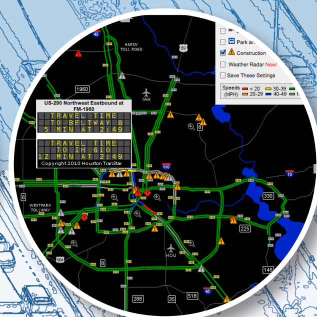
Strengthening Linkages between Transportation Demand Management and Traffic Management




U.S. Department of Transportation
Federal Highway Administration

Cover Photo Sources: Shutterstock and TTI Communications.

TECHNICAL REPORT DOCUMENTATION PAGE

<table>
<tr><td colspan="2">1. Report No.
FHWA-HOP-18-072</td><td colspan="2">2. Government Accession No.</td><td colspan="2">3. Recipient's Catalog No.</td></tr>
<tr><td colspan="4" rowspan="2">4. Title and Subtitle
Strengthening Linkages between Transportation Demand Management and Traffic Management</td><td colspan="2">5. Report Date
June 2019</td></tr>
<tr><td colspan="2">6. Performing Organization Code</td></tr>
<tr><td colspan="4">7. Authors
Deepak Gopalakrishna (ICF), Eva Hsu (ICF), Beverly Kuhn (TTI), Eric Schreffler (ESTC), and Lori Diggins (LDA)</td><td colspan="2">8. Performing Organization Report No.</td></tr>
<tr><td colspan="4" rowspan="2">9. Performing Organization Name and Address

ICF Incorporated, LLC
9300 Lee Highway
Fairfax, VA 22031</td><td colspan="2">10. Work Unit No. (TRAIS)</td></tr>
<tr><td colspan="2">11. Contract or Grant No.</td></tr>
<tr><td colspan="4" rowspan="2">12. Sponsoring Agency Name and Address
U.S. Department of Transportation
Federal Highway Administration
1200 New Jersey Avenue, SE
Washington, DC 20590</td><td colspan="2">13. Type of Report and Period Covered</td></tr>
<tr><td colspan="2">14. Sponsoring Agency Code</td></tr>
<tr><td colspan="6">15. Supplementary Notes
Jim Hunt, FHWA TOCOR</td></tr>
<tr><td colspan="6">16. Abstract

This document presents real-world examples of how State and local traffic managers and demand management professionals can work together to create a more comprehensive approach to proactively manage mobility and reliability concerns under different contexts. The document highlights the benefits of linking transportation demand management (TDM) and traffic management using case study examples that show how TDM and traffic management were combined to address a specific issue, the strategies implemented, if and how they affected a portion of the trip chain, and any opportunities for future improvement.</td></tr>
<tr><td colspan="4">17. Key Words
Demand Management, Traffic Management, Traveler Choices</td><td colspan="2">18. Distribution Statement</td></tr>
<tr><td colspan="2">19. Security Classif. (of this report)
Unclassified</td><td colspan="2">20. Security Classif. (of this page)
Unclassified</td><td>21. No of Pages
94</td><td>22. Price
N/A</td></tr>
</table>

Form DOT F 1700.7 (8-72) **Reproduction of completed page authorized**

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS

ACRONYM	DEFINITION
ADM	active demand management
ARC	Atlanta Regional Commission
ATDM	active transportation and demand management
ATM	active traffic management
Caltrans	California Department of Transportation
CIMS	Construction Impact Mitigation Strategies
ConOps	concept of operations
DDOT	District Department of Transportation
DMS	dynamic message sign
DOT	department of transportation
DTA	Duluth Transit Authority
FHWA	Federal Highway Administration
FRATIS	Freight Advanced Traveler Information Systems
GDOT	Georgia Department of Transportation
GHG	greenhouse gas
GRTC	Greater Richmond Transit Company
HOT	high-occupancy toll
HOV	high-occupancy vehicle
ICM	integrated corridor management
IDOT	Illinois Department of Transportation
ITS	intelligent transportation systems
LA Metro	Los Angeles County Metropolitan Transportation Authority
LADOT	Los Angeles Department of Transportation
LIRR	Long Island Railroad
MARTA	Metropolitan Atlanta Rapid Transit Authority
METRO	Metropolitan Transit Authority of Harris County
MnDOT	Minnesota Department of Transportation
MTA	Metropolitan Transportation Authority (New York)

ACRONYM	DEFINITION
MUNI	San Francisco Municipal Railway
MWCOG	Metropolitan Washington Council of Governments
NFL	National Football League
NJDOT	New Jersey Department of Transportation
NWS	National Weather Service
NYSDOT	New York State Department of Transportation
PANYNJ	Port Authority of New York and New Jersey
RTC	Regional Transportation Commission of Southern Nevada
SFMTA	San Francisco Municipal Transportation Agency
SOV	single-occupancy vehicle
TDM	transportation demand management
TIDC	Traveler Information during Construction
TMA	transportation management association
TMC	transportation management center
TMP	transportation management plan
TNC	transportation network company
TOC	Traffic Operations Center
TxDOT	Texas Department of Transportation
UCI	Union Cycliste Internationale
UDOT	Utah Department of Transportation
USDOT	U.S. Department of Transportation
VDOT	Virginia Department of Transportation
VMS	variable message sign
VMT	vehicle miles traveled
WMATA	Washington Metropolitan Transportation Authority
WYDOT	Wyoming Department of Transportation

EXECUTIVE SUMMARY

Transportation system users face many choices when planning their entire travel trip. Destination, mode, route, time-of-day, and what facility or lane are types of choices for travelers to consider and all have implications for transportation system management. These choices provide opportunities for public and private agencies to inform traveler decisions for both the traveler's and the transportation system's benefit. Linking transportation demand management (TDM) and traffic management enhances the ability for transportation stakeholders to address mobility and reliability concerns in travelers' decision-making processes and enable users to make informed decisions throughout their trip.

TDM addresses how and when people need to travel, and traffic management addresses how users traverse the transportation system efficiently. Traditionally, separate unconnected programs are responsible for managing travel demand on the transportation system and managing the resulting traffic from that demand. Traffic management strategies include incident management, arterial management, smart work zones, dynamic shoulder use, ramp meter, and emergency transportation operations. TDM strategies include bike and pedestrian support, first and last mile services, employer outreach, travel planning, mobility on demand, guaranteed ride home programs, and shared mobility modal support.

The difference between TDM and traffic management has become less distinct in recent years due to more targeted, actionable information that can improve traveler choices. Strategies that offer opportunities for TDM and traffic management collaboration include traveler information, priority treatment (e.g., transit signal priority), and toll operations and high-occupancy vehicle lane management. The concept of active transportation and demand management (ATDM) provides a framework to understand TDM and traffic management strategies as a holistic approach to manage traveler choices.

The Federal Highway Administration recognizes the possibility for ATDM to help transportation facilities and mass transit services achieve operational objectives, such as improved throughput, maximized system efficiency, reduced emissions, or improved safety.

The purpose of this report is to illustrate examples of linking TDM and traffic management to achieve improved outcomes of travel reliability and access. The document presents real-world examples of how State and local traffic managers and demand management professionals can work together to achieve common goals. This report does not establish any new requirements or replace any existing guidance.

The case studies of the report are organized into seven context areas:

1. Managing demand and traffic during weather events and natural disasters.
2. Linking TDM and traffic management as part of transit disruption.
3. Incorporating TDM as part of a major road reconstruction project.
4. Managing system efficiency using active demand management and active traffic management.

5. Using high-occupancy toll (HOT) and priority treatments for transit service enhancements.
6. Managing special events using parking, TDM, and traffic management.
7. Managing smart parking and considering local traffic management.

Each case study addresses the strategies that promote traveler choices for different choice types. The types of choices that are considered are as follows:

- Destination choice: where would the user like to go?
- Mode choice: what transportation mode will the user take?
- Route choice: which roads will the user take?
- Time-of-day choice: when will the user take the trip (off-peak or peak travel hours)?
- Facility or lane choice: what specific facility options are available and which will user choose?

Table 1 briefly summarizes the case studies that show how TDM and traffic management were combined to address a specific issue, the strategies implemented, if and how they affected a portion of the trip chain, and any opportunities for future improvement.

Table 1: Case studies of notable practices for integrating travel demand management (TDM) and traffic management.

CASE STUDY	NOTABLE PRACTICE
Hurricane Harvey Mobility Response—Houston TranStar	• Leveraged existing relationships to disseminate accelerated and coordinated information about 500+ road closures
Utah Department of Transportation's Traffic Operations Center Use of Proactive Messaging during Weather	• Provided streamlined, proactive messaging and signal adjustments through centralized Traffic Operations Center, which was able to analyze and distribute weather information in-house
SafeTrack—Washington, DC	• Coordinated among agencies to divert users to alternate modes • Encouraged employers to offer telework options, promoted bikeshare/carsharing, promoted bus ridership and implemented policies to improve bus service
Amtrak New York Pennsylvania Station Emergency Repair Work	• Developed mitigation plan to increase capacity on unaffected transit lines, reduce road congestion through roadside traffic management information, and inform travelers about alternative route and mode options
New Jersey Pulaski Skyway Reconstruction	• Began proactive outreach and coordination two years before construction • Coordinated with transportation agencies to provide continuous information and communication to travelers about alternate route options
Texas I-35 Freight Trip Optimization with Construction Information	• Integrated data-sharing systems to improve information on current and forecasted travel conditions
Atlanta's I-85 Bridge Collapse	• Communicated across agencies to disperse traffic amongst alternative modes • Reopened registration period for existing TDM program

Table 1: Case studies of notable practices for integrating TDM and traffic management. (continued)

CASE STUDY	NOTABLE PRACTICE
New York State Department of Transportation's ATDM Program	• Merged programs into a single ATDM program to ensure that project funding decision- making would consider and incorporate both TDM strategies and traffic management strategies
Houston's ConnectSmart Program	• Created a single app platform to integrate payment and route planning across an 8-county region • Collaborated among agencies to provide baseline data, collect and analyze future data, and react with appropriate management strategies
Mopac Improvement Project (Mopac Express Lanes)	• Created of HOT lanes to provide more reliable travel times • Offered toll exemptions to buses and vanpools to encourage shared-use modes
I-110/I-10 Express Lanes High-Occupancy Vehicle (HOV) Incentives (Los Angeles County)	• Converted HOV to HOT lanes to provide option of free-flow traffic lane • Offered financial incentives to vanpools and transit riders through loyalty program to encourage shared-use modes
I-55 Buses on Shoulder (Chicago Region)	• Provided more reliable travel times for commuter buses by allowing bus travel on shoulders when general purpose lanes are slowed below certain speeds • Partnered with public transit and vanpool providers and regional and State transportation agencies
Union Cycliste Internationale Road World Championships (Richmond, VA)	• Began pre-event planning across multiple agencies began two years before event • Communicated consistently with employers about the plan for road closures, which would change routes due to the race • Dry run of event for a smaller race
Mass Transit Super Bowl (New Jersey and New York)	• Created "Playbook" transportation plan to inform travelers who might be unfamiliar with transit options • Enhanced capacity and efficiency of rail, added bus capacity, halted construction during event
Wyoming Department of Transportation and the 2017 Solar Eclipse	• Released proactive messaging on VMS to discourage behavior that would be unsafe or reduce flow of traffic in rural area during rare event • Communicated clearly about parking and viewing locations leading up to event on website
SF*park*: Managing Parking Demand via Pricing (San Francisco, CA)	• Integrated of technology and data to provide demand responsive parking program in order to maintain parking availability on every block

The case studies included in this compendium show some easy strategies, some unique strategies, and some strategies requiring more buy-in or support—but all implementable and supportive of both TDM and traffic management goals. Regardless of the contexts described in the compendium, agencies seem to consistently rely on three tactics to integrate TDM with traffic management efforts:

- Establishing supportive policies.
- Making temporary changes to existing programs and systems.
- Finding new communications and partnership strategies.

Through the strategies described in the compendium, State and local agencies can support the traveling public in making choices, every single day, about the most efficient and effective mode, route, time, and destination for their travels. Ultimately, this helps traffic managers achieve the broader goal of increasing person throughput throughout an entire transportation system.

INTRODUCTION

MOTIVATION FOR THE DOCUMENT

Users of our transportation system expect their travel to be safe, reliable, and seamless. From a traveler's perspective, the focus on the entire trip, rather than just one section of it, is obvious and necessary. Travelers today want on-the-go travel choices throughout the trip, including the choice of destination (e.g., a park-and-ride lot or work location), mode (e.g., a single-occupancy vehicle [SOV], rideshare, a transportation network company [TNC], or mass transit), route, time of day, and facility or lane type (Table 2).

Table 2. Choices for travelers along a trip.

TYPE OF CHOICE	DESCRIPTION
D **Destination choice**	Where would the user like to go—home (if the person is teleworking), the work site (including a satellite office or branch location), a recreational site, an event site, a park-and-ride lot, a parking space, etc.?
M **Mode choice**	What type of transportation mode will the user take—SOV, carpool, walk, bicycle, vanpool, bus, train, shuttle, TNC, bikeshare, carshare, microtransit, etc.?
Rt **Route choice**	Which road(s) will the user take—arterials, highways, local streets, etc.?
T **Time-of-day choice**	When will the user take the trip—off-peak or peak travel hours or when incidents have been cleared?
L **Facility or lane choice**	What specific facility options will the motorist who decides to drive take—the choice of lanes (e.g., high-occupancy vehicle [HOV], high-occupancy toll [HOT], express toll, bus-only, truck-only, and shoulder lanes) or parking facilities (e.g., on-street spaces, garages, and lots).

Enabling travelers to make informed decisions across all of these choices clearly requires a proactive and regionally integrated approach to managing the system across the trip chain, linking different public and private agencies, functions, and roles. The trip chain represents the complete series of decisions made by a traveler throughout a trip from the choice of travel destination to the final choice of facility. Managing the entire trip chain broadly requires two functions:

- Managing the overall travel demand on the system, addressing how and when people need to travel.
- Managing the resultant traffic on the system, addressing how they traverse the system efficiently.

Traditionally, separate unconnected programs are responsible for these functions in a region. For example, a metropolitan area may have a transportation demand management (TDM) program, and several other agencies are responsible for traffic management. The motivation for this compendium is to illustrate the benefit of linking TDM and traffic management programs to achieve the improved outcomes of travel reliability and access. The intent of this compendium is to show how regions have connected demand and traffic management programs to provide enhanced choices to travelers and meet their growing customer expectations.

NATURE OF THE OPPORTUNITY

The motivation for this document also stems from the recent revolutions that have occurred in traffic management and travel management. Spurred by greater connectivity (to both the infrastructure and travelers), emerging approaches to TDM and traffic management are blurring the lines between the two functions.

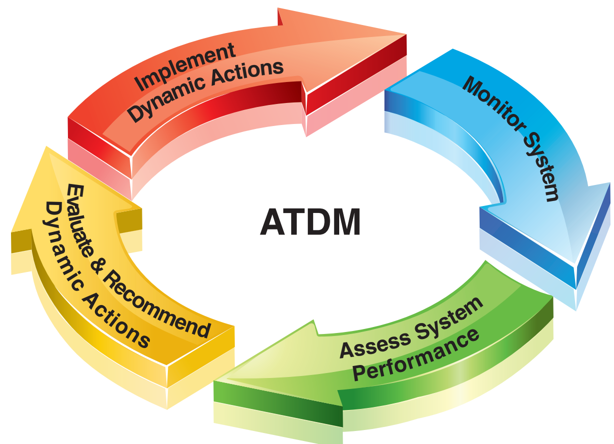


Figure 1. Illustration. The ATDM concept. (Source: Federal Highway Administration).

Operating agencies throughout the country have found value in moving from reactive to proactive postures in their system operations. With strategies such as variable speed limits, lane control, dynamic shoulder use, and queue warning, agencies have greatly expanded the toolbox of operational strategies that emphasize reliability of traffic on facilities.

Similarly, the notion of TDM has undergone a very visible revolution, with bicycle and pedestrian considerations, shared-use mobility opportunities, and smartphone usage largely driving the change. Strategies such as new first- and last-mile services, new modal options, personalized travel alerts, multimodal information integration, and advances in TDM have made it possible to provide targeted, actionable information to travelers that was not available even a few years ago.

With these advancements, the lines between what is considered TDM and what is considered traffic management are blurring. Over the last several years, the concept of active transportation and demand management (ATDM) has provided a programmatic framework to combine many of these strategies into a holistic approach to manage for reliability and improve traveler choices (figure 1).

WHAT IS THE ATDM CONCEPT?

ATDM is the real-time management, control, and influence of travel demand, traffic demand, and traffic flow through all transportation facilities (including roadways) and mass transit services to achieve operational objectives such as improved throughput, maximized system efficiency, reduced emissions, or improved safety. ATDM is achieved through the deployment of any number of active demand management, active traffic management, or active parking management approaches.

With that comes an opportunity to leverage the advancements in each area to achieve mutually beneficial outcomes. When traffic management and TDM efforts are linked, the transportation specialists can effectively manage traffic that results from travel demand, anticipate and respond to planned and unplanned events, and provide travelers with high quality information about the transportation system.

Figure 2 illustrates the nexus of these functions and identifies areas of collaboration that are possible between the two groups. At the middle of the diagram are the obvious functions that directly concern both groups. For example, both groups use pricing and incentives to influence route, time and mode choices. However, what is not immediately obvious is the connection between the seemingly unrelated functions (say traffic incident management and employer-based outreach services) in the two groups. Through effective collaboration, the impact of a specific function within traffic management can be enhanced with demand management strategies. For example, smarter work zone programs can benefit from targeted employer outreach around the work zone.

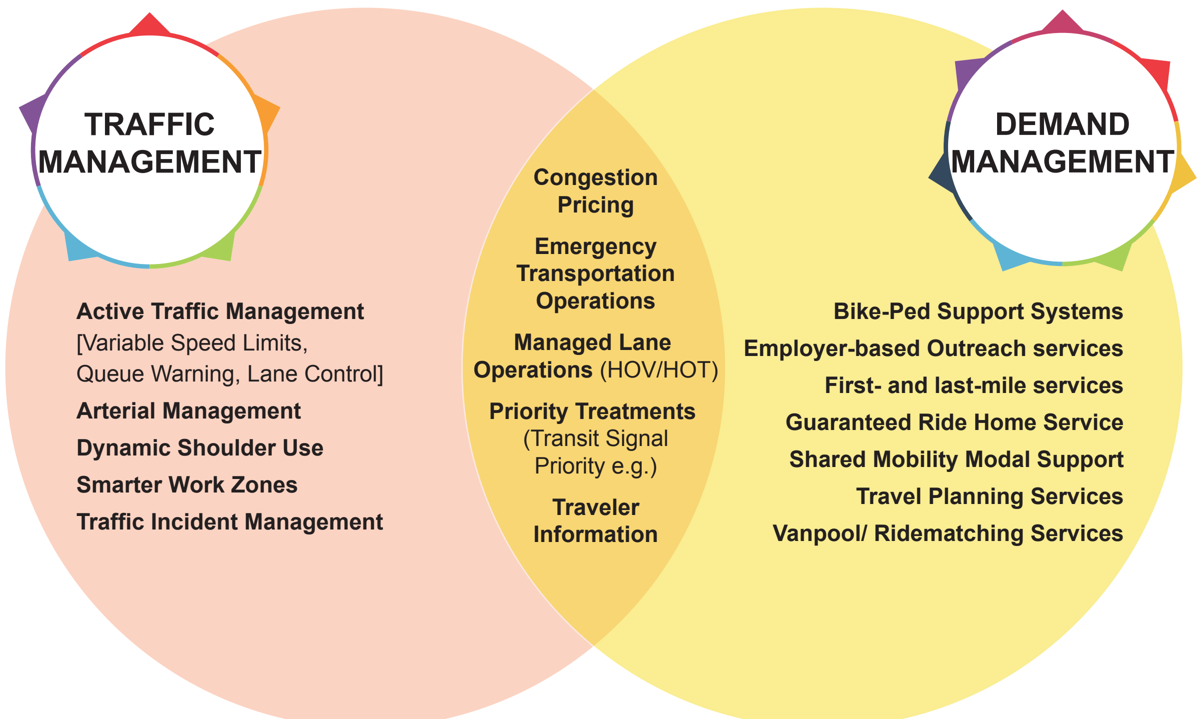


Figure 2. Illustration. The nexus between traffic management and demand management.

Historically, both TDM and traffic management have focused on recurrent congestion. In recent years, the emphasis on reliability has sharply brought into focus the non-recurrent aspect of congestion (e.g., weather, incidents, special events, and work zones). It is in this non-recurrent realm that the greatest and most immediate opportunity for demonstrating linkages for TDM and traffic management exist.

NEW POSSIBILITIES PRODUCED BY LINKING TRANSPORTATION DEMAND MANAGEMENT AND TRAFFIC MANAGEMENT STRATEGIES

Traffic managers may think that TDM efforts only provide planning-related strategies that address long-term commute reductions. This is not the case. Increasingly, TDM professionals leverage the connections they have with employers and other organizations to address short-term traffic challenges.

TDM professionals, on the other hand, may think that traffic managers are only concerned with vehicle throughput, not passenger throughput. In fact, many traffic managers are providing a variety of approaches to address traffic challenges.

Traffic managers also bring to the table real-time system conditions data and management of traffic control and restrictions, and are the providers of travel information. TDM professionals arm the traveling public with knowledge of their transportation options and may have unique, lesser-known ways and business models to get information out, especially to targeted populations (e.g., the mobility disadvantaged, employers, transit users, and the freight community).

How do these linkages play out in real life? Table 3 illustrates some potential ideas for how both groups working together can add creative new approaches to managing travel reliability.

Table 3. New possibilities to enhance travel reliability created by integrating TDM and traffic management strategies.

AREA	TYPICAL ACTIVITIES	NEW POSSIBILITIES
Construction	• Maintenance of traffic plans developed by the implementing agency, including local mitigation and traffic management practices • Outreach, varying by complexity of the project	• Temporary priority treatments for buses and HOVs • Targeted employer-based outreach • Integration of shared mobility services for first- and last- mile services during construction • Park-and-ride lot monitoring and information sharing
Weather	• Maintenance of roads • Communication of travel conditions through 511 and social media	• Advance notification of impending weather to travelers and employers • Encouraging safer options
Incidents	• Communication of incident location and status through travel information channels like 511 and social media • Local management of incidents including detours	• Local employer outreach about incident conditions • Transit impact assessment and coordination
Special events	• Parking and wayfinding information • Outreach varying by size of the event • Local traffic management including use of portable signs and temporary active traffic management	• Combination of transit access with event tickets • Parking information and reservations • Shuttle service coordination
Congestion mitigation	• Use of HOV/HOT lanes and ramp metering, and dynamic shoulder use	• Provide opportunities for travelers to carpool or utilize roads during non-rush hour traffic • Use of first- and last-mile services to support guaranteed ride home programs

For example, the following instances show the value of collaboration between TDM and traffic management:

- Working together to prioritize bus movement through a corridor during periods of highway construction. This allows for greater person throughput and includes strategies such as temporary dynamic shoulder use for specific periods for HOVs and transit.
- Enabling proactive messaging of weather forecasts on dynamic message signs to support time shifts in anticipation of bad weather.
- Temporarily monitoring park-and-ride lot availability and disseminating information during construction to increase transit use.
- Messaging employers in an area affected by a major incident (e.g., a bridge collapse).
- Targeting traveler information messaging around specific special events.
- Providing opportunities for shared use and alternate modes during periods of transit outages.

None of these examples are radical, and in fact agencies around the country routinely consider many of these techniques as they respond to pressing needs such as a winter storm, a transit strike, or a major reconstruction effort. Whether the SafeTrack in Washington, DC, the Pulaski Skyway reconstruction, or the solar eclipse, agencies are using these strategies to achieve their goals.

ABOUT THIS COMPENDIUM

This compendium presents 16 case studies organized by seven context areas. Each context represents a different scenario in which TDM and traffic management strategies could be jointly used to improve the travel experience for users, given the conditions. The contexts are:

1. Managing demand and traffic during weather events and natural disasters.
2. Linking TDM and traffic management as part of transit disruption.
3. Incorporating TDM as part of a major road reconstruction project.
4. Managing system efficiency using active demand management and active traffic management.
5. Using HOT and priority treatments for transit service enhancements.
6. Managing special events using parking, TDM, and traffic management.
7. Managing smart parking and considering local traffic management.

One to three case study examples are provided for each context and show how TDM and traffic management were linked to address a specific issue, the strategies implemented, if and how they affect a portion of the trip chain, and the unique successes of those case studies. The symbol(s) for the portion of the trip chain affected are also included at the beginning of the case study.
In addition, short vignettes or highlights of other examples of TDM and traffic management integration are also provided for each context.

INTENDED AUDIENCE AND USE

This document should be of interest to the following groups of transportation professionals in a region:

- TDM professionals working with departments of transportation (DOTs) or transportation management associations.
- Traffic management professionals working at transportation management centers and DOTs.
- Regional planners and transportation system management and operations coordinators at State and local agencies and metropolitan planning organizations.

The case studies provided in this compendium aim to spur ideas and encourage collaboration between demand management staff and traffic managers around specific areas of interest. The organization of the case studies into the seven contexts provides an entryway and motivation for these professionals to begin conversations with each other. In other words, for regions that might be considering a large construction project or anticipating a transit disruption, the case studies in the compendium provide insights on how agencies can improve their approaches to manage travel reliability during conditions when the transportation network is under stress.

In addition to providing a broad overview of approaches, reviewing the examples provided in this compendium can help regions begin the process of:

- Establishing supportive policies that allow the two groups to work together.
- Creating the ability to make temporary changes to existing programs and systems.
- Finding new communication and partnership strategies that amplify the impact of traveler-focused messaging.

CASE STUDIES

The next seven sections present the seven contexts and 16 case studies that highlight different aspects of linkages between transportation demand management (TDM) and traffic management. Table 4 provides the contexts and case studies used in the document. While no single case study or context fully illustrates all the linkages possible between TDM and traffic management, together they provide real-world examples of how agencies are leveraging these programs to support travel choices throughout the trip.

Table 4. Contexts and case studies included in the compendium.

CONTEXT	DESCRIPTION	CASE STUDIES
Managing demand and traffic during weather events and natural disasters	*Implementing traffic management strategies alongside TDM strategies to help travelers get around when weather has caused major disruptions on a transportation system*	**Case 1.** Hurricane Harvey Mobility Response—Houston TranStar
		Case 2. Utah Department of Transportation's Traffic Operations Center Use of Proactive Messaging during Weather
Linking TDM and traffic management as part of transit disruption	*Combining efforts of traffic managers who are mitigating the effects of the transit outage on the roadways and TDM professionals who can help travelers understand the range of alternative travel options available*	**Case 3.** SafeTrack—Washington, DC
		Case 4. Amtrak New York Pennsylvania Station Emergency Repair Work
Incorporating TDM as part of a major road reconstruction project	*Combining TDM and traffic management strategies to mitigate the impact of road construction*	**Case 5**. New Jersey Pulaski Skyway Reconstruction
		Case 6. Texas I-35 Freight Trip Optimization with Construction Information
		Case 7. Atlanta's I-85 Bridge Collapse
Managing system efficiency using active demand management (ADM) and active traffic management (ATM)	*Managing overall system efficiency through a combination of ADM and ATM strategies for recurring congestion*	**Case 8.** New York State Department of Transportation's Active Transportation and Demand Management Program
		Case 9. Houston's ConnectSmart Program, Funded by Advanced Transportation and Congestion Management Technologies Deployment
Using high-occupancy toll and priority treatments for transit service enhancements	*Managing demand through priority treatments for high-occupancy vehicles (HOVs)*	**Case 10.** Mopac Improvement Project (Mopac Express Lanes)
		Case 11. I-110/I-10 ExpressLanes HOV Incentives (Los Angeles County)
		Case 12. I-55 Buses on Shoulder (Chicago Region)
Managing special events using parking, TDM, and traffic management	*Linking demand and traffic strategies during special events*	**Case 13.** Union Cycliste Internationale Road World Championships (Richmond, VA)
		Case 14. Mass Transit Super Bowl (New Jersey and New York)
		Case 15. Wyoming Department of Transportation and the 2017 Solar Eclipse
Managing smart parking and considering local traffic management	*Linking parking technology and strategies to local demand and traffic management*	**Case 16.** SF*park*: Managing Parking Demand via Pricing (San Francisco, CA)

CONTEXT 1. MANAGING DEMAND AND TRAFFIC DURING WEATHER EVENTS AND NATURAL DISASTERS

More and more often, major weather events are wreaking havoc on transportation infrastructure and making it difficult for people to get around. Roads and mass transit (e.g., subway and rail) infrastructure can become flooded, covered with snow (figure 3), or blocked by debris, or can experience electrical outages and prevent limited or all travel. These issues are not problems that can be solved in hours—they often take days of cleanup and disruption of any normal schedule. And when mass transit is impacted, often a traveler's immediate solution is to jump in a personal vehicle.

Figure 3. Photo. A large snowstorm causing a traffic jam.[1] (Source: Pixabay).

CONSISTENT AND CLEAR MESSAGING ABOUT URGENCY AND IMPACT TO TRAVELERS NEEDED

A significant winter storm was forecast and occurred in Washington, D.C., on January 6, 2017. Forecasters were very clear that snow would begin between 4 a.m. and 6 a.m., which it did, and that accumulating snow would coincide with commuting times, making the commute a difficult one. However, the inability to consistently communicate urgency and impact to the travelers in the region led to significant delays and disrupted commutes. Working toward greater consistency of messaging among the public sector, private sector, National Weather Service and private meteorologists services, especially concerning urgency and impact, is necessary to effectively communicate adverse travel and road conditions on time. Greater consistency in messaging would have led to better outcomes for travelers.

Sources Used: Jason Samenow[2]

Figure 4. Photo. A subway station flooded by seawater during Hurricane Sandy (October 30, 2012).[(3)] (Source: Newsday/Metropolitan Transportation Authority/ Patrick Cashin).

If traffic management and TDM can present a more cohesive set of choices to the traveler, travelers are more likely to make more informed decisions about their travel modes, routes and times. For example, in New York City, in response to a hurricane in 2012 that caused flooding in many subway tunnels and shut down most subway operations for several days (figure 4), the city implemented high-occupancy vehicle (HOV) requirements on all of the bridges leading into the city. The purpose of this strategy was to mitigate the high volume of cars that were anticipated, given the absence of a mass transit option. Knowing this strategy, New York City TDM managers immediately worked with their contacts to communicate this policy change and encourage carpooling options, and enact contingency plans for enabling teleworking options. By knowing about this policy change in advance, TDM managers were able to construct a message to their employer contacts so that employees could be presented with teleworking opportunities as the first option.

As TDM managers and traffic managers continue to consider weather impacts on travel, they may have opportunities to collect better road data or traffic sensor data, especially on local roads or county roads. These types of data could help with analysis or predictions of how weather may impact local travel patterns, and help TDM managers and traffic managers think about how to manage demand.

The two case studies presented under this context show how important it is to implement traffic management strategies alongside TDM strategies to help travelers get around when weather has caused major disruptions on a transportation system. For both examples, it was imperative to:

- Disseminate the proper information quickly and through many sources (website viewership often jumped following a weather event).
- Find many and various ways to mitigate the initial reaction of travelers to use their personal vehicle by offering several alternative modes.

CASE 1. HURRICANE HARVEY MOBILITY RESPONSE—HOUSTON TRANSTAR

Leveraging TranStar and interagency partnerships for accelerated and coordinated information dissemination and traffic management in a rapidly changing situation

On August 25, 2017, Hurricane Harvey made landfall at San José Island, TX, as a category 4 storm. Over the following week, the storm caused catastrophic damage along the coast of Texas and Louisiana, including widespread flooding across the Houston metropolitan area. Some areas received over 40 inches of rain, hundreds of thousands of homes were flooded, more than 30,000 people were displaced, and over 500,000 vehicles were destroyed by the storm.(4)

Figure 5. Photo. Flooded street in Houston, TX.(5) (Source: Lt. Zachary West).

The breadth of flooding that occurred in the Houston area during Hurricane Harvey had widespread impacts on mobility in the region. At the height of the hurricane, over 500 State roadway closures created major challenges to public safety and mobility (figure 5). Taking advantage of existing partnerships and both the Houston TranStar (www.houstontranstar.org) and DriveTexas (www.drivetexas.org) websites, TranStar was able to provide real-time closure information to the more than 6 million residents in the region. The information was critical to public safety and mobility, and supported emergency responders throughout the event.

NOTEWORTHY PARTNERSHIP

Houston TranStar is a unique partnership (institutionalized by interagency agreements) of representatives from the City of Houston, Harris County, the Metropolitan Transit Authority of Harris County, and the Texas Department of Transportation, which share resources and exchange information under one roof to keep motorists informed, roadways clear, and lives safe in Houston. Established in 1993, TranStar manages the region's transportation system and is the primary coordination site for State, county, and local agencies when responding to incidents and emergencies.

Interdepartmental Coordination

The four agencies of the TranStar partnership each played unique roles in making sure residents received the crucial information needed to make their way safely around:

- The Texas Department of Transportation is responsible for the following operations: freeway operations, intelligent transportation systems design and special projects, media contractors, tolling support operations for SH 288, and transportation management systems.
- The City of Houston has sections of departments working from TranStar to support transportation and emergency management: the Traffic Signal Section, the Police Command Section, and various other key personnel.
- Harris County, which covers 1,788 square miles, has several departments working from TranStar: the Traffic Signal Section, the Sheriff's Office Motorist Assistance Patrol Unit, the Office of Homeland Security and Emergency Management, and the Office of Emergency Management.
- The Metropolitan Transit Authority of Harris County (METRO) has been providing the mass transit operations for the Houston region for many years. METRO has helped TranStar become a truly multimodal operation, with three operational sections conducting business at the center: HOV Operations, Police Dispatch, Bus Operations, and Rail Operations. METRO also supports TDM by providing the most up-to-date storm impact estimations and advice to METRO, which is responsible for orchestrating the region's vanpool program of nearly 6,000 users.

Rt Strategies Providing Route Choice

The primary challenge during the flooding was a lack of road closure information on county roads off the State system. The team held daily conference calls to document flooded roadways, and then TranStar and DriveTexas uploaded that information to their sites to communicate information to the traveling public and emergency personnel. The team also communicated with media outlets about the flood conditions and how they were expected to impact travel.

Successes Supportive of the Integration of Transportation Demand Management and Traffic Management

The TranStar partnership had the following successes:

- The real-time road closure information likely contributed to minimizing the number of deaths on flooded roadways. Traffic to the Houston TranStar website far exceeded that experienced for previous flood events. Usage topped 3 million unique users during the 12-day period, with a peak of over 30 million visits compared to 4 million during a typical time frame. Sometimes, the public agency's website is *the* source that the public trusts and uses, so the information on such a website can and should provide the information the traveling public needs, especially if the ideal scenario is a shift to non-single-occupancy vehicle modes.
- The extensive communication with media outlets about flood conditions likely increased the exposure of Houston TranStar and the availability of traveler information on its website. It is likely that that exposure will encourage citizens in the region to think of TranStar first when looking for traveler information in the future.

D T Rt

CASE 2. UTAH DEPARTMENT OF TRANSPORTATION'S TRAFFIC OPERATIONS CENTER USE OF PROACTIVE MESSAGING DURING WEATHER

Sharing anticipated weather information to traveler information leads to shifts in travel behavior

Utah has a mixture of remote roads and population centers, and a medley of extreme weather situations throughout the year. To manage the many different types of roadway warnings into a cohesive management system, the Utah Department of Transportation (UDOT) uses its Traffic Operations Center (TOC), a suite of 150 variable message signs (VMSs), social media, UDOT's website, and 511 phone service. UDOT developed a sophisticated system that identifies real-world conditions and events and then translates them into useful messages that can alter travel behavior. A traffic control room manager heads UDOT TOC and oversees the control room operators. These operators actively monitor traffic conditions and implement real-time messaging on current and forecasted road conditions. UDOT has a close relationship with the National Weather Service (NWS) to integrate weather impacts into its traffic analysis. An established VMS policy governs all VMS messages.[6] VMS messages are locally tailored and include predictive warnings and route guidance (figure 6). Messaging is used frequently in advance of high traffic demand periods and extreme events as a means to mitigate and disperse traffic, both geographically and temporally. Historically, the messaging has also been engaging and humorous to capture drivers' attention.

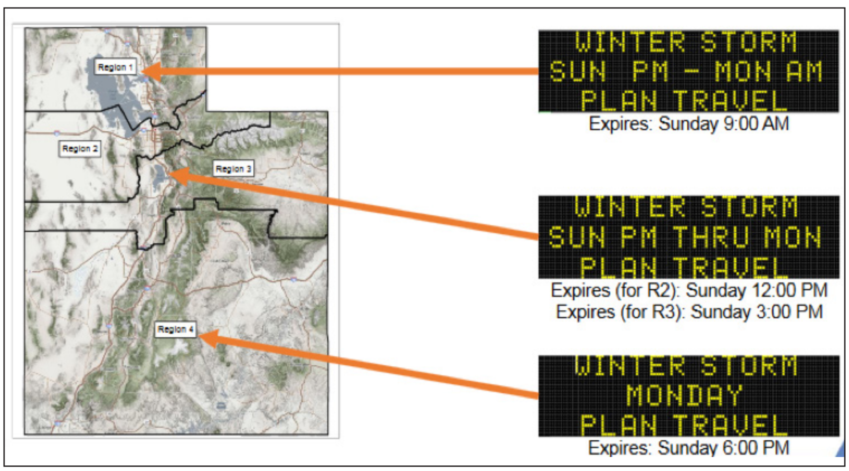


Figure 6. Map with illustration. Three VMSs alerting travelers to an upcoming winter storm. (Source: Federal Highway Administration).

Through its proactive messaging strategies on its various platforms, TOC has helped move travel demand to times before or after anticipated bad weather, thereby mitigating the worst possible congestion during major events. Various studies have seen that travel demand has shifted to avoid disruptive weather events, such as analysis showing a 40 percent volume decrease at a peak time.[8] Previously, NWS had operated independently, sometimes creating incongruous messaging to motorists. Now, NWS actively collaborates with in-house UDOT meteorologists to provide clear, consistent messaging about weather-related road conditions.

As a first step in the process of posting VMS messages, UDOT hosts a TOC weather briefing with 10–30 operational managers one to three days prior to every major event. Following the meeting, the weather program manager, control room manager, and travel information manager decide on an exact course of messaging, tailoring messages to specific areas. TOC also leverages a robust signal timing program to guide traffic and optimize traffic flow. The vast majority of signals are connected with fiber, allowing for real-time adjustments, which are controlled by TOC. **Since the incident monitoring, weather monitoring, VMS posting, and traffic signal timing adjustments are all run out of the same office, the process to translate conditions into immediate messaging and signal adjustments is very streamlined.**

NOTEWORTHY STRATEGY
Collaboration between in-house staff and NWS is valuable for consistent messaging to the public when weather is expected to impact travel.

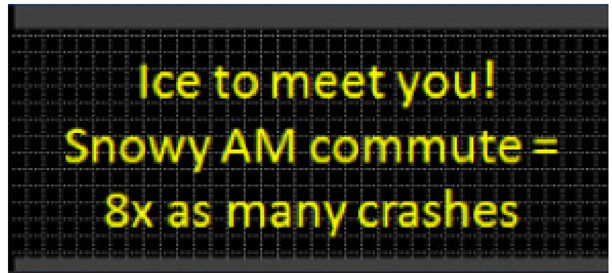
WYOMING ROAD CONDITION REPORTING APPLICATION

In 2015, the Wyoming Department of Transportation successfully implemented a road condition reporting application to improve the way maintenance staff report weather-related road conditions from the field to the statewide transportation management centers (TMCs). The app involves proactive traffic advisories and control and treatment strategies in direct response to roadway issues related to forecasted or deteriorating weather conditions. The project included the development of a new tablet-based software application. Department of transportation maintenance personnel use the app to report road weather information to the TMC, recommend variable speed limit changes, report snow performance measures, and report crashes and road hazards. In addition, the app shares information with maintenance employees, including the road conditions that are reported to the public, variable speed limit information, weather information, messages posted on dynamic message signs (DMSs), and map-based asset location information. A Federal Highway Administration (FHWA) review report notes that use of the app improved the effectiveness and efficiency of road condition reporting and TMC activities during weather events.

Sources Used: Roads and Bridges.[7]

Strategies Providing Destination Choice

By alerting users of when adverse weather conditions will be at their worst, UDOT may convince travelers to stay off the roads entirely or choose an alternate destination. Pre-event messaging is disseminated in the days and hours leading up to events such as snowstorms, thereby encouraging people to stay off the roads during the event. Figure 7 shows an example message that encourages travelers to stay home if possible.



It's going to be a snowy commute tomorrow morning. Join thousands of other savvy commuters in shifting your commute time, taking mass transit, or staying home. You've got options.

Figure 7. Illustration. Proactive messaging examples on VMS and UDOT website. (Source: Federal Highway Administration).

Strategies Providing Time Choice

VMS pre-event messaging is even used on a local scale to help make routing decisions. For example, messages are posted on roadways leading to ski destinations to encourage visitors to leave before an afternoon or evening storm arrives.

Strategies Providing Route Choice

Messages are sometimes simply vague guidance or information for the traveler to consume but sometimes go so far as to recommend specific alternate routes that travelers should take.

Successes Supportive of the Integration of Transportation Demand Management and Traffic Management

UDOT had the following successes:

- The UDOT executive director trusts TOC to successfully determine and implement DMS strategy, which allows TOC to move quickly without waiting long for buy-in.
- Having meteorologists on UDOT's staff allows for faster and more reliable weather information, thereby improving messaging.(9) This also hastens the process of turning weather forecasts into directives for maintenance staff.
- Pre-event DMS messaging is used frequently in advance of high traffic demand periods.

CONTEXT 2. LINKING TRANSPORTATION DEMAND MANAGEMENT AND TRAFFIC MANAGEMENT AS PART OF TRANSIT DISRUPTION

When an area relies heavily on transit services as a key option for transporting people to and from their destinations, loss of transit can put enormous pressure on the roadways as travelers choose to use a single-occupancy vehicle (SOV) as an alternative. Traffic managers recognize that transit disruptions lead to not only an increase of vehicles on the roadways, but possibly an increase of bicycles and pedestrians too. Providing the safe infrastructure to accommodate everyone and making sure travelers know about those alternatives are important. This effort requires the combined effort of traffic managers who are mitigating the effects of the transit outage on the roadways and transportation demand management (TDM) professionals who can help travelers understand the broader range of alternative travel options available.

Planned transit disruptions can run the gamut of bypassing a small number specific stations or stops for a short number of days, to having an entire line or lines suspended for several months. Regardless of the duration or severity of the disruption, travelers must find an alternative way to travel, and the key is to help them avoid SOV travel as much as possible.

When traffic managers and transit service operators put together a response to a planned transit disruption, they look at where the diverted transit passengers will go. Based on these assessments, example alternatives they may implement include:

- Offering a substitute mass transit mode that services roughly the same area.
- Implementing temporary high-occupancy vehicle (HOV) requirements.
- Implementing temporary bus priority lanes.
- Expanding bicycle and pedestrian infrastructure.
- Considering creative partnerships with shared mobility providers to address first- and last-mile impacts.

The two case studies for this context show how linkages between TDM and traffic management have been used during planned transit disruptions. SafeTrack in Washington, DC, had planned transit outages spread over one year and coordinated with other agencies to provide reliable transit service when possible to mitigate road congestion. During the emergency fixes at New York's Pennsylvania Station, park-and-ride lots were promoted to encourage transit and carpool use.

Having the alternatives identified and implemented to address the supply aspect is important, but if travelers are not aware of the changes, or if the changes also affect the upstream or downstream portion of their trip, the alternatives may not provide the anticipated relief. This is where TDM managers must be integrated into the planning process.

TDM managers are familiar with the whole gamut of transportation options available in an area, have connections to employers who may be most impacted by disruptions, and can offer various incentives from their toolbox to encourage travelers to use the alternatives. TDM managers can drill down to the individual level and help that person understand all the options.

COLLABORATING TO PROVIDE STRATEGIES TO ACCOMMODATE A MAJOR TRANSIT DISRUPTION

In 2019, the Metropolitan Transportation Authority is planning to suspend a large portion of the L train subway line in New York City for 15 months to repair damage caused by a 2012 hurricane. This subway line shuttles passengers between the Manhattan and Brooklyn boroughs and, as one of only three lines between these two boroughs, services almost 400,000 daily riders. The suspension will affect an estimated 275,000 riders. Different agencies, including the Metropolitan Transportation Authority and the New York City Department of Transportation, are looking at different strategies to accommodate the diversion of these riders to other modes, including expansion of bicycle and pedestrian facilities, bus-only access, and shuttle service. The TDM professionals supporting the New York City area have already been discussing contingency plans with employers affected by the suspension and encouraging use of the TDM program's incentives, such as the Guaranteed Ride Home program and aid in developing teleworking, vanpooling, and commute programs. While it is inevitable that the overall transportation system will be stressed during the L train suspension, problems can be eased if strategies are put into place to accommodate a variety of transportation modes, people are made aware of these accommodations, and they find it easy to switch to an alternative during the suspension.

Sources Used: New York City Department of Transportation.[(10)]

If TDM managers are involved at the planning stage, they can bring:

- Partnership opportunities with vanpools.
- Contingency planning ideas for employer partners.
- Unique ways to communicate with travelers in a specific region.

D M Rt T

CASE 3. SAFETRACK—WASHINGTON, DC

All hands on deck to provide a variety of alternatives during a long-term transit service suspension

In summer 2016, the Washington Metropolitan Area Transit Authority (WMATA) initiated SafeTrack, "an accelerated one-year track work plan to address safety recommendations and rehabilitate the Metrorail system (also known as Metro) to improve safety and reliability."[11] The process included 16 surges—one to two week-long track outages for major projects at various points in the Washington (DC) metropolitan region's Metrorail (subway) system. Prior to SafeTrack, improvement projects were uncoordinated and rail system reliability and schedule adherence dipped in part because of poor track maintenance.

This necessary repair effort meant that Metro passengers faced significant closures and delays, and ultimately were pushed toward other modes, including SOV travel, potentially exacerbating the region's existing congestion and affecting travel reliability across all modes for many months. The planned nature of these outages allowed WMATA, the Metropolitan Washington Council of Governments (MWCOG), and a host of state and local government partnering agencies to plan creatively to inform travelers of the routes and stations affected in each surge, provide bus, carpool, bike, and walk options, and provide a measure of reliability for Metro riders who would need or choose to continue using Metrorail.

Given the vital role that the Metro system played in Washington, DC's transportation system, no single alternative could have accommodated the spillover. Instead, the situation required a mixture of both traffic management and TDM responses and an ongoing coordinated effort of many state and local transportation agencies and transit service providers.

WMATA, along with a large array of partners, such as MWCOG, the District Department of Transportation (DDOT), the Virginia Department of Transportation (VDOT), and city and county governments, and local commuter assistance organizations worked diligently to provide thorough and timely information on the expected rail system delays and available travel alternatives (figure 8). These partners posted SafeTrack information on their websites, provided links to WMATA's website, geo-targeted messaging to residents in

Figure 8. Photo. WMATA tie replacement during SafeTrack maintenance.[12] (Source: WMATA).

affected areas, and conducted outreach to employers, property managers, residents, and others in their individual networks through both traditional media and social media channels.

To coordinate outreach and service efforts and share information, WMATA and MWCOG organized regular conference calls of the SafeTrack Work Group, comprised of representatives of governments and transportation organizations in the affected jurisdictions. Held one to two weeks before the start of each surge, team members reviewed ridership reports and WMATA's plans for the upcoming surge, debriefed on the results of informational and mode shifting initiatives from the previous surge, and reported on strategies their organizations planned for the upcoming period.

Overall, more than 500 WMATA staff were involved in the effort, along with many others from other agencies. Since SafeTrack began, there has been a 45 percent reduction in hours of service disruption, compared to previous improvement projects.

D Strategies Providing Destination Choice

Expanded telework provided commuting relief for some workers. For example, the Federal Office of Personnel Management published guidance for federal agencies to evaluate if and how to offer teleworking to federal employees during surges.(13) The Washington, DC, government developed telework plans tailored to employees based upon their commutes.(14) VDOT, which sponsors the Telework!VA program, and county governments also encouraged local businesses to implement teleworking programs for their employees, with one county even hosting webinars to guide businesses in this process.(15)

NOTEWORTHY STRATEGY
The hours for street parking restriction were extended to keep lanes open to accommodate more traffic later in the day.

T Strategies Providing Time Choice

WMATA's Trip Planner webtool was updated to include information from each maintenance cycle to include adjusted travel time suggestions. To reduce congestion from drivers looking for parking spaces, DDOT extended street parking restrictions in busy bus corridors by 30 minutes: restrictions were in place from 7 a.m. to 10 a.m. (rather than their normal ending time of 9:30 a.m.) and 4 p.m. to 7 p.m. (rather than their normal ending time of 6:30 p.m.).(16) Local government restricted its designated core hours for employees, giving them more flexibility to schedule their commutes outside the peak congested times.(17)

M Strategies Providing Mode Choice

One primary method employed to compensate for lost Metro service miles was to steer travelers to other modes. MWCOG, local governments and commuter assistance organizations, and county and city transit providers coordinated to provide travelers with alternate modal options during times of decreased service. MWCOG and commuter organizations provided information about bus and commuter rail transit, carpooling, vanpooling, and casual carpooling ("slugging"); several local governments expanded bikeshare and bike support services. DDOT provided information about carsharing, bikesharing, and other transit modes on its webpages and in public announcements. One of the options was a social carpooling app created by MWCOG. The app, Carpoolnow, was launched during the SafeTrack project.

DDOT also added a cheaper option for Capital Bikeshare users (a $2 trip option instead of $8 per day), and surrounding city governments added bikeshare stations at subway stations unaffected by surges, thereby making it easier to commute via an alternate line. Further, temporary allowances were made for cab drivers to pick up multiple unaffiliated riders within 1 mile of a subway station, essentially allowing them to function similarly to UberPOOL or Lyft Line. Usually, cab drivers are not allowed to group strangers together in one vehicle for a shared trip.

Adjustments to transit service and operations also helped to replace lost subway service by providing an alternative mass transit option. Bus systems in Alexandria, Arlington County, and Fairfax County (Fairfax Connector), Prince William County (PRTC OmniRide), Montgomery County (RideOn), and commuter rail and bus systems all added service for the surges that affected riders in their areas, DDOT extended the D.C. Circulator's operating hours until 3 a.m. on weekends to make up for Metro's early closing, and WMATA added additional shuttle routes at targeted locations that had reduced rail service, basically running shuttles in parallel to the rail routes for affected segments. (See for example reference[18].)

Rt Strategies Providing Route Choice

DDOT also implemented a moratorium on construction work on key corridors during SafeTrack updates, to improve traffic flow at these already-strained times. VDOT monitored traffic operations on state roads in the affected areas and adjusted signal timing to improve traffic flow. VDOT also reinforced HOV lane enforcement to encourage carpooling.

Success Supportive of the Integration of Transportation Demand Management and Traffic Management

The SafeTrack Work Group, run by Commuter Connections at MWCOG, was instrumental in assisting local governments to coordinate cross-border efforts and make adjustments in their transit systems. For example, Fairfax County was able to adjust its bus routes to utilize an existing HOV lane network on an alternate roadway. This method of replacement for lost rail service was generally positively reviewed by riders. Inter-organizational familiarity and relationships, fostered largely through MWCOG activities, made it easier for authorities to collaborate during SafeTrack.

Additionally, several previously-existing MWCOG regional coordinating committees, such as the Transportation Emergency Preparedness Committee, Regional Public Transportation Subcommittee, Bicycle and Pedestrian Subcommittee, and Management, Systems Management, Operations, and Technology Subcommittee served as forums for regional information exchange, an opportunity to provide information to local elected officials, and collect and share travel data.

CITY OF OTTAWA, CANADA, TRANSIT STRIKE IN 2008

In late December 2008, drivers and maintenance workers with Ottawa-Carleton Transportation Commission, Ottawa's transit authority, went on strike for more than 50 days during some of the coldest weather of the year. At the beginning of the strike, the City of Ottawa launched a series of initiatives, with substantial focus on active transportation and carpooling, to help commuters cope with the loss of transit. The city provided the OttawaRideMatch.com ridematching website and erected new signage for meeting spots for carpools at park- and-ride lots and along bus-only lanes in the downtown. The city opened 3,000 additional all-day parking stalls in previously one- to three-hour unmetered parking spots and discounted parking rates for carpoolers at all of their municipal parking lots. To provide options for active transportation, the city expanded snow- and ice-clearing efforts to provide a higher standard of safety for walkers and cyclists, and OttawaRideMatch.com modified its website to allow people to search for walking and cycling partners. The city opened a portion of a bus-only lane on Highway 174 to improve traffic flow from the eastern portion of the city.

Sources Used: City of Ottawa, Urban Transportation Showcase Program, Issue Paper 75.

D M Rt L

CASE 4. AMTRAK NEW YORK PENNSYLVANIA STATION EMERGENCY REPAIR WORK

Multi-pronged mitigation plan brings together different agencies to manage travel disruptions

In summer 2017, Amtrak was forced to make emergency repairs to rail lines into and out of New York Pennsylvania Station (Penn Station), which caused the cancellation or diversion of 15 morning rush hour trains of the Metropolitan Transportation Authority (MTA) Long Island Railroad (LIRR) service and impacted approximately 9,600 riders.[19] To facilitate a coordinated response to this event, New York Governor Andrew M. Cuomo established the Penn Station Task Force, which included representatives from the New York State Department of Transportation (NYSDOT), New York City Department of Transportation, New York State Congressmen, Nassau and Suffolk County Executives, and other key stakeholders. The Task Force increased collaboration among the agencies and stakeholders to help develop the mitigation plan.

MTA, with support of the Penn Station Task Force, developed a multi-pronged mitigation plan to manage travel during the construction. MTA provided several alternative transportation options to accommodate rush-hour passenger capacities and reduce delays. NYSDOT coordinated multiple roadside and traffic management actions to reduce road congestion as well as TDM, outreach, and marketing efforts through the 511NY Rideshare TDM outreach program. NYSDOT documented these efforts in the *Pennsylvania Station Emergency Repair Work Traffic Management Playbook* (figure 9). A robust public awareness campaign communicated these efforts and ensured commuters had the information needed to plan ahead.

2. List of Traffic Management Strategies/Actions

To support MTA, the following actions/strategies will be in place. Please click on each strategy for implementation details. Click on the hyperlink to go directly to the strategy

Number	Strategy	Status (Operational/Planning/Available)	Last Updated
2.1	Emergency Local Patrol (HELP) Coverage and Frequency Expansion	Operational	7/7/2017
2.2	Pre-deployment of maintenance crews and tow trucks	Operational	6/28/2017
2.3	Traffic signal timing adjustments	Operational	7/6/2017
2.4	Messaging on Variable Message Signs	Operational	7/7/2017
2.5	HOV Enforcement	Operational	7/6/2017
2.6	Park and Ride Lot monitoring and messaging	Operational	7/12/2017
2.7	Incident Command Structure and Staffing	Operational	7/13/2017

Figure 9. Screenshot. A sample of strategies included in NYSDOT's traffic management playbook.[20] (Source: NYSDOT).

After the strategies were carried out, most commuters chose to continue commuting by train on altered routes with expanded capacity. One month after the construction started, MTA reduced the temporary express bus and ferry services to reflect consumer demand. The construction turned out to be less disruptive than anticipated. **The planning and collaboration among the agencies and stakeholders to execute the mitigation plan prevented major disruptions.** After eight weeks of construction, normal train service resumed. Overall efforts by various agencies resulted in positive reaction to what was dubbed the "summer of hell." *The New York Times* ran an article titled "Summer Was Not So Hellish for Commuters at Penn Station."[21]

D Strategies Providing Destination Choice

Mass transit was still a desired mode choice, but it was important to try to alleviate usage across the different mass transit lines. MTA offered a 25 percent fare reduction to passengers traveling to alternate LIRR stations including Hunterspoint Avenue in Queens and Atlantic Terminal in Brooklyn.

NYSDOT staffed 14 express bus and park-and-ride lots to monitor parking capacity. Parking status updates were reported to NYSDOT's transportation management center and MTA's Emergency Operations Center key staff every 30 minutes. Over 100 message signs were temporarily placed at key locations to inform motorists of traffic restrictions and real-time express bus and park-and-ride lot parking capacities.

M Strategies Providing Mode Choice

To accommodate commuter capacities, MTA established several transportation alternatives including a modified train schedule, free LIRR-to-subway transfers, and the creation of a temporary bus and ferry network. MTA even lengthened trains with additional cars. MTA facilitated a widespread, multi-channel information campaign throughout the summer including mailings to employers to inform them of the service changes, informative commercials and newspaper advertisements, flyers on every seat of the LIRR, electronic messages direct to customers via text and email, social media announcements, and a significant increase in the number of LIRR representatives on trains and at stations. Both MTA and 511NY Rideshare maintained dedicated websites for the event, with up-to-date information about service changes and transportation alternatives, and communicated with employers to inform them of the service disruptions and alternative mode options. 511NY Rideshare also promoted its ridematching services and park-and-ride lot information to encourage carpooling, and added telework resources to inform travelers about the mode.

Rt Strategies Providing Route Choice

MTA implemented half-price tolls for trucks at all MTA crossings from 10 p.m. to 5 a.m. to encourage off-peak travel. The New York Governor's Office announced that all non-emergency road construction was suspended from 5 a.m. to 10 p.m. and that all lanes would remain open on major roadways in the New York City area.

L Strategies Providing Facility or Lane Choice

To encourage use of the HOV lanes as a way to reduce congestion, NYSDOT implemented messaging to remind motorists of the HOV regulations.

Success Supportive of the Integration of Transportation Demand Management and Traffic Management

During these emergency repairs, NYSDOT shared, for the first time, real-time parking lot capacity updates with motorists. The data were also shared across agencies. 511NY Rideshare fed the data to its park-and-ride lot map tool. Customers were able to easily check parking lot capacities and consider carpooling.

CONTEXT 3. INCORPORATING TRANSPORTATION DEMAND MANAGEMENT AS PART OF A MAJOR ROAD RECONSTRUCTION PROJECT

Typically, when roadway reconstruction activities are being planned, traffic managers plan a host of diversions, detours, and other roadway-based alternatives to alleviate the impacts from a closed or limited-access road. When the reconstruction project is anticipated for a long duration (from several weeks to several years), any opportunity to reduce the number of vehicles on the road at any given time can help alleviate the congestion induced by construction. Active traffic management can do this by providing real-time information such as camera views of traffic, anticipated travel times on variable message signs (VMSs), or even text message alerts customized to a traveler's specific route. Transportation demand management (TDM) professionals look at all the different modes available to travelers and help them find the best one to take, in light of construction activity.

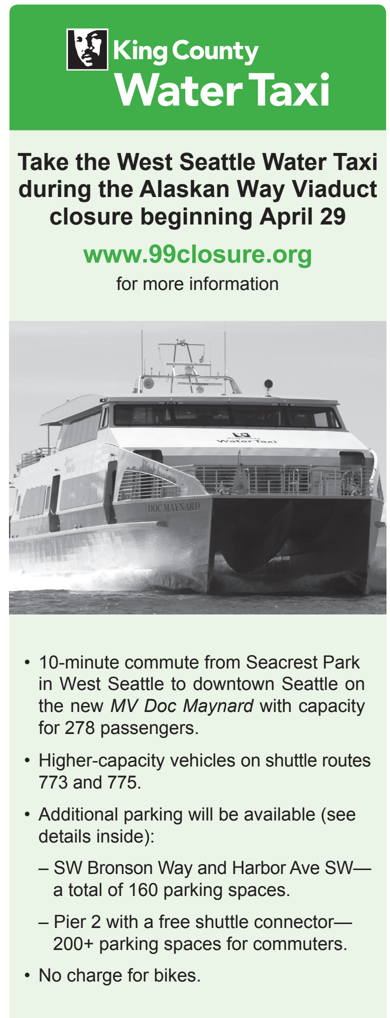


Figure 10. Excerpt from a pamphlet. Increased ferry service during a major road reconstruction project.[22] (Source: King County).

An example of where TDM and traffic management have been linked in an attempt to better mitigate the impacts of a major construction project is the Alaskan Way Viaduct Replacement Program in Seattle, WS (figure 10). This project included full closure for two weeks of a vital artery through the heart of Seattle. The Viaduct Program website provides real-time information related to traffic in the region (via Twitter feed) and construction and lane closure information to users. Because the Seattle Terminal and ferry dock are impacted by this program, the ferry section of the Washington State Department of Transportation website (and Twitter feed) provides comprehensive information related to ferry operations, including live camera feeds, real-time vehicle holding space capacity, and other information to help travelers make the most appropriate choices related to trips—including times—involving the ferries. King County also increased its water taxi service and expanded parking to an additional 200 parking spaces (with free shuttle connector) to accommodate more water taxi passengers.

The case studies in this chapter show different ways to share and disseminate construction-related information to travelers so they can use it to make the most informed travel decisions. In the New Jersey Pulaski Skyway Reconstruction, the State DOT and other agencies needed to mitigate the impacts from a complete shutdown of traffic going one way for almost two years, and it would not have been prudent to just find ways to divert existing traffic. In the Texas I-36 Freight Trip

Optimization project, the construction heavily affects a popular freight corridor, so providing real-time information is instrumental in helping freight managers and drivers determine the best time for their trip. In the Atlanta I-85 bridge collapse and recovery, the emphasis was on rapid response to an unanticipated event.

For any reconstruction project, providing as much information ahead of the project and during the project is crucial to help travelers plan ahead and around the construction, but could also help travelers see what the final impacts of the construction could be once regular travel resumes. To help travelers make informed decisions on all aspects of their trip chains, information should include road-related information (e.g., real-time traffic information and lane closures), travel options via other modes, other travel times, and even alternative destinations. It is also equally important that either traffic management decisions are relayed to TDM managers as soon as they are made, or TDM managers are included in the conversation about those decisions. TDM managers have not always been informed of these decisions, and there are opportunities to leverage TDM managers' local knowledge to appropriately message traffic management decisions to the right audiences.

Figure 11. Photo. Traffic directed through a work zone.[23] (Source: Michigan Department of Transportation).

For Las Vegas, Nevada's Project Neon construction project to widen a 3.7-mile section of I-15, RTC partnered with Waze, a real-time traffic app, to share information on Project Neon traffic and alternative route options. Under this partnership, RTC, which operates transit in the region, feeds the Waze app travel speed and incident data. Waze incorporates the data into its traffic and speed travel algorithm and reports the most efficient current route to Waze users. RTC also benefits from this partnership: Waze shares crowdsourced incident response data with RTC, adding new information to help RTC better understand regional travel patterns.

CASE 5. NEW JERSEY PULASKI SKYWAY RECONSTRUCTION

Mitigating the impact of complete shutdown of northbound traffic on a major connector

Since April 2014, the New Jersey Department of Transportation (NJDOT) has been undertaking a $1.5 billion rehabilitation program of the Pulaski Skyway, a four-lane bridge-causeway on US Route 1/9 in northeastern New Jersey. The 3.5-mile-long bridge crosses two rivers, connects Newark and Jersey City with the New Jersey Meadowlands sports complex, and serves as a link to Newark Airport and New York City (via the Holland Tunnel).

Figure 12. Photo. Center ramps closed to traffic, providing access to construction and emergency vehicles.[24] (Source: NJDOT).

From the start, the project was anticipated to cause significant travel disruption. Prior to the construction, the roadway carried 67,000 vehicles daily, including 10,500 northbound vehicles during the 6:00 a.m. to 9:00 a.m. peak period. More than 60 percent of the northbound traffic was destined for employment destinations in the Jersey City waterfront or New York City. Following discussions with other transportation organizations and local officials, NJDOT selected a construction approach to completely shut down northbound traffic for approximately two years while the existing deck was replaced (figure 12). Two southbound travel lanes were maintained during this phase. This approach was chosen because it was expected to reduce the duration of the construction work, avoid overlap with night and weekend construction closures on other roads, and minimize commuter confusion, safety issues, and daily backups that would have resulted from an approach that implemented daily lane reversals.

NJDOT served as the lead organization and was responsible for overall project planning, coordination with other organizations, and management of the construction. Due to the broad range of road users, including commercial/freight, commute, tourist, and local travelers, NJDOT conducted extensive coordination and outreach, beginning nearly two years before construction began. NJDOT communicated with major stakeholders, including NJ Transit, the Port Authority of New York and New Jersey (PANYNJ), New Jersey transportation management agencies, the North Jersey Transportation Planning Authority, and the New Jersey Turnpike Authority. NJDOT also held informational meetings with municipal and county elected officials, business groups, State legislative committees, port and trucking freight operators and users groups, and citizens groups.

Due to the high traffic volume on the road and the number and importance of destinations served, NJDOT along with NJ Transit, PANYNJ, and numerous other organizations implemented numerous traffic mitigation and TDM strategies to address traffic impacts during the construction. This integrated approach was to be expected, given NJDOT's Traffic Mitigation Policy and corresponding guidelines, which together guide the selection and implementation of traffic mitigation and TDM activities for road construction projects. Under the policy, which was developed in 2007, traffic mitigation is integrated throughout the project concept and planning stages, and NJDOT develops an individual transportation management plan (TMP) for each project. High-impact, multi-phase construction projects, such as the Skyway, receive extensive coordination, with a transportation management task force to facilitate intra-DOT and cross-agency coordination. A TMP task force for a high-impact project typically includes numerous NJDOT bureaus, transit agencies, other State transportation authorities, police and emergency services, elected officials, and business, commercial, and citizens groups. The Pulaski Skyway opened in July 2018, so the project has not yet undergone an overall traffic mitigation evaluation.

T Strategies Providing Time Choice

During the reconstruction project, several strategies were implemented to help travelers decide when to travel. NJDOT temporarily located 40 VMSs at strategic points to provide current trip time information to help motorists choose the fastest route for their current trip. The transportation management associations (TMAs) offered commuters short message service traffic alerts customized for the routes they used regularly. They also worked with employers, particularly those located in the Hoboken and Jersey City waterfronts, to develop telework and commuter flextime programs to shift travel out of the peak travel period.

NOTEWORTHY STRATEGY
A traffic mitigation policy and guidelines integrate traffic mitigation and TDM strategies into a reconstruction project concept and planning stages.

M Strategies Providing Mode Choice

Communication and outreach were essential elements to providing transportation options during this closure project. TMAs and transit agencies offered online and individual assistance to commuters to identify mode options and transit itineraries (NJ Transit, Port Authority Trans-Hudson trains, ferries, and private buses). Two TMAs had a central role in commuter and business outreach for the project. Hudson TMA and Meadowlink worked extensively with employers and commuters to identify alternative travel options, encourage taking a trial run of various options prior to the closure, provide links on their websites to transit, ferry, and other travel alternatives. The TMAs offered ongoing information on road detours and transit route adjustments through their websites and text message alerts, while NJDOT created a Pulaski Skyway Rehabilitation website, with accompanying television and radio advertisements to inform travelers of project progress, detours, alternate routes, and travel mode options. NJDOT, the TMAs, and media outlets provided information about NJDOT's 1-800-245-POOL ridematch service to help commuters form carpools.

NJDOT and the Hudson TMA worked with two ferry operators to develop and promote ferry options for coastal commuters traveling to the New Jersey waterfront and lower Manhattan destinations. NJDOT and PANYNJ even contracted with one of the operators for new ferry service for the duration of the construction. The various transit service providers expanded their rail and bus seating and service capacity, some particularly focusing on increased capacity during peak periods.

Success Supportive of the Integration of TDM and Traffic Management

The close coordination and partnerships between NJDOT, the TMAs, and the various mass transit service providers in the area enabled each agency to leverage each other's information on their own communications channels (e.g., websites, television, radio, and text message) and also find opportunities to enhance multimodal options for travelers in the corridor, even if they were temporary options. By offering a wealth of alternatives to use while the Pulaski Skyway was closed, the agencies helped spread travelers across many modes.

NOTEWORTHY STRATEGY
A $325 monthly subsidy for new vanpools was created during the construction project phase.

DISTRICT OF NORTH VANCOUVER—DEVELOPMENT CONSTRUCTION TRAFFIC MITIGATION PLANS

In an effort to minimize traffic disruption in communities affected by building construction activity, the District of North Vancouver established guidelines for development of Construction Impact Mitigation Strategies (CIMS). The objective of CIMS is to provide safe passage for pedestrians, cyclists, and personal and transit vehicle traffic around construction sites with minimal inconvenience, impact, and delay. The guidelines particularly focus on strategies and steps to maintain safe access for pedestrians and cyclists, preserve and improve transit access, and develop early communication and coordination with a wide range of business, resident, and community stakeholders. CIMS requires developers to provide a plan that maps sidewalks, bike paths, and transit routes around the site; describes the likely impact of construction on travelers of each mode; defines mitigation measures that will be implemented to minimize mobility impacts; outlines stakeholder communication approaches and coordination with neighboring communities; and describes monitoring activities to ensure that the plan is effective.

Source: District of North Vancouver.[25]

Rt T CASE 6. TEXAS I-35 FREIGHT TRIP OPTIMIZATION WITH CONSTRUCTION INFORMATION

Combining two data-sharing systems to provide information to help freight route or time choice

Since 2010, the Texas Department of Transportation (TxDOT) has been constructing improvements to 96 miles of the I-35 corridor between Salado and Hillsboro in Central Texas, expanding the facility from four-lane freeway sections to six-lane sections in rural areas and to eight-lane sections in Temple and Waco, TX. The corridor is a critical freight corridor through Texas. The construction project's length, rural environment, and influence on multiple jurisdictions create a unique challenge to traffic operations and traveler information. Throughout the construction, TxDOT has embraced the use of intelligent transportation systems to provide innovative traveler information to the driving population. Construction is complete on some parts of the corridor, with additional segments anticipated to be complete in 2019. Several years of additional expansion efforts though Waco are expected to start in late 2019 (figure 13).

The Federal Highway Administration (FHWA) is working with interested transportation agencies to make information available that allows trucking companies to more efficiently schedule and route their truck movements to avoid delays, through a system known as the Traveler Information during Construction (TIDC) data feed, which was integrated with FHWA's freight data program, the Freight Advanced Traveler Information Systems (FRATIS) program. For the I-35 project, this combined system provides information on current and forecasted travel conditions across multiple construction zones on I-35 with a focus on construction-related impacts. Information provided includes lane closures, estimated lane closure impacts, current roadway conditions, comparative travel time for alternate routes, and incidents. This project will help freight managers and drivers make the best route or time choices.

Prior to the launch of the project, trucking firms must obtain traveler information through a variety of independent sources and compile that information manually to incorporate into their corporate systems. The pilot project for the FRATIS-TDIC effort assembles multiple information sources and types to prepare a freight-carrier-specific distribution for consumption by dispatch and/or drivers. This additional and non-publicly available information enhances their trip planning, routing, and overall efficiency by minimizing delay. Corresponding savings in fuel and shipping costs are being evaluated separately under this pilot project.

While the project is ongoing, the companies in the pilot program have stated the new information has increased their efficiency and awareness of corridor conditions and have requested that the information availability be permanent. A full analysis of the overall economic benefits is in progress.

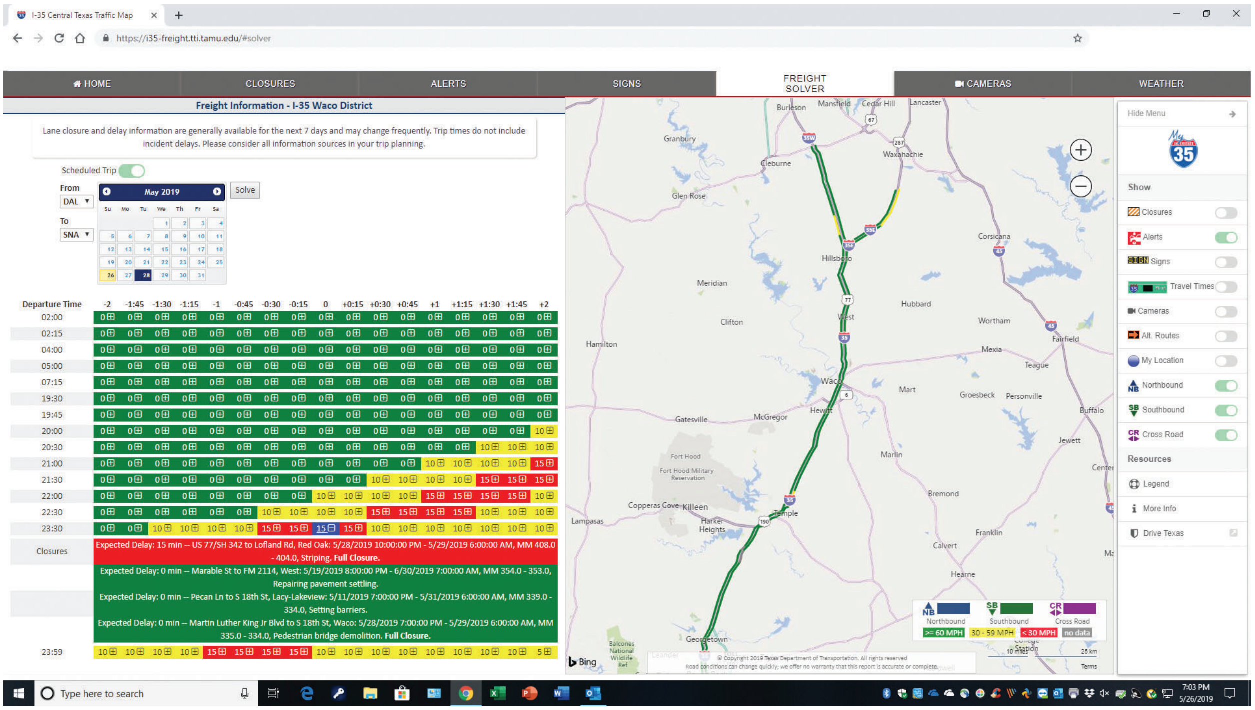


Figure 13. Illustration. Example of using FRATIS optimization engine customized for I-35 corridor.[26] (Source: TxDOT).

Rt Strategies Providing Route Choice

TIDC provides roadway condition information, which enables trucking companies to assess roadway conditions and incidents and determine the best route through the corridor: I-35 or alternate routes around Temple (using Loop 363) and Waco (using Loop 340). Through TIDC's data feed, freight companies are also able to obtain lane closure information (e.g., main lanes, ramps, frontage roads, and cross streets) and the estimated impacts of those closures on travel times. Freight drivers can make route choice decisions en route in response to these dynamic changes coming from the various construction activities.

T Strategies Providing Time Choice

Freight drivers can adjust departure times in response to these dynamic changes coming from the various construction activities. This wealth of information is helpful for freight companies who have a variable time window (plus or minus the scheduled time) in which they can actually depart to be on schedule.

Successes Supportive of the Integration of Transportation Demand Management and Traffic Management

TxDOT had the following successes:

- The ability of the freight carriers to adjust their departure time based on estimated conditions contributes to increased traffic stability, less delay, and more stable traffic flow by removing slower-moving vehicles from the roadway during heavy construction times.
- While benefits from the pilot are still being evaluated to provide quantitative economic data, the advanced freight information has been an unparalleled qualitative success based on feedback from the pilot companies about the benefits the information provides to dispatching, drivers, and company efficiency.

M Rt

CASE 7. ATLANTA'S I-85 BRIDGE COLLAPSE

Leveraging the TDM partnerships sees a 300 percent increase in TDM program registration rates during an unplanned disruption

Figure 14. Photo. The I-85 bridge collapse near Atlanta.[27] (Source: GDOT).

On March 20, 2017, a large section of the I-85 bridge outside of Atlanta, GA, collapsed, forcing approximately 2 miles of road to be closed for reconstruction. I-85 is a primary connector to downtown Atlanta and carries approximately 250,000 vehicles per day. The Georgia Department of Transportation (GDOT) was forced to simultaneously accomplish two tasks: fix the bridge as quickly as possible, and minimize the increases in congestion and travel times in the meantime. In addition to increased traffic on I-85, spillover traffic occurred on surrounding routes, and alternative modes risked becoming overcrowded. Since no singular mode or strategy could accommodate the traffic typically on I-85, a range of different complementary strategies were deployed. GDOT developed a website dedicated exclusively to updates on the I-85 bridge, which compiled all press releases and updates. The Atlanta Regional Commission (ARC) leveraged its network of employers and city government partners to provide resources on alternative modes and carpools, helping travelers learn about their alternatives. GDOT also employed traffic management strategies, such as reconfiguring traffic lanes.

Engagement in all aspects of ARC's TDM program increased after the collapse. ARC had an existing program Gimme Five, which offered qualifying new commuters $5 per day and up to $150 in total for trying new modes other than personal vehicles.[28] Registration rates for new participants in Gimme Five increased by more than 300 percent in the weeks following the bridge collapse.[1]

The strategies enacted were made possible in part by active communication across agencies. GDOT, ARC, and executives from major transit agencies held recurring meetings. The meetings continued after the bridge collapse and were critical in determining leadership and creating a consistent strategy. The partnership found signs of overall success in mitigating such a devastating strain on the network: total traffic at peak rush hour shifted earlier and remained at normal levels except for on I-85 (where there were still increases), indicating some teleworking, alternate modes, or flex-scheduling occurred to compensate for reduced I-85 capacity.[29]

1 Figures on TDM use came from an interview and email with Ryan Ellis of ARC.

Strategies Providing Mode Choice

Multiple agencies worked to promote mode shift by means of promoting and improving transit. The Metropolitan Atlanta Rapid Transit Authority (MARTA) experienced a 25 percent increase in passengers the day after the bridge collapse because many commuters sought rail as an alternative. In response, MARTA extended service hours and increased capacity. MARTA also negotiated with businesses and churches near the ends of its commuting rail lines to allow some of their parking to be used for MARTA riders, thereby meeting the increased demand for park-and-ride lots. GDOT complemented these efforts by highlighting in press releases and on its website the value of carpooling or taking transit. MARTA also informed local news organizations of various travel alternatives (in terms of both route and mode choice) so that the organizations could inform the public. The Georgia Regional Transit Authority changed bus routes and ran additional coaches from park-and-ride lots to MARTA stations.(30)

ARC, GDOT, and local TMAs leveraged a network of over 800 employers, who were a part of existing TDM programs, to provide updates and recommendations, and to encourage additional signups in their existing TDM programs. Prior to the collapse, the TMAs offered employers a discounted monthly transit pass beyond what was available to the general public. After the collapse, TMAs re-opened the purchase window for passes (because they would normally have been closed at the time of the collapse). Additionally, the Georgia Commute Options program, which was under GDOT's purview at the time of the collapse, leveraged an existing program that provided an opportunity for commuters to try a new mode. Intensified promotion of the program in the aftermath of the bridge collapse served as a viable means to mitigate traffic surges in the near term and potentially increase awareness of alternate modes in the long term.

GDOT and ARC actively encouraged teleworking, both in communication to the public and in conversations with employers. Many employers acted on this advice and facilitated teleworking for their employees, using the guidance that ARC disseminated. GDOT and ARC leveraged their Streetlytics-powered data to target very specific populations with their messaging.(31) Knowing which neighborhoods were most likely to have impacted commutes, they provided neighborhood-specific alternatives and shuttle route adjustments.

NOTEWORTHY PARTNERSHIP

The transit agency partnered with businesses and churches to get permission to use their parking lots for park and ride (transit).

While not arranged by government agencies, Uber and Lyft offered promotional subsidies of their shared ride services, UberPOOL and LyftLine. Rides were 25 percent off in the broader region and 50 percent off when connecting to MARTA stations. Uber noted that 10 percent of its commuter hour trips during the subsidy period began or ended at MARTA stations, and 8,000 riders took their first ride to a MARTA station.(32) (Lyft impacts are not available.) The subsidies were exclusively for their shared-ride services, which reduced overall traffic but, just as importantly, reduced parking strain at MARTA stations, which had been overcrowded since the collapse.(33)

VIRGINIA I-66 CONSTRUCTION COMMUTER PROGRAM

The 22.5-mile Northern Virginia I-66 corridor project, Transform 66 Outside the Beltway, was anticipated to create significant traffic delays as construction accelerated. In May 2018, the Virginia Department of Transportation (VDOT) and local government transportation provider partners considered how transit, carpool, vanpool, and telework could provide commuters with options to improve their commutes through the construction zone. New programs for bus services, vanpools and carpools, and telework policy expansions were initiated by VDOT and its partners across Northern Virginia and the Washington metropolitan region for the duration of the construction project. To raise awareness of these options, VDOT used a wide variety of media, including bus wrapping, community events, social media, targeted media campaign, and meetings with employers in the corridor.

Sources Used: VDOT.(34)

Rt Strategies Providing Route Choice

GDOT spearheaded several measures to change route choice. The agency kept travelers aware of current congestion levels and route alternatives by posting continuous video status updates, and by directing travelers to 511 call centers. GDOT also advised travelers to use a favorite wayfinding app. GDOT contacted trucking industry members to give advice on routing options.

Successes Supportive of the Integration of Transportation Demand Management and Traffic Management

GDOT and ARC had the following successes:

- ARC's ability to quickly model impacts from the bridge collapse was valuable for planning. Additionally, this event provided an opportunity to test the accuracy of the regional travel model's ability to predict network impacts from linkage breaks. In the aftermath of the event, due to the usefulness of the model, ARC is bolstering its efforts to use the model for scenario planning, testing the impacts of possible system breaks, and planning the sorts of TDM messaging that could accompany various situations.
- GDOT and ARC's position as a central information hub that provides resources to local governments and employers was critical. This allowed localities to narrowly target their outreach and make tailored adjustments, such as placing more traffic officers at impacted facilities or posting information on transit options at key office buildings.
- While some indicators of TDM program participation returned to normal levels after reconstruction, there were some examples of programs that retained participants even after the bridge was reconstructed, such as ARC's employer-based program encouraging transit ridership, which continues to see program use at levels 7 percent higher than before the bridge collapse.[2]

[2] ARC offers a matching program to employers to encourage transit use among employees.

TRANSIT ENHANCEMENTS FOR DULUTH, MN'S MEGA PROJECT

In 2010, the Minnesota Department of Transportation (MnDOT) initiated a three-year Mega Project to renovate and improve a 12-mile section of I-35 and related access roads in Duluth, MN, a regional shipping and manufacturing hub located on the western shore of Lake Superior. Due to topography constraints that limit parallel road options, I-35 carries a significant portion of both freight and commuter traffic traveling to and through downtown. To address the expected substantial travel impacts, MnDOT planned several typical approaches, including promotion of alternate driving routes, coordination with emergency services to address road incidents quickly, outreach to businesses and travelers to provide information before construction, and real-time delay messaging during the project.

Because removing vehicles from the roadway was a particular goal, MnDOT, in cooperation with the Duluth Transit Authority (DTA), also developed a comprehensive package of strategies to shift commuters to transit. DTA expanded both the span and frequency of bus service, extended some routes to serve more distant communities, and established five new temporary park-and-ride lots each with free, peak-period express bus service to and from downtown. MnDOT and the City of Duluth designated peak-period bus-only lanes on primary downtown arterials to provide a time advantage to mainline and express buses in the corridors. And DTA undertook an aggressive media campaign to promote the new transit options. These strategies attracted new riders and benefitted existing riders who now had more departure/arrival time options.

Ridership for the seven months of 2010 when the transit enhancements were at their peak increased about 4 percent over the previous year. A rider survey conducted in 2010 found that 14 percent of riders had "just started" using transit; another 50 percent rode before and had increased their bus use. About one quarter of riders said they chose transit to avoid freeway traffic, and a similar share wanted to avoid traffic on city streets. But six in ten chose transit because they could ride for free, demonstrating the traffic mitigation value of the fare-free service combined with enhanced service from new park-and-ride lots; 58 percent of the increased ridership was from free rides. A follow-up survey conducted with the same riders in 2012 found that 85 percent of commuters who had used transit during the enhanced service period continued to use transit for work or school travel, even though 60 percent of them had a personal vehicle available.

Sources Used: University of Minnesota.[35]

CONTEXT 4. MANAGING SYSTEM EFFICIENCY USING ACTIVE DEMAND MANAGEMENT AND ACTIVE TRAFFIC MANAGEMENT

Figure 15. Photo. Signs for HOV lanes and general-use lanes side by side.[36] (Source: Minnesota Department of Transportation).

When system efficiency improvements are addressed from the traffic management side (reducing congestion), often the approach may be to look at where there is a lot of traffic and congestion and identify the strategies that could eliminate the congestion. Traffic managers may look at one particular roadway and think about how to eliminate congestion on that one roadway using strategies such as road widening, high-occupancy vehicle (HOV) lanes, traffic signal coordination, ramp metering, or transit signal priority. They may use variable message signs to post real-time travel times or provide detour options to guide travelers to travel at a different time or to take a different road (figure 15). But oftentimes the congestion still persists.

The two case studies under this context discuss how transportation professionals are looking at the transportation system as a whole- all modes, information collection, dissemination. The efforts are to ultimately help system travelers make the best decision for their commute, even if the commute includes disruptions. The Commuter Connections commuter services program at the Metropolitan Washington Council of Governments (MWCOG) is an example of a service that helps commuters reduce their travel during peak-period congestion in the Washington metropolitan region by providing notifications about congestion on roadways.[37] Managing system efficiency through an integrated TDM and traffic management approach is still a relatively new tactic, and as seen through these case studies, the industry is just starting to explore this realm.

CASE 8. NEW YORK STATE DEPARTMENT OF TRANSPORTATION'S ACTIVE TRANSPORTATION AND DEMAND MANAGEMENT PROGRAM

Integrating TDM into traditionally traffic-focused planning and systems by funding efforts through an active transportation and demand management (ATDM) program

The New York State Department of Transportation (NYSDOT) has implemented a traditional TDM program in the New York State downstate regions (Hudson Valley, Long Island, and New York City) for over two decades. In 2015, NYSDOT decided to take its TDM program where no other program had gone and fully integrate TDM and active demand management into one program—an ATDM program—and expand it statewide. Under the ATDM program, NYSDOT looks at opportunities to fund projects that have a traffic management aspect but would simultaneously benefit from integration with TDM strategies, leveraging available funding for traffic projects in collaboration with the TDM program. This evolved program has tackled issues not typically addressed within a traditional TDM program, such as an integrated corridor management (ICM) concept of operations (ConOps) and Connected Corridors.

Operational Approach
A. Improved Corridor Monitoring
B. Enhanced Traveler Info
C. Corridor-Based Demand Mgmt.
D. Coordinated Incident & Event Mgmt.
E. Transit Bus Tech Improvements
F. Work Zone Coordination
G. Active Traffic Management

Figure 16. Illustration. List of potential operational approaches for an ICM ConOps.[38] (Source: NYSDOT).

While ICM and Connected Corridors efforts may be led by the traffic management and operations staff and historically thought of as traffic management programs, having the projects funded out of the ATDM program meant that TDM was fully integrated into the processes and that TDM strategies were considered alongside traffic management strategies in all plans. During the planning discussions, workshops, and the drafting of the various documents, both traffic operations and TDM operations were discussed (figure 16).

The outcome of this involvement of both TDM and traffic management throughout the planning process has been planning documents that address the issues from both angles and provide a combination of strategies to address issues such as travel reliability, real-time travel data, and better collaboration among different agencies.

For example, the ICM ConOps calls for setting up an ICM-495 Partnership of various agencies including departments of transportation, transit agencies, metropolitan planning organizations, emergency responders, and infrastructure maintainers. The ICM user needs include demand management aspects, not just supply-side needs. The ICM strategies included in the ConOps include various traffic management and TDM strategies to better improve system operations in the I-495 corridor. Since these approaches and strategies are listed in the ConOps, they will be at the forefront of focus when ICM is implemented. But throughout the development of the ConOps, the focus was not on developing a system that would reduce congestion; instead, the focus was on a system that would find ways to provide travelers and traffic managers real-time information and alternative options while looking at an entire corridor as a whole.

For the Connected Corridors project, which is still ongoing, potential strategies have been developed for the two corridors being studied (Bruckner Expressway and Gowanus Expressway). The two corridors are highly constrained and always congested, but there are opportunities to better leverage capacity on arterials, on shoulders, and on transit to have the systems within the corridors work better together. The strategies being recommended can be grouped into categories such as active traffic management (ATM), HOV management, demand management, and non-intelligent transportation system (ITS) traffic engineering solutions. For example, one of the strategies is to implement HOV lane monitoring so that buses and carpoolers can be informed of the travel time status on an HOV lane. Another strategy being considered is to implement cross-over gates to allow vehicles in HOV lanes to enter the general lane in the event an incident is blocking the HOV lane. Finding creative ways to obtain information about these corridors or monitor arterial performance (not just freeway performance) is another key aspect of the Connected Corridors project. In these Connected Corridors, the agencies involved recognize that congestion on these key roadways will occur, but if they can address some of the reasons that congestion occurs, find ways to spread the congestion to arterials, and make sure the right agencies have the information to share with travelers, then travelers can find a more reliable travel experience.

NYSDOT continues to look for other opportunities to provide linkages between traditionally traffic-focused efforts with TDM through its ATDM program. NYSDOT is exploring deployment of an incident information management system to provide real-time and continued situational awareness, and making sure TDM professionals benefit from this information in day-to-day operations, such as helping a traveler navigate the transportation system in response to an event disrupting normal travel patterns. NYSDOT is also exploring how to tie in TDM to a statewide transportation system management and operations engine that provides consistent reporting of road conditions to improve traveler information and traffic management needs. This engine would enable the development of a system to provide consistent reporting of road conditions (for work zones, road weather, and incidents) by transportation management center operators and field personnel across the State. This proposed system would support and interface with necessary NYSDOT and non-NYSDOT services to support both traveler information and traffic management needs.

Part of the Trip Chain Addressed

For this case study, the interesting element is the pursuit of traditionally traffic-management-focused projects through an ATDM program—not the specific strategies themselves. Through this approach, the TDM program had an equal voice at the table and was able to ensure that TDM-focused strategies were included alongside the traffic management strategies—and even identified opportunities in the TDM program. Some strategies mentioned included:

- Improving route diversions for buses to improve travel reliability for travelers, especially transit riders.
- Incorporating the impact of route diversions for buses' real-time status.
- Developing a corridor-focused employer-based telework program.
- Implementing HOV lane monitoring to improve travel time status and interest in using a reliable HOV lane.

Success Supportive of the Integration of Transportation Demand Management and Traffic Management

The major success was having representation of TDM at the table in processes that are heavily traffic management focused, when TDM typically would have been an afterthought or not included at all. NYSDOT's TDM program is mentioned in all planning documents, and the TDM program's elements are included as strategies to implement alongside the traffic management strategies.

CASE 9. HOUSTON'S CONNECTSMART PROGRAM

ConnectSmart: making mobility a service and a tool for area travelers

The Houston metropolitan area is a large, highly populated metro area with several overlapping jurisdictions and competing travel modes, although SOV travel still dominates. In October 2016, the Texas Department of Transportation (TxDOT) Houston District was awarded an $8.9 million Advanced Transportation and Congestion Management Technologies Deployment grant from the U.S. Department of Transportation for the implementation of the ConnectSmart program. ConnectSmart centers on creating an integrated platform with a mobile app component that can help reduce congestion and encouraging travelers to adopt new travel behavior. The mobile app, built off a developer's existing app, allows users to book trips on as many different modes and services as possible, and plan their trips with integrated payment and routing. Additionally, the platform will allow agencies to collect system data and provide information about modes, routes, or travel times. This critical ability for the program to serve as a tool for government to disseminate information, and as a tool to collect data, has earned it the moniker *mobility as a service and a tool*.

The project is still under development but aims to integrate transportation management systems across modes to benefit drivers, carpoolers, transit riders, and bicyclists by providing improved real-time information on all modes. The project's mobile app will cover the entire eight-county region with two pilot areas for ancillary services.

Prior to the development of the integrated app, TxDOT has been actively monitoring traffic flows and other system data to cultivate a baseline of information, which TxDOT can then compare to results after project implementation.

The ConnectSmart Program requires the collaboration of many agencies to provide the necessary data, analyze it, and use it appropriately in various traffic management and TDM efforts.

Once the program gets under way, TxDOT will leverage connections with university partners to analyze program data. While still yet to be determined, several memoranda of understanding will be needed between various stakeholders, particularly from TxDOT and the Houston-Galveston Area Council to various transit agencies and private entities, in transferring and storing data to be sent to and from the app. As the program emerges, and also as it evolves to include new features, outreach and communications staff at various agencies will need to be routinely involved.

CONTEXT 5. USING HIGH-OCCUPANCY TOLL AND PRIORITY TREATMENTS FOR TRANSIT SERVICE ENHANCEMENTS

Providing more reliable travel times during congested periods has become a central goal for the performance of key corridors and regional highway systems in most urban areas of the United States. Predictability in how long it will take to travel from, say, home to work or to school is of paramount interest to the traveling public. Several urban areas are providing a reliable alternative to congested lanes in the form of high-occupancy toll (HOT) lanes and dynamic priority lanes for buses (figure 17). These special lanes are a dynamic traffic management strategy that also take advantage of demand management approaches.

The three case studies under this context provide examples of how priced and other special lanes and the offer of enhanced transit and ridesharing services can be implemented to realize the benefits of this linkage.

HOT lanes provide excess capacity in carpool lanes to drive-alone travelers while maintaining free-flowing condition (generally set at level of service C or D). Single-occupancy vehicles (SOV) that wish to use the HOT lane are able to pay a variable-fee toll, which is adjusted in response to demand of the lane at a given time. The toll increases as the lane fills up and the increased toll reduces demand of the lane, allowing the lane to maintain free flow conditions.

Figure 17. Illustration. A Los Angeles County Metropolitan Transportation Authority bus traveling in a bus-only lane.[39] (Source: Los Angeles County Metropolitan Transportation Authority).

For these alternatives to be most effective, it is important to offer travelers both a priced alternative (toll) for single-occupant travelers and free or discounted use of the special lanes for high-occupancy and transit vehicles. Public outreach to help travelers understand the options is also needed.

Special bus-only lanes allow buses to bypass congestion by operating transit priority lanes at bottlenecks. In the case of the Chicago Pace bus-on-shoulder case study, some lanes dynamically use the breakdown lane or shoulder during peak periods to improve bus travel times and schedule adherence. Special bus-only lanes in Manhattan and the Lincoln Tunnel have operated for many years.

Use of priority treatments and transit use in HOT lanes provides a clear opportunity to emphasize person throughput on a facility. As highlighted in the following case studies, early consideration of transit and high-occupancy vehicle needs in managed lanes can provide improved choices to travelers across multiple modes.

CASE 10. MOPAC IMPROVEMENT PROJECT (MOPAC EXPRESS LANES)

Reliable toll, bus, and vanpool options in a congested Austin corridor

Texas State Highway Loop 1—also known as Mopac (after the Missouri Pacific Railroad that runs down the center of the facility)—is one of the most important transportation arteries in Austin (figure 18). Serving as a key central route to downtown, Mopac is a primary north/south alternate route for I-35 and carries more than 180,000 vehicles each day, with 2030 volumes projected to be more than 320,000 vehicles. The congested corridor experiences unreliable travel times during the peak hours.

Figure 18. Photo. Vehicles traveling on the northbound Mopac Express Lane and general-purpose lanes.[40] (Source: Central Texas Regional Mobility Authority).

The environmental study launched in 2010 to consider options for improving mobility in the corridor identified express lanes in the median with variable pricing as the preferred alternative for the corridor. The Texas Department of Transportation and the Central Texas Regional Mobility Authority signed a financial assistance agreement to support the development and construction of the Mopac Improvement Project in Travis County.

The Mopac Express Lanes, one lane in each direction, opened in 2017 and require all passenger vehicles to pay a toll. However, the facility exempts travelers in buses and vanpools operated by transit agencies from paying the toll. At this time, an overall evaluation of the project has yet to be completed. An analysis conducted in the first full month both express lanes were opened (October 2017) found that 61 percent of vehicles only used the express lane one time that month, demonstrating that most vehicles use the lane only when they need it most.[41] This same report noted that vehicles in the northbound Express Lane traveled an average 27 mph faster than vehicles traveling in the general-purpose lane.

Strategies Providing Mode Choice

The Express Lanes provide toll-exempt priority service to public transit buses and registered vanpools. To improve bus service, the Capital Metropolitan Transportation Authority, Austin's regional public transportation provider, added two new express routes (17 peak-period trips) and adjusted and increased frequency on two existing routes (from 21 to 60 trips per day) to use the special lanes. Additionally, bicycle and pedestrian improvements were made in the corridor including 4 miles of shared-use path, a bridge over the railroad tracks, four miles of sidewalks, Americans with Disabilities Act enhancements, and bike lane improvements at 13 cross streets.

L Strategies Providing Lane Choice

The variable pricing component of the Express Lanes project provides drivers with an uncongested and reliable alternative to the more congested general-purpose lanes. The system use 17 high-definition cameras and vehicle detectors to monitor traffic levels in the Express Lane, adjust the toll rates, and maximize the number of vehicles that can be carried in the Express Lanes at a target speed of 45 mph for a reliable, free-flowing trip. When traffic in the Express Lanes is moving slower because demand has been high, the toll rate for vehicles entering the Express Lanes is higher to discourage use. When demand for the Express Lanes reduces, the toll rate decreases.

NOTEWORTHY OUTCOME

During the first 30 days after opening, drivers traveled an average of 27 mph faster than those in the general-purpose lane during the afternoon rush hour.

Success Supportive of the Integration of Transportation Demand Management and Traffic Management

The addition of considerably more express bus service (new routes and new trips) has increased service by 50 percent. Routes were adjusted to use the Express Lanes for more reliable and faster trip times. Additionally, registered vanpools can use the lanes for free, and carpools can share the cost of the toll for more reliable travel times.

METRO RAPID DEMONSTRATION PROJECT—TRANSIT PRIORITY

In response to concerns about slow and unreliable bus service, the Los Angeles Department of Transportation (LADOT) introduced a new service designed to improve transit operating speeds through a system of operating changes and priority bus treatment strategies. These included bus signal priority, level boarding/alighting with low-floor buses, headway rather than timetable-based schedules, fewer stops, far-side intersection location of stations, and joint active management of the service in the field and the Metropolitan Transportation Authority Bus Operations Control Center. Since the initial date of service, the Metro Rapid operation has achieved an overall operating speed improvement of between 20 to 31 percent. Independent research conducted by the City of Los Angeles found that the bus signal priority system accounted for approximately one-third of the speed improvement, while the other elements accounted for the remaining two-thirds of the benefit. LADOT's running time data indicate that the segments with bus signal priority operate faster than the adjacent segments, especially when ridership loads are considered.

Sources Used: Federal Transit Administration.[42]

CASE 11. I-110/I-10 EXPRESSLANES HIGH-OCCUPANCY VEHICLE INCENTIVES (LOS ANGELES COUNTY)

Giving options to encourage HOV lane use

I-10 and I-110 are two urban freeway facilities serving downtown Los Angeles that each include busway facilities (one built in 1973 and the other in 2009) and are open to vanpools and carpools (one requiring three or more occupants and the other two or more occupants). Both are highly congested, especially during peak commute periods.

To increase the effective capacity of the two facilities, the California Department of Transportation (Caltrans) and Los Angeles County Metropolitan Transportation Authority (LA Metro) received a National Congestion Reduction Demonstration program grant from USDOT to convert these two HOV lanes to HOT lanes (called ExpressLanes) in 2013. The HOT demonstration project allowed SOV commuters to pay a variable-fee toll, ranging from $0.25 to $1.40 per mile, to use the facilities while at the same time improving transit services. HOVs can use the Express Lanes and be exempt from the told during specific times if they meet the occupancy requirement (Figure 19). Drivers can indicate their vehicle's occupancy using a flex toll transponder. A unique feature of the flex toll transponder is a switch with three positions (SOV, two-or-more-person carpool, and the three-or-more-person carpool) that a driver can adjust as needed. In addition to the lane conversion, as part of this program, federal funds were used to purchase 59 new clean-fuel buses, security and lighting improvements at transit stations, new bike lockers, construction of a new transit station, expanded transit signal priority in downtown Los Angeles, and LA Express Park- Los Angeles' new intelligent parking management program that uses sensors to gather parking occupancy data.

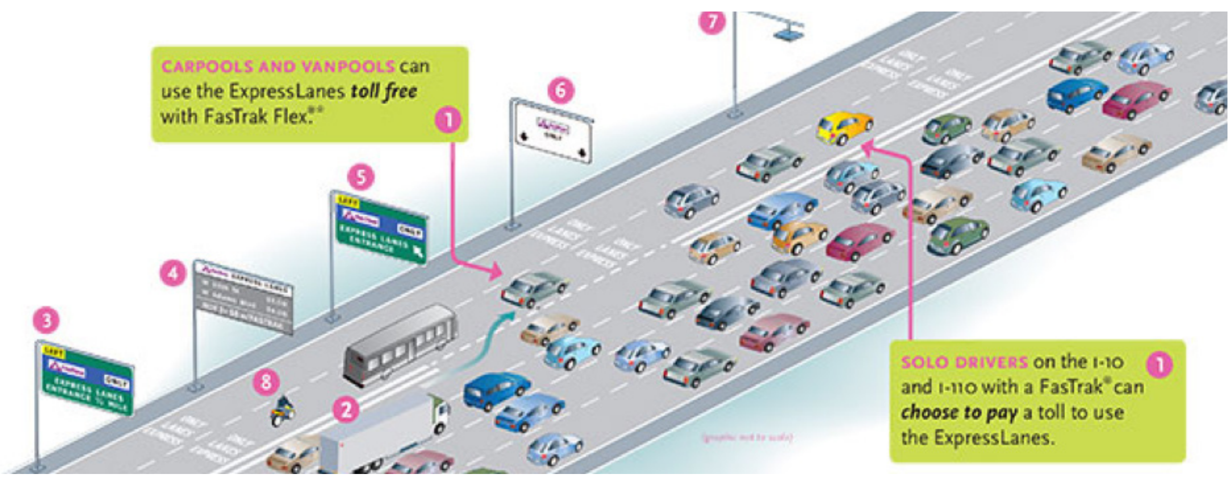


Figure 19. Illustration. How carpools, vanpools, and solo drivers can use the ExpressLanes.[43] (Source: LA Metro).

LA Metro cites the benefits of the ExpressLanes as "More choices for solo drivers, more rewards for carpoolers, more transit services."[44] The ExpressLanes demonstration project was widely viewed as a success for its improved service to transit, carpools, and vanpools. It has continued after the pilot period ended. Over 100 new vanpools were formed in the two corridors during the demonstration period.

Rt

Strategies Providing Route Choice

The ExpressLanes provide solo drivers with reliable travel times during peak travel periods along I-110 and I-10 to and from downtown Los Angeles. The ExpressLanes also serve as an alternative to parallel facilities, such as the 710 and 60 freeways.

L

Strategies Providing Facility or Lane Choice

When the regular lane is congested, the ExpressLanes provide solo drivers with an uncongested lane alternative and reliable travel times along I-110 and I-10 to and from downtown Los Angeles.

Success Supportive of the Integration of Transportation Demand Management and Traffic Management

The ultimate goal of this project was to address congestion through capacity, but this was tackled by bundling SOV traffic management strategy with improving service for transit, carpool, and vanpool modes.

M L

CASE 12. I-55 BUSES ON SHOULDER (CHICAGO REGION)

Dynamic coordination of transit and traffic during peak period

I-55 (the Stevenson Expressway) in Illinois serves suburban communities southwest of Chicago and their resultant long-distance commutes (15–25 miles) into downtown Chicago. Commuter rail services are limited. While the expressway is already used by Pace Suburban Bus (the public transit and vanpool provider servicing the Chicago suburbs) commuter express routes, travel times were highly unreliable due to recurring congestion on the Stevenson Expressway. Bus travel times were over one hour and varied by more than 15 minutes.

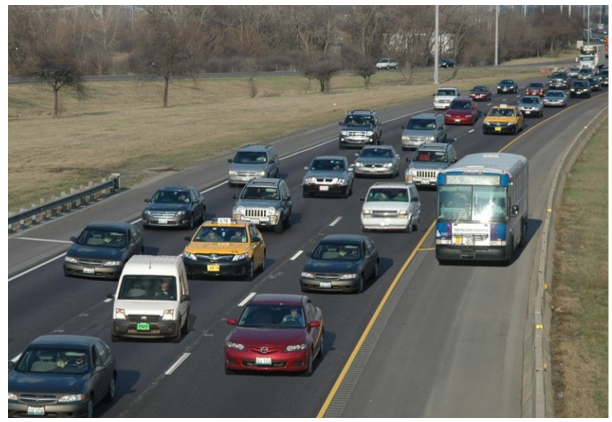


Figure 20. Photo. Bus traveling on the shoulder.[(45)] (Source: Pace Suburban Bus).

To increase the reliability of bus travel times and improve the attractiveness of public transit, a partnership between Pace and the Illinois Department of Transportation (IDOT) implemented a pilot program in 2011 to test the use of the shoulder for buses during congested conditions. Costing less than $1 million, the Buses on Shoulder pilot (planned by the regional transit authority) was promoted as a cheaper and more cost-effective alternative to constructing a new bus-only lane or rail line. The State passed legislation that allowed buses to use the shoulder and dictated the conditions for the use.

The pilot program involved two Pace commuter express bus routes. Buses could use the inside (left) shoulder when travel speeds in the main lanes dropped below 35 mph (figure 20). IDOT added signs on the shoulder indicating Pace transit vehicles may use the shoulder, and the buses themselves have external signage stating "Authorized to Use the Shoulder." IDOT's Operations and Communications Center closely coordinates with the Pace bus operations center to monitor conditions and use of the lane. Coordination on traffic and bus operations occurred prior to the pilot but were brought to a new dynamic level as a result of the use of the shoulder on I-55.

As a result of the success of the pilot, service has been expanded to include three more Buses on Shoulder routes, the State legislature enabled buses on the shoulder for all expressways and tollways in the region, and a new flex lane for Pace buses is operating on the shoulder of the Illinois Tollway (I-90) as part of an active traffic management scheme.

M

Strategies Providing Mode Choice

Initially, bus service levels were not changed, but improved transit travel time reliability made this commuting choice more attractive. Buses traveling faster than cars in a dedicated lane likely made this option appear more attractive.

L

Strategies Providing Facility or Lane Choice

The use of the left shoulder, on a dynamic basis (contingent on congestion levels and travel speeds), allowed Pace commuter express buses to improve their operating speed relative to main lane traffic and improve bus schedule reliability. This strategy enabled transit, which traditionally does not have the option to find a faster route (especially in a non-toll road environment), to have a choice to use a lane that would enable the vehicle to travel at a higher speed.

Success Supportive of the Integration of Transportation Demand Management and Traffic Management

A relatively simple traffic management technique (buses on the shoulder) made transit a more attractive alternative, inducing a mode shift and fostering enhanced cooperation between roadway (IDOT) and transit (Pace) operators. The Stevenson Expressway Buses on Shoulder pilot has resulted in a six-fold increase in bus ridership on Pace routes and an improvement in transit schedule reliability from less than 70 percent to more than 90 percent.

NOTEWORTHY OUTCOME

Bus ridership increased six-fold on Pace routes, and transit schedule reliability improved from less than 70 percent to more than 90 percent.

CONTEXT 6. MANAGING SPECIAL EVENTS USING PARKING, TRAFFIC DEMAND MANAGEMENT, AND TRAFFIC MANAGEMENT

Special events, such as sporting events, concerts, parades, cultural events, and festivals, offer communities the potential for substantial economic and social benefits. Events can provide a tangible, immediate economic return from entry fees and accompanying purchases from local merchants. They can also unite communities, foster civic pride, and engage community members who help to organize and participate in the event.

These benefits can be quickly undercut if traffic congestion, lack of parking, and missing or unclear signage makes it difficult to reach the venue, or if event traffic impedes the normal movements of residents and commuters—resulting in negative publicity and citizen and business resentment that can linger long after the event. Conversely, a well-organized event that makes access to the event venue easy and reasonable, while allowing local travel to continue relatively seamlessly, can enhance political and community support and extend economic benefits by encouraging other groups to consider the community or venue for future events.

Traditionally, special event traffic management has focused on limiting or controlling road access, expanding and managing event parking, and installing signage to guide participants. Many travelers use navigational or wayfinding apps such as Google Maps and Waze to detour around traffic bottlenecks. But when special events cause unusually high traffic volumes, these detouring vehicles can cause problems for residential communities near the venues. The towns of Mansfield and Norton, MA, encountered this situation for the sold-out crowd of 20,000 for a kickoff concert at a local arena. To mitigate residents' concerns in the hours during and following the concert, local police set up roadblocks on strategic roads so that travelers would input those roadblocks into their wayfinding apps and the apps would add those roadblocks into their navigating algorithms. Thus, the wayfinding apps did not include those roads in their detour routes, keeping traffic away from the neighborhoods. Following the concert, local police met with residents and successfully employed the same techniques for future concerts.

BIKE PARKING/BIKE VALET AT SPORTS ARENAS

Many venues are establishing bike parking and bike valet services. One example is Nationals Park in Washington, DC, which offers free, secure bike parking for more than 250 bicycles. The lot opens two hours prior to game time and remains open until one hour after the game ends. Capital Bikeshare also has docks and bikes available at the stadium. Bike valet parking is also offered at AT&T Park (San Francisco, CA), Amalie Arena (Tampa, FL), Golden 1 Center (Sacramento, CA), and Kauffman Stadium (Kansas City, MO).

The three event case studies in this section illustrate both commonalities and unique characteristics that might be encountered in special event management. The first case, the 2015 Union Cycliste Internationale (UCI) Road World Championships bicycle races, reflects a multi-day international event that involved travel for event spectators, extensive use of roadways for races, and potentially substantial impact on local commute travel in the downtown of a State capital. The second case, the 2014 Super Bowl, profiles a sports venue well served by public transit and well used to dealing with large crowds, but hosting a high-visibility showcase event attended by many very important persons and out-of-town visitors who might be unfamiliar with transit. The third case, the 2017 solar eclipse in Wyoming, represents a rare, once-in-a-lifetime event that attracted nearly 200,000 out-of-state visitors to a State that was unaccustomed to traffic congestion of any kind, for a one-hour, weather-dependent event.

COMBINING CONCERT AND TRANSIT TICKETS

The concert series Ogden Twilight in Ogden, UT, includes transit fare in the Twilight ticket price, locating the show just four blocks from a bus station served by three routes, and offering a bus pass with the concert ticket.

The common threads through these cases were development of modal and traffic management strategies appropriate for the events, wide dissemination of advance and real-time information, and extensive planning and coordination among a wide range of actors. Because many special events are one time or temporary in nature, transportation managers do not have the luxury of trial and error in managing event traffic; once the event begins, they have a limited amount of time in which to get it right. Thus, coordinated planning well in advance of the event is essential to define transportation, access, and information strategies; establish clear roles and responsibilities for traffic management tasks; brainstorm what could go wrong; and develop contingency plans. Integrated communication during the events, which connects transportation, public safety, emergency response, and public outreach and information functions in real time, can further smooth the process by quickly conveying information to event decision makers as issues arise during the event and coordinating rapid resolution.

Overall, these case studies demonstrate that a coordinated traffic mitigation—a transportation demand management (TDM) approach to special events—can result in a more successful event. The approach can also pay later dividends to the agencies and organizations involved in planning and managing the event, such as ongoing relationships established during the planning phase and in modal infrastructure and strategies developed for the event.

ESTABLISHING RIDESOURCING PICKUP LOCATIONS AT EVENT VENUES

During the month-long Mardi Gras celebration, options are available to allow visitors to leave their cars at home. In 2016, the transportation network company (TNC) Uber began a special promotion to encourage use of ridesourcing. Mardi Gras presents a particular traffic challenge because many roads and entire city sections are closed to vehicle traffic for the dozens of parades that occur over the month. Uber developed a Mardi Gras guide to direct potential riders to permissible pickup locations; the company has subsequently prepared similar guides for the Super Bowl in Houston and the Kentucky Derby in Louisville. Several event venues, including Nationals Park in Washington, DC, have worked with TNCs to designate a formal pickup area and limit curbside pickup.

Source: Uber.[46]

M Rt

CASE 13. UNION CYCLISTE INTERNATIONALE ROAD WORLD CHAMPIONSHIPS (RICHMOND, VA)

Pre-event planning and during-event coordination led to new communication links among key agencies that participated in traffic mitigation activities

Figure 21. Photo. Race participants at the starting line of the 2015 UCI Road World Championships.[47] (Source: Rena Schild/Shutterstock.com).

In September 2015, Richmond, VA, hosted the 2015 UCI Road World Championships, an annual 10-day bicycle racing event that attracts nearly half a million visitors, representing 34 States and 29 countries (figure 21). Major travel disruptions were expected not only from the influx of visitors, but also from rolling road closures that were required along the racecourses during daily road races that changed each day as the racecourse moved to different locations. The challenge presented by the race was to operate the event safely and efficiently and accommodate event visitors, while minimizing impacts on residents' daily lives and business operations.

The race planning task force met this challenge through a combination of detailed planning that started two years before the event; extensive cross-agency coordination among transportation agencies and transportation service providers, city and county staff, police and public safety agencies, and business entities; and implementation of strategies to encourage travelers to use public transportation, telework, and other alternatives to driving during the event period. This task force included Richmond 2015, a nonprofit corporation formed specifically to organize, manage, and promote the UCI event; the Virginia Department of Transportation; and the Greater Richmond Transit Company (GRTC) (including RideFinders, a division of GRTC that is a non-profit commuter assistant organization). Richmond 2015 partners included the Commonwealth of Virginia, the City of Richmond, two neighboring counties, and numerous corporate partners. This task force developed strategies that incorporated transit, bike share, and shuttle service options alongside careful race route planning, rolling-bubble road closures, and other traffic management strategies to ensure minimal impact to regular traffic.

NOTEWORTHY OUTCOME

These links and relationships have facilitated coordination on other projects since the event.

Because the event was so extensive and spanned a full business week, in addition to weekends, the City of Richmond required the event promoter to conduct a dry run event to test the interim planning. This test run was conducted in May 2014 for a smaller race that overlapped with only one commute day (Friday), but used course routes proposed for the UCI race and tested road closures, traffic and parking operations, and communications systems.

By transportation standards, the event was generally considered a success. There were no significant incidents, traffic impacts were minimized, and transit service accommodated riders as expected. The actual visitor count was lower than promoters had initially indicated, and thus the preparations for transit and parking demand were more than needed. But agencies involved with the planning indicated that capacity was available had the full visitor count been realized.

M Strategies Providing Mode Choice

Event organizers prepared two printed travel option guides called Navigate the Worlds (figure 22)—one providing information about intercity and intracity transit options, and another providing road closure information. An online resource, Navigate.Richmond2015.com, featured interactive mapping tools and information on where to watch the event, transit and parking options, and travel restrictions.

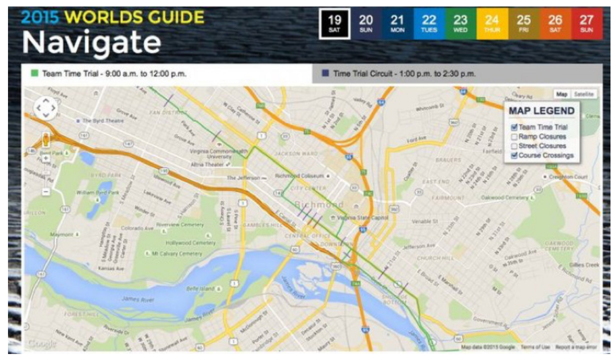


Figure 22. Screenshot. UCI Navigate the Worlds Transportation Guide.[48] (Source: Navigate.Richmond2015.com).

GRTC added bus runs on some commuter routes, rerouted some routes to avoid roads that were closed for race activities, and added temporary stops along some of the detour routes. GRTC offered unlimited ride privileges (any route, any time) for the duration of the racing event. To facilitate efficient bus operation, GRTC established a new downtown 9th Street Transfer Plaza and routed nearly all local bus and commuter bus routes to pass through the transfer point. The plaza, which can accommodate 90 buses per hour, was established more than one year before the UCI event, so regular riders had sufficient time to adjust to route changes. GRTC assigned staff to work at the plaza throughout the event to assist riders who were unfamiliar with the service.

Temporary bikeshare stations provided rental bikes for use by residents and visitors. Amtrak and the Virginia Department of Rail and Public Transportation offered enhanced walk-up bike service on select trains and at select stations during the event, enabling out-of-town visitors to have their personal bikes available. Bike valets were provided in convenient locations throughout the downtown race areas. To create awareness about bike valets, Richmond 2015 operated bike valets at multiple community events before the UCI event. In preparation for the event, the City of Richmond undertook a bike infrastructure expansion that included bike lanes and bike racks.

The City of Richmond and event organizers established three remote parking areas with free shuttles to bring visitors who were staying in hotels outside the city to race-viewing locations. Shuttles began running two hours prior to race events and made their last trip back to the lots two hours after the podium ceremony concluded. The shuttles carried nearly 9,000 riders over the course of the event. Downtown parking was restricted in areas adjacent to race routes, encouraging using remote parking lots.

RideFinders and GRTC offered individual assistance to commuters, State agencies, universities, and major employers to identify carpooling, transit, and bicycling options for commute trips. RideFinders also extended the hours of its downtown Transit Store to enhance access to transit information and pass sales.

Rt Strategies Providing Route or Time Choice

Racecourses were defined very early in the planning process, but a key element of the planning was early coordination between UCI, Richmond 2015, and transportation partners to define racecourses that took into account morning and evening commute patterns, while still providing a good experience for riders. The Richmond Police Department employed rolling bubbles to reopen streets block by block as cyclists passed. This minimized traffic disruption on racecourse routes and allowed police to lift access and parking restrictions as quickly as possible.

VDOT posted information about road and ramp closures and traffic alerts on 511virginia.org and used variable message signs (VMSs) to provide information to travelers who were en route to downtown. To respond to incidents on interstate and State routes, VDOT arranged for traffic cameras to feed to the Unified Command center to assist early responders to identify incident locations and service needs. VDOT also staged tow trucks and coordinated with local emergency services to promote timely response.

The City of Richmond and RideFinders worked with employers, particularly large employers, to provide telework and commuter flextime programs to shift travel out of the peak travel period. Several large employers, including State agencies, which comprise a substantial portion of employees traveling to the downtown, implemented liberal telework policies and minimized business activities that would require business travel to Richmond locations.

Successes Supportive of the Integration of Transportation Demand Management and Traffic Management

VDOT and its partners had the following successes:

- Event planning spanned two years and required extensive coordination among many organizations. During the event, a Unified Command coordinated traffic operations, police, emergency services, parking, and transit activities. The command center included two-way radio connections among race organizers and transportation/police staff to facilitate rapid response to issues that arose. The pre-event planning and during-event coordination developed new communication links among key agencies, which have facilitated coordination on other projects since the event.
- Preparation for the event included establishment of a bike stakeholders group, organized by the Department of Public Works, which met monthly to address biking issues and needs. The City of Richmond also developed new bike lanes, added bike accommodation on roadway bridges, installed bike racks in public areas, and created several bike repair stations along bike trails. The event increased public awareness and interest in bicycling, which has encouraged the City of Richmond to continue to expand its bike infrastructure.

M L

CASE 14. MASS TRANSIT SUPER BOWL (NEW JERSEY AND NEW YORK)

Heavy promotion of mass transit leads to many unused car parking spaces

Figure 23. Logo. Super Bowl XLVIII travel logo.[49] (Source: State of New Jersey Department of Transportation).

Super Bowl XLVIII, pitting the Seattle Seahawks against the Denver Broncos, was played on February 2, 2014, at the MetLife Stadium in the New Jersey Meadowlands Sports Complex, less than 5 miles from Manhattan, NY (figure 23). Because of its location, the complex is well served by numerous transit options, including a dedicated rail shuttle and charter buses. Vehicle parking for the complex is constrained at only 13,000 spaces. Of the more than 80,000 fans attending the football game itself, it was anticipated that 40,000–50,000 would arrive by charter or public bus, 10,000–12,000 by train, and 20,000 by car (although many would be getting dropped off instead of parking).

It was recognized that many fans attending the game would be from outside the region, so they may not have been familiar with the New Jersey/New York transit systems or even with riding transit at all, and would need information. To address this, a transportation plan (the Playbook) was jointly developed by NJ Transit and other area transit providers and the National Football League (NFL). The Playbook discussed how to plan for mass transit services during Super Bowl week as well as traffic mitigation strategies, such as traffic signalization and construction project suspension. Successful development of the plan required coordination among several agencies, each controlling different aspects of transportation. Assuming that other attendees could be New York residents or workers, the New York State Department of Transportation under the efforts of a TDM program (511NY Rideshare), also helped to carry out the travel management strategies in the Playbook through its TDM website. 511NY Rideshare conducts outreach to employers and individuals in New York City, Long Island, and the lower Hudson Valley and so had an opportunity to reach a large constituency.

M

Strategies Providing Mode Choice

Rail services and facilities were enhanced to maximize the carrying capacity and efficiency of the rail option. This included extending the platform to accommodate higher-capacity trains and adding capacity to most regional rail services and bus services. NJ Transit offered a Super Pass for unlimited rides during Super Bowl week. Based on prior experience with other Super Bowls, the NFL operated a Fan Express bus service from locations in Manhattan and New Jersey. This was a pre-ticketed, non-stop service from nine stops.

On Super Bowl Sunday, an unanticipated number of fans used the dedicated rail shuttle service and overwhelmed the transit system. Some 28,000 fans used the dedicated rail shuttle to access the complex, and 33,000 used this option to depart. However, projected mode splits were the opposite:

40,000–50,000 by bus and 10,000–12,000 by train. Over 20,000 fans bought their train tickets on game day, providing only a short window of opportunity to plan for the demand. Unfortunately, the number of fans accessing the rail system after the game far exceeded the capability of the rail service and its security system to move fans efficiently and quickly. Fans waited up to 90 minutes to get into the stadium and several hours to depart from the stadium after the game ended. To provide context, for events at the Meadowlands that are anticipated to exceed 50,000 persons, NJ Transit has never seen shuttle counts higher than 12,500 for regular-season NFL games. A report to the NJ Transit Corporation Board of Directors pointed out several key lessons learned, two of which were the need for contingency planning for unexpected demand, and the need to better communicate the capacity of each travel option.

L Strategies Providing Facility or Lane Choice

The Lincoln Tunnel Exclusive Bus Lane, operated by the Port Authority of New York and New Jersey, was expanded from one to two lanes for traffic from Manhattan to New Jersey (figure 24). Special approach lanes were also created for cars with a special NFL placard. Additionally, real-time information was provided via VMSs on the George Washington Bridge (another major crossing between New York City and New Jersey).

Figure 24. Photo. Buses traveling in the exclusive bus lane.[50] (Source: Port Authority of New York and New Jersey).

Successes Supportive of the Integration of Transportation Demand Management and Traffic Management

NJ Transit and its partners had the following successes:

- Service providers made enhancements to their services and facilities to accommodate more demand during the week.
- Transit services and traffic management were integrated into a single Playbook to accommodate moving fans for this large-scale special event. The Playbook detailed special services, special fares, maps, and a marketing campaign to promote the use of public transportation during Super Bowl week. The Playbook also detailed other traffic mitigation strategies, such as the New Jersey Department of Transportation's suspension of all roadway construction within a 20-mile radius of the stadium and ways to leverage the signal timing optimization system, which enables 144 traffic signals to self-adjust signal timings based on the flow of traffic rather than set times. The Playbook was a coordinated effort to maximize the use of public transit to get to the Super Bowl at the Meadowlands.

NOTEWORTHY LESSON LEARNED

The unanticipated heavy usage of train over bus led to lessons learned: have contingency planning for unexpected train demand and provide better communication on the capacity of travel options to travelers.

D Rt

CASE 15. WYOMING DEPARTMENT OF TRANSPORTATION AND THE 2017 SOLAR ECLIPSE

Finding ways to reduce congestion but still encourage travel to the State

The solar eclipse on August 21, 2017, passed across the entire State of Wyoming (figure 25) and attracted over 261,000 eclipse viewers, 197,600 of which were from outside the State. This rare event posed unusual challenges to a region that is typically unconcerned with traffic congestion and crowding. Further complicating planning for the event, there was no precedent with which to gage crowd levels. Through a collaborative, State-level planning approach, WYDOT sought to encourage carpooling, early arrivals, and informed departures for the event.

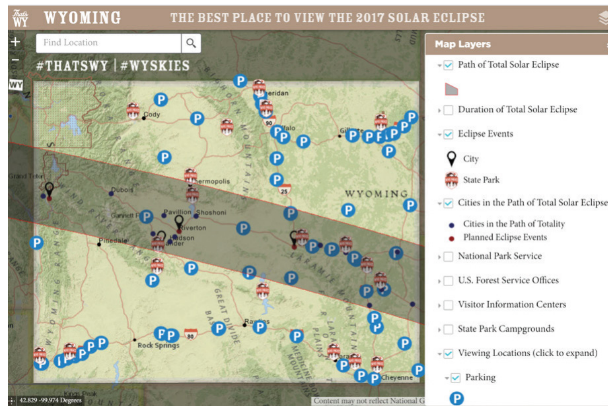


Figure 25. Wyoming visitor information website with layers to assist travelers wishing to view the total solar eclipse.[51] (Source: Wyoming DOT).

This was an unusual TDM and traffic management challenge in that WYDOT did not want to discourage people from traveling to see the eclipse, so strategies to reduce total travel or to shift traffic or destinations away from the totality path were not feasible options. Rather, WYDOT had to find other ways to manage the congestion and perhaps the total number of vehicles on the road.

During the eclipse event, many routes experienced an over 100 percent increase in vehicular traffic, with one segment of I-25 seeing an over 400 percent increase in traffic compared to the five-year average. Despite the traffic, WYDOT received no complaints from the public and credits proactive messaging about the event. Further, only one traffic fatality occurred, which was due to an illegal maneuver of a motorcycle. WYDOT had several planned activities to communicate weather and travel information for the event and executed all of them with the sustained assistance of the National Weather Service (NWS).

NOTEWORTHY OUTCOME

Routes experienced a 100 to 400 percent increase in traffic, but due to proactive messaging about anticipated delays, WYDOT received no complaints from the public.

D Strategies Providing Destination Choice

The WYDOT 511 map included a layer explicitly related to the eclipse, showing many possible parking and viewing locations. Pairing this information with the route suggestions and travel times that were available on the WYDOT 511 website, WYDOT helped spread visitors out across the State. On the day of the eclipse, WYDOT used dynamic message signs (DMSs) in three different ways:

- To discourage travelers from parking along the highway or within the emergency vehicle right of way; parking in these areas would prevent highway patrol and emergency vehicles from using these areas in case of an emergency.
- To discourage people from stopping on the road around the time of the eclipse and causing traffic to build up behind them.
- To help people find an appropriate area to view the eclipse and alert travelers when upcoming destinations were full.

Rt Strategies Providing Route or Time Choice

The Wyoming Office of Tourism attempted to get out-of-state travelers to consider extending their visits either before or after the eclipse via a Wyoming Skies advertisement campaign. This would spread out inbound and outbound travel demand and offer local economic benefits. Route suggestions and real-time travel times were available on the WYDOT 511 website to show travelers what current conditions were and help drivers avoid congested areas (figure 26). WYDOT used Pathfinder, a road weather management strategy that includes collaboration with NWS, to share clear and concise explanations of the impact of weather on road conditions and viewing locations.

Figure 26. Wyoming highways experienced high volumes of traffic from travelers coming to view the total solar eclipse.[52] (Source: WYDOT).

For freight, WYDOT issued proactive messaging through its Commercial Vehicle Operator Portal to make freight drivers aware that heavy traffic would be expected during the total solar eclipse and that no oversize load permits would be issued on that day. Further, WYDOT collaborated with the Wyoming Trucking Association to disseminate warnings and advisories to avoid the area during the eclipse.

To further reduce traffic buildup, WYDOT implemented a temporary moratorium on construction activities so that lane closures or slow construction zones would not impede routes.

Successes Supportive of the Integration of Transportation Demand Management and Traffic Management

WYDOT had the following successes:

- WYDOT and the Wyoming Office of Homeland Security set planning efforts at a State level, creating a consistent planning framework across the State. This allowed WYDOT to implement strategies such as placing a statewide moratorium on road construction and preemptively stationing emergency responders in key corridors.
- During the lead-up to the eclipse, regular meetings were held with a key group of about 10 individuals (the number of attendees was limited to ensure meetings were effective and fast moving). Attendees included the eclipse planning lead at WYDOT, maintenance engineers, the deputy of highway control, an intelligent transportation system specialist, a public relations specialist, and an aeronautics specialist since WYDOT has air travel in its purview. Now, after the eclipse, these personal relationships are making later collaboration easier.

CONTEXT 7. MANAGING SMART PARKING AND CONSIDERING LOCAL TRAFFIC MANAGEMENT

Parking is often considered separately from traffic flow, transportation choices, and mobility. However, the management of parking can impact traveler choice in significant ways. Dynamic parking information, dynamic parking pricing, and dynamic parking management can influence travel choices before and during a trip.

Dynamic parking information, both real time and predictive availability, can influence travel choices. In San Francisco, CA, real-time parking information is coupled with traffic conditions to offer commuters in the US 101 corridor an en-route choice to either continue driving or divert to a transit station with available parking. The Messaging Infrastructure for Travel Time Estimates to a Network of Signs project, undertaken by the Partners for Advanced Transportation Technology program at the University of California, Berkeley, implemented variable message signs (VMSs) on US 101 in San Mateo County. The VMSs provide information about travel times to downtown San Francisco and compare those travel times to parking and diverting to transit, namely Caltrain services (figure 27). NYSDOT has provided real-time parking availability updates during major transit disruptions where a transit agency established temporary shuttle service from certain park-and-ride lots and NYSDOT wanted to encourage use of those lots.

Figure 27. Photo. Variable message sign comparing driving the route with parking and taking transit.[53] (Source: California Department of Transportation).

NEW YORK STATE DEPARTMENT OF TRANSPORTATION CREATES A PARK-AND-RIDE LOT MAP WITH REAL-TIME SPACE AVAILABILITY

The New York State Department of Transportation (NYSDOT), during the Amtrak New York Pennsylvania Station emergency repair work in July and August 2017, worked closely with the Metropolitan Transportation Authority (MTA) to support the transit agencies' efforts to provide alternative transit services given the absence of certain rail lines between Long Island and Manhattan. MTA informed NYSDOT about which park-and-ride lots MTA would provide temporary shuttle service to, and NYSDOT created an interactive park-and-ride lot map that showed real-time counts of the available number of parking spaces at those lots and real-time notifications when lots became full (figure 28). The purpose of NYSDOT's communication was to help travelers understand their alternative transit options and mitigate the amount of shift to single-occupancy vehicle travel during the repair work period.

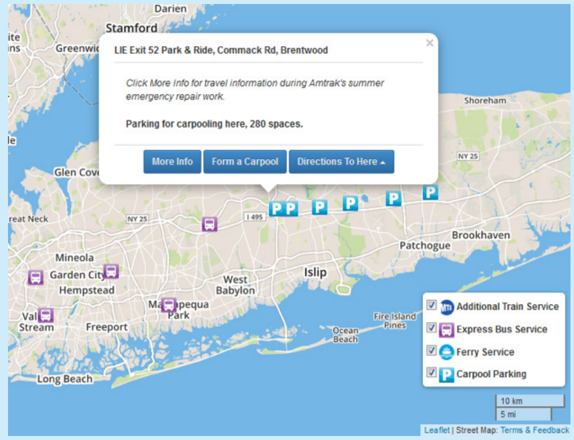


Figure 28. Screenshot. A map of park-and-ride lots with a pop-up box showing the number of available parking spaces.(54) (Sources Used: NYSDOT).

Many new parking applications for handheld devices provide real-time parking availability information. In fact, Google Maps now shows predicted parking availability for 25 metro areas.(55) In the routing feature, Google Maps shows a green (available), yellow (limited), or red (constrained) P icon to indicate availability associated with the destination.

Parking pricing and information can help manage scarce parking in high demand areas. Parking managers can set a parking price that is low enough to keep most spaces filled but high enough that the price deters enough people from parking to provide an open space to those who need to park and are willing to pay the cost. This strategy discourages people from driving around in search of an open space because enough spaces are open to those people who are willing to pay the price; people who are unwilling to pay the cost will not continue to search for an open space.

The Seattle Department of Transportation installed smart parking meters for performance-based parking and an electronic parking guidance system. This, coupled with the e-Park Program, which provides real-time parking space availability for various parking garages in downtown Seattle, is designed to reduce cruising for on-street parking and help people find parking.

The case study in this chapter shows how San Francisco, CA's parking pricing project is managing parking, but many other dynamic parking information applications help users plan and carry out their trip choices. Looking forward, with the advent of smart parking meters that can provide real-time information, there is an opportunity to explore how the information displayed by the smart meters can be used as another tool in the toolbox to manage the transportation system and provide travel choices.

Active parking management has been included as part of the strategy response package when dealing with the impacts from construction activities, major transit disruptions, or even special events (some have been mentioned in case studies under other contexts in this compendium).

D M T

CASE 16. SF*PARK*: MANAGING PARKING DEMAND VIA PRICING (SAN FRANCISCO, CA)

Managing on-street parking to increase availability and improve bus operations

Historically, cities have used time-limited parking meters to increase turnover, discourage all-day parking, and track parking duration to facilitate enforcement of time limits. SFMTA sought to address other public policy objectives through parking management. One specific objective was to help San Francisco Municipal Railway (MUNI), San Francisco, CA's public transportation system, realize more reliable bus schedule adherence by addressing the traffic speed or lane blockage impedances created by cars cruising for parking or double parking. SFMTA operates transit services including MUNI buses and manages parking in San Francisco. Therefore, demand-responsive pricing was viewed as a way the agency could improve parking availability while also reducing congestion.(56)

As part of a U.S. Department of Transportation urban partnership agreement, SFMTA implemented a two-year (2011–2013) pilot program aimed at managing parking availability via pricing in seven pilot areas. SFMTA described the goal as "to achieve a minimum level of availability so that it was easy to find a parking space most of the time on every block and that garages always have some open spaces available." This involved setting occupancy level targets at 60 to 80 percent.

Demand-Responsive Pricing Strategy:

Increase hourly rates by $0.25 when occupancy levels exceed 80 percent.

Decrease hourly rates by $0.25–$0.50 when occupancy levels dip below 60 percent.

While pricing was not fully dynamic (i.e., changing price on a real-time basis), SFMTA implemented demand-responsive pricing in those seven pilot areas, which entailed periodic changes to parking rates to improve both availability (open spaces when needed) and utilization (so space would not sit unused for too long). The project involved a comprehensive public information program and tools for users, including a website, mobile app, and new signage. Parking information was integrated into the regional 511 system as a partnership of the Metropolitan Transportation Commission and SF*park*.

Some of the positive outcomes of SFMTA's SF*park* pilot project evaluation are as follows:

- Parking availability improved—target parking occupancy (60–80 percent) was achieved 30 percent more often.
- Parking was easier to find—parking search time decreased by 43 percent.
- Double parking decreased by 22 percent.
- As a result of reduced parking search activity, vehicle miles traveled (VMT) decreased by 30 percent.
- Bus speeds improved by 2.3 percent in areas that reduced double parking.

Because of the success of the SF*park* pilot project, SFMTA implemented the program citywide in 2018.

D Strategies Providing Destination Choice

This demand-responsive pricing strategy can help travelers decide if they want to end their trip at a parking space that costs a certain amount of money or if they prefer to end their trip in another location, perhaps a nearby parking space that costs less to park in.

T Strategies Providing Time Choice

The SF*park* project lists the parking cost for all time segments at a specific parking location. This allows drivers to make decisions about their travel time and, if possible, to park when the parking costs are cheaper, meaning when there is more parking availability. By informing the public ahead of time of the parking costs, this strategy can help a traveler decide the best time to travel.

M Strategies Providing Mode Choice

Providing the pricing information on the website and mobile app gives people a chance to see the pricing information before they commit to driving. The SF*park* project also aimed to help the reliability of bus travel by reducing cruising and double parking by travelers seeking parking spaces.

Success Supportive of the Integration of Transportation Demand Management and Traffic Management

While the parking project did not induce a discernable mode shift, reducing parking search time led to a reduction in vehicle miles traveled. Pricing worked to improve traffic conditions and mobility by providing drivers with available parking when and where they wanted. While revenue from parking increased slightly, this was not an objective of the project.

KEY TAKEAWAYS

It is becoming more of a reality and a necessity to better integrate transportation demand management (TDM) and traffic management strategies to provide the traveling public with the information and opportunities to make informed decisions throughout the trip chain. The case studies included in this compendium show some easy strategies, some unique strategies, and some strategies requiring more buy-in or support—but all implementable and supportive of both TDM and traffic management goals.

Historically, providing the traveling public with this information in the silos of traffic data and mode data has created a disconnect for the traveling public in recognizing all their options on a daily and en-route basis. Travelers feel like they must take the same mode by the same route every day and deal with any unexpected disruptions.

By providing this integration, the traveling public can make a choice, every single day, about the most efficient and effective mode, route, time, and destination for their travels and ultimately help traffic managers achieve the broader goals. This compendium provides examples and resources with the aim of helping users find ways for their agencies to pursue more integration of the supply and demand aspects of transportation.

For each of the seven contexts, agencies seem to consistently use three groups of tactics as they integrate TDM with traffic management efforts:

- Establish supportive policies.
- Make temporary changes to existing programs and systems.
- Find new communications and partnership strategies.

For agencies that have not begun or are just starting to integrate TDM with traffic management, these tactics may be a good place to start their integration efforts. This section describes strategies for linking TDM and traffic management professionals and programs.

Establish Supportive Policies

To encourage more effective linking of TDM and traffic management efforts, policies and strategic plans must support the integration between these two sides. Having supportive polices in plans can also make it easier to implement when an event is taking place. Some opportunities include:

- Support shared-use mobility, mobility on demand (MOD), and mobility as a service (MaaS) elements to provide consumer choices.
- For road construction projects, develop guidelines that help choose or prioritize integrated traffic mitigation and TDM activities.

- Use variable message signs (VMSs) so they can be locally tailored and provide predictive warnings and specific route guidance.
- Have policies that allow agencies to post pre-event messaging.
- Integrate with other agencies that can provide valuable data for predictive analyses, such as the National Weather Service.
- Develop a system to consolidate freight-specific travel information, and make it available to freight managers.
- Develop a multi-jurisdictional signal-timing response plan to ensure the entire roadway system is considered and appropriate agencies are notified when signal timing changes are implemented.

Having the policy support for different activities that can help better link TDM and traffic management activities makes it easier to implement those strategies in response to a specific event. Sometimes it means certain temporary changes do not need to be introduced as a new idea because the support is already written in the plans. Sometimes, it means the data are already available to help model the anticipated response. When an event is a planned or anticipated event, such as a construction project or a major sporting event, there is time before the event starts to plan for the strategies. During the planning phase for an event, agencies can consider policy, program, or system-related changes as well as communications and partnership strategies.

Make Temporary Changes to Existing Programs and Systems

Short-term changes to existing programs and systems may also help advance the linkages between the two groups. Some examples include:

- Consider what temporary changes can guide travelers toward a modal decision that puts less pressure on the transportation system. In one case study, the agency temporarily removed a policy that prevented transportation network companies (TNCs) from picking up riders at transit stations to encourage use of transit and address first- and last-mile concerns.
- Consider if the temporary or dynamic use of shoulder lanes is effective as an high-occupancy vehicle lane, bus lane, etc.
- Encourage off-peak freight travel through different strategies, such as reducing tolls for trucks during off-peak hours.
- Proactively plan for increased traffic by adjusting traffic signal timing, which can also help with active management of bus travel times.
- Financial incentives (e.g., cost reductions or raffle entries for reward cards) for taking alternate modes of transportation to encourage mode shift to those alternate modes.
- Make changes to mass transit services to either accommodate increased ridership on existing services or offer a service that replaces something else.
- Temporarily cease construction activities to help mitigate traffic impacts for major disruptions.

Find New Communications and Partnership Strategies

Building new communications and partnership strategies by leveraging data and information available to each group can result in greater and more effective outreach to the traveling public. Examples include:

- Share communications about changes to the transportation system through as many avenues as possible, including TDM professionals and the media.
- Analyze data to determine which areas or commute routes will be most affected by an event, incident, construction, etc., and conduct targeted outreach.
- Proactively work with any non-transportation-related organizations, agencies, or stakeholders (e.g., the media and employer partners) to find creative ways to manage impacts on the transportation system and to disseminate information about planned changes. In one case study, the transportation agencies worked with a non-profit organization to identify parking lots owned by the organization that the agency could temporarily promote as overflow park-and-ride lots.
- Partner with TNCs to achieve goals related to increased occupancy vehicle travel.
- As soon as any changes to the transportation system are finalized, promote those changes as early as possible. Post the information on websites and at transit stations, share it with the media and other stakeholders and partners, and offer guidance plans and trip-planning assistance. Put the word out as soon as possible and through as many avenues as possible.
- Offer real-time travel updates on travel information sites like 511 and on VMSs, and consider whether the agency will provide customized, local updates.

REFERENCES

1. Eligon, J. (2013). Image Source: Pixabay.
2. Samenow, J. (2015). "A forecast that should've been good enough, but just wasn't." *The Washington Post*, Jan 7, 2015.
3. Barone, V. (2016). "Superstorm Sandy NYC: MTA continues to rebuild four years later." *AMNewYork*, Oct 27. https://www.amny.com/transit/superstorm-sandy-nyc-mta-continues-to-rebuild-four-years-later-1.12516779. Accessed January 29, 2019.
4. Nauls, D. (2018). *Webinar: When Disaster Strikes! Integrating TDM into Emergency Preparedness. Association for Commuter Transportation*, June 19. https://www.actweb.org/i4a/pages/index.cfm?pageid=3443. Accessed January 22, 2019.
5. Los Angeles Times (2017). "Today: The 'Cajun Navy' Sails Again." *Los Angeles Times*, August 31. https://www.latimes.com/newsletters/la-me-todays-headlines-20170831-story.html. Accessed January 29, 2019.
6. Utah Department of Transportation (2007). *Use of Variable Message Signs (VMS).* UDOT 06C-23, September 1. https://www.udot.utah.gov/main/uconowner.gf?n=10468026884462491. Accessed January 22, 2019.
7. Roads and Bridges (2016). "Traffic Management: Report Finds Successful Implementation of Road Condition Reporting App in Wyoming." March 11. https://www.roadsbridges.com/traffic-management-report-finds-successful-implementation-road-condition-reporting-app-wyoming. Accessed January 22, 2019.
8. Federal Highway Administration (2018). WMATA, "SafeTrack Photo Galleries." https://www.wmata.com/about/media-relations/photos/photo-gallery.cfm?id=1035. Accessed June 10, 2019
9. Murphy, R., R. Swick, G. Guevara (2012). *Best Practices for Road Weather Management, Version 3.0*. FHWA (FHWA-HOP-12-046). https://ops.fhwa.dot.gov/publications/fhwahop12046/fhwahop12046.pdf. Accessed January 31, 2019.
10. New York City Department of Transportation (2019). "Plans for L Train Tunnel Closure." http://www.nyc.gov/html/dot/html/about/ltrainclosure.shtml. Accessed January 22, 2019.
11. Washington Metropolitan Area Transit Authority (2019). "SafeTrack." www.wmata.com/service/SafeTrack.cfm. Accessed February 1, 2019.
12. Malouff, G. (2016). "Closing Metro Lines for Months Could Work, but Only If the Region Provides Transit Alternatives." Greater Greater Washington, March 31. https://ggwash.org/view/41260/closing-metro-lines-for-months-could-work-but-only-if-the-region-provides-transit-alternatives. Accessed January 22, 2019.
13. U.S. Office of Personnel Management (undated). *U.S. Office of Personnel Management Guidance on the Use of Telework during Metro SafeTrack Project.* OPM SafeTrack #2. https://www.opm.gov/policy-data-oversight/snow-dismissal-procedures/notices/opm-guidance-on-the-use-of-telework-during-metro-safetrack.pdf. Accessed January 22, 2019.
14. District Department of Transportation. "SafeTrack FAQs." https://ddot.dc.gov/page/safetrack-faqs. Accessed January 22, 2019.
15. Montgomery County Commuter Services (2016). "Telework during SafeTrack: Quick-Start

Programs for Business Continuity." *Better Ways to Work*, Vol. 4, No. 5, June. https://www.montgomerycountymd.gov/dot-dir/Resources/Files/commuter/BWTW%20Newsletters/NewsletterJune2016.pdf. Accessed January 22, 2019.

16. Siddiqui, F. (2016). "D.C.'s Plan for SafeTrack: Cheaper Bikeshare, Shared Rides and Extended Rush-Hour Parking Restrictions" *The Washington Post*, June 2. https://www.washingtonpost.com/news/dr-gridlock/wp/2016/06/02/d-c-s-plan-for-safetrack-cheaper-bikeshare-shared-rides-and-extended-rush-hour-parking-restrictions/?noredirect=on&utm_term=.cf71fa8ebcab. Accessed January 22, 2019.

17. Office of Public Affairs (2016). *Workplace Flexibilities Available during Metrorail's SafeTrack Project*. U.S. Department of Housing and Urban Development and Washington Metropolitan Area Transit Authority, June 3. http://afge476.org/documents/safetrack_email.pdf. Accessed January 22, 2019.

18. Washington Metropolitan Area Transit Authority (undated). *SafeTrack Surge 15: Orange Line Segment Shutdown Stadium-Armory–New Carrollton: DC Bus Alternatives*. https://ddot.dc.gov/sites/default/files/dc/sites/ddot/page_content/attachments/Surge%2015%20DC%20Bus%20Alternatives%20Map.pdf. Accessed January 22, 2019.

19. Metropolitan Transportation Authority (2017). "MTA Announces Comprehensive Transportation Plan to Prevent Major Disruptions to New Yorkers' Commutes During Amtrak-Forced Summer Service Cuts." June 12. http://www.mta.info/press-release/mta-headquarters/mta-announces-comprehensive-transportation-plan-prevent-major. Accessed January 22, 2019.

20. New York State Department of Transportation (2017). *Pennsylvania Station Emergency Repair Work Traffic Management Playbook*. Unpublished.

21. McGeehan, P. (2017). "Summer Was Not So Hellish for Commuters at Penn Station." *New York Times*, September 1. https://www.nytimes.com/2017/09/01/nyregion/summer-was-not-so-hellish-for-commuters-at-penn-station.html. Accessed January 22, 2019.

22. King County (undated). *King County Water Taxi: Take the West Seattle Water Taxi during the Alaskan Way Viaduct Closure beginning April 29*. http://www.wsdot.wa.gov/Projects/Viaduct/Media/Default/-NewDocuments/99closure/WaterTaxi_Viaduct_Closure_2016_WestSeattle.pdf. Accessed January 22, 2019.

23. Federal Highway Administration (2017). "May 3, 2011 Webinar on Developing Successful Transportation Management Plans (TMPs) Michigan Department of Transportation (Michigan DOT) TMPs Presentation." https://ops.fhwa.dot.gov/wz/resources/final_rule/tmp_examples/webinar050311/wzsm_mi_pres/index.htm. Accessed January 22, 2019.

24. New Jersey Department of Transportation (2014). "Pulaski Skyway." https://www.instagram.com/p/rlEL0zqNz_/?taken-by=pulaskiskyway. Accessed January 22, 2019.

25. District of North Vancouver (undated). *District of North Vancouver Guidelines for the Development of Construction Traffic Management Plans*. https://www.dnv.org/sites/default/files/edocs/traffic-management-plan.pdf. Accessed January 22, 2019.

26. Texas Department of Transportation (2019), "I-35 Traveler Information–Waco District." https://i35-maps.tti.tamu.edu/#home. Accessed June 10, 2019

27. Cook, R (2017). Georgia DOT, "GDOT Crews Continue to Remove Debris from I-85

Bridge Collapse." http://www.dot.ga.gov/AboutGeorgia/Pages/GDOTAnnouncementDetails.aspx?postID=229. Accessed June 10, 2019

28. Georgia Department of Transportation (2019). "Gimme Five." *Georgia Commute Options.* https://gacommuteoptions.com/commuters/ways-to-earn-cash/how-programs-work/gimme-five/. Accessed January 22, 2019.
29. Georgia Department of Transportation (2017). "GDOT Analysis: Commuters Chose Alternatives for Monday Morning Commute." April 10. http://www.dot.ga.gov/PartnerSmart/Public/PressReleases/I-85-CommutersChoseAlternatives-4-10-17.pdf. Accessed January 22, 2019.
30. Wickert, D. (2017). "I-85 Bridge Collapse: How to Cope with Your Atlanta Commute." *Atlanta Journal-Constitution*, April 8. http://www.ajc.com/news/local/bridge-collapse-how-cope-with-your-atlanta-commute/XnYxOi2ccBOi808f97kbJO/. Accessed January 22, 2019.
31. Citilabs (2017). "Streetlytics and Understanding the Impact of the Atlanta I-85 Bridge Collapse." May 23. http://www.citilabs.com/citilabs_blog/streetlytics-understanding-impact-atlanta-85-bridge-collapse/. Accessed January 22, 2019.
32. Uber (undated). *Uber, Mass Transit, and MARTA*. http://www.house.ga.gov/Documents/CommitteeDocuments/2017/Transit_Governance/Presentations/Savannah/Uber_presentation.pdf. Accessed January 22, 2019.
33. Vejnoska, J. (2017). "Update: Atlanta I-85 Collapse: Some MARTA Stations Run Out of Parking Early." *Atlanta Journal-Constitution*, April 4. http://www.ajc.com/news/update-atlanta-collapse-some-marta-stations-run-out-parking-early/F1rISiNenJBJc9hJSRBSjM/. Accessed January 22, 2019.
34. Virginia Department of Transportation (2018). "Half-Price Bus Fares, Carpool Incentives Available to Commuters as I-66 Construction Gets Underway." May 3. http://www.virginiadot.org/newsroom/northern_virginia/2018/half-price_bus_fares_carpool128155.asp. Accessed January 22, 2019.
35. Becker, C. (2013). *Mitigating Highway Construction Impacts through the Use of Transit*. University of Minnesota, sponsored by Minnesota Department of Transportation, May. https://www.lrrb.org/pdf/201313.pdf. Accessed January 22, 2019.
36. Minnesota Department of Transportation (2017). "MnPASS System Study Phase 3." Webinar Presentation. November 1. https://www.fhwa.dot.gov/ipd/pdfs/tolling_and_pricing/resources/webinars/managed_lanes_best_practices_webinar_110117.pdf. Accessed January 31, 2019.
37. Metropolitan Washington Council of Governments (2017). "New Commuter Connections Rewards Program Gives Commuters Information to Avoid Traffic Delays and Congestion." December 19. https://www.mwcog.org/newsroom/2017/12/19/new-commuter-connections-rewards-program-gives-commuters-information-to-avoid-traffic-delays-and-congestion/. Accessed January 22, 2019.
38. New York State Department of Transportation (2017). "Integrated Corridor Management Concept of Operations (ConOps) for the I-495 Corridor (ICM-495) in the New York Metropolitan Region. March 10.

39. Los Angeles County Metropolitan transportation Authority (2019). "Bust Rapid Transit Studies." https://www.metro.net/projects/bus-rapid-transit-studies/. Accessed January 29, 2019.

40. Texas Department of Transportation. "Managed Lanes – What They Are and Why We Need Them." https://www.txdot.gov/driver/travel/managed-lanes.html, Accessed January 31, 2019.

41. Central Texas Regional Mobility Authority (2018). *2017 Annual Report and Financial Statements*. https://issuu.com/mobilityauthority/docs/rma-ann-spreads. Accessed January 22, 2019.

42. Federal Transit Administration (2019). "Metro Rapid Demonstration Program Evaluation Report—Operating Speed, LADOT Transit Priority System, Service Quality." https://www.transit.dot.gov/research-innovation/metro-rapid-demonstration-program-evaluation-report-operating-speed-ladot. Accessed January 22, 2019.

43. Metro ExpressLanes (2019). "Using the ExpressLanes." https://www.metroexpresslanes.net/en/about/howit.shtml. Accessed January 22, 2019.

44. Metro Expresslanes (2019). "Overview." https://www.metroexpresslanes.net/en/about/about.shtml. Accessed January 31, 2019.

45. Pace Suburban Bus (2019). "Bus-on-Shoulder Service." http://www.pacebus.com/sub/vision2020/expressway_brt.asp. Accessed January 22, 2019.

46. Uber Blog (2018). "The Big Easy guide to celebrating Mardi Gras." https://www.uber.com/blog/new-orleans/mardi-gras-guide/. Accessed January 29, 2019.

47. Llovio, L. (2015). Image Source: Shutterstock/Rena Schild.

48. Robinson, M. (2015). "Know before You Go." *Richmond Magazine*, August 5. http://richmondmagazine.com/news/news/UCI-traffic-management-plan-released/. Accessed January 22, 2019.

49. State of New Jersey Department of Transportation (2019). "Motorist Assistance in New Jersey: Traffic Mitigation Plans." https://www.state.nj.us/transportation/commuter/motoristassistance/tmp.shtm. Accessed January 22, 2019.

50. Port Authority of New York and New Jersey (2019). "The Lincoln Tunnel Exclusive Bus Lanes." https://www.panynj.gov/bridges-tunnels/lincoln-tunnel-xbl.html. Accessed January 22, 2019.

51. FHWA, "Weather Savvy Roads, Pathfinder Case Study, Wyoming Total Solar Eclipse." FHWA-HOP-18-033, https://collaboration.fhwa.dot.gov/dot/fhwa/RWMX/Documents/11900%20FHWA%20WYDOT%20Eclipse%20Case%20Study%20v10.pdf. Accessed June 10, 2019

52. Rainey. L. (2017). "Wyoming Solar Eclipse Traffic Jam Was One for the Record Books." *The Denver Post*, August 22. https://www.denverpost.com/2017/08/22/solar-eclipse-wyoming-most-traffic-record/. Accessed January 22, 2019.

53. Mortazavi, A., X. Pan, E. Jin, M. Odioso, and Z. Sun. (2009). *Travel Times on Changeable Message Signs Volume II – Evaluation of Transit Signs*. UCB-ITS-CWP-2009-2, University of California, Berkeley.

54. New York State Department of Transportation. Map of Park and Ride Lots, Long Island. http://maps.511nyrideshare.org/?name=LongIslandArea. Accessed February 6, 2019.

55. Albertson, J. (2017). "Know before You Go: Parking Difficulty on Google Maps." The Keyword, January 26. https://www.blog.google/products/maps/know-you-go-parking-difficulty-google-maps/. Accessed January 22, 2019.

56. San Francisco Municipal Transportation Agency (2014). *SFpark: Putting Theory into Practice: Pilot Project Summary and Lessons Learned*. June. http://sfpark.org/wp-content/uploads/2014/06/SFpark_Pilot_Overview.pdf. Accessed January 22, 2019.

ACKNOWLEDGMENTS

As part of the development of this product, several subject matter experts were invited to participate in webinars to discuss the contents of this compendium. Their input is greatly appreciated. Development of this document also benefitted from input by FHWA staff involved in the review and development of intermediate deliverables.

U.S. Department of Transportation
Federal Highway Administration
Office of Operations
1200 New Jersey Avenue, SE
Washington, DC 20590

Office of Operations Web Site
https://ops.fhwa.dot.gov/

June 2019
FHWA-HOP-18-072