Functional Design Report

Main Street (Route 9)
2-Locations
Transportation Improvements

Spencer,
Massachusetts

Prepared for Town of Spencer
3 Old Meadow Road
Spencer, MA 01562

Prepared by **Vanasse Hangen Brustlin, Inc.**
Worcester, Massachusetts

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Introduction

Vanasse Hangen Brustlin, Inc. (VHB) has been retained by the Town of Spencer to provide engineering services for the design of roadway and traffic control improvements for the intersections of Main Street (Route 9) at Maple Street and Main Street (Route 9) at Pleasant Street/Wall Street in Spencer, Massachusetts. Route 9 is under the jurisdiction of MassDOT, while Maple Street and Pleasant Street are under the jurisdiction of the Town of Spencer.

This Functional Design Report (FDR) is intended to satisfy, in part, the 25 percent design stage requirements of MassDOT, and contains a summary of traffic volumes, crash data/safety analysis, roadway geometry, traffic signal warrants, and intersection capacity analysis. Findings are provided based on the analysis. Recommendations for roadway and traffic control improvements for the study locations are defined. Table 1-1 and Figure 1-1 identify the study intersections.

Table 1-1 Study Area Intersections

1	Main Street (Route 9) at Maple Street (Route 31)
2	Main Street (Route 9) at Pleasant Street (Route 31) & Wall Street

Note: Both locations are signalized.

Project Description

The focus of this project is to: improve traffic signal and roadway operations, as well as improve pedestrian and bicycle accommodations along the Main Street (Route 9) corridor through Downtown Spencer. The following summarizes some of the corridor improvements proposed:

- Geometric modifications to improve large vehicle turning movements including realignment and reconstruction of Pleasant Street to the west to better align with Wall Street south of Main Street.
- Sidewalk reconstruction with improved wheelchair ramps, sidewalks and crosswalks for pedestrian accessibility;

- Pavement rehabilitation (mill and overlay) and full depth reconstruction for minor roadway widening along Main Street;
- Addition of landscape and streetscape improvements; and
- Reconstruction of two existing signalized intersections and modification of signal timings to provide a coordinate traffic control system.

Project Scope

This FDR provides a brief summary and discussion of the needs, benefits, and issues relating to the proposed roadway/traffic control improvements for these intersections. The data profile sections provide a quick reference for existing and proposed intersection characteristics such as geometry and roadway operating conditions. A summary of analyses findings is also provided as a measure of the effectiveness of the proposed improvements. Appendix A provides the methodology used to evaluate traffic flow performance. Appendices B through F provide complete supporting information relating to the existing conditions data, signal warrant analyses, and capacity analysis worksheets for the study intersections.

Source: USGS 1982-1985

N

0 500 1,000 2,000 Feet

Vanasse Hangen Brustlin, Inc.

Figure 1
USGS Locus Map

July 2013

Main Street (Route 9)
Transportation Improvements
Spencer, Massachusetts

Analysis Criteria

The MassDOT review process requires that a FDR be prepared to evaluate the following design conditions:

- 2011 Existing Traffic Volumes with Existing Geometry,
- 2023 Future Traffic Volumes with Existing Geometry,
- 2023 Future Traffic Volumes with Proposed Geometry.

The term "geometry" represents all traffic control measures including physical roadway geometry and traffic signals. A projected twelve-year (2023) design condition has been used to measure the effectiveness of the proposed improvements.

Existing Traffic Volumes

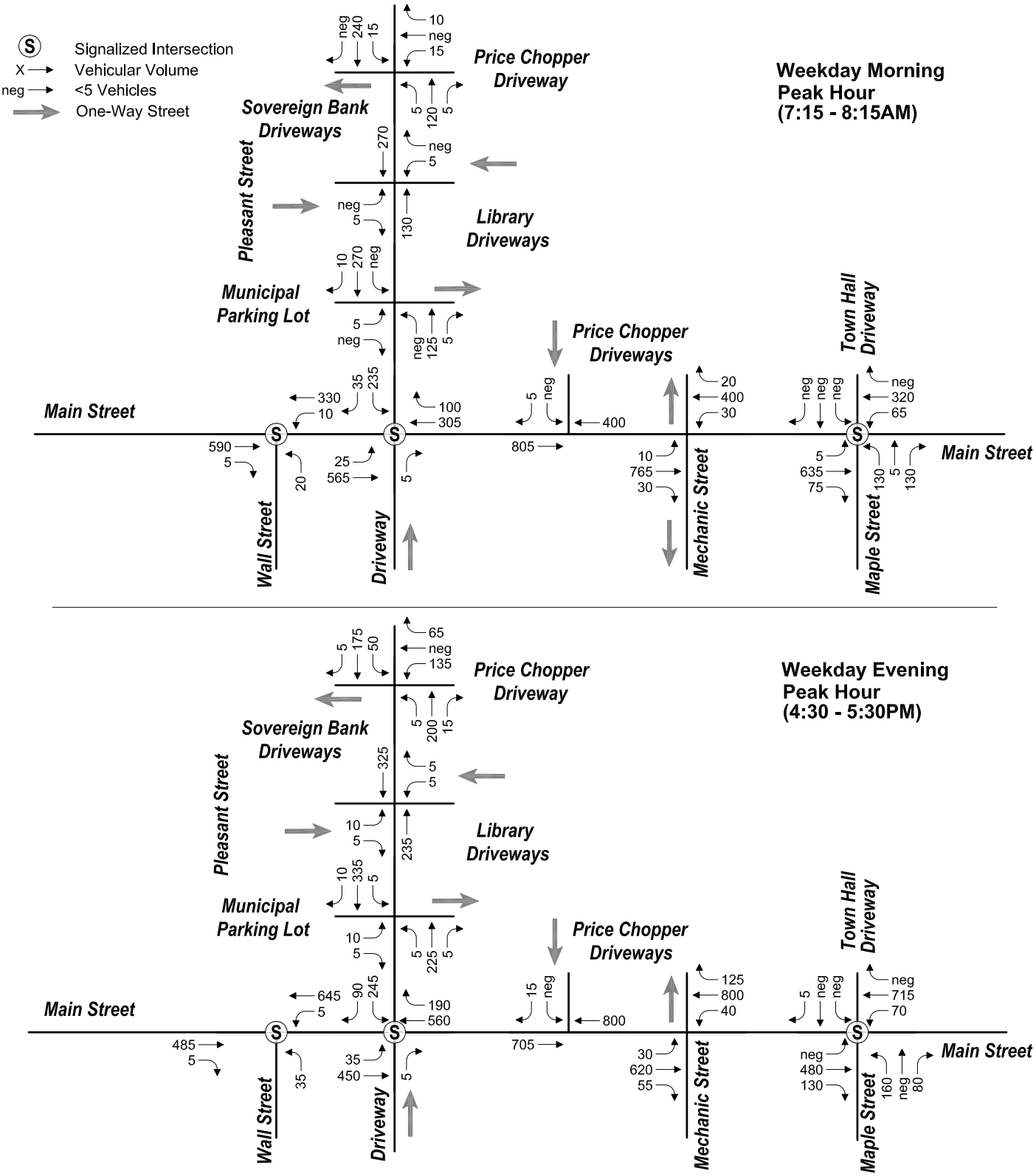
Traffic volume information for the study intersections were collected manually and mechanically by Innovative Data, LLC of Belchertown, Massachusetts, to provide a basis from which to evaluate traffic conditions. Manual turning movement counts (TMCs) were collected on a typical non-holiday weekday from 7:00 AM – 9:00 AM and from 4:00 PM – 6:00 PM, during the month of April 2011. These time periods represent the typical peak periods and were studied herein to define the intersection operations of the study intersections.

Based on the TMC data, the peak hours of traffic operation for the study intersections were determined to be 7:15 – 8:15 AM on a typical weekday morning, from 4:30 – 5:30 PM on a typical weekday evening.

In addition to the TMCs, Automatic Traffic Recorder Counts (ATRs) were conducted for a minimum of 48 hour period at each approach to the intersections during the month of April 2011. Traffic volume, traffic classification counts and speed data were collected at this time. These counts were used to confirm daily traffic along the roadways and to conduct signal warrant analyses for the study intersections.

Seasonal Variation

Based on the MassDOT Weekday Seasonal Factors, traffic volumes in April are eight percent higher than the average annual traffic volumes. To provide a conservative analysis, the traffic volumes collected in April of 2011 were not reduced to reflect average annual conditions. The 2011 Existing Conditions traffic volume networks are shown in Figure 1-2 for the weekday morning and weekday evening peak periods.



Vanasse Hangen Brustlin, Inc.

Existing Peak Hour Traffic Volumes

Figure 1-2

Main Street
Spencer, Massachusetts

Not to Scale

Area Growth/Design Year Volumes

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Historic Traffic Growth

Based on historical MassDOT traffic data within the Town, traffic volumes have remained constant or decreased slightly over the past several years. In order to provide a conservative estimate the existing traffic volumes were increased by 0.75 percent per year to account for potential future traffic growth not associated with identified planned/approved developments.

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Regional Specific Growth

Traffic volumes in the area can be affected by other nearby developments. In addition to accounting for background growth, the traffic associated with other planned and/or approved developments near the site were considered. Based on discussions with the Town of Spencer, there are no developments planned within the area that would be expected to generate additional traffic through the study area. Any smaller projects with relatively low traffic volume generation are accounted for through the use of the 0.75 percent annual background traffic growth factor.

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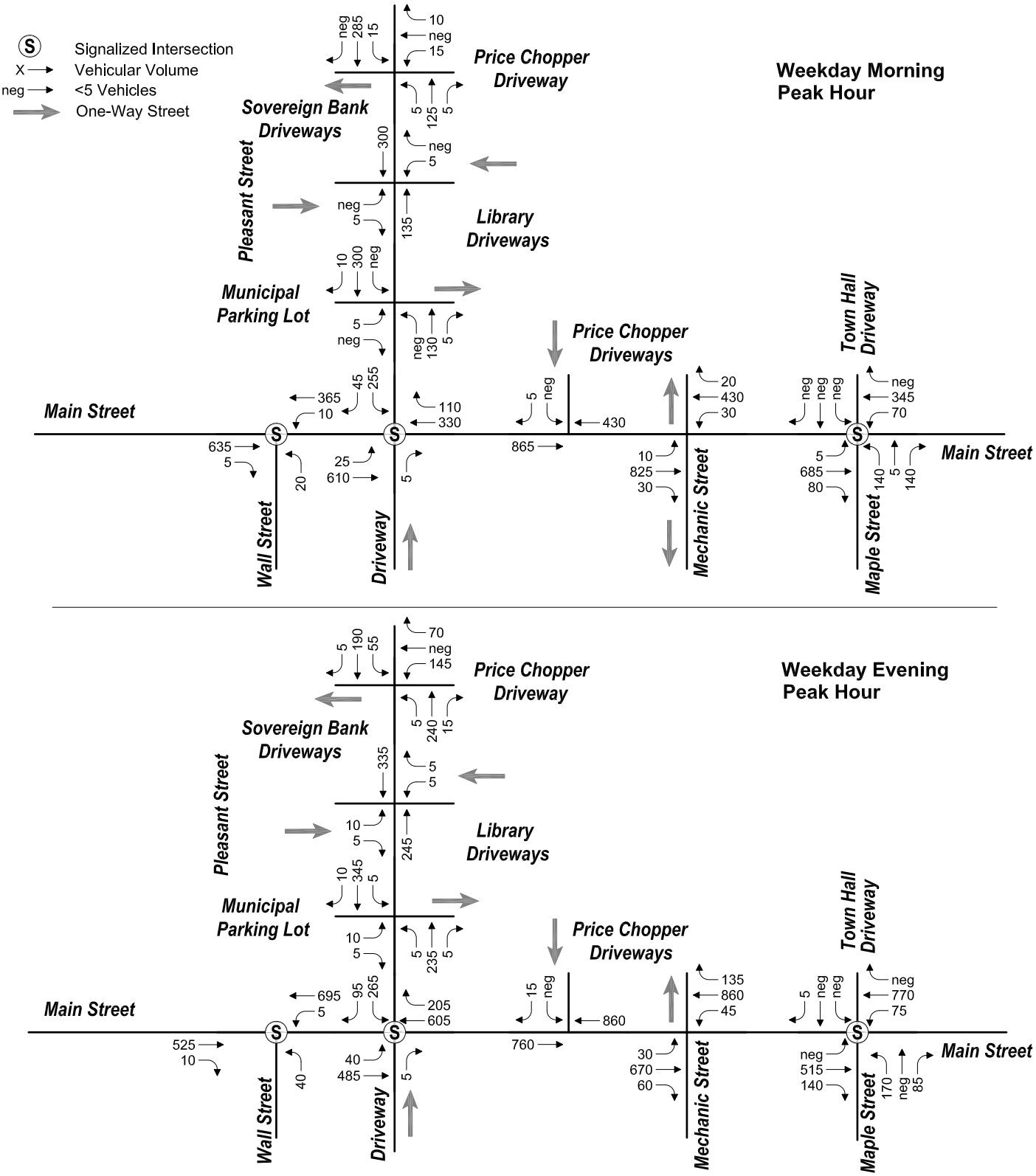
Design Year Traffic Volumes

The year 2023 Build traffic volumes, based on general background growth and known project developments are shown in Figure 1-4.



Vanasse Hangen Brustlin, Inc.

Future Peak Hour Traffic Volumes

Figure 1-3

Main Street
Spencer, Massachusetts

Not to Scale

Corridor Improvements

To improve traffic operations, bicycle mobility and pedestrian connectivity along this corridor, roadway and traffic signal control improvements have progressed to this 25 percent design stage. More specifically the following improvements are proposed:

- Reconstruction of existing traffic signal system at Maple Street and Main Street and introduction of north-south split phase operation (including an eastbound right-turn overlap phase) at the signal;
- Addition of bike accommodations at the eastbound approach of the Main Street at Maple Street intersection.;
- Provide wheelchair ramps to meet current ADA/AAB access standards at the intersection;
- Realignment of Pleasant Street with Wall Street to provide a more traditional four-way intersection geometry;
- Reconstruction of existing traffic signal system at Pleasant Street and Main Street to accommodate new Pleasant Street alignment;
- Installation of 5 foot shoulders along Main Street;
- Reconstruction of existing sidewalks and ADA-compliant ramps and crossings throughout the project limits;
- Installation of a Rectangular Rapid Flashing Beacon (RRFB) system at the unsignalized crosswalk just west of Mechanic Street for pedestrians;
- Improved definition of travel lanes, shoulders and on-street parking through the use of pavement markings; and
- Signage modifications as called for throughout the project limits.

Road Safety Audit

A Road Safety Audit (RSA) was conducted by BETA Group, Inc. for MassDOT in January 2013 and attended by representatives of the Town and VHB. The RSA focused on the Main Street corridor between Elm Street and High Street. The RSA included a review of crash data and conceptual designs that had been provided to the Town by VHB. Several existing safety issues were identified during the RSA with corresponding suggestions on how they may be improved. Suggestions were broken down into Short-Term, Mid-Term and Long-Term improvements. Suggestions that have been incorporated into the current design submission include:

- Realignment of Pleasant Street opposite Wall Street to provide a more traditional four-way intersection;
- Provide wider travel lanes and better defined lane transitions and parking limits;
- Reconstruct existing traffic signals with all new equipment, including backplates, countdown pedestrian signals, and emergency preemption;
- Provide advanced warning signage for the unsignalized crosswalk at Mechanic Street;
- Restrict on-street parking within twenty feet of all intersections;
- Provide bulb-outs on intersection corners; and
- Reduce width of wide curb-cuts with curbing and sidewalk.

Several of the suggestions either will be made obsolete by the current design or do not fall within the purview of this roadway design project, such as snow removal and police improvement, and thus have not been addressed here. Consideration was also given to additional measures including the closing of existing curb cuts on Main Street; however these have not been included in this design submission due to concerns of landowners and the Town, as well as the likely high project cost that would be associated with such improvements.

Crash Data

To identify crash trends in the study area, VHB reviewed data provided by the Spencer Police Department for the period between June 2009 and June 2012. This data was provided as part of the RSA process. The crash summary and collision diagram provided by MassDOT as part of the RSA have been included in Appendix F.

A total of 43 crashes occurred within the Project Limits between June 2009 and June 2012, of which the majority occurred at the two signalized locations. Over this same time period there were a total of four crashes that involved pedestrians within the project limits. It should also be noted that a fatal crash involving a pedestrian occurred in 2007 in the vicinity of the unsignalized Mechanic Street intersection with Main Street.

Rear-end crashes were the most common variety observed within the project limits, accounting for 20 (47%) of the total crashes.

As Table 1-1 indicates, there were 13 crashes during the three-year study period at the intersection of Main Street with Maple Street and 10 crashes at the intersection of Main Street with Pleasant Street and Wall Street. As would be

expected for signalized locations, the significant majority of crashes at these intersections were of the rear-end (15 of 23) and property damage (21 of 23) variety. A majority of the crashes occurred during off peak hours at these intersections, as well as within the corridor in general.

Table 1-2
Intersection Crash Summary

	Main Street at Maple Street	Main Street at Pleasant Street
Year		
2009[a]	1	0
2010	6	2
2011	5	5
2012[b]	1	3
Total	13	10
Annual Average	3.25	2.5
Collision Type		
Angle	2	3
Rear-end	8	7
Sideswipe, same direction	1	0
Single vehicle crash	2	0
Total	13	10
Crash Severity		
Non-fatal injury	2	0
Property damage only (none injured)	11	10
Total	13	10
Time of Day		
Weekday, 7:00 AM - 9:00 AM	2	1
Weekday, 4:00 PM - 6:00 PM	4	2
Saturday, 11:00 AM - 2:00 PM	0	0
Weekday, other time	5	2
Weekend, other time	2	5
Total	13	10
Pavement Conditions		
Dry	10	10
Wet	3	0
Total	13	10
Non Motorist (Bike, Pedestrian)		
Total	1	0
MassDOT Crash Rate	0.65	0.37

Source: Town of Spencer Police Department.
a data reflects crashes recorded from June 15, 2009 to December 31, 2009
b data reflects crashes recorded from January 1, 2012 and June 15, 2012

Standard MassDOT formulas, in the unit of crashes per million entering vehicles, were used to calculate the crash rate for the project intersections. The official statewide rate for the 2013 calendar year is 0.80 for signalized intersections. The Town of Spencer falls within MassDOT District 3 area. The 2010 crash rate for District 3 is 0.89 for signalized intersections. The crash rate calculated for the intersections of Main Street with Maple Street and Pleasant Street are 0.65 and 0.37, respectively, both of which are below the State and District 3 average crash rates.

Table 1-3 Intersection Crash Rates

Intersection	Crash Rate[1]
Main Street at Maple Street	0.65
Main Street at Pleasant Street/Wall Street	0.37

Source: Town of Spencer Police Department. Data provided for period between June 15, 2009 and June 15, 2012.
1 The MassDOT Crash Rate Worksheets are included in the Appendices

Standard MassDOT formulas, in the unit of crashes per million vehicle miles traveled, were also used to calculate the crash rate for Main Street within the project limits. Main Street (Route 9) is classified as an urban principal arterial within the project limits. The official statewide rate for the 2010 calendar year is 3.23 for urban principal arterials. The crash rate calculated for this section of Main Street is 11.08, which is more than three times higher than the Statewide average. It is worth noting, that the project limits, based on MassDOT resources, is located in a 2010 HSIP (Highway Safety Improvement Project) Pedestrian Cluster.

Table 1-4 Segmental Crash Rates

Roadway Segment	Crash Rate[1]
Main Street – Maple Street to High Street	11.08

Source: Town of Spencer Police Department. Data provided for period between June 15, 2009 and June 15, 2012.
1 The MassDOT Crash Rate Worksheets are included in the Appendices

Traffic Performance Measures

Level-of-service (LOS) is the term used to denote the different operating conditions which occur on a given roadway segment under various traffic volumes loading. It is a qualitative measurement of the effect of a number of factors including roadway geometry, speed, travel delay and freedom to maneuver. LOS provides an index to the operational qualities of a roadway segment or an intersection with letter designations ranging from A to F. LOS A represents the best operating condition, and LOS F represents the worst operating condition.

For signalized intersections, the analysis considers the operations of all traffic entering the intersection and the LOS designation is for the overall operations at

the intersection. The evaluation criteria used to analyze the study intersections are based on the Highway Capacity Manual[1] and described more fully in Appendix A of this report.

Traffic Management Strategy

As stated previously in this FDR, this project will consist of constructing the following: roadway realignment and associated pavement construction, new sidewalks, minor drainage improvements, pavement rehabilitation (pavement milling and overlay), minor full depth roadway widening, new wheelchair ramps, landscaping, geometric modifications, and improved traffic signals and coordination.

Based on automatic traffic recorder (ATR) counts, which are included in Appendices B & C, the overall traffic volumes along the corridor remain relatively constant throughout the day. While the overall volumes remain constant, the directional distribution varies depending on the commuting hours, with eastbound traffic heavier during the AM hours and westbound traffic heavier during the PM hours. Given the consistent volumes of traffic along the corridor, and its consistency, it is important to maintain reasonable traffic flow in all directions throughout the day. Detours are not expected to be necessary, and all turning movements at intersections shall be maintained so that businesses and traffic patterns are not significantly impacted. However, lane closures and lane shifts are expected to occur at various times throughout the duration of construction for the Project. Therefore, the Traffic Management Plan (TMP) for this project has been generally developed with the goal of reducing the existing roadway cross-sections by no more than one lane (on multi-lane roadways) during regular working hours, with a primary goal being to prevent unnecessary delays to the motoring public.. For the purposes of this Project, regular working hours are expected to be 7:00 AM to 4:00 PM. Any work that is to occur during peak traffic hours (7:00 AM to 9:00 AM and 4:00 PM to 6:00 PM) will be coordinated in advance with MassDOT and the Town of Spencer. Maintaining two-way traffic flow shall also be closely coordinated with maintaining pedestrian accessibility, as well as providing access for businesses and residents. Finally, the project is expected to be constructed in one construction season and work will not occur on Saturdays, Sundays or holidays, or on the day before or the day after a long weekend which involves a holiday without prior approval by MassDOT and the Town of Spencer.

The traffic management plan developed and analyzed for this project addresses the major aspects of construction. The following provides more details on the traffic management plan for the corridor.

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[1] Highway Capacity Manual 2000; Transportation Research Board, Washington, D.C., 2000.

Table 1-5 Observed Variations of Traffic Volumes

Location	Direction	Daily [1]	Hourly Traffic Range[2]			Commuter Hours[3]	
		Weekday	Low	High	Average	AM Peak	PM Peak
Main Street, east of Mechanic St	Eastbound	7,275	350	675	450	675	370
Main Street, east of Mechanic St	Westbound	7,400	350	575	475	380	565
Maple Street, south of Main St	Northbound	2,350	85	265	145	265	245
Maple St, south of Main St	Southbound	2,250	145	200	150	145	200
Mechanic St, south of Main St	Southbound	1,000	20	100	-	60	95
Pleasant St, north of Main St	Northbound	2,890	105	310	175	135	310
Pleasant St, north of Main St	Southbound	2,775	145	255	185	255	245
Wall St, south of Main St	Northbound	370	20	45	30	35	45
Wall St, south of Main St	Southbound	170	5	20	10	15	20

Source: Hourly traffic volumes for Main Street, Pleasant Street and Wall Street were obtained from Automatic Traffic Recorder (ATR) Counts conducted in April 2011. Commuter hour traffic volumes were obtained from Turning Movement Counts (TMC's) conducted in April 2011. All data was collected by Innovative Data, LLC for VHB and was rounded using the basic hourly report summaries from the traffic data.

Notes: Peak hour volumes reported in the table above may not coincide with the turning movement peak hours that are reported in this FDR. Traffic volumes for Mechanic Street are estimated based on TMC's.

1 average daily traffic volume expressed in vehicles per day

2 volumes expressed in vehicles per hour and report low, high and average hourly traffic volumes (by direction) between 7:00 AM and 7:00 PM.

3 volumes expressed in vehicles per hour and report commuter peak hour traffic between 7:00 AM – 9:00 AM (AM Peak) and between 4:00 PM – 6:00 PM (PM Peak).

Existing Conditions

The roadways within the project area comprise a network of primarily two-lane two-way roadways used to connect local residential streets to the downtown area of Spencer as well as to more regional destinations such as Worcester and Interstates 80 and 90. Main Street is a wide poorly marked two lane roadway that provides for turn lanes at intersections and on-street parking in-between. As stated previously, regular work hours for the Project as a whole will be 7:00AM to 4:00PM Monday thru Friday, although specific construction activities may require an alternative schedule. Due to the relative consistency of traffic volumes within the Project Area and a desire to limit disruption to the travelling public, work within the public way will take place between the hours of 9:00 AM to 4:00 PM. If the need for alternative work hours arises, this will be coordinated with MassDOT and the Town of Spencer. While traffic volumes are fairly consistent within the Project Area between the hours of 7:00 AM and 7:00 PM, no work that will disrupt travel on the roadway (lane closures, lane shifts, trenching, etc.) shall be done from 7:00 AM to 9:00 AM and from 4:00 PM to 6:00 PM; these time periods are the peak commuting times for the network. This is particularly important along the portion of Main Street located between Pleasant Street and Maple Street.

Pedestrian Accommodations

Currently there is significant pedestrian activity within the project area, consistent with a Downtown setting. Pedestrian accommodations are provided throughout the project limits, however the majority of pedestrian facilities are not ADA compliant. There are existing sidewalks on both sides of Main Street, Pleasant Street and Maple Street. In multiple locations along Main Street, there are two-tiered sidewalks, with the back portion adjacent to the buildings separated from the front by curbing. Marked crosswalks are provided at the signalized intersections of Main Street with Pleasant Street and Maple Street, as well as the unsignalized intersection at Mechanic Street. The existing pedestrian infrastructure may be utilized during construction to maintain adequate pedestrian connectivity, with minor adjustments to existing ramps and crossings.

If needed, a variety of proposed pedestrian bypass alternatives is illustrated on Sheet 21 of 33 of the contract documents. These details will be used during sidewalk and driveway construction along Main Street. Where possible, pedestrians will be maintained on the same side of the roadway and temporary wheelchair ramps will be provided to ramp the pedestrians from the existing sidewalk to the roadway. The pedestrians will be separated from the travel lanes by drums. If the width is not sufficient to accommodate traffic and pedestrian activity, then pedestrians will be directed to cross to the sidewalk on the opposite side of the street or at the closest adjacent intersection.

In addition, the work being performed is in the Downtown business area of the Town of Spencer, and access to all properties must be maintained at all times. The Contractor shall provide safe and ready means of ingress and egress to all stores and shops, public and private and professional offices and any other businesses or residences in the project area, both day and night, for the project duration. If the access needs to be restricted for a short period of time, the Contractor shall coordinate with the owner to determine an acceptable time to perform the work.

Bicycle Accommodations

Currently there is limited bicycle activity within the project area. Bicyclists currently share the road since shoulder width is minimal and do not have a separate facility for use; therefore, bicycles will be accommodated within normal vehicular traffic.

Lane Shifts and Closures

The following describes the remainder of traffic management details that may be used during construction. These plans are depicted in the 25% Design Submission on Sheet 21. As all roadways that are expected to be impacted by construction provide one-way travel, the majority of construction activity should

be accomplished through one, or a combination, of the described lane closure/shift details.

Two-Way Street Lane Shift: It is likely that this management detail will be used most frequently during construction of Main Street. It can be used for installation of new curbing, sidewalks, signage, utility work, or other work along the roadway edge. This detail may also be used during final paving and striping activities. Main Street is currently a two-lane roadway with on-street parking and turn lanes at intersections, resulting in an approximately 48 foot cross-section. While all vehicle movements will be maintained under this condition, the slight narrowing required by the lane shift may result in capacity being impacted slightly as a result of slower travel speeds and the requirement of traffic to shift through the work zone.

One Lane Closure: The one-lane closure details shall be used on roadways with single lanes in each direction in instances where travel in a single direction is to be blocked and an alternating two-way travel pattern will be accommodated on the other side of the roadway. It is expected that pavement milling and overlay, new curbing, sidewalks, signage or utility work may be accomplished using this traffic set-up. All roadways within the project limits other than Mechanic Street consist of these cross section conditions. Since this detail will reduce the overall cross section and number of lanes, the roadway capacity would be impacted. However, as is shown in Table 1-5, the streets where this condition is applicable all have adequate capacity to accommodate a single lane closure during the off peak periods as planned.

Traffic at Intersections

The majority of the intersection work would be constructed by maintaining at least one lane on all approaches where work is proposed. If a lane needs to be closed, this work shall be conducted during off-peak conditions so that traffic flows are not constrained at the study area intersections. Details illustrating the traffic management plan for intersections are shown on Sheet 21 in the 25% Design Submission.

One Lane Reduction at Intersection: This application shall be used for the installation of traffic signal equipment, as well as the construction of sidewalks and wheelchair ramps at locations within or directly adjacent to the intersection.

Local Road Closure: The local road closure at intersection detail shall be used in instances where a local roadway or signalized driveway shall be closed for a short period of time. It is expected that construction activities to be accomplished using this traffic set-up shall include traffic striping, paving and trenching activities. Roadways within the project limits where this traffic set-up may be

used include Wall Street, Mechanic Street and the signalized driveway to Town Hall and the signalized driveway opposite Pleasant Street. If an 11-foot cross-section can be maintained the One-Lane Reduction at Intersection shall be used. If this detail is utilized, the Contractor shall provide a detour plan to be approved by MassDOT and the Town of Spencer.

Table 1-6
Route 9 Work Zone Capacities

Location	Hourly Traffic Range[1]		Off Peak Hours[4]	Traffic Management Plan[3]																
				One Lane Closure – Left			One Lane Closure – Right			Two Way Street Lane Shift			One Lane Bi-directional Traffic at Intersection			Left Lane Closure – Center Workzone			Work on Near/Far Side of Intersection with Multilane Approach		
	Low	High	Average	Lanes[4]	Ideal Average Lane Capacity[5]	Meets MassDOT[6]	Lanes	Ideal Average Lane Capacity	Meets MassDOT	Lanes	Ideal Average Lane Capacity	Meets MassDOT	Lanes	Ideal Average Lane Capacity	Meets MassDOT	Lanes	Ideal Average Lane Capacity	Meets MassDOT	Lanes	Ideal Average Lane Capacity	Meets MassDOT
Main Street																					
Eastbound	350	675	450	2 to 1	1,340	Yes	2 to 1	1,340	Yes	2 to 1	1,340	Yes	2 to 1	1,340	Yes	2 to 1	1,340	Yes	2 to 1	1,340	Yes
Westbound	350	575	475	2 to 1	1,340	Yes	2 to 1	1,340	Yes	2 to 1	1,340	Yes	2 to 1	1,340	Yes	2 to 1	1,340	Yes	2 to 1	1,340	Yes
Maple Street																					
Northbound	85	265	145	2 to 1	1,340	Yes	2 to 1	1,340	Yes	2 to 1	1,340	Yes	2 to 1	1,340	Yes	2 to 1	1,340	Yes	2 to 1	1,340	Yes
Southbound	1,425	1,990	1,562	2 to 1	1,340	Yes	2 to 1	1,340	Yes	2 to 1	1,340	Yes	2 to 1	1,340	Yes	2 to 1	1,340	Yes	2 to 1	1,340	Yes
Pleasant Street																					
Northbound	105	310	175	2 to 1	1,340	Yes	2 to 1	1,340	Yes	2 to 1	1,340	Yes	2 to 1	1,340	Yes	2 to 1	1,340	Yes	2 to 1	1,340	Yes
Southbound	145	255	185	2 to 1	1,340	Yes	2 to 1	1,340	Yes	2 to 1	1,340	Yes	2 to 1	1,340	Yes	2 to 1	1,340	Yes	2 to 1	1,340	Yes
Wall Street																					
Northbound	1,350	2,340	1,532	2 to 1	1,340	Yes	2 to 1	1,340	Yes	2 to 1	1,340	Yes	2 to 1	1,340	Yes	2 to 1	1,340	Yes	2 to 1	1,340	Yes
Southbound	1,425	1,990	1,562	2 to 1	1,340	Yes	2 to 1	1,340	Yes	2 to 1	1,340	Yes	2 to 1	1,340	Yes	2 to 1	1,340	Yes	2 to 1	1,340	Yes

Source: Automatic Traffic Recorder (ATR) Counts: May 2011 collected by Precision Data Industries, LLC for VHB.

Notes: NA = the traffic management plan is Not Applicable (NA) for this section of the project; therefore, no assessment provided.

1 Volumes expressed in vehicles per hour and report low and high hourly traffic volumes between the hours of 7:00 AM and 7:00 PM.

2 Volumes expressed in vehicles per hour and report average hourly traffic volumes between the hours of 9:00 AM and 3:00 PM.

3 See Traffic Management Plans Included in 25% Submission

4 Indicates the cross sectional change for the corridor; i.e. 2 to 1 indicates that 2 travel lanes will be reduced to 1 travel lane during construction

5 Ideal Average Lane Capacity values obtained from FIGURE Gen-1, GENERAL GUIDELINES, Standard Details and Drawings for the Development of Traffic Management Plans, prepared by MassDOT/MassHighway.

6 Indicates whether this section of the corridor will meet the MassDOT guidelines for Average Lane Capacity in a work zone.

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Main Street (Route 9) at Maple Street (Route 31)

Maple Street and the Spencer Town Hall driveway intersect Main Street (Route 9) from the north and south, respectively, to form a four-legged signalized intersection. The intersection is located approximately 700 feet east of the intersection of Main Street (Route 9) at Pleasant Street. This intersection is under the Town of Spencer's jurisdiction. In the eastbound direction, Route 9 provides a single 12 foot through lane and a 12 foot dedicated right turn lane with 90 feet of vehicle storage. In the westbound direction, Route 9 westbound provides a single 10 foot through lane and a 11 foot dedicated left turn lane with 110 feet of vehicles storage. There is 2 foot shoulder on the westbound departure lane and a 5 foot shoulder on the eastbound departure lane. It should also be noted that there is a WRTA bus stop located immediately east of the intersection on Main Street, where buses use the shoulder to pull over. Maple Street and the municipal driveway both provide a single eleven foot travel lane. There is sidewalk present on all approaches to the intersection and crosswalks are provided across all legs of the intersection. There are currently no designated bicycle accommodations at this intersection. On-street parking is permitted just outside the limits of this intersection in all directions.

Route 9 is classified as a Principal Urban Arterial and is maintained by the Town of Spencer. The existing traffic signal system is owned and maintained by the Town as well. Main Street provides east-west access through the Town of Spencer and into Leicester and Worcester, which are located to the east. Maple Street (Route 31) is classified as an Urban Minor Arterial, which provides north-south access between downtown Spencer and the Town of Charlton to the south, including Route 20, which runs parallel to Route 9 in Spencer.

Summary of Proposed Improvements

In order to accommodate future traffic growth in the area, to provide safer and efficient traffic operation at this intersection, and to provide improved bicycle and pedestrian access, roadway and traffic signal improvements will be necessary. Under 2011 existing conditions, this intersection operates at an overall LOS C during the weekday morning and LOS B during the weekday evening peak periods, respectively. In absence of any improvements, the vehicle queues and intersection delays are expected to continue to increase, especially during peak hours, as traffic volumes increase at this intersection. There were 43 reported crashes at this intersection during the three-year period from June 2009 to December 2012. Finally, this intersection continues to satisfy the 2009 Manual on Uniform Traffic Control Devices (MUTCD) criteria for warranting a traffic signal under existing conditions.

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Proposed Geometric Changes

Proposed improvements at this intersection are detailed in the 25 percent design plans prepared with this FDR. These geometric improvements are as follows:

- Widen the Route 9 westbound leg to provide 5 foot shoulders on both the approach and departure lanes.
- Widen the Route 9 eastbound leg to provide a 5 foot eastbound bicycle lane and a 5 foot shoulder in the westbound direction.
- Provide wheelchair ramps to meet current ADA/AAB access standards at the intersection.
- Proposed milling and pavement overlay with full-depth widening.

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Proposed Traffic Control Improvements

Improvements to traffic control will be necessary due to the proposed geometric changes and to accommodate future traffic volumes, and to provide safe and efficient traffic operation at this intersection. These traffic control improvements are as follows:

- Fully-reconstruct the traffic signal system and provide timing for peak hour volume requirements to control all movements at this intersection.
- Provide split phasing for Maple Street and the Municipal driveway.
- Provide an eastbound right-turn overlap during the Maple Street northbound movement.

- Provide time of day coordination with the intersection of Main Street at Pleasant Street/Wall Street.
- Provide concurrent pedestrian phasing via push-button actuation.
- Provide emergency vehicle pre-emption on all approaches.
- Upgrade signage and pavement markings to meet with the proposed design.

Safety Enhancements

Through the implementation of protected phasing for the northbound left-turn movement, with the associated eastbound right-turn overlap phasing, vehicle queues will be reduced when compared to the existing condition. The reduced queues, as well as the presence of an eastbound bicycle lane and 5 foot shoulders will improve bicycle mobility.

Also, new reflective regulatory signs and pavement markings are proposed.

Benefits

With these improvements in place, the intersection is expected to operate at an overall LOS B (V/C = 0.72) and LOS B (V/C = 0.70) during the 2023 weekday morning and weekday evening peak hour, respectively.

Environmental

There are no environmental issues associated with the proposed improvements for this intersection.

Right-of-Way

Minor Right-of-Way alterations will be required on each corner and along Main Street to accommodate the proposed traffic signal equipment, sidewalks and wheelchair ramps.

■

Issues

The Town will maintain jurisdiction of this intersection.

Data Profile and Existing/Proposed Comparison

2011 Average Daily Traffic (ADT)

Automatic Traffic Recorder (ATR) counts taken on Main Street (Route 9) in April 2011 indicate the average daily traffic volume shown in Table 2-1.

Table 2-1
2011 Average Daily Traffic (ADT)

Roadway	Weekday Traffic Volume (vpd)
Main Street (east of Mechanic Street)	14,764

Geometric Conditions

As Table 2-2 illustrates, there is no difference between the existing and proposed geometric conditions.

Table 2-2
Main Street (Route 9) at Maple Street (Route 31) Geometric Conditions

Approach	Existing Geometry		Proposed Geometry	
	Movement	Number of Lanes	Movement	Number of Lanes
Main Street (EB)	LT-TH	1	LT-TH	1
	RT	1	RT	1
Main Street (WB)	LT	1	LT	1
	TH-RT	1	TH-RT	1
Maple Street (NB)	LT-TH-RT	1	LT-TH-RT	1
Municipal Drive (SB)	LT-TH-RT	1	LT-TH-RT	1

Speed

There are Special Speed Regulations on file with MassDOT for Route 31 in Spencer. Per Special Speed Regulation #7069-A, the speed limit on Maple Street is 25mph in both directions in the vicinity of Main Street. There is an existing 30mph speed limit sign for the eastbound direction approximately 1,000 feet east of Maple Street. There

is an existing 30mph speed limit sign for the westbound direction approximately 3,000 feet east of Maple Street (See Appendix D).

Table 2-3
Posted Speed Limit

Roadway	Posted Speed Limit
Main Street (Route 9) Eastbound (east of Maple Street)	30 MPH
Main Street (Route 9) Westbound (east of Maple Street)	30 MPH
Maple Street (Route 31)	25 MPH

Speed data was collected with the ATRs in April 2011. As shown in Table 2-4, the ATR indicates speeds typically between 23 and 28 MPH on Main Street in the vicinity of the intersection.

Table 2-4
Speed Counts

Roadway	85th Percentile Speed
Main Street Eastbound (east of Mechanic Street)	28 MPH
Main Street Westbound (east of Mechanic Street)	28 MPH

Based on ATRs conducted April 2011.

■

Recent Crash History

Table 2-5
Main Street at Maple Street Crash History

Year	Months	Total
2009	(June through December)	1
2010	(January through December)	6
2011	(January through December)	5
2012	(January through June)	1
	Total	13

Source: Spencer Police Department

As shown in Table 2-5, 13 crashes were reported at this location over the three years reviewed. Standard MassDOT formulas, in the unit of crashes per million entering vehicles, were used to calculate the crash rate for the project intersections. The official statewide rate for the 2013 calendar year is 0.80 for signalized intersections. The Town of Spencer falls within MassDOT District 3 area. The 2010 crash rate for District 3 is 0.89 for signalized intersections. The crash rate calculated for this intersection is 0.65, which is below both the State and District 3 average crash rates. A collision diagram was completed by MassDOT as part of the RSA process. The collision diagram, summary of crash data and the crash rate worksheet are included in Appendix B. This crash analysis was based on the crash reports provided by the Spencer Police Department.

■

Signal Warranting Condition

This intersection is currently signalized. With existing volumes, thresholds for Warrant #1 (Eight Hour Vehicle Volume) and Warrant #2 (Four Hour Vehicular Volume) are met. The analysis used in the signal warrants evaluation is included in Appendix B.

■

Capacity Analysis Summary

Table 2-6 summarizes the weekday morning and weekday evening capacity analysis results for the intersection of Main Street with Pleasant Street and Wall Street for the three design conditions. Capacity analysis worksheets are included in Appendix B.

■

Queue Length Summary

Table 2-7 summarizes the weekday morning and weekday evening average and 95th percentile vehicle queue lengths for the intersection of Main Street with Pleasant Street and Wall Street for the three design conditions. Queue length worksheets are included in Appendix B. Queue length graphics are shown in Figures 2-2 through 2-4.

Table 2-6
Main Street (Route 9) at Maple Street (Route 31) Capacity Analysis

		2011 Existing Volume/ Existing Geometry			2023 Future Volume/ Existing Geometry			2023 Future Volume/ Future Geometry		
	Approach	V/C[1]	Delay[2]	LOS[3]	V/C	Delay	LOS	V/C	Delay	LOS
Weekday Morning	Main St EB Left/Thru	0.55	9.9	A	0.60	10.8	B	0.74	13.6	B
	Main St EB Right	0.06	5.5	A	0.07	5.5	A	0.06	0.7	A
	Main St WB Left	0.19	6.9	A	0.22	7.4	A	0.37	16.0	B
	Main St WB Thru/Right	0.30	7.1	A	0.31	7.1	A	0.38	12.2	B
	Maple St NB	0.97	86.2	F	0.97	86.4	F	0.73	39.7	D
	Municipal Driveway SB	0.02	32.3	C	0.01	32.1	C	0.04	44.5	D
	Overall	0.65	24.4	C	0.68	24.1	C	0.72	17.6	B
Weekday Evening	Main St EB Left/Thru	0.40	7.8	A	0.45	8.5	A	0.49	6.2	A
	Main St EB Right	0.10	5.5	A	0.11	5.8	A	0.10	0.1	A
	Main St WB Left	0.14	6.0	A	0.17	6.6	A	0.20	8.4	A
	Main St WB Thru/Right	0.60	10.5	B	0.66	12.0	B	0.73	15.7	B
	Maple St NB	1.03	105.1	F	0.78	56.4	E	0.67	41.1	D
	Municipal Driveway SB	0.04	33.9	C	0.01	32.1	C	0.09	45.3	D
	Overall	0.69	25.0	C	0.72	16.8	B	0.70	15.1	B

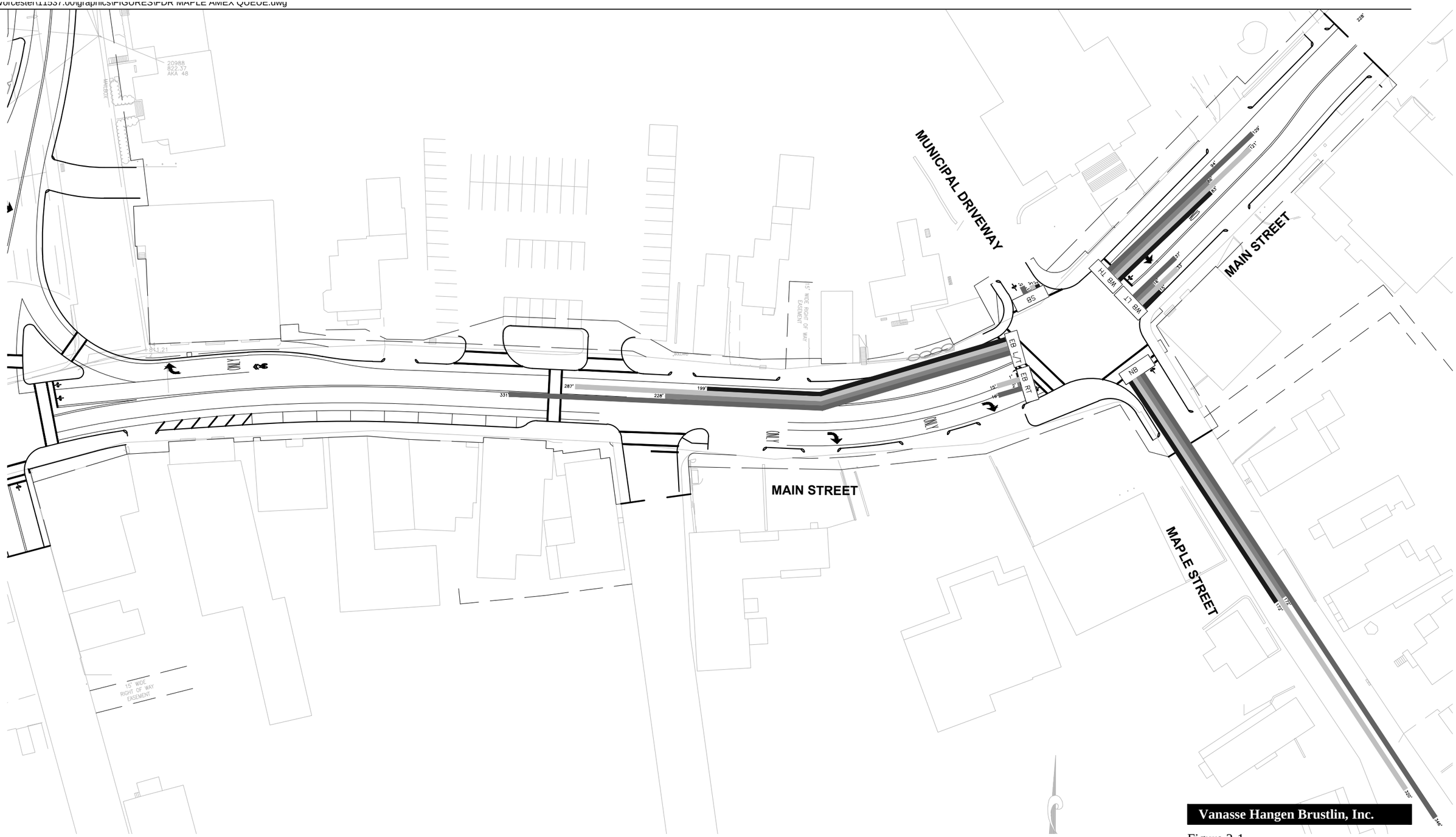
Source: Vanasse Hangen Brustlin, Inc.; based on ATRs conducted April 2011.
1 V/C -- Volume-to-capacity ratio.
2 Average Intersection delay, expressed in seconds per vehicle.
3 LOS -- Level-of-Service.

Table 2-7
Main Street (Route 9) at Maple Street (Route 31) Queue Length

		2011 Existing Volume/ Existing Geometry		2023 Future Volume/ Existing Geometry		2023 Future Volume/ Future Geometry	
	Approach	50th	95th	50th	95th	50th	95th
Weekday Morning	Main St EB Left/Thru	199	287	228	331	200	#582
	Main St EB Right	8	22	9	24	0	m3
	Main St WB Left	15	33	16	37	19	70
	Main St WB Thru/Right	83	121	86	129	94	207
	Maple St NB	172	#320	172	#346	136	#237
	Municipal Driveway SB	2	3	1	5	1	6
Weekday Evening	Main St EB Left/Thru	129	186	145	214	66	m235
	Main St EB Right	10	29	13	32	0	m0
	Main St WB Left	15	32	17	37	14	61
	Main St WB Thru/Right	200	342	272	405	223	#689
	Maple St NB	142	#304	163	#266	94	167
	Municipal Driveway SB	4	0	1	13	1	15

Source: Vanasse Hangen Brustlin, Inc.; based on ATRs conducted April 2011.
~ Volume exceeds capacity, queue is theoretically infinite.
# 95th percentile volume exceeds capacity, queue may be longer.
Queue length shown in feet.

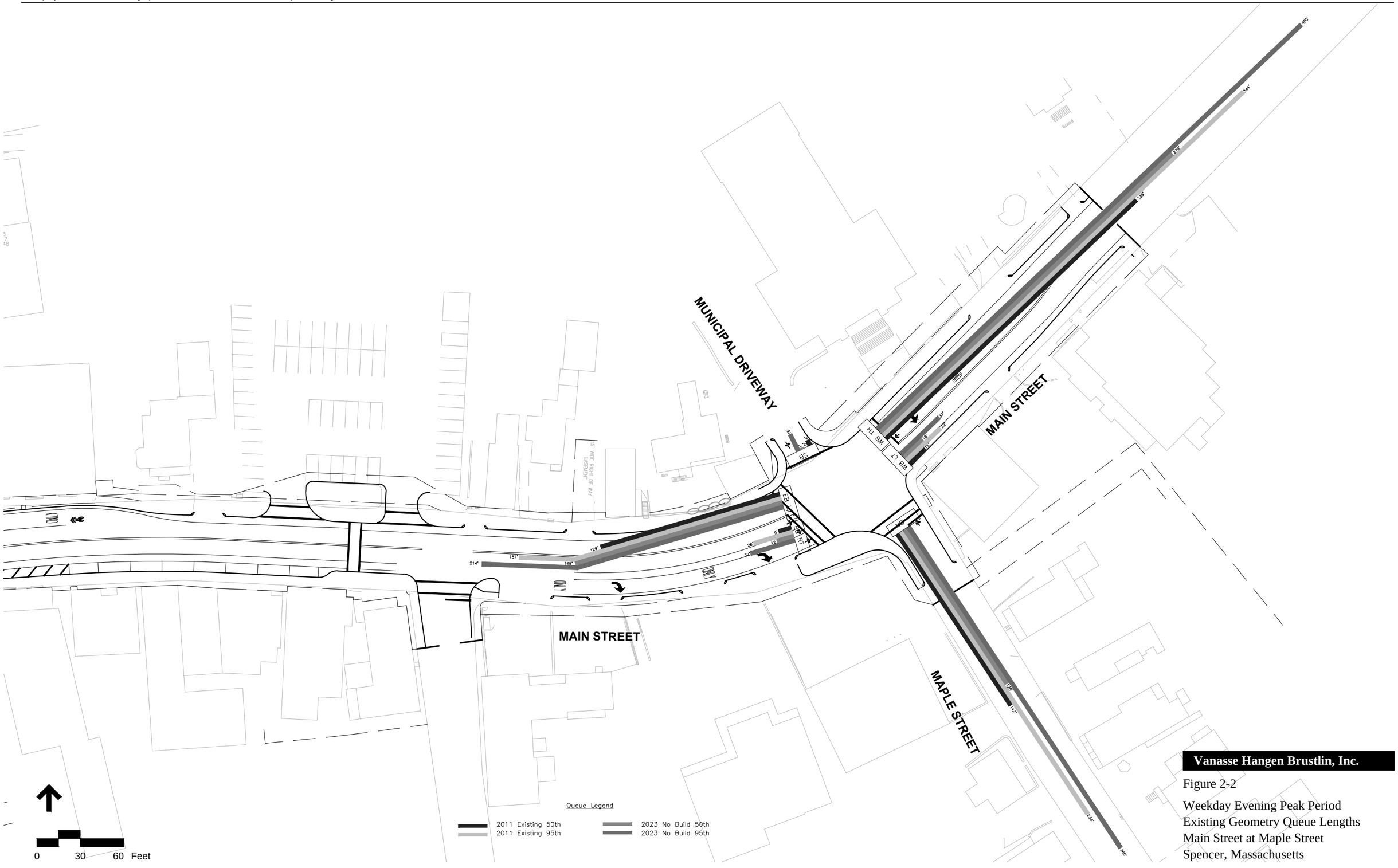
V:\0\proj\Worcester\11537.00\graphics\FIGURES\FDR MAPLE AMEX QUEUE.dwg



Vanasse Hangen Brustlin, Inc.

Figure 2-1

Weekday Morning Peak Period
Existing Geometry Queue Lengths
Main Street at Maple Street
Spencer, Massachusetts



Vanasse Hangen Brustlin, Inc.

Figure 2-2

Weekday Evening Peak Period
Existing Geometry Queue Lengths
Main Street at Maple Street
Spencer, Massachusetts

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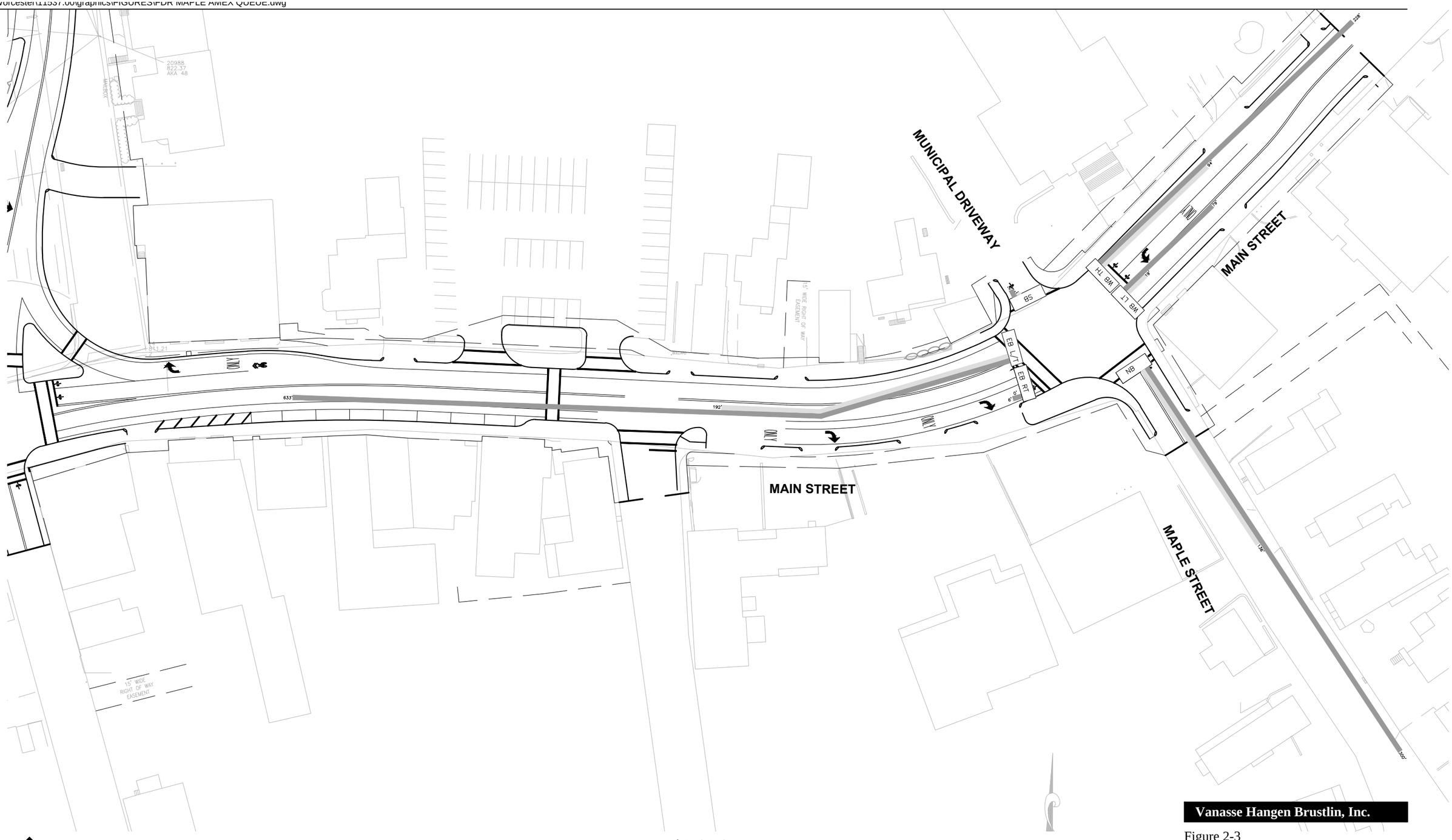
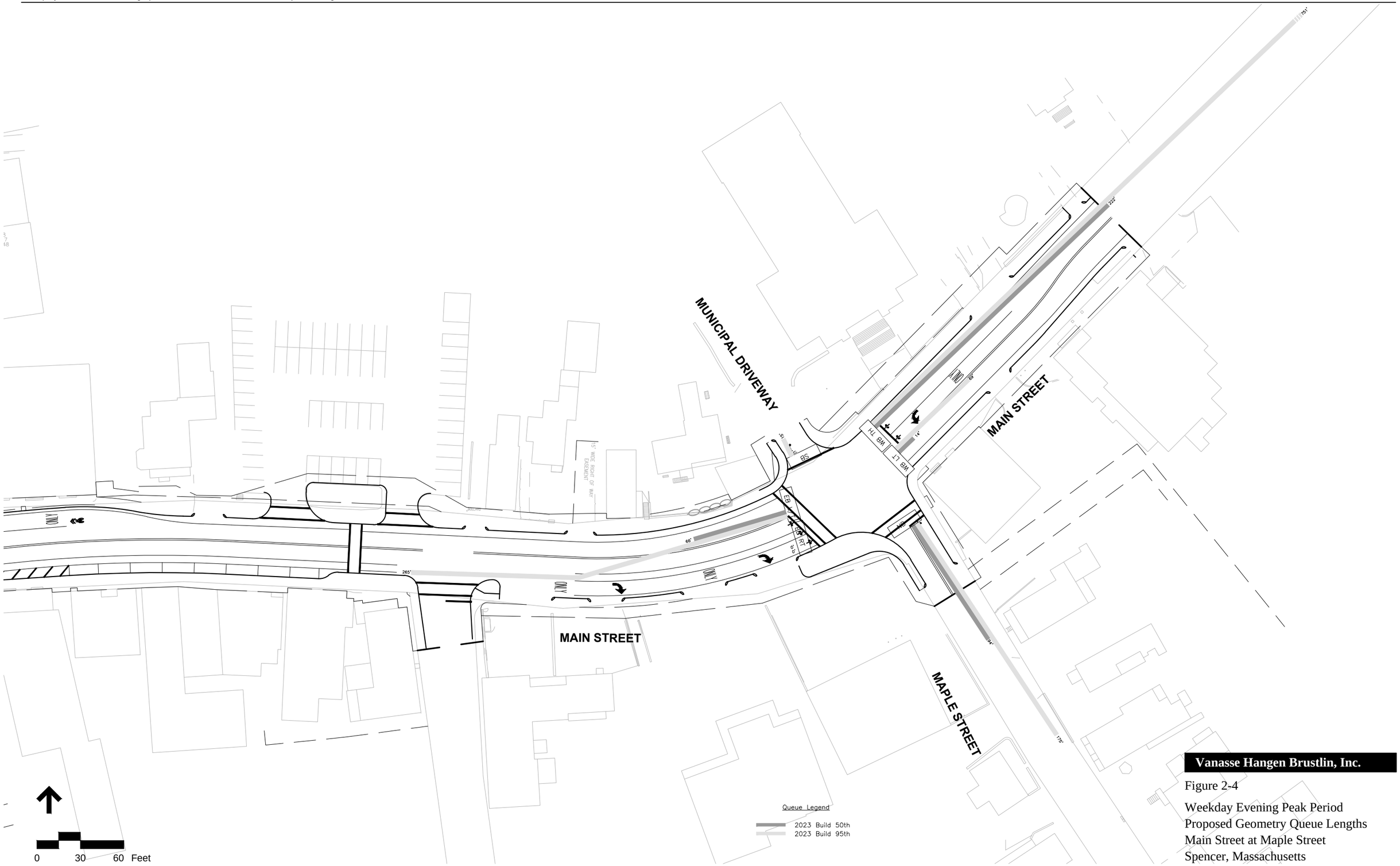


Vanasse Hangen Brustlin, Inc.

Figure 2-3

Weekday Morning Peak Period
Proposed Geometry Queue Lengths
Main Street at Maple Street
Spencer, Massachusetts



Vanasse Hangen Brustlin, Inc.

Figure 2-4

Weekday Evening Peak Period
Proposed Geometry Queue Lengths
Main Street at Maple Street
Spencer, Massachusetts

■

Design Designation Data

Table 2-8 summarizes the average daily roadway usage characteristics of Main Street, west of Maple Street. These characteristics are:

- Average Daily Traffic (ADT), the total volume of motor vehicle traffic using the roadway on any given day for both existing and design years, expressed in vehicles per day (vpd);
- Peaking Factor (K), the percentage of daily traffic that occurs during the peak hour travel period;
- Directional Distribution (D), the highest percentage of traffic in a single direction during the peak hour;
- Truck Volume (T), the percentage of heavy vehicles during the peak hour travel period and per-day average;
- Design Hourly Volume (DHV), the bi-directional peak hour volume for the design year, expressed in vehicles per hour (vph); and
- Directional Design Hourly Volume (DDHV), the highest direction volume during the design year peak hour, expressed in vph.

Table 2-8
Main Street (Route 9) Design Designation Data

Main Street (Route 9)	
Design Speed:	28 mph
ADT (2011):	14,775 vpd
ADT (2023):	16,150 vpd
K:	6%
D:	59.4% (WB)
T (Peak Hour):	1.7%
T (Average Day):	1.5%
DHV:	1,035 vph
DDHV:	615 vph (WB)

Source: Vanasse Hangen Brustlin, Inc.; based on ATRs conducted May 2011.

Calculations are provided in Appendix E.

3

Main Street (Route 9) at Pleasant Street (Route 31) & Wall Street

Summary of Proposed Improvements

■

Existing Conditions

At this location, Main Street is intersected by Pleasant Street (Route 31) from the north, Wall Street from the south and a commercial driveway from the south forming a 5-leg offset intersection. Wall Street intersects Main Street from the south and is offset from Pleasant Street by approximately 60-feet. Pleasant Street (Route 31) is an Urban Minor Arterial, while Wall Street is classified as a local roadway. The intersection is currently signalized.

The Main Street eastbound approach begins as a single wide lane before transitioning to a short two-lane segment with a dedicated left-turn lane between Wall Street and Pleasant Street. The Main Street westbound approach consists of a shared left-turn and through lane with an exclusive right-turn lane. The Pleasant Street southbound approach consists of a single general purpose travel lane. Wall Street consists of a single lane with movements restricted to left turns only. The northbound commercial driveway approach consists of a single lane restricted to right-out only. Wall Street and the commercial driveway are marked with stop bars but otherwise have no other pavement markings.

■

Need

In order to accommodate future traffic volumes through the study area and to provide efficient traffic operation, roadway and traffic control improvements will be necessary. Under 2011 existing conditions, the most critical movement at the intersection experiences a LOS C (v/c = 0.51) during the morning peak period and

LOS D (v/c=0.89). In the absence of any improvements, the intersection delay is expected to further increase, especially during peak hours as traffic volumes increase at this intersection.

In addition, ten crashes were reported at this intersection during the three-year period from June 2009 to June 2012.

Proposed Geometric Changes

Proposed improvements at this intersection are detailed in the 25 percent design plans prepared with this FDR. These geometric improvements are as follows:

- Realign Pleasant Street such that it intersects Main Street opposite Wall Street to form a more traditional intersection.
- Provide one exclusive left-turn lane and one shared through-right lane on Pleasant Street.
- Provide a channelized right-turn island for vehicles making the westbound right-turn movement from Main Street onto Pleasant Street.
- Provide a better defined exclusive left-turn lane using pavement markings on Main Street eastbound.
- Provide wheelchair ramps to meet current ADA/AAB access standards at the intersection.
- Proposed milling and pavement overlay with full-depth widening.

Proposed Traffic Control Improvements

Improvements to traffic control will be necessary to accommodate future traffic volumes, and to provide efficient traffic operation at this intersection. These traffic control improvements are as follows:

- Reconstruct existing signalized intersection with appropriate timing and phasing for peak hour volume requirements to control all movements at this intersection.
- Provide coordination with the proposed traffic signal at Main Street and Maple Street.
- Provide protected-permissive left turn phase for the Main Street eastbound approach.
- Install pedestrian crosswalks across the Main Street westbound, Pleasant Street and Wall Street approaches and provide concurrent pedestrian phasing.
- Upgrade existing signs and pavement markings to meet with the proposed design.
- Provide emergency vehicle pre-emption on all approaches.

■

Intersection Improvement Alternatives

Several alternatives were originally considered for improving operations and safety at this intersection. Through working sessions with the Town of Spencer and MassDOT District 3 personnel the option of retaining the current geometry was eliminated due to the extensive crash history and poor operations at the traffic signal. A roundabout would have required more than one circulating lane to achieve an acceptable level of service, and was hence eliminated due to the lack of available Right-of-Way, the presence of buildings on three of the four corners and a major grade change on the fourth corner.

■

Benefits

With these improvements in place, the intersection is expected to operate during 2023 signalized conditions at an overall LOS B (V/C=0.77) during the weekday morning peak hour and LOS C (V/C = 0.84) during the evening peak hour.

■

Environmental

There are no environmental issues associated with the proposed improvements for this intersection.

■

Right-of-Way

A significant Right-of-Way alteration is required to accommodate the realigned geometry of Pleasant Street. In addition, minor Right-of-Way alterations will be required on each corner and along Main Street to accommodate the proposed traffic signal equipment, sidewalks and wheelchair ramps.

■

Issues

The Town will have jurisdiction of this intersection.

Data Profile and Existing/Proposed Comparison

■

2011 Average Daily Traffic (ADT)

Table 3-1
2011 Average Daily Traffic (ADT)

Roadway	Weekday Traffic Volume (vpd)
Main Street (Route 9)	14,900
Pleasant Street (Route 31)	5,700
Wall Street	<600

■

Geometric Conditions

Table 3-2
Geometric Conditions

	Existing Geometry		Proposed Geometry	
Approach	Movement	Number of Lanes	Movement	Number of Lanes
Main Street EB)	LT	1	LT	1
	TH-RT	1	TH-RT	1
Main Street (WB)	LT-TH	1	LT-TH	1
	RT	1	RT	1
Wall Street (NB)	LT-TH-RT	1	LT-TH-RT	1
Pleasant Street (SB)	LT-TH-RT	1	LT	1
			TH-RT	1

■

Speed

There are Special Speed Regulations on file with MassDOT for Route 31 in Spencer. Per Special Speed Regulation #7069-A, the speed limit on Pleasant Street is 30 in both directions beginning/ending 100 feet north of Main Street. There is an existing 30mph speed limit sign for the eastbound direction approximately 2,700 feet west of Pleasant Street. There is an existing 30mph speed limit sign for the westbound direction approximately 3,000 feet east of Maple Street and another approximately 300 feet west of High Street (See Appendix D).

Table 3-3
Posted Speed Limit

Roadway	Posted Speed Limit
Main Street (Route 9) Eastbound (east of Maple Street)	30 MPH
Main Street (Route 9) Westbound (east of Maple Street)	30 MPH
Maple Street (Route 31)	25 MPH

Speed data was collected with the ATRs in April 2011. As shown in Table 2-4, the ATR indicates speeds typically between 23 and 28 MPH on Main Street in the vicinity of the intersection. The ATR data indicates speeds between 35 and 37 MPH on Pleasant Street north of the intersection.

Table 3-4
Speed Counts

Roadway	85th Percentile Speed
Main Street Eastbound (east of Mechanic Street)	28 MPH
Main Street Westbound (east of Mechanic Street)	28 MPH
Pleasant Street Northbound (north of Price Chopper Driveway)	37 MPH
Pleasant Street Southbound (north of Price Chopper Driveway)	35 MPH

Based on ATRs conducted April 2011.

Recent Crash History

Table 3-5
Main Street at Pleasant Street/Wall Street Crash History

Year	Months	Total
2009	(June through December)	0
2010	(January through December)	2
2011	(January through December)	5
2012	(January through May)	3
	Total	10

Source: Spencer Police Department

As shown in the above table, 10 crashes were reported at this location over the three year period. Using standard MassDOT formulas, a crash rate of 0.37 crashes per million entering vehicles was calculated.

Signal Warranting Condition

This intersection is currently signalized. With existing volumes, thresholds for Warrant #1 (Eight Hour Vehicle Volume), Warrant #2 (Four Hour Vehicular Volume) and Warrant #3 (Peak Hour Vehicular Volume) are met. The analysis used in the signal warrants evaluation is included in Appendix C.

Capacity Analysis Summary

Table 3-6 summarizes the weekday morning and weekday evening capacity analysis results for the intersection of Main Street with Pleasant Street and Wall Street for the three design conditions. Capacity analysis worksheets are included in Appendix C.

Queue Length Summary

Table 3-7 summarizes the weekday morning and weekday evening average and 95th percentile vehicle queue lengths for the intersection of Main Street with Pleasant Street and Wall Street for the three design conditions. Queue length worksheets are included in Appendix C. Queue length graphics are shown in Figures 3-2 through 3-6.

Table 3-6
Main Street (Route 9) at Pleasant Street (Route 31) Capacity Analysis

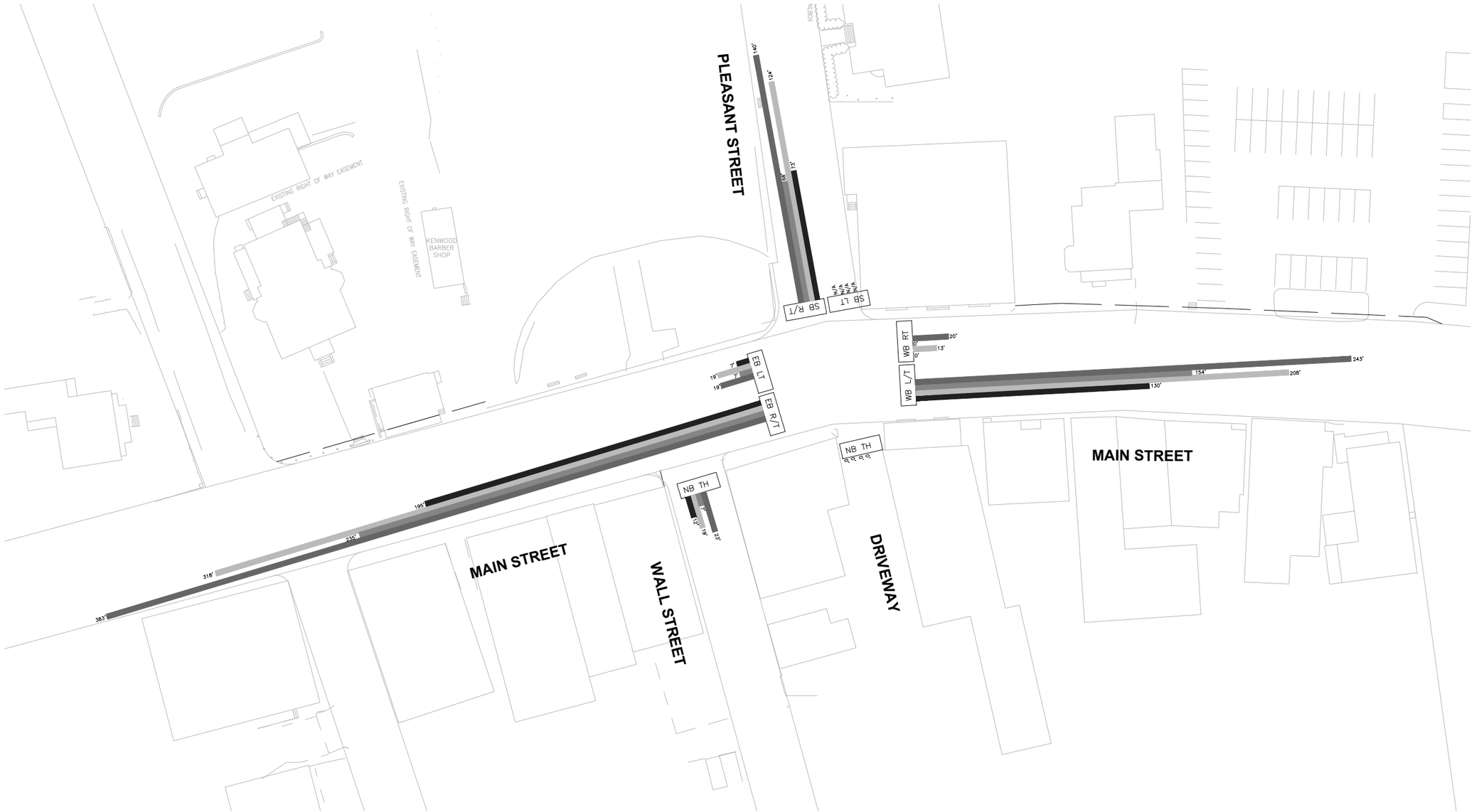
		2011 Existing Volume/ Existing Geometry			2023 Future Volume/ Existing Geometry			2023 Future Volume/ Future Geometry		
	Approach	V/C[1]	Delay[2]	LOS[3]	V/C	Delay	LOS	V/C	Delay	LOS
Weekday Morning	Main St EB Left	0.07	13.4	B	0.07	13.6	B	0.06	7.5	A
	Main St EB Thru/Right	0.67	19.3	B	0.74	22.0	C	0.66	14.6	B
	Main St WB Left/Thru	0.51	24.3	C	0.59	26.1	C	0.46	10.5	B
	Main St WB Right	0.07	18.1	B	0.08	18.2	B	0.10	3.3	A
	Wall St NB	0.06	17.9	B	0.04	17.7	B	0.02	25.4	C
	Driveway NB	0.01	17.4	B	0.00	17.4	B	n/a	n/a	n/a
	Pleasant St SB Left	n/a	n/a	n/a	n/a	n/a	n/a	0.83	47.1	D
	Pleasant St SB Thru/Right	0.40	22.2	C	0.38	22.0	C	0.04	25.5	C
	Overall	0.64	20.9	C	0.68	22.5	C	0.77	19.0	B
Weekday Evening	Main St EB Left	0.17	17.2	B	0.17	18.4	B	0.15	10.7	B
	Main St EB Thru/Right	0.54	16.0	B	0.53	15.9	B	0.47	10.5	B
	Main St WB Left/Thru	0.89	41.6	D	1.01	63.4	E	0.80	16.7	B
	Main St WB Right	0.13	18.6	B	0.14	18.8	B	0.25	4.0	A
	Wall St NB	0.06	17.9	B	0.07	18.0	B	0.04	26.0	C
	Driveway NB	0.00	17.4	B	0.00	17.4	B	n/a	n/a	n/a
	Pleasant St SB Left	n/a	n/a	n/a	n/a	n/a	C	0.90	58.2	E
	Pleasant St SB Thru/Right	0.46	23.1	C	0.50	23.9	C	0.08	26.3	C
	Overall	0.72	26.2	C	0.79	34.4	C	0.84	20.5	C

Source: Vanasse Hangen Brustlin, Inc.; based on ATRs conducted May 2011.
1 V/C -- Volume-to-capacity ratio.
2 Average Intersection delay, expressed in seconds per vehicle.
3 LOS -- Level-of-Service.

Table 3-7
Main Street (Route 9) at Pleasant Street (Route 31) Queue Length

		2011 Existing Volume/ Existing Geometry		2023 Future Volume/ Existing Geometry		2023 Future Volume/ Future Geometry	
	Approach	50th	95th	50th	95th	50th	95th
Weekday Morning	Main St EB Left	7	19	7	19	6	18
	Main St EB Thru/Right	195	318	235	383	238	403
	Main St WB Left/Thru	130	208	154	243	83	m119
	Main St WB Right	0	13	0	20	3	m5
	Wall St NB	12	19	7	23	2	27
	Driveway NB	0	0	0	0	n/a	n/a
	Pleasant St SB Left	n/a	n/a	n/a	n/a	146	#233
	Pleasant St SB Thru/Right	73	124	68	140	2	27
Weekday Evening	Main St EB Left	11	24	11	27	9	21
	Main St EB Thru/Right	155	211	153	244	156	233
	Main St WB Left/Thru	288	#483	~352	#579	341	#536
	Main St WB Right	0	42	0	45	42	m22
	Wall St NB	13	33	15	36	0	0
	Driveway NB	0	0	0	0	n/a	n/a
	Pleasant St SB Left	n/a	n/a	n/a	n/a	162	#307
	Pleasant St SB Thru/Right	92	172	104	193	2	41

Source: Vanasse Hangen Brustlin, Inc.; based on ATRs conducted May 2011.
m Volume for 95th percentile queue is metered by upstream signal
~ Volume exceeds capacity, queue is theoretically infinite.
# 95th percentile volume exceeds capacity, queue may be longer.
Queue length shown in feet.



Queue Legend

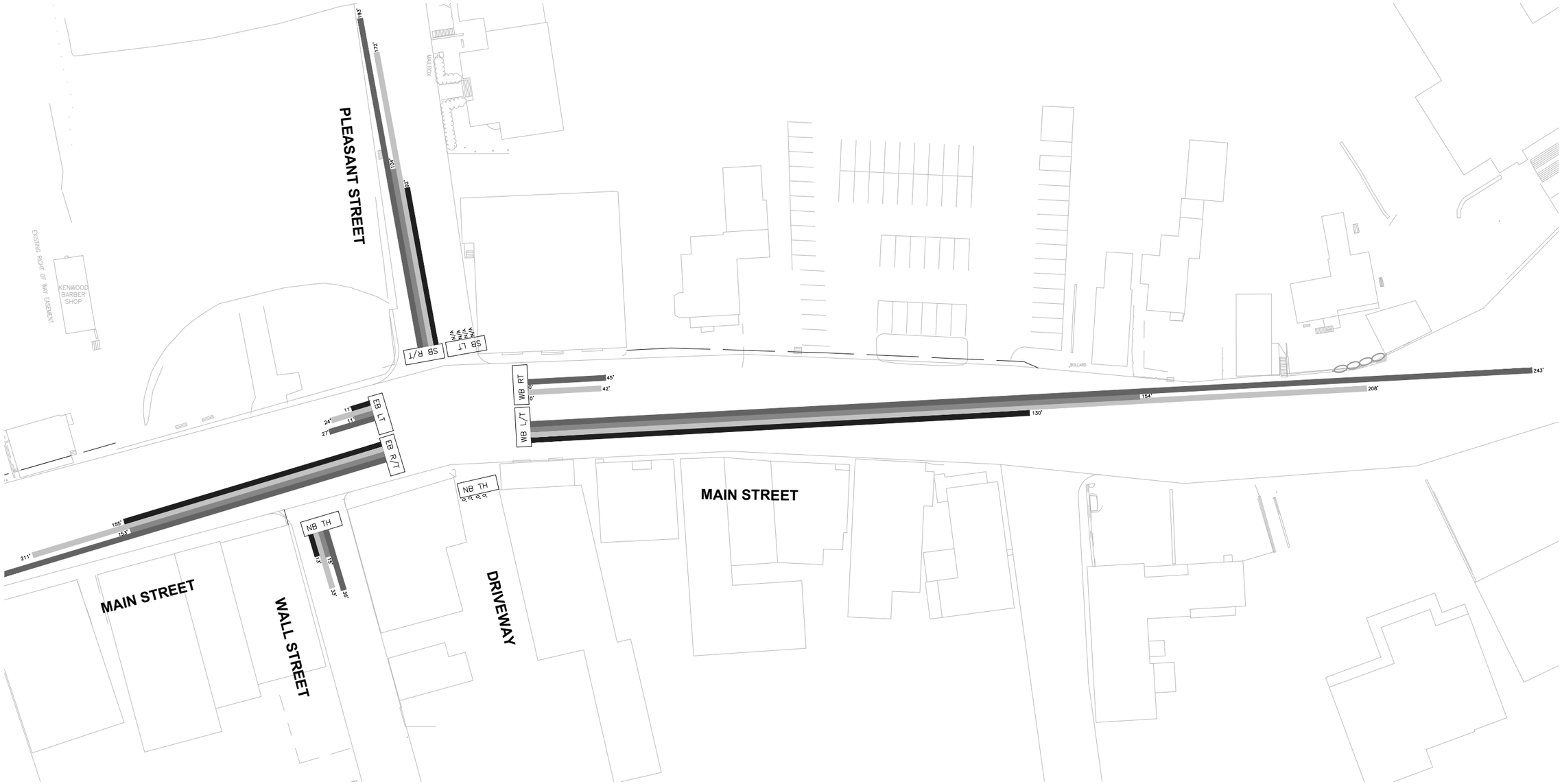
2011 Existing 50th
2011 Existing 95th
2023 No Build 50th
2023 No Build 95th

0 30 60 Feet

Vanasse Hangen Brustlin, Inc.

Figure 3-1

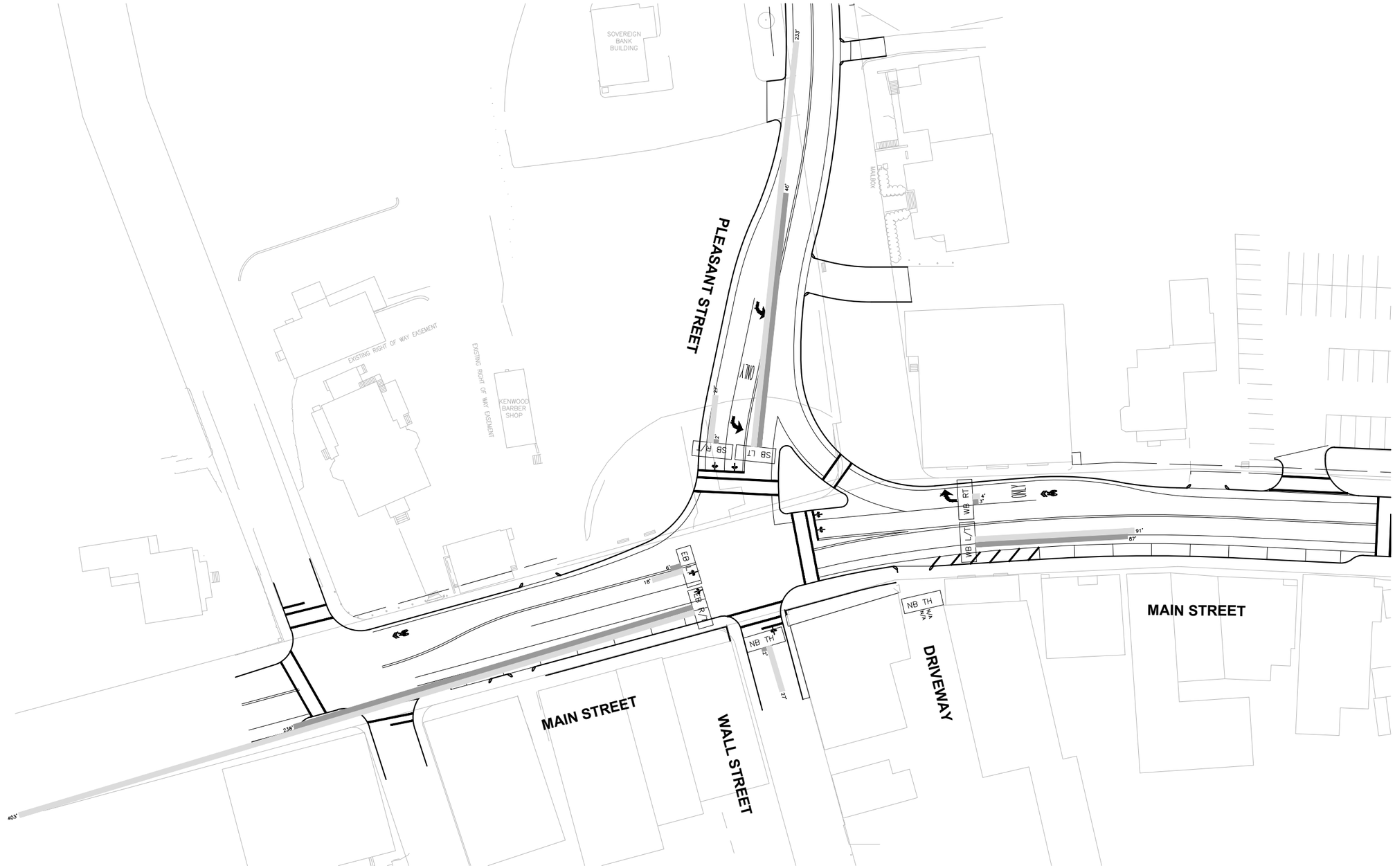
Weekday Morning Peak Period
Existing Geometry Queue Lengths
Pleasant Street at Main Street
Spencer, Massachusetts



Vanasse Hangen Brustlin, Inc.

Figure 3-2

Weekday Evening Peak Period
Existing Geometry Queue Lengths
Pleasant Street at Main Street
Spencer, Massachusetts



Queue Legend

2023 Build 50th

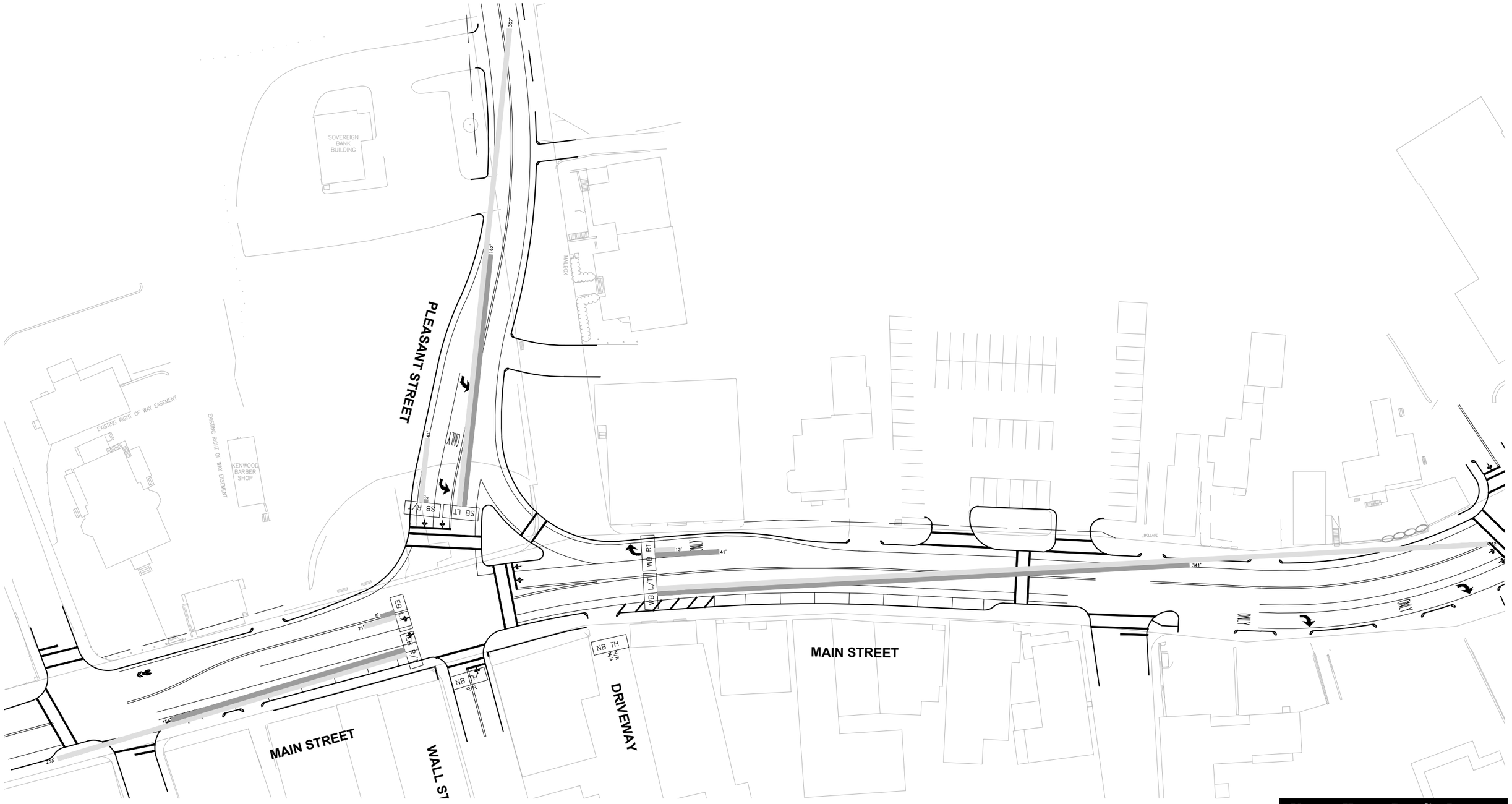
2023 Build 95th

0 30 60 Feet

Vanasse Hangen Brustlin, Inc.

Figure 3-3

Weekday Morning Peak Period
Proposed Geometry Queue Lengths
Pleasant Street at Main Street
Spencer, Massachusetts



0 30 60 Feet

Queue Legend

2023 Build 50th

2023 Build 95th

Vanasse Hangen Brustlin, Inc.

Figure 3-4

Weekday Evening Peak Period
Proposed Geometry Queue Lengths
Pleasant Street at Main Street
Spencer, Massachusetts

■

Design Designation Data

Table 3-8 summarizes the average daily roadway usage characteristics of Main Street, east of Pleasant Street. These characteristics are:

- Average Daily Traffic (ADT), the total volume of motor vehicle traffic using the roadway on any given day for both existing and design years, expressed in vehicles per day (vpd);
- Peaking Factor (K), the percentage of daily traffic that occurs during the peak hour travel period;
- Directional Distribution (D), the highest percentage of traffic in a single direction during the peak hour;
- Truck Volume (T), the percentage of heavy vehicles during the peak hour travel period and per-day average;
- Design Hourly Volume (DHV), the bi-directional peak hour volume for the design year, expressed in vehicles per hour (vph); and
- Directional Design Hourly Volume (DDHV), the highest direction volume during the design year peak hour, expressed in vph.

Table 3-8
Main Street (Route 9) Design Designation Data

Main Street (Route 9)	
Design Speed:	28 mph
ADT (2011):	14,775 vpd
ADT (2023):	16,150 vpd
K:	6%
D:	59.4% (WB)
T (Peak Hour):	1.7%
T (Average Day):	1.5%
DHV:	1,035 vph
DDHV:	615 vph (WB)

Calculations are provided in the Appendix E.

Appendix A: Capacity Analysis Criteria

Level-of-Service Analysis Procedures

■

Signalized Intersection Procedures

In the HCM approach, capacity at intersections is defined for lane groups rather than for approaches or the intersection as a whole. A lane group may be a single movement, a group of movements, or an entire approach and is defined by the geometry of the intersection and the distribution of movements over the various lanes. Capacity of a lane group is calculated as the maximum rate of flow that may pass through the intersection under prevailing traffic, roadway, and signalization conditions. The rate of flow is generally measured or projected for a 15-minute period and capacity is stated in vehicles per hour. Capacity analysis of intersections involves the computation of volume-to-capacity (v/c) ratio for each lane group, from which an overall intersection v/c ratio may be derived.

Generally, when two opposing flows are moving during a signal phase, one of the lane groups will require more green time than another to process all of its volume. This would be defined as the "critical" lane group for the subject signal phase. The concept of a critical v/c ratio is used to evaluate the intersection as a whole, considering only the critical lane groups or those with the greatest demand for green time within each signal phase. This procedure assumes that green time has been appropriately allocated. Thus it is possible to have an overall intersection v/c of less than 1.00 (under capacity), but still have individual movements be over saturated within the signal cycle if the green time has not been appropriately allocated to the various approaches.

The other major concept in signalized intersection analysis is level of service, which is an index used to grade intersection operations. Level of service is defined in terms of delay and ranges from LOS A (free-flow conditions) to LOS F (long delays). Delay represents a measure of driver discomfort and frustration, fuel consumption, and lost time. Specifically, level of service delay criteria are stated in terms of average stopped delay per vehicle for a 15-minute analysis period. The criteria are represented in Table A-1.

Table A-1
Level-of-Service Criteria for Signalized Intersections

Level of Service	Control Delay (sec/veh)
A	≤ 10
B	> 10 - 20
C	> 20 - 35
D	> 35 - 55
E	> 55 - 80
F	>80

Source: Highway Capacity Manual 2000, Transportation Research Board, Washington, DC, 2000.

Delay is a complex measure that depends upon a number of variables such as quality of signal progression, cycle length, allocation of green time, and v/c ratio. Of all the factors cited, v/c ratios have the least effect on delay. Thus, for any given v/c ratio, a range of delay values (and, therefore, level of service) may result. Conversely, for a given level of service, the v/c ratio may lie anywhere within a broad range.

The base saturation flow rate used in the signalized intersection analysis model varies from 1,800 to 1,900 passenger cars per hour of green per lane (pcphgpl). This value is adjusted for prevailing traffic conditions such as lane width, left turns, right turns, heavy vehicles, grades, parking, area type, bus blockage, and left-turn blockage.

Appendix B: Main Street (Route 9) at Maple Street

- Turning Movement Counts
- Automatic Traffic Recordings
- Crash Data
- Signal Warrant Analysis
- Intersection Capacity Analysis

Turning Movement Counts

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50 Alden Avenue
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N / S: Maple & Town Hall
E / W: Main Street (Route 9)
City, State: Spencer, Massachusetts
Client: VHB / M. Chase

File Name : AM Peak - Main @ Maple & Town Hall
Site Code : 3
Start Date : 4/13/2011
Page No : 1

Groups Printed- PCs and Peds - HVs / Buses - Bicycles

	Town Hall From North					Main Street From East					Maple Street From South					Main Street From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
07:00 AM	0	0	0	0	0	0	54	20	0	74	24	0	30	0	54	23	127	2	0	152	280
07:15 AM	0	0	0	1	1	0	75	15	0	90	16	2	41	0	59	30	161	0	0	191	341
07:30 AM	0	0	0	0	0	0	75	9	0	84	39	0	30	0	69	17	162	2	0	181	334
07:45 AM	0	0	1	0	1	0	90	20	0	110	33	1	22	0	56	11	156	0	0	167	334
Total	0	0	1	1	2	0	294	64	0	358	112	3	123	0	238	81	606	4	0	691	1289
08:00 AM	0	0	0	0	0	1	80	22	0	103	40	0	35	0	75	19	155	1	0	175	353
08:15 AM	0	0	1	0	1	1	107	24	0	132	34	1	28	0	63	21	141	2	0	164	360
08:30 AM	0	0	1	0	1	1	71	13	1	86	25	1	33	0	59	10	126	0	0	136	282
08:45 AM	1	0	1	1	3	0	102	6	1	109	24	0	25	1	50	12	110	0	0	122	284
Total	1	0	3	1	5	3	360	65	2	430	123	2	121	1	247	62	532	3	0	597	1279
Grand Total	1	0	4	2	7	3	654	129	2	788	235	5	244	1	485	143	1138	7	0	1288	2568
Apprch %	14.3	0	57.1	28.6		0.4	83	16.4	0.3		48.5	1	50.3	0.2		11.1	88.4	0.5	0		
Total %	0	0	0.2	0.1	0.3	0.1	25.5	5	0.1	30.7	9.2	0.2	9.5	0	18.9	5.6	44.3	0.3	0	50.2	
PCs and Peds																	1099				
% PCs and Peds	100	0	100	100	100	100	93.3	82.9	100	91.6	95.7	100	93	100	94.4	98.6	96.6	100	0	96.8	94.8
HVs / Buses																					
% HVs / Buses	0	0	0	0	0	0	6.6	17.1	0	8.2	4.3	0	7	0	5.6	1.4	3.4	0	0	3.2	5.2
Bicycles	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1
% Bicycles	0	0	0	0	0	0	0.2	0	0	0.1	0	0	0	0	0	0	0	0	0	0	0

	Town Hall From North					Main Street From East					Maple Street From South					Main Street From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:30 AM																					
07:30 AM	0	0	0	0	0	0	75	9	0	84	39	0	30	0	69	17	**162**	**2**	0	**181**	334
07:45 AM	0	0	**1**	0	**1**	0	90	20	0	110	33	**1**	22	0	56	11	156	0	0	167	334
08:00 AM	0	0	0	0	0	**1**	80	22	0	103	**40**	0	**35**	0	**75**	19	155	1	0	175	353
08:15 AM	0	0	1	0	1	1	**107**	**24**	0	**132**	34	1	28	0	63	**21**	141	2	0	164	**360**
Total Volume	0	0	2	0	2	2	352	75	0	429	146	2	115	0	263	68	614	5	0	687	1381
% App. Total	0	0	100	0		0.5	82.1	17.5	0		55.5	0.8	43.7	0		9.9	89.4	0.7	0		
PHF	.000	.000	.500	.000	.500	.500	.822	.781	.000	.813	.913	.500	.821	.000	.877	.810	.948	.625	.000	.949	.959
PCs and Peds																					
% PCs and Peds	0	0	100	0	100	100	93.8	90.7	0	93.2	95.2	100	92.2	0	93.9	100	96.7	100	0	97.1	95.3
HVs / Buses																					
% HVs / Buses	0	0	0	0	0	0	6.0	9.3	0	6.5	4.8	0	7.8	0	6.1	0	3.3	0	0	2.9	4.6
Bicycles	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1
% Bicycles	0	0	0	0	0	0	0.3	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0.1

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Client: VHB / M. Chase

File Name : AM Peak - Main @ Maple & Town Hall
Site Code : 3
Start Date : 4/13/2011
Page No : 1

Groups Printed- HVs / Buses

	Town Hall From North					Main Street From East					Maple Street From South					Main Street From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
07:00 AM	0	0	0	0	0	0	3	9	0	12	2	0	0	0	2	2	4	0	0	6	20
07:15 AM	0	0	0	0	0	0	3	5	0	8	0	0	5	0	5	0	6	0	0	6	19
07:30 AM	0	0	0	0	0	0	2	0	0	2	0	0	2	0	2	0	1	0	0	1	5
07:45 AM	0	0	0	0	0	0	2	0	0	2	3	0	0	0	3	0	9	0	0	9	14
Total	0	0	0	0	0	0	10	14	0	24	5	0	7	0	12	2	20	0	0	22	58
08:00 AM	0	0	0	0	0	0	6	4	0	10	4	0	2	0	6	0	6	0	0	6	22
08:15 AM	0	0	0	0	0	0	11	3	0	14	0	0	5	0	5	0	4	0	0	4	23
08:30 AM	0	0	0	0	0	0	9	0	0	9	1	0	2	0	3	0	3	0	0	3	15
08:45 AM	0	0	0	0	0	0	7	1	0	8	0	0	1	0	1	0	6	0	0	6	15
Total	0	0	0	0	0	0	33	8	0	41	5	0	10	0	15	0	19	0	0	19	75
Grand Total	0	0	0	0	0	0	43	22	0	65	10	0	17	0	27	2	39	0	0	41	133
Apprch %	0	0	0	0		0	66.2	33.8	0		37	0	63	0		4.9	95.1	0	0		
Total %	0	0	0	0	0	0	32.3	16.5	0	48.9	7.5	0	12.8	0	20.3	1.5	29.3	0	0	30.8	

	Town Hall From North					Main Street From East					Maple Street From South					Main Street From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 08:00 AM																					
08:00 AM	0	0	0	0	0	0	6	**4**	0	10	**4**	0	2	0	**6**	0	**6**	0	0	**6**	22
08:15 AM	0	0	0	0	0	0	**11**	3	0	**14**	0	0	**5**	0	5	0	4	0	0	4	**23**
08:30 AM	0	0	0	0	0	0	9	0	0	9	1	0	2	0	3	0	3	0	0	3	15
08:45 AM	0	0	0	0	0	0	7	1	0	8	0	0	1	0	1	0	6	0	0	6	15
Total Volume	0	0	0	0	0	0	33	8	0	41	5	0	10	0	15	0	19	0	0	19	75
% App. Total	0	0	0	0		0	80.5	19.5	0		33.3	0	66.7	0		0	100	0	0		
PHF	.000	.000	.000	.000	.000	.000	.750	.500	.000	.732	.313	.000	.500	.000	.625	.000	.792	.000	.000	.792	.815

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Client: VHB / M. Chase

File Name : PM Peak - Main @ Maple & Town Hall
Site Code : 3
Start Date : 4/13/2011
Page No : 1

Groups Printed- PCs and Peds - HVs / Buses - Bicycles

	Town Hall From North					Main Street From East					Maple Street From South					Main Street From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
04:00 PM	0	0	0	0	0	0	190	15	1	206	20	0	43	1	64	27	97	0	0	124	394
04:15 PM	3	0	3	5	11	1	156	18	3	178	26	0	43	1	70	18	91	0	0	109	368
04:30 PM	5	1	1	0	7	0	180	19	0	199	18	0	37	0	55	31	122	0	1	154	415
04:45 PM	0	0	0	0	0	0	152	14	1	167	26	0	48	1	75	32	100	1	2	135	377
Total	8	1	4	5	18	1	678	66	5	750	90	0	171	3	264	108	410	1	3	522	1554
05:00 PM	0	0	0	0	0	0	187	20	4	211	16	0	33	0	49	35	129	0	1	165	425
05:15 PM	0	0	0	0	0	0	195	18	1	214	18	0	41	3	62	31	129	0	0	160	436
05:30 PM	0	1	0	2	3	0	168	20	0	188	16	0	46	0	62	37	91	0	0	128	381
05:45 PM	0	0	0	3	3	0	160	30	0	190	16	0	48	0	64	25	67	0	0	92	349
Total	0	1	0	5	6	0	710	88	5	803	66	0	168	3	237	128	416	0	1	545	1591
Grand Total	8	2	4	10	24	1	1388	154	10	1553	156	0	339	6	501	236	826	1	4	1067	3145
Apprch %	33.3	8.3	16.7	41.7		0.1	89.4	9.9	0.6		31.1	0	67.7	1.2		22.1	77.4	0.1	0.4		
Total %	0.3	0.1	0.1	0.3	0.8	0	44.1	4.9	0.3	49.4	5	0	10.8	0.2	15.9	7.5	26.3	0	0.1	33.9	
PCs and Peds							1370														
% PCs and Peds	100	100	100	100	100	100	98.7	99.4	100	98.8	98.7	0	99.1	100	99	99.2	97.5	100	100	97.8	98.5
HVs / Buses																					
% HVs / Buses	0	0	0	0	0	0	1.3	0.6	0	1.2	1.3	0	0.9	0	1	0.8	2.5	0	0	2.2	1.5
Bicycles	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bicycles	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	Town Hall From North					Main Street From East					Maple Street From South					Main Street From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:30 PM																					
04:30 PM	**5**	**1**	**1**	0	**7**	0	180	19	0	199	18	0	37	0	55	31	122	0	1	154	415
04:45 PM	0	0	0	0	0	0	152	14	1	167	**26**	0	**48**	1	**75**	32	100	**1**	**2**	135	377
05:00 PM	0	0	0	0	0	0	187	**20**	**4**	211	16	0	33	0	49	**35**	**129**	0	1	**165**	425
05:15 PM	0	0	0	0	0	0	**195**	18	1	**214**	18	0	41	**3**	62	31	129	0	0	160	**436**
Total Volume	5	1	1	0	7	0	714	71	6	791	78	0	159	4	241	129	480	1	4	614	1653
% App. Total	71.4	14.3	14.3	0		0	90.3	9	0.8		32.4	0	66	1.7		21	78.2	0.2	0.7		
PHF	.250	.250	.250	.000	.250	.000	.915	.888	.375	.924	.750	.000	.828	.333	.803	.921	.930	.250	.500	.930	.948
PCs and Peds																					
% PCs and Peds	100	100	100	0	100	0	99.0	98.6	100	99.0	100	0	98.7	100	99.2	100	98.3	100	100	98.7	98.9
HVs / Buses																					
% HVs / Buses	0	0	0	0	0	0	1.0	1.4	0	1.0	0	0	1.3	0	0.8	0	1.7	0	0	1.3	1.1
Bicycles	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bicycles	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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Groups Printed- HVs / Buses

	Town Hall From North					Main Street From East					Maple Street From South					Main Street From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
04:00 PM	0	0	0	0	0	0	3	0	0	3	0	0	0	0	0	1	1	0	0	2	5
04:15 PM	0	0	0	0	0	0	4	0	0	4	0	0	0	0	0	0	7	0	0	7	11
04:30 PM	0	0	0	0	0	0	1	1	0	2	0	0	1	0	1	0	0	0	0	0	3
04:45 PM	0	0	0	0	0	0	2	0	0	2	0	0	0	0	0	0	4	0	0	4	6
Total	0	0	0	0	0	0	10	1	0	11	0	0	1	0	1	1	12	0	0	13	25
05:00 PM	0	0	0	0	0	0	2	0	0	2	0	0	1	0	1	0	3	0	0	3	6
05:15 PM	0	0	0	0	0	0	2	0	0	2	0	0	0	0	0	0	1	0	0	1	3
05:30 PM	0	0	0	0	0	0	3	0	0	3	1	0	0	0	1	0	4	0	0	4	8
05:45 PM	0	0	0	0	0	0	1	0	0	1	1	0	1	0	2	1	1	0	0	2	5
Total	0	0	0	0	0	0	8	0	0	8	2	0	2	0	4	1	9	0	0	10	22
Grand Total	0	0	0	0	0	0	18	1	0	19	2	0	3	0	5	2	21	0	0	23	47
Apprch %	0	0	0	0		0	94.7	5.3	0		40	0	60	0		8.7	91.3	0	0		
Total %	0	0	0	0	0	0	38.3	2.1	0	40.4	4.3	0	6.4	0	10.6	4.3	44.7	0	0	48.9	

	Town Hall From North					Main Street From East					Maple Street From South					Main Street From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:15 PM																					
04:15 PM	0	0	0	0	0	0	**4**	0	0	**4**	0	0	0	0	0	0	**7**	0	0	**7**	**11**
04:30 PM	0	0	0	0	0	0	1	**1**	0	2	0	0	**1**	0	**1**	0	0	0	0	0	3
04:45 PM	0	0	0	0	0	0	2	0	0	2	0	0	0	0	0	0	4	0	0	4	6
05:00 PM	0	0	0	0	0	0	2	0	0	2	0	0	1	0	1	0	3	0	0	3	6
Total Volume	0	0	0	0	0	0	9	1	0	10	0	0	2	0	2	0	14	0	0	14	26
% App. Total	0	0	0	0		0	90	10	0		0	0	100	0		0	100	0	0		
PHF	.000	.000	.000	.000	.000	.000	.563	.250	.000	.625	.000	.000	.500	.000	.500	.000	.500	.000	.000	.500	.591

Automatic Traffic Recordings

Innovative Data, L L C

50 Alden Avenue
Belchertown, MA 01007
413.668.5094 or www.datayourequested.com

Location: Main Street
Location: East of Mechanic
City, State: Spencer, Massachusetts
Client: VHB / M. Chase

Start Time	12-Apr-11 Tue	Westbound A.M.	Westbound P.M.	Eastbound A.M.	Eastbound P.M.	Combined A.M.	Combined P.M.	13-Apr- Wed	Westbound A.M.	Westbound P.M.	Eastbound A.M.	Eastbound P.M.	Combined A.M.	Combined P.M.
12:00		12	118	8	125	20	243		23	108	9	117	32	225
12:15		14	114	8	92	22	206		19	118	10	109	29	227
12:30		10	102	5	104	15	206		10	97	5	106	15	203
12:45		6	114	9	101	15	215		8	114	6	110	14	224
01:00		7	127	8	106	15	233		5	101	1	102	6	203
01:15		3	114	5	***95***	8	209		8	110	3	94	11	204
01:30		5	114	7	***127***	12	241		5	138	3	92	8	230
01:45		7	140	7	***101***	14	241		5	125	2	112	7	237
02:00		8	123	7	***116***	15	239		4	108	3	***106***	7	214
02:15		10	128	7	91	17	219		5	135	2	***108***	7	243
02:30		9	133	11	95	20	228		5	107	11	***118***	16	225
02:45		14	148	6	96	20	244		10	143	8	***116***	18	***259***
03:00		6	140	6	110	12	250		4	136	4	101	8	***237***
03:15		14	135	13	95	27	230		13	***153***	7	99	20	***252***
03:30		3	143	13	93	16	236		4	***141***	15	110	19	***251***
03:45		3	140	7	100	10	240		5	***139***	11	105	16	244
04:00		4	124	11	85	15	209		6	***153***	9	90	15	243
04:15		8	***149***	19	86	27	235		10	137	18	84	28	221
04:30		8	***141***	22	104	30	245		8	144	16	85	24	229
04:45		13	***150***	25	94	38	244		13	148	22	97	35	245
05:00		14	***134***	46	81	60	215		8	144	44	117	52	261
05:15		19	132	56	93	75	225		15	131	50	96	65	227
05:30		30	139	68	77	98	216		26	145	75	86	101	231
05:45		51	139	82	90	133	***229***		41	153	76	66	117	219
06:00		32	150	137	122	169	***272***		30	134	130	100	160	234
06:15		52	128	128	98	180	***226***		42	122	124	102	166	224
06:30		55	147	***170***	105	225	***252***		72	111	134	73	206	184
06:45		93	126	***149***	98	242	224		62	117	157	85	219	202
07:00		64	133	***170***	120	234	253		74	115	145	89	219	204
07:15		84	108	***192***	58	***276***	166		87	99	***181***	67	***268***	166
07:30		88	113	168	64	***256***	177		89	103	***171***	76	***260***	179
07:45		114	100	142	71	***256***	171		90	97	***161***	70	***251***	167
08:00		85	94	154	59	***239***	153		83	94	***169***	68	***252***	162
08:15		114	103	142	64	256	167		114	73	142	79	256	152
08:30		86	97	134	57	220	154		86	89	122	44	208	133
08:45		92	72	119	59	211	131		97	96	110	56	207	152
09:00		85	80	126	53	211	133		87	81	134	49	221	130
09:15		90	73	136	63	226	136		95	70	120	45	215	115
09:30		84	65	94	56	178	121		104	48	97	48	201	96
09:45		100	56	123	27	223	83		94	54	135	45	229	99
10:00		111	49	103	37	214	86		117	35	84	35	201	70
10:15		100	42	109	40	209	82		91	44	116	28	207	72
10:30		114	20	113	23	227	43		117	30	101	32	218	62
10:45		99	22	116	24	215	46		90	29	117	17	207	46
11:00		***101***	21	113	9	214	30		***114***	26	122	20	236	46
11:15		***113***	25	121	15	234	40		***130***	30	93	19	223	49
11:30		***117***	18	110	11	227	29		***125***	31	127	12	252	43
11:45		***105***	21	105	14	210	35		***104***	24	111	14	215	38
Total		2456	5004	3630	3704	6086	8708		2454	4880	3513	3699	5967	8579
Day Total		7460		7334		14794			7334		7212		14546	
% Total		16.6%	33.8%	24.5%	25.0%				16.9%	33.5%	24.2%	25.4%		
Peak		11:00	04:15	06:30	01:15	07:15	05:45		11:00	03:15	07:15	02:00	07:15	02:45
Vol.		436	574	681	439	1027	979		473	586	682	448	1031	999
P.H.F.		0.932	0.957	0.887	0.864	0.930	0.900		0.910	0.958	0.942	0.949	0.962	0.964

ADT	ADT 14,670	AADT 14,670

Innovative Data, L L C

50 Alden Avenue
Belchertown, MA 01007
413.668.5094 or www.datayourequested.com

Location: Main Street
Location: East of Mechanic
City, State: Spencer, Massachusetts
Client: VHB / M. Chase

Westbound

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Not Classed	Total
4/12/11	1	28	9	0	3	0	0	1	0	0	0	0	0	0	42
01:00	0	13	9	0	0	0	0	0	0	0	0	0	0	0	22
02:00	3	24	9	0	4	1	0	0	0	0	0	0	0	0	41
03:00	1	18	4	0	1	1	0	1	0	0	0	0	0	0	26
04:00	1	14	10	0	7	1	0	0	0	0	0	0	0	0	33
05:00	2	47	35	1	27	0	0	1	1	0	0	0	0	0	114
06:00	0	152	44	2	30	2	0	2	0	0	0	0	0	0	232
07:00	5	244	66	3	26	6	0	0	0	0	0	0	0	0	350
08:00	7	231	83	8	33	5	0	5	1	1	0	0	0	3	377
09:00	7	219	84	1	41	3	0	3	0	0	0	0	0	1	359
10:00	15	276	90	3	30	5	0	3	1	0	0	0	0	1	424
11:00	6	294	84	2	36	6	0	4	1	0	0	0	0	3	436
12 PM	10	305	83	2	32	7	0	3	1	0	0	0	0	5	448
13:00	12	333	109	2	28	4	1	5	0	0	0	0	0	1	495
14:00	12	373	99	4	28	5	0	5	4	1	0	0	0	1	532
15:00	14	409	92	3	26	7	0	5	0	0	0	0	0	2	558
16:00	15	439	85	0	16	5	0	1	0	0	1	0	0	2	564
17:00	4	430	79	0	23	3	0	4	0	1	0	0	0	0	544
18:00	7	383	110	1	39	6	1	2	0	0	0	0	0	2	551
19:00	6	313	94	1	27	4	0	6	2	0	0	0	0	1	454
20:00	3	272	66	1	16	2	0	0	2	0	0	0	0	4	366
21:00	6	191	62	1	13	1	0	0	0	0	0	0	0	0	274
22:00	1	74	46	0	11	0	0	0	0	0	0	0	0	1	133
23:00	1	33	35	0	16	0	0	0	0	0	0	0	0	0	85
Total	139	5115	1487	35	513	74	2	51	13	3	1	0	0	27	7460
Percent	1.9%	68.6%	19.9%	0.5%	6.9%	1.0%	0.0%	0.7%	0.2%	0.0%	0.0%	0.0%	0.0%	0.4%	
AM Peak	10:00	11:00	10:00	08:00	09:00	07:00		08:00	05:00	08:00				08:00	
Vol.	15	294	90	8	41	6		5	1	1				3	
PM Peak	16:00	16:00	18:00	14:00	18:00	12:00	13:00	19:00	14:00	14:00	16:00			12:00	
Vol.	15	439	110	4	39	7	1	6	4	1	1			5	

Innovative Data, L L C

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Client: VHB / M. Chase

Westbound

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Not Classed	Total
4/13/11	0	32	23	0	5	0	0	0	0	0	0	0	0	0	60
01:00	0	12	10	0	1	0	0	0	0	0	0	0	0	0	23
02:00	0	14	9	0	1	0	0	0	0	0	0	0	0	0	24
03:00	2	16	5	0	2	0	0	0	0	0	0	0	0	1	26
04:00	0	16	12	0	9	0	0	0	0	0	0	0	0	0	37
05:00	1	46	27	1	13	2	0	0	0	0	0	0	0	0	90
06:00	2	116	53	5	28	1	0	0	1	0	0	0	0	0	206
07:00	5	219	72	7	31	3	0	1	1	0	0	0	0	1	340
08:00	6	224	96	10	35	6	0	1	0	0	0	0	0	2	380
09:00	2	201	120	2	42	5	0	5	1	0	0	0	0	2	380
10:00	9	211	132	0	51	6	0	3	1	0	0	0	0	2	415
11:00	13	274	127	2	46	3	0	5	0	0	0	0	0	3	473
12 PM	4	273	101	6	44	7	0	1	0	0	0	0	0	1	437
13:00	11	341	83	0	28	5	0	2	1	0	0	0	0	3	474
14:00	12	350	84	3	28	8	0	5	1	0	0	0	0	2	493
15:00	8	396	114	6	30	4	0	6	0	0	0	0	0	5	569
16:00	13	433	89	3	31	4	0	8	0	0	0	0	0	1	582
17:00	7	440	95	1	17	3	0	7	0	0	1	0	0	2	573
18:00	6	362	82	2	24	3	0	1	0	0	0	0	0	4	484
19:00	12	305	67	2	19	3	0	3	2	0	0	0	0	1	414
20:00	5	246	75	0	17	0	0	4	0	0	0	0	0	5	352
21:00	3	173	59	0	18	0	0	0	0	0	0	0	0	0	253
22:00	1	98	30	0	9	0	0	0	0	0	0	0	0	0	138
23:00	0	68	34	0	8	0	0	1	0	0	0	0	0	0	111
Total	122	4866	1599	50	537	63	0	53	8	0	1	0	0	35	7334
Percent	1.7%	66.3%	21.8%	0.7%	7.3%	0.9%	0.0%	0.7%	0.1%	0.0%	0.0%	0.0%	0.0%	0.5%	
AM Peak	11:00	11:00	10:00	08:00	10:00	08:00		09:00	06:00					11:00	
Vol.	13	274	132	10	51	6		5	1					3	
PM Peak	16:00	17:00	15:00	12:00	12:00	14:00		16:00	19:00		17:00			15:00	
Vol.	13	440	114	6	44	8		8	2		1			5	
Grand Total	261	9981	3086	85	1050	137	2	104	21	3	2	0	0	62	14794
Percent	1.8%	67.5%	20.9%	0.6%	7.1%	0.9%	0.0%	0.7%	0.1%	0.0%	0.0%	0.0%	0.0%	0.4%	

Innovative Data, L L C

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Client: VHB / M. Chase

Eastbound

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Not Classed	Total
4/12/11	0	28	1	0	1	0	0	0	0	0	0	0	0	0	30
01:00	3	18	5	0	1	0	0	0	0	0	0	0	0	0	27
02:00	1	22	8	0	0	0	0	0	0	0	0	0	0	0	31
03:00	0	27	9	0	2	0	0	0	1	0	0	0	0	0	39
04:00	1	51	19	1	4	1	0	0	0	0	0	0	0	0	77
05:00	3	154	74	1	15	2	0	2	1	0	0	0	0	0	252
06:00	3	404	140	4	24	2	0	5	1	0	0	0	1	0	584
07:00	10	529	89	8	23	3	0	2	1	0	1	0	1	5	672
08:00	4	416	99	3	18	1	0	5	1	1	0	0	0	1	549
09:00	7	339	101	1	22	1	0	4	1	0	1	0	1	1	479
10:00	8	317	88	3	18	5	0	0	0	0	0	0	0	2	441
11:00	6	337	78	2	16	3	0	3	1	0	0	0	0	3	449
12 PM	8	290	94	2	11	5	0	7	1	0	0	0	0	4	422
13:00	7	298	101	4	13	1	0	2	2	0	0	0	0	1	429
14:00	1	304	66	2	17	2	0	3	0	0	0	0	0	3	398
15:00	7	326	47	1	14	1	0	0	1	0	0	0	0	1	398
16:00	8	306	39	0	5	4	0	4	0	1	0	0	0	2	369
17:00	8	271	44	0	12	1	0	0	3	0	1	0	0	1	341
18:00	6	317	81	0	15	2	1	1	0	0	0	0	0	0	423
19:00	8	242	50	2	8	0	0	0	0	0	0	0	0	3	313
20:00	3	199	32	1	3	0	0	1	0	0	0	0	0	0	239
21:00	1	160	35	0	2	0	0	0	0	0	0	0	0	1	199
22:00	0	93	26	0	5	0	0	0	0	0	0	0	0	0	124
23:00	0	26	21	0	2	0	0	0	0	0	0	0	0	0	49
Total	103	5474	1347	35	251	34	1	39	14	2	3	0	3	28	7334
Percent	1.4%	74.6%	18.4%	0.5%	3.4%	0.5%	0.0%	0.5%	0.2%	0.0%	0.0%	0.0%	0.0%	0.4%	
AM Peak	07:00	07:00	06:00	07:00	06:00	10:00		06:00	03:00	08:00	07:00		06:00	07:00	
Vol.	10	529	140	8	24	5		5	1	1	1		1	5	
PM Peak	12:00	15:00	13:00	13:00	14:00	12:00	18:00	12:00	17:00	16:00	17:00			12:00	
Vol.	8	326	101	4	17	5	1	7	3	1	1			4	

Innovative Data, L L C

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Client: VHB / M. Chase

Eastbound

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Not Classed	Total
4/13/11	0	22	6	0	2	0	0	0	0	0	0	0	0	0	30
01:00	0	7	2	0	0	0	0	0	0	0	0	0	0	0	9
02:00	0	20	3	0	1	0	0	0	0	0	0	0	0	0	24
03:00	0	28	7	0	2	0	0	0	0	0	0	0	0	0	37
04:00	0	46	13	1	5	0	0	0	0	0	0	0	0	0	65
05:00	1	163	55	1	23	0	0	1	1	0	0	0	0	0	245
06:00	1	367	132	4	39	1	0	1	0	0	0	0	0	0	545
07:00	1	508	108	11	25	4	0	1	0	0	0	0	0	0	658
08:00	2	409	108	2	14	1	0	3	0	0	0	0	0	4	543
09:00	4	289	136	2	43	2	0	4	0	0	0	0	0	6	486
10:00	2	260	114	2	34	0	0	2	0	0	0	0	0	4	418
11:00	5	303	107	1	26	4	0	2	1	0	0	0	0	4	453
12 PM	7	293	111	1	23	0	0	3	1	1	0	0	0	2	442
13:00	11	290	71	1	7	3	1	3	0	0	0	0	0	13	400
14:00	8	330	74	2	21	6	0	3	0	0	1	0	0	3	448
15:00	7	308	75	0	16	4	0	0	3	0	0	0	0	2	415
16:00	7	269	64	0	10	2	0	2	0	0	0	0	0	2	356
17:00	8	285	54	1	5	3	1	2	0	0	0	0	0	6	365
18:00	14	280	52	2	5	3	0	1	0	0	0	0	0	3	360
19:00	10	224	53	2	6	4	0	1	0	0	0	0	0	2	302
20:00	10	186	36	1	6	3	0	0	0	0	0	0	0	5	247
21:00	0	147	35	0	4	0	0	0	0	0	0	0	0	1	187
22:00	0	81	28	0	3	0	0	0	0	0	0	0	0	0	112
23:00	0	56	8	0	1	0	0	0	0	0	0	0	0	0	65
Total	98	5171	1452	34	321	40	2	29	6	1	1	0	0	57	7212
Percent	1.4%	71.7%	20.1%	0.5%	4.5%	0.6%	0.0%	0.4%	0.1%	0.0%	0.0%	0.0%	0.0%	0.8%	
AM Peak	11:00	07:00	09:00	07:00	09:00	07:00		09:00	05:00					09:00	
Vol.	5	508	136	11	43	4		4	1					6	
PM Peak	18:00	14:00	12:00	14:00	12:00	14:00	13:00	12:00	15:00	12:00	14:00			13:00	
Vol.	14	330	111	2	23	6	1	3	3	1	1			13	
Grand Total	201	10645	2799	69	572	74	3	68	20	3	4	0	3	85	14546
Percent	1.4%	73.2%	19.2%	0.5%	3.9%	0.5%	0.0%	0.5%	0.1%	0.0%	0.0%	0.0%	0.0%	0.6%	

Innovative Data, L L C

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Westbound, Eastbound

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Not Classed	Total
4/12/11	1	56	10	0	4	0	0	1	0	0	0	0	0	0	72
01:00	3	31	14	0	1	0	0	0	0	0	0	0	0	0	49
02:00	4	46	17	0	4	1	0	0	0	0	0	0	0	0	72
03:00	1	45	13	0	3	1	0	1	1	0	0	0	0	0	65
04:00	2	65	29	1	11	2	0	0	0	0	0	0	0	0	110
05:00	5	201	109	2	42	2	0	3	2	0	0	0	0	0	366
06:00	3	556	184	6	54	4	0	7	1	0	0	0	1	0	816
07:00	15	773	155	11	49	9	0	2	1	0	1	0	1	5	1022
08:00	11	647	182	11	51	6	0	10	2	2	0	0	0	4	926
09:00	14	558	185	2	63	4	0	7	1	0	1	0	1	2	838
10:00	23	593	178	6	48	10	0	3	1	0	0	0	0	3	865
11:00	12	631	162	4	52	9	0	7	2	0	0	0	0	6	885
12 PM	18	595	177	4	43	12	0	10	2	0	0	0	0	9	870
13:00	19	631	210	6	41	5	1	7	2	0	0	0	0	2	924
14:00	13	677	165	6	45	7	0	8	4	1	0	0	0	4	930
15:00	21	735	139	4	40	8	0	5	1	0	0	0	0	3	956
16:00	23	745	124	0	21	9	0	5	0	1	1	0	0	4	933
17:00	12	701	123	0	35	4	0	4	3	1	1	0	0	1	885
18:00	13	700	191	1	54	8	2	3	0	0	0	0	0	2	974
19:00	14	555	144	3	35	4	0	6	2	0	0	0	0	4	767
20:00	6	471	98	2	19	2	0	1	2	0	0	0	0	4	605
21:00	7	351	97	1	15	1	0	0	0	0	0	0	0	1	473
22:00	1	167	72	0	16	0	0	0	0	0	0	0	0	1	257
23:00	1	59	56	0	18	0	0	0	0	0	0	0	0	0	134
Total	242	10589	2834	70	764	108	3	90	27	5	4	0	3	55	14794
Percent	1.6%	71.6%	19.2%	0.5%	5.2%	0.7%	0.0%	0.6%	0.2%	0.0%	0.0%	0.0%	0.0%	0.4%	
AM Peak	10:00	07:00	09:00	07:00	09:00	10:00		08:00	05:00	08:00	07:00		06:00	11:00	
Vol.	23	773	185	11	63	10		10	2	2	1		1	6	
PM Peak	16:00	16:00	13:00	13:00	18:00	12:00	18:00	12:00	14:00	14:00	16:00			12:00	
Vol.	23	745	210	6	54	12	2	10	4	1	1			9	

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Westbound, Eastbound

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Not Classed	Total
4/13/11	0	54	29	0	7	0	0	0	0	0	0	0	0	0	90
01:00	0	19	12	0	1	0	0	0	0	0	0	0	0	0	32
02:00	0	34	12	0	2	0	0	0	0	0	0	0	0	0	48
03:00	2	44	12	0	4	0	0	0	0	0	0	0	0	1	63
04:00	0	62	25	1	14	0	0	0	0	0	0	0	0	0	102
05:00	2	209	82	2	36	2	0	1	1	0	0	0	0	0	335
06:00	3	483	185	9	67	2	0	1	1	0	0	0	0	0	751
07:00	6	727	180	18	56	7	0	2	1	0	0	0	0	1	998
08:00	8	633	204	12	49	7	0	4	0	0	0	0	0	6	923
09:00	6	490	256	4	85	7	0	9	1	0	0	0	0	8	866
10:00	11	471	246	2	85	6	0	5	1	0	0	0	0	6	833
11:00	18	577	234	3	72	7	0	7	1	0	0	0	0	7	926
12 PM	11	566	212	7	67	7	0	4	1	1	0	0	0	3	879
13:00	22	631	154	1	35	8	1	5	1	0	0	0	0	16	874
14:00	20	680	158	5	49	14	0	8	1	0	1	0	0	5	941
15:00	15	704	189	6	46	8	0	6	3	0	0	0	0	7	984
16:00	20	702	153	3	41	6	0	10	0	0	0	0	0	3	938
17:00	15	725	149	2	22	6	1	9	0	0	1	0	0	8	938
18:00	20	642	134	4	29	6	0	2	0	0	0	0	0	7	844
19:00	22	529	120	4	25	7	0	4	2	0	0	0	0	3	716
20:00	15	432	111	1	23	3	0	4	0	0	0	0	0	10	599
21:00	3	320	94	0	22	0	0	0	0	0	0	0	0	1	440
22:00	1	179	58	0	12	0	0	0	0	0	0	0	0	0	250
23:00	0	124	42	0	9	0	0	1	0	0	0	0	0	0	176
Total	220	10037	3051	84	858	103	2	82	14	1	2	0	0	92	14546
Percent	1.5%	69.0%	21.0%	0.6%	5.9%	0.7%	0.0%	0.6%	0.1%	0.0%	0.0%	0.0%	0.0%	0.6%	
AM Peak	11:00	07:00	09:00	07:00	09:00	07:00		09:00	05:00					09:00	
Vol.	18	727	256	18	85	7		9	1					8	
PM Peak	13:00	17:00	12:00	12:00	12:00	14:00	13:00	16:00	15:00	12:00	14:00			13:00	
Vol.	22	725	212	7	67	14	1	10	3	1	1			16	
Grand Total	462	20626	5885	154	1622	211	5	172	41	6	6	0	3	147	29340
Percent	1.6%	70.3%	20.1%	0.5%	5.5%	0.7%	0.0%	0.6%	0.1%	0.0%	0.0%	0.0%	0.0%	0.5%	

Innovative Data, L L C

50 Alden Avenue
Belchertown, MA 01007
413.668.5094 or www.datayourequested.com

Location: Main Street
Location: East of Mechanic
City, State: Spencer, Massachusetts
Client: VHB / M. Chase

Westbound

Start Time	1 15	16 20	21 25	26 30	31 35	36 40	41 45	46 50	51 55	56 60	61 65	66 70	71 75	76 999	Total	85th Percent	95th Percent
4/12/11	0	2	7	14	16	**3**	0	0	0	0	0	0	0	0	42	34	36
01:00	0	0	3	9	8	0	**1**	**1**	0	0	0	0	0	0	22	34	45
02:00	3	5	5	16	9	3	0	0	0	0	0	0	0	0	41	33	36
03:00	2	2	4	7	8	3	0	0	0	0	0	0	0	0	26	34	37
04:00	0	2	3	14	12	2	0	0	0	0	0	0	0	0	33	34	35
05:00	2	5	28	50	26	3	0	0	0	0	0	0	0	0	114	33	35
06:00	3	18	67	**107**	**37**	0	0	0	0	0	0	0	0	0	232	31	34
07:00	23	73	152	86	15	1	0	0	0	0	0	0	0	0	350	28	30
08:00	29	102	154	81	11	0	0	0	0	0	0	0	0	0	377	28	30
09:00	27	90	155	70	17	0	0	0	0	0	0	0	0	0	359	28	30
10:00	48	117	**202**	50	6	1	0	0	0	0	0	0	0	0	424	25	29
11:00	**52**	**129**	181	69	5	0	0	0	0	0	0	0	0	0	**436**	26	29
12 PM	63	137	172	69	6	0	1	0	0	0	0	0	0	0	448	26	29
13:00	46	161	186	87	15	0	0	0	0	0	0	0	0	0	495	27	30
14:00	80	248	161	39	3	1	0	0	0	0	0	0	0	0	532	24	27
15:00	77	270	173	33	5	0	0	0	0	0	0	0	0	0	558	24	27
16:00	**109**	263	168	23	1	0	0	0	0	0	0	0	0	0	**564**	24	25
17:00	93	**280**	137	33	1	0	0	0	0	0	0	0	0	0	544	24	26
18:00	40	137	**242**	116	15	1	0	0	0	0	0	0	0	0	551	28	30
19:00	39	92	179	129	14	1	0	0	0	0	0	0	0	0	454	28	30
20:00	16	58	117	131	39	5	0	0	0	0	0	0	0	0	366	30	34
21:00	12	22	58	**134**	**43**	4	1	0	0	0	0	0	0	0	274	31	34
22:00	1	5	24	53	41	7	**2**	0	0	0	0	0	0	0	133	34	36
23:00	0	2	6	31	30	**16**	0	0	0	0	0	0	0	0	85	36	39
Total	765	2220	2584	1451	383	51	5	1	0	0	0	0	0	0	7460		
Percent	10.3%	29.8%	34.6%	19.5%	5.1%	0.7%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%			
AM Peak	11:00	11:00	10:00	06:00	06:00	00:00	01:00	01:00							11:00		
Vol.	52	129	202	107	37	3	1	1							436		
PM Peak	16:00	17:00	18:00	21:00	21:00	23:00	22:00								16:00		
Vol.	109	280	242	134	43	16	2								564		

Innovative Data, L L C

50 Alden Avenue
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413.668.5094 or www.datayourequested.com

Location: Main Street
Location: East of Mechanic
City, State: Spencer, Massachusetts
Client: VHB / M. Chase

Westbound

Start Time	1 15	16 20	21 25	26 30	31 35	36 40	41 45	46 50	51 55	56 60	61 65	66 70	71 75	76 999	Total	85th Percent	95th Percent
4/13/11	0	3	9	18	19	**10**	**1**	0	0	0	0	0	0	0	60	36	39
01:00	1	0	5	9	7	1	0	0	0	0	0	0	0	0	23	33	35
02:00	0	1	5	10	6	2	0	0	0	0	0	0	0	0	24	33	36
03:00	3	0	2	9	10	2	0	0	0	0	0	0	0	0	26	34	36
04:00	0	1	8	14	10	3	1	0	0	0	0	0	0	0	37	34	37
05:00	0	3	9	42	32	4	0	0	0	0	0	0	0	0	90	34	35
06:00	2	10	52	93	**41**	8	0	0	0	0	0	0	0	0	206	33	35
07:00	14	28	138	127	30	2	1	0	0	0	0	0	0	0	340	30	33
08:00	18	82	172	83	23	2	0	0	0	0	0	0	0	0	380	28	32
09:00	13	48	140	**143**	34	2	0	0	0	0	0	0	0	0	380	30	33
10:00	21	87	150	115	38	4	0	0	0	0	0	0	0	0	415	30	33
11:00	**38**	**120**	**180**	111	23	1	0	0	0	0	0	0	0	0	**473**	28	30
12 PM	33	97	209	87	11	0	0	0	0	0	0	0	0	0	437	27	30
13:00	80	172	159	52	9	1	**1**	0	0	0	0	0	0	0	474	25	29
14:00	72	204	158	53	6	0	0	0	0	0	0	0	0	0	493	25	29
15:00	77	230	**217**	40	5	0	0	0	0	0	0	0	0	0	569	25	28
16:00	86	249	182	64	1	0	0	0	0	0	0	0	0	0	**582**	25	28
17:00	**107**	**283**	161	21	1	0	0	0	0	0	0	0	0	0	573	23	25
18:00	92	252	109	28	3	0	0	0	0	0	0	0	0	0	484	24	27
19:00	69	178	137	26	4	0	0	0	0	0	0	0	0	0	414	24	27
20:00	45	110	127	54	14	2	0	0	0	0	0	0	0	0	352	27	30
21:00	4	15	77	**100**	**51**	5	1	0	0	0	0	0	0	0	253	32	35
22:00	5	4	15	75	38	1	0	0	0	0	0	0	0	0	138	33	35
23:00	1	1	10	52	41	**6**	0	0	0	0	0	0	0	0	111	34	35
Total	781	2178	2431	1426	457	56	5	0	0	0	0	0	0	0	7334		
Percent	10.6%	29.7%	33.1%	19.4%	6.2%	0.8%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%			
AM Peak	11:00	11:00	11:00	09:00	06:00	00:00	00:00								11:00		
Vol.	38	120	180	143	41	10	1								473		
PM Peak	17:00	17:00	15:00	21:00	21:00	23:00	13:00								16:00		
Vol.	107	283	217	100	51	6	1								582		
Grand Total	1546	4398	5015	2877	840	107	10	1	0	0	0	0	0	0	14794		
Percent	10.5%	29.7%	33.9%	19.4%	5.7%	0.7%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%			

15th Percentile :	16 MPH
50th Percentile :	22 MPH
85th Percentile :	28 MPH
95th Percentile :	32 MPH

Statistics

10 MPH Pace Speed :	16-25 MPH
Number in Pace :	9413
Percent in Pace :	63.6%
Number of Vehicles > 35 MPH :	118
Percent of Vehicles > 35 MPH :	0.8%
Mean Speed(Average) :	22 MPH

Innovative Data, L L C

50 Alden Avenue
Belchertown, MA 01007
413.668.5094 or www.datayourequested.com

Location: Main Street
Location: East of Mechanic
City, State: Spencer, Massachusetts
Client: VHB / M. Chase

Eastbound

Start Time	1 15	16 20	21 25	26 30	31 35	36 40	41 45	46 50	51 55	56 60	61 65	66 70	71 75	76 999	Total	85th Percent	95th Percent
4/12/11	0	1	7	15	6	0	**1**	0	0	0	0	0	0	0	30	31	34
01:00	4	2	3	9	9	0	0	0	0	0	0	0	0	0	27	33	34
02:00	0	2	7	16	5	1	0	0	0	0	0	0	0	0	31	31	34
03:00	0	1	9	19	10	0	0	0	0	0	0	0	0	0	39	32	34
04:00	0	2	15	36	19	**5**	0	0	0	0	0	0	0	0	77	33	36
05:00	0	4	61	134	**48**	4	1	0	0	0	0	0	0	0	252	32	35
06:00	15	41	229	**266**	32	1	0	0	0	0	0	0	0	0	584	29	31
07:00	**60**	**142**	**347**	118	5	0	0	0	0	0	0	0	0	0	**672**	26	29
08:00	33	109	289	104	13	1	0	0	0	0	0	0	0	0	549	27	30
09:00	23	96	241	107	12	0	0	0	0	0	0	0	0	0	479	28	30
10:00	37	121	220	62	1	0	0	0	0	0	0	0	0	0	441	25	29
11:00	24	133	222	66	4	0	0	0	0	0	0	0	0	0	449	26	29
12 PM	19	139	191	72	1	0	0	0	0	0	0	0	0	0	422	26	29
13:00	29	126	201	64	9	0	0	0	0	0	0	0	0	0	**429**	26	29
14:00	23	167	168	36	4	0	0	0	0	0	0	0	0	0	398	25	28
15:00	22	147	195	31	3	0	0	0	0	0	0	0	0	0	398	25	28
16:00	**33**	**173**	138	24	1	0	0	0	0	0	0	0	0	0	369	24	27
17:00	26	129	165	20	1	0	0	0	0	0	0	0	0	0	341	25	26
18:00	16	96	**236**	73	2	0	0	0	0	0	0	0	0	0	423	26	29
19:00	10	38	165	90	9	1	0	0	0	0	0	0	0	0	313	28	30
20:00	0	14	117	96	12	0	0	0	0	0	0	0	0	0	239	29	30
21:00	0	7	51	**117**	23	1	0	0	0	0	0	0	0	0	199	30	33
22:00	0	3	18	71	**28**	**4**	0	0	0	0	0	0	0	0	124	33	35
23:00	0	0	1	21	20	4	**2**	**1**	0	0	0	0	0	0	49	35	41
Total	374	1693	3296	1667	277	22	4	1	0	0	0	0	0	0	7334		
Percent	5.1%	23.1%	44.9%	22.7%	3.8%	0.3%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%			
AM Peak	07:00	07:00	07:00	06:00	05:00	04:00	00:00								07:00		
Vol.	60	142	347	266	48	5	1								672		
PM Peak	16:00	16:00	18:00	21:00	22:00	22:00	23:00	23:00							13:00		
Vol.	33	173	236	117	28	4	2	1							429		

Innovative Data, L L C

50 Alden Avenue
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413.668.5094 or www.datayourequested.com

Location: Main Street
Location: East of Mechanic
City, State: Spencer, Massachusetts
Client: VHB / M. Chase

Eastbound

Start Time	1 15	16 20	21 25	26 30	31 35	36 40	41 45	46 50	51 55	56 60	61 65	66 70	71 75	76 999	Total	85th Percent	95th Percent
4/13/11	0	1	2	15	10	2	0	0	0	0	0	0	0	0	30	34	35
01:00	0	0	3	6	0	0	0	0	0	0	0	0	0	0	9	29	30
02:00	0	1	5	12	5	1	0	0	0	0	0	0	0	0	24	32	35
03:00	0	1	6	18	10	2	0	0	0	0	0	0	0	0	37	33	35
04:00	0	1	7	31	23	3	0	0	0	0	0	0	0	0	65	34	35
05:00	0	11	55	133	44	2	0	0	0	0	0	0	0	0	245	31	34
06:00	20	35	138	**282**	**65**	**5**	0	0	0	0	0	0	0	0	545	30	34
07:00	**47**	87	**286**	225	12	1	0	0	0	0	0	0	0	0	**658**	29	30
08:00	45	**102**	227	149	20	0	0	0	0	0	0	0	0	0	543	28	30
09:00	17	48	169	216	33	3	0	0	0	0	0	0	0	0	486	30	32
10:00	13	54	179	143	27	2	0	0	0	0	0	0	0	0	418	29	32
11:00	13	70	222	133	14	1	0	0	0	0	0	0	0	0	453	28	30
12 PM	13	67	**236**	**103**	22	1	0	0	0	0	0	0	0	0	442	28	31
13:00	**55**	160	145	40	0	0	0	0	0	0	0	0	0	0	400	25	28
14:00	29	168	190	57	4	0	0	0	0	0	0	0	0	0	**448**	25	29
15:00	23	125	199	63	5	0	0	0	0	0	0	0	0	0	415	26	29
16:00	17	138	164	35	2	0	0	0	0	0	0	0	0	0	356	25	28
17:00	12	**178**	152	23	0	0	0	0	0	0	0	0	0	0	365	24	26
18:00	35	169	137	19	0	0	0	0	0	0	0	0	0	0	360	24	26
19:00	15	134	138	14	1	0	0	0	0	0	0	0	0	0	302	24	25
20:00	12	92	115	23	4	1	0	0	0	0	0	0	0	0	247	25	29
21:00	1	2	63	101	20	0	0	0	0	0	0	0	0	0	187	30	33
22:00	0	4	28	53	**26**	1	0	0	0	0	0	0	0	0	112	32	34
23:00	0	3	9	30	17	**6**	0	0	0	0	0	0	0	0	65	34	37
Total	367	1651	2875	1924	364	31	0	0	0	0	0	0	0	0	7212		
Percent	5.1%	22.9%	39.9%	26.7%	5.0%	0.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%			
AM Peak	07:00	08:00	07:00	06:00	06:00	06:00									07:00		
Vol.	47	102	286	282	65	5									658		
PM Peak	13:00	17:00	12:00	12:00	22:00	23:00									14:00		
Vol.	55	178	236	103	26	6									448		
Grand Total	741	3344	6171	3591	641	53	4	1	0	0	0	0	0	0	14546		
Percent	5.1%	23.0%	42.4%	24.7%	4.4%	0.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%			

15th Percentile :	18 MPH
50th Percentile :	23 MPH
85th Percentile :	28 MPH
95th Percentile :	30 MPH

Statistics

10 MPH Pace Speed :	21-30 MPH
Number in Pace :	9762
Percent in Pace :	67.1%
Number of Vehicles > 35 MPH :	58
Percent of Vehicles > 35 MPH :	0.4%
Mean Speed(Average) :	23 MPH

Innovative Data, L L C

50 Alden Avenue
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Location: Main Street
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Client: VHB / M. Chase

Westbound, Eastbound

Start Time	1 15	16 20	21 25	26 30	31 35	36 40	41 45	46 50	51 55	56 60	61 65	66 70	71 75	76 999	Total	85th Percent	95th Percent
4/12/11	0	3	14	29	22	3	**1**	0	0	0	0	0	0	0	72	34	35
01:00	4	2	6	18	17	0	1	**1**	0	0	0	0	0	0	49	34	35
02:00	3	7	12	32	14	4	0	0	0	0	0	0	0	0	72	33	35
03:00	2	3	13	26	18	3	0	0	0	0	0	0	0	0	65	33	35
04:00	0	4	18	50	31	**7**	0	0	0	0	0	0	0	0	110	34	36
05:00	2	9	89	184	**74**	7	1	0	0	0	0	0	0	0	366	32	35
06:00	18	59	296	**373**	69	1	0	0	0	0	0	0	0	0	816	30	33
07:00	83	215	**499**	204	20	1	0	0	0	0	0	0	0	0	**1022**	27	30
08:00	62	211	443	185	24	1	0	0	0	0	0	0	0	0	926	27	30
09:00	50	186	396	177	29	0	0	0	0	0	0	0	0	0	838	28	30
10:00	**85**	238	422	112	7	1	0	0	0	0	0	0	0	0	865	25	29
11:00	76	**262**	403	135	9	0	0	0	0	0	0	0	0	0	885	26	29
12 PM	82	276	363	141	7	0	1	0	0	0	0	0	0	0	870	26	29
13:00	75	287	387	151	24	0	0	0	0	0	0	0	0	0	924	27	30
14:00	103	415	329	75	7	1	0	0	0	0	0	0	0	0	930	25	28
15:00	99	417	368	64	8	0	0	0	0	0	0	0	0	0	956	25	27
16:00	**142**	**436**	306	47	2	0	0	0	0	0	0	0	0	0	933	24	26
17:00	119	409	302	53	2	0	0	0	0	0	0	0	0	0	885	24	26
18:00	56	233	**478**	189	17	1	0	0	0	0	0	0	0	0	**974**	27	30
19:00	49	130	344	219	23	2	0	0	0	0	0	0	0	0	767	28	30
20:00	16	72	234	227	51	5	0	0	0	0	0	0	0	0	605	30	33
21:00	12	29	109	**251**	66	5	1	0	0	0	0	0	0	0	473	31	34
22:00	1	8	42	124	**69**	11	**2**	0	0	0	0	0	0	0	257	34	35
23:00	0	2	7	52	50	**20**	2	**1**	0	0	0	0	0	0	134	36	39
Total	1139	3913	5880	3118	660	73	9	2	0	0	0	0	0	0	14794		
Percent	7.7%	26.4%	39.7%	21.1%	4.5%	0.5%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%			
AM Peak	10:00	11:00	07:00	06:00	05:00	04:00	00:00	01:00							07:00		
Vol.	85	262	499	373	74	7	1	1							1022		
PM Peak	16:00	16:00	18:00	21:00	22:00	23:00	22:00	23:00							18:00		
Vol.	142	436	478	251	69	20	2	1							974		

Innovative Data, L L C

50 Alden Avenue
Belchertown, MA 01007
413.668.5094 or www.datayourequested.com

Location: Main Street
Location: East of Mechanic
City, State: Spencer, Massachusetts
Client: VHB / M. Chase

Westbound, Eastbound

Start Time	1 15	16 20	21 25	26 30	31 35	36 40	41 45	46 50	51 55	56 60	61 65	66 70	71 75	76 999	Total	85th Percent	95th Percent
4/13/11	0	4	11	33	29	12	**1**	0	0	0	0	0	0	0	90	35	38
01:00	1	0	8	15	7	1	0	0	0	0	0	0	0	0	32	32	34
02:00	0	2	10	22	11	3	0	0	0	0	0	0	0	0	48	33	36
03:00	3	1	8	27	20	4	0	0	0	0	0	0	0	0	63	34	36
04:00	0	2	15	45	33	6	1	0	0	0	0	0	0	0	102	34	36
05:00	0	14	64	175	76	6	0	0	0	0	0	0	0	0	335	33	35
06:00	22	45	190	**375**	**106**	**13**	0	0	0	0	0	0	0	0	751	31	34
07:00	61	115	**424**	352	42	3	1	0	0	0	0	0	0	0	**998**	29	30
08:00	**63**	184	399	232	43	2	0	0	0	0	0	0	0	0	923	28	30
09:00	30	96	309	359	67	5	0	0	0	0	0	0	0	0	866	30	33
10:00	34	141	329	258	65	6	0	0	0	0	0	0	0	0	833	29	33
11:00	51	**190**	402	244	37	2	0	0	0	0	0	0	0	0	926	28	30
12 PM	46	164	**445**	190	33	1	0	0	0	0	0	0	0	0	879	28	30
13:00	**135**	332	304	92	9	1	**1**	0	0	0	0	0	0	0	874	25	29
14:00	101	372	348	110	10	0	0	0	0	0	0	0	0	0	941	25	29
15:00	100	355	416	103	10	0	0	0	0	0	0	0	0	0	**984**	25	29
16:00	103	387	346	99	3	0	0	0	0	0	0	0	0	0	938	25	28
17:00	119	**461**	313	44	1	0	0	0	0	0	0	0	0	0	938	24	25
18:00	127	421	246	47	3	0	0	0	0	0	0	0	0	0	844	24	26
19:00	84	312	275	40	5	0	0	0	0	0	0	0	0	0	716	24	27
20:00	57	202	242	77	18	3	0	0	0	0	0	0	0	0	599	26	30
21:00	5	17	140	**201**	**71**	5	1	0	0	0	0	0	0	0	440	31	34
22:00	5	8	43	128	64	2	0	0	0	0	0	0	0	0	250	33	35
23:00	1	4	19	82	58	**12**	0	0	0	0	0	0	0	0	176	34	36
Total	1148	3829	5306	3350	821	87	5	0	0	0	0	0	0	0	14546		
Percent	7.9%	26.3%	36.5%	23.0%	5.6%	0.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%			
AM Peak	08:00	11:00	07:00	06:00	06:00	06:00	00:00								07:00		
Vol.	63	190	424	375	106	13	1								998		
PM Peak	13:00	17:00	12:00	21:00	21:00	23:00	13:00								15:00		
Vol.	135	461	445	201	71	12	1								984		
Grand Total	2287	7742	11186	6468	1481	160	14	2	0	0	0	0	0	0	29340		
Percent	7.8%	26.4%	38.1%	22.0%	5.0%	0.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%			

15th Percentile :	17 MPH
50th Percentile :	23 MPH
85th Percentile :	28 MPH
95th Percentile :	31 MPH

Statistics

10 MPH Pace Speed :	16-25 MPH
Number in Pace :	18928
Percent in Pace :	64.5%
Number of Vehicles > 35 MPH :	176
Percent of Vehicles > 35 MPH :	0.6%
Mean Speed(Average) :	22 MPH

Crash Data

INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : Spencer COUNT DATE :

DISTRICT : 3 UNSIGNALIZED : SIGNALIZED : **0.90**

~ INTERSECTION DATA ~

MAJOR STREET : Main Street

MINOR STREET(S) : Maple Street

INTERSECTION DIAGRAM (Label Approaches)

North

PEAK HOUR VOLUMES

APPROACH :	**1**	**2**	**3**	**4**	**5**	**Total Peak Hourly Approach Volume**
DIRECTION :	EB	WB	NB	SB		
PEAK HOURLY VOLUMES (AM/PM) :	610	785	240	5		**1,640**

" K " FACTOR : **0.090** INTERSECTION ADT (**V**) = TOTAL DAILY APPROACH VOLUME : **18,222**

TOTAL # OF CRASHES : 13 # OF YEARS : 3 AVERAGE # OF CRASHES PER YEAR (**A**) : **4.33**

CRASH RATE CALCULATION : **0.65** RATE = $\frac{(A * 1{,}000{,}000)}{(V * 365)}$

Comments :

Project Title & Date:

SEGMENT CRASH RATE WORKSHEET

CITY/TOWN : Spencer COUNT DATE :

DISTRICT : 3

~ SEGMENT DATA ~

ROADWAY NAME:

START POINT: Maple Street

END POINT: Pleasant Street

FUNCTIONAL CLASSIFICATION OF ROADWAY:

ROADWAY DIAGRAM (LABEL ROADWAY AND CROSS STREETS)

North

AVERAGE DAILY TRAFFIC

SEGMENT LENGTH IN MILES (**L**):	**0.24**
AVERAGE DAILY TRAFFIC VOLUME (**V**):	14,764

TOTAL # OF CRASHES:	43	# OF YEARS :	3	AVERAGE # OF CRASHES PER YEAR (**A**) :	**14.33**

CRASH RATE CALCULATION : **11.08**

$$\text{RATE} = \frac{(A * 1{,}000{,}000)}{(L * V * 365)}$$

Comments : Includes crashes at intersection of Main & Mechanic/Price Chopper

Project Title & Date:

Signal Warrant Analysis

2003 MUTCD

TRAFFIC SIGNAL WARRANT ANALYSIS (VOLUME BASED)

Intersection: Main Street at Maple Street

Major Street Direction: Eastbound-Westbound

Year: 2011 **Condition:** Existing

Operating speed on major roadway: 28 mph

Number of approaches: 4

			Required approach volumes	
Warrant 1	**EIGHT-HOUR VEHICULAR VOLUME**		Minimum*	Adjusted Minimum**
Warrant 1A	MINIMUM VEHICULAR VOLUME (8 hours of day)			
	Major Street :	2 Lane(s) on each approach	600	600
	Minor Street :	1 Lane(s) on each approach	150	150
Warrant 1B	INTERRUPTION OF CONTINUOUS TRAFFIC (8 hours of day)			
	Major Street :	2 Lane(s) on each approach	900	900
	Minor Street :	1 Lane(s) on each approach	75	75
80 PERCENT SATISFACTION OF WARRANT 1A **AND** WARRANT 1B			Warrant 1A	Warrant 1B
	Major Street :	2 Lane(s) on each approach	480	720
	Minor Street :	1 Lane(s) on each approach	120	60

Warrant 2	**FOUR HOUR VEHICULAR VOLUME**		
	Major Street :	2 Lane(s) on each approach	If "verify" indicated, see Figure 4C-1 or 4C-2.
	Minor Street :	1 Lane(s) on each approach	25 = accuracy of regression equations

Warrant 3	**PEAK HOUR VOLUME**		
	Major Street :	2 Lane(s) on each approach	If "verify" indicated, see Figure 4C-3 or 4C-4.
	Minor Street :	1 Lane(s) on each approach	25 = accuracy of regression equations

Hour	Entering Vol. Minor Road+	Entering Vol. on Major Road Eastbound	Entering Vol. on Major Road Westbound	Tot. Ent. Vol. On Major Rd	Meets the following volume-based warrants? 1A	1B	80%(1A&1B)	2	3
6:00 - 7:00 AM	176	584	174	758	Yes	No	Yes	No	No
7:00 - 8:00 AM	238	672	263	935	Yes	Yes	Yes	Yes	No
8:00 - 9:00 AM	247	549	283	832	Yes	No	Yes	Yes	No
9:00 - 10:00 AM	165	479	269	748	Yes	No	Yes	No	No
10:00 - 11:00 AM	144	441	318	759	No	No	Yes	No	No
11:00 - 12:00 AM	164	449	327	776	Yes	No	Yes	No	No
12:00 - 1:00 PM	171	422	336	758	Yes	No	Yes	No	No
1:00 - 2:00 PM	150	429	371	800	No	No	Yes	No	No
2:00 - 3:00 PM	176	398	399	797	Yes	No	Yes	No	No
3:00 - 4:00 PM	201	398	419	817	Yes	No	Yes	Yes	No
4:00 - 5:00 PM	264	369	423	792	Yes	No	Yes	Yes	No
5:00 - 6:00 PM	237	341	408	749	Yes	No	Yes	Yes	No
6:00 - 7:00 PM	155	423	413.25	836	Yes	No	Yes	No	No
	0:00				**Yes**	**No**	**Yes**	**Yes**	**No**
			Warrants Met?		**1**			**2**	**3**
					Yes			**Yes**	**No**

*From the criteria described for the warrant in the MUTCD.

**If the operating speed is higher than 40mph then the volumes can be adjusted to 70%. (If no adjusted minimum, the minimum from the previous column is shown)

+If more than one approach, report the approach that has the higher volume.

NON-VOLUME-BASED WARRANTS

Warrant 4, Minimum Pedestrian Volume: No

Peak Four Hour Pedestrian Volumes: 0

(non-concurrent) 0

0

0

Warrant 5, School Crossing:

See MUTCD for details.

Warrant 7, Crash Experience: No

# of accidents "correctable by signalization" occuring in the last 12 months: 0

Warrant 6, Coordinated Signal System:

See MUTCD for details.

Warrant 8, Roadway Network:

See MUTCD for details.

Source: *Manual on Uniform Traffic Control Devices* (MUTCD); 2003 Edition [2003]

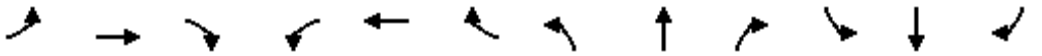
last updated: 08/05/05 [version]

Intersection Capacity Analysis

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT	ø9
Lane Configurations										
Volume (vph)	5	635	75	65	320	130	5	1	0	
Lane Group Flow (vph)	0	688	81	74	365	0	308	0	4	
Turn Type	Perm		Perm	Perm		Perm		Perm		
Protected Phases		1			1		2		2	9
Permitted Phases	1		1	1		2		2		
Detector Phase	1	1	1	1	1	2	2	2	2	
Switch Phase										
Minimum Initial (s)	6.0	6.0	6.0	6.0	6.0	5.0	5.0	5.0	5.0	14.0
Minimum Split (s)	12.0	12.0	12.0	12.0	12.0	11.0	11.0	11.0	11.0	18.0
Total Split (s)	56.0	56.0	56.0	56.0	56.0	26.0	26.0	26.0	26.0	18.0
Total Split (%)	56.0%	56.0%	56.0%	56.0%	56.0%	26.0%	26.0%	26.0%	26.0%	18%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	
Lead/Lag	Lead	Lead	Lead	Lead	Lead	Lag	Lag	Lag	Lag	
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Recall Mode	Max	Max	Max	Max	Max	C-Max	C-Max	C-Max	C-Max	None
v/c Ratio		0.55	0.08	0.19	0.30		0.97		0.02	
Control Delay		10.2	3.3	7.3	7.2		79.8		33.0	
Queue Delay		0.8	0.0	0.0	0.0		0.0		0.0	
Total Delay		11.0	3.3	7.3	7.2		79.8		33.0	
Queue Length 50th (ft)		199	8	15	83		172		2	
Queue Length 95th (ft)		287	22	33	121		#320		3	
Internal Link Dist (ft)		203			196		261		78	
Turn Bay Length (ft)			90	100						
Base Capacity (vph)		1252	1079	392	1219		317		197	
Starvation Cap Reductn		271	0	0	0		0		0	
Spillback Cap Reductn		0	0	0	0		0		0	
Storage Cap Reductn		0	0	0	0		0		0	
Reduced v/c Ratio		0.70	0.08	0.19	0.30		0.97		0.02	

Intersection Summary
Cycle Length: 100
Actuated Cycle Length: 100
Offset: 56 (56%), Referenced to phase 2:NBSB, Start of Green
Natural Cycle: 80
Control Type: Actuated-Coordinated
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 4: Main Street (Route 9) & Town Hall



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	5	635	75	65	320	1	130	5	130	1	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0	6.0	6.0	6.0			6.0			6.0	
Lane Util. Factor		1.00	1.00	1.00	1.00			1.00			1.00	
Frt		1.00	0.85	1.00	1.00			0.93			1.00	
Flt Protected		1.00	1.00	0.95	1.00			0.98			0.95	
Satd. Flow (prot)		1844	1568	1703	1792			1634			1805	
Flt Permitted		1.00	1.00	0.32	1.00			0.84			0.52	
Satd. Flow (perm)		1841	1568	576	1792			1410			984	
Peak-hour factor, PHF	0.93	0.93	0.93	0.88	0.88	0.88	0.86	0.86	0.86	0.25	0.25	0.25
Adj. Flow (vph)	5	683	81	74	364	1	151	6	151	4	0	0
RTOR Reduction (vph)	0	0	12	0	0	0	0	34	0	0	0	0
Lane Group Flow (vph)	0	688	69	74	365	0	0	274	0	0	4	0
Heavy Vehicles (%)	3%	3%	3%	6%	6%	6%	6%	6%	6%	0%	0%	0%
Turn Type	Perm		Perm	Perm			Perm			Perm		
Protected Phases		1			1			2			2	
Permitted Phases	1		1	1			2			2		
Actuated Green, G (s)		68.0	68.0	68.0	68.0			20.0			20.0	
Effective Green, g (s)		68.0	68.0	68.0	68.0			20.0			20.0	
Actuated g/C Ratio		0.68	0.68	0.68	0.68			0.20			0.20	
Clearance Time (s)		6.0	6.0	6.0	6.0			6.0			6.0	
Vehicle Extension (s)		3.0	3.0	3.0	3.0			3.0			3.0	
Lane Grp Cap (vph)		1252	1066	392	1219			282			197	
v/s Ratio Prot					0.20							
v/s Ratio Perm		c0.37	0.04	0.13				c0.19			0.00	
v/c Ratio		0.55	0.06	0.19	0.30			0.97			0.02	
Uniform Delay, d1		8.2	5.4	5.9	6.4			39.7			32.1	
Progression Factor		1.00	1.00	1.00	1.00			1.00			1.00	
Incremental Delay, d2		1.7	0.1	1.1	0.6			46.5			0.2	
Delay (s)		9.9	5.5	6.9	7.1			86.2			32.3	
Level of Service		A	A	A	A			F			C	
Approach Delay (s)		9.4			7.0			86.2			32.3	
Approach LOS		A			A			F			C	

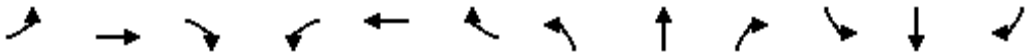
Intersection Summary			
HCM Average Control Delay	24.4	HCM Level of Service	C
HCM Volume to Capacity ratio	0.65		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	77.8%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT	ø9
Lane Configurations										
Volume (vph)	1	480	130	70	715	160	0	1	1	
Lane Group Flow (vph)	0	517	140	76	777	0	300	0	28	
Turn Type	Perm		Perm	Perm		Perm		Perm		
Protected Phases		1			1		2		2	9
Permitted Phases	1		1	1		2		2		
Detector Phase	1	1	1	1	1	2	2	2	2	
Switch Phase										
Minimum Initial (s)	6.0	6.0	6.0	6.0	6.0	5.0	5.0	5.0	5.0	14.0
Minimum Split (s)	12.0	12.0	12.0	12.0	12.0	11.0	11.0	11.0	11.0	21.0
Total Split (s)	56.0	56.0	56.0	56.0	56.0	26.0	26.0	26.0	26.0	21.0
Total Split (%)	54.4%	54.4%	54.4%	54.4%	54.4%	25.2%	25.2%	25.2%	25.2%	20%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	
Lead/Lag	Lead	Lead	Lead	Lead	Lead	Lag	Lag	Lag	Lag	
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Recall Mode	Max	Max	Max	Max	Max	C-Max	C-Max	C-Max	C-Max	None
v/c Ratio		0.40	0.12	0.14	0.60		1.03		0.08	
Control Delay		8.0	2.6	6.2	10.9		100.2		18.4	
Queue Delay		0.0	0.0	0.0	0.0		0.0		0.0	
Total Delay		8.0	2.6	6.2	10.9		100.2		18.4	
Queue Length 50th (ft)		129	10	15	239		~200		4	
Queue Length 95th (ft)		186	29	32	342		#304		0	
Internal Link Dist (ft)		203			196		261		78	
Turn Bay Length (ft)			90	100						
Base Capacity (vph)		1295	1129	554	1297		291		336	
Starvation Cap Reductn		0	0	0	0		0		0	
Spillback Cap Reductn		0	0	0	0		0		0	
Storage Cap Reductn		0	0	0	0		0		0	
Reduced v/c Ratio		0.40	0.12	0.14	0.60		1.03		0.08	

Intersection Summary
Cycle Length: 103
Actuated Cycle Length: 103
Offset: 56 (54%), Referenced to phase 2:NBSB, Start of Green
Natural Cycle: 90
Control Type: Actuated-Coordinated
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 4: Main Street (Route 9) & Town Hall



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	1	480	130	70	715	0	160	0	80	1	1	5
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0	6.0	6.0	6.0			6.0			6.0	
Lane Util. Factor		1.00	1.00	1.00	1.00			1.00			1.00	
Frt		1.00	0.85	1.00	1.00			0.95			0.90	
Flt Protected		1.00	1.00	0.95	1.00			0.97			0.99	
Satd. Flow (prot)		1881	1599	1787	1881			1739			1705	
Flt Permitted		1.00	1.00	0.43	1.00			0.78			0.96	
Satd. Flow (perm)		1880	1599	803	1881			1406			1644	
Peak-hour factor, PHF	0.93	0.93	0.93	0.92	0.92	0.92	0.80	0.80	0.80	0.25	0.25	0.25
Adj. Flow (vph)	1	516	140	76	777	0	200	0	100	4	4	20
RTOR Reduction (vph)	0	0	26	0	0	0	0	18	0	0	16	0
Lane Group Flow (vph)	0	517	114	76	777	0	0	282	0	0	12	0
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	1%	1%	1%	0%	0%	0%
Turn Type	Perm		Perm	Perm			Perm			Perm		
Protected Phases		1			1			2			2	
Permitted Phases	1		1	1			2			2		
Actuated Green, G (s)		71.0	71.0	71.0	71.0			20.0			20.0	
Effective Green, g (s)		71.0	71.0	71.0	71.0			20.0			20.0	
Actuated g/C Ratio		0.69	0.69	0.69	0.69			0.19			0.19	
Clearance Time (s)		6.0	6.0	6.0	6.0			6.0			6.0	
Vehicle Extension (s)		3.0	3.0	3.0	3.0			3.0			3.0	
Lane Grp Cap (vph)		1296	1102	554	1297			273			319	
v/s Ratio Prot					c0.41							
v/s Ratio Perm		0.28	0.07	0.09				c0.20			0.01	
v/c Ratio		0.40	0.10	0.14	0.60			1.03			0.04	
Uniform Delay, d1		6.9	5.4	5.5	8.5			41.5			33.7	
Progression Factor		1.00	1.00	1.00	1.00			1.00			1.00	
Incremental Delay, d2		0.9	0.2	0.5	2.1			63.6			0.2	
Delay (s)		7.8	5.5	6.0	10.5			105.1			33.9	
Level of Service		A	A	A	B			F			C	
Approach Delay (s)		7.3			10.1			105.1			33.9	
Approach LOS		A			B			F			C	

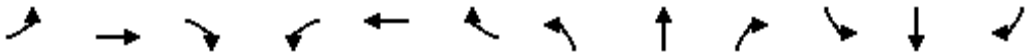
Intersection Summary			
HCM Average Control Delay	25.0	HCM Level of Service	C
HCM Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	103.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	88.6%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT	ø9
Lane Configurations										
Volume (vph)	5	685	80	70	345	140	5	1	0	
Lane Group Flow (vph)	0	750	87	76	376	0	309	0	1	
Turn Type	Perm		Perm	Perm		Perm		Perm		
Protected Phases		1			1		2		2	9
Permitted Phases	1		1	1		2		2		
Detector Phase	1	1	1	1	1	2	2	2	2	
Switch Phase										
Minimum Initial (s)	6.0	6.0	6.0	6.0	6.0	5.0	5.0	5.0	5.0	14.0
Minimum Split (s)	12.0	12.0	12.0	12.0	12.0	11.0	11.0	11.0	11.0	18.0
Total Split (s)	56.0	56.0	56.0	56.0	56.0	26.0	26.0	26.0	26.0	18.0
Total Split (%)	56.0%	56.0%	56.0%	56.0%	56.0%	26.0%	26.0%	26.0%	26.0%	18%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	
Lead/Lag	Lead	Lead	Lead	Lead	Lead	Lag	Lag	Lag	Lag	
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Recall Mode	Max	Max	Max	Max	Max	C-Max	C-Max	C-Max	C-Max	None
v/c Ratio		0.60	0.08	0.22	0.31		0.97		0.01	
Control Delay		11.1	3.5	7.9	7.3		79.6		32.0	
Queue Delay		1.0	0.0	0.0	0.0		0.0		0.0	
Total Delay		12.1	3.5	7.9	7.3		79.6		32.0	
Queue Length 50th (ft)		228	9	16	86		172		1	
Queue Length 95th (ft)		331	24	37	129		#346		5	
Internal Link Dist (ft)		203			196		261		78	
Turn Bay Length (ft)			90	100						
Base Capacity (vph)		1252	1078	349	1219		318		197	
Starvation Cap Reductn		254	0	0	0		0		0	
Spillback Cap Reductn		0	0	0	0		0		0	
Storage Cap Reductn		0	0	0	0		0		0	
Reduced v/c Ratio		0.75	0.08	0.22	0.31		0.97		0.01	

Intersection Summary
Cycle Length: 100
Actuated Cycle Length: 100
Offset: 56 (56%), Referenced to phase 2:NBSB, Start of Green
Natural Cycle: 90
Control Type: Actuated-Coordinated
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 4: Main Street (Route 9) & Town Hall



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	5	685	80	70	345	1	140	5	140	1	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0	6.0	6.0	6.0			6.0			6.0	
Lane Util. Factor		1.00	1.00	1.00	1.00			1.00			1.00	
Frt		1.00	0.85	1.00	1.00			0.93			1.00	
Flt Protected		1.00	1.00	0.95	1.00			0.98			0.95	
Satd. Flow (prot)		1844	1568	1703	1792			1633			1805	
Flt Permitted		1.00	1.00	0.29	1.00			0.84			0.52	
Satd. Flow (perm)		1841	1568	513	1792			1412			986	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	5	745	87	76	375	1	152	5	152	1	0	0
RTOR Reduction (vph)	0	0	12	0	0	0	0	35	0	0	0	0
Lane Group Flow (vph)	0	750	75	76	376	0	0	274	0	0	1	0
Heavy Vehicles (%)	3%	3%	3%	6%	6%	6%	6%	6%	6%	0%	0%	0%
Turn Type	Perm		Perm	Perm			Perm			Perm		
Protected Phases		1			1			2			2	
Permitted Phases	1		1	1			2			2		
Actuated Green, G (s)		68.0	68.0	68.0	68.0			20.0			20.0	
Effective Green, g (s)		68.0	68.0	68.0	68.0			20.0			20.0	
Actuated g/C Ratio		0.68	0.68	0.68	0.68			0.20			0.20	
Clearance Time (s)		6.0	6.0	6.0	6.0			6.0			6.0	
Vehicle Extension (s)		3.0	3.0	3.0	3.0			3.0			3.0	
Lane Grp Cap (vph)		1252	1066	349	1219			282			197	
v/s Ratio Prot					0.21							
v/s Ratio Perm		c0.41	0.05	0.15				c0.19			0.00	
v/c Ratio		0.60	0.07	0.22	0.31			0.97			0.01	
Uniform Delay, d1		8.6	5.4	6.0	6.5			39.7			32.0	
Progression Factor		1.00	1.00	1.00	1.00			1.00			1.00	
Incremental Delay, d2		2.1	0.1	1.4	0.7			46.7			0.0	
Delay (s)		10.8	5.5	7.4	7.1			86.4			32.1	
Level of Service		B	A	A	A			F			C	
Approach Delay (s)		10.2			7.2			86.4			32.1	
Approach LOS		B			A			F			C	

Intersection Summary			
HCM Average Control Delay	24.1	HCM Level of Service	C
HCM Volume to Capacity ratio	0.68		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	83.0%	ICU Level of Service	E
Analysis Period (min)	15		

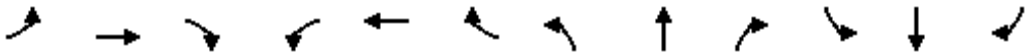
c Critical Lane Group

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT	ø9
Lane Configurations										
Volume (vph)	1	515	140	75	770	170	0	1	1	
Lane Group Flow (vph)	0	561	152	82	837	0	277	0	7	
Turn Type	Perm		Perm	Perm		Perm		Perm		
Protected Phases		1			1		2		2	9
Permitted Phases	1		1	1		2		2		
Detector Phase	1	1	1	1	1	2	2	2	2	
Switch Phase										
Minimum Initial (s)	6.0	6.0	6.0	6.0	6.0	5.0	5.0	5.0	5.0	14.0
Minimum Split (s)	12.0	12.0	12.0	12.0	12.0	11.0	11.0	11.0	11.0	21.0
Total Split (s)	56.0	56.0	56.0	56.0	56.0	26.0	26.0	26.0	26.0	21.0
Total Split (%)	54.4%	54.4%	54.4%	54.4%	54.4%	25.2%	25.2%	25.2%	25.2%	20%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	
Lead/Lag	Lead	Lead	Lead	Lead	Lead	Lag	Lag	Lag	Lag	
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Recall Mode	Max	Max	Max	Max	Max	C-Max	C-Max	C-Max	C-Max	None
v/c Ratio		0.43	0.13	0.16	0.65		0.94		0.02	
Control Delay		8.3	2.8	6.5	11.9		78.0		23.5	
Queue Delay		0.5	0.0	0.0	0.0		0.0		0.0	
Total Delay		8.9	2.8	6.5	11.9		78.0		23.5	
Queue Length 50th (ft)		145	13	17	272		168		1	
Queue Length 95th (ft)		207	32	35	391		#331		14	
Internal Link Dist (ft)		203			196		261		78	
Turn Bay Length (ft)			90	100						
Base Capacity (vph)		1295	1129	518	1297		295		326	
Starvation Cap Reductn		351	0	0	0		0		0	
Spillback Cap Reductn		0	0	0	0		0		0	
Storage Cap Reductn		0	0	0	0		0		0	
Reduced v/c Ratio		0.59	0.13	0.16	0.65		0.94		0.02	

Intersection Summary

Cycle Length: 103
Actuated Cycle Length: 103
Offset: 56 (54%), Referenced to phase 2:NBSB, Start of Green
Natural Cycle: 90
Control Type: Actuated-Coordinated
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

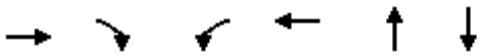
Splits and Phases: 4: Main Street (Route 9) & Town Hall



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	1	515	140	75	770	0	170	0	85	1	1	5
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0	6.0	6.0	6.0			6.0			6.0	
Lane Util. Factor		1.00	1.00	1.00	1.00			1.00			1.00	
Frt		1.00	0.85	1.00	1.00			0.96			0.90	
Flt Protected		1.00	1.00	0.95	1.00			0.97			0.99	
Satd. Flow (prot)		1881	1599	1787	1881			1739			1705	
Flt Permitted		1.00	1.00	0.40	1.00			0.80			0.97	
Satd. Flow (perm)		1880	1599	752	1881			1429			1658	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	1	560	152	82	837	0	185	0	92	1	1	5
RTOR Reduction (vph)	0	0	26	0	0	0	0	18	0	0	4	0
Lane Group Flow (vph)	0	561	126	82	837	0	0	259	0	0	3	0
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	1%	1%	1%	0%	0%	0%
Turn Type	Perm		Perm	Perm			Perm			Perm		
Protected Phases		1			1			2			2	
Permitted Phases	1		1	1			2			2		
Actuated Green, G (s)		71.0	71.0	71.0	71.0			20.0			20.0	
Effective Green, g (s)		71.0	71.0	71.0	71.0			20.0			20.0	
Actuated g/C Ratio		0.69	0.69	0.69	0.69			0.19			0.19	
Clearance Time (s)		6.0	6.0	6.0	6.0			6.0			6.0	
Vehicle Extension (s)		3.0	3.0	3.0	3.0			3.0			3.0	
Lane Grp Cap (vph)		1296	1102	518	1297			277			322	
v/s Ratio Prot					c0.44							
v/s Ratio Perm		0.30	0.08	0.11				c0.18			0.00	
v/c Ratio		0.43	0.11	0.16	0.65			0.94			0.01	
Uniform Delay, d1		7.1	5.4	5.6	9.0			40.9			33.5	
Progression Factor		1.00	1.00	1.00	1.00			1.00			1.00	
Incremental Delay, d2		1.1	0.2	0.7	2.5			39.9			0.1	
Delay (s)		8.1	5.6	6.2	11.4			80.7			33.6	
Level of Service		A	A	A	B			F			C	
Approach Delay (s)		7.6			11.0			80.7			33.6	
Approach LOS		A			B			F			C	

Intersection Summary			
HCM Average Control Delay	19.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.71		
Actuated Cycle Length (s)	103.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	93.6%	ICU Level of Service	F
Analysis Period (min)	15		

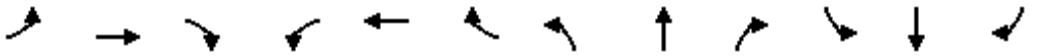
c Critical Lane Group



Lane Group	EBT	EBR	WBL	WBT	NBT	SBT
Lane Group Flow (vph)	760	92	76	381	309	1
v/c Ratio	0.67	0.06	0.34	0.35	0.76	0.01
Control Delay	12.5	0.3	16.8	11.1	39.9	39.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	12.5	0.3	16.8	11.1	39.9	39.0
Queue Length 50th (ft)	199	0	19	94	136	1
Queue Length 95th (ft)	#580	m3	70	207	#237	6
Internal Link Dist (ft)	203			196	261	78
Turn Bay Length (ft)		90	100			
Base Capacity (vph)	1130	1498	226	1100	416	221
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.67	0.06	0.34	0.35	0.74	0.00

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	5	695	85	70	350	1	140	5	140	1	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0	6.0	6.0	6.0			6.0			6.0	
Lane Util. Factor		1.00	1.00	1.00	1.00			1.00			1.00	
Frt		1.00	0.85	1.00	1.00			0.93			1.00	
Flt Protected		1.00	1.00	0.95	1.00			0.98			0.95	
Satd. Flow (prot)		1844	1568	1703	1792			1633			1805	
Flt Permitted		1.00	1.00	0.21	1.00			0.98			0.95	
Satd. Flow (perm)		1841	1568	368	1792			1633			1805	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	5	755	92	76	380	1	152	5	152	1	0	0
RTOR Reduction (vph)	0	0	13	0	0	0	0	37	0	0	0	0
Lane Group Flow (vph)	0	760	79	76	381	0	0	272	0	0	1	0
Heavy Vehicles (%)	3%	3%	3%	6%	6%	6%	6%	6%	6%	0%	0%	0%
Turn Type	Perm		pt+ov	Perm			Split			Split		
Protected Phases		6	6 3		2		3	3		4	4	
Permitted Phases	6			2								
Actuated Green, G (s)		50.4	76.8	50.4	50.4			20.4			1.2	
Effective Green, g (s)		50.4	76.8	50.4	50.4			20.4			1.2	
Actuated g/C Ratio		0.56	0.85	0.56	0.56			0.23			0.01	
Clearance Time (s)		6.0		6.0	6.0			6.0			6.0	
Vehicle Extension (s)		3.0		3.0	3.0			3.0			3.0	
Lane Grp Cap (vph)		1031	1338	206	1004			370			24	
v/s Ratio Prot			0.05		0.21			c0.17			c0.00	
v/s Ratio Perm		c0.41		0.21								
v/c Ratio		0.74	0.06	0.37	0.38			0.73			0.04	
Uniform Delay, d1		14.8	1.0	11.0	11.1			32.3			43.8	
Progression Factor		0.68	0.69	1.00	1.00			1.00			1.00	
Incremental Delay, d2		3.5	0.0	5.0	1.1			7.4			0.7	
Delay (s)		13.6	0.7	16.0	12.2			39.7			44.5	
Level of Service		B	A	B	B			D			D	
Approach Delay (s)		12.2			12.8			39.7			44.5	
Approach LOS		B			B			D			D	

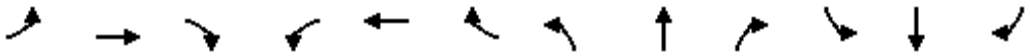
Intersection Summary			
HCM Average Control Delay	17.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.72		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	83.0%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBT	EBR	WBL	WBT	NBT	SBT
Lane Group Flow (vph)	572	152	87	848	282	7
v/c Ratio	0.45	0.14	0.17	0.66	0.93	0.02
Control Delay	8.7	2.8	6.8	12.5	74.6	22.5
Queue Delay	0.5	0.0	0.0	0.0	0.0	0.0
Total Delay	9.2	2.8	6.8	12.5	74.6	22.5
Queue Length 50th (ft)	149	12	18	279	165	1
Queue Length 95th (ft)	214	32	37	405	#326	13
Internal Link Dist (ft)	203			196	261	78
Turn Bay Length (ft)		90	100			
Base Capacity (vph)	1278	1115	499	1279	303	335
Starvation Cap Reductn	321	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.60	0.14	0.17	0.66	0.93	0.02

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	1	525	140	80	780	0	175	0	85	1	1	5
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0	6.0	6.0	6.0			6.0			6.0	
Lane Util. Factor		1.00	1.00	1.00	1.00			1.00			1.00	
Frt		1.00	0.85	1.00	1.00			0.96			0.90	
Flt Protected		1.00	1.00	0.95	1.00			0.97			0.99	
Satd. Flow (prot)		1881	1599	1787	1881			1740			1705	
Flt Permitted		1.00	1.00	0.39	1.00			0.79			0.96	
Satd. Flow (perm)		1880	1599	734	1881			1428			1653	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	1	571	152	87	848	0	190	0	92	1	1	5
RTOR Reduction (vph)	0	0	28	0	0	0	0	18	0	0	4	0
Lane Group Flow (vph)	0	572	124	87	848	0	0	264	0	0	3	0
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	1%	1%	1%	0%	0%	0%
Turn Type	Perm		Perm	Perm			Perm			Perm		
Protected Phases		1			1			2			2	
Permitted Phases	1		1	1			2			2		
Actuated Green, G (s)		68.0	68.0	68.0	68.0			20.0			20.0	
Effective Green, g (s)		68.0	68.0	68.0	68.0			20.0			20.0	
Actuated g/C Ratio		0.68	0.68	0.68	0.68			0.20			0.20	
Clearance Time (s)		6.0	6.0	6.0	6.0			6.0			6.0	
Vehicle Extension (s)		3.0	3.0	3.0	3.0			3.0			3.0	
Lane Grp Cap (vph)		1278	1087	499	1279			286			331	
v/s Ratio Prot					c0.45							
v/s Ratio Perm		0.30	0.08	0.12				c0.19			0.00	
v/c Ratio		0.45	0.11	0.17	0.66			0.92			0.01	
Uniform Delay, d1		7.4	5.5	5.8	9.3			39.3			32.1	
Progression Factor		1.00	1.00	1.00	1.00			1.00			1.00	
Incremental Delay, d2		1.1	0.2	0.8	2.7			36.9			0.0	
Delay (s)		8.5	5.8	6.6	12.0			76.2			32.1	
Level of Service		A	A	A	B			E			C	
Approach Delay (s)		7.9			11.5			76.2			32.1	
Approach LOS		A			B			E			C	

Intersection Summary			
HCM Average Control Delay	19.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.72		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	98.0%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Appendix C: Main Street (Route 9) at Pleasant Street & Wall Street

- Turning Movement Counts
- Automatic Traffic Recordings
- Crash Data
- Signal Warrant Analysis
- Intersection Capacity Analysis

Turning Movement Counts

Innovative Data, LLC

50 Alden Avenue
Belchertown, Massachusetts
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N / S: Pleasant & Wall
E / W: Main Street (Route 9)
City, State: Spencer, Massachusetts
Client: VHB / M. Chase

File Name : AM Peak - Main @ Pleasant & Wall
Site Code : 1
Start Date : 4/13/2011
Page No : 1

Groups Printed- PCs and Peds - HVs / Buses - Bicycles

	Pleasant Street From North					Main Street From East					Wall Street From South					Main Street From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right from Driveway	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
07:00 AM	5	0	51	0	56	21	57	2	0	80	0	0	7	0	7	0	112	9	0	121	264
07:15 AM	11	3	69	0	83	36	69	1	0	106	1	0	0	0	1	0	145	8	0	153	343
07:30 AM	10	0	57	0	67	26	74	0	0	100	1	0	5	0	6	1	136	5	0	142	315
07:45 AM	4	0	51	0	55	22	82	0	0	104	0	0	9	0	9	1	129	7	0	137	305
Total	30	3	228	0	261	105	282	3	0	390	2	0	21	0	23	2	522	29	0	553	1227
08:00 AM	8	0	58	0	66	17	74	5	0	96	1	0	4	0	5	0	155	4	0	159	326
08:15 AM	11	1	52	0	64	16	94	1	0	111	1	0	1	0	2	0	126	10	0	136	313
08:30 AM	5	0	38	0	43	26	68	6	0	100	1	0	8	0	9	0	107	8	0	115	267
08:45 AM	10	0	38	0	48	22	84	0	0	106	0	0	1	0	1	1	106	12	0	119	274
Total	34	1	186	0	221	81	320	12	0	413	3	0	14	0	17	1	494	34	0	529	1180
Grand Total	64	4	414	0	482	186	602	15	0	803	5	0	35	0	40	3	1016	63	0	1082	2407
Apprch %	13.3	0.8	85.9	0		23.2	75	1.9	0		12.5	0	87.5	0		0.3	93.9	5.8	0		
Total %	2.7	0.2	17.2	0	20	7.7	25	0.6	0	33.4	0.2	0	1.5	0	1.7	0.1	42.2	2.6	0	45	
PCs and Peds																					
% PCs and Peds	90.6	75	95.4	0	94.6	90.3	89.7	80	0	89.7	80	0	91.4	0	90	100	94.8	88.9	0	94.5	92.8
HVs / Buses																					
% HVs / Buses	9.4	25	4.6	0	5.4	9.7	10.3	20	0	10.3	20	0	8.6	0	10	0	5.2	11.1	0	5.5	7.2
Bicycles	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bicycles	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	Pleasant Street From North					Main Street From East					Wall Street From South					Main Street From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right from Driveway	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:15 AM																					
07:15 AM	**11**	**3**	**69**	0	**83**	**36**	69	1	0	**106**	**1**	0	0	0	1	0	145	**8**	0	153	**343**
07:30 AM	10	0	57	0	67	26	74	0	0	100	1	0	5	0	6	**1**	136	5	0	142	315
07:45 AM	4	0	51	0	55	22	**82**	0	0	104	0	0	**9**	0	**9**	1	129	7	0	137	305
08:00 AM	8	0	58	0	66	17	74	**5**	0	96	1	0	4	0	5	0	**155**	4	0	**159**	326
Total Volume	33	3	235	0	271	101	299	6	0	406	3	0	18	0	21	2	565	24	0	591	1289
% App. Total	12.2	1.1	86.7	0		24.9	73.6	1.5	0		14.3	0	85.7	0		0.3	95.6	4.1	0		
PHF	.750	.250	.851	.000	.816	.701	.912	.300	.000	.958	.750	.000	.500	.000	.583	.500	.911	.750	.000	.929	.940
PCs and Peds																					
% PCs and Peds	90.9	100	95.3	0	94.8	91.1	91.3	83.3	0	91.1	100	0	88.9	0	90.5	100	94.3	83.3	0	93.9	93.2
HVs / Buses																					
% HVs / Buses	9.1	0	4.7	0	5.2	8.9	8.7	16.7	0	8.9	0	0	11.1	0	9.5	0	5.7	16.7	0	6.1	6.8
Bicycles	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bicycles																					

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File Name : AM Peak - Main @ Pleasant & Wall
Site Code : 1
Start Date : 4/13/2011
Page No : 1

Groups Printed- HVs / Buses

	Pleasant Street From North					Main Street From East					Wall Street From South					Main Street From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right from Driveway	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
07:00 AM	2	0	2	0	4	2	3	0	0	5	0	0	0	0	0	0	7	0	0	7	16
07:15 AM	0	0	2	0	2	7	4	0	0	11	0	0	0	0	0	0	9	0	0	9	22
07:30 AM	1	0	2	0	3	1	8	0	0	9	0	0	0	0	0	0	8	1	0	9	21
07:45 AM	0	0	5	0	5	1	4	0	0	5	0	0	2	0	2	0	8	2	0	10	22
Total	3	0	11	0	14	11	19	0	0	30	0	0	2	0	2	0	32	3	0	35	81
08:00 AM	2	0	2	0	4	0	10	1	0	11	0	0	0	0	0	0	7	1	0	8	23
08:15 AM	1	1	2	0	4	1	15	0	0	16	1	0	0	0	1	0	3	1	0	4	25
08:30 AM	0	0	0	0	0	5	13	2	0	20	0	0	1	0	1	0	4	1	0	5	26
08:45 AM	0	0	4	0	4	1	5	0	0	6	0	0	0	0	0	0	7	1	0	8	18
Total	3	1	8	0	12	7	43	3	0	53	1	0	1	0	2	0	21	4	0	25	92
Grand Total	6	1	19	0	26	18	62	3	0	83	1	0	3	0	4	0	53	7	0	60	173
Apprch %	23.1	3.8	73.1	0		21.7	74.7	3.6	0		25	0	75	0		0	88.3	11.7	0		
Total %	3.5	0.6	11	0	15	10.4	35.8	1.7	0	48	0.6	0	1.7	0	2.3	0	30.6	4	0	34.7	

	Pleasant Street From North					Main Street From East					Wall Street From South					Main Street From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right from Driveway	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:45 AM																					
07:45 AM	0	0	**5**	0	**5**	1	4	0	0	5	0	0	**2**	0	**2**	0	**8**	**2**	0	**10**	22
08:00 AM	**2**	0	2	0	4	0	10	1	0	11	0	0	0	0	0	0	7	1	0	8	23
08:15 AM	1	**1**	2	0	4	1	**15**	0	0	16	**1**	0	0	0	1	0	3	1	0	4	25
08:30 AM	0	0	0	0	0	**5**	13	**2**	0	**20**	0	0	1	0	1	0	4	1	0	5	**26**
Total Volume	3	1	9	0	13	7	42	3	0	52	1	0	3	0	4	0	22	5	0	27	96
% App. Total	23.1	7.7	69.2	0		13.5	80.8	5.8	0		25	0	75	0		0	81.5	18.5	0		
PHF	.375	.250	.450	.000	.650	.350	.700	.375	.000	.650	.250	.000	.375	.000	.500	.000	.688	.625	.000	.675	.923

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File Name : PM Peak - Main @ Pleasant & Wall
Site Code : 1
Start Date : 4/13/2011
Page No : 1

Groups Printed- PCs and Peds - HVs / Buses - Bicycles

	Pleasant Street From North					Main Street From East					Wall Street From South					Main Street From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right from Driveway	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
04:00 PM	19	1	71	0	91	53	145	2	1	201	1	0	8	0	9	1	97	17	0	115	416
04:15 PM	18	1	35	0	54	59	126	0	0	185	1	0	11	0	12	2	101	10	0	113	364
04:30 PM	21	1	72	0	94	52	143	0	0	195	0	0	10	0	10	2	85	9	0	96	395
04:45 PM	21	1	57	0	79	45	130	0	0	175	1	0	8	0	9	0	110	10	0	120	383
Total	79	4	235	0	318	209	544	2	1	756	3	0	37	0	40	5	393	46	0	444	1558
05:00 PM	20	1	55	0	76	55	143	1	0	199	1	0	10	0	11	2	141	9	0	152	438
05:15 PM	24	0	61	0	85	39	145	0	0	184	2	0	9	0	11	3	116	9	0	128	408
05:30 PM	16	0	57	0	73	53	142	0	0	195	0	0	7	0	7	2	94	7	0	103	378
05:45 PM	15	0	38	0	53	46	145	1	0	192	0	0	3	0	3	0	74	13	0	87	335
Total	75	1	211	0	287	193	575	2	0	770	3	0	29	0	32	7	425	38	0	470	1559
Grand Total	154	5	446	0	605	402	1119	4	1	1526	6	0	66	0	72	12	818	84	0	914	3117
Apprch %	25.5	0.8	73.7	0		26.3	73.3	0.3	0.1		8.3	0	91.7	0		1.3	89.5	9.2	0		
Total %	4.9	0.2	14.3	0	19.4	12.9	35.9	0.1	0	49	0.2	0	2.1	0	2.3	0.4	26.2	2.7	0	29.3	
PCs and Peds							1095														
% PCs and Peds	98.7	100	98	0	98.2	97.8	97.9	100	100	97.8	100	0	100	0	100	91.7	96.9	98.8	0	97	97.7
HVs / Buses																					
% HVs / Buses	1.3	0	2	0	1.8	2.2	2.1	0	0	2.2	0	0	0	0	0	8.3	3.1	1.2	0	3	2.3
Bicycles	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bicycles	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	Pleasant Street From North					Main Street From East					Wall Street From South					Main Street From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right from Driveway	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:30 PM																					
04:30 PM	21	**1**	**72**	0	**94**	52	143	0	0	195	0	0	**10**	0	10	2	85	9	0	96	395
04:45 PM	21	1	57	0	79	45	130	0	0	175	1	0	8	0	9	0	110	**10**	0	120	383
05:00 PM	20	1	55	0	76	**55**	143	**1**	0	**199**	1	0	10	0	**11**	2	**141**	9	0	**152**	**438**
05:15 PM	**24**	0	61	0	85	39	**145**	0	0	184	**2**	0	9	0	11	**3**	116	9	0	128	408
Total Volume	86	3	245	0	334	191	561	1	0	753	4	0	37	0	41	7	452	37	0	496	1624
% App. Total	25.7	0.9	73.4	0		25.4	74.5	0.1	0		9.8	0	90.2	0		1.4	91.1	7.5	0		
PHF	.896	.750	.851	.000	.888	.868	.967	.250	.000	.946	.500	.000	.925	.000	.932	.583	.801	.925	.000	.816	.927
PCs and Peds																					
% PCs and Peds	98.8	100	98.8	0	98.8	98.4	98.6	100	0	98.5	100	0	100	0	100	85.7	98.2	100	0	98.2	98.5
HVs / Buses																					
% HVs / Buses	1.2	0	1.2	0	1.2	1.6	1.4	0	0	1.5	0	0	0	0	0	14.3	1.8	0	0	1.8	1.5
Bicycles	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bicycles																					

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Groups Printed- HVs / Buses

	Pleasant Street From North					Main Street From East					Wall Street From South					Main Street From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right from Driveway	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
04:00 PM	1	0	2	0	3	1	4	0	0	5	0	0	0	0	0	0	2	0	0	2	10
04:15 PM	0	0	2	0	2	3	6	0	0	9	0	0	0	0	0	0	6	1	0	7	18
04:30 PM	0	0	0	0	0	1	1	0	0	2	0	0	0	0	0	0	1	0	0	1	3
04:45 PM	1	0	3	0	4	1	2	0	0	3	0	0	0	0	0	0	3	0	0	3	10
Total	2	0	7	0	9	6	13	0	0	19	0	0	0	0	0	0	12	1	0	13	41
05:00 PM	0	0	0	0	0	0	2	0	0	2	0	0	0	0	0	0	3	0	0	3	5
05:15 PM	0	0	0	0	0	1	3	0	0	4	0	0	0	0	0	1	1	0	0	2	6
05:30 PM	0	0	1	0	1	2	3	0	0	5	0	0	0	0	0	0	6	0	0	6	12
05:45 PM	0	0	1	0	1	0	3	0	0	3	0	0	0	0	0	0	3	0	0	3	7
Total	0	0	2	0	2	3	11	0	0	14	0	0	0	0	0	1	13	0	0	14	30
Grand Total	2	0	9	0	11	9	24	0	0	33	0	0	0	0	0	1	25	1	0	27	71
Apprch %	18.2	0	81.8	0		27.3	72.7	0	0		0	0	0	0		3.7	92.6	3.7	0		
Total %	2.8	0	12.7	0	15.5	12.7	33.8	0	0	46.5	0	0	0	0	0	1.4	35.2	1.4	0	38	

	Pleasant Street From North					Main Street From East					Wall Street From South					Main Street From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right from Driveway	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:00 PM																					
04:00 PM	**1**	0	2	0	3	1	4	0	0	5	0	0	0	0	0	0	2	0	0	2	10
04:15 PM	0	0	2	0	2	**3**	**6**	0	0	**9**	0	0	0	0	0	0	**6**	**1**	0	**7**	**18**
04:30 PM	0	0	0	0	0	1	1	0	0	2	0	0	0	0	0	0	1	0	0	1	3
04:45 PM	1	0	**3**	0	**4**	1	2	0	0	3	0	0	0	0	0	0	3	0	0	3	10
Total Volume	2	0	7	0	9	6	13	0	0	19	0	0	0	0	0	0	12	1	0	13	41
% App. Total	22.2	0	77.8	0		31.6	68.4	0	0		0	0	0	0		0	92.3	7.7	0		
PHF	.500	.000	.583	.000	.563	.500	.542	.000	.000	.528	.000	.000	.000	.000	.000	.000	.500	.250	.000	.464	.569

Automatic Traffic Recordings

Innovative Data, L L C

50 Alden Avenue
Belchertown, MA 01007
413.668.5094 or www.datayourequested.com

Location: Wall Street
Location: S of Main
City, State: Spencer, Massachusetts
Client: VHB / M. Chase

Start Time	12-Apr-11 Tue	Southbound A.M.	Southbound P.M.	Northbound A.M.	Northbound P.M.	Combined A.M.	Combined P.M.	13-Apr- Wed	Southbound A.M.	Southbound P.M.	Northbound A.M.	Northbound P.M.	Combined A.M.	Combined P.M.
12:00		0	***5***	0	6	0	11		0	4	0	6	0	10
12:15		0	***4***	0	7	0	11		0	2	0	5	0	7
12:30		0	***4***	0	8	0	12		0	3	0	3	0	6
12:45		0	***4***	1	8	1	12		0	3	1	3	1	6
01:00		0	4	0	6	0	10		0	2	0	8	0	10
01:15		0	2	0	9	0	11		0	8	0	6	0	14
01:30		0	4	0	9	0	13		0	2	0	4	0	6
01:45		0	3	0	8	0	11		0	2	0	6	0	8
02:00		0	4	0	6	0	10		0	6	0	6	0	12
02:15		0	4	0	9	0	13		0	6	1	6	1	12
02:30		0	1	0	11	0	12		0	0	0	7	0	7
02:45		0	2	0	3	0	5		0	4	0	10	0	14
03:00		0	5	0	6	0	11		0	***4***	0	6	0	10
03:15		0	3	1	7	1	10		0	***4***	1	9	1	13
03:30		0	3	0	6	0	9		0	***4***	0	4	0	8
03:45		0	5	1	8	1	13		0	***7***	1	8	1	***15***
04:00		0	4	0	11	0	15		0	4	0	8	0	***12***
04:15		1	2	0	9	1	11		0	4	0	***12***	0	***16***
04:30		0	2	0	***11***	0	***13***		0	2	0	***9***	0	***11***
04:45		0	3	0	***12***	0	***15***		0	1	0	***8***	0	9
05:00		1	1	0	***13***	1	***14***		0	5	0	***12***	0	17
05:15		0	3	0	***13***	0	***16***		1	4	0	8	1	12
05:30		1	1	2	7	3	8		0	3	1	6	1	9
05:45		0	2	0	7	0	9		0	2	2	3	2	5
06:00		6	4	2	8	8	12		2	0	2	5	4	5
06:15		0	2	1	3	1	5		0	2	1	4	1	6
06:30		0	2	2	5	2	7		3	6	1	3	4	9
06:45		1	4	8	3	9	7		3	3	8	9	11	12
07:00		***5***	2	3	2	8	4		0	2	6	4	6	6
07:15		***3***	2	3	9	6	11		4	3	0	4	4	7
07:30		***3***	3	8	3	11	6		2	5	5	3	7	8
07:45		***3***	2	4	2	7	4		1	5	9	7	10	12
08:00		2	0	4	1	6	1		0	0	4	2	4	2
08:15		3	0	6	6	9	6		3	1	2	3	5	4
08:30		5	1	4	3	9	4		0	0	8	1	8	1
08:45		1	0	2	1	3	1		1	2	2	5	3	7
09:00		3	1	5	1	8	2		1	1	5	4	6	5
09:15		1	4	7	4	8	8		0	1	5	4	5	5
09:30		2	0	7	1	9	1		0	0	8	3	8	3
09:45		3	1	4	1	7	2		***2***	0	4	0	6	0
10:00		2	2	4	0	6	2		***2***	0	4	1	6	1
10:15		1	0	9	0	10	0		***6***	0	5	0	11	0
10:30		2	0	6	0	8	0		***6***	2	***6***	5	***12***	7
10:45		0	0	6	0	6	0		2	0	***5***	0	***7***	0
11:00		3	0	***6***	0	***9***	0		2	0	***9***	0	***11***	0
11:15		8	0	***4***	1	***12***	1		4	0	***8***	1	***12***	1
11:30		0	0	***14***	0	***14***	0		2	*	4	*	6	*
11:45		1	0	***13***	0	***14***	0		3	*	2	*	5	*
Total		61	105	137	254	198	359		50	119	120	231	170	350
Day Total		166		391		557			169		351		520	
% Total		11.0%	18.9%	24.6%	45.6%				9.6%	22.9%	23.1%	44.4%		
Peak		07:00	12:00	11:00	04:30	11:00	04:30		09:45	03:00	10:30	04:15	10:30	03:45
Vol.		14	17	37	49	49	58		16	19	28	41	42	54
P.H.F.		0.700	0.850	0.661	0.942	0.875	0.906		0.667	0.679	0.778	0.854	0.875	0.844

ADT	ADT 538	AADT 538

Innovative Data, L L C

50 Alden Avenue
Belchertown, MA 01007
413.668.5094 or www.datayourequested.com

Location: Main Street
Location: W of Pleasant
City, State: Spencer, Massachusetts
Client: VHB / M. Chase

Start Time	12-Apr-11 Tue	Westbound A.M.	Westbound P.M.	Eastbound A.M.	Eastbound P.M.	Combined A.M.	Combined P.M.	13-Apr- Wed	Westbound A.M.	Westbound P.M.	Eastbound A.M.	Eastbound P.M.	Combined A.M.	Combined P.M.
12:00		14	122	7	149	21	271		13	94	8	122	21	216
12:15		10	122	5	136	15	258		11	112	12	114	23	226
12:30		10	116	9	120	19	236		8	98	6	114	14	212
12:45		6	126	10	99	16	225		7	122	6	92	13	214
01:00		5	128	5	111	10	239		3	105	2	100	5	205
01:15		3	136	4	111	7	247		4	112	2	104	6	216
01:30		2	104	8	138	10	242		5	128	4	108	9	236
01:45		4	139	6	114	10	253		2	134	3	114	5	248
02:00		3	132	6	109	9	241		4	122	3	112	7	234
02:15		10	159	5	108	15	267		5	136	4	124	9	260
02:30		8	138	10	102	18	240		6	143	8	130	14	273
02:45		13	158	4	115	17	273		5	142	5	117	10	259
03:00		2	157	6	***142***	8	299		2	126	4	126	6	252
03:15		12	146	8	***122***	20	268		10	158	2	116	12	274
03:30		4	160	10	***142***	14	302		3	143	11	134	14	277
03:45		4	156	4	***138***	8	294		6	159	7	132	13	291
04:00		4	179	10	112	14	291		6	179	15	119	21	298
04:15		6	180	20	116	26	296		8	154	12	110	20	264
04:30		6	173	17	125	23	298		6	***182***	14	88	20	***270***
04:45		10	***164***	28	108	38	***272***		14	***164***	16	***130***	30	***294***
05:00		14	***218***	34	129	48	***347***		11	***178***	37	***152***	48	***330***
05:15		21	***178***	48	125	69	***303***		14	***192***	47	***127***	61	***319***
05:30		27	***184***	54	120	81	***304***		24	160	56	***108***	80	268
05:45		42	156	58	100	100	256		38	162	56	88	94	250
06:00		34	134	114	118	148	252		36	158	108	122	144	280
06:15		46	142	99	92	145	234		36	118	98	81	134	199
06:30		56	138	132	86	188	224		70	108	106	81	176	189
06:45		98	92	114	96	212	188		71	116	122	104	193	220
07:00		75	126	115	100	190	226		72	122	120	86	192	208
07:15		96	108	***184***	59	***280***	167		81	82	***157***	53	238	135
07:30		104	92	***164***	62	***268***	154		92	84	***140***	60	***232***	144
07:45		114	88	***140***	62	***254***	150		102	80	***145***	83	***247***	163
08:00		116	68	***140***	49	***256***	117		98	98	***150***	58	***248***	156
08:15		123	83	136	58	259	141		117	76	135	48	***252***	124
08:30		98	76	128	49	226	125		89	68	114	34	203	102
08:45		94	52	108	46	202	98		106	76	115	54	221	130
09:00		79	58	128	49	207	107		90	74	106	38	196	112
09:15		108	58	142	56	250	114		76	63	110	38	186	101
09:30		98	58	90	46	188	104		91	40	86	34	177	74
09:45		90	48	123	28	213	76		90	54	120	37	210	91
10:00		100	37	120	32	220	69		99	36	86	25	185	61
10:15		110	36	112	30	222	66		81	32	111	24	192	56
10:30		110	16	133	18	243	34		92	27	101	28	193	55
10:45		100	16	107	18	207	34		94	18	109	16	203	34
11:00		***112***	15	116	10	228	25		***108***	20	107	17	215	37
11:15		***124***	14	115	10	239	24		***120***	22	114	12	234	34
11:30		***122***	14	113	6	235	20		***129***	28	128	12	257	40
11:45		***132***	16	128	9	260	25		***103***	21	114	12	217	33
Total		2579	5216	3377	4080	5956	9296		2358	5026	3142	3938	5500	8964
Day Total		7795		7457		15252			7384		7080		14464	
% Total		16.9%	34.2%	22.1%	26.8%				16.3%	34.7%	21.7%	27.2%		
Peak		11:00	04:45	07:15	03:00	07:15	04:45		11:00	04:30	07:15	04:45	07:30	04:30
Vol.		490	744	628	544	1058	1226		460	716	592	517	979	1213
P.H.F.		0.928	0.853	0.853	0.958	0.945	0.883		0.891	0.932	0.943	0.850	0.971	0.919

ADT ADT 14,858 AADT 14,858

Innovative Data, L L C

50 Alden Avenue
Belchertown, MA 01007
413.668.5094 or www.datayourequested.com

Location: Pleasant Street
Location: N of Price Chopper
City, State: Spencer, Massachusetts
Client: VHB / M. Chase

Start Time	13-Apr-11 Wed	Southbound A.M.	Southbound P.M.	Northbound A.M.	Northbound P.M.	Combined A.M.	Combined P.M.	14-Apr- Thu	Southbound A.M.	Southbound P.M.	Northbound A.M.	Northbound P.M.	Combined A.M.	Combined P.M.
12:00		12	44	5	38	17	82		0	*	0	*	0	*
12:15		7	44	1	43	8	87		*	*	*	*	*	*
12:30		2	40	0	33	2	73		*	*	*	*	*	*
12:45		2	41	2	38	4	79		*	*	*	*	*	*
01:00		5	35	1	34	6	69		*	*	*	*	*	*
01:15		5	42	2	34	7	76		*	*	*	*	*	*
01:30		2	37	3	43	5	80		*	*	*	*	*	*
01:45		2	34	1	29	3	63		*	*	*	*	*	*
02:00		0	39	2	48	2	87		*	*	*	*	*	*
02:15		0	44	2	45	2	89		*	*	*	*	*	*
02:30		2	45	1	59	3	104		*	*	*	*	*	*
02:45		4	46	4	54	8	100		*	*	*	*	*	*
03:00		0	56	1	75	1	131		*	*	*	*	*	*
03:15		4	49	8	64	12	113		*	*	*	*	*	*
03:30		3	49	4	63	7	112		*	*	*	*	*	*
03:45		1	45	7	70	8	115		*	*	*	*	*	*
04:00		8	***61***	4	***74***	12	***135***		*	*	*	*	*	*
04:15		5	***55***	9	***84***	14	***139***		*	*	*	*	*	*
04:30		2	***65***	4	***75***	6	***140***		*	*	*	*	*	*
04:45		3	***64***	6	***74***	9	***138***		*	*	*	*	*	*
05:00		0	48	9	69	9	117		*	*	*	*	*	*
05:15		3	51	12	63	15	114		*	*	*	*	*	*
05:30		3	42	29	71	32	113		*	*	*	*	*	*
05:45		7	46	30	57	37	103		*	*	*	*	*	*
06:00		39	43	8	79	47	122		*	*	*	*	*	*
06:15		39	35	11	81	50	116		*	*	*	*	*	*
06:30		44	42	21	67	65	109		*	*	*	*	*	*
06:45		52	33	17	45	69	78		*	*	*	*	*	*
07:00		***72***	28	29	48	***101***	76		*	*	*	*	*	*
07:15		***69***	27	42	35	***111***	62		*	*	*	*	*	*
07:30		***55***	23	31	40	***86***	63		*	*	*	*	*	*
07:45		***56***	20	31	55	***87***	75		*	*	*	*	*	*
08:00		70	28	20	28	90	56		*	*	*	*	*	*
08:15		50	27	33	27	83	54		*	*	*	*	*	*
08:30		38	12	31	46	69	58		*	*	*	*	*	*
08:45		44	19	21	40	65	59		*	*	*	*	*	*
09:00		38	19	20	24	58	43		*	*	*	*	*	*
09:15		35	19	41	17	76	36		*	*	*	*	*	*
09:30		37	22	26	24	63	46		*	*	*	*	*	*
09:45		53	25	36	16	89	41		*	*	*	*	*	*
10:00		28	11	23	11	51	22		*	*	*	*	*	*
10:15		41	12	22	11	63	23		*	*	*	*	*	*
10:30		38	5	31	11	69	16		*	*	*	*	*	*
10:45		36	5	***33***	11	69	16		*	*	*	*	*	*
11:00		50	5	***32***	5	82	10		*	*	*	*	*	*
11:15		33	6	***36***	11	69	17		*	*	*	*	*	*
11:30		40	4	***36***	4	76	8		*	*	*	*	*	*
11:45		39	1	32	3	71	4		*	*	*	*	*	*
Total		1178	1593	810	2076	1988	3669		0	0	0	0	0	0
Day Total		2771		2886		5657			0		0		0	
% Total		20.8%	28.2%	14.3%	36.7%				0.0%	0.0%	0.0%	0.0%		
Peak		07:00	04:00	10:45	04:00	07:00	04:00							
Vol.		252	245	137	307	385	552							
P.H.F.		0.875	0.942	0.815	0.914	0.867	0.986							

ADT	ADT 5,657	AADT 5,657

Innovative Data, L L C

50 Alden Avenue
Belchertown, MA 01007
413.668.5094 or www.datayourequested.com

Location: Pleasant Street
Location: N of Price Chopper
City, State: Spencer, Massachusetts
Client: VHB / M. Chase

Start Time	Tue 12-Apr-11 A.M.	P.M.	Wed 13-Apr-11 A.M.	P.M.	Thu 14-Apr-11 A.M.	P.M.	Daily Average A.M.	P.M.
12:00	5	72	14	80	*	*	10	76
12:15	8	84	8	85	*	*	8	84
12:30	0	74	3	70	*	*	2	72
12:45	4	89	4	78	*	*	4	84
01:00	3	66	4	68	*	*	4	67
01:15	3	76	5	80	*	*	4	78
01:30	2	80	3	80	*	*	2	80
01:45	4	97	3	60	*	*	4	78
02:00	1	81	2	86	*	*	2	84
02:15	1	114	2	92	*	*	2	103
02:30	8	108	3	103	*	*	6	106
02:45	4	109	8	100	*	*	6	104
03:00	6	108	1	128	*	*	4	118
03:15	6	116	12	112	*	*	9	114
03:30	1	130	7	110	*	*	4	120
03:45	4	130	8	117	*	*	6	124
04:00	4	124	11	**136**	*	*	8	**130**
04:15	8	**140**	14	**128**	*	*	11	**134**
04:30	10	**148**	6	**138**	*	*	8	**143**
04:45	10	**128**	8	**137**	*	*	9	**132**
05:00	14	**134**	9	116	*	*	12	125
05:15	18	134	15	114	*	*	16	124
05:30	38	128	31	113	*	*	34	120
05:45	40	109	35	102	*	*	38	106
06:00	52	129	46	120	*	*	49	124
06:15	54	104	50	112	*	*	52	108
06:30	71	122	66	107	*	*	68	114
06:45	86	97	68	78	*	*	77	88
07:00	**94**	112	**101**	74	*	*	**98**	93
07:15	**110**	92	**112**	62	*	*	**111**	77
07:30	**124**	59	**85**	59	*	*	**104**	59
07:45	**115**	72	**87**	71	*	*	**101**	72
08:00	84	60	91	54	*	*	88	57
08:15	100	53	82	54	*	*	91	54
08:30	68	63	69	56	*	*	68	60
08:45	71	50	66	58	*	*	68	54
09:00	80	53	58	42	*	*	69	48
09:15	82	51	70	36	*	*	76	44
09:30	62	35	62	44	*	*	62	40
09:45	60	34	86	42	*	*	73	38
10:00	69	26	46	22	*	*	58	24
10:15	78	18	60	23	*	*	69	20
10:30	86	19	67	16	*	*	76	18
10:45	84	18	66	16	*	*	75	17
11:00	68	12	82	10	*	*	75	11
11:15	77	16	68	17	*	*	72	16
11:30	112	14	71	8	*	*	92	11
11:45	73	13	70	4	*	*	72	8
Total	2162	3901	1945	3618	0	0	2057	3761
Combined Total	6063		5563		0		5818	
Peak	07:00	04:15	07:00	04:00			07:00	04:00
Vol.	443	550	385	539			414	539
P.H.F.	0.893	0.929	0.859	0.976			0.932	0.942

ADT ADT 5,813 AADT 5,813

Innovative Data, L L C

50 Alden Avenue
Belchertown, MA 01007
413.668.5094 or www.datayourequested.com

Location: Pleasant Street
Location: N of Price Chopper
City, State: Spencer, Massachusetts
Client: VHB / M. Chase

Southbound

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Not Classed	Total
4/13/11	2	20	0	0	0	0	0	0	0	0	0	0	0	1	23
01:00	2	11	1	0	0	0	0	0	0	0	0	0	0	0	14
02:00	3	3	0	0	0	0	0	0	0	0	0	0	0	0	6
03:00	3	2	2	0	0	0	0	0	0	0	0	0	0	1	8
04:00	0	0	8	7	2	0	0	0	0	0	0	0	0	1	18
05:00	0	1	3	7	2	0	0	0	0	0	0	0	0	0	13
06:00	0	81	51	1	39	1	0	1	0	0	0	0	0	0	174
07:00	1	122	83	5	38	0	0	3	0	0	0	0	0	0	252
08:00	0	102	72	2	25	0	0	1	0	0	0	0	0	0	202
09:00	0	106	46	1	10	0	0	0	0	0	0	0	0	0	163
10:00	0	90	43	0	10	0	0	0	0	0	0	0	0	0	143
11:00	0	109	36	0	15	0	0	1	1	0	0	0	0	0	162
12 PM	0	98	45	2	21	1	0	1	0	0	0	0	0	1	169
13:00	0	81	42	0	22	1	0	2	0	0	0	0	0	0	148
14:00	2	82	65	2	22	0	0	1	0	0	0	0	0	0	174
15:00	2	95	67	2	32	0	0	0	0	0	0	0	0	1	199
16:00	0	137	77	0	26	1	0	2	0	0	0	0	0	2	245
17:00	0	86	80	0	18	1	0	1	0	0	0	0	0	1	187
18:00	1	89	46	0	16	0	0	0	0	0	0	0	0	1	153
19:00	0	51	38	0	8	1	0	0	0	0	0	0	0	0	98
20:00	0	40	36	0	9	1	0	0	0	0	0	0	0	0	86
21:00	0	42	34	0	7	0	0	1	0	0	0	0	0	1	85
22:00	0	19	13	0	1	0	0	0	0	0	0	0	0	0	33
23:00	0	10	6	0	0	0	0	0	0	0	0	0	0	0	16
Total	16	1477	894	29	323	7	0	14	1	0	0	0	0	10	2771
Percent	0.6%	53.3%	32.3%	1.0%	11.7%	0.3%	0.0%	0.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.4%	
AM Peak	02:00	07:00	07:00	04:00	06:00	06:00		07:00	11:00					00:00	
Vol.	3	122	83	7	39	1		3	1					1	
PM Peak	14:00	16:00	17:00	12:00	15:00	12:00		13:00						16:00	
Vol.	2	137	80	2	32	1		2						2	
Grand Total	16	1477	894	29	323	7	0	14	1	0	0	0	0	10	2771
Percent	0.6%	53.3%	32.3%	1.0%	11.7%	0.3%	0.0%	0.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.4%	

Innovative Data, L L C

50 Alden Avenue
Belchertown, MA 01007
413.668.5094 or www.datayourequested.com

Location: Pleasant Street
Location: N of Price Chopper
City, State: Spencer, Massachusetts
Client: VHB / M. Chase

Northbound

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Not Classed	Total
4/13/11	1	4	0	2	1	0	0	0	0	0	0	0	0	0	8
01:00	1	5	0	1	0	0	0	0	0	0	0	0	0	0	7
02:00	0	8	0	1	0	0	0	0	0	0	0	0	0	0	9
03:00	6	5	7	1	1	0	0	0	0	0	0	0	0	0	20
04:00	0	0	5	10	8	0	0	0	0	0	0	0	0	0	23
05:00	0	0	0	79	1	0	0	0	0	0	0	0	0	0	80
06:00	2	19	24	0	12	0	0	0	0	0	0	0	0	0	57
07:00	2	57	52	3	19	0	0	0	0	0	0	0	0	0	133
08:00	1	31	50	0	20	0	0	2	0	0	0	0	0	1	105
09:00	0	58	48	0	12	0	0	0	1	0	0	0	0	4	123
10:00	3	60	31	0	13	1	0	0	0	0	0	0	0	1	109
11:00	1	61	47	0	22	1	0	0	0	0	0	0	0	4	136
12 PM	3	64	58	1	23	0	1	0	0	0	0	0	0	2	152
13:00	2	57	53	1	25	0	0	1	0	0	0	0	0	1	140
14:00	1	67	102	2	32	0	0	1	0	0	0	0	0	1	206
15:00	4	104	119	1	42	0	0	1	0	0	0	0	0	1	272
16:00	6	119	124	0	45	2	0	0	0	0	0	0	0	11	307
17:00	2	97	124	0	33	0	0	0	0	0	0	0	0	4	260
18:00	2	92	128	1	41	1	0	0	0	0	0	0	0	7	272
19:00	4	61	94	0	14	0	0	0	0	0	0	0	0	5	178
20:00	1	52	65	0	21	0	0	1	0	0	0	0	0	1	141
21:00	1	40	30	0	8	0	0	0	0	0	0	0	0	2	81
22:00	1	22	18	0	3	0	0	0	0	0	0	0	0	0	44
23:00	0	14	6	0	2	0	0	0	0	0	0	0	0	1	23
Total	44	1097	1185	103	398	5	1	6	1	0	0	0	0	46	2886
Percent	1.5%	38.0%	41.1%	3.6%	13.8%	0.2%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	1.6%	
AM Peak	03:00	11:00	07:00	05:00	11:00	10:00		08:00	09:00					09:00	
Vol.	6	61	52	79	22	1		2	1					4	
PM Peak	16:00	16:00	18:00	14:00	16:00	16:00	12:00	13:00						16:00	
Vol.	6	119	128	2	45	2	1	1						11	
Grand Total	44	1097	1185	103	398	5	1	6	1	0	0	0	0	46	2886
Percent	1.5%	38.0%	41.1%	3.6%	13.8%	0.2%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	1.6%	

Innovative Data, L L C

50 Alden Avenue
Belchertown, MA 01007
413.668.5094 or www.datayourequested.com

Location: Pleasant Street
Location: N of Price Chopper
City, State: Spencer, Massachusetts
Client: VHB / M. Chase

Southbound, Northbound

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Not Classed	Total
4/13/11	3	24	0	2	1	0	0	0	0	0	0	0	0	1	31
01:00	3	16	1	1	0	0	0	0	0	0	0	0	0	0	21
02:00	3	11	0	1	0	0	0	0	0	0	0	0	0	0	15
03:00	9	7	9	1	1	0	0	0	0	0	0	0	0	1	28
04:00	0	0	13	17	10	0	0	0	0	0	0	0	0	1	41
05:00	0	1	3	86	3	0	0	0	0	0	0	0	0	0	93
06:00	2	100	75	1	51	1	0	1	0	0	0	0	0	0	231
07:00	3	179	135	8	57	0	0	3	0	0	0	0	0	0	385
08:00	1	133	122	2	45	0	0	3	0	0	0	0	0	1	307
09:00	0	164	94	1	22	0	0	0	1	0	0	0	0	4	286
10:00	3	150	74	0	23	1	0	0	0	0	0	0	0	1	252
11:00	1	170	83	0	37	1	0	1	1	0	0	0	0	4	298
12 PM	3	162	103	3	44	1	1	1	0	0	0	0	0	3	321
13:00	2	138	95	1	47	1	0	3	0	0	0	0	0	1	288
14:00	3	149	167	4	54	0	0	2	0	0	0	0	0	1	380
15:00	6	199	186	3	74	0	0	1	0	0	0	0	0	2	471
16:00	6	256	201	0	71	3	0	2	0	0	0	0	0	13	552
17:00	2	183	204	0	51	1	0	1	0	0	0	0	0	5	447
18:00	3	181	174	1	57	1	0	0	0	0	0	0	0	8	425
19:00	4	112	132	0	22	1	0	0	0	0	0	0	0	5	276
20:00	1	92	101	0	30	1	0	1	0	0	0	0	0	1	227
21:00	1	82	64	0	15	0	0	1	0	0	0	0	0	3	166
22:00	1	41	31	0	4	0	0	0	0	0	0	0	0	0	77
23:00	0	24	12	0	2	0	0	0	0	0	0	0	0	1	39
Total	60	2574	2079	132	721	12	1	20	2	0	0	0	0	56	5657
Percent	1.1%	45.5%	36.8%	2.3%	12.7%	0.2%	0.0%	0.4%	0.0%	0.0%	0.0%	0.0%	0.0%	1.0%	
AM Peak	03:00	07:00	07:00	05:00	07:00	06:00		07:00	09:00					09:00	
Vol.	9	179	135	86	57	1		3	1					4	
PM Peak	15:00	16:00	17:00	14:00	15:00	16:00	12:00	13:00						16:00	
Vol.	6	256	204	4	74	3	1	3						13	
Grand Total	60	2574	2079	132	721	12	1	20	2	0	0	0	0	56	5657
Percent	1.1%	45.5%	36.8%	2.3%	12.7%	0.2%	0.0%	0.4%	0.0%	0.0%	0.0%	0.0%	0.0%	1.0%	

Innovative Data, L L C

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Location: Pleasant Street
Location: N of Price Chopper
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Client: VHB / M. Chase

Southbound

Start Time	1 15	16 20	21 25	26 30	31 35	36 40	41 45	46 50	51 55	56 60	61 65	66 70	71 75	76 999	Total	85th Percent	95th Percent
4/13/11	0	0	0	3	1	0	0	**6**	1	**3**	2	**3**	0	4	23	76	78
01:00	0	0	1	3	1	0	2	1	2	0	**4**	0	0	0	14	62	63
02:00	0	0	0	1	0	1	0	3	1	0	0	0	0	0	6	48	51
03:00	0	0	1	1	3	0	0	1	2	0	0	0	0	0	8	51	52
04:00	0	0	0	0	1	2	3	0	**4**	0	0	2	**2**	4	18	76	78
05:00	0	0	1	0	2	2	1	0	0	0	0	0	0	**7**	13	80	81
06:00	1	1	6	53	84	**28**	1	0	0	0	0	0	0	0	174	36	39
07:00	**14**	**18**	**28**	**79**	**85**	26	2	0	0	0	0	0	0	0	**252**	35	38
08:00	1	6	17	64	85	25	**4**	0	0	0	0	0	0	0	202	35	39
09:00	0	1	13	68	68	11	2	0	0	0	0	0	0	0	163	35	37
10:00	0	3	22	56	46	14	2	0	0	0	0	0	0	0	143	35	38
11:00	0	9	19	54	63	16	1	0	0	0	0	0	0	0	162	35	38
12 PM	0	5	14	49	82	17	2	0	0	0	0	0	0	0	169	35	38
13:00	1	2	15	46	62	20	2	0	0	0	0	0	0	0	148	35	39
14:00	3	1	22	60	68	20	0	0	0	0	0	0	0	0	174	35	38
15:00	4	4	22	78	72	19	0	0	0	0	0	0	0	0	199	35	38
16:00	**5**	4	**31**	**93**	**92**	20	0	0	0	0	0	0	0	0	**245**	35	37
17:00	5	**11**	15	56	76	**22**	2	0	0	0	0	0	0	0	187	35	39
18:00	4	6	12	53	61	15	2	0	0	0	0	0	0	0	153	35	38
19:00	1	0	8	34	41	11	2	0	**1**	0	0	0	0	0	98	35	39
20:00	0	3	6	19	45	13	0	0	0	0	0	0	0	0	86	35	38
21:00	3	0	7	23	35	14	3	0	0	0	0	0	0	0	85	37	40
22:00	0	0	3	5	18	4	2	**1**	0	0	0	0	0	0	33	37	41
23:00	0	0	0	4	8	0	**4**	0	0	0	0	0	0	0	16	42	43
Total	42	74	263	902	1099	300	37	12	11	3	6	5	2	15	2771		
Percent	1.5%	2.7%	9.5%	32.6%	39.7%	10.8%	1.3%	0.4%	0.4%	0.1%	0.2%	0.2%	0.1%	0.5%			
AM Peak	07:00	07:00	07:00	07:00	07:00	06:00	08:00	00:00	04:00	00:00	01:00	00:00	04:00	05:00	07:00		
Vol.	14	18	28	79	85	28	4	6	4	3	4	3	2	7	252		
PM Peak	16:00	17:00	16:00	16:00	16:00	17:00	23:00	22:00	19:00						16:00		
Vol.	5	11	31	93	92	22	4	1	1						245		
Grand Total	42	74	263	902	1099	300	37	12	11	3	6	5	2	15	2771		
Percent	1.5%	2.7%	9.5%	32.6%	39.7%	10.8%	1.3%	0.4%	0.4%	0.1%	0.2%	0.2%	0.1%	0.5%			

15th Percentile :	26 MPH
50th Percentile :	31 MPH
85th Percentile :	35 MPH
95th Percentile :	40 MPH

Statistics

10 MPH Pace Speed :	26-35 MPH
Number in Pace :	2001
Percent in Pace :	72.2%
Number of Vehicles > 35 MPH :	391
Percent of Vehicles > 35 MPH :	14.1%
Mean Speed(Average) :	31 MPH

Innovative Data, L L C

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Location: Pleasant Street
Location: N of Price Chopper
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Client: VHB / M. Chase

Northbound

Start Time	1 15	16 20	21 25	26 30	31 35	36 40	41 45	46 50	51 55	56 60	61 65	66 70	71 75	76 999	Total	85th Percent	95th Percent
4/13/11	0	0	0	0	1	0	0	1	1	2	0	0	0	3	8	77	78
01:00	0	0	1	0	0	0	1	0	3	1	0	0	0	1	7	56	76
02:00	0	0	0	0	0	0	1	**4**	3	0	0	0	0	1	9	53	76
03:00	1	1	2	2	2	2	3	0	2	**4**	0	0	0	1	20	57	59
04:00	0	0	0	0	2	1	2	1	**4**	4	**1**	**2**	**2**	4	23	76	78
05:00	0	0	0	0	1	0	0	0	0	0	0	0	0	**79**	80	138	146
06:00	0	1	6	18	19	12	0	1	0	0	0	0	0	0	57	37	39
07:00	1	**5**	9	27	**67**	22	2	0	0	0	0	0	0	0	133	36	39
08:00	**2**	3	10	28	40	20	2	0	0	0	0	0	0	0	105	37	40
09:00	0	0	12	41	48	19	2	1	0	0	0	0	0	0	123	36	39
10:00	0	0	**15**	42	31	15	4	2	0	0	0	0	0	0	109	37	41
11:00	1	2	12	**45**	44	**26**	**6**	0	0	0	0	0	0	0	**136**	38	40
12 PM	0	5	27	38	49	29	3	**1**	0	0	0	0	0	0	152	37	40
13:00	0	4	18	46	56	10	6	0	0	0	0	0	0	0	140	35	40
14:00	1	3	19	59	97	21	5	1	0	0	0	0	0	0	206	35	39
15:00	**7**	2	**33**	87	109	28	6	0	0	0	0	0	0	0	272	35	39
16:00	1	**9**	24	**120**	**126**	25	2	0	0	0	0	0	0	0	**307**	35	38
17:00	0	2	30	77	106	**38**	**7**	0	0	0	0	0	0	0	260	36	40
18:00	1	2	15	98	118	33	5	0	0	0	0	0	0	0	272	35	39
19:00	0	2	13	58	87	15	3	0	0	0	0	0	0	0	178	35	38
20:00	0	0	4	38	71	20	7	1	0	0	0	0	0	0	141	37	41
21:00	2	0	4	26	40	8	1	0	0	0	0	0	0	0	81	35	38
22:00	1	1	1	13	16	11	1	0	0	0	0	0	0	0	44	37	40
23:00	0	0	1	5	8	7	2	0	0	0	0	0	0	0	23	39	41
Total	18	42	256	868	1138	362	71	13	13	11	1	2	2	89	2886		
Percent	0.6%	1.5%	8.9%	30.1%	39.4%	12.5%	2.5%	0.5%	0.5%	0.4%	0.0%	0.1%	0.1%	3.1%			
AM Peak	08:00	07:00	10:00	11:00	07:00	11:00	11:00	02:00	04:00	03:00	04:00	04:00	04:00	05:00	11:00		
Vol.	2	5	15	45	67	26	6	4	4	4	1	2	2	79	136		
PM Peak	15:00	16:00	15:00	16:00	16:00	17:00	17:00	12:00							16:00		
Vol.	7	9	33	120	126	38	7	1							307		
Grand Total	18	42	256	868	1138	362	71	13	13	11	1	2	2	89	2886		
Percent	0.6%	1.5%	8.9%	30.1%	39.4%	12.5%	2.5%	0.5%	0.5%	0.4%	0.0%	0.1%	0.1%	3.1%			

15th Percentile :	26 MPH
50th Percentile :	32 MPH
85th Percentile :	37 MPH
95th Percentile :	45 MPH

Statistics

10 MPH Pace Speed :	26-35 MPH
Number in Pace :	2006
Percent in Pace :	69.5%
Number of Vehicles > 35 MPH :	564
Percent of Vehicles > 35 MPH :	19.5%
Mean Speed(Average) :	34 MPH

Innovative Data, L L C

50 Alden Avenue
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Location: Pleasant Street
Location: N of Price Chopper
City, State: Spencer, Massachusetts
Client: VHB / M. Chase

Southbound, Northbound

Start Time	1 15	16 20	21 25	26 30	31 35	36 40	41 45	46 50	51 55	56 60	61 65	66 70	71 75	76 999	Total	85th Percent	95th Percent
4/13/11	0	0	0	3	2	0	0	**7**	2	**5**	2	3	0	7	31	77	80
01:00	0	0	2	3	1	0	3	1	5	1	**4**	0	0	1	21	62	64
02:00	0	0	0	1	0	1	1	7	4	0	0	0	0	1	15	53	54
03:00	1	1	3	3	5	2	3	1	4	4	0	0	0	1	28	56	59
04:00	0	0	0	0	3	3	5	1	**8**	4	1	**4**	**4**	8	41	77	81
05:00	0	0	1	0	3	2	1	0	0	0	0	0	0	**86**	93	136	145
06:00	1	2	12	71	103	40	1	1	0	0	0	0	0	0	231	36	39
07:00	**15**	**23**	**37**	106	**152**	**48**	4	0	0	0	0	0	0	0	**385**	35	39
08:00	3	9	27	92	125	45	6	0	0	0	0	0	0	0	307	36	39
09:00	0	1	25	**109**	116	30	4	1	0	0	0	0	0	0	286	35	39
10:00	0	3	37	98	77	29	6	2	0	0	0	0	0	0	252	35	39
11:00	1	11	31	99	107	42	**7**	0	0	0	0	0	0	0	298	36	39
12 PM	0	10	41	87	131	46	5	**1**	0	0	0	0	0	0	321	36	39
13:00	1	6	33	92	118	30	8	0	0	0	0	0	0	0	288	35	39
14:00	4	4	41	119	165	41	5	1	0	0	0	0	0	0	380	35	39
15:00	**11**	6	**55**	165	181	47	6	0	0	0	0	0	0	0	471	35	38
16:00	6	**13**	55	**213**	**218**	45	2	0	0	0	0	0	0	0	**552**	35	38
17:00	5	13	45	133	182	**60**	**9**	0	0	0	0	0	0	0	447	36	39
18:00	5	8	27	151	179	48	7	0	0	0	0	0	0	0	425	35	39
19:00	1	2	21	92	128	26	5	0	**1**	0	0	0	0	0	276	35	39
20:00	0	3	10	57	116	33	7	1	0	0	0	0	0	0	227	36	40
21:00	5	0	11	49	75	22	4	0	0	0	0	0	0	0	166	36	39
22:00	1	1	4	18	34	15	3	1	0	0	0	0	0	0	77	38	40
23:00	0	0	1	9	16	7	6	0	0	0	0	0	0	0	39	40	43
Total	60	116	519	1770	2237	662	108	25	24	14	7	7	4	104	5657		
Percent	1.1%	2.1%	9.2%	31.3%	39.5%	11.7%	1.9%	0.4%	0.4%	0.2%	0.1%	0.1%	0.1%	1.8%			
AM Peak	07:00	07:00	07:00	09:00	07:00	07:00	11:00	00:00	04:00	00:00	01:00	04:00	04:00	05:00	07:00		
Vol.	15	23	37	109	152	48	7	7	8	5	4	4	4	86	385		
PM Peak	15:00	16:00	15:00	16:00	16:00	17:00	17:00	12:00	19:00						16:00		
Vol.	11	13	55	213	218	60	9	1	1						552		
Grand Total	60	116	519	1770	2237	662	108	25	24	14	7	7	4	104	5657		
Percent	1.1%	2.1%	9.2%	31.3%	39.5%	11.7%	1.9%	0.4%	0.4%	0.2%	0.1%	0.1%	0.1%	1.8%			

15th Percentile :	26 MPH
50th Percentile :	31 MPH
85th Percentile :	36 MPH
95th Percentile :	41 MPH

Statistics

10 MPH Pace Speed :	26-35 MPH
Number in Pace :	4007
Percent in Pace :	70.8%
Number of Vehicles > 35 MPH :	955
Percent of Vehicles > 35 MPH :	16.9%
Mean Speed(Average) :	33 MPH

Crash Data

INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : Spencer COUNT DATE :

DISTRICT : 3 UNSIGNALIZED : SIGNALIZED : X

~ INTERSECTION DATA ~

MAJOR STREET : Main Street

MINOR STREET(S) : Pleasant Street / Wall Street

INTERSECTION DIAGRAM (Label Approaches)

PEAK HOUR VOLUMES

APPROACH :	1	2	3	4	5	Total Peak Hourly Approach Volume
DIRECTION :	EB	WB	NB	SB		
PEAK HOURLY VOLUMES (AM/PM) :	496	753	41	334		**1,624**

" K " FACTOR : **0.066** INTERSECTION ADT (**V**) = TOTAL DAILY APPROACH VOLUME : **24,606**

TOTAL # OF CRASHES : 10 # OF YEARS : 3 AVERAGE # OF CRASHES PER YEAR (**A**) : **3.33**

CRASH RATE CALCULATION : **0.37** RATE = $\frac{(A * 1{,}000{,}000)}{(V * 365)}$

Comments :

Project Title & Date:

SEGMENT CRASH RATE WORKSHEET

CITY/TOWN : Spencer COUNT DATE :

DISTRICT : 3

~ SEGMENT DATA ~

ROADWAY NAME:

START POINT: Maple Street

END POINT: Pleasant Street

FUNCTIONAL CLASSIFICATION OF ROADWAY:

ROADWAY DIAGRAM (LABEL ROADWAY AND CROSS STREETS)

North

AVERAGE DAILY TRAFFIC

SEGMENT LENGTH IN MILES (**L**):	**0.24**
AVERAGE DAILY TRAFFIC VOLUME (**V**):	14,764

TOTAL # OF CRASHES:	43	# OF YEARS :	3	AVERAGE # OF CRASHES PER YEAR (**A**) :	**14.33**

CRASH RATE CALCULATION : **11.08**

$$\text{RATE} = \frac{(A * 1{,}000{,}000)}{(L * V * 365)}$$

Comments : Includes crashes at intersection of Main & Mechanic/Price Chopper

Project Title & Date:

Signal Warrant Analysis

2003 MUTCD

TRAFFIC SIGNAL WARRANT ANALYSIS (VOLUME BASED)

Intersection: Main Street at Pleasant Street/Wall Street

Major Street Direction: Eastbound-Westbound

Year: 2011 **Condition:** Existing

Operating speed on major roadway: 28 mph

Number of approaches: 4

			Required approach volumes	
Warrant 1	**EIGHT-HOUR VEHICULAR VOLUME**		Minimum*	Adjusted Minimum**
Warrant 1A	MINIMUM VEHICULAR VOLUME (8 hours of day)			
	Major Street :	1 Lane(s) on each approach	500	500
	Minor Street :	1 Lane(s) on each approach	150	150
Warrant 1B	INTERRUPTION OF CONTINUOUS TRAFFIC (8 hours of day)			
	Major Street :	1 Lane(s) on each approach	750	750
	Minor Street :	1 Lane(s) on each approach	75	75
	80 PERCENT SATISFACTION OF WARRANT 1A **AND** WARRANT 1B		Warrant 1A	Warrant 1B
	Major Street :	1 Lane(s) on each approach	400	600
	Minor Street :	1 Lane(s) on each approach	120	60

Warrant 2	**FOUR HOUR VEHICULAR VOLUME**		
	Major Street :	1 Lane(s) on each approach	If "verify" indicated, see Figure 4C-1 or 4C-2.
	Minor Street :	1 Lane(s) on each approach	25 = accuracy of regression equations

Warrant 3	**PEAK HOUR VOLUME**		
	Major Street :	1 Lane(s) on each approach	If "verify" indicated, see Figure 4C-3 or 4C-4.
	Minor Street :	1 Lane(s) on each approach	25 = accuracy of regression equations

Hour	Entering Vol. Minor Road+	Entering Vol. on Major Road Eastbound	Entering Vol. on Major Road Westbound	Tot. Ent. Vol. On Major Rd	Meets the following volume-based warrants? 1A	1B	80%(1A&1B)	2	3
6:00 - 7:00 AM	174	459	232	691	Yes	No	Yes	Verify	No
7:00 - 8:00 AM	252	603	350	953	Yes	Yes	Yes	Yes	Yes
8:00 - 9:00 AM	202	512	377	889	Yes	Yes	Yes	Yes	No
9:00 - 10:00 AM	163	483	359	842	Yes	Yes	Yes	Verify	No
10:00 - 11:00 AM	143	472	424	896	No	Yes	Yes	Verify	No
11:00 - 12:00 AM	162	472	436	908	Yes	Yes	Yes	Yes	No
12:00 - 1:00 PM	169	504	448	952	Yes	Yes	Yes	Yes	No
1:00 - 2:00 PM	148	474	495	969	No	Yes	Yes	Yes	No
2:00 - 3:00 PM	174	434	532	966	Yes	Yes	Yes	Yes	No
3:00 - 4:00 PM	199	544	558	1102	Yes	Yes	Yes	Yes	Verify
4:00 - 5:00 PM	245	461	564	1025	Yes	Yes	Yes	Yes	Yes
5:00 - 6:00 PM	187	474	544	1018	Yes	Yes	Yes	Yes	Verify
6:00 - 7:00 PM	153	392	551	943	Yes	Yes	Yes	Yes	No
					Yes	**Yes**	**Yes**	**Yes**	**Yes**
			Warrants Met?		**1**			**2**	**3**
					Yes			**Yes**	**Yes**

*From the criteria described for the warrant in the MUTCD.

**If the operating speed is higher than 40mph then the volumes can be adjusted to 70%. (If no adjusted minimum, the minimum from the previous column is shown)

+If more than one approach, report the approach that has the higher volume.

NON-VOLUME-BASED WARRANTS

Warrant 4, Minimum Pedestrian Volume: No

Peak Four Hour Pedestrian Volumes: 0

(non-concurrent) 0

0

0

Warrant 5, School Crossing:

See MUTCD for details.

Warrant 6, Coordinated Signal System:

See MUTCD for details.

Warrant 7, Crash Experience: No

# of accidents "correctable by signalization" occuring in the last 12 months: 0

Warrant 8, Roadway Network:

See MUTCD for details.

Source: *Manual on Uniform Traffic Control Devices* (MUTCD); 2003 Edition [2003]

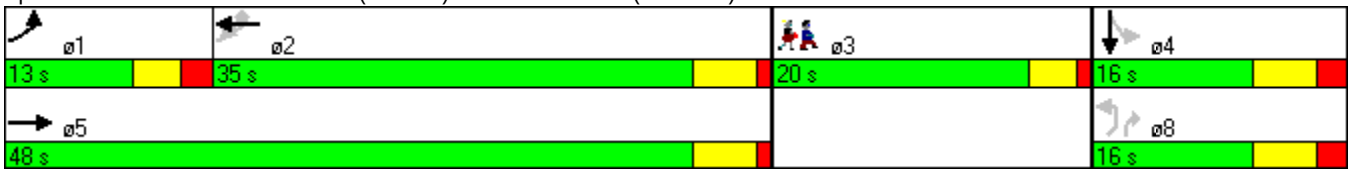
last updated: 08/05/05 [version]

Intersection Capacity Analysis

Lane Group	EBL	EBT	WBL	WBT	WBR	NBR	SBT	NEL2	ø3
Lane Configurations									
Volume (vph)	25	565	5	300	100	5	0	20	
Lane Group Flow (vph)	27	613	0	317	104	9	336	34	
Turn Type	D.P+P		Perm		Perm	custom		custom	
Protected Phases	1	5		2			4		3
Permitted Phases	2		2		2	8		8	
Detector Phase	1	5	2	2	2	8	4	8	
Switch Phase									
Minimum Initial (s)	8.0	43.0	30.0	30.0	30.0	10.0	10.0	10.0	16.0
Minimum Split (s)	13.0	48.0	35.0	35.0	35.0	16.0	16.0	16.0	20.0
Total Split (s)	13.0	48.0	35.0	35.0	35.0	16.0	16.0	16.0	20.0
Total Split (%)	15.5%	57.1%	41.7%	41.7%	41.7%	19.0%	19.0%	19.0%	24%
Yellow Time (s)	3.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	3.0
All-Red Time (s)	2.0	1.0	1.0	1.0	1.0	2.0	2.0	2.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	6.0	6.0	6.0	
Lead/Lag	Lead		Lag	Lag	Lag				
Lead-Lag Optimize?	Yes		Yes	Yes	Yes				
Recall Mode	Max	Max	C-Max	C-Max	C-Max	None	None	None	None
v/c Ratio	0.06	0.70		0.51	0.17	0.01	0.57	0.06	
Control Delay	10.0	20.3		24.9	4.9	0.0	26.7	19.2	
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Total Delay	10.0	20.3		24.9	4.9	0.0	26.7	19.2	
Queue Length 50th (ft)	6	227		130	0	0	140	12	
Queue Length 95th (ft)	19	356		208	32	0	197	20	
Internal Link Dist (ft)		448		166			557		
Turn Bay Length (ft)	25								
Base Capacity (vph)	435	874		617	596	833	591	565	
Starvation Cap Reductn	0	0		0	0	0	0	0	
Spillback Cap Reductn	0	0		0	0	0	0	0	
Storage Cap Reductn	0	0		0	0	0	0	0	
Reduced v/c Ratio	0.06	0.70		0.51	0.17	0.01	0.57	0.06	

Intersection Summary
Cycle Length: 84
Actuated Cycle Length: 84
Offset: 12 (14%), Referenced to phase 2:EBWB, Start of Green
Natural Cycle: 85
Control Type: Actuated-Coordinated

Splits and Phases: 2: Main Street (Route 9) & Pleasant Street (Route 31)



Movement	EBL	EBT	EBR2	WBL	WBT	WBR	NBR	SBL	SBT	SBR	SBR2	NEL2
Lane Configurations												
Volume (vph)	25	565	5	5	300	100	5	235	0	5	35	20
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0			5.0	5.0	6.0		6.0			6.0
Lane Util. Factor	1.00	1.00			1.00	1.00	1.00		1.00			1.00
Frt	1.00	1.00			1.00	0.85	0.86		0.98			1.00
Flt Protected	0.95	1.00			1.00	1.00	1.00		0.96			0.95
Satd. Flow (prot)	1583	1665			1742	1482	1494		1701			1641
Flt Permitted	0.44	1.00			0.99	1.00	1.00		0.96			0.95
Satd. Flow (perm)	740	1665			1728	1482	1494		1701			1641
Peak-hour factor, PHF	0.93	0.93	0.93	0.96	0.96	0.96	0.58	0.82	0.82	0.82	0.82	0.58
Adj. Flow (vph)	27	608	5	5	312	104	9	287	0	6	43	34
RTOR Reduction (vph)	0	0	0	0	0	67	6	0	5	0	0	0
Lane Group Flow (vph)	27	613	0	0	317	37	3	0	331	0	0	34
Heavy Vehicles (%)	14%	14%	14%	9%	9%	9%	10%	5%	5%	5%	5%	10%
Turn Type	D.P+P			Perm		Perm	custom	Perm				custom
Protected Phases	1	5			2				4			
Permitted Phases	2			2		2	8	4				8
Actuated Green, G (s)	39.1	44.1			30.0	30.0	28.9		28.9			28.9
Effective Green, g (s)	39.1	44.1			30.0	30.0	28.9		28.9			28.9
Actuated g/C Ratio	0.47	0.53			0.36	0.36	0.34		0.34			0.34
Clearance Time (s)	5.0	5.0			5.0	5.0	6.0		6.0			6.0
Vehicle Extension (s)	3.0	3.0			3.0	3.0	3.0		3.0			3.0
Lane Grp Cap (vph)	436	874			617	529	514		585			565
v/s Ratio Prot	0.01	c0.37										
v/s Ratio Perm	0.02				0.18	0.03	0.00		0.19			0.02
v/c Ratio	0.06	0.70			0.51	0.07	0.01		0.57			0.06
Uniform Delay, d1	12.5	15.0			21.3	17.8	18.1		22.4			18.5
Progression Factor	1.00	1.00			1.00	1.00	1.00		1.00			1.00
Incremental Delay, d2	0.3	4.7			3.0	0.3	0.0		1.3			0.0
Delay (s)	12.7	19.7			24.3	18.1	18.1		23.7			18.5
Level of Service	B	B			C	B	B		C			B
Approach Delay (s)		19.4			22.8				23.7			
Approach LOS		B			C				C			

Intersection Summary			
HCM Average Control Delay	21.3	HCM Level of Service	C
HCM Volume to Capacity ratio	0.65		
Actuated Cycle Length (s)	84.0	Sum of lost time (s)	11.0
Intersection Capacity Utilization	73.8%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	WBL	WBT	WBR	NBR	SBT	NEL2	ø3
Lane Configurations									
Volume (vph)	35	450	1	560	190	5	0	35	
Lane Group Flow (vph)	43	555	0	590	200	5	377	38	
Turn Type	D.P+P		Perm		Perm	custom		custom	
Protected Phases	1	5		2			4		3
Permitted Phases	2		2		2	8		8	
Detector Phase	1	5	2	2	2	8	4	8	
Switch Phase									
Minimum Initial (s)	8.0	43.0	30.0	30.0	30.0	10.0	10.0	10.0	16.0
Minimum Split (s)	13.0	48.0	35.0	35.0	35.0	16.0	16.0	16.0	20.0
Total Split (s)	13.0	48.0	35.0	35.0	35.0	16.0	16.0	16.0	20.0
Total Split (%)	15.5%	57.1%	41.7%	41.7%	41.7%	19.0%	19.0%	19.0%	24%
Yellow Time (s)	3.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	3.0
All-Red Time (s)	2.0	1.0	1.0	1.0	1.0	2.0	2.0	2.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	6.0	6.0	6.0	
Lead/Lag	Lead		Lag	Lag	Lag				
Lead-Lag Optimize?	Yes		Yes	Yes	Yes				
Recall Mode	Max	Max	C-Max	C-Max	C-Max	None	None	None	None
v/c Ratio	0.16	0.58		0.89	0.29	0.01	0.60	0.06	
Control Delay	11.9	17.2		43.2	4.2	0.0	25.9	18.3	
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Total Delay	11.9	17.2		43.2	4.2	0.0	25.9	18.3	
Queue Length 50th (ft)	11	192		288	0	0	152	13	
Queue Length 95th (ft)	24	250		#483	42	0	239	33	
Internal Link Dist (ft)		205		166			557		
Turn Bay Length (ft)	25								
Base Capacity (vph)	261	956		665	694	915	631	641	
Starvation Cap Reductn	0	0		0	0	0	0	0	
Spillback Cap Reductn	0	0		0	0	0	0	0	
Storage Cap Reductn	0	0		0	0	0	0	0	
Reduced v/c Ratio	0.16	0.58		0.89	0.29	0.01	0.60	0.06	

Intersection Summary
Cycle Length: 84
Actuated Cycle Length: 84
Offset: 12 (14%), Referenced to phase 2:EBWB, Start of Green
Natural Cycle: 85
Control Type: Actuated-Coordinated
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 2: Main Street (Route 9) & Pleasant Street (Route 31)

Movement	EBL	EBT	EBR2	WBL	WBT	WBR	NBR	SBL	SBT	SBR	SBR2	NEL2
Lane Configurations												
Volume (vph)	35	450	5	1	560	190	5	245	0	5	85	35
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0			5.0	5.0	6.0		6.0			6.0
Lane Util. Factor	1.00	1.00			1.00	1.00	1.00		1.00			1.00
Frt	1.00	1.00			1.00	0.85	0.86		0.96			1.00
Flt Protected	0.95	1.00			1.00	1.00	1.00		0.96			0.95
Satd. Flow (prot)	1770	1860			1863	1583	1644		1749			1805
Flt Permitted	0.13	1.00			1.00	1.00	1.00		0.96			0.95
Satd. Flow (perm)	248	1860			1862	1583	1644		1749			1805
Peak-hour factor, PHF	0.82	0.82	0.82	0.95	0.95	0.95	0.93	0.89	0.89	0.89	0.89	0.93
Adj. Flow (vph)	43	549	6	1	589	200	5	275	0	6	96	38
RTOR Reduction (vph)	0	0	0	0	0	129	3	0	11	0	0	0
Lane Group Flow (vph)	43	555	0	0	590	71	2	0	366	0	0	38
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	0%	1%	1%	1%	1%	0%
Turn Type	D.P+P			Perm		Perm	custom	Perm				custom
Protected Phases	1	5			2				4			
Permitted Phases	2			2		2	8	4				8
Actuated Green, G (s)	38.2	43.2			30.0	30.0	29.8		29.8			29.8
Effective Green, g (s)	38.2	43.2			30.0	30.0	29.8		29.8			29.8
Actuated g/C Ratio	0.45	0.51			0.36	0.36	0.35		0.35			0.35
Clearance Time (s)	5.0	5.0			5.0	5.0	6.0		6.0			6.0
Vehicle Extension (s)	3.0	3.0			3.0	3.0	3.0		3.0			3.0
Lane Grp Cap (vph)	261	957			665	565	583		620			640
v/s Ratio Prot	0.02	c0.30										
v/s Ratio Perm	0.06				c0.32	0.05	0.00		0.21			0.02
v/c Ratio	0.16	0.58			0.89	0.13	0.00		0.59			0.06
Uniform Delay, d1	15.6	14.1			25.4	18.2	17.5		22.1			17.9
Progression Factor	1.00	1.00			1.00	1.00	1.00		1.00			1.00
Incremental Delay, d2	1.4	2.6			16.2	0.5	0.0		1.5			0.0
Delay (s)	17.0	16.7			41.6	18.6	17.5		23.6			17.9
Level of Service	B	B			D	B	B		C			B
Approach Delay (s)		16.7			35.8				23.6			
Approach LOS		B			D				C			

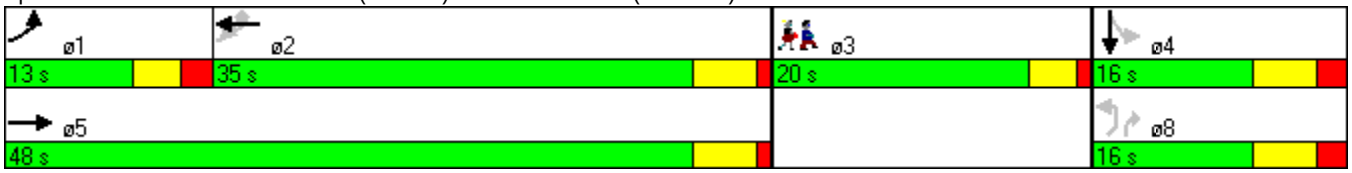
Intersection Summary			
HCM Average Control Delay	26.5	HCM Level of Service	C
HCM Volume to Capacity ratio	0.74		
Actuated Cycle Length (s)	84.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	77.4%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	WBL	WBT	WBR	NBR	SBT	NEL2	ø3
Lane Configurations									
Volume (vph)	25	610	5	325	110	5	0	20	
Lane Group Flow (vph)	27	668	0	358	120	5	325	22	
Turn Type	D.P+P		Perm		Perm	custom		custom	
Protected Phases	1	5		2			4		3
Permitted Phases	2		2		2	8		8	
Detector Phase	1	5	2	2	2	8	4	8	
Switch Phase									
Minimum Initial (s)	8.0	43.0	30.0	30.0	30.0	10.0	10.0	10.0	16.0
Minimum Split (s)	13.0	48.0	35.0	35.0	35.0	16.0	16.0	16.0	20.0
Total Split (s)	13.0	48.0	35.0	35.0	35.0	16.0	16.0	16.0	20.0
Total Split (%)	15.5%	57.1%	41.7%	41.7%	41.7%	19.0%	19.0%	19.0%	24%
Yellow Time (s)	3.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	3.0
All-Red Time (s)	2.0	1.0	1.0	1.0	1.0	2.0	2.0	2.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	6.0	6.0	6.0	
Lead/Lag	Lead		Lag	Lag	Lag				
Lead-Lag Optimize?	Yes		Yes	Yes	Yes				
Recall Mode	Max	Max	C-Max	C-Max	C-Max	None	None	None	None
v/c Ratio	0.06	0.75		0.58	0.20	0.01	0.56	0.04	
Control Delay	9.6	21.9		26.5	4.7	0.0	27.1	19.6	
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Total Delay	9.6	21.9		26.5	4.7	0.0	27.1	19.6	
Queue Length 50th (ft)	6	252		151	0	0	137	8	
Queue Length 95th (ft)	18	400		238	34	0	219	24	
Internal Link Dist (ft)		417		166			557		
Turn Bay Length (ft)	25								
Base Capacity (vph)	416	885		617	606	812	579	554	
Starvation Cap Reductn	0	0		0	0	0	0	0	
Spillback Cap Reductn	0	0		0	0	0	0	0	
Storage Cap Reductn	0	0		0	0	0	0	0	
Reduced v/c Ratio	0.06	0.75		0.58	0.20	0.01	0.56	0.04	

Intersection Summary
Cycle Length: 84
Actuated Cycle Length: 84
Offset: 12 (14%), Referenced to phase 2:EBWB, Start of Green
Natural Cycle: 85
Control Type: Actuated-Coordinated

Splits and Phases: 2: Main Street (Route 9) & Pleasant Street (Route 31)



Movement	EBL	EBT	EBR2	WBL	WBT	WBR	NBR	SBL	SBT	SBR	SBR2	NEL2
Lane Configurations												
Volume (vph)	25	610	5	5	325	110	5	255	0	5	40	20
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0			5.0	5.0	6.0		6.0			6.0
Lane Util. Factor	1.00	1.00			1.00	1.00	1.00		1.00			1.00
Frt	1.00	1.00			1.00	0.85	0.86		0.98			1.00
Flt Protected	0.95	1.00			1.00	1.00	1.00		0.96			0.95
Satd. Flow (prot)	1583	1665			1742	1482	1494		1701			1641
Flt Permitted	0.39	1.00			0.99	1.00	1.00		0.96			0.95
Satd. Flow (perm)	656	1665			1728	1482	1494		1701			1641
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	27	663	5	5	353	120	5	277	0	5	43	22
RTOR Reduction (vph)	0	0	0	0	0	77	3	0	5	0	0	0
Lane Group Flow (vph)	27	668	0	0	358	43	2	0	320	0	0	22
Heavy Vehicles (%)	14%	14%	14%	9%	9%	9%	10%	5%	5%	5%	5%	10%
Turn Type	D.P+P			Perm		Perm	custom	Perm				custom
Protected Phases	1	5			2				4			
Permitted Phases	2			2		2	8	4				8
Actuated Green, G (s)	39.6	44.6			30.0	30.0	28.4		28.4			28.4
Effective Green, g (s)	39.6	44.6			30.0	30.0	28.4		28.4			28.4
Actuated g/C Ratio	0.47	0.53			0.36	0.36	0.34		0.34			0.34
Clearance Time (s)	5.0	5.0			5.0	5.0	6.0		6.0			6.0
Vehicle Extension (s)	3.0	3.0			3.0	3.0	3.0		3.0			3.0
Lane Grp Cap (vph)	415	884			617	529	505		575			555
v/s Ratio Prot	0.01	c0.40										
v/s Ratio Perm	0.02				0.21	0.03	0.00		0.19			0.01
v/c Ratio	0.07	0.76			0.58	0.08	0.00		0.56			0.04
Uniform Delay, d1	12.4	15.4			21.9	17.9	18.4		22.7			18.7
Progression Factor	1.00	1.00			1.00	1.00	1.00		1.00			1.00
Incremental Delay, d2	0.3	6.0			3.9	0.3	0.0		1.2			0.0
Delay (s)	12.7	21.4			25.8	18.2	18.4		23.8			18.7
Level of Service	B	C			C	B	B		C			B
Approach Delay (s)		21.0			23.9				23.8			
Approach LOS		C			C				C			

Intersection Summary			
HCM Average Control Delay	22.5	HCM Level of Service	C
HCM Volume to Capacity ratio	0.68		
Actuated Cycle Length (s)	84.0	Sum of lost time (s)	11.0
Intersection Capacity Utilization	75.2%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	WBL	WBT	WBR	NBR	SBT	NEL2	ø3
Lane Configurations									
Volume (vph)	40	485	1	605	205	5	0	40	
Lane Group Flow (vph)	43	538	0	659	223	5	391	43	
Turn Type	D.P+P		Perm		Perm	custom		custom	
Protected Phases	1	5		2			4		3
Permitted Phases	2		2		2	8		8	
Detector Phase	1	5	2	2	2	8	4	8	
Switch Phase									
Minimum Initial (s)	8.0	43.0	30.0	30.0	30.0	10.0	10.0	10.0	16.0
Minimum Split (s)	13.0	48.0	35.0	35.0	35.0	16.0	16.0	16.0	20.0
Total Split (s)	13.0	48.0	35.0	35.0	35.0	16.0	16.0	16.0	20.0
Total Split (%)	15.5%	57.1%	41.7%	41.7%	41.7%	19.0%	19.0%	19.0%	24%
Yellow Time (s)	3.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	3.0
All-Red Time (s)	2.0	1.0	1.0	1.0	1.0	2.0	2.0	2.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	6.0	6.0	6.0	
Lead/Lag	Lead		Lag	Lag	Lag				
Lead-Lag Optimize?	Yes		Yes	Yes	Yes				
Recall Mode	Max	Max	C-Max	C-Max	C-Max	None	None	None	None
v/c Ratio	0.17	0.57		0.99	0.31	0.01	0.62	0.07	
Control Delay	12.0	16.9		61.8	4.1	0.0	26.4	18.3	
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Total Delay	12.0	16.9		61.8	4.1	0.0	26.4	18.3	
Queue Length 50th (ft)	11	183		340	0	0	160	15	
Queue Length 95th (ft)	27	278		#567	44	0	255	36	
Internal Link Dist (ft)		205		166			557		
Turn Bay Length (ft)	25								
Base Capacity (vph)	257	952		665	709	925	635	645	
Starvation Cap Reductn	0	0		0	0	0	0	0	
Spillback Cap Reductn	0	0		0	0	0	0	0	
Storage Cap Reductn	0	0		0	0	0	0	0	
Reduced v/c Ratio	0.17	0.57		0.99	0.31	0.01	0.62	0.07	

Intersection Summary

Cycle Length: 84
Actuated Cycle Length: 84
Offset: 12 (14%), Referenced to phase 2:EBWB, Start of Green
Natural Cycle: 95
Control Type: Actuated-Coordinated
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 2: Main Street (Route 9) & Pleasant Street (Route 31)

Movement	EBL	EBT	EBR2	WBL	WBT	WBR	NBR	SBL	SBT	SBR	SBR2	NEL2
Lane Configurations												
Volume (vph)	40	485	10	1	605	205	5	265	0	5	90	40
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0			5.0	5.0	6.0		6.0			6.0
Lane Util. Factor	1.00	1.00			1.00	1.00	1.00		1.00			1.00
Frt	1.00	1.00			1.00	0.85	0.86		0.96			1.00
Flt Protected	0.95	1.00			1.00	1.00	1.00		0.96			0.95
Satd. Flow (prot)	1770	1857			1863	1583	1644		1750			1805
Flt Permitted	0.13	1.00			1.00	1.00	1.00		0.96			0.95
Satd. Flow (perm)	248	1857			1862	1583	1644		1750			1805
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	43	527	11	1	658	223	5	288	0	5	98	43
RTOR Reduction (vph)	0	1	0	0	0	143	3	0	10	0	0	0
Lane Group Flow (vph)	43	537	0	0	659	80	2	0	381	0	0	43
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	0%	1%	1%	1%	1%	0%
Turn Type	D.P+P			Perm		Perm	custom	Perm				custom
Protected Phases	1	5			2				4			
Permitted Phases	2			2		2	8	4				8
Actuated Green, G (s)	38.0	43.0			30.0	30.0	30.0		30.0			30.0
Effective Green, g (s)	38.0	43.0			30.0	30.0	30.0		30.0			30.0
Actuated g/C Ratio	0.45	0.51			0.36	0.36	0.36		0.36			0.36
Clearance Time (s)	5.0	5.0			5.0	5.0	6.0		6.0			6.0
Vehicle Extension (s)	3.0	3.0			3.0	3.0	3.0		3.0			3.0
Lane Grp Cap (vph)	257	951			665	565	587		625			645
v/s Ratio Prot	0.02	c0.29										
v/s Ratio Perm	0.06				c0.35	0.05	0.00		0.22			0.02
v/c Ratio	0.17	0.56			0.99	0.14	0.00		0.61			0.07
Uniform Delay, d1	17.0	14.1			26.9	18.3	17.4		22.2			17.8
Progression Factor	1.00	1.00			1.00	1.00	1.00		1.00			1.00
Incremental Delay, d2	1.4	2.4			32.8	0.5	0.0		1.7			0.0
Delay (s)	18.4	16.5			59.6	18.8	17.4		23.9			17.8
Level of Service	B	B			E	B	B		C			B
Approach Delay (s)		16.6			49.3				23.9			
Approach LOS		B			D				C			

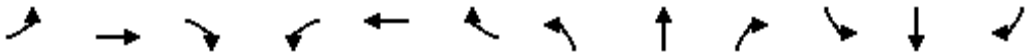
Intersection Summary			
HCM Average Control Delay	33.3	HCM Level of Service	C
HCM Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	84.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	78.8%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	WBT	WBR	NBT	SBL	SBT
Lane Group Flow (vph)	27	679	358	120	27	277	48
v/c Ratio	0.05	0.66	0.43	0.16	0.08	0.82	0.11
Control Delay	8.5	16.4	10.9	3.3	20.7	51.3	9.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	8.5	16.4	10.9	3.3	20.7	51.3	9.2
Queue Length 50th (ft)	6	238	82	6	9	146	2
Queue Length 95th (ft)	18	403	m119	m9	28	#233	27
Internal Link Dist (ft)		417	259		233		500
Turn Bay Length (ft)	100			50			
Base Capacity (vph)	505	1025	842	753	413	402	500
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.05	0.66	0.43	0.16	0.07	0.69	0.10

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	25	620	5	5	325	110	20	0	5	255	5	40
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	8	8	12	12	12	12	12	12
Total Lost time (s)	6.0	6.0			6.0	6.0		6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00			1.00	1.00		1.00		1.00	1.00	
Frt	1.00	1.00			1.00	0.85		0.97		1.00	0.87	
Flt Protected	0.95	1.00			1.00	1.00		0.96		0.95	1.00	
Satd. Flow (prot)	1583	1665			1510	1284		1618		1719	1566	
Flt Permitted	0.44	1.00			0.99	1.00		0.81		0.74	1.00	
Satd. Flow (perm)	728	1665			1499	1284		1364		1338	1566	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	27	674	5	5	353	120	22	0	5	277	5	43
RTOR Reduction (vph)	0	0	0	0	0	34	0	4	0	0	32	0
Lane Group Flow (vph)	27	679	0	0	358	86	0	23	0	277	16	0
Heavy Vehicles (%)	14%	14%	14%	9%	9%	9%	10%	10%	10%	5%	5%	5%
Turn Type	pm+pt			Perm		Perm	Perm			Perm		
Protected Phases	1	6			2			4			8	
Permitted Phases	6			2		2	4			8		
Actuated Green, G (s)	55.4	55.4			47.0	47.0		22.6		22.6	22.6	
Effective Green, g (s)	55.4	55.4			47.0	47.0		22.6		22.6	22.6	
Actuated g/C Ratio	0.62	0.62			0.52	0.52		0.25		0.25	0.25	
Clearance Time (s)	6.0	6.0			6.0	6.0		6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0			3.0	3.0		3.0		3.0	3.0	
Lane Grp Cap (vph)	471	1025			783	671		343		336	393	
v/s Ratio Prot	0.00	c0.41									0.01	
v/s Ratio Perm	0.03				0.24	0.07		0.02		c0.21		
v/c Ratio	0.06	0.66			0.46	0.13		0.07		0.82	0.04	
Uniform Delay, d1	7.4	11.2			13.5	11.0		25.7		31.8	25.5	
Progression Factor	1.00	1.00			0.65	0.44		1.00		1.00	1.00	
Incremental Delay, d2	0.1	3.4			1.7	0.4		0.1		15.0	0.0	
Delay (s)	7.5	14.6			10.5	5.2		25.8		46.9	25.5	
Level of Service	A	B			B	A		C		D	C	
Approach Delay (s)		14.3			9.2			25.8			43.7	
Approach LOS		B			A			C			D	

Intersection Summary			
HCM Average Control Delay	19.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.71		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	61.3%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBT	WBR	NBR	SBT	NEL2
Lane Group Flow (vph)	43	549	669	228	5	401	43
v/c Ratio	0.17	0.58	1.01	0.32	0.01	0.63	0.07
Control Delay	12.0	17.2	65.5	4.1	0.0	26.7	18.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	12.0	17.2	65.5	4.1	0.0	26.7	18.3
Queue Length 50th (ft)	11	189	~352	0	0	165	15
Queue Length 95th (ft)	27	286	#579	45	0	262	36
Internal Link Dist (ft)		205	166			557	
Turn Bay Length (ft)	25						
Base Capacity (vph)	257	952	665	712	921	636	645
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.17	0.58	1.01	0.32	0.01	0.63	0.07

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR2	WBL	WBT	WBR	NBR	SBL	SBT	SBR	SBR2	NEL2
Lane Configurations												
Volume (vph)	40	495	10	1	615	210	5	270	0	5	95	40
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0			5.0	5.0	6.0		6.0			6.0
Lane Util. Factor	1.00	1.00			1.00	1.00	1.00		1.00			1.00
Frt	1.00	1.00			1.00	0.85	0.86		0.96			1.00
Flt Protected	0.95	1.00			1.00	1.00	1.00		0.96			0.95
Satd. Flow (prot)	1770	1857			1863	1583	1644		1749			1805
Flt Permitted	0.13	1.00			1.00	1.00	1.00		0.96			0.95
Satd. Flow (perm)	248	1857			1862	1583	1644		1749			1805
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	43	538	11	1	668	228	5	293	0	5	103	43
RTOR Reduction (vph)	0	1	0	0	0	147	3	0	11	0	0	0
Lane Group Flow (vph)	43	548	0	0	669	81	2	0	390	0	0	43
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	0%	1%	1%	1%	1%	0%
Turn Type	D.P+P			Perm		Perm	custom	Perm				custom
Protected Phases	1	5			2				4			
Permitted Phases	2			2		2	8	4				8
Actuated Green, G (s)	38.0	43.0			30.0	30.0	30.0		30.0			30.0
Effective Green, g (s)	38.0	43.0			30.0	30.0	30.0		30.0			30.0
Actuated g/C Ratio	0.45	0.51			0.36	0.36	0.36		0.36			0.36
Clearance Time (s)	5.0	5.0			5.0	5.0	6.0		6.0			6.0
Vehicle Extension (s)	3.0	3.0			3.0	3.0	3.0		3.0			3.0
Lane Grp Cap (vph)	257	951			665	565	587		625			645
v/s Ratio Prot	0.02	c0.30										
v/s Ratio Perm	0.06				c0.36	0.05	0.00		0.22			0.02
v/c Ratio	0.17	0.58			1.01	0.14	0.00		0.62			0.07
Uniform Delay, d1	17.0	14.2			27.0	18.3	17.4		22.3			17.8
Progression Factor	1.00	1.00			1.00	1.00	1.00		1.00			1.00
Incremental Delay, d2	1.4	2.5			36.4	0.5	0.0		4.7			0.2
Delay (s)	18.4	16.7			63.4	18.8	17.4		27.0			18.0
Level of Service	B	B			E	B	B		C			B
Approach Delay (s)		16.9			52.1				27.0			
Approach LOS		B			D				C			

Intersection Summary			
HCM Average Control Delay	35.3	HCM Level of Service	D
HCM Volume to Capacity ratio	0.81		
Actuated Cycle Length (s)	84.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	79.4%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Appendix D: Speed Regulations

JUL 01 1981

TOWN OF SPENCER
SPECIAL SPEED REGULATION NO. 7069

Highway Location: SPENCER

Authority In Control: TOWN OF SPENCER

Name of Highway: ROUTE 31

In accordance with the provisions of Chapter 90, Section 18, of the General Laws (Ter. Ed.) as amended, the following Special Speed Regulation is

hereby Adopted

by the Board of Selectmen

of the Town of Spencer

That the following speed limits are established at which motor vehicles may be operated in the areas described:

ROUTE 31-NORTHBOUND

Beginning at the Charlton Town Line
Thence northerly on Route 31
3.70 miles at 40 miles per hour
0.53 " " 25 " " " ending at Route 9.

And beginning again 100 feet north of Route 9.
Thence northerly on Route 31
1.37 miles at 30 miles per hour
1.49 " " 40 " " "
1.03 " " 45 " " "
1.17 " " 40 " " "
0.57 " " 30 " " " ending at the Paxton Town Line; the total distance being 9.86 miles.

ROUTE 31-SOUTHBOUND

Beginning at the Paxton Town Line
Thence southerly on Route 31
0.57 miles at 30 miles per hour
1.17 " " 40 " " "
1.03 " " 45 " " "
1.49 " " 40 " " "
1.39 " " 30 " " " ending at Route 9.

And beginning again 100 feet south of Route 9
Thence southerly on Route 31
0.51 miles at 25 miles per hour
3.70 " " 40 " " " ending at the Charlton Town Line; the total distance being 9.86 miles.

Operation of a motor vehicle at a rate of speed in excess of these limits shall be prima facie evidence that such speed is greater than is reasonable and proper.

The provisions of this regulation shall not, however, abrogate in any sense Chapter 90, Section 14, of the General Laws (Ter. Ed).

Date of Passage

March 23, 1981

Board of Selectmen

Attest Elizabeth W. Noga
Town Clerk

COMMONWEALTH OF MASSACHUSETTS
DEPARTMENT OF PUBLIC WORKS

SPECIAL SPEED REGULATION NO. 7069

The Department of Public Works and the Registrar of Motor Vehicles, acting jointly, do hereby certify that this regulation is consistent with the public interests.

Standard signs must be erected at the beginning of each zone.

DATE: JUL 01 1981

FOR THE DEPARTMENT OF PUBLIC WORKS

BY: Traffic Engineer

Robert A. Pinora
Chief Deputy Registrar

THE COMMONWEALTH OF MASSACHUSETTS
HIGHWAY DEPARTMENT
TOWN OF SPENCER
SPECIAL SPEED REGULATION #7069-A

Highway Location: SPENCER

Authority In Control: TOWN OF SPENCER

Name of Highway (s): ROUTE 31

In accordance with the provisions of Chapter 90, Section 18, of the General Laws (Ter. Ed.) as amended, the following Special Speed Regulation is

Hereby Adopted

by the Board of Selectmen

of the Town of Spencer

Special Speed Regulation number 7069, dated July 1, 1981 is hereby amended as follows:

That the following speed limits are established at which motor vehicles may be operated in the areas described:

ROUTE 31 - NORTHBOUND

By striking out the clauses reading;
1.37 miles at 30 miles per hour
1.49 miles at 40 miles per hour
And inserting in place thereof
0.95 miles at 30 miles per hour
1.91 miles at 40 miles per hour

ROUTE 31 - SOUTHBOUND

By striking out the clauses reading;
1.49 miles at 40 miles per hour
1.39 miles at 30 miles per hour
And inserting in place thereof
1.91 miles at 40 miles per hour
0.97 miles at 30 miles per hour

Operation of a motor vehicle at a rate of speed in excess of these limits shall be prima facie evidence that such speed is greater than is reasonable and proper.

The provisions of this regulation shall not, however, abrogate in any sense Chapter 90, Section 14, of the General Laws (Ter. Ed.).

Date of Passage Nov. 18 1996

BOARD OF SELECTMEN

Attest Jean M. Mulhall
TOWN CLERK

COMMONWEALTH OF MASSACHUSETTS
HIGHWAY DEPARTMENT

SPECIAL SPEED REGULATION NO. 7069-A

The Highway Department and the Registry of Motor Vehicles, acting jointly, do hereby certify that this regulation is consistent with the public interest.

Standard signs must be erected at the beginning of each zone.

DATE: 9-25-97

FOR THE HIGHWAY DEPARTMENT

BY: _____
Traffic Engineer

FOR THE REGISTRY OF MOTOR VEHICLES

BY: Robert P. McDonnell
Chief Deputy Registrar

4/21/82

TOWN OF SPENCER
SPECIAL SPEED REGULATION
NO. 7118

Highway Location: TOWN OF SPENCER

Authority In Control: TOWN OF SPENCER

Name of Highway(s);: MECHANIC STREET
GREENVILLE ROAD

In accordance with the provisions of Chapter 90, Section 18, of the General Laws (Ter. Ed.) as amended, the following Special Speed Regulation is

hereby Adopted

by the Board of Selectmen

of the Town of Spencer

That the following speed limits are established at which motor vehicles may be operated in the areas described:

MECHANIC STREET---NORTHBOUND

Beginning at the Fish and Game Club
thence northerly on Mechanic Street
0.58 miles at 25 miles per hour ending at Cherry Street; the total distance being 0.58 miles.

MECHANIC STREET---SOUTHBOUND

Beginning at Main Street (Route 9)
thence southerly on Mechanic Street
0.66 miles at 25 miles per hour ending at the Fish and Game Club; the total distance being 0.66 miles.

GREENVILLE STREET---NORTHBOUND

Beginning at Chickering Road
thence northerly on Greenville Street
2.57 miles at 30 miles per hour
0.34 miles at 25 miles per hour ending at Main St. (Route 9); the total distance being 2.91 miles.

GREENVILLE STREET---SOUTHBOUND

Beginning at Main St. (Route 9)
thence southerly on Greenville St.
0.34 miles at 25 miles per hour
2.57 miles at 30 miles per hour ending at Chickering Road; the total distance being 2.91 miles.

4/21/82

NO. 7118

Operation of a motor vehicle at a rate of speed in excess of these limits shall be prima facie evidence that such speed is greater than is reasonable and proper.

The provisions of this regulation shall not, however, abrogate in any sense Chapter 90, Section 14, of the General Laws (Ter. Ed).

Date of Passage March 22, 1982

Richard G. G. Smith

[signature]

William [signature]

Board of Selectmen

Attest Elizabeth W [signature]
Town Clerk

COMMONWEALTH OF MASSACHUSETTS
DEPARTMENT OF PUBLIC WORKS

SPECIAL SPEED REGULATION NO. 7118

The Department of Public Works and the Registrar of Motor Vehicles, acting jointly, do hereby certify that this regulation is consistent with the public interests.

Standard signs must be erected at the beginning of each zone.

DATE: 4/21/82

FOR THE DEPARTMENT OF PUBLIC WORKS

BY: [signature]
Traffic Engineer

Robert A. Panora
Chief Deputy Registrar

Appendix E: Design Designation Data Calculations

Vanasse Hangen Brustlin, Inc.

Project:	Main Street (Rt 9)	Project #:	11537.00
Location:	Spencer, MA	Sheet:	1 of 2
Calculated by:	GJR	Date:	5/3/2011
Checked by:	MJC	Date:	5/3/2011
Title:	Design Designation Data-Main St between Maple St & Pleasant		

2011 Average Daily Traffic (ADT) = 7,271 + 7,493 = 14,764 vpd
ATRs from Tues 4-12-11 & Wed 4-13-11

Seasonally Adjusted ADT = 14,764 * 0.00% = 14,764 vpd

K Factor = (384 + 562) / 14,764 = 0.06
4:30 PM

D = 562 / (384 + 562) = 59.4% WB

Peak Hour % Trucks = (14 + 11) / 1,488 = 1.7%

Daily % Trucks = (88 + 135) / 14,764 = 1.5%

Design Year ADT = Background: 14,764 * (1+.0075)^12 = 16,149
Project:
Other Specific Projects:
Total: 16,149 vpd

DHV = 16,149 * 0.06 = 1,034 vph

DDHV = 1,034 * 59.4% = 615 vph

Appendix F: Road Safety Audit(RSA)

ROAD SAFETY AUDIT

Main Street (Route 9)
Elm Street to Maple Street (Route 31)

Town of Spencer

February 13, 2013

Prepared For:
MassDOT Highway Division

Prepared By:
BETA Group, Inc.

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Project Data

A Road Safety Audit for Main Street (Route 9) between Elm Street and Maple Street (Route 31) was held on January 7, 2013 at the Spencer Town Hall in Spencer, MA. As indicated in Table 1, the audit team consisted of representatives from State, Regional and Local agencies and included a cross-section of engineering, planning and emergency response expertise.

Table 1. Participating Audit Team Members

Audit Team Member	Agency/Affiliation
Silpa Munukutla	MassDOT Highway Division – Safety Section
Corey O'Connor	MassDOT Highway Division – Safety Section
Peter Calves	MassDOT Highway Division – Safety Section
Qing Qing You	MassDOT Highway Division – Safety Section
Lola Campbell	MassDOT Highway Division – District 3
Michael Bruce	MassDOT Highway Division – District 3 Traffic
Tom Currier	MassDOT Highway Division – Project Management
Sujatha Mohanakrishnan	CMRPC
Dan Daniska	CMRPC
Kevin Krasnecky	CMRPC
Michelle Buck	Town of Spencer – Town Planner
Matt Chase	VHB
Dave Darrin	Town of Spencer – Police Chief
Bob Parsons	Town of Spencer – Fire
Eben Butler	Town of Spencer – Highway
Steven Tyler	Town of Spencer – Highway/U&F
Greg Lucas	BETA Group, Inc.
Justin Curewitz	BETA Group, Inc.

Background

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. A Road Safety Audit was scheduled for Main Street (Route 9) in Spencer from Elm Street to Maple Street, a length of approximately 1,000 feet, because this segment is identified as a regional top 5% high pedestrian crash location, and the intersection of Main Street at Mechanic Street is a regional top 5% high crash location. A rehabilitation project extending from Elm Street to Grove Street, currently in the pre-25% design phase, has been advanced by the Town and is scheduled for reconstruction in 2016 under the statewide Transportation Improvement Plan (TIP). The RSA is intended to identify potential short and long term safety improvements that can be made along the Route 9 corridor, which can then be implemented through general maintenance for short term low cost improvements or incorporated into the planned rehabilitation project to the greatest extent practicable.

Project Description

Main Street (Route 9), shown in Figure 1, is a Principal Arterial providing east-west access through the Town of Spencer to Leicester and Worcester to the east and East Brookfield to the west. Route 31 is classified as a Rural Major Collector that runs north-south along Maple Street where it meets with Main Street (Route 9). From there it is carried along Main Street approximately 600 feet westward to Pleasant Street, then continues along Pleasant Street to the north. Main Street is under Town of Spencer jurisdiction as are all intersecting side streets within the study area. Route 9 is typically under MassDOT jurisdiction with the exception of a 1.4 mile stretch in the town center which includes the audit area, and is a National Highway System (NHS) roadway in Spencer and along its entire length statewide.

The horizontal and vertical alignment of Main Street through the study area creates steep grades at intersection approaches and both horizontal and vertical curves that restrict visibility for drivers, specifically those entering the roadway from side streets or driveways.

The four intersections included in the audit corridor are discussed in detail below.

Main Street at Maple Street (looking south)

Main Street (Route 9)/Maple Street (Route 31)

Main Street, Maple Street and the Spencer Town Hall driveway form a 4-legged intersection under traffic signal control. Main Street comprises the eastern and western legs of the intersection, while Maple Street comprises the southern leg. The northern leg of the intersection serves the municipal driveway for the Spencer Town Hall. Land use in the area is primarily commercial with some municipal and residential uses,

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Road Safety Audit
Route 9 (Main St) from Elm St to Maple St
Spencer, MA

Figure 1

Location Map

O:\4200s\4270 – MassDOT Road Safety Audit On Call\Assignment 10 – Spencer\Report\Figures\Location Map.dwg Feb 13,2013 10:24am

with Spencer Town Hall on the northeast corner, a Cumberland Farms on the southwest corner, and buildings housing both businesses and residences on the northwest and southeast corners. Operations at the intersection are also impacted by John's Pizza, which is adjacent to the Cumberland Farms west of Maple Street.

The Main Street westbound approach provides an exclusive left-turn lane and a shared lane for throughs and right turns, while the Main Street eastbound approach provides a shared lane for left turns and throughs, and an exclusive right-turn lane. Maple Street northbound and the municipal driveway approaches each provide a single general purpose lane at the intersection. Pavement markings at the intersection consist of double yellow centerlines, stop bars, and white edge lines for Main Street and Maple Street, while the municipal driveway provides only a stop bar.

Marked crosswalks are provided across all approaches at the intersection. Continuous sidewalks are provided on both sides of Maple Street as well as on Main Street throughout the study corridor. Apex style handicap ramps are provided at the intersection and do not consistently align with the marked crosswalks, which does not meet ADA and MassDOT guidelines. "STATE LAW Yield to Pedestrian in Crosswalk" signs are provided for the crosswalks across Main Street and Maple Street, but should be removed because the referenced state law applies only to unsignalized crossings.

Main Street/Mechanic Street

Main Street and Mechanic Street form an unsignalized T-intersection. Main Street comprises the eastern and western legs of the intersection, while Mechanic Street forms the southern leg and is a one-way roadway departing Main Street. Land use in the area is varied, consisting of residential and commercial use with the Price Chopper Plaza to the north of the intersection.

Main Street provides a single general purpose lane in each direction at the intersection, while Mechanic Street provides a single lane one-way southbound. Pavement markings at the intersection consist of a double yellow centerline and white edge lines for Main Street. On-street parking is provided along both sides of Mechanic Street.

Marked crosswalks are provided across Mechanic Street and across the east leg of Main Street, with apex style handicap ramps on the southwest and southeast corners that do not appear to meet current ADA and MassDOT guidelines. Continuous sidewalks are provided on both sides of Main Street and Mechanic Street. Pedestrian signage is provided for the Main Street crosswalk on both sides of the street, but visibility restrictions exist for these signs due to the buildings and layout of the roadway.

Main Street/Pleasant Street (Route 31)/Wall Street

Main Street, Pleasant Street, and Wall Street form an offset intersection under traffic signal control. Main Street comprises the eastern and western legs of the intersection, while Pleasant Street forms the northern leg. The southern leg of the intersection is comprised of Wall Street which is offset approximately 90 feet to the west. A driveway located between two buildings directly opposite Pleasant Street is also under signal control. Land use in the area is primarily commercial, with residential apartments above. Operations at the intersection are also impacted by the Price Chopper driveway on Pleasant Street approximately 300 feet north of Main Street.

Main Street at Pleasant Street (looking east)

Main Street eastbound provides a single travel lane with an adjacent parking lane approaching Wall Street, then provides an exclusive left-turn lane and a through lane between Wall Street and Pleasant Street with no on-street parking, and provides a single travel lane with adjacent on-street parking after Pleasant Street. The offset nature of the intersection creates the need for a stop line for eastbound vehicles west of Wall Street, before they can enter the left turn pocket. The lane alignment requires through vehicles to shift right in order to continue along Main Street, and creates an unusual transition from parking lane to through lane to parking lane. A lead phase is provided for the eastbound approach to accommodate left turning vehicles. Main Street westbound provides a through lane and an exclusive right-turn lane, while Pleasant Street and Wall Street each provide a single all-purpose lane in each direction at the intersection. Right turns from Wall Street to Main Street eastbound are restricted by signage, as are left turns from the signalized driveway. The signalized driveway connects to a parking area which also connects to Wall Street, and serves as a cut-through from Wall Street for vehicles intending to travel east on Main Street. The signal indications for the Wall Street and signalized driveway approaches are intended to reinforce the turn restrictions, with a green left arrow for Wall Street and a green right arrow for the driveway, but these signal indications may confuse drivers because they are typically used to indicate an exclusive, unopposed turn, as outlined in the Manual on Uniform Traffic Control Devices (MUTCD). The existing turns are permissive, meaning that other conflicting turns are allowed at the same time. Pavement markings at the intersection consist of double yellow centerlines, stop bars, and white edge lines for Main Street and Pleasant Street, while Wall Street and the signalized driveway provide only a stop bar.

Marked crosswalks are provided across the east leg of Main Street and across Pleasant Street. Continuous sidewalks are provided on both sides of Pleasant Street and Wall Street as well as on Main Street throughout the study corridor. Apex style handicap ramps are provided at the intersection for all marked crosswalks, but are generally in poor condition and do not meet ADA and MassDOT guidelines. "STATE LAW Yield to Pedestrian in Crosswalk" signs are provided for the crosswalk across Main Street and Pleasant Street, but should be removed because the referenced state law applies only to unsignalized crossings.

Main Street/Elm Street/High Street

Main Street, Elm Street, and High Street form a 4-legged intersection, with Elm Street approaching from the south and High Street approaching from the north, both under STOP control. Land use in the area is varied, consisting of residential and commercial use with the Kenwood Diner on the northeast corner of the intersection.

All approaches provide a single general purpose lane in each direction at the intersection with on-street parking provided on both sides of Main Street. Pavement markings at the intersection consist of a double yellow centerline for Main Street, while Elm Street and High Street provide only a stop bar.

Marked crosswalks are provided across Elm Street and High Street, with apex style handicap ramps on all corners that do not appear to meet current ADA and MassDOT guidelines. Continuous sidewalks are provided on both sides of all intersecting streets, with the sidewalk on the north side of Main Street west of the intersection separated from the edge of roadway by a grass strip.

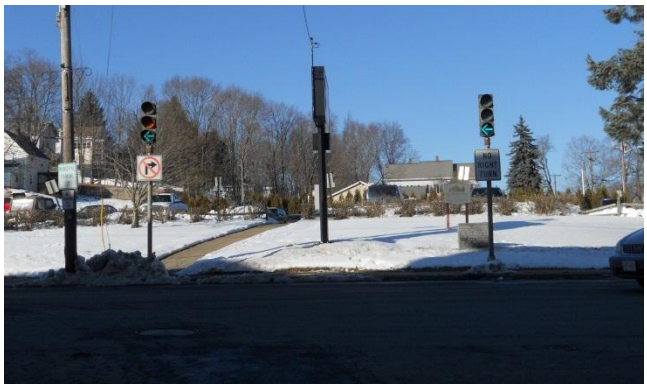
Crash Data

Crash data provided by the Spencer Police Department and summarized by MassDOT show 43 crashes occurred within the study area between July 2009 and July 2012. A fatal crash was also noted to have occurred in the study area in 2007. The prevalent crash type was rear-end crashes, comprising 47% of total crashes. A collision diagram showing all crashes is included in Appendix C. The diagram shows six rear-end crashes involving eastbound vehicles arriving at the Main/Maple Street intersection. Five crashes occurred between vehicles and pedestrians. Four of these crashes occurred at the unsignalized crosswalk near Mechanic Street, including the fatal crash in 2007. Two of the four crashes involved vehicles turning to Mechanic Street, one involved a westbound vehicle and the fatal crash involved a vehicle traveling eastbound. A pedestrian-involved crash also occurred with a westbound vehicle at the signalized intersection at Maple Street and the municipal driveway; solar glare was cited as a cause. A number of the descriptions in the summary included in Appendix C describe "failed to yield to the right of way," solar glare and "courtesy crashes." A courtesy crash refers to when a vehicle in the inside lane may stop for a turning vehicle, but the turning vehicle is then struck by a vehicle traveling in the other lane, named for the courtesy shown by the stopped driver. Visibility for drivers departing the Main/Maple Street intersection is impacted by the downhill grade and roadway alignment. The uphill grade of the westbound approach may also impact a driver's behavior. A summary of crash data and a collision diagram are included in the Appendix.

Audit Observations

Following a brief introduction to the RSA process and a summary of existing geometry and crash information, the audit participants were asked to discuss safety issues along Main Street from Elm Street to Maple Street. Audit participants then visited the location as a group, at which time they offered observations on safety issues. A summary of those major safety considerations is as follows:

- Intersection Alignment, Signal Phasing, Signal Equipment – These safety issues were discussed in conjunction regarding the Main Street/Pleasant Street/Wall Street intersection. Safety concerns created by the existing offset alignment of Pleasant Street and Wall Street spurred the implementation of turn restrictions from Wall Street and from the signalized driveway opposite Pleasant Street. Right turns are restricted from Wall Street to avoid conflicts between right-turning vehicles and vehicles turning left from Pleasant Street. A similar restriction exists for left turns from the signalized driveway. Town personnel confirmed that the green arrows facing these approaches are intended to reinforce the turn restrictions. The MUTCD states that a steady green arrow signal indication "shall be displayed only to allow vehicular movements, in the direction indicated, that are not in conflict with other vehicles moving on a green or yellow signal indication…"; in simpler terms, this states that a green arrow shall be used only when a turn is protected, meaning no other conflicting movements are allowed at the same time. This is not the case at this intersection, where vehicles departing Pleasant Street have a green indication at the same time as vehicles departing Wall Street and the signalized driveway. This creates a conflict between vehicles turning right from Pleasant Street and vehicles turning left from Wall Street, and may be a factor in the two crashes involving vehicles departing Wall Street. It should also be noted that a crash involved a vehicle turning right from Wall Street, despite the existing turn restriction.



Turn Restriction
(enforced by signage and green left arrows)

- Intersection Alignment – In addition to the signal phasing and signal head issues noted above, the offset alignment of the Main Street/Pleasant Street/Wall Street intersection creates potential confusion for eastbound drivers. An eastbound vehicle must stop at a stop line located before Wall Street, before the formation of the left turn lane for Pleasant Street. Once the light turns green a vehicle must make their choice of lane assignments and continue through the

Main Street eastbound at Pleasant Street

intersection on their intended path, but can no longer see the signal indications controlling their approach. An unfamiliar driver may treat the crosswalk across Main Street as a de facto stop line at the end of the turn lane before turning left onto Pleasant Street or continuing on Main Street eastbound. Two rear-end crashes on this approach may be related to confusion over intended traffic control.

- Intersection Alignment, Signal Phasing – An additional concern related to the alignment and existing signal control is the flow of cut-through traffic from Wall Street through the signalized driveway opposite Pleasant Street. Vehicles currently use this cut-through to travel east on Main Street, due to the existing right turn restriction from Wall Street. This increases traffic exiting the driveway, which exacerbates concerns related to intersection alignment and visibility.

- Lane Widths – Narrow existing lane widths along Main Street were cited as a safety concern.

- Lane Alignment/Lane Trap – Parking is provided along the south side of Main Street, but the parking lane is removed at Pleasant Street and Maple Street to accommodate the addition of an exclusive turn lane. The result for eastbound through vehicles is a lane shift where vehicles must shift right at Pleasant Street to remain in the designated through lane, then shift left to avoid conflicts with parked vehicles. The lack of pavement markings delineating these transitions and lack of lane designation signage may trap eastbound vehicles in the left turn lane at Pleasant Street. Lane widths and lane alignment may be a factor in sideswipe crashes within the study area.

- Pavement Condition – The pavement is rutted along Main Street throughout the study area.

- Pedestrian Travel – Pedestrians crossing Main Street in the vicinity of the Price Chopper plaza do not typically use the existing unsignalized crosswalk located east of Mechanic Street. It was noted that this crosswalk is on the east side of Mechanic Street from the Price Chopper parking area, and that pedestrians often cross directly from the parking area to the businesses along the south side of Main Street in this area.

- Pavement Markings – Markings are faded at the intersections and along Main Street, which adds to confusion over intended lane configurations. Town personnel noted that painted markings were reapplied in 2012. The lack of double yellow centerlines on side streets was also noted as a safety concern.

- Pedestrian Signals – The lack of countdown pedestrian signals was noted as a potential safety concern. It should be noted that countdown pedestrian signal heads are required by the latest MUTCD and by MassDOT regulations.

- Pedestrian Signage – Two issues related to crosswalk-related signage were discussed by the audit team.

    - R1-6 "STATE LAW Yield to Pedestrian in Crosswalk" signs are provided at all crosswalks within the study area. These signs are only appropriate at unsignalized intersections, where state law does require vehicles to yield to pedestrians in the crosswalk. Vehicle and pedestrian operation at signalized pedestrian crossings such as those at the Main Street/Pleasant Street/Wall Street and Main Street/Maple Street intersections are controlled by the signal indications.

    - Typical W11-2 Pedestrian warning signs with a supplemental arrow are provided at the unsignalized crosswalk at Mechanic Street. It was noted that no advance signage is provided for the crosswalk, and that the alignment of the roadway, location of buildings and location of the existing signs reduce the visibility of existing signs for approaching vehicles.

- Visibility – Visibility was noted as an issue for vehicles departing side streets and driveways due to the proximity of parked vehicles along Main Street. Town personnel noted that parking is prohibited within 15 feet of side streets by Town regulation, which is supported by existing signage. Visibility issues may be created by parked vehicles parking partially outside of legally allowed areas. It was noted that emergency vehicles have experienced crashes when departing Wall Street as a result of visibility concerns.

- Fire Truck Turns – It was noted that parked vehicles along Mechanic Street create a safety concern for fire trucks turning onto Mechanic Street from Main Street. Parked vehicles create a reduction in available width, and require the operator to carefully maneuver the truck to avoid contact.

- Signal Operation – It was noted that the existing traffic signals at Main Street and Maple Street often turn to flash mode when damp and must be manually reset. This typically indicates a short created by water coming into contact with wiring.

- Backplates – The lack of backplates on existing signal heads may exacerbate concerns related to sun glare due to the east-west alignment of Main Street. Existing backplates are provided on overhead signals at the Main Street/Maple Street intersection, but are missing at the Main Street/Pleasant Street/Wall Street intersection. Glare was noted as a problem along Main Street within the study area.

- Signage –

    - The lack of lane designation signage on all multi-lane approaches creates confusion over lane assignments and may be a factor in sideswipe and rear-end crashes.

    - One-way signage provided for Mechanic Street is inconsistent, with an R6-1 One Way sign on the west side and an R6-2 One Way sign on the east side. Drivers may be confused by this inconsistency. It should be noted that the Massachusetts Amendments to

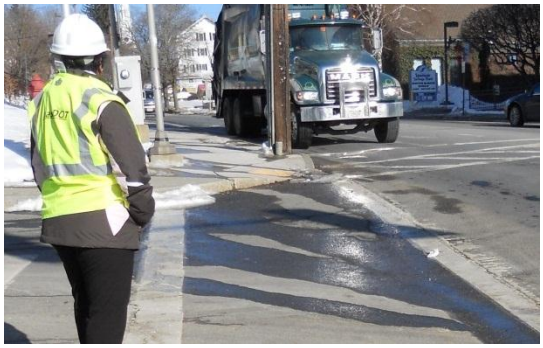
the MUTCD states that R6-2 signs should be used at locations where the one-way street goes away from an intersection, which is the case with Mechanic Street at Main Street.

- Sign clutter from private signs was noted as a safety issue. It was noted that temporary notices such as yard sale signs are often attached to utility poles along the corridor.

- Clearance Times – Clearance times at the Main Street/Pleasant Street/Wall Street intersection were observed on the day of the audit and determined to be inadequate to allow a vehicle on Main Street to clear the intersection before a green indication on Pleasant and Wall Streets. This may be a factor in both angle and rear-end crashes at the intersection. Clearance times were not observed at the Main Street/Maple Street intersection, but the history of rear-end crashes may indicate inadequate clearance times.

- Price Chopper Driveway – Vehicles departing Price Chopper onto Main Street are currently restricted to right turn movements only. It was noted that vehicle queues from the traffic signal at Pleasant Street often cause vehicles departing Price Chopper to block the westbound right turn lane at Pleasant Street, which may contribute to both rear-end and angle crashes in this area. The Price Chopper plaza has a second driveway on Pleasant Street that allows both entry and exit, and it was noted that drivers familiar with the area will use the Pleasant Street driveway for easier access to Main Street in either direction.

- Snow Removal – It was noted that snow was still partially blocking sidewalks and wheelchair ramps on the day of the audit from a prior snow event, reducing accessibility for all pedestrians.



- Wheelchair Ramps – Apex style ramps are provided at most locations within the study area, which do not allow for directional alignment of the ramp and the crosswalk and are not preferred under current MassDOT guidelines. Ramps do not clearly align with crosswalks at many locations, as shown at right.

- Wide Curb Cuts – The wide curb cuts for John's Pizza and the Cumberland Farms on the south side of Main Street between Mechanic Street and Maple Street were cited as a safety concern. Wide curb cuts provide limited channelization of entering and exiting vehicles. Two crashes occurred between westbound vehicles entering John's Pizza and eastbound through vehicles.

Potential Safety Enhancements

After the site visit, audit participants returned to the meeting location to discuss the safety issues and consider improvements. Audit participants were encouraged to consider both short and long term improvements for each issue. Each improvement considered has been categorized as short-term, mid-term, or long-term based on the definitions shown in Table 2. Additionally, a cost category has been assigned to each improvement based on the parameters set forth in Table 2.

Table 2. Estimated Time Frame and Costs Breakdown

Time Frame		Costs	
Short-term	<1 year	Low	<$10,000
Mid-term	1–3 years	Medium	$10,000–$50,000
Long-term	>3 years	High	>$50,000

- Replace green arrows with green balls on the Wall Street and signalized driveway approaches. The green arrow indications provided for the Wall Street and signalized driveway approaches are intended to reinforce turn restrictions, but are inappropriately used and should be removed and replaced with solid green ball indications. The existing turn restriction signage should remain. This is an immediate short-term, low cost improvement which addresses the non-compliant signal equipment at the intersection but does not address potential conflicts between Pleasant Street vehicles and vehicles departing Wall Street or the signalized driveway.

- Consider split phasing for the Pleasant Street, Wall Street and signalized driveway approaches. Split phasing would eliminate conflicts between the three approaches by providing two separate phases for side street traffic - one for the Wall Street approach and a shared phase for Pleasant Street and the signalized driveway approaches. Split phasing would allow for reintroduction of the restricted turns from the Wall Street and signalized driveway approach. This may negatively impact operation along Main Street. It was also noted that the existing traffic signal system at this location does not have the ability to add a phase, so the implementation of split phasing would require replacement of the traffic signal controller. This is a short-term, low cost improvement.

- Re-align the Main Street/Pleasant Street/Wall Street intersection. Shift Pleasant Street westward to align it opposite Wall Street to create a more typical 4-way intersection alignment and eliminate the need for turn restrictions. The proposed design ultimately advanced as part of the rehabilitation project must be in accordance with the MUTCD. This potential enhancement should remove the confusion that currently exists due to the existing conflicts. This is a mid-term, high cost improvement that may be part of the planned rehabilitation project.

- Increase enforcement of restricted turning movements and existing parking restrictions. Increased enforcement would deter illegal turns at the Main Street/Pleasant Street/Wall Street intersection, and would address existing concerns regarding cars parking outside the defined limits of parking along the south side of Main Street. This is a short-term improvement with a cost of allocation of limited police resources.

- Reconfigure the available pavement width to provide wider lanes, clear lane transitions and defined parking limits. The proposed design should aim to provide lane widths meeting minimum MassDOT requirements while also providing 4-foot shoulders to accommodate bicycles and a narrow parking lane. Lane transitions along the corridor will be more clearly defined to eliminate existing lane traps and provide a clear delineation between travel lanes and parking lanes. This is a mid-term, high cost improvement assumed to be included in the planned rehabilitation project. It should be noted that proposed lane and shoulder widths do not meet minimum requirements for an NHS roadway, which requires a design exception from FHWA.

- Rehabilitate pavement. Pavement will be rehabilitated along the corridor as part of planned improvements. The appropriate method of pavement rehabilitation should be determined based on the results of subsurface exploration. This is a mid-term, high cost improvement.

- Consider relocating the unsignalized crosswalk across Main Street based on pedestrian desire lines. It was noted that pedestrians do not currently utilize the crosswalk when crossing from the Price Chopper parking area to the businesses along the south side of Main Street. Pedestrian travel paths should be studied and a relocation of the crosswalk considered, assuming that it can be relocated to an area that provides adequate visibility. This is a low cost, mid-term improvement that could be included in the planned rehabilitation project. The proposed location should be accompanied by signage placed on both sides of the roadway for added visibility.

- Reapply pavement markings. It is assumed that markings will continue to be repainted as a short-term improvement by the Town of Spencer. Recessed pavement markings are recommended for the rehabilitation project, and should be six inches wide and reflective thermoplastic. This is a mid-term, low cost improvement assumed to be included in the proposed project.

- Reconstruct the existing traffic signals with all new equipment including mast arms, overhead signals with backplates, and countdown pedestrian signal heads. Backplates should have retroreflective borders conforming to current MassDOT and FHWA recommendations. This is a mid-term, high cost improvement assumed to be included in the planned project.

- Remove R1-6 “STATE LAW Yield to Pedestrian in Crosswalk” signs from signalized intersections, and replace with R10-15 signs as shown at right. Existing R1-6 signs are only appropriate at unsignalized locations. Proposed R10-15 signs will alert drivers regarding the need to yield to pedestrians when turning. This is a short-term, low cost improvement.

- Provide additional advance warning signage for crosswalks. An additional W11-2 Pedestrian warning sign with a supplemental “AHEAD” plaque should be placed on Main Street in advance of the unsignalized crosswalk at Mechanic Street in both directions. A W11-2 sign should also be placed on Main Street westbound before its intersection with Maple Street. This is a short-term, low cost improvement. These signs should be relocated or replaced as necessary as part of the planned project.

- Update No Parking signage to restrict parking within 20 feet of all intersections. It was noted that existing Town regulations prohibit parking within 15 feet of intersections. This restriction should be

increased to 20 feet from the crosswalk line or to the extension of the back of sidewalk line from the side street, in accordance with the MUTCD. This is a short-term, low cost improvement.

- Construct bulb-outs on intersection corners to define limits of on-street parking and provide additional area for pedestrian refuge. This is a mid-term improvement that can be included in the planned rehabilitation project to provide additional definition of legally allowed parking areas, while having the added benefit of reducing crosswalk lengths and providing increased refuge for pedestrians on intersection corners.

- Provide emergency preemption as part of traffic signal reconstruction. It was noted that existing signals do not have optical detectors, but Spencer fire vehicles have optical emitters. Preemption will help ease concerns regarding emergency vehicles departing side streets by providing a protected phase. It should be noted that Spencer police vehicles do not currently have optical emitters. This is a mid-term, medium cost improvement that should be included in the proposed project.

- Increase parking restrictions on the west side of Mechanic Street to facilitate fire truck turning movements. Parking is currently allowed beginning approximately 20 feet south of the crosswalk crossing Mechanic Street. Extending this restricted area would allow more room for turning trucks. The exact limits of the parking restriction should be determined through coordination with the fire department. This is a short-term, low cost improvement.

- Install lane usage signage on all multi-lane approaches. This will alert drivers to the intended lane use in tandem with pavement marking improvements. It is recommended that R3-8 graphical signs be provided on all affected approaches. This should be implemented as a short-term, low cost improvement on the Main Street approaches to Pleasant Street and Maple Street, and should be retained and/or updated as part of the proposed project.

- Remove private signs and temporary postings from utility poles and other structures within the Town right-of-way. This short-term, low cost improvement will reduce sign clutter along the corridor.

- Study clearance times, and implement changes as needed. The existing yellow and all red clearance times should be determined from the existing traffic signal controllers at both signalized intersections and compared to minimum requirements calculated based on current MassDOT guidance. If existing clearance times are insufficient, clearance times should be increased accordingly. This change in clearance times could reduce the occurrence of rear-end crashes within the study area. This is a short-term, low cost improvement that should be done in advance of planned improvements. Clearance times for the proposed geometry should also be calculated following the same methodology as part of planned improvements.

- Consider closing the Price Chopper exit driveway onto Main Street. The existing driveway impacts operations along Main Street due to queues extending from the traffic signal at Pleasant Street. Restricting exit at this location will require all vehicles to exit Price Chopper via its driveway on Pleasant Street. Entry will still be allowed via the existing driveway on Main Street. This short-term, low cost improvement eliminates conflicts between turning vehicles and would directly address rear-end and angle crashes along Main Street. This could be implemented as a temporary measure with

signage and barrier, but could be made permanent along with driveway and sidewalk modifications proposed with the rehabilitation project.

- Increase snow removal efforts to provide adequate clear paths along sidewalks. Snow was partially blocking sidewalks on the day of the audit. This is a short-term, ongoing improvement.

- Replace sidewalks and wheelchair ramps. It was noted that sidewalks and wheelchair ramps will be reconstructed as part of proposed improvements. Existing wheelchair ramps are apex style ramps that do not meet current ADA and MassDOT guidelines. This is a mid-term, high cost improvement.

- Reduce width of the curb cuts for Cumberland Farms and John's Pizza by installing additional curbing between the two driveways. This will provide better definition of entry and exit points for vehicles, and provide additional definition of the continuous sidewalk along the south side of Main Street. This is a mid-term, medium cost improvement that can be accommodated within driveway and sidewalk modifications proposed with the rehabilitation project.

Summary of Road Safety Audit

Table 3 summarizes potential recommendations discussed by the audit team. The recommendations are categorized based on the potential safety payoff, as well as by time frame and cost. The safety payoff is a qualitative judgment of the effectiveness of the potential safety improvements. Each recommendation has a responsibility assigned to it stating whether MassDOT or the Town of Spencer would be responsible for implementing the recommended improvement. The term "Project" refers to improvements that are assumed to be included or could reasonably be accommodated as part of planned improvements. Project improvements have a cost category assigned to them; short-term and ongoing maintenance improvements have an order of magnitude cost assigned.

Table 3. Potential Safety Enhancement Summary

Safety Issue	Safety Enhancement	Responsibility	Safety Payoff	Time Frame	Cost
Signal Equipment	Replace green arrows with green balls on the Wall Street and signalized driveway approaches.	Town	Medium	Short-term	$1,000
Signal Phasing, Signal Equipment	Consider split phasing for the Pleasant Street, Wall Street and signalized driveway approaches, providing two separate phases for side street traffic - one for the Wall Street approach and a shared phase for Pleasant Street and the signalized driveway approaches	Town	High	Short-term	$5,000
Intersection Alignment, Signal Phasing, Signal Equipment, Lane Alignment/Lane Trap	Re-align the Main Street/Pleasant Street/Wall Street intersection so that Pleasant Street is aligned opposite Wall Street. A more typical 4-way intersection would eliminate the need for turn restrictions.	Project	High	Mid-term	High*
Intersection Alignment, Lane Alignment/Lane Trap	Increase enforcement of restricted turning movements and existing parking restrictions.	Town	Medium	Short-term	Use of police resources
Lane Widths, Lane Alignment/Lane Trap	Reconfigure the available pavement to provide wider lanes, clear lane transitions and defined parking limits.	Project	High	Mid-term	High*
Pavement Condition	Rehabilitate pavement.	Project	Medium	Mid-term	High*
Pedestrian Travel	Consider relocating the unsignalized crosswalk across Main Street based on pedestrian desire lines. The proposed location should be accompanied by signage placed on both sides of the roadway for added visibility.	Project	High	Mid-term	Low*
Pavement Markings	Reapply pavement markings.	Town (Short) Project (Mid)	Medium	Short-term/ Mid-term	Low*
Signal Equipment, Pedestrian Signals, Signal Operation, Sun Glare	Reconstruct the existing traffic signals with all new equipment including mast arms, overhead signals with backplates, and countdown pedestrian signals. Backplates shall have retroreflective borders conforming to current MassDOT and FHWA recommendations.	Project	High	Mid-term	High*
Pedestrian Signage	Remove R1-6 “STATE LAW Yield to Pedestrian in Crosswalk” signs from signalized intersections, and replace with R10-15 “Turning Vehicles Yield to Pedestrian” signs.	Town	Medium	Short-term	$500

Table 3. Potential Safety Enhancement Summary

Safety Issue	Safety Enhancement	Responsibility	Safety Payoff	Time Frame	Cost
Pedestrian Signage	Provide advance warning signage for the unsignalized crosswalk at Mechanic Street.	Town	Medium	Short-term	$500
Visibility	Update No Parking signage to restrict parking within 20 feet of all intersections.	Town	Medium	Short-term	$2,000
Visibility	Construct bulb-outs on intersection corners to define limits of on-street parking and provide additional area for pedestrian refuge.	Project	Medium	Mid-term	High*
Signal Equipment, Visibility	Provide emergency preemption as part of traffic signal reconstruction.	Project	Medium	Mid-term	Medium*
Fire Truck Turns	Increase parking restrictions on the west side of Mechanic Street to facilitate fire truck turning movements.	Town	Medium	Short-term	$500
Signage	Install lane usage signage on all multi-lane approaches.	Town	Medium	Short-term	$1,000
Signage	Remove private signs and temporary postings from utility poles and other structures within the Town right-of-way.	Town	Medium	Short-term	$500
Clearance Times	Study existing clearance times and implement changes as needed.	Town	High	Short-term	$2,000
Price Chopper Driveway	Consider closing the Price Chopper exit driveway onto Main Street.	Town	High	Short-term	$1,000
		Project	High	Mid-term	Low*
Snow Removal	Increase snow removal efforts to provide adequate clear paths along sidewalks.	Town	Medium	Short-term (Ongoing)	-
Wheelchair Ramps	Replace sidewalks and handicap ramps at all locations.	Project	Medium	Mid-term	High*
Wide Curb Cuts	Reduce width of the curb cuts for Cumberland Farms and John's Pizza by installing additional curbing between the two driveways	Project	Medium	Mid-term	Medium*

* These improvements should be included in the next submission of the proposed project. Improvements to be incorporated are assumed to be included as part of the overall project cost.

Appendix A. RSA Meeting Agenda

Agenda

Road Safety Audit

Spencer

Main Street (Route 9) between Elm Street and Maple Street (Route 31)

Meeting Location: Spencer Town Hall, Meeting Room – A
157 Main Street, Spencer, MA 01562
Monday, January 7th, 2013
12:30 PM – 3:30 PM

Type of meeting:	**High Crash Location – Road Safety Audit**
Attendees:	**Invited Participants to Comprise a Multidisciplinary Team**
Please bring:	**Thoughts and Enthusiasm!!**
12:30 PM	**Welcome and Introductions**
12:45 PM	**Discussion of Safety Issues** • Crash history, Speed Regulations – provided in advance • Existing Geometries and Conditions
1:30 PM	**Site Visit** • Walk to the Corridor of Main Street (Route 9) between Elm Street and Maple Street (Route 31) • As a group, identify areas for improvement
2:30 PM	**Discussion of Potential Improvements** • Discuss observations and finalize safety issue areas • Discuss potential improvements and finalize recommendations
3:30 PM	**Adjourn for the Day – but the RSA has not ended**

Instructions for Participants:

- **Before attending the RSA on January 7th, participants are encouraged to drive/walk through the corridor and complete/consider elements on the RSA Prompt List with a focus on safety.**
- **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 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.**

Appendix B. RSA Audit Team Contact List

Spencer RSA Sign In Sheet 1/7/13

NAME	AGENCY	EMAIL	PHONE
Greg Lucas	BETA Group	GLucas@BETA-Inc.com	781-255-1982
Lola Campbell	D3 MassDOT	alolade.Campbell@state.ma.us	~~508-854-3~~
Michael Bruce	MassDOT D3 Traffic	michael.bruce@state.ma.us	508 929 3914
Sujatha Mohanakrishnan	CMRPC	Sujatha@cmrpc.org	508.459.3335
DAN DANISKA	CMRPC	DDANISKA@CMRPC.ORG	508-459-3331
Kevin Krasnecky	CMRPC	KKrasnecky@cmrpc.org	508-459-1314
MATT CHASE	VHB	MCHASE@VHB.COM	508-752-1001
Michelle Buck	Spencer - Town Planner	mbuck@spencerma.gov	508-885-7500 x182
DAVE DARRIN	Chief of Police	ddarrin@spencerMA.gov	508-885-6333
Justin Curowitz	BETA Group	JCurowitz@Beta-inc.com	781-255-1482
Tom Curtier	Mass DOT	Thomas.Curtier@DOT.state.ma.us	
Silpa M	Mass DOT	Silpa.munnkutla@dot.state.ma.us	978 368 9637
Qing qing You	Mass DOT	You.q@husky.neu.edu	857-294-5465
COREY O'CONNOR	MASS DOT SAFETY	COREY.OCONNOR@STATE.MA.US	857.368-9638
Peter Calves	Mass Dot Safety	calves.p@husky.neu.edu	
Bob Parsons	Spencer Town	rparsons@spencerma.gov	
Eben Butler	SPENCER Highway	ebutler@spencerma.gov	
Steven Tyler	Spencer Hwy/U&F	styler@spencerma.gov	508-885-7525

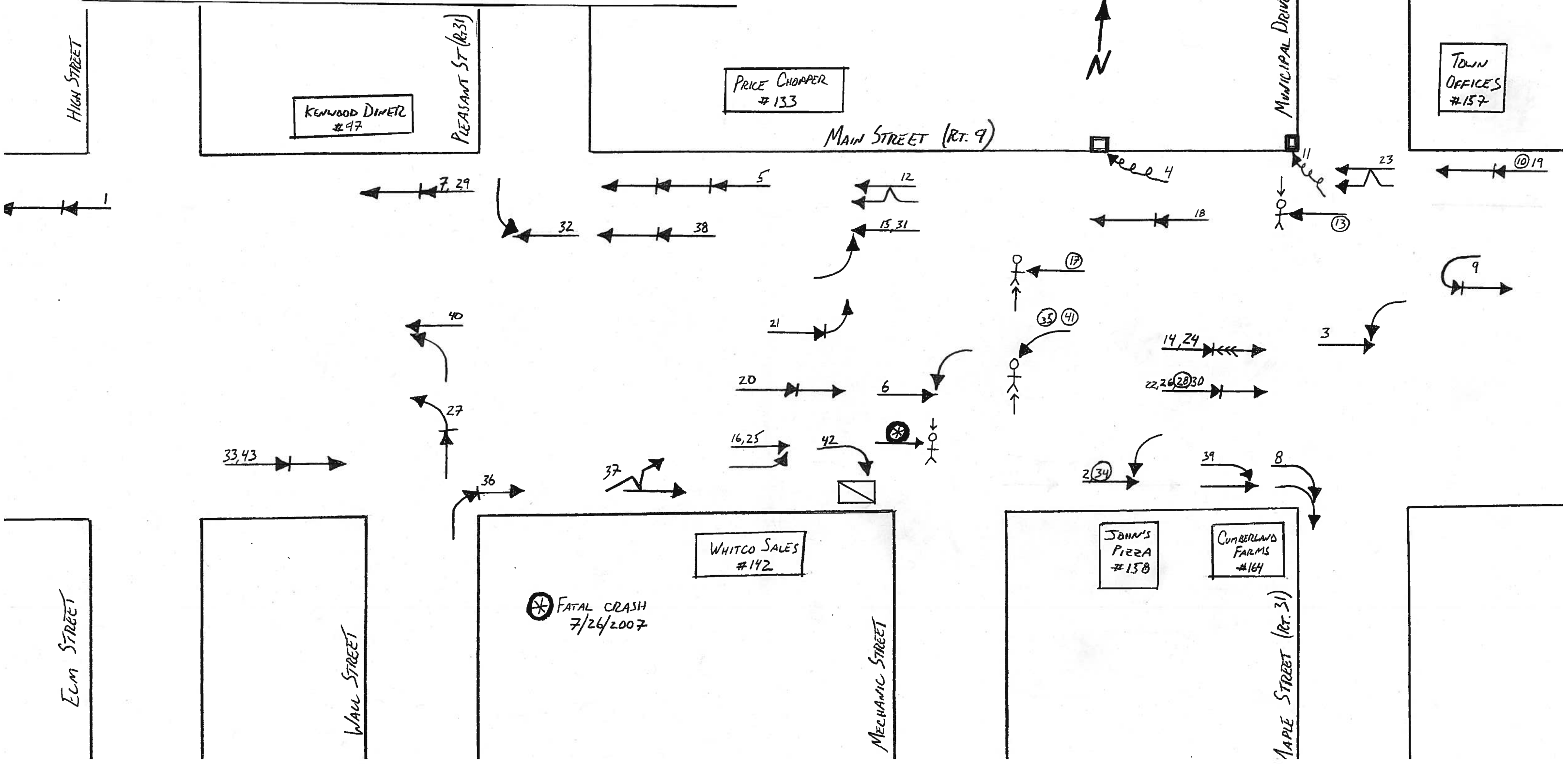
Appendix C. Detailed Crash Data

massDOT
Massachusetts Department of Transportation
Highway Division

COLLISION DIAGRAM

CITY/TOWN: SPENCER
DATE PREPARED: 8/27/12
REGION: CMRPC
PREPARED BY: CD
ROADWAY NAMES: MAIN ST (RT 9) BETWEEN ELM ST & MAPLE ST
TIME PERIOD ANALYZED: 7/15/2009 – 7/15/2012
SOURCE OF CRASH REPORTS: SPENCER POLICE DEPARTMENT

SYMBOLS		TYPES OF CRASH		SEVERITY	
→	Moving Vehicle	→	Head On		
⇇	Backing Vehicle	↗↘	Angle	○	Injury Accident
⇢	Non-Involved Vehicle	↘	Turning Move		
→ 🚶	Pedestrian	→ |	Rear End	●	Fatal Accident
→ ▭	Parked Vehicle	⟩⟨	Sideswipe		
→ □	Fixed Object	~	Out of Control		
→ 🚲	Bicycle				
→	Animal				



Crash Data Summary Table

Main Street (Rt. 9) between Elm Street and Maple Street; Spencer, MA

7/15/2009 - 7/15/2012

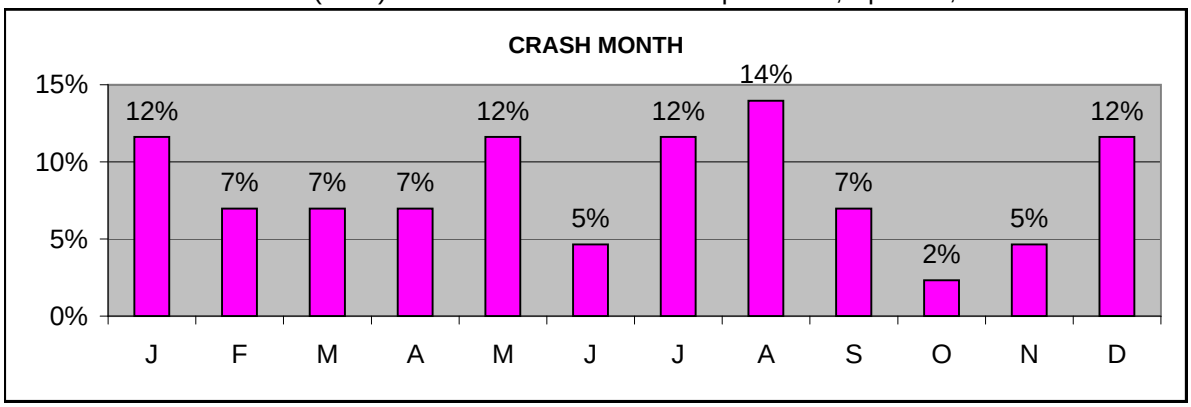
#	Crash Date	Crash Day	Time of Day	Manner of Collision	Light Condition	Weather Condition	Road Surface	Driver Contributing Code	Ages			Comments
	m/d/y			*Type*	*Type*	*Type*	*Type*	*Type*	*D1*	*D2*	*D3*	
1	8/22/09	Saturday	11:40 AM	Rear-end	Daylight	Clear	Dry	No Improper Driving	18	55		
2	8/30/09	Sunday	12:15 PM	Angle	Daylight	Cloudy	Dry	No Improper Driving	48	44		Non-involved operator in thru lane waved vehicle 2 into John's Pizza, Vehicle 1 traveling in RTL hit Vehicle 2
3	10/21/09	Wednesday	7:30 AM	Angle	Daylight	Cloudy	Dry	Failed to yield to right of way	40	18		
4	12/28/09	Monday	11:47 AM	Single Vehicle Crash	Daylight	Snow	Snow	No Improper Driving	22			Snowy and icy conditions, hit utility pole
5	1/10/10	Sunday	4:49 PM	Rear-end	Dusk	Clear	Dry	Inattention	62	40	20	
6	2/1/10	Monday	12:45 PM	Angle	Daylight	Clear	Dry	Failed to yield to right of way	65	58		
7	2/8/10	Monday	4:10 PM	Rear-end	Dusk	Clear	Dry	Glare	54	39		Vehicle 1 stopped to allow pedestrian to cross, Vehicle 2 did not see Vehicle 1 stop due to sun glare
8	2/11/10	Thursday	6:43 PM	Sideswipe, same direction	Dusk	Clear	Dry	Disregarded traffic signs, signals, road markings	48	Unk		Hit and run. Vehicle 1 turned right from RTL, Vehicle 2 turned right from thru lane and hit Vehicle 1
9	3/7/10	Sunday	6:55 PM	Rear-end	Dark - lighted roadway	Clear	Dry	Operating Vehicle in erratic, reckless, careless, negligent, or aggressive manner	18	23		Road rage
10	4/30/10	Friday	2:30 PM	Rear-end	Daylight	Clear	Dry	Inattention	59	49		Vehicle 2 inched forward in traffic, Vehicle 1 moved forward and rear-ended Vehicle 2
11	5/2/10	Sunday	10:37 AM	Single Vehicle Crash	Daylight	Clear	Dry	No Improper Driving	57			Vehicle lost control & hit traffic signal
12	5/13/10	Thursday	6:10 PM	Sideswipe, same direction	Daylight	Clear	Dry	No Improper Driving	29	22		
13	5/25/10	Tuesday	6:05 PM	Single Vehicle Crash	Daylight	Clear	Dry	Glare	38			Sun glare, crosswalk paint was faded
14	7/3/10	Saturday	10:20 PM	Rear-end	Dark - lighted	Clear	Dry	No Improper Driving	37	Unk		Hit and run. Vehicle 2 rolled back into Vehicle 1
15	7/13/10	Tuesday	5:40 PM	Angle	Daylight	Cloudy	Dry	No Improper Driving	49	17		Traffic stopped in thru lane, Vehicle 1 failed to see Vehicle 2
16	7/13/10	Tuesday	7:45 PM	Angle	Daylight	Cloudy	Dry	No Improper Driving	18	61		Entering traffic from parking space
17	8/5/10	Thursday	3:19 PM	Single Vehicle Crash	Daylight	Rain	Wet	Failed to yield to right of way	35			Non-involved vehicle stopped for pedestrian, Vehicle 1 passed non-involved vehicle on right and struck pedestrian
18	9/28/10	Tuesday	3:40 PM	Rear-end	Daylight	Rain	Wet	No Improper Driving	35	45		Traffic stopped for pedestrian crossing street
19	12/1/10	Wednesday	4:50 PM	Rear-end	Dark - lighted	Rain	Wet	No Improper Driving	51	18		
20	12/3/10	Friday	4:07 PM	Rear-end	Daylight	Cloudy	Dry	No Improper Driving	56	81		
21	12/10/10	Friday	12:00 PM	Rear-end	Daylight	Clear	Dry	No Improper Driving	75	Unk		Hit and run
22	3/9/11	Wednesday	1:00 PM	Rear-end	Daylight	Cloudy	Dry	Followed too closely	50	47		
23	3/25/11	Friday	3:00 PM	Sideswipe, same direction	Daylight	Clear	Dry	Inattention	60	61		Vehicle 1 traveling in LTL does not make left turn and side-swipes Vehicle 2 in thru lane
24	4/14/11	Thursday	4:00 PM	Rear-end	Daylight	Clear	Dry	No Improper Driving	24	39		Vehicle 1 rolled back into Vehicle 2
25	4/17/11	Sunday	12:23 PM	Angle	Daylight	Rain	Wet	Failed to yield to right of way	68	47		Entering traffic from parking space
26	5/23/11	Monday	5:52 PM	Rear-end	Daylight	Rain	Wet	Followed too closely	47	19		
27	5/25/11	Wednesday	6:52 PM	Rear-end	Daylight	Clear	Dry	Inattention	47	54		
28	6/2/11	Thursday	3:35 PM	Rear-end	Daylight	Cloudy	Dry	No Improper Driving	62	Unk		Operator 2 claims that foot slipped from brake pedal to gas pedal
29	7/9/11	Saturday	11:07 AM	Rear-end	Daylight	Clear	Dry	Inattention	18	24		
30	8/7/11	Sunday	9:36 AM	Rear-end	Daylight	Rain	Wet	Inattention	31	23		
31	8/18/11	Thursday	4:54 PM	Angle	Daylight	Clear	Dry	No Improper Driving	21	17		Traffic stopped in thru lane, Vehicle 1 failed to see Vehicle 2 passing traffic on right. *RTL does not begin until 25 ft. west of crash
32	8/26/11	Friday	11:30 AM	Angle	Daylight	Clear	Dry	Failed to yield to right of way	63	20		Operator 2 failed to stop at blinking red light, traffic in RTL on Main Street blocked view
33	9/3/11	Saturday	2:35 PM	Rear-end	Daylight	Clear	Dry	Inattention	21	50		
34	9/30/11	Friday	6:40 PM	Angle	Dark - lighted	Clear	Dry	Failed to yield to right of way	63	24		Traffic stopped in thru lane, Vehicle 2 failed to see Vehicle 1
35	11/10/11	Thursday	6:01 PM	Single Vehicle Crash	Dark - lighted	Rain	Wet		65			
36	11/28/11	Monday	2:46 PM	Angle	Daylight	Clear	Dry	Disregarded traffic signs, signals, road markings	28	31		
37	12/18/11	Sunday	2:36 PM	Sideswipe, same direction	Daylight	Clear	Dry	No Improper Driving	55	46		Vehicle 1 pulled to the side to wait for open parking spot, Vehicle 2 side-swiped Vehicle 1
38	1/1/12	Sunday	1:00 PM	Rear-end	Daylight	Clear	Dry	Followed too closely	65	71		
39	1/18/12	Wednesday	2:02 PM	Angle	Daylight	Clear	Dry	Made an improper turn	35	74		Vehicle 2 attempted to turn into Cumberland Farms from thru lane, hit Vehicle 1 in RTL
40	1/24/12	Tuesday	10:55 AM	Angle	Daylight	Clear	Dry	Failed to yield to right of way	88	44		
41	1/27/12	Friday	5:07 PM	Single Vehicle Crash	Dark - lighted	Rain	Wet	Failed to yield to right of way	69			
42	6/16/12	Saturday	7:00 PM	Sideswipe, same direction	Daylight	Clear	Dry	No Improper Driving	65	53		
43	7/11/12	Wednesday	7:30 AM	Rear-end	Daylight	Clear	Dry	Followed too closely	62	39		
*	7/26/07	Thursday	7:18 AM	Single Vehicle Crash	Daylight	Clear	Dry	Glare	44			Fatal crash with pedestrian

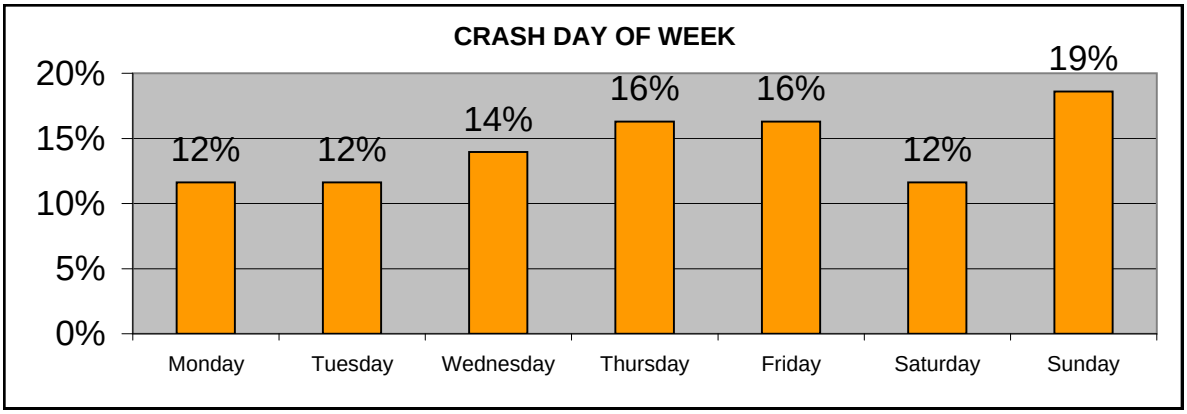
* Crash was not included in analysis charts.

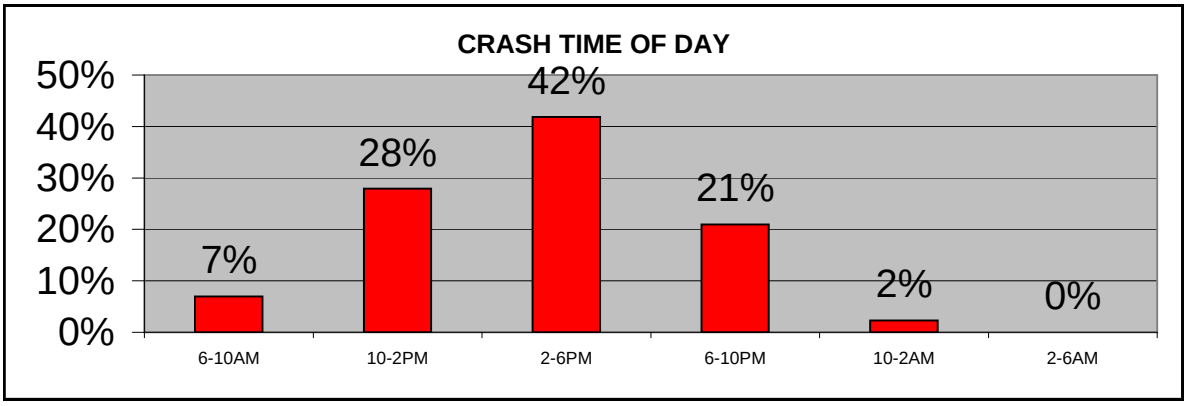
Summary based on Crash Reports obtained from the Spencer Police Department.

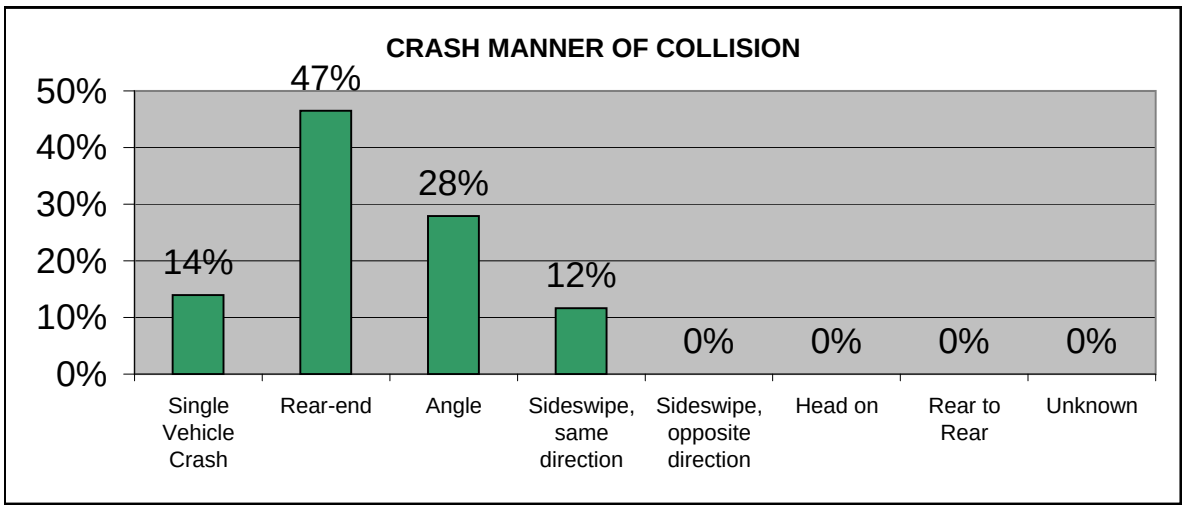
Crash Data Summary Tables and Charts

Main Street (Rt. 9) between Elm Street and Maple Street; Spencer, MA



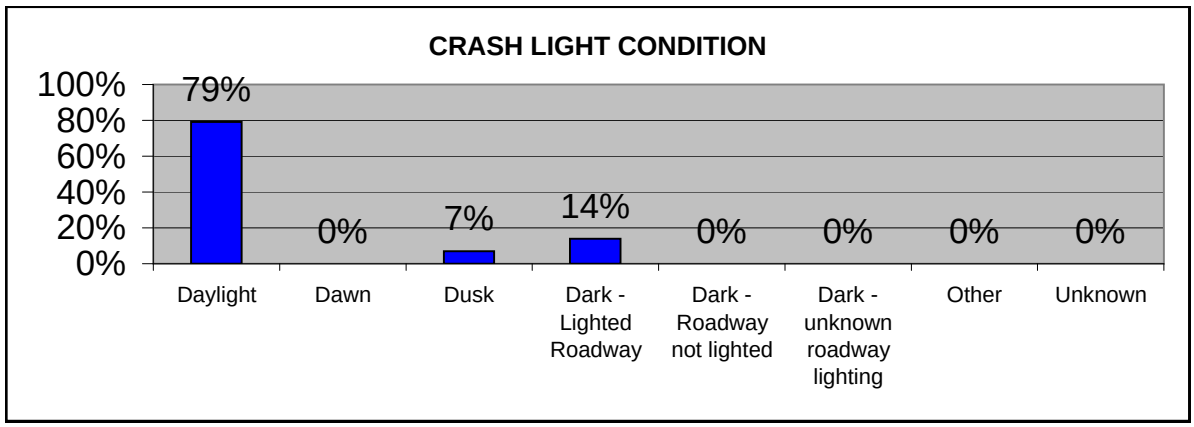


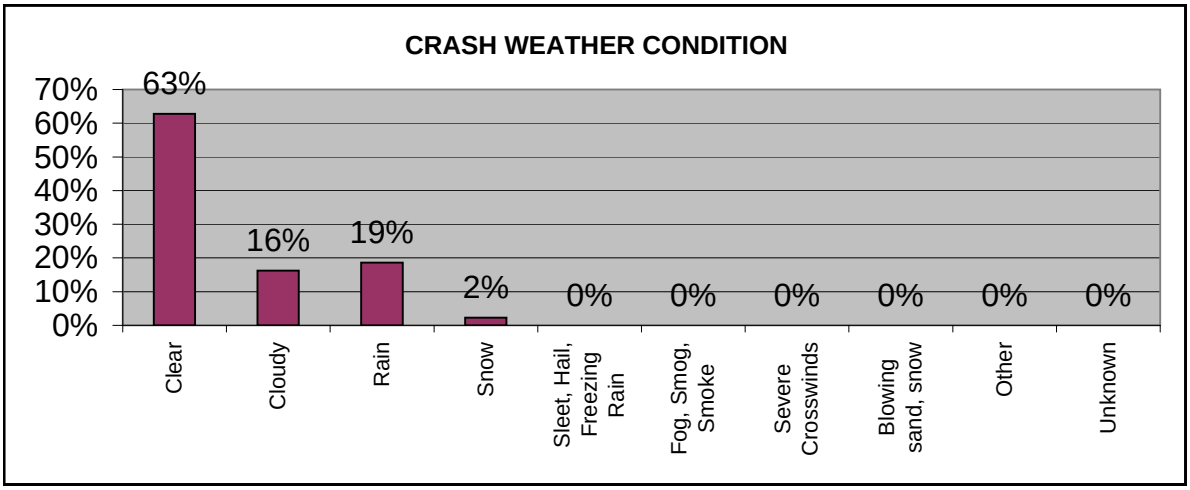


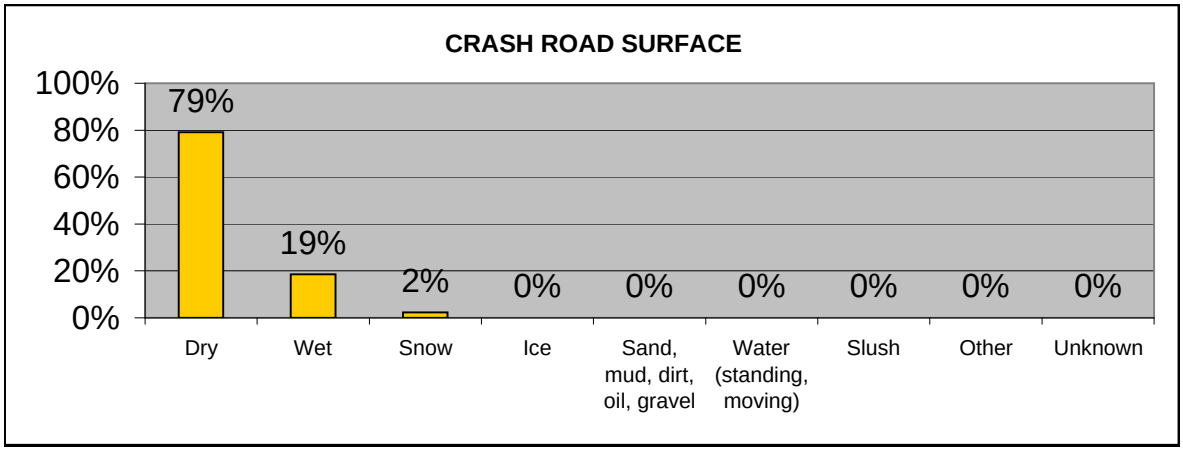


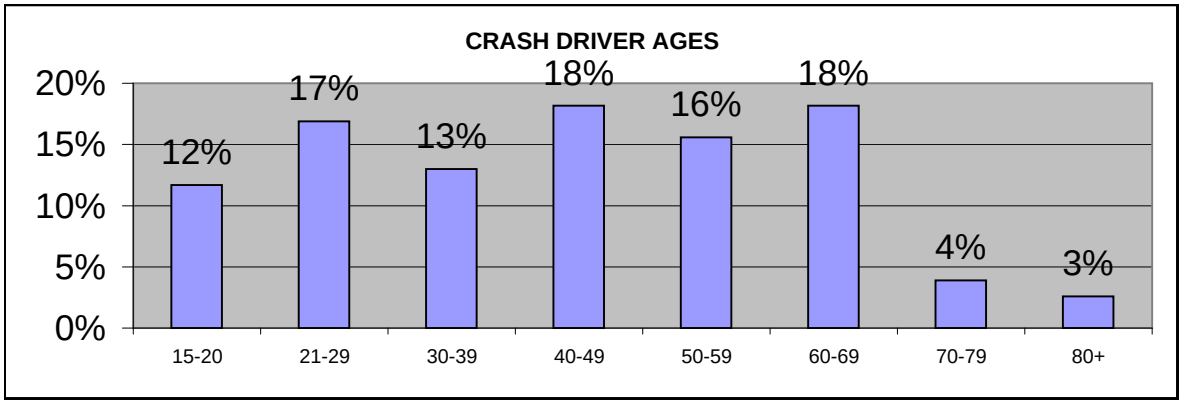
Crash Data Summary Tables and Charts

Main Street (Rt. 9) between Elm Street and Maple Street; Spencer, MA









Appendix D. Speed Regulations

JUL 01 1981

TOWN OF SPENCER
SPECIAL SPEED REGULATION NO. 7069

Highway Location: SPENCER

Authority In Control: TOWN OF SPENCER

Name of Highway: ROUTE 31

In accordance with the provisions of Chapter 90, Section 18, of the General Laws (Ter. Ed.) as amended, the following Special Speed Regulation is

hereby Adopted

by the Board of Selectmen

of the Town of Spencer

That the following speed limits are established at which motor vehicles may be operated in the areas described:

ROUTE 31-NORTHBOUND

Beginning at the Charlton Town Line
Thence northerly on Route 31
3.70 miles at 40 miles per hour
0.53 " " 25 " " " ending at Route 9.

And beginning again 100 feet north of Route 9.
Thence northerly on Route 31
1.37 miles at 30 miles per hour
1.49 " " 40 " " "
1.03 " " 45 " " "
1.17 " " 40 " " "
0.57 " " 30 " " " ending at the Paxton Town Line; the total distance being 9.86 miles.

ROUTE 31-SOUTHBOUND

Beginning at the Paxton Town Line
Thence southerly on Route 31
0.57 miles at 30 miles per hour
1.17 " " 40 " " "
1.03 " " 45 " " "
1.49 " " 40 " " "
1.39 " " 30 " " " ending at Route 9.

And beginning again 100 feet south of Route 9
Thence southerly on Route 31
0.51 miles at 25 miles per hour
3.70 " " 40 " " " ending at the Charlton Town Line; the total distance being 9.86 miles.

Operation of a motor vehicle at a rate of speed in excess of these limits shall be prima facie evidence that such speed is greater than is reasonable and proper.

The provisions of this regulation shall not, however, abrogate in any sense Chapter 90, Section 14, of the General Laws (Ter. Ed).

Date of Passage

March 23, 1981

Board of Selectmen

Attest Elizabeth W. Noga
Town Clerk

COMMONWEALTH OF MASSACHUSETTS
DEPARTMENT OF PUBLIC WORKS

SPECIAL SPEED REGULATION NO. 7069

The Department of Public Works and the Registrar of Motor Vehicles, acting jointly, do hereby certify that this regulation is consistent with the public interests.

Standard signs must be erected at the beginning of each zone.

DATE: JUL 01 1981

FOR THE DEPARTMENT OF PUBLIC WORKS

BY: Traffic Engineer

Robert A. Pinora
Chief Deputy Registrar

THE COMMONWEALTH OF MASSACHUSETTS
HIGHWAY DEPARTMENT
TOWN OF SPENCER
SPECIAL SPEED REGULATION #7069-A

Highway Location: SPENCER

Authority In Control: TOWN OF SPENCER

Name of Highway (s): ROUTE 31

In accordance with the provisions of Chapter 90, Section 18, of the General Laws (Ter. Ed.) as amended, the following Special Speed Regulation is

Hereby Adopted

by the Board of Selectmen

of the Town of Spencer

Special Speed Regulation number 7069, dated July 1, 1981 is hereby amended as follows:

That the following speed limits are established at which motor vehicles may be operated in the areas described:

ROUTE 31 - NORTHBOUND

By striking out the clauses reading;
1.37 miles at 30 miles per hour
1.49 miles at 40 miles per hour
And inserting in place thereof
0.95 miles at 30 miles per hour
1.91 miles at 40 miles per hour

ROUTE 31 - SOUTHBOUND

By striking out the clauses reading;
1.49 miles at 40 miles per hour
1.39 miles at 30 miles per hour
And inserting in place thereof
1.91 miles at 40 miles per hour
0.97 miles at 30 miles per hour

Operation of a motor vehicle at a rate of speed in excess of these limits shall be prima facie evidence that such speed is greater than is reasonable and proper.

The provisions of this regulation shall not, however, abrogate in any sense Chapter 90, Section 14, of the General Laws (Ter. Ed.).

Date of Passage Nov. 18 1996

BOARD OF SELECTMEN

Attest Jean M. Mulhall
TOWN CLERK

COMMONWEALTH OF MASSACHUSETTS
HIGHWAY DEPARTMENT

SPECIAL SPEED REGULATION NO. 7069-A

The Highway Department and the Registry of Motor Vehicles, acting jointly, do hereby certify that this regulation is consistent with the public interest.

Standard signs must be erected at the beginning of each zone.

DATE: 9-25-97

FOR THE HIGHWAY DEPARTMENT

BY: _____
Traffic Engineer

FOR THE REGISTRY OF MOTOR VEHICLES

BY: Robert P. McDonnell
Chief Deputy Registrar

4/21/82

TOWN OF SPENCER
SPECIAL SPEED REGULATION
NO. 7118

Highway Location: TOWN OF SPENCER

Authority In Control: TOWN OF SPENCER

Name of Highway(s);: MECHANIC STREET
GREENVILLE ROAD

In accordance with the provisions of Chapter 90, Section 18, of the General Laws (Ter. Ed.) as amended, the following Special Speed Regulation is

hereby Adopted

by the Board of Selectmen

of the Town of Spencer

That the following speed limits are established at which motor vehicles may be operated in the areas described:

MECHANIC STREET---NORTHBOUND

Beginning at the Fish and Game Club
thence northerly on Mechanic Street
0.58 miles at 25 miles per hour ending at Cherry Street; the total distance being 0.58 miles.

MECHANIC STREET---SOUTHBOUND

Beginning at Main Street (Route 9)
thence southerly on Mechanic Street
0.66 miles at 25 miles per hour ending at the Fish and Game Club; the total distance being 0.66 miles.

GREENVILLE STREET---NORTHBOUND

Beginning at Chickering Road
thence northerly on Greenville Street
2.57 miles at 30 miles per hour
0.34 miles at 25 miles per hour ending at Main St. (Route 9); the total distance being 2.91 miles.

GREENVILLE STREET---SOUTHBOUND

Beginning at Main St. (Route 9)
thence southerly on Greenville St.
0.34 miles at 25 miles per hour
2.57 miles at 30 miles per hour ending at Chickering Road; the total distance being 2.91 miles.

4/21/82

NO. 7118

Operation of a motor vehicle at a rate of speed in excess of these limits shall be prima facie evidence that such speed is greater than is reasonable and proper.

The provisions of this regulation shall not, however, abrogate in any sense Chapter 90, Section 14, of the General Laws (Ter. Ed).

Date of Passage March 22, 1982

Richard G. G. Smith

[signature]

William G. [signature]

Board of Selectmen

Attest Elizabeth W [signature]
Town Clerk

COMMONWEALTH OF MASSACHUSETTS
DEPARTMENT OF PUBLIC WORKS

SPECIAL SPEED REGULATION NO. 7118

The Department of Public Works and the Registrar of Motor Vehicles, acting jointly, do hereby certify that this regulation is consistent with the public interests.

Standard signs must be erected at the beginning of each zone.

DATE: 4/21/82

FOR THE DEPARTMENT OF PUBLIC WORKS

BY: [signature]
Traffic Engineer

Robert A. Panora
Chief Deputy Registrar