

Lane Departure Road Safety Audit for Main Street in Acushnet, Massachusetts



Prepared by
**Southeast Regional Planning & Economic Development District
and
University of Massachusetts Traffic Safety Research Program**



Prepared for

Massachusetts Highway Department

Federal Highway Administration



1.0 Introduction to Road Safety Audits & Lane Departure Crashes in Massachusetts

The Federal Highway Administration defines a Road Safety Audit (RSA) as *the formal safety examination* of an existing or future road or intersection by an *independent, multidisciplinary team*. The purpose of an RSA is to *identify potential safety issues and possible opportunities for safety improvements* considering all roadway users. Specific objectives of an RSA include, but are not limited to the following:

- Minimizing the risk and severity of road crashes that may be affected by the existing or future roadway at a specific location or nearby network;
- Improving the awareness of safe design practices which are likely to result in safety benefits based upon potential safety concerns.

Although RSA's have been employed in other countries for some time, they are being fully embraced across the United States as a low cost opportunity to make significant safety improvements at any number of stages ranging from project development and planning through existing operation. Furthermore, RSA's have proven to be effective on projects of all shapes and sizes. The RSA program here in the Commonwealth presents a unique and exciting opportunity for improvements in roadway safety.

The RSA program in Massachusetts is being implemented in accordance with the Commonwealth's role as a lead state in preventing run-off the road (lane departure) crashes and in conjunction with the Strategic Highway Safety Plan (SHSP). Lane departure crashes are a notable problem area for Massachusetts, especially for crashes with high injury severities. Between 2002 and 2004, lane departure crashes accounted for nearly 20 percent of all crashes in Massachusetts and approximately one-quarter of crashes involving an incapacitating injury. Almost one-half of fatal crashes between 2002 and 2004 were lane departure crashes. As the crash severity increases, so too does the percent of crashes that are lane departures as shown in Figure 1.

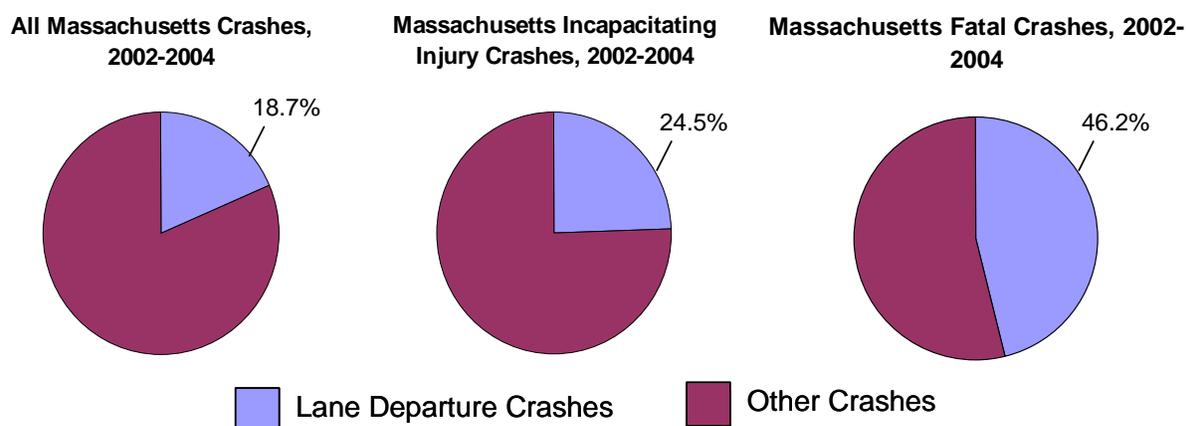


Figure 1. Relationship Between Lane Departure Crashes and Injury Severity

In an effort to combat the lane departure problem, a strategy was developed for the SHSP to identify hot spot lane departure locations, perform road safety audits and implement low-cost comprehensive countermeasures. The following report summarizes the findings of a RSA focused on lane departure crashes (LD) along Main Street in Acushnet, Massachusetts.

2.0 Background Material for Main Street in Acushnet

Acushnet is a Massachusetts municipality with approximately 10,000 residents located within Bristol County in the southeastern portion of the Commonwealth. Main Street is a major corridor in Acushnet, which connects New Bedford and Rochester, and totals 6.3 miles. Specifically, Main Street is a mixture of thickly settled residential units and commercially developed parcels with approximately 40 intersecting roadways. Main Street encompasses both a town-owned (4.8 miles) stretch to the south as well as a state-owned (1.5 miles section to the north where Main Street is also State Route 105). Throughout Acushnet, Main Street is a two-lane bidirectional roadway with varying lane and shoulder widths. Although there are only a few slight vertical changes throughout Main Street, there are several horizontal curves, including a high crash location known as “Diggle’s Curve”. A sample cross-section for Main Street is pictured in Figure 2, while some of the major characteristics, including crash clusters, for Main Street are summarized in Figure 3.



Figure 2. Sample Cross-Section for Main St

The LD-RSA for Main Street was held on August 20, 2007 at the Acushnet Town Hall. In total, 18 team members participated in the road safety audit as listed in Table 1. As indicated in Table 1 representatives were present from Federal, State, Regional and Local agencies and included a cross-section of engineering/planning, education, and enforcement expertise.

Table 1 Participating Audit Team Members

Audit Team Members	Agency/Affiliation	Audit Team Members	Agency/Affiliation
Bonnie Polin	Massachusetts Highway Department – Safety Section	Xian Chen	Massachusetts Highway Department – Safety Section
Lisa Estela-Pedro	Southeast Regional Planning & Economic Development District	Jemal Ali	Massachusetts Highway Department – Highway Design
Paul Mission	Southeast Regional Planning & Economic Development District	Alan Coutinho	Acushnet Town Administrator
Jim Hadfield	Southeast Regional Planning & Economic Development District	Michael Alves	Acushnet Police Department
Lilia Cabral	Southeast Regional Planning & Economic Development District	Paul Sylvia	Acushnet Department of Public Works
Tim White	Federal Highway Administration	Paul Melo	Acushnet Police Department
Henry Young	Town of Acushnet	Ray Barlow	Acushnet Department of Public Works
John Carvalho	Acushnet Department of Public Works	Robert Gregory	Massachusetts Highway Department – District 5
Samuel Gregorio	Massachusetts Highway Department – Safety Section	Michael Knodler	University of Massachusetts - Amherst

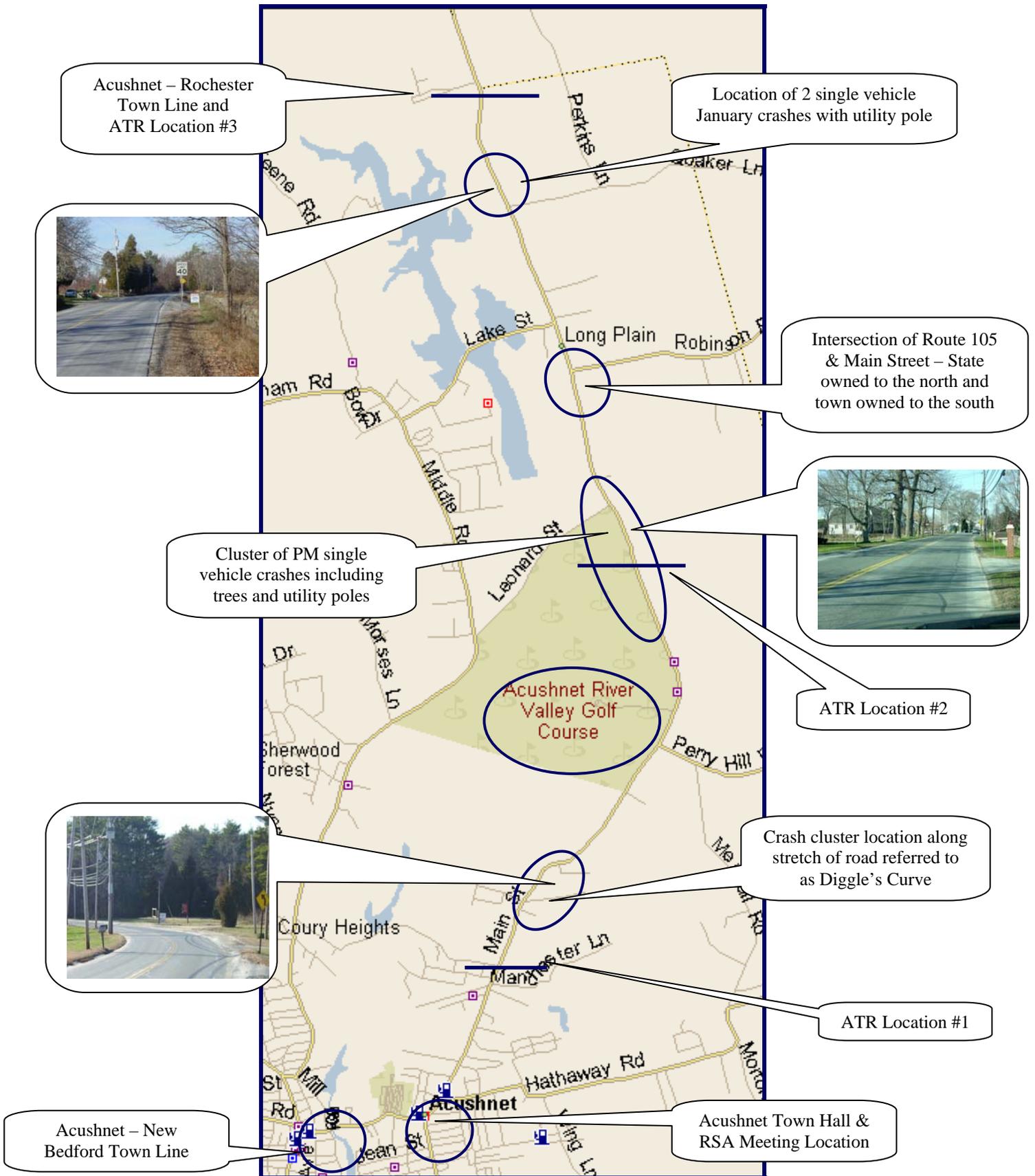


Figure 3. Characterization of Roadway Features for Main Street

Given the length of Main Street through Acushnet, audit team members were asked to visit the site in advance of the meeting to familiarize themselves with the roadway attributes and characteristics. A significant amount of data and information was compiled by the Southeast Regional Planning & Economic Development District (SRPEDD) with support from MassHighway prior to the RSA meeting and shared with participants in advance (see Appendix A). Specifically, the additional information provided was pertinent to the LD-RSA safety initiative and included traffic volumes and speeds, and a description of relevant crashes. A summary of the SRPEDD compiled data is as follows:

- Table 2 summarizes volume and speed data from 3 automatic traffic recorder (ATR) studies completed by SRPEDD. As shown in Table 2, the volume changes throughout Main Street, however, the directional split is fairly equal. Figure 3, presented previously, identifies the location of the 3 ATR study locations. The maximum reported ADT was 7,055 vehicles.
- Considering speed in greater detail, Main Street is similar in nature to many roadways, where the posted speeds vary with posted speed limits of 15, 20, 25, 35, and 40 mph. The official speed regulations for Main Street in Acushnet are summarized in Figure 4, which also shows the currently posted speed limits. As shown, these official speed limits do not appear to match the actual postings.
- Between 2003 and 2006 there were 28 reported crashes consistent with the lane departure initiative which were geolocated and are presented in Figure 5. An initial safety summary by SRPEDD found that among the 28 crashes there were 3 fatal crashes, 5 incapacitating injury crashes, 9 possible injury crashes, 8 non-incapacitating injury crashes, and 3 non-injury crashes. Considering the primary factors 13 crashes were attributed to excessive speed, 2 to fatigue/inattention, 7 to failure to keep in proper lane, 3 to weather, and 2 to animals. Additionally, 25 of the crashes involved a single vehicle, and 20 crashes resulted in a vehicle striking a utility pole or tree. It is important to note that this does not reflect all crashes along Main Street, but those deemed relevant to this initiative.

Table 2 Summary of ATR Volume and Speed Data for Main Street

ATR Location	Regulatory Speed	Parameter	NB	SB	Total
ATR Location #1: Main Street north of Hamlin Street	35 mph	Daily Volume	3,485 vpd	3,570 vpd	7,055 vpd
		Average Speed	41 mph	39 mph	40 mph
		85 th %tile Speed	46 mph	45 mph	45 mph
ATR Location #2: Main Street south of Leonard Street	40 mph	Daily Volume	2,163 vpd	2,213 vpd	4,376 vpd
		Average Speed	42 mph	42 mph	42 mph
		85 th %tile Speed	48 mph	48 mph	48 mph
ATR Location #3: Main Street at Rochester Town Line	40 mph	Daily Volume	1,060 vpd	1,139 vpd	2,199 vpd
		Average Speed	42 mph	45 mph	43 mph
		85 th %tile Speed	48 mph	50 mph	49 mph

Additional resources made available to the team during the audit meeting included field videos from several drives along Main Street which were used in aiding discussion of specific roadway elements. Also available were possible resources including the AASHTO Strategic Highway Safety Plan and the related National Cooperative Highway Research Program (NCHRP) 500 series reports.

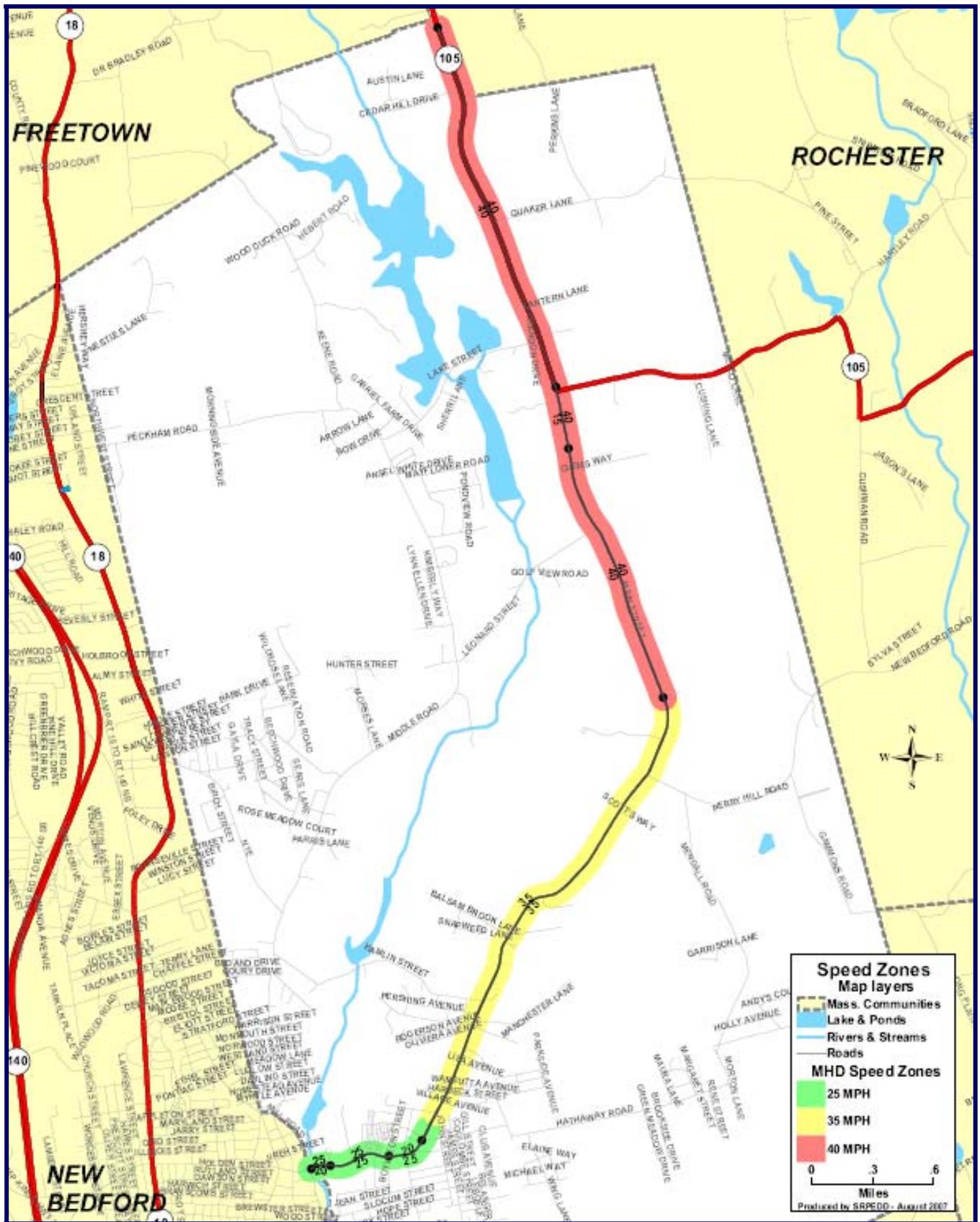


Figure 4. Main Street Posted Speed Limit Regulations

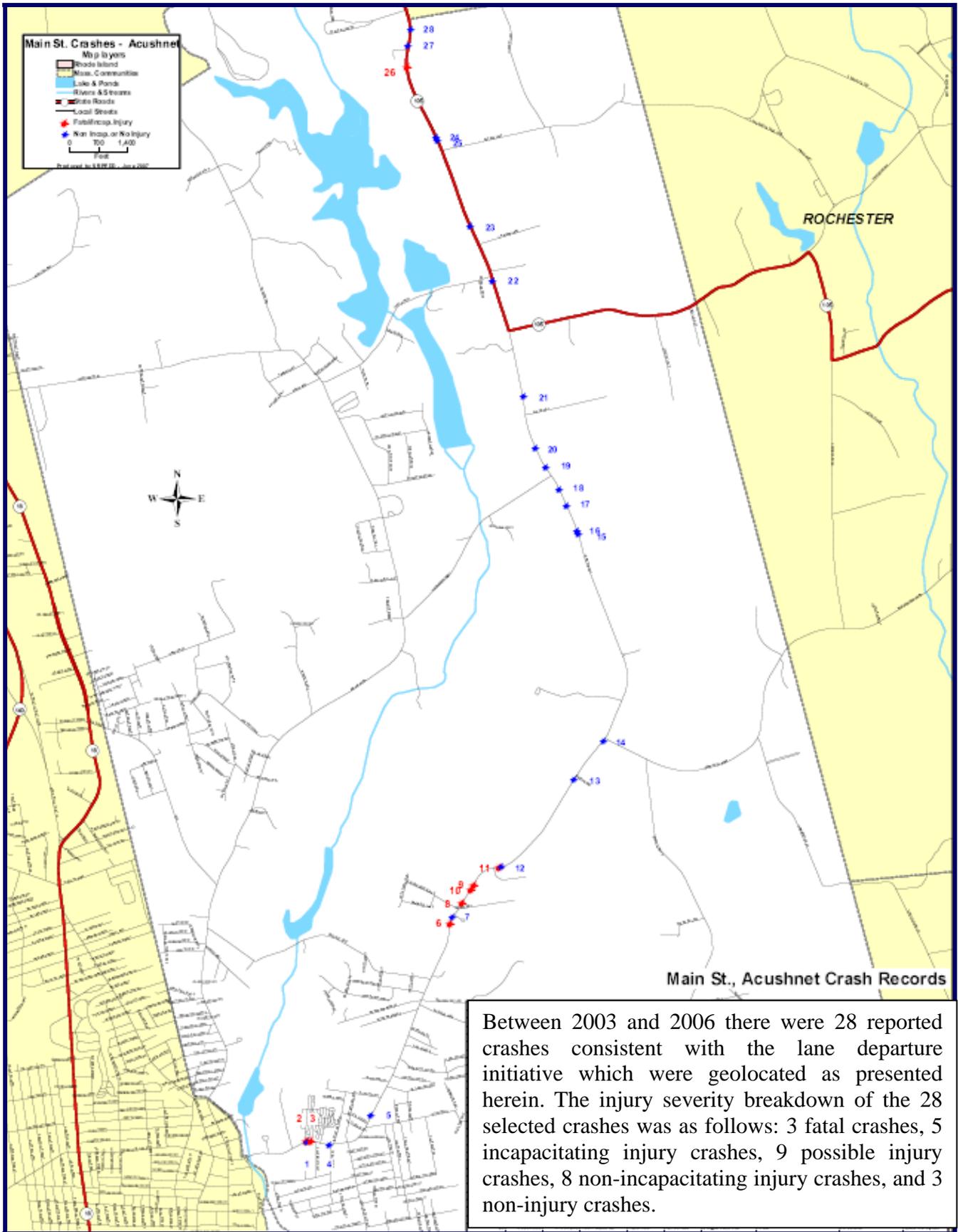


Figure 5. 2003 to 2006 Summary of Main Street Lane Departure-Related Crashes

3.0 Characterization of Major Traffic Safety Challenges

Following a brief introduction to the RSA process in general, the meeting participants were asked to summarize and characterize potential safety considerations along Main Street. The initial characterization of the major safety considerations focused on several key elements as follows:

- The identification of the problematic stretch of road and associated crashes known as Diggle’s curve (see Figure 6). Five of the 7 crashes at this curve involved an injury including 2 fatal crashes. Each of these crashes were single vehicle and four involved a utility pole.
- A second major factor discussed was the roadway speeds. As previously noted the posted speed limits vary greatly, including ranges from 15 to 45 mph. There was some discussion regarding the legitimacy of posting a 15 mph zone, which is not currently in the official speed regulations. This posting should be revised as soon as possible.

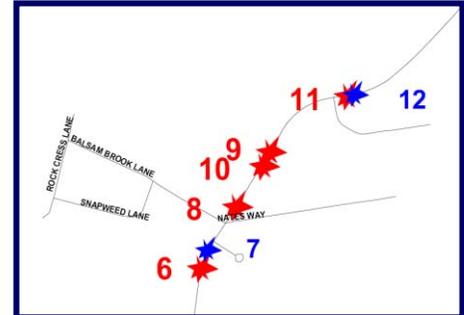


Figure 6. Crash Locations

- Additional speed consideration surfaced around discussion at curves. Specifically, strategies aimed at reducing the impacts of speed along Main Street should be explored. This may include traditional traffic calming measures or experimental treatments like optical speed bars.
- A third major topic of discussion involved the proximity of the traveled way to a myriad of utility poles and trees. Contributing to this concern is the inconsistent use of reflectors on utility poles and trees. Drivers are unable to identify these hazards particularly in the vicinity of curves, during inclement weather or at night. As documented in the crash data these objects are routinely struck during crashes along this corridor.
- Although it did not surface as a major factor within the crashes there was discussion regarding the drainage characteristics along Main Street. Specifically, several areas frequently puddle up during rain events.
- Another major factor that was identified during the initial SRPEDD summary was the lack of edge lines delineating the traveled way. It is worth noting that in the time between the initial summary and the actual RSA meeting the Town of Acushnet added edge lines along the portion of Main Street under their control. Additionally, during the time in which this report was being drafted MassHighway had added edge lines to the Route 105 portion. This immediate action on both parts should be considered an early success of the LD-RSA process.
- Other significant factors mentioned at the outset of the meeting that are discussed in some detail later in this report also included the following:
 - Presence of slow moving vehicles;
 - Passing zones; and
 - Crosswalk conspicuity.
- It is also worth noting that the conversation around major safety concerns also included an existing weight restriction for a nearby bridge (A-3-2). Currently, emergency response vehicles, which are overweight for the bridge, are forced to travel longer routes when in response. According to the discussion the matter is being addressed. Although beyond the scope of this RSA, the team is cognizant of the fact that this could be a factor when responding to a traffic crash along Main Street. The RSA team supports a quick resolution to this matter.

4.0 Summary of Short Term Recommendations for Main Street

The formal review of potential safety concerns along Main Street was completed by the entire audit team. Following identification of a potential safety issue the dialogue subsequently focused on possible countermeasures with some preliminary discussion regarding the feasibility of implementation (timeframe and cost) as well as the potential payoff of safety benefits. Given the potential for an immediate impact there was an added focus on short term (less than 1 year) and low cost (less than \$10,000) improvements that could be done almost instantaneously resulting in a positive safety impact. Resulting recommendations for immediate actions along Main Street include the following:

- Install “Curve Ahead” warning signs for each direction of the horizontal curves. Signs should be placed in advance of the curve to allow adequate response time for motorists. To further enhance this delineation, it is recommended that chevrons, embedded pavement markers, and roadside reflectors be considered for installation to increase conspicuity and delineation. In general, the goal across all horizontal curves is to provide motorists with a consistent series of markings. Specific locations where enhanced curve delineation is recommended include the addresses of: #67 to #91 Main Street; 340 to 444 Main Street (Diggles Curve); 1461 Main Street; and 1510 to 1590 Main Street (with the latter two curves are along the MassHighway controlled segment (Rte 105) of the corridor).
- Edge line installation was suggested following a preliminary safety summary completed at the time of baseline data collection. Prior to the meeting edge lines had been installed on the town owned portion. As previously noted, MassHighway has also added edge lines immediately following the RSA meeting. This short term strategy has the potential to pay safety dividends and should be considered an early success of this RSA.
- Given the reported prevalence of speed among the lane departure crashes, it is recommended that Main Street continue to remain a high speed enforcement area. It is also recommended that speed data collection be completed by the Town of Acushnet, perhaps with the aid of SRPEDD and MassHighway to track current operating speeds throughout the year. This may also prove useful in targeting day of week and time of day enforcement as well as the establishment of enforcement thresholds. Along the same lines, it is recommended that the speed regulations described in Figure 4 are consistent with the current operating practice. For immediate consideration, the posted speed limit signs should be consistent with speed regulations.
- It is recommended that advance yield lines (see MUTCD Figure 3B-14) and accompanying signs (R5-1 – Yield Here to Pedestrians) be installed for existing midblock crosswalks along Main Street. Additionally for the crosswalk located near the Acushnet Town Hall, it is recommended that the crosswalk be relocated at the intersection for enhanced visibility.
- Utility poles and trees are in close proximity to the traveled way (see Figure 7). While longer term strategies are considered for possible relocation of the most hazardous poles, it is recommended that the poles and selected trees be reflectorized.
- While longer term drainage strategies are also explored, it is recommended that warning signs alerting motorists of standing water be added in areas that frequently puddle.



Figure 7. Sample Roadside Hazards

5.0 Summary of Additional Main Street Countermeasures

Although an emphasis was placed upon short term and low cost improvements that could be carried out immediately, the focus of the team was not limited to solely those countermeasures. The following section details countermeasures discussed by the team, which are reflective of all costs and timeframes and includes both general (entire corridor) and specific safety opportunities. Please note that with respect to the timeframe there are some unknown variables that must be further explored. Additionally, some of the potential treatments discussed were experimental in nature resulting in an unknown level of safety benefits. Several definitions exist for low, mid, and high cost as well as for short, mid and long term implementation timeframes. For purposes of this report, low cost improvements will be under \$10,000, mid costs will be under \$50,000, and high costs will be above \$50,000. From a timeframe perspective short term will refer to less than 1 year while mid and long term will refer to countermeasures that will take 1 to 3, and greater than 3 years, respectively.

Potential Safety Issue	Possible Countermeasures	Implementation Timeframe & Cost	Potential Safety Payoff	Photos
Speed-related issues along entire Main Street corridor	Continue and expand upon a concentrated enforcement and educational (i.e. speed feedback, community meetings, etc) effort.	Short Term & Low/Mid Cost	Mid	
	Consider possible low-cost speed-related strategies, including restriping narrower lanes or optical speed bars.	Short Term & Low Cost	Experimental	 
	Work with MassHighway to revise the existing 15 mph speed limit sign, which violates driver expectancy.	Short Term & Low Cost	Low	
Horizontal curve delineation	Install curve ahead warning signs, chevrons and roadside reflectors for horizontal curves, including “Diggle’s Curve”.	Short Term & Low/Mid Cost	Mid	 
Pavement markings	Upgrade to 6 in and highly reflective edge and centerlines to aid in roadway delineation.	Short Term & Mid/High Cost	Mid	 

Potential Safety Issue	Possible Countermeasures	Implementation Timeframe & Cost	Potential Safety Payoff	Photos
Impact of passing vehicles	Existing passing zones should be recalculated with the assistance of MassHighway to assure adequate sight distance with observed speeds, particularly on curves.	Short Term & Low Cost	Low	 
Edge lines	Edge lines have recently been added to the town-owned portion of the roadway and have improved delineation. Suggest adding to the state-owned portion as well.	Short Term & Low Cost	Low/Mid	 
Safe crossing opportunities for pedestrians	<p>Install advance yield line with accompanying sign (R5-1) for existing midblock crosswalks.</p> <p>Relocate the crosswalk in front of Town Hall so it is at the intersection to increase visibility and expectancy.</p>	Short Term & Low Cost	Low/Mid	 
Presence of utility poles and trees within the roadway clear zone	Reflectorize utility poles and selected trees.	Short Term & Low Cost	Low	 
	Add guard rails for particularly hazardous utility poles consistent with horizontal curves and previous crash locations.	Mid Term & Low/Mid Cost	Low	
	Work with utility company to remove utility poles from clear zone.	Long Term & Mid/High Cost	Mid	

Potential Safety Issue	Possible Countermeasures	Implementation Timeframe & Cost	Potential Safety Payoff	Photos
Poor drainage results in slippery road surface and standing water	Redesign of drainage elements to account for residential development. In the short-term, warning signs alerting motorists to water on the road are advised. A specific location includes the ponding/icing which occurs near the 400 block of Main Street.	Long Term & High Cost	Mid	
Dark stretches of Roadway	Install lighting along dark stretches of road. Specific location may include horizontal curves and dark stretched of road along the state-owned stretch.	Long Term & Mid/High Cost	Mid	
Continued maintenance	The pavement condition and coverage resulting from brush are in good condition; however there is some covering brush on the state section of the roadway. To assure safety this needs be maintained.	Short Term & Low Cost	Mid	
No parking signs near Route 105	Assure adequate parking, adherence to no parking areas, as well appropriate pedestrian consideration near popular ice cream shop.	Mid Term & Mid Cost	Low	

6.0 Discussion

With respect to the safety improvement opportunities described in the previous section it is important to consider the following: 1) many treatments are both low cost and short term and 2) there is a complimentary nature of many of the safety strategies in that one improvement will aid with multiple safety issues. Although this document provides a series of specific recommendations which warrant short term implementation, it should be noted that the approach towards improved safety is dynamic in nature and warrants revisiting over time.

Several additional topics that were discussed at the audit meeting and warrant consideration include the following:

- Although previously discussed, the speed issues serve as a major challenge to the overall safety of the corridor and warrant further discussion. Several short term strategies were discussed herein regarding the appropriateness of existing speed postings, however, the RSA team strongly recommends that appropriate measures to reduce speeds in selected areas be undertaken immediately. For example, a curve advisory speed (w2-1a) sign between #67 and to #91 is recommended. Additional measures aimed at reducing speeds (i.e., in the vicinity of the ice cream stand) may include traditional traffic calming measures or more experimental measures such as optical speed bars.
- The major crash problem (considering injury severity) at Diggle's curve warrants consideration of long term solutions. Ideally this curve should be redesigned to provide a straighter alignment with appropriate superelevation.
- The weather related conditions and lack of superelevation which results in deficient drainage may be responsible for crashes. One initiative that may be employed would be the strategic placement of variable message signs (VMS), on occasion, reminding motorists of the changing conditions. One concern with this strategy would be the limited number of opportunities for space to locate a VMS.
- The narrow bridge located near 359 Main St was discussed as a concern as a result of both the narrow lane widths and the fact that it was along a curve. In the long term, this may need to be addressed in the event it surfaces as a high crash location; however, a shorter term strategy would be enhanced markings (i.e., warning signage).
- Additional concerns that were discussed involved other modes of traffic including slow moving vehicles, school buses, as well as bicyclists and pedestrians. For each the RSA discussed consideration of the following:
 - Assure safe school bus stops for students and adjacent motorists alike. For example, there was concern about the bus stop at 447 Main Street which was suggested to be moved further south.
 - Consider longer term provisions (sidewalks) for pedestrians.

7.0 Appendix A: Distributed RSA Meeting Materials

Materials provided to RSA team members in advance of the meeting included the following:

1. Agenda
2. RSA and Lane Departure Introduction
3. SRPEDD Crash, Speed, and Volume Data Summaries
4. Tabulated Crash Summary
5. Map of Geolocated Crashes
6. LD-RSA Checklist

Agenda

Road Safety Audit for Main St. in Acushnet

Meeting Location: Acushnet Town Hall
122 Main Street, Acushnet, MA
Monday, August 20, 2007
1:30 PM to 3:30 PM

Type of meeting:	Lane Departure – Road Safety Audit (RSA)
Attendees:	Invited Participants to Comprise a Multidisciplinary Team
Please bring:	Thoughts and Enthusiasm!!
1:30 PM	Welcome and Introductions
1:45 PM	Introduction to Road Safety Audits and Lane Departure Crashes
2:00 PM	Review of Site Specific Material <ul style="list-style-type: none">• Crash & Volume – provided in advance• Existing Geometries and Conditions• Video and Images
2:30 PM	Completion of RSA <ul style="list-style-type: none">• Identification of Safety Concerns – using checklists as a guide• Identification of Possible Countermeasures
3:30 PM	Adjourn for the Day – but the RSA has not ended

Instructions for Participants:

- Before attending the RSA on August 20th participants are encouraged to drive Main Street within Acushnet, MA and complete/consider elements on the RSA advisory checklist with a focus on safety factors affecting roadway departure 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.

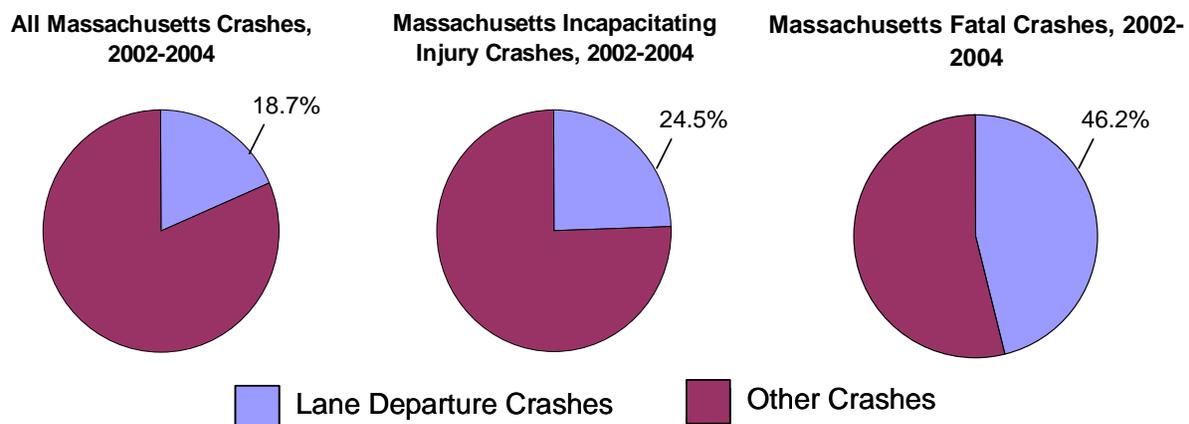
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In an effort to combat the lane departure problem, a strategy was developed for the SHSP to identify hot spot lane departure location, perform road safety audits and implement low-cost comprehensive countermeasures.

SRPEDD Crash, Speed, and Volume Data Summaries Main Street, Acushnet

Total Crashes - 28 (2003 - 2006)

- Fatal - 3
- Incapacitating - 5
- Possible injury - 9
- Non-incapacitating - 8
- No injury - 3

Primary Factors

- Speed - 13 (4 between 10 pm & 2 am - is alcohol a factor?)
- Fatigue/Inattention - 2
- Failure to Stay in Lane - 7 (speed and sharp curves involved in many of these)
- No Improper Driving - 7 (3 during adverse weather/road cond., 2 due to animal in road)

Dangerous Curves -

Vicinity of 67 - 91 Main St. - 3 crashes (1 fatal)

Vicinity of 340 - 444 Main St. (Referred to as Diggle's Curve) - 7 crashes (2 fatal) 'Curve Arrow' sign is on the curve instead of prior to the curve in the northbound direction in the vicinity of # 400 Main St. Worn center lines, intermittent roadside reflectors, no consistent edge markings.

Vicinity of 1461 Main St - 2 crashes, both in daylight and wet conditions Unpaved shoulder .

Vicinity of 1510 - 1550 Main St. - 3 crashes. No curve delineation prior to curves both north and southbound.

Excessive speed is an issue all along the Main Street corridor, with crashes occurring at the following addresses:

- #67 (11 pm, incapacitating) curve related
- #73 (10 pm, incapacitating) curve related
- #362 (5 am, non-incapacitating) curve related
- #405 (midnight, Fatal)** curve related
- #408 (midnight, incapacitating) curve related
- #444 (2 am, Fatal)** curve related
- #444 (9 pm, non-incapacitating) curve related
- #897 (4 pm, non-incapacitating)
- #949 (6 pm, non-incapacitating)
- #1069 (5 pm, non-incapacitating)
- #1118 (8 pm, non-incapacitating)
- #1510 (midnight, Fatal)** curve related
- #1517 (3 pm, no injury) curve related

Corridor needs may include: improved curve delineation, renewed pavement markings, edge markings, consistent roadside reflectors.

ATR traffic counts were conducted at three locations along the Main Street corridor. Each counts includes hourly directional volume and speed. Each location is summarized below:

Main Street south of Leonard Street

	Total	NB	SB
24 hour volume -	4,376 VPD	2,163 VPD	2,213 VPD
Average Speed -	42 MPH	42 MPH	42 MPH
85 th percentile Speed -	48 MPH	48 MPH	48 MPH

Main Street north of Hamlin Street

	Total	NB	SB
24 hour volume -	7,055 VPD	3,485 VPD	3,570 VPD
Average Speed -	40 MPH	41 MPH	39 MPH
85 th percentile Speed -	45 MPH	46 MPH	45 MPH

Main Street @ Rochester Town Line

	Total	NB	SB
24 hour volume -	2,199 VPD	1,060 VPD	1,139 VPD
Average Speed -	43 MPH	42 MPH	45 MPH
85 th percentile Speed -	49 MPH	48 MPH	50 MPH

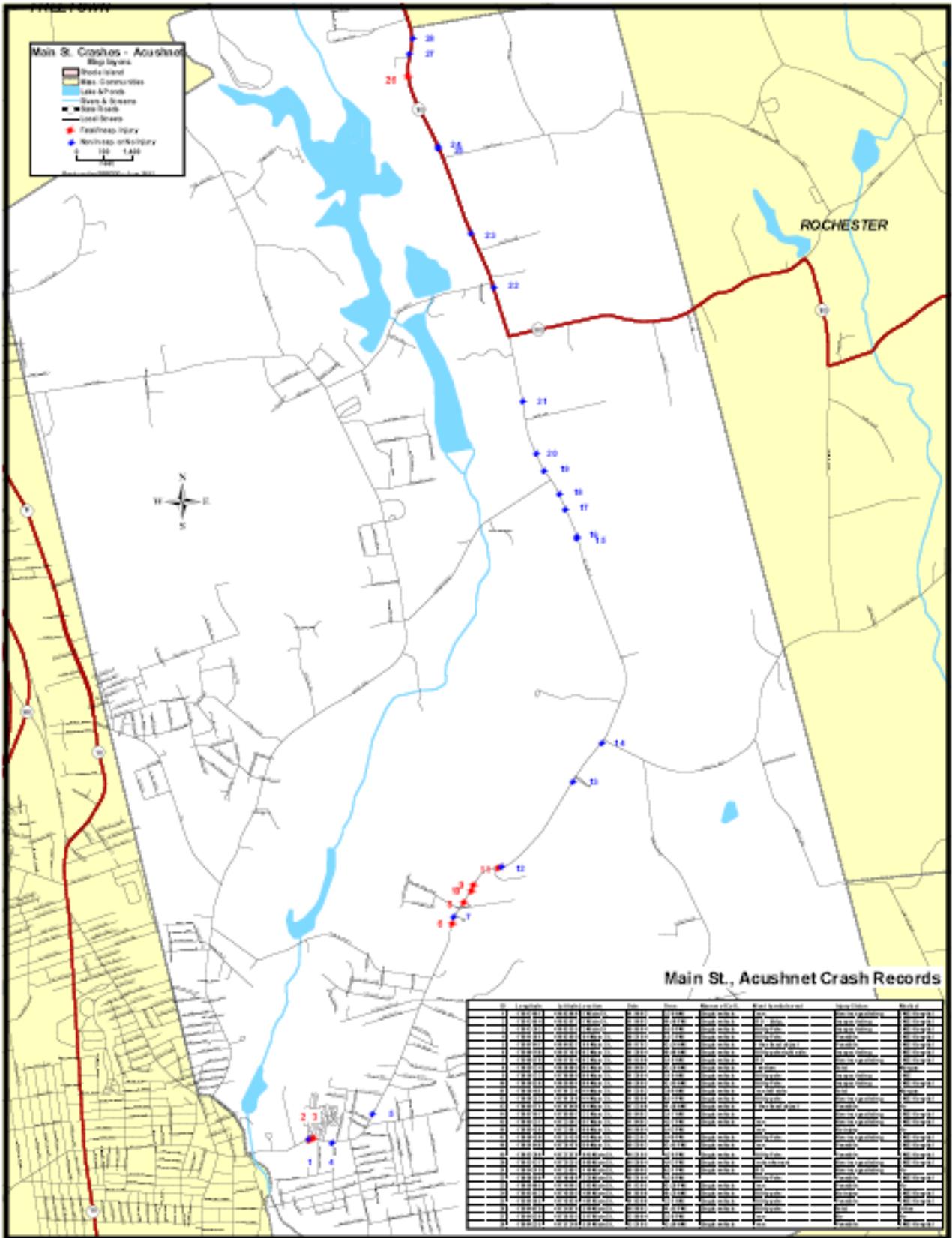
Report #	1	2	3	4	5	6
Location	67 Main St.	67 Main St.	73 Main St	104 Main St.	166 Main St.	362 Main St.
Date	01/10/03	11/10/03	09/05/04	08/31/04	06/17/03	01/28/04
Age of Driver	39	52	43	44	19	49
Time	2:30 AM	10:48 PM	9:59 PM	1:53 PM	12:24 AM	10:06 AM
Direction of travel	SB	WB	WB	WB	SB	NB
Light Cond	Dark - Road lit	Dark - Road lit	Dark - Road lit	Daylight	Dark - Road lit	Daylight
Weather	Cloudy	Clear	Clear	Clear	Clear	Snow
Traffic Control	Stop sign	None	None	None	None	None
Road Surface	Wet	Dry	Dry	Dry	Dry	Snow
Road/Int.Type	Roadway	Roadway	Roadway	Roadway	Roadway	Roadway
Manner of Coll.	Single vehicle	Single vehicle	Single vehicle	Single vehicle	Single vehicle	Single vehicle
1st Harmful location	Off road	Off road	Paved shoulder	On road	Roadside	On road
Collision with	Tree	Other	Utility Pole	Utility Pole	Curb	Utility pole
Veh. Prior to coll.	Other	Straight	Straight	Straight	Straight	Straight
Sequence of events 1	Tree	ROR right	Utility Pole #91/12	In traffic	Curb	Utility pole
Sequence of events 2		HFO - bldg.			Other fixed object	
Sequence of events 3					Overhead sign support	
Sequence of events 4						
Most harmful event	Tree	HFO - bldg.	Utility Pole	Utility Pole	Other fixed object	Utility pole right side
Driver factor 1	Reckless driving	Failed to stay in lane	Speeding	Inattention	Fatigued/sleep	No improper driving
Driver factor 2	Disregard markings		Reckless driving			
Seat belt used?	Air bag deployed	Unreported	No	No	No	No
Injury Status	Non-incapacitating	Incapacitating	Incapacitating	Possible	Possible	Incapacitating
Medical	EMS-Hospital	EMS-Hospital	EMS-Hospital	EMS-Hospital	EMS-Hospital	EMS-Hospital
Circumstances	Driver speeding , failed to stay in lane, ran stop sign	Failed to negotiate curve @ #91 Main St., ROR right side for 143' & hit bldg.	Speeding, hit pole on curve	Inattention while making LT onto Main St.	SB-crossed over & hit stone wall, then hit business sign	Lost control due to poor road cond.
Conclusions	Driver error	Driver error	Driver error	Driver error	Driver error	Weather
	Speed	Speed?	Speed	Inattention	Fell asleep at wheel. Possible hit stone wall.	Snow
Possible remedy	Enforcement	Curve delineation?	Enforcement			

Report #	7	8	9	10	11	12
Location	362 Main St.	405 Main St.	408 Main St.	408 Main St.	444 Main St.	444 Main St.
Date	06/15/06	10/04/03	01/30/04	08/28/05	01/25/03	11/05/06
Age of Driver	40	26	17	28	27	17
Time	5:18 AM	12:30 AM	7:10 AM	12:19 AM	2:00 AM	8:54 PM
Direction of travel	SB	SB	SB	SB	SB	SB
Light Cond	Daylight	Dark - Road lit	Daylight	Dark - Road lit	Dark -Road lit	Dark - Road not lit
Weather	Cloudy	Clear	Clear	Clear	Clear	Clear
Traffic Control	None	None	None	None	None	None
Road Surface	Dry	Dry	Ice	Dry	Dry	Dry
Road/Int.Type	Roadway	Roadway	Roadway	Roadway	Roadway	Roadway
Manner of Coll.	Single vehicle	Single vehicle	Single vehicle	Single vehicle	Single vehicle	Single vehicle
1st Harmful location	Off road	Off road	Roadside	Roadside	Off road	On road
Collision with	HFO	Overturn	Utility pole	Utility pole	Tree	Utility pole
Veh. Prior to coll.	Straight	Straight	Straight	Straight	Straight	Straight
Sequence of events 1	HFO	ROR right	Utility pole	Utility Pole	Tree	Utility pole
Sequence of events 2		ROR left			Ditch	
Sequence of events 3		Mailbox			Tree	
Sequence of events 4		Overturn				
Most harmful event	HFO	Overturn	Utility pole	Utility Pole	Tree left side	Utility pole
Driver factor 1	Speed	Failed to stay in lane	No improper driving	Speed	Speed	Speed
Driver factor 2	Failed to stay in lane	Overcorrect steering			Failed to stay in lane	Reckless driving
Seat belt used?	Yes	No	No	No	No	Yes
Injury Status	Non-incapacitating	Fatal	Incapacitating	Incapacitating	Fatal	Non-incapacitating
Medical	EMS-Hospital	Morgue	EMS	EMS-Hospital	Morgue	EMS-Hospital
Circumstances	Lost control while speeding	Veh. rolled over 3 times.	Began to loose control at 444 Main curve. Slid across road due to ice.	Failed to slow at "Diggle's Curve" @ 408 Main St. ROR-hit pole	Lost control at #459 Main curve. Slid across road, hit tree, airborne, hit 2nd tree. Speed calculated at 70 MPH.	Speed
Conclusions	Driver error	Driver error	Weather	Driver error	Driver error	Driver error
	Speed	Possible speed, possible DUI	Ice - curve	Speed 64 MPH	Speed 70 MPH , possible DUI	Speed, possible inexperience.
Possible remedy	Enforcement	Curve delineation?	Curve delineation?	Curve delineation?	Curve delineation?	Curve delineation?

Report #	13	14	15	16	17	18
Location	564 Main St.	632 Main St.	897 Main St.	900 Main St.	949 Main St.	990 Main St.
Date	07/23/06	05/04/03	11/04/03	04/18/04	09/23/03	09/29/03
Age of Driver	31	23	54	16/26	40	58
Time	11:56 AM	2:17 AM	4:27 PM	5:42 PM	5:40 PM	12:15 PM
Direction of travel	NB	SB	NB	NB/NB	SB	SB
Light Cond	Daylight	Daylight	Dusk	Daylight	Daylight	Daylight
Weather	Cloudy	Clear	Rain	Clear	Rain	Clear
Traffic Control	None	None	None	None	None	None
Road Surface	Dry	Dry	Wet	Dry	Wet	Dry
Road/Int.Type	Roadway	Roadway	Driveway	Driveway	Roadway	Roadway
Manner of Coll.	Single vehicle	Single vehicle	Single vehicle		Single vehicle	Single vehicle
1st Harmful location	Off road	Outside roadway	Tree	Roadside	Roadside	Roadside
Collision with	Utility pole	Tree	Tree	Tree	Utility pole	Tree
Veh. Prior to coll.	Straight	Straight	Straight	Entering traffic	Passing	Straight
Sequence of events 1	In traffic	Ran-off-road right side	Tree	ROR	Ran-off-road right side	In traffic
Sequence of events 2	Utility pole	Tree		Tree	Ran-off-road left side	Tree
Sequence of events 3	Mailbox				HFO	
Sequence of events 4	Other fixed object				Utility Pole	
Most harmful event	Other fixed object		Tree	Tree	Utility Pole	Tree
Driver factor 1	No improper driving	Failed to stay in lane	Speed too fast	Failed to yield	Speeding	No improper driving
Driver factor 2			Swerv to avoid water		Reckless driving	
Seat belt used?	Unreported	Yes	Yes	Unreported	No	No
Injury Status	Possible	Non-incapacitating	Non-incapacitating	No injury	Non-incapacitating	Possible
Medical	No	EMS-Hospital	EMS-Hospital	No	EMS-Hospital	EMS-Hospital
Circumstances	No details provided.	NB vehicle crossed into SB lane forcing veh off road into SB lane tree	Swerved to avoid standing water , lost control due to speed	Swerved off road to avoid veh backing into driveway	SB-ROR, then crossed over, hit pole	Blinded by sun, hit tree
Conclusions	Unreported	Driver error	Driver error	Driver error	Driver error	Blinded by sun
	No improper driving				Speeding	
Possible remedy			Drainage?		Enforcement	

Report #	19	20	21	22	23	24
Location	1015 Main St.	1069 Main St.	1118 Main St.	1235 Main St.	1282 Main St.	1461 Main St.
Date	04/21/05	04/20/04	09/09/05	05/21/04	11/12/05	01/05/06
Age of Driver	20	61	33	69	21	20
Time	4:28 PM	4:43 PM	8:21 PM	5:28 PM	12:36 PM	10:39 AM
Direction of travel	SB	NB	SB	NB	SB	SB
Light Cond	Daylight	Daylight	Dark - Road lit	Daylight	Daylight	Daylight
Weather	Clear	Clear	Clear	Clear	Clear	Rain
Traffic Control	None	None	None	None	None	Flashing control
Road Surface	Dry	Dry	Dry	Dry	Dry	Wet
Road/Int.Type	Roadway	Roadway	Roadway	Roadway	Roadway	Roadway
Manner of Coll.	Single vehicle	Single vehicle	Single vehicle		Single vehicle	Single vehicle
1st Harmful location	Roadside	Off road	Roadside	On road	Off road	Off road
Collision with	Utility pole	Embankment	Other movable object	Utility Pole	Dear	Utility pole
Veh. Prior to coll.	Straight	Straight	Straight	Straight	Straight	Straight
Sequence of events 1	Utility Pole	ROR left	Cross centerline	Utility Pole	Deer in Rd	Utility pole
Sequence of events 2		Embankment	ROR left			
Sequence of events 3			HFO			
Sequence of events 4						
Most harmful event	Utility Pole	Embankment	HFO	Utility Pole	Tree	Utility pole
Driver factor 1	Failed to stay in lane	Failed to stay in lane	Speeding	No improper driving	No improper driving	Failed to stay in lane
Driver factor 2		Speed	Failed to stay in lane	Swerved to avoid cat		
Seat belt used?	Yes	Yes	Yes	Unreported	Unreported	Yes
Injury Status	Possible	Non-incapacitating	Non-incapacitating	Possible	Possible	No injury
Medical	EMS-Hospital	EMS-Hospital	No	EMS-Hospital	No	EMS-Hospital
Circumstances	ROR-hit pole	Assumed to be speed related, veh. airborne for 146'	Crossed over & HFO	Swerved to avoid cat	Deer in road may have forced veh. off road into tree	Lost control, hit pole
Conclusions	Driver error	Driver error	Driver error	Animal	Animal	Driver error
		Speed	Speed			Wet pavement & possible speed.
Possible remedy		Enforcement	Enforcement			

Report #	25	26	27	28
Location	1461 Main St.	1510 Main St.	1517 Main St.	1551 Main St.
Date	01/03/06	04/18/03	12/09/04	12/31/05
Age of Driver	21	29	17/17	44
Time	7:21 AM	11:15 PM	2:36 PM	12:58 AM
Direction of travel	SB	SB	SB/SB	NB
Light Cond	Daylight	Dark - Road not lit	Daylight	Dark - Road lit
Weather	Sleet, freezing rain	Clear	Cloudy	Clear
Traffic Control	None	None	None	None
Road Surface	Slush	Dry	Dry	Dry
Road/Int. Type	Roadway	Roadway	Roadway	Roadway
Manner of Coll.	Single vehicle	Single vehicle		Single vehicle
1st Harmful location	Unpaved shoulder	Roadside	On road	Unpaved shoulder
Collision with	Utility pole	Other	Motor vehicle	Other
Veh. Prior to coll.	Straight	Straight	Straight/Passing	Straight
Sequence of events 1	Utility pole	Other	Ditch	Other
Sequence of events 2		Utility pole	Tree	Mailbox
Sequence of events 3		Utility pole		Tree
Sequence of events 4		Tree		Other
Most harmful event	Utility pole	Utility pole	Tree	Tree
Driver factor 1	No improper driving	Reckless driving	Speeding	Failed to stay in lane
Driver factor 2		Speeding		Other improper action
Seat belt used?	No	No	Unreported	No
Injury Status	Possible	Fatal	No	Possible
Medical	EMS-Hospital	Other	No	EMS-Hospital
Circumstances	Lost control, hit pole, weather related	Lost control due to excessive speed, striking pole, tree. & rolling on its side.	ROR into ditch & tree while passing other veh.	No details
Conclusions	Weather related	Driver error	Driver error	Driver error
		Speed	Speeding	
Possible remedy		Enforcement	Enforcement	



GEOMETRIC DESIGN – Main Street, Acushnet	
Issue	Comment
A. Speed – (Design Speed; Speed Limit & Zoning; Sight Distance; Overtaking)	
<p>Are there speed-related issues along the corridor? Please consider the following elements:</p> <ul style="list-style-type: none"> • Horizontal and vertical alignment; • Posted and advisory speeds • Driver compliance with speed limits • Approximate sight distance • Safety passing opportunities 	
B. Road alignment and cross section	
<p>With respect to the roadway alignment and cross-section please consider the appropriateness of the following elements:</p> <ul style="list-style-type: none"> • Functional class (Urban Principal Arterial) • Delineation of alignment; • Widths (lanes, shoulders, medians); • Sight distance for access points; • Cross-slopes • Curbs and gutters <p>Drainage features</p>	
C. Intersections	
<p>For intersections along the corridor please consider all potential safety issues. Some specific considerations should include the following:</p> <ul style="list-style-type: none"> • Intersections fit alignment (i.e. curvature) • Traffic control devices’ alert motorists as necessary • Sight distance and sight lines seem appropriate • Vehicles can safely slow/stop for turns • Conflict point management • Adequate spacing for various vehicle types <p>Capacity problems that result in safety problems</p>	
D. Auxiliary lanes	
<ul style="list-style-type: none"> • Do auxiliary lanes appear to be adequate? 	
<ul style="list-style-type: none"> • Could the taper locations and alignments be causing safety deficiencies? 	
<ul style="list-style-type: none"> • Are shoulder widths at merges causing safety deficiencies? 	

E. Clear zones and crash barriers	
<p>For the roadside the major considerations are clear zone issues and crash barriers. Consider the following:</p> <ul style="list-style-type: none"> • Do there appear to be clear zones issues? <ul style="list-style-type: none"> — Are hazards located too close the road? — Are side slopes acceptable? • Are suitable crash barriers (i.e, guard rails, curbs, etc.) appropriate for minimizing crash severity? • Barrier features: end treatments, visibility, etc. 	
F. Bridges and culverts – (if necessary)	
<p>Are there specific issues related to bridges and culverts that may result in safety concerns?</p>	
G. Pavement – (Defects, Skid Resistance, and Flooding)	
<ul style="list-style-type: none"> • Is the pavement free of defects including excessive roughness or rutting, potholes, loose material, edge drop-offs, etc.) that could result in safety problems (for example, loss of steering control)? • Does the pavement appear to have adequate skid resistance, particularly on curves, step grades and approaches to intersections? • Is the pavement free of areas where flooding or sheet flow of water could contribute to safety problems? • In general, is the pavement quality sufficient for safe travel of heavy and oversized vehicles? 	
H. Lighting (Lighting and Glare)	
<p>It is important to consider to the impacts of lighting. Some specifics include the following:</p> <p>Is lighting required and, if so, has it been adequately provided?</p> <p>Are there glare issues resulting from headlights during night time operations or from sunlight?</p>	

TRAFFIC CONTROL DEVICES	
Issue	Comment
I. Signs	
<p>Signage is a critical element in providing a safe roadway environment. Please consider the following:</p> <ul style="list-style-type: none"> • Are all current signs visible? Are they conspicuous and clear? Are the correct signs used for each situation? 	
<ul style="list-style-type: none"> • Are signs visible (consider both night and day)? • Does the retroreflectivity or illumination appear satisfactory? • Are there any concerns regarding sign supports? 	
J. Traffic signals	
<p>Although the focus of this RSA are lane departures, this does present an opportunity for us to consider any traffic signals. Specifically:</p> <ul style="list-style-type: none"> • If present, do the traffic signals appear to be designed, installed, and operating correctly? • Is the controller located in a safe position? (where it is unlikely to be hit, but maintenance access is safe) • Is there adequate sight distance to the ends of possible vehicle queues? 	
K. Marking and delineation	
<ul style="list-style-type: none"> • Is the line marking and delineation: <ul style="list-style-type: none"> — appropriate for the function of the road? — consistent along the route? — likely to be effective under all expected conditions? (day, night, wet, dry, fog, rising and setting sun, oncoming headlights, etc.) • Are centerlines, edgelines, and lane lines provided? If not, do drivers have adequate guidance? 	

ROADWAY ACTIVITY	
Issue	Comment
<p>With respect to roadway activity please consider safety elements related to the following:</p> <ul style="list-style-type: none"> • Pedestrians • Bicycles • Public transportation vehicles and riders • Emergency vehicles • Commercial vehicles • Slow moving vehicles 	

ENVIRONMENTAL CONSIDERATIONS	
Issue	Comment
Weather & Animals	
<p>From an environmental perspective it is important to consider any potential impacts. Most notably is likely to be the impacts of weather or animals, including:</p> <ul style="list-style-type: none"> • Possible effects of rain, fog, snow, ice, wind on design features. • Has snow fall accumulation been considered in the design (storage, sight distance around snowbanks, etc.)? • Are there any known animal travel/migration routes in surrounding areas which could affect design? 	