CONGESTION IN THE NORTHERN MIDDLESEX REGION

AN ASSESSMENT OF SYSTEM PERFORMANCE

APRIL 2006

A report prepared by the Northern Middlesex Council of Governments Planning Staff for the Northern Middlesex Metropolitan Planning Organization.
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Congestion Management Systems (CMS) were created as a way to address, manage, and/or mitigate the effects of congestion, and are a required component of the Metropolitan Planning process for designated Transportation Management Areas (TMA) with a population over 200,000. The Northern Middlesex region has been recently designated as a TMA, and thus required to maintain a CMS as part of their planning process. The CMS will now become an ongoing program of the Northern Middlesex Metropolitan Planning Organization (NMMPO). Planning staff for the Northern Middlesex Council of Governments (NMCOG) will be responsible for carrying out CMS activities.

This first CMS report for the NMMPO documents the region’s mobility. This report is intended to be a decision support tool, designed to assist the NMMPO in evaluating and implementing strategies to manage congestion and improve the movement of people and goods. More specifically, the purpose of this report is to:

1) Provide timely information on roadway system performance;
2) Recommend congestion-reducing and mobility enhancing actions; and
3) Expand the scope of future congestion monitoring activities.

In a broader sense, the Northern Middlesex CMS program will link the investment decision-making process with systems management. Figure 2.1 underscores the significance of integrating systems management into the Metropolitan Planning process. Integrating CMS monitoring and evaluation into the development of the region’s planning and programming documents, including the long-range plan, the Transportation Improvement Program (TIP), and the Unified Planning Work Program (UPWP) will help the NMMPO answer the following questions:

1) How is the region’s transportation system performing?
2) What are the congestion and mobility issues in the region?
3) What can be done to address the identified congestion and mobility concerns?

Travel time information was collected on regionally significant roadway facilities in the Northern Middlesex region identified as having mobility issues in the past. Roadways constituting regionally significant facilities are those classified as rural/urban arterials and expressways/interstates. In the Northern Middlesex region, there are approximately 285.53
centerline miles\(^1\) of roadways classified as arterials (both urban and rural combined) and 16.33 centerline miles\(^2\) of roadways are classified as interstates. Regionally significant roadways with mobility issues were identified using past and current transportation studies, the statewide travel demand model, and volume counts.

**SUMMARY OF FINDINGS**

**Arterial Roadways**

Data was collected on approximately 91.25 miles of arterial roadways in the Northern Middlesex region. For the most part, the data shows that majority of the CMS-monitored arterial roadway segments operate at acceptable LOS during the AM and PM peak periods and experience limited delay; however, the data does identify congestion issues in the region. Summarized below is the arterial roadway performance during the AM and PM peak periods.

During the AM Peak period:

- 1.1 percent of the total monitored Northern Middlesex arterial roadway miles are congested;
- 17 percent of the monitored arterial roadway miles experienced average speeds below 25 MPH; and
- Route 38 in Tewksbury had the greatest amount of roadway miles that experienced congestion.

During the PM peak period:

- 3 percent of the total monitored Northern Middlesex arterial roadway miles are congested;
- 6 percent of the monitored arterial roadway network experienced average speeds below 14 MPH;
- 30 percent of the monitored arterial roadway network experienced average speeds below 25 MPH; and
- Drum Hill Road in Chelmsford/Lowell and Route 3A in Lowell had the greatest amount of roadway miles that experienced congestion.

Field observations were conducted during the data collection process. Among the conditions observed as having an effect on congestion and mobility were the following:

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\(^2\) *ibid*
Lack of traffic signal coordination, actuation, and inefficient signal timing were noted to contribute to unnecessary delays along the monitored roadway segments and at intersections. The level of delay at some signalized intersections indicates that vehicles would have to wait in a queue for more than one traffic signal cycle.

Many signalized intersections did not have adequate signs and pavement markings to indicate lane assignments. Motorists become frustrated and confused when navigating through intersections that lack these items.

Many locations lack signs displaying street names and route designations, or have signs that are difficult to see.

**Limited-Access Roadways**

Data was collected to document conditions on the three limited-access facilities in the Northern Middlesex region: I-93, Route 3, and I-495. For the most part Route 3 north experienced more congested conditions than the other two limited-access facilities in the region. It should be noted that the data for Route 3 North was collected prior to the implementation of the improvement project. Below is a summary of the conditions on these facilities.

During the AM Peak period:

- Route 3 southbound is congested between Route 3A/Route 4 and Concord Road;
- The southbound segment of I-93 that passes through the Northern Middlesex region is congested; and
- I-495 experiences acceptable conditions both northbound and southbound.

During the PM Peak period:

- Route 3 northbound is congested between Treble Cove Road and Westford Road;
- The northbound segment of I-93 that passes through the Northern Middlesex region is congested; and
- I-495 experiences acceptable conditions both northbound and southbound.

**CONCLUSION**

The purpose of the CMS report is to identify the sources of congestion and recommend a set of mobility-enhancing strategies. CMS emphasizes the importance of taking a multi-jurisdictional and multi-institutional approach to address congestion in metropolitan areas. Using this report as an effective decision-support tool will require the participation of local, regional, and State institutions and organizations. These organization and institutions include the following:
• The Executive Office of Transportation;
• MassHighway;
• MassHighway District 3 and District 4 Offices;
• MBTA and LRTA;
• Municipalities in the Northern Middlesex region;
• Adjacent MPOs (Merrimack Valley MPO, Nashua Regional Planning Commission, and the Boston MPO);
• Adjacent RPAs (Merrimack Valley Planning Commission and Metropolitan Area Planning Council);
• Transportation Management Association (TMAs);
• Major employers in the region;
• MassRides; and the
• Lowell National Historical Park.

Transportation research underscores that congestion is not just an “urban” problem, only experienced in large cities. Congestion and mobility challenges are often experienced in small and medium-sized metropolitan areas. The Northern Middlesex region is no exception, and this CMS report demonstrates that this region experiences mobility challenges on the arterial and limited-access roadway network.
CHAPTER 1

Introduction

Congestion has been defined as "the level at which transportation system performance is no longer acceptable due to traffic interference." The level of acceptable system performance may vary by type of facility, geography, and/or time of day. According to the Federal Highway Administration (FHWA), congestion can be grouped into three broad categories:

1) Traffic-influencing events, such as work zones, inclement weather, and traffic incidents;
2) Traffic demand; and
3) Geometric features.

FIGURE 1-1: Causes of Congestion

Source: Federal Highway Administration

Congestion Management Systems (CMS) were created as a way to address, manage, and/or mitigate the effects of the above, and are a required component of the Metropolitan Planning process for designated Transportation Management Areas (TMA) with a population over 200,000. The Northern Middlesex region has been recently designated as a TMA, and thus required to maintain a CMS as part of their planning process. The CMS will now become an ongoing program of the Northern Middlesex

1 Federal Highway Administration, Traffic Congestion and Reliability: Trends and Advanced Strategies for Congestion Mitigation.
Metropolitan Planning Organization (NMMPO). Planning staff for the Northern Middlesex Council of Governments (NMCOG) will be responsible for carrying out CMS activities.

This first CMS report for the NMMPO documents the region’s mobility (region is depicted in figure 1.2). This report is intended to be a decision support tool, designed to assist the NMMPO in evaluating and implementing strategies to manage congestion and improve the movement of people and goods. More specifically, the purpose of this report is to:

1) Provide timely information on roadway system performance;
2) Recommend congestion-reducing and mobility enhancing actions; and
3) Expand the scope of future congestion monitoring activities.

The CMS program will be carried out by conducting a systematic and continuous process consisting of the following elements:

- **Data collection and analysis**- Data was collected and analyzed to assess the roadway system performance, and to identify congestion and mobility issues. To complete this element, NMCOG staff gathered data in the field, utilized existing sources from other transportation agencies and/or MPO regions, and researched transportation literature pertaining to congestion management.

- **Recommendations**- Based on the findings of the CMS data analysis, NMCOG will recommend to the NMMPO a set of strategies, initiatives, programs, and/or planning studies to address congestion and mobility concerns on identified facilities in the region. These recommendations will be one of the sources the NMMPO will utilize to develop its annual Unified Planning Work Program (UPWP).

- **CMS Data** - CMS data will be available to transportation decision-makers to ensure timely and effective input into the transportation planning and programming documents: the UPWP, the Transportation Improvement Program (TIP), and the Regional Transportation Plan (RTP).

- **CMS Reports** - CMS reports will be produced to document the results of the most recent performance activities, to summarize regional system performance, and to outline recommendations based on system performance. These reports will be continually revised to provide decision-makers with the most up-to-date information regarding system performance.
1.1 REPORT STRUCTURE

This report—the first report produced for the NMMPO—contains performance monitoring data for the Northern Middlesex region’s roadway network and sets forth recommendations based on that information. The following chapter provides a legislative background on Congestion Management Systems, and a description of the Northern Middlesex CMS program. Chapter 3 presents the performance monitoring efforts for the Northern Middlesex region. This chapter describes (1) peak-period performance measures and the corresponding congestion threshold levels; (2) data collection methods; (3) the roadway facilities; and (4) results of the monitoring. Chapter 4 provides a summary of the findings and identifies facilities of concern. Chapter 5 provides recommendations ranging from congestion-reducing strategies and programs to planning studies. Chapter 6 summarizes the findings of this report and provides some concluding remarks regarding congestion in the Northern Middlesex region.

This report contains numerous charts, figures, table, and graphics, designed to provide a succinct summary of the information. Those that summarize key pieces of information are contained in the body of the report; much of the information is provided in the report appendices. This report is available in common word formats (Word, PDF, etc.) for viewing and printing.
CHAPTER 2
Background

Congestion Management Systems (CMS) are mandated by federal legislation. This chapter describes the evolution of the CMS mandate at the federal level. Moreover, this chapter explains the focus of the CMS program and how it will serve the needs of the Northern Middlesex MPO’s transportation planning process.

2.1 FEDERAL LEGISLATION

The Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) required that Metropolitan Planning Organizations (MPOs) develop Congestion management Systems (CMS). The metropolitan planning provisions of Transportation Equity Act of the 21st Century (TEA-21), adopted in 1998, continued the requirement that transportation management areas over 200,000 in population maintain a CMS as part of their planning process. According to the metropolitan planning regulations:

"An effective CMS is a systematic process for managing congestion that provides information on transportation system performance and on alternatives strategies for alleviating congestion and enhancing the mobility of persons and goods to levels that meet State and local needs. The CMS results in serious consideration of implementation of strategies that provide the most efficient and effective use of existing and future transportation facilities (23 CFR 500.109a)."

CMS findings and recommendations must be considered during the preparation of the Regional Transportation Plan (RTP) and the Transportation Improvement Program (TIP). Moreover, in a transportation management area that has not attained federal air quality standards, any roadway expansion project must be considered in the context of a CMS. The Metropolitan Planning regulations stipulate that in air quality nonattainment areas, federal transportation funds may not be programmed for any project that will result in a significant increase in capacity for single-occupant vehicles, unless the project is derived from the CMS report. The Northern Middlesex region has been designated a Transportation Management Area (TMA) under the guidelines presented in the ISTEA and TEA-21. The 2000 Census reported a population of over 281,000 for the Northern Middlesex region; therefore the Northern Middlesex MPO is now required to develop and maintain a CMS as part of its planning activities.

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1 The Northern Middlesex MPO region is in a nonattainment area for ozone.
2.2 NORTHERN MIDDLESEX CMS PROGRAM

The focus of the Northern Middlesex CMS program is to document existing conditions on the region’s transportation system, and identify mobility issues through system monitoring. Mobility concerns are identified by analyzing the data collected from the field. The CMS program will provide a structured framework to:

1) Measure the performance of the multi-modal system;
2) Identify the causes of congestion;
3) Assess alternative actions and strategies;
4) Implement cost-effective actions; and
5) Evaluate the effectiveness of actions.
In a broader sense, the Northern Middlesex CMS program will link the investment decision-making process with systems management. Figure 2.1 underscores the significance of integrating systems management into the Metropolitan Planning process. Integrating CMS monitoring and evaluation into the development of the region’s planning and programming documents, including the long-range plan, the Transportation Improvement Program (TIP), and the Unified Planning Work Program (UPWP) will help the NMMPO answer the following questions:

1) How is the region’s transportation system performing?
2) What are the congestion and mobility issues in the region?
3) What can be done to address the identified congestion and mobility concerns?
CHAPTER 3

Roadways

In 2003, daily vehicle miles traveled in the Northern Middlesex region was estimated at 7,467,000. This represents approximately five percent of the statewide total. Traffic models estimated that roughly 47 percent of this daily travel occurred on the region’s limited-access roadway system (primarily I-495 and Route 3).¹

The following section reports the results of the CMS data collection effort on the network of CMS monitored arterial roadways and limited-access highways. Also, this chapter describes the data collection methods utilized by NMCOG planning staff.

CMS ROADWAYS

Travel time information was collected on regionally significant roadway facilities in the Northern Middlesex region identified as having mobility issues in the past. Roadways constituting regionally significant facilities are those classified as rural/urban arterials and expressways/interstates. In the Northern Middlesex region, there are approximately 285.53 centerline miles² of roadways classified as arterials (both urban and rural combined) and 16.33 centerline miles³ of roadways are classified as interstates. Regionally significant roadways with mobility issues were identified using past and current transportation studies, the statewide travel demand model, and volume counts.

Figure X and X depicts the CMS monitored roadways in the Northern Middlesex region. The CMS network in the Northern Middlesex region will be dynamic; monitored roadways can either be added or deleted as needed from the monitoring effort. The characteristics of each individual CMS-monitored roadway segment are described in Appendix A and Appendix B.

3.2 TRAVEL-TIME BASED PERFORMANCE MEASURES

The CMS measures roadway congestion on arterials using observed average travel speeds (for arterials and freeways) and delay (for arterials). These performance measures were calculated from travel time data collected during typical traffic conditions at three different periods of the day. These periods include a morning peak, an afternoon peak, and an off peak travel period. Congestion is mainly limited to the peak periods of the day, but off peak conditions were also monitored to help further identify problem areas on the Northern Middlesex roadway network.

¹Executive Office of Transportation, Office of Transportation Planning
³ibid
Arterial roadway classifications for the purpose of this analysis have been kept general. The CMS arterial roadway network is classified as Urban Street Class III or Urban Street Class IV.

### 3.2.1 Average Observed Travel Speeds

**Arterial Roadways**

Travel speed is a typical measure of performance for a roadway segment. The Highway Capacity Manual (HCM) defines level of service (LOS) on arterial roadways and freeways in terms of average speeds. One of the methods the 2000 HCM uses to establish roadway LOS is the analysis of average travel speeds. The LOS corresponding to the average speed varies depending on the roadway classification (see Table 3.1)

<table>
<thead>
<tr>
<th>ARTERIAL CLASSIFICATION</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typical Free Flow Speeds (MPH)</td>
<td>50</td>
<td>40</td>
<td>33</td>
<td>30</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LEVEL OF SERVICE</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Travel Speed (MPH)</td>
<td>42</td>
<td>35</td>
<td>30</td>
<td>25</td>
<td>16</td>
<td>&lt;16</td>
</tr>
</tbody>
</table>


**Freeways**

LOS for limited-access highways is expressed in terms of the flow of traffic relative to the free-flow speeds. LOS A, B, and C essentially describe conditions equal to or greater than free-flow speeds. LOS D describes conditions where speeds are beginning to decrease, and LOS E describes travel conditions at capacity. LOS F describes congested traffic flow conditions. Table 3.2 shows specific speed ranges assigned to each LOS category. These descriptions are based on the HCM descriptions of LOS.
Table 3-2: LOS Criteria for Freeways

<table>
<thead>
<tr>
<th>LEVEL OF SERVICE</th>
<th>AVERAGE TRAVEL SPEED (MPH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>&gt;60</td>
</tr>
<tr>
<td>B</td>
<td>55-&lt;60</td>
</tr>
<tr>
<td>C</td>
<td>50-55</td>
</tr>
<tr>
<td>D</td>
<td>&lt;50</td>
</tr>
</tbody>
</table>


3.2.2 DELAY

Another performance measure used to describe conditions on the Northern Middlesex arterial roadway network is control delay. Along roadway segments, delay is usually attributed to intersection controls (traffic signals, stop signs, etc.) at a segment endpoint. The HCM does not include a definition of a delay threshold for freeways.

**Signal Controlled Intersections**

The HCM defines control delay as the component of delay that results when a traffic control signal causes a lane or group to reduce speed or stop; it is measured by comparison with the uncontrolled condition⁴. Included in the control delay calculation are initial acceleration, stop and go movements in the queue, and reacceleration. Table XX shows delay ranges (expressed in vehicles/second) for signal controlled intersections. The average control delay per vehicle is estimated for each lane group and aggregated for each approach, and for the intersection as a whole. LOS is proportionally related to the control delay value.

Table 3-3: LOS Criteria for Signalized Intersections

<table>
<thead>
<tr>
<th>LOS</th>
<th>Control Delay per Vehicle (second/vehicle.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>= 10</td>
</tr>
<tr>
<td>B</td>
<td>&gt; 10-20</td>
</tr>
<tr>
<td>C</td>
<td>&gt; 20-35</td>
</tr>
<tr>
<td>D</td>
<td>&gt; 35-55</td>
</tr>
<tr>
<td>E</td>
<td>&gt; 55-80</td>
</tr>
<tr>
<td>F</td>
<td>&gt; 80</td>
</tr>
</tbody>
</table>


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⁴ Highway Capacity Manual, p. 5-3.
Stop-Controlled Intersections

Control delay is the appropriate performance measure for both two-way stop-controlled (TWSC) and all-way stop-controlled (AWSC) intersections. Stop controlled intersections have different LOS criteria than signal-control intersections. Table 3.4 shows the criteria used to determine LOS at TWSC and AWSC intersections.

<table>
<thead>
<tr>
<th>LOS</th>
<th>Control Delay per Vehicle (s/veh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>= 10</td>
</tr>
<tr>
<td>B</td>
<td>&gt; 10-15</td>
</tr>
<tr>
<td>C</td>
<td>&gt;15-25</td>
</tr>
<tr>
<td>D</td>
<td>&gt; 25-35</td>
</tr>
<tr>
<td>E</td>
<td>&gt; 35-50</td>
</tr>
<tr>
<td>F</td>
<td>&gt; 50</td>
</tr>
</tbody>
</table>


3.2.2 Travel Time Data Collection Method

Travel time data are collected using the "floating car" technique. This technique involves using a test vehicle traveling with the traffic near or at the posted speed limit on a given roadway segment during the designated time periods. For this CMS report, the designated time periods include the AM peak period (6:30-8:30 AM), the PM peak period (4:30-6:30 PM), and an off-peak period (10:00 AM-12:00 PM). A minimum of four test runs were performed during each period for each segment being analyzed. Each roadway segment has been broken down into smaller segments that have been analyzed in order to find where problem areas are within the roadway segment. Travel times are collected for each roadway segment and analyzed to determine average speed, level of service, and average control delay.

3.3 ROADWAY MONITORING RESULTS

3.3.1 Arterial Roadways

Average Observed Speeds

The arterial roadway segments identified as having mobility and/or congestion issues in the Northern Middlesex region are depicted in Appendix C. These segments were identified based on the recommendations of past and current corridor studies and from information derived from the Central Transportation Planning Staff's regional travel demand model and the statewide model. The average observed speeds along these segments during the peak travel periods are summarized in Table 3.5 and Table 3.6 and Figure 3.3 and Figure 3.4. The data contained in these tables reflects the most recent results for the CMS-monitored roadways in the Northern Middlesex region. Monitoring results for each individual CMS-monitored roadway segment are contained in Appendix A and Appendix B.
Class III Monitored Roadways

Overall, the vast majority of the monitored Class III roadway miles\(^5\) operated at acceptable LOS during the AM and PM peak periods with travel speeds ranging from 24-30 MPH. During the AM Peak Period, 72 percent of the monitored roadway miles operated at LOS B, while only 63 percent of the roadways miles operated at LOS B during the PM peak period. During the PM peak period, more of the Class III roadway miles experienced slower travel speeds and operated below LOS C. See Table 3.5 and Table 3.5 and Figure 3.3 for a breakdown of the monitored Class III roadway miles by average travel speed and LOS.

Class IV Monitored Roadways

Similar to the monitored Class III roadway miles, the vast majority of the Class IV roadway miles\(^6\) operated at acceptable LOS during the AM and PM peak periods with travel speeds ranging from 24-30 MPH. A greater percentage of the Class IV roadway miles than the Class III roadway miles operated at LOS C and experienced average travel speeds between 18-24 MPH. See Table 3.6 and Figure 3.4 for a breakdown of the monitored Class III roadway miles by average travel speed and LOS.

<table>
<thead>
<tr>
<th>Table 3-5: LOS Breakdown for Urban Class III Roadways</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LOS</strong></td>
</tr>
<tr>
<td>1-14 MPH</td>
</tr>
<tr>
<td>&gt;14-18 MPH</td>
</tr>
</tbody>
</table>

*Expressed as percent of total roadway miles monitored

<table>
<thead>
<tr>
<th>Table 3-6: LOS Breakdown for Urban Class IV Roadways</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LOS</strong></td>
</tr>
<tr>
<td>1-14 MPH</td>
</tr>
<tr>
<td>&gt;14-18 MPH</td>
</tr>
</tbody>
</table>

*Expressed as percent of total roadway miles monitored

\(^5\) Total miles for Class III roadways equals 72.80 and is the combined length of the roadway's two directions of travel.

\(^6\) Total miles for Class IV roadways equals 18.45 and the combined length of the roadway's two directions of travel.
As expected, observed delay was greater in the evening peak period than in the morning peak period. During the AM peak period, approximately two percent (2.53 miles) of the monitored arterial roadways experienced delay greater than 60 seconds. During the PM peak period, approximately five percent of the monitored roadways experienced an average delay greater than 60 seconds (4.63). Tables 3.7 and 3.8 below provide a listing...
of these segments. For the most part, delay along these segments could be attributed to the queues associated with signalized intersections. Most of the high-delay intersections are located in Lowell and Chelmsford.

Table 3-7: Segments Experiencing Significant Delay during the PM Peak Period

<table>
<thead>
<tr>
<th>Segment Name</th>
<th>City/Town</th>
<th>Direction</th>
<th>Segment Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Route 3A from Route 129 to Treble Cove Road</td>
<td>Billerica</td>
<td>Southbound</td>
<td>.09</td>
</tr>
<tr>
<td>Wood Street from Middlesex Street to Princeton Street</td>
<td>Lowell</td>
<td>Southbound</td>
<td>.10</td>
</tr>
<tr>
<td>Westford Street/Wood Street from Technology Drive to Pawtucket Boulevard</td>
<td>Lowell</td>
<td>Northbound</td>
<td>.78</td>
</tr>
<tr>
<td>Route 129 from Golden Cove Road to Route 110</td>
<td>Chelmsford</td>
<td>Westbound</td>
<td>.57</td>
</tr>
<tr>
<td>Route 4 from Summer Street to Route 129/Route 110</td>
<td>Chelmsford</td>
<td>Northbound</td>
<td>.25</td>
</tr>
<tr>
<td>Bridge Street from French Street to VFW Highway</td>
<td>Lowell</td>
<td>Northbound</td>
<td>.21</td>
</tr>
<tr>
<td>Route 38 from Rogers Street to Andover Street</td>
<td>Lowell</td>
<td>Northbound</td>
<td>.49</td>
</tr>
<tr>
<td>Plain Street from Lowell Connector SB Ramp to Route 110</td>
<td>Lowell</td>
<td>Westbound</td>
<td>.13</td>
</tr>
<tr>
<td>Route 3A from School Street to Route 110</td>
<td>Lowell</td>
<td>Southbound</td>
<td>.51</td>
</tr>
<tr>
<td>Route 38 from South Street to Shawsheen Street</td>
<td>Tewksbury</td>
<td>Northbound</td>
<td>.82</td>
</tr>
<tr>
<td>Boston Road from Crown Road to Main Street</td>
<td>Westford</td>
<td>Northbound</td>
<td>.43</td>
</tr>
<tr>
<td>Route 110 from Westford Valley Marketplace to Boston Road</td>
<td>Westford</td>
<td>Westbound</td>
<td>.25</td>
</tr>
</tbody>
</table>

Table 3-8: Segments Experiencing Significant Delay during the AM Peak Period

<table>
<thead>
<tr>
<th>Segment Name</th>
<th>City/Town</th>
<th>Direction</th>
<th>Segment Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Andover Road from Pond Street to Route 3A</td>
<td>Billerica</td>
<td>Westbound</td>
<td>.33</td>
</tr>
<tr>
<td>Wood Street from Middlesex Street to Pawtucket Boulevard</td>
<td>Lowell</td>
<td>Northbound</td>
<td>.33</td>
</tr>
<tr>
<td>Bridge Street from French Street to VFW Highway</td>
<td>Lowell</td>
<td>Northbound</td>
<td>.21</td>
</tr>
<tr>
<td>Plain Street from Lowell Connector SB Ramp to Route 110</td>
<td>Lowell</td>
<td>Westbound</td>
<td>.13</td>
</tr>
<tr>
<td>Route 38 from Post Office to Shawsheen Street</td>
<td>Tewksbury</td>
<td>Southbound</td>
<td>1.53</td>
</tr>
</tbody>
</table>

3.3.2 Limited-Access Highways

Three limited-access facilities serve the Northern Middlesex region: Route 3 from the New Hampshire State Line to the Billerica/Bedford Town Line; I-495 from the Littleton Town line to the Tewksbury/Andover Town line; and I-93 within the Town of Tewksbury. The Central Transportation Planning Staff (CTPS) collected speeds on these facilities in 1999 and 2000. Speed data for Northern Middlesex highways and expressways contained in this report is derived from CTPS's 2004 CMS report.\(^7\)

Travel speeds were collected during the morning peak commute hour, from 6:00 to 10:00 AM, and during the evening peak hours, from 3:00 to 7:00 PM. For the CMS summary of travel speeds, the observations are averaged over a 2.5-hour morning peak period (6:30 to 9:30 AM) and a three-hour evening peak period (3:30 to 6:30 PM). The speed

\(^7\) Mobility in the Boston Region: Existing Conditions and Next Steps

The 2004 Congestion Management System Report
experienced along roadway segments during the peak travel periods have been summarized for the limited-access facilities in the Northern Middlesex region, including interstate highways and regional expressways.

**ROUTE 3 NORTH**

Figure 3.5 below shows the observed travel speeds on Route 3 northbound and southbound during the AM and PM peak periods. Route 3 southbound during the AM peak period and Route 3 northbound during the PM peak period experienced congestion between the Route 3A/Route 129 and the Treble Cove Road exits. Along this segment of Route 3, travel speeds dropped below 30 MPH during the AM peak period and below 20 MPH during the PM peak period.

![Figure 3-5: Route 3 North Observed Travel Speeds](image)

Note that travel speeds were collected on Route 3 North prior to the completion of the expansion project⁸. It is anticipated that CTPS and MassHighway will collect data on Route 3 north in the near future to assess the impact of this project on regional travel conditions.

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⁸ The Route 3 North expansion project entailed the construction of an additional travel lane in each direction, and the redesign of all 11 interchanges.
INTERSTATE 495

Figure 3.6 below shows the observed travel speeds on I-495 northbound and southbound during the AM and PM peak periods. I-495 operates at acceptable LOS along all segments during both the AM peak period and the PM peak period. Speeds along all segments of I-495 in the Northern Middlesex region did not drop below 50 MPH. I-495 northbound during the PM peak period between the Lowell Connector and Woburn Street experienced the greatest drop in speed.

INTERSTATE 93

A small segment of I-93 runs through the Town of Tewksbury in the Northern Middlesex region. Recently, the MassHighway and the Merrimack Valley Planning Commission completed an I-93 corridor study. Since the segment of I-93 in Tewksbury was included in the existing conditions analysis, LOS was derived directly from this report. Table 3-9 shows that southbound segment during the AM peak period and the northbound segment during the PM peak period operate at unacceptable LOS.

TABLE 3-9: I-93 LOS

<table>
<thead>
<tr>
<th></th>
<th>I-93 Northbound</th>
<th>I-93 Southbound</th>
</tr>
</thead>
<tbody>
<tr>
<td>AM Peak Period</td>
<td>LOS B</td>
<td>LOS E</td>
</tr>
<tr>
<td>PM Peak Period</td>
<td>LOS E</td>
<td>LOS D</td>
</tr>
</tbody>
</table>

*Source: Vanasse Hangen Brustlin, Inc. (VHB)*
4.1 ARTERIAL ROADWAYS

4.1.1 Summary of Findings

Data was collected on approximately 91.25 miles of arterial roadways in the Northern Middlesex region. For the most part, the data shows that majority of the CMS-monitored arterial roadway segments operate at acceptable LOS during the AM and PM peak periods and experience limited delay; however, the data does identify congestion issues in the region. Figures 4-1 through 4-3 show the locations of congested roadway segments during the AM, PM, and Off-Peak periods. Summarized below is the arterial roadway performance during the AM and PM peak periods.

During the AM Peak period:

• 1.1 percent of the total monitored Northern Middlesex arterial roadway miles are congested;

• 17 percent of the monitored arterial roadway miles experienced average speeds below 25 MPH; and

• Route 38 in Tewksbury had the greatest amount of roadway miles that experienced congestion.

During the PM peak period:

• 3 percent of the total monitored Northern Middlesex arterial roadway miles are congested;

• 6 percent of the monitored arterial roadway network experienced average speeds 14 MPH;

• 30 percent of the monitored arterial roadway network experienced average speeds below 25 MPH; and

• Drum Hill Road in Chelmsford/Lowell and Route 3A in Lowell had the greatest amount of roadway miles that experienced congestion.
During the Off-Peak period the following arterial segments are congested:

- Drum Hill Road westbound between Route 4 south and Route 4 north;
- Route 129 eastbound between Mill Road and Route 3 south ramps;
- Route 4 northbound between Route 110/Route 129;
- Gorham Street northbound between Church Street and Merrimack Street;
- Gorham Street northbound between French Street and VFW Highway;
- Plain Street westbound between the Lowell Connector southbound ramp and Route 3A;
- Route 110 northbound between Westford Street and the southbound Thorndike Street Ramp;
- Route 110 northbound between Middlesex Street east and Middlesex Street west;
- Route 3A southbound between Route 110 and southbound Thorndike Street ramp;
- Route 3A southbound between Highland Street and YMCA Drive;
- Route 3A northbound between Highland Street and Terminal Drive;
- Route 3A northbound between Middlesex Street east and Middlesex Street west;
- Route 3A between Livingston Street and Shawsheen Street;
- Route 110 westbound between Westford Valley Marketplace;
- Andover Road westbound between Pond Street and Route 3A;
- Route 3A southbound between Route 129 and Treble Cove Road; and
- Dalton Road westbound

Field observations were conducted during the data collection process. Among the issues observed as having an effect on congestion and mobility were the following:

- Lack of traffic signal coordination, actuation, and inefficient signal timing were noted to contribute to unnecessary delays along the monitored roadway segments and at intersections. The level of delay at some signalized intersections indicates that vehicles have to wait in a queue for more than one traffic signal cycle.
• Many signalized intersections did not have adequate signs and pavement markings to indicate lane assignments. Motorists become frustrated and confused when navigating through intersections that lack these items.

• Many locations lack signs displaying street names and route designations, or have signs that are difficult to see.

4.2 LIMITED-ACCESS ROADWAYS

4.2.1 Summary of Findings

Data was collected to document conditions on the three limited-access facilities in the Northern Middlesex region: I-93, Route 3, and I-495. For the most part Route 3 north experienced more congested conditions than the other two limited-access facilities in the region. It should be noted that the data for Route 3 North was collected prior to the implementation of the improvement project. Below is a summary of the performance of the limited-access roadways.

During the AM Peak period:

• Route 3 southbound is congested between Route 3A/Route 4 and Concord Road;

• The southbound segment of I-93 that passes through the Northern Middlesex region is congested; and

• I-495 experiences acceptable conditions both northbound and southbound.

During the PM Peak period:

• Route 3 northbound is congested between Treble Cove Road and Westford Road;

• The northbound segment of I-93 that passes through the Northern Middlesex region is congested; and

• I-495 experiences acceptable conditions both northbound and southbound.
CHAPTER 5

Recommendations

The general mobility-enhancing strategies are intended to address the effects of congestion in this region, and are derived from the information contained in the Texas Transportation Institute's 2005 Urban Mobility Report\(^1\). This report, published annually, quantifies the costs of congestion and measures the effectiveness of congestion mitigation techniques in metropolitan areas throughout the country. The recommendations for corridor studies and follow-up studies are derived straight from the results of the CMS monitoring, and will guide the development of the NMMPO's three certification documents: the RTP, UPWP, and the TIP.

5.1 General Mobility-Enhancing Strategies

Adding capacity to address congestion in the long-term is generally not feasible or cost-effective given the lack of available right-of-way and financial resources, and the Commonwealth’s emphasis on system preservation over expansion. Applying various technologies, operating practices, demand management strategies and programs can maximize the efficiency of the roadway system.\(^2\) Individually these strategies may not seem to offer significant reduction in congestion, but their cumulative effects can substantially improve the existing travel conditions in the Northern Middlesex region.

Transportation Demand Management

Transportation Demand Management (TDM) is the implementation of specific strategies and/or programs designed to reduce or modify the demand for travel. TDM strategies can include a variety of methods, including carpooling, vanpooling, preferential parking, transit subsidies, and the encouragement to travel outside peak periods. These strategies can help maximize the efficiency of the transportation network by managing the travel demand. MassRIDES—the Executive Office of Transportation's new statewide travel options program—offers assistance and outreach services to commuters, employers, students, and other traveler markets to promote the implementation of TDM strategies in Eastern Massachusetts. NMCOG staff, through its economic development and transportation planning outreach efforts, should encourage major employers in the region to partner with MassRIDES to develop, market, and implement effective TDM programs.

Manage Construction and Maintenance Projects

Construction and maintenance projects intended to improve mobility along a corridor can actually cause severe congestion. Implementing more effective techniques to manage construction and maintenance projects can make a difference in reducing congestion.

\(^1\) David L Schrank and Timothy J. Lomax, 2005 Urban Mobility Report, Texas Transportation Institute

\(^2\) Ibid.
Some of the traditional strategies involve methods to improve the construction phase by shortening the duration of construction, or moving construction to periods where traffic volume is relatively low. MassHighway is sensitive to the effect of construction projects on congestion. A 2003 Engineering Directive entitled "Measures to Limit Motorist Travel Delays Through Construction Work Zones" requires project engineers to take all appropriate actions to reduce motorist delays caused by construction operations. Another successful strategy employed to help reduce congestion caused by construction is the creation of project websites. These websites relay information about the project status, potential route detours, etc., and provide information on alternative commuting options. Project websites, similar to the one created for the Route 3 north project, should always be considered as a construction management tool in the Northern Middlesex region.

Incident Management

An incident management program has been in effect on most limited-access facilities since the early 1990s to reduce the level of delay caused by nonrecurring congestion. One of its most successful components is the "CaresVan" program, a partnership between MassHighway and the Commerce Insurance Company. The "CaresVan" service consists of 33 roving service patrols or tow trucks that provide free roadside assistance to disabled motorists in the metropolitan areas of Boston, Worcester and Springfield. Figure 5.2 from the Texas Transportation Institute below shows the success of service patrols in reducing delay in metropolitan areas throughout the country.

Geometric Improvements

The implementation of geometric improvements can help improve mobility along arterial corridors in the Northern Middlesex region. Motorists become frustrated and confused when they travel through intersections that lack directional signage, proper turning lanes, and inadequate pavement markings. Constructing exclusive turning lanes, furnishing
directional signing, and installing pavement markings is a cost-effective way to help improve safety and traffic operations at congested intersections. Many intersections in the Northern Middlesex region are undergoing geometric upgrades. Follow-up monitoring should be conducted at these locations (see descriptions in the following section) to verify the effectiveness of these improvements.

**Traffic Signal Coordination**

Traffic signal coordination is the application of various tools and technologies to coordinate the operations of signals along major arterial corridors. Signal coordination allows platoons of vehicle to travel through a consecutive set of intersections under low-delay condition, and has shown to be an effective mobility-enhancing strategy (see figures below). Traffic signal coordination is one of the most cost-effective ways to maximize the efficiency of the arterial roadway system, to enhance the on-time performance of buses, and improve the overall safety of the roadway corridor. Implementing an effective signal coordination program could even postpone or eliminate the need for expensive construction projects.

**Figure 5-3: Signal Coordination Benefits**

![Figure 5-3: Signal Coordination Benefits](image)

Source: Texas Transportation Institute, 2005 Urban Mobility Report

**Figure 5-4: Delay-Reduction Benefits of Principal Arterial Street Signal Coordination**

<table>
<thead>
<tr>
<th>Population Group</th>
<th>Average Covered Lane-miles</th>
<th>Percentage</th>
<th>Principal Arterial Hours of Delay (million) Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Large (13)</td>
<td>2,064</td>
<td>64</td>
<td>6.2</td>
</tr>
<tr>
<td>Large (26)</td>
<td>681</td>
<td>50</td>
<td>3.1</td>
</tr>
<tr>
<td>Medium (30)</td>
<td>357</td>
<td>57</td>
<td>1.4</td>
</tr>
<tr>
<td>Small (16)</td>
<td>174</td>
<td>55</td>
<td>0.2</td>
</tr>
<tr>
<td>85 Area Average</td>
<td>808</td>
<td>53</td>
<td>–</td>
</tr>
<tr>
<td>85 Area Total</td>
<td>68,678</td>
<td>59</td>
<td>10.9</td>
</tr>
</tbody>
</table>

Source: Texas Transportation Institute, 2005 Urban Mobility Report; HPMS; IDAS
5.2 Recommended Corridor Studies in Northern Middlesex Region

Based on the results of the monitoring, three corridor studies are recommended to identify, develop, prioritize, and recommend mobility enhancement strategies for these locations. These recommendations are described in detail below.

**Route 3A/Gallagher Terminal Circulation Study**

The CMS data shows that Route 3A (Thorndike Street) experiences congestion during the peak hours of the day. The LRTA bus hub has recently been moved from downtown Lowell to Gallagher Terminal. C&C Consulting Engineers, on behalf of the LRTA, conducted a circulation study that analyzed traffic operations at Gallagher Terminal and the surrounding street network with the relocated bus hub. This study showed that the recommended circulation pattern in place currently would maintain acceptable traffic operations in and around Gallagher Terminal. Although the CMS-monitoring was conducted prior to the bus hub being operational, the data has shown that Thorndike Street experienced significant congestion in the vicinity of Gallagher Terminal. A follow-up study should be conducted to reevaluate the feasibility of the current circulation pattern and to identify its impacts on traffic operations at Gallagher Terminal and the surrounding street network.

**Route 3A Corridor Study - Billerica**

Prior to conducting the CMS monitoring, the Town of Billerica requested that NMCOG Staff conduct a corridor on Route 3A to identify strategies for alleviating congestion along this corridor. Route 3A has traditionally served as an alternate route to avoid the congestion on Route 3. According to the CMS data, Route 3A experiences significant congestion and levels of delays during peak and off-peak periods. MassHighway is in the process of implementing improvements along five intersections on Route 3A. The improvements include a new fully actuated traffic control signal system, new signs and pavement markings. These improvements will improve safety and traffic operations along this corridor. A corridor study should be conducted to measure the effectiveness of these improvements, analyze the impact of the recently implemented improvements on Route 3, and identify additional measures to improve traffic operations and safety on Route 3A.

**Gorham Street - Bridge Street from Lowell Connector to VFW Highway in Lowell**

According to the CMS data, the roadway network serving the downtown Lowell area experiences significant delays and operates at a poor LOS during the peak periods. Specifically, the lack of crossings over the Merrimack River exacerbates traffic conditions in downtown. The City has hired a transportation engineering firm to look at traffic issues in the Jackson/Appleton/Middlesex (JAM) Streets Hamilton Canal District. The Lowell Historical National Park, the City, the LRTA, and NMCOG have partnered in a Downtown Lowell circulation study aimed at examining transit options downtown. As the City is moving forward with its downtown redevelopment initiatives, capacity-related issues should be further analyzed.
5.3 Recommended Follow-Up Monitoring

Many of the congested roadway segments and corridors examined in this report have been recently reconstructed, or are currently undergoing reconstruction. These locations have been selected for detailed follow-up studies to gauge the effectiveness of the implemented improvements on reducing congestion.

**Route 4/Dalton Road Intersection- Chelmsford**

According to the CMS data, Dalton Road operates at acceptable LOS and experiences minimal delay during the peak and off-peak periods along most of the monitored segments. The data does point out that significant delay occurs at its intersection with Route 4. Problematic geometry appears to contribute to the level of delay and present a safety hazard at this location. In 2001, the Town of Chelmsford initiated implementation of safety improvements at this intersection and retained VHB to prepare a Functional Design Report (25% design). This report verified the results of the CMS monitoring, and recommended signalization and associated geometric upgrades at this location. Construction of these improvements is slated for spring 2006. To ensure their effectiveness, this location should be monitored in subsequent CMS-monitoring efforts.

**Route 38 (Main Street)/Shawsheen Street- Tewksbury**

Route 38 in Tewksbury operates at acceptable LOS and experiences minimal delay along most of monitored segments. The CMS data does indicate congested conditions and safety issues at the Route 38/Shawsheen Street intersection. Field observations confirmed these results, and identified the problematic intersection geometry as having an impact on safety and traffic operations at this location. MassHighway is currently constructing improvements (signalization and associated geometric upgrades) at this location to increase capacity and provide safe conditions for vehicles and pedestrians. To assess the effectiveness of these improvements, a follow-up evaluation should be conducted subsequent to their implementation.

**Boston Road/I-495 ramps - Westford**

The CMS data shows that congestion on Boston Road occurs mostly at the I-495 ramps. Empirical observations confirmed that the queuing left-turning vehicles were the main cause of the delay at this location. MassHighway has recently installed traffic signals at the northbound and southbound ramps and constructed associated geometric improvements. The purpose of this project is to facilitate the efficient movement of left-turning vehicles from I-495 to Boston Road and to increase the capacity on Boston Road and its intersection at Route 110. The traffic signals are operational and the pavement markings have been installed with associated signage to be erected in the immediate future. A follow-up analysis should be conducted in the near future to ensure the effectiveness of these improvements.
Chelmsford Street (Route 110)/Plain Street /Powell Street intersection- Lowell

The CMS data indicates that the Route 110/Plain Street intersection experiences congestion during peak and off-peak periods. To enhance safety and improve traffic operations, the City of Lowell has initiated the implementation of improvements at this location. According the Functional Design Report, the project entails the replacement of the outdated traffic signal equipment with a new fully actuated traffic signal and the construction of geometric improvements. Other improvements include the installation of an exclusive push-button pedestrian phase, wheelchair ramps, crosswalks, new signs and pavement markings. The NMMPO has approved funding for this project, and it is programmed in the 2006-2010 TIP.

Route 3 North Improvement Project Follow-Up

The expansion of Route 3 North from four lanes to six lanes, and the reconstruction of several of its interchanges, has been completed. The CMS-monitoring data reflects conditions prior to the implementation of these improvements. To gauge the effectiveness of these improvements, CTPS is performing a study to ascertain the LOS on the Route 3 mainline with the improvements in place. To compliment this effort, an evaluation of the improvements' impact on traffic operations and safety should be performed. Based on the CMS findings, the following locations are recommended for further study:

- The Route 3 /Route 129 interchange;
- Route 129/Turnpike intersection;
- Route 129/Golden Cove Road intersection; and
- Drum Hill Square.

5.4 Expansion of Monitoring Activities

CMS underscores the importance of evaluating the overall efficiency of the multimodal transportation system and gauging the effectiveness of transportation improvements. Expansion of the CMS monitoring activities in the Northern Middlesex region will provide even more detailed information on the performance of the region's transportation system. This first CMS monitoring effort has focused on collecting traffic data to measure the performance of the arterial and limited-access roadway system. To fully recognize and appreciate the mobility-related issues in this region, it would be prudent to measure performance from a multimodal perspective. Furthermore, engaging in a continuous data collection effort will facilitate a better understanding of conditions on the region's multimodal transportation system, and help NMMPO staff gauge the effectiveness of recommended and implemented actions. CMS data should be collected, catalogued, and analyzed annually. A year-to-year comparison of conditions can be documented in subsequent CMS reports. Transit performance data should be collected from the LRTA to document the on-time performance of their buses, as schedule adherence is affected by roadway conditions.
CHAPTER 6

Conclusion

The purpose of the CMS report is to identify the sources of congestion and recommend a set of mobility-enhancing strategies. CMS emphasizes the importance of taking multi-jurisdictional and multi-institutional approaches to address congestion in metropolitan areas. Using this report as an effective decision-support tool will require the participation of local, regional, and State institutions and organizations. These organization and institutions include the following:

- The Executive Office of Transportation;
- MassHighway;
- MassHighway District 3 and District 4 Offices;
- MBTA and LRTA;
- Municipalities in the Northern Middlesex region;
- Adjacent MPOs (Merrimack Valley MPO and the Boston MPO);
- Adjacent RPAs (Merrimack Valley Planning Commission, Nashua Regional Planning Commission, and Metropolitan Area Planning Council);
- MassRides;
- Transportation Management Association (TMAs); and
- Major employers in the region.

Transportation research underscores that congestion is not just an “urban” problem, only experienced in large cities. Congestion and mobility challenges are often experienced in small and medium-sized metropolitan areas. The Northern Middlesex region is no exception, and this CMS report demonstrates that this region experiences its fair share of mobility challenges on the arterial and limited-access roadway network.