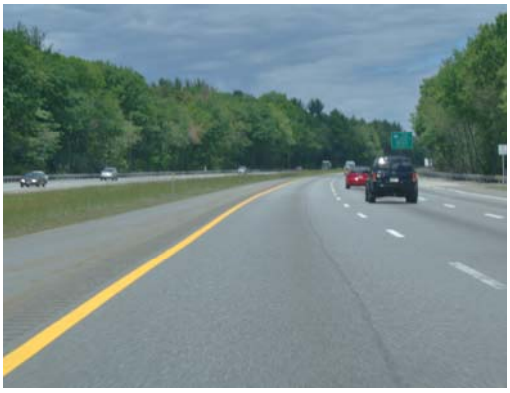
ROAD SAFETY AUDIT

ROUTE 3 BEDFORD-BILLERICA-CHELMSFORD

MAJOR HIGHWAY MEDIAN CROSS-OVER CRASHES



Prepared for

MASS HIGHWAY

Prepared by
MS Transportation Systems, Inc.
Framingham, Massachusetts

February 2009

ROAD SAFETY AUDIT

ROUTE 3 BEDFORD-BILLERICA-CHELMSFORD

MAJOR HIGHWAY MEDIAN
CROSS-OVER CRASHES

Final Report

February 2009

Prepared for

Massachusetts Highway Department

Prepared by

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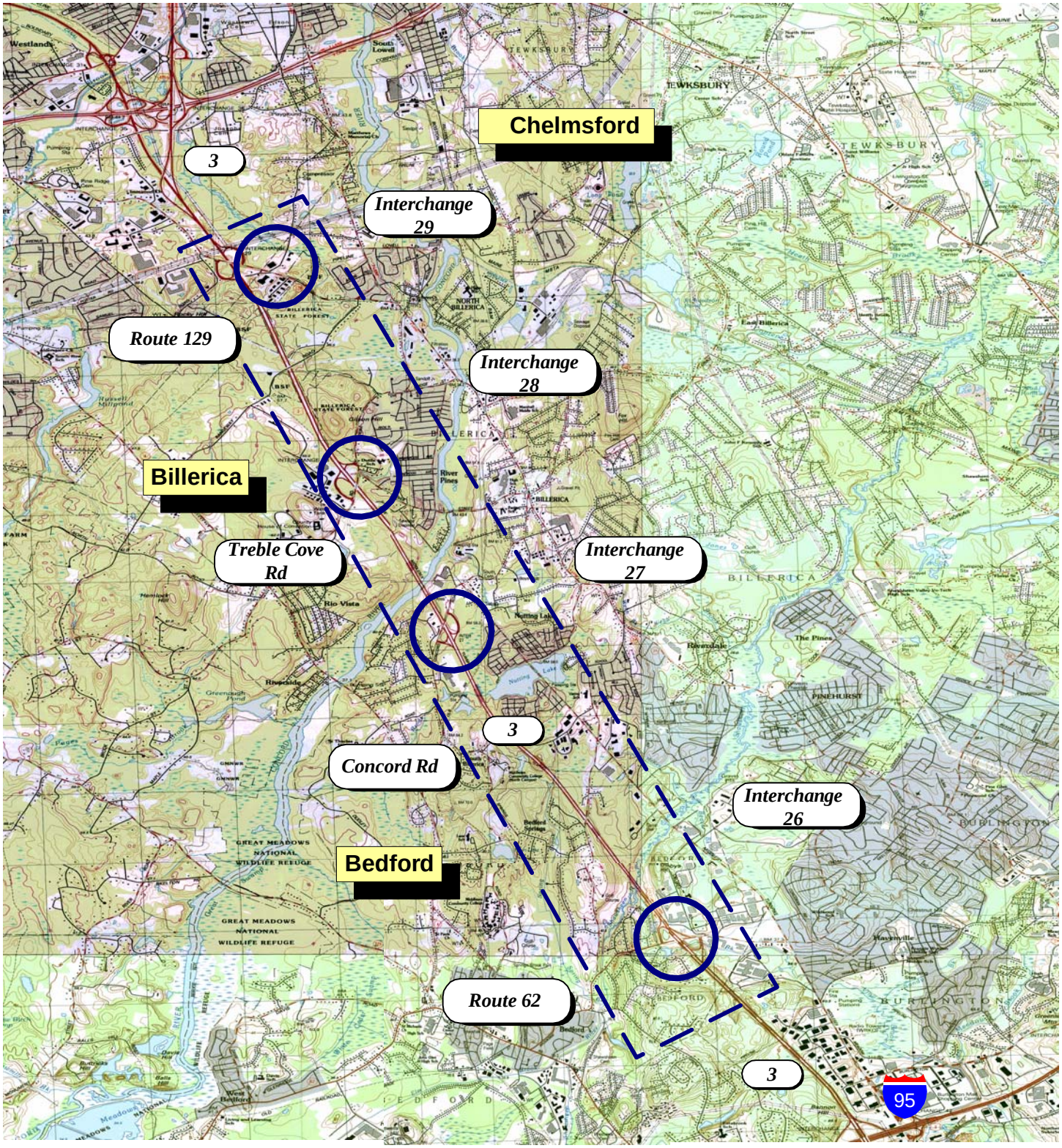
Introduction

Lane departure crashes are one of the primary fatal crash types in Massachusetts. The Commonwealth exceeds the national average for the proportion of fatal lane departure crashes and was designated a lead state in lane departure crashes by the American Association of State Highway and Transportation Officials (AASHTO). The Massachusetts Highway Department (MassHighway) conducted a study of the problem and found that during 2002-2004, lane departure crashes accounted for 25 percent of all injury crashes and nearly half, 46 percent, of all fatal crashes.

As part of the effort in implementing the safety plan and specifically reducing lane departure crashes, the MassHighway is completing a Road Safety Audit (RSA) Review Project specifically focused on median crossing (or median cross-over) crashes on its major highways. Road safety audits are a formal safety performance examination on existing or future roadways by an independent audit team. These specific audits are being conducted in locations where cross-over experience has been or has the potential to be of concern and where the RSA team has judged that factors exist that could affect the safety risk. During the audit, the RSA team works to identify opportunities for enhancing safety and to recommend specific enhancements intended to reduce median cross-over crashes and improve the overall safety along the highway.

A RSA was conducted for a section of Route 3 primarily in Bedford and Billerica and a short section in Chelmsford. Figure 1 shows the corridor section under study. It extended from Interchange No. 26 in Bedford to Interchange 29 in Chelmsford. While Route 3 underwent a major reconstruction project in the early 2000's, this section had experienced a number of median related crashes during and after reconstruction with a high proportion being median *cross-over* crashes.

The purpose of this Route 3 RSA is to identify current safety conditions on the highway section under study and to recommend a set of actions to address the identified issues. Recommendations contained in this report reflect the overall consent of the RSA team and do not necessarily reflect the official views of MassHighway.



Project Location

Route 3 Road Safety Audit
Bedford-Billerica-Chelmsford, Massachusetts

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1 : 25,000

MS Transportation Systems, Inc. Framingham, Massachusetts

FIGURE 1

RSA Process

The general process outlined in the guideline[1] was essentially followed although with some minor variations incorporated in the overall procedure. These were due in part to the project location being a high speed, high volume section of an access controlled highway. With these characteristics, there are limited areas to safely stop and gather as a group along the section without potentially hindering traffic flow or the safety of the RSA team. In addition, there were a larger number of people (16) involved in the project. Given the team size and general character with the corridor, the team members who visited the site prior to the team meeting did so either individually or in smaller groups. A video recording of a drive-thru in both directions was collected by the RSA consultant and used at the meeting to review conditions as a group. Background material and plans were transmitted to the RSA consultant to compile and review prior to the initial RSA team meeting. Crash and traffic volume data were transmitted to RSA team members prior to the meeting as well. Once the initial RSA team meeting was conducted, the RSA consultant gathered the input completed the analysis and prepared a draft document for team members to review. Data including summary crash records for the 2004-2007 period, ten (10) detailed crash narratives of cross-over crashes, and available record highway plans were obtained and reviewed by the RSA consultant.

- **RSA Team**

The following individuals participated in the Route 3 Road Safety Audit:

Brett Loosian, MassHighway District 4, Maintenance
Timothy White, FHWA
David Phaneuf, MassHighway Boston
Bonnie Polin, MassHighway Safety Management Unit
Lisa Schletzbaum, MassHighway Safety Management Unit
John Gregg, MassHighway District 4, Traffic
Mena Slimen, MassHighway District 4, Traffic
Rick Wilson, MassHighway Boston
Lt. Edward Downer, Mass State Police Andover
William J. Scully, MS Transportation Systems (RSA Consultant)
Dave Ginns, Northern Middlesex Council of Government
Justin Howard, Northern Middlesex Council of Government
Seth Asante, CTPS
Ashish Patel, MassHighway Design
Lt. James Bailey, Mass State Police Concord
Andrew Hirshfield, MassHighway Intern

Team members represented various agencies, disciplines and expertise.

[1] MS Transportation Systems, Inc., Road Safety Audits, Median Cross-Over Crashes, Audit Guidelines, Prepared for MassHighway, October 2007.

- **RSA Meeting**

A meeting was held on June 5, 2008 at the MassHighway District 4 Office. At the meeting, the RSA consultant provided a brief overview of the RSA purpose, a summary of the roadway section's characteristics and the results of the review to date in terms of geometry, volume and crash data researched and the field visit observations. The RSA team members listed above were present at the meeting. The video record of Route 3, taken while driving the corridor, was viewed. During and following the video, there were further discussions related to the possible factors related to the cross-median crashes and possible solutions to prevent or alleviate similar characteristics in the future. The RSA team provided input on the background supporting data, the key items observed in the field and those items that were listed on the RSA Median Cross-Over Prompt List.

Key items noted at the meeting included the following:

- The widening and reconstruction of Route 3 was essentially completed with some punch list items to complete.

- There are no noticeable or unique items such as geometry or cross-section characteristics that have been observed since the roadway project was completed that would be causing unforeseen safety problems.

- The group noted that, in general, the engineering design does not seem to be a contributing factor to the current safety characteristics as 30 foot clear zones exist; the acceleration lanes were designed longer than typically provided, wide outside and inside shoulders exist and rumble strips have been provided. That said, there was also a general sense by several team members that the resulting condition (i.e. straight, level sections) may contribute to driver complacency and inattention as well as the high travel speeds.

- High speeds are a significant problem when combined with the high volumes and interchange access, conflicts and crashes are more likely to occur.

- A large speed differential that has been observed on the study section was also noted as a major contributing factor to lane changing behavior that can lead to errant drivers and crashes. The 55-mile per hour speed

limit was discussed as a possible cause to the large range or differential in speeds.

- ♦ It was noted that a large proportion of median related crashes that have occurred over the past several years are cross over crashes.

Following the RSA meeting, the RSA consultant compiled the information, completed the analysis and circulated the draft report to team members.

- **Analysis Procedures**

As previously indicated, the RSA analysis generally followed the procedure described in the previously referenced Guideline with some variations and also took into consideration the methods published by the Federal Highway Administration[2] and those included in training materials[3]. The basic tasks included:

- Obtaining and reviewing crash and other traffic characteristic data and available record plans.
- Conducting site reconnaissance and collecting a current record of condition via photos and video,
- Identifying potentially hazardous issues, and
- Identifying and evaluating potential actions to address the noted issues.

In assessing the issues identified by the RSA Team, the relative seriousness and potential risk relative to crash frequency and severity were determined. Using the guidelines of FHWA as input and considering characteristics of this specific RSA, the relative frequency criteria and severity criteria were identified and are presented in Table 1 and Table 2, respectively.

Taking into consideration both frequency and severity, the relative risk of a particular audit item was rated. The risk ratings are shown in Table 3. For each safety issue identified, the potential seriousness of the issue as well as possible mitigation measures have been indicated.

[2] Federal Highway Administration, FHWA Road Safety Audit Guidelines, Publication No. FHWA SA-06-06, Washington, D.C., 2006.

[3] Federal Highway Administration, Resource Center, Road Safety Audits Mini-Workshop, Jeffrey Shaw, PE, PTOE, presented to New England ITE Section, September 19, 2006.

TABLE 1
FREQUENCY RATING

ESTIMATED		EXPECTED CRASH FREQUENCY (PER AUDIT ITEM)	FREQUENCY RATING
Exposure	**Probability**		
high	high	5 or more crashes per year	*Frequent*
medium	high		
high	medium	1 to 4 crashes per year	*Occasional*
medium	medium		
low	high		
high	low	Less that 1 crash per year, but more than 1 crash every 5 years	*Infrequent*
low	medium		
medium	low	Less than 1 crash every 5 years	*Rare*
low	low		

Source: FHWA RSA Training Workshop

TABLE 2
SEVERITY RATING

Typical Crashes Expected (per audit item)	Expected Crash Severity	Severity Rating
High-speed crashes; head on and rollover crashes	Probable fatality or incapacitating injury	*Extreme*
Moderate-speed crashes; fixed object or off-road crashes	Moderate to severe injury	*High*
Crashes involving medium to low speeds; lane changing or sideswipe crashes	Minor to moderate injury	*Moderate*
Crashes involving low to medium speeds; typical of rear-end or sideswipe crashes	Property damage only or minor injury	*Low*

Source: FHWA RSA Training Workshop

TABLE 3
CRASH RISK ASSESSMENT

Frequency Rating		Severity Rating		
	Low	Moderate	High	Extreme
Frequent	C	D	E	F
Occasional	B	C	D	E
Infrequent	A	B	C	D
Rare	A	A	B	C

Source: FHWA RSA Training Workshop

Crash Risk Ratings:
A: minimal risk level
B: low risk level
C: moderate risk level
D: significant risk level
E: high risk level
F: extreme risk level

- **RSA Field Audit**

Field audits were conducted prior to the RSA meeting held on June 5, 2008. The field audits included several drive-thrus in each direction of travel as well as through the interchanges. A Prompt List developed for median cross-over RSA's was used for further guidance. The Prompt List is included in the Appendix. The following were noted during the audit:

- The inside shoulder is about 10+ feet in width with some off-pavement leveling area provided depending on the specific location. (construction plans were later checked and confirmed that a level, unpaved area of approximately 12 feet is provided for future widening).

- Rumble strips exist on the inside shoulder and are located approximately 6 inches beyond the edge line.

- A rumble strip is also in place on the outside shoulder. The outside shoulder appears to be 10 to 12 feet in width.

- The median is depressed and grassed for the most part – there may be drainage structures in the center of the median (plans to be checked),

- Speeds are posted at 55 mph with observed motorists generally traveling above speed limit – few signs were noted.

- There are imbedded reflectors in the pavement along lane lines.

- The current pavement markings and roadway/surface are in good condition.

- White post markers noting approximate location of buried fiberoptic cable.

Analysis

Route 3 in the Bedford-Billerica-Chelmsford study section is a major State highway that provides north-south movement in Eastern Massachusetts connecting the Boston metropolitan area in the south to New Hampshire to the north. It was reconstructed in the early to mid-2000's with the majority of construction completed by 2006. Reconstruction included widening, increasing horizontal and vertical clearances and other related safety and operational features. In the section under study, it consists of three (3) travel lanes per direction. The roadway also has a full (12 foot) outside shoulder and an inside shoulder in the range of 10 to 12 feet. Rumble strips have been installed on both the inside and outside shoulders. The vertical and horizontal alignment is varying but can be characterized as "gentle". It was noted that the speed limits are posted at 55 miles per hour (mph). The unpaved portion of the median width through the section is approximately 56 feet. Taking into account the existing inside shoulders, the total "median" width is approximately 76 to 80 feet. While the length of the study section is approximately 8.5 miles, a review of the corridor shows that the length of the "open" median in this section is approximately 6.1 miles. The slope of the median varies from flatter than 10:1 to a 6:1 slope more in the center section. Typical cross-section diagrams are included in the Appendix of this report. Figures 2 through 5 present photographs that depict the current conditions along the study section.

Figure 2 - Route 3 in Northbound direction – wide inside shoulder with rumble strip in place.

In the vicinity of Interchange No. 29 (Chelmsford Route 129), a concrete "Jersey" barrier has been installed as the median narrows in width from that point north through the I-495

interchange. It should be noted that the reconstructed highway was designed to accommodate a fourth travel lane in each direction in the future. This would result in a median width of approximately 52 feet.

Another note with respect to the median is that when the highway was reconstructed, fiber-optic cable was installed underground in the median. There are white marker posts identifying the approximate location of the underground cable.

Figure 3 - Northbound at Interchange 26 on-ramp.

A review of safety data was completed as part of this RSA. The review of data included crash reports with narratives submitted electronically for the years 2004 to 2007. The summary table and spot map are included in the appendix. Key aspects noted in the data included the following:

- A total of 34 median related crashes were reported between 2004 and 2007 or 8.5 per year.
- Of all the reported median related crashes reviewed, 10 or 29% were cross median.
- Of 10 median related crashes reported in 2007, 4 or 40% were cross-median crashes.
- One fatal cross-median crash occurred near Interchange 28.
- Approximately 50% of the electronically reported median crashes resulted in personal injuries.
- Reported crashes were split about evenly in NB and SB direction.

- Of the 34 reported median related crashes, 68% of crashes occurred during daylight period.
- Only 18% of reported median related crashes occurred during rain or snow conditions

Figure 4 - Route 3 Southbound south of Interchange 27 – horizontal curve and elevation difference between directions at this location.

One interesting finding from the data was the relatively high proportion (29%) of cross-median crashes in relation to the total median crashes. In 2007, 4 of 10 or 40% of the median crashes were cross-median events. However, there was not any one predominant crash reason provided although 12 were noted as "failure to keep in proper lane".

In assessing the characteristics of the crashes, there was no one reason that stood out among the possible contributing causes. It is generally acknowledged that drivers may leave the roadway as a result of the following four reasons:

- Driver Error
- Collision Avoidance
- Roadway Condition
- Vehicle Component Failure

Figure 5 - Section south of Interchange 26 – typical median section.

In reviewing the Route 3 crash reports for the section under study, driver error and collision avoidance are more predominant than the other two reasons.

The traffic volumes observed on Route 3 in this section generally exceed 100,000 on an average weekday. Figure 6 depicts the volume measures in May 2007 near the Chelmsford-Billerica town line. One can see from the chart that directional volumes are significant in the peak direction during the peak hour with 5,000 vehicles being exceeded for several hours. Historical truck traffic counts were from MassHighway showing that a relatively high number of trucks traverse the study section. It amounted to 3% or approximately 180 trucks during the peak hour and 5% or approximately 5,000 trucks over the course of a day.

In addition to the traffic volumes, speed data was collected during 2005 following completion of major construction. The data was collected during off-peak hours when traffic volumes are reduced and more free-flow like conditions occur. It was found that there was a large range of speeds (average pace speed 64 mph to 73 mph). Though the posted speeds were 55 mph, it was observed that 32 percent of the motorists during off-peak hours traveled at speeds greater than 70 mph.

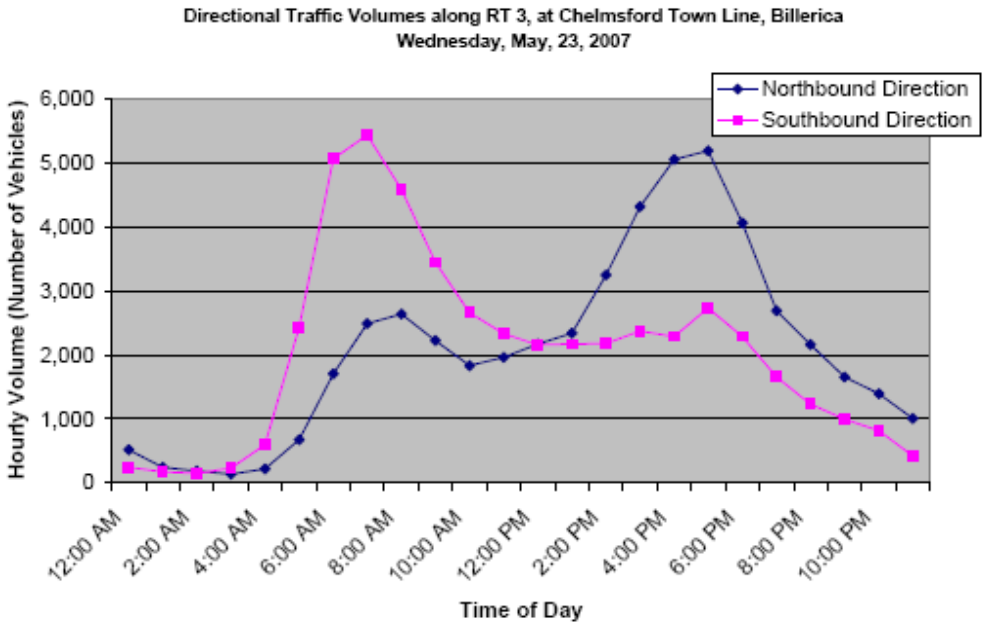


Figure 6
Route 3 Traffic Volume

In summary, the RSA has identified a number of physical and operational characteristics contributing to the safety factors or risk although each with varied levels of seriousness. The major characteristics include:

- Slope of the median is 6:1 or flatter and is highly crossable,
- There is no barrier in median,
- The median (edgeline to edgeline) is currently 76± feet in width,
- When the highway is widened in the future as anticipated, the median width will be 52 feet,
- The high volumes (>100,000 on average weekday), and
- The "comfortable" design results in high speeds (32% > 70 mph) and large speed differential currently exists with the 55 mph posted speed.

The next section will discuss these key issues and the potential actions to consider for addressing them.

Summary of RSA Findings/Potential Actions

Based on the field review, the review of crash data and discussions among the RSA team members, the issues related to the safe operating conditions of the Route 3 in the study section were identified. There were four safety factors or issues of concern identified by the RSA team as potentially having an effect on the risk and these are listed in Table 4 along with the assigned risk rating.

TABLE 4
SUMMARY OF SAFETY ISSUES THAT POTENTIALLY AFFECT THE RISK OF SAFETY RELATED EVENTS

Safety Issue	Risk Rating
Median is relatively level, open and easily crossable	E
High travel speeds, high differential or range of travel speeds	D
Driver behavior	D
Long, straight sections of comfortable driving	B

Given the high volume and high number of median crossings even with the positive design aspects of the highway, the open median issue was assigned a high risk factor 'E'. In other words, the operational and physical characteristics of the highway section under study is such that once a motorist makes a mistake or becomes "errant" and enters the median, there is a high probability that the motorist will cross the median and enter the opposing direction of flow. With the volumes in excess of 100,000 vehicles per day, this type of crash becomes a greater possibility.

The remaining three factors listed in Table 4 contribute to the possibility of a motorist getting into a crash in a section of Route 3 that entering and crossing the median is a good possibility. However, it's the open, flat median that poses the greatest risk. The risk rating for the other three factors are assigned somewhat lower ratings. The high speeds and driving behavior were assigned a rating of 'D' while the long, straight section factor was assigned a 'B'.

Suggested actions identified are intended to reduce or eliminate cross-median crashes and reduce the number and severity of other types of crashes as well. Given the focus of this RSA program on median cross-over crashes, the initial action evaluated was the installation of a median barrier. This is followed by the Recommendation section of the report in which potential actions to address each of the identified factors are identified.

- **Consideration of a Median Barrier**

A barrier can be considered when there is a higher than desirable chance or a greater risk for median cross-over crashes to occur and that have or could result in fatalities and/or a high proportion of injury related crashes. Median barriers can also be considered as a way to reduce the severity of the crashes. It was the consensus of the RSA team that the physical condition and the design of Route 3 in this study section was very good although the high degree of driver comfort provided by the design may encourage higher than desired speeds and once the motorist makes an error or "quick" move to avoid a collision, it is difficult to recover.

Factors that generally come into play in deciding on whether a median should be installed involve the following:

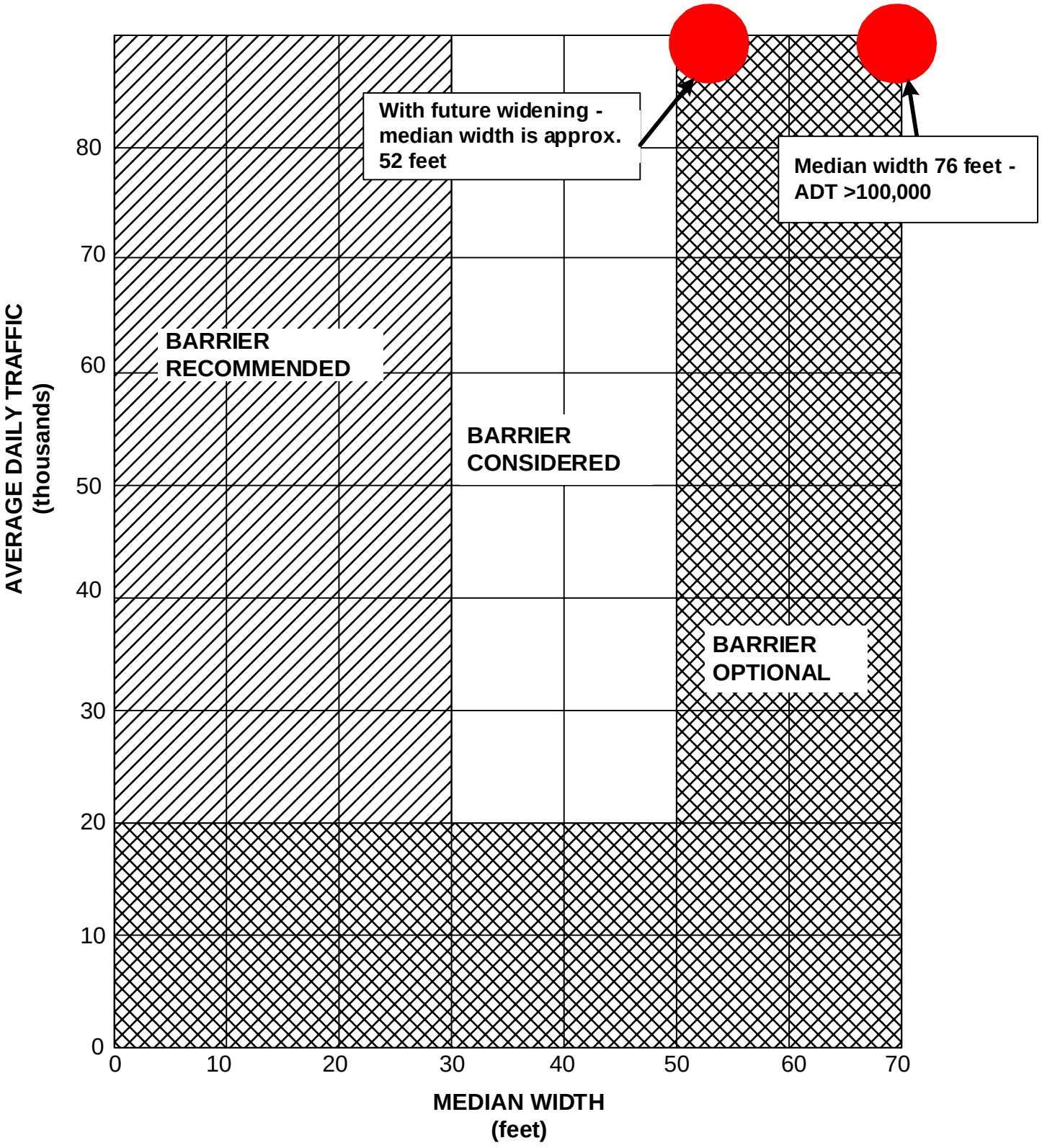
- High volumes and speeds
- Truck volumes and relative mix
- Narrow median
- History of cross-median crashes
- High risk of catastrophic event

These items have been reviewed relative to the Route 3 section under study in the municipalities of Bedford, Billerica and Chelmsford.

Figure 7 presents a review of the corridor in relation to the median warrant criteria presented in the AASHTO RDG[4]. As shown in the diagram, with the median (as measured from edge line to edge line) is approximately 76 feet and a volume of over 100,000 vehicles on an average day, the intersection of the two items is in the area of the chart where a barrier is "optional". However, if one also considers that the highway has been designed for future accommodation of additional travel lanes on the inside portion of the route, the median width (from edge line to edge line) will be reduced to approximately 52 feet. Under a 52 foot wide median, the point of intersection in the chart of volume and median width indicate that a median barrier should still be optional but is much closer (almost bordering) the "barrier considered" category.

In addition to the warrant criteria, which is a guideline, further consideration was given to the following:

[4] American Association of State Highway and Transportation Officials, Roadside Design Guide, Washington, D.C., 2002, Chapter 6 Update 2006.



Source: ASSHTO RDG Chapter 6, 2006 Update

Median Barrier Warrant Analysis

Route 3 Road Safety Audit
Bedford-Billerica, Massachusetts

MS Transportation Systems, Inc. Framingham, Massachusetts

Figure 7

- The high volume presents a likelihood of greater number of errant vehicles entering the median,
- A fairly high number of trucks on the highway during both the peak hours and over the day,
- The median appears to be very crossable under current conditions as evidenced by the large percentage (40% in 2007) of median related crashes that are cross-over crashes.

Based on the analysis of the data, the field drive-thru and discussion of the conditions by the RSA team members, it is suggested that a median barrier be installed along the length of the study route. This will represent approximately six (6) miles of barrier to be installed. The RSA team discussed the potential difficulty installing a median barrier due to the fiber optic cable run that exists and this must be a consideration. The selection of the barrier type is briefly discussed in the next section.

- **Barrier Selection**

There are a number of barrier types that can be considered in addressing the median cross-over crashes. These types include the following:

- Weak post W-beam
- Box beam
- Generic low tension cable
- High tension cable barrier
- Strong post W-Beam
- Thrie Beam
- Concrete (Jersey)

In deciding on the type of barrier, recommended guidelines in selection are included in Table 5 taken from the AASHTO Roadside Design Guide[5].

From a cost and aesthetic perspective, the cable (flexible) barrier has its advantages over the various guardrail systems or concrete barrier. The median slope and/or recovery area also affects the use and placement of any barrier including guardrail. In addition to the cable barrier systems, team members also suggested that guardrail be considered in the evaluation. The alternative types of guardrail were reviewed for potential application on this route. Considerations included the volume of traffic, relative amount of truck traffic and travel speeds. Based on these, the most applicable types of guardrail for this route include the W-beam with strong post or the strong post thrie-

[5] American Association of State Highway and Transportation Officials, Roadside Design Guide, Washington, D.C., 2002, Chapter 6 Update 2006.

beam. These rails are appropriate for high speed highways and high volumes with a relatively high proportion of truck traffic. Costs for each are similar. The weak post W-beam and box beam can be eliminated due to the slope and type of highway. The concrete barrier would generally be applicable in urban sections with limited median widths available. As a result, the median barrier options that are valid for consideration for Route 3 in this section are the cable barrier and strong post guard rail.

TABLE 5
CRITERIA FOR BARRIER SELECTION

Criteria	Comments
1. Performance Capability	Barrier must be structurally able to contain and redirect design vehicle.
2. Deflection	Expected deflection of barrier should not exceed available deflection distance.
3. Site Conditions	Slope approaching the barrier and distance from traveled way may preclude use of some barrier types.
4. Compatibility	Barrier must be compatible with planned end anchor and capable of transitioning to other barrier systems (such as bridge railings).
5. Cost	Standard barrier systems are relatively consistent in cost, but high-performance railings can cost significantly more.
6. Maintenance	
A. Routine	Few systems require a significant amount of routine maintenance.
B. Collision	Generally, flexible or semi-rigid systems require significantly more maintenance after a collision than rigid or high-performance railings.
C. Material Storage	The fewer different systems used, the fewer inventory items/storage space required.
D. Simplicity	Simpler designs, besides costing less, are more likely to be reconstructed properly by field personnel.
7. Aesthetics	Occasionally, barrier aesthetics are an important consideration in selection.
8. Field Experience	The performance and maintenance requirements of existing systems should be monitored to identify problems that could be lessened or eliminated by using a difference barrier type.

Source: AASHTO, Roadside Design Guide, 2002, Chapter 5 Roadside Barriers.

Maintenance issues are also an important consideration when evaluating median barrier installations. The maintenance issues that are of concern include:

- Barrier hits per mile
- Frequency of hits
- Cost recovery
- Cable downtime

- Repair effect on traffic
- Maintaining tension

Final selection of the barrier type should be based on the costs, the ability to maintain a recovery zone, likely maintenance or repair requirements, and compatibility with future planned widening. The key points of the cable barrier or guardrail are summarized below.

Cable Barrier

While the low tension generic cable system has been in existence for more than 50 years, most of the recent cable system research and installation is focused on the high tension systems. There are currently six (6) manufacturers with systems approved by the Federal Highway Administration (FHWA) for use under certain conditions. There are 3-rope or 4-rope cable systems as shown in the following two photographs.

This barrier can be installed on slopes of 6:1 or flatter with little constraint on placement. While not the situation in the Route 3 study section, certain systems (Brifen and Gibraltor 4 rope) have been approved for slopes as steep as 4:1. The cable can usually be installed sufficiently away from the paved surface so as to maintain a clear zone and to minimize 'hits'.

One issue that will potentially affect the installation on Route 3 in the project area is the location of the underground fiberoptic cable currently located in the median. This will require greater care in locating the fiberoptic cable prior to installing the barrier posts. As-Built plans are expected to be received by the Department in the near future that should provide this information. Also, if Route 3 is to be widened in the future, placement of the barrier needs to take that into account.

3 Cable CASS System on Route 213

4 – Rope Brifen System on I-495

Guardrail

The guardrail could be placed in the median where slopes are 10:1 or flatter, particularly in narrow medians (i.e. Route 128 Needham). Typically, guardrail is used at the edge of steep slopes or where minimal recovery zones exist and obstructions are present. With the guardrail placed within several feet of the pavement edge, the existing or future clear zone (or recovery area) would be eliminated at least on one side. Another potential fact to consider is that if the guardrail is installed near the current pavement edge, it will need to be shifted when the roadway is widened in the future.

Estimated per mile costs of the two basic types of median barrier treatment to be considered are summarized in Table 6. As can be seen, the costs for installing the cable barrier in the study section are significantly less than the guardrail.

TABLE 6
COMPARISON PER MILE COSTS
Cable vs. Guardrail

	Costs/Mile	Preliminary Installation Cost[3]
Cable[1]	$144,000	$870,000
Thrie beam[2]	$213,000	$1,280.000

1 Based on average costs of Methuen and Middleboro installations.
2 Based on 2004 MassHighway unit bid costs for double faced rail adjusted for inflation.
3 Does not include engineering costs or verifying underground utilities.

Recommendations

In summary, the RSA of Route 3 in the Bedford-Billerica-Chelmsford area has examined the potential risk factors and identified a number of solutions to decrease cross-median crashes, address the risk factors and enhance the overall safety of the study section. Based on the analysis of available information and data, the field reviews and considering the risk factors, recommendations were formulated by the RSA team. These are outlined below and summarized in Table 7. Also, shown in the table are the estimated costs that could be determined and a potential timeframe for implementation. The timeframes were classified as short (0-1 year), medium (1-3 years) and long term (>3 years).

TABLE 7
SUMMARY OF RECOMMENDATIONS

Safety Issue	Risk Rating	Recommendation	Estimated Cost	Implementation Timeframe
Median is relatively level, open and easily crossable	E	▪ Install cable barrier	$870,000	▪ short to medium term
High travel speeds, high differential or range of travel speeds	D	▪ Increase number of posted speed limit signs and other reminders, ▪ Increase the speed limit from existing 55 mph level to 65 mph	$3,500 N/A	▪ short term ▪ short term
Driver behavior	D	▪ Increase enforcement ▪ Increase education	TBD	▪ short ▪ short
Long, straight sections of comfortable driving	B	▪ Provide motorist “Drive Safely” related reminders ▪ Implement ITS sign system for section	TBD TBD	▪ Short term - using portable VMS ▪ Medium to long term - with permanent plan

First and foremost, the RSA team is recommending the installation of a median barrier. Based on costs, future highway widening plans, aesthetics and available recovery zone, it was further recommended that the median barrier be a cable type barrier. With an approximate open median area of 6 miles, the costs for installing a cable barrier in all the open areas is estimated to be $870,000. This is based on the per mile cost of $144,000. With regard to the cable barrier, it should be placed as far from the pavement edge as feasible, possibly near the center of the median. Implementation will need to also

consider the existing fiber-optic cable and be positioned so it accommodates a future roadway widening while remaining effective. The placement will need to be finalized during design.

- **Speed Management**

Based on recent speed data and discussions of the RSA team, it has been established that a large proportion of Route 3 motorists exceed the 55 mph speed limit. Additionally, the range in speeds is large and more than desirable between the low and high ends. The RSA team generally viewed this differential as a significant factor in increasing the risk and likelihood of changing lanes which has been shown to be a contributing crash factor.

Actions suggested to address the issue of high speeds and the speed differential include:

- Installing additional speed limit signs along the route – particularly after on-ramps.
- Continue to emphasize and enhance speed enforcement.
- Consider increasing the speed limit to 65 mph.

As MassHighway's planned ITS system including Variable Message Signs (VMS) is installed on the route, then other reminders of appropriate travel speeds, safe driving and motorist information on congestion and delays along the route can be provided. This VMS use may also have an effect on reducing driver fatigue and driver complacency along the study section.

A more substantive change is to possibly change the legal posted speed from 55 mph to 65 mph. The thesis is that with the speed limits raised, the speed differential will be effectively reduced. Discussion by the RSA team noted that the large speed range could in fact be influencing the frequency of lane-change maneuvers that currently occur increasing the risk of an incident. The more lane-changes that occur increase the possibility of driver error or errant vehicles. While raising the speed limits was a concern of the team (as it is not the intent to increase the average or 85th percentile speeds from current levels), reducing the differential has merit.

In addition to the above, continuing to emphasize driver education and enforcement as well as informing the motorists of "real time" driving conditions along the route in an enhanced manner are important tools to consider in approaching the drive behavior

issue. Informing motorists consistently in regards to congestion, queue back ups and merging traffic can contribute to reducing driver frustration and encouraging smarter decisions by motorists in relation to travel speeds, lane-changing and their respective "level of caution". ITS monitoring and signage systems lend themselves to this strategy.

The RSA team has also recommended several actions related to speed management and the goal of encouraging a more uniform speed along Route 3 and reducing the magnitude of the differential. Consequently, it was recommended that:

- Additional speed limit signs be put in place following each on-ramp as a reminder to motorists.
- Increase posted speed to 65 mph to reduce the speed differential along with increased enforcement and police presence.
- Enhance driver education program.
- Advance the ITS sign/motorist information system for the corridor.

Appendix

- RSA Meeting Agenda
- RSA Attendants List
- Median Crash Diagram
- Crash Data
- Traffic Volume Data
- Truck Volume Percentages
- Speed Data

Agenda

Road Safety Audit

Bedford, Billerica, Chelmsford – Route 3

Meeting Location: MassHighway District 4 Office
519 Appleton Street, Arlington
Thursday, June 5, 2008
10:00 AM – 12:00 PM

Type of meeting:	**Cross Median – Road Safety Audit**
Attendees:	**Invited Participants to Comprise a Multidisciplinary Team**
Please bring:	**Thoughts and Enthusiasm!!**
10:00 AM	**Welcome and Introductions**
10:15 AM	**Introduction to Road Safety Audits and Cross Median Crashes**
10:30 AM	**Review of Site Specific Material** • Crash & Volume Summaries– provided in advance • Existing Geometries and Conditions • Video and Images
11:00 AM	**Completion of RSA** • Identification of Safety Concerns – using RSA Prompt List as a guide • Identification of Possible Countermeasures
12:00 PM	**Adjourn for the Day – but the RSA has not ended**

Instructions for Participants:

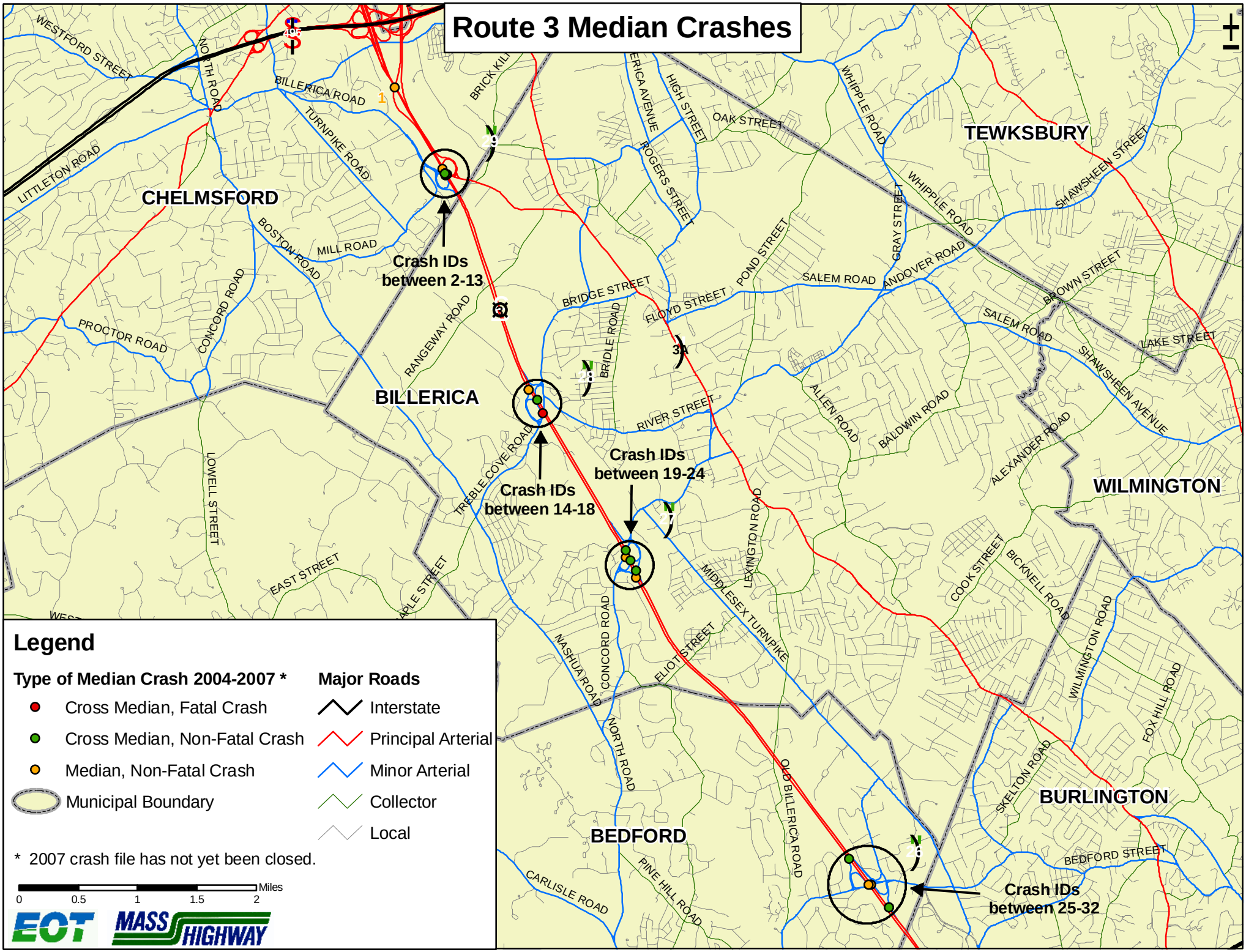
- **Before attending the RSA on June 5th participants are encouraged to drive Route 3 in the three communities (between interchanges 26 and 30) and complete/consider elements on the RSA Prompt List with a focus on safety factors affecting cross median crashes.**
- **All participants will be actively involved in the process throughout. Participants are encouraged to come with thoughts and ideas, but are reminded that the synergy that develops and respect for others' opinions are key elements to the success of the overall RSA process.**
- **After the initial RSA meeting, participants will be asked to comment and respond to the document materials to assure it is reflective of the RSA completed by the multidisciplinary team.**

ROAD SAFETY AUDIT MEETING

Route 3 Bedford-Billerica - June 5, 2008
MassHighway District 4 Offices, Arlington, MA

Attendance List

Name	Agency/Dept.	Email
Bill Scully	MS Transportation Systems, Inc.	bscullyjr@mac.com
Dave Ginns	NMCOG	dginns@nmcog.org
Justin Howard	NMCOG	jhoward@nmcog.org
Bonnie Polin	MHD	bonnie.polin@mhd.state.ma.us
Seth Asante	CTPS	setha@ctps.org
Ashish Patel	MHD	ashish.patel@mhd.state.ma.us
John Gregg	MHD - District 4 Traffic	john.gregg@mhd.state.ma.us
Mena Sliman	MHD - District 4 Traffic	mena76sl@aol.com
Rick Wilson	MHD - Boston	richard.wilson@mhd.state.ma.us
Xian Chen	MHD	xian.chen@mhd.state.ma.us
Andrew Hirshfield	MHD	andrew/hirshfield@mhd.state.ma.us
Tim White	FHWA	timothy.a.white@fhwa.dot.gov
Lt. John Baily	MSP Concord	james.baily@pol.state.ma.us
Lt. Edward Downer	MSP Andover	edward.downer@pol.state.ma.us
Lisa Schletzbaum	MassHighway Safety	lisa.schletzbaum@mhd.state.ma.us
Brett Loosian	MHD - District 4 Mnt	brett.loosian@mhd.state.ma.us
Daniel Flavry	MHD	


Route 3 Median Crashes
CHELMSFORD
BILLERICA
TEWKSBURY
WILMINGTON
BURLINGTON
BEDFORD
Crash IDs between 2-13
Crash IDs between 14-18
Crash IDs between 19-24
Crash IDs between 25-32
WESTFORD STREET
LITTLETON ROAD
NORTH ROAD
BILLERICA ROAD
TURNPIKE ROAD
BRICK KILN
ERICA AVENUE
HIGH STREET
OAK STREET
WHIPPLE ROAD
ROGERS STREET
GRAY STREET
SHAWSHEEN STREET
BOSTON ROAD
MILL ROAD
CONCORD ROAD
PROCTOR ROAD
RANGEWAY ROAD
BRIDGE STREET
FLOYD STREET
POND STREET
SALEM ROAD
ANDOVER ROAD
BROWN STREET
LAKE STREET
SHAWSHEEN AVENUE
BRIDLE ROAD
RIVER STREET
ALLEN ROAD
BALDWIN ROAD
ALEXANDER ROAD
TREBLE COVE ROAD
LOWELL STREET
EAST STREET
LEXINGTON ROAD
MIDDLESEX TURNPIKE
COOK STREET
BICKNELL ROAD
WILMINGTON ROAD
FOX HILL ROAD
NASHUA ROAD
CONCORD ROAD
ELIOT STREET
NORTH ROAD
OLD BILLERICA ROAD
SKELTON ROAD
BEDFORD STREET
CARLISLE ROAD
PINE HILL ROAD
Legend
Type of Median Crash 2004-2007 *
Cross Median, Fatal Crash
Cross Median, Non-Fatal Crash
Median, Non-Fatal Crash
Municipal Boundary
Major Roads
Interstate
Principal Arterial
Minor Arterial
Collector
Local
* 2007 crash file has not yet been closed.
0 0.5 1 1.5 2 Miles
EOT
MASS HIGHWAY

MASSACHUSETTS HIGHWAY SAFETY DIVISION

CRASH SUMMARY

ROADWAY: RT-3 **CITY:** BEDFORD, BILLERICA AND CHELMSFORD

STUDY PERIOD: 1/1/2004 TO 12/31/2007 **LOCATION:** EXIT 26 - EXIT 29

NO.	CRASH NUMBER	CRASH DATE	TRAVEL DIRECTION	LIGHT CONDITION	WEATHER CONDITION	ROAD SURFACE	REASON FOR RUNNING OFF ROAD LEFT	VEHICLE MOVEMENT	MEDIAN OR CROSS MEDIAN CRASHES	DRIVER CONTRIBUTING CAUSE	CRASH SEVERITY
	1781047	8/8/2004	NB	Daylight	Clear	Dry	Vehicle tried to change lanes and struck another vehicle on the right passenger door	N/B Travel Lane to S/B Travel Lane	Cross Median	Failure to keep in proper lane	Property Damage Only
	1795545	1/10/2004	SB	Daylight	Clear	Dry	Vehicle changed lanes, lost control and spun out	Travel Lane to Right Guardrail to Median	Median	Failure to keep in proper lane	Property Damage Only
	1795704	1/16/2004	SB	Daylight	Clear	Dry	Vehicle was coming from the ramp, struck jersey barrier, overturned and struck another vehicle	On-Ramp to Right Jersey Barrier to Median Jersey Barrier to Travel Lane	Median	Failure to keep in proper lane	Non-Fatal Injury
	1796004	6/12/2004	NB	Daylight	Clear	Dry	Crash avoidance with vehicle from suddenly slowing traffic caused the vehicle to overturn	Travel Lane to Median to Travel Lane	Median	Followed too closely	Non-Fatal Injury
	1897058	5/10/2005	SB	Daylight	Clear	Dry	Inexperienced driver lost control of vehicle and cut the wheel hard to the left	Travel Lane to Breakdown Lane to Median Jersey Barrier	Median	Failure to keep in proper lane	Non-Fatal Injury
	1904166	8/5/2004	NB	Dark - Unknown Lighting	Unknown	Dry	Driver felt an impact from the right side and lost control of vehicle	N/B Travel Lane to S/B Travel Lane	Cross Median	No Improper Driving	Non-Fatal Injury
	1911777	7/11/2005	SB	Dark - Lighted	Clear	Dry	Driver swerved to avoid something small, blew out his left tire and overturned	S/B Travel Lane to N/B Breakdown Lane	Cross Median	Exceeded Speed Limit	Property Damage Only
	1916072	1/20/2005	SB	Daylight	Clear	Dry	Vehicle was rear ended by an unknown vehicle and was pushed into the jersey barrier	Travel Lane to Median Jersey Barrier	Median	Followed too closely	Non-Fatal Injury
	1932816	9/19/2005	SB	Daylight	Clear	Dry	Vehicle crossed the median and collided head on with another vehicle	S/B Travel Lane to N/B Travel Lane	Cross Median	Failure to keep in proper lane	Fatal Injury
	2001234	5/17/2005	SB	Dawn	Cloudy	Dry	Vehicle tried to change lanes and struck another vehicle on the passenger side	Travel Lane to Median Guardrail	Median	Failure to keep in proper lane	Property Damage Only
	2001371	7/15/2005	SB	Dawn	Clear	Dry	Lost control of vehicle and overturned	Travel Lane to Median Jersey Barrier to Travel Lane	Median	Exceeded Speed Limit	Non-Fatal Injury
	2007439	3/26/2005	SB	Dark - Not Lighted	Clear	Dry	Lost control of vehicle and overturned	Travel Lane to Median	Median	Exceeded Speed Limit	Non-Fatal Injury
	2014678	2/23/2006	SB	Dusk	Rain	Wet	Vehicle suddenly braked hard and caused another vehicle to hydroplane on the wet roadway	Travel Lane to Median Jersey Barrier	Median	Swerving due to slippery surface in roadway	Non-Fatal Injury
	2050576*	5/12/2006	SB	Dark - Not Lighted	Rain	Wet	Vehicle hit a deer and lost control	Travel Lane to Median	Median	No Improper Driving	Property Damage Only
	2050610	5/21/2006	NB	Daylight	Clear	Dry	Vehicles for an unknown reason sideswiped each other and caused one vehicle to cross the median	N/B Travel Lane to S/B Travel Lane	Cross Median	Failure to keep in proper lane	Non-Fatal Injury
	2059789	1/27/2006	SB	Daylight	Clear	Dry	Lost control of vehicle due to racing with another vehicle	Travel Lane to Median Jersey Barrier to Travel Lane to Median Jersey Barrier	Median	Operating vehicle in erratic, reckless manner	Property Damage Only
	2087323	8/4/2006	SB	Daylight	Rain	Wet	Unknown vehicle hit another vehicle on the right front corner	Travel Lane to Median Barrier	Median	Failure to keep in proper lane	Property Damage Only
	2114743	6/2/2006	NB	Daylight	Clear	Dry	Lost control of vehicle and hit the median barrier	Travel Lane to Median Barrier to Breakdown Lane	Median	Failure to keep in proper lane	Property Damage Only
	2115099	8/28/2006	NB	Dark - Not Lighted	Rain	Wet	Fallen asleep and vehicle crossed the roadway	N/B Travel Lane to S/B Right Shoulder Embankment	Cross Median	Fatigued/Asleep	Property Damage Only
	2115143	9/11/2006	NB	Daylight	Clear	Dry	Vehicle hood opened, blocked the view of the driver and caused vehicle to overturn	Travel Lane to Far Median	Median	Exceeded Speed Limit	Property Damage Only
	2115147	9/11/2006	SB	Daylight	Clear	Dry	Vehicle sideswiped another vehicle and caused the vehicle to spin into the median barrier	Travel Lane to Median Barrier to Travel Lane	Median	Failure to keep in proper lane	Non-Fatal Injury
	2146409*	11/22/2006	NB	Daylight	Cloudy	Dry	Pavement truck swerved to the left lane and caused vehicle to hit the jersey barrier	Travel Lane to Median Jersey Barrier	Median	Failure to keep in proper lane	Property Damage Only
	2177947	2/28/2007	NB	Daylight	Not Reported	Dry	Driver tried to change lanes due to another vehicle approaching in high speed, lost control and overturned	N/B Travel Lane to S/B Travel Lane	Cross Median	Failure to keep in proper lane	Non-Fatal Injury
	2178901	3/19/2007	NB	Daylight	Clear	Dry	Lost control of vehicle and struck the cab of a tractor trailer	Travel Lane to Median Jersey Barrier	Median	Failure to keep in proper lane	Property Damage Only
	2202605	12/30/2006	NB	Daylight	Snow	Wet	Unknown vehicle changed lanes and caused the other vehicle to hit the guardrail	Travel Lane to Median Guardrail	Median	Failure to keep in proper lane	Not Reported
	2211308	4/12/2007	SB	Daylight	Sleet, Hail, Freezing Rain	Ice	Vehicle spun out on ice covered surface	Travel Lane to Median Jersey Barrier	Median	Swerving due to slippery surface in roadway	Property Damage Only
	2211789	5/30/2007	SB	Daylight	Clear	Dry	Vehicle changed lanes to an already occupied lane and struck the side of another vehicle	Travel Lane to Median	Median	Failure to keep in proper lane	Property Damage Only
	2217506	7/14/2007	NB	Daylight	Clear	Dry	Lost control of vehicle due to traffic slowing and struck another vehicle in the front	Travel Lane to Median Guardrail	Median	Followed too closely	Non-Fatal Injury
	2229123	5/30/2007	NB	Daylight	Clear	Dry	Fallen asleep and vehicle overturned	Travel Lane to Median	Median	Fatigued/Asleep	Non-Fatal Injury
	2235735	8/19/2007	SB	Dark - Not Lighted	Not Reported	Dry	Driver operated the vehicle in erratic manner and crossed the median	S/B Travel Lane to N/B Right Guardrail	Cross Median	Operating vehicle in erratic, reckless manner	Not Reported
	2239776	9/26/2007	NB	Daylight	Clear	Dry	Lost control of vehicle, crossed the median and was hit by another vehicle	N/B Travel Lane to S/B Travel Lane	Cross Median	Failure to keep in proper lane	Non-Fatal Injury
	2244399	8/10/2007	NB	Daylight	Rain	Wet	Lost control of vehicle and overturned	S/B Travel Lane to N/B Travel Lane	Cross Median	Failure to keep in proper lane	Non-Fatal Injury
	2254364	4/12/2007	SB	Daylight	Sleet, Hail, Freezing Rain	Ice	Vehicle hit patch of ice and struck the jersey barrier	Travel Lane to Median Jersey Barrier	Median	Swerving due to slippery surface in roadway	Property Damage Only
	2256413	9/26/2007	NB	Dark - Not Lighted	Clear	Dry	Vehicle struck a large plastic trash barrel and hit the bridge concrete barrier	Travel Lane to Bridge Concrete Barrier to Median Guardrail	Median	No Improper Driving	Non-Fatal Injury
	2259493	11/1/2007	SB	Dark - Not Lighted	Not Reported	Dry	Vehicle rear ended by another vehicle and overturned	Travel Lane to Median	Median	Exceeded Speed Limit and Alcohol	Non-Fatal Injury

TOTAL NO.	LIGHT CONDITION						WEATHER CONDITION			
	DAYLIGHT	DAWN	DUSK	DARK - LIGHTED	DARK - NOT LIGHTED	DARK - UNKNOWN LIGHTING	CLEAR	CLOUDY	RAIN	SNOW
35	24	2	1	1	6	1	21	2	5	1
100%	69%	6%	3%	3%	17%	3%	60%	6%	14%	3%

WEATHER CONDITION			ROAD SURFACE			MEDIAN OR CROSS MEDIAN		CRASH SEVERITY	
SLEET, HAIL FREEZING RAIN	NOT REPORTED	UNKNOWN	DRY	WET	ICE	MEDIAN	CROSS MEDIAN	PROPERTY DAMAGE ONLY	NON-FATAL INJURY	FATAL - INJURY
2	3	1	27	6	2	25	10	15	17	1
6%	9%	3%	77%	17%	6%	71%	29%	43%	49%	3%

CRASH SEVERITY	DRIVER CONTRIBUTING CAUSE							
NOT REPORTED	NO IMPROPER DRIVING	EXCEEDED SPEED LIMIT	EXCEEDED SPEED LIMIT & ALCOHOL	FOLLOWED TOO CLOSELY	FAILURE TO KEEP IN PROPER LANE	SWERVING DUE TO SLIPPERY SURFACE IN ROADWAY	OPERATING VEHICLE IN ERRATIC, RECKLESS MANNER	FATIGUED/ASLEEP
2	3	4	1	3	17	3	2	2
6%	9%	11%	3%	9%	49%	9%	6%	6%

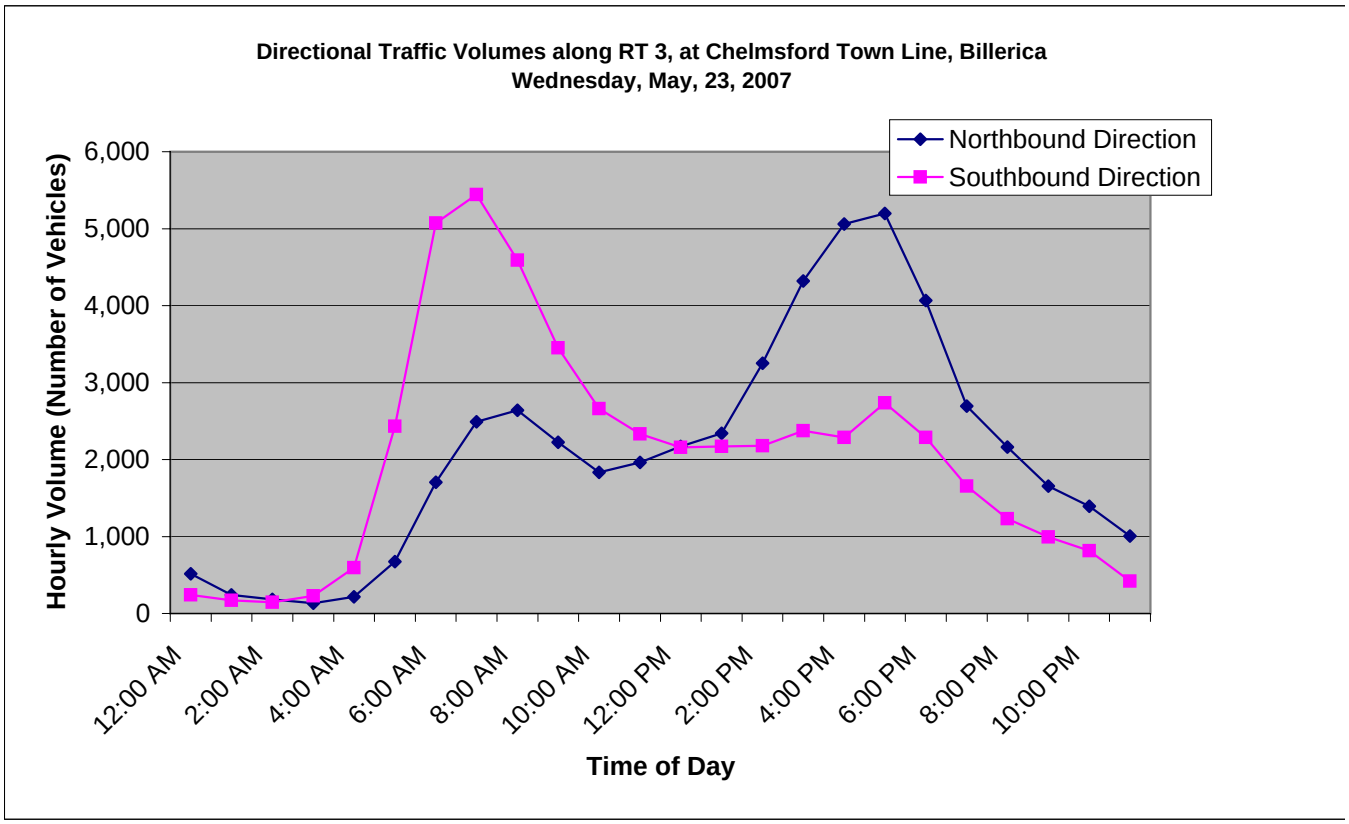
*** Crash location was not able to be determined from State Police Crash Form**

2007 CRASH INFORMATION ARE NOT COMPLETE

CRASH SUMMARY IS BASED ON CRASH REPORTS WITH STATE POLICE NARRATIVES

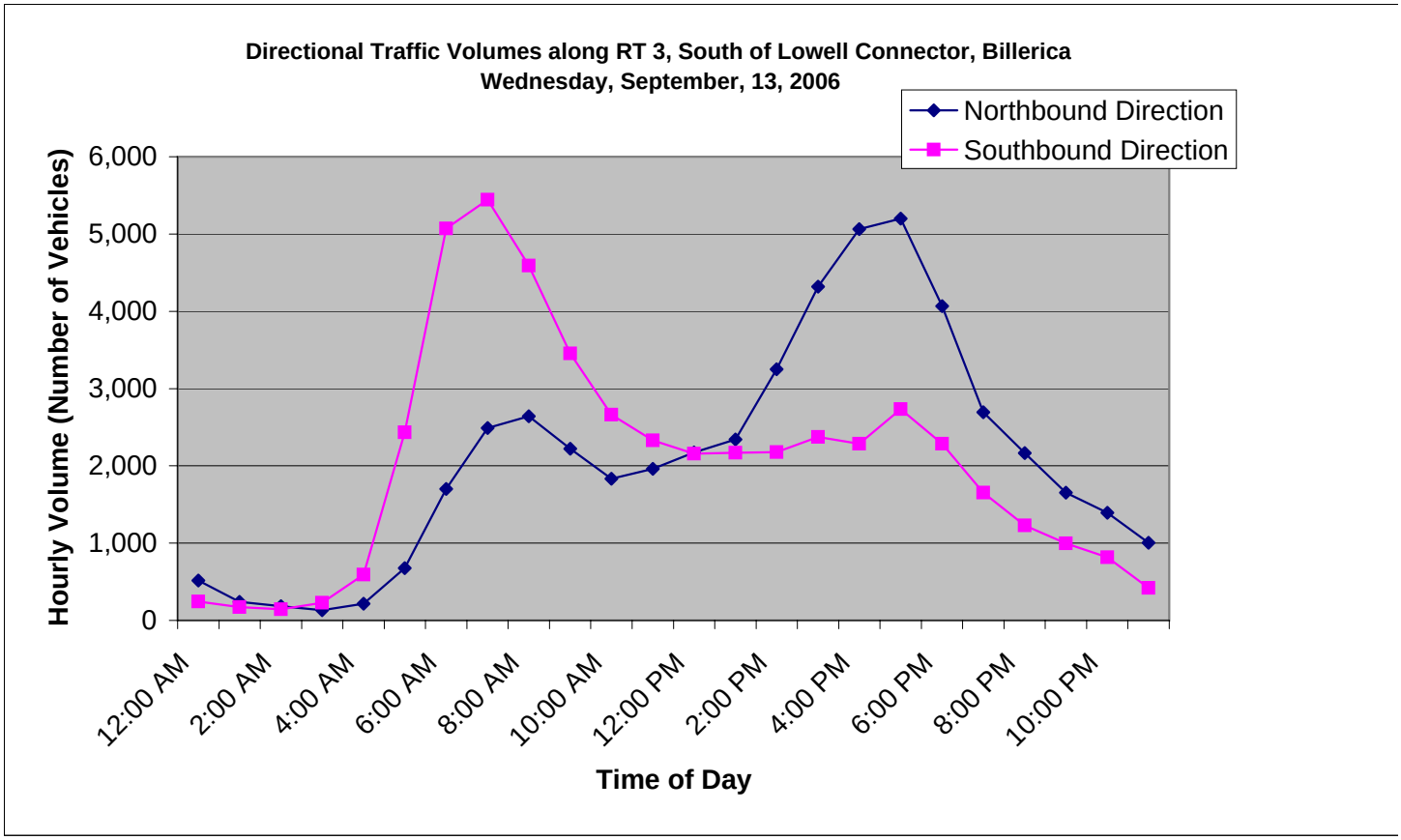
RT 3, AT CHELMSFORD TOWN LINE 05/23/2007

Start time	Northbound Direction	Southbound Direction	TOTAL
12:00 AM	535	242	777
1:00 AM	232	169	401
2:00 AM	142	150	292
3:00 AM	157	228	385
4:00 AM	231	667	898
5:00 AM	706	3,377	4,083
6:00 AM	1,791	6,633	8,424
7:00 AM	2,897	6,231	9,128
8:00 AM	3,095	5,474	8,569
9:00 AM	2,482	4,452	6,934
10:00 AM	2,043	2,837	4,880
11:00 AM	2,201	2,563	4,764
12:00 PM	2,382	2,625	5,007
1:00 PM	2,702	2,502	5,204
2:00 PM	3,973	2,815	6,788
3:00 PM	5,610	2,888	8,498
4:00 PM	6,411	3,034	9,445
5:00 PM	6,060	3,473	9,533
6:00 PM	5,400	2,456	7,856
7:00 PM	3,051	1,792	4,843
8:00 PM	2,168	1,501	3,669
9:00 PM	1,870	1,177	3,047
10:00 PM	1,318	915	2,233
11:00 PM	1,004	511	1,515
Daily Total	**58,461**	**58,712**	**117,173**



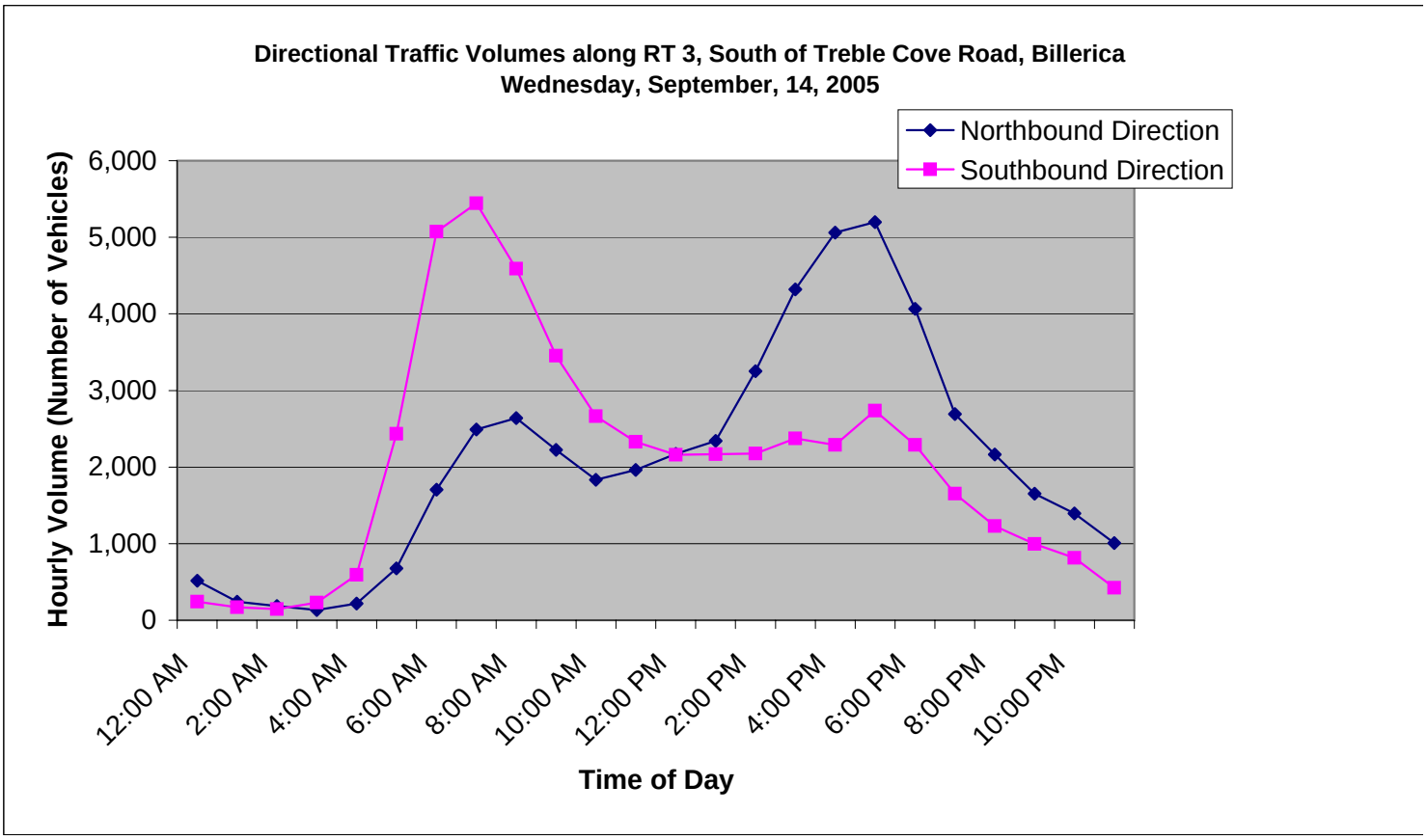
RT 3 MAINLINE 09/13/2006
SOUTH OF LOWELL CONNECTOR

Start time	Northbound Direction	Southbound Direction	TOTAL
12:00 AM	650	303	953
1:00 AM	348	259	607
2:00 AM	312	283	595
3:00 AM	444	416	860
4:00 AM	396	800	1,196
5:00 AM	710	3,252	3,962
6:00 AM	1,793	5,886	7,679
7:00 AM	3,036	5,819	8,855
8:00 AM	2,987	5,716	8,703
9:00 AM	2,484	4,168	6,652
10:00 AM	2,211	2,874	5,085
11:00 AM	2,542	2,689	5,231
12:00 PM	2,659	2,742	5,401
1:00 PM	2,874	2,806	5,680
2:00 PM	3,888	2,981	6,869
3:00 PM	5,387	2,991	8,378
4:00 PM	6,113	2,860	8,973
5:00 PM	6,421	3,137	9,558
6:00 PM	5,030	2,566	7,596
7:00 PM	3,067	1,782	4,849
8:00 PM	2,358	1,394	3,752
9:00 PM	1,952	1,140	3,092
10:00 PM	1,504	940	2,444
11:00 PM	1,079	525	1,604
Daily Total	*60,245*	*58,329*	*118,574*



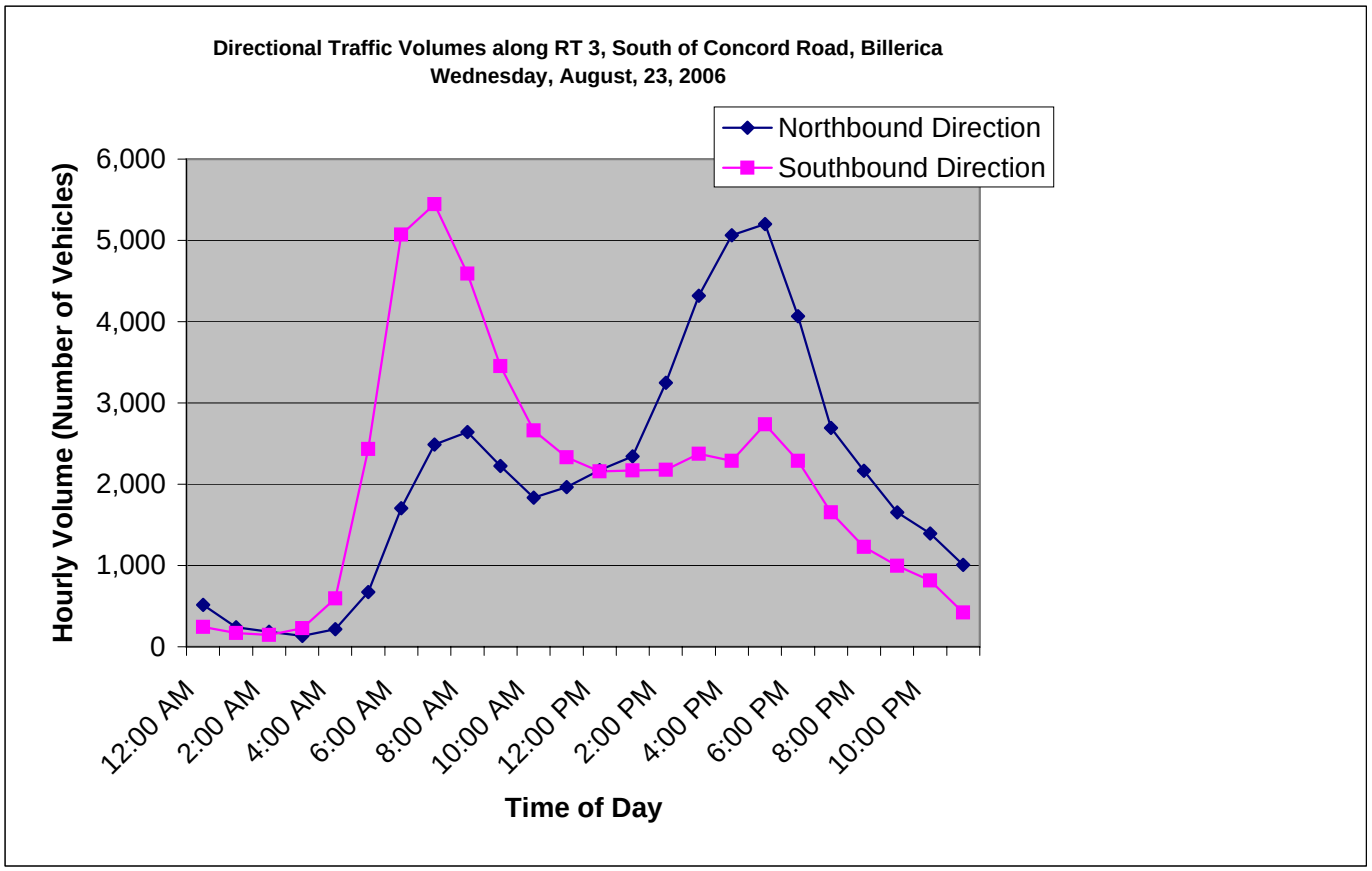
RT 3, SOUTH OF TREBLE COVE ROAD 09/14/2005

Start time	Northbound Direction	Southbound Direction	TOTAL
12:00 AM	488	265	753
1:00 AM	236	183	419
2:00 AM	172	157	329
3:00 AM	165	258	423
4:00 AM	207	647	854
5:00 AM	610	2,532	3,142
6:00 AM	1,719	5,370	7,089
7:00 AM	2,778	5,429	8,207
8:00 AM	2,660	5,608	8,268
9:00 AM	2,217	4,136	6,353
10:00 AM	1,852	2,576	4,428
11:00 AM	2,003	2,311	4,314
12:00 PM	2,167	2,328	4,495
1:00 PM	2,312	2,367	4,679
2:00 PM	3,295	2,491	5,786
3:00 PM	4,456	2,587	7,043
4:00 PM	5,185	2,522	7,707
5:00 PM	5,240	2,988	8,228
6:00 PM	4,581	2,478	7,059
7:00 PM	2,814	1,620	4,434
8:00 PM	1,907	1,180	3,087
9:00 PM	1,548	1,048	2,596
10:00 PM	1,141	841	1,982
11:00 PM	820	408	1,228
Daily Total	*50,573*	*52,330*	*102,903*



RT 3, SOUTH OF CONCORD Road 08/23/2006

Start time	Northbound Direction	Southbound Direction	TOTAL
12:00 AM	515	243	758
1:00 AM	240	171	411
2:00 AM	184	146	330
3:00 AM	133	229	362
4:00 AM	218	593	811
5:00 AM	675	2,433	3,108
6:00 AM	1,703	5,072	6,775
7:00 AM	2,490	5,443	7,933
8:00 AM	2,641	4,591	7,232
9:00 AM	2,223	3,453	5,676
10:00 AM	1,834	2,663	4,497
11:00 AM	1,963	2,331	4,294
12:00 PM	2,172	2,159	4,331
1:00 PM	2,342	2,169	4,511
2:00 PM	3,250	2,177	5,427
3:00 PM	4,319	2,375	6,694
4:00 PM	5,062	2,287	7,349
5:00 PM	5,199	2,735	7,934
6:00 PM	4,065	2,287	6,352
7:00 PM	2,693	1,653	4,346
8:00 PM	2,164	1,229	3,393
9:00 PM	1,654	995	2,649
10:00 PM	1,393	815	2,208
11:00 PM	1,006	422	1,428
Daily Total	*50,138*	*48,671*	*98,809*



TRUCK VOLUME PERCENTAGES - ROUTE 3

City / Town	Location	TPH	TAD	TPH	TAD	TPH	TAD
Billerica	Concord Rd					2%	4%
Billerica	Treble Cove			2%	4%		
Chelmsford	S of Rt 4	4%	6%			3%	5%

ROUTE 3 NORTH SPEED STUDY

SUMMARY

- 98% of motorists are traveling >55 mph (posted limit)
- 68% of motorists are traveling >65 mph (proposed limit)
- 32% of motorists are traveling >70 mph
- 11% of motorists are traveling >75 mph
- Trial runs at 65 mph in the right hand travel lane resulted in only one vehicle passed in each direction along the entire 20 mile stretch of Route 3
- The 85th percentile speed ranges from 73 to 76 mph
- The 50th percentile speed ranges from 67 to 68 mph
- The average Pace speed range is 64 to 73 mph! (the upper limit of the Pace is typically where speed limits are set at or near)
- The 85th percentile speed on the southbound CD Road at the I-495/Route 110 interchange is 68 mph (55 proposed)