
TRAFFIC IMPACT ASSESSMENT

for

237 Pleasant Street Housing Development Franklin, Massachusetts

Prepared for:

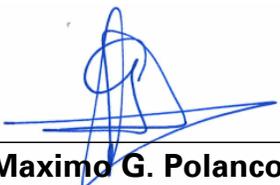
Town of Franklin

On Behalf of:

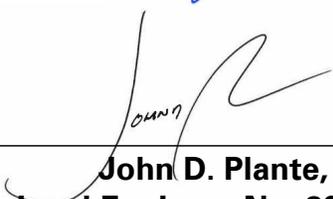
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LANGAN

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EXECUTIVE SUMMARY

Langan has prepared this traffic impact assessment to identify the potential impacts of the proposed affordable housing development at 237 Pleasant Street in Franklin, Massachusetts (See **Figure 1**). The analysis demonstrates that the proposed development is a low traffic generator and will not noticeably affect traffic operations in the surrounding roadway network.

The 19.46-acre site is currently occupied by a 5,125 square-foot church (St. John's Episcopal Church), served by two driveways to Pleasant Street. The north driveway operates as an enter-only driveway and the south driveway operates as an exit-only driveway. The proposed development will not demolish the existing church; rather the project is proposing to reconfigure the existing driveways to separate the church traffic from the residential traffic. Both driveways will operate as full-access driveways. The north driveway will serve the residential development and the south driveway will serve the church. Both driveways will have sufficient sight distance to provide safe access to the site. We verified that the proposed north driveway meets the minimum spacing requirements with Padden Road as specified in the Town's bylaws Art. 4 section 300-10g(1).

The proposed residential development will comprise the construction of seven three-story residential buildings with a total of 64 units and a surface parking lot with 104 vehicle parking spaces. The project will also redevelop the existing surface parking lot of the church to provide safe access and proper circulation with a new parking layout of 53 parking spaces, matching the existing number of parking spaces serving the church. In addition, the church will have an emergency access connection to the proposed residential parking lot.

Video turning-movement, vehicle-classification counts, speed data and gap data were conducted in December 2022, while schools were in session, at four intersections and two roadway segments, which were used as a basis for this evaluation. Langan used the Institute of Transportation Engineers (ITE) Land-Use Code 220 – Multifamily Housing - Low-Rise to develop the trip generation for the proposed development. These trip generation volumes were used to evaluate the peak-hour and average annual daily traffic (AADT) for the 2029 build-year traffic operations conditions.

The analysis of the most recent five years of crash data at the study area intersections shows various types of crashes (angle collisions, rear-ends, head-on collisions, sideswipe, and fixed object/ single vehicle crashes), which are behaviors typical for the type of roadway corridors such as Pleasant Street and confirmed that none of the accidents resulted in fatalities.

While not specifically impacted by the proposed development, we reviewed specific traffic conditions at the intersection of Padden Road and Pleasant Street and provided suggestions to enhance safety at this location. This task was undertaken based on concerns expressed by local residents. We will work with the Town to review the appropriate actions to help mitigate this existing condition, as appropriate.

1.0 INTRODUCTION

Langan has prepared this traffic impact assessment for the proposed affordable housing development at 237 Pleasant Street in Franklin, Massachusetts. The analysis demonstrates that the proposed development is a low traffic generator and will not noticeably impact the surrounding roadway network. The 19.46-acre site is currently occupied by the St. John's Episcopal Church, which is served by two driveways to Pleasant Street. The north driveway operates as an enter-only driveway and the south driveway operates as an exit-only driveway. The site location is shown on **Figure 1** below.

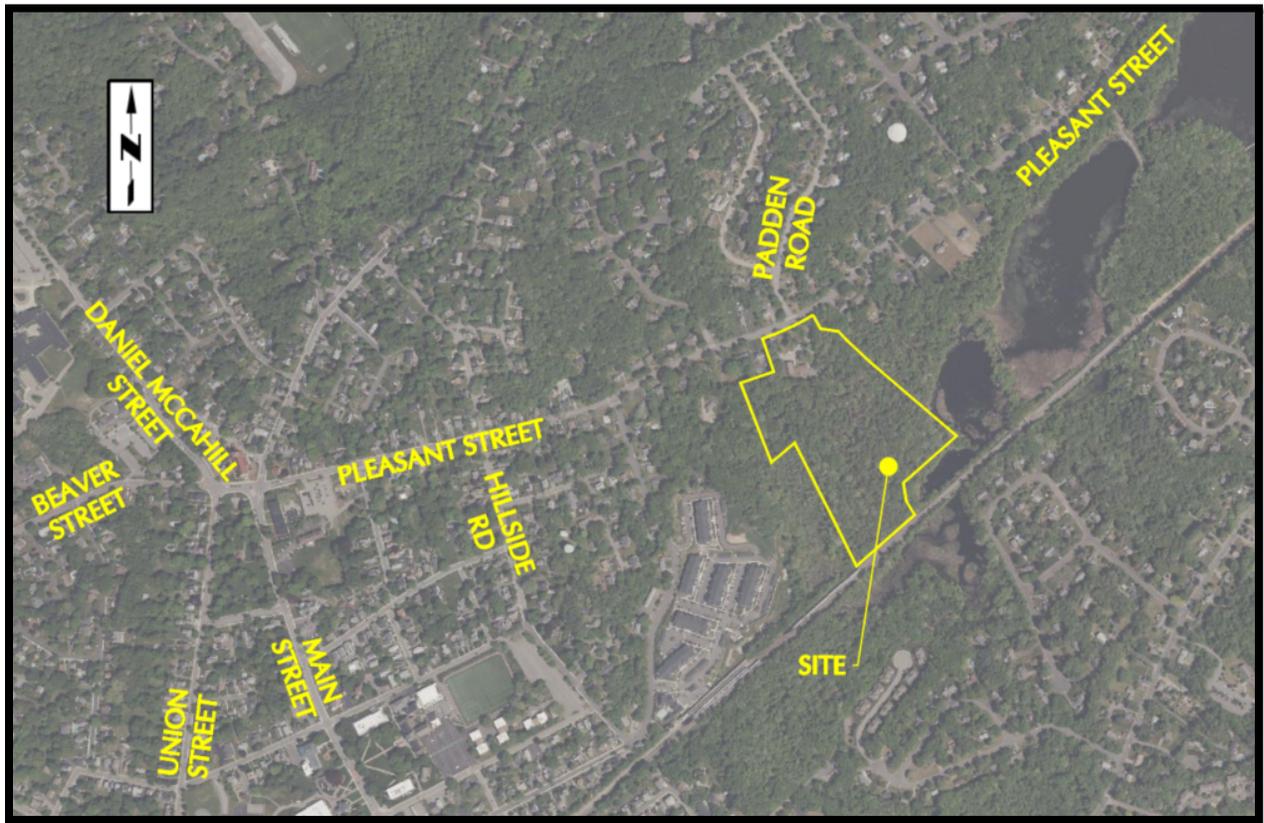


Figure 1: Location Map

The proposed development will not demolish the existing church; rather the project is proposing to reconfigure the existing driveways to separate the church traffic from the residential traffic. Both driveways will be modified to operate as full-access driveways. The north driveway will serve the residential development and the south driveway will serve the church. We verified that the proposed north driveway meets the minimum spacing requirements with Padden Road as specified in the Town's bylaws Art. 4 section 300-10g(1).

The proposed residential development will comprise the construction of seven (7) three-story residential buildings with a total of 64 units and a surface parking lot with 104 vehicle parking spaces. The project will also redevelop the existing surface parking lot of the church to enhance access and circulation with a new parking layout of 53 parking spaces, matching the existing parking supply serving the church. The church will also have an emergency access connection to the proposed residential parking lot. Appendix A includes a preliminary site plan for the proposed development and shows the spacing between the north driveway to Padden Road.

1.1 Study Locations

The roadway network in the vicinity of the site including and the following four key intersections were studied to assess the potential impacts from the proposed development (See **Figure 2** below):

1. Beaver Street / Church Square & Union Street / Daniel McCahill Street (signalized)
2. Pleasant Street / Church Square & Main Street (signalized)
3. Pleasant Street & Dean Avenue (unsignalized)
4. Pleasant Street & Padden Road (unsignalized)

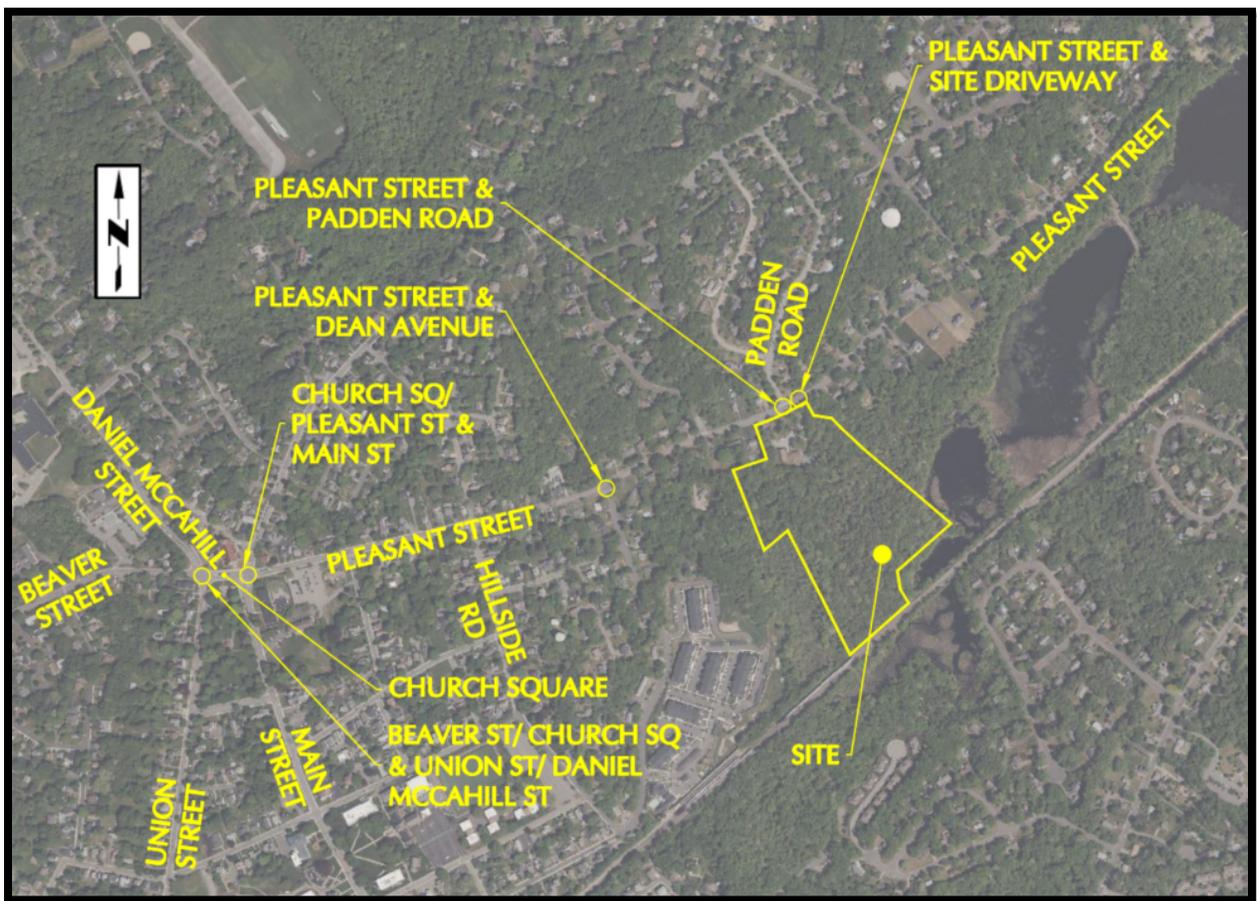


Figure 2: Study Intersections

We also, collected 72-hour automatic traffic recorder counts with speed data along two segments of Pleasant Street. Appendix B includes the traffic data collected.

In addition to reviewing the traffic impact of the proposed project within the study area, we also, based on local concerns, reviewed separately specific traffic conditions at Padden Road and Pleasant Street. Findings of this review are included on Appendix C along with suggestions to enhance safety at this intersection.

2.0 EXISTING CONDITIONS

2.1 Area Roadway Network

Pleasant Street is a two lane, east-west, undivided, minor collector roadway under local jurisdiction, with a posted speed limit of 35 MPH east of Hillside Road and 25 MPH west of Hillside Road. It generally provides two 15-foot wide travel lanes. Based on count data, Pleasant Street has an Average Daily Traffic (ADT) of $\pm 9,600$ vehicles per day. In addition, Pleasant Street has sidewalks on both sides of the road between Union Street and Hillside Road and a sidewalk on the north side north of Hillside Road.

Union Street is a two lane, north-south, undivided roadway under local jurisdiction, with a posted speed limit of 30 MPH within the study area. It generally provides two 12-foot wide travel lanes.

Daniel McCahill Street is a two lane, north-south, undivided roadway under local jurisdiction, with a posted speed limit of 35 MPH within the study area. It generally provides two 15-foot wide travel lanes.

Main Street is a two lane, north-south, undivided roadway under local jurisdiction, with a posted speed limit of 30 MPH within the study area. It generally provides two 12-foot wide travel lanes.

Dean Avenue is a two lane, north-south, undivided roadway under local jurisdiction, with a posted speed limit of 30 MPH within the study area. It generally provides two 15-foot wide travel lanes.

Padden Road is a two lane, north-south, undivided roadway under local jurisdiction, with an assumed speed limit of 30 MPH within the study area. It generally provides two 14-foot wide travel lanes.

2.2 Study Intersections

Beaver Street / Church Square & Union Street / Daniel McCahill Street is a signalized, four-way intersection with the following geometry:

- Beaver Street (Eastbound) – one shared left/thru/right lane
- Church Square (Westbound) – one shared left/thru lane and a right turn lane with approximately 65 feet of storage
- Union Street (Northbound) – one shared left/thru lane and a right turn lane with approximately 80 feet of storage

- Daniel McCahill Street (Southbound) – one shared right/thru lane and a left turn lane with approximately 90 feet of storage

Pleasant Street / Church Square & Main Street is a signalized four-way intersection with the following geometry:

- Church Square (Eastbound) – one shared left/thru/right lane
- Pleasant Street (Westbound) – one shared left/thru/right lane
- Main Street (Northbound) – one shared right/thru lane and a left turn lane with approximately 55 feet of storage
- Main Street (Southbound) – one shared left/thru/right lane

Pleasant Street & Dean Avenue is a stop-sign controlled “T” intersection with one shared lane on each approach.

Pleasant Street & Padden Road is a stop-sign controlled “T” intersection with one shared lane on each approach.

3.0 TRAFFIC VOLUMES

3.1 Traffic Count Data

Traffic count data was collected on a weekday in December 2022 at the study intersections. Video turning movement and vehicle classification counts were conducted during the morning and evening peak hour periods. The turning movement counts were conducted on Thursday, December 8th 2022, from 7:00 AM to 9:00 AM and from 4:00 PM to 6:00 PM. A review of the existing count data reveals that the peak hours for the study area occur from 7:00 – 8:00 in the morning and from 4:15 – 5:15 in the evening. We also collected 72-hour automatic traffic recorder counts and speed data along two roadway segments of Pleasant Street.

3.2 Base Year Traffic Volumes

Seasonal Factors

The count data was been adjusted to account for seasonal traffic fluctuations, using data provided by MassDOT. Since the study area lies within the R4-R7 factor group (rural minor arterials, collectors and local roads), a 13% seasonal factor was applied based on the seasonal rates for the month of December. The MassDOT correction factor table is included in Appendix B.

The morning and evening peak hours (four consecutive 15-minute periods comprising the highest volume) from the intersection counts were used to determine the 2022 existing peak hour traffic volumes as shown on **Figure 3** below.

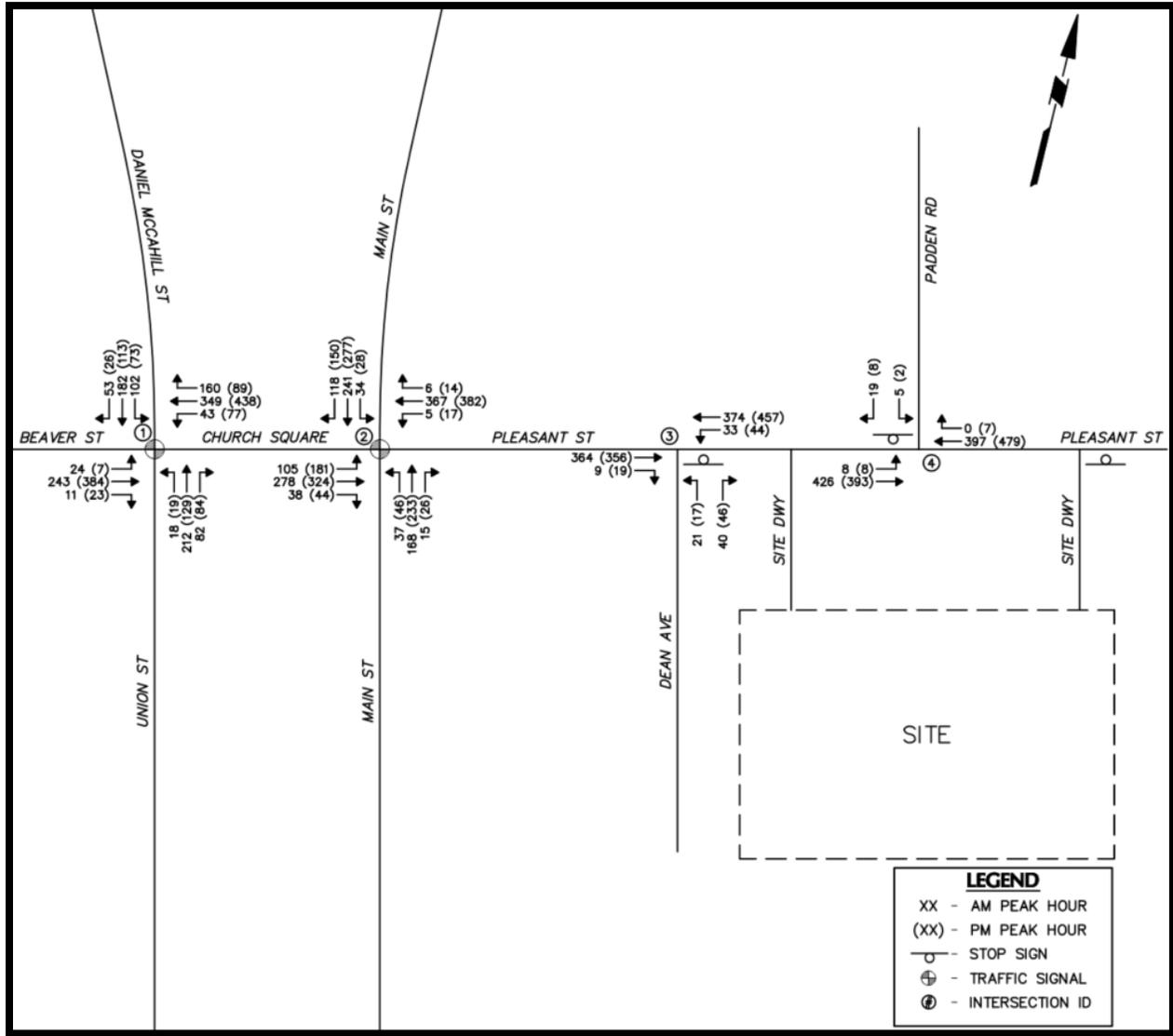


Figure 3: 2022 Existing Peak Hour Volumes

Annual Background Growth Rate

The existing traffic volumes were projected seven years into the future, per the MassDOT Guidelines, by adding an appropriate growth factor. These volumes were then analyzed to understand the 2029 no build traffic operating conditions, or what can be expected to exist in the

study area without the proposed development. These conditions are then compared to the operating conditions resulting from the addition of the proposed development.

The traffic data was been grown to the design year using data provided by MassDOT. Since the study area lies within the R4-R7 factor group (rural minor arterials, collectors and local roads), a 0.34% seasonal growth rate was determined. We also confirmed with the Town that there is no historical data available to evaluate the traffic growth along Pleasant Street. However, to be conservative, a 1% growth per year was applied.

We also contacted the town of Franklin Planning Department and confirmed that there are no planned or approved developments in our study area that would affect future traffic volumes in our study area. We applied the seasonal factor and growth rate to the 2022 existing peak hour volumes to develop the 2029 No Build Peak Hour Volumes as shown on **Figure 4**. Appendix B also includes the spreadsheets that show a detail breakdown of the no-build traffic volumes.

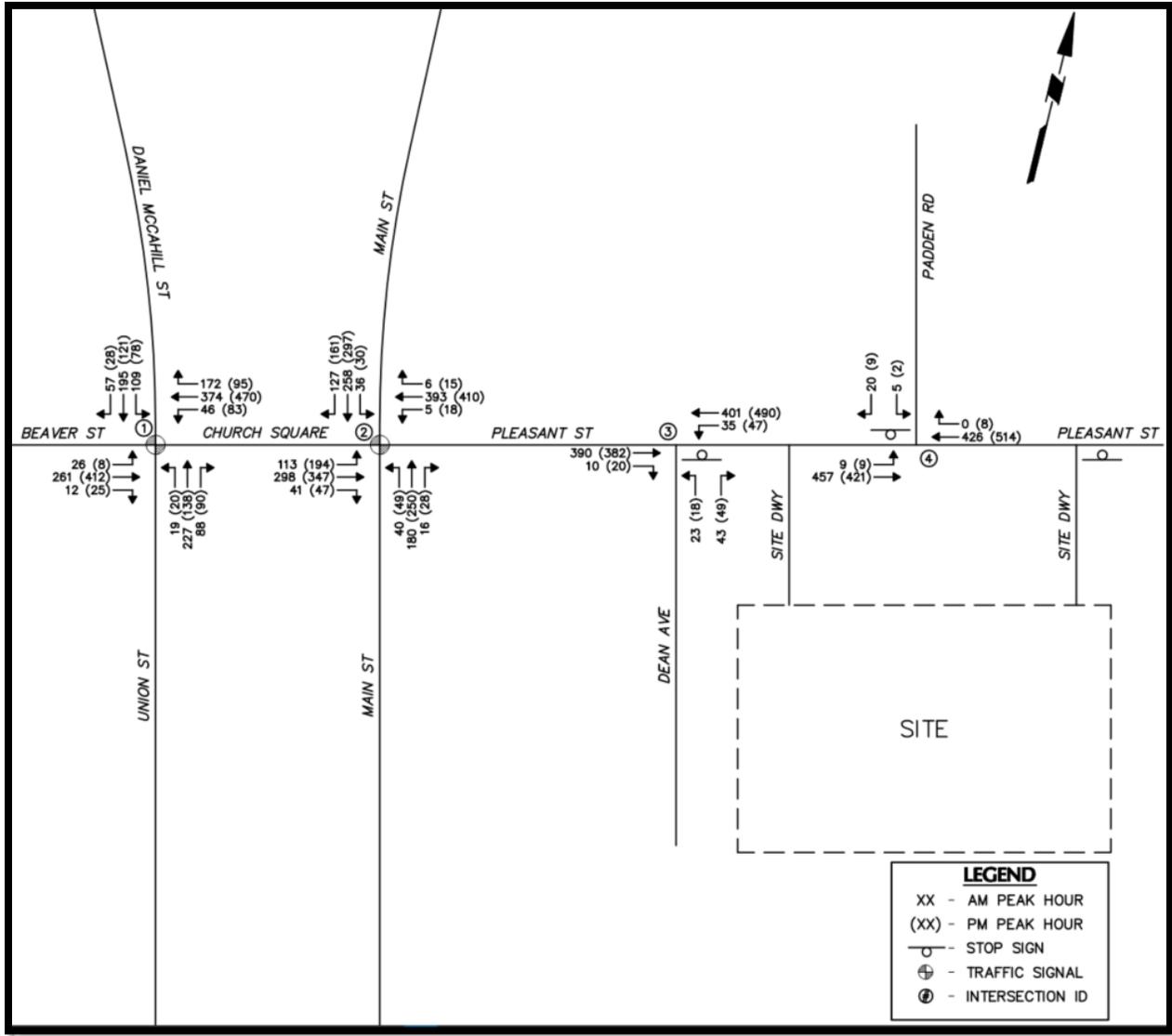


Figure 4: 2029 No Build Peak Hour Volumes

3.3 Future Year Traffic Volumes

Site Trip Generation

Langan estimated the trip generation for the proposed residential development with 64 units using trip generation data contained in the *Trip Generation Manual*, 11th Edition, published by the Institute of Transportation Engineers (ITE), Land Use Code 220 – Multifamily Housing - Low-Rise. No multi-modal credit was applied due to the absence of surrounding transit and pedestrian / bicycle infrastructure.

The resulting trip generation calculations indicate that the proposed development would generate 486 daily trips, 43 AM peak hour trips and 48 PM peak hour trips. The trip generation calculation, as well as the vehicle classification breakdown, is shown below on **Table 1**.

TABLE 1 ANTICIPATED TRIP GENERATION – 237 PLEASANT ST RESIDENTIAL								
USE	LAND USE CODE ¹	DAILY ²	AM PEAK HOUR ³			PM PEAK HOUR ³		
			ENTER	EXIT	TOTAL	ENTER	EXIT	TOTAL
Multifamily Housing - Low-Rise (64 DU)	220	486	10	33	43	30	18	48

1. Land Use Code and site trips based on ITE Trip Generation Manual 11 Edition.

2. Vehicle per day.

3. Vehicle per hour.

Site Trip Distribution

Langan estimated employee trip distribution for the proposed facility using a Journey to Work model detailed in Appendix D. The OnTheMap website created by the United States Census Bureau, was used to produce a Distance/Direction Report. Trip distributions were devised from this data and are shown on **Figure 5**. The site trips assignment are shown in **Figure 6**. Appendix B also includes the spreadsheets that show a detail breakdown of the build traffic volumes.

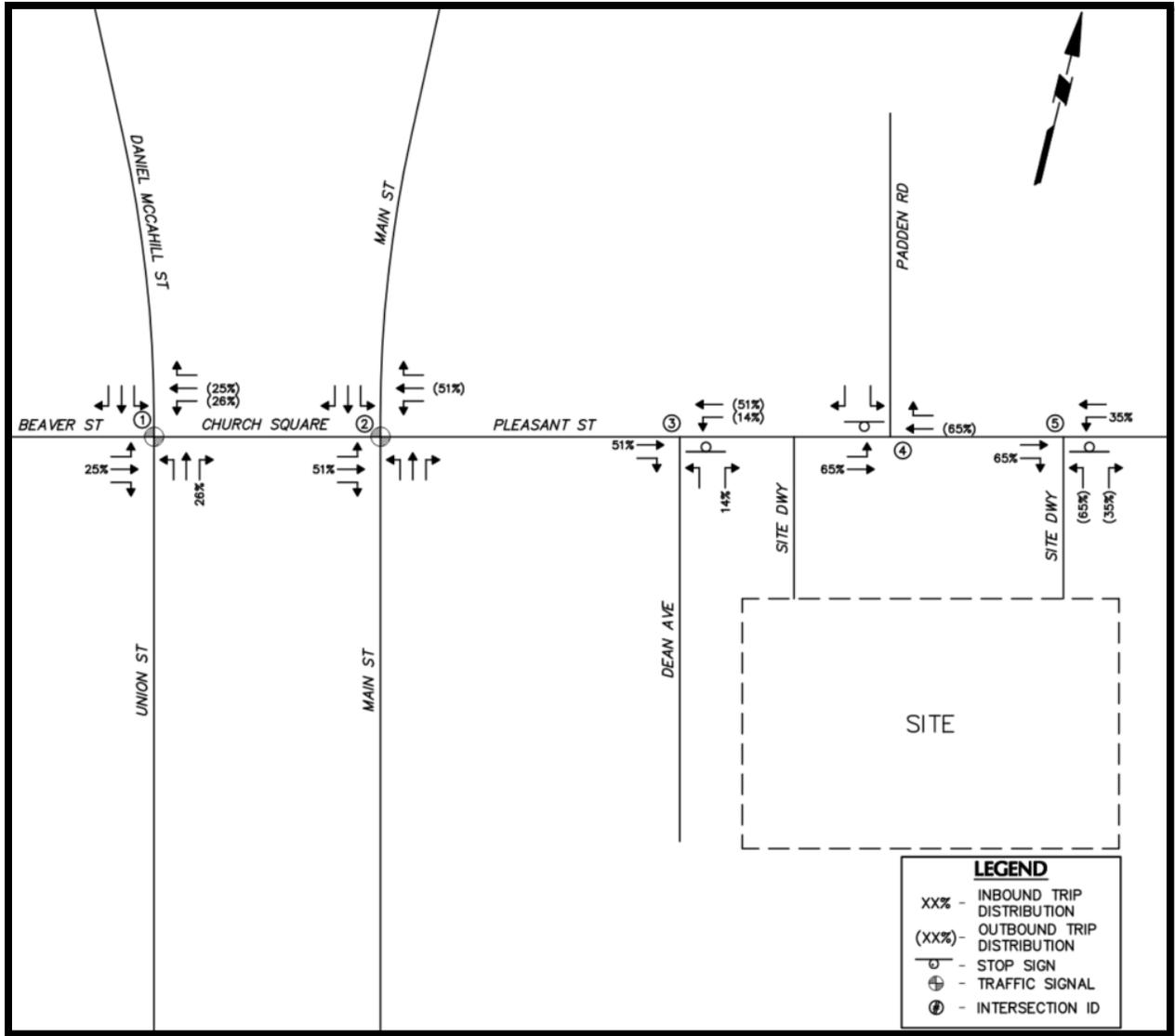


Figure 5: Site Trips Distribution

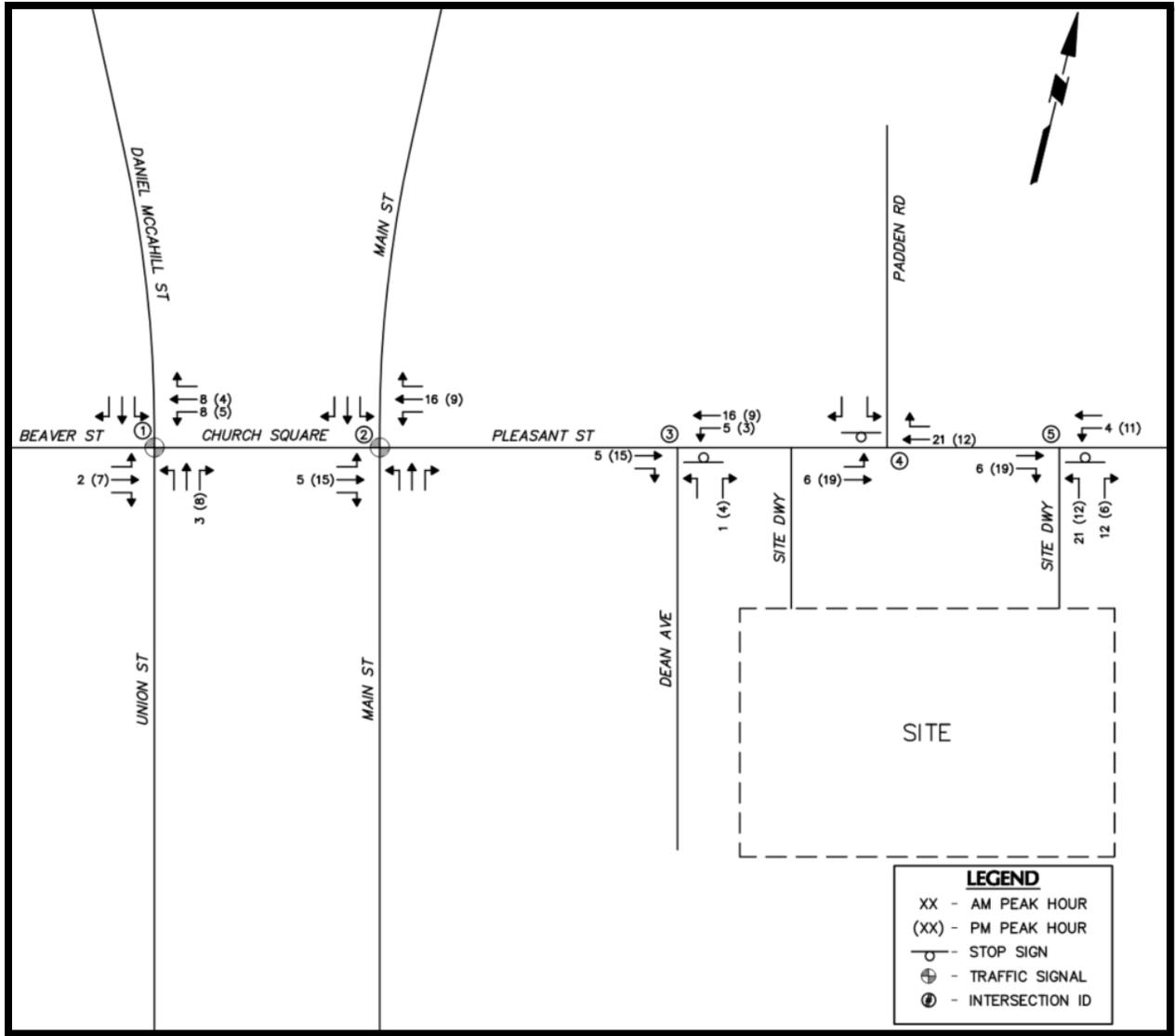


Figure 6: Site Trips Assignment

Future Traffic Volumes with Development

The total site trips were combined with the 2029 no build volumes to develop the 2029 build peak hour volumes as shown in **Figure 7**.

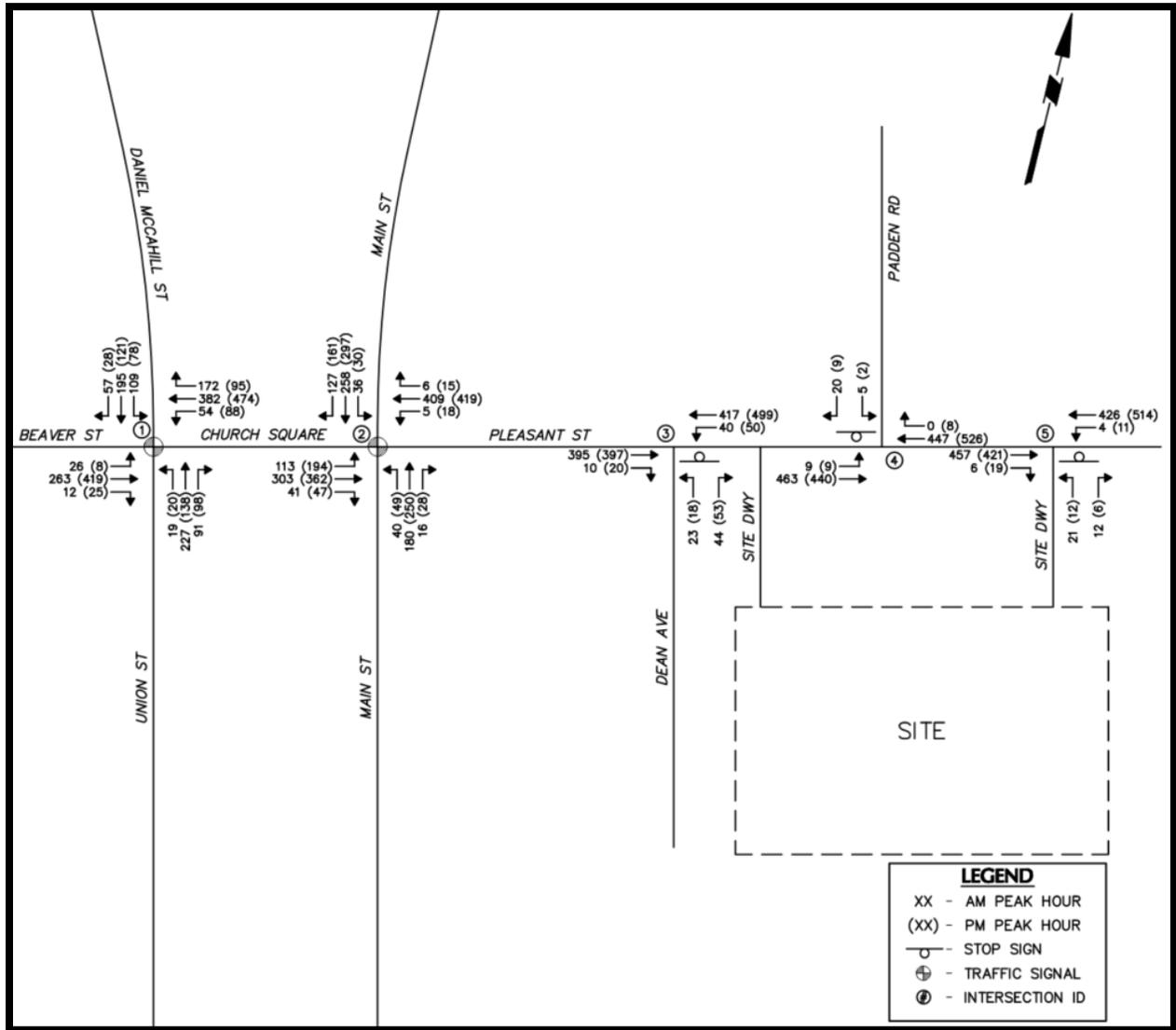


Figure 7: 2029 Build Peak Hour Volumes

4.0 OPERATIONAL ANALYSIS

4.1 Intersection Capacity Analysis Measures

Methodology

This evaluation identifies the potential traffic impacts generated by the proposed residential development on the surrounding area road network. Capacity analyses were conducted for the existing, no build and build traffic conditions to assess operating conditions of the key intersections. Capacity analyses provide an indication of the adequacy of the intersections to serve traffic demands.

Level of Service Criteria

Level of Service (LOS) is the term used to denote the different operating conditions that occur at an intersection under various traffic volume demands. LOS is a qualitative measure that considers a number of factors including road geometry, speed and travel delay. LOS provides an index to the operational qualities of an intersection. LOS designations range from A to F, with LOS A representing the best operating conditions and LOS F representing the worst operating conditions. The LOS designation is reported differently for signalized intersections and unsignalized intersections.

For signalized intersections, the analysis considers the operation of all traffic entering the intersection. For unsignalized intersections, however, the analysis considers the operation of all movements that are in conflict with other movements such as mainline left turns and traffic exiting the side street. An overall LOS is given for signalized intersections. For unsignalized intersections, LOS is given for each specific approach.

The evaluation criteria used to analyze the study area intersections are based on the Highway Capacity Manual (HCM) 6th Edition, published by the Transportation Research Board (TRB).

The HCM 6th Edition defines level of service for signalized intersections as follows:

<u>Level of Service</u>	<u>Control Delay per Vehicle (sec/veh)</u>
A	≤10
B	>10 – 20
C	>20 – 35
D	>35 – 55
E	>55 – 80
F	>80

The HCM defines level of service for unsignalized intersections as follows:

<u>Level of Service</u>	<u>Control Delay per Vehicle (sec/veh)</u>
A	≤10
B	>10 – 15
C	>15 – 25
D	>25 – 35
E	>35 – 50
F	> 50

4.2 Analysis Scenarios

In accordance with MassDOT guidelines, the following scenarios have been analyzed:

1. Existing Traffic Volumes with Existing Geometry (2022 Existing Conditions)
2. Future Year Traffic Volumes with Existing Geometry (2029 No Build Conditions)
3. Future Year Traffic Volumes including full build development trips (2029 Build Conditions)

We visually assessed the current traffic signal operation to evaluate the operating conditions at the signalized intersections.

Existing Conditions

Langan evaluated the existing 2022 traffic operating conditions for the study area intersections during the roadway peak-hour periods using the volumes shown on Figure 3. The analysis shows that all study intersections are operating at an acceptable level of service (LOS). It should be noted that the eastbound approach at the signalized intersection of Union Street and Beaver Street is experiencing a large delay and operating at LOS “F” during both peak hours. The intersections of Beaver Street at Union Street and Church Square at Main Street operate in a

cluster condition, where the eastbound and westbound approaches operate simultaneously and both approaches have a red time (clearance interval) of approximately 18 seconds, that is intended to clear all vehicles along Church Square between Union Street and Main Street. This setup causes these approaches to operate under unacceptable conditions and experience long delays. **Tables 2** and **3** compare the traffic operating conditions for the study area intersections during the peak-hour periods. Detailed reports can be found in Appendix E.

No Build Conditions

The traffic operating conditions for the study area intersections were analyzed during the peak-hour periods using the 2029 no build traffic volumes illustrated in Figure 4. The analysis shows that all study intersections are operating at an acceptable level of service (LOS) with the exception of eastbound approach at the intersection of Union Street/Daniel McCahill Street and Beaver Street/Church Square which is expected to operate at LOS F during both peak hours with the current signal timing operations. Tables 2 and 3 compare the traffic operating conditions for the study area intersections during the peak-hour periods. Detailed reports can be found in Appendix F.

Build Conditions

The resulting traffic volumes illustrated in **Figure 7** were evaluated to determine the effective operating conditions of the study area intersections. Langan evaluated the 2029 Build traffic conditions for the study area intersections during the roadway peak hour periods. The analysis shows that all study intersections are operating at an acceptable level of service (LOS) with the exception of the intersection of Union Street/Daniel McCahill Street and Beaver Street/Church Square. This intersection is expected to operate overall with an LOS F during the afternoon peak hour.

Tables 2 and **3** compare the traffic operating conditions for the key study area intersections during the peak-hour periods. Appendix G provides detailed reports for the 2029 build conditions.

It should be noted that based on the existing traffic along Pleasant Street ($\pm 9,600$ ADT) the proposed development is expected to add 486 daily trips, which represents 5% of the existing traffic in the entire segment. Therefore, the proposed development is not expected to cause a noticeable traffic impact to the surrounding roadway network.

Queuing Evaluation

In addition to the traffic operating conditions, we evaluated the resulting vehicular queuing for all conditions to assess the impacts at study intersections. In evaluating queuing length, the industry

standard is to utilize the 50th and the 95th percentile queue lengths developed by the analysis. The 50th percentile queue represents the average or typical vehicular queue that can be expected during the peak-hour. The 95th percentile queue length represents the queuing experience during the highest peak periods, which accounts for 5% of the analysis period. Queues are calculated in feet, and approximately 25 feet of queue is equal to a single vehicle.

Tables 2 and **3** provide the expected 50th and 95th percentile queue lengths for the analyzed periods. For most analyzed intersections, queue lengths do not increase more than four car lengths. Any increase in queuing due to the proposed development is minimal and the existing roadway network can fully accommodate the anticipated queues.

Volume-to-Capacity (V/C) Ratio Evaluation

Lastly, we evaluated the volume-to-capacity ratios (V/C ratios) in all conditions to understand the degree of saturation at each study intersection. The V/C ratio is the ratio between traffic flow volumes through an intersection and the capacity of the intersection. Typically, a V/C ratio below 0.85 indicates that the intersection has sufficient capacity and significant delays and queues are not expected. A V/C ratio above 1.00 at signalized intersections indicates that the traffic volume demand has exceeded the available capacity of the intersection, resulting in possible increased delays and queues.

Tables 2 and **3** show the expected V/C ratios for the analyzed intersections and periods. The analysis shows that most of the study intersections do not experience a significant increase in their V/C ratio and demonstrate that the existing roadway network has the capacity to accommodate the expected traffic from the proposed development. The analysis shows that some approaches at the intersections of Union Street/Daniel McCahill Street and Beaver Street/Church Square and Main Street and Church Square/Pleasant Street are operating beyond capacity during both peak hours. In order to mitigate this existing condition, we optimized the signalized intersection to reduce the current and expected delays at these intersections. The proposed signal-timing optimizations shown in **Table 4** are expected to reduce the V/C ratios to levels below the no build conditions for both the AM and PM peak periods. Appendix H includes details reports of the recommended optimizations.

Signal Warrant Analysis

We performed a signal warrant analysis at the intersection of Padden Road and Pleasant Street determined the existing and projected volumes at the subject intersection do not meet the minimum thresholds of the Manual of Uniform Traffic Control Devices (MUTCD) signal-warrants. The current MUTCD provides nine traffic signal-warrants, but only the first three are applicable to the subject intersection. The existing volumes at the southbound approach (minor approach) are not expected exceed 50 peak hour trips and therefore do not meet the minimum thresholds to warrant a traffic signal.

Warrant 1 is evaluated using eight hours of intersection volume data and includes two criteria, conditions A and B. Condition A is based on the minimum vehicular volume and is intended for application where a large volume of intersecting traffic is the main reason for installing the traffic signal, where the threshold for the minor approach is 150 vehicles/hr.

Condition B is based on the interruption of continuous traffic and is intended for application at locations where condition A is not satisfied and where the traffic volume on a major street is so high that traffic on the minor street experiences excessive delay or conflict in entering or crossing the major street and with a threshold for the minor approach of 75 vehicles/hr.

Conditions A and B are applied separately but can be combined when neither A or B are met and should be applied after an adequate trial of other alternatives to reduce delay has been failed. Warrant 2 is applied where the volume of the intersecting traffic is the principal reason to consider the installation of a traffic signal with a threshold for the minor approach of 80 vehicles/hr. Warrant 3 is applied when due to the traffic conditions, the minor street traffic suffer excessive delay when entering or crossing the major street, with a threshold for the minor approach of 100 vehicles/hr. In addition, as shown on the traffic analysis the stop-sign controlled approach at this intersection is expected to operate at LOS B during the morning and afternoon peak hours with the proposed development. Therefore, none of the warrants are met.

**TABLE 2
 CAPACITY ANALYSIS SUMMARY - WEEKDAY A.M. PEAK HOUR**

INTERSECTION	CONTROL TYPE	LANE USE	STORAGE LENGTH (ft)	2022 EXISTING AM PEAK HOUR					2029 NO BUILD AM PEAK HOUR					2029 BUILD AM PEAK HOUR				
				LOS	DELAY (sec)	V/C RATIO	QUEUES (ft)		LOS	DELAY (sec)	V/C RATIO	QUEUES (ft)		LOS	DELAY (sec)	V/C RATIO	QUEUES (ft)	
							50th%	95th%				50th%	95th%				50th%	95th%
Union Street/Daniel McCahill Street & Beaver Street/Church Square	SEMI ACTUATED-UNCOORDINATED	Overall		C	33.5	0.82			D	51.7	0.96			E	61	1.02		
		EB-LTR	370'	F	100.5	1.07	~237'	#321'	F	193	1.31	~299'	#382'	F	243	1.43	~316'	#400'
		WB-LT	180'	B	13.3	0.63	112'	126'	B	14.4	0.68	120'	134'	B	15.2	0.71	122'	136'
		WB-R	65'	A	7	0.22	21'	32'	A	6.9	0.24	24'	34'	A	6.6	0.24	23'	33'
		NB-LT	710'	C	24.3	0.46	130'	168'	C	25	0.5	142'	181'	C	25	0.5	142'	181'
		NB-R	80'	B	18.8	0.07	0'	0'	B	18.9	0.08	0'	0'	B	18.9	0.08	0'	0'
		SB-L	90'	C	24.9	0.4	56'	89'	C	26.6	0.46	62'	97'	C	26.6	0.46	62'	97'
		SB-TR	550'	C	24.1	0.46	127'	165'	C	24.8	0.49	139'	177'	C	24.8	0.49	139'	177'
Main Street & Church Square/Pleasant Street	SEMI ACTUATED-UNCOORDINATED	Overall		C	24.1	0.88			C	25.2	0.95			C	25.5	0.96		
		EB-LTR	180'	B	12.4	0.61	105'	m115'	B	12.6	0.67	114'	m112'	B	12.3	0.68	115'	m109'
		WB-LTR	±2000'	C	32.3	0.66	216'	310'	C	34	0.71	235'	336'	D	35.2	0.73	247'	352'
		NB-L	55'	C	20.6	0.16	16'	40'	C	21.1	0.18	17'	43'	C	21.1	0.18	17'	43'
		NB-TR	630'	C	21.7	0.31	83'	136'	C	22.1	0.34	90'	145'	C	22.1	0.34	90'	145'
		SB-LTR	570'	C	30.1	0.68	209'	310'	C	32.1	0.73	230'	340'	C	32.1	0.73	230'	340'
Dean Avenue & Pleasant Street	UN SIGNALIZED	EB-TR		-	-	-			-	-	-			-	-	-		
		WB-LT		A	8.3	0.032		3'	A	8.4	0.035		3'	A	8.4	0.04		3'
		NB-LR		A	0	-			A	0	-			A	0	-		
Pleasant Street & Padden Road	UN SIGNALIZED	EB-LT		A	8.3	0.008		0'	A	8.4	0.01		0'	A	8.4	0.01		0'
		WB-TR		-	-	-			-	-	-			-	-	-		
		SB-LR		B	12.9	0.058		5'	B	13.4	0.063		5'	B	13.7	0.066		5'
Site Driveway & Pleasant Street	UN SIGNALIZED	EB-TR												-	-	-		
		WB-LT		A	8.4	0.04			A	0	-			A	8.4	0.04		0'
		NB-LR		C	16.7	0.105			C	16.7	0.105			C	16.7	0.105		8'

**TABLE 3
 CAPACITY ANALYSIS SUMMARY - WEEKDAY P.M. PEAK HOUR**

INTERSECTION	CONTROL TYPE	LANE USE	STORAGE LENGTH (ft)	2022 EXISTING PM PEAK HOUR					2029 NO BUILD PM PEAK HOUR					2029 BUILD PM PEAK HOUR				
				LOS	DELAY (sec)	V/C RATIO	QUEUES (ft)	QUEUES (ft)	LOS	DELAY (sec)	V/C RATIO	QUEUES (ft)	QUEUES (ft)	LOS	DELAY (sec)	V/C RATIO	QUEUES (ft)	QUEUES (ft)
							50th%	95th%				50th%	95th%				50th%	95th%
Union Street/Daniel McCahill Street & Beaver Street/Church Square	SEMI ACTUATED-UNCOORDINATED	Overall		D	43.2	0.7			E	78.3	0.86			F	88	0.9		
		EB-LTR	370'	F	111.9	1.11	~288'	#473'	F	233.7	1.41	~365'	#555'	F	266.7	1.49	~382'	#574'
		WB-LT	180'	B	14.2	0.67	115'	237'	B	15.5	0.73	124'	445'	B	16	0.75	124'	476'
		WB-R	65'	A	8	0.07	4'	m8'	A	7.4	0.07	4'	m8'	A	7.2	0.07	4'	m7'
		NB-LT	710'	C	20.6	0.23	60'	105'	C	20.8	0.24	64'	111'	C	20.8	0.24	64'	111'
		NB-R	80'	B	18.7	0.06	0'	0'	B	18.7	0.06	0'	0'	B	18.8	0.06	0'	0'
		SB-L	90'	C	20	0.16	29'	60'	C	20.2	0.18	31'	64'	C	20.2	0.18	31'	64'
		SB-TR	550'	C	20.3	0.2	52'	95'	C	20.5	0.22	56'	100'	C	20.5	0.22	56'	100'
Main Street & Church Square/Pleasant Street	SEMI ACTUATED-UNCOORDINATED	Overall		C	24.2	1.02			C	25.2	1.11			C	24.9	1.12		
		EB-LTR	180'	B	12.3	0.77	86'	m88'	B	11.2	0.83	93'	m81'	B	10	0.85	96'	m82'
		WB-LTR	±2000'	C	33.2	0.68	221'	327'	D	35.4	0.74	242'	357'	D	36.1	0.75	248'	366'
		NB-L	55'	C	21.3	0.2	19'	46'	C	22	0.23	21'	50'	C	22	0.23	21'	50'
		NB-TR	630'	C	23	0.4	113'	182'	C	23.6	0.43	124'	196'	C	23.6	0.43	124'	196'
		SB-LTR	570'	C	31.3	0.71	227'	347'	C	34.1	0.77	252'	#390'	C	34.1	0.77	252'	#390'
Dean Avenue & Pleasant Street	UN SIGNALIZED	EB-TR		-	-	-			-	-	-			-	-	-		
		WB-LT		A	8.2	0.042		3'	A	8.3	0.046		3'	A	8.4	0.049		5'
		NB-LR		A	0	-			A	0	-			A	0	-		
Pleasant Street & Padden Road	UN SIGNALIZED	EB-LT		A	8.4	0.008		0'	A	8.5	0.009		0'	A	8.6	0.09		0'
		WB-TR		-	-	-			-	-	-			-	-	-		
		SB-LR		B	13	0.023		3'	B	13.4	0.026		3'	B	13.6	0.027		3'
Site Driveway & Pleasant Street	UN SIGNALIZED	EB-TR												-	-	-		
		WB-LT		A	8.4	0.011			A	0	-			A	0	-		0'
		NB-LR		C	17.5	0.064			C					C				5'

TABLE 4 CAPACITY ANALYSIS SUMMARY - PROPOSED OPTIMIZATION													
INTERSECTION	CONTROL TYPE	LANE USE	STORAGE LENGTH (ft)	2029 BUILD AM PEAK HOUR - WITH OPT					2029 BUILD PM PEAK HOUR - WITH OPT				
				LOS	DELAY (sec)	V/C RATIO	QUEUES (ft)		LOS	DELAY (sec)	V/C RATIO	QUEUES (ft)	
							50th%	95th%				50th%	95th%
Union Street/Daniel McCahill Street & Beaver Street/Church Square	SEMI ACTUATED-UNCOORDINATED	Overall		C	22.2	0.75			B	19.3	0.64		
		EB-LTR	370'	D	36.1	0.79	196'	249'	C	24.3	0.58	205'	303'
		WB-LT	180'	B	15.4	0.71	122'	136'	B	16.5	0.75	124'	440'
		WB-R	65'	A	6.7	0.28	23'	33'	A	7.2	0.12	4'	m12'
		NB-LT	710'	C	25	0.5	142'	181'	C	20.8	0.24	64'	111'
		NB-R	80'	B	18.9	0.18	0'	7'	B	18.8	0.15	0'	10'
		SB-L	90'	C	26.6	0.46	62'	97'	C	20.2	0.18	31'	64'
		SB-TR	550'	C	24.8	0.5	139'	177'	C	20.5	0.23	56'	100'
Main Street & Church Square/Pleasant Street	SEMI ACTUATED-UNCOORDINATED	Overall		C	23	0.84			C	25.7	0.99		
		EB-LTR	180'	B	14.1	0.68	115'	m184'	C	21.4	0.86	336'	543'
		WB-LTR	±2000'	C	24.1	0.57	212'	302'	C	24.3	0.58	212'	311'
		NB-L	55'	C	21.1	0.18	17'	43'	C	22	0.23	21'	50'
		NB-TR	630'	C	22.1	0.34	90'	145'	C	23.6	0.43	124'	196'
		SB-LTR	570'	C	32.1	0.74	230'	340'	C	34.1	0.78	252'	#390'

5.0 SAFETY ANALYSIS

5.1 Crash Analysis

Langan obtained the most recent five years (2018 to 2022) of accident data from the MassDOT Crash Portal at the study intersections. **Table 5** provides a summary of the accident data. A total of 19 accidents occurred over the five year period. It was determined that none of the intersections had more than two accidents per year. In addition, we evaluated the crash rate at each intersection and found that none of the intersections have a crash rate greater than the district's and statewide average rates.

Accidents included angle collisions, rear-ends, head-on collisions, sideswipe (same direction), and fixed object/ single vehicle crashes, two (11%) of the reported accidents included injuries and no fatalities were reported. The majority of accidents occurred during dry weather conditions (89%) and during daylight hours (68%). Appendix I includes the crash data and the crash rate worksheets.

TABLE 5 ACCIDENT DATA SUMMARY (2018 - 2022)										
INTERSECTION	NUMBER OF ACCIDENTS		CRASH RATE	SEVERITY			CONDITIONS			
	Total	Avg. Per Year	MEV ¹	Property Damage Only	Personal Injury	Fatality	Clear (Dry)	Rain/Snow	Day	Night
(1) Beaver St & Union St	5	1.0	0.17	4 (80%)	1 (20%)	0 (0%)	5 (100%)	0 (0%)	3 (0%)	2 (40%)
(2) Pleasant St & Main St	10	2.0	0.3	9 (90%)	1 (10%)	0 (0%)	9 (90%)	1 (10%)	7 (70%)	3 (30%)
(3) Pleasant St & Dean Ave	0	0.0	0.0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
(4) Pleasant St & Padden Rd	4	0.8	0.2	4 (100%)	0 (0%)	0 (0%)	3 (75%)	1 (25%)	3 (75%)	1 (25%)
TOTAL	19	3.8	N/A	17 (89%)	2 (11%)	0 (0%)	17 (89%)	2 (11%)	13 (68%)	6 (32%)

1. Crash rate per million entering vehicles

5.2 Sight Distance

Langan evaluated the sight distances at the proposed site driveway on Pleasant Street to determine if the available sight distances meet with minimum requirements established by the by the American Association of State Highway and Transportation Officials (AASHTO) as outlined in A Policy on Geometric Design of Highways and Streets, 7th Edition (also known as the AASHTO Green Book). In order to evaluate the sight distance we collected speed data along two segments of Pleasant Street north and south of Padden Road and determined an 85th percentile speed of 40 MPH for the roadway segments evaluated, which confirms that speed behaviors are typical based on the 35 MPH posted speed limit. As shown in Table 6, the intersection sight distances (ISDs) provided at the proposed driveway meet AASHTO minimum requirements. Appendix A includes plans showing the sight triangles at the project driveways.

TABLE 6				
INTERSECTION SIGHT DISTANCE SUMMARY				
LOCATION	85th Percentile Speed²	Required SSD¹	ISD	
			Passenger Car³	
			Required	Provided
Pleasant Street Site Driveways (unsignalized)				
Right Turn from Stop	40 mph	305 ft	385 ft	>385 ft
Left Turn from Stop		305 ft	445 ft	445 ft

1. - Based on Table 3.2 of AASHTO Greenbook 7 Ed.

2. - Based on speed data collected along Pleasant Street.

3.- Based on Tables 9.7 & 9.9 of AASHTO Greenbook 7 Ed.

6.0 PARKING DEMAND ANALYSIS

Langan estimated the parking demand for the proposed residential development with 64 units using parking generation data contained in the *Parking Generation Manual*, 5th Edition, published by the Institute of Transportation Engineers (ITE), Land Use Code 223 – Affordable Housing – based on Income Limits.

The resulting weekday parking generation calculations indicate that the proposed development would have a peak parking demand of 63 spaces and this peak demand would occur between 11:00 PM and 6:00 AM. The site is proposed to include 102 parking spaces, thus ample parking will be provided.

**TABLE 7
 ITE PARKING DEMAND SUMMARY**

USE	LUC ¹	SIZE	ITE WEEKDAY AVERAGE PARKING RATE	ITE WEEKEND AVERAGE PARKING RATE	PARKING DEMAND ³	
					WEEKDAY	WEEKEND
Affordable Housing	223	64 DU ²	0.99 Spaces per DU	0.96 Spaces per DU	63	61
Expected Average Parking Demand					63	61

1. - Land Use Code based in ITE Parking Manual.
2. - Dwelling Units.
3. - Parking Spaces.

7.0 CONCLUSIONS

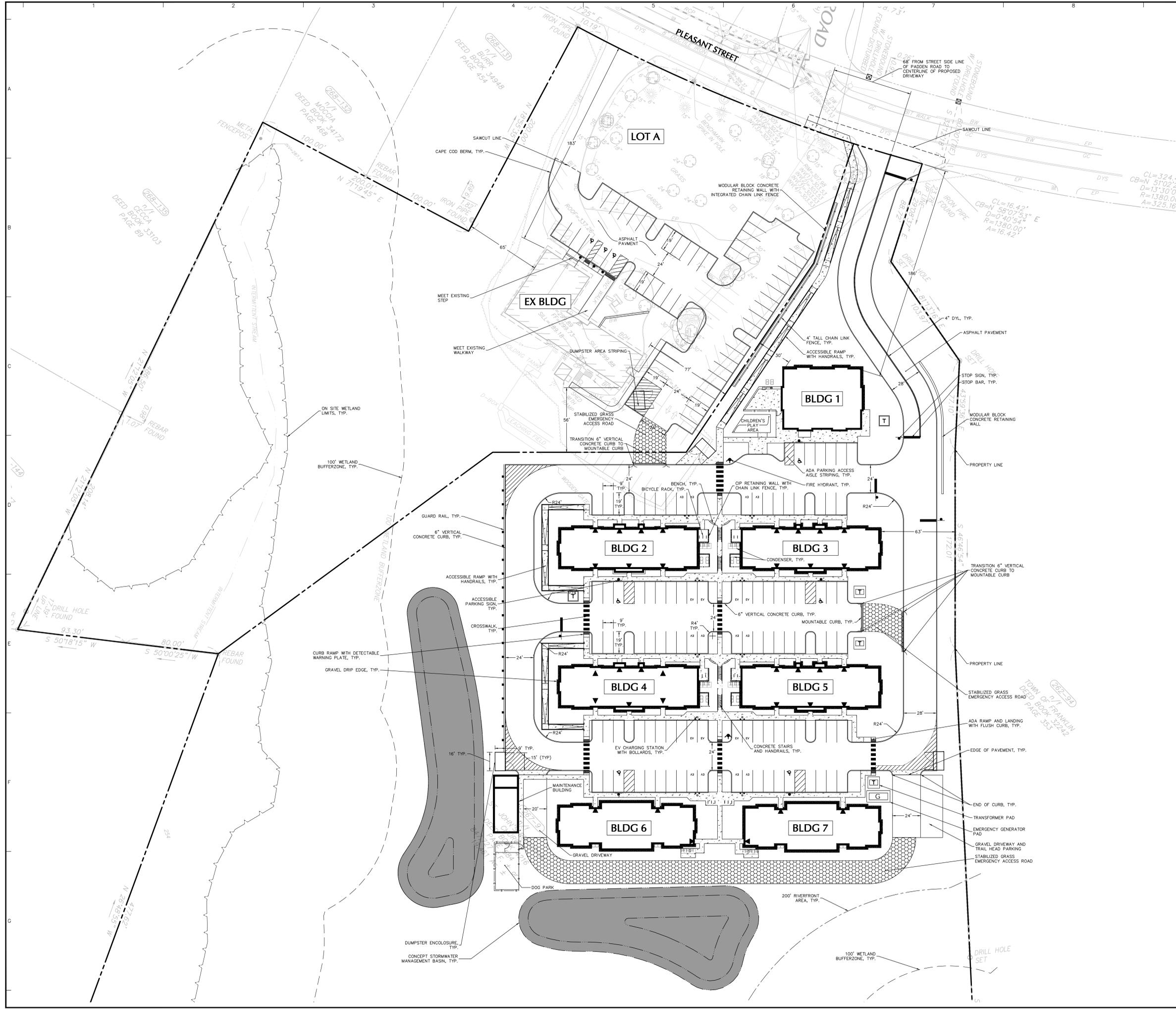
This traffic impact assessment identifies the potential traffic impacts generated by the proposed affordable housing development at 237 Pleasant Street on the surrounding area roadway network. We performed a capacity analysis for the existing, background, and build scenarios for the four intersections expected to be most impacted by the development and found that the existing roadway infrastructure is adequate to support the nominal increase in traffic volume generated by the proposed warehouse development. No improvements to the study intersections are required or recommended at this time; signal-timing optimization should be considered at the intersections of Union Street/Daniel McCahill Street & Beaver Street/Church Square and Main Street & Church Square/Pleasant Street to improve delay and queues of specific approaches in the future as needed. All proposed driveways are expected to operate at an acceptable LOS.

The analysis of the most recent five years of crash data at the study intersections shows that the occurred accidents included various types of crashes (angle collisions, rear-ends, head-on collisions, sideswipe, and fixed object/ single vehicle crashes), which are behaviors typical for the roadway networks such as the Pleasant Street corridor. None of the accidents resulted in fatalities.

APPENDIX A

Preliminary Site Plan

ZONING TABLE			
ZONE: SINGLE-FAMILY RESIDENTIAL III			
USE: MULTIFAMILY OR APARTMENT (6.1)			
MIN. LOT AREA	20,000 SF	PROPOSED LOT A ±188,550 SF	PROPOSED LOT B ±659,200 SF
MIN. LOT FRONTAGE	125 FT	±257 FT	±61 FT
MIN. LOT DEPTH	160 FT	>160 FT	>160 FT
MIN. LOT WIDTH	112.50 FT	>112.5 FT	±61 FT
MIN. FRONT YARD	40 FT	±177 FT	±186 FT
MIN. SIDE YARD	25 FT	±65 FT	±27 FT
MIN. REAR YARD	30 FT	±62 FT	±442 FT
MAX BLDG. HEIGHT	35 FT	N/A	33.7 FT
MAX BLDG. STORIES	3	N/A	3
MAX BLDG. AREA	25%	±2.8%	±4.8%
MAX BLDG. + PAVEMENT AREA	35%	±13.1%	±15.7%
OFF-STREET PARKING	2 PER DWELLING UNIT	53 SPACES	102 SPACES [1.5 PER DWELLING UNIT (96) + 1 PER 500 GSA OF COMMUNITY BUILDING (6)]
PARKING SPACE DIM.	9 FT X 19 FT	9 FT X 19 FT	9 FT X 19 FT



Date	Description	No.
01/11/2023	PEER REVIEW COMMENTS	2
11/23/2022	STORMWATER REPORT	1

Revisions



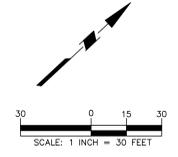
LANGAN
 Langan Engineering and Environmental Services, Inc.
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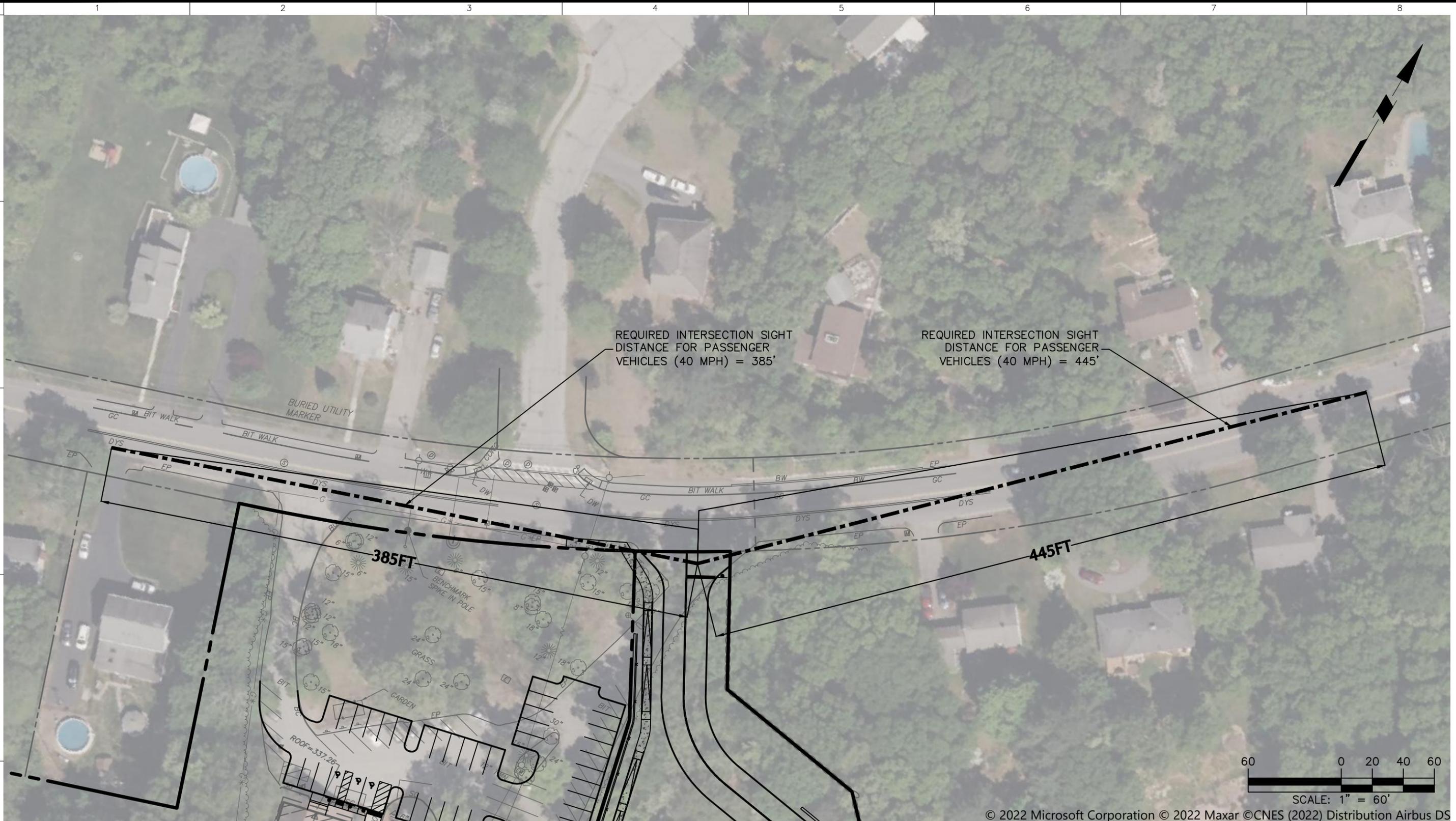
Project
237 PLEASANT STREET CONCEPT PLANS

NORFOLK COUNTY FRANKLIN MASSACHUSETTS
 Drawing Title

SITE PLAN

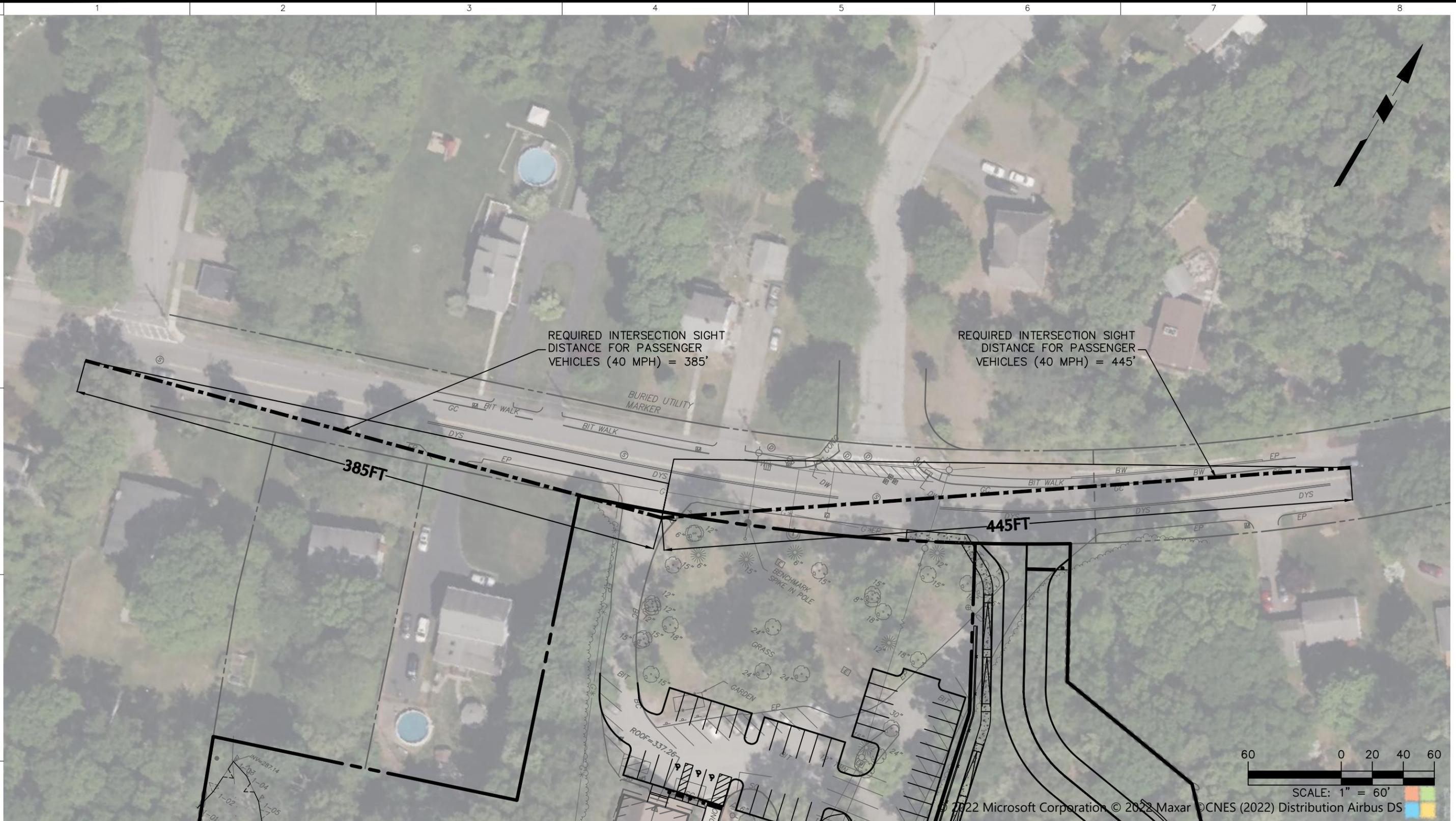
Project No. 151019602	Drawing No. CS100
Date 09/10/2022	Checked By KH
Drawn By KH	Checked By PH





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<p>LANGAN Langan Engineering and Environmental Services, Inc. 100 Cambridge Street, Suite 1310 Boston, MA 02114 T: 617.824.9100 F: 617.824.9101 www.langan.com</p>	Project	Drawing Title	Project No.	Drawing No.
	237 PLEASANT STREET	SIGHT DISTANCE PLAN	151019602	KT101
	FRANKLIN NORFOLK COUNTY MASSACHUSETTS		Date	
			01/12/2023	
			Drawn By	
			JSP	
			Checked By	
			MGP	

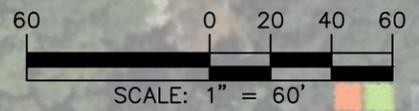


REQUIRED INTERSECTION SIGHT
DISTANCE FOR PASSENGER
VEHICLES (40 MPH) = 385'

REQUIRED INTERSECTION SIGHT
DISTANCE FOR PASSENGER
VEHICLES (40 MPH) = 445'

385FT

445FT



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<p>LANGAN Langan Engineering and Environmental Services, Inc. 100 Cambridge Street, Suite 1310 Boston, MA 02114 T: 617.824.9100 F: 617.824.9101 www.langan.com</p>	Project	Drawing Title	Project No.	Drawing No.
	237 PLEASANT STREET	SIGHT DISTANCE PLAN	151019602	KT102
	FRANKLIN NORFOLK COUNTY MASSACHUSETTS		Date	
			01/12/2023	
			Drawn By	
			JSP	
			Checked By	
			MGP	

APPENDIX B

Traffic Data, Seasonal Factors & Growth Rates

INT #1
Traffic Counts

Approach Name	Daniel McCahill St				Church Square				Union St				Beaver St				Data Date
Approach Direction	Southbound				Westbound				Northbound				Eastbound				12/8/2022
Start Time	Left	Through	Right	Total	Left	Through	Right	Total	Left	Through	Right	Total	Left	Through	Right	Total	
7:00 AM	18	38	14	70	8	71	46	125	2	68	19	89	8	44	3	55	
7:15 AM	29	60	19	108	7	75	62	144	4	89	22	115	6	52	1	59	
7:30 AM	28	43	11	82	15	77	20	112	3	15	22	40	6	64	3	73	
7:45 AM	15	20	3	38	8	86	14	108	7	16	10	33	1	55	3	59	
8:00 AM	12	20	2	34	13	88	20	121	3	30	14	47	4	72	3	79	
8:15 AM	35	38	18	91	12	91	24	127	2	15	16	33	5	46	0	51	
8:30 AM	18	21	6	45	12	87	17	116	1	27	14	42	1	55	0	56	
8:45 AM	13	22	4	39	20	63	17	100	10	18	18	46	7	59	4	70	
9:00 AM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Total	168	262	77	507	95	638	220	953	32	278	135	445	38	447	17	502	

Trucks	1	4	0	5	1	9	1	11	0	4	5	9	0	22	4	26
% Trucks	0.6%	1.5%	0.0%	1.0%	1.1%	1.4%	0.5%	1.2%	0.0%	1.4%	3.7%	2.0%	0.0%	4.9%	23.5%	5.2%
Buses	2	3	0	5	2	8	2	12	0	5	1	6	2	10	0	12
%Buses	1.2%	1.1%	0.0%	1.0%	2.1%	1.3%	0.9%	1.3%	0.0%	1.8%	0.7%	1.3%	5.3%	2.2%	0.0%	2.4%
Total HV	3	7	0	10	3	17	3	23	0	9	6	15	2	32	4	38
Total % HV	2%	3%	0%	2%	3%	3%	1%	2%	0%	3%	4%	3%	5%	7%	24%	8%

Peak Hour	Daniel McCahill St				Church Square				Union St				Beaver St				Time Period
Hourly Total	Southbound				Westbound				Northbound				Eastbound				
	Left	Through	Right	Total	Left	Through	Right	Total	Left	Through	Right	Total	Left	Through	Right	Total	
1310	90	161	47	298	38	309	142	489	16	188	73	277	21	215	10	246	7:00 AM to 8:00 AM
1252	84	143	35	262	43	326	116	485	17	150	68	235	17	243	10	270	7:15 AM to 8:15 AM
1128	90	121	34	245	48	342	78	468	15	76	62	153	16	237	9	262	7:30 AM to 8:30 AM
1080	80	99	29	208	45	352	75	472	13	88	54	155	11	228	6	245	7:45 AM to 8:45 AM
1097	78	101	30	209	57	329	78	464	16	90	62	168	17	232	7	256	8:00 AM to 9:00 AM
816	66	81	28	175	44	241	58	343	13	60	48	121	13	160	4	177	8:15 AM to 9:15 AM
514	31	43	10	84	32	150	34	216	11	45	32	88	8	114	4	126	8:30 AM to 9:30 AM
255	13	22	4	39	20	63	17	100	10	18	18	46	7	59	4	70	8:45 AM to 9:45 AM
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9:00 AM to 10:00 AM

Roadway Peak Hour						
7:00 AM	70	125	89	55	7:00 AM to 8:00 AM	
7:15 AM	108	144	115	59		
7:30 AM	82	112	40	73		
7:45 AM	38	108	33	59		
Peak Hour Total	298	489	277	246	1310	
PHF	0.69	0.85	0.60	0.84	0.77	

User Selected Peak Hour						
7:00 AM	70	125	89	55	7:00 AM to 8:00 AM	
7:15 AM	108	144	115	59		
7:30 AM	82	112	40	73		
7:45 AM	38	108	33	59		
Peak Hour Total	298	489	277	246	1310	
PHF	0.69	0.85	0.60	0.84	0.77	

INT #1
Traffic Counts

Approach Name	Daniel McCahill St				Church Square				Union St				Beaver St				Data Date
Approach Direction	Southbound				Westbound				Northbound				Eastbound				12/8/2022
Start Time	Left	Through	Right	Total	Left	Through	Right	Total	Left	Through	Right	Total	Left	Through	Right	Total	
4:00 PM	18	24	6	48	15	102	21	138	4	27	11	42	2	74	8	84	
4:15 PM	19	27	2	48	16	106	29	151	3	25	21	49	1	74	7	82	
4:30 PM	18	28	11	57	14	101	17	132	3	30	15	48	4	73	5	82	
4:45 PM	15	19	7	41	21	91	19	131	5	31	17	53	0	99	5	104	
5:00 PM	13	26	3	42	17	90	14	121	6	28	21	55	1	94	3	98	
5:15 PM	18	20	5	43	15	107	19	141	2	23	25	50	1	77	2	80	
5:30 PM	11	22	2	35	10	97	13	120	2	23	13	38	5	75	2	82	
5:45 PM	14	20	5	39	5	113	16	134	3	29	30	62	9	79	1	89	
6:00 PM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Total	126	186	41	353	113	807	148	1068	28	216	153	397	23	645	33	701	

Trucks	0	1	0	1	2	7	0	9	0	0	1	1	0	3	0	3
% Trucks	0.0%	0.5%	0.0%	0.3%	1.8%	0.9%	0.0%	0.8%	0.0%	0.0%	0.7%	0.3%	0.0%	0.5%	0.0%	0.4%
Buses	0	0	0	0	0	2	4	6	0	0	0	0	0	1	0	1
%Buses	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	2.7%	0.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.1%
Total HV	0	1	0	1	2	9	4	15	0	0	1	1	0	4	0	4
Total % HV	0%	1%	0%	0%	2%	1%	3%	1%	0%	0%	1%	0%	0%	1%	0%	1%

Hourly Total	Daniel McCahill St				Church Square				Union St				Beaver St				Time Period
	Southbound				Westbound				Northbound				Eastbound				
	Left	Through	Right	Total	Left	Through	Right	Total	Left	Through	Right	Total	Left	Through	Right	Total	
1290	70	98	26	194	66	400	86	552	15	113	64	192	7	320	25	352	4:00 PM to 5:00 PM
1294	65	100	23	188	68	388	79	535	17	114	74	205	6	340	20	366	4:15 PM to 5:15 PM
1278	64	93	26	183	67	389	69	525	16	112	78	206	6	343	15	364	4:30 PM to 5:30 PM
1234	57	87	17	161	63	385	65	513	15	105	76	196	7	345	12	364	4:45 PM to 5:45 PM
1229	56	88	15	159	47	407	62	516	13	103	89	205	16	325	8	349	5:00 PM to 6:00 PM
913	43	62	12	117	30	317	48	395	7	75	68	150	15	231	5	251	5:15 PM to 6:15 PM
599	25	42	7	74	15	210	29	254	5	52	43	100	14	154	3	171	5:30 PM to 6:30 PM
324	14	20	5	39	5	113	16	134	3	29	30	62	9	79	1	89	5:45 PM to 6:45 PM
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6:00 PM to 7:00 PM

Roadway Peak Hour						
4:15 PM	48	151	49	82	4:15 PM to 5:15 PM	
4:30 PM	57	132	48	82		
4:45 PM	41	131	53	104		
5:00 PM	42	121	55	98		
Peak Hour Total	188	535	205	366	1294	
PHF	0.82	0.89	0.93	0.88	0.98	

User Selected Peak Hour						
4:15 PM	48	151	49	82	4:15 PM to 5:15 PM	
4:30 PM	57	132	48	82		
4:45 PM	41	131	53	104		
5:00 PM	42	121	55	98		
Peak Hour Total	188	535	205	366	1294	
PHF	0.82	0.89	0.93	0.88	0.98	

INT #2
Traffic Counts

Approach Name	Main St				Pleasant St				Main St				Church Square				Data Date
Approach Direction	Southbound				Westbound				Northbound				Eastbound				12/8/2022
Start Time	Left	Through	Right	Total	Left	Through	Right	Total	Left	Through	Right	Total	Left	Through	Right	Total	
7:00 AM	6	50	26	82	1	82	1	84	6	38	2	46	19	60	5	84	
7:15 AM	10	57	29	96	0	102	1	103	17	42	3	62	24	67	4	95	
7:30 AM	10	49	23	82	1	70	1	72	5	36	4	45	27	73	13	113	
7:45 AM	4	57	26	87	2	71	2	75	5	33	4	42	23	46	12	81	
8:00 AM	3	63	41	107	0	68	2	70	6	37	3	46	40	42	13	95	
8:15 AM	4	50	45	99	1	82	3	86	5	30	4	39	26	51	18	95	
8:30 AM	1	55	29	85	2	78	1	81	4	37	6	47	20	52	15	87	
8:45 AM	1	33	33	67	3	61	1	65	4	27	6	37	21	48	14	83	
9:00 AM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Total	39	414	252	705	10	614	12	636	52	280	32	364	200	439	94	733	

Trucks	3	5	1	9	0	18	4	22	0	8	0	8	6	27	1	34
% Trucks	7.7%	1.2%	0.4%	1.3%	0.0%	2.9%	33.3%	3.5%	0.0%	2.9%	0.0%	2.2%	3.0%	6.2%	1.1%	4.6%
Buses	3	1	3	7	0	8	1	9	1	2	0	3	2	9	2	13
%Buses	7.7%	0.2%	1.2%	1.0%	0.0%	1.3%	8.3%	1.4%	1.9%	0.7%	0.0%	0.8%	1.0%	2.1%	2.1%	1.8%
Total HV	6	6	4	16	0	26	5	31	1	10	0	11	8	36	3	47
Total % HV	15%	1%	2%	2%	0%	4%	42%	5%	2%	4%	0%	3%	4%	8%	3%	6%

Hourly Total	Main St				Pleasant St				Main St				Church Square				Time Period	
	Southbound				Westbound				Northbound				Eastbound					
	Left	Through	Right	Total	Left	Through	Right	Total	Left	Through	Right	Total	Left	Through	Right	Total		
1249	30	213	104	347	4	325	5	334	33	149	13	195	93	246	34	373	7:00 AM to 8:00 AM	
1271	27	226	119	372	3	311	6	320	33	148	14	195	114	228	42	384	7:15 AM to 8:15 AM	
1234	21	219	135	375	4	291	8	303	21	136	15	172	116	212	56	384	7:30 AM to 8:30 AM	
1222	12	225	141	378	5	299	8	312	20	137	17	174	109	191	58	358	7:45 AM to 8:45 AM	
1189	9	201	148	358	6	289	7	302	19	131	19	169	107	193	60	360	8:00 AM to 9:00 AM	
871	6	138	107	251	6	221	5	232	13	94	16	123	67	151	47	265	8:15 AM to 9:15 AM	
552	2	88	62	152	5	139	2	146	8	64	12	84	41	100	29	170	8:30 AM to 9:30 AM	
252	1	33	33	67	3	61	1	65	4	27	6	37	21	48	14	83	8:45 AM to 9:45 AM	
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9:00 AM to 10:00 AM	

Roadway Peak Hour						
7:15 AM	96	103	62	95	7:15 AM to 8:15 AM	
7:30 AM	82	72	45	113		
7:45 AM	87	75	42	81		
8:00 AM	107	70	46	95		
Peak Hour Total	372	320	195	384	1271	
PHF	0.87	0.78	0.79	0.85	0.89	

User Selected Peak Hour						
7:00 AM	82	84	46	84	7:00 AM to 8:00 AM	
7:15 AM	96	103	62	95		
7:30 AM	82	72	45	113		
7:45 AM	87	75	42	81		
Peak Hour Total	347	334	195	373	1249	
PHF	0.90	0.81	0.79	0.83	0.88	

INT #2
Traffic Counts

Approach Name	Main St				Pleasant St				Main St				Church Square				Data Date 12/8/2022
Approach Direction	Southbound				Westbound				Northbound				Eastbound				
Start Time	Left	Through	Right	Total	Left	Through	Right	Total	Left	Through	Right	Total	Left	Through	Right	Total	
4:00 PM	2	68	39	109	8	86	4	98	8	52	5	65	33	63	15	111	
4:15 PM	3	67	43	113	4	92	1	97	10	43	5	58	40	58	15	113	
4:30 PM	9	57	33	99	3	89	2	94	15	41	4	60	35	72	7	114	
4:45 PM	10	58	27	95	3	79	3	85	10	63	10	83	37	91	9	137	
5:00 PM	3	63	30	96	5	78	6	89	6	59	4	69	48	66	8	122	
5:15 PM	5	77	31	113	2	97	5	104	8	42	5	55	36	65	18	119	
5:30 PM	4	58	23	85	7	84	1	92	11	58	9	78	33	71	9	113	
5:45 PM	5	47	37	89	5	80	1	86	14	55	5	74	43	70	7	120	
6:00 PM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Total	41	495	263	799	37	685	23	745	82	413	47	542	305	556	88	949	

Trucks	0	3	4	7	0	12	0	12	0	6	0	6	6	5	1	12
% Trucks	0.0%	0.6%	1.5%	0.9%	0.0%	1.8%	0.0%	1.6%	0.0%	1.5%	0.0%	1.1%	2.0%	0.9%	1.1%	1.3%
Buses	0	0	2	2	0	3	0	3	0	0	0	0	0	1	0	1
%Buses	0.0%	0.0%	0.8%	0.3%	0.0%	0.4%	0.0%	0.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.1%
Total HV	0	3	6	9	0	15	0	15	0	6	0	6	6	6	1	13
Total % HV	0%	1%	2%	1%	0%	2%	0%	2%	0%	1%	0%	1%	2%	1%	1%	1%

Hourly Total	Main St				Pleasant St				Main St				Church Square				Time Period	
	Southbound				Westbound				Northbound				Eastbound					
	Left	Through	Right	Total	Left	Through	Right	Total	Left	Through	Right	Total	Left	Through	Right	Total		
1531	24	250	142	416	18	346	10	374	43	199	24	266	145	284	46	475	4:00 PM	to 5:00 PM
1524	25	245	133	403	15	338	12	365	41	206	23	270	160	287	39	486	4:15 PM	to 5:15 PM
1534	27	255	121	403	13	343	16	372	39	205	23	267	156	294	42	492	4:30 PM	to 5:30 PM
1535	22	256	111	389	17	338	15	370	35	222	28	285	154	293	44	491	4:45 PM	to 5:45 PM
1504	17	245	121	383	19	339	13	371	39	214	23	276	160	272	42	474	5:00 PM	to 6:00 PM
1128	14	182	91	287	14	261	7	282	33	155	19	207	112	206	34	352	5:15 PM	to 6:15 PM
737	9	105	60	174	12	164	2	178	25	113	14	152	76	141	16	233	5:30 PM	to 6:30 PM
369	5	47	37	89	5	80	1	86	14	55	5	74	43	70	7	120	5:45 PM	to 6:45 PM
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6:00 PM	to 7:00 PM

Roadway Peak Hour								
4:45 PM	95		85		83		137	4:45 PM to 5:45 PM
5:00 PM	96		89		69		122	
5:15 PM	113		104		55		119	
5:30 PM	85		92		78		113	
Peak Hour Total	389		370		285		491	1535
PHF	0.86		0.89		0.86		0.90	0.96

User Selected Peak Hour								
4:15 PM	113		97		58		113	4:15 PM to 5:15 PM
4:30 PM	99		94		60		114	
4:45 PM	95		85		83		137	
5:00 PM	96		89		69		122	
Peak Hour Total	403		365		270		486	1524
PHF	0.89		0.94		0.81		0.89	0.95

INT #3
Traffic Counts

Approach Name					Pleasant St				Dean Ave				Pleasant St				Data Date
Approach Direction	Southbound				Westbound				Northbound				Eastbound				12/8/2022
Start Time	Left	Through	Right	Total	Left	Through	Right	Total	Left	Through	Right	Total	Left	Through	Right	Total	
7:00 AM	-	-	-	-	9	88	-	97	10	-	7	17	-	74	1	75	
7:15 AM	-	-	-	-	3	96	-	99	2	-	10	12	-	91	5	96	
7:30 AM	-	-	-	-	9	72	-	81	4	-	7	11	-	94	1	95	
7:45 AM	-	-	-	-	8	75	-	83	3	-	11	14	-	63	1	64	
8:00 AM	-	-	-	-	17	83	-	100	6	-	6	12	-	45	2	47	
8:15 AM	-	-	-	-	6	84	-	90	4	-	4	8	-	66	2	68	
8:30 AM	-	-	-	-	5	70	-	75	8	-	7	15	-	62	1	63	
8:45 AM	-	-	-	-	10	66	-	76	2	-	3	5	-	55	2	57	
9:00 AM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Total	0	0	0	0	67	634	0	701	39	0	55	94	0	550	15	565	

Trucks	-	-	-	-	2	16	-	18	0	-	1	1	-	30	1	31
% Trucks	#N/A	#N/A	#N/A	#N/A	3.0%	2.5%	#N/A	2.6%	0.0%	#N/A	1.8%	1.1%	#N/A	5.5%	6.7%	5.5%
Buses	-	-	-	-	0	8	-	8	0	-	0	0	-	12	0	12
%Buses	#N/A	#N/A	#N/A	#N/A	0.0%	1.3%	#N/A	1.1%	0.0%	#N/A	0.0%	0.0%	#N/A	2.2%	0.0%	2.1%
Total HV	-	-	-	-	2	24	-	26	0	-	1	1	-	42	1	43
Total % HV	#N/A	#N/A	#N/A	#N/A	3%	4%	#N/A	4%	0%	#N/A	2%	1%	#N/A	8%	7%	8%

Peak Hour					Pleasant St				Dean Ave				Pleasant St				Time Period
	Southbound				Westbound				Northbound				Eastbound				
Hourly Total	Left	Through	Right	Total	Left	Through	Right	Total	Left	Through	Right	Total	Left	Through	Right	Total	
744	0	0	0	0	29	331	0	360	19	0	35	54	0	322	8	330	7:00 AM to 8:00 AM
714	0	0	0	0	37	326	0	363	15	0	34	49	0	293	9	302	7:15 AM to 8:15 AM
673	0	0	0	0	40	314	0	354	17	0	28	45	0	268	6	274	7:30 AM to 8:30 AM
639	0	0	0	0	36	312	0	348	21	0	28	49	0	236	6	242	7:45 AM to 8:45 AM
616	0	0	0	0	38	303	0	341	20	0	20	40	0	228	7	235	8:00 AM to 9:00 AM
457	0	0	0	0	21	220	0	241	14	0	14	28	0	183	5	188	8:15 AM to 9:15 AM
291	0	0	0	0	15	136	0	151	10	0	10	20	0	117	3	120	8:30 AM to 9:30 AM
138	0	0	0	0	10	66	0	76	2	0	3	5	0	55	2	57	8:45 AM to 9:45 AM
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9:00 AM to 10:00 AM

Roadway Peak Hour								
7:00 AM	-	-	-	-	97	17	75	7:00 AM to 8:00 AM
7:15 AM	-	-	-	-	99	12	96	
7:30 AM	-	-	-	-	81	11	95	
7:45 AM	-	-	-	-	83	14	64	
Peak Hour Total	0	0	0	0	360	54	330	744
PHF	-	-	-	-	0.91	0.79	0.86	0.90

User Selected Peak Hour								
7:00 AM	-	-	-	-	97	17	75	7:00 AM to 8:00 AM
7:15 AM	-	-	-	-	99	12	96	
7:30 AM	-	-	-	-	81	11	95	
7:45 AM	-	-	-	-	83	14	64	
Peak Hour Total	0	0	0	0	360	54	330	744
PHF	-	-	-	-	0.91	0.79	0.86	0.90

INT #3
Traffic Counts

Approach Name	Southbound				Pleasant St Westbound				Dean Ave Northbound				Pleasant St Eastbound				Data Date
Approach Direction	Left	Through	Right	Total	Left	Through	Right	Total	Left	Through	Right	Total	Left	Through	Right	Total	12/8/2022
4:00 PM	-	-	-	-	11	90	-	101	5	-	4	9	-	74	7	81	
4:15 PM	-	-	-	-	10	107	-	117	7	-	7	14	-	62	3	65	
4:30 PM	-	-	-	-	9	85	-	94	3	-	9	12	-	82	3	85	
4:45 PM	-	-	-	-	15	99	-	114	3	-	15	18	-	92	4	96	
5:00 PM	-	-	-	-	5	113	-	118	2	-	10	12	-	79	7	86	
5:15 PM	-	-	-	-	8	103	-	111	6	-	7	13	-	73	3	76	
5:30 PM	-	-	-	-	13	90	-	103	4	-	12	16	-	82	1	83	
5:45 PM	-	-	-	-	13	89	-	102	5	-	12	17	-	80	2	82	
6:00 PM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Total	0	0	0	0	84	776	0	860	35	0	76	111	0	624	30	654	

Trucks	-	-	-	-	0	10	-	10	1	-	2	3	-	4	0	4
% Trucks	#N/A	#N/A	#N/A	#N/A	0.0%	1.3%	#N/A	1.2%	2.9%	#N/A	2.6%	2.7%	#N/A	0.6%	0.0%	0.6%
Buses	-	-	-	-	0	3	-	3	0	-	0	0	-	1	0	1
%Buses	#N/A	#N/A	#N/A	#N/A	0.0%	0.4%	#N/A	0.3%	0.0%	#N/A	0.0%	0.0%	#N/A	0.2%	0.0%	0.2%
Total HV	-	-	-	-	0	13	-	13	1	-	2	3	-	5	0	5
Total % HV	#N/A	#N/A	#N/A	#N/A	0%	2%	#N/A	2%	3%	#N/A	3%	3%	#N/A	1%	0%	1%

Hourly Total	Southbound				Pleasant St Westbound				Dean Ave Northbound				Pleasant St Eastbound				Time Period	
	Left	Through	Right	Total	Left	Through	Right	Total	Left	Through	Right	Total	Left	Through	Right	Total		
806	0	0	0	0	45	381	0	426	18	0	35	53	0	310	17	327	4:00 PM	to 5:00 PM
831	0	0	0	0	39	404	0	443	15	0	41	56	0	315	17	332	4:15 PM	to 5:15 PM
835	0	0	0	0	37	400	0	437	14	0	41	55	0	326	17	343	4:30 PM	to 5:30 PM
846	0	0	0	0	41	405	0	446	15	0	44	59	0	326	15	341	4:45 PM	to 5:45 PM
819	0	0	0	0	39	395	0	434	17	0	41	58	0	314	13	327	5:00 PM	to 6:00 PM
603	0	0	0	0	34	282	0	316	15	0	31	46	0	235	6	241	5:15 PM	to 6:15 PM
403	0	0	0	0	26	179	0	205	9	0	24	33	0	162	3	165	5:30 PM	to 6:30 PM
201	0	0	0	0	13	89	0	102	5	0	12	17	0	80	2	82	5:45 PM	to 6:45 PM
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6:00 PM	to 7:00 PM

Roadway Peak Hour								
4:45 PM	-	-	-	-	114	18	96	4:45 PM to 5:45 PM
5:00 PM	-	-	-	-	118	12	86	
5:15 PM	-	-	-	-	111	13	76	
5:30 PM	-	-	-	-	103	16	83	
Peak Hour Total	0	0	0	0	446	59	341	846
PHF	-	-	-	-	0.94	0.82	0.89	0.93

User Selected Peak Hour								
4:15 PM	-	-	-	-	117	14	65	4:15 PM to 5:15 PM
4:30 PM	-	-	-	-	94	12	85	
4:45 PM	-	-	-	-	114	18	96	
5:00 PM	-	-	-	-	118	12	86	
Peak Hour Total	0	0	0	0	443	56	332	831
PHF	-	-	-	-	0.94	0.78	0.86	0.91

INT #4
Traffic Counts

Approach Name	Padden Rd				Pleasant St								Pleasant St				Data Date
Approach Direction	Southbound				Westbound				Northbound				Eastbound				12/8/2022
Start Time	Left	Through	Right	Total	Left	Through	Right	Total	Left	Through	Right	Total	Left	Through	Right	Total	
7:00 AM	1	-	7	8	-	90	0	90	-	-	-	-	0	80	-	80	
7:15 AM	0	-	7	7	-	95	0	95	-	-	-	-	4	115	-	119	
7:30 AM	3	-	2	5	-	80	0	80	-	-	-	-	3	99	-	102	
7:45 AM	0	-	1	1	-	86	0	86	-	-	-	-	0	83	-	83	
8:00 AM	4	-	5	9	-	91	1	92	-	-	-	-	0	52	-	52	
8:15 AM	0	-	2	2	-	83	0	83	-	-	-	-	1	69	-	70	
8:30 AM	1	-	0	1	-	84	0	84	-	-	-	-	2	72	-	74	
8:45 AM	0	-	3	3	-	70	0	70	-	-	-	-	1	60	-	61	
9:00 AM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Total	9	0	27	36	0	679	1	680	0	0	0	0	11	630	0	641	

Trucks	0	-	0	0	-	15	0	15	-	-	-	-	0	31	-	31	
% Trucks	0.0%	#N/A	0.0%	0.0%	#N/A	2.2%	0.0%	2.2%	#N/A	#N/A	#N/A	#N/A	0.0%	4.9%	#N/A	4.8%	
Buses	0	-	0	0	-	9	0	9	-	-	-	-	0	14	-	14	
%Buses	0.0%	#N/A	0.0%	0.0%	#N/A	1.3%	0.0%	1.3%	#N/A	#N/A	#N/A	#N/A	0.0%	2.2%	#N/A	2.2%	
Total HV	0	-	0	0	-	24	0	24	-	-	-	-	0	45	-	45	
Total % HV	0%	#N/A	0%	0%	#N/A	4%	0%	4%	#N/A	#N/A	#N/A	#N/A	0%	7%	#N/A	7%	

Hourly Total	Padden Rd				Pleasant St								Pleasant St				Time Period	
	Left	Through	Right	Total	Left	Through	Right	Total	Left	Through	Right	Total	Left	Through	Right	Total		
756	4	0	17	21	0	351	0	351	0	0	0	0	7	377	0	384	7:00 AM	to 8:00 AM
731	7	0	15	22	0	352	1	353	0	0	0	0	7	349	0	356	7:15 AM	to 8:15 AM
665	7	0	10	17	0	340	1	341	0	0	0	0	4	303	0	307	7:30 AM	to 8:30 AM
637	5	0	8	13	0	344	1	345	0	0	0	0	3	276	0	279	7:45 AM	to 8:45 AM
601	5	0	10	15	0	328	1	329	0	0	0	0	4	253	0	257	8:00 AM	to 9:00 AM
448	1	0	5	6	0	237	0	237	0	0	0	0	4	201	0	205	8:15 AM	to 9:15 AM
293	1	0	3	4	0	154	0	154	0	0	0	0	3	132	0	135	8:30 AM	to 9:30 AM
134	0	0	3	3	0	70	0	70	0	0	0	0	1	60	0	61	8:45 AM	to 9:45 AM
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9:00 AM	to 10:00 AM

Roadway Peak Hour						
7:00 AM	8	90	-	80	7:00 AM to 8:00 AM	
7:15 AM	7	95	-	119		
7:30 AM	5	80	-	102		
7:45 AM	1	86	-	83		
Peak Hour Total	21	351	0	384	756	
PHF	0.66	0.92	-	0.81	0.86	

User Selected Peak Hour						
7:00 AM	8	90	-	80	7:00 AM to 8:00 AM	
7:15 AM	7	95	-	119		
7:30 AM	5	80	-	102		
7:45 AM	1	86	-	83		
Peak Hour Total	21	351	0	384	756	
PHF	0.66	0.92	-	0.81	0.86	

INT #4
Traffic Counts

Approach Name	Padden Rd				Pleasant St				Northbound				Pleasant St				Data Date
Approach Direction	Southbound				Westbound				Northbound				Eastbound				12/8/2022
Start Time	Left	Through	Right	Total	Left	Through	Right	Total	Left	Through	Right	Total	Left	Through	Right	Total	
4:00 PM	1	-	0	1	-	108	2	110	-	-	-	-	2	67	-	69	
4:15 PM	1	-	0	1	-	112	0	112	-	-	-	-	1	72	-	73	
4:30 PM	0	-	4	4	-	96	3	99	-	-	-	-	1	90	-	91	
4:45 PM	0	-	2	2	-	102	1	103	-	-	-	-	1	100	-	101	
5:00 PM	1	-	1	2	-	114	2	116	-	-	-	-	4	86	-	90	
5:15 PM	1	-	2	3	-	112	0	112	-	-	-	-	5	68	-	73	
5:30 PM	0	-	2	2	-	108	2	110	-	-	-	-	3	84	-	87	
5:45 PM	0	-	0	0	-	101	2	103	-	-	-	-	3	83	-	86	
6:00 PM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Total	4	0	11	15	0	853	12	865	0	0	0	0	20	650	0	670	

Trucks	1	-	0	1	-	11	0	11	-	-	-	-	0	8	-	8
% Trucks	25.0%	#N/A	0.0%	6.7%	#N/A	1.3%	0.0%	1.3%	#N/A	#N/A	#N/A	#N/A	0.0%	1.2%	#N/A	1.2%
Buses	0	-	0	0	-	2	0	2	-	-	-	-	0	1	-	1
%Buses	0.0%	#N/A	0.0%	0.0%	#N/A	0.2%	0.0%	0.2%	#N/A	#N/A	#N/A	#N/A	0.0%	0.2%	#N/A	0.1%
Total HV	1	-	0	1	-	13	0	13	-	-	-	-	0	9	-	9
Total % HV	25%	#N/A	0%	7%	#N/A	2%	0%	2%	#N/A	#N/A	#N/A	#N/A	0%	1%	#N/A	1%

Hourly Total	Padden Rd				Pleasant St				Northbound				Pleasant St				Time Period	
	Left	Through	Right	Total	Left	Through	Right	Total	Left	Through	Right	Total	Left	Through	Right	Total		
766	2	0	6	8	0	418	6	424	0	0	0	0	5	329	0	334	4:00 PM	to 5:00 PM
794	2	0	7	9	0	424	6	430	0	0	0	0	7	348	0	355	4:15 PM	to 5:15 PM
796	2	0	9	11	0	424	6	430	0	0	0	0	11	344	0	355	4:30 PM	to 5:30 PM
801	2	0	7	9	0	436	5	441	0	0	0	0	13	338	0	351	4:45 PM	to 5:45 PM
784	2	0	5	7	0	435	6	441	0	0	0	0	15	321	0	336	5:00 PM	to 6:00 PM
576	1	0	4	5	0	321	4	325	0	0	0	0	11	235	0	246	5:15 PM	to 6:15 PM
388	0	0	2	2	0	209	4	213	0	0	0	0	6	167	0	173	5:30 PM	to 6:30 PM
189	0	0	0	0	0	101	2	103	0	0	0	0	3	83	0	86	5:45 PM	to 6:45 PM
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6:00 PM	to 7:00 PM

Roadway Peak Hour						
4:45 PM	2	103	-	101	4:45 PM to 5:45 PM	
5:00 PM	2	116	-	90		
5:15 PM	3	112	-	73		
5:30 PM	2	110	-	87		
Peak Hour Total	9	441	0	351	801	
PHF	0.75	0.95	-	0.87	0.96	

User Selected Peak Hour						
4:15 PM	1	112	-	73	4:15 PM to 5:15 PM	
4:30 PM	4	99	-	91		
4:45 PM	2	103	-	101		
5:00 PM	2	116	-	90		
Peak Hour Total	9	430	0	355	794	
PHF	0.56	0.93	-	0.88	0.95	

Massachusetts Highway Department
Statewide Traffic Data Collection
2019 Weekday Seasonal Factors

Factor Group	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Axle Factor
R1	1.22	1.14	1.12	1.06	1.00	0.96	0.87	0.85	0.96	0.99	1.04	1.12	0.85
R2	0.95	0.96	0.98	0.97	0.97	0.93	0.97	0.94	0.96	0.90	0.92	0.93	0.96
R3	1.15	1.06	1.07	1.00	0.89	0.88	0.89	0.89	0.95	0.92	1.02	1.01	0.97
R4-R7	1.09	1.09	1.11	1.02	0.96	0.92	0.89	0.89	0.99	0.98	1.09	1.13	0.98
U1-Boston	1.03	1.01	0.98	0.94	0.94	0.92	0.95	0.93	0.94	0.94	0.97	1.04	0.96
U1-Essex	1.09	1.06	1.03	0.99	0.94	0.90	0.88	0.86	0.93	0.94	0.99	1.06	0.93
U1-Southeast	1.06	1.05	1.01	0.97	0.95	0.93	0.93	0.90	0.94	0.94	0.98	1.04	0.98
U1-West	1.19	1.14	1.09	0.95	0.92	0.89	0.89	0.86	0.91	0.95	0.97	1.07	0.84
U1-Worcester	1.02	1.04	0.97	0.94	0.93	0.91	0.95	0.91	0.93	0.92	0.95	1.10	0.88
U2	1.01	1.00	0.94	0.93	0.91	0.89	0.93	0.90	0.90	0.91	0.94	1.02	0.99
U3	1.06	1.03	0.98	0.94	0.93	0.91	0.95	0.91	0.92	0.93	0.97	1.00	0.98
U4-U7	1.01	1.00	0.95	0.92	0.88	0.86	0.92	0.91	0.92	0.94	0.99	1.04	0.99
Rec - East	1.04	1.16	1.12	0.98	0.92	0.88	0.77	0.81	0.94	1.02	1.08	1.12	0.99
Rec - West	1.30	1.23	1.32	1.18	0.95	0.82	0.70	0.69	0.97	0.96	1.16	1.15	0.98

Round off:

0-999 = 10

>1000 = 100

U = Urban

R = Rural

1 - Interstate

2 - Freeway and Expressway

3 - Other Principal Arterial

4 - Minor Arterial

5 - Major Collector

6 - Minor Collector

7 - Local Road and Street

Recreational - East Group - Cape Cod (all towns) including the town of Plymouth south of Route 3A (stations 7014,7079,7080,7090,7091,7092,7093,7094,7095,7096,7097,7108 and 7178), Martha's Vineyard and Nantucket.

Recreational - West Group - Continuous Stations 2 and 189 including stations 1066,1067,1083,1084,1085,1086,1087,1088,1089,1090,1091,1092,1093,1094,1095,1096,1097,1098,1099,1100,1101,1102,1103,1104,1105,1106,1107,1108,1113,1114,1116,2196,2197 and 2198.

**MassDOT Yearly Growth Rates
for data from 2014 to 2018**

Growth Factors					
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

AM Peak Hour Volumes

Intersection	Road Name	DIRECTION	MOVEMENT	Site													
				AM PEAK 2022 Raw Existing Volumes	AM PEAK 2022 Seasonal Factor	AM PEAK 2022 Adjusted Existing Volumes	AM PEAK 2029 Regional Growth	AM PEAK 2029 No Build Traffic (No Committed Dev)	AM PEAK 2029 Committed Development Traffic (Cars)	AM PEAK 2029 Committed Development Traffic (Trucks)	AM PEAK 2029 Committed Development Traffic (Total)	AM PEAK 2029 No Build Traffic	INBOUND Site %	AM PEAK Site Trips	AM PEAK Total Site Trips	AM PEAK 2029 Build Traffic	
(1) Beaver Street/Church Square & Union Street/Daniel McCahill Street	Beaver Street/Church Square	Eastbound	EBL	21	3	24	2	26	0	0	0	26	0%	0	0	26	
			EBT	215	28	243	18	261	0	0	0	261	25%	2	2	263	
			EBR	10	1	11	1	12	0	0	0	12	0%	0	0	12	
		Approach	246	32	278	21	299	0	0	0	299	25%	2	2	301		
		Westbound	WBL	38	5	43	3	46	0	0	0	46	0%	8	8	54	
			WBT	309	40	349	25	374	0	0	0	374	0%	8	8	382	
	WBR		142	18	160	12	172	0	0	0	172	0%	0	0	172		
	Approach	489	63	552	40	592	0	0	0	592	0%	16	16	608			
	Union Street/Daniel McCahill Street	Northbound	NBL	16	2	18	1	19	0	0	0	19	0%	0	0	19	
			NBT	188	24	212	15	227	0	0	0	227	0%	0	0	227	
			NBR	73	9	82	6	88	0	0	0	88	26%	3	3	91	
		Approach	277	35	312	22	334	0	0	0	334	26%	3	3	337		
		Southbound	SBL	90	12	102	7	109	0	0	0	109	0%	0	0	109	
			SBT	161	21	182	13	195	0	0	0	195	0%	0	0	195	
	SBR		47	6	53	4	57	0	0	0	57	0%	0	0	57		
	Approach	298	39	337	24	361	0	0	0	361	0%	0	0	361			
	(2) Church Square/Pleasant Street & Main Street	Church Square/Pleasant Street	Eastbound	EBL	93	12	105	8	113	0	0	0	113	0%	0	0	113
				EBT	246	32	278	20	298	0	0	0	298	51%	5	5	303
				EBR	34	4	38	3	41	0	0	0	41	0%	0	0	41
			Approach	373	48	421	31	452	0	0	0	452	51%	5	5	457	
Westbound			WBL	4	1	5	0	5	0	0	0	5	0%	0	0	5	
			WBT	325	42	367	26	393	0	0	0	393	0%	16	16	409	
		WBR	5	1	6	0	6	0	0	0	6	0%	0	0	6		
Approach		334	44	378	26	404	0	0	0	404	0%	16	16	420			
Main Street		Northbound	NBL	33	4	37	3	40	0	0	0	40	0%	0	0	40	
			NBT	149	19	168	12	180	0	0	0	180	0%	0	0	180	
			NBR	13	2	15	1	16	0	0	0	16	0%	0	0	16	
			Approach	195	25	220	16	236	0	0	0	236	0%	0	0	236	
		Southbound	SBL	30	4	34	2	36	0	0	0	36	0%	0	0	36	
			SBT	213	28	241	17	258	0	0	0	258	0%	0	0	258	
	SBR		104	14	118	9	127	0	0	0	127	0%	0	0	127		
	Approach		347	46	393	28	421	0	0	0	421	0%	0	0	421		
(3) Pleasant Street & Dean Avenue	Pleasant Street	Eastbound	EBL	0	0	0	0	0	0	0	0	0	0%	0	0	0	
			EBT	322	42	364	26	390	0	0	0	390	51%	5	5	395	
			EBR	8	1	9	1	10	0	0	0	10	0%	0	0	10	
		Approach	330	43	373	27	400	0	0	0	400	51%	5	5	405		
		Westbound	WBL	29	4	33	2	35	0	0	0	35	0%	5	5	40	
			WBT	331	43	374	27	401	0	0	0	401	0%	16	16	417	
	WBR		0	0	0	0	0	0	0	0	0	0%	0	0	0		
	Approach	360	47	407	29	436	0	0	0	436	0%	21	21	457			
	Dean Avenue	Northbound	NBL	19	2	21	2	23	0	0	0	23	0%	0	0	23	
			NBT	0	0	0	0	0	0	0	0	0%	0	0	0		
			NBR	35	5	40	3	43	0	0	0	43	14%	1	1	44	
			Approach	54	7	61	5	66	0	0	0	66	14%	1	1	67	
		Southbound	SBL	0	0	0	0	0	0	0	0	0	0%	0	0	0	
			SBT	0	0	0	0	0	0	0	0	0	0%	0	0	0	
SBR			0	0	0	0	0	0	0	0	0	0%	0	0	0		
Approach			0	0	0	0	0	0	0	0	0	0%	0	0	0		

Int 1

Int 2

Int 3

AM Peak Hour Volumes

Intersection	Road Name	DIRECTION	MOVEMENT	AM PEAK 2022 Raw Existing Volumes	AM PEAK 2022 Seasonal Factor	AM PEAK 2022 Adjusted Existing Volumes	AM PEAK 2029 Regional Growth	AM PEAK 2029 No Build Traffic (No Committed Dev)	AM PEAK 2029 Committed Development Traffic (Cars)	AM PEAK 2029 Committed Development Traffic (Trucks)	AM PEAK 2029 Committed Development Traffic (Total)	AM PEAK 2029 No Build Traffic	Site			AM PEAK 2029 Build Traffic		
													INBOUND Site %	AM PEAK Site Trips	AM PEAK Total Site Trips			
(4) Pleasant Street & Padden Road	Pleasant Street	Eastbound	EBL	7	1	8	1	9	0	0	0	9	0%	0	0	9		
			EBT	377	49	426	31	457	0	0	0	457	65%	6	6	463		
			EBR	0	0	0	0	0	0	0	0	0	0	0	0%	0	0	0
		Approach	384	50	434	32	466	0	0	0	466	65%	6	6	472			
		Westbound	WBL	0	0	0	0	0	0	0	0	0	0	0	0%	0	0	0
			WBT	351	46	397	29	426	0	0	0	426	0%	21	21	447		
	WBR		0	0	0	0	0	0	0	0	0	0	0	0%	0	0	0	
	Approach	351	46	397	29	426	0	0	0	426	0%	21	21	447				
	Padden Road	Northbound	NBL	0	0	0	0	0	0	0	0	0	0	0%	0	0	0	
			NBT	0	0	0	0	0	0	0	0	0	0	0%	0	0	0	
			NBR	0	0	0	0	0	0	0	0	0	0	0	0%	0	0	0
			Approach	0	0	0	0	0	0	0	0	0	0	0	0%	0	0	0
		Southbound	SBL	4	1	5	0	5	0	0	0	0	5	0%	0	0	5	
			SBT	0	0	0	0	0	0	0	0	0	0	0	0%	0	0	0
			SBR	17	2	19	1	20	0	0	0	0	20	0%	0	0	20	
			Approach	21	3	24	1	25	0	0	0	25	0%	0	0	25		
			Site Driveway	SBL	0	0	0	0	0	0	0	0	0	0	0%	0	0	0
				Approach	0	0	0	0	0	0	0	0	0	0	0%	0	0	0
	(5) Pleasant Street & Site Driveway	Pleasant Street	Eastbound	EBL	0	0	0	0	0	0	0	0	0	0%	0	0	0	
				EBT	377	49	426	31	457	0	0	0	457	0%	0	0	457	
EBR				0	0	0	0	0	0	0	0	0	0	65%	6	6	6	
Approach			377	49	426	31	457	0	0	0	457	65%	6	6	463			
Westbound			WBL	0	0	0	0	0	0	0	0	0	0	35%	4	4	4	
			WBT	351	46	397	29	426	0	0	0	426	0%	0	0	426		
		WBR	0	0	0	0	0	0	0	0	0	0	0%	0	0	0		
Approach		351	46	397	29	426	0	0	0	426	35%	4	4	430				
Site Driveway		Northbound	NBL	0	0	0	0	0	0	0	0	0	0	0%	21	21	21	
			NBT	0	0	0	0	0	0	0	0	0	0	0%	0	0	0	
			NBR	0	0	0	0	0	0	0	0	0	0	0%	12	12	12	
			Approach	0	0	0	0	0	0	0	0	0	0	0%	33	33	33	
		Southbound	SBL	0	0	0	0	0	0	0	0	0	0	0%	0	0	0	
			SBT	0	0	0	0	0	0	0	0	0	0	0%	0	0	0	
			SBR	0	0	0	0	0	0	0	0	0	0	0%	0	0	0	
			Approach	0	0	0	0	0	0	0	0	0	0	0%	0	0	0	
			Site Driveway	SBL	0	0	0	0	0	0	0	0	0	0	0%	0	0	0
				Approach	0	0	0	0	0	0	0	0	0	0	0%	0	0	0

Int 4

Int 5

PM Peak Hour Volumes

Intersection	Road NPMe	DIRECTION	MOVEMENT	PM PEAK 2022 Raw Existing Volumes	PM PEAK 2022 Seasonal Factor	PM PEAK 2022 Adjusted Existing Volumes	PM PEAK 2029 Regional Growth	PM PEAK 2029 No Build Traffic (No Committed Dev)	PM PEAK 2029 Committed Development Traffic (Cars)	PM PEAK 2029 Committed Development Traffic (Trucks)	PM PEAK 2029 Committed Development Traffic (Total)	PM PEAK 2029 No Build Traffic	Site			PM PEAK 2029 Build Traffic	
													OUTBOUND Site %	PM PEAK Site Trips	PM PEAK Total Site Trips		
(1) Beaver Street/Church Square & Union Street/Daniel McCahill Street	Beaver Street/Church Square	Eastbound	EBL	6	1	7	1	8	0	0	0	8	0%	0	0	8	
			EBT	340	44	384	28	412	0	0	0	412	0%	7	7	419	
			EBR	20	3	23	2	25	0	0	0	25	0%	0	0	25	
		Approach	366	48	414	31	445	0	0	0	445	0%	7	7	452		
		Westbound	WBL	68	9	77	6	83	0	0	0	83	26%	5	5	88	
			WBT	388	50	438	32	470	0	0	0	470	25%	4	4	474	
	WBR		79	10	89	6	95	0	0	0	95	0%	0	0	95		
	Union Street/Daniel McCahill Street	Northbound	Approach	535	69	604	44	648	0	0	0	648	51%	9	9	657	
			NBL	17	2	19	1	20	0	0	0	20	0%	0	0	20	
			NBT	114	15	129	9	138	0	0	0	138	0%	0	0	138	
		Southbound	NBR	74	10	84	6	90	0	0	0	90	0%	8	8	98	
			Approach	205	27	232	16	248	0	0	0	248	0%	8	8	256	
			SBL	65	8	73	5	78	0	0	0	78	0%	0	0	78	
				SBT	100	13	113	8	121	0	0	0	121	0%	0	0	121
				SBR	23	3	26	2	28	0	0	0	28	0%	0	0	28
				Approach	188	24	212	15	227	0	0	0	227	0%	0	0	227
(2) Church Square/Pleasant Street & Main Street	Church Square/Pleasant Street	Eastbound	EBL	160	21	181	13	194	0	0	0	194	0%	0	0	194	
			EBT	287	37	324	23	347	0	0	0	347	0%	15	15	362	
			EBR	39	5	44	3	47	0	0	0	47	0%	0	0	47	
		Approach	486	63	549	39	588	0	0	0	588	0%	15	15	603		
		Westbound	WBL	15	2	17	1	18	0	0	0	18	0%	0	0	18	
			WBT	338	44	382	28	410	0	0	0	410	51%	9	9	419	
	WBR		12	2	14	1	15	0	0	0	15	0%	0	0	15		
	Approach	365	48	413	30	443	0	0	0	443	51%	9	9	452			
	Main Street	Northbound	NBL	41	5	46	3	49	0	0	0	49	0%	0	0	49	
			NBT	206	27	233	17	250	0	0	0	250	0%	0	0	250	
			NBR	23	3	26	2	28	0	0	0	28	0%	0	0	28	
		Approach	270	35	305	22	327	0	0	0	327	0%	0	0	327		
		Southbound	SBL	25	3	28	2	30	0	0	0	30	0%	0	0	30	
			SBT	245	32	277	20	297	0	0	0	297	0%	0	0	297	
	SBR		133	17	150	11	161	0	0	0	161	0%	0	0	161		
	Approach	403	52	455	33	488	0	0	0	488	0%	0	0	488			
(3) Pleasant Street & Dean Avenue	Pleasant Street	Eastbound	EBL	0	0	0	0	0	0	0	0	0	0%	0	0	0	
			EBT	315	41	356	26	382	0	0	0	382	0%	15	15	397	
			EBR	17	2	19	1	20	0	0	0	20	0%	0	0	20	
		Approach	332	43	375	27	402	0	0	0	402	0%	15	15	417		
		Westbound	WBL	39	5	44	3	47	0	0	0	47	14%	3	3	50	
			WBT	404	53	457	33	490	0	0	0	490	51%	9	9	499	
	WBR		0	0	0	0	0	0	0	0	0	0%	0	0	0		
	Approach	443	58	501	36	537	0	0	0	537	65%	12	12	549			
	Dean Avenue	Northbound	NBL	15	2	17	1	18	0	0	0	18	0%	0	0	18	
			NBT	0	0	0	0	0	0	0	0	0	0%	0	0	0	
			NBR	41	5	46	3	49	0	0	0	49	0%	4	4	53	
		Approach	56	7	63	4	67	0	0	0	67	0%	4	4	71		
		Southbound	SBL	0	0	0	0	0	0	0	0	0	0	0%	0	0	0
			SBT	0	0	0	0	0	0	0	0	0	0	0%	0	0	0
	SBR		0	0	0	0	0	0	0	0	0	0	0%	0	0	0	
	Approach	0	0	0	0	0	0	0	0	0	0	0%	0	0	0		

PM Peak Hour Volumes

Intersection	Road NPMe	DIRECTION	MOVEMENT	PM PEAK 2022 Raw Existing Volumes	PM PEAK 2022 Seasonal Factor	PM PEAK 2022 Adjusted Existing Volumes	PM PEAK 2029 Regional Growth	PM PEAK 2029 No Build Traffic (No Committed Dev)	PM PEAK 2029 Committed Development Traffic (Cars)	PM PEAK 2029 Committed Development Traffic (Trucks)	PM PEAK 2029 Committed Development Traffic (Total)	PM PEAK 2029 No Build Traffic	Site			PM PEAK 2029 Build Traffic	
													OUTBOUND Site %	PM PEAK Site Trips	PM PEAK Total Site Trips		
(4) Pleasant Street & Padden Road	Pleasant Street	Eastbound	EBL	7	1	8	1	9	0	0	0	9	0%	0	0	9	
			EBT	348	45	393	28	421	0	0	0	421	0%	19	19	440	
			EBR	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Approach	355	46	401	29	430	0	0	0	430	0%	19	19	449		
		Westbound	WBL	0	0	0	0	0	0	0	0	0	0	0%	0	0	0
			WBT	424	55	479	35	514	0	0	0	514	65%	12	12	526	
	WBR		6	1	7	1	8	0	0	0	8	0%	0	0	8		
	Approach	430	56	486	36	522	0	0	0	522	65%	12	12	534			
	Padden Road	Northbound	NBL	0	0	0	0	0	0	0	0	0	0	0%	0	0	0
			NBT	0	0	0	0	0	0	0	0	0	0	0%	0	0	0
			NBR	0	0	0	0	0	0	0	0	0	0	0%	0	0	0
			Approach	0	0	0	0	0	0	0	0	0	0	0%	0	0	0
		Southbound	SBL	2	0	2	0	2	0	0	0	0	2	0%	0	0	2
			SBT	0	0	0	0	0	0	0	0	0	0	0%	0	0	0
			SBR	7	1	8	1	9	0	0	0	9	0%	0	0	9	
			Approach	9	1	10	1	11	0	0	0	11	0%	0	0	11	
	(5) Pleasant Street & Site Driveway	Pleasant Street	Eastbound	EBL	0	0	0	0	0	0	0	0	0	0%	0	0	0
				EBT	348	45	393	28	421	0	0	0	421	0%	0	0	421
				EBR	0	0	0	0	0	0	0	0	0	0	0%	19	19
			Approach	348	45	393	28	421	0	0	0	421	0%	19	19	440	
Westbound			WBL	0	0	0	0	0	0	0	0	0	0	0%	11	11	11
			WBT	424	55	479	35	514	0	0	0	514	0%	0	0	514	
		WBR	0	0	0	0	0	0	0	0	0	0	0%	0	0	0	
Approach		424	55	479	35	514	0	0	0	514	0%	11	11	525			
Site Driveway		Northbound	NBL	0	0	0	0	0	0	0	0	0	0	65%	12	12	12
			NBT	0	0	0	0	0	0	0	0	0	0	0%	0	0	0
			NBR	0	0	0	0	0	0	0	0	0	0	35%	6	6	6
			Approach	0	0	0	0	0	0	0	0	0	0	100%	18	18	18
		Southbound	SBL	0	0	0	0	0	0	0	0	0	0	0%	0	0	0
			SBT	0	0	0	0	0	0	0	0	0	0	0%	0	0	0
			SBR	0	0	0	0	0	0	0	0	0	0	0%	0	0	0
			Approach	0	0	0	0	0	0	0	0	0	0	0%	0	0	0

Int 4

Int 5

APPENDIX C

Padden Road and Pleasant Street Evaluation

100 Cambridge Street, Suite 1310 Boston, MA 02114 T: 617.824.9100 F: 617.824.9101

To: Michael Maglio, PE Franklin Town Engineer

From: Maximo Polanco
John Plante, PE

CC: The Community Builders, Inc.

Date: January 2023

Re: Padden Road and Pleasant Street Evaluation
237 Pleasant Street Residential Development
Franklin, Massachusetts
Langan Project No.: 151019601

While not specifically impacted by the proposed development at 237 Pleasant Street, we reviewed specific traffic conditions at the intersection of Padden Road and Pleasant Street and provided suggestions to enhance safety at this location. This task was undertaken based on concerns expressed by local residents. We will work with the Town to review the appropriate actions to help mitigate this existing condition, as appropriate.

Padden Road and Pleasant Street

Padden Road is an existing residential street off Pleasant Street in Franklin, MA. Padden Road serves as one of two access points to a single-family residential area north of Pleasant Street that includes Philomena Way, Longhill Road and Sargent Lane. Access to this neighborhood is also provided via Flintlocke Road approximately 1,300 feet northeast of Padden Road off of Pleasant Street. Padden Road is a two-lane residential street with 14-foot wide travel lanes that forms a "T" intersection with Pleasant Street. Padden Road has an Average Daily Traffic (ADT) of ± 250 vehicles per day while Pleasant Street at that location has an ADT of $\pm 9,600$ vehicles per day. The posted speed on Pleasant Street in the vicinity of Padden Road is 35 mph. Sidewalks are present along the northern side of Pleasant Street.

Input from residents of the area indicate that sight distance to the northeast to and from Padden Road is limited. This was confirmed by our own field observations as well as discussions with the Town of Franklin (DPW). The limited sight distance is created by side slope conditions and a horizontal curve along Pleasant Street. This restriction results in difficult sight lines for vehicles exiting Padden Road onto Pleasant Street. The figure below show the existing sights constrains on Padden Road.

Padden Road also serves as the pickup/drop off point for the school bus along Pleasant Street. The school bus approaches from the northeast in the AM and southwest in the PM. Children cross Pleasant Street in front of the stopped school bus during the PM drop off period.



Figure 1: Sight line looking northeast from Padden Road.

Accident Frequency/Recorded Speed Data

There were four (4) property-damage-only accidents for the five year period from 2018 to 2022 according to the MassDOT Accident Database at the Padden Road/Pleasant Street intersection. The resulting crash rate at the intersection is 0.30 per million entering vehicles (MEV) which is well below District's average. Video recorded traffic count data did, however, corroborate some anecdotal observations by residents that left turning vehicles do accept shorter gaps onto Pleasant Street resulting in some "near miss" situations. This is likely due to the limited sight distance at the intersection.

Speed data was recorded at two locations - northeast of Padden Road and north of Dean Avenue along Pleasant Street. The data indicates that southwest bound vehicles approaching Padden Road are traveling within predictable levels (85th percentile speed is 40 mph which is within the tolerance level based on the posted speed limit according to MassDOT).

Conclusion/Safety Improvement Suggestions

There does not appear to be any tangible accident issue at the intersection despite the existing sight distance limitations to and from the northeast along Pleasant Street. Furthermore, this is a pre-existing condition that is not affected by the proposed residential development across the street. That being said, there are following recommendations can be implemented to enhance awareness for southwest bound traffic along Pleasant Street in accordance with the Manual of Uniform Traffic Control Devices (MUTCD) guidelines.

- 1) Advance warning signage. Advisory speed signs and intersection ahead signs can raise awareness for drivers approaching Padden Road. The accompanying Conceptual Plan shows a suggested signage placement that would increase awareness at the curve prior to Padden Road.
- 2) Relocate bus drop off to the northeast to enhance visibility during drop off. Relocating the drop off point to a location near the proposed project's residential driveway would provide greater visibility of the school bus for vehicles approaching from the northeast.
- 3) Advance school bus signage.

\\langan.com\data\BOS\data6\151019601\Project Data_Discipline\Traffic\Reports\2 - Traffic Impact Study\Padden Road MEMO.docx

APPENDIX D

Journey to Work Model

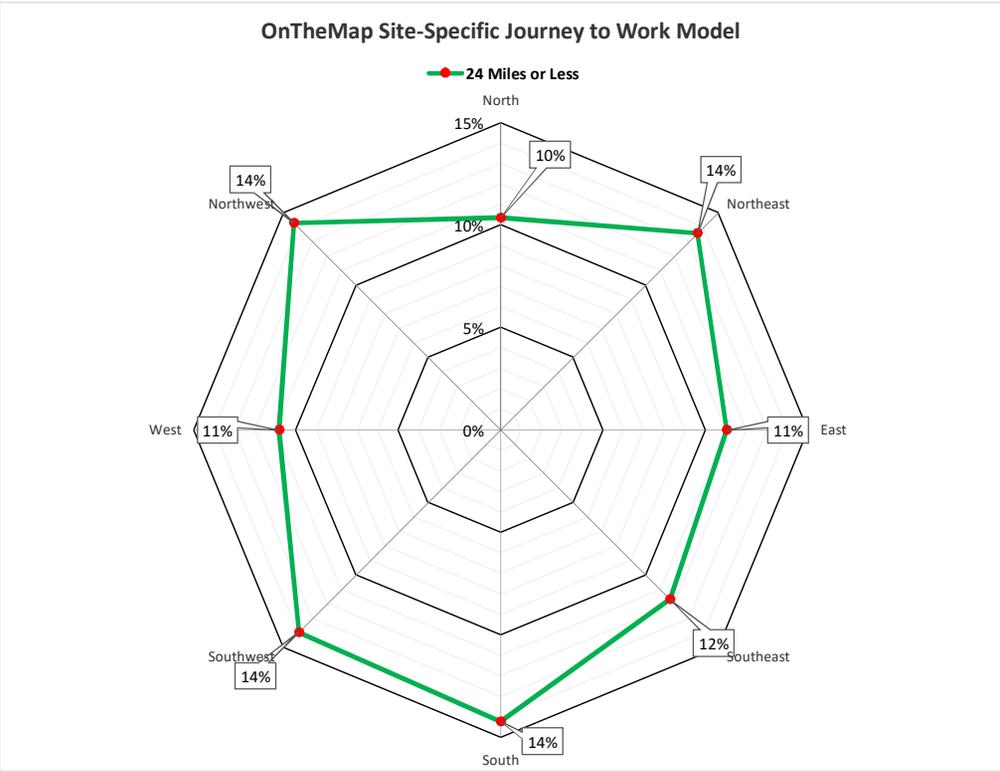
Distance/Direction Report - Home Census Block to Work Census Block

Job Counts in Home Blocks by Distance Only

	All		North		Northeast		East		Southeast		South		Southwest		West		Northwest	
	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%
Total All Private Jobs	7,699	100.0%	920	11.9%	1,130	14.7%	817	10.6%	970	12.6%	931	12.1%	928	12.1%	933	12.1%	1,070	13.9%
Less than 10 miles	3,215	100.0%	355	11.0%	307	9.5%	324	10.1%	343	10.7%	289	9.0%	707	22.0%	361	11.2%	529	16.5%
10 to 24 miles	2,711	100.0%	259	9.6%	498	18.4%	330	12.2%	350	12.9%	554	20.4%	120	4.4%	281	10.4%	319	11.8%
25 to 50 miles	1,314	100.0%	252	19.2%	287	21.8%	139	10.6%	215	16.4%	87	6.6%	24	1.8%	113	8.6%	197	15.0%
Greater than 50 miles	459	100.0%	54	11.8%	38	8.3%	24	5.2%	62	13.5%	1	0.2%	77	16.8%	178	38.8%	25	5.4%

Include:

24 Miles or Less	5,926	100%	614	10%	805	14%	654	11%	693	12%	843	14%	827	14%	642	11%	848	14%
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APPENDIX E

Capacity Analysis – 2022 Existing Traffic Conditions

Timings

1: Union Street/Daniel McCahill Street & Beaver Street/Church Square



Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	Ø9
Lane Configurations		↕		↕	↕		↕	↕	↕	↕	
Traffic Volume (vph)	24	243	43	349	160	18	212	82	102	182	
Future Volume (vph)	24	243	43	349	160	18	212	82	102	182	
Turn Type	Perm	NA	Perm	NA	Perm	Perm	NA	Perm	Perm	NA	
Protected Phases		4		8			2			6	9
Permitted Phases	4		8		8	2		2	6		
Detector Phase	4	4	8	8	8	2	2	2	6	6	
Switch Phase											
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	52.0	52.0	52.0	52.0	52.0	41.0	41.0	41.0	41.0	41.0	26.0
Total Split (s)	52.0	52.0	52.0	52.0	52.0	41.0	41.0	41.0	41.0	41.0	26.0
Total Split (%)	43.7%	43.7%	43.7%	43.7%	43.7%	34.5%	34.5%	34.5%	34.5%	34.5%	22%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	2.0
All-Red Time (s)	18.0	18.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	4.0
Lost Time Adjust (s)		0.0		0.0	0.0		0.0	0.0	0.0	0.0	
Total Lost Time (s)		22.0		6.0	6.0		6.0	6.0	6.0	6.0	
Lead/Lag											
Lead-Lag Optimize?											
Recall Mode	Max	None									

Intersection Summary

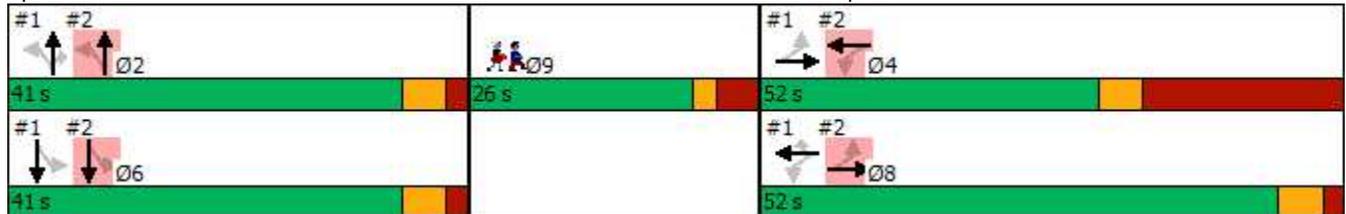
Cycle Length: 119

Actuated Cycle Length: 93

Natural Cycle: 130

Control Type: Semi Act-Uncoord

Splits and Phases: 1: Union Street/Daniel McCahill Street & Beaver Street/Church Square



Queues

1: Union Street/Daniel McCahill Street & Beaver Street/Church Square



Lane Group	EBT	WBT	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	361	509	208	298	106	132	305
v/c Ratio	1.07	0.63	0.26	0.46	0.15	0.40	0.46
Control Delay	101.9	13.6	4.6	24.8	0.5	25.9	23.7
Queue Delay	11.1	2.4	0.8	0.0	0.0	0.0	0.0
Total Delay	113.0	16.1	5.4	24.8	0.5	25.9	23.7
Queue Length 50th (ft)	~237	112	21	130	0	56	127
Queue Length 95th (ft)	#321	126	32	168	0	89	165
Internal Link Dist (ft)	368	184		709			548
Turn Bay Length (ft)			65		80	90	
Base Capacity (vph)	337	812	806	645	707	330	660
Starvation Cap Reductn	0	184	351	0	0	0	0
Spillback Cap Reductn	20	0	0	0	4	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	1.14	0.81	0.46	0.46	0.15	0.40	0.46

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

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

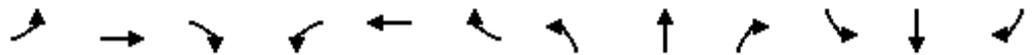
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis

237 Pleasant Street TIS

1: Union Street/Daniel McCahill Street & Beaver Street/Church Square

2022 Existing - AM Peak Hour



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕	↕		↕	↕	↕	↕	
Traffic Volume (vph)	24	243	11	43	349	160	18	212	82	102	182	53
Future Volume (vph)	24	243	11	43	349	160	18	212	82	102	182	53
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	16	16	16	11	11	11	11	11	11	11	11	11
Total Lost time (s)		22.0			6.0	6.0		6.0	6.0	6.0	6.0	
Lane Util. Factor		1.00			1.00	1.00		1.00	1.00	1.00	1.00	
Frt		0.99			1.00	0.85		1.00	0.85	1.00	0.97	
Flt Protected		1.00			0.99	1.00		1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1984			1773	1546		1780	1501	1711	1734	
Flt Permitted		0.52			0.92	1.00		0.96	1.00	0.49	1.00	
Satd. Flow (perm)		1042			1643	1546		1714	1501	877	1734	
Peak-hour factor, PHF	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
Adj. Flow (vph)	31	316	14	56	453	208	23	275	106	132	236	69
RTOR Reduction (vph)	0	1	0	0	0	42	0	0	66	0	8	0
Lane Group Flow (vph)	0	360	0	0	509	166	0	298	40	132	297	0
Heavy Vehicles (%)	5%	7%	24%	3%	3%	1%	0%	3%	4%	2%	3%	0%
Turn Type	Perm	NA		Perm	NA	Perm	Perm	NA	Perm	Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8		8	2		2	6		
Actuated Green, G (s)		30.0			46.0	46.0		35.0	35.0	35.0	35.0	
Effective Green, g (s)		30.0			46.0	46.0		35.0	35.0	35.0	35.0	
Actuated g/C Ratio		0.32			0.49	0.49		0.38	0.38	0.38	0.38	
Clearance Time (s)		22.0			6.0	6.0		6.0	6.0	6.0	6.0	
Vehicle Extension (s)		3.0			3.0	3.0		3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		336			812	764		645	564	330	652	
v/s Ratio Prot												0.17
v/s Ratio Perm		c0.35			0.31	0.11		c0.17	0.03	0.15		
v/c Ratio		1.07			0.63	0.22		0.46	0.07	0.40	0.46	
Uniform Delay, d1		31.5			17.2	13.3		21.9	18.6	21.3	21.8	
Progression Factor		1.00			0.59	0.48		1.00	1.00	1.00	1.00	
Incremental Delay, d2		69.0			3.2	0.6		2.4	0.2	3.6	2.3	
Delay (s)		100.5			13.3	7.0		24.3	18.8	24.9	24.1	
Level of Service		F			B	A		C	B	C	C	
Approach Delay (s)		100.5			11.4			22.8			24.3	
Approach LOS		F			B			C			C	

Intersection Summary

HCM 2000 Control Delay	33.5	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	93.0	Sum of lost time (s)	34.0
Intersection Capacity Utilization	86.8%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Timings
2: Main Street & Church Square/Pleasant Street

237 Pleasant Street TIS
2022 Existing - AM Peak Hour

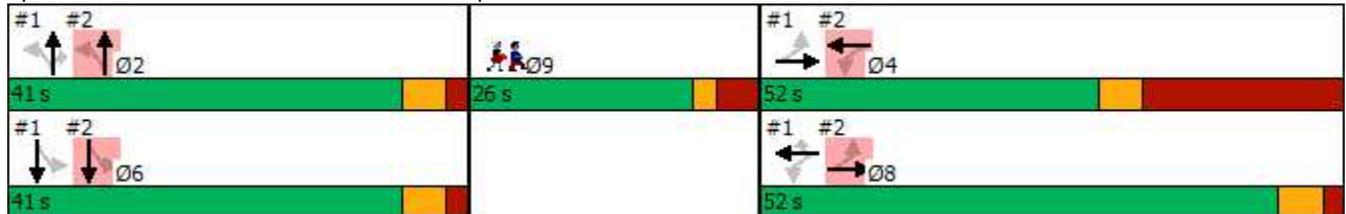


Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	Ø9
Lane Configurations		↕		↕	↗	↖		↕	
Traffic Volume (vph)	105	278	5	367	37	168	34	241	
Future Volume (vph)	105	278	5	367	37	168	34	241	
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA	
Protected Phases		8		4		2		6	9
Permitted Phases	8		4		2		6		
Detector Phase	8	8	4	4	2	2	6	6	
Switch Phase									
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	52.0	52.0	52.0	52.0	41.0	41.0	41.0	41.0	26.0
Total Split (s)	52.0	52.0	52.0	52.0	41.0	41.0	41.0	41.0	26.0
Total Split (%)	43.7%	43.7%	43.7%	43.7%	34.5%	34.5%	34.5%	34.5%	22%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	2.0
All-Red Time (s)	2.0	2.0	18.0	18.0	2.0	2.0	2.0	2.0	4.0
Lost Time Adjust (s)		0.0		0.0	0.0	0.0		0.0	
Total Lost Time (s)		6.0		22.0	6.0	6.0		6.0	
Lead/Lag									
Lead-Lag Optimize?									
Recall Mode	Max	None							

Intersection Summary

Cycle Length: 119
 Actuated Cycle Length: 93
 Natural Cycle: 130
 Control Type: Semi Act-Uncoord

Splits and Phases: 2: Main Street & Church Square/Pleasant Street



Queues
 2: Main Street & Church Square/Pleasant Street

237 Pleasant Street TIS
 2022 Existing - AM Peak Hour



Lane Group	EBT	WBT	NBL	NBT	SBT
Lane Group Flow (vph)	478	430	42	208	447
v/c Ratio	0.61	0.66	0.16	0.31	0.69
Control Delay	12.7	32.9	21.4	21.8	29.9
Queue Delay	27.2	1.1	0.0	0.0	0.0
Total Delay	39.9	33.9	21.4	21.8	29.9
Queue Length 50th (ft)	105	216	16	83	209
Queue Length 95th (ft)	m115	310	40	136	310
Internal Link Dist (ft)	184	2003		629	573
Turn Bay Length (ft)			55		
Base Capacity (vph)	780	651	260	661	651
Starvation Cap Reductn	312	0	0	0	0
Spillback Cap Reductn	0	73	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	1.02	0.74	0.16	0.31	0.69

Intersection Summary

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

HCM Signalized Intersection Capacity Analysis
2: Main Street & Church Square/Pleasant Street

237 Pleasant Street TIS
2022 Existing - AM Peak Hour



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕		↗	↘			↕	
Traffic Volume (vph)	105	278	38	5	367	6	37	168	15	34	241	118
Future Volume (vph)	105	278	38	5	367	6	37	168	15	34	241	118
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	16	16	16	16	16	16	11	11	11	12	12	12
Total Lost time (s)		6.0			22.0		6.0	6.0			6.0	
Lane Util. Factor		1.00			1.00		1.00	1.00			1.00	
Frt		0.99			1.00		1.00	0.99			0.96	
Flt Protected		0.99			1.00		0.95	1.00			1.00	
Satd. Flow (prot)		1972			2053		1711	1750			1771	
Flt Permitted		0.79			0.98		0.39	1.00			0.96	
Satd. Flow (perm)		1573			2015		694	1750			1700	
Peak-hour factor, PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	119	316	43	6	417	7	42	191	17	39	274	134
RTOR Reduction (vph)	0	3	0	0	1	0	0	2	0	0	11	0
Lane Group Flow (vph)	0	475	0	0	429	0	42	206	0	0	436	0
Heavy Vehicles (%)	4%	8%	3%	0%	4%	42%	2%	4%	0%	15%	1%	2%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		8			4			2			6	
Permitted Phases	8			4			2			6		
Actuated Green, G (s)		46.0			30.0		35.0	35.0			35.0	
Effective Green, g (s)		46.0			30.0		35.0	35.0			35.0	
Actuated g/C Ratio		0.49			0.32		0.38	0.38			0.38	
Clearance Time (s)		6.0			22.0		6.0	6.0			6.0	
Vehicle Extension (s)		3.0			3.0		3.0	3.0			3.0	
Lane Grp Cap (vph)		778			650		261	658			639	
v/s Ratio Prot								0.12				
v/s Ratio Perm		c0.30			0.21		0.06				c0.26	
v/c Ratio		0.61			0.66		0.16	0.31			0.68	
Uniform Delay, d1		17.0			27.1		19.3	20.5			24.3	
Progression Factor		0.59			1.00		1.00	1.00			1.00	
Incremental Delay, d2		2.4			5.2		1.3	1.2			5.8	
Delay (s)		12.4			32.3		20.6	21.7			30.1	
Level of Service		B			C		C	C			C	
Approach Delay (s)		12.4			32.3			21.5			30.1	
Approach LOS		B			C			C			C	

Intersection Summary

HCM 2000 Control Delay	24.1	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.88		
Actuated Cycle Length (s)	93.0	Sum of lost time (s)	34.0
Intersection Capacity Utilization	107.5%	ICU Level of Service	G
Analysis Period (min)	15		

c Critical Lane Group

Intersection						
Int Delay, s/veh	1.4					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	364	9	33	374	21	40
Future Vol, veh/h	364	9	33	374	21	40
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	90	90	90	90	90	90
Heavy Vehicles, %	8	7	3	4	0	2
Mvmt Flow	404	10	37	416	23	44

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	414	0	899 409
Stage 1	-	-	-	-	409 -
Stage 2	-	-	-	-	490 -
Critical Hdwy	-	-	4.13	-	6.4 6.22
Critical Hdwy Stg 1	-	-	-	-	5.4 -
Critical Hdwy Stg 2	-	-	-	-	5.4 -
Follow-up Hdwy	-	-	2.227	-	3.5 3.318
Pot Cap-1 Maneuver	-	-	1140	-	312 642
Stage 1	-	-	-	-	675 -
Stage 2	-	-	-	-	620 -
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1140	-	299 642
Mov Cap-2 Maneuver	-	-	-	-	299 -
Stage 1	-	-	-	-	675 -
Stage 2	-	-	-	-	594 -

Approach	EB	WB	NB
HCM Control Delay, s	0	0.7	14.2
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	460	-	-	1140	-
HCM Lane V/C Ratio	0.147	-	-	0.032	-
HCM Control Delay (s)	14.2	-	-	8.3	0
HCM Lane LOS	B	-	-	A	A
HCM 95th %tile Q(veh)	0.5	-	-	0.1	-

Intersection						
Int Delay, s/veh	0.5					
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↶	↷		↶	
Traffic Vol, veh/h	8	426	397	0	5	19
Future Vol, veh/h	8	426	397	0	5	19
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	86	86	86	86	86	86
Heavy Vehicles, %	0	7	4	0	0	0
Mvmt Flow	9	495	462	0	6	22

Major/Minor	Major1	Major2	Minor2		
Conflicting Flow All	462	0	-	0	975
Stage 1	-	-	-	-	462
Stage 2	-	-	-	-	513
Critical Hdwy	4.1	-	-	-	6.4
Critical Hdwy Stg 1	-	-	-	-	5.4
Critical Hdwy Stg 2	-	-	-	-	5.4
Follow-up Hdwy	2.2	-	-	-	3.5
Pot Cap-1 Maneuver	1110	-	-	-	281
Stage 1	-	-	-	-	638
Stage 2	-	-	-	-	605
Platoon blocked, %		-	-	-	
Mov Cap-1 Maneuver	1110	-	-	-	278
Mov Cap-2 Maneuver	-	-	-	-	278
Stage 1	-	-	-	-	631
Stage 2	-	-	-	-	605

Approach	EB	WB	SB
HCM Control Delay, s	0.2	0	12.9
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1110	-	-	-	485
HCM Lane V/C Ratio	0.008	-	-	-	0.058
HCM Control Delay (s)	8.3	0	-	-	12.9
HCM Lane LOS	A	A	-	-	B
HCM 95th %tile Q(veh)	0	-	-	-	0.2

Timings

1: Union Street/Daniel McCahill Street & Beaver Street/Church Square



Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	Ø9
Lane Configurations		↕		↕	↕		↕	↕	↕	↕	
Traffic Volume (vph)	7	384	77	438	89	19	129	84	73	113	
Future Volume (vph)	7	384	77	438	89	19	129	84	73	113	
Turn Type	Perm	NA	Perm	NA	Perm	Perm	NA	Perm	Perm	NA	
Protected Phases		4		8			2			6	9
Permitted Phases	4		8		8	2		2	6		
Detector Phase	4	4	8	8	8	2	2	2	6	6	
Switch Phase											
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	52.0	52.0	52.0	52.0	52.0	41.0	41.0	41.0	41.0	41.0	26.0
Total Split (s)	52.0	52.0	52.0	52.0	52.0	41.0	41.0	41.0	41.0	41.0	26.0
Total Split (%)	43.7%	43.7%	43.7%	43.7%	43.7%	34.5%	34.5%	34.5%	34.5%	34.5%	22%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	2.0
All-Red Time (s)	18.0	18.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	4.0
Lost Time Adjust (s)		0.0		0.0	0.0		0.0	0.0	0.0	0.0	
Total Lost Time (s)		22.0		6.0	6.0		6.0	6.0	6.0	6.0	
Lead/Lag											
Lead-Lag Optimize?											
Recall Mode	Max	None									

Intersection Summary

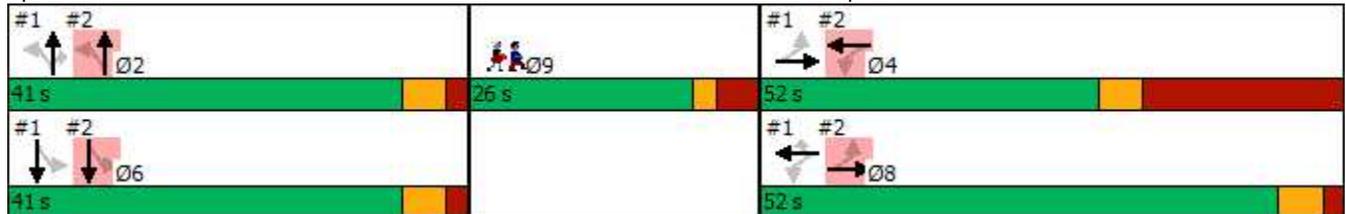
Cycle Length: 119

Actuated Cycle Length: 93

Natural Cycle: 130

Control Type: Semi Act-Uncoord

Splits and Phases: 1: Union Street/Daniel McCahill Street & Beaver Street/Church Square



Queues

1: Union Street/Daniel McCahill Street & Beaver Street/Church Square



Lane Group	EBT	WBT	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	422	526	91	151	86	74	142
v/c Ratio	1.11	0.67	0.12	0.23	0.12	0.16	0.21
Control Delay	112.5	14.7	2.5	21.0	0.3	20.5	19.3
Queue Delay	0.6	2.8	0.0	0.0	0.0	0.0	0.0
Total Delay	113.1	17.5	2.5	21.0	0.3	20.5	19.3
Queue Length 50th (ft)	~288	115	4	60	0	29	52
Queue Length 95th (ft)	#473	237	m8	105	0	60	95
Internal Link Dist (ft)	368	184		709			548
Turn Bay Length (ft)			65		80	90	
Base Capacity (vph)	379	784	791	662	724	456	671
Starvation Cap Reductn	0	155	0	0	0	0	0
Spillback Cap Reductn	20	0	0	0	4	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	1.18	0.84	0.12	0.23	0.12	0.16	0.21

Intersection Summary

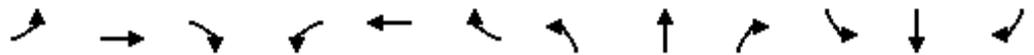
- ~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
- m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis

237 Pleasant Street TIS

1: Union Street/Daniel McCahill Street & Beaver Street/Church Square

2022 Existing - PM Peak Hour



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔	↔		↔	↔	↔	↔	
Traffic Volume (vph)	7	384	23	77	438	89	19	129	84	73	113	26
Future Volume (vph)	7	384	23	77	438	89	19	129	84	73	113	26
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	16	16	16	11	11	11	11	11	11	11	11	11
Total Lost time (s)		22.0			6.0	6.0		6.0	6.0	6.0	6.0	
Lane Util. Factor		1.00			1.00	1.00		1.00	1.00	1.00	1.00	
Frt		0.99			1.00	0.85		1.00	0.85	1.00	0.97	
Flt Protected		1.00			0.99	1.00		0.99	1.00	0.95	1.00	
Satd. Flow (prot)		2116			1802	1516		1825	1546	1745	1770	
Flt Permitted		0.55			0.87	1.00		0.96	1.00	0.66	1.00	
Satd. Flow (perm)		1172			1587	1516		1760	1546	1214	1770	
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	7	392	23	79	447	91	19	132	86	74	115	27
RTOR Reduction (vph)	0	1	0	0	0	42	0	0	54	0	6	0
Lane Group Flow (vph)	0	421	0	0	526	49	0	151	32	74	136	0
Heavy Vehicles (%)	0%	1%	0%	2%	1%	3%	0%	0%	1%	0%	1%	0%
Turn Type	Perm	NA		Perm	NA	Perm	Perm	NA	Perm	Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8		8	2		2	6		
Actuated Green, G (s)		30.0			46.0	46.0		35.0	35.0	35.0	35.0	
Effective Green, g (s)		30.0			46.0	46.0		35.0	35.0	35.0	35.0	
Actuated g/C Ratio		0.32			0.49	0.49		0.38	0.38	0.38	0.38	
Clearance Time (s)		22.0			6.0	6.0		6.0	6.0	6.0	6.0	
Vehicle Extension (s)		3.0			3.0	3.0		3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		378			784	749		662	581	456	666	
v/s Ratio Prot												0.08
v/s Ratio Perm		c0.36			0.33	0.03		c0.09	0.02	0.06		
v/c Ratio		1.11			0.67	0.07		0.23	0.06	0.16	0.20	
Uniform Delay, d1		31.5			17.8	12.3		19.8	18.5	19.3	19.6	
Progression Factor		1.00			0.61	0.64		1.00	1.00	1.00	1.00	
Incremental Delay, d2		80.4			3.5	0.1		0.8	0.2	0.8	0.7	
Delay (s)		111.9			14.2	8.0		20.6	18.7	20.0	20.3	
Level of Service		F			B	A		C	B	C	C	
Approach Delay (s)		111.9			13.3			19.9			20.2	
Approach LOS		F			B			B			C	

Intersection Summary

HCM 2000 Control Delay	43.2	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.70		
Actuated Cycle Length (s)	93.0	Sum of lost time (s)	34.0
Intersection Capacity Utilization	98.0%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Timings
2: Main Street & Church Square/Pleasant Street

237 Pleasant Street TIS
2022 Existing - PM Peak Hour

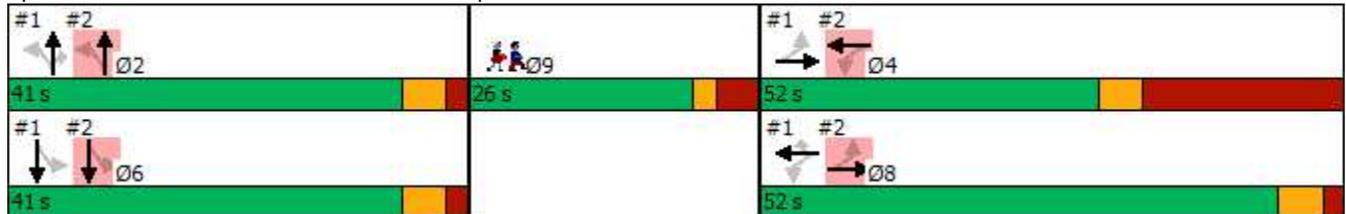


Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	Ø9
Lane Configurations		↕		↕	↗	↖		↕	
Traffic Volume (vph)	181	324	17	382	46	233	28	277	
Future Volume (vph)	181	324	17	382	46	233	28	277	
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA	
Protected Phases		8		4		2		6	9
Permitted Phases	8		4		2		6		
Detector Phase	8	8	4	4	2	2	6	6	
Switch Phase									
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	52.0	52.0	52.0	52.0	41.0	41.0	41.0	41.0	26.0
Total Split (s)	52.0	52.0	52.0	52.0	41.0	41.0	41.0	41.0	26.0
Total Split (%)	43.7%	43.7%	43.7%	43.7%	34.5%	34.5%	34.5%	34.5%	22%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	2.0
All-Red Time (s)	2.0	2.0	18.0	18.0	2.0	2.0	2.0	2.0	4.0
Lost Time Adjust (s)		0.0		0.0	0.0	0.0		0.0	
Total Lost Time (s)		6.0		22.0	6.0	6.0		6.0	
Lead/Lag									
Lead-Lag Optimize?									
Recall Mode	Max	None							

Intersection Summary

Cycle Length: 119
 Actuated Cycle Length: 93
 Natural Cycle: 130
 Control Type: Semi Act-Uncoord

Splits and Phases: 2: Main Street & Church Square/Pleasant Street



Queues
 2: Main Street & Church Square/Pleasant Street

237 Pleasant Street TIS
 2022 Existing - PM Peak Hour



Lane Group	EBT	WBT	NBL	NBT	SBT
Lane Group Flow (vph)	578	435	48	272	479
v/c Ratio	0.77	0.68	0.20	0.40	0.72
Control Delay	12.9	33.9	22.2	23.1	31.0
Queue Delay	44.4	2.0	0.0	0.0	0.0
Total Delay	57.3	35.9	22.2	23.1	31.0
Queue Length 50th (ft)	86	221	19	113	227
Queue Length 95th (ft)	m88	327	46	182	347
Internal Link Dist (ft)	184	2003		629	573
Turn Bay Length (ft)			55		
Base Capacity (vph)	754	636	246	677	665
Starvation Cap Reductn	219	0	0	0	0
Spillback Cap Reductn	0	93	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	1.08	0.80	0.20	0.40	0.72

Intersection Summary

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

HCM Signalized Intersection Capacity Analysis
2: Main Street & Church Square/Pleasant Street

237 Pleasant Street TIS
2022 Existing - PM Peak Hour



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕		↕	↕			↕	
Traffic Volume (vph)	181	324	44	17	382	14	46	233	26	28	277	150
Future Volume (vph)	181	324	44	17	382	14	46	233	26	28	277	150
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	16	16	16	16	16	16	11	11	11	12	12	12
Total Lost time (s)		6.0			22.0		6.0	6.0			6.0	
Lane Util. Factor		1.00			1.00		1.00	1.00			1.00	
Frt		0.99			1.00		1.00	0.99			0.96	
Flt Protected		0.98			1.00		0.95	1.00			1.00	
Satd. Flow (prot)		2068			2100		1745	1793			1787	
Flt Permitted		0.72			0.94		0.36	1.00			0.97	
Satd. Flow (perm)		1521			1973		656	1793			1734	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	191	341	46	18	402	15	48	245	27	29	292	158
RTOR Reduction (vph)	0	2	0	0	1	0	0	3	0	0	13	0
Lane Group Flow (vph)	0	576	0	0	434	0	48	269	0	0	466	0
Heavy Vehicles (%)	2%	1%	1%	0%	2%	0%	0%	1%	0%	0%	1%	2%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		8			4			2			6	
Permitted Phases	8			4			2			6		
Actuated Green, G (s)		46.0			30.0		35.0	35.0			35.0	
Effective Green, g (s)		46.0			30.0		35.0	35.0			35.0	
Actuated g/C Ratio		0.49			0.32		0.38	0.38			0.38	
Clearance Time (s)		6.0			22.0		6.0	6.0			6.0	
Vehicle Extension (s)		3.0			3.0		3.0	3.0			3.0	
Lane Grp Cap (vph)		752			636		246	674			652	
v/s Ratio Prot								0.15				
v/s Ratio Perm		c0.38			0.22		0.07				c0.27	
v/c Ratio		0.77			0.68		0.20	0.40			0.71	
Uniform Delay, d1		19.1			27.4		19.5	21.3			24.7	
Progression Factor		0.42			1.00		1.00	1.00			1.00	
Incremental Delay, d2		4.4			5.9		1.8	1.8			6.6	
Delay (s)		12.3			33.2		21.3	23.0			31.3	
Level of Service		B			C		C	C			C	
Approach Delay (s)		12.3			33.2			22.8			31.3	
Approach LOS		B			C			C			C	

Intersection Summary

HCM 2000 Control Delay	24.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	1.02		
Actuated Cycle Length (s)	93.0	Sum of lost time (s)	34.0
Intersection Capacity Utilization	124.1%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Intersection						
Int Delay, s/veh	1.3					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	356	19	44	457	17	46
Future Vol, veh/h	356	19	44	457	17	46
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	91	91	91	91	91	91
Heavy Vehicles, %	1	0	0	2	3	3
Mvmt Flow	391	21	48	502	19	51

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	412	0	1000
Stage 1	-	-	-	-	402
Stage 2	-	-	-	-	598
Critical Hdwy	-	-	4.1	-	6.43
Critical Hdwy Stg 1	-	-	-	-	5.43
Critical Hdwy Stg 2	-	-	-	-	5.43
Follow-up Hdwy	-	-	2.2	-	3.527
Pot Cap-1 Maneuver	-	-	1158	-	268
Stage 1	-	-	-	-	673
Stage 2	-	-	-	-	547
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1158	-	253
Mov Cap-2 Maneuver	-	-	-	-	253
Stage 1	-	-	-	-	673
Stage 2	-	-	-	-	516

Approach	EB	WB	NB
HCM Control Delay, s	0	0.7	14.3
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	455	-	-	1158	-
HCM Lane V/C Ratio	0.152	-	-	0.042	-
HCM Control Delay (s)	14.3	-	-	8.2	0
HCM Lane LOS	B	-	-	A	A
HCM 95th %tile Q(veh)	0.5	-	-	0.1	-

Intersection						
Int Delay, s/veh	0.2					
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕	↕		↕	
Traffic Vol, veh/h	8	393	479	7	2	8
Future Vol, veh/h	8	393	479	7	2	8
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	95	95	95	95	95	95
Heavy Vehicles, %	0	1	2	0	25	0
Mvmt Flow	8	414	504	7	2	8

Major/Minor	Major1	Major2	Minor2		
Conflicting Flow All	511	0	-	0	938
Stage 1	-	-	-	-	508
Stage 2	-	-	-	-	430
Critical Hdwy	4.1	-	-	-	6.65
Critical Hdwy Stg 1	-	-	-	-	5.65
Critical Hdwy Stg 2	-	-	-	-	5.65
Follow-up Hdwy	2.2	-	-	-	3.725
Pot Cap-1 Maneuver	1065	-	-	-	267
Stage 1	-	-	-	-	560
Stage 2	-	-	-	-	610
Platoon blocked, %		-	-	-	
Mov Cap-1 Maneuver	1065	-	-	-	264
Mov Cap-2 Maneuver	-	-	-	-	264
Stage 1	-	-	-	-	554
Stage 2	-	-	-	-	610

Approach	EB	WB	SB
HCM Control Delay, s	0.2	0	13
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1065	-	-	-	462
HCM Lane V/C Ratio	0.008	-	-	-	0.023
HCM Control Delay (s)	8.4	0	-	-	13
HCM Lane LOS	A	A	-	-	B
HCM 95th %tile Q(veh)	0	-	-	-	0.1

APPENDIX F

Capacity Analysis - 2029 No Build Traffic Conditions

Timings

1: Union Street/Daniel McCahill Street & Beaver Street/Church Square



Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	Ø9
Lane Configurations		↕		↕	↕		↕	↕	↕	↕	
Traffic Volume (vph)	26	261	46	374	172	19	227	88	109	195	
Future Volume (vph)	26	261	46	374	172	19	227	88	109	195	
Turn Type	Perm	NA	Perm	NA	Perm	Perm	NA	Perm	Perm	NA	
Protected Phases		4		8			2			6	9
Permitted Phases	4		8		8	2		2	6		
Detector Phase	4	4	8	8	8	2	2	2	6	6	
Switch Phase											
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	52.0	52.0	52.0	52.0	52.0	41.0	41.0	41.0	41.0	41.0	26.0
Total Split (s)	52.0	52.0	52.0	52.0	52.0	41.0	41.0	41.0	41.0	41.0	26.0
Total Split (%)	43.7%	43.7%	43.7%	43.7%	43.7%	34.5%	34.5%	34.5%	34.5%	34.5%	22%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	2.0
All-Red Time (s)	18.0	18.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	4.0
Lost Time Adjust (s)		0.0		0.0	0.0		0.0	0.0	0.0	0.0	
Total Lost Time (s)		22.0		6.0	6.0		6.0	6.0	6.0	6.0	
Lead/Lag											
Lead-Lag Optimize?											
Recall Mode	Max	None									

Intersection Summary

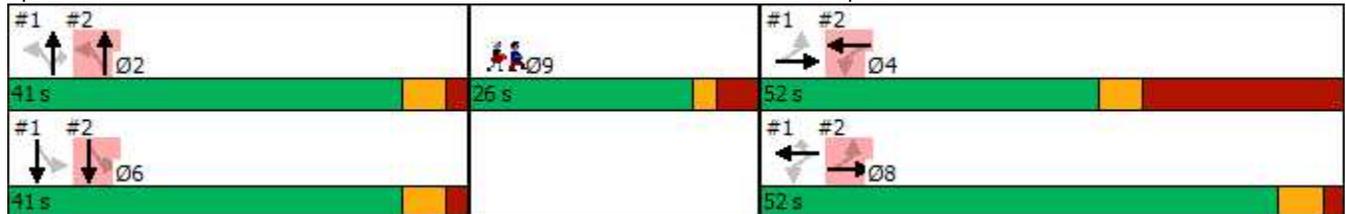
Cycle Length: 119

Actuated Cycle Length: 93

Natural Cycle: 150

Control Type: Semi Act-Uncoord

Splits and Phases: 1: Union Street/Daniel McCahill Street & Beaver Street/Church Square





Lane Group	EBT	WBT	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	389	546	223	320	114	142	327
v/c Ratio	1.31	0.68	0.28	0.50	0.16	0.46	0.50
Control Delay	191.0	14.8	4.7	25.6	0.5	27.7	24.4
Queue Delay	1.2	3.8	0.9	0.0	0.0	0.0	0.0
Total Delay	192.2	18.6	5.6	25.6	0.5	27.7	24.4
Queue Length 50th (ft)	~299	120	24	142	0	62	139
Queue Length 95th (ft)	#382	134	34	181	0	97	177
Internal Link Dist (ft)	368	184		709			548
Turn Bay Length (ft)			65		80	90	
Base Capacity (vph)	297	807	806	643	707	312	660
Starvation Cap Reductn	0	178	350	0	0	0	0
Spillback Cap Reductn	27	0	0	0	6	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	1.44	0.87	0.49	0.50	0.16	0.46	0.50

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

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

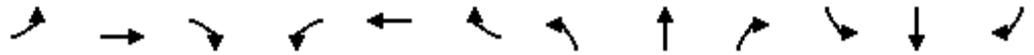
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis

237 Pleasant Street TIS

1: Union Street/Daniel McCahill Street & Beaver Street/Church Square

2029 No Build - AM Peak Hour



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔	↔		↔	↔	↔	↔	↔
Traffic Volume (vph)	26	261	12	46	374	172	19	227	88	109	195	57
Future Volume (vph)	26	261	12	46	374	172	19	227	88	109	195	57
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	16	16	16	11	11	11	11	11	11	11	11	11
Total Lost time (s)		22.0			6.0	6.0		6.0	6.0	6.0	6.0	
Lane Util. Factor		1.00			1.00	1.00		1.00	1.00	1.00	1.00	
Frt		0.99			1.00	0.85		1.00	0.85	1.00	0.97	
Flt Protected		1.00			0.99	1.00		1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1983			1773	1546		1780	1501	1711	1734	
Flt Permitted		0.46			0.92	1.00		0.96	1.00	0.46	1.00	
Satd. Flow (perm)		918			1633	1546		1708	1501	830	1734	
Peak-hour factor, PHF	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
Adj. Flow (vph)	34	339	16	60	486	223	25	295	114	142	253	74
RTOR Reduction (vph)	0	1	0	0	0	42	0	0	71	0	8	0
Lane Group Flow (vph)	0	388	0	0	546	181	0	320	43	142	319	0
Heavy Vehicles (%)	5%	7%	24%	3%	3%	1%	0%	3%	4%	2%	3%	0%
Turn Type	Perm	NA		Perm	NA	Perm	Perm	NA	Perm	Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8		8	2		2	6		
Actuated Green, G (s)		30.0			46.0	46.0		35.0	35.0	35.0	35.0	
Effective Green, g (s)		30.0			46.0	46.0		35.0	35.0	35.0	35.0	
Actuated g/C Ratio		0.32			0.49	0.49		0.38	0.38	0.38	0.38	
Clearance Time (s)		22.0			6.0	6.0		6.0	6.0	6.0	6.0	
Vehicle Extension (s)		3.0			3.0	3.0		3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		296			807	764		642	564	312	652	
v/s Ratio Prot												0.18
v/s Ratio Perm		c0.42			0.33	0.12		c0.19	0.03	0.17		
v/c Ratio		1.31			0.68	0.24		0.50	0.08	0.46	0.49	
Uniform Delay, d1		31.5			17.8	13.5		22.3	18.6	21.8	22.2	
Progression Factor		1.00			0.59	0.47		1.00	1.00	1.00	1.00	
Incremental Delay, d2		161.5			3.8	0.6		2.8	0.3	4.7	2.6	
Delay (s)		193.0			14.4	6.9		25.0	18.9	26.6	24.8	
Level of Service		F			B	A		C	B	C	C	
Approach Delay (s)		193.0			12.2			23.4			25.3	
Approach LOS		F			B			C			C	

Intersection Summary

HCM 2000 Control Delay	51.7	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.96		
Actuated Cycle Length (s)	93.0	Sum of lost time (s)	34.0
Intersection Capacity Utilization	91.2%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Timings
2: Main Street & Church Square/Pleasant Street

237 Pleasant Street TIS
2029 No Build - AM Peak Hour

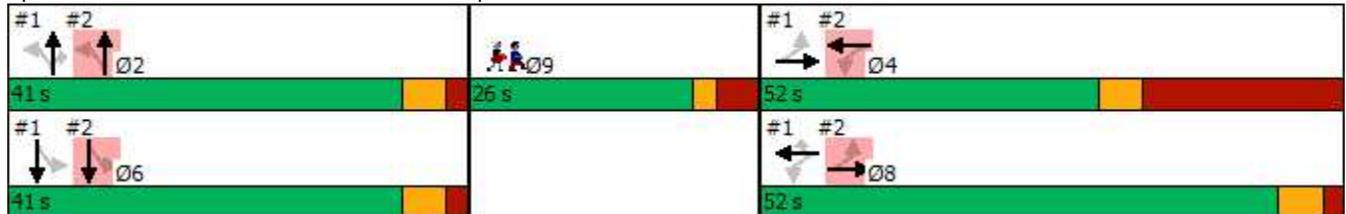


Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	Ø9
Lane Configurations		↕		↕	↗	↖		↕	
Traffic Volume (vph)	113	298	5	393	40	180	36	258	
Future Volume (vph)	113	298	5	393	40	180	36	258	
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA	
Protected Phases		8		4		2		6	9
Permitted Phases	8		4		2		6		
Detector Phase	8	8	4	4	2	2	6	6	
Switch Phase									
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	52.0	52.0	52.0	52.0	41.0	41.0	41.0	41.0	26.0
Total Split (s)	52.0	52.0	52.0	52.0	41.0	41.0	41.0	41.0	26.0
Total Split (%)	43.7%	43.7%	43.7%	43.7%	34.5%	34.5%	34.5%	34.5%	22%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	2.0
All-Red Time (s)	2.0	2.0	18.0	18.0	2.0	2.0	2.0	2.0	4.0
Lost Time Adjust (s)		0.0		0.0	0.0	0.0		0.0	
Total Lost Time (s)		6.0		22.0	6.0	6.0		6.0	
Lead/Lag									
Lead-Lag Optimize?									
Recall Mode	Max	None							

Intersection Summary

Cycle Length: 119
 Actuated Cycle Length: 93
 Natural Cycle: 150
 Control Type: Semi Act-Uncoord

Splits and Phases: 2: Main Street & Church Square/Pleasant Street



Queues
 2: Main Street & Church Square/Pleasant Street

237 Pleasant Street TIS
 2029 No Build - AM Peak Hour



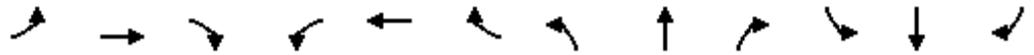
Lane Group	EBT	WBT	NBL	NBT	SBT
Lane Group Flow (vph)	514	460	45	223	478
v/c Ratio	0.67	0.71	0.18	0.34	0.74
Control Delay	12.9	34.6	22.0	22.1	32.1
Queue Delay	54.3	2.5	0.0	0.0	0.0
Total Delay	67.3	37.1	22.0	22.1	32.1
Queue Length 50th (ft)	114	235	17	90	230
Queue Length 95th (ft)	m112	336	43	145	340
Internal Link Dist (ft)	184	2003		629	573
Turn Bay Length (ft)			55		
Base Capacity (vph)	768	650	246	661	650
Starvation Cap Reductn	322	0	0	0	0
Spillback Cap Reductn	0	95	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	1.15	0.83	0.18	0.34	0.74

Intersection Summary

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

HCM Signalized Intersection Capacity Analysis
 2: Main Street & Church Square/Pleasant Street

237 Pleasant Street TIS
 2029 No Build - AM Peak Hour



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕		↗	↘			↕	
Traffic Volume (vph)	113	298	41	5	393	6	40	180	16	36	258	127
Future Volume (vph)	113	298	41	5	393	6	40	180	16	36	258	127
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	16	16	16	16	16	16	11	11	11	12	12	12
Total Lost time (s)		6.0			22.0		6.0	6.0			6.0	
Lane Util. Factor		1.00			1.00		1.00	1.00			1.00	
Frt		0.99			1.00		1.00	0.99			0.96	
Flt Protected		0.99			1.00		0.95	1.00			1.00	
Satd. Flow (prot)		1972			2055		1711	1750			1771	
Flt Permitted		0.78			0.98		0.36	1.00			0.95	
Satd. Flow (perm)		1548			2015		654	1750			1698	
Peak-hour factor, PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	128	339	47	6	447	7	45	205	18	41	293	144
RTOR Reduction (vph)	0	3	0	0	1	0	0	2	0	0	11	0
Lane Group Flow (vph)	0	511	0	0	459	0	45	221	0	0	467	0
Heavy Vehicles (%)	4%	8%	3%	0%	4%	42%	2%	4%	0%	15%	1%	2%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		8			4			2			6	
Permitted Phases	8			4			2			6		
Actuated Green, G (s)		46.0			30.0		35.0	35.0			35.0	
Effective Green, g (s)		46.0			30.0		35.0	35.0			35.0	
Actuated g/C Ratio		0.49			0.32		0.38	0.38			0.38	
Clearance Time (s)		6.0			22.0		6.0	6.0			6.0	
Vehicle Extension (s)		3.0			3.0		3.0	3.0			3.0	
Lane Grp Cap (vph)		765			650		246	658			639	
v/s Ratio Prot								0.13				
v/s Ratio Perm		c0.33			0.23		0.07				c0.27	
v/c Ratio		0.67			0.71		0.18	0.34			0.73	
Uniform Delay, d1		17.7			27.6		19.4	20.7			24.9	
Progression Factor		0.59			1.00		1.00	1.00			1.00	
Incremental Delay, d2		2.1			6.4		1.6	1.4			7.2	
Delay (s)		12.6			34.0		21.1	22.1			32.1	
Level of Service		B			C		C	C			C	
Approach Delay (s)		12.6			34.0			21.9			32.1	
Approach LOS		B			C			C			C	

Intersection Summary		
HCM 2000 Control Delay	25.2	HCM 2000 Level of Service
HCM 2000 Volume to Capacity ratio	0.95	C
Actuated Cycle Length (s)	93.0	Sum of lost time (s)
Intersection Capacity Utilization	112.8%	34.0
Analysis Period (min)	15	ICU Level of Service
		H

c Critical Lane Group

Intersection						
Int Delay, s/veh	1.4					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	390	10	35	401	23	43
Future Vol, veh/h	390	10	35	401	23	43
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	90	90	90	90	90	90
Heavy Vehicles, %	8	7	3	4	0	2
Mvmt Flow	433	11	39	446	26	48

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	444	0	963 439
Stage 1	-	-	-	-	439 -
Stage 2	-	-	-	-	524 -
Critical Hdwy	-	-	4.13	-	6.4 6.22
Critical Hdwy Stg 1	-	-	-	-	5.4 -
Critical Hdwy Stg 2	-	-	-	-	5.4 -
Follow-up Hdwy	-	-	2.227	-	3.5 3.318
Pot Cap-1 Maneuver	-	-	1111	-	286 618
Stage 1	-	-	-	-	654 -
Stage 2	-	-	-	-	598 -
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1111	-	273 618
Mov Cap-2 Maneuver	-	-	-	-	273 -
Stage 1	-	-	-	-	654 -
Stage 2	-	-	-	-	570 -

Approach	EB	WB	NB
HCM Control Delay, s	0	0.7	15.1
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	429	-	-	1111	-
HCM Lane V/C Ratio	0.171	-	-	0.035	-
HCM Control Delay (s)	15.1	-	-	8.4	0
HCM Lane LOS	C	-	-	A	A
HCM 95th %tile Q(veh)	0.6	-	-	0.1	-

Intersection						
Int Delay, s/veh	0.5					
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↔	↔		↔	
Traffic Vol, veh/h	9	457	426	0	5	20
Future Vol, veh/h	9	457	426	0	5	20
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	86	86	86	86	86	86
Heavy Vehicles, %	0	7	4	0	0	0
Mvmt Flow	10	531	495	0	6	23

Major/Minor	Major1	Major2	Minor2		
Conflicting Flow All	495	0	-	0	1046 495
Stage 1	-	-	-	-	495 -
Stage 2	-	-	-	-	551 -
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	1079	-	-	-	255 579
Stage 1	-	-	-	-	617 -
Stage 2	-	-	-	-	581 -
Platoon blocked, %		-	-	-	
Mov Cap-1 Maneuver	1079	-	-	-	252 579
Mov Cap-2 Maneuver	-	-	-	-	252 -
Stage 1	-	-	-	-	609 -
Stage 2	-	-	-	-	581 -

Approach	EB	WB	SB
HCM Control Delay, s	0.2	0	13.4
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1079	-	-	-	460
HCM Lane V/C Ratio	0.01	-	-	-	0.063
HCM Control Delay (s)	8.4	0	-	-	13.4
HCM Lane LOS	A	A	-	-	B
HCM 95th %tile Q(veh)	0	-	-	-	0.2

Timings

1: Union Street/Daniel McCahill Street & Beaver Street/Church Square



Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	Ø9
Lane Configurations		↕		↕	↕		↕	↕	↕	↕	
Traffic Volume (vph)	8	412	83	470	95	20	138	90	78	121	
Future Volume (vph)	8	412	83	470	95	20	138	90	78	121	
Turn Type	Perm	NA	Perm	NA	Perm	Perm	NA	Perm	Perm	NA	
Protected Phases		4		8			2			6	9
Permitted Phases	4		8		8	2		2	6		
Detector Phase	4	4	8	8	8	2	2	2	6	6	
Switch Phase											
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	52.0	52.0	52.0	52.0	52.0	41.0	41.0	41.0	41.0	41.0	26.0
Total Split (s)	52.0	52.0	52.0	52.0	52.0	41.0	41.0	41.0	41.0	41.0	26.0
Total Split (%)	43.7%	43.7%	43.7%	43.7%	43.7%	34.5%	34.5%	34.5%	34.5%	34.5%	22%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	2.0
All-Red Time (s)	18.0	18.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	4.0
Lost Time Adjust (s)		0.0		0.0	0.0		0.0	0.0	0.0	0.0	
Total Lost Time (s)		22.0		6.0	6.0		6.0	6.0	6.0	6.0	
Lead/Lag											
Lead-Lag Optimize?											
Recall Mode	Max	None									

Intersection Summary

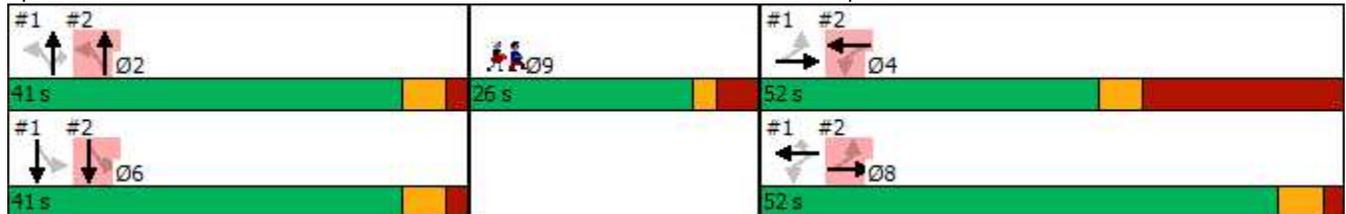
Cycle Length: 119

Actuated Cycle Length: 93

Natural Cycle: 150

Control Type: Semi Act-Uncoord

Splits and Phases: 1: Union Street/Daniel McCahill Street & Beaver Street/Church Square





Lane Group	EBT	WBT	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	454	565	97	161	92	80	152
v/c Ratio	1.41	0.73	0.12	0.24	0.13	0.18	0.23
Control Delay	230.3	16.0	2.5	21.2	0.4	20.8	19.5
Queue Delay	1.2	5.0	0.0	0.0	0.0	0.0	0.0
Total Delay	231.5	21.0	2.5	21.2	0.4	20.8	19.5
Queue Length 50th (ft)	~365	124	4	64	0	31	56
Queue Length 95th (ft)	#555	445	m8	111	0	64	100
Internal Link Dist (ft)	368	184		709			548
Turn Bay Length (ft)			65		80	90	
Base Capacity (vph)	322	777	791	661	724	452	671
Starvation Cap Reductn	0	150	0	0	0	0	0
Spillback Cap Reductn	32	0	0	0	6	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	1.57	0.90	0.12	0.24	0.13	0.18	0.23

Intersection Summary

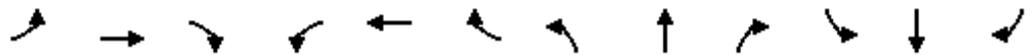
- ~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
- m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis

237 Pleasant Street TIS

1: Union Street/Daniel McCahill Street & Beaver Street/Church Square

2029 No Build - PM Peak Hour



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔	↔		↔	↔	↔	↔	
Traffic Volume (vph)	8	412	25	83	470	95	20	138	90	78	121	28
Future Volume (vph)	8	412	25	83	470	95	20	138	90	78	121	28
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	16	16	16	11	11	11	11	11	11	11	11	11
Total Lost time (s)		22.0			6.0	6.0		6.0	6.0	6.0	6.0	
Lane Util. Factor		1.00			1.00	1.00		1.00	1.00	1.00	1.00	
Frt		0.99			1.00	0.85		1.00	0.85	1.00	0.97	
Flt Protected		1.00			0.99	1.00		0.99	1.00	0.95	1.00	
Satd. Flow (prot)		2115			1802	1516		1825	1546	1745	1770	
Flt Permitted		0.47			0.86	1.00		0.96	1.00	0.66	1.00	
Satd. Flow (perm)		998			1570	1516		1758	1546	1203	1770	
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	8	420	26	85	480	97	20	141	92	80	123	29
RTOR Reduction (vph)	0	1	0	0	0	42	0	0	57	0	6	0
Lane Group Flow (vph)	0	453	0	0	565	55	0	161	35	80	146	0
Heavy Vehicles (%)	0%	1%	0%	2%	1%	3%	0%	0%	1%	0%	1%	0%
Turn Type	Perm	NA		Perm	NA	Perm	Perm	NA	Perm	Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8		8	2		2	6		
Actuated Green, G (s)		30.0			46.0	46.0		35.0	35.0	35.0	35.0	
Effective Green, g (s)		30.0			46.0	46.0		35.0	35.0	35.0	35.0	
Actuated g/C Ratio		0.32			0.49	0.49		0.38	0.38	0.38	0.38	
Clearance Time (s)		22.0			6.0	6.0		6.0	6.0	6.0	6.0	
Vehicle Extension (s)		3.0			3.0	3.0		3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		321			776	749		661	581	452	666	
v/s Ratio Prot												0.08
v/s Ratio Perm		c0.45			0.36	0.04		c0.09	0.02	0.07		
v/c Ratio		1.41			0.73	0.07		0.24	0.06	0.18	0.22	
Uniform Delay, d1		31.5			18.6	12.3		19.9	18.5	19.4	19.7	
Progression Factor		1.00			0.61	0.59		1.00	1.00	1.00	1.00	
Incremental Delay, d2		202.2			4.2	0.1		0.9	0.2	0.9	0.8	
Delay (s)		233.7			15.5	7.4		20.8	18.7	20.2	20.5	
Level of Service		F			B	A		C	B	C	C	
Approach Delay (s)		233.7			14.3			20.0			20.4	
Approach LOS		F			B			C			C	

Intersection Summary

HCM 2000 Control Delay	78.3	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	93.0	Sum of lost time (s)	34.0
Intersection Capacity Utilization	102.7%	ICU Level of Service	G
Analysis Period (min)	15		

c Critical Lane Group

Timings
2: Main Street & Church Square/Pleasant Street

237 Pleasant Street TIS
2029 No Build - PM Peak Hour

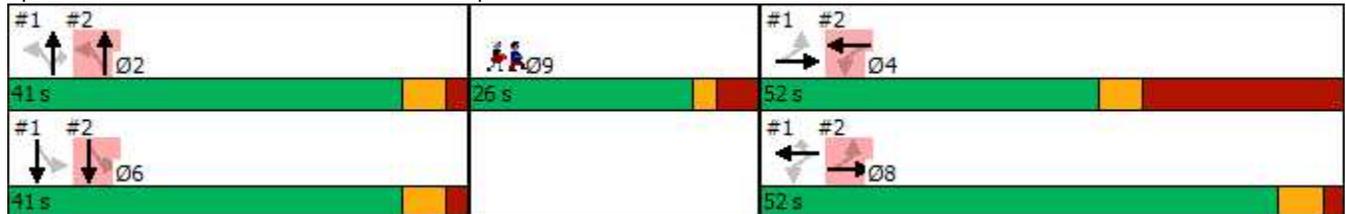


Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	Ø9
Lane Configurations		↕		↕	↗	↖		↕	
Traffic Volume (vph)	194	347	18	410	49	250	30	297	
Future Volume (vph)	194	347	18	410	49	250	30	297	
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA	
Protected Phases		8		4		2		6	9
Permitted Phases	8		4		2		6		
Detector Phase	8	8	4	4	2	2	6	6	
Switch Phase									
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	52.0	52.0	52.0	52.0	41.0	41.0	41.0	41.0	26.0
Total Split (s)	52.0	52.0	52.0	52.0	41.0	41.0	41.0	41.0	26.0
Total Split (%)	43.7%	43.7%	43.7%	43.7%	34.5%	34.5%	34.5%	34.5%	22%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	2.0
All-Red Time (s)	2.0	2.0	18.0	18.0	2.0	2.0	2.0	2.0	4.0
Lost Time Adjust (s)		0.0		0.0	0.0	0.0		0.0	
Total Lost Time (s)		6.0		22.0	6.0	6.0		6.0	
Lead/Lag									
Lead-Lag Optimize?									
Recall Mode	Max	None							

Intersection Summary

Cycle Length: 119
 Actuated Cycle Length: 93
 Natural Cycle: 150
 Control Type: Semi Act-Uncoord

Splits and Phases: 2: Main Street & Church Square/Pleasant Street



Queues
2: Main Street & Church Square/Pleasant Street

237 Pleasant Street TIS
2029 No Build - PM Peak Hour



Lane Group	EBT	WBT	NBL	NBT	SBT
Lane Group Flow (vph)	618	467	52	292	514
v/c Ratio	0.83	0.74	0.23	0.43	0.78
Control Delay	12.7	36.1	23.1	23.7	34.0
Queue Delay	51.3	5.3	0.0	0.0	0.0
Total Delay	64.0	41.3	23.1	23.7	34.0
Queue Length 50th (ft)	93	242	21	124	252
Queue Length 95th (ft)	m81	357	50	196	#390
Internal Link Dist (ft)	184	2003		629	573
Turn Bay Length (ft)			55		
Base Capacity (vph)	741	635	230	677	663
Starvation Cap Reductn	244	0	0	0	0
Spillback Cap Reductn	0	113	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	1.24	0.89	0.23	0.43	0.78

Intersection Summary

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

Queue shown is maximum after two cycles.

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

HCM Signalized Intersection Capacity Analysis

2: Main Street & Church Square/Pleasant Street

237 Pleasant Street TIS
2029 No Build - PM Peak Hour



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕		↗	↘			↕	
Traffic Volume (vph)	194	347	47	18	410	15	49	250	28	30	297	161
Future Volume (vph)	194	347	47	18	410	15	49	250	28	30	297	161
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	16	16	16	16	16	16	11	11	11	12	12	12
Total Lost time (s)		6.0			22.0		6.0	6.0			6.0	
Lane Util. Factor		1.00			1.00		1.00	1.00			1.00	
Frt		0.99			1.00		1.00	0.99			0.96	
Flt Protected		0.98			1.00		0.95	1.00			1.00	
Satd. Flow (prot)		2068			2100		1745	1793			1787	
Flt Permitted		0.71			0.94		0.33	1.00			0.96	
Satd. Flow (perm)		1497			1968		614	1793			1728	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	204	365	49	19	432	16	52	263	29	32	313	169
RTOR Reduction (vph)	0	2	0	0	1	0	0	3	0	0	13	0
Lane Group Flow (vph)	0	616	0	0	466	0	52	289	0	0	501	0
Heavy Vehicles (%)	2%	1%	1%	0%	2%	0%	0%	1%	0%	0%	1%	2%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		8			4			2			6	
Permitted Phases	8			4			2			6		
Actuated Green, G (s)		46.0			30.0		35.0	35.0			35.0	
Effective Green, g (s)		46.0			30.0		35.0	35.0			35.0	
Actuated g/C Ratio		0.49			0.32		0.38	0.38			0.38	
Clearance Time (s)		6.0			22.0		6.0	6.0			6.0	
Vehicle Extension (s)		3.0			3.0		3.0	3.0			3.0	
Lane Grp Cap (vph)		740			634		231	674			650	
v/s Ratio Prot								0.16				
v/s Ratio Perm		c0.41			0.24		0.08				c0.29	
v/c Ratio		0.83			0.74		0.23	0.43			0.77	
Uniform Delay, d1		20.2			28.0		19.8	21.6			25.5	
Progression Factor		0.42			1.00		1.00	1.00			1.00	
Incremental Delay, d2		2.7			7.4		2.2	2.0			8.6	
Delay (s)		11.2			35.4		22.0	23.6			34.1	
Level of Service		B			D		C	C			C	
Approach Delay (s)		11.2			35.4			23.3			34.1	
Approach LOS		B			D			C			C	

Intersection Summary

HCM 2000 Control Delay	25.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	1.11		
Actuated Cycle Length (s)	93.0	Sum of lost time (s)	34.0
Intersection Capacity Utilization	130.6%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Intersection						
Int Delay, s/veh	1.4					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	382	20	47	490	18	49
Future Vol, veh/h	382	20	47	490	18	49
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	91	91	91	91	91	91
Heavy Vehicles, %	1	0	0	2	3	3
Mvmt Flow	420	22	52	538	20	54

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	442	0	1073 431
Stage 1	-	-	-	-	431 -
Stage 2	-	-	-	-	642 -
Critical Hdwy	-	-	4.1	-	6.43 6.23
Critical Hdwy Stg 1	-	-	-	-	5.43 -
Critical Hdwy Stg 2	-	-	-	-	5.43 -
Follow-up Hdwy	-	-	2.2	-	3.527 3.327
Pot Cap-1 Maneuver	-	-	1129	-	243 622
Stage 1	-	-	-	-	653 -
Stage 2	-	-	-	-	522 -
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1129	-	227 622
Mov Cap-2 Maneuver	-	-	-	-	227 -
Stage 1	-	-	-	-	653 -
Stage 2	-	-	-	-	488 -

Approach	EB	WB	NB
HCM Control Delay, s	0	0.7	15.3
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	424	-	-	1129	-
HCM Lane V/C Ratio	0.174	-	-	0.046	-
HCM Control Delay (s)	15.3	-	-	8.3	0
HCM Lane LOS	C	-	-	A	A
HCM 95th %tile Q(veh)	0.6	-	-	0.1	-

Intersection						
Int Delay, s/veh	0.2					
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕	↕		↕	
Traffic Vol, veh/h	9	421	514	8	2	9
Future Vol, veh/h	9	421	514	8	2	9
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	95	95	95	95	95	95
Heavy Vehicles, %	0	1	2	0	25	0
Mvmt Flow	9	443	541	8	2	9

Major/Minor	Major1	Major2	Minor2		
Conflicting Flow All	549	0	-	0	1006 545
Stage 1	-	-	-	-	545 -
Stage 2	-	-	-	-	461 -
Critical Hdwy	4.1	-	-	-	6.65 6.2
Critical Hdwy Stg 1	-	-	-	-	5.65 -
Critical Hdwy Stg 2	-	-	-	-	5.65 -
Follow-up Hdwy	2.2	-	-	-	3.725 3.3
Pot Cap-1 Maneuver	1031	-	-	-	243 542
Stage 1	-	-	-	-	538 -
Stage 2	-	-	-	-	589 -
Platoon blocked, %		-	-	-	
Mov Cap-1 Maneuver	1031	-	-	-	240 542
Mov Cap-2 Maneuver	-	-	-	-	240 -
Stage 1	-	-	-	-	532 -
Stage 2	-	-	-	-	589 -

Approach	EB	WB	SB
HCM Control Delay, s	0.2	0	13.4
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1031	-	-	-	441
HCM Lane V/C Ratio	0.009	-	-	-	0.026
HCM Control Delay (s)	8.5	0	-	-	13.4
HCM Lane LOS	A	A	-	-	B
HCM 95th %tile Q(veh)	0	-	-	-	0.1

APPENDIX G

Capacity Analysis - 2029 Build Traffic Conditions

Timings

1: Union Street/Daniel McCahill Street & Beaver Street/Church Square

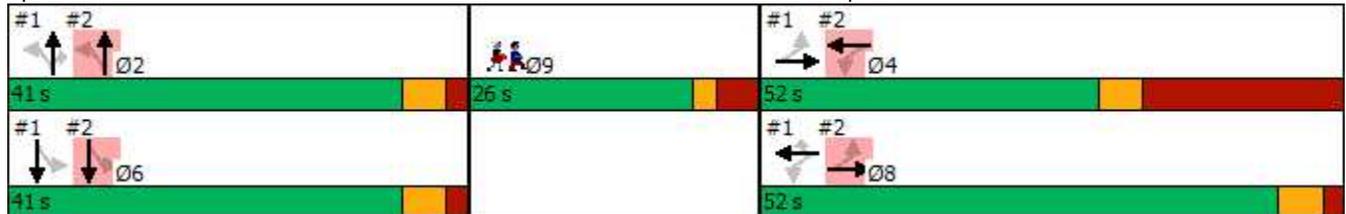


Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	Ø9
Lane Configurations		↕		↕	↕		↕	↕	↕	↕	
Traffic Volume (vph)	26	263	54	382	172	19	227	91	109	195	
Future Volume (vph)	26	263	54	382	172	19	227	91	109	195	
Turn Type	Perm	NA	Perm	NA	Perm	Perm	NA	Perm	Perm	NA	
Protected Phases		4		8			2			6	9
Permitted Phases	4		8		8	2		2	6		
Detector Phase	4	4	8	8	8	2	2	2	6	6	
Switch Phase											
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	52.0	52.0	52.0	52.0	52.0	41.0	41.0	41.0	41.0	41.0	26.0
Total Split (s)	52.0	52.0	52.0	52.0	52.0	41.0	41.0	41.0	41.0	41.0	26.0
Total Split (%)	43.7%	43.7%	43.7%	43.7%	43.7%	34.5%	34.5%	34.5%	34.5%	34.5%	22%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	2.0
All-Red Time (s)	18.0	18.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	4.0
Lost Time Adjust (s)		0.0		0.0	0.0		0.0	0.0	0.0	0.0	
Total Lost Time (s)		22.0		6.0	6.0		6.0	6.0	6.0	6.0	
Lead/Lag											
Lead-Lag Optimize?											
Recall Mode	Max	None									

Intersection Summary

Cycle Length: 119
 Actuated Cycle Length: 93
 Natural Cycle: 150
 Control Type: Semi Act-Uncoord

Splits and Phases: 1: Union Street/Daniel McCahill Street & Beaver Street/Church Square





Lane Group	EBT	WBT	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	392	566	223	320	118	142	327
v/c Ratio	1.42	0.71	0.28	0.50	0.17	0.46	0.50
Control Delay	237.3	15.6	4.5	25.6	0.5	27.7	24.4
Queue Delay	1.3	4.9	0.9	0.0	0.0	0.0	0.0
Total Delay	238.6	20.5	5.4	25.6	0.5	27.7	24.4
Queue Length 50th (ft)	~316	122	23	142	0	62	139
Queue Length 95th (ft)	#400	136	33	181	0	97	177
Internal Link Dist (ft)	368	184		709			548
Turn Bay Length (ft)			65		80	90	
Base Capacity (vph)	276	795	806	643	707	312	660
Starvation Cap Reductn	0	164	353	0	0	0	0
Spillback Cap Reductn	26	0	0	0	6	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	1.57	0.90	0.49	0.50	0.17	0.46	0.50

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.

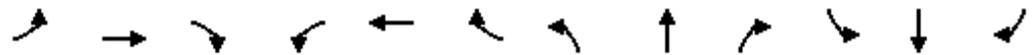
Queue shown is maximum after two cycles.

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

Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis
 1: Union Street/Daniel McCahill Street & Beaver Street/Church Square

237 Pleasant Street TIS
 2029 Build - AM Peak Hour



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕	↕		↕	↕	↕	↕	↕
Traffic Volume (vph)	26	263	12	54	382	172	19	227	91	109	195	57
Future Volume (vph)	26	263	12	54	382	172	19	227	91	109	195	57
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	16	16	16	11	11	11	11	11	11	11	11	11
Total Lost time (s)		22.0			6.0	6.0		6.0	6.0	6.0	6.0	
Lane Util. Factor		1.00			1.00	1.00		1.00	1.00	1.00	1.00	
Frt		0.99			1.00	0.85		1.00	0.85	1.00	0.97	
Flt Protected		1.00			0.99	1.00		1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1983			1772	1546		1780	1501	1711	1734	
Flt Permitted		0.43			0.90	1.00		0.96	1.00	0.46	1.00	
Satd. Flow (perm)		851			1608	1546		1708	1501	830	1734	
Peak-hour factor, PHF	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
Adj. Flow (vph)	34	342	16	70	496	223	25	295	118	142	253	74
RTOR Reduction (vph)	0	1	0	0	0	42	0	0	74	0	8	0
Lane Group Flow (vph)	0	391	0	0	566	181	0	320	44	142	319	0
Heavy Vehicles (%)	5%	7%	24%	3%	3%	1%	0%	3%	4%	2%	3%	0%
Turn Type	Perm	NA		Perm	NA	Perm	Perm	NA	Perm	Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8		8	2		2	6		
Actuated Green, G (s)		30.0			46.0	46.0		35.0	35.0	35.0	35.0	
Effective Green, g (s)		30.0			46.0	46.0		35.0	35.0	35.0	35.0	
Actuated g/C Ratio		0.32			0.49	0.49		0.38	0.38	0.38	0.38	
Clearance Time (s)		22.0			6.0	6.0		6.0	6.0	6.0	6.0	
Vehicle Extension (s)		3.0			3.0	3.0		3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		274			795	764		642	564	312	652	
v/s Ratio Prot												0.18
v/s Ratio Perm		c0.46			0.35	0.12		c0.19	0.03	0.17		
v/c Ratio		1.43			0.71	0.24		0.50	0.08	0.46	0.49	
Uniform Delay, d1		31.5			18.3	13.5		22.3	18.6	21.8	22.2	
Progression Factor		1.00			0.58	0.45		1.00	1.00	1.00	1.00	
Incremental Delay, d2		211.5			4.4	0.6		2.8	0.3	4.7	2.6	
Delay (s)		243.0			15.2	6.6		25.0	18.9	26.6	24.8	
Level of Service		F			B	A		C	B	C	C	
Approach Delay (s)		243.0			12.8			23.4			25.3	
Approach LOS		F			B			C			C	

Intersection Summary		
HCM 2000 Control Delay	61.0	HCM 2000 Level of Service
HCM 2000 Volume to Capacity ratio	1.02	E
Actuated Cycle Length (s)	93.0	Sum of lost time (s)
Intersection Capacity Utilization	91.3%	34.0
Analysis Period (min)	15	ICU Level of Service
		F

c Critical Lane Group

Timings
2: Main Street & Church Square/Pleasant Street

237 Pleasant Street TIS
2029 Build - AM Peak Hour

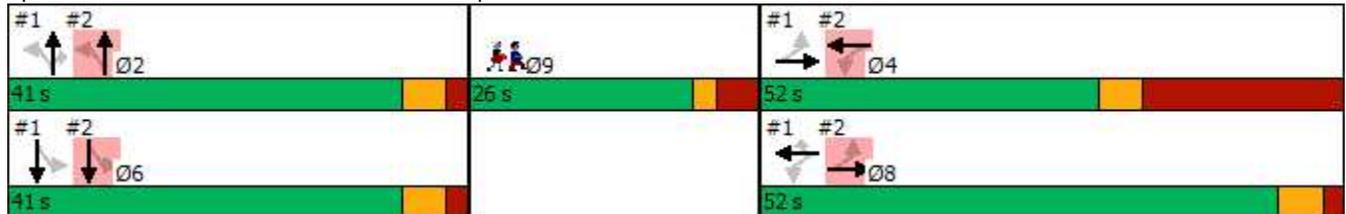


Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	Ø9
Lane Configurations		↕		↕	↗	↖		↕	
Traffic Volume (vph)	113	303	5	409	40	180	36	258	
Future Volume (vph)	113	303	5	409	40	180	36	258	
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA	
Protected Phases		8		4		2		6	9
Permitted Phases	8		4		2		6		
Detector Phase	8	8	4	4	2	2	6	6	
Switch Phase									
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	52.0	52.0	52.0	52.0	41.0	41.0	41.0	41.0	26.0
Total Split (s)	52.0	52.0	52.0	52.0	41.0	41.0	41.0	41.0	26.0
Total Split (%)	43.7%	43.7%	43.7%	43.7%	34.5%	34.5%	34.5%	34.5%	22%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	2.0
All-Red Time (s)	2.0	2.0	18.0	18.0	2.0	2.0	2.0	2.0	4.0
Lost Time Adjust (s)		0.0		0.0	0.0	0.0		0.0	
Total Lost Time (s)		6.0		22.0	6.0	6.0		6.0	
Lead/Lag									
Lead-Lag Optimize?									
Recall Mode	Max	None							

Intersection Summary

Cycle Length: 119
Actuated Cycle Length: 93
Natural Cycle: 150
Control Type: Semi Act-Uncoord

Splits and Phases: 2: Main Street & Church Square/Pleasant Street



Queues
 2: Main Street & Church Square/Pleasant Street

237 Pleasant Street TIS
 2029 Build - AM Peak Hour



Lane Group	EBT	WBT	NBL	NBT	SBT
Lane Group Flow (vph)	519	478	45	223	478
v/c Ratio	0.68	0.73	0.18	0.34	0.74
Control Delay	12.6	35.8	22.0	22.1	32.1
Queue Delay	54.5	4.1	0.0	0.0	0.0
Total Delay	67.1	39.9	22.0	22.1	32.1
Queue Length 50th (ft)	115	247	17	90	230
Queue Length 95th (ft)	m109	352	43	145	340
Internal Link Dist (ft)	184	2003		629	573
Turn Bay Length (ft)			55		
Base Capacity (vph)	764	651	246	661	650
Starvation Cap Reductn	328	0	0	0	0
Spillback Cap Reductn	0	106	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	1.19	0.88	0.18	0.34	0.74

Intersection Summary

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

HCM Signalized Intersection Capacity Analysis

2: Main Street & Church Square/Pleasant Street

237 Pleasant Street TIS
2029 Build - AM Peak Hour



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕		↗	↘			↕	
Traffic Volume (vph)	113	303	41	5	409	6	40	180	16	36	258	127
Future Volume (vph)	113	303	41	5	409	6	40	180	16	36	258	127
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	16	16	16	16	16	16	11	11	11	12	12	12
Total Lost time (s)		6.0			22.0		6.0	6.0			6.0	
Lane Util. Factor		1.00			1.00		1.00	1.00			1.00	
Frt		0.99			1.00		1.00	0.99			0.96	
Flt Protected		0.99			1.00		0.95	1.00			1.00	
Satd. Flow (prot)		1972			2055		1711	1750			1771	
Flt Permitted		0.77			0.98		0.36	1.00			0.95	
Satd. Flow (perm)		1540			2017		654	1750			1698	
Peak-hour factor, PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	128	344	47	6	465	7	45	205	18	41	293	144
RTOR Reduction (vph)	0	3	0	0	1	0	0	2	0	0	11	0
Lane Group Flow (vph)	0	516	0	0	477	0	45	221	0	0	467	0
Heavy Vehicles (%)	4%	8%	3%	0%	4%	42%	2%	4%	0%	15%	1%	2%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		8			4			2			6	
Permitted Phases	8			4			2			6		
Actuated Green, G (s)		46.0			30.0		35.0	35.0			35.0	
Effective Green, g (s)		46.0			30.0		35.0	35.0			35.0	
Actuated g/C Ratio		0.49			0.32		0.38	0.38			0.38	
Clearance Time (s)		6.0			22.0		6.0	6.0			6.0	
Vehicle Extension (s)		3.0			3.0		3.0	3.0			3.0	
Lane Grp Cap (vph)		761			650		246	658			639	
v/s Ratio Prot								0.13				
v/s Ratio Perm		c0.34			0.24		0.07				c0.27	
v/c Ratio		0.68			0.73		0.18	0.34			0.73	
Uniform Delay, d1		17.9			28.0		19.4	20.7			24.9	
Progression Factor		0.59			1.00		1.00	1.00			1.00	
Incremental Delay, d2		1.6			7.2		1.6	1.4			7.2	
Delay (s)		12.3			35.2		21.1	22.1			32.1	
Level of Service		B			D		C	C			C	
Approach Delay (s)		12.3			35.2			21.9			32.1	
Approach LOS		B			D			C			C	

Intersection Summary

HCM 2000 Control Delay	25.5	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.96		
Actuated Cycle Length (s)	93.0	Sum of lost time (s)	34.0
Intersection Capacity Utilization	113.9%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Intersection						
Int Delay, s/veh	1.5					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	395	10	40	417	23	44
Future Vol, veh/h	395	10	40	417	23	44
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	90	90	90	90	90	90
Heavy Vehicles, %	8	7	3	4	0	2
Mvmt Flow	439	11	44	463	26	49

Major/Minor	Major1	Major2	Minor1	Minor2	Minor3
Conflicting Flow All	0	0	450	0	996
Stage 1	-	-	-	-	445
Stage 2	-	-	-	-	551
Critical Hdwy	-	-	4.13	-	6.4
Critical Hdwy Stg 1	-	-	-	-	5.4
Critical Hdwy Stg 2	-	-	-	-	5.4
Follow-up Hdwy	-	-	2.227	-	3.5
Pot Cap-1 Maneuver	-	-	1105	-	273
Stage 1	-	-	-	-	650
Stage 2	-	-	-	-	581
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1105	-	258
Mov Cap-2 Maneuver	-	-	-	-	258
Stage 1	-	-	-	-	650
Stage 2	-	-	-	-	550

Approach	EB	WB	NB
HCM Control Delay, s	0	0.7	15.5
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	416	-	-	1105	-
HCM Lane V/C Ratio	0.179	-	-	0.04	-
HCM Control Delay (s)	15.5	-	-	8.4	0
HCM Lane LOS	C	-	-	A	A
HCM 95th %tile Q(veh)	0.6	-	-	0.1	-

Intersection						
Int Delay, s/veh	0.5					
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕	↕		↕	
Traffic Vol, veh/h	9	463	447	0	5	20
Future Vol, veh/h	9	463	447	0	5	20
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	86	86	86	86	86	86
Heavy Vehicles, %	0	7	4	0	0	0
Mvmt Flow	10	538	520	0	6	23

Major/Minor	Major1	Major2	Minor2		
Conflicting Flow All	520	0	-	0	1078 520
Stage 1	-	-	-	-	520 -
Stage 2	-	-	-	-	558 -
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	1056	-	-	-	244 560
Stage 1	-	-	-	-	601 -
Stage 2	-	-	-	-	577 -
Platoon blocked, %		-	-	-	
Mov Cap-1 Maneuver	1056	-	-	-	241 560
Mov Cap-2 Maneuver	-	-	-	-	241 -
Stage 1	-	-	-	-	593 -
Stage 2	-	-	-	-	577 -

Approach	EB	WB	SB
HCM Control Delay, s	0.2	0	13.7
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1056	-	-	-	443
HCM Lane V/C Ratio	0.01	-	-	-	0.066
HCM Control Delay (s)	8.4	0	-	-	13.7
HCM Lane LOS	A	A	-	-	B
HCM 95th %tile Q(veh)	0	-	-	-	0.2

Intersection						
Int Delay, s/veh	0.6					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↔			↔	↔	
Traffic Vol, veh/h	457	6	4	426	21	12
Future Vol, veh/h	457	6	4	426	21	12
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	7	2	2	4	2	2
Mvmt Flow	497	7	4	463	23	13

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	504	0	972 501
Stage 1	-	-	-	-	501 -
Stage 2	-	-	-	-	471 -
Critical Hdwy	-	-	4.12	-	6.42 6.22
Critical Hdwy Stg 1	-	-	-	-	5.42 -
Critical Hdwy Stg 2	-	-	-	-	5.42 -
Follow-up Hdwy	-	-	2.218	-	3.518 3.318
Pot Cap-1 Maneuver	-	-	1061	-	280 570
Stage 1	-	-	-	-	609 -
Stage 2	-	-	-	-	628 -
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1061	-	279 570
Mov Cap-2 Maneuver	-	-	-	-	279 -
Stage 1	-	-	-	-	609 -
Stage 2	-	-	-	-	625 -

Approach	EB	WB	NB
HCM Control Delay, s	0	0.1	16.7
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	343	-	-	1061	-
HCM Lane V/C Ratio	0.105	-	-	0.004	-
HCM Control Delay (s)	16.7	-	-	8.4	0
HCM Lane LOS	C	-	-	A	A
HCM 95th %tile Q(veh)	0.3	-	-	0	-

Timings

1: Union Street/Daniel McCahill Street & Beaver Street/Church Square



Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	Ø9
Lane Configurations		↕		↕	↕		↕	↕	↕	↕	
Traffic Volume (vph)	8	419	88	474	95	20	138	98	78	121	
Future Volume (vph)	8	419	88	474	95	20	138	98	78	121	
Turn Type	Perm	NA	Perm	NA	Perm	Perm	NA	Perm	Perm	NA	
Protected Phases		4		8			2			6	9
Permitted Phases	4		8		8	2		2	6		
Detector Phase	4	4	8	8	8	2	2	2	6	6	
Switch Phase											
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	52.0	52.0	52.0	52.0	52.0	41.0	41.0	41.0	41.0	41.0	26.0
Total Split (s)	52.0	52.0	52.0	52.0	52.0	41.0	41.0	41.0	41.0	41.0	26.0
Total Split (%)	43.7%	43.7%	43.7%	43.7%	43.7%	34.5%	34.5%	34.5%	34.5%	34.5%	22%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	2.0
All-Red Time (s)	18.0	18.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	4.0
Lost Time Adjust (s)		0.0		0.0	0.0		0.0	0.0	0.0	0.0	
Total Lost Time (s)		22.0		6.0	6.0		6.0	6.0	6.0	6.0	
Lead/Lag											
Lead-Lag Optimize?											
Recall Mode	Max	None									

Intersection Summary

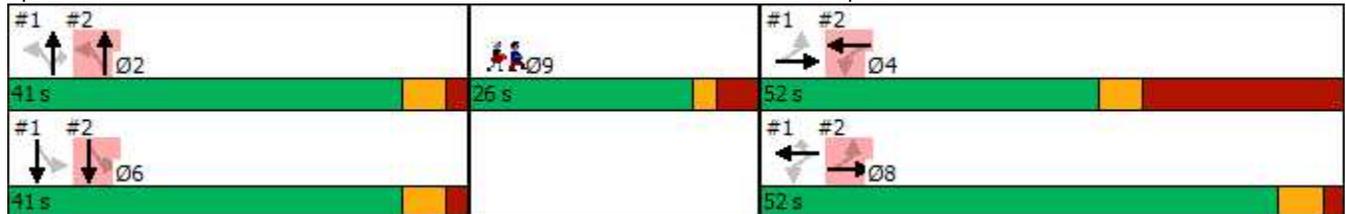
Cycle Length: 119

Actuated Cycle Length: 93

Natural Cycle: 150

Control Type: Semi Act-Uncoord

Splits and Phases: 1: Union Street/Daniel McCahill Street & Beaver Street/Church Square





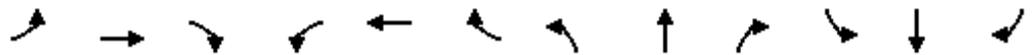
Lane Group	EBT	WBT	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	462	574	97	161	100	80	152
v/c Ratio	1.48	0.75	0.12	0.24	0.14	0.18	0.23
Control Delay	260.4	16.6	2.5	21.2	0.4	20.8	19.5
Queue Delay	1.4	6.3	0.0	0.0	0.0	0.0	0.0
Total Delay	261.8	22.9	2.5	21.2	0.4	20.8	19.5
Queue Length 50th (ft)	~382	124	4	64	0	31	56
Queue Length 95th (ft)	#574	476	m7	111	0	64	100
Internal Link Dist (ft)	368	184		709			548
Turn Bay Length (ft)			65		80	90	
Base Capacity (vph)	312	768	791	661	724	452	671
Starvation Cap Reductn	0	146	0	0	0	0	0
Spillback Cap Reductn	34	0	0	0	7	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	1.66	0.92	0.12	0.24	0.14	0.18	0.23

Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
- m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis
 1: Union Street/Daniel McCahill Street & Beaver Street/Church Square

237 Pleasant Street TIS
 2029 Build - PM Peak Hour



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔	↔		↔	↔	↔	↔	↔
Traffic Volume (vph)	8	419	25	88	474	95	20	138	98	78	121	28
Future Volume (vph)	8	419	25	88	474	95	20	138	98	78	121	28
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	16	16	16	11	11	11	11	11	11	11	11	11
Total Lost time (s)		22.0			6.0	6.0		6.0	6.0	6.0	6.0	
Lane Util. Factor		1.00			1.00	1.00		1.00	1.00	1.00	1.00	
Frt		0.99			1.00	0.85		1.00	0.85	1.00	0.97	
Flt Protected		1.00			0.99	1.00		0.99	1.00	0.95	1.00	
Satd. Flow (prot)		2116			1802	1516		1825	1546	1745	1770	
Flt Permitted		0.45			0.86	1.00		0.96	1.00	0.66	1.00	
Satd. Flow (perm)		963			1555	1516		1758	1546	1203	1770	
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	8	428	26	90	484	97	20	141	100	80	123	29
RTOR Reduction (vph)	0	1	0	0	0	42	0	0	62	0	6	0
Lane Group Flow (vph)	0	461	0	0	574	55	0	161	38	80	146	0
Heavy Vehicles (%)	0%	1%	0%	2%	1%	3%	0%	0%	1%	0%	1%	0%
Turn Type	Perm	NA		Perm	NA	Perm	Perm	NA	Perm	Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8		8	2		2	6		
Actuated Green, G (s)		30.0			46.0	46.0		35.0	35.0	35.0	35.0	
Effective Green, g (s)		30.0			46.0	46.0		35.0	35.0	35.0	35.0	
Actuated g/C Ratio		0.32			0.49	0.49		0.38	0.38	0.38	0.38	
Clearance Time (s)		22.0			6.0	6.0		6.0	6.0	6.0	6.0	
Vehicle Extension (s)		3.0			3.0	3.0		3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		310			769	749		661	581	452	666	
v/s Ratio Prot												0.08
v/s Ratio Perm		c0.48			0.37	0.04		c0.09	0.02	0.07		
v/c Ratio		1.49			0.75	0.07		0.24	0.06	0.18	0.22	
Uniform Delay, d1		31.5			18.8	12.3		19.9	18.5	19.4	19.7	
Progression Factor		1.00			0.61	0.57		1.00	1.00	1.00	1.00	
Incremental Delay, d2		235.2			4.6	0.1		0.9	0.2	0.9	0.8	
Delay (s)		266.7			16.0	7.2		20.8	18.8	20.2	20.5	
Level of Service		F			B	A		C	B	C	C	
Approach Delay (s)		266.7			14.7			20.0			20.4	
Approach LOS		F			B			C			C	

Intersection Summary

HCM 2000 Control Delay	88.0	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	0.90		
Actuated Cycle Length (s)	93.0	Sum of lost time (s)	34.0
Intersection Capacity Utilization	103.6%	ICU Level of Service	G
Analysis Period (min)	15		

c Critical Lane Group

Timings
2: Main Street & Church Square/Pleasant Street

237 Pleasant Street TIS
2029 Build - PM Peak Hour

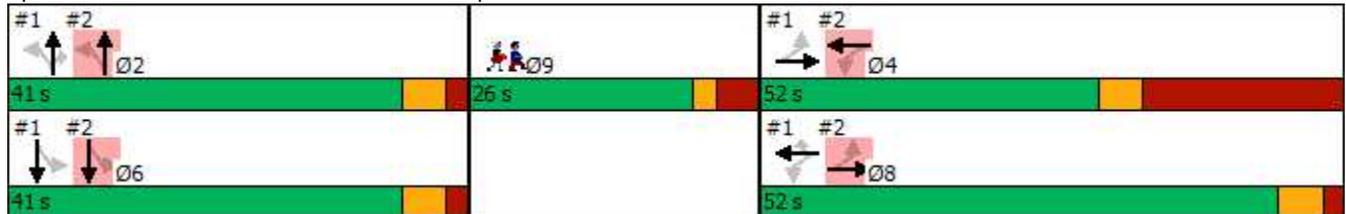


Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	Ø9
Lane Configurations		↕		↕	↗	↖		↕	
Traffic Volume (vph)	194	362	18	419	49	250	30	297	
Future Volume (vph)	194	362	18	419	49	250	30	297	
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA	
Protected Phases		8		4		2		6	9
Permitted Phases	8		4		2		6		
Detector Phase	8	8	4	4	2	2	6	6	
Switch Phase									
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	52.0	52.0	52.0	52.0	41.0	41.0	41.0	41.0	26.0
Total Split (s)	52.0	52.0	52.0	52.0	41.0	41.0	41.0	41.0	26.0
Total Split (%)	43.7%	43.7%	43.7%	43.7%	34.5%	34.5%	34.5%	34.5%	22%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	2.0
All-Red Time (s)	2.0	2.0	18.0	18.0	2.0	2.0	2.0	2.0	4.0
Lost Time Adjust (s)		0.0		0.0	0.0	0.0		0.0	
Total Lost Time (s)		6.0		22.0	6.0	6.0		6.0	
Lead/Lag									
Lead-Lag Optimize?									
Recall Mode	Max	None							

Intersection Summary

Cycle Length: 119
 Actuated Cycle Length: 93
 Natural Cycle: 150
 Control Type: Semi Act-Uncoord

Splits and Phases: 2: Main Street & Church Square/Pleasant Street



Queues
 2: Main Street & Church Square/Pleasant Street

237 Pleasant Street TIS
 2029 Build - PM Peak Hour



Lane Group	EBT	WBT	NBL	NBT	SBT
Lane Group Flow (vph)	634	476	52	292	514
v/c Ratio	0.85	0.75	0.23	0.43	0.78
Control Delay	11.5	36.9	23.1	23.7	34.0
Queue Delay	51.0	7.2	0.0	0.0	0.0
Total Delay	62.5	44.1	23.1	23.7	34.0
Queue Length 50th (ft)	96	248	21	124	252
Queue Length 95th (ft)	m82	366	50	196	#390
Internal Link Dist (ft)	184	2003		629	573
Turn Bay Length (ft)			55		
Base Capacity (vph)	746	634	230	677	663
Starvation Cap Reductn	253	0	0	0	0
Spillback Cap Reductn	0	118	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	1.29	0.92	0.23	0.43	0.78

Intersection Summary

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

Queue shown is maximum after two cycles.

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

HCM Signalized Intersection Capacity Analysis
2: Main Street & Church Square/Pleasant Street

237 Pleasant Street TIS
2029 Build - PM Peak Hour



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕		↕	↕			↕	
Traffic Volume (vph)	194	362	47	18	419	15	49	250	28	30	297	161
Future Volume (vph)	194	362	47	18	419	15	49	250	28	30	297	161
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	16	16	16	16	16	16	11	11	11	12	12	12
Total Lost time (s)		6.0			22.0		6.0	6.0			6.0	
Lane Util. Factor		1.00			1.00		1.00	1.00			1.00	
Frt		0.99			1.00		1.00	0.99			0.96	
Flt Protected		0.98			1.00		0.95	1.00			1.00	
Satd. Flow (prot)		2070			2100		1745	1793			1787	
Flt Permitted		0.72			0.93		0.33	1.00			0.96	
Satd. Flow (perm)		1506			1967		614	1793			1728	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	204	381	49	19	441	16	52	263	29	32	313	169
RTOR Reduction (vph)	0	2	0	0	1	0	0	3	0	0	13	0
Lane Group Flow (vph)	0	632	0	0	475	0	52	289	0	0	501	0
Heavy Vehicles (%)	2%	1%	1%	0%	2%	0%	0%	1%	0%	0%	1%	2%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		8			4			2			6	
Permitted Phases	8			4			2			6		
Actuated Green, G (s)		46.0			30.0		35.0	35.0			35.0	
Effective Green, g (s)		46.0			30.0		35.0	35.0			35.0	
Actuated g/C Ratio		0.49			0.32		0.38	0.38			0.38	
Clearance Time (s)		6.0			22.0		6.0	6.0			6.0	
Vehicle Extension (s)		3.0			3.0		3.0	3.0			3.0	
Lane Grp Cap (vph)		744			634		231	674			650	
v/s Ratio Prot								0.16				
v/s Ratio Perm		c0.42			0.24		0.08				c0.29	
v/c Ratio		0.85			0.75		0.23	0.43			0.77	
Uniform Delay, d1		20.5			28.1		19.8	21.6			25.5	
Progression Factor		0.43			1.00		1.00	1.00			1.00	
Incremental Delay, d2		1.2			7.9		2.2	2.0			8.6	
Delay (s)		10.0			36.1		22.0	23.6			34.1	
Level of Service		B			D		C	C			C	
Approach Delay (s)		10.0			36.1			23.3			34.1	
Approach LOS		B			D			C			C	

Intersection Summary

HCM 2000 Control Delay	24.9	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	1.12		
Actuated Cycle Length (s)	93.0	Sum of lost time (s)	34.0
Intersection Capacity Utilization	131.9%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Intersection						
Int Delay, s/veh	1.5					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	397	20	50	499	18	53
Future Vol, veh/h	397	20	50	499	18	53
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	91	91	91	91	91	91
Heavy Vehicles, %	1	0	0	2	3	3
Mvmt Flow	436	22	55	548	20	58

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	458	0	1105 447
Stage 1	-	-	-	-	447 -
Stage 2	-	-	-	-	658 -
Critical Hdwy	-	-	4.1	-	6.43 6.23
Critical Hdwy Stg 1	-	-	-	-	5.43 -
Critical Hdwy Stg 2	-	-	-	-	5.43 -
Follow-up Hdwy	-	-	2.2	-	3.527 3.327
Pot Cap-1 Maneuver	-	-	1114	-	232 609
Stage 1	-	-	-	-	642 -
Stage 2	-	-	-	-	513 -
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1114	-	216 609
Mov Cap-2 Maneuver	-	-	-	-	216 -
Stage 1	-	-	-	-	642 -
Stage 2	-	-	-	-	477 -

Approach	EB	WB	NB
HCM Control Delay, s	0	0.8	15.6
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	417	-	-	1114	-
HCM Lane V/C Ratio	0.187	-	-	0.049	-
HCM Control Delay (s)	15.6	-	-	8.4	0
HCM Lane LOS	C	-	-	A	A
HCM 95th %tile Q(veh)	0.7	-	-	0.2	-

Intersection						
Int Delay, s/veh	0.2					
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↶	↷		↶	
Traffic Vol, veh/h	9	440	526	8	2	9
Future Vol, veh/h	9	440	526	8	2	9
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	95	95	95	95	95	95
Heavy Vehicles, %	0	1	2	0	25	0
Mvmt Flow	9	463	554	8	2	9

Major/Minor	Major1	Major2	Minor2		
Conflicting Flow All	562	0	-	0	1039 558
Stage 1	-	-	-	-	558 -
Stage 2	-	-	-	-	481 -
Critical Hdwy	4.1	-	-	-	6.65 6.2
Critical Hdwy Stg 1	-	-	-	-	5.65 -
Critical Hdwy Stg 2	-	-	-	-	5.65 -
Follow-up Hdwy	2.2	-	-	-	3.725 3.3
Pot Cap-1 Maneuver	1019	-	-	-	231 533
Stage 1	-	-	-	-	530 -
Stage 2	-	-	-	-	577 -
Platoon blocked, %		-	-	-	
Mov Cap-1 Maneuver	1019	-	-	-	228 533
Mov Cap-2 Maneuver	-	-	-	-	228 -
Stage 1	-	-	-	-	524 -
Stage 2	-	-	-	-	577 -

Approach	EB	WB	SB
HCM Control Delay, s	0.2	0	13.6
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1019	-	-	-	429
HCM Lane V/C Ratio	0.009	-	-	-	0.027
HCM Control Delay (s)	8.6	0	-	-	13.6
HCM Lane LOS	A	A	-	-	B
HCM 95th %tile Q(veh)	0	-	-	-	0.1

Intersection						
Int Delay, s/veh	0.4					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	421	19	11	514	12	6
Future Vol, veh/h	421	19	11	514	12	6
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	1	2	2	2	2	2
Mvmt Flow	458	21	12	559	13	7

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	479	0	1052 469
Stage 1	-	-	-	-	469 -
Stage 2	-	-	-	-	583 -
Critical Hdwy	-	-	4.12	-	6.42 6.22
Critical Hdwy Stg 1	-	-	-	-	5.42 -
Critical Hdwy Stg 2	-	-	-	-	5.42 -
Follow-up Hdwy	-	-	2.218	-	3.518 3.318
Pot Cap-1 Maneuver	-	-	1083	-	251 594
Stage 1	-	-	-	-	630 -
Stage 2	-	-	-	-	558 -
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1083	-	247 594
Mov Cap-2 Maneuver	-	-	-	-	247 -
Stage 1	-	-	-	-	630 -
Stage 2	-	-	-	-	549 -

Approach	EB	WB	NB
HCM Control Delay, s	0	0.2	17.5
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	307	-	-	1083	-
HCM Lane V/C Ratio	0.064	-	-	0.011	-
HCM Control Delay (s)	17.5	-	-	8.4	0
HCM Lane LOS	C	-	-	A	A
HCM 95th %tile Q(veh)	0.2	-	-	0	-

APPENDIX H

Capacity Analysis 2029 - Build Traffic Conditions with Optimization

Timings

1: Union Street/Daniel McCahill Street & Beaver Street/Church Square 2029 Build w/ Imp - AM Peak Hour

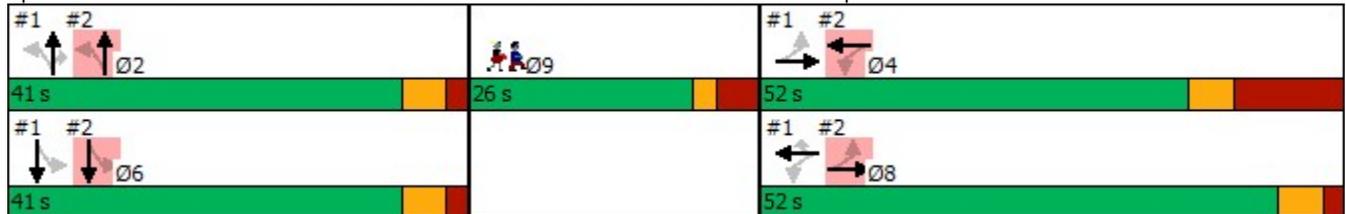


Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	Ø9
Lane Configurations		↕		↕	↕		↕	↕	↕	↕	
Traffic Volume (vph)	26	263	54	382	172	19	227	91	109	195	
Future Volume (vph)	26	263	54	382	172	19	227	91	109	195	
Turn Type	Perm	NA	Perm	NA	Perm	Perm	NA	Perm	Perm	NA	
Protected Phases		4		8			2			6	9
Permitted Phases	4		8		8	2		2	6		
Detector Phase	4	4	8	8	8	2	2	2	6	6	
Switch Phase											
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	52.0	52.0	52.0	52.0	52.0	41.0	41.0	41.0	41.0	41.0	26.0
Total Split (s)	52.0	52.0	52.0	52.0	52.0	41.0	41.0	41.0	41.0	41.0	26.0
Total Split (%)	43.7%	43.7%	43.7%	43.7%	43.7%	34.5%	34.5%	34.5%	34.5%	34.5%	22%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	2.0
All-Red Time (s)	10.0	10.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	4.0
Lost Time Adjust (s)		0.0		0.0	0.0		0.0	0.0	0.0	0.0	
Total Lost Time (s)		14.0		6.0	6.0		6.0	6.0	6.0	6.0	
Lead/Lag											
Lead-Lag Optimize?											
Recall Mode	Max	None									

Intersection Summary

Cycle Length: 119
 Actuated Cycle Length: 93
 Natural Cycle: 140
 Control Type: Semi Act-Uncoord

Splits and Phases: 1: Union Street/Daniel McCahill Street & Beaver Street/Church Square



Queues

1: Union Street/Daniel McCahill Street & Beaver Street/Church Square 2029 Build w/ Imp - AM Peak Hour



Lane Group	EBT	WBT	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	392	566	223	320	118	142	327
v/c Ratio	0.79	0.71	0.28	0.50	0.18	0.46	0.50
Control Delay	37.6	15.8	4.6	25.6	2.1	27.7	24.4
Queue Delay	2.8	0.4	0.6	0.0	0.0	0.0	0.0
Total Delay	40.4	16.3	5.2	25.6	2.1	27.7	24.4
Queue Length 50th (ft)	196	122	23	142	0	62	139
Queue Length 95th (ft)	249	136	33	181	7	97	177
Internal Link Dist (ft)	368	184		709			548
Turn Bay Length (ft)			65		80	90	
Base Capacity (vph)	496	795	806	643	662	312	660
Starvation Cap Reductn	0	39	302	0	0	0	0
Spillback Cap Reductn	42	0	0	0	5	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.86	0.75	0.44	0.50	0.18	0.46	0.50

Intersection Summary

HCM Signalized Intersection Capacity Analysis

237 Pleasant Street TIS

1: Union Street/Daniel McCahill Street & Beaver Street/Church Square 2029 Build w/ Imp - AM Peak Hour



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕	↕		↕	↕	↕	↕	↕
Traffic Volume (vph)	26	263	12	54	382	172	19	227	91	109	195	57
Future Volume (vph)	26	263	12	54	382	172	19	227	91	109	195	57
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	16	16	16	11	11	11	11	11	11	11	11	11
Total Lost time (s)		14.0			6.0	6.0		6.0	6.0	6.0	6.0	
Lane Util. Factor		1.00			1.00	1.00		1.00	1.00	1.00	1.00	
Frt		0.99			1.00	0.85		1.00	0.85	1.00	0.97	
Flt Protected		1.00			0.99	1.00		1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1983			1772	1546		1780	1501	1711	1734	
Flt Permitted		0.61			0.90	1.00		0.96	1.00	0.46	1.00	
Satd. Flow (perm)		1212			1608	1546		1708	1501	830	1734	
Peak-hour factor, PHF	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
Adj. Flow (vph)	34	342	16	70	496	223	25	295	118	142	253	74
RTOR Reduction (vph)	0	1	0	0	0	42	0	0	74	0	8	0
Lane Group Flow (vph)	0	391	0	0	566	181	0	320	44	142	319	0
Heavy Vehicles (%)	5%	7%	24%	3%	3%	1%	0%	3%	4%	2%	3%	0%
Turn Type	Perm	NA		Perm	NA	Perm	Perm	NA	Perm	Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8		8	2		2	6		
Actuated Green, G (s)		38.0			46.0	46.0		35.0	35.0	35.0	35.0	
Effective Green, g (s)		38.0			46.0	46.0		35.0	35.0	35.0	35.0	
Actuated g/C Ratio		0.41			0.49	0.49		0.38	0.38	0.38	0.38	
Clearance Time (s)		14.0			6.0	6.0		6.0	6.0	6.0	6.0	
Vehicle Extension (s)		3.0			3.0	3.0		3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		495			795	764		642	564	312	652	
v/s Ratio Prot												0.18
v/s Ratio Perm		0.32			0.35	0.12		0.19	0.03	0.17		
v/c Ratio		0.79			0.71	0.24		0.50	0.08	0.46	0.49	
Uniform Delay, d1		24.0			18.3	13.5		22.3	18.6	21.8	22.2	
Progression Factor		1.00			0.58	0.45		1.00	1.00	1.00	1.00	
Incremental Delay, d2		12.1			4.8	0.6		2.8	0.3	4.7	2.6	
Delay (s)		36.1			15.4	6.7		25.0	18.9	26.6	24.8	
Level of Service		D			B	A		C	B	C	C	
Approach Delay (s)		36.1			12.9			23.4			25.3	
Approach LOS		D			B			C			C	

Intersection Summary		
HCM 2000 Control Delay	22.2	HCM 2000 Level of Service
HCM 2000 Volume to Capacity ratio	0.75	C
Actuated Cycle Length (s)	93.0	Sum of lost time (s)
Intersection Capacity Utilization	84.7%	26.0
Analysis Period (min)	15	ICU Level of Service
		E

c Critical Lane Group

Timings
2: Main Street & Church Square/Pleasant Street

237 Pleasant Street TIS
2029 Build w/ Imp - AM Peak Hour

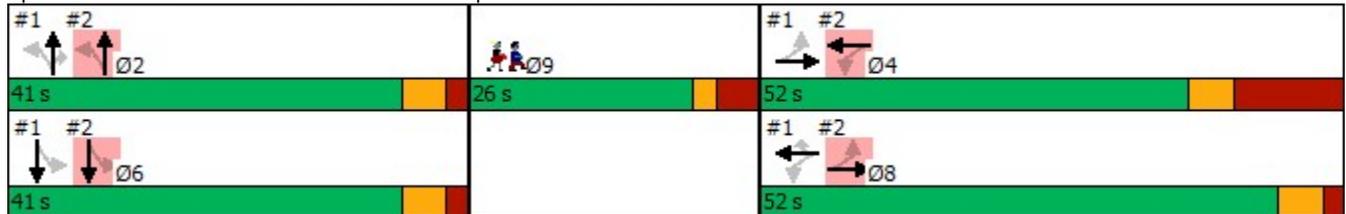


Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	Ø9
Lane Configurations		↕		↕	↗	↖		↕	
Traffic Volume (vph)	113	303	5	409	40	180	36	258	
Future Volume (vph)	113	303	5	409	40	180	36	258	
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA	
Protected Phases		8		4		2		6	9
Permitted Phases	8		4		2		6		
Detector Phase	8	8	4	4	2	2	6	6	
Switch Phase									
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	52.0	52.0	52.0	52.0	41.0	41.0	41.0	41.0	26.0
Total Split (s)	52.0	52.0	52.0	52.0	41.0	41.0	41.0	41.0	26.0
Total Split (%)	43.7%	43.7%	43.7%	43.7%	34.5%	34.5%	34.5%	34.5%	22%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	2.0
All-Red Time (s)	2.0	2.0	10.0	10.0	2.0	2.0	2.0	2.0	4.0
Lost Time Adjust (s)		0.0		0.0	0.0	0.0		0.0	
Total Lost Time (s)		6.0		14.0	6.0	6.0		6.0	
Lead/Lag									
Lead-Lag Optimize?									
Recall Mode	Max	None							

Intersection Summary

Cycle Length: 119
 Actuated Cycle Length: 93
 Natural Cycle: 140
 Control Type: Semi Act-Uncoord

Splits and Phases: 2: Main Street & Church Square/Pleasant Street



Queues
2: Main Street & Church Square/Pleasant Street

237 Pleasant Street TIS
2029 Build w/ Imp - AM Peak Hour



Lane Group	EBT	WBT	NBL	NBT	SBT
Lane Group Flow (vph)	519	478	45	223	478
v/c Ratio	0.68	0.57	0.18	0.34	0.74
Control Delay	14.5	24.6	22.0	22.1	32.1
Queue Delay	6.8	0.6	0.0	0.0	0.0
Total Delay	21.3	25.2	22.0	22.1	32.1
Queue Length 50th (ft)	115	212	17	90	230
Queue Length 95th (ft)	m184	302	43	145	340
Internal Link Dist (ft)	184	2003		629	573
Turn Bay Length (ft)			55		
Base Capacity (vph)	768	832	246	661	650
Starvation Cap Reductn	200	0	0	0	0
Spillback Cap Reductn	0	108	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.91	0.66	0.18	0.34	0.74

Intersection Summary

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

HCM Signalized Intersection Capacity Analysis

2: Main Street & Church Square/Pleasant Street

237 Pleasant Street TIS
2029 Build w/ Imp - AM Peak Hour



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕		↗	↘			↕	
Traffic Volume (vph)	113	303	41	5	409	6	40	180	16	36	258	127
Future Volume (vph)	113	303	41	5	409	6	40	180	16	36	258	127
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	16	16	16	16	16	16	11	11	11	12	12	12
Total Lost time (s)		6.0			14.0		6.0	6.0			6.0	
Lane Util. Factor		1.00			1.00		1.00	1.00			1.00	
Fr _t		0.99			1.00		1.00	0.99			0.96	
Fl _t Protected		0.99			1.00		0.95	1.00			1.00	
Satd. Flow (prot)		1972			2055		1711	1750			1771	
Fl _t Permitted		0.78			0.99		0.36	1.00			0.95	
Satd. Flow (perm)		1549			2036		654	1750			1698	
Peak-hour factor, PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	128	344	47	6	465	7	45	205	18	41	293	144
RTOR Reduction (vph)	0	3	0	0	1	0	0	2	0	0	11	0
Lane Group Flow (vph)	0	516	0	0	477	0	45	221	0	0	467	0
Heavy Vehicles (%)	4%	8%	3%	0%	4%	42%	2%	4%	0%	15%	1%	2%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		8			4			2			6	
Permitted Phases	8			4			2			6		
Actuated Green, G (s)		46.0			38.0		35.0	35.0			35.0	
Effective Green, g (s)		46.0			38.0		35.0	35.0			35.0	
Actuated g/C Ratio		0.49			0.41		0.38	0.38			0.38	
Clearance Time (s)		6.0			14.0		6.0	6.0			6.0	
Vehicle Extension (s)		3.0			3.0		3.0	3.0			3.0	
Lane Grp Cap (vph)		766			831		246	658			639	
v/s Ratio Prot								0.13				
v/s Ratio Perm		c0.33			0.23		0.07				c0.27	
v/c Ratio		0.67			0.57		0.18	0.34			0.73	
Uniform Delay, d ₁		17.8			21.3		19.4	20.7			24.9	
Progression Factor		0.58			1.00		1.00	1.00			1.00	
Incremental Delay, d ₂		3.8			2.9		1.6	1.4			7.2	
Delay (s)		14.1			24.1		21.1	22.1			32.1	
Level of Service		B			C		C	C			C	
Approach Delay (s)		14.1			24.1			21.9			32.1	
Approach LOS		B			C			C			C	

Intersection Summary

HCM 2000 Control Delay	23.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	93.0	Sum of lost time (s)	26.0
Intersection Capacity Utilization	107.3%	ICU Level of Service	G
Analysis Period (min)	15		

c Critical Lane Group

Timings

1: Union Street/Daniel McCahill Street & Beaver Street/Church Square 2029 Build w/ Imp - PM Peak Hour

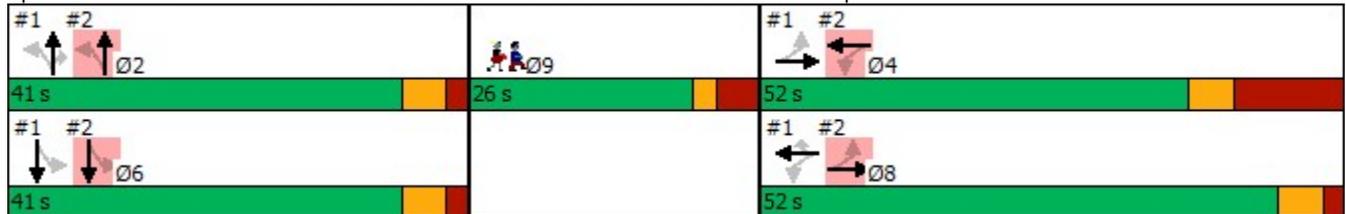


Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	Ø9
Lane Configurations		↔		↕	↗		↕	↗	↖	↘	
Traffic Volume (vph)	8	419	88	474	95	20	138	98	78	121	
Future Volume (vph)	8	419	88	474	95	20	138	98	78	121	
Turn Type	Perm	NA	Perm	NA	Perm	Perm	NA	Perm	Perm	NA	
Protected Phases		4		8			2			6	9
Permitted Phases	4		8		8	2		2	6		
Detector Phase	4	4	8	8	8	2	2	2	6	6	
Switch Phase											
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	52.0	52.0	52.0	52.0	52.0	41.0	41.0	41.0	41.0	41.0	26.0
Total Split (s)	52.0	52.0	52.0	52.0	52.0	41.0	41.0	41.0	41.0	41.0	26.0
Total Split (%)	43.7%	43.7%	43.7%	43.7%	43.7%	34.5%	34.5%	34.5%	34.5%	34.5%	22%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	2.0
All-Red Time (s)	10.0	10.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	4.0
Lost Time Adjust (s)		0.0		0.0	0.0		0.0	0.0	0.0	0.0	
Total Lost Time (s)		14.0		6.0	6.0		6.0	6.0	6.0	6.0	
Lead/Lag											
Lead-Lag Optimize?											
Recall Mode	Max	None									

Intersection Summary

Cycle Length: 119
 Actuated Cycle Length: 93
 Natural Cycle: 150
 Control Type: Semi Act-Uncoord

Splits and Phases: 1: Union Street/Daniel McCahill Street & Beaver Street/Church Square



Queues

1: Union Street/Daniel McCahill Street & Beaver Street/Church Square 2029 Build w/ Imp - PM Peak Hour



Lane Group	EBT	WBT	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	462	574	97	161	100	80	152
v/c Ratio	0.58	0.75	0.12	0.24	0.15	0.18	0.23
Control Delay	24.7	17.1	2.5	21.2	1.3	20.8	19.5
Queue Delay	0.6	0.2	0.0	0.0	0.0	0.0	0.0
Total Delay	25.3	17.2	2.5	21.2	1.3	20.8	19.5
Queue Length 50th (ft)	205	124	4	64	0	31	56
Queue Length 95th (ft)	303	440	m12	111	10	64	100
Internal Link Dist (ft)	368	184		709			548
Turn Bay Length (ft)			65		80	90	
Base Capacity (vph)	800	769	791	661	679	452	671
Starvation Cap Reductn	0	13	0	0	0	0	0
Spillback Cap Reductn	104	0	0	0	7	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.66	0.76	0.12	0.24	0.15	0.18	0.23

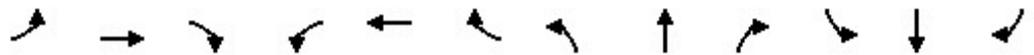
Intersection Summary

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

HCM Signalized Intersection Capacity Analysis

237 Pleasant Street TIS

1: Union Street/Daniel McCahill Street & Beaver Street/Church Square 2029 Build w/ Imp - PM Peak Hour



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔	↔		↔	↔	↔	↔	
Traffic Volume (vph)	8	419	25	88	474	95	20	138	98	78	121	28
Future Volume (vph)	8	419	25	88	474	95	20	138	98	78	121	28
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	16	16	16	11	11	11	11	11	11	11	11	11
Total Lost time (s)		14.0			6.0	6.0		6.0	6.0	6.0	6.0	
Lane Util. Factor		1.00			1.00	1.00		1.00	1.00	1.00	1.00	
Fr _t		0.99			1.00	0.85		1.00	0.85	1.00	0.97	
Fl _t Protected		1.00			0.99	1.00		0.99	1.00	0.95	1.00	
Satd. Flow (prot)		2116			1802	1516		1825	1546	1745	1770	
Fl _t Permitted		0.92			0.86	1.00		0.96	1.00	0.66	1.00	
Satd. Flow (perm)		1954			1556	1516		1758	1546	1203	1770	
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	8	428	26	90	484	97	20	141	100	80	123	29
RTOR Reduction (vph)	0	2	0	0	0	42	0	0	62	0	6	0
Lane Group Flow (vph)	0	460	0	0	574	55	0	161	38	80	146	0
Heavy Vehicles (%)	0%	1%	0%	2%	1%	3%	0%	0%	1%	0%	1%	0%
Turn Type	Perm	NA		Perm	NA	Perm	Perm	NA	Perm	Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8		8	2		2	6		
Actuated Green, G (s)		38.0			46.0	46.0		35.0	35.0	35.0	35.0	
Effective Green, g (s)		38.0			46.0	46.0		35.0	35.0	35.0	35.0	
Actuated g/C Ratio		0.41			0.49	0.49		0.38	0.38	0.38	0.38	
Clearance Time (s)		14.0			6.0	6.0		6.0	6.0	6.0	6.0	
Vehicle Extension (s)		3.0			3.0	3.0		3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		798			769	749		661	581	452	666	
v/s Ratio Prot												0.08
v/s Ratio Perm		0.24			c0.37	0.04		c0.09	0.02	0.07		
v/c Ratio		0.58			0.75	0.07		0.24	0.06	0.18	0.22	
Uniform Delay, d ₁		21.3			18.8	12.3		19.9	18.5	19.4	19.7	
Progression Factor		1.00			0.60	0.57		1.00	1.00	1.00	1.00	
Incremental Delay, d ₂		3.0			5.3	0.2		0.9	0.2	0.9	0.8	
Delay (s)		24.3			16.5	7.2		20.8	18.8	20.2	20.5	
Level of Service		C			B	A		C	B	C	C	
Approach Delay (s)		24.3			15.2			20.0			20.4	
Approach LOS		C			B			C			C	

Intersection Summary

HCM 2000 Control Delay	19.3	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.64		
Actuated Cycle Length (s)	93.0	Sum of lost time (s)	26.0
Intersection Capacity Utilization	96.9%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Timings
2: Main Street & Church Square/Pleasant Street

237 Pleasant Street TIS
2029 Build w/ Imp - PM Peak Hour

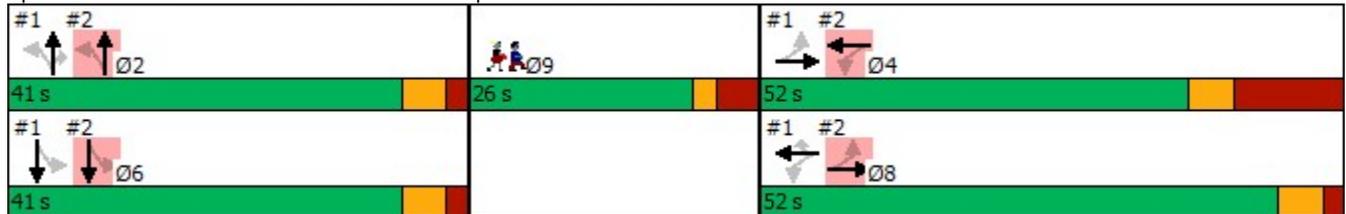


Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	Ø9
Lane Configurations		↕		↕	↗	↖		↕	
Traffic Volume (vph)	194	362	18	419	49	250	30	297	
Future Volume (vph)	194	362	18	419	49	250	30	297	
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA	
Protected Phases		8		4		2		6	9
Permitted Phases	8		4		2		6		
Detector Phase	8	8	4	4	2	2	6	6	
Switch Phase									
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	52.0	52.0	52.0	52.0	41.0	41.0	41.0	41.0	26.0
Total Split (s)	52.0	52.0	52.0	52.0	41.0	41.0	41.0	41.0	26.0
Total Split (%)	43.7%	43.7%	43.7%	43.7%	34.5%	34.5%	34.5%	34.5%	22%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	2.0
All-Red Time (s)	2.0	2.0	10.0	10.0	2.0	2.0	2.0	2.0	4.0
Lost Time Adjust (s)		0.0		0.0	0.0	0.0		0.0	
Total Lost Time (s)		6.0		14.0	6.0	6.0		6.0	
Lead/Lag									
Lead-Lag Optimize?									
Recall Mode	Max	None							

Intersection Summary

Cycle Length: 119
 Actuated Cycle Length: 93
 Natural Cycle: 150
 Control Type: Semi Act-Uncoord

Splits and Phases: 2: Main Street & Church Square/Pleasant Street



Queues
 2: Main Street & Church Square/Pleasant Street

237 Pleasant Street TIS
 2029 Build w/ Imp - PM Peak Hour



Lane Group	EBT	WBT	NBL	NBT	SBT
Lane Group Flow (vph)	634	476	52	292	514
v/c Ratio	0.86	0.58	0.23	0.43	0.78
Control Delay	22.9	24.7	23.1	23.7	34.0
Queue Delay	0.5	0.7	0.0	0.0	0.0
Total Delay	23.4	25.5	23.1	23.7	34.1
Queue Length 50th (ft)	336	212	21	124	252
Queue Length 95th (ft)	#543	311	50	196	#390
Internal Link Dist (ft)	184	2003		629	573
Turn Bay Length (ft)			55		
Base Capacity (vph)	740	821	230	677	663
Starvation Cap Reductn	12	0	0	0	0
Spillback Cap Reductn	0	123	0	0	1
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.87	0.68	0.23	0.43	0.78

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis
2: Main Street & Church Square/Pleasant Street

237 Pleasant Street TIS
2029 Build w/ Imp - PM Peak Hour



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕		↗	↘			↕	
Traffic Volume (vph)	194	362	47	18	419	15	49	250	28	30	297	161
Future Volume (vph)	194	362	47	18	419	15	49	250	28	30	297	161
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	16	16	16	16	16	16	11	11	11	12	12	12
Total Lost time (s)		6.0			14.0		6.0	6.0			6.0	
Lane Util. Factor		1.00			1.00		1.00	1.00			1.00	
Frt		0.99			1.00		1.00	0.99			0.96	
Flt Protected		0.98			1.00		0.95	1.00			1.00	
Satd. Flow (prot)		2070			2100		1745	1793			1787	
Flt Permitted		0.71			0.95		0.33	1.00			0.96	
Satd. Flow (perm)		1492			2009		614	1793			1728	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	204	381	49	19	441	16	52	263	29	32	313	169
RTOR Reduction (vph)	0	2	0	0	1	0	0	3	0	0	13	0
Lane Group Flow (vph)	0	632	0	0	475	0	52	289	0	0	501	0
Heavy Vehicles (%)	2%	1%	1%	0%	2%	0%	0%	1%	0%	0%	1%	2%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		8			4			2			6	
Permitted Phases	8			4			2			6		
Actuated Green, G (s)		46.0			38.0		35.0	35.0			35.0	
Effective Green, g (s)		46.0			38.0		35.0	35.0			35.0	
Actuated g/C Ratio		0.49			0.41		0.38	0.38			0.38	
Clearance Time (s)		6.0			14.0		6.0	6.0			6.0	
Vehicle Extension (s)		3.0			3.0		3.0	3.0			3.0	
Lane Grp Cap (vph)		737			820		231	674			650	
v/s Ratio Prot								0.16				
v/s Ratio Perm		c0.42			0.24		0.08				c0.29	
v/c Ratio		0.86			0.58		0.23	0.43			0.77	
Uniform Delay, d1		20.6			21.3		19.8	21.6			25.5	
Progression Factor		0.48			1.00		1.00	1.00			1.00	
Incremental Delay, d2		11.4			3.0		2.2	2.0			8.6	
Delay (s)		21.4			24.3		22.0	23.6			34.1	
Level of Service		C			C		C	C			C	
Approach Delay (s)		21.4			24.3			23.3			34.1	
Approach LOS		C			C			C			C	

Intersection Summary

HCM 2000 Control Delay	25.7	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.99		
Actuated Cycle Length (s)	93.0	Sum of lost time (s)	26.0
Intersection Capacity Utilization	125.2%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

APPENDIX I

Crash Data

Intersection Beaver & Union Crash Data

Crash Number	Crash Severity	Crash Year	Light Conditions	Manner of Collision	Road Surface Condition	Latitude	Longitude	Roadway
4609920	Property damage only (none injured)	2018	Dark - lighted roadway	Single vehicle crash	Dry	42.08949	-71.40205	UNION STREET
4710492	Property damage only (none injured)	2019	Daylight	Head-on	Dry	42.08949	-71.40205	CHURCH SQ / UNION STREET / BEAVER STREET
4969399	Non-fatal injury	2021	Daylight	Angle	Dry	42.08949	-71.40205	UNION ST / BEAVER ST / DANIEL MCCAHERN
4985562	Property damage only (none injured)	2021	Dark - lighted roadway	Single vehicle crash	Dry	42.08949	-71.40205	UNION STREET / BEAVER STREET
5119935	Property damage only (none injured)	2022	Daylight	Rear-end	Dry	42.08950988	-71.40180277	BEAVER STREET

Data Level: CRASH

Query Type: Spatial

Intersection Pleasant & Main Crash Data

Crash Number	Crash Severity	Crash Year	Light Conditions	Manner of Collision	Road Surface Condition	Latitude	Longitude	Roadway
4529572	Property damage only (none injured)	2018	Dark - lighted roadway	Sideswipe, same direction	Dry	42.08954	-71.40111	MAIN / MAIN STREET / PLEASANT STREET
4605323	Property damage only (none injured)	2018	Daylight	Rear-end	Dry	42.0895528	-71.40100761	PLEASANT
4687467	Property damage only (none injured)	2019	Daylight	Angle	Dry	42.08954	-71.40111	MAIN STREET / BEAVER STREET / PLEASANT STREET
4752266	Non-fatal injury	2019	Daylight	Single vehicle crash	Dry	42.08954	-71.40111	MAIN ST / PLEASANT ST / PLEASANT STREET / MAIN STREET
4789171	Property damage only (none injured)	2019	Dark - lighted roadway	Angle	Dry	42.08954	-71.40111	PLEASANT STREET / MAIN STREET
4832363	Property damage only (none injured)	2020	Daylight	Sideswipe, opposite direction	Wet	42.08954	-71.40111	MAIN STREET / PLEASANT STREET
5023085	Unknown	2021	Daylight	Angle	Dry	42.08954	-71.40111	MAIN STREET / PLEASANT STREET
5045169	Property damage only (none injured)	2021	Dark - lighted roadway	Sideswipe, opposite direction	Dry	42.08954	-71.40111	PLEASANT ST / MAIN ST
5076425	Property damage only (none injured)	2022	Daylight	Angle	Dry	42.08954	-71.40111	MAIN STREET / PLEASANT STREET
5103340	Property damage only (none injured)	2022	Daylight	Angle	Dry	42.08954	-71.40111	MAIN STREET / PLEASANT STREET / CHURCH SQUARE

Data Level: CRASH

Query Type: Spatial

Intersection Pleasant & Padden Crash Data

Crash Number	Crash Severity	Crash Year	Light Conditions	Manner of Collision	Road Surface Condition	Latitude	Longitude	Roadway
4552637	Property damage only (none injured)	2018	Daylight	Rear-end	Dry	42.09216758	-71.38978727	PLEASANT
4706417	Property damage only (none injured)	2019	Dark - unknown roadway lighting	Rear-end	Wet	42.09222245	-71.38965772	PLEASANT STREET
4724210	Property damage only (none injured)	2019	Daylight	Sideswipe, same direction		42.09202349	-71.390253	PLEASANT
5092751	Property damage only (none injured)	2022	Daylight	Single vehicle crash	Dry	42.09235138	-71.38937744	PLEASANT STREET

Data Level: CRASH

Query Type: Spatial

