

MEMORANDUM

TO: Weathervane at Pembroke Country Club, LLC
c/o Mr. James E. Bristol III
Bristol Bros. Development Corporation
190 Old Derby Street, Suite 311
Hingham, MA 02043

FROM: Mr. Jeffrey S. Dirk, P.E., PTOE, FITE
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Professional Engineer in CT, MA, ME, NH, RI and VA

DATE: October 28, 2022

RE: 9214

SUBJECT: Supplemental Transportation Impact Assessment
Proposed Age-Qualified Residential Development – 94 West Elm Street
Pembroke, Massachusetts

Vanasse & Associates, Inc. (VAI) has prepared a supplemental Transportation Impact Assessment (TIA) in support of the proposed age-qualified residential development to be located within the Pembroke Country Club at 94 West Elm Street in Pembroke, Massachusetts (hereafter referred to as the “Project”), in response to a request from the Hanover Planning Board to expand the study area that was assessed in the July 2022 *Transportation Impact Assessment* that was prepared for the Project (the “July 2022 TIA”).¹ Specifically, the Town of Hanover Planning Board submitted a comment letter for consideration by the Pembroke Planning Board that the study area that was assessed in the July 2022 TIA be expanded to include the following intersections: Broadway at Elm Street and Columbia Road (Routes 53 and 139) at Broadway. This supplemental TIA is responsive to this request and supplements and expands the data collection effort and analyses that are presented in the July 2022 TIA.

Based on this supplemental assessment, we have concluded the following with respect to the Project as it relates to impacts within the Town of Hanover:

1. The Project is predicted to add 25 vehicle trips to Elm Street/Broadway within the Town of Hanover during the weekday morning peak-hour and 30 vehicle trips during the weekday evening peak-hour, which represents an increase in peak-hour traffic volumes of less than 3 percent, which is within the range of normal daily traffic volume fluctuations and below the 5 percent threshold of significance that is considered by the Massachusetts Department of Transportation (MassDOT) when establishing the study area for a TIA;
2. The Project will not result in a significant impact (increase) on motorist delays or vehicle queuing over existing or anticipated future conditions without the Project (No-Build conditions), acknowledging that one or more movements at the Columbia Road/Broadway intersection are currently operating at or over capacity (i.e., level-of-service (LOS) “E” or “F”) independent of the

¹*Transportation Impact Assessment*, Proposed Age-Qualified Residential Development; Pembroke Country Club, 94 West Elm Street, Pembroke, Massachusetts; July 2022.



Project, with Project-related impacts at the intersection generally defined as an increase in average motorist delay that resulted in a corresponding increase in vehicle queuing of up to one (1) vehicle; and

3. Independent of the Project, the Columbia Road/Broadway intersection has been designated by MassDOT as a high crash cluster location for 2017-2019 and is included on MassDOT's Top 200 high crash locations (no. 169 out of 200 locations). A Road Safety Audit (RSA) has been conducted at this intersection that included specific recommendations to improve safety.²

Consistent with the findings of the July 2022 TIA and as expanded as a part of this supplemental TIA, we have concluded that the Project can be accommodated within the confines of the existing transportation infrastructure in a safe and efficient manner with the implementation of the recommendations defined in the July 2022 TIA and as expanded as a part of this supplemental assessment.

The following details the findings as they related to the expanded study area intersections within the Town of Hanover.

PROJECT DESCRIPTION

As described in the July 2022 TIA, the Project will entail the construction of 170± age-qualified residential units (162 detached units and eight (8) attached units) to be situated within the Pembroke Country Club at 94 West Elm Street in Pembroke, Massachusetts. In conjunction with the Project, the existing 18-hole golf course will be reconfigured to accommodate the addition of the residential units and the construction of the associated supporting infrastructure, and the clubhouse, restaurant and two (2) function halls will remain.

Access to the Project will be provided as follows:

- ***Pembroke Country Club and Attached Residential Units (8 units)*** – Pembroke Country Club Drive which intersects the west side of West Elm Street.
- ***Pembroke Country Club Home Sites (117± units)*** - New roadway that will traverse a general north-south alignment between the existing Pembroke Country Club driveway and Dwelley Street at the location of the existing maintenance driveway for the Pembroke Country Club. The new roadway will include an access control gate at its intersection with the Pembroke Country Club driveway and at a point south of Dwelley Street that will limit the use of the roadway to residents, service/maintenance vehicles and emergency vehicles.
- ***Dwelley Street Residences (22± units)*** – New roadway that will intersect the south side of Dwelley Street opposite Maple Street.
- ***Hazelwood Drive Residences (23± units)*** – New roadway that will intersect north side of the cul-de-sac at the terminus of Hazelwood Drive.

In addition, emergency vehicle access drives will be provided to connect the proposed roadways that will be 20-foot wide and constructed with a gravel surface.

²Road Safety Audit, Columbia Road (Routes 53 and 139) at Broadway, Hanover, Massachusetts; June 2021: Old Colony Planning Council.



Off-street parking will be provided for the residential units in individual garages and driveways that will accommodate a minimum of two (2) vehicles per dwelling. Parking for the golf course, clubhouse, restaurant and function halls will be retained as currently provided.

EXPANDED STUDY AREA

The July 2022 TIA included a detailed assessment of Project-related impacts along West Elm Street, Dwelley Street and Oldham Street, and at the following specific intersections: Elm Street at Water Street; West Elm Street at Dwelley Street and Milbery Lane; West Elm Street at Oldham Street; and Oldham Street at Hazelwood Drive. At the request of the Town of Hanover Planning Board, this study area has been expanded to include the following intersections which are depicted on Figure 1A: Broadway at Elm Street and Columbia Road (Routes 53 and 139) at Broadway. This supplemental assessment focuses on potential Project-related impacts at these intersections, the results of which follow and supplement the information that is presented in the July 2022 TIA, which are included by reference herein.

EXISTING CONDITIONS

A comprehensive field inventory of existing conditions within the expanded study area was conducted in September 2022. This inventory included the collection of traffic volume data, as well as a review of existing pedestrian and bicycle accommodations, public transportation services, and motor vehicle crash data. The following summarizes existing conditions within the study area.

Intersection

Table 1 and Figure 2A summarize existing lane use, traffic control, and pedestrian and bicycle accommodations at the expanded study area intersections as observed in September 2022.

Table 1
STUDY AREA INTERSECTION DESCRIPTION

Intersection	Traffic Control Type^a	No. of Travel Lanes Provided	Shoulder Provided? (Yes/No/Width)	Pedestrian Accommodations? (Yes/No/Description)	Bicycle Accommodations? (Yes/No/Description)
Broadway/Elm St.	S	1 general-purpose travel lane on all approaches	Yes; 1 to 2-feet along all legs	No	Yes; shared traveled-way along Broadway
Columbia Rd./ Broadway	TS	1 general-purpose travel lane on Broadway approaches, 2 general-purpose travel lanes on Columbia Rd. approaches	Yes; 1 to 5-feet along all legs	Yes; crosswalks (faded) provided for crossing all legs of the intersection; pedestrian traffic signal equipment and phasing (exclusive) provided	Yes; shared traveled-way along Broadway

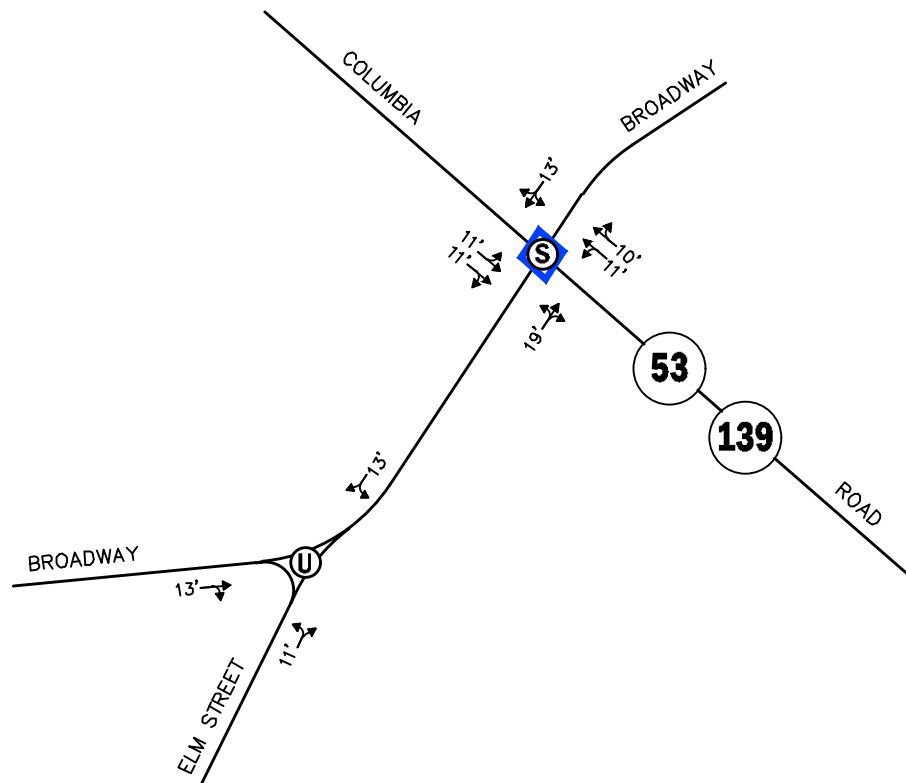
^aS = STOP-sign control; TS = traffic signal control.

^bCombined shoulder and travel lane width equal to or exceed 14 feet.



Legend:

- Ⓢ Signalized Intersection
- Ⓤ Unsignalized Intersection
- Crosswalk
- xx' ↔ Lane Use and Travel Lane Width



Not To Scale



Figure 2A

**Existing Intersection Lane Use,
Travel Lane Width, and
Pedestrian Facilities**

Existing Traffic Volumes

In order to determine existing traffic-volume demands and flow patterns within the study area, turning movement counts (TMCs) and vehicle classification counts were completed in September 2022. The peak period TMCs were performed at the expanded study intersections during the weekday morning (7:00 to 9:00 AM) and evening (4:00 to 6:00 PM) peak periods on Thursday, September 29th, 2022. These time periods were selected for analysis purposes as they are representative of the peak-traffic-volume hours for both the Project and the adjacent roadway network, and are consistent with time periods that are assessed in the July 2022 TIA.

In order to evaluate the potential for seasonal fluctuation of traffic volumes within the study area, MassDOT weekday seasonal factors for Urban Group 4-7 roadways (minor arterials, major collectors, minor collectors, and local roads and streets) were reviewed.³ Based on a review of this data, it was determined that traffic volumes for the month of September are approximately 8.0 percent above average-month conditions. As such, the September traffic volumes did not require a seasonal adjustment as they are representative of above average conditions.

In order to account for the impact on traffic volumes and trip patterns resulting from the COVID-19 pandemic, traffic-volume data collected at MassDOT Continuous Count Station No. 6255, which is located on Route 3, north of Route 18 in Weymouth, in September 2022 was compared to data collected at the same count station in September 2018. The 2018 traffic volumes were expanded to 2019 by applying the traffic growth procedure detailed in the April 2020 “Guidance on Traffic Counting Data” published by MassDOT⁴ in order to allow for a comparison of the data. Based on this pre- and post-COVID-19 traffic-volume comparison, the September traffic volume data that was collected as part of this assessment was found to be within the range of normal daily and seasonal fluctuations that existed prior to the COVID-19 pandemic. As such and with consideration that the September traffic volumes are 8.0 percent higher than those under average-month conditions, a pandemic-related adjustment was not applied to the traffic count data.

The 2022 Existing weekday morning and evening peak-hour traffic volumes at the expanded study area intersections are graphically depicted on Figure 3A.

Pedestrian and Bicycle Facilities

As detailed on Figure 2A, sidewalks are not provided along the study area roadways; however, marked crosswalks (faded) are provided for crossing all legs of the Columbia Road/Broadway intersection, with pedestrian traffic signal equipment and phasing provided. Formal bicycle facilities are not provided within the study; however, Broadway provides sufficient width (combined travel lane and shoulder) to support bicycle travel in a shared traveled-way configuration.⁵

Motor Vehicle Crash Data

Motor vehicle crash information for the expanded study area intersections was provided by the MassDOT Highway Division Safety Management/Traffic Operations Unit for the most recent five-year period available (2015 through 2019, inclusive) in order to examine motor vehicle crash trends occurring within the study area. The data is summarized by intersection, type, severity, roadway and weather conditions, and day of occurrence, and presented in Table 2.

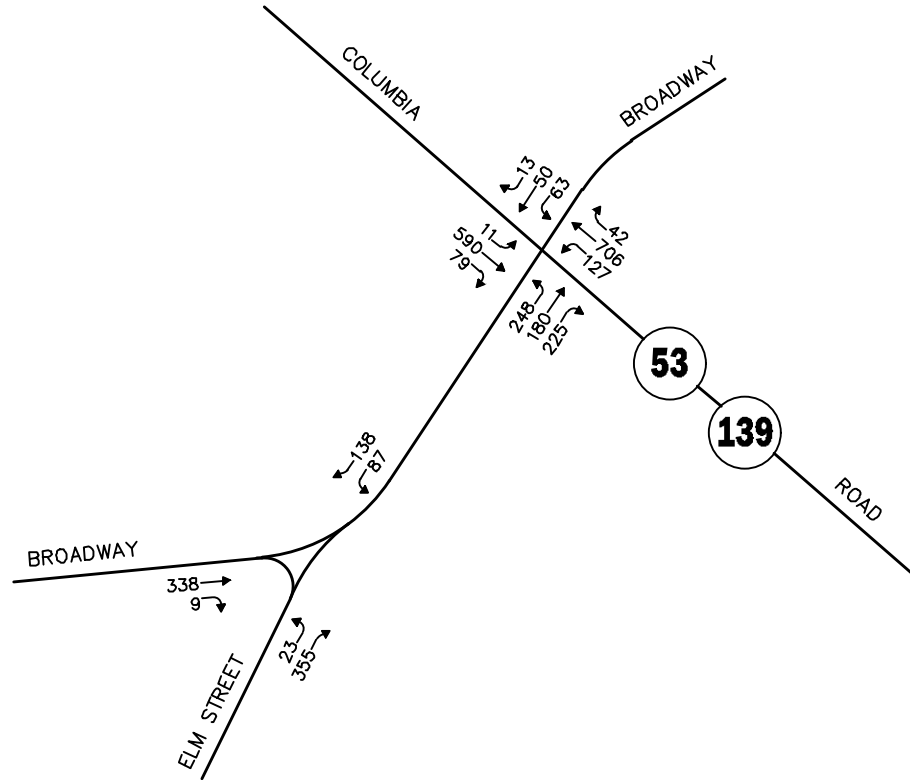
³MassDOT statewide Traffic Data Collection; 2019 Weekday Seasonal Factors, Group U4-7.

⁴*Guidance on Traffic Counting Data*; MassDOT; revised April 2020.

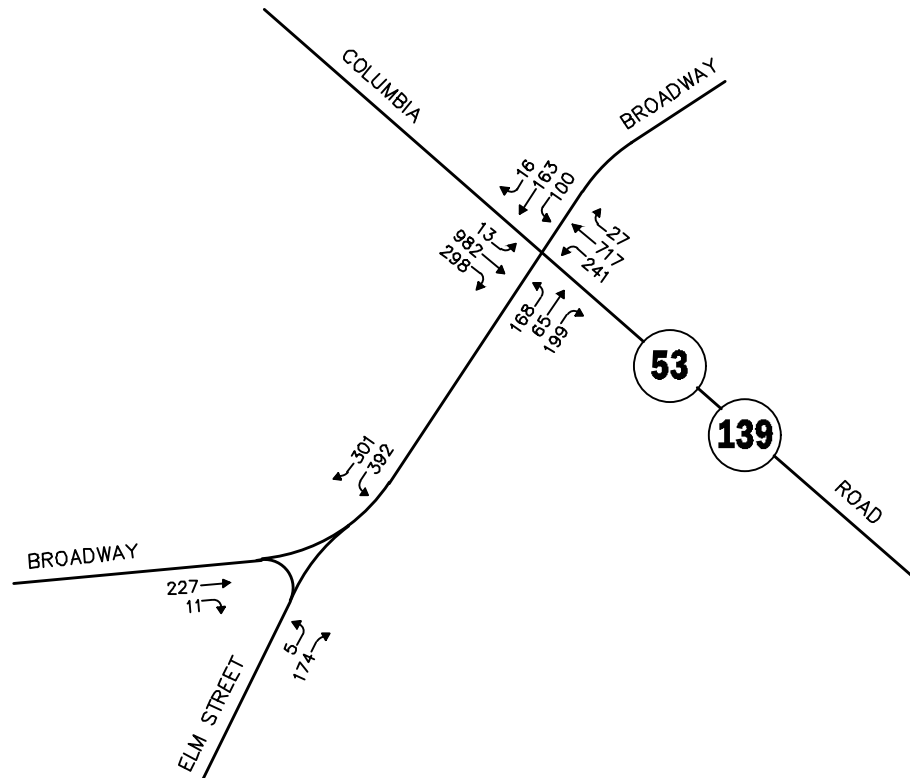
⁵A minimum combined travel lane and paved shoulder width of 14-feet is required to support bicycle travel in a shared traveled-way condition.



WEEKDAY MORNING PEAK HOUR (7:00-8:00 AM)



WEEKDAY EVENING PEAK HOUR (4:00-5:00 PM)



Note: Imbalances exist due to numerous curb cuts and side streets that are not shown.

Not To Scale

Figure 3A

Table 2
MOTOR VEHICLE CRASH DATA SUMMARY^a

	Broadway at Elm Street	Columbia Road at Broadway
Traffic Control Type: ^b	S	TS
<i>Year:</i>		
2015	4	10
2016	3	7
2017	0	4
2018	2	10
<u>2019</u>	<u>1</u>	<u>9</u>
Total	10	40
Average	2.00	8.00
Rate ^c	0.44	0.66
MassDOT Crash Rate: ^d	0.57/0.57	0.78/0.75
Significant? ^e	No	No
<i>Type:</i>		
Angle	0	25
Rear-End	4	4
Head-On	1	4
Sideswipe	0	5
Fixed Object	5	2
Pedestrian/Bicycle	0	0
<u>Unknown/Other</u>	<u>0</u>	<u>0</u>
Total	10	40
<i>Conditions:</i>		
Clear	7	24
Cloudy	1	9
Rain	1	4
<u>Snow/Ice</u>	<u>1</u>	<u>3</u>
Total	10	40
<i>Lighting:</i>		
Daylight	7	26
Dawn/Dusk	0	0
Dark (Road Lit)	1	12
<u>Dark (Road Unlit)</u>	<u>2</u>	<u>2</u>
Total	10	40
<i>Day of Week:</i>		
Monday through Friday	7	31
Saturday	2	5
<u>Sunday</u>	<u>1</u>	<u>4</u>
Total	10	40
<i>Severity:</i>		
Property Damage Only	4	17
Personal Injury	5	20
Fatality	0	1
<u>Unknown</u>	<u>1</u>	<u>2</u>
Total	10	40

^aSource: MassDOT Safety Management/Traffic Operations Unit records, 2015 through 2019.

^bTraffic Control Type: S = STOP-sign control, TS = traffic signal control.

^cCrash rate per million vehicles entering the intersection.

^dStatewide/District crash rate.

^eThe intersection crash rate is significant if it is found to exceed the MassDOT crash rate for the MassDOT Highway Division District in which the Project is located (District 5).



As can be seen in Table 2, the expanded study area intersections were found to have experienced an average of 8.0 or fewer reported motor vehicle crashes over the five-year review period and were found to have motor vehicle crash rates *below* the MassDOT statewide and District averages for similar intersections for the MassDOT Highway Division District in which the intersections are located (District 5). The majority of the crashes were reported to have occurred on a weekday; under clear weather conditions; during daylight; and involved angle or rear-end type collisions that resulted in non-fatal injuries. The detailed MassDOT Crash Rate Worksheets are provided as an attachment.

One motor vehicle crash that resulted in a fatality was reported at the Columbia Road/Broadway intersection. The crash occurred on Friday, November 1st, 2019, at approximately 8:13 PM and involved a vehicle traveling northbound on Columbia Road turning left onto Broadway that collided with a motorcyclist.

A review of the MassDOT high crash location database indicates that the following Columbia Road/Broadway intersection is included on MassDOT's Highway Safety Improvement Program (HSIP) listing as a cluster location 2017-2019 and is also included on MassDOT's Top 200 Crash Location list (no. 169 out of 200 locations). MassDOT defines a HSIP eligible cluster as: "...one in which the total number of 'equivalent property damage only' crashes are within the top 5% in the region." The Equivalent Property Damage Only (EPDO) index is a method of combining the number of crashes with the severity of crashes based on a weighted scale, where a property damage only crash is worth 1 point and injury and fatal crashes are worth 21 points. Designation as a HSIP location allows for MassDOT to prioritize funding for safety-related improvements in a specific region of the state. A Road Safety Audit (RSA) was conducted in 2021 at the Columbia Road/Broadway intersection that provided suggestions for improvements to enhance safety at the intersection.⁶

FUTURE CONDITIONS

Consistent with the July 2022 TIA, traffic volumes at the expanded study area intersections were projected to the year 2029, which reflects a seven-year planning horizon consistent with MassDOT guidelines. Independent of the Project, traffic volumes on the roadway network in the year 2029 under No-Build conditions include all existing traffic and new traffic resulting from background traffic growth. Anticipated Project-generated traffic volumes superimposed upon the 2029 No-Build traffic volumes reflect 2029 Build traffic volume conditions with the Project.

Future Traffic Growth

Future traffic growth is a function of the expected land development in the immediate area and the surrounding region. Several methods can be used to estimate this growth. A procedure frequently employed estimates an annual percentage increase in traffic growth and applies that percentage to all traffic volumes under study. The drawback to such a procedure is that some turning volumes may actually grow at either a higher or a lower rate at particular intersections.

An alternative procedure identifies the location and type of planned development, estimates the traffic to be generated, and assigns it to the area roadway network. This procedure produces a more realistic estimate of growth for local traffic; however, potential population growth and development external to the study area would not be accounted for in the resulting traffic projections.

⁶Ibid 2.



To provide a conservative analysis framework, both procedures were used, the salient components of which are described below.

Specific Development by Others

The Town of Hanover Planning Department was contacted in order to determine if there are any projects planned within the study area that would have an impact on future traffic volumes at the expanded study area intersections. Based on this consultation, the following developments were identified for review in conjunction with this supplemental assessment.

- ***Starbucks Restaurant, 303 Columbia Road, Hanover, Massachusetts.*** This project entails the construction of a 3,360± square foot (sf) Starbucks restaurant with a drive-through facility to be located at 303 Columbia Road, on the southwest corner of the Columbia Road/Broadway intersection and the north of the Project site.
- ***Previte's Marketplace Expansion, 285 Columbia Road, Hanover, Massachusetts.*** This project entails the construction of a 3,000± sf expansion to the Previte's Marketplace located at 285 Columbia Road, on the northwest corner of the Columbia Road/Broadway intersection and north of the Project site.
- ***Oakland Estates Residential Development, Oakland Street, Hanover, Massachusetts.*** This project entails the construction of a nine (9) lot subdivision off of Oakland Street to the north of the Project site.
- ***Nathan Estates Residential Development, Broadway, Hanover, Massachusetts.*** This project entails the construction of a six (6) lot subdivision off of Broadway to the north of the Project site.

Traffic volumes associated with the aforementioned specific development projects by others were developed using trip generation statistics published by the Institute of Transportation Engineers (ITE)⁷ and were assigned onto the study area roadway network based on existing traffic patterns where no other information was available. No other developments were identified at this time that are expected to result in an increase in traffic within the study area beyond the general background traffic growth rate.

General Background Traffic Growth

As described in the July 2022 TIA, a 1.0 percent per year compounded annual background traffic growth rate was used in order to account for future traffic growth and presently unforeseen development within the study area.

Roadway Improvement Projects

The Town of Hanover and MassDOT were contacted in order to determine if there were any planned future roadway improvement projects expected to be complete by 2029 within the study area. Based on these discussions, no roadway improvement projects aside from routine maintenance activities were identified to be planned within the expanded study area at this time.

⁷Ibid 1.



No-Build Traffic Volumes

Consistent with the July 2022 TIA, the 2029 No-Build condition peak-hour traffic-volumes were developed by applying the 1.0 percent per year compounded annual background traffic growth rate to the 2022 Existing peak-hour traffic volumes and adding the traffic volumes associated with the identified specific development project by others. The resulting 2029 No-Build weekday morning and evening peak-hour traffic volumes for the expanded study area intersections are shown on Figure 4A.

PROJECT-GENERATED TRAFFIC

A detailed discussion on the methodology and procedures used to develop Project related traffic volumes is provided in the July 2022 TIA. In summary, the Project is expected to generate 724 vehicle trips on an average weekday (two-way, 24-hour volume, or 362 vehicles entering and 362 exiting), with 58 vehicles trips (19 vehicles entering and 39 exiting) expected during the weekday morning peak-hour and 67 vehicle trips (40 vehicles entering and 27 exiting) expected during the weekday evening peak-hour.

TRIP DISTRIBUTION AND ASSIGNMENT

As described in the July 2022 TIA, the directional distribution of generated trips to and from the Project site was determined based on a review of Journey-to-Work data obtained from the U.S. Census for the Town of Pembroke, and then refined based on existing traffic patterns within the study area. The general trip distribution for the Project within the expanded study area is graphically depicted on Figure 5A. The additional traffic expected to be generated by the Project was assigned on the expanded study area roadway network as shown on Figure 6A for the weekday morning and weekday evening peak-hour.

FUTURE TRAFFIC VOLUMES - BUILD CONDITION

The 2029 Build condition traffic volumes consist of the 2029 No-Build traffic volumes with the additional traffic expected to be generated by the Project added to them. The 2029 Build weekday morning and evening peak-hour traffic volumes for the expanded study area intersections are graphically depicted on Figure 7A.

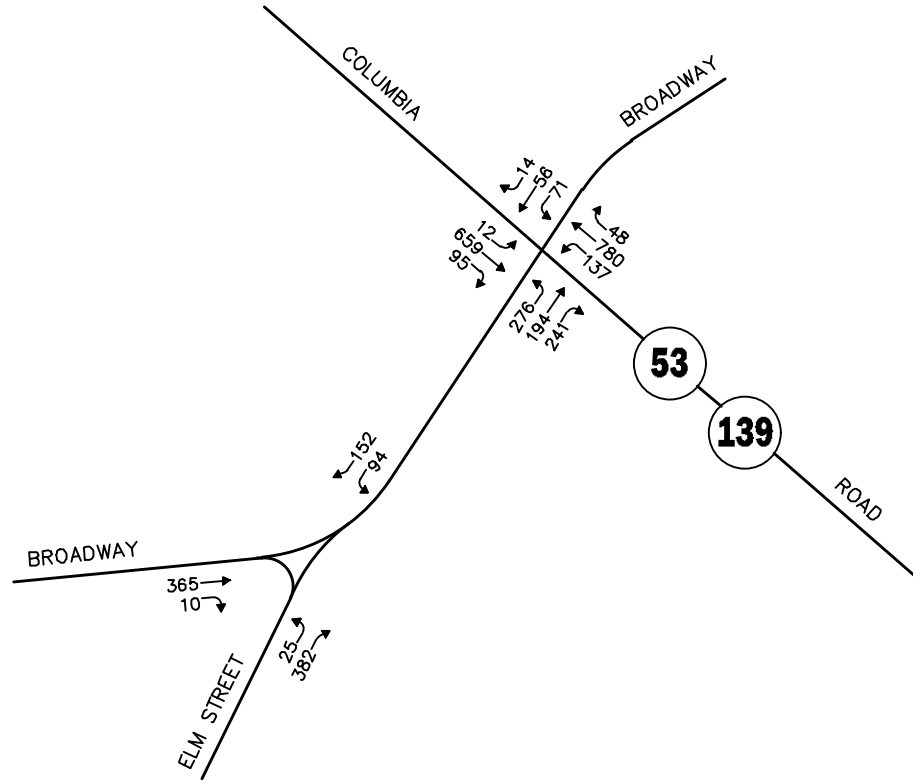
TRAFFIC OPERATIONS ANALYSIS

In order to assess the potential impact of the Project on the roadway network, a detailed traffic operations analysis (motorist delays, vehicle queuing, and level-of-service) was performed at the Project site driveway intersection with Pleasant Street. Capacity analyses provide an indication of how well transportation facilities serve the traffic demands placed upon them, with vehicle queue analyses providing a secondary measure of the operational characteristics of an intersection or section of roadway under study.

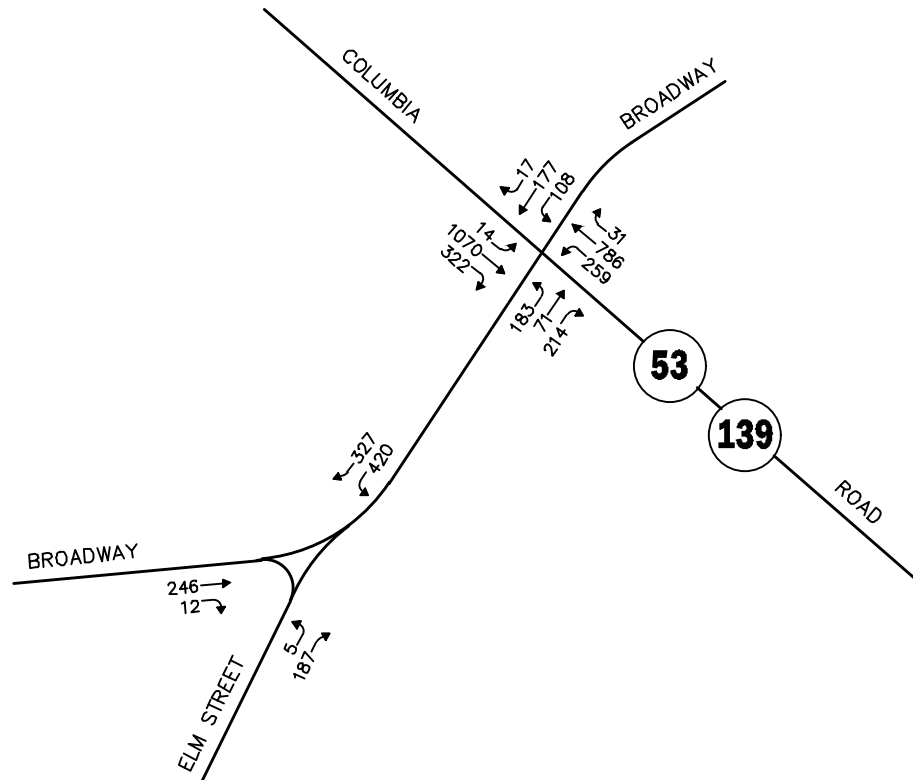
In brief, six levels of service are defined for each type of facility. They are given letter designations ranging from A to F, with level-of-service (LOS) “A” representing the best operating conditions and LOS “F” representing congested or constrained operations. An LOS of “E” is representative of a transportation facility that is operating at its design capacity with an LOS of “D” generally defined as the limit of “acceptable” traffic operations. Since the level-of-service of a traffic facility is a function of the flows placed upon it, such a facility may operate at a wide range of levels of service depending on the time of day, day of week, or period of the year. The Synchro® intersection capacity analysis software, which is



WEEKDAY MORNING PEAK HOUR (7:00-8:00 AM)



WEEKDAY EVENING PEAK HOUR (4:00-5:00 PM)



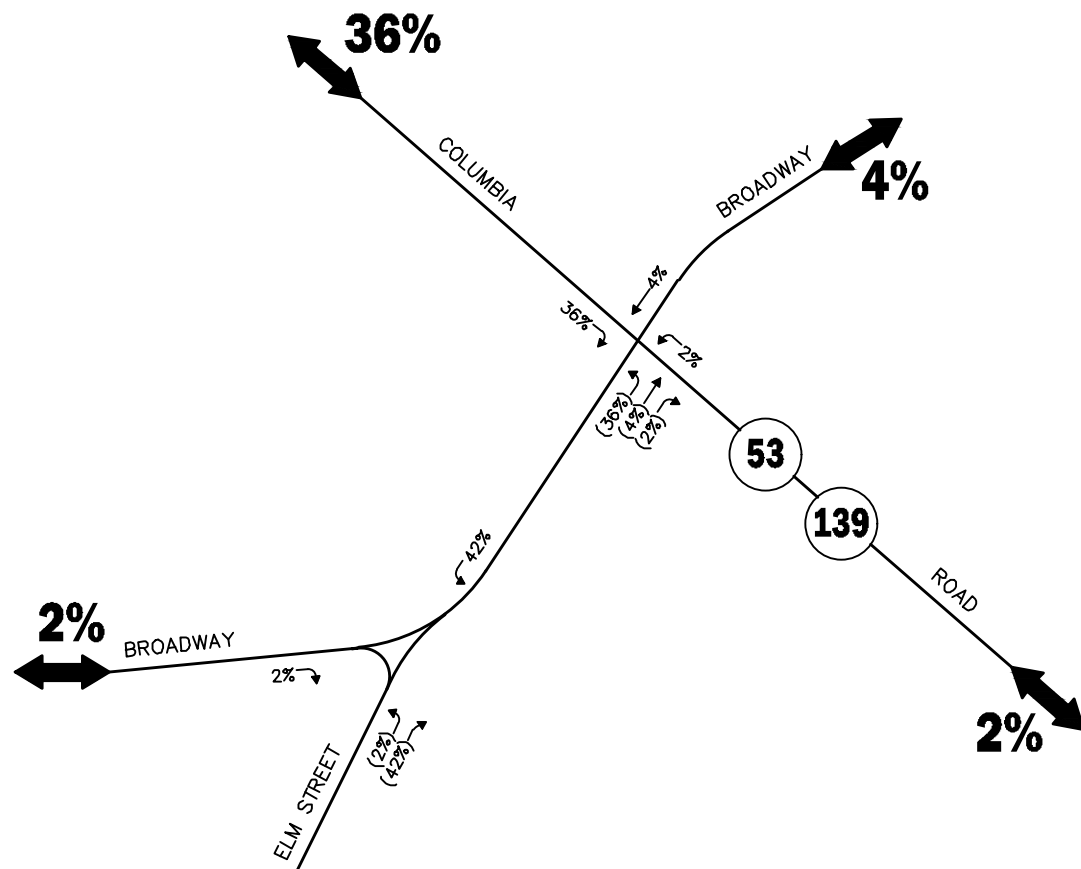
Note: Imbalances exist due to numerous curb cuts and side streets that are not shown.

Not To Scale

Figure 4A

Legend:

XX Entering Trips
(XX) Exiting Trips



Based on the 44% of trips distributed to Hanover in the July 2022 TIA.

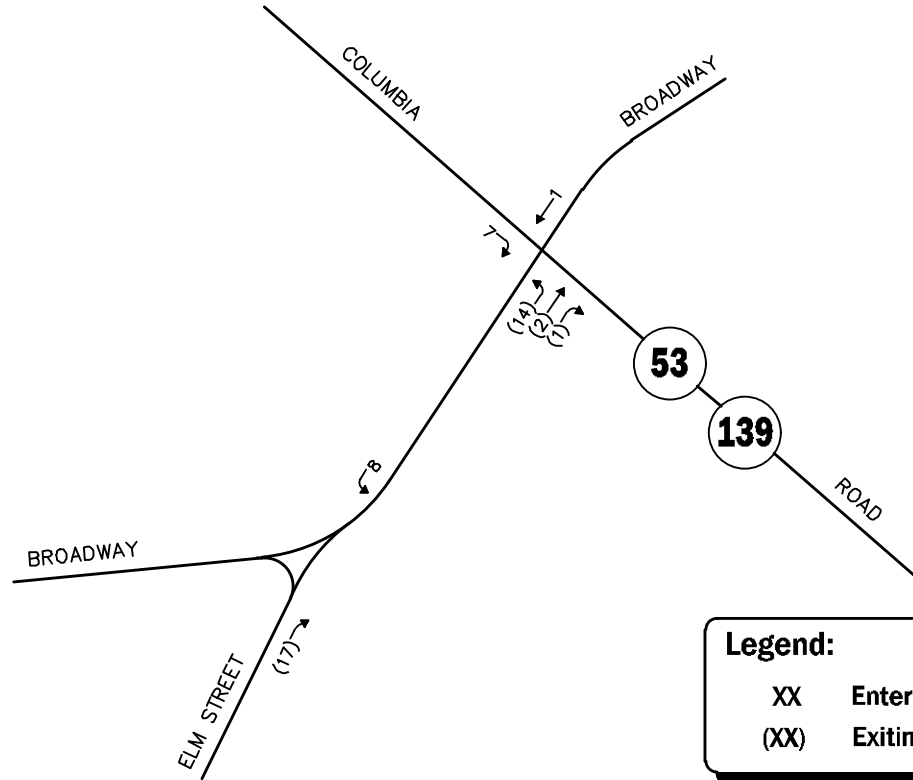
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Figure 5A

Trip Distribution Map



WEEKDAY MORNING PEAK HOUR (7:00-8:00 AM)



WEEKDAY EVENING PEAK HOUR (4:00-5:00 PM)

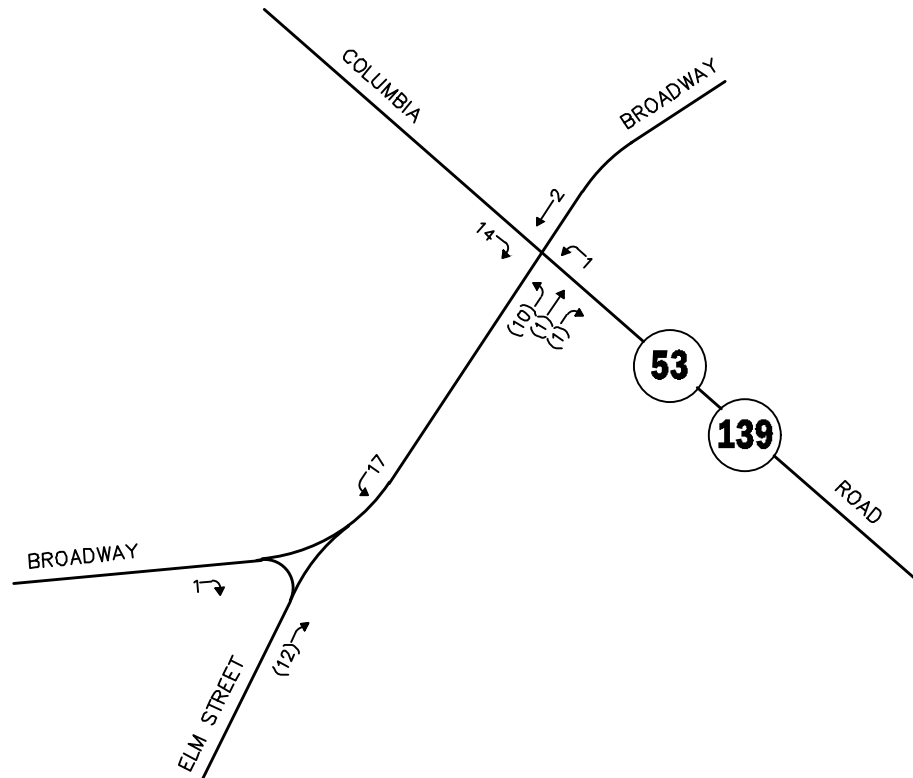
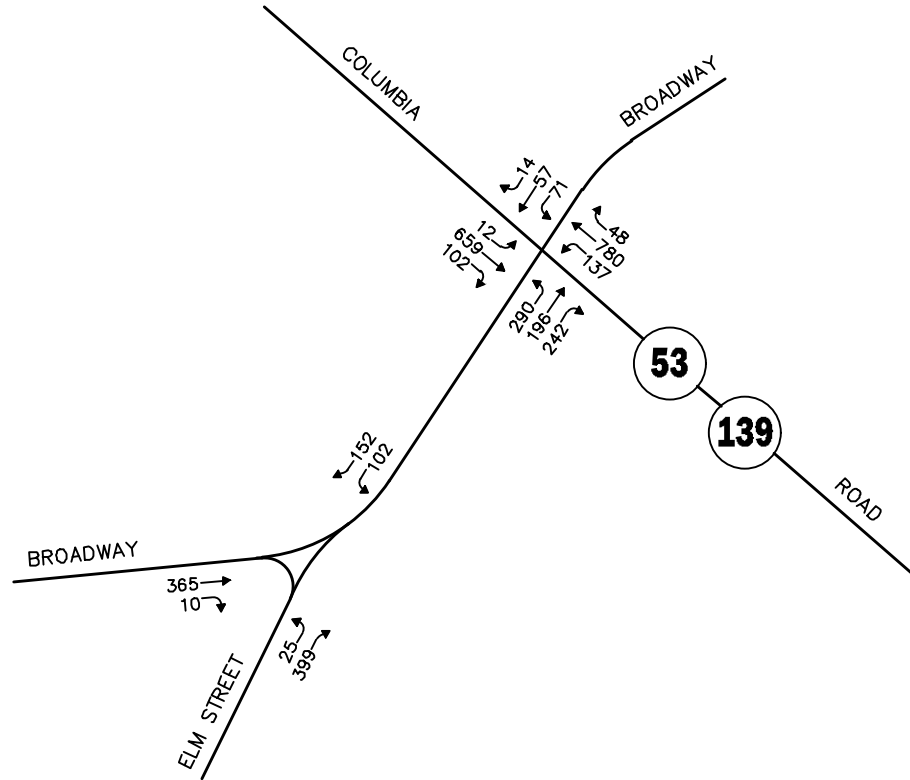


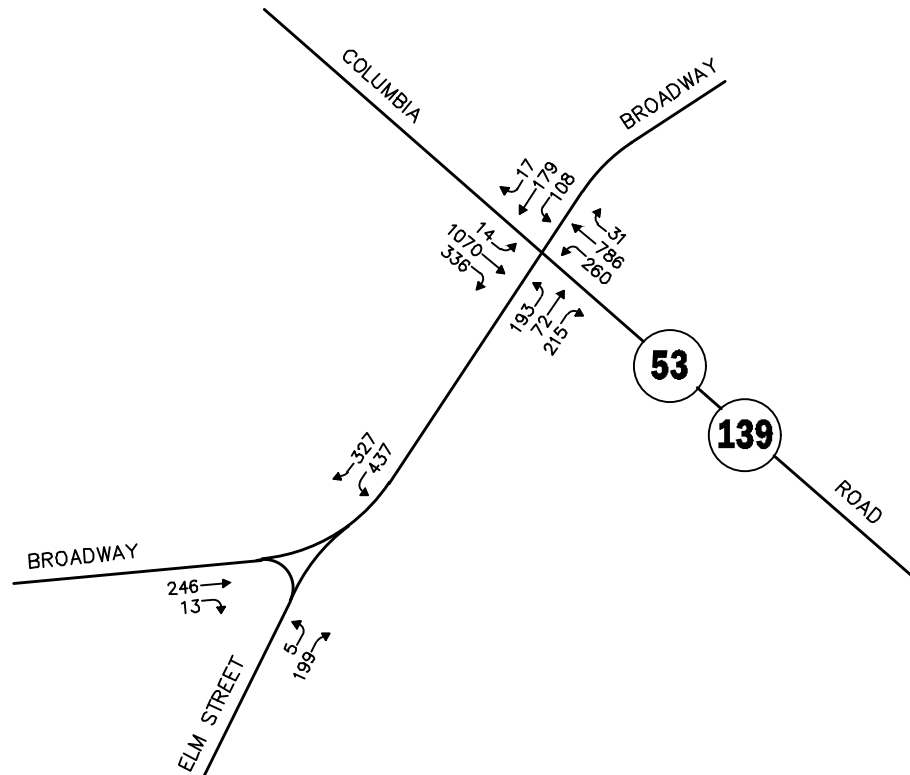
Figure 6A

Project-Generated
Peak-Hour Traffic Volumes

WEEKDAY MORNING PEAK HOUR (7:00-8:00 AM)



WEEKDAY EVENING PEAK HOUR (4:00-5:00 PM)



Note: Imbalances exist due to numerous curb cuts and side streets that are not shown.

Not To Scale

Figure 7A

based on the analysis methodologies and procedures presented in the 2000 Highway Capacity Manual (HCM)⁸ for signalized intersections and in the 2010 HCM⁹ for unsignalized intersection, was used to complete the level-of-service and vehicle queue analyses.

Analysis Results

Columbia Road at Broadway

The addition of Project-related traffic was shown to result in an increase in overall average motorist delay of 6.1 seconds that result in a degradation in overall intersection level-of-service from LOS E to LOS F during the weekday morning peak-hour, with vehicle queuing at the intersection shown to increase by up to one (1) vehicle as a result of the Project. Independent of the Project, overall intersection operations are currently at capacity (i.e., LOS “E”) during both peak hours, with the Broadway eastbound and Columbia Road northbound approaches currently operating over their design capacity (i.e., LOS “F”) during the weekday morning and evening peak hours, respectively.

Broadway at Elm Street

No change in level-of-service or vehicle queuing is predicted to occur for any movement over No-Build conditions, with all movements continue to operate at LOS D or better and Project-related impacts generally defined as an increase in average motorist delay of up to 1.8 seconds.

⁸*Highway Capacity Manual*; Transportation Research Board; Washington, DC; 2000.

⁹*Highway Capacity Manual*; Transportation Research Board; Washington, DC; 2010.



Table 3
SIGNALIZED INTERSECTION LEVEL-OF-SERVICE AND VEHICLE QUEUE SUMMARY

Signalized Intersection/Peak Hour/Movement	2022 Existing				2029 No-Build				2029 Build			
	V/C ^a	Delay ^b	LOS ^c	Queue ^d 50 th /95 th	V/C	Delay	LOS	Queue 50 th /95 th	V/C	Delay	LOS	Queue 50 th /95 th
Columbia Road at Broadway												
<i>Weekday Morning:</i>												
Broadway EB LT/TH/RT	1.27	>80.0	F	19/25	1.41	>80.0	F	23/28	1.45	>80.0	F	23/29
Broadway WB LT/TH/RT	0.37	18.4	B	2/4	0.42	19.0	B	3/4	0.42	18.9	B	3/4
Columbia Road NB LT/TH/RT	0.75	16.9	B	7/10	0.87	23.6	C	9/14	0.88	23.8	C	9/15
Columbia Road SB LT/TH/RT	0.44	11.6	B	4/6	0.49	12.1	B	5/7	0.50	12.1	B	5/7
Overall	--	57.6	E	--	--	77.3	E	--	--	83.4	F	--
<i>Weekday Evening:</i>												
Broadway EB LT/TH/RT	0.81	31.4	C	7/14	0.91	42.7	D	8/16	0.94	49.1	D	9/17
Broadway WB LT/TH/RT	0.66	23.4	C	5/8	0.73	26.5	C	6/9	0.73	26.7	C	6/9
Columbia Road NB LT/TH/RT	2.95	>80.0	F	15/19	3.17	>80.0	F	17/21	3.18	>80.0	F	17/21
Columbia Road SB LT/TH/RT	0.82	18.9	B	11/15	0.90	23.5	C	13/20	0.91	24.4	C	13/20
Overall	--	56.8	E	--	--	75.9	E	--	--	76.6	E	--

^aVolume-to-capacity ratio.

^bControl (signal) delay per vehicle in seconds.

^cLevel-of-Service.

^dQueue length in vehicles based on 25-feet per vehicle.

NB = northbound; SB = southbound; EB = eastbound; WB = westbound.

LT = left-turning movements; TH = through movements; RT = right-turning movements.



Table 4
UNSIGNALIZED INTERSECTION LEVEL-OF-SERVICE AND VEHICLE QUEUE SUMMARY

Unsignalized Intersection/Peak Hour/Movement	2022 Existing				2029 No-Build				2029 Build			
	Demand ^a	Delay ^b	LOS ^c	Queue ^d 95 th	Demand	Delay	LOS	Queue 95 th	Demand	Delay	LOS	Queue 95 th
<i>Broadway at Elm Street</i>												
<i>Weekday Morning:</i>												
Broadway EB: TH/RT	347	0.0	A	0	375	0.0	A	0	375	0.0	A	0
Broadway WB: LT/TH	225	3.2	A	1	246	3.2	A	1	254	3.4	A	1
Hazelwood Drive SB: LT/RT	378	20.6	C	5	410	25.7	D	7	424	27.5	D	7
<i>Weekday Evening:</i>												
Oldham Street EB: LT/TH	338	0.0	A	0	258	0.0	A	0	259	0.0	A	0
Oldham Street WB: TH/RT	693	5.2	A	2	747	5.4	A	2	764	5.5	A	2
Hazelwood Drive SB: LT/RT	179	13.4	B	2	192	14.5	B	2	204	14.9	B	2

^aDemand in vehicles per hour.

^bAverage control delay per vehicle (in seconds).

^cLevel of service.

^dQueue length in vehicles.

NB = northbound; SB = southbound; EB = eastbound; WB = westbound; LT = left-turning movements; TH = through movements; RT = right-turning movements.



SUMMARY

VAI has prepared a supplemental TIA in support of the proposed age-qualified residential development to be located within the Pembroke Country Club at 94 West Elm Street in Pembroke, Massachusetts, in response to a request from the Hanover Planning Board to expand the study area that was assessed in the July 2022 TIA.¹⁰ As requested, this supplemental assessed has evaluated the potential impacts of the Project at the intersections of Broadway at Elm Street and Columbia Road (Routes 53 and 139) at Broadway. Based on this supplemental assessment, we have concluded the following with respect to the Project as it relates to impacts within the Town of Hanover:

1. The Project is predicted to add 25 vehicle trips to Elm Street/Broadway within the Town of Hanover during the weekday morning peak-hour and 30 vehicle trips during the weekday evening peak-hour, which represents an increase in peak-hour traffic volumes of less than 3 percent, which is within the range of normal daily traffic volume fluctuations and below the 5 percent threshold of significance that is considered by the MassDOT when establishing the study area for a TIA;
2. The Project will not result in a significant impact (increase) on motorist delays or vehicle queuing over existing or anticipated future conditions without the Project (No-Build conditions), acknowledging that one or more movements at the Columbia Road/Broadway intersection are currently operating at or over capacity (i.e., LOS “E” or “F”) independent of the Project, with Project-related impacts at the intersection generally defined as an increase in average motorist delay that resulted in a corresponding increase in vehicle queuing of up to one (1) vehicle; and
3. Independent of the Project, the Columbia Road/Broadway intersection has been designated by MassDOT as a high crash cluster location for 2017-2019 and is included on MassDOT’s Top 200 high crash locations (no. 169 out of 200 locations). A Road Safety Audit (RSA) has been conducted at this intersection that included specific recommendations to improve safety.¹¹

Consistent with the findings of the July 2022 TIA and as expanded as a part of this supplemental TIA, we have concluded that the Project can be accommodated within the confines of the existing transportation infrastructure in a safe and efficient manner with the implementation of the recommendations defined in the July 2022 TIA and as expanded follows:

Off-Site

Columbia Road/Broadway

Independent of the Project, overall intersection operations and operating conditions for specific movements at the Columbia Road/Broadway intersection are currently operating at or over capacity (i.e., LOS “E” and “F”, respectively). The addition of Project-related traffic to the intersection was shown to result in a predicted increase in overall average motorist delay over No-Build conditions of up to 6.1 seconds that caused a degradation in overall LOS from LOS E to LOS F during the weekday morning peak-hour and an increase in vehicle queuing of up to one (1) vehicle. In addition, and also independent of the Project, the Columbia/Broadway intersection has been identified by MassDOT as a high crash cluster location for 2017-2019 and the intersection is included on MassDOT’s Top 200 high crash locations (no. 169 out of 200 locations). A RSA was conducted at the intersection in 2021 that include specific suggestions for improvements to enhance safety.

¹⁰Ibid 1.

¹¹Ibid 2.



In an effort to off-set the predicted impact of the Project and to enhance safety at the Columbia Road/Broadway intersection, the Project proponent will design and implement an optimal traffic signal timing plan, with a specific emphasis on the yellow all-red clearance intervals (the timings most closely associated with motorist and pedestrian safety) prior to the issuance of a Certificate of Occupancy for the Project and subject to the receipt of all necessary right, permits and approvals.

cc: File



ATTACHMENTS

TURNING MOVEMENT COUNT DATA

SEASONAL ADJUSTMENT DATA

COVID ADJUSTMENT DATA

MASSDOT CRASH RATE WORKSHEETS AND HIGH CRASH LOCATION
MAPPING

BACKGROUND DEVELOPMENT NETWORKS

JOURNEY-TO-WORK TRIP DISTRIBUTIONS

CAPACITY ANALYSIS WORKSHEETS



TURNING MOVEMENT COUNT DATA



Accurate Counts

978-664-2565

N/S Street : Elm Street
E/W Street : Broadway
City/State : Pembroke, MA
Weather : Clear

File Name : 92140001
Site Code : 92140001
Start Date : 9/29/2022
Page No : 1

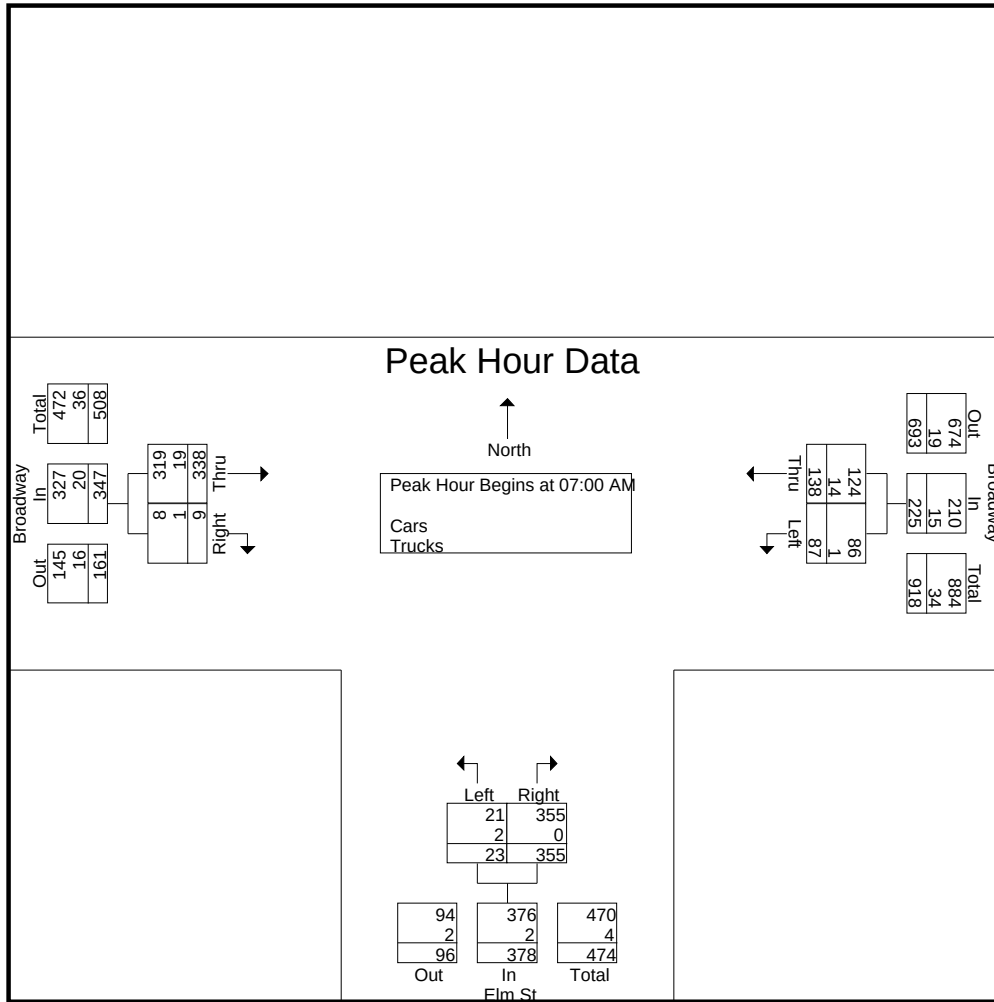
Groups Printed- Cars - Trucks

	Broadway From East		Elm St From South		Broadway From West		
Start Time	Left	Thru	Left	Right	Thru	Right	Int. Total
07:00 AM	25	35	4	83	75	2	224
07:15 AM	20	28	9	93	72	4	226
07:30 AM	19	33	7	90	98	0	247
07:45 AM	23	42	3	89	93	3	253
Total	87	138	23	355	338	9	950
08:00 AM	24	31	5	65	61	4	190
08:15 AM	28	44	2	76	73	3	226
08:30 AM	28	43	2	65	69	0	207
08:45 AM	26	49	2	82	65	1	225
Total	106	167	11	288	268	8	848
Grand Total	193	305	34	643	606	17	1798
Apprch %	38.8	61.2	5	95	97.3	2.7	
Total %	10.7	17	1.9	35.8	33.7	0.9	
Cars	192	265	31	639	570	16	1713
% Cars	99.5	86.9	91.2	99.4	94.1	94.1	95.3
Trucks	1	40	3	4	36	1	85
% Trucks	0.5	13.1	8.8	0.6	5.9	5.9	4.7

	Broadway From East			Elm St From South			Broadway From West			
Start Time	Left	Thru	App. Total	Left	Right	App. Total	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1										
Peak Hour for Entire Intersection Begins at 07:00 AM										
07:00 AM	25	35	60	4	83	87	75	2	77	224
07:15 AM	20	28	48	9	93	102	72	4	76	226
07:30 AM	19	33	52	7	90	97	98	0	98	247
07:45 AM	23	42	65	3	89	92	93	3	96	253
Total Volume	87	138	225	23	355	378	338	9	347	950
% App. Total	38.7	61.3		6.1	93.9		97.4	2.6		
PHF	.870	.821	.865	.639	.954	.926	.862	.563	.885	.939
Cars	86	124	210	21	355	376	319	8	327	913
% Cars	98.9	89.9	93.3	91.3	100	99.5	94.4	88.9	94.2	96.1
Trucks	1	14	15	2	0	2	19	1	20	37
% Trucks	1.1	10.1	6.7	8.7	0	0.5	5.6	11.1	5.8	3.9

N/S Street : Elm Street
E/W Street : Broadway
City/State : Pembroke, MA
Weather : Clear

File Name : 92140001
Site Code : 92140001
Start Date : 9/29/2022
Page No : 2

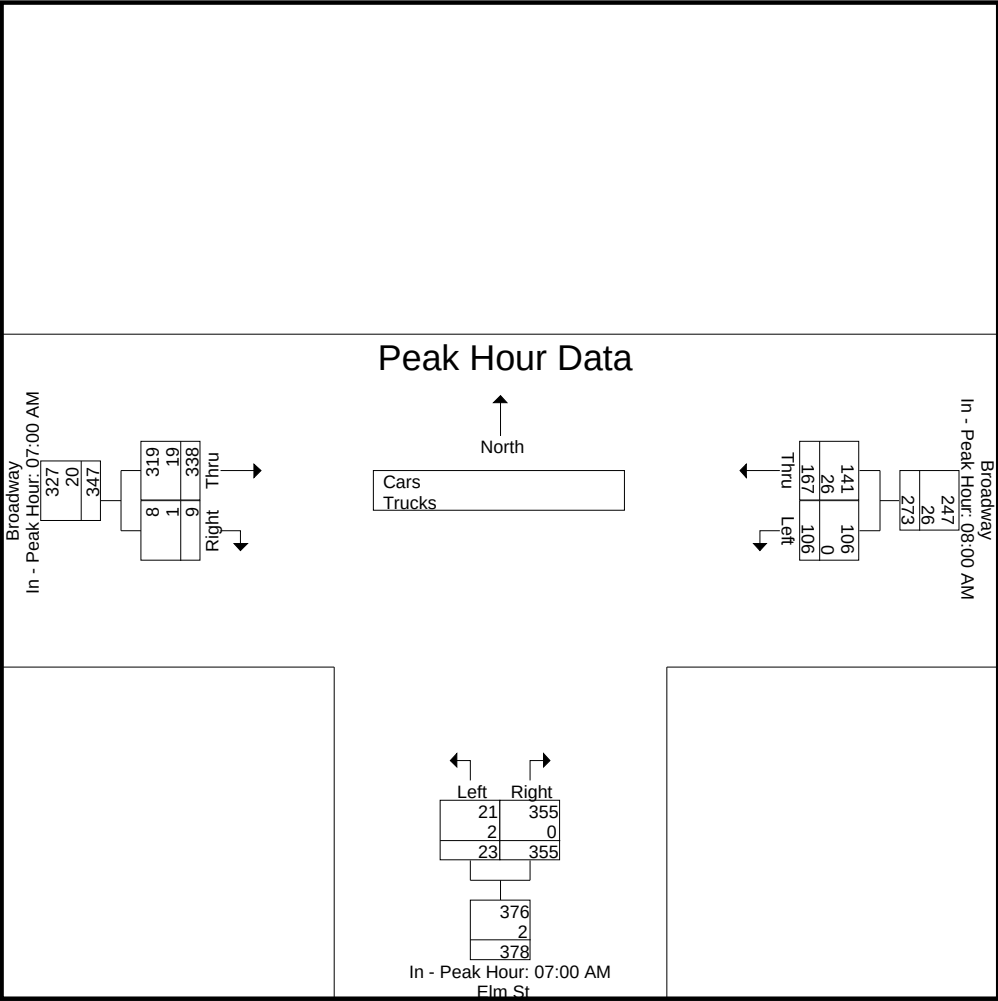


Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	08:00 AM			07:00 AM			07:00 AM		
+0 mins.	24	31	55	4	83	87	75	2	77
+15 mins.	28	44	72	9	93	102	72	4	76
+30 mins.	28	43	71	7	90	97	98	0	98
+45 mins.	26	49	75	3	89	92	93	3	96
Total Volume	106	167	273	23	355	378	338	9	347
% App. Total	38.8	61.2		6.1	93.9		97.4	2.6	
PHF	.946	.852	.910	.639	.954	.926	.862	.563	.885
Cars	106	141	247	21	355	376	319	8	327
% Cars	100	84.4	90.5	91.3	100	99.5	94.4	88.9	94.2
Trucks	0	26	26	2	0	2	19	1	20
% Trucks	0	15.6	9.5	8.7	0	0.5	5.6	11.1	5.8

N/S Street : Elm Street
E/W Street : Broadway
City/State : Pembroke, MA
Weather : Clear

File Name : 92140001
Site Code : 92140001
Start Date : 9/29/2022
Page No : 3



Accurate Counts

978-664-2565

N/S Street : Elm Street
E/W Street : Broadway
City/State : Pembroke, MA
Weather : Clear

File Name : 92140001
Site Code : 92140001
Start Date : 9/29/2022
Page No : 4

Groups Printed- Cars

	Broadway From East		Elm St From South		Broadway From West		
Start Time	Left	Thru	Left	Right	Thru	Right	Int. Total
07:00 AM	25	35	2	83	65	1	211
07:15 AM	20	27	9	93	70	4	223
07:30 AM	19	26	7	90	95	0	237
07:45 AM	22	36	3	89	89	3	242
Total	86	124	21	355	319	8	913
08:00 AM	24	30	4	64	55	4	181
08:15 AM	28	35	2	75	71	3	214
08:30 AM	28	39	2	63	64	0	196
08:45 AM	26	37	2	82	61	1	209
Total	106	141	10	284	251	8	800
Grand Total	192	265	31	639	570	16	1713
Apprch %	42	58	4.6	95.4	97.3	2.7	
Total %	11.2	15.5	1.8	37.3	33.3	0.9	

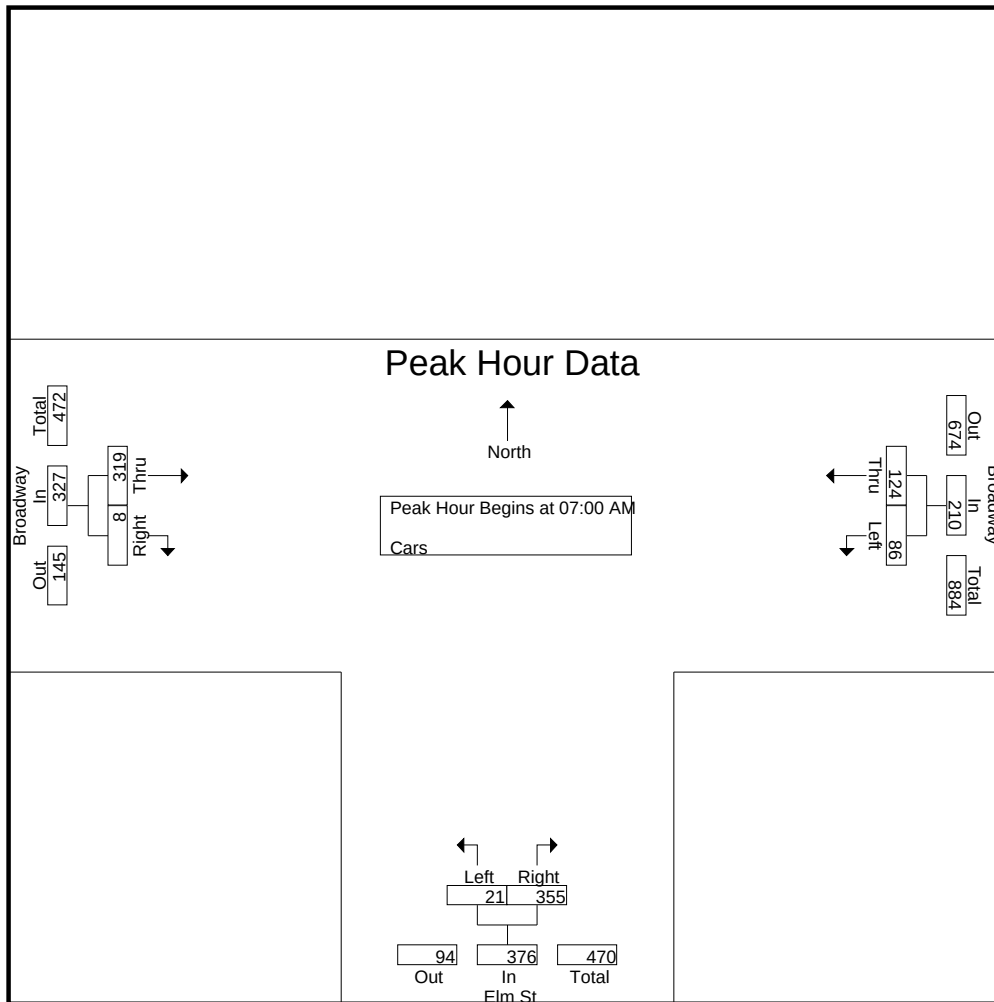
	Broadway From East			Elm St From South			Broadway From West			
Start Time	Left	Thru	App. Total	Left	Right	App. Total	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1										
Peak Hour for Entire Intersection Begins at 07:00 AM										
07:00 AM	25	35	60	2	83	85	65	1	66	211
07:15 AM	20	27	47	9	93	102	70	4	74	223
07:30 AM	19	26	45	7	90	97	95	0	95	237
07:45 AM	22	36	58	3	89	92	89	3	92	242
Total Volume	86	124	210	21	355	376	319	8	327	913
% App. Total	41	59		5.6	94.4		97.6	2.4		
PHF	.860	.861	.875	.583	.954	.922	.839	.500	.861	.943

Accurate Counts

978-664-2565

N/S Street : Elm Street
 E/W Street : Broadway
 City/State : Pembroke, MA
 Weather : Clear

File Name : 92140001
 Site Code : 92140001
 Start Date : 9/29/2022
 Page No : 5

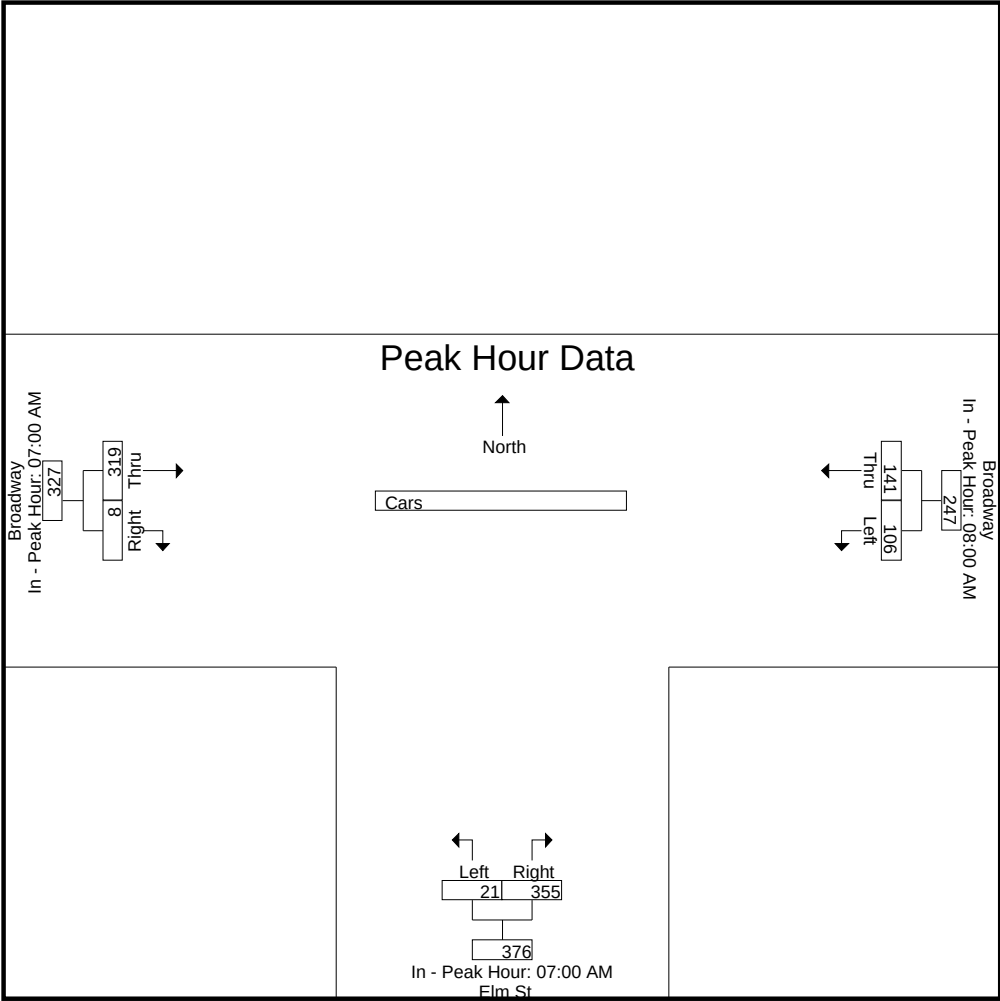


Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1
 Peak Hour for Each Approach Begins at:

	08:00 AM			07:00 AM			07:00 AM		
+0 mins.	24	30	54	2	83	85	65	1	66
+15 mins.	28	35	63	9	93	102	70	4	74
+30 mins.	28	39	67	7	90	97	95	0	95
+45 mins.	26	37	63	3	89	92	89	3	92
Total Volume	106	141	247	21	355	376	319	8	327
% App. Total	42.9	57.1		5.6	94.4		97.6	2.4	
PHF	.946	.904	.922	.583	.954	.922	.839	.500	.861

N/S Street : Elm Street
E/W Street : Broadway
City/State : Pembroke, MA
Weather : Clear

File Name : 92140001
Site Code : 92140001
Start Date : 9/29/2022
Page No : 6



Accurate Counts

978-664-2565

N/S Street : Elm Street
E/W Street : Broadway
City/State : Pembroke, MA
Weather : Clear

File Name : 92140001
Site Code : 92140001
Start Date : 9/29/2022
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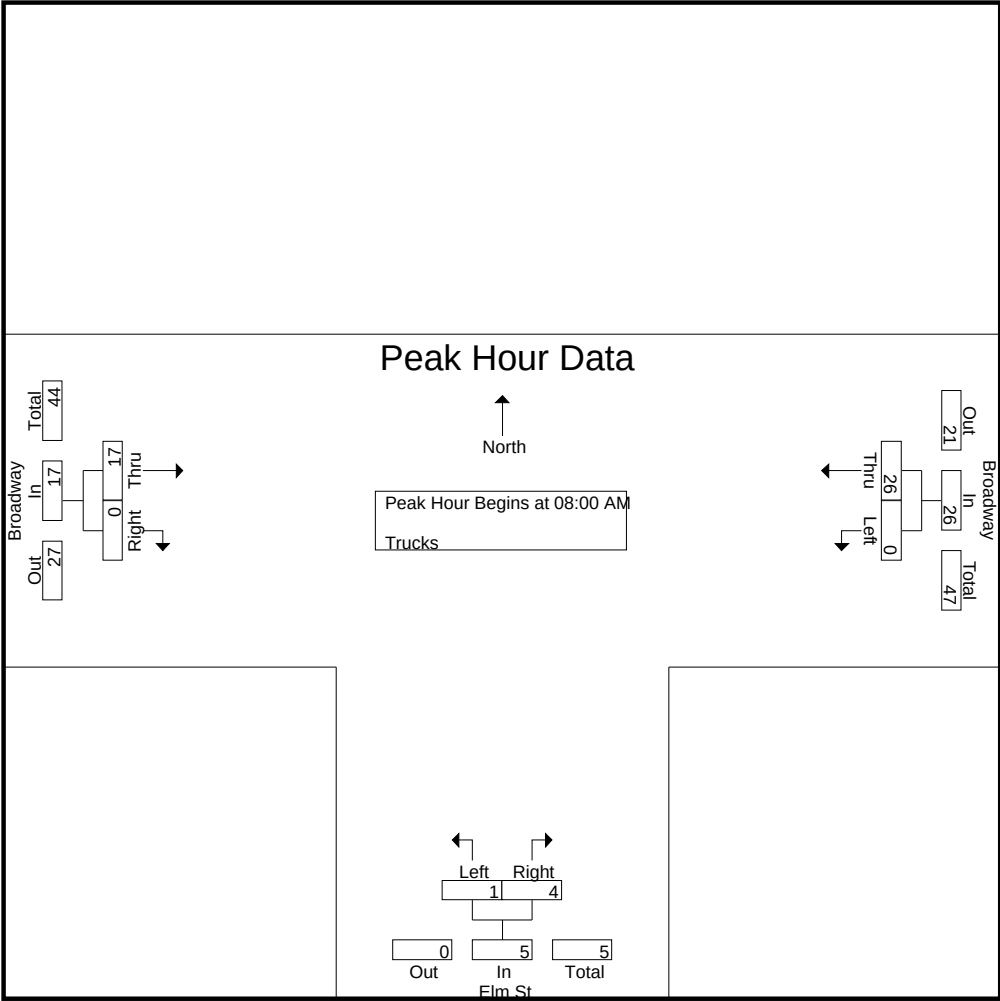
Groups Printed- Trucks

	Broadway From East		Elm St From South		Broadway From West		
Start Time	Left	Thru	Left	Right	Thru	Right	Int. Total
07:00 AM	0	0	2	0	10	1	13
07:15 AM	0	1	0	0	2	0	3
07:30 AM	0	7	0	0	3	0	10
07:45 AM	1	6	0	0	4	0	11
Total	1	14	2	0	19	1	37
08:00 AM	0	1	1	1	6	0	9
08:15 AM	0	9	0	1	2	0	12
08:30 AM	0	4	0	2	5	0	11
08:45 AM	0	12	0	0	4	0	16
Total	0	26	1	4	17	0	48
Grand Total	1	40	3	4	36	1	85
Apprch %	2.4	97.6	42.9	57.1	97.3	2.7	
Total %	1.2	47.1	3.5	4.7	42.4	1.2	

	Broadway From East			Elm St From South			Broadway From West			
Start Time	Left	Thru	App. Total	Left	Right	App. Total	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1										
Peak Hour for Entire Intersection Begins at 08:00 AM										
08:00 AM	0	1	1	1	1	2	6	0	6	9
08:15 AM	0	9	9	0	1	1	2	0	2	12
08:30 AM	0	4	4	0	2	2	5	0	5	11
08:45 AM	0	12	12	0	0	0	4	0	4	16
Total Volume	0	26	26	1	4	5	17	0	17	48
% App. Total	0	100		20	80		100	0		
PHF	.000	.542	.542	.250	.500	.625	.708	.000	.708	.750

N/S Street : Elm Street
E/W Street : Broadway
City/State : Pembroke, MA
Weather : Clear

File Name : 92140001
Site Code : 92140001
Start Date : 9/29/2022
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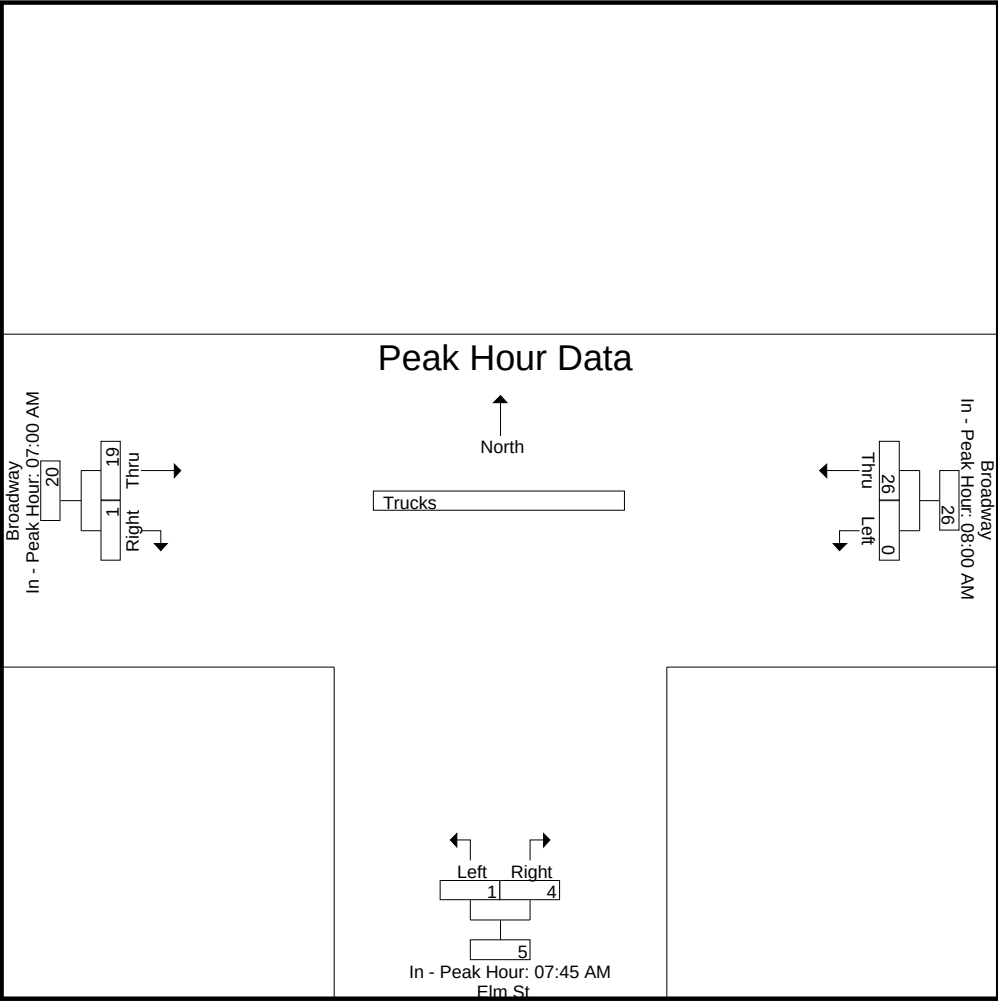


Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	08:00 AM			07:45 AM			07:00 AM		
+0 mins.	0	1	1	0	0	0	10	1	11
+15 mins.	0	9	9	1	1	2	2	0	2
+30 mins.	0	4	4	0	1	1	3	0	3
+45 mins.	0	12	12	0	2	2	4	0	4
Total Volume	0	26	26	1	4	5	19	1	20
% App. Total	0	100		20	80		95	5	
PHF	.000	.542	.542	.250	.500	.625	.475	.250	.455

N/S Street : Elm Street
E/W Street : Broadway
City/State : Pembroke, MA
Weather : Clear

File Name : 92140001
Site Code : 92140001
Start Date : 9/29/2022
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Accurate Counts

978-664-2565

N/S Street : Elm Street
E/W Street : Broadway
City/State : Pembroke, MA
Weather : Clear

File Name : 92140001
Site Code : 92140001
Start Date : 9/29/2022
Page No : 10

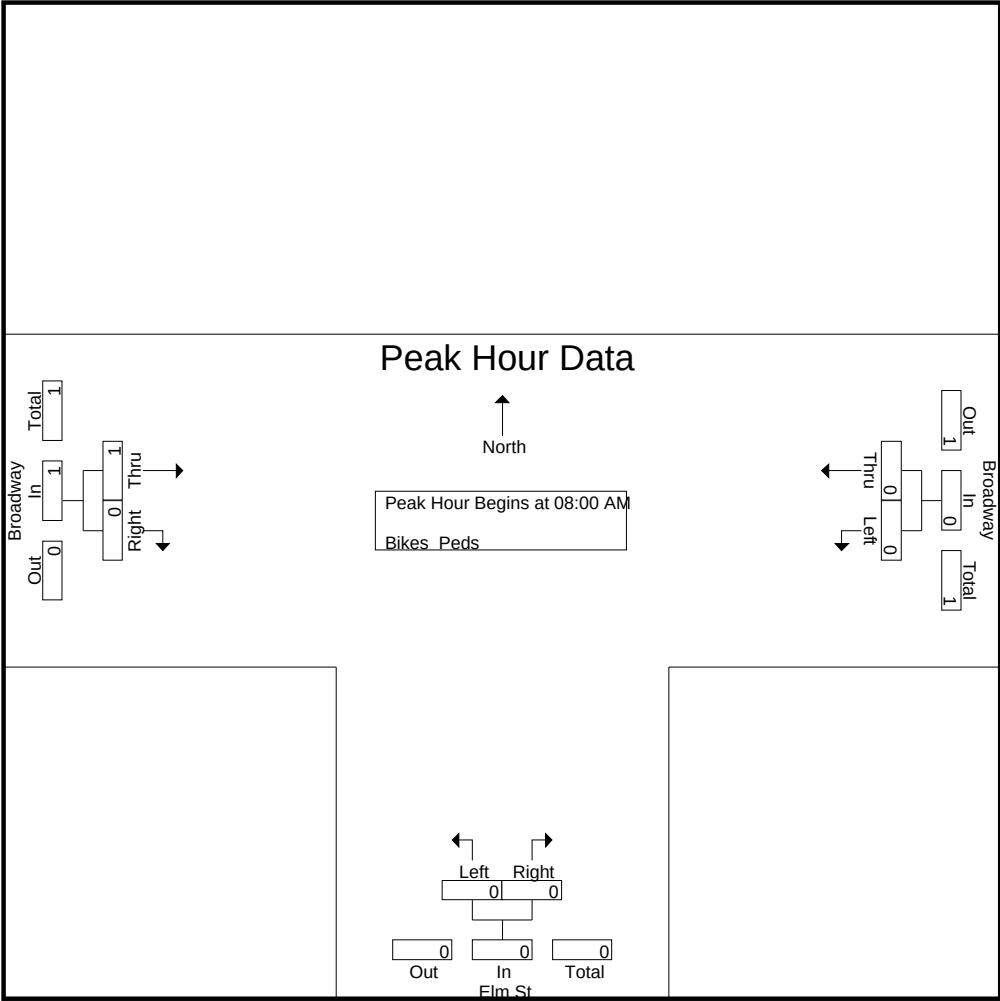
Groups Printed- Bikes Peds

	Broadway From East			Elm St From South			Broadway From West			Exclu. Total	Inclu. Total	Int. Total
Start Time	Left	Thru	Peds	Left	Right	Peds	Thru	Right	Peds			
07:00 AM	0	0	0	0	0	0	0	0	0	0	0	0
07:15 AM	0	0	0	0	0	0	0	0	0	0	0	0
07:30 AM	0	0	0	0	0	0	0	0	0	0	0	0
07:45 AM	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
08:00 AM	0	0	0	0	0	0	0	0	0	0	0	0
08:15 AM	0	0	0	0	0	0	0	0	0	0	0	0
08:30 AM	0	0	0	0	0	0	0	0	0	0	0	0
08:45 AM	0	0	0	0	0	0	1	0	0	0	1	1
Total	0	0	0	0	0	0	1	0	0	0	1	1
Grand Total	0	0	0	0	0	0	1	0	0	0	1	1
Apprch %	0	0		0	0		100	0				
Total %	0	0		0	0		100	0		0	100	

	Broadway From East			Elm St From South			Broadway From West			
Start Time	Left	Thru	App. Total	Left	Right	App. Total	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1										
Peak Hour for Entire Intersection Begins at 08:00 AM										
08:00 AM	0	0	0	0	0	0	0	0	0	0
08:15 AM	0	0	0	0	0	0	0	0	0	0
08:30 AM	0	0	0	0	0	0	0	0	0	0
08:45 AM	0	0	0	0	0	0	1	0	1	1
Total Volume	0	0	0	0	0	0	1	0	1	1
% App. Total	0	0		0	0		100	0		
PHF	.000	.000	.000	.000	.000	.000	.250	.000	.250	.250

N/S Street : Elm Street
E/W Street : Broadway
City/State : Pembroke, MA
Weather : Clear

File Name : 92140001
Site Code : 92140001
Start Date : 9/29/2022
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Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	07:00 AM			07:00 AM			08:00 AM		
+0 mins.	0	0	0	0	0	0	0	0	0
+15 mins.	0	0	0	0	0	0	0	0	0
+30 mins.	0	0	0	0	0	0	0	0	0
+45 mins.	0	0	0	0	0	0	1	0	1
Total Volume	0	0	0	0	0	0	1	0	1
% App. Total	0	0		0	0		100	0	
PHF	.000	.000	.000	.000	.000	.000	.250	.000	.250

978-664-2565

978-664-2565

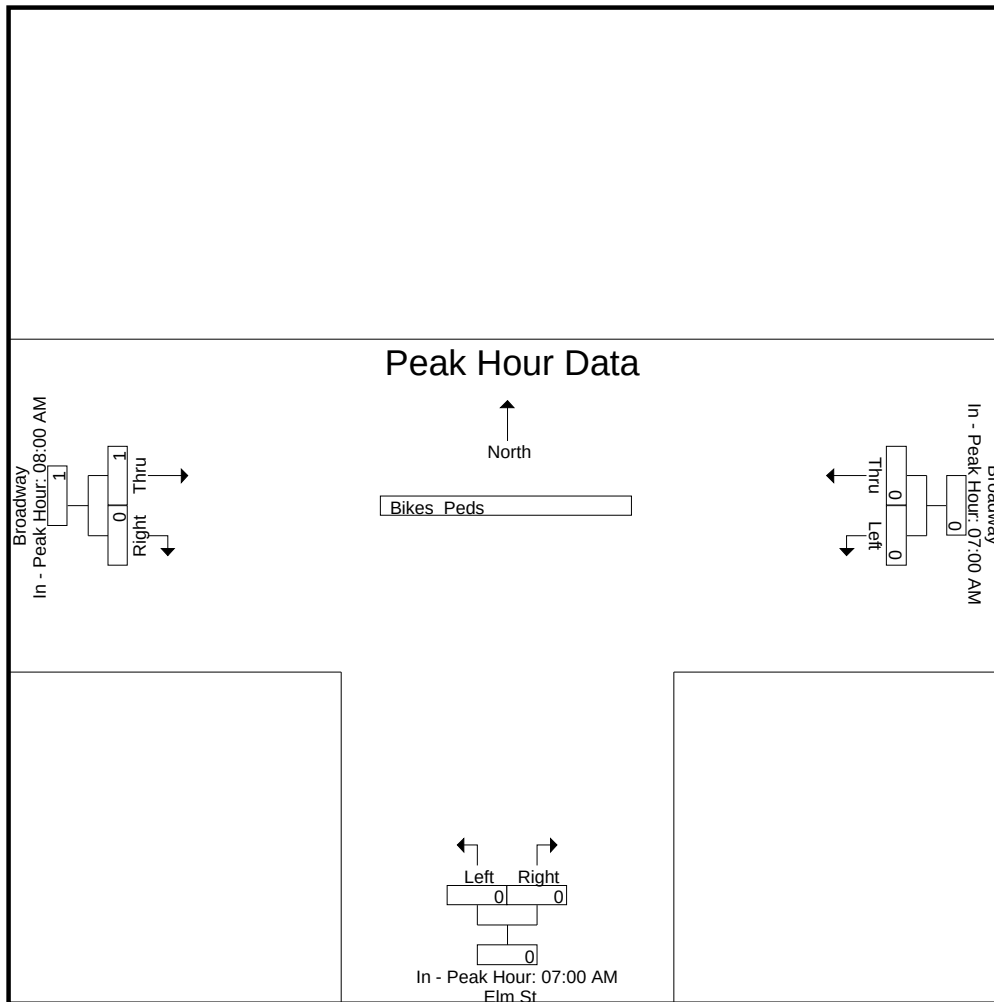
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Site Code : 92140001

Start Date : 9/29/2022

Page No : 12

N/S Street : Elm Street
E/W Street : Broadway
City/State : Pembroke, MA
Weather : Clear



Accurate Counts

978-664-2565

N/S Street : Elm Street
E/W Street : Broadway
City/State : Pembroke, MA
Weather : Clear

File Name : 92140001
Site Code : 92140001
Start Date : 9/29/2022
Page No : 1

Groups Printed- Cars - Trucks

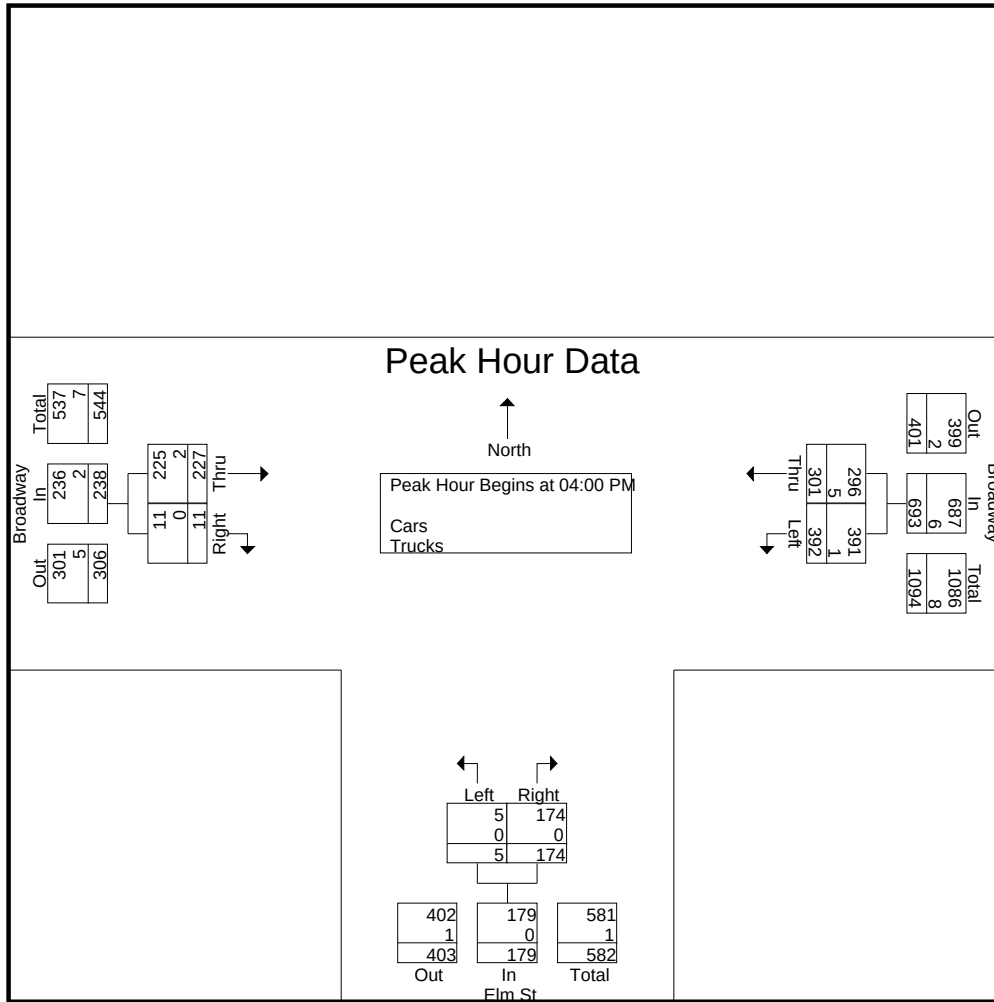
	Broadway From East		Elm St From South		Broadway From West		
Start Time	Left	Thru	Left	Right	Thru	Right	Int. Total
04:00 PM	92	68	1	46	68	8	283
04:15 PM	104	80	4	42	50	0	280
04:30 PM	97	74	0	39	52	0	262
04:45 PM	99	79	0	47	57	3	285
Total	392	301	5	174	227	11	1110
05:00 PM	86	89	5	39	56	8	283
05:15 PM	91	74	0	50	54	2	271
05:30 PM	99	60	5	49	51	4	268
05:45 PM	83	83	0	62	54	1	283
Total	359	306	10	200	215	15	1105
Grand Total	751	607	15	374	442	26	2215
Apprch %	55.3	44.7	3.9	96.1	94.4	5.6	
Total %	33.9	27.4	0.7	16.9	20	1.2	
Cars	745	597	15	374	440	26	2197
% Cars	99.2	98.4	100	100	99.5	100	99.2
Trucks	6	10	0	0	2	0	18
% Trucks	0.8	1.6	0	0	0.5	0	0.8

	Broadway From East			Elm St From South			Broadway From West			
Start Time	Left	Thru	App. Total	Left	Right	App. Total	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1										
Peak Hour for Entire Intersection Begins at 04:00 PM										
04:00 PM	92	68	160	1	46	47	68	8	76	283
04:15 PM	104	80	184	4	42	46	50	0	50	280
04:30 PM	97	74	171	0	39	39	52	0	52	262
04:45 PM	99	79	178	0	47	47	57	3	60	285
Total Volume	392	301	693	5	174	179	227	11	238	1110
% App. Total	56.6	43.4		2.8	97.2		95.4	4.6		
PHF	.942	.941	.942	.313	.926	.952	.835	.344	.783	.974
Cars	391	296	687	5	174	179	225	11	236	1102
% Cars	99.7	98.3	99.1	100	100	100	99.1	100	99.2	99.3
Trucks	1	5	6	0	0	0	2	0	2	8
% Trucks	0.3	1.7	0.9	0	0	0	0.9	0	0.8	0.7

Accurate Counts
978-664-2565

N/S Street : Elm Street
E/W Street : Broadway
City/State : Pembroke, MA
Weather : Clear

File Name : 92140001
Site Code : 92140001
Start Date : 9/29/2022
Page No : 2

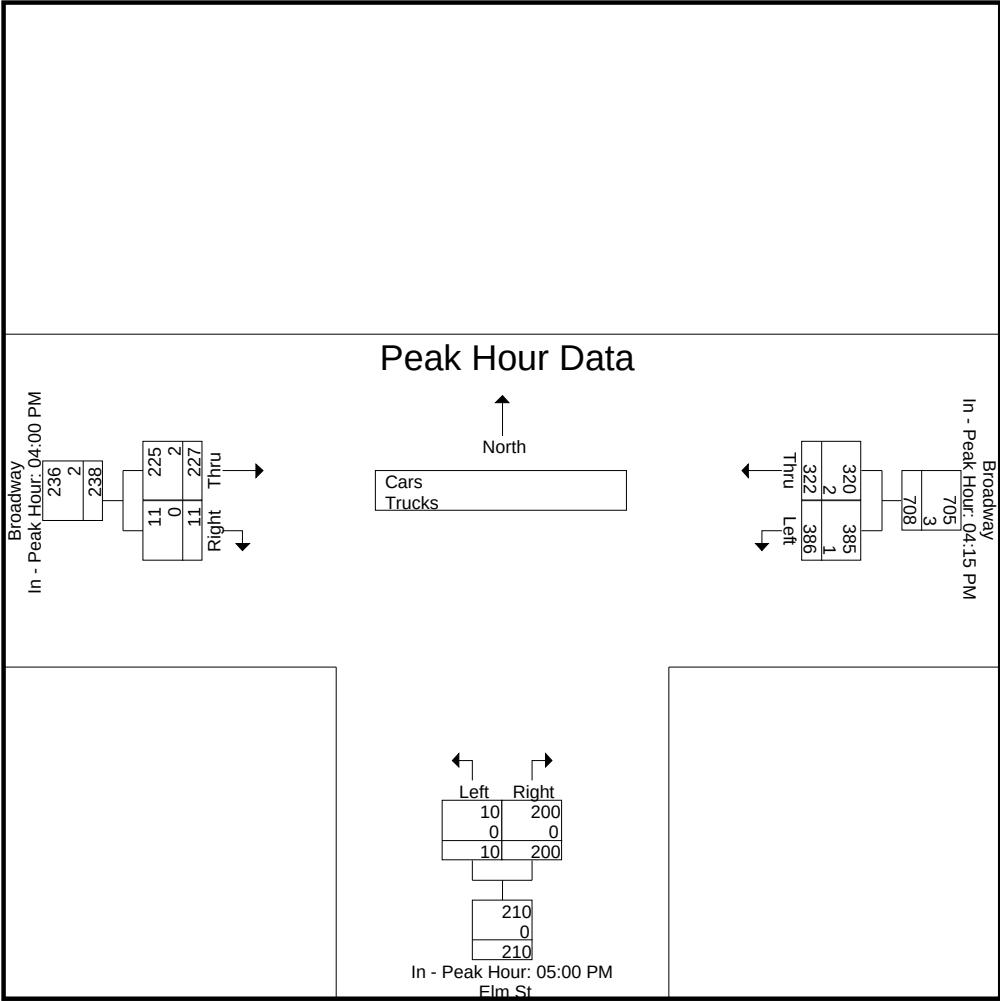


Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	04:15 PM			05:00 PM			04:00 PM		
+0 mins.	104	80	184	5	39	44	68	8	76
+15 mins.	97	74	171	0	50	50	50	0	50
+30 mins.	99	79	178	5	49	54	52	0	52
+45 mins.	86	89	175	0	62	62	57	3	60
Total Volume	386	322	708	10	200	210	227	11	238
% App. Total	54.5	45.5		4.8	95.2		95.4	4.6	
PHF	.928	.904	.962	.500	.806	.847	.835	.344	.783
Cars	385	320	705	10	200	210	225	11	236
% Cars	99.7	99.4	99.6	100	100	100	99.1	100	99.2
Trucks	1	2	3	0	0	0	2	0	2
% Trucks	0.3	0.6	0.4	0	0	0	0.9	0	0.8

N/S Street : Elm Street
E/W Street : Broadway
City/State : Pembroke, MA
Weather : Clear

File Name : 92140001
Site Code : 92140001
Start Date : 9/29/2022
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Accurate Counts

978-664-2565

N/S Street : Elm Street
E/W Street : Broadway
City/State : Pembroke, MA
Weather : Clear

File Name : 92140001
Site Code : 92140001
Start Date : 9/29/2022
Page No : 4

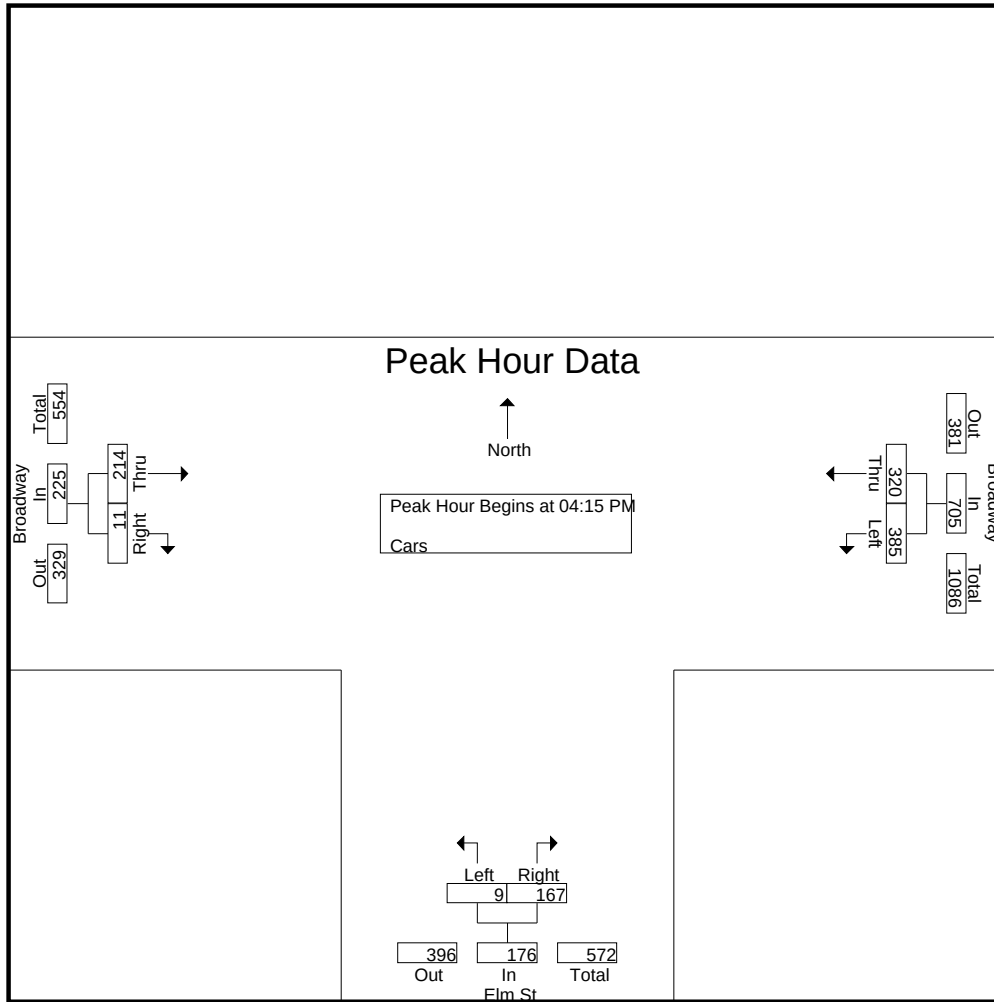
Groups Printed- Cars

	Broadway From East		Elm St From South		Broadway From West		
Start Time	Left	Thru	Left	Right	Thru	Right	Int. Total
04:00 PM	92	65	1	46	67	8	279
04:15 PM	103	78	4	42	50	0	277
04:30 PM	97	74	0	39	51	0	261
04:45 PM	99	79	0	47	57	3	285
Total	391	296	5	174	225	11	1102
05:00 PM	86	89	5	39	56	8	283
05:15 PM	91	72	0	50	54	2	269
05:30 PM	99	59	5	49	51	4	267
05:45 PM	78	81	0	62	54	1	276
Total	354	301	10	200	215	15	1095
Grand Total	745	597	15	374	440	26	2197
Apprch %	55.5	44.5	3.9	96.1	94.4	5.6	
Total %	33.9	27.2	0.7	17	20	1.2	

	Broadway From East			Elm St From South			Broadway From West			
Start Time	Left	Thru	App. Total	Left	Right	App. Total	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1										
Peak Hour for Entire Intersection Begins at 04:15 PM										
04:15 PM	103	78	181	4	42	46	50	0	50	277
04:30 PM	97	74	171	0	39	39	51	0	51	261
04:45 PM	99	79	178	0	47	47	57	3	60	285
05:00 PM	86	89	175	5	39	44	56	8	64	283
Total Volume	385	320	705	9	167	176	214	11	225	1106
% App. Total	54.6	45.4		5.1	94.9		95.1	4.9		
PHF	.934	.899	.974	.450	.888	.936	.939	.344	.879	.970

N/S Street : Elm Street
E/W Street : Broadway
City/State : Pembroke, MA
Weather : Clear

File Name : 92140001
Site Code : 92140001
Start Date : 9/29/2022
Page No : 5

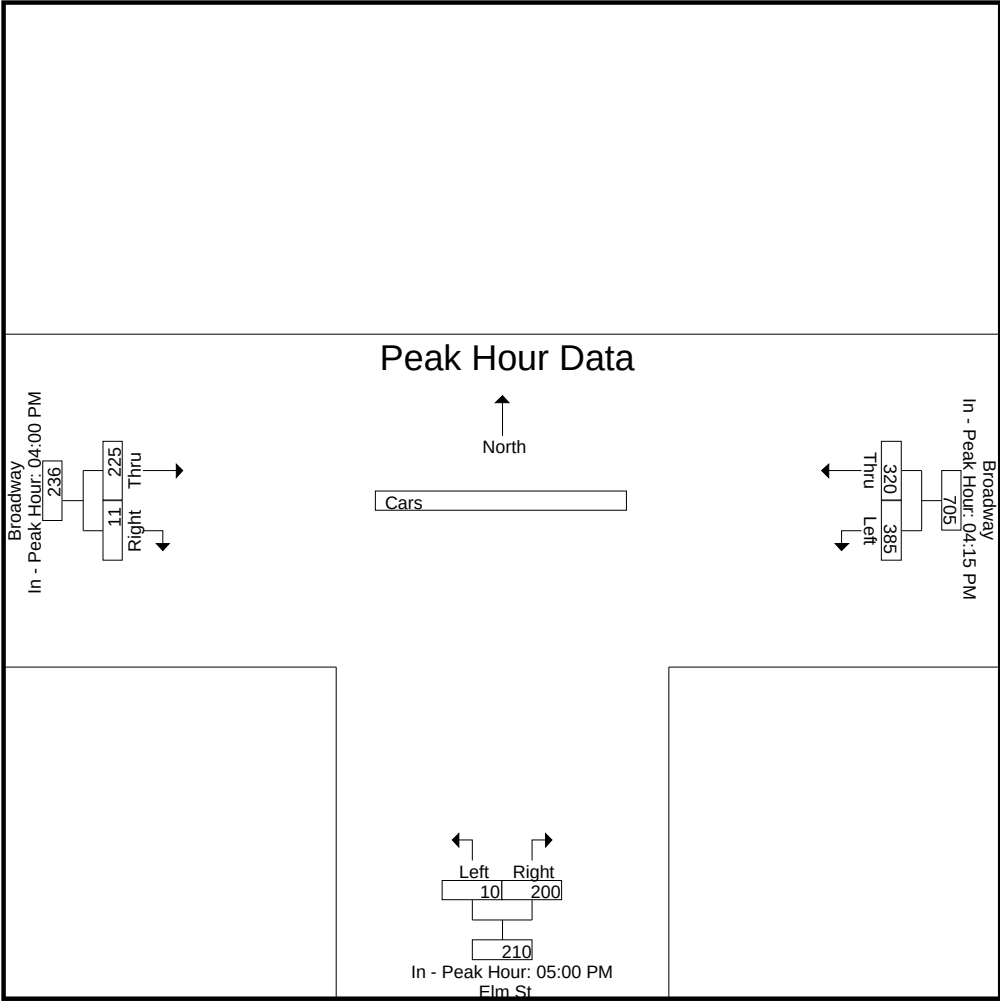


Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	04:15 PM			05:00 PM			04:00 PM		
+0 mins.	103	78	181	5	39	44	67	8	75
+15 mins.	97	74	171	0	50	50	50	0	50
+30 mins.	99	79	178	5	49	54	51	0	51
+45 mins.	86	89	175	0	62	62	57	3	60
Total Volume	385	320	705	10	200	210	225	11	236
% App. Total	54.6	45.4		4.8	95.2		95.3	4.7	
PHF	.934	.899	.974	.500	.806	.847	.840	.344	.787

N/S Street : Elm Street
E/W Street : Broadway
City/State : Pembroke, MA
Weather : Clear

File Name : 92140001
Site Code : 92140001
Start Date : 9/29/2022
Page No : 6



978-664-2565

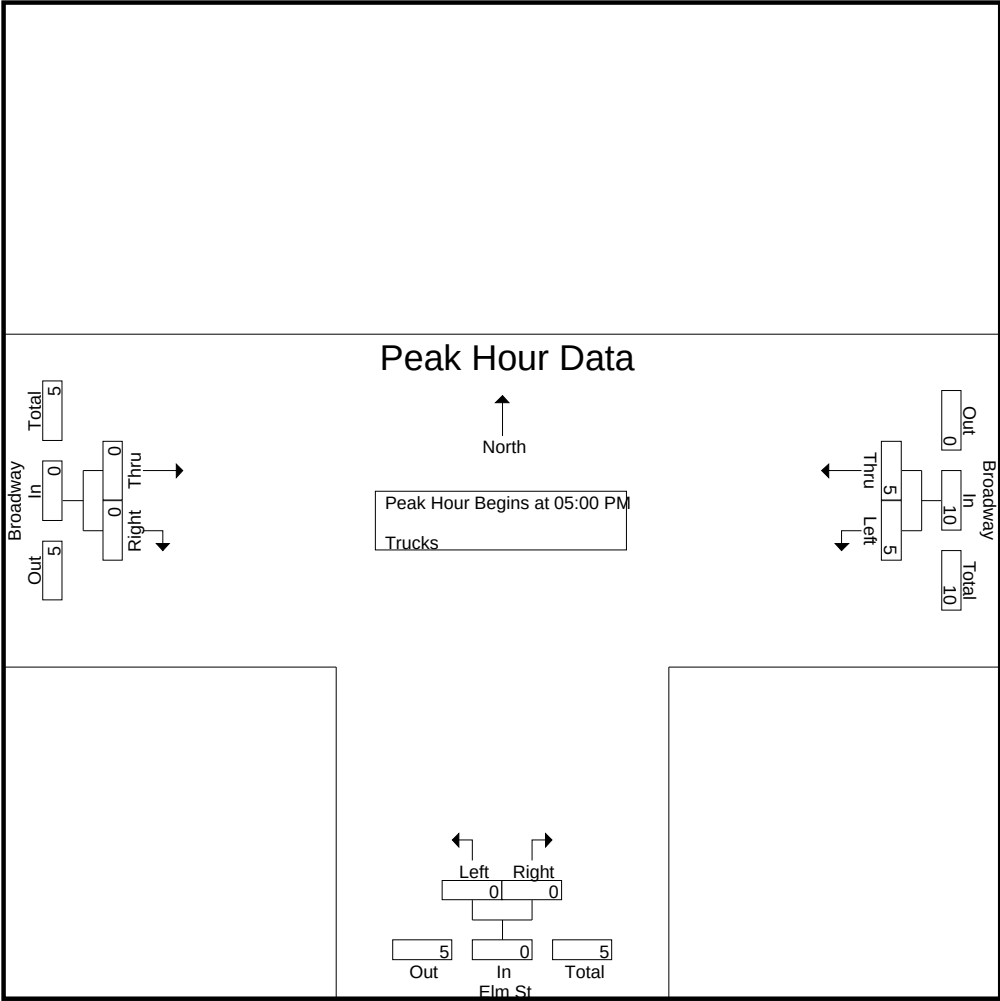
File Name : 92140001
Site Code : 92140001
Start Date : 9/29/2022
Page No : 7

	Broadway From East		Elm St From South		Broadway From West		
Start Time	Left	Thru	Left	Right	Thru	Right	Int. Total
04:00 PM	0	3	0	0	1	0	4
04:15 PM	1	2	0	0	0	0	3
04:30 PM	0	0	0	0	1	0	1
04:45 PM	0	0	0	0	0	0	0
Total	1	5	0	0	2	0	8
05:00 PM	0	0	0	0	0	0	0
05:15 PM	0	2	0	0	0	0	2
05:30 PM	0	1	0	0	0	0	1
05:45 PM	5	2	0	0	0	0	7
Total	5	5	0	0	0	0	10
Grand Total	6	10	0	0	2	0	18
Apprch %	37.5	62.5	0	0	100	0	
Total %	33.3	55.6	0	0	11.1	0	

[illegible]

N/S Street : Elm Street
E/W Street : Broadway
City/State : Pembroke, MA
Weather : Clear

File Name : 92140001
Site Code : 92140001
Start Date : 9/29/2022
Page No : 8

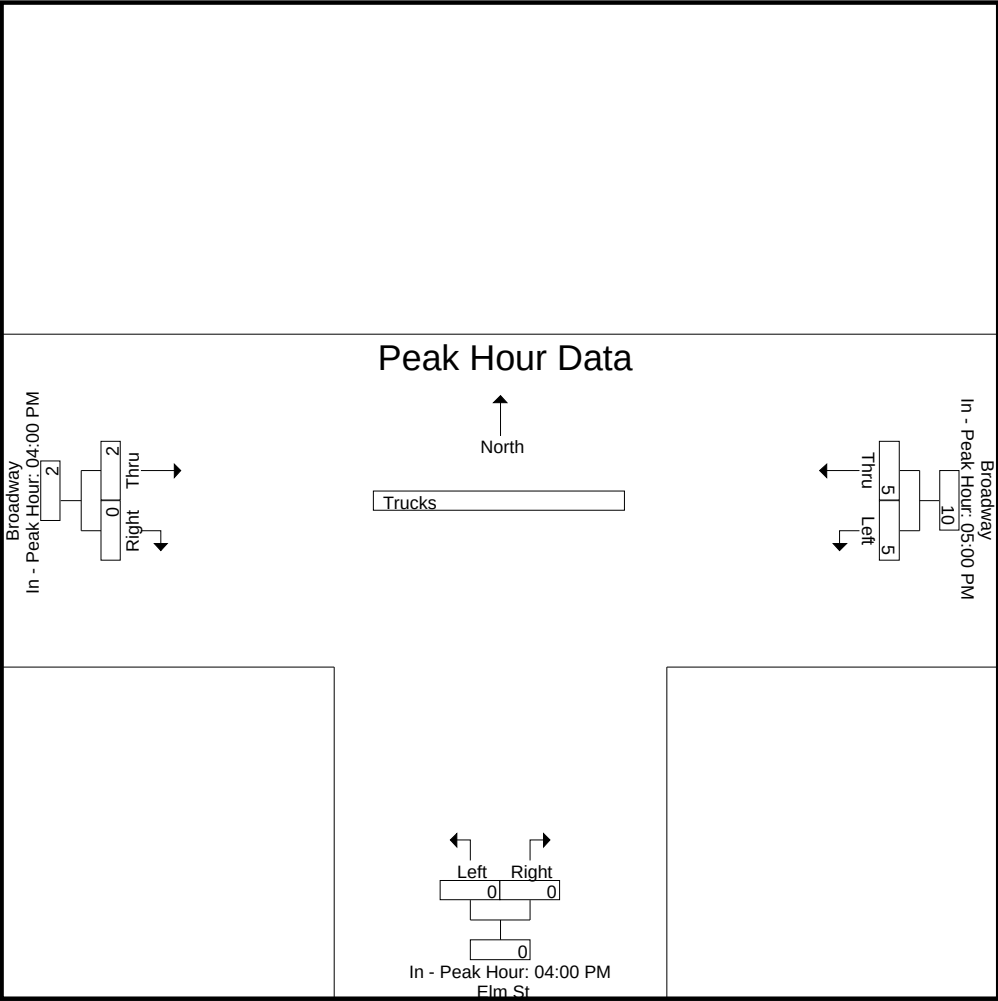


Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	05:00 PM			04:00 PM			04:00 PM		
+0 mins.	0	0	0	0	0	0	1	0	1
+15 mins.	0	2	2	0	0	0	0	0	0
+30 mins.	0	1	1	0	0	0	1	0	1
+45 mins.	5	2	7	0	0	0	0	0	0
Total Volume	5	5	10	0	0	0	2	0	2
% App. Total	50	50		0	0		100	0	
PHF	.250	.625	.357	.000	.000	.000	.500	.000	.500

N/S Street : Elm Street
E/W Street : Broadway
City/State : Pembroke, MA
Weather : Clear

File Name : 92140001
Site Code : 92140001
Start Date : 9/29/2022
Page No : 9



Accurate Counts

978-664-2565

N/S Street : Elm Street
E/W Street : Broadway
City/State : Pembroke, MA
Weather : Clear

File Name : 92140001
Site Code : 92140001
Start Date : 9/29/2022
Page No : 10

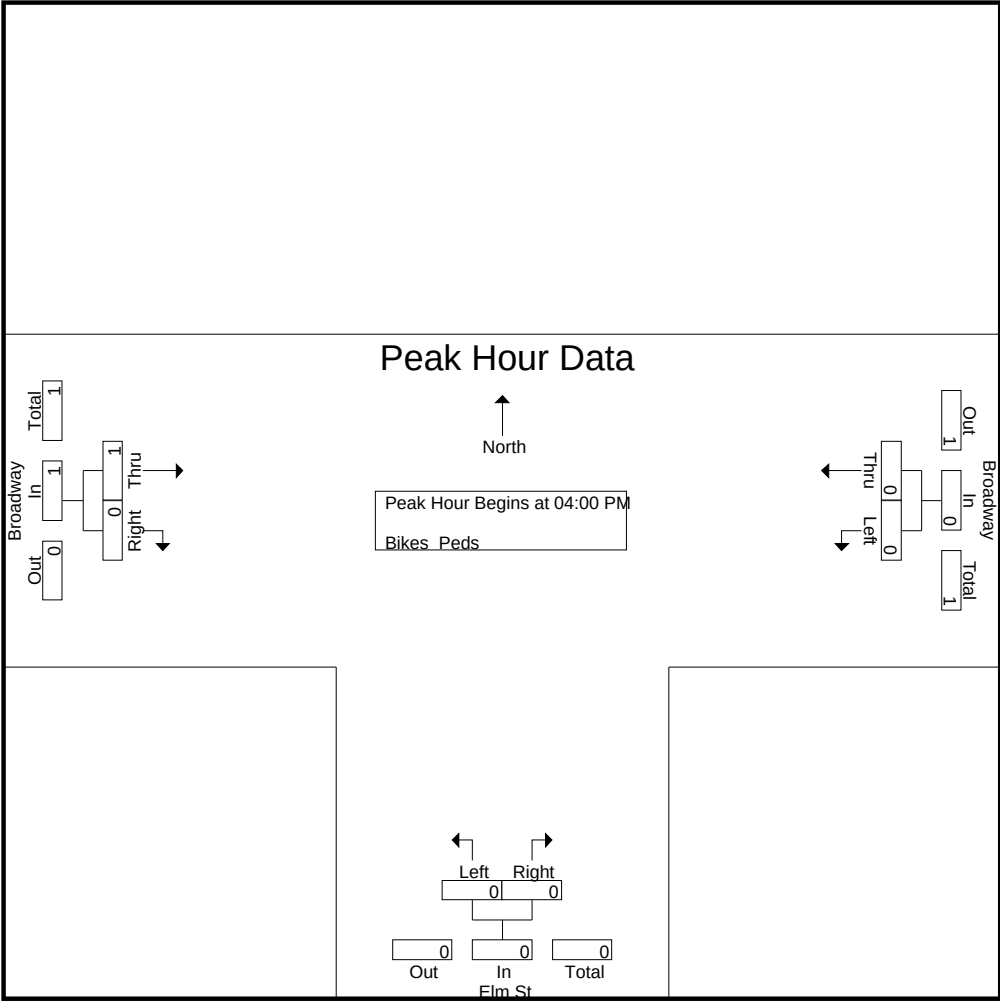
Groups Printed- Bikes Peds

	Broadway From East			Elm St From South			Broadway From West			Exclu. Total	Inclu. Total	Int. Total
Start Time	Left	Thru	Peds	Left	Right	Peds	Thru	Right	Peds			
04:00 PM	0	0	0	0	0	0	0	0	0	0	0	0
04:15 PM	0	0	0	0	0	0	1	0	0	0	1	1
04:30 PM	0	0	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	1	0	0	0	1	1
05:00 PM	0	0	0	0	0	0	0	0	0	0	0	0
05:15 PM	0	0	0	0	0	0	0	0	0	0	0	0
05:30 PM	0	0	0	0	0	0	0	0	0	0	0	0
05:45 PM	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	0	0	0	0	0	0	1	0	0	0	1	1
Apprch %	0	0		0	0		100	0				
Total %	0	0		0	0		100	0		0	100	

	Broadway From East			Elm St From South			Broadway From West			
Start Time	Left	Thru	App. Total	Left	Right	App. Total	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1										
Peak Hour for Entire Intersection Begins at 04:00 PM										
04:00 PM	0	0	0	0	0	0	0	0	0	0
04:15 PM	0	0	0	0	0	0	1	0	1	1
04:30 PM	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	0	0	0	0	0	0	0	0	0
Total Volume	0	0	0	0	0	0	1	0	1	1
% App. Total	0	0		0	0		100	0		
PHF	.000	.000	.000	.000	.000	.000	.250	.000	.250	.250

N/S Street : Elm Street
E/W Street : Broadway
City/State : Pembroke, MA
Weather : Clear

File Name : 92140001
Site Code : 92140001
Start Date : 9/29/2022
Page No : 11

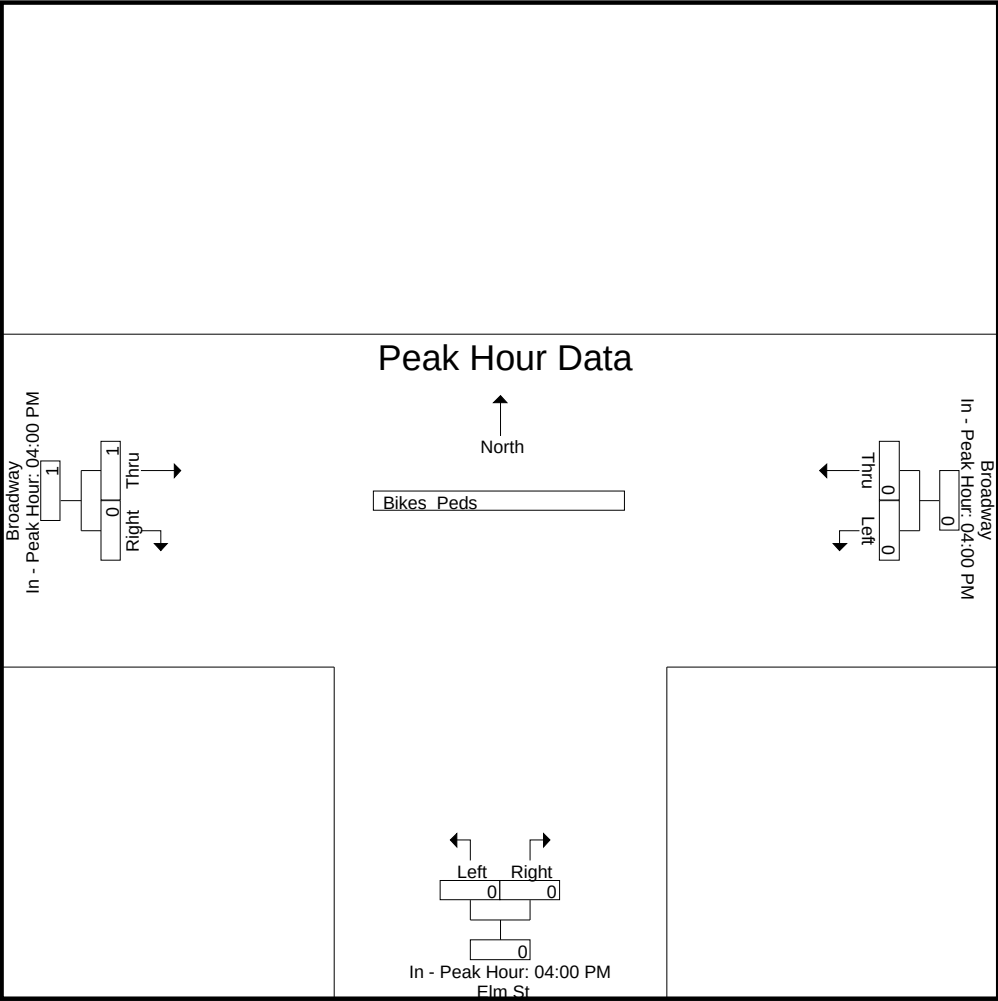


Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	04:00 PM			04:00 PM			04:00 PM		
+0 mins.	0	0	0	0	0	0	0	0	0
+15 mins.	0	0	0	0	0	0	1	0	1
+30 mins.	0	0	0	0	0	0	0	0	0
+45 mins.	0	0	0	0	0	0	0	0	0
Total Volume	0	0	0	0	0	0	1	0	1
% App. Total	0	0		0	0		100	0	
PHF	.000	.000	.000	.000	.000	.000	.250	.000	.250

N/S Street : Elm Street
E/W Street : Broadway
City/State : Pembroke, MA
Weather : Clear

File Name : 92140001
Site Code : 92140001
Start Date : 9/29/2022
Page No : 12



Accurate Counts

978-664-2565

N/S Street : Columbia Road
E/W Street : Broadway
City/State : Hanover, MA
Weather : Clear

File Name : 92140002
Site Code : 92140002
Start Date : 9/29/2022
Page No : 1

Groups Printed- Cars - Trucks

	Columbia Rd From North			Broadway From East			Columbia Rd From South			Broadway From West			Int. Total
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
07:00 AM	4	89	17	10	15	3	32	158	6	64	30	59	487
07:15 AM	6	111	14	13	17	3	18	160	10	72	41	49	514
07:30 AM	0	139	14	9	10	3	27	166	9	65	53	76	571
07:45 AM	5	154	21	20	15	2	37	182	9	76	45	49	615
Total	15	493	66	52	57	11	114	666	34	277	169	233	2187
08:00 AM	4	147	18	15	9	3	31	188	14	60	45	39	573
08:15 AM	2	150	26	19	16	5	32	170	10	47	37	61	575
08:30 AM	3	130	27	22	12	3	33	182	7	55	30	54	558
08:45 AM	4	170	23	16	8	4	45	183	16	63	28	54	614
Total	13	597	94	72	45	15	141	723	47	225	140	208	2320
Grand Total	28	1090	160	124	102	26	255	1389	81	502	309	441	4507
Apprch %	2.2	85.3	12.5	49.2	40.5	10.3	14.8	80.5	4.7	40.1	24.7	35.2	
Total %	0.6	24.2	3.6	2.8	2.3	0.6	5.7	30.8	1.8	11.1	6.9	9.8	
Cars	27	1057	158	122	98	26	222	1370	78	499	297	410	4364
% Cars	96.4	97	98.8	98.4	96.1	100	87.1	98.6	96.3	99.4	96.1	93	96.8
Trucks	1	33	2	2	4	0	33	19	3	3	12	31	143
% Trucks	3.6	3	1.2	1.6	3.9	0	12.9	1.4	3.7	0.6	3.9	7	3.2

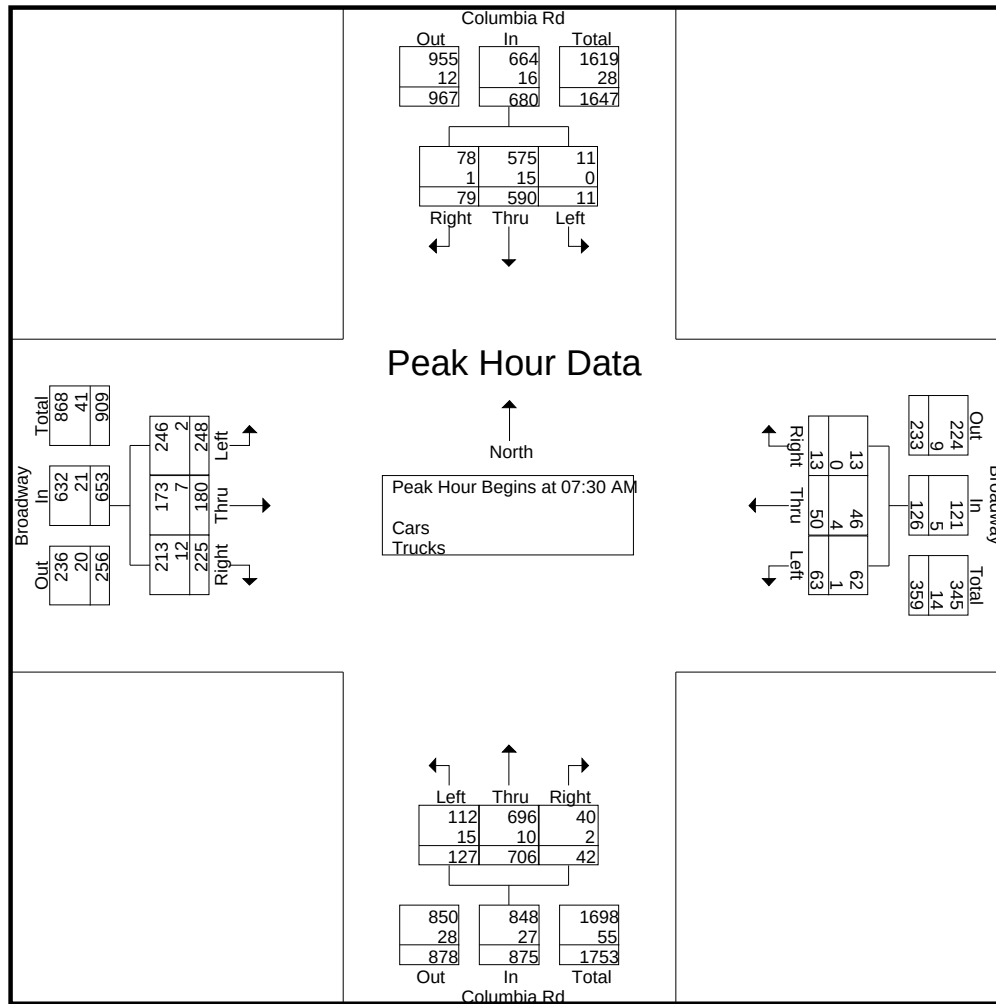
	Columbia Rd From North				Broadway From East				Columbia Rd From South				Broadway From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 07:30 AM																	
07:30 AM	0	139	14	153	9	10	3	22	27	166	9	202	65	53	76	194	571
07:45 AM	5	154	21	180	20	15	2	37	37	182	9	228	76	45	49	170	615
08:00 AM	4	147	18	169	15	9	3	27	31	188	14	233	60	45	39	144	573
08:15 AM	2	150	26	178	19	16	5	40	32	170	10	212	47	37	61	145	575
Total Volume	11	590	79	680	63	50	13	126	127	706	42	875	248	180	225	653	2334
% App. Total	1.6	86.8	11.6		50	39.7	10.3		14.5	80.7	4.8		38	27.6	34.5		
PHF	.550	.958	.760	.944	.788	.781	.650	.788	.858	.939	.750	.939	.816	.849	.740	.841	.949
Cars	11	575	78	664	62	46	13	121	112	696	40	848	246	173	213	632	2265
% Cars	100	97.5	98.7	97.6	98.4	92.0	100	96.0	88.2	98.6	95.2	96.9	99.2	96.1	94.7	96.8	97.0
Trucks	0	15	1	16	1	4	0	5	15	10	2	27	2	7	12	21	69
% Trucks	0	2.5	1.3	2.4	1.6	8.0	0	4.0	11.8	1.4	4.8	3.1	0.8	3.9	5.3	3.2	3.0

Accurate Counts

978-664-2565

N/S Street : Columbia Road
E/W Street : Broadway
City/State : Hanover, MA
Weather : Clear

File Name : 92140002
Site Code : 92140002
Start Date : 9/29/2022
Page No : 2

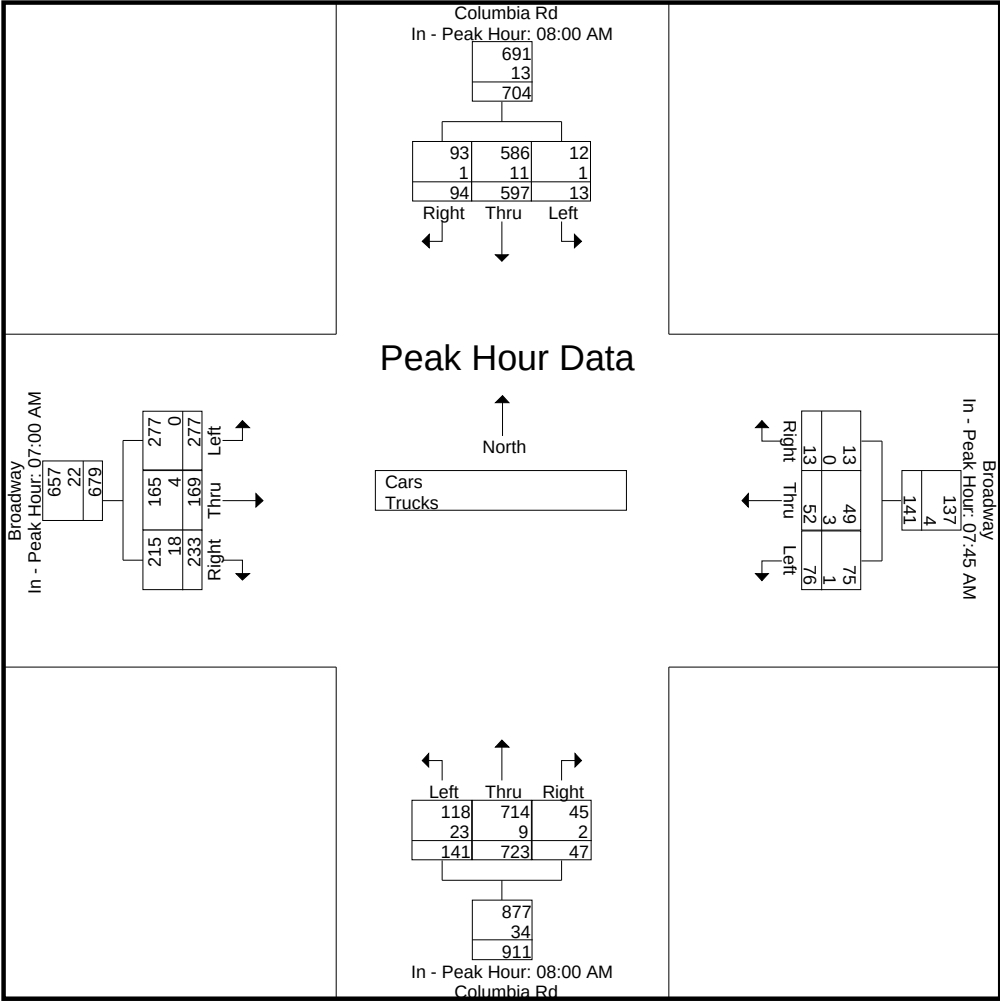


Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	08:00 AM				07:45 AM				08:00 AM				07:00 AM			
+0 mins.	4	147	18	169	20	15	2	37	31	188	14	233	64	30	59	153
+15 mins.	2	150	26	178	15	9	3	27	32	170	10	212	72	41	49	162
+30 mins.	3	130	27	160	19	16	5	40	33	182	7	222	65	53	76	194
+45 mins.	4	170	23	197	22	12	3	37	45	183	16	244	76	45	49	170
Total Volume	13	597	94	704	76	52	13	141	141	723	47	911	277	169	233	679
% App. Total	1.8	84.8	13.4		53.9	36.9	9.2		15.5	79.4	5.2		40.8	24.9	34.3	
PHF	.813	.878	.870	.893	.864	.813	.650	.881	.783	.961	.734	.933	.911	.797	.766	.875
Cars	12	586	93	691	75	49	13	137	118	714	45	877	277	165	215	657
% Cars	92.3	98.2	98.9	98.2	98.7	94.2	100	97.2	83.7	98.8	95.7	96.3	100	97.6	92.3	96.8
Trucks	1	11	1	13	1	3	0	4	23	9	2	34	0	4	18	22
% Trucks	7.7	1.8	1.1	1.8	1.3	5.8	0	2.8	16.3	1.2	4.3	3.7	0	2.4	7.7	3.2

N/S Street : Columbia Road
E/W Street : Broadway
City/State : Hanover, MA
Weather : Clear

File Name : 92140002
Site Code : 92140002
Start Date : 9/29/2022
Page No : 3



Accurate Counts

978-664-2565

N/S Street : Columbia Road

E/W Street : Broadway

City/State : Hanover, MA

Weather : Clear

File Name : 92140002

Site Code : 92140002

Start Date : 9/29/2022

Page No : 4

Groups Printed- Cars

	Columbia Rd From North			Broadway From East			Columbia Rd From South			Broadway From West			Int. Total
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
07:00 AM	4	82	17	9	15	3	32	156	6	64	30	49	467
07:15 AM	6	105	14	13	17	3	16	158	10	72	40	47	501
07:30 AM	0	134	14	9	9	3	22	165	8	65	51	73	553
07:45 AM	5	150	20	20	13	2	34	177	9	76	44	46	596
Total	15	471	65	51	54	11	104	656	33	277	165	215	2117
08:00 AM	4	145	18	15	9	3	30	186	13	59	42	36	560
08:15 AM	2	146	26	18	15	5	26	168	10	46	36	58	556
08:30 AM	3	129	26	22	12	3	26	179	7	54	27	51	539
08:45 AM	3	166	23	16	8	4	36	181	15	63	27	50	592
Total	12	586	93	71	44	15	118	714	45	222	132	195	2247
Grand Total	27	1057	158	122	98	26	222	1370	78	499	297	410	4364
Apprch %	2.2	85.1	12.7	49.6	39.8	10.6	13.3	82	4.7	41.4	24.6	34	
Total %	0.6	24.2	3.6	2.8	2.2	0.6	5.1	31.4	1.8	11.4	6.8	9.4	

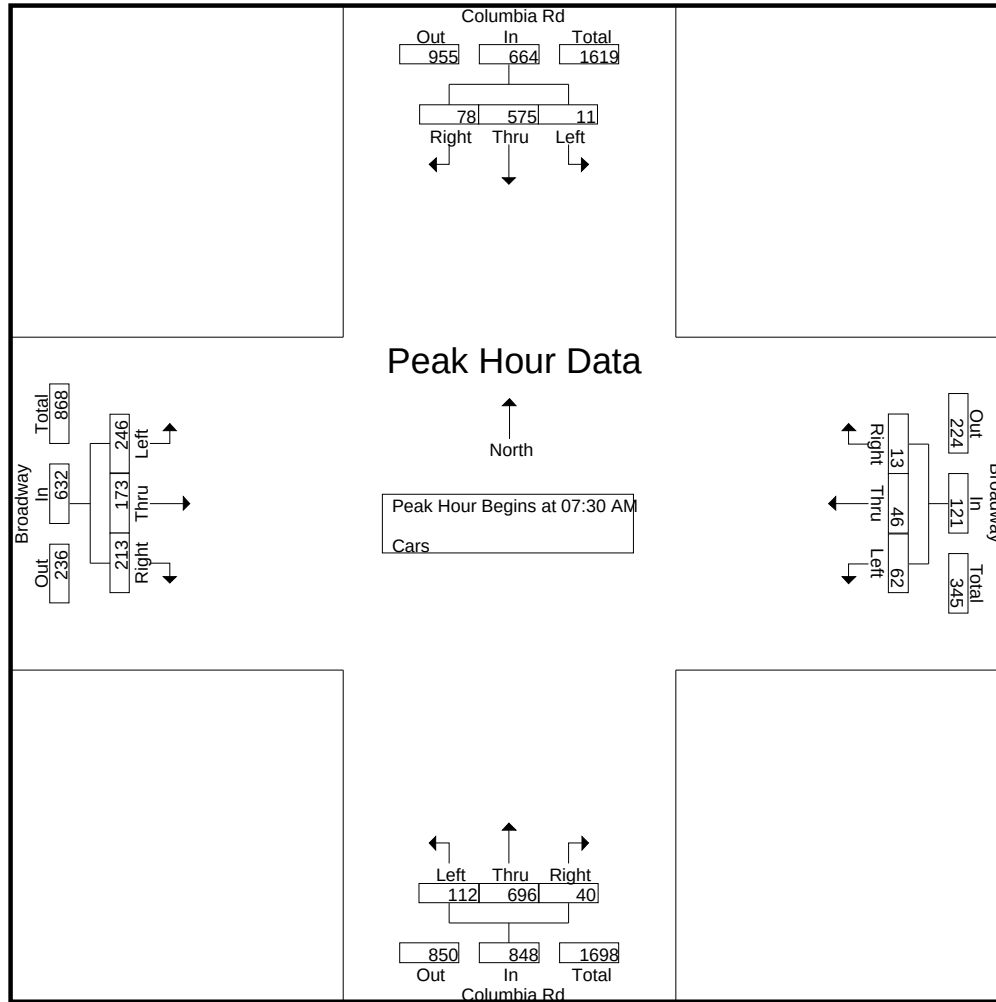
	Columbia Rd From North				Broadway From East				Columbia Rd From South				Broadway From West				Int. Total
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 07:30 AM																	
07:30 AM	0	134	14	148	9	9	3	21	22	165	8	195	65	51	73	189	553
07:45 AM	5	150	20	175	20	13	2	35	34	177	9	220	76	44	46	166	596
08:00 AM	4	145	18	167	15	9	3	27	30	186	13	229	59	42	36	137	560
08:15 AM	2	146	26	174	18	15	5	38	26	168	10	204	46	36	58	140	556
Total Volume	11	575	78	664	62	46	13	121	112	696	40	848	246	173	213	632	2265
% App. Total	1.7	86.6	11.7		51.2	38	10.7		13.2	82.1	4.7		38.9	27.4	33.7		
PHF	.550	.958	.750	.949	.775	.767	.650	.796	.824	.935	.769	.926	.809	.848	.729	.836	.950

Accurate Counts

978-664-2565

N/S Street : Columbia Road
E/W Street : Broadway
City/State : Hanover, MA
Weather : Clear

File Name : 92140002
Site Code : 92140002
Start Date : 9/29/2022
Page No : 5

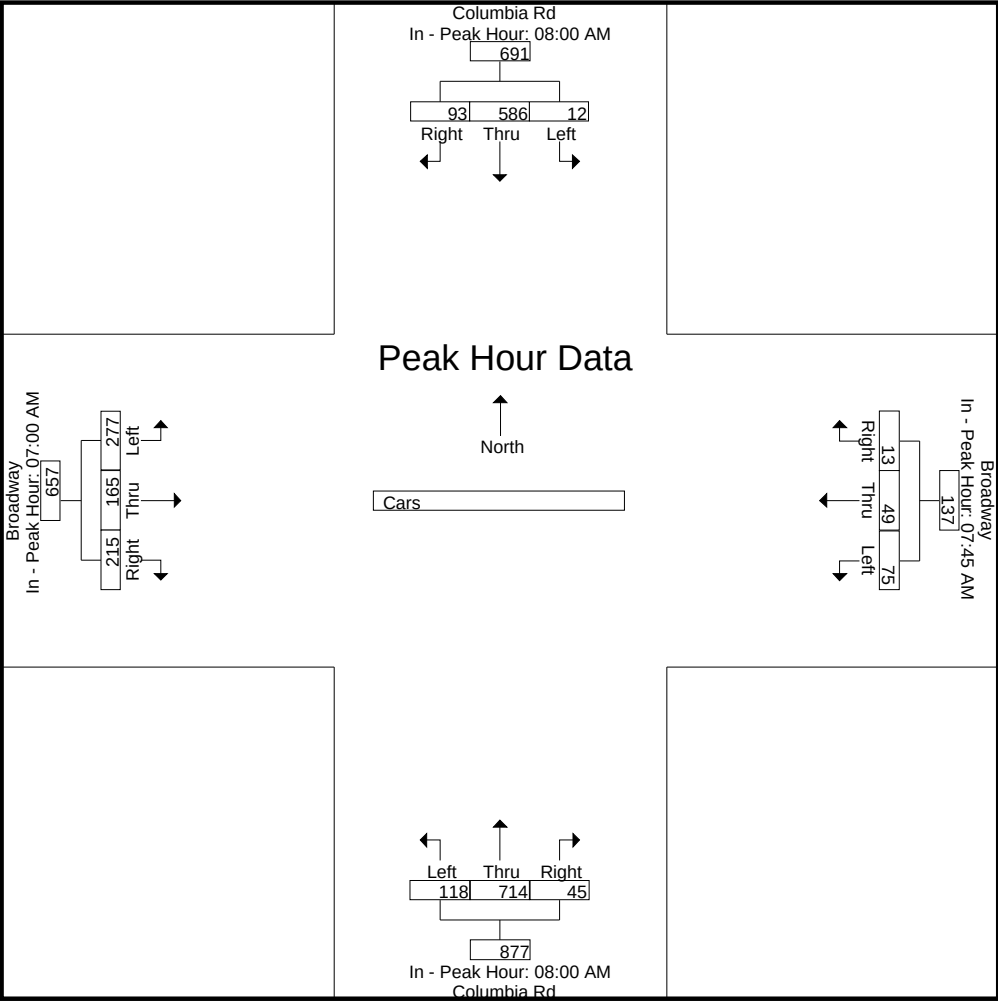


Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	08:00 AM				07:45 AM				08:00 AM				07:00 AM			
+0 mins.	4	145	18	167	20	13	2	35	30	186	13	229	64	30	49	143
+15 mins.	2	146	26	174	15	9	3	27	26	168	10	204	72	40	47	159
+30 mins.	3	129	26	158	18	15	5	38	26	179	7	212	65	51	73	189
+45 mins.	3	166	23	192	22	12	3	37	36	181	15	232	76	44	46	166
Total Volume	12	586	93	691	75	49	13	137	118	714	45	877	277	165	215	657
% App. Total	1.7	84.8	13.5		54.7	35.8	9.5		13.5	81.4	5.1		42.2	25.1	32.7	
PHF	.750	.883	.894	.900	.852	.817	.650	.901	.819	.960	.750	.945	.911	.809	.736	.869

N/S Street : Columbia Road
E/W Street : Broadway
City/State : Hanover, MA
Weather : Clear

File Name : 92140002
Site Code : 92140002
Start Date : 9/29/2022
Page No : 6



Accurate Counts

978-664-2565

N/S Street : Columbia Road

E/W Street : Broadway

City/State : Hanover, MA

Weather : Clear

File Name : 92140002

Site Code : 92140002

Start Date : 9/29/2022

Page No : 7

Groups Printed- Trucks

	Columbia Rd From North			Broadway From East			Columbia Rd From South			Broadway From West			Int. Total
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
07:00 AM	0	7	0	1	0	0	0	2	0	0	0	10	20
07:15 AM	0	6	0	0	0	0	2	2	0	0	1	2	13
07:30 AM	0	5	0	0	1	0	5	1	1	0	2	3	18
07:45 AM	0	4	1	0	2	0	3	5	0	0	1	3	19
Total	0	22	1	1	3	0	10	10	1	0	4	18	70
08:00 AM	0	2	0	0	0	0	1	2	1	1	3	3	13
08:15 AM	0	4	0	1	1	0	6	2	0	1	1	3	19
08:30 AM	0	1	1	0	0	0	7	3	0	1	3	3	19
08:45 AM	1	4	0	0	0	0	9	2	1	0	1	4	22
Total	1	11	1	1	1	0	23	9	2	3	8	13	73
Grand Total	1	33	2	2	4	0	33	19	3	3	12	31	143
Apprch %	2.8	91.7	5.6	33.3	66.7	0	60	34.5	5.5	6.5	26.1	67.4	
Total %	0.7	23.1	1.4	1.4	2.8	0	23.1	13.3	2.1	2.1	8.4	21.7	

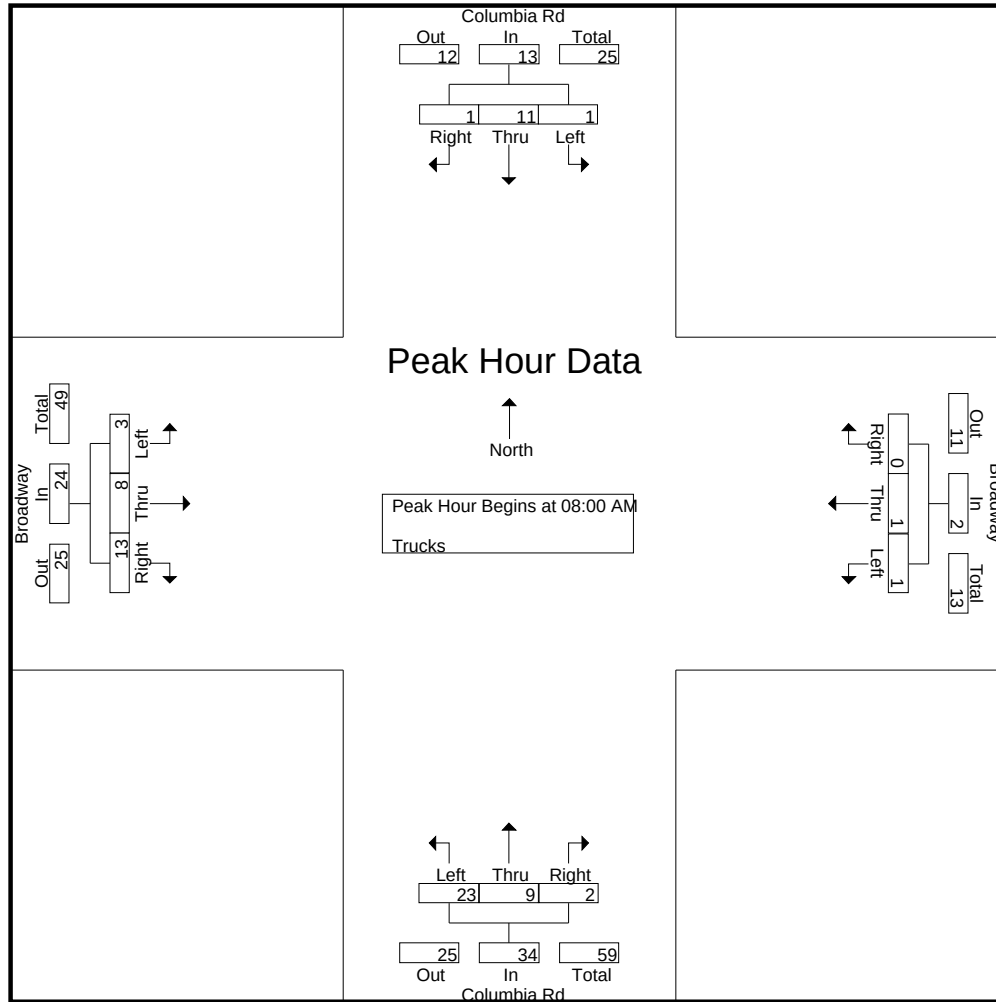
	Columbia Rd From North				Broadway From East				Columbia Rd From South				Broadway From West				Int. Total
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 08:00 AM																	
08:00 AM	0	2	0	2	0	0	0	0	1	2	1	4	1	3	3	7	13
08:15 AM	0	4	0	4	1	1	0	2	6	2	0	8	1	1	3	5	19
08:30 AM	0	1	1	2	0	0	0	0	7	3	0	10	1	3	3	7	19
08:45 AM	1	4	0	5	0	0	0	0	9	2	1	12	0	1	4	5	22
Total Volume	1	11	1	13	1	1	0	2	23	9	2	34	3	8	13	24	73
% App. Total	7.7	84.6	7.7		50	50	0		67.6	26.5	5.9		12.5	33.3	54.2		
PHF	.250	.688	.250	.650	.250	.250	.000	.250	.639	.750	.500	.708	.750	.667	.813	.857	.830

Accurate Counts

978-664-2565

N/S Street : Columbia Road
E/W Street : Broadway
City/State : Hanover, MA
Weather : Clear

File Name : 92140002
Site Code : 92140002
Start Date : 9/29/2022
Page No : 8

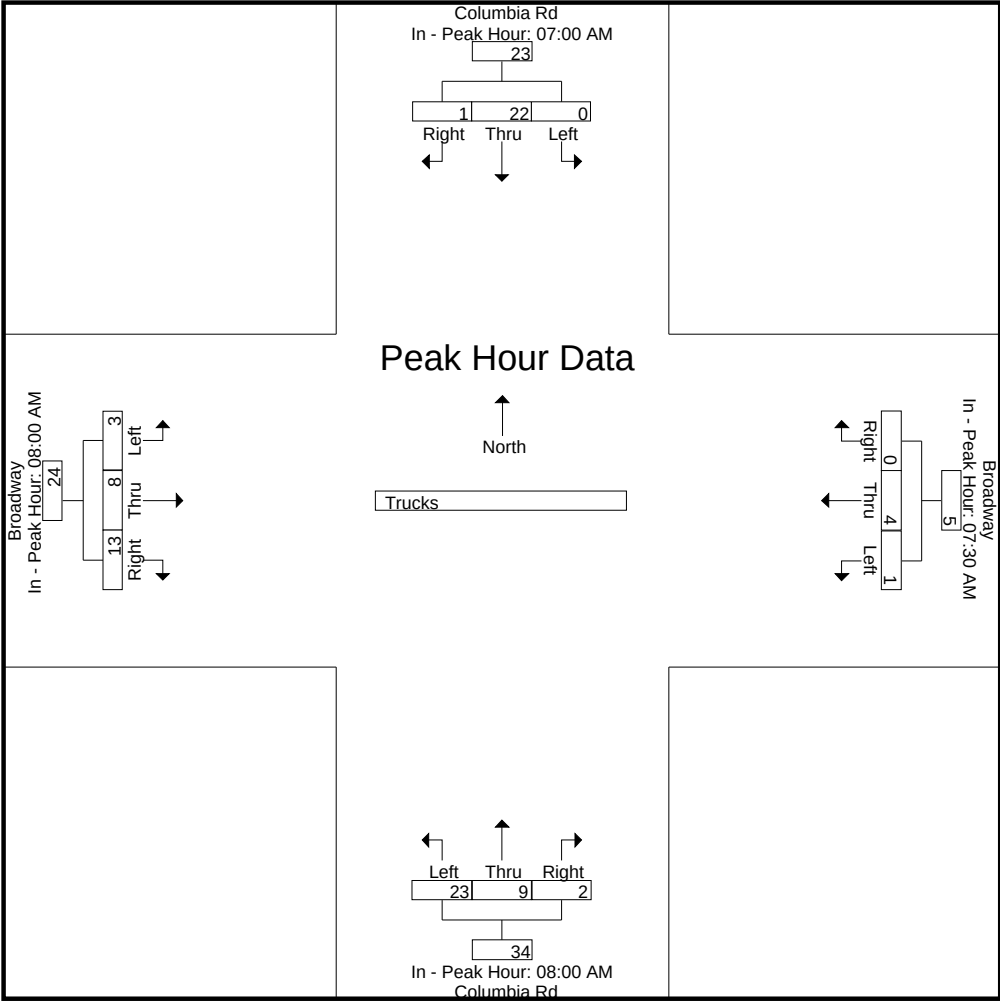


Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	07:00 AM				07:30 AM				08:00 AM				08:00 AM			
+0 mins.	0	7	0	7	0	1	0	1	1	2	1	4	1	3	3	7
+15 mins.	0	6	0	6	0	2	0	2	6	2	0	8	1	1	3	5
+30 mins.	0	5	0	5	0	0	0	0	7	3	0	10	1	3	3	7
+45 mins.	0	4	1	5	1	1	0	2	9	2	1	12	0	1	4	5
Total Volume	0	22	1	23	1	4	0	5	23	9	2	34	3	8	13	24
% App. Total	0	95.7	4.3		20	80	0		67.6	26.5	5.9		12.5	33.3	54.2	
PHF	.000	.786	.250	.821	.250	.500	.000	.625	.639	.750	.500	.708	.750	.667	.813	.857

N/S Street : Columbia Road
E/W Street : Broadway
City/State : Hanover, MA
Weather : Clear

File Name : 92140002
Site Code : 92140002
Start Date : 9/29/2022
Page No : 9



978-664-2565

Page No : 10

[illegible]

978-664-2565

File Name : 92140002
Site Code : 92140002
Start Date : 9/29/2022
Page No : 11

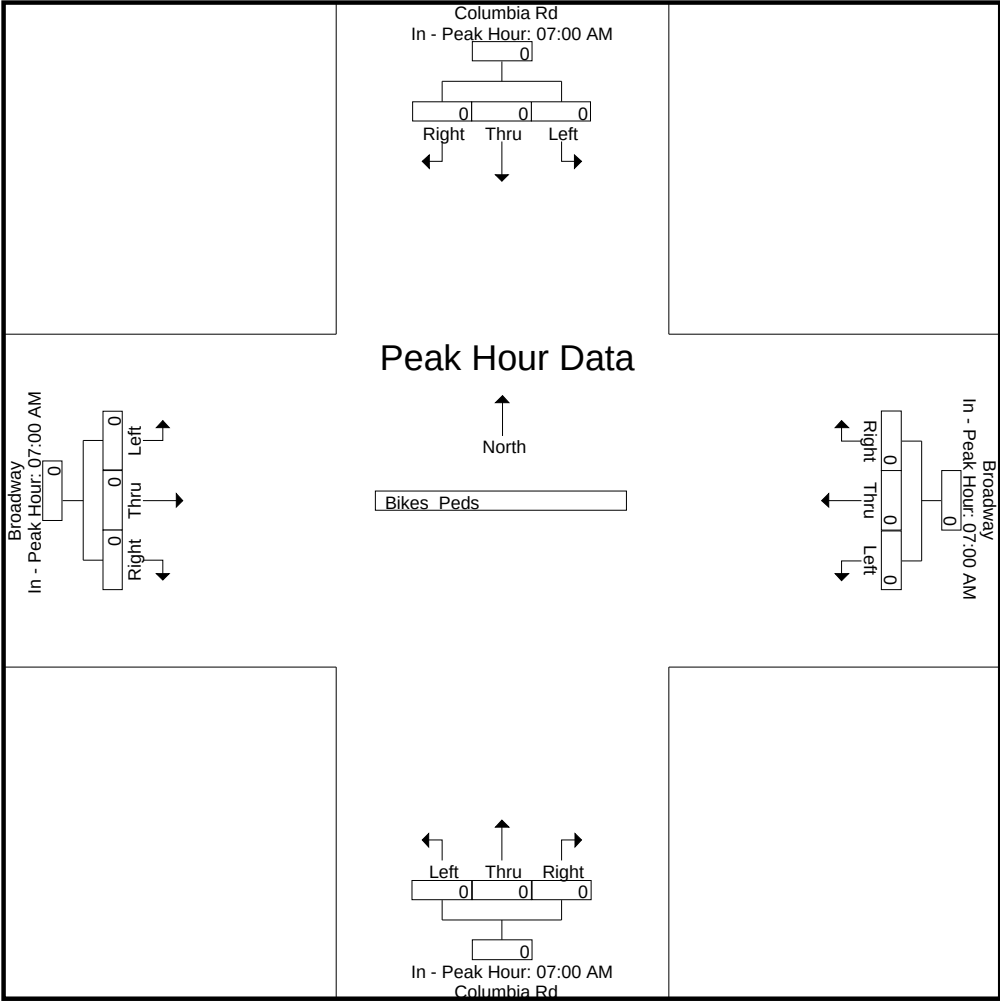


Peak Hour Begins at 07:00 AM
Bikes Peds

[illegible]

N/S Street : Columbia Road
E/W Street : Broadway
City/State : Hanover, MA
Weather : Clear

File Name : 92140002
Site Code : 92140002
Start Date : 9/29/2022
Page No : 12



Accurate Counts

978-664-2565

N/S Street : Columbia Road
E/W Street : Broadway
City/State : Hanover, MA
Weather : Clear

File Name : 92140002
Site Code : 92140002
Start Date : 9/29/2022
Page No : 1

Groups Printed- Cars - Trucks

	Columbia Rd From North			Broadway From East			Columbia Rd From South			Broadway From West			Int. Total
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
04:00 PM	6	217	79	28	38	6	51	206	6	44	24	64	769
04:15 PM	3	224	74	31	51	5	57	179	7	41	16	45	733
04:30 PM	3	230	79	29	35	3	56	176	10	39	17	50	727
04:45 PM	4	230	69	27	53	4	67	162	6	39	9	59	729
Total	16	901	301	115	177	18	231	723	29	163	66	218	2958
05:00 PM	1	267	65	27	39	5	64	210	9	44	19	44	794
05:15 PM	5	255	85	17	36	4	54	169	2	46	20	46	739
05:30 PM	2	234	73	27	29	5	54	162	6	42	18	47	699
05:45 PM	4	218	75	20	34	2	70	185	11	48	25	54	746
Total	12	974	298	91	138	16	242	726	28	180	82	191	2978
Grand Total	28	1875	599	206	315	34	473	1449	57	343	148	409	5936
Apprch %	1.1	74.9	23.9	37.1	56.8	6.1	23.9	73.2	2.9	38.1	16.4	45.4	
Total %	0.5	31.6	10.1	3.5	5.3	0.6	8	24.4	1	5.8	2.5	6.9	
Cars	28	1865	593	205	311	34	466	1434	57	343	148	407	5891
% Cars	100	99.5	99	99.5	98.7	100	98.5	99	100	100	100	99.5	99.2
Trucks	0	10	6	1	4	0	7	15	0	0	0	2	45
% Trucks	0	0.5	1	0.5	1.3	0	1.5	1	0	0	0	0.5	0.8

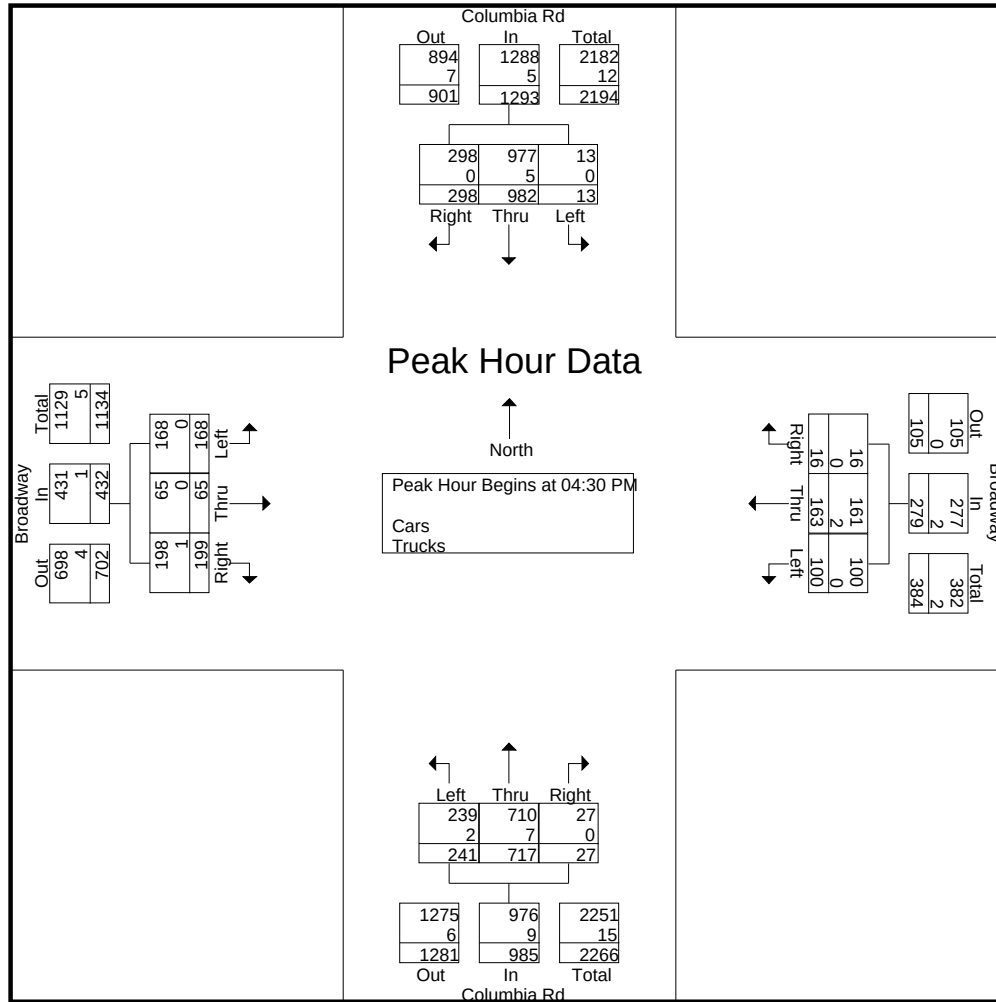
	Columbia Rd From North				Broadway From East				Columbia Rd From South				Broadway From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 04:30 PM																	
04:30 PM	3	230	79	312	29	35	3	67	56	176	10	242	39	17	50	106	727
04:45 PM	4	230	69	303	27	53	4	84	67	162	6	235	39	9	59	107	729
05:00 PM	1	267	65	333	27	39	5	71	64	210	9	283	44	19	44	107	794
05:15 PM	5	255	85	345	17	36	4	57	54	169	2	225	46	20	46	112	739
Total Volume	13	982	298	1293	100	163	16	279	241	717	27	985	168	65	199	432	2989
% App. Total	1	75.9	23		35.8	58.4	5.7		24.5	72.8	2.7		38.9	15	46.1		
PHF	.650	.919	.876	.937	.862	.769	.800	.830	.899	.854	.675	.870	.913	.813	.843	.964	.941
Cars	13	977	298	1288	100	161	16	277	239	710	27	976	168	65	198	431	2972
% Cars	100	99.5	100	99.6	100	98.8	100	99.3	99.2	99.0	100	99.1	100	100	99.5	99.8	99.4
Trucks	0	5	0	5	0	2	0	2	2	7	0	9	0	0	1	1	17
% Trucks	0	0.5	0	0.4	0	1.2	0	0.7	0.8	1.0	0	0.9	0	0	0.5	0.2	0.6

Accurate Counts

978-664-2565

N/S Street : Columbia Road
E/W Street : Broadway
City/State : Hanover, MA
Weather : Clear

File Name : 92140002
Site Code : 92140002
Start Date : 9/29/2022
Page No : 2

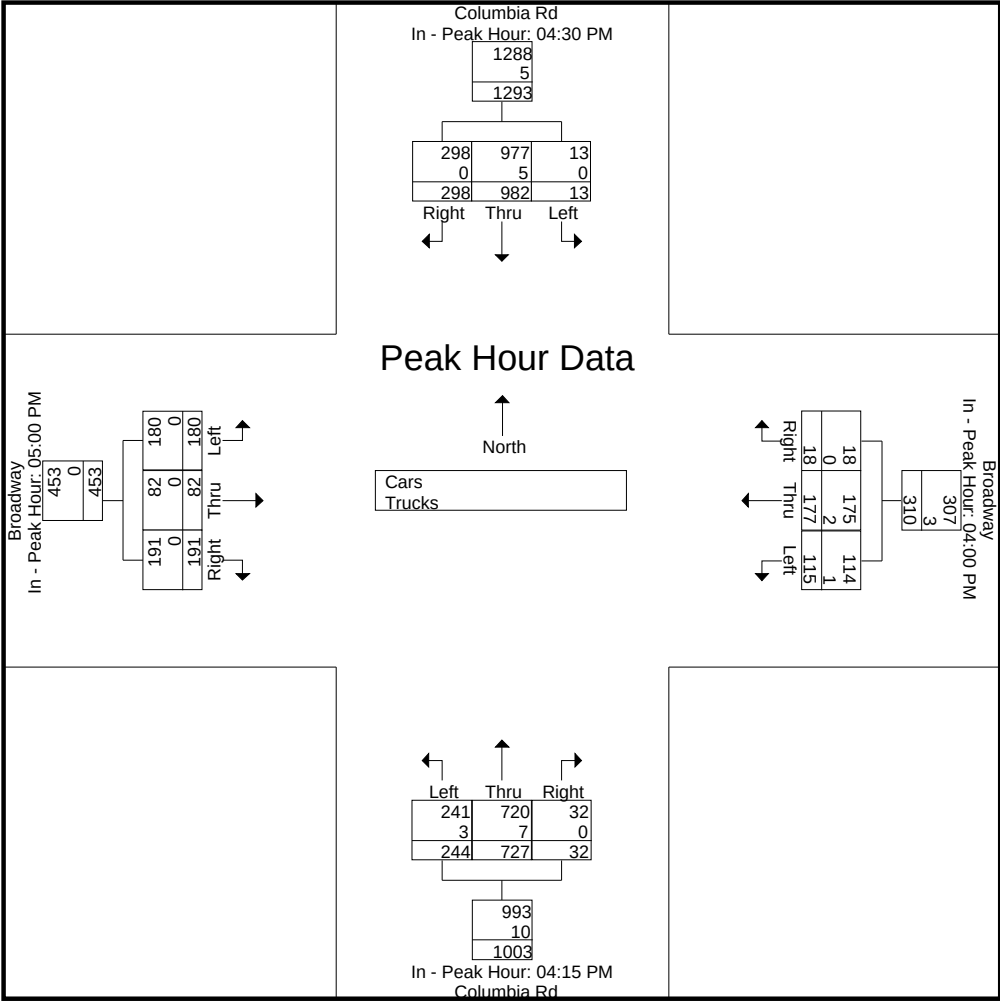


Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	04:30 PM				04:00 PM				04:15 PM				05:00 PM			
+0 mins.	3	230	79	312	28	38	6	72	57	179	7	243	44	19	44	107
+15 mins.	4	230	69	303	31	51	5	87	56	176	10	242	46	20	46	112
+30 mins.	1	267	65	333	29	35	3	67	67	162	6	235	42	18	47	107
+45 mins.	5	255	85	345	27	53	4	84	64	210	9	283	48	25	54	127
Total Volume	13	982	298	1293	115	177	18	310	244	727	32	1003	180	82	191	453
% App. Total	1	75.9	23		37.1	57.1	5.8		24.3	72.5	3.2		39.7	18.1	42.2	
PHF	.650	.919	.876	.937	.927	.835	.750	.891	.910	.865	.800	.886	.938	.820	.884	.892
Cars	13	977	298	1288	114	175	18	307	241	720	32	993	180	82	191	453
% Cars	100	99.5	100	99.6	99.1	98.9	100	99	98.8	99	100	99	100	100	100	100
Trucks	0	5	0	5	1	2	0	3	3	7	0	10	0	0	0	0
% Trucks	0	0.5	0	0.4	0.9	1.1	0	1	1.2	1	0	1	0	0	0	0

N/S Street : Columbia Road
E/W Street : Broadway
City/State : Hanover, MA
Weather : Clear

File Name : 92140002
Site Code : 92140002
Start Date : 9/29/2022
Page No : 3



Accurate Counts

978-664-2565

N/S Street : Columbia Road

E/W Street : Broadway

City/State : Hanover, MA

Weather : Clear

File Name : 92140002

Site Code : 92140002

Start Date : 9/29/2022

Page No : 4

Groups Printed- Cars

	Columbia Rd From North			Broadway From East			Columbia Rd From South			Broadway From West			Int. Total
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
04:00 PM	6	216	79	27	37	6	50	203	6	44	24	63	761
04:15 PM	3	223	74	31	51	5	55	179	7	41	16	45	730
04:30 PM	3	227	79	29	35	3	56	175	10	39	17	49	722
04:45 PM	4	228	69	27	52	4	67	157	6	39	9	59	721
Total	16	894	301	114	175	18	228	714	29	163	66	216	2934
05:00 PM	1	267	65	27	39	5	63	209	9	44	19	44	792
05:15 PM	5	255	85	17	35	4	53	169	2	46	20	46	737
05:30 PM	2	233	73	27	29	5	53	161	6	42	18	47	696
05:45 PM	4	216	69	20	33	2	69	181	11	48	25	54	732
Total	12	971	292	91	136	16	238	720	28	180	82	191	2957
Grand Total	28	1865	593	205	311	34	466	1434	57	343	148	407	5891
Apprch %	1.1	75	23.9	37.3	56.5	6.2	23.8	73.3	2.9	38.2	16.5	45.3	
Total %	0.5	31.7	10.1	3.5	5.3	0.6	7.9	24.3	1	5.8	2.5	6.9	

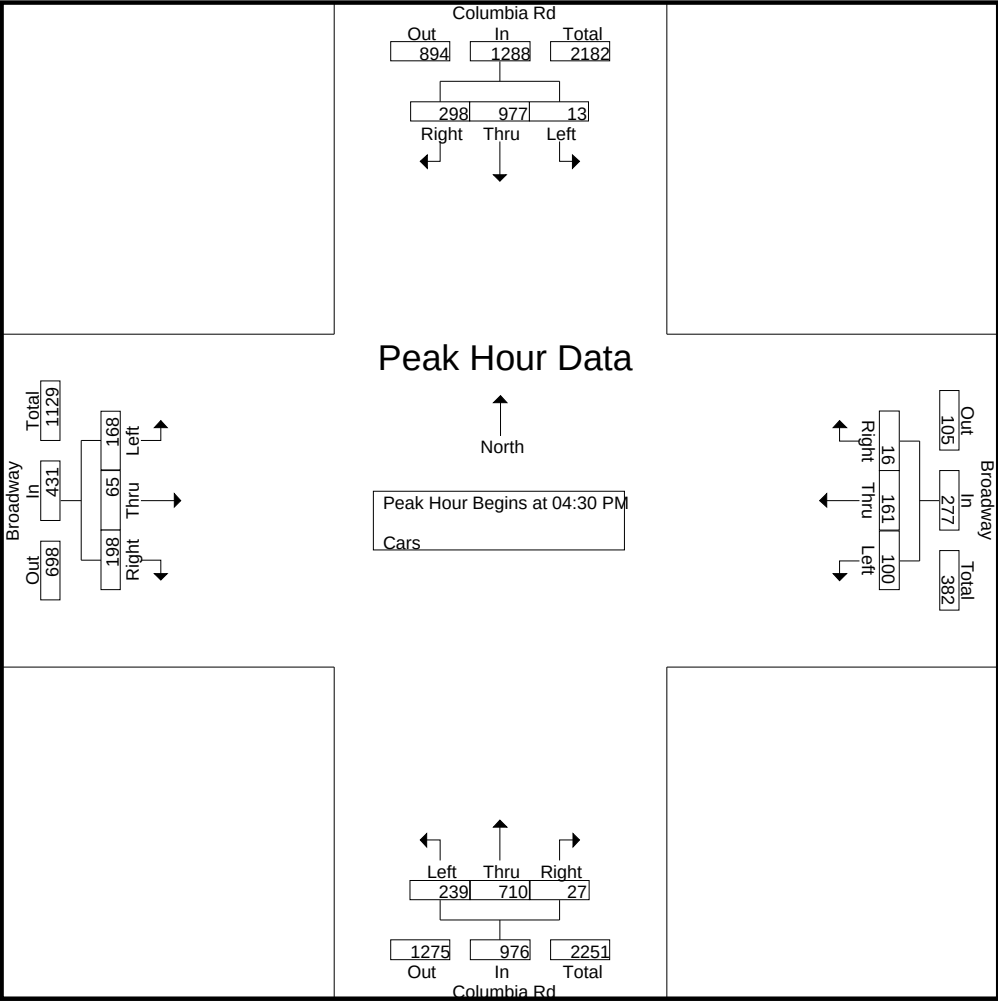
	Columbia Rd From North				Broadway From East				Columbia Rd From South				Broadway From West				Int. Total
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 04:30 PM																	
04:30 PM	3	227	79	309	29	35	3	67	56	175	10	241	39	17	49	105	722
04:45 PM	4	228	69	301	27	52	4	83	67	157	6	230	39	9	59	107	721
05:00 PM	1	267	65	333	27	39	5	71	63	209	9	281	44	19	44	107	792
05:15 PM	5	255	85	345	17	35	4	56	53	169	2	224	46	20	46	112	737
Total Volume	13	977	298	1288	100	161	16	277	239	710	27	976	168	65	198	431	2972
% App. Total	1	75.9	23.1		36.1	58.1	5.8		24.5	72.7	2.8		39	15.1	45.9		
PHF	.650	.915	.876	.933	.862	.774	.800	.834	.892	.849	.675	.868	.913	.813	.839	.962	.938

Accurate Counts

978-664-2565

N/S Street : Columbia Road
 E/W Street : Broadway
 City/State : Hanover, MA
 Weather : Clear

File Name : 92140002
 Site Code : 92140002
 Start Date : 9/29/2022
 Page No : 5

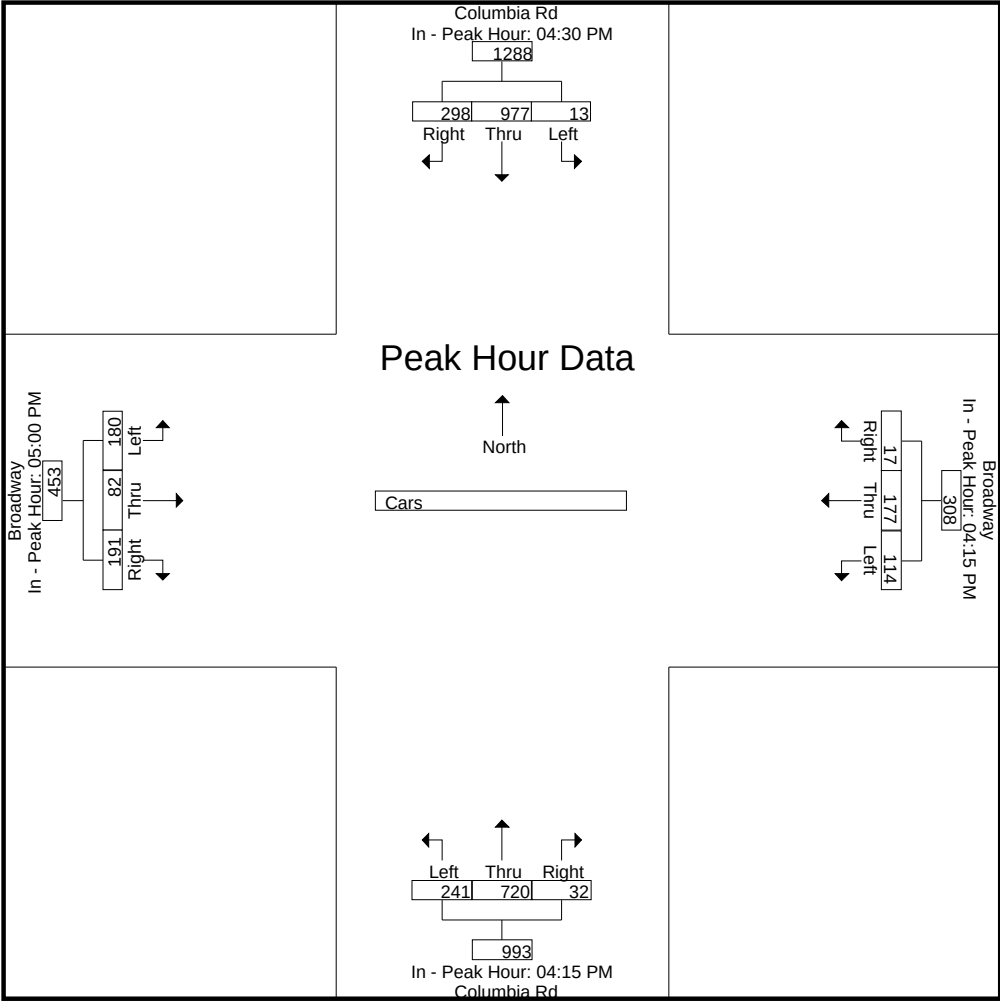


Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1
 Peak Hour for Each Approach Begins at:

	04:30 PM				04:15 PM				04:15 PM				05:00 PM			
+0 mins.	3	227	79	309	31	51	5	87	55	179	7	241	44	19	44	107
+15 mins.	4	228	69	301	29	35	3	67	56	175	10	241	46	20	46	112
+30 mins.	1	267	65	333	27	52	4	83	67	157	6	230	42	18	47	107
+45 mins.	5	255	85	345	27	39	5	71	63	209	9	281	48	25	54	127
Total Volume	13	977	298	1288	114	177	17	308	241	720	32	993	180	82	191	453
% App. Total	1	75.9	23.1		37	57.5	5.5		24.3	72.5	3.2		39.7	18.1	42.2	
PHF	.650	.915	.876	.933	.919	.851	.850	.885	.899	.861	.800	.883	.938	.820	.884	.892

N/S Street : Columbia Road
E/W Street : Broadway
City/State : Hanover, MA
Weather : Clear

File Name : 92140002
Site Code : 92140002
Start Date : 9/29/2022
Page No : 6



Accurate Counts

978-664-2565

N/S Street : Columbia Road
E/W Street : Broadway
City/State : Hanover, MA
Weather : Clear

File Name : 92140002
Site Code : 92140002
Start Date : 9/29/2022
Page No : 7

Groups Printed- Trucks

	Columbia Rd From North			Broadway From East			Columbia Rd From South			Broadway From West			Int. Total
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
04:00 PM	0	1	0	1	1	0	1	3	0	0	0	1	8
04:15 PM	0	1	0	0	0	0	2	0	0	0	0	0	3
04:30 PM	0	3	0	0	0	0	0	1	0	0	0	1	5
04:45 PM	0	2	0	0	1	0	0	5	0	0	0	0	8
Total	0	7	0	1	2	0	3	9	0	0	0	2	24
05:00 PM	0	0	0	0	0	0	1	1	0	0	0	0	2
05:15 PM	0	0	0	0	1	0	1	0	0	0	0	0	2
05:30 PM	0	1	0	0	0	0	1	1	0	0	0	0	3
05:45 PM	0	2	6	0	1	0	1	4	0	0	0	0	14
Total	0	3	6	0	2	0	4	6	0	0	0	0	21
Grand Total	0	10	6	1	4	0	7	15	0	0	0	2	45
Apprch %	0	62.5	37.5	20	80	0	31.8	68.2	0	0	0	100	
Total %	0	22.2	13.3	2.2	8.9	0	15.6	33.3	0	0	0	4.4	

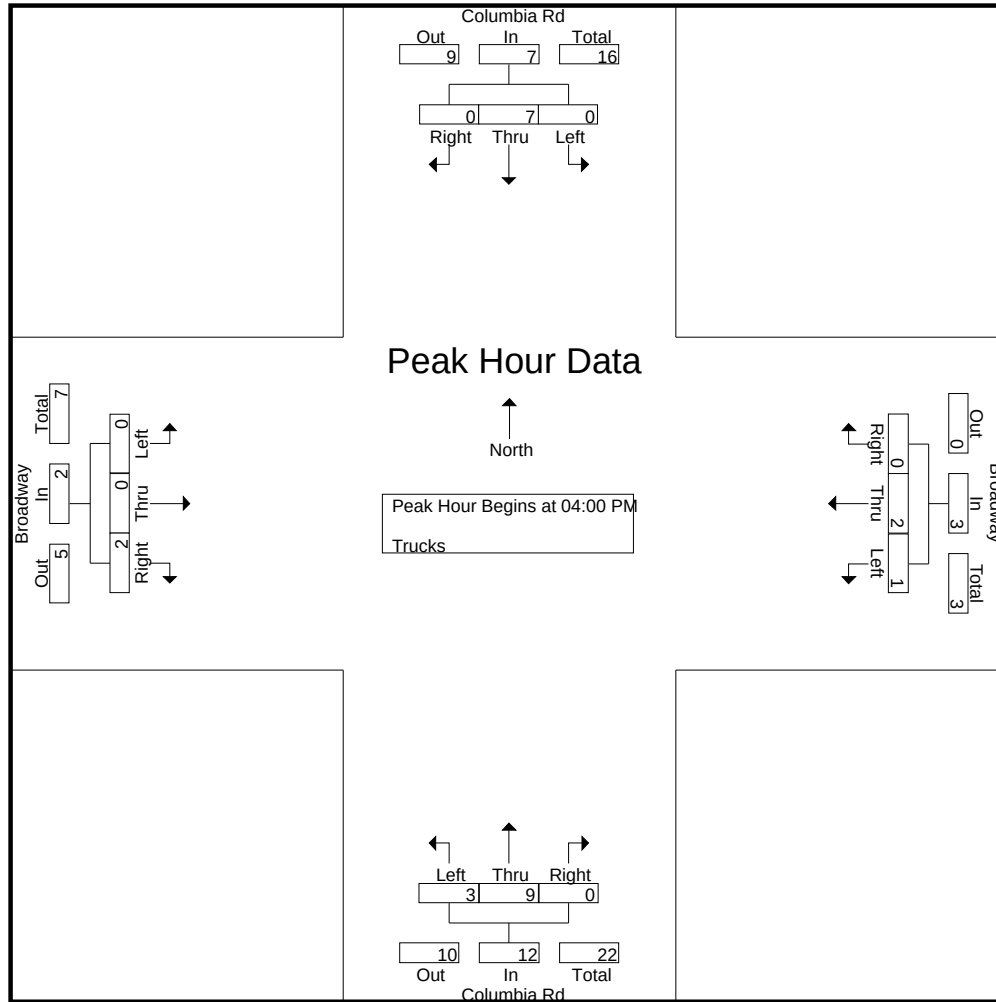
	Columbia Rd From North				Broadway From East				Columbia Rd From South				Broadway From West				Int. Total
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 04:00 PM																	
04:00 PM	0	1	0	1	1	1	0	2	1	3	0	4	0	0	1	1	8
04:15 PM	0	1	0	1	0	0	0	0	2	0	0	2	0	0	0	0	3
04:30 PM	0	3	0	3	0	0	0	0	0	1	0	1	0	0	1	1	5
04:45 PM	0	2	0	2	0	1	0	1	0	5	0	5	0	0	0	0	8
Total Volume	0	7	0	7	1	2	0	3	3	9	0	12	0	0	2	2	24
% App. Total	0	100	0		33.3	66.7	0		25	75	0		0	0	100		
PHF	.000	.583	.000	.583	.250	.500	.000	.375	.375	.450	.000	.600	.000	.000	.500	.500	.750

Accurate Counts

978-664-2565

N/S Street : Columbia Road
E/W Street : Broadway
City/State : Hanover, MA
Weather : Clear

File Name : 92140002
Site Code : 92140002
Start Date : 9/29/2022
Page No : 8

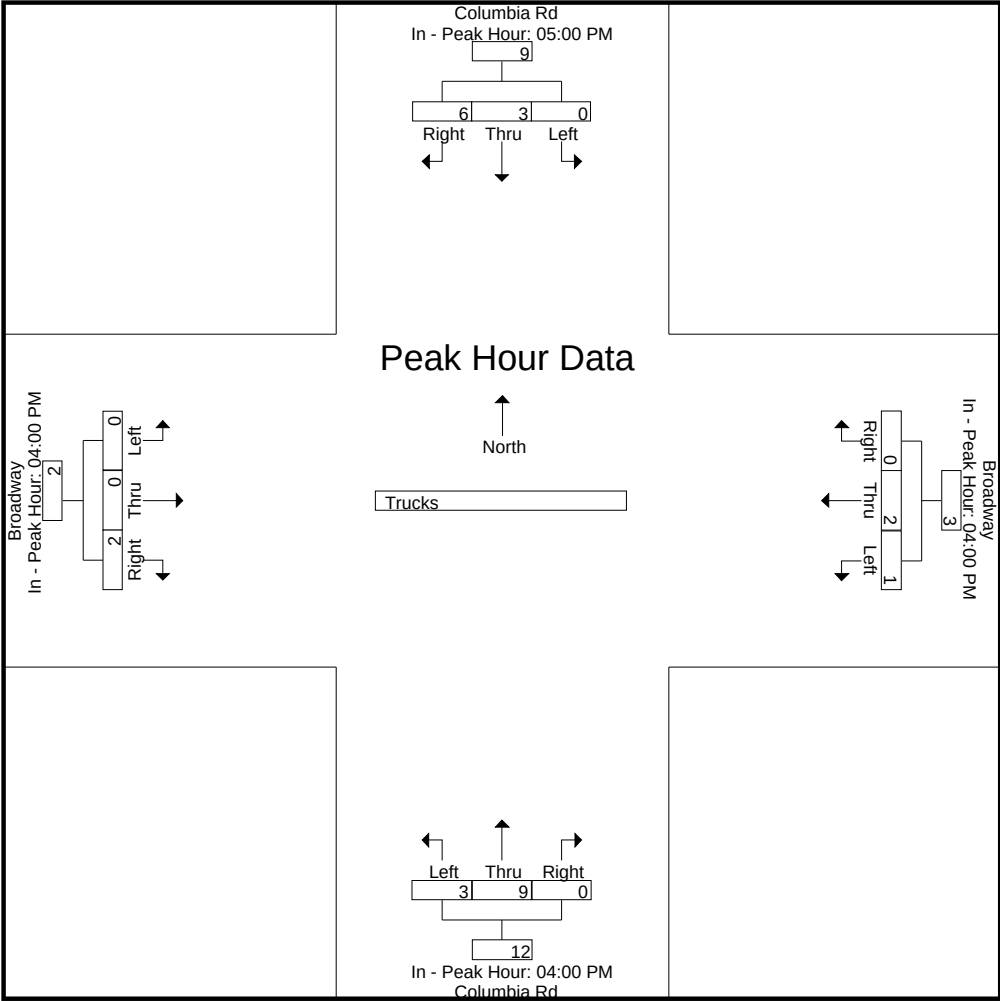


Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	05:00 PM				04:00 PM				04:00 PM				04:00 PM			
+0 mins.	0	0	0	0	1	1	0	2	1	3	0	4	0	0	1	1
+15 mins.	0	0	0	0	0	0	0	0	2	0	0	2	0	0	0	0
+30 mins.	0	1	0	1	0	0	0	0	0	1	0	1	0	0	1	1
+45 mins.	0	2	6	8	0	1	0	1	0	5	0	5	0	0	0	0
Total Volume	0	3	6	9	1	2	0	3	3	9	0	12	0	0	2	2
% App. Total	0	33.3	66.7		33.3	66.7	0		25	75	0		0	0	100	
PHF	.000	.375	.250	.281	.250	.500	.000	.375	.375	.450	.000	.600	.000	.000	.500	.500

N/S Street : Columbia Road
E/W Street : Broadway
City/State : Hanover, MA
Weather : Clear

File Name : 92140002
Site Code : 92140002
Start Date : 9/29/2022
Page No : 9



978-664-2565

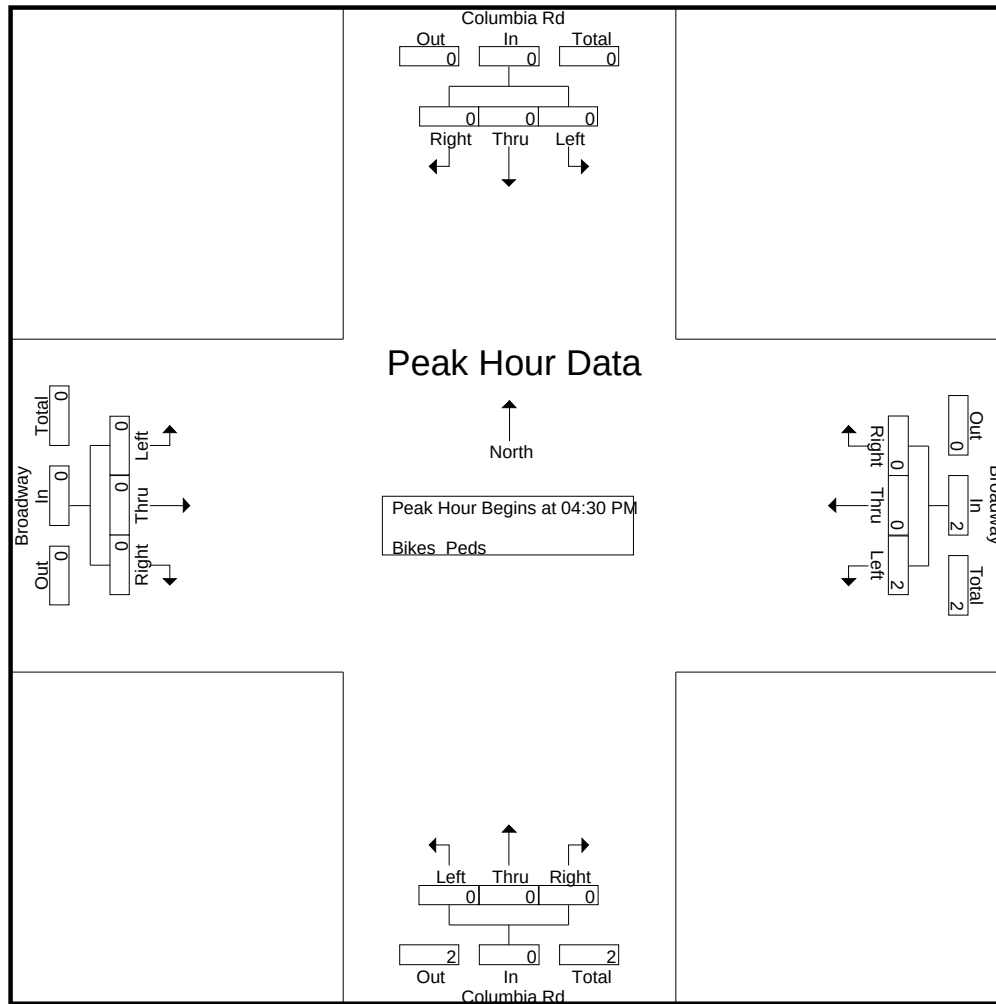
File Name : 92140002
Site Code : 92140002
Start Date : 9/29/2022
Page No : 10

	Columbia Rd From North				Broadway From East				Columbia Rd From South				Broadway From West						
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Exclu. Total	Inclu. Total	Int. Total
04:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1
04:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:45 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	1	0	0	0	1	1
05:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:15 PM	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2	2
05:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2	2
Grand Total	0	0	0	0	2	0	0	0	0	0	0	0	0	1	0	0	0	3	3
Apprch %	0	0	0		100	0	0		0	0	0		0	100	0				
Total %	0	0	0		66.7	0	0		0	0	0		0	33.3	0		0	100	

[illegible]

N/S Street : Columbia Road
E/W Street : Broadway
City/State : Hanover, MA
Weather : Clear

File Name : 92140002
Site Code : 92140002
Start Date : 9/29/2022
Page No : 11

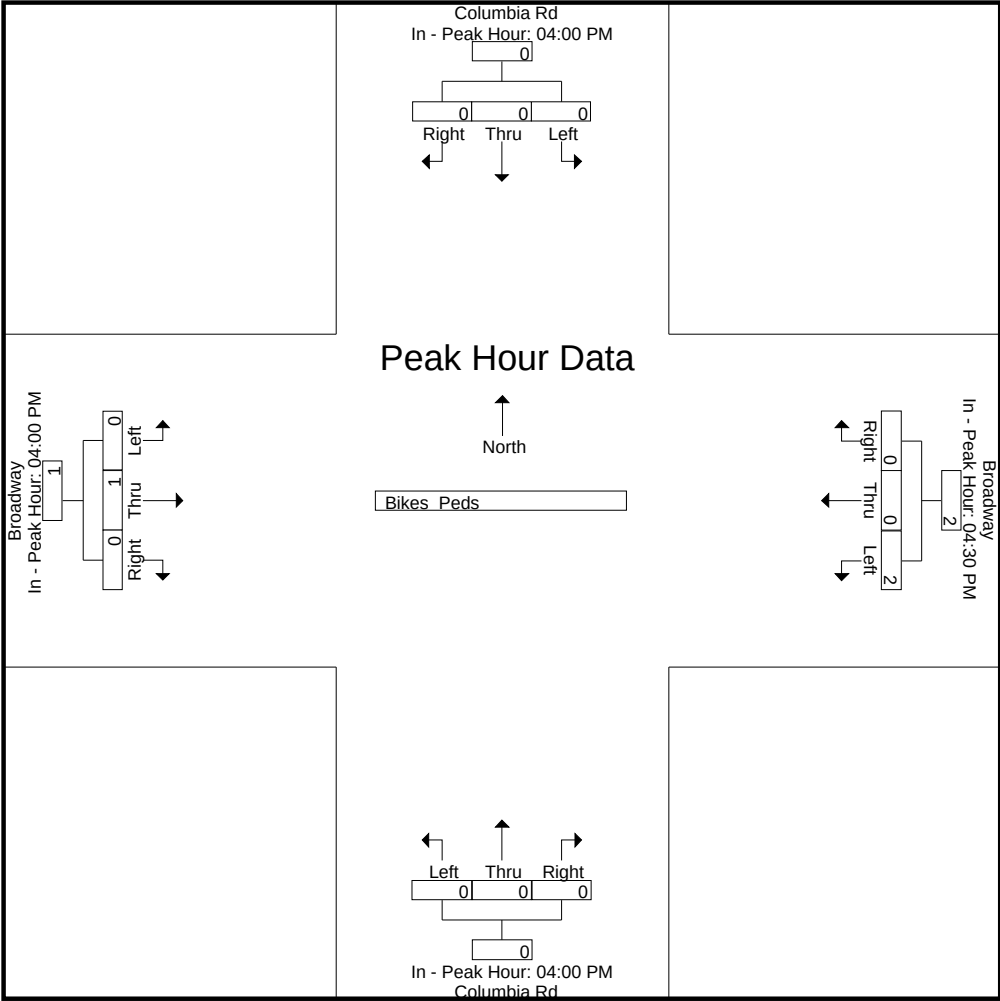


Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	04:00 PM				04:30 PM				04:00 PM				04:00 PM			
+0 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+15 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
+30 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+45 mins.	0	0	0	0	2	0	0	2	0	0	0	0	0	0	0	0
Total Volume	0	0	0	0	2	0	0	2	0	0	0	0	0	1	0	1
% App. Total	0	0	0		100	0	0		0	0	0		0	100	0	
PHF	.000	.000	.000	.000	.250	.000	.000	.250	.000	.000	.000	.000	.000	.250	.000	.250

N/S Street : Columbia Road
E/W Street : Broadway
City/State : Hanover, MA
Weather : Clear

File Name : 92140002
Site Code : 92140002
Start Date : 9/29/2022
Page No : 12



SEASONAL ADJUSTMENT DATA



Massachusetts Highway Department

6255: Monthly Hourly Volume for September 2018

Location ID: 6255
County: Norfolk
Functional Class: 2
Location: PILGRIM HIGHWAY

Seasonal Factor Group: U2
Daily Factor Group:
Axle Factor Group: U2
Growth Factor Group:

	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	TOTAL	QC Status
1	1763	1159	894	734	980	1966	3899	5378	6845	7862	8580	8721	8243	7958	7927	7781	7215	7392	6734	6225	5698	4646	3821	2781	125202	Accepted
2	1609	1128	788	533	586	1110	2283	3234	4699	6508	7995	8365	8725	8171	8157	7608	7702	7608	7049	6671	6246	5420	3875	2894	118964	Accepted
3	1618	965	596	492	647	1278	2280	3339	4507	6241	7424	8012	7736	7969	7703	7231	7042	6969	6547	6466	6031	5007	2969	1664	110733	Accepted
4	870	517	420	679	2277	6431	7924	8210	8030	7809	7973	8346	8288	8432	8747	8017	8679	8845	8028	6805	4982	3572	2625	2222	138728	Accepted
5	1355	594	477	686	2170	6584	7902	9020	8105	7924	8118	7733	7887	8126	8600	8742	8553	8735	8024	7057	5536	4069	2720	1959	140676	Accepted
6	1132	637	507	655	2180	6489	8048	8253	8244	7978	7975	8138	8089	8477	8686	8229	7846	7984	7802	6898	5694	3974	2921	2200	139036	Accepted
7																										
8	2029	1218	861	745	1237	2446	3999	5426	6864	8021	8937	8941	8986	9149	9165	8832	8878	8245	7677	6439	5728	4672	4068	3313	135876	Accepted
9	2208	1259	849	635	656	1239	2421	3796	5336	7129	8401	8925	9284	8961	8392	8194	8249	8340	7571	6033	5033	3342	2444	1768	120465	Accepted
10	1337	634	446	658	2292	6409	8227	8514	8646	7852	7697	7389	7636	8062	8717	8567	8398	8224	7421	6154	4740	3447	2349	1643	135459	Accepted
11	986	587	454	591	2162	6082	7332	7759	8036	7746	7614	7576	7790	8291	8595	9005	9115	9199	8049	6428	4896	3903	3095	2135	137426	Accepted
12	1181	618	434	684	2253	6506	7610	8265	8370	8267	7526	7790	7748	8137	7866	7959	8293	8674	7813	6406	5237	4151	3131	2389	137308	Accepted
13	1236	706	548	683	2088	6020	7257	8258	8635	8135	7940	8228	8279	8232	8798	8817	9062	8973	7747	7086	5982	4522	3242	2716	143190	Accepted
14	1359	785	587	753	2057	6217	8207	9111	8434	7943	8187	8192	8361	8409	8508	8968	9033	8598	7844	7289	5863	4783	4119	3154	146761	Accepted
15	2126	1285	876	703	1082	2344	4028	5570	7007	7970	8918	8875	9172	8925	8879	8818	8448	8261	7756	6626	5908	5247	4152	3285	136261	Accepted
16	2350	1404	840	640	802	1174	2424	3620	5373	7242	8605	8882	8244	8955	8613	8393	8468	7993	7745	7058	6220	3996	2680	1595	123316	Accepted
17	887	588	446	624	2298	6513	7757	8407	8796	7679	7666	7776	7701	8114	8744	9293	8985	9116	8077	6569	4810	3741	2680	1755	139022	Accepted
18	975	585	404	656	2184	6259	7359	8059	8059	7493	7172	6243	6028	6805	7535	7847	7952	8513	7319	5817	4648	3667	2560	1823	125962	Accepted
19	975	572	396	633	2220	6250	7411	7732	8375	7967	7630	7921	7833	8174	8595	8799	8789	8984	7856	6474	5287	4082	2965	2007	137927	Accepted
20	1100	611	425	651	2224	6714	8027	8604	8158	8403	7833	8197	8333	8286	8802	8897	9009	9125	8306	7088	5709	4590	3232	2320	144644	Accepted
21	1424	820	616	693	2196	6213	8196	9058	8474	8107	8166	8421	8612	8538	7263	8390	9157	9230	8628	7201	5309	4618	3703	3073	146106	Accepted
22	1976	1123	813	652	976	2335	4081	5635	6937	7921	8700	9133	9348	9141	9040	8231	8793	8369	7996	6337	5520	4544	4142	3297	135040	Accepted
23	2164	1239	851	742	773	1310	2485	3832	5012	6847	8343	9156	9058	9091	8714	8969	8493	8394	7879	6791	4922	3270	2532	1853	122720	Accepted
24	1013	549	418	672	2361	6578	7944	8220	8556	7707	7804	8010	7654	7851	8533	8374	8714	8822	7675	6181	4913	3382	2817	2144	136892	Accepted
25	1116	607	493	698	2291	6732	7658	8282	8016	7322	7562	7561	7474	7871	7980	8241	7720	8235	7533	6546	5025	3422	2606	1900	132891	Accepted
26	1073	585	446	674	2161	6352	7733	8306	8304	8119	7804	7858	7905	8155	8558	8938	8706	9008	8156	6565	5522	4142	3067	2202	140339	Accepted
27	1400	776	583	731	2182	6548	7751	8437	8698	7986	8044	7817	7790	8123	8521	8429	8566	9059	8204	7125	5609	4355	3173	2404	142311	Accepted
28	1591	833	626	732	2182	6228	7841	8075	8258	7789	7654	7958	7975	7995	8224	8120	7105	8808	8220	6775	5282	4302	3808	3139	139520	Accepted
29	2358	1165	805	726	1052	2389	3966	5729	7391	8366	8821	9180	9011	8968	8851	8873	8767	8434	8018	6862	5526	4896	4247	3161	137562	Accepted
30	2111	1216	840	623	731	1269	2591	3958	5402	7297	8505	8859	9102	7309	8093	8032	8564	8475	7756	6577	5074	3616	2563	1688	120251	Accepted
																								134158.2	September 2018 ADT	
																								133,238	2018 AADT	
																								0.006859	0.69% above average	

COVID ADJUSTMENT DATA



Massachusetts Highway Department

6255: Monthly Hourly Volume for September 2022

Location ID:			6255								Seasonal Factor Group:															
County:			Norfolk								Daily Factor Group:															
Functional Class			2								Axle Factor Group:															
Location:			PILGRIM HIGHWAY								Growth Factor Group:															
	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	TOTAL	QC Status
1	986	559	417	607	1972	5705	7985	9043	8259	8198	8412	8880	8533	8994	9012	9145	9229	8973	8795	7792	6649	4438	3197	2406	148186	Accepted
2																										
3	1382	845	575	576	824	1599	3262	5196	6923	8603	8852	8939	8862	8423	8433	8342	8116	7739	7062	6297	5853	4485	3772	2436	127396	Accepted
4	1399	874	657	441	517	899	2066	2970	4401	6654	8404	9213	9063	8604	8597	7893	8157	7731	7431	6656	5948	4870	3179	2405	119029	Accepted
5	1210	682	448	388	581	1070	2140	2851	4130	5446	6931	7210	7243	7099	6937	7035	7052	6649	6332	5484	4591	2844	1870	1172	97395	Accepted
6	591	379	305	533	1916	5658	7072	7736	7689	7178	7027	7561	7839	8200	8980	8556	8468	8580	7550	5848	4319	2876	1913	1356	128130	Accepted
7	702	386	326	525	1968	5439	7024	8512	8006	7814	8031	7947	8217	8540	9305	9550	9663	9799	8382	6773	5060	3337	2390	1616	139312	Accepted
8	984	482	397	581	1955	6045	8168	8687	7862	7727	8131	8299	8577	8694	9281	9439	9096	9486	8553	7239	5611	3655	2733	2121	143803	Accepted
9	1725	673	475	601	1888	5587	7947	9040	8192	8034	8401	8653	8653	8857	8910	8978	9142	9327	8678	6893	5784	4482	3240	2430	146590	Accepted
10	1650	807	668	575	1039	2233	3626	5319	6801	8448	9323	9228	8899	8609	9419	9206	9029	8561	8122	6483	5668	4395	3608	2773	134489	Accepted
11	2064	1089	675	528	673	1239	2271	3679	4891	7151	8708	9605	9358	8878	8597	8648	8455	8146	7493	6260	4976	3047	2035	1345	119811	Accepted
12	706	438	339	539	1915	5815	7094	8017	8230	7702	7759	7752	8251	8390	9212	9366	9264	9213	7666	6225	4534	2963	2149	1361	134900	Accepted
13																										
14	856	458	356	545	2008	6110	8141	8336	8217	7869	7941	8096	8270	8682	9381	9679	9433	9625	8611	7223	5394	3538	2786	2002	143557	Accepted
15	1141	504	380	576	1919	5854	8251	8074	8076	7306	7326	7998	7269	8653	9046	9319	9480	9345	8782	7606	5796	3796	3032	2141	141670	Accepted
16	963	617	427	602	1884	5431	7822	8934	8346	8034	8380	8164	9066	8984	9190	9302	9156	9281	8679	6863	5343	4244	3491	2768	145971	Accepted
17	1530	836	542	546	979	2142	3723	5251	6881	8445	9512	9396	8921	9206	9467	9061	8991	8708	7566	6888	5621	4636	3907	2982	135737	Accepted
18	1685	1001	654	483	564	1141	2336	3571	4840	7311	8875	9138	9376	8807	8634	8865	8938	8476	8128	6955	5185	3267	2157	1260	121647	Accepted
19	743	442	377	507	1913	5942	7486	7063	8474	7419	7532	7751	7844	8335	9221	9372	9543	9580	7790	5870	4085	2755	1985	1469	133498	Accepted
20	791	458	328	533	1947	5992	7744	8372	8044	7640	7612	7737	7925	8286	9405	9624	9605	9713	8449	6470	4696	3299	2197	1550	138417	Accepted
21	781	453	384	586	2015	6007	7604	8123	7888	7606	8037	7955	8202	8707	9374	9436	9354	9992	8705	7060	5199	3604	2583	1813	141468	Accepted
22																										
23	988	620	458	593	1846	5518	7859	8748	8179	8018	8151	9126	9026	9284	9256	9099	9296	9347	8438	7014	5247	4099	3380	2640	146230	Accepted
24	1549	842	632	525	875	2033	3672	5260	6967	8620	9297	9669	9463	9131	9438	9145	8126	8716	8081	7031	5747	4720	3849	2791	136179	Accepted
25	1581	999	647	468	618	1134	2233	3774	5086	7538	9073	9653	9640	9309	9124	8826	8648	8589	7378	6249	4666	3065	2091	1403	121792	Accepted
26	723	382	356	544	1916	5833	7660	8434	7926	7561	7667	8086	7644	8524	9368	9300	9226	9362	7972	5404	4715	2890	2064	1407	134964	Accepted
27	745	488	357	575	2038	6077	7685	8132	8422	7566	7675	7854	7788	8359	9198	9158	9081	9586	8615	6644	4830	3126	2388	1739	138126	Accepted
28	791	415	380	571	1918	6039	7881	8365	7849	7850	7861	8207	8307	8588	9481	9530	9661	9717	8463	7081	5150	3466	2560	1873	142004	Accepted
29	979	488	398	602	1926	5917	7939	8416	8174	7998	7938	8315	8593	8677	6605	9437	9590	9692	8530	7254	5628	3937	2748	1827	141608	Accepted
30	907	569	484	611	1899	5421	7772	8637	8210	7891	8012	8352	8706	9310	9547	9660	9778	9694	8892	6809	5125	4146	3246	2677	146355	Accepted
																							135120.9		September 2022 ADT	

MassDOT Yearly Growth Rates

for data from 2014 to 2018

Growth					
Group	Grow 2014 to 2015	Grow 2015 to 2016	Grow 2016 to 2017	Grow 2017 to 2018	Grow 2018 to 2019
R1	0	0.023	0.004	0.018	0.016
R2	0.05	0.068	0.004	0.014	0.014
R3	-0.038	0.002	0.008	0.011	0.06
R4-7	-0.01	0.003	0.001	0.011	0.012
Rec - East		0.032	0.02	0.041	0.025
Rec - West		0.051	-0.008	0.029	0
U1-Boston	0.061	0.07	-0.003	0.012	0.006
U1-Essex	0.024	0.025	0.007	0.014	0.011
U1-Southeast	0.05	0.062	0.021	0.014	0
U1-West	0.03	-0.027	0.02	0.028	0.013
U1-Worcester	0.042	0.005	0.018	0.01	0.01
U2	0.04	0.048	0.008	0.01	0.02
U3	0.011	0.013	0.011	0.014	0.004
U4-7	0.023	0.062	0.017	0.003	-0.004

updated 5/1/2020

2018 Average Count Data – Sta. 6255

September ADT: 134,159

Growth Rate (2018-2019): 0.0% [MassDOT Yearly Growth Rates (U1-Southeast)]

Adjusted 2019 Calculations

$$134,159 \times (1 + 0.000) = 134,159$$

Adjusted September ADT: 134,159

2022 Average Count Data – Sta. 6255

September ADT: 135,121

COVID Adjustment

$$1 - \frac{134,159}{135,121} = 0.007$$

September Volumes are 0.7% above Pre-COVID conditions

MASSDOT CRASH RATE WORKSHEETS AND HIGH CRASH LOCATION MAPPING



INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : Hanover COUNT DATE : 9/29/2022

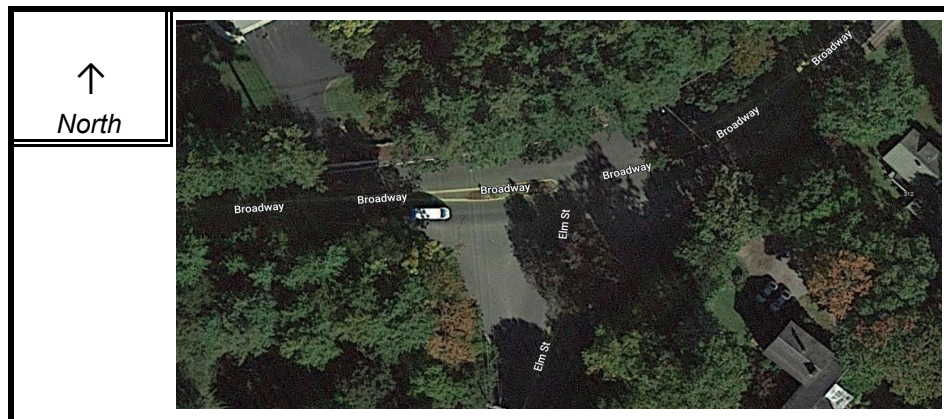
DISTRICT : 5 UNSIGNALIZED : ☒ X SIGNALIZED : ☐

~ INTERSECTION DATA ~

MAJOR STREET : Broadway

MINOR STREET(S) : Elm Street

**INTERSECTION
DIAGRAM
(Label Approaches)**



PEAK HOUR VOLUMES

APPROACH :	1	2	3	4	5	Total Peak Hourly Approach Volume
DIRECTION :	NB	SB	EB	WB		
PEAK HOURLY VOLUMES (AM/PM) :	179	0	238	693		1,110

" K " FACTOR :

0.090

INTERSECTION ADT (V) = TOTAL DAILY APPROACH VOLUME :

12,333

TOTAL # OF CRASHES :

10

OF YEARS :

5

AVERAGE # OF CRASHES PER YEAR (A) :

2.00

CRASH RATE CALCULATION :

0.44

RATE =

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

Comments : Below MassDOT District/Statewide Crash Rates

Project Title & Date : 9214 - Pembroke: Proposed Age Qualified Residential Development

INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : Hanover COUNT DATE : 9/29/2022

DISTRICT : 5 UNSIGNALIZED : ☒ SIGNALIZED : ☐

~ INTERSECTION DATA ~

MAJOR STREET : Route 53 (Columbia Road)

MINOR STREET(S) : Broadway

**INTERSECTION
DIAGRAM
(Label Approaches)**



PEAK HOUR VOLUMES

APPROACH :	1	2	3	4	5	Total Peak Hourly Approach Volume
DIRECTION :	NB	SB	EB	WB		
PEAK HOURLY VOLUMES (AM/PM) :	985	1,293	432	279		2,989

" K " FACTOR :

0.090

INTERSECTION ADT (V) = TOTAL DAILY APPROACH VOLUME :

33,211

TOTAL # OF CRASHES :

40

OF YEARS :

5

AVERAGE # OF CRASHES PER YEAR (A) :

8.00

CRASH RATE CALCULATION :

0.66

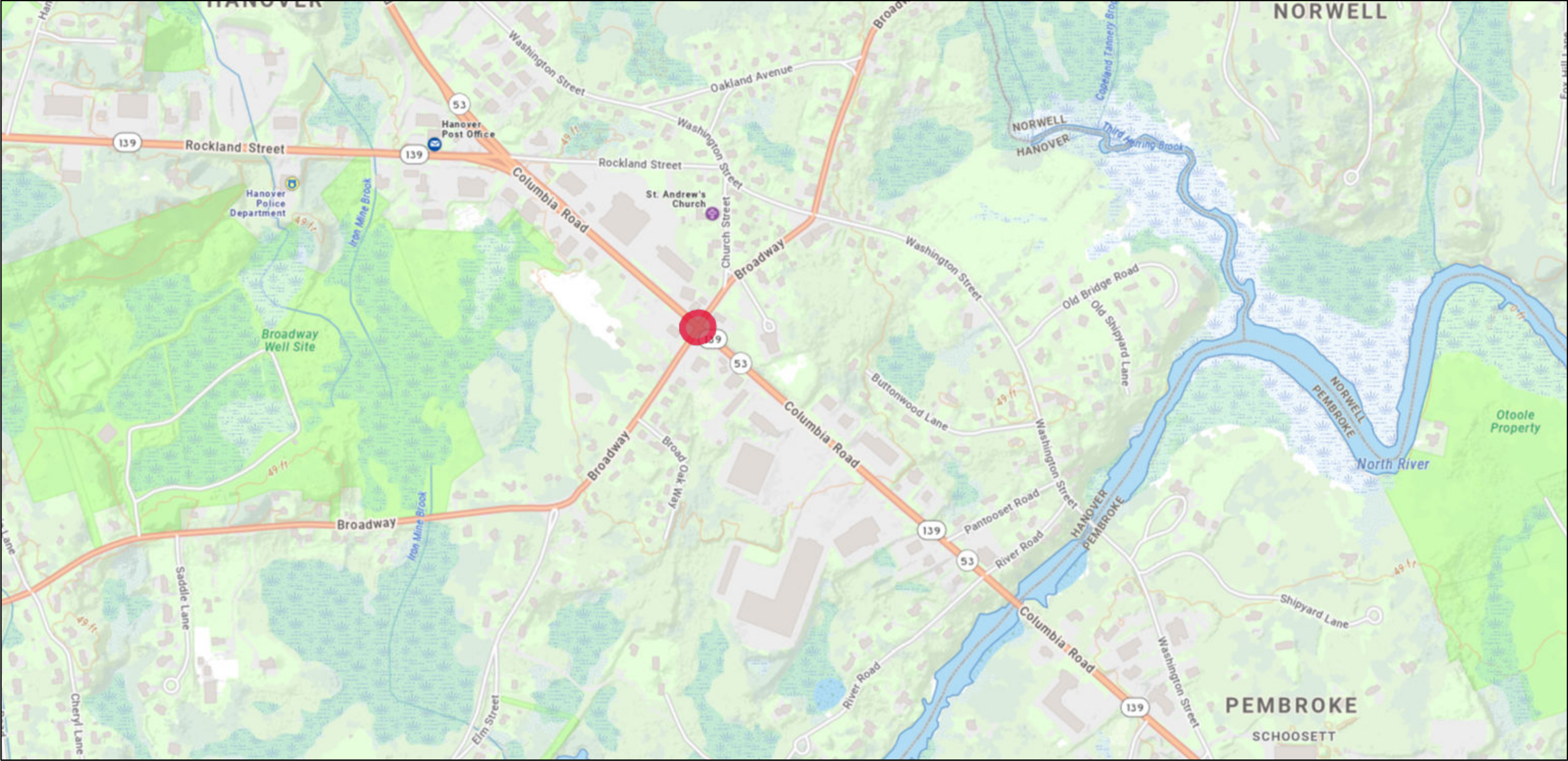
RATE =

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

Comments : Below MassDOT District/Statewide Crash Rates

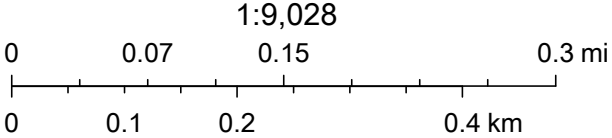
Project Title & Date : 9214 - Pembroke: Proposed Age Qualified Residential Development

MassDOT Top Crash Locations



10/25/2022, 1:59:09 PM

- Top 5% Intersection Crash Clusters 2017-2019
- Top 200 Crash Clusters 2017-2019

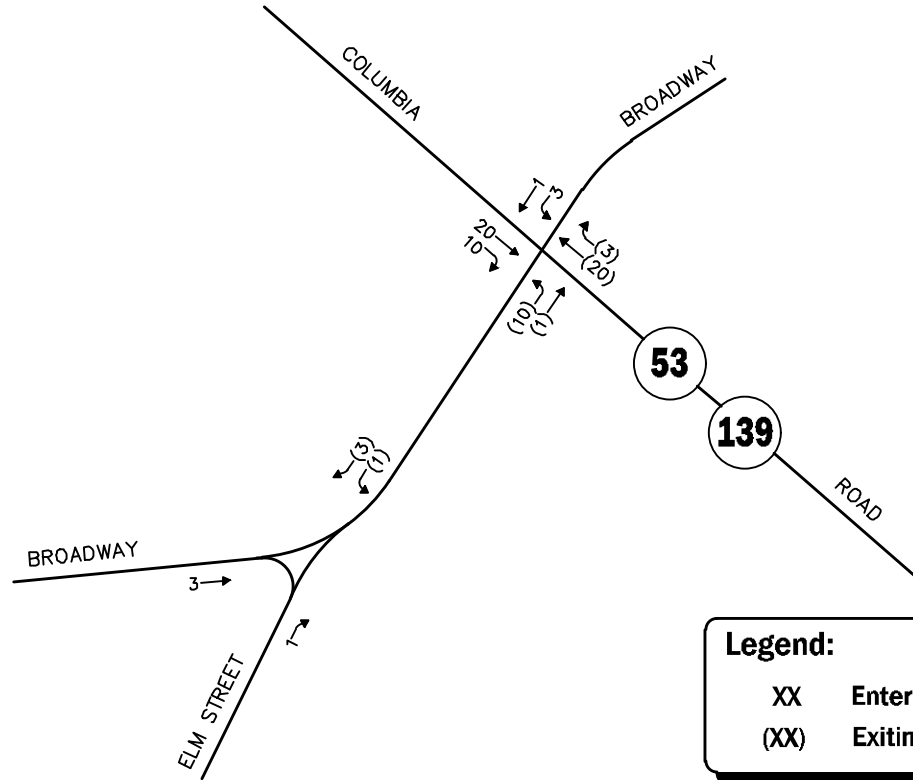


MassGIS

BACKGROUND DEVELOPMENT NETWORKS



WEEKDAY MORNING PEAK HOUR (7:00-8:00 AM)



WEEKDAY EVENING PEAK HOUR (4:00-5:00 PM)

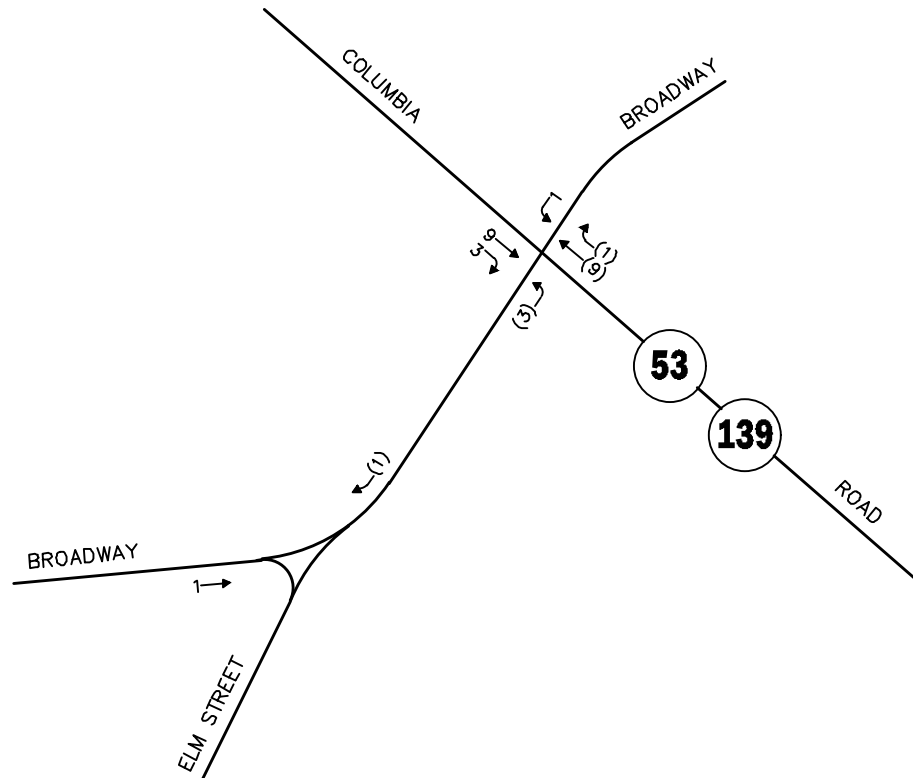
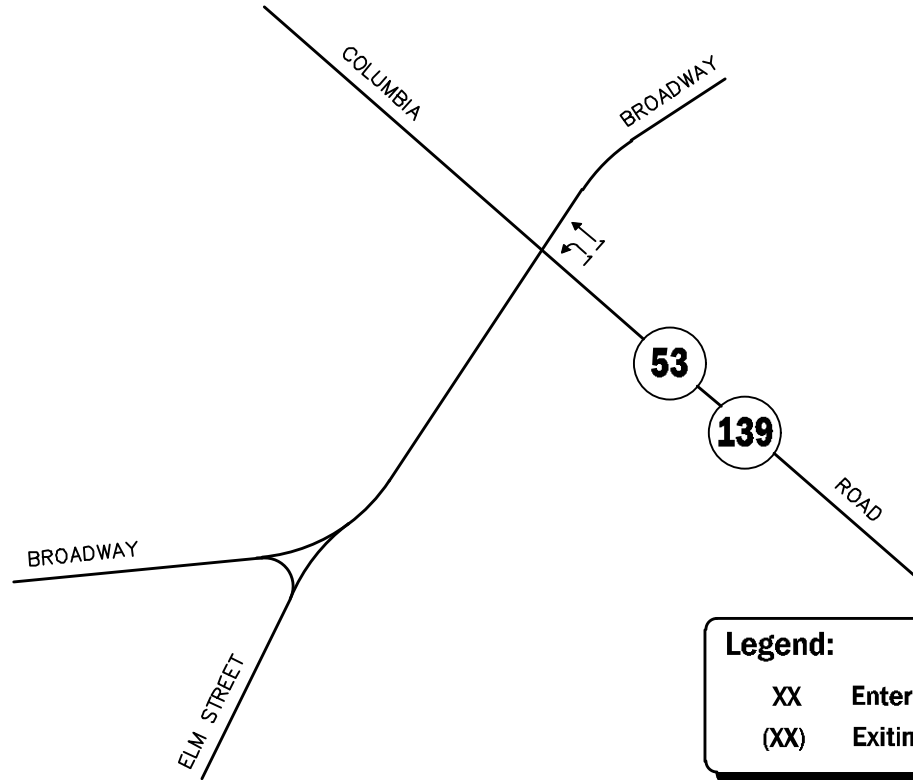


Figure A-1A

Proposed Starbucks
303 Columbia Road
Peak-Hour Traffic Volumes

WEEKDAY MORNING PEAK HOUR (7:00-8:00 AM)



WEEKDAY EVENING PEAK HOUR (4:00-5:00 PM)

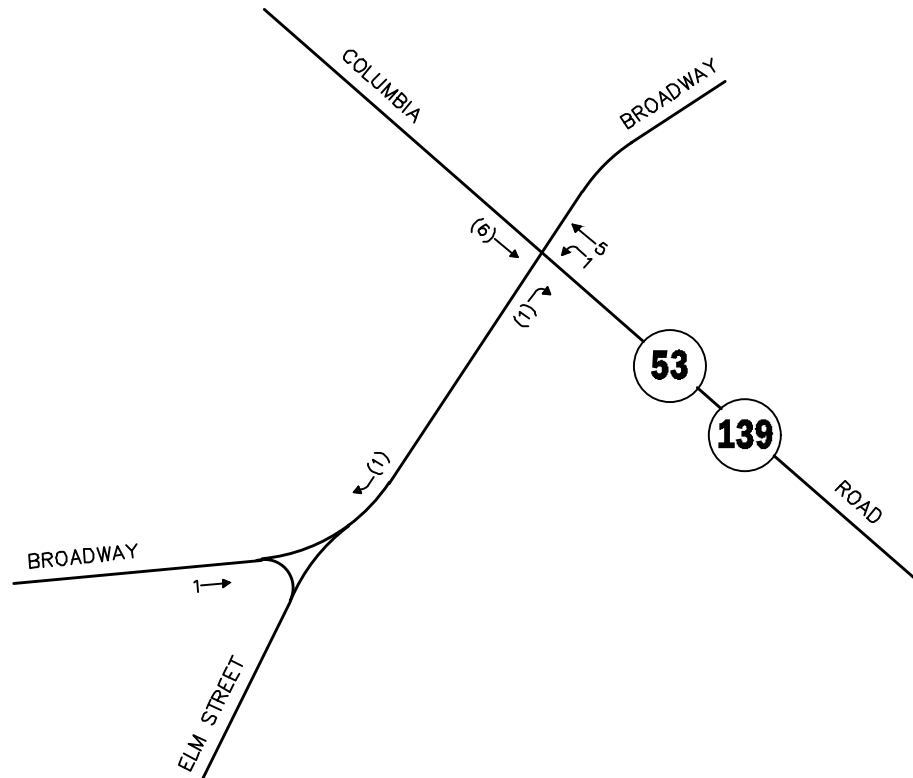
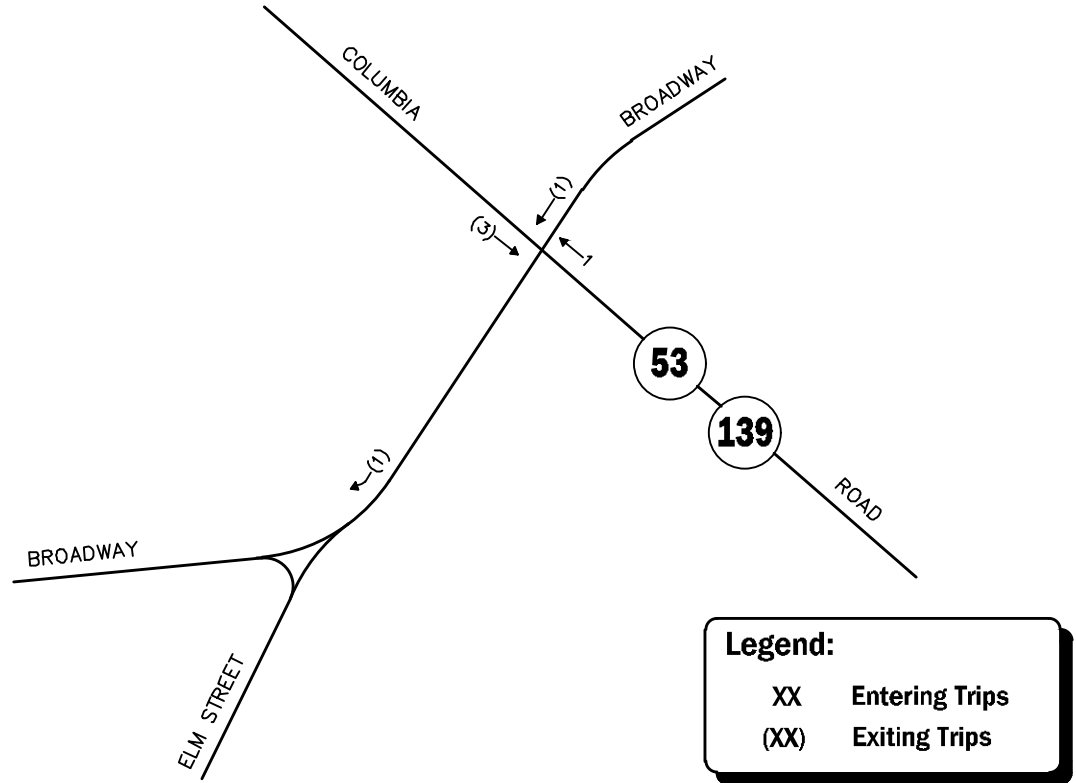


Figure A-2A

Proposed Previte's
Marketplace Expansion
Peak-Hour Traffic Volumes

WEEKDAY MORNING PEAK HOUR (7:00-8:00 AM)



WEEKDAY EVENING PEAK HOUR (4:00-5:00 PM)

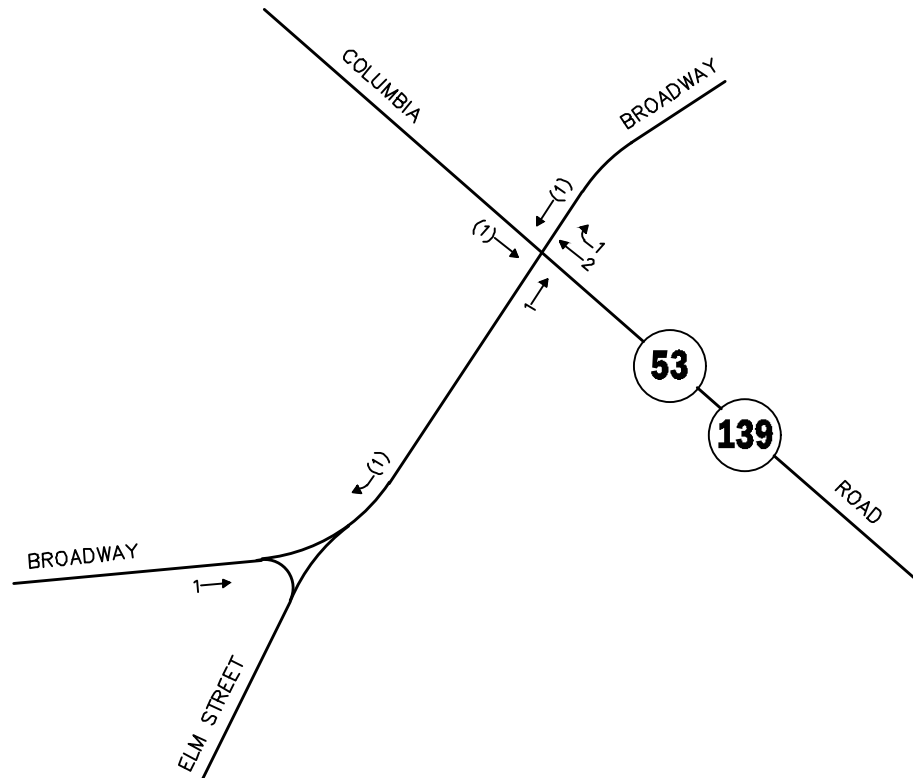
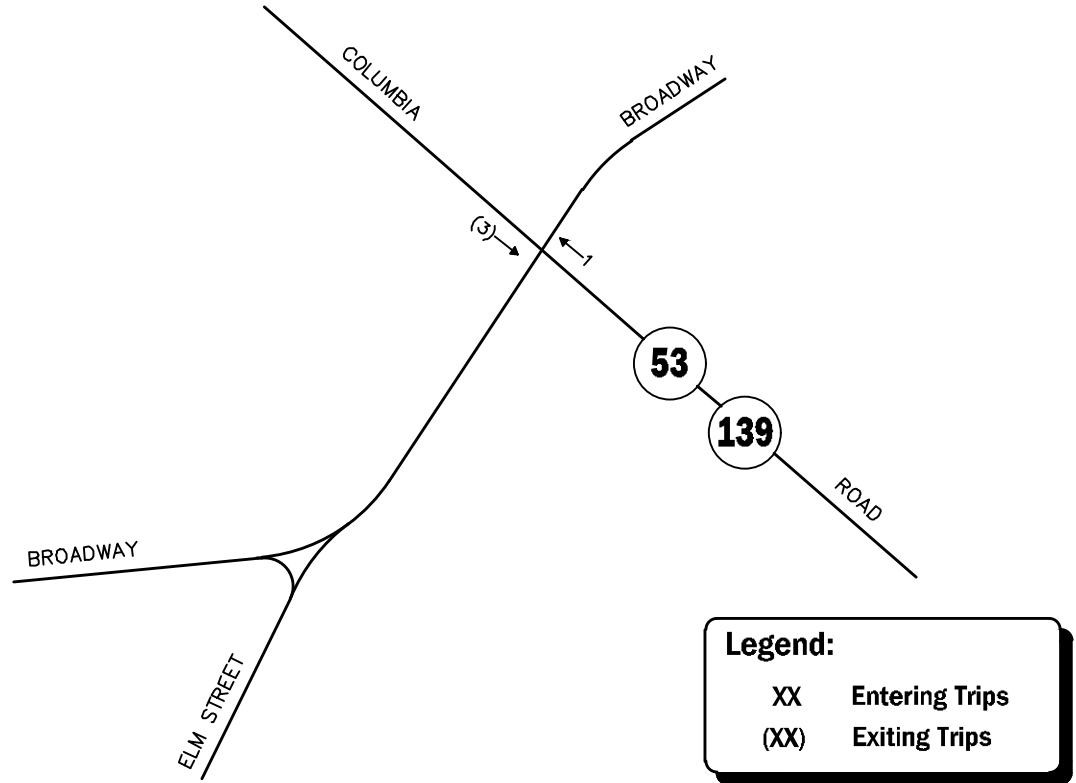


Figure A-3A

Proposed Oakland Estates
Peak-Hour Traffic Volumes

WEEKDAY MORNING PEAK HOUR (7:00-8:00 AM)



WEEKDAY EVENING PEAK HOUR (4:00-5:00 PM)

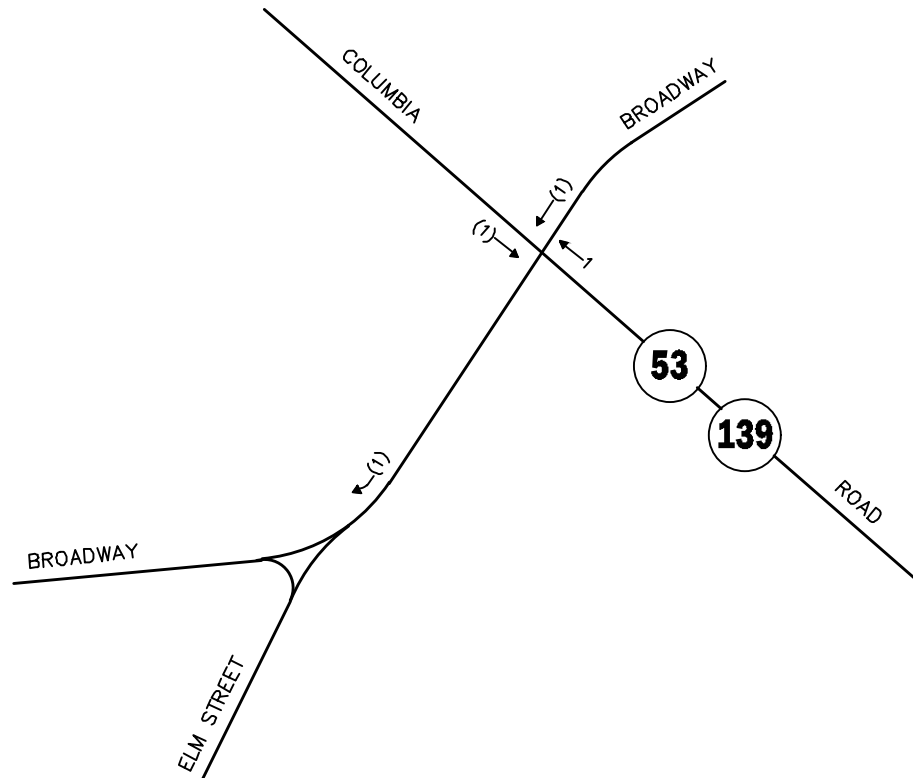


Figure A-4A



Proposed Nathan Estates
Peak-Hour Traffic Volumes

JOURNEY-TO-WORK TRIP DISTRIBUTIONS



Proposed Age-Qualified Residential Development
Pembroke, Massachusetts

Residence	Workplace	Number	Dwelley Street (West)		Oldham Street (West)		Oldham Street (East)		Broadway (West)		Broadway (East)		Columbia Road (North)		Columbia Road (South)	
Pembroke town	Pembroke town	1,828		0	25%	457	75%	1371		0		0		0		0
Pembroke town	Boston city	1,200		0		0		0		0		0	100%	1200		0
Pembroke town	Plymouth town	598		0		0	100%	598		0		0		0		0
Pembroke town	Hanover town	524	50%	262		0		0	25%	131		0	25%	131		0
Pembroke town	Brockton city	505	50%	253	50%	253		0		0		0		0		0
Pembroke town	Quincy city	446		0		0		0		0		0	100%	446		0
Pembroke town	Hingham town	388		0		0		0	20%	78	20%	78	60%	233		0
Pembroke town	Marshfield town	334		0		0	50%	167		0		0		0	50%	167
Pembroke town	Kingston town	301		0		0	100%	301		0		0		0		0
Pembroke town	Norwell town	297		0		0		0		0	100%	297		0		0
Pembroke town	Weymouth Town city	289		0		0		0		0		0	100%	289		0
Pembroke town	Braintree Town city	272		0		0		0		0		0	100%	272		0
Pembroke town	Duxbury town	265		0		0	100%	265		0		0		0		0
Pembroke town	Canton town	221	25%	55	25%	55		0		0		0	50%	111		0
Pembroke town	Rockland town	167	100%	167		0		0		0		0		0		0
Pembroke town	Abington town	159	50%	80	50%	80		0		0		0		0		0
Pembroke town	Hanson town	139	50%	70	50%	70		0		0		0		0		0
Pembroke town	Whitman town	102	50%	51	50%	51		0		0		0		0		0
Pembroke town	Bridgewater town	84		0	100%	84		0		0		0		0		0
Pembroke town	Norwood town	83		0		0		0		0		0	100%	83		0
Pembroke town	Sandwich town	75		0		0	100%	75		0		0		0		0
Pembroke town	Dedham town	71		0		0		0		0		0	100%	71		0
Pembroke town	East Bridgewater town	70		0	100%	70		0		0		0		0		0
Pembroke town	Westwood town	65		0		0		0		0		0	100%	65		0
Pembroke town	Barnstable Town city	64		0		0	100%	64		0		0		0		0
Pembroke town	Randolph town	59	50%	30	50%	30		0		0		0		0		0
Pembroke town	Westford town	57		0		0		0		0		0	100%	57		0
Pembroke town	Waltham city	48		0		0		0		0		0	100%	48		0
Pembroke town	Middleborough town	47		0	100%	47		0		0		0		0		0
Pembroke town	Wellesley town	45		0		0		0		0		0	100%	45		0
Pembroke town	Foxborough town	43		0		0		0		0		0	100%	43		0
Pembroke town	Newton city	41		0		0		0		0		0	100%	41		0
		8,887	966		1,195		2,841		209		375		3,134		167	
			10.9%		13.4%		32.0%		2.3%		4.2%		35.3%		1.9%	
		<u>SAY</u>	11.0%		13.0%		32.0%		2.0%		4.0%		36.0%		2.0%	

CAPACITY ANALYSIS WORKSHEETS

Broadway at Elm Street

Columbia Road (Routes 53 and 139) at Broadway



Broadway at Elm Street



2022 Existing Weekday Morning
1: Elm Street & Broadway

10/04/2022

Intersection						
Int Delay, s/veh	8.7					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	338	9	87	138	23	355
Future Vol, veh/h	338	9	87	138	23	355
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	89	89	87	87	93	93
Heavy Vehicles, %	6	1	1	10	9	0
Mvmt Flow	380	10	100	159	25	382
Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	390	0	744	385
Stage 1	-	-	-	-	385	-
Stage 2	-	-	-	-	359	-
Critical Hdwy	-	-	4.11	-	6.49	6.2
Critical Hdwy Stg 1	-	-	-	-	5.49	-
Critical Hdwy Stg 2	-	-	-	-	5.49	-
Follow-up Hdwy	-	-	2.209	-	3.581	3.3
Pot Cap-1 Maneuver	-	-	1174	-	372	667
Stage 1	-	-	-	-	673	-
Stage 2	-	-	-	-	691	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1174	-	337	667
Mov Cap-2 Maneuver	-	-	-	-	337	-
Stage 1	-	-	-	-	673	-
Stage 2	-	-	-	-	627	-
Approach	EB		WB		NB	
HCM Control Delay, s	0		3.2		20.6	
HCM LOS					C	
Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT	
Capacity (veh/h)	629	-	-	1174	-	
HCM Lane V/C Ratio	0.646	-	-	0.085	-	
HCM Control Delay (s)	20.6	-	-	8.4	0	
HCM Lane LOS	C	-	-	A	A	
HCM 95th %tile Q(veh)	4.7	-	-	0.3	-	

2022 Existing Weekday Evening
1: Elm Street & Broadway

10/04/2022

Intersection						
Int Delay, s/veh	5.2					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	227	11	392	301	5	174
Future Vol, veh/h	227	11	392	301	5	174
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	78	78	94	94	95	95
Heavy Vehicles, %	1	0	0	2	0	0
Mvmt Flow	291	14	417	320	5	183
Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	305	0	1452	298
Stage 1	-	-	-	-	298	-
Stage 2	-	-	-	-	1154	-
Critical Hdwy	-	-	4.1	-	6.4	6.2
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	-	-	2.2	-	3.5	3.3
Pot Cap-1 Maneuver	-	-	1267	-	145	746
Stage 1	-	-	-	-	758	-
Stage 2	-	-	-	-	303	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1267	-	87	746
Mov Cap-2 Maneuver	-	-	-	-	87	-
Stage 1	-	-	-	-	758	-
Stage 2	-	-	-	-	182	-
Approach	EB		WB		NB	
HCM Control Delay, s	0		5.2		13.4	
HCM LOS					B	
Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT	
Capacity (veh/h)	616	-	-	1267	-	
HCM Lane V/C Ratio	0.306	-	-	0.329	-	
HCM Control Delay (s)	13.4	-	-	9.2	0	
HCM Lane LOS	B	-	-	A	A	
HCM 95th %tile Q(veh)	1.3	-	-	1.5	-	

2029 No-Build Weekday Morning
1: Elm Street & Broadway

10/04/2022

Intersection						
Int Delay, s/veh	10.7					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	365	10	94	152	25	385
Future Vol, veh/h	365	10	94	152	25	385
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	89	89	87	87	93	93
Heavy Vehicles, %	6	1	1	10	9	0
Mvmt Flow	410	11	108	175	27	414
Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	421	0	807	416
Stage 1	-	-	-	-	416	-
Stage 2	-	-	-	-	391	-
Critical Hdwy	-	-	4.11	-	6.49	6.2
Critical Hdwy Stg 1	-	-	-	-	5.49	-
Critical Hdwy Stg 2	-	-	-	-	5.49	-
Follow-up Hdwy	-	-	2.209	-	3.581	3.3
Pot Cap-1 Maneuver	-	-	1144	-	341	641
Stage 1	-	-	-	-	651	-
Stage 2	-	-	-	-	668	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1144	-	305	641
Mov Cap-2 Maneuver	-	-	-	-	305	-
Stage 1	-	-	-	-	651	-
Stage 2	-	-	-	-	598	-
Approach	EB		WB		NB	
HCM Control Delay, s	0		3.2		25.7	
HCM LOS	D					
Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT	
Capacity (veh/h)	601	-	-	1144	-	
HCM Lane V/C Ratio	0.734	-	-	0.094	-	
HCM Control Delay (s)	25.7	-	-	8.5	0	
HCM Lane LOS	D	-	-	A	A	
HCM 95th %tile Q(veh)	6.3	-	-	0.3	-	

2029 No-Build Weekday Evening
1: Elm Street & Broadway

10/04/2022

Intersection						
Int Delay, s/veh	5.4					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	246	12	420	327	5	187
Future Vol, veh/h	246	12	420	327	5	187
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	78	78	94	94	95	95
Heavy Vehicles, %	1	0	0	2	0	0
Mvmt Flow	315	15	447	348	5	197
Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	330	0	1565	323
Stage 1	-	-	-	-	323	-
Stage 2	-	-	-	-	1242	-
Critical Hdwy	-	-	4.1	-	6.4	6.2
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	-	-	2.2	-	3.5	3.3
Pot Cap-1 Maneuver	-	-	1241	-	124	723
Stage 1	-	-	-	-	738	-
Stage 2	-	-	-	-	275	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1241	-	69	723
Mov Cap-2 Maneuver	-	-	-	-	69	-
Stage 1	-	-	-	-	738	-
Stage 2	-	-	-	-	152	-
Approach	EB		WB		NB	
HCM Control Delay, s	0		5.4		14.5	
HCM LOS					B	
Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT	
Capacity (veh/h)	580	-	-	1241	-	
HCM Lane V/C Ratio	0.348	-	-	0.36	-	
HCM Control Delay (s)	14.5	-	-	9.5	0	
HCM Lane LOS	B	-	-	A	A	
HCM 95th %tile Q(veh)	1.6	-	-	1.7	-	

Intersection						
Int Delay, s/veh	11.6					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	365	10	102	152	25	399
Future Vol, veh/h	365	10	102	152	25	399
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	89	89	87	87	93	93
Heavy Vehicles, %	6	1	1	10	9	0
Mvmt Flow	410	11	117	175	27	429
Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	421	0	825	416
Stage 1	-	-	-	-	416	-
Stage 2	-	-	-	-	409	-
Critical Hdwy	-	-	4.11	-	6.49	6.2
Critical Hdwy Stg 1	-	-	-	-	5.49	-
Critical Hdwy Stg 2	-	-	-	-	5.49	-
Follow-up Hdwy	-	-	2.209	-	3.581	3.3
Pot Cap-1 Maneuver	-	-	1144	-	333	641
Stage 1	-	-	-	-	651	-
Stage 2	-	-	-	-	656	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1144	-	295	641
Mov Cap-2 Maneuver	-	-	-	-	295	-
Stage 1	-	-	-	-	651	-
Stage 2	-	-	-	-	582	-
Approach	EB		WB		NB	
HCM Control Delay, s	0		3.4		27.5	
HCM LOS	D					
Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT	
Capacity (veh/h)	600	-	-	1144	-	
HCM Lane V/C Ratio	0.76	-	-	0.102	-	
HCM Control Delay (s)	27.5	-	-	8.5	0	
HCM Lane LOS	D	-	-	A	A	
HCM 95th %tile Q(veh)	6.9	-	-	0.3	-	

Intersection						
Int Delay, s/veh	5.6					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	246	13	437	327	5	199
Future Vol, veh/h	246	13	437	327	5	199
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	78	78	94	94	95	95
Heavy Vehicles, %	1	0	0	2	0	0
Mvmt Flow	315	17	465	348	5	209
Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	332	0	1602	324
Stage 1	-	-	-	-	324	-
Stage 2	-	-	-	-	1278	-
Critical Hdwy	-	-	4.1	-	6.4	6.2
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	-	-	2.2	-	3.5	3.3
Pot Cap-1 Maneuver	-	-	1239	-	118	722
Stage 1	-	-	-	-	738	-
Stage 2	-	-	-	-	264	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1239	-	63	722
Mov Cap-2 Maneuver	-	-	-	-	63	-
Stage 1	-	-	-	-	738	-
Stage 2	-	-	-	-	141	-
Approach	EB		WB		NB	
HCM Control Delay, s	0		5.5		14.9	
HCM LOS					B	
Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT	
Capacity (veh/h)	575	-	-	1239	-	
HCM Lane V/C Ratio	0.373	-	-	0.375	-	
HCM Control Delay (s)	14.9	-	-	9.6	0	
HCM Lane LOS	B	-	-	A	A	
HCM 95th %tile Q(veh)	1.7	-	-	1.8	-	

Columbia Road at Broadway



2022 Existing Weekday Morning
2: Columbia Road & Broadway

10/04/2022

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	248	180	225	63	50	13	127	706	42	11	590	79
Future Volume (vph)	248	180	225	63	50	13	127	706	42	11	590	79
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	0.95	0.95	0.95	0.95
Frt		0.953			0.986			0.993			0.983	
Flt Protected		0.981			0.975			0.993			0.999	
Satd. Flow (prot)	0	1951	0	0	1812	0	0	3348	0	0	3336	0
Flt Permitted		0.814			0.612			0.702			0.938	
Satd. Flow (perm)	0	1619	0	0	1137	0	0	2367	0	0	3133	0
Satd. Flow (RTOR)		25			5			6			13	
Adj. Flow (vph)	295	214	268	80	63	16	135	751	45	12	628	84
Lane Group Flow (vph)	0	777	0	0	159	0	0	931	0	0	724	0
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		Perm	NA	
Protected Phases		4			8		5	2			6	
Permitted Phases	4			8			2			6		
Detector Phase	4	4		8	8		5	2		6	6	
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Minimum Split (s)	22.5	22.5		22.5	22.5		9.5	22.5		22.5	22.5	
Total Split (s)	33.0	33.0		33.0	33.0		15.0	45.0		30.0	30.0	
Total Split (%)	31.7%	31.7%		31.7%	31.7%		14.4%	43.3%		28.8%	28.8%	
Maximum Green (s)	29.0	29.0		29.0	29.0		11.0	41.0		26.0	26.0	
Yellow Time (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0		1.0	1.0	
Lost Time Adjust (s)		0.0			0.0			0.0			0.0	
Total Lost Time (s)		4.0			4.0			4.0			4.0	
Lead/Lag							Lead			Lag	Lag	
Lead-Lag Optimize?							Yes			Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None		None	None		None	None	
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
v/c Ratio		1.26			0.37			0.75			0.44	
Control Delay		154.5			20.5			19.0			12.2	
Queue Delay		0.0			0.0			0.0			0.0	
Total Delay		154.5			20.5			19.0			12.2	
Queue Length 50th (ft)		~477			53			173			104	
Queue Length 95th (ft)		#623			87			249			145	
Internal Link Dist (ft)		912			305			347			340	
Turn Bay Length (ft)												
Base Capacity (vph)		617			425			1247			1653	
Starvation Cap Reductn		0			0			0			0	
Spillback Cap Reductn		0			0			0			0	
Storage Cap Reductn		0			0			0			0	
Reduced v/c Ratio		1.26			0.37			0.75			0.44	
Intersection Summary												
Cycle Length: 104												

Lane Group	Ø9
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Satd. Flow (RTOR)	
Adj. Flow (vph)	
Lane Group Flow (vph)	
Turn Type	
Protected Phases	9
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	5.0
Minimum Split (s)	26.0
Total Split (s)	26.0
Total Split (%)	25%
Maximum Green (s)	24.0
Yellow Time (s)	2.0
All-Red Time (s)	0.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	7.0
Flash Dont Walk (s)	17.0
Pedestrian Calls (#/hr)	0
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	
Intersection Summary	

2022 Existing Weekday Morning 2: Columbia Road & Broadway

10/04/2022

Actuated Cycle Length: 78

Natural Cycle: 145

Control Type: Actuated-Uncoordinated

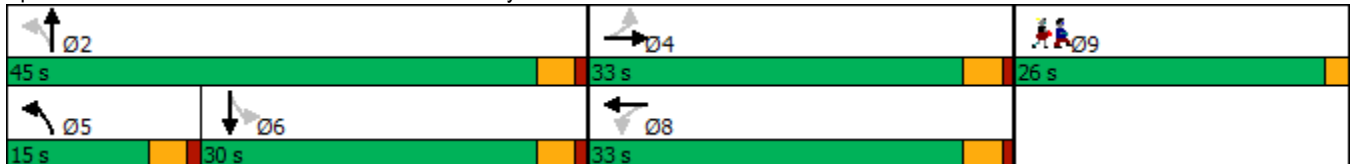
~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

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

Queue shown is maximum after two cycles.

Splits and Phases: 2: Columbia Road & Broadway



2022 Existing Weekday Morning
2: Columbia Road & Broadway

10/04/2022

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	248	180	225	63	50	13	127	706	42	11	590	79
Future Volume (vph)	248	180	225	63	50	13	127	706	42	11	590	79
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	16	16	16	13	13	13	11	11	11	11	11	11
Total Lost time (s)		4.0			4.0			4.0			4.0	
Lane Util. Factor		1.00			1.00			0.95			0.95	
Frt		0.95			0.99			0.99			0.98	
Flt Protected		0.98			0.98			0.99			1.00	
Satd. Flow (prot)		1952			1813			3346			3335	
Flt Permitted		0.81			0.61			0.70			0.94	
Satd. Flow (perm)		1618			1137			2366			3131	
Peak-hour factor, PHF	0.84	0.84	0.84	0.79	0.79	0.79	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	295	214	268	80	63	16	135	751	45	12	628	84
RTOR Reduction (vph)	0	16	0	0	3	0	0	3	0	0	6	0
Lane Group Flow (vph)	0	761	0	0	156	0	0	928	0	0	718	0
Heavy Vehicles (%)	1%	4%	5%	2%	8%	0%	12%	1%	5%	0%	3%	1%
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		Perm	NA	
Protected Phases		4			8		5	2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		29.0			29.0			41.0			41.0	
Effective Green, g (s)		29.0			29.0			41.0			41.0	
Actuated g/C Ratio		0.37			0.37			0.53			0.53	
Clearance Time (s)		4.0			4.0			4.0			4.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		601			422			1243			1645	
v/s Ratio Prot												
v/s Ratio Perm		c0.47			0.14			c0.39			0.23	
v/c Ratio		1.27			0.37			0.75			0.44	
Uniform Delay, d1		24.5			17.8			14.4			11.4	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		132.9			0.5			2.5			0.2	
Delay (s)		157.4			18.4			16.9			11.6	
Level of Service		F			B			B			B	
Approach Delay (s)		157.4			18.4			16.9			11.6	
Approach LOS		F			B			B			B	
Intersection Summary												
HCM 2000 Control Delay			57.6				HCM 2000 Level of Service				E	
HCM 2000 Volume to Capacity ratio			1.05									
Actuated Cycle Length (s)			78.0				Sum of lost time (s)			14.0		
Intersection Capacity Utilization			96.1%				ICU Level of Service			F		
Analysis Period (min)			15									
c Critical Lane Group												

2022 Existing Weekday Evening
2: Columbia Road & Broadway

10/04/2022

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	168	65	199	100	163	16	241	717	27	13	982	298
Future Volume (vph)	168	65	199	100	163	16	241	717	27	13	982	298
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	0.95	0.95	0.95	0.95
Frt		0.938			0.992			0.996			0.965	
Flt Protected		0.981			0.982			0.988			0.999	
Satd. Flow (prot)	0	1972	0	0	1890	0	0	3401	0	0	3339	0
Flt Permitted		0.699			0.709			0.517			0.940	
Satd. Flow (perm)	0	1405	0	0	1365	0	0	1780	0	0	3142	0
Satd. Flow (RTOR)		41			3			3			36	
Adj. Flow (vph)	175	68	207	120	196	19	277	824	31	14	1045	317
Lane Group Flow (vph)	0	450	0	0	335	0	0	1132	0	0	1376	0
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		Perm	NA	
Protected Phases		4			8		5	2			6	
Permitted Phases	4			8			2			6		
Detector Phase	4	4		8	8		5	2		6	6	
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Minimum Split (s)	22.5	22.5		22.5	22.5		9.5	22.5		22.5	22.5	
Total Split (s)	33.0	33.0		33.0	33.0		15.0	45.0		30.0	30.0	
Total Split (%)	31.7%	31.7%		31.7%	31.7%		14.4%	43.3%		28.8%	28.8%	
Maximum Green (s)	29.0	29.0		29.0	29.0		11.0	41.0		26.0	26.0	
Yellow Time (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0		1.0	1.0	
Lost Time Adjust (s)		0.0			0.0			0.0			0.0	
Total Lost Time (s)		4.0			4.0			4.0			4.0	
Lead/Lag							Lead			Lag	Lag	
Lead-Lag Optimize?							Yes			Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None		None	None		None	None	
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
v/c Ratio		0.82			0.66			2.95dl			0.82	
Control Delay		34.8			27.6			125.3			20.5	
Queue Delay		0.0			0.0			0.0			0.0	
Total Delay		34.8			27.6			125.3			20.5	
Queue Length 50th (ft)		177			131			~361			268	
Queue Length 95th (ft)		#342			198			#461			365	
Internal Link Dist (ft)		912			305			347			340	
Turn Bay Length (ft)												
Base Capacity (vph)		548			509			937			1668	
Starvation Cap Reductn		0			0			0			0	
Spillback Cap Reductn		0			0			0			0	
Storage Cap Reductn		0			0			0			0	
Reduced v/c Ratio		0.82			0.66			1.21			0.82	
Intersection Summary												
Cycle Length: 104												

Lane Group	Ø9
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Satd. Flow (RTOR)	
Adj. Flow (vph)	
Lane Group Flow (vph)	
Turn Type	
Protected Phases	9
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	5.0
Minimum Split (s)	26.0
Total Split (s)	26.0
Total Split (%)	25%
Maximum Green (s)	24.0
Yellow Time (s)	2.0
All-Red Time (s)	0.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	7.0
Flash Dont Walk (s)	17.0
Pedestrian Calls (#/hr)	0
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	
Intersection Summary	

2022 Existing Weekday Evening 2: Columbia Road & Broadway

10/04/2022

Actuated Cycle Length: 78

Natural Cycle: 145

Control Type: Actuated-Uncoordinated

~ Volume exceeds capacity, queue is theoretically infinite.

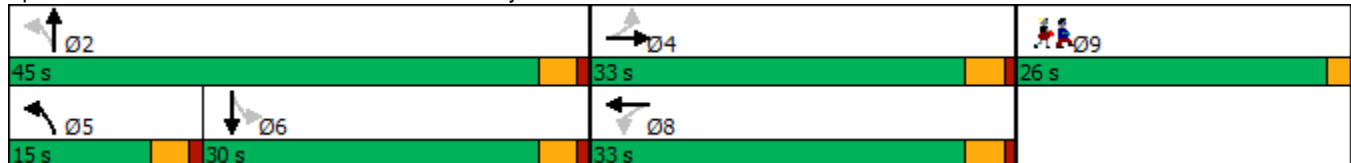
Queue shown is maximum after two cycles.

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

Queue shown is maximum after two cycles.

dl Defacto Left Lane. Recode with 1 though lane as a left lane.

Splits and Phases: 2: Columbia Road & Broadway



2022 Existing Weekday Evening
2: Columbia Road & Broadway

10/04/2022

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	168	65	199	100	163	16	241	717	27	13	982	298
Future Volume (vph)	168	65	199	100	163	16	241	717	27	13	982	298
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	16	16	16	13	13	13	11	11	11	11	11	11
Total Lost time (s)		4.0			4.0			4.0			4.0	
Lane Util. Factor		1.00			1.00			0.95			0.95	
Frt		0.94			0.99			1.00			0.97	
Flt Protected		0.98			0.98			0.99			1.00	
Satd. Flow (prot)		1972			1892			3400			3342	
Flt Permitted		0.70			0.71			0.52			0.94	
Satd. Flow (perm)		1406			1365			1779			3142	
Peak-hour factor, PHF	0.96	0.96	0.96	0.83	0.83	0.83	0.87	0.87	0.87	0.94	0.94	0.94
Adj. Flow (vph)	175	68	207	120	196	19	277	824	31	14	1045	317
RTOR Reduction (vph)	0	26	0	0	2	0	0	1	0	0	17	0
Lane Group Flow (vph)	0	424	0	0	333	0	0	1131	0	0	1359	0
Heavy Vehicles (%)	0%	0%	1%	0%	2%	0%	1%	1%	0%	0%	1%	0%
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		Perm	NA	
Protected Phases		4			8		5	2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		29.0			29.0			41.0			41.0	
Effective Green, g (s)		29.0			29.0			41.0			41.0	
Actuated g/C Ratio		0.37			0.37			0.53			0.53	
Clearance Time (s)		4.0			4.0			4.0			4.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		522			507			935			1651	
v/s Ratio Prot												
v/s Ratio Perm		c0.30			0.24			c0.64			0.43	
v/c Ratio		0.81			0.66			2.95dl			0.82	
Uniform Delay, d1		22.1			20.4			18.5			15.5	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		9.4			3.1			104.2			3.5	
Delay (s)		31.4			23.4			122.7			18.9	
Level of Service		C			C			F			B	
Approach Delay (s)		31.4			23.4			122.7			18.9	
Approach LOS		C			C			F			B	
Intersection Summary												
HCM 2000 Control Delay		56.8			HCM 2000 Level of Service			E				
HCM 2000 Volume to Capacity ratio		1.14										
Actuated Cycle Length (s)		78.0			Sum of lost time (s)			14.0				
Intersection Capacity Utilization		108.3%			ICU Level of Service			G				
Analysis Period (min)		15										
dl Defacto Left Lane. Recode with 1 though lane as a left lane.												
c Critical Lane Group												

2029 No-Build Weekday Morning
2: Columbia Road & Broadway

10/04/2022

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	276	194	241	71	56	14	137	780	48	12	659	95
Future Volume (vph)	276	194	241	71	56	14	137	780	48	12	659	95
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	0.95	0.95	0.95	0.95
Frt		0.954			0.986			0.993			0.981	
Flt Protected		0.981			0.975			0.993			0.999	
Satd. Flow (prot)	0	1953	0	0	1812	0	0	3348	0	0	3330	0
Flt Permitted		0.799			0.603			0.663			0.936	
Satd. Flow (perm)	0	1591	0	0	1120	0	0	2236	0	0	3120	0
Satd. Flow (RTOR)		25			5			6			14	
Adj. Flow (vph)	329	231	287	90	71	18	146	830	51	13	701	101
Lane Group Flow (vph)	0	847	0	0	179	0	0	1027	0	0	815	0
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		Perm	NA	
Protected Phases		4			8		5	2			6	
Permitted Phases	4			8			2			6		
Detector Phase	4	4		8	8		5	2		6	6	
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Minimum Split (s)	22.5	22.5		22.5	22.5		9.5	22.5		22.5	22.5	
Total Split (s)	33.0	33.0		33.0	33.0		15.0	45.0		30.0	30.0	
Total Split (%)	31.7%	31.7%		31.7%	31.7%		14.4%	43.3%		28.8%	28.8%	
Maximum Green (s)	29.0	29.0		29.0	29.0		11.0	41.0		26.0	26.0	
Yellow Time (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0		1.0	1.0	
Lost Time Adjust (s)		0.0			0.0			0.0			0.0	
Total Lost Time (s)		4.0			4.0			4.0			4.0	
Lead/Lag							Lead			Lag	Lag	
Lead-Lag Optimize?							Yes			Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None		None	None		None	None	
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
v/c Ratio		1.40			0.43			0.87			0.50	
Control Delay		212.1			21.7			26.4			12.9	
Queue Delay		0.0			0.0			0.0			0.0	
Total Delay		212.1			21.7			26.4			12.9	
Queue Length 50th (ft)		~557			62			214			122	
Queue Length 95th (ft)		#702			99			#356			169	
Internal Link Dist (ft)		912			305			347			340	
Turn Bay Length (ft)												
Base Capacity (vph)		607			419			1178			1646	
Starvation Cap Reductn		0			0			0			0	
Spillback Cap Reductn		0			0			0			0	
Storage Cap Reductn		0			0			0			0	
Reduced v/c Ratio		1.40			0.43			0.87			0.50	
Intersection Summary												
Cycle Length: 104												

Lane Group	Ø9
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Satd. Flow (RTOR)	
Adj. Flow (vph)	
Lane Group Flow (vph)	
Turn Type	
Protected Phases	9
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	5.0
Minimum Split (s)	26.0
Total Split (s)	26.0
Total Split (%)	25%
Maximum Green (s)	24.0
Yellow Time (s)	2.0
All-Red Time (s)	0.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	7.0
Flash Dont Walk (s)	17.0
Pedestrian Calls (#/hr)	0
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	
Intersection Summary	

2029 No-Build Weekday Morning 2: Columbia Road & Broadway

10/04/2022

Actuated Cycle Length: 78

Natural Cycle: 145

Control Type: Actuated-Uncoordinated

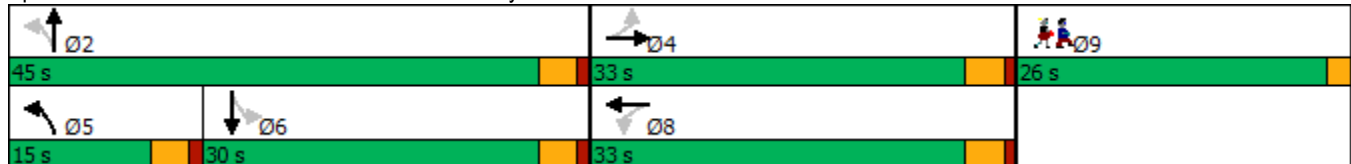
~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

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

Queue shown is maximum after two cycles.

Splits and Phases: 2: Columbia Road & Broadway



2029 No-Build Weekday Morning
2: Columbia Road & Broadway

10/04/2022

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	276	194	241	71	56	14	137	780	48	12	659	95
Future Volume (vph)	276	194	241	71	56	14	137	780	48	12	659	95
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	16	16	16	13	13	13	11	11	11	11	11	11
Total Lost time (s)		4.0			4.0			4.0			4.0	
Lane Util. Factor		1.00			1.00			0.95			0.95	
Frt		0.95			0.99			0.99			0.98	
Flt Protected		0.98			0.98			0.99			1.00	
Satd. Flow (prot)		1954			1813			3347			3332	
Flt Permitted		0.80			0.60			0.66			0.94	
Satd. Flow (perm)		1591			1121			2235			3120	
Peak-hour factor, PHF	0.84	0.84	0.84	0.79	0.79	0.79	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	329	231	287	90	71	18	146	830	51	13	701	101
RTOR Reduction (vph)	0	16	0	0	3	0	0	3	0	0	7	0
Lane Group Flow (vph)	0	831	0	0	176	0	0	1024	0	0	808	0
Heavy Vehicles (%)	1%	4%	5%	2%	8%	0%	12%	1%	5%	0%	3%	1%
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		Perm	NA	
Protected Phases		4			8		5	2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		29.0			29.0			41.0			41.0	
Effective Green, g (s)		29.0			29.0			41.0			41.0	
Actuated g/C Ratio		0.37			0.37			0.53			0.53	
Clearance Time (s)		4.0			4.0			4.0			4.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		591			416			1174			1640	
v/s Ratio Prot												
v/s Ratio Perm		c0.52			0.16			c0.46			0.26	
v/c Ratio		1.41			0.42			0.87			0.49	
Uniform Delay, d1		24.5			18.3			16.2			11.8	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		193.0			0.7			7.4			0.2	
Delay (s)		217.5			19.0			23.6			12.1	
Level of Service		F			B			C			B	
Approach Delay (s)		217.5			19.0			23.6			12.1	
Approach LOS		F			B			C			B	
Intersection Summary												
HCM 2000 Control Delay			77.3				HCM 2000 Level of Service			E		
HCM 2000 Volume to Capacity ratio			1.20									
Actuated Cycle Length (s)			78.0				Sum of lost time (s)			14.0		
Intersection Capacity Utilization			105.0%				ICU Level of Service			G		
Analysis Period (min)			15									
c Critical Lane Group												

2029 No-Build Weekday Evening
2: Columbia Road & Broadway

10/04/2022

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	183	71	214	108	177	17	259	786	31	14	1070	322
Future Volume (vph)	183	71	214	108	177	17	259	786	31	14	1070	322
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	0.95	0.95	0.95	0.95
Frt		0.938			0.993			0.996			0.966	
Flt Protected		0.981			0.982			0.988			0.999	
Satd. Flow (prot)	0	1972	0	0	1892	0	0	3401	0	0	3342	0
Flt Permitted		0.685			0.692			0.521			0.937	
Satd. Flow (perm)	0	1377	0	0	1333	0	0	1793	0	0	3135	0
Satd. Flow (RTOR)		40			3			3			36	
Adj. Flow (vph)	191	74	223	130	213	20	298	903	36	15	1138	343
Lane Group Flow (vph)	0	488	0	0	363	0	0	1237	0	0	1496	0
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		Perm	NA	
Protected Phases		4			8		5	2			6	
Permitted Phases	4			8			2			6		
Detector Phase	4	4		8	8		5	2		6	6	
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Minimum Split (s)	22.5	22.5		22.5	22.5		9.5	22.5		22.5	22.5	
Total Split (s)	33.0	33.0		33.0	33.0		15.0	45.0		30.0	30.0	
Total Split (%)	31.7%	31.7%		31.7%	31.7%		14.4%	43.3%		28.8%	28.8%	
Maximum Green (s)	29.0	29.0		29.0	29.0		11.0	41.0		26.0	26.0	
Yellow Time (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0		1.0	1.0	
Lost Time Adjust (s)		0.0			0.0			0.0			0.0	
Total Lost Time (s)		4.0			4.0			4.0			4.0	
Lead/Lag							Lead			Lag	Lag	
Lead-Lag Optimize?							Yes			Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None		None	None		None	None	
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
v/c Ratio		0.91			0.73			3.17dl			0.90	
Control Delay		45.5			31.5			169.5			25.4	
Queue Delay		0.0			0.0			0.0			0.0	
Total Delay		45.5			31.5			169.5			25.4	
Queue Length 50th (ft)		204			148			~417			315	
Queue Length 95th (ft)		#395			221			#518			#484	
Internal Link Dist (ft)		912			305			347			340	
Turn Bay Length (ft)												
Base Capacity (vph)		537			497			943			1664	
Starvation Cap Reductn		0			0			0			0	
Spillback Cap Reductn		0			0			0			0	
Storage Cap Reductn		0			0			0			0	
Reduced v/c Ratio		0.91			0.73			1.31			0.90	
Intersection Summary												
Cycle Length: 104												

Lane Group	Ø9
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Satd. Flow (RTOR)	
Adj. Flow (vph)	
Lane Group Flow (vph)	
Turn Type	
Protected Phases	9
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	5.0
Minimum Split (s)	26.0
Total Split (s)	26.0
Total Split (%)	25%
Maximum Green (s)	24.0
Yellow Time (s)	2.0
All-Red Time (s)	0.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	7.0
Flash Dont Walk (s)	17.0
Pedestrian Calls (#/hr)	0
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	
Intersection Summary	

2029 No-Build Weekday Evening 2: Columbia Road & Broadway

10/04/2022

Actuated Cycle Length: 78

Natural Cycle: 145

Control Type: Actuated-Uncoordinated

~ Volume exceeds capacity, queue is theoretically infinite.

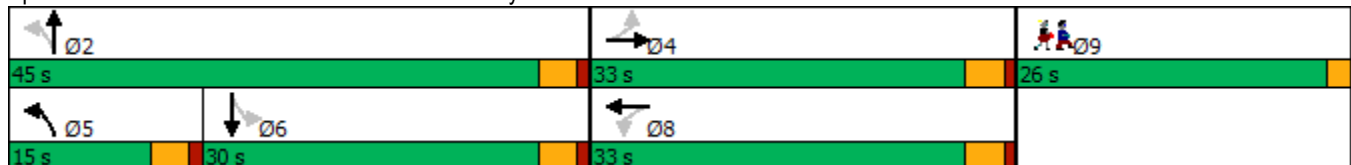
Queue shown is maximum after two cycles.

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

Queue shown is maximum after two cycles.

dl Defacto Left Lane. Recode with 1 though lane as a left lane.

Splits and Phases: 2: Columbia Road & Broadway



2029 No-Build Weekday Evening
2: Columbia Road & Broadway

10/04/2022

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	183	71	214	108	177	17	259	786	31	14	1070	322
Future Volume (vph)	183	71	214	108	177	17	259	786	31	14	1070	322
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	16	16	16	13	13	13	11	11	11	11	11	11
Total Lost time (s)		4.0			4.0			4.0			4.0	
Lane Util. Factor		1.00			1.00			0.95			0.95	
Frt		0.94			0.99			1.00			0.97	
Flt Protected		0.98			0.98			0.99			1.00	
Satd. Flow (prot)		1973			1892			3400			3343	
Flt Permitted		0.68			0.69			0.52			0.94	
Satd. Flow (perm)		1377			1333			1792			3134	
Peak-hour factor, PHF	0.96	0.96	0.96	0.83	0.83	0.83	0.87	0.87	0.87	0.94	0.94	0.94
Adj. Flow (vph)	191	74	223	130	213	20	298	903	36	15	1138	343
RTOR Reduction (vph)	0	25	0	0	2	0	0	1	0	0	17	0
Lane Group Flow (vph)	0	463	0	0	361	0	0	1236	0	0	1479	0
Heavy Vehicles (%)	0%	0%	1%	0%	2%	0%	1%	1%	0%	0%	1%	0%
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		Perm	NA	
Protected Phases		4			8		5	2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		29.0			29.0			41.0			41.0	
Effective Green, g (s)		29.0			29.0			41.0			41.0	
Actuated g/C Ratio		0.37			0.37			0.53			0.53	
Clearance Time (s)		4.0			4.0			4.0			4.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		511			495			941			1647	
v/s Ratio Prot												
v/s Ratio Perm		c0.34			0.27			c0.69			0.47	
v/c Ratio		0.91			0.73			3.17dl			0.90	
Uniform Delay, d1		23.2			21.1			18.5			16.6	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		19.5			5.3			148.5			6.9	
Delay (s)		42.7			26.5			167.0			23.5	
Level of Service		D			C			F			C	
Approach Delay (s)		42.7			26.5			167.0			23.5	
Approach LOS		D			C			F			C	
Intersection Summary												
HCM 2000 Control Delay		75.9			HCM 2000 Level of Service			E				
HCM 2000 Volume to Capacity ratio		1.25										
Actuated Cycle Length (s)		78.0			Sum of lost time (s)			14.0				
Intersection Capacity Utilization		117.0%			ICU Level of Service			H				
Analysis Period (min)		15										
dl Defacto Left Lane. Recode with 1 though lane as a left lane.												
c Critical Lane Group												

2029 Build Weekday Morning
2: Columbia Road & Broadway

10/04/2022

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	290	196	242	71	57	14	137	780	48	12	659	102
Future Volume (vph)	290	196	242	71	57	14	137	780	48	12	659	102
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	0.95	0.95	0.95	0.95
Frt		0.955			0.986			0.993			0.980	
Flt Protected		0.980			0.976			0.993			0.999	
Satd. Flow (prot)	0	1954	0	0	1813	0	0	3348	0	0	3327	0
Flt Permitted		0.794			0.611			0.660			0.936	
Satd. Flow (perm)	0	1583	0	0	1135	0	0	2226	0	0	3117	0
Satd. Flow (RTOR)		24			5			6			16	
Adj. Flow (vph)	345	233	288	90	72	18	146	830	51	13	701	109
Lane Group Flow (vph)	0	866	0	0	180	0	0	1027	0	0	823	0
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		Perm	NA	
Protected Phases		4			8		5	2			6	
Permitted Phases	4			8			2			6		
Detector Phase	4	4		8	8		5	2		6	6	
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Minimum Split (s)	22.5	22.5		22.5	22.5		9.5	22.5		22.5	22.5	
Total Split (s)	33.0	33.0		33.0	33.0		15.0	45.0		30.0	30.0	
Total Split (%)	31.7%	31.7%		31.7%	31.7%		14.4%	43.3%		28.8%	28.8%	
Maximum Green (s)	29.0	29.0		29.0	29.0		11.0	41.0		26.0	26.0	
Yellow Time (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0		1.0	1.0	
Lost Time Adjust (s)		0.0			0.0			0.0			0.0	
Total Lost Time (s)		4.0			4.0			4.0			4.0	
Lead/Lag							Lead			Lag	Lag	
Lead-Lag Optimize?							Yes			Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None		None	None		None	None	
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
v/c Ratio		1.44			0.42			0.88			0.50	
Control Delay		229.7			21.6			26.8			13.0	
Queue Delay		0.0			0.0			0.0			0.0	
Total Delay		229.7			21.6			26.8			13.0	
Queue Length 50th (ft)		~579			62			214			124	
Queue Length 95th (ft)		#725			99			#357			171	
Internal Link Dist (ft)		912			305			347			340	
Turn Bay Length (ft)												
Base Capacity (vph)		603			425			1172			1646	
Starvation Cap Reductn		0			0			0			0	
Spillback Cap Reductn		0			0			0			0	
Storage Cap Reductn		0			0			0			0	
Reduced v/c Ratio		1.44			0.42			0.88			0.50	
Intersection Summary												
Cycle Length: 104												

Lane Group	Ø9
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Satd. Flow (RTOR)	
Adj. Flow (vph)	
Lane Group Flow (vph)	
Turn Type	
Protected Phases	9
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	5.0
Minimum Split (s)	26.0
Total Split (s)	26.0
Total Split (%)	25%
Maximum Green (s)	24.0
Yellow Time (s)	2.0
All-Red Time (s)	0.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	7.0
Flash Dont Walk (s)	17.0
Pedestrian Calls (#/hr)	0
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	
Intersection Summary	

2029 Build Weekday Morning 2: Columbia Road & Broadway

10/04/2022

Actuated Cycle Length: 78

Natural Cycle: 145

Control Type: Actuated-Uncoordinated

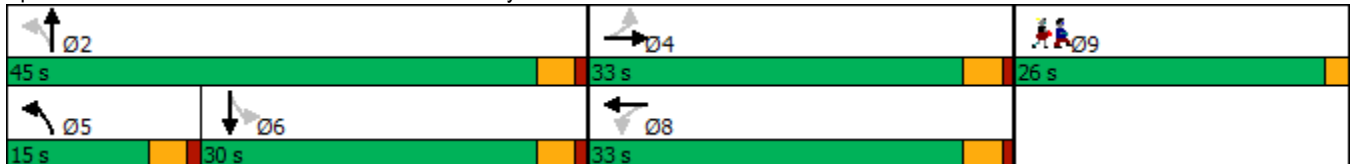
~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

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

Queue shown is maximum after two cycles.

Splits and Phases: 2: Columbia Road & Broadway



2029 Build Weekday Morning
2: Columbia Road & Broadway

10/04/2022

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	290	196	242	71	57	14	137	780	48	12	659	102
Future Volume (vph)	290	196	242	71	57	14	137	780	48	12	659	102
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	16	16	16	13	13	13	11	11	11	11	11	11
Total Lost time (s)		4.0			4.0			4.0			4.0	
Lane Util. Factor		1.00			1.00			0.95			0.95	
Frt		0.96			0.99			0.99			0.98	
Flt Protected		0.98			0.98			0.99			1.00	
Satd. Flow (prot)		1955			1813			3347			3328	
Flt Permitted		0.79			0.61			0.66			0.94	
Satd. Flow (perm)		1584			1136			2226			3117	
Peak-hour factor, PHF	0.84	0.84	0.84	0.79	0.79	0.79	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	345	233	288	90	72	18	146	830	51	13	701	109
RTOR Reduction (vph)	0	15	0	0	3	0	0	3	0	0	8	0
Lane Group Flow (vph)	0	851	0	0	177	0	0	1024	0	0	815	0
Heavy Vehicles (%)	1%	4%	5%	2%	8%	0%	12%	1%	5%	0%	3%	1%
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		Perm	NA	
Protected Phases		4			8		5	2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		29.0			29.0			41.0			41.0	
Effective Green, g (s)		29.0			29.0			41.0			41.0	
Actuated g/C Ratio		0.37			0.37			0.53			0.53	
Clearance Time (s)		4.0			4.0			4.0			4.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		588			422			1170			1638	
v/s Ratio Prot												
v/s Ratio Perm		c0.54			0.16			c0.46			0.26	
v/c Ratio		1.45			0.42			0.88			0.50	
Uniform Delay, d1		24.5			18.2			16.3			11.9	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		210.7			0.7			7.5			0.2	
Delay (s)		235.2			18.9			23.8			12.1	
Level of Service		F			B			C			B	
Approach Delay (s)		235.2			18.9			23.8			12.1	
Approach LOS		F			B			C			B	
Intersection Summary												
HCM 2000 Control Delay			83.4				HCM 2000 Level of Service				F	
HCM 2000 Volume to Capacity ratio			1.22									
Actuated Cycle Length (s)			78.0				Sum of lost time (s)			14.0		
Intersection Capacity Utilization			106.7%				ICU Level of Service			G		
Analysis Period (min)			15									
c Critical Lane Group												

2029 Build Weekday Evening
2: Columbia Road & Broadway

10/04/2022

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	193	72	215	108	179	17	260	786	31	14	1070	336
Future Volume (vph)	193	72	215	108	179	17	260	786	31	14	1070	336
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	0.95	0.95	0.95	0.95
Frt		0.940			0.993			0.996			0.965	
Flt Protected		0.980			0.983			0.988				
Satd. Flow (prot)	0	1975	0	0	1894	0	0	3401	0	0	3342	0
Flt Permitted		0.677			0.694			0.522			0.937	
Satd. Flow (perm)	0	1364	0	0	1337	0	0	1797	0	0	3132	0
Satd. Flow (RTOR)		39			3			3			38	
Adj. Flow (vph)	201	75	224	130	216	20	299	903	36	15	1138	357
Lane Group Flow (vph)	0	500	0	0	366	0	0	1238	0	0	1510	0
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		Perm	NA	
Protected Phases		4			8		5	2			6	
Permitted Phases	4			8			2			6		
Detector Phase	4	4		8	8		5	2		6	6	
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Minimum Split (s)	22.5	22.5		22.5	22.5		9.5	22.5		22.5	22.5	
Total Split (s)	33.0	33.0		33.0	33.0		15.0	45.0		30.0	30.0	
Total Split (%)	31.7%	31.7%		31.7%	31.7%		14.4%	43.3%		28.8%	28.8%	
Maximum Green (s)	29.0	29.0		29.0	29.0		11.0	41.0		26.0	26.0	
Yellow Time (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0		1.0	1.0	
Lost Time Adjust (s)		0.0			0.0			0.0			0.0	
Total Lost Time (s)		4.0			4.0			4.0			4.0	
Lead/Lag							Lead			Lag	Lag	
Lead-Lag Optimize?							Yes			Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None		None	None		None	None	
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
v/c Ratio		0.94			0.73			3.18dl			0.91	
Control Delay		51.4			31.7			168.2			26.2	
Queue Delay		0.0			0.0			0.0			0.0	
Total Delay		51.4			31.7			168.2			26.2	
Queue Length 50th (ft)		215			149			~417			321	
Queue Length 95th (ft)		#412			223			#518			#493	
Internal Link Dist (ft)		912			305			347			340	
Turn Bay Length (ft)												
Base Capacity (vph)		531			498			946			1664	
Starvation Cap Reductn		0			0			0			0	
Spillback Cap Reductn		0			0			0			0	
Storage Cap Reductn		0			0			0			0	
Reduced v/c Ratio		0.94			0.73			1.31			0.91	
Intersection Summary												
Cycle Length: 104												

Lane Group	Ø9
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Satd. Flow (RTOR)	
Adj. Flow (vph)	
Lane Group Flow (vph)	
Turn Type	
Protected Phases	9
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	5.0
Minimum Split (s)	26.0
Total Split (s)	26.0
Total Split (%)	25%
Maximum Green (s)	24.0
Yellow Time (s)	2.0
All-Red Time (s)	0.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	7.0
Flash Dont Walk (s)	17.0
Pedestrian Calls (#/hr)	0
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	
Intersection Summary	

2029 Build Weekday Evening 2: Columbia Road & Broadway

10/04/2022

Actuated Cycle Length: 78

Natural Cycle: 145

Control Type: Actuated-Uncoordinated

~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

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

Queue shown is maximum after two cycles.

dl Defacto Left Lane. Recode with 1 though lane as a left lane.

Splits and Phases: 2: Columbia Road & Broadway

 Ø2	 Ø4	 Ø9
45 s	33 s	26 s
 Ø5	 Ø6	 Ø8
15 s	30 s	33 s

2029 Build Weekday Evening
2: Columbia Road & Broadway

10/04/2022

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	193	72	215	108	179	17	260	786	31	14	1070	336
Future Volume (vph)	193	72	215	108	179	17	260	786	31	14	1070	336
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	16	16	16	13	13	13	11	11	11	11	11	11
Total Lost time (s)		4.0			4.0			4.0			4.0	
Lane Util. Factor		1.00			1.00			0.95			0.95	
Frt		0.94			0.99			1.00			0.96	
Flt Protected		0.98			0.98			0.99			1.00	
Satd. Flow (prot)		1974			1893			3400			3339	
Flt Permitted		0.68			0.69			0.52			0.94	
Satd. Flow (perm)		1363			1337			1795			3131	
Peak-hour factor, PHF	0.96	0.96	0.96	0.83	0.83	0.83	0.87	0.87	0.87	0.94	0.94	0.94
Adj. Flow (vph)	201	75	224	130	216	20	299	903	36	15	1138	357
RTOR Reduction (vph)	0	25	0	0	2	0	0	1	0	0	18	0
Lane Group Flow (vph)	0	476	0	0	364	0	0	1237	0	0	1492	0
Heavy Vehicles (%)	0%	0%	1%	0%	2%	0%	1%	1%	0%	0%	1%	0%
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		Perm	NA	
Protected Phases		4			8		5	2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		29.0			29.0			41.0			41.0	
Effective Green, g (s)		29.0			29.0			41.0			41.0	
Actuated g/C Ratio		0.37			0.37			0.53			0.53	
Clearance Time (s)		4.0			4.0			4.0			4.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		506			497			943			1645	
v/s Ratio Prot												
v/s Ratio Perm		c0.35			0.27			c0.69			0.48	
v/c Ratio		0.94			0.73			3.18dl			0.91	
Uniform Delay, d1		23.7			21.2			18.5			16.8	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		25.4			5.5			147.7			7.6	
Delay (s)		49.1			26.7			166.2			24.4	
Level of Service		D			C			F			C	
Approach Delay (s)		49.1			26.7			166.2			24.4	
Approach LOS		D			C			F			C	
Intersection Summary												
HCM 2000 Control Delay			76.6				HCM 2000 Level of Service				E	
HCM 2000 Volume to Capacity ratio			1.26									
Actuated Cycle Length (s)			78.0				Sum of lost time (s)			14.0		
Intersection Capacity Utilization			118.9%				ICU Level of Service			H		
Analysis Period (min)			15									
dl Defacto Left Lane. Recode with 1 though lane as a left lane.												
c Critical Lane Group												