
Traffic Impact and Access Study

**Proposed Highfield Village Development
Lunenburg, Massachusetts**

Updated Analysis

Prepared For

**JEG Holdings, LLC
Town of Lunenburg**

Prepared By

MS Transportation Systems, Inc.
Consulting Engineers and Planners
P.O. Box 967, 300 Howard Street
Framingham, Massachusetts 01701
(508) 620-2832



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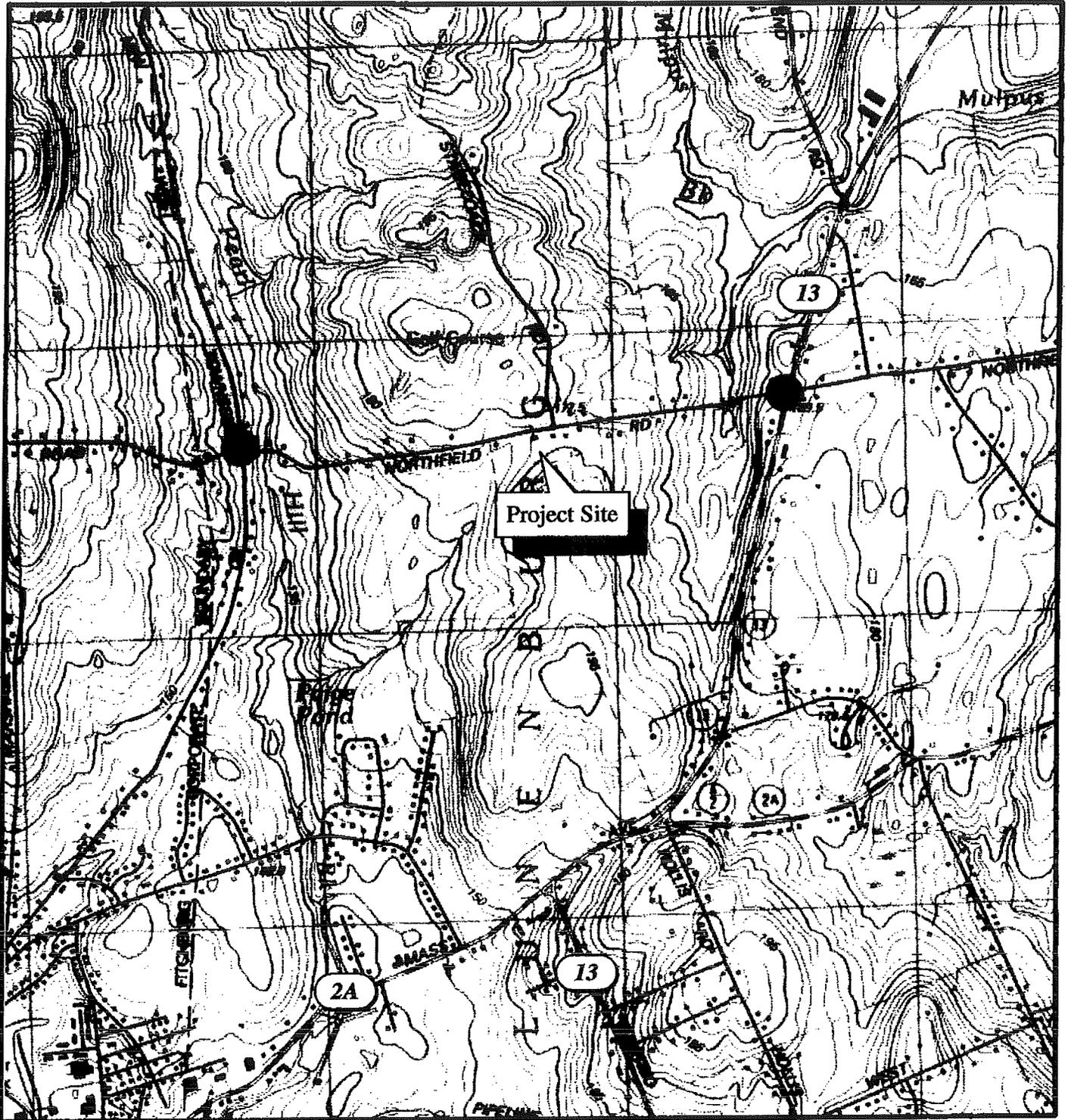
Introduction

This traffic impact and access study provides an updated analysis of the traffic impacts, area circulation and access-egress characteristics associated with the proposed Highfield Village to be located in the Town of Lunenburg, Massachusetts. The project is to be located off of Northfield Road. The project location, with respect to the area's roadway system, is shown on Figure 1.

Highfield Village is a proposed residential development currently consisting of 66 single family homes. Access to the residential development is proposed to be via a driveway at Northfield Road intersecting Northfield Road from the south.

This study includes analysis and evaluation of existing and future (No-Build and Build) traffic volume networks, roadway/site access, traffic circulation and safety considerations. Information and data collected as part of the original study¹ were used as appropriate. In general, the traffic study follows guidelines established by the Executive Office of Transportation (EOT) and the Institute of Transportation Engineers (ITE).

¹ MS Transportation Systems, Inc., Traffic Impact & Access Study Proposed Highfield Village, Lunenburg, MA, February, 2005.



Project Location

*Proposed Highfield Village Development
Lunenburg, Massachusetts*



Not to Scale

Executive Summary

This study was completed for the purpose of assessing potential traffic impacts and future access characteristics associated with the proposed Highfield Village, a residential project consisting of 66 single family homes. The study involved an updated assessment of existing and future traffic volume networks, forecasts of new traffic, an evaluation of site access/traffic roadway/intersection operational and safety consideration. The following paragraphs summarize the results of the study.

Existing Conditions

The study area includes residential, golf course, and wooded area. Northfield Road, which provides direct access to the project, is a two-lane local roadway in the project vicinity and under local jurisdiction. Automatic Traffic Counts (ATR) collection indicated that daily traffic volume on Northfield Road close to the project site was approximately 1,445 vehicles. Peak hour flows represent approximately 8.3% and 9.6% of the daily flows.

The analysis of existing conditions has indicated that the Northfield Road intersection with New West Townsend Road operates at good levels of service while the unsignalized Northfield Road intersection with Route 13 operates at LOS 'E' or 'F' depending on the peak period and minor intersecting approach.

In addition to the volume studies, a review of the accident history was completed. The accident data from the Massachusetts Highway Department (MHD) indicated that no severe safety related issues exist at the study intersections.

Future Conditions

Traffic was forecasted for both the No-Build and Build conditions. Based on the guidelines published by the Institute of Transportation Engineers, it was estimated that the project will generate approximately 710 vehicle trips on a weekday basis consisting 355 entering and 355 exiting trips. The project is also expected to generate 56 trips (14 entering/42 exiting) during the morning peak hour and 74 trips (457 entering/27 exiting) during the evening peak hour.

Vehicle trips were assigned to the study area network with consideration of the regional employment and current traffic patterns. It was estimated that 74% of the project traffic would be oriented towards Chase Road (Route 13). The future No-Build networks were developed for the year 2012 based on a background growth rate.

The analysis showed that the New West Townsend Street/Northfield Road and the Site Drive intersections are expected to operate at good levels of service during AM and PM peak periods. The Northfield Road intersection with Route 13, however, is estimated to operate at LOS 'F' with or without the proposed development.

Recommendations

While the project access can be safely provided and site traffic generally accommodated on the abutting street system, a number of recommendations have been made as follows:

- Install a STOP sign and mark a STOP bar on the proposed site drive approach at the Northfield Road intersection.
- Consider widen the eastbound Northfield Road approach to Chase Road if feasible with layout to provide a two lane approach.
- An advanced warning sign of "Stopped Vehicles Ahead" is proposed to be installed on Northfield Road for eastbound motorists approximately 200 feet prior to the Route 13 intersection.
- The analysis of the Northfield Road intersection with Chase Road indicated long side street delays occurring under existing conditions and future conditions without the project. The review also showed the majority of the accidents at the intersection of Northfield Road with Chase Road are angle type potentially due to the left turning vehicles delays in entering the Chase Road traffic stream. An analysis of projected future volumes indicated that signal warrant criteria would be satisfied. The Town, therefore, should consider signalizing the intersection of Northfield Road with Chase Road regardless of the proposed project which would address the level of service issues and alleviate safety concerns. As part of this study, a conceptual improvement plan was prepared for the purpose of providing the Town information to the feasibility of improving this location.
- Whether or not this proposed project is approved, the Town should implement an improved speed management program for Northfield Road that could include "Thickly Settled" speed warning signs, a regular application of speed trailer to remind motorists of speed limits and obtaining data on actual speeds and increased enforcement.

Existing Traffic Conditions

A. GEOMETRY/TRAFFIC OPERATIONS

The proposed Highfield Village residential development is to be located on Northfield Road, between Chase Road (Route 13) and New West Townsend Road in the Town of Lunenburg, Massachusetts. As described previously, access to the project is proposed to be provided through a site drive off Northfield Road, located approximately 800 feet east of the Maplewood Golf Course driveway. This project focused on the study of major roadways/intersections in the vicinity of the site including Northfield Road, Chase Road (Route 13), and New West Townsend Road. The following sections describe the physical network and operating characteristics of the study area.

Northfield Road

Northfield Road is a two-lane, local roadway that has a general east-west alignment. It connects Route 2A in the east and New West Townsend Road in the west in the Town of Lunenburg. The roadway can be characterized as rolling alignment in the study area with a horizontal curve close to its intersection with New West Townsend Road. The pavement width ranges from 20 to 22 feet, depending on location. Center lines, edge lines, and sidewalks do not exist along the Northfield Road section between Chase Road and New West Townsend Road. Posted speed limits were not observed as well in the study area. The bituminous pavement is considered to be in average to good condition.

The Northfield Road intersection with Chase Road is a four-way, unsignalized intersection with a "STOP" sign installed on the Northfield Road approaches. All intersecting roadways contain one lane. Northfield Road contains an approximately 15% downgrade from east to west about 100 feet west of the intersection. Crosswalks do not exist at this intersection.

The Northfield Road intersection with New West Townsend Road is a four-way, unsignalized intersection with a "STOP" sign installed on the Northfield Road approaches. Single lanes exist on all intersection approaches. Crosswalks do not exist at this intersection.

Land uses along Northfield Road in the study area consist of residential uses, a golf course, and wooded areas. The Maplewood Golf Course is located approximately several hundred feet west of the project site.

Chase Road (Route 13)

Chase Road is a major two-lane arterial that connects the Town of Townsend in the north with the Town of Lunenburg in the south. It is under local jurisdiction and has a general north-south alignment in the study area. The typical cross-section of Route 13 near the project area consists of two 14-foot lanes and 6-foot shoulders. The posted speed limit is 40 mph in the immediate study location. Sidewalks do not exist along the roadway in the study area. The bituminous pavement is considered to be in good condition.

Land uses along Chase Road in the vicinity of Northfield Road consist of wooded, undeveloped land and residential uses, with scattered commercial land uses also in this area.

New West Townsend Road

New West Townsend Road is a two-lane, local roadway that has a general north-south alignment. It connects with Lunenburg Road in the north in the Town of Townsend and gets into the City of Fitchburg in the south. The pavement width is 22 feet in the immediate study location with a single yellow center line separating the directional flows. Posted speed limits, edge lines, or sidewalks were not observed in the study area. The bituminous pavement is considered to be in above average condition in the study area.

Land uses along New West Townsend Road consist of residential uses and wooded areas.

B. TRAFFIC VOLUMES

This analysis used historical traffic volume data as a starting point. These data were collected in February 2005. The historical data included the weekday morning peak period (7:00AM-9:00AM) and evening peak period (4:00PM-6:00PM) manual turning movement and vehicle classification counts (TMC) as well as a 24-hour Automatic Traffic recorder (ATR) counts which was collected on Northfield Road in the vicinity of the project site. In addition to this, new 24-hour ATR counts were performed in March 2007 on Northfield Road west of Chase Road and on Chase Road south of Northfield Road. The ATR count data of 2007 is summarized in Table 1, and was utilized to determine Average Daily Traffic (ADT) flows as well as to determine the traffic volume changes on the study area roadways since the 2005 count period.

TABLE 1
SUMMARY OF OBSERVED TRAFFIC DATA
Weekday Traffic Volumes

Location	Date	Total (vehicles)	Morning Peak	K (%)	Evening Peak	K (%)
Northfield Road west of Chase Road	3/07	1,445	121	8.3	141	9.6
	2/05	1,450	140	9.7	160	11.0
Chase Road south of Northfield Road	3/07	12,340	763	6.2	1,017	8.2
Chase Road north of Massachusetts Ave	5/04	14,975	867	5.8	1,168	7.8

Note: Data has been rounded.

As can be seen, the 2007 ATR data indicated a weekday volume of approximately 1,445 vehicles on Northfield Road. Peak hours represent between 8.3 and 9.6 percent of the daily. Similarly, it was observed that Chase Road carries approximately 12,340 vehicles on a daily basis; and peak hours represent between 6.2 and 8.2 percent of the daily. It was noted that given the time of year, the golf course is inactive. As also noted, the 2007 flows are similar or lower than the 2005 flows.

The turning movement count (TMC) data and the Automatic Traffic Recorder (ATR) count data are included in the Appendix.

Seasonal Adjustments

In developing the 2007 analysis network, historical and seasonal traffic volumes for the area from 2000-2005 were reviewed to determine the relationship between the average month traffic volumes and traffic volumes for the months of February, and to determine if seasonal adjustments were required for the turning movement counts of February 2005. For this purpose, data from the closest Massachusetts Highway Department (MHD) permanent count stations to the site (Station No. 5 on Route 12 in Sterling; Station 3008 on Route 2 in Westminster; and Station 3296 on Route 190 in Lancaster) were examined.

Monthly count data available from the MHD Traffic Count Report² from the above stations indicated that traffic during the month of February, on an average, were approximately 7.5% lower than the average month volumes. The original February data collected in 2005 was increased by 7.5% to reflect the average condition.

Further, the ATR data of 2005 and 2007 were compared to determine the change in traffic volume in the vicinity of the project site. The comparison indicated that the traffic on Northfield Road has decreased at a rate of approximately 0.2% per year from 2005 to 2007 which indicate essentially stable, no change conditions. A decrease in traffic flow on Chase Road of approximately 6.0% per year for the same time period was also noted. Based on this observation, no traffic growth adjustment was used to develop the existing 2007 traffic network from the 2005 data.

In addition to seasonal and growth adjustments, traffic related with the existing golf course was estimated using the Institute of Transportation Engineers (ITE) Land Use Code (LUC) 430. The estimated traffic was then applied to the existing traffic networks based on the estimated trip distribution pattern that is based on current volume patterns.

Figure 2 illustrates the estimated 2007 weekday morning and evening peak hour traffic volume networks.

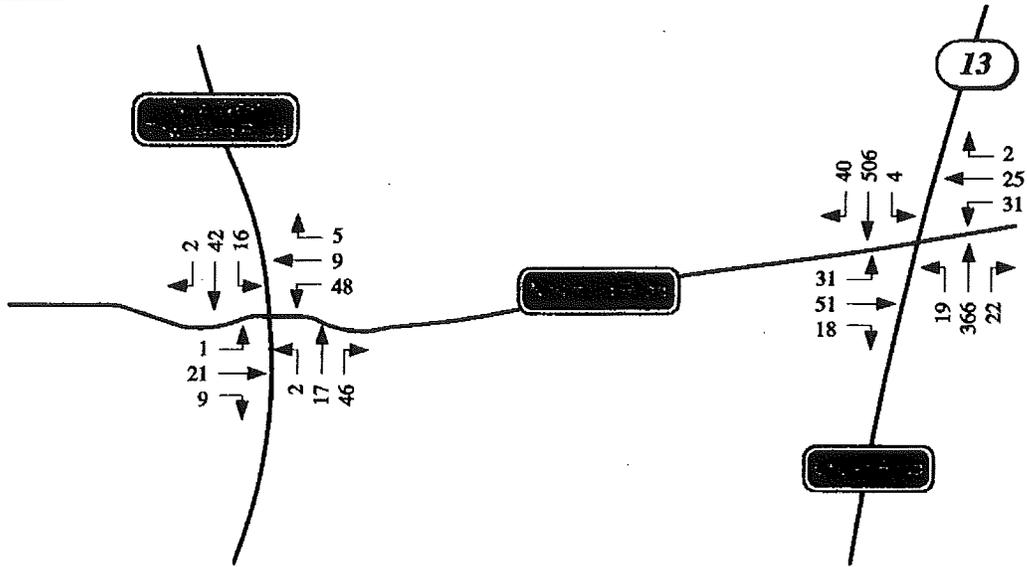
C. ACCIDENT DATA REVIEW

Updated accident data for the Town of Lunenburg was obtained from the Massachusetts Highway Department's (MHD) Accident Record System (ARS) and was compiled for the study locations. Table 2 summarizes the accident history at analysis intersections for the three-year period from 2003 to 2005.

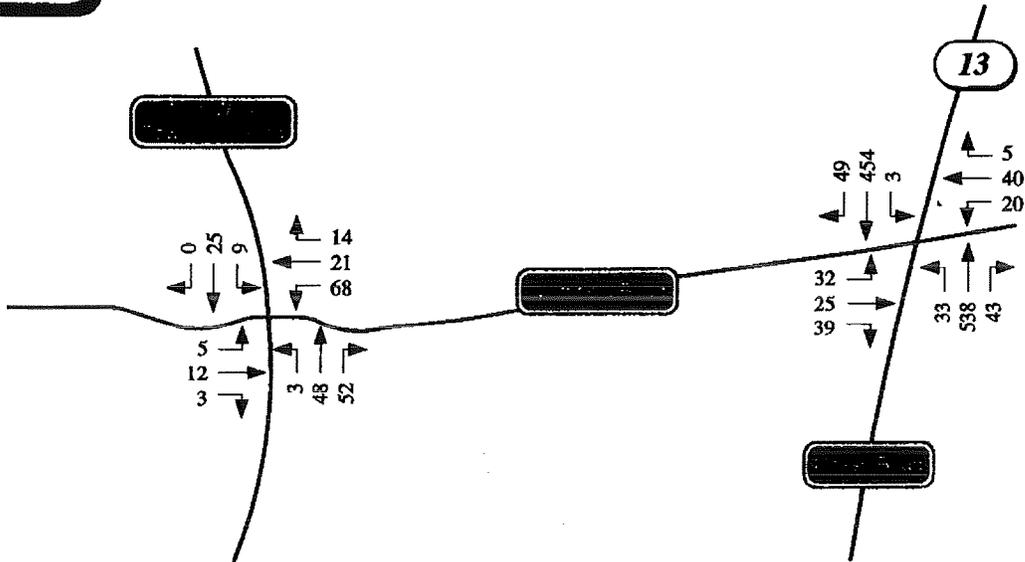
Review of the accident data indicated a total of 15 reported accidents at the two analysis intersections. Of the total recorded accidents over the three-year analysis period, five (5) involved personal injury and the remaining 10 resulted in property damage only. As indicated by the data reported, none of the accidents during this three-year period involved any fatalities.

² Mass Highway Department, 2005 Traffic Volumes for the Commonwealth of Massachusetts, Boston, 2005.

AM Peak



PM Peak



**Estimated 2007 Average Month
Traffic Networks**

*Proposed Highfield Village Development
Framingham, Massachusetts*



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TABLE 2
SUMMARY OF ACCIDENT DATA (2003-2005)

Location	NUMBER OF ACCIDENTS		Crash Rate	SEVERITY				ACCIDENT TYPE				PERCENT DURING	
	Total	Average per Year		PD ^a	PI ^b	F ^c	CM ^d	RE ^e	HO ^f	FO ^g	Other	Peak Hours	Wet/Icy Conditions
Route 13 @ Northfield Road	11	3.67	0.75	8	3	0	5	0	3	0	3	363%	18%
Northfield Road @ New West Townsend Road	4	1.33	1.35	2	2	0	1	0	0	0	3	25%	0%
Total	15			10	5	0	6	0	3	0	6	40%	13%

a Property Damage Only b Personal Injury c Fatality d Cross Movement (or Angle) e Rear End f Head On g Fixed Object

As can be seen in Table 2, angle-type accidents accounted for a large percentage of the total accidents. Wet, snowy and/or cloudy conditions were a contributing factor in two of the accidents (13%), while the remaining accidents occurring under clear weather conditions. Of the total recorded accidents, six accidents occurred (40%) during the peak hour periods.

As part of this safety review, crash rates were also computed for the above locations that had reported accidents. The crash rate considers the number of accidents that occur, but also accounts for the number of vehicles passing through the intersection. It provides another measure of the accident experience at a location. The rates can then be compared to the MHD averages. The Massachusetts Highway Department District 3 average crash rate for unsignalized intersections is 0.79. The computed crash rates are also included in Table 2 with the details in the Appendix.

As can be seen the crash rate computed at the Northfield Road intersection with New West Townsend Road exceeds the District 3 average. However, considering the number of accidents occurred at the intersection (1.3 per year), it can be concluded that no safety-related issues exist at this intersection.

With respect to the Route 13 intersection with Northfield Road, while the average number of crashes per year are relatively low, the crash rate of 0.75 is just below the District 3 average.

Probable Impacts of the Project

In this section of the report, the study evaluates the impact of the Highfield Village project on the surrounding roadway network under future No-Build and Build conditions. For the purposes of this analysis, it was assumed that the project would be built-out over five (5) years. The year 2012 No-Build traffic network was developed by considering existing traffic volumes, area traffic growth over five years, and traffic from site-specific (background) developments together. The addition of site generated traffic volumes to the No-Build traffic volume network produced the Build traffic network.

A. NO-BUILD TRAFFIC VOLUMES

This section of the report analyzes potential impacts to area traffic conditions taking into account traffic growth on area roadways and traffic from unbuilt but approved developments in the immediate vicinity of the site.

With the base year 2007, year 2012 was selected as the build-out year of proposed project, which complies with the State's guidelines for traffic analysis. The year 2012 No-Build scenario represents traffic situation at analysis intersections five years into the future, before traffic from the proposed development is incorporated into the traffic network. In general, traffic volumes have tended to increase over time. This is due to combinations of overall population growth, household growth and auto ownership growth. In addition, traffic volumes in a specific area may be increasing due to land development. To provide a relatively reasonable future traffic estimate, two components, general background growth in traffic and traffic from site-specific developments were researched to develop the No-Build traffic scenario.

1. Background Traffic Growth

The traffic growth pattern in close proximity of the project site has already been discussed earlier. However, the historical traffic count data from the Massachusetts Highway Department (MHD) was also reviewed. The "Traffic Count Report" stations previously listed established that traffic for the area grew at an approximate rate of 1.5% per year. MassHighway Group data has indicated virtually no or minimal growth the past several years. As discussed earlier, traffic in close proximity of the project site has shown a downward trend or least stable level in the past two years. However, a 2% annual growth rate was selected in order to present a conservative analysis as well as to be consistent with the previous study completed for the project. This growth factor was cumulatively applied to the adjusted 2007 existing peak hour traffic volumes for five (5) years to obtain growth in traffic volumes.

2. Site-specific Development

In addition to background growth, research on potential additional projects that are anticipated within the build-out time frame of five (5) years in the vicinity of the study area that could potentially impact the development analysis intersections was completed. There are several projects approved or under construction in the project area. However, these projects are small peak hour trip generators and were assumed to be taken into account in the background growth rate.

The year 2012 No-Build traffic volumes were thus determined by adding the five (5) year traffic volume growth to the existing traffic volumes. The No-Build traffic volumes projected for weekday morning and evening peak hours at the analysis intersections are shown in Figure 3.

B. BUILD TRAFFIC VOLUMES

In this section, site traffic for the proposed residential project is estimated and assigned to roadways and intersections in the immediate vicinity of the site to develop the Build traffic conditions. The project currently being advanced consists of 66 single family homes. There is an adjacent parcel that could accommodate up to 17 additional homes, however, plans for this parcel have not been developed. Consequently, this detailed evaluation has been for the 66 unit project.

1. Trip Generation

In order to estimate the number of trips that will be generated by the proposed development, statistics published by the Institute of Transportation Engineers (ITE) in Trip Generation³ for similar land uses were examined. ITE trip generation statistics represent compilation of data from studies/projects throughout the United States, on trip generation characteristics for different types of land uses and developments.

The land use type in this study is single family homes, which correspond to the ITE Single Family Detached Housing (Land Use Code 210) code. Using the independent variables of the number of units, trips were projected for the proposed development project. The trips generated for the residential development are presented in Table 3.

**TABLE 3
SUMMARY OF TRIP GENERATION**

	In	Out	Total
Weekday			
Daily	355	355	710
AM Peak Hour	14	42	56
PM Peak Hour	47	27	74

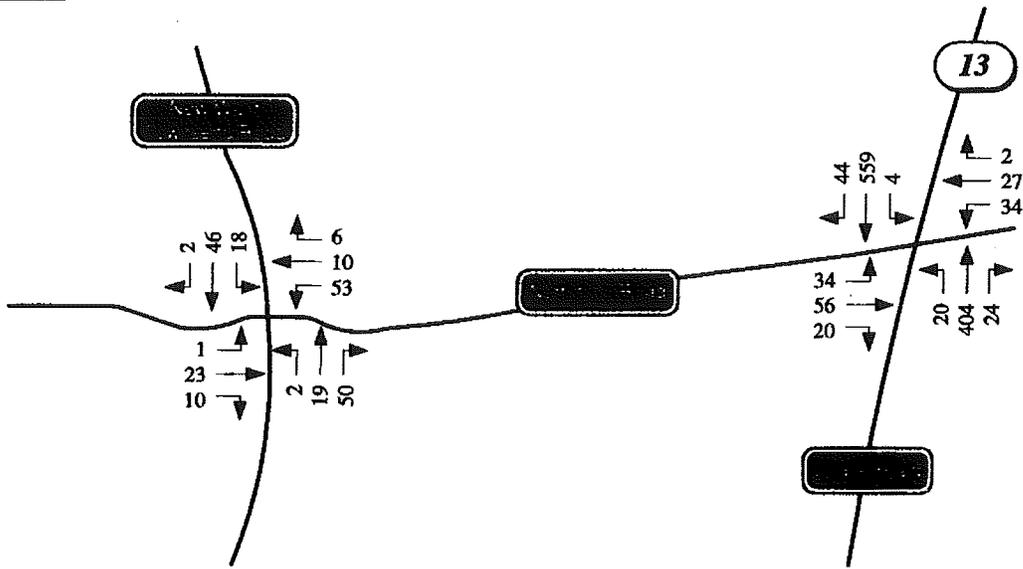
Source: ITE Trip Generation Land Use Code 210

As shown in Table 3, the residential development as proposed and based on the ITE Trip Generation rate is estimated to generate 710 vehicle trips over the course of an average day with 355 entering and 355 exiting trips. The peak hours are expected to generate 56 (14 entering/42 exiting), and 74 (47 entering/27 exiting) vehicle trips during the morning and afternoon peak hours, respectively.

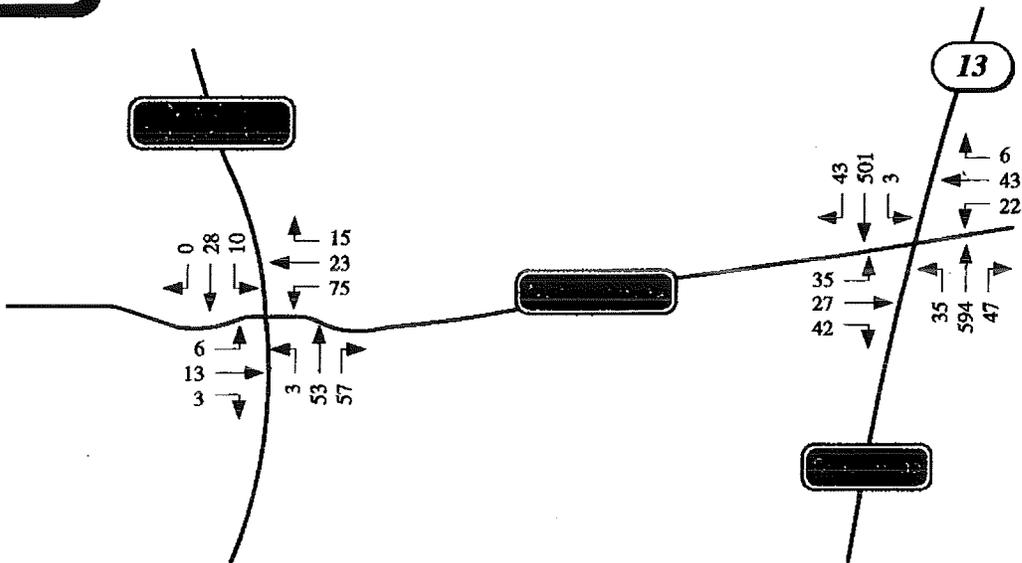
Detailed trip generation calculations for the project are included in the Appendix.

³ Institute of Transportation Engineers, Trip Generation, 7th Edition, Washington, D.C., 2003.

AM Peak

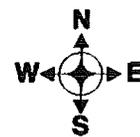


PM Peak



Estimated 2012 No-Build Traffic Networks

Proposed Highfield Village Development
Framingham, Massachusetts



Not to Scale

As noted above, an adjacent parcel could accommodate up to 17 additional homes though plans have not been submitted depicting this project. However, for informational purposes, the 17 additional single family homes are estimated to generate peak hour trips of 9 and 12 vehicle trips during the morning and afternoon peak hours, respectively.

2. Trip Distribution/Assignment

Once the number of trips projected to be generated by a development is determined, these trips are assigned to the site driveway and study area roadways/intersections based on an estimated trip distribution for the site. For the purpose of this study, it was determined that the project related peak hour traffic would follow the commuter patterns, which were estimated by resident to workplace patterns of the Town⁴ as well as current traffic patterns in the immediate project area. This information was obtained from the 2000 census.

Figure 4 shows the trip distribution pattern for the proposed residential development.

3. Build Traffic Volumes

Based on the overall trip distribution patterns in Figure 4, the generated traffic volumes were added to the No-Build traffic volumes shown in Figure 3 to establish the Build traffic networks. Figure 5 presents 2012 Build traffic volume networks for the weekday morning and afternoon peak hours.

C. ANALYSIS

This traffic and transportation study focuses on the analysis of the intersections adjacent to the proposed project. Previous sections of this report developed the No-Build and Build traffic volume network considering annual traffic growth, traffic from background developments and projected site traffic.

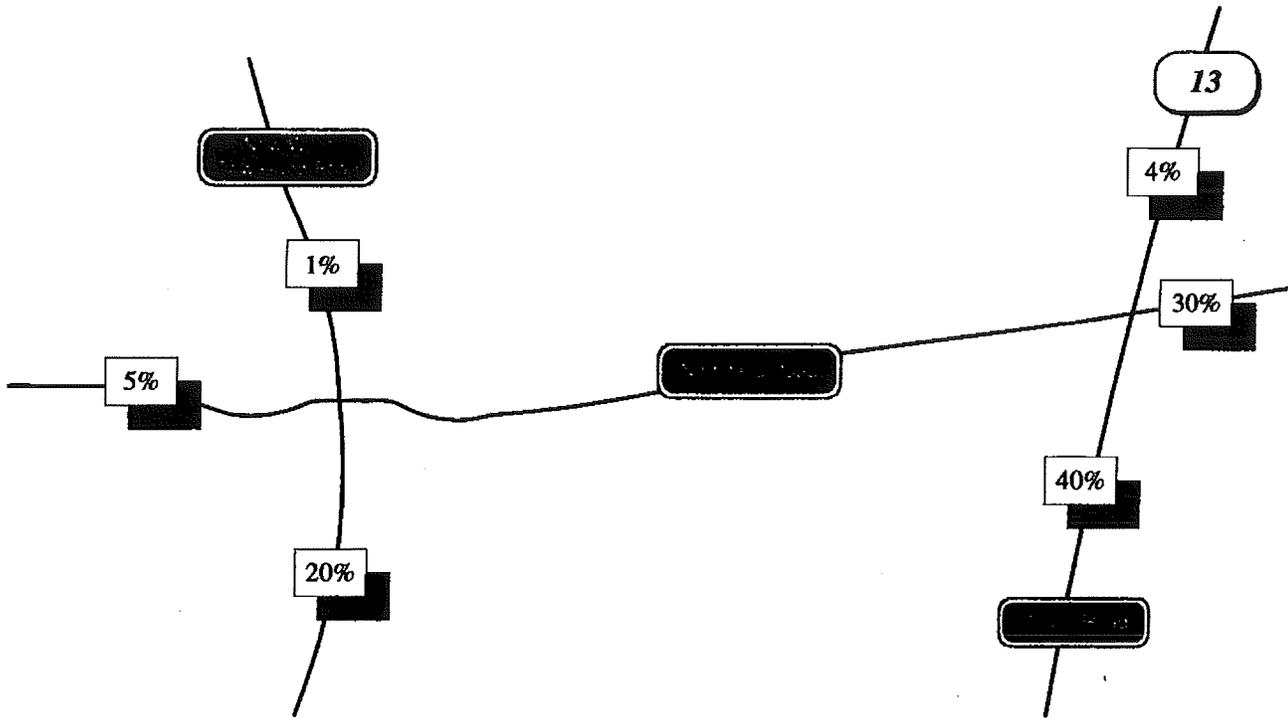
Included in this section is an examination of the traffic increases expected on study area roadways under No-Build and Build conditions, capacity/Level of Service (LOS) analysis for the study intersections, and sight distance evaluation for the proposed driveway intersection.

1. Traffic Increases

Assuming the buildout of the proposed project, the estimated traffic generated by the development will result in minor to medium traffic increases along the roadways within the study area. The changes in traffic volumes are summarized in Table 4 and presented in the following:

- Table 4 indicates that the majority of site trips on Northfield Road will be east of the site a result in increases of 43 to 55 vehicle trips depending on peak hour. West of the site, the project will generate minimal increases of 15 to 19 trips on Northfield Road or 1 vehicle every 2 to 3 minutes.

⁴ U.S. Census Bureau, Census 2000 Data, <http://www.census.gov/population/www/socdemo/journey.html>



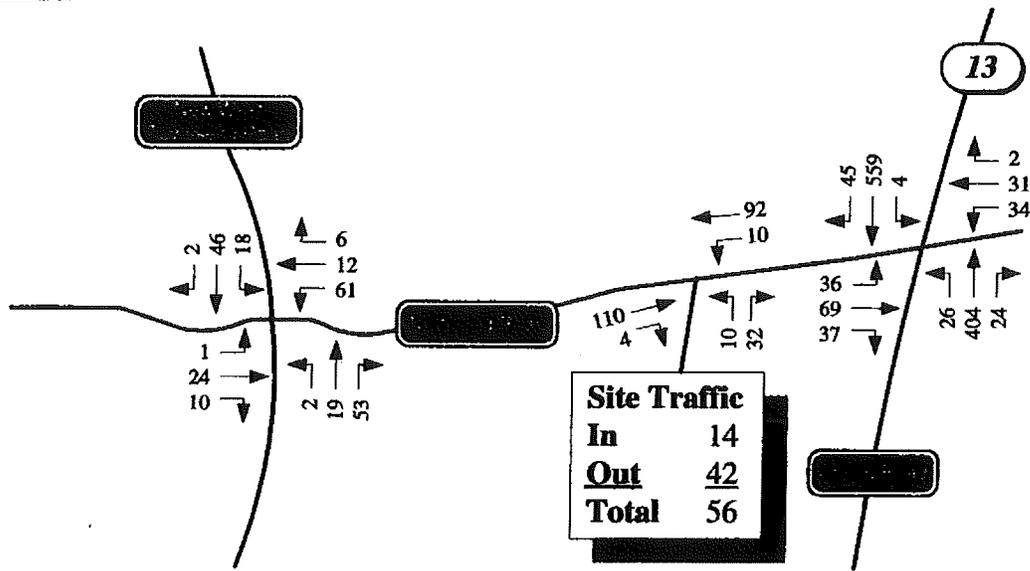
Estimated Trip Distribution

*Proposed Highfield Village Development
Lunenburg, Massachusetts*

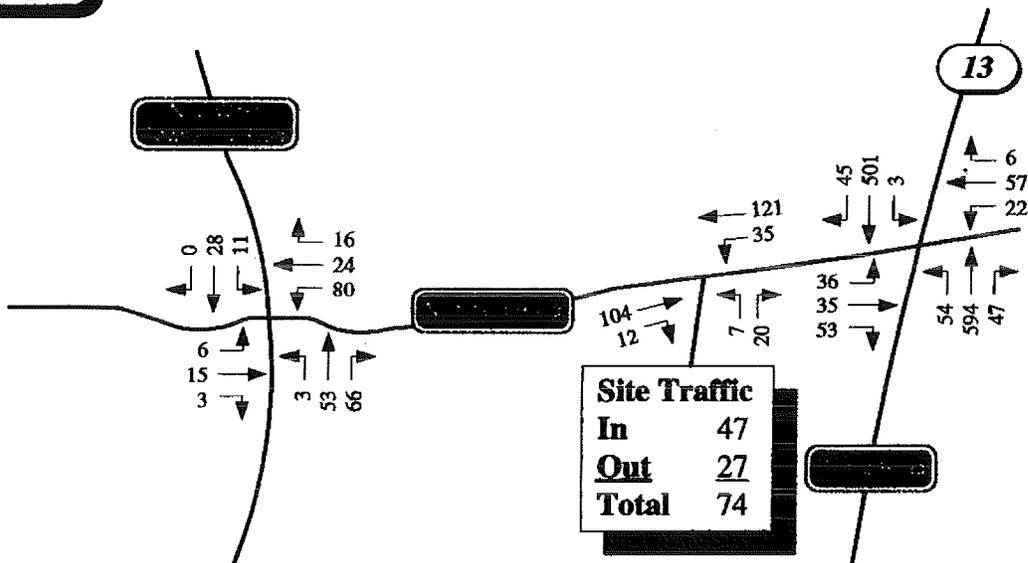


Not to Scale

AM Peak



PM Peak



Estimated 2012 Build Traffic Networks

*Proposed Highfield Village Development
Lunenburg, Massachusetts*



Not to Scale

- Away from the site, Chase Road south of Northfield Road is estimated to incur increases in the 2.2 to 2.4 percent range depending on the period.

**TABLE 4
SUMMARY OF ESTIMATED ROADWAY TRAFFIC INCREASES¹⁾**

Location	AM Peak			PM Peak		
	No-Build	Build	D Volume	No-Build	Build	D Volume
<i>Northfield Road</i>						
West of Site Drive	201	216	15	225	244	19
East of Site Drive	201	244	43	225	280	55
West of New West Townsend Road	48	51	3	48	51	3
East Chase Road	147	164	17	148	170	22
<i>Chase Road</i>						
North of Northfield Road	1047	1050	3	1182	1185	3
South of Northfield Road	1061	1084	23	1241	1271	30
<i>New West Townsend Road</i>						
North of Northfield Road	92	92	0	112	114	2
South of Northfield Road	180	191	11	219	233	14

2. Capacity/Level of Service (LOS) Analysis

As a part of this study, the study intersections/site driveway have been examined with regard to capacity and delay characteristics to determine the Level of Service (LOS) provided under existing and future (No-Build and Build) network conditions. Level of Service is an indicator of the operating conditions which occur on a given roadway feature while accommodating varying levels of traffic volumes. It is a qualitative measure which accounts for a number of operational factors including roadway geometry, speed, travel delay, freedom to maneuver and driver expectation. When the criteria are assessed and an LOS is assigned to a roadway or intersection, it is equivalent to presenting an "index" to the operational qualities of the section under study. Level of Service (LOS) is defined in the Highway Capacity Manual⁵ by six levels, 'A' to 'F'. In practice, any given roadway or intersection may operate at a wide LOS range depending upon time of day, day of week or period of year. Table 5 summarizes the levels of service and delay criteria for unsignalized intersection.

**TABLE 5
SUMMARY OF LEVEL OF SERVICE ANALYSIS
Unsignalized Intersection**

Level of Service	Controlled Delay (s/veh)
A	0-10
B	>10 and ≤15
C	>15 and ≤25
D	>25 and ≤35
E	>35 and ≤50
F	>50

Source: Highway Capacity Manual 2000

⁵ Transportation Research Board, Highway Capacity Manual, 4th Edition, Washington D.C., 2000.

The study intersections were evaluated based upon the techniques published in the Highway Capacity Manual. The Highway Capacity Software (HCS) computer model, which follows the procedures established in the Highway Capacity Manual, was used for analysis of the study intersections. Using these evaluation criteria, the traffic operations were evaluated under existing conditions as well as anticipated future (No-Build and Build) conditions. Analysis results are presented in Table 6.

**TABLE 6
SUMMARY OF LEVEL OF SERVICE ANALYSIS**

Intersections	Existing				No-Build				Build			
	AM Peak		PM Peak		AM Peak		PM Peak		AM Peak		PM Peak	
	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
<i>Northfield Road at Chase Road</i>												
Northfield Road												
EB Left/Thru/Right	34.7	D	62.4	F	50.3	E	>100	F	68.3	F	>100	F
WB Left/Thru/Right	49.2	E	64.2	F	83.0	F	>100	F	>100	F	>100	F
Chase Road												
NB Left/Thru/Right	8.7	A	8.6	A	8.9	A	8.8	A	8.9	A	8.9	A
SB Left/Thru/Right	8.2	A	9.0	A	8.3	A	9.2	A	8.3	A	9.2	A
<i>Northfield Road at New West Townsend Road</i>												
Northfield Road												
EB Left/Thru/Right	10.0	A	10.0	B	10.1	B	10.2	B	10.2	B	10.4	B
WB Left/Thru/Right	10.4	B	10.4	B	10.6	B	10.7	B	10.8	B	10.9	B
New West Townsend Road												
NB Left/Thru/Right	7.3	A	7.3	A	7.3	A	7.3	A	7.3	A	7.3	A
SB Lefts/Thru/Right	7.4	A	7.5	A	7.4	A	7.5	A	7.4	A	7.5	A
<i>Northfield Road at Proposed Site Drive</i>												
Proposed Site Drive												
NB Left/Right	--	--	--	--	--	--	--	--	9.3	A	9.4	A
Northfield Road												
WB Left/Thru	--	--	--	--	--	--	--	--	7.5	A	7.5	A

^a Avg. Total Delay for the Lane Group or Movement (sec/veh)

^b Level of Service

The Level of Service (LOS) analysis indicated that:

- The proposed site drive is expected to operate at LOS 'A' with minimal delays under the future Build condition during the morning and evening peak periods. Motorists are expected to be able to enter or exit the site with safety and efficiency.
- The exiting movements on the minor approaches at Chase Road are expected to operate at LOS 'F' and experience long delays during the study peak periods, with or without the proposed residential development. Currently, the analysis shows LOS 'F' is incurred during the PM peak hour. However, it should be noted that field observations indicated that right turn motorists on eastbound Northfield Road approach were able to bypass the waiting vehicles, which increases the intersection operating efficiency and reduces the overall average delays.

- The Northfield Road intersection with New West Townsend Road is expected to operate at LOS 'B' and experience minor differences between the future No-Build and Build conditions.

Given the estimated conditions of the Chase Road intersection with and without the proposed project, the volumes were evaluated in terms of traffic signal warrant criteria. The results, which are included in the Appendix, showed that minimum volume criteria as defined in the Manual on Uniform Traffic Control Devices (MUTCD)⁶, would be satisfied under projected future conditions. Assuming a traffic signal is installed, a level of service analysis was completed. The LOS analysis indicated that with a traffic signal, LOS 'A' would be expected during both weekday peak periods.

4. Sight Distance Analysis

As part of the driveway safety assessment, sight distances relative to the proposed Site Drive at Northfield Road were determined in the field. Adequate sight distance is an important safety consideration. The sight distance analysis is divided into two categories: approach (stopping) sight distance and exiting (corner) sight distance.

Stopping sight distance (SSD), which is more important of the two as it relates to safety, is the distance required for an approaching driver at a height of 3.5 feet to perceive and react accordingly to an object 2 feet tall at the driveway. The values are based on a perception and reaction time of 2.5 seconds and braking distance required under wet, level pavements. Corner sight distance (CSD) is based on the time required to perceive, react, and complete desired exiting maneuver from a driveway once the driver decides to execute the maneuver. Values for exiting sight distance represent the time to (1) turn left or right, in addition to accelerating to the operating speed of the roadway, without causing approaching vehicles to reduce speed by more than 10 mph, and (2) upon turning left, to clear the near half of the intersection without conflicting with the vehicles approaching from the left. When the roadway is either on an upgrade or downgrade, grade correction factors are applied.

There are no posted speed limits along Northfield Road in the vicinity of the project site. Collected speed data indicated that approximately 85% percent of eastbound and westbound vehicles traveled at 48 mph. Table 7 summarizes the speed data for Northfield Road. For the purpose of this study, both 45 mph and 50 mph criteria were used to assess the sight distances at the proposed site drive and the results are shown in Table 8.

**TABLE 7
SUMMARY OF SPEED DATA**

Northfield Road	Average Speed* (mph)	85% Speed* (mph)
<i>EB</i>	42	48
<i>WB</i>	42	48

* Based on 2007 collected ATR speed data

⁶

Based on the 45 mph and 50 mph speeds, it was determined that the stopping sight distance (SSD) requirements are 360 and 425 feet, respectively. Drivers traveling eastbound and westbound on Northfield Road can detect an object on proposed Site Drive from approximately 650 feet or more away. All the field measurements on Northfield Road for SSD, which is the most critical safety criteria, clearly exceed criteria.

TABLE 8
SUMMARY OF SIGHT DISTANCE ANALYSIS

Sight Distance	Measured Distance (ft)	Criteria for 45 mph (ft) ¹	Criteria for 50 mph (ft) ¹
Northfield Road at proposed Site Drive			
Stopping Sight Distance			
Approaching from East	>800	360	425
Approaching from West	650	360	425
Corner Sight Distance			
Looking East	>800	500	555
Looking West	650	500	555

¹ Source: American Association of State Highway and Transportation Officials (AASHTO), A Policy on Geometric Design of Highways and Streets, Washington, D.C., 2003

Based on the 85 percent observed eastbound and westbound speeds on Northfield Road, the 50 mph criteria for corner sight distance (CSD) are 555 feet for both directions. From field measurements, it was determined that the CSD at the proposed Site Drive on Northfield Road will satisfy the criteria with appropriate clearing and grading for the construction of the site driveway. A more important issue for the Town, however, would appear to be encouraging slower speeds on Northfield Road. Actions that could be considered include speed detection monitoring, new or additional warning signs and increased enforcement.

Conclusions/Recommendations

The previous sections of this traffic report detailed the analysis procedures and results of this traffic study. The roadways and intersections within the study area are expected to experience certain traffic volumes increases due to the proposed Highfield Village. The following is a summary of the traffic analysis:

- The proposed Highfield Village residential project with 66 housing units is projected to generate approximately 710 trips on a weekday basis, with 56 trips during the morning peak hour and 74 trips during the evening peak hour.
- The proposed access/egress drive way off Northfield Road is expected to operate at LOS 'A' during both AM and PM peak periods. Motorists are expected to enter and exit the site with safety and efficiency.
- Field review of sight distances at the proposed access/egress drive way indicated both stopping sight distances and corner sight distances to be adequate.
- The analysis also showed that motorists exiting Northfield Road onto Chase Road currently experience peak hour delays. This will continue in the future regardless of the project. However, the analysis also showed that Chase Road can accommodate the added traffic exiting Northfield Road.

While the proposed project can be accommodated on area roads, a series of recommendations have been developed to improve traffic operation and safety in the vicinity of the site drive. They are as follows:

- Install a STOP sign and mark a STOP bar on the proposed site drive approach at the Northfield Road intersection.
- Consider widen the eastbound Northfield Road approach to Chase Road if feasible with layout to provide a two lane approach.
- An advanced warning sign of "Stopped Vehicles Ahead" is proposed to be installed on Northfield Road for eastbound motorists approximately 200 feet prior to the Route 13 intersection.
- The analysis of the Northfield Road intersection with Chase Road indicated long side street delays occurring under existing conditions and future conditions without the project. The review also showed the majority of the accidents at the intersection of Northfield Road with Chase Road are angle type potentially due to the left turning vehicles delays in entering the Chase Road traffic stream. An analysis of projected future volumes indicated that signal warrant criteria would be satisfied. The Town, therefore, should consider signalizing the intersection of Northfield Road with Chase Road regardless of the proposed project which would address the level of service

issues and alleviate safety concerns. As part of this study, a conceptual improvement plan was prepared for the purpose of providing the Town information to the feasibility of improving this location.

- Whether or not this proposed project is approved, the Town should implement an improved speed management program for Northfield Road that could include "Thickly Settled" speed warning signs, a regular application of speed trailer to remind motorists of speed limits and obtaining data on actual speeds and increased enforcement.

In conclusion, while the project traffic can generally be accommodated on Northfield Road, the study area requires some attention to transportation related improvements to enhance safe and efficient traffic flow independent of the proposed project.

Appendix

- **ATR data**
- **TMC data**
- **Accident Data**
- **Seasonal/Annual Adjustments**
- **Trip Generation**
- **Trip Assignment**
- **LOS Analysis**
- **Signal Warrant**
- **Mitigation**

Appendix

- **ATR data**
- **TMC data**
- **Accident Data**
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- **Mitigation**

-
- **ATR data**

Northfield Road west of
 Chase Road (Route 13)
 City/State: Lunenburg, MA
 Client: MST/S. Akhtar

Eastbound

Start Time	1	16	21	26	31	36	41	46	51	56	61	66	71	76	Total
	15	20	25	30	35	40	45	50	55	60	65	70	75	999	
03/21/07	0	0	0	0	2	1	1	1	0	0	0	0	0	0	5
01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:00	0	0	0	0	1	1	0	0	0	0	0	0	0	0	2
04:00	0	0	0	0	0	1	2	0	0	0	0	0	0	0	3
05:00	0	0	0	0	0	4	4	3	1	0	0	0	0	0	12
06:00	0	0	0	0	6	12	19	13	5	1	0	0	0	0	56
07:00	0	0	0	1	13	16	30	15	3	1	0	0	0	0	79
08:00	1	0	0	1	6	12	22	8	3	0	0	0	0	0	53
09:00	0	0	0	0	4	11	13	2	1	0	0	0	0	0	31
10:00	0	0	0	0	4	6	9	4	1	0	0	0	0	0	24
11:00	0	0	0	0	4	9	12	4	1	0	0	0	0	0	30
12 PM	0	0	0	0	2	10	17	7	1	2	0	0	0	0	39
13:00	0	0	0	1	2	12	24	13	1	0	0	0	0	0	53
14:00	0	0	1	0	4	13	16	7	2	0	0	1	1	0	45
15:00	0	0	1	2	3	11	23	7	0	1	0	0	0	0	48
16:00	0	0	0	1	4	9	16	9	2	1	0	0	0	0	42
17:00	1	1	0	0	4	15	28	9	5	1	0	0	0	0	64
18:00	0	0	0	0	4	13	18	7	0	0	0	0	0	0	42
19:00	0	3	2	1	4	11	13	4	0	0	0	0	0	0	38
20:00	0	0	0	0	6	9	9	3	1	0	0	0	0	0	28
21:00	0	0	0	1	2	4	3	2	1	0	0	0	0	0	13
22:00	0	0	0	0	2	2	3	1	1	0	0	0	0	0	9
23:00	0	0	0	0	0	2	4	2	0	0	0	0	0	0	8
Total	2	4	4	8	77	184	286	121	29	7	0	1	1	0	724

Daily

15th Percentile :	38 MPH
50th Percentile :	42 MPH
85th Percentile :	48 MPH
95th Percentile :	51 MPH
Mean Speed(Average) :	42 MPH
10 MPH Pace Speed :	36-45 MPH
Number in Pace :	470
Percent in Pace :	64.9%
Number of Vehicles > 35 MPH :	629
Percent of Vehicles > 35 MPH :	86.9%

Northfield Road west of
Chase Road (Route 13)
City/State: Lunenburg, MA
Client: MSTs/S. Akhtar

Westbound

Start Time	1	16	21	26	31	36	41	46	51	56	61	66	71	76	Total
	15	20	25	30	35	40	45	50	55	60	65	70	75	999	
09/21/07	0	0	0	0	0	0	2	0	0	0	0	0	0	0	2
01:00	0	0	0	0	2	0	0	0	0	0	0	0	0	0	2
02:00	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
03:00	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
04:00	0	0	0	0	0	0	3	0	0	0	0	0	0	0	3
05:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06:00	0	0	0	2	2	3	1	3	0	0	0	0	0	0	11
07:00	0	0	0	1	4	6	17	5	3	0	0	0	0	0	36
08:00	1	0	1	0	5	12	10	6	1	1	0	0	0	0	37
09:00	0	0	0	1	2	7	13	6	1	1	0	0	0	0	31
10:00	0	0	0	0	2	6	14	5	3	0	0	0	0	0	30
11:00	1	0	0	0	6	15	6	2	2	0	0	0	0	0	32
12 PM	0	0	0	0	0	10	14	7	1	0	0	0	0	0	32
13:00	0	0	1	0	3	10	10	5	2	0	0	0	0	0	31
14:00	0	0	1	0	3	10	17	5	4	1	0	1	0	0	42
15:00	0	0	0	1	3	18	21	10	5	0	0	0	0	0	58
16:00	0	0	0	0	5	19	41	11	4	1	0	0	0	0	81
17:00	0	0	0	2	7	24	43	10	2	0	0	0	0	0	88
18:00	0	0	0	1	3	15	26	4	3	1	2	0	0	0	55
19:00	0	0	1	1	8	18	17	2	0	0	0	0	0	0	47
20:00	0	0	0	1	3	11	7	0	1	0	0	0	0	0	23
21:00	0	0	0	0	5	5	4	2	1	0	0	0	0	0	17
22:00	0	0	0	0	1	4	3	3	1	0	0	0	0	0	12
23:00	0	0	0	0	1	4	2	0	0	0	0	0	0	0	7
Total	2	0	4	11	66	197	271	86	34	5	2	1	0	0	679

Daily

15th Percentile :	36 MPH
50th Percentile :	42 MPH
85th Percentile :	47 MPH
95th Percentile :	52 MPH
Mean Speed(Average) :	41 MPH
10 MPH Pace Speed :	36-45 MPH
Number in Pace :	468
Percent in Pace :	68.9%
Number of Vehicles > 35 MPH :	596
Percent of Vehicles > 35 MPH :	87.8%

Northfield Road west of
Chase Road (Route 13)
City/State: Lunenburg, MA
Client: MST/S. Akhtar

Eastbound

Start Time	1	16	21	26	31	36	41	46	51	56	61	66	71	76	Total
	15	20	25	30	35	40	45	50	55	60	65	70	75	999	
03/22/07	0	0	0	0	1	1	1	0	1	0	0	0	0	0	4
01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02:00	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
03:00	0	0	0	0	0	1	1	0	0	0	0	0	0	0	2
04:00	0	0	0	0	0	1	3	0	0	0	0	0	0	0	4
05:00	0	0	0	0	0	8	1	4	2	0	0	0	0	0	15
06:00	0	0	0	1	4	12	20	9	6	1	0	0	0	0	53
07:00	6	0	0	0	13	24	27	9	3	2	0	0	0	0	84
08:00	0	0	0	5	6	20	30	8	3	0	0	0	0	0	72
09:00	0	0	0	3	3	7	12	2	2	1	0	0	0	0	30
10:00	0	1	0	0	2	6	20	4	2	0	0	0	0	0	35
11:00	0	0	0	0	5	9	6	6	3	0	0	0	0	0	29
12 PM	0	0	0	1	3	8	15	3	2	0	0	0	0	0	32
13:00	1	0	0	0	9	16	15	6	0	0	0	0	0	0	47
14:00	0	0	0	0	7	15	16	13	2	1	0	0	0	0	54
15:00	0	2	1	2	4	14	20	4	2	1	2	0	0	0	52
16:00	0	0	0	0	4	16	25	11	5	2	0	0	0	0	63
17:00	0	0	0	3	3	15	22	5	1	1	1	0	0	0	51
18:00	0	0	0	0	9	12	15	4	2	1	0	0	0	0	43
19:00	0	0	0	2	3	5	8	4	3	0	0	0	0	0	25
20:00	0	0	0	2	11	10	9	4	1	0	0	0	0	0	37
21:00	0	0	0	1	1	3	2	2	1	0	0	0	0	0	10
22:00	0	0	0	1	1	2	3	2	0	0	0	0	0	0	9
23:00	0	0	0	0	1	3	4	0	0	0	0	0	0	0	8
Total	7	3	1	21	90	208	276	100	41	10	3	0	0	0	760

Daily

15th Percentile :	35 MPH
50th Percentile :	41 MPH
85th Percentile :	47 MPH
95th Percentile :	52 MPH
Mean Speed(Average) :	41 MPH
10 MPH Pace Speed :	36-45 MPH
Number in Pace :	484
Percent in Pace :	63.7%
Number of Vehicles > 35 MPH :	638
Percent of Vehicles > 35 MPH :	83.9%

Grand Total	9	7	5	29	167	392	562	221	70	17	3	1	1	0	1484
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Overall	15th Percentile :	36 MPH
	50th Percentile :	42 MPH
	85th Percentile :	48 MPH
	95th Percentile :	52 MPH
	Mean Speed(Average) :	41 MPH
	10 MPH Pace Speed :	36-45 MPH
	Number in Pace :	954
	Percent in Pace :	64.3%
	Number of Vehicles > 35 MPH :	1267
	Percent of Vehicles > 35 MPH :	85.4%

Northfield Road west of
 Chase Road (Route 13)
 City/State: Lunenburg, MA
 Client: MST/S. Akhtar

Westbound

Start Time	1	16	21	26	31	36	41	46	51	56	61	66	71	76	Total
	15	20	25	30	35	40	45	50	55	60	65	70	75	999	
03/22/07	0	0	0	0	0	2	1	1	1	0	0	0	0	0	5
01:00	0	0	0	0	1	0	1	0	0	0	0	0	0	0	2
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:00	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
04:00	0	0	0	0	1	0	1	0	0	0	0	0	0	0	2
05:00	0	0	0	0	0	1	2	0	0	0	0	0	0	0	3
06:00	0	0	0	1	1	5	4	2	0	0	0	0	0	0	13
07:00	3	0	0	2	4	15	12	5	1	0	0	0	0	0	42
08:00	0	0	2	1	3	19	21	4	4	0	0	0	0	0	54
09:00	0	0	0	1	3	9	10	12	1	0	0	0	0	0	36
10:00	2	0	0	0	2	13	10	6	1	0	0	0	0	0	34
11:00	0	0	0	0	5	11	13	7	1	0	0	0	0	0	37
12 PM	0	0	0	0	1	15	15	2	1	0	0	0	0	0	34
13:00	0	0	0	2	1	9	9	3	3	0	0	0	0	0	27
14:00	0	0	1	0	1	18	18	6	2	0	1	0	0	0	47
15:00	1	1	1	1	6	23	28	15	2	0	0	0	0	0	78
16:00	1	0	0	0	4	24	36	11	2	1	0	0	0	0	79
17:00	0	0	1	1	6	25	29	13	3	0	0	0	0	0	78
18:00	0	0	0	0	8	13	22	7	1	1	1	0	0	0	53
19:00	0	0	0	0	1	12	16	7	1	0	0	0	0	0	37
20:00	0	1	0	1	6	9	11	2	0	0	0	0	0	0	30
21:00	0	0	0	0	2	7	3	3	0	0	0	0	0	0	15
22:00	0	0	0	1	2	10	1	1	0	0	0	0	0	0	15
23:00	0	0	0	0	1	2	1	2	0	0	0	0	0	0	6
Total	7	2	5	11	60	242	264	109	24	2	2	0	0	0	728

Daily

15th Percentile :	36 MPH
50th Percentile :	41 MPH
85th Percentile :	47 MPH
95th Percentile :	50 MPH
Mean Speed(Average) :	41 MPH
10 MPH Pace Speed :	36-45 MPH
Number In Pace :	506
Percent In Pace :	69.5%
Number of Vehicles > 35 MPH :	643
Percent of Vehicles > 35 MPH :	88.3%

Grand Total	9	2	9	22	126	439	535	195	58	7	4	1	0	0	1407
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Overall	15th Percentile :	36 MPH
	50th Percentile :	41 MPH
	85th Percentile :	47 MPH
	95th Percentile :	50 MPH
	Mean Speed(Average) :	41 MPH
	10 MPH Pace Speed :	36-45 MPH
	Number In Pace :	974
	Percent In Pace :	69.2%
	Number of Vehicles > 35 MPH :	1239
	Percent of Vehicles > 35 MPH :	88.1%

Chase Road (Route 13)
south of Northfield Road
City/State: Lunenburg, MA
Client: MST/S. Akhtar

Northbound

Start Time	15	20	25	30	35	40	45	50	55	60	65	70	75	Total
03/21/07	0	0	0	1	0	3	9	7	2	0	0	0	0	22
01:00	0	0	0	1	2	2	4	5	2	0	1	0	0	17
02:00	0	1	0	0	1	2	4	4	3	0	0	0	0	15
03:00	0	0	0	0	0	2	4	6	1	1	0	0	0	14
04:00	0	0	0	0	0	1	11	15	4	0	0	0	0	31
05:00	0	0	0	0	1	6	31	24	7	0	1	0	0	70
06:00	0	0	0	0	2	10	96	78	13	1	0	0	0	200
07:00	0	0	0	0	2	20	106	118	47	1	1	0	0	295
08:00	0	0	0	1	13	33	118	104	44	7	0	0	0	320
09:00	0	0	0	7	9	23	104	92	31	4	1	0	0	271
10:00	0	0	0	0	6	46	130	84	30	2	0	0	0	298
11:00	0	0	2	2	10	39	135	114	47	4	1	0	0	354
12 PM	0	1	2	3	16	48	130	112	31	4	1	0	0	348
13:00	0	0	0	2	17	53	159	114	38	4	0	0	0	387
14:00	0	0	0	7	20	74	175	143	34	7	0	1	0	461
15:00	0	0	1	5	17	94	224	147	35	4	0	0	0	527
16:00	0	0	0	7	15	93	236	182	51	6	0	0	0	590
17:00	0	1	0	3	25	88	217	164	44	6	0	0	0	547
18:00	0	0	0	2	12	59	186	198	39	4	0	0	0	500
19:00	0	0	0	4	22	75	164	108	38	4	0	0	0	411
20:00	0	0	0	2	17	66	107	65	19	2	0	0	0	278
21:00	0	0	0	1	14	54	118	57	16	2	0	0	0	262
22:00	0	0	1	4	7	30	48	33	12	2	0	0	0	137
23:00	0	0	0	1	3	14	28	23	7	1	0	0	0	77
Total	0	3	6	53	231	935	2544	1995	593	85	6	1	0	6432
Percent	0.0%	0.0%	0.1%	0.8%	3.6%	14.5%	39.6%	31.0%	9.2%	1.0%	0.1%	0.0%	0.0%	

Statistics

15th Percentile : 39 MPH
50th Percentile : 44 MPH
85th Percentile : 50 MPH
90th Percentile : 51 MPH

Chase Road (Route 13)
 south of Northfield Road
 City/State: Lunenburg, MA
 Client: MSTs/S. Akhtar

Southbound

Start Time	15	20	25	30	35	40	45	50	55	60	65	70	75	Total
03/21/07	0	0	0	0	2	1	4	5	3	3	0	0	0	18
01:00	0	0	0	0	0	2	6	3	3	0	0	0	0	14
02:00	0	0	0	2	0	0	1	1	3	0	0	0	0	7
03:00	0	0	0	0	2	2	6	8	1	0	0	0	0	19
04:00	0	0	0	0	1	2	7	14	2	0	0	0	0	26
05:00	0	0	1	0	3	7	23	42	31	4	2	1	0	114
06:00	0	0	0	2	9	22	110	102	40	3	1	0	0	289
07:00	0	0	0	2	14	28	105	202	82	5	0	0	0	438
08:00	0	0	1	2	7	21	74	164	91	11	2	0	0	373
09:00	0	1	0	0	6	23	102	134	81	15	3	0	0	365
10:00	0	0	0	3	10	26	84	122	78	13	2	0	0	338
11:00	0	0	1	1	12	21	106	109	70	9	1	0	0	330
12 PM	0	0	1	6	7	24	92	133	87	17	5	1	0	373
13:00	0	0	0	2	4	26	77	112	88	26	3	2	0	340
14:00	0	1	0	4	14	29	93	144	78	34	2	1	0	400
15:00	0	0	0	4	14	40	128	158	95	19	5	3	0	466
16:00	0	0	0	4	11	39	114	167	115	28	2	0	0	480
17:00	0	0	0	8	12	43	118	182	125	30	1	1	0	520
18:00	0	0	0	1	11	40	95	134	101	27	4	2	0	415
19:00	0	0	0	2	9	30	87	98	56	12	2	0	0	296
20:00	0	0	0	2	7	19	57	60	38	7	0	0	0	190
21:00	0	0	0	0	1	9	45	54	28	5	2	0	0	144
22:00	0	0	0	0	4	12	30	27	12	3	0	0	0	88
23:00	0	0	0	0	1	3	11	14	17	7	2	1	0	58
Total	0	2	4	45	161	469	1575	2189	1325	278	39	12	0	6099
Percent	0.0%	0.0%	0.1%	0.7%	2.6%	7.7%	25.8%	35.9%	21.7%	4.6%	0.6%	0.2%	0.0%	

Statistics

15th Percentile : 41 MPH
 50th Percentile : 47 MPH
 85th Percentile : 53 MPH
 90th Percentile : 54 MPH

Transportation Data Corporation
P.O. Box 334 Wakefield, MA 01880
Tel. (781) 587-0086 Fax (781) 587-0189
Email: mperonel@comcast.net

Page 2
03699Aspeed
Site Code: 908

Chase Road (Route 13)
south of Northfield Road
City/State: Lunenburg, MA
Client: MSTs/S. Akhtar

Northbound

Start Time	15	20	25	30	35	40	45	50	55	60	65	70	75	Total
03/22/07	0	0	0	0	1	8	20	17	6	1	0	0	0	53
01:00	0	0	0	0	1	6	14	11	4	1	0	0	0	37
02:00	0	0	0	0	2	3	7	7	3	0	0	0	0	22
03:00	0	1	0	0	2	6	9	7	3	0	0	0	0	28
04:00	0	0	0	0	1	8	16	10	3	0	0	0	0	38
05:00	0	0	0	1	2	15	40	37	9	1	0	0	0	105
06:00	0	0	0	1	3	31	105	64	19	2	0	0	0	225
07:00	0	0	0	3	11	41	129	121	29	2	0	0	0	336
08:00	0	0	0	3	24	45	100	98	27	3	0	0	0	300
09:00	0	0	0	1	10	28	126	100	38	3	0	0	0	306
10:00	0	0	1	3	19	29	115	84	43	2	0	0	0	296
11:00	0	0	1	1	5	32	130	131	36	9	0	0	0	345
12 PM	0	0	0	2	6	39	144	132	47	5	0	0	0	375
13:00	0	0	0	3	2	38	133	136	36	5	2	1	0	356
14:00	0	0	2	2	11	38	122	141	54	7	0	0	0	377
15:00	0	0	0	3	12	65	175	179	54	4	0	0	0	492
16:00	0	0	1	5	8	74	230	164	47	5	0	0	0	534
17:00	0	0	0	3	10	45	185	220	62	5	1	0	0	551
18:00	0	0	0	1	9	43	137	180	65	6	2	0	0	443
19:00	0	0	0	0	8	60	137	77	15	2	0	0	0	299
20:00	0	0	0	5	20	85	134	33	5	2	0	0	0	284
21:00	0	0	0	1	17	42	86	47	8	0	0	0	0	201
22:00	0	0	0	0	12	18	67	37	5	2	0	0	0	141
23:00	0	0	0	1	2	7	19	20	6	1	0	0	0	56
Total	0	1	5	39	199	806	2360	2053	644	68	5	1	0	6200
Percent	0.0%	0.0%	0.1%	0.6%	3.2%	13.0%	38.4%	33.1%	10.4%	1.1%	0.1%	0.0%	0.0%	

Statistics

15th Percentile : 40 MPH
50th Percentile : 45 MPH
85th Percentile : 50 MPH
90th Percentile : 51 MPH

Grand Total	0	4	11	92	429	1741	4924	4048	1237	133	11	2	0	12632
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15th Percentile : 39 MPH
50th Percentile : 45 MPH
85th Percentile : 50 MPH
95th Percentile : 54 MPH

Statistics
Mean Speed(Average) : 45 MPH
10 MPH Pace Speed : 41-50 MPH
Number in Pace : 8972
Percent in Pace : 71.0%
Number of Vehicles > 45 MPH : 5431
Percent of Vehicles > 45 MPH : 43.0%

Chase Road (Route 13)
south of Northfield Road
City/State: Lunenburg, MA
Client: MSTs/S. Akhtar

Southbound

Start Time	15	20	25	30	35	40	45	50	55	60	65	70	75	Total
03/22/07	0	0	0	0	0	1	3	5	4	4	1	0	0	18
01:00	0	0	0	0	0	1	0	1	1	0	0	0	0	3
02:00	0	0	0	0	1	0	0	3	0	0	0	0	0	4
03:00	0	0	0	1	0	1	3	3	0	1	0	0	0	9
04:00	0	0	0	0	2	3	8	9	9	2	0	0	0	33
05:00	0	0	0	2	3	9	19	43	28	14	1	1	1	121
06:00	0	0	0	1	13	29	90	109	54	18	3	0	0	317
07:00	0	0	0	1	14	44	102	170	106	17	2	1	0	457
08:00	0	2	1	5	23	33	87	151	108	34	3	1	0	448
09:00	0	0	0	4	12	28	90	146	112	28	3	2	0	425
10:00	0	0	0	7	16	21	89	120	54	7	4	0	0	318
11:00	0	0	1	5	10	45	82	113	57	6	2	0	0	321
12 PM	0	0	1	4	7	15	84	144	80	14	0	1	0	330
13:00	0	0	0	1	14	31	107	111	44	9	2	0	0	319
14:00	0	0	4	10	24	43	128	114	50	6	1	0	0	380
15:00	0	0	0	2	21	51	149	140	46	6	1	0	0	416
16:00	0	0	0	1	19	64	173	152	32	4	0	0	0	445
17:00	0	0	1	7	6	41	179	187	68	10	0	0	0	499
18:00	0	0	0	10	22	30	139	139	52	10	0	0	0	402
19:00	0	0	0	2	11	39	102	79	17	4	0	0	0	254
20:00	0	0	1	3	11	33	72	35	9	0	0	0	0	164
21:00	0	0	0	2	9	14	57	38	6	2	0	0	0	128
22:00	0	0	0	0	2	9	35	30	7	1	0	0	0	84
23:00	0	0	0	0	0	2	19	22	6	2	0	0	0	51
Total	0	2	9	68	240	587	1817	2064	930	199	23	6	1	5946
Percent	0.0%	0.0%	0.2%	1.1%	4.0%	9.9%	30.8%	34.7%	15.6%	3.3%	0.4%	0.1%	0.0%	

Statistics

15th Percentile : 40 MPH
50th Percentile : 46 MPH
85th Percentile : 52 MPH
90th Percentile : 54 MPH

Grand Total	0	4	13	113	401	1056	3392	4253	2255	477	62	18	1	12045
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15th Percentile : 41 MPH
50th Percentile : 47 MPH
85th Percentile : 53 MPH
95th Percentile : 55 MPH

Statistics

Mean Speed(Average) : 46 MPH
10 MPH Pace Speed : 41-50 MPH
Number in Pace : 7645
Percent in Pace : 63.5%
Number of Vehicles > 45 MPH : 7066
Percent of Vehicles > 45 MPH : 58.7%

TDC

Transportation Data Corporation

P.O. Box 734 Natick, MA 01760
Office: 508-651-1610 Fax: 508-651-1229

Chase Road (Route 13) north of
Massachusetts Ave (Route 2A)
City, State: Lunenburg, MA
Client: MSTs/D. Dumais

Site Code
02959AVOLL

20-May-04
Thu

Start Time	SB		NB		Combined			
	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.		
12:00	7	98	16	100	23	198		
12:15	3	96	13	90	16	186		
12:30	4	98	8	110	12	208		
12:45	6	20 116	408 10	47 110	410 16	67 226	818	
01:00	4	94	8	96	12	190		
01:15	7	92	7	124	14	216		
01:30	3	114	5	102	8	216		
01:45	1	15 118	418 4	24 118	440 5	39 236	858	
02:00	4	124	4	120	8	244		
02:15	3	130	8	150	11	280		
02:30	4	106	1	136	5	242		
02:45	2	13 106	466 1	14 122	528 3	27 228	994	
03:00	8	122	4	135	12	257		
03:15	6	132	2	136	8	268		
03:30	3	116	0	144	3	260		
03:45	2	19 130	500 2	8 132	547 4	27 262	1047	
04:00	7	124	3	132	10	256		
04:15	6	134	6	140	12	274		
04:30	6	123	10	163	16	286		
04:45	12	31 119	500 14	33 142	577 26	64 261	1077	
05:00	28	157	34	146	62	303		
05:15	40	140	20	152	60	292		
05:30	60	138	28	162	88	300		
05:45	54	182 109	544 42	124 168	628 96	306 277	1172	
06:00	62	134	52	143	114	277		
06:15	70	148	58	136	128	284		
06:30	84	106	72	122	156	228		
06:45	100	316 91	479 74	256 126	527 174	572 217	1006	
07:00	107	126	58	96	165	222		
07:15	134	88	90	101	224	189		
07:30	152	82	90	104	242	186		
07:45	127	520 101	397 90	328 110	411 217	848 211	808	
08:00	123	76	78	91	201	167		
08:15	134	76	80	94	214	170		
08:30	122	53	78	78	200	131		
08:45	122	501 54	259 79	315 79	342 201	816 133	601	
09:00	104	48	92	68	196	116		
09:15	126	41	86	64	212	105		
09:30	120	38	100	65	220	103		
09:45	122	472 36	163 86	364 58	255 208	836 94	418	
10:00	100	26	102	49	202	75		
10:15	122	34	92	46	214	80		
10:30	112	32	98	34	210	66		
10:45	96	430 26	118 108	400 22	151 204	830 48	269	
11:00	89	12	118	18	207	30		
11:15	107	25	116	15	223	40		
11:30	118	11	113	16	231	27		
11:45	98	412 7	55 87	434 18	67 185	846 25	122	
Total	2931	4307	2347	4883	5278	9190		
Percent	55.5%	46.9%	44.5%	53.1%				

Day Total		7238		7230		14468		
Peak Vol.	07:15	04:45	10:45	05:00	07:15	05:00		
P.H.F.	0.882	0.882	0.964	0.935	0.913	0.967		

TDC

Transportation Data Corporation

P.O. Box 734 Natick, MA 01760
Office: 508-651-1610 Fax: 508-651-1229

Chase Road (Route 13) north of
Massachusetts Ave (Route 2A)
City: Lunenburg, MA
Client: MSTIS/D. Dumais

Site Code: 771
02959AVOLUME

Start Time	SB		NB		Combined		21-May-04 Fri					
	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.						
12:00	5	110	17	114	22	224						
12:15	10	129	18	129	28	258						
12:30	14	110	8	122	22	232						
12:45	6	35	110	459	15	58	222	946				
01:00	1	116	7	122	8	238						
01:15	4	112	6	126	10	238						
01:30	1	92	12	130	13	222						
01:45	5	11	100	420	12	37	120	498	17	48	220	918
02:00	14	118	3	145	17	263						
02:15	2	133	4	154	6	287						
02:30	2	120	10	136	12	256						
02:45	3	21	112	483	3	20	138	573	6	41	250	1056
03:00	1	130	5	160	6	290						
03:15	6	140	4	130	10	270						
03:30	8	133	4	172	12	305						
03:45	11	26	116	519	10	23	148	610	21	49	264	1129
04:00	8	134	4	142	12	276						
04:15	10	154	8	141	18	295						
04:30	4	132	14	150	18	282						
04:45	10	32	122	542	16	42	160	593	26	74	282	1135
05:00	32	148	18	144	50	292						
05:15	25	137	22	176	47	313						
05:30	54	133	27	170	81	303						
05:45	44	155	120	538	28	95	136	626	72	250	256	1164
06:00	58	134	52	161	110	295						
06:15	74	138	74	154	148	292						
06:30	96	128	80	150	176	278						
06:45	5	318	102	502	82	288	132	597	172	606	234	1099
07:00	112	102	76	112	188	214						
07:15	134	118	85	99	219	217						
07:30	145	107	93	95	238	202						
07:45	140	531	83	410	100	354	102	408	240	885	185	818
08:00	114	71	98	88	212	159						
08:15	142	64	86	75	228	139						
08:30	108	61	75	96	183	157						
08:45	128	492	49	245	98	357	70	329	226	849	119	574
09:00	110	54	85	71	195	125						
09:15	143	56	104	72	247	128						
09:30	120	53	88	78	208	131						
09:45	117	490	44	207	96	373	62	283	213	863	106	490
10:00	106	40	118	72	224	112						
10:15	104	32	113	49	217	81						
10:30	135	46	122	48	257	94						
10:45	97	442	38	156	117	470	33	202	214	912	71	358
11:00	113	22	106	54	219	76						
11:15	98	31	116	44	214	75						
11:30	124	19	106	26	230	45						
11:45	120	455	16	88	92	420	32	156	212	875	48	244
Total	3008	4569	2537	5362	5545	9931						
Percent	54.2%	46.0%	45.8%	54.0%								
Day Total		7577		7899		15476						
Peak Vol.	07:30	04:15	10:00	04:45	07:30	04:45						
P.H.F.	541	556	470	650	918	1190						
	0.933	0.903	0.963	0.923	0.893	0.950						

TDC

Transportation Data Corporation

P.O. Box 734 Natick, MA 01760
Office: 508-651-1610 Fax: 508-651-1229

Chase Road (Route 13) north of
Massachusetts Ave (Route 2A)
City, State: Lunenburg, MA
Client: MSTIS/D. Dumais

Site Code
02959AVOLU

Start Time	SB		NB		Combined		22-May-04 Sat						
	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.							
12:00	8	132	19	142	27	274							
12:15	12	149	10	142	22	291							
12:30	12	146	16	127	28	273							
12:45	8	40	20	65	146	557	1112						
01:00	12	132	12	143	24	275							
01:15	7	162	20	147	27	309							
01:30	4	124	13	133	17	257							
01:45	5	28	9	54	130	553	1102						
02:00	9	121	11	129	20	250							
02:15	1	118	10	128	11	246							
02:30	5	107	6	141	11	248							
02:45	5	20	8	35	110	508	973						
03:00	1	97	7	154	8	251							
03:15	4	123	5	117	9	240							
03:30	4	140	2	123	6	263							
03:45	4	13	1	15	118	512	1002						
04:00	6	142	8	117	14	259							
04:15	6	138	8	114	14	252							
04:30	6	127	10	114	16	241							
04:45	9	27	7	33	137	482	1012						
05:00	6	127	6	108	12	235							
05:15	14	112	8	108	22	220							
05:30	24	99	11	106	35	205							
05:45	21	65	12	37	100	422	870						
06:00	26	116	17	88	43	204							
06:15	32	95	32	94	64	189							
06:30	36	108	34	94	70	202							
06:45	56	150	84	403	36	119	358	269	166	761			
07:00	45	96	47	96	92	192							
07:15	60	95	34	84	94	179							
07:30	62	74	54	76	116	150							
07:45	78	245	49	314	52	187	74	330	432	123	844		
08:00	68	68	73	58	141	126							
08:15	88	53	64	66	152	119							
08:30	78	52	62	47	140	99							
08:45	122	356	51	224	78	277	45	216	200	633	96	440	
09:00	110	48	92	52	202	100							
09:15	98	49	78	78	174	127							
09:30	110	33	102	42	212	75							
09:45	115	431	43	173	112	384	54	226	227	815	97	399	
10:00	138	27	93	59	231	86							
10:15	131	27	116	41	247	68							
10:30	154	36	116	44	270	80							
10:45	157	580	15	105	110	435	24	168	267	1015	39	273	
11:00	135	24	120	28	255	52							
11:15	140	20	130	34	270	54							
11:30	134	14	144	35	278	49							
11:45	160	569	16	74	126	520	28	125	286	1089	44	199	
Total	2524	4330	2161	4457	4685	8787							
Percent	53.0%	49.3%	46.1%	50.7%									
Day Total		6854		6618		13472							
Peak Vol.	586	568	520	569	1089	1131							
P.H.F.	0.916	0.877	0.903	0.924	0.952	0.915							



**PRECISION
D A T A
INDUSTRIES, LLC**

P.O. Box 307 Berlin, MA 01503
Office: 508.481.3999 Toll Free: 888.734.7344
Fax: 508.481.0716 Email: info@pdilic.com

Northfield Road
500' west of Chase Road (Route 13)
City, State: Lunenburg, MA
Client: MSTIS/D. Hao

50104A volume
Site Code: 803

Start Time	EB		WB		Combined		09-Feb-05 Wed
	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	
12:00	2	15	1	10	3	25	
12:15	1	15	0	6	1	21	
12:30	2	8	0	8	2	16	
12:45	0	5	6	44	0	11	73
01:00	2	11	1	8	3	19	
01:15	1	5	0	9	1	14	
01:30	0	6	0	8	0	14	
01:45	0	3	8	30	0	18	65
02:00	0	7	0	8	0	15	
02:15	1	12	0	22	1	34	
02:30	0	19	0	9	0	28	
02:45	0	1	9	47	0	20	97
03:00	0	14	0	22	0	36	
03:15	0	24	0	21	0	45	
03:30	0	12	1	13	1	25	
03:45	1	1	8	58	1	23	129
04:00	1	17	0	21	1	38	
04:15	2	14	0	22	2	36	
04:30	0	12	1	32	1	44	
04:45	2	5	22	65	0	41	159
05:00	3	19	0	23	3	42	
05:15	4	16	1	27	5	43	
05:30	10	11	3	21	13	32	
05:45	6	23	12	58	1	21	138
06:00	10	13	0	14	10	27	
06:15	13	10	2	13	15	23	
06:30	13	8	6	17	19	25	
06:45	15	51	12	43	6	27	102
07:00	20	3	14	7	34	10	
07:15	19	6	8	8	27	14	
07:30	20	4	18	2	38	6	
07:45	20	79	6	19	16	9	39
08:00	7	4	9	10	16	14	
08:15	13	6	8	7	21	13	
08:30	23	5	6	7	29	12	
08:45	10	53	8	23	8	13	52
09:00	10	5	11	11	21	16	
09:15	10	1	13	9	23	10	
09:30	4	3	6	7	10	10	
09:45	4	28	3	12	4	4	40
10:00	7	1	3	5	10	6	
10:15	8	4	10	2	18	6	
10:30	7	7	11	4	18	11	
10:45	6	28	4	16	7	5	28
11:00	6	0	8	2	14	2	
11:15	6	5	6	0	12	5	
11:30	7	5	6	3	13	8	
11:45	4	23	5	15	7	6	21
Total	300	430	203	513	503	943	
Percent	59.6%	45.6%	40.4%	54.4%			
Day Total		730		716		1446	
Peak	07:00	04:30	07:00	04:30	07:00	04:30	
Vol.	79	89	56	101	135	170	
H.F.	0.859	0.719	0.778	0.789	0.888	0.944	



**PRECISION
D A T A
INDUSTRIES, LLC**

P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Toll Free: 888.734.7344
Fax: 508.481.0716 Email: info@pdill.com

Northfield Road
500' west of Chase Road (Route 13)
City, State: Lunenburg, MA
Client: MST'S/D. Hao

50104Aspeed
Site Code: 803

EB

Start Time	14	15	20	25	30	35	40	45	50	55	60	65	70	Total	Ave. MPH
02/09/05	0	0	0	0	1	1	3	0	0	0	0	0	0	5	39
01:00	0	0	0	0	0	2	0	1	0	0	0	0	0	3	39
02:00	0	0	0	0	0	0	1	0	0	0	0	0	0	1	40
03:00	0	0	0	0	0	0	1	0	0	0	0	0	0	1	40
04:00	0	0	0	0	0	1	2	1	1	0	0	0	0	5	44
05:00	0	0	0	0	1	2	10	8	2	0	0	0	0	23	44
06:00	1	0	0	0	1	11	17	18	3	0	0	0	0	51	42
07:00	0	0	0	0	6	14	39	14	4	2	0	0	0	79	42
08:00	0	0	0	3	3	9	16	17	5	0	0	0	0	53	42
09:00	1	0	0	0	2	3	14	8	0	0	0	0	0	28	41
10:00	0	0	0	0	2	2	13	8	2	0	1	0	0	28	44
11:00	0	0	0	0	0	6	7	6	3	1	0	0	0	23	44
12 PM	1	0	0	1	7	6	20	8	1	0	0	0	0	44	40
13:00	0	0	0	0	3	6	11	8	1	1	0	0	0	30	42
14:00	0	0	0	2	2	10	20	10	2	0	0	0	1	47	42
15:00	0	0	0	0	6	10	20	16	3	2	1	0	0	58	43
16:00	1	0	1	2	6	9	26	16	2	2	0	0	0	65	41
17:00	0	0	1	2	8	13	25	5	3	0	1	0	0	58	40
18:00	0	0	1	0	4	16	10	11	1	0	0	0	0	43	40
19:00	0	0	0	1	3	6	5	4	0	0	0	0	0	19	39
20:00	0	0	0	0	3	4	8	4	4	0	0	0	0	23	43
21:00	0	0	0	1	0	3	5	3	0	0	0	0	0	12	41
22:00	0	0	0	1	1	6	6	2	0	0	0	0	0	16	39
23:00	1	0	0	0	1	2	7	3	1	0	0	0	0	15	39
Total	5	0	3	13	60	142	286	171	38	8	3	0	1	730	
%	0.7%	0.0%	0.4%	1.8%	8.2%	19.5%	39.2%	23.4%	5.2%	1.1%	0.4%	0.0%	0.1%		

%ile Speed
 15th Percentile : 35 MPH
 50th Percentile : 42 MPH
 85th Percentile : 48 MPH
 95th Percentile : 51 MPH

Stats
 10 MPH Pace Speed : 40-49 MPH
 Number in Pace : 457
 Percent in Pace : 62.6%
 Number of Vehicles > 40 MPH : 449
 Percent of Vehicles > 40 MPH : 61.5%
 Mean Speed(Average) : 42 MPH



PRECISION
D A T A
INDUSTRIES, LLC

P.O. Box 301 Berth, MA 01503
Office: 508.481.9999 Toll Free: 888.734.7344
Fax: 508.481.0716 Email: info@pdilic.com

Northfield Road
500' west of Chase Road (Route 13)
City, State: Lunenburg, MA
Client: MST5/D. Hao

50104Aspeed
Site Code: 803

Start Time	14	15	20	25	30	35	40	45	50	55	60	65	70	Total	Ave. MPH
WB	19	24	29	34	39	44	49	54	59	64	69	9999			
02/09/05	0	0	0	0	0	1	0	0	0	0	0	0	0	1	35
01:00	0	0	0	0	0	1	0	0	0	0	0	0	0	1	35
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*
03:00	0	0	0	0	1	1	0	0	0	0	0	0	0	2	34
04:00	0	0	0	0	1	0	0	0	0	0	0	0	0	1	30
05:00	0	0	0	0	0	2	1	1	1	0	0	0	0	5	43
06:00	1	0	0	0	3	4	2	3	0	1	0	0	0	14	38
07:00	0	0	0	0	4	11	25	13	2	1	0	0	0	56	42
08:00	0	0	0	0	5	4	8	10	2	0	2	0	0	31	43
09:00	0	0	0	0	2	4	8	13	6	0	1	0	0	34	45
10:00	0	0	0	0	1	6	12	8	3	1	0	0	0	31	43
11:00	0	0	0	0	2	4	13	7	0	1	0	0	0	27	42
12 PM	0	0	1	2	2	7	10	5	1	1	0	0	0	29	40
13:00	0	0	0	2	1	13	9	5	4	0	1	0	0	35	41
14:00	1	0	0	1	8	9	17	11	3	0	0	0	0	50	40
15:00	1	0	0	1	1	15	35	14	3	1	0	0	0	71	42
16:00	0	0	0	1	9	18	39	17	8	1	1	0	0	94	42
17:00	0	0	0	0	6	15	40	16	3	0	0	0	0	80	42
18:00	0	1	0	1	2	11	25	14	4	1	0	0	0	59	42
19:00	0	0	0	0	2	5	6	4	2	1	0	0	0	20	42
20:00	0	0	0	0	3	8	10	5	3	0	0	0	0	29	42
21:00	0	1	1	0	1	7	9	7	2	0	0	0	0	28	41
22:00	0	0	0	0	2	2	5	3	0	0	0	0	0	12	41
23:00	1	0	0	0	0	2	1	1	0	1	0	0	0	6	36
Total	4	2	2	8	56	150	275	157	47	10	5	0	0	716	
%	0.6%	0.3%	0.3%	1.1%	7.8%	20.9%	38.4%	21.9%	6.6%	1.4%	0.7%	0.0%	0.0%		

%ile Speed

15th Percentile : 36 MPH
 50th Percentile : 42 MPH
 85th Percentile : 48 MPH
 95th Percentile : 52 MPH

Stats

10 MPH Pace Speed : 40-49 MPH
 Number in Pace : 432
 Percent in Pace : 60.3%
 Number of Vehicles > 40 MPH : 439
 Percent of Vehicles > 40 MPH : 61.3%
 Mean Speed(Average) : 42 MPH

-
- **TMC data**



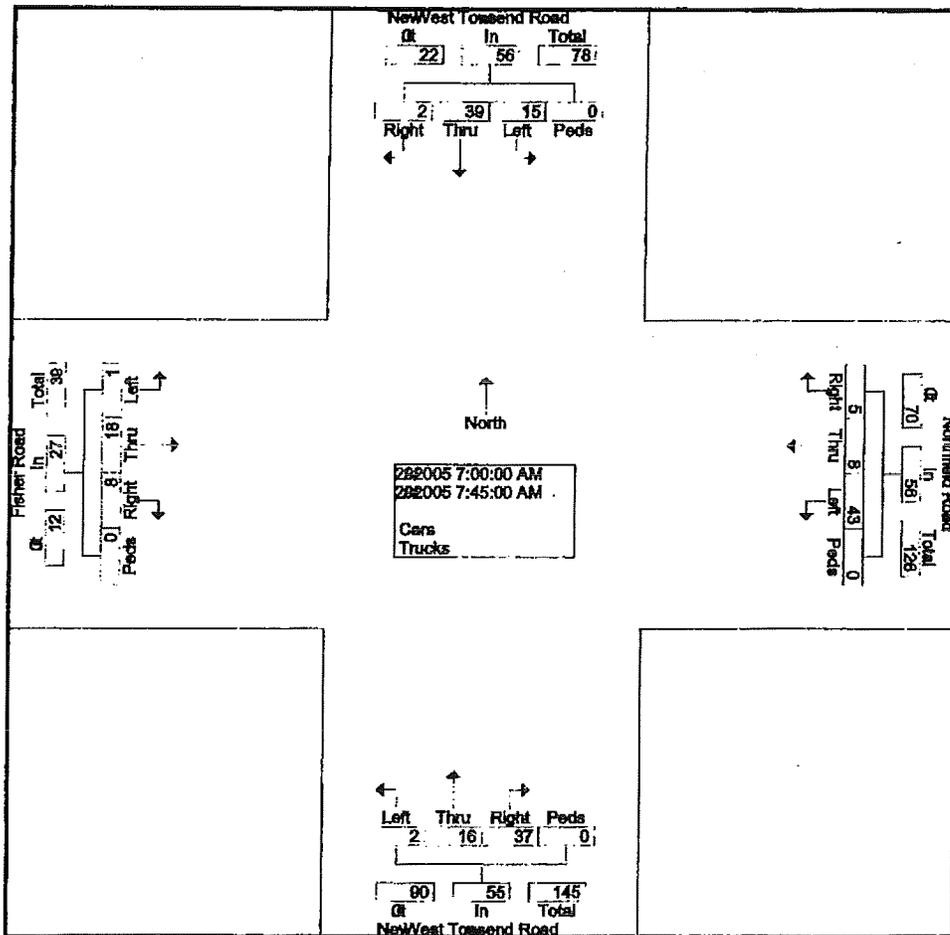
PRECISION
DATA
INDUSTRIES, LLC

R.O. Box 501 Berlin, MA 01503
Office: 508.481.3999 Toll Free: 888.734.7344
Fax: 508.481.0716 Email: info@pdilc.com

N/S: New West Townsend Road
E/W: Northfield Road/Fisher Road
City, State: Lunenburg, MA
Client: MSTSD. Hao

File Name : 50104A
Site Code : 803
Start Date : 2/9/2005
Page No : 1

Start Time	NewWest Townsend Road From North					Northfield Road From East					NewWest Townsend Road From South					Fisher Road From West					Int. Total
	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	
Peak Hour From 07:00 AM to 08:45 AM - Peak 1 of 1																					
Intersection	07:00 AM																				
Volume	2	39	15	0	56	5	8	43	0	56	37	16	2	0	55	8	18	1	0	27	194
Percent	3.6	69.6	26.8	0.0		8.9	14.3	76.8	0.0		67.3	29.1	3.6	0.0		29.6	66.7	3.7	0.0		
07:30	07:30 AM																				
Volume	0	11	5	0	16	1	2	16	0	19	11	8	0	0	19	1	6	1	0	8	62
Peak Factor	0.782																				
High Int.	07:45 AM																				
Volume	1	14	5	0	20	1	3	16	0	20	11	8	0	0	19	1	7	0	0	8	8
Peak Factor	0.700					0.700					0.724					0.844					





PRECISION
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P.O. Box 301 Berlin, MA 01503
Office: 508.481.9999 Toll Free: 888.734.7344
Fax: 508.481.0716 Email: info@pdillc.com

N/S: New West Townsend Road
E/W: Northfield Road/Fisher Road
City, State: Lunenburg, MA
Client: MSTIS/D. Hao

File Name : 50104A
Site Code : 803
Start Date : 2/9/2005
Page No : 1

Groups Printed- Cars - Trucks

Start Time	New West Townsend Road From North				Northfield Road From East				New West Townsend Road From South				Fisher Road From West			Int. Total	
	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left		Peds
07:00 AM	1	6	2	0	3	3	5	0	6	3	1	0	1	7	0	0	38
07:15 AM	0	8	3	0	0	0	6	0	12	2	1	0	5	3	0	0	40
07:30 AM	0	11	5	0	1	2	16	0	11	8	0	0	1	6	1	0	62
07:45 AM	1	14	5	0	1	3	16	0	8	3	0	0	1	2	0	0	54
Total	2	39	15	0	5	8	43	0	37	16	2	0	8	18	1	0	194
08:00 AM	0	12	1	0	0	0	9	0	3	2	0	0	3	1	1	0	32
08:15 AM	0	8	0	0	0	0	8	0	10	3	1	0	1	0	0	0	31
08:30 AM	0	6	1	0	1	0	6	0	11	1	0	0	0	5	0	0	31
08:45 AM	0	3	0	0	2	0	3	0	7	5	0	0	0	1	0	0	21
Total	0	29	2	0	3	0	26	0	31	11	1	0	4	7	1	0	115
Grand Total	2	68	17	0	8	8	69	0	68	27	3	0	12	25	2	0	309
Approch %	2.3	78.2	19.5	0.0	9.4	9.4	81.2	0.0	69.4	27.6	3.1	0.0	30.8	64.1	5.1	0.0	
Total %	0.6	22.0	5.5	0.0	2.6	2.6	22.3	0.0	22.0	8.7	1.0	0.0	3.9	8.1	0.6	0.0	

Start Time	New West Townsend Road From North					Northfield Road From East					New West Townsend Road From South					Fisher Road From West					Int. Total
	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	
Peak Hour From 07:00 AM to 08:45 AM - Peak 1 of 1																					
Intersection																					
07:00 AM	2	39	15	0	56	5	8	43	0	56	37	16	2	0	55	8	18	1	0	27	194
Volume	2	39	15	0	56	5	8	43	0	56	37	16	2	0	55	8	18	1	0	27	194
Percent	3.6	69.6	26.8	0.0		8.9	14.3	76.8	0.0		67.3	29.1	3.6	0.0		29.6	66.7	3.7	0.0		
07:30 AM	0	11	5	0	16	1	2	16	0	19	11	8	0	0	19	1	6	1	0	8	62
Volume	0	11	5	0	16	1	2	16	0	19	11	8	0	0	19	1	6	1	0	8	62
Peak Factor																					
High Int.	07:45 AM					07:45 AM					07:30 AM					07:00 AM					
Volume	1	14	5	0	20	1	3	16	0	20	11	8	0	0	19	1	7	0	0	8	
Peak Factor					0.700					0.700					0.724					0.844	



PRECISION
DATA
INDUSTRIES, LLC

P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Toll Free: 888.734.7344
Fax: 508.481.0716 Email: info@pdillc.com

N/S: New West Townsend Road
E/W: Northfield Road/Fisher Road
City, State: Lunenburg, MA
Client: MSTSD/D. Hao

File Name : 50104A
Site Code : 803
Start Date : 2/9/2005
Page No : 1

Groups Printed - Cars

Start Time	New West Townsend Road From North				Northfield Road From East				New West Townsend Road From South				Fisher Road From West				Int. Total
	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	
07:00 AM	1	6	2	0	3	3	5	0	6	3	1	0	1	7	0	0	38
07:15 AM	0	8	3	0	0	0	6	0	12	2	1	0	5	3	0	0	40
07:30 AM	0	11	5	0	1	2	16	0	11	7	0	0	1	6	1	0	61
07:45 AM	1	14	5	0	1	3	16	0	8	3	0	0	1	2	0	0	54
Total	2	39	15	0	5	8	43	0	37	15	2	0	8	18	1	0	193
08:00 AM	0	12	1	0	0	0	8	0	3	2	0	0	3	1	1	0	31
08:15 AM	0	8	0	0	0	0	8	0	9	3	1	0	1	0	0	0	30
08:30 AM	0	6	1	0	1	0	6	0	11	1	0	0	0	5	0	0	31
08:45 AM	0	3	0	0	2	0	3	0	7	5	0	0	0	1	0	0	21
Total	0	29	2	0	3	0	25	0	30	11	1	0	4	7	1	0	113
Grand Total	2	68	17	0	8	8	68	0	67	26	3	0	12	25	2	0	306
Apprch %	2.3	78.2	19.5	0.0	9.5	9.5	81.0	0.0	69.8	27.1	3.1	0.0	30.8	64.1	5.1	0.0	
Total %	0.7	22.2	5.6	0.0	2.6	2.6	22.2	0.0	21.9	8.5	1.0	0.0	3.9	8.2	0.7	0.0	

Start Time	New West Townsend Road From North					Northfield Road From East					New West Townsend Road From South					Fisher Road From West					Int. Total						
	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total							
Peak Hour From 07:00 AM to 08:45 AM - Peak 1 of 1																											
Intersection																											
07:00 AM	2	39	15	0	56	5	8	43	0	56	37	15	2	0	54	8	18	1	0	27	193						
Volume	3.6	69.6	26.8	0.0		8.9	14.3	76.8	0.0		68.5	27.8	3.7	0.0		29.6	66.7	3.7	0.0								
Percent	0	11	5	0	16	1	2	16	0	19	11	7	0	0	18	1	6	1	0	8	61						
07:30 AM																											
Volume	0	11	5	0	16	1	2	16	0	19	11	7	0	0	18	1	6	1	0	8	61						
Peak Factor																					0.791						
High Int.																											
07:45 AM	1	14	5	0	20	07:45 AM	1	3	16	0	20	07:30 AM	11	7	0	0	18	07:00 AM	1	7	0	0	8				
Volume	0.700																				0.700	0.750					0.844
Peak Factor																											



PRECISION
D A T A
INDUSTRIES, LLC

P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Toll Free: 888.734.7344
Fax: 508.481.0716 Email: info@pdifc.com

N/S: New West Townsend Road
E/W: Northfield Road/Fisher Road
City, State: Lunenburg, MA
Client: MSTSD. Hao

File Name : 50104A
Site Code : 803
Start Date : 2/9/2005
Page No : 1

Groups Printed- Trucks

Start Time	New West Townsend Road From North				Northfield Road From East				New West Townsend Road From South				Fisher Road From West				Int. Total
	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	
07:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:30 AM	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
07:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
08:00 AM	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
08:15 AM	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
08:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	2
Grand Total	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	3
Approch %	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	50.0	50.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total %	0.0	0.0	0.0	0.0	0.0	0.0	33.3	0.0	33.3	33.3	0.0	0.0	0.0	0.0	0.0	0.0	

Start Time	New West Townsend Road From North					Northfield Road From East					New West Townsend Road From South					Fisher Road From West					Int. Total
	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	
Peak Hour From 07:00 AM to 08:45 AM - Peak 1 of 1																					
Intersection	07:30 AM																				
Volume	0	0	0	0	0	0	0	1	0	1	1	1	0	0	2	0	0	0	0	0	3
Percent	0.0	0.0	0.0	0.0		0.0	0.0	100.0	0.0		50.0	50.0	0.0	0.0		0.0	0.0	0.0	0.0		
08:15 Volume	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	1
Peak Factor																					
High Int. Volume	6:45:00 AM					08:00 AM					07:30 AM					6:45:00 AM					
Peak Factor						0.250					0.500										



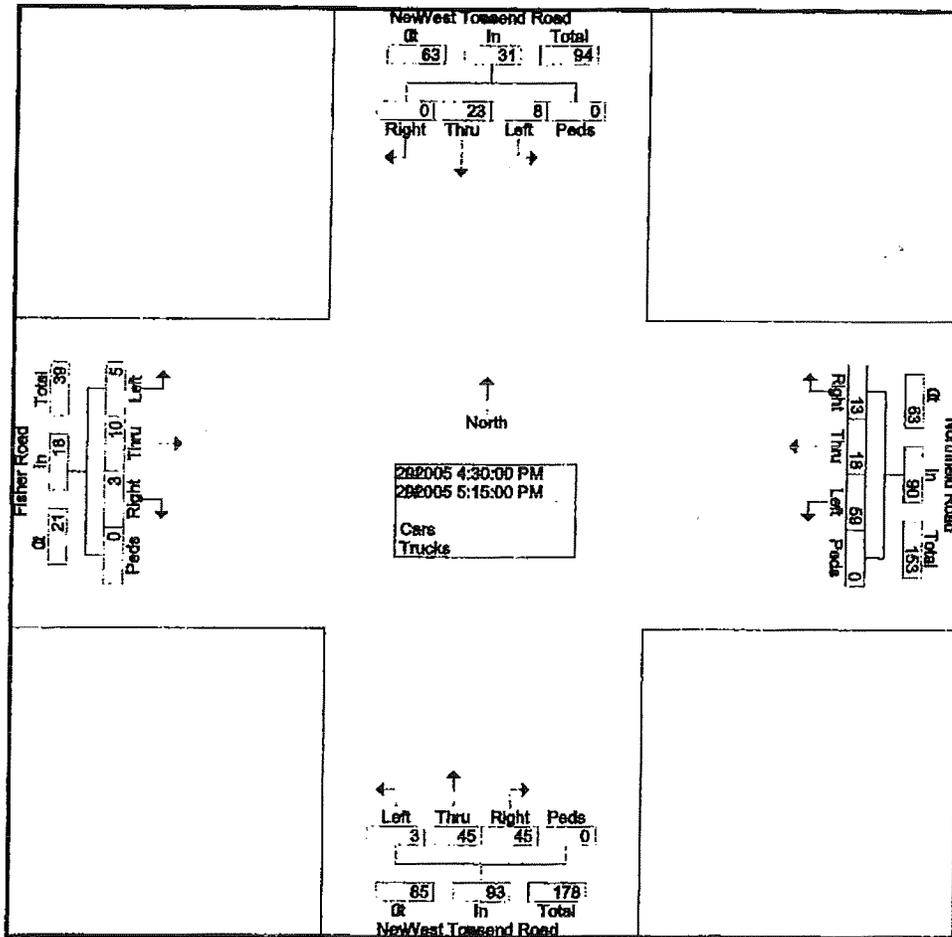
PRECISION
DATA
INDUSTRIES, LLC

P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Toll Free: 888.734.7344
Fax: 508.481.0716 Email: info@pdilc.com

N/S: New West Townsend Road
E/W: Northfield Road/Fisher Road
City, State: Lunenburg, MA
Client: MSTs/D. Hao

File Name : 50104AA
Site Code : 803
Start Date : 2/9/2005
Page No : 1

Start Time	NewWest Townsend Road From North					Northfield Road From East					NewWest Townsend Road From South					Fisher Road From West					Int. Total
	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	
Peak Hour From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Intersection																					
04:30 PM	0	23	8	0	31	13	18	59	0	90	45	45	3	0	93	3	10	5	0	18	232
Volume	0	23	8	0	31	13	18	59	0	90	45	45	3	0	93	3	10	5	0	18	
Percent	0.0	74.2	25.8	0.0		14.4	20.0	65.6	0.0		48.4	48.4	3.2	0.0		16.7	55.6	27.8	0.0		
05:15	0	7	2	0	9	3	10	13	0	26	10	13	0	0	23	0	3	1	0	4	62
Volume	0	7	2	0	9	3	10	13	0	26	10	13	0	0	23	0	3	1	0	4	
Peak Factor																					
High Int. Peak Factor	0.705					0.865					0.750					0.750					
05:00 PM	0	7	4	0	11	3	10	13	0	26	18	11	2	0	31	2	4	0	0	6	
Volume	0	7	4	0	11	3	10	13	0	26	18	11	2	0	31	2	4	0	0	6	
Peak Factor																					





PRECISION
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City, State: Lunenburg, MA
Client: MSTIS/D. Hao

File Name : 50104AA
Site Code : 803
Start Date : 2/9/2005
Page No : 1

Groups Printed- Cars - Trucks

Start Time	New West Townsend Road From North				Northfield Road From East				New West Townsend Road From South				Fisher Road From West				Int. Total
	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	
04:00 PM	0	3	1	0	7	1	8	0	12	8	2	0	0	2	1	0	45
04:15 PM	0	1	1	0	3	3	10	0	9	11	1	0	1	1	0	0	41
04:30 PM	0	8	0	0	2	2	18	0	11	12	1	0	0	1	2	0	57
04:45 PM	0	1	2	0	5	3	15	0	18	11	2	0	1	2	2	0	62
Total	0	13	4	0	17	9	51	0	50	42	6	0	2	6	5	0	205
05:00 PM	0	7	4	0	3	3	13	0	6	9	0	0	2	4	0	0	51
05:15 PM	0	7	2	0	3	10	13	0	10	13	0	0	0	3	1	0	62
05:30 PM	0	9	2	0	4	4	10	0	9	13	1	0	0	1	1	0	54
05:45 PM	1	7	3	0	0	1	7	0	6	9	1	0	1	1	0	0	37
Total	1	30	11	0	10	18	43	0	31	44	2	0	3	9	2	0	204
Grand Total	1	43	15	0	27	27	94	0	81	86	8	0	5	15	7	0	409
Apprch %	1.7	72.9	25.4	0.0	18.2	18.2	63.5	0.0	46.3	49.1	4.6	0.0	18.5	55.6	25.9	0.0	
Total %	0.2	10.5	3.7	0.0	6.6	6.6	23.0	0.0	19.8	21.0	2.0	0.0	1.2	3.7	1.7	0.0	

Start Time	New West Townsend Road From North					Northfield Road From East					New West Townsend Road From South					Fisher Road From West					Int. Total
	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	
Peak Hour From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Intersection																					
04:30 PM																					
Volume	0	23	8	0	31	13	18	59	0	90	45	45	3	0	93	3	10	5	0	18	232
Percent	0.0	74.2	25.8	0.0		14.4	20.0	65.6	0.0		48.4	48.4	3.2	0.0		16.7	55.6	27.8	0.0		
05:15 PM																					
Volume	0	7	2	0	9	3	10	13	0	26	10	13	0	0	23	0	3	1	0	4	62
Peak Factor																					0.935
High Int.																					
05:00 PM						05:15 PM					04:45 PM					05:00 PM					
Volume	0	7	4	0	11	3	10	13	0	26	18	11	2	0	31	2	4	0	0	6	
Peak Factor	0.705					0.865					0.750					0.750					



PRECISION
DATA
INDUSTRIES, LLC

P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Toll Free: 888.734.7344
Fax: 508.481.0716 Email: info@pdillc.com

N/S: New West Townsend Road
E/W: Northfield Road/Fisher Road
City, State: Lunenburg, MA
Client: MSTSD/D. Hao

File Name : 50104AA
Site Code : 803
Start Date : 2/9/2005
Page No : 1

Groups Printed- Cars

Start Time	New West Townsend Road From North				Northfield Road From East				New West Townsend Road From South				Fisher Road From West			Int. Total	
	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left		Peds
04:00 PM	0	3	1	0	7	1	8	0	12	8	2	0	0	2	1	0	45
04:15 PM	0	1	1	0	3	3	10	0	9	11	1	0	1	1	0	0	41
04:30 PM	0	7	0	0	2	2	18	0	11	11	1	0	0	1	2	0	55
04:45 PM	0	1	2	0	5	3	15	0	18	10	2	0	1	2	2	0	61
Total	0	12	4	0	17	9	51	0	50	40	6	0	2	6	5	0	202
05:00 PM	0	7	4	0	3	3	13	0	6	9	0	0	2	4	0	0	51
05:15 PM	0	7	2	0	3	10	13	0	10	13	0	0	0	3	1	0	62
05:30 PM	0	9	2	0	4	4	10	0	9	13	1	0	0	1	1	0	54
05:45 PM	1	7	3	0	0	1	7	0	6	9	1	0	1	1	0	0	37
Total	1	30	11	0	10	18	43	0	31	44	2	0	3	9	2	0	204
Grand Total	1	42	15	0	27	27	94	0	81	84	8	0	5	15	7	0	406
Approch %	1.7	72.4	25.9	0.0	18.2	18.2	63.5	0.0	46.8	48.6	4.6	0.0	18.5	55.6	25.9	0.0	
Total %	0.2	10.3	3.7	0.0	6.7	6.7	23.2	0.0	20.0	20.7	2.0	0.0	1.2	3.7	1.7	0.0	

Start Time	New West Townsend Road From North					Northfield Road From East					New West Townsend Road From South					Fisher Road From West					Int. Total
	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	
Peak Hour From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Intersection	04:30 PM																				
Volume	0	22	8	0	30	13	18	59	0	90	45	43	3	0	91	3	10	5	0	18	229
Percent	0.0	73.3	26.7	0.0		14.4	20.0	65.6	0.0		49.5	47.3	3.3	0.0		16.7	55.6	27.8	0.0		
Volume	05:15																				
Peak Factor	0	7	2	0	9	3	10	13	0	26	10	13	0	0	23	0	3	1	0	4	62
High Int.	05:00 PM					05:15 PM					04:45 PM					05:00 PM					
Volume	0	7	4	0	11	3	10	13	0	26	18	10	2	0	30	2	4	0	0	6	
Peak Factor	0.682					0.865					0.758					0.750					



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INDUSTRIES, LLC

P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Toll Free: 888.734.7344
Fax: 508.481.0716 Email: info@pdic.com

N/S: New West Townsend Road
E/W: Northfield Road/Fisher Road
City, State: Lunenburg, MA
Client: MSTs/D. Hao

File Name : 50104AA
Site Code : 803
Start Date : 2/9/2005
Page No : 1

Groups Printed- Trucks

Start Time	New West Townsend Road From North				Northfield Road From East				New West Townsend Road From South				Fisher Road From West				Int. Total
	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	
04:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:30 PM	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2
04:45 PM	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
Total	0	1	0	0	0	0	0	0	0	2	0	0	0	0	0	0	3
05:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	0	1	0	0	0	0	0	0	0	2	0	0	0	0	0	0	3
Approch %	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total %	0.0	33.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	66.7	0.0	0.0	0.0	0.0	0.0	0.0	

Start Time	New West Townsend Road From North					Northfield Road From East					New West Townsend Road From South					Fisher Road From West					Int. Total			
	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total				
Peak Hour From 04:00 PM to 05:45 PM - Peak 1 of 1																								
Intersection																								
04:00 PM	0	1	0	0	1	0	0	0	0	0	0	2	0	0	2	0	0	0	0	0	3			
Volume	0	1	0	0	1	0	0	0	0	0	0	2	0	0	2	0	0	0	0	0				
Percent	0.0	100.0	0.0	0.0		0.0	0.0	0.0	0.0		0.0	100.0	0.0	0.0		0.0	0.0	0.0	0.0					
04:30 PM	0	1	0	0	1	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	2			
Volume	0	1	0	0	1	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0				
Peak Factor	0.250										0.500													
High Int.																								
04:30 PM	0	1	0	0	1	3:45:00 PM	0	0	0	0	0	04:30 PM	0	1	0	0	1	3:45:00 PM	0	0	0	0	0	0.375
Volume	0	1	0	0	1	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0				
Peak Factor	0.250										0.500													



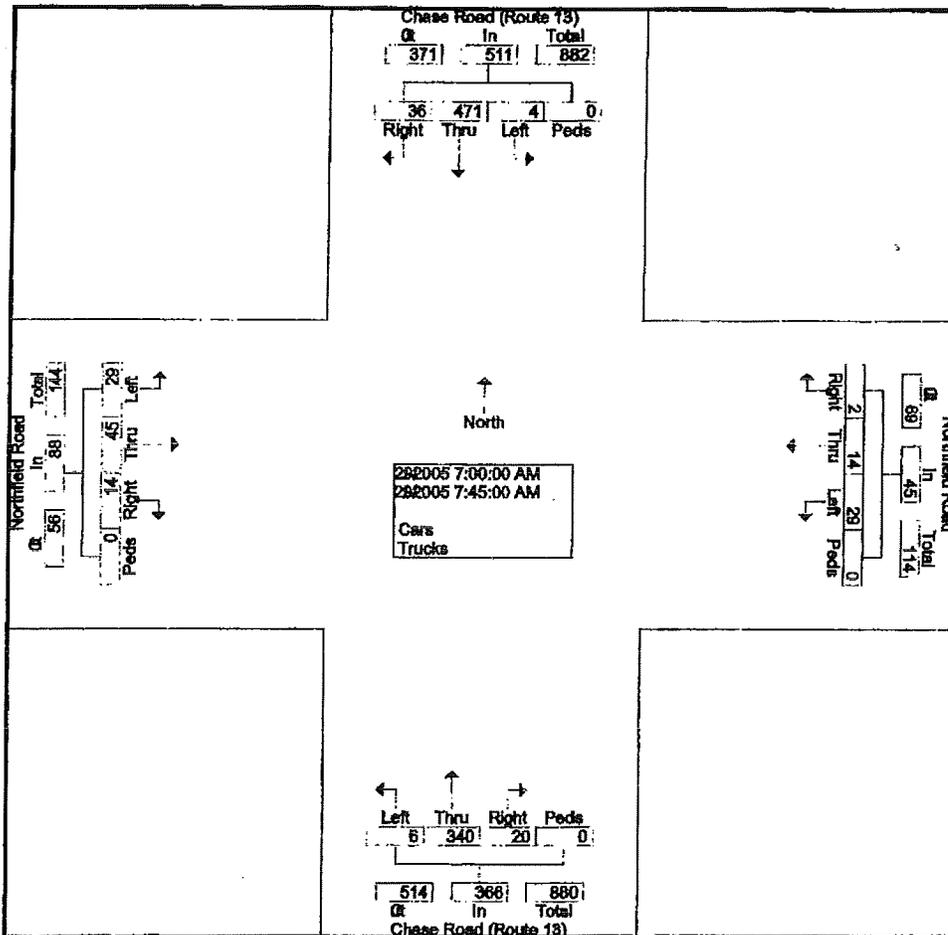
PRECISION
D A T A
INDUSTRIES, LLC

RD. Box 901 Berlin, MA 01503
Office: 508.481.3999 Toll Free: 888.734.7344
Fax: 508.481.0716 Email: info@pdilic.com

N/S: Chase Road (Route 13)
E/W: Northfield Road
City, State: Lunenburg, MA
Client: MSTSD/D. Hao

File Name : 50104B
Site Code : 803
Start Date : 2/9/2005
Page No : 1

Start Time	Chase Road (Route 13) From North					Northfield Road From East					Chase Road (Route 13) From South					Northfield Road From West					Int. Total
	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	
Peak Hour From 07:00 AM to 08:45 AM - Peak 1 of 1																					
Intersection																					
07:00 AM	36	471	4	0	511	2	14	29	0	45	20	340	6	0	366	14	45	29	0	88	1010
Volume	36	471	4	0	511	2	14	29	0	45	20	340	6	0	366	14	45	29	0	88	1010
Percent	7.0	92.2	0.8	0.0		4.4	31.1	64.4	0.0		5.5	92.9	1.6	0.0		15.9	51.1	33.0	0.0		
07:30 AM	13	123	0	0	136	1	5	15	0	21	3	97	2	0	102	2	9	10	0	21	280
Volume	13	123	0	0	136	1	5	15	0	21	3	97	2	0	102	2	9	10	0	21	280
Peak Factor	0.939					0.536					0.897					0.917					0.902
High Int. Peak	0.939					0.536					0.897					0.917					0.902
High Int. Peak Factor	0.939					0.536					0.897					0.917					0.902





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INDUSTRIES, LLC

P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Toll Free: 888.734.7344
Fax: 508.481.0716 Email: info@pdtilc.com

File Name : 50104B
Site Code : 803
Start Date : 2/9/2005
Page No : 1

N/S: Chase Road (Route 13)
E/W: Northfield Road
City, State: Lunenburg, MA
Client: MSTIS/D. Hao

Groups Printed- Cars - Trucks

Start Time	Chase Road (Route 13) From North				Northfield Road From East				Chase Road (Route 13) From South				Northfield Road From West			Int. Total	
	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left		Peds
07:00 AM	6	106	1	0	1	6	4	0	2	63	1	0	5	14	3	0	212
07:15 AM	7	123	1	0	0	1	8	0	8	87	1	0	2	9	10	0	257
07:30 AM	13	123	0	0	1	5	15	0	3	97	2	0	2	9	10	0	280
07:45 AM	10	119	2	0	0	2	2	0	7	93	2	0	5	13	6	0	261
Total	36	471	4	0	2	14	29	0	20	340	6	0	14	45	29	0	1010
08:00 AM	5	93	1	0	0	4	4	0	6	69	2	0	2	1	3	0	190
08:15 AM	5	100	2	0	1	0	3	0	3	58	3	0	5	7	3	0	190
08:30 AM	3	105	1	0	2	3	6	0	3	58	1	0	9	9	9	0	209
08:45 AM	5	116	3	0	1	1	4	0	6	67	3	0	4	3	4	0	217
Total	18	414	7	0	4	8	17	0	18	252	9	0	20	20	19	0	806
Grand Total	54	885	11	0	6	22	46	0	38	592	15	0	34	65	48	0	1816
Apprch %	5.7	93.2	1.2	0.0	8.1	29.7	62.2	0.0	5.9	91.8	2.3	0.0	23.1	44.2	32.7	0.0	
Total %	3.0	48.7	0.6	0.0	0.3	1.2	2.5	0.0	2.1	32.6	0.8	0.0	1.9	3.6	2.6	0.0	

Start Time	Chase Road (Route 13) From North					Northfield Road From East					Chase Road (Route 13) From South					Northfield Road From West					Int. Total
	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	
Peak Hour From 07:00 AM to 08:45 AM - Peak 1 of 1																					
Intersection																					
07:00 AM																					
Volume	36	471	4	0	511	2	14	29	0	45	20	340	6	0	366	14	45	29	0	88	1010
Percent	7.0	92.2	0.8	0.0		4.4	31.1	64.4	0.0		5.5	92.9	1.6	0.0		15.9	51.1	33.0	0.0		
07:30 AM																					
Volume	13	123	0	0	136	1	5	15	0	21	3	97	2	0	102	2	9	10	0	21	280
Peak Factor																					0.902
High Int.																					
07:30 AM						07:30 AM										07:45 AM					
Volume	13	123	0	0	136	1	5	15	0	21	3	97	2	0	102	5	13	6	0	24	
Peak Factor	0.939					0.536					0.897					0.917					



PRECISION
DATA
INDUSTRIES, LLC

P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Toll Free: 888.734.7344
Fax: 508.481.0716 Email: info@pdillc.com

N/S: Chase Road (Route 13)
E/W: Northfield Road
City, State: Lunenburg, MA
Client: MST5/D. Hao

File Name : 50104B
Site Code : 803
Start Date : 2/9/2005
Page No : 1

Groups Printed- Cars

Start Time	Chase Road (Route 13) From North				Northfield Road From East				Chase Road (Route 13) From South				Northfield Road From West				Int. Total
	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	
07:00 AM	6	103	1	0	1	6	4	0	2	55	1	0	5	14	3	0	201
07:15 AM	7	120	1	0	0	1	8	0	8	87	1	0	2	9	10	0	254
07:30 AM	13	121	0	0	1	5	15	0	2	94	2	0	2	9	10	0	274
07:45 AM	10	110	2	0	0	2	2	0	7	89	2	0	5	13	6	0	248
Total	36	454	4	0	2	14	29	0	19	325	6	0	14	45	29	0	977
08:00 AM	4	88	1	0	0	4	4	0	6	66	2	0	2	1	3	0	181
08:15 AM	5	96	1	0	0	0	3	0	3	58	3	0	5	7	3	0	184
08:30 AM	3	100	1	0	2	3	6	0	3	55	1	0	9	9	7	0	199
08:45 AM	4	113	3	0	1	1	4	0	5	59	3	0	4	3	4	0	204
Total	16	397	6	0	3	8	17	0	17	238	9	0	20	20	17	0	768
Grand Total	52	851	10	0	5	22	46	0	36	563	15	0	34	65	46	0	1745
Approch %	5.7	93.2	1.1	0.0	6.8	30.1	63.0	0.0	5.9	91.7	2.4	0.0	23.4	44.8	31.7	0.0	
Total %	3.0	48.8	0.6	0.0	0.3	1.3	2.6	0.0	2.1	32.3	0.9	0.0	1.9	3.7	2.6	0.0	

Start Time	Chase Road (Route 13) From North					Northfield Road From East					Chase Road (Route 13) From South					Northfield Road From West					Int. Total		
	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total			
Peak Hour From 07:00 AM to 08:45 AM - Peak 1 of 1																							
Intersection																							
07:00 AM	36	454	4	0	494	2	14	29	0	45	19	325	6	0	350	14	45	29	0	88	977		
Volume	36	454	4	0	494	2	14	29	0	45	19	325	6	0	350	14	45	29	0	88	977		
Percent	7.3	91.9	0.8	0.0		4.4	31.1	64.4	0.0		5.4	92.9	1.7	0.0		15.9	51.1	33.0	0.0				
07:30 AM	13	121	0	0	134	1	5	15	0	21	2	94	2	0	98	2	9	10	0	21	274		
Volume	13	121	0	0	134	1	5	15	0	21	2	94	2	0	98	2	9	10	0	21	274		
Peak Factor																					0.891		
High Int.	07:30 AM																						
Volume	13	121	0	0	134	1	5	15	0	21	2	94	2	0	98	5	13	6	0	24			
Peak Factor					0.922						0.536						0.893						0.917



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INDUSTRIES, LLC

P.O. Box 301 Berlin, MA 01503
Office: 508.481.2999 Toll Free: 888.734.7344
Fax: 508.481.0716 Email: info@pdilc.com

N/S: Chase Road (Route 13)
E/W: Northfield Road
City, State: Lunenburg, MA
Client: MSTIS/D. Hao

File Name : 50104B
Site Code : 803
Start Date : 2/9/2005
Page No : 1

Groups Printed- Trucks

Start Time	Chase Road (Route 13) From North				Northfield Road From East				Chase Road (Route 13) From South				Northfield Road From West				Int. Total	
	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds		
07:00 AM	0	3	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	11
07:15 AM	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
07:30 AM	0	2	0	0	0	0	0	0	1	3	0	0	0	0	0	0	0	6
07:45 AM	0	9	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	13
Total	0	17	0	0	0	0	0	0	1	15	0	0	0	0	0	0	0	33
08:00 AM	1	5	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	9
08:15 AM	0	4	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	6
08:30 AM	0	5	0	0	0	0	0	0	0	3	0	0	0	0	0	2	0	10
08:45 AM	1	3	0	0	0	0	0	0	1	8	0	0	0	0	0	0	0	13
Total	2	17	1	0	1	0	0	0	1	14	0	0	0	0	0	2	0	38
Grand Total	2	34	1	0	1	0	0	0	2	29	0	0	0	0	0	2	0	71
Apprch %	5.4	91.9	2.7	0.0	100.0	0.0	0.0	0.0	6.5	93.5	0.0	0.0	0.0	0.0	100.0	0.0	0.0	
Total %	2.8	47.9	1.4	0.0	1.4	0.0	0.0	0.0	2.8	40.8	0.0	0.0	0.0	0.0	2.8	0.0	0.0	

Start Time	Chase Road (Route 13) From North					Northfield Road From East					Chase Road (Route 13) From South					Northfield Road From West					Int. Total
	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	
Peak Hour From 07:00 AM to 08:45 AM - Peak 1 of 1																					
Intersection	07:45 AM																				
Volume	1	23	1	0	25	1	0	0	0	1	0	10	0	0	10	0	0	2	0	2	38
Percent	4.0	92.0	4.0	0.0		100.0	0.0	0.0	0.0		0.0	100.0	0.0	0.0		0.0	0.0	100.0	0.0		
07:45 Volume	0	9	0	0	9	0	0	0	0	0	0	4	0	0	4	0	0	0	0	0	13
Peak Factor	0.731																				
High Int.	07:45 AM																				
Volume	0	9	0	0	9	08:15 AM					07:45 AM					08:30 AM					
Peak Factor	0.894										0.250					0.625					0.250



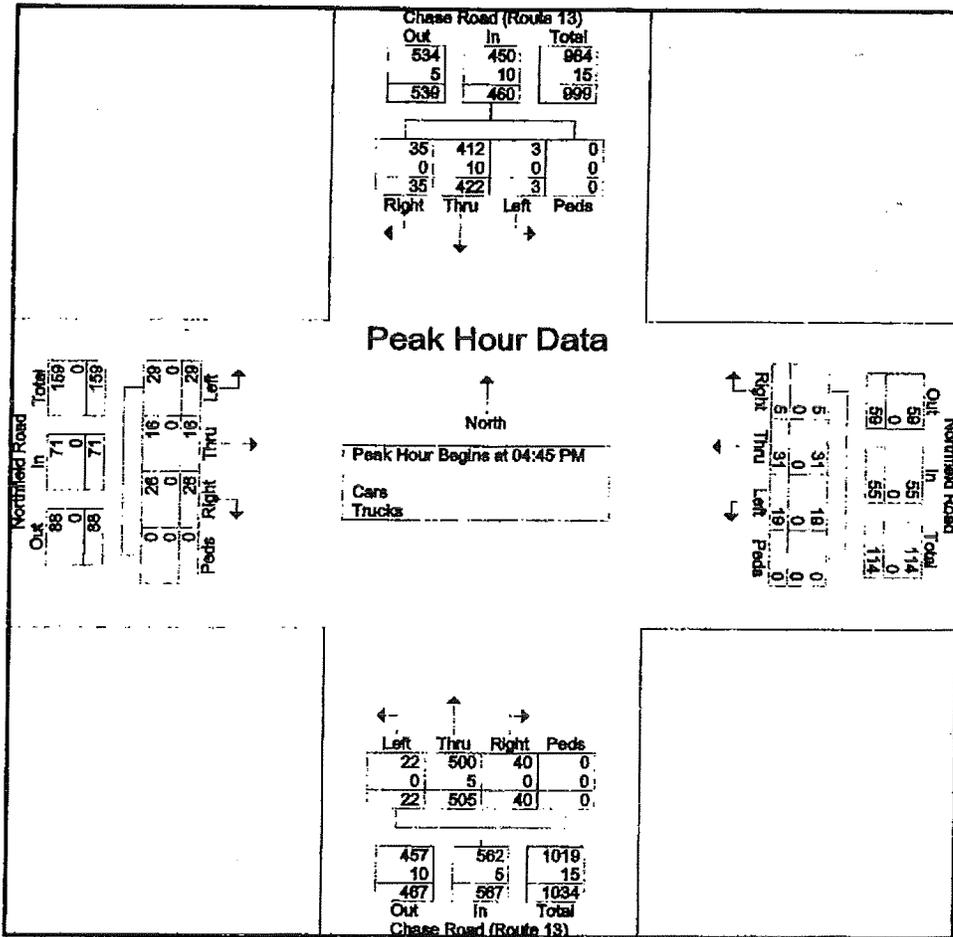
PRECISION
DATA
INDUSTRIES, LLC

P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Toll Free: 888.734.7344
Fax: 508.481.0716 Email: info@pdinc.com

N/S: Chase Road (Route 13)
E/W: Northfield Road
City, State: Lunenburg, MA
Client: MSTSD. Hao

File Name : 50104BB
Site Code : 803
Start Date : 2/9/2005
Page No : 1

Start Time	Chase Road (Route 13) From North					Northfield Road From East					Chase Road (Route 13) From South					Northfield Road From West					Int. Total
	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:45 PM																					
04:45 PM	8	101	1	0	110	0	6	8	0	14	8	117	3	0	128	5	5	12	0	22	274
05:00 PM	9	95	1	0	105	2	10	6	0	18	9	113	4	0	126	4	2	10	0	16	265
05:15 PM	11	115	1	0	127	0	7	2	0	9	16	143	9	0	168	11	4	4	0	19	323
05:30 PM	7	111	0	0	118	3	8	3	0	14	7	132	6	0	145	6	5	3	0	14	291
Total Volume	35	422	3	0	460	5	31	19	0	55	40	505	22	0	567	26	16	29	0	71	1153
% App. Total	7.6	91.7	0.7	0		9.1	56.4	34.5	0		7.1	89.1	3.9	0		36.6	22.5	40.8	0		
PHF	.795	.917	.750	.000	.906	.417	.775	.594	.000	.764	.625	.883	.611	.000	.844	.591	.800	.804	.000	.807	.892
Cars	35	412	3	0	450	5	31	19	0	55	40	500	22	0	562	26	16	29	0	71	1138
% Cars	100	97.6	100	0	97.8	100	100	100	0	100	100	99.0	100	0	99.1	100	100	100	0	100	98.7
Trucks	0	10	0	0	10	0	0	0	0	0	0	5	0	0	5	0	0	0	0	0	15
% Trucks	0	2.4	0	0	2.2	0	0	0	0	0	0	1.0	0	0	0.9	0	0	0	0	0	1.3





PRECISION
D A T A
INDUSTRIES, LLC

P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Toll Free: 888.734.7344
Fax: 508.481.0716 Email: info@pdillc.com

N/S: Chase Road (Route 13)
E/W: Northfield Road
City, State: Lunenburg, MA
Client: MSTS/D. Hao

File Name : 50104BB
Site Code : 803
Start Date : 2/9/2005
Page No : 1

Groups Printed- Cars - Trucks

Start Time	Chase Road (Route 13) From North				Northfield Road From East				Chase Road (Route 13) From South				Northfield Road From West				Int. Total
	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	
04:00 PM	4	119	1	0	1	6	9	0	6	103	8	0	5	4	5	0	269
04:15 PM	7	118	0	0	2	8	5	0	12	126	9	0	3	7	7	0	304
04:30 PM	14	97	1	0	2	12	3	0	15	119	9	0	3	5	7	0	287
04:45 PM	8	101	1	0	0	6	8	0	8	117	3	0	5	5	12	0	274
Total	33	435	3	0	5	32	25	0	41	465	27	0	16	21	31	0	1134
05:00 PM	9	95	1	0	2	10	6	0	9	113	4	0	4	2	10	0	265
05:15 PM	11	115	1	0	0	7	2	0	16	143	9	0	11	4	4	0	323
05:30 PM	7	111	0	0	3	8	3	0	7	132	6	0	6	5	3	0	291
05:45 PM	6	99	0	0	2	2	3	0	9	87	1	0	4	4	3	0	220
Total	33	420	2	0	7	27	14	0	41	475	20	0	25	15	20	0	1099
Grand Total	66	855	5	0	12	59	39	0	82	940	47	0	41	36	51	0	2233
Approch %	7.1	92.3	0.5	0	10.9	53.6	35.5	0	7.7	87.9	4.4	0	32	28.1	39.8	0	
Total %	3	38.3	0.2	0	0.5	2.6	1.7	0	3.7	42.1	2.1	0	1.8	1.6	2.3	0	
Cars	66	835	5	0	12	59	39	0	82	928	47	0	41	36	50	0	2200
% Cars	100	97.7	100	0	100	100	100	0	100	98.7	100	0	100	100	98	0	98.5
Trucks	0	20	0	0	0	0	0	0	0	12	0	0	0	0	1	0	33
% Trucks	0	2.3	0	0	0	0	0	0	0	1.3	0	0	0	0	2	0	1.5

Start Time	Chase Road (Route 13) From North					Northfield Road From East					Chase Road (Route 13) From South					Northfield Road From West					Int. Total
	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:45 PM																					
04:45 PM	8	101	1	0	110	0	6	8	0	14	8	117	3	0	128	5	5	12	0	22	274
05:00 PM	9	95	1	0	105	2	10	6	0	18	9	113	4	0	126	4	2	10	0	16	265
05:15 PM	11	115	1	0	127	0	7	2	0	9	16	143	9	0	168	11	4	4	0	19	323
05:30 PM	7	111	0	0	118	3	8	3	0	14	7	132	6	0	145	6	5	3	0	14	291
Total Volume	35	422	3	0	460	5	31	19	0	55	40	505	22	0	567	26	16	29	0	71	1153
% App. Total	7.6	91.7	0.7	0		9.1	56.4	34.5	0		7.1	89.1	3.9	0		36.6	22.5	40.8	0		
PHF	.795	.917	.750	.000	.906	.417	.775	.594	.000	.764	.625	.883	.611	.000	.844	.591	.800	.604	.000	.807	.892



**PRECISION
D A T A
INDUSTRIES, LLC**

P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Toll Free: 888.734.7344
Fax: 508.481.0716 Email: info@pdilic.com

N/S: Chase Road (Route 13)
E/W: Northfield Road
City, State: Lunenburg, MA
Client: MST/S/D. Hao

File Name : 50104BB
Site Code : 803
Start Date : 2/9/2005
Page No : 1

Groups Printed - Cars

Start Time	Chase Road (Route 13) From North				Northfield Road From East				Chase Road (Route 13) From South				Northfield Road From West				Int. Total
	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	
04:00 PM	4	116	1	0	1	6	9	0	6	102	6	0	5	4	5	0	265
04:15 PM	7	115	0	0	2	8	5	0	12	124	9	0	3	7	7	0	299
04:30 PM	14	95	1	0	2	12	3	0	15	115	9	0	3	5	7	0	281
04:45 PM	8	101	1	0	0	6	8	0	8	115	3	0	5	5	12	0	272
Total	33	427	3	0	5	32	25	0	41	456	27	0	16	21	31	0	1117
05:00 PM	9	92	1	0	2	10	6	0	9	110	4	0	4	2	10	0	259
05:15 PM	11	113	1	0	0	7	2	0	16	143	9	0	11	4	4	0	321
05:30 PM	7	106	0	0	3	8	3	0	7	132	6	0	6	5	3	0	286
05:45 PM	6	97	0	0	2	2	3	0	9	87	1	0	4	4	2	0	217
Total	33	408	2	0	7	27	14	0	41	472	20	0	25	15	19	0	1083
Grand Total	66	835	5	0	12	59	39	0	82	928	47	0	41	36	50	0	2200
Approch %	7.3	92.2	0.6	0	10.9	53.6	35.5	0	7.8	87.8	4.4	0	32.3	28.3	39.4	0	
Total %	3	38	0.2	0	0.5	2.7	1.8	0	3.7	42.2	2.1	0	1.9	1.6	2.3	0	

Start Time	Chase Road (Route 13) From North					Northfield Road From East					Chase Road (Route 13) From South					Northfield Road From West					Int. Total
	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	
Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:45 PM																					
04:45 PM	8	101	1	0	110	0	6	8	0	14	8	115	3	0	126	5	5	12	0	22	272
05:00 PM	9	92	1	0	102	2	10	6	0	18	9	110	4	0	123	4	2	10	0	16	259
05:15 PM	11	113	1	0	125	0	7	2	0	9	16	143	9	0	168	11	4	4	0	19	321
05:30 PM	7	106	0	0	113	3	8	3	0	14	7	132	6	0	145	6	5	3	0	14	286
Total Volume	35	412	3	0	450	5	31	19	0	55	40	500	22	0	562	26	16	29	0	71	1138
% App. Total	7.8	91.6	0.7	0		9.1	58.4	34.5	0		7.1	89	3.9	0		36.6	22.5	40.8	0		
PHF	.795	.912	.750	.000	.900	.417	.775	.594	.000	.764	.625	.874	.611	.000	.836	.591	.800	.604	.000	.807	.886

-
-
- **Seasonal Annual Adjustment**

MS TRANSPORTATION SYSTEMS, INC.

Two Bishop Street
P.O. Box 967
FRAMINGHAM, MA 01760
(508) 620-2832 FAX (508) 620-6897

JOB 908
SHEET NO. 1 OF _____
CALCULATED BY SA DATE 3/26/07
CHECKED BY _____ DATE _____
SCALE _____

COMPARISON BETWEEN NEW AND OLD DATA

April, 2004

Chase Road North of Massachusetts Avenue

ADT = 14,975

March 2007

Chase Road South of Northfield Road

ADT = 12,340

Annual Growth = $(-6)\%$

February 2005

Northfield Road West of Chase Road

ADT = 1,450

March 2007

Northfield Road West of Chase Road

ADT = 1,445

Annual Growth = $(-0.2)\%$

STATION 5 - STERLING - RTE.12 - NORTH OF RTE.I-190

YR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
93	6,425	6,557	6,590	7,492	7,552	7,606	7,182	7,771	7,593	7,494	7,040	6,873	7,181
95	6,917	6,830	7,451	7,653	7,816	7,983	7,467	7,740	7,755	7,698	7,220	6,969	7,458
96	6,647	7,088	7,384	7,695	8,062	8,136	7,512	7,737	7,703	7,839	7,402	7,081	7,524
97	6,903	7,293	7,362	7,825	8,294	8,337	7,810	7,957	8,062	8,005	7,434	7,352	7,720
98	7,077	7,509	7,695	8,000	8,157	8,398	8,143	7,791	8,088	8,167	7,642	7,731	7,857
99	7,076	7,648	7,851	8,452	8,436	8,500	8,402	8,266	8,389	8,293	7,901	8,123	8,111
00	7,387	7,834	8,293	8,351	8,819	9,269	8,184	8,612	8,492	8,300	7,995	7,746	8,274
01	7,547	8,223	8,010	8,889	9,289	9,746	8,541	9,185	8,882	9,012	8,630	7,768	8,644
02	7,778	7,900	8,405	8,864	9,000	9,406	9,155	9,222	9,071	8,745	8,700	7,516	8,647
03	8,381	7,671	8,589	9,207	9,373	9,575	9,792	9,501	9,482	9,500	8,753	7,808	8,969

STATION 34 - LANCASTER - RTE.2 - WEST OF RTE.70

YR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
93	34,667	35,532	35,060	38,015	39,348	40,287	39,894	41,090	39,800	40,315	37,656	36,235	38,158
95	35,857	36,053	38,028	39,645	41,077	43,552	42,140	43,199	40,854	41,602	39,016	36,404	39,768
96	31,907	36,840	37,666	39,082	41,169	42,774	41,187	43,539	41,393	42,117	39,389	37,747	39,568
97	35,688	36,986	38,440	39,622	42,835	45,150	43,846	44,837	43,484	44,963	39,190	39,608	41,221
98	36,051	40,072	41,649	43,504	43,869	45,430	45,830	46,137	46,000	45,000	41,401	42,075	43,085
99	37,255	39,000	42,799	45,215	44,404	47,351	46,969	46,276	42,444	46,896	44,588	43,238	43,870

STATION 3008 - WESTMINSTER - RTE.2 - EAST OF RTE.140

YR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
96	30,391	32,128	33,007	33,472	35,982	36,076	33,803	37,897	36,061	37,344	34,599	33,165	34,494
97	31,416	33,910	32,854	34,256	36,701	37,424	36,611	38,128	37,247	39,034	33,863	35,424	35,572
98	32,619	35,127	34,346	36,580	37,396	37,942	38,488	38,957	39,185	40,172	37,369	37,632	37,151
99	32,186	36,257	36,464	38,719	39,500	40,904	39,966	40,787	43,858	41,499	38,924	39,148	39,018
00	34,286	37,417	38,005	38,419	39,993	40,982	39,455	41,644	41,369	42,207	39,587	38,983	39,362
01	37,611	38,525	38,900	39,929	41,305	41,989	41,208	43,222	41,949	43,821	41,874	40,746	40,923
02	40,000	41,414	40,589	41,551	43,290	43,569	43,295	44,903	43,926	45,256	41,939	42,222	42,663
03	38,836	38,504	41,344	40,137	42,019	43,168	44,000	45,093	44,481	45,454	42,455	40,519	42,168

STATION 3296 - LANCASTER - RTE.I-190 - NORTH OF RTE.117

YR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
96	26,493	29,229	29,191	30,294	32,038	31,949	31,379	32,974	32,467	33,319	31,746	30,345	30,952
97	29,399	30,888	30,563	32,190	33,775	34,335	33,253	29,915	34,282	35,430	32,063	32,950	32,420
98	30,412	31,976	33,243	35,011	35,338	36,455	35,769	34,133	36,073	37,385	34,508	35,711	34,668
99	31,019	34,336	36,076	37,860	37,376	38,866	36,699	37,606	37,956	37,515	36,247	36,563	36,510
00	32,639	34,767	37,116	37,052	38,744	39,891	36,843	39,591	39,412	39,918	38,388	37,334	37,641
01	34,233	36,553	37,000	39,595	40,615	37,641	38,000	39,000	38,000	37,799	36,227	35,220	37,490
02	35,521	37,000	38,337	39,836	40,974	40,920	40,064	41,674	41,332	42,340	39,475	38,669	39,679
03	35,336	36,000	38,956	39,329	41,740	42,970	40,250	39,236	41,370	41,904	39,609	38,248	39,579

STATION 3045 - Lunenburg - RTE. 13 AT LEOMINSTER T.I.

93	94	95	96	97	98	99
	13,000	11,500			11,000	11,000
					10,900	11,300

STATION 3050 - Lunenburg - RTE. 13 AT TOWNSEND T.I.

93	94	95	96	97	98	99
8,400	8,200	8,900	9,500	8,800	9,100	9,400
					9,100	9,100
					9,200	9,200
					9,200	9,800

STATION 3046 - Lunenburg - WHITE ST. AT FITCHBURG C.L.

93	94	95	96	97	98	99
2,000		2,400	1,900		2,200	1,800
					2,200	1,800
					2,600	2,200

STATION 5 - STERLING - RTE.12 - NORTH OF RTE.I-190

YR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
01	7,547	8,223	8,010	8,889	9,289	9,746	8,541	9,185	8,882	9,012	8,630	7,768	8,644
	3%	-4%	5%	0%	-3%	-3%	7%	0%	2%	-3%	1%	-3%	0%
02	7,778	7,900	8,405	8,864	9,000	9,406	9,155	9,222	9,071	8,745	8,700	7,516	8,647
	8%	-3%	2%	4%	4%	2%	7%	3%	5%	9%	1%	4%	4%
03	8,381	7,671	8,589	9,207	9,373	9,575	9,792	9,501	9,482	9,500	8,753	7,808	8,969
05	7,333	8,200	8,308	8,194	9,300	9,439	8,516	8,669	8,559	8,500	8,300	8,100	8,452

STATION 3008 - WESTMINSTER - RTE.2 - EAST OF RTE.140

YR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
01	37,611	38,525	38,900	39,929	41,305	41,989	41,208	43,222	41,949	43,821	41,874	40,746	40,923
	6%	7%	4%	4%	5%	4%	5%	4%	5%	3%	0%	4%	4%
02	40,000	41,414	40,589	41,551	43,290	43,569	43,295	44,903	43,926	45,256	41,939	42,222	42,663
	-3%	-7%	2%	-3%	-3%	-1%	2%	0%	1%	0%	1%	-4%	-1%
03	38,836	38,504	41,344	40,137	42,019	43,168	44,000	45,093	44,481	45,454	42,455	40,519	42,168
	0%	7%	1%	8%	5%	4%	0%	0%	1%	1%	0%	6%	3%
04	38,644	41,389	41,609	43,344	44,000	44,982	43,873	44,950	45,043	45,788	42,597	42,869	43,257
	-3%	1%	0%	-1%	0%	2%	0%	1%	-2%	-5%	1%	-1%	-1%
05	37,646	41,772	41,547	43,078	44,052	45,837	43,823	45,205	43,941	43,432	43,140	42,423	42,991

STATION 3296 - LANCASTER - RTE.I-190 - NORTH OF RTE.117

YR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
01	34,233	36,553	37,000	39,595	40,615	37,641	38,000	39,000	38,000	37,799	36,227	35,220	37,490
	4%	1%	4%	1%	1%	9%	5%	7%	9%	12%	9%	10%	6%
02	35,521	37,000	38,337	39,836	40,974	40,920	40,064	41,674	41,332	42,340	39,475	38,669	39,679
	-1%	-3%	2%	-1%	2%	5%	0%	-6%	0%	-1%	0%	-1%	0%
03	35,336	36,000	38,956	39,329	41,740	42,970	40,250	39,236	41,370	41,904	39,609	38,248	39,579
	4%	6%	0%	9%	1%	2%	5%	9%	4%	-1%	5%	5%	4%
04	36,810	38,324	38,825	42,716	42,326	43,731	42,280	42,840	42,852	41,638	41,626	40,051	41,168

MHD Permanent Count Station Data
Seasonal Adjustments and Annual Traffic Growth Calculations

STATION 3296 - LANCASTER - RTE.I-190 - NORTH OF RTE.117

STATION 5 - STERLING - RTE.12 - NORTH OF RTE.I-190

Year	February ADT	Average Month ADT
2000	7,834	8,274
2001	8,223	8,644
2002	7,900	8,647
2003	7,671	8,969
2005	8,200	8,452
Average	7966	8597
Seasonal Adjustment	February	
Annual Traffic Growth (1993-2005)	7.93%	0.43%

Year	February ADT	Average Month ADT
2000	34,767	37,641
2001	36,553	37,490
2002	37,000	39,679
2003	36,000	39,579
2004	38,324	41,168
Average	36529	39111
Seasonal Adjustment	February	
Annual Traffic Growth (1996-2004)	7.07%	2.26%

STATION 3008 - WESTMINSTER - RTE.2 - EAST OF RTE.140

Year	February ADT	Average Month ADT
2000	37,417	39,362
2001	38,525	40,923
2002	41,414	42,663
2003	38,504	42,168
2004	41,389	43,257
2005	41,772	42,991
Average	39837	41894
Seasonal Adjustment	February	
Annual Traffic Growth (1996-2005)	5.16%	1.78%

Average Seasonal Adjustment	February	
Average Annual Traffic Growth	7.50%	1.49%

- **Accident History**

Mass-Highway Crash Report for Lunenburg in the year 2003 - 2005

Crash No.	Date/Time	Location	Crash Type	Severity	Property Damage	Injury	Fatalities	Vehicle Damage	Vehicle Type	Driver	Weather	Lighting	Other	Notes
02-06-03	6:11 PM	VT Southbound / VT Southbound	Vehicle in traffic / VC Collision with motor vehicle in traffic	0	0	0	0	0	0	0	Clear	Day	Clear	CHASE ROAD / NEW WEST TOWNSHIP ROAD
02-06-03	6:21 PM	VT Southbound / VT Southbound	Vehicle in traffic / VC Collision with motor vehicle in traffic	0	0	0	0	0	0	0	Clear	Day	Clear	CHASE ROAD / NEW WEST TOWNSHIP ROAD
02-06-03	6:54 AM	VT Southbound / VT Southbound	Vehicle in traffic / VC Collision with motor vehicle in traffic	0	0	0	0	0	0	0	Clear	Day	Clear	CHASE ROAD / NEW WEST TOWNSHIP ROAD
02-06-03	5:03 PM	VT Southbound / VT Southbound	Vehicle in traffic / VC Collision with motor vehicle in traffic	0	0	0	0	0	0	0	Clear	Day	Clear	CHASE ROAD / NEW WEST TOWNSHIP ROAD
02-06-03	4:50 PM	VT Southbound / VT Southbound	Vehicle in traffic / VC Collision with motor vehicle in traffic	0	0	0	0	0	0	0	Clear	Day	Clear	CHASE ROAD / NEW WEST TOWNSHIP ROAD
02-06-03	5:13 PM	VT Southbound / VT Southbound	Vehicle in traffic / VC Collision with motor vehicle in traffic	0	0	0	0	0	0	0	Clear	Day	Clear	CHASE ROAD / NEW WEST TOWNSHIP ROAD
02-06-03	5:08 PM	VT Southbound / VT Southbound	Vehicle in traffic / VC Collision with motor vehicle in traffic	0	0	0	0	0	0	0	Clear	Day	Clear	CHASE ROAD / NEW WEST TOWNSHIP ROAD
02-06-03	5:28 PM	VT Southbound / VT Southbound	Vehicle in traffic / VC Collision with motor vehicle in traffic	0	0	0	0	0	0	0	Clear	Day	Clear	CHASE ROAD / NEW WEST TOWNSHIP ROAD
02-06-03	5:19 PM	VT Southbound / VT Southbound	Vehicle in traffic / VC Collision with motor vehicle in traffic	0	0	0	0	0	0	0	Clear	Day	Clear	CHASE ROAD / NEW WEST TOWNSHIP ROAD
02-06-03	11:06 AM	VT Southbound / VT Southbound	Vehicle in traffic / VC Collision with motor vehicle in traffic	0	0	0	0	0	0	0	Clear	Day	Clear	CHASE ROAD / NEW WEST TOWNSHIP ROAD
02-06-03	8:48 AM	VT Southbound / VT Southbound	Vehicle in traffic / VC Collision with motor vehicle in traffic	0	0	0	0	0	0	0	Clear	Day	Clear	CHASE ROAD / NEW WEST TOWNSHIP ROAD
02-06-03	5:08 PM	VT Southbound / VT Southbound	Vehicle in traffic / VC Collision with motor vehicle in traffic	0	0	0	0	0	0	0	Clear	Day	Clear	CHASE ROAD / NEW WEST TOWNSHIP ROAD
02-06-03	10:08 AM	VT Southbound / VT Southbound	Vehicle in traffic / VC Collision with motor vehicle in traffic	0	0	0	0	0	0	0	Clear	Day	Clear	CHASE ROAD / NEW WEST TOWNSHIP ROAD

MassHighway

CRASH RATE WORKSHEET

CITY/TOWN : Lunenburg, MA COUNT DATE : Feb-07

DISTRICT : 3 UNSIGNALIZED : Yes SIGNALIZED :

MHD USE ONLY

Source #

~ INTERSECTION DATA ~

MAJOR STREET : Chase Road

RIN #

MINOR STREET(S) : Northfield Road

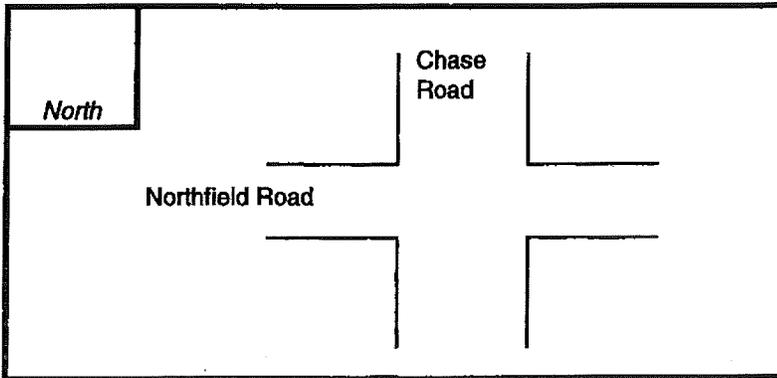
RIN #

RIN #

RIN #

RIN #

**INTERSECTION
DIAGRAM**
(Label Approaches)



INTERSECTION

REF #

Peak Hour Volumes

APPROACH :	1	2	3	4	5	6
DIRECTION :	EB	WB	NB	SB		
VOLUMES (PM) :	96	65	614	506		

" K " FACTOR : APPROACH ADT : ADT = TOTAL VOL/"K" FACT.

TOTAL # OF ACCIDENTS : # OF YEARS : AVERAGE # OF ACCIDENTS (A) :

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

Comments : _____

MassHighway

CRASH RATE WORKSHEET

CITY/TOWN : Lunenburg, MA COUNT DATE : Feb-05

MHD USE ONLY

DISTRICT : 3 UNSIGNALIZED : Yes SIGNALIZED :

Source #

~ INTERSECTION DATA ~

MAJOR STREET : New West Townsend Road

RIN #

MINOR STREET(S) : Northfield Road

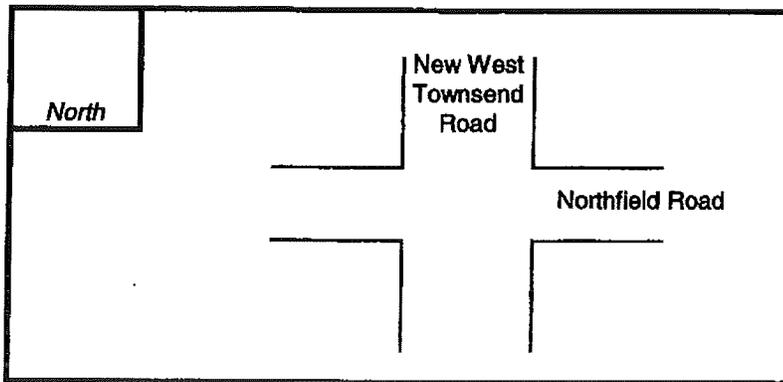
RIN #

RIN #

RIN #

RIN #

**INTERSECTION
DIAGRAM**
(Label Approaches)



INTERSECTION
REF #

Peak Hour Volumes

APPROACH :	1	2	3	4	5	6
DIRECTION :	EB	WB	NB	SB		
VOLUMES (PM) :	18	103	103	34		

* K * FACTOR : APPROACH ADT : ADT = TOTAL VOL/*K* FACT.

TOTAL # OF ACCIDENTS : # OF YEARS : AVERAGE # OF ACCIDENTS (A) :

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

Comments : _____

- **Trip Generation**

TRIP GENERATION WORKSHEET
MS Transportation Systems, Inc.

LAND USE: *Single Family Detached Housing*
 LAND USE CODE: 210 Independent Variable---Trips per DU

JOB: Proposed Highfield Village Development, Lunenburg, MA
 JOB NUMBER: 908 Number of Units: 66

WEEKDAY

RATES:	Total Trip Ends			Directional Dist.	
	Average	Low	High	Enter	Exit
DAILY	9.57	4.31	21.85	50%	50%
AM PEAK	0.75	0.33	2.27	25%	75%
PM PEAK	1.01	0.42	2.98	63%	37%
PK GEN AM	0.77	0.33	2.27	26%	74%
PK GEN PM	1.02	0.42	2.98	64%	36%

	BY AVERAGE		
	Total	Enter	Exit
DAILY	632	316	316
AM PEAK	50	13	38
PM PEAK	67	42	25
PK GEN AM	51	13	38
PK GEN PM	67	43	24

	BY REGRESSION		
	Total	Enter	Exit
DAILY	709	355	355
AM PEAK	56	14	42
PM PEAK	74	47	27
PK GEN AM	58	15	43
PK GEN PM	77	49	28

SATURDAY

RATES:	Total Trip Ends			Directional Dist.	
	Average	Low	High	Enter	Exit
DAILY	10.10	5.32	15.25	50%	50%
PEAK HR	0.94	0.5	1.75	54%	46%

	BY AVERAGE		
	Total	Enter	Exit
DAILY	667	334	334
PEAK HR	62	33	29

	BY REGRESSION		
	Total	Enter	Exit
DAILY	712	356	356
PEAK HR	70	38	32

SUNDAY

RATES:	Total Trip Ends			Directional Dist.	
	Average	Low	High	Enter	Exit
DAILY	8.78	4.74	12.31	50%	50%
PEAK HR	0.86	0.55	1.48	53%	47%

	BY AVERAGE		
	Total	Enter	Exit
DAILY	579	290	290
PEAK HR	57	30	27

	BY REGRESSION		
	Total	Enter	Exit
DAILY	573	287	287
PEAK HR	65	34	31

TRIP GENERATION WORKSHEET
MS Transportation Systems, Inc.

LAND USE: *Golf Course*
LAND USE CODE: 430

Independent Variable---Trips per Hole

JOB: Lunenburg Golf Course, Lunenburg, MA

JOB NUMBER: 908 No. of Holes: 18

WEEKDAY

RATES:

	Total Trip Ends			Directional Dist.	
	Average	Low	High	Enter	Exit
DAILY	35.74	14.50	54.44	50%	50%
AM PEAK	2.22	1.06	4.52	79%	21%
PM PEAK	2.74	1.67	4.11	44%	56%
PK GEN AM	3.01	2.25	4.72	47%	53%
PK GEN PM	3.56	3.42	3.83	43%	57%

	BY AVERAGE		
	Total	Enter	Exit
DAILY	643	322	322
AM PEAK	40	32	8
PM PEAK	49	22	27
PK GEN AM	54	25	29
PK GEN PM	64	28	36

	BY REGRESSION		
	Total	Enter	Exit
DAILY	<--- Not Given --->		
AM PEAK	<--- Not Given --->		
PM PEAK	<--- Not Given --->		
PK GEN AM	<--- Not Given --->		
PK GEN PM	<--- Not Given --->		

SATURDAY

RATES:

	Total Trip Ends			Directional Dist.	
	Average	Low	High	Enter	Exit
DAILY	40.63	16.0	70.83	50%	50%
PEAK HR	4.59	1.61	7.17	49%	51%

	BY AVERAGE		
	Total	Enter	Exit
DAILY	731	366	366
PEAK HR	83	41	42

	BY REGRESSION		
	Total	Enter	Exit
DAILY	<--- Not Given --->		
PEAK HR	<--- Not Given --->		

SUNDAY

RATES:

	Total Trip Ends			Directional Dist.	
	Average	Low	High	Enter	Exit
DAILY	39.53	18.89	56.61	50%	50%
PEAK HR	4.43	2.5	7.0	49%	51%

	BY AVERAGE		
	Total	Enter	Exit
DAILY	712	356	356
PEAK HR*	80	39	41

	BY REGRESSION		
	Total	Enter	Exit
DAILY	<--- Not Given --->		
PEAK HR*	<--- Not Given --->		

* In/Out Distribution based on Saturday information.

- **Trip Assignment**

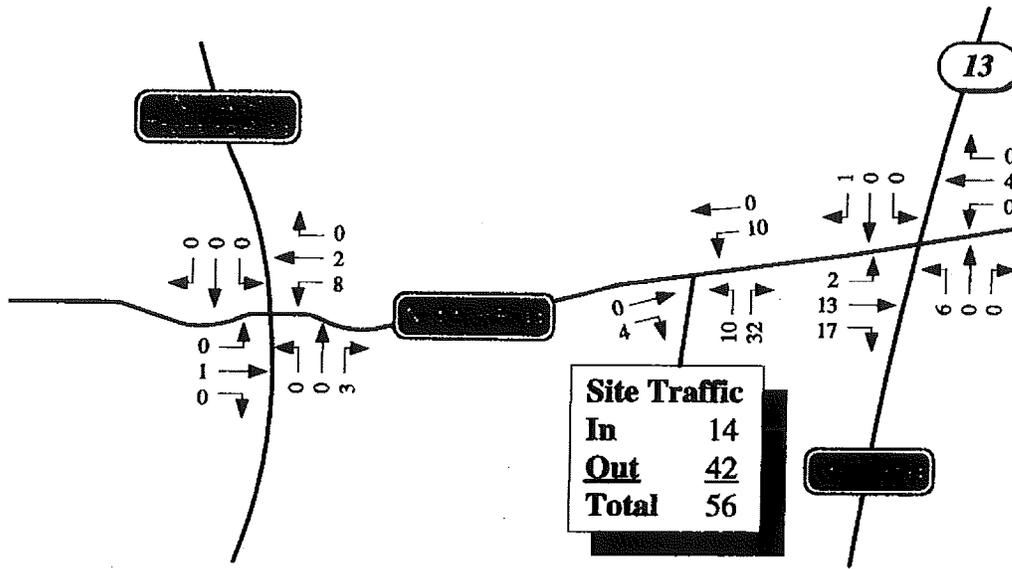
Res. To Work Trip Dist. Cal. Sheet*

Working City/Town	Trips	Percentage	Via Route
Lowell	49	1.3%	Route 2A E
Concord	50	1.3%	Route 2A E
Westborough	50	1.3%	Route 2A E
Shrewsbury	51	1.3%	Route 2A E
Clinton	69	1.8%	Route 13 S
Boston	96	2.5%	Route 2A E
Marlborough	97	2.5%	Route 2A E
Gardener	105	2.7%	Route 2A W
Acton	108	2.8%	Route 2A E
Townsend	126	3.3%	Route 13 N
Littleton	141	3.7%	Route 13 S
Ayer	143	3.7%	Route 2A E
Worcester	291	7.6%	Route 13 S
Leominster	689	18.0%	Route 13 S
Fitchburg	833	21.8%	Route 2A W
Lunenburg	923	24.2%	Route 2A E(12.1%)/Route 13 S(12.1%)
Total	3821		

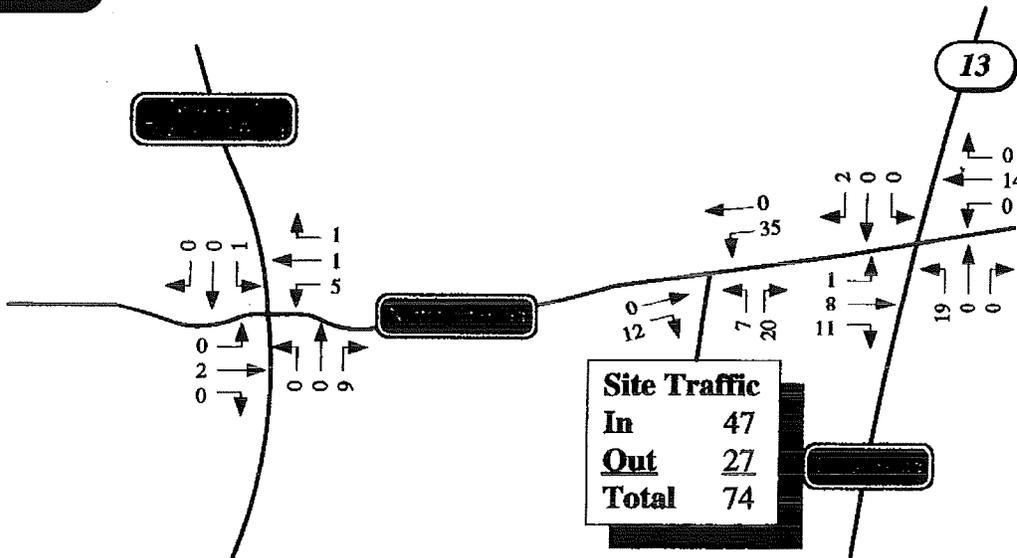
	Est. Dist.
Northfield Rd. West	5%
Northfield Rd East	30%
New W. Townsend Rd. North	1%
New W. Townsend Rd. South	20%
Route 13 North	4%
Route 13 South	40%
Total	100.0%

Note: * Based on Year 2000 Census Data

AM Peak



PM Peak



Trip Assignment

*Proposed Highfield Village Development
Amherstburg, Massachusetts*



Not to Scale

-
- **LOS Analysis**

TWO-WAY STOP CONTROL SUMMARY

Analyst: SA
 Agency/Co.: MS Transportation Systems, Inc
 Date Performed: 3/24/2007
 Analysis Time Period: Existing AM Peak
 Intersection: Northfield Rd@Chase Rd
 Jurisdiction: Lunenburg
 Units: U. S. Customary
 Analysis Year: 2007
 Project ID: 904 Highfield Village, Lunenburg, MA
 East/West Street: Northfield Road
 North/South Street: Chase Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach Movement	Northbound			Southbound		
	1 L	2 T	3 R	4 L	5 T	6 R
Volume	19	366	22	4	506	40
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.94	0.94	0.94
Hourly Flow Rate, HFR	21	406	24	4	538	42
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration	LTR			LTR		
Upstream Signal?	No			No		

Minor Street: Approach Movement	Westbound			Eastbound		
	7 L	8 T	9 R	10 L	11 T	12 R
Volume	31	25	2	31	51	18
Peak Hour Factor, PHF	0.54	0.54	0.54	0.92	0.92	0.92
Hourly Flow Rate, HFR	57	46	3	33	55	19
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)	0			0		
Flared Approach: Exists?/Storage	No			No		
Lanes	0	1	0	0	1	0
Configuration	LTR			LTR		

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound			Eastbound		
	1	4	7	8	9	10	11	12
Lane Config	LTR	LTR	LTR			LTR		
v (vph)	21	4	106			107		
C(m) (vph)	1004	1140	182			225		
v/c	0.02	0.00	0.58			0.48		
95% queue length	0.06	0.01	3.14			2.35		
Control Delay	8.7	8.2	49.2			34.7		
LOS	A	A	E			D		
Approach Delay			49.2			34.7		
Approach LOS			E			D		

TWO-WAY STOP CONTROL SUMMARY

Analyst: SA
 Agency/Co.: MS Transportation Systems, Inc
 Date Performed: 3/24/2005
 Analysis Time Period: Existing AM Peak
 Intersection: Northfield Rd@New W. Townsen
 Jurisdiction: Lunenburg
 Units: U. S. Customary
 Analysis Year: 2007
 Project ID:
 East/West Street: Northfield Road
 North/South Street: New West Townsend Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach Movement	Northbound			Southbound		
	1 L	2 T	3 R	4 L	5 T	6 R
Volume	2	17	46	16	42	2
Peak-Hour Factor, PHF	0.72	0.72	0.72	0.70	0.70	0.70
Hourly Flow Rate, HFR	2	23	63	22	60	2
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration	LTR			LTR		
Upstream Signal?	No			No		

Minor Street: Approach Movement	Westbound			Eastbound		
	7 L	8 T	9 R	10 L	11 T	12 R
Volume	48	9	5	1	21	9
Peak Hour Factor, PHF	0.70	0.70	0.70	0.84	0.84	0.84
Hourly Flow Rate, HFR	68	12	7	1	25	10
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)	0			0		
Flared Approach: Exists?/Storage	No			No		
Lanes	0	1	0	0	1	0
Configuration	LTR			LTR		

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound			Eastbound			
	1 LTR	4 LTR	7 LTR	8 LTR	9 LTR	10 LTR	11 LTR	12 LTR	
v (vph)	2	22	87			36			
C(m) (vph)	1554	1523	759			761			
v/c	0.00	0.01	0.11			0.05			
95% queue length	0.00	0.04	0.39			0.15			
Control Delay	7.3	7.4	10.4			10.0-			
LOS	A	A	B			A			
Approach Delay				10.4			10.0-		
Approach LOS				B			A		

TWO-WAY STOP CONTROL SUMMARY

Analyst: SA
 Agency/Co.: MS Transportation Systems, Inc
 Date Performed: 3/24/2007
 Analysis Time Period: Existing PM Peak
 Intersection: Northfield Rd@Chase Rd
 Jurisdiction:
 Units: U. S. Customary
 Analysis Year: 2007
 Project ID: 908 Highfield Village, Lunenburg, MA
 East/West Street: Northfield Road
 North/South Street: Chase Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach Movement	Northbound			Southbound		
	1 L	2 T	3 R	4 L	5 T	6 R
Volume	33	538	43	3	454	39
Peak-Hour Factor, PHF	0.84	0.84	0.84	0.91	0.91	0.91
Hourly Flow Rate, HFR	39	640	51	3	498	42
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration	LTR			LTR		
Upstream Signal?	No			No		

Minor Street: Approach Movement	Westbound			Eastbound		
	7 L	8 T	9 R	10 L	11 T	12 R
Volume	20	40	5	32	25	39
Peak Hour Factor, PHF	0.76	0.76	0.76	0.81	0.81	0.81
Hourly Flow Rate, HFR	26	52	6	39	30	48
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)	0			0		
Flared Approach: Exists?/Storage	No			No		
Lanes	0	1	0	0	1	0
Configuration	LTR			LTR		

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound			Eastbound		
	1	4	7	8	9	10	11	12
Lane Config	LTR	LTR	LTR			LTR		
v (vph)	39	3	84			117		
C(m) (vph)	1039	913	139			171		
v/c	0.04	0.00	0.60			0.68		
95% queue length	0.12	0.01	3.14			4.06		
Control Delay	8.6	9.0	64.2			62.4		
LOS	A	A	F			F		
Approach Delay			64.2			62.4		
Approach LOS			F			F		

TWO-WAY STOP CONTROL SUMMARY

Analyst: SA
 Agency/Co.: MS Transportation Systems, Inc
 Date Performed: 3/24/2007
 Analysis Time Period: Existing PM Peak
 Intersection: Northfield Rd@New W. Townsen
 Jurisdiction: Lunenburg
 Units: U. S. Customary
 Analysis Year: 2007
 Project ID: 908 Highfield Village, Lunenburg, MA
 East/West Street: Northfield Road
 North/South Street: New West Townsend Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach Movement	Northbound			Southbound		
	1 L	2 T	3 R	4 L	5 T	6 R
Volume	3	48	52	9	25	0
Peak-Hour Factor, PHF	0.75	0.75	0.75	0.71	0.71	0.71
Hourly Flow Rate, HFR	4	64	69	12	35	0
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration	LTR			LTR		
Upstream Signal?	No			No		

Minor Street: Approach Movement	Westbound			Eastbound		
	7 L	8 T	9 R	10 L	11 T	12 R
Volume	68	21	14	5	12	3
Peak Hour Factor, PHF	0.87	0.87	0.87	0.75	0.75	0.75
Hourly Flow Rate, HFR	78	24	16	6	16	4
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)	0			0		
Flared Approach: Exists?/Storage	No			/		
Lanes	0	1	0	0	1	0
Configuration	LTR			LTR		

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound			Eastbound			
	1 LTR	4 LTR	7 LTR	8 LTR	9 LTR	10 LTR	11 LTR	12 LTR	
v (vph)	4	12	118			26			
C(m) (vph)	1589	1464	780			741			
v/c	0.00	0.01	0.15			0.04			
95% queue length	0.01	0.02	0.53			0.11			
Control Delay	7.3	7.5	10.4			10.0+			
LOS	A	A	B			B			
Approach Delay				10.4			10.0+		
Approach LOS				B			B		

TWO-WAY STOP CONTROL SUMMARY

Analyst: SA
 Agency/Co.: MS Transportation Systems, Inc
 Date Performed: 3/21/2005
 Analysis Time Period: No-Build AM Peak
 Intersection: Northfield Rd@Chase Rd
 Jurisdiction: Lunenburg
 Units: U. S. Customary
 Analysis Year: 2012
 Project ID: 908 Highfield Village, Lunenburg, MA
 East/West Street: Northfield Road
 North/South Street: Chase Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach Movement	Northbound			Southbound		
	1 L	2 T	3 R	4 L	5 T	6 R
Volume	20	404	24	4	559	44
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.94	0.94	0.94
Hourly Flow Rate, HFR	22	448	26	4	594	46
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration	LTR			LTR		
Unstream Signal?	No			No		

Minor Street: Approach Movement	Westbound			Eastbound		
	7 L	8 T	9 R	10 L	11 T	12 R
Volume	34	27	2	34	56	20
Peak Hour Factor, PHF	0.54	0.54	0.54	0.92	0.92	0.92
Hourly Flow Rate, HFR	62	49	3	36	60	21
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)	0			0		
Flared Approach: Exists?/Storage	No			/ No /		
Lanes	0	1	0	0	1	0
Configuration	LTR			LTR		

Delay, Queue Length, and Level of Service

Approach Movement Lane Config	NB	SB	Westbound			Eastbound		
	1 LTR	4 LTR	7 LTR	8 LTR	9 LTR	10 LTR	11 LTR	12 LTR
v (vph)	22	4	114			117		
C(m) (vph)	954	1099	148			190		
v/c	0.02	0.00	0.77			0.62		
95% queue length	0.07	0.01	4.75			3.48		
Control Delay	8.9	8.3	83.0			50.3		
LOS	A	A	F			F		
Approach Delay			83.0			50.3		
Approach LOS			F			F		

TWO-WAY STOP CONTROL SUMMARY

Analyst: SA
 Agency/Co.: MS Transportation Systems, Inc
 Date Performed: 3/44/2007
 Analysis Time Period: No-Build AM Peak
 Intersection: Northfield Rd@New W. Townsen
 Jurisdiction: Lunenburg
 Units: U. S. Customary
 Analysis Year: 2012
 Project ID: 908 Highfield Village, Lunenburg, MA
 East/West Street: Northfield Road
 North/South Street: New West Townsend Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach Movement	Northbound			Southbound		
	1 L	2 T	3 R	4 L	5 T	6 R
Volume	2	19	50	18	46	2
Peak-Hour Factor, PHF	0.72	0.72	0.72	0.70	0.70	0.70
Hourly Flow Rate, HFR	2	26	69	25	65	2
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration	LTR			LTR		
Upstream Signal?	No			No		

Minor Street: Approach Movement	Westbound			Eastbound		
	7 L	8 T	9 R	10 L	11 T	12 R
Volume	53	10	6	1	23	10
Peak Hour Factor, PHF	0.70	0.70	0.70	0.84	0.84	0.84
Hourly Flow Rate, HFR	75	14	8	1	27	11
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)	0			0		
Flared Approach: Exists?/Storage	No			No		
Lanes	0	1	0	0	1	0
Configuration	LTR			LTR		

Delay, Queue Length, and Level of Service

Approach Movement Lane Config	NB	SB	Westbound			Eastbound		
	1 LTR	4 LTR	7 LTR	8 LTR	9 LTR	10 LTR	11 LTR	12 LTR
v (vph)	2	25	97			39		
C(m) (vph)	1547	1512	737			744		
v/c	0.00	0.02	0.13			0.05		
95% queue length	0.00	0.05	0.45			0.17		
Control Delay	7.3	7.4	10.6			10.1		
LOS	A	A	B			B		
Approach Delay			10.6			10.1		
Approach LOS			B			B		

TWO-WAY STOP CONTROL SUMMARY

Analyst: SA
 Agency/Co.: MS Transportation Systems, Inc
 Date Performed: 3/24/2007
 Analysis Time Period: No-Build PM Peak
 Intersection: Northfield Rd@Chase Rd
 Jurisdiction: Lunenburg
 Units: U. S. Customary
 Analysis Year: 2012
 Project ID: 908 Highfield Village, Lunenburg, MA
 East/West Street: Northfield Road
 North/South Street: Chase Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach Movement	Northbound			Southbound		
	1 L	2 T	3 R	4 L	5 T	6 R
Volume	35	594	47	3	501	43
Peak-Hour Factor, PHF	0.84	0.84	0.84	0.91	0.91	0.91
Hourly Flow Rate, HFR	41	707	55	3	550	47
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration	LTR			LTR		
Upstream Signal?	No			No		

Minor Street: Approach Movement	Westbound			Eastbound		
	7 L	8 T	9 R	10 L	11 T	12 R
Volume	22	43	6	35	27	42
Peak Hour Factor, PHF	0.76	0.76	0.76	0.81	0.81	0.81
Hourly Flow Rate, HFR	28	56	7	43	33	51
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)	0			0		
Flared Approach: Exists?/Storage	No			No		
Lanes	0	1	0	0	1	0
Configuration	LTR			LTR		

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound			Eastbound		
	1 LTR	4 LTR	7 LTR	8 LTR	9 LTR	10 LTR	11 LTR	12 LTR
v (vph)	41	3	91			127		
C(m) (vph)	989	859	110			129		
v/c	0.04	0.00	0.83			0.98		
95% queue length	0.13	0.01	4.77			6.78		
Control Delay	8.8	9.2	115.9			140.7		
LOS	A	A	F			F		
Approach Delay			115.9			140.7		
Approach LOS			F			F		

TWO-WAY STOP CONTROL SUMMARY

Analyst: SA
 Agency/Co.: MS Transportation Systems, Inc
 Date Performed: 3/24/2007
 Analysis Time Period: No-Build PM Peak
 Intersection: Northfield Rd@New W. Townsen
 Jurisdiction: Lunenburg
 Units: U. S. Customary
 Analysis Year: 2012
 Project ID: 908 Highfield Village, Lunenburg, MA
 East/West Street: Northfield Road
 North/South Street: New West Townsend Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach Movement	Northbound			Southbound		
	1 L	2 T	3 R	4 L	5 T	6 R
Volume	3	53	57	10	28	0
Peak-Hour Factor, PHF	0.75	0.75	0.75	0.71	0.71	0.71
Hourly Flow Rate, HFR	4	70	76	14	39	0
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration	LTR			LTR		
Upstream Signal?	No			No		

Minor Street: Approach Movement	Westbound			Eastbound		
	7 L	8 T	9 R	10 L	11 T	12 R
Volume	75	23	15	6	13	3
Peak Hour Factor, PHF	0.87	0.87	0.87	0.75	0.75	0.75
Hourly Flow Rate, HFR	86	26	17	8	17	4
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)	0			0		
Flared Approach: Exists?/Storage	No			/ No /		
Lanes	0	1	0	0	1	0
Configuration	LTR			LTR		

Delay, Queue Length, and Level of Service

Approach Movement Lane Config	NB	SB	Westbound			Eastbound		
	1 LTR	4 LTR	7 LTR	8 LTR	9 LTR	10 LTR	11 LTR	12 LTR
v (vph)	4	14	129			29		
C(m) (vph)	1584	1448	758			719		
v/c	0.00	0.01	0.17			0.04		
95% queue length	0.01	0.03	0.61			0.13		
Control Delay	7.3	7.5	10.7			10.2		
LOS	A	A	B			B		
Approach Delay	10.7			10.2				
Approach LOS	B			B				

TWO-WAY STOP CONTROL SUMMARY

Analyst: SA
 Agency/Co.: MS Transportation Systems, Inc
 Date Performed: 3/24/2007
 Analysis Time Period: Build AM Peak
 Intersection: Northfield Rd@Chase Rd
 Jurisdiction: Lunenburg
 Units: U. S. Customary
 Analysis Year: 2012
 Project ID: 908 Highfield Village, Lunenburg, MA
 East/West Street: Northfield Road
 North/South Street: Chase Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach Movement	Northbound			Southbound		
	1 L	2 T	3 R	4 L	5 T	6 R
Volume	26	404	24	4	559	45
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.94	0.94	0.94
Hourly Flow Rate, HFR	28	448	26	4	594	47
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration	LTR			LTR		
Upstream Signal?	No			No		

Minor Street: Approach Movement	Westbound			Eastbound		
	7 L	8 T	9 R	10 L	11 T	12 R
Volume	34	31	2	36	69	37
Peak Hour Factor, PHF	0.54	0.54	0.54	0.92	0.92	0.92
Hourly Flow Rate, HFR	62	57	3	39	74	40
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)	0			0		
Flared Approach: Exists?/Storage			No			No
Lanes	0	1	0	0	1	0
Configuration	LTR			LTR		

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound			Eastbound		
	1	4	7	8	9	10	11	12
Lane Config	LTR	LTR		LTR			LTR	
v (vph)	28	4	122			153		
C(m) (vph)	953	1099	132			196		
v/c	0.03	0.00	0.92			0.78		
95% queue length	0.09	0.01	6.17			5.35		
Control Delay	8.9	8.3	123.1			68.3		
LOS	A	A	F			F		
Approach Delay			123.1			68.3		
Approach LOS			F			F		

TWO-WAY STOP CONTROL SUMMARY

Analyst: SA
 Agency/Co.: MS Transportation Systems, Inc
 Date Performed: 2/14/2005
 Analysis Time Period: Build AM Peak
 Intersection: Northfield Rd@New W. Townsen
 Jurisdiction: Lunenburg
 Units: U. S. Customary
 Analysis Year: 2012
 Project ID: 908 Highfield Village, Lunenburg, MA
 East/West Street: Northfield Road
 North/South Street: New West Townsend Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach Movement	Northbound			Southbound		
	1 L	2 T	3 R	4 L	5 T	6 R
Volume	2	19	53	18	46	2
Peak-Hour Factor, PHF	0.72	0.72	0.72	0.70	0.70	0.70
Hourly Flow Rate, HFR	2	26	73	25	65	2
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes Configuration	0	1	0	0	1	0
Upstream Signal?	LTR No			LTR No		

Minor Street: Approach Movement	Westbound			Eastbound		
	7 L	8 T	9 R	10 L	11 T	12 R
Volume	61	12	6	1	24	10
Peak Hour Factor, PHF	0.70	0.70	0.70	0.84	0.84	0.84
Hourly Flow Rate, HFR	87	17	8	1	28	11
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)	0			0		
Flared Approach: Exists?/Storage	No			/		
Lanes Configuration	0	1	0	0	1	0
	LTR			LTR		

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound			Eastbound			
	1	4	7	8	9	10	11	12	
Lane Config	LTR	LTR	LTR			LTR			
v (vph)	2	25	112			40			
C(m) (vph)	1547	1507	731			739			
v/c	0.00	0.02	0.15			0.05			
95% queue length	0.00	0.05	0.54			0.17			
Control Delay	7.3	7.4	10.8			10.2			
LOS	A	A	B			B			
Approach Delay				10.8			10.2		
Approach LOS				B			B		

HCS+: Unsignalized Intersections Release 5.21

TWO-WAY STOP CONTROL SUMMARY

Analyst: SA
 Agency/Co.: MS Transportation Systems, Inc
 Date Performed: 3/24/2007
 Analysis Time Period: Build PM Peak
 Intersection: Northfield Rd@Chase Rd
 Jurisdiction: Lunenburg
 Units: U. S. Customary
 Analysis Year: 2012
 Project ID: 908 Highfield Village, Lunenburg, MA
 East/West Street: Northfield Road
 North/South Street: Chase Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach Movement	Northbound			Southbound		
	1 L	2 T	3 R	4 L	5 T	6 R
Volume	54	594	47	3	501	45
Peak-Hour Factor, PHF	0.84	0.84	0.84	0.91	0.91	0.91
Hourly Flow Rate, HFR	64	707	55	3	550	49
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration	LTR			LTR		
Unstream Signal?	No			No		

Minor Street: Approach Movement	Westbound			Eastbound		
	7 L	8 T	9 R	10 L	11 T	12 R
Volume	22	57	6	36	35	53
Peak Hour Factor, PHF	0.76	0.76	0.76	0.81	0.81	0.81
Hourly Flow Rate, HFR	28	75	7	44	43	65
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)	0			0		
Flared Approach: Exists?/Storage	No			/ No /		
Lanes	0	1	0	0	1	0
Configuration	LTR			LTR		

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound			Eastbound		
	1	4	7	8	9	10	11	12
Lane Config	LTR	LTR	LTR			LTR		
v (vph)	64	3	110			152		
C(m) (vph)	988	859	94			101		
v/c	0.06	0.00	1.17			1.50		
95% queue length	0.21	0.01	7.50			11.38		
Control Delay	8.9	9.2	228.7			346.7		
LOS	A	A	F			F		
Approach Delay			228.7			346.7		
Approach LOS			F			F		

TWO-WAY STOP CONTROL SUMMARY

Analyst: SA
 Agency/Co.: MS Transportation Systems, Inc
 Date Performed: 3/24/2007
 Analysis Time Period: Build PM Peak
 Intersection: Northfield Rd@New W. Townsen
 Jurisdiction: Lunenburg
 Units: U. S. Customary
 Analysis Year: 2012
 Project ID: 908Highfield Village, Lunenburg, MA
 East/West Street: Northfield Road
 North/South Street: New West Townsend Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach Movement	Northbound			Southbound		
	1 L	2 T	3 R	4 L	5 T	6 R
Volume	3	53	66	11	28	0
Peak-Hour Factor, PHF	0.75	0.75	0.75	0.71	0.71	0.71
Hourly Flow Rate, HFR	4	70	88	15	39	0
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration	LTR			LTR		
Upstream Signal?	No			No		

Minor Street: Approach Movement	Westbound			Eastbound		
	7 L	8 T	9 R	10 L	11 T	12 R
Volume	80	24	16	6	15	3
Peak Hour Factor, PHF	0.87	0.87	0.87	0.75	0.75	0.75
Hourly Flow Rate, HFR	91	27	18	8	20	4
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)	0			0		
Flared Approach: Exists?/Storage	No			No		
Lanes	0	1	0	0	1	0
Configuration	LTR			LTR		

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound			Eastbound		
	1 LTR	4 LTR	7 LTR	8 LTR	9 LTR	10 LTR	11 LTR	12 LTR
v (vph)	4	15	136			32		
C(m) (vph)	1584	1434	746			703		
v/c	0.00	0.01	0.18			0.05		
95% queue length	0.01	0.03	0.66			0.14		
Control Delay	7.3	7.5	10.9			10.4		
LOS	A	A	B			B		
Approach Delay	10.9			10.4				
Approach LOS	B			B				

TWO-WAY STOP CONTROL SUMMARY

Analyst: SA
 Agency/Co.: MS Transportation Systems, Inc
 Date Performed: 3/24/2007
 Analysis Time Period: Build AM Peak
 Intersection: Northfield Road@Site Drive
 Jurisdiction: Lunenburg
 Units: U. S. Customary
 Analysis Year: 2012
 Project ID: 908 Highfield Village, Lunenburg, MA
 East/West Street: Northfield Road
 North/South Street: Proposed Site Drive
 Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach Movement	Eastbound			Westbound		
	1 L	2 T	3 R	4 L	5 T	6 R
Volume		110	4	10	92	
Peak-Hour Factor, PHF		0.92	0.92	0.92	0.92	
Hourly Flow Rate, HFR		119	4	10	99	
Percent Heavy Vehicles		--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0		0	1
Configuration		TR			LT	
Unstream Signal?		No			No	

Major Street: Approach Movement	Northbound			Southbound		
	7 L	8 T	9 R	10 L	11 T	12 R
Volume	10		32			
Peak Hour Factor, PHF	0.92		0.92			
Hourly Flow Rate, HFR	10		34			
Percent Heavy Vehicles	0		0			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No	/		/
Lanes	0		0			
Configuration		LR				

Delay, Queue Length, and Level of Service

Approach Movement	EB	WB	Northbound			Southbound		
	1	4	7	8	9	10	11	12
Lane Config		LT		LR				
v (vph)	10		44					
C(m) (vph)	1477		885					
v/c	0.01		0.05					
95% queue length	0.02		0.16					
Control Delay	7.5		9.3					
LOS	A		A					
Approach Delay			9.3					
Approach LOS			A					

HCS+: Unsignalized Intersections Release 5.21

TWO-WAY STOP CONTROL SUMMARY

Analyst: SA
 Agency/Co.: MS Transportation Systems, Inc
 Date Performed: 3/24/2007
 Analysis Time Period: Build PM Peak
 Intersection: Northfield Road@Site Drive
 Jurisdiction: Lunenburg
 Units: U. S. Customary
 Analysis Year: 2012
 Project ID: 908 Highfield Village, Lunenburg, MA
 East/West Street: Northfield Road
 North/South Street: Proposed Site Drive
 Intersection Orientation: EW
 Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach Movement	Eastbound			Westbound		
	1 L	2 T	3 R	4 L	5 T	6 R
Volume		104	12	35	121	
Peak-Hour Factor, PHF		0.92	0.92	0.92	0.92	
Hourly Flow Rate, HFR		113	13	38	131	
Percent Heavy Vehicles		--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes Configuration		1	0		0	1
Upstream Signal?		No			No	

Minor Street: Approach Movement	Northbound			Southbound		
	7 L	8 T	9 R	10 L	11 T	12 R
Volume	7		20			
Peak Hour Factor, PHF	0.92		0.92			
Hourly Flow Rate, HFR	7		21			
Percent Heavy Vehicles	0		0			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No	/		/
Lanes Configuration	0		0			
		LR				

Delay, Queue Length, and Level of Service

Approach Movement	EB	WB	Northbound			Southbound		
	1	4	7	8	9	10	11	12
Lane Config		LT		LR				
v (vph)		38		28				
C(m) (vph)		1473		846				
v/c		0.03		0.03				
95% queue length		0.08		0.10				
Control Delay		7.5		9.4				
LOS		A		A				
Approach Delay				9.4				
Approach LOS				A				

TWO-WAY STOP CONTROL SUMMARY

Analyst: SA
 Agency/Co.: MS Transportation Systems, Inc
 Date Performed: 3/24/2007
 Analysis Time Period: Build AM Peak with Improvement
 Intersection: Northfield Rd@Chase Rd
 Jurisdiction: Lunenburg
 Units: U. S. Customary
 Analysis Year: 2012
 Project ID: 908 Highfield Village, Lunenburg, MA
 East/West Street: Northfield Road
 North/South Street: Chase Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach Movement	Northbound			Southbound		
	1 L	2 T	3 R	4 L	5 T	6 R
Volume	26	404	24	4	559	45
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.94	0.94	0.94
Hourly Flow Rate, HFR	28	448	26	4	594	47
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration	LTR			LTR		
Upstream Signal?	No			No		

Major Street: Approach Movement	Westbound			Eastbound		
	7 L	8 T	9 R	10 L	11 T	12 R
Volume	34	31	2	36	69	37
Peak Hour Factor, PHF	0.54	0.54	0.54	0.92	0.92	0.92
Hourly Flow Rate, HFR	62	57	3	39	74	40
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)	0			0		
Flared Approach: Exists?/Storage	No			/ No /		
Lanes	0	1	0	0	1	0
Configuration	LTR			LTR		

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound			Eastbound			
	1 LTR	4 LTR	7	8 LTR	9	10	11 LTR	12	
v (vph)	28	4	122			153			
C(m) (vph)	953	1099	132			196			
v/c	0.03	0.00	0.92			0.78			
95% queue length	0.09	0.01	6.17			5.35			
Control Delay	8.9	8.3	123.1			68.3			
LOS	A	A	F			F			
Approach Delay				123.1			68.3		
Approach LOS				F			F		

HCS+: Unsignalized Intersections Release 5.21

TWO-WAY STOP CONTROL SUMMARY

Analyst: SA
 Agency/Co.: MS Transportation Systems, Inc
 Date Performed: 3/24/2007
 Analysis Time Period: Build PM Peak with Improvement
 Intersection: Northfield Rd@Chase Rd
 Jurisdiction: Lunenburg
 Units: U. S. Customary
 Analysis Year: 2012
 Project ID: 908 Highfield Village, Lunenburg, MA
 East/West Street: Northfield Road
 North/South Street: Chase Road
 Intersection Orientation: NS
 Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach Movement	Northbound			Southbound		
	1 L	2 T	3 R	4 L	5 T	6 R
Volume	54	594	47	3	501	45
Peak-Hour Factor, PHF	0.84	0.84	0.84	0.91	0.91	0.91
Hourly Flow Rate, HFR	64	707	55	3	550	49
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes Configuration	0	1	0	0	1	0
Upstream Signal?	LTR No			LTR No		

Minor Street: Approach Movement	Westbound			Eastbound		
	7 L	8 T	9 R	10 L	11 T	12 R
Volume	22	57	6	36	35	53
Peak Hour Factor, PHF	0.76	0.76	0.76	0.81	0.81	0.81
Hourly Flow Rate, HFR	28	75	7	44	43	65
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)	0			0		
Flared Approach: Exists?/Storage	No			/		
Lanes Configuration	1	1	0	1	1	0
	L		TR	L		TR

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound			Eastbound		
	1 LTR	4 LTR	7 L	8	9 TR	10 L	11	12 TR
v (vph)	64	3	28		82	44		108
C(m) (vph)	988	859	57		121	44		214
v/c	0.06	0.00	0.49		0.68	1.00		0.50
95% queue length	0.21	0.01	1.90		3.62	4.06		2.56
Control Delay	8.9	9.2	118.2		81.9	278.7		37.8
LOS	A	A	F		F	F		E
Approach Delay				91.2				107.5
Approach LOS				F				F

TWO-WAY STOP CONTROL SUMMARY

Analyst: SA
 Agency/Co.: MS Transportation Systems, Inc
 Date Performed: 3/24/2007
 Analysis Time Period: Build AM Peak with Improvement
 Intersection: Northfield Rd@Chase Rd
 Jurisdiction: Lunenburg
 Units: U. S. Customary
 Analysis Year: 2012
 Project ID: 908 Highfield Village, Lunenburg, MA
 East/West Street: Northfield Road
 North/South Street: Chase Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach Movement	Northbound			Southbound		
	1 L	2 T	3 R	4 L	5 T	6 R
Volume	26	404	24	4	559	45
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.94	0.94	0.94
Hourly Flow Rate, HFR	28	448	26	4	594	47
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration	LTR			LTR		
Upstream Signal?	No			No		

Minor Street: Approach Movement	Westbound			Eastbound		
	7 L	8 T	9 R	10 L	11 T	12 R
Volume	34	31	2	36	69	37
Peak Hour Factor, PHF	0.54	0.54	0.54	0.92	0.92	0.92
Hourly Flow Rate, HFR	62	57	3	39	74	40
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)	0			0		
Flared Approach: Exists?/Storage	No			/		
Lanes	0	1	0	1	1	0
Configuration	LTR			L	TR	

Delay, Queue Length, and Level of Service

Approach Movement Lane Config	NB	SB	Westbound			Eastbound		
	1 LTR	4 LTR	7	8 LTR	9	10 L	11	12 TR
v (vph)	28	4		122		39		114
C(m) (vph)	953	1099		132		126		241
v/c	0.03	0.00		0.92		0.31		0.47
95% queue length	0.09	0.01		6.17		1.21		2.35
Control Delay	8.9	8.3		123.1		45.9		32.7
LOS	A	A		F		E		D
Approach Delay				123.1				36.0
Approach LOS				F				E

HCS+: Unsignalized Intersections Release 5.21

TWO-WAY STOP CONTROL SUMMARY

Analyst: SA
 Agency/Co.: MS Transportation Systems, Inc
 Date Performed: 3/24/2007
 Analysis Time Period: Build PM Peak with Improvement
 Intersection: Northfield Rd@Chase Rd
 Jurisdiction: Lunenburg
 Units: U. S. Customary
 Analysis Year: 2012
 Project ID: 908 Highfield Village, Lunenburg, MA
 East/West Street: Northfield Road
 North/South Street: Chase Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach Movement	Northbound			Southbound		
	1 L	2 T	3 R	4 L	5 T	6 R
Volume	54	594	47	3	501	45
Peak-Hour Factor, PHF	0.84	0.84	0.84	0.91	0.91	0.91
Hourly Flow Rate, HFR	64	707	55	3	550	49
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes Configuration	0	1	0	0	1	0
Upstream Signal?	LTR No			LTR No		

Minor Street: Approach Movement	Westbound			Eastbound		
	7 L	8 T	9 R	10 L	11 T	12 R
Volume	22	57	6	36	35	53
Peak Hour Factor, PHF	0.76	0.76	0.76	0.81	0.81	0.81
Hourly Flow Rate, HFR	28	75	7	44	43	65
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)	0			0		
Flared Approach: Exists?/Storage	No			/		
Lanes Configuration	1	1	0	1	1	0
	L		TR	L		TR

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound			Eastbound		
	1	4	7	8	9	10	11	12
Lane Config	LTR	LTR	L		TR	L		TR
v (vph)	64	3	28		82	44		108
C(m) (vph)	988	859	57		121	44		214
v/c	0.06	0.00	0.49		0.68	1.00		0.50
95% queue length	0.21	0.01	1.90		3.62	4.06		2.56
Control Delay	8.9	9.2	118.2		81.9	278.7		37.8
LOS	A	A	F		F	F		E
Approach Delay				91.2				107.5
Approach LOS				F				F

MS Transportation Systems, Inc.

- **Signal Warrant**

Warrants Summary													
Information													
Analyst	SA MS Transportation Systems, Inc						Intersection	Chase Road at Northfield Road					
Agency/Co	4/11/2007 (Exist Cond w/GC)						Jurisdiction	Lunenburg					
Date Performed	908 - Lunenburg						Units	U.S. Customary					
Project ID	Northfield Road						Time Period Analyzed	6:00AM - 6:00PM					
East/West Street	2007 Exist Sigwarran						North/South Street	Chase Road					
File Name							Major Street	North-South					
Project Description 908 - Lunenburg													
General							Roadway Network						
Major Street Speed (mph)	48	<input type="checkbox"/>	Population < 10,000				Two Major Routes				<input type="checkbox"/>		
Nearest Signal (ft)	0	<input type="checkbox"/>	Coordinated Signal System				Weekend Count				<input type="checkbox"/>		
Crashes (per year)	4	<input type="checkbox"/>	Adequate Trials of Alternatives				5-yr Growth Factor				0		
Geometry and Traffic	EB			WB			NB			SB			
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
Number of lanes, N	0	1	0	0	1	0	0	1	0	0	1	0	
Lane usage		LTR			LTR			LTR			LTR		
Vehicle Volume Averages (vph)	0	72	0	0	68	0	0	392	0	0	402	0	
Peds (ped/h) / Gaps (gaps/h)	--	/	--	--	/	--	--	/	--	--	/	--	
Delay (s/veh) / (veh-hr)	--	/	--	--	/	--	--	/	--	--	/	--	
Warrant 1: Eight-Hour Vehicular Volume												<input type="checkbox"/>	
1 A. Minimum Vehicular Volumes (Both major approaches --and-- higher minor approach) --or--												<input type="checkbox"/>	
1 B. Interruption of Continuous Traffic (Both major approaches --and-- higher minor approach) --or--												<input type="checkbox"/>	
1 80% Vehicular --and-- Interruption Volumes (Both major approaches --and-- higher minor approach)												<input type="checkbox"/>	
Warrant 2: Four-Hour Vehicular Volume												<input type="checkbox"/>	
2 A. Four-Hour Vehicular Volumes (Both major approaches --and-- higher minor approach)												<input type="checkbox"/>	
Warrant 3: Peak Hour												<input type="checkbox"/>	
3 A. Peak-Hour Conditions (Minor delay --and-- minor volume --and-- total volume) --or--												<input type="checkbox"/>	
3 B. Peak- Hour Vehicular Volumes (Both major approaches --and-- higher minor approach)												<input type="checkbox"/>	
Warrant 4: Pedestrian Volume												<input type="checkbox"/>	
4 A. Pedestrian Volumes (Four hours --or-- one hour) --and--												<input type="checkbox"/>	
4 B. Gaps Same Period (Four hours --or-- one hour)												<input type="checkbox"/>	
Warrant 5: School Crossing												<input type="checkbox"/>	
5. Student Volumes --and--												<input type="checkbox"/>	
5. Gaps Same Period												<input type="checkbox"/>	
Warrant 6: Coordinated Signal System												<input type="checkbox"/>	
6. Degree of Platooning (Predominant direction or both directions)												<input type="checkbox"/>	
Warrant 7: Crash Experience												<input type="checkbox"/>	
7 A. Adequate trials of alternatives, observance and enforcement failed --and--												<input type="checkbox"/>	
7 B. Reported crashes susceptible to correction by signal (12-month period) --and--												<input type="checkbox"/>	

7 C. 80% Volumes for Warrants 1A, 1B --or-- 4 are satisfied	F
---	---

Warrant 8: Roadway Network	F
8 A. Weekday Volume (Peak hour total --and-- projected warrants 1, 2 or 3) --or--	F
8 B. Weekend Volume (Five hours total)	F

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Warrants Summary													
Information													
Analyst	SA								Chase Road at Northfield Road				
Agency/Co	MS Transportation Systems, Inc			Intersection					Lunenburg				
Date Performed	4/11/2007 (No-Build Cond w/GC)			Jurisdiction					U.S. Customary				
Project ID	908 - Lunenburg			Units					6:00AM - 6:00PM				
East/West Street	Northfield Road			Time Period Analyzed					Chase Road				
File Name	2012 No-BuildSigwarran			North/South Street					Major Street				
Project Description 908 - Lunenburg													
General									Roadway Network				
Major Street Speed (mph)	48	Population < 10,000			Two Major Routes								
Nearest Signal (ft)	0	Coordinated Signal System			Weekend Count								
Crashes (per year)	4	Adequate Trials of Alternatives			5-yr Growth Factor					0			
Geometry and Traffic	EB			WB			NB			SB			
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
Number of lanes, N	0	1	0	0	1	0	0	1	0	0	1	0	
Lane usage	LTR			LTR			LTR			LTR			
Vehicle Volume Averages (vph)	0	77	0	0	72	0	0	433	0	0	444	0	
Peds (ped/h) / Gaps (gaps/h)	-	/	-	-	/	-	-	/	-	-	/	-	
Delay (s/veh) / (veh-hr)	-	/	-	-	/	-	-	/	-	-	/	-	
Warrant 1: Eight-Hour Vehicular Volume													
1 A. Minimum Vehicular Volumes (Both major approaches --and-- higher minor approach) --or--													<input type="checkbox"/>
1 B. Interruption of Continuous Traffic (Both major approaches --and-- higher minor approach) --or--													<input type="checkbox"/>
1 80% Vehicular --and-- Interruption Volumes (Both major approaches --and-- higher minor approach)													<input type="checkbox"/>
Warrant 2: Four-Hour Vehicular Volume													
2 A. Four-Hour Vehicular Volumes (Both major approaches --and-- higher minor approach)													<input type="checkbox"/>
Warrant 3: Peak Hour													
3 A. Peak-Hour Conditions (Minor delay --and-- minor volume --and-- total volume) --or--													<input type="checkbox"/>
3 B. Peak- Hour Vehicular Volumes (Both major approaches --and-- higher minor approach)													<input type="checkbox"/>
Warrant 4: Pedestrian Volume													
4 A. Pedestrian Volumes (Four hours --or-- one hour) --and--													<input type="checkbox"/>
4 B. Gaps Same Period (Four hours --or-- one hour)													<input type="checkbox"/>
Warrant 5: School Crossing													
5. Student Volumes --and--													<input type="checkbox"/>
5. Gaps Same Period													<input type="checkbox"/>
Warrant 6: Coordinated Signal System													
6. Degree of Platooning (Predominant direction or both directions)													<input type="checkbox"/>
Warrant 7: Crash Experience													
7 A. Adequate trials of alternatives, observance and enforcement failed --and--													<input type="checkbox"/>
7 B. Reported crashes susceptible to correction by signal (12-month period) --and--													<input type="checkbox"/>

7 C. 80% Volumes for Warrants 1A, 1B --or-- 4 are satisfied	
---	--

Warrant 8: Roadway Network	
8 A. Weekday Volume (Peak hour total --and-- projected warrants 1, 2 or 3) --or--	
8 B. Weekend Volume (Five hours total)	

Warrants Summary												
Information												
Analyst	SA					Intersection	Chase Road at Northfield Road					
Agency/Co	MS Transportation Systems, Inc					Jurisdiction	Lunenburg					
Date Performed	4/11/2007 (Build Cond w/GC)					Units	U.S. Customary					
Project ID	908 - Lunenburg					Time Period Analyzed	6:00AM - 6:00PM					
East/West Street	Northfield Road					North/South Street	Chase Road					
File Name	2012 BuildSigwarran					Major Street	North-South					
Project Description 908 - Lunenburg												
General									Roadway Network			
Major Street Speed (mph)	48	<input type="checkbox"/>	Population < 10,000					Two Major Routes		<input type="checkbox"/>		
Nearest Signal (ft)	0	<input type="checkbox"/>	Coordinated Signal System					Weekend Count		<input type="checkbox"/>		
Crashes (per year)	4	<input type="checkbox"/>	Adequate Trials of Alternatives					5-yr Growth Factor		0		
Geometry and Traffic	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of lanes, N	0	1	0	0	1	0	0	1	0	0	1	0
Lane usage	LTR			LTR			LTR			LTR		
Vehicle Volume Averages (vph)	0	92	0	0	72	0	0	433	0	0	444	0
Peds (ped/h) / Gaps (gaps/h)	-	/	-	-	/	-	-	/	-	-	/	-
Delay (s/veh) / (veh-hr)	-	/	-	-	/	-	-	/	-	-	/	-
Warrant 1: Eight-Hour Vehicular Volume												<input type="checkbox"/>
1 A. Minimum Vehicular Volumes (Both major approaches --and-- higher minor approach) --or--												<input type="checkbox"/>
1 B. Interruption of Continuous Traffic (Both major approaches --and-- higher minor approach) --or--												<input type="checkbox"/>
1 80% Vehicular --and-- Interruption Volumes (Both major approaches --and-- higher minor approach)												<input type="checkbox"/>
Warrant 2: Four-Hour Vehicular Volume												<input type="checkbox"/>
2 A. Four-Hour Vehicular Volumes (Both major approaches --and-- higher minor approach)												<input type="checkbox"/>
Warrant 3: Peak Hour												<input type="checkbox"/>
3 A. Peak-Hour Conditions (Minor delay --and-- minor volume --and-- total volume) --or--												<input type="checkbox"/>
3 B. Peak- Hour Vehicular Volumes (Both major approaches --and-- higher minor approach)												<input type="checkbox"/>
Warrant 4: Pedestrian Volume												<input type="checkbox"/>
4 A. Pedestrian Volumes (Four hours --or-- one hour) --and--												<input type="checkbox"/>
4 B. Gaps Same Period (Four hours --or-- one hour)												<input type="checkbox"/>
Warrant 5: School Crossing												<input type="checkbox"/>
5. Student Volumes --and--												<input type="checkbox"/>
5. Gaps Same Period												<input type="checkbox"/>
Warrant 6: Coordinated Signal System												<input type="checkbox"/>
6. Degree of Platooning (Predominant direction or both directions)												<input type="checkbox"/>
Warrant 7: Crash Experience												<input type="checkbox"/>
7 A. Adequate trials of alternatives, observance and enforcement failed --and--												<input type="checkbox"/>
7 B. Reported crashes susceptible to correction by signal (12-month period) --and--												<input type="checkbox"/>

7 C. 80% Volumes for Warrants 1A, 1B --or-- 4 are satisfied	
---	--

Warrant 8: Roadway Network	
8 A. Weekday Volume (Peak hour total --and-- projected warrants 1, 2 or 3) --or--	
8 B. Weekend Volume (Five hours total)	

DATA FOR SIGNAL WARRANT ANALYSIS UNDER EXISTING CONDITION INCLUDING GOLF COURSE TRIPS

	2007 Seasonally Adjusted Volume				Golf Course		Including Golf Course	
	NB	SB	EB	WB	EB	WB	EB	WB
6-7 AM	205	296	57	11	8	32	65	43
7-8 AM	302	449	81	37	26	24	107	61
8-9 AM	328	382	54	38	26	24	80	62
9-10 AM	278	374	32	32	26	24	58	56
10-11 AM	305	346	25	31	26	24	51	55
11-12 PM	363	338	31	33	26	24	57	57
12-1 PM	357	382	40	33	26	24	66	57
1-2 PM	397	349	54	32	26	24	80	56
2-3 PM	473	410	46	43	26	24	72	67
3-4 PM	540	478	49	59	26	24	75	83
4-5 PM	605	492	43	83	26	24	69	107
5-6 PM	561	533	66	90	27	22	93	112

DATA FOR SIGNAL WARRANT ANALYSIS UNDER NO-BUILD CONDITION INCLUDING GOLF COURSE TRIPS

	2012 Projected Volume				Golf Course		Including Golf Course	
	NB	SB	EB	WB	EB	WB	EB	WB
6-7 AM	226	327	63	12	8	32	71	44
7-8 AM	334	496	89	41	26	24	115	65
8-9 AM	362	422	60	42	26	24	86	66
9-10 AM	307	413	35	35	26	24	61	59
10-11 AM	337	382	27	34	26	24	53	58
11-12 PM	401	373	34	36	26	24	60	60
12-1 PM	394	422	44	36	26	24	70	60
1-2 PM	438	385	60	35	26	24	86	59
2-3 PM	522	453	51	48	26	24	77	72
3-4 PM	596	527	54	66	26	24	80	90
4-5 PM	668	543	48	92	26	24	74	116
5-6 PM	619	588	72	100	27	22	99	122

24-Hour Traffic Volume on Chase Road

	2007 Raw Data		2007 Seasonally Adjusted		2012 Projected Volumes	
	NB	SB	NB	SB	NB	SB
12-1 AM	22	18	23	18	25	20
1-2 AM	17	14	17	14	19	16
2-3 AM	15	7	15	7	17	8
3-4 AM	14	19	14	19	16	22
4-5 AM	31	26	32	27	35	29
5-6 AM	70	114	72	117	79	129
6-7 AM	200	289	205	296	226	327
7-8 AM	295	438	302	449	334	496
8-9 AM	320	373	328	382	362	422
9-10 AM	271	365	278	374	307	413
10-11 AM	288	338	305	346	337	382
11-12 PM	354	330	363	338	401	373
12-1 PM	348	373	357	382	394	422
1-2 PM	387	340	397	349	438	385
2-3 PM	461	400	473	410	522	453
3-4 PM	527	466	540	478	596	527
4-5 PM	590	480	605	492	668	543
5-6 PM	547	520	561	533	619	588
6-7 PM	500	415	513	425	566	470
7-8 PM	411	296	421	303	465	335
8-9 PM	278	190	285	195	315	215
9-10 PM	262	144	269	148	296	163
10-11 PM	137	88	140	90	155	100
11-12 AM	77	56	79	57	87	63

24-Hour Traffic Volume on Northfield Road

	2007 Raw Data		2007 Seasonally Adjusted		2012 Projected Volumes		Golf Course Trips		2012 Projected Volumes Including Golf Course Trips		2012 Projected Volumes Including EB Site Trips	
	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB
12-1 AM	5	2	5	2	6	2	0	0	6	2	8	2
1-2 AM	0	2	0	2	0	2	0	0	0	2	1	2
2-3 AM	0	1	0	1	0	1	0	0	0	1	2	1
3-4 AM	2	1	2	1	2	1	0	0	2	1	2	1
4-5 AM	3	3	3	3	3	3	0	0	3	3	5	3
5-6 AM	12	0	12	0	14	0	4	20	18	20	22	20
6-7 AM	56	11	57	11	63	12	8	32	71	44	80	44
7-8 AM	79	36	81	37	89	41	26	24	115	65	130	65
8-9 AM	53	37	54	38	60	42	26	24	86	66	101	66
9-10 AM	31	31	32	32	35	35	26	24	61	59	74	59
10-11 AM	24	30	25	31	27	34	26	24	53	58	63	58
11-12 PM	30	32	31	33	34	36	26	24	60	60	74	60
12-1 PM	39	32	40	33	44	36	26	24	70	60	82	60
1-2 PM	53	31	54	32	60	35	26	24	86	59	101	59
2-3 PM	45	42	46	43	51	48	26	24	77	72	93	72
3-4 PM	48	58	49	59	54	66	26	24	80	90	99	90
4-5 PM	42	81	43	83	48	92	26	24	74	116	92	116
5-6 PM	64	88	66	90	72	100	27	22	99	122	125	122
6-7 PM	42	35	43	36	45	62	20	10	68	72	87	72
7-8 PM	38	47	39	48	43	53	0	0	43	53	61	53
8-9 PM	28	23	29	24	32	26	0	0	32	26	48	26
9-10 PM	13	17	13	17	15	19	0	0	15	19	26	19
10-11 PM	9	12	9	12	10	14	0	0	10	14	16	14
11-12 AM	8	7	8	7	9	8	0	0	9	8	13	8

- **Mitigation**

Queues

3: Northfield Road & Chase Road

3/25/2007

								
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Volume (vph)	36	69	34	31	26	404	4	559
Lane Group Flow (vph)	0	154	0	73	0	493	0	661
Turn Type	Perm		Perm		pm+pt		Perm	
Protected Phases		4		8	5	2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	5	2	6	6
Switch Phase								
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	21.0	21.0	21.0	21.0	8.0	21.0	21.0	21.0
Total Split (s)	21.0	21.0	21.0	21.0	8.0	39.0	31.0	31.0
Total Split (%)	35.0%	35.0%	35.0%	35.0%	13.3%	65.0%	51.7%	51.7%
Yellow Time (s)	4.0	4.0	4.0	4.0	3.5	4.0	4.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	0.5	1.0	1.0	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	4.0	5.0	5.0	5.0
Lead/Lag					Lead		Lag	Lag
Lead-Lag Optimize?					Yes		Yes	Yes
Recall Mode	None	None	None	None	None	Max	Max	Max
v/c Ratio		0.54		0.31		0.41		0.53
Control Delay		23.3		21.8		6.5		7.8
Queue Delay		0.0		0.0		0.0		0.0
Total Delay		23.3		21.8		6.5		7.8
Queue Length 50th (ft)		36		20		63		95
Queue Length 95th (ft)		80		49		145		217
Internal Link Dist (ft)		444		444		393		282
Turn Bay Length (ft)								
Base Capacity (vph)		397		336		1198		1251
Starvation Cap Reductn		0		0		0		0
Spillback Cap Reductn		0		0		0		0
Storage Cap Reductn		0		0		0		0
Reduced v/c Ratio		0.39		0.22		0.41		0.53

Intersection Summary

Cycle Length: 60

Actuated Cycle Length: 68.8

Natural Cycle: 60

Control Type: Actuated-Uncoordinated

Splits and Phases: 3: Northfield Road & Chase Road



HCM Signalized Intersection Capacity Analysis

3: Northfield Road & Chase Road

3/25/2007

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	36	69	37	34	31	2	26	404	24	4	559	45
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	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		0.96			1.00			0.99			0.99	
Flt Protected		0.99			0.98			1.00			1.00	
Satd. Flow (prot)		1775			1810			1844			1844	
Flt Permitted		0.89			0.77			0.95			1.00	
Satd. Flow (perm)		1608			1437			1761			1840	
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)	39	75	40	37	34	2	28	439	26	4	608	49
RTOR Reduction (vph)	0	24	0	0	2	0	0	2	0	0	2	0
Lane Group Flow (vph)	0	130	0	0	71	0	0	491	0	0	659	0
Turn Type	Perm			Perm			pm+pt			Perm		
Protected Phases		4			8		5	2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		11.1			11.1			46.7			46.7	
Effective Green, g (s)		11.1			11.1			46.7			46.7	
Actuated g/C Ratio		0.16			0.16			0.69			0.69	
Clearance Time (s)		5.0			5.0			5.0			5.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		263			235			1213			1267	
v/s Ratio Prot												
v/s Ratio Perm		c0.08			0.05			0.28			c0.36	
v/c Ratio		0.49			0.30			0.40			0.52	
Uniform Delay, d1		25.8			24.9			4.6			5.1	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		1.5			0.7			0.2			1.5	
Delay (s)		27.2			25.7			4.8			6.6	
Level of Service		C			C			A			A	
Approach Delay (s)		27.2			25.7			4.8			6.6	
Approach LOS		C			C			A			A	
Intersection Summary												
HCM Average Control Delay			9.3			HCM Level of Service				A		
HCM Volume to Capacity ratio			0.51									
Actuated Cycle Length (s)			67.8			Sum of lost time (s)		10.0				
Intersection Capacity Utilization			57.5%			ICU Level of Service		B				
Analysis Period (min)			15									
c Critical Lane Group												

Queues

3: Northfield Road & Chase Road

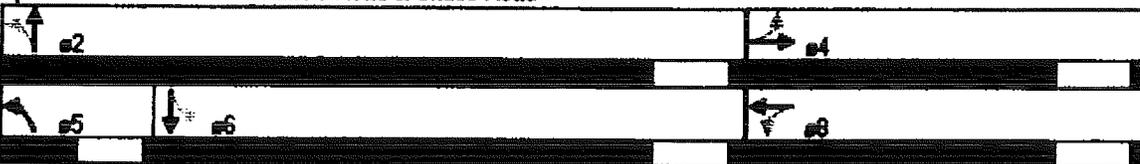
3/25/2007

								
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Volume (vph)	36	35	22	57	54	594	3	501
Lane Group Flow (vph)	0	135	0	93	0	756	0	597
Turn Type	Perm		Perm		pm+pt		Perm	
Protected Phases		4		8	5	2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	5	2	6	6
Switch Phase								
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	21.0	21.0	21.0	21.0	8.0	21.0	21.0	21.0
Total Split (s)	21.0	21.0	21.0	21.0	8.0	39.0	31.0	31.0
Total Split (%)	35.0%	35.0%	35.0%	35.0%	13.3%	65.0%	51.7%	51.7%
Yellow Time (s)	4.0	4.0	4.0	4.0	3.5	4.0	4.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	0.5	1.0	1.0	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	4.0	5.0	5.0	5.0
Lead/Lag					Lead		Lag	Lag
Lead-Lag Optimize?					Yes		Yes	Yes
Recall Mode	None	None	None	None	None	Max	Max	Max
v/c Ratio		0.49		0.39		0.61		0.45
Control Delay		17.8		22.9		8.6		6.0
Queue Delay		0.0		0.0		0.0		0.0
Total Delay		17.8		22.9		8.6		6.0
Queue Length 50th (ft)		21		24		112		73
Queue Length 95th (ft)		61		57		271		166
Internal Link Dist (ft)		444		444		393		282
Turn Bay Length (ft)								
Base Capacity (vph)		410		382		1231		1325
Starvation Cap Reductn		0		0		0		0
Spillback Cap Reductn		0		0		0		0
Storage Cap Reductn		0		0		0		0
Reduced v/c Ratio		0.33		0.24		0.61		0.45

Intersection Summary

Cycle Length: 60
 Actuated Cycle Length: 67.8
 Natural Cycle: 60
 Control Type: Actuated-Uncoordinated

Splits and Phases: 3: Northfield Road & Chase Road



HCM Signalized Intersection Capacity Analysis

3: Northfield Road & Chase Road

3/25/2007

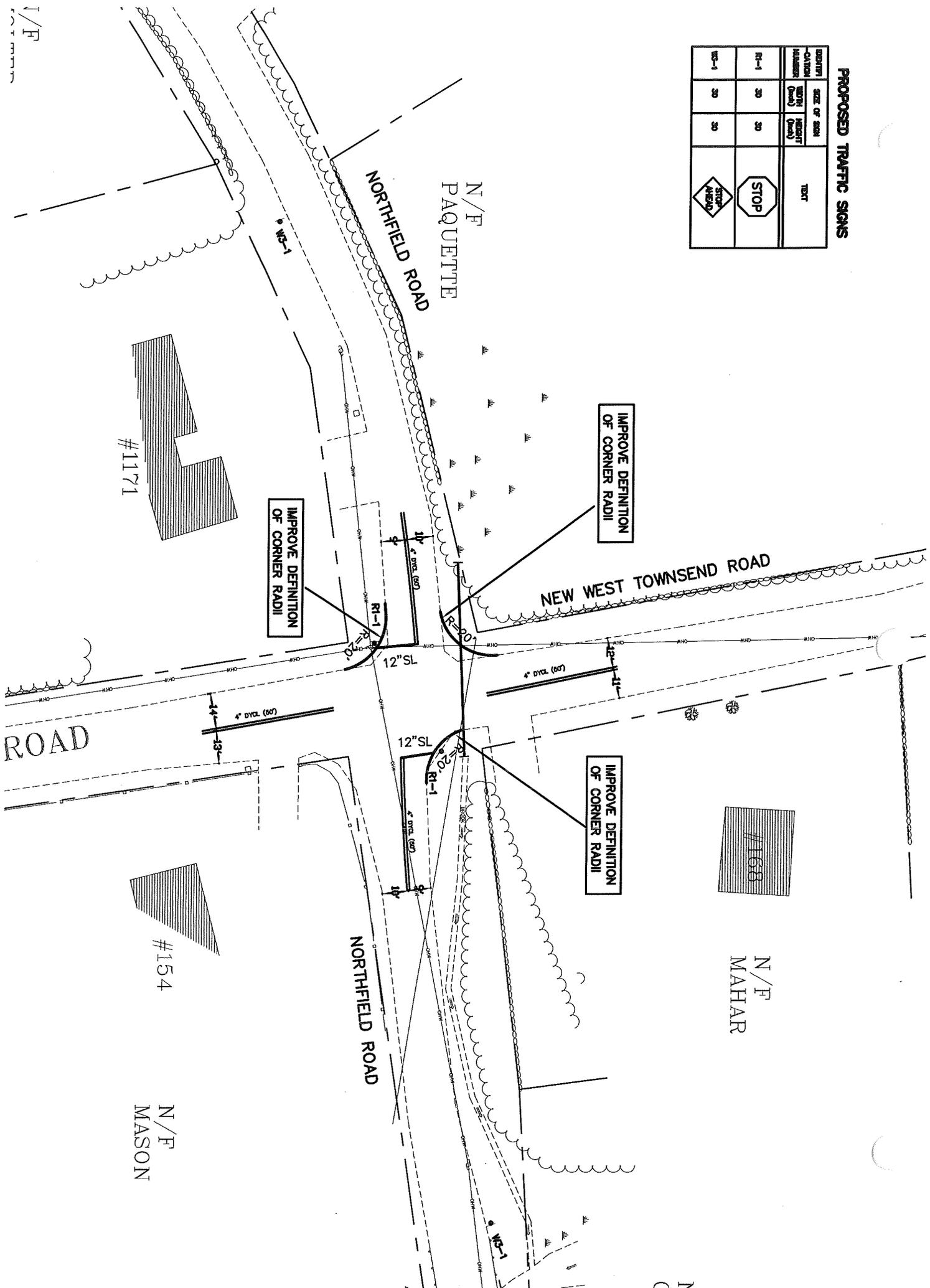
												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	36	35	53	22	57	6	54	594	47	3	501	45
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0			5.0			5.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		0.94			0.99			0.99			0.99	
Flt Protected		0.99			0.99			1.00			1.00	
Satd. Flow (prot)		1730			1820			1839			1842	
Flt Permitted		0.90			0.88			0.93			1.00	
Satd. Flow (perm)		1584			1631			1707			1838	
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)	39	38	58	24	62	7	59	646	51	3	545	49
RTOR Reduction (vph)	0	50	0	0	6	0	0	3	0	0	3	0
Lane Group Flow (vph)	0	85	0	0	87	0	0	753	0	0	594	0
Turn Type	Perm			Perm			pm+pt			Perm		
Protected Phases		4			8		5	2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		9.1			9.1			48.2			48.2	
Effective Green, g (s)		9.1			9.1			48.2			48.2	
Actuated g/C Ratio		0.14			0.14			0.72			0.72	
Clearance Time (s)		5.0			5.0			5.0			5.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		214			221			1223			1316	
v/s Ratio Prot												
v/s Ratio Perm		c0.05			0.05			c0.44			0.32	
v/c Ratio		0.40			0.39			0.62			0.45	
Uniform Delay, d1		26.6			26.6			4.8			4.0	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		1.2			1.2			0.9			1.1	
Delay (s)		27.8			27.7			5.8			5.1	
Level of Service		C			C			A			A	
Approach Delay (s)		27.8			27.7			5.8			5.1	
Approach LOS		C			C			A			A	

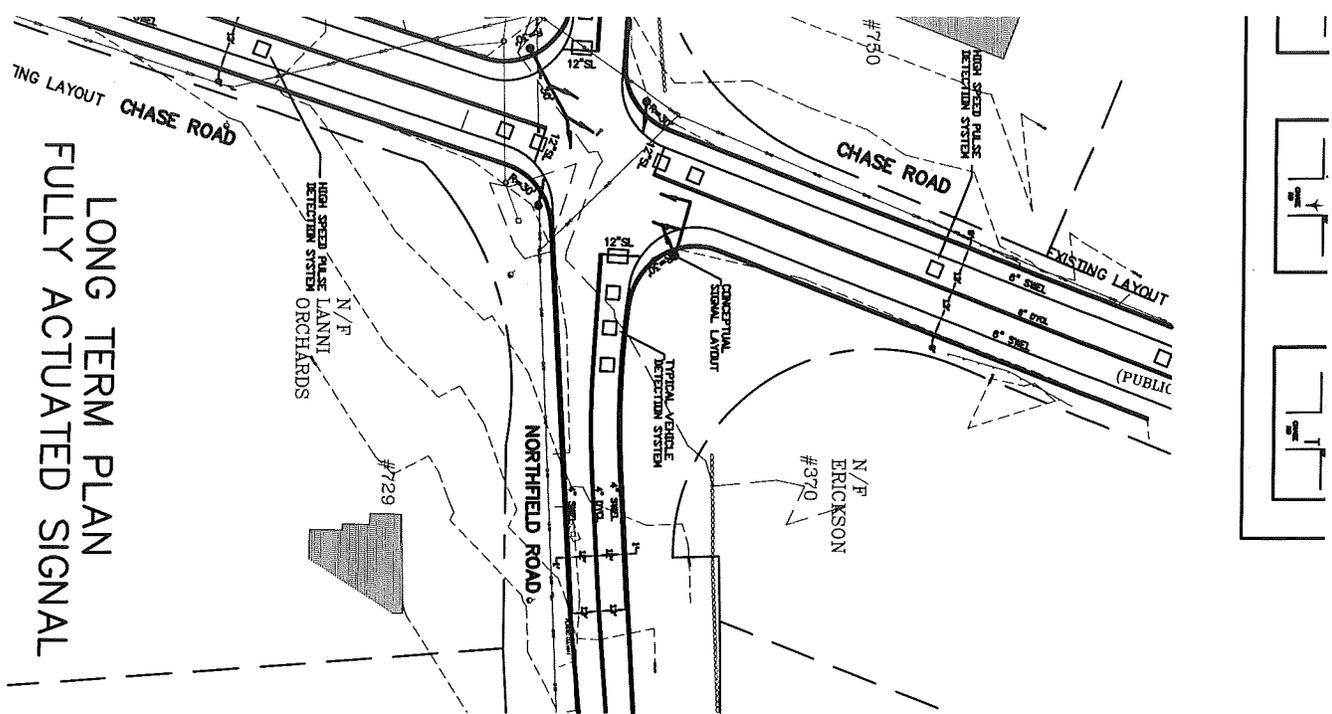
Intersection Summary

HCM Average Control Delay	8.7	HCM Level of Service	A
HCM Volume to Capacity ratio	0.58		
Actuated Cycle Length (s)	67.3	Sum of lost time (s)	10.0
Intersection Capacity Utilization	88.7%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

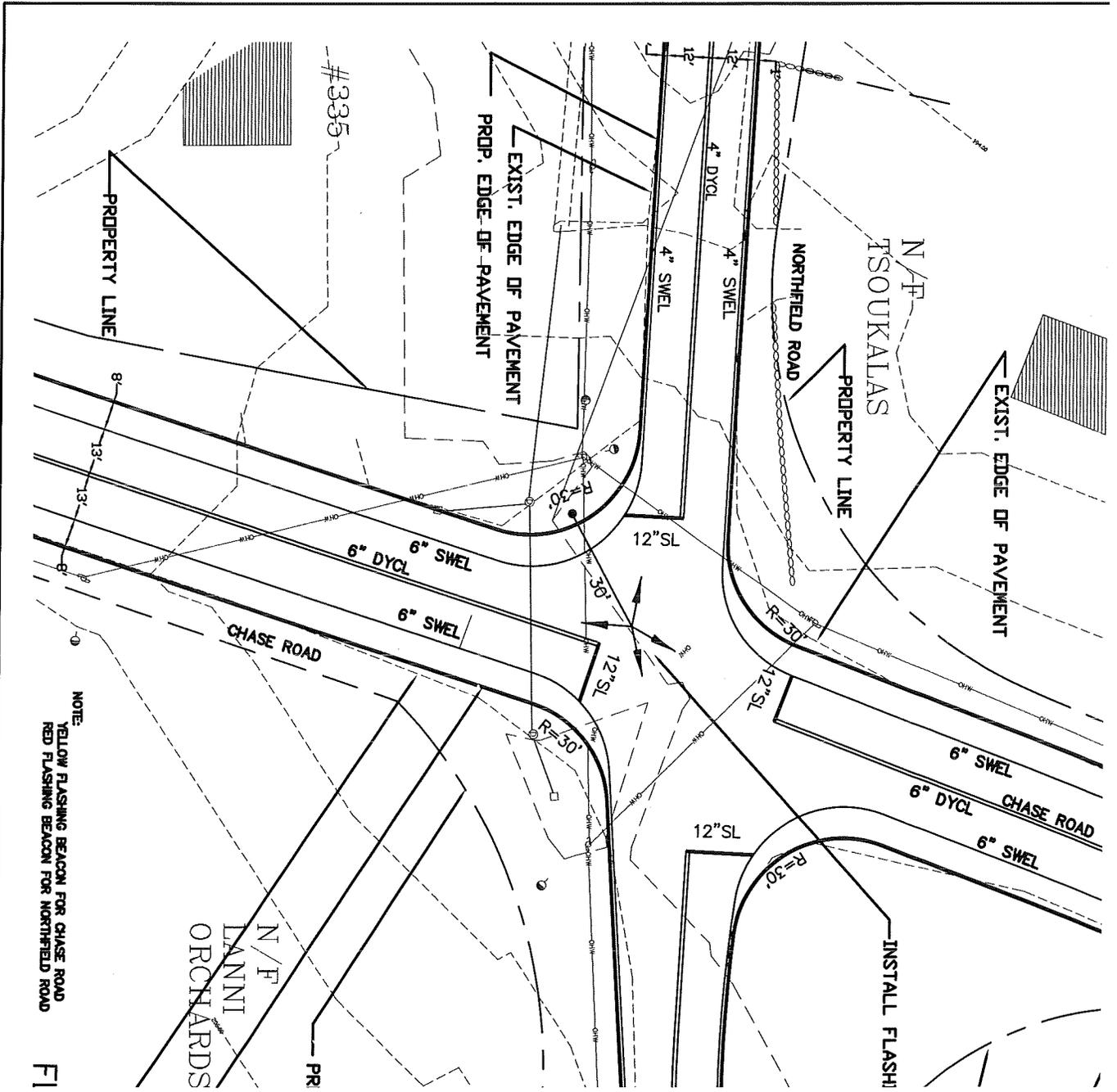
PROPOSED TRAFFIC SIGNS

IDENTIFICATION NUMBER	SIZE OF SIGN		TEXT
	WIDTH (feet)	HEIGHT (feet)	
Rt-1	30	30	STOP
WS-1	30	30	STOP AHEAD





**LONG TERM PLAN
FULLY ACTUATED SIGNAL**



NOTE:
YELLOW FLASHING BEACON FOR CHASE ROAD
RED FLASHING BEACON FOR NORTHFIELD ROAD

F1

“Highfield Village”

66 Lot Residential Subdivision
Lunenburg, Massachusetts

Stormwater Management Plan

May 21, 2007

Prepared For:

Landcraft Corporation
52 Cachalot Lane
Falmouth, MA 02540

Prepared By:

SRA & New England Engineering Group
601 Shea St
Fitchburg, MA 01420
978-878-7016

