Data Collection Schedule and Responsibilities

The Seattle/LWC local partners will be responsible for conducting surveys and interviews 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 Survey, Interviews, and Workshops Test Plan document, provide the local partners specific guidance and recommendations on the key aspects of the survey methodology, including specific information to be collected.

Baseline surveys should be conducted shortly before the bulk of the UPA strategies (e.g., tolling, enhanced transit, etc.) become operational although the surveys can be done earlier if necessary to avoid the influence of UPA or other construction that may distort the baseline data. Post-deployment surveying should occur near the end of the one-year, post-deployment operational period.

4.2.7 Environmental Test Plan

Data Sources

The environmental test plan will generate data to be used primarily in the environmental and the cost benefit analyses. It also supports the congestion and equity analyses.

As noted in the Environmental Analysis portion of this document, the environmental analysis for the national UPA evaluation will utilize observed traffic data (e.g., volumes and speeds) in conjunction with emission rates to estimate the change in emissions associated with the UPA project. No monitoring of air pollutants is planned as part of the Seattle/LWC UPA evaluation. The specific air quality analysis approach has not yet been determined. The national evaluation team is in the midst of discussions with USDOT regarding those specifics. U.S. DOT has requested that the EPA MOVES model be utilized. The MOVES model can be used both to generate emission rates (as formerly done in the EPA MOBILE model) and apply those emission rates to user-supplied traffic data to yield emissions. The specific data required for emission calculations will be determined through the on-going discussions with U.S. DOT and the local partners and reflected in the Environmental Test Plan document to be produced in November or December 2009.

The analysis of energy impacts will utilize many of the same sorts of data as utilized in the air quality analysis and will follow the same general approach of multiplying observed VMT by fuel consumption factors to estimate the change in fuel consumption. For the energy analysis, it will be important to take into consideration what kinds of fuel will be used by the new transit buses being added as a UPA project.

Likely environmental data needs—considering both the air quality and energy analyses—include the following:

- vehicle classification (e.g., percent buses);
- transit vehicle alternative fuel use;
- traffic volumes;
- traffic speeds;
- vehicle-occupancy levels;
- mode shift survey data; and
- trips removed through telecommuting and TDM initiative.

Data Availability

Most of the key data will be collected through the other national evaluation analyses and test plans. For example, VMT and vehicle speeds will be developed through the Traffic System Data Test Plan. Data availability issues will be resolved in the full Environmental Test Plan document that will be produced once on-going discussions with U.S. DOT and the local partners are concluded.

Data Analysis

Energy consumption and emissions will be calculated and compared between the pre- and post-deployment scenarios to determine the impact of the UPA project. The specific analysis approach will be resolved in the full Environmental Test Plan document that will be produced once on-going discussions with U.S. DOT and the local partners are concluded.

Data Collection Schedule and Responsibilities

On-going discussions will impact final decisions about the role to be played by the national evaluation team, U.S. DOT and the local partners in collecting necessary data and carrying out the analyses. The final approach will be specified in the full Environmental Test Plan document.

4.2.8 Content Analysis Test Plan

Data Sources

The content analysis test plan focuses on collecting and analyzing information on the Seattle/LWC UPA outreach activities, including comments from the public, policy makers and other groups in response to outreach, and UPA-related media coverage. The information collected and analyzed in this test plan will be used primarily in the non-technical success factors analysis. Information from this test plan also plays a supporting role in all the other analyses except the cost benefit analysis.

Two primary data sources will be used in this test plan. The first data source is the on-line search engines Google Alerts and Vocus. Information from the local UPA partners represents the second data source.

Google Alerts and Vocus. Google Alerts is a free on-line search engine that tracks news articles, web-based information, blogs, videos, and other media information based on search terms. Members of the Battelle team, including the Seattle/Lake Washington UPA site leader, have signed up with Google Alerts and have entered key terms based on each of the UPA sites. Examples of key terms for the Seattle/LWC UPA projects include SR 520 bridge, tolling, park-and-ride lots, and Seattle/Lake Washington UPA. Vocus is a private company providing a range of web-based products and services. The Texas Transportation Institute's (TTI) Media Relations Group contracts with Vocus for a variety of services, including tracking media and on-line coverage based on search terms. The key words noted above for the Seattle/Lake Washington UPA have been added to TTI's search terms at no cost to the national UPA evaluation.

Seattle/LWC UPA Partnership Agency Information. Press releases and outreach, public education, public and policy maker comment and other communications, and marketing materials issued by the Seattle/LWC UPA agencies represent the second source of information for the content analysis test plan. WSDOT, PSRC, King County, and other partners use these methods to communicate with the public, travelers in the targeted corridors, policy makers, and other groups whose understanding and, to vary degrees, support, will impact the success of the UPA deployment. The national evaluation team requests that the local partners maintain archives of this information and to include the Battelle evaluation team Seattle site leader on distributions lists for these materials.

Data Availability

The availability of most data is assumed to be good in so much as the local partners will be maintaining archives. The exception is television and radio coverage where the local partners have indicated that they do not maintain archives.

Data Analysis

The information obtained in this test plan will be used in the non-technical success factors analysis and will provide context for interpreting results in the other analyses. The following questions provide examples of how the qualitative information obtained in the test plan will be applied in the evaluation.

- What types of outreach materials and activities were used by the Seattle/LWC UPA partners?
- What was the extent and nature of media coverage of the Seattle/LWC UPA projects?
- What was the reaction of travelers in the corridors and areas affected by the UPA projects as reported in the media and in communications to the agencies?
- What was the reaction of policy makers to the UPA projects as described by the local partners and as reported in the media?

Members of the Battelle team will document the results of the Google Alerts and Vocus on-line search tools and information obtained from the partnership agencies. Table 4-26 illustrates how the information will be tracked, categorized, and analyzed.

Table 4-26. Content Analysis Tracking Log

Date of Item	Source	Audience (if available)	UPA Projects Referenced	Nature of Comments/Coverage	Evaluation Team Discussion
				Examples might include: • Was coverage neutral, positive, negative, • Type of information (status, use guidelines, technical, policy-oriented, etc.)	

Data Collection Schedule and Responsibilities

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

4.2.9 Cost Benefit Analysis Test Plan

Data Sources

This test plan focuses on obtaining and analyzing data related to the costs of the various Seattle/LWC UPA projects and the intended resulting benefits, including improvements in travel conditions on highways, transit services, and the environment. Data sources include many of the other evaluation analyses (e.g., congestion, environment, etc.) and the PSRC regional travel demand forecasting model.

The cost benefit analysis test plan will use two major sources of data. The first source is the detailed costs associated with the UPA project. These data will be provided by WSDOT, the PSRC, King County and any other agencies expending funds on UPA activities. The second source is data collected through other Seattle evaluation analyses. These data will be analyzed using PSRC's regional travel forecast model and associated cost benefits module.

Cost Data from Participating Agencies. Cost data will be obtained from WSDOT, the PSRC, King County and any other agencies making UPA project expenditures. Data include the capital costs associated with various projects, the operating and maintenance costs, and the replacement and re-investment costs. The following are examples of the cost categories needed for this test plan.

- Capital investment costs:
  - Construction of the SR 520 toll collection system
  - Transit expansion, including purchasing the 45 new buses, expanding the Redmond Park-and-Ride lot, and implementing station/stop improvements
  - Implementation of the SR 520 and I-90 ATM systems
  - Implementation of the three SR 520 corridor travel time signs
- Operating and maintenance costs:
  - Operating and maintaining the expanded transit services
  - Operating and maintaining the toll collection, ATM and travel time sign systems
  - Compliance costs for enforcing the toll facility
- Replacement and re-investment costs for UPA equipment and infrastructure, including the toll system, ATM system, travel time signs, and transit station/stop traveler information system.

Travel Demand Forecasting Model. The PSRC regional traffic model will be used to generate 10-year forecasts of travel patterns in the region resulting from the UPA strategies. The model is well suited to application in this evaluation. In 2008, PSRC in consultation with WSDOT staff revised the model to better respond to how people make travel choices when a facility is tolled for use in the SR 520 Bridge tolling analysis. A peer review of the revised model found it to be in accordance with the best state-of-the-practice, and made short-term and mid-term recommendations for enhancements. In addition, significant changes are being made in the model as part of the overall Integrated Modeling Framework.

Improvements have also been made in the model to provide the capability to model additional strategies and alternatives in the development of the Transportation 2040 long-range plan. These strategies include tolling/pricing options, freight analyses, modal choice analyses, speed and reliability impacts, and assessing greenhouse gas emissions.

Most relevant to this test plan, the PSRC Integrated Modeling Framework also includes a new cost benefit analysis tool. The model will be used in two capacities in the cost benefit analysis. First, it will provide the needed long range travel estimates (the cost benefits analysis considers a 10-year post-deployment timeframe) and second, using the special cost benefit module, it will be used by PSRC to calculate the benefits associated with the UPA travel impacts.

Other Seattle/LWC UPA Test Plans. Another important source of data for the cost benefit analysis is other test plans. The data from various test plans, including the following data, will be used to compare the scenarios before and after the UPA projects are implemented:

- Reduction in travel time from the traffic system data test plan (for baseline and post-deployment year 1);
- Improvement in travel reliability 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 transit system data test plan;
- Improvement in air quality and fuel costs from the environmental test plan;
- Changes in safety conditions from the safety test plan; and
- Reduction in travel time and travel costs for telecommuting workers from the telecommuting data test plan.

Data Availability

At this point, it is expected that all necessary data will be available, either, as in the case of public cost data, from the UPA local partners, or from other test plans, or from the PSRC regional model and associated cost benefit module.

Data Analysis

The PSRC regional travel demand model will be used to estimate the benefits related to congestion reduction resulting from the UPA projects. WSDOT and PSRC have used the traffic forecasts produced from the regional model to conduct cost benefit analysis for other transportation improvement projects.

Data Collection Schedule and Responsibilities

The cost benefit analysis will be initiated prior to deployment of the Seattle/LWC UPA projects. The analysis will be completed after all the UPA projects are in operation. The local partners will be responsible for providing public agency cost information and, via other test plans, a range of other data that will be used in the cost benefit analysis. The national evaluation team will work with the local partners and U.S. DOT to agree upon specific data elements, formats and collection procedures as the full test plan document is developed.

Staff from PSRC will run the regional travel forecast model to generate the travel forecasts for the 10-year post-deployment time frame. They will also run cost benefit analysis software developed by ECONorthwest, a consulting firm, to compute the net benefit of the UPA projects.

Members of the Battelle team will examine the methodologies implemented in the cost-benefit analysis software to ensure that the methods will be consistent with those to be implemented in other UPA sites. The Battelle team will also perform the analysis to crosscheck the results obtained from the software to ensure correctness.

4.2.10 Exogenous Factors Test Plan

Data Sources

The exogenous factors test plan will be used to monitor elements un-related to the Seattle/LWC UPA projects that may influence travel in the SR 520 corridor, 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. As outlined in this section, elements included in the test plan are unemployment rates, gasoline prices, non-UPA roadway construction, and non-typical weather conditions, traffic incidents, and special events. Regional, and if possible, control corridor changes in VMT, transit ridership, and other factors will be monitored as described in other test plans.

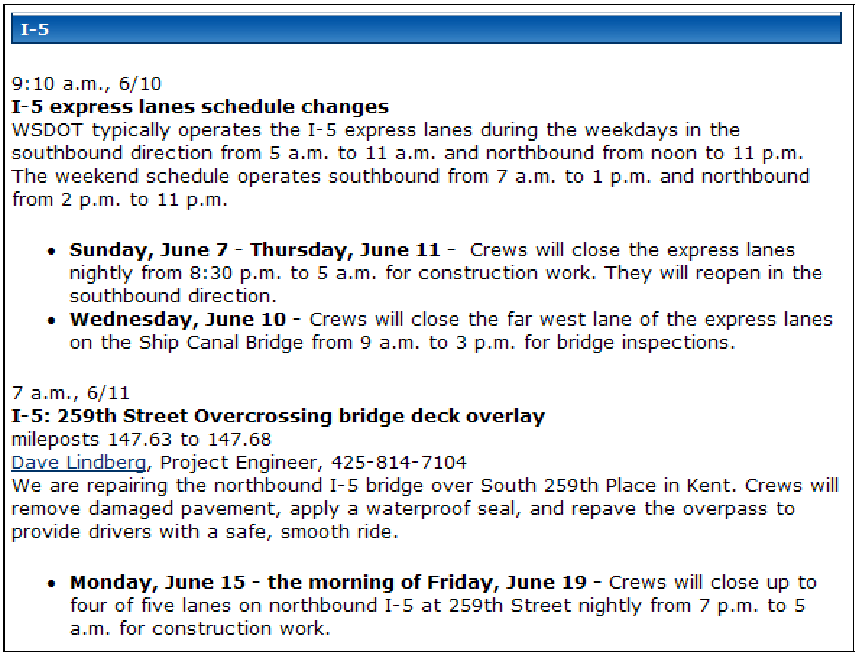
The details related to exogenous factors data will be determined through the development of the full test plan document. The following describe data sources under consideration.

PSRC and U.S. Department of Labor Unemployment Rates. Data will be examined from 2000 to the conclusion of the UPA evaluation.

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 on-line since 2000. Data will be monitored over the course of the UPA evaluation. Various commercial Internet sites that provide Seattle region gas prices will also be consulted.

Non-UPA Roadway Construction. A weekly updated WSDOT website (**http://www.wsdot.wa.gov/Northwest/King/Construction**) will be used to identify road construction that may influence travel patterns, bus routes, and other factors. This information will be monitored over the course of the evaluation. Figure 4-3 shows an example of the type of data contained in the WSDOT database.

Non-typical Weather Conditions. A number of sources will be used to determine when weather conditions impact traffic operations. Control center operator logs will be reviewed to determine if traffic management center operators have identified weather as causing or contributing to incidents or capacity breakdowns. Archived daily and hourly weather information will be obtained from the National Weather Climate Data website (**http://cdo.ncdc.noaa.gov/ulcd/ULCD**). Weather data from the weather reporting station at Boeing Field/King County International Airport (BFI) will be correlated with traffic sensor data. Examples of the types of weather events that will be examined for possible traffic impacts include limited visibility (less than 1 mile), heavy snow or rain events, or icing events.



I-5

9:10 a.m., 6/10
I-5 express lanes schedule changes
WSDOT typically operates the I-5 express lanes during the weekdays in the southbound direction from 5 a.m. to 11 a.m. and northbound from noon to 11 p.m. The weekend schedule operates southbound from 7 a.m. to 1 p.m. and northbound from 2 p.m. to 11 p.m.

- **Sunday, June 7 - Thursday, June 11 -** Crews will close the express lanes nightly from 8:30 p.m. to 5 a.m. for construction work. They will reopen in the southbound direction.
- **Wednesday, June 10 -** Crews will close the far west lane of the express lanes on the Ship Canal Bridge from 9 a.m. to 3 p.m. for bridge inspections.

7 a.m., 6/11
I-5: 259th Street Overcrossing bridge deck overlay
mileposts 147.63 to 147.68
Dave Lindberg, Project Engineer, 425-814-7104
We are repairing the northbound I-5 bridge over South 259th Place in Kent. Crews will remove damaged pavement, apply a waterproof seal, and repave the overpass to provide drivers with a safe, smooth ride.

- **Monday, June 15 - the morning of Friday, June 19 -** Crews will close up to four of five lanes on northbound I-5 at 259th Street nightly from 7 p.m. to 5 a.m. for construction work.

Figure 4-3. Sample Log of Construction and Maintenance Activities Ongoing in the Puget Sound Area

Incident Conditions. Incidents can be a major source of variation in travel time and other MOEs of interest to the evaluation. For the UPA evaluation, it will be important to determine when and where MOEs have been impacted by traffic incidents. Data on incident conditions is expected to come from WSDOT TSMC Operator logs and, if possible, from WSDOT logs of their incident-related travel information dissemination to the public, including through their website (http://www.wsdot.wa.gov/traffic/seattle/incidents/). Another source of potential data are the dispatch logs associated with WSDOT IRT that respond to traffic incidents on state roadways and the reports prepared by these teams.

Special Events. Some special events (such as professional sporting events, major festivals, etc.) can significantly impact travel. Data on special events impacting the SR 520 corridor will be collected from the same WSDOT website that contains construction activities. Figure 4-4 shows a sample of the types of special events contained in this log. These records appear to be updated monthly.

Special Events

Graduations

- **Friday, June 12** - Green River Community College at the White River Amphitheater - 7 p.m.
- **Friday, June 12** - Renton High School at the ShoWare Center - 7 p.m.
- **Saturday, June 13** - Seattle University at the KeyArena - 9:30 a.m.
- **Saturday, June 13** - Kent School District at the ShoWare Center - 9 a.m.
- **Saturday, June 13** - University of Washington at Husky Stadium - 1:30 p.m.
- **Sunday, June 14** - Seattle University (graduate) at KeyArena - 3 p.m.
- **Monday, June 15** - Enumclaw High School at the White River Amphitheater - 7 p.m.

Seattle Sounders Soccer

- **Saturday, June 13** - The Seattle Sounders play the San Jose Earthquakes at Qwest Field. Game time is 7:30 p.m.
- **Wednesday, June 17** - The Seattle Sounders play DC United at Qwest Field. Game time is 8 p.m.

Seattle Mariners Baseball

- **Friday, June 19** - The Seattle Mariners will play the Arizona Diamondbacks at Safeco Field. Game time is 7:10 p.m.
- **Saturday, June 20** - The Seattle Mariners will play the Arizona Diamondbacks at Safeco Field. Game time is 7:10 p.m.
- **Sunday, June 21** - The Seattle Mariners will play the Arizona Diamondbacks at Safeco Field. Game time is 1:10 p.m.
- **Tuesday, June 23** - The Seattle Mariners will play the San Diego Padres at Safeco Field. Game time is 7:10 p.m.
- **Wednesday, June 24** - The Seattle Mariners will play the San Diego Padres at Safeco Field. Game time is 7:10 p.m.
- **Thursday, June 25** - The Seattle Mariners will play the San Diego Padres at Safeco Field. Game time is 1:40 p.m.

Figure 4-4. Example of Information Contained in Special Events Log

Control Corridors. Monitoring various travel and traffic MOEs of interest on one or more control corridors provides another method for assessing how much of any observed SR 520 changes could have been expected without the UPA. In discussions to date, the Seattle 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.

Data Availability

Historical, pre-deployment, and post-deployment data is 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, mode changes, and use of telecommuting in the SR 520 corridor.

Data Collection Schedule and Responsibilities

Table 4-27 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 program/policy/project 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 4-27. Exogenous Factors Data Collection Schedule

Data Source	Historical Data	Pre-Deployment Data	Post-Deployment Data
Unemployment Rates	✔	✔	✔
Gasoline Prices	✔	✔	✔
Non-UPA Roadway Construction	Not Needed	Some	✔
Non-typical Weather Conditions	Not Needed	Some	✔
Incident Conditions	Not Needed	Some	✔
Special Events	Not Needed	Some	✔
Control Corridors	Not Needed	Some	✔

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5.0 NEXT STEPS

The next steps in the Seattle/LWC UPA National Evaluation are highlighted below.

- Detailed test plans will be developed. It is anticipated that the test plans will be developed and reviewed individually in November or December 2009.
- Baseline data collection, including developing trend lines, will be initiated.
- Members of the national evaluation team will continue to monitor the deployment status of the Seattle/LWC UPA projects and will provide assistance with elements of the evaluation as requested.
- Members of the national evaluation team will continue to coordinate with other UPA/CRD sites and share experiences and "lessons learned."

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