Memorandum

To: Mr. Israel Lopez
Development Manager
The Gutierrez Company
One Wall Street
Burlington, MA 01803

Date: December 16, 2020

Project #: 14767.00

From: Robert Nagi, PE, Principal
Tess Benson, EIT

Re: Bartlett Street Definitive Subdivision Plans
Traffic Impact Memorandum
Northborough, Massachusetts

VHB has been retained by The Gutierrez Company to prepare a traffic impact assessment for the definitive subdivision plan for the 0 Bartlett Street parcels (identified on separate plans as B-1, B-2, H-1, and H-2 prepared by Allen & Major Associates) in Northborough, Massachusetts. Whereas the development of the subdivision by itself does not generate any traffic that might create impacts on area roadways, the site engineer has developed the plan to meet the Town's subdivision guidelines to which VHB has reviewed. From a safety perspective, it should be noted that the subdivision roadway plan exceeds the required sight line accommodations at its intersection with Bartlett Street and that ample pedestrian accommodations are provided.

However, in order to present an assessment of the potential development on the parcels, VHB has prepared the following traffic memorandum that focuses on the development of an approximately 151,000 square foot (sf) warehousing facility (the "Facility") on the parcel. This memorandum documents the existing and future transportation conditions within the study area based on the proposed warehouse development's impact. The evaluation is based on previous and current traffic volumes collected at the study area intersections, observations by VHB, and discussions with the Developer and the Town of Northborough.

Based on the findings of this memorandum, the proposed subdivision roadway is able to support the warehousing facility and is not expected to have a significant operational impact on the surrounding roadway network. The existing roadway infrastructure can adequately accommodate the amount of traffic that will be generated by the Facility.

Project Description

The Project Site is located along Bartlett Street in the Town of Northborough, Massachusetts. Shown in Figure 1, the site is bordered by Bartlett Street to the south, wooded land to the north, and an existing warehouse facility to the southeast. The A. Duie Pyle and FedEx shipping facilities are located opposite the site across Bartlett Street. Access to the site will be via a proposed single driveway on Bartlett Street, to the west of the existing FedEx Driveway.

The proposed warehouse facility involves the construction of one contiguous warehouse building. A total of approximately 150 parking spaces will be provided to support the building program. The conceptual site plan is shown in Figure 2.

Existing Conditions

Based on VHB's knowledge of the area and expected operations of the warehousing Facility, the intersections that could potentially be impacted by the project were included in this study. Study area intersections are shown in Figure 3, and include:

- Lyman Street at Bartlett Street
- Existing FedEx Site Driveway at Bartlett Street
- Cedar Hill Street at Bartlett Street

Bartlett Street

Bartlett Street is an east-west roadway that runs from the Marlborough municipal boundary to the east to Route 20 to the northwest. Within the study area, Bartlett Street is under the local Town of Northborough jurisdiction, and consists of one lane in each direction with varying 2- to 6-foot wide shoulders. Land uses along Bartlett Street are either undeveloped or of a generally industrial use. The speed limit within the vicinity of the site is posted at 45 miles per hour (mph).

Traffic Volumes

To understand the existing vehicular patterns at and near the proposed development site, daily traffic volumes and peak hour turning movement counts (TMC) were conducted during the weekday morning and evening peak hours in October 2019. Due to current nationwide conditions associated with the COVID-19 pandemic, collecting new traffic data would underestimate the volume of traffic along area roadways and was, therefore, not pursued at this time. All traffic volumes collected in October 2019 were increased using a one-percent annual growth rate to reflect 2020 conditions and are expected to be representative of current conditions in the absence of COVID-19.

Weekday daily traffic volumes were collected along Bartlett Street, using automatic traffic recorders (ATR) over a 48-hour period. Concurrent with the ATR counts, turning movement counts (TMCs) were conducted at the study area intersections in October 2019 during the weekday morning peak period from 6:30 AM to 9:00 AM and the weekday evening peak period from 4:00 PM to 6:00 PM. The TMC data indicates that, within the immediate area of the Project Site, the weekday morning peak hour generally occurs between 7:45 AM and 8:45 AM and the weekday evening peak hour occurs between 4:30 PM and 5:30 PM. Traffic volume data is included in the Attachments.

As shown in Table 1, approximately 8,600 vehicles travel along Bartlett Street on an average weekday. By way of comparison, this is a slight increase from the 7,900 trips observed in 2015. Peak hour traffic accounts for approximately 10 percent of the daily traffic during both the morning and evening peak hours. Observations noted that traffic volumes along Bartlett Street are heavily influenced by commuter traffic. The majority of the traffic during the morning peak hour is traveling eastbound, while the pattern is reversed in the evening peak hour, with the majority of the traffic traveling westbound.

Table 1 Observed Traffic Volume Summary

	Daily [a]	Weekday Morning Peak Hour			Weekday Evening Peak Hour		
Location	**Weekday**	**Volume [b]**	**K Factor [c]**	**Dir. Dist. [d]**	**Volume**	**K Factor**	**Dir. Dist.**
Bartlett Street, West of FedEx Site Driveway	8,600	855	10.0%	74% EB	970	11.3%	77% WB

Source: Vanasse Hangen Brustlin, Inc. Based on automatic traffic recorder (ATR) counts conducted in October 2019 and increased using a 1-percent annual growth rate to reflect October 2020 conditions.

a average daily traffic (ADT) volume expressed in vehicles per day

b peak period traffic volumes expressed in vehicles per hour (Note: In 2014, the AM volume was 780 vpd and the PM volume was 745 vpd)

c percent of daily traffic that occurs during the peak period

d directional distribution of peak period traffic

Seasonality of Count Data

The peak hour traffic data collected for the supplemental evaluation was obtained during the month of October. To quantify the seasonal variation of traffic volumes in the area, historic traffic data available from MassDOT was reviewed. Based on the MassDOT seasonal data, October traffic counts are generally higher than average month conditions. Therefore, to provide a conservative analysis, no seasonal adjustment factor was applied to the traffic counts to establish the 2020 Existing Conditions peak hour traffic volumes.

The seasonal adjustment data is included in the Attachments and the 2020 Existing Conditions peak hour traffic volume networks are reflected in Figures 4 and 5.

Vehicular Crash History

To identify potential vehicle crash trends in the study area, vehicular crash data for the study area intersections were obtained from Massachusetts Department of Transportation (MassDOT) for the most recent five-year period (2013-2017) available. A summary of the MassDOT vehicle crash history is provided in Table 2 and the detailed crash data is provided in the Attachments.

In addition to summarizing the crash history, VHB also calculated crash rates for the study area intersections. Intersection crash rates are calculated based on the number of crashes at an intersection and the volume of traffic traveling through that intersection on a daily basis. The MassDOT average intersection crash rate for District 3 (the MassDOT district designation for the Town of Northborough) is 0.89 for signalized intersections and 0.61 for unsignalized intersections. In other words, on average, 0.89 crashes occurred per million vehicles entering signalized intersections and 0.61 crashes occurred per million vehicles entering unsignalized intersections throughout District 3. Any crash rate higher than these factors indicate a higher than average crash tendency for a given facility or intersection. The crash rate worksheets for the study area intersections are included in the Attachments.

Table 2 Vehicular Crash Summary (2013 – 2017)

	Bartlett Street at Lynman Street	Bartlett Street at FedEx Driveway	Bartlett Street at Cedar Hill Street
Signalized?	No	No	No
MassDOT Average Crash Rate	0.61	0.61	0.61
Calculated Crash Rate	0.38	0.09	0.47
Year			
2013	1	1	1
2014	1	0	3
2015	4	0	3
2016	2	0	2
2017	2	1	2
Total	**10**	**2**	**11**
Collision Type			
Angle	4	1	4
Head-on	0	0	0
Rear-end	2	0	3
Rear-to-rear	0	0	0
Sideswipe, opposite direction	1	0	0
Sideswipe, same direction	0	0	0
Single Vehicle Crash	3	1	4
Not reported/Unknown	1	0	0
Severity			
Fatal Injury	0	0	0
Non-Fatal Injury	1	0	1
Property Damage Only	8	2	10
Not Reported	1	0	0
Time of day			
Weekday, 7:00 AM - 9:00 AM	3	0	2
Weekday, 4:00 – 6:00 PM	4	0	2
Saturday, 11:00 AM – 2:00 PM	1	0	0
Weekday, other time	1	1	7
Weekend, other time	1	1	0
Pavement Conditions			
Dry	6	1	5
Wet	2	1	3
Snow	2	0	3
Not reported	0	0	0
Non-Motorist (Bike, Pedestrian)	0	0	0

Source: MassDOT Crash Portal 2013-2017.

As shown in Table 2, the study area intersections did not have calculated crash rates over the local MassDOT District 3 average. Of particular note is that the location that demonstrated the highest crash tendencies, Cedar Hill Street at Bartlett Street, was recently upgraded by the Applicant as part of the mitigation for a separate project in the area. These improvements upgraded the channelization of intersection and provided improved guidance for drivers entering and driving through this location with the goal of improving safety at an intersection that featured a wide pavement area.

The crashes that occurred within the study area were primarily angle, rear-end, and single-vehicle crashes, resulting in property damage and non-fatal injuries. No crashes were reported involving fatal injuries. No crashes were reported involving a non-motorist (bike, pedestrian) within the study area. Additionally, as part of this effort, VHB reviewed the MassDOT Highway Safety Improvement Program (HSIP) listing and found that none of the study area intersections are listed as an HSIP-eligible cluster.

Future Conditions

To determine the impacts of the development on the surrounding roadway network, future conditions for the traffic assessment was conducted. The baseline 2020 traffic volumes in the study area were projected to year 2027, reflecting a seven-year traffic planning horizon. Background traffic growth based on known development projects that may affect traffic flow was then included in the traffic volumes under the 2027 No-Build Condition. Traffic generated by the project was added to the 2027 No-Build Condition (without the project) to reflect the 2027 Build Condition (with the project).

Background Traffic Growth

Traffic growth on area roadways is a function of the expected land development, economic activity, and changes in demographics. A frequently used procedure is to estimate traffic generated by planned new major developments that would be expected to affect the project study area roadways. Another procedure involves the estimation of annual percentage increase in traffic volumes and apply that increase to study-area traffic volumes. To provide a conservative analysis, both methods were utilized to assess the potential future traffic volumes.

Regional Traffic Growth

A review of available traffic data and prior traffic studies prepared for other projects in the area indicated that the use of 1 percent per year growth rate is appropriate. This is further supported by our observations of traffic volumes along Bartlett Street as shown in Table 1 above. As such, VHB has used this growth rate to account for general background growth for the 2027 No-Build Condition and to account for several developments that may impact this area as shown in Table 3 below.

Site Specific Growth

Based on a review of other recent traffic studies and discussions with the City of Marlborough and the Town of Northborough, it was determined that there are several planned development projects within the immediate vicinity of the study area that would need to be considered as part of the future traffic conditions, independent of the Project. Table 3 summarizes the available information for the developments and Figure 6 presents the approximate location of the developments along with a number of other developments that are still in the planning/construction stage.

Table 3 Background Developments

Project	Location	Land Use	Size	Status
Marlborough Corporate Place	Ames Street, between Route 20 and Nickerson Road	Office/R&D	235,000 sf	No construction recently
Devonshire at 495 Center	Hayes Memorial Drive	Office	204,000 ± [a]	Original project modified. No construction recently
Forest Park	Forest Street and Simarano Drive	R&D, Residential	300,000 ± 200 apartments	Apartments under construction, R&D space unbuilt
Crane Meadow Corporate Center	Simarano Drive, between Cedar Hill Street and I-495 Exit 23C ramps	Office	400,000 sf	Developed as residential, office development status unknown
The Campus at Marlborough – Phase II [b]	Campus Drive, between Forest Street and Simarano Drive	Office/R&D	650,000 sf	Status unknown
One Lyman Street	Lyman Street	Office/Warehouse	3ksf office/17 ksf warehouse	Permitted
301 Bartlett Street	Bartlett Street	Warehouse	220,000 sf	Built, majority vacant
370 Bartlett Street	Bartlett Street	Warehouse	Two 300,000 sf warehouses	Permitted, Warehouse user recently announced intention to construct
Parcel G	Hayes Memorial Drive	Warehouse	167,000 sf	permitted

a Original project was reviewed for a 600,000 sf office development. But approx. 50% of the Site was subsequently re-permitted for a data center. For analysis purposes, it was assumed that half of the full office development would be built at some point in the future on the remaining 50% of the Site. The current site plan approval provides for a 204,000 SF Office/ R&D Highway Facility.

b The Campus at Marlborough – Phase II (permitted in 1996) has been mentioned for reference purpose only and was not included in the No Build analysis. Due to the large building program (650,000 sf of office) and the lack of activity on the site, it is expected that any development proposed on the site would need to evaluate its own project impacts.

It should be noted that not all the projects listed in Table 3 have a definitive construction timeline. In fact, several of the projects have been dormant for several years with an unknown implementation schedule. Some of the sites have undergone changes, such as sub-division, which renders the prior review of the development potential on those sites outdated. As a result, any new development plans for the sites, when pursued, would require additional filings/review by local and state agencies. In effect, it is possible that some of these projects may not come back in their currently known configuration, or not come back at all.

While the projects listed in Table 3 are all within the vicinity of the Facility, only new traffic from those projects with a known status update in Table 3 were included in the 2027 No-Build Conditions. The other "status unknown" developments are included for reference purposes only as they are not expected to generate traffic that will impact the Site.

Traffic volumes generated from the planned development projects were obtained from published traffic studies for use in the analysis. In cases where published studies were not available, VHB followed typical industry convention and generated traffic estimates using standardized ITE Trip Generation[1] data based on their size and land use. Recently, it was announced that the two warehouse buildings located at 370 Bartlett Street would be leased to Amazon. VHB has confirmed with the property owner that these uses are consistent with the original warehousing uses and the site is not intended to be used as a "last-mile" fulfillment center. Therefore the original assumptions for the development are consistent with its expected traffic generation and distribution. All information is included in the Attachments to this memorandum.

No-Build Traffic Volumes

The 2027 No-Build Traffic Volumes were developed based on the annual growth rate and site-specific growth. First, the 1 percent annual growth over the seven-year study horizon was applied to the 2020 Existing Condition traffic volumes. The traffic volumes from site specific background projects were then added to the projected traffic volumes. Figures 7 and 8 reflects the 2027 No-Build morning and evening peak hour traffic volumes.

Trip Generation

Trip generation rates provided in the Trip Generation[2] manual, published by the Institute of Transportation Engineers were used to identify the number of vehicle trips that will be generated by the proposed project. After review of potential land uses, ITE land use code 150 (Warehousing), was determined to be the most appropriate use for this warehouse development. Attached to this memorandum is a traffic generation memorandum that outlines other possible traffic generation estimates for uses that fall under the Warehousing sub-categories. To provide a conservative analysis, a 151,000 sf warehousing facility was assumed for trip generation estimation. The estimated trip generation for the development is based on standard ITE rates and is summarized in Table 4. Calculations and supporting documentation are included in the Attachments. As shown, the Facility is expected to generate 43 morning peak hour trips, 46 evening peak hour trips and a total of 284 daily trips.

[1] Trip Generation (9th edition), Institute of Transportation Engineers, Washington DC, 2013

[2] Trip Generation (9th edition), Institute of Transportation Engineers, Washington DC, 2013

Table 4 Trip Generation

Development Type ITE Land Use Code Size Type of Trips	Warehousing[a] 150 151 ksf ITE Trips
Weekday Daily[b]	284
Weekday AM[c]	
Enter	33
Exit	10
Total	43
Weekday PM[c]	
Enter	12
Exit	34
Total	46

a – Institute of Transportation Engineers, Trip Generation, 9th Edition - Land Use Code 150 [Warehousing] 151 ksf; by regression for weekday, AM Peak and PM Peak (note: The actual development size is 150,900 sf, while insignificant, the results shown in Table 4 are slightly higher than ITE projections might suggest.)

b – expressed in vehicles per day

c – expressed in vehicles per hour

Trip Distribution and Assignment

The directional distribution of the vehicular traffic approaching and departing the site is a function of population densities, the location of employment, existing travel patterns, and the efficiency of the existing roadway system.

The localized trip distribution (i.e. site access) was developed based on both observing the traffic patterns along Bartlett Street as well as observing the arrival and departure patterns separately for trucks and passenger vehicles at the existing FedEx access driveway location. In this case, to provide a conservative analysis, the peak hour distributions represent the observed passenger vehicle distributions – later in this memorandum, recommendation for heavy vehicle distributions are made which will orient their impacts from and towards the major highways in the area. Table 5 and Figures 9 and 10 reflect the anticipated vehicular trip distribution pattern during the morning and evening peak periods for the proposed warehouse Facility.

Table 5 Trip Distribution

Roadway	Direction (to/from)	Peak Period	Trip Distribution	
			Entering	Exiting
Bartlett Street	East	AM	27%	12%
	West	AM	73%	88%
Bartlett Street	East	PM	44%	48%
	West	PM	56%	52%
Total			**100%**	**100%**

As with prior studies in this area, the Applicant will work with commercial shipping providers to focus their heavy vehicle arrival and departure patterns towards the I-495 interchange 23C or 23A&B in Marlborough so as to limit the impact of these vehicles on local streets in Northborough and Westborough.

Build Traffic Volumes

The site generated traffic volumes by the proposed warehouse Facility, as shown in Table 4, were distributed to the study area roadways based on the trip distribution under the 2020 Existing conditions for the nearby FedEx facility (southeast of the Site). The 2027 Build traffic volumes were then developed by adding the distributed trips to the 2027 No-Build Condition. Figures 11 and 12 reflect the 2027 Build morning and evening peak hour traffic volumes.

Traffic Operations Analysis

To assess the quality and flow of the existing and future traffic conditions, roadway capacity analyses were conducted for the 2020 Existing, 2027 No-Build and 2027 Build Conditions, which will provide an indication of the adequacy of the roadway facilities that will serve the anticipated traffic demands.

The roadway capacity analysis is based on the Highway Capacity Manual 6th Edition[3]. The term 'level of service' (LOS) is used to denote the different operating conditions that occur on a given roadway segment under various traffic volume loads. The level of service provides an index to the operational qualities of a roadway segment or an intersection. It is a qualitative measure of a number of factors including roadway geometrics, speed, travel delay and freedom to maneuver. Level-of-service ranges from LOS A, representing the least congested operating conditions, to LOS F, representing the most congested operating condition. Level of service designations are based on delay, which is dependent on various variables such as volume-to-capacity (v/c) ratios. Comparison of intersection capacity analysis requires that in addition to the level-of-service, as such, other measures of effectiveness were also be considered.

[3] Highway Capacity Manual 6th Edition (2016); Transportation Research Board.

The level-of-service designations for unsignalized intersections (the three study area intersections) are for the critical movement exiting the minor street only and is typically the left turn from the minor street or the site driveway. This is based on the assumption that the traffic on the mainline is not affected by traffic on the minor streets.

Intersection Capacity Analysis

Level of service analyses were conducted for the 2020 Existing, 2027 No-Build, and 2027 Build Conditions and are summarized in Table 6. The analysis results are included in the Attachments.

The analytical methodologies typically used for the analysis of unsignalized intersections use conservative analysis parameters, such as high critical gaps[4]. Actual field observations indicate that drivers on minor streets generally accept smaller gaps in traffic than those used in the analysis procedures and therefore experience less delay than reported by analysis software. Consequently, the analysis results tend to overstate the actual delays experienced in the field. For this reason, the results of the unsignalized intersection analyses should be considered highly conservative.

[4] 'critical gap' is defined as the minimum time, in seconds, between successive major-stream vehicles, in which a minor-street vehicle can make a maneuver

Table 6 Unsignalized Intersection Capacity Analysis

Location / Movement	2020 Existing Conditions					2027 No-Build Conditions					2027 Build Conditions				
	D [a]	v/c [b]	Del [c]	LOS [d]	95 Q [e]	D	v/c	Del	LOS	95 Q	D	v/c	Del	LOS	95 Q
Bartlett Street at Lyman Street															
Weekday Morning															
WB L	75	0.09	9	A	8	85	0.13	11	B	10	85	0.13	11	B	13
NB L/R	255	0.81	41	E	183	280	1.12	>120	F	320	280	1.17	>120	F	343
Weekday Evening															
WB L	355	0.34	10	A	38	385	0.37	10	A	43	385	0.38	10	B	45
NB L/R	325	>1.20	>120	F	835	370	>1.20	>120	F	1105	370	>1.20	>120	F	1140
Bartlett Street at FedEx Driveway															
Weekday Morning															
WB L	10	0.02	11	B	3	30	0.06	12	B	5	30	0.06	12	B	5
NB L/R	30	0.24	29	D	23	55	0.44	51	F	50	55	0.45	52	F	50
Weekday Evening															
WB L	10	0.01	9	A	0	20	0.02	9	A	3	20	0.02	9	A	3
NB L/R	40	0.13	16	C	10	115	0.52	35	E	68	115	0.74	69	F	115
Bartlett Street at Cedar Hill Street															
Weekday Morning															
WB L	60	0.07	9	A	5	65	0.09	10	A	8	65	0.09	10	A	8
NB L	135	0.33	17	C	35	145	0.48	26	D	63	145	0.48	26	D	63
NB R	25	0.04	10	B	3	25	0.04	11	B	3	25	0.04	11	B	3
Weekday Evening															
WB L	55	0.05	8	A	5	60	0.06	8	A	5	60	0.06	8	A	5
NB L	345	>1.20	>120	F	1098	370	>1.20	>120	F	585	370	>1.20	>120	F	628
NB R	60	0.07	9	A	5	65	0.09	10	A	8	65	0.09	10	A	8
Bartlett Street at Proposed Bartlett Street Driveway															
Weekday Morning	*Driveway does not exist under 2020 Existing Conditions*					*Driveway does not exist under 2027 No Build Conditions*									
EB L											25	0.02	8	A	3
SB L/R											11	0.02	12	B	3
Weekday Evening															
EB L											5	0.01	11	B	0
SB L/R											35	0.20	28	D	18

a Demand, in vehicles
b Volume to capacity ratio.
c Average total delay, in seconds per vehicle.
d Level-of-service.
e 95th percentile queue, in feet.

As shown, under the 2020 Existing Condition, the northbound left-turn movement at the intersection of Lyman Street at Bartlett Street currently operates at LOS E and LOS F during the morning and evening peak periods respectively. This movement will continue to be congested (LOS F) during the morning peak period under all 2027 future conditions with or without the proposed Facility. Operations during the evening peak period will continue to operate at LOS F under all future conditions. The westbound left-turn movement will continue to operate at an acceptable level of service under all conditions.

Under the 2020 Existing Condition, the northbound left-turn movement at the intersection of FedEx Driveway at Bartlett Street currently operates at LOS D and LOS C during the weekday morning and evening peak periods respectively. Under the 2027 No-Build conditions this movement will degrade to LOS F and LOS E respectively. This movement will continue to be congested (LOS F) during both peak periods with the addition of Project-related trips under the 2027 Build condition. The westbound left-turn movement will continue to operate at an acceptable level of service under all conditions.

Under the 2020 Existing Condition, the northbound left-turn movement at the intersection of Cedar Hill Street at Bartlett Street currently operates at LOS C and LOS F during the morning and evening peak periods respectively. This movement will degrade to LOS D and LOS F, respectively, under all 2027 future conditions with or without the proposed Facility. The westbound left-turn movement and northbound right-turn movement will continue to operate at an acceptable level of service under all conditions.

At the site driveway, the level of service is projected to operate at LOS B and LOS D under the 2027 Build Condition during the morning and evening peak hours respectively when the proposed Facility is operational. Even though the site driveway is expected to operate at a reasonable level of service during the evening peak period, any delays will be contained to the site driveway and will not impact any other mainline Bartlett Street movements within the intersection.

Recommendations

To minimize the potential impacts at the site driveway, VHB recommends the site driveway either consider a wide single exit lane or provide two separate turning lanes, an exclusive left-turn lane and an exclusive right-turn lane for vehicles exiting the site. Under either option, the left-turn movement is expected to operate at LOS B during the morning peak period and LOS D during the evening peak period. The left-turn volumes exiting the driveway are relatively low (1 during the morning peak hour and 15 during the evening peak hour). Separate turning lanes can help improve the operation of the right-turning traffic exiting the site driveway. In addition, the site driveway should be configured while taking into consideration the relatively high volume of heavy vehicles.

The existing trip distribution for heavy vehicles at the facility should focus on orienting them towards the I-495 interchanges in Marlborough. To reduce the number of heavy vehicles on the local roadway network in the Town of Northborough, VHB recommends the applicant work with their commercial drivers to orient truck traffic towards the I-495 interchanges and (unless specifically destined to local destinations within Northborough, Shrewsbury, or Westborough to the west) and the community in developing these requirement.

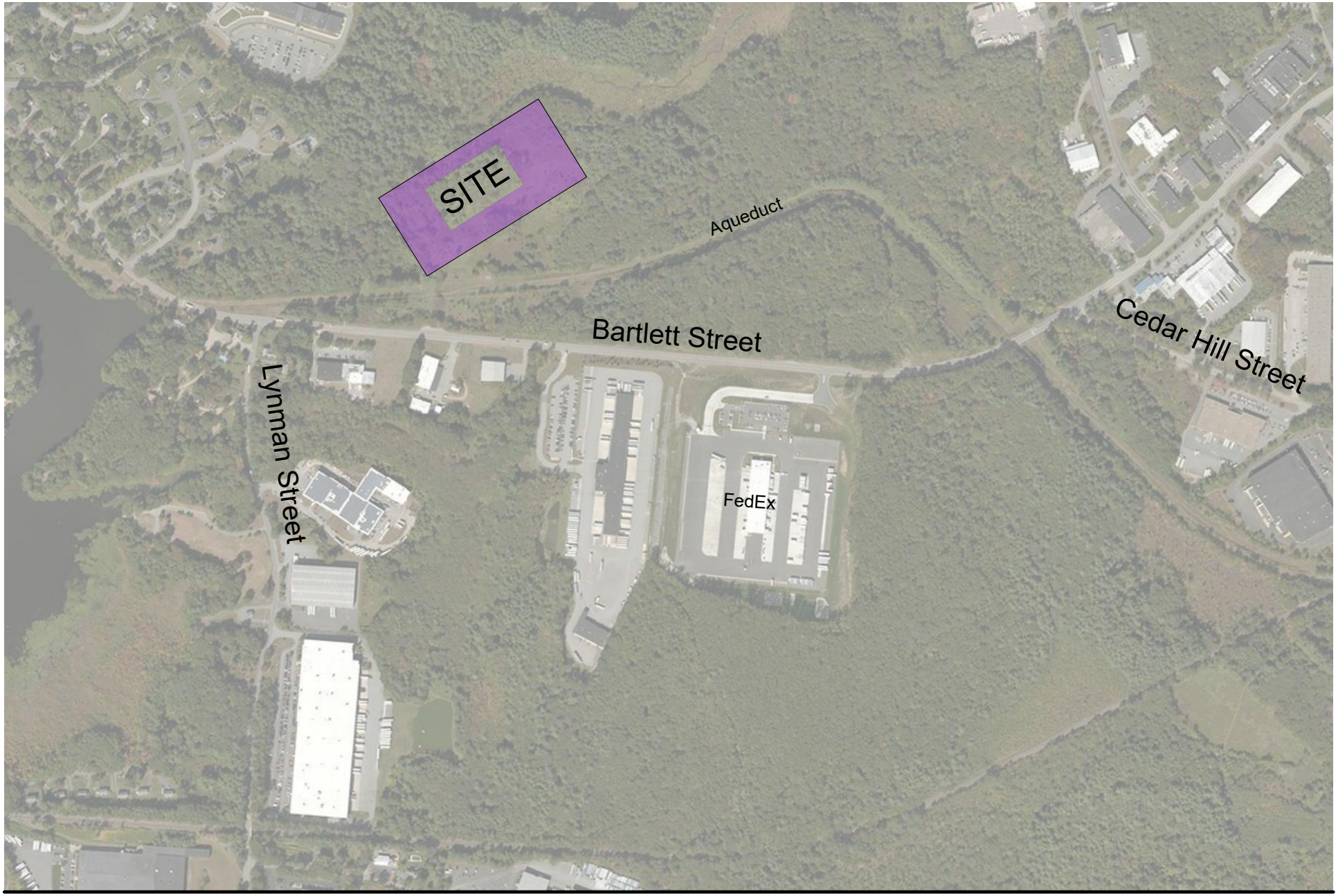
Signal Warrants

In considering the impact of the development on area intersections as well as considering the current volumes and delays experienced at both the Cedar Hill intersection as well as the Lyman Street intersection with Bartlett Street, VHB evaluated the need for improved traffic control at each location. The MUTCD outlines the volume-based thresholds needed to justify the placement of a traffic signal at a specific location. The resulting assessment prepared by VHB noted that there is not currently enough volume on a regular basis to justify the need for a traffic signal at either the site driveway, the intersection of Bartlett Street at Cedar Hill Street, or the intersection of Bartlett Street at Lyman Street under the Facility development plan. That said, the intersection of Bartlett Street at Lyman Street is projected to be close to meeting the warrants for signalization based on the long-term buildout assumptions noted in this memorandum and should be monitored over time as area developments start to become occupied.

Conclusions

From the traffic study outlined above, the subdivision roadway is designed to Northborough standards and the potential development of a 151,000 sf warehouse Facility is not expected to have a significant impact on traffic operations or increase delay on the surrounding area roadways for motorists. As described in the previous sections, it is recommended that the site driveway either provide for a wide exit lane or provide separate right- and left-turning lanes for traffic exiting the facility. This will improve the operations for all exiting drivers from the Facility. Nonetheless, the subdivision roadway meets the current Town of Northborough requirements from a design perspective.

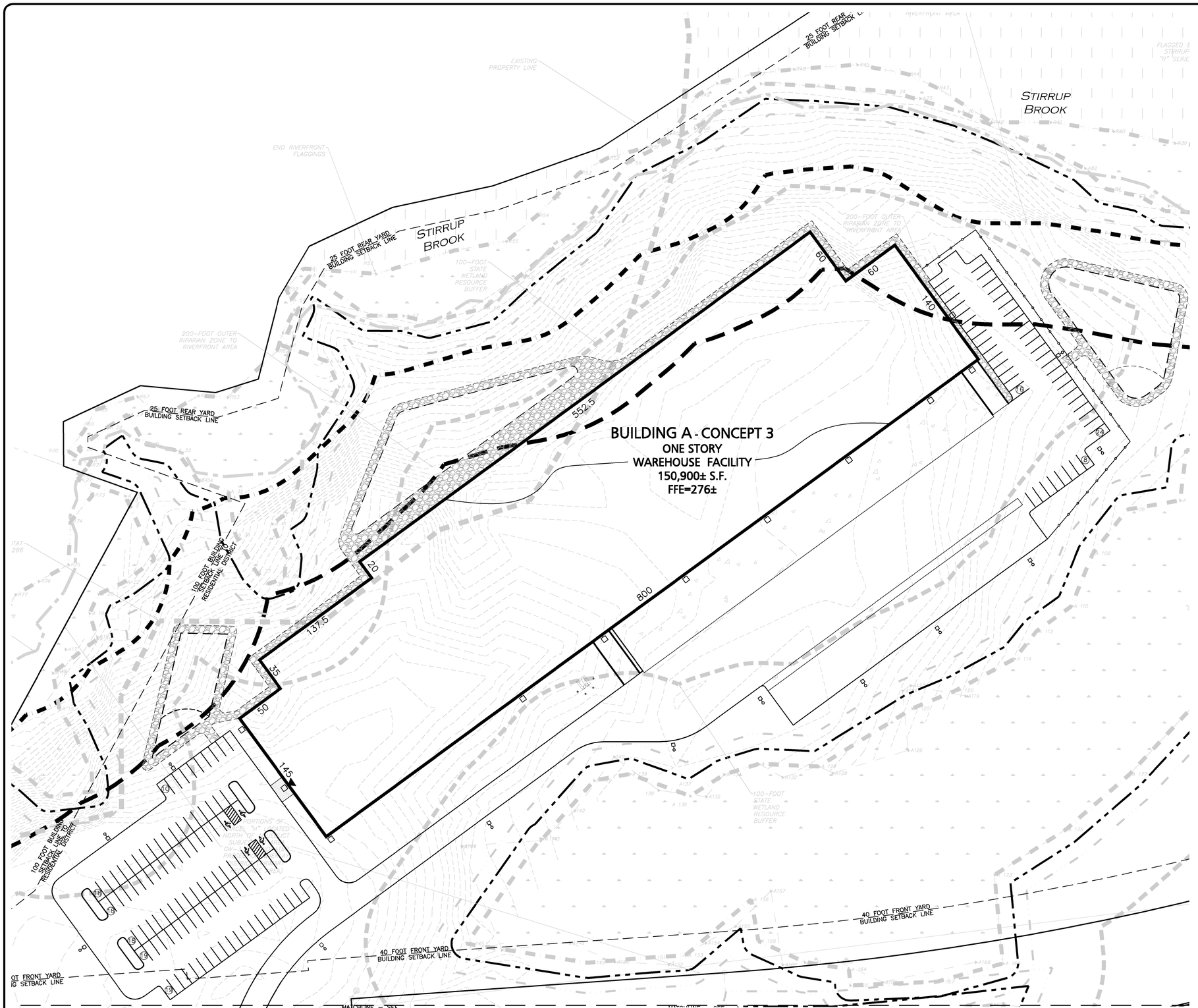
\\vhb\gbl\prop\Watertown\83468.19\Draft Contracts\Work\Graphics\Site Location Map 2.dwg



Not to Scale

Figure 1

Site Location Map
Northborough, Massachusetts



LEGEND

EXIST. PROPERTY LINE	
SIGN	
BOLLARD	
BUILDING	
BUILDING ARCHITECTURE	
BUILDING INTERIOR WALLS	
CURB	
RETAINING WALL	
PARKING STRIPING	
ROADWAY STRIPING	
HEAVY DUTY CONCRETE	
SIDEWALK	
ADA ACCESSIBLE RAMP	
ADA DET. WARNING SURFACE	
SETBACK LINE	
PARKING COUNT	(10)
SITE LIGHTING	
DOORWAY	
CURB RADIUS (FEET)	R15'
PRECAST CONCRETE CURB	PCC
VERTICAL GRANITE CURB	VGC
LANDSCAPED AREA	LA

NOTES:

1. THE INFORMATION SHOWN ON THIS PLAN IS THE SOLE PROPERTY OF ALLEN & MAJOR ASSOCIATES, INC. ITS INTENDED USE IS TO PROVIDE INFORMATION. ANY ALTERATION, MISUSE, OR RECALCULATION OF INFORMATION OR DATA WITHOUT THE EXPRESSED, WRITTEN CONSENT OF ALLEN & MAJOR ASSOCIATES, INC. IS STRICTLY PROHIBITED.
2. THIS PLAN WAS PREPARED USING AVAILABLE SITE INFORMATION FROM SEVERAL SOURCES, SOME OF WHICH IS UNCONFIRMED. THE EXISTING CONDITIONS SURVEY BASE WAS TAKEN FROM MULTIPLE PLANS ENTITLED "EXISTING CONDITIONS" PREPARED BY ALLEN & MAJOR ASSOCIATES, INC. DATED APRIL 2, 2018, ORIGINAL SCALE 1"=40', "ANR PLAN OF LAND" SHEETS 1–3, DATED APRIL 2, 2018, ORIGINAL SCALE 1"=100', AS WELL AS ONLINE GIS DATA FROM STATE AND LOCAL SOURCES.
3. THE LOCATIONS OF EXISTING UNDERGROUND UTILITIES ARE SHOWN IN AN APPROXIMATE WAY ONLY AND HAVE NOT BEEN INDEPENDENTLY VERIFIED BY THE OWNER OR IT'S REPRESENTATIVE. THE CONTRACTOR SHALL DETERMINE THE EXACT LOCATION OF ALL EXISTING UTILITIES BEFORE COMMENCING WORK, AND AGREES TO BE FULLY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MIGHT BE OCCASIONED BY THE CONTRACTOR'S FAILURE TO EXACTLY LOCATE AND PRESERVE ANY AND ALL UNDERGROUND UTILITIES.
4. ALL ELEVATIONS REFER TO NAVD 88.
5. WETLAND RESOURCE AREAS AND TOP OF BANK TO THE STIRRUP BROOK DELINEATED BY GODDARD CONSULTING ON OCTOBER 6, 2017, FEBRUARY 6, 2018 AND FEBRUARY 14, 2018 AND FIELD LOCATED BY INSTRUMENT.
6. FEMA FIRM FLOODPLAIN LINE WAS SCALED IN AND FLOOD ZONE DESIGNATIONS WERE TAKEN FROM COMMUNITY PANEL 25027C0653F, EFFECTIVE DATE JULY 16, 2014.
7. ALL RESOURCE AREAS ON THIS PLAN ARE SHOWN IN AN APPROXIMATE WAY ONLY FOR COORDINATION PURPOSES AND ARE SUBJECT TO UPDATES AS THE PROJECT PROGRESSES.
8. REFERENCED INFORMATION INCLUDING PROPERTY LINE, TOPOGRAPHY AND WETLANDS DELINEATION PROVIDED IN DIGITAL FORMAT BY THE CLIENT IN AN AUTOCAD FORMAT DRAWING ENTITLED "BARTLETT TOPO HILLSIDE POST FED EX" DATED 2011–09–01, TO BE FIELD CONFIRMED.
9. "DEVELOPABLE AREA" REFERS TO THE AREA OF FORESTED UPLAND ON–SITE, NORTH OF THE AQUEDUCT AND OUTSIDE OF THE 100' INNER RIVERFRONT AREA AS WELL AS OUTSIDE OF THE 15' LOCAL NO–DISTURB WETLAND AREA. NO STRUCTURES ARE PERMITTED WITHIN THE 30' BUFFER TO BORDERING VEGETATED WETLANDS.
10. ALL CALCULATED AREAS AND INFORMATION IS APPROXIMATE ONLY FOR COORDINATION PURPOSES AND SUBJECT TO CHANGE UNTIL AN ON–THE–GROUND TOPOGRAPHIC SURVEY HAS BEEN COMPLETED.
11. ARE MEASUREMENTS PROVIDED ARE TO FACE OF CURBING, BUILDING, RETAINING WALLS ETC. UNLESS OTHERWISE NOTED.
12. ALL CURB RADII ARE TO BE 3' UNLESS OTHERWISE NOTED.
13. 198 PARKING STALLS PROVIDED FOR BUILDING A, INCLUDING 6 HANDICAPPED STALLS. 41 PARKING STALLS PROVIDED FOR BUILDING B, INCLUDING 2 HANDICAPPED STALLS.
14. SITE LIGHTING SHOWN FOR COORDINATION PURPOSES ONLY AND ARE SUBJECT TO CHANGE PENDING A PHOTOMETRICS PLAN. LIGHTING LOCATIONS AND STYLES TO BE PROVIDED BY LIGHTING CONSULTANT.
15. BUILDING FOOTPRINT SHOWN FOR COORDINATION PURPOSES ONLY AND IS SUBJECT TO CHANGE PENDING ARCHITECTURAL DRAWINGS AND SITE CONSTRAINTS FROM AN ON–THE–GROUND TOPOGRAPHIC SURVEY.
16. THIS IS A CONCEPTUAL PLAN FOR THE PURPOSE OF MASTER PLANNING THE SUBJECT SITE(S). THIS PLAN IS NOT TO BE USED FOR CONSTRUCTION OR PERMITTING PURPOSES.
17. RIVERFRONT AREA ON–SITE = 399,342± S.F.
10% OF ON–SITE RFA = 39,934± S.F.
PROPOSED RFA DISTURBANCE = 39,740± S.F.
PERCENTAGE OF ON–SITE RFA DISTURBANCE = 9.95%

GRAPHIC SCALE

40 0 20 40 80 160

(IN FEET)
1 inch = 40 ft.

NOT FOR CONSTRUCTION

PRELIMINARY LIST OF PERMITS & WAIVERS

THE PROPOSED PROJECT IS A DISTRIBUTION WAREHOUSE DEVELOPMENT. THE FOLLOWING IS A PRELIMINARY LIST OF REQUIRED PERMITS AND WAIVERS SOUGHT. AS THE DEVELOPMENT PROGRESSES, ADDITIONAL WAIVERS AND PERMITS MAY BE ADDED.

THE APPLICANT ANTICIPATES THE FOLLOWING PERMITS SHALL BE REQUIRED:

NORTHBOROUGH PERMITS:
- SITE PLAN APPROVAL WITH SPECIAL PERMIT FOR GWOPD (PLANNING BOARD)
- ORDER OF CONDITIONS (NOI)
- EARTH REMOVAL PERMIT
- DESIGN REVIEW COMMITTEE APPROVAL

NORTHBOROUGH WAIVERS:
- TBD

TOWN OF NORTHBOROUGH, MA
PLANNING BOARD SITE PLAN APPROVAL

SPECIAL PERMIT APPROVAL WITH GWOPD

SIGNATURE DATE

CONCEPT 3 ISSUED FOR CLIENT REVIEW
JULY 18, 2019

PROFESSIONAL ENGINEER FOR ALLEN & MAJOR ASSOCIATES, INC.

REV	DATE	DESCRIPTION

APPLICANT\OWNER:
THE GUTIERREZ COMPANY
200 SUMMIT DRIVE, SUITE 400
BURLINGTON, MA 01803

PROJECT:
PARCEL H DEVELOPMENT
BARTLETT STREET
MAP 51 LOT 3 PARCEL 3A &
MAP 66 LOT 5 PARCEL 2B
NORTHBOROUGH, MA

PROJECT NO.	1145-09	DATE:	2019-04-23
SCALE:	1"=40'	DWG. NAME:	C-1145-09
DESIGNED BY:	DMR	CHECKED BY:	TJW

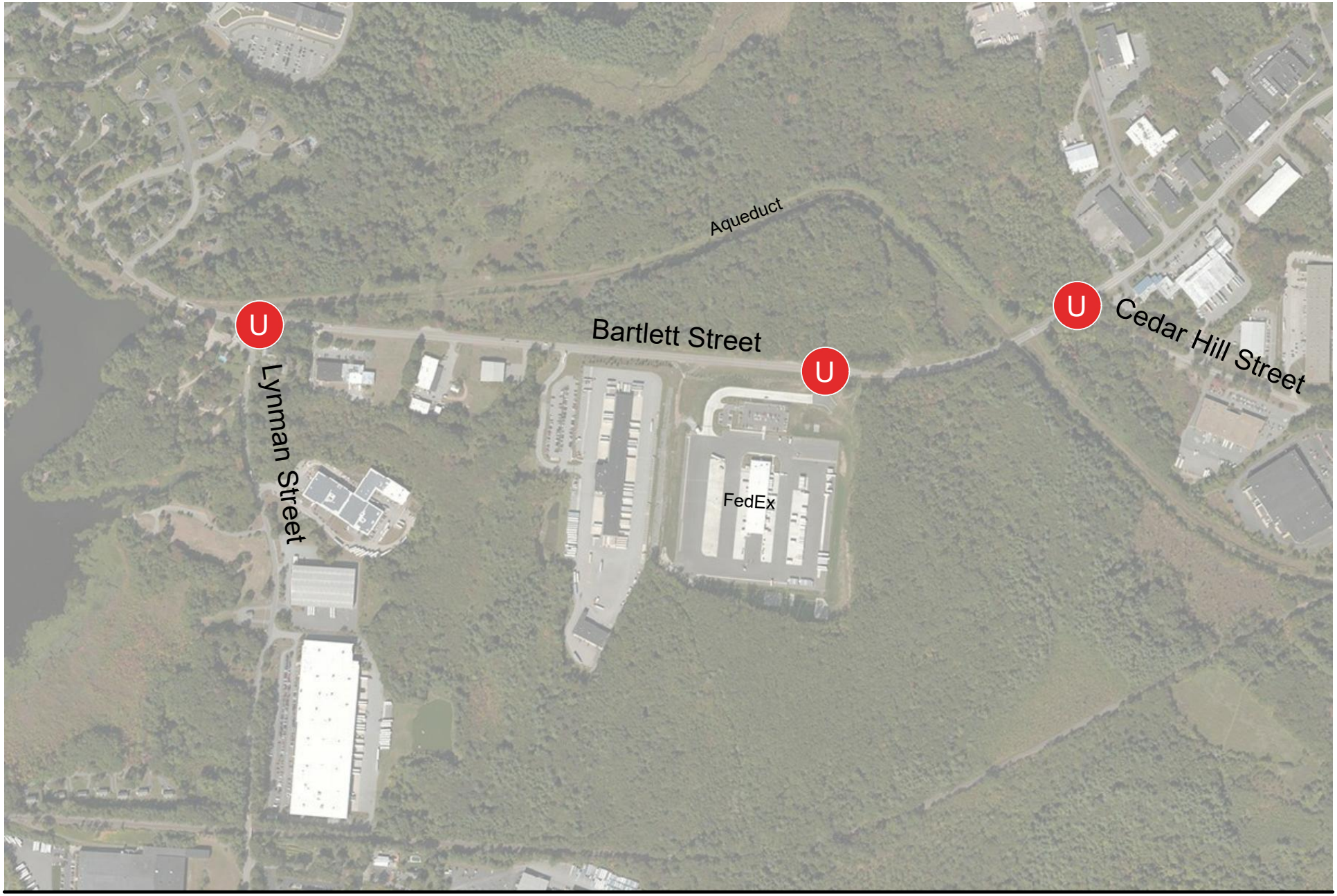
PREPARED BY
ALLEN & MAJOR ASSOCIATES, INC.
civil & structural engineering ◆ land surveying
environmental consulting ◆ landscape architecture
www.allenmajor.com
100 COMMERCE WAY
SUITE 5
WOBURN MA 01801
TEL: (781) 935-6889
FAX: (781) 935-2896
WOBURN, MA ◆ LAKEVILLE, MA ◆ MANCHESTER, NH

DRAWING TITLE:
CONCEPTUAL LAYOUT
PLAN - BUILDING A

SHEET No.
C-102A

N:\PROJECTS\1145-09\CIVIL\DRAWINGS\CURRENT\C-1145-09 - LAYOUT & MATERIALS PLAN.DWG

\\vhb\gbl\proj\Wat-TS\14767.00 Bartlett St Warehouse\Graphics\FIGURES\Graphics\Study Area Intersections.dwg



Not to Scale

Figure 3

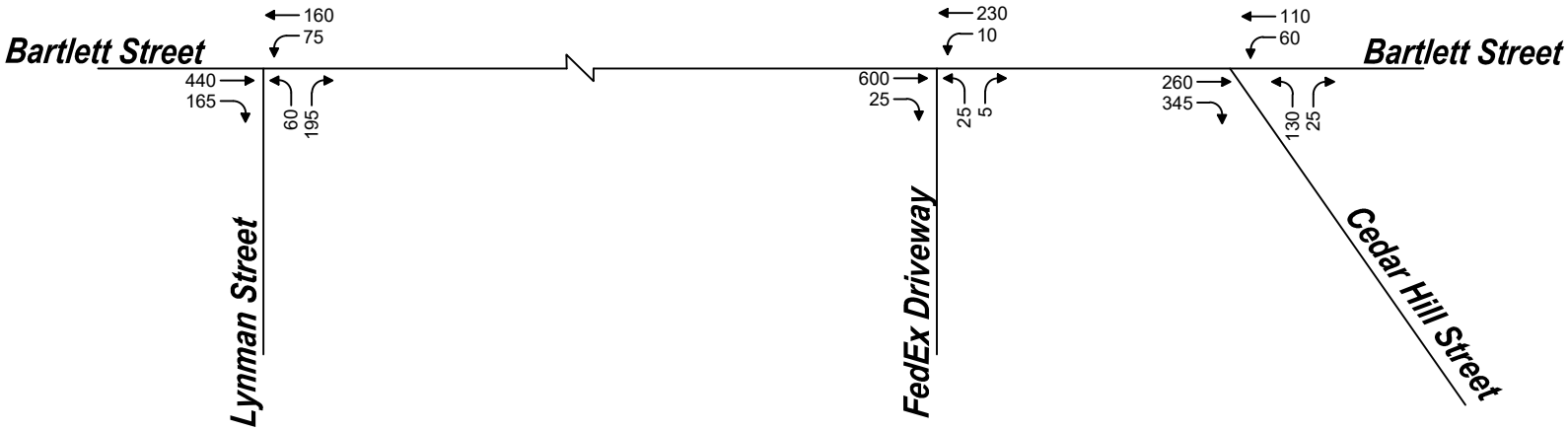
Study Area Intersections
Northborough, Massachusetts

Not to Scale

Figure 6

Development Locations
Northborough, Massachusetts

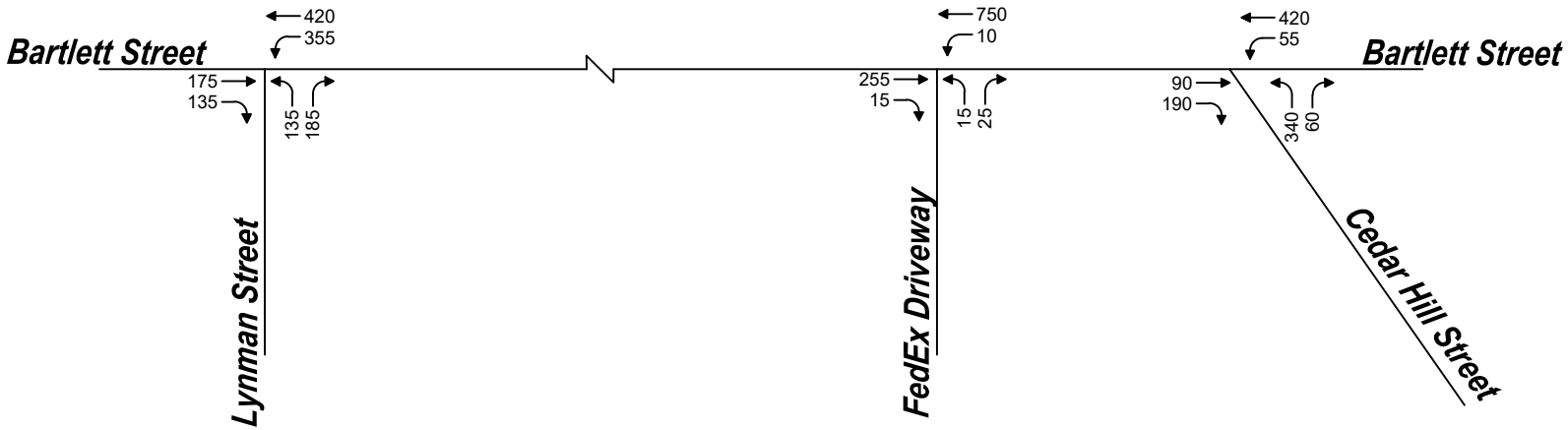
neg = Negligible



Not to Scale

Figure 4
2020 Existing Conditions
Weekday Morning Peak Hour Traffic Volumes
Warehouse Facility
Northborough, Massachusetts

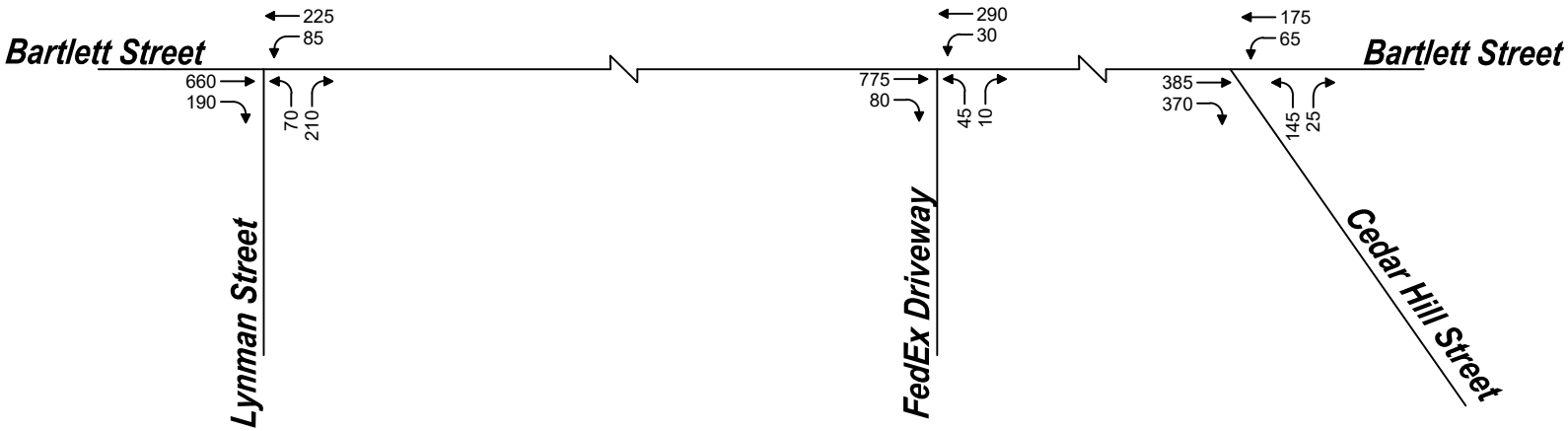
neg = Negligible



Not to Scale

Figure 5
2020 Existing Conditions
Weekday Evening Peak Hour Traffic Volumes
Warehouse Facility
Northborough, Massachusetts

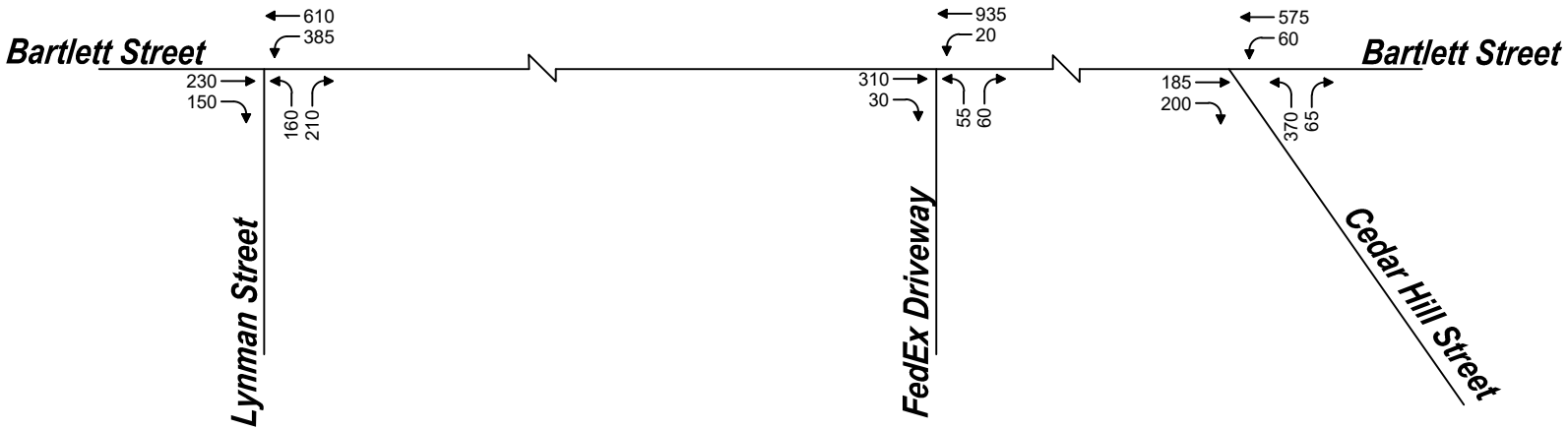
neg = Negligible



Not to Scale

Figure 7
2027 No-Build Conditions
Weekday Morning Peak Hour Traffic Volumes
Warehouse Facility
Northborough, Massachusetts

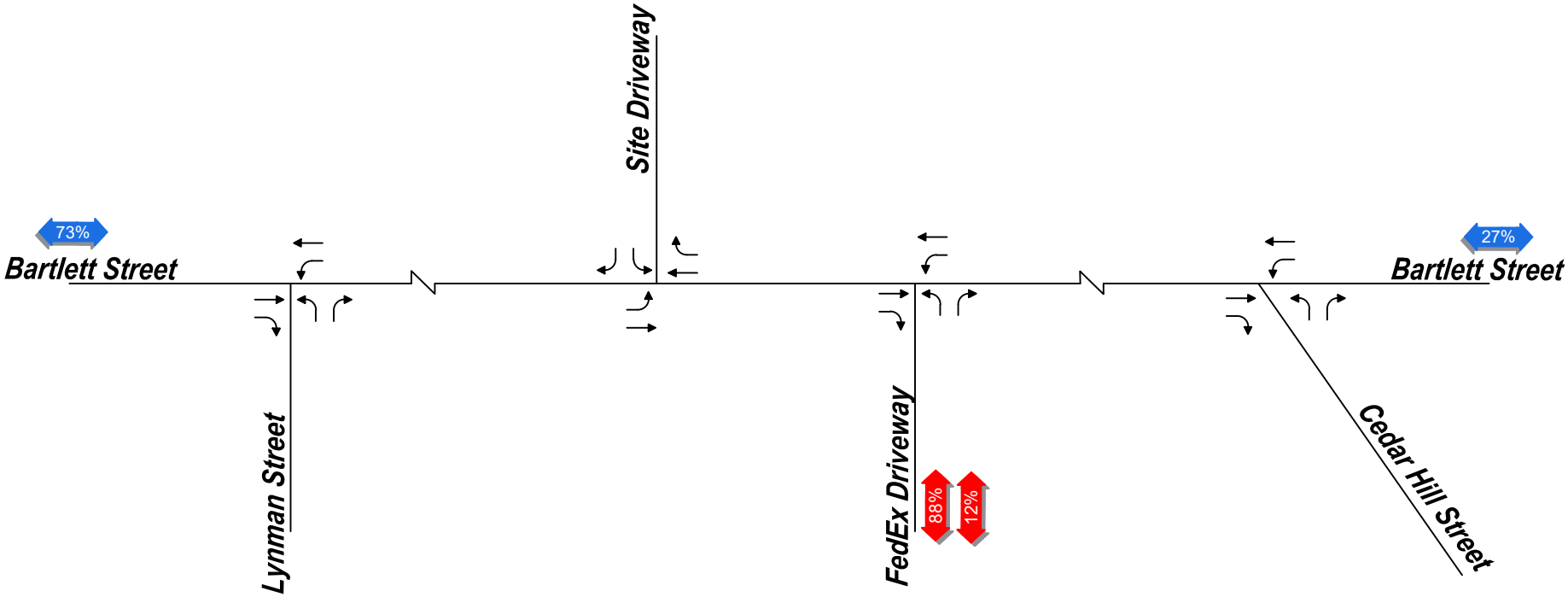
neg = Negligible



Not to Scale

Figure 8
2027 No-Build Conditions
Weekday Evening Peak Hour Traffic Volumes
Warehouse Facility
Northborough, Massachusetts

X% Entering Trip Distribution
X% Exiting Trip Distribution

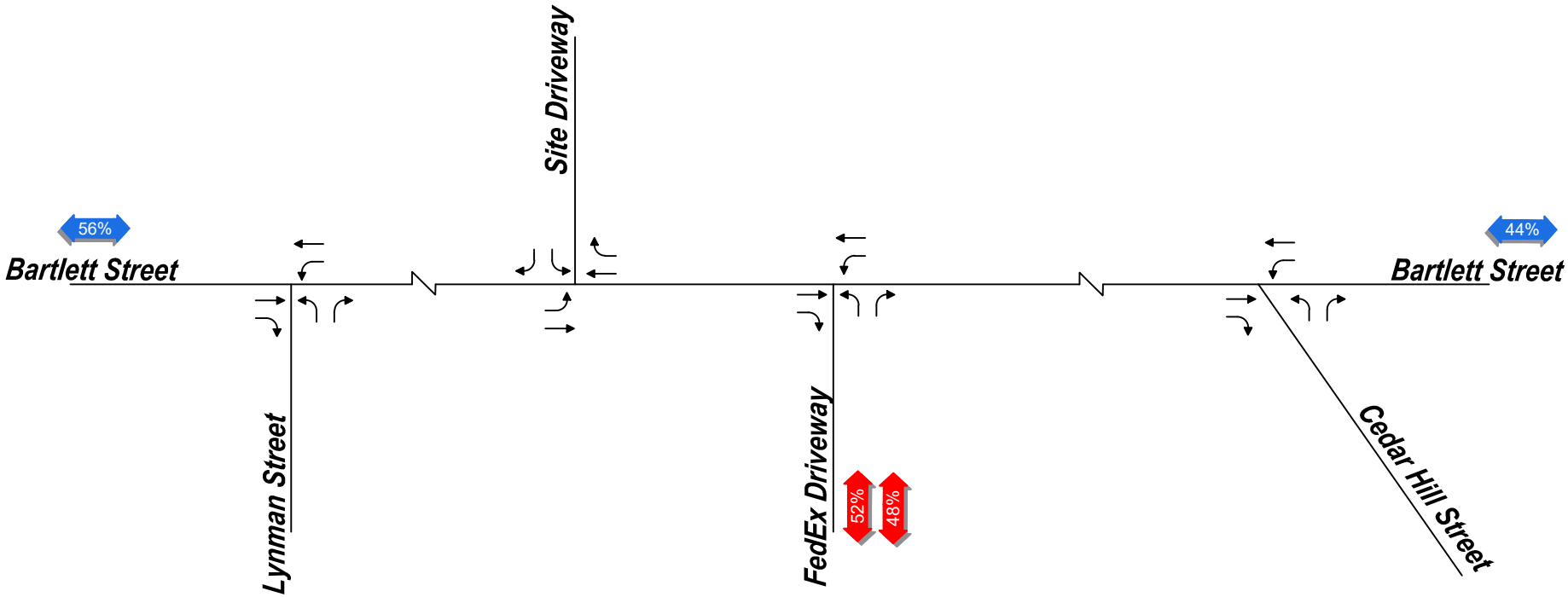


Not to Scale

Figure 9
AM Trip Distribution

Warehouse Facility
Northborough, Massachusetts

X% Entering Trip Distribution
X% Exiting Trip Distribution

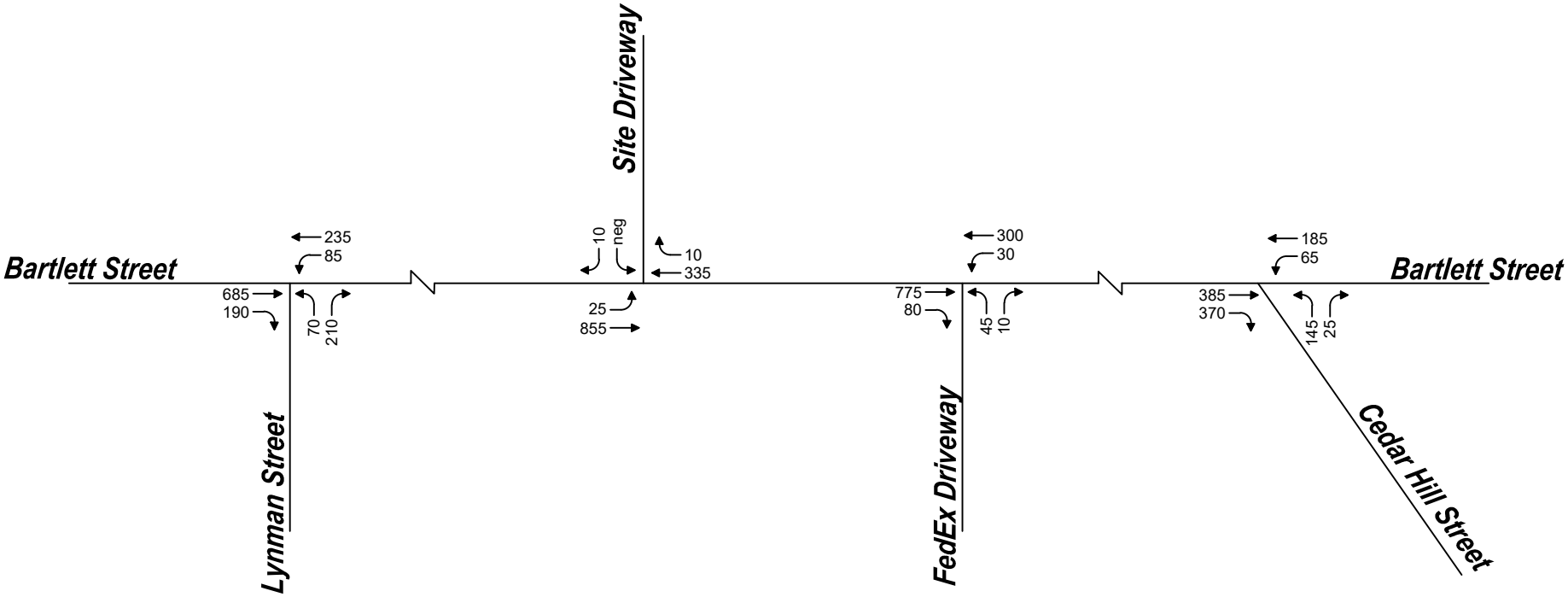


Not to Scale

Figure 10
PM Trip Distribution

Warehouse Facility
Northborough, Massachusetts

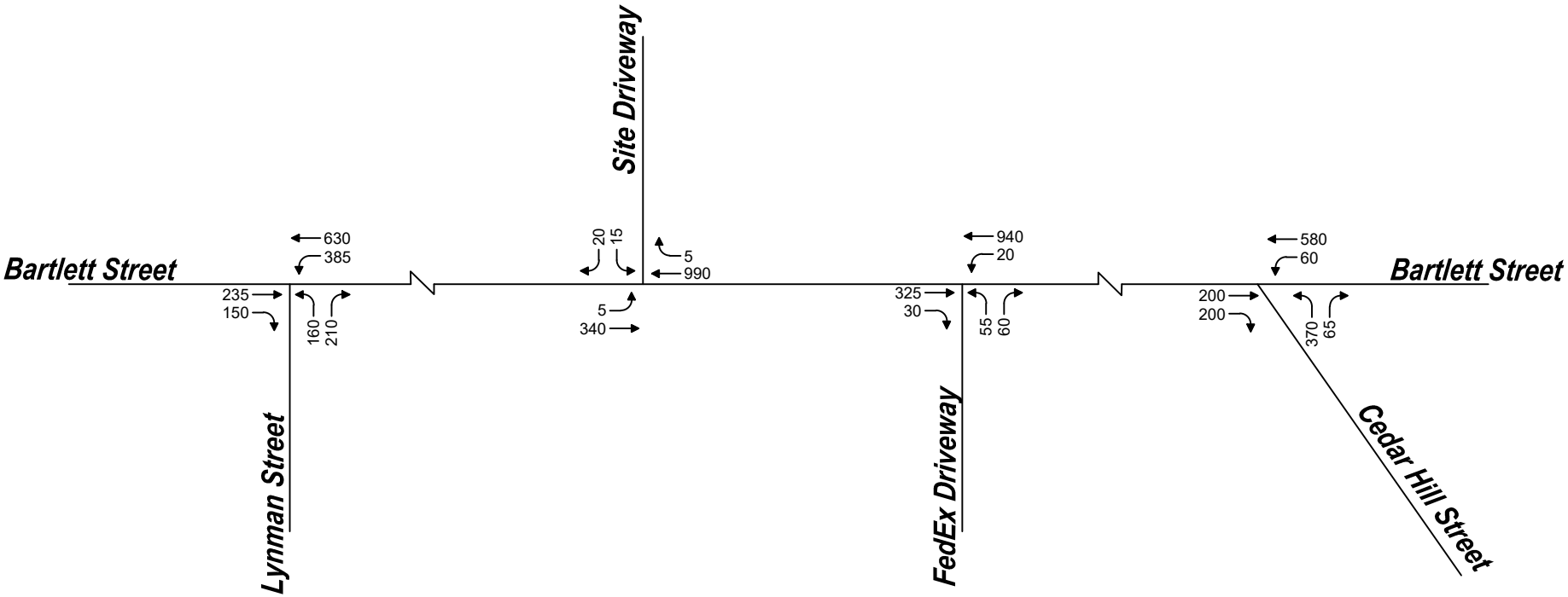
neg = Negligible



Not to Scale

Figure 11
2027 Build Conditions
Weekday Morning Peak Hour Traffic Volumes
Warehouse Facility
Northborough, Massachusetts

neg = Negligible



Not to Scale

Figure 12
2027 Build Conditions
Weekday Evening Peak Hour Traffic Volumes
Warehouse Facility
Northborough, Massachusetts

Attachments

- Traffic Volume Data
- Seasonal Adjustment Data
- Vehicular Crash Data
- Planned/Approved Developments
- Traffic Generation Memorandum
- Trip Generation
- Intersection Capacity Analyses

Location Map: 197253 Northborough, MA

Precision Data Industries, LLC 46 Morton Street, Framingham, MA 01702 ph: 508-875-0100 email: datarequests@pdillc.com

Client:	Engineer:	Site Code:	Date:	PDI Job #	City, State:
VHB	T. Benson	83468.19	Wed 10/16 thru Thurs 10/17/2019	197253	Northborough, MA

Bartlett Street
west of Cedarr Hill Road
City, State: Northborough, MA
Client: VHB/ T. Benson

PRECISION DATA INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

197253 A Volume
Site Code: 83468.19
Date Start: 10/16/19
Date End: 10/17/19

Start	EB				WB				Combined				10/16/19
Time	A.M.		P.M.		A.M.		P.M.		A.M.		P.M.		Wed
12:00	4		52		2		77		6		129		
12:15	1		53		3		45		4		98		
12:30	0		59		4		46		4		105		
12:45	0	5	61	225	1	10	49	217	1	15	110	442	
01:00	4		57		6		51		10		108		
01:15	5		47		3		52		8		99		
01:30	0		49		5		66		5		115		
01:45	6	15	62	215	3	17	46	215	9	32	108	430	
02:00	3		66		4		45		7		111		
02:15	1		50		5		59		6		109		
02:30	3		68		1		88		4		156		
02:45	2	9	77	261	4	14	73	265	6	23	150	526	
03:00	1		86		4		95		5		181		
03:15	2		61		4		72		6		133		
03:30	6		60		5		107		11		167		
03:45	7	16	54	261	10	23	75	349	17	39	129	610	
04:00	3		45		9		119		12		164		
04:15	9		52		8		118		17		170		
04:30	14		71		4		163		18		234		
04:45	15	41	69	237	6	27	174	574	21	68	243	811	
05:00	27		68		10		214		37		282		
05:15	18		71		12		211		30		282		
05:30	36		37		20		192		56		229		
05:45	49	130	47	223	21	63	155	772	70	193	202	995	
06:00	48		55		22		105		70		160		
06:15	47		37		31		96		78		133		
06:30	73		30		43		69		116		99		
06:45	110	278	28	150	78	174	69	339	188	452	97	489	
07:00	108		31		101		41		209		72		
07:15	120		27		38		37		158		64		
07:30	161		30		40		34		201		64		
07:45	145	534	40	128	77	256	38	150	222	790	78	278	
08:00	139		29		61		32		200		61		
08:15	146		25		59		19		205		44		
08:30	168		18		52		15		220		33		
08:45	166	619	19	91	35	207	12	78	201	826	31	169	
09:00	115		16		56		19		171		35		
09:15	92		17		29		15		121		32		
09:30	67		19		33		15		100		34		
09:45	58	332	14	66	31	149	16	65	89	481	30	131	
10:00	52		15		29		11		81		26		
10:15	41		12		41		8		82		20		
10:30	48		2		31		11		79		13		
10:45	37	178	3	32	39	140	7	37	76	318	10	69	
11:00	41		8		27		10		68		18		
11:15	41		2		32		8		73		10		
11:30	47		1		54		9		101		10		
11:45	67	196	8	19	51	164	7	34	118	360	15	53	
Total	2353		1908		1244		3095		3597		5003		
Percent	65.4%		38.1%		34.6%		61.9%						
Day Total		4261				4339				8600			
Peak	08:00	-	02:30	-	06:30	-	04:45	-	07:45	-	04:30	-	- -
Vol.	619	-	292	-	260	-	791	-	847	-	1041	-	- -
P.H.F.	0.921		0.849		0.644		0.924		0.954		0.923		

Bartlett Street
west of Cedarr Hill Road
City, State: Northborough, MA
Client: VHB/ T. Benson

PRECISION DATA INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

197253 A Volume
Site Code: 83468.19
Date Start: 10/16/19
Date End: 10/17/19

Start	EB				WB				Combined				10/17/19
Time	A.M.		P.M.		A.M.		P.M.		A.M.		P.M.		Thu
12:00	4		60		2		70		6		130		
12:15	0		56		3		54		3		110		
12:30	3		56		3		55		6		111		
12:45	1	8	64	236	1	9	49	228	2	17	113	464	
01:00	2		62		3		48		5		110		
01:15	2		48		1		44		3		92		
01:30	0		47		5		43		5		90		
01:45	1	5	42	199	5	14	34	169	6	19	76	368	
02:00	4		66		6		58		10		124		
02:15	3		58		1		55		4		113		
02:30	0		59		3		69		3		128		
02:45	4	11	69	252	9	19	76	258	13	30	145	510	
03:00	2		67		5		75		7		142		
03:15	5		63		2		79		7		142		
03:30	11		45		3		123		14		168		
03:45	6	24	49	224	13	23	121	398	19	47	170	622	
04:00	6		48		7		118		13		166		
04:15	14		47		5		120		19		167		
04:30	18		48		4		156		22		204		
04:45	18	56	38	181	5	21	150	544	23	77	188	725	
05:00	17		64		11		197		28		261		
05:15	25		38		15		190		40		228		
05:30	29		50		13		160		42		210		
05:45	43	114	60	212	23	62	131	678	66	176	191	890	
06:00	51		43		21		97		72		140		
06:15	58		56		26		114		84		170		
06:30	72		34		38		71		110		105		
06:45	102	283	18	151	81	166	64	346	183	449	82	497	
07:00	90		20		105		45		195		65		
07:15	119		27		41		36		160		63		
07:30	160		37		55		38		215		75		
07:45	156	525	29	113	56	257	32	151	212	782	61	264	
08:00	150		42		61		26		211		68		
08:15	172		31		44		17		216		48		
08:30	175		18		35		15		210		33		
08:45	170	667	22	113	48	188	17	75	218	855	39	188	
09:00	121		17		43		12		164		29		
09:15	68		28		36		15		104		43		
09:30	71		26		51		16		122		42		
09:45	70	330	20	91	41	171	11	54	111	501	31	145	
10:00	52		10		35		14		87		24		
10:15	52		6		17		14		69		20		
10:30	36		7		31		13		67		20		
10:45	38	178	4	27	31	114	5	46	69	292	9	73	
11:00	47		5		37		18		84		23		
11:15	39		4		36		7		75		11		
11:30	49		4		50		13		99		17		
11:45	46	181	4	17	79	202	7	45	125	383	11	62	
Total	2382		1816		1246		2992		3628		4808		
Percent	65.7%		37.8%		34.3%		62.2%						
Day Total		4198				4238				8436			
Peak	08:00	-	02:30	-	06:45	-	04:45	-	08:00	-	05:00	-	- -
Vol.	667	-	258	-	282	-	697	-	855	-	890	-	- -
P.H.F.	0.953		0.935		0.671		0.885		0.981		0.852		

PRECISION
D A T A
INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

Bartlett Street
west of Cedarr Hill Road
City, State: Northborough, MA
Client: VHB/ T. Benson

197253 A Class
Site Code: 83468.19
Date Start: 16-Oct-19
Date End: 17-Oct-19

EB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
10/16/1														
9	0	1	0	0	1	0	0	0	3	0	0	0	0	5
01:00	1	5	2	1	0	1	0	0	4	0	1	0	0	15
02:00	0	1	0	1	0	1	0	0	5	0	1	0	0	9
03:00	0	6	1	1	0	0	0	0	7	0	0	1	0	16
04:00	1	22	8	2	5	1	0	1	1	0	0	0	0	41
05:00	3	66	26	3	20	3	0	2	7	0	0	0	0	130
06:00	2	183	48	11	24	1	0	6	3	0	0	0	0	278
07:00	6	408	72	11	21	6	1	4	4	1	0	0	0	534
08:00	6	482	81	5	29	3	1	9	2	1	0	0	0	619
09:00	7	231	38	8	28	6	0	7	6	0	0	1	0	332
10:00	2	101	26	1	11	2	1	28	6	0	0	0	0	178
11:00	2	124	30	3	23	4	2	5	3	0	0	0	0	196
12 PM	4	153	38	3	17	4	1	4	1	0	0	0	0	225
13:00	0	146	38	5	14	1	2	5	4	0	0	0	0	215
14:00	4	177	42	3	21	5	2	3	4	0	0	0	0	261
15:00	0	178	49	5	16	6	0	3	4	0	0	0	0	261
16:00	7	157	32	2	25	12	1	0	1	0	0	0	0	237
17:00	4	167	40	0	8	1	0	1	1	1	0	0	0	223
18:00	2	106	22	1	12	1	1	2	3	0	0	0	0	150
19:00	0	89	25	1	8	0	0	1	3	0	1	0	0	128
20:00	1	52	19	0	9	0	0	3	1	0	6	0	0	91
21:00	3	33	10	1	4	2	0	1	8	0	4	0	0	66
22:00	0	23	5	0	2	0	0	0	2	0	0	0	0	32
23:00	1	9	2	0	1	1	0	0	5	0	0	0	0	19
Total	56	2920	654	68	299	61	12	85	88	3	13	2	0	4261
Percent	1.3%	68.5%	15.3%	1.6%	7.0%	1.4%	0.3%	2.0%	2.1%	0.1%	0.3%	0.0%	0.0%	
AM Peak	09:00	08:00	08:00	06:00	08:00	07:00	11:00	10:00	03:00	07:00	01:00	03:00		08:00
Vol.	7	482	81	11	29	6	2	28	7	1	1	1		619
PM Peak	16:00	15:00	15:00	13:00	16:00	16:00	13:00	13:00	21:00	17:00	20:00			14:00
Vol.	7	178	49	5	25	12	2	5	8	1	6			261

PRECISION
D A T A
INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

Bartlett Street
west of Cedarr Hill Road
City, State: Northborough, MA
Client: VHB/ T. Benson

197253 A Class
Site Code: 83468.19
Date Start: 16-Oct-19
Date End: 17-Oct-19

EB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
10/17/1														
9	0	1	1	0	1	0	0	0	5	0	0	0	0	8
01:00	0	1	1	0	0	0	0	0	2	0	1	0	0	5
02:00	1	1	0	3	0	1	0	0	4	0	1	0	0	11
03:00	3	9	1	1	3	3	0	0	4	0	0	0	0	24
04:00	2	25	11	1	5	3	0	1	8	0	0	0	0	56
05:00	3	56	30	2	10	5	0	3	5	0	0	0	0	114
06:00	1	192	53	10	13	1	0	5	7	0	1	0	0	283
07:00	6	424	66	9	8	3	1	4	3	0	1	0	0	525
08:00	9	551	70	4	20	4	1	5	3	0	0	0	0	667
09:00	2	237	56	6	12	5	1	8	2	0	0	1	0	330
10:00	5	102	28	2	11	0	0	25	5	0	0	0	0	178
11:00	4	111	36	1	11	3	0	11	4	0	0	0	0	181
12 PM	9	155	42	2	13	6	1	2	6	0	0	0	0	236
13:00	4	146	31	2	12	2	1	1	0	0	0	0	0	199
14:00	2	184	46	2	12	1	0	3	2	0	0	0	0	252
15:00	3	175	34	0	9	0	0	1	2	0	0	0	0	224
16:00	1	148	19	3	7	0	0	3	0	0	0	0	0	181
17:00	3	157	37	1	11	1	0	1	1	0	0	0	0	212
18:00	1	123	12	0	11	1	0	2	1	0	0	0	0	151
19:00	3	84	16	1	4	0	0	1	2	0	2	0	0	113
20:00	3	83	12	1	3	2	0	1	2	0	6	0	0	113
21:00	1	63	11	1	2	1	0	1	6	0	5	0	0	91
22:00	1	18	1	0	0	1	0	0	6	0	0	0	0	27
23:00	2	7	3	0	4	1	0	0	0	0	0	0	0	17
Total	69	3053	617	52	182	44	5	78	80	0	17	1	0	4198
Percent	1.6%	72.7%	14.7%	1.2%	4.3%	1.0%	0.1%	1.9%	1.9%	0.0%	0.4%	0.0%	0.0%	
AM Peak	08:00	08:00	08:00	06:00	08:00	05:00	07:00	10:00	04:00		01:00	09:00		08:00
Vol.	9	551	70	10	20	5	1	25	8		1	1		667
PM Peak	12:00	14:00	14:00	16:00	12:00	12:00	12:00	14:00	12:00		20:00			14:00
Vol.	9	184	46	3	13	6	1	3	6		6			252

PRECISION
D A T A
INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

Bartlett Street
west of Cedarr Hill Road
City, State: Northborough, MA
Client: VHB/ T. Benson

197253 A Class
Site Code: 83468.19
Date Start: 16-Oct-19
Date End: 17-Oct-19

WB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
10/16/1														
9	2	4	1	0	0	2	0	0	0	0	1	0	0	10
01:00	2	6	1	0	0	2	0	1	4	0	1	0	0	17
02:00	2	2	0	1	1	3	0	0	4	0	0	1	0	14
03:00	5	7	1	0	0	5	0	0	4	0	1	0	0	23
04:00	3	11	3	2	0	3	0	1	2	0	2	0	0	27
05:00	4	31	9	2	10	3	0	2	0	0	2	0	0	63
06:00	5	110	25	12	10	5	0	0	3	0	4	0	0	174
07:00	5	193	42	2	5	2	0	0	5	0	2	0	0	256
08:00	7	145	36	1	8	7	0	1	1	0	1	0	0	207
09:00	7	102	21	5	8	2	1	1	1	0	1	0	0	149
10:00	2	88	26	4	10	4	0	5	1	0	0	0	0	140
11:00	2	116	29	5	7	1	0	3	1	0	0	0	0	164
12 PM	4	153	34	3	13	6	0	4	0	0	0	0	0	217
13:00	2	131	40	11	21	4	1	4	1	0	0	0	0	215
14:00	7	186	37	3	20	5	0	4	3	0	0	0	0	265
15:00	4	258	55	6	18	2	0	3	3	0	0	0	0	349
16:00	4	443	91	2	17	3	0	12	2	0	0	0	0	574
17:00	7	612	101	3	22	4	1	20	2	0	0	0	0	772
18:00	8	254	38	0	18	4	1	10	6	0	0	0	0	339
19:00	4	112	18	2	6	0	0	6	2	0	0	0	0	150
20:00	0	51	17	1	4	1	0	0	4	0	0	0	0	78
21:00	3	45	9	1	1	3	0	0	3	0	0	0	0	65
22:00	2	22	6	0	3	2	0	1	1	0	0	0	0	37
23:00	0	23	6	0	0	1	0	0	4	0	0	0	0	34
Total	91	3105	646	66	202	74	4	78	57	0	15	1	0	4339
Percent	2.1%	71.6%	14.9%	1.5%	4.7%	1.7%	0.1%	1.8%	1.3%	0.0%	0.3%	0.0%	0.0%	
AM Peak	08:00	07:00	07:00	06:00	05:00	08:00	09:00	10:00	07:00		06:00	02:00		07:00
Vol.	7	193	42	12	10	7	1	5	5		4	1		256
PM Peak	18:00	17:00	17:00	13:00	17:00	12:00	13:00	17:00	18:00					17:00
Vol.	8	612	101	11	22	6	1	20	6					772

PRECISION
D A T A
INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

Bartlett Street
west of Cedarr Hill Road
City, State: Northborough, MA
Client: VHB/ T. Benson

197253 A Class
Site Code: 83468.19
Date Start: 16-Oct-19
Date End: 17-Oct-19

WB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
10/17/1														
9	0	2	0	0	0	0	0	0	6	0	1	0	0	9
01:00	1	4	3	0	1	1	0	1	2	0	1	0	0	14
02:00	2	1	1	1	2	2	0	0	10	0	0	0	0	19
03:00	4	5	7	0	2	3	0	0	2	0	0	0	0	23
04:00	4	6	3	0	1	4	0	0	2	0	0	1	0	21
05:00	4	30	10	3	5	4	0	1	2	0	3	0	0	62
06:00	7	103	22	12	8	2	0	1	3	0	8	0	0	166
07:00	4	207	27	2	6	7	1	0	1	0	1	1	0	257
08:00	5	138	29	4	6	3	0	2	0	0	1	0	0	188
09:00	5	106	35	3	9	7	0	3	3	0	0	0	0	171
10:00	3	76	27	2	4	1	0	1	0	0	0	0	0	114
11:00	6	137	30	3	11	8	0	6	1	0	0	0	0	202
12 PM	5	166	40	3	9	1	0	4	0	0	0	0	0	228
13:00	4	113	25	8	17	0	0	1	0	0	1	0	0	169
14:00	4	189	45	3	12	0	0	3	2	0	0	0	0	258
15:00	7	296	63	6	12	4	0	10	0	0	0	0	0	398
16:00	7	442	74	2	10	2	0	6	1	0	0	0	0	544
17:00	13	543	81	2	20	3	0	13	3	0	0	0	0	678
18:00	6	267	38	3	12	2	1	10	7	0	0	0	0	346
19:00	6	109	17	2	7	2	0	6	2	0	0	0	0	151
20:00	1	59	9	1	1	2	0	0	2	0	0	0	0	75
21:00	2	44	3	0	0	2	0	0	3	0	0	0	0	54
22:00	4	35	2	0	2	3	0	0	0	0	0	0	0	46
23:00	2	29	10	0	1	2	0	0	1	0	0	0	0	45
Total	106	3107	601	60	158	65	2	68	53	0	16	2	0	4238
Percent	2.5%	73.3%	14.2%	1.4%	3.7%	1.5%	0.0%	1.6%	1.3%	0.0%	0.4%	0.0%	0.0%	
AM Peak	06:00	07:00	09:00	06:00	11:00	11:00	07:00	11:00	02:00		06:00	04:00		07:00
Vol.	7	207	35	12	11	8	1	6	10		8	1		257
PM Peak	17:00	17:00	17:00	13:00	17:00	15:00	18:00	17:00	18:00		13:00			17:00
Vol.	13	543	81	8	20	4	1	13	7		1			678

PRECISION
D A T A
INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

Bartlett Street
west of Cedarr Hill Road
City, State: Northborough, MA
Client: VHB/ T. Benson

197253 A Speed
Site Code: 83468.19
Date Start: 16-Oct-19
Date End: 17-Oct-19

EB

Start Time	1 14	15 19	20 24	25 29	30 34	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 9999	Total	85th Perce	Avera (Mean
10/16/ 19	0	0	0	0	2	2	0	1	0	0	0	0	0	5	45	37
01:00	0	0	0	1	5	5	3	0	1	0	0	0	0	15	41	37
02:00	0	0	0	0	1	5	2	0	1	0	0	0	0	9	43	39
03:00	0	0	0	2	3	4	3	2	2	0	0	0	0	16	47	39
04:00	0	0	0	0	3	7	12	17	2	0	0	0	0	41	47	43
05:00	0	0	0	2	13	21	44	34	13	3	0	0	0	130	48	43
06:00	0	0	0	1	16	54	133	64	9	1	0	0	0	278	46	42
07:00	0	1	0	**8**	**29**	**115**	**247**	112	21	1	0	0	0	534	46	42
08:00	0	0	0	0	17	63	241	**223**	**71**	3	**1**	0	0	**619**	48	44
09:00	0	**3**	0	8	18	39	96	127	36	**5**	0	0	0	332	48	44
10:00	0	0	**1**	0	21	47	52	46	9	2	0	0	0	178	47	41
11:00	0	0	0	3	8	49	57	67	11	1	0	0	0	196	47	42
12 PM	0	0	0	**15**	12	25	84	72	16	1	0	0	0	225	47	42
13:00	0	0	0	1	9	47	98	52	8	0	0	0	0	215	46	42
14:00	0	**1**	0	4	**20**	**52**	99	68	16	1	0	0	0	**261**	47	42
15:00	0	0	0	2	10	33	**109**	**85**	**19**	2	**1**	0	0	261	47	43
16:00	**2**	1	0	0	13	42	90	67	19	**3**	0	0	0	237	47	43
17:00	0	1	0	0	3	35	101	67	15	1	0	0	0	223	47	43
18:00	0	0	**2**	0	13	35	50	34	13	3	0	0	0	150	48	42
19:00	0	0	1	7	3	26	59	25	7	0	0	0	0	128	46	41
20:00	0	0	0	4	12	22	26	22	3	1	1	0	0	91	47	41
21:00	0	1	0	1	12	16	23	11	2	0	0	0	0	66	45	40
22:00	0	0	0	0	3	13	9	7	0	0	0	0	0	32	45	40
23:00	0	0	0	2	6	5	5	1	0	0	0	0	0	19	42	36
Total	2	8	4	61	252	762	1643	1204	294	28	3	0	0	4261		
%	0.0%	0.2%	0.1%	1.4%	5.9%	17.9%	38.6%	28.3%	6.9%	0.7%	0.1%	0.0%	0.0%			
AM Peak		09:00	10:00	07:00	07:00	07:00	07:00	08:00	08:00	09:00	08:00			08:00		
Vol.		3	1	8	29	115	247	223	71	5	1			619		
PM Peak	16:00	14:00	18:00	12:00	14:00	14:00	15:00	15:00	15:00	16:00	15:00			14:00		
Vol.	2	1	2	15	20	52	109	85	19	3	1			261		

Stats

15th Percentile :	36 MPH
50th Percentile :	42 MPH
85th Percentile :	47 MPH
95th Percentile :	50 MPH
Mean Speed(Average) :	42 MPH
10 MPH Pace Speed :	40-49 MPH
Number in Pace :	2847
Percent in Pace :	66.8%
Number of Vehicles > 40 MPH :	2843
Percent of Vehicles > 40 MPH :	66.7%

PRECISION
D A T A
INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

Bartlett Street
west of Cedarr Hill Road
City, State: Northborough, MA
Client: VHB/ T. Benson

197253 A Speed
Site Code: 83468.19
Date Start: 16-Oct-19
Date End: 17-Oct-19

EB

Start Time	1 14	15 19	20 24	25 29	30 34	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 9999	Total	85th Perce	Avera (Mean
10/17/ 19	0	0	0	1	2	5	0	0	0	0	0	0	0	8	37	34
01:00	0	0	0	0	1	4	0	0	0	0	0	0	0	5	38	36
02:00	0	0	2	0	3	3	2	1	0	0	0	0	0	11	42	35
03:00	0	0	0	2	2	7	5	6	1	0	0	**1**	0	24	47	41
04:00	0	0	0	3	10	9	18	13	2	1	0	0	0	56	46	40
05:00	0	0	1	13	17	27	31	21	4	0	0	0	0	114	45	39
06:00	0	0	2	6	50	110	89	20	5	1	0	0	0	283	43	38
07:00	0	0	0	6	**55**	**182**	208	67	7	0	0	0	0	525	43	40
08:00	0	0	**3**	**35**	45	157	**286**	**119**	**20**	**2**	0	0	0	**667**	45	41
09:00	0	0	0	5	39	92	123	62	9	0	0	0	0	330	45	40
10:00	0	0	2	13	37	39	50	30	7	0	0	0	0	178	45	39
11:00	0	0	0	4	24	41	52	47	12	1	0	0	0	181	47	41
12 PM	**1**	**1**	0	**6**	14	**50**	93	61	9	1	0	0	0	236	46	41
13:00	0	0	0	4	5	38	83	56	11	2	0	0	0	199	47	43
14:00	0	0	0	0	6	36	**108**	**84**	14	**4**	0	0	0	**252**	47	44
15:00	0	0	0	2	4	40	103	55	**16**	3	**1**	0	0	224	47	43
16:00	0	0	0	0	5	26	74	62	13	1	0	0	0	181	47	44
17:00	0	0	**1**	5	9	35	79	65	16	2	0	0	0	212	47	43
18:00	0	0	1	2	5	30	63	44	5	1	0	0	0	151	47	42
19:00	0	0	0	0	5	26	44	34	4	0	0	0	0	113	47	42
20:00	0	0	0	4	11	42	33	16	7	0	0	0	0	113	45	40
21:00	0	0	0	2	**15**	26	29	15	4	0	0	0	0	91	45	40
22:00	0	0	0	2	0	8	8	9	0	0	0	0	0	27	46	41
23:00	0	0	0	1	4	2	6	3	1	0	0	0	0	17	46	40
Total	1	1	12	116	368	1035	1587	890	167	19	1	1	0	4198		
%	0.0%	0.0%	0.3%	2.8%	8.8%	24.7%	37.8%	21.2%	4.0%	0.5%	0.0%	0.0%	0.0%			
AM Peak			08:00	08:00	07:00	07:00	08:00	08:00	08:00	08:00		03:00		08:00		
Vol.			3	35	55	182	286	119	20	2		1		667		
PM Peak	12:00	12:00	17:00	12:00	21:00	12:00	14:00	14:00	15:00	14:00	15:00			14:00		
Vol.	1	1	1	6	15	50	108	84	16	4	1			252		

Stats

15th Percentile :	34 MPH
50th Percentile :	40 MPH
85th Percentile :	46 MPH
95th Percentile :	48 MPH
Mean Speed(Average) :	41 MPH
10 MPH Pace Speed :	35-44 MPH
Number in Pace :	2622
Percent in Pace :	62.5%
Number of Vehicles > 40 MPH :	2348
Percent of Vehicles > 40 MPH :	55.9%

PRECISION
D A T A
INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

Bartlett Street
west of Cedarr Hill Road
City, State: Northborough, MA
Client: VHB/ T. Benson

197253 A Speed
Site Code: 83468.19
Date Start: 16-Oct-19
Date End: 17-Oct-19

WB

Start Time	1 14	15 19	20 24	25 29	30 34	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 9999	Total	85th Perce	Avera (Mean
10/16/ 19	0	0	0	5	0	1	3	1	0	0	0	0	0	10	43	35
01:00	0	0	0	6	8	2	0	1	0	0	0	0	0	17	35	32
02:00	0	0	1	7	2	2	0	2	0	0	0	0	0	14	38	32
03:00	0	0	**3**	9	4	3	2	2	0	0	0	0	0	23	40	32
04:00	0	0	2	11	3	5	5	0	0	1	0	0	0	27	40	33
05:00	0	**1**	1	9	11	20	12	7	2	0	0	0	0	63	43	37
06:00	0	0	0	**15**	**38**	62	40	14	4	1	0	0	0	174	43	37
07:00	**1**	1	2	10	24	**80**	**91**	**41**	5	1	0	0	0	**256**	45	40
08:00	0	0	2	12	18	61	76	31	**6**	1	0	0	0	207	45	40
09:00	0	0	0	4	18	50	52	20	4	1	0	0	0	149	44	40
10:00	0	0	0	6	20	37	60	14	1	**2**	0	0	0	140	43	39
11:00	0	0	0	6	22	58	50	25	3	0	0	0	0	164	44	39
12 PM	0	**2**	1	7	19	65	85	34	4	0	0	0	0	217	44	40
13:00	0	1	3	9	26	79	72	22	2	1	0	0	0	215	43	39
14:00	**1**	0	0	19	23	79	89	47	7	0	0	0	0	265	45	40
15:00	0	0	0	7	33	107	140	51	11	0	0	0	0	349	44	40
16:00	1	0	0	5	29	145	254	**116**	**22**	**2**	0	0	0	574	46	41
17:00	0	0	**10**	13	**78**	**267**	**308**	84	11	1	0	0	0	**772**	43	39
18:00	0	0	4	**20**	58	111	96	47	3	0	0	0	0	339	43	38
19:00	0	0	0	10	34	46	45	10	4	1	0	0	0	150	43	38
20:00	0	0	0	9	11	26	25	5	2	0	0	0	0	78	43	38
21:00	1	1	2	3	11	29	15	2	1	0	0	0	0	65	41	36
22:00	0	1	2	7	12	10	3	2	0	0	0	0	0	37	38	33
23:00	0	0	0	4	13	9	5	3	0	0	0	0	0	34	41	36
Total	4	7	33	213	515	1354	1528	581	92	12	0	0	0	4339		
%	0.1%	0.2%	0.8%	4.9%	11.9%	31.2%	35.2%	13.4%	2.1%	0.3%	0.0%	0.0%	0.0%			
AM Peak	07:00	05:00	03:00	06:00	06:00	07:00	07:00	07:00	08:00	10:00				07:00		
Vol.	1	1	3	15	38	80	91	41	6	2				256		
PM Peak	14:00	12:00	17:00	18:00	17:00	17:00	17:00	16:00	16:00	16:00				17:00		
Vol.	1	2	10	20	78	267	308	116	22	2				772		

Stats

15th Percentile :	32 MPH
50th Percentile :	39 MPH
85th Percentile :	44 MPH
95th Percentile :	48 MPH
Mean Speed(Average) :	39 MPH
10 MPH Pace Speed :	35-44 MPH
Number in Pace :	2882
Percent in Pace :	66.4%
Number of Vehicles > 40 MPH :	1907
Percent of Vehicles > 40 MPH :	44.0%

PRECISION
D A T A
INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

Bartlett Street
west of Cedarr Hill Road
City, State: Northborough, MA
Client: VHB/ T. Benson

197253 A Speed
Site Code: 83468.19
Date Start: 16-Oct-19
Date End: 17-Oct-19

WB

Start Time	1 14	15 19	20 24	25 29	30 34	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 9999	Total	85th Perce	Avera (Mean
10/17/ 19	0	0	2	4	1	1	1	0	0	0	0	0	0	9	37	29
01:00	0	0	0	5	6	2	1	0	0	0	0	0	0	14	36	32
02:00	0	0	0	10	5	2	1	1	0	0	0	0	0	19	36	31
03:00	0	0	**4**	3	6	6	3	0	0	0	**1**	0	0	23	39	34
04:00	0	0	0	8	8	4	0	1	0	0	0	0	0	21	36	32
05:00	0	0	4	10	17	19	9	3	0	0	0	0	0	62	40	34
06:00	0	0	0	**17**	**43**	57	39	10	0	0	0	0	0	166	42	36
07:00	0	0	1	10	35	**127**	**65**	19	0	0	0	0	0	**257**	42	38
08:00	0	0	0	17	27	75	59	10	0	0	0	0	0	188	42	37
09:00	0	**2**	3	5	38	55	52	16	0	0	0	0	0	171	43	38
10:00	0	0	2	1	23	48	32	5	**3**	0	0	0	0	114	42	38
11:00	0	0	4	13	39	63	57	**23**	3	0	0	0	0	202	43	38
12 PM	0	**1**	2	7	27	86	70	28	7	0	0	0	0	228	44	39
13:00	0	1	0	9	18	54	59	20	8	0	0	0	0	169	44	39
14:00	0	0	1	7	20	97	93	36	3	**1**	0	0	0	258	44	40
15:00	0	0	1	10	41	133	162	47	4	0	0	0	0	398	43	40
16:00	0	0	0	17	51	193	210	64	**9**	0	0	0	0	544	43	40
17:00	0	0	5	21	**79**	**265**	**233**	**70**	5	0	0	0	0	**678**	43	39
18:00	0	0	**7**	**32**	45	136	87	34	5	0	0	0	0	346	43	38
19:00	0	0	3	12	24	57	44	10	1	0	0	0	0	151	42	37
20:00	0	0	0	5	16	22	24	7	1	0	0	0	0	75	43	38
21:00	0	0	0	5	5	19	18	5	2	0	0	0	0	54	43	39
22:00	0	0	0	10	3	11	17	4	1	0	0	0	0	46	43	38
23:00	0	1	1	2	11	14	9	5	2	0	0	0	0	45	44	37
Total	0	5	40	240	588	1546	1345	418	54	1	1	0	0	4238		
%	0.0%	0.1%	0.9%	5.7%	13.9%	36.5%	31.7%	9.9%	1.3%	0.0%	0.0%	0.0%	0.0%			
AM Peak		09:00	03:00	06:00	06:00	07:00	07:00	11:00	10:00		03:00			07:00		
Vol.		2	4	17	43	127	65	23	3		1			257		
PM Peak		12:00	18:00	18:00	17:00	17:00	17:00	17:00	16:00	14:00				17:00		
Vol.		1	7	32	79	265	233	70	9	1				678		

Stats

15th Percentile :	31 MPH
50th Percentile :	38 MPH
85th Percentile :	43 MPH
95th Percentile :	47 MPH
Mean Speed(Average) :	38 MPH
10 MPH Pace Speed :	35-44 MPH
Number in Pace :	2891
Percent in Pace :	68.2%
Number of Vehicles > 40 MPH :	1550
Percent of Vehicles > 40 MPH :	36.6%

PDI File #: **197253 A**
Location: **S: Lyman Street**
Location: **E: Bartlett Street W: Bartlett Street**
City, State: **Northborough, MA**
Client: **VHB/ T. Benson**
Site Code: **83468.19**
Count Date: **Wednesday, October 16, 2019**
Start Time: **6:30 AM**
End Time: **9:00 AM**
Class:

PRECISION DATA INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

Cars and Heavy Vehicles (Combined)

	Bartlett Street from East				Lyman Street from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
6:30 AM	19	4	0	23	13	14	0	27	15	62	0	77	127
6:45 AM	60	11	0	71	24	46	0	70	27	81	0	108	249
Total	79	15	0	94	37	60	0	97	42	143	0	185	376
7:00 AM	87	12	0	99	27	48	0	75	28	83	0	111	285
7:15 AM	24	8	0	32	31	12	0	43	19	97	0	116	191
7:30 AM	25	11	0	36	46	12	0	58	29	115	0	144	238
7:45 AM	42	23	1	66	43	13	0	56	44	120	0	164	286
Total	178	54	1	233	147	85	0	232	120	415	0	535	1000
8:00 AM	44	9	0	53	44	13	0	57	39	101	0	140	250
8:15 AM	37	19	0	56	46	11	0	57	38	117	0	155	268
8:30 AM	37	23	0	60	61	22	0	83	43	104	0	147	290
8:45 AM	20	12	0	32	38	16	0	54	47	129	0	176	262
Total	138	63	0	201	189	62	0	251	167	451	0	618	1070
Grand Total	395	132	1	528	373	207	0	580	329	1009	0	1338	2446
Approach %	74.8	25.0	0.2		64.3	35.7	0.0		24.6	75.4	0.0		
Total %	16.1	5.4	0.0	21.6	15.2	8.5	0.0	23.7	13.5	41.3	0.0	54.7	
Exiting Leg Total				1383				461				602	2446
Cars	352	123	1	476	352	184	0	536	315	961	0	1276	2288
% Cars	89.1	93.2	100.0	90.2	94.4	88.9	0.0	92.4	95.7	95.2	0.0	95.4	93.5
Exiting Leg Total				1314				438				536	2288
Heavy Vehicles	43	9	0	52	21	23	0	44	14	48	0	62	158
% Heavy Vehicles	10.9	6.8	0.0	9.8	5.6	11.1	0.0	7.6	4.3	4.8	0.0	4.6	6.5
Exiting Leg Total				69				23				66	158

Peak Hour Analysis from 06:30 AM to 09:00 AM begins at:

7:45 AM	Bartlett Street from East				Lyman Street from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
7:45 AM	42	23	1	66	43	13	0	56	44	120	0	164	286
8:00 AM	44	9	0	53	44	13	0	57	39	101	0	140	250
8:15 AM	37	19	0	56	46	11	0	57	38	117	0	155	268
8:30 AM	37	23	0	60	61	22	0	83	43	104	0	147	290
Total Volume	160	74	1	235	194	59	0	253	164	442	0	606	1094
% Approach Total	68.1	31.5	0.4		76.7	23.3	0.0		27.1	72.9	0.0		
PHF	0.909	0.804	0.250	0.890	0.795	0.670	0.000	0.762	0.932	0.921	0.000	0.924	0.943
Cars	140	68	1	209	184	51	0	235	159	424	0	583	1027
Cars %	87.5	91.9	100.0	88.9	94.8	86.4	0.0	92.9	97.0	95.9	0.0	96.2	93.9
Heavy Vehicles	20	6	0	26	10	8	0	18	5	18	0	23	67
Heavy Vehicles %	12.5	8.1	0.0	11.1	5.2	13.6	0.0	7.1	3.0	4.1	0.0	3.8	6.1
Cars Enter Leg	140	68	1	209	184	51	0	235	159	424	0	583	1027
Heavy Enter Leg	20	6	0	26	10	8	0	18	5	18	0	23	67
Total Entering Leg	160	74	1	235	194	59	0	253	164	442	0	606	1094
Cars Exiting Leg				609				227				191	1027
Heavy Exiting Leg				28				11				28	67
Total Exiting Leg				637				238				219	1094

PDI File #: **197253 A**
Location: **S: Lyman Street**
Location: **E: Bartlett Street W: Bartlett Street**
City, State: **Northborough, MA**
Client: **VHB/ T. Benson**
Site Code: **83468.19**
Count Date: **Wednesday, October 16, 2019**
Start Time: **6:30 AM**
End Time: **9:00 AM**
Class:

PRECISION DATA INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

Cars

	Bartlett Street from East				Lyman Street from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
6:30 AM	15	4	0	19	12	8	0	20	15	60	0	75	114
6:45 AM	53	10	0	63	23	41	0	64	26	77	0	103	230
Total	68	14	0	82	35	49	0	84	41	137	0	178	344
7:00 AM	85	10	0	95	24	47	0	71	24	70	0	94	260
7:15 AM	20	8	0	28	29	11	0	40	19	92	0	111	179
7:30 AM	22	11	0	33	46	11	0	57	28	112	0	140	230
7:45 AM	37	22	1	60	39	12	0	51	43	114	0	157	268
Total	164	51	1	216	138	81	0	219	114	388	0	502	937
8:00 AM	40	9	0	49	43	11	0	54	39	99	0	138	241
8:15 AM	35	17	0	52	45	10	0	55	37	112	0	149	256
8:30 AM	28	20	0	48	57	18	0	75	40	99	0	139	262
8:45 AM	17	12	0	29	34	15	0	49	44	126	0	170	248
Total	120	58	0	178	179	54	0	233	160	436	0	596	1007
Grand Total	352	123	1	476	352	184	0	536	315	961	0	1276	2288
Approach %	73.9	25.8	0.2		65.7	34.3	0.0		24.7	75.3	0.0		
Total %	15.4	5.4	0.0	20.8	15.4	8.0	0.0	23.4	13.8	42.0	0.0	55.8	
Exiting Leg Total				1314				438				536	2288

Peak Hour Analysis from 06:30 AM to 09:00 AM begins at:

7:45 AM	Bartlett Street from East				Lyman Street from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
7:45 AM	37	22	1	60	39	12	0	51	43	114	0	157	268
8:00 AM	40	9	0	49	43	11	0	54	39	99	0	138	241
8:15 AM	35	17	0	52	45	10	0	55	37	112	0	149	256
8:30 AM	28	20	0	48	57	18	0	75	40	99	0	139	262
Total Volume	140	68	1	209	184	51	0	235	159	424	0	583	1027
% Approach Total	67.0	32.5	0.5		78.3	21.7	0.0		27.3	72.7	0.0		
PHF	0.875	0.773	0.250	0.871	0.807	0.708	0.000	0.783	0.924	0.930	0.000	0.928	0.958
Entering Leg	140	68	1	209	184	51	0	235	159	424	0	583	1027
Exiting Leg				609				227				191	1027
Total				818				462				774	2054

PDI File #: **197253 A**
Location: **S: Lyman Street**
Location: **E: Bartlett Street W: Bartlett Street**
City, State: **Northborough, MA**
Client: **VHB/ T. Benson**
Site Code: **83468.19**
Count Date: **Wednesday, October 16, 2019**
Start Time: **6:30 AM**
End Time: **9:00 AM**

PRECISION DATA INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

Class: **Heavy Vehicles-Combined (Buses, Single-Unit Trucks, Articulated Trucks)**

	Bartlett Street from East				Lyman Street from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
6:30 AM	4	0	0	4	1	6	0	7	0	2	0	2	13
6:45 AM	7	1	0	8	1	5	0	6	1	4	0	5	19
Total	11	1	0	12	2	11	0	13	1	6	0	7	32
7:00 AM	2	2	0	4	3	1	0	4	4	13	0	17	25
7:15 AM	4	0	0	4	2	1	0	3	0	5	0	5	12
7:30 AM	3	0	0	3	0	1	0	1	1	3	0	4	8
7:45 AM	5	1	0	6	4	1	0	5	1	6	0	7	18
Total	14	3	0	17	9	4	0	13	6	27	0	33	63
8:00 AM	4	0	0	4	1	2	0	3	0	2	0	2	9
8:15 AM	2	2	0	4	1	1	0	2	1	5	0	6	12
8:30 AM	9	3	0	12	4	4	0	8	3	5	0	8	28
8:45 AM	3	0	0	3	4	1	0	5	3	3	0	6	14
Total	18	5	0	23	10	8	0	18	7	15	0	22	63
Grand Total	43	9	0	52	21	23	0	44	14	48	0	62	158
Approach %	82.7	17.3	0.0		47.7	52.3	0.0		22.6	77.4	0.0		
Total %	27.2	5.7	0.0	32.9	13.3	14.6	0.0	27.8	8.9	30.4	0.0	39.2	
Exiting Leg Total				69				23				66	158
Buses	9	0	0	9	0	9	0	9	7	11	0	18	36
% Buses	20.9	0.0	0.0	17.3	0.0	39.1	0.0	20.5	50.0	22.9	0.0	29.0	22.8
Exiting Leg Total				11				7				18	36
Single-Unit Trucks	25	5	0	30	17	10	0	27	5	29	0	34	91
% Single-Unit	58.1	55.6	0.0	57.7	81.0	43.5	0.0	61.4	35.7	60.4	0.0	54.8	57.6
Exiting Leg Total				46				10				35	91
Articulated Trucks	9	4	0	13	4	4	0	8	2	8	0	10	31
% Articulated	20.9	44.4	0.0	25.0	19.0	17.4	0.0	18.2	14.3	16.7	0.0	16.1	19.6
Exiting Leg Total				12				6				13	31

Peak Hour Analysis from 06:30 AM to 09:00 AM begins at:

6:30 AM	Bartlett Street from East				Lyman Street from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
6:30 AM	4	0	0	4	1	6	0	7	0	2	0	2	13
6:45 AM	7	1	0	8	1	5	0	6	1	4	0	5	19
7:00 AM	2	2	0	4	3	1	0	4	4	13	0	17	25
7:15 AM	4	0	0	4	2	1	0	3	0	5	0	5	12
Total Volume	17	3	0	20	7	13	0	20	5	24	0	29	69
% Approach Total	85.0	15.0	0.0		35.0	65.0	0.0		17.2	82.8	0.0		
PHF	0.607	0.375	0.000	0.625	0.583	0.542	0.000	0.714	0.313	0.462	0.000	0.426	0.690
Buses	9	0	0	9	0	7	0	7	5	11	0	16	32
Buses %	52.9	0.0	0.0	45.0	0.0	53.8	0.0	35.0	100.0	45.8	0.0	55.2	46.4
Single-Unit Trucks	7	1	0	8	7	3	0	10	0	10	0	10	28
Single-Unit %	41.2	33.3	0.0	40.0	100.0	23.1	0.0	50.0	0.0	41.7	0.0	34.5	40.6
Articulated Trucks	1	2	0	3	0	3	0	3	0	3	0	3	9
Articulated %	5.9	66.7	0.0	15.0	0.0	23.1	0.0	15.0	0.0	12.5	0.0	10.3	13.0
Buses	9	0	0	9	0	7	0	7	5	11	0	16	32
Single-Unit Trucks	7	1	0	8	7	3	0	10	0	10	0	10	28
Articulated Trucks	1	2	0	3	0	3	0	3	0	3	0	3	9
Total Entering Leg	17	3	0	20	7	13	0	20	5	24	0	29	69
Buses				11				5				16	32
Single-Unit Trucks				17				1				10	28
Articulated Trucks				3				2				4	9
Total Exiting Leg				31				8				30	69

PDI File #: **197253 A**
Location: **S: Lyman Street**
Location: **E: Bartlett Street W: Bartlett Street**
City, State: **Northborough, MA**
Client: **VHB/ T. Benson**
Site Code: **83468.19**
Count Date: **Wednesday, October 16, 2019**
Start Time: **6:30 AM**
End Time: **9:00 AM**

PRECISION DATA INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

Class: **Buses**

	Bartlett Street from East				Lyman Street from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
6:30 AM	3	0	0	3	0	2	0	2	0	2	0	2	7
6:45 AM	6	0	0	6	0	4	0	4	1	3	0	4	14
Total	9	0	0	9	0	6	0	6	1	5	0	6	21
7:00 AM	0	0	0	0	0	1	0	1	4	6	0	10	11
7:15 AM	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	0	0
7:45 AM	0	0	0	0	0	1	0	1	0	0	0	0	1
Total	0	0	0	0	0	2	0	2	4	6	0	10	12
8:00 AM	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
8:30 AM	0	0	0	0	0	0	0	0	1	0	0	1	1
8:45 AM	0	0	0	0	0	1	0	1	1	0	0	1	2
Total	0	0	0	0	0	1	0	1	2	0	0	2	3
Grand Total	9	0	0	9	0	9	0	9	7	11	0	18	36
Approach %	100.0	0.0	0.0		0.0	100.0	0.0		38.9	61.1	0.0		
Total %	25.0	0.0	0.0	25.0	0.0	25.0	0.0	25.0	19.4	30.6	0.0	50.0	
Exiting Leg Total				11				7				18	36

Peak Hour Analysis from 06:30 AM to 09:00 AM begins at:

6:30 AM	Bartlett Street from East				Lyman Street from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
6:30 AM	3	0	0	3	0	2	0	2	0	2	0	2	7
6:45 AM	6	0	0	6	0	4	0	4	1	3	0	4	14
7:00 AM	0	0	0	0	0	1	0	1	4	6	0	10	11
7:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Volume	9	0	0	9	0	7	0	7	5	11	0	16	32
% Approach Total	100.0	0.0	0.0		0.0	100.0	0.0		31.3	68.8	0.0		
PHF	0.375	0.000	0.000	0.375	0.000	0.438	0.000	0.438	0.313	0.458	0.000	0.400	0.571
Entering Leg	9	0	0	9	0	7	0	7	5	11	0	16	32
Exiting Leg				11				5				16	32
Total				20				12				32	64

PDI File #: **197253 A**
Location: **S: Lyman Street**
Location: **E: Bartlett Street W: Bartlett Street**
City, State: **Northborough, MA**
Client: **VHB/ T. Benson**
Site Code: **83468.19**
Count Date: **Wednesday, October 16, 2019**
Start Time: **6:30 AM**
End Time: **9:00 AM**

PRECISION DATA INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

Class: **Single-Unit Trucks**

	Bartlett Street from East				Lyman Street from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
6:30 AM	1	0	0	1	1	3	0	4	0	0	0	0	5
6:45 AM	0	0	0	0	1	0	0	1	0	1	0	1	2
Total	1	0	0	1	2	3	0	5	0	1	0	1	7
7:00 AM	2	1	0	3	3	0	0	3	0	6	0	6	12
7:15 AM	4	0	0	4	2	0	0	2	0	3	0	3	9
7:30 AM	2	0	0	2	0	1	0	1	1	2	0	3	6
7:45 AM	2	0	0	2	2	0	0	2	0	5	0	5	9
Total	10	1	0	11	7	1	0	8	1	16	0	17	36
8:00 AM	4	0	0	4	1	2	0	3	0	2	0	2	9
8:15 AM	1	2	0	3	1	1	0	2	1	3	0	4	9
8:30 AM	6	2	0	8	4	3	0	7	2	5	0	7	22
8:45 AM	3	0	0	3	2	0	0	2	1	2	0	3	8
Total	14	4	0	18	8	6	0	14	4	12	0	16	48
Grand Total	25	5	0	30	17	10	0	27	5	29	0	34	91
Approach %	83.3	16.7	0.0		63.0	37.0	0.0		14.7	85.3	0.0		
Total %	27.5	5.5	0.0	33.0	18.7	11.0	0.0	29.7	5.5	31.9	0.0	37.4	
Exiting Leg Total				46				10				35	91

Peak Hour Analysis from 06:30 AM to 09:00 AM begins at:

7:45 AM	Bartlett Street from East				Lyman Street from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
7:45 AM	2	0	0	2	2	0	0	2	0	5	0	5	9
8:00 AM	4	0	0	4	1	2	0	3	0	2	0	2	9
8:15 AM	1	2	0	3	1	1	0	2	1	3	0	4	9
8:30 AM	6	2	0	8	4	3	0	7	2	5	0	7	22
Total Volume	13	4	0	17	8	6	0	14	3	15	0	18	49
% Approach Total	76.5	23.5	0.0		57.1	42.9	0.0		16.7	83.3	0.0		
PHF	0.542	0.500	0.000	0.531	0.500	0.500	0.000	0.500	0.375	0.750	0.000	0.643	0.557
Entering Leg	13	4	0	17	8	6	0	14	3	15	0	18	49
Exiting Leg				23				7				19	49
Total				40				21				37	98

PDI File #: **197253 A**
Location: **S: Lyman Street**
Location: **E: Bartlett Street W: Bartlett Street**
City, State: **Northborough, MA**
Client: **VHB/ T. Benson**
Site Code: **83468.19**
Count Date: **Wednesday, October 16, 2019**
Start Time: **6:30 AM**
End Time: **9:00 AM**
Class:

PRECISION DATA INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

Articulated Trucks

	Bartlett Street from East				Lyman Street from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
6:30 AM	0	0	0	0	0	1	0	1	0	0	0	0	1
6:45 AM	1	1	0	2	0	1	0	1	0	0	0	0	3
Total	1	1	0	2	0	2	0	2	0	0	0	0	4
7:00 AM	0	1	0	1	0	0	0	0	0	1	0	1	2
7:15 AM	0	0	0	0	0	1	0	1	0	2	0	2	3
7:30 AM	1	0	0	1	0	0	0	0	0	1	0	1	2
7:45 AM	3	1	0	4	2	0	0	2	1	1	0	2	8
Total	4	2	0	6	2	1	0	3	1	5	0	6	15
8:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0
8:15 AM	1	0	0	1	0	0	0	0	0	2	0	2	3
8:30 AM	3	1	0	4	0	1	0	1	0	0	0	0	5
8:45 AM	0	0	0	0	2	0	0	2	1	1	0	2	4
Total	4	1	0	5	2	1	0	3	1	3	0	4	12
Grand Total	9	4	0	13	4	4	0	8	2	8	0	10	31
Approach %	69.2	30.8	0.0		50.0	50.0	0.0		20.0	80.0	0.0		
Total %	29.0	12.9	0.0	41.9	12.9	12.9	0.0	25.8	6.5	25.8	0.0	32.3	
Exiting Leg Total				12				6				13	31

Peak Hour Analysis from 06:30 AM to 09:00 AM begins at:

7:45 AM	Bartlett Street from East				Lyman Street from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
7:45 AM	3	1	0	4	2	0	0	2	1	1	0	2	8
8:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0
8:15 AM	1	0	0	1	0	0	0	0	0	2	0	2	3
8:30 AM	3	1	0	4	0	1	0	1	0	0	0	0	5
Total Volume	7	2	0	9	2	1	0	3	1	3	0	4	16
% Approach Total	77.8	22.2	0.0		66.7	33.3	0.0		25.0	75.0	0.0		
PHF	0.583	0.500	0.000	0.563	0.250	0.250	0.000	0.375	0.250	0.375	0.000	0.500	0.500
Entering Leg	7	2	0	9	2	1	0	3	1	3	0	4	16
Exiting Leg				5				3				8	16
Total				14				6				12	32

PDI File #: **197253 A**
Location: **S: Lyman Street**
Location: **E: Bartlett Street W: Bartlett Street**
City, State: **Northborough, MA**
Client: **VHB/ T. Benson**
Site Code: **83468.19**
Count Date: **Wednesday, October 16, 2019**
Start Time: **6:30 AM**
End Time: **9:00 AM**
Class:

PRECISION DATA INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

Bicycles (on Roadway and Crosswalks)

	Bartlett Street from East						Lyman Street from South						Bartlett Street from West						
	Thru	Left	U-Turn	CW-SB	CW-NB	Total	Right	Left	U-Turn	CW-WB	CW-EB	Total	Right	Thru	U-Turn	CW-NB	CW-SB	Total	Total
6:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:00 AM	0	0	0	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	0	0	0
7:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:00 AM	0	0	0	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	0	0	0
8:30 AM	0	0	0	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	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Approach %	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0		
Total %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Exiting Leg Total						0						0						0	0

Peak Hour Analysis from 06:30 AM to 09:00 AM begins at:

6:30 AM	Bartlett Street from East						Lyman Street from South						Bartlett Street from West						
	Thru	Left	U-Turn	CW-SB	CW-NB	Total	Right	Left	U-Turn	CW-WB	CW-EB	Total	Right	Thru	U-Turn	CW-NB	CW-SB	Total	Total
6:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:00 AM	0	0	0	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	0	0	0
Total Volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Approach Total	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0		
PHF	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Entering Leg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Exiting Leg						0						0						0	0
Total						0						0						0	0

PDI File #: **197253 A**
Location: **S: Lyman Street**
Location: **E: Bartlett Street W: Bartlett Street**
City, State: **Northborough, MA**
Client: **VHB/ T. Benson**
Site Code: **83468.19**
Count Date: **Wednesday, October 16, 2019**
Start Time: **6:30 AM**
End Time: **9:00 AM**
Class:

PRECISION DATA INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

Pedestrians

	Bartlett Street from East						Lyman Street from South						Bartlett Street from West						
	Thru	Left	U-Turn	CW-SB	CW-NB	Total	Right	Left	U-Turn	CW-WB	CW-EB	Total	Right	Thru	U-Turn	CW-NB	CW-SB	Total	Total
6:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:00 AM	0	0	0	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	0	0	0
7:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:00 AM	0	0	0	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	0	0	0
8:30 AM	0	0	0	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	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Approach %	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
Total %	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Exiting Leg Total						0						0						0	0

Peak Hour Analysis from 06:30 AM to 09:00 AM begins at:

6:30 AM	Bartlett Street from East						Lyman Street from South						Bartlett Street from West						
	Thru	Left	U-Turn	CW-SB	CW-NB	Total	Right	Left	U-Turn	CW-WB	CW-EB	Total	Right	Thru	U-Turn	CW-NB	CW-SB	Total	Total
6:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:00 AM	0	0	0	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	0	0	0
Total Volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Approach Total	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0		
PHF	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Entering Leg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Exiting Leg						0						0						0	0
Total						0						0						0	0

PDI File #: **197253 AA**
Location: **S: Lyman Street**
Location: **E: Bartlett Street W: Bartlett Street**
City, State: **Northborough, MA**
Client: **VHB/ T. Benson**
Site Code: **83468.19**
Count Date: **Wednesday, October 16, 2019**
Start Time: **4:00 PM**
End Time: **6:00 PM**
Class:

PRECISION DATA INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

Cars and Heavy Vehicles (Combined)

	Bartlett Street from East				Lyman Street from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
4:00 PM	69	49	0	118	25	31	1	57	17	25	0	42	217
4:15 PM	74	46	0	120	16	39	0	55	25	37	0	62	237
4:30 PM	101	74	0	175	23	30	0	53	23	36	0	59	287
4:45 PM	95	76	0	171	19	27	0	46	26	44	0	70	287
Total	339	245	0	584	83	127	1	211	91	142	0	233	1028
5:00 PM	122	92	0	214	23	41	0	64	46	40	0	86	364
5:15 PM	104	111	0	215	20	39	0	59	40	53	0	93	367
5:30 PM	107	88	0	195	14	25	0	39	34	23	0	57	291
5:45 PM	77	54	0	131	13	20	0	33	34	37	0	71	235
Total	410	345	0	755	70	125	0	195	154	153	0	307	1257
Grand Total	749	590	0	1339	153	252	1	406	245	295	0	540	2285
Approach %	55.9	44.1	0.0		37.7	62.1	0.2		45.4	54.6	0.0		
Total %	32.8	25.8	0.0	58.6	6.7	11.0	0.0	17.8	10.7	12.9	0.0	23.6	
Exiting Leg Total				448				836				1001	2285
Cars	731	575	0	1306	140	247	1	388	238	271	0	509	2203
% Cars	97.6	97.5	0.0	97.5	91.5	98.0	100.0	95.6	97.1	91.9	0.0	94.3	96.4
Exiting Leg Total				411				814				978	2203
Heavy Vehicles	18	15	0	33	13	5	0	18	7	24	0	31	82
% Heavy Vehicles	2.4	2.5	0.0	2.5	8.5	2.0	0.0	4.4	2.9	8.1	0.0	5.7	3.6
Exiting Leg Total				37				22				23	82

Peak Hour Analysis from 04:00 PM to 06:00 PM begins at:

4:45 PM	Bartlett Street from East				Lyman Street from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
4:45 PM	95	76	0	171	19	27	0	46	26	44	0	70	287
5:00 PM	122	92	0	214	23	41	0	64	46	40	0	86	364
5:15 PM	104	111	0	215	20	39	0	59	40	53	0	93	367
5:30 PM	107	88	0	195	14	25	0	39	34	23	0	57	291
Total Volume	428	367	0	795	76	132	0	208	146	160	0	306	1309
% Approach Total	53.8	46.2	0.0		36.5	63.5	0.0		47.7	52.3	0.0		
PHF	0.877	0.827	0.000	0.924	0.826	0.805	0.000	0.813	0.793	0.755	0.000	0.823	0.892
Cars	423	357	0	780	69	129	0	198	144	154	0	298	1276
Cars %	98.8	97.3	0.0	98.1	90.8	97.7	0.0	95.2	98.6	96.3	0.0	97.4	97.5
Heavy Vehicles	5	10	0	15	7	3	0	10	2	6	0	8	33
Heavy Vehicles %	1.2	2.7	0.0	1.9	9.2	2.3	0.0	4.8	1.4	3.8	0.0	2.6	2.5
Cars Enter Leg	423	357	0	780	69	129	0	198	144	154	0	298	1276
Heavy Enter Leg	5	10	0	15	7	3	0	10	2	6	0	8	33
Total Entering Leg	428	367	0	795	76	132	0	208	146	160	0	306	1309
Cars Exiting Leg				223				501				552	1276
Heavy Exiting Leg				13				12				8	33
Total Exiting Leg				236				513				560	1309

PDI File #: **197253 AA**
Location: **S: Lyman Street**
Location: **E: Bartlett Street W: Bartlett Street**
City, State: **Northborough, MA**
Client: **VHB/ T. Benson**
Site Code: **83468.19**
Count Date: **Wednesday, October 16, 2019**
Start Time: **4:00 PM**
End Time: **6:00 PM**

PRECISION DATA INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

Class: **Cars**

	Bartlett Street from East				Lyman Street from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
4:00 PM	62	48	0	110	24	31	1	56	17	21	0	38	204
4:15 PM	70	46	0	116	15	38	0	53	22	30	0	52	221
4:30 PM	99	70	0	169	20	29	0	49	22	30	0	52	270
4:45 PM	93	74	0	167	18	26	0	44	26	44	0	70	281
Total	324	238	0	562	77	124	1	202	87	125	0	212	976
5:00 PM	120	88	0	208	21	41	0	62	45	38	0	83	353
5:15 PM	103	110	0	213	17	37	0	54	40	49	0	89	356
5:30 PM	107	85	0	192	13	25	0	38	33	23	0	56	286
5:45 PM	77	54	0	131	12	20	0	32	33	36	0	69	232
Total	407	337	0	744	63	123	0	186	151	146	0	297	1227
Grand Total	731	575	0	1306	140	247	1	388	238	271	0	509	2203
Approach %	56.0	44.0	0.0		36.1	63.7	0.3		46.8	53.2	0.0		
Total %	33.2	26.1	0.0	59.3	6.4	11.2	0.0	17.6	10.8	12.3	0.0	23.1	
Exiting Leg Total				411				814				978	2203

Peak Hour Analysis from 04:00 PM to 06:00 PM begins at:

4:45 PM	Bartlett Street from East				Lyman Street from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
4:45 PM	93	74	0	167	18	26	0	44	26	44	0	70	281
5:00 PM	120	88	0	208	21	41	0	62	45	38	0	83	353
5:15 PM	103	110	0	213	17	37	0	54	40	49	0	89	356
5:30 PM	107	85	0	192	13	25	0	38	33	23	0	56	286
Total Volume	423	357	0	780	69	129	0	198	144	154	0	298	1276
% Approach Total	54.2	45.8	0.0		34.8	65.2	0.0		48.3	51.7	0.0		
PHF	0.881	0.811	0.000	0.915	0.821	0.787	0.000	0.798	0.800	0.786	0.000	0.837	0.896
Entering Leg	423	357	0	780	69	129	0	198	144	154	0	298	1276
Exiting Leg				223				501				552	1276
Total				1003				699				850	2552

PDI File #: **197253 AA**
Location: **S: Lyman Street**
Location: **E: Bartlett Street W: Bartlett Street**
City, State: **Northborough, MA**
Client: **VHB/ T. Benson**
Site Code: **83468.19**
Count Date: **Wednesday, October 16, 2019**
Start Time: **4:00 PM**
End Time: **6:00 PM**

PRECISION DATA INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

Class: **Heavy Vehicles-Combined (Buses, Single-Unit Trucks, Articulated Trucks)**

	Bartlett Street from East				Lyman Street from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
4:00 PM	7	1	0	8	1	0	0	1	0	4	0	4	13
4:15 PM	4	0	0	4	1	1	0	2	3	7	0	10	16
4:30 PM	2	4	0	6	3	1	0	4	1	6	0	7	17
4:45 PM	2	2	0	4	1	1	0	2	0	0	0	0	6
Total	15	7	0	22	6	3	0	9	4	17	0	21	52
5:00 PM	2	4	0	6	2	0	0	2	1	2	0	3	11
5:15 PM	1	1	0	2	3	2	0	5	0	4	0	4	11
5:30 PM	0	3	0	3	1	0	0	1	1	0	0	1	5
5:45 PM	0	0	0	0	1	0	0	1	1	1	0	2	3
Total	3	8	0	11	7	2	0	9	3	7	0	10	30
Grand Total	18	15	0	33	13	5	0	18	7	24	0	31	82
Approach %	54.5	45.5	0.0		72.2	27.8	0.0		22.6	77.4	0.0		
Total %	22.0	18.3	0.0	40.2	15.9	6.1	0.0	22.0	8.5	29.3	0.0	37.8	
Exiting Leg Total				37				22				23	82
Buses	0	1	0	1	2	1	0	3	1	0	0	1	5
% Buses	0.0	6.7	0.0	3.0	15.4	20.0	0.0	16.7	14.3	0.0	0.0	3.2	6.1
Exiting Leg Total				2				2				1	5
Single-Unit Trucks	13	9	0	22	3	3	0	6	3	19	0	22	50
% Single-Unit	72.2	60.0	0.0	66.7	23.1	60.0	0.0	33.3	42.9	79.2	0.0	71.0	61.0
Exiting Leg Total				22				12				16	50
Articulated Trucks	5	5	0	10	8	1	0	9	3	5	0	8	27
% Articulated	27.8	33.3	0.0	30.3	61.5	20.0	0.0	50.0	42.9	20.8	0.0	25.8	32.9
Exiting Leg Total				13				8				6	27

Peak Hour Analysis from 04:00 PM to 06:00 PM begins at:

4:00 PM	Bartlett Street from East				Lyman Street from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
4:00 PM	7	1	0	8	1	0	0	1	0	4	0	4	13
4:15 PM	4	0	0	4	1	1	0	2	3	7	0	10	16
4:30 PM	2	4	0	6	3	1	0	4	1	6	0	7	17
4:45 PM	2	2	0	4	1	1	0	2	0	0	0	0	6
Total Volume	15	7	0	22	6	3	0	9	4	17	0	21	52
% Approach Total	68.2	31.8	0.0		66.7	33.3	0.0		19.0	81.0	0.0		
PHF	0.536	0.438	0.000	0.688	0.500	0.750	0.000	0.563	0.333	0.607	0.000	0.525	0.765
Buses	0	1	0	1	1	0	0	1	1	0	0	1	3
Buses %	0.0	14.3	0.0	4.5	16.7	0.0	0.0	11.1	25.0	0.0	0.0	4.8	5.8
Single-Unit Trucks	10	4	0	14	3	2	0	5	2	17	0	19	38
Single-Unit %	66.7	57.1	0.0	63.6	50.0	66.7	0.0	55.6	50.0	100.0	0.0	90.5	73.1
Articulated Trucks	5	2	0	7	2	1	0	3	1	0	0	1	11
Articulated %	33.3	28.6	0.0	31.8	33.3	33.3	0.0	33.3	25.0	0.0	0.0	4.8	21.2
Buses	0	1	0	1	1	0	0	1	1	0	0	1	3
Single-Unit Trucks	10	4	0	14	3	2	0	5	2	17	0	19	38
Articulated Trucks	5	2	0	7	2	1	0	3	1	0	0	1	11
Total Entering Leg	15	7	0	22	6	3	0	9	4	17	0	21	52
Buses				1				2				0	3
Single-Unit Trucks				20				6				12	38
Articulated Trucks				2				3				6	11
Total Exiting Leg				23				11				18	52

PDI File #: **197253 AA**
Location: **S: Lyman Street**
Location: **E: Bartlett Street W: Bartlett Street**
City, State: **Northborough, MA**
Client: **VHB/ T. Benson**
Site Code: **83468.19**
Count Date: **Wednesday, October 16, 2019**
Start Time: **4:00 PM**
End Time: **6:00 PM**

PRECISION DATA INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

Class: **Buses**

	Bartlett Street from East				Lyman Street from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
4:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
4:15 PM	0	0	0	0	1	0	0	1	1	0	0	1	2
4:30 PM	0	1	0	1	0	0	0	0	0	0	0	0	1
4:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	1	0	1	1	0	0	1	1	0	0	1	3
5:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
5:15 PM	0	0	0	0	0	1	0	1	0	0	0	0	1
5:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
5:45 PM	0	0	0	0	1	0	0	1	0	0	0	0	1
Total	0	0	0	0	1	1	0	2	0	0	0	0	2
Grand Total	0	1	0	1	2	1	0	3	1	0	0	1	5
Approach %	0.0	100.0	0.0		66.7	33.3	0.0		100.0	0.0	0.0		
Total %	0.0	20.0	0.0	20.0	40.0	20.0	0.0	60.0	20.0	0.0	0.0	20.0	
Exiting Leg Total				2				2				1	5

Peak Hour Analysis from 04:00 PM to 06:00 PM begins at:

4:00 PM	Bartlett Street from East				Lyman Street from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
4:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
4:15 PM	0	0	0	0	1	0	0	1	1	0	0	1	2
4:30 PM	0	1	0	1	0	0	0	0	0	0	0	0	1
4:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Volume	0	1	0	1	1	0	0	1	1	0	0	1	3
% Approach Total	0.0	100.0	0.0		100.0	0.0	0.0		100.0	0.0	0.0		
PHF	0.000	0.250	0.000	0.250	0.250	0.000	0.000	0.250	0.250	0.000	0.000	0.250	0.375
Entering Leg	0	1	0	1	1	0	0	1	1	0	0	1	3
Exiting Leg				1				2				0	3
Total				2				3				1	6

PDI File #: **197253 AA**
Location: **S: Lyman Street**
Location: **E: Bartlett Street W: Bartlett Street**
City, State: **Northborough, MA**
Client: **VHB/ T. Benson**
Site Code: **83468.19**
Count Date: **Wednesday, October 16, 2019**
Start Time: **4:00 PM**
End Time: **6:00 PM**

PRECISION DATA INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

Class: **Single-Unit Trucks**

	Bartlett Street from East				Lyman Street from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
4:00 PM	5	0	0	5	1	0	0	1	0	4	0	4	10
4:15 PM	2	0	0	2	0	1	0	1	2	7	0	9	12
4:30 PM	1	2	0	3	2	0	0	2	0	6	0	6	11
4:45 PM	2	2	0	4	0	1	0	1	0	0	0	0	5
Total	10	4	0	14	3	2	0	5	2	17	0	19	38
5:00 PM	2	4	0	6	0	0	0	0	0	1	0	1	7
5:15 PM	1	0	0	1	0	1	0	1	0	0	0	0	2
5:30 PM	0	1	0	1	0	0	0	0	1	0	0	1	2
5:45 PM	0	0	0	0	0	0	0	0	0	1	0	1	1
Total	3	5	0	8	0	1	0	1	1	2	0	3	12
Grand Total	13	9	0	22	3	3	0	6	3	19	0	22	50
Approach %	59.1	40.9	0.0		50.0	50.0	0.0		13.6	86.4	0.0		
Total %	26.0	18.0	0.0	44.0	6.0	6.0	0.0	12.0	6.0	38.0	0.0	44.0	
Exiting Leg Total				22				12				16	50

Peak Hour Analysis from 04:00 PM to 06:00 PM begins at:

4:00 PM	Bartlett Street from East				Lyman Street from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
4:00 PM	5	0	0	5	1	0	0	1	0	4	0	4	10
4:15 PM	2	0	0	2	0	1	0	1	2	7	0	9	12
4:30 PM	1	2	0	3	2	0	0	2	0	6	0	6	11
4:45 PM	2	2	0	4	0	1	0	1	0	0	0	0	5
Total Volume	10	4	0	14	3	2	0	5	2	17	0	19	38
% Approach Total	71.4	28.6	0.0		60.0	40.0	0.0		10.5	89.5	0.0		
PHF	0.500	0.500	0.000	0.700	0.375	0.500	0.000	0.625	0.250	0.607	0.000	0.528	0.792
Entering Leg	10	4	0	14	3	2	0	5	2	17	0	19	38
Exiting Leg				20				6				12	38
Total				34				11				31	76

PDI File #: **197253 AA**
Location: **S: Lyman Street**
Location: **E: Bartlett Street W: Bartlett Street**
City, State: **Northborough, MA**
Client: **VHB/ T. Benson**
Site Code: **83468.19**
Count Date: **Wednesday, October 16, 2019**
Start Time: **4:00 PM**
End Time: **6:00 PM**

PRECISION DATA INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

Class:

Articulated Trucks

	Bartlett Street from East				Lyman Street from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
4:00 PM	2	1	0	3	0	0	0	0	0	0	0	0	3
4:15 PM	2	0	0	2	0	0	0	0	0	0	0	0	2
4:30 PM	1	1	0	2	1	1	0	2	1	0	0	1	5
4:45 PM	0	0	0	0	1	0	0	1	0	0	0	0	1
Total	5	2	0	7	2	1	0	3	1	0	0	1	11
5:00 PM	0	0	0	0	2	0	0	2	1	1	0	2	4
5:15 PM	0	1	0	1	3	0	0	3	0	4	0	4	8
5:30 PM	0	2	0	2	1	0	0	1	0	0	0	0	3
5:45 PM	0	0	0	0	0	0	0	0	1	0	0	1	1
Total	0	3	0	3	6	0	0	6	2	5	0	7	16
Grand Total	5	5	0	10	8	1	0	9	3	5	0	8	27
Approach %	50.0	50.0	0.0		88.9	11.1	0.0		37.5	62.5	0.0		
Total %	18.5	18.5	0.0	37.0	29.6	3.7	0.0	33.3	11.1	18.5	0.0	29.6	
Exiting Leg Total				13				8				6	27

Peak Hour Analysis from 04:00 PM to 06:00 PM begins at:

4:30 PM	Bartlett Street from East				Lyman Street from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
4:30 PM	1	1	0	2	1	1	0	2	1	0	0	1	5
4:45 PM	0	0	0	0	1	0	0	1	0	0	0	0	1
5:00 PM	0	0	0	0	2	0	0	2	1	1	0	2	4
5:15 PM	0	1	0	1	3	0	0	3	0	4	0	4	8
Total Volume	1	2	0	3	7	1	0	8	2	5	0	7	18
% Approach Total	33.3	66.7	0.0		87.5	12.5	0.0		28.6	71.4	0.0		
PHF	0.250	0.500	0.000	0.375	0.583	0.250	0.000	0.667	0.500	0.313	0.000	0.438	0.563
Entering Leg	1	2	0	3	7	1	0	8	2	5	0	7	18
Exiting Leg				12				4				2	18
Total				15				12				9	36

PDI File #: **197253 AA**
Location: **S: Lyman Street**
Location: **E: Bartlett Street W: Bartlett Street**
City, State: **Northborough, MA**
Client: **VHB/ T. Benson**
Site Code: **83468.19**
Count Date: **Wednesday, October 16, 2019**
Start Time: **4:00 PM**
End Time: **6:00 PM**

PRECISION DATA INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

Class: **Bicycles (on Roadway and Crosswalks)**

	Bartlett Street from East						Lyman Street from South						Bartlett Street from West						
	Thru	Left	U-Turn	CW-SB	CW-NB	Total	Right	Left	U-Turn	CW-WB	CW-EB	Total	Right	Thru	U-Turn	CW-NB	CW-SB	Total	Total
4:00 PM	0	0	0	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	0	0	0
4:30 PM	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
4:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
5:00 PM	0	0	0	0	0	0	0	0	0	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	0	0	0
5:30 PM	0	0	0	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	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Approach %	100.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0		
Total %	100.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Exiting Leg Total						0						0						1	1

Peak Hour Analysis from 04:00 PM to 06:00 PM begins at:

4:00 PM	Bartlett Street from East						Lyman Street from South						Bartlett Street from West						
	Thru	Left	U-Turn	CW-SB	CW-NB	Total	Right	Left	U-Turn	CW-WB	CW-EB	Total	Right	Thru	U-Turn	CW-NB	CW-SB	Total	Total
4:00 PM	0	0	0	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	0	0	0
4:30 PM	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
4:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Volume	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
% Approach Total	100.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0		
PHF	0.250	0.000	0.000	0.000	0.000	0.250	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.250
Entering Leg	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Exiting Leg						0						0						1	1
Total						1						0						1	2

PDI File #: **197253 AA**
Location: **S: Lyman Street**
Location: **E: Bartlett Street W: Bartlett Street**
City, State: **Northborough, MA**
Client: **VHB/ T. Benson**
Site Code: **83468.19**
Count Date: **Wednesday, October 16, 2019**
Start Time: **4:00 PM**
End Time: **6:00 PM**
Class:

PRECISION DATA INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

Pedestrians

	Bartlett Street from East						Lyman Street from South						Bartlett Street from West						
	Thru	Left	U-Turn	CW-SB	CW-NB	Total	Right	Left	U-Turn	CW-WB	CW-EB	Total	Right	Thru	U-Turn	CW-NB	CW-SB	Total	Total
4:00 PM	0	0	0	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	0	0	0
4:30 PM	0	0	0	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	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:00 PM	0	0	0	0	0	0	0	0	0	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	0	0	0
5:30 PM	0	0	0	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	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Approach %	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
Total %	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Exiting Leg Total						0						0						0	0

Peak Hour Analysis from 04:00 PM to 06:00 PM begins at:

4:00 PM	Bartlett Street from East						Lyman Street from South						Bartlett Street from West						
	Thru	Left	U-Turn	CW-SB	CW-NB	Total	Right	Left	U-Turn	CW-WB	CW-EB	Total	Right	Thru	U-Turn	CW-NB	CW-SB	Total	Total
4:00 PM	0	0	0	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	0	0	0
4:30 PM	0	0	0	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	0	0	0
Total Volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Approach Total	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0		
PHF	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Entering Leg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Exiting Leg						0						0						0	0
Total						0						0						0	0

PDI File #: **197253 B**
Location: **S: FedEx Driveway**
Location: **E: Bartlett Street W: Bartlett Street**
City, State: **Northborough, MA**
Client: **VHB/ T. Benson**
Site Code: **83468.19**
Count Date: **Wednesday, October 16, 2019**
Start Time: **6:30 AM**
End Time: **9:00 AM**
Class:

PRECISION DATA INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

Cars and Heavy Vehicles (Combined)

	Bartlett Street from East				FedEx Driveway from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
6:30 AM	28	10	0	38	3	0	0	3	4	67	0	71	112
6:45 AM	72	5	0	77	2	1	0	3	1	112	0	113	193
Total	100	15	0	115	5	1	0	6	5	179	0	184	305
7:00 AM	99	0	0	99	1	2	0	3	6	105	0	111	213
7:15 AM	32	4	0	36	2	3	0	5	5	117	0	122	163
7:30 AM	33	6	0	39	1	2	0	3	6	160	0	166	208
7:45 AM	72	2	0	74	1	4	0	5	7	145	0	152	231
Total	236	12	0	248	5	11	0	16	24	527	0	551	815
8:00 AM	49	3	0	52	0	5	0	5	3	139	0	142	199
8:15 AM	55	2	0	57	2	4	0	6	6	149	0	155	218
8:30 AM	48	1	0	49	1	10	0	11	9	168	0	177	237
8:45 AM	30	5	0	35	3	3	0	6	5	156	0	161	202
Total	182	11	0	193	6	22	0	28	23	612	0	635	856
Grand Total	518	38	0	556	16	34	0	50	52	1318	0	1370	1976
Approach %	93.2	6.8	0.0		32.0	68.0	0.0		3.8	96.2	0.0		
Total %	26.2	1.9	0.0	28.1	0.8	1.7	0.0	2.5	2.6	66.7	0.0	69.3	
Exiting Leg Total				1334				90				552	1976
Cars	481	29	0	510	8	9	0	17	29	1251	0	1280	1807
% Cars	92.9	76.3	0.0	91.7	50.0	26.5	0.0	34.0	55.8	94.9	0.0	93.4	91.4
Exiting Leg Total				1259				58				490	1807
Heavy Vehicles	37	9	0	46	8	25	0	33	23	67	0	90	169
% Heavy Vehicles	7.1	23.7	0.0	8.3	50.0	73.5	0.0	66.0	44.2	5.1	0.0	6.6	8.6
Exiting Leg Total				75				32				62	169

Peak Hour Analysis from 06:30 AM to 09:00 AM begins at:

7:45 AM	Bartlett Street from East				FedEx Driveway from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
7:45 AM	72	2	0	74	1	4	0	5	7	145	0	152	231
8:00 AM	49	3	0	52	0	5	0	5	3	139	0	142	199
8:15 AM	55	2	0	57	2	4	0	6	6	149	0	155	218
8:30 AM	48	1	0	49	1	10	0	11	9	168	0	177	237
Total Volume	224	8	0	232	4	23	0	27	25	601	0	626	885
% Approach Total	96.6	3.4	0.0		14.8	85.2	0.0		4.0	96.0	0.0		
PHF	0.778	0.667	0.000	0.784	0.500	0.575	0.000	0.614	0.694	0.894	0.000	0.884	0.934
Cars	213	3	0	216	1	6	0	7	11	579	0	590	813
Cars %	95.1	37.5	0.0	93.1	25.0	26.1	0.0	25.9	44.0	96.3	0.0	94.2	91.9
Heavy Vehicles	11	5	0	16	3	17	0	20	14	22	0	36	72
Heavy Vehicles %	4.9	62.5	0.0	6.9	75.0	73.9	0.0	74.1	56.0	3.7	0.0	5.8	8.1
Cars Enter Leg	213	3	0	216	1	6	0	7	11	579	0	590	813
Heavy Enter Leg	11	5	0	16	3	17	0	20	14	22	0	36	72
Total Entering Leg	224	8	0	232	4	23	0	27	25	601	0	626	885
Cars Exiting Leg				580				14				219	813
Heavy Exiting Leg				25				19				28	72
Total Exiting Leg				605				33				247	885

PDI File #: **197253 B**
Location: **S: FedEx Driveway**
Location: **E: Bartlett Street W: Bartlett Street**
City, State: **Northborough, MA**
Client: **VHB/ T. Benson**
Site Code: **83468.19**
Count Date: **Wednesday, October 16, 2019**
Start Time: **6:30 AM**
End Time: **9:00 AM**
Class:

PRECISION DATA INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

Cars

	Bartlett Street from East				FedEx Driveway from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
6:30 AM	21	8	0	29	3	0	0	3	4	61	0	65	97
6:45 AM	63	4	0	67	1	1	0	2	1	103	0	104	173
Total	84	12	0	96	4	1	0	5	5	164	0	169	270
7:00 AM	94	0	0	94	1	0	0	1	1	92	0	93	188
7:15 AM	31	4	0	35	1	0	0	1	3	109	0	112	148
7:30 AM	30	5	0	35	1	1	0	2	5	158	0	163	200
7:45 AM	69	0	0	69	1	0	0	1	2	138	0	140	210
Total	224	9	0	233	4	1	0	5	11	497	0	508	746
8:00 AM	48	1	0	49	0	3	0	3	2	135	0	137	189
8:15 AM	50	1	0	51	0	1	0	1	3	145	0	148	200
8:30 AM	46	1	0	47	0	2	0	2	4	161	0	165	214
8:45 AM	29	5	0	34	0	1	0	1	4	149	0	153	188
Total	173	8	0	181	0	7	0	7	13	590	0	603	791
Grand Total	481	29	0	510	8	9	0	17	29	1251	0	1280	1807
Approach %	94.3	5.7	0.0		47.1	52.9	0.0		2.3	97.7	0.0		
Total %	26.6	1.6	0.0	28.2	0.4	0.5	0.0	0.9	1.6	69.2	0.0	70.8	
Exiting Leg Total				1259				58				490	1807

Peak Hour Analysis from 06:30 AM to 09:00 AM begins at:

7:45 AM	Bartlett Street from East				FedEx Driveway from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
7:45 AM	69	0	0	69	1	0	0	1	2	138	0	140	210
8:00 AM	48	1	0	49	0	3	0	3	2	135	0	137	189
8:15 AM	50	1	0	51	0	1	0	1	3	145	0	148	200
8:30 AM	46	1	0	47	0	2	0	2	4	161	0	165	214
Total Volume	213	3	0	216	1	6	0	7	11	579	0	590	813
% Approach Total	98.6	1.4	0.0		14.3	85.7	0.0		1.9	98.1	0.0		
PHF	0.772	0.750	0.000	0.783	0.250	0.500	0.000	0.583	0.688	0.899	0.000	0.894	0.950
Entering Leg	213	3	0	216	1	6	0	7	11	579	0	590	813
Exiting Leg				580				14				219	813
Total				796				21				809	1626

PDI File #: **197253 B**
Location: **S: FedEx Driveway**
Location: **E: Bartlett Street W: Bartlett Street**
City, State: **Northborough, MA**
Client: **VHB/ T. Benson**
Site Code: **83468.19**
Count Date: **Wednesday, October 16, 2019**
Start Time: **6:30 AM**
End Time: **9:00 AM**

PRECISION DATA INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

Class: **Heavy Vehicles-Combined (Buses, Single-Unit Trucks, Articulated Trucks)**

	Bartlett Street from East				FedEx Driveway from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
6:30 AM	7	2	0	9	0	0	0	0	0	6	0	6	15
6:45 AM	9	1	0	10	1	0	0	1	0	9	0	9	20
Total	16	3	0	19	1	0	0	1	0	15	0	15	35
7:00 AM	5	0	0	5	0	2	0	2	5	13	0	18	25
7:15 AM	1	0	0	1	1	3	0	4	2	8	0	10	15
7:30 AM	3	1	0	4	0	1	0	1	1	2	0	3	8
7:45 AM	3	2	0	5	0	4	0	4	5	7	0	12	21
Total	12	3	0	15	1	10	0	11	13	30	0	43	69
8:00 AM	1	2	0	3	0	2	0	2	1	4	0	5	10
8:15 AM	5	1	0	6	2	3	0	5	3	4	0	7	18
8:30 AM	2	0	0	2	1	8	0	9	5	7	0	12	23
8:45 AM	1	0	0	1	3	2	0	5	1	7	0	8	14
Total	9	3	0	12	6	15	0	21	10	22	0	32	65
Grand Total	37	9	0	46	8	25	0	33	23	67	0	90	169
Approach %	80.4	19.6	0.0		24.2	75.8	0.0		25.6	74.4	0.0		
Total %	21.9	5.3	0.0	27.2	4.7	14.8	0.0	19.5	13.6	39.6	0.0	53.3	
Exiting Leg Total				75				32				62	169
Buses	9	0	0	9	0	0	0	0	0	11	0	11	20
% Buses	24.3	0.0	0.0	19.6	0.0	0.0	0.0	0.0	0.0	16.4	0.0	12.2	11.8
Exiting Leg Total				11				0				9	20
Single-Unit Trucks	9	2	0	11	1	19	0	20	19	30	0	49	80
% Single-Unit	24.3	22.2	0.0	23.9	12.5	76.0	0.0	60.6	82.6	44.8	0.0	54.4	47.3
Exiting Leg Total				31				21				28	80
Articulated Trucks	19	7	0	26	7	6	0	13	4	26	0	30	69
% Articulated	51.4	77.8	0.0	56.5	87.5	24.0	0.0	39.4	17.4	38.8	0.0	33.3	40.8
Exiting Leg Total				33				11				25	69

Peak Hour Analysis from 06:30 AM to 09:00 AM begins at:

6:30 AM	Bartlett Street from East				FedEx Driveway from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
6:30 AM	7	2	0	9	0	0	0	0	0	6	0	6	15
6:45 AM	9	1	0	10	1	0	0	1	0	9	0	9	20
7:00 AM	5	0	0	5	0	2	0	2	5	13	0	18	25
7:15 AM	1	0	0	1	1	3	0	4	2	8	0	10	15
Total Volume	22	3	0	25	2	5	0	7	7	36	0	43	75
% Approach Total	88.0	12.0	0.0		28.6	71.4	0.0		16.3	83.7	0.0		
PHF	0.611	0.375	0.000	0.625	0.500	0.417	0.000	0.438	0.350	0.692	0.000	0.597	0.750
Buses	9	0	0	9	0	0	0	0	0	11	0	11	20
Buses %	40.9	0.0	0.0	36.0	0.0	0.0	0.0	0.0	0.0	30.6	0.0	25.6	26.7
Single-Unit Trucks	3	0	0	3	0	5	0	5	6	14	0	20	28
Single-Unit %	13.6	0.0	0.0	12.0	0.0	100.0	0.0	71.4	85.7	38.9	0.0	46.5	37.3
Articulated Trucks	10	3	0	13	2	0	0	2	1	11	0	12	27
Articulated %	45.5	100.0	0.0	52.0	100.0	0.0	0.0	28.6	14.3	30.6	0.0	27.9	36.0
Buses	9	0	0	9	0	0	0	0	0	11	0	11	20
Single-Unit Trucks	3	0	0	3	0	5	0	5	6	14	0	20	28
Articulated Trucks	10	3	0	13	2	0	0	2	1	11	0	12	27
Total Entering Leg	22	3	0	25	2	5	0	7	7	36	0	43	75
Buses				11				0				9	20
Single-Unit Trucks				14				6				8	28
Articulated Trucks				13				4				10	27
Total Exiting Leg				38				10				27	75

PDI File #: **197253 B**
Location: **S: FedEx Driveway**
Location: **E: Bartlett Street W: Bartlett Street**
City, State: **Northborough, MA**
Client: **VHB/ T. Benson**
Site Code: **83468.19**
Count Date: **Wednesday, October 16, 2019**
Start Time: **6:30 AM**
End Time: **9:00 AM**

PRECISION DATA INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

Class: **Buses**

	Bartlett Street from East				FedEx Driveway from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
6:30 AM	3	0	0	3	0	0	0	0	0	1	0	1	4
6:45 AM	6	0	0	6	0	0	0	0	0	4	0	4	10
Total	9	0	0	9	0	0	0	0	0	5	0	5	14
7:00 AM	0	0	0	0	0	0	0	0	0	6	0	6	6
7:15 AM	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	0	0
7:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	6	0	6	6
8:00 AM	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
8:30 AM	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
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	9	0	0	9	0	0	0	0	0	11	0	11	20
Approach %	100.0	0.0	0.0		0.0	0.0	0.0		0.0	100.0	0.0		
Total %	45.0	0.0	0.0	45.0	0.0	0.0	0.0	0.0	0.0	55.0	0.0	55.0	
Exiting Leg Total				11				0				9	20

Peak Hour Analysis from 06:30 AM to 09:00 AM begins at:

6:30 AM	Bartlett Street from East				FedEx Driveway from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
6:30 AM	3	0	0	3	0	0	0	0	0	1	0	1	4
6:45 AM	6	0	0	6	0	0	0	0	0	4	0	4	10
7:00 AM	0	0	0	0	0	0	0	0	0	6	0	6	6
7:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Volume	9	0	0	9	0	0	0	0	0	11	0	11	20
% Approach Total	100.0	0.0	0.0		0.0	0.0	0.0		0.0	100.0	0.0		
PHF	0.375	0.000	0.000	0.375	0.000	0.000	0.000	0.000	0.000	0.458	0.000	0.458	0.500
Entering Leg	9	0	0	9	0	0	0	0	0	11	0	11	20
Exiting Leg				11				0				9	20
Total				20				0				20	40

PDI File #: **197253 B**
Location: **S: FedEx Driveway**
Location: **E: Bartlett Street W: Bartlett Street**
City, State: **Northborough, MA**
Client: **VHB/ T. Benson**
Site Code: **83468.19**
Count Date: **Wednesday, October 16, 2019**
Start Time: **6:30 AM**
End Time: **9:00 AM**

PRECISION DATA INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

Class: **Single-Unit Trucks**

	Bartlett Street from East				FedEx Driveway from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
6:30 AM	1	0	0	1	0	0	0	0	0	1	0	1	2
6:45 AM	0	0	0	0	0	0	0	0	0	4	0	4	4
Total	1	0	0	1	0	0	0	0	0	5	0	5	6
7:00 AM	2	0	0	2	0	2	0	2	5	4	0	9	13
7:15 AM	0	0	0	0	0	3	0	3	1	5	0	6	9
7:30 AM	2	0	0	2	0	0	0	0	0	1	0	1	3
7:45 AM	0	1	0	1	0	3	0	3	4	3	0	7	11
Total	4	1	0	5	0	8	0	8	10	13	0	23	36
8:00 AM	1	1	0	2	0	2	0	2	1	2	0	3	7
8:15 AM	2	0	0	2	0	2	0	2	2	0	0	2	6
8:30 AM	0	0	0	0	0	6	0	6	5	7	0	12	18
8:45 AM	1	0	0	1	1	1	0	2	1	3	0	4	7
Total	4	1	0	5	1	11	0	12	9	12	0	21	38
Grand Total	9	2	0	11	1	19	0	20	19	30	0	49	80
Approach %	81.8	18.2	0.0		5.0	95.0	0.0		38.8	61.2	0.0		
Total %	11.3	2.5	0.0	13.8	1.3	23.8	0.0	25.0	23.8	37.5	0.0	61.3	
Exiting Leg Total				31				21				28	80

Peak Hour Analysis from 06:30 AM to 09:00 AM begins at:

7:45 AM	Bartlett Street from East				FedEx Driveway from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
7:45 AM	0	1	0	1	0	3	0	3	4	3	0	7	11
8:00 AM	1	1	0	2	0	2	0	2	1	2	0	3	7
8:15 AM	2	0	0	2	0	2	0	2	2	0	0	2	6
8:30 AM	0	0	0	0	0	6	0	6	5	7	0	12	18
Total Volume	3	2	0	5	0	13	0	13	12	12	0	24	42
% Approach Total	60.0	40.0	0.0		0.0	100.0	0.0		50.0	50.0	0.0		
PHF	0.375	0.500	0.000	0.625	0.000	0.542	0.000	0.542	0.600	0.429	0.000	0.500	0.583
Entering Leg	3	2	0	5	0	13	0	13	12	12	0	24	42
Exiting Leg				12				14				16	42
Total				17				27				40	84

PDI File #: **197253 B**
Location: **S: FedEx Driveway**
Location: **E: Bartlett Street W: Bartlett Street**
City, State: **Northborough, MA**
Client: **VHB/ T. Benson**
Site Code: **83468.19**
Count Date: **Wednesday, October 16, 2019**
Start Time: **6:30 AM**
End Time: **9:00 AM**
Class:

PRECISION DATA INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

Articulated Trucks

	Bartlett Street from East				FedEx Driveway from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
6:30 AM	3	2	0	5	0	0	0	0	0	4	0	4	9
6:45 AM	3	1	0	4	1	0	0	1	0	1	0	1	6
Total	6	3	0	9	1	0	0	1	0	5	0	5	15
7:00 AM	3	0	0	3	0	0	0	0	0	3	0	3	6
7:15 AM	1	0	0	1	1	0	0	1	1	3	0	4	6
7:30 AM	1	1	0	2	0	1	0	1	1	1	0	2	5
7:45 AM	3	1	0	4	0	1	0	1	1	4	0	5	10
Total	8	2	0	10	1	2	0	3	3	11	0	14	27
8:00 AM	0	1	0	1	0	0	0	0	0	2	0	2	3
8:15 AM	3	1	0	4	2	1	0	3	1	4	0	5	12
8:30 AM	2	0	0	2	1	2	0	3	0	0	0	0	5
8:45 AM	0	0	0	0	2	1	0	3	0	4	0	4	7
Total	5	2	0	7	5	4	0	9	1	10	0	11	27
Grand Total	19	7	0	26	7	6	0	13	4	26	0	30	69
Approach %	73.1	26.9	0.0		53.8	46.2	0.0		13.3	86.7	0.0		
Total %	27.5	10.1	0.0	37.7	10.1	8.7	0.0	18.8	5.8	37.7	0.0	43.5	
Exiting Leg Total				33				11				25	69

Peak Hour Analysis from 06:30 AM to 09:00 AM begins at:

7:30 AM	Bartlett Street from East				FedEx Driveway from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
7:30 AM	1	1	0	2	0	1	0	1	1	1	0	2	5
7:45 AM	3	1	0	4	0	1	0	1	1	4	0	5	10
8:00 AM	0	1	0	1	0	0	0	0	0	2	0	2	3
8:15 AM	3	1	0	4	2	1	0	3	1	4	0	5	12
Total Volume	7	4	0	11	2	3	0	5	3	11	0	14	30
% Approach Total	63.6	36.4	0.0		40.0	60.0	0.0		21.4	78.6	0.0		
PHF	0.583	1.000	0.000	0.688	0.250	0.750	0.000	0.417	0.750	0.688	0.000	0.700	0.625
Entering Leg	7	4	0	11	2	3	0	5	3	11	0	14	30
Exiting Leg				13				7				10	30
Total				24				12				24	60

PDI File #: **197253 B**
Location: **S: FedEx Driveway**
Location: **E: Bartlett Street W: Bartlett Street**
City, State: **Northborough, MA**
Client: **VHB/ T. Benson**
Site Code: **83468.19**
Count Date: **Wednesday, October 16, 2019**
Start Time: **6:30 AM**
End Time: **9:00 AM**
Class:

PRECISION DATA INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

Bicycles (on Roadway and Crosswalks)

	Bartlett Street from East						FedEx Driveway from South						Bartlett Street from West						
	Thru	Left	U-Turn	CW-SB	CW-NB	Total	Right	Left	U-Turn	CW-WB	CW-EB	Total	Right	Thru	U-Turn	CW-NB	CW-SB	Total	Total
6:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:00 AM	0	0	0	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	0	0	0
7:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:00 AM	0	0	0	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	0	0	0
8:30 AM	0	0	0	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	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Approach %	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0		
Total %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Exiting Leg Total						0						0						0	0

Peak Hour Analysis from 06:30 AM to 09:00 AM begins at:

6:30 AM	Bartlett Street from East						FedEx Driveway from South						Bartlett Street from West						
	Thru	Left	U-Turn	CW-SB	CW-NB	Total	Right	Left	U-Turn	CW-WB	CW-EB	Total	Right	Thru	U-Turn	CW-NB	CW-SB	Total	Total
6:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:00 AM	0	0	0	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	0	0	0
Total Volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Approach Total	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0		
PHF	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Entering Leg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Exiting Leg						0						0						0	0
Total						0						0						0	0

PDI File #: **197253 B**
Location: **S: FedEx Driveway**
Location: **E: Bartlett Street W: Bartlett Street**
City, State: **Northborough, MA**
Client: **VHB/ T. Benson**
Site Code: **83468.19**
Count Date: **Wednesday, October 16, 2019**
Start Time: **6:30 AM**
End Time: **9:00 AM**
Class:

PRECISION DATA INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

Pedestrians

	Bartlett Street from East						FedEx Driveway from South						Bartlett Street from West						
	Thru	Left	U-Turn	CW-SB	CW-NB	Total	Right	Left	U-Turn	CW-WB	CW-EB	Total	Right	Thru	U-Turn	CW-NB	CW-SB	Total	Total
6:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:00 AM	0	0	0	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	0	0	0
7:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:00 AM	0	0	0	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	0	0	0
8:30 AM	0	0	0	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	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Approach %	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
Total %	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Exiting Leg Total						0						0						0	0

Peak Hour Analysis from 06:30 AM to 09:00 AM begins at:

6:30 AM	Bartlett Street from East						FedEx Driveway from South						Bartlett Street from West						
	Thru	Left	U-Turn	CW-SB	CW-NB	Total	Right	Left	U-Turn	CW-WB	CW-EB	Total	Right	Thru	U-Turn	CW-NB	CW-SB	Total	Total
6:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:00 AM	0	0	0	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	0	0	0
Total Volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Approach Total	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0		
PHF	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Entering Leg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Exiting Leg						0						0						0	0
Total						0						0						0	0

PDI File #: **197253 BB**
Location: **S: FedEx Driveway**
Location: **E: Bartlett Street W: Bartlett Street**
City, State: **Northborough, MA**
Client: **VHB/ T. Benson**
Site Code: **83468.19**
Count Date: **Wednesday, October 16, 2019**
Start Time: **4:00 PM**
End Time: **6:00 PM**
Class:

PRECISION DATA INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

Cars and Heavy Vehicles (Combined)

	Bartlett Street from East				FedEx Driveway from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
4:00 PM	118	2	0	120	1	4	0	5	7	39	0	46	171
4:15 PM	114	3	0	117	7	3	0	10	6	47	0	53	180
4:30 PM	160	2	0	162	7	3	0	10	7	60	0	67	239
4:45 PM	172	2	0	174	7	2	0	9	2	58	0	60	243
Total	564	9	0	573	22	12	0	34	22	204	0	226	833
5:00 PM	211	3	0	214	4	7	0	11	2	64	0	66	291
5:15 PM	207	2	0	209	5	3	0	8	6	71	0	77	294
5:30 PM	185	5	0	190	2	7	0	9	1	35	0	36	235
5:45 PM	143	9	0	152	1	3	0	4	0	48	0	48	204
Total	746	19	0	765	12	20	0	32	9	218	0	227	1024
Grand Total	1310	28	0	1338	34	32	0	66	31	422	0	453	1857
Approach %	97.9	2.1	0.0		51.5	48.5	0.0		6.8	93.2	0.0		
Total %	70.5	1.5	0.0	72.1	1.8	1.7	0.0	3.6	1.7	22.7	0.0	24.4	
Exiting Leg Total				456				59				1342	1857
Cars	1272	9	0	1281	22	27	0	49	10	407	0	417	1747
% Cars	97.1	32.1	0.0	95.7	64.7	84.4	0.0	74.2	32.3	96.4	0.0	92.1	94.1
Exiting Leg Total				429				19				1299	1747
Heavy Vehicles	38	19	0	57	12	5	0	17	21	15	0	36	110
% Heavy Vehicles	2.9	67.9	0.0	4.3	35.3	15.6	0.0	25.8	67.7	3.6	0.0	7.9	5.9
Exiting Leg Total				27				40				43	110

Peak Hour Analysis from 04:00 PM to 06:00 PM begins at:

4:30 PM	Bartlett Street from East				FedEx Driveway from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
4:30 PM	160	2	0	162	7	3	0	10	7	60	0	67	239
4:45 PM	172	2	0	174	7	2	0	9	2	58	0	60	243
5:00 PM	211	3	0	214	4	7	0	11	2	64	0	66	291
5:15 PM	207	2	0	209	5	3	0	8	6	71	0	77	294
Total Volume	750	9	0	759	23	15	0	38	17	253	0	270	1067
% Approach Total	98.8	1.2	0.0		60.5	39.5	0.0		6.3	93.7	0.0		
PHF	0.889	0.750	0.000	0.887	0.821	0.536	0.000	0.864	0.607	0.891	0.000	0.877	0.907
Cars	728	4	0	732	13	15	0	28	6	242	0	248	1008
Cars %	97.1	44.4	0.0	96.4	56.5	100.0	0.0	73.7	35.3	95.7	0.0	91.9	94.5
Heavy Vehicles	22	5	0	27	10	0	0	10	11	11	0	22	59
Heavy Vehicles %	2.9	55.6	0.0	3.6	43.5	0.0	0.0	26.3	64.7	4.3	0.0	8.1	5.5
Cars Enter Leg	728	4	0	732	13	15	0	28	6	242	0	248	1008
Heavy Enter Leg	22	5	0	27	10	0	0	10	11	11	0	22	59
Total Entering Leg	750	9	0	759	23	15	0	38	17	253	0	270	1067
Cars Exiting Leg				255				10				743	1008
Heavy Exiting Leg				21				16				22	59
Total Exiting Leg				276				26				765	1067

PDI File #: **197253 BB**
Location: **S: FedEx Driveway**
Location: **E: Bartlett Street W: Bartlett Street**
City, State: **Northborough, MA**
Client: **VHB/ T. Benson**
Site Code: **83468.19**
Count Date: **Wednesday, October 16, 2019**
Start Time: **4:00 PM**
End Time: **6:00 PM**

PRECISION DATA INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

Class: **Cars**

	Bartlett Street from East				FedEx Driveway from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
4:00 PM	116	1	0	117	0	0	0	0	3	39	0	42	159
4:15 PM	110	2	0	112	6	2	0	8	0	46	0	46	166
4:30 PM	154	1	0	155	1	3	0	4	3	53	0	56	215
4:45 PM	166	2	0	168	3	2	0	5	2	58	0	60	233
Total	546	6	0	552	10	7	0	17	8	196	0	204	773
5:00 PM	205	0	0	205	4	7	0	11	0	61	0	61	277
5:15 PM	203	1	0	204	5	3	0	8	1	70	0	71	283
5:30 PM	181	1	0	182	2	7	0	9	1	34	0	35	226
5:45 PM	137	1	0	138	1	3	0	4	0	46	0	46	188
Total	726	3	0	729	12	20	0	32	2	211	0	213	974
Grand Total	1272	9	0	1281	22	27	0	49	10	407	0	417	1747
Approach %	99.3	0.7	0.0		44.9	55.1	0.0		2.4	97.6	0.0		
Total %	72.8	0.5	0.0	73.3	1.3	1.5	0.0	2.8	0.6	23.3	0.0	23.9	
Exiting Leg Total				429				19				1299	1747

Peak Hour Analysis from 04:00 PM to 06:00 PM begins at:

4:45 PM	Bartlett Street from East				FedEx Driveway from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
4:45 PM	166	2	0	168	3	2	0	5	2	58	0	60	233
5:00 PM	205	0	0	205	4	7	0	11	0	61	0	61	277
5:15 PM	203	1	0	204	5	3	0	8	1	70	0	71	283
5:30 PM	181	1	0	182	2	7	0	9	1	34	0	35	226
Total Volume	755	4	0	759	14	19	0	33	4	223	0	227	1019
% Approach Total	99.5	0.5	0.0		42.4	57.6	0.0		1.8	98.2	0.0		
PHF	0.921	0.500	0.000	0.926	0.700	0.679	0.000	0.750	0.500	0.796	0.000	0.799	0.900
Entering Leg	755	4	0	759	14	19	0	33	4	223	0	227	1019
Exiting Leg				237				8				774	1019
Total				996				41				1001	2038

PDI File #: **197253 BB**
Location: **S: FedEx Driveway**
Location: **E: Bartlett Street W: Bartlett Street**
City, State: **Northborough, MA**
Client: **VHB/ T. Benson**
Site Code: **83468.19**
Count Date: **Wednesday, October 16, 2019**
Start Time: **4:00 PM**
End Time: **6:00 PM**

PRECISION DATA INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

Class: **Heavy Vehicles-Combined (Buses, Single-Unit Trucks, Articulated Trucks)**

	Bartlett Street from East				FedEx Driveway from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
4:00 PM	2	1	0	3	1	4	0	5	4	0	0	4	12
4:15 PM	4	1	0	5	1	1	0	2	6	1	0	7	14
4:30 PM	6	1	0	7	6	0	0	6	4	7	0	11	24
4:45 PM	6	0	0	6	4	0	0	4	0	0	0	0	10
Total	18	3	0	21	12	5	0	17	14	8	0	22	60
5:00 PM	6	3	0	9	0	0	0	0	2	3	0	5	14
5:15 PM	4	1	0	5	0	0	0	0	5	1	0	6	11
5:30 PM	4	4	0	8	0	0	0	0	0	1	0	1	9
5:45 PM	6	8	0	14	0	0	0	0	0	2	0	2	16
Total	20	16	0	36	0	0	0	0	7	7	0	14	50
Grand Total	38	19	0	57	12	5	0	17	21	15	0	36	110
Approach %	66.7	33.3	0.0		70.6	29.4	0.0		58.3	41.7	0.0		
Total %	34.5	17.3	0.0	51.8	10.9	4.5	0.0	15.5	19.1	13.6	0.0	32.7	
Exiting Leg Total				27				40				43	110
Buses	1	0	0	1	0	0	0	0	0	2	0	2	3
% Buses	2.6	0.0	0.0	1.8	0.0	0.0	0.0	0.0	0.0	13.3	0.0	5.6	2.7
Exiting Leg Total				2				0				1	3
Single-Unit Trucks	18	2	0	20	12	4	0	16	14	7	0	21	57
% Single-Unit	47.4	10.5	0.0	35.1	100.0	80.0	0.0	94.1	66.7	46.7	0.0	58.3	51.8
Exiting Leg Total				19				16				22	57
Articulated Trucks	19	17	0	36	0	1	0	1	7	6	0	13	50
% Articulated	50.0	89.5	0.0	63.2	0.0	20.0	0.0	5.9	33.3	40.0	0.0	36.1	45.5
Exiting Leg Total				6				24				20	50

Peak Hour Analysis from 04:00 PM to 06:00 PM begins at:

4:15 PM	Bartlett Street from East				FedEx Driveway from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
4:15 PM	4	1	0	5	1	1	0	2	6	1	0	7	14
4:30 PM	6	1	0	7	6	0	0	6	4	7	0	11	24
4:45 PM	6	0	0	6	4	0	0	4	0	0	0	0	10
5:00 PM	6	3	0	9	0	0	0	0	2	3	0	5	14
Total Volume	22	5	0	27	11	1	0	12	12	11	0	23	62
% Approach Total	81.5	18.5	0.0		91.7	8.3	0.0		52.2	47.8	0.0		
PHF	0.917	0.417	0.000	0.750	0.458	0.250	0.000	0.500	0.500	0.393	0.000	0.523	0.646
Buses	1	0	0	1	0	0	0	0	0	1	0	1	2
Buses %	4.5	0.0	0.0	3.7	0.0	0.0	0.0	0.0	0.0	9.1	0.0	4.3	3.2
Single-Unit Trucks	14	0	0	14	11	1	0	12	10	7	0	17	43
Single-Unit %	63.6	0.0	0.0	51.9	100.0	100.0	0.0	100.0	83.3	63.6	0.0	73.9	69.4
Articulated Trucks	7	5	0	12	0	0	0	0	2	3	0	5	17
Articulated %	31.8	100.0	0.0	44.4	0.0	0.0	0.0	0.0	16.7	27.3	0.0	21.7	27.4
Buses	1	0	0	1	0	0	0	0	0	1	0	1	2
Single-Unit Trucks	14	0	0	14	11	1	0	12	10	7	0	17	43
Articulated Trucks	7	5	0	12	0	0	0	0	2	3	0	5	17
Total Entering Leg	22	5	0	27	11	1	0	12	12	11	0	23	62
Buses				1				0				1	2
Single-Unit Trucks				18				10				15	43
Articulated Trucks				3				7				7	17
Total Exiting Leg				22				17				23	62

PDI File #: **197253 BB**
Location: **S: FedEx Driveway**
Location: **E: Bartlett Street W: Bartlett Street**
City, State: **Northborough, MA**
Client: **VHB/ T. Benson**
Site Code: **83468.19**
Count Date: **Wednesday, October 16, 2019**
Start Time: **4:00 PM**
End Time: **6:00 PM**

PRECISION DATA INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

Class: **Buses**

	Bartlett Street from East				FedEx Driveway from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
4:00 PM	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
4:30 PM	1	0	0	1	0	0	0	0	0	1	0	1	2
4:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	1	0	0	1	0	0	0	0	0	1	0	1	2
5:00 PM	0	0	0	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
5:30 PM	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	1	0	1	1
Total	0	0	0	0	0	0	0	0	0	1	0	1	1
Grand Total	1	0	0	1	0	0	0	0	0	2	0	2	3
Approach %	100.0	0.0	0.0		0.0	0.0	0.0		0.0	100.0	0.0		
Total %	33.3	0.0	0.0	33.3	0.0	0.0	0.0	0.0	0.0	66.7	0.0	66.7	
Exiting Leg Total				2				0				1	3

Peak Hour Analysis from 04:00 PM to 06:00 PM begins at:

4:00 PM	Bartlett Street from East				FedEx Driveway from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
4:00 PM	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
4:30 PM	1	0	0	1	0	0	0	0	0	1	0	1	2
4:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Volume	1	0	0	1	0	0	0	0	0	1	0	1	2
% Approach Total	100.0	0.0	0.0		0.0	0.0	0.0		0.0	100.0	0.0		
PHF	0.250	0.000	0.000	0.250	0.000	0.000	0.000	0.000	0.000	0.250	0.000	0.250	0.250
Entering Leg	1	0	0	1	0	0	0	0	0	1	0	1	2
Exiting Leg				1				0				1	2
Total				2				0				2	4

PDI File #: **197253 BB**
Location: **S: FedEx Driveway**
Location: **E: Bartlett Street W: Bartlett Street**
City, State: **Northborough, MA**
Client: **VHB/ T. Benson**
Site Code: **83468.19**
Count Date: **Wednesday, October 16, 2019**
Start Time: **4:00 PM**
End Time: **6:00 PM**

PRECISION DATA INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

Class: **Single-Unit Trucks**

	Bartlett Street from East				FedEx Driveway from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
4:00 PM	1	0	0	1	1	3	0	4	4	0	0	4	9
4:15 PM	0	0	0	0	1	1	0	2	6	1	0	7	9
4:30 PM	4	0	0	4	6	0	0	6	4	4	0	8	18
4:45 PM	5	0	0	5	4	0	0	4	0	0	0	0	9
Total	10	0	0	10	12	4	0	16	14	5	0	19	45
5:00 PM	5	0	0	5	0	0	0	0	0	2	0	2	7
5:15 PM	1	0	0	1	0	0	0	0	0	0	0	0	1
5:30 PM	1	0	0	1	0	0	0	0	0	0	0	0	1
5:45 PM	1	2	0	3	0	0	0	0	0	0	0	0	3
Total	8	2	0	10	0	0	0	0	0	2	0	2	12
Grand Total	18	2	0	20	12	4	0	16	14	7	0	21	57
Approach %	90.0	10.0	0.0		75.0	25.0	0.0		66.7	33.3	0.0		
Total %	31.6	3.5	0.0	35.1	21.1	7.0	0.0	28.1	24.6	12.3	0.0	36.8	
Exiting Leg Total				19				16				22	57

Peak Hour Analysis from 04:00 PM to 06:00 PM begins at:

4:00 PM	Bartlett Street from East				FedEx Driveway from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
4:00 PM	1	0	0	1	1	3	0	4	4	0	0	4	9
4:15 PM	0	0	0	0	1	1	0	2	6	1	0	7	9
4:30 PM	4	0	0	4	6	0	0	6	4	4	0	8	18
4:45 PM	5	0	0	5	4	0	0	4	0	0	0	0	9
Total Volume	10	0	0	10	12	4	0	16	14	5	0	19	45
% Approach Total	100.0	0.0	0.0		75.0	25.0	0.0		73.7	26.3	0.0		
PHF	0.500	0.000	0.000	0.500	0.500	0.333	0.000	0.667	0.583	0.313	0.000	0.594	0.625
Entering Leg	10	0	0	10	12	4	0	16	14	5	0	19	45
Exiting Leg				17				14				14	45
Total				27				30				33	90

PDI File #: **197253 BB**
Location: **S: FedEx Driveway**
Location: **E: Bartlett Street W: Bartlett Street**
City, State: **Northborough, MA**
Client: **VHB/ T. Benson**
Site Code: **83468.19**
Count Date: **Wednesday, October 16, 2019**
Start Time: **4:00 PM**
End Time: **6:00 PM**

PRECISION DATA INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

Class:

Articulated Trucks

	Bartlett Street from East				FedEx Driveway from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
4:00 PM	1	1	0	2	0	1	0	1	0	0	0	0	3
4:15 PM	4	1	0	5	0	0	0	0	0	0	0	0	5
4:30 PM	1	1	0	2	0	0	0	0	0	2	0	2	4
4:45 PM	1	0	0	1	0	0	0	0	0	0	0	0	1
Total	7	3	0	10	0	1	0	1	0	2	0	2	13
5:00 PM	1	3	0	4	0	0	0	0	2	1	0	3	7
5:15 PM	3	1	0	4	0	0	0	0	5	1	0	6	10
5:30 PM	3	4	0	7	0	0	0	0	0	1	0	1	8
5:45 PM	5	6	0	11	0	0	0	0	0	1	0	1	12
Total	12	14	0	26	0	0	0	0	7	4	0	11	37
Grand Total	19	17	0	36	0	1	0	1	7	6	0	13	50
Approach %	52.8	47.2	0.0		0.0	100.0	0.0		53.8	46.2	0.0		
Total %	38.0	34.0	0.0	72.0	0.0	2.0	0.0	2.0	14.0	12.0	0.0	26.0	
Exiting Leg Total				6				24				20	50

Peak Hour Analysis from 04:00 PM to 06:00 PM begins at:

5:00 PM	Bartlett Street from East				FedEx Driveway from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
5:00 PM	1	3	0	4	0	0	0	0	2	1	0	3	7
5:15 PM	3	1	0	4	0	0	0	0	5	1	0	6	10
5:30 PM	3	4	0	7	0	0	0	0	0	1	0	1	8
5:45 PM	5	6	0	11	0	0	0	0	0	1	0	1	12
Total Volume	12	14	0	26	0	0	0	0	7	4	0	11	37
% Approach Total	46.2	53.8	0.0		0.0	0.0	0.0		63.6	36.4	0.0		
PHF	0.600	0.583	0.000	0.591	0.000	0.000	0.000	0.000	0.350	1.000	0.000	0.458	0.771
Entering Leg	12	14	0	26	0	0	0	0	7	4	0	11	37
Exiting Leg				4				21				12	37
Total				30				21				23	74

PDI File #: **197253 BB**
Location: **S: FedEx Driveway**
Location: **E: Bartlett Street W: Bartlett Street**
City, State: **Northborough, MA**
Client: **VHB/ T. Benson**
Site Code: **83468.19**
Count Date: **Wednesday, October 16, 2019**
Start Time: **4:00 PM**
End Time: **6:00 PM**

PRECISION DATA INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

Class: **Bicycles (on Roadway and Crosswalks)**

	Bartlett Street from East						FedEx Driveway from South						Bartlett Street from West						
	Thru	Left	U-Turn	CW-SB	CW-NB	Total	Right	Left	U-Turn	CW-WB	CW-EB	Total	Right	Thru	U-Turn	CW-NB	CW-SB	Total	Total
4:00 PM	0	0	0	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	0	0	0
4:30 PM	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
4:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
5:00 PM	0	0	0	0	0	0	0	0	0	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	0	0	0
5:30 PM	0	0	0	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	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Approach %	100.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0		
Total %	100.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Exiting Leg Total						0						0						1	1

Peak Hour Analysis from 04:00 PM to 06:00 PM begins at:

4:00 PM	Bartlett Street from East						FedEx Driveway from South						Bartlett Street from West						
	Thru	Left	U-Turn	CW-SB	CW-NB	Total	Right	Left	U-Turn	CW-WB	CW-EB	Total	Right	Thru	U-Turn	CW-NB	CW-SB	Total	Total
4:00 PM	0	0	0	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	0	0	0
4:30 PM	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
4:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Volume	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
% Approach Total	100.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0		
PHF	0.250	0.000	0.000	0.000	0.000	0.250	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.250
Entering Leg	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Exiting Leg						0						0						1	1
Total						1						0						1	2

PDI File #: **197253 BB**
Location: **S: FedEx Driveway**
Location: **E: Bartlett Street W: Bartlett Street**
City, State: **Northborough, MA**
Client: **VHB/ T. Benson**
Site Code: **83468.19**
Count Date: **Wednesday, October 16, 2019**
Start Time: **4:00 PM**
End Time: **6:00 PM**

PRECISION DATA INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

Class: **Pedestrians**

	Bartlett Street from East						FedEx Driveway from South						Bartlett Street from West						
	Thru	Left	U-Turn	CW-SB	CW-NB	Total	Right	Left	U-Turn	CW-WB	CW-EB	Total	Right	Thru	U-Turn	CW-NB	CW-SB	Total	Total
4:00 PM	0	0	0	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	0	0	0
4:30 PM	0	0	0	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	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:00 PM	0	0	0	0	0	0	0	0	0	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	0	0	0
5:30 PM	0	0	0	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	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Approach %	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
Total %	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Exiting Leg Total						0						0						0	0

Peak Hour Analysis from 04:00 PM to 06:00 PM begins at:

4:00 PM	Bartlett Street from East						FedEx Driveway from South						Bartlett Street from West						
	Thru	Left	U-Turn	CW-SB	CW-NB	Total	Right	Left	U-Turn	CW-WB	CW-EB	Total	Right	Thru	U-Turn	CW-NB	CW-SB	Total	Total
4:00 PM	0	0	0	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	0	0	0
4:30 PM	0	0	0	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	0	0	0
Total Volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Approach Total	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0		
PHF	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Entering Leg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Exiting Leg						0						0						0	0
Total						0						0						0	0

PDI File #: **197253 C**
Location: **S: Cedar Hill Street**
Location: **E: Bartlett Street W: Bartlett Street**
City, State: **Northborough, MA**
Client: **VHB/ T. Benson**
Site Code: **83468.19**
Count Date: **Wednesday, October 16, 2019**
Start Time: **6:30 AM**
End Time: **9:00 AM**
Class:

PRECISION DATA INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

Cars and Heavy Vehicles (Combined)

	Bartlett Street from East				Cedar Hill Street from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
6:30 AM	12	6	0	18	4	29	0	33	51	19	0	70	121
6:45 AM	24	16	0	40	4	54	0	58	78	31	0	109	207
Total	36	22	0	58	8	83	0	91	129	50	0	179	328
7:00 AM	25	18	0	43	6	72	0	78	76	29	0	105	226
7:15 AM	18	14	0	32	11	19	0	30	77	41	0	118	180
7:30 AM	18	14	0	32	5	22	0	27	93	68	0	161	220
7:45 AM	43	17	0	60	9	32	0	41	82	58	0	140	241
Total	104	63	0	167	31	145	0	176	328	196	0	524	867
8:00 AM	24	15	0	39	5	34	0	39	79	61	0	140	218
8:15 AM	23	15	0	38	5	33	0	38	85	65	0	150	226
8:30 AM	19	12	0	31	6	33	0	39	96	72	0	168	238
8:45 AM	14	15	0	29	5	21	0	26	96	65	0	161	216
Total	80	57	0	137	21	121	0	142	356	263	0	619	898
Grand Total	220	142	0	362	60	349	0	409	813	509	0	1322	2093
Approach %	60.8	39.2	0.0		14.7	85.3	0.0		61.5	38.5	0.0		
Total %	10.5	6.8	0.0	17.3	2.9	16.7	0.0	19.5	38.8	24.3	0.0	63.2	
Exiting Leg Total				569				955				569	2093
Cars	214	128	0	342	53	305	0	358	753	495	0	1248	1948
% Cars	97.3	90.1	0.0	94.5	88.3	87.4	0.0	87.5	92.6	97.2	0.0	94.4	93.1
Exiting Leg Total				548				881				519	1948
Heavy Vehicles	6	14	0	20	7	44	0	51	60	14	0	74	145
% Heavy Vehicles	2.7	9.9	0.0	5.5	11.7	12.6	0.0	12.5	7.4	2.8	0.0	5.6	6.9
Exiting Leg Total				21				74				50	145

Peak Hour Analysis from 06:30 AM to 09:00 AM begins at:

7:45 AM	Bartlett Street from East				Cedar Hill Street from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
7:45 AM	43	17	0	60	9	32	0	41	82	58	0	140	241
8:00 AM	24	15	0	39	5	34	0	39	79	61	0	140	218
8:15 AM	23	15	0	38	5	33	0	38	85	65	0	150	226
8:30 AM	19	12	0	31	6	33	0	39	96	72	0	168	238
Total Volume	109	59	0	168	25	132	0	157	342	256	0	598	923
% Approach Total	64.9	35.1	0.0		15.9	84.1	0.0		57.2	42.8	0.0		
PHF	0.634	0.868	0.000	0.700	0.694	0.971	0.000	0.957	0.891	0.889	0.000	0.890	0.957
Cars	107	58	0	165	22	113	0	135	324	250	0	574	874
Cars %	98.2	98.3	0.0	98.2	88.0	85.6	0.0	86.0	94.7	97.7	0.0	96.0	94.7
Heavy Vehicles	2	1	0	3	3	19	0	22	18	6	0	24	49
Heavy Vehicles %	1.8	1.7	0.0	1.8	12.0	14.4	0.0	14.0	5.3	2.3	0.0	4.0	5.3
Cars Enter Leg	107	58	0	165	22	113	0	135	324	250	0	574	874
Heavy Enter Leg	2	1	0	3	3	19	0	22	18	6	0	24	49
Total Entering Leg	109	59	0	168	25	132	0	157	342	256	0	598	923
Cars Exiting Leg				272				382				220	874
Heavy Exiting Leg				9				19				21	49
Total Exiting Leg				281				401				241	923

PDI File #: **197253 C**
Location: **S: Cedar Hill Street**
Location: **E: Bartlett Street W: Bartlett Street**
City, State: **Northborough, MA**
Client: **VHB/ T. Benson**
Site Code: **83468.19**
Count Date: **Wednesday, October 16, 2019**
Start Time: **6:30 AM**
End Time: **9:00 AM**
Class:

PRECISION DATA INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

Cars

	Bartlett Street from East				Cedar Hill Street from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
6:30 AM	12	4	0	16	4	20	0	24	45	19	0	64	104
6:45 AM	23	15	0	38	4	46	0	50	70	30	0	100	188
Total	35	19	0	54	8	66	0	74	115	49	0	164	292
7:00 AM	24	17	0	41	4	69	0	73	65	29	0	94	208
7:15 AM	18	10	0	28	11	18	0	29	70	38	0	108	165
7:30 AM	16	13	0	29	4	19	0	23	91	68	0	159	211
7:45 AM	42	16	0	58	8	27	0	35	77	57	0	134	227
Total	100	56	0	156	27	133	0	160	303	192	0	495	811
8:00 AM	23	15	0	38	4	30	0	34	76	59	0	135	207
8:15 AM	23	15	0	38	5	27	0	32	79	65	0	144	214
8:30 AM	19	12	0	31	5	29	0	34	92	69	0	161	226
8:45 AM	14	11	0	25	4	20	0	24	88	61	0	149	198
Total	79	53	0	132	18	106	0	124	335	254	0	589	845
Grand Total	214	128	0	342	53	305	0	358	753	495	0	1248	1948
Approach %	62.6	37.4	0.0		14.8	85.2	0.0		60.3	39.7	0.0		
Total %	11.0	6.6	0.0	17.6	2.7	15.7	0.0	18.4	38.7	25.4	0.0	64.1	
Exiting Leg Total				548				881				519	1948

Peak Hour Analysis from 06:30 AM to 09:00 AM begins at:

7:45 AM	Bartlett Street from East				Cedar Hill Street from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
7:45 AM	42	16	0	58	8	27	0	35	77	57	0	134	227
8:00 AM	23	15	0	38	4	30	0	34	76	59	0	135	207
8:15 AM	23	15	0	38	5	27	0	32	79	65	0	144	214
8:30 AM	19	12	0	31	5	29	0	34	92	69	0	161	226
Total Volume	107	58	0	165	22	113	0	135	324	250	0	574	874
% Approach Total	64.8	35.2	0.0		16.3	83.7	0.0		56.4	43.6	0.0		
PHF	0.637	0.906	0.000	0.711	0.688	0.942	0.000	0.964	0.880	0.906	0.000	0.891	0.963
Entering Leg	107	58	0	165	22	113	0	135	324	250	0	574	874
Exiting Leg				272				382				220	874
Total				437				517				794	1748

PDI File #: **197253 C**
Location: **S: Cedar Hill Street**
Location: **E: Bartlett Street W: Bartlett Street**
City, State: **Northborough, MA**
Client: **VHB/ T. Benson**
Site Code: **83468.19**
Count Date: **Wednesday, October 16, 2019**
Start Time: **6:30 AM**
End Time: **9:00 AM**

PRECISION DATA INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

Class: **Heavy Vehicles-Combined (Buses, Single-Unit Trucks, Articulated Trucks)**

	Bartlett Street from East				Cedar Hill Street from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
6:30 AM	0	2	0	2	0	9	0	9	6	0	0	6	17
6:45 AM	1	1	0	2	0	8	0	8	8	1	0	9	19
Total	1	3	0	4	0	17	0	17	14	1	0	15	36
7:00 AM	1	1	0	2	2	3	0	5	11	0	0	11	18
7:15 AM	0	4	0	4	0	1	0	1	7	3	0	10	15
7:30 AM	2	1	0	3	1	3	0	4	2	0	0	2	9
7:45 AM	1	1	0	2	1	5	0	6	5	1	0	6	14
Total	4	7	0	11	4	12	0	16	25	4	0	29	56
8:00 AM	1	0	0	1	1	4	0	5	3	2	0	5	11
8:15 AM	0	0	0	0	0	6	0	6	6	0	0	6	12
8:30 AM	0	0	0	0	1	4	0	5	4	3	0	7	12
8:45 AM	0	4	0	4	1	1	0	2	8	4	0	12	18
Total	1	4	0	5	3	15	0	18	21	9	0	30	53
Grand Total	6	14	0	20	7	44	0	51	60	14	0	74	145
Approach %	30.0	70.0	0.0		13.7	86.3	0.0		81.1	18.9	0.0		
Total %	4.1	9.7	0.0	13.8	4.8	30.3	0.0	35.2	41.4	9.7	0.0	51.0	
Exiting Leg Total				21				74				50	145
Buses	1	1	0	2	1	8	0	9	10	1	0	11	22
% Buses	16.7	7.1	0.0	10.0	14.3	18.2	0.0	17.6	16.7	7.1	0.0	14.9	15.2
Exiting Leg Total				2				11				9	22
Single-Unit Trucks	3	11	0	14	5	12	0	17	18	11	0	29	60
% Single-Unit	50.0	78.6	0.0	70.0	71.4	27.3	0.0	33.3	30.0	78.6	0.0	39.2	41.4
Exiting Leg Total				16				29				15	60
Articulated Trucks	2	2	0	4	1	24	0	25	32	2	0	34	63
% Articulated	33.3	14.3	0.0	20.0	14.3	54.5	0.0	49.0	53.3	14.3	0.0	45.9	43.4
Exiting Leg Total				3				34				26	63

Peak Hour Analysis from 06:30 AM to 09:00 AM begins at:

6:30 AM	Bartlett Street from East				Cedar Hill Street from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
6:30 AM	0	2	0	2	0	9	0	9	6	0	0	6	17
6:45 AM	1	1	0	2	0	8	0	8	8	1	0	9	19
7:00 AM	1	1	0	2	2	3	0	5	11	0	0	11	18
7:15 AM	0	4	0	4	0	1	0	1	7	3	0	10	15
Total Volume	2	8	0	10	2	21	0	23	32	4	0	36	69
% Approach Total	20.0	80.0	0.0		8.7	91.3	0.0		88.9	11.1	0.0		
PHF	0.500	0.500	0.000	0.625	0.250	0.583	0.000	0.639	0.727	0.333	0.000	0.818	0.908
Buses	1	1	0	2	0	8	0	8	10	1	0	11	21
Buses %	50.0	12.5	0.0	20.0	0.0	38.1	0.0	34.8	31.3	25.0	0.0	30.6	30.4
Single-Unit Trucks	1	5	0	6	2	2	0	4	9	2	0	11	21
Single-Unit %	50.0	62.5	0.0	60.0	100.0	9.5	0.0	17.4	28.1	50.0	0.0	30.6	30.4
Articulated Trucks	0	2	0	2	0	11	0	11	13	1	0	14	27
Articulated %	0.0	25.0	0.0	20.0	0.0	52.4	0.0	47.8	40.6	25.0	0.0	38.9	39.1
Buses	1	1	0	2	0	8	0	8	10	1	0	11	21
Single-Unit Trucks	1	5	0	6	2	2	0	4	9	2	0	11	21
Articulated Trucks	0	2	0	2	0	11	0	11	13	1	0	14	27
Total Entering Leg	2	8	0	10	2	21	0	23	32	4	0	36	69
Buses				1				11				9	21
Single-Unit Trucks				4				14				3	21
Articulated Trucks				1				15				11	27
Total Exiting Leg				6				40				23	69

PDI File #: **197253 C**
Location: **S: Cedar Hill Street**
Location: **E: Bartlett Street W: Bartlett Street**
City, State: **Northborough, MA**
Client: **VHB/ T. Benson**
Site Code: **83468.19**
Count Date: **Wednesday, October 16, 2019**
Start Time: **6:30 AM**
End Time: **9:00 AM**

PRECISION DATA INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

Class: **Buses**

	Bartlett Street from East				Cedar Hill Street from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
6:30 AM	0	1	0	1	0	3	0	3	1	0	0	1	5
6:45 AM	1	0	0	1	0	5	0	5	3	1	0	4	10
Total	1	1	0	2	0	8	0	8	4	1	0	5	15
7:00 AM	0	0	0	0	0	0	0	0	6	0	0	6	6
7:15 AM	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	0	0
7:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	6	0	0	6	6
8:00 AM	0	0	0	0	1	0	0	1	0	0	0	0	1
8:15 AM	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
8:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	1	0	0	1	0	0	0	0	1
Grand Total	1	1	0	2	1	8	0	9	10	1	0	11	22
Approach %	50.0	50.0	0.0		11.1	88.9	0.0		90.9	9.1	0.0		
Total %	4.5	4.5	0.0	9.1	4.5	36.4	0.0	40.9	45.5	4.5	0.0	50.0	
Exiting Leg Total				2				11				9	22

Peak Hour Analysis from 06:30 AM to 09:00 AM begins at:

6:30 AM	Bartlett Street from East				Cedar Hill Street from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
6:30 AM	0	1	0	1	0	3	0	3	1	0	0	1	5
6:45 AM	1	0	0	1	0	5	0	5	3	1	0	4	10
7:00 AM	0	0	0	0	0	0	0	0	6	0	0	6	6
7:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Volume	1	1	0	2	0	8	0	8	10	1	0	11	21
% Approach Total	50.0	50.0	0.0		0.0	100.0	0.0		90.9	9.1	0.0		
PHF	0.250	0.250	0.000	0.500	0.000	0.400	0.000	0.400	0.417	0.250	0.000	0.458	0.525
Entering Leg	1	1	0	2	0	8	0	8	10	1	0	11	21
Exiting Leg				1				11				9	21
Total				3				19				20	42

PDI File #: **197253 C**
Location: **S: Cedar Hill Street**
Location: **E: Bartlett Street W: Bartlett Street**
City, State: **Northborough, MA**
Client: **VHB/ T. Benson**
Site Code: **83468.19**
Count Date: **Wednesday, October 16, 2019**
Start Time: **6:30 AM**
End Time: **9:00 AM**

PRECISION DATA INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

Class: **Single-Unit Trucks**

	Bartlett Street from East				Cedar Hill Street from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
6:30 AM	0	0	0	0	0	1	0	1	1	0	0	1	2
6:45 AM	0	1	0	1	0	0	0	0	3	0	0	3	4
Total	0	1	0	1	0	1	0	1	4	0	0	4	6
7:00 AM	1	1	0	2	2	1	0	3	2	0	0	2	7
7:15 AM	0	3	0	3	0	0	0	0	3	2	0	5	8
7:30 AM	1	1	0	2	1	1	0	2	1	0	0	1	5
7:45 AM	0	1	0	1	1	2	0	3	1	1	0	2	6
Total	2	6	0	8	4	4	0	8	7	3	0	10	26
8:00 AM	1	0	0	1	0	1	0	1	1	2	0	3	5
8:15 AM	0	0	0	0	0	3	0	3	0	0	0	0	3
8:30 AM	0	0	0	0	1	2	0	3	3	3	0	6	9
8:45 AM	0	4	0	4	0	1	0	1	3	3	0	6	11
Total	1	4	0	5	1	7	0	8	7	8	0	15	28
Grand Total	3	11	0	14	5	12	0	17	18	11	0	29	60
Approach %	21.4	78.6	0.0		29.4	70.6	0.0		62.1	37.9	0.0		
Total %	5.0	18.3	0.0	23.3	8.3	20.0	0.0	28.3	30.0	18.3	0.0	48.3	
Exiting Leg Total				16				29				15	60

Peak Hour Analysis from 06:30 AM to 09:00 AM begins at:

8:00 AM	Bartlett Street from East				Cedar Hill Street from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
8:00 AM	1	0	0	1	0	1	0	1	1	2	0	3	5
8:15 AM	0	0	0	0	0	3	0	3	0	0	0	0	3
8:30 AM	0	0	0	0	1	2	0	3	3	3	0	6	9
8:45 AM	0	4	0	4	0	1	0	1	3	3	0	6	11
Total Volume	1	4	0	5	1	7	0	8	7	8	0	15	28
% Approach Total	20.0	80.0	0.0		12.5	87.5	0.0		46.7	53.3	0.0		
PHF	0.250	0.250	0.000	0.313	0.250	0.583	0.000	0.667	0.583	0.667	0.000	0.625	0.636
Entering Leg	1	4	0	5	1	7	0	8	7	8	0	15	28
Exiting Leg				9				11				8	28
Total				14				19				23	56

PDI File #: **197253 C**
Location: **S: Cedar Hill Street**
Location: **E: Bartlett Street W: Bartlett Street**
City, State: **Northborough, MA**
Client: **VHB/ T. Benson**
Site Code: **83468.19**
Count Date: **Wednesday, October 16, 2019**
Start Time: **6:30 AM**
End Time: **9:00 AM**

PRECISION DATA INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

Class: **Articulated Trucks**

	Bartlett Street from East				Cedar Hill Street from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
6:30 AM	0	1	0	1	0	5	0	5	4	0	0	4	10
6:45 AM	0	0	0	0	0	3	0	3	2	0	0	2	5
Total	0	1	0	1	0	8	0	8	6	0	0	6	15
7:00 AM	0	0	0	0	0	2	0	2	3	0	0	3	5
7:15 AM	0	1	0	1	0	1	0	1	4	1	0	5	7
7:30 AM	1	0	0	1	0	2	0	2	1	0	0	1	4
7:45 AM	1	0	0	1	0	3	0	3	4	0	0	4	8
Total	2	1	0	3	0	8	0	8	12	1	0	13	24
8:00 AM	0	0	0	0	0	3	0	3	2	0	0	2	5
8:15 AM	0	0	0	0	0	3	0	3	6	0	0	6	9
8:30 AM	0	0	0	0	0	2	0	2	1	0	0	1	3
8:45 AM	0	0	0	0	1	0	0	1	5	1	0	6	7
Total	0	0	0	0	1	8	0	9	14	1	0	15	24
Grand Total	2	2	0	4	1	24	0	25	32	2	0	34	63
Approach %	50.0	50.0	0.0		4.0	96.0	0.0		94.1	5.9	0.0		
Total %	3.2	3.2	0.0	6.3	1.6	38.1	0.0	39.7	50.8	3.2	0.0	54.0	
Exiting Leg Total				3				34				26	63

Peak Hour Analysis from 06:30 AM to 09:00 AM begins at:

6:30 AM	Bartlett Street from East				Cedar Hill Street from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
6:30 AM	0	1	0	1	0	5	0	5	4	0	0	4	10
6:45 AM	0	0	0	0	0	3	0	3	2	0	0	2	5
7:00 AM	0	0	0	0	0	2	0	2	3	0	0	3	5
7:15 AM	0	1	0	1	0	1	0	1	4	1	0	5	7
Total Volume	0	2	0	2	0	11	0	11	13	1	0	14	27
% Approach Total	0.0	100.0	0.0		0.0	100.0	0.0		92.9	7.1	0.0		
PHF	0.000	0.500	0.000	0.500	0.000	0.550	0.000	0.550	0.813	0.250	0.000	0.700	0.675
Entering Leg	0	2	0	2	0	11	0	11	13	1	0	14	27
Exiting Leg				1				15				11	27
Total				3				26				25	54

PDI File #: **197253 C**
Location: **S: Cedar Hill Street**
Location: **E: Bartlett Street W: Bartlett Street**
City, State: **Northborough, MA**
Client: **VHB/ T. Benson**
Site Code: **83468.19**
Count Date: **Wednesday, October 16, 2019**
Start Time: **6:30 AM**
End Time: **9:00 AM**
Class:

PRECISION DATA INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

Bicycles (on Roadway and Crosswalks)

	Bartlett Street from East						Cedar Hill Street from South						Bartlett Street from West						
	Thru	Left	U-Turn	CW-SB	CW-NB	Total	Right	Left	U-Turn	CW-WB	CW-EB	Total	Right	Thru	U-Turn	CW-NB	CW-SB	Total	Total
6:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:00 AM	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	1
7:15 AM	0	0	0	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	0	0	0	0	0	0	0	0
7:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	1
8:00 AM	0	0	0	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	0	0	0
8:30 AM	0	0	0	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	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	1
Approach %	0.0	0.0	0.0	0.0	0.0		0.0	100.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0		
Total %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	
Exiting Leg Total						0						0						1	1

Peak Hour Analysis from 06:30 AM to 09:00 AM begins at:

6:30 AM	Bartlett Street from East						Cedar Hill Street from South						Bartlett Street from West						
	Thru	Left	U-Turn	CW-SB	CW-NB	Total	Right	Left	U-Turn	CW-WB	CW-EB	Total	Right	Thru	U-Turn	CW-NB	CW-SB	Total	Total
6:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:00 AM	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	1
7:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Volume	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	1
% Approach Total	0.0	0.0	0.0	0.0	0.0		0.0	100.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0		
PHF	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.250	0.000	0.000	0.000	0.250	0.000	0.000	0.000	0.000	0.000	0.000	0.250
Entering Leg	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	1
Exiting Leg						0						0						1	1
Total						0						1						1	2

PDI File #: **197253 C**
Location: **S: Cedar Hill Street**
Location: **E: Bartlett Street W: Bartlett Street**
City, State: **Northborough, MA**
Client: **VHB/ T. Benson**
Site Code: **83468.19**
Count Date: **Wednesday, October 16, 2019**
Start Time: **6:30 AM**
End Time: **9:00 AM**
Class:

PRECISION DATA INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

Pedestrians

	Bartlett Street from East						Cedar Hill Street from South						Bartlett Street from West						
	Thru	Left	U-Turn	CW-SB	CW-NB	Total	Right	Left	U-Turn	CW-WB	CW-EB	Total	Right	Thru	U-Turn	CW-NB	CW-SB	Total	Total
6:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:00 AM	0	0	0	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	0	0	0
7:30 AM	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	1
7:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	1
8:00 AM	0	0	0	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	0	0	0
8:30 AM	0	0	0	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	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	1
Approach %	0	0	0	0	0		0	0	0	100	0		0	0	0	0	0		
Total %	0	0	0	0	0	0	0	0	0	100	0	100	0	0	0	0	0	0	
Exiting Leg Total						0						1						0	1

Peak Hour Analysis from 06:30 AM to 09:00 AM begins at:

6:45 AM	Bartlett Street from East						Cedar Hill Street from South						Bartlett Street from West						
	Thru	Left	U-Turn	CW-SB	CW-NB	Total	Right	Left	U-Turn	CW-WB	CW-EB	Total	Right	Thru	U-Turn	CW-NB	CW-SB	Total	Total
6:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:00 AM	0	0	0	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	0	0	0
7:30 AM	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	1
Total Volume	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	1
% Approach Total	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	100.0	0.0		0.0	0.0	0.0	0.0	0.0		
PHF	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.250	0.000	0.250	0.000	0.000	0.000	0.000	0.000	0.000	0.250
Entering Leg	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	1
Exiting Leg						0						1						0	1
Total						0						2						0	2

PDI File #: **197253 CC**
Location: **S: Cedar Hill Street**
Location: **E: Bartlett Street W: Bartlett Street**
City, State: **Northborough, MA**
Client: **VHB/ T. Benson**
Site Code: **83468.19**
Count Date: **Wednesday, October 16, 2019**
Start Time: **4:00 PM**
End Time: **6:00 PM**
Class:

PRECISION DATA INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

Cars and Heavy Vehicles (Combined)

	Bartlett Street from East				Cedar Hill Street from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
4:00 PM	63	7	1	71	21	54	0	75	21	24	0	45	191
4:15 PM	58	9	0	67	9	59	0	68	30	21	0	51	186
4:30 PM	99	11	0	110	14	66	0	80	46	22	0	68	258
4:45 PM	94	9	0	103	17	79	0	96	49	19	0	68	267
Total	314	36	1	351	61	258	0	319	146	86	0	232	902
5:00 PM	122	13	0	135	16	93	0	109	38	28	0	66	310
5:15 PM	103	21	0	124	13	100	0	113	52	23	0	75	312
5:30 PM	99	14	0	113	7	92	0	99	23	13	0	36	248
5:45 PM	69	9	0	78	15	83	0	98	25	23	0	48	224
Total	393	57	0	450	51	368	0	419	138	87	0	225	1094
Grand Total	707	93	1	801	112	626	0	738	284	173	0	457	1996
Approach %	88.3	11.6	0.1		15.2	84.8	0.0		62.1	37.9	0.0		
Total %	35.4	4.7	0.1	40.1	5.6	31.4	0.0	37.0	14.2	8.7	0.0	22.9	
Exiting Leg Total				286				377				1333	1996
Cars	691	85	1	777	103	585	0	688	264	169	0	433	1898
% Cars	97.7	91.4	100.0	97.0	92.0	93.5	0.0	93.2	93.0	97.7	0.0	94.7	95.1
Exiting Leg Total				273				349				1276	1898
Heavy Vehicles	16	8	0	24	9	41	0	50	20	4	0	24	98
% Heavy Vehicles	2.3	8.6	0.0	3.0	8.0	6.5	0.0	6.8	7.0	2.3	0.0	5.3	4.9
Exiting Leg Total				13				28				57	98

Peak Hour Analysis from 04:00 PM to 06:00 PM begins at:

4:30 PM	Bartlett Street from East				Cedar Hill Street from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
4:30 PM	99	11	0	110	14	66	0	80	46	22	0	68	258
4:45 PM	94	9	0	103	17	79	0	96	49	19	0	68	267
5:00 PM	122	13	0	135	16	93	0	109	38	28	0	66	310
5:15 PM	103	21	0	124	13	100	0	113	52	23	0	75	312
Total Volume	418	54	0	472	60	338	0	398	185	92	0	277	1147
% Approach Total	88.6	11.4	0.0		15.1	84.9	0.0		66.8	33.2	0.0		
PHF	0.857	0.643	0.000	0.874	0.882	0.845	0.000	0.881	0.889	0.821	0.000	0.923	0.919
Cars	407	50	0	457	56	321	0	377	169	90	0	259	1093
Cars %	97.4	92.6	0.0	96.8	93.3	95.0	0.0	94.7	91.4	97.8	0.0	93.5	95.3
Heavy Vehicles	11	4	0	15	4	17	0	21	16	2	0	18	54
Heavy Vehicles %	2.6	7.4	0.0	3.2	6.7	5.0	0.0	5.3	8.6	2.2	0.0	6.5	4.7
Cars Enter Leg	407	50	0	457	56	321	0	377	169	90	0	259	1093
Heavy Enter Leg	11	4	0	15	4	17	0	21	16	2	0	18	54
Total Entering Leg	418	54	0	472	60	338	0	398	185	92	0	277	1147
Cars Exiting Leg				146				219				728	1093
Heavy Exiting Leg				6				20				28	54
Total Exiting Leg				152				239				756	1147

PDI File #: **197253 CC**
Location: **S: Cedar Hill Street**
Location: **E: Bartlett Street W: Bartlett Street**
City, State: **Northborough, MA**
Client: **VHB/ T. Benson**
Site Code: **83468.19**
Count Date: **Wednesday, October 16, 2019**
Start Time: **4:00 PM**
End Time: **6:00 PM**

PRECISION DATA INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

Class: **Cars**

	Bartlett Street from East				Cedar Hill Street from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
4:00 PM	63	6	1	70	18	52	0	70	19	24	0	43	183
4:15 PM	56	7	0	63	8	56	0	64	29	20	0	49	176
4:30 PM	94	10	0	104	13	64	0	77	36	20	0	56	237
4:45 PM	90	7	0	97	16	77	0	93	45	19	0	64	254
Total	303	30	1	334	55	249	0	304	129	83	0	212	850
5:00 PM	120	13	0	133	15	86	0	101	37	28	0	65	299
5:15 PM	103	20	0	123	12	94	0	106	51	23	0	74	303
5:30 PM	97	14	0	111	6	86	0	92	22	13	0	35	238
5:45 PM	68	8	0	76	15	70	0	85	25	22	0	47	208
Total	388	55	0	443	48	336	0	384	135	86	0	221	1048
Grand Total	691	85	1	777	103	585	0	688	264	169	0	433	1898
Approach %	88.9	10.9	0.1		15.0	85.0	0.0		61.0	39.0	0.0		
Total %	36.4	4.5	0.1	40.9	5.4	30.8	0.0	36.2	13.9	8.9	0.0	22.8	
Exiting Leg Total				273				349				1276	1898

Peak Hour Analysis from 04:00 PM to 06:00 PM begins at:

4:45 PM	Bartlett Street from East				Cedar Hill Street from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
4:45 PM	90	7	0	97	16	77	0	93	45	19	0	64	254
5:00 PM	120	13	0	133	15	86	0	101	37	28	0	65	299
5:15 PM	103	20	0	123	12	94	0	106	51	23	0	74	303
5:30 PM	97	14	0	111	6	86	0	92	22	13	0	35	238
Total Volume	410	54	0	464	49	343	0	392	155	83	0	238	1094
% Approach Total	88.4	11.6	0.0		12.5	87.5	0.0		65.1	34.9	0.0		
PHF	0.854	0.675	0.000	0.872	0.766	0.912	0.000	0.925	0.760	0.741	0.000	0.804	0.903
Entering Leg	410	54	0	464	49	343	0	392	155	83	0	238	1094
Exiting Leg				132				209				753	1094
Total				596				601				991	2188

PDI File #: **197253 CC**
Location: **S: Cedar Hill Street**
Location: **E: Bartlett Street W: Bartlett Street**
City, State: **Northborough, MA**
Client: **VHB/ T. Benson**
Site Code: **83468.19**
Count Date: **Wednesday, October 16, 2019**
Start Time: **4:00 PM**
End Time: **6:00 PM**

PRECISION DATA INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

Class: **Heavy Vehicles-Combined (Buses, Single-Unit Trucks, Articulated Trucks)**

	Bartlett Street from East				Cedar Hill Street from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
4:00 PM	0	1	0	1	3	2	0	5	2	0	0	2	8
4:15 PM	2	2	0	4	1	3	0	4	1	1	0	2	10
4:30 PM	5	1	0	6	1	2	0	3	10	2	0	12	21
4:45 PM	4	2	0	6	1	2	0	3	4	0	0	4	13
Total	11	6	0	17	6	9	0	15	17	3	0	20	52
5:00 PM	2	0	0	2	1	7	0	8	1	0	0	1	11
5:15 PM	0	1	0	1	1	6	0	7	1	0	0	1	9
5:30 PM	2	0	0	2	1	6	0	7	1	0	0	1	10
5:45 PM	1	1	0	2	0	13	0	13	0	1	0	1	16
Total	5	2	0	7	3	32	0	35	3	1	0	4	46
Grand Total	16	8	0	24	9	41	0	50	20	4	0	24	98
Approach %	66.7	33.3	0.0		18.0	82.0	0.0		83.3	16.7	0.0		
Total %	16.3	8.2	0.0	24.5	9.2	41.8	0.0	51.0	20.4	4.1	0.0	24.5	
Exiting Leg Total				13				28				57	98
Buses	1	0	0	1	0	0	0	0	0	1	0	1	2
% Buses	6.3	0.0	0.0	4.2	0.0	0.0	0.0	0.0	0.0	25.0	0.0	4.2	2.0
Exiting Leg Total				1				0				1	2
Single-Unit Trucks	11	6	0	17	7	8	0	15	15	3	0	18	50
% Single-Unit	68.8	75.0	0.0	70.8	77.8	19.5	0.0	30.0	75.0	75.0	0.0	75.0	51.0
Exiting Leg Total				10				21				19	50
Articulated Trucks	4	2	0	6	2	33	0	35	5	0	0	5	46
% Articulated	25.0	25.0	0.0	25.0	22.2	80.5	0.0	70.0	25.0	0.0	0.0	20.8	46.9
Exiting Leg Total				2				7				37	46

Peak Hour Analysis from 04:00 PM to 06:00 PM begins at:

4:15 PM	Bartlett Street from East				Cedar Hill Street from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
4:15 PM	2	2	0	4	1	3	0	4	1	1	0	2	10
4:30 PM	5	1	0	6	1	2	0	3	10	2	0	12	21
4:45 PM	4	2	0	6	1	2	0	3	4	0	0	4	13
5:00 PM	2	0	0	2	1	7	0	8	1	0	0	1	11
Total Volume	13	5	0	18	4	14	0	18	16	3	0	19	55
% Approach Total	72.2	27.8	0.0		22.2	77.8	0.0		84.2	15.8	0.0		
PHF	0.650	0.625	0.000	0.750	1.000	0.500	0.000	0.563	0.400	0.375	0.000	0.396	0.655
Buses	1	0	0	1	0	0	0	0	0	1	0	1	2
Buses %	7.7	0.0	0.0	5.6	0.0	0.0	0.0	0.0	0.0	33.3	0.0	5.3	3.6
Single-Unit Trucks	10	3	0	13	3	5	0	8	13	2	0	15	36
Single-Unit %	76.9	60.0	0.0	72.2	75.0	35.7	0.0	44.4	81.3	66.7	0.0	78.9	65.5
Articulated Trucks	2	2	0	4	1	9	0	10	3	0	0	3	17
Articulated %	15.4	40.0	0.0	22.2	25.0	64.3	0.0	55.6	18.8	0.0	0.0	15.8	30.9
Buses	1	0	0	1	0	0	0	0	0	1	0	1	2
Single-Unit Trucks	10	3	0	13	3	5	0	8	13	2	0	15	36
Articulated Trucks	2	2	0	4	1	9	0	10	3	0	0	3	17
Total Entering Leg	13	5	0	18	4	14	0	18	16	3	0	19	55
Buses				1				0				1	2
Single-Unit Trucks				5				16				15	36
Articulated Trucks				1				5				11	17
Total Exiting Leg				7				21				27	55

PDI File #: **197253 CC**
Location: **S: Cedar Hill Street**
Location: **E: Bartlett Street W: Bartlett Street**
City, State: **Northborough, MA**
Client: **VHB/ T. Benson**
Site Code: **83468.19**
Count Date: **Wednesday, October 16, 2019**
Start Time: **4:00 PM**
End Time: **6:00 PM**

PRECISION DATA INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

Class: **Buses**

	Bartlett Street from East				Cedar Hill Street from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
4:00 PM	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
4:30 PM	1	0	0	1	0	0	0	0	0	1	0	1	2
4:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	1	0	0	1	0	0	0	0	0	1	0	1	2
5:00 PM	0	0	0	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
5:30 PM	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
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	1	0	0	1	0	0	0	0	0	1	0	1	2
Approach %	100.0	0.0	0.0		0.0	0.0	0.0		0.0	100.0	0.0		
Total %	50.0	0.0	0.0	50.0	0.0	0.0	0.0	0.0	0.0	50.0	0.0	50.0	
Exiting Leg Total				1				0				1	2

Peak Hour Analysis from 04:00 PM to 06:00 PM begins at:

4:00 PM	Bartlett Street from East				Cedar Hill Street from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
4:00 PM	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
4:30 PM	1	0	0	1	0	0	0	0	0	1	0	1	2
4:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Volume	1	0	0	1	0	0	0	0	0	1	0	1	2
% Approach Total	100.0	0.0	0.0		0.0	0.0	0.0		0.0	100.0	0.0		
PHF	0.250	0.000	0.000	0.250	0.000	0.000	0.000	0.000	0.000	0.250	0.000	0.250	0.250
Entering Leg	1	0	0	1	0	0	0	0	0	1	0	1	2
Exiting Leg				1				0				1	2
Total				2				0				2	4

PDI File #: **197253 CC**
Location: **S: Cedar Hill Street**
Location: **E: Bartlett Street W: Bartlett Street**
City, State: **Northborough, MA**
Client: **VHB/ T. Benson**
Site Code: **83468.19**
Count Date: **Wednesday, October 16, 2019**
Start Time: **4:00 PM**
End Time: **6:00 PM**

PRECISION DATA INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

Class: **Single-Unit Trucks**

	Bartlett Street from East				Cedar Hill Street from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
4:00 PM	0	1	0	1	2	0	0	2	2	0	0	2	5
4:15 PM	1	2	0	3	1	0	0	1	1	1	0	2	6
4:30 PM	3	0	0	3	0	0	0	0	8	1	0	9	12
4:45 PM	4	1	0	5	1	1	0	2	4	0	0	4	11
Total	8	4	0	12	4	1	0	5	15	2	0	17	34
5:00 PM	2	0	0	2	1	4	0	5	0	0	0	0	7
5:15 PM	0	1	0	1	1	1	0	2	0	0	0	0	3
5:30 PM	1	0	0	1	1	0	0	1	0	0	0	0	2
5:45 PM	0	1	0	1	0	2	0	2	0	1	0	1	4
Total	3	2	0	5	3	7	0	10	0	1	0	1	16
Grand Total	11	6	0	17	7	8	0	15	15	3	0	18	50
Approach %	64.7	35.3	0.0		46.7	53.3	0.0		83.3	16.7	0.0		
Total %	22.0	12.0	0.0	34.0	14.0	16.0	0.0	30.0	30.0	6.0	0.0	36.0	
Exiting Leg Total				10				21				19	50

Peak Hour Analysis from 04:00 PM to 06:00 PM begins at:

4:15 PM	Bartlett Street from East				Cedar Hill Street from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
4:15 PM	1	2	0	3	1	0	0	1	1	1	0	2	6
4:30 PM	3	0	0	3	0	0	0	0	8	1	0	9	12
4:45 PM	4	1	0	5	1	1	0	2	4	0	0	4	11
5:00 PM	2	0	0	2	1	4	0	5	0	0	0	0	7
Total Volume	10	3	0	13	3	5	0	8	13	2	0	15	36
% Approach Total	76.9	23.1	0.0		37.5	62.5	0.0		86.7	13.3	0.0		
PHF	0.625	0.375	0.000	0.650	0.750	0.313	0.000	0.400	0.406	0.500	0.000	0.417	0.750
Entering Leg	10	3	0	13	3	5	0	8	13	2	0	15	36
Exiting Leg				5				16				15	36
Total				18				24				30	72

PDI File #: **197253 CC**
Location: **S: Cedar Hill Street**
Location: **E: Bartlett Street W: Bartlett Street**
City, State: **Northborough, MA**
Client: **VHB/ T. Benson**
Site Code: **83468.19**
Count Date: **Wednesday, October 16, 2019**
Start Time: **4:00 PM**
End Time: **6:00 PM**

PRECISION DATA INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

Class:

Articulated Trucks

	Bartlett Street from East				Cedar Hill Street from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
4:00 PM	0	0	0	0	1	2	0	3	0	0	0	0	3
4:15 PM	1	0	0	1	0	3	0	3	0	0	0	0	4
4:30 PM	1	1	0	2	1	2	0	3	2	0	0	2	7
4:45 PM	0	1	0	1	0	1	0	1	0	0	0	0	2
Total	2	2	0	4	2	8	0	10	2	0	0	2	16
5:00 PM	0	0	0	0	0	3	0	3	1	0	0	1	4
5:15 PM	0	0	0	0	0	5	0	5	1	0	0	1	6
5:30 PM	1	0	0	1	0	6	0	6	1	0	0	1	8
5:45 PM	1	0	0	1	0	11	0	11	0	0	0	0	12
Total	2	0	0	2	0	25	0	25	3	0	0	3	30
Grand Total	4	2	0	6	2	33	0	35	5	0	0	5	46
Approach %	66.7	33.3	0.0		5.7	94.3	0.0		100.0	0.0	0.0		
Total %	8.7	4.3	0.0	13.0	4.3	71.7	0.0	76.1	10.9	0.0	0.0	10.9	
Exiting Leg Total				2				7				37	46

Peak Hour Analysis from 04:00 PM to 06:00 PM begins at:

5:00 PM	Bartlett Street from East				Cedar Hill Street from South				Bartlett Street from West				
	Thru	Left	U-Turn	Total	Right	Left	U-Turn	Total	Right	Thru	U-Turn	Total	Total
5:00 PM	0	0	0	0	0	3	0	3	1	0	0	1	4
5:15 PM	0	0	0	0	0	5	0	5	1	0	0	1	6
5:30 PM	1	0	0	1	0	6	0	6	1	0	0	1	8
5:45 PM	1	0	0	1	0	11	0	11	0	0	0	0	12
Total Volume	2	0	0	2	0	25	0	25	3	0	0	3	30
% Approach Total	100.0	0.0	0.0		0.0	100.0	0.0		100.0	0.0	0.0		
PHF	0.500	0.000	0.000	0.500	0.000	0.568	0.000	0.568	0.750	0.000	0.000	0.750	0.625
Entering Leg	2	0	0	2	0	25	0	25	3	0	0	3	30
Exiting Leg				0				3				27	30
Total				2				28				30	60

PDI File #: **197253 CC**
Location: **S: Cedar Hill Street**
Location: **E: Bartlett Street W: Bartlett Street**
City, State: **Northborough, MA**
Client: **VHB/ T. Benson**
Site Code: **83468.19**
Count Date: **Wednesday, October 16, 2019**
Start Time: **4:00 PM**
End Time: **6:00 PM**

PRECISION DATA INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

Class:

Bicycles (on Roadway and Crosswalks)

	Bartlett Street from East						Cedar Hill Street from South						Bartlett Street from West						
	Thru	Left	U-Turn	CW-SB	CW-NB	Total	Right	Left	U-Turn	CW-WB	CW-EB	Total	Right	Thru	U-Turn	CW-NB	CW-SB	Total	Total
4:00 PM	0	0	0	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	0	0	0
4:30 PM	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
4:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
5:00 PM	0	0	0	0	0	0	0	0	0	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	0	0	0
5:30 PM	0	0	0	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	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Approach %	100.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0		
Total %	100.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Exiting Leg Total						0						0						1	1

Peak Hour Analysis from 04:00 PM to 06:00 PM begins at:

4:00 PM	Bartlett Street from East						Cedar Hill Street from South						Bartlett Street from West						
	Thru	Left	U-Turn	CW-SB	CW-NB	Total	Right	Left	U-Turn	CW-WB	CW-EB	Total	Right	Thru	U-Turn	CW-NB	CW-SB	Total	Total
4:00 PM	0	0	0	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	0	0	0
4:30 PM	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
4:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Volume	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
% Approach Total	100.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0		
PHF	0.250	0.000	0.000	0.000	0.000	0.250	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.250
Entering Leg	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Exiting Leg						0						0						1	1
Total						1						0						1	2

PDI File #: **197253 CC**
Location: **S: Cedar Hill Street**
Location: **E: Bartlett Street W: Bartlett Street**
City, State: **Northborough, MA**
Client: **VHB/ T. Benson**
Site Code: **83468.19**
Count Date: **Wednesday, October 16, 2019**
Start Time: **4:00 PM**
End Time: **6:00 PM**

PRECISION DATA INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

Class:

Pedestrians

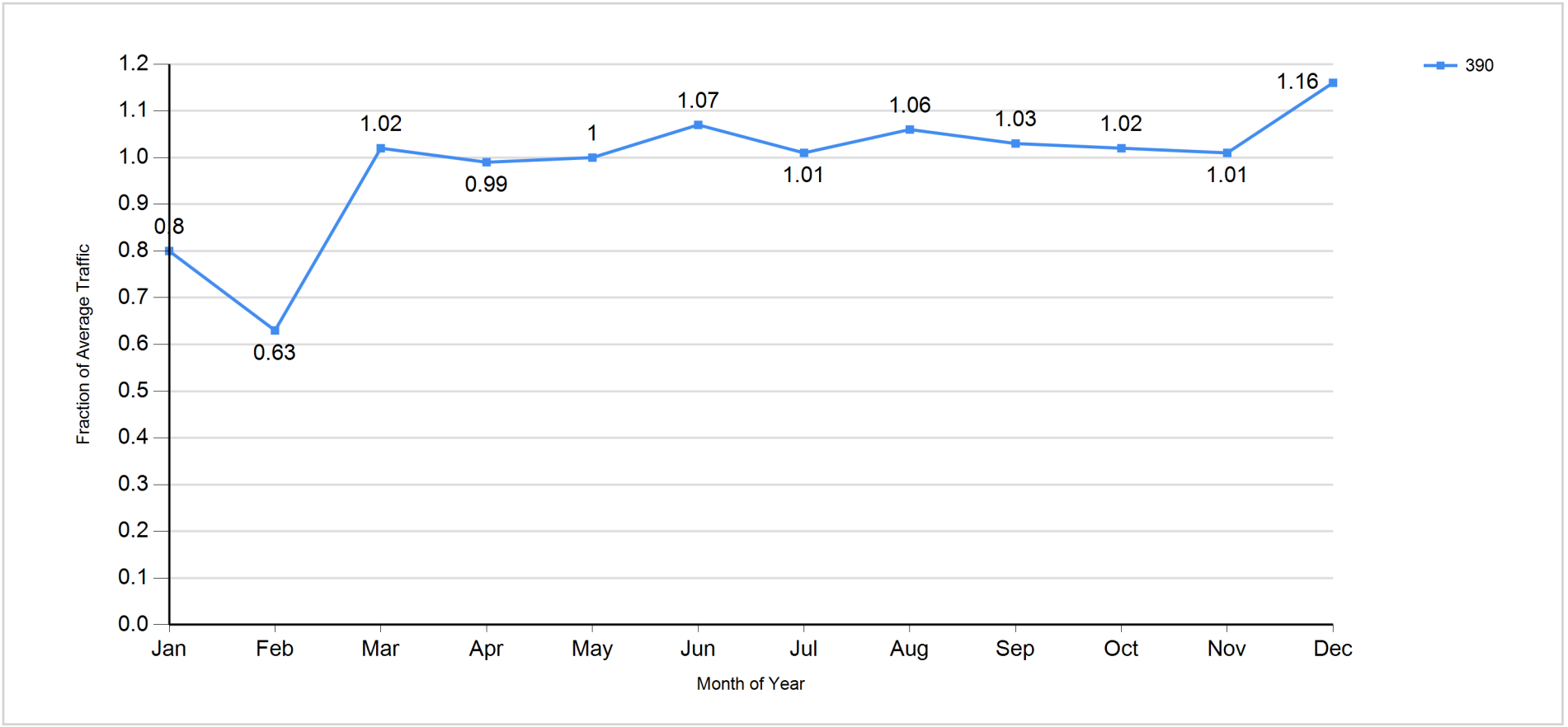
	Bartlett Street from East						Cedar Hill Street from South						Bartlett Street from West						
	Thru	Left	U-Turn	CW-SB	CW-NB	Total	Right	Left	U-Turn	CW-WB	CW-EB	Total	Right	Thru	U-Turn	CW-NB	CW-SB	Total	Total
4:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:30 PM	0	0	0	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	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:00 PM	0	0	0	0	0	0	0	0	0	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	0	0	0
5:30 PM	0	0	0	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	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Approach %	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
Total %	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Exiting Leg Total						0						0						0	0

Peak Hour Analysis from 04:00 PM to 06:00 PM begins at:

4:00 PM	Bartlett Street from East						Cedar Hill Street from South						Bartlett Street from West						
	Thru	Left	U-Turn	CW-SB	CW-NB	Total	Right	Left	U-Turn	CW-WB	CW-EB	Total	Right	Thru	U-Turn	CW-NB	CW-SB	Total	Total
4:00 PM	0	0	0	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	0	0	0
4:30 PM	0	0	0	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	0	0	0
Total Volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Approach Total	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0		
PHF	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Entering Leg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Exiting Leg						0						0						0	0
Total						0						0						0	0

Massachusetts Highway Department

Traffic Pattern by Month for 1/1/2016 - 12/31/2016



Traffic Pattern by Month for 1/1/2016 - 12/31/2016

Factor Group	Station	Weight	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
U1-Boston	390	0	0.804	0.626	1.020	0.994	0.999	1.072	1.012	1.058	1.033	1.016	1.012	1.159
	Average of Weighted Factors		**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**

Bartlett Street at Cedar Hill Street

Crash Number	City Town Name	Crash Date	Crash Severity	Crash Time	Max Injury Severity Reported	Number of Vehicles	Police Agency Type	Age of Driver - Youngest Known	Age of Driver - Oldest Known	Driver Contributing Circumstances (All Drivers)	Light Conditions	Manner of Collision	MassDOT District	Non-Motorist Type (All Persons)	RMV Document Numbers	Road Surface Condition	Total Fatalities	Total Non-Fatal Injuries	Vehicle Actions Prior to Crash (All Vehicles)	Vehicle Configuration (All Vehicles)	Vehicle Travel Directions (All Vehicles)	Weather Conditions	Crash Report IDs	Most Harmful Event (All Vehicles)	Street Number	Roadway	Near Intersection Roadway
232781	NORTHBOROUGH	01/14/2013	Property damage only (none injured)	7:55 AM	No injury	2	Local police	25-34	35-44	D1: (No improper driving) / D2: (Other improper action)	Daylight	Angle	3		PR2013022301129	Snow	0	0	V1: Travelling straight ahead / V2: Travelling straight ahead	V1:(Light truck(van, mini-van, pickup, sport utility)) / V2:(Passenger car)	V1: E. / V2: N.	Snow/Snow		V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)		BARTLETT STREET / CEDAR HILL STREET	
372661	MARLBOROUGH	01/13/2014	Property damage only (none injured)	5:13 PM	No injury	3	Local police	21-24	45-54	D1: (No improper driving) / D2: (Inattention) / D3: (Inattention)	Dark - roadway not lighted	Rear-end	3		PW20140340151 4	Dry	0	0	V1: Slowing or stopped in traffic / V2: Slowing or stopped in traffic / V3: Slowing or stopped in traffic	V1:(Passenger car) / V2:(Passenger car) / V3:(Passenger car)	V1: N. / V2: N. / V3: N.	Clear	14-66-AC	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic) / V3:(Collision with motor vehicle in traffic)		CEDAR HILL STREET / BARTLETT STREET	
278103	NORTHBOROUGH	01/23/2014	Property damage only (none injured)	7:05 AM	No injury	1	Local police	21-24	21-24	D1: (Driving too fast for conditions),(Disregarded traffic signs, signals, road markings)	Dark - lighted roadway	Single vehicle crash	3		PR2014051100727	Dry	0	0	V1: Travelling straight ahead	V1:(Passenger car)	V1: W.	Clear		V1:(Collision with utility pole)		CEDAR HILL STREET / BARTLETT STREET	
298787	NORTHBOROUGH	11/14/2014	Property damage only (none injured)	4:58 PM	No injury	2	Local police	16-17	55-64	D1: (No improper driving) / D2: (Failed to yield right of way)	Dawn	Angle	3		PR2014356600634	Wet	0	0	V1: Travelling straight ahead / V2: Turning left	V1:(Passenger car) / V2:(Passenger car)	V1: E. / V2: W.	Clear	14000024663	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)		BARTLETT STREET / CEDAR HILL STREET	
404324	NORTHBOROUGH	03/31/2015	Non-fatal injury	4:17 PM	Non-fatal injury - Possible	1	Local police	25-34	35-34	D1: (Failure to keep in proper lane or running off road)	Daylight	Single vehicle crash	3		PR2015112200231	Dry	0	1	V1: Turning left	V1:(Passenger car)	V1: W.	Clear	2015000007337	V1:(Collision with embankment)	548	BARTLETT STREET	CEDAR HILL STREET
415844	NORTHBOROUGH	02/05/2016	Property damage only (none injured)	10:59 AM	No injury	2	Local police	21-24	35-44	D1: (No improper driving),(No improper driving) / D2: (No improper driving),(No improper driving)	Daylight	Rear-end	3		PR2016055500340	Snow	0	0	V1: Travelling straight ahead / V2: Slowing or stopped in traffic	V1:(Passenger car) / V2:(Tractor/semi-trailer)	V1: N. / V2: N.	Snow/Sleet, hail (freezing rain or drizzle)	2016000002584	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)		BARTLETT STREET / CEDAR HILL STREET	
416299	NORTHBOROUGH	05/08/2016	Property damage only (none injured)	6:54 AM	No injury	2	Local police	16-17	21-24	D1: (No improper driving) / D2: (Failed to yield right of way),(Inattention)	Daylight	Angle	3		PR2016029900416 / PR2016028801101 / PR2016040100464	Dry	0	0	V1: Travelling straight ahead / V2: Turning left	V1:(Passenger car) / V2:(Passenger car)	V1: S. / V2: E	Clear	1510451 / 15-610451	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)		BARTLETT STREET / CEDAR HILL STREET	
416447	NORTHBOROUGH	12/23/2015	Property damage only (none injured)	12:24 PM	No injury	1	Local police	21-24	21-24	D1: (Driving too fast for conditions)	Daylight	Single vehicle crash	3		PR2016014400150 / PR2016040400201	Wet	0	0	V1: Travelling straight ahead	V1:(Passenger car)	V1: N.	Cloudy	15-027832	V1:(Collision with tree)		BARTLETT STREET / CEDAR HILL ROAD	
429567	NORTHBOROUGH	10/24/2016	Property damage only (none injured)	2:36 PM	No injury	1	Local police	21-24	21-24	D1: (Exceeded authorized speed limit),(Failure to keep in proper lane or running off road)	Dark - lighted roadway	Single vehicle crash	3		PR2016342200511	Dry	0	0	V1: Travelling straight ahead	V1:(Passenger car)	V1: S.	Clear	1600001857	V1:(Collision with tree)		CEDAR HILL STREET / BARTLETT STREET	
433097	NORTHBOROUGH	01/12/2017	Property damage only (none injured)	7:55 PM	No injury	3	Local police	16-20	21-24	D1: (No improper driving) / D2: (Failed to yield right of way),(Inattention) / D3: (No improper driving)	Dark - lighted roadway	Angle	3		PR2017030000449	Wet	0	0	V1: Travelling straight ahead / V2: Turning left / V3: Slowing or stopped in traffic	V1:(Passenger car) / V2:(Light truck(van, mini-van, pickup, sport utility)) / V3:(Passenger car)	V1: S. / V2: E. / V3: E	Cloudy	17000003529	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic) / V3:(Collision with motor vehicle in traffic)		BARTLETT STREET / CEDAR HILL STREET	
434869	NORTHBOROUGH	02/13/2017	Property damage only (none injured)	7:58 AM	No injury	2	Local police	16-17	16-17	D1: (No improper driving) / D2: (Failed to yield right of way)	Daylight	Rear-end	3		PR2017087200444	Snow	0	0	V1: Travelling straight ahead / V2: Turning left	V1:(Light truck(van, mini-van, pickup, sport utility)) / V2:(Light truck(van, mini-van, pickup, sport utility))	V1: W. / V2: W.	Clear	2017000002141	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)		CEDAR HILL STREET / BARTLETT STREET	

Data Level: CRASH
Query Type: Spatial
Criteria: If you conducted an Advanced Query your SQL statement will be listed here

Bartlett Street at FedEX Driveway

Crash Number	City Town Name	Crash Date	Crash Severity	Crash Time	Max Injury Severity Reported	Number of Vehicles	Police Agency Type	Age of Driver - Youngest Known	Age of Driver - Oldest Known	Driver Contributing Circumstances (All Drivers)	Light Conditions	Manner of Collision	MassDOT District	Non-Motorist Type (All Persons)	RMV Document Numbers	Road Surface Condition	Total Fatalities	Total Non-Fatal Injuries	Vehicle Actions Prior to Crash (All Vehicles)	Vehicle Configuration (All Vehicles)	Vehicle Travel Directions (All Vehicles)	Weather Conditions	Crash Report IDs	Most Harmful Event (All Vehicles)	Street Number	Roadway	Near Intersection Roadway
3733423	NORTHBOROUGH	10/12/2013	Property damage only (none injured)	11:50 PM	No injury	1	Local police	25-34	25-34	D1: (No improper driving)	Dark - roadway not lighted	Angle	3		PR201336500444	Wet	0	0	V1: Travelling straight ahead	V1:(Passenger car)	V1: E	Clear	13000020107	V1:(Collision with animal - deer)	300	BARTLETT STREET	CEDAR HILL STREET
4496981	NORTHBOROUGH	12/05/2017	Property damage only (none injured)	6:49 AM	No injury	1	Local police	21-24	21-24		Daylight	Single vehicle crash	3		PR201800900140 / PW201827100509	Dry	0	0	V1: Travelling straight ahead	V1:(Passenger car)	V1: E	Clear	1720959 / 2017000020959	V1:(Collision with animal - deer)		BARTLETT STREET	BARTLETT STREET

Data Level:	CRASH
Query Type:	Spatial
Criteria:	If you conducted an Advanced Query your SQL statement will be listed here

Bartlett Street at Lynman Street

Crash Number	City Town Name	Crash Date	Crash Severity	Crash Time	Max Injury Severity Reported	Number of Vehicles	Police Agency Type	Age of Driver - Youngest Known	Age of Driver - Oldest Known	Driver Contributing Circumstances (All Drivers)	Light Conditions	Manner of Collision	MassDOT District	Non-Motorist Type (All Persons)	RMV Document Numbers	Road Surface Condition	Total Fatalities	Total Non-Fatal Injuries	Vehicle Actions Prior to Crash (All Vehicles)	Vehicle Configuration (All Vehicles)	Vehicle Travel Directions (All Vehicles)	Weather Conditions	Crash Report IDs	Most Harmful Event (All Vehicles)	Street Number	Roadway	Near Intersection Roadway
3396491	NORTHBOROUGH	02/16/2013	Unknown	4:19 PM	Unknown	1	Local police			D1: (Unknown),(Unknown)	Daylight	Single vehicle crash	3		PR201309500331	Dry	0	0	V1: Turning right	V1:(Light truck(van, mini-van, pickup, sport utility))	V1: E	Clear/Clear	201300003055	V1:(Collision with light pole or other post/support)		BARTLETT STREET / LYMAN STREET	
3994712	NORTHBOROUGH	11/17/2014	Property damage only (none injured)	5:14 PM	No injury	1	Local police	45-54	45-54	D1: (No improper driving)	Dark - roadway not lighted	Single vehicle crash	3		PR201435700122	Wet	0	0	V1: Travelling straight ahead	V1:(Passenger car)	V1: E	Rain	14-24895	V1:(Collision with animal - deer)	300	BARTLETT STREET	LYMAN STREET
4061320	NORTHBOROUGH	02/03/2015	Property damage only (none injured)	8:39 AM	No injury	2	Local police	25-34	45-54	D1: (No improper driving) / D2: (Failed to yield right of way)	Daylight	Angle	3		PR201507101810	Snow	0	0	V1: Travelling straight ahead / V2: Travelling straight ahead	V1:(Light truck(van, mini-van, pickup, sport utility)) / V2:(Passenger car)	V1: E / V2: N	Clear	15-2781	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)		LYMAN STREET / BARTLETT STREET	
4061803	NORTHBOROUGH	01/22/2015	Property damage only (none injured)	5:27 PM	No injury	1	Local police	35-44	35-44	D1: (No improper driving)	Daylight	Sideswipe, opposite direction	3		PR201507101822	Dry	0	0	V1: Travelling straight ahead	V1:(Passenger car)	V1: S	Clear	15-1909	V1:(Collision with motor vehicle in traffic)		BARTLETT STREET / LYMAN STREET	
4074018	NORTHBOROUGH	05/20/2015	Property damage only (none injured)	6:48 PM	No injury	2	Local police	16-17	21-24	D1: (No improper driving) / D2: (Inattention),(Other improper action)	Daylight	Rear-end	3		PR201517000135	Dry	0	0	V1: Turning right / V2: Travelling straight ahead	V1:(Passenger car) / V2:(Light truck(van, mini-van, pickup, sport utility))	V1: S / V2: S	Clear		V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)		LYMAN STREET / BARTLETT STREET	
4168870	NORTHBOROUGH	12/17/2015	Non-fatal injury	4:45 PM	Non-fatal injury - Non-incapacitating	2	Local police	16-17	65-74	D1: (No improper driving) / D2: (Failed to yield right of way)	Dark - lighted roadway	Angle	3		PR201607800145	Wet	0	2	V1: Travelling straight ahead / V2: Turning left	V1:(Light truck(van, mini-van, pickup, sport utility)) / V2:(Light truck(van, mini-van, pickup, sport utility))	V1: E / V2: S	Rain	15000027485	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)		BARTLETT STREET / LYMAN STREET	
4193578	NORTHBOROUGH	04/11/2016	Property damage only (none injured)	5:23 PM	No injury	2	Local police	45-54	45-54	D1: (No improper driving)	Daylight	Single vehicle crash	3		PR201612400116	Dry	0	0	V1: Slowing or stopped in traffic / V2: Not reported	V1:(Passenger car)	V1: N / V2: Not Reported	Clear		V1:(Collision with motor vehicle in traffic)		LYMAN STREET / BARTLETT STREET	
4322842	NORTHBOROUGH	12/17/2016	Property damage only (none injured)	1:33 PM	No injury	2	Local police	18-20	35-44	D1: (No improper driving) / D2: (Made an improper turn)	Daylight	Angle	3		PR201703400103	Snow	0	0	V1: Slowing or stopped in traffic / V2: Turning right	V1:(Passenger car) / V2:(Light truck(van, mini-van, pickup, sport utility))	V1: N / V2: S	Cloudy/Sleet, hail (freezing rain or drizzle)	16000020781	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)		LYMAN STREET / BARTLETT STREET	
4486228	NORTHBOROUGH	12/14/2017	Property damage only (none injured)	8:34 AM	No injury	2	Local police	35-44	35-44	D1: (Inattention) / D2: (No improper driving)	Daylight	Rear-end	3		PW201801901005	Dry	0	0	V1: Backing / V2: Slowing or stopped in traffic	V1:(Tractor/semi-trailer) / V2:(Light truck(van, mini-van, pickup, sport utility))	V1: E / V2: E	Clear	2017000021571	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)		LYMAN ST / BARTLETT STREET	
4492245	NORTHBOROUGH	11/03/2017	Property damage only (none injured)	8:27 AM	No injury	2	Local police	25-34	45-54		Daylight	Angle	3		PW201827100401 / PR201734000342	Dry	0	0	V1: Travelling straight ahead / V2: Turning left	V1:(Passenger car) / V2:(Passenger car)	V1: E / V2: N	Clear	2017000018932 / 170018932	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)		BARTLETT ST. / LYMAN STREET	

Data Level: CRASH
Query Type: Spatial
Criteria: If you conducted an Advanced Query your SQL statement will be listed here

INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : Northborough | COUNT DATE : 10/16/2019

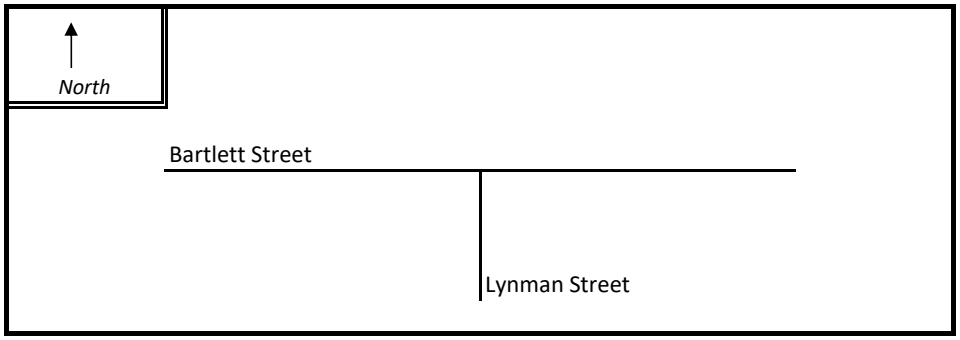
DISTRICT : 3 | UNSIGNALIZED : X (0.61) | SIGNALIZED : (0.89)

~ INTERSECTION DATA ~

MAJOR STREET : Bartlett Street

MINOR STREET(S) : Lynman Street

INTERSECTION DIAGRAM (Label Approaches)



PEAK HOUR VOLUMES

APPROACH :	1	2	3	4	5	Total Peak Hourly Approach Volume
DIRECTION :	EB	WB	NB			
PEAK HOURLY VOLUMES (AM/**PM**) :	308	775	222			**1,305**

" K " FACTOR : **0.090**

INTERSECTION ADT (**V**) = TOTAL DAILY APPROACH VOLUME : **14,500**

TOTAL # OF CRASHES : 10 | # OF YEARS : 5 | AVERAGE # OF CRASHES PER YEAR (**A**) : **2.00**

CRASH RATE CALCULATION : **0.38**

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

Comments : MassDOT Accident Data (2013-2017)

Project Title & Date: 14767.00 Northborough (Portal accessed October 2019)

INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : Northborough

COUNT DATE : 10/16/2019

DISTRICT : 3

UNSIGNALIZED : X (0.61)

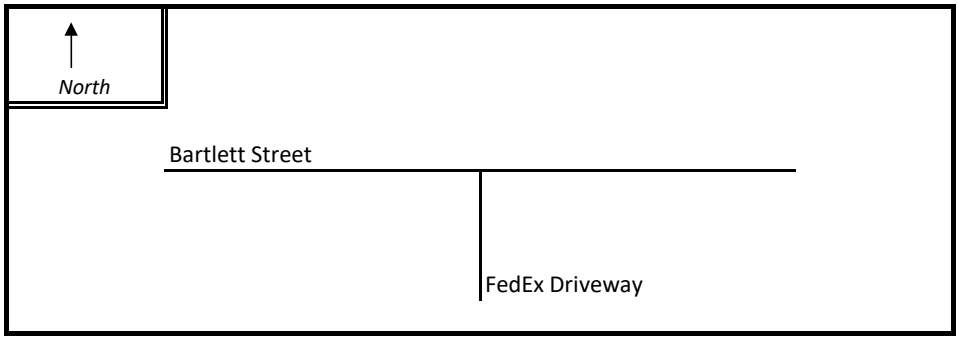
SIGNALIZED : (0.89)

~ INTERSECTION DATA ~

MAJOR STREET : Bartlett Street

MINOR STREET(S) : FedEx Driveway

INTERSECTION DIAGRAM (Label Approaches)



PEAK HOUR VOLUMES

APPROACH :	1	2	3	4	5	Total Peak Hourly Approach Volume
DIRECTION :	EB	WB	NB			
PEAK HOURLY VOLUMES (AM/**PM**) :	270	759	38			**1,067**

" K " FACTOR : **0.090**

INTERSECTION ADT (**V**) = TOTAL DAILY APPROACH VOLUME : **11,856**

TOTAL # OF CRASHES : 2

OF YEARS : 5

AVERAGE # OF CRASHES PER YEAR (**A**) : **0.40**

CRASH RATE CALCULATION : **0.09**

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

Comments : MassDOT Accident Data (2013-2017)

Project Title & Date: 14767.00 Northborough (Portal accessed October 2019)

INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : Northborough | COUNT DATE : 10/16/2019

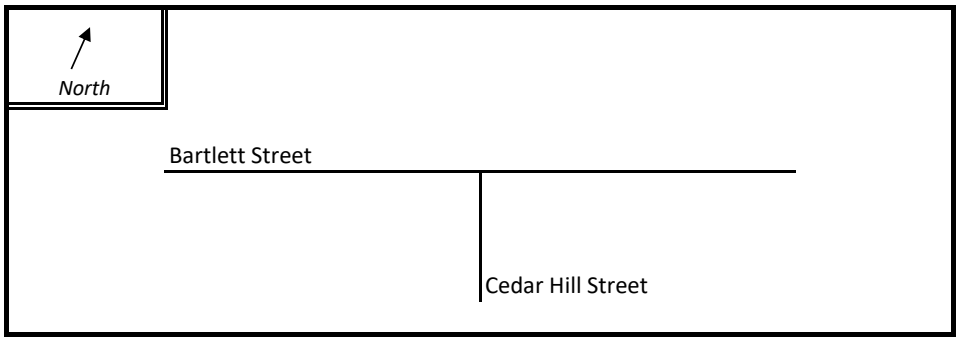
DISTRICT : 3 | UNSIGNALIZED : X (0.61) | SIGNALIZED : (0.89)

~ INTERSECTION DATA ~

MAJOR STREET : Bartlett Street

MINOR STREET(S) : Cedar Hill Street

INTERSECTION DIAGRAM (Label Approaches)



PEAK HOUR VOLUMES

APPROACH :	1	2	3	4	5	Total Peak Hourly Approach Volume
DIRECTION :	EB	WB	NB			
PEAK HOURLY VOLUMES (AM/**PM**) :	277	472	398			**1,147**

" K " FACTOR : **0.090**

INTERSECTION ADT (**V**) = TOTAL DAILY APPROACH VOLUME : **12,744**

TOTAL # OF CRASHES : 11 | # OF YEARS : 5 | AVERAGE # OF CRASHES PER YEAR (**A**) : **2.20**

CRASH RATE CALCULATION : **0.47**

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

Comments : MassDOT Accident Data (2013-2017)

Project Title & Date: 14767.00 Northborough (Portal accessed October 2019)

Background Developments

Project Name: Northborough
Project No: 83468.19

Rate of Growth = 0.01
Future Conditions Years of Growth = 7
Existing Conditions Years of Growth 1

XX XX XX

		BACKGROUND DEVELOPMENTS																	
		Marlborough Corporate Place		Devonshire at 495 Center		Forest Park		Crane Meadow Corporate Center		The Campus at Marlborough		301 Bartlett St Warehouse		370 Bartlett Street Warehouses		Hayes Memorial Drive Warehouse		One Lynman Street Warehouse		TOTAL BACKGROUND DEVELOPMENTS	
INTERSECTION	MOVEMENT	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
1. BARTLETT STREET AT LYNMAN STREET																					
Bartlett Street	EB T			71	13							29	8	55	15	26	7			181	43
	EB R																	15	4	15	4
Bartlett Street	WB L																	6	4	6	4
	WB T			12	79							11	21	19	38	9	18			51	156
Lynman Street	NB L																	5	11	5	11
	NB R																	1	11	1	11
2. BARTLETT STREET AT FEDEX DRIVEWAY																					
Bartlett Street	EB T			71	13							29	8			26	7	1	11	127	39
	EB R													55	15					55	15
Bartlett Street	WB L													20	12					20	12
	WB T			12	79							11	21			9	18	6	4	38	122
FedEx Driveway	NB L													19	38					19	38
	NB R													3	35					3	35
3. BARTLETT STREET AT CEDAR HILL STREET																					
Bartlett Street	EB T			71	13							1	19	3	35	26	7	1	11	102	85
	EB R																				
Bartlett Street	WB L																				
	WB T			12	79							11	7	20	12	9	18	6	4	58	120
Cedar Hill Street	NB L																				
	NB R																				
4. BARTLETT STREET AT SITE DRIVEWAY																					
Bartlett Street	EB L																				
	EB T			71	13							29	8	55	15	26	7	1	11	182	54
Bartlett Street	WB T			12	79							11	21	19	38	9	18	6	4	57	160
	WB R																				
Site Driveway	SB L																				
	SB R																				

Memorandum

To: Ms Kerri Martinek, Chair
Northborough Planning Board
Northborough Town Offices
63 Main Street
Northborough, MA 01532

Date: October 16, 2020

Project #: 14767.00

From: Robert Nagi, PE
Principal
Traffic Planning & Operations

Re: Warehousing Trip Generation Review
0 Bartlett Street Site Plan
Northborough, Massachusetts

This technical memorandum is being provided to address questions and comments from the Planning Board and the public relative to the traffic study submitted by VHB as updated on August 17, 2020 (the "Traffic Study").

The Planning Board has raised questions regarding the different uses that could be developed on the site that generate more traffic than the category of "warehouse" studied in the Traffic Study submitted by VHB. While the plans and documents submitted by the civil engineer (Allen & Major) and the Applicant (the Gutierrez Company) note the development as a 150,900 sf warehouse building, there continues to be additional commentary that the use could be something other than the type of warehouse presented; and thereby generate significantly more traffic.

This memorandum:

- summarizes how traffic generation estimates for projects are developed;
- summarizes how the traffic estimates for the 0 Bartlett Street proposal were originally presented;
- highlights various subcategories of warehousing that were or could be considered for the site;
- provides a comparison of the traffic generation in the Traffic Study with a more intensive warehouse subcategory; and
- shows how the findings presented in the Traffic Study continue to reflect the most reasonable estimate of traffic impacts on area roadways.

Trip Generation Overview

Trip generation rates provided in the Traffic Study were developed using standardized traffic estimates which are gathered and published by the Institute of Transportation Engineers (ITE) and are summarized in the Trip Generation[1] manual. The Massachusetts Department of Transportation (MassDOT) and the Massachusetts Environmental Policy Act (MEPA) require the use of this manual, along with virtually every municipality in the Commonwealth, to provide traffic estimates for future developments. These projected traffic volumes are then used as the basis for evaluating the impacts of a particular development when preparing a traffic study. ITE considers a number of general land uses (Office Building, for example) and in some cases breaks those land uses down into smaller, more specialized sub

[1] Trip Generation (9th edition), Institute of Transportation Engineers, Washington DC, 2013

101 Walnut Street
PO Box 9151
Watertown, MA 02472-4026
P 617.924.1770

Memorandum

categories (Medical Office Building, Government Office Building, and Research & Development Building, for example) as these uses might have slightly different trip projections associated with them or might experience a slightly different arrival/departure pattern than that of a generic office building.

Determining the trip generation for a proposed land use is the function of several potential variables, some of which are known and some of which are not at the permitting/planning stage of the development. The most common variable that ITE considers is the square footage of the building being proposed. In many cases, there is a statistical correlation between the number of trips a specific use might generate vs the size of the building. Other variables that might impact the number of trips expected by a proposed development include the number of employees (if known), the number of units (for a housing project), the number of gas pumps, etc.

Trip Generation allows traffic engineers to estimate the number of trips a typical development would be expected to generate over the course of a typical 24-hour weekday (or weekend) and commonly provides information on the development's peak hour(s) of generation. Depending on the land use, the peak hour may focus on different peak hours of the day including the morning and evening peak commuter hours or the peak generation time period of the development itself. This information is then input into a model to determine the overall impact of the development on the surrounding roadway network.

Beyond the traffic generation for the specific development, it is industry practice to apply a growth factor to those volumes collected as part of the existing conditions assessment and to identify the trip generation estimates of other planned and permitted developments that may come on-line during the seven-year study time frame.

Original Trip Generation Estimates

In discussing the Project with the development team and reviewing the components of the site plan, VHB consulted the Trip Generation manual to identify the land use that most accurately represented the land use being considered. In this case, the ITE's land use code 150 (Warehousing) was determined to be the most appropriate use for this development. Warehousing, as defined by the ITE is generically defined as, "*A warehouse is primarily devoted to the storage of materials, but it may also include office and maintenance areas*." ITE notes that there are several potential subgroups that could also be considered when reviewing warehousing facilities including varieties of High Cube warehouses, which are described and discussed below.

To provide a conservative analysis, a 151,000 sf warehousing facility was assumed for trip generation estimation. Table 1 summarizes the projected trip generation associated with the development based on the standardized ITE rates for land use code 150 "Warehousing". This information was presented in the original traffic study and formed the basis of determining the Project's traffic impact on the driveway and along the surrounding roadway network. As shown, a 151,000 sf warehousing building is expected to generate 43 morning peak hour trips, 46 evening peak hour trips and a total of 284 daily trips.

101 Walnut Street
PO Box 9151
Watertown, MA 02472-4026
P 617.924.1770

Memorandum

Table 1 Trip Generation

Development Type ITE Land Use Code Size Type of Trips	Warehousing[a] 150 151 ksf ITE Trips
Weekday Daily[b]	284
Weekday AM[c]	
Enter	33
Exit	10
Total	43
Weekday PM[c]	
Enter	12
Exit	34
Total	46

a – Institute of Transportation Engineers, Trip Generation, 9th Edition - Land Use Code 150 [Warehousing] 151 ksf; by regression for weekday, AM Peak and PM Peak (note: The actual development size is 150,900 sf, while insignificant, the results shown in Table 1are slightly higher than ITE projections might suggest.)

b – expressed in vehicles per day

c – expressed in vehicles per hour

High Cube Warehousing Traffic Generation

As noted above, ITE also provides several potential subsets in Trip Generation that might be considered if additional information about the development is known. In this case, the term High Cube Warehousing is a subset of the overall warehousing land use. These types of facilities are defined by ITE as follows, "*A high-cube warehouse (HCW) is a building that typically has at least 200,000 gross square feet of floor area, has a ceiling height of 24 feet or more, and is used primarily for the storage and/or consolidation of manufactured goods (and to a lesser extent, raw materials) prior to their distribution to retail locations or other warehouses*". While VHB considered this land use in the development of the traffic study, the definition of the land use does not meet the description of the Project being proposed, namely HCW's typically are 200,000 sf in size or greater (most of the facilities studied were in the 800,000-1,450,000 sf range). Additionally, the more detailed descriptions of HCWs compared to the proposed site layout do not match the needs of the end users defined by these land uses.

Looking closer at the options, High Cube Warehousing can be further divided into even more specific subsets that include uses such as short term and transload warehousing (ITE Land Use Code 154), fulfilment warehousing (ITE Land Use Code 155), and parcel hub warehousing (ITE Land Use Code 156). Each use is discussed below in detail.

101 Walnut Street
PO Box 9151
Watertown, MA 02472-4026
P 617.924.1770

Memorandum

High Cube Warehouse Short-Term Storage and Transload facilities are defined by ITE's Land Use Code 154 as follows:

> "*HCWs included in this land use include transload and short-term facilities. Transload facilities have a primary function of consolidation and distribution of pallet loads (or larger) for manufacturers, wholesalers, or retailers. They typically have little storage duration, high throughput, and are high-efficiency facilities. Short-term HCWs are high-efficiency distribution facilities often with custom/special features built into structure for movement of large volumes of freight with only short-term storage of products*."

More detailed descriptions provided by ITE also note that the range of sizes studied for this use are between 240,000 sf to 1,015,000 sf; these uses typically provide a range of dock doors for shipping and receiving that are between 1 door for every 5,000-15,000 sf of building space; and provide on average 0.5 to 1.5 truck parking space for dock door (with 1.0 spaces per door being the average). Similarly, docks are usually provided on one or two sides of the building. By comparison, the proposed Project is 37% smaller than the low end of this category size range, has dock doors (28 doors) only on one side of the building and they are not evenly distributed along the length of the building as is typical for this category, and have less than one truck parking space (26 spaces) per dock door.

Nonetheless, this ITE land use description provides the most plausible match to the proposed Project.

High Cube Fulfillment Center Warehousing is defined by ITE's Land Use Code 155 as follows:

> "*High-cube fulfillment center warehouses include warehouses characterized by a significant storage function and direct distribution of ecommerce product to end users. These facilities typically handle smaller packages and quantities than other types of HCWs and often contain multiple mezzanine levels*."

More detailed descriptions provided by ITE also note that the range of sizes studied for this use are between 818,000 sf to 1,466,000 sf; they do not have a defined number of dock doors to building space; and note that these facilities have a "*significantly higher truck parking ratio than other HCWs*".

Figure 1 – Typical HCW Fulfillment Center, 1msf.
Amazon Fulfillment Ctr, 1180 Innovation Way, Assonet, MA
Source: BingMaps/MicroSoft © 2020

101 Walnut Street
PO Box 9151
Watertown, MA 02472-4026
P 617.924.1770

Memorandum

Figure 1 (inset) illustrates the typical HCW Fulfillment Center layout that is defined by ITE in their assessments. In reviewing the land use descriptions, this land use was dismissed as it clearly is not representative of the site plan being proposed by the Developer.

High Cube Parcel Hub Warehousing is defined by ITE's Land Use Code 156 as follows:

> "*High-cube parcel hub warehouses typically serve as regional and local freight-forwarder facilities for time sensitive shipments via airfreight and ground carriers. These sites also often include truck maintenance, wash, or fueling facilities.*"

More detailed descriptions provided by ITE also note that the range of sizes studied for this use are between 225,000 sf to 363,000 sf; they do not have a defined number of dock doors to building space (but they do note that typically access to dock doors is provided on multiple sides of the building, and commonly all four sides); and that the ratio of building area to truck parking spaces being defined as 2.0 or more spaces per dock door.

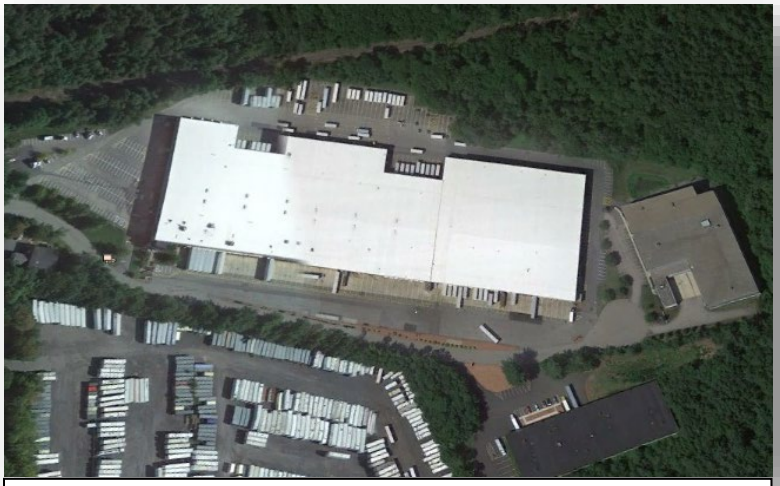


Figure 2 – Typical HCW Parcel Hub, ~305,000sf
FedEx Parcel Hub Facility, 1 Beeman Road, Northborough, MA
Source: GoogleEarth© 2020

Figure 2 (inset) illustrates the typical HCW Parcel Hub layout that is defined by ITE. In reviewing the land use descriptions, there are several notable differences between the site plan being proposed and the descriptions offered by ITE; however, an assessment of this use is provided below for comparative purposes.

Comparison of Uses

Table 2 below provides a summary of the ITE-based traffic generation for the various HCW options reviewed and considered potentially viable as discussed above and provides a summary of the ITE projections noted in the Traffic Study.

101 Walnut Street
PO Box 9151
Watertown, MA 02472-4026
P 617.924.1770

Memorandum

Table 2 Trip Generation Comparison

Development Type	Warehousing (from Traffic Study)[a]	HCW Short Term Storage & Transload[b]	HCW Parcel Hub Center[c]
ITE Land Use Code	**150**	**154**	**156**
Size	**151ksf**	**151ksf**	**151 ksf**
Type of Trips			
Weekday Daily[d]	284	211	1,170
Weekday AM[e]			
Enter	33	9	53
Exit	10	3	53
Total	43	12	106
Weekday PM[e]			
Enter	12	4	66
Exit	34	11	31
Total	46	15	97

a – From Table 1 above.
b – Institute of Transportation Engineers, Trip Generation, 10th Edition - Land Use Code 154 [High Cube Short Term Storage and Transload Warehousing] 151 ksf; by average rates for weekday, AM Peak and PM Peak (note: The actual development size is 150,900 sf, while insignificant, the results shown in Table 2 are slightly higher than ITE projections might suggest.)
c - Institute of Transportation Engineers, Trip Generation, 10th Edition - Land Use Code 156 [High Cube Parcel Hub Warehousing] 151 ksf; by average rates for weekday, AM Peak and PM Peak (note: The actual development size is 150,900 sf, while insignificant, the results shown in Table 2 are slightly higher than ITE projections might suggest.)
d – expressed in vehicles per day
e – expressed in vehicles per hour

As Table 2 notes, the short-term storage and transload warehouse land use that matches up well with the description of the facility and site plan generates about 30 peak hour trips less than what was modeled in the original traffic study. The Parcel Hub warehouse option, that does not meet some of the descriptions outlined by ITE, would be expected to generate about 2 to 2.5 times the peak hour rates studied.

Project Impacts & Findings

As noted in the Traffic Study, the Project's impacts on traffic operations at the study area intersections vary between one to two seconds of additional delay for motorists seeking to turn off Lyman Street onto Bartlett Street. The Project's site driveway is designed to accommodate the movements in and out of the site in a manner that meets typical design requirements and accommodates both passenger vehicles as well as tractor-trailer trucks.

101 Walnut Street
PO Box 9151
Watertown, MA 02472-4026
P 617.924.1770

Memorandum

As noted previously, the ITE data suggests that a use similar to a short-term storage and/or transloading facility will have less of an impact on the area roadways while a use that is more robust like the parcel hub land use would have more of an impact.

However unlikely the scenario is that this use would occupy the site for a number of reasons, the traffic impact of the parcel hub was considered on the roadway network in the vicinity of the Project. This assessment found that the additional traffic will create between three to five seconds of delay on side streets during the peak hours over and above the no-build conditions (an increase of two to three more seconds over the traditional 'warehouse' use studied). As noted in the Traffic Study, this additional time delay is contained to the Lyman Street approach and does not represent any additional delay to the mainline Bartlett Street traffic. While this does not represent a significant impact to the roadway network resulting in a drop in level of service, it does create a potential need for additional roadway infrastructure which is discussed below.

> As discussed in the Traffic Study, the intersection of Bartlett Street and Lyman Street is on the threshold of meeting the volume-based warrants for traffic signalization. Should the site be occupied by a higher intensity user (such as a parcel hub warehouse user) and they are combined with the other background developments identified in the most recent version of the traffic study, note that the traffic signal warrants would now be marginally met at this location. This does not mean that a traffic signal should automatically be installed at this location, but it does note that the necessary requirements that allow the installation are met if all the background projects that were modeled do materialize.

In consideration of the above analysis, VHB continues to stand by the selection of ITE's Warehousing land use as the most reasonable indicator of how this facility will ultimately generate traffic. However, for the purposes of presenting an assessment of the potential warehousing options, the assessment of a parcel hub-type use was presented.

101 Walnut Street
PO Box 9151
Watertown, MA 02472-4026
P 617.924.1770

ITE TRIP GENERATION WORKSHEET
(10th Edition, Updated 2017)

LANDUSE: Warehousing
LANDUSE CODE: 150
LOCATION: General Urban / Suburban
JOB NAME:
JOB NUMBER:

Independent Variable --- 1,000 Sq. Feet Gross Floor Area

FLOOR AREA (KSF): 151.0

WEEKDAY

RATES:

	# Studies	R^2	Total Trip Ends Average	Total Trip Ends Low	Total Trip Ends High	Independent Variable Range Average	Independent Variable Range Low	Independent Variable Range High	Directional Distribution Enter	Directional Distribution Exit
DAILY	29	0.93	1.74	0.15	16.93	285	1	3,200	50%	50%
AM PEAK OF GENERATOR	23	0.85	0.22	0.02	2.08	274	1	3,200	65%	35%
PM PEAK OF GENERATOR	25	0.91	0.24	0.02	1.80	275	1	3,200	24%	76%
AM PEAK (ADJACENT ST)	34	0.69	0.17	0.02	1.93	451	1	3,200	77%	23%
PM PEAK (ADJACENT ST)	47	0.65	0.19	0.01	1.80	400	1	3,200	27%	73%

TRIPS:

	BY AVERAGE Total	BY AVERAGE Enter	BY AVERAGE Exit	BY REGRESSION Total	BY REGRESSION Enter	BY REGRESSION Exit
DAILY	263	131	131	284	142	142
AM PEAK OF GENERATOR	33	22	12	47	30	16
PM PEAK OF GENERATOR	36	9	28	45	11	34
AM PEAK (ADJACENT ST)	26	20	6	43	33	10
PM PEAK (ADJACENT ST)	29	8	21	46	12	34

SATURDAY

RATES:

	# Studies	R^2	Total Trip Ends Average	Total Trip Ends Low	Total Trip Ends High	Independent Variable Range Average	Independent Variable Range Low	Independent Variable Range High	Directional Distribution Enter	Directional Distribution Exit
DAILY	3	--	0.15	0.01	1.58	226	55	420	50%	50%
PEAK OF GENERATOR	2	--	0.05	0.01	0.22	129	55	202	64%	36%

TRIPS:

	BY AVERAGE Total	BY AVERAGE Enter	BY AVERAGE Exit	BY REGRESSION Total	BY REGRESSION Enter	BY REGRESSION Exit
DAILY	23	11	11	N/A	N/A	N/A
PEAK OF GENERATOR	8	5	3	N/A	N/A	N/A

SUNDAY

RATES:

	# Studies	R^2	Total Trip Ends Average	Total Trip Ends Low	Total Trip Ends High	Independent Variable Range Average	Independent Variable Range Low	Independent Variable Range High	Directional Distribution Enter	Directional Distribution Exit
DAILY	3	--	0.06	0.03	0.32	226	55	420	50%	50%
PEAK OF GENERATOR	2	--	0.04	0.02	0.11	129	55	202	52%	48%

TRIPS:

	BY AVERAGE Total	BY AVERAGE Enter	BY AVERAGE Exit	BY REGRESSION Total	BY REGRESSION Enter	BY REGRESSION Exit
DAILY	9	5	5	N/A	N/A	N/A
PEAK OF GENERATOR	6	3	3	N/A	N/A	N/A

ITE TRIP GENERATION WORKSHEET
(10th Edition, Updated 2017)

LANDUSE: High-Cube Transload and Short-Term Storage Warehouse
LANDUSE CODE: 154 Independent Variable --- 1,000 Sq. Feet Gross Floor Area
LOCATION: General Urban / Suburban
JOB NAME: **FLOOR AREA (KSF):** 151.0
JOB NUMBER:

WEEKDAY

RATES:

	# Studies	R^2	Total Trip Ends Average	Total Trip Ends Low	Total Trip Ends High	Independent Variable Range Average	Independent Variable Range Low	Independent Variable Range High	Directional Distribution Enter	Directional Distribution Exit
DAILY	91	--	1.40	0.20	4.32	798	240	1,820	50%	50%
AM PEAK OF GENERATOR	30	--	0.12	0.02	0.24	1,015	300	2,900	83%	17%
PM PEAK OF GENERATOR	33	0.63	0.16	0.07	0.31	991	300	2,900	33%	67%
AM PEAK (ADJACENT ST)	102	--	0.08	0.01	0.31	846	240	2,900	77%	23%
PM PEAK (ADJACENT ST)	103	--	0.10	0.00	0.25	840	240	2,900	28%	72%

TRIPS:

	BY AVERAGE Total	BY AVERAGE Enter	BY AVERAGE Exit	BY REGRESSION Total	BY REGRESSION Enter	BY REGRESSION Exit
DAILY	211	106	106	N/A	N/A	N/A
AM PEAK OF GENERATOR	18	15	3	N/A	N/A	N/A
PM PEAK OF GENERATOR	24	8	16	25	8	17
AM PEAK (ADJACENT ST)	12	9	3	N/A	N/A	N/A
PM PEAK (ADJACENT ST)	15	4	11	N/A	N/A	N/A

SATURDAY

RATES:

	# Studies	R^2	Total Trip Ends Average	Total Trip Ends Low	Total Trip Ends High	Independent Variable Range Average	Independent Variable Range Low	Independent Variable Range High	Directional Distribution Enter	Directional Distribution Exit
DAILY	10	--	0.94	0.04	1.65	847	300	1,200	50%	50%
PEAK OF GENERATOR	9	--	0.12	0.01	0.23	905	300	1,200	*Not Available*	

TRIPS:

	BY AVERAGE Total	BY AVERAGE Enter	BY AVERAGE Exit	BY REGRESSION Total	BY REGRESSION Enter	BY REGRESSION Exit
DAILY	142	71	71	N/A	N/A	N/A
PEAK OF GENERATOR	18	N/A	N/A	N/A	N/A	N/A

SUNDAY

RATES:

	# Studies	R^2	Total Trip Ends Average	Total Trip Ends Low	Total Trip Ends High	Independent Variable Range Average	Independent Variable Range Low	Independent Variable Range High	Directional Distribution Enter	Directional Distribution Exit
DAILY	10	--	0.87	0.01	1.49	847	300	1,200	50%	50%
PEAK OF GENERATOR	9	--	0.12	0..01	0.21	905	300	1,200	*Not Available*	

TRIPS:

	BY AVERAGE Total	BY AVERAGE Enter	BY AVERAGE Exit	BY REGRESSION Total	BY REGRESSION Enter	BY REGRESSION Exit
DAILY	131	66	66	N/A	N/A	N/A
PEAK OF GENERATOR	18	N/A	N/A	N/A	N/A	N/A

ITE TRIP GENERATION WORKSHEET
(10th Edition, Updated 2017)

LANDUSE: High-Cube Parcel Hub Warehouse
LANDUSE CODE: 156 — Independent Variable --- 1,000 Sq. Feet Gross Floor Area
LOCATION: General Urban / Suburban
JOB NAME: — **FLOOR AREA (KSF):** 151.0
JOB NUMBER:

WEEKDAY

RATES:

	# Studies	R^2	Total Trip Ends: Average	Low	High	Independent Variable Range: Average	Low	High	Directional Distribution: Enter	Exit
DAILY	3	--	7.75	4.20	10.64	363	313	442	50%	50%
AM PEAK OF GENERATOR	2	--	0.88	0.57	1.17	324	313	335	34%	66%
PM PEAK OF GENERATOR	2	--	0.71	0.44	0.95	324	313	335	63%	37%
AM PEAK (ADJACENT ST)	4	0.93	0.70	0.38	0.85	329	225	442	50%	50%
PM PEAK (ADJACENT ST)	4	0.86	0.64	0.26	0.86	329	225	442	68%	32%

TRIPS:

	BY AVERAGE: Total	Enter	Exit	BY REGRESSION: Total	Enter	Exit
DAILY	1,170	585	585	N/A	N/A	N/A
AM PEAK OF GENERATOR	133	45	88	N/A	N/A	N/A
PM PEAK OF GENERATOR	107	68	40	N/A	N/A	N/A
AM PEAK (ADJACENT ST)	106	53	53	-11	-6	-6
PM PEAK (ADJACENT ST)	97	66	31	-41	-28	-13

SATURDAY

RATES:

	# Studies	R^2	Total Trip Ends: Average	Low	High	Independent Variable Range: Average	Low	High	Directional Distribution: Enter	Exit
PEAK OF GENERATOR	--	--	--	--	--	--	--	--	--	--

TRIPS:

	BY AVERAGE: Total	Enter	Exit	BY REGRESSION: Total	Enter	Exit
PEAK OF GENERATOR	N/A	N/A	N/A	N/A	N/A	N/A

SUNDAY

RATES:

	# Studies	R^2	Total Trip Ends: Average	Low	High	Independent Variable Range: Average	Low	High	Directional Distribution: Enter	Exit
PEAK OF GENERATOR	--	--	--	--	--	--	--	--	--	--

TRIPS:

	BY AVERAGE: Total	Enter	Exit	BY REGRESSION: Total	Enter	Exit
PEAK OF GENERATOR	N/A	N/A	N/A	N/A	N/A	N/A

HIGH-CUBE WAREHOUSE VEHICLE TRIP GENERATION ANALYSIS

PREPARED FOR

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT

AND

NATIONAL ASSOCIATION OF INDUSTRIAL AND OFFICE PROPERTIES

PREPARED BY

INSTITUTE OF TRANSPORTATION ENGINEERS

WASHINGTON, DC

OCTOBER 2016

ACKNOWLEDGEMENT AND DISCLAIMER

This report was prepared as a result of work sponsored, paid for, in whole or in part, by the South Coast Air Quality Management District (SCAQMD) and NAIOP (National Association of Industrial and Office Properties (NAIOP). The report is the product of a collaborative process by which ITE, SCAQMD, and NAIOP embarked upon an effort to better understand vehicle trip generation rates at high-cube warehouse facilities.

The NAIOP Inland Empire and Southern California Chapters provided direct input for various items of the report, including a suggested high-cube warehouse classification system.

EXECUTIVE SUMMARY

Purpose – South Coast Air Quality Management District (SCAQMD) and NAIOP (National Association of Industrial and Office Properties) provided funding to the Institute of Transportation Engineers (ITE) to help in the establishment of national guidance for the estimation of vehicle trip generation at what are commonly called high-cube warehouse distribution centers (HCW).

Definition of High-Cube Warehouse – A high-cube warehouse is a building that typically has at least 200,000 gross square feet of floor area, has a ceiling height of 24 feet or more, and is used primarily for the storage and/or consolidation of manufactured goods (and to a lesser extent, raw materials) prior to their distribution to retail locations or other warehouses. A typical HCW has a high level of on-site automation and logistics management. The automation and logistics enable highly-efficient processing of goods through the HCW. For the purpose of this trip generation analysis, HCWs are grouped into five types: fulfillment center, parcel hub, cold storage facility, transload facility, and short-term storage facility.

Data Sources – The analysis contained herein is based on data from 15 separate data sources, including recent data collected under the sponsorship of SCAQMD and NAIOP. The database includes trip generation information from 107 individual sites.

Findings – The HCW market continues to evolve as individual tenants/owners implement different e-commerce business plans. For example, some deliver goods to the customer within two days and others deliver orders to the nearest store for customer pick-up. As business plans and technology continue to evolve, these should continue to be monitored. Although the tenant or its planned operations are often unknown at the time of site development review, for the purpose of estimating vehicle trip generation, it may be as important to know the tenant as much as other facility factors.

For transload, short-term storage, and cold storage HCWs, the proportionate mix of types of vehicles (i.e., cars versus trucks) accessing the site is very consistent, both daily and during the AM and PM peak hours.

For a cold storage HCW, the currently available data demonstrates a useable, direct correlation between building size and vehicle trip generation.

The single data points for fulfillment centers and parcel hubs indicate that they have significantly different vehicle trip generation characteristics compared to other HCWs. However, there are insufficient data from which to derive useable trip generation rates.

For transload and short-term storage HCW sites, additional data sites and additional information on past sites are needed in order to derive useable trip generation rates.

Recommendations (Action Plan) – A strategically-developed data collection program is needed that targets each type of HCW individually. The strategy should include a prioritized plan for collecting additional data at five classifications of HCWs that are representative of the types of facilities expected to be commonly developed in coming years. The data should be collected at mature facilities, each of which clearly fits within one HCW classification, during periods of typical levels of activity based on the types of facilities and businesses served.

All future data collection should seek to acquire an enhanced set of site descriptive information that will enable development of better predictive models than are currently available.

STUDY PURPOSE AND PROCESS

South Coast Air Quality Management District (SCAQMD) and NAIOP (National Association of Industrial and Office Properties) provided funding to the Institute of Transportation Engineers (ITE) to help in the establishment of consensus-based national guidance for the estimation of trip generation at what are commonly called high-cube warehouses (HCW). This report documents the results of that effort to develop a credible and defensible procedure for collecting and analyzing site trip generation data for use in transportation impact analyses (TIA) and air quality/vehicular emissions analyses (AQA[1]) for HCW-type facilities.

ITE convened a meeting of practitioner-based experts at ITE Headquarters on April 1, 2015. The meeting participants are listed in Table 1. At the meeting's conclusion, several individuals were tasked with development of specific products, including the following:

- An overall work plan for this report and for subsequent data collection and analysis
- A clear and consistent definition of HCW for this report and for future studies and analysis
- A vehicle classification scheme that satisfies ultimate data requirements for TIA and AQA and complies with reasonable data collection capabilities and budgets

ITE staff assumed responsibility for compilation and analysis of existing HCW trip generation data.

The full expert panel provided comments and suggestions on each interim product that eventually became part of this complete report. Nevertheless, responsibility for content completeness and data analysis accuracy rests with ITE staff.

Table 1. Expert Panel for High-Cube Warehouse Trip Generation Study

Mr. Brian Bochner	Texas A&M Transportation Institute, College Station, Texas
Mr. Paul Basha	City of Scottsdale, Arizona
Mr. Milton Carrasco	Transoft Solutions, Inc., Richmond, British Columbia
Dr. Kelly Clifton	Portland State University, Portland, Oregon
Mr. Henry Hogo (for Mr. Barry Wallerstein)	South Coast Air Quality Management District, Diamond Bar, California
Mr. Kim Snyder	Prologis, Cerritos, California
Ms. Cecilia Ho	Federal Highway Administration, Washington, DC
Mr. Ian Macmillan	South Coast Air Quality Management District, Diamond Bar, California
Mr. Thomas Phelan	VHB, Newark, New Jersey
Mr. Jeremy Raw	Federal Highway Administration, Washington, DC
Mr. Erik Ruehr	VRPA Technologies, San Diego, California
Mr. Frank Sherkow	Southstar Engineering and Consulting, Inc., Yachats, Oregon
Mr. Joe Zietsman	Texas A&M Transportation Institute, College Station, Texas
Mr. Tom Brahms	Institute of Transportation Engineers, Washington, DC
Mr. Kevin Hooper	Institute of Transportation Engineers, Washington, DC
Ms. Lisa Tierney	Institute of Transportation Engineers, Washington, DC

[1] In California, when a new warehouse project is proposed, it undergoes environmental review pursuant to the California Environmental Quality Act (CEQA). Air quality analyses conducted pursuant to CEQA typically compare project emissions against local air district thresholds to determine the potential significance of the project's air quality impacts. These emission estimates rely on trip generation rates to determine the volume of cars and trucks that could visit the proposed project site.

HIGH-CUBE WAREHOUSE DEFINITION

A high-cube warehouse (HCW) is a building that typically has at least 200,000 gross square feet of floor area, has a ceiling height of 24 feet or more, and is used primarily for the storage and/or consolidation of manufactured goods (and to a lesser extent, raw materials) prior to their distribution to retail locations or other warehouses. A typical HCW has a high level of on-site automation and logistics management. The automation and logistics enable highly-efficient processing of goods through the HCW.[2]

A classification scheme for different types of HCWs is presented in Table 2 along with their distinctive characteristics. The characteristics of a typical standard warehouse are provided for comparative purposes. The five types of HCW are the following:

- Transload – usually pallet loads or larger handling products of manufacturers, wholesalers/distributors, or retailers with little or no storage durations
- Short-Term Storage – products held on-site for a short time
- Cold Storage – HCW with permanent cold storage in at least part of the building
- Fulfillment Center – storage and direct distribution of e-commerce product to end users
- Parcel Hub – transload function for a parcel delivery company

[2] High-cube warehouses are classified as Land Use Code 152 in ITE *Trip Generation Manual*, 9th Edition. The definition provided in *Trip Generation Manual* for HCW is as follows:

> "High-cube warehouses/distribution centers are used for the storage of materials, goods and merchandise prior to their distribution to retail outlets, distribution centers or warehouses. These facilities are typically characterized by ceiling heights of at least 24 feet with small employment counts due to a high level of mechanization. High-cube warehouses/distribution centers generally consist of large steel or masonry shell buildings and may be occupied by or multiple tenants. A small ancillary office use component may be included and some limited assembly and repackaging may occur within these facilities.
>
> "High-cube warehouses/distribution centers may be located in industrial parks or be free-standing. Intermodal truck terminal (Land Use 030), industrial park (Land Use 130), manufacturing (Land Use 140) and warehousing (Land Use 150) are related uses."

When the 10th edition of *Trip Generation Manual* is developed, the findings and recommendations of this report will be reflected in an updated definition for high-cube warehouses.

Table 2. High-Cube Warehouse Classifications

	Standard Warehouse/ Storage	Transload Facility	Short-Term Storage	Cold Storage	Fulfillment Center	Parcel Hub
Description and Key Warehouse Functions						
Typical Functions	Products stored on-site typically for more than one month	Focus on consolidation and distribution of pallet loads (or larger) of manufacturers, wholesalers, or retailers; little storage duration; high throughput and high-efficiency	Focus on warehousing/ distribution with distribution space operated at high efficiency; often with custom/special features built into structure for movement of large volumes of freight	Temperature-controlled for frozen food or other perishable products stored in any type of HCW; building built with substantial insulation, including foundation, walls, and roof[3]	Storage and direct distribution of e-commerce product to end users; smaller packages and quantities than for other types of HCW; often multiple mezzanine levels for product storage and picking	Regional and local freight-forwarder facility for time-sensitive shipments via air freight and ground (e.g., UPS, FedEx, USPS); site often includes truck maintenance, wash, or fueling facilities
Break-Bulk or Assembly	Can include break-bulk and assembly activities	Very limited pick-and-pack area within facility	May or may not include break-bulk, repack or assembly activities	Limited or no break-bulk, repack or assembly activities	Pick-and-pack area comprises majority of space	Limited or no break-bulk, repack or assembly activities
Place in Supply Chain		Usually for final distribution to retail stores but can be for manufacturer to wholesale distribution		Typically, late in the supply chain for final distribution to retail stores or local, smaller distribution centers	Typically, freight for final consumption (business-to-business and consumers)	Can be situated at multiple points in the supply chain (intermediate or final delivery)

[3] Cold storage products (e.g., flowers and other perishables) that are not frozen must be shipped within hours or a few days. Cold storage products that are frozen may take a long time to ship. Products in these facilities may be treated more like typical HCW products.

	Standard Warehouse/ Storage	Transload Facility	Short-Term Storage	Cold Storage	Fulfillment Center	Parcel Hub
Location	Typically in an industrial area within urban area or urban periphery	Typically in an area with convenient freeway access; often in rural or urban periphery area	Typically in an area with convenient freeway access	Depends on supply and demand markets	Often near a parcel hub or USPS facility, due to time sensitivity of freight	Typically in close proximity to airport; often stand-alone
Overall Site Layout						
Employee Parking		Smaller employee parking ratio (per facility square foot) than fulfillment center or parcel hub	Smaller employee parking ratio (per facility square foot) than fulfillment center or parcel hub		Larger parking supply ratio than for all other HCW types	Larger employee parking ratios; truck drivers often based at facility (i.e., parking may be for both site employees and drivers)
Truck & Trailer Parking	Limited truck parking area; increases with distance to major distribution hub	Large, open trailer parking area surrounding facility; produces high land to building ratio	Ratio of truck parking spaces to docks can vary between 0.5:1 and 1.5:1, with 1:1 being very common	Can vary with whether products are frozen or perishable[4]	Significantly higher truck parking ratios than for other HCWs	Very high truck parking ratios to dock positions, often 2:1 or more
Loading Dock Location	Either on one side or on two adjacent sides	Minimum of two sides (adjacent or opposite); can be on four sides	On either one or two sides			Usually on both long sides of building; can be on four sides
Building Dimensions						
Length vs. Depth		Typical length vs. depth ranges between 3:1 and 2:1; shallower than Standard	Typical length vs. depth is 2:1; shallower than Standard			Typical configuration is cross-dock; building typically more shallow (150-300 feet across) than other HCWs

[4] Cold storage product handling must be done quickly. Any product stored in a trailer on the site requires either an idling truck or an external power supply to maintain the temperature within the required ranges.

	Standard Warehouse/ Storage	Transload Facility	Short-Term Storage	Cold Storage	Fulfillment Center	Parcel Hub
Ceiling Height	Typically between 28 and 40 feet	Typically, lower than for other HCW	Typically between 28 and 34 feet, with some facilities in excess of 40 feet	Typically higher (70-100 feet) to maximize efficiency of refrigeration; frozen food tends to have a higher ceiling than produce handling	Often as high as 40 feet in order to accommodate up to three levels of interior mezzanines	Typically not as tall as other HCW; commonly between 18 and 20 feet range; racking not usually provided (i.e. floor-stack only)
Number of Docks	Low number of dock positions to overall facility, 1:20,000 square feet or lower	Typical dock-high loading door ratio is 1:10,000 square feet; common range between 1:5,000 & 1:15,000 square feet	Typically, 1:10,000 square feet or lower			
Automation						
Material Handling Systems	Little or no automation; mechanization limited to pallet jacks and forklifts	Very highly-mechanized material handling systems	Very highly-mechanized material handling systems; high ratio of material handling equipment to overall floor area	Very high clear height requires sophisticated material handling equipment	High levels of automation in material handling equipment	High levels of automation in material handling equipment
Conveying Systems	Little or no automation	Usually automated mechanized conveying	Usually limited automated conveying	Very high clear height requires a sophisticated conveyance system	High levels of automation in conveying systems	High levels of automation in conveying systems
Warehouse Mgmt Systems (WMS)		Some facilities use ASRS (Automated Storage and Retrieval Systems)			High levels of automation; some use of ASRS	High levels of automation

Table 2. Additional Descriptive Features

Typical Floor Area Ratios range between 35 and 60 percent. Standard, Fulfillment Center, and Parcel Hub sites tend to have higher values than Transload and Short-Term Storage HCW.

Office/Employee Welfare[5] Space is highly variable and is insignificant within overall building square footage. Common values are between 3,000 and 5,000 square feet for Cold Storage and between 5,000 and 10,000 square feet for Transload Facility, Fulfillment Center, and Parcel Hub.

Movement of Goods in Trucks – For a Transload site, typical truck movements are comprised of full load, large trailers, both inbound and outbound. For some "last mile" or local distribution centers, long-haul trucks or international containers can arrive loaded and depart empty, while local delivery trucks arrive empty and depart loaded. For national and regional distribution centers, trucks can come in loaded and re-load with different product mix and depart loaded.

Hours of Operation and Peak Periods – Peak truck movement activity is often outside the peak commuting period on the adjacent street system. HCW operations are often 24 hours per day, every day of the year. For a Standard site, there is a greater likelihood that the site peak period of traffic operations may coincide with or be near the street peak period.

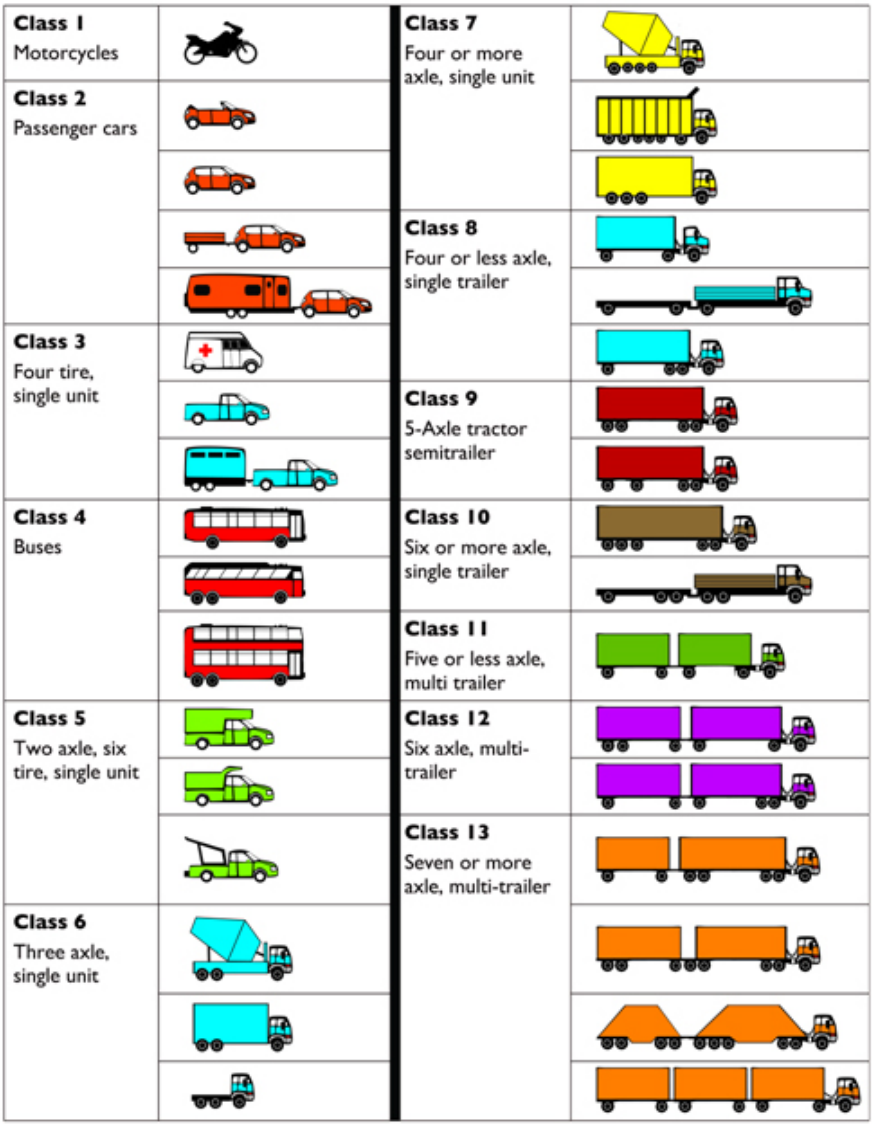
Truck Sizes – Truck size can vary significantly between similar sites. Sizes and types are a function of the origins and destinations of the goods processed at the facility (i.e., location in the supply chain). Local deliveries to business/residential customers are commonly made with smaller trucks (except warehouses that, for example, deliver bulky items to a home improvement store). Longer distance travel or deliveries at early stages in the supply chain are typically with larger trailers. For Cold Storage and Fulfillment Center, the outbound trucks are often smaller because of cargo weight and last-mile distribution needs. Intermediate hubs accommodate large trucks on both the inbound and outbound side (e.g., FedEx Ground). "Final delivery" hubs have small trucks on the outbound side (e.g., FedEx Overnight).

[5] Employee welfare area includes restrooms, locker rooms, and break rooms.

VEHICLE CLASSIFICATION FOR WAREHOUSE TRIP GENERATION DATA

The preferred vehicle classification scheme should satisfy both the ultimate needs for TIA and AQA analysis and comply with reasonable data collection capabilities and budgets. FHWA maintains a 13-category classification system for motorized vehicles (presented in Figure 1 and maintained at the following website: http://www.fhwa.dot.gov/policyinformation/tmguide/tmg_2013/vehicle-types.cfm).

Figure 1. FHWA Vehicle Classification Types



The vehicle types that enter and exit a HCW site can be separated to correspond to individual "markets:"

- Vehicles used for employee and facility service access (i.e., for goods and services consumed on site)
- Vehicles used for local delivery access (e.g., wholesale and retail delivery for consumption in the local metropolitan area)
- Vehicles used for high-volume transfer (e.g., long-distance freight, relay distribution to other distribution or warehouse facilities)

A simple and straightforward correlation between "markets" and the 13 FHWA classifications is as follows:

1. Facility Access: includes Classes 2 and 3 (passenger cars and light trucks), and Classes 1 and 4 (motorcycles and buses) if observed
2. Local Goods Movement: includes Classes 5 through 7 (two-, three-, and four-axle single-unit trucks)
3. Long Distance Goods Movement: includes Classes 8 through 13 (multi-unit trucks)

A significant limitation to this classification scheme is the growing disconnect between truck size and trip length over time. They do not correlate as well for many carriers as they did in the past. There is a wide range of practices in deliveries and many prominent retail chains currently use trucks in Classes 8 and 9, for example, for local deliveries. In other words, a Class 8-13 vehicle is not necessarily a long-distance truck trip.

The primary advantage of mapping these vehicle types to the FHWA classification scheme is that commercially available automated monitoring equipment is generally capable of reporting the FHWA vehicle classes without specialized data interpretation.

Encouraging agencies to develop local counts of these facilities will also be more successful if the agencies can use standard automated counters without specialized software, even at the expense of occasional misclassification relative to "ideal" categories for a warehouse trip generation study. Video detection could make more information available, but at greater expense for data processing.

It is also important to recognize that counting equipment manufacturers (and often representatives of a public agency) are able to reprogram automated counters to use an alternate classification scheme. For example, if there is a specific axle configuration commonly used for domestic container freight versus international container freight at a particular data collection site, it may be feasible to detect. Such schemes are relatively easy to share among agencies using the same types of equipment.

As noted above, the observed physical vehicle type based on a FHWA class may not provide sufficient information on its own to identify the "purpose" of the truck trip. The classification scheme may need to be adjusted to reflect the specific trip-making to and from a subject warehouse site. The following are examples of refinements that could be necessary given the particular characteristics of a warehouse site:

1. Even in a standard traffic monitoring application, the distinction between a passenger car (Class 2) and a light truck (Class 3: pickups, large SUVs, vans) has limited benefit and is difficult to establish decisively. For the warehouse trip generation application, the merging of these classes should improve overall accuracy.
2. Local goods movement may also include Class 3 vehicles (specifically two-axle vans). If separate driveways are used for goods movement and general facility access, the Class 3 vehicles in the goods movement driveway can be considered local goods movement vehicles.
3. It is sometimes difficult for automated equipment to distinguish between a Class 4 vehicle (bus) and a Class 5/6 truck. In the rare circumstance where a bus enters or exits a warehouse site driveway, a manual count or simple reference to a published transit service schedule may be necessary.
4. Class 5 vehicles include "dualie" pickups which may operate as personal vehicles for facility access or as larger panel trucks often used for local goods delivery. The presence of and use of separate driveways for goods movement and general facility access may be the only means to distinguish between the two types of uses.

DATA NEEDS FOR TIA AND AQA

Typical data requirements for TIA and AQA are listed in Table 3. Some measures are used to classify a building type. Some measures can be used as independent variables with a direct relationship to the quantity of vehicle trips generated by a site (by vehicle type).

Table 3. Data Needs for HCW Trip Generation Analysis

Vehicle Trip Data	TIA	AQA
Vehicle Trips by Vehicle Classification		
• 2 classifications – car, truck	√	
• 4 classifications – personal passenger vehicle, parcel delivery, single unit truck, tractor-trailer combination	*[6]	√
Vehicle Trips by Time-of-Day (by vehicle classification)		
• Directional 15-minute volumes on a weekday (typically Tuesday, Wednesday, or Thursday)		
o AM peak hour for generator	√	
o AM peak hour for adjacent street	√	
o PM peak hour for generator	√	
o PM peak hour for adjacent street	√	
• Non-directional 24-hour volume on a weekday		√
Vehicle Trips by Driveway (if employees and freight delivery use separate driveways)	√	√
Vehicle Trips within Context of Seasonal Variations		
• Daily Variations	√	√
• Monthly Variations		√
• Highest Day of Year		√
Independent Variable Data		
Building Size		
Building GSF[7] (total, office, retail, manufacturing/enhancements, storage/distribution)	√	√
Building Volume (cubic feet)	√	√
Building Shape (length-to-depth ratio)		√
Number of High-Loading docks	√	√
Building Function		
Cold Storage Provided	√	√
NAICS Industrial Code	√	√
Employees	√	√
Commodity type (retail, manufacturing, other)	√	√
Where in Supply Chain (parts, manufacturer/assembly, wholesale/distributor, retailer)		√
Site Size		
Site acres	√	√
Floor area ratio (FAR)	√	√
Parking spaces (employee/visitor, truck/trailer)	√	√
Site Context		
Area type (urban, suburban, rural)	√	√
Distance to port (seaport, intermodal center, regional air cargo)	√	√

[6] Some TIA may require truck classification information.

[7] GSF is gross square footage of the building.

ASSEMBLY AND CLASSIFICATION OF CURRENTLY AVAILABLE DATA

Data from the following studies were compiled and analyzed for possible use in the trip generation analysis for the High-Cube Warehouse study:

- Warehouse Truck Trip Study, Data Results and Usage, South Coast Air Quality Management District, Diamond Bar, CA 2014
- Trip Generation Analysis for High-Cube Warehouse Distribution Center, prepared for NAIOP by Kunzman Associates, Laguna Hills, CA 2011
- Trip Generation Characteristics of Discount/Home Improvement Superstores, Major Distribution Centers, and Small Box Stores, prepared for Florida Department of Transportation by Wilbur Smith Associates 2011
- Western Riverside County Warehouse/Distribution Center Trip Generation Study, prepared for NAIOP by Crain & Associates, Los Angeles, CA 2008
- Westside Industrial Park Warehouse Trip Generation, prepared for Premier Airport Park by King Engineering Associates, Jacksonville, FL 2008
- Trip Generation Study, Existing High-Cube Warehouse Facilities, Visalia CA, prepared for The Allen group by Peters Engineering Group, Clovis CA 2008
- Large-Scale Retail Distribution Centers, prepared for Walmart Sores, Inc. by Kimley-Horn and Associates, Tampa, FL 2007
- Trip Generation Study, High-Cube Warehouse Buildings, Fresno, California, prepared for Diversified Development Group by Peters Engineering Group, Clovis CA 2007
- Trip Generation Study, High Cube Warehouse, prepared by Schoor Depalma, Manalapan, NJ 2006
- San Bernardino/Riverside County Warehouse/Distribution Center Vehicle Trip Generation Study, prepared for NAIOP by Crain & Associates, Los Angeles, CA 2005
- Truck Trip Generation Study, prepared for City of Fontana (CA) by Transportation Engineering and Planning, Inc. 2003
- Trip Generation Analysis for High-Cube Warehouses, prepared for City of Livermore, CA by Fehr & Peers Associates, Lafayette, CA 1989

The data also includes site trip generation data provided by Texas A&M Transportation Institute (2008-2009), Randall Parker (2007), and Washington State Department of Transportation (2002).

The data were reviewed for their applicability and only acceptable sites with appropriate data are used in the analysis presented in the following section of this report. Some of the purported high-cube warehouses are instead standard storage warehouses or multi-building industrial parks. Some of the high-cube warehouse data for individual sites could not be used due to unexplained data characteristics (e.g., a significant imbalance in inbound and outbound daily vehicle trips).

The final current database of HCW sites contains 107 data records with varying degrees of vehicle classification data and of daily and peak hour traffic counts.

HIGH-CUBE WAREHOUSE TRIP GENERATION DATA ANALYSIS[8]

Classification of Individual Data Records

Each record in the database of HCW sites was classified as one of five building types, defined earlier in this report. The criteria used to classify the sites represent information that is likely to be available at the time of site development review.

The database includes one fulfillment center, one parcel hub, and nine HCWs with a significant cold storage component[9]. The remaining 95 HCWs were separated into transload and short-term storage HCW based on two building configuration criteria:

- A transload building is assumed to have a length-to-depth ratio of at least 2:1 and has loading docks on at least two sides (either opposite or adjacent); there are 56 transload data points
- The remaining HCW sites (i.e., those that are not considered transload, cold storage, fulfillment center, or parcel hub) are classified as short-term storage HCWs; they total 39 sites

Building configuration is known at the time of site development review but has the limitation of not necessarily being indicative of the function of the HCW activities. If additional characteristics can be identified that (1) are predictive of the HCW function and (2) are available at the time of site development review, the database can be reexamined and potentially reclassified and reanalyzed.

Key Findings – Cars vs. Total Vehicles

There is a significant correlation between the number of cars that enter and exit a HCW site and the total number of vehicles that enter and exit a HCW site.

Table 4 lists the weighted averages for cars as a percentage of the total site-generated traffic at the five types of HCW. At short-term storage, transload, and cold storage HCWs, nearly 68 percent of the total daily site-generated vehicle trips are cars. During the AM peak hour, the measured percentage of cars is markedly similar (69 percent) to the daily (68 percent). During the PM peak hour, the measured percentage of cars is significantly higher (78 percent) than the daily value. The higher car percentage (and therefore, the lower truck percentage) is likely due to truck operations avoiding the afternoon peak period.

The fulfillment center has a significantly higher percentage of cars during the AM and PM peak hours and daily (due largely to the significantly higher number of employees at a fulfillment center compared to the other types of HCWs). The parcel hub has a significantly lower percentage of cars (and therefore a higher percentage of trucks) during the AM and PM peak hours and daily.

Table 4. Weighted Averages for Percentage of Total Daily Vehicles that are Cars, by Type of HCW

Type of High-Cube Warehouse	Cars as Percentage of Total Vehicles		
	Daily	AM Peak Hour	PM Peak Hour
Short-Term Storage, Transload & Cold Storage (100)	67.8%	69.2%	78.3%
Fulfillment Center (1)	91.2	97.2	98.2
Parcel Hub (1)	62.3	50.3	70.7

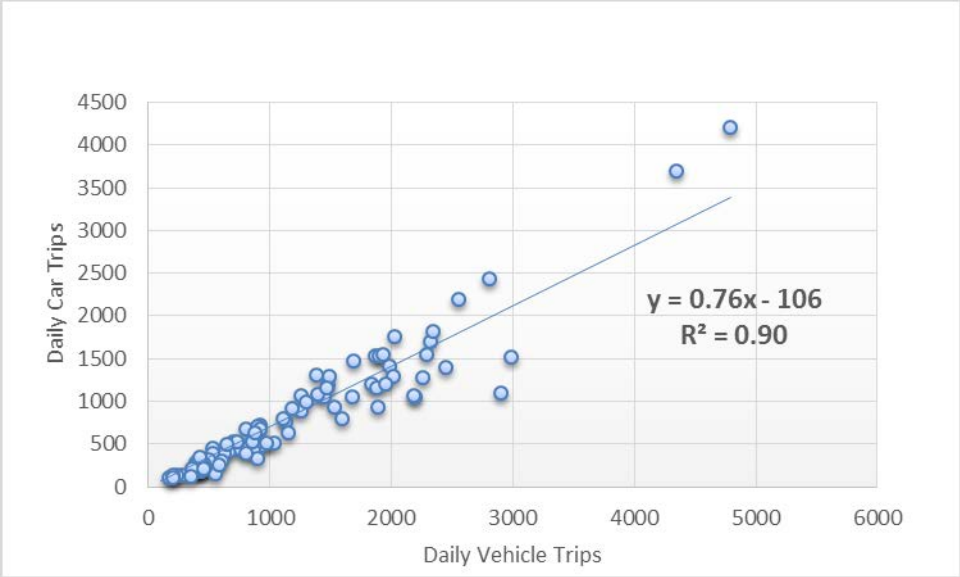
Note: The values in parentheses represent the number of data collection sites for HCW type.

[8] This section presents key analysis findings. Appendix A presents additional analyses of the HCW data.

[9] Sites were classified as cold storage either through self-categorization by data submitter (e.g., Walmart), by type of tenant (e.g., Ralphs, Publix), or by online site description (e.g., Americold, Millard Refrigeration Services).

Figure 2 is a plot of daily car trips versus daily vehicle trips generated at transload, short-term storage, and cold storage HCWs. The plot demonstrates strong correlation between the two trip-making characteristics of HCW sites. The data yields a linear fitted curve equation with an R^2 value of 0.90. The correlation between the daily truck trips and daily vehicle trips is not as strong and yields a linear fitted curve equation R^2 value that is less than the ITE acceptability threshold of 0.50.

Figure 2. Correlation between Daily Cars and Total Daily Traffic at Transload, Short-Term Storage and Cold Storage HCW Sites



Key Findings – Daily Trip Generation

Table 5 compares daily trip rates for the five different types of HCWs. The table includes weighted average rates for all vehicles, cars, trucks, and 5-or-more-axle trucks. The table also includes the weighted average rate for daily vehicle trips contained in ITE *Trip Generation Manual* 9th Edition, for high-cube warehouses (land use code 152). The single fulfillment center count was taken during a holiday shopping season when activity would be expected to be higher than an annual average.

Table 5. Weighted Average Rates for Daily Trips at High-Cube Warehouses

Type of High-Cube Warehouse	Weighted Average for Daily Trips per 1,000 GSF[10]			
	All Vehicles	Cars	Trucks	5+ Axle Trucks
Transload & Short-Term Storage (91)	1.432	1.000	0.454	0.233
Cold Storage (9)	2.115	1.282	0.836	0.749
Fulfillment Center (1)	8.178	7.461	0.717	0.242
Parcel Hub (1)	10.638	6.631	4.007	0.982
ITE *Trip Generation Manual* – 9th Edition	1.68	--	--	--

Note: The values in parentheses represent the number of data collection sites for HCW type.

[10] The weighted average rates for cars and trucks may not sum to match the "all vehicle" rates because some data sources collected total vehicle trips and did not separate cars and trucks.

Fulfillment Center and Parcel Hub

Based on data from single data points, it is likely that vehicle trip generation rates for fulfillment centers and parcel hubs are significantly different from those at other HCW sites.

The single fulfillment center has a substantially higher vehicle trip generation rate than transload, short-term storage, and cold storage HCW sites. The higher rate is due both to a higher number of passenger cars (i.e., employees) entering and exiting the site and to the count being conducted in December during the holiday shopping season.

The single parcel hub HCW has a rate that is higher than even the fulfillment center for all vehicles. The rate for trucks (both total and 5+ axle) is substantially higher than for the other HCW types.

Cold Storage

For the relatively small number of data points in the HCW database that are classified as cold storage facilities, there is a strong correlation between vehicle trips and building gross square footage.

Figure 3 is a plot of daily total vehicle trips versus building gross square footage at all cold storage facilities in the database. The data yields a linear fitted curve equation with an R^2 value of 0.69. As recommended in ITE *Trip Generation Handbook* 3rd Edition, the fitted curve should be considered acceptable only within the building site size range in the dataset[11]. The weighted average rate (shown above in Table 5) is 2.115 total vehicles per 1,000 GSF for a cold storage HCW site.

Figure 3. Correlation between Daily Total Vehicles and Cold Storage GSF (All Sites)

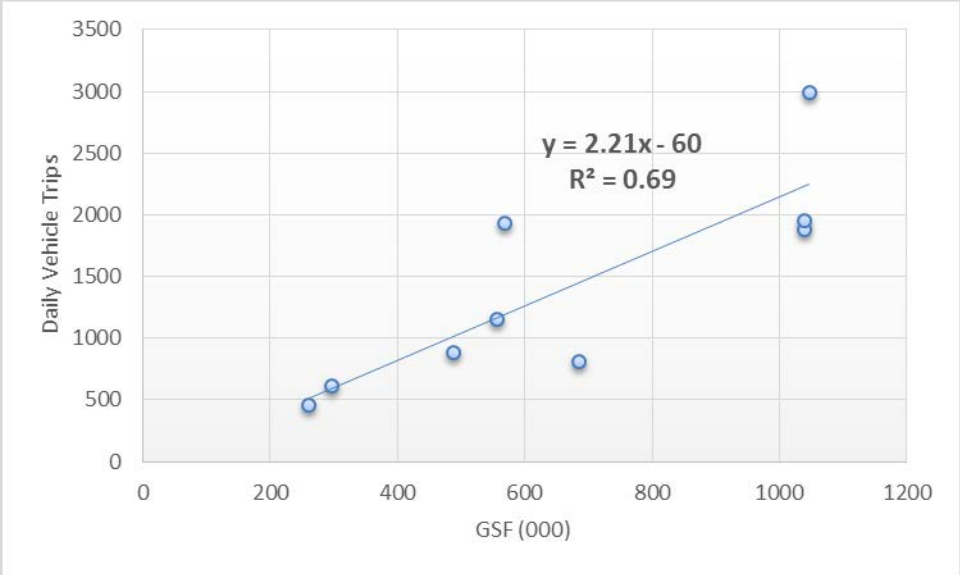
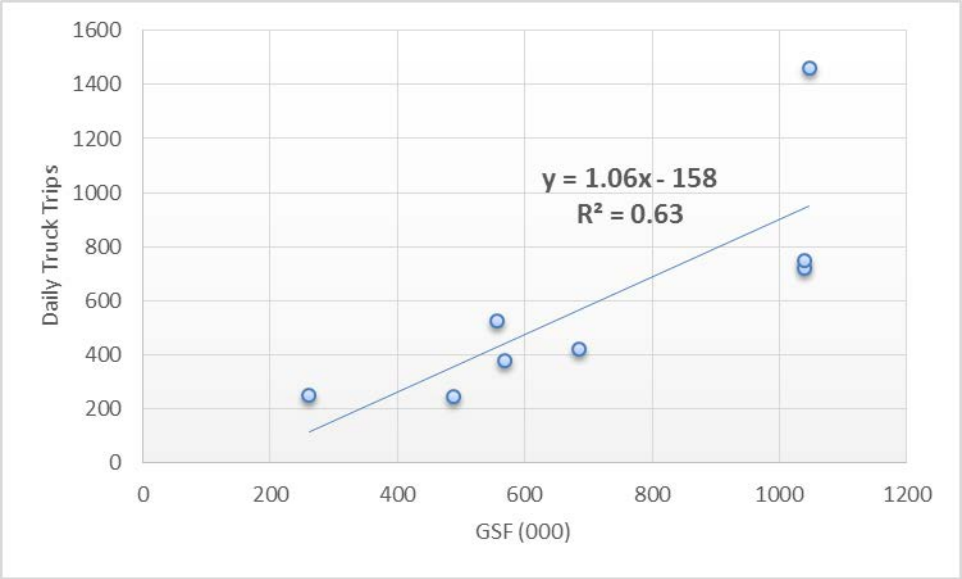


Figure 4 presents the data plot for daily trucks. The plot includes a fitted curve equation with an acceptable R^2 value. The weighted average rate for daily trucks at a cold storage HCW is 0.836 trucks per 1,000 GSF.

[11] The best correlation is found for sites with gross square footage of 500,000 or less, with greater data scatter for larger buildings. Nevertheless, there are several sites with gross square footage of more than 500,000 that have daily vehicle trip generation rates that mirror the small sites.

Figure 4. Correlation between Daily Trucks and Cold Storage GSF (SCAQMD & NAIOP Sites)



Transload and Short-Term Storage

It would be expected that a transload site could generate a different number of vehicle trips than a short-term storage HCW. But, as currently classified in this report, the sites that fall into the two categories show very little difference between the two. Therefore, the two types are analyzed together in this report. If an appropriate building characteristic can be identified at the time of site development review, the sites in the database can be re-examined and potentially reclassified and the trip-generating characteristics reanalyzed.

For this combination of HCW types, the relationship between building gross square footage and vehicle trips does not produce an acceptable level of correlation to develop a fitted curve equation. Figure 5 presents a plot of daily vehicle trips against building square footage.

The weighted average rate for transload and short-term storage HCW sites is 1.432 daily vehicle trips per 1,000 GSF (listed earlier in Table 5). As a point of comparison, this rate is lower than the weighted average rate of 1.68 provided in ITE *Trip Generation Manual* 9th Edition, for the High-Cube Warehouse land use.

The transload and short-term storage HCW dataset is much larger than the other HCW datasets. This larger dataset exhibits much greater scatter than the smaller datasets. This circumstance suggests that more data for the other HCW facility types are necessary to determine if the small dataset high correlations are accurate and justified.

Figure 5. Daily Vehicle Trips at Transload and Short-Term Storage HCW

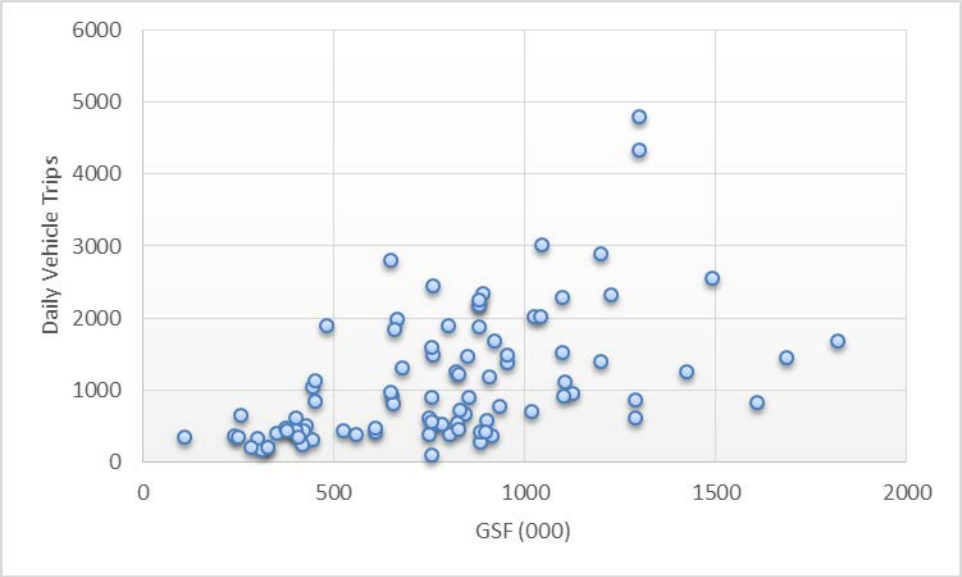
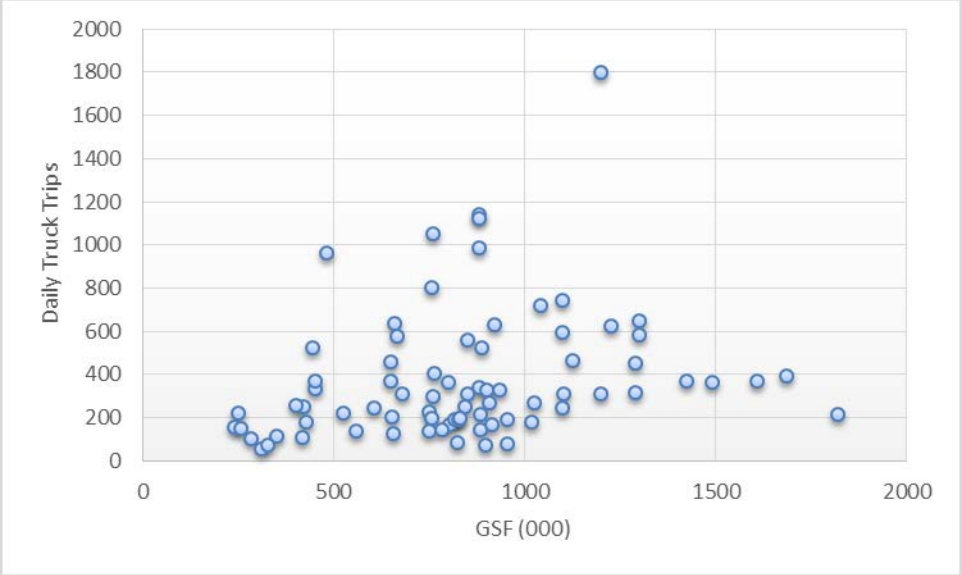


Figure 6 presents a plot of daily truck trips against building square footage at transload and short-term storage HCW. For trucks, the weighted average rate is 0.454 trucks per 1,000 GSF.

Figure 6. Daily Truck Trips at Transload and Short-Term Storage HCW



Key Findings – Peak Hour Trip Generation

Tables 6 and 7 list the weighted average rates for the AM and PM peak hours, respectively, for the five types of HCWs. The tables also include the weighted average rate for peak hour vehicle trips contained in ITE *Trip Generation Manual* 9th Edition, for high-cube warehouse (land use code 152).

Table 6. Weighted Average Rates for AM Peak Hour Trips at High-Cube Warehouses

Type of High-Cube Warehouse	Weighted Average for AM Peak Hour Trips per 1,000 GSF			
	All Vehicles	Cars	Trucks	5+ Axle Trucks
Transload & Short-Term Storage (94)	0.082	0.057	0.024	0.015
Cold Storage (9)	0.103	0.061	0.038	0.027
Fulfillment Center (1)	0.841	0.818	0.023	0.009
Parcel Hub (1)	0.851	0.428	0.423	0.041
ITE *Trip Generation Manual* – 9th Edition	0.11	--	--	--

Note: The values in parentheses represent the number of data collection sites for HCW type.

Table 7. Weighted Average Rates for PM Peak Hour Trips at High-Cube Warehouses

Type of High-Cube Warehouse	Weighted Average for PM Peak Hour Trips per 1,000 GSF			
	All Vehicles	Cars	Trucks	5+ Axle Trucks
Transload & Short-Term Storage (95)	0.108	0.086	0.023	0.010
Cold Storage (9)	0.129	0.087	0.042	0.031
Fulfillment Center (1)	1.979	1.944	0.035	0.013
Parcel Hub (1)	0.803	0.568	0.235	0.009
ITE *Trip Generation Manual* – 9th Edition	0.12	--	--	--

Note: The values in parentheses represent the number of data collection sites for HCW type.

Fulfillment Center

The single surveyed fulfillment center HCW has a significantly higher rate for passenger cars during both the AM and PM peak hours (as is the case for daily trips at the fulfillment center). The single fulfillment center count was taken during the December holiday shopping season.

The single surveyed parcel hub HCW has significantly higher rates for both cars and trucks during both the AM and PM peak hours (as is the case for daily trips at the fulfillment center).

Cold Storage

For cold storage HCW, fitted curve equations can be developed for estimating total vehicles during the AM and PM peak hours. The equations are:

- AM peak hour: $y = 0.17x - 40$ ($R^2 = 0.82$)
- PM peak hour: $y = 0.17x - 35$ ($R^2 = 0.83$)

The cold storage HCW weighted average rates during the AM and PM peak hours are, respectively, 0.103 and 0.129 total vehicle trips per 1,000 GSF. Both rates are close to the ITE *Trip Generation Manual* 9th Edition rate for all high-cube warehouses (land use code 152).

Transload and Short-Term Storage

Data plots for the AM and PM peak hours (not presented in this report) are comparable to the daily plot in terms of data scatter and little correlation. The weighted average rates for the AM and PM peak hours are:

- 0.082 total vehicles per 1,000 GSF during the AM peak hour
- 0.108 total vehicles per 1,000 GSF during the PM peak hour

As points of comparison, these rates are lower than the AM and PM weighted average rates of 0.11 and 0.12, respectively, provided in ITE *Trip Generation Manual* 9th Edition for the High-Cube Warehouse land use.

The weighted average rates for truck trips at transload and short-term storage HCWs during the AM and PM peak hours are:

- 0.024 trucks per 1,000 GSF during the AM peak hour
- 0.023 trucks per 1,000 GSF during the PM peak hour

RECOMMENDATIONS

The preceding analysis of available HCW trip generation data identified significant weaknesses in the ability to forecast vehicle trips with confidence. The following recommendations present a plan of action for quantifying necessary vehicle trip estimates to an acceptable level of precision for all types of HCWs.

Fulfillment Center HCW

The single available data point indicates that the trip generation characteristics (total vehicle trips and trips by vehicle type) for a fulfillment center HCW are significantly different from those for all other types of HCWs. A targeted data collection effort should be undertaken (as described below) to achieve a total of at least six sites. Included should be circulation of a Call for Data by ITE that specifically requests data for fulfillment centers. If future analysis reveals an unacceptable level of stability in the trip generation relationships, data should be collected at additional sites.

Parcel Hub HCW

The single available data point indicates that the trip generation characteristics (total vehicle trips and trips by vehicle type) for a parcel hub HCW are significantly different from those for all other types of HCWs. It is recommended that ITE circulate a Call for Data that specifically requests data for parcel hubs. A targeted data collection effort should be undertaken (as described below) to achieve a total of at least six sites. If future analysis reveals an unacceptable level of stability in the trip generation relationships, data should be collected at additional sites.

Cold Storage HCW

The limited data available for cold storage facilities produce acceptable levels of statistical precision for the estimation of vehicle trips. However, vehicle trip generation rates based on recently collected data are higher than those derived from data collected at least 10 years ago. It is recommended that (1) further investigation be made into the existing data and (2) additional data be collected.

The cold storage sites in the database are classified as such based on the interpretation of the data submitter. Confirmation of the applicability of the cold storage classification can be completed through determination of the proportion of the HCW building space devoted to cold storage. This information will also help in the development of a clear definition of cold storage facilities and their characteristics.

If some of the cold storage sites are reclassified, a targeted data collection effort should be undertaken (as described below) to achieve a total of at least six sites. Included should be circulation of a Call for Data by ITE that specifically requests data for cold storage facilities. If future analysis reveals an unacceptable level of stability in the trip generation relationships, data should be collected at additional sites.

Transload and Short-Term Storage HCW

The current database of sites for this subset of HCW types has been separated in accordance with building and dock configurations specified earlier in this report. To use a metaphor, it is possible that instead of separating the sites into apples and oranges, the sites have been separated into two sets that each contain both apples and oranges. The result is a pair of databases that (1) are not significantly different from each other in terms of trip generation and (2) do not yield satisfactory levels of correlation between building gross square footage and vehicle trips. It is possible that a more accurate allocation of the available data points between the two types of HCWs could produce better predictive relationships.

It is recommended that an analysis and evaluation of potential stratifications be undertaken and an appropriate set of data (along with a weighted average rate) be selected for use as interim rates until further study is complete (as described below).

Overall

It is recommended that a targeted data collection plan be undertaken in an attempt to further define and identify relationships between potential independent variables and vehicle trips generated at each type of HCW. A six-step process is presented below.

Step 1: Select 15 Sites[12] with Similar Characteristics for Data Collection and Further Analysis

- For each site, compile the data specified earlier in Table 3
- If the Table 3 data are available for the sites at which SCAQMD or NAIOP collected data, these sites and their data can be considered part of the initial 15
- Limit sites to one or two metropolitan regions. Preference should be given to a region with an existing freight model that disaggregates truck trips and commodity flow to the county or traffic analysis zone level, for cross-referencing purposes.

Step 2: Collect Data at the Initial 15 Sites

- Collect the vehicle volume data specified in Table 8

Step 3: Analyze Complete Data for Consistency and Correlation with One or More Independent Variables

- If consistency and correlations are found, skip to Step 5

Step 4: Identify 15 Additional Sites and Undertake Data Collection

- Summarize and analyze results, assessing consistency
- The results will set an approximate expectation for future data. They may be described statistically and/or in other clear terms.
- If variability is still considered significantly high by ITE standards, assess probable causes, further partition data into more subgroups, and reanalyze data. Use results to determine how to classify warehouse types for future data collection.

Step 5: Identify 15 Sites and Collect Data for Next Priority HCW Classification

- 15-30 sites (including usable existing data) in at least two metropolitan regions (may be selected to reflect funding sources)
- 3 year-long counts
- Compare year-long counts from second HCW type with those from first HCW type to determine if additional year-long counts are needed to show variability in different types of HCWs

[12] For a database with substantial uniformity in the characteristics that influence trip generation, a relatively small number of sites can produce predictive relationships with excellent statistical reliability (for example, perhaps the cold storage facilities). However, for sites with substantial variability, a database total of approximately 30 sites is typically recommended based on the central limit theorem. The theorem states that the sampling distribution of the means will approach that of a normal distribution with that quantity of data points even if the population being sampled is not normally distributed.

Step 6: Summarize and analyze data for each type of HCW, developing rates and equations where correlation is suitable. Identify patterns, trends, and other findings relevant to estimating HCW trip generation for use in TIAs and AQAs. Assess how many HCW types are needed/justified.

Table 8. Minimum Data Collection for Each HCW Type

• 15 sites including those for which there are usable existing data
• One or two metropolitan regions – preference should be for a region with an existing freight model that disaggregates truck trips and commodity flow to the county or TAZ level, for cross-referencing purposes
• Similar site characteristics (to minimize variability of results (desirably most common in metro region where data to be collected)
• 1-2 NAICS industrial codes – we may need to loosen this requirement in order to find 15 acceptable sites in a single metropolitan area; we may need to use data from sites in multiple metropolitan areas; should be used in site selection process, not as a prescriptive requirement
• Year-long count at 3 sites
• All counts by video; all files to be retained for possible future use; examine via simultaneous video and tube counts what the discrepancy rates might be for purpose classification based physical vehicle types and standard FHWA classes versus actually seeing the trucks on video
• All counts to follow ITE site trip generation count procedures with counts being made directionally by vehicle classification and recorded by driveway, by direction, and by 15 minute period so they can be checked (and reconstructed if necessary)

APPENDIX A. SUPPLEMENTAL DETAILED DATA ANALYSIS

Data Analysis Process

The database of 106 HCWs with vehicle trip generation data consists of one fulfillment center, one parcel hub, nine cold storage, 56 transload, and 39 short-term storage.

For each data record, a range of traffic count data is available.

- For many records, a daily count is provided. For many records, AM and PM peak hour traffic counts are provided.
- For some data records, the count data is reported simply as total vehicles. In some records, the vehicle counts are classified as cars or trucks. In some records, the vehicle counts are classified as cars and trucks, disaggregated by number of axles.

The data were disaggregated and aggregated in a variety of ways to help determine the effects of certain potential variables on vehicle trip generation.

- The entire database for each facility type
- Only the recent SCAQMD-sponsored data collection sites
- Only the recent NAIOP-sponsored data collection sites
- The combination of the recent SCAQMD- and NAIOP-sponsored data collection sites
- All data except for the recent SCAQMD- and NAIOP-sponsored data collection sites
- Sites with at least 500,000 gross square footage
- Sites with at least 800,000 gross square footage
- Sites with at least 1 million gross square footage
- Sites with data collected prior to 2007
- Sites with data collected after 2006
- Sites with data collected prior to 2010
- Sites with data collected after 2009
- Only California sites
- Only sites with close proximity to major port facilities

The vehicle count data were analyzed separately for the fulfillment center, parcel hub, cold storage, transload, and short-term storage HCWs.

- The results for fulfillment center, parcel hub, and cold storage are distinctly different from each other and are addressed separately below
- The results for transload and short-term storage HCWs are not substantially different from each other and are treated in combination below

The database enabled the compilation of over 1,500 subsets of HCW trip generation data that reflect:

- 7 different combinations of building types,
- 6 different sets for individual vehicle classifications or combinations,
- 13 different subsets of the database, and
- 3 different time periods (daily, AM, PM)

Weighted averages of vehicles per 1,000 gross square feet in the building were computed for each subset. Data plots with best fit linear curves were prepared for each subset. Examination of the data yields very few definitive relationships between site characteristics and vehicle trip generation. Key findings from these analyses are presented below.

Cars vs. Total Vehicles

Table A1 presents the weighted averages for cars, trucks, and 5+ axle trucks as a percentage of total daily vehicles measured at HCW sites. Separate calculations are presented for the entire database and for13 different subsets. When the complete set is included, the overall average is approximately 68 percent cars and 32 percent trucks of the total daily vehicles. There is minimal variation between the most recent data sources (SCAQMD and NAIOP) or between different building sizes. However, the more recent average data (post-2006 and post-2009) has a higher proportion of cars than does the older data collection sites.

Table A1. Weighted Averages for Percentage of Total Daily Vehicles for Cars and Trucks

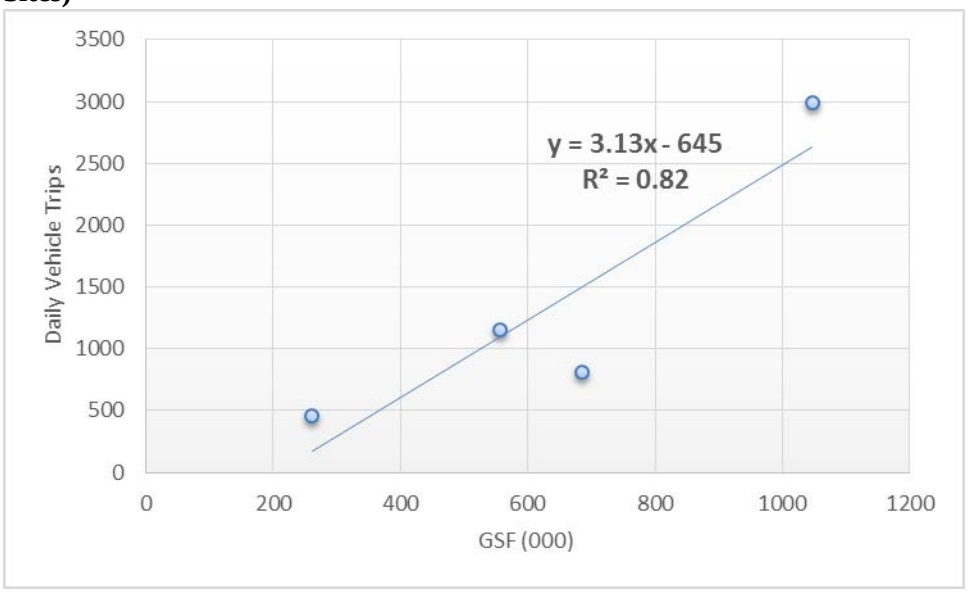
Data Site Subset	Percentage of Total Daily Vehicles		
	Cars	Trucks	5+ Axle Trucks
All	67.8%	32.2%	19.4%
SCAQMD	69.0	31.0	17.7
NAIOP	68.6	31.4	21.8
SCAQMD & NAIOP	68.8	31.2	19.0
Non-SCAQMD or NAIOP	66.6	33.4	---
More than 500,000 GSF	68.7	31.3	19.2
More than 800,000 GSF	69.4	30.6	18.5
More than 1,000,000 GSF	70.3	29.7	21.2
Pre-2007	62.1	37.9	---
Post-2006	70.1	29.9	19.5
Pre-2010	60.9	39.1	28.2
Post-2009	70.7	29.3	19.0
California Only	67.6	32.4	18.9

Cold Storage HCW

If the cold storage HCW data are restricted to only include data collected under sponsorship of SCAQMD and NAIOP within the past eight years, the correlation between daily total vehicles and site gross square footage can be improved beyond the full dataset correlation. Figure A1 presents the data plot and associated fitted curve[13]. As recommended in ITE *Trip Generation Handbook* 3rd Edition, the fitted curve should be considered acceptable only within the building site size range in the dataset.

[13] Granted, the improved correlation in Figure A3 is due in part to requiring correlation to only four data points.

Figure A1. Correlation between Daily Total Vehicles and Cold Storage GSF (SCAQMD & NAIOP Sites)



Correlation is also exhibited for cars, trucks, and 5+ axle trucks for daily traffic generated at cold storage facilities. Figures A2, A3, and A4 present the data plots for cars, trucks, and 5+ axle trucks, respectively. As recommended in ITE *Trip Generation Handbook* 3rd Edition, the fitted curves should be considered acceptable only within the building site size range in the dataset.

Figure A2. Correlation between Daily Cars and Cold Storage GSF (SCAQMD & NAIOP Sites)

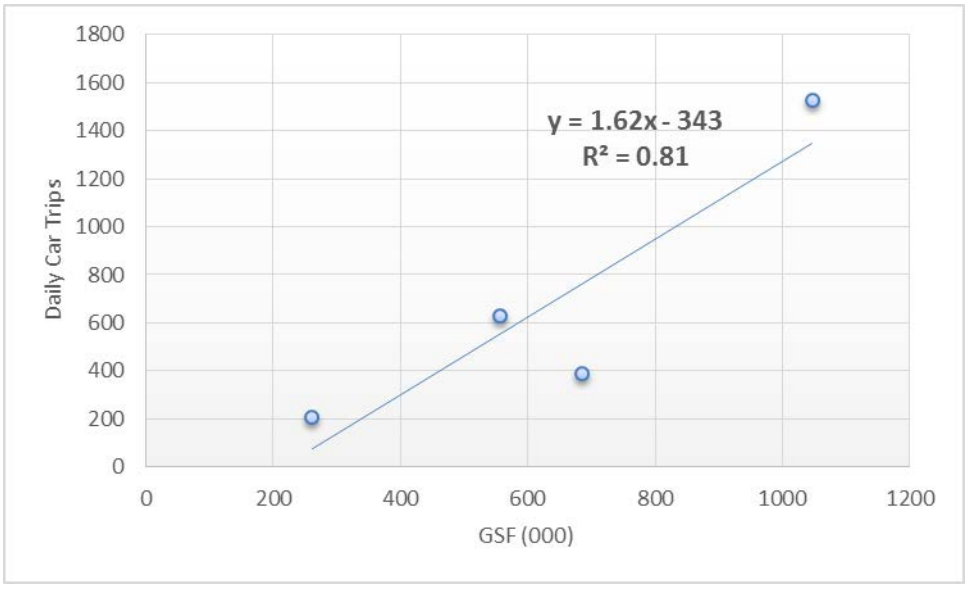


Figure A3. Correlation between Daily Trucks and Cold Storage GSF (SCAQMD & NAIOP Sites)

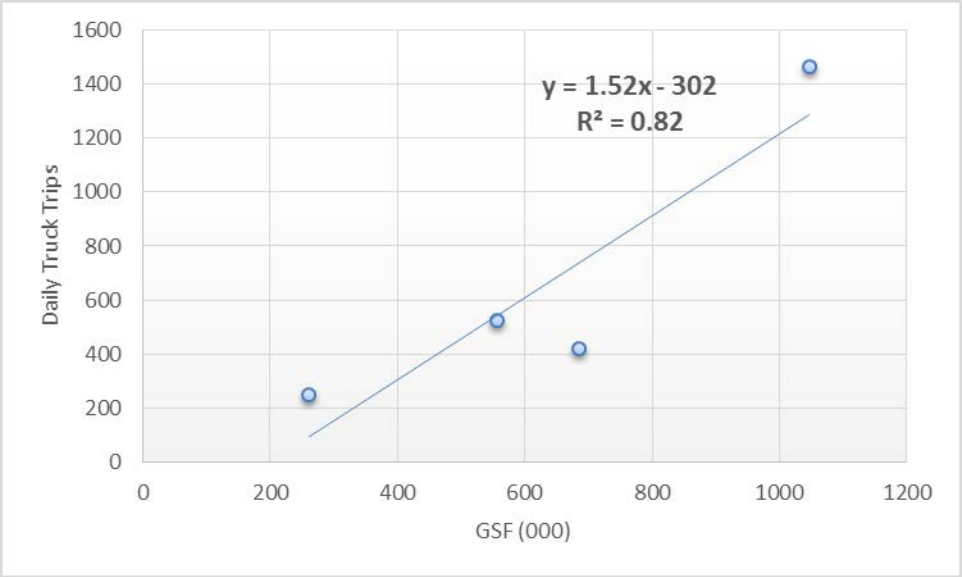


Figure A4. Correlation between Daily 5+ Axle Trucks and Cold Storage GSF (SCAQMD & NAIOP Sites)

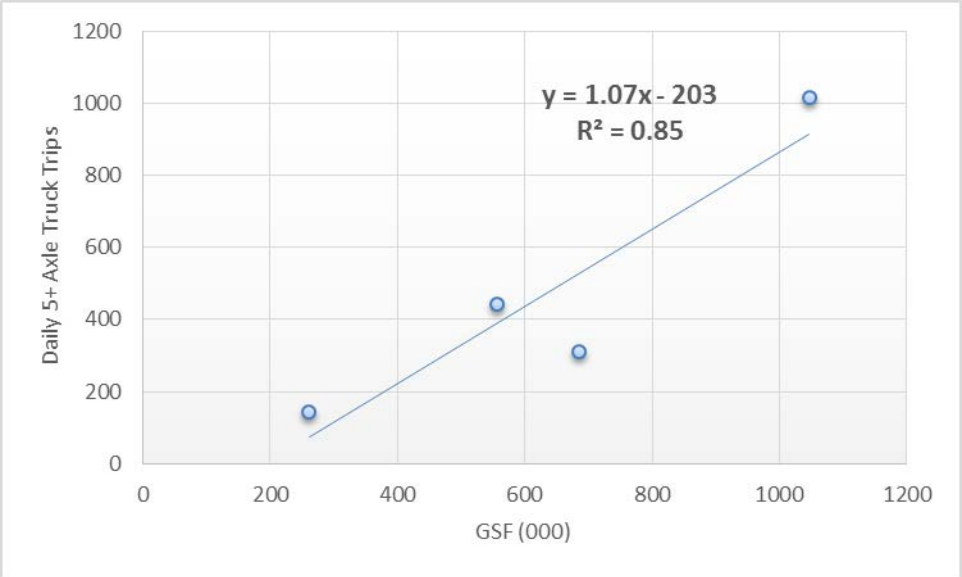


Table A2 presents the weighted average rates for all vehicles, cars, trucks, and 5+ axle trucks per 1,000 GSF at cold storage sites. Separate calculations are presented for the complete database plus 13 different subsets. When the complete set is included, the overall weighted average rate for all vehicles is 2.12. The rate is nearly identical whether calculated with only the SCAQMD and NAIOP data or with the other data points in the complete dataset.

Another observation from the table is that newer data (post-2006 and post-2009) have higher rates than do the older data, sometimes substantially higher. The newer and older datasets are comprised of relatively small numbers of data points, 6 and 3, respectively. Additional data points would be helpful to derive a more reliable estimate of cold storage HCW trip generation.

Table A2. Weighted Average Rates for Daily Trips at Cold Storage Facilities

Data Site Subset (Cold Storage)	Weighted Average for Daily Trips per 1,000 GSF			
	All Vehicles	Cars	Trucks	5+ Axle Trucks
All (9)	2.115	1.282	0.836	0.749 (4)
SCAQMD (3)	2.466	1.265	1.201	0.858
NAIOP (1)	1.179	0.564	0.615	0.455
SCAQMD & NAIOP (4)	2.120	1.077	1.043	0.749
Non-SCAQMD or NAIOP (5)	2.111	1.449	0.667	---
More than 500,000 GSF (5)	2.009	1.121	0.888	0.772
More than 800,000 GSF (3)	2.179	1.242	0.938	0.968
More than 1,000,000 GSF (3)	2.179	1.242	0.938	0.968
Pre-2007 (3)	1.868	1.134	0.706	---
Post-2006 (6)	2.278	1.368	0.910	0.749
Pre-2010 (3)	1.868	1.134	0.706	---
Post-2009 (6)	2.278	1.368	0.910	0.749
California Only (5)	2.114	1.077	1.043	0.749
Port Only (5)	2.114	1.077	1.043	0.749

Note: The values in parentheses represent the number of data collection sites for that particular subset of cold storage sites.

Tables A3 and A4 repeat the information presented in Table A2, but for the AM and PM peak hours, respectively.

Table A3. Weighted Average Rates for AM Peak Hour Trips at Cold Storage Facilities

Data Site Subset (Cold Storage)	Weighted Average for AM Peak Hour Trips per 1,000 GSF			
	All Vehicles	Cars	Trucks	5+ Axle Trucks
All (9)	0.103	0.061	0.038	0.027
SCAQMD (3)	0.124	0.070	0.054	0.026
NAIOP (1)	0.071	0.039	0.032	0.029
SCAQMD & NAIOP (4)	0.110	0.062	0.048	0.027
Non-SCAQMD or NAIOP (5)	0.098	0.061	0.030	---
More than 500,000 GSF (5)	0.092	0.054	0.038	0.028
More than 800,000 GSF (3)	0.099	0.058	0.041	0.030
More than 1,000,000 GSF (3)	0.099	0.058	0.041	0.030
Pre-2007 (3)	0.084	0.046	0.025	---
Post-2006 (6)	0.115	0.070	0.045	0.027
Pre-2010 (3)	0.084	0.046	0.025	---
Post-2009 (6)	0.115	0.070	0.045	0.027
California Only (5)	0.116	0.062	0.048	0.027
Port Only (5)	0.116	0.062	0.048	0.027

Note: The values in parentheses represent the number of data collection sites for that particular subset of cold storage sites.

Table A4. Weighted Average Rates for PM Peak Hour Trips at Cold Storage Facilities

Data Site Subset (Cold Storage)	Weighted Average for PM Peak Hour Trips per 1,000 GSF			
	All Vehicles	Cars	Trucks	5+ Axle Trucks
All (9)	0.117	0.080	0.037	0.029
SCAQMD (3)	0.129	0.087	0.042	0.031
NAIOP (1)	0.089	0.050	0.039	0.026
SCAQMD & NAIOP (4)	0.118	0.077	0.041	0.029
Non-SCAQMD or NAIOP (5)	0.117	0.083	0,034	---
More than 500,000 GSF (5)	0.106	0.069	0.037	0.029
More than 800,000 GSF (3)	0.116	0.079	0.037	0.029
More than 1,000,000 GSF (3)	0.116	0.079	0.037	0.029
Pre-2007 (3)	0.097	0.058	0.037	---
Post-2006 (6)	0.131	0.093	0.038	0.029
Pre-2010 (3)	0.097	0.058	0.037	---
Post-2009 (6)	0.131	0.093	0.038	0.029
California Only (5)	0.117	0.077	0.041	0.029
Port Only (5)	0.117	0.077	0.041	0.029

Note: Values in parentheses represent the number of data collection sites for that particular subset.

Transload and Short-Term Storage HCW

Weighted average rates for daily trips at transload and short-term storage HCWs are listed in Table A5 for four vehicle classifications (all vehicles, car, truck, and 5+ axle truck) and for the complete database plus 13 subsets. One observation about the data is that the more recent data sites have, on average, lower daily trip generation rates (for all vehicle types) than the older sites[14]. This relationship is also found for the AM and PM peak hours presented in Tables A6 and A7.

Table A5. Weighted Average Rates for Daily Trips at Transload and Short-Term Storage HCW

Data Site Subset (Transload & Short-Term Storage)	Weighted Average for Daily Trips per 1,000 GSF			
	All Vehicles	Cars	Trucks	5+ Axle Trucks
All	1.432	1.000	0.454	0.233
SCAQMD	1.412	1.006	0.406	0.217
NAIOP	1.069	0.749	0.339	0.276
SCAQMD & NAIOP	1.275	0.901	0.374	0.221
Non-SCAQMD or NAIOP	1.701	1.183	0.603	---
More than 500,000 GSF	1.433	1.008	0.431	0.223
More than 800,000 GSF	1.417	0.978	0.405	0.200
More than 1,000,000 GSF	1.493	1.044	0.392	0.257
Pre-2007	1.653	1.203	0.732	---
Post-2006	1.397	0.994	0.402	0.233
Pre-2010	1.621	1.097	0.708	0.614
Post-2009	1.347	0.970	0.377	0.221
California Only	1.226	0.871	0.388	0.221
Port Only	1.258	0.871	0.388	0.221
ITE *Trip Generation Manual* – 9th Edition	1.68	--	--	--

[14] A decline in HCW auto traffic is likely because of a reduction in employee density as HCWs have become more automated. The reduction in truck trips does not have a clear explanation. Continued data collection is recommended to enable the development of current trip generation rates that do not need to rely on older data.

Tables A6 and A7 list the weighted average rates for the AM and PM peak hours, respectively.

Table A6. Weighted Average Rates for AM Peak Hour Trips at Transload and Short-Term Storage HCW

Data Site Subset (Transload & Short-Term Storage)	Weighted Average for AM Peak Hour Trips per 1,000 GSF			
	All Vehicles	Cars	Trucks	5+ Axle Trucks
All	0.082	0.057	0.024	0.015
SCAQMD	0.073	0.049	0.024	0.013
NAIOP	0.060	0.040	0.019	0.016
SCAQMD & NAIOP	0.068	0.046	0.022	0.014
Non-SCAQMD or NAIOP	0.100	0.075	0.028	0.022
More than 500,000 GSF	0.078	0.055	0.023	0.014
More than 800,000 GSF	0.074	0.050	0.022	0.014
More than 1,000,000 GSF	0.078	0.049	0.025	0.022
Pre-2007	0.110	0.087	0.032	0.016
Post-2006	0.079	0.057	0.022	0.015
Pre-2010	0.101	0.073	0.032	0.022
Post-2009	0.072	0.051	0.021	0.014
California Only	0.067	0.045	0.023	0.014
Port Only	0.071	0.046	0.023	0.014
ITE *Trip Generation Manual* – 9th Edition	0.11			

Table A7. Weighted Average Rates for PM Peak Hour Trips at Transload and Short-Term Storage HCW

Data Site Subset (Transload & Short-Term Storage)	Weighted Average for PM Peak Hour Trips per 1,000 GSF			
	All Vehicles	Cars	Trucks	5+ Axle Trucks
All	0.108	0.086	0.023	0.010
SCAQMD	0.081	0.060	0.021	0.010
NAIOP	0.091	0.075	0.016	0.010
SCAQMD & NAIOP	0.085	0.066	0.019	0.010
Non-SCAQMD or NAIOP	0.135	0.117	0.028	0.015
More than 500,000 GSF	0.108	0.087	0.022	0.010
More than 800,000 GSF	0.110	0.087	0.022	0.009
More than 1,000,000 GSF	0.120	0.097	0.019	0.010
Pre-2007	0.145	0.133	0.031	0.012
Post-2006	0.107	0.086	0.020	0.010
Pre-2010	0.141	0.122	0.031	0.015
Post-2009	0.091	0.072	0.019	0.010
California Only	0.082	0.063	0.019	0.010
Port Only	0.086	0.065	0.019	0.010
ITE *Trip Generation Manual* – 9th Edition	0.12			

Tables A5, A6, and A7 also include the ITE *Trip Generation Manual* 9th Edition, weighted average rate for high-cube warehouses (land use code 152). The data analyzed in this report generally produce lower rates than contained in *Trip Generation Manual*.

Intersection	
Int Delay, s/veh	33.4

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	695	190	90	250	70	215
Future Vol, veh/h	695	190	90	250	70	215
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	4	3	8	13	14	5
Mvmt Flow	755	207	98	272	76	234

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	962	0	1327	859
Stage 1	-	-	-	-	859	-
Stage 2	-	-	-	-	468	-
Critical Hdwy	-	-	4.18	-	6.54	6.25
Critical Hdwy Stg 1	-	-	-	-	5.54	-
Critical Hdwy Stg 2	-	-	-	-	5.54	-
Follow-up Hdwy	-	-	2.272	-	3.626	3.345
Pot Cap-1 Maneuver	-	-	692	-	162	352
Stage 1	-	-	-	-	396	-
Stage 2	-	-	-	-	606	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	692	-	135	352
Mov Cap-2 Maneuver	-	-	-	-	135	-
Stage 1	-	-	-	-	396	-
Stage 2	-	-	-	-	505	-

Approach	EB	WB	NB
HCM Control Delay, s	0	2.9	173.7
HCM LOS			F

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	252	-	-	692	-
HCM Lane V/C Ratio	1.229	-	-	0.141	-
HCM Control Delay (s)	173.7	-	-	11.1	0
HCM Lane LOS	F	-	-	B	A
HCM 95th %tile Q(veh)	15	-	-	0.5	-

Intersection	
Int Delay, s/veh	2.8

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	795	80	30	320	45	10
Future Vol, veh/h	795	80	30	320	45	10
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	4	56	63	5	74	75
Mvmt Flow	864	87	33	348	49	11

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	951	0	1322	908
Stage 1	-	-	-	-	908	-
Stage 2	-	-	-	-	414	-
Critical Hdwy	-	-	4.73	-	7.14	6.95
Critical Hdwy Stg 1	-	-	-	-	6.14	-
Critical Hdwy Stg 2	-	-	-	-	6.14	-
Follow-up Hdwy	-	-	2.767	-	4.166	3.975
Pot Cap-1 Maneuver	-	-	526	-	123	249
Stage 1	-	-	-	-	297	-
Stage 2	-	-	-	-	537	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	526	-	113	249
Mov Cap-2 Maneuver	-	-	-	-	113	-
Stage 1	-	-	-	-	297	-
Stage 2	-	-	-	-	495	-

Approach	EB	WB	NB
HCM Control Delay, s	0	1.1	57.8
HCM LOS			F

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	125	-	-	526	-
HCM Lane V/C Ratio	0.478	-	-	0.062	-
HCM Control Delay (s)	57.8	-	-	12.3	0
HCM Lane LOS	F	-	-	B	A
HCM 95th %tile Q(veh)	2.2	-	-	0.2	-

Intersection	
Int Delay, s/veh	4.4

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	395	380	65	195	155	25
Future Vol, veh/h	395	380	65	195	155	25
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	350	180	-	0	50
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	5	2	2	14	12
Mvmt Flow	429	413	71	212	168	27

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	842	0	783	429
Stage 1	-	-	-	-	429	-
Stage 2	-	-	-	-	354	-
Critical Hdwy	-	-	4.12	-	6.54	6.32
Critical Hdwy Stg 1	-	-	-	-	5.54	-
Critical Hdwy Stg 2	-	-	-	-	5.54	-
Follow-up Hdwy	-	-	2.218	-	3.626	3.408
Pot Cap-1 Maneuver	-	-	794	-	346	605
Stage 1	-	-	-	-	632	-
Stage 2	-	-	-	-	685	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	794	-	315	605
Mov Cap-2 Maneuver	-	-	-	-	315	-
Stage 1	-	-	-	-	632	-
Stage 2	-	-	-	-	624	-

Approach	EB	WB	NB
HCM Control Delay, s	0	2.5	26.4
HCM LOS			D

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	315	605	-	-	794	-
HCM Lane V/C Ratio	0.535	0.045	-	-	0.089	-
HCM Control Delay (s)	28.8	11.2	-	-	10	-
HCM Lane LOS	D	B	-	-	A	-
HCM 95th %tile Q(veh)	3	0.1	-	-	0.3	-

Intersection	
Int Delay, s/veh	0.7

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	35	855	335	20	15	40
Future Vol, veh/h	35	855	335	20	15	40
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	Stop
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	0	2	2	4	2	0
Mvmt Flow	38	929	364	22	16	43

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	386	0	-	0	1380	375
Stage 1	-	-	-	-	375	-
Stage 2	-	-	-	-	1005	-
Critical Hdwy	4.1	-	-	-	6.42	6.2
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.2	-	-	-	3.518	3.3
Pot Cap-1 Maneuver	1184	-	-	-	159	676
Stage 1	-	-	-	-	695	-
Stage 2	-	-	-	-	354	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1184	-	-	-	149	676
Mov Cap-2 Maneuver	-	-	-	-	149	-
Stage 1	-	-	-	-	649	-
Stage 2	-	-	-	-	354	-

Approach	EB	WB	SB
HCM Control Delay, s	0.3	0	12.4
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1184	-	-	-	546
HCM Lane V/C Ratio	0.032	-	-	-	0.109
HCM Control Delay (s)	8.1	0	-	-	12.4
HCM Lane LOS	A	A	-	-	B
HCM 95th %tile Q(veh)	0.1	-	-	-	0.4

Intersection	
Int Delay, s/veh	615.6

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	255	150	390	635	160	230
Future Vol, veh/h	255	150	390	635	160	230
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	4	3	8	13	14	5
Mvmt Flow	277	163	424	690	174	250

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	440	0	1897	359
Stage 1	-	-	-	-	359	-
Stage 2	-	-	-	-	1538	-
Critical Hdwy	-	-	4.18	-	6.54	6.25
Critical Hdwy Stg 1	-	-	-	-	5.54	-
Critical Hdwy Stg 2	-	-	-	-	5.54	-
Follow-up Hdwy	-	-	2.272	-	3.626	3.345
Pot Cap-1 Maneuver	-	-	1089	-	~ 71	679
Stage 1	-	-	-	-	681	-
Stage 2	-	-	-	-	183	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1089	-	~ 26	679
Mov Cap-2 Maneuver	-	-	-	-	~ 26	-
Stage 1	-	-	-	-	681	-
Stage 2	-	-	-	-	~ 68	-

Approach	EB	WB	NB
HCM Control Delay, s	0	4	$ 2862.5
HCM LOS			F

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	60	-	-	1089	-
HCM Lane V/C Ratio	7.065	-	-	0.389	-
HCM Control Delay (s)	$ 2862.5	-	-	10.4	0
HCM Lane LOS	F	-	-	B	A
HCM 95th %tile Q(veh)	48.8	-	-	1.9	-

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

Intersection	
Int Delay, s/veh	6.2

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	335	30	20	960	55	60
Future Vol, veh/h	335	30	20	960	55	60
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	4	56	63	5	74	75
Mvmt Flow	364	33	22	1043	60	65

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	397	0	1468	381
Stage 1	-	-	-	-	381	-
Stage 2	-	-	-	-	1087	-
Critical Hdwy	-	-	4.73	-	7.14	6.95
Critical Hdwy Stg 1	-	-	-	-	6.14	-
Critical Hdwy Stg 2	-	-	-	-	6.14	-
Follow-up Hdwy	-	-	2.767	-	4.166	3.975
Pot Cap-1 Maneuver	-	-	896	-	98	532
Stage 1	-	-	-	-	558	-
Stage 2	-	-	-	-	238	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	896	-	92	532
Mov Cap-2 Maneuver	-	-	-	-	92	-
Stage 1	-	-	-	-	558	-
Stage 2	-	-	-	-	224	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.2	77.6
HCM LOS			F

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	162	-	-	896	-
HCM Lane V/C Ratio	0.772	-	-	0.024	-
HCM Control Delay (s)	77.6	-	-	9.1	0
HCM Lane LOS	F	-	-	A	A
HCM 95th %tile Q(veh)	4.9	-	-	0.1	-

Intersection	
Int Delay, s/veh	92.2

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	205	205	60	585	380	65
Future Vol, veh/h	205	205	60	585	380	65
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	350	180	-	0	50
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	5	2	2	14	12
Mvmt Flow	223	223	65	636	413	71

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	446	0	989	223
Stage 1	-	-	-	-	223	-
Stage 2	-	-	-	-	766	-
Critical Hdwy	-	-	4.12	-	6.54	6.32
Critical Hdwy Stg 1	-	-	-	-	5.54	-
Critical Hdwy Stg 2	-	-	-	-	5.54	-
Follow-up Hdwy	-	-	2.218	-	3.626	3.408
Pot Cap-1 Maneuver	-	-	1114	-	~ 260	792
Stage 1	-	-	-	-	786	-
Stage 2	-	-	-	-	438	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1114	-	~ 245	792
Mov Cap-2 Maneuver	-	-	-	-	~ 245	-
Stage 1	-	-	-	-	786	-
Stage 2	-	-	-	-	~ 413	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.8	$ 309.7
HCM LOS			F

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	245	792	-	-	1114	-
HCM Lane V/C Ratio	1.686	0.089	-	-	0.059	-
HCM Control Delay (s)	$ 361	10	-	-	8.4	-
HCM Lane LOS	F	B	-	-	A	-
HCM 95th %tile Q(veh)	26.8	0.3	-	-	0.2	-

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

Intersection	
Int Delay, s/veh	0.8

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	40	340	990	20	15	20
Future Vol, veh/h	40	340	990	20	15	20
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	Stop
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	0	2	2	2	4	0
Mvmt Flow	43	370	1076	22	16	22

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	1098	0	-	0	1543	1087
Stage 1	-	-	-	-	1087	-
Stage 2	-	-	-	-	456	-
Critical Hdwy	4.1	-	-	-	6.44	6.2
Critical Hdwy Stg 1	-	-	-	-	5.44	-
Critical Hdwy Stg 2	-	-	-	-	5.44	-
Follow-up Hdwy	2.2	-	-	-	3.536	3.3
Pot Cap-1 Maneuver	643	-	-	-	125	265
Stage 1	-	-	-	-	321	-
Stage 2	-	-	-	-	634	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	643	-	-	-	115	265
Mov Cap-2 Maneuver	-	-	-	-	115	-
Stage 1	-	-	-	-	294	-
Stage 2	-	-	-	-	634	-

Approach	EB	WB	SB
HCM Control Delay, s	1.2	0	20.6
HCM LOS			C

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	643	-	-	-	268
HCM Lane V/C Ratio	0.068	-	-	-	0.142
HCM Control Delay (s)	11	0	-	-	20.6
HCM Lane LOS	B	A	-	-	C
HCM 95th %tile Q(veh)	0.2	-	-	-	0.5

2003 MUTCD

TRAFFIC SIGNAL WARRANT ANALYSIS (VOLUME BASED)

Intersection: Bartlett Street at Lynman Street

Major Street Direction: Eastbound-Westbound

Year: 2027 **Condition:** Build -Peak Conditions

Operating speed on major roadway: 45 mph

Number of approaches: 3

Required approach volumes

			Minimum*	Adjusted Minimum**
Warrant 1	**EIGHT-HOUR VEHICULAR VOLUME**			
Warrant 1A	MINIMUM VEHICULAR VOLUME (8 hours of day)			
	Major Street :	1 Lane(s) on each approach	500	350
	Minor Street :	1 Lane(s) on each approach	150	105
Warrant 1B	INTERRUPTION OF CONTINUOUS TRAFFIC (8 hours of day)			
	Major Street :	1 Lane(s) on each approach	750	525
	Minor Street :	1 Lane(s) on each approach	75	53
	80 PERCENT SATISFACTION OF WARRANT 1A **AND** WARRANT 1B		Warrant 1A	Warrant 1B
	Major Street :	1 Lane(s) on each approach	400	600
	Minor Street :	1 Lane(s) on each approach	120	60

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

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

Hour	Entering Vol. Minor Road+	Entering Vol. on Major Road Eastbound	Entering Vol. on Major Road Westbound	Tot. Ent. Vol. On Major Rd	Meets the following volume-based warrants? 1A	1B	80%(1A&1B)	2	3
6:00 - 7:00 AM				0	No	No	No	No	No
7:00 - 8:00 AM	295	885	340	1225	Yes	Yes	Yes	Yes	Yes
8:00 - 9:00 AM	295	885	340	1225	Yes	Yes	Yes	Yes	Yes
9:00 - 10:00 AM				0	No	No	No	No	No
10:00 - 11:00 AM				0	No	No	No	No	No
11:00 - 12:00 AM				0	No	No	No	No	No
12:00 - 1:00 PM				0	No	No	No	No	No
1:00 - 2:00 PM				0	No	No	No	No	No
2:00 - 3:00 PM				0	No	No	No	No	No
3:00 - 4:00 PM				0	No	No	No	No	No
4:00 - 5:00 PM	390	405	1025	1430	Yes	Yes	Yes	Yes	Yes
5:00 - 6:00 PM	390	405	1025	1430	Yes	Yes	Yes	Yes	Yes
6:00 - 7:00 PM				0	No	No	No	No	No
					No	No	No	Yes	Yes
			Warrants Met?			1		2	3
						NO		Yes	Yes

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

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

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

NON-VOLUME-BASED WARRANTS

Warrant 4, Minimum Pedestrian Volume: No

Peak Four Hour Pedestrian Volumes: 0

(non-concurrent) 0

0

0

Warrant 5, School Crossing:

See MUTCD for details.

Warrant 7, Crash Experience: No

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

Warrant 6, Coordinated Signal System:

See MUTCD for details.

Warrant 8, Roadway Network:

See MUTCD for details.

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

last updated: 08/05/05 [version]

ITE TRIP GENERATION WORKSHEET
(10th Edition, Updated 2017)

LANDUSE: Warehousing
LANDUSE CODE: 150
LOCATION: General Urban / Suburban
JOB NAME:
JOB NUMBER:

Independent Variable --- 1,000 Sq. Feet Gross Floor Area

FLOOR AREA (KSF): 151.0

WEEKDAY

RATES:

	# Studies	R^2	Total Trip Ends Average	Low	High	Independent Variable Range Average	Low	High	Directional Distribution Enter	Exit
DAILY	29	0.93	1.74	0.15	16.93	285	1	3,200	50%	50%
AM PEAK OF GENERATOR	23	0.85	0.22	0.02	2.08	274	1	3,200	65%	35%
PM PEAK OF GENERATOR	25	0.91	0.24	0.02	1.80	275	1	3,200	24%	76%
AM PEAK (ADJACENT ST)	34	0.69	0.17	0.02	1.93	451	1	3,200	77%	23%
PM PEAK (ADJACENT ST)	47	0.65	0.19	0.01	1.80	400	1	3,200	27%	73%

TRIPS:

	BY AVERAGE Total	Enter	Exit	BY REGRESSION Total	Enter	Exit
DAILY	263	131	131	284	142	142
AM PEAK OF GENERATOR	33	22	12	47	30	16
PM PEAK OF GENERATOR	36	9	28	45	11	34
AM PEAK (ADJACENT ST)	26	20	6	43	33	10
PM PEAK (ADJACENT ST)	29	8	21	46	12	34

SATURDAY

RATES:

	# Studies	R^2	Total Trip Ends Average	Low	High	Independent Variable Range Average	Low	High	Directional Distribution Enter	Exit
DAILY	3	--	0.15	0.01	1.58	226	55	420	50%	50%
PEAK OF GENERATOR	2	--	0.05	0.01	0.22	129	55	202	64%	36%

TRIPS:

	BY AVERAGE Total	Enter	Exit	BY REGRESSION Total	Enter	Exit
DAILY	23	11	11	N/A	N/A	N/A
PEAK OF GENERATOR	8	5	3	N/A	N/A	N/A

SUNDAY

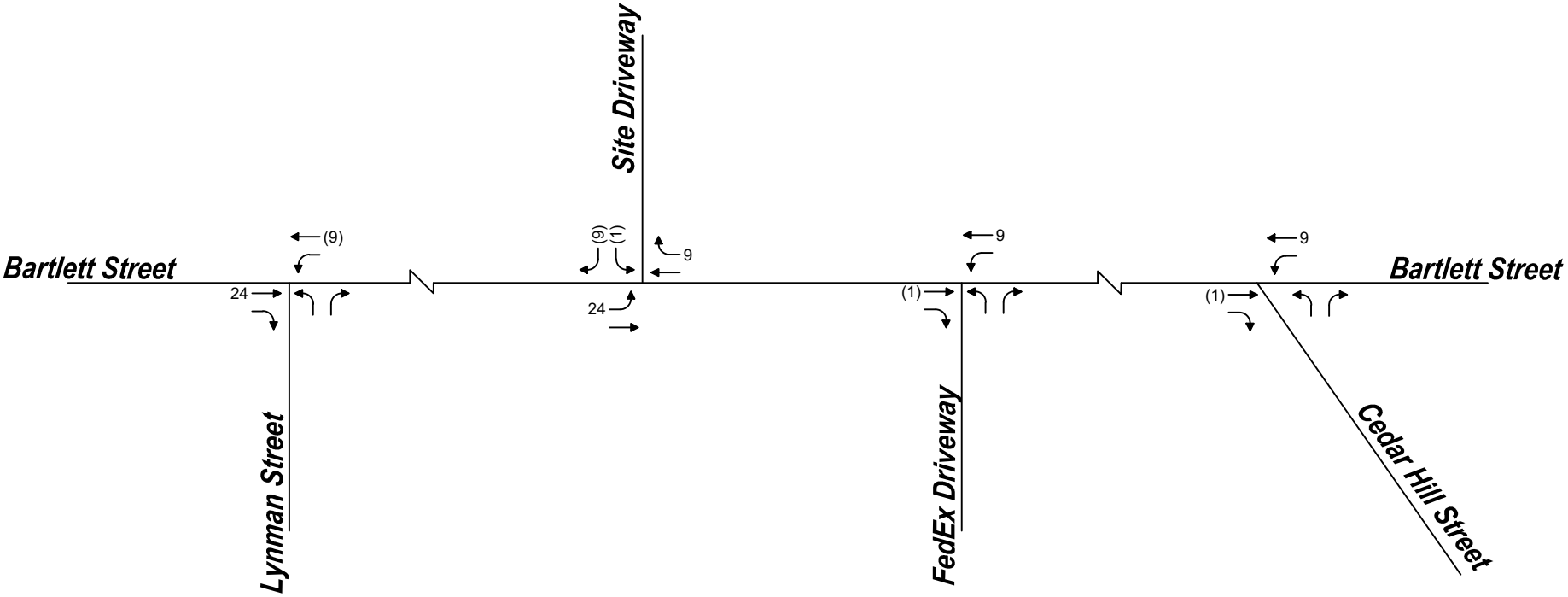
RATES:

	# Studies	R^2	Total Trip Ends Average	Low	High	Independent Variable Range Average	Low	High	Directional Distribution Enter	Exit
DAILY	3	--	0.06	0.03	0.32	226	55	420	50%	50%
PEAK OF GENERATOR	2	--	0.04	0.02	0.11	129	55	202	52%	48%

TRIPS:

	BY AVERAGE Total	Enter	Exit	BY REGRESSION Total	Enter	Exit
DAILY	9	5	5	N/A	N/A	N/A
PEAK OF GENERATOR	6	3	3	N/A	N/A	N/A

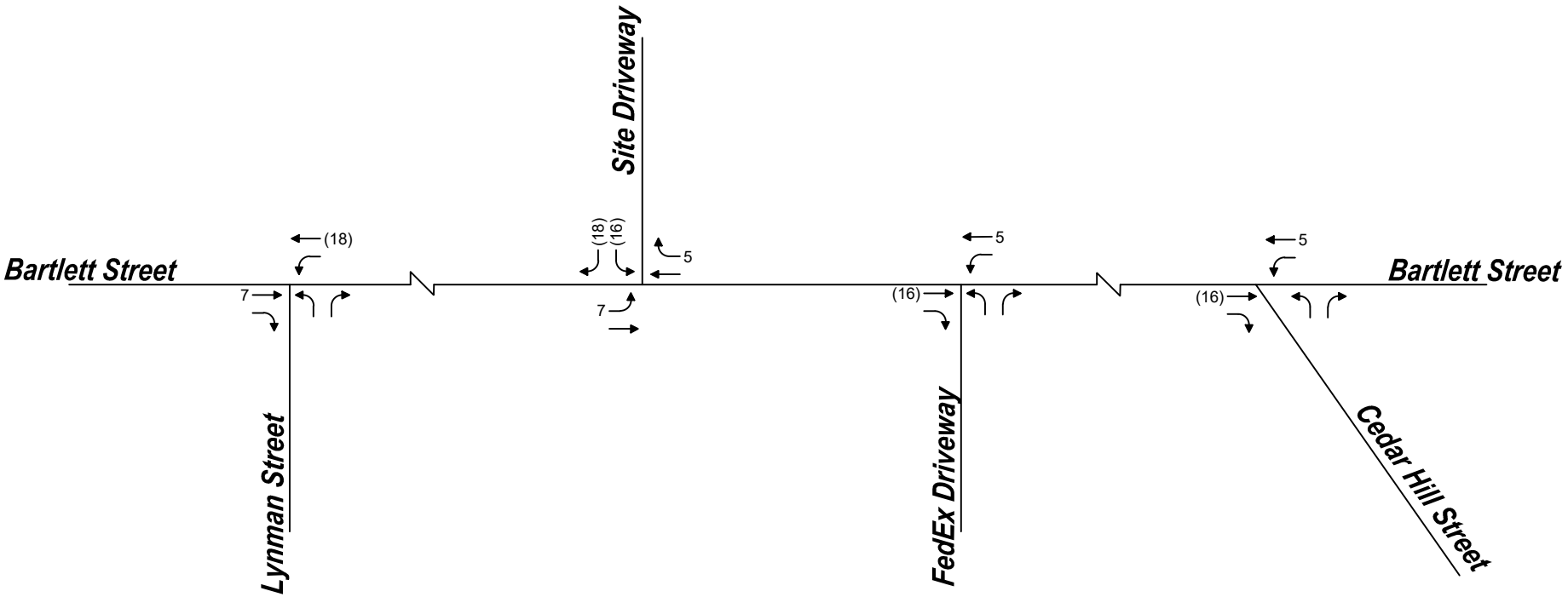
xx - Entering Trips
(xx) - Exiting Trips



Not to Scale

Figure A-1
Site-Generated Traffic Volumes
Weekday Morning Peak Hour
Warehouse Facility
Northborough, Massachusetts

xx - Entering Trips
(xx) - Exiting Trips



Not to Scale

Figure A-2
Site-Generated Traffic Volumes
Weekday Evening Peak Hour
Warehouse Facility
Northborough, Massachusetts

Intersection	
Int Delay, s/veh	11.6

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	445	165	75	160	60	195
Future Vol, veh/h	445	165	75	160	60	195
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	89	89	76	76
Heavy Vehicles, %	4	3	8	13	14	5
Mvmt Flow	484	179	84	180	79	257

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	663	0	922	574
Stage 1	-	-	-	-	574	-
Stage 2	-	-	-	-	348	-
Critical Hdwy	-	-	4.18	-	6.54	6.25
Critical Hdwy Stg 1	-	-	-	-	5.54	-
Critical Hdwy Stg 2	-	-	-	-	5.54	-
Follow-up Hdwy	-	-	2.272	-	3.626	3.345
Pot Cap-1 Maneuver	-	-	898	-	286	513
Stage 1	-	-	-	-	540	-
Stage 2	-	-	-	-	689	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	898	-	256	513
Mov Cap-2 Maneuver	-	-	-	-	256	-
Stage 1	-	-	-	-	540	-
Stage 2	-	-	-	-	617	-

Approach	EB	WB	NB
HCM Control Delay, s	0	3	41.4
HCM LOS			E

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	415	-	-	898	-
HCM Lane V/C Ratio	0.808	-	-	0.094	-
HCM Control Delay (s)	41.4	-	-	9.4	0
HCM Lane LOS	E	-	-	A	A
HCM 95th %tile Q(veh)	7.3	-	-	0.3	-

Intersection	
Int Delay, s/veh	1.4

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	605	25	10	235	25	5
Future Vol, veh/h	605	25	10	235	25	5
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	88	88	78	78	61	61
Heavy Vehicles, %	4	56	63	5	74	75
Mvmt Flow	688	28	13	301	41	8

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	716	0	1029	702
Stage 1	-	-	-	-	702	-
Stage 2	-	-	-	-	327	-
Critical Hdwy	-	-	4.73	-	7.14	6.95
Critical Hdwy Stg 1	-	-	-	-	6.14	-
Critical Hdwy Stg 2	-	-	-	-	6.14	-
Follow-up Hdwy	-	-	2.767	-	4.166	3.975
Pot Cap-1 Maneuver	-	-	660	-	192	336
Stage 1	-	-	-	-	381	-
Stage 2	-	-	-	-	594	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	660	-	187	336
Mov Cap-2 Maneuver	-	-	-	-	187	-
Stage 1	-	-	-	-	381	-
Stage 2	-	-	-	-	580	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.4	28.5
HCM LOS			D

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	202	-	-	660	-
HCM Lane V/C Ratio	0.243	-	-	0.019	-
HCM Control Delay (s)	28.5	-	-	10.6	0
HCM Lane LOS	D	-	-	B	A
HCM 95th %tile Q(veh)	0.9	-	-	0.1	-

Intersection	
Int Delay, s/veh	3.3

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	265	345	60	110	135	25
Future Vol, veh/h	265	345	60	110	135	25
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	350	180	-	0	50
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	5	2	2	14	12
Mvmt Flow	288	375	65	120	147	27

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	663	0	538	288
Stage 1	-	-	-	-	288	-
Stage 2	-	-	-	-	250	-
Critical Hdwy	-	-	4.12	-	6.54	6.32
Critical Hdwy Stg 1	-	-	-	-	5.54	-
Critical Hdwy Stg 2	-	-	-	-	5.54	-
Follow-up Hdwy	-	-	2.218	-	3.626	3.408
Pot Cap-1 Maneuver	-	-	926	-	484	728
Stage 1	-	-	-	-	734	-
Stage 2	-	-	-	-	764	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	926	-	450	728
Mov Cap-2 Maneuver	-	-	-	-	450	-
Stage 1	-	-	-	-	734	-
Stage 2	-	-	-	-	711	-

Approach	EB	WB	NB
HCM Control Delay, s	0	3.2	15.8
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	450	728	-	-	926	-
HCM Lane V/C Ratio	0.326	0.037	-	-	0.07	-
HCM Control Delay (s)	16.8	10.1	-	-	9.2	-
HCM Lane LOS	C	B	-	-	A	-
HCM 95th %tile Q(veh)	1.4	0.1	-	-	0.2	-

Intersection	
Int Delay, s/veh	192.3

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	175	135	355	425	140	185
Future Vol, veh/h	175	135	355	425	140	185
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	83	83	90	90	87	87
Heavy Vehicles, %	7	1	3	2	3	11
Mvmt Flow	211	163	394	472	161	213

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	374	0	1553	293
Stage 1	-	-	-	-	293	-
Stage 2	-	-	-	-	1260	-
Critical Hdwy	-	-	4.13	-	6.43	6.31
Critical Hdwy Stg 1	-	-	-	-	5.43	-
Critical Hdwy Stg 2	-	-	-	-	5.43	-
Follow-up Hdwy	-	-	2.227	-	3.527	3.399
Pot Cap-1 Maneuver	-	-	1179	-	~ 124	725
Stage 1	-	-	-	-	755	-
Stage 2	-	-	-	-	266	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1179	-	~ 68	725
Mov Cap-2 Maneuver	-	-	-	-	~ 68	-
Stage 1	-	-	-	-	755	-
Stage 2	-	-	-	-	~ 146	-

Approach	EB	WB	NB
HCM Control Delay, s	0	4.4	$ 820.5
HCM LOS			F

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	140	-	-	1179	-
HCM Lane V/C Ratio	2.668	-	-	0.335	-
HCM Control Delay (s)	$ 820.5	-	-	9.6	0
HCM Lane LOS	F	-	-	A	A
HCM 95th %tile Q(veh)	33.4	-	-	1.5	-

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

Intersection	
Int Delay, s/veh	0.7

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	255	15	10	760	15	25
Future Vol, veh/h	255	15	10	760	15	25
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	88	88	89	89	86	86
Heavy Vehicles, %	4	65	56	3	0	43
Mvmt Flow	290	17	11	854	17	29

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	307	0	1175	299
Stage 1	-	-	-	-	299	-
Stage 2	-	-	-	-	876	-
Critical Hdwy	-	-	4.66	-	6.4	6.63
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	-	-	2.704	-	3.5	3.687
Pot Cap-1 Maneuver	-	-	1002	-	214	654
Stage 1	-	-	-	-	757	-
Stage 2	-	-	-	-	411	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1002	-	210	654
Mov Cap-2 Maneuver	-	-	-	-	210	-
Stage 1	-	-	-	-	757	-
Stage 2	-	-	-	-	402	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.1	16.3
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	365	-	-	1002	-
HCM Lane V/C Ratio	0.127	-	-	0.011	-
HCM Control Delay (s)	16.3	-	-	8.6	0
HCM Lane LOS	C	-	-	A	A
HCM 95th %tile Q(veh)	0.4	-	-	0	-

Intersection	
Int Delay, s/veh	351.7

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	95	185	55	425	345	60
Future Vol, veh/h	95	185	55	425	345	60
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	350	180	-	0	50
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	87	25	88	88
Heavy Vehicles, %	2	9	7	3	5	7
Mvmt Flow	103	201	63	1700	392	68

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	304	0	1929	103
Stage 1	-	-	-	-	103	-
Stage 2	-	-	-	-	1826	-
Critical Hdwy	-	-	4.17	-	6.45	6.27
Critical Hdwy Stg 1	-	-	-	-	5.45	-
Critical Hdwy Stg 2	-	-	-	-	5.45	-
Follow-up Hdwy	-	-	2.263	-	3.545	3.363
Pot Cap-1 Maneuver	-	-	1229	-	~ 72	938
Stage 1	-	-	-	-	914	-
Stage 2	-	-	-	-	~ 138	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1229	-	~ 68	938
Mov Cap-2 Maneuver	-	-	-	-	~ 68	-
Stage 1	-	-	-	-	914	-
Stage 2	-	-	-	-	~ 131	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.3	$ 1930.5
HCM LOS			F

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	68	938	-	-	1229	-
HCM Lane V/C Ratio	5.765	0.073	-	-	0.051	-
HCM Control Delay (s)	$ 2264.6	9.1	-	-	8.1	-
HCM Lane LOS	F	A	-	-	A	-
HCM 95th %tile Q(veh)	43.9	0.2	-	-	0.2	-

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

Intersection	
Int Delay, s/veh	25.8

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	660	190	85	225	70	210
Future Vol, veh/h	660	190	85	225	70	210
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	4	3	8	13	14	5
Mvmt Flow	717	207	92	245	76	228

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	924	0	1250	821
Stage 1	-	-	-	-	821	-
Stage 2	-	-	-	-	429	-
Critical Hdwy	-	-	4.18	-	6.54	6.25
Critical Hdwy Stg 1	-	-	-	-	5.54	-
Critical Hdwy Stg 2	-	-	-	-	5.54	-
Follow-up Hdwy	-	-	2.272	-	3.626	3.345
Pot Cap-1 Maneuver	-	-	715	-	180	370
Stage 1	-	-	-	-	413	-
Stage 2	-	-	-	-	632	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	715	-	153	370
Mov Cap-2 Maneuver	-	-	-	-	153	-
Stage 1	-	-	-	-	413	-
Stage 2	-	-	-	-	538	-

Approach	EB	WB	NB
HCM Control Delay, s	0	3	129.4
HCM LOS			F

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	273	-	-	715	-
HCM Lane V/C Ratio	1.115	-	-	0.129	-
HCM Control Delay (s)	129.4	-	-	10.8	0
HCM Lane LOS	F	-	-	B	A
HCM 95th %tile Q(veh)	12.8	-	-	0.4	-

Intersection	
Int Delay, s/veh	2.6

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	775	80	30	290	45	10
Future Vol, veh/h	775	80	30	290	45	10
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	4	56	63	5	74	75
Mvmt Flow	842	87	33	315	49	11

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	929	0	1267	886
Stage 1	-	-	-	-	886	-
Stage 2	-	-	-	-	381	-
Critical Hdwy	-	-	4.73	-	7.14	6.95
Critical Hdwy Stg 1	-	-	-	-	6.14	-
Critical Hdwy Stg 2	-	-	-	-	6.14	-
Follow-up Hdwy	-	-	2.767	-	4.166	3.975
Pot Cap-1 Maneuver	-	-	537	-	133	257
Stage 1	-	-	-	-	305	-
Stage 2	-	-	-	-	558	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	537	-	123	257
Mov Cap-2 Maneuver	-	-	-	-	123	-
Stage 1	-	-	-	-	305	-
Stage 2	-	-	-	-	517	-

Approach	EB	WB	NB
HCM Control Delay, s	0	1.1	50.8
HCM LOS			F

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	136	-	-	537	-
HCM Lane V/C Ratio	0.44	-	-	0.061	-
HCM Control Delay (s)	50.8	-	-	12.1	0
HCM Lane LOS	F	-	-	B	A
HCM 95th %tile Q(veh)	2	-	-	0.2	-

Intersection	
Int Delay, s/veh	4

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	385	370	65	175	145	25
Future Vol, veh/h	385	370	65	175	145	25
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	350	180	-	0	50
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	5	2	2	14	12
Mvmt Flow	418	402	71	190	158	27

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	820	0	750	418
Stage 1	-	-	-	-	418	-
Stage 2	-	-	-	-	332	-
Critical Hdwy	-	-	4.12	-	6.54	6.32
Critical Hdwy Stg 1	-	-	-	-	5.54	-
Critical Hdwy Stg 2	-	-	-	-	5.54	-
Follow-up Hdwy	-	-	2.218	-	3.626	3.408
Pot Cap-1 Maneuver	-	-	809	-	362	614
Stage 1	-	-	-	-	639	-
Stage 2	-	-	-	-	701	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	809	-	330	614
Mov Cap-2 Maneuver	-	-	-	-	330	-
Stage 1	-	-	-	-	639	-
Stage 2	-	-	-	-	639	-

Approach	EB	WB	NB
HCM Control Delay, s	0	2.7	23.4
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	330	614	-	-	809	-
HCM Lane V/C Ratio	0.478	0.044	-	-	0.087	-
HCM Control Delay (s)	25.5	11.1	-	-	9.9	-
HCM Lane LOS	D	B	-	-	A	-
HCM 95th %tile Q(veh)	2.5	0.1	-	-	0.3	-

Intersection	
Int Delay, s/veh	434.9

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	230	150	385	610	160	210
Future Vol, veh/h	230	150	385	610	160	210
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	7	1	3	2	3	11
Mvmt Flow	250	163	418	663	174	228

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	413	0	1831	332
Stage 1	-	-	-	-	332	-
Stage 2	-	-	-	-	1499	-
Critical Hdwy	-	-	4.13	-	6.43	6.31
Critical Hdwy Stg 1	-	-	-	-	5.43	-
Critical Hdwy Stg 2	-	-	-	-	5.43	-
Follow-up Hdwy	-	-	2.227	-	3.527	3.399
Pot Cap-1 Maneuver	-	-	1141	-	~ 83	689
Stage 1	-	-	-	-	725	-
Stage 2	-	-	-	-	203	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1141	-	~ 35	689
Mov Cap-2 Maneuver	-	-	-	-	~ 35	-
Stage 1	-	-	-	-	725	-
Stage 2	-	-	-	-	~ 85	-

Approach	EB	WB	NB
HCM Control Delay, s	0	3.9	$ 2040.4
HCM LOS			F

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	76	-	-	1141	-
HCM Lane V/C Ratio	5.292	-	-	0.367	-
HCM Control Delay (s)	$ 2040.4	-	-	10	0
HCM Lane LOS	F	-	-	A	A
HCM 95th %tile Q(veh)	44.2	-	-	1.7	-

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

Intersection	
Int Delay, s/veh	3

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	310	30	20	935	55	60
Future Vol, veh/h	310	30	20	935	55	60
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	4	65	56	3	0	43
Mvmt Flow	337	33	22	1016	60	65

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	370	0	1414	354
Stage 1	-	-	-	-	354	-
Stage 2	-	-	-	-	1060	-
Critical Hdwy	-	-	4.66	-	6.4	6.63
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	-	-	2.704	-	3.5	3.687
Pot Cap-1 Maneuver	-	-	945	-	153	607
Stage 1	-	-	-	-	715	-
Stage 2	-	-	-	-	336	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	945	-	145	607
Mov Cap-2 Maneuver	-	-	-	-	145	-
Stage 1	-	-	-	-	715	-
Stage 2	-	-	-	-	318	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.2	35
HCM LOS			E

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	241	-	-	945	-
HCM Lane V/C Ratio	0.519	-	-	0.023	-
HCM Control Delay (s)	35	-	-	8.9	0
HCM Lane LOS	E	-	-	A	A
HCM 95th %tile Q(veh)	2.7	-	-	0.1	-

Intersection	
Int Delay, s/veh	72.3

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	185	200	60	575	370	65
Future Vol, veh/h	185	200	60	575	370	65
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	350	180	-	0	50
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	9	7	3	5	7
Mvmt Flow	201	217	65	625	402	71

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	418	0	956	201
Stage 1	-	-	-	-	201	-
Stage 2	-	-	-	-	755	-
Critical Hdwy	-	-	4.17	-	6.45	6.27
Critical Hdwy Stg 1	-	-	-	-	5.45	-
Critical Hdwy Stg 2	-	-	-	-	5.45	-
Follow-up Hdwy	-	-	2.263	-	3.545	3.363
Pot Cap-1 Maneuver	-	-	1115	-	~ 283	827
Stage 1	-	-	-	-	826	-
Stage 2	-	-	-	-	459	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1115	-	~ 267	827
Mov Cap-2 Maneuver	-	-	-	-	~ 267	-
Stage 1	-	-	-	-	826	-
Stage 2	-	-	-	-	432	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.8	240.6
HCM LOS			F

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	267	827	-	-	1115	-
HCM Lane V/C Ratio	1.506	0.085	-	-	0.058	-
HCM Control Delay (s)	281.1	9.8	-	-	8.4	-
HCM Lane LOS	F	A	-	-	A	-
HCM 95th %tile Q(veh)	23.4	0.3	-	-	0.2	-

Notes

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

Intersection	
Int Delay, s/veh	28.9

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	685	190	85	235	70	210
Future Vol, veh/h	685	190	85	235	70	210
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	4	3	8	13	14	5
Mvmt Flow	745	207	92	255	76	228

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	952	0	1288	849
Stage 1	-	-	-	-	849	-
Stage 2	-	-	-	-	439	-
Critical Hdwy	-	-	4.18	-	6.54	6.25
Critical Hdwy Stg 1	-	-	-	-	5.54	-
Critical Hdwy Stg 2	-	-	-	-	5.54	-
Follow-up Hdwy	-	-	2.272	-	3.626	3.345
Pot Cap-1 Maneuver	-	-	698	-	171	356
Stage 1	-	-	-	-	400	-
Stage 2	-	-	-	-	625	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	698	-	145	356
Mov Cap-2 Maneuver	-	-	-	-	145	-
Stage 1	-	-	-	-	400	-
Stage 2	-	-	-	-	529	-

Approach	EB	WB	NB
HCM Control Delay, s	0	2.9	149.1
HCM LOS			F

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	261	-	-	698	-
HCM Lane V/C Ratio	1.166	-	-	0.132	-
HCM Control Delay (s)	149.1	-	-	10.9	0
HCM Lane LOS	F	-	-	B	A
HCM 95th %tile Q(veh)	13.7	-	-	0.5	-

Intersection	
Int Delay, s/veh	2.6

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	775	80	30	300	45	10
Future Vol, veh/h	775	80	30	300	45	10
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	4	56	63	5	74	75
Mvmt Flow	842	87	33	326	49	11

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	929	0	1278	886
Stage 1	-	-	-	-	886	-
Stage 2	-	-	-	-	392	-
Critical Hdwy	-	-	4.73	-	7.14	6.95
Critical Hdwy Stg 1	-	-	-	-	6.14	-
Critical Hdwy Stg 2	-	-	-	-	6.14	-
Follow-up Hdwy	-	-	2.767	-	4.166	3.975
Pot Cap-1 Maneuver	-	-	537	-	131	257
Stage 1	-	-	-	-	305	-
Stage 2	-	-	-	-	551	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	537	-	121	257
Mov Cap-2 Maneuver	-	-	-	-	121	-
Stage 1	-	-	-	-	305	-
Stage 2	-	-	-	-	510	-

Approach	EB	WB	NB
HCM Control Delay, s	0	1.1	51.9
HCM LOS			F

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	134	-	-	537	-
HCM Lane V/C Ratio	0.446	-	-	0.061	-
HCM Control Delay (s)	51.9	-	-	12.1	0
HCM Lane LOS	F	-	-	B	A
HCM 95th %tile Q(veh)	2	-	-	0.2	-

Intersection	
Int Delay, s/veh	4

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	385	370	65	185	145	25
Future Vol, veh/h	385	370	65	185	145	25
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	350	180	-	0	50
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	5	2	2	14	12
Mvmt Flow	418	402	71	201	158	27

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	820	0	761	418
Stage 1	-	-	-	-	418	-
Stage 2	-	-	-	-	343	-
Critical Hdwy	-	-	4.12	-	6.54	6.32
Critical Hdwy Stg 1	-	-	-	-	5.54	-
Critical Hdwy Stg 2	-	-	-	-	5.54	-
Follow-up Hdwy	-	-	2.218	-	3.626	3.408
Pot Cap-1 Maneuver	-	-	809	-	357	614
Stage 1	-	-	-	-	639	-
Stage 2	-	-	-	-	693	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	809	-	326	614
Mov Cap-2 Maneuver	-	-	-	-	326	-
Stage 1	-	-	-	-	639	-
Stage 2	-	-	-	-	632	-

Approach	EB	WB	NB
HCM Control Delay, s	0	2.6	23.8
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	326	614	-	-	809	-
HCM Lane V/C Ratio	0.483	0.044	-	-	0.087	-
HCM Control Delay (s)	26	11.1	-	-	9.9	-
HCM Lane LOS	D	B	-	-	A	-
HCM 95th %tile Q(veh)	2.5	0.1	-	-	0.3	-

Intersection	
Int Delay, s/veh	0.3

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	25	855	335	10	1	10
Future Vol, veh/h	25	855	335	10	1	10
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	27	929	364	11	1	11

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	375	0	-	0	1353	370
Stage 1	-	-	-	-	370	-
Stage 2	-	-	-	-	983	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1183	-	-	-	165	676
Stage 1	-	-	-	-	699	-
Stage 2	-	-	-	-	362	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1183	-	-	-	157	676
Mov Cap-2 Maneuver	-	-	-	-	157	-
Stage 1	-	-	-	-	666	-
Stage 2	-	-	-	-	362	-

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

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1183	-	-	-	520
HCM Lane V/C Ratio	0.023	-	-	-	0.023
HCM Control Delay (s)	8.1	0	-	-	12.1
HCM Lane LOS	A	A	-	-	B
HCM 95th %tile Q(veh)	0.1	-	-	-	0.1

Intersection	
Int Delay, s/veh	0.3

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	30	755	320	10	1	10
Future Vol, veh/h	30	755	320	10	1	10
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	33	821	348	11	1	11

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	359	0	-	0	1241	354
Stage 1	-	-	-	-	354	-
Stage 2	-	-	-	-	887	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1200	-	-	-	193	690
Stage 1	-	-	-	-	710	-
Stage 2	-	-	-	-	402	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1200	-	-	-	183	690
Mov Cap-2 Maneuver	-	-	-	-	183	-
Stage 1	-	-	-	-	674	-
Stage 2	-	-	-	-	402	-

Approach	EB	WB	SB
HCM Control Delay, s	0.3	0	11.7
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1200	-	-	-	551
HCM Lane V/C Ratio	0.027	-	-	-	0.022
HCM Control Delay (s)	8.1	0	-	-	11.7
HCM Lane LOS	A	A	-	-	B
HCM 95th %tile Q(veh)	0.1	-	-	-	0.1

Intersection	
Int Delay, s/veh	525.7

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	235	150	385	630	160	210
Future Vol, veh/h	235	150	385	630	160	210
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	4	3	8	13	14	5
Mvmt Flow	255	163	418	685	174	228

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	418	0	1858	337
Stage 1	-	-	-	-	337	-
Stage 2	-	-	-	-	1521	-
Critical Hdwy	-	-	4.18	-	6.54	6.25
Critical Hdwy Stg 1	-	-	-	-	5.54	-
Critical Hdwy Stg 2	-	-	-	-	5.54	-
Follow-up Hdwy	-	-	2.272	-	3.626	3.345
Pot Cap-1 Maneuver	-	-	1110	-	~ 75	698
Stage 1	-	-	-	-	697	-
Stage 2	-	-	-	-	187	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1110	-	~ 29	698
Mov Cap-2 Maneuver	-	-	-	-	~ 29	-
Stage 1	-	-	-	-	697	-
Stage 2	-	-	-	-	~ 73	-

Approach	EB	WB	NB
HCM Control Delay, s	0	3.9	$ 2504.1
HCM LOS			F

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	64	-	-	1110	-
HCM Lane V/C Ratio	6.284	-	-	0.377	-
HCM Control Delay (s)	$ 2504.1	-	-	10.2	0
HCM Lane LOS	F	-	-	B	A
HCM 95th %tile Q(veh)	45.6	-	-	1.8	-

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

Intersection	
Int Delay, s/veh	5.7

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	325	30	20	940	55	60
Future Vol, veh/h	325	30	20	940	55	60
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	4	56	63	5	74	75
Mvmt Flow	353	33	22	1022	60	65

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	386	0	1436	370
Stage 1	-	-	-	-	370	-
Stage 2	-	-	-	-	1066	-
Critical Hdwy	-	-	4.73	-	7.14	6.95
Critical Hdwy Stg 1	-	-	-	-	6.14	-
Critical Hdwy Stg 2	-	-	-	-	6.14	-
Follow-up Hdwy	-	-	2.767	-	4.166	3.975
Pot Cap-1 Maneuver	-	-	905	-	103	540
Stage 1	-	-	-	-	565	-
Stage 2	-	-	-	-	244	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	905	-	97	540
Mov Cap-2 Maneuver	-	-	-	-	97	-
Stage 1	-	-	-	-	565	-
Stage 2	-	-	-	-	230	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.2	69.4
HCM LOS			F

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	170	-	-	905	-
HCM Lane V/C Ratio	0.735	-	-	0.024	-
HCM Control Delay (s)	69.4	-	-	9.1	0
HCM Lane LOS	F	-	-	A	A
HCM 95th %tile Q(veh)	4.6	-	-	0.1	-

Intersection	
Int Delay, s/veh	83.6

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	200	200	60	580	370	65
Future Vol, veh/h	200	200	60	580	370	65
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	350	180	-	0	50
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	5	2	2	14	12
Mvmt Flow	217	217	65	630	402	71

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	434	0	977	217
Stage 1	-	-	-	-	217	-
Stage 2	-	-	-	-	760	-
Critical Hdwy	-	-	4.12	-	6.54	6.32
Critical Hdwy Stg 1	-	-	-	-	5.54	-
Critical Hdwy Stg 2	-	-	-	-	5.54	-
Follow-up Hdwy	-	-	2.218	-	3.626	3.408
Pot Cap-1 Maneuver	-	-	1126	-	~ 264	798
Stage 1	-	-	-	-	791	-
Stage 2	-	-	-	-	441	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1126	-	~ 249	798
Mov Cap-2 Maneuver	-	-	-	-	~ 249	-
Stage 1	-	-	-	-	791	-
Stage 2	-	-	-	-	415	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.8	282.3
HCM LOS			F

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	249	798	-	-	1126	-
HCM Lane V/C Ratio	1.615	0.089	-	-	0.058	-
HCM Control Delay (s)	$ 330.1	9.9	-	-	8.4	-
HCM Lane LOS	F	A	-	-	A	-
HCM 95th %tile Q(veh)	25.1	0.3	-	-	0.2	-

Notes

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

Intersection	
Int Delay, s/veh	0.8

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	5	340	990	5	15	20
Future Vol, veh/h	5	340	990	5	15	20
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	5	370	1076	5	16	22

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	1081	0	-	0	1459	1079
Stage 1	-	-	-	-	1079	-
Stage 2	-	-	-	-	380	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	645	-	-	-	142	265
Stage 1	-	-	-	-	326	-
Stage 2	-	-	-	-	691	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	645	-	-	-	141	265
Mov Cap-2 Maneuver	-	-	-	-	141	-
Stage 1	-	-	-	-	323	-
Stage 2	-	-	-	-	691	-

Approach	EB	WB	SB
HCM Control Delay, s	0.2	0	28.3
HCM LOS			D

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	645	-	-	-	192
HCM Lane V/C Ratio	0.008	-	-	-	0.198
HCM Control Delay (s)	10.6	0	-	-	28.3
HCM Lane LOS	B	A	-	-	D
HCM 95th %tile Q(veh)	0	-	-	-	0.7