


## MEMORANDUM

**DATE:** March 26, 2020

**TO:** Ms. Pamela Harding  
Town Planner/Director of Planning and Development  
Town of Holden  
1204 Main Street  
Holden, MA 01520

**FROM:** Robert J. Michaud, P.E. – Managing Principal  
Daniel A. Dumais, P.E. – Senior Project Manager 

**RE:** **Response to Comments Issued by Green International Affiliates, Inc.**  
Proposed Residential Development  
Salisbury Pine Tree Estates, Holden, Massachusetts

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MDM Transportation Consultants, Inc. (MDM) has prepared the following response to transportation-related comments as issued in a letter by Green International Affiliates, Inc (Green). dated February 18, 2020. To facilitate review, the specific comment is paraphrased with the corresponding response.

### OCTOBER 2019 TIAS

Comment 1. *"The TIAS included the following four study intersections:*

- *Main Street (Route 122A) at Salisbury Street*
- *Main Street (Route 122A) at Bailey Road*
- *Bailey Road at proposed west Site Driveway*
- *Salisbury Street at Pine Tree Road*

*Green concurs with the study area used in the TIAS."*

**Response:** No response necessary.

Comment 2. *"Traffic count data were collected in May of 2019. Seasonal data suggests above-average annual conditions during the month of May, hence, no revisions to volumes were made. Automatic Traffic Recorders (ATRs), including 24-hour counts and speed data were collected on Tuesday May 7th and Thursday May 9th. Turning Movement Counts (TMCs) were collected on Tuesday May 7th, 2019. Green concurs with using more conservative traffic data to perform the analysis."*

**Response:** Peer review concurs that the May 2019 data represents a conservative basis for the TIAS. MDM further notes that in response to inquiry by the Planning Board at the February 25, 2020 the May 2019 data was collected during a period when Anna Maria College was in session (the final examination period for undergraduate and graduate schools was in effect). Count data presented in the TIAS presents a reasonable and slightly conservative basis for analysis.

*Comment 3. "Crash data were presented from information provided by the MassDOT Highway Division Safety Management/Traffic Operations Unit for the years 2014-2018 for the three existing study intersections (the intersections on Main Street, and of Salisbury Street at Pine Tree Road). During the five-year period that was examined, the Main Street (Route 122A) at Bailey Road intersection was stated to have experienced 12 crashes, the Main Street at Salisbury Street intersection was stated to have experienced 21 crashes, and the Salisbury Street at Pine Tree Road intersection was stated to have experienced 0 crashes.*

*Green reviewed the numbers of crashes with data available from the MassDOT IMPACT Crash Query and Visualization tool and identifies 28 crashes as being reported at the Main Street/Salisbury Street intersection in the same five-year crash period. This is anticipated to increase the crash rate at this intersection. Green recommends further review of crash history and taking the additional crashes into consideration when evaluating potential impacts and improvements."*

**Response:** MDM recalculated the crash rate at the Main Street/Salisbury Street intersection using the 28 crashes over the 5-year period and the resulting crash rate of 0.49 remains well below the average crash rate for a signalized intersection within the MassDOT District 3 area. Therefore, no immediate safety countermeasures are warranted based on the crash history at the study location.

*Comment 4. "Green notes a typographical error in the crash history review. Two crashes at the Main Street/Bailey Road intersection were stated to have occurred in 2018 but four crashes were reviewed to have occurred in that year. The total number of crashes and the crash rate stated in the TIAS appear to be correct."*

**Response:** Total crashes and associated crash rates are correctly noted and the subject location is not classified as a high crash location. No further response necessary.

*Comment 5. "Based on field observation, MDM's measurements of the Stopping Sight Distance (SSD) and Intersection Sight Distance (ISD) in both directions at both proposed sight drive locations appears to be accurate."*

**Response:** Applicable sight lines exceed recommended minimum values and available sight lines as reported in the TIAS are deemed accurate. No further response necessary.

Comment 6. *“The future conditions were evaluated for a five-year horizon which is not consistent with MassDOT TIA guidelines which require a minimum of seven years. The background growth is indicated to be 0.5% per year, with two specific planned developments in the area consisting of two age-restricted housing developments approximately three miles south of the project. The two projects were stated as not expecting to provide trips onto the study roadways exceeding the background growth rate, even though the two projects total 237 units and are located on one of the study roadways. Green recommends explaining the decision to use a five-year horizon and re-analysis using a seven-year horizon. Green also recommends including the two planned background developments as they could contribute a sizeable number of trips to/from Main Street in Holden. In addition, the background growth rate of 0.5% per year appears to be lower than typically applied the past several years, considering growth occurring along Route 122A in neighboring Rutland, and we request additional supporting documentation for this rate (possibly CMRPC backup data or forecasts) or the background rate may need to be increased.”*

**Response:**

(a) Study Horizon. The TIAS utilized a five-year planning horizon (2024 No-Build and 2024 Build conditions). Although MassDOT Traffic Impact Assessment Guidelines suggest a 7-year study horizon, the five-year planning horizon used in the TIAS is consistent with industry-standard guidelines published by the Institute of Transportation Engineers in Transportation Planning Handbook, 4th Edition. Since the study area intersection is under local (Town) jurisdiction, a five-year planning horizon is appropriate.

MDM further notes that the use of a 7-year horizon would not alter the project impacts with respect to No-Build vs. Build conditions nor the recommendations and conclusions of the TIAS. Extrapolation of 2019 volumes to include two additional years of growth (from 5-year horizon to 7-year horizon) at 0.5% per year (1 percent total) is inconsequential and is more than accounted for by using unadjusted May data which is 2 percent above average season conditions.

(b) Annual Growth Rate. CMRPC confirms that growth trends used in the TIAS are valid. In correspondence of March 18, 2020 CMRPC specifically cites *“According to the CMRPC travel demand model which is calibrated with our traffic counts we project about a 0.4%-0.5% growth in traffic per year in the entire Town of Holden and in that more focused area [included in the TIAS]”*. CMRPC email correspondence is included in the **Attachments**.

MDM further notes that there are two additional sources of data that indicate that actual growth trends are lower than 0.4-0.5 percent per CMRPC modeling as follows:

- (i) Nearby permanent count station data published by MassDOT indicates a 0.26 percent per year growth rate.

- (ii) TMC and ATR count data along Salisbury Street collected by MDM in May 2008 for the exact same TIAS study locations (see Attachments) indicate a 0.14 percent annual growth rate along Salisbury Street over the past 11 years (based on daily counts); TMC' data for the signalized Main Street at Salisbury Street indicates a flat (-0.65 percent per year) growth rate during the weekday morning commuter period and flat (- 0.06 percent per year) growth rate during the weekday evening commuter period.

In summary, the 0.5 percent annualized growth rate used in the TIAS is conservatively higher than empirical data for the area, is higher than MassDOT permanent count station data, and is consistent with CMRPC compared to the available daily and peak hour data along Salisbury Street and the available MassDOT data. The growth rate calculations are provided in the **Attachments**.

(c) Background Project Growth. The following two age restricted projects were reviewed as background projects:

- **757 Salisbury Street:** This development includes the construction of 123 age-restricted on Salisbury Street in Worcester, Massachusetts.
- **Salisbury Hill:** This development includes the construction of 114 additional age restricted units to Salisbury Hill condominium complex in Worcester, Massachusetts.

MDM has estimated the peak hour trips through the study intersections from these two developments and calculation are provide in the **Attachments**. Upon review, traffic associated with these developments are negligible through the study area intersections, representing less than 5 peak hour trips. Therefore, the two projects are appropriately accounted for in the 0.5 percent compounded annual growth rate used in the TIAS (and the conservative May data) and no further analysis is required.

*Comment 7. "Green recommends including mention and a brief description of MassDOT projects #606563 and #608815 on Main Street, located within approximately one mile from Main Street/Salisbury Street and Main Street/Bailey Road study intersections in the list of background projects, although these are non-development projects."*

**Response:** According to MassDOT's project information database the two projects cited projects include the following future work along Route 122A:

- a) Project 606563. This project covers the area between Route 31 to Route 68 and is in the preliminary design stage with no set construction timeline or funding source. The work will include cold planing and resurfacing; reconstructing sidewalk and wheelchair ramps, adjusting drainage structures; replacing berm; and replacing existing and installing new guardrail and end treatment upgrades as needed. Incidental work includes installing permanent pavement markings, sign replacement, and instituting traffic controls during construction operations.
- b) Project 608815. This project entails resurfacing and related work along Route 112A in the Town of Holden. The project is funded for construction on the 2022 Transportation Improvement Program (TIP) with design currently at the 75% stage.

These MassDOT projects are of no consequence to the TIAS analysis or conclusions.

*Comment 8. "The number of units stated in the TIAS is 102; however, the number of units depicted in the plans is 101 and the notes under Table 6 refer to a different number. It should be clarified as to the correct number of units proposed and used in the analysis as well as if it includes the existing house whose driveway is proposed to be reconnected to Henry Way. Green also recommends revising the Table 6 notes to conform the correct number of units used in the analyses."*

**Response:** The latest Site plan prepared by Places Associates, Inc. indicates 101 total units (including the existing single-family home on Bailey Road) with 11 single family homes and 90 multi-family units (2 family, 3 family, and 4 family buildings). The difference between the current Site plan and the TIAS is that the Town indicated that two single family homes along Salisbury Street could not be included in the project and the unit count on the Site plan includes the existing single family home along Bailey Road. This project will therefore result in 100 new residential units plus the single-family home with access along Bailey Road. The TIAS footnote on Table 6 should read as follows: Based on ITE LUC 210 (Single Family Detached) applied to 12 Units and ITE LUC 220 (Multifamily Housing (Low-Rise) applied to 90 units). Accordingly, the TIAS analysis conservatively includes two units that no longer exist as part of the project along Salisbury Street and consequently presents a conservative analysis.

*Comment 9. "The trip generation was evaluated using the assumption that 90 units are considered as Low-Rise Multifamily Housing (LUC 220) per ITE's Trip Generation Manual with the remainder as Single-Family Detached Housing (LUC 210). An issue noted is that ITE's description of LUC 220 states that it is defined as residential units "located within the same building with at least three other dwelling units", a description that applies to only 36 of the total proposed units. ITE's description for LUC 210, although generally for detached units, states that "a typical site surveyed is a suburban subdivision." Given these descriptions, Green recommends re-evaluating the trip generation with only the buildings containing three (or more) units as LUC 220."*

**Response:** The ITE Trip Generation Manual identifies Single-Family Detached Housing (LUC 210) as single-family detached homes on individual lots. The use of LUC 210 is not consistent with the project characteristics for the multi-unit lots and would represent a grossly conservative basis for estimating trips. MDM contends that LUC 220 much better represents the smaller unit sizes and multi-family nature of the majority of proposed units compared to a typical single, larger scale single family home. Nonetheless, the alternative trip methodology assuming the “single family detached housing” category is considered below. Comparison of trips between the TIAS methodology and the suggested Green International methodology is presented in **Table R1**.

**TABLE R1**  
**TRIP-GENERATION COMPARISON**

Peak Hour/Direction	TIAS Methodology <sup>1</sup>	Green International Methodology <sup>2</sup>	Difference (Δ)
<i>Weekday Morning Peak Hour:</i>			
Entering	12	16	+4
<u>Exiting</u>	<u>38</u>	<u>49</u>	<u>+11</u>
Total	50	65	+15
<i>Weekday Evening Peak Hour:</i>			
Entering	40	55	+15
<u>Exiting</u>	<u>24</u>	<u>32</u>	<u>+8</u>
Total	64	87	+23

Source: ITE *Trip Generation*, Tenth Edition; 2018.

<sup>1</sup>Based on ITE LUC 210 (Single Family Detached) applied to 10 Units and ITE LUC 220 (Multifamily (Low-Rise) applied to 90 units).

<sup>2</sup>Based on ITE LUC 210 (Single Family Detached) applied to 64 Units and ITE LUC 220 (Multifamily (Low-Rise) applied to 36 units).

In summary, the highly conservative trip generation methodology requested by Green would result in 15 additional trips during the weekday morning peak hour and 23 additional trips during the weekday evening peak hour. Distributing these trips according to the patterns identified in the TIAS would result in an inconsequential change in area roadway volumes, well within normal day-to-day fluctuations that is immaterial to traffic operations summarized in the TIAS. Specifically, the Green International methodology would result in one (1) additional trip along Route 122A every 4 minutes and one (1) additional trip through the Route 122A intersection with Salisbury Street every 7 to 10 minutes during the peak hours. Therefore, no additional analysis is warranted.

Comment T10. *“In the TIA, there are minor errors noted in the trip generation volume network diagrams:*

- a. *The PM Peak Hour volume network is missing one exiting trip since 25 exiting trips are predicted but only 24 trips are shown exiting the site. Green recommends adding this missing trip to the figures and analyses.*

- b. *The lower-right corner of Figure 5 states "Weekday Evening Peak Hour" although the distribution is intended for both peak hours. Green recommends revising this text to conform with the analyses conducted.*

*Note: with the anticipated revisions in estimated trip generation as noted in above Comment #9, the Build networks would be updated for the AM and PM periods."*

**Response:**

(a) PM peak hour volumes. The PM Peak hour volume networks are not missing one trip; the trip was assumed to occurred from the two single family homes that were formerly proposed along Salisbury Street. These units are no longer proposed.

(b) TIAS Figure 5. The "Weekday Evening Peak Hour" box show on the trip distribution Figure has been removed from the graphic. The revised **Figure 5** is provided in the **Attachments**.

As summarized under Comment 9, the traffic volume networks included in the TIAS remain valid given the nominal change in volume using the more conservative trip generation methodology requested by Green.

*Comment T11. "Although Green mostly agrees with the trip distribution external of the study area, the percentage of traffic accessing workplaces within Holden via Bailey Road and Salisbury Street heading south appears high given the residential characteristics within the town along these roadways south of the project site. Additionally, the sum of trip distributions for Holden-only trips exceeds 100%. Green recommends revising the trip percentages for Holden-only trips and updating the analyses accordingly."*

**Response:** A very minor adjustment has been applied to ensure that the trips originating from Holden total to 100 percent. This minor adjustment does not result in any material difference in trip assignment and the analysis presented in TIAS remains valid. The revised trip distribution calculations are provided in the **Attachments**.

*Comment T12. "In the intersection capacity analysis, the same peak hour factor (PHF) was used for the overall intersection and heavy vehicle percentages were applied per movement. MassDOT Transportation Impact Assessment (TIA) Guidelines, which refer to MassDOT's Traffic and Safety Engineering 25% Design Submission Guidelines, state to apply PHF "on an approach-by-approach basis". These guidelines also state to apply heavy vehicle percentages "on an approach-by-approach basis or by lane group, as necessary". The Proponent should re-perform the analyses applying PHF and heavy vehicle percentages per MassDOT guidelines."*

**Response:** The project is not subject to State review. Based on extensive past experience with projects under MassDOT review including consultation with the District 3 office, the use of peak hour factors by intersection is appropriate and is an accepted methodology that is in conformance with the Highway Capacity Manual (HCM) procedures. As outlined in the HCM,

*“The use of a single peak hour factor for the entire intersection is intended to avoid the likelihood of creating demand scenarios with conflicting volumes that are disproportionate to the actual volumes during the 15-minute analysis period. If peak hour factors for each individual approach or movement are used, they are likely to generate demand volume from one 15-minute period that are in apparent conflict with demand volumes from another 15-minute period, whereas in reality these peak volumes do not occur at the same time.”*

MDM also notes that MassDOT’s *Traffic and Safety Engineering 25% Design Submission Guidelines* indicate that “The PHF shall be applied on an approach by approach basis for analysis of base year traffic volumes.” Again, based on our experience with MassDOT, the methodology of future year traffic projections is appropriately modeled with a PHF for the intersection (rather than by approach). The base year traffic volumes are generally reported using the same guidelines to provide an “apples to apples” comparison of traffic growth impacts to the baseline condition. The heavy vehicle percentages were added in the analysis by individual movement which is appropriate given the allocation of volumes under the HCM by lane group. Accordingly, it is the opinion and experience of MDM that the methodology used in the TIAS is appropriate for planning purposes and no further analysis is warranted.

Comment T13. *“The intersection capacity analysis was conducted using the Highway Capacity Manual 2010 rather than using the latest HCM reference that was published in MassDOT’s TIA Guidelines and MassDOT’s Traffic and Safety Engineering 25% Design Submission Guidelines. Although it may provide similar results, the Proponent should have performed the analyses using Highway Capacity Manual 6th Edition, as MassDOT guidelines state to use “procedures from the most recent edition of the Highway Capacity Manual (HCM)”. Any updates to the analysis, given the network updates requested above, should utilize the latest HCM and the available tools that are based on that version.”*

**Response:** Capacity analysis of signalized intersection Main Street at Salisbury Street was developed using Synchro® computer software, which implements the methods of the Highway Capacity Manual (HCM). The Synchro® model (percentile method delay output) is an accepted MassDOT modeling protocol and generally provides a better representation of operations at signalized locations, especially for nearly saturated and oversaturated conditions. Unlike HCM, the percentile delay results produced by Synchro accounts for vehicle queue interaction and signal coordination (HCM does not). For informational purposes, capacity analysis results using the HCM6 delay values for unsignalized intersections is also reported for comparison to HCM 2010 delay results as summarized in **Table R2** and **Table R3**. Detailed analysis results provided in the **Attachments**.

**TABLE R2**  
**INTERSECTION CAPACITY ANALYSIS RESULTS**  
**WEEKDAY MORNING PEAK HOUR**

Location	Approach	2024 Build Condition					
		TIAS <sup>1</sup>			HCM 6 <sup>th</sup> Edition		
		v/c <sup>1</sup>	Delay <sup>2</sup>	LOS <sup>3</sup>	v/c	Delay	LOS
<i>Salisbury Street at Pine Tree Road</i>	Eastbound	0.07	12	B	0.07	12	B
	Northbound	0.01	<5	A	0.01	<5	A
<i>Bailey Road at Proposed Site Drive</i>	Westbound	0.01	9	A	0.01	9	A
	Southbound	0.00	<5	A	0.00	<5	A
<i>Main Street (Route 122A) at Bailey Road</i>	Eastbound	0.01	<5	A	0.01	<5	A
	Westbound	0.04	<5	A	0.04	<5	A
	Northbound	>1.0	>50	F	>1.0	>50	F
	Southbound	0.08	48	E	0.08	48	E

<sup>1</sup>Volume-to-capacity ratio; <sup>2</sup>Average control delay per vehicle (in seconds); <sup>3</sup>Level of service; <sup>4</sup>n/a = not applicable

**TABLE R3**  
**INTERSECTION CAPACITY ANALYSIS RESULTS**  
**WEEKDAY EVENING PEAK HOUR**

Location	Approach	2024 Build Condition					
		TIAS <sup>1</sup>			HCM 6 <sup>th</sup> Edition		
		v/c <sup>1</sup>	Delay <sup>2</sup>	LOS <sup>3</sup>	v/c	Delay	LOS
<i>Salisbury Street at Pine Tree Road</i>	Eastbound	0.05	14	B	0.05	14	B
	Northbound	0.02	<5	A	0.02	8	A
<i>Bailey Road at Proposed Site Drive</i>	Westbound	0.01	9	A	0.01	9	A
	Southbound	0.00	<5	A	0.00	<5	A
<i>Main Street (Route 122A) at Bailey Road</i>	Eastbound	0.02	<5	A	0.02	<5	A
	Westbound	0.05	<5	A	0.05	<5	A
	Northbound	>1.0	>50	F	>1.0	>50	F
	Southbound	0.40	>50	F	0.40	>50	F

<sup>1</sup>Volume-to-capacity ratio; <sup>2</sup>Average control delay per vehicle (in seconds); <sup>3</sup>Level of service; <sup>4</sup>n/a = not applicable

As summarized in **Table R2 and R3** the HCM6 results are the same as the HCM 2010 results, therefore, the TIAS remains valid under the latest version of the HCM and no further analysis is warranted.

Comment T14. *“The TIAS referenced a waiver to propose 24-foot wide roadways within the site and that this width meets the minimum AASHTO recommended width for a local roadway. However, the minimum AASHTO recommended width for a local roadway is 26 feet (20-foot travel width plus 3-foot graded shoulders on both sides of the road). If the project proposes to meet AASHTO minimum recommended roadway widths, then the TIAS should be revised accordingly. Green also recommends reconciling the differences between the waiver request and the site design, which proposes 28-foot wide roadways. Furthermore, prior to any final decision on the proposed roadway widths, it is recommended that the Proponent evaluate large truck (i.e. WB-50) and appropriate fire apparatus vehicle movement within as well as entering/exiting the proposed site.”*

**Response:** When the TIAS was originally prepared the Town required 28-foot subdivision roadways. Accordingly, MDM provided guidance with respect to an appropriate design of the roadway width per AASHTO regarding roadway width for very low volume local roadways. On this basis, AASHTO minimum roadway width is a 20-foot paved travel way and 3-foot graded shoulders. The currently proposed roadway width of 24 feet meets this AASHTO guidance and in fact is consistent with the Town’s current dimensional requirement of 24 foot roadway width. Providing a wider 28-foot width is excessive, is contrary to the design philosophy of encouraging lower travel speeds on local roadways and is not required to properly support emergency access and circulation for the project. MDM stands by its conclusion that a 24-foot-wide roadway is appropriate for the project and comports with AASHTO guidance and current Town dimensional standards. An AutoTurn analysis for the current road layout based on the Holden Fire Department design vehicle is provided in the **Attachments** for reference.

#### **OCTOBER 2019 SITE PLAN**

Comment 15. *“The site plans generally conform to the Town of Holden Subdivision regulations.”*

**Response:** No response necessary.

Comment 16. *“The proposed internal intersection of Pine Tree Road and Farmer’s Way has a 90-degree bend/corner and is proposed to have one of the approaches operate under STOP control, although both approaches meet at approximately the same angle. Green recommends either making both approaches operate under STOP control for safety or provide a curve radius that facilitates travel at the design speed from the Pine Tree Road approach without the need for STOP signs.”*

**Response:** The Proponent proposes STOP control for approaches at this intersection. Providing an all-way STOP will also provide a traffic calming measure to the neighborhood and will reduce travel speeds through the development. The installed signs shall be compliant with the Manual on Traffic Control Devices (MUTCD).

Comment 17. *“The proposed crosswalks within the site depict chevron markings. Green recommends that the crosswalks conform with Figure 3B-19 of the Manual on Uniform Traffic Control Devices or be of “ladder-style” with perpendicular markings.”*

**Response:** The crosswalks will be adjusted to include the “ladder-style” markings consistent with the crosswalks along Salisbury Street on the final site plan set to be prepared by Places Associates, Inc.

Comment 18. *“The internal pedestrian crossings are depicted as upstream of the STOP bar at the east end of Henry Way, the north end of Farmer’s Way, and the east end of Pine Tree Road. A car stopped at the Stop sign/bar at these locations will block the pedestrian travel path. Green recommends relocating the STOP bars/signs and the crosswalks such that stopped vehicles are upstream of the pedestrian crossings.”*

**Response:** The crosswalks will be adjusted with a STOP line provided 4-feet back from the crosswalk on the final site plan set to be prepared by Places Associates, Inc.

Comment 19. *“Although pedestrian crossings with crosswalks are provided at the ends of the other site roadways, there is no crosswalk proposed across the west end of Henry Way. Green recommends that a pedestrian crossing is also installed across the west end of Henry Way to provide a connection between these sidewalk ends.”*

**Response:** A crosswalk will be added to the final site plan set to be prepared by Places Associates, Inc.

Comment 20. *“It is recommended that where possible, driveways openings are consolidated for multiple unit buildings (i.e. Lot numbers 15, 16, 17, 24, and 38).”*

**Response:** Individual driveway are proposed in conformance with Town requirements, allowing ample off-street parking for each of the units and minimizing impervious area coverage that would otherwise be created if driveways were consolidated and supplemental parking areas became necessary.

### **ADDITIONAL MITIGATION**

Comment 21. *“The TIAS recommends installing STOP signs at the approaches exiting the site at each of Salisbury Street and Bailey Road, to maintain sight distances by maintaining low vegetation and other landscaping features near the exiting approaches, and to connect to the existing sidewalk on Salisbury Street. Green recommends also maintaining sight distances for the internal site intersections by maintaining trimmed vegetation and other landscaping features near the exiting approaches.”*

**Response:** MDM concurs, no response necessary.

Comment 22. *“The Town’s Complete Streets Prioritization Plan includes a project to install sidewalk along Bailey Road. Green recommends that the Proponent coordinate with the Town regarding the sidewalk proposed along Bailey Road and consider participating in its implementation. The design/construction of any sidewalk will need to be ADA compliant in terms of wheelchair ramps.”*

**Response:** Proposed sidewalk connections for the project to existing sidewalks along Town roads is compliant with complete streets design philosophy. The Proponent further proposes a contribution toward a sidewalk capitalization fund that could be used by the Town to construct a sidewalk along Bailey Road if it chooses, subject to approval of a waiver allowing the Proponent to eliminate a sidewalk along one side of the project roadway system and a 24-foot wide roadway.

Comment 23. *“Green recommends re-evaluating mitigation measures needed at the Main Street study intersections once the traffic analysis and trip distribution have been re-performed.”*

**Response:** The results of the TIAS remain valid; the limited project impacts to off-site locations does not warrant additional mitigation actions or commitments. Even considering the highly conservative trip generation methodology requested by Green, project trip impacts to off-site locations is well within normal day-to-day traffic fluctuations and will not present a material or consequential impact to traffic operations or safety. All proposed design elements will comply with applicable safety criteria as recommended by AASHTO.

Comment 24. *“Although the minimum ISD appears to be satisfied for the Bailey Road approach at its intersection with Main Street if the ISD measurement is performed strictly as specified by AASHTO, however, if a vehicle is stopped at the stop line of Bailey Road, vegetation restricts visibility such that the minimum ISD would not be satisfied. This condition was observed to force vehicles to encroach onto the crosswalk to improve visibility of Main Street. Furthermore, the vegetation on Bailey Street also restricts the visibility of its STOP sign. Green recommends that vegetation trimming is performed within right-of-way along the Bailey Road approach and potentially installing a W3-1 Stop Ahead sign on Bailey Road in advance of the intersection.”*

**Response:** MDM recommends that the Town trim and maintain the vegetation with the right-of-way as described above to enhance the existing/ambient sight lines on the Bailey Road approach to Main Street. If not already installed by the Town, the Proponent will purchase a W3-1 (STOP Ahead) sign for the Town to install on the Bailey Road approach to the STOP sign. The sign will be compliant with the Manual on Traffic Control Devices (MUTCD).

# ATTACHMENTS

- Yearly Growth Data
- Background Projects
- MassDOT Projects
- Trip Generation
- Revised Figures
- Trip Distribution Calculations
- Capacity Analysis
- AutoTURN® Analysis



□ Yearly Growth



Main Street at Salisbury Street  
Growth Rate Calc

Total Entering Volume	7-May-08	7-May-19	Yearly Growth
7 AM - 9 AM	4113	3817	-0.65%
4 PM - 6 PM	4657	4627	-0.06%

## Dan Lindquist

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**From:** Robert Raymond <[rreaymond@cmrpc.org](mailto:rreaymond@cmrpc.org)>  
**Sent:** Wednesday, March 18, 2020 9:44 AM  
**To:** Dan Lindquist  
**Subject:** RE: Holden Area Growth Rate

Hi Dan,

Thank you for your request. According to the CMRPC travel demand model which is calibrated with our traffic counts we project about a .4%-.5% growth in traffic per year in the entire Town of Holden and in that more focused area that you mentioned.

If you have any other questions please let me know,

Rob

**Robert Raymond**  
Transportation Planner  
Central Massachusetts Regional Planning Commission  
1 Mercantile Street, Suite 520  
Worcester, MA 01608  
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Please be advised that the Massachusetts Secretary of State and the Massachusetts Attorney General consider e-mail to be a public record, and therefore subject to the Massachusetts Public Records Law, M.G.L. c. 66 § 10.

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**From:** Dan Lindquist [<mailto:dlindquist@mdmtrans.com>]  
**Sent:** Tuesday, March 17, 2020 1:31 PM  
**To:** Robert Raymond <[rreaymond@cmrpc.org](mailto:rreaymond@cmrpc.org)>  
**Subject:** Holden Area Growth Rate

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>>>WARNING: This email originated outside of CMRPC<<<

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Rob,

MDM is responding to peer review comments on a development between Salisbury St and Bailey Rd near Main Street in Holden, MA. Our ATR data shows a 0.14% per year growth rate in the area, MassDOT count station data indicates a 0.26% per year growth rate. Green International Affiliates, Inc. has requested additional data to support our use of a growth rate of 0.5% per year.

# MDM TRANSPORTATION CONSULTANTS, INC.

Planners & Engineers

28 Lord Road, Suite 280  
Marlborough, MA

E/W: Main Street  
NB: Salisbury Street  
Holden, MA

File Name : 435 Main Salisbury St 5-7-19  
Site Code : 435  
Start Date : 5/7/2019  
Page No : 1

## Groups Printed- Lights - Mediums - Articulated Trucks

Start Time	Main Street From East				Salisbury Street From South				Main Street From West				Int. Total
	Thru	Left	Peds	App. Total	Right	Left	Peds	App. Total	Right	Thru	Peds	App. Total	
07:00 AM	118	10	0	128	23	45	0	68	49	239	0	288	484
07:15 AM	81	12	0	93	17	33	0	50	43	219	0	262	405
07:30 AM	98	15	0	113	23	16	0	39	56	252	0	308	460
07:45 AM	131	21	0	152	21	31	0	52	57	239	0	296	500
Total	428	58	0	486	84	125	0	209	205	949	0	1154	1849
08:00 AM	151	27	0	178	25	31	0	56	82	238	0	320	554
08:15 AM	107	21	0	128	26	26	0	52	63	228	0	291	471
08:30 AM	115	27	0	142	20	35	0	55	54	199	0	253	450
08:45 AM	122	23	0	145	30	49	0	79	59	210	0	269	493
Total	495	98	0	593	101	141	0	242	258	875	0	1133	1968
04:00 PM	254	24	0	278	26	56	0	82	46	173	0	219	579
04:15 PM	248	36	0	284	12	60	0	72	53	210	0	263	619
04:30 PM	241	29	0	270	32	63	0	95	48	175	0	223	588
04:45 PM	224	41	0	265	32	63	0	95	50	181	0	231	591
Total	967	130	0	1097	102	242	0	344	197	739	0	936	2377
05:00 PM	250	36	0	286	45	64	0	109	55	151	0	206	601
05:15 PM	244	17	0	261	18	60	0	78	40	180	0	220	559
05:30 PM	222	30	0	252	21	61	0	82	47	146	0	193	527
05:45 PM	257	35	0	292	33	53	0	86	29	156	0	185	563
Total	973	118	0	1091	117	238	0	355	171	633	0	804	2250
Grand Total	2863	404	0	3267	404	746	0	1150	831	3196	0	4027	8444
Apprch %	87.6	12.4	0		35.1	64.9	0		20.6	79.4	0		
Total %	33.9	4.8	0	38.7	4.8	8.8	0	13.6	9.8	37.8	0	47.7	
Lights	2784	397	0	3181	393	729	0	1122	812	3132	0	3944	8247
% Lights	97.2	98.3	0	97.4	97.3	97.7	0	97.6	97.7	98	0	97.9	97.7
Mediums	67	7	0	74	10	17	0	27	19	59	0	78	179
% Mediums	2.3	1.7	0	2.3	2.5	2.3	0	2.3	2.3	1.8	0	1.9	2.1
Articulated Trucks	12	0	0	12	1	0	0	1	0	5	0	5	18
% Articulated Trucks	0.4	0	0	0.4	0.2	0	0	0.1	0	0.2	0	0.1	0.2

# MDM TRANSPORTATION CONSULTANTS, INC.

Planners & Engineers

28 Lord Road, Suite 280  
Marlborough, MA

Main Street (Route 122A)  
Salisbury Street  
Holden, MA

File Name : 435 - Main St Salisbury St AM  
Site Code : 00435001  
Start Date : 5/7/2008  
Page No : 1

## Groups Printed- Passenger Vehicles - Heavy Vehicles

	Main Street (Route 122A) From East				Salisbury Street From South				Main Street (Route 122A) From West				
Start Time	Thru	Left	Peds	App. Total	Right	Left	Peds	App. Total	Right	Thru	Peds	App. Total	Int. Total
07:00 AM	110	14	0	124	11	37	0	48	35	284	0	319	491
07:15 AM	115	11	0	126	20	30	0	50	43	288	0	331	507
07:30 AM	104	14	0	118	32	25	0	57	72	282	0	354	529
07:45 AM	135	24	0	159	31	17	1	49	61	276	1	338	546
Total	464	63	0	527	94	109	1	204	211	1130	1	1342	2073
08:00 AM	117	14	0	131	26	27	1	54	71	288	4	363	548
08:15 AM	119	21	0	140	11	27	0	38	54	236	1	291	469
08:30 AM	124	25	0	149	23	35	6	64	63	229	0	292	505
08:45 AM	142	17	0	159	18	38	0	56	64	238	1	303	518
Total	502	77	0	579	78	127	7	212	252	991	6	1249	2040
Grand Total	966	140	0	1106	172	236	8	416	463	2121	7	2591	4113
Apprch %	87.3	12.7	0		41.3	56.7	1.9		17.9	81.9	0.3		
Total %	23.5	3.4	0	26.9	4.2	5.7	0.2	10.1	11.3	51.6	0.2	63	
Passenger Vehicles	888	127	0	1015	166	224	8	398	448	2054	7	2509	3922
% Passenger Vehicles	91.9	90.7	0	91.8	96.5	94.9	100	95.7	96.8	96.8	100	96.8	95.4
Heavy Vehicles	78	13	0	91	6	12	0	18	15	67	0	82	191
% Heavy Vehicles	8.1	9.3	0	8.2	3.5	5.1	0	4.3	3.2	3.2	0	3.2	4.6

	Main Street (Route 122A) From East				Salisbury Street From South				Main Street (Route 122A) From West				
Start Time	Thru	Left	Peds	App. Total	Right	Left	Peds	App. Total	Right	Thru	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 07:15 AM													
07:15 AM	115	11	0	126	20	30	0	50	43	288	0	331	507
07:30 AM	104	14	0	118	32	25	0	57	72	282	0	354	529
07:45 AM	135	24	0	159	31	17	1	49	61	276	1	338	546
08:00 AM	117	14	0	131	26	27	1	54	71	288	4	363	548
Total Volume	471	63	0	534	109	99	2	210	247	1134	5	1386	2130
% App. Total	88.2	11.8	0		51.9	47.1	1		17.8	81.8	0.4		
PHF	.872	.656	.000	.840	.852	.825	.500	.921	.858	.984	.313	.955	.972
Passenger Vehicles	435	59	0	494	105	99	2	206	237	1099	5	1341	2041
% Passenger Vehicles	92.4	93.7	0	92.5	96.3	100	100	98.1	96.0	96.9	100	96.8	95.8
Heavy Vehicles	36	4	0	40	4	0	0	4	10	35	0	45	89
% Heavy Vehicles	7.6	6.3	0	7.5	3.7	0	0	1.9	4.0	3.1	0	3.2	4.2

# MDM TRANSPORTATION CONSULTANTS, INC.

Planners & Engineers

28 Lord Road, Suite 280  
Marlborough, MA

Main Street (Route 122A)  
Salisbury Street  
Holden, MA

File Name : 435 - Main St Salisbury St PM  
Site Code : 00435004  
Start Date : 5/7/2008  
Page No : 1

## Groups Printed- Passenger Vehicles - Heavy Vehicles

	Main Street (Route 122A) From East				Salisbury Street From South				Main Street (Route 122A) From West				
Start Time	Thru	Left	Peds	App. Total	Right	Left	Peds	App. Total	Right	Thru	Peds	App. Total	Int. Total
04:00 PM	288	22	0	310	13	48	0	61	32	175	1	208	579
04:15 PM	265	13	0	278	17	52	0	69	40	168	0	208	555
04:30 PM	276	24	0	300	34	55	0	89	39	157	1	197	586
04:45 PM	265	37	0	302	21	69	0	90	36	183	1	220	612
Total	1094	96	0	1190	85	224	0	309	147	683	3	833	2332
05:00 PM	260	31	0	291	35	47	0	82	32	160	1	193	566
05:15 PM	272	29	0	301	16	57	0	73	55	169	0	224	598
05:30 PM	307	21	0	328	21	64	0	85	27	148	0	175	588
05:45 PM	242	30	0	272	33	57	0	90	39	172	0	211	573
Total	1081	111	0	1192	105	225	0	330	153	649	1	803	2325
Grand Total	2175	207	0	2382	190	449	0	639	300	1332	4	1636	4657
Apprch %	91.3	8.7	0		29.7	70.3	0		18.3	81.4	0.2		
Total %	46.7	4.4	0	51.1	4.1	9.6	0	13.7	6.4	28.6	0.1	35.1	
Passenger Vehicles	2137	203	0	2340	181	442	0	623	294	1296	4	1594	4557
% Passenger Vehicles	98.3	98.1	0	98.2	95.3	98.4	0	97.5	98	97.3	100	97.4	97.9
Heavy Vehicles	38	4	0	42	9	7	0	16	6	36	0	42	100
% Heavy Vehicles	1.7	1.9	0	1.8	4.7	1.6	0	2.5	2	2.7	0	2.6	2.1

	Main Street (Route 122A) From East				Salisbury Street From South				Main Street (Route 122A) From West				
Start Time	Thru	Left	Peds	App. Total	Right	Left	Peds	App. Total	Right	Thru	Peds	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 04:45 PM													
04:45 PM	265	37	0	302	21	69	0	90	36	183	1	220	612
05:00 PM	260	31	0	291	35	47	0	82	32	160	1	193	566
05:15 PM	272	29	0	301	16	57	0	73	55	169	0	224	598
05:30 PM	307	21	0	328	21	64	0	85	27	148	0	175	588
Total Volume	1104	118	0	1222	93	237	0	330	150	660	2	812	2364
% App. Total	90.3	9.7	0		28.2	71.8	0		18.5	81.3	0.2		
PHF	.899	.797	.000	.931	.664	.859	.000	.917	.682	.902	.500	.906	.966
Passenger Vehicles	1092	116	0	1208	87	234	0	321	150	644	2	796	2325
% Passenger Vehicles	98.9	98.3	0	98.9	93.5	98.7	0	97.3	100	97.6	100	98.0	98.4
Heavy Vehicles	12	2	0	14	6	3	0	9	0	16	0	16	39
% Heavy Vehicles	1.1	1.7	0	1.1	6.5	1.3	0	2.7	0	2.4	0	2.0	1.6



## □ Background Projects



<b>Institute of Transportation Engineers (ITE) 10th Edition</b> <b>Land Use Code (LUC) 252 - Senior Adult Housing - Attached</b>
---

Average Vehicle Trips Ends vs: Dwelling Units

Independent Variable (X): 237

<b>AVERAGE WEEKDAY DAILY</b>
------------------------------

T =  $3.70 \times (X)$  (Small Sample Size - Use with Caution)

T =  $3.70 \times 237$

T = 876.90 vehicle trips

T = 876

with 50% ( 438 vpd) entering and 50% ( 438 vpd) exiting.

<b>WEEKDAY MORNING PEAK HOUR OF ADJACENT STREET TRAFFIC</b>
---

T =  $0.2 \times (X)$

T =  $0.20 \times 237$

T = 47.00 vehicle trips

T = 47

with 35% ( 16 vph) entering and 65% ( 31 vph) exiting.

<b>WEEKDAY EVENING PEAK HOUR OF ADJACENT STREET TRAFFIC</b>
---

T =  $0.26 \times (X)$

T =  $0.26 \times 237$

T = 62.00

T = 62

with 55% ( 34 vph) entering and 45% ( 28 vph) exiting.

<b>SATURDAY DAILY</b>
-----------------------

T =  $3.23 \times (X)$  (Small Sample Size - Use with Caution)

T =  $3.23 \times 237$

T = 765.51

T = 766 vehicle trips

with 50% ( 383 vpd) entering and 50% ( 383 vpd) exiting.

<b>SATURDAY MIDDAY PEAK HOUR OF GENERATOR</b>
---

T =  $0.33 \times (X)$

T =  $0.33 \times 237$

T = 78.21

T = 78 vehicle trips

with 62% ( 48 vph) entering and 38% ( 30 vph) exiting.



□ MassDOT Projects



Enter a City or Road name to  
search for a new project:

[Advanced Project Search](#)

**Project 606563**

[\(Click here for a glossary of terms\)](#)


**HOLDEN- RESURFACING & RELATED WORK ON ROUTE 122A, FROM ROUTE 31 TO ROUTE 68**

**Project Description:** The work includes cold planing and resurfacing; reconstructing sidewalk and wheel chair ramps; adjusting drainage structures; replacing berm; and replacing existing and installing new guardrail and end treatment upgrades as needed. Incidental work includes installing permanent pavement markings, sign replacement, and instituting traffic controls during construction operations.

**Location:** • [Town of Holden](#)

**Design Responsibility:** In-House Boston

**Right of Way Responsibility:** MassDOT

**Project Manager:** Lyris Liautaud 

**Estimated Total Federal Participating Construction Cost:** \$2,400,000.00

**Estimated Total Contract Cost:** \$2,200,000.00

**District:** District 3

**Current Status:** This project is in the preliminary design phase.

**Contracts (0)**

**Status**

No contracts associated with this project

**Bridges**

• - none -



**Project Task Information**

**Project Status**

Project Need Form	PNF Entered 08/08/2011
Project Initiation Form	PIF Entered 08/08/2011
Project Initiation Form	PRC Submitted 08/09/2011
Project Review Committee	PRC Approved 08/11/2011

**Project Management**

Enter a City or Road name to  
search for a new project:

[Advanced Project Search](#)

## Project 608815

[\(Click here for a glossary of terms\)](#)

Project Description: **HOLDEN- RESURFACING AND RELATED WORK ON ROUTE 122A**

Location: • [Town of Holden](#)

Design Responsibility: In-House Boston

Right of Way Responsibility: MassDOT

Construction Begins: Winter 2021/2022

Project Manager: Lyris Liautaud



Estimated Total Federal  
Participating Construction Cost: \$2,978,028.80

Estimated Total Contract Cost: \$2,837,961.00

Funding Provision: This project is planned to be funded through the 2022 Transportation Improvement Program for the Central Massachusetts Metropolitan Planning Organization.

District: District 3

Current Status: 75% Package Comments to DE (as of 12/27/2018 )

### Contracts (0)

### Status

No contracts associated with this project

### Bridges

- G08002 [details...](#)
- G08030 [details...](#)



### Project Task Information

#### Project Status

Project Need Form	PNF Entered 03/02/2017
Project Initiation Form	PIF Entered 03/02/2017
Project Initiation Form	PRC Submitted 03/02/2017
Project Review Committee	PRC Approved 03/23/2017

#### Project Management

25% Design	25% Package Received 09/11/2018
75% Design	75% Package Received 09/11/2018
75% Design	75% Package Comments to DE 12/27/2018

## □ Trip Generation



<b>Institute of Transportation Engineers (ITE) 10th Edition</b> <b>Land Use Code (LUC) 210 - Single-Family Detached Housing</b>
--

Average Vehicle Trips Ends vs: Dwelling Units  
 Independent Variable (X): 64

<b>AVERAGE WEEKDAY DAILY</b>
------------------------------

$T = 9.5^* (X)$   
 $T = 9.5^* \quad 64$   
 $T = 608.00$   
 $T = 608$  vehicle trips  
 with 50% ( 304 vph) entering and 50% ( 304 vph) exiting.

<b>WEEKDAY MORNING PEAK HOUR OF ADJACENT STREET TRAFFIC</b>
---

$T = 0.74^* (X)$   
 $T = 0.74^* \quad 64$   
 $T = 47.36$   
 $T = 47$  vehicle trips  
 with 25% ( 12 vph) entering and 75% ( 35 vph) exiting.

<b>WEEKDAY EVENING PEAK HOUR OF ADJACENT STREET TRAFFIC</b>
---

$T = 0.99^* (X)$   
 $T = 0.99^* \quad 64$   
 $T = 63.36$   
 $T = 63$  vehicle trips  
 with 63% ( 40 vph) entering and 37% ( 23 vph) exiting.

<b>SATURDAY DAILY</b>
-----------------------

$T = 9.54^* (X)$   
 $T = 9.54^* \quad 64$   
 $T = 610.56$   
 $T = 610$  vehicle trips  
 with 50% ( 305 vph) entering and 50% ( 305 vph) exiting.

<b>SATURDAY MIDDAY PEAK HOUR OF GENERATOR</b>
---

$T = 0.93^* (X)$   
 $T = 0.93^* \quad 64$   
 $T = 59.52$   
 $T = 60$  vehicle trips  
 with 54% ( 32 vph) entering and 46% ( 27 vph) exiting.

**Institute of Transportation Engineers (ITE) 10th Edition**  
**Land Use Code (LUC) 220 - Multifamily Housing (Low-Rise)**

Average Vehicle Trips Ends vs: Dwelling Units  
Independent Variable (X): 36

**AVERAGE WEEKDAY DAILY**

$$\begin{aligned}T &= 7.56 (X) - 40.86 \\T &= 7.56 * 36 - (40.86) \\T &= 231.30 \\T &= 232 \quad \text{vehicle trips} \\&\quad \text{with 50\% ( 116 vpd) entering and 50\% ( 116 vpd) exiting.}\end{aligned}$$

**WEEKDAY MORNING PEAK HOUR OF ADJACENT STREET TRAFFIC**

$$\begin{aligned}\ln T &= 0.95 \ln (X) - 0.51 \\ \ln T &= 0.95 \ln 36 - (0.51) \\ \ln T &= 2.89 \\ T &= 18.07 \\ T &= 18 \quad \text{vehicle trips} \\&\quad \text{with 23\% ( 4 vph) entering and 77\% ( 14 vph) exiting.}\end{aligned}$$

**WEEKDAY EVENING PEAK HOUR OF ADJACENT STREET TRAFFIC**

$$\begin{aligned}\ln T &= 0.89 \ln (X) - 0.02 \\ \ln T &= 0.89 \ln 36 - (0.02) \\ \ln T &= 3.17 \\ T &= 23.79 \\ T &= 24 \quad \text{vehicle trips} \\&\quad \text{with 63\% ( 15 vph) entering and 37\% ( 9 vph) exiting.}\end{aligned}$$

**SATURDAY DAILY**

$$\begin{aligned}T &= 14.01 * (X) - 521.69 \\T &= 14.01 * 36 - (521.69) \\T &= -17.33 \\T &= -18 \quad \text{vehicle trips} \\&\quad \text{with 50\% ( -9 vpd) entering and 50\% ( -9 vpd) exiting.}\end{aligned}$$

**SATURDAY MIDDAY PEAK HOUR OF GENERATOR**

$$\begin{aligned}T &= 1.08 * (X) - 33.24 \\T &= 1.08 * 36 - (33.24) \\T &= 5.64 \\T &= 6 \quad \text{vehicle trips} \\&\quad \text{with 50\% ( 3 vph) entering and 50\% ( 3 vph) exiting.}\end{aligned}$$

□ Revised Figures



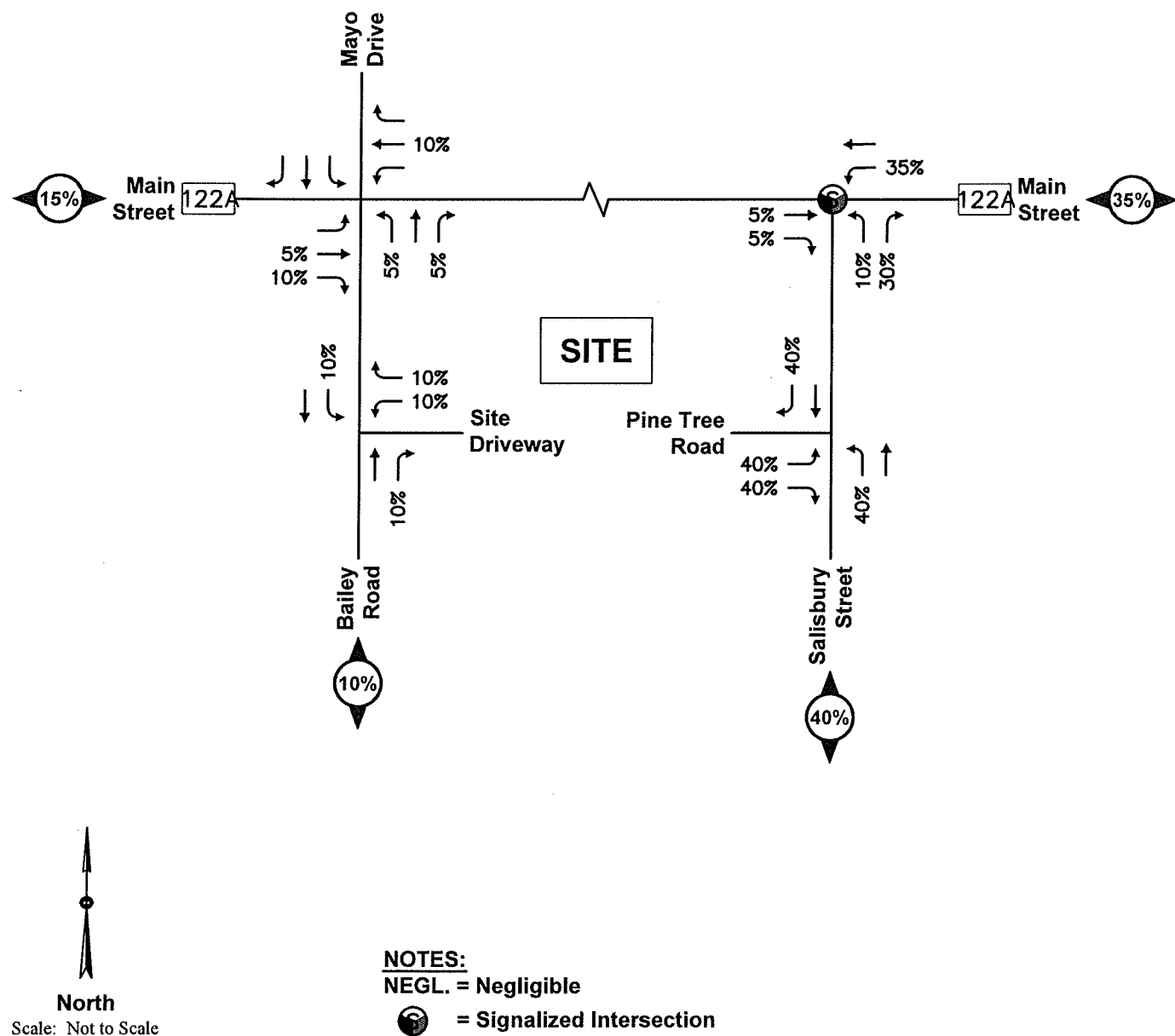


Figure 5



## □ Trip Distribution Calculations



# Journey-to-Work Distribution

Residence Town Name	Workplace Town Name	All Workers (To Frammingham)	% of Total	% of Total Rounded
Holden town	Worcester city	3,046	35.46%	35.5%
Holden town	Holden town	1,363	15.87%	15.9%
Holden town	Shrewsbury town	328	3.82%	3.8%
Holden town	Westborough town	312	3.63%	3.6%
Holden town	Frammingham town	273	3.18%	3.2%
Holden town	Marlborough city	223	2.60%	2.6%
Holden town	West Boylston town	208	2.42%	2.4%
Holden town	Boston city	165	1.92%	1.9%
Holden town	Sterling town	131	1.52%	1.5%
Holden town	Auburn town	122	1.42%	1.4%
Holden town	Milford town	96	1.12%	1.1%
Holden town	Leominster city	87	1.01%	1.0%
Holden town	Southborough town	85	0.99%	1.0%
Holden town	Waltham city	72	0.84%	0.8%
Holden town	Hopkinton town	69	0.80%	0.8%
Holden town	Bedford town	67	0.78%	0.8%
Holden town	Chelmsford town	61	0.71%	0.7%
Holden town	Hudson town	59	0.69%	0.7%
Holden town	Spencer town	59	0.69%	0.7%
Holden town	Burlington town	56	0.65%	0.7%
Holden town	Acton town	55	0.64%	0.6%
Holden town	Natick town	55	0.64%	0.6%
Holden town	Oxford town	54	0.63%	0.6%
Holden town	Northborough town	53	0.62%	0.6%
Holden town	Cambridge city	50	0.58%	0.6%
Holden town	Providence city	48	0.56%	0.6%
Holden town	Sudbury town	46	0.54%	0.5%
Holden town	Grafton town	45	0.52%	0.5%
Holden town	Stonham town	43	0.50%	0.5%
Holden town	Boylston town	42	0.49%	0.5%
Holden town	Millbury town	41	0.48%	0.5%
Holden town	Nashua city	39	0.45%	0.5%
Other		1,138	13.25%	13.2%
Total		8,591	100.00%	100%

Source: 2010 US Census Journey-to-Work Data

Residence	To/From Routes					Total
	Main Street (From East)	Main Street (From West)	Bailey Road (From South)	Salisbury Street (From South)		
Worcester city	0.0%	0.0%	20%	7.1%	80%	28.4%
Holden town	10%	1.6%	50%	7.9%	40%	6.3%
Shrewsbury town	100%	3.8%	0.0%	0.0%	0.0%	3.8%
Westborough town	100%	3.6%	0.0%	0.0%	0.0%	3.6%
Frammingham town	100%	3.2%	0.0%	0.0%	0.0%	3.2%
Marlborough city	100%	2.6%	0.0%	0.0%	0.0%	2.6%
West Boylston town	100%	2.4%	0.0%	0.0%	0.0%	2.4%
Boston city	100%	1.9%	0.0%	0.0%	0.0%	1.9%
Sterling town	0.0%	1.5%	0.0%	0.0%	0.0%	1.5%
Auburn town	50%	0.7%	0.0%	0.0%	25%	0.4%
Milford town	100%	1.1%	0.0%	0.0%	0.0%	1.1%
Leominster city	50%	0.5%	50%	0.0%	0.0%	1.0%
Southborough town	100%	1.0%	0.0%	0.0%	0.0%	1.0%
Waltham city	50%	0.4%	50%	0.0%	0.4%	0.8%
Hopkinton town	100%	0.8%	0.0%	0.0%	0.0%	0.8%
Bedford town	0.0%	0.0%	100%	0.8%	0.0%	0.8%
Chelmsford town	50%	0.4%	0.0%	0.0%	0.0%	0.4%
Hudson town	50%	0.3%	50%	0.3%	0.0%	0.7%
Spencer town	0.0%	0.0%	50%	0.3%	0.0%	0.3%
Burlington town	50%	0.3%	50%	0.3%	0.0%	0.6%
Acton town	50%	0.3%	50%	0.3%	0.0%	0.6%
Natick town	100%	0.6%	0.0%	0.0%	0.0%	0.6%
Oxford town	50%	0.3%	0.0%	0.0%	25%	0.2%
Northborough town	100%	0.6%	0.0%	0.0%	0.0%	0.6%
Cambridge city	50%	0.3%	0.0%	0.0%	0.0%	0.3%
Providence city	100%	0.6%	0.0%	0.0%	0.0%	0.6%
Sudbury town	100%	0.5%	0.0%	0.0%	0.0%	0.5%
Grafton town	100%	0.5%	0.0%	0.0%	0.0%	0.5%
Stonham town	50%	0.3%	50%	0.3%	0.0%	0.6%
Boylston town	100%	0.5%	0.0%	0.0%	0.0%	0.5%
Millbury town	100%	0.5%	0.0%	0.0%	0.0%	0.5%
Nashua city	0.0%	0.5%	100%	0.0%	0.0%	0.5%
	29.7%	13.8%	7.9%	9.2%	35.2%	86.8%
	34.3%	15.0%	10%	40.6%	100%	100%

SAY

40%



## □ Sight Capacity Analysis



HCM 6th TWSC  
1: Pine Tree Road & Salisbury Street

2024 Build Conditions  
Weekday Morning Peak Hour

Intersection

Int Delay, s/veh	0.8					
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	YY			↑↑	↑↑	
Traffic Vol, veh/h	17	18	5	203	350	6
Future Vol, veh/h	17	18	5	203	350	6
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	0	0	0	2	5	0
Mvmt Flow	18	20	5	221	380	7

Major/Minor	Minor2	Major1		Major2		
Conflicting Flow All	615	384	387	0	-	0
Stage 1	384	-	-	-	-	-
Stage 2	231	-	-	-	-	-
Critical Hdwy	6.4	6.2	4.1	-	-	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.3	2.2	-	-	-
Pot Cap-1 Maneuver	458	668	1183	-	-	-
Stage 1	693	-	-	-	-	-
Stage 2	812	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	456	668	1183	-	-	-
Mov Cap-2 Maneuver	456	-	-	-	-	-
Stage 1	690	-	-	-	-	-
Stage 2	812	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	12.1	0.2	0
HCM LOS	B		




Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1183	-	545	-	-
HCM Lane V/C Ratio	0.005	-	0.07	-	-
HCM Control Delay (s)	8.1	0	12.1	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0	-	0.2	-	-

HCM 6th TWSC  
2: 124 Bailey Road & Bailey Road

2024 Build Conditions  
Weekday Morning Peak Hour

Intersection

Int Delay, s/veh 0.8

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	4	4	57	1	1	31
Future Vol, veh/h	4	4	57	1	1	31
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	0	0	2	0	0	6
Mvmt Flow	4	4	62	1	1	34

Major/Minor	Minor1	Major1	Major2
Conflicting Flow All	99	63	0
Stage 1	63	-	-
Stage 2	36	-	-
Critical Hdwy	6.4	6.2	4.1
Critical Hdwy Stg 1	5.4	-	-
Critical Hdwy Stg 2	5.4	-	-
Follow-up Hdwy	3.5	3.3	2.2
Pot Cap-1 Maneuver	905	1007	1553
Stage 1	965	-	-
Stage 2	992	-	-
Platoon blocked, %		-	-
Mov Cap-1 Maneuver	904	1007	1553
Mov Cap-2 Maneuver	904	-	-
Stage 1	965	-	-
Stage 2	991	-	-

Approach	WB	NB	SB
HCM Control Delay, s	8.8	0	0.2
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	SBL	SBT
Capacity (veh/h)	-	-	953	1553
HCM Lane V/C Ratio	-	-	0.009	0.001
HCM Control Delay (s)	-	-	8.8	7.3
HCM Lane LOS	-	-	A	A
HCM 95th %tile Q(veh)	-	-	0	0

HCM 6th TWSC  
3: Bailey Road/Mayo Drive & Main Street (Route 122A)

2024 Build Conditions  
Weekday Morning Peak Hour

Intersection

Int Delay, s/veh 12.3

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	12	1206	15	17	582	15	12	0	49	3	0	4
Future Vol, veh/h	12	1206	15	17	582	15	12	0	49	3	0	4
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	-2	-	-	3	-	-	9	-	-	-6	-
Peak Hour Factor	91	91	91	91	91	91	91	91	91	91	91	91
Heavy Vehicles, %	0	3	7	6	5	0	0	0	2	0	0	0
Mvmt Flow	13	1325	16	19	640	16	13	0	54	3	0	4

Major/Minor	Major1		Major2		Minor1		Minor2					
Conflicting Flow All	656	0	0	1341	0	0	2047	2053	1333	2072	2053	648
Stage 1	-	-	-	-	-	-	1359	1359	-	686	686	-
Stage 2	-	-	-	-	-	-	688	694	-	1386	1367	-
Critical Hdwy	4.1	-	-	4.16	-	-	8.9	8.3	7.12	5.9	5.3	5.6
Critical Hdwy Stg 1	-	-	-	-	-	-	7.9	7.3	-	4.9	4.3	-
Critical Hdwy Stg 2	-	-	-	-	-	-	7.9	7.3	-	4.9	4.3	-
Follow-up Hdwy	2.2	-	-	2.254	-	-	3.5	4	3.318	3.5	4	3.3
Pot Cap-1 Maneuver	941	-	-	501	-	-	15	20	135	80	111	528
Stage 1	-	-	-	-	-	-	94	111	-	554	567	-
Stage 2	-	-	-	-	-	-	312	316	-	284	342	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	941	-	-	501	-	-	14	18	135	44	99	528
Mov Cap-2 Maneuver	-	-	-	-	-	-	14	18	-	44	99	-
Stage 1	-	-	-	-	-	-	89	105	-	524	533	-
Stage 2	-	-	-	-	-	-	291	297	-	161	323	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.1	0.3	\$ 375.7	47.7
HCM LOS			F	E

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	50	941	-	-	501	-	-	92
HCM Lane V/C Ratio	1.341	0.014	-	-	0.037	-	-	0.084
HCM Control Delay (s)	\$ 375.7	8.9	0	-	12.5	0	-	47.7
HCM Lane LOS	F	A	A	-	B	A	-	E
HCM 95th %tile Q(veh)	6.2	0	-	-	0.1	-	-	0.3




Notes

~: Volume exceeds capacity    \$: Delay exceeds 300s    +: Computation Not Defined    \*: All major volume in platoon

HCM 6th TWSC  
1: Pine Tree Road & Salisbury Street

2024 Build Conditions  
Weekday Evening Peak Hour

Intersection

Int Delay, s/veh	0.6					
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	11	10	19	379	356	18
Future Vol, veh/h	11	10	19	379	356	18
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	0	0	0	2	5	0
Mvmt Flow	12	11	21	412	387	20

Major/Minor	Minor2	Major1		Major2		
Conflicting Flow All	851	397	407	0	-	0
Stage 1	397	-	-	-	-	-
Stage 2	454	-	-	-	-	-
Critical Hdwy	6.4	6.2	4.1	-	-	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.3	2.2	-	-	-
Pot Cap-1 Maneuver	333	657	1163	-	-	-
Stage 1	683	-	-	-	-	-
Stage 2	644	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	325	657	1163	-	-	-
Mov Cap-2 Maneuver	325	-	-	-	-	-
Stage 1	667	-	-	-	-	-
Stage 2	644	-	-	-	-	-




Approach	EB	NB	SB
HCM Control Delay, s	13.9	0.4	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1163	-	428	-	-
HCM Lane V/C Ratio	0.018	-	0.053	-	-
HCM Control Delay (s)	8.2	0	13.9	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0.1	-	0.2	-	-

HCM 6th TWSC  
2: 124 Bailey Road & Bailey Road

2024 Build Conditions  
Weekday Evening Peak Hour

Intersection

Int Delay, s/veh	0.5					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	2	2	40	4	4	62
Future Vol, veh/h	2	2	40	4	4	62
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	0	0	5	0	0	2
Mvmt Flow	2	2	43	4	4	67

Major/Minor	Minor1	Major1		Major2	
Conflicting Flow All	120	45	0	0	47
Stage 1	45	-	-	-	-
Stage 2	75	-	-	-	-
Critical Hdwy	6.4	6.2	-	-	4.1
Critical Hdwy Stg 1	5.4	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-
Follow-up Hdwy	3.5	3.3	-	-	2.2
Pot Cap-1 Maneuver	880	1031	-	-	1573
Stage 1	983	-	-	-	-
Stage 2	953	-	-	-	-
Platoon blocked, %			-	-	-
Mov Cap-1 Maneuver	877	1031	-	-	1573
Mov Cap-2 Maneuver	877	-	-	-	-
Stage 1	983	-	-	-	-
Stage 2	950	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	8.8	0	0.4
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	SBL	SBT
Capacity (veh/h)	-	-	948	1573
HCM Lane V/C Ratio	-	-	0.005	0.003
HCM Control Delay (s)	-	-	8.8	7.3
HCM Lane LOS	-	-	A	A
HCM 95th %tile Q(veh)	-	-	0	0

HCM 6th TWSC  
3: Bailey Road/Mayo Drive & Main Street (Route 122A)

2024 Build Conditions  
Weekday Evening Peak Hour

Intersection												
Int Delay, s/veh	12.2											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Traffic Vol, veh/h	12	851	32	34	1223	15	9	1	32	12	0	23
Future Vol, veh/h	12	851	32	34	1223	15	9	1	32	12	0	23
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	-2	-	-	3	-	-	9	-	-	-6	-
Peak Hour Factor	97	97	97	97	97	97	97	97	97	97	97	97
Heavy Vehicles, %	0	1	0	3	1	7	0	0	7	8	0	0
Mvmt Flow	12	877	33	35	1261	15	9	1	33	12	0	24

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	1276	0	0	910	0	0	2269	2264	894	2274	2273	1269
Stage 1	-	-	-	-	-	-	918	918	-	1339	1339	-
Stage 2	-	-	-	-	-	-	1351	1346	-	935	934	-
Critical Hdwy	4.1	-	-	4.13	-	-	8.9	8.3	7.17	5.98	5.3	5.6
Critical Hdwy Stg 1	-	-	-	-	-	-	7.9	7.3	-	4.98	4.3	-
Critical Hdwy Stg 2	-	-	-	-	-	-	7.9	7.3	-	4.98	4.3	-
Follow-up Hdwy	2.2	-	-	2.227	-	-	3.5	4	3.363	3.572	4	3.3
Pot Cap-1 Maneuver	551	-	-	744	-	-	~ 9	13	266	58	87	256
Stage 1	-	-	-	-	-	-	207	223	-	286	349	-
Stage 2	-	-	-	-	-	-	95	113	-	424	474	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	551	-	-	744	-	-	~ 7	10	266	40	70	256
Mov Cap-2 Maneuver	-	-	-	-	-	-	~ 7	10	-	40	70	-
Stage 1	-	-	-	-	-	-	198	213	-	273	292	-
Stage 2	-	-	-	-	-	-	72	95	-	353	453	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.2	0.3	\$ 579.9	69.5
HCM LOS			F	F

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	28	551	-	-	744	-	-	90
HCM Lane V/C Ratio	1.546	0.022	-	-	0.047	-	-	0.401
HCM Control Delay (s)	\$ 579.9	11.7	0	-	10.1	0	-	69.5
HCM Lane LOS	F	B	A	-	B	A	-	F
HCM 95th %tile Q(veh)	5.1	0.1	-	-	0.1	-	-	1.6

Notes

~: Volume exceeds capacity    \$: Delay exceeds 300s    +: Computation Not Defined    \*: All major volume in platoon

## □ AutoTURN® Analysis



