

# Traffic Impact Study

## Proposed Gas Station & Convenience Store

Commerce Boulevard  
Wrentham, Massachusetts

RECEIVED  
06/21/23  
Planning Dept  
Exhibit # 6

Prepared by  
**McMahon, a Bowman Company**  
350 Myles Standish Boulevard Ste 103  
Taunton, MA

Prepared for  
**Edgewood Development Company, LLC**  
May 2023

## TABLE OF CONTENTS

<b>Introduction .....</b>	<b>1</b>
Project Description.....	1
Study Methodology.....	3
Study Area .....	3
<b>Existing Conditions.....</b>	<b>4</b>
Roadway Network .....	4
2023 Existing Traffic Volumes.....	4
Crash Summary .....	7
<b>Future Conditions .....</b>	<b>8</b>
Wrentham Business Center.....	8
Background Traffic Growth.....	8
Future Roadway Improvements.....	9
2030 Background Traffic Volumes .....	10
Site-Generated Traffic.....	12
Project Trip Distribution and Assignment.....	12
2030 Build Traffic Volumes .....	13
MUTCD Signal Warrant Analysis.....	13
Intersection Improvements.....	14
<b>Traffic Operations Analysis .....</b>	<b>18</b>
Level-of-Service Criteria.....	18
Capacity Analysis Results.....	18
Site Access and Circulation.....	20
<b>Conclusion .....</b>	<b>21</b>

## LIST OF TABLES

Table 1: Proposed Project Trips .....	12
Table 2: Unsignalized Intersection Capacity Analysis.....	19
Table 3: Overall Signalized Intersection Capacity Analysis.....	19

## LIST OF FIGURES

Figure 1: Site Location Map .....	2
Figure 2: 2023 Existing Peak Hour Traffic Volumes.....	6
Figure 3: 2030 No Build Peak Hour Traffic Volumes.....	11
Figure 4: Directions of Arrival and Departure.....	15
Figure 5: Peak Hour New Project Trips .....	16
Figure 6: 2030 Build Peak Hour Traffic Volumes.....	17

## LIST OF APPENDICES

Appendix A: Traffic Count Data	
Appendix B: Seasonal Adjustment Data	
Appendix C: Traffic Projection Model	
Appendix D: Crash Analysis	
Appendix E: Signal Warrant Analysis	
Appendix F: Highway Capacity Manual Methodologies	
Appendix G: 2023 Existing Capacity/Level-of-Service Analysis	
Appendix H: 2030 No Build Capacity/Level-of-Service Analysis	
Appendix I: 2030 Build Capacity/Level-of-Service Analysis	
Appendix J: Capacity/Level-of-Service Analysis Summary	

## **INTRODUCTION**

McMahon, a Bowman company has completed a review of the existing traffic operations and potential traffic impacts associated with the proposed gas station and convenience store development located on the south side of Commerce Boulevard in Wrentham, Massachusetts. The purpose of this traffic impact study is to evaluate existing and projected traffic operations and safety conditions associated with the proposed development within the study area.

The assessment documented in this traffic impact study is based on a review of existing traffic volumes, recent crash data, and the anticipated traffic generating characteristics of the proposed project. The study examines existing and projected traffic operations (both without and with the proposed development) at the intersection of Washington Street (Route 1) at Hawes Street/Commerce Boulevard. This study provides a detailed analysis of traffic operations during the weekday morning, weekday afternoon, and Saturday midday peak hours, when the combination of adjacent roadway volumes and project trips would be expected to be the greatest.

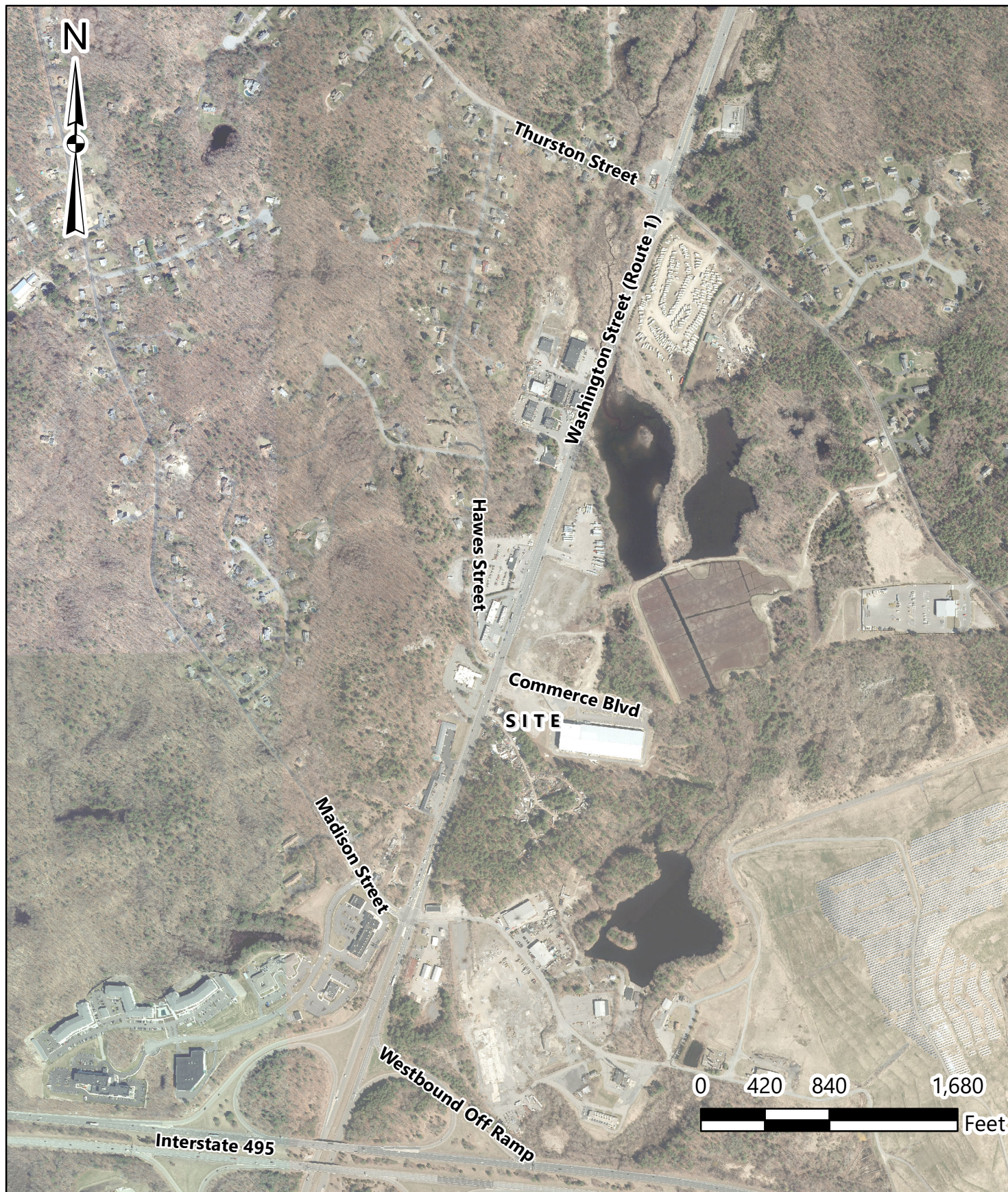
Based on the analysis presented in this study, the traffic projected to be generated by the proposed development, in conjunction with the proposed improvements, would have a minor impact on the study area roadways and intersections.

### **Project Description**

The proposed gas station and convenience store would be developed on Lot 1 of the overall Wrentham Business Center subdivision project, located on the east side of Washington Street (Route 1) across from Hawes Street. The project site is located on the southeastern corner of the intersection of Washington Street at Hawes Street/Commerce Boulevard, as depicted in Figure 1. The site is bounded by Washington Street to the west, the Supercharged Entertainment facility to the east, Commerce Boulevard to the north, and Turnpike Truck Parts to the south.

The project would involve the construction of an approximately 4,500 square foot convenience store building with six vehicle fueling pumps (12 total fueling positions). A total of 25 parking spaces would be provided on the site, including one disability-accessible space. Access to the site would be provided via two full-access driveways on Commerce Boulevard. For the purposes of this traffic impact study, the intersection of Washington Street at Hawes Street/Commerce Boulevard would be placed under traffic signal control as part of other elements being developed for the Wrentham Business Center project.







## **Study Methodology**

This traffic impact study evaluates existing and projected traffic operations within the study area for the weekday morning, weekday afternoon, and Saturday midday peak hour traffic conditions, when the combination of the adjacent roadway volumes and estimated project trips would be expected to be the greatest.

The study was conducted in three steps. The first step consisted of an inventory of existing traffic conditions within the project study area. As part of this inventory, manual turning movement counts were collected at the study intersection during the weekday morning, weekday afternoon, and Saturday midday peak periods. Crash data for the intersection of Washington Street at Hawes Street/Commerce Boulevard was obtained from the Massachusetts Department of Transportation (MassDOT) to determine if the intersection has any existing traffic safety deficiencies.

The second step of the study built upon the data collected in the first step of the study to establish the basis for evaluating potential transportation impacts associated with the projected future conditions. During this second step, the projected traffic demands associated with planned future developments which could influence traffic volumes at the study intersection were assessed. Consistent with MassDOT traffic study guidelines, 2023 Existing traffic volumes were forecasted to the future year 2030 to establish 2030 No Build (without project) conditions and 2030 Build (with project) conditions.

The third step of this study determined if measures were necessary to improve future traffic operations and safety, minimize potential traffic impacts, and provide safe and efficient access to the proposed project site.

## **Study Area**

Based on a review of the anticipated traffic generating characteristics of the proposed project and a review of the adjacent roadways serving the project site, the intersection of Washington Street (Route 1) at Hawes Street/Commerce Boulevard was selected for analysis. This report documents existing and future traffic conditions for this intersection.

## EXISTING CONDITIONS

An accurate assessment of the potential traffic impacts associated with the proposed project requires a comprehensive understanding of the existing traffic conditions within the project study area. The existing conditions assessment included in this study consists of an inventory of intersection and roadway geometries, an inventory of traffic control devices, the collection of peak period traffic volumes, and a review of recent crash data. The existing conditions in the vicinity of the project site are summarized below.

### Roadway Network

#### Washington Street (Route 1)

Washington Street (Route 1) generally travels in a north to south direction through the Town of Wrentham and provides access to primarily commercial land uses in the vicinity of the project site. Washington Street (Route 1) is classified as an urban principal arterial under MassDOT jurisdiction and typically provides two travel lanes in each direction measuring approximately 12 feet wide in the vicinity of the project site. No sidewalks or bicycle facilities are provided along Washington Street (Route 1). A speed limit of 55 miles per hour (mph) is posted on Washington Street (Route 1) in each direction approaching the project site.

#### Hawes Street

Hawes Street is classified as a local roadway under Town of Wrentham jurisdiction and generally travels in a north to south direction between Washington Street (Route 1) and Thurston Street. Hawes Street measures between 20 and 24 feet wide and accommodates two-way travel. Travel lanes on Hawes Street are unmarked, and sidewalks are not provided on either side of the roadway. No speed limits are posted on Hawes Street in either direction.

#### Commerce Boulevard

Commerce Boulevard is a private roadway which extends from Washington Street (Route 1) approximately 450 feet to the east, where it dead ends. Commerce Boulevard was developed as part of the Wrentham Business Center subdivision and serves three separate lots including the Supercharged entertainment center, a proposed warehouse, and the currently proposed gas station and convenience store. Commerce Boulevard is approximately 44 feet wide and allows for two-way vehicle traffic. With the proposed gas station and convenience store project in place, sidewalks would be constructed on both sides of Commerce Boulevard. No speed limit is posted on Commerce Boulevard.

### 2023 Existing Traffic Volumes

To assess peak hour traffic conditions, manual turning movement counts (TMCs) were conducted at the study area intersection during the weekday morning, weekday afternoon, and Saturday midday peak periods.

Counts were conducted on Saturday, April 1, 2023 from 11:00 AM to 2:00 PM and on Tuesday, April 4, 2023 from 7:00 AM to 7:00 PM. The results of the turning movement counts are tabulated by 15-minute periods and are provided in Appendix A of this report. The four highest consecutive 15-minute intervals during each of these count periods constitute the peak hours that are the basis of the traffic analysis provided in this report. As noted in MassDOT's *Traffic and Safety Engineering 25% Design*

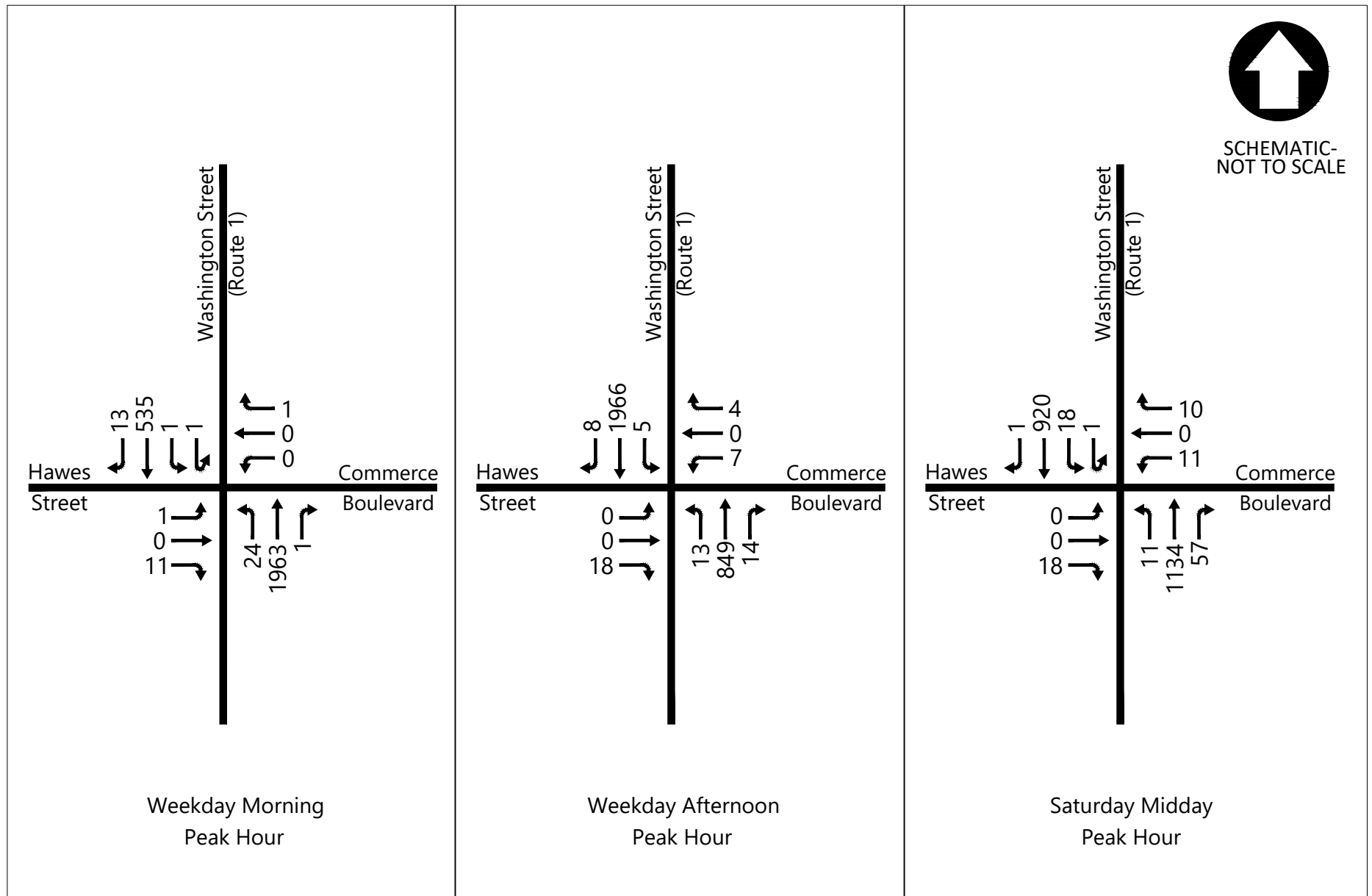
*Submission Guidelines*, MassDOT prefers the use of counts taken after March 1, 2022, when the impacts of the COVID-19 pandemic are considered to have settled into a “new normal”. Based on a review of the peak period traffic data, the weekday morning peak hour at the study area intersection occurs between 7:00 AM and 8:00 AM, the weekday afternoon peak hour occurs between 4:45 PM and 5:45 PM, and the Saturday midday peak hour occurs between 11:45 AM and 12:45 PM.

#### Seasonal Variation

To account for seasonal variation in traffic volumes, historic traffic count data on Interstate 495 (MassDOT Count Station 6312) was reviewed from the MassDOT Transportation Data Management System dashboard. Based on the continuous count station data, traffic volumes collected during the month of April are shown to be approximately 3.6% lower than an average month. Therefore, to provide a more conservative analysis, the volumes collected were adjusted upward to reflect an average month. The seasonal adjustment data is provided in Appendix B of this report.

The 2023 Existing peak hour traffic volumes are displayed in Figure 2 and are documented in the traffic projection model provided in Appendix C of this report.





## **Crash Summary**

Crash data for the study area intersection was obtained from the MassDOT crash data portal. The most recent five-year period of data available on the portal is 2016 through 2020. However, as the COVID-19 pandemic may have significantly affected traffic and crash patterns during 2020, this study summarizes data for 2015 through 2020. A detailed summary of the available crash data for the years 2015 to 2019 is provided in Appendix D.

The MassDOT Crash Rate Worksheet calculations were used to determine whether the crash frequency at the study intersection was unusually high given the travel demands. The MassDOT Crash Rate Worksheet calculates a crash rate expressed in crashes per million entering vehicles. The calculated rate is then compared to the average rate for unsignalized intersections statewide and within MassDOT District 5. For unsignalized intersections, the statewide and District 5 average crash rates are both 0.57 crashes per million entering vehicles.

The unsignalized intersection of Washington Street at Hawes Street/Commerce Boulevard had a total of 16 reported crashes between 2015 and 2020, resulting in a crash rate of 0.26 crashes per million entering vehicles, which is below the state and districtwide crash rates. Of the total 16 crashes, five were angle collisions, four were rear-end collisions, three were sideswipe collisions, three were single vehicle crashes, and the remaining crash type was unknown. Six crashes resulted in personal injury, nine crashes resulted in property damage only, and the result of the remaining crash was unknown.

## **FUTURE CONDITIONS**

To establish future traffic demands on the study area intersection, the 2023 Existing traffic volumes were projected to the future-year 2030, by which time the project would be anticipated to be built and occupied. Traffic volumes on the study area roadways in 2030 are considered to include existing traffic, new traffic resulting from general population growth, and traffic from other planned development projects independent of the proposed project. The potential background traffic growth, independent of the project, was considered in the development of the 2030 No Build (without project) peak hour traffic volumes. The estimated traffic increases associated with the proposed project were then added to the 2030 No Build volumes to reflect the 2030 Build (with project) traffic conditions. A description of the development of the 2030 No Build and 2030 Build traffic volume networks is presented below.

### **Wrentham Business Center**

The proposed gas station and convenience store project site is located within the Wrentham Business Center which includes a subdivision of three lots that were created in 2017 through the use of the Subdivision Control Law and were permitted through the Wrentham Planning Board. The first phase (on Lot 2) of the Wrentham Business Center project has been constructed and is operational as a 116,000 square foot indoor recreational facility called Supercharged Entertainment. The next phase of the Wrentham Business Center project includes a proposed approximately 179,000 square foot warehouse with a minor office component on Lot 3, and the construction of the 12 fueling position gas station and 4,500 square foot convenience store on Lot 1. The warehouse component of the Wrentham Business Center has been approved by the Wrentham Planning Board and the entire subdivision project is currently under review through the Massachusetts Environmental Policy Act (MEPA). With the previous approval of the warehouse, the trips associated with that portion of the development could be included as a background development and included in the 2030 No Build condition volumes. However, the overall build program of the Wrentham Business Center calls for the warehouse development and the proposed gas station and convenience store to be constructed concurrently with each other; as such, the warehouse project is included under 2030 Build conditions, but not as a background development within the No Build condition. The other background traffic growth discussed below is included in both the 2030 No Build and 2030 Build conditions.

### **Background Traffic Growth**

Traffic growth is primarily a function of changes in motor vehicle use and expected land developments within the area. To establish the rate at which traffic on the study area roadways can be anticipated to grow during the seven-year forecast period (2023 to 2030), both general traffic growth and local planned developments were reviewed.

#### Development-Specific Growth

Conversations with the Town of Wrentham identified two planned developments located within close proximity to the project site that would be expected to impact future traffic volumes on the study area roadways, namely:

- A proposed gas station and convenience store at 500 Thurston Street
- A proposed warehouse development at 500-524 Thurston Street

The proposed gas station and convenience store project located at 500 Thurston Street involves the construction of an approximately 6,000 square foot convenience store and 17 total vehicle fueling positions, as well as a single-stall car wash. The April 2019 Transportation Impact Assessment conducted by Vanasse & Associates, Inc. was referenced to determine the number of additional trips on the study area roadways estimated to be generated by the project. The resulting trips are displayed in the traffic projection model included in Appendix C.

The proposed warehouse project to be located at 500-524 Thurston Street would construct an approximately 132,000 square foot building on the southeast corner of the intersection of Washington Street at Thurston Street. The trips associated with this proposed warehouse were included in the future traffic volume projections based on information provided in the Traffic Impact Assessment prepared by Vanasse & Associates, Inc. dated September 2021.

The town also identified two other development projects in the vicinity of the project site: a potential warehouse project at 544 Thurston Street and a solar farm project at 80 Washington Street which is anticipated to be under construction in 2023. At the time of discussion, the warehouse development project had not yet filed with the Wrentham Planning Board. Therefore, traffic estimated to be generated by this development is not known at this time and is expected to be captured in the background growth rate discussed below. ITE does not provide data for vehicle trips associated with solar energy facilities, however a review of impact studies prepared for solar farms shows that trip generation associated with operations are generally minimal. Any trips associated with occasional maintenance or other occurrences at the solar farm are expected to be captured in the background growth rate.

#### Background Traffic Growth

Background traffic growth accounts for changes in traffic volumes associated with general changes in population and other developments that are not known at this time. An annual background traffic growth rate of 1.0% per year, compounded annually, was established for the study area based on coordination with Town of Wrentham and used to grow the 2023 traffic volumes to future year 2030.

The resulting projected traffic volumes at the study area intersection are documented in the traffic projection model located in Appendix C.

#### **Future Roadway Improvements**

Based on previous discussions with the Town of Wrentham, no future town-funded roadway improvement projects are currently proposed in the vicinity of the project site that would be expected to impact traffic volumes or operations. During the local permitting process for the proposed warehouse at 15 Commerce Boulevard, residents and business owners discussed existing travel patterns, access, and safety along Hawes Street. In an effort to address existing concerns on Hawes Street and at its intersection with Washington Street, the Town of Wrentham has stated an intention to pursue potential signage and striping changes. The Wrentham Police Department and Wrentham Department of Public Works would work together with MassDOT, as appropriate, to review and implement potential changes.

Intersection improvements at the intersection of Washington Street at Thurston Street are planned as part of the development of a proposed gas station and convenience store and a proposed warehouse development on Thurston Street. As part of the improvements, the eastbound and westbound Thurston Street approaches would be reconfigured to accommodate exclusive left-turn lanes and a shared through/right-turn lane in each direction. Signal timing and phasing adjustments would also be expected

as part of the intersection improvement. For the purposes of this study, the reconfiguration of Thurston Street and associated signal timing and phasing adjustments have been included in the No Build analysis.

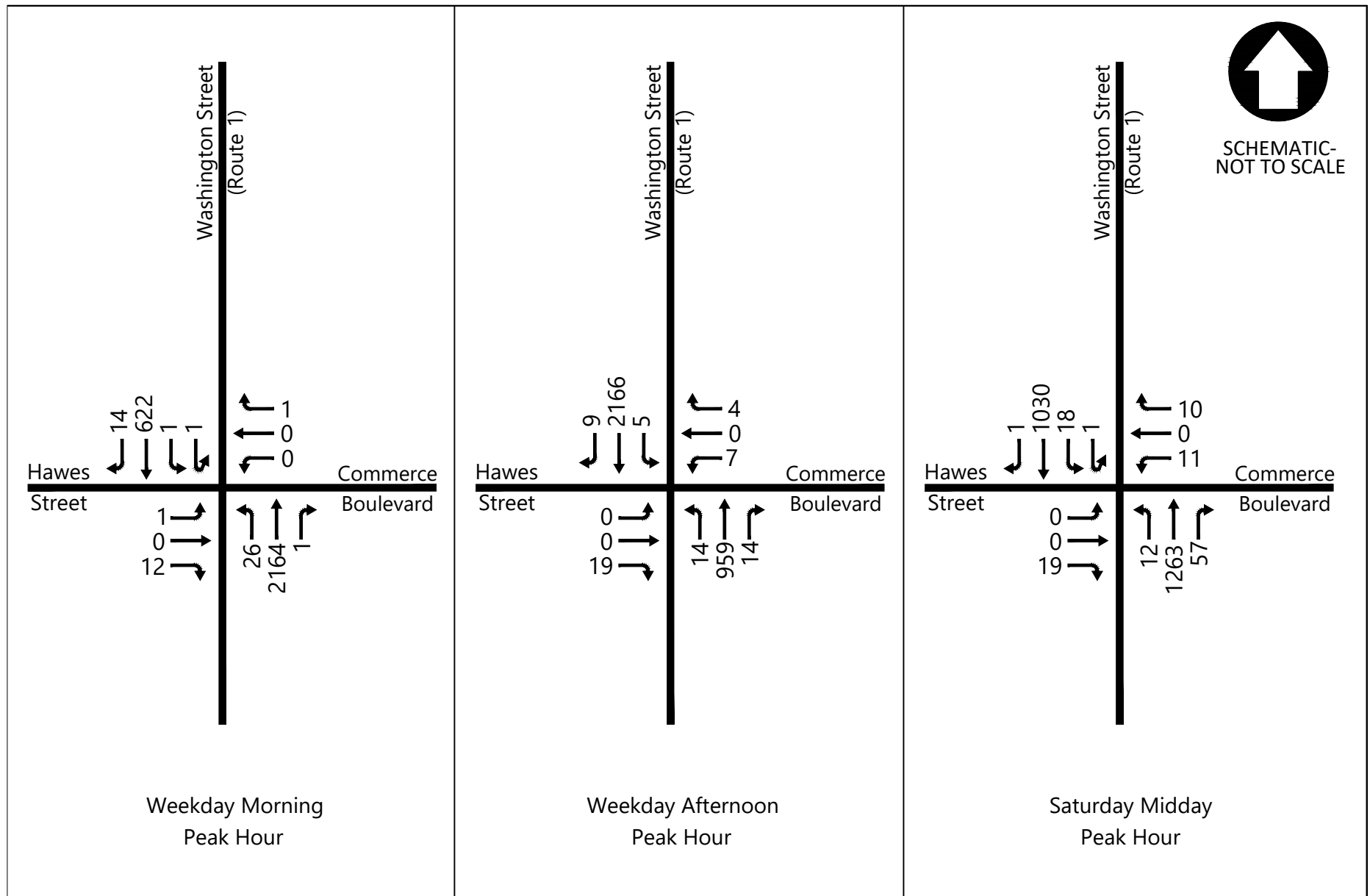
The project team has also coordinated with MassDOT in an effort to understand future roadway improvements that may impact transportation operations within the study area. MassDOT identified a Washington Street (Route 1) Corridor project that is evaluating alternative cross-sections for the Washington Street corridor from just north of the I-495 interchange in the south to the Wrentham town-line in the north. The Washington Street (Route 1) Corridor project is currently in the pre-25% design submittal stage, where MassDOT is exploring concepts for the corridor and study area intersections. MassDOT has previously shared that refined concepts for corridor improvements may include a median along Washington Street in the vicinity of Hawes Street and Commerce Boulevard. Therefore, the Wrentham Business Center project considers that a median may ultimately be proposed. Further development of concepts is being reviewed in coordination with MassDOT as part of the MEPA review process and future access permitting. Based on the information received to date, no specific corridor improvements are included as part of the future year conditions for this traffic impact study.

As outlined in previous processes (locally and with MEPA) the proposed signalization of Commerce Boulevard/Hawes Street is an integral part of the development of the Wrentham Business Center. Reasoning has been previously provided regarding the installation of a signal at the intersection of Commerce Boulevard/Hawes Street independent of the proposed warehouse, gas station, and convenience store land uses, to address existing safety concerns within this segment of the Washington Street corridor. The installation of a traffic signal is proposed to be completed as part of the warehouse and gas station development and construction. Although the warehouse land use has already been approved by the Wrentham Planning Board with the proposed signal in place under future conditions, the traffic signal would ultimately need to be approved by MassDOT. For the purposes of this study, the signalization of the Commerce Boulevard/Hawes Street intersection has not been included in the 2030 No Build condition of this traffic impact study.

### **2030 Background Traffic Volumes**

The 2023 Existing peak hour traffic volumes were grown by one percent per year (compounded annually) over the seven-year study horizon (2023 to 2030) to establish the 2030 No Build conditions. The peak hour traffic volumes associated with the two developments identified by the Town were then added to the base future traffic volumes. The resulting 2030 No Build weekday morning, weekday afternoon, and Saturday midday peak hour traffic volumes are illustrated in Figure 3 and are documented in the traffic projection model presented in Appendix C of this report.





## Site-Generated Traffic

In order to estimate the number of vehicle trips associated with the proposed development, the Institute of Transportation Engineers' (ITE) publication, *Trip Generation Manual, 11<sup>th</sup> Edition*, was referenced. The publication provides traffic generation information for various land uses compiled from studies conducted by members nationwide. Vehicle trip estimates for the proposed gas station and convenience store development were estimated based on data presented in this publication for Land Use Code 945 (Convenience Store/Gas Station) and the subcategory for a convenience store between 4,000 and 5,500 square feet. These references establish vehicle trip rates (in this case expressed in trips per square foot of convenience store gross floor area) based on actual traffic counts conducted at similar types of existing land uses. The estimated vehicle trips to the proposed site are presented in Table 1.

Not all trips to convenience stores and gas stations are new trips. A significant portion of the total trips attracted to such uses are pass-by trips. According to ITE, for Land Use Code 945 (Convenience Store/Gas Station), approximately 76 percent of the total weekday morning peak hour trips of this land use type are attributed to pass-by trips, while approximately 75 percent of the total weekday afternoon peak hour trips of this land use type are attributed to pass-by trips. A pass-by rate is not provided for the Saturday midday site peak hour through ITE. Therefore, the more conservative weekday afternoon peak hour pass-by rate of 75 percent was used to estimate total pass-by trips for the Saturday midday site peak hour. The vehicle trips estimated to be generated by the proposed gas station and convenience store development are separated into pass-by vehicle trips and new vehicle trips as shown in Table 1.

**Table 1: Proposed Project Trips**

Description	Size	Weekday AM Peak Hour			Weekday PM Peak Hour			Saturday Midday Peak Hour		
		In	Out	Total	In	Out	Total	In	Out	Total
Convenience Store/Gas Station <sup>1</sup>	12 VFP	162	162	324	137	137	274	125	120	245
- Pass-By Trips <sup>2</sup>		-123	-123	-246	-103	-103	-206	-92	-92	-184
<b>New Project Trips</b>		<b>39</b>	<b>39</b>	<b>78</b>	<b>34</b>	<b>34</b>	<b>68</b>	<b>33</b>	<b>28</b>	<b>61</b>

1 ITE Land Use Code 945 (Convenience Store/Gas Station for 4-5.5k square feet), based on 12 fueling positions.

2 Based on ITE Land Use Code 945, 76% of weekday morning and 75% of weekday afternoon peak hour vehicle trips are considered pass-by trips. Saturday midday peak hour pass-by rates are not available for LUC 945, therefore weekday afternoon pass-by rates were applied to the Saturday midday period.

As shown in Table 1, the proposed development is estimated to result in approximately 78 new vehicle trips (39 entering vehicles and 39 exiting vehicles) during the weekday morning peak hour, approximately 68 new vehicle trips (34 entering vehicles and 34 exiting vehicles) during the weekday afternoon peak hour, and approximately 61 new vehicle trips (33 entering vehicles and 28 exiting vehicles) during the Saturday midday peak hour.

## Project Trip Distribution and Assignment

The additional traffic estimated to be generated by the proposed development was distributed onto the study area roadways based on existing travel patterns of vehicles in the study area. The resulting

arrival and departure patterns are presented in Figure 4 and are documented in the traffic projection model found in Appendix C.

The project-related traffic was then assigned to the surrounding roadway network based on the project trip distribution patterns presented in Figure 4, and the resulting new peak hour project trips are shown in Figure 5 for the weekday morning, weekday afternoon, and Saturday midday peak hours.

### **2030 Build Traffic Volumes**

To establish the 2030 Build peak hour traffic volumes, the distributed project trips were added to the 2030 No Build peak hour traffic volumes. As mentioned in previous sections of this report, peak hour traffic volumes associated with the proposed warehouse development at 15 Commerce Boulevard were not included in the 2030 No Build traffic volumes. These volumes have been included in the 2030 Build peak hour volumes based on the estimates and trip distribution patterns identified in previous documentation submitted to the Town of Wrentham and MEPA. The resulting 2030 Build weekday morning, weekday afternoon and Saturday midday peak hour traffic volumes are presented in Figure 6 and are documented in the traffic projection model presented in Appendix C of this report.

### **MUTCD Signal Warrant Analysis**

Based on coordination with the project team, the Town of Wrentham, and MassDOT, the intersection of Washington Street at Hawes Street/Commerce Boulevard is proposed to be signalized in conjunction as part of the overall Wrentham Business Center project. As part of the analysis to determine if signalization is justified, signal warrant analysis was completed based on a methodology previously approved by MassDOT. The methodology includes the use of 12-hour turning movement counts at the intersection, which is preferred for use in signal warrant analyses, with no future projection growth for the Washington Street and the Hawes Street approaches. Vehicle trips associated with the proposed warehouse at 15 Commerce Boulevard and the proposed gas station and convenience store project were then added to the counted Commerce Boulevard approach volumes. The 12-hour turning movement counts were conducted in April 2023, as discussed in previous sections of this report. Vehicle trips exiting Commerce Boulevard were identified utilizing the daily trip generation and hourly distribution identified by ITE for each of the proposed land uses. The use of the daily trip generation and hourly distribution results in differing volumes for the project site than are presented for the weekday morning and afternoon peak hours in the other sections of this report. The vehicle trip estimate completed using the hourly distribution of traffic applied to the daily trip generation for the project provides a more conservative approach to the signal warrant analysis.

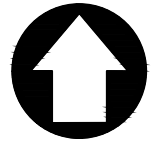
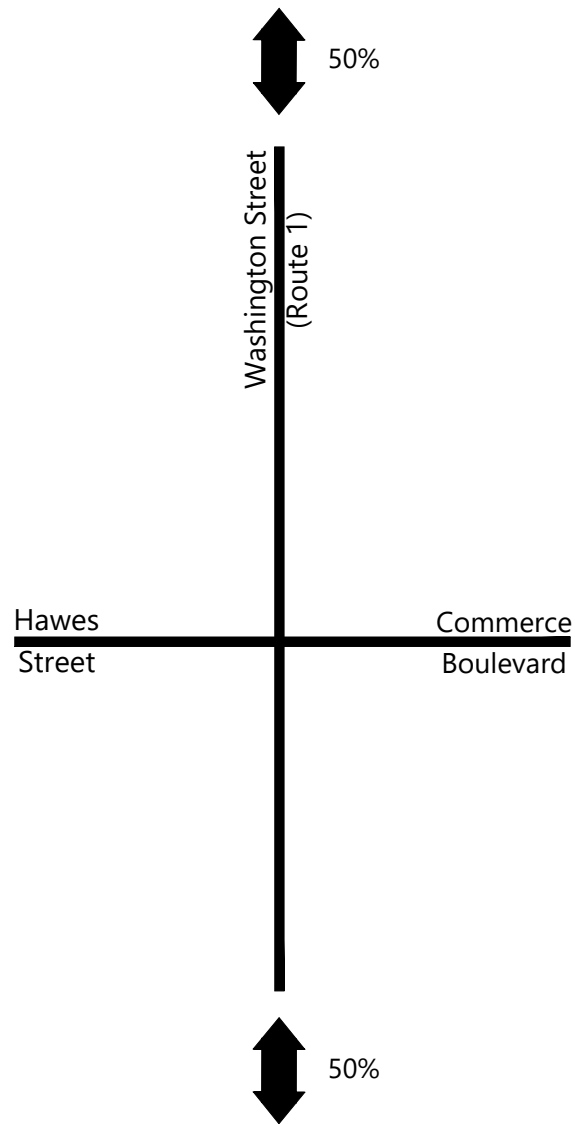
Signal warrant analyses were performed for the intersection of Washington Street at Hawes Street/Commerce Boulevard based on methodologies described in the 2009 *Manual on Uniform Traffic Control Devices* (MUTCD). The analyses performed for this report are based on the criteria for the eight-hour and four-hour volume warrants. The Eight-Hour (Warrant 1) and Four-Hour (Warrant 2) vehicular volume signal warrant conditions are intended to be applied where the volume of intersecting traffic is the principal reason to consider installing traffic signal control. For the Eight-Hour vehicular volume signal warrant to be met, minimum vehicular volumes for the major street and minor street, found in Table 4C-1 of the MUTCD, must be exceeded. To satisfy the Four-Hour signal warrant, the plotted point representing the hourly volumes on the major street and minor street intersection approaches during any four hours of an average weekday must be above the applicable curve in Figure 4C-1 of the MUTCD.

The eight-hour and four-hour warrant analyses were completed utilizing Highway Capacity Software (HCS). The HCS worksheets are provided in Appendix E of this report for reference. Based on the completed signal warrant analysis, the intersection of Washington Street at Hawes Street/Commerce Boulevard is shown to meet the Eight-Hour and the Four-Hour warrants under the volume conditions analyzed. Based on the warrant analysis, coordination with the Town of Wrentham and MassDOT, and anticipated excessive delay for vehicles on Commerce Boulevard, a traffic signal is proposed at the intersection of Washington Street at Hawes Street/Commerce Boulevard as part of the 2030 Build conditions.

### **Intersection Improvements**

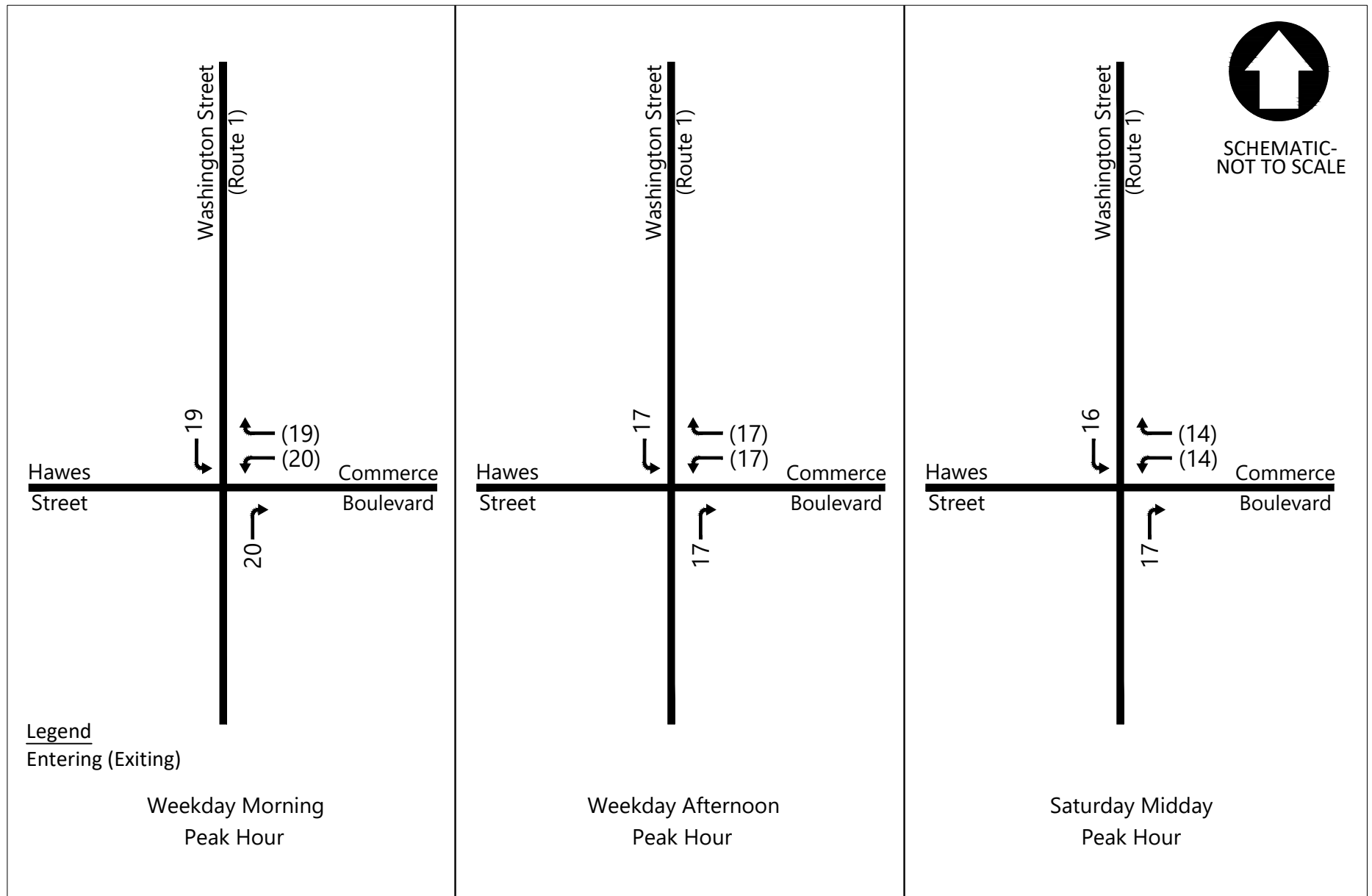
Based on discussions with the Town of Wrentham and through coordination with MassDOT, a traffic signal is proposed to be installed at the intersection of Washington Street at Hawes Street/Commerce Boulevard as part of the proposed Wrentham Business Center project. The potential configuration of the proposed signal at Commerce Boulevard/Hawes Street has gone through several iterations in an effort to identify the most appropriate signal timing and phasing configuration to serve the needs of the overall corridor. As mentioned previously, MassDOT is undertaking a review of the Washington Street corridor north and south of Commerce Boulevard, which is in the early stages of concept design and development. Therefore, the intersection configuration of a traffic signal at Commerce Boulevard/Hawes Street has not yet been identified and would need to be approved by MassDOT. As such, the phasing and configuration of the proposed signal presented in the analysis of this traffic impact study is a concept and is expected to undergo further review, adjustment, and design as the MassDOT and MEPA processes progress. It is expected that access along the corridor for individual land uses and side streets will be reviewed and addressed in full detail as part of the MassDOT project.

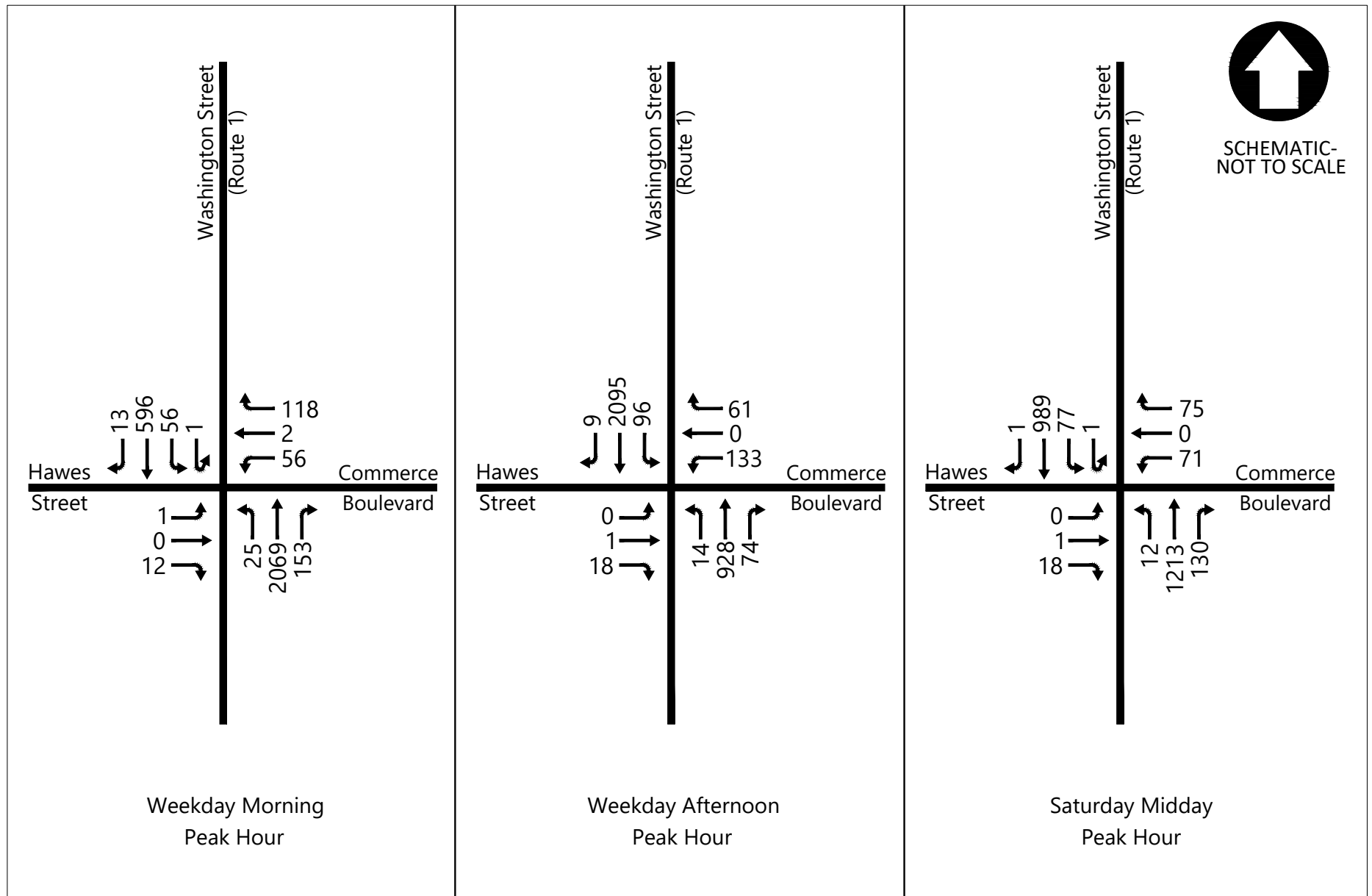
For the purposes of the 2030 Build analysis documented in this traffic impact study, the intersection improvements would include restriping the northbound and southbound Washington Street approaches to accommodate an exclusive left-turn lane, a through lane, and a shared through/right-turn lane. The westbound Commerce Boulevard approach would include an exclusive left-turn lane and a shared through/right-turn lane. The eastbound Hawes Street approach would continue to provide one general purpose travel lane. Crosswalks would be proposed at the signal to provide for pedestrian crossings across Washington Street and Commerce Boulevard. The intersection phasing would include a protected left-turn phase for Washington Street northbound and southbound traffic, followed by northbound and southbound general traffic, an exclusive pedestrian phase activated upon push-button only, and the Hawes Street/Commerce Boulevard eastbound and westbound general traffic. The proposed traffic signal would be coordinated with the signals along Washington Street at Thurston Street, Madison Street, and the existing pedestrian crossing signal, as determined appropriate by MassDOT, to facilitate traffic flow through the corridor.



SCHEMATIC-  
NOT TO SCALE







## Traffic Operations Analysis

In previous sections of this report, the quantity of traffic within the study area has been discussed. The following sections describe the overall quality of the traffic flow at the study area intersection during the weekday morning, weekday afternoon, and Saturday midday peak hours. As a basis for this assessment, intersection capacity analysis was conducted using the Synchro capacity analysis software at the intersection of Washington Street at Hawes Street/Commerce Boulevard under the 2023 Existing, 2030 No Build, and 2030 Build peak hour traffic conditions. The analysis is based on Synchro capacity analysis methodologies and procedures contained in the *Highway Capacity Manual, 6<sup>th</sup> Edition* (HCM), which is summarized in Appendix F. A discussion of the evaluation criteria and a summary of the results of the capacity analysis are presented below.

### Level-of-Service Criteria

Average total vehicle delay is reported as level-of-service (LOS) on a scale of A to F. LOS A represents delays of 10 seconds or less and LOS F represents delays in excess of 50 seconds for unsignalized intersections and greater than 80 seconds for signalized intersections. A more detailed description of the LOS criteria is provided in Appendix F.

### Capacity Analysis Results

Intersection capacity analysis was conducted using Synchro capacity analysis software for the intersection of Washington Street at Hawes Street/Commerce Boulevard to evaluate the 2023 Existing, 2030 No Build, and 2030 Build traffic conditions during the weekday morning, weekday afternoon, and Saturday midday peak hours. As mentioned previously, the peak hour traffic volumes utilized as part of this analysis are provided in the traffic projection model, attached in Appendix C of this report.

The Synchro capacity analysis results for the 2023 Existing, 2030 No Build, and 2030 Build traffic conditions are presented in Appendix G, Appendix H, and Appendix I, respectively. The capacity analysis results for the stop-controlled Hawes Street eastbound and Commerce Boulevard westbound approaches to the study area intersection under 2023 Existing and 2023 No Build conditions are presented in Table 2. The overall capacity analysis results for the study intersection under the proposed 2030 Build signalized condition are presented in Table 3. A more detailed summary of the capacity analysis each study area intersection is provided in Appendix J. The results of the capacity analysis at the study area intersection are discussed below.

**Table 2: Unsignalized Intersection Capacity Analysis**

Intersection	Peak Hour	Approach	2023 Existing			2030 No Build		
			LOS <sup>1</sup>	Delay <sup>2</sup>	V/C <sup>3</sup>	LOS	Delay	V/C
Washington Street at Hawes Street/ Commerce Boulevard	AM	EB	B	13.4	0.05	C	15.3	0.04
		WB	E	37.4	0.04	E	49.5	0.01
	PM	EB	C	22.2	0.12	C	23.9	0.10
		WB	F	163.9	0.50	F	273.2	0.52
	SAT	EB	B	11.8	0.04	B	12.7	0.04
		WB	F	83.8	0.39	F	159.6	0.53

1 Level-of-Service

2 Average vehicle delay in seconds

3 Volume to capacity ratio

As shown in Table 2 above, the eastbound Hawes Street approach of the intersection of Washington Street at Hawes Street/Commerce Boulevard is shown to currently operate at LOS B during the weekday morning peak hour, LOS C during the weekday afternoon peak hour, and LOS B during the Saturday midday peak hour. The westbound Commerce Boulevard approach is shown to currently operate at LOS E during the weekday morning peak hour, and LOS F but under capacity during the weekday afternoon and Saturday midday peak hours. Under 2030 No Build conditions, the eastbound Hawes Street approach is projected to operate at LOS during the weekday morning peak hour. All other approaches are projected to operate at the same LOS under 2023 Existing and 2030 No Build conditions during the peak hours analyzed.

**Table 3: 2030 Build Signalized Intersection Capacity Analysis**

Intersection	Movement	Weekday Morning Peak Hour			Weekday Afternoon Peak Hour			Saturday Midday Peak Hour		
		LOS <sup>1</sup>	Delay <sup>2</sup>	V/C <sup>3</sup>	LOS	Delay	V/C	LOS	Delay	V/C
Washington Street at Hawes Street/ Commerce Boulevard	EB LTR	A	0.8	0.08	B	17.2	0.09	B	17.2	0.12
	WB L	E	76.5	0.65	E	73.0	0.80	D	51.8	0.54
	TR	C	31.1	0.65	A	1.0	0.18	A	2.2	0.27
	NB L	D	38.6	0.25	A	5.2	0.09	D	49.2	0.11
	TR	B	18.0	0.97	A	7.6	0.49	A	6.2	0.61
	SB L	E	70.0	0.59	A	1.9	0.28	D	41.4	0.51
	TR	A	4.0	0.28	B	13.2	0.92	B	10.0	0.39
	<b>Overall</b>	<b>B</b>	<b>17.9</b>	<b>0.82</b>	<b>B</b>	<b>13.4</b>	<b>0.92</b>	<b>B</b>	<b>10.2</b>	<b>0.68</b>

1 Level-of-Service

2 Average vehicle delay in seconds

3 Volume to capacity ratio, intersection capacity utilization reported for overall

With the proposed signal in place, the intersection of Washington Street at Hawes Street/Commerce Boulevard would be projected to operate at overall LOS B during the weekday morning, weekday afternoon, and Saturday midday peak hours. The northbound and southbound through movements on Washington Street are projected to operate at LOS B or better during the peak hours analyzed. The

westbound left-turn movement is shown to operate at LOS E during the weekday morning and afternoon peak hours, and LOS D during the Saturday midday peak hour. Signal timings which result in higher delay experienced by the Commerce Boulevard approach are intended to prioritize the Washington Street corridor and will be reviewed in more detail with MassDOT during future permitting processes.

### **Site Access and Circulation**

Access to the proposed gas station and convenience store would be provided via two full-access driveways on Commerce Boulevard. Sidewalks would be provided on both sides of Commerce Boulevard to facilitate pedestrian access between the project site and Washington Street. The proposed traffic signal at the intersection of Washington Street at Hawes Street would provide more protected access for vehicles turning into and out of Commerce Boulevard. As part of the signalization, proposed crosswalks on the north and east side of the intersection would provide additional pedestrian access to and from the Wrentham Business Center, including the proposed gas station and convenience store.



## CONCLUSION

The proposed gas station and convenience store would be developed on Lot 1 of the overall Wrentham Business Center subdivision project located on the east side of Washington Street (Route 1) in Wrentham, MA. The project would construct an approximately 4,500 square foot convenience store and a gas station with six vehicle fueling pumps (12 total fueling positions). Access to the site would be provided by two driveways on Commerce Boulevard.

Based on the analysis presented in this traffic impact study, the proposed development is estimated to result in approximately 78 new vehicle trips (39 entering vehicles and 39 exiting vehicles) during the weekday morning peak hour, approximately 68 new vehicle trips (34 entering vehicles and 34 exiting vehicles) during the weekday afternoon peak hour, and approximately 61 new vehicle trips (33 entering vehicles and 28 exiting vehicles) during the Saturday midday peak hour.

As part of the proposed Wrentham Business Center project, the intersection of Washington Street at Hawes Street/Commerce Boulevard is proposed to be placed under traffic signal control. The proposed signal is warranted based on the counted vehicle volumes on Washington Street and Hawes Street, and the projected vehicle volumes on Commerce Boulevard with the proposed warehouse and gas station projects in place. Signal timings and coordination would be adjusted along the Washington Street corridor to facilitate efficient traffic flow. The proposed signalization of the intersection would include crosswalks on the north and east sides of the intersection. Pedestrian access to and from the project site and proposed signal would be provided via sidewalks on both sides of Commerce Boulevard.

Under 2030 Build conditions, with the proposed gas station and convenience store project, proposed warehouse project, and the traffic signal in place, the intersection of Washington Street at Hawes Street/Commerce Boulevard is projected to operate at overall LOS B during the weekday morning, weekday afternoon, and Saturday midday peak hours. Signal timing and phasing included in the analysis of this traffic impact study is proposed to prioritize movements along the Washington Street corridor, while providing additional signalized protection of vehicles entering and exiting Commerce Boulevard and Hawes Street. Additional coordination and review will be required by MassDOT to finalize the ultimate signal timing, phasing, and configuration of the proposed signalized intersection.

Based on the analysis presented in this study, the traffic projected to be generated by the proposed gas station and convenience store development is not shown to have a significant impact on the study area intersection with the proposed traffic signal in place.

# Appendix for Traffic Impact Study

## Proposed Gas Station & Convenience Store

Commerce Boulevard  
Wrentham, MA

Prepared by  
**McMahon, a Bowman Company**  
350 Myles Standish Boulevard Ste 103  
Taunton, MA

Prepared for  
**Edgewood Development Company, LLC**  
May 2023

**APPENDIX A**  
Traffic Count Data

Client: Emil Gruber, EIT  
 Project #: 1231\_1\_MM  
 BTD #: Location 3  
 Location: Wrentham, MA  
 Street 1: Washington Street (Route 1)  
 Street 2: Hawes St/Supercharged driveway  
 Count Date: 4/1/2023  
 Day of Week: Saturday  
 Weather: Rain, 40°F

# BOSTON

## TRAFFIC DATA

PO BOX 1723, Framingham, MA 01701  
 Office: 978-746-1259  
 DataRequest@BostonTrafficData.com  
 www.BostonTrafficData.com

### PASSENGER CARS & HEAVY VEHICLES COMBINED

Washington Street (Route 1) Northbound					Washington Street (Route 1) Southbound				Hawes Street Eastbound				Supercharged driveway Westbound			
Start Time	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right
11:00 AM	0	0	210	6	0	1	202	1	0	0	0	3	0	1	0	1
11:15 AM	0	4	222	4	0	0	211	3	0	1	0	5	0	1	0	0
11:30 AM	0	4	248	6	0	0	221	0	0	0	0	5	0	0	0	1
11:45 AM	0	1	291	19	1	5	228	1	0	0	0	4	0	4	0	2
12:00 PM	0	2	279	17	0	6	226	0	0	0	0	5	0	1	0	6
12:15 PM	0	4	254	8	0	4	217	0	0	0	0	3	0	2	0	0
12:30 PM	0	4	269	13	0	3	212	0	0	0	0	5	0	4	0	2
12:45 PM	0	2	258	17	0	5	223	0	0	0	0	7	1	6	0	3
1:00 PM	0	3	233	3	1	4	252	3	0	0	0	3	0	4	0	3
1:15 PM	0	3	256	15	0	7	193	1	0	0	0	0	0	4	0	0
1:30 PM	0	5	284	14	0	6	245	2	0	0	0	3	0	10	0	2
1:45 PM	0	2	274	15	0	6	262	0	0	0	0	5	0	3	0	5

MID PEAK HOUR 1:00 PM to 2:00 PM	Washington Street (Route 1) Northbound				Washington Street (Route 1) Southbound				Hawes Street Eastbound				Supercharged driveway Westbound			
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right
	0	13	1047	47	1	23	952	6	0	0	0	11	0	21	0	10
<b>PHF</b>	<b>0.91</b>				<b>0.92</b>				<b>0.55</b>				<b>0.65</b>			
<b>HV %</b>	0.0%	0.0%	0.8%	0.0%	0.0%	0.0%	0.5%	0.0%	0.0%	0.0%	0.0%	9.1%	0.0%	0.0%	0.0%	0.0%

Client: Emil Gruber, EIT  
 Project #: 1231\_1\_MM  
 BTD #: Location 3  
 Location: Wrentham, MA  
 Street 1: Washington Street (Route 1)  
 Street 2: Hawes St/Supercharged driveway  
 Count Date: 4/1/2023  
 Day of Week: Saturday  
 Weather: Rain, 40°F

# BOSTON

## TRAFFIC DATA

PO BOX 1723, Framingham, MA 01701  
 Office: 978-746-1259  
 DataRequest@BostonTrafficData.com  
 www.BostonTrafficData.com

### HEAVY VEHICLES

Washington Street (Route 1) Northbound					Washington Street (Route 1) Southbound				Hawes Street Eastbound				Supercharged driveway Westbound			
Start Time	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right
11:00 AM	0	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0
11:15 AM	0	0	1	0	0	0	4	0	0	0	0	0	0	0	0	0
11:30 AM	0	0	4	0	0	0	1	0	0	0	0	0	0	0	0	0
11:45 AM	0	0	2	0	0	0	3	0	0	0	0	1	0	0	0	0
12:00 PM	0	0	5	0	0	0	1	0	0	0	0	0	0	0	0	0
12:15 PM	0	0	3	0	0	0	4	0	0	0	0	0	0	0	0	0
12:30 PM	0	0	2	0	0	0	4	0	0	0	0	0	0	0	0	0
12:45 PM	0	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0
1:00 PM	0	0	2	0	0	0	3	0	0	0	0	0	0	0	0	0
1:15 PM	0	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0
1:30 PM	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
1:45 PM	0	0	2	0	0	0	0	0	0	0	0	1	0	0	0	0

MID PEAK HOUR 11:45 AM to 12:45 PM <i>PHF</i>	Washington Street (Route 1) Northbound				Washington Street (Route 1) Southbound				Hawes Street Eastbound				Supercharged driveway Westbound			
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right
	0	0	12	0	0	0	12	0	0	0	0	1	0	0	0	0
	0.60				0.75				0.25				0.00			



Client: Emil Gruber, EIT  
 Project #: 1231\_1\_MM  
 BTM #: Location 3  
 Location: Wrentham, MA  
 Street 1: Washington Street (Route 1)  
 Street 2: Hawes St/Supercharged driveway  
 Count Date: 4/1/2023  
 Day of Week: Saturday  
 Weather: Rain, 40°F

# BOSTON

## TRAFFIC DATA

PO BOX 1723, Framingham, MA 01701  
 Office: 978-746-1259  
 DataRequest@BostonTrafficData.com  
 www.BostonTrafficData.com

### PEDESTRIANS & BICYCLES

Washington Street (Route 1) Northbound					Washington Street (Route 1) Southbound				Hawes Street Eastbound				Supercharged driveway Westbound			
Start Time	Left	Thru	Right	PED	Left	Thru	Right	PED	Left	Thru	Right	PED	Left	Thru	Right	PED
11:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11:30 AM	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
11:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
12:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12:15 PM	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
12:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

MID PEAK HOUR 1:00 PM to 2:00 PM	Washington Street (Route 1) Northbound				Washington Street (Route 1) Southbound				Hawes Street Eastbound				Supercharged driveway Westbound			
	Left	Thru	Right	PED	Left	Thru	Right	PED	Left	Thru	Right	PED	Left	Thru	Right	PED
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

NOTE: Peak hour summaries here correspond to peak hours identified for passenger car and heavy vehicles combined.

Client: Emil Gruber, EIT  
 Project #: 1232\_1\_MM  
 BTM #: Location 3  
 Location: Wrentham, MA  
 Street 1: Washington Street (Route 1)  
 Street 2: Hawes St/Supercharged driveway  
 Count Date: 4/4/2023  
 Day of Week: Tuesday  
 Weather: Clouds & Sun, 50°F

**BOSTON**  
**TRAFFIC DATA**  
 PO BOX 1723, Framingham, MA 01701  
 Office: 978-746-1259  
 DataRequest@BostonTrafficData.com  
 www.BostonTrafficData.com

**PASSENGER CARS & HEAVY VEHICLES COMBINED**

Washington Street (Route 1)				Washington Street (Route 1)				Hawes Street				Supercharged driveway				
Northbound				Southbound				Eastbound				Westbound				
Start Time	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right
7:00 AM	0	14	437	0	0	0	127	4	0	0	0	2	0	0	0	0
7:15 AM	0	7	487	0	0	0	132	5	0	1	0	3	0	0	0	0
7:30 AM	0	1	482	0	1	1	140	1	0	0	0	5	0	0	0	1
7:45 AM	0	1	486	1	0	0	117	3	0	0	0	1	0	0	0	0
8:00 AM	0	4	391	0	0	0	132	5	0	0	0	1	0	0	0	1
8:15 AM	0	1	371	1	0	0	150	1	0	1	0	1	0	0	0	0
8:30 AM	1	1	352	1	0	0	162	1	0	0	0	2	0	0	0	0
8:45 AM	0	1	313	3	0	0	142	0	0	0	0	5	0	1	0	0
9:00 AM	0	2	283	1	0	0	161	1	0	0	0	1	0	1	0	0
9:15 AM	0	1	264	1	0	0	141	0	0	0	0	3	0	0	0	1
9:30 AM	0	2	240	0	0	0	148	1	0	0	0	1	0	0	0	0
9:45 AM	0	3	268	0	0	0	148	2	0	0	0	1	0	0	0	0
10:00 AM	0	0	173	1	0	0	164	1	0	0	0	1	0	0	0	1
10:15 AM	0	1	195	1	0	0	146	0	0	0	0	2	0	1	0	1
10:30 AM	0	1	209	1	0	0	185	0	0	0	0	3	0	0	0	0
10:45 AM	0	2	211	2	0	0	163	1	0	0	0	1	0	0	0	0
11:00 AM	0	2	191	0	0	0	175	1	0	0	0	1	0	1	0	0
11:15 AM	0	2	149	1	0	0	192	0	0	0	0	0	0	0	0	0
11:30 AM	0	2	169	0	0	0	175	1	0	0	0	2	0	0	0	1
11:45 AM	0	3	167	4	0	0	207	3	0	0	0	1	0	1	0	0
12:00 PM	0	1	179	0	0	0	186	0	0	0	0	0	0	0	0	1
12:15 PM	0	5	182	2	0	0	157	0	0	0	0	1	0	0	0	1
12:30 PM	0	2	222	4	0	1	210	1	0	0	0	2	0	0	0	1
12:45 PM	0	2	191	4	0	0	205	5	0	0	0	9	0	3	0	0
1:00 PM	0	4	175	2	0	2	199	1	0	0	0	2	0	1	0	0
1:15 PM	0	3	210	2	0	1	238	0	0	0	0	5	0	0	0	1
1:30 PM	0	0	218	1	0	1	210	0	0	0	0	2	0	1	0	0
1:45 PM	0	3	167	2	0	1	213	2	0	0	0	2	0	1	0	1
2:00 PM	0	5	213	1	0	0	270	4	0	0	0	4	0	1	0	0
2:15 PM	0	3	213	0	0	1	465	2	0	0	0	3	0	0	0	4
2:30 PM	0	6	221	1	0	0	318	0	0	0	0	5	0	1	0	0
2:45 PM	0	5	225	1	0	0	305	1	0	0	0	2	0	0	0	1
3:00 PM	0	3	183	1	0	0	404	2	0	0	0	0	0	0	0	0
3:15 PM	0	1	182	1	0	0	392	1	0	0	0	1	0	1	0	0
3:30 PM	0	1	197	2	0	4	415	2	0	0	0	2	0	0	0	0
3:45 PM	0	4	192	4	0	3	394	0	0	0	0	4	0	4	0	2
4:00 PM	0	3	207	0	0	2	453	3	0	0	0	5	0	5	0	2
4:15 PM	0	2	199	1	0	1	455	2	0	0	0	2	0	1	0	0
4:30 PM	0	3	206	2	0	0	442	1	0	0	0	3	0	1	0	1
4:45 PM	0	3	202	0	0	4	474	1	0	0	0	2	0	1	0	2
5:00 PM	0	6	206	4	0	1	482	3	0	0	0	4	0	0	0	1
5:15 PM	0	1	205	6	0	0	529	3	0	0	0	4	0	1	0	1
5:30 PM	0	3	205	4	0	0	410	1	0	0	0	7	0	5	0	0
5:45 PM	0	2	207	1	1	4	349	5	0	0	0	6	0	1	0	2
6:00 PM	0	8	175	0	1	1	339	2	0	0	0	2	0	3	0	4
6:15 PM	0	7	151	5	0	0	353	0	0	0	0	0	0	1	0	1
6:30 PM	0	2	172	4	0	1	217	1	0	0	0	5	0	0	0	0
6:45 PM	0	5	146	3	0	1	198	1	0	0	0	2	0	0	0	0

AM PEAK HOUR 7:00 AM to 8:00 AM		Washington Street (Route 1) Northbound				Washington Street (Route 1) Southbound				Hawes Street Eastbound				Supercharged driveway Westbound			
PHF		U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right
HV %		0	23	1892	1	1	1	516	13	0	1	0	11	0	0	0	1
		0.97				0.93				0.60				0.25			
		0.0%	0.0%	3.9%	0.0%	0.0%	100.0%	13.0%	0.0%	0.0%	0.0%	0.0%	9.1%	0.0%	0.0%	0.0%	100.0%

MID PEAK HOUR 12:30 PM to 1:30 PM		Washington Street (Route 1) Northbound				Washington Street (Route 1) Southbound				Hawes Street Eastbound				Supercharged driveway Westbound			
PHF		U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right
HV %		0	11	798	12	0	4	852	7	0	0	0	18	0	4	0	2
		0.90				0.90				0.50				0.50			
		0.0%	9.1%	7.4%	8.3%	0.0%	25.0%	8.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	25.0%	0.0%	0.0%

PM PEAK HOUR 4:30 PM to 5:30 PM		Washington Street (Route 1) Northbound				Washington Street (Route 1) Southbound				Hawes Street Eastbound				Supercharged driveway Westbound			
PHF		U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right
HV %		0	13	819	12	0	5	1927	8	0	0	0	13	0	3	0	5
		0.98				0.91				0.81				0.67			
		0.0%	7.7%	2.9%	0.0%	0.0%	0.0%	1.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Client: Emil Gruber, EIT  
 Project #: 1232\_1\_MM  
 BTD #: Location 3  
 Location: Wrentham, MA  
 Street 1: Washington Street (Route 1)  
 Street 2: Hawes St/Supercharged driveway  
 Count Date: 4/4/2023  
 Day of Week: Tuesday  
 Weather: Clouds & Sun, 50°F



### HEAVY VEHICLES

Washington Street (Route 1)					Washington Street (Route 1)				Hawes Street				Supercharged driveway			
Northbound					Southbound				Eastbound				Westbound			
Start Time	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right
7:00 AM	0	0	21	0	0	0	17	0	0	0	0	1	0	0	0	0
7:15 AM	0	0	21	0	0	0	16	0	0	0	0	0	0	0	0	0
7:30 AM	0	0	15	0	0	1	20	0	0	0	0	0	0	0	0	1
7:45 AM	0	0	17	0	0	0	14	0	0	0	0	0	0	0	0	0
8:00 AM	0	0	18	0	0	0	16	1	0	0	0	0	0	0	0	0
8:15 AM	0	0	23	0	0	0	17	0	0	0	0	0	0	0	0	0
8:30 AM	0	0	16	0	0	0	13	0	0	0	0	0	0	0	0	0
8:45 AM	0	0	11	0	0	0	16	0	0	0	0	0	0	0	0	0
9:00 AM	0	0	19	1	0	0	22	0	0	0	0	0	0	0	0	0
9:15 AM	0	0	15	0	0	0	18	0	0	0	0	0	0	0	0	1
9:30 AM	0	0	14	0	0	0	15	0	0	0	0	0	0	0	0	0
9:45 AM	0	0	25	0	0	0	21	0	0	0	0	0	0	0	0	0
10:00 AM	0	0	14	0	0	0	21	0	0	0	0	0	0	0	0	0
10:15 AM	0	0	17	0	0	0	15	0	0	0	0	0	0	0	0	0
10:30 AM	0	0	16	0	0	0	15	0	0	0	0	0	0	0	0	0
10:45 AM	0	0	11	0	0	0	20	0	0	0	0	0	0	0	0	0
11:00 AM	0	0	21	0	0	0	21	1	0	0	0	0	0	0	0	0
11:15 AM	0	0	8	0	0	0	23	0	0	0	0	0	0	0	0	0
11:30 AM	0	0	7	0	0	0	14	0	0	0	0	0	0	0	0	0
11:45 AM	0	0	12	0	0	0	13	0	0	0	0	0	0	0	0	0
12:00 PM	0	0	15	0	0	0	12	0	0	0	0	0	0	0	0	0
12:15 PM	0	0	14	0	0	0	12	0	0	0	0	0	0	0	0	0
12:30 PM	0	0	18	1	0	0	17	0	0	0	0	0	0	0	0	0
12:45 PM	0	0	13	0	0	0	21	0	0	0	0	0	0	1	0	0
1:00 PM	0	1	10	0	0	0	17	0	0	0	0	0	0	0	0	0
1:15 PM	0	0	18	0	0	1	18	0	0	0	0	0	0	0	0	0
1:30 PM	0	0	10	0	0	0	11	0	0	0	0	0	0	1	0	0
1:45 PM	0	0	8	0	0	0	13	0	0	0	0	0	0	0	0	0
2:00 PM	0	0	16	0	0	0	19	0	0	0	0	0	0	0	0	0
2:15 PM	0	0	6	0	0	0	8	0	0	0	0	0	0	0	0	0
2:30 PM	0	0	8	0	0	0	14	0	0	0	0	1	0	0	0	0
2:45 PM	0	1	5	0	0	0	15	0	0	0	0	0	0	0	0	0
3:00 PM	0	0	9	0	0	0	9	0	0	0	0	0	0	0	0	0
3:15 PM	0	0	12	0	0	0	13	0	0	0	0	0	0	0	0	0
3:30 PM	0	0	11	0	0	0	16	1	0	0	0	0	0	0	0	0
3:45 PM	0	0	15	0	0	0	9	0	0	0	0	0	0	0	0	0
4:00 PM	0	0	6	0	0	0	9	0	0	0	0	0	0	0	0	0
4:15 PM	0	0	6	0	0	0	8	0	0	0	0	0	0	0	0	0
4:30 PM	0	0	7	0	0	0	13	0	0	0	0	0	0	0	0	0
4:45 PM	0	0	12	0	0	0	5	0	0	0	0	0	0	0	0	0
5:00 PM	0	1	2	0	0	0	10	0	0	0	0	0	0	0	0	0
5:15 PM	0	0	3	0	0	0	6	0	0	0	0	0	0	0	0	0
5:30 PM	0	0	6	0	0	0	7	0	0	0	0	0	0	0	0	0
5:45 PM	0	0	3	0	0	0	4	0	0	0	0	0	0	0	0	0
6:00 PM	0	0	3	0	0	0	3	0	0	0	0	0	0	0	0	0
6:15 PM	0	0	2	0	0	0	3	0	0	0	0	0	0	0	0	0
6:30 PM	0	0	3	0	0	0	3	0	0	0	0	0	0	0	0	0
6:45 PM	0	0	3	0	0	0	2	0	0	0	0	0	0	0	0	0

AM PEAK HOUR 9:00 AM to 10:00 AM PHF	Washington Street (Route 1) Northbound				Washington Street (Route 1) Southbound				Hawes Street Eastbound				Supercharged driveway Westbound			
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right
	0	0	73	1	0	0	76	0	0	0	0	0	0	0	0	1
0.74				0.86				0.00				0.25				

MID PEAK HOUR 10:15 AM to 11:15 AM PHF	Washington Street (Route 1) Northbound				Washington Street (Route 1) Southbound				Hawes Street Eastbound				Supercharged driveway Westbound			
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right
	0	0	65	0	0	0	71	1	0	0	0	0	0	0	0	0
0.77				0.82				0.00				0.00				

PM PEAK HOUR 3:00 PM to 4:00 PM PHF	Washington Street (Route 1) Northbound				Washington Street (Route 1) Southbound				Hawes Street Eastbound				Supercharged driveway Westbound			
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right
	0	0	47	0	0	0	47	1	0	0	0	0	0	0	0	0
0.78				0.71				0.00				0.00				

Client: Emil Gruber, EIT  
 Project #: 1232\_1\_MM  
 BTM #: Location 3  
 Location: Wrentham, MA  
 Street 1: Washington Street (Route 1)  
 Street 2: Hawes St/Supercharged driveway  
 Count Date: 4/4/2023  
 Day of Week: Tuesday  
 Weather: Clouds & Sun, 50°F

# BOSTON

## TRAFFIC DATA

PO BOX 1723, Framingham, MA 01701  
 Office: 978-746-1259  
 DataRequest@BostonTrafficData.com  
 www.BostonTrafficData.com

### PEDESTRIANS & BICYCLES

Start Time	Washington Street (Route 1) Northbound				Washington Street (Route 1) Southbound				Hawes Street Eastbound				Supercharged driveway Westbound			
	Left	Thru	Right	PED	Left	Thru	Right	PED	Left	Thru	Right	PED	Left	Thru	Right	PED
7:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:30 AM	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
7:45 AM	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	1
8:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11:00 AM	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
11:15 AM	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
11:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12:15 PM	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
12:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
12:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3:15 PM	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
3:30 PM	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
3:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
4:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:00 PM	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
5:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
6:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
6:30 PM	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
6:45 PM	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0

AM PEAK HOUR 7:00 AM to 8:00 AM	Washington Street (Route 1) Northbound				Washington Street (Route 1) Southbound				Hawes Street Eastbound				Supercharged driveway Westbound			
	Left	Thru	Right	PED	Left	Thru	Right	PED	Left	Thru	Right	PED	Left	Thru	Right	PED
	0	0	0	1	0	0	0	0	0	0	0	3	0	0	0	1

MID PEAK HOUR 12:30 PM to 1:30 PM	Washington Street (Route 1) Northbound				Washington Street (Route 1) Southbound				Hawes Street Eastbound				Supercharged driveway Westbound			
	Left	Thru	Right	PED	Left	Thru	Right	PED	Left	Thru	Right	PED	Left	Thru	Right	PED
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1

PM PEAK HOUR 4:30 PM to 5:30 PM	Washington Street (Route 1) Northbound				Washington Street (Route 1) Southbound				Hawes Street Eastbound				Supercharged driveway Westbound			
	Left	Thru	Right	PED	Left	Thru	Right	PED	Left	Thru	Right	PED	Left	Thru	Right	PED
	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0

NOTE: Peak hour summaries here correspond to peak hours identified for passenger car and heavy vehicles combined.

**APPENDIX B**  
Seasonal Adjustment Data

## SEASONAL ADJUSTMENT DATA

**Proposed Gas Station & Convenience Store**

**Wrentham, MA**

MassDOT Continuous Count Station					% Above	
ID	Town	Roadway	Year	AADT	April ADT	AADT
6312	Mansfield	I-495	2017	85,149	81,244	-4.6%
			2015	79,034	76,995	-2.6%
Average				82,098	79,120	-3.6%

**APPENDIX C**  
Traffic Projection Model

## TRAFFIC PROJECTION MODEL

**Weekday Morning Peak Hour**

**Proposed Gas Station & Convenience Store**

**Wrentham, MA**

Intersection	Dir.	Turn	2023 Counted Volumes	Seasonal Adjustment	2023 Existing Volumes	Background Growth 7 yrs (1% per year)	500 Thurston St Gas Station	500-524 Thurston St Warehouse	2030 No Build Volumes	15 Commerce Blvd Warehouse	Project Trips PERCENT ENTER	Project Trips ENTER	Project Trips PERCENT EXIT	Project Trips EXIT	Pass-by Trips	Project Trips TOTAL	2030 Build Volumes
Washington Street at	EB	L	1	0	1	0			1						0	0	1
Hawes Street/Commerce Blvd		T	0	0	0	0			0	0					0	0	0
& ITP South Driveway		R	11	0	11	1			12						0	0	12
	WB	L	0	0	0	0			0	10			50%	20	26	46	56
		T	0	0	0	0			0	0					2	2	2
		R	1	0	1	0			1	3			50%	19	95	114	118
	NB	U	0	0	0	0			0							0	0
		L	23	1	24	2			26						-1	-1	25
		T	1892	71	1963	142	44	15	2164						-95	-95	2069
		R	1	0	1	0			1	36	50%	20			96	116	153
	SB	U	1	0	1	0			1							0	1
		L	1	0	1	0			1	9	50%	19			27	46	56
		T	516	19	535	39	43	5	622						-26	-26	596
		R	13	0	13	1			14						-1	-1	13

Peak Hour: 7:00AM - 8:00AM



## TRAFFIC PROJECTION MODEL

Weekday Afternoon Peak Hour

Proposed Gas Station & Convenience Store

Wrentham, MA

Intersection	Dir.	Turn	2023 Counted Volumes	Seasonal Adjustment	2023 Existing Volumes	Background Growth 7 yrs (1% per year)	500 Thurston St Gas Station	500-524 Thurston St Warehouse	2030 No Build Volumes	15 Commerce Blvd Warehouse	Project Trips PERCENT ENTER	Project Trips ENTER	Project Trips PERCENT EXIT	Project Trips EXIT	Pass-by Trips	Project Trips TOTAL	2030 Build Volumes
Washington Street at	EB	L	0	0	0	0			0						0	0	0
Hawes Street/Commerce Blvd		T	0	0	0	0			0	0					1	1	1
& ITP South Driveway		R	17	1	18	1			19						-1	-1	18
	WB	L	7	0	7	0			7	37			50%	17	72	89	133
		T	0	0	0	0			0	0					0	0	0
		R	4	0	4	0			4	9			50%	17	31	48	61
	NB	U	0	0	0	0			0						0	0	0
		L	13	0	13	1			14						0	0	14
		T	818	31	849	61	43	6	959						-31	-31	928
		R	14	0	14	0			14	12	50%	17			31	48	74
	SB	U	0	0	0	0			0							0	0
		L	5	0	5	0			5	3	50%	17			71	88	96
		T	1895	71	1966	142	42	16	2166						-71	-71	2095
		R	8	0	8	1			9						0	0	9

Peak Hour: 4:45PM - 5:45PM

## TRAFFIC PROJECTION MODEL

**Saturday Midday Peak Hour**  
**Proposed Gas Station & Convenience Store**  
**Wrentham, MA**

Intersection	Dir.	Turn	2023 Counted Volumes	Seasonal Adjustment	2023 Existing Volumes	Background Growth 7 yrs (1% per year)	500 Thurston St Gas Station	500-524 Thurston St Warehouse	2030 No Build Volumes	15 Commerce Blvd Warehouse	Project Trips PERCENT ENTER	Project Trips ENTER	Project Trips PERCENT EXIT	Project Trips EXIT	Pass-by Trips	Project Trips TOTAL	2030 Build Volumes
Washington Street at	EB	L	0	0	0	0			0						0	0	0
Hawes Street/Commerce Blvd		T	0	0	0	0			0	0					1	1	1
& ITP South Driveway		R	17	1	18	1			19						-1	-1	18
	WB	L	11	0	11	0			11	4			50%	14	42	56	71
		T	0	0	0	0			0	0					0	0	0
		R	10	0	10	0			10	1			50%	14	50	64	75
	NB	U	0	0	0	0			0						0	0	0
		L	11	0	11	1			12						0	0	12
		T	1093	41	1134	82	44	3	1263						-50	-50	1213
		R	57	0	57	0			57	6	50%	17			50	67	130
	SB	U	1	0	1	0			1							0	1
		L	18	0	18	0			18	2	50%	16			41	57	77
		T	883	33	920	66	42	2	1030						-41	-41	989
		R	1	0	1	0			1						0	0	1

Peak Hour: 11:45AM - 12:45PM

**APPENDIX D**  
Crash Analysis

## CRASH ANALYSIS

### Proposed Gas Station & Convenience Store Wrentham, MA

Washington Street at Hawes Street	
<b>Year</b>	
2015	2
2016	1
2017	4
2018	5
2019	2
2020	2
<b>Type</b>	
Angle	5
Rear-end	4
Sideswipe	3
Head-on	0
Single Vehicle	3
Other	0
Unknown	1
<b>Severity</b>	
Property Damage	9
Personal Injury	6
Fatality	0
Unknown	1
<b>Weather</b>	
Clear	9
Cloudy	2
Rain	3
Snow	0
Fog	0
Unknown	2
<i>Total</i>	16
<b>Road Surface</b>	
Dry	12
Wet	3
Ice	0
Snow	0
Unknown	1
<b>Time</b>	
7:00 AM to 9:00 AM	0
9:00 AM to 4:00 PM	7
4:00 PM to 6:00 PM	3
6:00 PM to 7:00 AM	6
<b>Total</b>	<b>16</b>
Crash Rate	0.26
State Average	0.57
District 5 Average	0.57
Source: MassDOT	

**APPENDIX E**  
Signal Warrant Analysis

# HCS7 Warrants Report

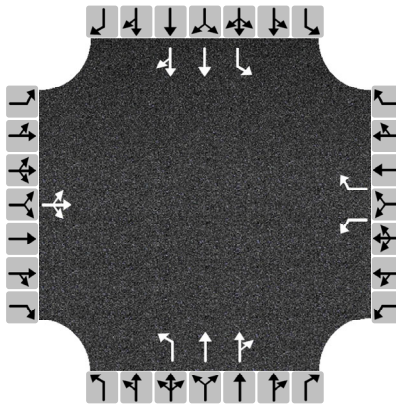
## Project Information

Analyst	McMahon Associates	Date	5/19/2023
Agency		Analysis Year	
Jurisdiction	MassDOT	Time Period Analyzed	2023 Existing w/ Project
Project Description	Wrentham Business Center		

## General

Major Street Direction	North-South	Population < 10,000	No
Starting Time Interval	6	Coordinated Signal System	Yes
Median Type	Undivided	Crashes (crashes/year)	0
Major Street Speed (mi/h)	55	Adequate Trials of Crash Exp. Alt.	No
Nearest Signal (ft)	2400		

## Geometry and Traffic



Approach	Eastbound			Westbound			Northbound			Southbound		
Movement	L	T	R	L	T	R	L	T	R	L	T	R
Number of Lanes, N	0	1	0	1	0	1	1	2	0	1	2	0
Lane Usage		LTR		L		R	L	TR		L	TR	
Vehicle Volumes Averages (veh/h)	0	0	10	65	0	51	12	940	6	2	1032	6
Pedestrian Averages (peds/h)	0			0			0			0		
Gap Averages (gaps/h)	0			0			0			0		
Delay (s/veh)	0.0			0.0			0.0			0.0		
Delay (veh-hrs)	0.0			0.0			0.0			0.0		

## School Crossing and Roadway Network

Number of Students in Highest Hour	0	Two or More Major Routes	No
Number of Adequate Gaps in Period	0	Weekend Counts	No
Number of Minutes in Period	0	5-year Growth Factor (%)	0

## Railroad Crossing

Grade Crossing Approach	None	Rail Traffic (trains/day)	0
Highest Volume Hour with Trains	Unknown	High Occupancy Buses (%)	0
Distance to Stop Line (ft)		Tractor-Trailer Trucks (%)	7

# HCS7 Warrants Report

## Volume Summary

Hour	Major Volume	Minor Volume	Total Volume	Peds/h	Gaps/h	1A ( 70% )	1A ( 56% )	1B ( 70% )	1B ( 56% )	2 ( 70% )	3A ( 70% )	3B ( 70% )	4A ( 70% )	4B ( 70% )
07 - 08	2446	100	2558	0	0	No	No	Yes	Yes	Yes	No	No	No	No
08 - 09	2032	112	2154	0	0	No	Yes	Yes	Yes	Yes	No	Yes	No	No
09 - 10	1667	102	1775	0	0	No	No	Yes	Yes	Yes	No	Yes	No	No
10 - 11	1457	99	1563	0	0	No	No	Yes	Yes	Yes	No	No	No	No
11 - 12	1444	111	1559	0	0	No	No	Yes	Yes	Yes	No	Yes	No	No
12 - 13	1559	127	1698	0	0	No	Yes	Yes	Yes	Yes	No	Yes	No	No
13 - 14	1655	111	1777	0	0	No	No	Yes	Yes	Yes	No	Yes	No	No
14 - 15	2260	117	2391	0	0	No	Yes	Yes	Yes	Yes	No	Yes	No	No
15 - 16	2388	138	2533	0	0	No	Yes	Yes	Yes	Yes	No	Yes	No	No
16 - 17	2666	140	2818	0	0	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No
17 - 18	2637	142	2800	0	0	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No
18 - 19	1792	101	1902	0	0	No	No	Yes	Yes	Yes	No	Yes	No	No
Total	24003	1400	25528	0	0	2	6	12	12	12	0	10	0	0

## Warrants

### Warrant 1: Eight-Hour Vehicular Volume



A. Minimum Vehicular Volumes (Both major approaches --and-- higher minor approach) --or--

B. Interruption of Continuous Traffic (Both major approaches --and-- higher minor approach) --or--



56% Vehicular --and-- Interruption Volumes (Both major approaches --and-- higher minor approach)

### Warrant 2: Four-Hour Vehicular Volume



Four-Hour Vehicular Volume (Both major approaches --and-- higher minor approach)



### Warrant 3: Peak Hour



A. Peak-Hour Conditions (Minor delay -- and-- minor volume --and-- total volume) --or--

B. Peak-Hour Vehicular Volumes (Both major approaches --and-- higher minor approach)



### Warrant 4: Pedestrian Volume

A. Four Hour Volumes --or--

B. One-Hour Volumes

### Warrant 5: School Crossing

Gaps Same Period --and--

Student Volumes

Nearest Traffic Control Signal (optional)



### Warrant 6: Coordinated Signal System



Degree of Platooning (Predominant direction or both directions)



### Warrant 7: Crash Experience

A. Adequate trials of alternatives, observance and enforcement failed --and--

B. Reported crashes susceptible to correction by signal (12-month period) --and--

C. 56% Volumes for Warrants 1A, 1B, --or-- 4 are satisfied



### Warrant 8: Roadway Network

A. Weekday Volume (Peak hour total --and-- projected warrants 1, 2, or 3) --or--

B. Weekend Volume (Five hours total)

### Warrant 9: Grade Crossing

A. Grade Crossing within 140 ft --and--

B. Peak-Hour Vehicular Volumes

## **APPENDIX F**

### Highway Capacity Manual Methodologies



## CAPACITY/LEVEL-OF-SERVICE ANALYSES METHODOLOGY

The detailed capacity/level-of-service analysis contained in this traffic impact study was performed in accordance with the standard techniques contained in the *Highway Capacity Manual*.<sup>(1)</sup> By definition, capacity represents “the maximum rate of flow that can reasonably be expected to pass a point on a uniform section of a lane or roadway under prevailing roadway, traffic, and control conditions.” The level of functioning of an intersection or a uniform section of a lane or roadway can be expressed in terms of levels of service. Level of service (LOS) is defined as “a qualitative measure describing operational conditions within a traffic stream, and their perception by motorists and/or passengers”. Such measures include “speed and travel time, freedom to maneuver, traffic interruptions, comfort and convenience, and safety.”

At unsignalized intersections, a methodology for evaluating the relative functioning of intersections controlled by stop or yield signs has been developed, and is based on several assumptions, including:

- Major street flows are not affected by the minor (stop-sign controlled) street movements.
- Left turns from the major street to the minor street are influenced only by opposing major street through flow.
- Minor street left turns are impeded by all major street traffic plus opposing minor street traffic.
- Minor street through traffic is impeded by all major street traffic.
- Minor street right turns are impeded only by the major street traffic coming from the left.

The concept of stop-controlled or yield-controlled intersection analysis is based on the estimate of average total delay on minor streets. The methodology of analysis relies on three elements: the size and distribution of gaps in the major traffic stream, the usefulness of these gaps to the minor stream drivers, and the relative priority of the various traffic streams at the intersection. The results of the analysis provide an estimate of average total delay for the various critical movements at the unsignalized intersections. Correlation between average total delay and the respective levels of service are provided for unsignalized intersections as follows:

---

(1) *Transportation Research Board, Highway Capacity Manual, 6<sup>th</sup> Edition, published by the Transportation Research Board, Washington, DC, 2016.*

<i>Unsignalized Intersections</i>	
Level of Service	Control Delay Per Vehicle (seconds)
A	0 – 10
B	>10 – 15
C	>15 – 25
D	>25 – 35
E	>35 – 50
F	> 50

At signalized intersections, an additional element must be considered: time allocation. Level of service is based on the average control delay per vehicle for various movements within the intersection. Volume/capacity relationships also affect the operations of signalized intersections. Thus, both volume/capacity and delay must be considered to evaluate the overall operation of a signalized intersection. Correlation between average delay per vehicle and the respective levels of service are provided for signalized intersections as follows:

<i>Signalized Intersections</i>	
Level of Service	Control Delay Per Vehicle (seconds)
A	$\leq 10$
B	>10 – 20
C	>20 – 35
D	>35 – 55
E	>55 – 80
F	> 80

## **APPENDIX G**

### 2023 Existing Capacity/Level-of-Service Analysis

Wrentham Gas & Convenience  
1: Washington Street & Hawes Street/Commerce Boulevard

Weekday Morning Peak Hour  
2023 Existing

Intersection												
Int Delay, s/veh	0.5											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	1	0	11	0	0	1	24	1963	1	2	535	13
Future Vol, veh/h	1	0	11	0	0	1	24	1963	1	2	535	13
Conflicting Peds, #/hr	0	0	0	0	0	0	1	0	0	0	0	1
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	-4	-	-	1	-	-	-1	-	-	1	-
Peak Hour Factor	60	60	60	25	25	25	97	97	97	93	93	93
Heavy Vehicles, %	0	0	9	0	0	100	0	4	0	100	13	0
Mvmt Flow	2	0	18	0	0	4	25	2024	1	2	575	14

Major/Minor	Minor2		Minor1		Major1		Major2					
Conflicting Flow All	1649	2662	296	2367	2669	1013	590	0	0	2025	0	0
Stage 1	587	587	-	2075	2075	-	-	-	-	-	-	-
Stage 2	1062	2075	-	292	594	-	-	-	-	-	-	-
Critical Hdwy	6.7	5.7	6.68	7.7	6.7	9	4.1	-	-	6.1	-	-
Critical Hdwy Stg 1	5.7	4.7	-	6.7	5.7	-	-	-	-	-	-	-
Critical Hdwy Stg 2	5.7	4.7	-	6.7	5.7	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4	3.39	3.5	4	4.3	2.2	-	-	3.2	-	-
Pot Cap-1 Maneuver	96	41	703	17	20	115	995	-	-	78	-	-
Stage 1	533	569	-	50	86	-	-	-	-	-	-	-
Stage 2	307	154	-	686	480	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	90	39	702	16	19	115	994	-	-	78	-	-
Mov Cap-2 Maneuver	90	39	-	16	19	-	-	-	-	-	-	-
Stage 1	532	547	-	50	86	-	-	-	-	-	-	-
Stage 2	296	154	-	643	461	-	-	-	-	-	-	-

Approach	EB		WB		NB		SB	
HCM Control Delay, s	13.4		37.4		0.1		1.2	
HCM LOS	B		E					

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1WBLn1	SBL	SBT	SBR
Capacity (veh/h)	994	-	-	448	115	78	-
HCM Lane V/C Ratio	0.025	-	-	0.045	0.035	0.028	-
HCM Control Delay (s)	8.7	0	-	13.4	37.4	52.5	1
HCM Lane LOS	A	A	-	B	E	F	A
HCM 95th %tile Q(veh)	0.1	-	-	0.1	0.1	0.1	-

Wrentham Gas & Convenience  
1: Washington Street & Hawes Street/Commerce Boulevard

Weekday Afternoon Peak Hour  
2023 Existing

Intersection												
Int Delay, s/veh	1.7											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	0	0	18	7	0	4	13	849	14	5	1966	8
Future Vol, veh/h	0	0	18	7	0	4	13	849	14	5	1966	8
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	-4	-	-	1	-	-	-1	-	-	1	-
Peak Hour Factor	61	61	61	55	55	55	98	98	98	90	90	90
Heavy Vehicles, %	0	0	0	0	0	0	8	3	0	0	1	0
Mvmt Flow	0	0	30	13	0	7	13	866	14	6	2184	9

Major/Minor	Minor2		Minor1		Major1		Major2					
Conflicting Flow All	2660	3107	1097	2003	3104	440	2193	0	0	880	0	0
Stage 1	2201	2201	-	899	899	-	-	-	-	-	-	-
Stage 2	459	906	-	1104	2205	-	-	-	-	-	-	-
Critical Hdwy	6.7	5.7	6.5	7.7	6.7	7	4.26	-	-	4.1	-	-
Critical Hdwy Stg 1	5.7	4.7	-	6.7	5.7	-	-	-	-	-	-	-
Critical Hdwy Stg 2	5.7	4.7	-	6.7	5.7	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4	3.3	3.5	4	3.3	2.28	-	-	2.2	-	-
Pot Cap-1 Maneuver	20	23	239	32	10	563	218	-	-	777	-	-
Stage 1	76	136	-	290	343	-	-	-	-	-	-	-
Stage 2	616	437	-	215	74	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	18	20	239	26	9	563	218	-	-	777	-	-
Mov Cap-2 Maneuver	18	20	-	26	9	-	-	-	-	-	-	-
Stage 1	67	136	-	256	303	-	-	-	-	-	-	-
Stage 2	537	386	-	188	74	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	22.2	163.9	1.6	0
HCM LOS	C	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1WBLn1	SBL	SBT	SBR
Capacity (veh/h)	218	-	-	239	40	777	-
HCM Lane V/C Ratio	0.061	-	-	0.123	0.5	0.007	-
HCM Control Delay (s)	22.6	1.3	-	22.2	163.9	9.7	0
HCM Lane LOS	C	A	-	C	F	A	A
HCM 95th %tile Q(veh)	0.2	-	-	0.4	1.8	0	-

Wrentham Gas & Convenience  
1: Washington Street & Hawes Street/Commerce Boulevard

Saturday Midday Peak Hour  
2023 Existing

Intersection												
Int Delay, s/veh	1.6											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	0	0	18	11	0	10	11	1134	57	19	920	1
Future Vol, veh/h	0	0	18	11	0	10	11	1134	57	19	920	1
Conflicting Peds, #/hr	0	0	1	1	0	0	0	0	1	1	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	-4	-	-	1	-	-	-1	-	-	1	-
Peak Hour Factor	85	85	85	75	75	75	93	93	93	96	96	96
Heavy Vehicles, %	2	2	6	0	2	0	0	1	0	0	1	0
Mvmt Flow	0	0	21	15	0	13	12	1219	61	20	958	1

Major/Minor	Minor2		Minor1		Major1		Major2					
Conflicting Flow All	1633	2304	481	1795	2274	641	959	0	0	1281	0	0
Stage 1	999	999	-	1275	1275	-	-	-	-	-	-	-
Stage 2	634	1305	-	520	999	-	-	-	-	-	-	-
Critical Hdwy	6.74	5.74	6.62	7.7	6.74	7	4.1	-	-	4.1	-	-
Critical Hdwy Stg 1	5.74	4.74	-	6.7	5.74	-	-	-	-	-	-	-
Critical Hdwy Stg 2	5.74	4.74	-	6.7	5.74	-	-	-	-	-	-	-
Follow-up Hdwy	3.52	4.02	3.36	3.5	4.02	3.3	2.2	-	-	2.2	-	-
Pot Cap-1 Maneuver	96	63	549	47	35	415	725	-	-	549	-	-
Stage 1	326	399	-	167	220	-	-	-	-	-	-	-
Stage 2	499	305	-	498	302	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	84	55	548	41	30	414	725	-	-	548	-	-
Mov Cap-2 Maneuver	84	55	-	41	30	-	-	-	-	-	-	-
Stage 1	307	368	-	157	207	-	-	-	-	-	-	-
Stage 2	454	287	-	441	278	-	-	-	-	-	-	-

Approach	EB		WB		NB		SB	
HCM Control Delay, s	11.8		83.8		0.4		0.6	
HCM LOS	B		F					

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1WBLn1	SBL	SBT	SBR
Capacity (veh/h)	725	-	-	548	72	548	-
HCM Lane V/C Ratio	0.016	-	-	0.039	0.389	0.036	-
HCM Control Delay (s)	10	0.3	-	11.8	83.8	11.8	0.4
HCM Lane LOS	B	A	-	B	F	B	A
HCM 95th %tile Q(veh)	0.1	-	-	0.1	1.5	0.1	-

## **APPENDIX H**

### 2030 No Build Capacity/Level-of-Service Analysis

Wrentham Gas & Convenience  
1: Washington Street & Hawes Street/Commerce Boulevard

Weekday Morning Peak Hour  
2030 No Build

Intersection												
Int Delay, s/veh	0.8											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	1	0	12	0	0	1	26	2164	1	2	622	14
Future Vol, veh/h	1	0	12	0	0	1	26	2164	1	2	622	14
Conflicting Peds, #/hr	0	0	0	0	0	0	1	0	0	0	0	1
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	-4	-	-	1	-	-	-1	-	-	1	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	0	9	0	0	100	0	4	0	100	13	0
Mvmt Flow	1	0	13	0	0	1	28	2352	1	2	676	15

Major/Minor	Minor2		Minor1		Major1		Major2					
Conflicting Flow All	1921	3098	347	2751	3105	1177	692	0	0	2353	0	0
Stage 1	689	689	-	2409	2409	-	-	-	-	-	-	-
Stage 2	1232	2409	-	342	696	-	-	-	-	-	-	-
Critical Hdwy	6.74	5.7	6.68	7.7	6.7	9	4.1	-	-	6.1	-	-
Critical Hdwy Stg 1	5.74	4.7	-	6.7	5.7	-	-	-	-	-	-	-
Critical Hdwy Stg 2	5.74	4.7	-	6.7	5.7	-	-	-	-	-	-	-
Follow-up Hdwy	3.52	4	3.39	3.5	4	4.3	2.2	-	-	3.2	-	-
Pot Cap-1 Maneuver	62	24	654	8	10	82	912	-	-	50	-	-
Stage 1	469	524	-	30	57	-	-	-	-	-	-	-
Stage 2	247	111	-	640	429	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	58	22	653	7	9	82	911	-	-	50	-	-
Mov Cap-2 Maneuver	58	22	-	7	9	-	-	-	-	-	-	-
Stage 1	469	489	-	30	57	-	-	-	-	-	-	-
Stage 2	244	111	-	586	401	-	-	-	-	-	-	-

Approach	EB		WB		NB		SB	
HCM Control Delay, s	15.3		49.5		0.1		2.8	
HCM LOS	C		E					

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1WBLn1	SBL	SBT	SBR
Capacity (veh/h)	911	-	-	365	82	50	-
HCM Lane V/C Ratio	0.031	-	-	0.039	0.013	0.043	-
HCM Control Delay (s)	9.1	0	-	15.3	49.5	80.2	2.6
HCM Lane LOS	A	A	-	C	E	F	A
HCM 95th %tile Q(veh)	0.1	-	-	0.1	0	0.1	-



Wrentham Gas & Convenience  
1: Washington Street & Hawes Street/Commerce Boulevard

Weekday Afternoon Peak Hour  
2030 No Build

Intersection												
Int Delay, s/veh	1.9											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕↔			↕↔	
Traffic Vol, veh/h	0	0	19	7	0	4	14	959	14	5	2166	9
Future Vol, veh/h	0	0	19	7	0	4	14	959	14	5	2166	9
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	-4	-	-	1	-	-	-1	-	-	1	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	0	0	0	0	0	0	8	3	0	0	1	0
Mvmt Flow	0	0	21	8	0	4	15	1042	15	5	2354	10
Major/Minor	Minor2		Minor1		Major1		Major2					
Conflicting Flow All	2920	3456	1182	2267	3454	529	2364	0	0	1057	0	0
Stage 1	2369	2369	-	1080	1080	-	-	-	-	-	-	-
Stage 2	551	1087	-	1187	2374	-	-	-	-	-	-	-
Critical Hdwy	6.7	5.7	6.5	7.7	6.7	7	4.26	-	-	4.1	-	-
Critical Hdwy Stg 1	5.7	4.7	-	6.7	5.7	-	-	-	-	-	-	-
Critical Hdwy Stg 2	5.7	4.7	-	6.7	5.7	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4	3.3	3.5	4	3.3	2.28	-	-	2.2	-	-
Pot Cap-1 Maneuver	14	15	211	20	6	492	186	-	-	667	-	-
Stage 1	62	116	-	223	280	-	-	-	-	-	-	-
Stage 2	555	375	-	190	60	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	12	12	211	15	5	492	186	-	-	667	-	-
Mov Cap-2 Maneuver	12	12	-	15	5	-	-	-	-	-	-	-
Stage 1	50	116	-	179	225	-	-	-	-	-	-	-
Stage 2	442	302	-	171	60	-	-	-	-	-	-	-
Approach	EB		WB		NB		SB					
HCM Control Delay, s	23.9		273.2		2.8		0					
HCM LOS	C		F									
Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR				
Capacity (veh/h)	186	-	-	211	23	667	-	-				
HCM Lane V/C Ratio	0.082	-	-	0.098	0.52	0.008	-	-				
HCM Control Delay (s)	26.1	2.5	-	23.9	273.2	10.4	0	-				
HCM Lane LOS	D	A	-	C	F	B	A	-				
HCM 95th %tile Q(veh)	0.3	-	-	0.3	1.5	0	-	-				

Wrentham Gas & Convenience  
1: Washington Street & Hawes Street/Commerce Boulevard

Saturday Midday Peak Hour  
2030 No Build

Intersection												
Int Delay, s/veh	2.3											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	0	0	19	11	0	10	12	1263	57	19	1030	1
Future Vol, veh/h	0	0	19	11	0	10	12	1263	57	19	1030	1
Conflicting Peds, #/hr	0	0	1	1	0	0	0	0	1	1	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	-4	-	-	1	-	-	-1	-	-	1	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	6	0	2	2	0	1	0	0	1	0
Mvmt Flow	0	0	21	12	0	11	13	1373	62	21	1120	1




















Major/Minor	Minor2		Minor1		Major1		Major2					
Conflicting Flow All	1876	2625	562	2034	2594	719	1121	0	0	1436	0	0
Stage 1	1163	1163	-	1431	1431	-	-	-	-	-	-	-
Stage 2	713	1462	-	603	1163	-	-	-	-	-	-	-
Critical Hdwy	6.74	5.74	6.62	7.7	6.74	7.04	4.1	-	-	4.1	-	-
Critical Hdwy Stg 1	5.74	4.74	-	6.7	5.74	-	-	-	-	-	-	-
Critical Hdwy Stg 2	5.74	4.74	-	6.7	5.74	-	-	-	-	-	-	-
Follow-up Hdwy	3.52	4.02	3.36	3.5	4.02	3.32	2.2	-	-	2.2	-	-
Pot Cap-1 Maneuver	67	42	490	30	21	364	631	-	-	479	-	-
Stage 1	268	346	-	133	183	-	-	-	-	-	-	-
Stage 2	456	265	-	443	250	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	55	33	490	24	17	364	631	-	-	478	-	-
Mov Cap-2 Maneuver	55	33	-	24	17	-	-	-	-	-	-	-
Stage 1	240	306	-	119	164	-	-	-	-	-	-	-
Stage 2	396	237	-	375	221	-	-	-	-	-	-	-

Approach	EB		WB		NB		SB	
HCM Control Delay, s	12.7		159.6		0.7		0.9	
HCM LOS	B		F					

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1WBLn1	SBL	SBT	SBR
Capacity (veh/h)	631	-	-	490	43	478	-
HCM Lane V/C Ratio	0.021	-	-	0.042	0.531	0.043	-
HCM Control Delay (s)	10.8	0.6	-	12.7	159.6	12.9	0.7
HCM Lane LOS	B	A	-	B	F	B	A
HCM 95th %tile Q(veh)	0.1	-	-	0.1	1.9	0.1	-













## **APPENDIX I**

### 2030 Build Capacity/Level-of-Service Analysis

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	1	0	12	56	2	118	25	2069	153	57	596	13
Future Volume (vph)	1	0	12	56	2	118	25	2069	153	57	596	13
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		-4%			1%			-1%			1%	
Satd. Flow (prot)	0	1557	0	1761	1579	0	1814	3458	0	1761	3176	0
Flt Permitted		0.814		0.748			0.950			0.950		
Satd. Flow (perm)	0	1272	0	1386	1579	0	1808	3458	0	1761	3176	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		98			99			17			5	
Link Speed (mph)		30			30			55			55	
Link Distance (ft)		141			266			1704			143	
Travel Time (s)		3.2			6.0			21.1			1.8	
Confl. Peds. (#/hr)							1					1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	2%	2%	9%	2%	2%	2%	0%	4%	2%	2%	13%	0%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	14	0	61	130	0	27	2415	0	62	662	0
Turn Type	Perm	NA		Perm	NA		Prot	NA		Prot	NA	
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8								
Detector Phase	4	4		8	8		5	2		1	6	
Switch Phase												
Minimum Initial (s)	6.0	6.0		6.0	6.0		6.0	10.0		6.0	10.0	
Minimum Split (s)	12.0	12.0		12.0	12.0		12.0	16.0		12.0	16.0	
Total Split (s)	13.0	13.0		13.0	13.0		12.0	75.0		12.0	75.0	
Total Split (%)	13.0%	13.0%		13.0%	13.0%		12.0%	75.0%		12.0%	75.0%	
Yellow Time (s)	4.0	4.0		4.0	4.0		5.0	5.0		5.0	5.0	
All-Red Time (s)	2.0	2.0		2.0	2.0		1.0	1.0		1.0	1.0	
Lost Time Adjust (s)		0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)		6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lead/Lag							Lead	Lag		Lead	Lag	
Lead-Lag Optimize?							Yes	Yes		Yes	Yes	
Recall Mode	None	None		None	None		None	C-Min		None	C-Min	
Act Effect Green (s)		6.8		6.8	6.8		6.0	71.6		6.0	74.0	
Actuated g/C Ratio		0.07		0.07	0.07		0.06	0.72		0.06	0.74	
v/c Ratio		0.08		0.65	0.65		0.25	0.97		0.59	0.28	
Control Delay		0.8		76.5	31.1		38.6	18.0		70.0	4.0	
Queue Delay		0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay		0.8		76.5	31.1		38.6	18.0		70.0	4.0	
LOS		A		E	C		D	B		E	A	
Approach Delay		0.8			45.6			18.3			9.6	
Approach LOS		A			D			B			A	
Queue Length 50th (ft)		0		39	19		16	~235		40	60	
Queue Length 95th (ft)		0		#101	#94		m19	#977		m#89	73	
Internal Link Dist (ft)		61			186			1624			63	
Turn Bay Length (ft)												
Base Capacity (vph)		180		97	202		108	2480		105	2351	
Starvation Cap Reductn		0		0	0		0	0		0	0	

Wrentham Gas & Convenience  
1: Washington Street & Hawes Street/Commerce Boulevard

Weekday Morning Peak Hour  
2030 Build

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Spillback Cap Reductn		0		0	0		0	0		0	0	
Storage Cap Reductn		0		0	0		0	0		0	0	
Reduced v/c Ratio		0.08		0.63	0.64		0.25	0.97		0.59	0.28	

Intersection Summary

Area Type: Other

Cycle Length: 100

Actuated Cycle Length: 100

Offset: 25 (25%), Referenced to phase 2:NBT and 6:SBT, Start of Green

Natural Cycle: 90

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.97

Intersection Signal Delay: 17.9

Intersection LOS: B

Intersection Capacity Utilization 81.8%

ICU Level of Service D

Analysis Period (min) 15

~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.




















# 95th percentile volume exceeds capacity, queue may be longer.













Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 1: Washington Street & Hawes Street/Commerce Boulevard

	Ø1		Ø2 (R)		Ø4
12 s		75 s		13 s	
	Ø5		Ø6 (R)		Ø8
12 s		75 s		13 s	

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	1	18	133	0	61	14	928	74	96	2095	9
Future Volume (vph)	0	1	18	133	0	61	14	928	74	96	2095	9
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		-4%			1%			-1%			1%	
Satd. Flow (prot)	0	1686	0	1761	1575	0	1680	3486	0	1761	3553	0
Flt Permitted				0.744			0.064			0.204		
Satd. Flow (perm)	0	1686	0	1379	1575	0	113	3486	0	378	3553	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		20			196			13			1	
Link Speed (mph)		30			30			55			55	
Link Distance (ft)		141			266			1704			143	
Travel Time (s)		3.2			6.0			21.1			1.8	
Confl. Bikes (#/hr)												1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	2%	0%	2%	2%	2%	8%	3%	2%	2%	1%	0%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	21	0	145	66	0	15	1089	0	104	2287	0
Turn Type		NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8			2			6		
Detector Phase	4	4		8	8		5	2		1	6	
Switch Phase												
Minimum Initial (s)	6.0	6.0		6.0	6.0		6.0	10.0		6.0	10.0	
Minimum Split (s)	12.0	12.0		12.0	12.0		12.0	16.0		12.0	16.0	
Total Split (s)	20.0	20.0		20.0	20.0		12.0	62.0		18.0	68.0	
Total Split (%)	20.0%	20.0%		20.0%	20.0%		12.0%	62.0%		18.0%	68.0%	
Yellow Time (s)	4.0	4.0		4.0	4.0		5.0	5.0		5.0	5.0	
All-Red Time (s)	2.0	2.0		2.0	2.0		1.0	1.0		1.0	1.0	
Lost Time Adjust (s)		0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)		6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lead/Lag							Lead	Lag		Lead	Lag	
Lead-Lag Optimize?							Yes	Yes		Yes	Yes	
Recall Mode	None	None		None	None		None	C-Min		None	C-Min	
Act Effect Green (s)		13.2		13.2	13.2		68.9	64.1		73.2	70.0	
Actuated g/C Ratio		0.13		0.13	0.13		0.69	0.64		0.73	0.70	
v/c Ratio		0.09		0.80	0.18		0.09	0.49		0.28	0.92	
Control Delay		17.2		73.0	1.0		5.2	7.6		1.9	13.2	
Queue Delay		0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay		17.2		73.0	1.0		5.2	7.6		1.9	13.2	
LOS		B		E	A		A	A		A	B	
Approach Delay		17.2			50.5			7.6			12.7	
Approach LOS		B			D			A			B	
Queue Length 50th (ft)		1		90	0		1	121		3	32	
Queue Length 95th (ft)		22		#189	0		m7	125		m4	m#942	
Internal Link Dist (ft)		61			186			1624			63	
Turn Bay Length (ft)												
Base Capacity (vph)		253		193	389		172	2239		448	2488	
Starvation Cap Reductn		0		0	0		0	0		0	0	

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Spillback Cap Reductn		0		0	0		0	0		0	0	
Storage Cap Reductn		0		0	0		0	0		0	0	
Reduced v/c Ratio		0.08		0.75	0.17		0.09	0.49		0.23	0.92	

## Intersection Summary

Area Type: Other

Cycle Length: 100

Actuated Cycle Length: 100

Offset: 54 (54%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green

Natural Cycle: 90

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.92

Intersection Signal Delay: 13.4

Intersection LOS: B

Intersection Capacity Utilization 92.2%

ICU Level of Service F





Analysis Period (min) 15




















# 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.













m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 1: Washington Street &amp; Hawes Street/Commerce Boulevard

 Ø1	 Ø2 (R)	 Ø4
18 s	62 s	20 s
 Ø5	 Ø6 (R)	 Ø8
12 s	68 s	20 s

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	1	18	71	0	75	12	1213	130	78	989	1
Future Volume (vph)	0	1	18	71	0	75	12	1213	130	78	989	1
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		-4%			1%			-1%			1%	
Satd. Flow (prot)	0	1574	0	1796	1575	0	1814	3538	0	1796	3556	0
Flt Permitted				0.744			0.950			0.950		
Satd. Flow (perm)	0	1574	0	1403	1575	0	1814	3538	0	1795	3556	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		20			157			20				
Link Speed (mph)		30			30			55			55	
Link Distance (ft)		141			266			1704			143	
Travel Time (s)		3.2			6.0			21.1			1.8	
Confl. Peds. (#/hr)			1	1					1	1		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	2%	2%	6%	0%	2%	2%	0%	1%	0%	0%	1%	0%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	21	0	77	82	0	13	1459	0	85	1076	0
Turn Type		NA		Perm	NA		Prot	NA		Prot	NA	
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8								
Detector Phase	4	4		8	8		5	2		1	6	
Switch Phase												
Minimum Initial (s)	6.0	6.0		6.0	6.0		6.0	10.0		6.0	10.0	
Minimum Split (s)	12.0	12.0		12.0	12.0		12.0	16.0		12.0	16.0	
Total Split (s)	18.0	18.0		18.0	18.0		12.0	56.0		16.0	60.0	
Total Split (%)	20.0%	20.0%		20.0%	20.0%		13.3%	62.2%		17.8%	66.7%	
Yellow Time (s)	4.0	4.0		4.0	4.0		5.0	5.0		5.0	5.0	
All-Red Time (s)	2.0	2.0		2.0	2.0		1.0	1.0		1.0	1.0	
Lost Time Adjust (s)		0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)		6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lead/Lag							Lead	Lag		Lead	Lag	
Lead-Lag Optimize?							Yes	Yes		Yes	Yes	
Recall Mode	None	None		None	None		None	C-Min		None	C-Min	
Act Effect Green (s)		9.2		9.2	9.2		6.0	60.5		8.3	70.0	
Actuated g/C Ratio		0.10		0.10	0.10		0.07	0.67		0.09	0.78	
v/c Ratio		0.12		0.54	0.27		0.11	0.61		0.51	0.39	
Control Delay		17.2		51.8	2.2		49.2	6.2		41.4	10.0	
Queue Delay		0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay		17.2		51.8	2.2		49.2	6.2		41.4	10.0	
LOS		B		D	A		D	A		D	B	
Approach Delay		17.2			26.2			6.6			12.3	
Approach LOS		B			C			A			B	
Queue Length 50th (ft)		1		42	0		8	68		47	204	
Queue Length 95th (ft)		22		85	1		m16	70		94	273	
Internal Link Dist (ft)		61			186			1624			63	
Turn Bay Length (ft)												
Base Capacity (vph)		227		187	346		120	2384		199	2766	
Starvation Cap Reductn		0		0	0		0	0		0	0	



												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Spillback Cap Reductn		0		0	0		0	0		0	0	
Storage Cap Reductn		0		0	0		0	0		0	0	
Reduced v/c Ratio		0.09		0.41	0.24		0.11	0.61		0.43	0.39	

## Intersection Summary

Area Type: Other

Cycle Length: 90

Actuated Cycle Length: 90

Offset: 45 (50%), Referenced to phase 2:NBT and 6:SBT, Start of Green

Natural Cycle: 60

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.61

Intersection Signal Delay: 10.2

Intersection LOS: B



Intersection Capacity Utilization 68.3%

ICU Level of Service C

Analysis Period (min) 15

m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 1: Washington Street &amp; Hawes Street/Commerce Boulevard

 Ø1	 Ø2 (R)	 Ø4
16 s	56 s	18 s
 Ø5	 Ø6 (R)	 Ø8
12 s	60 s	18 s

## **APPENDIX J**

### Capacity/Level-of-Service Analysis Summary

## CAPACITY ANALYSIS SUMMARY

**Weekday Morning Peak Hour**

**Proposed Gas Station & Convenience Store**

**Wrentham, MA**

Intersection	Movement	2023 Existing			2030 No Build			2030 Build		
		LOS <sup>1</sup>	Delay <sup>2</sup>	V/C <sup>3</sup>	LOS	Delay	V/C	LOS	Delay	V/C
Washington Street at Hawes Street/ Commerce Boulevard	EB LTR	B	13.4	0.05	C	15.3	0.04	A	0.8	0.08
	WB LTR	E	37.4	0.04	E	49.5	0.01	-	-	-
	L	-	-	-	-	-	-	E	76.5	0.65
	TR	-	-	-	-	-	-	C	31.1	0.65
	NB LTR	A	0.1	0.03	A	0.1	0.03	-	-	-
	L	-	-	-	-	-	-	D	38.6	0.25
	TR	-	-	-	-	-	-	B	18.0	0.97
	SB LTR	A	1.2	0.03	A	2.8	0.04	-	-	-
	L	-	-	-	-	-	-	E	70.0	0.59
	TR	-	-	-	-	-	-	A	4.0	0.28
<i>Overall</i>		-	-	-	-	-	-	<i>B</i>	<i>17.9</i>	<i>0.82</i>

1 Level-of-Service

2 Average vehicle delay in seconds

3 Volume to capacity ratio, intersection capacity utilization reported for signalized overall

- Not applicable

## QUEUE SUMMARY

**Weekday Morning Peak Hour**

**Proposed Gas Station & Convenience Store**

**Wrentham, MA**

Intersection	Movement	2023 Existing		2030 No Build		2030 Build	
		50th Queue <sup>1</sup>	95th Queue <sup>2</sup>	50th Queue	95th Queue	50th Queue	95th Queue
Washington Street	EB LTR	-	3	-	3	0	0
at Hawes Street/	WB LTR	-	3	-	0	-	-
Commerce Boulevard	L	-	-	-	-	39	110
	TR	-	-	-	-	20	104
	NB LTR	-	3	-	3	-	-
	L	-	-	-	-	17	19
	TR	-	-	-	-	220	965
	SB LTR	-	3	-	3	-	-
	L	-	-	-	-	40	87
	R	-	-	-	-	57	70

1 50th percentile queue in feet

2 95th percentile queue in feet

- Not applicable

## CAPACITY ANALYSIS SUMMARY

**Weekday Afternoon Peak Hour**

**Proposed Gas Station & Convenience Store**

**Wrentham, MA**

Intersection	Movement		2023 Existing			2030 No Build			2030 Build		
			LOS <sup>1</sup>	Delay <sup>2</sup>	V/C <sup>3</sup>	LOS	Delay	V/C	LOS	Delay	V/C
Washington Street at Hawes Street/ Commerce Boulevard	EB	LTR	C	22.2	0.12	C	23.9	0.10	B	17.2	0.09
	WB	LTR	F	163.9	0.50	F	273.2	0.52	-	-	-
	L		-	-	-	-	-	-	E	73.0	0.80
		TR	-	-	-	-	-	-	A	1.0	0.18
	NB	LTR	A	1.6	0.06	A	2.8	0.08	-	-	-
	L		-	-	-	-	-	-	A	5.2	0.09
		TR	-	-	-	-	-	-	A	7.6	0.49
	SB	LTR	A	0.0	0.01	A	0.0	0.01	-	-	-
	L		-	-	-	-	-	-	A	1.9	0.28
		TR	-	-	-	-	-	-	B	13.2	0.92
	<i>Overall</i>		-	-	-	-	-	-	<i>B</i>	<i>13.4</i>	<i>0.92</i>

1 Level-of-Service

2 Average vehicle delay in seconds

3 Volume to capacity ratio, intersection capacity utilization reported for signalized overall

- Not applicable

## QUEUE SUMMARY

**Weekday Afternoon Peak Hour**

**Proposed Gas Station & Convenience Store**

**Wrentham, MA**

Intersection	Movement	2023 Existing		2030 No Build		2030 Build	
		50th Queue <sup>1</sup>	95th Queue <sup>2</sup>	50th Queue	95th Queue	50th Queue	95th Queue
Washington Street	EB LTR	-	10	-	8	1	22
at Hawes Street/ Commerce Boulevard	WB LTR	-	45	-	38	-	-
	L	-	-	-	-	90	189
	TR	-	-	-	-	0	0
	NB LTR	-	5	-	8	-	-
	L	-	-	-	-	1	7
	TR	-	-	-	-	121	125
	SB LTR	-	0	-	0	-	-
	L	-	-	-	-	3	4
	R	-	-	-	-	32	942

<sup>1</sup> 50th percentile queue in feet

<sup>2</sup> 95th percentile queue in feet

- Not applicable

## CAPACITY ANALYSIS SUMMARY

**Saturday Midday Peak Hour**

**Proposed Gas Station & Convenience Store**

**Wrentham, MA**

Intersection	Movement		2023 Existing			2030 No Build			2030 Build		
			LOS <sup>1</sup>	Delay <sup>2</sup>	V/C <sup>3</sup>	LOS	Delay	V/C	LOS	Delay	V/C
Washington Street	EB	LTR	B	11.8	0.04	B	12.7	0.04	B	17.2	0.12
at Hawes Street/ Commerce Boulevard	WB	LTR	F	83.8	0.39	F	159.6	0.53	-	-	-
		L	-	-	-	-	-	-	D	51.8	0.54
		TR	-	-	-	-	-	-	A	2.2	0.27
	NB	LTR	A	0.4	0.02	A	0.7	0.02	-	-	-
		L	-	-	-	-	-	-	D	49.2	0.11
		TR	-	-	-	-	-	-	A	6.2	0.61
	SB	LTR	A	0.6	0.04	A	0.9	0.04	-	-	-
		L	-	-	-	-	-	-	D	41.4	0.51
		TR	-	-	-	-	-	-	B	10.0	0.39
	<i>Overall</i>		-	-	-	-	-	-	<i>B</i>	<i>10.2</i>	<i>0.68</i>

1 Level-of-Service

2 Average vehicle delay in seconds

3 Volume to capacity ratio, intersection capacity utilization reported for signalized overall

- Not applicable

## QUEUE SUMMARY

**Saturday Midday Peak Hour**

**Proposed Gas Station & Convenience Store**

**Wrentham, MA**

Intersection	Movement	2023 Existing		2030 No Build		2030 Build	
		50th Queue <sup>1</sup>	95th Queue <sup>2</sup>	50th Queue	95th Queue	50th Queue	95th Queue
Washington Street	EB LTR	-	3	-	3	1	22
at Hawes Street/ Commerce Boulevard	WB LTR	-	38	-	48	-	-
	L	-	-	-	-	42	85
	TR	-	-	-	-	0	1
	NB LTR	-	3	-	3	-	-
	L	-	-	-	-	8	16
	TR	-	-	-	-	68	70
	SB LTR	-	3	-	3	-	-
	L	-	-	-	-	47	94
	R	-	-	-	-	204	273

<sup>1</sup> 50th percentile queue in feet

<sup>2</sup> 95th percentile queue in feet

- Not applicable