

January 16, 2018



Ref: 13810.00

Mr. David R. Consigli, Chair  
Zoning Board of Appeals  
Town of Milford  
Town Hall  
52 Main Street  
Milford, MA 01757

Attn: Sam Offei-Addo, PE, PTOE

Re: Response to Comments  
BSC Group, Inc. Transportation Engineering Peer Review  
Robsham Village, 462-466 East Main Street  
Milford, Massachusetts

Dear Mr. Consigli and members of the Zoning Board of Appeals:

This letter provides information and responds to comments raised in a letter dated, January 2, 2018 from Sam Offi-Addo, PE, PTOE to your board. This letter provides additional responses and clarification to those comments for the ZBA's information.

It should be noted that the Route 16 corridor is under the jurisdiction of the Massachusetts Department of Transportation (MassDOT) and following the issuance of the Comprehensive Permit for this development, the Applicant will be filing an Application to Access State Highway Layout as it relates to the site driveway and the design elements associated with it. The ZBA should also be aware that MassDOT has exclusive jurisdiction over all curb cuts that intersect with State Highway Layout (SHLO).

The Applicant is committed to the design and development of a safe and efficient site access for the Project that is multimodal and efficient. The Applicant will consider the comments of the Peer Reviewer and the Town staff and other stakeholders as they relate to the design-related issues, but also respectfully submits that MassDOT is the regulatory authority that will approve the design elements of the final site access onto Route 16. The Applicant recommends that the ZBA provide a condition in their approval that the driveway design is subject to the issuance of a Highway Access Permit from MassDOT in this regard.

This letter highlights the outstanding issues raised in the BSC letter (in **bold**) and provides the response to the comment by the Applicant (in *italics*).

Engineers | Scientists | Planners | Designers

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**BSC COMMENT #1 ~ The TIAS states that the study area was selected "based on discussions with Planning, Engineering, and Police Departments at the Town of Milford" and the area was confirmed with MassDOT District 3 offices.**

APPLICANT RESPONSE ~ *Comment acknowledged, no response necessary.*

**BSC COMMENT #2 ~ The description for East Main Street (Route 16) states that "The posted speed limit on Route 16 eastbound is 45 miles per hour (MPH). Posted speed limit signs were not visible in the westbound direction." Based on the field visit, a posted speed limit of 40 MPH was available in both the eastbound and westbound directions on East Main Street (Route 16) in the vicinity of the project.**

APPLICANT RESPONSE ~ *Comment acknowledged, no response necessary. Sight distance measurements (discussed below in comment #8 have been adjusted and are all based on 85<sup>th</sup> percentile speeds).*

#### Traffic Volumes

**BSC COMMENT #3 ~ Turning movement counts were collected in February 2017 during the weekday morning (7-9AM) and afternoon (4-6PM) commuter peak hours. These times are consistent with standard procedures. These volumes were increased by one percent in order to account for the seasonal variation in volumes; BSC concurs with this action.**

APPLICANT RESPONSE ~ *Comment acknowledged, no response necessary.*

#### Crash History

**BSC COMMENT #4 ~ The TIAS provides crash information for the intersection of East Main Street at Fortune Boulevard / Beaver Street. The report also summarizes the segment crash information along Route 16 between I-495 and Adams Street. BSC Group requests intersection crash information at the remaining study area intersections, including the intersections of Route 16 at Zain Circle, Whispering Pine Drive, and Adams Street. Crash rates should be calculated for these locations and compared to the MassDOT District and statewide averages.**

APPLICANT RESPONSE ~ *VHB has provided the crash data requested in summary table format for the three intersections noted as Attachment #1. As presented, none of these locations has exhibited a significant number of crashes during the most recent 5 years of data available and none exceed the MassDOT district or statewide averages for comparable locations.*

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**BSC COMMENT #5 ~ The TIAS indicates that crash data was also requested from the Milford Police Department. BSC Group requests an update to the crash data based on any additional information provided by the Town.**

APPLICANT RESPONSE ~ *No additional data has been provided to VHB from the Town. VHB will follow up with Town police administrative staff to determine if any specific data is available.*

#### Future Conditions

**BSC COMMENT #6 ~ The future conditions were projected under a seven-year planning horizon. BSC Group concurs with this timeline, which is consistent with current MassDOT standards.**

APPLICANT RESPONSE ~ *Comment acknowledged, no response necessary.*

**BSC COMMENT #7 ~ Future No Build conditions were estimated by applying a one-percent annual growth rate and adding vehicle trips from specific known developments in the area. BSC Group concurs with this methodology.**

APPLICANT RESPONSE ~ *Comment acknowledged. It should be noted that traffic associated with the proposed Concrete Plant (to be located at 400 East Main Street in Milford) were included in the evaluation of future traffic impact.*

#### Trip Generation

**BSC COMMENT #8 ~ Table 3 summarizes the estimated number of vehicle trips for the proposed development. Trips for the proposed development were estimated using rates from the Institute of Transportation Engineers (ITE) Trip Generation, which is the standard methodology used by traffic engineers to estimate trips, when specific site-development volumes are not available. Since the preparation of the TIAS in July 2017, ITE has released the 10th edition of the Trip Generation Manual. BSC Group recommends comparing the estimated number of trips for the proposed development using the rates included in the 10th edition.**

APPLICANT RESPONSE ~ *The analysis was conducted as requested and is presented in the attachments to this letter as Attachment 2.*

*The one significant difference between the ITE's Trip Generation 9<sup>th</sup> and 10<sup>th</sup> editions is how the data was grouped for different uses. Under the 9<sup>th</sup> edition, the generic land use code 220/apartments was used to capture all residential rental units (apartments). The 10<sup>th</sup> edition changed that description stating that there was no difference between a rental unit (traditional apartment) and an owner-occupied unit (townhouse/condominium).*



*The Proposed 300-unit Project was reclassified in the ITE 10<sup>th</sup> edition to Land Use Code 221/mid-rise multifamily housing (meaning it had between three and ten stories of height to it). The comparison is as follows:*

|              | 9 <sup>th</sup> Edition | 10 <sup>th</sup> Edition | Difference |
|--------------|-------------------------|--------------------------|------------|
| DAILY TRIPS  | 1,940 trips             | 1,635 trips              | -305 trips |
| AM PEAK HOUR | 150 trips               | 100 trips                | -50 trips  |
| PM PEAK HOUR | 185 trips               | 125 trips                | -60 trips  |

*Clearly, the change in ITE Trip Generation manuals suggests that there would be a significant reduction in overall trips due to the reclassification of the uses. The analysis in the TIAS was based on the 9<sup>th</sup> edition results and, therefore represents a conservative (worst-case) scenario when evaluating project impacts on the surrounding roadway network.*

**BSC COMMENT #9 ~ Please confirm the number of Weekday Daily trips shown in Table 3 for the Trip Generation Summary.**

APPLICANT RESPONSE ~ *There appears to have been a transcribing error in Table 3 from the TIAS. Table 3 indicates that there will be 970 weekday daily trips per ITE Trip Generation estimates for a 300-unit development (land use code 220/apartment). That was a one-way total. The corrected number should be 1,940 daily trips on a weekday (970 entering and 970 exiting).*

**Trip Distribution**

**BSC COMMENT #10 ~ BSC Group generally concurs with the methodology used to estimate the trip distribution patterns. The TIAS indicates that specific Journey to Work data has been included in the Appendix, but this information appears to be missing. Please provide the specific data used to estimate the trip distribution patterns.**

APPLICANT RESPONSE ~ *Comment acknowledged, no response necessary on the trip distribution methodology. Attachment 3 to this Response to Comments letter provides a summary of the Journey to Work data used to develop the trip distribution patterns for the TIAS.*

**Site Access**

**BSC COMMENT #11 ~ The Proponent is proposing to locate the Site driveway across from the existing intersection of Whispering Pine Drive with East Main Street (Route 16). The site frontage appears to extend approximately 150 feet east and 500 feet west of the proposed driveway location. BSC Group recommends that the Proponent consider the implications of moving the driveway further west, including driveway offset distances, ease of access for current residents on**



**Whispering Pine Drive, and sight distance impacts. BSC Group understands that East Main Street (Route 16) is under the state's jurisdiction and MassDOT's approval is required for the location of the access and any work done within the state highway layout.**

*APPLICANT RESPONSE ~ The location of the driveway placement was something that the Project design team spent considerable time evaluating. The driveway placement is intended to consider a number of variables (including impacts to wetland resources, sight lines, and traditional transportation planning guidance which suggests minimizing the length of the driveway).*

*The applicant has met with several Town staff members, including the fire chief, who are comfortable with the placement of the driveway from an emergency response perspective and the driveway has been demonstrated to meet certain safety design criteria. Furthermore, as the attached plans indicate, any shifts to the east or west of the driveway would impact wetland resource areas without providing any benefits to the traveling public.*

*Once the Project completes the local Comprehensive Permit process, the Applicant will work with MassDOT to finalize any design details on how it will interact with the Route 16 State Highway Layout. The applicant would be comfortable with a condition stating that the design of the driveway is subject to MassDOT approvals.*

**BSC COMMENT #12 ~ Please confirm that the proposed Site driveway will be median-divided. The Layout and Materials Plan (C4.1) included in the submission does not show a median.**

*APPLICANT RESPONSE ~ The most recent plans are attached for the Project and consider the placement of a 30-foot wide access roadway from Route 16 that would have sidewalk on one side of the driveway servicing the site. This access drive would not be median divided.*

*As noted in the response to BSC Comment #11, the Applicant has met with the Town's Fire Department who has expressed a level of comfort with this design approach from an emergency response perspective and, as also noted, the impacts to the wetland resource areas are reduced using this design approach.*



Sight Distance Analysis

**BSC COMMENT #13 ~ During the field visit on December 12, 2017, BSC Group performed independent sight distance measurements at the approximate location of the proposed driveway, to be located across from Whispering Pine Drive. The Table below compares the Stopping Sight Distances shown in the TIAS versus those measured by BSC Group. The Table below compares the Stopping Sight Distances shown in the TIAS versus those measured by BSC Group.**

| Direction   | From TIAS Table 6       |                 | BSC Group Analysis      |                          |
|---|-------------------------|-----------------|-------------------------|--------------------------|
|   | Minimum Required (feet) | Measured (feet) | Minimum Required (feet) | Measured in Field (feet) |
| Route 16 eastbound towards proposed Site Driveway | 325                     | >700            | 325                     | 365                      |
| Route 16 westbound towards proposed Site Driveway | 290                     | >700            | 301 <sup>a</sup>        | 805                      |

<sup>a</sup>based on posted speed limit of 40 MPH

As can be seen in the above Table, BSC Group measured 365 feet for the SSD traveling eastbound on Route 16, compared to the >700 feet shown in the TIAS. Please confirm the measured SSD measurements as they are shown in the TIAS.

APPLICANT RESPONSE ~ *Comment Acknowledged. VHB agrees with the use of the higher design speed in the westbound direction as the posted 40mph measurement and acknowledges that under both the VHB analysis and the BSC Group assessment, the minimum required Stopping Sight Distance provided at the Project's driveway is exceeded.*

**BSC COMMENT #14 ~ It should be noted that, as stated in Comment 2, the posted speed limit along Route 16 in the vicinity of the project is 40 MPH. Standard practice is to determine the minimum required sight distances based upon the higher of the posted speed limit or the 85th percentile speed limit. Therefore, BSC Group suggests that for vehicles traveling in the eastbound direction on Route 16, the minimum required SSD be based upon the recorded 85th percentile speed of 42 MPH (as stated in the TIAS) and for vehicles traveling in the westbound direction on Route 16, the minimum required SSD be based upon the posted speed limit of 40 MPH.**

APPLICANT RESPONSE ~ *Comment Acknowledged. VHB agrees with the use of the higher design speed in the westbound direction as the posted 40mph measurement. See response to BSC Comment #15 and Comment #16 for additional details on how this change is being addressed.*



**BSC COMMENT #15 ~ Based on the field visit, BSC Group concurs that the Intersection Sight Distance (ISD) was not able to be measured in the field due to the existing vegetation. The TIAS appendix provides a Sight Distance figure showing the areas to be kept clear in order to maintain lines of sight for vehicles exiting the proposed driveway. As with the SSD, BSC Group recommends that the minimum ISD requirements be recalculated based upon the higher of the posted speed limit or the 85th percentile speed limit. This would result in a larger minimum desired ISD for vehicles looking left and turning right onto Route 16.**

*APPLICANT RESPONSE ~ Comment Acknowledged. VHB agrees with the use of the higher design speed in the westbound direction as the posted 40mph measurement. The added mile per hour of speed to the design criteria does not change the results of the Table indicating that there is adequate intersection sight distance available to the project site driveway.*

*Again, it should be noted that the final design of the driveway and the sight line adequacy will be the subject of a MassDOT design-review through their Highway Access Permit process.*

**BSC COMMENT #16 ~ As stated in the TIAS, the ISD looking to the left of the site driveway traverses the adjacent site property. Today, sight lines are not restricted by the property, however the measured available distance, if it were to be limited by this property in the future, is measured as 275 feet. The TIAS states that this distance is approximately equal to the required SSD. However, the required SSD when calculated according to the posted speed limit of 40 MPH is 301 feet, resulting in an available ISD that is 26 feet below the minimum ISD equivalent to SSD. BSC Group recommends that an easement may need to be acquired from the adjacent property in order to maintain clear sight lines.**

*APPLICANT RESPONSE ~ The Applicant has met with the neighboring property owner and will be securing a sight line easement in order to meet the ISD requirements set forth by AASHTO. The final design of the driveway and the sight line adequacy will be the subject of a MassDOT design-review through their Highway Access Permit process.*

**BSC COMMENT #17 ~ It should be noted that the profile of Route 16 to the east of the Site Driveway is characterized by both horizontal and vertical curvature. The desired ISD looking in this direction may also be restricted by the existing vertical curvature, in addition to the adjacent property limitations, as stated in the TIAS.**

*APPLICANT RESPONSE ~ As noted in response to BSC Comment #16, the Applicant has met with the neighboring property owner and will be securing a sight line easement to meet the ISD requirements set forth by AASHTO. The final design of the driveway and the sight line adequacy will be the subject of a MassDOT design-review through their Highway Access Permit process.*



#### Signal Warrant Analysis

**BSC COMMENT #18 ~ Signal warrant analyses were conducted based on the future Build condition volumes. Please provide additional information as to how the 8-hour Build condition volumes were projected.**

*APPLICANT RESPONSE ~ The Signal Warrant spreadsheets are attached to this letter as Attachment #5. The 8-hour warrant was determined using the daily trip generation estimate for the project site and having the temporal distribution of residential traffic as noted in the Trip Generation Handbook over the course of a typical day. Using this information and the results of the ATR data collected along the corridor, the signal warrant assessment was conducted. The results indicate that the 8-hour traffic warrants were not met.*

*The final design of the driveway and the applicable traffic control at the site driveway will be the subject of a MassDOT design-review through their Highway Access Permit process.*

**BSC COMMENT #19 ~ The TIAS indicates that the signal warrant analysis worksheets are included in the Appendix. This information appears to be missing; please provide.**

*APPLICANT RESPONSE ~ The Signal Warrant spreadsheets are attached to this letter as Attachment #5.*

#### Left-turn Lane Warrant Analysis

**BSC COMMENT #20 ~ The TIAS indicates that a left-turn lane warrant analysis was completed and that the worksheets are included in the Appendix. This information appears to be missing; please provide.**

*APPLICANT RESPONSE ~ The Left-turn lane warrant spreadsheets are attached to this letter as Attachment #6.*

**BSC COMMENT #21 ~ A left-turn lane is warranted according to the analysis provided in the TIAS. The Conclusions section states that the Proponent is committed to fund the design and construction of, among other improvements, an eastbound left-turn lane on Route 16 to accommodate vehicles waiting to turn into the site. BSC Group suggests that the Proponent conduct a revised capacity analysis at the intersection to evaluate the operational impacts of such a left-turn lane. In addition, conceptual roadway plans should be prepared to show how this left-turn lane will be placed on the roadway and what, if any, impacts the additional lane will have on right-of-way.**





APPLICANT RESPONSE ~ *The results of the left-turn lane warrant suggest a left-turn lane is warranted at this location. This specific issue will be discussed with MassDOT as part of the final design of the driveway. This, and any other applicable traffic control, will be the subject of a MassDOT design-review through their Highway Access Permit process. Any widening requires to accommodate the left-turn lane will take place on the project side of Route 16 or within the existing right of way.*

#### Traffic Operations Analysis

**BSC COMMENT #22 ~ Table 7 indicates that the overall delay at the signalized intersection of East Main Street (Route 16) at Fortune Boulevard / Beaver Street is expected to increase by no more than 3 seconds due to the proposed project. At the un-signalized intersection of East Main Street (Route 16) at Whispering Pine Drive / Proposed Site Driveway, the Whispering Pine Drive approach is expected to experience a delay increase from 25 to 48 seconds during the weekday morning peak hour and from 30 to 75 seconds during the weekday afternoon peak hour. Figures 8 and 9 project that a total of 5 and 20 vehicles will exit Whispering Pine Drive under the future Build condition during the weekday morning and afternoon peak hours, respectively. BSC Group agrees with the methodology used to evaluate the operating conditions at the study area intersections.**

APPLICANT RESPONSE ~ *Comment acknowledged, no response necessary.*

**BSC COMMENT #23 ~ The Proponent also conducted a gap analysis in order to evaluate whether there will be enough available gaps in the traffic stream along Route 16 to accommodate the vehicles generated by the proposed Project. BSC Group concurs with the methodology used to conduct the gap analysis. The results indicate that the available gaps will be able to accommodate up to 272 vehicles during the weekday morning peak hour and 305 vehicles during the weekday afternoon peak hour. By comparison, the TIAS estimates that the number of vehicles expected to exit the side streets (both Whispering Pine Drive and the proposed site driveway) will be 140 vehicles during the weekday morning peak hour and 70 during the weekday afternoon peak hour.**

APPLICANT RESPONSE ~ *Comment acknowledged, no response necessary.*

#### Pedestrian Safety

**24. The Proponent is proposing a sidewalk along the frontage of the Site, on the north side of East Main Street and along the west side of the Site driveway. Additionally, bus pull-outs are proposed on both sides of East Main Street west of the Site driveway, with a potential bus shelter on the north side of East Main Street. BSC recommends that the Proponent consult the MBTA Bus Stop Planning and Design Guidelines on the design and location of the bus shelter.**

APPLICANT RESPONSE ~ *It is the Applicant's intention of providing those elements noted (sidewalks, bus shelters, pedestrian crossings, etc....) as part of the final design of the Route 16 access and site frontage. The Applicant will be meeting with MassDOT and MWRTA at the appropriate time to refine the design of the Route 16 layout and the elements noted in the comment.*



**25. The Proponent should reconcile the differences in the location of the sidewalk along the Site driveway shown in the Civil and the Architectural drawings.**

APPLICANT RESPONSE ~ *See the attached site plans (Attachment #7) illustrating the locations of the sidewalk located alongside the site driveway.*

**26. The Proponent is proposing a crosswalk on East Main Street, west of the Site driveway. BSC Group recommends that advance warning signs and signs identifying the location of the proposed crosswalk should be shown on the Plans. The crosswalk detail included in the Site Plans should be updated to reflect the latest MUTCD signs. If warranted and approved by the MassDOT, the Proponent should install Rectangular Rapid Flash Beacon (RRFB) to enhance the proposed pedestrian crosswalk.**

APPLICANT RESPONSE ~ *The Applicant will be meeting with MassDOT at the appropriate time to refine the design of the pedestrian crosswalk along Route 16. Appropriate signage that complied with the MUTCD will be designed and installed under the direction of the MassDOT.*

**27. The Site Plans does not include sufficient design detail for BSC Group to comment on pedestrian access ramps at specific locations. The Proponent should provide the location of individual pedestrian ramps and their design for review.**

APPLICANT RESPONSE ~ *The Applicant will refine the design of the pedestrian ramps at the design phase of this project. All designs will meet the current version of the ADA/AAB requirements for pedestrian ramp design and layout.*

**28. Proponent should clarify how a person parked in one of the four exterior handicap parking spaces near the North Entrance will access the building via an accessible path.**

APPLICANT RESPONSE ~ *The access to the building will be through the parking lot and into the building through the Porte Cochere via the north entrance. Handicapped accessible ramps will be provided at the entrance for wheelchair accessibility.*

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We trust that the above information is helpful to address the comments raised at the ZBA hearing and to be responsive to the most recent VAI letter. If you have any questions on the attached, please feel free to contact me at your convenience.

Sincerely,

Vanasse Hangen Brustlin, Inc.

A handwritten signature in dark ink, appearing to read "Robert L. Nagi", written over a horizontal line.

Robert L. Nagi, PE

Principal

## **ATTACHMENT #1**

### **Supplemental Crash Data**

**Table 1      Crash Summary (2011-2015)**

|                                 | Route 16 (East Main Street) at<br>Route 16 (East Main Street) at Zain Circle      Route 16 (East Main Street) at<br>Whispering Pine Circle      Route 16 (East Main Street) at Adams Street |      |      |
|---------------------------------|---|------|------|
| Signalized?                     | No  | No   | No   |
| MassDOT Average Crash Rate      | 0.65  | 0.65 | 0.65 |
| Calculated Crash Rate           | 0.23  | 0.08 | 0.20 |
| Exceeds Average?                | No  | No   | No   |
| <b>Year</b>                     |   |      |      |
| 2011                            | 0   | 1    | 0    |
| 2012                            | 1   | 0    | 0    |
| 2013                            | 2   | 0    | 0    |
| 2014                            | 1   | 0    | 3    |
| 2015                            | 2   | 1    | 2    |
| Total                           | 6   | 2    | 5    |
| Average Crashes/Year            | 1.20  | 0.40 | 1.00 |
| <b>Collision Type</b>           |   |      |      |
| Angle                           | 2   | 1    | 0    |
| Rear-end                        | 2   | 0    | 5    |
| Sideswipe, opposite direction   | 1   | 0    | 0    |
| Single vehicle crash            | 1   | 1    | 0    |
| <b>Severity</b>                 |   |      |      |
| Fatal Injury                    | 0   | 0    | 0    |
| Non-Fatal Injury                | 1   | 1    | 3    |
| Property Damage Only            | 5   | 1    | 2    |
| <b>Time of day</b>              |   |      |      |
| Weekday, 7:00 AM - 9:00 AM      | 0   | 0    | 0    |
| Weekday, 4:00 - 6:00 PM         | 1   | 0    | 2    |
| Saturday 11:00 AM - 2:00 PM     | 2   | 0    | 0    |
| Weekday, other time             | 2   | 2    | 1    |
| Weekend, other time             | 1   | 0    | 2    |
| <b>Pavement Conditions</b>      |   |      |      |
| Dry                             | 4   | 2    | 4    |
| Wet                             | 2   | 0    | 1    |
| Non-Motorist (Bike, Pedestrian) | 0   | 0    | 0    |

Source: MassDOT crash portal, accessed January 2018.

## INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : Milford COUNT DATE : 2017

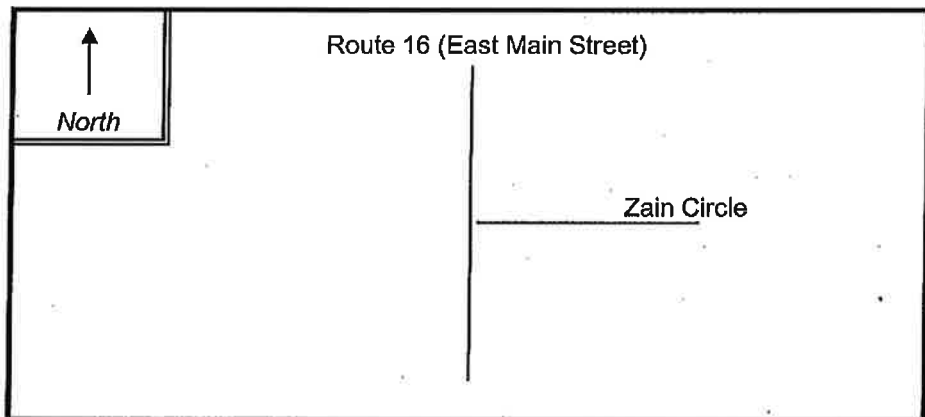
DISTRICT : 3 UNSIGNALIZED : ☒ 0.65 SIGNALIZED : ☐ 0.90

### ~ INTERSECTION DATA ~

MAJOR STREET : Route 16 (East Main Street)

MINOR STREET(S) : Zain Circle

**INTERSECTION  
DIAGRAM**  
(Label Approaches)



### PEAK HOUR VOLUMES

| APPROACH :                    | 1   | 2   | 3  | 4  | 5 | Total Peak Hourly Approach Volume |
|-------------------------------|-----|-----|----|----|---|-----------------------------------|
| DIRECTION :                   | NB  | SB  | EB | WB |   |                                   |
| PEAK HOURLY VOLUMES (AM/PM) : | 555 | 725 |    | 15 |   | 1,295                             |

"K" FACTOR : 0.090 INTERSECTION ADT ( V ) = TOTAL DAILY APPROACH VOLUME : 14,389

TOTAL # OF CRASHES : 6 # OF YEARS : 5 AVERAGE # OF CRASHES PER YEAR ( A ) : 1.20

CRASH RATE CALCULATION : 0.23 RATE =  $\frac{(A * 1,000,000)}{(V * 365)}$

Comments : MassDOT Accident Data (2011-2015)

Project Title & Date : \_\_\_\_\_

## INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : Milford COUNT DATE : 2017

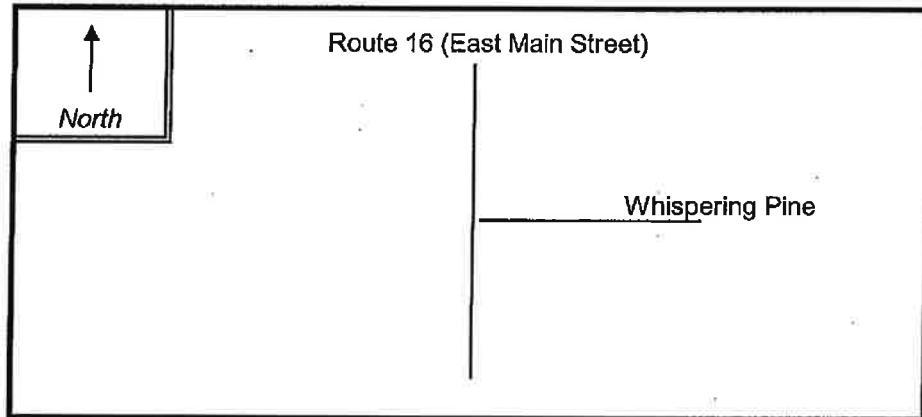
DISTRICT : 3 UNSIGNALIZED : ☒ 0.65 SIGNALIZED : ☐ 0.90

### ~ INTERSECTION DATA ~

MAJOR STREET : Route 16 (East Main Street)

MINOR STREET(S) : Whispering Pine Circle

INTERSECTION  
 DIAGRAM  
 (Label Approaches)



### PEAK HOUR VOLUMES

| APPROACH :                    | 1   | 2   | 3  | 4  | 5 | Total Peak Hourly Approach Volume |
|-------------------------------|-----|-----|----|----|---|-----------------------------------|
| DIRECTION :                   | NB  | SB  | EB | WB |   |                                   |
| PEAK HOURLY VOLUMES (AM/PM) : | 540 | 720 |    | 5  |   | 1,265                             |

"K" FACTOR :  INTERSECTION ADT ( V ) = TOTAL DAILY APPROACH VOLUME :

TOTAL # OF CRASHES :  # OF YEARS :  AVERAGE # OF CRASHES PER YEAR ( A ) :

CRASH RATE CALCULATION :

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

Comments : MassDOT Accident Data (2011-2015)

Project Title & Date : \_\_\_\_\_

## INTERSECTION CRASH RATE WORKSHEET

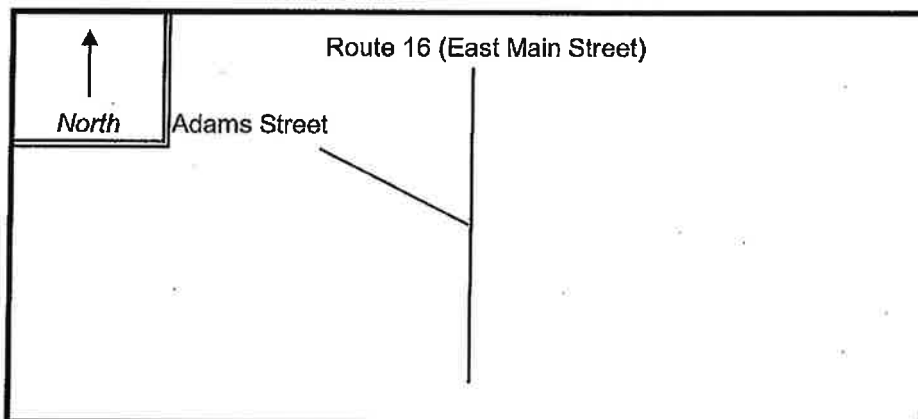
CITY/TOWN : Milford COUNT DATE : 2017

DISTRICT : 3 UNSIGNALIZED : ☒ X SIGNALIZED : ☐  
0.65 0.90

### ~ INTERSECTION DATA ~

MAJOR STREET : Route 16 (East Main Street)  
 MINOR STREET(S) : Adams Street

**INTERSECTION  
 DIAGRAM**  
 (Label Approaches)



### PEAK HOUR VOLUMES

| APPROACH :                    | 1   | 2   | 3  | 4  | 5 | Total Peak Hourly Approach Volume |
|-------------------------------|-----|-----|----|----|---|-----------------------------------|
| DIRECTION :                   | NB  | SB  | EB | WB |   |                                   |
| PEAK HOURLY VOLUMES (AM/PM) : | 515 | 685 | 40 |    |   | 1,240                             |

"K" FACTOR :

0.090

INTERSECTION ADT ( V ) = TOTAL DAILY APPROACH VOLUME :

13,778

TOTAL # OF CRASHES :

5

# OF YEARS :

5

AVERAGE # OF CRASHES PER YEAR ( A ) :

1.00

CRASH RATE CALCULATION :

0.20

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

Comments : MassDOT Accident Data (2011-2015)

Project Title & Date : \_\_\_\_\_



## **ATTACHMENT #2**

### **Supplemental Trip Generation Data**

## Multifamily Housing (Mid-Rise) (221)

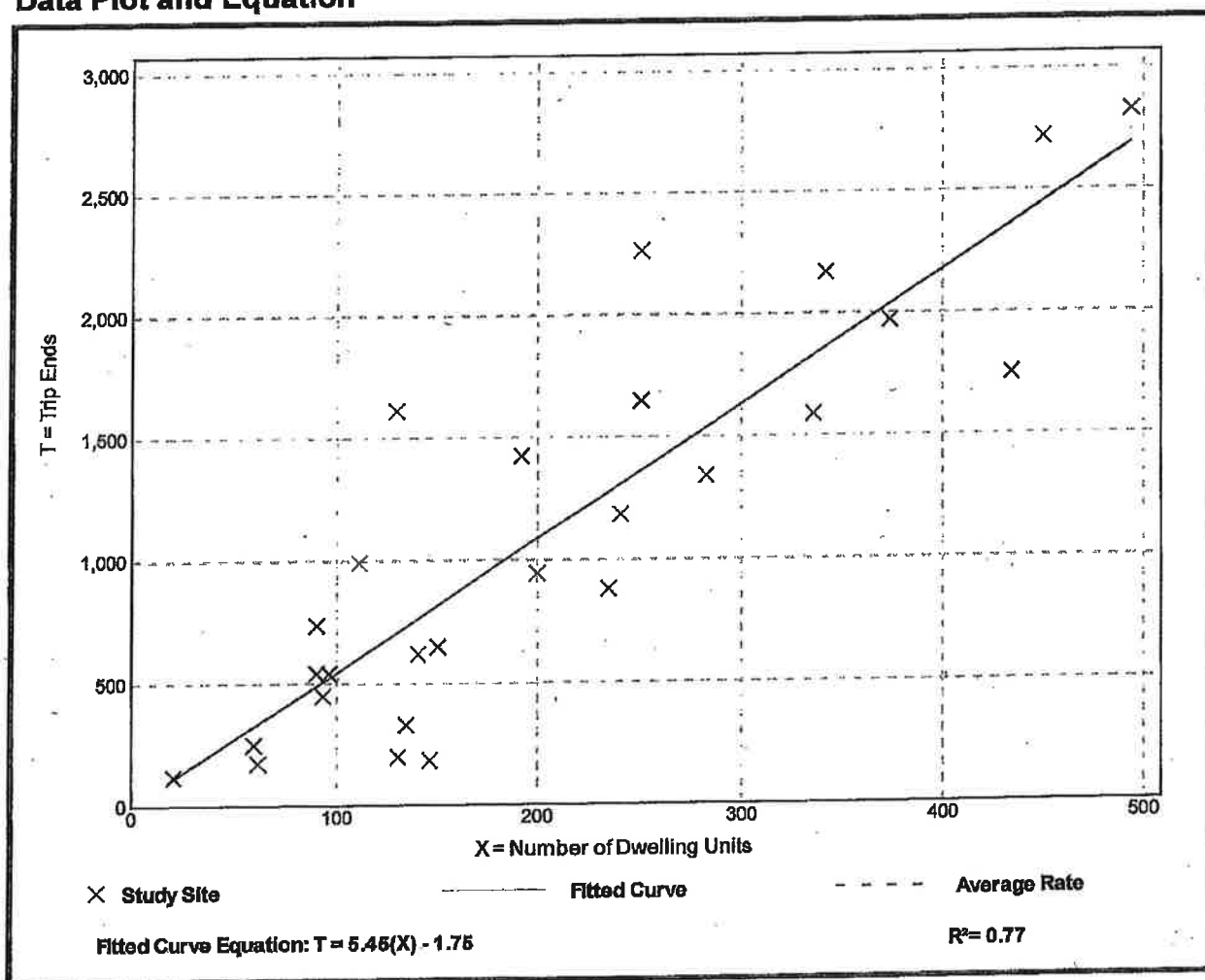
Vehicle Trip Ends vs: Dwelling Units  
On a: Weekday

Setting/Location: General Urban/Suburban  
Number of Studies: 27  
Avg. Num. of Dwelling Units: 205  
Directional Distribution: 50% entering, 50% exiting

### Vehicle Trip Generation per Dwelling Unit

| Average Rate | Range of Rates | Standard Deviation |
|--------------|----------------|--------------------|
| 5.44         | 1.27 - 12.50   | 2.03               |

### Data Plot and Equation



## Multifamily Housing (Mid-Rise) (221)

**Vehicle Trip Ends vs: Dwelling Units**

**On a: Weekday,  
Peak Hour of Adjacent Street Traffic,  
One Hour Between 7 and 9 a.m.**

**Setting/Location: General Urban/Suburban**

**Number of Studies: 53**

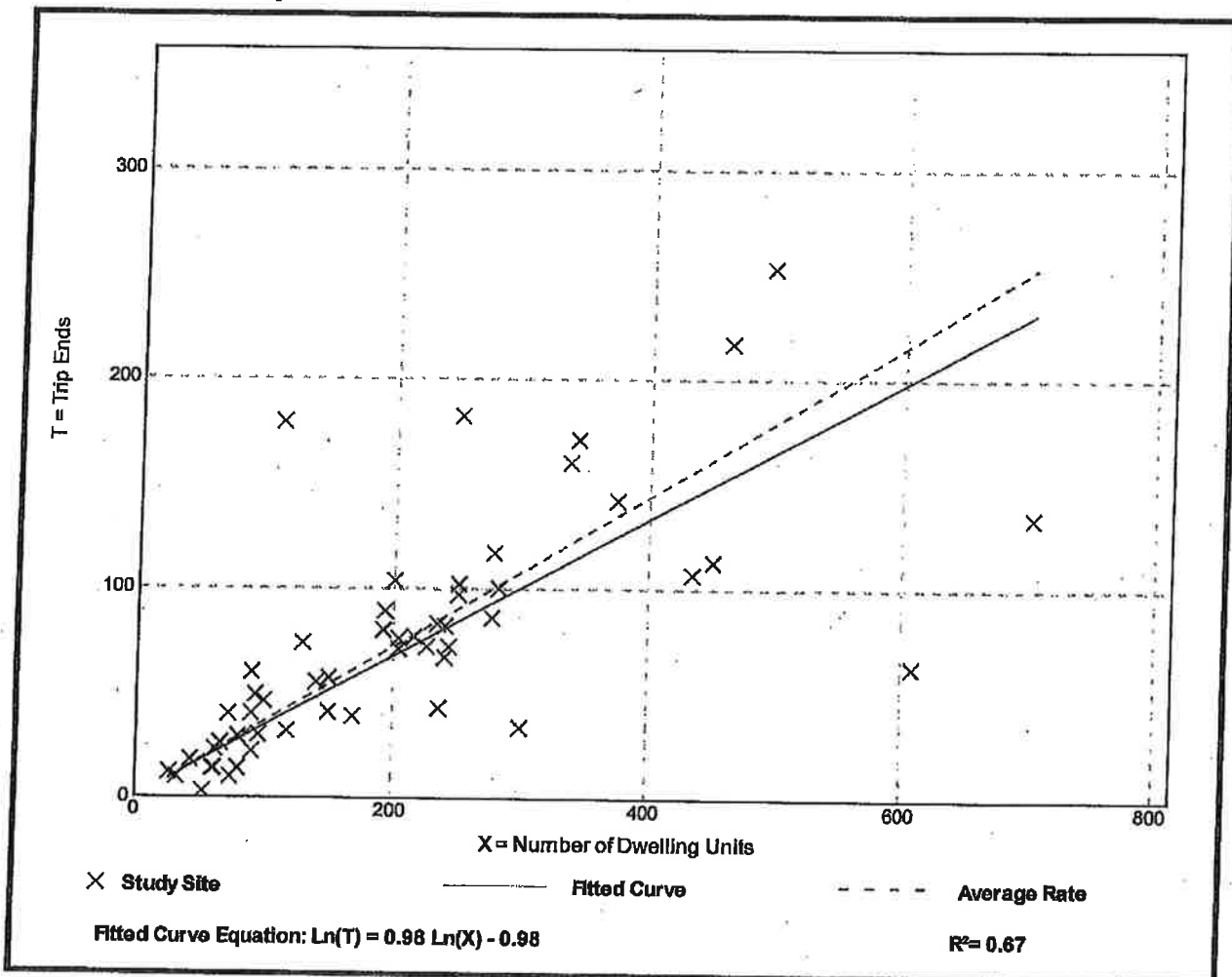
**Avg. Num. of Dwelling Units: 207**

**Directional Distribution: 26% entering, 74% exiting**

### Vehicle Trip Generation per Dwelling Unit

| Average Rate | Range of Rates | Standard Deviation |
|--------------|----------------|--------------------|
| 0.36         | 0.06 - 1.61    | 0.19               |

### Data Plot and Equation



## Multifamily Housing (Mid-Rise) (221)

**Vehicle Trip Ends vs: Dwelling Units**

**On a: Weekday,**

**Peak Hour of Adjacent Street Traffic,  
One Hour Between 4 and 6 p.m.**

**Setting/Location: General Urban/Suburban**

**Number of Studies: 60**

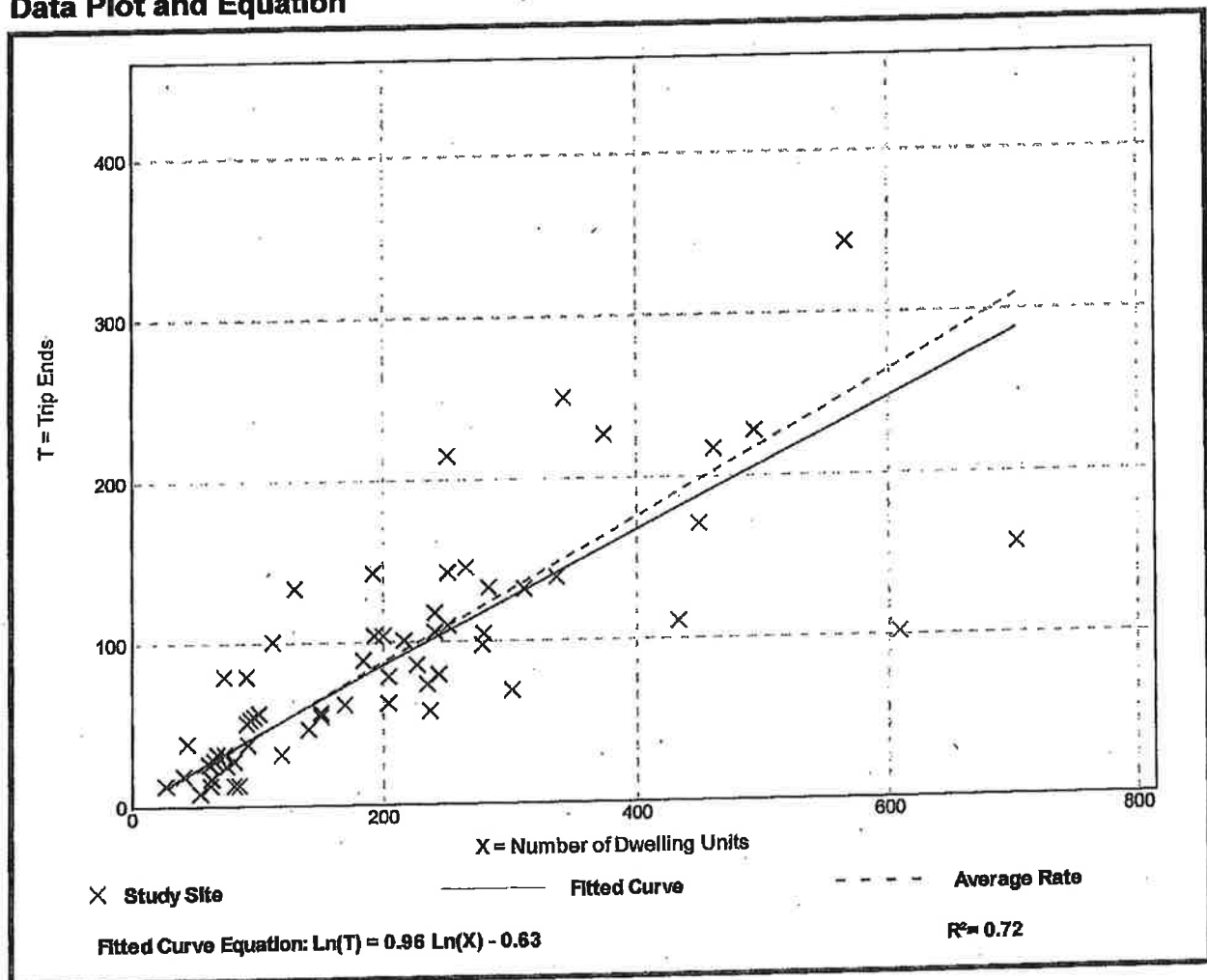
**Avg. Num. of Dwelling Units: 208**

**Directional Distribution: 61% entering, 39% exiting**

### Vehicle Trip Generation per Dwelling Unit

| Average Rate | Range of Rates | Standard Deviation |
|--------------|----------------|--------------------|
| 0.44         | 0.15 - 1.11    | 0.19               |

### Data Plot and Equation



1/12/2018  
RLNA61

ITE LAND USE CODE 221  
10<sup>TH</sup> EDITION.

### DAILY TRIP GENERATION

$$\begin{aligned}T &= 5.45(x) - 1.75 \\&= 5.45(300) - 1.75 \\&= 1633.25\end{aligned}$$

1633 ← DAILY TRIPS

### AM PEAK HOUR

$$\begin{aligned}\ln(T) &= 0.98 \ln(x) - 0.98 \\&= 0.98 \ln(300) - 0.98 \\&= 100.45\end{aligned}$$

100 AM PEAK HOUR TRIP  
(25 IN / 75 OUT)

### PM PEAK HOUR

$$\begin{aligned}\ln(T) &= 0.96 \ln(x) - 0.63 \\&= 0.96 \ln(300) - 0.63 \\&= 127.18\end{aligned}$$

125 PM PEAK HOUR TRIP  
(75 IN / 50 OUT)

## **ATTACHMENT #3**

### **Journey to Work Data**

Current date: 2/7/2017 1:56:30 PM (Eastern Standard Time)

[illegible]

|  |    |       |
|--|----|-------|
| Quincy city, Norfolk County, Massachusetts             | 25 | 0.17% |
| Stoughton town, Norfolk County, Massachusetts          | 25 | 0.17% |
| Auburn town, Worcester County, Massachusetts           | 25 | 0.17% |
| Hardwick town, Worcester County, Massachusetts         | 25 | 0.17% |
| Princeton town, Worcester County, Massachusetts        | 25 | 0.17% |
| Southbridge Town city, Worcester County, Massachusetts | 25 | 0.17% |
| Central Falls city, Providence County, Rhode Island    | 25 | 0.17% |
| Andover town, Essex County, Massachusetts              | 20 | 0.14% |
| Lawrence city, Essex County, Massachusetts             | 20 | 0.14% |
| Lincoln town, Middlesex County, Massachusetts          | 20 | 0.14% |
| Maynard town, Middlesex County, Massachusetts          | 20 | 0.14% |
| Somerville city, Middlesex County, Massachusetts       | 20 | 0.14% |
| Stow town, Middlesex County, Massachusetts             | 20 | 0.14% |
| Brantree Town city, Norfolk County, Massachusetts      | 20 | 0.14% |
| Weymouth Town city, Norfolk County, Massachusetts      | 20 | 0.14% |
| Brockton city, Plymouth County, Massachusetts          | 20 | 0.14% |
| Northborough town, Worcester County, Massachusetts     | 20 | 0.14% |
| Oxford town, Worcester County, Massachusetts           | 20 | 0.14% |
| Rutland town, Worcester County, Massachusetts          | 20 | 0.14% |
| Woonsocket city, Providence County, Rhode Island       | 20 | 0.14% |
| South Kingstown town, Washington County, Rhode Island  | 20 | 0.14% |
| Killingly town, Windham County, Connecticut            | 15 | 0.10% |
| New Bedford city, Bristol County, Massachusetts        | 15 | 0.10% |
| Lowell city, Middlesex County, Massachusetts           | 15 | 0.10% |
| Bridgewater town, Plymouth County, Massachusetts       | 15 | 0.10% |
| Chelsea city, Suffolk County, Massachusetts            | 15 | 0.10% |
| Lunenburg town, Worcester County, Massachusetts        | 15 | 0.10% |
| North Smithfield town, Providence County, Rhode Island | 15 | 0.10% |
| Falmouth town, Barnstable County, Massachusetts        | 10 | 0.07% |
| Yarmouth town, Barnstable County, Massachusetts        | 10 | 0.07% |
| Taunton city, Bristol County, Massachusetts            | 10 | 0.07% |
| Swampscott town, Essex County, Massachusetts           | 10 | 0.07% |
| Chicopee city, Hampden County, Massachusetts           | 10 | 0.07% |
| Dracut town, Middlesex County, Massachusetts           | 10 | 0.07% |
| Plymouth town, Plymouth County, Massachusetts          | 10 | 0.07% |
| Athol town, Worcester County, Massachusetts            | 10 | 0.07% |
| Bolton town, Worcester County, Massachusetts           | 10 | 0.07% |
| Brookfield town, Worcester County, Massachusetts       | 10 | 0.07% |
| Douglas town, Worcester County, Massachusetts          | 10 | 0.07% |
| Sutton town, Worcester County, Massachusetts           | 10 | 0.07% |
| Manchester city, Hillsborough County, New Hampshire    | 10 | 0.07% |
| Stratham town, Rockingham County, New Hampshire        | 10 | 0.07% |
| Newport city, Newport County, Rhode Island             | 10 | 0.07% |
| East Providence city, Providence County, Rhode Island  | 10 | 0.07% |
| Smithfield town, Providence County, Rhode Island       | 10 | 0.07% |
| Wayland town, Middlesex County, Massachusetts          | 4  | 0.03% |
| Gardner city, Worcester County, Massachusetts          | 4  | 0.03% |
| Millbury town, Worcester County, Massachusetts         | 4  | 0.03% |

14,522

U.S. Census Bureau, American Community Survey 2006-2010 Five-year estimates. Special Tabulation: Census Transportation Planning



**ATTACHMENT #4**

**Driveway Layout / no median dividing island**





## **ATTACHMENT #5**

### **Signal Warrant Spreadsheets**

## 2009 MUTCD

### TRAFFIC SIGNAL WARRANT ANALYSIS (VOLUME BASED)

Intersection:

Major Street Direction: Eastbound-Westbound

Year: 2017 Condition: Full Build

Operating speed on major roadway: 42 mph

Number of approaches: 4

Required approach volumes

| Warrant 1 EIGHT-HOUR VEHICULAR VOLUME                          |               |                            |  | Minimum*   | Adjusted Minimum** |
|--|---------------|----------------------------|--|------------|--------------------|
| Warrant 1A MINIMUM VEHICULAR VOLUME (8 hours of day)           |               |                            |  |            |                    |
|  | Major Street: | 2 Lane(s) on each approach |  | 600        | 420                |
|  | Minor Street: | 2 Lane(s) on each approach |  | 200        | 140                |
| Warrant 1B INTERRUPTION OF CONTINUOUS TRAFFIC (8 hours of day) |               |                            |  |            |                    |
|  | Major Street: | 2 Lane(s) on each approach |  | 900        | 630                |
|  | Minor Street: | 2 Lane(s) on each approach |  | 100        | 70                 |
| 80 PERCENT SATISFACTION OF WARRANT 1A AND WARRANT 1B           |               |                            |  | Warrant 1A | Warrant 1B         |
|  | Major Street: | 2 Lane(s) on each approach |  | 480        | 720                |
|  | Minor Street: | 2 Lane(s) on each approach |  | 160        | 80                 |

#### Warrant 2 FOUR-HOUR VEHICULAR VOLUME

Major Street: 2 Lane(s) on each approach  
Minor Street: 2 Lane(s) on each approach

If "verify" indicated, see Figure 4C-1 or 4C-2.  
25 = accuracy of regression equations

#### Warrant 3 PEAK HOUR VOLUME

Major Street: 2 Lane(s) on each approach  
Minor Street: 2 Lane(s) on each approach

If "verify" indicated, see Figure 4C-3 or 4C-4.  
25 = accuracy of regression equations

| Hour             | Entering Vol. Minor Road+ | Entering Vol. on Major Road |           | Tot. Ent. Vol. On Major Rd | Meets the following volume-based warrants? |     |            |     |     |
|------------------|---------------------------|-----------------------------|-----------|----------------------------|--|-----|------------|-----|-----|
|                  |                           | Eastbound                   | Westbound |                            | 1A   | 1B  | 80%(1A&1B) | 2   | 3   |
| 6:00 - 7:00 AM   | 28                        | 649                         | 216       | 865                        | No   | No  | No         | No  | No  |
| 7:00 - 8:00 AM   | 120                       | 696                         | 518       | 1214                       | No   | Yes | No         | Yes | Yes |
| 8:00 - 9:00 AM   | 44                        | 510                         | 418       | 928                        | No   | No  | No         | No  | No  |
| 9:00 - 10:00 AM  | 32                        | 351                         | 394       | 745                        | No   | No  | No         | No  | No  |
| 10:00 - 11:00 AM | 27                        | 349                         | 397       | 746                        | No   | No  | No         | No  | No  |
| 11:00 - 12:00 AM | 28                        | 365                         | 380       | 745                        | No   | No  | No         | No  | No  |
| 12:00 - 1:00 PM  | 28                        | 395                         | 486       | 881                        | No   | No  | No         | No  | No  |
| 1:00 - 2:00 PM   | 28                        | 370                         | 398       | 768                        | No   | No  | No         | No  | No  |
| 2:00 - 3:00 PM   | 29                        | 375                         | 487       | 862                        | No   | No  | No         | No  | No  |
| 3:00 - 4:00 PM   | 31                        | 392                         | 635       | 1027                       | No   | No  | No         | No  | No  |
| 4:00 - 5:00 PM   | 64                        | 671                         | 862       | 1533                       | No   | No  | No         | No  | No  |
| 5:00 - 6:00 PM   | 32                        | 477                         | 692       | 1169                       | No   | No  | No         | No  | No  |
| 6:00 - 7:00 PM   | 30                        | 379                         | 468       | 847                        | No   | No  | No         | No  | No  |
|                  |                           |                             |           |                            | No   | No  | No         | No  | Yes |
|                  |                           |                             |           |                            | Warrants Met?                              |     |            | 1   | 2   |
|                  |                           |                             |           |                            |  |     |            | NO  | 3   |
|                  |                           |                             |           |                            |  |     |            | No  | Yes |

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

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

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

### NON-VOLUME-BASED WARRANTS

Warrant 4, Minimum Pedestrian Volume:

Peak Four Hour Pedestrian Volumes:  
(non-concurrent)

No

0

0

0

0

Warrant 5, School Crossing:

See MUTCD for details.

Warrant 7, Crash Experience:

No

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

Warrant 6, Coordinated Signal System:

See MUTCD for details.

Warrant 8, Roadway Network:

See MUTCD for details.

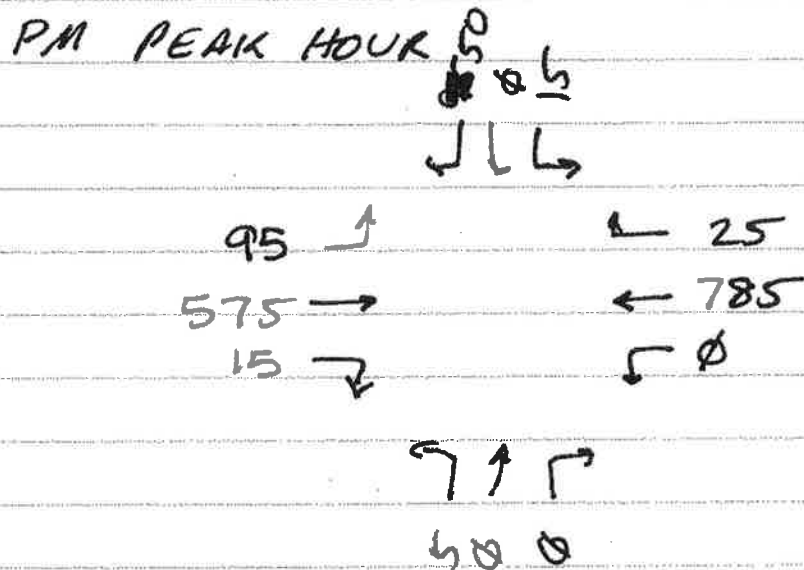
Source: Manual on Uniform Traffic Control Devices (MUTCD); 2009 Edition

## **ATTACHMENT #6**

### **Site Driveway / Left Turn Lane Warrant**

1/12/18  
RL Nogi

## LEFT TURN WARRANT EVALUATION



USING EXHIBIT 6-23 FROM THE MASSDOT  
HIGHWAY DESIGN GUIDE

ADVANCING VOLUME = 685  
LT VOLUME = 95  
LT % = 14%

OPPOSING VOLUME = 810

PER CHART, IF ADVANCING VOLUME IS  
GREATER THAN 204, LT LANE IS  
JUSTIFIED.

ADVANCING VOLUME IS 685 > 204  
\*JUSTIFIED

### Exhibit 6-23 Criteria for Left Turn Lanes

#### A. Unsignalized Intersections, Two-Lane Roads and Streets:

| Design Speed   | Opposing Volume (motor vehicles per hour) | Advancing Motor Vehicle Volume (vehicles per hour) |                |                |                |
|----------------|---|--|----------------|----------------|----------------|
|                |   | 5% Left Turns                                      | 10% Left Turns | 20% Left Turns | 30% Left Turns |
| 30 mph or less | 800                                       | 370  | 265            | 195            | 185            |
|                | 600                                       | 460  | 345            | 250            | 225            |
|                | 400                                       | 570  | 430            | 305            | 275            |
|                | 200                                       | 720  | 530            | 390            | 335            |
| 40 mph         | 800                                       | 330  | 240            | 180            | 160            |
|                | 600                                       | 410  | 305            | 225            | 200            |
|                | 400                                       | 510  | 380            | 275            | 245            |
|                | 200                                       | 640  | 470            | 350            | 305            |
| 50 mph         | 800                                       | 280  | 210            | 165            | 135            |
|                | 600                                       | 350  | 260            | 195            | 170            |
|                | 400                                       | 430  | 320            | 240            | 210            |
|                | 200                                       | 550  | 400            | 300            | 270            |
| 60 mph         | 800                                       | 230  | 170            | 125            | 115            |
|                | 600                                       | 290  | 210            | 160            | 140            |
|                | 400                                       | 365  | 270            | 200            | 175            |
|                | 200                                       | 450  | 330            | 250            | 215            |

#### B. Signalized Intersections:

##### Left-Turn Lane Configuration

Single exclusive left-turn lane  
Dual exclusive left-turn lane

##### Minimum Turn Volume

100 motor vehicles per hour  
300 motor vehicles per hour

Source: *Highway Capacity Manual*, 2000

### Exhibit 6-24 Criteria for Right-Turn Lane Placement

| Positive Criteria<br>(Favoring Right-Turn Placement)     | Negative Indicators<br>(Arguing Against Right-Turn Lane Placement) |
|--|--|
| High speed arterial highways                             | In residential areas   |
| High right-turn motor vehicle volumes                    | In urban core areas  |
| High right-turn plus high cross-street left-turn volumes | On walking routes to schools                                       |
| Long right-turn queues                                   | Where pedestrians are frequent                                     |
| Intersection capacity nearly exhausted                   | Low right turn volumes   |
| History of crashes involving right-turning vehicles      |  |
| Little to no pedestrian activity                         |  |

Source: Adapted from A Policy on the Geometric Design of Streets and Highways, AASHTO, 2004. Chapter 9 Intersections

## **ATTACHMENT #7**

### **Internal Driveway Layout with Sidewalk**



**EM STREET  
LLC**  
171 LOCKE DRIVE  
MARLBOROUGH, MASSACHUSETTS  
01752

EM STREET  
MILFORD, LLC  
43719/205



**NICHOLAEFF**  
**ARCHITECTURE + DESIGN**  
301 Main Street  
Galveston, TX 77550  
T 409.420.5266  
F 409.420.5240

**BSA**  
Bennett Sullivan Associates Inc.  
Architects and Planners  
344-201, Three Parkway Office Park  
Southbury, Connecticut 06489  
203-264-8262

REPAIRED BY:

SEALS AND THOMAS, INC.  
Reservoir Corporate Center  
44 Turrette Road  
Southborough, Massachusetts 01772-2104

[illegible]

PROJECT: ROBESHAM VILLAGE  
462-466 EAST MAIN  
STREET  
MILFORD, MASSACHUSETTS 01757  
(WORCESTER COUNTY)

## LAYOUT AND MATERIALS PLAN

C4.1

