Congestion Management Process Report

Metropolitan Hartford Area

June 26, 2013

Capitol Region Council of Governments
Central Connecticut Regional Planning Agency
Midstate Regional Planning Agency

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NOTE: MRPA has merged with the Connecticut River Estuary Regional Planning Agency to form the Lower Connecticut River Valley Council of Governments. Since most of the work on this report was done prior to this merger, we continue to refer to the agency as MRPA.

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NOTE: In May 2012, CCRPA prepared a CMP for the following arterials: Rt 6, Rt 10, Rt 72 and Rt 229. That document is available at: http://www.ccrpa.org/transportation/CMP/cmp_report_2012.pdf

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Chapter 1 - Introduction

A Congestion Management Process (CMP) is a systematic approach to measuring transportation system performance and developing proposals to manage traffic congestion. It is required by the *Moving Ahead for Progress in the 21st Century Act*[1] (MAP-21) that each metropolitan area with a population over 200,000 develops and implements the CMP as part of the metropolitan planning process.

The Capitol Region Council of Governments (CRCOG) has carried out a transportation monitoring and management program in the Hartford metropolitan area since 2005 as part of its transportation planning activities. It is a joint program of three regional planning agencies, CRCOG, the Central Connecticut Regional Planning Agency (CCRPA) and the Midstate Regional Planning Agency (MRPA)[2], and the Connecticut Department of Transportation. The first Transportation System Monitoring Report in 2005 provided a profile of traffic conditions and operations in the Hartford metropolitan area. Serving as a baseline, the report documented the start of system performance assessment, and using the information gathered through this process, identified a process to guide system management. This report is a result of the continuation of the transportation monitoring program. It builds upon and updates the 2005 report, and also expands upon it by incorporating the system performance trends through 2005-2010.[3]

The major function of the CMP is to enable the metropolitan planning organization (MPO) to implement regional management and operations (M&O) strategies by identifying and addressing congestion in the region. A complete CMP should contain potential strategies to address congestion and alleviate its impact. Subsequently, the implemented strategies and measures should be evaluated for effectiveness through before and after analyses.

The CMP can be incorporated into the Transportation Improvement Program (TIP) by proposing and prioritizing improvement projects in the metropolitan area. The CMP is also a valuable tool for monitoring and evaluating the effectiveness of these projects and programs. The CMP seeks solutions to address the congestion of the multimodal system, including highway management, transit priority, incident management, and so on. In this regard, the CMP incorporates transportation management and operations into the planning process, and provides vital support for decision makers.

1.1 Objectives

According to the 2012 Urban Mobility Report from the Texas Transportation Institute (TTI), congestion cost Americans $121 billion in 2011, translating to $818 per U.S. commuter. In that report, Hartford, with a congestion cost of $479 million, was ranked the 46th among the 498 urban areas. This translates to $781 congestion cost per auto commuter in Hartford with annual congestion delay of 38 hours. The congestion not only wastes energy and causes extra travel time; it also causes significant negative impact on the environment through increased green house gas emissions. With

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1 Signed into law on July 6, 2012; CMP was first required under the Safe Accountable Flexible Efficient Transportation Equity Act — A Legacy for the Users (SAFETEA-LU) and built upon the requirements for a the Congestion Management Systems first introduced in the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA).

2 MRPA subsequently merged with the Connecticut River Estuary Regional Planning Agency to form the Lower Connecticut River Valley Council of Governments. Since most of the work on this report was done prior to this merger, we continue to refer to the agency as MRPA.

3 In May 2012, CCRPA prepared a CMP for the following arterials: Rt 6, Rt 10, Rt 72 and Rt 229. The report is available at: http://www.ccrpa.org/transportation/CMP/cmp_report_2012.pdf

proper planning, assessment and strategies, corrective actions can be taken to mitigate congestion and thus reduce its effects.

In order to address these issues, CRCOG, therefore, plans to assess the current condition, develop strategies and improve its transportation monitoring program on a continual basis. This CMP was developed through the collaborative efforts of CTDOT and the three regional planning agencies to promote the safe and efficient operation and management of the intermodal surface transportation systems in the region, so as to better serve the mobility needs of people and freight. The major objectives of the CMP are:

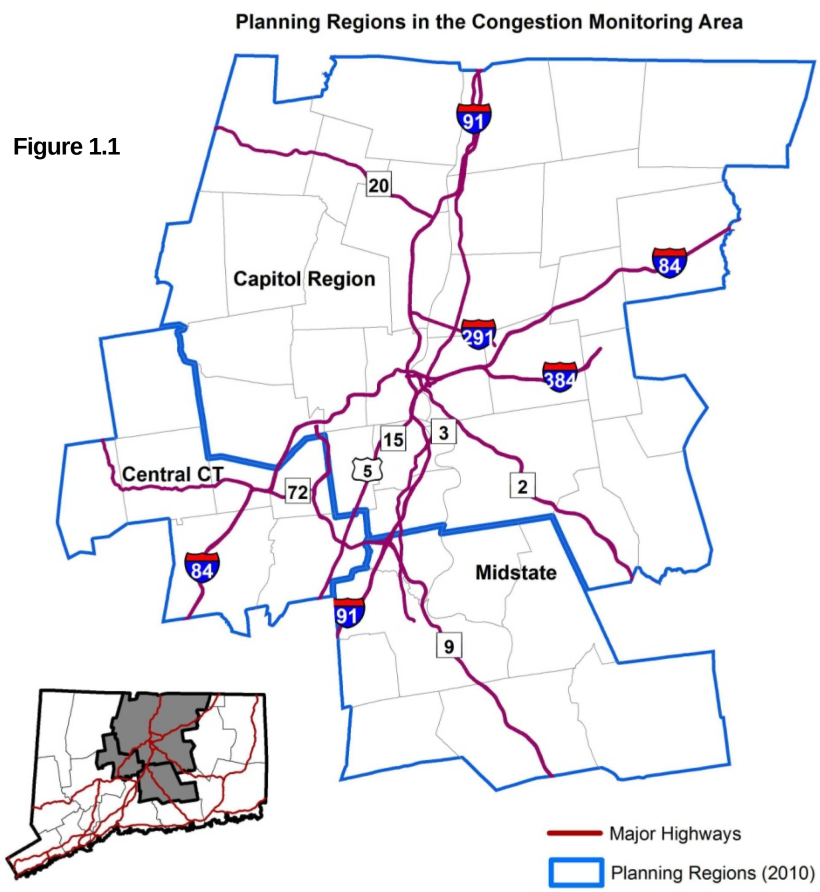
1. *To monitor and assess system performance.*
2. *To identify congested locations and causes for congestion.*
3. *To evaluate strategies to reduce or mitigate the impact of congestion.*
4. *To monitor the effectiveness of strategies following implementation.*

1.2 Overview of the Study Area

We conducted our transportation monitoring program in the Greater Hartford area, as shown in Figure 1.1. It is comprised of 45 towns in three planning regions: the Capitol Region, the Central Connecticut Region, and the Midstate Region. The 2010 population of Greater Hartford was 1,118,881.

There is an extensive Interstate system in the study area. This includes Interstate 84 and Interstate 91, the two most heavily traveled, as well as I-291, I-384 and I-691. Major state highways include Route 9, Route 72, Route 2, Route 3, Route 17, Route 20, and Route 5/15. The interstates, along with the state highways, carry most of the traffic, especially long distance trips and through traffic. They also function as the major commuting routes, and can be heavily congested during rush hour due to the large suburban population.

Figure 1.1

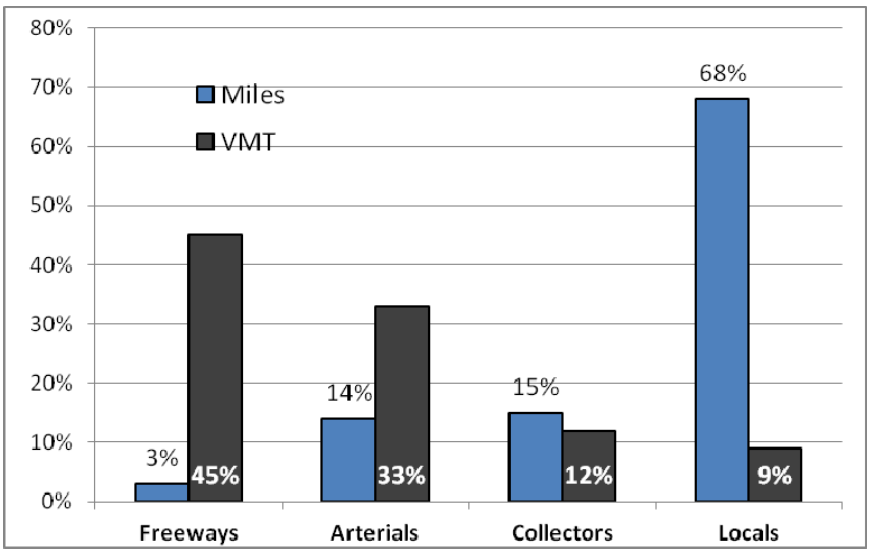


Public transportation has always been an important part of the multi-modal transportation system in the area. Bus services in the congestion monitoring corridors are primarily operated by CT Transit, New Britain Transportation Company and Middletown Area Transit, serving a total of 45 local and 12 express routes. CT Transit, in 2012, recorded 14,655,630 bus riders with average weekday ridership of about 50,000.Amtrak runs service between Springfield and New Haven, with stops at Berlin, Hartford, Windsor, and Windsor Locks. This service carried 380,896 passengers during 2011, a 4.8 percent increase from 2010.

1.3 System Definition and Data Collection Techniques

The transportation congestion monitoring program is mainly focused on the area's roadway system. This monitoring program is further subdivided into freeways and arterial routes, since the two are distinctively different in function and operation. The transit system is also an integral part of the transportation system and plays an important role in the system operations. The definitions of the systems and the data collection techniques are describe below.

Figure 1.2 Roadway System in the Study Area



Freeway System. The Freeway System is defined as those roadways with limited access, grade-separated facilities and whose function is to serve longer distance trips and through traffic. As seen in Figure 1.2, freeways compose only 3% of the roadway system in the study area, but carry 45% of the daily traffic.

The system for monitoring and assessing freeway performance was developed based on data collected through the Regional Traffic Management System (RTMS). This is a system operated by the Connecticut Department of Transportation (CTDOT) through their Highway Operations Center in Newington. It consists of traffic flow monitors, cameras, variable message signs, and highway advisory radio. It covers nearly 50 miles of freeway in the Hartford metropolitan area and includes 144 traffic flow monitors.

The traffic flow monitors are the critical component for collecting data on system performance. The monitors collect data on traffic volume, speed, and occupancy. Each monitor collects the data for 30-second intervals for each individual travel lane. This data is collected 24 hours per day each day of the week, and provides a wealth of information on system performance over time.

The goal of this planning project is to compile the operational data collected from the RTMS and use it to assess system performance. The challenge is to develop a process for easily extracting and compiling such an enormous amount of raw data.

Arterial System. Arterial roadways are not limited access and generally have at-grade intersections. They typically serve a dual purpose of carrying longer distance trips, but also serve shorter trips and provide access to abutting land uses. The arterial system composes 14% of the roadway system while carrying 33% of the daily traffic.

Where the freeway system monitoring process relies on data extracted from an extensive system of permanent field monitoring stations, the arterial monitoring system relies on in-vehicle data collection conducted by staff and volunteers who drive selected routes during selected peak and off-peak travel times.

Transit System. The transit system is the sum of local bus routes and commuter routes operated throughout the area. These transit services are provided by CT Transit, New Britain Transportation Company and Middletown Area Transit. CT Transit is owned by the Connecticut Department of Transportation, and operates in seven metropolitan areas in the state. The Hartford Division is the largest, providing service on 30 local routes and 12 express routes in the Capitol Region. The other two companies operate 15 routes in Central Connecticut and Middletown area respectively. This report relies on performance reports from the CT Transit to assess transit operations. This is expected to complement the monitoring of the highway system, and provides a more comprehensive understanding on the performance of the multi-modal transportation system in the area.

Chapter 2 Development of Performance Measures

Appropriate measures must be developed to effectively monitor congestion and assess the performance of the transportation network. According to the FHWA's guidebook on the congestion management process, characteristics of good performance measures are that they should be simple and clear to present and interpret, able to describe the existing condition and predict changes, analytical and accurate.

Based on these criteria and on data that is readily available, the following performance measures, as summarized in Table 2.1, were selected to monitor and quantify the transportation system's performance in the metropolitan area. These measures can be classified into four categories, namely, vehicle throughput, mobility, safety, and transit performance.

The CMP includes safety performance measures because a major component of the highway delay is incident-related. Crashes, disabled vehicles, and other incidents are attributed to 25 percent of the total highway congestion (FHWA). Thus, safety performance measures will help in understanding the non-recurring congestion in the area.

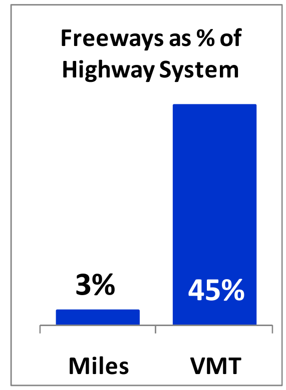
Table 2.1: CMP Performance Measures

	Performance Measures	Definition
Vehicle Throughput	Vehicle Miles of Travel	total miles traveled by vehicles in a station area or segment
	Vehicle Hours of Travel	the total time spent by all vehicles traveling through a station area or segment
Mobility	Travel Time	average travel time through a segment of a corridor
	Average Speed	average speed of all vehicles traveling through a station area or segment
	Delay	the total time vehicles spend traveling below the free-flow speed
	Travel Time Index	a ratio of the average travel time during peak period or peak hour conditions versus the travel time during uncongested periods
Safety	Crash Rate & Locations	the number of crashes per million vehicle miles traveled and locations of high crash rate
Transit & Land Use Connections, Non-motorized Alternatives	Bus Ridership	the number of passengers using the bus services
	Load Factor	the ratio of total passengers at the peak load point of each line to the number of seats on the bus
	Park & Ride Lots	the number of Park & Ride Lots, their usage and their locations around the metropolitan area
	Land Use Strategies	effective land use planning strategies to reduce total VMT and carbon emission
	Bikes & Pedestrian Programs	utilization of available resources to encourage use of bicycle other non-motorized mode of transportation

Chapter 3 System Monitoring

3.1 Freeway System

METRO HARTFORD FREEWAY SYSTEM



The freeway network serving the Hartford metropolitan area is illustrated in Figure 3.1. There are about 165 route miles including both Interstate routes and non-Interstate freeways. The freeway system accounts for 3 percent of the total roadway network in the area, but it carries about 45 percent of the region's traffic.[4] The freeways are the highest level in the hierarchy of roadway classes, and their importance is reflected in the disproportionately high share of traffic they serve. The Interstate routes are I-84, I-91, I-691, I-291, and I-384. Non-Interstate routes include Route 9, Route 72, Route 2, Route 3, Route 17, Route 20, and Route 5-15.

Interstates 84 and 91. I-91 and I-84 **are the two major Interstate routes** in the Region, and they carry a large volume of long distance traffic. They are also important commuter routes. I-84 is a primary east-west route through Connecticut. West of the Hartford metro area, it links to the Connecticut cities of Waterbury and Danbury, the Hudson River Valley in New York, and northeastern Pennsylvania. To the east, it links to I-90 (in Sturbridge, Massachusetts), which is a primary route to the Boston metropolitan area. I-91 is a primary north-south route through Connecticut. To the south, it connects to I-95 in New Haven. To the north, it connects to I-90 in Springfield. It is also a primary route to destinations further north in Vermont and New Hampshire.

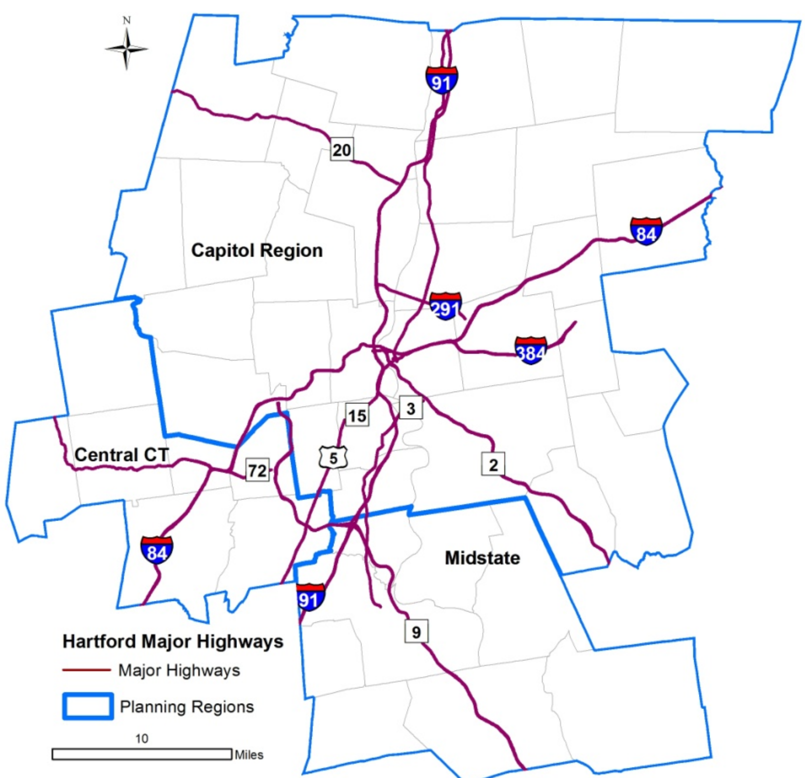


Figure 3.1

Radial Shaped Freeway Network. A key feature of the freeway network in the Hartford area is its radial configuration with a focus on Hartford. I-84 and I-91 intersect in downtown Hartford, and Route 2 intersects with I-84 just east of the I-84/I-91 junction. This configuration results in five key commuter routes radiating out from Hartford: I-91 to the north, I-84 to the east, Route 2 to the southeast, I-91 to the south, and I-84 to the west.

[4] Estimate based on Highway Performance and Monitoring System prepared by Conn DOT.

Incomplete Beltway. Early plans for a set of circumferential freeways to link the radial spokes and create a beltway around Hartford were largely abandoned. Today only three significant segments of the beltway exist: I-291 in the northeast quadrant, Route 3 in the southeast quadrant, and Route 9 in the southwest quadrant. This means the radial network serves the traditional city-suburb commute trips plus some suburb-suburb commute trips that must pass through the central city to reach destinations on another side of Hartford.

Traffic Volumes. Daily traffic volumes from 2009 are displayed in Figure 3.2. The highest traffic volumes on the freeway system are found near the center of the radial network. Daily traffic volumes on I-84 in downtown Hartford is about 150,000. On I-91, they are about 130,000. Volumes remain high on the primary routes radiating out of downtown. Daily volumes exceed 100,000 vehicles on I-91 north to Windsor Locks, on I-84 east to Vernon, on I-91 south to Meriden (I-691), and on I-84 west to Farmington (Route 9). Route 2 carries more than 50,000 vehicles daily on the inner segments through East Hartford and Glastonbury.

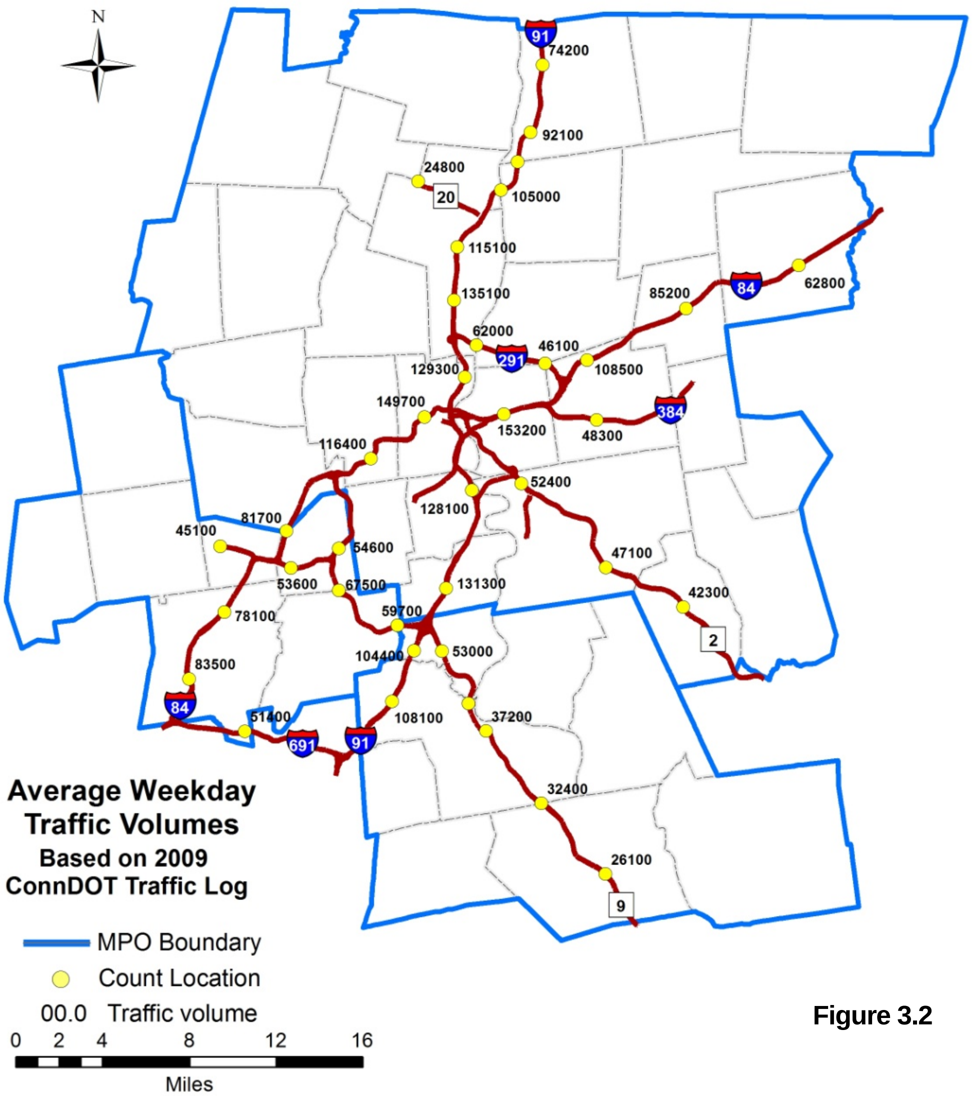


Figure 3.2

FREEWAY MONITORING SYSTEM

The freeway monitoring system developed for this report is based on data extracted from DOT's Regional Traffic Management System (RTMS), which is operated by the Highway Operations Center. The RTMS is operated 24 hours a day, seven days a week and consists of a network of cameras, traffic flow (speed) monitoring stations, electronic message signs, and highway advisory radio. The system covers nearly 50 miles of freeway in the Hartford metro area. It is concentrated on the highest traffic volume segments at the urban core of the freeway network. The routes monitored are shown in Figure 3.3 and include I-84, from Farmington to Manchester, I-91 from Cromwell to Windsor Locks, and Route 2 in East Hartford and Glastonbury.

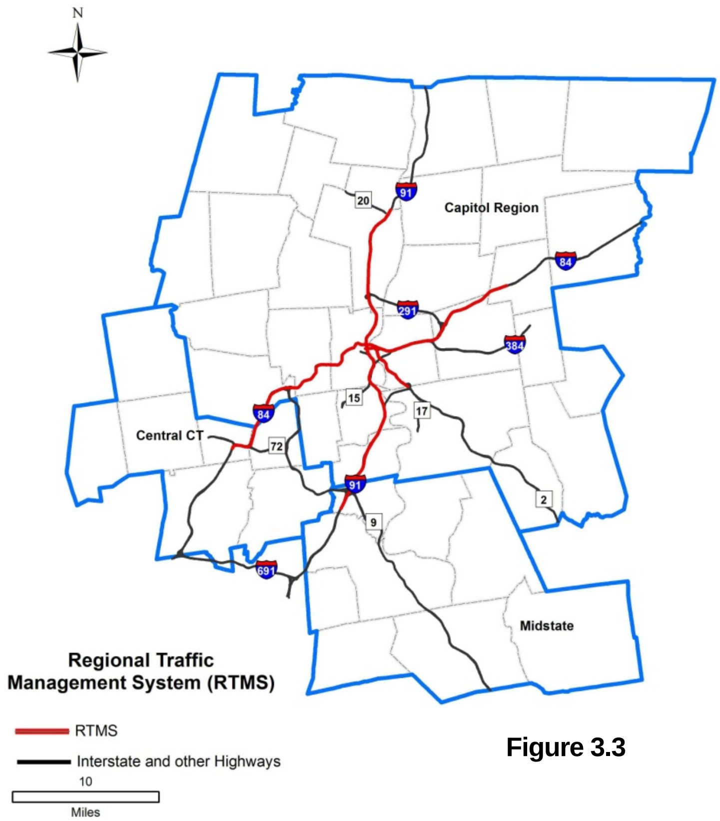


Figure 3.3

The RTMS includes 144 traffic flow monitors located approximately every half-mile within the RTMS coverage area. The monitors record traffic volume, speed, and occupancy for each travel lane and for each direction of travel. The data is recorded and stored for each 30-second time period throughout the day. This is done 24 hours per day for 365 days per year. This provides continuous coverage of traffic conditions for the 50 miles of freeway within the busiest **sections** of Hartford's freeway network. With this wealth of information, we can develop very detailed and accurate information on freeway operations and performance.[5]

Segment-Level Data. For analysis purposes, the freeways within RTMS area are divided into roughly one-half mile long segments. Each segment corresponds to one of the 144 RTMS traffic-monitoring stations. The traffic data recorded at the station is assumed to be representative of conditions throughout the half-mile segment of freeway adjacent to the station. Since stations are spaced roughly a half-mile apart; we create an unbroken series of contiguous segments for each freeway route within the RTMS area. These segments are the basic units of measurement used in this report.

The segment-level data is used primarily for map analysis. By mapping measures such as average speed and traffic volume, we can provide a good visual profile of traffic conditions on the freeway network, and how those conditions vary across the network.

[5] The principal challenge with the RTMS database is how to process a database of this enormous size and level of detail. To aid in this task, CRCOG developed a software program to extract and summarize the data in a more manageable form. This year's report is the second use of the program. Further refinement of the software will be done to address problems as they are identified in the future.

Route-Level & System-Level Data. While data is collected at the segment level, it is easily aggregated to other levels. For this report, it is aggregated to the route level and to the system level. For example, the data for all the segments on I-91 can be compiled to provide an assessment of conditions on I-91 as a whole. Likewise, the data for all routes can be aggregated to develop system-level performance measures.

FREEWAY PERFORMANCE MEASURES

Most of the freeway performance measures developed for this report are a continuation of the basic, but informative, measures that were developed for the 2005 report. They include vehicle miles of travel (VMT), vehicle hours of travel (VHT), average vehicle speed in peak hour (speed), vehicle hours of delay (delay), and the travel time index (TTI).

The long-term goal of this program is to develop a set of measures comparable to those used in the Urban Mobility Report prepared by the Texas Transportation Institute. The Mobility Report established a standard set of measures that they apply for all cities across the United States. The objective is to replicate the measures, but increase the accuracy on the measurements by using the RTMS database and other more direct methods of measurement. In contrast to the Urban Mobility Report, which estimates speed and congestion levels using formulas that *estimate* speed based on recorded traffic volume data, roadway capacity, and assumed relationships between speed, volume, and capacity, the RTMS data allows us to measure speed and congestion directly and continuously throughout the year. Our database allows us to prepare more comprehensive and accurate profiles of freeway operating conditions and performance.

RTMS Database: Segment Level Data. As explained above, each of the 144 RTMS traffic-monitoring stations records information on traffic volume and speed at the station location. This is essentially point-level data, or information describing conditions at that single point on the freeway. To be useful for our purposes, we assume that the same conditions that exist at the station site also extend roughly one-quarter mile before and after the station. The data for the station is assumed to be representative of traffic conditions throughout the roughly half-mile segment of freeway closest to the station. Since the stations are spaced roughly a half-mile apart, this allows the creation of continuous series of segments for each freeway route within the RTMS area. Thus, the basic unit of measurement is the segment, and each segment is roughly one-half mile in length.

> *Vehicle Miles of Travel.* VMT is the total miles traveled by vehicles in a station area or segment. It is calculated at the segment level by multiplying the number of vehicles counted at a station times the length of the station segment. The segment totals can be added across all segments to calculate a RTMS area total.
>
> *Average Speed.* Average speed is the average speed of all vehicles traveling through a station area or segment. For this report, average speed is presented only for the morning peak hour (7:30 AM – 8:30 AM), and the afternoon peak hour (4:30 PM – 5:30 PM). It is generally calculated only at the segment level, but is sometimes calculated at the route level to allow comparison of different routes.
>
> *Vehicle Hours of Travel.* VHT is the total time spent by all vehicles traveling through a station area or segment. It is derived from the VMT and average speed.
>
> *Hours of Delay.* Hours of delay is the total time vehicles spend traveling at rates of speed below 60 miles per hour (mph). Sixty mph was selected as the threshold speed since it is the threshold speed used in the Urban Mobility Report, and a goal of the Hartford monitoring program is to develop measures comparable to the Mobility Report.
>
> *Travel Time Index.* The travel time index is a ratio of the average travel time during **peak period** or peak hour conditions versus the travel time during **uncongested periods.** If the

index or ratio is 1.0, it means that there is no delay during peak periods. A ratio greater than 1.0 indicates that there is delay or congestion. The amount of delay is indicated by the size of the ratio. For example, a ratio of 1.25 means that it takes 25 percent longer to travel a given distance in the corridor during the peak period than during off-peak periods. This type of 'relative' measure of delay makes it easier to compare different corridors or different segments within a corridor.

To measure delay accurately, the calculations are based on 5-minute time intervals. The standard time interval for many traffic performance measures is one hour or 60 minutes. However in this case, a shorter time interval is needed to assure that we identify and measure even short periods of delay that might be substantially less than an hour. The average speed is calculated for each 5-minute interval, and delay is calculated based on the difference between this 5-minute average speed and the threshold speed of 60 mph.

FREEWAY PERFORMANCE RESULTS

To assess freeway performance, we analyzed four months of data from the RTMS: September and October in 2009 and February and March in 2010. The two autumn months in 2009 were selected, because they are generally representative of average annual conditions, and do not include some of the unusual travel patterns found during winter weather conditions and summer vacation periods. The data for February and March in 2010 were selected because they are the latest months for which data was available when this analysis was initiated.

Only weekday data (Monday – Friday) was analyzed.

Overview of Monitored Corridors

Table 3.1 gives an overview of the corridors monitored by the RTMS. The system covers 49.9 miles of freeway in the central section of the Hartford metropolitan area. It serves about 5,906,000 vehicle miles of travel on a daily basis. The 'average' traffic volume is 118,000 (VMT/mile). Such high daily VMT and traffic volumes illustrate the critical role the freeway system plays in the Hartford metro area.

Table 3.1
Freeway Overview

Corridor	Corridor length (miles)	RTMS coverage (miles)	% of corridor covered	RTMS VMT daily	RTMS VMT per mile
I-84 East of I-91	22.8	11.2	49.1%	1,269,286	113,329
I-84 West of I-91	21.3	13.6	63.8%	1,460,141	107,363
I-91 North of I-84	19.5	9.7	49.7%	1,438,388	148,287
I-91 South of I-84	19.7	11.1	56.3%	1,465,086	131,990
Route 2	19.2	4.3	22.4%	273,142	63,521
All Corridors	**102.5**	**49.9**	**48.7%**	**5,906,044**	**118,358**

NOTE: From here forward, we refer to the I-84 and I-91 freeway segments by their location relative to the City of Hartford. For example, "I-84 West" refers to the segment of I-84 both eastbound and westbound that is located west of Hartford. "I-91 North" refers to the segment of I-91 both northbound and southbound north of Hartford.

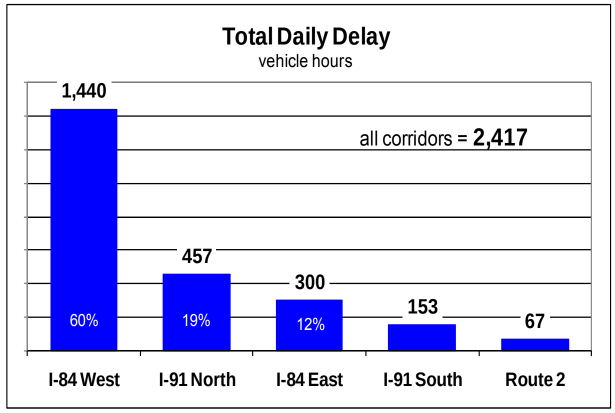
Corridor-Level Performance.

Three different performance measures are used to evaluate the performance of each corridor: (1) vehicle delay, (2) average peak hour speed, and (3) travel time index. The results are discussed below. As with the VMT data, these are corridor-wide measures and do not represent conditions on any individual location within the corridor.

1. Vehicle Delay.

Total daily vehicle delay for each corridor is presented in Figure 3.4. This is the cumulative amount of delay experienced by all vehicles traveling in the corridor over a 24-hour period. It is the most general measure of delay, but very helpful in identifying differences among the corridors.

Figure 3.4 – Delay in 2010



Total Freeway Delay (2,417 hours). The total delay recorded for the entire freeway network monitored by RTMS is 2,417 hours. This is the total hours of vehicle delay recorded in all five corridors over an entire day.

Most Congested Freeways. In general, the most congested corridors are ***I-84 West*** and ***I-91 North***, which together account for about 80 percent of all congestion recorded. The analysis below is based on the information shown in Table 3.2.

Table 3.2 Vehicle Delay by Direction and Time Period

Corridor	miles	AM peak hour			PM peak hour			Daily Delay			
		IN	OUT	Total	IN	OUT	Total	IN	OUT	Total	Per Mile
I-84 West	13.6	191	19	210	118	113	23'	906	534	1440	105.9
I-91 North	9.7	109	4	114	50	18	68	398	59	457	47.1
I-84 East	11.2	105	1	107	5	11	16	241	59	300	26.7
I-91 South	11.1	15	0	15	4	19	24	68	85	153	13.8
Route 2	4.3	19	0	19	1	1	2	52	15	67	15.7
All Corridors	49.9	440	24	465	178	162	341	1667	750	2417	48.4

<u>*I-84 West – Most Congested*</u>. This is the most congested corridor with 1,440 hours of total delay per day. This is about 60 percent of the total network delay of 2,417 hours. When averaged over the 13.6 miles in the corridor, this amounts to 106 hours per mile, which is more than twice as much as ***I-91 North*** and <u>*four times as high as any other corridor.*</u>

- *Inbound vs. Outbound.* The delay on ***I-84 West*** is significantly imbalanced between the inbound and outbound directions. There are about 906 hours of delay in the inbound direction, and about 534 hours outbound.
- *AM peak vs. PM peak*. Based on the peak hour data, the total delay in the AM peak hour (210 hours) is slightly lower than that in the PM peak hour (231 hours).

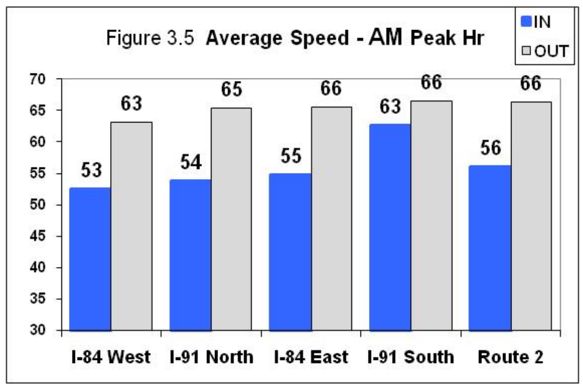
- In the AM peak, as would be expected, the delay is the heaviest in the inbound direction (191 hours).
- In the PM peak, both the inbound and outbound directions are heavily congested (118 hours and 113 hours, respectively).

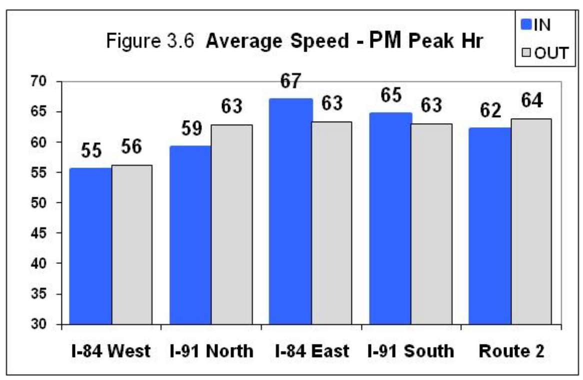
I-91 North - 2nd Most Congested. The second most congested corridor is ***I-91 North*** with 457 hours of total delay per day.

- *Inbound vs. Outbound.* Similar to the I-84 West corridor, there is a large imbalance between the inbound and outbound directions. The inbound direction records more than six times as much delay as the outbound direction, with 398 hours of daily inbound delay as compared to 59 hours for the outbound direction.
- *AM peak vs. PM peak.* In contrast to the ***I-84 West*** corridor, most of the congestion occurs in the morning (114 hours) rather than the afternoon (68 hours) for this corridor.
- In the AM peak, almost all delay occurs in the inbound direction (109 hours vs. 4 hours in the outbound direction as shown in Table 3.2).
- In the PM peak, 50 hours of delay is evident in the inbound direction while there are 18 hours of delay in the outbound direction.

2. Average "Peak Hour" Speed.

The speeds presented in figures 3.5 and 3.6 are the average for the entire corridor. They are an indicator of overall corridor performance and do not reflect conditions at any one location within the corridor. Nonetheless, this general performance measure allows a rough comparison of the performance of all five corridors.



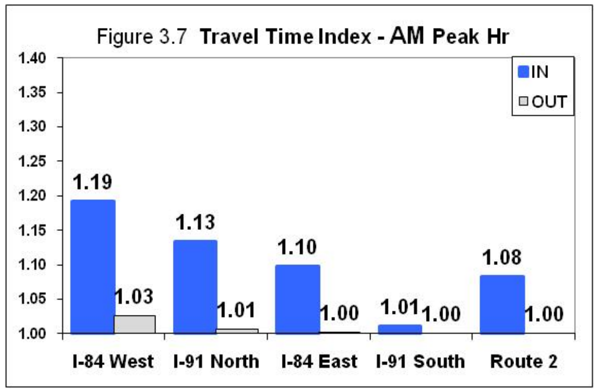


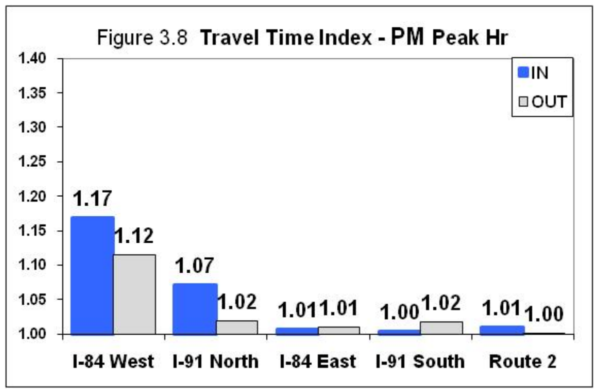
The lowest average peak-hour speeds are found in the AM peak hour for the inbound direction in ALL corridors except ***I-91 South*** *(which has a relatively high speed of 63 mph both inbound in the morning and outbound in the afternoon)*. The outbound speeds are much higher in the AM peak hours, which reflect the directional imbalance discussed in the prior section.

In the PM peak hour, speeds drop to 55 miles per hour (mph) inbound and 56 mph outbound in the ***I-84 West*** corridor. The average speeds in the other corridors are generally much higher. Only in the inbound direction of the ***I-91 North*** corridor, do the speeds drop below 60 mph

3. Travel Time Index by Corridor.

The travel time index (TTI) is a measure of the amount of extra time it takes to travel in a corridor during the peak hour versus the time it takes to travel the same distance during off-peak or free-flow conditions. For purposes of this analysis, the off-peak speed is assumed to be 60 mph.[6] The index is a simple ratio of peak-hour travel time to time required to travel the same distance at an uninterrupted 60 mph. A ratio of **1.25** means that it takes **25 percent longer** to travel in the peak hour than it does in the off-peak period. The minimum ratio is set to 1.0 and means that peak-hour speeds are equal to or higher than 60 mph. The results are presented in Figures 3.7 and 3.8.





I-84 West. The highest TTIs were recorded inbound for both the AM and the PM peak in the I-84 West corridor. A ratio of 1.19 was recorded for the AM peak and 1.17 for the PM peak. The outbound direction of this corridor also has a relatively high TTI in the PM peak (1.12).

Other Corridors. Similar to the average peak-hour speeds, higher TTIs are found in the AM peak hour for the inbound direction for all other corridors, except ***I-91 South***, where the outbound PM speed is slightly slower than the inbound AM speed. In addition, the inbound direction of ***I-91 North*** corridor during the PM peak has a relatively high ratio.

In summary, these measures indicate that the corridor with the worst congestion is I-84 West in both the AM (inbound) and the PM (inbound and outbound) peak hours. In addition, inbound traffic for the AM peak is of some concern for all corridors except I-91 South, as is inbound traffic on I-91 North for the PM peak.

Segment-Level Performance. *Average Peak Hour Speeds*

The previous section examined overall corridor performance without attempting to determine where problems occur within the corridor. This section on segment-level performance examines how conditions vary within each corridor.

> SPECIAL NOTE: *Speeds displayed are the 'average' over the entire 60-minute peak hour. Speeds vary within the 60-minute period and can be higher or lower than the average during portions of the hour.*

Average speeds are mapped for each individual monitoring station or segment within a corridor. The average peak-hour speeds for individual freeway segments are shown in Figure 3.9 (AM peak) on page 15 and Figure 3.10 (PM peak) located on page 1. The mapping of the speed data allows a more detailed assessment of each corridor and gives an indication of where problems are occurring within the corridor.

Morning Peak Period.

Figure 3.9 shows the morning inbound and outbound speeds separately in a side-by-side comparison. As expected, there is widespread delay in the inbound direction, and only isolated problems in the outbound direction.

[6] 60 mph is the standard used by the Texas Transportation Institute in their mobility reports.

I-84 West of Hartford. *(AM peak)*

This is the ***worst corridor*** in the morning.

Inbound. Delay is severe in the inbound direction. It is the most extensive morning problem of all corridors. There are choke points at several locations. The outermost one is in Farmington prior to Route 9 where the lanes drop from three to two. The second and most significant is the long segment in West Hartford prior to and in the vicinity of the Trout Brook curves, where the speed drops below 45 mph. Congestion continues through the rest of the corridor through Hartford, with 'average' speeds are slightly higher at 45-55 mph.

Outbound. In the outbound direction, the delay (50-55 mph) is limited to downtown Hartford at and immediately to the west of I-91. Much of this is traffic destined for the Asylum Hill employment district and could be considered as 'inbound' traffic from other corridors.

I-91 North of Hartford. *(AM peak)*

This is the second most congested corridor in the morning.

Inbound. Most of this 9.7 mile corridor operates at speeds below 60 miles per hour. About one third of the corridor is below 50 mph.

Outbound. The outbound direction operates relatively free of delay in the morning, with a minor delay in the vicinity of Park Avenue (Route 178) in Windsor.

I-91 South of Hartford. *(AM peak)*

Inbound. Speeds remain above 55 mph in this corridor.

Outbound. The outbound direction operates free of delay in the morning.

I-84 East of Hartford. *(AM peak)*

Inbound. While most of this corridor is relatively delay free in the morning, there is a critical chokepoint in the inner sections near the I-84/Route 15 split and the Connecticut River crossing. These segments are the slowest segments in the entire system, operating below 45 mph at the I-84/Route 15 split and less than 40 mph at the River crossing.

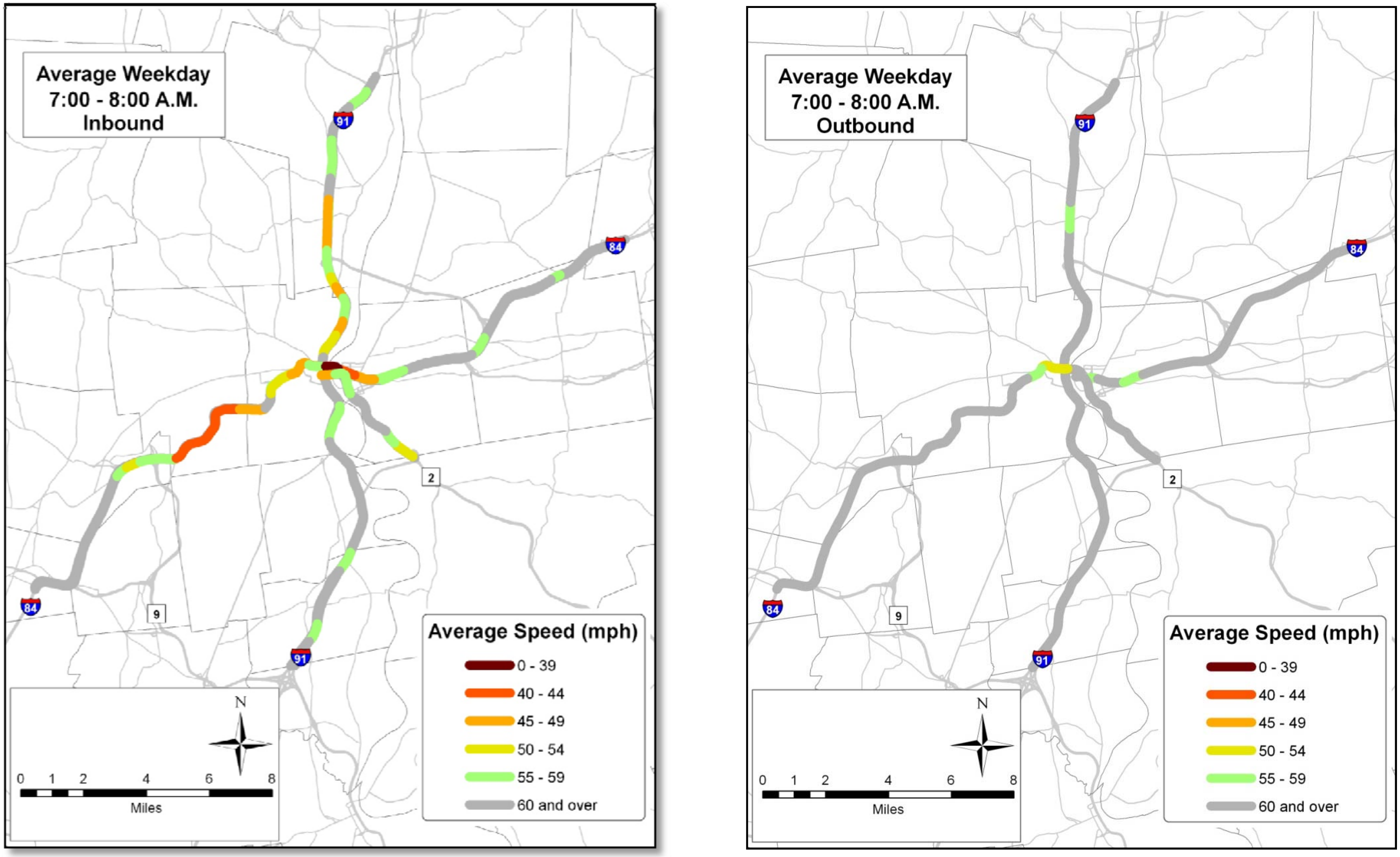
Outbound. The outbound direction operates relatively free of delay in the morning.

Route 2. *(AM peak)*

Inbound. There are traffic slowdowns near the junction with Route 3 and again near the approaches to the Founders Bridge and the Bulkeley Bridge (I-84).

Outbound. The outbound direction operates mostly free of delay in the morning.

Figure 3.9: Average Speeds During Morning Peak Hour



<u>Afternoon Peak Period.</u>

Figure 3.10 shows the afternoon inbound and outbound speeds in a side-by-side comparison.

Reverse (Inbound) Flows. Unlike the morning peak hour when there were stark differences between inbound and outbound conditions, <u>there is substantial delay in both directions in the afternoon</u>. During the PM commute, we expect congestion in the outbound flow as commuters leave Hartford. While this is true for some corridors, we also find major delays in the 'inbound' direction in most corridors. This reflects the higher levels of background traffic in the afternoon and the large volume of suburb-suburb commuting that the radial network must accommodate.

I-84 West of Hartford.

This is the ***worst corridor*** in the afternoon. Delay is <u>severe</u> in <u>both</u> directions.

Inbound. In the inbound direction, congestion begins at the West Hartford/Hartford townline and builds all the way to downtown Hartford. In Hartford, speeds are mostly below 50 mph, with a long section below 40 mph. Much of this delay appears to be due to the weaving traffic pattern and restricted capacity on I-84 in the area approaching the 'tunnel' in downtown (at the I-91 interchange).

Outbound (peak direction): Congestion is continuous from downtown all the way through Hartford and much of West Hartford. It is most severe in Hartford where speeds drop below 45 mph and below 40 mph in one section.

I-91 North of Hartford.

Afternoon congestion appears less severe than morning congestion, but continues to occur primarily in the inbound (reverse) direction.

Inbound. Delays occur regularly in the inbound (reverse) direction. The most severe reductions in speed occur in the North Meadows area of Hartford just north of downtown where speeds drop below 45 mph Speeds drop again in the section of Windsor north of I-291 and south of the Day Hill corporate area.

Outbound (peak direction): Minor delays occur in the same two sections as in the inbound direction: North Meadows in Hartford and south of the Day Hill corporate area in Windsor.

I-91 South of Hartford.

Inbound. Inbound delays are minor. Traffic drops to below 60 mph for a stretch prior to the Putnam Bridge.

Outbound (peak direction): Delays are moderate from downtown south to the Hartford-Wethersfield town line.

I-84 East of Hartford.

Inbound. There little delay except for the innermost section from Main Street in East Hartford to the I-84/I-91 interchange.

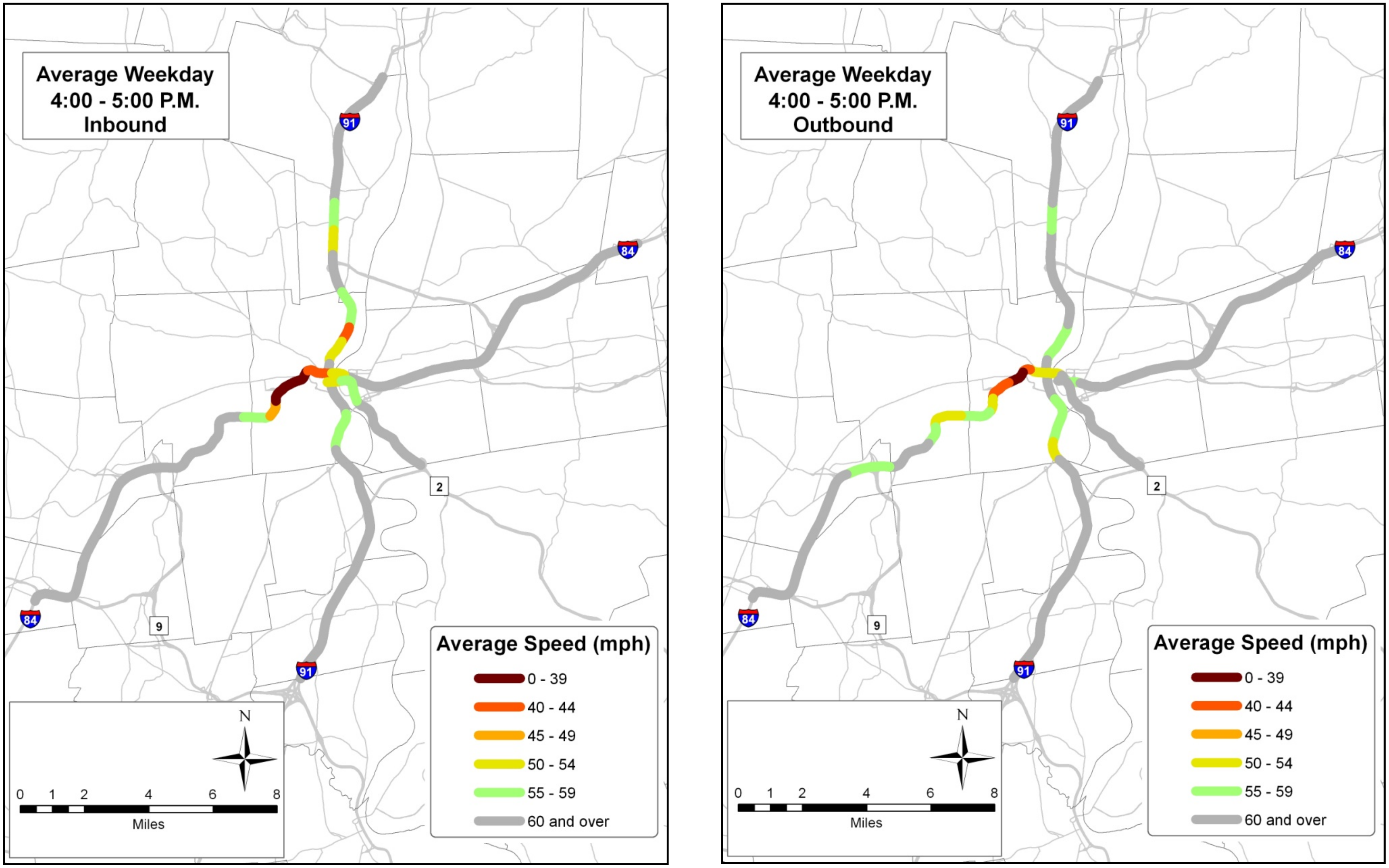
Outbound (peak direction): There are minor delays near the I-84/Route 15 split.

Route 2.

Inbound. There is some congestion near the approach to I-84 westbound and the Founders Bridge to downtown Hartford.

Outbound (peak direction): Delays are minor or not a regular occurrence.

Figure 3.10: Average Speeds During <u>Afternoon</u> Peak Hour



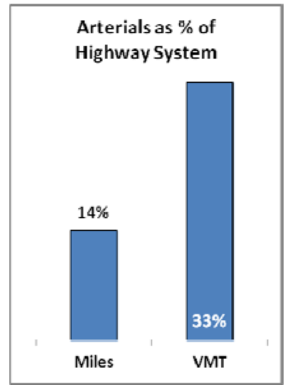
3.2 Arterial System

The monitoring system for arterials covers only a limited portion of all the arterials in the Hartford metropolitan area. Without the advantage of an electronic surveillance system like the freeway RTMS, it is not practical to develop an extensive monitoring program. While GPS technology assists the process, data collection still relies on individual drivers travelling the arterial routes to gather traffic speed data. This severely limits our ability to monitor conditions. Surveys are limited to a small number of roads and a few select periods of time during the day.

METRO HARTFORD ARTERIAL SYSTEM

The arterial network serving the Hartford metropolitan includes about 830 miles of road. Arterials comprise about 14 percent of the total roadway network (miles), carry about 33 percent of the region's traffic (figure 3.11).[7] This is a smaller percent of the traffic than the freeway system, with a disproportionately large share of total traffic. Like the freeway system, the arterial system is critical to serving the region's mobility needs.

Figure 3.11



ARTERIAL MONITORING SYSTEM

The arterial monitoring system developed for this report is less extensive and less accurate than the monitoring system developed for freeways. As noted above, the monitoring relies on more labor-intensive methods. These are explained below.

Speed & Travel Time Survey. To facilitate trend analysis and provide comparability with the 2005 CMS report, the same arterial routes in Capitol Region were selected to collect data on traffic speed and travel times. The other two MPO had either not collected any data or omitted some routes. There were a total of five routes monitored for this report. Speed and travel time data was collected by driving these routes with GPS equipment.

The selected routes were surveyed during the morning peak period, the afternoon peak period, and during the midday or off-peak period. Surveys were also limited to the peak direction, which is the inbound direction in the morning and the outbound direction in the afternoon. In each case, we tried to conduct at least 5-10 trials during each trial period.

Trials were generally conducted during the spring and the fall of 2010 on days and weeks considered most typical of average annual conditions. For the routes in Midstate Region, data was collected in the spring and fall of 2008.

Routes Included in Survey. The routes surveyed were important arterials of special interest to the respective agency. The five routes surveyed are shown in Figure 3.12.

[7] Estimate based on Highway Performance and Monitoring System prepared by CT DOT (2011).

ARTERIAL PERFORMANCE MEASURES

The arterial performance measures developed for this report are the same basic measures developed for the freeway system. They include vehicle miles of travel (VMT), vehicle hours of travel (VHT), average vehicle speed in peak hour (speed), vehicle hours of delay (delay), and the travel time index (TTI). This report also looks into the traffic trends between 2005 and 2010 (See Chapter 4).

However, these measures are limited to the routes surveyed, and they are much less accurate since they are based on a smaller sample of days and time periods.

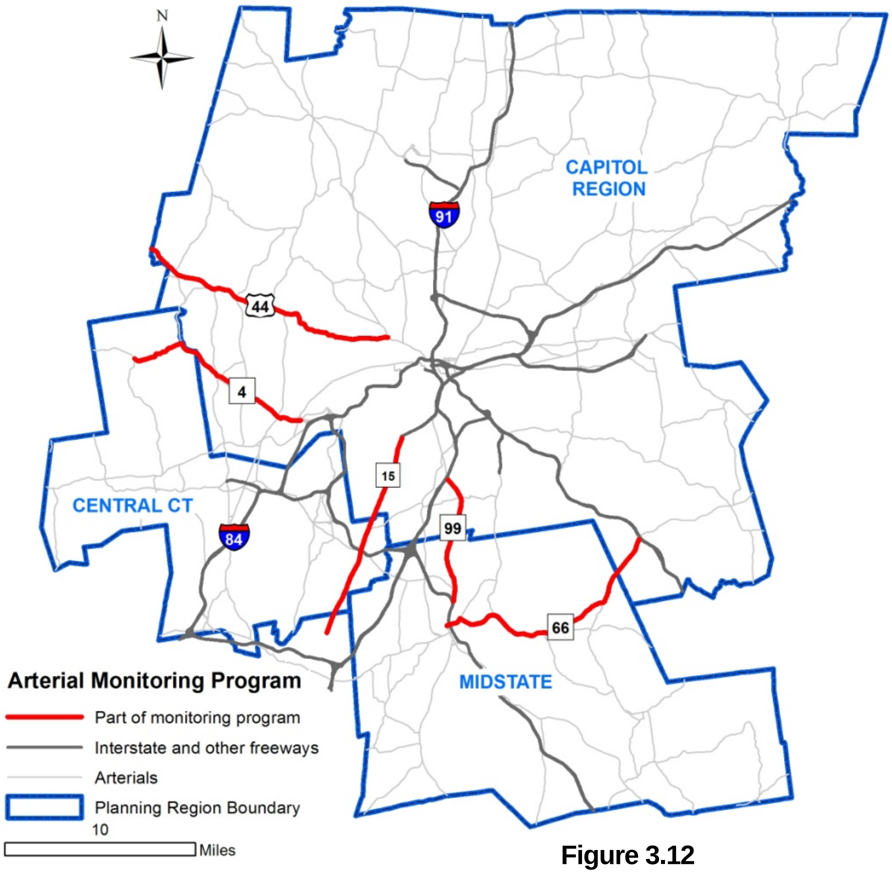


Figure 3.12
CMP Arterial Routes

Vehicle Miles of Travel. VMT is the total miles traveled by vehicles on a road. It is calculated at the segment level by multiplying the number of vehicles counted on that segment of road times the length of the segment. The segment totals can be added across all segments to calculate a route total. The traffic counts are collected separately by CTDOT as part of the regular traffic counting.

Average Speed. This is the average speed of all vehicles traveling on a road. For this report, it is presented only for two hours in the morning peak (7:00 am – 9:00 am), and two hours in the afternoon peak (4:00 pm – 6:00 pm) depending on the travel route. It is calculated at both the segment and route level.

Vehicle Hours of Travel. VHT is the total time spent by all vehicles traveling through a station area or segment. It is derived from the VMT and average speed.

Hours of Delay. This is the time vehicles spend traveling at rates of speed below an acceptable threshold speed. In the case of freeways, this was set to 60 mph. Since arterials vary so much in terms of road geometry, traffic controls, and adjacent land use, the threshold speed was set differently. It was set separately for each segment of each route by establishing the off-peak or free-flow speed for that segment. This required a travel time and speed survey during the off-peak period in addition to the peak period.

Travel Time Index. The travel time index (TTI) is a ratio of the average travel time during peak period conditions versus the travel time during uncongested periods. If the index or ratio is 1.0, it means that there is no delay during peak periods. A ratio greater than 1.0 indicates that there is delay or congestion. The amount of delay is indicated by the size of the ratio. For example, a ratio of 1.25 means that it takes 25 percent longer to travel a given distance in the corridor during the peak period than during off-peak periods.

ARTERIAL PERFORMANCE RESULTS

A summary of the results is presented in Table 3.3. A total of 56.5 miles of road were surveyed and a total of 1,105 hours of delay was identified. The average speed was 33.3 mph, but speeds varied greatly between corridors and even within corridors. The overall travel time index (TTI) was 1.17 which represents a 17 percent increase in travel time due to delay.

PM Peak More Congested. Congestion is worse in the afternoon peak than in the morning peak. The TTI was worse in the afternoon and the total hours of delay was greater in the PM peak for all corridors except Route 44. For all five routes combined, there was 636 hours of delay in the PM peak and 469 in the AM peak.

Table 3.3

Arterial Summary

AM=Inbound (7am to 9am) PM=Outbound (4pm to 6pm)

Route	Length (mile)	Average Speed			VMT			Delay (Hours)			Travel Rate Index		
		AM	PM	Both	AM	PM	Both	AM	PM	Both	AM	PM	Both
RT 15	11.3	38.8	33.2	36.0	32,368	38,044	70,412	61	237	297	1.07	1.24	1.16
RT 44	14.2	28.1	30.7	29.4	35,872	30,438	66,310	319	165	484	1.30	1.15	1.23
RT 4	10.7	30.3	27.6	28.9	16,999	16,619	33,619	67	147	215	1.11	1.29	1.20
RT 66	13.5	35.5	36.1	35.8	23,508	23,607	47,115	18	71	89	1.05	1.12	1.09
RT 99	6.8	37.5	35.4	36.4	4,538	5,928	10,466	4	16	20	1.04	1.09	1.07
All	56.5	34.0	32.6	33.3	113,286	114,635	227,921	469	636	1,105	1.14	1.19	1.17

Corridor-Level Performance.

A more in depth review of corridor performance is provided below. Separate reviews are presented for each of three performance measures:

- **Delay** (total vehicle delay in peak periods)
- **Travel Time Index** (TTI)
- **Speed** (average speed in peak periods)

Delay

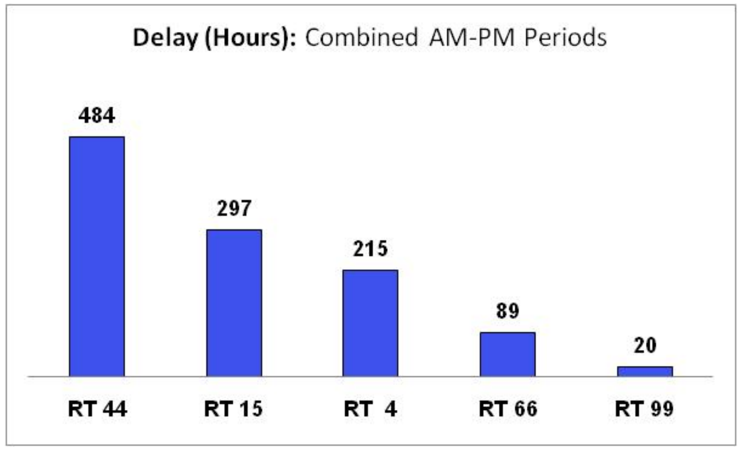
The three corridors with the most hours of delay are:

- Route 44
- Route 15 (Berlin Turnpike)
- Route 4

This is illustrated in Figure 3.13, on the following page. All three corridors have some common behaviors and features. All three corridors serve as major retail corridors and major commute routes. Route 15 has various retail activities throughout the corridor. Route 4 and 44 provide retail and other business activities around major intersections along the corridor.

***Route 44**.* The arterial corridor with the largest total delay accumulated by all vehicles during the peak-hour is Route 44. The total delay in the combined morning (7:00 am – 9:00 am) and afternoon peaks (4:00 pm – 6:00 pm) is 484 hours, which may be largely caused by construction on this route. From 2008 to 2010, major widening and realignment of Route 44 from CT 10 to the West Hartford town line has been undertaken to address safety concerns in the Avon Mountain area. The travel time analysis indicates the morning commute has been heavily impacted by the construction as shown in Figure 3.14. The morning peak delay is about twice the afternoon peak delay, and is distinctively different from other routes.

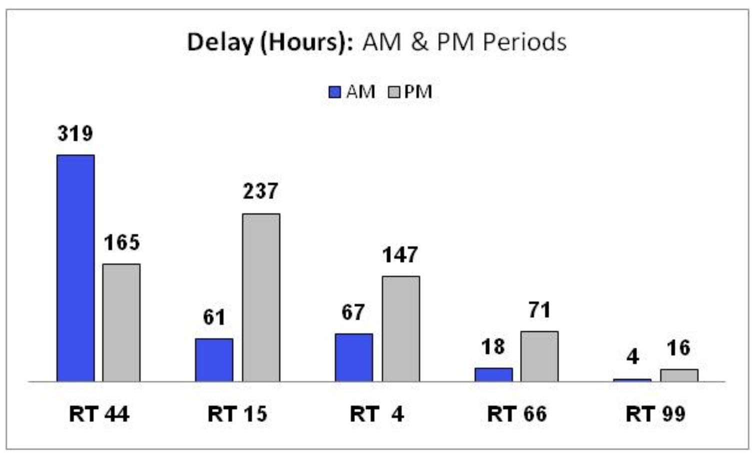
Figure 3.13: Total Peak Hour Delay



On completion of the safety improvement project, traffic is expected to flow more smoothly and safely. Future monitoring of this route will be continued in our next CMP report to evaluate the effectiveness of the measures taken to address the safety and congestion.

Route 15 (Berlin Turnpike). The arterial corridor with the second largest total delay during peak hours is Route 15. The large volume of delay (297 hours in the combined morning and afternoon peaks) is a function of congested travel conditions, plus the large volume of traffic throughout the corridor.

Figure 3.14: AM & PM Delay



As seen in Figure 3.14, evening peak-hour outbound commute is more delayed than the morning inbound commute. This is likely due to the larger 'background' or non-commute traffic that tends to be more prevalent in the afternoon. Since the Berlin Turnpike is also a retail destination, there is a heavy volume of retail traffic in the afternoon.

Route 4. Route 4 behaves much like Route 44, with retail and other business activities along the major intersections in the area. This route also has some lane merge and complex intersections, which create traffic bottlenecks and delay during the peak hour commute, especially during evening hours.

Average Speed

Average speed yields a much different result than any other performance measure. The reason for this difference has to do with both (1) the type and geometric characteristics of a roadway, and (2) congestion. In fact, geometric characteristics probably affect speed more than congestion does. For example, Route 15 is a divided roadway with a wide median with some grade separated roadway crossings. It is designed to function as a higher speed roadway and the recorded speeds reflect this.

Since average speed reflects the facility type and geometry, it is not as good a measure of congestion as total delay or the travel time index. The results are presented in Figure 3.15 and 3.16.

Overall speeds vary from 28.9 mph for Route 4 to 36.4 mph for Route 99. Slower speeds are found on Route 4 and 44 (about 29 mph), while the speeds on the other routes are all about 36 mph. Speeds in the PM peak are generally lower than in the AM peak except for Route 44 and Route 66. The largest difference is observed on Route 15 with 39 mph in the AM peak and 33 mph in the PM peak.

Figure 3.15: Travel Speed

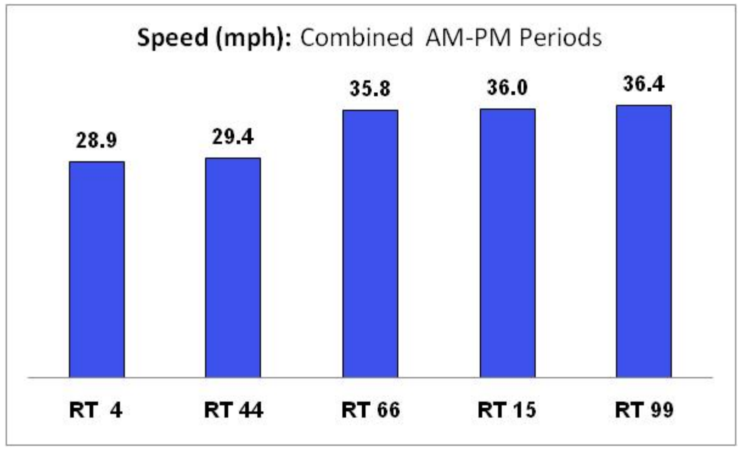
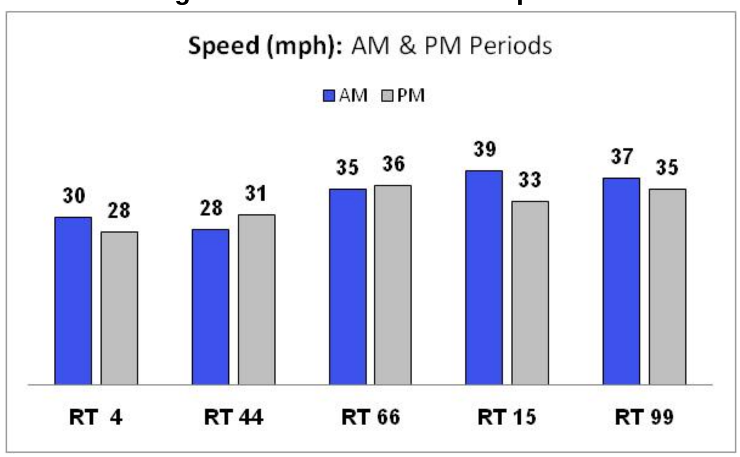


Figure 3.16: AM & PM Travel Speed



Travel Time Index

The three corridors with the highest Travel Time Indices are:

- Route 44
- Route 4
- Route 15 (Berlin Turnpike)

These three corridors are the same as the top three corridors for total delay. Route 44 has both the highest TTI as well as the most accumulated delay. Route 4 and Route 15, however, have traded places, with Route 4 having the second highest TTI. Construction was underway on both Route 44 and Route 4 during the data collection period and could very well be the reason for this TTI.

Route 44. Route 44 has the highest Travel Time Index of the arterial corridors (Figures 3.17 and 3.18). The index is higher in the morning peak (1.30) than in the afternoon peak (1.15). This is mainly due to delays caused by safety improvement work along Avon Mountain area.

Route 4. Route 4 has the second highest overall TTI of 1.20. This means that on average it takes 20 percent more time to travel during peak periods than off-peak periods. The delay along this route is mainly caused by the road improvement work being done near the intersection of Route 4 and Route

10 in Farmington. When the improvement work was completed in the fall of 2010, much less travel delay and congestion was observed than was in the spring of 2010.

As noted in the previous section, congestion is worse on Route 4 in the afternoon than in the morning. The PM peak TTI is 1.29, while the AM peak TTI is 1.11.

Route 15 (Berlin Turnpike). The overall TTI for Route 15 is 1.16. PM peak conditions are worse with a TTI of 1.24, while the AM peak TTI is 1.07. As stated previously, the imbalance between the AM and PM peaks partly reflects the concentration of retail activity in the corridor.

Figure 3.17: Travel Time Index

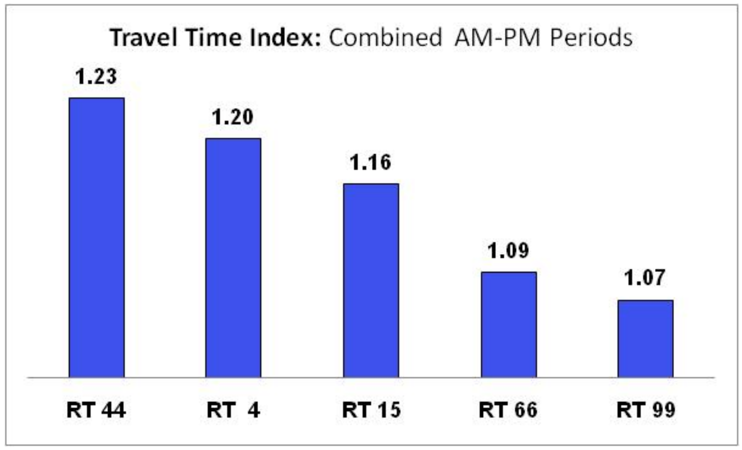
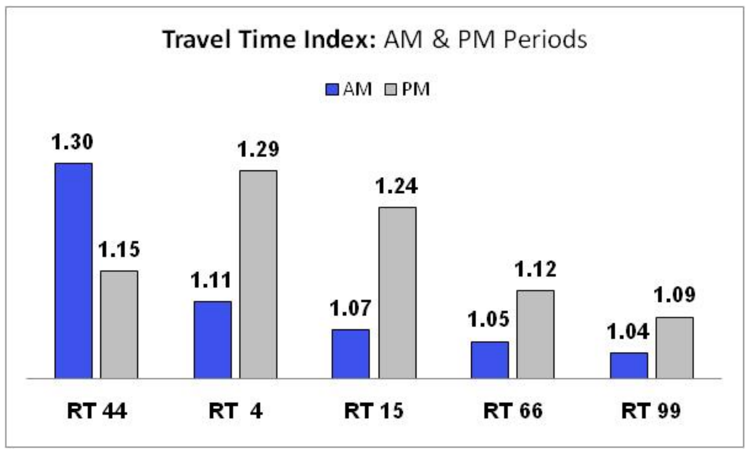


Figure 3.18: AM & PM Travel Time Index



Segment-Level Performance.

<u>Average Peak Hour Speeds</u>

The previous section examined overall corridor performance without attempting to determine where problems occur within the corridor. This section on segment-level performance examines how conditions vary within each corridor.

Average speeds are mapped for each segment within a corridor. The average peak-hour speeds for individual arterial segments are reported in Figure 3.19 (AM peak) on page 25 and Figure 3.20 (PM peak) on page 27. The mapping of the speed data allows a more detailed assessment of each corridor and identifies specifically where problems are occurring within the corridor.

Morning Peak Period.

Figure 3.19 shows the morning inbound speeds: 7-8 am and 8-9 am respectively in a side-by-side comparison. The segments with lower speeds (speed ≤ 35) are generally consistent for 7-8 and 8-9 periods, with speeds in 8-9 a little bit lower for many of the segments. However, on Route 44 and Route 66, the congestion seems to be more severe between 7-8 am.

Route 44

Route 44 has the worst conditions compared to the other arterials. During 7-8 am, speeds on most segments drop below 35 mph. Continuous congestion was observed in Avon, where construction is underway to improve the roadway safety in the area, as explained in the previous sections. In some segments of the corridor, mainly between Route 177 and Route 167, and from Route 10 to the Avon/West Hartford town line and again as the route enters the City of Hartford, speeds falls below 25 mph, or even below 15 mph.

Route 4

Lower speeds are observed at segments of Route 4 that are close to the major intersections, including Route 177, Route 167 and Route 10, where speeds can drop below 15 mph. There is a choke point at the intersection with Route 10 with traffic backing up behind and at the intersection. That area is complex with multiple merging and turning lanes. Because of this and the high volume of intersecting traffic, this area is very congested during both morning and evening peak hours.

Route 15

Many segments on this arterial operate with few delays, especially those outer segments in Meriden and Berlin, where vehicles travel in free-flow speed. Traffic starts to slow down between Woodlawn/Wethersfield Road and Route 160/Deming Road, and then near the intersection with Route 287. Speed drop is also observed from the Route 175 underpass to the Route 5/15 on ramp.

Route 66[8]

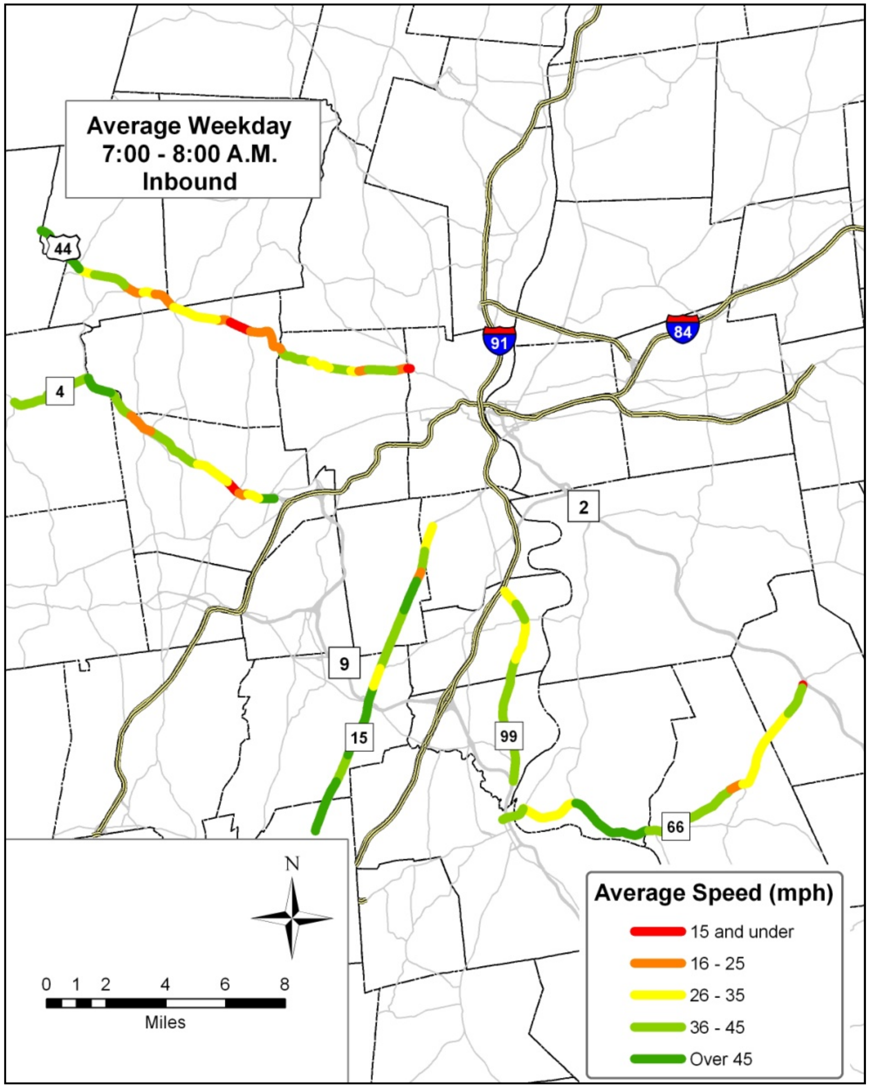
Significant congestion is observed from the Route 2 interchange to Main Street in Marlborough with average speed of about 6 mph. Speed also drops on the segment from Lakeview Street to Main Street in East Hampton due to turning traffic accessing the many commercial driveways in this section.

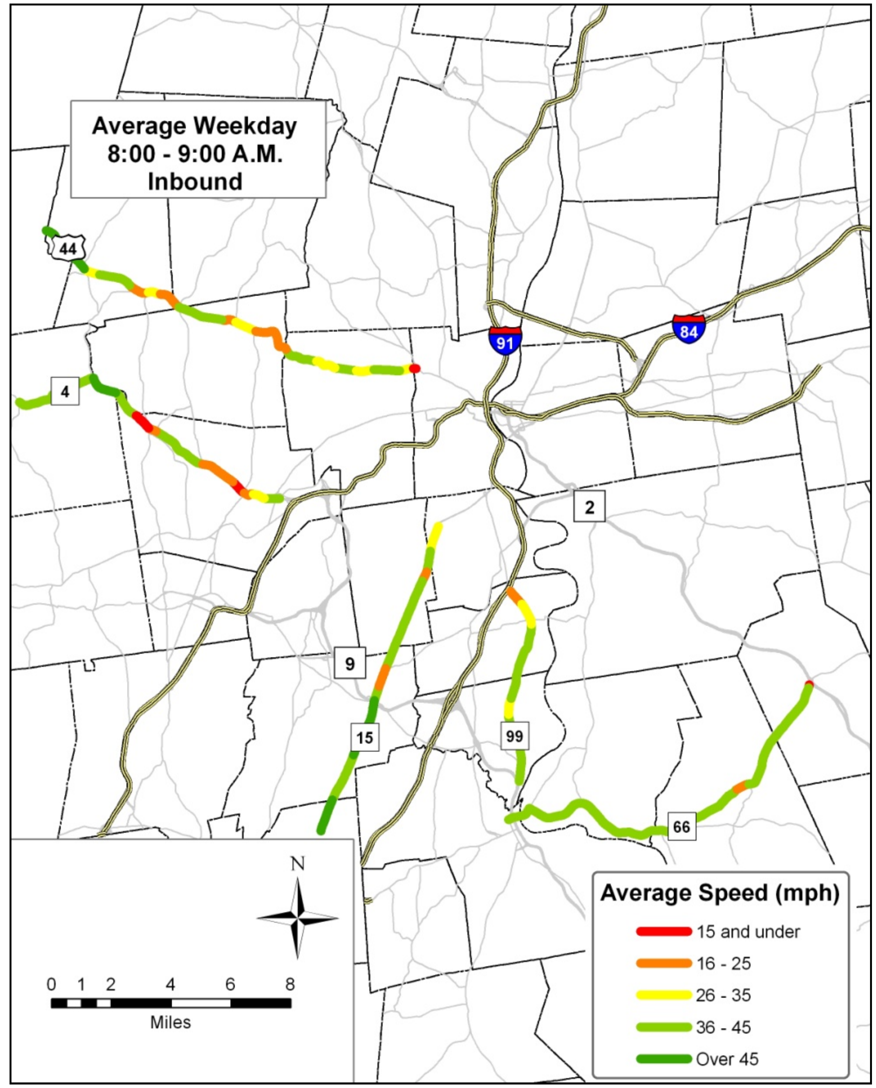
Route 99

Average speeds drop below 25 near the I-91 northbound on-ramp mainly because of merging traffic.

[8] Westbound traffic toward Middletown is considered “inbound” on Route 66.

Figure 3.19: Average Speeds During Morning Peak Hour





Afternoon Peak Period.

Figure 3.20 shows the afternoon outbound speeds in a side-by-side comparison of 4-5 pm and 5-6 pm.

Route 44

Low speeds (< 25 mph) are still observed on segments close to major intersections, where Route 44 intersects with Route 177, Route 167, Route 10, Route 218 (Bishops Corner) and Route 189. The overall speeds for most segments of the arterial are higher than in the morning peak period.

Route 4

The most significant delays on Route 4 occur in segments close to Route 10 and Route 167. Speeds drop to 25 mph or even 15 mph. As mentioned earlier, the delay at Route 4 near Route 10 interchange is mainly due to lanes merging from two to one approaching the intersection of Route 4 and Route 10. The lane merge creates a bottleneck for freeway exiting traffic, creating a significant delay and congestion in that area. Traffic delay near Route 167 is mainly due to commercial traffic in the area.

Route 15

Speeds on most segments are lower in the afternoon peak than in the morning peak. Average speeds stay low (≤ 35 mph) from Route 5/15 off-ramp all the way through Woodlawn/Wethersfield Road in Berlin. As stated in previous sections, this can be attributed to the reverse commute traffic as well as the concentration of retail activity along the arterial in Newington and northeast Berlin.

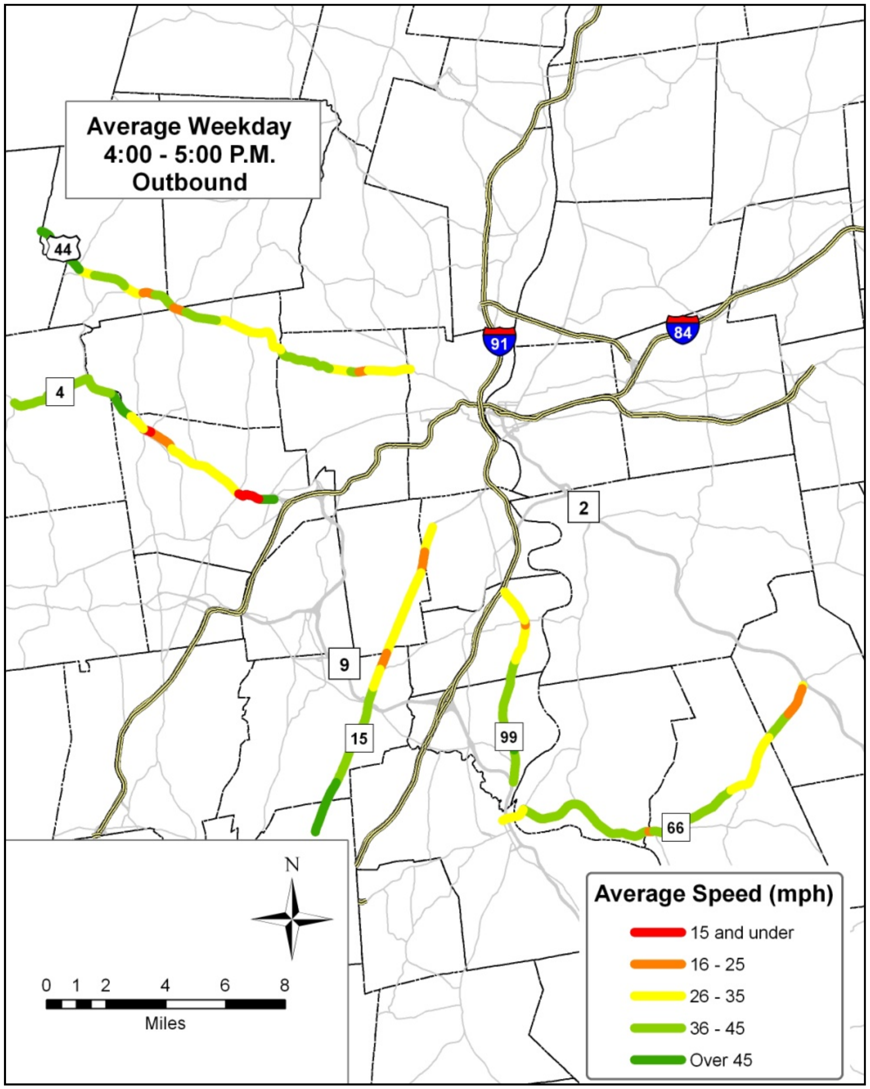
Route 66

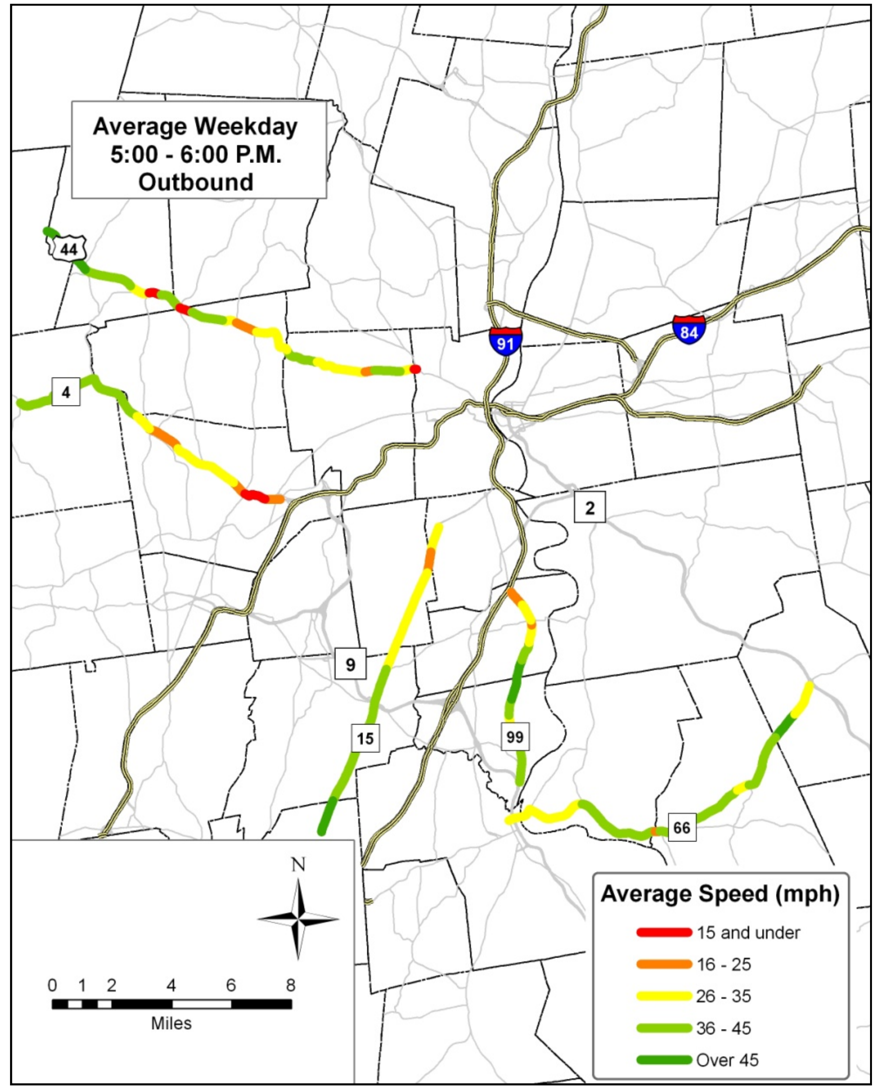
Speeds are reduced below 25 near Route 151 in East Hampton and a section from Main Street in Marlborough westward.

Route 99

There is congestion near Route 160 and again near the I-91 northbound on-ramp.

Figure 3.20: Average Speeds During <u>Afternoon</u> Peak Hour





Travel Time Index

The previous section examined speed variation with each arterial. However, the varied speeds may result not only from congestion, but also from the differences in roadway geometrics. Thus, a further investigation into the Travel Time Index (TTI) for each segment within the arterial is necessary to validate the findings based on the average speeds.

Morning Peak Period.

Figure 3.21 shows the TTI in the morning peak periods (7-8 a.m. and 8-9 a.m.). As can be seen from the figure, conditions on Route 44 and Route 4 are generally much worse than the other three routes.

Route 44

On Route 44, there are quite a few segments with TTI over 1.40, which means that the travel time on the segments during the peak period is 40 percent more than during off-peak period. The most severe segments are the ones from Secret Lake Road in Canton to Route 167 in Simsbury, from Route 10 to the Avon town line, and from West Hartford town line to Route 189, with the TTI during 7-8 am of 2.4, 2.3 and 3.0 respectively. This means it would take 1.3 to 2 times longer traveling on these segments during the morning peak period.

Route 4

Route 4 is less congested than Route 44. TTIs over 1.3 are recorded at Route 177, and from Brickyard Road to Route 10.

Route 15

The segment between Woodlawn/Wethersfield Road and Route 160/Deming Road has a TTI of more than 1.4 during the morning peak hour between 8 and 9 a.m. Other than that, this arterial operates similarly during the peak and off-peak periods.

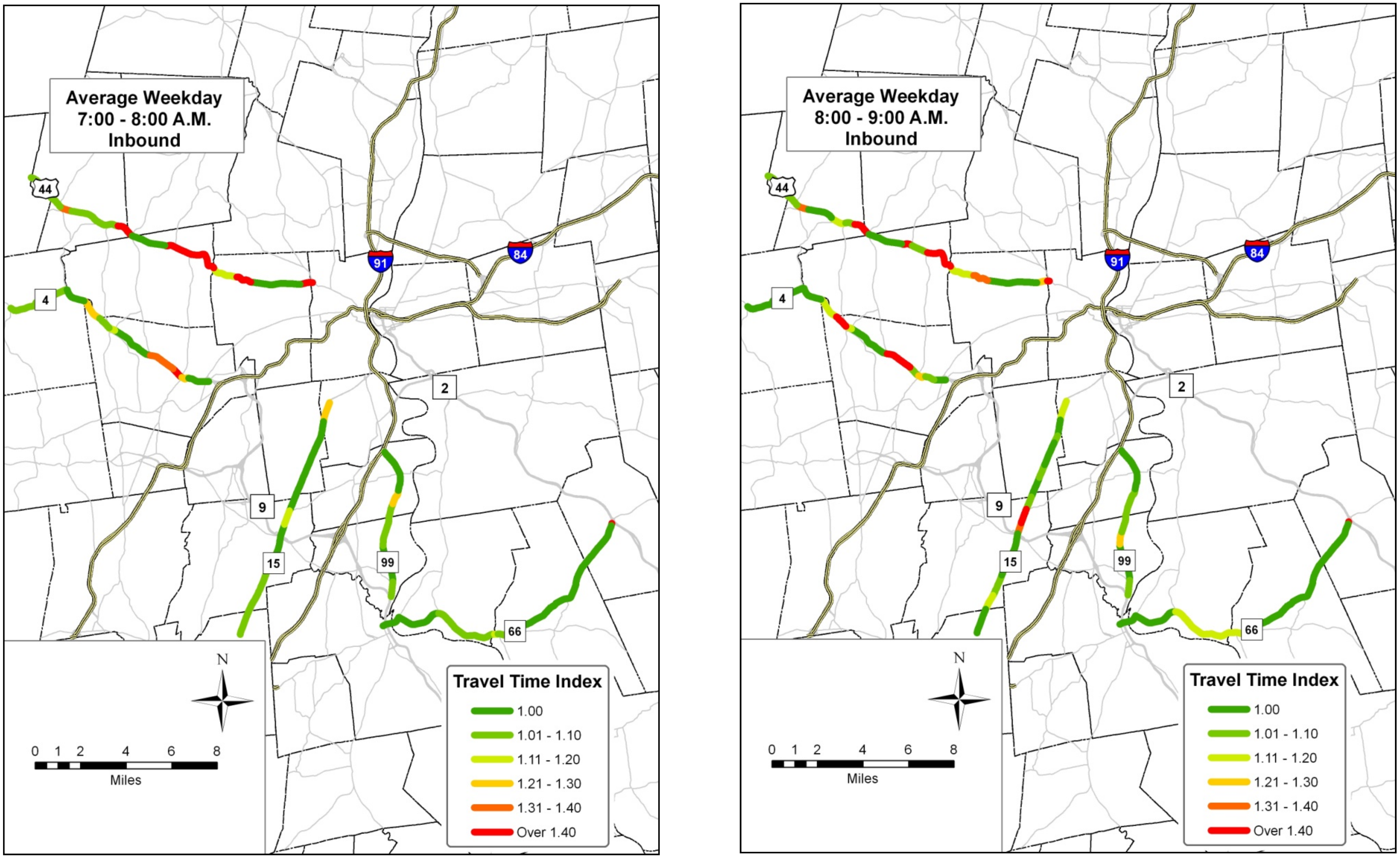
Route 66

A TTI of more than 1.4 is observed near the Route 2 interchange in Marlborough.

Route 99

The differences in travel times on most segments in peak and off-peak are not significant. The TTI are generally below 1.1 except for two segments that have a slightly higher TTI.

Figure 3.21: Travel Time Index During <u>Morning</u> Peak Hour



Afternoon Peak Period.

Figure 3.22 shows the TTI in the afternoon peak period.

Route 44

Fewer congested segments are observed in the afternoon than in the morning peak periods. Segments with highest TTI include the ones from Baily Road to Route 167 and from Secret Lake Road to Route 177, with TTI of 3.1 and 2.2 respectively during the 5-6 pm time period. Delays are also experienced near Route 10, with travel time increased by 50 percent during the peak period.

Route 4

The segment from Farmington Avenue to Mountain Spring Road experiences the most delay. TTI of this segment is over 2.7. The other segment with higher than 1.4 is the one approaching Route 167. As shown in Figure 3.20, the average speed from the Town Farm Road to the Monteith Drive is below 35 mph. However, the TTI for the same segments are mostly 1.0 or slightly higher than 1.0, which indicates no delay in traffic flow during peak hours.

Route 15

Congestion is more severe during the afternoon period than in the morning. Delays begin from the Route 5/15 off ramp and continue until past the Berlin town line. The highest TTI is about 1.5 at segments near Route 175 and Route 287.

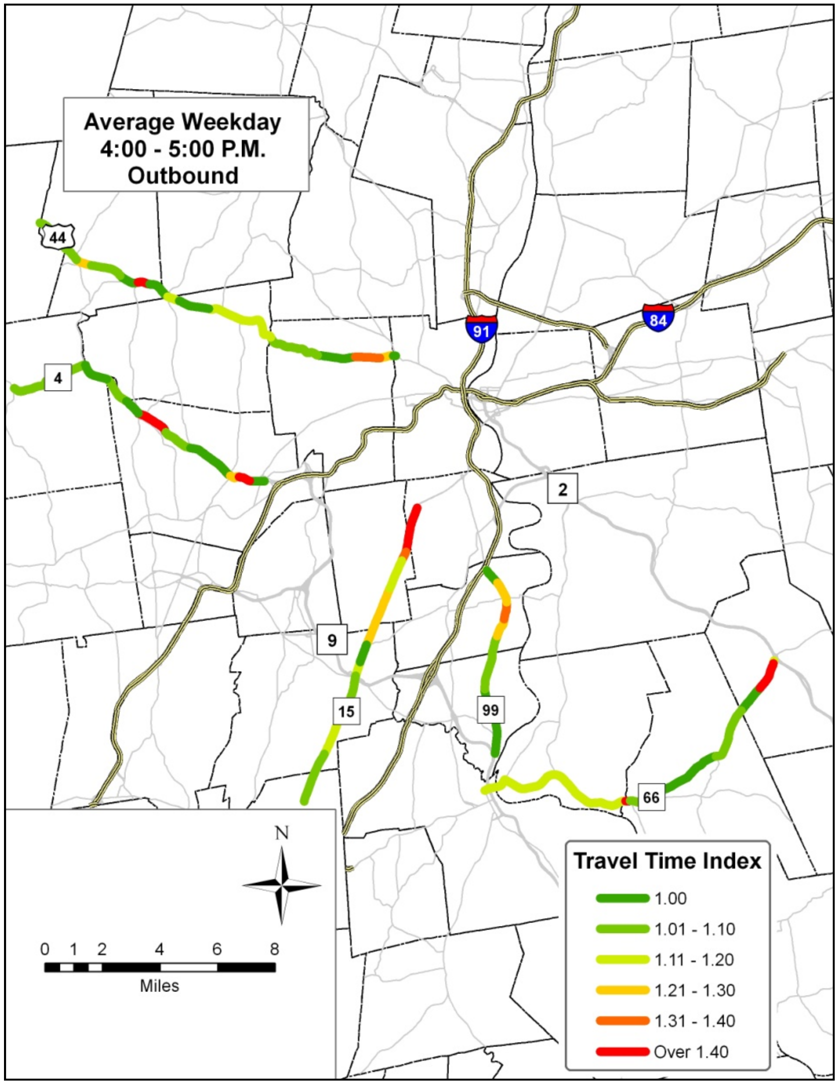
Route 66

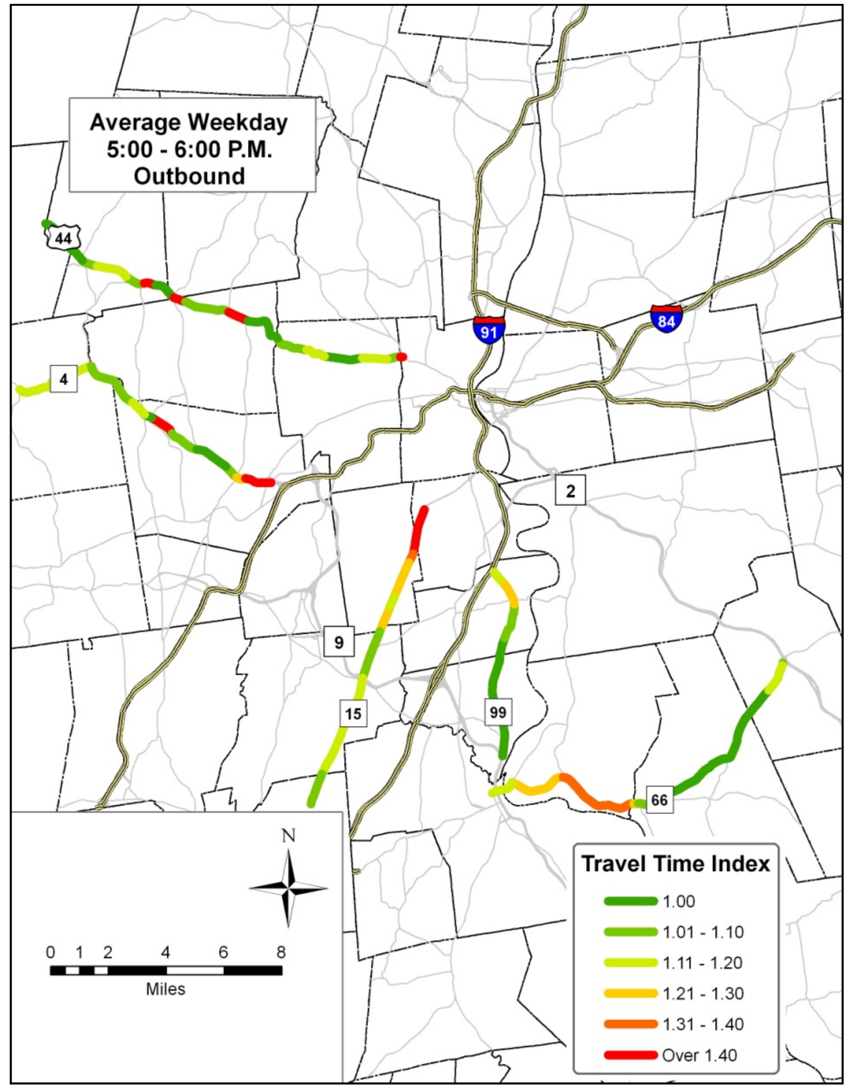
There are some delays on Route 66 in Portland with TTI higher than 1.3 for the segment from Route 17 to Route 151. TTI are mostly below 1.1 in East Hampton, indicating no differences in travel time during the peak and off-peak periods in the area. TTI of 1.2 or more are experienced near Main Street in Marlborough.

Route 99

There are few delays on Route 99 in Rocky Hill. Delays build up a little bit as traffic approaches the I-91 on ramp. Basically, the congestion on this arterial is minor.

Figure 3.22: Travel Time Index During Afternoon Peak Hour





Chapter 4 Performance Trend Analysis: 2005 - 2010

Travel time data collected in both 2005 and 2010 provide an opportunity to compare data and realize trends in travel time. CRCOG has data detailing the performance measures including Vehicle Miles Traveled (VMT), the average speed, total delay hours, and Travel Rate Index (TTI) for each corridor for both 2005 and 2010 as part of its CMP data record. With this data, trends over the 5-year time period can be realized. The changes on each freeway and arterial are discussed in the following sections.

4.1 Freeway Performance Trend

CORRIDOR-LEVEL PERFORMANCE TREND

The total daily freeway delay between 2005 - 2010 increased by 192 hours, a nine percent increase in total delay for five corridors. Individually, the corridors, except ***I-91 North,*** show increases in delay. Table 4.1 below summarizes the total daily delay for 2005 and 2010.

Table 4.1: Total Daily Delay 2005-2010

Corridor/Length		Total Daily Delay (hours)						Total Change in Delay (hours) (2005-2010)
		2005			2010			
Corridor	Miles	In	Out	Total	In	Out	Total	
I-84 West	13.6	680	503	1,183	906	534	1,440	257
I-91 North	9.7	593	118	711	398	59	457	(254)
I-84 East	11.2	178	17	195	241	58	300	105
I-91 South	11.1	46	62	108	68	85	153	45
Route 2	4.3	27	1	28	52	15	67	39
All Corridors	49.9	1,524	701	2,225	1,666	751	2,417	192

Between 2005-2010 period, ***I-84 West*** and ***I-91 North*** remained the most congested corridors, which together account for about 80 percent of all congestion recorded. Even though the most congested freeways remained the same as in 2005, the congestion level in ***I-84 West*** had a significant increase while the congestion in ***I-91 North*** has decreased significantly. This decrease can possibly be attributed to the loss of employment in Hartford area due to recession and relocation of some employers from downtown Hartford to suburban towns.

I-84 West remained the most congested corridor with 1,440 hours of delay per day compared to 1,183 hours in 2005. This is a 22 percent increase in congestion since 2005. As shown in Table 4.2, the most noticeable change is observed along the inbound traffic during the morning peak hours (75 increased to 191 hours).

Table 4.2: Total Peak Hour Delay Comparison 2005-2010

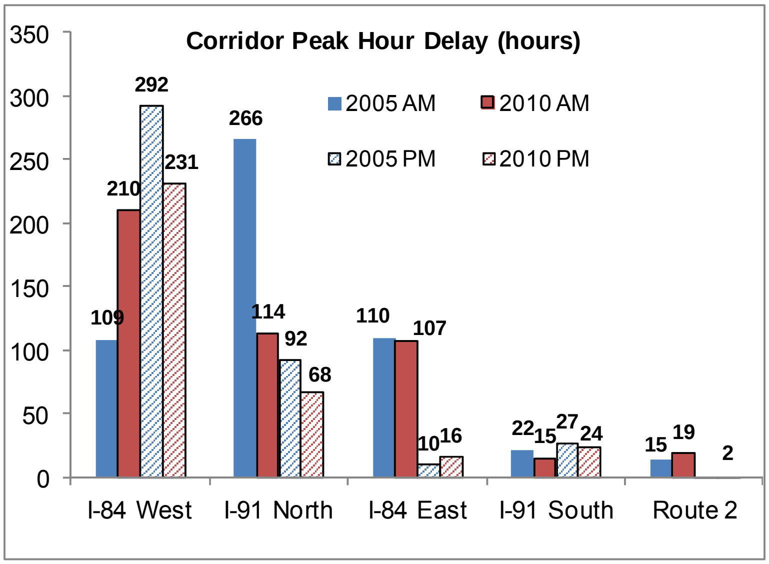
		2005						2010					
		AM peak hour			PM peak hour			AM peak hour			PM peak hour		
Corridor	Miles	In	Out	Total	In	Out	Total	In	Out	Total	In	Out	Total
I-84 West	13.6	75	34	109	199	93	292	19'	19	210	118	113	231
I-91 North	9.7	262	4	266	44	48	92	109	4	114	50	18	68
I-84 East	11.2	110	0	110	5	5	10	105	1	107	5	11	16
I-91 South	11.1	22	0	22	1	26	27	15	0	15	4	19	24
Route 2	4.3	15	0	15	0	0	0	19	0	19	1	1	2
All Corridors	49.9	483	38	521	249	172	421	440	24	465	178	162	341

The total delay in the AM peak hour (210 hours) is slightly lower than that in the PM peak hour (231 hours). During the AM peak, the inbound delay has significantly increased from 75 hours to 191 hours, indicating a worsening of travel conditions in the inbound direction. The PM peak, however, experienced improving traffic conditions from 2005 to 2010, mainly in the inbound direction (199 hours vs. 118 hours).

Although ***I-91 North*** is still the second most congested corridor with 457 hours of daily delay (Table 4.1), I-91 North improved significantly between 2005 and 2010. This improvement took place primarily, as shown in the Table 4.2, in the AM peak inbound direction (262 hours down to 109 hours of delay) and somewhat in the PM peak outbound direction (48 hours down to 18 hours of delay).

There are no significant changes of travel conditions in other routes being monitored. The average speed in the peak period hasn't changed noticeably. Figure 4.1 shows peak hour delays for both AM and PM in 2005 and 2010 for each corridor.

Figure 4.1: Peak Hour Delays



SEGMENT-LEVEL PERFORMANCE TREND

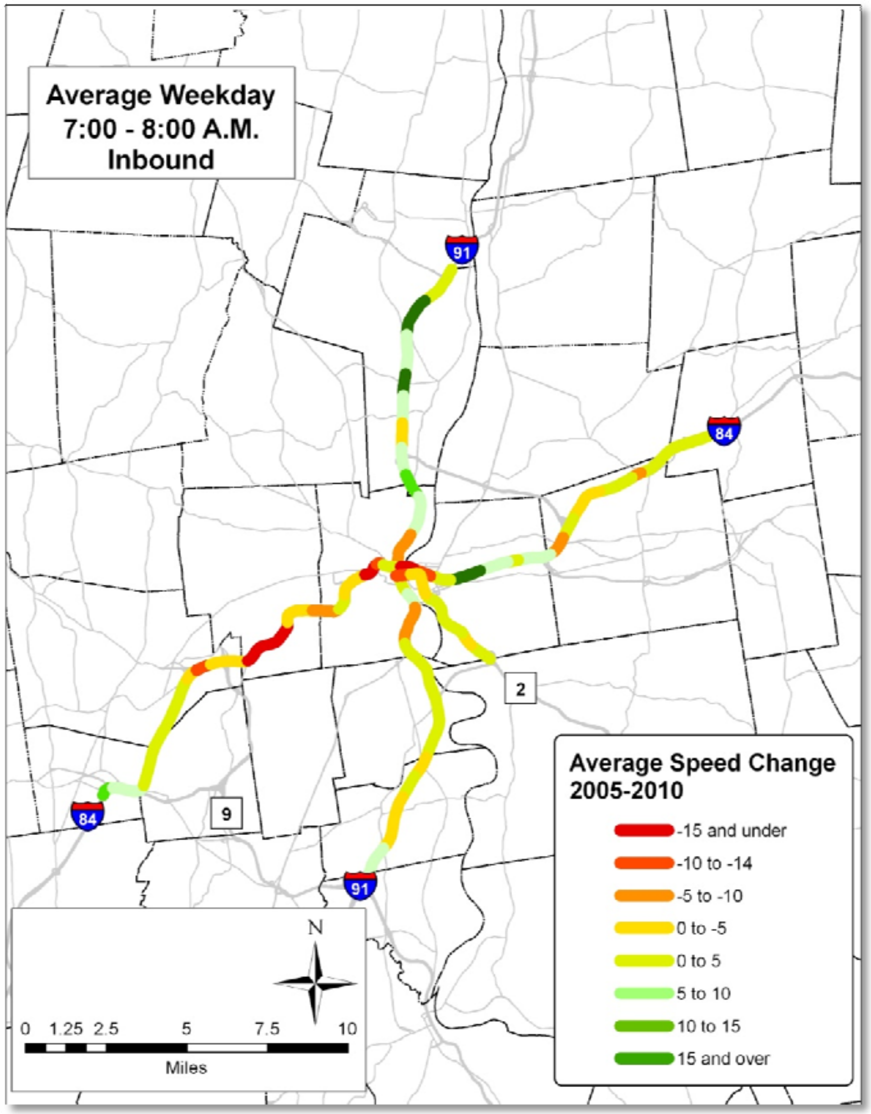
In addition to documenting the overall freeway performance trend, the performance changes for each corridor were also analyzed by segment. Figures 4.3 and 4.4 on pages 34 and 35 show the change in travel speed between 2005 and 2010 for the AM and PM peak periods respectively.

Several segments of inbound traffic on the ***I-84 West*** corridor showed significant decreases in travel speed in the AM peak period. Two segments along the corridor experienced a drop in speed of more than 15 mph and three segments experienced a drop in speed between 10 and 15 mph. There are choke points at several locations in the corridor.

As mentioned earlier, the second most congested corridor, ***I-91 North*** experienced significant improvement in travel speed and delays between 2005 and 2010, with the most significant improvement being evidenced in the AM peak inbound direction.

Increases in travel speed were identified in most corridors as they approached the I-91 and I-84 interchange.

Figure 4.2: Change in AM peak travel speed 2005-2010



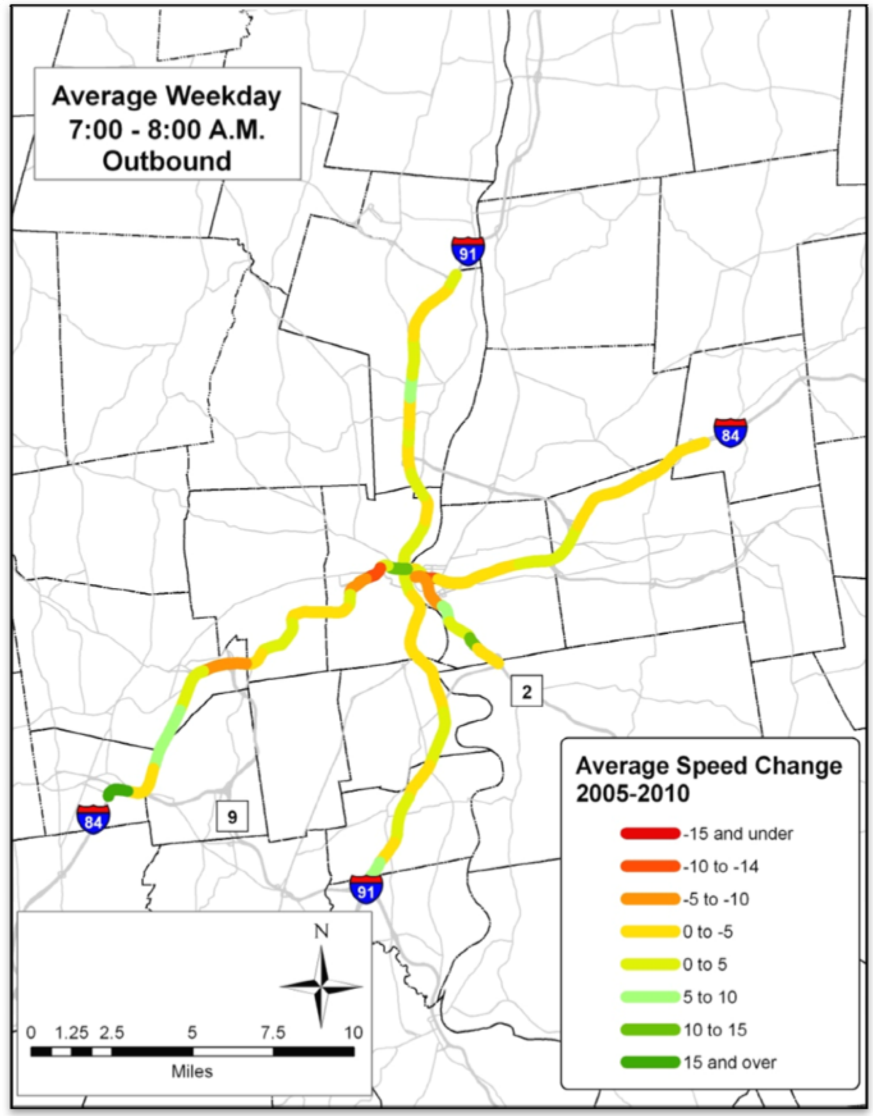
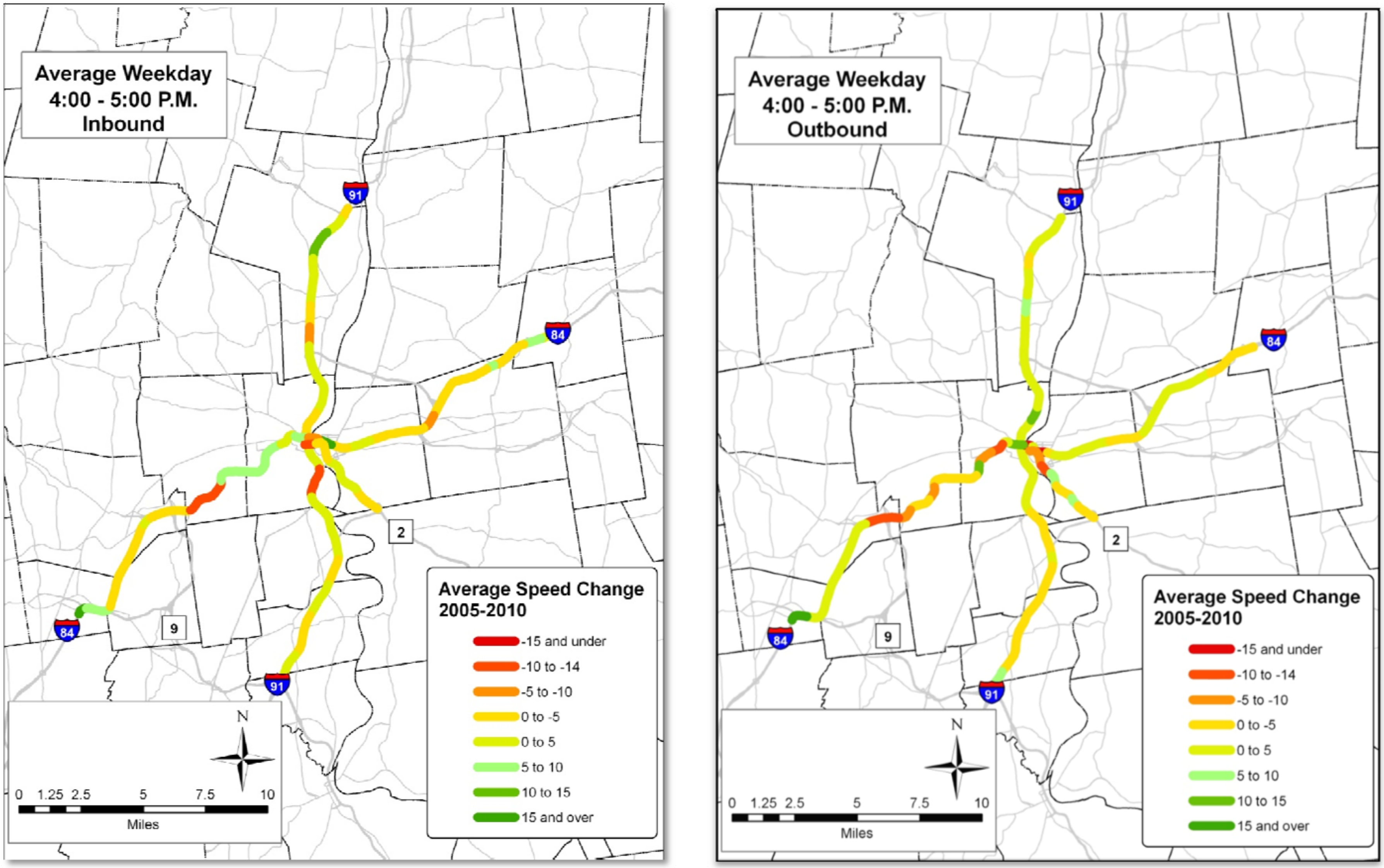


Figure 4.3: Change in PM peak travel speed 2005-2010



4.2 Arterial Performance Trend

CORRIDOR-LEVEL PERFORMANCE TREND

This section provides a snapshot of change in the traffic pattern over the last five years[9].

Figure 4.4: Peak Hour Speed

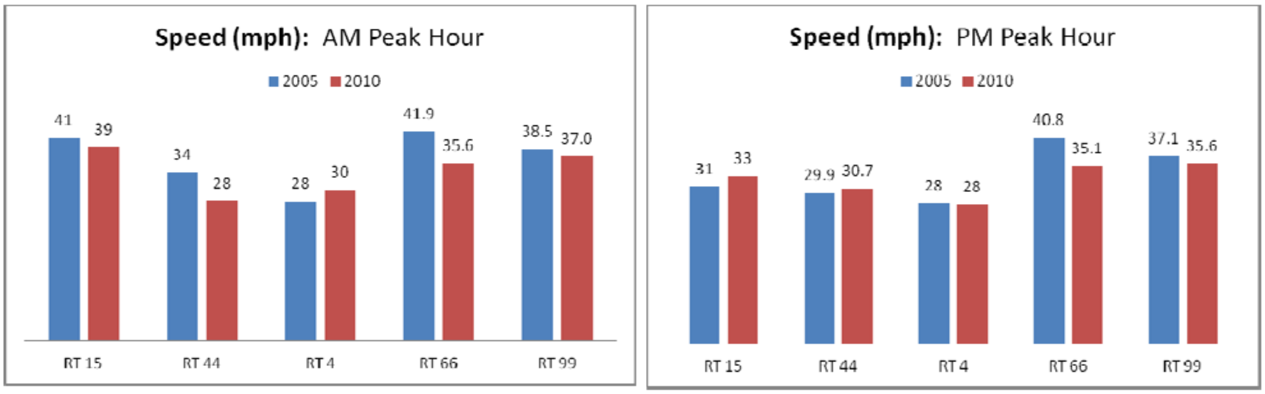


Figure 4.5: Peak Hour Delay

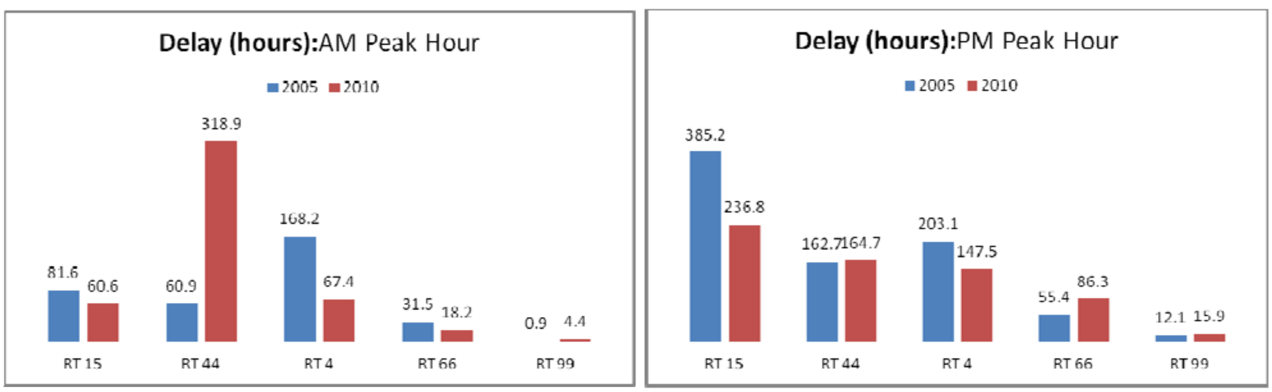
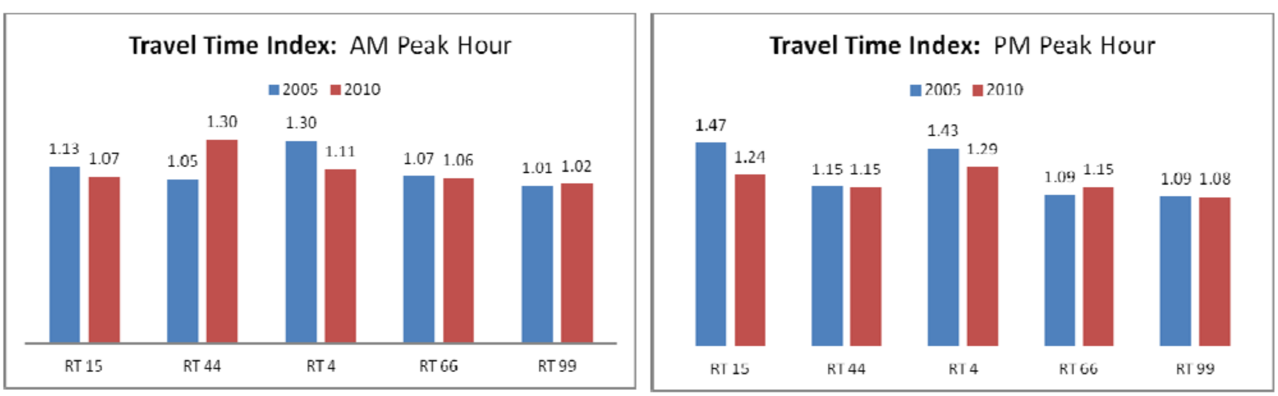


Figure 4.6: Peak Hour Travel Time Index



[9] Data for Routes 66 and 99 are from 2008.

Route 15 is more congested in the afternoon peak period for both 2005 and 2010 due to the retail activities along the route. During the five-year period, the delays decreased from 82 to 61 hours in the morning and from 385 to 237 hours in the afternoon, resulting in a 57% drop in the total delay during the peak periods. While a slight decrease of the TTI from 1.13 to 1.07 is noted in the morning peak period, the travel speed is down from 41 to 39 mph. This can be attributed to the increased VMT from 2005 to 2010. With more vehicles and miles traveled on the route, speed becomes slower in both peak and off-peak periods, but the ratio of the speeds between the two periods can rise. In the afternoon, the travel speed increased from 31 to 33 mph, and the TTI decreased from 1.47 to 1.24. Thus, it is safe to conclude that the traffic condition of Route 15 has improved since 2005, especially in the afternoon peak period.

Route 44 experienced increasing delays during the morning peak period, from 61 to 319 hours between 2005 and 2010. The average speed is 28 mph in 2010, a decrease of 6 mph from 2005. In the afternoon, only slight changes are found in terms of delay, speed and TTI between 2005 and 2010. Overall, the peak-period speed has decreased by about 3 mph, and the TTI is increased from 1.1 to 1.23. As explained in the previous chapter, the more congested conditions on Route 44 in 2010 are largely due to the construction aimed to improve roadway safety in the Avon Mountain area. Further monitoring of this route upon the completion of the roadway safety improvement work will provide a better picture of the travel time assessment and congestion.

Route 4 experienced a 42% decrease in total peak hour delay between 2005 and 2010. The delay hours dropped from168 to 67 hours in the morning peak, and from 203 to 148 hours in the afternoon peak. The most noticeable change is observed in the 7-8 am period (134 to 37 hours), which is accompanied by an increase in the travel speed from 24 to 31 mph. Travel speed in the afternoon peak remains more or less the same at about 28 mph from 2005 to 2010. With regard to the TTI, the travel time in the peak periods is 50% more than that in the off-peak periods in 2005 compared to 20% in 2010. This improvement in traffic conditions has mainly been a result of roadway improvements made on Route 4 near the Route 10 intersection during the last five years.

Route 66 saw little change in TTI in the morning peak period in between 2005 to 2008 period, but the average speed is down by 6 mph from 42 to 36 mph. A similar trend is observed in the afternoon with speeds down from 41 to 35 mph. The delay on Route 66 is much less than that on Route 15 and Route 4. In 2008, the total delay for the peak period was 105 hours, a 20% increase from 2005. The average TTI rises from 1.08 to 1.10, indicating that the peak-period travel times are not much higher than the off-peak in both 2005 and 2008. Generally, travel conditions on Route 66 were slightly worse in 2008 than in 2005, with a reduction of speed and an increase of total delay.

There are no significant changes in overall travel conditions on ***Route 99*** from 2005 to 2008. The average speed in the peak period is down from 38 to 36 mph and TTI rose from 1.05 to 1.06. Although the total delay increased by 7 hours from 13 to 20 hours since 2005, it is the lowest among the five arterial routes that are monitored.

Table 4.3 below summarizes the overall arterial performance trends between 2005 and 2010.

Table 4.3: Overall Arterial Performance Trends: 2005-2010

Average Speed (mph)

	AM				PM				Both			
	2005	2010	Difference	%	2005	2010	Difference	%	2005	2010	Difference	%
RT 15	40.7	38.8	-1.9	-5%	31.0	33.2	2.2	7%	35.9	36.0	0.1	0%
RT 44	33.8	28.1	-5.7	-17%	29.9	30.7	0.8	3%	31.8	29.4	-2.5	-8%
RT 4	27.9	30.3	2.3	8%	27.8	27.6	-0.2	-1%	27.9	28.9	1.1	4%
RT 66	41.9	35.6	-6.4	-15%	40.8	35.1	-5.7	-14%	41.4	35.3	-6.0	-15%
RT 99	38.5	37.0	-1.5	-4%	37.1	35.6	-1.5	-4%	37.8	36.3	-1.5	-4%

Delay (hours)

	AM				PM				Both			
	2005	2010	Difference	%	2005	2010	Difference	%	2005	2010	Difference	%
RT 15	81.6	60.6	-21.0	-26%	385.2	236.8	-148.4	-39%	466.8	297.5	-169.3	-36%
RT 44	60.9	318.9	258.1	424%	162.7	164.7	2.0	1%	223.6	483.6	260.0	116%
RT 4	168.2	67.4	-100.8	-60%	203.1	147.5	-55.6	-27%	371.3	214.9	-156.4	-42%
RT 66	31.5	18.2	-13.3	-42%	55.4	86.3	30.9	56%	86.9	104.5	17.6	20%
RT 99	0.9	4.4	3.6	407%	12.1	15.9	3.8	31%	13.0	20.3	7.3	57%

Travel Time Index

	AM				PM				Both			
	2005	2010	Difference	%	2005	2010	Difference	%	2005	2010	Difference	%
RT 15	1.1	1.1	-0.1	-6%	1.5	1.2	-0.2	-16%	1.3	1.2	-0.2	-12%
RT 44	1.1	1.3	0.3	24%	1.2	1.2	0.0	0%	1.1	1.2	0.1	12%
RT 4	1.3	1.1	-0.2	-15%	1.4	1.3	-0.1	-10%	1.4	1.2	-0.2	-12%
RT 66	1.1	1.1	0.0	-1%	1.1	1.2	0.1	5%	1.1	1.1	0.0	2%
RT 99	1.0	1.0	0.0	1%	1.1	1.1	0.0	0%	1.1	1.1	0.0	1%

SEGMENT-LEVEL PERFORMANCE TREND

In addition to examining the overall performance trend for each arterial route at the corridor level, we also examined the performance changes for each segment of the arterials. Figure 4.8 shows the change in speed between 2005-2010 for both the morning and afternoon peak periods. Based on these maps, segments with considerable changes during the five-year period can be identified. Generally, more segments are observed with speed decreases rather than increases. The worst speed reduction is noted in the AM peak period on Route 44 and Route 66, where three segments have speeds that dropped by more than 15 mph. In the afternoon peak period, there are more segments with speed decreases than in the morning, but the changes are all less than 15 mph. A detailed analysis at the segment level follows:

AM Peak

There are two segments on ***Route 44*** with speed reductions of more than 15 mph, during the AM peak hours. As shown in the Figure 4.8, Route 44 at Route 167 and again at Route 10 are the two most degraded areas since 2005. These are also segments with low speeds and high TTIs. The ongoing safety improvement work in the area has resulted in this speed reduction. Most of the other segments have experienced moderate speed decreases.

Some segments along ***Route 15*** experienced speeds that dropped by more than 5 mph. Between the Route 9 overpass and Route 160, speeds dropped by 7 mph, and between Route 175 and the Route 15 on ramp, speeds dropped by 6 mph. Travel speeds increased by 6 mph after passing Route 176 and then dropped again approaching Route 175. Most of the speed changes on Route 15 are within the 5 mph range.

On **Route 66**, speeds dropped significantly between the retail districts of Marlborough and East Hampton. Other routes in the region experienced mostly minor decreases in travel speed during the AM peak hour.

PM Peak

Route 44 performed much better during the PM peak when average travel speed dropped by lesser amounts. Segments experiencing a decrease in speed on Route 44 are, as in the AM peak, the segment approaching Route 167 and the segment approaching Route 10. Other than these two segments, speed decreases are all less than 5 mph. In addition, notable increases in the speeds have been observed in many areas along Route 44, including the ones between Route 202 and Route 10, and in the vicinity of Route 173.

Two segments on ***Route 4***, one near Route 167 and the other near Route 169, have travel speeds reduced by 9 mph and 7 mph respectively. For the other segments of Route 4, travel speeds have not changed very much between 2005 and 2010.

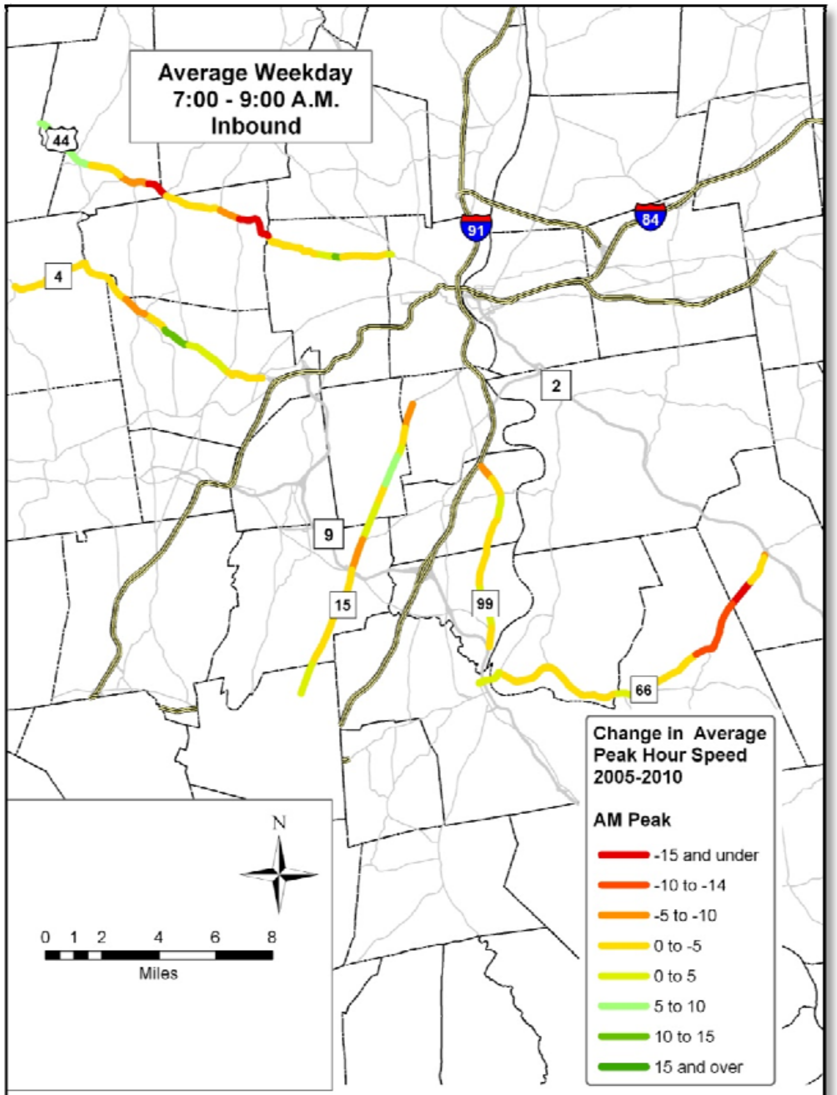
Compared to the morning peak period, ***Route 15*** experienced more segments with speeds decreasing from 5 to 15 mph. These segments include the ones between Route 15 and Route 175, and in the vicinity of the Berlin town line, where speeds decreased by 8 to 10 mph. Segments south of Route 9 experienced a drop in average speed between 1 and 7 mph.

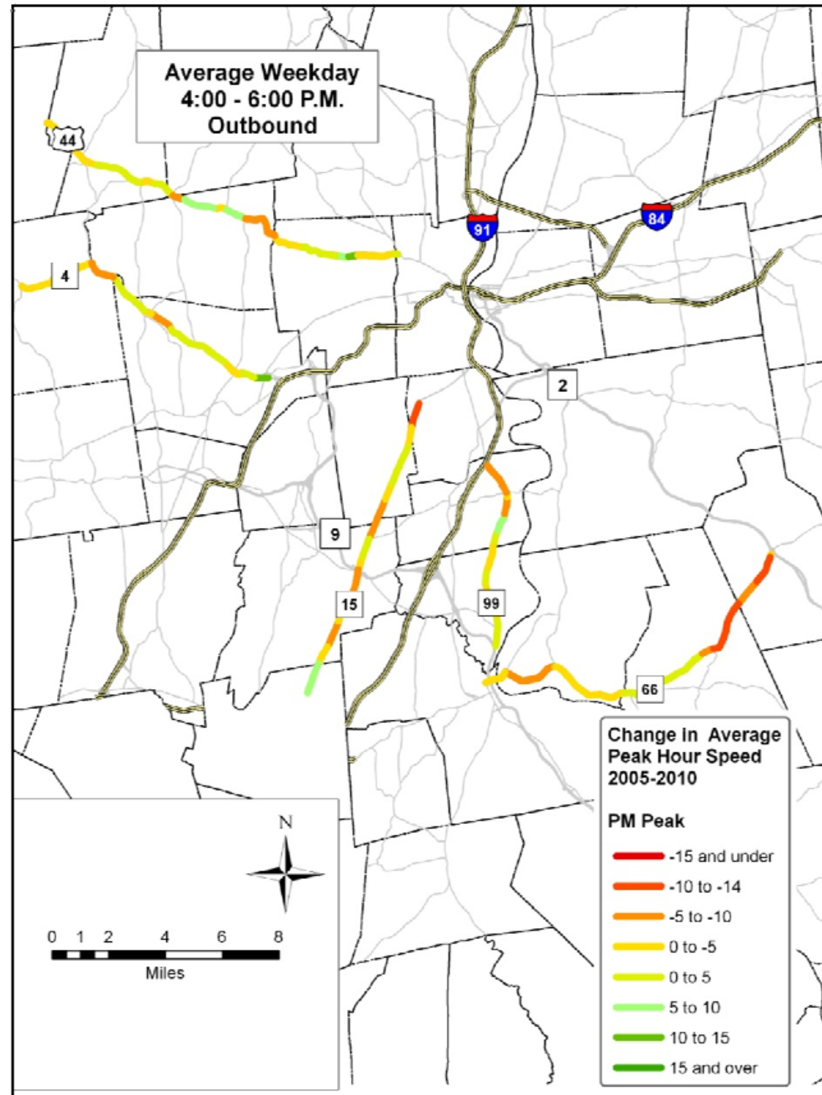
There was no significant change between 2005 and 2008 along ***Route 99*** except for one segment, from the I-91 interchange to just past West Street, where the travel speed was down by 4 to 6 mph.

Route 66 showed some areas of significant change during the PM peak travel speed between 2005 and 2008. Travel speeds along the segment from the retail area in East Hampton to Main Street in Marlborough decreased by nearly 15 mph. Other segments along the corridor saw some reductions in the travel speed mainly from Main Street in Middletown through Portland.

Figure 4.7: Change in Peak Hour Travel Speed

2005-2010





Chapter 5 Congestion Mitigation Strategies

CRCOG has taken a balanced approach to congestion mitigation, utilizing an array of strategies throughout the region. Traditionally, roadway reconfiguration and capacity projects have been the focus of congestion mitigation efforts, however CRCOG has also advanced transit, bridge monitoring and rehabilitation, safety, land use, and bicycle/pedestrian initiatives as part of the solution. This chapter discusses our efforts in each of these categories.

5.1 Roadway Safety and Congestion Management Projects along CMP Corridors

The Capitol Region Transportation Improvement Plan (TIP) has several roadway improvement projects along the monitored CMP corridors. Some of these projects are in the initial planning stage while others are in design and construction. All of these projects ultimately help mitigate congestion, although some have a primary focus on safety. Table 5.1 gives a summary of the roadway safety and congestion management projects that are planned in the 2012-2015 TIP.

Table 5.1 TIP Projects along CMS Corridors

CMP Corridor	Project Name	Mitigation Strategy	Phase
I-84	Viaduct Replacement Study	Bridge Monitoring/ Replacement	Study
I-84	Hartford Viaduct Value Pricing Study	Mobility / ITS	Study
I-84	I-84 Rehabilitate Various Structures in Hartford Viaduct	Bridge Rehabilitation	Design & ROW
I-84	Pavement Preservation in Manchester & East Hartford	Mobility	Construction
I-91	Bridge Rehabilitation – I-91 NB and CT SR 508 over the Park River	Bridge Rehabilitation	Design & Construction
I-91	Pavement Preservation in Hartford	Mobility	Construction
RT 2	Resurfacing and Median Replacement	Mobility	Design
RT 3	Putnam Bridge Rehabilitation	Bridge Rehabilitation	Construction
RT 4	Pavement Preservation in Farmington	Mobility	Construction
RT 44	Safety Improvements, Homestead Ave to Garden St	Safety	Construction
Other	CT***fastrak***	Transit	Construction
Other	New Haven-Hartford-Springfield Rail	Transit	Construction
Other	New Haven-Hartford-Springfield Rail Alternatives Analysis	Transit	Study
Other	Greater Hartford Transit Enhancement Study	Transit	Study
Other	ITS Strategic Plan & Architecture	Mobility / ITS	Study
Various	CTTransit Replace Buses; Purchase Electric/Clean Fuel Buses & Charging Stations	Transit	Acquisition

5. 2 Transit System

TRANSIT PERFORMANCE

Having a robust transit system is a key strategy in mitigating roadway congestion. A good transit system can be instrumental in reducing the number of vehicles on the road network by providing an alternate mode of transportation, thus relieving congestion during peak traffic hours. Connecticut Transit (CTTransit) operates transit services in the Metropolitan Hartford area with a total of 43 bus routes including 12 express commuter routes. About 4,500 daily commuters currently utilize transit to and from Hartford's downtown core. Figure 5.1 displays the number of peak hour transit commuters by general cardinal direction.

Data obtained from CTTransit shows that the majority of its routes have ridership above 50% during both AM and PM peak hours (spring 2010 data), and in some instances ridership exceeds the available seating capacity. Figures 5.2 and 5.3 show the bus routes in the Capitol Region with load factors during the AM and PM peak weekday hours, respectively. Load factor is a measurement of ridership and is calculated by dividing the number of passengers by the number of available seats during the peak periods.

Some of the highest load factors are experienced on routes that generally run parallel to I-84 West, the Region's most congested corridor. These routes include the following:

- #31-33 Park Street – local service between Downtown Hartford and Westfarms Mall/Corbins Corner via Parkville and West Hartford

- #37-39 New Britain Avenue – local service between Downtown Hartford and Westfarms Mall via Trinity College, Flatbush Ave, and Elmwood.

- #60-66 Farmington Avenue – local service between Downtown Hartford and West Hartford Center/Tunxis Community College via Asylum Hill, UConn Health Center, and Unionville.

CT***fastrak***, a bus rapid transit system currently under construction, will offer an additional option for transit users in this corridor. Other bus routes with notably high load factors (0.80+) include:

- #47 Franklin Avenue – local service between Hartford and Wethersfield, Newington, and Rocky Hill via Hartford's Southend
- #50-54 Blue Hills Avenue – local service between Hartford and Cottage Grove Road (RT 218) in Bloomfield, the Wintonbury Mall, and Day Hill Road in Windsor via Albany Avenue and Blue Hills Avenue.
- #82-84 Tolland Turnpike – local service between Hartford and Buckland Hills Mall, Depot Square in Vernon, and Vernon Center
- #83-85 Silver Lane – local service between Hartford and Main Street in East Hartford, Manchester Community College, Main Street in Manchester, and Buckland Hills Mall
- #86-88 Burnside Avenue – local service between Hartford and East Catholic High School, Manchester Memorial Hospital, Manchester Center, and the Department of Social Services in Manchester.
- #106/6 Cromwell – express service between Hartford and the Cromwell Park & Ride and the Cromwell Hills Apartments.

Table 5.2 shows the number of trips, capacity, and the load factor during morning and afternoon peak weekday hours for each of the local and express bus routes operated by CTTransit.

CRCOG is preparing to initiate a Comprehensive Transit Service Analysis that will study current travel patterns and service, understand Regional needs taking into account new transit initiatives such as CT***fastrak*** and the New Haven-Hartford-Springfield Rail, and make recommendations on modifications that will better serve transit users. Service improvements may attract new users, relieving congestion in the Region.

Figure 5.1 Number of Transit Commuters To/From Hartford's Downtown (CTTransit, 2010)

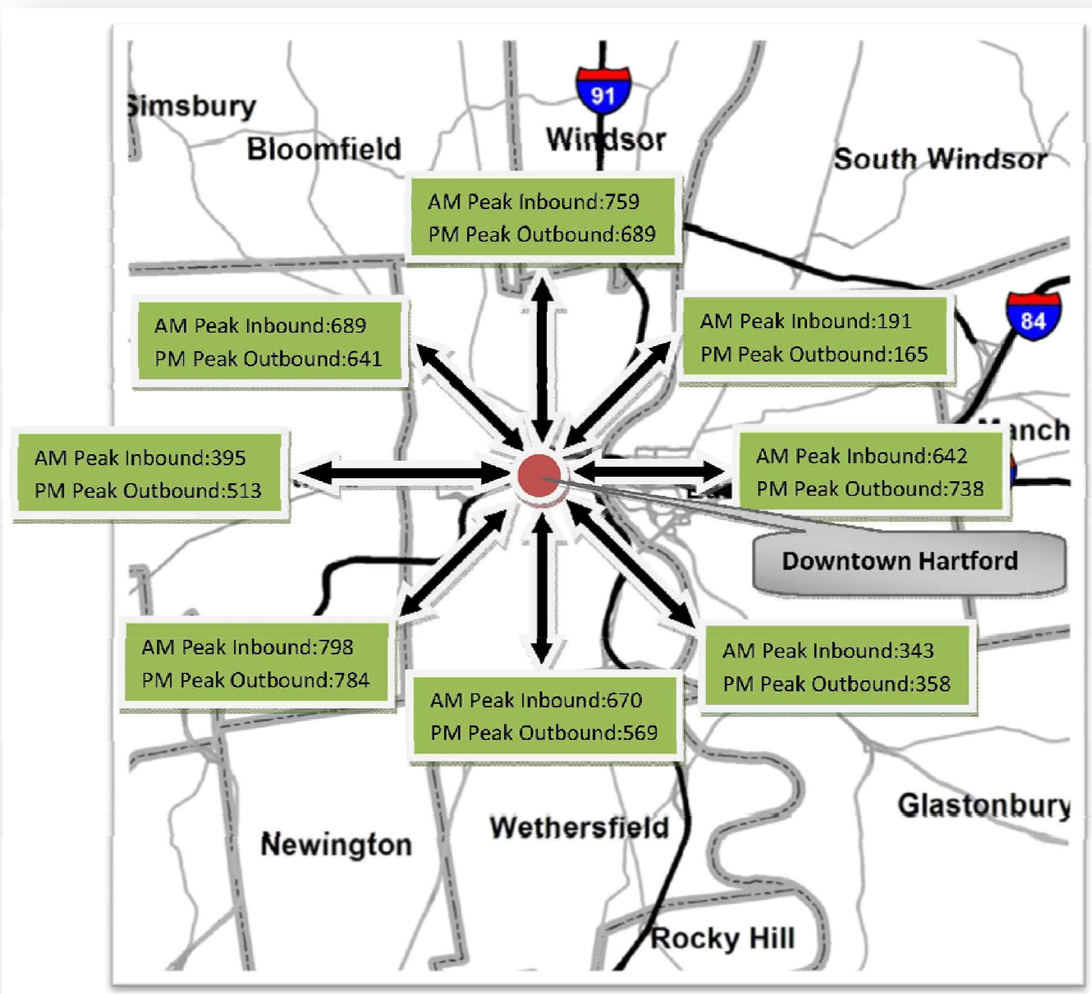


Figure 5.2: Transit Routes and Morning Peak Load Factor

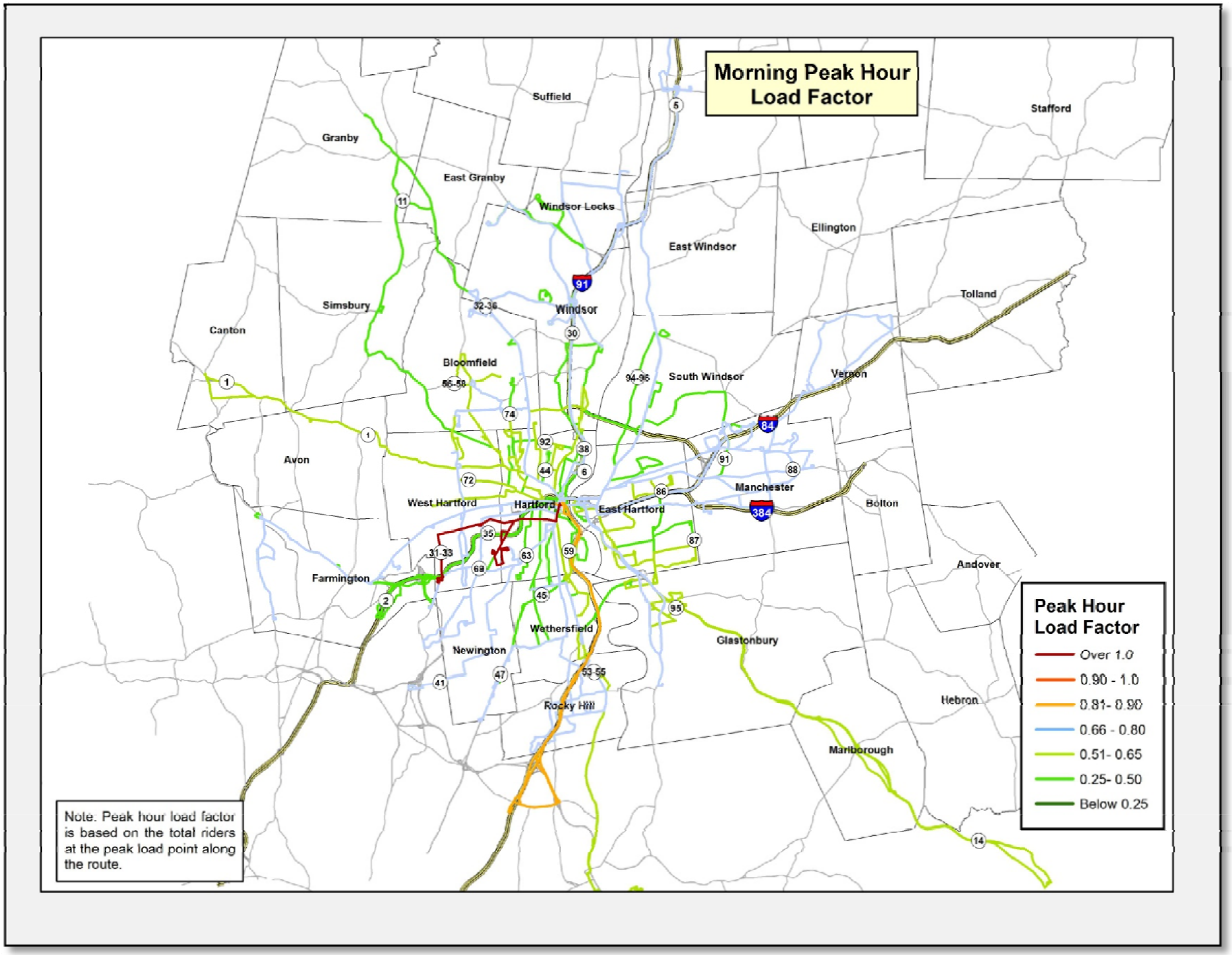


Figure 5.3: Transit Routes and <u>Afternoon</u> Peak Load Factor

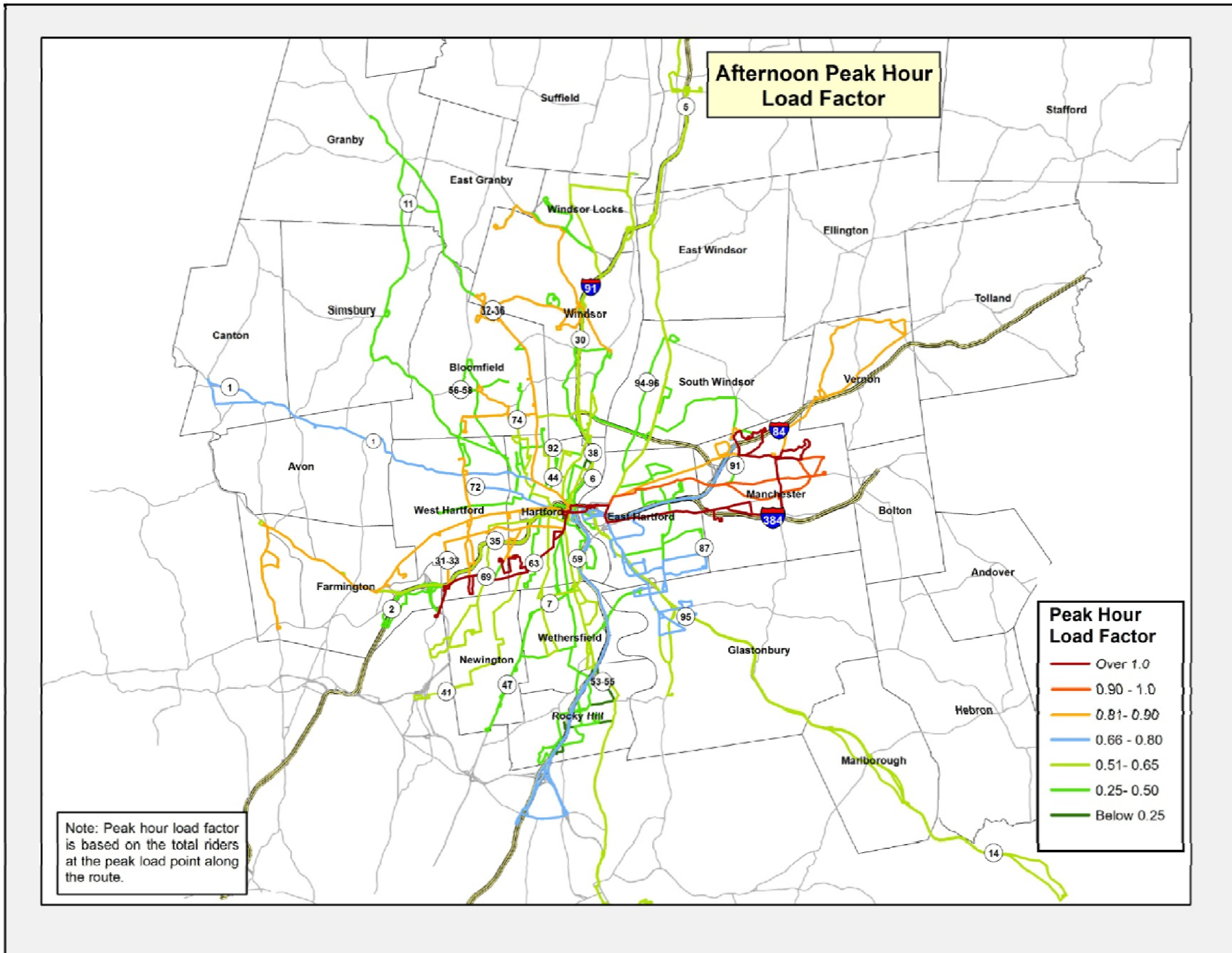


Table 5.2: Peak Hour Ridership and Load Factor*

CT TRANSIT

PEAK HOUR LOAD FACTOR ANALYSIS
HARTFORD DIVISION - SPRING 2010

	LOCAL ROUTES		AM PEAK				PM PEAK			
			TRIPS	SEATS	PASSENGERS	LOAD FACTOR	TRIPS	SEATS	PASSENGERS	LOAD FACTOR
	30	BRADLEY FLYER	2	76	29	.39	2	76	24	.32
X	31-33	PARK ST	7	266	330	1.24	9	342	287	.84
X	32-34-36	WINDSOR	7	266	114	.43	6	228	113	.50
X	37-39	NEW BRITAIN AV	7	266	207	.78	5	190	198	1.04
	38	WESTON ST	3	114	30	.27	4	152	12	.08
X	41	NEW BRITAIN	3	114	79	.70	3	114	74	.65
X	42	NORTH MAIN ST	7	266	155	.59	7	266	141	.53
	43	CAMPFIELD AV	4	152	72	.48	5	190	72	.38
X	44	GARDEN ST	3	114	45	.40	3	114	39	.35
X	46	VINE ST	7	266	135	.51	8	304	108	.36
	47	FRANKLIN AV	7	266	211	.80	8	304	144	.48
X	50-54	BLUE HILLS AV	7	266	210	.79	8	304	252	.83
	53-55	WETHERSFIELD-MIDDLETOWN	6	228	115	.51	6	228	128	.56
X	56-58	ALBANY AV	5	190	106	.56	5	190	90	.48
	59	LOCUST ST	3	114	49	.43	3	114	58	.50
	60-66	FARMINGTON AV	8	304	219	.72	11	418	335	.81
	61	BROAD ST	4	152	72	.48	4	152	89	.59
	63	HILLSIDE AV	4	152	68	.45	5	190	79	.42
	69	CAPITOL AV	3	114	82	.72	3	114	66	.58
	72	ASYLUM AV	4	152	79	.52	5	190	64	.34
X	74	GRANBY ST	3	114	48	.43	3	114	57	.50
X	76	ASHLEY ST	5	190	115	.61	4	152	92	.61
	82-84	TOLLAND TPK	4	152	117	.77	4	152	130	.86
	83-85	SILVER LA	4	152	106	.70	4	152	183	1.21
	86	BURNSIDE AV/RONDY LA	3	114	89	.81	3	114	51	.45
	87	BREWER ST	3	114	34	.30	3	114	40	.35
	88	BURNSIDE AV/MANCHESTER	5	190	145	.77	5	190	174	.92
	91	FORBES ST	2	76	32	.43	2	76	35	.48
X	92	TOWER AV	2	76	21	.28	2	76	34	.45
	94-96	SOUTH WINDSOR/PARK AV	4	152	74	.49	2	76	35	.48
	95	GLASTONBURY	3	114	70	.62	4	152	99	.66
	H-CR	DOWNTOWN CIRCULATOR	5	125	23	.19	5	125	14	.12
	TOTAL		144	5407	3261	.61	149	5673	3311	.62

Minority routes are indicated by an "X".

EXPRESS ROUTES		AM PEAK				PM PEAK			
		TRIPS	SEATS	PASSENGERS	LOAD FACTOR	TRIPS	SEATS	PASSENGERS	LOAD FACTOR
101	AVON/CANTON	3	106	54	.51	3	106	71	.67
102	CORBINS CORNER	4	120	42	.35	4	128	59	.46
103	BURR CRN/BUCKLAND	8	295	205	.70	8	278	200	.72
104	GLASTONBURY	4	128	84	.66	4	136	76	.56
105	ENFIELD/WINDSOR LOCKS	10	378	251	.67	12	427	252	.59
106	CROMWELL	4	128	106	.83	5	158	114	.73
107	NEWINGTON	3	98	34	.35	3	114	35	.31
109	UNIONVILLE	2	90	40	.45	2	68	41	.61
110	CENTURY HILLS	3	121	83	.69	3	121	22	.19
111	SIMSBURY/GRANBY	5	193	96	.50	4	128	64	.50
114	COLCHESTER/MARLB.	5	239	155	.65	5	258	143	.56
115	BLOOMFIELD	2	78	35	.45	2	76	22	.29
COMMUTER TOTAL		53	1,974	1,185	.60	55	2,000	1,099	.55
LOCAL TOTAL		143	5,407	3,261	.61	149	5,369	3,311	.62
SYSTEM TOTAL		200	7,381	4,446	.61	204	7,369	4,410	.60

*Data Source: CTTransit

TRANSIT INITIATIVES

CT***fastrak***

Connecticut's first bus rapid transit system, known as CT***fastrak***, is being constructed to relieve congestion on the segment of I-84 in the western part of Hartford, the most congested corridor in the region. The dedicated transit roadway will offer a congestion-free option to commuters traveling between Hartford and New Britain with convenient stops along the way. The benefits of CT***fastrak*** will also extend to outlying communities, with 68 routes that will feed through or connect with the dedicated CT***fastrak*** line. There are eleven stations located in New Britain, Newington, West Hartford, and Hartford and additional service is planned to provide a one-seat ride to passengers traveling to and from Westfarms Mall, UConn Health Center in Farmington, Central Connecticut State University, Bishop's Corner/West Hartford Center, St. Francis Care Hospital and Medical Center, Newington Veteran's Hospital, and Newington Market Square. Peak service will operate every three minutes along the dedicated route. A five-mile multi-use trail for pedestrians and cyclists will also be constructed in the vicinity of the busway, south of the Newington Junction station. Construction began in May 2012 and is scheduled to initiate operations early 2015.

New Haven-Hartford-Springfield (NHHS) Rail Service

The Connecticut Department of Transportation is also working on providing new commuter passenger rail service along the existing New Haven-Hartford-Springfield rail corridor. The system will strengthen the connection between communities, generate economic growth, help build energy independence, and provide links to travel corridors and markets beyond the Capitol Region. NHHS rail service is scheduled to commence in 2016 with service expansions planned through 2030. In 2016 we will realize up to 17 round trip trains with 45-minute frequencies in the peak hour (hourly off-peak) with bi-directional service south of Hartford. A shuttle connector from the Windsor Locks station will provide direct service to Bradley International Airport. The longer term vision is for 25 round trip trains and additional connections to Boston and Montreal.

TRANSIT ENHANCEMENT STUDIES

CRCOG received funding through a U.S. Department of Housing and Urban Development (HUD) Sustainable Communities Regional Planning Grant for three transit enhancement bus studies in the region. These studies focused on improving connections to job centers and new transit investments that increase economic opportunity and mobility.

Enfield has a large transit-dependent population and did not have regular local bus service yet hosted several state offices that need to be accessed by transit users. Enfield currently does not have rail service at this time, but the NHHS Rail project will reestablish a station in the Thompsonville section of Enfield with plans to develop an intermodal center adjacent to the proposed rail station. The study recommendations included the establishment of a loop bus service which began operations in early 2013.

Manchester is home to a thriving retail area which has long been identified as a location where a mini bus hub that could provide connections within town and to other regional destinations. The study identified recommendations to improve transit services within Manchester and assessed the feasibility and types of service that a mini hub could provide.

Windsor houses a large corporate office park and currently has an Amtrak station in the town center which will be improved to become a station on the NHHS Rail Line. This study analyzed the potential for and the current corporate interest in establishing a Transportation Management Association (TMA) to provide shuttle services to offices from a proposed transit hub.

PARK & RIDE LOTS

Park and ride lots support ridesharing, transit services, and active transportation. Commuters who want to avoid traffic congestion and save on commuting costs have the option to leave their cars in commuter parking lots while they use carpools, vanpools, buses, or walk/bike a portion of their trip to and from work. Usage of commuter lots relieves highway congestion by reducing single-occupant vehicle travel by increasing ridesharing, public transit utilization, and other modes of transportation.

There are hundreds of park and ride lots conveniently located throughout the state. In the metropolitan Hartford area, there are 49 park and ride lots with about 7,000 parking spaces distributed in 29 towns. Figure 5.4 maps all park and ride locations in the analysis area and indicates whether bus services are provided. Table 5.3 shows an inventory of park and ride lots and each respective capacity, utilization, provided amenities and transit service connectivity. Many of these park and ride lots are located in the vicinity of freeways and major commuting routes and are served by local and commuter bus services. Below is an analysis of the existing lots by travel corridor, with key utilization rates indicated.

Interstate 84: There are ten park and ride lots along this corridor, three west of Downtown Hartford (Exit 29, 37 and 39) and six to the east (Exit 62, 64-65, 67, 68, 69, and Route 30 at Sacred Heart Church). The total number of available spaces is 1,903, of which 187 spaces are provided collectively in the three sites in the western section of I-84. Almost all of these park and ride lots are paved and lighted. Most of the park and ride lots in the eastern section of I-84 have shelters and provide both local and/or express bus services. The Buckland Street park and ride lot in Manchester has a 49% utilization rate and 743 parking spaces; it is the largest park and ride lot in the metropolitan Hartford area. The lot at Exit 64-65 in Vernon provides 192 parking spaces and has a high utilization rate, 81%. Although it seems that additional park and ride lots/capacity west of Hartford may promote usage and relieve some congestion on I-84, the existing lots located in Farmington and Southington experience a lower than average collective utilization rate of 32%. Any new capacity should consider location and likelihood of potential users. It should be noted that one of the three park and ride lots along I-84 West is a small, 15-space lot that is fully utilized. Expansion to this lot may encourage additional usage.

Interstate 91: This corridor has the second largest capacity of parking spaces with eight existing park and ride lots. There are six located to the north of Hartford, of which four are in the town of Windsor (Exit 35, 37, 38 and 39), one in Windsor Locks (Exit 42), and one in Enfield (Exit 47), providing a total of 1,306 parking spaces. The one located in Enfield has 400 spaces and a 61% utilization rate; it is the second largest lot in the metropolitan area. South of Hartford, there are two park and ride lots (Exit 20 and 21) providing 120 spaces total. The lot at Exit 20 in Middletown provides 50 spaces and has an 86% utilization rate. All of these park and ride lots are paved and include lighting and shelters. Express bus services are provided in most of the sites.

Route 44: There are 2 park and ride lots west of Hartford containing 181 spaces. One is at Route 179 in Canton and the other is at the Wal-Mart shopping center near Route 167 and Route 10 in Avon. They are both paved, well lit, and provide express bus service to Hartford. These lots experience a 30% and 66% utilization rate, respectively.

Route 4: There are 3 parking lots with an aggregate capacity of 127 spaces. All of these facilities are located in the town of Farmington. As mentioned previously, the lot near Route 4 and I-84 has only 15 spaces and has experienced over 100% utilization; an expansion may be considered to facilitate and encourage additional park and ride users. The remaining two lots offer 40 and 72 spaces with utilization rates of 50% and 14%, respectively.

Route 15: South of Hartford, along the Route 15 corridor, there are two park and ride lots. One is located at the Connecticut DOT headquarters in Newington and the other is located at Wolcott Hill

Road and Jordan Lane in Wethersfield (near exit 85 off Route 15). The two parking lots provide a total of 318 spaces. Express bus service is provided at the Newington lot and local service is provided at the Wethersfield lot. The utilization rates are 25% and 33%, respectively.

Route 66: There is a small park and ride lot located near the intersection with Route 16 in East Hampton that provides 27 spaces and local bus service. It has a 19% utilization rate.

Although it is not adjacent to one of the major commuting corridors listed above, the park and ride lot in Bristol located at Route 229 and Lake Street has 143 spaces and a utilization rate that exceeds its capacity (103%). Vehicles that wish to use the parking lot likely park on the nearby grass. An expansion of this lot would provide appropriate amenities for existing and new park and ride users.

Commuter lots are supportive of active transportation as well. A commuter may choose to ride a bicycle or walk to a park and ride lot and may continue their journey with provided transit services or ridesharing. Promoting active transport would reduce congestion local to the park and ride lot and result in several other benefits such as improved air quality and health. All CTTransit buses are now equipped with dual bike racks, so commuters may take their bicycles with them. Very few lots, however, provide a designated place for commuters to park/secure bicycles appropriately (the two Manchester locations are the only park and ride lots that currently have lockers). The provision of bike parking/lockers at more park and ride lot locations may encourage commuters to bike to the parking lot instead of driving a motor vehicle.

Figure 5.4: Park and Ride Lots in the Capitol Region and Surrounding Areas

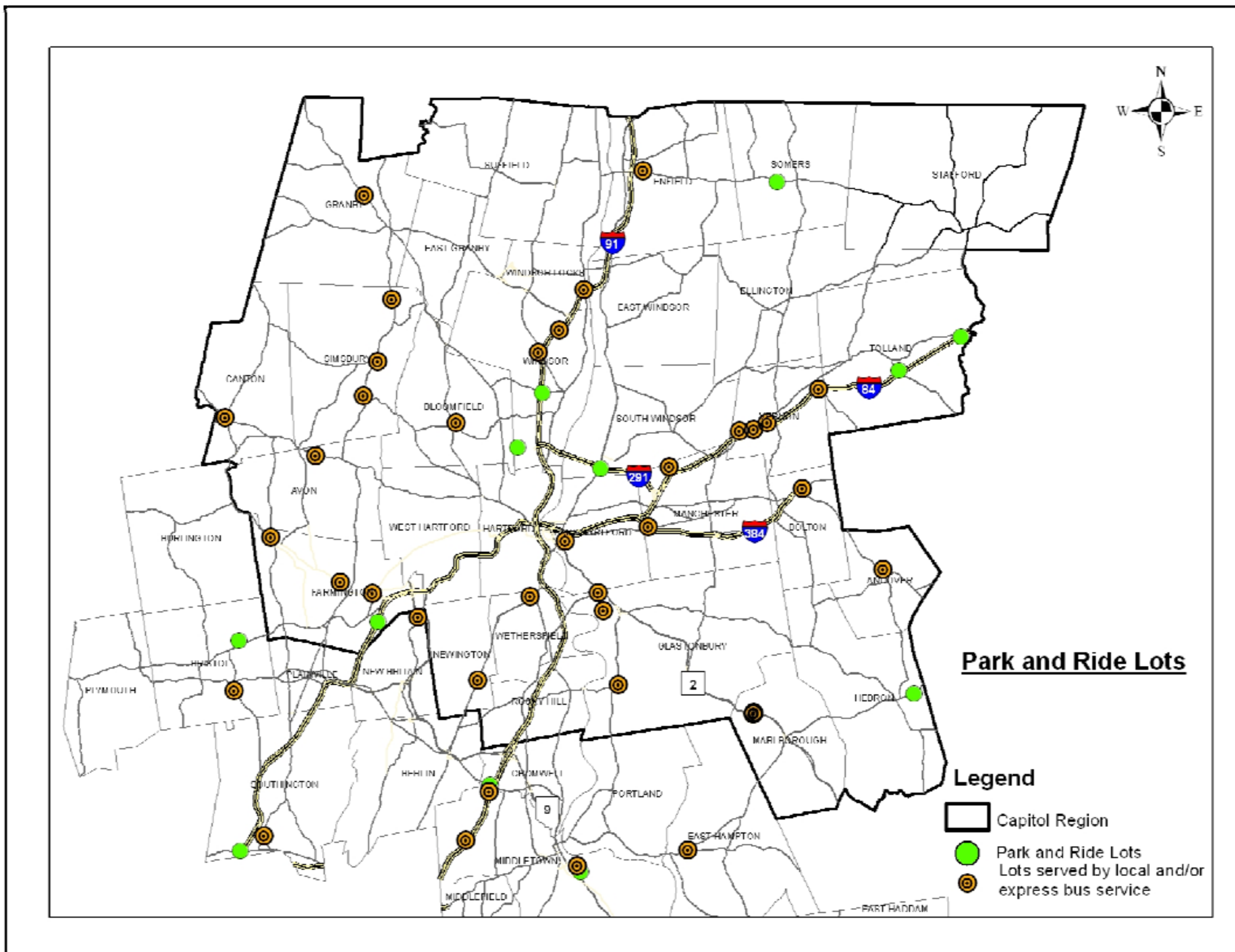


Table 5.3: Park & Ride Facility Profile

Town	Location	Capacity (# spaces available)	2010 % Utilization	Paved	Lighted	Shelter	Telephone	Bike Lockers	Local Bus Service	Express Bus Service
Andover	Routes 6 1/2 mile west of Route 316	60	47%	Y	Y	Y	N	N	N	Y
Avon	Route 44 @ Wal-Mart	100	66%	Y	Y	Y	N	N	N	Y
Bloomfield	Route 189, Sacred Heart Church	85	14%	Y	Y	N	N	N	Y	N
Bolton	Routes 6, 44 & I-384	87	69%	Y	Y	Y	Y	N	N	Y
Bristol	Mix St., Barnes Field Lot	57	5%	Y	N	N	N	N	N	N
Bristol	Route 229 (Middle St.) @ Lake Avenue	143	103%	Y	Y	N	N	N	N	Y
Canton	Route 179 @ Route 44	81	30%	Y	Y	N	N	N	N	Y
Cromwell	I-91 @ Route 372 (Exit 21)	70	70%	Y	Y	Y	Y	N	N	N
East Hampton	Route 66 @ Route 16	27	19%	Y	Y	N	Y	N	Y	N
East Hartford	Route 5 @ Main Street (Route 15 Exit 30)	255	20%	Y	Y	Y	N	N	Y	N
Enfield	I-91, Rt. 190 @ Freshwater/Enfield Mall (Exit 47)	400	61%	Y	Y	Y	N	N	N	Y
Farmington	I-84, Fienemann Rd. (Exit 37)	70	20%	Y	Y	N	Y	N	N	N
Farmington	Routes I-84 & 4 (Exit 39)	15	100%	N	N	N	Y	N	Y	N
Farmington	Route 4 @ St. Mary's Church	40	50%	Y	Y	N	N	N	N	Y
Farmington	Route 4 @ Town Farm Rd.	72	14%	N	Y	Y	N	N	Y	Y
Glastonbury	Routes 2 & 3, Main St. (Exit 5)	323	26%	Y	Y	Y	Y	N	Y	Y
Glastonbury	St. Paul's Church, Main St.	165	39%	Y	Y	Y	N	N	Y	Y
Glastonbury	St. Augustine's, Hopewell Road	96	14%	Y	Y	Y	N	N	N	Y
Granby	Rt. 189, N. Granby Rd. @ 1st Cong. Ch.	65	18%	Y	Y	N	N	N	N	Y
Haddam	Route 9 @ Beaver Meadow Rd. (Exit 8)	25	16%	Y	Y	N	Y	N	N	N
Hebron	Route 66 @ Wellswood Road	62	6%	Y	Y	Y	Y	N	N	N
Manchester	I-84 @ Buckland St. (Exit 62)	743	49%	Y	Y	Y	Y	Y	N	Y

Town	Location	Capacity (# spaces available)	2010 % Utilization	Paved	Lighted	Shelter	Telephone	Bike Lockers	Local Bus Service	Express Bus Service
Manchester	I-384 @ Spencer Street (Exit 1)	245	29%	Y	Y	Y	Y	Y	Y	N
Marlborough	Route 2 @ West Rd. (Exit 12) 3 Lots	210	77%	Y	Y	Y	Y	N	N	Y
Middletown	Industrial Park Road (off Route 372)	250	50%	Y	Y	Y	N	N	Y	Y
Middletown	Route 9 @ Silver Street (Exit 12)	86	76%	Y	Y	Y	Y	N	N	Y
Middletown	I-91 @ Country Club Road (Exit 20)	50	86%	Y	Y	N	Y	N	N	Y
Middletown	Eastern Drive (Conn. Valley Hosp.)	12	50%	Y	Y	N	N	N	N	N
New Britain	Route 71 south of West Farms Mall	227	31%	Y	Y	Y	N	N	Y	Y
Newington	Route 15 @ DOT Headquarters	157	25%	Y	Y	Y	Y	N	N	Y
Simsbury	Route 10 north of Rt. 185	85	67%	Y	Y	Y	Y	N	N	Y
Simsbury	Route 10 @ Hwy. Maint. Garage	55	27%	Y	Y	Y	N	N	N	Y
Simsbury	Iron Horse Boulevard	179	25%	Y	Y	Y	N	N	N	Y
Somers	Route 190 (Main Street) @ Ninth District Road	29	0%	Y	Y	N	N	N	N	N
South Windsor	Route 30 @ I-291 (Exit 4)	157	63%	Y	Y	Y	N	N	N	N
Southington	I-84 @ Route 10 (Exit 29)	102	29%	Y	Y	N	Y	N	N	Y
Southington	Route 322 @ Waterbury Turnpike	105	10%	Y	Y	N	N	N	N	N
Tolland	I-84 @ Route 195 (Exit 68)	132	36%	Y	Y	Y	N	N	N	N
Tolland	I-84 @ Route 74 (Exit 69)	59	24%	Y	Y	Y	Y	N	N	N
Vernon	I-84 @ Route 31 (Exit 67)	241	15%	Y	Y	Y	Y	N	N	Y
Vernon	I-84 & Rt. 83 @ Green Cir.Rd.(Exit 64-65)	192	81%	Y	Y	Y	N	N	Y	N
Vernon	I-84 @ Route 30 (Exit 64-65)	179	34%	Y	Y	Y	Y	N	Y	Y
Vernon	Route 30 @ Sacred Heart Church	170	58%	Y	Y	N	N	N	Y	Y
Wethersfield	Wolcott Hill Road @ Jordan Lane	161	33%	Y	Y	N	N	N	Y	N
Windsor	I-91 @ Kennedy Road (Exit 39)	88	24%	Y	Y	Y	N	N	Y	N

Town	Location	Capacity (# spaces available)	2010 % Utilization	Paved	Lighted	Shelter	Telephone	Bike Lockers	Local Bus Service	Express Bus Service
Windsor	I-91 @ Route 75 (Exit 38)	219	53%	Y	Y	Y	N	N	Y	Y
Windsor	I-91 @ Route 305 (Exit 37)	49	9%	Y	Y	Y	Y	N	N	N
Windsor	I-91 @ Route 218 (Exit 35)	208	5%	Y	Y	Y	N	N	N	N
Windsor Locks	I-91 @ Route 159 (Exit 42)	342	22%	Y	Y	Y	Y	N	N	Y

5.3 Bridges

Bridges play an important role in mobility throughout the region. Closure of certain bridges could result in the detour of several thousands of vehicles each day, likely to roads not designed to handle that increased amount of traffic volume. The result is increased congestion and longer trip length and delay. Further, the planning, design and construction of bridge rehabilitation and reconstruction projects can take several years. Therefore it is critical to monitor the sufficiency of bridges, particularly those that carry large volumes of traffic, and plan for necessary maintenance projects well in advance in order to maintain adequate mobility in the region.

All bridges greater than 20 feet in length are inspected regularly to ensure the safe passage of the vehicles that utilize them. Bridge structures are evaluated on several parameters and are assigned one of the following overall status ratings:

- Structurally Deficient – deteriorated conditions of significant bridge elements; potential reduced load-carrying capacity; designation does not imply that a bridge is unsafe, but significant maintenance and repair are typically needed to remain in service and major rehabilitation or replacement is needed to address the underlying deficiency.[10]
- Functionally Obsolete – deck geometry (e.g. lane width), load carrying capacity, or approach roadway alignment that does not meet the current design criteria for the system of which the bridge is a part.[11]
- Not Deficient – new construction, replacement, or major rehabilitation completed within the last 10 years and/or determined not to be structurally deficient or functionally obsolete.

The National Bridge Inventory is a database of bridge inspection results and includes the sufficiency ratings of state and municipal bridges. These ratings help understand existing and future needs to aid in CRCOG's regional planning efforts.

Of particular concern are those structures within the Congestion Management Area that are critical for commuters and other regional traffic. Two critical bridges in need of repair/replacement are the I-84 Viaduct in the heart of downtown Hartford and the Putnam Bridge, connecting Wethersfield and Glastonbury across the Connecticut River.

The Hartford I-84 Viaduct is located in between the Capitol Avenue and Sisson Avenue ramps (see Figure 5.3 for location map). Built in 1965, it carries I-84 over the Amtrak Railroad, parking lots, and several city streets. The Viaduct is about ¾ mile long and carries about 175,000 vehicles per day, the highest average daily traffic on any roadway segment in the State, and varies between 3 and 5 lanes in each direction. This Interstate segment is relied upon by commuters traveling to Hartford and elsewhere within the region, and is also used by those traveling much longer distances such as the trip from New York City to Boston. In 2007 the structures that comprise the Viaduct underwent a comprehensive inspection and were found to have a deficient concrete deck, deteriorated joints, steel corrosion, and reduced load capacity. As a result, short term repairs were implemented to extend the life of the bridge while planning for the Viaduct's ultimate replacement was underway. These repairs were completed at the end of 2010 and CTDOT continues to monitor the Viaduct for additional repairs. CRCOG completed an initial planning study for the replacement of the Viaduct in 2010 and CTDOT has taken the lead on the next planning phase, including the Environmental Impact Statement. It is imperative that a robust plan for the maintenance and protection of traffic be prepared and utilized during construction of the Viaduct replacement. Scheduling the bulk of

[10] FHWA 2010 Conditions and Performance Report, Chapter 2.
[11] *Ibid.*

necessary closures during non-commuting hours, as was done during the earlier repair project, and identifying a robust diversion route is preferable to mitigate effects on congestion during the peak traffic periods. Consideration of local access to employment and other needs as well as the effective dissemination of any detour information are important factors in the development of the Plan. CT***fastrak*** will play a significant role in reducing congestion during the construction period by providing an alternate transportation option.

The Putnam Bridge carries the Route 3 Expressway over the Connecticut River, connecting I-91 in Wethersfield and Route 2 in Glastonbury (see Figure 5.3 for location map). Built in 1959, the Putnam Bridge is almost a ½ mile long and carries about 54,000 vehicles per day. The four-lane bridge is the southernmost crossing of the Connecticut River in the Hartford area and carries two lanes in each direction. In early 2011, an in-depth bridge inspection was completed; it was found that active leakage is occurring causing parts of the superstructure to deteriorate at a rapid pace. Repair work began in April 2013 and is anticipated to be completed within two years. The repairs are intended to address the major deficiencies, restore the load carrying capacity, and to remove the bridge from the structurally deficient list. A 6-foot-wide pedestrian walkway will be added to the Putnam Bridge as part of this project, enhancing the bike and pedestrian network within the region and providing multimodal options for travelers. The construction phase of this rehabilitation project will change traffic patterns and may cause longer travel times and additional delay. CTDOT has developed a traffic maintenance and protection plan for use during the construction period, scheduling lane closures during non-commuting hours and directional closures on weekends.

In future Congestion Monitoring Reports, we plan to map and monitor all structurally deficient and functionally obsolete bridges located on interstate and limited access highways within the Congestion Management Area.

FIGURE 5.5 : Location Map of Hartford Viaduct and Putnam Bridge

5.4 Roadway System Operational Improvements

Safety is one of the most important components of congestion mitigation. For every minute that an intersection is blocked during peak congestion, four minutes of travel delay result[12]. Even if it takes 15 minutes to clear an incident, the backup could last an hour. Safe, operationally efficient roadways are a preventative measure and coordinated, rapid incident response greatly assists in alleviating congestion during and after vehicular incidents. This section of the report provides an analysis on high incidence roadway crash locations for targeted safety improvements, discusses intelligent transportation facilities along the monitored corridors, and provides information on relevant traffic incident management efforts.

TARGETED SAFETY IMPROVEMENTS

Roadway crashes and the time required to manage incident aftermath is the largest contributing factor for non-recurring congestion. Site reviews of high incident crash locations may reveal improvements to roadway sections and intersections that may improve overall safety and reduce crash rates. Improvements may include roadway reconfiguration, signage, and/or pavement markings depending on a safety review of the locations. The review may include a traditional engineering safety review and/or a Road Safety Audit.

Since road characteristics such as traffic volumes, traffic speeds, and access controls differ between roads, crash data was analyzed specific to the roadway type. CTDOT utilizes the rate-number quality control method to calculate the critical accident rate (RC)for a particular location. A comparison of the RC to the actual accident rate (RA) identifies locations that have experienced a higher incidence of crashes than expected when compared to statewide data. The most current available crash data with RA and RC calculations completed was used for this analysis, covering the three year period between 2006 and 2008. Figure 5.4 displays the 2006-2008 CMP corridor crash rate analysis graphically (RA/RC). Table 5.5 lists the locations with the highest crash experience compared to the critical crash rate along the CMP corridors during the analysis period. Safety improvements focused on these areas have the potential to reduce crash rates and alleviate non-recurring congestion in the Capitol Region.

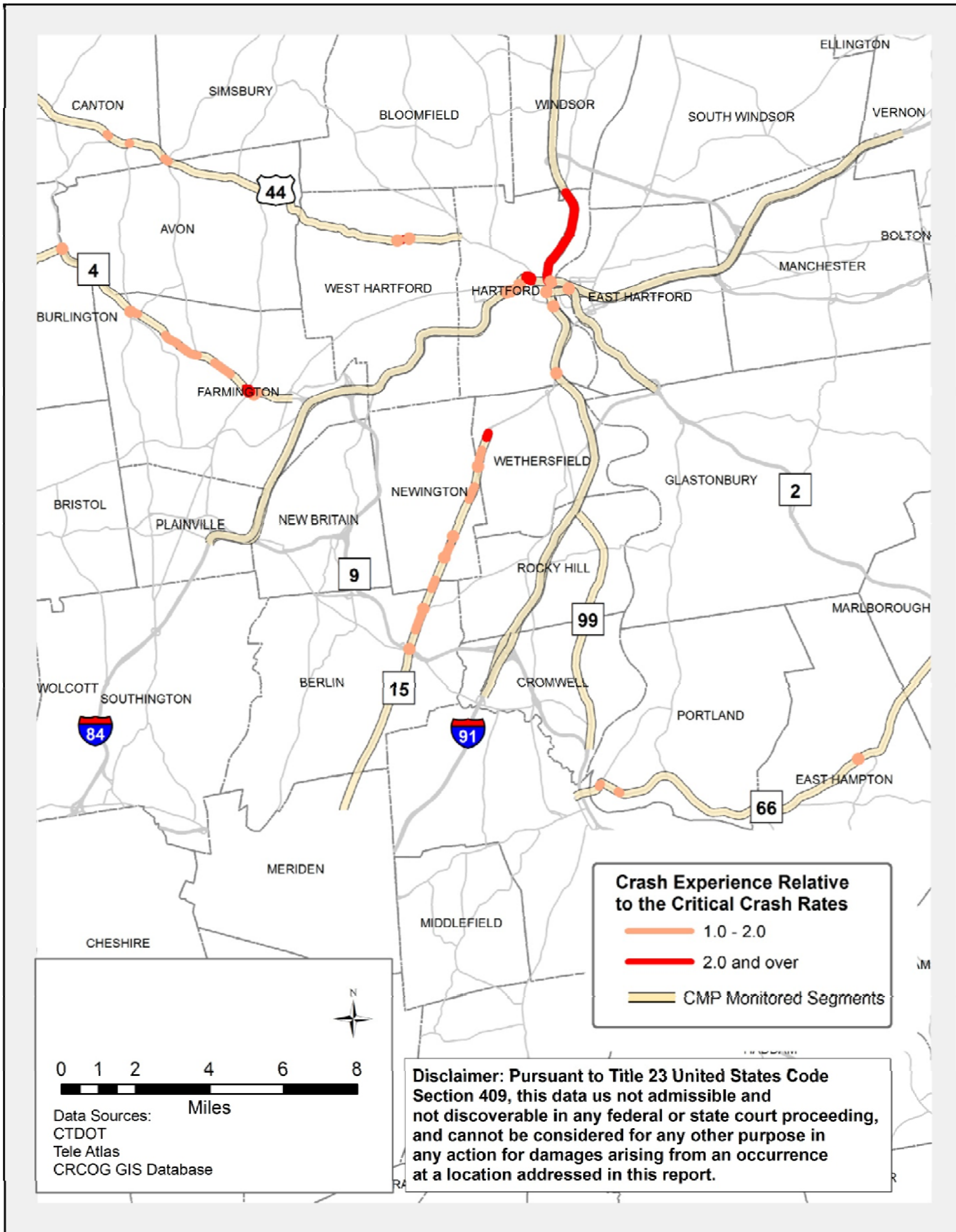
Table 5.4: 2006-2008 CMP Corridor High Incidence Crash Locations Relative to Critical Accident Rates

ROUTE	Town	Location	Total Number of Crashes	MILLION VEHICLE MILES	Actual Accident Rate (RA)	Critical Accident Rate (RC)	RA/RC
4	Farmington	Between Rt 10 & High St	68	4.6	14.77	3.782	3.90
I-84	Hartford	At High St & Ann St Intersection	502	88.7	5.66	2.479	2.28
4	Farmington	AT Rt 10 (Main & Waterville)	72	1.3	2.33	1.053	2.21
4	Farmington	Between Garden St & Rt 10 Water Rd	21	2.4	0.79	0.362	2.19
15	Wethersfield	Between Rt 15 Sb & Nott St	38	6.3	6.02	2.805	2.15
I-91	Hartford	Between I-84 & Rt 159 Interchange	441	70.9	1.63	0.785	2.08
44	West Hartford	Between Rt 218 & Starkel Rd	24	1.8	1.07	0.516	2.07
4	Farmington	Between beginning & end of 3 lanes	18	3.0	5.93	2.918	2.03
15	Berlin	At Ramps 175,177 & 052	46	0.6	1.59	0.795	2.00

Disclaimer: Pursuant to Title 23 United States Code Section 409, this data is not admissible and not discoverable in any federal or state court proceeding, and cannot be considered for any other purpose in any action for damages arising from an occurrence at a location addressed in this report.

[12] National Traffic Incident Management Coalition: *Benefits of Traffic Incident Management*, available online: http://www.transportation.org/sites/ntimc/docs/Benefits11-07-06.pdf.

FIGURE 5.6 : Crash Experience Relative to the Critical Crash Rates



INTELLIGENT TRANSPORTATION SYSTEMS (ITS)

ITS plays an important role in congestion mitigation and management of traffic capacity. A well implemented system can: 1) Divert motorists to an alternate route in the event of an incident resulting in lane or road closures, and 2) Improve traffic operations without adding more lanes to the roads through better management of the existing infrastructure. Faster incident response time and real-time traffic monitoring are some of the benefits of ITS that help alleviate roadway congestion.

Figure 5.7: ITS Facilities Located Along the CMP Corridors

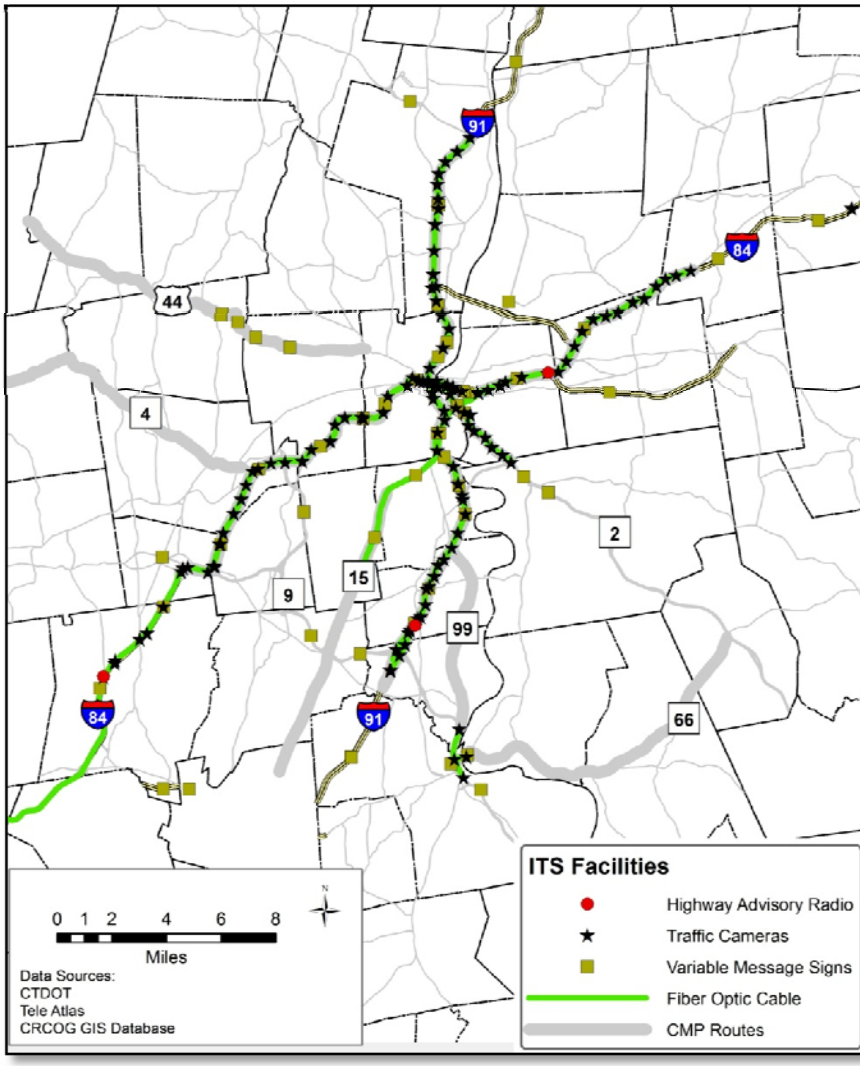


Figure 5.5 displays a map that locates ITS facilities that are implemented along the CMP corridors. ITS equipment within the CMP monitoring area include three highway advisory radio trans-mitters, closed-circuit video cameras and traffic flow monitors, variable message signs, and fiber optic cables to transmit the collected data.

In 1997, CRCOG adopted a strategic plan for the deployment of ITS systems in the Capitol Region. The ITS Plan identified applications that benefit the operation of freeways, arterial roads, and public transit. Most of the basic recommendations in the ITS Plan have been implemented and newer technologies have emerged since that plan was published. Working with CRCOG, CTDOT is now in the process of advancing an ITS Strategic Plan and Regional ITS Architecture Update. The products of this work will incorporate newer technologies to relieve congestion, improve transit operations and user information, and aid traffic incident response. A major component of this plan will be to review opportunities to improve signal coordination through established operations and maintenance policies and plans.

Additionally, CRCOG has been a partner in educating our member municipalities on Adaptive Signal Control Technology (ASCT). This type of system allows traffic signals to adjust to changing traffic patterns in order to ease traffic congestion, providing the optimal signal timing based on current conditions. CRCOG promotes project development involving ASCT in accordance with the systems engineering process.

TRAFFIC INCIDENT MANAGEMENT

According to the Oak Ridge National Laboratory (http://cta.ornl.gov), a three-lane freeway loses about half of its capacity when one of its lanes is blocked as a result of a crash. This effect is further amplified during peak-hour travel or along high volume roadways where the traffic is already at the road's capacity. Even a vehicle located on a roadway shoulder can have significant impacts on traffic mobility if not handled efficiently. Further, the likelihood of a second incident increases 2.8% with each minute of blockage[13]. These findings underline the importance of rapid incident response and effective Traffic Incident Management (TIM).

TIM was introduced to the greater Hartford area in 1997, when CTDOT, along with the Capitol Region Council of Governments (CRCOG), established the Greater Hartford Incident Management Steering Committee. This committee was made up of representatives from local fire and police departments, regional emergency management services, towers, three regional planning agencies, State Police, DOT and DEP, and FHWA who worked together toward the goal of improving coordination, cooperation and communication among emergency responders. Later, the steering committee assumed an added emergency planning role through the DEMHS Region 3 RESF-1. The RESF-1 continues to meet on an as needed basis, and reports to the Capitol Region Emergency Planning Committee (CREPC). This committee assisted with the development and distribution of diversion plans for major routes in the region. Additional work is needed to continue the promotion of cross-disciplinary coordination necessary for proper TIM.

In 2003, the Transportation Strategy Board (TSB) established the Statewide Incident Management Task Force (SIMTF). Guided by representatives of the State Departments of Public Safety, Transportation, Motor Vehicles, and Environmental Protection, as well as local police, local fire, towing and recovery professionals, and regional planners, the SIMTF developed a list of 40+ policy, program and project recommendations for improving the response and clearance of incidents on Connecticut's highways. In 2010, the SIMTF reviewed the status of these original recommendations and updated the list to reflect current needs and best practices. The revised recommendations were identified by the Governor 's Transition Team as the third-priority transportation policy initiative. With the dissolution of the TSB, the SIMTF is investigating various organizational structures to continue the statewide effort to improve TIM. The SIMTF was responsible for the development of a Unified Response Manual, providing guidance to agencies on incident response. CRCOG is also undertaking a revitalization of a regional TIM effort under the Region 3 RESF-1 committee referenced above.

According to the Texas Transportation Institute, it is estimated that 2 million hours of delay were the result of incidents on freeways within the Hartford area in 2010 and that the annual cost due to these incidents was $43.5m. Effective TIM is capable of reducing this congestion and cost, but regional and statewide planning and coordination efforts are necessary to do so.

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[13] Karlaftis, Latoski and Sinha Richards. "ITS Impacts on Safety and Traffic Management: An Investigation of Secondary Crash Causes," *ITS Journal*, 1999, Vol. 5, pg. 39-52.

5.5 Transit-Land Use Connections

One of the strategies to mitigate roadway congestion and thus motor vehicle emissions is land use planning based on Smart Growth principles. This allows people to live closer to their work and other destinations, spending less time driving in traffic.

In 2009, the Regional Plan Association and the Lincoln Institute for Land Policy held a workshop, *Redesigning the Edgeless City,* in the Capitol Region. This workshop focused on envisioning potential transit lines in the Region and the analysis of possible development scenarios that could occur based on current and revised land use regulations. Participants developed alternative scenarios for growth in three corridors that would increase household access to transit from 6% to 64% and reduce future VMT (vehicle miles travelled) and carbon emissions up to 18%, a reduction of 1.3 tons per household per year.

Region-wide, the workshop identified development scenarios that incorporate infill, transit-oriented development nodes, and expanded transit to reduce per household emissions up to 25% while building almost 21,000 new households in livable communities (50% more than permitted under current zoning for these areas). Coordinating development policies with transportation planning can reduce VMT and air pollution, meet the growing mobility needs of the Region's residents and employers, and produce an economically sustainable transit system.

Encouraging transit supportive land use can have a direct impact on congestion management while still allowing for growth and economic development. Table 5.6 below shows estimates for an example transit corridor, Hartford Busway East (from Hartford to Vernon), to demonstrate these concepts.

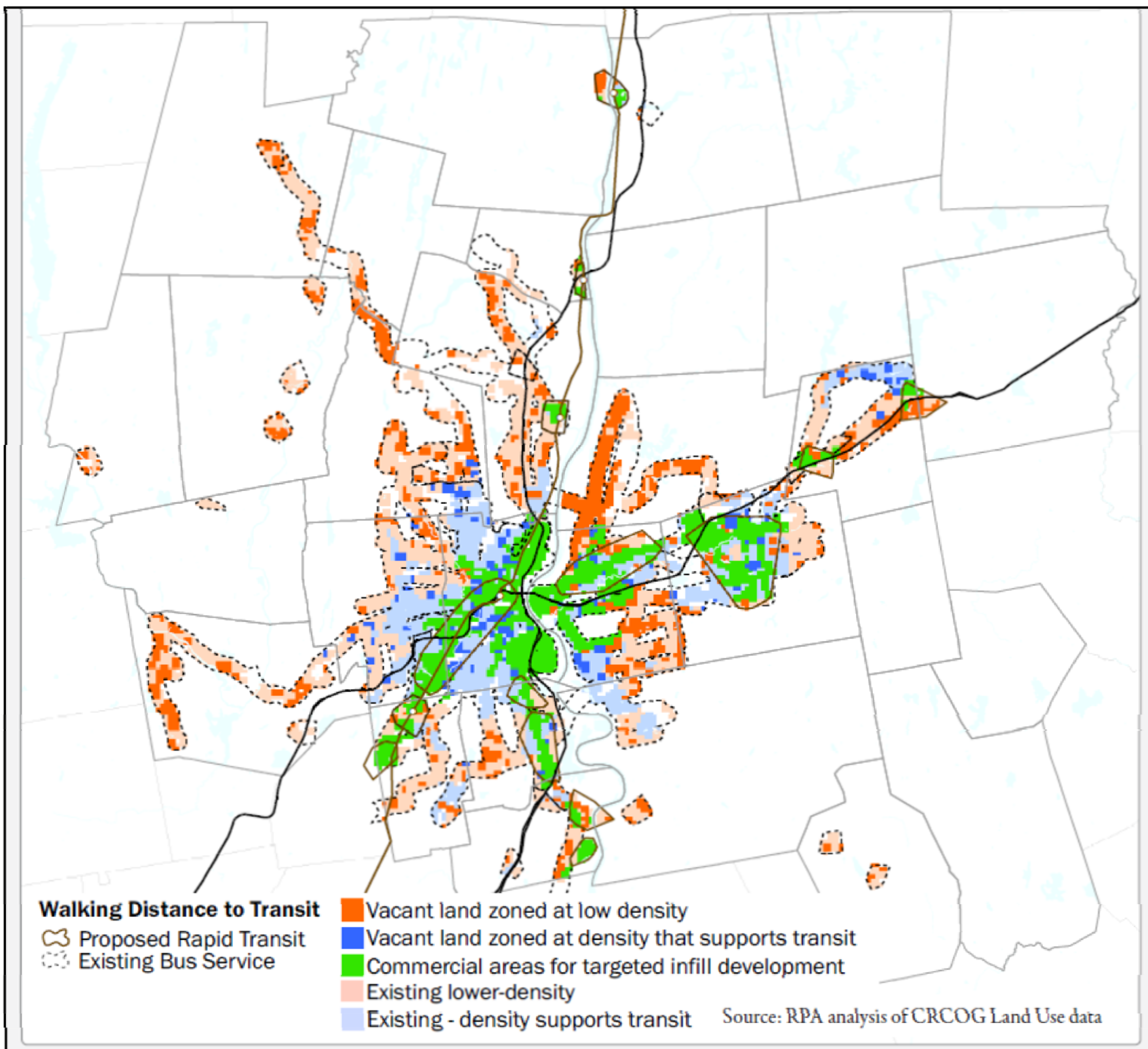
Table 5.5: Growth Estimates in the Busway East Corridor

	Existing Conditions	Future Conditions				
		Trend (under Current Zoning)		Transit-supportive		
			Compared to Existing		Compared to Existing	Compared to Trend
Housing Units	32,770	36,920	113%	40,370	123%	109%
Annual VMT per Household	11,336	11,617	102%	10,165	90%	87%
AnnualEmissions per Household*	5.2	5.3	102%	4.7	90%	87%
Annual Emissions per Corridor*	170,142	196,441	115%	187,940	110%	96%
Active Transit: Busway East (Hartford/East Hartford/Manchester/Vernon) *Emissions are measured in metric tons CO2 equivalent						

Comparison of Trend Development and Transit Supportive Development;
Growing Economy Shrinking Emissions, Regional Plan Association, 2009

Residential growth in the Greater Hartford area is projected to grow at a marginal 4% over the next twenty years. The location of that new residential development plays a major role in how far people will need to travel and by what means. All of Greater Hartford's expected residential growth for the next twenty years could be accommodated within walking distance to transit if undeveloped residential land along current transit routes is rezoned to at least 4 units per acre. The map below from the *Growing Economy, Shrinking Emissions* report show the levels of density allowed currently within existing and proposed transit corridors in the Capitol Region. While many of the corridors currently do not have zoning for densities high enough to support transit, the Capitol Region is working toward developing model sustainable land use regulations for its communities which will help encourage this type of development. Over time, this map can be used as a benchmark to measure changes in transit supportiveness within municipal land regulations.

Figure 5.8: Density Allowed Under Current Zoning in Existing & Proposed Transit Corridors



Growing Economy, Shrinking Emissions,
Regional Plan Association, 2009

5.6 Bicycle & Pedestrian Program

Another tool to address roadway congestion is to accommodate and encourage non motorized travel – bicycling and walking. CRCOG has been working steadily since 1999 to create more transportation options for the residents of the region through our bicycle and pedestrian planning program. Over that time, much has been accomplished, but more opportunities to making the region fully walkable and bikeable exist.

Not all trips can be converted to walking or biking as generally acceptable trip lengths are under 1 mile for walking and 5 miles or less for bicycling (though many regular bicycle commuters travel more than 10 miles to work). However, the National Passenger Household survey (2001) indicates that there are many candidate trips for conversion: 50% of all trips are 3 miles or shorter, 40% of all trips are 2 miles or shorter and of the trips under 2 miles, over 80% are currently made by a car.

There are a few obstacles preventing bicycling and walking throughout the region: poor bicycle and pedestrian connections to our transit system (last mile problem); the roadway infrastructure is mostly built for vehicular travel, not bicycle or pedestrian mobility; sidewalks are discontinuous or nonexistent and roadway crossings are not perceived as safe.

To address these obstacles and work toward reducing congestion, CRCOG is evaluating options to enhance bicycle and pedestrian mobility throughout the region. Options, such as the creation of a regional bicycle share system, are being discussed with regional partners. The regional multi use path system is expanding, in fact, an analysis of 2000 census data indicated that where downtown workers have access to a trail near their home (such as the Charter Oak Greenway), rates of bicycling to work are 10 times higher than in locations that are not accessible to a trail. CRCOG's 2008 Regional Pedestrian and Bicycle Plan identifies all existing and proposed trails (Figure 5.7) and recommends additional links between these multiuse paths (Figure 5.8). Municipalities across the region are making progress in striping bicycle lanes on local road and the state's Complete Streets policies are working to ensure transportation projects are designed with all users, including non motorized users, in mind.

Education is another important component to bicycle and pedestrian travel within the region. CRCOG has been active in promoting programs that educate bicyclists and motorists on how to share the road safely and that encourage individuals to give biking and walking a try. We initiated a bike to work program in 2000 and a bicycle safety education program that are now both managed by Bike Walk CT. A Share the Road brochure developed by CRCOG is used statewide. These efforts were aimed at getting more people biking and walking with the existing roadway infrastructure.

All of these bicycle and pedestrian initiatives will aid in improving bicycle and pedestrian mobility in the region, assisting to reduce congestion.

Figure 5.9: Existing and Proposed Multi-Use Trails

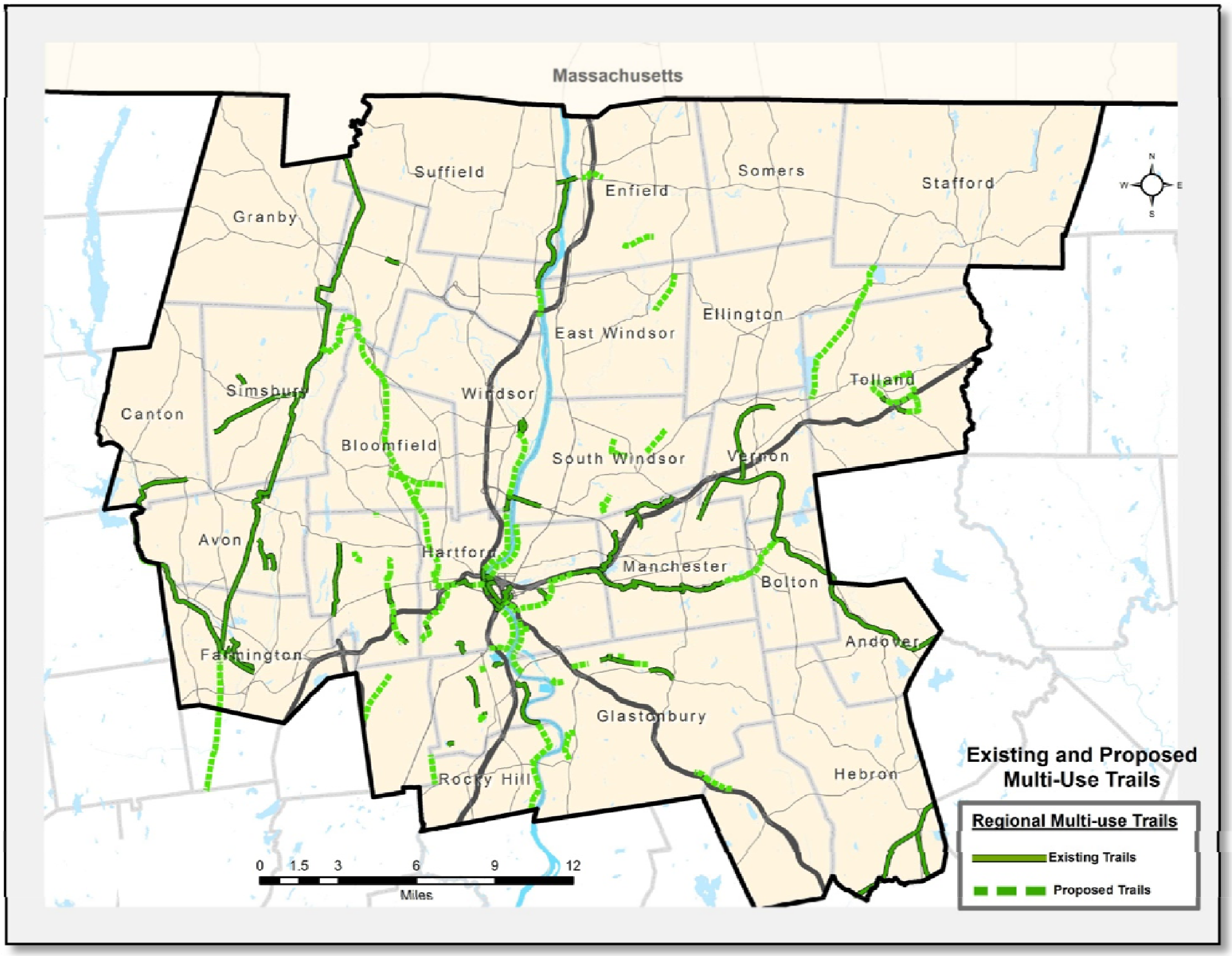
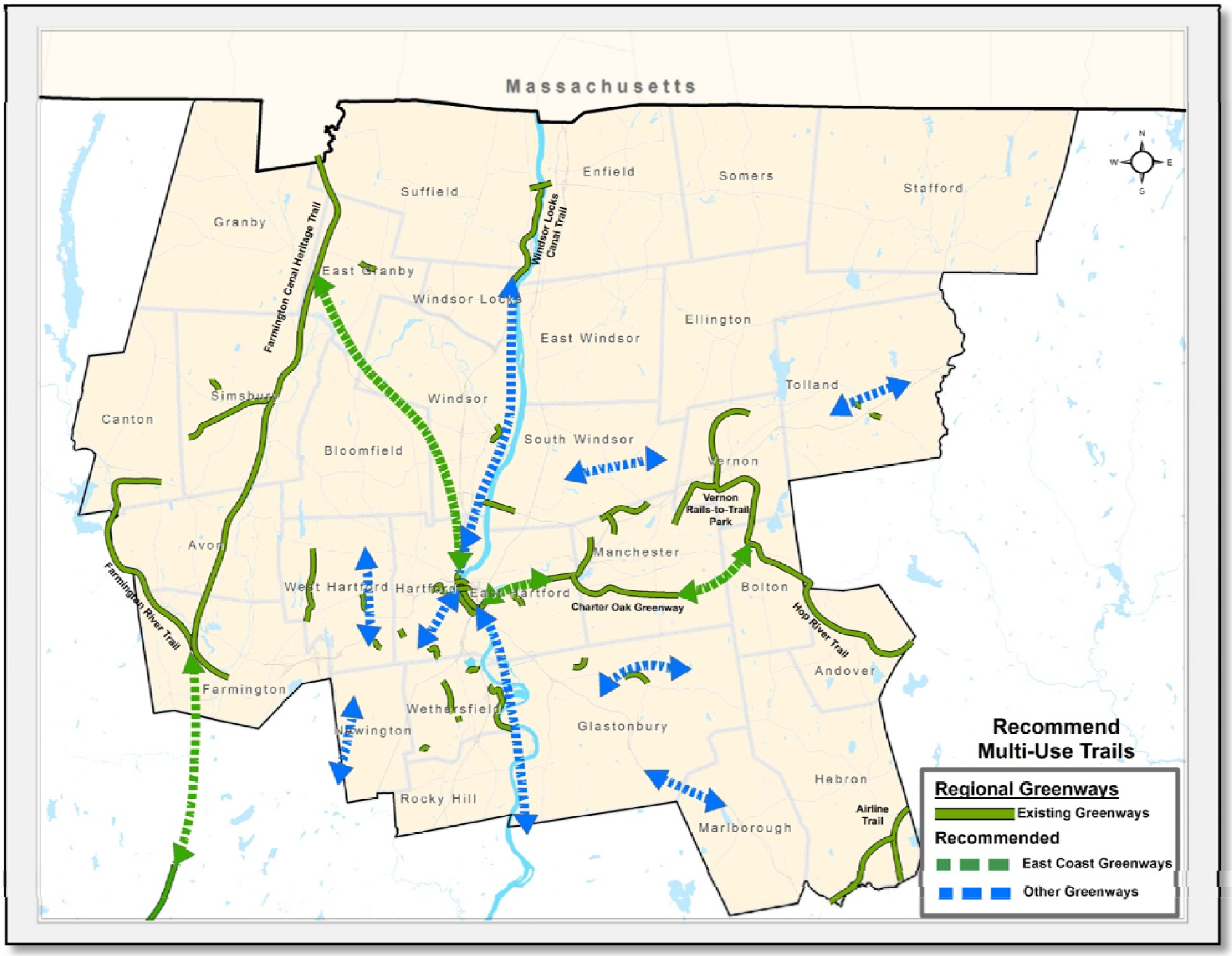


Figure 5.10: Recommended Multi-Use Trail Connections



5.7 Transportation Demand Management

Transportation Demand Management (TDM) is the use of strategies and policies that provide travel choices in mode, time, work location, and route. Measures such as car and vanpooling, transit options, bike and pedestrian amenities, flexible work hours, telecommuting, and congestion pricing are all TDM strategies that can mitigate congestion along busy highways without the significant financial investment and community impacts associated with increasing roadway capacity. As part of its Long Range Transportation Plan, CRCOG supports the integration of TDM strategies into our transportation programs whenever possible.

All CRCOG corridor studies review improvements to all modes of transportation, including bicycle, pedestrian, and transit infrastructure and amenities. The review of sidewalk connectivity, crosswalks, pedestrian pushbuttons, streetscape improvements, bicycle suitability, bus shelters, and park and ride availability are core task items in our studies. Recent examples of studies that focused on or integrated TDM into the planning process include the Windsor Transportation Management Association (TMA) Feasibility Study, and Route 10 Corridor Study. Under the Windsor TMA Feasibility Study three phases for the development of a TMA were identified beginning with a focus on working with employers on carpooling and telecommuting options, advancing to the establishment of an employer-based shuttle service to the longer term establishment of a TMA. As it relates to the Route 10 study, in addition to recommended roadway and intersection improvements, recommendations also included the establishment of a suburban transit hub and enhancements to the pedestrian and bicycle system (including streetscapes, infill sidewalks, on-street bicycle lanes, crosswalks, and pedestrian signal phases).

In addition, CRCOG will be undertaking a comprehensive route analysis of the bus routes in the Metropolitan Hartford Area in the near future. The study will assist in realizing and addressing any deficiencies in the current route system. This will also enable the local bus system to function better with CT***fastrak*** and planned commuter rail systems.

Congestion Pricing is a management tool that is currently under exploration in the State of Connecticut, particularly on Interstate 84 in Hartford and along the Interstate 95 corridor from New Haven to New York State. This TDM strategy uses electronic tolling to balance travel demand with roadway supply by encouraging motorists to travel at less congested times of day, shift to less congested routes, or shift to other modes of transportation. CTDOT has received Value Pricing Pilot Project funding to study the viability of this strategy to reduce congestion, assess potential impacts, and understand the financials of this type of program.

Chapter 6 Conclusions & Next Steps

This congestion monitoring report provides a snapshot of congestion in the region and is a significant addition to our initial 2005 CMS report. We have advanced our congestion monitoring techniques and have added new performance measures. A critical component of this release is the discussion of mitigation strategies. Since these are newly introduced in this report, comparison data is not yet available but will be included in the next update of the report.

Next Steps

Congestion management is an evolving process. CRCOG is continuously striving to improve monitoring techniques to gain a better understanding of congestion, its causes, and the most effective mitigation strategies. Our goals over the next few years include the following.

Refine & Improve Data Collection and Techniques

- Develop a method to separate total delay into two major categories:
  - Recurring delay caused by normal heavy traffic volumes
  - Non-recurring delay caused by crashes, weather, or other incidents
- Add reliability measures to the freeway monitoring system.
- Assess the CMP area and expand it as necessary.
- Further improve sampling techniques for arterial roads (ie evaluate the use of cellular and other commercially available data sources).
- Identify additional performance measures that will assist congestion monitoring and management in the region.

Analysis

- This report analyzed trends between 2005 and 2010. The next report will build on this with additional data and a longer history, allowing for richer trend analysis.
- As mitigation strategies are implemented, data collection and analysis of performance measures will help understand the effectiveness of these initiatives.

Additional Congestion Elements

- We expect to evaluate additional congestion related elements in the next report. This may include new mitigation strategies and additional performance measures.

Implement Mitigation Strategies

We identified a wide variety of congestion mitigation strategies in this report. The key to reducing congestion in the region is to implement and continue to support these strategies. A summary of the mitigation action items is provided below:

- Advance projects in the TIP that relate to congestion mitigation.
- Complete the Comprehensive Transit Service Analysis to understand potential local/express transit service improvements throughout the region.
- Advance and promote CTfastrak and NHHS Rail Service to expand transit options and connectivity.

- Work to advance Transit System Enhancements study findings identified in the Sustainable Communities Initiative projects conducted in Enfield, Manchester and Windsor.
- Monitor park and ride lot usage and work with CTDOT on improvements such as expanding lots with high utilization rates, reviewing transit service access as part of the Comprehensive Service Analysis, and providing/upgrading amenities such as shelters and bike racks/lockers where appropriate.
- Monitor the status / ratings (structurally deficient/functionally obsolete) of bridges on interstate and limited access highways within the congestion management area, particular attention will be given to those with very high average daily traffic.
- Partner with CTDOT to identify potential improvements at locations along the CMS corridors with a higher than expected crash rate.
- Complete an update to the CRCOG ITS Strategic Plan.
- Support the statewide effort to improve Traffic Incident Management.
- Encourage Transit Oriented Development (TOD) including the development of model sustainable land use regulations.
- Enhance pedestrian and bicycle connections throughout the Capitol Region by exploring options that create a regional bicycle sharing program; Provide technical support to communities strengthening the multimodal network and continue to build upon our regional trail system.
- Support educational initiatives that encourage safe bicycle and pedestrian transportation.