Nitsch Engineering

Mystic Water Works
Senior Affordable Rental Housing
Somerville, MA

Traffic Study

September 2011

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Nitsch Engineering Project # 8398

TABLE OF CONTENTS

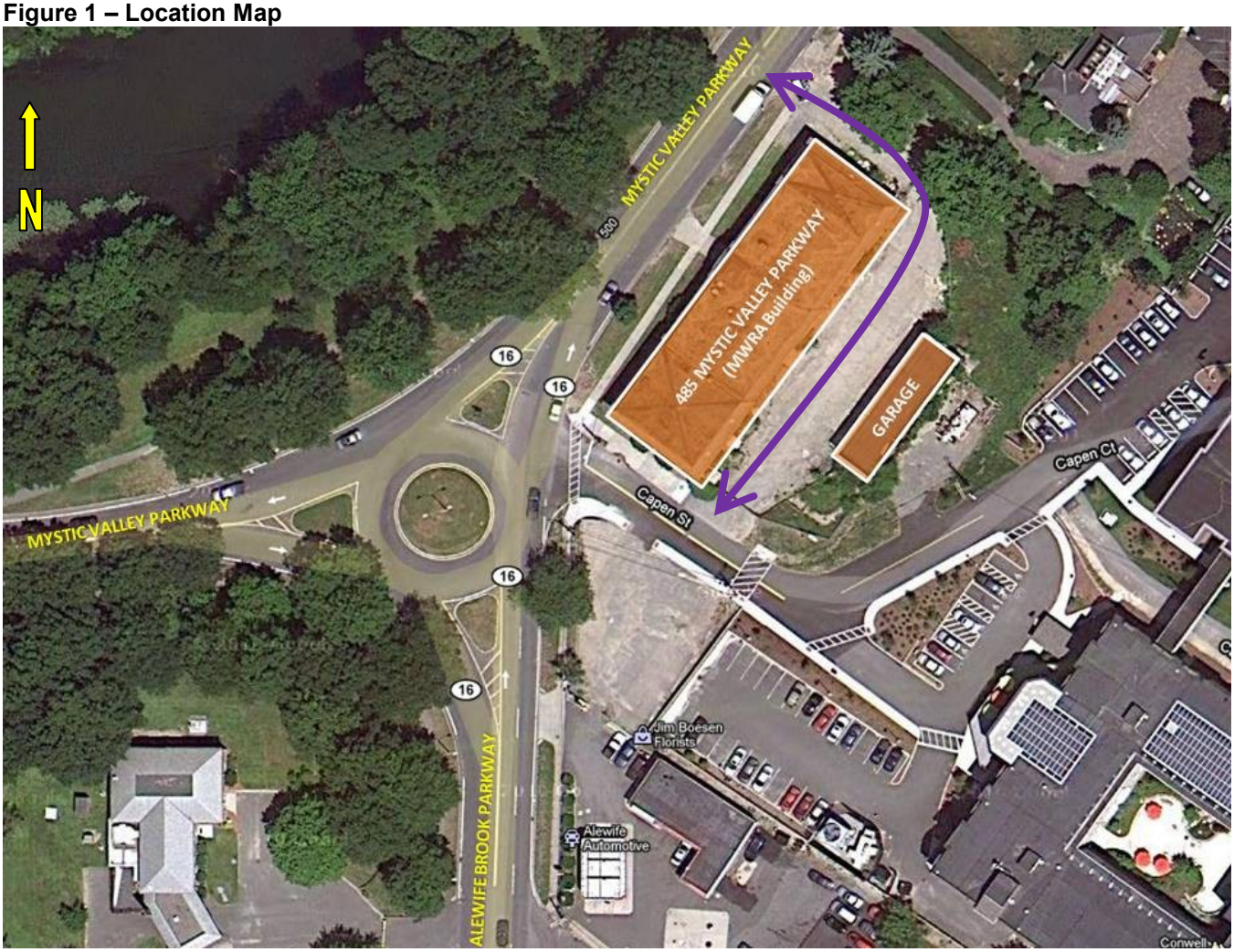
LIST OF TABLES

LIST OF FIGURES

1. INTRODUCTION

The City of Somerville is proposing to construct 60 affordable, senior rental apartments at an existing Massachusetts Water Resource Authority (MWRA) building located at 485 Mystic River Parkway in Somerville, MA. The MWRA building is located at the front of the site, and a parking garage is located in the rear. The purpose of this traffic study is to review the proposed vehicular access and egress, traffic operations at the intersection of Mystic Valley Parkway and Alewife Brook Parkway, and pedestrian access. Figure 1 shows the existing study area.

Figure 1 – Location Map



As seen in Figure 1, the Site Driveway loops around the rear of the existing building, connecting to Mystic Valley Parkway on the northern side of the site and Capen Street on the southern side. Vehicular trips from the proposed development directly impact the roundabout at Mystic Valley Parkway and Alewife Brook Parkway. The Department of Conservation and Recreation (DCR) oversees permits for access onto Mystic Valley Parkway and Alewife Brook Parkway in this area.

The following three traffic conditions are evaluated in this study -

1. Existing conditions (2011) – the 2011 traffic counts with existing traffic operations at the roundabout;
2. No-Build conditions (2021) – the 2011 traffic counts projected to 2021 using a background growth rate under existing traffic operations at the roundabout;

3. Build conditions (2021) – the 2021 No-Build traffic volumes with additional trips from the proposed affordable senior rental apartments.

2. EXISTING CONDITIONS

In this section, we examine the existing conditions of the roadway segments, intersection geometry, pavement markings, traffic volumes, and crash history in detail. For clarity, we reference the approaches by their true geographic directions such as Mystic Valley Parkway eastbound (EB), Capen Street westbound (WB), Alewife Brook Parkway northbound (NB) and Mystic Valley Parkway southbound (SB).

2.1. Study Area Description

Mystic Valley Parkway and Alewife Brook Parkway(Route 16)/Capen Street

This is a four-legged roundabout with Capen Street approaching from the east, Mystic Valley Parkway approaching from the north and west, and Alewife Brook Parkway (Route 16) approaching from the south. The Capen Street approach comprises the east leg of the roundabout and consists of one lane in each direction. Bi-directional travel is separated by a double yellow centerline. A stop line and crosswalk are present on the Capen Street approach. The Mystic Valley Parkway approaches comprise the north and west legs of the roundabout. The north leg consists of two lanes in each direction and the west leg consists of one lane in each direction. The Alewife Brook Parkway comprises the south leg of the intersection and consists of two lanes in each direction. A majority of the traffic travels in the north and south directions at the roundabout. The roundabout contains one circulating lane.

A speed limit of 30 miles per hour (mph) is posted on Mystic Valley Parkway facing the westbound direction departing the roundabout. A speed limit of 35 mph is posted on Alewife Brook Parkway facing the southbound direction departing the roundabout. Pavement markings at the roundabout are faded but visible.

2.2. Traffic Volumes

Nitsch Engineering coordinated the data collection effort with Precision Data Inc. (PDI), to collect 2011 Turning Movement Counts (TMCs). TMCs are necessary to evaluate existing traffic operations at intersections during typical weekday morning and evening peak hours. PDI recorded the TMCs at the roundabout on Wednesday, June 29, 2011 during peak hours from 7:00 to 9:00 AM and from 4:00 to 6:00 PM. The data included passenger cars, trucks, pedestrians, and bicyclists.

PDI also installed Automatic Traffic Recorders (ATRs) that collected 48-hour continuous counts on Mystic Valley Parkway and Alewife Brook Parkway on Wednesday, July 6 and Thursday, July 7, 2011. Based on the data collected, the average daily traffic (ADT) on Mystic Valley Parkway, north of the roundabout is approximately 29,200 vehicles per day (vpd). The ADT on Alewife Brook Parkway, south of the roundabout is approximately 26,700 vpd. Table 1 provides a summary of the data deduced from the counts.

Table 1 – Existing Traffic Volume Summary

Location	Peak Hour of Traffic Volumes (Turning Movement Counts)	Peak Hour Factor[1]	Peak Hourly Volume (approximately, in vehicles per hour)	Automatic Traffic Recorder Data		
				Average Daily Traffic (vpd)	K-factor[2]	Directional Distribution
Mystic Valley Parkway & Alewife Brook Parkway/Capen St.	AM Peak: 7:30 - 8:30 AM	0.96	2,700	-	-	-
	PM Peak: 4:15 - 5:15 PM	0.96	2,500	-	-	-
Alewife Brook Parkway, south of Roundabout	-	-	-	26,700	7%	50% NB
Mystic Valley Parkway, north of Roundabout	-	-	-	29,200	7%	49% NB

[1] Peak Hour Factor is defined as the variation in traffic during the peak hour. A value closer to 1.0 indicates constant flow[2] K-factor indicates the percentage of daily traffic flowing during the peak hour

2.3. Seasonal Adjustment and Background Growth

Seasonal Adjustment

The Massachusetts Department of Transportation (MassDOT) collects traffic volume data at various count stations across the state to study the monthly variation in traffic on roadways that are within MassDOT's jurisdiction. Standard engineering practice is to compare collected traffic volumes for a study, with the nearest MassDOT station to establish variation from 'average' traffic volumes.

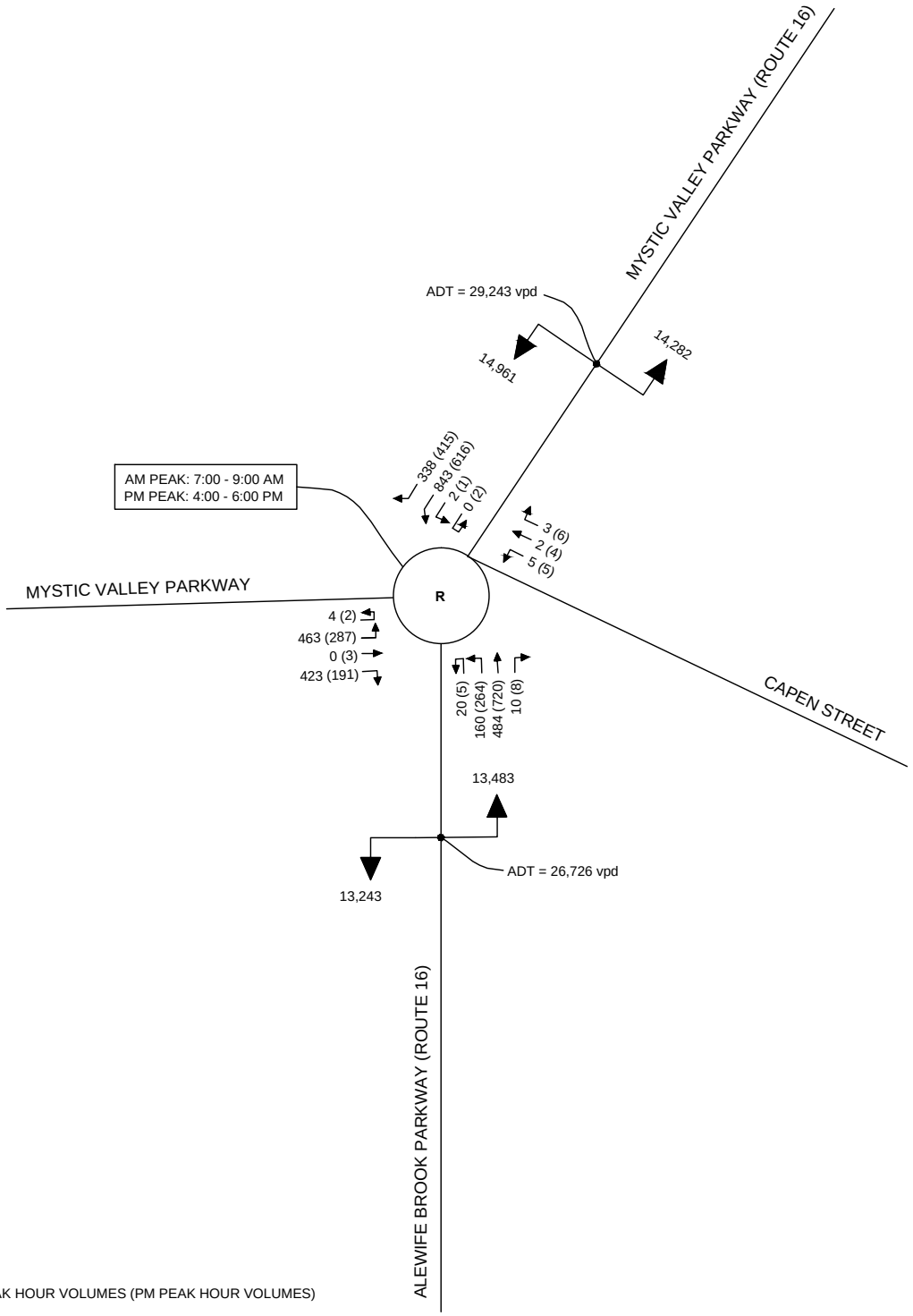
Based on data from the single count station in Somerville (Station 8098), traffic volumes in the month of June were typically 1-4% higher than the average month traffic volumes from 2006 to 2008. We did not adjust the traffic volumes in order to remain conservative in our analyses. The data from the count station is included in the Appendix of this report.

Figure 2 (located on page 4) shows the 2011 traffic volumes at the Mystic Valley Parkway and Alewife Brook Parkway/Capen Street roundabout.

Background Growth

MassDOT also records traffic volumes at stations over multiple years to identify annual shifts in traffic. Of the 25 count stations in Somerville, only four stations had counts for multiple years. Between 2000 and 2008, the traffic volumes at two of the four locations (Stations 8001 and 8098L) indicated a downward trend between 1 and 3%. At the remaining locations (Stations 8081 and 8089), the traffic volumes indicated a marginal upward trend of 1 to 2%. The average trend at the four stations combined was -0.1%. We used a background growth rate of 0.5% per year to project future year volumes, to account for unforeseen growth.

Figure 3 shows the 2021 No-Build traffic volumes at the Mystic Valley Parkway and Alewife Brook Parkway/Capen Street roundabout.



LEGEND

XX (XX) - AM PEAK HOUR VOLUMES (PM PEAK HOUR VOLUMES)

Ⓡ - ROUNDABOUT INTERSECTION

- AUTOMATIC TRAFFIC RECORDER LOCATION

2011 EXISTING TMC & ATR VOLUMES

ALEWIFE BROOK PARKWAY & MYSTIC VALLEY PARKWAY
SOMERVILLE, MA

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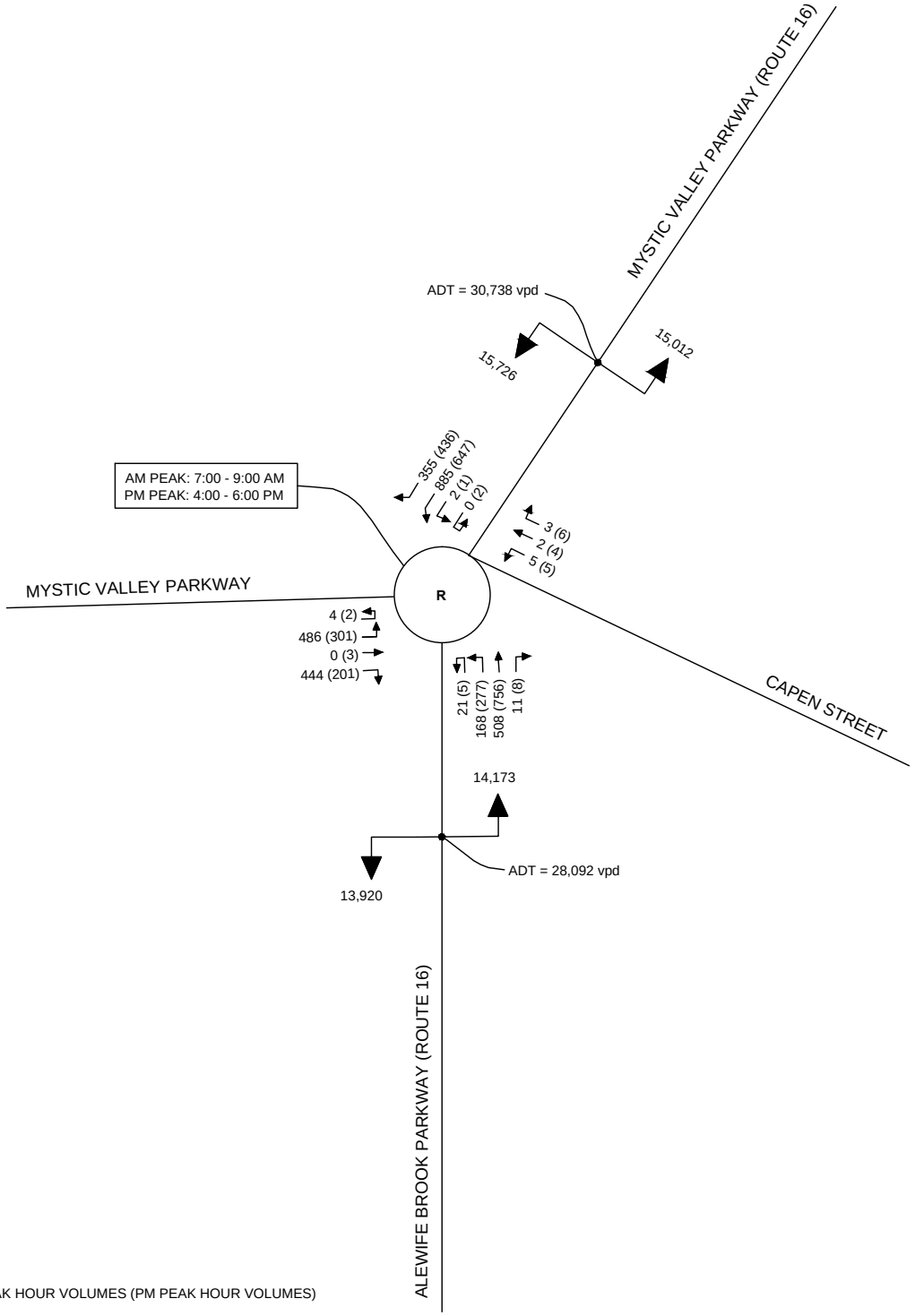
FIGURE 2



LEGEND

XX (XX) - AM PEAK HOUR VOLUMES (PM PEAK HOUR VOLUMES)

Ⓡ - ROUNDABOUT INTERSECTION

- AUTOMATIC TRAFFIC RECORDER LOCATION

2021 NO-BUILD TMC & ATR VOLUMES

ALEWIFE BROOK PARKWAY & MYSTIC VALLEY PARKWAY
SOMERVILLE, MA

PREPARED FOR:

DIMELLA SHAFFER

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Nitsch Engineering

FIGURE 3

2.4. Crash History

The crash history for the study area was investigated through data provided by MassDOT Traffic Operations Safety Management System. The data covers the three-year period of 2006 - 2008 and is summarized in Table 2.

The crash data indicates that there were no fatalities at the intersection within the period analyzed. The majority of crashes (55%) involved property damage only, 36% involved non-fatal personal injury and 9% of the crashes have not reported crash severity. The most common type of crashes reported were rear-end (18%) and angle (18%) crashes. The data shows that 27% of crashes occurred during peak hour periods and 47% of the crashes occurred under wet or icy roadway conditions. The raw crash data is included in the Technical Appendix.

Table 2 – Crash Summary

Location	Year	Number of Crashes		Severity				Type					Percent During	
		Total	Avg. per Year	PD[a]	PI[b]	NR[c]	F[d]	AN[e]	RE[f]	HO[g]	Ped[h]	Other[h]	Peak Hours	Wet/Icy Conditions
Mystic Valley Parkway & Alewife Brook Parkway/Capen St.	2008	5	4	2	3	-	-	1	1	-	-	3	40%	0%
	2007	3		1	1	1	-	-	-	1	-	2	0%	67%
	2006	3		3	-	-	-	1	1	-	-	1	33%	33%
Total		*11*	*4*	*6*	*4*	*1*	*0*	*2*	*2*	*1*	*0*	*6*	*27%*	*27%*
Average Percentage				55%	36%	9%	0	18%	18%	9%	0%	55%		

[a]Property Damage Only; [b]Personal Injury; [c]Not Reported/Unknown; [d]Fatality; [e]Cross Movement (or angle); [f]Rear end; [g]Head on; [h]Pedestrian; [h]Sideswipe, opposite direction; sideswipe, same direction, single vehicle crash, not reported, unknown etc.

Crash Rate

In order to evaluate the significance of crashes at an intersection, the number of crashes must be compared to the traffic volumes entering the intersection. The intersection crash rate is a measure of the frequency of crashes compared to the intersection traffic volumes. The crash rate is based on accidents (A) per million entering vehicles (MEV). MassDOT releases average statewide and district rates that can be used to compare safety hazards at specific intersections. The average statewide rate for the 2008 calendar year is 0.62 A/MEV for unsignalized intersections. The District 6 crash rate for 2008 is currently unavailable. Accident rates greater than these averages could indicate potential safety issues that require corrective measures. Crash rate worksheets have been included in the Appendix of this report.

The computed crash rate at the roundabout is 0.32 A/MEV, which is significantly lower than the statewide average.

2.5. Sight Distance

Stopping Sight Distance (SSD) is the minimum visibility required for a vehicle on a major street to observe the presence of another object/vehicle on a minor roadway, and safely stop the vehicle to prevent collision. Intersection Sight Distance (ISD) is the minimum visibility for a vehicle stopped on the minor street to observe and assess traffic on the major street in order to safely enter the intersection. It must be noted that

while the SSD is required, ISD is for guidance only and is not mandatory. See section 3.7 of the MassDOT Project Development and Design Guide[1] to reference the required minimum SSD and ISD.

The crash rate at the study intersection is significantly lower than the Statewide average. This indicates that the roundabout is operating with few safety concerns. Additionally, the proposed project would not be changing access to and from the site to the roundabout.

3. BUILD YEAR CONDITIONS

In accordance with the guidelines of the Executive Office of Environmental and Energy Affairs (EOEEA) and MassDOT, we analyzed the traffic operations in the study area over a 10-year design horizon, to year 2021, to understand future impacts from the projected growth. To establish the 2021 volumes, we projected traffic counts from the year 2011 to 2021 using a background growth rate of 0.5% annually. Then we calculated trips generated by the project and distributed them to the study intersection to establish the 2021 Build scenario.

3.1. Trip Generation

The Institute of Transportation Engineers (ITE) publishes trip generation rates for various land uses to assist engineers in estimating trips associated with a development. Land Use Code (LUC) 223 – Mid-Rise Apartments described as "*dwelling units in rental buildings that have between 3 and 10 levels*", and LUC (252) – Senior Adult Housing-Attached described as "*housing for seniors who live independently with little to no medical supervision and with no centralized dining facilities*", together meet the description for the proposed use. We computed the trip generation from both uses during morning and evening peak hours for 60 dwelling units. Table 3 provides a summary of the LUCs and their projected trips.

Table 3 – Trip Generation

Land Use Code	Description	Trips Generated				Daily Trips*
		AM Peak Hour (between 7:00-9:00 AM)	AM Trips Generated	PM Peak Hour (between 4:00 -6:00 PM)	PM Trips Generated	
223	Mid-Rise Apartments	0.30 trips per unit	18	0.39 trips per unit	23	330
252	Senior Adult Housing - Attached	0.13 trips per unit	8	0.16 trips per unit	10	86
* Daily trip generation rate unavailable from the LUC. Computed assuming 7% of daily traffic flows during peak hour.						

As seen in Table 3, LUC 223 provides a greater trip estimate than LUC 252 during both the peak hours reviewed. To remain conservative and establish a worst case scenario, we distributed the trips estimated under LUC 223 Mid-Ride Apartments to the roundabout to analyze design year 2021 conditions.

The trip generation in Table 3 represents the trips that the proposed development would generate if all 60 units are occupied. Fewer occupied units would generate fewer trips and the traffic impacts, if any, would also be reduced.

3.2. Trip Distribution

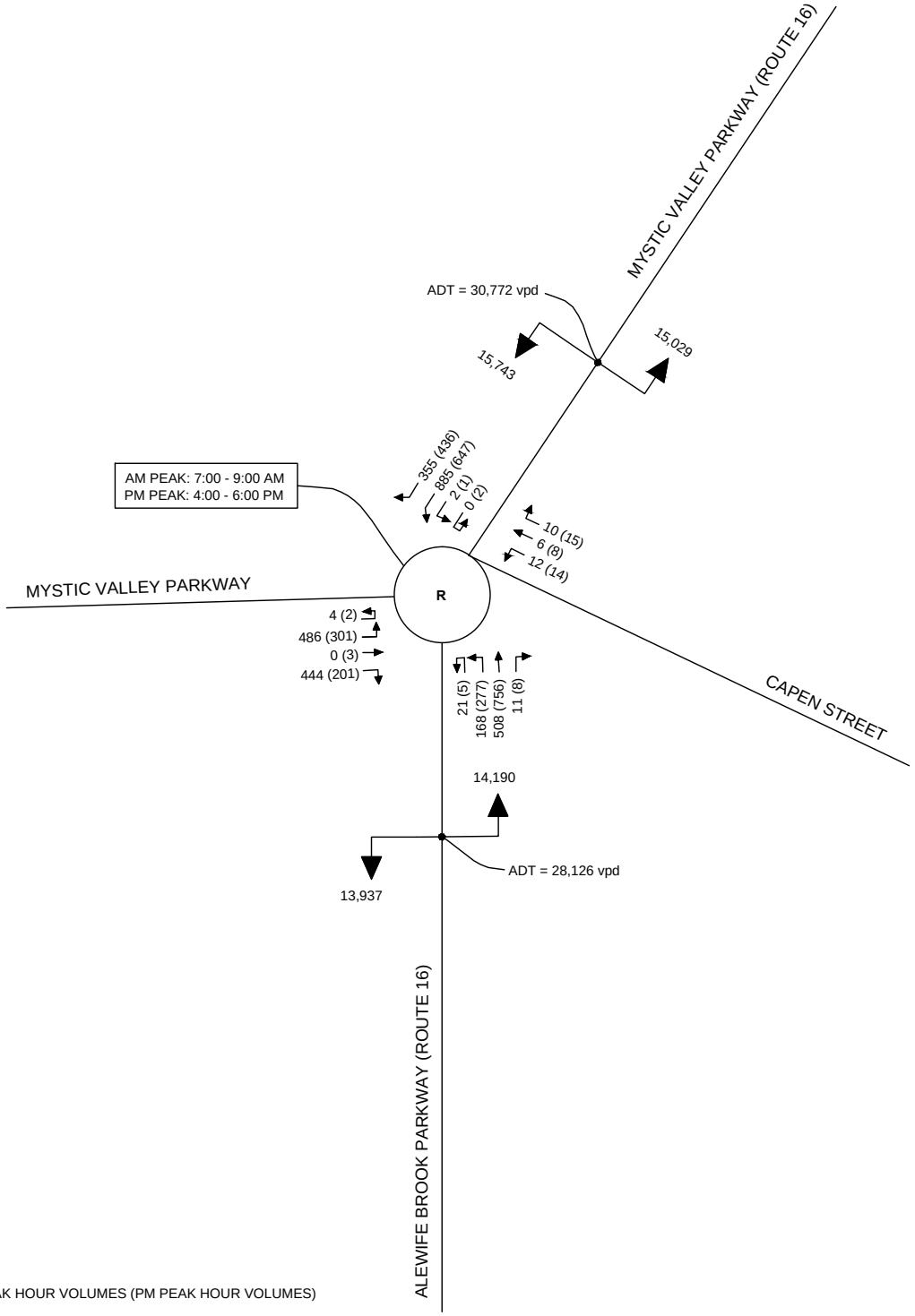
The trip distribution assumes that 40% of the traffic from the development would turn left towards Alewife Brook Parkway, 40% of the traffic would turn right towards Mystic Valley Parkway north and 20% of the traffic would go to Mystic Valley Parkway west. We based these percentages on the existing traffic distribution under the 2011 Existing conditions. Accordingly, during the AM peak hour, we distributed 7 trips

1 Project Development and Design Guide, Massachusetts Highway Department, 2006

to/from Alewife Brook Parkway, 7 trips to/from Mystic Valley Parkway north and 4 trips to/from Mystic Valley Parkway west. During the PM peak hour, we distributed 9 trips to/from Alewife Brook Parkway, 9 trips to/from Mystic Valley Parkway north and 4 trips to/from Mystic Valley Parkway west. Figure 4 shows the 2021 build year volumes, which reflect the 2011 existing volumes projected to the year 2021 at a background growth rate of 0.5%, with the addition of project trips.

3.3. Signal Warrant Analysis

The Manual on Uniform Traffic Control Devices (MUTCD) outlines eight warrants that are used to verify the need for a traffic signal at an intersection. Of the eight warrants, three are based on traffic volumes. The roundabout at Mystic Valley Parkway and Alewife Brook Parkway has heavy volumes on three of the four approaches during both the morning and evening peak hours. The roundabout would meet one or more warrants (1, 2, and 3) for the installation of a signal, based on the existing traffic volumes. However, the size of the project and the projected trips constitute a small impact on the roundabout. No additional access points are being added to the intersection, and it currently operates a very low crash rate. These factors led us to determine that the impacts do not justify the costs incurred for the installation of a traffic signal. In addition, roundabouts are often put in place in lieu of a signalized intersection, where the volumes are high enough for a traffic signal, but the design preference is for a roundabout. Roundabouts are not typically signalized.



LEGEND

XX (XX) - AM PEAK HOUR VOLUMES (PM PEAK HOUR VOLUMES)

Ⓡ - ROUNDABOUT INTERSECTION

2021 BUILD TMC & ATR VOLUMES

ALEWIFE BROOK PARKWAY & MYSTIC VALLEY PARKWAY
SOMERVILLE, MA

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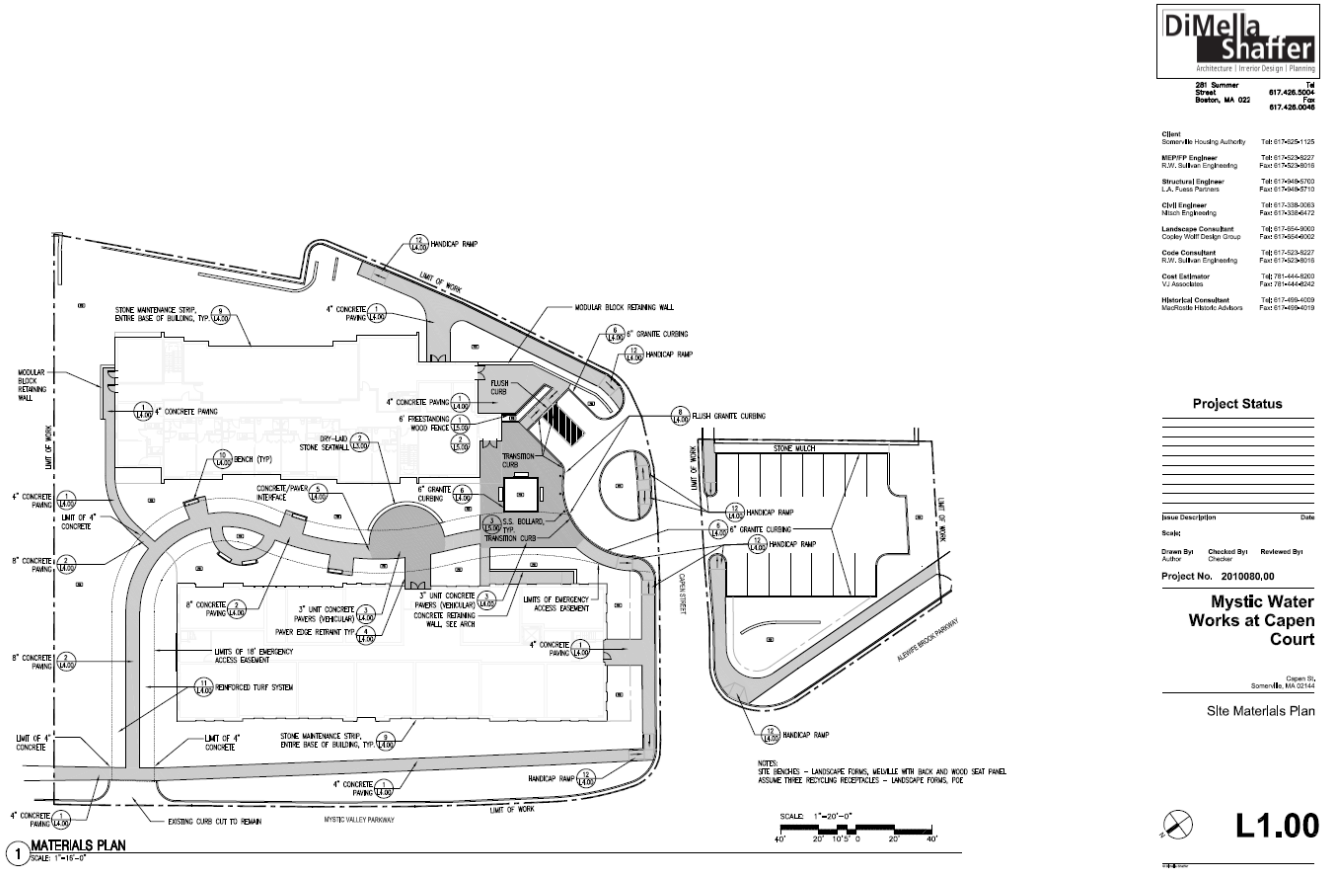
FIGURE 4

4. SITE PLAN REVIEW

Nitsch Engineering reviewed the conceptual site plan developed by the architects DiMella & Shaffer for the proposed 60-unit affordable, senior rental apartments at the intersection of Mystic Valley Parkway and Alewife Brook Parkway. Figure 5 shows the current site plan.

Figure 5 – Conceptual Site Plan



As seen from Figure 5, the primary entry and egress for all project trips would be from Capen Street. Since parking for apartment buildings 1 and 2 would be located on the other side of Capen Street, across from the apartment buildings, we assigned all project trips to and from the development to the Capen Street approach. The only access onto Mystic Valley Parkway is a Fire Lane, which will be restricted to emergency vehicles only.

Parking

The ITE Parking Generation Manual, 3rd edition, recommends a parking supply of one space per dwelling unit, for a low to mid-rise apartment building (LUC 221). The recommendation is based on observations at 12 study sites in urban settings with about half of them reported as affordable housing. LUC 252 – Senior Adult Housing – attached, does not have corresponding parking data.

According to the information provided to us by the architects, the City of Somerville's housing department owns the property adjacent to the proposed site which consists of 95 units with a parking capacity of 72 spaces. Of the 72 spaces only 32 spaces are used, yielding a parking demand ratio of 0.33 spaces per unit. Accordingly, the City of Somerville passed a variance that allows providing 0.40 spaces per dwelling unit if the land use is senior housing. Applying this parking supply ratio to the proposed 60-unit development, the required number of spaces would be 24. The site plan indicates that 18 parking spaces would be located on

the other side of Capen Street, across from the apartment buildings. The City anticipates that the unused spaces in the property adjacent to the proposed site would support the remaining demand.

Based on the data available, we concur with the parking supply designed for this project, which is higher than the ITE recommendation. We recommend that SHA management review demand for handicap accessible spaces on occasion to ensure that they provide adequate designated parking.

5. TRAFFIC ANALYSIS

5.1. Level of Service

Level of Service (LOS) is a qualitative measure that describes operational conditions within a traffic stream. Six (6) levels of LOS are used to describe the quality of traffic flow for any type of facility control, with LOS-A representing the best operating condition and LOS-F representing the worst operating condition. LOS for unsignalized intersections is calculated using the operational analysis methodology detailed in the Highway Capacity Manual (HCM). Table 4 summarizes the relationship between LOS and average control delay for unsignalized intersections.

Table 4 – Level of Service for Unsignalized Intersections

Unsignalized Intersections	
Level of Service[1]	**Stopped Delay per Vehicle (Seconds)**
A	0 to 10
B	>10 to 15
C	>15 to 25
D	>25 to 35
E	>35 to 50
F	Over 50

1 Reference: 2000 Highway Capacity Manual, Transportation Research Board

SIDRA Intersection software, version 4.1 was used to model the traffic operations at the roundabout. SIDRA utilizes the HCM methodology to compute delays and LOS at the roundabout and is accepted by MassDOT to analyze traffic operations at a roundabout. The results of the traffic analysis are discussed in the following section.

5.2. Capacity Analyses

Capacity analyses were performed for the three scenarios, namely:

1. 2011 Existing condition; 2011 traffic volumes on the existing roadway network

2. 2021 No-Build; projected 2021 traffic volumes without the proposed housing complex

3. 2021 Build; projected 2021 traffic volumes with the project trips caused from proposed housing complex

A summary of the traffic analyses including the volume-to-capacity ratio, delay, LOS and 95th percentile queue for each approach under each scenario are shown in Table 5 through Table 7.

2011 Existing Conditions

Table 5 – 2011 Existing Conditions Level of Service

	2011 AM Peak Hour				2011 PM Peak Hour			
MOVEMENT	**V/C[1]**	**DELAY[2]**	**LOS[3]**	**95% Q[4]**	**V/C[1]**	**DELAY[2]**	**LOS[3]**	**95% Q[4]**
Mystic Valley Parkway & Alewife Brook Parkway/Capen Street								
Mystic Valley Parkway EB	>1.0	++[5]	F	++	0.86	22.2	C	313
Capen Street WB	0.10	24.7	C	20	0.13	31.1	C	27
Alewife Brook Parkway NB	0.78	11.9	B	242	>1.0	96.7	F	++
Mystic Valley Parkway SB	>1.0	++	F	++	>1.0	123	F	++

[1] Volume to Capacity Ratio; [2] Vehicle Delay, measured in seconds; [3] Level Of Service; [4] 95th Percentile Queue (in feet); [5] Indicates a high value

As seen in Table 5, the Capen Street approach operates as LOS C under both the AM and PM peak hours. The Mystic Valley Parkway SB approach experiences significant delays during both peak hours. The Mystic Valley Parkway EB approach operates at LOS C during the PM peak hour, but operates at LOS F with high delays during the AM peak hour due to high levels of conflicting traffic from the Mystic Valley Parkway SB approach. The Alewife Brook Parkway approach operates at LOS B during the AM peak hour and at LOS F during the PM peak hour. The Technical Appendix of this report includes detailed output from the traffic analysis for the 2011 Existing conditions.

2021 No-Build Conditions

Table 6 – 2021 No-Build Level of Service

	2021 AM Peak Hour				2021 PM Peak Hour			
MOVEMENT	**V/C[1]**	**DELAY[2]**	**LOS[3]**	**95% Q[4]**	**V/C[1]**	**DELAY[2]**	**LOS[3]**	**95% Q[4]**
Mystic Valley Parkway & Alewife Brook Parkway/Capen Street								
Mystic Valley Parkway EB	>1.0	++[5]	F	++	0.84	21	C	293
Capen Street WB	0.05	26	C	9	0.09	31.4	C	19
Alewife Brook Parkway NB	0.78	11.7	B	254	>1.0	105.3	F	++
Mystic Valley Parkway SB	>1.0	118.5	F	++	>1.0	88	F	++

[1] Volume to Capacity Ratio; [2] Vehicle Delay, measured in seconds; [3] Level Of Service; [4] 95th Percentile Queue (in feet); [5] Indicates a high value

As seen in Table 6, the LOS for all the movements under the 2021 No-Build conditions would be similar to the 2011 Existing conditions. The model computes a small decrease in 95th percentile queues between the 2011 Existing conditions and the 2021 No-Build conditions because we changed the peak hour factor from individual values to 0.92 across all the movements. This is standard practice and is done to create a base condition for the design year 2021. We assume that existing trips and project trips arrive uniformly throughout the peak hour.

In reality, there would be a very minor change in operations at the roundabout with a 0.5% annual increase in traffic volumes between 2011 Existing and the 2021 No-Build conditions. The Technical Appendix of this report includes detailed output for the 2021 No-Build conditions.

2021 Build Conditions

Table 7 – 2021 Build Level of Service

	2021 AM Peak Hour				2021 PM Peak Hour			
MOVEMENT	**V/C[1]**	**DELAY[2]**	**LOS[3]**	**95% Q[4]**	**V/C[1]**	**DELAY[2]**	**LOS[3]**	**95% Q[4]**
Mystic Valley Parkway & Alewife Brook Parkway/Capen Street								
Mystic Valley Pkwy EB	>1.0	++[5]	F	++	0.84	21	C	294
Capen Street WB	0.12	25.3	C	23	0.24	32.6	C	47
Alewife Brook Parkway NB	0.79	11.8	B	256	>1.0	105.2	F	++
Mystic Valley Pkwy SB	>1.0	125.6	F	++	>1.0	94.5	F	++

[1] Volume to Capacity Ratio; [2] Vehicle Delay, measured in seconds; [3] Level Of Service; [4] 95th Percentile Queue; [5] Indicates a high value

As seen in Table 7, delay under the 2021 Build conditions will increase slightly from the 2021 No-Build conditions. The Capen Street approach would experience a small increase in delay, but the overall LOS would remain at LOS C. The Mystic Valley Parkway and the Alewife Brook Parkway approaches would experience small increases in queuing and delay compared to the 2021 No-Build conditions, because the increase in volumes on the Capen Street approach impacts all other approaches at a roundabout. The Technical Appendix to this report includes detailed reports for the 2021 Build conditions.

6. CONCLUSIONS

Based on our review and analysis of traffic conditions at the proposed site, once built, the project would generate 18 trips during the AM peak hour and 23 trips during the PM peak hour under the worst case scenario. Compared to the approximately 2000 trips flowing through the roundabout during peak hours under the 2011 Existing conditions, the project trips are minimal and would have no significant impacts on the operations of the roundabout. The intersection currently has a significantly lower crash rate than the statewide average. The intersection would meet signal warrants based on the traffic volumes under the 2011 Existing conditions, but the existing roundabout negates the necessity for a signalized intersection. Our recommendations for the project include the following:

1. Provide pavement markings and signing in compliance with MUTCD, and

2. Review the need for handicap accessible parking to provide adequate parking

Nitsch Engineering concludes that the proposed site can accommodate the 60-unit affordable senior rental apartment development without significant traffic impacts.