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Refining the Real-Timed Urban Mobility Report

Final Report

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16. Abstract

The Texas Transportation Institute (TTI) is considered a national leader in providing congestion and mobility information. The *Urban Mobility Report* (*UMR*) is the most widely quoted report on urban congestion and the associated costs in the nation. The report measures system delay, wasted fuel, and the annual cost of congestion in all U.S. urban areas. In 2011, researchers also produced the *Congested Corridors Report (CCR)* which focused on traffic congestion along 328 corridors across the U.S. The *CCR* is the first report to include travel reliability statistics on a nationwide basis. In recent years, the *UMR/CCR* researchers partnered with a private-sector historical speed provider—INRIX—to obtain nationwide speed data to generate the best possible estimate of mobility conditions across the nation. The data that are available from this partnership continue to allow the *UMR/CCR* methodology to evolve. While much more is understood about freeway operations and mobility, the INRIX data are allowing researchers to take a closer look at arterial street operations and mobility. This report describes a methodological improvement in the *UMR* arterial street congestion calculations, including a change in the definition of "free-flow speed," which is used for delay calculations on arterial streets. This research improves the estimates of congestion and its costs, and maintains TTI's position as *the* most authoritative source of mobility and congestion information.

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EXECUTIVE SUMMARY

Introduction

The Texas Transportation Institute (TTI) is a national leader in providing congestion and mobility information. TTI's mobility information is provided mostly through the annual *Urban Mobility Report* (http://mobility.tamu.edu/ums), but several other national, state, and regional activities also disseminate mobility information. The *Urban Mobility Report* is recognized internationally as the most comprehensive and authoritative analysis of traffic congestion in the United States. The report has evolved over the years, with several methodology and data changes, but with a consistent focus on providing technical information in an easily understood format.

The transportation industry is constantly evolving, with much technological advancement affecting the travel on roadways and the traffic data that are collected. TTI needs to ensure that one of its premier publications, the *Urban Mobility Report* (*UMR*), keeps pace with current trends and evolves to include the best data sources and most accurate information analytics.

The primary objective of this research project was to incorporate the historical speed data from INRIX, a private-sector speed company, into the methodology that generates the statistics in the *UMR,* and to produce the *2011 UMR*. These improvements and enhancements fall into the following three specific areas:

1. conflate the Highway Performance Monitoring System (HPMS) roadway inventory and INRIX speed networks,
2. review the arterial street measures, and
3. produce and communicate the *2011 UMR*.

Task 1: Conflate the Roadway Inventory and Speed Networks

The *2010 UMR* was the first report produced with measured speed data used in the estimation of congestion statistics. The traffic volume network used was the Highway Performance Monitoring System database from the Federal Highway Administration. This network shapefile included only the higher level functional classification roadways such as freeways and did not include as many lower classification roadway such as arterial streets. Since the *UMR* methodology has always calculated delay on the freeway and arterial street system, it is imperative that the arterial street system be included in the traffic volume network. This task obtained the volume networks from the individual state departments of transportation (DOTs) rather than relying on a national network in an attempt to get more of the lower functional classification roadways in the report. Without an extensive roadway network of arterial streets, a great deal of estimation had to be done to complete the *2010 UMR*. Once the state networks were obtained, the state volume networks were conflated with the speed networks from INRIX. This task built upon previous University Transportation Center for Mobility™ (UTCM)-sponsored research projects 09-17-09 and 10-65-55.

Task 2: Review the Arterial Street Measures

In the earlier versions of the *UMR* prior to 2010, the freeflow operating speeds of the freeways and arterial streets were arbitrarily fixed at 60 mph and 35 mph, respectively, for all roadways across the United States. With the inclusion of the INRIX speed data, each section of roadway was assigned the freeflow speed estimated on that section by INRIX. These freeflow speeds from INRIX appeared to work well for the freeway sections in the *UMR* where there was a consistent freeflow speed when traffic volumes were lighter. Traffic on the arterial streets behave very differently from traffic on the freeways since many other outside elements, in addition to traffic levels, control how the traffic flows. These other factors include such items as signal timing plans, signal density, driveway density, and access management features such as raised medians. During overnight hours when fewer vehicles are on the roadway, arterial streets may have different freeflow speeds than during daylight hours when different signal timing plans are used. Progression along a corridor may be enhanced by additional greentime during peak operating conditions, which changes the freeflow speeds for the street. Due to these unique issues on the arterial streets, this task determined whether one freeflow speed—such as has been used up to this point—or multiple freeflow speeds may be needed to better represent the operations of arterial streets. This task reviewed different freeflow possibilities such as:

- one freeflow speed, determined when traffic levels are relatively light;
- one freeflow speed for overnight or light traffic conditions and a separate speed for daylight hours when traffic is heavier; and
- multiple freeflow speeds representing light traffic conditions and heavier traffic conditions during peak periods and midday traffic levels.

Task 3: Produce and Communicate the *2010 UMR*

The *2011 UMR* required additional information to explain some modifications to the methodology and how it differed from previous reports. It also required more detailed descriptions of the new findings, which were very different in some cases from previous *UMR* reports. Since the changes in some of the statistics were substantial, it was important to develop explanations for the differences between previous methodologies and the newer speed-based methodology in order to maintain the credibility and allow readers and sponsors to be comfortable with the new statistics. The *2011 Urban Mobility Report* is included as Appendix A of this research report.

INTRODUCTION

TTI is a national leader in providing congestion and mobility information. TTI's mobility information is provided mostly through the annual *Urban Mobility Report* (http://mobility.tamu.edu/ums), but several other national, state, and regional activities also disseminate mobility information. The *Urban Mobility Report* is recognized internationally as the most comprehensive and authoritative analysis of traffic congestion in the United States. The *Urban Mobility Report* provides key stakeholders in transportation across the government, business, and public sectors with an unrivaled source of information on congestion problems and trends for the nation's roadways. The report has evolved over the years, with several methodology and data changes, but with a consistent focus on providing technical information in an easily understood format.

Problem Statement

The transportation industry is constantly evolving, with much technological advancement affecting the travel on roadways and the traffic data that are collected. TTI needs to ensure that one of its premier publications, the *Urban Mobility Report*, keeps pace with current trends and evolves to include the best data sources and most accurate information analytics.

Research Objectives

The primary objective of this research project was to develop several procedures that could be used to improve and enhance information currently provided in the *Urban Mobility Report*. These improvements and enhancements fall into the following three specific areas:

1. conflate the Highway Performance Monitoring System roadway inventory and INRIX speed networks,
2. review the arterial street measures, and
3. produce and communicate the *2011 UMR*.

Overview of This Report

This report is structured around six areas and is organized as follows:

- *Introduction*—provides a brief overview of the relevant issues and project objectives.
- *Review of Arterial Street Measures*—summarizes the process for joining the roadway inventory data and private-sector historical speed data geographical information system (GIS) shapefiles.
- *Refining INRIX Reference Speeds for Use in the UMR*—shows the process used to determine new freeflow speeds on arterial streets to determine congestion levels.
- *Appendix A—The 2011 Urban Mobility Report*—provides a national analysis of long-term congestion trends, the most recent congestion comparisons, and a description of many congestion improvement strategies.
- *Appendix B—Methodology for the 2011 Urban Mobility Report*—details the data and calculations behind the performance measures.
- *Appendix C—The 2011 Congested Corridors Report*—provides a national analysis of some of the worst traffic locations in the U.S. and discusses travel reliability for the first time in a national publication.

REVIEW OF ARTERIAL STREET MEASURES

A previous UTCM research project, UTCM 09-17-09, demonstrated the possibility of conflating a public-sector roadway inventory network such as the HPMS with a private-sector speed network such as INRIX. The project's report went into detail about how the process works. There were more than 200,000 miles of roadway in the private-sector speed database to match with the public-sector network for the *2010 UMR*. This task required a significant amount of project resources to complete but is not a task that is easy to demonstrate results for.

About two-thirds of the urban vehicle travel in the 101 urban areas analyzed extensively in the *UMR* was located on conflated or "matched" roadways where both traffic volumes and speeds were available. The remaining vehicle travel occurred on "unmatched" roadways. There were several reasons why roadways did not conflate based on the two networks:

- There was no section in the speed network that matched the roadway inventory network.
- The roadway inventory network was incomplete. (This was especially true of the surface-street data for the minor arterial streets that were not included in the network shapefile because many of these roadways are not maintained by state DOTs but by local agencies.)
- The speed data for a roadway section were incomplete.

The methodology described in the next section of this report discusses the procedures used to handle roadway sections where conflation did not occur.

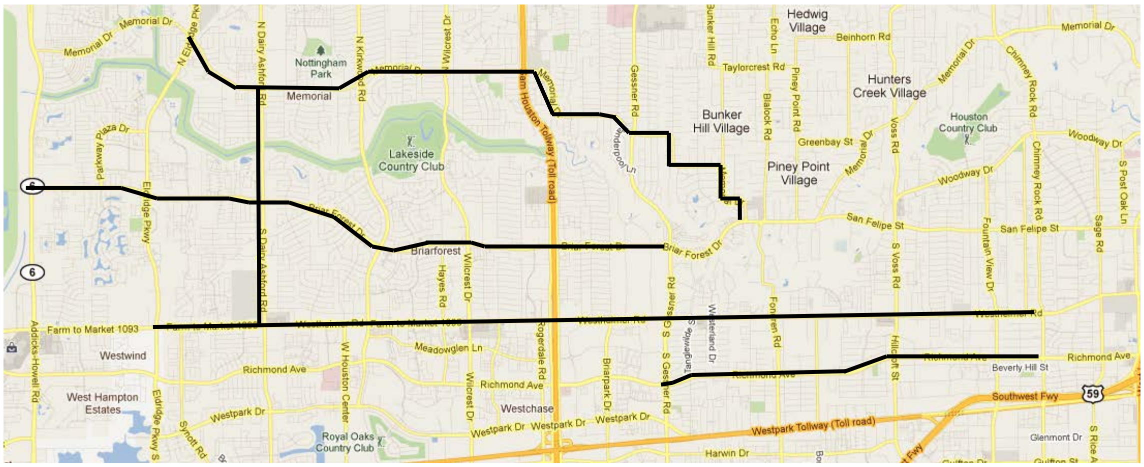
REFINING INRIX® REFERENCE SPEEDS FOR USE IN THE URBAN MOBILITY REPORT

Introduction

Accurate travel time information is needed to manage traffic conditions effectively. In the last 20 years, the hours lost per year by the average driver has increased by 300 percent in the 85 largest US cities (*1*). This translates into lost productivity and increased costs. State Department of Transportation (DOT) agencies and other government organizations need accurate travel time and speed information to better combat this congestion faced by motorists. In the past, ground truth travel time information was typically collected with probe vehicles using the "floating car" method. However, new methods such as Global Positioning System (GPS) data collection by private companies such as INRIX® and NAVTEQ® have emerged that allow for travel time data to be obtained more cost-effectively. The *Urban Mobility Report (UMR)* has turned to these companies, specifically, INRIX®, for calculating congestion indexes across the United States. This is done by analyzing hourly average speeds and reference (free flow) speeds supplied by INRIX®.

However, there is a need to investigate the difference between freeway analysis and arterial analysis. Analyses on both functional classifications of roadways in the *UMR* rely on INRIX®-supplied reference speeds to estimate delay. These INRIX® reference speeds are producing high delay on many suburban arterials, to the point that some arterial roads are showing higher congestion than some of the urban interstates in the same urban areas. Currently, the reference speeds are determined by taking the 85th percentile of 672 speed bins created from the 15-minute average speeds for the average week of data (often resulting in speeds that occur at night [10:00p.m. to 6:00a.m.]). This is acceptable for freeway analysis as freeways operate under uninterrupted flow. However, arterials operate under interrupted flow due to signal operations. These signal operations vary based on time of day and direction of flow and can have a significant impact on travel speeds, and therefore the congestion statistics. There is a need to refine the reference speed on arterials to account for signal operations, particularly during the daytime hours. Using Bluetooth® and INRIX® speed data, a new reference speed is desired that accurately reflects arterial delay during the daytime hours. The purpose of this paper is to refine the methodology INRIX® uses to determine reference speeds on arterial streets. This will be accomplished by analyzing Bluetooth® and INRIX® data for a group of roads located in west Houston, Texas. An overview of the study area can be found in Exhibit 1. Bluetooth® speed data will be used to determine the validity of the INRIX® speed data.

Exhibit 1. West Houston, Texas Initial Study Area



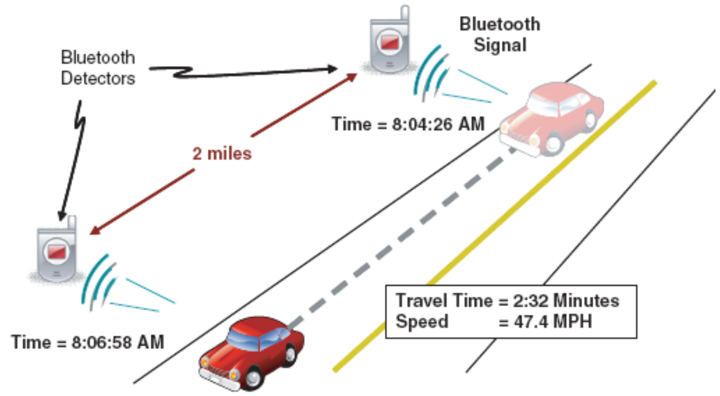
Literature Review

In the past, ground truth travel time information on arterials was often collected with probe vehicles using the “floating car” method. This method of collection involves sending out drivers who record how long it takes to travel from one reference point such as a signalized intersection to the next. This is usually done on major arterials during peak periods using a stop watch and recording the time by hand, or more recently, by attaching a GPS antenna on the vehicle.

Emerging technologies such as Bluetooth® and GPS allow agencies to determine vehicle travel times quickly without the need for floating car drivers. These technologies can be used to measure delay, determine level of service, and evaluate signal operations.

Bluetooth® is an Institute of Electrical and Electronics Engineers (IEEE) standard used for short range wireless communication between devices. Most cell phones incorporate Bluetooth® technology, as well as some GPS units and modern car entertainment systems. Because of its widespread use, Bluetooth® tracking gives officials the ability to collect a larger portion of vehicle movements than traditional methods. Bluetooth® is implemented by placing receivers on the side of the road to track the progression of a particular Bluetooth® signal along the link or corridor. This collected data can then be used to determine travel time and travel speed data. An illustration of a Bluetooth® traffic monitoring system can be found in Exhibit 2.

Exhibit 2. Bluetooth® Traffic Monitoring Operation Concept (Adapted from Reference *2*)



A successful Bluetooth® data collection is dependent on the placement of the receivers and the hardware used. Bluetooth® reader placement is dependent on whether the application is for short-term data collection or for permanent continuous data collection.

For a permanent data collection location, Bluetooth® readers are usually installed in existing traffic signal cabinets. These cabinets are usually located at a signalized intersection. This location allows for a better understanding of link travel times to the public, but it can reduce the ability to accurately measure individual intersection delay, especially if other signalized intersections exist between adjacent Bluetooth® readers.

GPS data is collected by private companies such as INRIX® and NAVTEQ®. These companies aggregate data from taxis, airport shuttles, service delivery vans, long-haul trucks, consumer vehicles, and GPS-enabled consumer smartphones to name a few. The data collected includes the speed, location, and heading of a particular vehicle at a reported date and time (*3*). However, this technology is fairly new and requires validation and application, particularly for arterial operations.

Research Methodology and Data

Bluetooth® data supplied by the Texas Transportation Institute (TTI) and the City of Houston were used for comparison and validation of the INRIX®-supplied speed data. Five different arterial corridors were used for the initial analysis, all located in the west Houston, Texas area. For some segments of the corridors, Bluetooth® data points were combined and averaged (weighted by distance) to match up with the INRIX® segments. Conversely, some INRIX® segments were combined and averaged (weighted by distance) to line up with the Bluetooth® reader pair locations. The corridors used in the analysis are listed in Exhibit 3.

Exhibit 3. Study Corridors

Road Name	Western-most Point	Eastern-most Point
Memorial Dr	Eldridge Pkwy	Blalock Rd
Briar Forest Dr	SH-6	Gessner Rd
Westheimer Pkwy	Eldridge Pkwy	Gessner Rd
Dairy Ashford Rd	Westheimer Pkwy (Southern-most point)	Memorial Dr (Northern-most point)
Richmond Ave	Gessner Rd	Chimney Rock Rd

Exhibit 4 lists the segments that required multiple data points to be averaged to determine a common segment for the analysis.

Exhibit 4. Combined Segments

Road Name	Bluetooth® Segments (# Combined)	INRIX® Segments (# Combined)
Memorial Dr	Dairy Ashford-Wilcrest (2)	Wilcrest-Blalock Rd (4)
Briar Forest Dr	Dairy Ashford-Wilcrest (2)	Wilcrest-Gessner (2)
Westheimer Pkwy	-	Wilcrest-Gessner (2)
Dairy Ashford Rd	-	-
Richmond Ave	-	-

After segments were combined to produce a common dataset, both Bluetooth® and INRIX® speed data were graphed and compared. From this analysis and comparison, it was determined that the INRIX® speed data sufficiently reflected the ground-truth Bluetooth® speed data and are suitable for application. Exhibit 5 shows a comparison of Bluetooth® and INRIX® data for various segments along the Westheimer corridor in Houston. During the daylight hours, when most congestion occurs, the speeds from both sources are fairly consistent. During the overnight hours when the number of probes on the system is limited, there is a greater disparity between the data from the two providers, but this may be due to small sample sizes.

A variety of techniques were explored to develop a suitable methodology for determining an accurate reference speed. Currently, INRIX® supplies a single reference speed for the entire day for each road segment. All of the proposed methods studied the possibility of using a daytime reference speed and nighttime reference speed. To determine accurate daytime and nighttime periods, signal timing plans and information were provided by the City of Houston Public Works and Engineering Department and the Harris County Public Infrastructure Department. Because it is not possible to retrieve this type of data on a national scale, these signal timing data were used along with Bluetooth® and INRIX® data to see if there was a broadly applicable and analytical approach to define daytime and nighttime periods.

Method 1 Approach

After discussion with INRIX® staff, it was found that their reference speed calculation is determined by taking the 85th percentile of 672 speed bins created from the 15-minute average speeds for the average week of data (often resulting in speeds that occur at night [10:00p.m. to 6:00a.m.]). It was decided that a daytime variation of the 85th percentile should be looked at as a possible new reference speed to better reflect the congestion seen on the arterial corridors. Two corridors in west Houston, Westheimer from SH 6 to Chimney Rock and Dairy Ashford from Westheimer to Memorial were chosen for further analysis. Using Bluetooth® data as the ground truth data, two methods were devised to determine the beginning and end of this daytime period.

The first method uses the equation $\frac{Standard\ Deviation\ for\ Each\ Hour}{24\ Hour\ 85th\ Percentile} \leq X$. This equation was graphed with time on the x-axis and the value 'X' on the y-axis. Using these graphs, a value was determined that resulted in start/end points that generally occurred at the signal timing plan changes. Plots for the selected corridors can be found in Exhibit 6, with the vertical bars denoting signal timing changes.

Exhibit 5. Comparison of Bluetooth® and INRIX® on Westheimer Corridor

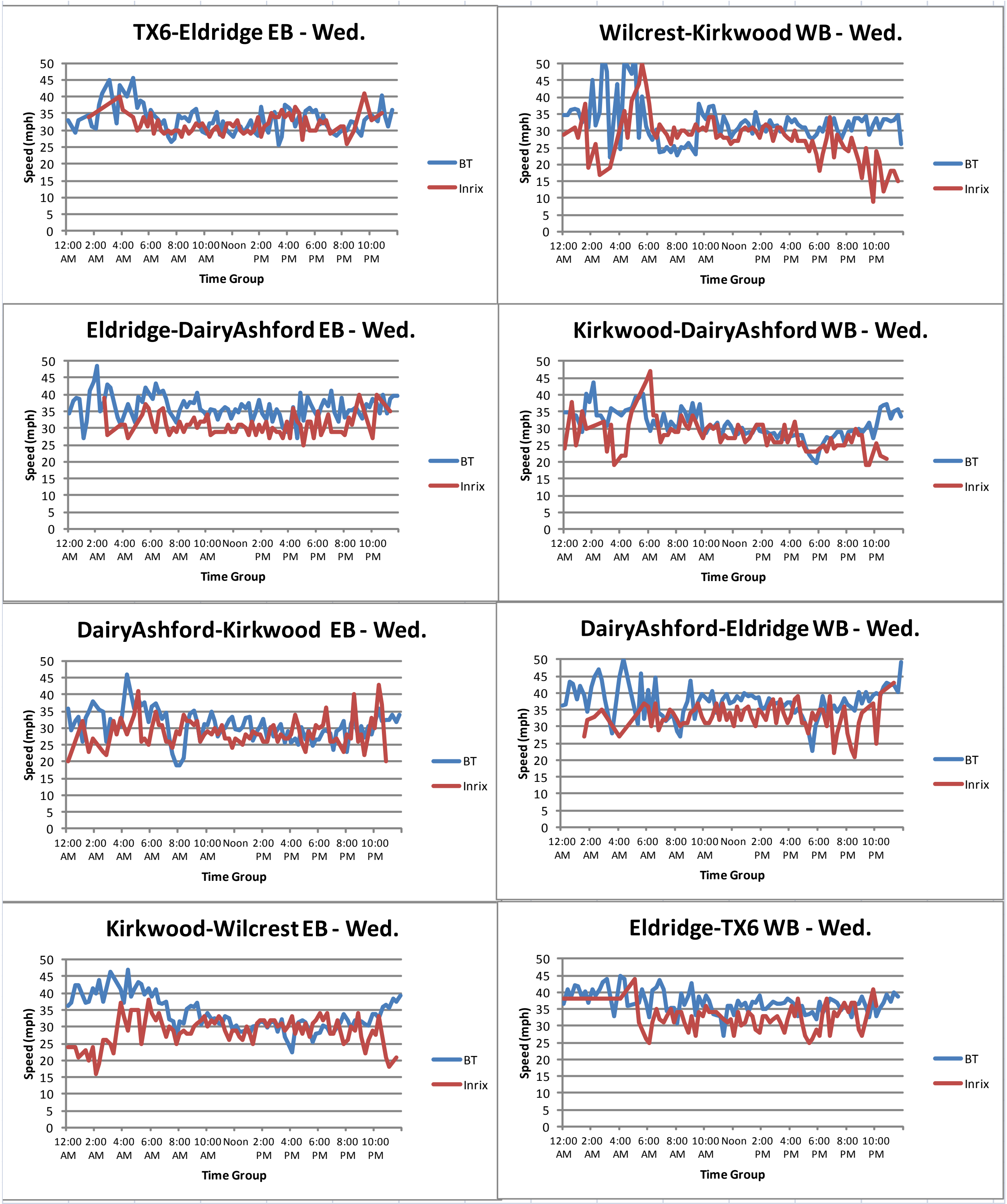
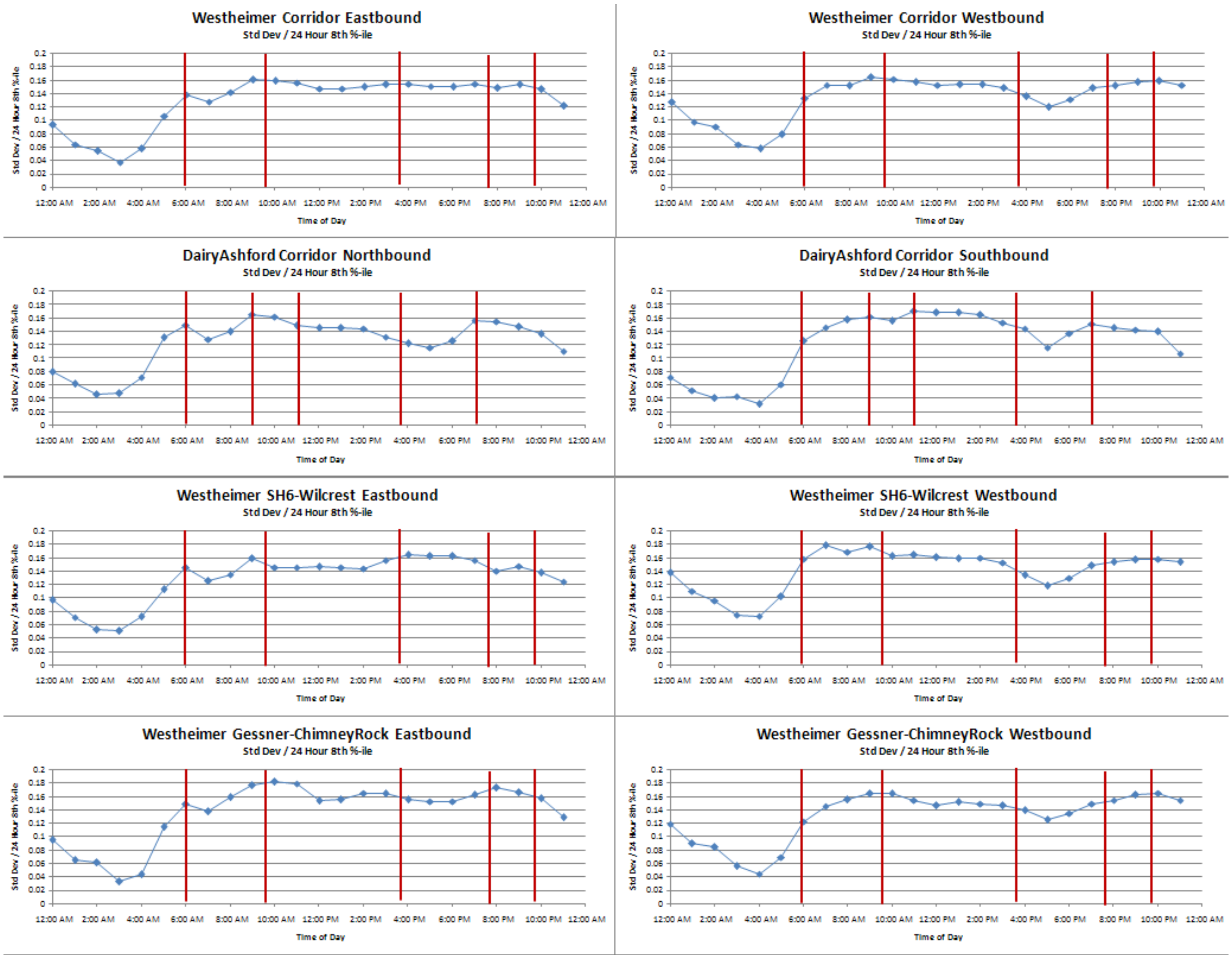


Exhibit 6. Method 1 Corridor Plots



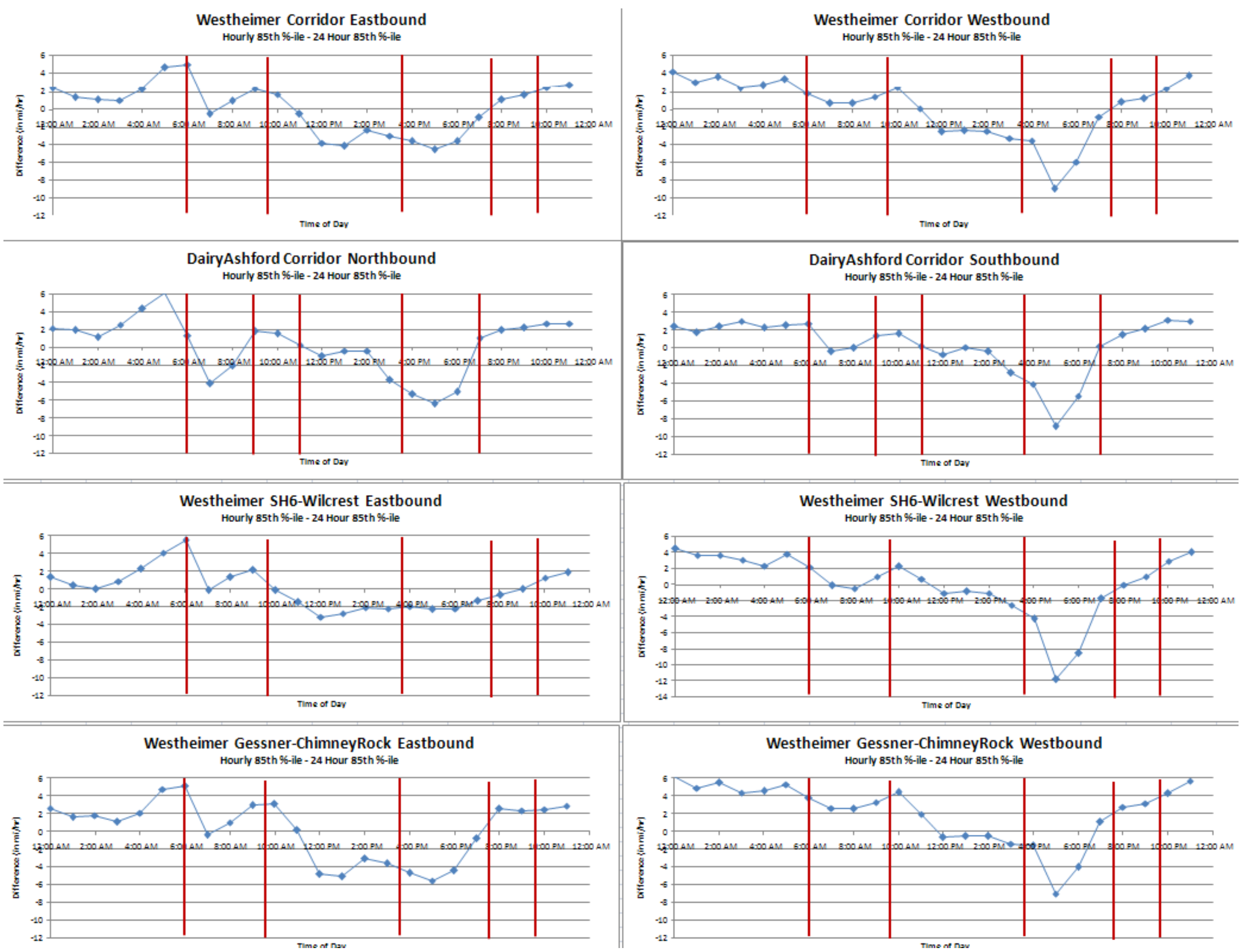
From the signal timing plans, it was found that the morning peak signal timing begins near 6:00a.m. From the plots in Exhibit 6, a $\frac{Standard\ Deviation\ for\ Each\ Hour}{24\ Hour\ 85th\ Percentile} \leq X$ value of ~0.12-0.14 was found at approximately 6:00a.m. It can be seen that the $\frac{Standard\ Deviation\ for\ Each\ Hour}{24\ Hour\ 85th\ Percentile} \leq X$values are lower during the nighttime (off-peak) periods and begin to increase during the morning peak period, with a noticeable increase in the $\frac{Standard\ Deviation\ for\ Each\ Hour}{24\ Hour\ 85th\ Percentile} \leq X$ values between the 5:00a.m. and 6:00a.m. data points. Using these findings, it was determined that the daytime peak begins when a value of 0.13 is reached.

The evening peak signal timing plan is active from 3:30p.m.-7:30p.m. (7:00p.m. for Dairy Ashford). Both the Westheimer westbound and Dairy Ashford southbound plots show a decrease in the ratio value around 5:00p.m., but it is important to note that these two corridors experience heavy evening volumes and that this decrease is not as prevalent in the opposing directions. A possible cause for this decrease might be due to the initial inefficiency of the arterial system to handle evening demand. As volumes become similar to what the evening timing plan was designed for, the values begin to increase again as the real world conditions begin to match the design parameters. Another possible explanation is that this dip might represent where the evening peak ends and where the evening home-based trips begin. However, it is hypothesized that the former explanation is more plausible. For this analysis, it was determined that the daytime 85th percentile would end where the $\frac{Standard\ Deviation\ for\ Each\ Hour}{24\ Hour\ 85th\ Percentile} \le X$ value was the lowest between 4:00p.m. and 8:00p.m. If this method were to be explored in more depth, this endpoint might be shifted to an hour or more after the lowest value.

Method 2 Approach

The second method compared the 24-hour 85th percentile to each hourly 85th percentile and determined where they started to differ. The "hourly 85th percentile minus the 24-hour 85th percentile" was plotted with time on the x-axis and the difference on the y-axis and can be found in Exhibit 7. From these plots, it was seen that the hourly 85th percentile usually began to decrease between 6:00a.m. and 7:00a.m. which coincides with the timing plan changes at 6:00a.m. Therefore, the daytime 85th percentile was determined to be from the first negative (in morning peak) hourly 85th percentile minus 24-hour 85th percentile until the last negative hourly 85th percentile minus 24-hour 85th percentile (in evening peak).

Exhibit 7. Method 2 Corridor Plots



The evening peak timing plan begins at 3:30p.m. for both corridors studied. It is more difficult to predict the evening timing plan changes compared to the morning. In the evening, the hourly 85th percentile remains lower than the 24-hour 85th percentile until around 6:00p.m.-8:00p.m. depending on the road section. There was a noticeable drop in the hourly 85th percentile during the evening peak for most of the corridor sections examined. The beginning of this decrease might be useful in estimating the beginning of the evening signal timing plan if that information was desired.

The Westheimer corridor reverts back to the off-peak timing plan at 7:30p.m. and the Dairy Ashford corridor reverts back to the off-peak timing plan at 7:00p.m. These times are fairly similar to when the 85th percentiles begin to improve. Therefore, using a daytime 85th percentile from 6:00a.m. or 7:00a.m. to 7:00p.m. or 8:00p.m. might be useful. For a broader application, one possible way of determining the end 85th percentile range might be when the hourly 85th percentile equals the 24-hour 85th percentile. For most of the segments, this was around 7:00p.m.-8:00p.m., which coincides closely to when the evening peak timing plan ends.

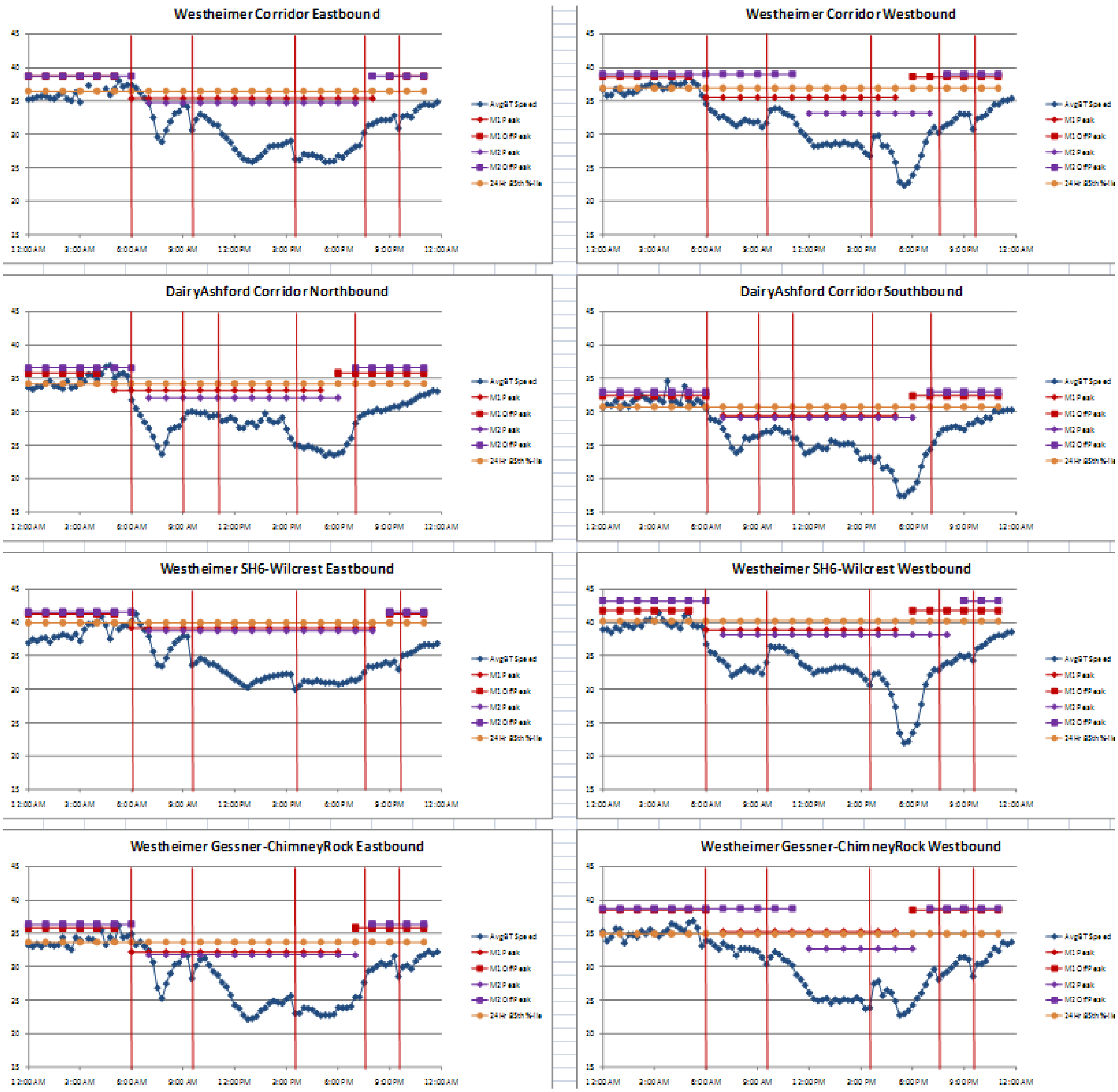
A summary of these two methods' proposed criteria for determining daytime peak periods can be found in Exhibit 8.

Exhibit 8. Daytime 85th Percentile Criteria

Method	Daytime Period Begins (morning)	Daytime Period Ends (evening)
$\frac{Standard\ Deviation\ for\ Each\ Hour}{24\ Hour\ 85th\ Percentile} \leq X$ (Method 1)	When $\frac{Standard\ Deviation\ for\ Each\ Hour}{24-Hour\ 85th\ Percentile} = 0.13$	Lowest hour between 4:00p.m.-8:00p.m.
Hourly 85th Percentile minus 24-Hour 85th Percentile (Method 2)	First negative Hourly 85th Percentile minus 24-Hour 85th Percentile in the morning peak period	Last negative Hourly 85th Percentile minus 24-Hour 85th Percentile in the evening peak period

Exhibit 9 illustrates these new daytime and nighttime 85th percentiles using the two methods previously described. The orange line (oval markers) represents the 24 hour 85th percentile speed which is currently used to determine congestion. The lower red line (higher diamond marker) represents the new daytime 85th percentile speed based on method 1, while the lower purple line (lower diamond marker) represents the new daytime 85th percentile speed based on method 2.

Exhibit 9. New 85th Percentiles

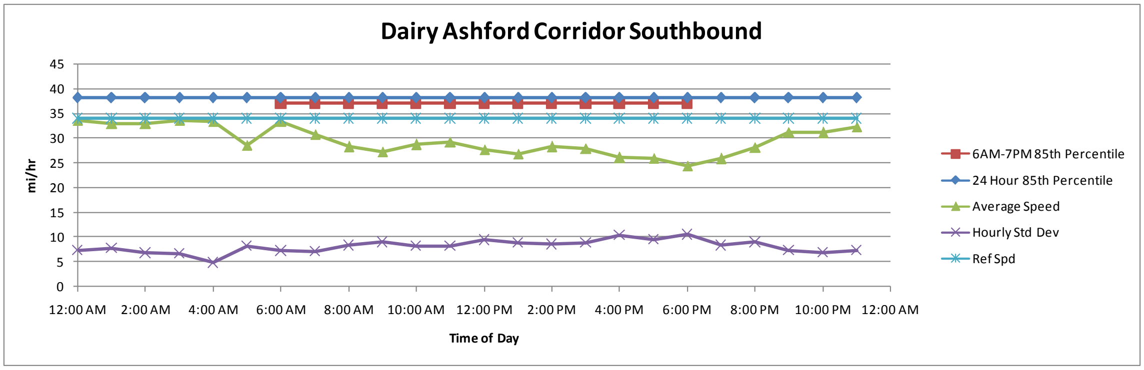


From these plots, it can be seen that method 1 (red/upper diamond markers) tends to end before the average speeds return to ‘normal’. Method 2 tended to have a shorter daytime period, especially for directions experiencing heavy evening directional volumes as seen in Westheimer westbound. However, this was not seen for the Dairy Ashford southbound corridor. It was hypothesized that of the two methods, method 1 fits the best. After studying timing plans and the speed data, it was concluded that the daytime period fits approximately to 6:00a.m.-7:00p.m. This definite timeframe reflects the results of both methods and is easier to process on a large scale than time frames that can change depending on each segment. Therefore, it was initially thought that this 6:00a.m.-7:00p.m. timeframe for the daytime 85th percentile should be used with the INRIX® speed data for determining the daytime reference speed.

Review of the Daytime 85th Percentile Speed

After analysis over all five arterial corridors in the study area using the INRIX® average speed data, it was found that the 6:00a.m.-7:00p.m. 85th percentile still produced artificially high speed values which were not representative of actual conditions. This is evident in Exhibit 10. Based on the findings of this analysis, researchers rejected the notion of using the 85th percentile of the 6:00a.m.-7:00p.m. time period as the new reference speed.

Exhibit 10. Daytime 85th Percentile for the Dairy Ashford Corridor Southbound



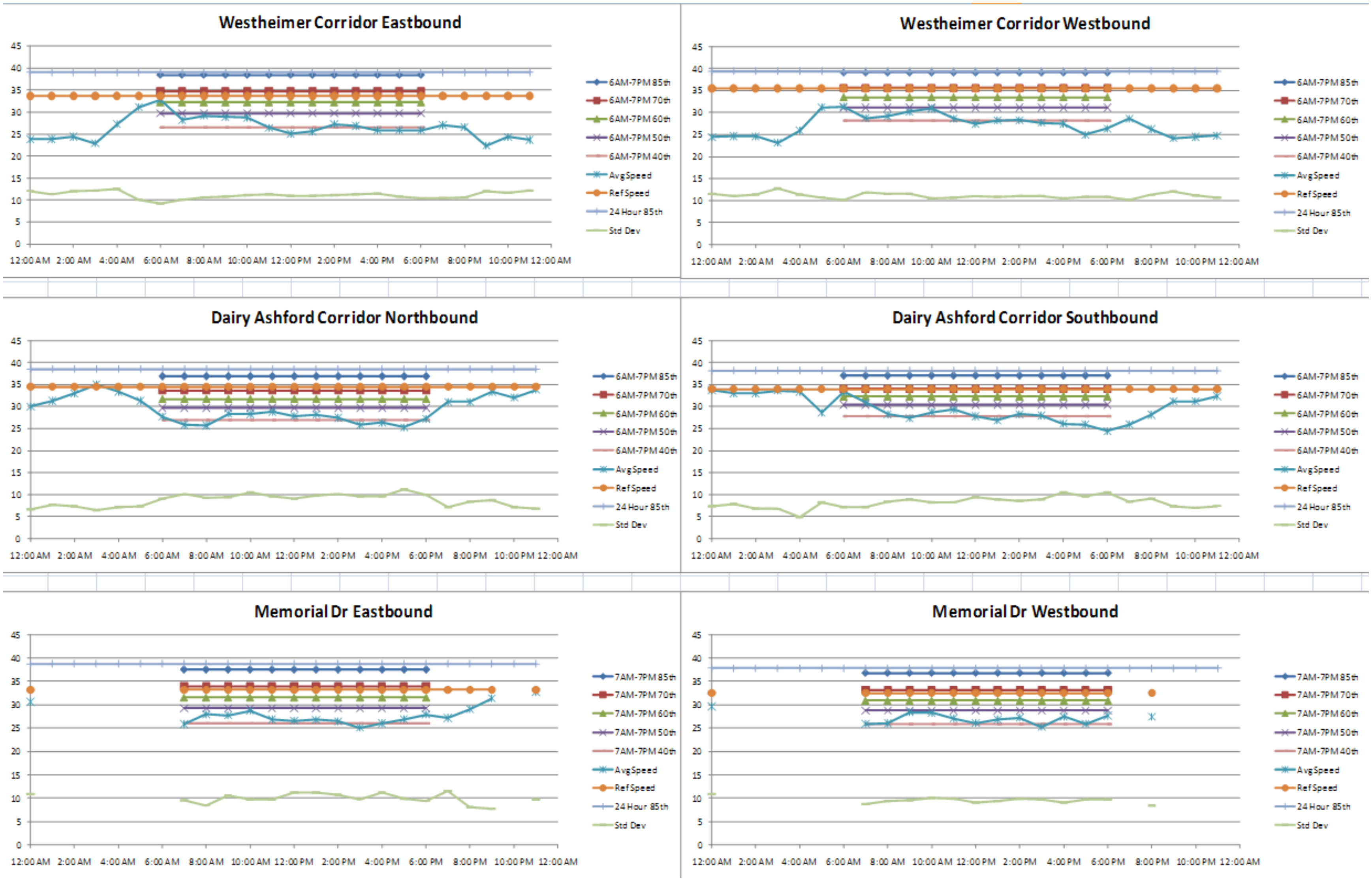
Investigation of Other Percentiles

A new methodology was needed after the rejection of the first two methods based on the 85th percentile. Researchers explored using other percentiles to accurately represent the reference speed. Exhibit 11 represents a range of percentiles (40th, 50th, 60th, 70th, 85th) using INRIX® speed data for three of the corridors (which had all of the necessary statistics available) in the study area. These percentiles are based on average hourly INRIX® speed data for the 6:00a.m.-7:00p.m. period, as determined previously. The hourly percentiles were averaged for the period from 6:00a.m. to 7:00p.m. so that the given percentile would not fluctuate from hour to hour. After analyzing the different percentiles over a variety of corridors, it was determined that the 60th percentile (seen in green-triangle markers in Exhibit 11) appears to best represent the reference speed for these corridors.

After studying the data, it was found that this new reference speed seems to depict what acceptable daytime speeds could be given the proper conditions. As it is a reference speed, it is used as a benchmark for congestion. As was the case in this study, actual speeds should not exceed it given the heavy daytime traffic volumes. By reducing the reference speed from one that is based on the 85th percentile to the 60th percentile, researchers were able to remove a lot of "inherent delay" that is constantly present on arterials due to the characteristics of interrupted flow that is not present on freeway systems. This "inherent delay" produced artificially high congestion numbers for many arterial streets. Removing this inherent delay allows for a better comparison and understanding of congestion when comparing arterials to freeways and provides improvements in accuracy and reliably to data found in the *UMR* congestion report.

Based on these results, researchers recommend the implementation of the 60th average speed percentile for 6:00a.m. to 7:00p.m. to replace the current INRIX® reference speed for congestion calculations of arterial streets in the *Urban Mobility Report.* The INRIX® reference speed will continue to be used for the 7:00p.m. to 6:00a.m. timeframe when most signalized systems are in some form of actuated mode.

Exhibit 11. INRIX® Percentiles



Conclusions

Interrupted flow found on arterial streets poses new challenges for accurately calculating congestion. New technologies such as GPS provide sufficient data but need refinement. This paper validated the use of Bluetooth® readers for collecting accurate travel time data and also discussed current issues with using INRIX® speed data and reference speeds on arterial roads.

Multiple methods were explored for determining representative daytime periods and reference speeds. Based on this research, it appears that the 60th percentile for a daytime period of 6:00a.m. to 7:00p.m. depicts a reasonable new reference speed when estimating delay. By reducing the reference speed from one that is based on the 85th percentile to the 60th percentile, researchers were able to remove a lot of inherent delay that is constantly present on arterials due to the characteristics of interrupted flow that is not present on freeway systems. It is hypothesized that this will allow for a better comparison and understanding of delay when comparing operations on arterial versus freeways and provides improvements in accuracy and reliably to data found in the *UMR*.

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APPENDIX A—THE 2011 URBAN MOBILITY REPORT

This appendix includes the 2011 Urban Mobility Report, which was released on September 27, 2011. See website http://mobility.tamu.edu/ums.

TTI's 2011 URBAN MOBILITY REPORT
Powered by INRIX Traffic Data

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September 2011

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American Road & Transportation Builders Association – Transportation Development Foundation
American Public Transportation Association
Texas Transportation Institute

2011 Urban Mobility Report

For the complete report and congestion data on your city, see: http://mobility.tamu.edu/ums.

Congestion is a significant problem in America's 439 urban areas. And, although readers and policy makers may have been distracted by the economy-based congestion reductions in the last few years, the 2010 data indicate the problem will not go away by itself – action is needed.

- First, the problem is very large. In 2010, congestion caused urban Americans to travel 4.8 billion hours more and to purchase an extra 1.9 billion gallons of fuel for a congestion cost of $101 billion. (see Exhibit 1)
- Second, 2008 was the best year for congestion in recent times (see Exhibit 2); congestion was worse in 2009 and 2010.
- Third, there is only a short-term cause for celebration. Prior to the economy slowing, just 4 years ago, congestion levels were much higher than a decade ago; these conditions will return with a strengthening economy.

There are many ways to address congestion problems; the data show that these are not being pursued aggressively enough. The most effective strategy is one where agency actions are **complemented** by efforts of businesses, manufacturers, commuters and travelers. There is no **rigid prescription** for the "best way"**—each region** must identify the projects, programs and policies that achieve goals, solve problems and capitalize on opportunities.

Exhibit 1. Major Findings of the 2011 Urban Mobility Report (439 U.S. Urban Areas)

(Note: See page 2 for description of changes since the 2010 Report)

Measures of…	1982	2000	2005	2009	2010
… Individual Congestion					
Yearly delay per auto commuter (hours)	14	35	39	34	34
Travel Time Index	1.09	1.21	1.25	1.20	1.20
Commuter Stress Index	--	--	--	1.29	1.30
"Wasted" fuel per auto commuter (gallons)	6	14	17	14	14
Congestion cost per auto commuter (2010 dollars)	$301	$701	$814	$723	$713
… The Nation's Congestion Problem					
Travel delay (billion hours)	1.0	4.0	5.2	4.8	4.8
"Wasted" fuel (billion gallons)	0.4	1.6	2.2	1.9	1.9
Truck congestion cost (billions of 2010 dollars)	--	--	--	$24	$23
Congestion cost (billions of 2010 dollars)	$21	$79	$108	$101	$101
… The Effect of Some Solutions					
Yearly travel delay saved by:					
Operational treatments (million hours)	8	190	312	321	327
Public transportation (million hours)	381	720	802	783	796
Fuel saved by:					
Operational treatments (million gallons)	1	79	126	128	131
Public transportation (million gallons)	139	294	326	313	303
Yearly congestion costs saved by:					
Operational treatments (billions of 2010$)	$0.2	$3.1	$6.5	$6.7	$6.9
Public transportation (billions of 2010$)	$6.9	$12.0	$16.9	$16.5	$16.8

Yearly delay per auto commuter – The extra time spent traveling at congested speeds rather than free-flow speeds by private vehicle drivers and passengers who typically travel in the peak periods.

Travel Time Index (TTI) – The ratio of travel time in the peak period to travel time at free-flow conditions. A Travel Time Index of 1.30 indicates a 20-minute free-flow trip takes 26 minutes in the peak period.

Commuter Stress Index – The ratio of travel time for the peak direction to travel time at free-flow conditions. A TTI calculation for only the most congested direction in both peak periods.

Wasted fuel – Extra fuel consumed during congested travel.

Congestion cost – The yearly value of delay time and wasted fuel.

The Congestion Trends

(And the New Data Providing a More Accurate View)

The 2011 *Urban Mobility Report* is the 2nd prepared in partnership with INRIX, a leading private sector provider of travel time information for travelers and shippers. This means the 2011 Urban Mobility Report has millions of data points resulting in an average speed on almost every mile of major road in urban America for almost every hour of the day. For the congestion analyst, this is an awesome amount of information. For the policy analyst and transportation planner, these congestion problems can be described in detail and solutions can be targeted with much greater specificity and accuracy.

The INRIX speed data is combined with traffic volume data from the states to provide a much better and more detailed picture of the problems facing urban travelers. This one-of-its-kind data combination gives the Urban Mobility Report an unrivaled picture of urban traffic congestion.

INRIX (*1*) anonymously collects traffic speed data from personal trips, commercial delivery vehicle fleets and a range of other agencies and companies and compiles them into an average speed profile for most major roads. The data show conditions for every day of the year and include the effect of weather problems, traffic crashes, special events, holidays, work zones and the other congestion causing (and reducing) elements of today's traffic problems. TTI combined these speeds with detailed traffic volume data (*2*) to present an estimate of the scale, scope and patterns of the congestion problem in urban America.

The new data and analysis changes the way the mobility information can be presented and how the problems are evaluated. Key aspects of the 2011 report are summarized below.

- Hour-by-hour speeds collected from a variety of sources on every day of the year on most major roads are used in the 101 detailed study areas and the 338 other urban areas. For more information about INRIX, go to www.inrix.com.
- The data for all 24 hours makes it possible to track congestion problems for the midday, overnight and weekend time periods.
- Truck freight congestion is explored in more detail thanks to research funding from the National Center for Freight and Infrastructure Research and Education (CFIRE) at the University of Wisconsin (http://www.wistrans.org/cfire/).
- A new wasted fuel estimation process was developed to use the more detailed speed data. The procedure is based on the Environmental Protection Agency's new modeling procedure-Motor Vehicle Emission Simulator (MOVES). While this model does not capture the second-to-second variations in fuel consumption due to stop-and-go driving, it, along with the INRIX hourly speed data, provides a better estimate than previous procedures based on average daily traffic speeds.
- One new congestion measure is debuted in the 2011 Urban Mobility Report. Total travel time is the sum of delay time and free-flow travel time. It estimates the amount of time spent on the road. More information on total travel time can be found at: http://mobility.tamu.edu/resources/

Exhibit 2. National Congestion Measures, 1982 to 2010

Year	Travel Time Index	Delay per Commuter (hours)	Total Delay (billion hours)	Fuel Wasted (billion gallons)	Total Cost (2010$ billion)	Hours Saved (million hours)		Gallons Saved (million gallons)		Dollars Saved (billions of 2010$)	
						Operational Treatments & HOV Lanes	Public Transp	Operational Treatments & HOV Lanes	Public Transp	Operational Treatments & HOV Lanes	Public Transp
1982	1.09	14.4	0.99	0.36	20.6	8	381	1	139	0.2	6.9
1983	1.09	15.7	1.09	0.40	22.3	10	389	3	142	0.2	7.1
1984	1.10	16.9	1.19	0.44	24.3	14	403	5	149	0.3	7.3
1985	1.11	19.0	1.38	0.51	28.0	19	427	6	160	0.3	7.6
1986	1.12	21.1	1.59	0.60	31.2	25	404	8	156	0.4	7.0
1987	1.13	23.2	1.76	0.68	34.6	32	416	11	161	0.6	7.2
1988	1.14	25.3	2.03	0.79	39.7	42	508	14	197	0.7	8.8
1989	1.16	27.4	2.22	0.87	43.8	51	544	17	214	0.8	9.5
1990	1.16	28.5	2.35	0.93	46.4	58	542	20	216	0.9	9.4
1991	1.16	28.5	2.41	0.96	47.4	61	536	21	216	1.0	9.3
1992	1.16	28.5	2.57	1.02	50.5	69	527	24	211	1.1	9.1
1993	1.17	29.6	2.71	1.07	53.1	77	520	27	208	1.2	9.0
1994	1.17	30.6	2.82	1.12	55.4	86	541	30	217	1.4	9.4
1995	1.18	31.7	3.02	1.21	59.7	101	569	35	232	1.7	9.9
1996	1.19	32.7	3.22	1.30	63.8	116	589	40	241	1.9	10.3
1997	1.19	33.8	3.40	1.37	67.1	132	607	46	249	2.2	10.6
1998	1.20	33.8	3.54	1.44	68.9	150	644	52	267	2.4	11.0
1999	1.21	34.8	3.80	1.55	73.9	173	683	59	285	2.8	11.7
2000	1.21	34.8	3.97	1.63	79.2	190	720	79	294	3.1	12.0
2001	1.22	35.9	4.16	1.71	82.6	215	749	89	307	3.7	12.9
2002	1.23	36.9	4.39	1.82	87.2	239	758	101	314	4.2	13.2
2003	1.23	36.9	4.66	1.93	92.4	276	757	115	311	4.8	13.3
2004	1.24	39.1	4.96	2.06	100.2	299	798	127	331	5.5	14.8
2005	1.25	39.1	5.22	2.16	108.1	325	809	135	336	6.3	15.9
2006	1.24	39.1	5.25	2.18	110.0	359	845	150	354	7.2	17.3
2007	1.24	38.4	5.19	2.20	110.3	363	889	152	372	7.6	18.9
2008	1.20	33.7	4.62	1.88	97.0	312	802	126	326	6.5	16.9
2009	1.20	34.0	4.80	1.92	100.9	321	783	128	313	6.7	16.5
2010	1.20	34.4	4.82	1.94	100.9	327	796	131	303	6.9	16.8

Note: For more congestion information see Tables 1 to 9 and http://mobility.tamu.edu/ums.

One Page of Congestion Problems

In many regions, traffic jams can occur at any daylight hour, many nighttime hours and on weekends. The problems that travelers and shippers face include extra travel time, unreliable travel time and a system that is vulnerable to a variety of irregular congestion-producing occurrences. All of these are a much greater problem now than in 1982. Some key descriptions are listed below. See data for your city at mobility.tamu.edu/ums/congestion_data.

Congestion costs are increasing. The congestion "invoice" for the cost of extra time and fuel in 439 urban areas was (all values in constant 2010 dollars):

- In 2010 – $101 billion
- In 2000 – $79 billion
- In 1982 – $21 billion

Congestion wastes a massive amount of time, fuel and money. In 2010:

- 1.9 billion gallons of wasted fuel (equivalent to about 2 months of flow in the Alaska Pipeline).
- 4.8 billion hours of extra time (equivalent to the time Americans spend relaxing and thinking in 10 weeks).
- $101 billion of delay and fuel cost (the negative effect of uncertain or longer delivery times, missed meetings, business relocations and other congestion-related effects are not included).
- $23 billion of the delay cost was the effect of congestion on truck operations; this does not include any value for the goods being transported in the trucks.
- The cost to the average commuter was $713 in 2010 compared to an inflation-adjusted $301 in 1982.

Congestion affects people who make trips during the peak period.

- Yearly peak period delay for the average commuter was 34 hours in 2010, up from 14 hours in 1982.
- Those commuters wasted 14 gallons of fuel in the peak periods in 2010 – a week's worth of fuel for the average U.S. driver – up from 6 gallons in 1982.
- Congestion effects were even larger in areas with over one million persons – 44 hours and 20 gallons in 2010.
- "Rush hour" – possibly the most misnamed period ever – lasted 6 hours in the largest areas in 2010.
- Fridays are the worst days to travel. The combination of work, school, leisure and other trips mean that urban residents earn their weekend after suffering 200 million more delay hours than Monday.
- 60 million Americans suffered more than 30 hours of delay in 2010.

Congestion is also a problem at other hours.

- Approximately 40 percent of total delay occurs in the midday and overnight (outside of the peak hours of 6 to 10 a.m. and 3 to 7 p.m.) times of day when travelers and shippers expect free-flow travel. Many manufacturing processes depend on a free-flow trip for efficient production; it is difficult to achieve the most desirable outcome with a network that may be congested at any time of day.

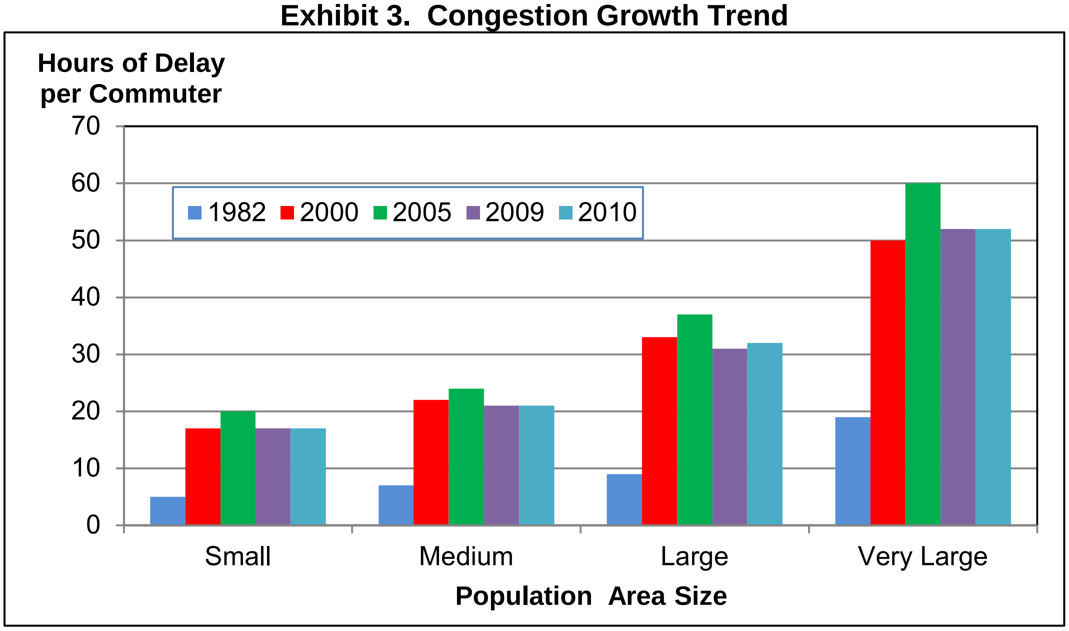
More Detail About Congestion Problems

Congestion, by every measure, has increased substantially over the 29 years covered in this report. The recent decline in congestion brought on by the economic recession has been reversed in most urban regions. This is consistent with the pattern seen in some metropolitan regions in the 1980s and 1990s; economic recessions cause fewer goods to be purchased, job losses mean fewer people on the road in rush hours and tight family budgets mean different travel decisions are made. As the economy recovers, so does traffic congestion. In previous regional recessions, once employment began a sustained, significant growth period, congestion increased as well.

The total congestion problem in 2010 was approximately near the levels recorded in 2004; growth in the number of commuters means that the delay per commuter is less in 2010. This "reset" in the congestion trend, and the low prices for construction, should be used as a time to promote congestion reduction programs, policies and projects.

Congestion is worse in areas of every size – it is not just a big city problem. The growing delays also hit residents of smaller cities (Exhibit 3). Regions of all sizes have problems implementing enough projects, programs and policies to meet the demand of growing population and jobs. Major projects, programs and funding efforts take 10 to 15 years to develop.

Exhibit 3. Congestion Growth Trend



Small = less than 500,000
Medium = 500,000 to 1 million
Large = 1 million to 3 million
Very Large = more than 3 million

Think of what else could be done with the 34 hours of extra time suffered by the average urban auto commuter in 2010:

- 4 vacation days
- The time the average American spends eating and drinking in a month.

And the 4.8 billion hours of delay is the equivalent of more than 1,400 days of Americans playing Angry Birds – this is a lot of time.

Congestion builds through the week from Monday to Friday. The two weekend days have less delay than any weekday (Exhibit 4). Congestion is worse in the evening but it can be a problem all day (Exhibit 5). Midday hours comprise a significant share of the congestion problem (approximately 30% of total delay).

Exhibit 4. Percent of Delay for Each Day

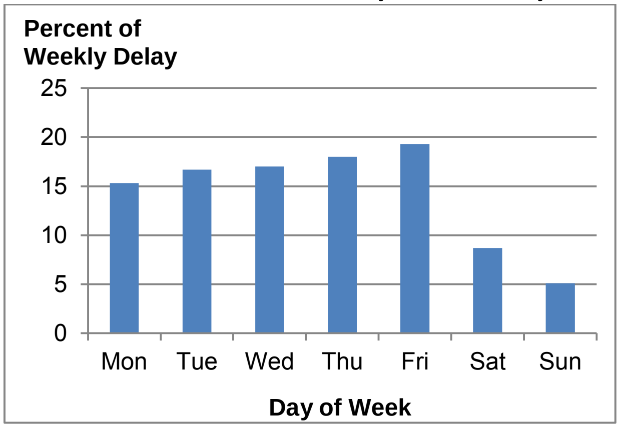
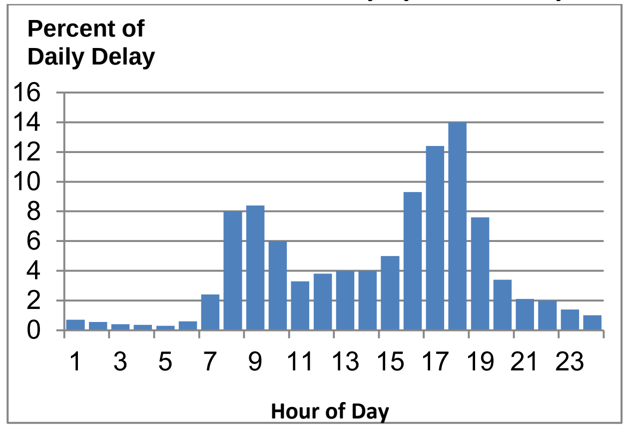
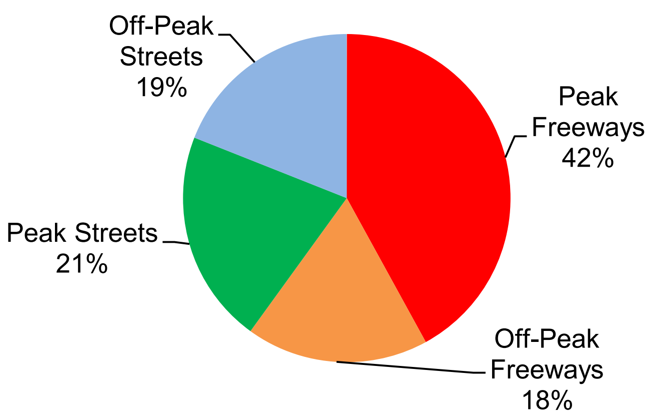


Exhibit 5. Percent of Delay by Time of Day



Freeways have more delay than streets, but not as much as you might think (Exhibit 6).

Exhibit 6. Percent of Delay for Road Types



The "surprising" congestion levels have logical explanations in some regions.

The urban area congestion level rankings shown in Tables 1 through 9 may surprise some readers. The areas listed below are examples of the reasons for higher than expected congestion levels.

- *Work zones* – Baton Rouge. Construction, even when it occurs in the off-peak, can increase traffic congestion.
- *Smaller urban areas with a major interstate highway* – Austin, Bridgeport, Salem. High volume highways running through smaller urban areas generate more traffic congestion than the local economy causes by itself.
- *Tourism* – Orlando, Las Vegas. The traffic congestion measures in these areas are divided by the local population numbers causing the per-commuter values to be higher than normal

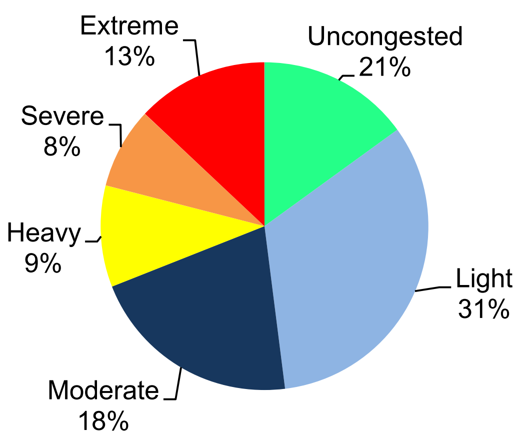
- *Geographic constraints* – Honolulu, Pittsburgh, Seattle. Water features, hills and other geographic elements cause more traffic congestion than regions with several alternative routes.

Travelers and shippers must plan around congestion more often.

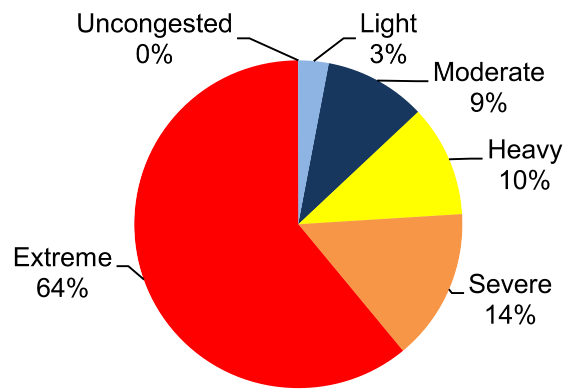
- In all 439 urban areas, the worst congestion levels affected only 1 in 9 trips in 1982, but almost 1 in 4 trips in 2010 (Exhibit 7).
- The most congested sections of road account for 78% of peak period delays, with only 21% of the travel (Exhibit 7).
- Delay has grown about five times larger overall since 1982.

Exhibit 7. Peak Period Congestion and Congested Travel in 2010

Vehicle travel in congestion ranges



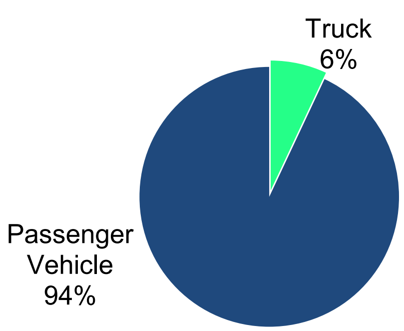
Travel delay in congestion ranges



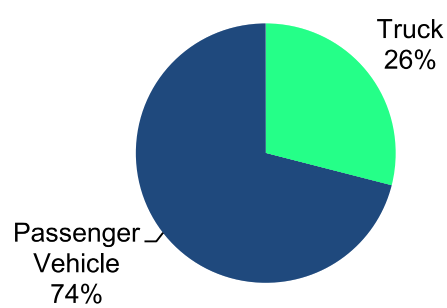
While **trucks** only account for about 6 percent of the miles traveled in urban areas, they are **almost 26 percent of the urban "congestion invoice."** In addition, the cost in Exhibit 8 only includes the cost to operate the truck in heavy traffic; the extra cost of the commodities is not included.

Exhibit 8. 2010 Congestion Cost for Urban Passenger and Freight Vehicles

Travel by Vehicle Type



Congestion Cost by Vehicle Type



The Future of Congestion

As Yogi Berra said, "I don't like to make predictions, especially about the future…" But with a few clearly stated assumptions, this report provides some estimates of the near-future congestion problem. Basically, these assumptions relate to the growth in travel and the amount of effort being made to accommodate that growth, as well as address the current congestion problem. In summary, the outlook is not sunshine and kittens.

- Population and employment growth—two primary factors in rush hour travel demand—are projected to grow slightly slower from 2010 to 2020 than in the previous ten years.
- The combined role of the government and private sector will yield approximately the same rate of transportation system expansion (both roadway and public transportation). (The analysis assumed that policies and funding levels will remain about the same).
- The growth in usage of any of the alternatives (biking, walking, work or shop at home) will continue at the same rate.
- Decisions as to the priorities and level of effort in solving transportation problems will continue as in the recent past.
- The period before the economic recession was used as the indicator of the effect of growth. The years from 2000 to 2006 had generally steady economic growth in most U.S. urban regions; these years are assumed to be a good indicator of the future level of investment in solutions and the resulting increase in congestion.

If this "status quo" benchmark is applied to the next five to ten years, a rough estimate of future congestion can be developed. The congestion estimate for any single region will be affected by the funding, project selections and operational strategies; the simplified estimation procedure used in this report will not capture these variations. Combining all the regions into one value for each population group, however, may result in a balance between estimates that are too high and those that are too low.

- The national congestion cost will grow from $101 billion to $133 billion in 2015 and $175 billion in 2020 (in 2010 dollars).
- Delay will grow to 6.1 billion hours in 2015 and 7.7 billion hours in 2020.
- The average commuter will see their cost grow to $937 in 2015 and $1,232 in 2020 (in 2010 dollars). They will waste 37 hours and 16 gallons in 2015 and 41 hours and 19 gallons in 2020.
- Wasted fuel will increase to 2.5 billion gallons in 2015 and 3.2 billion gallons in 2020.
- If the price of gasoline grows to $5 per gallon, the congestion-related fuel cost would grow to $13 billion in 2015 and $16 billion in 2020.

Freight Congestion and Commodity Value

Trucks carry goods to suppliers, manufacturers and markets. They travel long and short distances in peak periods, middle of the day and overnight. Many of the trips conflict with commute trips, but many are also to warehouses, ports, industrial plants and other locations that are not on traditional suburb to office routes. Trucks are a key element in the just-in-time (or lean) manufacturing process; these business models use efficient delivery timing of components to reduce the amount of inventory warehouse space. As a consequence, however, trucks become a mobile warehouse and if their arrival times are missed, production lines can be stopped, at a cost of many times the value of the truck delay times.

Congestion, then, affects truck productivity and delivery times and can also be caused by high volumes of trucks, just as with high car volumes. One difference between car and truck congestion costs is important; a significant share of the $23 billion in truck congestion costs in 2010 was passed on to consumers in the form of higher prices. The congestion effects extend far beyond the region where the congestion occurs.

The 2010 Urban Mobility Report, with funding from the National Center for Freight and Infrastructure Research and Education (CFIRE) at the University of Wisconsin and data from USDOT's Freight Analysis Framework (*6*), developed an estimate of the value of commodities being shipped by truck to and through urban areas and in rural regions. The commodity values were matched with truck delay estimates to identify regions where high values of commodities move on congested roadway networks.

Table 5 points to a correlation between commodity value and truck delay—higher commodity values are associated with more people; more people are associated with more traffic congestion. Bigger cities consume more goods, which means a higher value of freight movement. While there are many cities with large differences in commodity and delay ranks, only 17 urban areas are ranked with commodity values much higher than their delay ranking.

The Table also illustrates the role of long corridors with important roles in freight movement. Some of the smaller urban areas along major interstate highways along the east and west coast and through the central and Midwestern U.S., for example, have commodity value ranks much higher than their delay ranking. High commodity values and lower delay might sound advantageous—lower congestion levels with higher commodity values means there is less chance of congestion getting in the way of freight movement. At the areawide level, this reading of the data would be correct, but in the real world the problem often exists at the road or even intersection level—and solutions should be deployed in the same variety of ways.

Possible Solutions

Urban and rural corridors, ports, intermodal terminals, warehouse districts and manufacturing plants are all locations where truck congestion is a particular problem. Some of the solutions to these problems look like those deployed for person travel—new roads and rail lines, new lanes on existing roads, lanes dedicated to trucks, additional lanes and docking facilities at warehouses and distribution centers. New capacity to handle freight movement might be an even larger need in coming years than passenger travel capacity. Goods are delivered to retail and commercial stores by trucks that are affected by congestion. But "upstream" of the store shelves, many manufacturing operations use just-in-time processes that rely on the ability of trucks to maintain a reliable schedule. Traffic congestion at any time of day causes potentially costly disruptions. The solutions might be implemented in a broad scale to address freight traffic growth or targeted to road sections that cause freight bottlenecks.

Other strategies may consist of regulatory changes, operating practices or changes in the operating hours of freight facilities, delivery schedules or manufacturing plants. Addressing customs, immigration and security issues will reduce congestion at border ports-of-entry. These technology, operating and policy changes can be accomplished with attention to the needs of all stakeholders and can produce as much from the current systems and investments as possible.

The Next Generation of Freight Measures

The dataset used for Table 5 provides origin and destination information, but not routing paths. The *2011 Urban Mobility Report* developed an estimate of the value of commodities in each urban area, but better estimates of value will be possible when new freight models are examined. Those can be matched with the detailed speed data from INRIX to investigate individual congested freight corridors and their value to the economy.

Congestion Relief – An Overview of the Strategies

We recommend a ***balanced and diversified approach*** to reduce congestion – one that focuses on more of everything. It is clear that our current investment levels have not kept pace with the problems. Population growth will require more systems, better operations and an increased number of travel alternatives. And most urban regions have big problems now – more congestion, poorer pavement and bridge conditions and less public transportation service than they would like. There will be a different mix of solutions in metro regions, cities, neighborhoods, job centers and shopping areas. Some areas might be more amenable to construction solutions, other areas might use more travel options, productivity improvements, diversified land use patterns or redevelopment solutions. In all cases, the solutions need to work together to provide an interconnected network of transportation services.

More information on the possible solutions, places they have been implemented, the effects estimated in this report and the methodology used to capture those benefits can be found on the website http://mobility.tamu.edu/solutions.

- **Get as much service as possible from what we have** – Many low-cost improvements have broad public support and can be rapidly deployed. These management programs require innovation, constant attention and adjustment, but they pay dividends in faster, safer and more reliable travel. Rapidly removing crashed vehicles, timing the traffic signals so that more vehicles see green lights, improving road and intersection designs, or adding a short section of roadway are relatively simple actions.
- **Add capacity in critical corridors** – Handling greater freight or person travel on freeways, streets, rail lines, buses or intermodal facilities often requires "more." Important corridors or growth regions can benefit from more road lanes, new streets and highways, new or expanded public transportation facilities, and larger bus and rail fleets.
- **Change the usage patterns** – There are solutions that involve changes in the way employers and travelers conduct business to avoid traveling in the traditional "rush hours." Flexible work hours, internet connections or phones allow employees to choose work schedules that meet family needs and the needs of their jobs.
- **Provide choices** – This might involve different routes, travel modes or lanes that involve a toll for high-speed and reliable service—a greater number of options that allow travelers and shippers to customize their travel plans.
- **Diversify the development patterns** – These typically involve denser developments with a mix of jobs, shops and homes, so that more people can walk, bike or take transit to more, and closer, destinations. Sustaining the "quality of life" and gaining economic development without the typical increment of mobility decline in each of these sub-regions appear to be part, but not all, of the solution.
- **Realistic expectations** are also part of the solution. Large urban areas will be congested. Some locations near key activity centers in smaller urban areas will also be congested. But congestion does not have to be an all-day event. Identifying solutions and funding sources that meet a variety of community goals is challenging enough without attempting to eliminate congestion in all locations at all times.

Congestion Solutions – The Effects

The *2011Urban Mobility Report* database includes the effect of several widely implemented congestion solutions. These strategies provide faster and more reliable travel and make the most of the roads and public transportation systems that have been built. These solutions use a combination of information, technology, design changes, operating practices and construction programs to create value for travelers and shippers. There is a double benefit to efficient operations-travelers benefit from better conditions and the public sees that their tax dollars are being used wisely. The estimates described in the next few pages are a reflection of the benefits from these types of roadway operating strategies and public transportation systems.

Benefits of Public Transportation Service

Regular-route public transportation service on buses and trains provides a significant amount of peak-period travel in the most congested corridors and urban areas in the U.S. If public transportation service had been discontinued and the riders traveled in private vehicles in 2010, the 439 urban areas would have suffered an additional 796 million hours of delay and consumed 300 million more gallons of fuel (Exhibit 9). The value of the additional travel delay and fuel that would have been consumed if there were no public transportation service would be an additional $16.8 billion, a 17% increase over current congestion costs in the 439 urban areas.

There were approximately 55 billion passenger-miles of travel on public transportation systems in the 439 urban areas in 2010 (*4*). The benefits from public transportation vary by the amount of travel and the road congestion levels (Exhibit 9). More information on the effects for each urban area is included in Table 3.

Exhibit 9. Delay Increase in 2010 if Public Transportation Service Were Eliminated – 439 Areas

Population Group and Number of Areas	Average Annual Passenger-Miles of Travel (Million)	Reduction Due to Public Transportation			
		Hours of Delay Saved (Million)	Percent of Base Delay	Gallons of Fuel (Million)	Dollars Saved ($ Million)
Very Large (15)	41,481	681	24	271	14,402
Large (33)	5,867	74	7	23	1,518
Medium (32)	1,343	12	3	2	245
Small (21)	394	3	3	1	62
Other (338)	5,930	26	5	6	584
National Urban Total	55,015	796	16	303	$16,811

Source: Reference (*4*) and Review by Texas Transportation Institute

Better Traffic Flow

Improving transportation systems is about more than just adding road lanes, transit routes, sidewalks and bike lanes. It is also about operating those systems efficiently. Not only does congestion cause slow speeds, it also decreases the traffic volume that can use the roadway; stop-and-go roads only carry half to two-thirds of the vehicles as a smoothly flowing road. This is why simple volume-to-capacity measures are not good indicators; actual traffic volumes are low in stop-and-go conditions, so a volume/capacity measure says there is no congestion problem. Several types of improvements have been widely deployed to improve traffic flow on existing roadways.

Five prominent types of operational treatments are estimated to relieve a total of 327 million hours of delay (6% of the total) with a value of $6.9 billion in 2010 (Exhibit 10). If the treatments were deployed on all major freeways and streets, the benefit would expand to almost 740 million hours of delay (14% of delay) and more than $15 billion would be saved. These are significant benefits, especially since these techniques can be enacted more quickly than significant roadway or public transportation system expansions can occur. The operational treatments, however, are not large enough to replace the need for those expansions.

Exhibit 10. Operational Improvement Summary for All 439 Urban Areas

Population Group and Number of Areas	Reduction Due to Current Projects			Delay Reduction if In Place on All Roads (Million Hours)
	Hours of Delay Saved (Million)	Gallons of Fuel Saved (Million)	Dollars Saved ($ Million)	
Very Large (15)	235	103	4,948	580
Large (33)	60	21	1,264	82
Medium (32)	12	3	245	31
Small (21)	3	1	62	7
Other (338)	17	3	356	36
TOTAL	327	131	$6,875	736

Note: This analysis uses nationally consistent data and relatively simple estimation procedures. Local or more detailed evaluations should be used where available. These estimates should be considered preliminary pending more extensive review and revision of information obtained from source databases (*2, 5*).

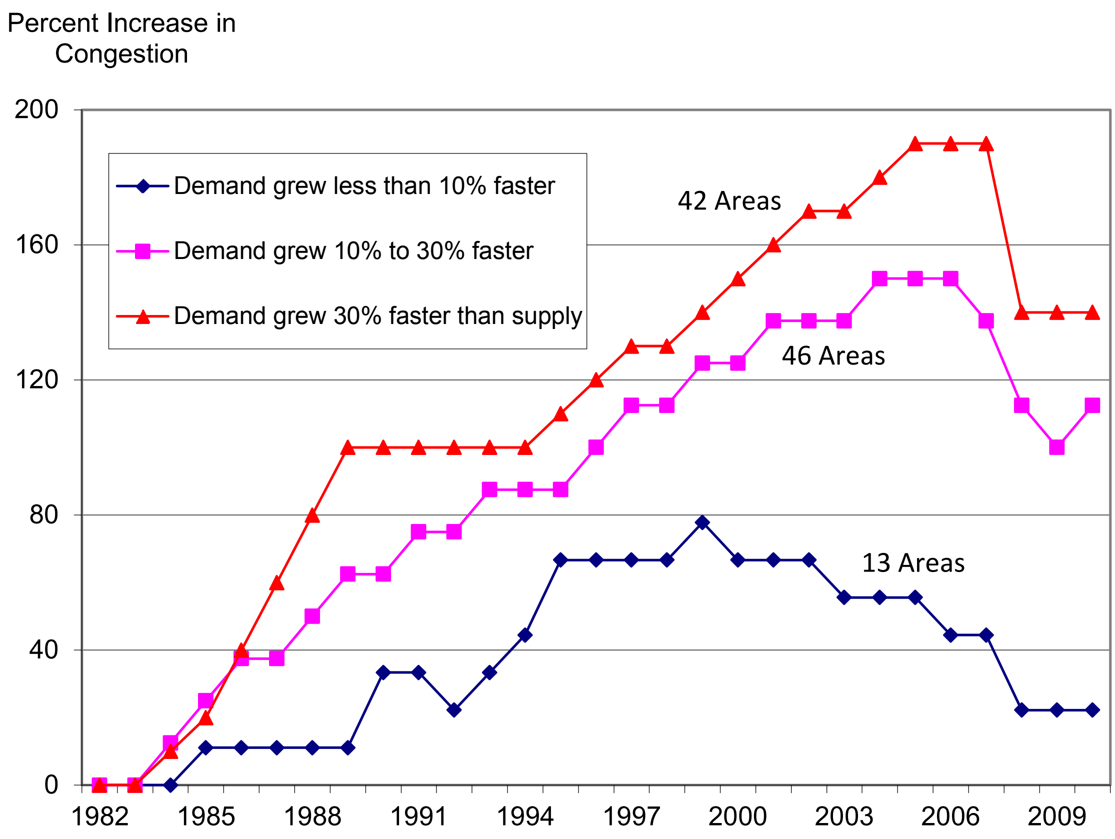
More information about the specific treatments and examples of regions and corridors where they have been implemented can be found at the website http://mobility.tamu.edu/resources/

More Capacity

Projects that provide more road lanes and more public transportation service are part of the congestion solution package in most growing urban regions. New streets and urban freeways will be needed to serve new developments, public transportation improvements are particularly important in congested corridors and to serve major activity centers, and toll highways and toll lanes are being used more frequently in urban corridors. Capacity expansions are also important additions for freeway-to-freeway interchanges and connections to ports, rail yards, intermodal terminals and other major activity centers for people and freight transportation.

Additional roadways reduce the rate of congestion increase. This is clear from comparisons between 1982 and 2010 (Exhibit 11). Urban areas where capacity increases matched the demand increase saw congestion grow much more slowly than regions where capacity lagged behind demand growth. It is also clear, however, that if only areas were able to accomplish that rate, there must be a broader and larger set of solutions applied to the problem. Most of these regions (listed in Table 9) were not in locations of high economic growth, suggesting their challenges were not as great as in regions with booming job markets.

Exhibit 11. Road Growth and Mobility Level



Source: Texas Transportation Institute analysis, see and http://mobility.tamu.edu/ums/methodology/

Total Travel Time

Another approach to measuring some aspects of congestion is the total time spent traveling in the peak periods. The measure can be used with other *Urban Mobility Report* statistics in a balanced transportation and land use pattern evaluation program. As with any measure, the analyst must understand the components of the measure and the implications of its use. In the *Urban Mobility Report* context where trends are important, values for cities of similar size and/or congestion levels can be used as comparisons. Year-to-year changes for an area can also be used to help an evaluation of long-term policies. The measure is particularly well-suited for long-range scenario planning as it shows the effect of the combination of different transportation investments and land use arrangements.

Some have used total travel time to suggest that it shows urban residents are making poor home and job location decisions or are not correctly evaluating their travel options. There are several factors that should be considered when examining values of total travel time.

- Travel delay – The extra travel time due to congestion
- Type of road network – The mix of high-speed freeways and slower streets
- Development patterns – The physical arrangement of living, working, shopping, medical, school and other activities
- Home and job location – Distance from home to work is a significant portion of commuting
- Decisions and priorities – It is clear that congestion is not the only important factor in the location and travel decisions made by families

Individuals and families frequently trade one or two long daily commutes for other desirable features such as good schools, medical facilities, large homes or a myriad of other factors.

Total travel time (see Table 4) can provide additional explanatory power to a set of mobility performance measures. It provides some of the desirable aspects of accessibility measures, while at the same time being a travel time quantity that can be developed from actual travel speeds. Regions that are developed in a relatively compact urban form will also score well, which is why the measure may be particularly well-suited to public discussions about regional plans and how investments support can support the attainment of goals.

Preliminary Calculation for 2011 Report

The calculation procedures and base data used for the total travel time measure in the *2011 Urban Mobility Report* are a first attempt at combining several datasets that have not been used for these purposes. There are clearly challenges to a broader use of the data; the data will be refined in the next few years. Any measure that appears to suggest that Jackson, Mississippi has the second worst traffic conditions and Baltimore is 67th requires some clarification. The measure is in peak period minutes of road travel per auto commuter, so some of the problem may be in the estimates of commuters. Other problems may be derived from the local street travel estimates that have not been extensively used. Many of the values in Table 4 are far in excess of the average commuting times reported for the regions (for example, the time for a one-way commute multiplied by two trips per day).

More information about total travel time measure can be found at: http://mobility.tamu.edu/resources/

Using the Best Congestion Data & Analysis Methodologies

The base data for the *2011 Urban Mobility Report* come from INRIX, the U.S. Department of Transportation and the states (*1, 2, 4*). Several analytical processes are used to develop the final measures, but the biggest improvement in the last two decades is provided by INRIX data. The speed data covering most major roads in U.S. urban regions eliminates the difficult process of estimating speeds and dramatically improves the accuracy and level of understanding about the congestion problems facing US travelers.

The methodology is described in a series of technical reports (*7, 8, 9, 10*) that are posted on the mobility report website: http://mobility.tamu.edu/ums/methodology/.

- The INRIX traffic speeds are collected from a variety of sources and compiled in their National Average Speed (NAS) database. Agreements with fleet operators who have location devices on their vehicles feed time and location data points to INRIX. Individuals who have downloaded the INRIX application to their smart phones also contribute time/location data. The proprietary process filters inappropriate data (e.g., pedestrians walking next to a street) and compiles a dataset of average speeds for each road segment. TTI was provided a dataset of hourly average speeds for each link of major roadway covered in the NAS database for 2007 to 2010 (approximately 1 million centerline miles in 2010).
- Hourly travel volume statistics were developed with a set of procedures developed from computer models and studies of real-world travel time and volume data. The congestion methodology uses daily traffic volume converted to average hourly volumes using a set of estimation curves developed from a national traffic count dataset (*11*).
- The hourly INRIX speeds were matched to the hourly volume data for each road section on the FHWA maps.
- An estimation procedure was also developed for the INRIX data that was not matched with an FHWA road section. The INRIX sections were ranked according to congestion level (using the Travel Time Index); those sections were matched with a similar list of most to least congested sections according to volume per lane (as developed from the FHWA data) (*2*). Delay was calculated by combining the lists of volume and speed.
- The effect of operational treatments and public transportation services were estimated using methods similar to previous Urban Mobility Reports.
- The trend in delay from years 1982 to 2007 from the previous Urban Mobility Report methodology was used to create the updated urban delay values.

Future Changes

There will be other changes in the report methodology over the next few years. There is more information available every year from freeways, streets and public transportation systems that provides more descriptive travel time and volume data. Congested corridor data and travel time reliability statistics are two examples of how the improved data and analysis procedures can be used. In addition to the travel speed information from INRIX, some advanced transit operating systems monitor passenger volume, travel time and schedule information. These data can be used to more accurately describe congestion problems on public transportation and roadway systems.

Concluding Thoughts

Congestion has gotten worse in many ways since 1982:

- Trips take longer and are less reliable.
- Congestion affects more of the day.
- Congestion affects weekend travel and rural areas.
- Congestion affects more personal trips and freight shipments.

The *2011 Urban Mobility Report* points to a $101 billion congestion cost, $23 billion of which is due to truck congestion—and that is only the value of wasted time, fuel and truck operating costs. Congestion causes the average urban resident to spend an extra 34 hours of travel time and use 14 extra gallons of fuel, which amounts to an average cost of $713 per commuter. The report includes a comprehensive picture of congestion in all 439 U.S. urban areas and provides an indication of how the problem affects travel choices, arrival times, shipment routes, manufacturing processes and location decisions.

The economic slowdown points to one of the basic rules of traffic congestion—if fewer people are traveling, there will be less congestion. Not exactly "man bites dog" type of findings. Before everyone gets too excited about the decline in congestion, consider these points:

- The decline in driving after more than a doubling in the price of fuel was the equivalent of about 1 mile per day for the person traveling the average 12,000 annual miles.
- Previous recessions in the 1980s and 1990s saw congestion declines that were reversed as soon as the economy began to grow again. And we think 2008 was the best year for mobility in the last several; congestion was worse in 2009 and 2010.

Anyone who thinks the congestion problem has gone away should check the past.

Solutions and Performance Measurement

There are solutions that work. There are significant benefits from aggressively attacking congestion problems—whether they are large or small, in big metropolitan regions or smaller urban areas and no matter the cause. Performance measures and detailed data like those used in the *2011 Urban Mobility Report* can guide those investments, identify operating changes that should be made and provide the public with the assurance that their dollars are being spent wisely. Decision-makers and project planners alike should use the comprehensive congestion data to describe the problems and solutions in ways that resonate with traveler experiences and frustrations.

All of the potential congestion-reducing strategies are needed. Getting more productivity out of the existing road and public transportation systems is vital to reducing congestion and improving travel time reliability. Businesses and employees can use a variety of strategies to modify their times and modes of travel to avoid the peak periods or to use less vehicle travel and more electronic "travel." In many corridors, however, there is a need for additional capacity to move people and freight more rapidly and reliably.

The good news from the *2011 Urban Mobility Report* is that the data can improve decisions and the methods used to communicate the effects of actions. The information can be used to study congestion problems in detail and decide how to fund and implement projects, programs and policies to attack the problems. And because the data relate to everyone's travel experiences, the measures are relatively easy to understand and use to develop solutions that satisfy the transportation needs of a range of travelers, freight shippers, manufacturers and others.

National Congestion Tables

Table 1. What Congestion Means to You, 2010

Urban Area	Yearly Delay per Auto Commuter		Travel Time Index		Excess Fuel per Auto Commuter		Congestion Cost per Auto Commuter	
	Hours	Rank	Value	Rank	Gallons	Rank	Dollars	Rank
Very Large Average (15 areas)	**52**		**1.27**		**25**		**1,083**	
Washington DC-VA-MD	74	1	1.33	2	37	1	1,495	2
Chicago IL-IN	71	2	1.24	13	36	2	1,568	1
Los Angeles-Long Beach-Santa Ana CA	64	3	1.38	1	34	3	1,334	3
Houston TX	57	4	1.27	6	28	4	1,171	4
New York-Newark NY-NJ-CT	54	5	1.28	3	22	7	1,126	5
San Francisco-Oakland CA	50	7	1.28	3	22	7	1,019	7
Boston MA-NH-RI	47	9	1.21	20	21	11	980	9
Dallas-Fort Worth-Arlington TX	45	10	1.23	16	22	7	924	11
Seattle WA	44	12	1.27	6	23	6	942	10
Atlanta GA	43	13	1.23	16	20	12	924	11
Philadelphia PA-NJ-DE-MD	42	14	1.21	20	17	18	864	14
Miami FL	38	15	1.23	16	18	16	785	19
San Diego CA	38	15	1.19	23	20	12	794	17
Phoenix AZ	35	23	1.21	20	20	12	821	16
Detroit MI	33	27	1.16	37	17	18	687	26

Very Large Urban Areas—over 3 million population.
Large Urban Areas—over 1 million and less than 3 million population.
Medium Urban Areas—over 500,000 and less than 1 million population.
Small Urban Areas—less than 500,000 population.
Yearly Delay per Auto Commuter—Extra travel time during the year divided by the number of people who commute in private vehicles in the urban area.
Travel Time Index—The ratio of travel time in the peak period to the travel time at free-flow conditions. A value of 1.30 indicates a 20-minute free-flow trip takes 26 minutes in the peak period.
Excess Fuel Consumed—Increased fuel consumption due to travel in congested conditions rather than free-flow conditions.
Congestion Cost—Value of travel time delay (estimated at $8 per hour of person travel and $88 per hour of truck time) and excess fuel consumption (estimated using state average cost per gallon for gasoline and diesel).
Note: Please do not place too much emphasis on small differences in the rankings. There may be little difference in congestion between areas ranked (for example) 6th and 12th. The actual measure values should also be examined.
Also note: The best congestion comparisons use multi-year trends and are made between similar urban areas.

Table 1. What Congestion Means to You, 2010, Continued

Urban Area	Yearly Delay per Auto Commuter		Travel Time Index		Excess Fuel per Auto Commuter		Congestion Cost per Auto Commuter	
	Hours	Rank	Value	Rank	Gallons	Rank	Dollars	Rank
Large Average (32 areas)	**31**		**1.17**		**11**		**642**	
Baltimore MD	52	6	1.19	23	22	7	1,102	6
Denver-Aurora CO	49	8	1.24	13	24	5	993	8
Minneapolis-St. Paul MN	45	10	1.23	16	20	12	916	13
Austin TX	38	15	1.28	3	10	27	743	23
Orlando FL	38	15	1.18	26	12	23	791	18
Portland OR-WA	37	19	1.25	9	10	27	744	22
San Jose CA	37	19	1.25	9	13	22	721	25
Nashville-Davidson TN	35	23	1.18	26	10	27	722	24
New Orleans LA	35	23	1.17	34	11	26	746	20
Virginia Beach VA	34	26	1.18	26	9	31	654	30
San Juan PR	33	27	1.25	9	12	23	665	29
Tampa-St. Petersburg FL	33	27	1.16	37	18	16	670	28
Pittsburgh PA	31	31	1.18	26	8	36	641	32
Riverside-San Bernardino CA	31	31	1.18	26	17	18	684	27
San Antonio TX	30	34	1.18	26	9	31	591	35
St. Louis MO-IL	30	34	1.10	56	14	21	642	31
Las Vegas NV	28	36	1.24	13	7	41	532	42
Milwaukee WI	27	38	1.18	26	7	41	541	38
Salt Lake City UT	27	38	1.11	51	7	41	512	45
Charlotte NC-SC	25	42	1.17	34	8	36	539	39
Jacksonville FL	25	42	1.09	68	7	41	496	50
Raleigh-Durham NC	25	42	1.14	43	9	31	537	40
Sacramento CA	25	42	1.19	23	8	36	507	46
Indianapolis IN	24	49	1.17	34	6	49	506	47
Kansas City MO-KS	23	52	1.11	51	7	41	464	55
Louisville KY-IN	23	52	1.10	56	6	49	477	52
Memphis TN-MS-AR	23	52	1.12	48	7	41	477	52
Cincinnati OH-KY-IN	21	60	1.13	45	6	49	427	60
Cleveland OH	20	64	1.10	56	5	58	383	65
Providence RI-MA	19	67	1.12	48	7	41	365	71
Columbus OH	18	72	1.11	51	5	58	344	79
Buffalo NY	17	77	1.10	56	5	58	358	73

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Excess Fuel Consumed—Increased fuel consumption due to travel in congested conditions rather than free-flow conditions.
Congestion Cost—Value of travel time delay (estimated at $16 per hour of person travel and $88 per hour of truck time) and excess fuel consumption (estimated using state average cost per gallon for gasoline and diesel).
Note: Please do not place too much emphasis on small differences in the rankings. There may be little difference in congestion between areas ranked (for example) 6th and 12th. The actual measure values should also be examined.
Also note: The best congestion comparisons use multi-year trends and are made between similar urban areas.

Table 1. What Congestion Means to You, 2010, Continued

Urban Area	Yearly Delay per Auto Commuter		Travel Time Index		Excess Fuel per Auto Commuter		Congestion Cost per Auto Commuter	
	Hours	Rank	Value	Rank	Gallons	Rank	Dollars	Rank
Medium Average (33 areas)	**21**		**1.11**		**5**		**426**	
Baton Rouge LA	36	21	1.25	9	9	31	832	15
Bridgeport-Stamford CT-NY	36	21	1.27	6	12	23	745	21
Honolulu HI	33	27	1.18	26	6	49	620	33
Colorado Springs CO	31	31	1.13	45	9	31	602	34
New Haven CT	28	36	1.13	45	7	41	559	36
Birmingham AL	27	38	1.15	41	10	27	556	37
Hartford CT	26	41	1.15	41	6	49	501	49
Albuquerque NM	25	42	1.10	56	4	66	525	44
Charleston-North Charleston SC	25	42	1.16	37	8	36	529	43
Oklahoma City OK	24	49	1.10	56	4	66	476	54
Tucson AZ	23	52	1.11	51	5	58	506	47
Allentown-Bethlehem PA-NJ	22	57	1.07	79	4	66	432	59
El Paso TX-NM	21	60	1.16	37	4	66	427	60
Knoxville TN	21	60	1.06	85	5	58	423	62
Omaha NE-IA	21	60	1.09	68	4	66	389	64
Richmond VA	20	64	1.06	85	5	58	375	68
Wichita KS	20	64	1.07	79	4	66	379	67
Grand Rapids MI	19	67	1.05	94	4	66	372	69
Oxnard-Ventura CA	19	67	1.12	48	6	49	383	65
Springfield MA-CT	18	72	1.08	73	4	66	355	75
Tulsa OK	18	72	1.08	73	4	66	368	70
Albany-Schenectady NY	17	77	1.08	73	6	49	359	72
Lancaster-Palmdale CA	16	79	1.10	56	3	81	312	84
Sarasota-Bradenton FL	16	79	1.09	68	4	66	318	82
Akron OH	15	83	1.05	94	3	81	288	85
Dayton OH	14	87	1.06	85	3	81	277	88
Indio-Cathedral City-Palm Springs CA	14	87	1.11	51	2	89	279	87
Fresno CA	13	91	1.07	79	3	81	260	92
Rochester NY	13	91	1.05	94	2	89	241	94
Toledo OH-MI	12	93	1.05	94	3	81	237	95
Bakersfield CA	10	96	1.07	79	2	89	232	96
Poughkeepsie-Newburgh NY	10	96	1.04	99	2	89	205	97
McAllen TX	7	101	1.10	56	1	100	125	101

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Also note: The best congestion comparisons use multi-year trends and are made between similar urban areas.

Table 1. What Congestion Means to You, 2010, Continued

Urban Area	Yearly Delay per Auto Commuter		Travel Time Index		Excess Fuel per Auto Commuter		Congestion Cost per Auto Commuter	
	Hours	Rank	Value	Rank	Gallons	Rank	Dollars	Rank
Small Average (21 areas)	**18**		**1.08**		**4**		**363**	
Columbia SC	25	42	1.09	68	8	36	533	41
Little Rock AR	24	49	1.10	56	6	49	490	51
Cape Coral FL	23	52	1.10	56	4	66	464	55
Beaumont TX	22	57	1.08	73	4	66	445	58
Salem OR	22	57	1.09	68	5	58	451	57
Boise ID	19	67	1.10	56	3	81	345	78
Jackson MS	19	67	1.06	85	4	66	418	63
Pensacola FL-AL	18	72	1.08	73	3	81	350	77
Worcester MA	18	72	1.06	85	6	49	354	76
Greensboro NC	16	79	1.06	85	4	66	358	73
Spokane WA	16	79	1.10	56	4	66	329	80
Boulder CO	15	83	1.14	43	5	58	288	85
Brownsville TX	15	83	1.04	99	2	89	321	81
Winston-Salem NC	15	83	1.06	85	3	81	314	83
Anchorage AK	14	87	1.05	94	2	89	272	90
Provo UT	14	87	1.08	73	2	89	274	89
Laredo TX	12	93	1.07	79	2	89	264	91
Madison WI	12	93	1.06	85	2	89	246	93
Corpus Christi TX	10	96	1.07	79	2	89	194	98
Stockton CA	9	99	1.02	101	1	100	184	99
Eugene OR	8	100	1.06	85	2	89	171	100
101 Area Average	**40**		**1.21**		**17**		**829**	
Remaining Areas	**16**		**1.12**		**3**		**327**	
All 439 Urban Areas	**34**		**1.20**		**14**		**713**	

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Excess Fuel Consumed—Increased fuel consumption due to travel in congested conditions rather than free-flow conditions.
Congestion Cost—Value of travel time delay (estimated at $16 per hour of person travel and $88 per hour of truck time) and excess fuel consumption (estimated using state average cost per gallon for gasoline and diesel).
Note: Please do not place too much emphasis on small differences in the rankings. There may be little difference in congestion between areas ranked (for example) 6th and 12th. The actual measure values should also be examined.
Also note: The best congestion comparisons use multi-year trends and are made between similar urban areas.

Table 2. What Congestion Means to Your Town, 2010

Urban Area	Travel Delay		Excess Fuel Consumed		Truck Congestion Cost		Total Congestion Cost	
	(1000 Hours)	Rank	(1000 Gallons)	Rank	($ million)	Rank	($ million)	Rank
Very Large Average (15 areas)	**187,872**		**90,718**		**895**		**3,981**	
Los Angeles-Long Beach-Santa Ana CA	521,449	1	278,318	1	2,254	2	10,999	1
New York-Newark NY-NJ-CT	465,564	2	190,452	2	2,218	3	9,794	2
Chicago IL-IN	367,122	3	183,738	3	2,317	1	8,206	3
Washington DC-VA-MD	188,650	4	95,365	4	683	5	3,849	4
Dallas-Fort Worth-Arlington TX	163,585	5	80,587	5	666	6	3,365	5
Houston TX	153,391	6	76,531	6	688	4	3,203	6
Miami FL	139,764	7	66,104	7	604	9	2,906	7
Philadelphia PA-NJ-DE-MD	134,899	8	55,500	8	659	7	2,842	8
Atlanta GA	115,958	11	53,021	10	623	8	2,489	9
San Francisco-Oakland CA	120,149	9	53,801	9	484	11	2,479	10
Boston MA-NH-RI	117,234	10	51,806	11	459	13	2,393	11
Phoenix AZ	81,829	15	47,180	12	467	12	1,913	12
Seattle WA	87,919	12	46,373	13	603	10	1,905	13
Detroit MI	87,572	13	43,941	14	382	15	1,828	15
San Diego CA	72,995	18	38,052	16	321	16	1,541	18

Very Large Urban Areas—over 3 million population.
Large Urban Areas—over 1 million and less than 3 million population.
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Travel Delay—Value of extra travel time during the year (estimated at $16 per hour of person travel).
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Table 2. What Congestion Means to Your Town, 2010, Continued

Urban Area	Travel Delay (1000 Hours)	Rank	Excess Fuel Consumed (1000 Gallons)	Rank	Truck Congestion Cost ($ million)	Rank	Total Congestion Cost ($ million)	Rank
Large Average (32 areas)	**33,407**		**11,968**		**148**		**688**	
Baltimore MD	87,199	14	36,303	17	449	14	1,853	14
Denver-Aurora CO	80,837	16	40,151	15	319	17	1,659	16
Minneapolis-St. Paul MN	78,483	17	34,689	18	300	18	1,595	17
Tampa-St. Petersburg FL	53,047	19	28,488	19	210	21	1,097	19
St. Louis MO-IL	47,042	21	23,190	20	283	19	1,034	20
San Juan PR	50,229	20	17,731	22	174	25	1,012	21
Riverside-San Bernardino CA	40,875	25	22,387	21	229	20	902	22
Pittsburgh PA	41,081	24	10,951	25	200	23	850	23
Portland OR-WA	41,743	23	10,931	26	185	24	850	23
San Jose CA	42,846	22	14,664	23	133	28	842	25
Orlando FL	38,260	26	11,883	24	207	22	811	26
Virginia Beach VA	36,538	27	9,301	28	98	40	693	27
Austin TX	31,038	28	8,425	30	119	32	617	28
Sacramento CA	29,602	30	9,374	27	123	30	603	29
San Antonio TX	30,207	29	8,883	29	105	37	593	30
Nashville-Davidson TN	26,475	33	6,971	34	142	26	556	31
Milwaukee WI	26,699	32	7,086	33	127	29	549	32
Las Vegas NV	27,386	31	7,428	31	83	45	530	33
Kansas City MO-KS	24,185	34	7,147	32	119	32	501	34
Cincinnati OH-KY-IN	23,297	35	5,889	38	120	31	486	35
New Orleans LA	20,565	39	6,218	37	135	27	453	36
Indianapolis IN	20,800	38	5,253	43	119	32	443	37
Raleigh-Durham NC	19,247	40	6,586	36	75	46	418	39
Cleveland OH	21,380	36	5,530	40	115	35	417	40
Charlotte NC-SC	17,730	43	5,228	44	101	39	378	41
Jacksonville FL	18,005	42	5,461	41	84	44	371	42
Memphis TN-MS-AR	17,197	44	5,038	45	87	42	358	43
Louisville KY-IN	17,033	45	4,574	47	61	50	357	44
Salt Lake City UT	18,366	41	4,713	46	85	43	353	45
Providence RI-MA	15,539	48	5,335	42	45	59	302	49
Columbus OH	14,651	51	3,904	48	53	51	289	51
Buffalo NY	11,450	56	3,257	52	51	54	234	56

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Table 2. What Congestion Means to Your Town, 2010, Continued

Urban Area	Travel Delay (1000 Hours)	Rank	Excess Fuel Consumed (1000 Gallons)	Rank	Truck Congestion Cost ($ million)	Rank	Total Congestion Cost ($ million)	Rank
Medium Average (33 areas)	**9,513**		**2,216**		**42**		**193**	
Bridgeport-Stamford CT-NY	21,233	37	6,857	35	102	38	441	38
Baton Rouge LA	14,577	52	3,295	51	66	49	331	46
Oklahoma City OK	16,848	46	2,847	57	110	36	329	47
Birmingham AL	15,832	47	5,639	39	71	47	326	48
Hartford CT	15,072	49	3,462	50	52	52	295	50
Honolulu HI	15,035	50	2,774	58	42	61	287	52
Tucson AZ	11,412	57	2,342	61	39	64	262	53
Richmond VA	13,800	53	3,105	53	92	41	262	53
New Haven CT	11,643	55	3,032	54	49	56	235	55
Albuquerque NM	10,477	58	1,724	69	37	66	231	57
Colorado Springs CO	11,897	54	3,552	49	69	48	228	58
El Paso TX-NM	10,452	59	1,971	64	52	52	214	59
Allentown-Bethlehem PA-NJ	9,777	60	1,777	66	43	60	197	60
Charleston-North Charleston SC	9,160	62	2,852	56	51	54	195	61
Oxnard-Ventura CA	9,009	64	2,869	55	39	64	184	62
Tulsa OK	9,086	63	1,861	65	42	61	183	63
Omaha NE-IA	9,299	61	1,737	68	23	78	173	65
Sarasota-Bradenton FL	8,015	67	2,240	62	32	69	161	66
Springfield MA-CT	8,305	66	1,975	63	27	76	161	66
Albany-Schenectady NY	7,467	71	2,384	60	32	69	156	69
Grand Rapids MI	7,861	68	1,595	72	35	67	155	70
Knoxville TN	7,518	70	1,622	70	32	69	151	71
Dayton OH	7,096	73	1,470	73	28	74	140	73
Lancaster-Palmdale CA	6,906	74	1,069	80	22	80	132	74
Wichita KS	6,858	75	1,460	74	21	81	131	75
Fresno CA	5,999	78	1,200	77	21	81	124	77
Rochester NY	6,377	76	1,229	76	29	73	123	78
Akron OH	6,198	77	1,042	81	21	81	120	79
Indio-Cathedral City-Palm Springs CA	5,633	80	983	82	28	74	116	80
Bakersfield CA	4,005	90	925	84	31	72	91	84
Poughkeepsie-Newburgh NY	4,271	85	809	88	20	85	87	87
Toledo OH-MI	4,223	86	951	83	18	88	85	88
McAllen TX	2,598	96	475	96	9	99	50	96

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Table 2. What Congestion Means to Your Town, 2010, Continued

Urban Area	Travel Delay		Excess Fuel Consumed		Truck Congestion Cost		Total Congestion Cost	
	(1000 Hours)	Rank	(1000 Gallons)	Rank	($ million)	Rank	($ million)	Rank
Small Average (21 areas)	**4,166**		**881**		**21**		**86**	
Columbia SC	8,515	65	2,723	59	47	57	181	64
Cape Coral FL	7,600	69	1,366	75	41	63	158	68
Little Rock AR	7,345	72	1,615	71	33	68	149	72
Jackson MS	5,488	81	1,124	78	47	57	128	76
Worcester MA	5,639	79	1,777	66	19	86	111	81
Provo UT	5,056	82	695	90	18	88	97	82
Pensacola FL-AL	4,699	83	888	86	19	86	93	83
Greensboro NC	4,104	87	1,110	79	26	77	90	85
Spokane WA	4,306	84	923	85	23	78	90	85
Winston-Salem NC	4,054	89	837	87	21	81	84	89
Salem OR	3,912	91	787	89	18	88	80	90
Beaumont TX	3,814	92	615	91	17	92	77	91
Boise ID	4,063	88	578	92	10	98	75	92
Madison WI	3,375	93	533	94	18	88	70	93
Anchorage AK	3,013	94	512	95	13	96	61	94
Stockton CA	2,648	95	394	98	15	93	55	95
Brownsville TX	2,323	98	326	100	15	93	50	96
Corpus Christi TX	2,432	97	469	97	13	96	50	96
Laredo TX	2,041	99	378	99	15	93	46	99
Boulder CO	1,612	100	541	93	3	101	30	100
Eugene OR	1,456	101	315	101	7	100	30	100
101 Area Total	**4,288,547**		**1,835,371**		**19,989**		**89,881**	
101 Area Average	**42,461**		**18,172**		**198**		**890**	
Remaining Area Total	**534,712**		**107,964**		**2,846**		**11,011**	
Remaining Area Average	**1,582**		**319**		**8**		**33**	
All 439 Areas Total	**4,823,259**		**1,943,335**		**22,835**		**100,892**	
All 439 Areas Average	**10,987**		**4,427**		**52**		**230**	

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Table 3. Solutions to Congestion Problems, 2010

Urban Area	Operational Treatment Savings				Public Transportation Savings		
	Treatments	Delay (1000 Hours)	Rank	Cost ($ Million)	Delay (1000 Hours)	Rank	Cost ($ Million)
Very Large Average (15 areas)		**15,636**		**$330.0**	**45,381**		**$960.0**
Los Angeles-Long Beach-Santa Ana CA	r,i,s,a,h	63,652	1	1,342.6	33,606	4	708.8
New York-Newark NY-NJ-CT	r,i,s,a,h	46,192	2	971.7	377,069	1	7,932.1
Houston TX	r,i,s,a,h	15,896	3	332.0	7,082	12	147.9
Chicago IL-IN	r,i,s,a	15,821	4	353.6	91,109	2	2,036.5
Washington DC-VA-MD	r,i,s,a,h	14,922	5	304.5	35,567	3	725.7
San Francisco-Oakland CA	r,i,s,a,h	14,679	6	302.9	28,431	6	586.6
Miami FL	i,s,a,h	12,065	7	250.9	9,276	10	192.9
Dallas-Fort Worth-Arlington TX	r,i,s,a,h	10,334	8	212.6	6,137	15	126.2
Philadelphia PA-NJ-DE-MD	r,i,s,a,h	8,851	9	186.5	26,082	7	549.5
Seattle WA	r,i,s,a,h	7,411	11	161.3	14,377	8	312.8
San Diego CA	r,i,s,a	6,340	12	133.8	6,460	13	136.3
Atlanta GA	r,i,s,a,h	5,603	13	120.3	8,589	11	184.4
Boston MA-NH-RI	i,s,a	4,988	14	101.8	32,477	5	662.9
Phoenix AZ	r,i,s,a,h	4,619	17	107.5	2,519	22	58.6
Detroit MI	r,i,s,a	3,170	22	66.2	1,937	25	40.4

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Public Transportation—Regular route service from all public transportation providers in an urban area.

Delay savings are affected by the amount of treatment or service in each area, as well as the amount of congestion and the urban area population.

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Table 3. Solutions to Congestion Problems, 2010, Continued

Urban Area	Operational Treatment Savings				Public Transportation Savings		
	Treatments	Delay (1000 Hours)	Rank	Cost ($ Million)	Delay (1000 Hours)	Rank	Cost ($ Million)
Large Average (32 areas)		**1,934**		**$40.0**	**2,304**		**$47.0**
Minneapolis-St. Paul MN	r,i,s,a,h	7,593	10	154.3	5,360	18	109.0
Denver-Aurora CO	r,i,s,a,h	4,720	15	96.8	6,376	14	130.8
Baltimore MD	i,s,a	4,644	16	98.7	13,924	9	295.8
Tampa-St. Petersburg FL	i,s,a	3,873	18	80.1	1,021	36	21.1
Portland OR-WA	r,i,s,a,h	3,701	19	75.4	5,581	17	113.7
Riverside-San Bernardino CA	r,i,s,a,h	3,636	20	80.2	1,140	35	25.2
San Jose CA	r,i,s,a	3,501	21	68.8	1,896	26	37.2
Virginia Beach VA	i,s,a,h	2,936	23	55.7	1,300	33	24.7
Sacramento CA	r,i,s,a,h	2,750	24	56.0	1,367	30	27.8
Orlando FL	i,s,a	2,254	25	47.8	1,399	29	29.7
Milwaukee WI	r,i,s,a	2,033	26	41.8	1,849	28	38.0
St. Louis MO-IL	i,s,a	1,975	27	43.4	2,805	21	61.7
Austin TX	i,s,a	1,541	28	30.6	1,941	24	38.5
Las Vegas NV	i,s,a	1,526	29	29.5	1,317	32	25.5
Pittsburgh PA	i,s,a	1,482	30	30.7	5,058	19	104.7
New Orleans LA	i,s,a	1,280	31	28.2	1,879	27	41.4
San Juan PR	s,a	1,217	32	24.5	5,798	16	116.8
Kansas City MO-KS	i,s,a	1,145	33	23.7	442	47	9.2
San Antonio TX	i,s,a	1,095	34	21.5	1,366	31	26.8
Jacksonville FL	i,s,a	1,055	35	21.8	398	51	8.2
Nashville-Davidson TN	i,s,a	1,040	36	21.9	509	45	10.7
Charlotte NC-SC	i,s,a	803	39	17.1	665	42	14.2
Raleigh-Durham NC	i,s,a	796	40	17.3	685	41	14.8
Salt Lake City UT	r,i,s,a	759	42	14.8	3,251	20	63.3
Cleveland OH	i,s,a	729	44	14.3	2,098	23	41.1
Cincinnati OH-KY-IN	r,i,s,a	715	45	14.9	1,255	34	26.2
Memphis TN-MS-AR	i,s,a	662	49	13.8	414	49	8.6
Columbus OH	r,i,s,a	472	54	9.3	310	56	6.1
Louisville KY-IN	i,s,a	449	55	9.3	426	48	8.8
Indianapolis IN	i,s,a	447	56	9.5	360	54	7.7
Providence RI-MA	i,s,a	324	62	6.3	747	40	14.5
Buffalo NY	i,s,a	287	65	5.9	804	38	16.4

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Urban Area	Operational Treatment Savings				Public Transportation Savings		
	Treatments	Delay (1000 Hours)	Rank	Cost ($ Million)	Delay (1000 Hours)	Rank	Cost ($ Million)
Medium Average (33 areas)		**363**		**$7.0**	**263**		**$5.0**
Bridgeport-Stamford CT-NY	i,s,a	887	37	18.4	306	57	6.4
Baton Rouge LA	i,s,a	872	38	19.7	140	82	3.2
Honolulu HI	i,s,a	767	41	14.6	463	46	8.8
Birmingham AL	i,s,a	745	43	15.3	198	72	4.1
Albuquerque NM	i,s,a	705	46	15.3	212	67	4.6
Omaha NE-IA	i,s,a	687	47	12.8	152	79	2.8
Tucson AZ	i,s,a	673	48	15.5	362	53	8.3
El Paso TX-NM	i,s,a	659	50	13.5	764	39	15.7
Hartford CT	i,s,a	625	51	12.2	957	37	18.7
Richmond VA	i,s,a	544	52	10.3	571	43	10.8
Sarasota-Bradenton FL	i,s,a	509	53	10.2	116	85	2.3
Fresno CA	r,i,s,a	429	57	8.8	185	74	3.8
Colorado Springs CO	i,s,a	411	59	8.0	389	52	7.6
New Haven CT	i,s,a	384	60	7.8	269	58	5.4
Knoxville TN	i,s,a	318	63	6.4	51	93	1.0
Charleston-North Charleston SC	i,s,a	298	64	6.3	106	87	2.2
Oxnard-Ventura CA	i,s,a	239	66	4.9	156	78	3.2
Allentown-Bethlehem PA-NJ	r,i,s,a	235	67	4.7	254	59	5.1
Wichita KS	i,s,a	231	68	4.4	211	68	4.0
Albany-Schenectady NY	i,s,a	211	70	4.4	323	55	6.7
Indio-Cathedral City-Palm Springs CA	i,s,a	193	73	4.0	157	77	3.2
Oklahoma City OK	i,s,a	184	76	3.6	113	86	2.2
Rochester NY	i,s,a	167	78	3.2	221	64	4.3
Grand Rapids MI	s,a	163	79	3.2	250	61	5.0
Bakersfield CA	i,s,a	157	80	3.6	200	70	4.6
Dayton OH	s,a	157	80	3.1	198	72	3.9
Springfield MA-CT	i,s,a	154	83	3.0	240	62	4.7
Lancaster-Palmdale CA	s,a	147	84	2.8	571	43	10.9
Tulsa OK	i,s,a	58	93	1.2	44	96	0.9
Poughkeepsie-Newburgh NY	s,a	54	94	1.1	173	76	3.5
Toledo OH-MI	i,s,a	48	95	1.0	146	80	2.9
Akron OH	i,s,a	43	96	0.8	143	81	2.8
McAllen TX	s,a	16	101	0.3	25	100	0.5

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Urban Area	Operational Treatment Savings				Public Transportation Savings		
	Treatments	Delay (1000 Hours)	Rank	Cost ($ Million)	Delay (1000 Hours)	Rank	Cost ($ Million)
Small Average (21 areas)		**142**		**$3.0**	**132**		**$3.0**
Little Rock AR	i,s,a	428	58	8.7	21	101	0.4
Cape Coral FL	i,s,a	382	61	8.0	132	83	2.7
Provo UT	i,s,a	225	69	4.3	49	94	0.9
Greensboro NC	i,s,a	205	71	4.5	118	84	2.6
Winston-Salem NC	i,s,a	203	72	4.2	39	97	0.8
Spokane WA	i,s,a	193	73	4.1	406	50	8.5
Jackson MS	s,a	189	75	4.4	53	92	1.2
Worcester MA	s,a	179	77	3.5	54	91	1.1
Columbia SC	i,s,a	155	82	3.3	254	59	5.4
Stockton CA	i,s,a	120	85	2.5	178	75	3.7
Salem OR	s,a	91	86	1.8	203	69	4.2
Beaumont TX	s,a	89	87	1.8	37	99	0.7
Anchorage AK	s,a	84	88	1.7	214	66	4.3
Eugene OR	i,s,a	78	89	1.6	217	65	4.5
Pensacola FL-AL	s,a	74	90	1.5	45	95	0.9
Boise ID	i,s,a	72	91	1.3	39	97	0.7
Madison WI	s,a	71	92	1.5	227	63	4.7
Brownsville TX	s,a	43	96	0.9	199	71	4.3
Laredo TX	i,s,a	40	98	0.9	102	88	2.3
Boulder CO	s,a	36	99	0.7	84	90	1.6
Corpus Christi TX	s,a	23	100	0.5	94	89	1.9
101 Area Total		**309,455**		**6,518.0**	**765,886**		**16,151.0**
101 Area Average		**3,095**		**65.0**	**7,583**		**160.0**
All Urban Areas Total		**327,157**		**6,875.0**	**795,668**		**16,811.0**
All Urban Areas Average		**745**		**15.0**	**1,812**		**39.0**

Very Large Urban Areas—over 3 million population.
Large Urban Areas—over 1 million and less than 3 million population.
Medium Urban Areas—over 500,000 and less than 1 million population.
Small Urban Areas—less than 500,000 population.
Operational Treatments—Freeway incident management (i), freeway ramp metering (r), arterial street signal coordination (s), arterial street access management (a) and high-occupancy vehicle lanes (h).
Public Transportation—Regular route service from all public transportation providers in an urban area.
Delay savings are affected by the amount of treatment or service in each area, as well as the amount of congestion and the urban area population.
Congestion Cost Savings—Value of delay, fuel and truck congestion cost.
Note: Please do not place too much emphasis on small differences in the rankings. There may be little difference in congestion between areas ranked (for example) 6th and 12th. The actual measure values should also be examined.
Also note: The best congestion comparisons use multi-year trends and are made between similar urban areas.

Table 4. Other Congestion Measures, 2010

Urban Area	Total Peak Period Travel Time		Delay per Non-Peak Traveler		Commuter Stress Index	
	Minutes	Rank	Hours	Rank	Value	Rank
Very Large Area (15 areas)	**107**		**13**		**1.38**	
Washington DC-VA-MD	120	4	17	2	1.48	2
Chicago IL-IN	102	26	19	1	1.34	11
Los Angeles-Long Beach-Santa Ana CA	107	18	16	3	1.57	1
Houston TX	106	20	14	6	1.40	4
New York-Newark NY-NJ-CT	116	6	11	13	1.39	5
San Francisco-Oakland CA	105	21	12	9	1.42	3
Boston MA-NH-RI	109	15	11	13	1.31	19
Dallas-Fort Worth-Arlington TX	96	37	14	6	1.34	11
Seattle WA	101	28	10	22	1.39	5
Atlanta GA	127	1	11	13	1.34	11
Philadelphia PA-NJ-DE-MD	105	22	12	9	1.29	22
Miami FL	106	19	12	9	1.32	18
San Diego CA	94	42	10	22	1.29	22
Phoenix AZ	99	32	10	22	1.30	21
Detroit MI	109	16	11	13	1.20	44

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Commuter Stress Index—The ratio of travel time in the peak period to the travel time at free-flow conditions for the peak directions of travel in both peak periods. A value of 1.40 indicates a 20-minute free-flow trip takes 28 minutes in the most congested directions of the peak periods.
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Table 4. Other Congestion Measures, 2010, Continued

Urban Area	Total Peak Period Travel Time		Delay per Non-Peak Traveler		Commuter Stress Index	
	Minutes	Rank	Hours	Rank	Value	Rank
Large Area Average (32 areas)	**93**		**9**		**1.25**	
Baltimore MD	83	67	16	3	1.28	26
Denver-Aurora CO	90	52	15	5	1.34	11
Minneapolis-St. Paul MN	100	30	10	22	1.33	17
Austin TX	82	69	8	45	1.38	8
Orlando FL	120	3	13	8	1.23	35
Portland OR-WA	85	62	8	45	1.38	8
San Jose CA	82	70	9	29	1.39	5
Nashville-Davidson TN	114	8	11	13	1.25	31
New Orleans LA	84	65	10	22	1.20	44
Virginia Beach VA	96	38	12	9	1.29	22
San Juan PR	61	91	9	29	1.34	11
Tampa-St. Petersburg FL	104	24	11	13	1.22	36
Pittsburgh PA	80	74	11	13	1.21	40
Riverside-San Bernardino CA	88	58	9	29	1.29	22
San Antonio TX	95	40	8	45	1.27	28
St. Louis MO-IL	109	13	9	29	1.15	62
Las Vegas NV	92	48	10	22	1.34	11
Milwaukee WI	88	59	8	45	1.27	28
Salt Lake City UT	76	79	9	29	1.20	44
Charlotte NC-SC	110	12	7	60	1.26	30
Jacksonville FL	108	17	8	45	1.14	63
Raleigh-Durham NC	115	7	8	45	1.20	44
Sacramento CA	82	68	7	60	1.28	26
Indianapolis IN	112	10	9	29	1.22	36
Kansas City MO-KS	101	29	7	60	1.17	53
Louisville KY-IN	88	56	8	45	1.17	53
Memphis TN-MS-AR	95	39	9	29	1.17	53
Cincinnati OH-KY-IN	93	45	6	74	1.20	44
Cleveland OH	91	49	5	85	1.16	58
Providence RI-MA	85	63	6	74	1.18	49
Columbus OH	86	61	5	85	1.18	49
Buffalo NY	92	46	6	74	1.14	63

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Table 4. Other Congestion Measures, 2010, Continued

Urban Area	Total Peak Period Travel Time		Delay per Non-Peak Traveler		Commuter Stress Index	
	Minutes	Rank	Hours	Rank	Value	Rank
Medium Area Average (33 areas)	**83**		**7**		**1.16**	
Baton Rouge LA	91	51	11	13	1.31	19
Bridgeport-Stamford CT-NY	92	47	8	45	1.35	10
Honolulu HI	73	83	9	29	1.24	32
Colorado Springs CO	81	73	11	13	1.17	53
New Haven CT	79	75	9	29	1.21	40
Birmingham AL	102	25	9	29	1.22	36
Hartford CT	94	41	7	60	1.21	40
Albuquerque NM	82	72	8	45	1.21	40
Charleston-North Charleston SC	88	57	9	29	1.24	32
Oklahoma City OK	117	5	10	22	1.16	58
Tucson AZ	113	9	9	29	1.18	49
Allentown-Bethlehem PA-NJ	79	76	9	29	1.09	83
El Paso TX-NM	69	88	7	60	1.24	32
Knoxville TN	112	11	8	45	1.09	83
Omaha NE-IA	94	43	8	45	1.13	67
Richmond VA	102	27	8	45	1.08	92
Wichita KS	84	64	6	74	1.12	71
Grand Rapids MI	94	44	6	74	1.10	79
Oxnard-Ventura CA	73	82	6	74	1.18	49
Springfield MA-CT	89	53	8	45	1.12	71
Tulsa OK	97	35	7	60	1.11	75
Albany-Schenectady NY	75	80	7	60	1.11	75
Lancaster-Palmdale CA	37	101	6	74	1.14	63
Sarasota-Bradenton FL	73	84	7	60	1.12	71
Akron OH	67	89	5	85	1.07	97
Dayton OH	89	55	5	85	1.09	83
Indio-Cathedral City-Palm Springs CA	54	97	5	85	1.22	36
Fresno CA	77	78	4	95	1.11	75
Rochester NY	82	71	4	95	1.08	92
Toledo OH-MI	87	60	4	95	1.08	92
Bakersfield CA	57	94	4	95	1.09	83
Poughkeepsie-Newburgh NY	72	86	5	85	1.05	100
McAllen TX	60	92	3	100	1.13	67

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Table 4. Other Congestion Measures, 2010, Continued

Urban Area	Total Peak Period Travel Time		Delay per Non-Peak Traveler		Commuter Stress Index	
	Minutes	Rank	Hours	Rank	Value	Rank
Small Area Average (21 areas)	**80**		**7**		**1.11**	
Columbia SC	104	23	9	29	1.12	71
Little Rock AR	109	14	7	60	1.16	58
Cape Coral FL	89	54	9	29	1.13	67
Beaumont TX	96	36	8	45	1.13	67
Salem OR	66	90	9	29	1.11	75
Boise ID	71	87	7	60	1.17	53
Jackson MS	126	2	7	60	1.09	83
Pensacola FL-AL	98	33	8	45	1.10	79
Worcester MA	100	31	7	60	1.10	79
Greensboro NC	98	34	7	60	1.09	83
Spokane WA	91	50	6	74	1.14	63
Boulder CO	52	98	6	74	1.16	58
Brownsville TX	56	96	6	74	1.08	92
Winston-Salem NC	83	66	5	85	1.07	97
Anchorage AK	50	100	6	74	1.07	97
Provo UT	73	81	7	60	1.09	83
Laredo TX	56	95	5	85	1.08	92
Madison WI	73	85	5	85	1.09	83
Corpus Christi TX	78	77	5	85	1.10	79
Stockton CA	52	99	4	95	1.03	101
Eugene OR	59	93	3	100	1.09	83
101 Area Average	**90**		**11**		**1.30**	
Remaining Area Average			**7**		**1.12**	
All 439 Area Average			**10**		**1.30**	

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Table 5. Truck Commodity Value and Truck Delay, 2010

Urban Area	Total Delay		Truck Delay			Truck Commodity Value	
	(1000 Hours)	Rank	(1000 Hours)	Rank	Congestion Cost ($ million)	($ million)	Rank
Very Large Average (15 areas)	**187,872**		**12,120**		**895**	**206,375**	
Chicago IL-IN	367,122	3	31,378	1	2,317	357,816	3
Los Angeles-Long Beach-Santa Ana CA	521,449	1	30,347	2	2,254	406,939	2
New York-Newark NY-NJ-CT	465,564	2	30,185	3	2,218	475,730	1
Houston TX	153,391	6	9,299	4	688	230,769	4
Washington DC-VA-MD	188,650	4	9,204	5	683	95,965	17
Dallas-Fort Worth-Arlington TX	163,585	5	9,037	6	666	227,514	5
Philadelphia PA-NJ-DE-MD	134,899	8	8,970	7	659	172,905	7
Atlanta GA	115,958	11	8,459	8	623	189,488	6
Miami FL	139,764	7	8,207	9	604	153,596	9
Phoenix AZ	81,829	15	8,139	10	603	129,894	12
San Francisco-Oakland CA	120,149	9	6,558	11	484	130,852	11
Seattle WA	87,919	12	6,296	12	467	150,998	10
Boston MA-NH-RI	117,234	10	6,227	13	459	128,143	13
Detroit MI	87,572	13	5,186	15	382	159,328	8
San Diego CA	72,995	18	4,316	17	321	85,686	20

Very Large Urban Areas—over 3 million population.
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Travel Delay—Travel time above that needed to complete a trip at free-flow speeds for all vehicles.
Truck Delay—Travel time above that needed to complete a trip at free-flow speeds for large trucks.
Truck Commodity Value—Value of all commodities moved by truck estimated to be traveling in the urban area.
Note: Please do not place too much emphasis on small differences in the rankings. There may be little difference in congestion between areas ranked (for example) 6th and 12th. The actual measure values should also be examined.
Also note: The best congestion comparisons use multi-year trends and are made between similar urban areas

Table 5. Truck Commodity Value and Truck Delay, 2010, Continued

Urban Area	Total Delay (1000 Hours)	Total Delay Rank	Truck Delay (1000 Hours)	Truck Delay Rank	Truck Delay Congestion Cost ($million)	Truck Commodity Value ($ million)	Truck Commodity Value Rank
Large Average (32 areas)	**33,407**		**2,024**		**148**	**62,310**	
Baltimore MD	87,199	14	6,103	14	449	94,943	19
Denver-Aurora CO	80,837	16	4,324	16	319	76,023	22
Minneapolis-St. Paul MN	78,483	17	4,073	18	300	95,819	18
St. Louis MO-IL	47,042	21	3,841	19	283	107,010	15
Riverside-San Bernardino CA	40,875	25	3,080	20	229	108,218	14
Orlando FL	38,260	26	2,856	21	207	63,106	32
Tampa-St. Petersburg FL	53,047	19	2,842	22	210	61,906	33
Pittsburgh PA	41,081	24	2,755	23	200	69,290	25
Portland OR-WA	41,743	23	2,546	24	185	64,964	30
San Juan PR	50,229	20	2,417	25	174	23,130	60
Nashville-Davidson TN	26,475	33	1,961	26	142	65,449	29
New Orleans LA	20,565	39	1,859	27	135	34,270	50
San Jose CA	42,846	22	1,815	28	133	52,079	36
Milwaukee WI	26,699	32	1,746	29	127	66,629	28
Sacramento CA	29,602	30	1,688	30	123	51,883	37
Cincinnati OH-KY-IN	23,297	35	1,660	31	120	64,323	31
Indianapolis IN	20,800	38	1,657	32	119	83,984	21
Kansas City MO-KS	24,185	34	1,641	33	119	72,545	23
Austin TX	31,038	28	1,636	34	119	32,824	52
Raleigh-Durham NC	19,247	40	1,569	35	115	49,468	40
San Antonio TX	30,207	29	1,428	37	105	50,600	39
Charlotte NC-SC	17,730	43	1,383	38	101	68,196	26
Virginia Beach VA	36,538	27	1,344	40	98	43,056	42
Memphis TN-MS-AR	17,197	44	1,195	42	87	98,356	16
Louisville KY-IN	17,033	45	1,170	43	85	55,226	35
Jacksonville FL	18,005	42	1,158	44	84	41,508	44
Las Vegas NV	27,386	31	1,141	45	83	35,458	49
Cleveland OH	21,380	36	1,016	46	75	67,808	27
Salt Lake City UT	18,366	41	823	50	61	56,160	34
Columbus OH	14,651	51	727	51	53	69,664	24
Buffalo NY	11,450	56	698	55	51	48,387	41
Providence RI-MA	15,539	48	610	59	45	21,633	61

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Table 5. Truck Commodity Value and Truck Delay, 2010, Continued

Urban Area	Total Delay (1000 Hours)	Total Delay Rank	Truck Delay (1000 Hours)	Truck Delay Rank	Truck Delay Congestion Cost ($ million)	Truck Commodity Value ($ million)	Truck Commodity Value Rank
Medium Average (33 areas)	**9,513**		**578**		**42**	**18,478**	
Baton Rouge LA	14,577	52	1,519	36	110	32,636	54
Bridgeport-Stamford CT-NY	21,233	37	1,380	39	102	11,205	73
Tucson AZ	11,412	57	1,287	41	92	28,654	58
Birmingham AL	15,832	47	971	47	71	38,401	45
Albuquerque NM	10,477	58	963	48	69	14,035	67
Oklahoma City OK	16,848	46	912	49	66	37,779	46
Hartford CT	15,072	49	716	52	52	42,403	43
El Paso TX-NM	10,452	59	714	53	52	31,703	55
Charleston-North Charleston SC	9,160	62	701	54	51	10,552	76
New Haven CT	11,643	55	676	56	49	8,276	86
Allentown-Bethlehem PA-NJ	9,777	60	597	60	43	15,827	65
Honolulu HI	15,035	50	595	61	42	10,125	78
Tulsa OK	9,086	63	562	63	42	28,827	57
Richmond VA	13,800	53	530	64	39	37,643	47
Oxnard-Ventura CA	9,009	64	529	65	39	9,187	83
Colorado Springs CO	11,897	54	509	66	37	6,546	91
Albany-Schenectady NY	7,467	71	484	67	35	32,655	53
Grand Rapids MI	7,861	68	446	69	32	37,551	48
Sarasota-Bradenton FL	8,015	67	446	69	32	7,591	89
Knoxville TN	7,518	70	439	71	32	11,989	72
Bakersfield CA	4,005	90	425	72	31	10,838	75
Fresno CA	5,999	78	396	73	29	9,474	81
Indio-Cathedral City-Palm Springs CA	5,633	80	389	74	28	5,455	94
Dayton OH	7,096	73	382	75	28	33,645	51
Springfield MA-CT	8,305	66	378	76	27	9,238	82
Omaha NE-IA	9,299	61	314	79	23	8,668	85
Lancaster-Palmdale CA	6,906	74	303	80	22	2,728	99
Rochester NY	6,377	76	295	81	21	26,077	59
Akron OH	6,198	77	290	82	21	9,828	80
Wichita KS	6,858	75	280	84	21	7,901	87
Poughkeepsie-Newburgh NY	4,271	85	272	85	20	13,714	68
Toledo OH-MI	4,223	86	247	90	18	10,950	74
McAllen TX	2,598	96	125	99	9	7,678	88

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Table 5. Truck Commodity Value and Truck Delay, 2010, Continued

Urban Area	Total Delay (1000 Hours)	Total Delay Rank	Truck Delay (1000 Hours)	Truck Delay Rank	Truck Delay Congestion Cost ($ million)	Truck Commodity Value ($ million)	Truck Commodity Value Rank
Small Average (21 areas)	**4,166**		**288**		**21**	**12,275**	
Columbia SC	8,515	65	651	57	47	12,404	70
Jackson MS	5,488	81	648	58	47	16,984	64
Cape Coral FL	7,600	69	567	62	41	5,962	93
Little Rock AR	7,345	72	457	68	33	15,221	66
Greensboro NC	4,104	87	362	77	26	50,964	38
Spokane WA	4,306	84	323	78	23	7,230	90
Winston-Salem NC	4,054	89	287	83	21	8,679	84
Pensacola FL-AL	4,699	83	261	86	19	6,339	92
Worcester MA	5,639	79	259	87	19	10,115	79
Salem OR	3,912	91	256	88	18	3,864	97
Madison WI	3,375	93	252	89	18	17,361	63
Provo UT	5,056	82	240	91	18	12,681	69
Beaumont TX	3,814	92	236	92	17	20,504	62
Laredo TX	2,041	99	212	93	15	30,799	56
Brownsville TX	2,323	98	206	94	15	2,380	100
Stockton CA	2,648	95	203	95	15	10,264	77
Anchorage AK	3,013	94	183	96	13	4,454	96
Corpus Christi TX	2,432	97	172	97	13	12,327	71
Boise ID	4,063	88	137	98	10	4,772	95
Eugene OR	1,456	101	98	100	7	3,658	98
Boulder CO	1,612	100	47	101	3	820	101
101 Area Average	**42,461**		**2,690**		**198**	**58,981**	
Remaining Area Average	**1,582**		**119**		**9**	**3,183**	
All 439 Area Average	**10,987**		**710**		**52**	**16,021**	

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Truck Commodity Value—Value of all commodities moved by truck estimated to be traveling in the urban area.
Note: Please do not place too much emphasis on small differences in the rankings. There may be little difference in congestion between areas ranked (for example) 6th and 12th. The actual measure values should also be examined.
Also note: The best congestion comparisons use multi-year trends and are made between similar urban areas.

Table 6. State Truck Commodity Value, 2010

State	Total Truck Commodity Value ($ million)	Rural Truck Commodity Value ($ million)	Urban Truck Commodity Value ($ million)
Alabama	225,316	140,281	85,035
Alaska	17,161	12,082	5,079
Arizona	266,930	102,058	164,872
Arkansas	160,049	130,440	29,609
California	1,235,308	295,145	940,164
Colorado	153,998	62,081	91,917
Connecticut	110,515	7,578	102,937
Delaware	35,030	12,397	22,633
Florida	552,621	138,470	414,151
Georgia	417,906	182,728	235,178
Hawaii	16,307	5,592	10,715
Idaho	57,974	47,004	10,970
Illinois	548,431	174,621	373,810
Indiana	368,446	199,151	169,296
Iowa	157,013	130,758	26,255
Kansas	142,534	100,076	42,458
Kentucky	222,880	146,951	75,929
Louisiana	217,425	101,396	116,029
Maine	44,693	36,143	8,550
Maryland	205,976	51,098	154,878
Massachusetts	164,871	10,433	154,438
Michigan	348,470	101,493	246,977
Minnesota	189,643	86,720	102,923
Mississippi	155,821	121,572	34,249
Missouri	297,147	150,722	146,425
Montana	41,673	39,489	2,184
Nebraska	96,020	84,448	11,572
Nevada	78,514	37,075	41,440
New Hampshire	38,649	23,312	15,338
New Jersey	295,927	12,901	283,026
New Mexico	111,128	91,403	19,725
New York	482,018	111,566	370,451
North Carolina	373,822	146,171	227,652
North Dakota	47,109	42,718	4,391

Total Truck Commodity Value—Value of all commodities moved by truck estimated to be traveling in the state.
Rural Truck Commodity Value—Value of all commodities moved by truck estimated to be traveling in the rural areas of the state.
Urban Truck Commodity Value—Value of all commodities moved by truck estimated to be traveling in the urban areas of the state.

Table 6. State Truck Commodity Value, 2010, Continued

State	Total Truck Commodity Value ($ million)	Rural Truck Commodity Value ($ million)	Urban Truck Commodity Value ($ million)
Ohio	447,564	177,760	269,805
Oklahoma	205,346	137,892	67,453
Oregon	153,382	82,144	71,239
Pennsylvania	443,946	195,660	248,286
Rhode Island	21,139	3,786	17,353
South Carolina	192,648	97,765	94,883
South Dakota	44,693	39,879	4,813
Tennessee	349,114	156,776	192,337
Texas	1,150,012	441,184	708,828
Utah	143,138	60,146	82,992
Vermont	24,158	21,648	2,510
Virginia	253,058	110,587	142,471
Washington	273,611	91,855	181,756
West Virginia	85,762	62,040	23,722
Wisconsin	326,741	190,205	136,536
Wyoming	48,921	46,372	2,549
District of Columbia	9,059	-	9,059
Puerto Rico	38,653	3,494	35,159

Total Truck Commodity Value—Value of all commodities moved by truck estimated to be traveling in the state.
Rural Truck Commodity Value—Value of all commodities moved by truck estimated to be traveling in the rural areas of the state.
Urban Truck Commodity Value—Value of all commodities moved by truck estimated to be traveling in the urban areas of the state.

Table 7. Congestion Trends – Wasted Hours (Yearly Delay per Auto Commuter, 1982 to 2010)

Urban Area	Yearly Hours of Delay per Auto Commuter					Long-Term Change 1982 to 2010	
	2010	2009	2005	2000	1982	Hours	Rank
Very Large Average (15 areas)	**52**	**52**	**60**	**50**	**19**	**33**	
Washington DC-VA-MD	74	72	83	73	20	54	1
Chicago IL-IN	71	74	77	55	18	53	2
New York-Newark NY-NJ-CT	54	53	51	35	10	44	3
Dallas-Fort Worth-Arlington TX	45	46	51	40	7	38	6
Boston MA-NH-RI	47	48	57	44	13	34	8
Seattle WA	44	44	51	49	10	34	8
Houston TX	57	56	55	45	24	33	10
Atlanta GA	43	44	58	52	13	30	11
Philadelphia PA-NJ-DE-MD	42	43	42	32	12	30	11
San Diego CA	38	37	46	35	8	30	11
San Francisco-Oakland CA	50	50	74	60	20	30	11
Miami FL	38	39	45	38	10	28	16
Los Angeles-Long Beach-Santa Ana CA	64	63	82	76	39	25	23
Detroit MI	33	32	41	36	14	19	36
Phoenix AZ	35	36	44	34	24	11	79

Very Large Urban Areas—over 3 million population.
Large Urban Areas—over 1 million and less than 3 million population.
Medium Urban Areas—over 500,000 and less than 1 million population.
Small Urban Areas—less than 500,000 population.
Yearly Delay per Auto Commuter—Extra travel time during the year divided by the number of people who commute in private vehicles in the urban area.
Note: Please do not place too much emphasis on small differences in the rankings. There may be little difference in congestion between areas ranked (for example) 6th and 12th. The actual measure values should also be examined.
Also note: The best congestion comparisons use multi-year trends and are made between similar urban areas.

Table 7. Congestion Trends – Wasted Hours (Yearly Delay per Auto Commuter, 1982 to 2010), Continued

Urban Area	Yearly Hours of Delay per Auto Commuter					Long-Term Change 1982 to 2010	
	2010	2009	2005	2000	1982	Hours	Rank
Large Average (32 areas)	**31**	**31**	**37**	**33**	**9**	**22**	
Baltimore MD	52	50	57	41	11	41	4
Minneapolis-St. Paul MN	45	43	54	48	6	39	5
Denver-Aurora CO	49	47	53	47	12	37	7
Austin TX	38	39	52	36	9	29	15
Riverside-San Bernardino CA	31	30	37	24	3	28	16
San Juan PR	33	33	34	26	5	28	16
Orlando FL	38	41	44	47	11	27	19
Portland OR-WA	37	36	42	38	11	26	21
San Antonio TX	30	30	33	30	4	26	21
Las Vegas NV	28	32	32	24	5	23	26
Salt Lake City UT	27	28	25	27	6	21	27
Charlotte NC-SC	25	26	25	19	5	20	31
Raleigh-Durham NC	25	25	31	26	5	20	31
San Jose CA	37	35	54	53	17	20	31
Virginia Beach VA	34	32	41	37	14	20	31
Kansas City MO-KS	23	21	30	33	4	19	36
St. Louis MO-IL	30	31	38	44	11	19	36
Tampa-St. Petersburg FL	33	34	34	27	14	19	36
Memphis TN-MS-AR	23	24	28	24	5	18	43
Milwaukee WI	27	25	31	32	9	18	43
Nashville-Davidson TN	35	35	43	36	17	18	43
New Orleans LA	35	31	26	25	17	18	43
Cincinnati OH-KY-IN	21	19	28	29	4	17	50
Cleveland OH	20	19	17	20	3	17	50
Providence RI-MA	19	19	26	19	2	17	50
Columbus OH	18	17	19	15	2	16	56
Sacramento CA	25	24	35	27	9	16	56
Jacksonville FL	25	26	31	26	10	15	61
Indianapolis IN	24	25	30	31	10	14	68
Louisville KY-IN	23	22	25	25	9	14	68
Buffalo NY	17	17	21	16	4	13	74
Pittsburgh PA	31	33	37	35	18	13	74

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Yearly Delay per Auto Commuter—Extra travel time during the year divided by the number of people who commute in private vehicles in the urban area.
Note: Please do not place too much emphasis on small differences in the rankings. There may be little difference in congestion between areas ranked (for example) 6th and 12th. The actual measure values should also be examined. Also note: The best congestion comparisons use multi-year trends and are made between similar urban areas.

Table 7. Congestion Trends – Wasted Hours (Yearly Delay per Auto Commuter, 1982 to 2010), Continued

Urban Area	Yearly Hours of Delay per Auto Commuter					Long-Term Change 1982 to 2010	
	2010	2009	2005	2000	1982	Hours	Rank
Medium Average (33 areas)	**21**	**21**	**24**	**22**	**7**	**14**	
Baton Rouge LA	36	37	37	31	9	27	19
Bridgeport-Stamford CT-NY	36	35	47	44	11	25	23
Colorado Springs CO	31	31	53	45	6	25	23
Hartford CT	26	24	27	26	5	21	27
New Haven CT	28	29	34	34	7	21	27
Birmingham AL	27	28	31	30	7	20	31
Honolulu HI	33	31	32	25	14	19	36
Oklahoma City OK	24	25	23	23	5	19	36
El Paso TX-NM	21	21	28	20	3	18	43
Omaha NE-IA	21	20	18	16	3	18	43
Oxnard-Ventura CA	19	19	23	16	2	17	50
Albuquerque NM	25	26	33	30	9	16	56
Richmond VA	20	19	17	13	4	16	56
Allentown-Bethlehem PA-NJ	22	22	24	24	7	15	61
Charleston-North Charleston SC	25	27	28	25	10	15	61
Grand Rapids MI	19	19	19	18	4	15	61
Knoxville TN	21	21	23	26	6	15	61
Albany-Schenectady NY	17	18	19	14	3	14	68
Tulsa OK	18	18	16	15	4	14	68
Wichita KS	20	20	19	19	6	14	68
Akron OH	15	16	19	22	3	12	77
Tucson AZ	23	23	28	19	11	12	77
Rochester NY	13	12	13	12	3	10	83
Toledo OH-MI	12	12	17	19	2	10	83
Bakersfield CA	10	11	7	4	1	9	86
Springfield MA-CT	18	19	19	18	9	9	86
Dayton OH	14	15	15	19	7	7	89
Sarasota-Bradenton FL	16	17	20	19	9	7	89
Fresno CA	13	14	16	18	7	6	93
McAllen TX	7	7	7	6	1	6	93
Poughkeepsie-Newburgh NY	10	11	10	8	5	5	96
Lancaster-Palmdale CA	16	18	17	12	19	-3	100
Indio-Cathedral City-Palm Springs CA	14	14	20	15	22	-8	101

Very Large Urban Areas—over 3 million population.
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Yearly Delay per Auto Commuter—Extra travel time during the year divided by the number of people who commute in private vehicles in the urban area.
Note: Please do not place too much emphasis on small differences in the rankings. There may be little difference in congestion between areas ranked (for example) 6th and 12th. The actual measure values should also be examined.
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Table 7. Congestion Trends – Wasted Hours (Yearly Delay per Auto Commuter, 1982 to 2010), Continued

Urban Area	Yearly Hours of Delay per Auto Commuter					Long-Term Change 1982 to 2010	
	2010	2009	2005	2000	1982	Hours	Rank
Small Average (21 areas)	**18**	**18**	**20**	**17**	**5**	**13**	
Columbia SC	25	25	20	17	4	21	27
Little Rock AR	24	24	23	17	5	19	36
Salem OR	22	24	32	30	4	18	43
Beaumont TX	22	21	26	18	5	17	50
Boise ID	19	21	24	20	2	17	50
Jackson MS	19	19	20	12	3	16	56
Cape Coral FL	23	23	28	23	8	15	61
Pensacola FL-AL	18	19	21	16	3	15	61
Brownsville TX	15	14	10	8	1	14	68
Greensboro NC	16	15	19	24	3	13	74
Laredo TX	12	12	8	7	1	11	77
Winston-Salem NC	15	16	20	13	4	11	79
Worcester MA	18	20	22	22	7	11	79
Spokane WA	16	16	17	22	6	10	83
Provo UT	14	14	14	11	5	9	86
Madison WI	12	11	7	6	5	7	89
Stockton CA	9	9	10	7	2	7	89
Boulder CO	15	15	28	28	9	6	93
Corpus Christi TX	10	10	11	9	5	5	96
Eugene OR	8	9	14	15	5	3	98
Anchorage AK	14	14	21	20	16	-2	99
101 Area Average	**40**	**40**	**46**	**40**	**14**	**26**	
Remaining Area Average	**16**	**18**	**20**	**20**	**10**	**6**	
All 439 Area Average	**34**	**34**	**39**	**35**	**14**	**20**	

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Also note: The best congestion comparisons use multi-year trends and are made between similar urban areas.

Table 8. Congestion Trends – Wasted Time (Travel Time Index, 1982 to 2010)

Urban Area	Travel Time Index					Point Change in Peak-Period Time Penalty 1982 to 2010	
	2010	2009	2005	2000	1982	Points	Rank
Very Large Average (15 areas)	**1.27**	**1.26**	**1.32**	**1.27**	**1.12**	**15**	
Washington DC-VA-MD	1.33	1.30	1.35	1.31	1.11	22	1
Seattle WA	1.27	1.24	1.33	1.31	1.08	19	4
Dallas-Fort Worth-Arlington TX	1.23	1.22	1.27	1.20	1.05	18	6
New York-Newark NY-NJ-CT	1.28	1.27	1.37	1.28	1.10	18	6
Los Angeles-Long Beach-Santa Ana CA	1.38	1.38	1.42	1.39	1.21	17	12
Chicago IL-IN	1.24	1.25	1.29	1.21	1.08	16	15
San Francisco-Oakland CA	1.28	1.27	1.40	1.34	1.13	15	16
Atlanta GA	1.23	1.22	1.28	1.25	1.08	15	17
San Diego CA	1.19	1.18	1.25	1.20	1.04	15	17
Miami FL	1.23	1.23	1.31	1.27	1.09	14	20
Boston MA-NH-RI	1.21	1.20	1.32	1.26	1.09	12	25
Philadelphia PA-NJ-DE-MD	1.21	1.19	1.22	1.18	1.09	12	25
Phoenix AZ	1.21	1.20	1.21	1.18	1.10	11	29
Houston TX	1.27	1.25	1.33	1.26	1.18	9	38

Very Large Urban Areas—over 3 million population.
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Small Urban Areas—less than 500,000 population.
Travel Time Index—The ratio of travel time in the peak period to the travel time at free-flow conditions. A value of 1.30 indicates a 20-minute free-flow trip takes 26 minutes in the peak period.
Note: Please do not place too much emphasis on small differences in the rankings. There may be little difference in congestion between areas ranked (for example) 6th and 12th. The actual measure values should also be examined.
Also note: The best congestion comparisons use multi-year trends and are made between similar urban areas.

Table 8. Congestion Trends – Wasted Time (Travel Time Index, 1982 to 2010), Continued

Urban Area	Travel Time Index					Point Change in Peak-Period Time Penalty 1982 to 2010	
	2010	2009	2005	2000	1982	Points	Rank
Large Average (31 areas)	**1.17**	**1.17**	**1.21**	**1.19**	**1.07**	**10**	
Austin TX	1.28	1.28	1.32	1.23	1.08	20	2
Portland OR-WA	1.25	1.23	1.27	1.26	1.06	19	4
Las Vegas NV	1.24	1.26	1.29	1.25	1.06	18	6
Minneapolis-St. Paul MN	1.23	1.21	1.33	1.31	1.05	18	6
San Juan PR	1.25	1.25	1.24	1.21	1.07	18	6
Denver-Aurora CO	1.24	1.22	1.28	1.26	1.07	17	12
Riverside-San Bernardino CA	1.18	1.16	1.19	1.13	1.01	17	12
San Antonio TX	1.18	1.16	1.21	1.18	1.03	15	17
Baltimore MD	1.19	1.17	1.19	1.14	1.05	14	20
Sacramento CA	1.19	1.18	1.26	1.20	1.05	14	20
San Jose CA	1.25	1.23	1.31	1.30	1.12	13	23
Milwaukee WI	1.18	1.16	1.17	1.18	1.06	12	25
Charlotte NC-SC	1.17	1.17	1.20	1.19	1.06	11	29
Indianapolis IN	1.17	1.18	1.15	1.15	1.06	11	29
Orlando FL	1.18	1.20	1.22	1.23	1.07	11	29
Cincinnati OH-KY-IN	1.13	1.12	1.14	1.15	1.03	10	34
Raleigh-Durham NC	1.14	1.13	1.17	1.13	1.04	10	34
Columbus OH	1.11	1.11	1.11	1.09	1.02	9	38
Providence RI-MA	1.12	1.14	1.18	1.15	1.03	9	38
Virginia Beach VA	1.18	1.19	1.24	1.21	1.09	9	42
Cleveland OH	1.10	1.10	1.12	1.15	1.03	7	49
Kansas City MO-KS	1.11	1.10	1.15	1.18	1.04	7	49
Memphis TN-MS-AR	1.12	1.13	1.18	1.18	1.05	7	49
Nashville-Davidson TN	1.18	1.15	1.20	1.18	1.11	7	54
Buffalo NY	1.10	1.10	1.13	1.11	1.04	6	57
Salt Lake City UT	1.11	1.12	1.16	1.18	1.05	6	57
Louisville KY-IN	1.10	1.10	1.12	1.11	1.06	4	72
Jacksonville FL	1.09	1.12	1.17	1.13	1.06	3	79
New Orleans LA	1.17	1.15	1.19	1.19	1.14	3	79
Pittsburgh PA	1.18	1.17	1.22	1.22	1.15	3	79
Tampa-St. Petersburg FL	1.16	1.16	1.18	1.15	1.13	3	79
St. Louis MO-IL	1.10	1.12	1.17	1.21	1.08	2	93

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Table 8. Congestion Trends – Wasted Time (Travel Time Index, 1982 to 2010), Continued

Urban Area	Travel Time Index					Point Change in Peak-Period Time Penalty 1982 to 2010	
	2010	2009	2005	2000	1982	Points	Rank
Medium Average (33 areas)	**1.11**	**1.11**	**1.12**	**1.11**	**1.04**	**7**	
Bridgeport-Stamford CT-NY	1.27	1.25	1.26	1.24	1.07	20	2
Baton Rouge LA	1.25	1.24	1.21	1.19	1.07	18	6
El Paso TX-NM	1.16	1.15	1.18	1.16	1.03	13	23
Oxnard-Ventura CA	1.12	1.12	1.12	1.08	1.01	11	28
Birmingham AL	1.15	1.14	1.15	1.12	1.04	11	29
Colorado Springs CO	1.13	1.12	1.18	1.18	1.03	10	34
Hartford CT	1.15	1.13	1.17	1.18	1.05	10	34
McAllen TX	1.10	1.09	1.08	1.07	1.01	9	38
Honolulu HI	1.18	1.18	1.18	1.15	1.09	9	42
New Haven CT	1.13	1.15	1.15	1.15	1.04	9	42
Oklahoma City OK	1.10	1.09	1.07	1.07	1.02	8	46
Omaha NE-IA	1.09	1.08	1.10	1.08	1.02	7	49
Charleston-North Charleston SC	1.16	1.15	1.17	1.16	1.09	7	54
Bakersfield CA	1.07	1.08	1.08	1.05	1.01	6	57
Tulsa OK	1.08	1.07	1.05	1.06	1.02	6	57
Albany-Schenectady NY	1.08	1.10	1.10	1.07	1.03	5	65
Albuquerque NM	1.10	1.13	1.16	1.17	1.05	5	65
Indio-Cathedral City-Palm Springs CA	1.11	1.13	1.12	1.08	1.06	5	65
Fresno CA	1.07	1.07	1.08	1.10	1.03	4	72
Toledo OH-MI	1.05	1.05	1.07	1.08	1.01	4	72
Tucson AZ	1.11	1.11	1.15	1.12	1.07	4	72
Wichita KS	1.07	1.08	1.06	1.06	1.03	4	72
Akron OH	1.05	1.05	1.08	1.09	1.02	3	79
Allentown-Bethlehem PA-NJ	1.07	1.08	1.08	1.09	1.04	3	79
Grand Rapids MI	1.05	1.06	1.05	1.06	1.02	3	79
Lancaster-Palmdale CA	1.10	1.11	1.10	1.07	1.07	3	79
Richmond VA	1.06	1.06	1.07	1.06	1.03	3	79
Sarasota-Bradenton FL	1.09	1.10	1.11	1.11	1.06	3	79
Springfield MA-CT	1.08	1.09	1.09	1.09	1.05	3	79
Knoxville TN	1.06	1.06	1.09	1.10	1.04	2	93
Rochester NY	1.05	1.07	1.07	1.06	1.03	2	93
Dayton OH	1.06	1.06	1.07	1.08	1.05	1	97
Poughkeepsie-Newburgh NY	1.04	1.04	1.05	1.04	1.03	1	97

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Table 8. Congestion Trends – Wasted Time (Travel Time Index, 1982 to 2010), Continued

Urban Area	Travel Time Index					Point Change in Peak-Period Time Penalty 1982 to 2010	
	2010	2009	2005	2000	1982	Points	Rank
Small Average (21 areas)	**1.08**	**1.08**	**1.08**	**1.08**	**1.03**	**5**	
Boulder CO	1.14	1.13	1.14	1.15	1.05	9	42
Boise ID	1.10	1.12	1.15	1.12	1.02	8	46
Little Rock AR	1.10	1.10	1.08	1.07	1.02	8	46
Columbia SC	1.09	1.09	1.07	1.06	1.02	7	49
Beaumont TX	1.08	1.08	1.06	1.05	1.02	6	57
Laredo TX	1.07	1.07	1.06	1.05	1.01	6	57
Provo UT	1.08	1.06	1.05	1.04	1.02	6	57
Salem OR	1.09	1.10	1.12	1.12	1.03	6	57
Greensboro NC	1.06	1.05	1.07	1.08	1.01	5	65
Pensacola FL-AL	1.08	1.07	1.10	1.09	1.03	5	65
Spokane WA	1.10	1.10	1.10	1.14	1.05	5	65
Winston-Salem NC	1.06	1.06	1.07	1.05	1.01	5	65
Corpus Christi TX	1.07	1.07	1.07	1.06	1.03	4	72
Jackson MS	1.06	1.07	1.09	1.06	1.02	4	72
Cape Coral FL	1.10	1.12	1.12	1.10	1.07	3	79
Madison WI	1.06	1.06	1.05	1.05	1.03	3	79
Worcester MA	1.06	1.07	1.09	1.09	1.03	3	79
Brownsville TX	1.04	1.04	1.07	1.07	1.02	2	93
Eugene OR	1.06	1.07	1.13	1.13	1.05	1	97
Stockton CA	1.02	1.02	1.05	1.03	1.01	1	97
Anchorage AK	1.05	1.05	1.06	1.05	1.05	0	101
101 Area Average	**1.21**	**1.20**	**1.25**	**1.22**	**1.09**	**12**	
Remaining Areas	**1.08**	**1.09**	**1.12**	**1.10**	**1.04**	**4**	
All 439 Urban Areas	**1.20**	**1.20**	**1.25**	**1.21**	**1.09**	**11**	

Very Large Urban Areas—over 3 million population.
Large Urban Areas—over 1 million and less than 3 million population.
Medium Urban Areas—over 500,000 and less than 1 million population.
Small Urban Areas—less than 500,000 population.
Travel Time Index—The ratio of travel time in the peak period to the travel time at free-flow conditions. A value of 1.30 indicates a 20-minute free-flow trip takes 26 minutes in the peak period.
Note: Please do not place too much emphasis on small differences in the rankings. There may be little difference in congestion between areas ranked (for example) 6th and 12th. The actual measure values should also be examined.
Also note: The best congestion comparisons use multi-year trends and are made between similar urban areas.

Table 9. Urban Area Demand and Roadway Growth Trends

Less Than 10% Faster (13)	10% to 30% Faster (46)	10% to 30% Faster (cont.)	More Than 30% Faster (40)	More Than 30% Faster (cont.)
Anchorage AK	Allentown-Bethlehem PA-NJ	Memphis TN-MS-AR	Akron OH	Minneapolis-St. Paul MN
Boulder CO	Baton Rouge LA	Milwaukee WI	Albany-Schenectady NY	New Haven CT
Dayton OH	Beaumont TX	Nashville-Davidson TN	Albuquerque NM	New York-Newark NY-NJ-CT
Greensboro NC	Boston MA-NH-RI	Oklahoma City OK	Atlanta GA	Omaha NE-IA
Indio-Cath City-P Springs CA	Brownsville TX	Pensacola FL-AL	Austin TX	Orlando FL
Lancaster-Palmdale CA	Buffalo NY	Philadelphia PA-NJ-DE-MD	Bakersfield CA	Oxnard-Ventura CA
Madison WI	Cape Coral FL	Phoenix AZ	Baltimore MD	Providence RI-MA
New Orleans LA	Charleston-N Charleston SC	Portland OR-WA	Birmingham AL	Raleigh-Durham NC
Pittsburgh PA	Charlotte NC-SC	Richmond VA	Boise ID	Riverside-S Bernardino CA
Poughkeepsie-Newburgh NY	Cleveland OH	Rochester NY	Bridgeport-Stamford CT-NY	Sacramento CA
Provo UT	Corpus Christi TX	Salem OR	Chicago IL-IN	San Antonio TX
St. Louis MO-IL	Detroit MI	Salt Lake City UT	Cincinnati OH-KY-IN	San Diego CA
Wichita KS	El Paso TX-NM	San Jose CA	Colorado Springs CO	San Francisco-Oakland CA
	Eugene OR	Seattle WA	Columbia SC	San Juan PR
	Fresno CA	Spokane WA	Columbus OH	Sarasota-Bradenton FL
	Grand Rapids MI	Springfield MA-CT	Dallas-Ft Worth-Arlington TX	Stockton CA
	Honolulu HI	Tampa-St. Petersburg FL	Denver-Aurora CO	Washington DC-VA-MD
	Houston TX	Toledo OH-MI	Hartford CT	
	Indianapolis IN	Tucson AZ	Jacksonville FL	
	Jackson MS	Tulsa OK	Laredo TX	
	Kansas City MO-KS	Virginia Beach VA	Las Vegas NV	
	Knoxville TN	Winston-Salem NC	Little Rock AR	
	Louisville KY-IN	Worcester MA	Los Angeles-L Bch-S Ana CA	
	McAllen TX		Miami FL	

Note: See Exhibit 12 for comparison of growth in demand, road supply and congestion.

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7 *Urban Mobility Report Methodology*. Prepared by Texas Transportation Institute For University Transportation Center for Mobility™, College Station, Texas. 2009. Available: http://mobility.tamu.edu/ums/methodology/

8 *An Early Look at the 2010 Urban Mobility Report: "Change" is Improving the Information.* Prepared by Texas Transportation Institute For University Transportation Center for Mobility™, College Station, TX. September 2010. http://tti.tamu.edu/documents/TTI-2010-9.pdf

9 *Developing a Total Travel Time Performance Measure: A Concept Paper.* Prepared by Texas Transportation Institute For Mobility Measurement in Urban Transportation Pooled Fund Study. College Station, TX. August 2010. http://tti.tamu.edu/documents/TTI-2010-7.pdf

10 *Incorporating Sustainability Factors Into The Urban Mobility Report: A Draft Concept Paper.* Prepared by Texas Transportation Institute For Mobility Measurement in Urban Transportation Pooled Fund Study. College Station, TX. August 2010. http://tti.tamu.edu/documents/TTI-2010-8.pdf

11 *Development of Diurnal Traffic Distribution and Daily, Peak and Off-Peak Vehicle Speed Estimation Procedures for Air Quality Planning.* Final Report, Work Order B-94-06, Prepared for Federal Highway Administration, April 1996.

APPENDIX B—METHODOLOGY FOR THE 2011 URBAN MOBILITY REPORT

This appendix includes the methodology used to produce the 2011 Urban Mobility Report (Appendix A). See website http://mobility.tamu.edu/ums/methodology.

Methodology for the 2011 Urban Mobility Report

The procedures used in the 2011 Urban Mobility Report have been developed by the Texas Transportation Institute over several years and several research projects. The congestion estimates for all study years are recalculated every time the methodology is altered to provide a consistent data trend. The estimates and methodology from this report should be used in place of any other previous measures. All the measures and many of the input variables for each year and every city are provided in a spreadsheet that can be downloaded at http://mobility.tamu.edu/ums/congestion-data/.

This memo documents the analysis conducted for the methodology utilized in preparing the 2011 Urban Mobility Report. This methodology incorporates private sector traffic speed data from INRIX for calendar year 2010 into the calculation of the mobility performance measures presented in the initial calculations. The roadway inventory data source for most of the calculations is the Highway Performance Monitoring System from the Federal Highway Administration (*1*). A detailed description of that dataset can be found at: http://www.fhwa.dot.gov/policy/ohpi/hpms/index.htm.

Methodology Changes to the 2011 UMR

There are several changes to the UMR methodology for the 2011 report. The largest changes have to do with how wasted fuel is calculated and how commercial vehicle operating costs are calculated. These changes are documented in more detail in the following sections of the Methodology. Here are brief summaries of what has changed:

- New fuel efficiency equations have been incorporated that are based on the more fuel efficient fleets that we operate in the U.S. as compared with 10 and 20 years ago. The previous fuel efficiency equation used in the UMR was based on 1980's data. Separate fuel efficiency equations for passenger cars and commercial vehicles are now being used in calculating the UMR statistics. In the past, one efficiency equation was used for all vehicle types.
- Diesel costs are now being utilized to calculate commercial vehicle operating costs. In the past, the fuel costs were rolled into the hourly operating costs of commercial vehicles. Now the fuel costs are separated out for commercial vehicles just like passenger vehicles and the diesel prices are applied to the commercial vehicle wasted fuel. The commercial vehicle hourly operating costs in the 2011 UMR only reflect such items as wasted time and operating/maintenance costs; fuel is no longer a component

Summary

The Urban Mobility Report (UMR) procedures provide estimates of mobility at the areawide level. The approach that is used describes congestion in consistent ways allowing for comparisons across urban areas or groups of urban areas. As with the last several editions of the UMR, this report includes the effect of several operational treatments and to public transportation. The goal is to include all improvements, but good data is necessary to accomplish this.

The previous UMR methodology used a set of estimation procedures and data provided by state DOT's and regional planning agencies to develop a set of mobility measures. This memo describes the congestion calculation procedure that uses a dataset of traffic speeds from INRIX, a private company that provides travel time information to a variety of customers. INRIX's 2010 data is an annual average of traffic speed for each section of road for every hour of each day for a total of 168 day/time period cells (24 hours x 7 days).

The travel speed data addresses the biggest shortcoming of previous editions of the UMR – the speed estimation process. INRIX's speed data improves the freeway and arterial street congestion measures in the following ways:

- "Real" rush hour speeds used to estimate a range of congestion measures; *speeds are measured not estimated.*
- Overnight speeds were used to identify the free-flow speeds that are used as a comparison standard; *low-volume speeds on each road section were used as the comparison standard.*
- The volume and roadway inventory data from FHWA's Highway Performance Monitoring System (HPMS) files were used with the speeds to calculate travel delay statistics; *the best speed data is combined with the best volume information to produce high-quality congestion measures.*

The Congestion Measure Calculation with Speed and Volume Datasets

The following steps were used to calculate the congestion performance measures for each urban roadway section.

1. Obtain HPMS traffic volume data by road section
2. Match the HPMS road network sections with the traffic speed dataset road sections

3. Estimate traffic volumes for each hour time interval from the daily volume data
4. Calculate average travel speed and total delay for each hour interval
5. Establish free-flow (i.e., low volume) travel speed
6. Calculate congestion performance measures
7. Additional steps when volume data had no speed data match

The mobility measures require four data inputs:

- Actual travel speed
- Free-flow travel speed
- Vehicle volume
- Vehicle occupancy (persons per vehicle) to calculate person-hours of travel delay

The 2010 private sector traffic speed data provided a better data source for the first two inputs, actual and free-flow travel time. The UMR analysis required vehicle and person volume estimates for the delay calculations; these were obtained from FHWA's HPMS dataset. The geographic referencing systems are different for the speed and volume datasets, a geographic matching process was performed to assign traffic speed data to each HPMS road section for the purposes of calculating the performance measures. When INRIX traffic speed data was not available for sections of road or times of day in urban areas, the speeds were estimated. This estimation process is described in more detail in Step 7.

Step 1. Identify Traffic Volume Data

The HPMS dataset from FHWA provided the source for traffic volume data, although the geographic designations in the HPMS dataset are not identical to the private sector speed data. The daily traffic volume data must be divided into the same time interval as the traffic speed data (hour intervals). While there are some detailed traffic counts on major roads, the most widespread and consistent traffic counts available are average daily traffic (ADT) counts. The hourly traffic volumes for each section, therefore, were estimated from these ADT counts using typical time-of-day traffic volume profiles developed from continuous count locations or other data sources. The section "Estimation of Hourly Traffic Volumes" shows the average hourly volume profiles used in the measure calculations.

Volume estimates for each day of the week (to match the speed database) were created from the average volume data using the factors in Exhibit 1. Automated traffic recorders from around the country were reviewed and the factors in Exhibit 1 are a "best-fit" average for both freeways and major streets. Creating an hourly volume to be used with the traffic speed values, then, is a process of multiplying the annual average by the daily factor and by the hourly factor.

Exhibit 1. Day of Week Volume Conversion Factors

Day of Week	Adjustment Factor (to convert average annual volume into day of week volume)
Monday to Thursday	+5%
Friday	+10%
Saturday	-10%
Sunday	-20%

Step 2. Combine the Road Networks for Traffic Volume and Speed Data

The second step was to combine the road networks for the traffic volume and speed data sources, such that an estimate of traffic speed and traffic volume was available for each roadway segment in each urban area. The combination (also known as conflation) of the traffic volume and traffic speed networks was accomplished using Geographic Information Systems (GIS) tools. The INRIX speed network was chosen as the base network; an ADT count from the HPMS network was applied to each segment of roadway in the speed network. The traffic count and speed data for each roadway segment were then combined into areawide performance measures.

Step 3. Estimate Traffic Volumes for Shorter Time Intervals

The third step was to estimate traffic volumes for one-hour time intervals for each day of the week. Typical time-of-day traffic distribution profiles are needed to estimate hourly traffic flows from average daily traffic volumes. Previous analytical efforts[1,2] have developed typical traffic profiles at the hourly level (the roadway traffic and inventory databases are used for a variety of traffic and economic studies). These traffic distribution profiles were developed for the following different scenarios (resulting in 16 unique profiles):

- Functional class: freeway and non-freeway
- Day type: weekday and weekend

[1] *Roadway Usage Patterns: Urban Case Studies*. Prepared for Volpe National Transportation Systems Center and Federal Highway Administration, July 22, 1994.

[2] *Development of Diurnal Traffic Distribution and Daily, Peak and Off-peak Vehicle Speed Estimation Procedures for Air Quality Planning*. Final Report, Work Order B-94-06, Prepared for Federal Highway Administration, April 1996.

- Traffic congestion level: percentage reduction in speed from free-flow (varies for freeways and streets)
- Directionality: peak traffic in the morning (AM), peak traffic in the evening (PM), approximately equal traffic in each peak

The 16 traffic distribution profiles shown in Exhibits 2 through 6 are considered to be very comprehensive, as they were developed based upon 713 continuous traffic monitoring locations in urban areas of 37 states.

Exhibit 2. Weekday Traffic Distribution Profile for No to Low Congestion

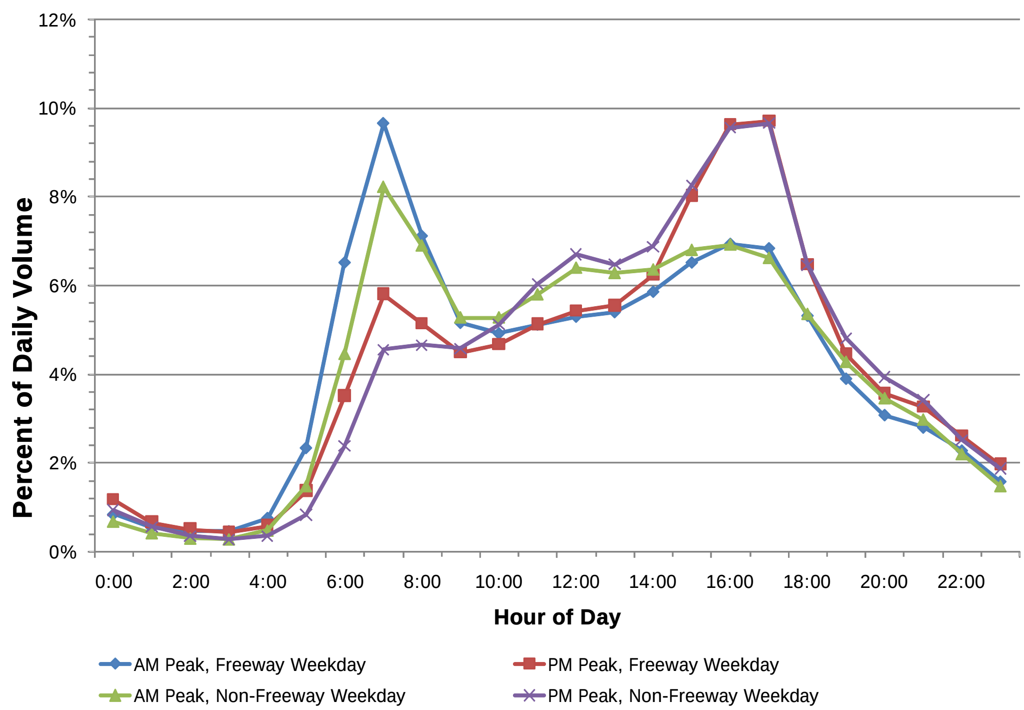


Exhibit 3. Weekday Traffic Distribution Profile for Moderate Congestion

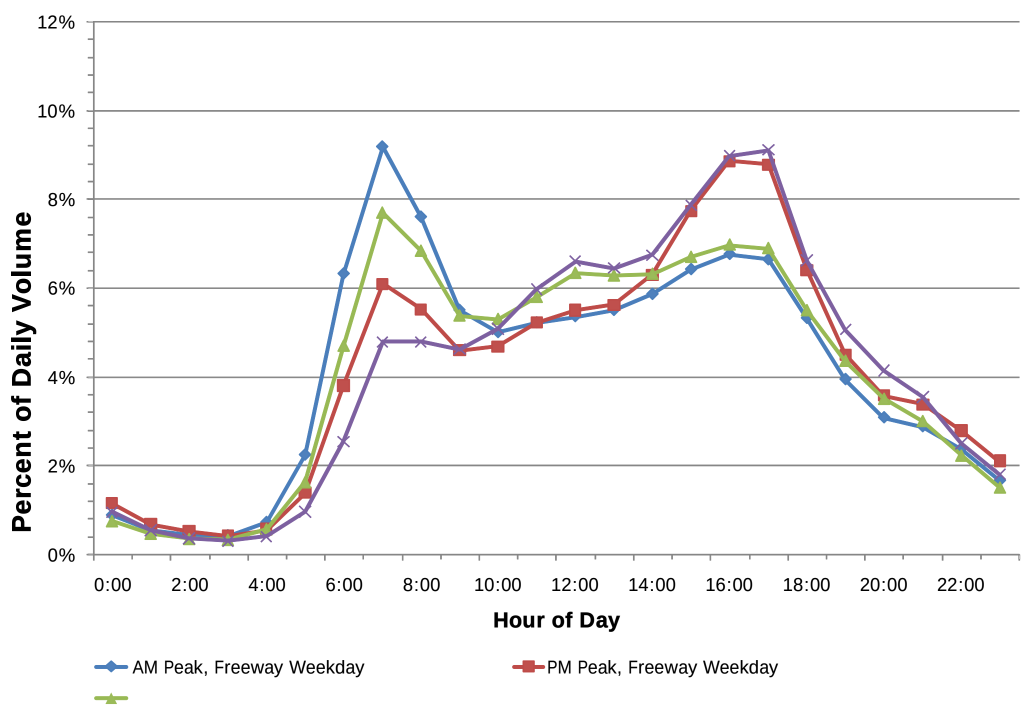


Exhibit 4. Weekday Traffic Distribution Profile for Severe Congestion

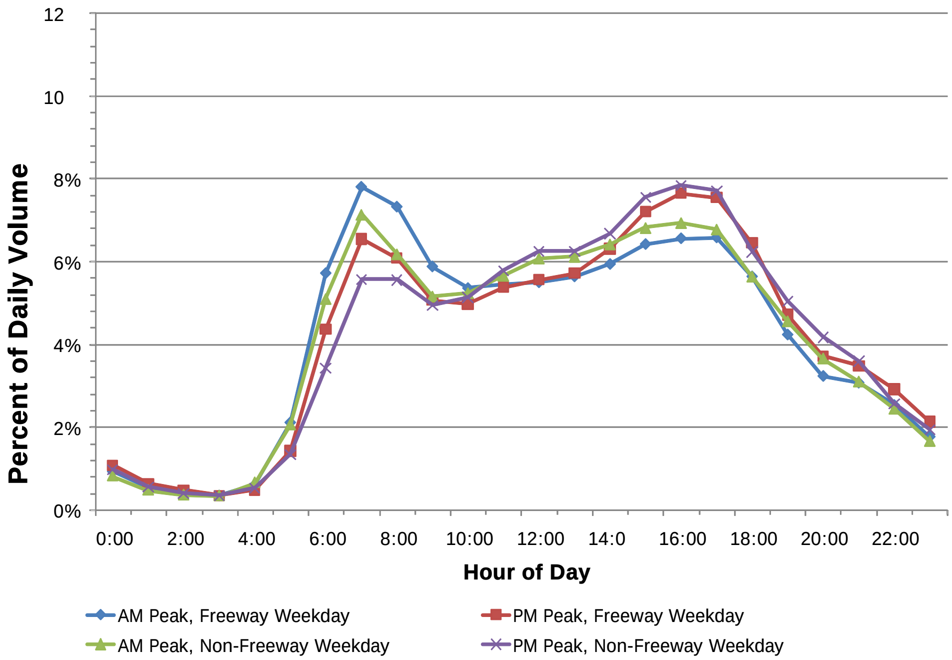


Exhibit 5. Weekend Traffic Distribution Profile

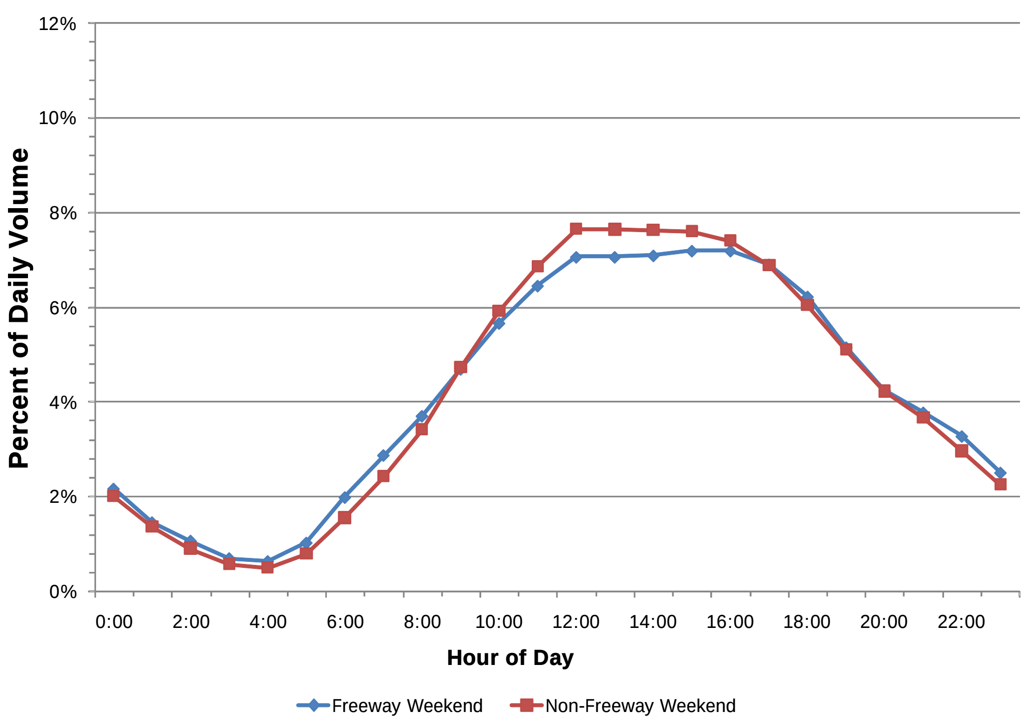
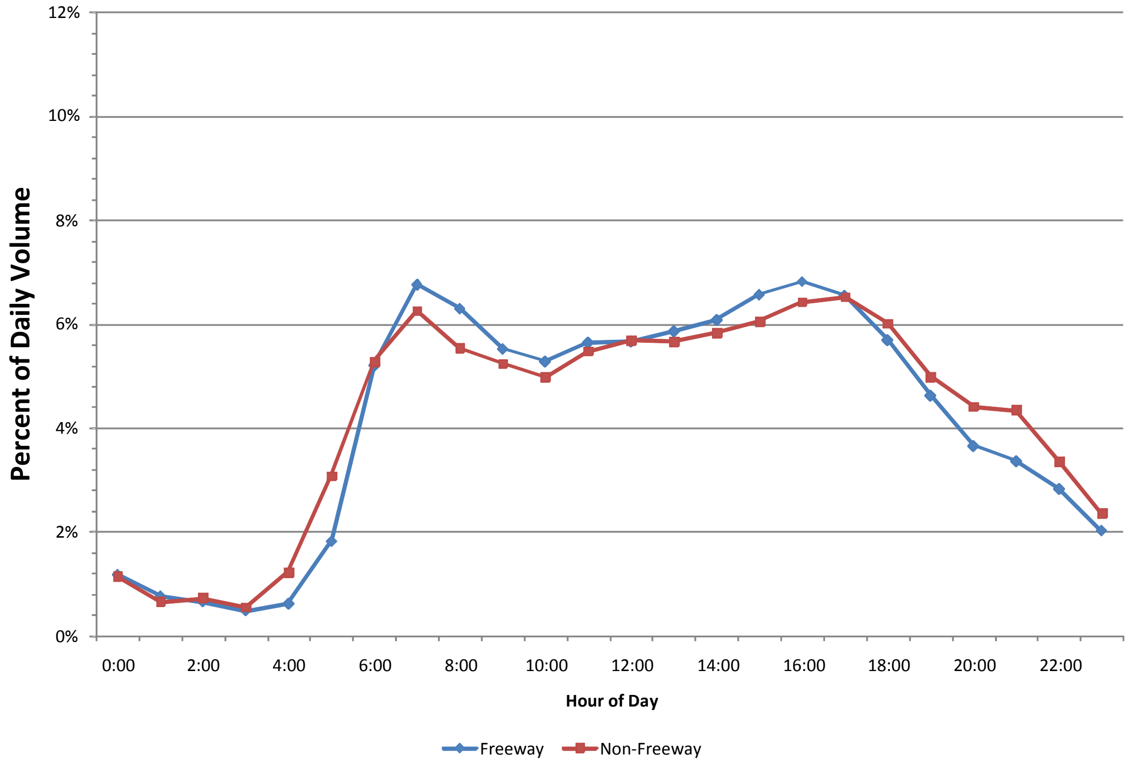


Exhibit 6. Weekday Traffic Distribution Profile for Severe Congestion and Similar Speeds in Each Peak Period



The next step in the traffic flow assignment process is to determine which of the 16 traffic distribution profiles should be assigned to each Traffic Message Channel (TMC) path (the "geography" used by the private sector data providers), such that the hourly traffic flows can be calculated from traffic count data supplied by HPMS. The assignment should be as follows:

- Functional class: assign based on HPMS functional road class
  - Freeway – access-controlled highways
  - Non-freeway – all other major roads and streets

- Day type: assign volume profile based on each day
  - Weekday (Monday through Friday)
  - Weekend (Saturday and Sunday)

- Traffic congestion level: assign based on the peak period speed reduction percentage calculated from the private sector speed data. The peak period speed reduction is calculated as follows: 1) Calculate a simple average peak period speed (add up all the morning and evening peak period speeds and divide the total by the 8 periods in the eight peak hours) for each TMC path using speed data from 6 a.m. to 10 a.m. (morning peak period) and 3 p.m. to 7 p.m. (evening peak period).

2) Calculate a free-flow speed during the light traffic hours (e.g., 10 p.m. to 5 a.m.) to be used as the baseline for congestion calculations.

3) Calculate the peak period speed reduction by dividing the average combined peak period speed by the free-flow speed.

$$\begin{matrix}\text{Speed} \\ \text{Reduction Factor}\end{matrix} = \frac{\begin{matrix}\text{Average Peak} \\ \text{Period Speed}\end{matrix}}{\begin{matrix}\text{Free-Flow Speed} \\ (10\text{ p.m. to } 5\text{ a.m.})\end{matrix}} \qquad \text{(Eq. 1)}$$

For Freeways:

- speed reduction factor ranging from 90% to 100% (no to low congestion)
- speed reduction factor ranging from 75% to 90% (moderate congestion)
- speed reduction factor less than 75% (severe congestion)

For Non-Freeways:

- speed reduction factor ranging from 80% to 100% (no to low congestion)
- speed reduction factor ranging from 65% to 80% (moderate congestion)
- speed reduction factor less than 65% (severe congestion)

- Directionality: Assign this factor based on peak period speed differentials in the private sector speed dataset. The peak period speed differential is calculated as follows:

  1) Calculate the average morning peak period speed (6 a.m. to 10 a.m.) and the average evening peak period speed (3 p.m. to 7 p.m.)

  2) Assign the peak period volume curve based on the speed differential. The lowest speed determines the peak direction. Any section where the difference in the morning and evening peak period speeds is 6 mph or less will be assigned the even volume distribution.

Step 4. Calculate Travel and Time

The hourly speed and volume data was combined to calculate the total travel time for each one hour time period. The one hour volume for each segment was multiplied by the corresponding travel time to get a quantity of vehicle-hours; these were summed across the entire urban area.

Step 5. Establish Free-Flow Travel Speed and Time

The calculation of congestion measures required establishing a congestion threshold, such that delay was accumulated for any time period once the speeds are lower than the congestion threshold. There has been considerable debate about the appropriate congestion thresholds, but for the purpose of the UMR methodology, the data was used to identify the speed at low volume conditions (for example, 10 p.m. to 5 a.m.). This speed is relatively high, but varies according to the roadway design characteristics. An upper limit of 65 mph was placed on the freeway free-flow speed to maintain a reasonable estimate of delay; no limit was placed on the arterial street free-flow speeds.

Step 6. Calculate Congestion Performance Measures

The mobility performance measures were calculated using the equations shown in the next section of this methodology once the one-hour dataset of actual speeds, free-flow travel speeds and traffic volumes was prepared.

Step 7. Estimate Speed Data Where Volume Data Had No Matched Speed Data

The UMR methodology analyzes travel on all freeways and arterial streets in each urban area. In many cases, the arterial streets are not maintained by the state DOT's so they are not included in the roadway network GIS shapefile that is reported in HPMS (all roadway classes will be added to the GIS roadway shapefiles within the next few years by the state DOTs as mandated by FHWA). A technique for handling the unmatched sections of roadway was developed for the 2010 UMR. The percentage of arterial streets that had INRIX speed data match ranged from about 20 to 40 percent across the U.S. while the freeway match percentages ranged from about 80 to 100 percent.

After the original conflation of the volume and speed networks in each urban area was completed, there were unmatched volume sections of roadway and unmatched INRIX speed sections of roadway. After reviewing how much speed data was unmatched in each urban area, it was decided that unmatched data would be handled differently in urban areas over under one million in population versus areas over one million in population.

Areas Under One Million Population

The HPMS volume data for each urban area that was unmatched was separated into freeway and arterial street sections. The HPMS sections of road were divided by each county in which the urban area was located. If an urban area was located in two counties, the unmatched traffic volume data from each county would be analyzed separately. The volume data was then aggregated such that it was treated like one large traffic count for freeways and another for street sections.0.

The unmatched speed data was separated by county also. All of the speed data and freeflow speed data was then averaged together to create a speed profile to represent the unmatched freeway sections and unmatched street sections.

The volume data and the speed data were combined and Steps 1 through 6 were repeated for the unmatched data in these smaller urban areas.

Areas Over One Million Population

In urban areas with populations over one million, the unmatched data was handled in one or two steps depending on the area. The core counties of these urban areas (these include the counties with at least 15 to 20 percent of the entire urban area's VMT) were treated differently because they tended to have more unmatched speed data available than some of the more suburban counties.

In the suburban counties (non-core), where less than 15 or 20 percent of the area's VMT was in a particular county, the volume and speed data from those counties were treated the same as the data in smaller urban areas with populations below one million discussed earlier. Steps 1 through 6 were repeated for the non-core counties of these urban areas.

In each of the core counties, all of the unmatched HPMS sections were gathered and ranked in order of highest traffic density (VMT per lane-mile) down to lowest for both freeways and arterial streets. These sections of roadway were divided into three groups. The top 25 percent of the lane-miles, with highest traffic density, were grouped together into the first set. The next 25 percent were grouped into a second set and the remaining lane-miles were grouped into a third set.

Similar groupings were made with the unmatched speed data for each core county for both functional classes of roadway. The roadway sections of unmatched speed data were ordered from most congested to least congested based on their Travel Time Index value. Since the lane-miles of roadway for these sections were not available with the INRIX speed data, the listing was divided into the same splits as the traffic volume data (25/25/50 percent). (The Travel Time Index was used instead of speed because the TTI includes both free-flow and actual speed).

The volume data from each of the 3 groups was matched with the corresponding group of speed data and steps 1 through 6 were repeated for the unmatched data in the core counties.

Calculation of the Congestion Measures

This section summarizes the methodology utilized to calculate many of the statistics shown in the Urban Mobility Report and is divided into three main sections containing information on the constant values, variables and calculation steps of the main performance measures of the mobility database.

1. **National Constants**
2. **Urban Area Constants and Inventory Values**
3. **Variable and Performance Measure Calculation Descriptions**
    1) Travel Speed
    2) Travel Delay
    3) Annual Person Delay
    4) Annual Delay per Auto Commuter
    5) Annual Peak Period Travel Time
    6) Travel Time Index
    7) Commuter Stress Index
    8) Wasted Fuel
    9) Total Congestion Cost and Truck Congestion Cost
    10) Truck Commodity Value
    11) Roadway Congestion Index
    12) Number of Rush Hours
    13) Percent of Daily and Peak Travel in Congested Conditions
    14) Percent of Congested Travel

Generally, the sections are listed in the order that they will be needed to complete all calculations.

National Constants

The congestion calculations utilize the values in Exhibit 7 as national constants—values used in all urban areas to estimate the effect of congestion.

Exhibit 7. National Congestion Constants for 2011 Urban Mobility Report

Constant	Value
Vehicle Occupancy	1.25 persons per vehicle
Average Cost of Time ($2010)*	$16.30 per person hour[1]
Commercial Vehicle Operating Cost ($2010)	$88.12 per vehicle hour[1, 2]
Working Days (5x50)	250 days
Total Travel Days (7x52)	364 days

[1] Adjusted annually using the Consumer Price Index.

[2] Adjusted periodically using industry cost and logistics data.

*Source: (Reference *7,8*)

Vehicle Occupancy

The average number of persons in each vehicle during peak period travel is 1.25.

Working Days and Weeks

With the addition of the INRIX speed data in the 2011 UMR, the calculations are based on a full year of data that includes all days of the week rather than just the working days. The delay from each day of the week is multiplied by 50 work weeks to annualize the delay. The weekend days are multiplied by 57 to help account for the lighter traffic days on holidays. Total delay for the year is based on 364 total travel days in the year.

Average Cost of Time

The 2010 value of person time used in the report is $16.30 per hour based on the value of time, rather than the average or prevailing wage rate (*7*).

Commercial Vehicle Operating Cost

Truck travel time and operating costs (excluding diesel costs) are valued at $88.12 per hour (*8*).

Urban Area Variables

In addition to the national constants, four urbanized area or state specific values were identified and used in the congestion cost estimate calculations.

Daily Vehicle-Miles of Travel

The daily vehicle-miles of travel (DVMT) is the average daily traffic (ADT) of a section of roadway multiplied by the length (in miles) of that section of roadway. This allows the daily volume of all urban facilities to be presented in terms that can be utilized in cost calculations. DVMT was estimated for the freeways and principal arterial streets located in each urbanized study area. These estimates originate from the HPMS database and other local transportation data sources.

Population, Peak Travelers and Commuters

Population data were obtained from a combination of U.S. Census Bureau estimates and the Federal Highway Administration's Highway Performance Monitoring System (HPMS) (*1,9*). Estimates of peak period travelers are derived from the National Household Travel Survey (NHTS) (*10*) data on the time of day when trips begin. Any resident who begins a trip, by any mode, between 6 a.m. and 10 a.m. or 3 p.m. and 7 p.m. is counted as a peak-period traveler. Data are available for many of the major urban areas and a few of the smaller areas. Averages for areas of similar size are used in cities with no specific data. The traveler estimate for some regions, specifically high tourism areas, may not represent all of the transportation users on an average day. These same data from NHTS was also used to calculate an estimate of commuters who were traveling during the peak periods by private vehicle—a subset of the peak period travelers.

Fuel Costs

Statewide average fuel cost estimates were obtained from daily fuel price data published by the American Automobile Association (AAA) (*11*). Values for gasoline and diesel are reported separately.

Truck Percentage

The percentage of passenger cars and trucks for each urban area was estimated from the Highway Performance Monitoring System dataset (*1*). The values are used to estimate congestion costs and are not used to adjust the roadway capacity.

Variable and Performance Measure Calculation Descriptions

The major calculation products are described in this section. In some cases the process requires the use of variables described elsewhere in this methodology.

Travel Speed

The peak period average travel speeds from INRIX are shown in Exhibit 8 for the freeways and arterial streets. Also shown are the freeflow travel speeds used to calculate the delay-based measures in the report. These speeds are based on the “matched” traffic volume/speeds datasets as well as the “unmatched” traffic volume/speed datasets described in Step 7 of the “Process” description.

Exhibit 8. 2010 Traffic Speed Data

Urban Area	Freeway Peak Speed	Freeway Freeflow Speed	Arterial Streets Peak Speed	Arterial Streets Freeflow Speed	Urban Area	Freeway Peak Speed	Freeway Freeflow Speed	Arterial Streets Peak Speed	Arterial Streets Freeflow Speed
Very Large Areas					Large Areas				
Atlanta GA	56.0	63.3	34.5	42.4	Minneapolis-St. Paul MN	51.4	60.1	35.1	42.1
Boston MA-NH-RI	55.3	62.5	29.8	35.9	Nashville-Davidson TN	57.2	62.1	39.6	46.0
Chicago IL-IN	49.4	58.2	29.0	35.5	New Orleans LA	51.5	60.8	31.1	38.2
Dallas-Fort Worth-Arlington TX	53.0	61.3	31.3	37.4	Orlando FL	57.3	62.5	33.7	40.8
Detroit MI	56.7	61.7	31.4	37.4	Pittsburgh PA	53.5	58.8	41.3	46.6
Houston TX	51.8	61.9	34.7	42.8	Portland OR-WA	48.6	56.5	36.2	42.0
Los Angeles-Long Beach-Santa Ana CA	47.3	60.3	29.9	37.1	Providence RI-MA	56.7	60.8	34.7	38.9
Miami FL	58.3	62.9	32.5	37.8	Raleigh-Durham NC	59.1	63.3	41.0	46.9
New York-Newark NY-NJ-CT	52.3	60.6	32.5	40.8	Riverside-San Bernardino CA	53.8	59.8	34.2	39.8
Philadelphia PA-NJ-DE-MD	55.3	61.5	34.0	40.6	Sacramento CA	53.2	59.6	32.2	38.7
Phoenix AZ	58.1	62.2	37.2	42.6	San Antonio TX	56.3	62.5	37.5	44.5
San Diego CA	55.9	62.3	34.0	40.5	Salt Lake UT	59.2	62.5	50.6	55.1
San Francisco-Oakland CA	51.8	60.5	29.8	36.4	San Jose CA	52.9	61.4	37.3	42.7
Seattle WA	49.1	58.9	30.6	37.0	San Juan PR	55.0	61.7	35.8	39.1
Washington DC-VA-MD	48.2	60.8	33.4	41.5	St. Louis MO-IL	57.4	60.0	35.1	40.3
					Tampa-St. Petersburg FL	60.4	63.8	36.0	42.5
Large Areas					Virginia Beach VA	54.6	60.0	36.9	43.2
Austin TX	48.4	61.2	39.2	49.5					
Baltimore MD	54.0	61.2	34.0	40.9					
Buffalo NY	55.4	58.9	36.4	41.1					
Charlotte NC-SC	56.8	62.2	35.8	42.5					
Cincinnati OH-KY-IN	56.7	59.9	38.8	42.7					
Cleveland OH	56.1	59.3	38.8	42.7					
Columbus OH	58.1	60.5	43.1	48.2					
Denver-Aurora CO	51.1	60.4	31.1	37.3					
Indianapolis IN	41.8	52.7	35.4	39.6					
Jacksonville FL	59.1	61.9	40.4	45.3					
Kansas City MO-KS	57.1	61.4	36.0	40.5					
Las Vegas NV	56.0	61.0	34.7	40.0					
Louisville KY-IN	57.5	60.3	36.0	41.6					
Memphis TN-MS-AR	55.5	59.5	39.8	44.1					
Milwaukee WI	54.1	60.4	39.7	43.2					

Exhibit 8. 2010 Traffic Speed Data, continued

	Freeway		Arterial Streets			Freeway		Arterial Streets	
Urban Area	Peak Speed	Freeflow Speed	Peak Speed	Freeflow Speed	Urban Area	Peak Speed	Freeflow Speed	Peak Speed	Freeflow Speed
Medium Areas					Medium Areas				
Akron OH	58.4	59.2	36.7	40.3	Toledo OH-MI	59.2	60.1	37.5	41.6
Albany-Schenectady NY	59.8	62.0	33.1	38.4	Tucson AZ	60.7	60.0	35.8	41.3
Albuquerque NM	59.5	61.0	42.4	47.5	Tulsa OK	58.4	62.0	50.7	52.7
Allentown-Bethlehem PA-NJ	60.6	61.5	41.4	46.0	Wichita KS	58.3	60.4	45.1	51.3
Bakersfield CA	57.0	58.6	32.8	39.6					
Baton Rouge LA	53.5	61.7	39.5	47.2	Small Areas				
Birmingham AL	58.5	62.3	35.3	43.1	Anchorage AK	59.7	62.9	32.9	39.1
Bridgeport-Stamford CT-NY	51.9	62.0	28.9	34.7	Beaumont TX	60.4	63.5	45.7	50.0
Charleston-North Charleston SC	57.0	61.4	38.8	45.6	Boise ID	58.4	60.4	35.5	41.8
Colorado Springs CO	55.3	59.5	34.4	39.8	Boulder CO	47.1	55.0	31.9	37.6
Dayton OH	59.6	59.9	46.4	48.8	Brownsville TX	61.7	63.5	36.7	43.3
El Paso TX-NM	54.1	60.2	55.0	56.3	Cape Coral FL	67.4	65.0	40.1	46.3
Fresno CA	58.0	58.3	37.0	41.4	Columbia SC	60.9	63.1	32.8	38.3
Grand Rapids MI	60.4	61.0	41.2	46.9	Corpus Christi TX	62.7	64.0	63.0	63.9
Hartford CT	57.3	62.3	38.5	43.8	Eugene OR	54.6	56.8	43.1	46.9
Honolulu HI	0.0	0.0	34.1	41.9	Greensboro NC	59.5	61.5	35.6	41.8
Indio-Cathedral City-Palm Springs CA	58.5	59.5	35.9	38.9	Jackson MS	62.3	63.8	46.8	52.4
Knoxville TN	58.2	59.9	43.7	48.0	Laredo TX	58.1	60.8	32.6	38.6
Lancaster-Palmdale CA	59.7	60.5	43.6	47.9	Little Rock AR	59.8	63.1	33.8	38.4
McAllen TX	59.4	63.4	44.7	48.1	Madison WI	60.5	62.7	44.8	49.2
New Haven CT	59.1	63.0	40.3	47.2	Pensacola FL-AL	63.6	63.3	37.9	43.4
Oklahoma City OK	58.3	61.5	39.3	45.2	Provo UT	58.9	64.2	33.7	38.4
Omaha NE-IA	57.5	59.8	32.5	37.5	Salem OR	55.3	57.1	38.0	41.2
Oxnard-Ventura CA	56.4	60.6	46.3	49.5	Spokane WA	57.6	59.2	29.4	33.2
Poughkeepsie-Newburgh NY	61.5	62.3	42.6	46.8	Stockton CA	58.2	58.6	49.6	51.4
Richmond VA	61.1	62.5	37.1	42.3	Winston-Salem NC	59.4	61.5	38.4	43.7
Rochester NY	58.8	60.9	32.9	39.0	Worcester MA	61.2	62.7	37.5	41.8
Sarasota-Bradenton FL	67.8	65.0	39.0	44.2					
Springfield MA-CT	60.9	62.6	34.6	38.9					

Travel Delay

Most of the basic performance measures presented in the Urban Mobility Report are developed in the process of calculating travel delay—the amount of extra time spent traveling due to congestion. The travel delay calculations have been greatly simplified with the addition of the INRIX speed data. This speed data reflects the effects of both recurring delay (or usual) and incident delay (crashes, vehicle breakdowns, etc.). The delay calculations are performed at the individual roadway section level and for each hour of the week. Depending on the application, the delay can be aggregated into summaries such as weekday peak period, weekend, weekday off-peak period, etc.

$$\begin{array}{c}\text{Daily Vehicle-Hours}\\ \text{of Delay}\end{array} = \left(\frac{\begin{array}{c}\text{DailyVehicle-Miles}\\ \text{of Travel}\end{array}}{\text{Speed}}\right) - \left(\frac{\begin{array}{c}\text{DailyVehicle-Miles}\\ \text{of Travel}\end{array}}{\text{Free-Flow Speed}}\right) \qquad \text{(Eq. 2)}$$

Annual Person Delay

This calculation is performed to expand the daily vehicle-hours of delay estimates for freeways and arterial streets to a yearly estimate in each study area. To calculate the annual person-hours of delay, multiply each day-of-the-week delay estimate by the average vehicle occupancy (1.25 persons per vehicle) and by 50 working weeks per year (Equation 3).

$$\begin{array}{c}\text{Annual}\\ \text{Persons-Hours}\\ \text{of Delay}\end{array} = \begin{array}{c}\text{Daily Vehicle-Hours}\\ \text{of Delay on}\\ \text{Frwys and Arterial Streets}\end{array} \times \begin{array}{c}\text{Annual Conversion}\\ \text{Factor}\end{array} \times \begin{array}{c}\text{1.25 Persons}\\ \text{per Vehicle}\end{array} \qquad \text{(Eq. 3)}$$

Annual Delay per Auto Commuter

Annual delay per auto commuter is a measure of the extra travel time endured throughout the year by auto commuters who make trips during the peak period. The procedure used in the Urban Mobility Report applies estimates of the number of people and trip departure times during the morning and evening peak periods from the National Household Travel Survey (10) to the urban area population estimate to derive the average number of auto commuters and number of travelers during the peak periods (*15*).

The delay calculated for each commuter comes from delay during peak commute times and delay that occurs during other times of the day. All of the delay that occurs during the peak hours of the day (6:00 a.m. to 10:00 a.m. and 3:00 p.m. to 7:00 p.m.) is assigned to the pool of commuters. In addition to this, the delay that occurs outside of the peak period is assigned to the entire population of the urban area. Equation 4 shows how the delay per auto commuter is calculated. The reason that the off-peak delay is also assigned to the commuters is that their trips are not limited to just peak driving times but they also contribute to the delay that occurs during other times of the weekdays and the weekends.

$$\begin{matrix}\text{Delay per}\\\text{Auto Commuter}\end{matrix} = \left(\frac{\text{Peak Period Delay}}{\text{Auto Commuters}}\right) + \left(\frac{\text{Remaining Delay}}{\text{Population}}\right) \qquad \text{(Eq. 4)}$$

Annual Peak Period Major Road Travel Time

Total travel time can be used as both a performance measure and as a component in other calculations. The 2010 Urban Mobility Report used travel time as a component; future reports will incorporate other information and expand on the use of total travel time as a performance measure.

Total travel time is the sum of travel delay and free-flow travel time. Both of the quantities are only calculated for freeways and arterial streets. Free-flow travel time is the amount of time needed to travel the roadway section length at the free-flow speeds (provided by INRIX for each roadway section) (Equation 5).

$$\begin{matrix}\text{Annual Free-Flow}\\\text{Travel Time}\\\text{(Vehicle-Hours)}\end{matrix} = \frac{1}{\begin{matrix}\text{Free-Flow}\\\text{Travel Speed}\end{matrix}} \times \begin{matrix}\text{Daily}\\\text{Vehicle-Miles}\\\text{of Travel}\end{matrix} \times \begin{matrix}\text{Annual}\\\text{Conversion}\\\text{Factor}\end{matrix} \qquad \text{(Eq. 5)}$$

$$\begin{matrix}\text{Annual}\\\text{Travel Time}\end{matrix} = \underbrace{\left(\begin{matrix}\text{Freeway}\\\text{Delay}\end{matrix} + \begin{matrix}\text{Arterial}\\\text{Street Delay}\end{matrix}\right)}_{\text{(Eq. 3)}} + \underbrace{\left(\begin{matrix}\text{Freeway}\\\text{Free-Flow}\\\text{Travel Time}\end{matrix} + \begin{matrix}\text{Arterial}\\\text{Free-Flow}\\\text{Travel Time}\end{matrix}\right)}_{\text{(Eq. 5)}} \qquad \text{(Eq. 6)}$$

Travel Time Index

The Travel Time Index (TTI) compares peak period travel time to free-flow travel time. The Travel Time Index includes both recurring and incident conditions and is, therefore, an estimate of the conditions faced by urban travelers. Equation 5 illustrates the ratio used to calculate the TTI. The ratio has units of time divided by time and the Index, therefore, has no units. This “unitless” feature allows the Index to be used to compare trips of different lengths to estimate the travel time in excess of that experienced in free-flow conditions.

The free-flow travel time for each functional class is subtracted from the average travel time to estimate delay. The Travel Time Index is calculated by comparing total travel time to the free-flow travel time (Equations 7 and 8).

$$\text{Travel Time Index} = \frac{\text{Peak Travel Time}}{\text{Free-Flow Travel Time}} \qquad \text{(Eq. 7)}$$

$$\text{Travel Time Index} = \frac{\text{Delay Time} + \text{Free-Flow Travel Time}}{\text{Free-Flow Travel Time}} \qquad \text{(Eq. 8)}$$

Commuter Stress Index

The Commuter Stress Index (CSI) is the same as the TTI except that it includes only the travel in the peak directions during the peak periods; the TTI includes travel in all directions during the peak period. Thus, the CSI is more indicative of the work trip experienced by each commuter on a daily basis.

Wasted Fuel

The average fuel economy calculation is used to estimate the difference in fuel consumption of the vehicles operating in congested and uncongested conditions. Equations 9 and 10 are the regression equations resulting from fuel efficiency data from EPA/FHWA's MOVES model (*16*).

$$\begin{matrix}\text{Passenger Car}\\ \text{Fuel Economy}\end{matrix} = -0.0066 \times (\text{speed})^2 + 0.823 \times (\text{speed}) + 6.1577 \qquad \text{(Eq. 9)}$$

$$\begin{matrix}\text{Truck Fuel}\\ \text{Economy}\end{matrix} = 1.4898 \text{ x } \text{In}(\text{speed}) - 0.2554 \qquad \text{(Eq. 10)}$$

The Urban Mobility Report calculates the wasted fuel due to vehicles moving at speeds slower than free-flow throughout the day. Equation 11 calculates the fuel wasted in delay conditions from Equation 3, the average hourly speed, and the average fuel economy associated with the hourly speed (Equation 9 and 10).

$$\frac{\text{Annual}}{\text{Fuel Wasted}} = \begin{matrix}\text{Travel Time}\\ \text{(vehicle hours)}\\ \text{(Eq. 5)}\end{matrix} \times \begin{matrix}\text{Average Hourly}\\ \text{Speed}\\ \text{(Eq. 2)}\end{matrix} \div \begin{matrix}\text{Average Fuel}\\ \text{Economy}\\ \text{(Eq. 9,10)}\end{matrix} \times \begin{matrix}\text{Annual}\\ \text{Conversion Factor}\end{matrix} \qquad \text{(Eq. 11)}$$

Equation 12 incorporates the same factors to calculate fuel that would be consumed in free-flow conditions. The fuel that is deemed "wasted due to congestion" is the difference between the amount consumed at peak speeds and free-flow speeds (Equation 11).

$$\begin{matrix}\text{Annual Fuel}\\ \text{Consumed in}\\ \text{Free-Flow Conditions}\end{matrix} = \begin{matrix}\text{Travel Time}\\ \text{(Eq. 5)}\end{matrix} \times \begin{matrix}\text{Free-Flow Speed}\\ \text{from INRIX Data}\end{matrix} \div \begin{matrix}\text{Average Fuel}\\ \text{Economy for}\\ \text{Free-Flow Speeds}\\ \text{(Eq. 9,10)}\end{matrix} \times \begin{matrix}\text{Annual}\\ \text{Conversion}\\ \text{Factor}\end{matrix} \qquad \text{(Eq. 12)}$$

$$\begin{matrix}\text{Annual Fuel}\\ \text{Wasted in Congestion}\end{matrix} = \begin{matrix}\text{Annual Fuel}\\ \text{Consumed in}\\ \text{Congestion}\end{matrix} - \begin{matrix}\text{Annual Fuel That}\\ \text{Would be Consumed}\\ \text{in Free-flow Conditions}\end{matrix} \qquad \text{(Eq. 13)}$$

Total Congestion Cost and Truck Congestion Cost

Two cost components are associated with congestion: delay cost and fuel cost. These values are directly related to the travel speed calculations. The following sections and Equations 14 through 16 show how to calculate the cost of delay and fuel effects of congestion.

Passenger Vehicle Delay Cost. The delay cost is an estimate of the value of lost time in passenger vehicles in congestion. Equation 14 shows how to calculate the passenger vehicle delay costs that result from lost time.

$$\begin{matrix}\text{Annual Psgr-Veh}\\ \text{Delay Cost}\end{matrix} = \begin{matrix}\text{Daily Psgr Vehicle}\\ \text{Hours of Delay}\\ \text{(Eq. 4)}\end{matrix} \times \begin{matrix}\text{Value of}\\ \text{Person Time}\\ \text{(\$ / hour)}\end{matrix} \times \begin{matrix}\text{Vehicle}\\ \text{Occupancy}\\ \text{(pers/vehicle)}\end{matrix} \times \begin{matrix}\text{Annual}\\ \text{Conversion}\\ \text{Factor}\end{matrix} \qquad \text{(Eq. 14)}$$

Passenger Vehicle Fuel Cost. Fuel cost due to congestion is calculated for passenger vehicles in Equation 15. This is done by associating the wasted fuel, the percentage of the vehicle mix that is passenger, and the fuel costs.

$$\begin{matrix}\text{Annual} \\ \text{Fuel Cost}\end{matrix} = \begin{matrix}\text{Daily Fuel} \\ \text{Wasted} \\ \text{(Eq. 13)}\end{matrix} \times \begin{matrix}\text{Percent of} \\ \text{Passenger} \\ \text{Vehicles}\end{matrix} \times \begin{matrix}\text{Gasoline} \\ \text{Cost}\end{matrix} \times \begin{matrix}\text{Annual} \\ \text{Conversion Factor}\end{matrix} \qquad \text{(Eq. 15)}$$

Truck or Commercial Vehicle Delay Cost. The delay cost is an estimate of the value of lost time in commercial vehicles and the increased operating costs of commercial vehicles in congestion. Equation 16 shows how to calculate the passenger vehicle delay costs that result from lost time.

$$\begin{matrix}\text{Annual Comm-Veh} \\ \text{Delay Cost}\end{matrix} = \begin{matrix}\text{Daily Comm Vehicle} \\ \text{Hours of Delay} \\ \text{(Eq. 4)}\end{matrix} \times \begin{matrix}\text{Value of} \\ \text{Comm Vehicle Time} \\ \text{(\$ / hour)}\end{matrix} \times \begin{matrix}\text{Annual} \\ \text{Conversion} \\ \text{Factor}\end{matrix} \qquad \text{(Eq. 16)}$$

Truck or Commercial Vehicle Fuel Cost. Fuel cost due to congestion is calculated for commercial vehicles in Equation A-16. This is done by associating the wasted fuel, the percentage of the vehicle mix that is commercial, and the fuel costs.

$$\begin{matrix}\text{Annual} \\ \text{Fuel Cost}\end{matrix} = \begin{matrix}\text{Daily Fuel} \\ \text{Wasted} \\ \text{(Eq. 13)}\end{matrix} \times \begin{matrix}\text{Percent of} \\ \text{Commercial} \\ \text{Vehicles}\end{matrix} \times \begin{matrix}\text{Diesel} \\ \text{Cost}\end{matrix} \times \begin{matrix}\text{Annual} \\ \text{Conversion Factor}\end{matrix} \qquad \text{(Eq. 17)}$$

Total Congestion Cost. Equation 18 combines the cost due to travel delay and wasted fuel to determine the annual cost due to congestion resulting from incident and recurring delay.

$$\begin{matrix}\text{Annual Cost} \\ \text{Due to} \\ \text{Congestion}\end{matrix} = \left(\begin{matrix}\text{Annual Passenger} \\ \text{Vehicle Delay Cost} \\ \text{(Eq. 14)}\end{matrix} + \begin{matrix}\text{Annual Passenger} \\ \text{Fuel Cost} \\ \text{(Eq. 15)}\end{matrix} \right) + \begin{matrix}\text{Annual Comm} \\ \text{Veh Delay Cost} \\ \text{(Eq. 16)}\end{matrix} + \begin{matrix}\text{Annual Comm} \\ \text{Veh Fuel Cost} \\ \text{(Eq. 17)}\end{matrix} \qquad \text{(Eq. 18)}$$

Truck Commodity Value

The data for this performance measure came from the Freight Analysis Framework (FAF) and the Highway Performance Monitoring System (HPMS) from the Federal Highway Administration. The basis of this measure is the integration of the commodity value supplied by FAF and the truck vehicle-miles of travel (VMT) calculated from the HPMS roadway inventory database.

There are 5 steps involved in calculating the truck commodity value for each urban area.

1. Calculate the national commodity value for all truck movements
2. Calculate the HPMS truck VMT percentages for states, urban areas and rural roadways

3. Estimate the state and urban commodity values using the HPMS truck VMT percentages
4. Calculate the truck commodity value of origins and destinations for each urban area
5. Average the VMT-based commodity value with the origin/destination-based commodity value for each urban area.

Step 1 - National Truck Commodity Value. The FAF (version 3) database has truck commodity values that originate and end in 131 regions of the U.S. The database contains a 131 by 131 matrix of truck goods movements (tons and dollars) between these regions. Using just the value of the commodities that originate within the 131 regions, the value of the commodities moving within the 131 regions is determined (if the value of the commodities destined for the 131 regions was included also, the commodity values would be double-counted). The FAF database has commodity value estimates for different years. The base year for FAF-3 is 2007 with estimates of commodity values in 2010 through 2040 in 5-year increments. The 2008 and 2009 commodity value was estimated using a constant percentage growth trend between the 2007 and 2010 FAF values.

Step 2 – Truck VMT Percentages. The HPMS state truck VMT percentages are calculated in Equation 19 using each state's estimated truck VMT and the national truck VMT. This percentage will be used to approximate total commodity value at the state level.

$$\begin{matrix}\text{State Truck}\\\text{VMT Percentage}\end{matrix} = \left(\frac{\text{State Truck VMT}}{\text{U.S. Truck VMT}}\right) \times 100\% \qquad \text{(Eq. 19)}$$

The urban percentages within each state are calculated similarly, but with respect to the state VMT. The equation used for the urban percentage is given in Equation 20. The rural truck VMT percentage for each state is shown in Equation 21.

$$\begin{matrix}\text{State Urban}\\\text{Truck VMT Percentage}\end{matrix} = \left(\frac{\begin{matrix}\text{State Urban}\\\text{Truck VMT}\end{matrix}}{\begin{matrix}\text{State Truck}\\\text{VMT}\end{matrix}}\right) \times 100\% \qquad \text{(Eq. 20)}$$

$$\begin{matrix}\text{State Rural Truck}\\\text{VMT Percentage}\end{matrix} = 100\% - \begin{matrix}\text{State Urban Truck}\\\text{VMT Percentage}\end{matrix} \qquad \text{(Eq. 21)}$$

The urban area truck VMT percentage is used in the final calculation. The truck VMT in each urban area in a given state is divided by all of the urban truck VMT for the state (Equation 20).

$$\text{Urban Area Truck VMT Percentage} = \left(\frac{\text{Urban Area Truck VMT}}{\text{State Urban Truck VMT}} \right) \qquad \text{(Eq. 22)}$$

Step 3 – Estimate State and Urban Area VMT from Truck VMT percentages. The national estimate of truck commodity value from Step 1 is used with the percentages calculated in Step 2 to assign a VMT-based commodity value to the urban and rural roadways within each state and to each urban area.

$$\text{State Urban Truck VMT-Based Commodity Value} = \text{U.S. Truck Commodity Value} \times \text{State Urban Truck Percentage} \qquad \text{(Eq. 23)}$$

$$\text{State Rural Truck VMT-Based Commodity Value} = \text{U.S. Truck Commodity Value} \times \text{State Rural Truck Percentage} \qquad \text{(Eq. 24)}$$

$$\text{Urban Area Truck VMT-Based Commodity Value} = \text{State Urban Truck VMT-Based Commodity Value} \times \text{Urban Area Truck VMT Percentage} \qquad \text{(Eq. 25)}$$

Step 4 – Calculate Origin/Destination-Based Commodity Value. The results in Step 3 show the commodity values for the U.S. distributed based on the truck VMT flowing through states in both rural portions and urban areas. The Step 3 results place equal weighting on a truck mile in a rural area and a truck mile in an urban area. Step 4 redistributes the truck commodity values with more emphasis placed on the urban regions where the majority of the truck trips were originating or ending.

The value of commodities with trips that began or ended in each of the 131 FAF regions was calculated and the results were combined to get a total for the U.S. The percentage of the total U.S. origin/destination-based commodity values corresponding to each of the FAF regions, shown in Equations 26 and 27, was calculated and these percentages were used to redistribute the national freight commodity value estimated in Step 1 that were based only on the origin-based commodities. Equation 28 shows that this redistribution was first done at the state level by summing the FAF regions within each state. After the new state commodity values were calculated, the commodity values were assigned to each urban area within each state based on the new percentages calculated from the origin/destination-based commodity data. Urban areas not included in a FAF region were assigned a commodity value based on their truck VMT relative to all the truck VMT which remained unassigned to a FAF region (Equation 29).

$$\begin{matrix}\text{FAF Region}\\ \text{O/D-Based Commodity Value \%}\end{matrix} = \left(\frac{\begin{matrix}\text{FAF Region}\\ \text{O/D-Based Commodity Value}\end{matrix}}{\begin{matrix}\text{U.S. O/D-Based}\\ \text{Commodity Value}\end{matrix}}\right) \times 100\% \qquad \text{(Eq. 26)}$$

$$\begin{matrix}\text{FAF Region O/D-Based}\\ \text{Commodity Value}\end{matrix} = \begin{matrix}\text{FAF Region O/D-Based}\\ \text{Commodity Value \%}\end{matrix} \times \begin{matrix}\text{U.S. O/D-Based}\\ \text{Commodity Value}\end{matrix} \qquad \text{(Eq. 27)}$$

$$\begin{matrix}\frac{\text{O}}{\text{D}}\text{-Based}\\ \text{Commodity Value for State 1}\end{matrix} = \begin{matrix}\text{FAF Region 1}\\ \text{Value from State 1}\end{matrix} + \begin{matrix}\text{FAF Region 2}\\ \text{Value from State 1}\end{matrix} \qquad \text{(Eq. 28)}$$

$$\begin{matrix}\text{Non-FAF Region}\\ \text{Urban Area O/D-Based}\\ \text{Commodity Value from State 1}\end{matrix} = \begin{matrix}\text{Remaining Unassigned}\\ \text{State 1 FAF O/D-Based}\\ \text{Commodity Value}\end{matrix} \times \left(\frac{\begin{matrix}\text{Non-FAF Urban Area Truck}\\ \text{VMT Percentage}\end{matrix}}{\begin{matrix}\text{Remaining Unassigned State 1}\\ \text{Truck VMT Percentage}\end{matrix}}\right) \qquad \text{(Eq. 29)}$$

Step 5 – Final Commodity Value for Each Urban Area. The VMT-based commodity value and the O/D-based commodity value were averaged for each urban area to create the final commodity value to be presented in the Urban Mobility Report.

$$\begin{matrix}\text{Final Commodity}\\ \text{Value for}\\ \text{Urban Area}\end{matrix} = \left(\begin{matrix}\text{Urban Area}\\ \text{VMT-Based}\\ \text{Commodity Value}\end{matrix} + \begin{matrix}\text{Urban Area}\\ \text{O/D-Based}\\ \text{Commodity Value}\end{matrix}\right) \div 2 \qquad \text{(Eq. 30)}$$

Roadway Congestion Index

Early versions of the Urban Mobility Report used the roadway congestion index as a primary measure. While other measures that define congestion in terms of travel time and delay have replaced the RCI, it is still a useful performance measure in some applications. The RCI measures the density of traffic across the urban area using generally available data. Urban area estimates of vehicle-miles of travel (VMT) and lane-miles of roadway (Ln-Mi) are combined in a ratio using the amount of travel on each portion of the system. The combined index measures conditions on the freeway and arterial street systems according to the amount of travel on each type of road (Eq. 31). This variable weighting factor allows comparisons between areas that carry different percentages of regional vehicle travel on arterial streets and freeways. The resulting ratio indicates an undesirable level of areawide congestion if the index value is greater than or equal to 1.0.

The traffic density ratio (VMT per lane-mile) is divided by a value that represents congestion for a system with the same mix of freeway and street volume. The RCI is, therefore, a measure of both intensity and duration of congestion. While it may appear that the travel volume factors (e.g., freeway VMT) on the top and bottom of the equation cancel each other, a sample calculation should satisfy the reader that this is not the case.

$$\begin{matrix}\text{Roadway}\\\text{Congestion}\\\text{Index}\end{matrix} = \frac{\begin{matrix}\text{Freeway}\\\text{VMT/Ln. Mi.}\end{matrix} \times \begin{matrix}\text{Freeway}\\\text{VMT}\end{matrix} + \begin{matrix}\text{Prin Art Str}\\\text{VMT/Ln. Mi.}\end{matrix} \times \begin{matrix}\text{Prin Art Str}\\\text{VMT}\end{matrix}}{14{,}000 \times \begin{matrix}\text{Freeway}\\\text{VMT}\end{matrix} + 5{,}000 \times \begin{matrix}\text{Prin Art Str}\\\text{VMT}\end{matrix}} \qquad \text{(Eq. 31)}$$

An Illustration of Travel Conditions When an Urban Area RCI Equals 1.0

The congestion index is a macroscopic measure which does not account for local bottlenecks or variations in travel patterns that affect time of travel or origin-destination combinations. It also does not include the effect of improvements such as freeway entrance ramp signals, or treatments designed to give a travel speed advantage to transit and carpool riders. The urban area may see several of the following effects:

- Typical commute time 25% longer than off-peak travel time.
- Slower moving traffic during the peak period on the freeways, but not sustained stop-and-go conditions.
- Moderate congestion for 1 1/2 to 2 hours during each peak-period.
- Wait through one or two red lights at heavily traveled intersections.
- The RCI includes the effect of roadway expansion, demand management, and vehicle travel reduction programs.
- The RCI does not include the effect of operations improvements (e.g., clearing accidents quickly, regional traffic signal coordination), person movement efficiencies (e.g., bus and carpool lanes) or transit improvements (e.g., priority at traffic signals).
- The RCI does not address situations where a traffic bottleneck means much less capacity than demand over a short section of road (e.g., a narrow bridge or tunnel crossing a harbor or river), or missing capacity due to a gap in the system.
- The urban area congestion index averages all the developments within an urban area; there will be locations where congestion is much worse or much better than average.

Number of "Rush Hours"

The length of time each day that the roadway system contains congestion is presented as the number of "rush hours" of traffic. This measure is calculated differently than under previous methodologies. The average Travel Time Index is calculated for each urban area for each hour of the average weekday. The TTI for each hour of the day and the population of the urban area determ*ine the number of "rush hours".*

For each hour of the average weekday in each urban area, the TTI values are analyzed with the criteria in Exhibit 9. For example, if the TTI value meets the highest criteria, the entire hour is considered congested. The TTI values in these calculations are based on areawide statistics. In order to be considered a "rush hour" the amount of congestion has to meet a certain level of congestion to be considered areawide. In the case of Very Large urban areas, the minimum TTI value for a portion of an hour to be considered congested is 1.12.

Exhibit 9. Estimation of Rush Hours

Population Group	TTI Range	Number of Hours of Congestion
Very Large	Over 1.22	1.00
	1.17-1.22	0.50
	1.12-1.17	0.25
	Under 1.12	0.00
Large	Over 1.20	1.00
	1.15-1.20	0.50
	1.10-1.15	0.25
	Under 1.10	0.00
Medium/Small	Over 1.17	1.00
	1.12-1.17	0.50
	1.07-1.12	0.25
	Under 1.07	0.00

The following two measures are not based on the INRIX speeds and the new methodology. Due to some low match rates in some of the urban areas between the INRIX speed network and the HPMS roadway inventory data and because we currently use hourly speed and volume data instead of 15-minute, these measures are based on the previous methodology with estimated speeds. In the future as the match rate improves, these measures will be based on the new methodology with measured speeds.

Percent of Daily and Peak Travel in Congested Conditions

Traditional peak travel periods in urban areas are the morning and evening “rush hours” when slow speeds are most likely to occur. The length of the peak period is held constant—essentially the most traveled four hours in the morning and evening—but the amount of the peak period that may suffer congestion is estimated separately. Large urban areas have peak periods that are typically longer than smaller or less congested areas because not all of the demand can be handled by the transportation network during a single hour. The congested times of day have increased since the start of the UMR.

These percentages have been estimated again for the 2010 UMR. The historical measured speed data will make it possible in future reports to calculate the travel that occurs at a speed that is under a certain congestion threshold speed. However, in this report, the travel percentages were estimated using the process described below as changes to the methodology were not incorporated prior to this release.

Exhibit 10 illustrates the estimation procedure used for all urban areas. The UMR procedure uses the Roadway Congestion Index (RCI)—a ratio of daily traffic volume to the number of lane-miles of arterial street and freeway—to estimate the length of the peak period. In this application, the RCI acts as an indicator of the number of hours of the day that might be affected by congested conditions (a higher RCI value means more traffic during more hours of the day). Exhibit 10 illustrates the process used to estimate the amount of the day (and the amount of travel) when travelers might encounter congestion. Travel during the peak period, but outside these possibly congested times, is considered uncongested and is assigned a free-flow speed. The maximum percentage of daily travel that can be in congestion is 50 percent which is also the maximum amount of travel that can occur in the peak periods of the day. The percentage of peak period travel that is congested comes from the 50 percent of travel that is assigned to the peak periods.

Exhibit 10. Percent of Daily Travel in Congested Conditions

Percent of Congested Travel

The percentage of travel in each urban area that is congested both for peak travel and daily travel can be calculated. The equations are very similar with the only difference being the amount of travel in the denominator. For calculations involving only the congested periods (Equations 32 and 33), the amount of travel used is half of the daily total since the assumption is made that only 50 percent of daily travel occurs in the peak driving times. For the daily percentage (Equation 34), the factor in the denominator is the daily miles of travel.

$$\begin{matrix}\text{Peak Period}\\\text{Congested Travel}\end{matrix} = \begin{matrix}\text{Percent of Congested}\\\text{Peak Period Travel}\end{matrix} \times \begin{matrix}\text{VMT for}\\\text{Roadway Type}\end{matrix} \qquad \text{(Eq. 32)}$$

$$\begin{matrix}\text{Percent Congested}\\\text{Peak Period Travel}\end{matrix} = \begin{matrix}\text{Percent Congested}\\\text{Daily Travel}\end{matrix} \div 50\text{ percent} \qquad \text{(Eq. 33)}$$

$$\begin{matrix}\text{Percent Congested}\\\text{Daily Travel}\end{matrix} = \frac{\begin{matrix}\text{Freeway}\\\text{Congested Travel}\end{matrix} + \begin{matrix}\text{Arterial}\\\text{Congested Travel}\end{matrix}}{\text{Daily Travel}} \qquad \text{(Eq. 34)}$$

APPENDIX C—TTI'S 2011 CONGESTED CORRIDORS REPORT

This appendix includes the 2011 Congested Corridors Report which was released on November 15, 2011. See website http://mobility.tamu.edu/corridors.

TTI's 2011 CONGESTED CORRIDORS REPORT
Powered by INRIX Traffic Data

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2011 Congested Corridors Report

http://mobility.tamu.edu/corridors

Congestion is a significant problem in America's urban areas. This is well documented in the Texas Transportation Institute's *Urban Mobility Report* (*1*). Powered by 2010 INRIX traffic data, the *2011 Congested Corridors Report* includes analysis along 328 specific (directional) freeway corridors in the United States. These corridors include many of the worst places for congestion in the United States, and the detailed data allow for more extensive analysis and a better picture of the locations, times and effects of stop-and-go traffic. The report doesn't list every bad location for congestion, but the issues explored here advance the understanding of when, how and where congestion occurs.

What did we find?

The 328 directional corridors account for:

- 6 percent of the national urban freeway lane-miles
- 36 percent of the urban freeway delay with only 10 percent of the national urban freeway vehicle-miles of travel
- 33 percent of the urban freeway truck delay with only 8 percent of the national urban freeway truck vehicle-miles of travel

These roads have more stop-and-go traffic than others, but perhaps more frustrating, it is also difficult to predict how much time the trips will take. For important trips, this forces motorists and truckers to plan much more time to ensure they will not be late.

What are the purposes of this report?

- We show congestion levels along specific corridors— the level where transportation improvements are determined. The very detailed hour-by-hour data shows when and where congestion occurs.
- We can suggest how much extra "buffer" time to allow. In addition to average congestion conditions, we include performance measures that describe the unreliability of congested corridors. While you know how long a trip will take on average, what about those days that you have to be on time? This report has a measure for that!

How did we perform the analysis?

We let the data tell these stories; we investigated all freeways and highways in the United States looking for traffic problems. As first explored in the *2010 INRIX National Traffic Scorecard* (*2*), a short directional roadway segment (less than 1 mile) with congestion for more than 10 hours in a week was the beginning of a congested corridor. ("Congestion" was having a speed less than half of the free-flow speed). Each directional, adjacent and upstream segment of roadway that was congested for 4 hours per week was included in the corridor. Four hours was chosen as the threshold after reviewing the data which showed that many upstream segments had some congestion nearly every weekday. Since it typically did not constitute every day of the week, choosing four hours allows one day per week to have a different queuing pattern. A minimum corridor length was set at 3 miles. This resulted in 328 directional freeway corridors. We combined traffic volume information from the states with the speed data to compute the performance measures along these corridors.

What measures are included?
The *2011 Congested Corridors Report* measures the extra travel time, increased fuel consumption and the congestion costs; it also measures the reliability problem — how much the congestion problems change from day to day. Tables illustrate the corridors with the most congestion or the worst reliability all day, in the morning, the mid-day, in the afternoon or on the weekends. The measures show conditions for all traffic and for trucks.

Can you tell me more about reliability?
A predictable transportation system is important to motorists and goods movers. Reliability describes the extra time you add to a trip to ensure you will be on time. Reliability is important if you have to be on time for work, to catch an airplane, to pick up a child at daycare, to ensure just-in-time deliveries are made—any trip when you simply can't be late. We all make important trips, and we add additional time over what a trip takes on a typical day so that we know we will make it on time. Reliability performance measures illustrate the variability in traffic congestion so that we can estimate the extra "buffer" time we need to add to be sure we are on time.

At the national level, the Federal Highway Administration (FHWA) is moving towards a greater focus on performance management in its programs. FHWA's Office of Operations has been focusing on supporting system reliability, and specifically, the use of travel-time based reliability measures (*3*). Many state departments of transportation (DOTs) and metropolitan planning organizations (MPOs) are investigating the use of reliability measures. Some examples of FHWA's efforts supporting reliability measures are documented in:

- *2010 Urban Congestion Trends: Enhancing System Reliability with Operations*—produced annually to identify urban congestion trends (*3*), and
- *Urban Congestion Reports*—produced on a quarterly basis to characterize congestion and reliability trends both nationally and at the city level (*4*).
- *Travel Time Reliability: Making It There on Time, All the Time*—describes reliability measures and applications (*5*).

The *2011 Congested Corridors Report* highlights the use of similar congestion and reliability measures.

What can we do to fix these congestion problems?
We suggest that implementing congestion solutions would start at the "to" end of the corridors identified in the tables of this report; that's close to where the bottleneck is and where solutions would be most effective.

Once the start of the problem is located, the next step is identifying the types of congestion problems and when they occur. There are many types of congestion problems—too many travelers, not enough roads, buses, or rail capacity; crashes and stalled vehicles; or special events, to name a few. Each of these problems has different solutions.

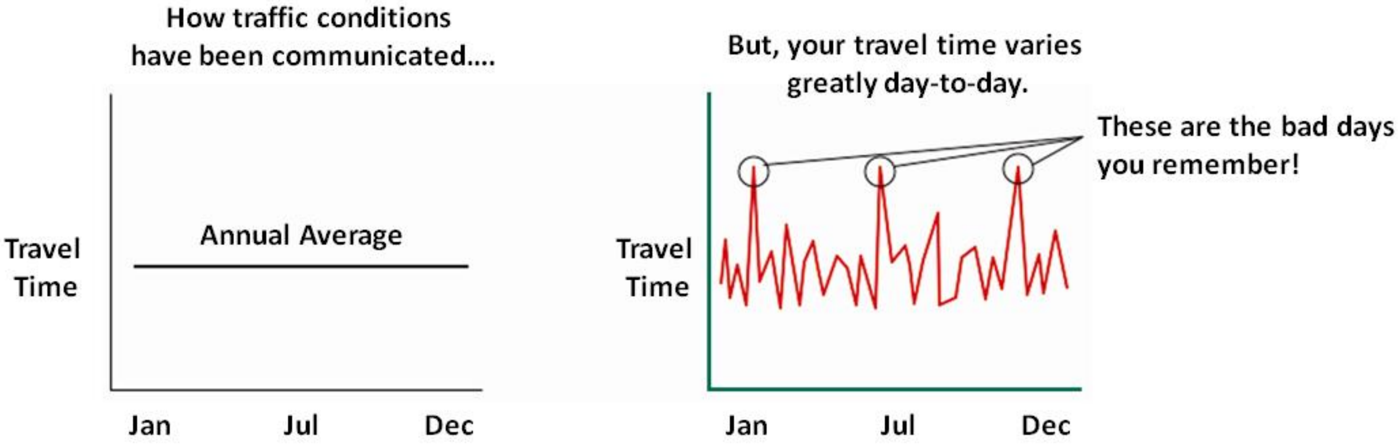
As far as solutions go, there are many ways to address congestion problems identified on these specific corridors; the *Urban Mobility Report* data show that there is still work to do. The most effective strategy is one where agency actions are **complemented** by efforts of businesses, manufacturers, commuters and travelers. There is no **rigid prescription** for the "best way"—**each region** must identify the projects, programs and policies that achieve goals, solve problems and capitalize on opportunities.

Travel Time Reliability
Concepts and Measures

"I've got to get to work on time today or Mr. NoLeeway will surely fire me!"
"If this delivery is late, the assembly line will shut down!"
"If I don't get to the daycare by 5:30 to pick up Zach, Ms. Timely will make me pay extra again!"
"I can't miss the start of my daughter's soccer game!"

Any of these sound familiar? We've all made urgent trips. Motorists and truckers make them every day. For trips that are not urgent, you have an expectation of how long it will take you to get there. On your daily commute trips, this is the average time it takes you based on your past experiences. For more urgent trips, you will add extra time to your average trip time to ensure you get there on time. That extra time "buffer" is what reliability performance measures are designed to help us understand.

As shown in the graphic below, your travel time can vary greatly from day to day. The "bad days" (very unreliable) are the ones you will remember. That's the day there was a crash, several stalled vehicles, a snowstorm, or construction that made the trip take much longer. When you have an urgent trip, you will use these "bad days" to help you estimate the extra buffer time you need to guarantee you get there on time.



Source: Federal Highway Administration (4)

The travel time index (TTI) is a congestion measure that captures average congestion levels. It compares travel conditions in the peak period to travel conditions during free-flow conditions. For example, a TTI of 1.50 means that a trip that takes 20-minutes in light traffic will take 30 minutes (on average) in the peak period (20 minutes x 1.50 = 30 minutes).

We estimated reliability using 2 measures—the planning time index and the buffer index. With the INRIX speed data, we captured travel time values for every hour of every weekday (say 7 to 8 am); the reliability measures show the amount of variation in travel time between those weekdays.

The planning time index (PTI) represents the total travel time that you should plan for a trip. It differs from the BI in that it includes typical delay as well as unexpected delay. For example, a PTI of 2.25 means that for a 20-minute trip in light traffic, 45 minutes should be planned (20 minutes x 2.25 = 45 minutes).

Both the TTI and PTI measure congestion relative to free-flow conditions.

The buffer index (BI) is a measure of trip reliability that expresses the amount of extra “buffer” time needed to be on time for 95 percent of trips (e.g., the time you would need to add to the average travel time so that you are only late for 1 trip out of 20). The BI is expressed as a percentage. For example, a BI of 50 percent means that for a trip that usually takes 30 minutes, you should plan for an extra 15 minutes of “buffer time” (30 minutes x 50% = 15 minutes). The BI identifies how much extra time you need to add to your average trip time.

The Detailed Methodology section of Appendix C provides a brief summary of the methodology used to compute of all the congestion measures used in this report.

The Congested Corridor Rankings

The analysis is performed using several types of measures to examine the various congestion problems.

- **Total measures** (including hours of delay, gallons of fuel wasted, and congestion cost) are calculated on an hourly basis for each day of the week and then annualized by multiplying by 52 weeks.
- **Peak measures** (including peak period delay, buffer index, planning time index, travel time index) are based on travel during the peak period times (6 to 10 am and 3 to 7 pm).

Delay per mile is the primary ranking measure because the corridors in this analysis vary a great deal in length. This measure allows corridors of different lengths to be compared because this measure focuses on the intensity of the delay. The magnitude of the congestion problems in each corridor are further described with the total gallons of wasted fuel and the total congestion cost.

Several tabular groupings were created to show that the corridors in the study have different peaking characteristics. For example, some corridors have a greater proportion of their daily delay in the morning peak period, while others have more delay occurring on the weekend. The following tables are included in this report to show these various characteristics:

- Table 1 – Reliably Unreliable (top 40 corridors ranked by buffer index)
- Table 2 – Congestion Leaders (top 40 corridors ranked by delay per mile)
- Table 3 – 3-cup Mornings (top 40 corridors for morning peak period delay per mile)
- Table 4 – Dog Day Afternoon (top 40 corridors for afternoon peak period delay per mile)
- Table 5 – Lunch Bunch (top 40 corridors for mid-day delay per mile)
- Table 6 – Weekend Warriors (top 40 corridors for weekend delay per mile)
- Table 7 – Where the Big Trucks Are (top 40 corridors for truck delay per mile)
- Table 8 – One-Hit Wonders (corridors in cities with only one or 2 corridors from the 328 corridors)
- Table 9 – Reliably Unreliable (all 328 corridors ranked by buffer index)
- Table 10 – Congestion Leaders (all 328 corridors ranked by delay per mile)

The following pages include descriptions and performance measure values.

Reliably Unreliable (Table 1)

Table 1 shows the top 40 corridors from 2010 ranked by the buffer index (weekday peak period travel time reliability). The full ranking of these corridors is shown in Tables 9 and 10. Key findings of Table 1 are:

- The least reliable corridor is the southbound section of GA 400 in Atlanta between Toll Plaza and I-85. This corridor has a buffer index of 256 percent. This means that drivers have to allow 256 percent more time than the average to complete their trip on time 19 out of 20 times.
- The northbound Van Wyck Expressway in New York between Belt Parkway and Main Street ranked highest in the planning time index. The planning time index of 6.88 means that a driver has to add 588 percent more time to ensure on-time arrival for 95 percent of the trips. This is a very congested corridor; the travel time index of 3.72 shows that it takes 272 percent longer to make a peak period trip than the same trip at free-flow speeds.
- The New York area has 5 of the top 20 corridors for least reliable travel based on the buffer index. Atlanta and Washington, D.C. each have 2 corridors in the top 20.

Congestion Leaders (Table 2)

Table 2 contains the top 40 corridors from 2010 ranked by annual delay per mile. Also shown in the table are the annual gallons of wasted fuel and the annual congestion cost associated with the delay and fuel. The full ranking of these corridors is shown in Tables 9 and 10. Key findings of Table 2 are:

- The highest ranked corridor for delay per mile is the Harbor Freeway (northbound) in Los Angeles from I-10 to Stadium Way. While this corridor ranks first in delay per mile, it ranks 27th in total congestion cost because it is one of the shorter corridors in the study. This corridor has about 1.4 million hours of delay per mile.
- 7 of the 10 most congested corridors in the U.S. are found in the Los Angeles region.
- The top 21 corridors in this list had at least a half million hours of delay per mile in 2010.
- 284 corridors contained at least 100,000 hours of delay per mile in 2010.
- The most wasted fuel and highest congestion cost occurred on US 101 southbound in Los Angeles between Ventura Boulevard and Vignes Street. This is a long corridor (approximately 27 miles) so it is not surprising that it would rank near the top of the magnitude measures in the table.

Highlights when comparing the “Reliably Unreliable” (Table 1) with the “Congestion Leaders” (Table 2) rankings:

- There are more regions represented in the “Reliably Unreliable” (Table 1) list than the “Congestion Leaders” (Table 2). Unreliability is a more distributed problem.
- The corridors with geographic or operational challenges (e.g., narrow roads, bridges, tunnels, toll plazas, etc) may rank worse in reliability than some of their more congested counterparts because a crash or bad weather event can have more affect on these constrained corridors.

3-Cup Mornings (Table 3)

Table 3 shows the corridors with the largest delay per mile in the morning peak period (6 am to 10 am). This table includes the same measures as Table 2, but it is based only on traffic during the morning peak period. Key findings of this table include:

- The southbound I-405 (San Diego Freeway) in Los Angeles from Nordhoff Street to Mulholland Drive tops this list with about 365,000 hours of delay per mile in the morning peak period for 2010.
- The top 9 corridors had at least 200,000 hours of delay per mile.
- 16 different urban areas have at least one corridor appearing in this top 40 list with delay per mile values ranging from about 120,000 hours to 365,000 hours.
- The total morning peak period congestion cost in these corridors ranged from about $10 million to just over $83 million in 2010.

Dog Day Afternoons (Table 4)

Table 4 shows the corridors with the worst afternoon congestion (3 to 7 pm). This table includes the same measures as Table 2, but it is based only on traffic during the afternoon peak period. Key findings of this table include:

- The northbound Harbor Freeway (CA-110) in Los Angeles from I-10 to Stadium Way tops the list with about 756,000 hours of delay in 2010.
- The top 24 corridors had at least 300,000 hours of delay per mile.
- 9 urban areas have corridors included in the top 40 list.
- Delay per mile ranges from about 256,000 hours to 756,000 hours.
- Total congestion cost in the top 40 ranged from about $17 million to about $189 million.
- *Congestion problems are much greater in the afternoon peak period than the morning peak period*; compare the delay per mile values in Tables 3 and 4. The top 40 afternoon peak period delay per mile values are all higher than 250,000 hours per mile, while only the top 3 corridors are over 250,000 hours per mile in the morning peak period.

Lunch Bunch (Table 5)

Table 5 shows the congestion problem in corridors through the midday hours (10 am to 3 pm). While one may not think that congestion is a problem on freeway corridors in the middle of the day, proximity to lunch locations, shopping areas, medical centers, and other activity centers can cause slow traffic. This table includes the same measures as Table 2, but it is based only on traffic during the midday hours. Key findings of this table include:

- The northbound Harbor Freeway (CA-110) from I-10 to Stadium Way in Los Angeles led the list with about 226,000 hours of delay per mile in 2010 during the midday hours.
- 11 corridors had at least 100,000 hours of delay per mile.
- 10 different urban areas have at least one corridor in the top 40 list with Los Angeles topping the list with 14 corridors. New York is second with 11 corridors.
- The highest ranking corridor in this list has less delay per mile (226,000 hours) than the number 40th ranked corridor in afternoon peak period delay (see Table 4).

Weekend Warriors (Table 6)

Table 6 shows weekend congestion problems. Congestion is rarely a stop-and-go speeds type of problem on freeway corridors on Saturdays and Sundays, but it can occur near major shopping areas, sporting arenas, and other recreational activity centers. This table includes the same measures as Table 2, but it is based only on traffic during the weekends. Key findings of this table include:

- The northbound Harbor Freeway (CA-110) from I-10 to Stadium Way in Los Angeles led the list with about 253,000 hours of delay per mile in 2010 on the weekends, more than during the weekday midday periods.
- 6 urban areas have at least 100,000 hours of delay per mile.
- Total congestion cost ranged from about $4 million to about $40 million in the corridors included in this list.
- 10 urban areas have corridors in this list.

Where the Big Trucks Are (Table 7)

Table 7 includes the amount of daily truck travel on each corridor into the congestion measures. This table includes the same measures as Table 2, but it is based entirely on truck travel. Key findings of this table include:

- The northbound Harbor Freeway in Los Angeles between I-10 and Stadium Way has the most truck delay per mile at just under 100,000 hours per mile in 2010.
- The US-101 southbound in Los Angeles between Ventura Boulevard and Vignes Street ranked first for wasted diesel by trucks with over 1.5 million gallons.
- The Riverside Freeway (CA-91) eastbound in Los Angeles between CA-55 and McKinley Street ranked number one for truck congestion cost at over $67 million in 2010.
- The Los Angeles area had 16 corridors ranked in the top 40 for truck delay. New York had the second most corridors ranked for truck delay with 9, while Chicago was third with 4 corridors. Each of these regions has significant truck traffic due to large populations and proximity to ports and intermodal facilities.
- Significant truck congestion was not limited to corridors in the largest metropolitan regions. For example, Baton Rouge with eastbound I-12 and Austin with both northbound and southbound I-35 were included in the top 40 corridors.

One-Hit Wonders (Table 8)

Table 8 is a subset of Table 2. It includes urban areas that only have one or 2 corridors included in Table 2. Key findings of this table include:

- The list contains 26 urban areas.
- Southbound I-275 in Tampa from Floribraska Avenue to US-92 tops this list with about 278,000 hours of delay per mile in 2010.
- 10 corridors have at least 200,000 hours of delay per mile while 28 corridors have at least 100,000 hour of delay per mile.
- Total congestion costs range from just over $1 million to about $75 million.

Using the Best Congestion Data & Analysis Methodologies

The base data for the *2011 Congested Corridors Report* come from INRIX and FHWA (*6, 7*). The methodology and analysis procedures are described in more detail in Appendix B.

- The INRIX traffic speeds are collected from a variety of sources and compiled in their National Average Speed (NAS) database. Agreements with fleet operators who have location devices on their vehicles feed time and location data points to INRIX. Individuals who have downloaded the INRIX application to their smart phones also contribute time/location data. The proprietary process filters inappropriate data (e.g., pedestrians walking next to a street) and compiles a dataset of average speeds for each road segment. TTI was provided a dataset of hourly average speeds by day of week for each link of major roadway covered in the NAS database for 2010. This covered about 1 million centerline miles in 2010.
- We let the data tell these stories; we investigated all freeways and highways in the United States looking for traffic problems. As first explored in the *2010 INRIX National Traffic Scorecard* (*2*), a short directional roadway segment (less than 1 mile) with congestion for more than 10 hours in a week was the beginning of a congested corridor. ("Congestion" was having a speed less than half of the free-flow speed). Each directional, adjacent and upstream segment of roadway that was congested for 4 hours per week was included in the corridor. Four hours was chosen as the threshold after reviewing the data which showed that many upstream segments had some congestion nearly every weekday. Since it typically did not constitute every day of the week, choosing four hours allows one day per week to have a different queuing pattern. A minimum corridor length was set at 3 miles. This resulted in 328 directional freeway corridors. We combined traffic volume information from the states with the speed data to compute the performance measures along these corridors.
- Hourly travel volume statistics were developed with a set of procedures developed from computer models and studies of real-world travel time and volume data. The congestion methodology uses daily traffic volume converted to average hourly volumes using a set of estimation curves developed from a national traffic count dataset (*8*).
- The hourly INRIX speeds were matched to the hourly volume data for each congested corridor.
- Performance measures were then computed including delay per mile, planning time index, buffer index, travel time index, gallons of wasted fuel, and congestion cost. A number of different tables and rankings were produced to illustrate the most congestion or the worst reliability all day, in the morning, the mid-day, in the afternoon or on the weekends. The measures show conditions for all traffic and for trucks.

Future Changes

There will be other changes in the report methodology over the next few years. There is more information available every year that provides more descriptive travel time and volume data. This report will begin a dialogue for computing and ranking corridors with reliability measures. Improved data will yield more precision in corridor analyses. The authors are considering further investigation of:

- Long sections with multiple bottlenecks
- The sensitivity of altering the value of 10 hours in a week that indicates the start of the congested corridor
- Seasonality changes in the congestion levels.

We would like to hear your ideas for more detailed analyses. What do you want to know? What do you care about? What decisions are you making with related data and measures?

Congestion Relief – An Overview of the Strategies

We recommend a ***balanced and diversified approach*** to reduce congestion – one that focuses on more of everything. It is clear that our current investment levels have not kept pace with the problems. Population growth will require more systems, better operations and an increased number of travel alternatives. And most urban regions have big problems now – more congestion, poorer pavement and bridge conditions and less public transportation service than they would like. There will be a different mix of solutions in metro regions, cities, neighborhoods, job centers and shopping areas. Some areas might be more amenable to construction solutions, other areas might use more travel options, productivity improvements, diversified land use patterns or redevelopment solutions. In all cases, the solutions need to work together to provide an interconnected network of transportation services. More information on the possible solutions and the places they have been implemented can be found on the website http://mobility.tamu.edu/solutions.

- **Get as much service as possible from what we have** – Many low-cost improvements have broad public support and can be rapidly deployed. These management programs require innovation, constant attention and adjustment, but they pay dividends in faster, safer and more reliable travel. Rapidly removing crashed vehicles, adding a short section of roadway, and providing traveler information while ensuring alternate routes parallel to the freeways are operating efficiently (timing the traffic signals so that more vehicles see green lights, improving road and intersection designs) are all relatively simple actions.
- **Add capacity in critical corridors** – Handling greater freight or person travel on freeways, streets, rail lines, buses or intermodal facilities often requires "more." Important corridors or growth regions can benefit from more road lanes, new streets and highways, new or expanded public transportation facilities, and larger bus and rail fleets.
- **Change the usage patterns** – There are solutions that involve changes in the way employers and travelers conduct business to avoid traveling in the traditional "rush hours." Flexible work hours, internet connections or phones allow employees to choose work schedules that meet family needs and the needs of their jobs.
- **Provide choices** – This might involve different routes, travel modes or lanes that involve a toll for high-speed and reliable service—a greater number of options that allow travelers and shippers to customize their travel plans.
- **Diversify the development patterns** – These typically involve denser developments with a mix of jobs, shops and homes, so that more people can walk, bike or take transit to more, and closer, destinations. Sustaining the "quality of life" and gaining economic development without the typical increment of mobility decline in each of these sub-regions appear to be part, but not all, of the solution.
- **Realistic expectations** are also part of the solution. Large urban areas will be congested. Some locations near key activity centers in smaller urban areas will also be congested. But congestion does not have to be an all-day event. Identifying solutions and funding sources that meet a variety of community goals is challenging enough without attempting to eliminate congestion in all locations at all times.

Concluding Thoughts

The *2011 Congested Corridors Report* identified many of the worst places for freeway congestion in the United States. The 328 corridors account for only 6 percent of the urban freeway miles and 10 percent of the traffic, but have 36 percent of the urban congestion. The detailed data allow for more extensive analysis and a better picture of the location, time and effects of stop-and-go traffic.

Solutions and Performance Measurement

So what can be done to fix these congestion problems? There are solutions that work. There are also significant benefits from aggressively attacking congestion problems. Performance measures and detailed data like those used in the *2011 Congested Corridors Report* can guide those investments, identify operating changes and provide the public with the assurance that their dollars are being spent wisely. Decision-makers and project planners alike should use the comprehensive congestion data to describe the problems and solutions in ways that resonate with traveler experiences and frustrations.

All of the potential congestion-reducing strategies are needed. In many of these corridors additional capacity is needed to move people and freight more rapidly and reliably. Getting more productivity out of the existing road and public transportation systems is also vital to reducing congestion and improving travel time reliability. Businesses and employees can use a variety of strategies to modify their times and modes of travel to avoid the peak periods or to use less vehicle travel and more electronic "travel."

The good news from the *2011 Congested Corridors Report* is that the data can improve decisions and communication about the problems and the effect of solutions. The information can be used to study congestion problems in detail and decide how to fund and implement projects, programs and policies to attack the problems. And because the data relate to everyone's travel experiences, the measures are relatively easy to understand and use to develop solutions that satisfy the transportation needs of a range of travelers, freight shippers, manufacturers and others.

At the national level, the Federal Highway Administration (FHWA) is moving towards a greater focus on performance management in its programs. FHWA's Office of Operations has been focusing on supporting system reliability, and specifically, the use of travel-time based reliability measures through a number of efforts (*3, 4, 5*).

Tables of Rankings

Note: Tables 1 through 8 contain the "Top 40" for each category.
Tables 9 and 10 contains the ranking of all 328 corridors for Table 1 and Table 2
.

Table 1. Reliably Unreliable (Top 40)

Area	Corridor	Corridor Endpoints From To	Corridor Length (miles)	2010 Weekday Peak-period Travel Time Reliability					
				Buffer Index (%)	Rank	Planning Time Index	Rank	Travel Time Index	Rank
Atlanta	GA-400 SB	Toll Plaza I-85/Exit 87	4.1	256	1	4.83	15	1.63	216
Atlanta	I-75 SB	Mount Zion Pkwy/Exit 231 Hudson Bridge Rd/Exit 224	6.7	253	2	4.68	23	1.34	314
New York	Hutchinson River Pkwy NB	Cross County Pkwy/Exit 15 Mamaroneck Rd/Exit 22	4.5	215	3	4.69	22	1.49	273
New York	Bronx Whitestone Brg NB|Whitestone Expy NB	Linden Pl/Exit 14 Toll Plaza	3.4	215	3	4.62	24	1.80	130
Norfolk	Hampton Roads Beltway/I-64 EB	Rip Rap Rd/Exit 265 Hampton Roads Brg Tunl(Hampton)	3.1	198	5	5.28	6	1.89	98
New York	Pulaski Skwy NB	I-95/Exp US-1 Tonnele Ave	3.3	197	6	4.29	29	1.70	179
New Haven	I-84 WB	I-691 (Cheshire) (West) Austin Rd/Exit 25A	3.4	189	7	4.26	33	1.64	213
Houston	N Loop W Fwy/I-610 EB	US-290 Yale St	4.0	188	8	4.03	58	2.23	34
Pittsburgh	Penn Lincoln Pkwy/I-376 EB	Lydia St/Exit 2 US-19 TK RT/PA-51/Exit 5	3.4	186	9	6.84	2	3.12	3
Riverside	Ontario Fwy/I-15 NB	I-210/Exit 115 Glen Helen Pkwy	6.2	182	10	3.23	167	1.26	321
New York	Major Deegan Expy SB	Van Cortlandt Park/Exit 11 I-95/Cross Bronx Expy/Exit 7	3.5	173	11	4.96	9	1.89	98
Washington, DC	I-70 WB	MD-144/Exit 59 US-15/US-340/Exit 52	6.8	173	11	3.31	148	1.27	320
New Orleans	I-10 EB	Loyola Dr Veterans Memorial Blvd	3.5	170	13	4.45	26	1.75	153
Louisville	I-64 WB	Cannons Ln/Exit 10 I-71/Exit 6	4.4	170	13	4.18	42	1.64	213
Washington, DC	I-95 SB	I-395 Russell Rd/Exit 148	23.9	165	15	4.71	21	1.89	98
New York	I-95 SB (NE Thwy, Bruckner/Cross Bronx Expys)	Conner St/Exit 13 Hudson Ter	22.7	161	16	5.58	3	2.74	6
San Francisco	California Delta Hwy/CA-4 EB	Bailey Rd Somersville Rd	5.8	161	16	5.39	4	2.08	52
Baltimore	John Hanson Hwy/US-50/US-301 EB	I-97/Exit 21 MD-70/Rowe Blvd/Exit 24	3.4	161	16	4.09	51	1.67	198
Baton Rouge	I-10 EB	LA-415/Exit 151 Dalrymple Dr/Exit 156	4.7	157	19	4.12	49	1.67	198
Chicago	I-55 NB	IL-53/Exit 267 IL-83/Kingery Hwy/Exit 274	8.9	155	20	3.66	90	1.49	273
New Haven	I-95 NB	Marsh Hill Rd/Exit 41 Ella T Grasso Blvd/Exit 45	4.0	151	21	4.29	29	1.85	110

Buffer Index—measure of trip reliability that expresses the amount of extra "buffer" time needed to be on time for 95 percent of trips. A BI of 150 percent means that for a trip that takes 30 minutes on average, 45 extra minutes should be planned (30 minutes x 150% = 45 minutes). Planning Time Index—represents the total travel time that should be planned for a trip. It differs from the BI in that it includes typical delay as well as unexpected delay. A PTI of 2.50 means that for a 30-minute trip in light traffic, 75 minutes should be planned (30 minutes x 2.50 = 75 minutes). Travel Time Index—the ratio of travel time in the peak period to the travel time at free-flow conditions. A value of 1.30 indicates a 20-minute free-flow trip takes 26 minutes in the peak period. Note: Please do not place too much emphasis on small differences in rankings. There may be little difference between (for example) 5th and 10th. The actual measure values should also be examined.

Table 1. Reliably Unreliable (Top 40), continued

Area	Corridor	Corridor Endpoints From To	Corridor Length (miles)	2010 Weekday Peak-period Travel Time Reliability: Buffer Index (%)	Rank	Planning Time Index	Rank	Travel Time Index	Rank
Cincinnati	I-75 SB	I-74/US-52/US-27/Exit 4 W 7th St/Exit 1	3.4	151	21	4.09	51	1.89	98
Birmingham	I-65 SB	US-31/Montgomery Hwy/Exit 252 Jefferson/Shelby County Line	3.5	151	21	2.66	270	1.36	310
Chicago	Stevenson Expy/I-55 SB	IL-43/Harlem Ave/Exit 283 County Line Rd/Exit 276A	7.3	150	24	4.07	53	1.69	189
Baton Rouge	I-10 WB	Siegen Ln/Exit 163 Perkins Rd/Exit 157	6.4	150	24	3.70	86	1.48	277
San Francisco	I-580 EB	Eden Canyon Rd El Charro Rd/Fallon Rd	9.6	147	26	4.24	35	1.92	92
Chicago	Eisenhower Expy/I-290 EB	IL-72/Higgins Rd/Exit 1 Austin Blvd/Exit 23A	21.5	144	27	4.61	25	1.99	75
Washington, DC	Capital Beltway/I-495 Inner Loop	I-95/I-395/Exit 57 MD-650/New Hampshire Ave/Exit28	41.4	144	27	4.29	29	2.06	59
Cincinnati	I-75 SB	OH-126/Exit 14 Ronald Reagan Cross County Hwy/Exit10	3.9	140	29	3.83	76	1.68	195
Chicago	Eisenhower Expy/I-290 WB	S Ashland Ave/Exit 28B 9th Ave/Exit 19B	8.9	139	30	4.87	12	2.07	56
Charlotte	I-85 NB	University City Blvd Speedway Blvd/Exit 49	6.2	134	31	3.28	153	1.40	304
Los Angeles	I-710 NB	Alondra Blvd Imperial Hwy	3.0	133	32	3.83	76	1.70	179
Boston	I-495 NB	MA-110/Chelmsford St/Exit 34 Woburn St/Exit 37	3.0	132	33	3.94	71	1.77	147
Atlanta	I-75/I-85 NB	GA-166 US-78/US-278/US-29/Exit 249	7.6	132	33	3.27	156	1.78	143
New York	Major Deegan Expy/I-87 NB	I-278/Bruckner Expy I-95/Cross Bronx Expy/Exit 7	4.1	131	35	4.75	19	2.19	38
Dallas-Fort Worth	Thornton Fwy/I-30 WB	Saint Francis Ave/Exit 52 Griffin St	7.2	130	36	4.13	48	1.96	80
Houston	I-10 EB	T C Jester Blvd/Exit 765 Mckee St/San Jacinto St	4.4	129	37	4.18	42	2.17	42
Chicago	I-290 WB	I-88/Exit 15A IL-83/Exit 10A	6.0	128	38	3.95	68	1.69	189
Atlanta	I-85 SB	GA-13/Exit 86 (East) I-75/Exit 85	2.5	127	39	5.30	5	2.37	23
New York	Henry Hudson Pkwy NB	W 72nd St I-95/Riverside Dr/Exit 14-15	6.2	126	40	4.20	38	1.79	137
New York	FDR Dr NB	I-495/Tunnel Exit St/Queens Midtown Tunl 116th St/Exit 16	4.0	126	40	3.93	72	1.88	103
Seattle	I-5 SB	84th St/Hosmer St/Exit 128 41st Division Dr/Exit 120	7.9	126	40	3.16	173	1.47	280

Buffer Index—measure of trip reliability that expresses the amount of extra "buffer" time needed to be on time for 95 percent of trips. A BI of 150 percent means that for a trip that takes 30 minutes on average, 45 extra minutes should be planned (30 minutes x 150%= 45 minutes). Planning Time Index—represents the total travel time that should be planned for a trip. It differs from the BI in that it includes typical delay as well as unexpected delay. A PTI of 2.50 means that for a 30-minute trip in light traffic, 75 minutes should be planned (30 minutes x 2.50 = 75 minutes). Travel Time Index—the ratio of travel time in the peak period to the travel time at free-flow conditions. A value of 1.30 indicates a 20-minute free-flow trip takes 26 minutes in the peak period. Note: Please do not place too much emphasis on small differences in rankings. There may be little difference between (for example) 5th and 10th. The actual measure values should also be examined.

Table 2. Congestion Leaders (Top 40)

Urban Area	Corridor	Corridor Endpoints From To	Corridor Length (miles)	2010 All-day Everyday Congestion: Delay Per Mile Person-hrs (x 1000)	Rank	Wasted Fuel Gallons (x 1000)	Rank	Congestion Cost (x $1000)	Rank
Los Angeles	Harbor Fwy/CA-110 NB	I-10/Santa Monica Fwy Stadium Way/Exit 24C	3.1	1,440	1	2,170	28	95,020	27
Los Angeles	Harbor Fwy/I-110 NB	111th Pl I-110/I-10/Santa Monica Fwy	6.5	1,126	2	3,665	13	158,173	14
Los Angeles	San Diego Fwy/I-405 NB	I-105/Imperial Hwy Getty Center Dr	13.1	965	3	6,057	2	269,925	2
New York	Van Wyck Expy/I-678 NB	Belt Pkwy/Exit 1 Main St/Exit 8	3.1	690	4	1,086	68	46,928	69
Los Angeles	San Gabriel River Fwy/I-605 SB	Beverly Blvd Florence Ave	4.8	681	5	1,644	43	70,454	43
Los Angeles	Santa Monica Fwy/I-10 EB	CA-1/Lincoln Blvd/Exit 1B Alameda St	14.9	640	6	4,664	8	203,998	8
Los Angeles	Santa Monica Fwy/I-10 WB	I-5/Golden State Fwy National Blvd	12.6	633	7	3,831	11	169,842	11
San Francisco	I-80 EB (James Lick Fwy/Bay Brdg)	US-101 Treasure Island Rd	3.6	600	8	1,005	76	43,711	79
San Francisco	Grove Shafter Fwy/CA-24 WB	Saint Stephens Dr Caldecott Tunnel	3.5	600	8	934	84	43,359	82
Los Angeles	I-110 SB	W Vernon Ave 51st St	2.5	582	10	670	124	30,929	114
New York	I-278 EB (Gowanus Expy/Brooklyn Queens)	92nd St/Exit 17 Apollo St/Meeker Ave/Exit 34	11.6	581	11	3,618	15	149,860	15
Los Angeles	Riverside Fwy/CA-91 EB	CA-55/Costa Mesa Fwy Mckinley St	20.7	576	12	5,698	3	260,647	3
New York	I-278 WB (Brooklyn Queens/Gowanus Expy)	NY-25A/Northern Blvd/Exit 41 NY-27/Prospect Expy/Exit 24	10.2	550	13	2,966	19	124,355	20
Austin	I-35 SB	US-183/Exit 239-240 Woodland Ave	6.7	546	14	1,698	38	77,880	37
San Francisco	Eastshore Fwy/I-80 EB/I-580 WB	Cypress St University Ave	3.3	538	15	847	91	36,568	98
Austin	I-35 NB	Shelby Ln/St Elmo Rd/Exit 230 Martin Luther King Blvd/19th St/Exit 235	4.7	536	16	1,243	58	54,236	61
Los Angeles	CA-110 SB (Pasadena/Harbor Fwys)	Avenue 60 Olympic Blvd/9th St	6.6	526	17	1,679	40	73,700	41
Los Angeles	I-5 SB (Santa Ana/Golden St Fwys)	East Ceasar Chavez Ave Valley View Ave	17.5	523	18	4,541	9	196,333	9
New York	Van Wyck Expy/I-678 SB	Horace Harding Expy/Exit 12A Linden Blvd/Exit 3	6.2	520	19	1,625	44	70,308	44
San Francisco	Eastshore Fwy/I-80 WB/I-580 EB	Cutting Blvd Bay Bridge Toll Plz	8.5	515	20	2,122	29	90,264	29

Delay Per Mile—Extra travel time during the year due to congestion, divided by the corridor length. Wasted Fuel—Increased fuel consumption due to travel in congested conditions rather than free-flow conditions. Congestion Cost—Value of travel time delay (estimated at $16 per hour for person travel and $88 per hour for truck time) and excess fuel consumption (estimated using state average cost per gallon of gasoline and diesel). Note: Please do not place too much emphasis on small differences in the rankings. There may be little difference between (for example) 5th and 10th. The actual measure values should also be examined.

Table 2. Congestion Leaders (Top 40), continued

Urban Area	Corridor	Corridor Endpoints From To	Corridor Length (miles)	2010 All-day Everyday Congestion: Delay Per Mile Person-hrs (x 1000)	Delay Per Mile Rank	Wasted Fuel Gallons (x 1000)	Wasted Fuel Rank	Congestion Cost (x $1000)	Congestion Cost Rank
Los Angeles	US-101 NB (Santa Ana/Hollywood Fwys)	I-5/CA-60 Haskell Ave	21.5	503	21	5,386	6	232,387	6
Los Angeles	San Diego Fwy/I-405 NB	Macarthur Blvd Brookhurst St	7.8	497	22	1,777	37	81,506	35
Los Angeles	I-5 NB (Santa Ana/Golden St Fwys)	CA-39/Beach Blvd Riverside Dr	22.5	487	23	5,442	5	235,356	5
Los Angeles	San Bernadino Fwy/I-10 EB	City Terrace Dr/Herbert Ave Baldwin Park Blvd	12.8	487	23	3,041	18	132,990	17
Los Angeles	US-101 SB (Ventura/Hollywood Fwys)	Ventura Blvd/Shoup Ave Vignes St/Exit 2B	26.7	485	25	6,262	1	277,782	1
Houston	I-10 EB	T C Jester Blvd/Exit 765 Mckee St/San Jacinto St	4.4	475	26	951	81	43,270	83
Boston	Southeast Expy/I-93 NB	MA-28/Randolph Ave/Exit 5 Columbia Rd/Exit 15	10.4	470	27	2,442	22	105,165	22
Washington, DC	Capital Beltway/I-495 Outer Loop	US-1/Baltimore Ave/Exit 25 MD-97/Georgia Ave/Exit 31	6.3	465	28	1,360	55	61,030	54
Houston	N Loop W Fwy/I-610 EB	US-290 Yale St	4.0	460	29	885	89	39,255	90
Los Angeles	San Diego Fwy/I-405 SB	Nordhoff St Mulholland Dr	8.1	458	30	1,793	36	79,085	36
Houston	US-59 NB (Southwest/Eastex Fwys)	Buffalo Speedway I-45	4.8	453	31	1,025	74	45,426	72
New York	Major Deegan Expy/I-87 NB	I-278/Bruckner Expy I-95/Cross Bronx Expy/Exit 7	4.1	452	32	975	80	41,142	86
Seattle	I-5 SB	WA-523/145Th St/Exit 175 Union St/Exit 165	8.9	441	33	1,930	32	84,806	33
Pittsburgh	Penn Lincoln Pkwy/I-376 EB	Lydia St/Exit 2 US-19 TK RT/PA-51/Exit 5	3.4	433	34	728	107	33,336	108
Miami	Dolphin Expy/SR 836 EB	107th Ave FL-959/Red Rd	5.0	431	35	1,105	67	45,316	73
New York	Long Island Expy/I-495 EB	Maurice Ave/Exit 18 Mineola Ave/Willis Ave/Exit 37	16.0	426	36	3,506	16	149,511	16
New York	I-95 SB (NE Thwy, Bruckner/Cross Bronx Expys)	Conner St/Exit 13 Hudson Ter	22.7	425	37	4,907	7	213,006	7
Los Angeles	I-605 NB	Beverly Blvd Valley Blvd	5.0	423	38	1,038	71	44,997	74
Chicago	Stevenson Expy/I-55 SB	State St/Exit 293C Pulaski Rd/Exit 287	5.7	414	39	1,249	56	55,001	59
New York	Goethals Brg EB|I-278 EB	Meeker Ave/Forest Ave/Exit 4 Bradley Ave/Exit 11	3.3	414	39	716	111	30,094	124

Delay Per Mile—Extra travel time during the year due to congestion, divided by the corridor length. Wasted Fuel—Increased fuel consumption due to travel in congested conditions rather than free-flow conditions. Congestion Cost—Value of travel time delay (estimated at $16 per hour for person travel and $88 per hour for truck time) and excess fuel consumption (estimated using state average cost per gallon of gasoline and diesel). Note: Please do not place too much emphasis on small differences in the rankings. There may be little difference between (for example) 5th and 10th. The actual measure values should also be examined.

Table 3. 3-Cup Mornings (Top 40)

Urban Area	Corridor	Corridor Endpoints From To	Corridor Length (miles)	2010 Morning Peak Period Congestion (6 to -10 am)					
				Delay Per Mile		Wasted Fuel		Congestion Cost	
				Person-hrs (x 1000)	Rank	Gallons (x 1000)	Rank	(x $1000)	Rank
Los Angeles	San Diego Fwy/I-405 SB	Nordhoff St Mulholland Dr	8.1	365	1	1,449	3	63,088	4
Los Angeles	Harbor Fwy/I-110 NB	111th Pl I-110/I-10/Santa Monica Fwy	6.5	352	2	1,167	7	49,422	7
Washington, DC	Capital Beltway/I-495 Outer Loop	US-1/Baltimore Ave/Exit 25 MD-97/Georgia Ave/Exit 31	6.3	290	3	891	12	38,119	13
Los Angeles	Santa Monica Fwy/I-10 WB	I-5/Golden State Fwy National Blvd	12.6	245	4	1,516	2	65,587	3
Pittsburgh	Penn Lincoln Pkwy/I-376 EB	Lydia St/Exit 2 US-19 TK RT/PA-51/Exit 5	3.4	245	4	355	45	18,852	37
Riverside	Riverside Fwy/CA-91 WB	McKinley St Auto Center Dr/Serfas Club Dr	5.6	228	6	653	22	29,083	21
Boston	Southeast Expy/I-93 NB	MA-28/Randolph Ave/Exit 5 Columbia Rd/Exit 15	10.4	224	7	1,192	6	50,213	6
Los Angeles	Pomona Fwy/CA-60 WB	Fairway Dr Peck Rd	10.4	207	8	1,082	8	45,686	8
Los Angeles	I-10 WB	Citrus St Baldwin Park Blvd	5.2	203	9	537	26	22,645	29
Los Angeles	I-405 NB	Avalon Blvd Inglewood Ave	7.3	195	10	684	18	29,942	20
New York	Van Wyck Expy/I-678 NB	Belt Pkwy/Exit 1 Main St/Exit 8	3.1	195	10	296	58	13,270	58
Los Angeles	I-210 WB	I-605 Baldwin Ave	5.5	192	12	535	27	22,437	30
San Francisco	Nimitz Fwy/I-880 SB	I-238/Washington Ave CA-92/Jackson St	4.3	191	13	397	39	16,718	43
Houston	I-45 NB	Clearwood Dr/Edgebrook St Broadway St/Park Place Blvd/Exit39	3.8	191	13	340	49	14,856	50
Los Angeles	I-10 WB	Valley Blvd Atlantic Blvd	6.4	185	15	606	24	25,354	24
Boston	I-93 SB	I-95/MA-128/Exit 37 US-1/Exit 27	9.8	182	16	889	13	38,112	14
Philadelphia	Delaware Expy/I-95 SB	Academy Rd/Exit 32 Girard Ave/Exit 23	8.3	179	17	744	17	32,085	17
Miami	Dolphin Expy/SR 836 EB	107th Ave FL-959/Red Rd	5.0	172	18	430	37	18,092	39
Los Angeles	I-405 SB	Valley View St Warner Ave	6.6	170	19	510	30	23,422	27
Los Angeles	CA-55 SB	Katella Ave McFadden Ave	6.0	167	20	470	34	20,967	32

Delay Per Mile—Extra travel time during the year due to congestion, divided by the corridor length. Wasted Fuel—Increased fuel consumption due to travel in congested conditions rather than free-flow conditions. Congestion Cost—Value of travel time delay (estimated at $16 per hour for person travel and $88 per hour for truck time) and excess fuel consumption (estimated using state average cost per gallon of gasoline and diesel). Note: Please do not place too much emphasis on small differences in the rankings. There may be little difference between (for example) 5th and 10th. The actual measure values should also be examined.

Table 3. 3-Cup Mornings (Top 40), continued

Urban Area	Corridor	Corridor Endpoints From To	Corridor Length (miles)	2010 Morning Peak Period Congestion (6 to 10 am)					
				Delay Per Mile		Wasted Fuel		Congestion Cost	
				Person-hrs (x 1000)	Rank	Gallons (x 1000)	Rank	(x $1000)	Rank
Los Angeles	CA-110 SB (Pasadena/Harbor Fwys)	Avenue 60 Olympic Blvd/9th St	6.6	159	21	513	29	22,216	31
Houston	I-45 SB	Tidwell Rd Cavalcade St/Exit 50	3.4	156	22	247	67	11,324	66
Houston	Eastex Fwy/US-59 SB	Quitman St/Liberty Rd TX-288	4.1	154	23	301	57	12,984	60
San Francisco	California Delta Hwy/CA-4 WB	Hillcrest Ave Somersville Rd	3.0	151	24	211	78	9,591	75
Los Angeles	San Diego Fwy/I-405 NB	I-105/Imperial Hwy Getty Center Dr	13.1	149	25	960	11	41,596	11
Pittsburgh	Penn Lincoln Pkwy/I-376 WB	US-22 Bus/Exit 10 Squirrel Hill Tunl	5.3	146	26	367	42	17,583	40
Los Angeles	US-101 SB (Ventura/Hollywood Fwys)	Ventura Blvd/Shoup Ave Vignes St/Exit 2B	26.7	145	27	1,911	1	82,964	2
Chicago	Stevenson Expy/I-55 NB	US-20/US-45/US-12/Exit 279A Pulaski Rd/Exit 287	8.9	140	28	670	21	29,044	22
New York	Long Island Expy/I-495 WB	Glen Cove Rd/Exit 39 Woodhaven Blvd	14.9	139	29	1,052	9	45,597	9
New York	Laurelton/Belt/Shore Pkwys WB	Francis Lewis Blvd/Exit 24 Nassau Expy/Exit 19	4.9	138	30	350	47	14,876	49
New York	I-278 EB (Gowanus Expy/Brooklyn Queens)	92nd St/Exit 17 Apollo St/Meeker Ave/Exit 34	11.6	137	31	823	15	35,237	16
Los Angeles	Century Fwy/I-105 WB	Bellflower Blvd Crenshaw Blvd	12.5	136	32	810	16	35,797	15
Bridgeport	Connecticut Turnpike/I-95 SB	Stratford Ave/Exit 28 Round Hill Rd/Exit 22	4.9	131	33	330	51	14,209	51
Dallas-Fort Worth	TX-183 EB	I-820 Bedford Rd	4.0	129	34	239	69	10,902	68
Los Angeles	San Gabriel River Fwy/I-605 SB	Beverly Blvd Florence Ave	4.8	128	35	307	56	13,280	57
Seattle	I-5 NB	Albro Pl/Swift Ave/Exit 161 James St/Exit 164	4.1	128	35	271	63	11,405	65
Los Angeles	I-5 NB (Santa Ana/Golden St Fwys)	CA-39/Beach Blvd Riverside Dr	22.5	126	37	1,405	4	60,634	5
New York	Goethals Brg EB/I-278 EB	Meeker Ave/Forest Ave/Exit 4 Bradley Ave/Exit 11	3.3	126	37	216	76	9,145	79
San Jose	Sinclair Fwy/I-280 NB	CA-87/Guadalupe Pkwy I-880/CA-17	3.7	123	39	200	80	9,023	81
Atlanta	GA-400/US-19 SB	GA-120/Old Milton Pkwy/Exit 10 GA-140/Holcomb Bridge Rd/Exit 7	4.7	120	40	289	59	12,808	61

Delay Per Mile—Extra travel time during the year due to congestion, divided by the corridor length. Wasted Fuel—Increased fuel consumption due to travel in congested conditions rather than free-flow conditions. Congestion Cost—Value of travel time delay (estimated at $16 per hour for person travel and $88 per hour for truck time) and excess fuel consumption (estimated using state average cost per gallon of gasoline and diesel). Note: Please do not place too much emphasis on small differences in the rankings. There may be little difference between (for example) 5th and 10th. The actual measure values should also be examined.

Table 4. Dog Day Afternoons (Top 40)

Urban Area	Corridor	Corridor Endpoints From / To	Corridor Length (miles)	2010 Afternoon Peak Period Congestion (3 to 7 pm): Delay Per Mile, Person-hrs (x 1000)	Delay Per Mile Rank	Wasted Fuel, Gallons (x 1000)	Wasted Fuel Rank	Congestion Cost (x $1000)	Congestion Cost Rank
Los Angeles	Harbor Fwy/CA-110 NB	I-10/Santa Monica Fwy Stadium Way/Exit 24C	3.1	756	1	1,095	31	49,904	31
Los Angeles	San Diego Fwy/I-405 NB	I-105/Imperial Hwy Getty Center Dr	13.1	494	2	3,016	2	138,164	2
Los Angeles	San Diego Fwy/I-405 NB	MacArthur Blvd Brookhurst St	7.8	433	3	1,619	17	70,940	18
Los Angeles	I-110 SB	W Vernon Ave 51st St	2.5	422	4	525	90	22,417	93
San Francisco	Eastshore Fwy/I-80 EB/I-580 WB	Cypress St University Ave	3.3	419	5	673	70	28,469	71
Los Angeles	Riverside Fwy/CA-91 EB	CA-55/Costa Mesa Fwy McKinley St	20.7	418	6	4,132	1	188,902	1
Austin	I-35 SB	US-183/Exit 239-240 Woodland Ave	6.7	384	7	1,168	29	54,806	27
Los Angeles	San Gabriel River Fwy/I-605 SB	Beverly Blvd Florence Ave	4.8	383	8	937	41	39,574	42
San Francisco	I-80 EB (James Lick Fwy/Bay Brdg)	US-101 Treasure Island Rd	3.6	366	9	586	81	26,648	77
Los Angeles	Harbor Fwy/I-110 NB	111th Pl I-110/I-10/Santa Monica Fwy	6.5	364	10	1,138	30	51,185	30
Houston	I-10 EB	T C Jester Blvd/Exit 765 McKee St/San Jacinto St	4.4	356	11	711	65	32,425	60
Los Angeles	Santa Monica Fwy/I-10 EB	CA-1/Lincoln Blvd/Exit 1B Alameda St	14.9	350	12	2,617	6	111,451	6
Houston	US-59 NB (Southwest/Eastex Fwys)	Buffalo Speedway I-45	4.8	349	13	804	52	35,011	53
Los Angeles	San Bernadino Fwy/I-10 EB	City Terrace Dr/Herbert Ave Baldwin Park Blvd	12.8	342	14	2,165	9	93,561	12
Dallas-Fort Worth	TX-360 SB	Post N Paddock St Division St	3.0	329	15	477	102	20,485	104
Los Angeles	I-5 SB (Santa Ana/Golden St Fwys)	East Cesar Chavez Ave Valley View Ave	17.5	325	16	2,849	4	121,882	4
Los Angeles	I-710 SB	Floral Dr Atlantic Blvd/Bandini Blvd	3.7	320	17	596	77	24,884	86
New York	Van Wyck Expy/I-678 SB	Horace Harding Expy/Exit 12A Linden Blvd/Exit 3	6.2	314	18	953	40	42,489	37
Houston	Gulf Fwy/I-45 SB	Dumble St I-610/Exit 40	3.6	309	19	535	89	22,768	92
Austin	I-35 NB	Shelby Ln/St Elmo Rd/Exit 230 Martin Luther King Blvd/19th St/Exit 235	4.7	306	20	700	67	30,982	66

Delay Per Mile—Extra travel time during the year due to congestion, divided by the corridor length. Wasted Fuel—Increased fuel consumption due to travel in congested conditions rather than free-flow conditions. Congestion Cost—Value of travel time delay (estimated at $16 per hour for person travel and $88 per hour for truck time) and excess fuel consumption (estimated using state average cost per gallon of gasoline and diesel). Note: Please do not place too much emphasis on small differences in the rankings. There may be little difference between (for example) 5th and 10th. The actual measure values should also be examined.

Table 4. Dog Day Afternoons (Top 40), continued

Urban Area	Corridor	Corridor Endpoints From To	Corridor Length (miles)	2010 Afternoon Peak Period Congestion (3 to 7 pm): Delay Per Mile, Person-hrs (x 1000)	Delay Per Mile Rank	Wasted Fuel, Gallons (x 1000)	Wasted Fuel Rank	Congestion Cost (x $1000)	Congestion Cost Rank
Seattle	I-405 SB	WA-520/Ne 14th St/Exit 14 SE Coal Creek Pkwy/Exit 10	4.5	304	21	702	66	29,467	69
Los Angeles	I-5 NB	Penrose St Osborne St	3.3	303	22	519	93	21,534	98
Chicago	Stevenson Expy/I-55 SB	State St/Exit 293C Pulaski Rd/Exit 287	5.7	300	23	888	43	39,822	41
Los Angeles	I-605 NB	Beverly Blvd Valley Blvd	5.0	300	23	757	59	31,865	63
Los Angeles	Santa Ana Fwy/I-5 NB	Sand Canyon Ave 17th St	8.4	297	25	1,245	27	53,271	29
Los Angeles	Foothill Fwy/I-210 EB	Lincoln Ave CA-39/Azusa Ave	17.2	295	26	2,560	7	108,140	7
Houston	N Loop W Fwy/I-610 EB	US-290 Yale St	4.0	292	27	560	88	24,892	85
New York	Van Wyck Expy/I-678 NB	Belt Pkwy/Exit 1 Main St/Exit 8	3.1	286	28	443	114	19,418	108
Los Angeles	Costa Mesa Fwy/CA-55 NB	CA-73 4th St/Irvine Blvd	6.5	276	29	846	51	37,666	45
New York	I-278 WB	New York Ave Slosson Ave/Exit 12	3.2	276	29	454	108	19,185	112
Los Angeles	Orange Fwy/CA-57 NB	I-5/CA-22/Chapman Ave (Orange) CA-60/Pomona Fwy	14.7	269	31	1,961	12	83,856	14
San Francisco	Grove Shafter Fwy/CA-24 WB	Saint Stephens Dr Caldecott Tunnel	3.5	267	32	399	125	19,300	111
Miami	Dolphin Expy/SR 836 WB	I-95 FL-959/Red Rd	5.5	266	33	720	63	29,658	68
Miami	Palmetto Expy/SR 826 SB	74th St 25th St	3.2	265	34	402	123	17,090	128
Los Angeles	Pomona Fwy/CA-60 EB	Whittier Blvd Brea Canyon Rd	21.7	264	35	2,914	3	121,982	3
New York	I-278 WB (Brooklyn Queens/Gowanus Expy)	NY-25A/Northern Blvd/Exit 41 NY-27/Prospect Expy/Exit 24	10.2	264	35	1,370	21	59,555	22
Los Angeles	I-5 SB	Alton Pkwy El Toro Rd	3.4	264	35	425	116	19,061	114
Dallas-Fort Worth	Stemmons Fwy/I-35E SB	Empire Central Dr/Exit 434A I-30/Exit 428	6.7	263	38	848	49	37,358	47
Atlanta	I-285 EB	Riverside Dr/Exit 24 I-85/Exit 33	9.1	260	39	1,230	28	54,343	28
Houston	W Loop Fwy/I-610 NB	Braeswood Blvd/S Post Oak Rd/Exit 4 Woodway Dr/Exit 10	5.8	256	40	688	69	31,048	65

Delay Per Mile—Extra travel time during the year due to congestion, divided by the corridor length. Wasted Fuel—Increased fuel consumption due to travel in congested conditions rather than free-flow conditions. Congestion Cost—Value of travel time delay (estimated at $16 per hour for person travel and $88 per hour for truck time) and excess fuel consumption (estimated using state average cost per gallon of gasoline and diesel). Note: Please do not place too much emphasis on small differences in the rankings. There may be little difference between (for example) 5th and 10th. The actual measure values should also be examined.

Table 5. Lunch Bunch (Top 40)

Urban Area	Corridor	Corridor Endpoints From / To	Corridor Length (miles)	2010 Midday Period Congestion (10 am to 3 pm): Delay Per Mile Person-hrs (x 1000)	Delay Per Mile Rank	Wasted Fuel Gallons (x 1000)	Wasted Fuel Rank	Congestion Cost (x $1000)	Congestion Cost Rank
Los Angeles	Harbor Fwy/CA-110 NB	I-10/Santa Monica Fwy Stadium Way/Exit 24C	3.1	226	1	363	22	14,916	22
Los Angeles	Harbor Fwy/I-110 NB	111th Pl I-110/I-10/Santa Monica Fwy	6.5	198	2	662	9	27,826	10
New York	Major Deegan Expy/I-87 NB	I-278/Bruckner Expy I-95/Cross Bronx Expy/Exit 7	4.1	149	3	327	28	13,569	28
Los Angeles	San Diego Fwy/I-405 NB	I-105/Imperial Hwy Getty Center Dr	13.1	147	4	959	4	41,145	4
San Francisco	Grove Shafter Fwy/CA-24 WB	Saint Stephens Dr Caldecott Tunnel	3.5	144	5	240	39	10,418	39
New York	I-278 EB (Gowanus Expy/Brooklyn Queens)	92nd St/Exit 17 Apollo St/Meeker Ave/Exit 34	11.6	141	6	902	5	36,401	6
Los Angeles	San Gabriel River Fwy/I-605 SB	Beverly Blvd Florence Ave	4.8	138	7	335	25	14,243	25
Miami	Dolphin Expy/SR 836 EB	107th Ave FL-959/Red Rd	5.0	130	8	354	24	13,646	27
New York	I-278 WB (Brooklyn Queens/Gowanus Expy)	NY-25A/Northern Blvd/Exit 41 NY-27/Prospect Expy/Exit 24	10.2	117	9	679	8	26,479	12
New York	Major Deegan Expy SB	Van Cortlandt Park/Exit 11 I-95/Cross Bronx Expy/Exit 7	3.5	114	10	219	43	8,922	46
Los Angeles	Santa Monica Fwy/I-10 WB	I-5/Golden State Fwy National Blvd	12.6	109	11	658	10	29,301	9
Los Angeles	I-5 NB (Santa Ana/Golden St Fwys)	CA-39/Beach Blvd Riverside Dr	22.5	99	12	1,129	3	47,865	3
New York	I-95 SB (NE Thwy, Bruckner/Cross Bronx Expys)	Conner St/Exit 13 Hudson Ter	22.7	98	13	1,169	2	55,107	2
Los Angeles	US-101 SB (Ventura/Hollywood Fwys)	Ventura Blvd/Shoup Ave Vignes St/Exit 2B	26.7	97	14	1,263	1	55,621	1
New York	Van Wyck Expy/I-678 NB	Belt Pkwy/Exit 1 Main St/Exit 8	3.1	86	15	146	61	5,839	66
Houston	N Loop W Fwy/I-610 EB	US-290 Yale St	4.0	85	16	183	49	7,270	55
Los Angeles	Santa Monica Fwy/I-10 EB	CA-1/Lincoln Blvd/Exit 1B Alameda St	14.9	84	17	588	11	26,825	11
Los Angeles	I-5 SB (Santa Ana/Golden St Fwys)	East Cesar Chavez Ave Valley View Ave	17.5	83	18	717	7	31,080	8
New York	Van Wyck Expy/I-678 SB	Horace Harding Expy/Exit 12A Linden Blvd/Exit 3	6.2	82	19	273	34	11,044	37
Seattle	I-5 NB	Albro Pl/Swift Ave/Exit 161 James St/Exit 164	4.1	82	19	173	54	7,287	54

Delay Per Mile—Extra travel time during the year due to congestion, divided by the corridor length. Wasted Fuel—Increased fuel consumption due to travel in congested conditions rather than free-flow conditions. Congestion Cost—Value of travel time delay (estimated at $16 per hour for person travel and $88 per hour for truck time) and excess fuel consumption (estimated using state average cost per gallon of gasoline and diesel). Note: Please do not place too much emphasis on small differences in the rankings. There may be little difference between (for example) 5th and 10th. The actual measure values should also be examined.

Table 5. Lunch Bunch (Top 40), continued

Urban Area	Corridor	Corridor Endpoints From / To	Corridor Length (miles)	2010 Midday Period Congestion (10 am to 3 pm): Delay Per Mile, Person-hrs (x 1000)	Delay Per Mile Rank	Wasted Fuel, Gallons (x 1000)	Wasted Fuel Rank	Congestion Cost (x $1000)	Congestion Cost Rank
Los Angeles	US-101 NB (Santa Ana/Hollywood Fwys)	I-5/CA-60 Haskell Ave	21.5	80	21	857	6	36,963	5
Seattle	I-5 SB	WA-523/145th St/Exit 175 Union St/Exit 165	9.0	77	22	331	27	14,781	23
San Francisco	Eastshore Fwy/I-80 WB/I-580 EB	Cutting Blvd Bay Bridge Toll Plz	8.5	72	23	299	29	12,616	30
Austin	I-35 NB	Shelby Ln/St Elmo Rd/Exit 230 Martin Luther King Blvd/19th St/Exit 235	4.7	69	24	166	55	6,943	59
Los Angeles	I-605 NB	Beverly Blvd Valley Blvd	5.0	67	25	155	58	7,069	56
Los Angeles	I-110 SB	W Vernon Ave 51st St	2.5	67	25	64	117	3,535	104
New York	Long Island Expy/I-495 EB	Maurice Ave/Exit 18 Mineola Ave/Willis Ave/Exit 37	16.0	65	27	536	12	22,656	14
Los Angeles	San Diego Fwy/I-405 SB	Nordhoff St Mulholland Dr	8.1	65	27	263	35	11,176	36
New York	I-95 NB (Cross Bronx/Bruckner Expys)	I-80/NJ Tpke Pelham Pkwy/Exit 8	11.5	64	29	412	18	16,468	21
Houston	W Loop Fwy/I-610 SB	US-290/18th St Evergreen St/Exit 5	6.9	64	29	228	40	9,251	44
Pittsburgh	Penn Lincoln Pkwy/I-376 EB	Lydia St/Exit 2 US-19 TK RT/PA-51/Exit 5	3.4	63	31	137	64	4,827	76
Houston	I-45 SB	Tidwell Rd Cavalcade St/Exit 50	3.4	63	31	105	81	4,554	79
Boston	Southeast Expy/I-93 SB	I-90 Freeport St/Exit 13	3.7	62	33	116	74	4,900	75
Houston	I-45 NB (Gulf/North Fwys)	Dumble St Gulf Bank Rd/Exit 57	13.6	61	34	415	17	17,567	19
San Francisco	I-80 EB (James Lick Fwy/Bay Brdg)	US-101 Treasure Island Rd	3.6	61	34	112	75	4,464	82
Dallas-Fort Worth	Loop 820/I-820 WB	TX-26/Grapevine Hwy US-377/Denton Hwy/Exit 19	3.1	61	34	109	78	4,111	89
New York	Long Island Expy/I-495 WB	Glen Cove Rd/Exit 39 Woodhaven Blvd	14.9	59	37	444	16	19,184	16
Philadelphia	Schuylkill Expy/I-76 WB	Oregon Ave/Passyunk Ave/Exit347 Belmont Ave/Exit 338	9.5	59	37	332	26	12,527	31
Los Angeles	CA-110 SB (Pasadena/Harbor Fwys)	Avenue 60 Olympic Blvd/9th St	6.6	58	39	182	50	8,191	47
New York	Belt Pkwy EB	Knapp St Pennsylvania Ave/Exit 14	7.5	55	40	212	44	9,031	45

Delay Per Mile—Extra travel time during the year due to congestion, divided by the corridor length. Wasted Fuel—Increased fuel consumption due to travel in congested conditions rather than free-flow conditions. Congestion Cost—Value of travel time delay (estimated at $16 per hour for person travel and $88 per hour for truck time) and excess fuel consumption (estimated using state average cost per gallon of gasoline and diesel). Note: Please do not place too much emphasis on small differences in the rankings. There may be little difference between (for example) 5th and 10th. The actual measure values should also be examined.

Table 6. Weekend Warriors (Top 40)

Urban Area	Corridor	Corridor Endpoints From To	Corridor Length (miles)	2010 Weekend Congestion (Saturday and Sunday): Delay Per Mile — Person-hrs (x 1000)	Delay Per Mile — Rank	Wasted Fuel — Gallons (x 1000)	Wasted Fuel — Rank	Congestion Cost — (x $1000)	Congestion Cost — Rank
Los Angeles	Harbor Fwy/CA-110 NB	I-10/Santa Monica Fwy Stadium Way/Exit 24C	3.07	253	1	398	18	16,667	19
Los Angeles	Harbor Fwy/I-110 NB	111th Pl I-110/I-10/Santa Monica Fwy	6.54	160	2	526	10	22,440	12
New York	Goethals Brg EB/I-278 EB	Meeker Ave/Forest Ave/Exit 4 Bradley Ave/Exit 11	3.3	120	3	210	30	8,733	34
San Francisco	Grove Shafter Fwy/CA-24 WB	Saint Stephens Dr Caldecott Tunnel	3.49	119	4	190	35	8,571	36
San Francisco	Eastshore Fwy/I-80 WB/I-580 EB	Cutting Blvd Bay Bridge Toll Plz	8.5	114	5	486	13	20,067	13
Los Angeles	San Diego Fwy/I-405 NB	I-105/Imperial Hwy Getty Center Dr	13.08	101	6	632	5	28,312	5
New York	I-278 EB (Gowanus Expy/Brooklyn Queens)	92nd St/Exit 17 Apollo St/Meeker Ave/Exit 34	11.61	97	7	617	7	25,100	7
New York	Van Wyck Expy/I-678 NB	Belt Pkwy/Exit 1 Main St/Exit 8	3.1	95	8	154	46	6,486	52
New York	I-95 NB (Cross Bronx/Bruckner Expys)	I-80/NJ Tpke Pelham Pkwy/Exit 8	11.54	93	9	568	8	23,789	8
San Francisco	I-80 EB (James Lick Fwy/Bay Brdg)	US-101 Treasure Island Rd	3.55	93	9	166	41	6,781	49
Seattle	I-5 NB	72nd St/74th St/Exit 129 I-705/WA-7/Exit 133	4.21	92	11	196	34	8,331	37
New York	Bronx Whitestone Brg NB/Whitestone Expy NB	Linden Pl/Exit 14 Toll Plaza	3.41	85	12	161	43	6,494	51
New York	Cross Island Pkwy NB	Grand Central Pkwy/Exit 29 I-295/Throgs Neck Brg/Exit 33	4.67	84	13	205	32	8,657	35
Los Angeles	I-5 NB (Santa Ana/Golden St Fwys)	CA-39/Beach Blvd Riverside Dr	22.45	83	14	928	1	39,875	1
Los Angeles	US-101 NB (Santa Ana/Hollywood Fwys)	I-5/CA-60 Haskell Ave	21.51	81	15	860	2	37,464	3
Los Angeles	Santa Monica Fwy/I-10 EB	CA-1/Lincoln Blvd/Exit 1B Alameda St	14.89	73	16	507	12	23,116	11
Los Angeles	I-5 SB	CA-73 CA-1/Camino De Vis	5.79	73	16	208	31	9,135	31
New York	Laurelton/Belt/Shore Pkwys WB	Francis Lewis Blvd/Exit 24 Nassau Expy/Exit 19	4.89	73	16	190	35	7,902	40
Seattle	I-5 SB	WA-523/145th St/Exit 175 Union St/Exit 165	8.95	71	19	307	21	13,718	23
New York	Belt Pkwy EB	Knapp St Pennsylvania Ave/Exit 14	7.47	70	20	273	27	11,560	28

Delay Per Mile—Extra travel time during the year due to congestion, divided by the corridor length. Wasted Fuel—Increased fuel consumption due to travel in congested conditions rather than free-flow conditions. Congestion Cost—Value of travel time delay (estimated at $16 per hour for person travel and $88 per hour for truck time) and excess fuel consumption (estimated using state average cost per gallon of gasoline and diesel). Note: Please do not place too much emphasis on small differences in the rankings. There may be little difference between (for example) 5th and 10th. The actual measure values should also be examined.

Table 6. Weekend Warriors (Top 40), continued

Urban Area	Corridor	Corridor Endpoints From To	Corridor Length (miles)	2010 Weekend Congestion (Saturday and Sunday)					
				Delay Per Mile		Wasted Fuel		Congestion Cost	
				Person-hrs (x 1000)	Rank	Gallons (x 1000)	Rank	(x $1000)	Rank
New York	Major Deegan Expy SB	Van Cortlandt Park/Exit 11 I-95/Cross Bronx Expy/Exit 7	3.5	70	20	134	52	5,431	60
Los Angeles	US-101 SB (Ventura/Hollywood Fwys)	Ventura Blvd/Shoup Ave Vignes St/Exit 2B	26.73	68	22	859	3	38,756	2
Austin	I-35 NB	Shelby Ln/St Elmo Rd/Exit 230 Martin Luther King Blvd/19th St/Exit 235	4.71	67	23	160	44	6,812	48
San Francisco	I-80 WB	Hillcrest Rd US-101	3.51	67	23	115	62	4,881	66
San Francisco	Eastshore Fwy/I-80 EB/I-580 WB	Cypress St University Ave	3.33	66	25	103	70	4,462	71
Los Angeles	CA-110 SB (Pasadena/Harbor Fwys)	Avenue 60 Olympic Blvd/9th St	6.56	64	26	200	33	9,007	32
Los Angeles	Riverside Fwy/CA-91 EB	CA-55/Costa Mesa Fwy McKinley St	20.72	62	27	618	6	28,247	6
Los Angeles	I-5 SB (Santa Ana/Golden St Fwys)	East Cesar Chavez Ave Valley View Ave	17.52	62	27	532	9	23,458	10
Seattle	I-5 NB	Albro Pl/Swift Ave/Exit 161 James St/Exit 164	4.12	61	29	131	53	5,480	58
Washington, DC	I-95 SB	I-395 Russell Rd/Exit 148	23.94	60	30	650	4	29,677	4
Houston	I-45 SB	Sam Houston Tollway/Exit 32 FM-2351/Exit 29	3.65	59	31	104	68	4,557	69
Chicago	Eisenhower Expy/I-290 WB	S Ashland Ave/Exit 28B 9th Ave/Exit 19B	8.87	57	32	295	24	12,110	26
New York	Van Wyck Expy/I-678 SB	Horace Harding Expy/Exit 12A Linden Blvd/Exit 3	6.15	57	32	182	39	7,688	42
New York	Long Island Expy/I-495 WB	Glen Cove Rd/Exit 39 Woodhaven Blvd	14.92	56	34	419	15	18,291	15
Philadelphia	Schuylkill Expy/I-76 WB	Oregon Ave/Passyunk Ave/Exit347 Belmont Ave/Exit 338	9.48	55	35	291	26	11,797	27
New York	Long Island Expy/I-495 EB	Maurice Ave/Exit 18 Mineola Ave/Willis Ave/Exit 37	15.97	54	36	441	14	18,795	14
Los Angeles	Santa Monica Fwy/I-10 WB	I-5/Golden State Fwy National Blvd	12.55	53	37	299	23	14,119	22
Dallas-Fort Worth	Loop 820/I-820 WB	TX-26/Grapevine Hwy US-377/Denton Hwy/Exit 19	3.13	53	37	85	80	3,583	87
New York	Belt/Shore/Laurelton Pkwys EB	I-678/Van Wyck Expy/Exit 20 Merrick Blvd/Exit 24	3.56	51	39	90	75	3,971	80
Los Angeles	San Bernadino Fwy/I-10 EB	City Terrace Dr/Herbert Ave Baldwin Park Blvd	12.8	50	40	304	22	13,693	24
Austin	I-35 SB	US-183/Exit 239-240 Woodland Ave	6.69	50	40	165	42	7,169	44
Los Angeles	I-10 WB	Citrus St Baldwin Park Blvd	5.22	50	40	117	60	5,594	57

Delay Per Mile—Extra travel time during the year due to congestion, divided by the corridor length. Wasted Fuel—Increased fuel consumption due to travel in congested conditions rather than free-flow conditions. Congestion Cost—Value of travel time delay (estimated at $16 per hour for person travel and $88 per hour for truck time) and excess fuel consumption (estimated using state average cost per gallon of gasoline and diesel). Note: Please do not place too much emphasis on small differences in the rankings. There may be little difference between (for example) 5th and 10th. The actual measure values should also be examined.

Table 7. Where the Big Trucks Are (Top 40)

Urban Area	Corridor	Corridor Endpoints From To	Corridor Length (miles)	2010 All-day Everyday Truck Congestion: Delay Per Mile Person-hrs (x 1000)	Rank	Wasted Fuel Gallons (x 1000)	Rank	Congestion Cost (x $1000)	Rank
Los Angeles	Harbor Fwy/CA-110 NB	I-10/Santa Monica Fwy Stadium Way/Exit 24C	3.1	98	1	469	34	22,655	33
Los Angeles	Harbor Fwy/I-110 NB	111th Pl I-110/I-10/Santa Monica Fwy	6.5	76	2	806	16	37,507	16
Los Angeles	San Diego Fwy/I-405 NB	I-105/Imperial Hwy Getty Center Dr	13.1	64	3	1,340	3	63,503	3
New York	Van Wyck Expy/I-678 NB	Belt Pkwy/Exit 1 Main St/Exit 8	3.1	52	4	244	78	12,200	65
New York	I-278 EB (Gowanus Expy/Brooklyn Queens)	92nd St/Exit 17 Apollo St/Meeker Ave/Exit 34	11.6	46	5	827	15	40,450	12
Los Angeles	San Gabriel River Fwy/I-605 SB	Beverly Blvd Florence Ave	4.8	45	6	365	50	16,435	49
Los Angeles	Riverside Fwy/CA-91 EB	CA-55/Costa Mesa Fwy McKinley St	20.7	43	7	1,485	2	67,672	1
New York	I-278 WB (Brooklyn Queens/Gowanus Expy)	NY-25A/Northern Blvd/Exit 41 NY-27/Prospect Expy/Exit 24	10.2	43	7	681	19	33,105	18
Los Angeles	Santa Monica Fwy/I-10 EB	CA-1/Lincoln Blvd/Exit 1B Alameda St	14.9	42	9	1,075	9	47,961	9
Los Angeles	Santa Monica Fwy/I-10 WB	I-5/Golden State Fwy National Blvd	12.6	42	9	893	12	39,895	13
Chicago	Stevenson Expy/I-55 SB	State St/Exit 293C Pulaski Rd/Exit 287	5.7	42	9	385	44	18,063	43
Chicago	Eisenhower Expy/I-290 WB	S Ashland Ave/Exit 28B 9th Ave/Exit 19B	8.9	40	12	606	25	26,869	24
New York	Van Wyck Expy/I-678 SB	Horace Harding Expy/Exit 12A Linden Blvd/Exit 3	6.2	40	12	377	47	18,496	38
Pittsburgh	Penn Lincoln Pkwy/I-376 EB	Lydia St/Exit 2 US-19 TK RT/PA-51/Exit 5	3.4	40	12	209	97	10,241	81
Austin	I-35 SB	US-183/Exit 239-240 Woodland Ave	6.7	38	15	397	40	19,202	37
Baton Rouge	I-12 EB	Essen Ln O'Neal Ln	5.8	38	15	343	52	16,632	47
Austin	I-35 NB	Shelby Ln/St Elmo Rd/Exit 230 Martin Luther King Blvd/19th St/Exit 235	4.7	38	15	293	61	13,596	57
Los Angeles	I-110 SB	W Vernon Ave 51st St	2.5	38	15	167	126	7,206	127
Chicago	Eisenhower Expy/I-290 EB	IL-72/Higgins Rd/Exit 1 Austin Blvd/Exit 23A	21.5	36	19	1,340	3	59,182	4
Chicago	I-90/I-94 EB (Kennedy/Dan Ryan Expys)	I-294/Tri State Tollway Ruble St/Exit 52B	15.9	36	19	903	11	42,869	11

Delay Per Mile—Extra travel time during the year due to congestion, divided by the corridor length. Wasted Fuel—Increased fuel consumption due to travel in congested conditions rather than free-flow conditions. Congestion Cost—Value of travel time delay (estimated at $16 per hour for person travel and $88 per hour for truck time) and excess fuel consumption (estimated using state average cost per gallon of gasoline and diesel). Note: Please do not place too much emphasis on small differences in the rankings. There may be little difference between (for example) 5th and 10th. The actual measure values should also be examined.

Table 7. Where the Big Trucks Are (Top 40), continued

Urban Area	Corridor	Corridor Endpoints From / To	Corridor Length (miles)	2010 All-day Everyday Truck Congestion: Delay Per Mile, Person-hrs (x 1000)	Delay Per Mile Rank	Wasted Fuel, Gallons (x 1000)	Wasted Fuel Rank	Congestion Cost (x $1000)	Congestion Cost Rank
New York	Major Deegan Expy/I-87 NB	I-278/Bruckner Expy I-95/Cross Bronx Expy/Exit 7	4.1	36	19	232	84	11,249	74
Los Angeles	I-5 SB (Santa Ana/Golden St Fwys)	East Cesar Chavez Ave Valley View Ave	17.5	35	22	1,017	10	46,126	10
New York	I-95 SB (NE Thwy, Bruckner/Cross Bronx Expys)	Conner St/Exit 13 Hudson Ter	22.7	34	23	1,153	8	57,540	5
Los Angeles	US-101 NB (Santa Ana/Hollywood Fwys)	I-5/CA-60 Haskell Ave	21.5	34	23	1,223	6	55,039	7
Philadelphia	Schuylkill Expy/I-76 WB	Oregon Ave/Passyunk Ave/Exit347 Belmont Ave/Exit 338	9.5	34	23	545	30	24,557	29
Los Angeles	CA-110 SB (Pasadena/Harbor Fwys)	Avenue 60 Olympic Blvd/9th St	6.6	34	23	375	48	17,134	45
Los Angeles	I-5 NB (Santa Ana/Golden St Fwys)	CA-39/Beach Blvd Riverside Dr	22.5	33	27	1,256	5	56,422	6
Boston	Southeast Expy/I-93 NB	MA-28/Randolph Ave/Exit 5 Columbia Rd/Exit 15	10.4	33	27	569	28	26,031	26
San Francisco	Grove Shafter Fwy/CA-24 WB	Saint Stephens Dr Caldecott Tunnel	3.5	33	27	181	115	8,815	103
Los Angeles	US-101 SB (Ventura/Hollywood Fwys)	Ventura Blvd/Shoup Ave Vignes St/Exit 2B	26.7	32	30	1,513	1	66,000	2
New York	Long Island Expy/I-495 EB	Maurice Ave/Exit 18 Mineola Ave/Willis Ave/Exit 37	16.0	32	30	855	14	39,269	14
Los Angeles	San Bernadino Fwy/I-10 EB	City Terrace Dr/Herbert Ave Baldwin Park Blvd	12.8	32	30	662	21	30,872	19
New York	Goethals Brg EB/I-278 EB	Meeker Ave/Forest Ave/Exit 4 Bradley Ave/Exit 11	3.3	32	30	169	124	7,946	117
Los Angeles	San Diego Fwy/I-405 NB	MacArthur Blvd Brookhurst St	7.8	31	34	416	38	18,489	39
Houston	N Loop W Fwy/I-610 EB	US-290 Yale St	4.0	31	34	216	92	9,446	95
San Francisco	I-80 EB (James Lick Fwy/Bay Brdg)	US-101 Treasure Island Rd	3.6	31	34	171	122	8,256	111
Seattle	I-5 SB	WA-523/145th St/Exit 175 Union St/Exit 165	9.0	30	37	469	34	20,537	35
Atlanta	I-285 EB	Riverside Dr/Exit 24 I-85/Exit 33	9.1	30	37	461	36	20,503	36
Los Angeles	San Diego Fwy/I-405 SB	Nordhoff St Mulholland Dr	8.1	30	37	382	46	18,151	42
New York	Major Deegan Expy SB	Van Cortlandt Park/Exit 11 I-95/Cross Bronx Expy/Exit 7	3.5	30	37	172	121	8,035	116
New York	I-95 NB (Cross Bronx/Bruckner Expys)	I-80/NJ Tpke Pelham Pkwy/Exit 8	11.5	29	41	538	31	25,256	27
New York	I-278 WB	New York Ave Slosson Ave/Exit 12	3.2	29	41	145	137	6,853	132

Delay Per Mile—Extra travel time during the year due to congestion, divided by the corridor length. Wasted Fuel—Increased fuel consumption due to travel in congested conditions rather than free-flow conditions. Congestion Cost—Value of travel time delay (estimated at $16 per hour for person travel and $88 per hour for truck time) and excess fuel consumption (estimated using state average cost per gallon of gasoline and diesel). Note: Please do not place too much emphasis on small differences in the rankings. There may be little difference between (for example) 5th and 10th. The actual measure values should also be examined.

Table 8. One-Hit Wonders (Top 40)

Urban Area	Corridor	Corridor Endpoints From To	Corridor Length (miles)	2010 All-day Everyday Congestion: Delay Per Mile, Person-hrs (x 1000)	Rank	Wasted Fuel, Gallons (x 1000)	Rank	Congestion Cost (x $1000)	Rank
Tampa	I-275 SB	Floribraska Ave/28th Ave/Exit 28 US-92/Dale Mabry Hwy/Exit 23	4.2	278	93	562	153	24,682	152
Las Vegas	I-15 NB	Tropicana Ave/Exit 37 Sahara Ave/Exit 40	3.2	273	100	427	190	18,787	194
Denver	I-25 SB	58th Ave/Exit 215 CO-2/Colorado Blvd/Exit 204	10.9	265	107	1,402	50	61,549	52
Phoenix	Papago Fwy/I-10 WB	AZ-51/AZ-202/Exit 147 35th Ave/Exit 141	6.2	253	118	784	102	33,970	107
Orlando	I-4 EB	Floridas Turnpike/Exit 31 FL-423/Lee Rd/Exit 46	9.8	252	119	1,149	63	51,759	63
Phoenix	I-10 EB (Papago/Maricopa Fwys)	Buckeye Rd/Exit 149 Broadway Rd/52nd St/Exit153B	6.1	252	119	759	105	33,067	110
Denver	I-25 NB	Evans Ave/Exit 203 84th Ave/Exit 219	15.1	235	132	1,679	40	75,464	40
Detroit	Edsel Ford Fwy/I-94 EB	Grand Blvd/Exit 213 Chene St/Exit 217	4.0	204	158	397	204	17,187	208
Norfolk	Hampton Roads Beltway/I-64 EB	Rip Rap Rd/Exit 265 Hampton Roads Brg Tunl(Hampton)	3.1	204	158	310	234	13,230	246
Santa Cruz	Cabrillo Hwy/CA-1 SB	CA-17 Park Ave	4.8	200	161	420	194	18,526	195
Norfolk	Hampton Roads Beltway/I-64 WB	VA-168/Tidewater Dr/Exit 277 Hampton Roads Brg Tunl(Norfolk)	6.4	195	167	587	147	25,823	147
Providence	I-95 SB	US-1/George St/Exit 27 RI-7/RI-146/Charles St/Exit 23	3.2	191	171	287	248	12,266	262
Orlando	I-4 WB	FL-423/Lee Rd/Exit 46 FL-408/Exit 36	5.7	190	172	497	170	22,645	167
Hartford	I-84 EB	S Main St/Exit 41 I-91/Exit 51-52	6.7	189	175	614	139	26,683	141
Tampa	I-275 NB	Howard Franklin Brg Lois Ave/Exit 22	3.4	182	186	283	249	12,891	249
Charlotte	I-485 EB	NC-49/Tryon St/Exit 1 NC-51/Exit 64	5.3	178	192	451	181	20,543	180
Providence	I-95 NB	US-1/Elmwood Ave/Exit 17 US-6/RI-10/Exit 22	4.0	173	197	331	224	14,014	235
Nashville	I-440 EB	TN-1/End Ave/Exit 1 US-31 Alt/US-41 Alt/Nolensville Pike/Exit6	4.8	160	212	414	197	17,674	206
Hartford	I-84 WB	US-5/Main St Flatbush Ave/Exit 45	5.5	148	224	396	205	16,818	211

Delay Per Mile—Extra travel time during the year due to congestion, divided by the corridor length. Wasted Fuel—Increased fuel consumption due to travel in congested conditions rather than free-flow conditions. Congestion Cost—Value of travel time delay (estimated at $16 per hour for person travel and $88 per hour for truck time) and excess fuel consumption (estimated using state average cost per gallon of gasoline and diesel). Note: Please do not place too much emphasis on small differences in the rankings. There may be little difference between (for example) 5th and 10th. The actual measure values should also be examined.

Table 8. One-Hit Wonders (Top 40), continued

Urban Area	Corridor	Corridor Endpoints From To	Corridor Length (miles)	2010 All-day Everyday Congestion: Delay Per Mile Person-hrs (x 1000)	Rank	Wasted Fuel Gallons (x 1000)	Rank	Congestion Cost (x $1000)	Rank
Santa Barbara	US-101 SB	Mission St San Ysidro Rd	5.9	147	227	414	197	18,211	199
Santa Rosa CA	US-101 NB	Railroad Ave Commerce Blvd/Wilfred Ave	4.2	136	238	274	255	12,249	263
Charleston	I-26 WB	Dorchester Rd W Aviation Ave	4.3	132	247	270	259	12,485	256
Oxnard CA	Ventura Fwy/US-101 NB	Camarillo Springs Rd Las Posas Rd	5.2	128	255	320	229	14,503	228
St. Louis	I-270 SB	Ladue Rd/Exit 13 Dougherty Ferry Rd/Exit 8	5.1	124	259	294	245	13,642	243
San Antonio	I-410 EB	Starcrest Dr/Exit 25 Interchange Pkwy/Exit 26	1.1	121	261	63	327	2,682	327
Raleigh	I-40 EB	Airport Blvd/Exit 284 NC-54/Exit 290	6.9	116	265	371	213	17,992	200
Kansas City	I-70 EB	18th St/Exit 4 I-435/Exit 8	4.2	103	281	207	289	9,024	294
San Antonio	I-35 NB	Judson Rd/Exit 170 Evans Rd/Exit 174	3.8	100	285	147	310	7,606	301
Louisville	I-64 WB	Cannons Ln/Exit 10 I-71/Exit 6	4.4	92	289	203	290	9,093	292
Harrisburg	I-83 NB	3rd St/Exit 42 Union Deposit Rd/Exit 48	6.7	86	296	305	239	13,703	242
Dayton	I-75 NB	Dixie Hwy/Central Ave/Exit 47 Keowee St/Exit 55	7.2	83	298	329	225	14,291	232
Charlotte	I-85 NB	University City Blvd Speedway Blvd/Exit 49	6.2	78	304	219	284	10,708	275
Vallejo-Fairfield CA	I-80 EB	Suisun Valley Rd N Texas St	7.4	70	310	229	277	10,524	277
Birmingham	I-65 SB	US-31/Montgomery Hwy/Exit 252 Jefferson/Shelby County Line	3.5	66	311	108	320	5,365	318
Charleston	I-26 EB	US-78/University Blvd Dorchester Rd	10.5	52	320	240	271	12,230	264
Statesville-Mooresville NC	I-77 SB	NC-150/Exit 36 Iredell/Mecklenburg Co Line	8.8	44	324	176	296	8,528	297
Allentown PA-NJ	US-22 WB	15th St PA-145/Macarthur Rd	3.4	13	328	15	328	1,018	328

Delay Per Mile—Extra travel time during the year due to congestion, divided by the corridor length. Wasted Fuel—Increased fuel consumption due to travel in congested conditions rather than free-flow conditions. Congestion Cost—Value of travel time delay (estimated at $16 per hour for person travel and $88 per hour for truck time) and excess fuel consumption (estimated using state average cost per gallon of gasoline and diesel). Note: Please do not place too much emphasis on small differences in the rankings. There may be little difference between (for example) 5th and 10th. The actual measure values should also be examined.

Table 9. Reliably Unreliable (All 328 Corridors)

Area	Corridor	Limits (From/To)	Corridor Length (miles)	2010 Weekday Peak-period Travel Time Reliability					
				Buffer Index (%)	Rank	Planning Time Index	Rank	Travel Time Index	Rank
Atlanta	GA-400 SB	Toll Plaza I-85/Exit 87	4.1	256	1	4.83	15	1.63	216
Atlanta	I-75 SB	Mount Zion Pkwy/Exit 231 Hudson Bridge Rd/Exit 224	6.7	253	2	4.68	23	1.34	314
New York	Hutchinson River Pkwy NB	Cross County Pkwy/Exit 15 Mamaroneck Rd/Exit 22	4.5	215	3	4.69	22	1.49	273
New York	Bronx Whitestone Brg NB/Whitestone Expy NB	Linden Pl/Exit 14 Toll Plaza	3.4	215	3	4.62	24	1.80	130
Norfolk	Hampton Roads Beltway/I-64 EB	Rip Rap Rd/Exit 265 Hampton Roads Brg Tunl(Hampton)	3.1	198	5	5.28	6	1.89	98
New York	Pulaski Skwy NB	I-95/Exp US-1 Tonnele Ave	3.3	197	6	4.29	29	1.70	179
New Haven	I-84 WB	I-691 (Cheshire) (West) Austin Rd/Exit 25A	3.4	189	7	4.26	33	1.64	213
Houston	N Loop W Fwy/I-610 EB	US-290 Yale St	4.0	188	8	4.03	58	2.23	34
Pittsburgh	Penn Lincoln Pkwy/I-376 EB	Lydia St/Exit 2 US-19 TK RT/PA-51/Exit 5	3.4	186	9	6.84	2	3.12	3
Riverside	Ontario Fwy/I-15 NB	I-210/Exit 115 Glen Helen Pkwy	6.2	182	10	3.23	167	1.26	321
New York	Major Deegan Expy SB	Van Cortlandt Park/Exit 11 I-95/Cross Bronx Expy/Exit 7	3.5	173	11	4.96	9	1.89	98
Washington, DC	I-70 WB	MD-144/Exit 59 US-15/US-340/Exit 52	6.8	173	11	3.31	148	1.27	320
New Orleans	I-10 EB	Loyola Dr Veterans Memorial Blvd	3.5	170	13	4.45	26	1.75	153
Louisville	I-64 WB	Cannons Ln/Exit 10 I-71/Exit 6	4.4	170	13	4.18	42	1.64	213
Washington, DC	I-95 SB	I-395 Russell Rd/Exit 148	23.9	165	15	4.71	21	1.89	98
New York	I-95 SB (NE Thwy, Bruckner/Cross Bronx Expys)	Conner St/Exit 13 Hudson Ter	22.7	161	16	5.58	3	2.74	6
San Francisco	California Delta Hwy/CA-4 EB	Bailey Rd Somersville Rd	5.8	161	16	5.39	4	2.08	52
Baltimore	John Hanson Hwy/US-50/US-301 EB	I-97/Exit 21 MD-70/Rowe Blvd/Exit 24	3.4	161	16	4.09	51	1.67	198

Buffer Index—measure of trip reliability that expresses the amount of extra "buffer" time needed to be on time for 95 percent of trips. A BI of 150 percent means that for a trip that takes 30 minutes on average, 45 extra minutes should be planned (30 minutes x 150% = 45 minutes). Planning Time Index—represents the total travel time that should be planned for a trip. It differs from the BI in that it includes typical delay as well as unexpected delay. A PTI of 2.50 means that for a 30-minute trip in light traffic, 75 minutes should be planned (30 minutes x 2.50 = 75 minutes). Travel Time Index—the ratio of travel time in the peak period to the travel time at free-flow conditions. A value of 1.30 indicates a 20-minute free-flow trip takes 26 minutes in the peak period. Note: Please do not place too much emphasis on small differences in rankings. There may be little difference between (for example) 5th and 10th. The actual measure values should also be examined.

Table 9. Reliably Unreliable (All 328 Corridors), continued

Area	Corridor	Limits (From/To)	Corridor Length (miles)	2010 Weekday Peak-period Travel Time Reliability					
				Buffer Index (%)	Rank	Planning Time Index	Rank	Travel Time Index	Rank
Baton Rouge	I-10 EB	LA-415/Exit 151 Dalrymple Dr/Exit 156	4.7	157	19	4.12	49	1.67	198
Chicago	I-55 NB	IL-53/Exit 267 IL-83/Kingery Hwy/Exit 274	8.9	155	20	3.66	90	1.49	273
New Haven	I-95 NB	Marsh Hill Rd/Exit 41 Ella T Grasso Blvd/Exit 45	4.0	151	21	4.29	29	1.85	110
Cincinnati	I-75 SB	I-74/US-52/US-27/Exit 4 W 7th St/Exit 1	3.4	151	21	4.09	51	1.89	98
Birmingham	I-65 SB	US-31/Montgomery Hwy/Exit 252 Jefferson/Shelby County Line	3.5	151	21	2.66	270	1.36	310
Chicago	Stevenson Expy/I-55 SB	IL-43/Harlem Ave/Exit 283 County Line Rd/Exit 276A	7.3	150	24	4.07	53	1.69	189
Baton Rouge	I-10 WB	Siegen Ln/Exit 163 Perkins Rd/Exit 157	6.4	150	24	3.70	86	1.48	277
San Francisco	I-580 EB	Eden Canyon Rd El Charro Rd/Fallon Rd	9.6	147	26	4.24	35	1.92	92
Chicago	Eisenhower Expy/I-290 EB	IL-72/Higgins Rd/Exit 1 Austin Blvd/Exit 23A	21.5	144	27	4.61	25	1.99	75
Washington, DC	Capital Beltway/I-495 Inner Loop	I-95/I-395/Exit 57 MD-650/New Hampshire Ave/Exit28	41.4	144	27	4.29	29	2.06	59
Cincinnati	I-75 SB	OH-126/Exit 14 Ronald Reagan Cross County Hwy/Exit10	3.9	140	29	3.83	76	1.68	195
Chicago	Eisenhower Expy/I-290 WB	S Ashland Ave/Exit 28B 9th Ave/Exit 19B	8.9	139	30	4.87	12	2.07	56
Charlotte	I-85 NB	University City Blvd Speedway Blvd/Exit 49	6.2	134	31	3.28	153	1.40	304
Los Angeles	I-710 NB	Alondra Blvd Imperial Hwy	3.0	133	32	3.83	76	1.70	179
Boston	I-495 NB	MA-110/Chelmsford St/Exit 34 Woburn St/Exit 37	3.0	132	33	3.94	71	1.77	147
Atlanta	I-75/I-85 NB	GA-166 US-78/US-278/US-29/Exit 249	7.6	132	33	3.27	156	1.78	143
New York	Major Deegan Expy/I-87 NB	I-278/Bruckner Expy I-95/Cross Bronx Expy/Exit 7	4.1	131	35	4.75	19	2.19	38
Dallas-Fort Worth	Thornton Fwy/I-30 WB	Saint Francis Ave/Exit 52 Griffin St	7.2	130	36	4.13	48	1.96	80

Buffer Index—measure of trip reliability that expresses the amount of extra "buffer" time needed to be on time for 95 percent of trips. A BI of 150 percent means that for a trip that takes 30 minutes on average, 45 extra minutes should be planned (30 minutes x 150% = 45 minutes). Planning Time Index—represents the total travel time that should be planned for a trip. It differs from the BI in that it includes typical delay as well as unexpected delay. A PTI of 2.50 means that for a 30-minute trip in light traffic, 75 minutes should be planned (30 minutes x 2.50 = 75 minutes). Travel Time Index—the ratio of travel time in the peak period to the travel time at free-flow conditions. A value of 1.30 indicates a 20-minute free-flow trip takes 26 minutes in the peak period. Note: Please do not place too much emphasis on small differences in rankings. There may be little difference between (for example) 5th and 10th. The actual measure values should also be examined.

Table 9. Reliably Unreliable (All 328 Corridors), continued

Area	Corridor	Limits (From/To)	Corridor Length (miles)	2010 Weekday Peak-period Travel Time Reliability: Buffer Index (%)	Rank	Planning Time Index	Rank	Travel Time Index	Rank
Houston	I-10 EB	T C Jester Blvd/Exit 765 McKee St/San Jacinto St	4.4	129	37	4.18	42	2.17	42
Chicago	I-290 WB	I-88/Exit 15A IL-83/Exit 10A	6.0	128	38	3.95	68	1.69	189
Atlanta	I-85 SB	GA-13/Exit 86 (East) I-75/Exit 85	2.5	127	39	5.30	5	2.37	23
New York	Henry Hudson Pkwy NB	W 72nd St I-95/Riverside Dr/Exit 14-15	6.2	126	40	4.20	38	1.79	137
New York	FDR Dr NB	I-495/Tunnel Exit St/Queens Midtown Tunl 116th St/Exit 16	4.0	126	40	3.93	72	1.88	103
Seattle	I-5 SB	84th St/Hosmer St/Exit 128 41st Division Dr/Exit 120	7.9	126	40	3.16	173	1.47	280
New York	Garden State Pkwy SB	Watchung Ave/Exit 151 Walnut St/Exit 147	4.5	125	43	3.27	156	1.58	235
Boston	I-93 NB	MA-213/Exit 48 Pelham Rd/Exit 2	7.3	125	43	2.98	213	1.38	308
Boston	Southeast Expy/I-93 NB	MA-28/Randolph Ave/Exit 5 Columbia Rd/Exit 15	10.4	124	45	4.84	14	2.45	16
New York	Goethals Brg EB/I-278 EB	Meeker Ave/Forest Ave/Exit 4 Bradley Ave/Exit 11	3.3	124	45	4.80	17	2.33	27
Washington, DC	Capital Beltway/I-495 Outer Loop	US-1/Baltimore Ave/Exit 25 MD-97/Georgia Ave/Exit 31	6.3	124	45	4.73	20	2.26	31
Chicago	Stevenson Expy/I-55 NB	US-20/US-45/US-12/Exit 279A Pulaski Rd/Exit 287	8.9	123	48	4.20	38	1.93	91
Dayton	I-75 NB	Dixie Hwy/Central Ave/Exit 47 Keowee St/Exit 55	7.2	123	48	3.16	173	1.43	295
San Francisco	I-680 NB	Scott Creek Rd Andrade Rd/Mission Rd	9.5	122	50	3.53	109	1.67	198
Dallas-Fort Worth	North Fwy/I-35W NB	Rosedale St/Exit 49B Western Center Blvd/Exit 58	9.5	121	51	4.19	40	2.01	69
New York	I-287 NB	Randolphville Rd/Exit 7 Easton Ave/Exit 10	3.4	121	51	3.93	72	1.78	143
Baltimore	Baltimore Beltway Outer Loop/I-695 SB	MD-140/Reisterstown Rd/Exit20 US-40/Exit 15	7.1	121	51	3.67	89	1.67	198
Norfolk	Hampton Roads Beltway/I-64 WB	VA-168/Tidewater Dr/Exit 277 Hampton Roads Brg Tunl(Norfolk)	6.4	120	54	4.14	46	1.96	80

Buffer Index—measure of trip reliability that expresses the amount of extra "buffer" time needed to be on time for 95 percent of trips. A BI of 150 percent means that for a trip that takes 30 minutes on average, 45 extra minutes should be planned (30 minutes x 150% = 45 minutes). Planning Time Index—represents the total travel time that should be planned for a trip. It differs from the BI in that it includes typical delay as well as unexpected delay. A PTI of 2.50 means that for a 30-minute trip in light traffic, 75 minutes should be planned (30 minutes x 2.50 = 75 minutes). Travel Time Index—the ratio of travel time in the peak period to the travel time at free-flow conditions. A value of 1.30 indicates a 20-minute free-flow trip takes 26 minutes in the peak period. Note: Please do not place too much emphasis on small differences in rankings. There may be little difference between (for example) 5th and 10th. The actual measure values should also be examined.

Table 9. Reliably Unreliable (All 328 Corridors), continued

Area	Corridor	Limits (From/To)	Corridor Length (miles)	2010 Weekday Peak-period Travel Time Reliability					
				Buffer Index (%)	Rank	Planning Time Index	Rank	Travel Time Index	Rank
Boston	I-93 SB	I-95/MA-128/Exit 37 US-1/Exit 27	9.8	120	54	3.41	126	1.95	85
New York	Cross Island Pkwy NB	Grand Central Pkwy/Exit 29 I-295/Throgs Neck Brg/Exit 33	4.7	120	54	3.04	201	1.41	301
Seattle	I-5 SB	WA-523/145th St/Exit 175 Union St/Exit 165	9.0	118	57	4.05	57	1.94	89
New York	I-278 EB (Gowanus Expy/Brooklyn Queens)	92nd St/Exit 17 Apollo St/Meeker Ave/Exit 34	11.6	117	58	4.82	16	2.46	15
Seattle	WA-520 WB	148th Ave 84th Ave	4.2	117	58	3.33	140	2.00	70
Washington, DC	I-270 NB	Middlebrook Rd/Exit 13 MD-109/Exit 22	8.5	117	58	3.26	160	1.45	288
Dallas-Fort Worth	North Fwy/I-35W SB	Golden Triangle Blvd/Exit 64 TX-121/Exit 52	11.8	116	61	4.01	61	1.96	80
Dallas-Fort Worth	I-635 WB	US-75/Exit 19 Josey Ln/Exit 26	8.3	116	61	3.51	114	1.65	210
Philadelphia	Schuylkill Expy/I-76 WB	Oregon Ave/Passyunk Ave/Exit347 Belmont Ave/Exit 338	9.5	115	63	4.02	59	2.14	45
Bridgeport	Connecticut Turnpike/I-95 SB	Brookside Dr US-1/Exit 5	4.3	115	63	3.32	143	1.56	243
Houston	Eastex Fwy/US-59 SB	Quitman St/Liberty Rd TX-288	4.1	114	65	4.02	59	1.95	85
Portland	US-26 EB	OR-217/Exit 69 Canyon Rd/Exit 73	4.2	114	65	3.72	84	1.83	119
Santa Barbara	US-101 SB	Mission St San Ysidro Rd	5.9	114	65	3.64	91	1.68	195
New York	Belt Pkwy EB	Knapp St Pennsylvania Ave/Exit 14	7.5	114	65	3.62	96	1.62	224
Los Angeles	I-5 SB	Buena Vista St Mission Rd	12.6	114	65	2.92	224	1.54	252
Hartford	I-84 EB	S Main St/Exit 41 I-91/Exit 51-52	6.7	111	70	3.73	82	1.77	147
New Orleans	Pontchartrain Expy WB	Whitney Ave Oretha C Haley Blvd	3.6	111	70	3.64	91	1.84	114
Dallas-Fort Worth	I-35E NB	Hundley Dr/Exit 457B Post Oak Dr/Exit 461	3.8	111	70	3.59	99	1.79	137

Buffer Index—measure of trip reliability that expresses the amount of extra "buffer" time needed to be on time for 95 percent of trips. A BI of 150 percent means that for a trip that takes 30 minutes on average, 45 extra minutes should be planned (30 minutes x 150% = 45 minutes). Planning Time Index—represents the total travel time that should be planned for a trip. It differs from the BI in that it includes typical delay as well as unexpected delay. A PTI of 2.50 means that for a 30-minute trip in light traffic, 75 minutes should be planned (30 minutes x 2.50 = 75 minutes). Travel Time Index—the ratio of travel time in the peak period to the travel time at free-flow conditions. A value of 1.30 indicates a 20-minute free-flow trip takes 26 minutes in the peak period. Note: Please do not place too much emphasis on small differences in rankings. There may be little difference between (for example) 5th and 10th. The actual measure values should also be examined.

Table 9. Reliably Unreliable (All 328 Corridors), continued

Area	Corridor	Limits (From/To)	Corridor Length (miles)	2010 Weekday Peak-period Travel Time Reliability					
				Buffer Index (%)	Rank	Planning Time Index	Rank	Travel Time Index	Rank
New York	Belt Pkwy WB	Ocean Pkwy Bay 8th St/Exit 4	3.5	111	70	2.90	226	1.36	310
New York	Van Wyck Expy/I-678 NB	Belt Pkwy/Exit 1 Main St/Exit 8	3.1	110	74	6.88	1	3.72	1
Boston	I-95/MA-128 NB	Neponset St/Exit 11 MA-1A/Exit 15	6.0	110	74	3.46	121	1.47	280
Bridgeport	Merritt Pkwy/CT-15 NB	Den Rd/Exit 33 CT-57/Exit 42	12.8	110	74	3.38	130	1.55	245
Philadelphia	Delaware Expy/I-95 NB	I-495/DE-92/Naamans Rd/Exit 11 US-322/Exit2/Exit3	3.2	109	77	3.06	195	1.55	245
Washington, DC	Shirley Hwy/I-395 NB	I-95/I-495 Southwest Fwy	21.6	108	78	4.00	63	1.82	123
Washington, DC	I-95 NB	Dale Blvd/Smoketown Rd/Eb Exit 156 VA-123/Exit 160	4.8	108	78	2.94	220	1.42	297
New York	Harlem River Dr NB	Willis Avenue Brg/Exit 18 I-95/Amsterdam Ave/Exit 23	3.2	107	80	4.80	17	2.37	23
New York	Cross Island Pkwy SB	14th Ave/Exit 35 NY-25/Exit 27	7.5	107	80	3.76	80	1.80	130
Riverside	Riverside Fwy/CA-91 EB	Van Buren Blvd Central Ave (East)	4.2	107	80	2.96	218	1.44	289
Baton Rouge	I-12 EB	Essen Ln O'Neal Ln	5.8	106	83	5.17	8	2.44	17
Los Angeles	Riverside Fwy/CA-91 EB	CA-55/Costa Mesa Fwy McKinley St	20.7	106	83	4.10	50	2.12	47
Chicago	Edens Expy/I-94 EB	Tower Rd/Exit 31 I-90/Kennedy Expy	11.0	106	83	3.87	75	2.12	47
Orlando	I-4 WB	FL-423/Lee Rd/Exit 46 FL-408/Exit 36	5.7	106	83	2.99	208	1.51	266
New York	I-287 WB	I-87/I-287 (Irvington) NY-303/Exit 12	7.9	106	83	2.81	241	1.44	289
Seattle	I-5 NB	Albro Pl/Swift Ave/Exit 161 James St/Exit 164	4.1	105	88	3.88	74	1.92	92
New York	Laurelton/Belt/Shore Pkwys WB	Francis Lewis Blvd/Exit 24 Nassau Expy/Exit 19	4.9	105	88	3.58	102	2.08	52
New York	Grand Central Pkwy WB	Little Neck Pkwy/Exit 24 Homelawn St/Exit 17/Exit 18	4.6	105	88	3.40	127	1.64	213

Buffer Index—measure of trip reliability that expresses the amount of extra "buffer" time needed to be on time for 95 percent of trips. A BI of 150 percent means that for a trip that takes 30 minutes on average, 45 extra minutes should be planned (30 minutes x 150% = 45 minutes). Planning Time Index—represents the total travel time that should be planned for a trip. It differs from the BI in that it includes typical delay as well as unexpected delay. A PTI of 2.50 means that for a 30-minute trip in light traffic, 75 minutes should be planned (30 minutes x 2.50 = 75 minutes). Travel Time Index—the ratio of travel time in the peak period to the travel time at free-flow conditions. A value of 1.30 indicates a 20-minute free-flow trip takes 26 minutes in the peak period. Note: Please do not place too much emphasis on small differences in rankings. There may be little difference between (for example) 5th and 10th. The actual measure values should also be examined.

Table 9. Reliably Unreliable (All 328 Corridors), continued

Area	Corridor	Limits (From/To)	Corridor Length (miles)	2010 Weekday Peak-period Travel Time Reliability					
				Buffer Index (%)	Rank	Planning Time Index	Rank	Travel Time Index	Rank
Philadelphia	Schuylkill Expy/I-76 EB	I-276 South St/Exit 346	18.9	105	88	3.24	166	1.78	143
Austin	I-35 SB	US-183/Exit 239-240 Woodland Ave	6.7	104	92	4.87	12	2.79	5
Chicago	I-90/I-94 WB (Dan Ryan/Kennedy Expys)	Pershing Rd/Exit 55B Sayre Ave/Exit 81B	15.4	104	92	4.25	34	2.50	13
Riverside	Riverside Fwy/CA-91 WB	McKinley St Auto Center Dr/Serfas Club Dr	5.6	104	92	3.69	88	1.66	204
New York	Southern State Pkwy EB	Franklin Ave/Exit 16 Wantagh Ave/Exit 28	10.3	104	92	3.64	91	1.80	130
Dallas-Fort Worth	I-30 EB	Hampton Rd/Exit 42 Barry Ave/Exit 48	6.9	104	92	3.55	106	1.70	179
Portland	I-5 SB	OR-99W/Barbur Blvd/Exit 294 Elligsen Rd/Exit 286	7.7	104	92	2.66	270	1.33	318
New York	I-278 WB (Brooklyn Queens/Gowanus Expy)	NY-25A/Northern Blvd/Exit 41 NY-27/Prospect Expy/Exit 24	10.2	103	98	4.88	11	2.61	10
Miami	Palmetto Expy/SR 826 SB	74th St 25th St	3.2	103	98	4.07	53	1.99	75
Baltimore	Baltimore Beltway Inner Loop/I-695 EB	MD-140/Reisterstown Rd/Exit20 MD-542/Loch Raven Blvd/Exit 29	10.2	103	98	3.52	112	1.72	165
San Francisco	Grove Shafter Fwy/CA-24 WB	Saint Stephens Dr Caldecott Tunnel	3.5	102	101	4.22	36	2.43	18
Dallas-Fort Worth	Loop 820/I-820 EB	Mark IV Pkwy/Exit 16 Rufe Snow Dr/Exit 20	5.2	102	101	3.99	64	2.08	52
Riverside	Ontario Fwy/I-15 NB	Limonite Ave Jurupa St	5.1	102	101	2.43	302	1.30	319
New York	I-95 NB (Cross Bronx/Bruckner Expys)	I-80/NJ Tpke Pelham Pkwy/Exit 8	11.5	101	104	3.31	148	1.81	126
Charleston	I-26 WB	Dorchester Rd W Aviation Ave	4.3	101	104	3.17	170	1.55	245
Boston	Southeast Expy/I-93 SB	I-90 Freeport St/Exit 13	3.7	101	104	3.07	190	1.72	165
Pittsburgh	Penn Lincoln Pkwy/I-376 WB	US-22 Bus/Exit 10 Squirrel Hill Tunl	5.3	100	107	4.18	42	2.37	23
Atlanta	I-285 EB	Riverside Dr/Exit 24 I-85/Exit 33	9.1	100	107	3.97	66	1.97	78

Buffer Index—measure of trip reliability that expresses the amount of extra "buffer" time needed to be on time for 95 percent of trips. A BI of 150 percent means that for a trip that takes 30 minutes on average, 45 extra minutes should be planned (30 minutes x 150% = 45 minutes). Planning Time Index—represents the total travel time that should be planned for a trip. It differs from the BI in that it includes typical delay as well as unexpected delay. A PTI of 2.50 means that for a 30-minute trip in light traffic, 75 minutes should be planned (30 minutes x 2.50 = 75 minutes). Travel Time Index—the ratio of travel time in the peak period to the travel time at free-flow conditions. A value of 1.30 indicates a 20-minute free-flow trip takes 26 minutes in the peak period. Note: Please do not place too much emphasis on small differences in rankings. There may be little difference between (for example) 5th and 10th. The actual measure values should also be examined.

Table 9. Reliably Unreliable (All 328 Corridors), continued

Area	Corridor	Limits (From/To)	Corridor Length (miles)	2010 Weekday Peak-period Travel Time Reliability					
				Buffer Index (%)	Rank	Planning Time Index	Rank	Travel Time Index	Rank
New York	Garden State Pkwy NB	I-78/Mill Rd/Exit 142 I-280/Exit 145	3.8	100	107	3.52	112	1.83	119
Seattle	I-5 NB	WA-527/Exit 189 Marine View Dr/Exit 195	5.6	100	107	3.48	118	1.70	179
Dallas-Fort Worth	US-75 NB	Exchange Pkwy/Exit 36 Eldorado Pkwy/Exit 39	4.4	100	107	3.14	177	1.58	235
Harrisburg	I-83 NB	3rd St/Exit 42 Union Deposit Rd/Exit 48	6.7	99	112	3.01	205	1.52	261
Chicago	I-90/I-94 EB (Kennedy/Dan Ryan Expys)	I-294/Tri State Tollway Ruble St/Exit 52B	15.9	98	113	4.35	28	2.72	7
New York	Grand Central Pkwy EB	I-278 I-295/NY-25/Exit 21	10.6	98	113	3.71	85	1.87	107
New York	NJ-17	Paramus Rd/Saddle River Rd Passaic St	5.5	98	113	3.61	97	1.79	137
Los Angeles	Pomona Fwy/CA-60 WB	Fairway Dr Peck Rd	10.4	98	113	3.47	120	1.69	189
Hartford	I-84 WB	US-5/Main St Flatbush Ave/Exit 45	5.5	98	113	3.34	138	1.66	204
Providence	I-95 NB	US-1/Elmwood Ave/Exit 17 US-6/RI-10/Exit 22	4.0	98	113	3.08	188	1.55	245
Boston	Pilgrims Hwy/MA-3 NB	MA-228/Hingham St/Exit 14 Union St/Exit 17	6.6	98	113	2.99	208	1.46	285
Seattle	I-5 NB	72nd St/74th St/Exit 129 I-705/WA-7/Exit 133	4.2	98	113	2.78	249	1.52	261
New York	Van Wyck Expy/I-678 SB	Horace Harding Expy/Exit 12A Linden Blvd/Exit 3	6.2	97	121	5.20	7	2.81	4
Detroit	Edsel Ford Fwy/I-94 EB	Grand Blvd/Exit 213 Chene St/Exit 217	4.0	97	121	3.77	79	1.83	119
San Francisco	Eastshore Fwy/I-80 WB/I-580 EB	Cutting Blvd Bay Bridge Toll Plz	8.5	97	121	3.57	103	1.94	89
Boston	I-95/MA-128 SB	US-3/Middlesex Tpke/Exit 32 MA-9/Worcester St/Exit 20	13.1	97	121	2.90	226	1.58	235
San Francisco	Nimitz Fwy/I-880 SB	I-238/Washington Ave CA-92/Jackson St	4.3	96	125	3.45	123	1.81	126
Riverside	Escondido Fwy/I-15 NB	CA-79/Old Town Front St CA-79/Winchester Rd	3.2	95	126	2.66	270	1.36	310

Buffer Index—measure of trip reliability that expresses the amount of extra "buffer" time needed to be on time for 95 percent of trips. A BI of 150 percent means that for a trip that takes 30 minutes on average, 45 extra minutes should be planned (30 minutes x 150% = 45 minutes). Planning Time Index—represents the total travel time that should be planned for a trip. It differs from the BI in that it includes typical delay as well as unexpected delay. A PTI of 2.50 means that for a 30-minute trip in light traffic, 75 minutes should be planned (30 minutes x 2.50 = 75 minutes). Travel Time Index—the ratio of travel time in the peak period to the travel time at free-flow conditions. A value of 1.30 indicates a 20-minute free-flow trip takes 26 minutes in the peak period. Note: Please do not place too much emphasis on small differences in rankings. There may be little difference between (for example) 5th and 10th. The actual measure values should also be examined.

Table 9. Reliably Unreliable (All 328 Corridors), continued

Area	Corridor	Limits (From/To)	Corridor Length (miles)	2010 Weekday Peak-period Travel Time Reliability					
				Buffer Index (%)	Rank	Planning Time Index	Rank	Travel Time Index	Rank
Houston	US-59 NB (Southwest/Eastex Fwys)	Buffalo Speedway I-45	4.8	94	127	4.36	27	2.29	30
Tampa	I-275 SB	Floribraska Ave/28th Ave/Exit 28 US-92/Dale Mabry Hwy/Exit 23	4.2	94	127	3.50	116	1.88	103
Los Angeles	Century Fwy/I-105 EB	Nash St I-605	17.6	94	127	3.42	125	1.80	130
Minneapolis-St. Paul	Crosstown Hwy/MN-62 EB	US-169/US-212 Cr-32/Penn Ave	4.6	94	127	3.27	156	1.69	189
Providence	I-95 SB	US-1/George St/Exit 27 RI-7/RI-146/Charles St/Exit 23	3.2	94	127	3.17	170	1.70	179
Los Angeles	I-5 SB	Alton Pkwy El Toro Rd	3.4	94	127	3.14	177	1.67	198
Dallas-Fort Worth	I-35E SB	Ave D/Exit 466B Mayhill Rd/Exit 462	4.4	94	127	2.81	241	1.54	252
Houston	I-45 NB	Clearwood Dr/Edgebrook St Broadway St/Park Place Blvd/Exit39	3.8	93	134	3.36	134	1.90	96
Chicago	Tri State Tollway/I-294 SB	IL-58/Golf Rd Ohare Oasis	7.6	93	134	3.14	177	1.84	114
Cincinnati	I-75 NB	I-275/Exit 185 KY-1072/Kyles Ln/Exit 189	3.5	93	134	2.97	214	1.53	257
Houston	W Loop Fwy/I-610 NB	Braeswood Blvd/S Post Oak Rd/Exit 4 Woodway Dr/Exit 10	5.8	92	137	4.01	61	2.09	51
Orlando	I-4 EB	Floridas Turnpike/Exit 31 FL-423/Lee Rd/Exit 46	9.8	92	137	3.40	127	1.74	154
Sacramento	I-80 EB	El Camino Ave Northgate Blvd	3.6	92	137	3.20	169	1.72	165
Baltimore	Baltimore Beltway Outer Loop/I-695 WB	US-1/Exit 32 MD-139/Charles St/Exit 25	7.5	92	137	3.07	190	1.71	175
Atlanta	GA-400/US-19 SB	GA-120/Old Milton Pkwy/Exit 10 GA-140/Holcomb Bridge Rd/Exit 7	4.7	91	141	3.54	107	1.79	137
Dallas-Fort Worth	Stemmons Fwy/I-35E SB	Empire Central Dr/Exit 434A I-30/Exit 428	6.7	91	141	3.01	205	1.91	95
Los Angeles	I-710 SB	Floral Dr Atlantic Blvd/Bandini Blvd	3.7	90	143	4.19	40	2.10	50
New York	Southern State Pkwy WB	New Hwy/Exit 34 Brookside Ave/Exit 21	10.8	90	143	2.86	231	1.51	266

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Table 9. Reliably Unreliable (All 328 Corridors), continued

Area	Corridor	Limits (From/To)	Corridor Length (miles)	2010 Weekday Peak-period Travel Time Reliability					
				Buffer Index (%)	Rank	Planning Time Index	Rank	Travel Time Index	Rank
New York	Belt/Shore/Laurelton Pkwys EB	I-678/Van Wyck Expy/Exit 20 Merrick Blvd/Exit 24	3.6	90	143	2.47	301	2.16	43
Minneapolis-St. Paul	I-494 EB	US-212/Prairie Center Dr/Exit 1 Cr-32/Penn Ave/Exit 6	5.7	89	146	3.95	68	2.16	43
Portland	I-5 NB	Corbett Ave/Exit 298 N Tomahawk Island Dr/Exit 308	10.1	89	146	3.78	78	2.23	34
Washington, DC	Capital Beltway SB	MD-650/New Hampshire Ave/Exit28 MD-201/Kenilworth Ave/Exit 23	4.8	89	146	2.99	208	1.55	245
Bridgeport	Merritt Pkwy/CT-15 NB	CT-58/Black Rock Tpke/Exit 44 CT-25/Exit 49	5.6	89	146	2.79	246	1.47	280
Cincinnati	I-75 NB	I-74/US-52/US-27/Exit 4 OH-4/Paddock Rd/Exit 9	5.0	88	150	3.51	114	1.84	114
Seattle	I-5 NB	Center Dr/Exit 118 Berkeley St/Exit 122	4.6	87	151	3.33	140	1.74	154
Sacramento	I-80 WB	Horseshoe Bar Rd Douglas Blvd	6.8	87	151	2.56	286	1.39	306
Tampa	I-275 NB	Howard Franklin Brg Lois Ave/Exit 22	3.4	87	151	2.49	298	1.83	119
Los Angeles	Orange Fwy/CA-57 NB	I-5/CA-22/Chapman Ave (Orange) CA-60/Pomona Fwy	14.7	86	154	3.50	116	1.88	103
Seattle	WA-167 SB	277th St 8th St	7.3	86	154	3.36	134	1.72	165
Bridgeport	Connecticut Turnpike/I-95 NB	Field Point Rd Mill Plain Rd/Exit 21	22.2	86	154	3.27	156	1.70	179
Los Angeles	I-5 NB (Santa Ana/Golden St Fwys)	CA-39/Beach Blvd Riverside Dr	22.5	86	154	3.07	190	1.92	92
Bridgeport	Merritt Pkwy/CT-15 SB	Main St/Exit 48 CT-33/Exit 41	9.9	86	154	2.84	235	1.42	297
Riverside	Ontario Fwy/I-15 SB	4th St CA-60	4.4	86	154	2.54	289	1.34	314
New York	NJ-4	Teaneck Rd Forest Ave	3.3	85	160	3.06	195	1.65	210
San Jose	CA-17 SB	Camden Ave/San Tomas Expy CA-9	3.2	85	160	1.83	324	1.24	322
Austin	I-35 NB	Shelby Ln/St Elmo Rd/Exit 230 Martin Luther King Blvd/19th St/Exit 235	4.7	84	162	4.06	56	2.63	9

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Area	Corridor	Limits (From/To)	Corridor Length (miles)	2010 Weekday Peak-period Travel Time Reliability					
				Buffer Index (%)	Rank	Planning Time Index	Rank	Travel Time Index	Rank
Washington, DC	MD 295/ Baltimore Washington Pkwy NB	MD-450 Powder Mill Rd	7.7	84	162	3.32	143	1.85	110
Boston	I-95/MA-128 NB	MA-2/Exit 29 MA-28/Main St/Exit 38	11.1	84	162	3.29	151	1.73	163
Minneapolis-St. Paul	I-394 EB	Xenia Ave/Park Place Blvd/Exit 5 US-12/Exit 8B	3.3	84	162	3.12	185	1.76	150
Vallejo-Fairfield CA	I-80 EB	Suisun Valley Rd N Texas St	7.4	84	162	2.02	319	1.17	323
Minneapolis-St. Paul	I-694 EB	Cr-44/Silver Lake Rd/Exit 39 Lexington Ave/Exit 43	3.6	83	167	3.35	137	1.81	126
Las Vegas	I-15 NB	Tropicana Ave/Exit 37 Sahara Ave/Exit 40	3.2	83	167	3.13	183	1.69	189
Dallas-Fort Worth	US-75 NB	Ross Ave/Exit 286 Mockingbird Ln/Exit 3	3.6	83	167	3.04	201	1.66	204
Raleigh	I-40 EB	Airport Blvd/Exit 284 NC-54/Exit 290	6.9	83	167	2.93	222	1.57	241
San Jose	Sinclair Fwy/I-280 NB	CA-87/Guadalupe Pkwy I-880/CA-17	3.7	83	167	2.84	235	1.47	280
Seattle	I-90 WB	Bellevue Way/Exit 9 Mercer Way/Exit 6	3.3	83	167	2.73	256	1.72	165
Bridgeport	I-84 EB	Mill Plain Rd/Old Ridgebury Rd/Exit 2 CT-37/Exit 6	4.3	83	167	2.61	276	1.38	308
Chicago	Stevenson Expy/I-55 SB	State St/Exit 293C Pulaski Rd/Exit 287	5.7	82	174	4.27	32	2.42	20
Santa Cruz	Cabrillo Hwy/CA-1 SB	CA-17 Park Ave	4.8	82	174	4.14	46	2.26	31
Los Angeles	San Diego Fwy/I-405 NB	I-105/Imperial Hwy Getty Center Dr	13.1	82	174	3.97	66	2.65	8
New Orleans	I-10 WB	Causeway Blvd/Exit 228 End Blvd/Florida Blvd	5.0	82	174	3.63	95	2.00	70
Austin	Loop 1/Mopac Expy SB	US-183/Research Blvd Barton Skwy	9.1	82	174	3.46	121	2.03	67
Dallas-Fort Worth	LBJ Fwy/I-635 EB	Valley View Ln/Exit 30 Kingsley Rd/Exit 13	16.7	82	174	3.11	186	1.70	179
San Diego	San Diego Fwy/I-5 NB	I-805 (North) Manchester Ave	7.6	82	174	2.91	225	1.63	216

Buffer Index—measure of trip reliability that expresses the amount of extra "buffer" time needed to be on time for 95 percent of trips. A BI of 150 percent means that for a trip that takes 30 minutes on average, 45 extra minutes should be planned (30 minutes x 150% = 45 minutes). Planning Time Index—represents the total travel time that should be planned for a trip. It differs from the BI in that it includes typical delay as well as unexpected delay. A PTI of 2.50 means that for a 30-minute trip in light traffic, 75 minutes should be planned (30 minutes x 2.50 = 75 minutes). Travel Time Index—the ratio of travel time in the peak period to the travel time at free-flow conditions. A value of 1.30 indicates a 20-minute free-flow trip takes 26 minutes in the peak period. Note: Please do not place too much emphasis on small differences in rankings. There may be little difference between (for example) 5th and 10th. The actual measure values should also be examined.

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Area	Corridor	Limits (From/To)	Corridor Length (miles)	2010 Weekday Peak-period Travel Time Reliability					
				Buffer Index (%)	Rank	Planning Time Index	Rank	Travel Time Index	Rank
Seattle	I-5 SB	320th St/Exit 143 I-705/WA-7/Exit 133	11.1	82	174	2.89	228	1.58	235
Minneapolis-St. Paul	I-494 WB	34th Ave/Exit 1 Cr-32/Penn Ave/Exit 6	4.1	81	182	3.73	82	2.18	39
Los Angeles	Santa Monica Fwy/I-10 WB	I-5/Golden State Fwy National Blvd	12.6	81	182	3.59	99	2.21	36
Los Angeles	CA-134 EB	Bob Hope Dr I-5/Golden Hwy	3.1	81	182	3.38	130	1.84	114
Miami	Palmetto Expy/SR 826 NB	56th St/Miller Dr US-27/Okeechobee Rd	10.5	81	182	3.14	177	1.73	163
Seattle	I-405 NB	61st Ave 44th St/Exit 7	7.0	81	182	3.14	177	1.68	195
Minneapolis-St. Paul	I-35W NB	Cleveland Ave/Exit 24 I-694/Exit 27	3.9	81	182	2.89	228	1.49	273
Los Angeles	I-5 NB	Brand Blvd CA-14	5.8	81	182	2.64	274	1.46	285
Miami	Dolphin Expy/SR 836 EB	107th Ave FL-959/Red Rd	5.0	80	189	3.48	118	1.96	80
Los Angeles	US-101 SB (Ventura/Hollywood Fwys)	Ventura Blvd/Shoup Ave Vignes St/Exit 2B	26.7	80	189	3.32	143	1.85	110
Los Angeles	US-101 NB (Santa Ana/Hollywood Fwys)	I-5/CA-60 Haskell Ave	21.5	80	189	3.26	160	1.85	110
Denver	I-25 SB	58th Ave/Exit 215 CO-2/Colorado Blvd/Exit 204	10.9	80	189	3.05	198	1.71	175
Miami	Palmetto Expy/SR 826 SB	FL-823/57th Ave/Red Rd W 68th St/Gratigny Dr	4.6	80	189	2.85	234	1.53	257
Houston	I-45 SB	Tidwell Rd Cavalcade St/Exit 50	3.4	80	189	2.81	241	1.54	252
Portland	I-205 NB	Division St/Exit 19 US-30 Bus/Columbia Blvd/Exit 23	4.1	80	189	2.81	241	1.50	270
Washington, DC	Custis Mem Pkwy/I-66 EB	VA-234/Pr Wm Pkwy/Exit 44 N. Patrick Henry Dr	24.4	80	189	2.80	245	1.52	261
Los Angeles	CA-57 SB	Brea Canyon Rd Orangewood Ave	11.7	80	189	2.61	276	1.42	297
New York	I-278 WB	New York Ave Slosson Ave/Exit 12	3.2	79	198	3.95	68	2.24	33

Buffer Index—measure of trip reliability that expresses the amount of extra "buffer" time needed to be on time for 95 percent of trips. A BI of 150 percent means that for a trip that takes 30 minutes on average, 45 extra minutes should be planned (30 minutes x 150% = 45 minutes). Planning Time Index—represents the total travel time that should be planned for a trip. It differs from the BI in that it includes typical delay as well as unexpected delay. A PTI of 2.50 means that for a 30-minute trip in light traffic, 75 minutes should be planned (30 minutes x 2.50 = 75 minutes). Travel Time Index—the ratio of travel time in the peak period to the travel time at free-flow conditions. A value of 1.30 indicates a 20-minute free-flow trip takes 26 minutes in the peak period. Note: Please do not place too much emphasis on small differences in rankings. There may be little difference between (for example) 5th and 10th. The actual measure values should also be examined.

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				Buffer Index (%)	Rank	Planning Time Index	Rank	Travel Time Index	Rank
Los Angeles	CA-110 SB (Pasadena/Harbor Fwys)	Avenue 60 Olympic Blvd/9th St	6.6	79	198	3.70	86	2.38	21
Los Angeles	Santa Ana Fwy/I-5 NB	Sand Canyon Ave 17th St	8.4	79	198	3.25	163	1.87	107
Santa Rosa CA	US-101 NB	Railroad Ave Commerce Blvd/Wilfred Ave	4.2	79	198	2.95	219	1.67	198
Portland	I-205 SB	Airport Way/Exit 24 Washington St/Stark St/Exit 20	4.0	79	198	2.58	284	1.43	295
Statesville-Mooresville NC	I-77 SB	NC-150/Exit 36 Iredell/Mecklenburg Co Line	8.8	79	198	1.85	323	1.34	314
Oxnard CA	Ventura Fwy/US-101 NB	Camarillo Springs Rd Las Posas Rd	5.2	78	204	2.21	314	1.44	289
Dallas-Fort Worth	Loop 820/I-820 WB	TX-26/Grapevine Hwy US-377/Denton Hwy/Exit 19	3.1	77	205	4.07	53	2.43	18
Seattle	I-405 SB	WA-520/Ne 14th St/Exit 14 Se Coal Creek Pkwy/Exit 10	4.5	77	205	3.99	64	2.18	39
New York	Long Island Expy/I-495 WB	Glen Cove Rd/Exit 39 Woodhaven Blvd	14.9	77	205	3.32	143	2.02	68
New Haven	I-95 SB	CT-100/High St/Exit 52 Ella T Grasso Blvd/Exit 45	4.7	77	205	2.59	280	1.63	216
San Diego	San Diego Fwy/I-5 SB	Harbor Dr Birmingham Dr	14.8	77	205	2.39	308	1.36	310
Boston	I-93 NB	Storrow Dr/Exit 26B Montvale Ave/Exit 36	8.9	77	205	2.19	315	1.72	165
Los Angeles	San Gabriel River Fwy/I-605 SB	Beverly Blvd Florence Ave	4.8	76	211	3.64	91	2.34	26
Austin	Loop 1/Mopac Expy NB	US-290/TX-71 FM-2222/Northland Dr	9.8	76	211	3.15	176	1.78	143
Boston	Southeast Expy/I-93 SB	Granite Ave/Exit 11 MA-3/Exit 7	3.8	75	213	3.34	138	1.80	130
Chicago	I-94 WB	W Lawrence Ave Touhy Ave/Exit 39	3.9	75	213	2.79	246	1.61	227
Los Angeles	San Diego Fwy/I-405 NB	MacArthur Blvd Brookhurst St	7.8	74	215	3.59	99	2.06	59
Los Angeles	San Bernadino Fwy/I-10 EB	City Terrace Dr/Herbert Ave Baldwin Park Blvd	12.8	74	215	3.54	107	2.18	39

Buffer Index—measure of trip reliability that expresses the amount of extra "buffer" time needed to be on time for 95 percent of trips. A BI of 150 percent means that for a trip that takes 30 minutes on average, 45 extra minutes should be planned (30 minutes x 150% = 45 minutes). Planning Time Index—represents the total travel time that should be planned for a trip. It differs from the BI in that it includes typical delay as well as unexpected delay. A PTI of 2.50 means that for a 30-minute trip in light traffic, 75 minutes should be planned (30 minutes x 2.50 = 75 minutes). Travel Time Index—the ratio of travel time in the peak period to the travel time at free-flow conditions. A value of 1.30 indicates a 20-minute free-flow trip takes 26 minutes in the peak period. Note: Please do not place too much emphasis on small differences in rankings. There may be little difference between (for example) 5th and 10th. The actual measure values should also be examined.

Table 9. Reliably Unreliable (All 328 Corridors), continued

Area	Corridor	Limits (From/To)	Corridor Length (miles)	2010 Weekday Peak-period Travel Time Reliability					
				Buffer Index (%)	Rank	Planning Time Index	Rank	Travel Time Index	Rank
Los Angeles	Foothill Fwy/I-210 EB	Lincoln Ave CA-39/Azusa Ave	17.2	74	215	3.17	170	1.84	114
Baltimore	Baltimore Beltway Inner Loop/I-695 NB	US-1/Southwestern Blvd/Exit 12 Security Blvd/Exit 17	5.3	74	215	3.08	188	1.76	150
Houston	I-45 NB (Gulf/North Fwys)	Dumble St Gulf Bank Rd/Exit 57	13.6	74	215	2.99	208	1.66	204
Milwaukee	North-South Fwy/I-43 SB/I-94 WB	WI-59/6th St/Exit 311 Howard Ave/Exit 314	3.5	74	215	2.71	261	1.54	252
San Francisco	I-80 EB (James Lick Fwy/Bay Brdg)	US-101 Treasure Island Rd	3.6	73	221	4.18	42	2.47	14
Atlanta	I-20 EB	GA-155/Candler Rd/Exit 65 Wesley Chapel Rd/Exit 68	3.0	73	221	3.05	198	1.79	137
Atlanta	I-285 WB	Ashford Dunwoody Rd/Exit 29 I-75/Exit 20	8.1	73	221	2.83	238	1.57	241
Riverside	Corona Fwy/I-15 SB	Hidden Valley Pkwy El Cerrito Rd	5.0	73	221	2.54	289	1.47	280
Bridgeport	Connecticut Turnpike/I-95 SB	Bronson Rd/Exit 20 US-1/Post Rd/Exit 13	10.8	73	221	2.54	289	1.39	306
Los Angeles	I-405 NB	Ventura Blvd Rinaldi St	9.5	73	221	2.53	293	1.44	289
San Francisco	California Delta Hwy/CA-4 WB	Hillcrest Ave Somersville Rd	3.0	72	227	4.22	36	2.38	21
San Francisco	Grove Shafter Fwy/CA-24 EB	I-580/I-980 Caldecott Tunnel	4.1	72	227	3.45	123	2.06	59
Pittsburgh	Penn Lincoln Pkwy/I-376 EB	2nd Ave/1st Ave/Exit 1 William Penn Hwy/Exit 10A	8.1	72	227	3.36	134	2.06	59
Minneapolis-St. Paul	I-694 WB	I-35E/I-694/Exit 46 MN-51/Exit 42	3.9	72	227	3.13	183	1.81	126
Boston	Newburyport Tpke/US-1 SB	MA-129/Salem St Essex St	4.1	72	227	2.59	280	1.44	289
San Antonio	I-35 NB	Judson Rd/Exit 170 Evans Rd/Exit 174	3.8	72	227	2.43	302	1.41	301
Los Angeles	I-110 SB	W Vernon Ave 51st St	2.5	71	233	3.75	81	2.04	64
San Jose	Bayshore Fwy/US-101 SB	Fair Oaks Ave De La Cruz Blvd	4.2	71	233	3.53	109	2.08	52

Buffer Index—measure of trip reliability that expresses the amount of extra "buffer" time needed to be on time for 95 percent of trips. A BI of 150 percent means that for a trip that takes 30 minutes on average, 45 extra minutes should be planned (30 minutes x 150% = 45 minutes). Planning Time Index—represents the total travel time that should be planned for a trip. It differs from the BI in that it includes typical delay as well as unexpected delay. A PTI of 2.50 means that for a 30-minute trip in light traffic, 75 minutes should be planned (30 minutes x 2.50 = 75 minutes). Travel Time Index—the ratio of travel time in the peak period to the travel time at free-flow conditions. A value of 1.30 indicates a 20-minute free-flow trip takes 26 minutes in the peak period. Note: Please do not place too much emphasis on small differences in rankings. There may be little difference between (for example) 5th and 10th. The actual measure values should also be examined.

Table 9. Reliably Unreliable (All 328 Corridors), continued

Area	Corridor	Limits (From/To)	Corridor Length (miles)	2010 Weekday Peak-period Travel Time Reliability					
				Buffer Index (%)	Rank	Planning Time Index	Rank	Travel Time Index	Rank
Nashville	I-440 EB	TN-1/End Ave/Exit 1 US-31 Alt/US-41 Alt/Nolensville Pike/Exit6	4.8	71	233	3.40	127	2.00	70
Houston	W Loop Fwy/I-610 SB	US-290/18th St Evergreen St/Exit 5	6.9	71	233	3.32	143	2.04	64
Atlanta	I-75 NB	Mount Paran Rd/Exit 256 Barrett Pkwy/Exit 269	12.8	71	233	3.03	203	1.74	154
Dallas-Fort Worth	Loop 12 SB	I-35E Union Bower Rd	4.1	71	233	2.94	220	1.61	227
Kansas City	I-70 EB	18th St/Exit 4 I-435/Exit 8	4.2	71	233	2.86	231	1.63	216
San Francisco	I-880 NB	CA-84/Decoto Rd Tennyson Rd	5.3	71	233	2.79	246	1.70	179
St. Louis	I-270 SB	Ladue Rd/Exit 13 Dougherty Ferry Rd/Exit 8	5.1	71	233	2.67	269	1.50	270
Minneapolis-St. Paul	I-35E SB	US-10 Pennsylvania Ave/Exit 108	4.8	71	233	2.65	273	1.55	245
Milwaukee	I-94 EB	Moorland Rd/Exit 301B WI-181/84th St/Exit 306	4.4	71	233	2.59	280	1.52	261
Bridgeport	Connecticut Turnpike/I-95 SB	Stratford Ave/Exit 28 Round Hill Rd/Exit 22	4.9	70	244	3.16	173	1.70	179
Washington, DC	Custis Mem Pkwy/I-66 WB	US-29/Lee Hwy/Exit 73 VA-123/Exit 60	14.8	70	244	2.99	208	1.72	165
Los Angeles	Harbor Fwy/I-110 NB	111th Pl I-110/I-10/Santa Monica Fwy	6.5	70	244	2.97	214	2.51	11
Los Angeles	CA-55 SB	Katella Ave McFadden Ave	6.0	70	244	2.89	228	1.61	227
Philadelphia	Delaware Expy/I-95 SB	Academy Rd/Exit 32 Girard Ave/Exit 23	8.3	70	244	2.75	253	1.95	85
New York	Northern State Pkwy WB	Willis Ave/Exit 28 Lakeville Rd/Exit 25	3.4	70	244	2.72	260	1.58	235
San Diego	I-805 SB	I-5 La Jolla Village Dr/Miramar Rd	2.9	69	250	3.38	130	2.00	70
Los Angeles	I-605 NB	Beverly Blvd Valley Blvd	5.0	69	250	3.33	140	1.86	109
Dallas-Fort Worth	TX-183 EB	I-820 Bedford Rd	4.0	69	250	3.01	205	1.80	130

Buffer Index—measure of trip reliability that expresses the amount of extra "buffer" time needed to be on time for 95 percent of trips. A BI of 150 percent means that for a trip that takes 30 minutes on average, 45 extra minutes should be planned (30 minutes x 150% = 45 minutes). Planning Time Index—represents the total travel time that should be planned for a trip. It differs from the BI in that it includes typical delay as well as unexpected delay. A PTI of 2.50 means that for a 30-minute trip in light traffic, 75 minutes should be planned (30 minutes x 2.50 = 75 minutes). Travel Time Index—the ratio of travel time in the peak period to the travel time at free-flow conditions. A value of 1.30 indicates a 20-minute free-flow trip takes 26 minutes in the peak period. Note: Please do not place too much emphasis on small differences in rankings. There may be little difference between (for example) 5th and 10th. The actual measure values should also be examined.

Table 9. Reliably Unreliable (All 328 Corridors), continued

Area	Corridor	Limits (From/To)	Corridor Length (miles)	2010 Weekday Peak-period Travel Time Reliability					
				Buffer Index (%)	Rank	Planning Time Index	Rank	Travel Time Index	Rank
Minneapolis-St. Paul	I-35W SB	Washington Ave/Exit 17C Diamond Lake Rd/Exit 12B	7.7	69	250	2.84	235	1.74	154
Cincinnati	I-71 NB	Dana Ave/Exit 5 Red Bank Rd/Exit 9	3.8	69	250	2.68	267	1.53	257
Los Angeles	US-101 SB	Liberty Canyon Rd Parkway Calabasas	4.4	69	250	2.55	288	1.46	285
Los Angeles	I-5 SB (Santa Ana/Golden St Fwys)	East Cesar Chavez Ave Valley View Ave	17.5	68	256	3.31	148	2.12	47
Milwaukee	I-94 WB	I-43/I-794 General Mitchell Blvd/Exit 308	2.9	68	256	3.29	151	2.04	64
Los Angeles	CA-91 EB (Gardena/Artesia Fwys)	I-110 (East) Cherry Ave	6.7	68	256	3.26	160	1.89	98
San Antonio	I-410 EB	Starcrest Dr/Exit 25 Interchange Pkwy/Exit 26	1.1	68	256	3.06	195	1.74	154
New York	Long Island Expy EB	Sagtikos State Pkwy NY-111/Exit 56	3.2	68	256	3.03	203	1.72	165
Dallas-Fort Worth	I-35E NB	Harry Hines Blvd/Exit 435 Valley View Ln/Exit 441	5.8	68	256	2.82	239	1.65	210
San Francisco	I-880 NB	98th Ave 23rd Ave	4.2	68	256	2.42	305	1.42	297
Houston	Northwest Fwy/ US-290 WB	Mangum Rd N Eldridge Pkwy	11.0	67	263	3.07	190	1.76	150
San Francisco	US-101 SB	CA-84/Woodside Rd University Ave	4.4	67	263	2.70	263	1.62	224
New York	Long Island Expy/I-495 EB	Maurice Ave/Exit 18 Mineola Ave/Willis Ave/Exit 37	16.0	66	265	3.57	103	2.30	29
Los Angeles	I-405 NB	Avalon Blvd Inglewood Ave	7.3	66	265	2.78	249	1.63	216
Los Angeles	CA-2 SB	CA-134/Holly Dr Fletcher Dr	3.1	66	265	2.71	261	1.52	261
New York	I-80 WB	US-202/Exit 42 Cr-513/Exit 37	4.7	66	265	2.52	295	1.61	227
Los Angeles	Santa Monica Fwy/I-10 EB	CA-1/Lincoln Blvd/Exit 1B Alameda St	14.9	65	269	3.60	98	2.31	28
Miami	Dolphin Expy/SR 836 WB	I-95 FL-959/Red Rd	5.5	65	269	3.56	105	2.21	36

Buffer Index—measure of trip reliability that expresses the amount of extra "buffer" time needed to be on time for 95 percent of trips. A BI of 150 percent means that for a trip that takes 30 minutes on average, 45 extra minutes should be planned (30 minutes x 150% = 45 minutes). Planning Time Index—represents the total travel time that should be planned for a trip. It differs from the BI in that it includes typical delay as well as unexpected delay. A PTI of 2.50 means that for a 30-minute trip in light traffic, 75 minutes should be planned (30 minutes x 2.50 = 75 minutes). Travel Time Index—the ratio of travel time in the peak period to the travel time at free-flow conditions. A value of 1.30 indicates a 20-minute free-flow trip takes 26 minutes in the peak period. Note: Please do not place too much emphasis on small differences in rankings. There may be little difference between (for example) 5th and 10th. The actual measure values should also be examined.

Table 9. Reliably Unreliable (All 328 Corridors), continued

Area	Corridor	Limits (From/To)	Corridor Length (miles)	2010 Weekday Peak-period Travel Time Reliability					
				Buffer Index (%)	Rank	Planning Time Index	Rank	Travel Time Index	Rank
Los Angeles	Costa Mesa Fwy/CA-55 NB	CA-73 4th St/Irvine Blvd	6.5	65	269	3.28	153	1.95	85
Chicago	I-94 WB	115th St/Exit 66B US-20/US-12/95th St/Exit 62	3.8	65	269	2.73	256	1.54	252
Los Angeles	I-405 SB	Valley View St Warner Ave	6.6	65	269	2.59	280	1.51	266
Portland	Beaverton Tigard Fwy NB	I-5/Exit 7 Hall Blvd/Exit 4A	4.2	65	269	2.33	309	1.41	301
Minneapolis-St. Paul	I-94 WB	Cretin Ave/Vandalia St/Exit 237 I-35W/11th St/Exit 233	4.1	64	275	3.25	163	2.07	56
Milwaukee	Zoo Fwy/US-45 SB	WI-190/Capitol Dr/Exit 44 I-94/Exit 38	3.8	64	275	3.25	163	1.97	78
Los Angeles	Pomona Fwy/CA-60 EB	Whittier Blvd Brea Canyon Rd	21.7	64	275	3.14	177	1.82	123
Los Angeles	I-210 WB	I-605 Baldwin Ave	5.5	64	275	2.69	264	1.60	232
Washington, DC	John Hanson Hwy/US-50 WB	Garden City Dr/Exit 6 Columbia Park Rd	3.0	64	275	2.68	267	1.58	235
Seattle	I-405 NB	8th St/Se 12th St/Exit 12 Juanita Woodinville Way/Exit 22	10.0	64	275	2.58	284	1.51	266
San Jose	Bayshore Fwy/US-101 NB	CA-237 San Antonio Rd	4.7	63	281	3.21	168	1.96	80
Seattle	I-405 SB	WA-527/26th Ave/Exit 26 WA-908/85th St/Exit 18	8.7	62	282	2.50	297	1.44	289
San Jose	Nimitz Fwy/I-880 SB	CA-237/W Calaveras Blvd 1st St	4.6	61	283	2.97	214	1.80	130
Phoenix	I-10 EB (Papago/Maricopa Fwys)	Buckeye Rd/Exit 149 Broadway Rd/52nd St/Exit153B	6.1	61	283	2.82	239	1.74	154
Minneapolis-St. Paul	US-169 NB	Cr-3/Excelsior Blvd MN-55	4.0	60	285	2.93	222	1.77	147
Denver	I-25 NB	Evans Ave/Exit 203 84th Ave/Exit 219	15.1	60	285	2.73	256	1.66	204
Los Angeles	I-10 WB	Citrus St Baldwin Park Blvd	5.2	60	285	2.69	264	1.66	204
San Francisco	Eastshore Fwy/I-80 EB/I-580 WB	Cypress St University Ave	3.3	59	288	3.37	133	2.07	56

Buffer Index—measure of trip reliability that expresses the amount of extra "buffer" time needed to be on time for 95 percent of trips. A BI of 150 percent means that for a trip that takes 30 minutes on average, 45 extra minutes should be planned (30 minutes x 150% = 45 minutes). Planning Time Index—represents the total travel time that should be planned for a trip. It differs from the BI in that it includes typical delay as well as unexpected delay. A PTI of 2.50 means that for a 30-minute trip in light traffic, 75 minutes should be planned (30 minutes x 2.50 = 75 minutes). Travel Time Index—the ratio of travel time in the peak period to the travel time at free-flow conditions. A value of 1.30 indicates a 20-minute free-flow trip takes 26 minutes in the peak period. Note: Please do not place too much emphasis on small differences in rankings. There may be little difference between (for example) 5th and 10th. The actual measure values should also be examined.

Table 9. Reliably Unreliable (All 328 Corridors), continued

Area	Corridor	Limits (From/To)	Corridor Length (miles)	2010 Weekday Peak-period Travel Time Reliability					
				Buffer Index (%)	Rank	Planning Time Index	Rank	Travel Time Index	Rank
San Francisco	I-80 WB	Hillcrest Rd US-101	3.5	59	288	2.86	231	1.79	137
Los Angeles	I-405 SB	CA-55/Costa Mesa Fwy Jeffrey Rd/University Dr	4.5	59	288	2.60	279	1.63	216
Houston	US-59 SB	Greenbriar Dr I-610 (Houston) (South)	3.0	59	288	2.53	293	1.55	245
Portland	I-84 EB	I-5 I-205/Exit 8	6.0	58	292	2.28	312	1.56	243
Sacramento	Capital City Fwy/I-80 Bus EB	US-50/CA-99 Fulton Ave	7.3	57	293	2.78	249	1.72	165
San Diego	CA-78 EB	Rancho Santa Fe Rd Mission Rd	4.2	56	294	3.10	187	1.98	77
San Francisco	US-101 NB	Whipple Ave Marine Pkwy/Ralston Ave	3.1	56	294	2.75	253	1.74	154
Houston	South Fwy NB	McHard Rd Orem Dr	3.3	56	294	2.73	256	1.63	216
Houston	Northwest Fwy EB	Telge Rd West Rd	4.5	56	294	2.54	289	1.53	257
Chicago	I-94 EB	75th St 87th St/Exit 61B	3.4	56	294	2.51	296	1.71	175
San Francisco	I-680 NB	Stone Valley Rd N Main St	5.3	56	294	2.49	298	1.61	227
Houston	Gulf Fwy/I-45 SB	Dumble St I-610/Exit 40	3.6	55	300	3.07	190	2.00	70
Atlanta	I-85 NB	Chamblee Tucker Rd/Exit 94 GA-140/Jimmy Carter Blvd/Exit 99	4.7	55	300	2.63	275	1.63	216
Charlotte	I-485 EB	NC-49/Tryon St/Exit 1 NC-51/Exit 64	5.3	54	302	3.28	153	2.13	46
Phoenix	Papago Fwy/I-10 WB	AZ-51/AZ-202/Exit 147 35th Ave/Exit 141	6.2	54	302	2.76	252	1.74	154
Austin	I-35 NB	E Fm-1626/Crown Colony Dr William Cannon Dr/Exit 228	3.7	54	302	2.41	307	1.48	277
Los Angeles	San Diego Fwy/I-405 SB	Nordhoff St Mulholland Dr	8.1	53	305	2.97	214	2.06	59
New York	NJ-17	I-80 Garden State Pkwy	4.7	53	305	2.48	300	1.60	232

Buffer Index—measure of trip reliability that expresses the amount of extra "buffer" time needed to be on time for 95 percent of trips. A BI of 150 percent means that for a trip that takes 30 minutes on average, 45 extra minutes should be planned (30 minutes x 150% = 45 minutes). Planning Time Index—represents the total travel time that should be planned for a trip. It differs from the BI in that it includes typical delay as well as unexpected delay. A PTI of 2.50 means that for a 30-minute trip in light traffic, 75 minutes should be planned (30 minutes x 2.50 = 75 minutes). Travel Time Index—the ratio of travel time in the peak period to the travel time at free-flow conditions. A value of 1.30 indicates a 20-minute free-flow trip takes 26 minutes in the peak period. Note: Please do not place too much emphasis on small differences in rankings. There may be little difference between (for example) 5th and 10th. The actual measure values should also be examined.

Table 9. Reliably Unreliable (All 328 Corridors), continued

Area	Corridor	Limits (From/To)	Corridor Length (miles)	2010 Weekday Peak-period Travel Time Reliability					
				Buffer Index (%)	Rank	Planning Time Index	Rank	Travel Time Index	Rank
Los Angeles	Harbor Fwy/CA-110 NB	I-10/Santa Monica Fwy Stadium Way/Exit 24C	3.1	52	307	4.89	10	3.20	2
San Jose	Bayshore Fwy/US-101 SB	Alum Rock Ave/Santa Clara St Tully Rd	3.7	52	307	3.05	198	1.82	123
Houston	South Fwy/TX-288 SB	Southmore Blvd Airport Blvd	5.7	52	307	2.75	253	1.69	189
San Jose	W Valley Fwy/CA-85 SB	Central Expy Fremont Ave	3.0	50	310	2.69	264	1.74	154
Los Angeles	I-10 WB	Valley Blvd Atlantic Blvd	6.4	50	310	2.56	286	1.62	224
Dallas-Fort Worth	TX-360 SB	Post N Paddock St Division St	3.0	49	312	3.53	109	2.51	11
Seattle	I-5 NB	45th St/Exit 169 236th St/Exit 177	8.8	49	312	2.33	309	1.50	270
Washington, DC	Shirley Hwy/I-395 SB	Quaker Ln/Exit 6 VA-236/Duke St/Exit 3	3.6	48	314	2.61	276	1.71	175
Atlanta	I-85 SB	GA-120/Duluth Hwy/Exit 107 Steve Reynolds Blvd/Exit 103	3.7	48	314	2.25	313	1.72	165
Houston	I-45 SB	Sam Houston Tollway/Exit 32 FM-2351/Exit 29	3.7	48	314	1.93	321	1.88	103
Los Angeles	I-5 SB	CA-73 CA-1/Camino De Vis	5.8	47	317	1.52	326	1.08	327
Los Angeles	Century Fwy/I-105 WB	Bellflower Blvd Crenshaw Blvd	12.5	46	318	2.42	305	1.59	234
Boston	Broadway	MA-99 MA-129/Salem St	4.5	46	318	2.17	316	1.48	277
Miami	FL Tpke Ext/FL-821 NB	FL-874/Exit 17 US-41/8th St/Sw 25th Ter/Exit 25	11.9	45	320	2.30	311	1.49	273

Buffer Index—measure of trip reliability that expresses the amount of extra "buffer" time needed to be on time for 95 percent of trips. A BI of 150 percent means that for a trip that takes 30 minutes on average, 45 extra minutes should be planned (30 minutes x 150% = 45 minutes). Planning Time Index—represents the total travel time that should be planned for a trip. It differs from the BI in that it includes typical delay as well as unexpected delay. A PTI of 2.50 means that for a 30-minute trip in light traffic, 75 minutes should be planned (30 minutes x 2.50 = 75 minutes). Travel Time Index—the ratio of travel time in the peak period to the travel time at free-flow conditions. A value of 1.30 indicates a 20-minute free-flow trip takes 26 minutes in the peak period. Note: Please do not place too much emphasis on small differences in rankings. There may be little difference between (for example) 5th and 10th. The actual measure values should also be examined.

Table 9. Reliably Unreliable (All 328 Corridors), continued

Area	Corridor	Limits (From/To)	Corridor Length (miles)	2010 Weekday Peak-period Travel Time Reliability					
				Buffer Index (%)	Rank	Planning Time Index	Rank	Travel Time Index	Rank
Los Angeles	I-5 NB	Penrose St Osborne St	3.3	44	321	2.43	302	1.90	96
Charleston	I-26 EB	US-78/University Blvd Dorchester Rd	10.5	43	322	1.86	322	1.17	323
Sacramento	I-80 WB	I-5/CA-99 Capitol Ave/Enterprise Blvd	5.0	42	323	1.54	325	1.09	325
San Jose	Sinclair Fwy/I-680 SB	CA-237/Calaveras Blvd Berryessa Rd	3.5	40	324	2.04	318	1.40	304
San Jose	W Valley Fwy/CA-85 NB	I-280 CA-82/El Camino Real	3.8	39	325	2.00	320	1.34	314
New York	Garden State Pkwy NB	Cr-539/Exit 58 Forked River Rest Area	17.5	37	326	1.43	327	1.04	328
Sacramento	S Sacramento Fwy/CA-99 SB	12th Ave Mack Rd/Bruceville Rd	5.4	24	327	2.11	317	1.70	179
Allentown PA-NJ	US-22 WB	15th St PA-145/Macarthur Rd	3.4	18	328	1.30	328	1.09	325

Buffer Index—measure of trip reliability that expresses the amount of extra "buffer" time needed to be on time for 95 percent of trips. A BI of 150 percent means that for a trip that takes 30 minutes on average, 45 extra minutes should be planned (30 minutes x 150% = 45 minutes). Planning Time Index—represents the total travel time that should be planned for a trip. It differs from the BI in that it includes typical delay as well as unexpected delay. A PTI of 2.50 means that for a 30-minute trip in light traffic, 75 minutes should be planned (30 minutes x 2.50 = 75 minutes). Travel Time Index—the ratio of travel time in the peak period to the travel time at free-flow conditions. A value of 1.30 indicates a 20-minute free-flow trip takes 26 minutes in the peak period. Note: Please do not place too much emphasis on small differences in rankings. There may be little difference between (for example) 5th and 10th. The actual measure values should also be examined.

Table 10. Congestion Leaders (All 328 Corridors)

Urban Area	Corridor	Corridor Endpoints From To	Corridor Length (miles)	2010 All-day Everyday Congestion: Delay Per Mile Person-hrs (x 1000)	Delay Per Mile Rank	Wasted Fuel Gallons (x 1000)	Wasted Fuel Rank	Congestion Cost (x $1000)	Congestion Cost Rank
Los Angeles	Harbor Fwy/CA-110 NB	I-10/Santa Monica Fwy Stadium Way/Exit 24C	3.1	1,440	1	2,170	28	95,020	27
Los Angeles	Harbor Fwy/I-110 NB	111th Pl I-110/I-10/Santa Monica Fwy	6.5	1,126	2	3,665	13	158,173	14
Los Angeles	San Diego Fwy/I-405 NB	I-105/Imperial Hwy Getty Center Dr	13.1	965	3	6,057	2	269,925	2
New York	Van Wyck Expy/I-678 NB	Belt Pkwy/Exit 1 Main St/Exit 8	3.1	690	4	1,086	68	46,928	69
Los Angeles	San Gabriel River Fwy/I-605 SB	Beverly Blvd Florence Ave	4.8	681	5	1,644	43	70,454	43
Los Angeles	Santa Monica Fwy/I-10 EB	CA-1/Lincoln Blvd/Exit 1B Alameda St	14.9	640	6	4,664	8	203,998	8
Los Angeles	Santa Monica Fwy/I-10 WB	I-5/Golden State Fwy National Blvd	12.6	633	7	3,831	11	169,842	11
San Francisco	I-80 EB (James Lick Fwy/Bay Brdg)	US-101 Treasure Island Rd	3.6	600	8	1,005	76	43,711	79
San Francisco	Grove Shafter Fwy/CA-24 WB	Saint Stephens Dr Caldecott Tunnel	3.5	600	8	934	84	43,359	82
Los Angeles	I-110 SB	W Vernon Ave 51st St	2.5	582	10	670	124	30,929	114
New York	I-278 EB (Gowanus Expy/Brooklyn Queens)	92nd St/Exit 17 Apollo St/Meeker Ave/Exit 34	11.6	581	11	3,618	15	149,860	15
Los Angeles	Riverside Fwy/CA-91 EB	CA-55/Costa Mesa Fwy Mckinley St	20.7	576	12	5,698	3	260,647	3
New York	I-278 WB (Brooklyn Queens/Gowanus Expy)	NY-25A/Northern Blvd/Exit 41 NY-27/Prospect Expy/Exit 24	10.2	550	13	2,966	19	124,355	20
Austin	I-35 SB	US-183/Exit 239-240 Woodland Ave	6.7	546	14	1,698	38	77,880	37
San Francisco	Eastshore Fwy/I-80 EB/I-580 WB	Cypress St University Ave	3.3	538	15	847	91	36,568	98
Austin	I-35 NB	Shelby Ln/St Elmo Rd/Exit 230 Martin Luther King Blvd/19th St/Exit 235	4.7	536	16	1,243	58	54,236	61
Los Angeles	CA-110 SB (Pasadena/Harbor Fwys)	Avenue 60 Olympic Blvd/9th St	6.6	526	17	1,679	40	73,700	41
Los Angeles	I-5 SB (Santa Ana/Golden St Fwys)	East Ceasar Chavez Ave Valley View Ave	17.5	523	18	4,541	9	196,333	9

Delay Per Mile—Extra travel time during the year due to congestion, divided by the corridor length.
Wasted Fuel—Increased fuel consumption due to travel in congested conditions rather than free-flow conditions.
Congestion Cost—Value of travel time delay (estimated at $16 per hour for person travel and $88 per hour for truck time) and excess fuel consumption (estimated using state average cost per gallon of gasoline and diesel).
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Table 10. Congestion Leaders (All 328 Corridors), continued

Urban Area	Corridor	Limits (From/To)	Corridor Length (miles)	2010 All-day Everyday Congestion: Delay Per Mile Person-hrs (x 1000)	Delay Per Mile Rank	Wasted Fuel Gallons (x 1000)	Wasted Fuel Rank	Congestion Cost (x $1000)	Congestion Cost Rank
New York	Van Wyck Expy/I-678 SB	Horace Harding Expy/Exit 12A Linden Blvd/Exit 3	6.2	520	19	1,625	44	70,308	44
San Francisco	Eastshore Fwy/I-80 WB/I-580 EB	Cutting Blvd Bay Bridge Toll Plz	8.5	515	20	2,122	29	90,264	29
Los Angeles	US-101 NB (Santa Ana/Hollywood Fwys)	I-5/CA-60 Haskell Ave	21.5	503	21	5,386	6	232,387	6
Los Angeles	San Diego Fwy/I-405 NB	Macarthur Blvd Brookhurst St	7.8	497	22	1,777	37	81,506	35
Los Angeles	I-5 NB (Santa Ana/Golden St Fwys)	CA-39/Beach Blvd Riverside Dr	22.5	487	23	5,442	5	235,356	5
Los Angeles	San Bernadino Fwy/I-10 EB	City Terrace Dr/Herbert Ave Baldwin Park Blvd	12.8	487	23	3,041	18	132,990	17
Los Angeles	US-101 SB (Ventura/Hollywood Fwys)	Ventura Blvd/Shoup Ave Vignes St/Exit 2B	26.7	485	25	6,262	1	277,782	1
Houston	I-10 EB	T C Jester Blvd/Exit 765 Mckee St/San Jacinto St	4.4	475	26	951	81	43,270	83
Boston	Southeast Expy/I-93 NB	MA-28/Randolph Ave/Exit 5 Columbia Rd/Exit 15	10.4	470	27	2,442	22	105,165	22
Washington, DC	Capital Beltway/I-495 Outer Loop	US-1/Baltimore Ave/Exit 25 MD-97/Georgia Ave/Exit 31	6.3	465	28	1,360	55	61,030	54
Houston	N Loop W Fwy/I-610 EB	US-290 Yale St	4.0	460	29	885	89	39,255	90
Los Angeles	San Diego Fwy/I-405 SB	Nordhoff St Mulholland Dr	8.1	458	30	1,793	36	79,085	36
Houston	US-59 NB (Southwest/Eastex Fwys)	Buffalo Speedway I-45	4.8	453	31	1,025	74	45,426	72
New York	Major Deegan Expy/I-87 NB	I-278/Bruckner Expy I-95/Cross Bronx Expy/Exit 7	4.1	452	32	975	80	41,142	86
Seattle	I-5 SB	WA-523/145th St/Exit 175 Union St/Exit 165	8.9	441	33	1,930	32	84,806	33
Pittsburgh	Penn Lincoln Pkwy/I-376 EB	Lydia St/Exit 2 US-19 TK RT/PA-51/Exit 5	3.4	433	34	728	107	33,336	108
Miami	Dolphin Expy/SR 836 EB	107th Ave FL-959/Red Rd	5.0	431	35	1,105	67	45,316	73
New York	Long Island Expy/I-495 EB	Maurice Ave/Exit 18 Mineola Ave/Willis Ave/Exit 37	16.0	426	36	3,506	16	149,511	16

Delay Per Mile—Extra travel time during the year due to congestion, divided by the corridor length.
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Table 10. Congestion Leaders (All 328 Corridors), continued

Urban Area	Corridor	Limits (From/To)	Corridor Length (miles)	2010 All-day Everyday Congestion: Delay Per Mile, Person-hrs (x 1000)	Rank	Wasted Fuel, Gallons (x 1000)	Rank	Congestion Cost (x $1000)	Rank
New York	I-95 SB (NE Thwy, Bruckner/Cross Bronx Expys)	Conner St/Exit 13 Hudson Ter	22.7	425	37	4,907	7	213,006	7
Los Angeles	I-605 NB	Beverly Blvd Valley Blvd	5.0	423	38	1,038	71	44,997	74
Chicago	Stevenson Expy/I-55 SB	State St/Exit 293C Pulaski Rd/Exit 287	5.7	414	39	1,249	56	55,001	59
New York	Goethals Brg EB/I-278 EB	Meeker Ave/Forest Ave/Exit 4 Bradley Ave/Exit 11	3.3	414	39	716	111	30,094	124
Seattle	I-5 NB	Albro Pl/Swift Ave/Exit 161 James St/Exit 164	4.1	398	41	836	96	35,495	102
Los Angeles	Santa Ana Fwy/I-5 NB	Sand Canyon Ave 17th St	8.4	397	42	1,595	45	71,034	42
Philadelphia	Schuylkill Expy/I-76 WB	Oregon Ave/Passyunk Ave/Exit347 Belmont Ave/Exit 338	9.5	391	43	1,961	31	83,569	34
Los Angeles	I-5 NB	Penrose St Osborne St	3.3	388	44	641	131	27,533	137
Dallas-Fort Worth	TX-360 SB	Post N Paddock St Division St	3.0	385	45	557	156	23,967	158
New York	I-278 WB	New York Ave Slosson Ave/Exit 12	3.2	378	46	622	137	26,235	142
Houston	W Loop Fwy/I-610 SB	US-290/18th St Evergreen St/Exit 5	6.9	375	47	1,225	60	54,336	60
New York	Major Deegan Expy SB	Van Cortlandt Park/Exit 11 I-95/Cross Bronx Expy/Exit 7	3.5	375	47	707	114	29,288	129
Chicago	Eisenhower Expy/I-290 WB	S Ashland Ave/Exit 28B 9th Ave/Exit 19B	8.8	368	49	1,847	35	77,727	38
New York	I-95 NB (Cross Bronx/Bruckner Expys)	I-80/NJ Tpke Pelham Pkwy/Exit 8	11.5	365	50	2,229	25	93,448	28
Dallas-Fort Worth	Loop 820/I-820 WB	TX-26/Grapevine Hwy US-377/Denton Hwy/Exit 19	3.1	364	51	569	152	24,587	153
Los Angeles	Foothill Fwy/I-210 EB	Lincoln Ave CA-39/Azusa Ave	17.2	363	52	3,073	17	132,885	18
Miami	Palmetto Expy/SR 826 SB	74th St 25th St	3.2	362	53	526	164	23,317	162
Houston	I-45 NB (Gulf/North Fwys)	Dumble St Gulf Bank Rd/Exit 57	13.6	361	54	2,302	23	104,654	23

Delay Per Mile—Extra travel time during the year due to congestion, divided by the corridor length.
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Table 10. Congestion Leaders (All 328 Corridors), continued

Urban Area	Corridor	Limits (From/To)	Corridor Length (miles)	2010 All-day Everyday Congestion					
				Delay Per Mile		Wasted Fuel		Congestion Cost	
				Person-hrs (x 1000)	Rank	Gallons (x 1000)	Rank	(x $1000)	Rank
Los Angeles	I-710 SB	Floral Dr Atlantic Blvd/Bandini Blvd	3.7	359	55	649	130	27,869	135
Houston	W Loop Fwy/I-610 NB	Braeswood Blvd/S Post Oak Rd/Exit 4 Woodway Dr/Exit 10	5.8	357	56	946	83	43,412	81
Los Angeles	Pomona Fwy/CA-60 EB	Whittier Blvd Brea Canyon Rd	21.7	357	56	3,828	12	165,020	12
Houston	Gulf Fwy/I-45 SB	Dumble St I-610/Exit 40	3.6	355	58	591	145	26,134	145
Dallas-Fort Worth	Stemmons Fwy/I-35E SB	Empire Central Dr/Exit 434A I-30/Exit 428	6.7	354	59	1,163	62	50,255	64
Los Angeles	Costa Mesa Fwy/CA-55 NB	CA-73 4th St/Irvine Blvd	6.5	351	60	1,025	74	47,964	67
New York	Long Island Expy/I-495 WB	Glen Cove Rd/Exit 39 Woodhaven Blvd	14.9	351	60	2,633	21	115,117	21
Los Angeles	I-5 SB	Alton Pkwy El Toro Rd	3.4	346	62	542	159	25,004	151
New York	Belt/Shore/Laurelton Pkwys EB	I-678/Van Wyck Expy/Exit 20 Merrick Blvd/Exit 24	3.6	346	62	627	135	27,041	139
Chicago	Eisenhower Expy/I-290 EB	IL-72/Higgins Rd/Exit 1 Austin Blvd/Exit 23A	21.5	345	64	3,953	10	174,780	10
Miami	Dolphin Expy/SR 836 WB	I-95 FL-959/Red Rd	5.5	342	65	911	88	38,161	92
San Francisco	Nimitz Fwy/I-880 SB	I-238/Washington Ave CA-92/Jackson St	4.3	342	65	674	121	29,968	125
Seattle	I-405 SB	WA-520/Ne 14th St/Exit 14 SE Coal Creek Pkwy/Exit 10	4.5	342	65	774	103	33,127	109
New York	Laurelton/Belt/Shore Pkwys WB	Francis Lewis Blvd/Exit 24 Nassau Expy/Exit 19	4.9	335	68	846	92	36,004	99
Washington, DC	I-95 SB	I-395 Russell Rd/Exit 148	23.9	333	69	3,637	14	164,962	13
Chicago	I-90/I-94 EB (Kennedy/Dan Ryan Expys)	I-294/Tri State Tollway Ruble St/Exit 52B	15.9	330	70	2,876	20	124,436	19
San Francisco	I-80 WB	Hillcrest Rd US-101	3.5	329	71	559	154	23,833	159
Houston	I-45 NB	Clearwood Dr/Edgebrook St Broadway St/Park Place Blvd/Exit39	3.8	323	72	545	157	25,207	150

Delay Per Mile—Extra travel time during the year due to congestion, divided by the corridor length.
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Table 10. Congestion Leaders (All 328 Corridors), continued

Urban Area	Corridor	Limits (From/To)	Corridor Length (miles)	2010 All-day Everyday Congestion: Delay Per Mile, Person-hrs (x 1000)	Rank	Wasted Fuel, Gallons (x 1000)	Rank	Congestion Cost (x $1000)	Rank
Los Angeles	Orange Fwy/CA-57 NB	I-5/CA-22/Chapman Ave (Orange) CA-60/Pomona Fwy	14.7	321	73	2,260	24	100,145	25
Houston	I-45 SB	Tidwell Rd Cavalcade St/Exit 50	3.4	318	74	484	174	23,078	164
Los Angeles	I-10 WB	Citrus St Baldwin Park Blvd	5.2	317	75	786	101	35,294	103
Atlanta	I-285 EB	Riverside Dr/Exit 24 I-85/Exit 33	9.10	307	76	1,420	48	64,012	49
Houston	I-45 SB	Sam Houston Tollway/Exit 32 FM-2351/Exit 29	3.7	306	77	502	168	23,533	160
San Francisco	Grove Shafter Fwy/CA-24 EB	I-580/I-980 Caldecott Tunnel	4.1	305	78	601	141	25,648	148
New York	Grand Central Pkwy EB	I-278 I-295/NY-25/Exit 21	10.6	300	79	1,654	42	70,149	45
Washington, DC	Capital Beltway/I-495 Inner Loop	I-95/I-395/Exit 57 MD-650/New Hampshire Ave/Exit28	41.4	300	79	5,625	4	257,175	4
Los Angeles	I-710 NB	Alondra Blvd Imperial Hwy	3.0	299	81	437	186	19,195	189
Riverside	Riverside Fwy/CA-91 WB	McKinley St Auto Center Dr/Serfas Club Dr	5.6	299	81	837	95	38,149	93
Minneapolis-St. Paul	I-94 WB	Cretin Ave/Vandalia St/Exit 237 I-35W/11th St/Exit 233	4.1	298	83	576	150	24,302	155
Minneapolis-St. Paul	I-494 WB	34th Ave/Exit 1 Cr-32/Penn Ave/Exit 6	4.1	297	84	571	151	24,438	154
Dallas-Fort Worth	Thornton Fwy/I-30 WB	Saint Francis Ave/Exit 52 Griffin St	7.2	294	85	1,027	72	44,426	78
San Jose	Bayshore Fwy/US-101 SB	Alum Rock Ave/Santa Clara St Tully Rd	3.7	291	86	513	166	21,716	175
Los Angeles	CA-91 EB (Gardena/Artesia Fwys)	I-110 (East) Cherry Ave	6.7	288	87	947	82	41,016	87
San Francisco	I-580 EB	Eden Canyon Rd El Charro Rd/Fallon Rd	9.6	288	87	1,232	59	55,924	57
San Jose	Bayshore Fwy/US-101 SB	Fair Oaks Ave De La Cruz Blvd	4.2	287	89	558	155	24,079	157
Boston	Southeast Expy/I-93 SB	Granite Ave/Exit 11 MA-3/Exit 7	3.8	283	90	528	163	23,193	163

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Table 10. Congestion Leaders (All 328 Corridors), continued

Urban Area	Corridor	Limits (From/To)	Corridor Length (miles)	2010 All-day Everyday Congestion: Delay Per Mile Person-hrs (x 1000)	Delay Per Mile Rank	Wasted Fuel Gallons (x 1000)	Wasted Fuel Rank	Congestion Cost (x $1000)	Congestion Cost Rank
Los Angeles	Pomona Fwy/CA-60 WB	Fairway Dr Peck Rd	10.4	281	91	1,374	53	62,000	51
New York	Southern State Pkwy EB	Franklin Ave/Exit 16 Wantagh Ave/Exit 28	10.3	279	92	1,384	52	62,819	50
Houston	Eastex Fwy/US-59 SB	Quitman St/Liberty Rd TX-288	4.1	278	93	531	162	23,441	161
Philadelphia	Delaware Expy/I-95 SB	Academy Rd/Exit 32 Girard Ave/Exit 23	8.3	278	93	1,129	65	49,912	65
Tampa	I-275 SB	Floribraska Ave/28th Ave/Exit 28 US-92/Dale Mabry Hwy/Exit 23	4.2	278	93	562	153	24,682	152
Portland	I-5 NB	Corbett Ave/Exit 298 N Tomahawk Island Dr/Exit 308	10.1	275	96	1,39.6	51	59,113	55
Los Angeles	I-10 WB	Valley Blvd Atlantic Blvd	6.4	274	97	839	94	37,490	95
Los Angeles	I-405 NB	Avalon Blvd Inglewood Ave	7.3	274	97	859	90	42,017	85
New York	FDR Dr NB	I-495/Tunnel Exit St/Queens Midtown Tunl 116th St/Exit 16	4.0	274	97	593	143	24,161	156
Las Vegas	I-15 NB	Tropicana Ave/Exit 37 Sahara Ave/Exit 40	3.2	273	100	427	190	18,787	194
Los Angeles	Century Fwy/I-105 EB	Nash St I-605	17.6	272	101	2,208	26	102,055	24
Dallas-Fort Worth	Loop 820/I-820 EB	Mark Iv Pkwy/Exit 16 Rufe Snow Dr/Exit 20	5.2	270	102	711	113	30,693	117
Minneapolis-St. Paul	I-494 EB	US-212/Prairie Center Dr/Exit 1 Cr-32/Penn Ave/Exit 6	5.7	270	102	672	123	30,503	120
New York	Belt Pkwy EB	Knapp St Pennsylvania Ave/Exit 14	7.5	269	104	1,039	70	44,527	77
New York	Bronx Whitestone Brg NB/Whitestone Expy NB	Linden Pl/Exit 14 Toll Plaza	3.4	268	105	504	167	20,416	183
New York	Garden State Pkwy NB	I-78/Mill Rd/Exit 142 I-280/Exit 145	3.8	266	106	470	177	22,157	171
Denver	I-25 SB	58th Ave/Exit 215 CO-2/Colorado Blvd/Exit 204	10.9	265	107	1,402	50	61,549	52
Chicago	I-290 WB	I-88/Exit 15A IL-83/Exit 10A	6.0	264	108	845	93	37,497	94

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Urban Area	Corridor	Limits (From/To)	Corridor Length (miles)	2010 All-day Everyday Congestion: Delay Per Mile Person-hrs (x 1000)	Delay Per Mile Rank	Wasted Fuel Gallons (x 1000)	Wasted Fuel Rank	Congestion Cost (x $1000)	Congestion Cost Rank
Los Angeles	I-210 WB	I-605 Baldwin Ave	5.5	264	108	689	116	30,873	115
Boston	Southeast Expy/I-93 SB	I-90 Freeport St/Exit 13	3.7	263	110	485	173	20,641	178
Atlanta	I-75 NB	Mount Paran Rd/Exit 256 Barrett Pkwy/Exit 269	12.8	262	111	1,683	39	76,923	39
Pittsburgh	Penn Lincoln Pkwy/I-376 WB	US-22 Bus/Exit 10 Squirrel Hill Tunl	5.3	260	112	724	108	31,422	113
Miami	Palmetto Expy/SR 826 NB	56th St/Miller Dr US-27/Okeechobee Rd	10.5	259	113	1,245	57	55,742	58
Dallas-Fort Worth	TX-183 EB	I-820 Bedford Rd	4.0	258	114	462	179	21,818	173
Dallas-Fort Worth	I-635 WB	US-75/Exit 19 Josey Ln/Exit 26	8.3	258	114	923	86	44,566	76
Los Angeles	CA-134 EB	Bob Hope Dr I-5/Golden Hwy	3.1	258	114	384	208	16,734	213
Los Angeles	I-5 SB	Buena Vista St Mission Rd	12.6	254	117	1,488	46	68,161	46
Phoenix	Papago Fwy/I-10 WB	AZ-51/AZ-202/Exit 147 35th Ave/Exit 141	6.2	253	118	784	102	33,970	107
Chicago	Stevenson Expy/I-55 NB	US-20/US-45/US-12/Exit 279A Pulaski Rd/Exit 287	8.9	252	119	1,172	61	52,206	62
Orlando	I-4 EB	Floridas Turnpike/Exit 31 FL-423/Lee Rd/Exit 46	9.8	252	119	1,149	63	51,759	63
Phoenix	I-10 EB (Papago/Maricopa Fwys)	Buckeye Rd/Exit 149 Broadway Rd/52nd St/Exit153B	6.1	252	119	759	105	33,067	110
Dallas-Fort Worth	LBJ Fwy/I-635 EB	Valley View Ln/Exit 30 Kingsley Rd/Exit 13	16.7	251	122	1,919	33	88,647	30
Houston	US-59 SB	Greenbriar Dr I-610 (Houston) (South)	3.0	248	123	329	225	15,476	222
New Haven	I-95 NB	Marsh Hill Rd/Exit 41 Ella T Grasso Blvd/Exit 45	4.0	248	123	488	172	21,720	174
Portland	US-26 EB	OR-217/Exit 69 Canyon Rd/Exit 73	4.2	244	125	543	158	22,394	169
San Francisco	I-880 NB	CA-84/Decoto Rd Tennyson Rd	5.3	241	126	580	149	26,147	143

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Urban Area	Corridor	Limits (From/To)	Corridor Length (miles)	2010 All-day Everyday Congestion: Delay Per Mile, Person-hrs (x 1000)	Delay Per Mile, Rank	Wasted Fuel, Gallons (x 1000)	Wasted Fuel, Rank	Congestion Cost (x $1000)	Congestion Cost, Rank
Chicago	I-90/I-94 WB (Dan Ryan/Kennedy Expys)	Pershing Rd/Exit 55B Sayre Ave/Exit 81B	15.4	240	127	2,054	30	88,085	31
New York	NJ-17	Paramus Rd/Saddle River Rd Passaic St	5.5	239	128	636	134	26,939	140
San Francisco	California Delta Hwy/CA-4 EB	Bailey Rd Somersville Rd	5.8	238	129	659	128	29,239	130
San Jose	Bayshore Fwy/US-101 NB	CA-237 San Antonio Rd	4.7	238	129	496	171	22,171	170
Seattle	I-5 NB	72nd St/74th St/Exit 129 I-705/WA-7/Exit 133	4.2	236	131	477	176	21,310	176
Denver	I-25 NB	Evans Ave/Exit 203 84th Ave/Exit 219	15.1	235	132	1,679	40	75,464	40
San Francisco	US-101 NB	Whipple Ave Marine Pkwy/Ralston Ave	3.1	233	133	306	237	14,456	229
San Francisco	California Delta Hwy/CA-4 WB	Hillcrest Ave Somersville Rd	3.0	232	134	329	225	14,793	226
Baton Rouge	I-12 EB	Essen Ln O'Neal Ln	5.8	231	135	789	99	35,987	100
Boston	I-93 SB	I-95/MA-128/Exit 37 US-1/Exit 27	9.8	230	136	1,106	66	48,371	66
Dallas-Fort Worth	I-30 EB	Hampton Rd/Exit 42 Barry Ave/Exit 48	6.9	229	137	793	98	34,165	106
San Diego	San Diego Fwy/I-5 NB	I-805 (North) Manchester Ave	7.6	229	137	684	118	34,806	105
San Diego	I-805 SB	I-5 La Jolla Village Dr/Miramar Rd	2.9	229	137	304	240	13,491	244
New York	Harlem River Dr NB	Willis Avenue Brg/Exit 18 I-95/Amsterdam Ave/Exit 23	3.2	225	140	355	217	15,570	221
Philadelphia	Schuylkill Expy/I-76 EB	I-276 South St/Exit 346	18.9	225	140	2,189	27	95,520	26
Baltimore	Baltimore Beltway Inner Loop/I-695 NB	US-1/Southwestern Blvd/Exit 12 Security Blvd/Exit 17	5.3	223	142	592	144	26,083	146
Los Angeles	CA-55 SB	Katella Ave McFadden Ave	6.0	223	142	582	148	28,041	133
Los Angeles	I-405 SB	Valley View St Warner Ave	6.6	223	142	595	142	30,783	116

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Los Angeles	I-405 SB	CA-55/Costa Mesa Fwy Jeffrey Rd/University Dr	4.5	223	142	419	196	21,040	177
Dallas-Fort Worth	US-75 NB	Ross Ave/Exit 286 Mockingbird Ln/Exit 3	3.6	218	146	363	215	16,353	215
Los Angeles	Century Fwy/I-105 WB	Bellflower Blvd Crenshaw Blvd	12.5	215	147	1,143	64	56,633	56
Cincinnati	I-75 SB	I-74/US-52/US-27/Exit 4 W 7th St/Exit 1	3.4	214	148	343	221	15,739	220
Atlanta	I-75/I-85 NB	GA-166 US-78/US-278/US-29/Exit 249	7.6	213	149	808	97	37,126	96
Atlanta	I-85 NB	Chamblee Tucker Rd/Exit 94 GA-140/Jimmy Carter Blvd/Exit 99	4.7	213	149	502	168	23,007	165
Baltimore	Baltimore Beltway Outer Loop/I-695 SB	MD-140/Reisterstown Rd/Exit20 US-40/Exit 15	7.1	211	151	674	121	32,677	111
Milwaukee	Zoo Fwy/US-45 SB	WI-190/Capitol Dr/Exit 44 I-94/Exit 38	3.8	211	151	394	206	16,792	212
San Diego	CA-78 EB	Rancho Santa Fe Rd Mission Rd	4.2	211	151	406	200	17,966	201
Washington, DC	Custis Mem Pkwy/I-66 WB	US-29/Lee Hwy/Exit 73 VA-123/Exit 60	14.8	211	151	1,463	47	65,408	47
New York	Garden State Pkwy SB	Watchung Ave/Exit 151 Walnut St/Exit 147	4.5	208	155	454	180	20,287	184
San Jose	Nimitz Fwy/I-880 SB	CA-237/W Calaveras Blvd 1st St	4.6	207	156	447	183	19,151	190
Atlanta	I-20 EB	GA-155/Candler Rd/Exit 65 Wesley Chapel Rd/Exit 68	3.0	206	157	312	233	14,267	233
Detroit	Edsel Ford Fwy/I-94 EB	Grand Blvd/Exit 213 Chene St/Exit 217	4.0	204	158	397	204	17,187	208
Norfolk	Hampton Roads Beltway/I-64 EB	Rip Rap Rd/Exit 265 Hampton Roads Brg Tunl(Hampton)	3.1	204	158	310	234	13,230	246
Milwaukee	I-94 WB	I-43/I-794 General Mitchell Blvd/Exit 308	2.9	202	160	294	245	12,133	266
Dallas-Fort Worth	North Fwy/I-35W NB	Rosedale St/Exit 49B Western Center Blvd/Exit 58	9.5	200	161	913	87	39,923	89
Santa Cruz	Cabrillo Hwy/CA-1 SB	CA-17 Park Ave	4.8	200	161	420	194	18,526	195

Delay Per Mile—Extra travel time during the year due to congestion, divided by the corridor length.
Wasted Fuel—Increased fuel consumption due to travel in congested conditions rather than free-flow conditions.
Congestion Cost—Value of travel time delay (estimated at $16 per hour for person travel and $88 per hour for truck time) and excess fuel consumption (estimated using state average cost per gallon of gasoline and diesel).
Note: Please do not place too much emphasis on small differences in the rankings. There may be little difference between (for example) 5th and 10th. The actual measure values should also be examined.

Table 10. Congestion Leaders (All 328 Corridors), continued

Urban Area	Corridor	Limits (From/To)	Corridor Length (miles)	2010 All-day Everyday Congestion: Delay Per Mile Person-hrs (x 1000)	Delay Per Mile Rank	Wasted Fuel Gallons (x 1000)	Wasted Fuel Rank	Congestion Cost (x $1000)	Congestion Cost Rank
Baltimore	Baltimore Beltway Inner Loop/I-695 EB	MD-140/Reisterstown Rd/Exit20 MD-542/Loch Raven Blvd/Exit 29	10.2	199	163	976	79	45,506	71
Seattle	I-5 SB	320th St/Exit 143 I-705/WA-7/Exit 133	11.1	199	163	1,058	69	47,150	68
Houston	Northwest Fwy/ US-290 WB	Mangum Rd N Eldridge Pkwy	11.0	197	165	978	78	44,833	75
Washington, DC	Shirley Hwy/I-395 SB	Quaker Ln/Exit 6 VA-236/Duke St/Exit 3	3.6	197	165	317	231	14,333	231
Boston	I-95/MA-128 NB	MA-2/Exit 29 MA-28/Main St/Exit 38	11.1	195	167	1,027	72	46,457	70
Norfolk	Hampton Roads Beltway/I-64 WB	VA-168/Tidewater Dr/Exit 277 Hampton Roads Brg Tunl(Norfolk)	6.4	195	167	587	147	25,823	147
Minneapolis-St. Paul	I-35W SB	Washington Ave/Exit 17C Diamond Lake Rd/Exit 12B	7.7	193	169	705	115	29,597	127
New York	Cross Island Pkwy NB	Grand Central Pkwy/Exit 29 I-295/Throgs Neck Brg/Exit 33	4.7	192	170	438	185	19,843	186
Providence	I-95 SB	US-1/George St/Exit 27 RI-7/RI-146/Charles St/Exit 23	3.2	191	171	287	248	12,266	262
Cincinnati	I-75 NB	I-74/US-52/US-27/Exit 4 OH-4/Paddock Rd/Exit 9	5.0	190	172	480	175	20,426	182
Orlando	I-4 WB	FL-423/Lee Rd/Exit 46 FL-408/Exit 36	5.7	190	172	497	170	22,645	167
Washington, DC	I-95 NB	Dale Blvd/Smoketown Rd/Eb Exit 156 VA-123/Exit 160	4.8	190	172	379	210	19,070	191
Chicago	Stevenson Expy/I-55 SB	IL-43/Harlem Ave/Exit 283 County Line Rd/Exit 276A	7.3	189	175	718	110	31,721	112
Hartford	I-84 EB	S Main St/Exit 41 I-91/Exit 51-52	6.7	189	175	614	139	26,683	141
New York	Grand Central Pkwy WB	Little Neck Pkwy/Exit 24 Homelawn St/Exit 17/Exit 18	4.6	187	177	422	191	18,883	193
Austin	Loop 1/Mopac Expy SB	US-183/Research Blvd Barton Skwy	9.1	186	178	787	100	35,733	101
New York	Cross Island Pkwy SB	14th Ave/Exit 35 NY-25/Exit 27	7.5	186	178	686	117	30,440	122
San Francisco	I-880 NB	98th Ave 23rd Ave	4.2	186	178	339	222	16,073	217

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Table 10. Congestion Leaders (All 328 Corridors), continued

Urban Area	Corridor	Limits (From/To)	Corridor Length (miles)	2010 All-day Everyday Congestion					
				Delay Per Mile		Wasted Fuel		Congestion Cost	
				Person-hrs (x 1000)	Rank	Gallons (x 1000)	Rank	(x $1000)	Rank
New Orleans	Pontchartrain Expy WB	Whitney Ave Oretha C Haley Blvd	3.6	185	181	364	214	15,438	223
Boston	I-93 NB	Storrow Dr/Exit 26B Montvale Ave/Exit 36	8.9	184	182	773	104	34,841	104
San Francisco	US-101 SB	CA-84/Woodside Rd University Ave	4.4	184	182	339	222	16,139	216
Washington, DC	MD 295/ Baltimore Washington Pkwy NB	MD-450 Powder Mill Rd	7.7	184	182	678	120	30,485	121
New York	NJ-17	I-80 Garden State Pkwy	4.7	183	185	421	193	17,806	205
Baltimore	Baltimore Beltway Outer Loop/I-695 WB	US-1/Exit 32 MD-139/Charles St/Exit 25	7.5	182	186	661	127	30,543	119
Tampa	I-275 NB	Howard Franklin Brg Lois Ave/Exit 22	3.4	182	186	283	249	12,891	249
New Haven	I-95 SB	CT-100/High St/Exit 52 Ella T Grasso Blvd/Exit 45	4.7	181	188	422	191	18,426	197
New Orleans	I-10 WB	Causeway Blvd/Exit 228 End Blvd/Florida Blvd	5.0	181	188	463	178	20,524	181
Sacramento	Capital City Fwy/I-80 Bus EB	US-50/CA-99 Fulton Ave	7.3	181	188	627	135	28,006	134
Washington, DC	Capital Beltway SB	MD-650/New Hampshire Ave/Exit28 MD-201/Kenilworth Ave/Exit 23	4.8	179	191	348	219	17,824	204
Charlotte	I-485 EB	NC-49/Tryon St/Exit 1 NC-51/Exit 64	5.3	178	192	451	181	20,543	180
New York	NJ-4	Teaneck Rd Forest Ave	3.3	178	192	304	240	12,811	252
Minneapolis-St. Paul	I-394 EB	Xenia Ave/Park Place Blvd/Exit 5 US-12/Exit 8B	3.3	176	194	269	260	11,679	270
Atlanta	I-85 SB	GA-13/Exit 86 (East) I-75/Exit 85	2.5	175	195	225	279	10,286	280
Bridgeport	Connecticut Turnpike/I-95 NB	Field Point Rd Mill Plain Rd/Exit 21	22.2	174	196	1,879	34	85,821	32
New York	Henry Hudson Pkwy NB	W 72nd St I-95/Riverside Dr/Exit 14-15	6.2	173	197	539	160	22,484	168
Providence	I-95 NB	US-1/Elmwood Ave/Exit 17 US-6/RI-10/Exit 22	4.0	173	197	331	224	14,014	235

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Table 10. Congestion Leaders (All 328 Corridors), continued

Urban Area	Corridor	Limits (From/To)	Corridor Length (miles)	2010 All-day Everyday Congestion: Delay Per Mile Person-hrs (x 1000)	Delay Per Mile Rank	Wasted Fuel Gallons (x 1000)	Wasted Fuel Rank	Congestion Cost (x $1000)	Congestion Cost Rank
San Francisco	I-680 NB	Stone Valley Rd N Main St	5.3	173	197	404	201	18,436	196
Dallas-Fort Worth	North Fwy/I-35W SB	Golden Triangle Blvd/Exit 64 TX-121/Exit 52	11.8	172	200	990	77	43,602	80
Dallas-Fort Worth	I-35E NB	Harry Hines Blvd/Exit 435 Valley View Ln/Exit 441	5.8	171	201	432	187	19,871	185
New York	Northern State Pkwy WB	Willis Ave/Exit 28 Lakeville Rd/Exit 25	3.4	170	202	260	264	12,551	255
Seattle	WA-520 WB	148th Ave 84th Ave	4.2	170	202	346	220	15,132	224
New Orleans	I-10 EB	Loyola Dr Veterans Memorial Blvd	3.5	169	204	292	247	13,382	245
Pittsburgh	Penn Lincoln Pkwy/I-376 EB	2nd Ave/1st Ave/Exit 1 William Penn Hwy/Exit 10A	8.1	169	204	682	119	30,684	118
New York	Long Island Expy EB	Sagtikos State Pkwy NY-111/Exit 56	3.2	168	206	252	269	11,728	269
Los Angeles	I-5 NB	Brand Blvd CA-14	5.8	166	207	430	188	20,620	179
San Jose	Sinclair Fwy/I-280 NB	CA-87/Guadalupe Pkwy I-880/CA-17	3.7	166	207	238	274	12,152	265
Cincinnati	I-75 SB	OH-126/Exit 14 Ronald Reagan Cross County Hwy/Exit10	3.9	164	209	325	228	13,979	236
Seattle	I-5 NB	WA-527/Exit 189 Marine View Dr/Exit 195	5.6	164	209	440	184	19,521	188
Atlanta	I-285 WB	Ashford Dunwoody Rd/Exit 29 I-75/Exit 20	8.1	161	211	638	132	29,800	126
Los Angeles	CA-57 SB	Brea Canyon Rd Orangewood Ave	11.7	160	212	752	106	39,075	91
Nashville	I-440 EB	TN-1/End Ave/Exit 1 US-31 Alt/US-41 Alt/Nolensville Pike/Exit6	4.8	160	212	414	197	17,674	206
New York	Southern State Pkwy WB	New Hwy/Exit 34 Brookside Ave/Exit 21	10.8	159	214	712	112	37,001	97
Boston	I-495 NB	MA-110/Chelmsford St/Exit 34 Woburn St/Exit 37	3.0	158	215	203	290	10,140	284
Cincinnati	I-75 NB	I-275/Exit 185 KY-1072/Kyles Ln/Exit 189	3.5	158	215	279	252	12,295	261

Delay Per Mile—Extra travel time during the year due to congestion, divided by the corridor length.
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Table 10. Congestion Leaders (All 328 Corridors), continued

Urban Area	Corridor	Limits (From/To)	Corridor Length (miles)	2010 All-day Everyday Congestion: Delay Per Mile, Person-hrs (x 1000)	Rank	Wasted Fuel, Gallons (x 1000)	Rank	Congestion Cost (x $1000)	Rank
Dallas-Fort Worth	I-35E NB	Hundley Dr/Exit 457B Post Oak Dr/Exit 461	3.8	154	217	258	265	11,974	267
Seattle	I-405 NB	61st Ave 44th St/Exit 7	7.0	154	217	521	165	22,823	166
Boston	I-95/MA-128 SB	US-3/Middlesex Tpke/Exit 32 MA-9/Worcester St/Exit 20	13.1	153	219	932	85	42,850	84
Riverside	Corona Fwy/I-15 SB	Hidden Valley Pkwy El Cerrito Rd	5.0	151	220	400	203	17,123	210
Seattle	I-90 WB	Bellevue Way/Exit 9 Mercer Way/Exit 6	3.3	150	221	240	271	10,427	278
New York	Belt Pkwy WB	Ocean Pkwy Bay 8th St/Exit 4	3.5	149	222	248	270	11,448	272
Seattle	I-5 NB	45th St/Exit 169 236th St/Exit 177	8.8	149	222	618	138	27,848	136
Hartford	I-84 WB	US-5/Main St Flatbush Ave/Exit 45	5.5	148	224	396	205	16,818	211
Portland	I-84 EB	I-5 I-205/Exit 8	6.0	148	224	450	182	18,944	192
San Francisco	I-680 NB	Scott Creek Rd Andrade Rd/Mission Rd	9.5	148	224	657	129	28,534	132
Chicago	Tri State Tollway/I-294 SB	IL-58/Golf Rd Ohare Oasis	7.6	147	227	609	140	25,621	149
Los Angeles	I-405 NB	Ventura Blvd Rinaldi St	9.5	147	227	638	132	29,550	128
Los Angeles	US-101 SB	Liberty Canyon Rd Parkway Calabasas	4.4	147	227	298	243	13,833	240
Santa Barbara	US-101 SB	Mission St San Ysidro Rd	5.9	147	227	414	197	18,211	199
Bridgeport	Connecticut Turnpike/I-95 SB	Stratford Ave/Exit 28 Round Hill Rd/Exit 22	4.9	145	231	350	218	15,805	219
Riverside	Ontario Fwy/I-15 SB	4th St CA-60	4.4	143	232	269	260	13,116	247
Seattle	I-405 NB	8th St/Se 12th St/Exit 12 Juanita Woodinville Way/Exit 22	10.0	142	233	662	126	30,159	123
Seattle	I-5 NB	Center Dr/Exit 118 Berkeley St/Exit 122	4.6	142	233	310	234	13,910	237

Delay Per Mile—Extra travel time during the year due to congestion, divided by the corridor length.
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Table 10. Congestion Leaders (All 328 Corridors), continued

Urban Area	Corridor	Limits (From/To)	Corridor Length (miles)	2010 All-day Everyday Congestion: Delay Per Mile Person-hrs (x 1000)	Delay Per Mile Rank	Wasted Fuel Gallons (x 1000)	Wasted Fuel Rank	Congestion Cost (x $1000)	Congestion Cost Rank
New York	I-287 NB	Randolphville Rd/Exit 7 Easton Ave/Exit 10	3.4	138	235	215	285	10,335	279
New York	I-80 WB	US-202/Exit 42 Cr-513/Exit 37	4.7	138	235	298	243	13,900	238
Washington, DC	Shirley Hwy/I-395 NB	I-95/I-495 Southwest Fwy	21.6	137	237	1,374	53	61,381	53
Portland	I-205 NB	Division St/Exit 19 US-30 Bus/Columbia Blvd/Exit 23	4.1	136	238	271	257	11,896	268
Sacramento	I-80 EB	El Camino Ave Northgate Blvd	3.6	136	238	237	275	10,151	282
San Diego	San Diego Fwy/I-5 SB	Harbor Dr Birmingham Dr	14.8	136	238	724	108	40,350	88
Santa Rosa CA	US-101 NB	Railroad Ave Commerce Blvd/Wilfred Ave	4.2	136	238	274	255	12,249	263
Houston	South Fwy/TX-288 SB	Southmore Blvd Airport Blvd	5.7	135	242	361	216	15,896	218
Riverside	Riverside Fwy/CA-91 EB	Van Buren Blvd Central Ave (East)	4.2	135	242	271	257	12,815	251
Atlanta	GA-400/US-19 SB	GA-120/Old Milton Pkwy/Exit 10 GA-140/Holcomb Bridge Rd/Exit 7	4.7	134	244	313	232	14,365	230
Riverside	Ontario Fwy/I-15 NB	Limonite Ave Jurupa St	5.1	134	244	306	237	14,754	227
Miami	Palmetto Expy/SR 826 SB	FL-823/57th Ave/Red Rd W 68th St/Gratigny Dr	4.6	133	246	254	267	12,396	258
Austin	Loop 1/Mopac Expy NB	US-290/TX-71 Fm-2222/Northland Dr	9.8	132	247	588	146	27,383	138
Charleston	I-26 WB	Dorchester Rd W Aviation Ave	4.3	132	247	270	259	12,485	256
Minneapolis-St. Paul	I-35E SB	US-10 Pennsylvania Ave/Exit 108	4.8	132	247	265	263	12,585	254
Baton Rouge	I-10 EB	LA-415/Exit 151 Dalrymple Dr/Exit 156	4.7	131	250	373	212	16,615	214
Bridgeport	Connecticut Turnpike/I-95 SB	Brookside Dr US-1/Exit 5	4.3	130	251	253	268	12,356	259
Philadelphia	Delaware Expy/I-95 NB	I-495/DE-92/Naamans Rd/Exit 11 US-322/Exit2/Exit3	3.2	130	251	188	295	8,995	295

Delay Per Mile—Extra travel time during the year due to congestion, divided by the corridor length.
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Urban Area	Corridor	Limits (From/To)	Corridor Length (miles)	2010 All-day Everyday Congestion					
				Delay Per Mile		Wasted Fuel		Congestion Cost	
				Person-hrs (x 1000)	Rank	Gallons (x 1000)	Rank	(x $1000)	Rank
Baltimore	John Hanson Hwy/US-50/US-301 EB	I-97/Exit 21 MD-70/Rowe Blvd/Exit 24	3.4	129	253	215	285	9,927	285
Washington, DC	Custis Mem Pkwy/I-66 EB	VA-234/Pr Wm Pkwy/Exit 44 N. Patrick Henry Dr	24.4	129	253	1,413	49	64,800	48
Oxnard CA	Ventura Fwy/US-101 NB	Camarillo Springs Rd Las Posas Rd	5.2	128	255	320	229	14,503	228
Dallas-Fort Worth	Loop 12 SB	I-35E Union Bower Rd	4.1	127	256	209	287	10,146	283
Minneapolis-St. Paul	I-694 EB	Cr-44/Silver Lake Rd/Exit 39 Lexington Ave/Exit 43	3.6	127	256	197	293	9,097	291
Cincinnati	I-71 NB	Dana Ave/Exit 5 Red Bank Rd/Exit 9	3.8	126	258	240	271	10,573	276
St. Louis	I-270 SB	Ladue Rd/Exit 13 Dougherty Ferry Rd/Exit 8	5.1	124	259	294	245	13,642	243
San Jose	W Valley Fwy/CA-85 SB	Central Expy Fremont Ave	3.0	123	260	152	307	7,289	305
Dallas-Fort Worth	US-75 NB	Exchange Pkwy/Exit 36 Eldorado Pkwy/Exit 39	4.4	121	261	226	278	11,042	273
San Antonio	I-410 EB	Starcrest Dr/Exit 25 Interchange Pkwy/Exit 26	1.1	121	261	63	327	2,682	327
Minneapolis-St. Paul	US-169 NB	Cr-3/Excelsior Blvd MN-55	4.0	118	263	222	281	9,466	290
Sacramento	I-80 WB	Horseshoe Bar Rd Douglas Blvd	6.8	117	264	383	209	17,174	209
Baton Rouge	I-10 WB	Siegen Ln/Exit 163 Perkins Rd/Exit 157	6.4	116	265	420	194	19,783	187
Raleigh	I-40 EB	Airport Blvd/Exit 284 NC-54/Exit 290	6.9	116	265	371	213	17,992	200
Minneapolis-St. Paul	I-694 WB	I-35E/I-694/Exit 46 MN-51/Exit 42	3.9	115	267	198	292	8,870	296
Chicago	Edens Expy/I-94 EB	Tower Rd/Exit 31 I-90/Kennedy Expy	11.0	114	268	668	125	29,155	131
Los Angeles	CA-2 SB	CA-134/Holly Dr Fletcher Dr	3.1	114	268	161	304	7,349	304
Seattle	WA-167 SB	277th St 8th St	7.3	114	268	408	199	17,830	203

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Urban Area	Corridor	Limits (From/To)	Corridor Length (miles)	2010 All-day Everyday Congestion					
				Delay Per Mile		Wasted Fuel		Congestion Cost	
				Person-hrs (x 1000)	Rank	Gallons (x 1000)	Rank	(x $1000)	Rank
Atlanta	GA-400 SB	Toll Plaza I-85/Exit 87	4.1	112	271	220	282	10,737	274
Bridgeport	Connecticut Turnpike/I-95 SB	Bronson Rd/Exit 20 US-1/Post Rd/Exit 13	10.8	109	272	534	161	26,140	144
Milwaukee	I-94 EB	Moorland Rd/Exit 301B WI-181/84th St/Exit 306	4.4	108	273	220	282	9,884	286
New Haven	I-84 WB	I-691 (Cheshire) (West) Austin Rd/Exit 25A	3.4	108	273	170	301	7,772	300
Boston	I-95/MA-128 NB	Neponset St/Exit 11 MA-1A/Exit 15	6.0	107	275	310	234	13,860	239
Portland	I-205 SB	Airport Way/Exit 24 Washington St/Stark St/Exit 20	4.0	107	275	208	288	9,042	293
Minneapolis-St. Paul	Crosstown Hwy/MN-62 EB	US-169/US-212 Cr-32/Penn Ave	4.6	105	277	225	279	9,541	289
San Jose	Sinclair Fwy/I-680 SB	CA-237/Calaveras Blvd Berryessa Rd	3.5	105	277	148	309	7,155	307
Seattle	I-5 SB	84th St/Hosmer St/Exit 128 41st Division Dr/Exit 120	7.9	105	277	379	210	17,639	207
Los Angeles	I-5 SB	CA-73 CA-1/Camino De Vis	5.8	104	280	275	253	12,936	248
Boston	Broadway	MA-99 MA-129/Salem St	4.5	103	281	231	276	9,571	288
Kansas City	I-70 EB	18th St/Exit 4 I-435/Exit 8	4.2	103	281	207	289	9,024	294
Sacramento	S Sacramento Fwy/CA-99 SB	12th Ave Mack Rd/Bruceville Rd	5.4	103	281	272	256	11,614	271
New York	Pulaski Skwy NB	I-95/Exp US-1 Tonnele Ave	3.3	101	284	170	301	7,148	308
Milwaukee	North-South Fwy/I-43 SB/I-94 WB	WI-59/6th St/Exit 311 Howard Ave/Exit 314	3.5	100	285	172	300	7,415	303
San Antonio	I-35 NB	Judson Rd/Exit 170 Evans Rd/Exit 174	3.8	100	285	147	310	7,606	301
Seattle	I-405 SB	WA-527/26th Ave/Exit 26 WA-908/85th St/Exit 18	8.7	100	285	404	201	18,318	198
Atlanta	I-85 SB	GA-120/Duluth Hwy/Exit 107 Steve Reynolds Blvd/Exit 103	3.7	95	288	175	297	7,913	298

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Table 10. Congestion Leaders (All 328 Corridors), continued

Urban Area	Corridor	Limits (From/To)	Corridor Length (miles)	2010 All-day Everyday Congestion					
				Delay Per Mile		Wasted Fuel		Congestion Cost	
				Person-hrs (x 1000)	Rank	Gallons (x 1000)	Rank	(x $1000)	Rank
Louisville	I-64 WB	Cannons Ln/Exit 10 I-71/Exit 6	4.4	92	289	203	290	9,093	292
Miami	FL Tpke Ext/FL-821 NB	FL-874/Exit 17 US-41/8th St/Sw 25th Ter/Exit 25	11.9	92	289	430	188	21,979	172
Atlanta	I-75 SB	Mount Zion Pkwy/Exit 231 Hudson Bridge Rd/Exit 224	6.7	90	291	275	253	13,798	241
Boston	Pilgrims Hwy/MA-3 NB	MA-228/Hingham St/Exit 14 Union St/Exit 17	6.6	87	292	256	266	12,355	260
Chicago	I-55 NB	IL-53/Exit 267 IL-83/Kingery Hwy/Exit 274	8.9	87	292	389	207	17,863	202
Dallas-Fort Worth	I-35E SB	Ave D/Exit 466B Mayhill Rd/Exit 462	4.4	87	292	174	299	7,861	299
Minneapolis-St. Paul	I-35W NB	Cleveland Ave/Exit 24 I-694/Exit 27	3.9	87	292	136	312	6,657	311
Harrisburg	I-83 NB	3rd St/Exit 42 Union Deposit Rd/Exit 48	6.7	86	296	305	239	13,703	242
Riverside	Ontario Fwy/I-15 NB	I-210/Exit 115 Glen Helen Pkwy	6.2	86	296	281	250	12,440	257
Dayton	I-75 NB	Dixie Hwy/Central Ave/Exit 47 Keowee St/Exit 55	7.2	83	298	329	225	14,291	232
Houston	South Fwy NB	Mchard Rd Orem Dr	3.3	83	298	121	315	5,576	315
New York	I-287 WB	I-87/I-287 (Irvington) NY-303/Exit 12	7.9	82	300	318	230	14,138	234
Austin	I-35 NB	E Fm-1626/Crown Colony Dr William Cannon Dr/Exit 228	3.7	81	301	142	311	6,398	313
Boston	Newburyport Tpke/US-1 SB	MA-129/Salem St Essex St	4.1	81	301	168	303	6,992	309
Houston	Northwest Fwy EB	Telge Rd West Rd	4.5	79	303	154	306	7,289	305
Charlotte	I-85 NB	University City Blvd Speedway Blvd/Exit 49	6.2	78	304	219	284	10,708	275
Portland	I-5 SB	OR-99W/Barbur Blvd/Exit 294 Elligsen Rd/Exit 286	7.7	77	305	281	250	12,589	253
Portland	Beaverton Tigard Fwy NB	I-5/Exit 7 Hall Blvd/Exit 4A	4.2	77	305	157	305	6,877	310

Delay Per Mile—Extra travel time during the year due to congestion, divided by the corridor length.
Wasted Fuel—Increased fuel consumption due to travel in congested conditions rather than free-flow conditions.
Congestion Cost—Value of travel time delay (estimated at $16 per hour for person travel and $88 per hour for truck time) and excess fuel consumption (estimated using state average cost per gallon of gasoline and diesel).
Note: Please do not place too much emphasis on small differences in the rankings. There may be little difference between (for example) 5th and 10th. The actual measure values should also be examined.

Table 10. Congestion Leaders (All 328 Corridors), continued

Urban Area	Corridor	Limits (From/To)	Corridor Length (miles)	2010 All-day Everyday Congestion: Delay Per Mile, Person-hrs (x 1000)	Delay Per Mile Rank	Wasted Fuel, Gallons (x 1000)	Wasted Fuel Rank	Congestion Cost (x $1000)	Congestion Cost Rank
Washington, DC	I-270 NB	Middlebrook Rd/Exit 13 MD-109/Exit 22	8.5	73	307	269	260	12,851	250
Washington, DC	John Hanson Hwy/US-50 WB	Garden City Dr/Exit 6 Columbia Park Rd	3.0	72	308	98	323	4,479	324
Riverside	Escondido Fwy/I-15 NB	CA-79/Old Town Front St CA-79/Winchester Rd	3.2	71	309	114	319	5,144	320
Vallejo-Fairfield CA	I-80 EB	Suisun Valley Rd N Texas St	7.4	70	310	229	277	10,524	277
Birmingham	I-65 SB	US-31/Montgomery Hwy/Exit 252 Jefferson/Shelby County Line	3.5	66	311	108	320	5,365	318
New York	Hutchinson River Pkwy NB	Cross County Pkwy/Exit 15 Mamaroneck Rd/Exit 22	4.5	62	312	123	314	6,013	314
Bridgeport	Merritt Pkwy/CT-15 NB	CT-58/Black Rock Tpke/Exit 44 CT-25/Exit 49	5.6	61	313	152	307	7,533	302
Chicago	I-94 EB	75th St 87th St/Exit 61B	3.4	61	313	107	321	4,716	322
San Jose	CA-17 SB	Camden Ave/San Tomas Expy CA-9	3.2	61	313	82	326	4,011	326
Bridgeport	I-84 EB	Mill Plain Rd/Old Ridgebury Rd/Exit 2 CT-37/Exit 6	4.3	60	316	120	316	5,423	317
San Jose	W Valley Fwy/CA-85 NB	I-280 CA-82/El Camino Real	3.8	60	316	88	325	4,526	323
Chicago	I-94 WB	W Lawrence Ave Touhy Ave/Exit 39	3.9	59	318	117	317	5,235	319
Bridgeport	Merritt Pkwy/CT-15 NB	Den Rd/Exit 33 CT-57/Exit 42	12.8	53	319	304	240	15,079	225
Charleston	I-26 EB	US-78/University Blvd Dorchester Rd	10.5	52	320	240	271	12,230	264
Chicago	I-94 WB	115Th St/Exit 66B US-20/US-12/95th St/Exit 62	3.8	46	321	94	324	4,022	325
Sacramento	I-80 WB	I-5/CA-99 Capitol Ave/Enterprise Blvd	5.0	46	321	103	322	4,970	321
Bridgeport	Merritt Pkwy/CT-15 SB	Main St/Exit 48 CT-33/Exit 41	9.9	45	323	191	294	9,809	287
Statesville-Mooresville NC	I-77 SB	NC-150/Exit 36 Iredell/Mecklenburg Co Line	8.8	44	324	176	296	8,528	297

Delay Per Mile—Extra travel time during the year due to congestion, divided by the corridor length.
Wasted Fuel—Increased fuel consumption due to travel in congested conditions rather than free-flow conditions.
Congestion Cost—Value of travel time delay (estimated at $16 per hour for person travel and $88 per hour for truck time) and excess fuel consumption (estimated using state average cost per gallon of gasoline and diesel).
Note: Please do not place too much emphasis on small differences in the rankings. There may be little difference between (for example) 5th and 10th. The actual measure values should also be examined.

Table 10. Congestion Leaders (All 328 Corridors), continued

Urban Area	Corridor	Limits (From/To)	Corridor Length (miles)	2010 All-day Everyday Congestion					
				Delay Per Mile		Wasted Fuel		Congestion Cost	
				Person-hrs (x 1000)	Rank	Gallons (x 1000)	Rank	(x $1000)	Rank
Boston	I-93 NB	MA-213/Exit 48 Pelham Rd/Exit 2	7.3	41	325	127	313	6,450	312
Washington, DC	I-70 WB	MD-144/Exit 59 US-15/US-340/Exit 52	6.8	32	326	116	318	5,430	316
New York	Garden State Pkwy NB	Cr-539/Exit 58 Forked River Rest Area	17.5	26	327	175	297	10,178	281
Allentown PA-NJ	US-22 WB	15th St PA-145/Macarthur Rd	3.4	13	328	15	328	1,018	328

Delay Per Mile—Extra travel time during the year due to congestion, divided by the corridor length.
Wasted Fuel—Increased fuel consumption due to travel in congested conditions rather than free-flow conditions.
Congestion Cost—Value of travel time delay (estimated at $16 per hour for person travel and $88 per hour for truck time) and excess fuel consumption (estimated using state average cost per gallon of gasoline and diesel).
Note: Please do not place too much emphasis on small differences in the rankings. There may be little difference between (for example) 5th and 10th. The actual measure values should also be examined.

Detailed Methodology

Detailed Methodology provides the details of the methodology for the *2011 Congested Corridors Report* (*CCR*).

A short roadway segment (less than 1 mile) with congestion for more than 10 hours in a week was the beginning of a congested corridor. ("Congestion" was having a speed less than half of the free-flow speed). Each adjacent, upstream segment of roadway that was congested for four hours per week was included in the corridor. Four hours was chosen as the threshold after reviewing the data which showed that many upstream segments had some congestion nearly every weekday. Since it typically did not constitute every day of the week, choosing four hours allows one day per week to have a different queuing pattern. Researchers combined traffic volume information from the states with the speed data to compute the performance measures.

After the corridor limits were established, the following steps were used to calculate the congestion performance measures for each corridor.

1. Obtain HPMS traffic volume data by road section
2. Match the HPMS road network sections with the traffic speed dataset road sections for each corridor
3. Estimate traffic volumes for each hour time interval from the daily volume data
4. Calculate average travel speed and total delay for each hour interval
5. Establish free-flow (i.e., low volume) travel speed
6. Calculate congestion performance measures

Step 1. Identify Traffic Volume Data

The HPMS dataset from FHWA provided the source for traffic volume data, although the geographic designations in the HPMS dataset are not identical to the private sector speed data. The daily traffic volume data must be divided into the same time interval as the traffic speed data (hour intervals). While there are some detailed traffic counts on major roads, the most widespread and consistent traffic counts available are average daily traffic (ADT) counts. The hourly traffic volumes for each section, therefore, were estimated from these ADT counts using typical time-of-day traffic volume profiles developed from continuous count locations or other data sources. Step 3 shows the average hourly volume profiles used in the measure calculations.

Volume estimates for each day of the week (to match the speed database) were created from the average volume data using the factors in Exhibit 1. Automated traffic recorders from around the country were reviewed and the factors in Exhibit 1 are a "best-fit" average for both freeways and major streets. Creating an hourly volume to be used with the traffic speed values, then, is a process of multiplying the annual average by the daily factor and by the hourly factor.

Exhibit 1. Volume Adjustment Factors

Day of Week	Adjustment Factor (to convert average annual volume into day of week volume)
Monday to Thursday	+5%
Friday	+10%
Saturday	-10%
Sunday	-20%

Step 2. Combine the Road Networks for Traffic Volume and Speed Data
The second step was to combine the road networks for the traffic volume and speed data sources, such that an estimate of traffic speed and traffic volume was available for each corridor. The combination (also known as conflation) of the traffic volume and traffic speed networks was accomplished using Geographic Information Systems (GIS) tools. The INRIX speed network was chosen as the base network; an ADT count from the HPMS network was applied to each segment of roadway in the speed network. The traffic count and speed data for each roadway segment were then combined into areawide performance measures.

Step 3. Estimate Traffic Volumes for Shorter Time Intervals

The third step was to estimate traffic volumes for one-hour time intervals for each day of the week.

Typical time-of-day traffic distribution profiles are needed to estimate hourly traffic flows from average daily traffic volumes. Previous analytical efforts3,4 have developed typical traffic profiles at the hourly level (the roadway traffic and inventory databases are used for a variety of traffic and economic studies). These traffic distribution profiles were developed for the following different scenarios (resulting in 16 unique profiles):

- Functional class: freeway and non-freeway
- Day type: weekday and weekend
- Traffic congestion level: percentage reduction in speed from free-flow (varies for freeways and streets)
- Directionality: peak traffic in the morning (AM), peak traffic in the evening (PM), approximately equal traffic in each peak

The 16 traffic distribution profiles shown in Exhibits 2 through 6 are considered to be very comprehensive, as they were developed based upon 713 continuous traffic monitoring locations in urban areas of 37 states.

[3] *Roadway Usage Patterns: Urban Case Studies*. Prepared for Volpe National Transportation Systems Center and Federal Highway Administration, July 22, 1994.

[4] *Development of Diurnal Traffic Distribution and Daily, Peak and Off-peak Vehicle Speed Estimation Procedures for Air Quality Planning*. Final Report, Work Order B-94-06, Prepared for Federal Highway Administration, April 1996.

Exhibit 2. Weekday Traffic Distribution Profile for No to Low Congestion

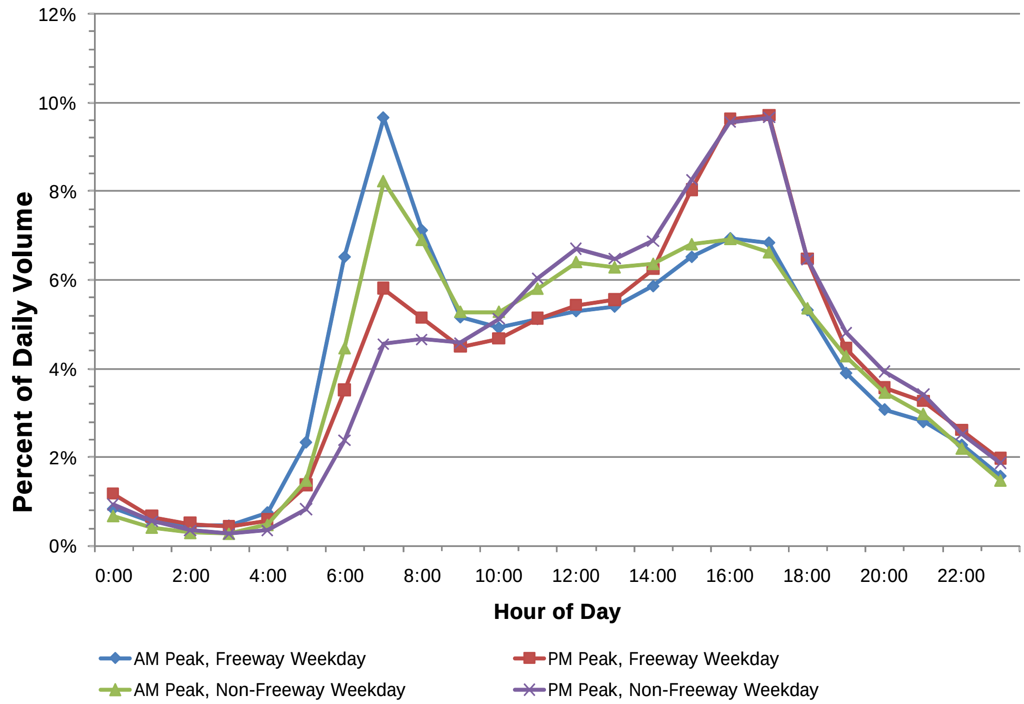


Exhibit 3. Weekday Traffic Distribution Profile for Moderate Congestion

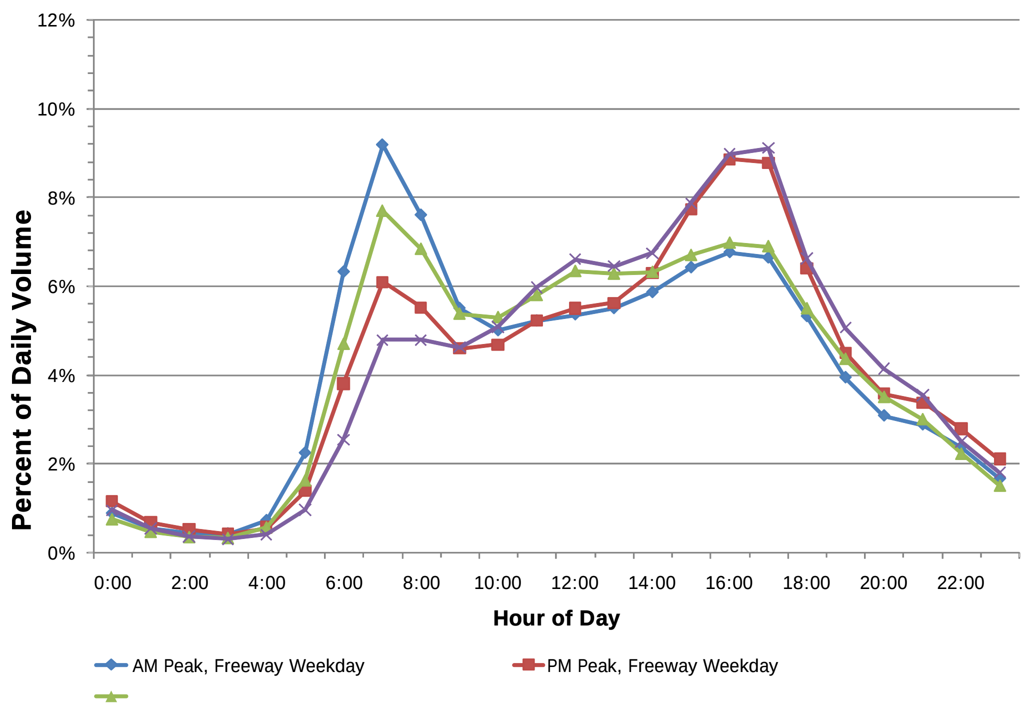


Exhibit 4. Weekday Traffic Distribution Profile for Severe Congestion

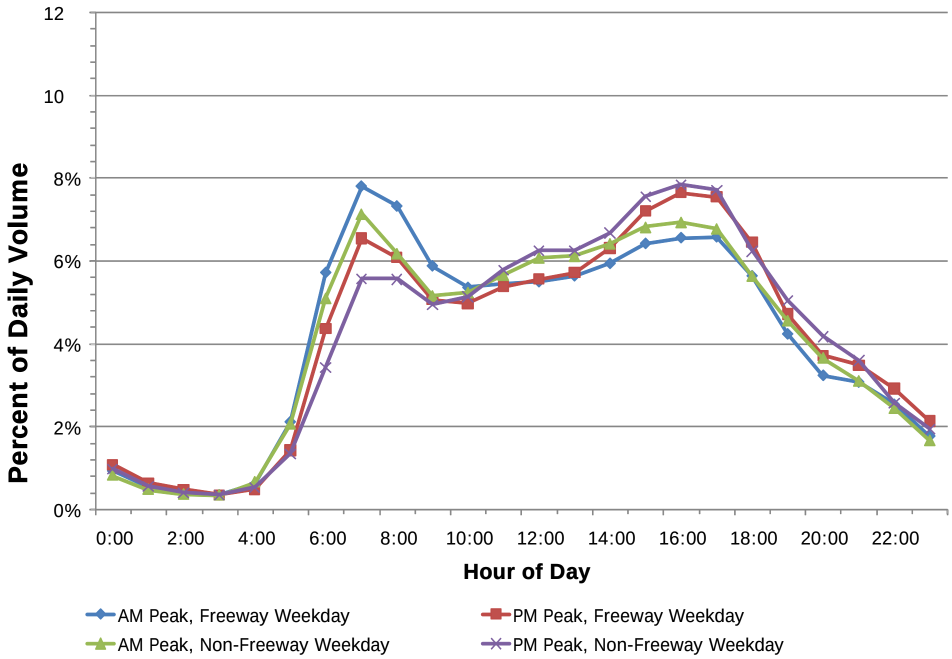


Exhibit 5. Weekend Traffic Distribution Profile

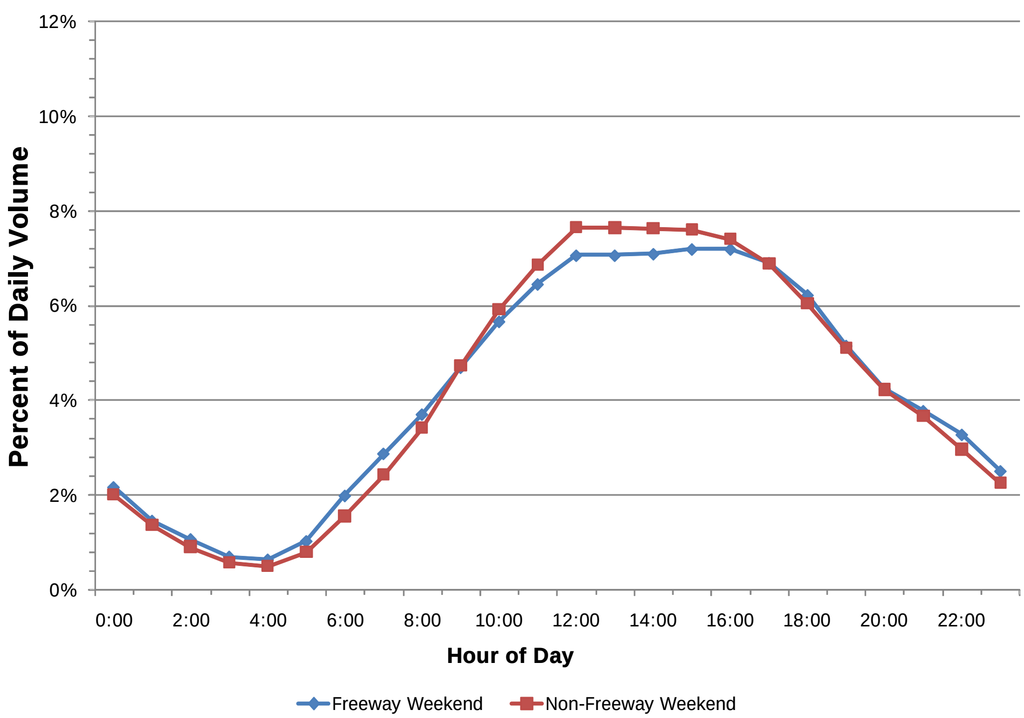
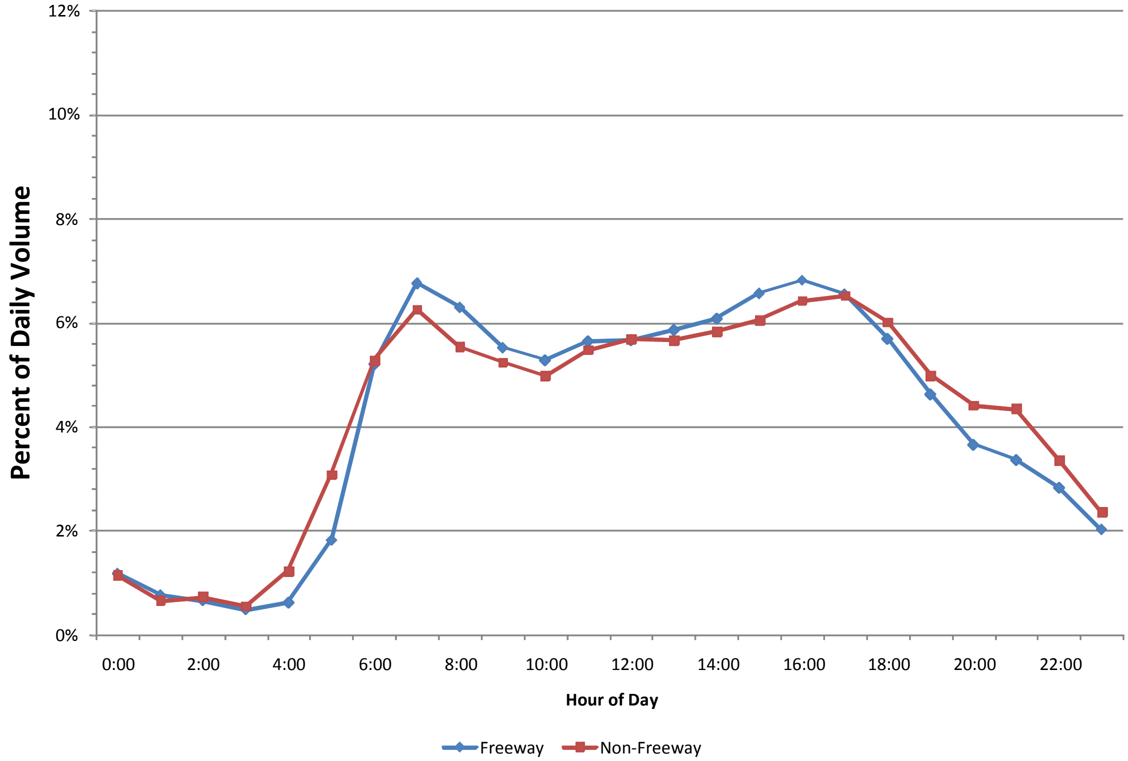


Exhibit 6. Weekday Traffic Distribution Profile for Severe Congestion and Similar Speeds in Each Peak Period



The next step in the traffic flow assignment process is to determine which of the 16 traffic distribution profiles should be assigned to each Traffic Message Channel (TMC) path (the "geography" used by the private sector data providers), such that the hourly traffic flows can be calculated from traffic count data supplied by HPMS. The assignment should be as follows: Functional class: assign based on HPMS functional road class

- Freeway – access-controlled highways
    - Non-freeway – all other major roads and streets (not used in the *2011 CCR*)

- Day type: assign volume profile based on each day
    - Weekday (Monday through Friday)
    - Weekend (Saturday and Sunday)

- Traffic congestion level: assign based on the peak period speed reduction percentage calculated from the private sector speed data. The peak period speed reduction is calculated as follows:
  1) Calculate a simple average peak period speed (add up all the morning and evening peak period speeds and divide the total by the 8 periods in the eight peak hours) for each TMC path using speed data from 6 a.m. to 10 a.m. (morning peak period) and 3 p.m. to 7 p.m. (evening peak period).
  2) Calculate a free-flow speed during the light traffic hours (e.g., 10 p.m. to 5 a.m.) to be used as the baseline for congestion calculations. Since INRIX provides a free-flow speed in its archived average speed set, this speed was used in the calculations.

3) Calculate the peak period speed reduction by dividing the average combined peak period speed by the free-flow speed.

$$\text{Speed Reduction Factor} = \frac{\text{Average Peak Period Speed}}{\text{Free-Flow Speed } (10 \text{ p.m. to } 5 \text{ a.m.})} \qquad \text{(Eq. 1)}$$

For Freeways:

- o speed reduction factor ranging from 90% to 100% (no to low congestion)
- o speed reduction factor ranging from 75% to 90% (moderate congestion)
- o speed reduction factor less than 75% (severe congestion)

For Non-Freeways:

- speed reduction factor ranging from 80% to 100% (no to low congestion)
- speed reduction factor ranging from 65% to 80% (moderate congestion)
- speed reduction factor less than 65% (severe congestion)

- Directionality: Assign this factor based on peak period speed differentials in the private sector speed dataset. The peak period speed differential is calculated as follows:
  1) Calculate the average morning peak period speed (6 a.m. to 10 a.m.) and the average evening peak period speed (3 p.m. to 7 p.m.)
  2) Assign the peak period volume curve based on the speed differential. The lowest speed determines the peak direction. Any section where the difference in the morning and evening peak period speeds is 6 mph or less will be assigned the even volume distribution.

Step 4. Calculate Travel and Time

The hourly speed and volume data was combined to calculate the total travel time for each one hour time period. The one hour volume for each segment was multiplied by the corresponding travel time to get a quantity of vehicle-hours; these were summed across the entire corridor.

Step 5. Establish Free-Flow Travel Speed and Time

The calculation of congestion measures required establishing a congestion threshold, such that delay was accumulated for any time period once the speeds are lower than the congestion threshold. There has been considerable debate about the appropriate congestion thresholds, but for the purpose of the *CCR* methodology, the data was used to identify the speed at low volume conditions (for example, 10 p.m. to 5 a.m.). This speed is relatively high, but varies according to the roadway design characteristics. An upper limit of 65 mph was placed on the freeway free-flow speed to maintain a reasonable estimate of delay.

Step 6. Calculate Congestion Performance Measures

The mobility performance measures were calculated using the equations shown in the next section of this methodology once the one-hour dataset of actual speeds, free-flow travel speeds and traffic volumes was prepared.

Calculation of the Congestion Measures

This section summarizes the methodology utilized to calculate many of the statistics shown in the *Congested Corridors Report* and is divided into three main sections containing information on the constant values, variables and calculation steps of the main performance measures of the mobility database.

4. **National Constants**
5. **Urban Area Constants and Inventory Values**
6. **Variable and Performance Measure Calculation Descriptions**
    1) Travel Speed
    2) Travel Delay
    3) Annual Person Delay
    4) Annual Peak Period Travel Time
    5) Travel Time Index
    6) Wasted Fuel
    7) Total Congestion Cost
    8) Buffer Index
    9) Planning Time Index

Generally, the sections are listed in the order that they will be needed to complete all calculations.

National Constants

The congestion calculations utilize the values in Exhibit 7 as national constants—values used along all corridors to estimate the effect of congestion.

Exhibit 7. National Congestion Constants for *2011 Congested Corridors Report*

Constant	Value
Vehicle Occupancy	1.25 persons per vehicle
Average Cost of Time ($2010)*	$16.30 per person hour[1]
Commercial Vehicle Operating Cost ($2010)	$88.12 per vehicle hour[1, 2]
Working Days (5x50)	250 days
Total Travel Days (7x52)	364 days

[1] Adjusted annually using the Consumer Price Index.
[2] Adjusted periodically using industry cost and logistics data.
*Source: (Reference *9,10*)

Vehicle Occupancy
The average number of persons in each vehicle during peak period travel is 1.25.

Working Days and Weeks
With the addition of the INRIX speed data in the 2011 *CCR*, the calculations are based on a full year of data that includes all days of the week rather than just the working days. The delay from each day of the week is multiplied by 50 work weeks to annualize the delay. The weekend days are multiplied by 57 to help account for the lighter traffic days on holidays. Total delay for the year is based on 364 total travel days in the year.

Average Cost of Time
The 2010 value of person time used in the report is $16.30 per hour based on the value of time, rather than the average or prevailing wage rate (*9*).

Commercial Vehicle Operating Cost
Truck travel time and operating costs (excluding diesel costs) are valued at $88.12 per hour (*10*).

Corridor Variables

In addition to the national constants, four urbanized area or state specific values were identified and used in the congestion cost estimate calculations.

Daily Vehicle-Miles of Travel
The daily vehicle-miles of travel (DVMT) is the average daily traffic (ADT) of a section of roadway multiplied by the length (in miles) of that section of roadway. This allows the daily volume of all urban facilities to be presented in terms that can be utilized in cost calculations. DVMT was estimated for the freeways corridors located in each urbanized study area. These estimates originate from the HPMS database and other local transportation data sources.

Fuel Costs
Statewide average fuel cost estimates were obtained from daily fuel price data published by the American Automobile Association (AAA) (*11*). Values for gasoline and diesel are reported separately.

Truck Percentage
The percentage of passenger cars and trucks for each corridor was estimated from the Highway Performance Monitoring System dataset (*7*). The values are used to estimate congestion costs and are not used to adjust the roadway capacity.

Variable and Performance Measure Calculation Descriptions

The major calculation products are described in this section. In some cases the process requires the use of variables described elsewhere in this methodology.
Travel Speed
The peak period average travel speeds were obtained from INRIX. Researchers also obtained free-flow travel speeds from INRIX to calculate the delay-based measures in the report.

Travel Delay
Most of the basic performance measures presented in the *Congested Corridors Report* are developed in the process of calculating travel delay—the amount of extra time spent traveling due to congestion. The travel delay calculations have been greatly simplified with the addition of the INRIX speed data. This speed data reflects the effects of both recurring delay (or usual) and incident delay (crashes, vehicle breakdowns, etc.). The delay calculations are performed at the individual roadway section level and for each hour of the week. Depending on the application, the delay can be aggregated into summaries such as weekday peak period, weekend, weekday off-peak period, etc.

$$\begin{matrix}\text{Daily Vehicle-Hours} \\ \text{of Delay}\end{matrix} = \left(\frac{\begin{matrix}\text{DailyVehicle-Miles} \\ \text{of Travel}\end{matrix}}{\text{Speed}}\right) - \left(\frac{\begin{matrix}\text{DailyVehicle-Miles} \\ \text{of Travel}\end{matrix}}{\text{Free-Flow Speed}}\right) \quad \text{(Eq. 2)}$$

Annual Person Delay

This calculation is performed to expand the daily vehicle-hours of delay estimates for the freeways to a yearly estimate in each study area. To calculate the annual person-hours of delay, multiply each day-of-the-week delay estimate by the average vehicle occupancy (1.25 persons per vehicle) and by 52 working weeks per year (Equation 3).

$$\begin{matrix}\text{Annual} \\ \text{Persons-Hours} \\ \text{of Delay}\end{matrix} = \begin{matrix}\text{Daily Vehicle-Hours} \\ \text{of Delay on} \\ \text{Freeways}\end{matrix} \times \begin{matrix}\text{Annual Conversion} \\ \text{Factor}\end{matrix} \times \begin{matrix}\text{1.25 Persons} \\ \text{per Vehicle}\end{matrix} \quad \text{(Eq. 3)}$$

The Annual Person-Hours of Delay (Equation 3) was divided by the congested corridor length to obtain the delay per mile values used for the rankings in the *2011 Congested Corridors Report.*

Annual Peak Period Major Road Travel Time

Total travel time can be used as both a performance measure and as a component in other calculations. The *2011 Congested Corridor Report* used travel time as a component; future reports will incorporate other information and expand on the use of total travel time as a performance measure.

Total travel time is the sum of travel delay and free-flow travel time. Both of the quantities are only calculated for the freeways. Free-flow travel time is the amount of time needed to travel the roadway section length at the free-flow speeds (provided by INRIX for each roadway section) (Equation 4).

$$\begin{matrix}\text{Annual Free-Flow} \\ \text{Travel Time} \\ \text{(Vehicle-Hours)}\end{matrix} = \frac{1}{\begin{matrix}\text{Free-Flow} \\ \text{Travel Speed}\end{matrix}} \times \begin{matrix}\text{Daily} \\ \text{Vehicle-Miles} \\ \text{of Travel}\end{matrix} \times \begin{matrix}\text{Annual} \\ \text{Conversion} \\ \text{Factor}\end{matrix} \quad \text{(Eq. 4)}$$

$$\begin{matrix}\text{Annual} \\ \text{Travel Time}\end{matrix} = \underset{\text{(Eq. 3)}}{\begin{matrix}\text{Freeway} \\ \text{Delay}\end{matrix}} + \underset{\text{(Eq. 4)}}{\begin{matrix}\text{Freeway} \\ \text{Free-Flow} \\ \text{Travel Time}\end{matrix}} \quad \text{(Eq. 5)}$$

Travel Time Index

The Travel Time Index (TTI) compares peak period travel time to free-flow travel time. The Travel Time Index includes both recurring and incident conditions and is, therefore, an estimate of the conditions faced by urban travelers. Equation 6 illustrates the ratio used to calculate the TTI. The ratio has units of time divided by time and the Index, therefore, has no units. This “unitless” feature allows the Index to be used to compare trips of different lengths to estimate the travel time in excess of that experienced in free-flow conditions.

The free-flow travel time for each functional class is subtracted from the average travel time to estimate delay. The Travel Time Index is calculated by comparing total travel time to the free-flow travel time (Equations 6 and 7). The corridor Travel Time Index is calculated by weighting the individual section indices by the vehicle-miles of travel in each section (See Equation 20).

$$\text{Travel Time Index} = \frac{\text{Peak Travel Time}}{\text{Free-Flow Travel Time}} \qquad \text{(Eq. 6)}$$

$$\text{Travel Time Index} = \frac{\text{Delay Time} + \text{Free-Flow Travel Time}}{\text{Free-Flow Travel Time}} \qquad \text{(Eq. 7)}$$

Wasted Fuel

The average fuel economy calculation is used to estimate the difference in fuel consumption of the vehicles operating in congested and uncongested conditions. Equations 8 and 9 are the regression equations resulting from fuel efficiency data from EPA/FHWA's MOVES model (*12*).

$$\begin{matrix}\text{Passenger Car}\\\text{Fuel Economy}\end{matrix} = 0.0066 \times (\text{speed})^2 + 0.823 \times (\text{speed}) + 6.1577 \qquad \text{(Eq. 8)}$$

$$\begin{matrix}\text{Truck Fuel}\\\text{Economy}\end{matrix} = 1.4898 \text{ x } \ln(\text{speed}) - 0.2554 \qquad \text{(Eq. 9)}$$

The *CCR* calculates the wasted fuel due to vehicles moving at speeds slower than free-flow throughout the day. Equation 10 calculates the fuel wasted in delay conditions from Equation 3, the average hourly speed, and the average fuel economy associated with the hourly speed (Equation 8 and 9).

$$\begin{matrix}\text{Annual}\\\text{Fuel Wasted}\end{matrix} = \begin{matrix}\text{Travel Time}\\\text{(vehicle hours)}\\\text{(Eq. 4)}\end{matrix} \times \begin{matrix}\text{Average Hourly}\\\text{Speed}\\\text{(Eq. 2)}\end{matrix} \div \begin{matrix}\text{Average Fuel}\\\text{Economy}\\\text{(Eq. 8,9)}\end{matrix} \times \begin{matrix}\text{Annual}\\\text{Conversion Factor}\end{matrix} \qquad \text{(Eq. 10)}$$

Equation 11 incorporates the same factors to calculate fuel that would be consumed in free-flow conditions. The fuel that is deemed "wasted due to congestion" is the difference between the amount consumed at peak speeds and free-flow speeds (Equation 10).

$$\begin{matrix}\text{Annual Fuel}\\\text{Consumed in}\\\text{Free-Flow Conditions}\end{matrix} = \begin{matrix}\text{Travel Time}\\\text{(Eq. 4)}\end{matrix} \times \begin{matrix}\text{Free-Flow}\\\text{Speed from}\\\text{INRIX Data}\end{matrix} \div \begin{matrix}\text{Average Fuel}\\\text{Economy for}\\\text{Free-Flow Speeds}\\\text{(Eq. 8,9)}\end{matrix} \times \begin{matrix}\text{Annual}\\\text{Conversion}\\\text{Factor}\end{matrix} \qquad \text{(Eq. 11)}$$

$$\text{Annual Fuel Wasted in Congestion} = \text{Annual Fuel Consumed in Congestion} - \text{Annual Fuel That Would be Consumed in Free-flow Conditions} \qquad \text{(Eq. 12)}$$

Total Congestion Cost

Two cost components are associated with congestion: delay cost and fuel cost. These values are directly related to the travel speed calculations. The following sections and Equations 14 through 16 show how to calculate the cost of delay and fuel effects of congestion.

Passenger Vehicle Delay Cost. The delay cost is an estimate of the value of lost time in passenger vehicles in congestion. Equation 13 shows how to calculate the passenger vehicle delay costs that result from lost time.

$$\text{Annual Psgr-Veh Delay Cost} = \text{Daily Psgr Vehicle Hours of Delay (Eq. 3)} \times \text{Value of Person Time (\$ / hour)} \times \text{Vehicle Occupancy (pers/vehicle)} \times \text{Annual Conversion Factor} \qquad \text{(Eq. 13)}$$

Passenger Vehicle Fuel Cost. Fuel cost due to congestion is calculated for passenger vehicles in Equation 14. This is done by associating the wasted fuel, the percentage of the vehicle mix that is passenger, and the fuel costs.

$$\text{Annual Fuel Cost} = \text{Daily Fuel Wasted (Eq. 12)} \times \text{Percent of Passenger Vehicles} \times \text{Gasoline Cost} \times \text{Annual Conversion Factor} \qquad \text{(Eq. 14)}$$

Truck or Commercial Vehicle Delay Cost. The delay cost is an estimate of the value of lost time in commercial vehicles and the increased operating costs of commercial vehicles in congestion. Equation 15 shows how to calculate the passenger vehicle delay costs that result from lost time.

$$\text{Annual Comm-Veh Delay Cost} = \text{Daily Comm Vehicle Hours of Delay (Eq. 3)} \times \text{Value of Comm Vehicle Time (\$ / hour)} \times \text{Annual Conversion Factor} \qquad \text{(Eq. 15)}$$

Truck or Commercial Vehicle Fuel Cost. Fuel cost due to congestion is calculated for commercial vehicles in Equation 16. This is done by associating the wasted fuel, the percentage of the vehicle mix that is commercial, and the fuel costs.

$$\text{Annual Fuel Cost} = \text{Daily Fuel Wasted (Eq. 12)} \times \text{Percent of Commercial Vehicles} \times \text{Diesel Cost} \times \text{Annual Conversion Factor} \qquad \text{(Eq. 16)}$$

Total Congestion Cost. Equation 17 combines the cost due to travel delay and wasted fuel to determine the annual cost due to congestion resulting from incident and recurring delay.

$$\text{Annual Cost Due to Congestion} = \left(\text{Annual Passenger Vehicle Delay Cost (Eq. 13)} + \text{Annual Passenger Fuel Cost (Eq. 14)} \right) + \text{Annual Comm Veh Delay Cost (Eq. 15)} + \text{Annual Comm Veh Fuel Cost (Eq 16)} \qquad \text{(Eq. 17)}$$

Buffer Index. Equation 18 shows the computation performed to compute the buffer index reliability measure.

$$\text{Buffer Index (\%)} = 100\% \text{ x} \frac{\left(\begin{matrix}\text{95th Percentile}\\ \text{Travel Time(minutes)}\end{matrix} - \begin{matrix}\text{Average Travel Time}\\ \text{(minutes)}\end{matrix}\right)}{\begin{matrix}\text{Average Travel Time}\\ \text{(minutes)}\end{matrix}} \qquad \text{(Eq. 18)}$$

Planning Time Index. Equation 19 shows the computation performed to compute the planning time index reliability measure.

$$\text{Planning Time Index} = \frac{\begin{matrix}\text{95th Percent Travel Time}\\ \text{(minutes)}\end{matrix}}{\begin{matrix}\text{Free} - \text{flow Travel Time}\\ \text{(minutes)}\end{matrix}} \qquad \text{(Eq. 19)}$$

Volume weighting of Indices. Separate travel time indices, buffer indices, and planning time indices were calculated for each segment within a corridor. These indices were weighted together by vehicle-miles of travel from each segment to generate a corridor travel time index, buffer index, and planning time index. Equation 20 shows how a particular corridor index would be calculated.

$$\begin{matrix}\text{Corridor}\\ \text{Index}\end{matrix} = \frac{\left(\begin{matrix}\text{Index}\\ \text{Segment 1}\end{matrix} \times \begin{matrix}\text{VMT}\\ \text{Segment 1}\end{matrix} + \begin{matrix}\text{Index}\\ \text{Segment 2}\end{matrix} \times \begin{matrix}\text{VMT}\\ \text{Segment 2}\end{matrix} + \begin{matrix}\text{... Index}\\ \text{Segment n}\end{matrix} \times \begin{matrix}\text{VMT}\\ \text{Segment n}\end{matrix}\right)}{\left(\begin{matrix}\text{VMT}\\ \text{Segment 1}\end{matrix} + \begin{matrix}\text{VMT}\\ \text{Segment 2}\end{matrix} + \begin{matrix}\text{... VMT}\\ \text{Segment n}\end{matrix}\right)} \qquad \text{(Eq. 20)}$$

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