MEMORANDUM

TO:	Mr. Michael Coffman Coffman Realty, Inc. 1300 Belmont Street Brockton, MA 02301	**FROM:**	Mr. Jeffrey S. Dirk, P.E., PTOE Vanasse & Associates, Inc. 10 New England Business Center Drive Suite 314 Andover, MA 01810-1066 (978) 474-8800
DATE:	December 17, 2009	**RE:**	5556
SUBJECT:	Proposed Commercial Development Blue Hill Avenue/Temple Shalom of Milton Milton, Massachusetts		

Vanasse & Associates, Inc. (VAI) has conducted a Traffic Impact Assessment (TIA) in order to determine the potential traffic impacts associated with the construction of a proposed commercial development to be situated on the site of Temple Shalom of Milton located at 180 Blue Hill Avenue (Route 138) in Milton, Massachusetts (the "Project"). This study has been prepared in advance of a formal Traffic Impact and Access Study (TIAS) for the purpose of determining: access requirements; projected parking demands; potential off-site improvements; and safety considerations; and identifies and analyzes existing traffic conditions and future traffic conditions both with and without the Project at ten (10) intersections located along Blue Hill Avenue, Blue Hills Parkway, Decker Street and Crown Street. The formal TIAS will be completed in support of the subsequent Planning Board approval process for the Project and will expand upon the elements of this TIA with specific regard to the identified off-site roadway and intersection improvements; however, the impact assessment and the primary components of the transportation improvement program for the Project as defined herein will not change.

A review of the findings of this TIA indicates that the Project can be accommodated within the confines of the transportation infrastructure in a safe and efficient manner with the implementation of defined roadway, intersection and neighborhood focused improvements. The following summarizes our findings with respect to the Project.

PROJECT DESCRIPTION

As proposed, the Project consists of three major components: 1) relocation and reconstruction of the Temple Shalom in the eastern portion of the Project site; 2) construction of a 13,013± square foot (sf) CVS/Pharmacy with drive-through prescription facility in the northwest quadrant of the Project site; and 3) construction of a 10,000± sf neighborhood grocery store in the southwest quadrant of the Project site. The Project site is situated on the southeast corner of the intersection of Blue Hill Avenue at Decker Street, with Decker Street bounding the Project site to the north; Crown Street to the east; residential properties to the south; and Blue Hill Avenue to the west. Currently, access to the Project site is provided by way of an entrance driveway that intersects the east side of Blue Hill Avenue and is offset slightly north of Concord Avenue; an exit driveway that intersects the east side of Blue Hill Avenue south of Concord Avenue; an exit driveway that intersects the west side of Crown Street south of Decker Street; and a full-access driveway that intersects the west side of Crown Street south of the exit driveway. With the completion of the Project, the existing driveways will be closed and a new driveway will be constructed that will intersect the east side of Blue Hill Avenue opposite Concord Avenue. Figure 1 depicts the Project locus in relation to the local roadway network.

STUDY METHODOLOGY

This study was prepared in consultation with the Town of Milton and the Massachusetts Department of Transportation (MassDOT); was performed in accordance with the Commonwealth of Massachusetts Executive Office of Energy and Environmental Affairs (EOEEA)/MassDOT Guidelines for Environmental Impact Report/Environmental Impact Statement Traffic Impact Assessments (TIAs) and the standards of the Traffic Engineering and Transportation Planning professions for the preparation of such reports; and was conducted in three distinct stages.

The first stage involved an assessment of existing conditions in the study area and included an inventory of roadway geometrics; pedestrian and bicycle facilities; public transportation services; observations of traffic flow; and collection of daily and peak period traffic counts.

In the second stage of the study, future traffic conditions were projected and analyzed. Specific travel demand forecasts for the Project were assessed along with future traffic demands due to expected traffic growth independent of the Project. A five-year time horizon was selected for analyses consistent with State guidelines for the preparation of TIAs. The traffic analysis conducted in stage two identifies existing or projected future roadway capacity, traffic safety, and site access issues.

The third stage of the study presents and evaluates measures to address traffic and safety issues, if any, identified in stage two of the study.

EXISTING CONDITIONS

A detailed field inventory of existing conditions within the study area was conducted in September and October 2009. The field investigation consisted of an inventory of existing roadway geometrics, traffic volumes, and operating characteristics, as well as posted speed limits and land use information within the study area. The study area for the Project was selected to contain the major roadways providing access to the Project site, as well as ten major intersections located along these roadways through which project-related traffic will travel which are listed below.

1. Blue Hill Avenue (Route 138) at Tucker Street and Churchill Street
2. Blue Hill Avenue at Decker Street
3. Blue Hill Avenue at Aberdeen Road
4. Blue Hill Avenue at Concord Avenue and the Temple Shalom driveways
5. Blue Hill Avenue at Blue Hill Terrace Street
6. Blue Hill Avenue at Hudson Street and Amor Road
7. Decker Street at Crown Street
8. Crown Street at the Temple Shalom driveways
9. Blue Hills Parkway at Churchill Street and Kahler Avenue
10. Blue Hills Parkway at Blue Hill Terrace Street

Traffic Impact Assessment - Proposed Commercial Development - Milton, Massachusetts

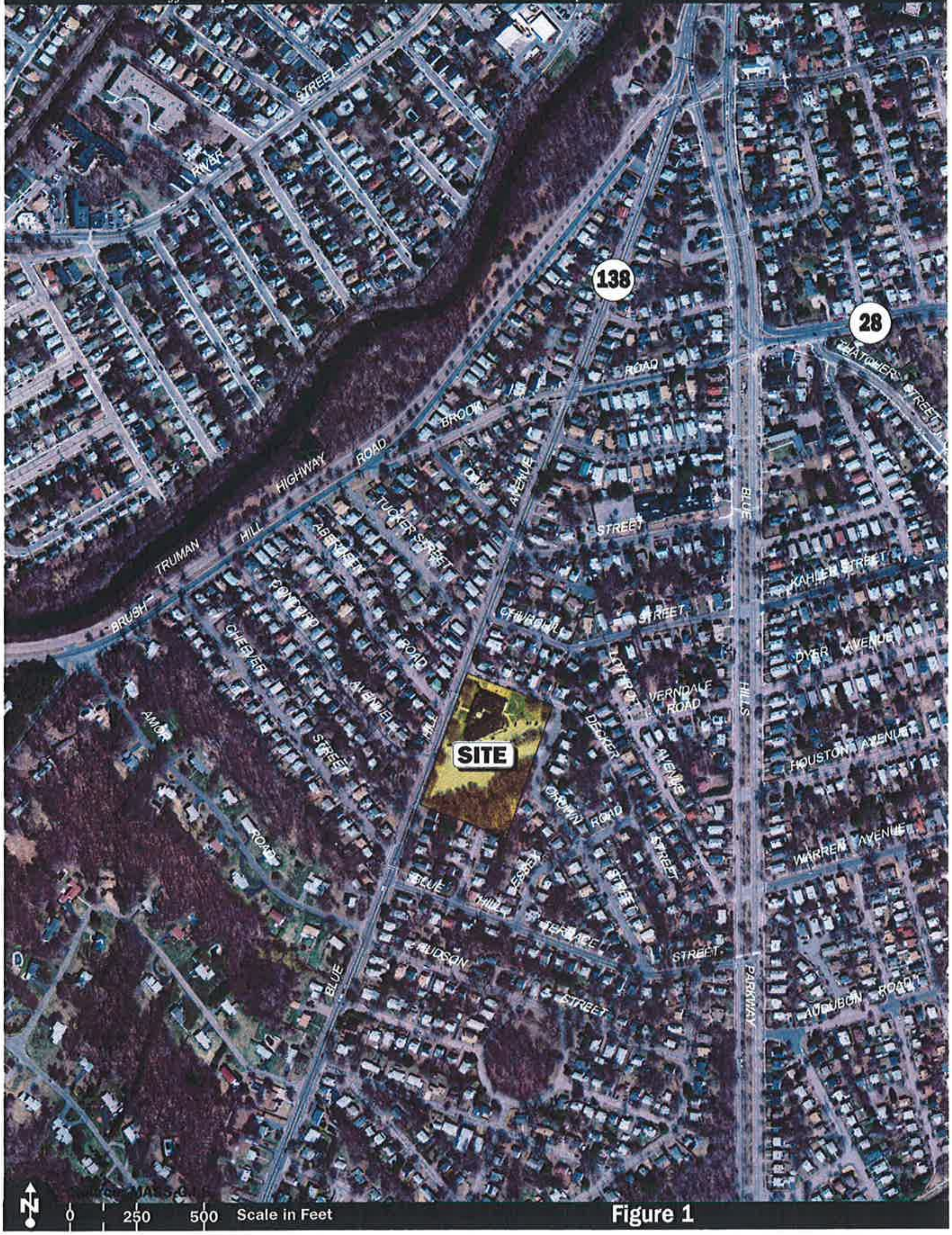

Figure 1

Site Location Map

Vanasse & Associates, Inc.
Transportation Engineers & Planners

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Roadways

Blue Hill Avenue (Route 138)

Blue Hill Avenue (Route 138) is a two-lane, principal arterial roadway under state jurisdiction that traverses the study area in a general north-south direction. In the vicinity of the Project site, Blue Hill Avenue provides two 12-foot wide travel lanes separated by a double-yellow centerline with 9 to 11-foot wide marked shoulders provided. Sidewalks are generally provided along both sides of the roadway with illumination provided by way of street lights mounted on wood poles. A signalized pedestrian crossing is provided between Decker Street and Aberdeen Road. The posted speed limit along Blue Hill Avenue in the vicinity of the Project site is 35 miles per hour (mph). Land use along Blue Hill Avenue consists of residential properties and the Project site.

Blue Hills Parkway

Blue Hills Parkway is a five-lane (three lanes northbound and two lanes southbound), urban minor arterial roadway under the jurisdiction of the Department of Conservation and Recreation (DCR) that traverses the study area in a general north-south direction. Within the study area, Blue Hills Parkway provides three 11 to 12-foot wide northbound travel lanes and two 11 to 12-foot wide southbound travel lanes separated by a landscaped median with 1 to 2-foot wide marked shoulders provided adjacent to the median and no marked shoulder provided along the outside travel lane. Sidewalks are provided along both sides of the roadway with illumination provided by way of street lights mounted on concrete poles. Land use along Blue Hills Parkway consists primarily of residential properties.

Decker Street

Decker Street is a local roadway that is under Town jurisdiction and traverses the study area in a general northwest-southeast direction between Blue Hill Avenue and Blue Hills Parkway. Within the study area, Decker Street is a 20 to 21-foot wide paved roadway that accommodates two-way travel with no marked centerline or shoulders provided. Sidewalks are provided along both sides of Decker Street within the study area with illumination provided by way of street lights mounted on wood poles. Land use along Decker Street within the study area consists of residential properties and the Project site.

Crown Street

Crown Street is a local roadway that is under Town jurisdiction and traverses the study area in a general northwest-southeast direction between Decker Street and Blue Hills Parkway. Within the study area, Crown Street is a 24-foot wide paved roadway that accommodates two-way travel with no marked centerline or shoulders provided. Sidewalks are provided along the east side of Crown Street within the study area with illumination provided by way of street lights mounted on wood poles. Land use along Crown Street within the study area consists of residential properties and the Project site.

Churchill Street

Churchill Street is a local roadway that is under Town jurisdiction and traverses the study area in a general east-west direction between Blue Hill Avenue and Blue Hills Parkway. Within the study area, Churchill Street is a 20-foot wide paved roadway that accommodates two-way travel with no marked centerline or shoulders provided. Sidewalks are provided along the north side of Churchill Street within the study area with illumination provided by way of street lights mounted on wood poles. Land use along Churchill Street within the study area consists of residential properties and the Project site.

Blue Hill Terrace Street

Blue Hill Terrace Street is a two-lane roadway that is under Town jurisdiction and traverses the study area in a general east-west direction between Blue Hill Avenue and Blue Hills Parkway. Within the study area, Blue Hill Terrace Street provides two 11 to 13-foot wide travel lanes separated by a double-yellow centerline with no marked shoulder provided. Sidewalks are provided along both sides of Blue Hill Terrace Street within the study area with illumination provided by way of street lights mounted on wood poles. Land use along Blue Hill Terrace Street within the study area consists of residential properties.

Intersections

Blue Hill Avenue at Tucker Street and Churchill Street

Churchill Street intersects Blue Hill Avenue from the east and Tucker Street intersects Blue Hill Avenue from the west and slightly offset to the south, to form this four-legged, unsignalized intersection under STOP-sign control. The Blue Hill Avenue north and southbound approaches consist of a 12-foot wide general-purpose travel lane with a 9-foot wide marked shoulder provided. The directions of travel along Blue Hill Avenue are separated by a double-yellow centerline. Tucker Street and Churchill Street are 19 to 20-foot wide paved roadways that accommodate two-way travel with no marked centerline or shoulders provided and vehicles approaching Blue Hill Avenue are under STOP-sign control. Sidewalks are provided along both sides of Blue Hill Avenue and Tucker Street, and along the north side of Churchill Street. Illumination is provided by way of street lights mounted on wood poles. Land use in the vicinity of the intersection consists of residential properties.

Blue Hill Avenue at Decker Street

Decker Street intersects Blue Hill Avenue from the east to form this three-legged, 'T'-type, unsignalized intersection under assumed Stop control. The Blue Hill Avenue north and southbound approaches consist of an 11 to 12-foot wide general-purpose travel lane with a 9-foot wide marked shoulder provided. The directions of travel along Blue Hill Avenue are separated by a double-yellow centerline. Decker Street is a 20-foot wide paved roadway that accommodates two-way travel with no marked centerline or shoulders provided and vehicles approaching Blue Hill Avenue are under assumed Stop control (i.e., a STOP-sign is not provided). Sidewalks are provided along both sides of Blue Hill Avenue and Decker Street, with a pedestrian crossing under traffic signal control located on Blue Hill Avenue south of Decker Street. Illumination is provided by way of street lights mounted on wood poles. Land use in the vicinity of the intersection consists of residential properties and the Project site.

Blue Hill Avenue at Aberdeen Road

Aberdeen Road intersects Blue Hill Avenue from the west to form this three-legged, unsignalized intersection under STOP-sign control. The Blue Hill Avenue north and southbound approaches consist of a 12-foot wide general-purpose travel lane with a 9-foot wide marked shoulder provided. The directions of travel along Blue Hill Avenue are separated by a double-yellow centerline. Aberdeen Road is a 24-foot wide paved roadway that accommodates two-way travel with no marked centerline or shoulders provided and vehicles approaching Blue Hill Avenue are under STOP-sign control. Sidewalks are provided along both sides of the intersecting roadways, with a pedestrian crossing under traffic signal control located on Blue Hill Avenue north of Aberdeen Road. Illumination is provided by way of street lights mounted on wood poles. Land use in the vicinity of the intersection consists of residential properties and the Project site.

Blue Hill Avenue at the Temple Shalom Driveways and Concord Avenue

The Temple Shalom entrance driveway intersects Blue Hill Avenue from the east and Concord Avenue intersects Blue Hill Avenue from the west and slightly offset to the south, to form this four-legged, unsignalized intersection under STOP-sign control. The Temple Shalom exit driveway intersects Blue Hill Avenue from the east south of Concord Avenue. The Blue Hill Avenue north and southbound approaches consist of a 12-foot wide general-purpose travel lane with a 9-foot wide marked shoulder provided. The directions of travel along Blue Hill Avenue are separated by a double-yellow centerline. Concord Avenue is a 23-foot wide paved roadway that accommodates two-way travel with no marked centerline or shoulders provided and vehicles approaching Blue Hill Avenue are under STOP-sign control. The Temple Shalom entrance and exit driveways are approximately 26 and 22 feet wide, respectively, with exiting vehicles under assumed Stop control (i.e., a STOP-sign is not provided). Sidewalks are provided along both sides of Blue Hill Avenue and Concord Avenue, with a crosswalk provided across Concord Avenue. Illumination is provided by way of street lights mounted on wood poles. Land use in the vicinity of the intersection consists of residential properties and the Project site.

Blue Hill Avenue at Blue Hill Terrace Street and Cheever Street

Blue Hill Terrace Street intersects Blue Hill Avenue from the east and Cheever Street intersects Blue Hill Avenue from the west and slightly offset to the north, to form this four-legged intersection under traffic signal control. The Blue Hill Avenue north and southbound approaches consist of a 12-foot wide general-purpose travel lane with a 10-foot wide marked shoulder provided. The directions of travel along Blue Hill Avenue are separated by a double-yellow centerline. Cheever Street is a 24-foot wide paved roadway that accommodates two-way travel with no marked centerline or shoulders provided. The Blue Hill Terrace Street westbound approach consists of an 11-foot wide general-purpose lane with no marked shoulder provided. The directions of travel along Blue Hill Terrace Street are separated by a double-yellow centerline. Right-Turns-On-Red are prohibited from the Blue Hills Terrace Street and Cheever Street approaches, and trucks are restricted from using Cheever Street. Sidewalks are provided along both sides of the intersecting roadways, with crosswalks provided across Blue Hill Terrace Street and Cheever Street, and across Blue Hill Avenue between Cheever Street and Blue Hill Terrace Street. Illumination is provided by way of street lights mounted on wood poles. Land use in the vicinity of the intersection consists of residential properties. The traffic signal operates in a three-phase, fully actuated mode, with separate phases provided for Blue Hill Terrace Street and Cheever Street. An exclusive pedestrian phase is provided upon pushbutton actuation.

Blue Hill Avenue at Hudson Street and Amor Road

Hudson Street intersects Blue Hill Avenue from the east and Amor Road intersects Blue Hill Avenue from the west and slightly offset to the north, to form this four-legged, unsignalized intersection under STOP-sign control. The Blue Hill Avenue north and southbound approaches consist of a 12-foot wide general-purpose travel lane with a 10 to 11-foot wide marked shoulder provided. The directions of travel along Blue Hill Avenue are separated by a double-yellow centerline. Hudson Street and Amor Road are 24 to 25-foot wide paved roadways that accommodate two-way travel with no marked centerline or shoulders provided and vehicles approaching Blue Hill Avenue are under STOP-sign control. Sidewalks are provided along both sides of Blue Hill Avenue and Hudson Street, with a crosswalk provided across Hudson Street. Illumination is provided by way of street lights mounted on wood poles. Land use in the vicinity of the intersection consists of residential properties.

Decker Street at Crown Street

Crown Street intersects Decker Street from the south to form this three-legged, 'T'-type, unsignalized intersection under STOP-sign control. Decker Street is a 20 to 21-foot wide paved roadway that accommodates two-way travel with no marked centerline or shoulders provided. Crown Street is a 24-foot wide paved roadway that accommodates two-way travel with no marked centerline or shoulders provided and vehicles approaching Decker Street are under STOP-sign control. Sidewalks are provided along both sides of Decker Street and along the east side of Crown Street. Illumination is provided by way of street lights mounted on wood poles. Land use in the vicinity of the intersection consists of residential properties and the Project site.

Crown Street at the Temple Shalom driveways

The Temple Shalom driveways intersect the west side of Crown Street south of Decker Street to form two (2) three-legged, 'T'-type, unsignalized intersections under assumed Stop control that are located approximately 55-feet apart. Crown Street is a 24-foot wide paved roadway that accommodates two-way travel with no marked centerline or shoulders provided. The Temple Shalom exit driveway (northern driveway) is 50 feet wide and vehicles approaching Crown Street are under assumed Stop control (i.e., a STOP-sign is not provided). The Temple Shalom southern driveway consists of a 26-foot wide entering travel lane and a 16-foot wide exit lane under assumed Stop control. The directions of travel along the Temple Shalom southern driveway are separated by a landscaped median. Sidewalks are provided along the east side of Crown Street. Illumination is provided by way of street lights mounted on wood poles. Land use in the vicinity of the intersection consists of residential properties and the Project site.

Blue Hills Parkway at Kahler Avenue and Churchill Street

Kahler Avenue and Churchill Street intersect Blue Hills Parkway from the east and west, respectively, to form this four-legged, unsignalized intersection under STOP-sign control. The Blue Hills Parkway northbound approach consists of three 11 to 12-foot wide general-purpose travel lanes with a 1-foot wide marked shoulder provided along the west side (adjacent to the median) and no shoulder provided along the east side. The Blue Hills Parkway southbound approach consists of two 11.5 to 12.5-foot wide general-purpose travel lanes with a 2-foot wide marked shoulder provided along the east side (adjacent to the median) and no shoulder provided along the west side. The directions of travel along Blue Hills Parkway are separated by a landscaped median. Churchill Street and Kahler Avenue are 20 to 24-foot wide paved roadways that accommodate two-way travel with no marked centerline or shoulders provided and vehicles approaching Blue Hills Parkway are under STOP-sign control. Sidewalks are provided along both sides of the intersecting roadways, with crosswalks provided across Kahler Avenue and Churchill Street. Illumination is provided by way of street lights mounted on concrete poles. Land use in the vicinity of the intersection consists of residential properties.

Blue Hills Parkway at Blue Hill Terrace Street

Blue Hill Terrace Street intersects Blue Hills Parkway from the west to form this three-legged, 'T'-type, unsignalized intersection under STOP-sign control. The Blue Hills Parkway northbound approach consists of three 11 to 12-foot wide general-purpose travel lanes with a 1 to 2-foot wide marked shoulder provided along the west side (adjacent to the median) and no shoulder provided along the east side. The Blue Hills Parkway southbound approach consists of two 12-foot wide general-purpose travel lanes with a 1 to 2-foot wide marked shoulder provided along the east side (adjacent to the median) and no shoulder provided along the west side. The directions of travel along Blue Hills Parkway are separated by a landscaped median. The Blue Hill Terrace Street eastbound approach consists of a 13-foot wide general-purpose travel lane with no marked shoulder provided and vehicles approaching Blue Hills Parkway under STOP-sign control. Sidewalks are provided along both sides of the intersecting roadways, with crosswalks provided across Blue Hill Terrace Street and the Blue Hills Parkway north leg of the intersection. Illumination is provided by way of street lights mounted on concrete poles. Land use in the vicinity of the intersection consists of residential properties.

Existing Traffic Volumes

In order to establish existing traffic-volume demands and flow patterns within the study area, automatic traffic recorder (ATR) counts, manual turning movement counts (TMCs) and vehicle classification counts were completed in September and October 2009. The TMCs were collected during the weekday evening (4:00 to 6:00 PM) and Saturday midday (11:00 AM to 2:00 PM) peak periods at the study area intersections. These time periods were selected as they represent the peak traffic volume hours for both the roadway network within the study area and the Project. The ATR counts were completed on Blue Hill Avenue in the vicinity of the Project site in order to record weekday daily and Saturday traffic conditions over an extended period.

Traffic Volume Adjustments

In order to evaluate the potential for seasonal fluctuation of traffic volumes within the study area, historic traffic count data were reviewed for the nearest MassDOT permanent count stations to the Project site.[1] Based on a review of this data, it was determined that traffic volumes for the months of September and October are approximately 5.7 and 5.6 percent above average-month conditions, respectively, and were not adjusted downward to average-month conditions in order to provide a conservative (above-average) analysis condition. The 2009 Existing weekday evening and Saturday midday peak hour traffic volume networks are depicted on Figures 2 and 3, respectively, and summarized in Table 1.

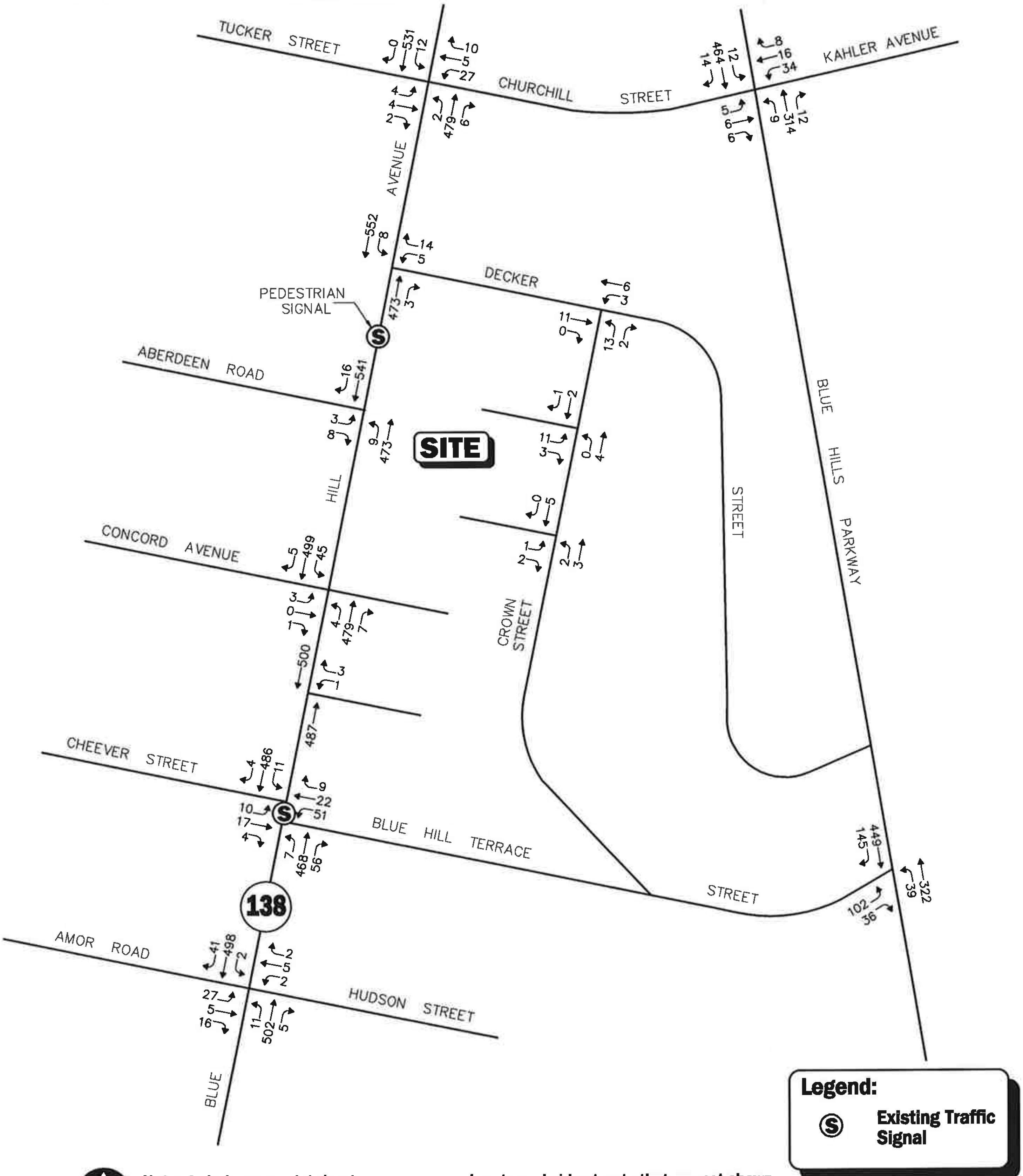
Table 1
2009 EXISTING TRAFFIC VOLUMES

		Weekday Evening Peak Hour				Saturday Midday Peak Hour		
Location	AWT[a]	VPH[b]	K Factor (Percent of Daily Traffic)[c]	Directional Distribution[d]	Saturday[e]	VPH	K Factor (Percent of Daily Traffic)	Directional Distribution
Blue Hill Avenue, south of Concord Avenue	14,500	988	6.8	50.7% SB	12,600	740	5.9	55.0% SB

[a]Average weekday traffic in vehicles per day.
[b]Vehicles per hour.
[c]Percent of daily traffic that occurs during the peak hour.
[d]Percent traveling in the peak direction.
[e]Vehicles.
NB = northbound; SB = southbound.

As can be seen in Table 1, Blue Hill Avenue south of Concord Avenue was found to accommodate approximately 14,500 vehicles on an average weekday (two-way 24,-hour volume), with approximately 988 vehicles per hour (vph) during the weekday evening peak hour. On a Saturday, this segment of

[1]MassDOT Traffic Volumes for the Commonwealth of Massachusetts; Permanent Count Station 13 located on Route 138 north of Atherton Street in Milton; 2009.



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

Not To Scale

Figure 2

2009 Existing Weekday Evening Peak Hour Traffic Volumes

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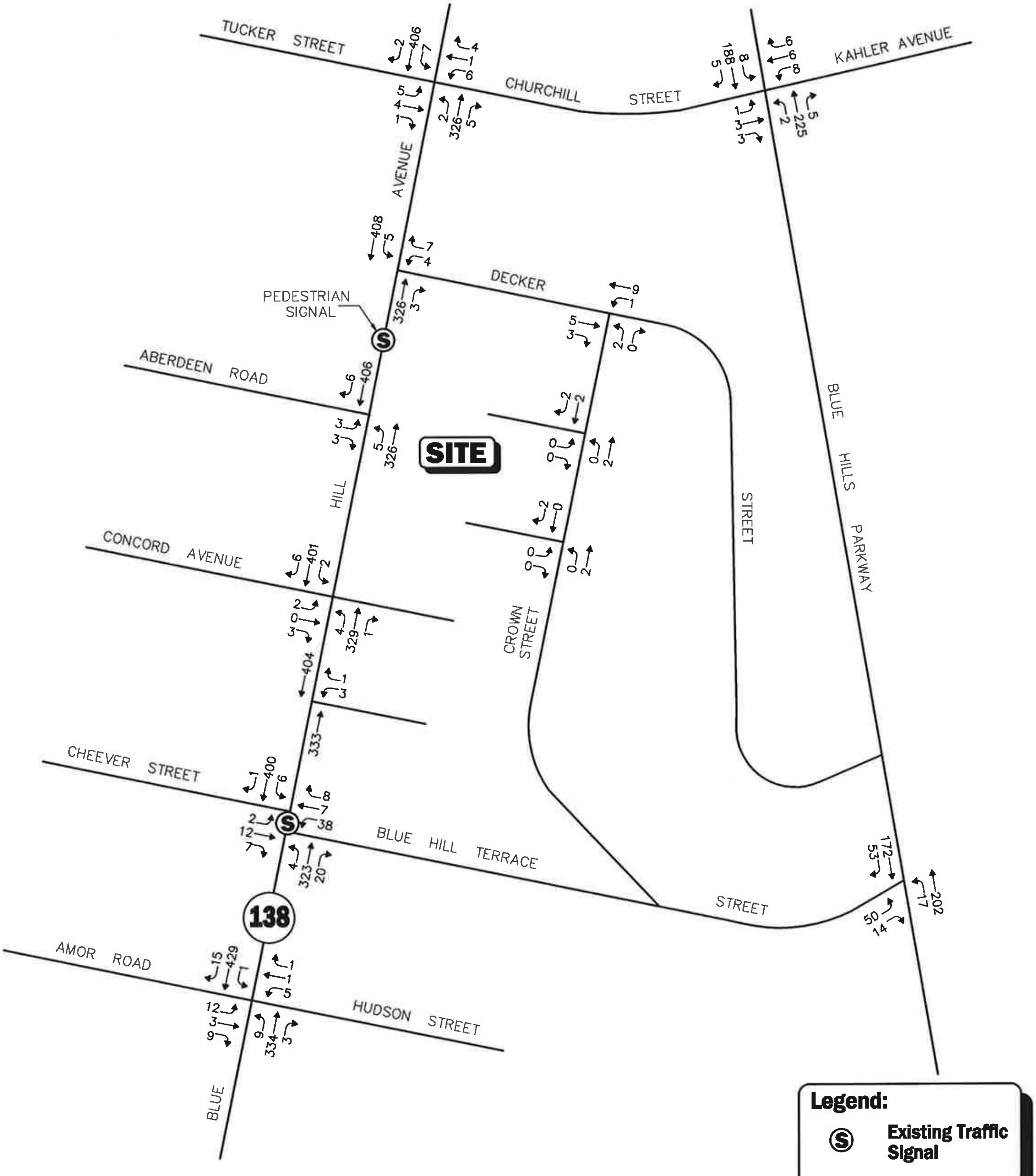

Note: Imbalances exist due to numerous curb cuts and side streets that are not shown.

Not To Scale

Figure 3

2009 Existing Saturday Midday Peak Hour Traffic Volumes

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Blue Hill Avenue was found to accommodate approximately 12,600 vehicles, with approximately 740 vph during the Saturday midday peak hour.

A review of the peak-period traffic counts indicates that the weekday evening peak hour generally occurs between 4:45 and 5:45 PM, with the Saturday midday peak hour generally occurring between 1:00 and 2:00 PM.

Pedestrian and Bicycle Facilities

A comprehensive field inventory of pedestrian and bicycle facilities within the study area was undertaken in September and October 2009. The field inventory consisted of a review of the location of sidewalks and pedestrian crossing locations along the study roadways and at the study intersections, as well as the location of existing and planned future bicycle facilities. In general, sidewalks are provided along one or both sides of the study roadways, with crosswalks provided at major intersections. Pedestrian traffic signal equipment and phasing are provided as a part of the Blue Hill Avenue/Blue Hill Terrace Street/Cheever Street traffic signal system. In addition, a mid-block crossing with a pedestrian actuated traffic signal is provided on Blue Hill Avenue between Decker Street and Aberdeen Road.

Formal bicycle accommodations are not currently provided within the study area. Shoulders are provided along Blue Hill Avenue that are sufficient to accommodate bicycle travel in a shared traveled-way condition.

Public Transportation

Public transportation services are provided within the study area by JBL Bus Lines with financial assistance from the Massachusetts Bay Transportation Authority (MBTA). JBL Bus Lines operates Bus Route 716, *Cobbs Corner – Mattapan Station via Canton Center*, between Cobbs Corner in Canton and the Mattapan MBTA station in Boston, with scheduled stops at Canton Center, Royall Street/ Trailside Museum/Park-n-Ride in Canton, and Curry College in Milton. Connections to Brockton Area Transit (BAT) bus Route 14 can be made at Cobbs Corner with service to Brockton and the Westgate Mall. Bus Route 716 travels along Blue Hill Avenue and past the Project site, and will stop at any safe location along the route. Route 716 bus service is provided Monday through Friday from 6:30 AM to 6:30 PM, and on Saturday from 8:00 AM to 1:00 PM. Bus Route 716 generally operates on 60-minute headways on weekdays until noon and on Saturdays, and on 75 to 90-minute headways during the weekday afternoon and evening. Local roundtrip fares for adults are $1.25, with a $0.60 fare for students and a $0.50 fare for senior citizens and persons with disabilities. Children age 11 and under ride for free. JBL Bus Line schedule and fare information for Bus Route 716 are provided in the Appendix.

Speed Measurements

Vehicle travel speed measurements were performed on Blue Hill Avenue south of Concord Avenue over a continuous forty-eight hour period (Friday through Saturday) using a pneumatic speed measuring device (ATR). Table 2 summarizes the vehicle travel speed measurements.

Table 2
VEHICLE TRAVEL SPEED MEASUREMENTS

	Blue Hill Avenue south of Concord Avenue	
	Northbound	Southbound
Mean Travel Speed (mph)	37	30
85^{th} Percentile Speed (mph)	43	39
Posted Speed Limit (mph)	**35**	**35**

mph = miles per hour.

As can be seen in Table 2, the average vehicle travel speed along Blue Hill Avenue south of Concord Avenue was found to be approximately 34 miles per hour (mph), with the average measured 85^{th} percentile vehicle travel speed found to be 41 mph, or 6 mph above the posted speed limit of 35 mph. The 85^{th} percentile vehicle travel speed is used as the basis of engineering design and in the evaluation of sight distances, and is often used in establishing posted speed limits.

Motor Vehicle Crash Data

Motor vehicle crash information for the study area intersections was provided by the MassDOT Highway Division Safety Management/Traffic Operations Unit for the most recent three-year period available (2005 through 2007 inclusive) in order to examine motor vehicle crash trends occurring within the study area. The data is summarized by intersection, type, severity, and day of occurrence, and presented in Table 3.

As can be seen in Table 3, the study area intersections averaged fewer than 4 reported motor vehicle crashes per year over the three-year review period. The Blue Hills Parkway/Blue Hill Terrace Street intersection experienced the largest number of reported motor vehicle crashes over the three-year review period. The majority of the crashes occurring at this intersection involved personal injury (7 out of 11); occurred on a weekday (11 out of 11); and involved angle type collisions (5 out of 11).

The intersections of Blue Hills Parkway/Blue Hill Terrace Street and Crown Street/Decker Street were found to have a motor vehicle crash rate that was <u>above</u> the MassDOT average for unsignalized intersections for the MassDOT Highway Division District in which the Project is located (District 4). This does not necessarily indicate that a specific safety deficiency exists at this location; however, the data does suggest that a more detailed assessment of the cause of the motor vehicle collisions occurring at these intersections should be undertaken. In conjunction with this assessment, specific improvements have been identified at these intersections that are designed to reduce the frequency of occurrence of motor vehicle collisions. These improvements are identified in the *Recommendations* section of this assessment. No fatal motor vehicle crashes were reported at the study area intersections over the three-year review period. The detailed MassDOT Crash Rate Worksheets are provided in the Appendix.

Table 3
MOTOR VEHICLE CRASH DATA SUMMARY[a]

	Blue Hill Avenue/ Churchill Street/ Tucker Street	Blue Hill Avenue/ Decker Street	Blue Hill Avenue/ Aberdeen Road	Blue Hill Avenue/ Concord Avenue/ Temple Shalom Driveways	Blue Hill Avenue/ Cheever Street/ Blue Hill Terrace Street
Year					
2005	1	1	0	0	3
2006	0	0	1	1	3
2007	1	3	1	0	3
Total	2	4	2	1	9
Average	0.67	1.33	0.67	0.33	3.0
Rate[b]	0.15	0.31	0.16	0.08	0.65
Significant?[c]	No	No	No	No	No
Type:					
Angle	2	2	0	0	1
Rear-End	0	2	1	0	6
Fixed-Object	0	0	0	1	0
Head-On	0	0	0	0	0
Sideswipe	0	0	1	0	2
Pedestrian/Bicycle	0	0	0	0	0
Unknown/Other	0	0	0	0	0
Total	2	4	2	1	9
Day of Week:					
Monday through Friday	1	4	2	0	9
Saturday	0	0	0	0	0
Sunday	1	0	0	1	0
Total	2	4	2	1	9
Severity:					
Property Damage Only	0	4	2	1	6
Personal Injury	2	0	0	0	3
Fatal	0	0	0	0	0
Total	2	4	2	1	9

See notes at end of table.

Table 3 (Continued)
MOTOR VEHICLE CRASH DATA SUMMARY[a]

	Blue Hill Avenue/ Amor Road/ Hudson Street	Decker Street/ Crown Street	Crown Street/ Temple Shalom Driveways	Blue Hills Parkway/ Churchill Street/ Kahler Avenue	Blue Hills Parkway/ Blue Hill Terrace Street
Year					
2005	2	1	0	1	4
2006	3	0	0	1	5
2007	0	1	0	1	2
Total	5	2	0	3	11
Average	1.67	0.67	0.00	1.0	3.67
Rate[b]	0.37	4.70	0.00	0.27	0.83
Significant?[c]	No	Yes	No	No	Yes
Type:					
Angle	3	1	0	2	5
Rear-End	1	0	0	0	1
Fixed-Object	1	0	0	0	1
Head-On	0	1	0	0	2
Sideswipe	0	0	0	1	0
Pedestrian/Bicycle	0	0	0	0	0
Unknown/Other	0	0	0	0	2
Total	5	2	0	3	11
Day of Week:					
Monday through Friday	1	2	0	3	11
Saturday	2	0	0	0	0
Sunday	2	0	0	0	0
Total	5	2	0	3	11
Severity:					
Property Damage Only	3	2	0	2	4
Personal Injury	2	0	0	1	7
Fatal	0	0	0	0	0
Total	5	2	0	3	11

[a]Source: MassDOT Safety Management/Traffic Operations Unit records, 2005 through 2007.
[b]Crash rate per million vehicles entering the intersection.
[c]The intersection crash rate is significant if it is found to exceed 0.58 crashes per million vehicles entering the intersection for unsignalized intersections and 0.78 crashes per million vehicles entering the intersection for signalized intersections as defined by MassDOT for the MassDOT Highway Division District in which the Project is located (District 4).

FUTURE CONDITIONS

Traffic volumes in the study area were projected to the year 2014, which reflects a five-year planning horizon consistent with State traffic study guidelines. Independent of the Project, traffic volumes on the roadway network in the year 2014 under No-Build conditions include all existing traffic and new traffic resulting from background traffic growth. Anticipated Project-generated traffic volumes superimposed upon this 2014 No-Build traffic network reflect the 2014 Build conditions with the Project.

Future Traffic Growth

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

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

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

Specific Development by Others

MassDOT, the Town of Milton Planning Department and the Boston Redevelopment Authority (BRA) were contacted in order to determine if there were any projects planned within the area that would have an impact on future traffic volumes at the study intersections. Based on these discussions, the following projects were identified:

- **Curry College Access Improvements** – This project consists of modifying the main access to Curry College located off Blue Hill Avenue and approximately 2 miles south of the Project site to improve safety for vehicles and pedestrians. This project is not expected to have an impact on future traffic volumes within the study area.
- **Olmstead Green Mixed-Use Development** – This project consists of the redevelopment of the former Boston State Hospital located off Harvard and Morton Streets in Mattapan, Massachusetts. This redevelopment project includes: 287 residential condominium/townhouse units; 153 apartments; 83 senior adult housing units; a 123-bed skilled nursing home; and a community center. Traffic volumes expected to be generated by this proposed project were obtained from the traffic study conducted for the development and were distributed onto the roadway network based on the trip-distribution pattern presented therein.
- **Mass Bio Lab Phase II** – This project consists of the construction of a 97,000 sf research and administration building to be located off Walk Hill Street in Mattapan, Massachusetts. Traffic volumes expected to be generated by this proposed project were obtained from the traffic study conducted for the development and were distributed onto the roadway network based on the trip-distribution pattern presented therein.

No other projects were identified at this time that would impact future traffic volumes within the study area beyond the general background traffic growth rate.

General Background Traffic Growth

Traffic-volume data compiled by MassDOT from permanent count stations and historic traffic counts in the area were reviewed in order to determine general background traffic growth trends. Based on a review of this data, it was determined that traffic volumes within the study area have fluctuated over the past several years, ranging from increases of approximately 2.6 percent to decreases of approximately 0.6 percent. On average, traffic volumes were found to have generally increased by approximately 0.8 percent per year. Based on this review, a 1.0 percent per year compounded annual background traffic growth rate was used in order to account for future traffic growth and presently unforeseen development within the study area.

Roadway Improvement Projects

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

No-Build Traffic Volumes

The 2014 No-Build peak-hour traffic-volume networks were developed by applying the 1.0 percent per year compounded annual background traffic growth rate to the 2009 Existing peak-hour traffic volumes and then superimposing the peak-hour traffic volumes expected to be generated by the previously identified specific development by others. The resulting 2014 No-Build weekday evening and Saturday midday peak-hour traffic-volume networks are depicted on Figures 4 and 5, respectively.

Project-Generated Traffic

Design year (2014 Build) traffic volumes for the study area roadways were determined by estimating Project-generated traffic volumes and assigning those volumes on the study roadways. The following sections describe the methodology used to develop the anticipated traffic characteristics of the Project.

In order to develop the traffic characteristics of the Project, trip-generation statistics published by the Institute of Transportation Engineers (ITE)[2] for similar land uses as those proposed were used. The ITE provides trip-generation information for various types of land uses developed as a result of scientific studies that have been conducted over the past 50 plus years. This data includes trip estimates for land uses similar to those that may be developed as a part of the Project (pharmacy/drug store with drive-through window and a neighborhood grocery store). ITE Land Use Code (LUC) 881, *Pharmacy/Drugstore with Drive-Through Window*, with the independent variable of gross floor area equal to 13.013 (13,013 sf), was used to develop the traffic characteristics of the CVS/Pharmacy, with LUC 850, *Supermarket*, with the independent variable of gross floor area equal to 10.0 (10,000 sf), used to develop the traffic characteristics of the neighborhood grocery store.

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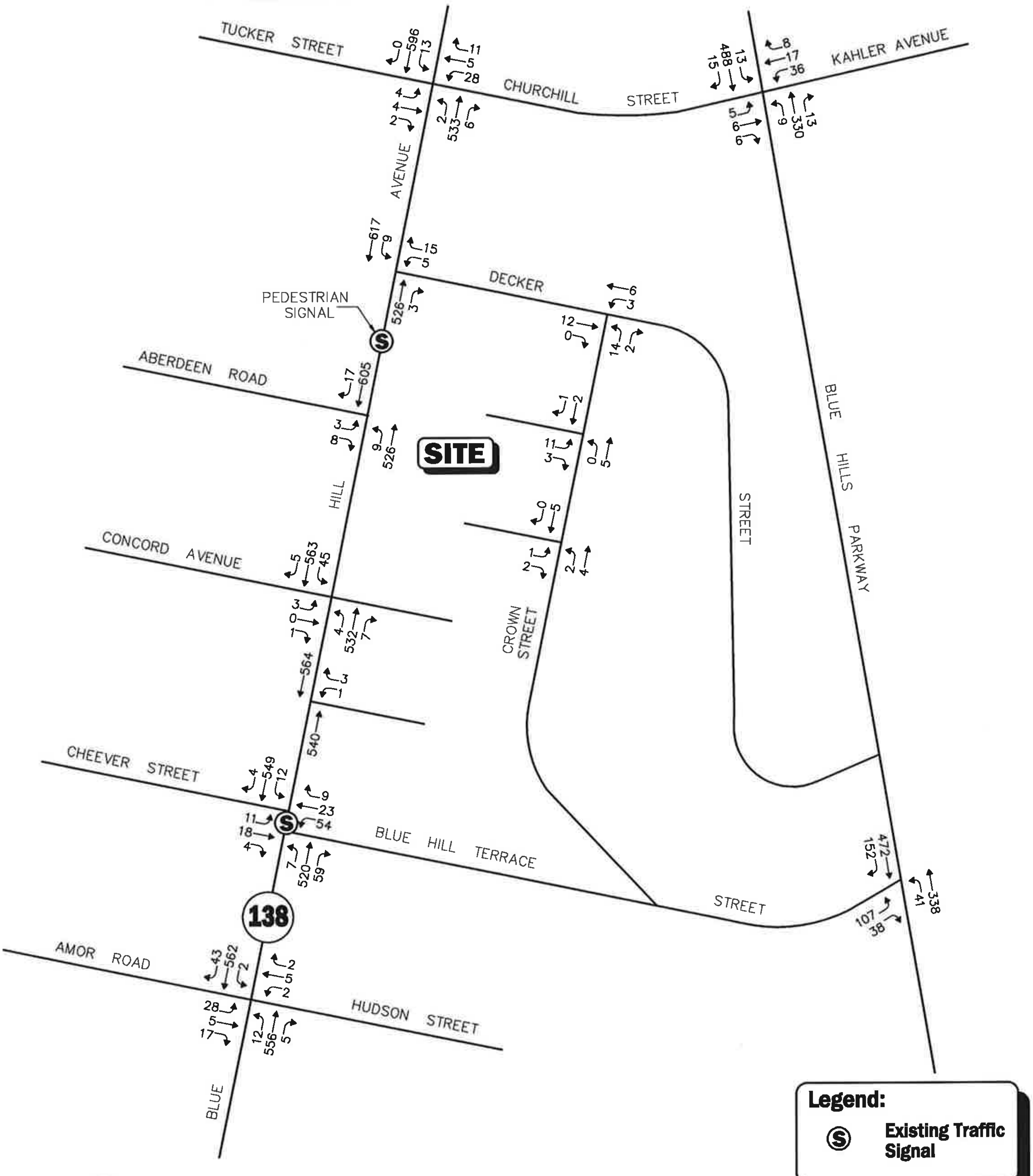
[2] *Trip Generation*, Eighth Edition; Institute of Transportation Engineers; Washington, DC; 2008.



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

Not To Scale

Figure 4

2014 No-Build Weekday Evening Peak Hour Traffic Volumes

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Transportation Engineers & Planners

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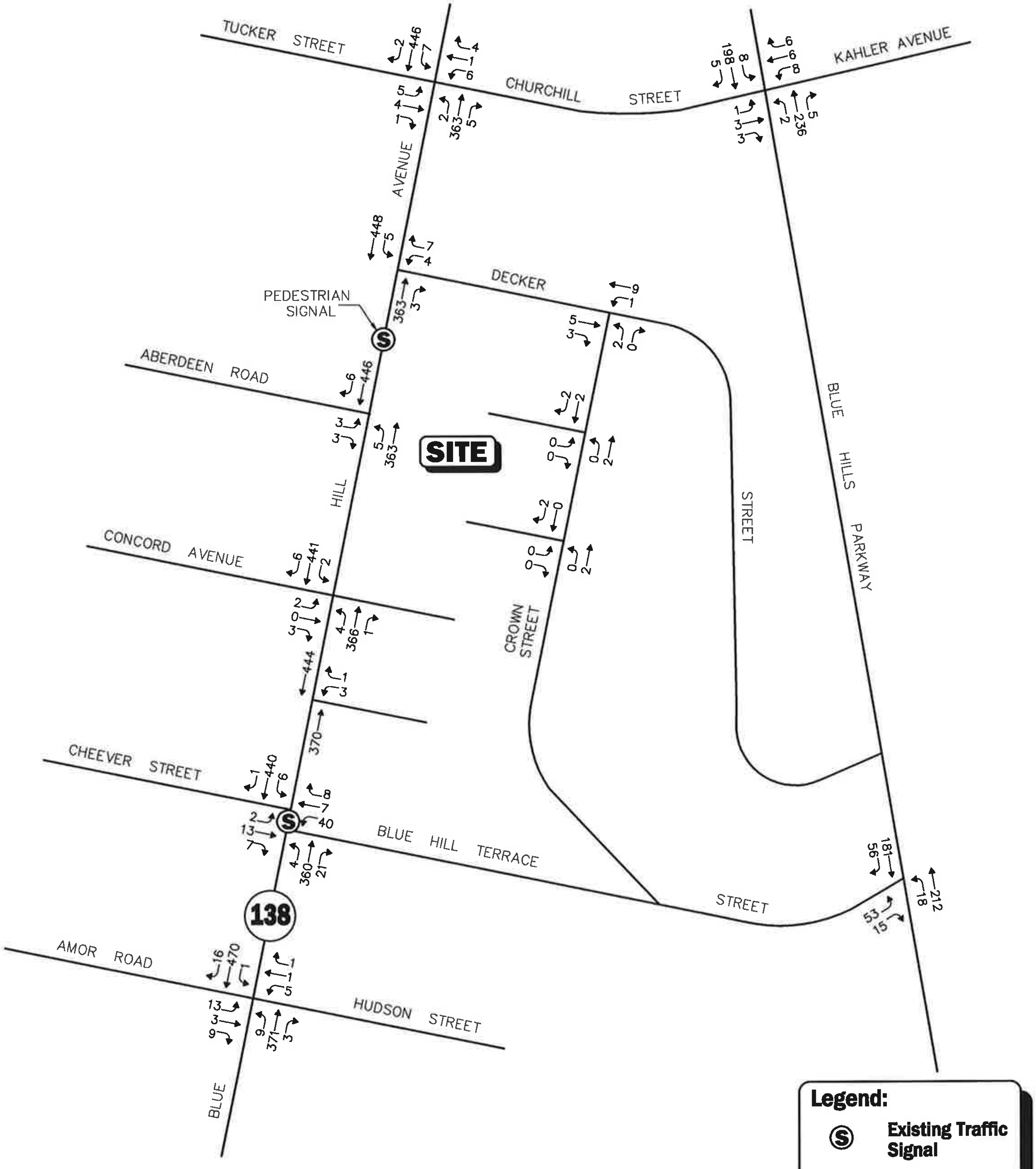

Note: Imbalances exist due to numerous curb cuts and side streets that are not shown.

Not To Scale

Figure 5

Vanasse & Associates, Inc.
Transportation Engineers & Planners

2014 No-Build
Saturday Midday
Peak Hour Traffic Volumes

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Pass-By Trips

Not all the trips expected to be generated by the Project will consist of new trips on the roadway network. A portion of the trips will consist of pass-by trips, or vehicles already traveling along Blue Hill Avenue for other purposes that will patronize the Project in conjunction with their trip and then continue on to their original destination. For reference, based on statistics published by ITE[3], on average up to 49 percent of the trips associated with a pharmacy with a drive-up prescription facility and 36 percent of the trips generated by a neighborhood grocery store (supermarket) may consist of pass-by trips, or vehicles that are traveling along roadways adjacent to the Project that will patronize one or more of the uses within the development and then continue to their original destination. These trips are not new trips on the roadway network as a result of the Project. In accordance with state standards for the preparation of TIAs, a 25 percent pass-by trip rate was applied to the trip-generation calculations for the Project.

Internal Trips

In addition to pass-by trips, a portion of the trips associated with the Project will consist of internal trips, or a trip that is made between uses within a site when multiple uses are present. By way of example, a patron of the neighborhood grocery store may also visit the CVS/Pharmacy in conjunction with their trip. Such trips are not directly accounted for in the trip estimates for a project with multiple land uses when the calculations are performed on an individual land use basis. In order to account for internal trips, a 10 percent reduction was applied to the ITE trip generation calculations for the alternative development program (i.e., it was assumed that 10 percent of the trips would consist of patrons visiting more than one use within the site).

Table 4 summarizes the anticipated traffic characteristics of the Project. ***It should be noted that the creation of residential housing on the Project site (an identified alternative to the Project consisting of up to 100 apartment units) would result in all new traffic to the area and along the proximate residential roadways, negating the benefits of an appropriately designed neighborhood based retail plaza.***

[3]*Trip Generation Handbook, an ITE Recommended Practice*; Institute of Transportation Engineers; Washington DC; June 2004.

Table 4
TRIP-GENERATION SUMMARY

Time Period/Direction	(A) Proposed Pharmacy (13,013 sf)[a]	(B) Proposed Grocery Store (10,000 sf)[b]	(C = A + B) Total Trips	(D = C x 0.10) Internal Trips (10 Percent)	(E = C – D) Net Trips	(F = E x 0.25) Pass-By Trips (25 Percent)	(G = E - F) Primary Trips
Average Weekday Daily							
Entering	574	511	1,085	109	976	244	732
Exiting	574	511	1,085	109	976	244	732
Total	1,148	1,022	2,170	218	1,952	488	1,464
Weekday Evening Peak Hour							
Entering	68	54	122	12	110	27	83
Exiting	67	51	118	12	106	27	79
Total	135	105	240	24	216	54	162
Saturday							
Entering	435	888	1,323	133	1,190	298	892
Exiting	435	888	1,323	133	1,190	298	892
Total	870	1,776	2,646	266	2,380	596	1,784
Saturday Midday Peak Hour							
Entering	51	55	106	11	95	24	71
Exiting	51	53	104	11	93	24	69
Total	102	108	210	22	188	48	140

[a]Based on ITE LUC 881, Pharmacy/Drugstore with Drive-Through Window; 13,013 sf.
[b]Based on ITE LUC 850, Supermarket; 10,000 sf.

Project-Generated Traffic Volume Summary

As can be seen in Table 4, incorporating a 25 percent pass-by trip rate and a 10 percent internal trip reduction for shared trips between the uses to be located within the Project site, the Project was shown to generate approximately 1,464 new vehicle trips (two-way) on an average weekday (732 vehicles entering and 732 vehicles exiting), with approximately 162 new vehicle trips (83 vehicles entering and 79 vehicles exiting) expected during the weekday evening peak hour. On a Saturday, the alternative development program was shown to generate approximately 1,784 new vehicle trips (two-way) (892 vehicles entering and 892 vehicles exiting), with 140 new vehicle trips (71 vehicles entering and 69 vehicles exiting) expected during the Saturday midday peak hour.

Vehicle Trip Distribution and Assignment

The directional distribution of trips to and from the Project was determined based on a review of competing opportunities in the area; existing travel patterns; and the roadway network serving the Project site. ***The Project has been designed and appropriately sized to serve as a neighborhood based retail plaza. As such, the Project is expected to draw primarily from the surrounding residential neighborhoods located within a 1.0 mile radius of the Project site.*** The general trip distribution pattern for the Project is graphically depicted on Figure 6, with the detailed trip distribution pattern depicted on Figure 7. The additional trips expected to be generated by the Project were assigned on the study area roadway network as shown on Figures 8 and 9 for the weekday evening and Saturday midday peak hours, respectively.

Build Traffic Volumes

The 2014 Build condition traffic-volume networks consist of the 2014 No-Build traffic volumes with the anticipated Project-generated traffic added to them. Traffic volumes associated with Temple Shalom, which will be reconstructed in the eastern portion of the Project site, were reassigned from the current driveways that serve the Project site (two (2) located off Blue Hill Avenue and two (2) off Crown Street) to the proposed Blue Hill Avenue driveway. The resulting 2014 Build condition weekday evening and Saturday midday peak-hour traffic-volume networks are graphically depicted on Figures 10 and 11, respectively.

A summary of peak-hour projected traffic-volume increases external to the study area that is the subject of this assessment is shown on Table 5. These volumes are based on the expected increases from the Project.

As shown in Table 5, Project-related traffic volume increases external to the study area are anticipated to range from 1.8 to 22.2 percent, with vehicle increases ranging from 2 to 41 vehicles during the peak periods.

With specific regard to the residential streets intersecting Blue Hill Avenue and Blue Hills Parkway and excepting Blue Hill Terrace Street, the Project is expected to result in between 2 and 8 new vehicles travelling along these roadways during the peak traffic volume hours, or less than 1 new vehicle every 8 minutes. Such increases would not be readily apparent over current conditions and would not result in a material increase in motorist delays or vehicle queuing.

N 0 250 500 Scale in Feet

Figure 6

General Trip Distribution

VAi *Vanasse & Associates, Inc.*
Transportation Engineers & Planners

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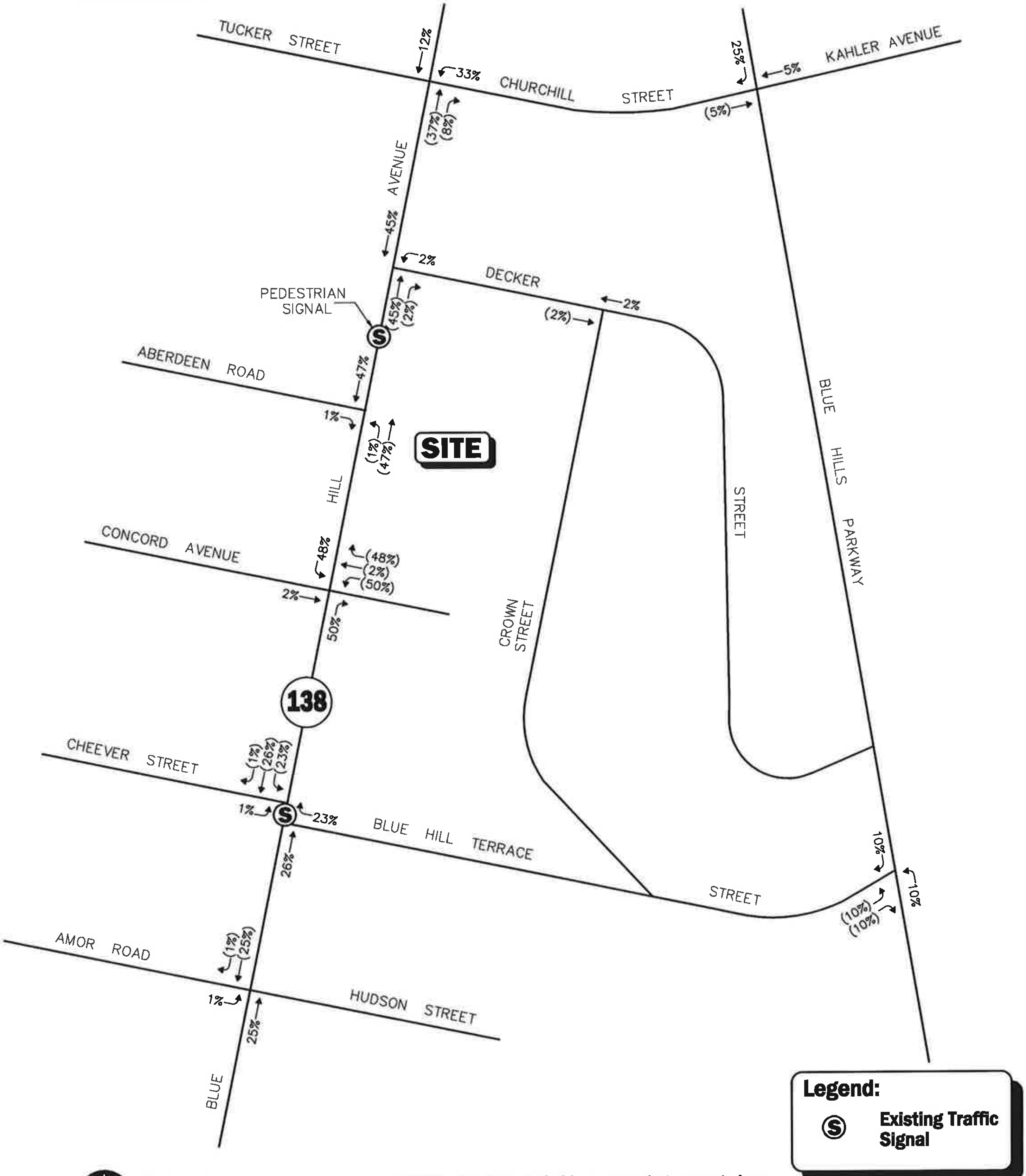

Note: Imbalances exist due to numerous curb cuts and side streets that are not shown.

Not To Scale

Figure 7

Trip Distibution Map

Vanasse & Associates, Inc.
Transportation Engineers & Planners

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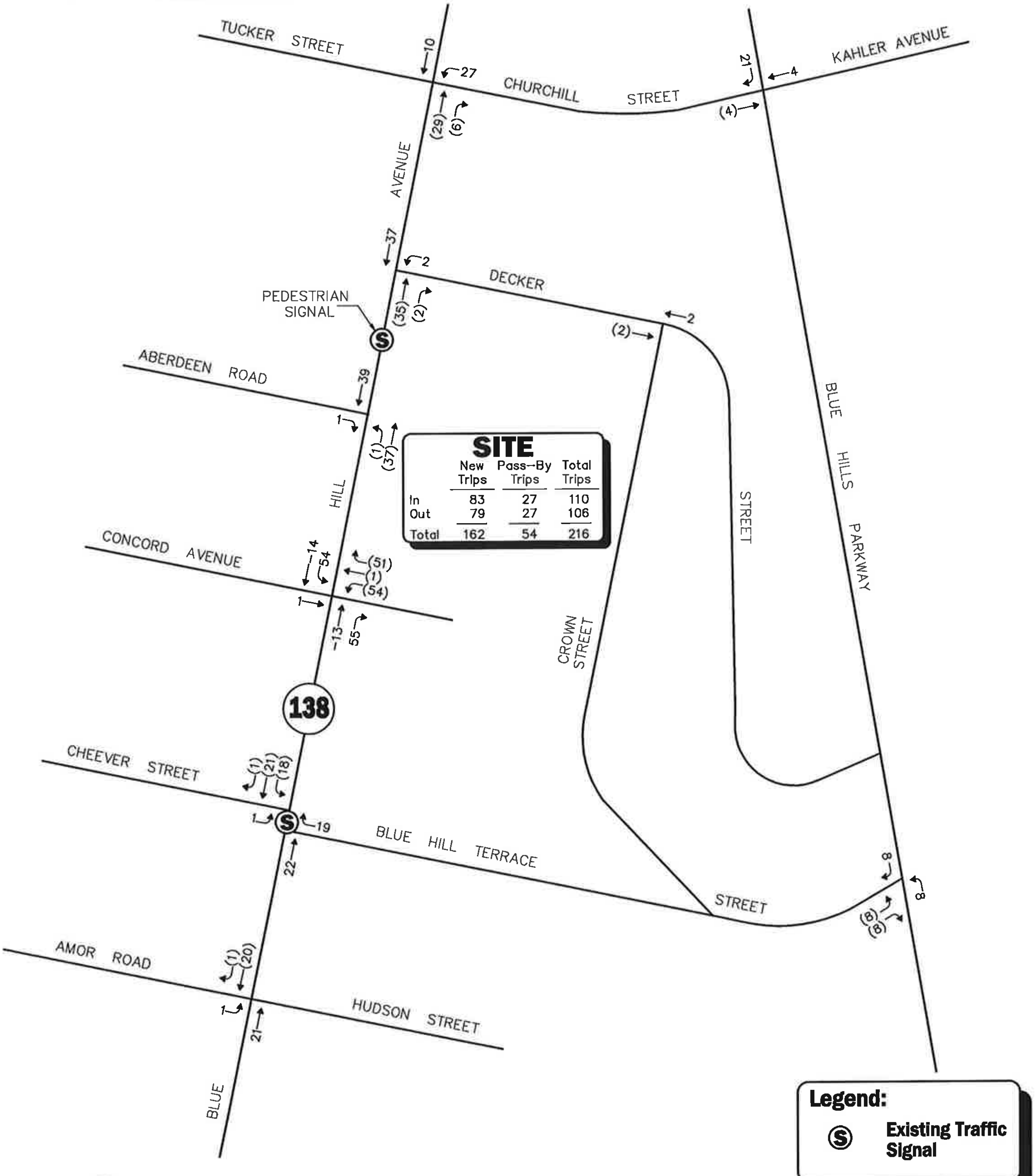

Note: Imbalances exist due to numerous curb cuts and side streets that are not shown.

Not To Scale

Figure 8

Vanasse & Associates, Inc.
Transportation Engineers & Planners

Pharmacy and Grocery Store
Project Generated
Weekday Evening
Peak Hour Traffic Volumes

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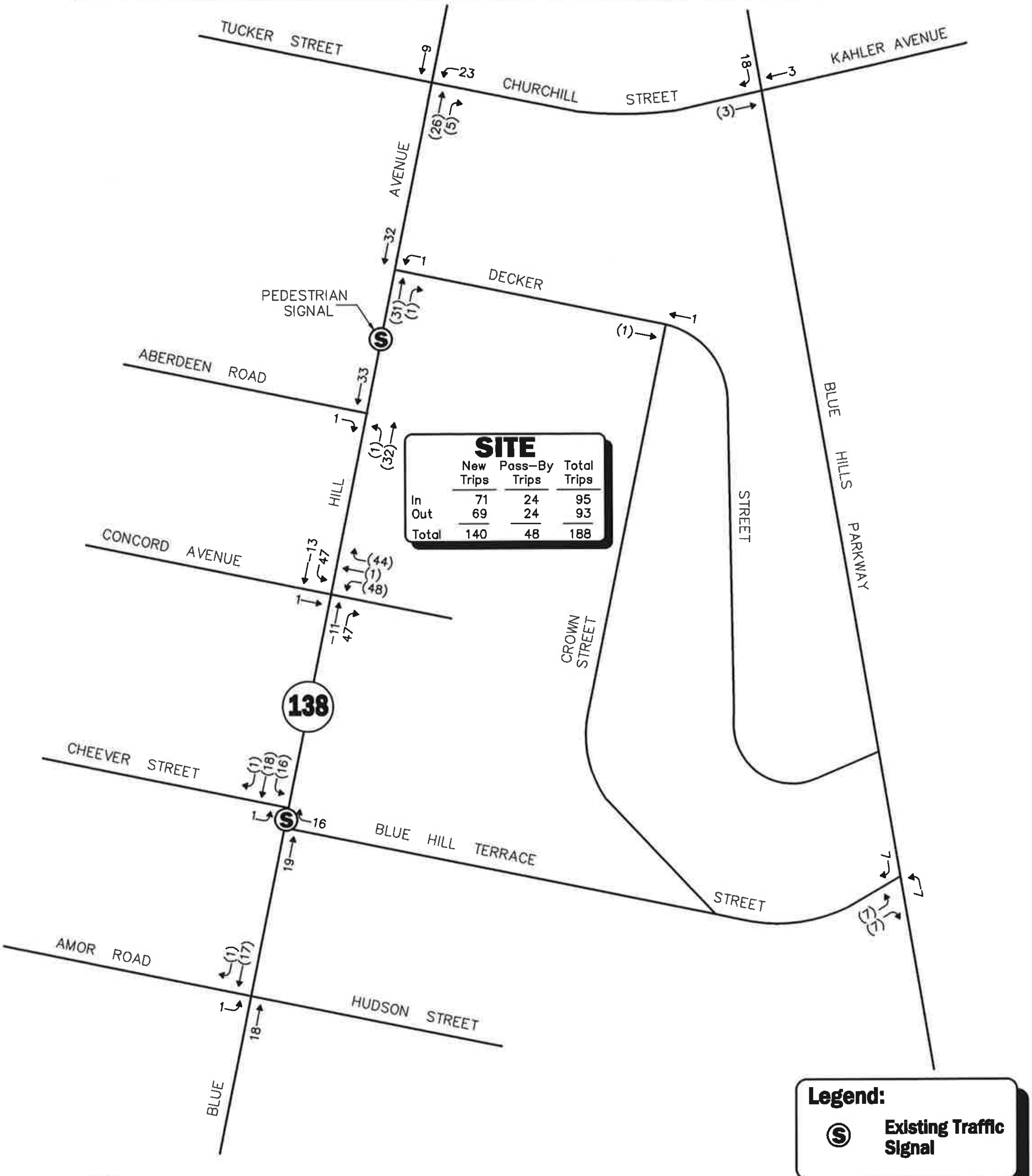

Note: Imbalances exist due to numerous curb cuts and side streets that are not shown.

Not To Scale

Figure 9

Vanasse & Associates, Inc.
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Pharmacy and Grocery Store
Project Generated
Saturday Midday
Peak Hour Traffic Volumes

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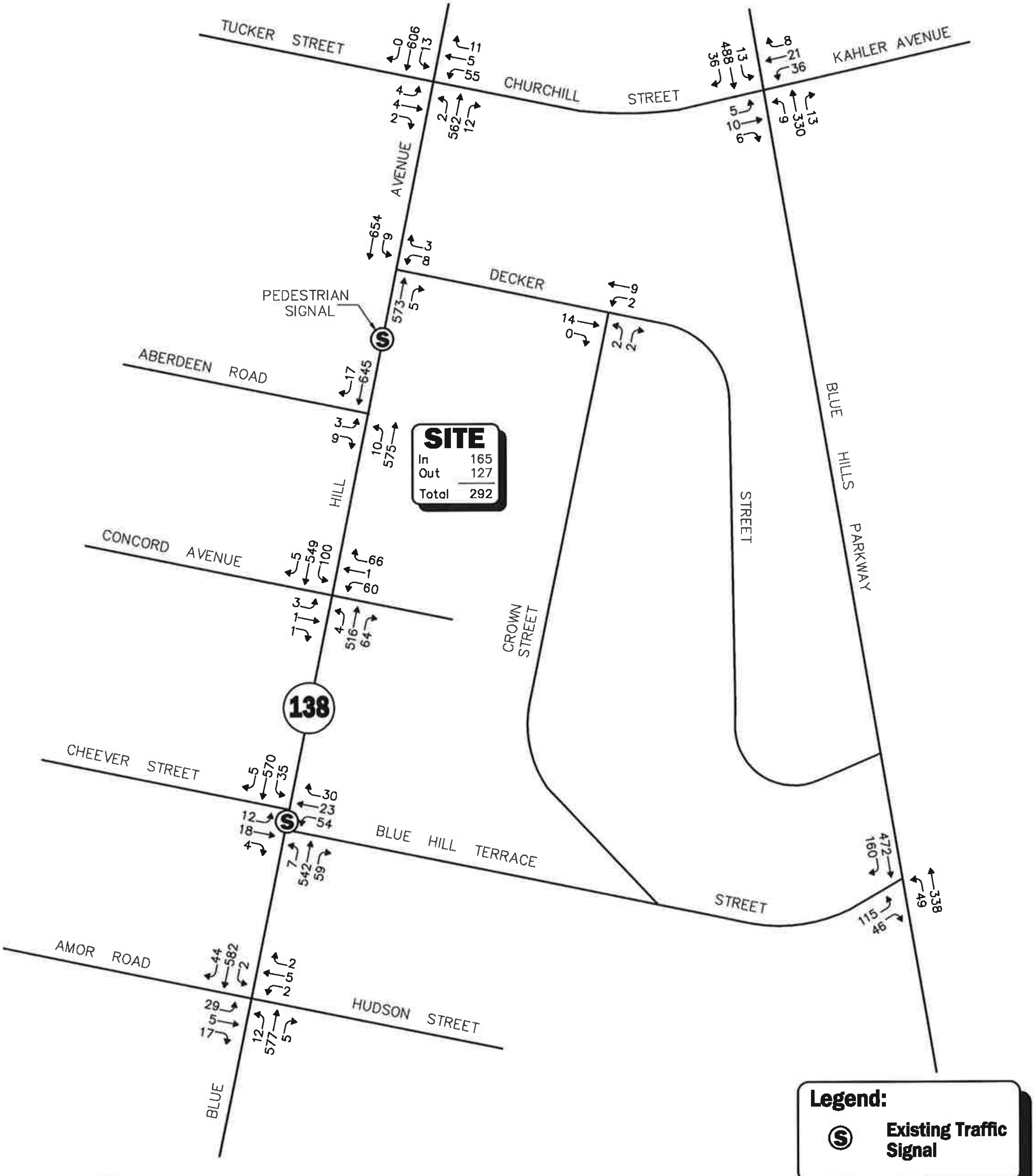

Note: Imbalances exist due to numerous curb cuts and side streets that are not shown.

Not To Scale

Figure 10

Vanasse & Associates, Inc.
Transportation Engineers & Planners

2014 Build
Pharmacy and Grocery Store
Weekday Evening
Peak Hour Traffic Volumes

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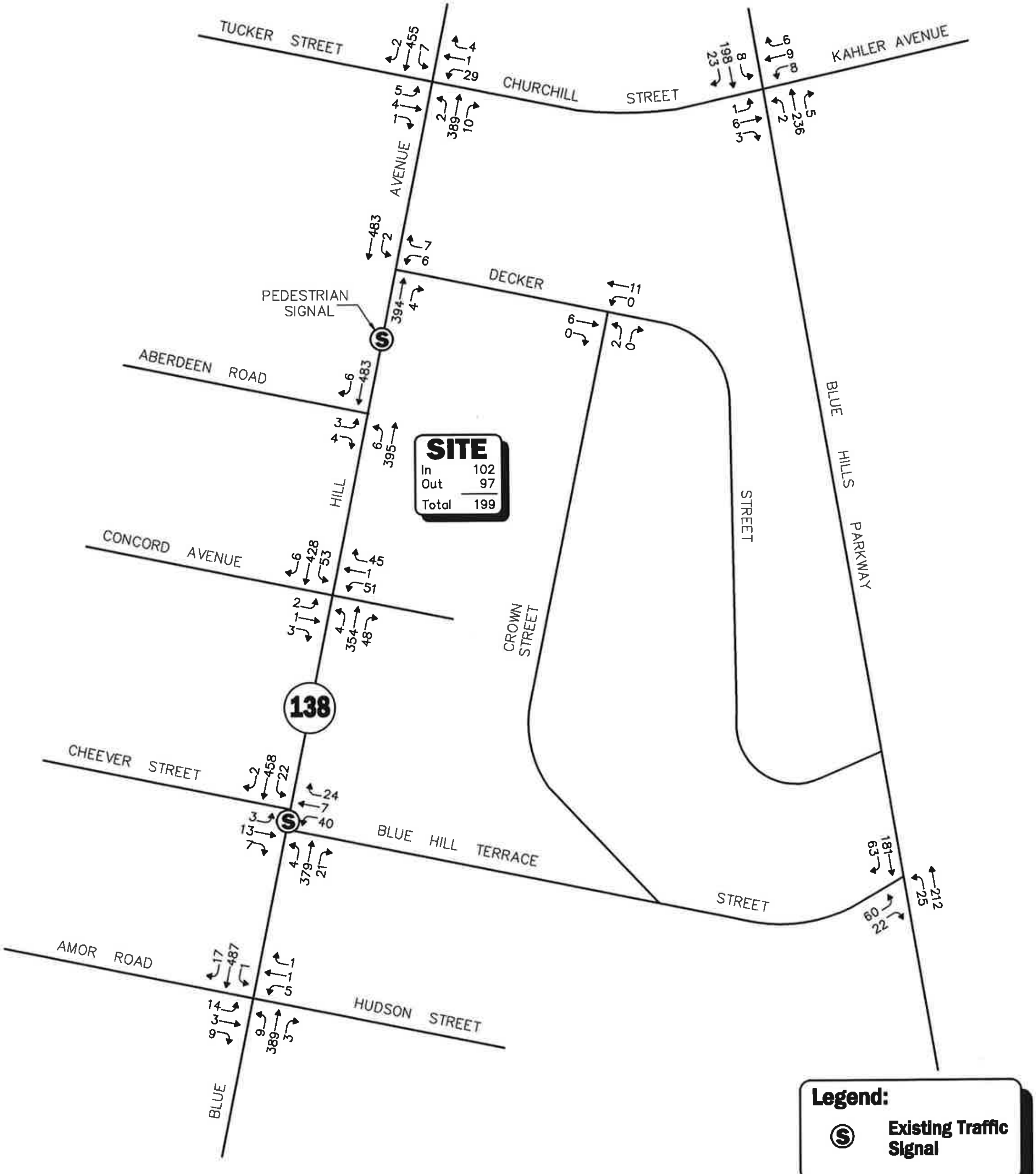

Note: Imbalances exist due to numerous curb cuts and side streets that are not shown.

Not To Scale

Figure 11

Vanasse & Associates, Inc.
Transportation Engineers & Planners

2014 Build
Pharmacy and Grocery Store
Saturday Midday
Peak Hour Traffic Volumes

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Table 5
PEAK-HOUR TRAFFIC-VOLUME INCREASES

Location/Peak Hour	2009 Existing	2014 No-Build	2014 Build	Volume Increase Over No-Build	Percent Increase Over No-Build
Blue Hill Avenue, north of Churchill Street					
Weekday Evening	1,036	1,157	1,196	39	3.4
Saturday Midday	750	827	862	35	4.2
Blue Hill Avenue, south of Hudson Street					
Weekday Evening	1,034	1,154	1,195	41	3.6
Saturday Midday	789	867	902	35	4.0
Blue Hills Parkway, north of Churchill Street					
Weekday Evening	817	859	880	21	2.4
Saturday Midday	433	454	472	18	4.0
Blue Hills Parkway, south of Blue Hill Terrace Street					
Weekday Evening	846	889	905	16	1.8
Saturday Midday	405	426	440	14	3.3
Aberdeen Road, west of Blue Hill Avenue					
Weekday Evening	36	37	39	2	5.4
Saturday Midday	17	17	19	2	11.8
Concord Avenue, west of Blue Hill Avenue					
Weekday Evening	13	13	15	2	15.4
Saturday Midday	15	15	17	2	13.3
Cheever Street, west of Blue Hill Avenue					
Weekday Evening	64	67	69	2	3.0
Saturday Midday	33	34	36	2	5.6
Amor Road, west of Blue Hill Avenue					
Weekday Evening	105	110	112	2	1.8
Saturday Midday	49	51	53	2	3.9
Kahler Avenue, east of Blue Hills Parkway					
Weekday Evening	88	93	101	8	8.6
Saturday Midday	36	36	44	8	22.2

TRAFFIC OPERATIONS ANALYSIS

In order to assess the potential impact of the Project on the roadway network, traffic operations and vehicle queue analyses were performed at the study intersections under 2009 Existing, 2014 No-Build and 2014 Build conditions. Capacity analyses provide an indication of how well the roadway facilities serve the traffic demands placed upon them, with vehicle queue analyses providing a secondary measure of the operational characteristics of an intersection or section of roadway under study.

In brief, six levels of service are defined for each type of facility. They are given letter designations ranging from A to F, with level-of-service (LOS) A representing the best operating conditions and LOS F representing congested or constrained operations. Since the level-of-service of a traffic facility is a function of the flows placed upon it, such a facility may operate at a wide range of levels of service depending on the time of day, day of week, or period of the year. The Synchro© intersection capacity analysis software, which is based on the analysis methodologies and procedures presented in the 2000 *Highway Capacity Manual* (HCM)[4] for signalized and unsignalized intersections, was used to complete the level-of-service and vehicle queue analyses.

Analysis Results

Level-of-service and vehicle queue analyses were conducted for 2009 Existing, 2014 No-Build and 2014 Build conditions for the intersections within the study area. The results of the intersection capacity and vehicle queue analyses are summarized in Tables 6 and 7 for the unsignalized and signalized study intersections, respectively. The detailed analysis worksheets are provided in the Appendix.

Unsignalized Intersections

As can be seen in Table 6, under 2009 Existing conditions, the critical movements at the unsignalized study intersections were shown to operate at acceptable levels-of-service (defined as LOS D or better) during both the weekday evening and Saturday midday peak hours. Under 2014 No-Build and Build conditions, the critical movements were generally shown to continue to operate at acceptable levels of service with the following of note:

- *Blue Hill Avenue/Tucker Street/Churchill Street* - Critical movements at this unsignalized intersection (all movements from Churchill Street) were shown to degrade from LOS D during the weekday evening peak-hour under 2009 Existing conditions to LOS F under 2014 No-Build and Build conditions as a result of traffic volume increases independent of the Project. Specific improvements have been identified at this intersection to address the impacts of the Project.

- *Blue Hill Avenue/Concord Avenue/Project Driveway* - Critical movements at this unsignalized intersection (all movements from Concord Avenue or the Project driveway) were shown to degrade from LOS D during the weekday evening peak-hour under 2009 Existing and 2014 No-Build conditions to LOS F under 2014 Build conditions with the addition of Project-related traffic. Specific improvements have been identified for this intersection to address the impacts of the Project including the installation of a traffic control signal.

- *Blue Hill Avenue/Amor Road/Hudson Street* - Critical movements at this unsignalized intersection (all movements from Amor Road) were shown to degrade from LOS D during the weekday evening peak-hour under 2009 Existing conditions to LOS E under 2014 No-Build conditions as a result of traffic volume increases independent of the Project. With the addition of

[4] *Highway Capacity Manual*, Transportation Research Board; Washington, DC; 2000.

Project-related traffic, the critical movements were shown to degrade from LOS E during the weekday evening peak-hour under 2014 No-Build conditions to LOS F under 2014 Build conditions. Specific improvements have been identified at this intersection to address the impacts of the Project.

With the exception of the Project driveway prior to the planned installation of a traffic control signal, vehicle queues at the unsignalized study intersections were shown to range from 0 to 4 vehicles during the peak periods, with negligible vehicle queuing reported along Blue Hill Avenue. The addition of Project-related traffic was shown to result in a minimal increase in vehicle queues at the study intersections over No-Build conditions (0 to 1 vehicle during the peak periods).

Signalized Intersection

As can be seen in Table 7, under 2009 Existing, 2014 No-Build, and 2014 Build conditions, the signalized intersection of Blue Hill Avenue/Cheever Street/Blue Hill Terrace Street was shown to operate at an overall LOS B during both the weekday evening and Saturday midday peak hours. Vehicle queues at the intersection were shown to range from 0 to 18 vehicles during the peak periods. The addition of Project-related traffic was not shown to result in a significant increase in vehicle queues at the intersections over No-Build conditions (0 to 3 vehicles during the peak periods).

Table 6
UNSIGNALIZED INTERSECTION LEVEL-OF-SERVICE AND VEHICLE QUEUE SUMMARY

	2009 Existing				2014 No-Build				2014 Build			
Unsignalized Intersection/Peak Hour/Movement	Demand[a]	Delay[b]	LOS[c]	Queue[d] 95th	Demand	Demand	LOS	Queue 95th	Demand	Delay	LOS	Queue 95th
Blue Hill Avenue at Tucker Street and Churchill Street												
Weekday Evening:												
Tucker Street EB LT/TH/RT	10	25.6	D	1	10	33.3	D	1	10	35.4	E	1
Churchill Street WB LT/TH/RT	42	33.3	D	2	44	>50.0	F	3	71	>50.0	F	4
Blue Hill Avenue NB LT/TH/RT	487	0.1	A	0	541	0.1	A	0	576	0.1	A	0
Blue Hill Avenue SB LT/TH/RT	543	0.4	A	0	609	0.4	A	0	619	0.4	A	0
Saturday Midday:												
Tucker Street EB LT/TH/RT	10	17.6	C	0	10	19.4	C	1	10	20.4	C	1
Churchill Street WB LT/TH/RT	11	15.8	C	0	11	17.3	C	1	34	24.8	C	1
Blue Hill Avenue NB LT/TH/RT	333	0.1	A	0	370	0.1	A	0	400	0.1	A	0
Blue Hill Avenue SB LT/TH/RT	415	0.2	A	0	455	0.2	A	0	464	0.2	A	0
Blue Hill Avenue at Decker Street												
Weekday Evening:												
Decker Street WB LT/RT	19	14.8	B	1	20	16.5	C	1	11	28.3	D	1
Blue Hill Avenue NB TH/RT	476	0.0	A	0	529	0.0	A	0	578	0.0	A	0
Blue Hill Avenue SB LT/TH	560	0.2	A	0	626	0.3	A	0	663	0.3	A	0
Saturday Midday:												
Decker Street WB LT/RT	11	12.1	B	0	11	12.7	B	0	13	14.1	B	0
Blue Hill Avenue NB TH/RT	329	0.0	A	0	366	0.0	A	0	398	0.0	A	0
Blue Hill Avenue SB LT/TH	413	0.1	A	0	453	0.1	A	0	485	0.1	A	0
Blue Hill Avenue at Aberdeen Road												
Weekday Evening:												
Aberdeen Road EB LT/RT	11	15.8	C	0	11	18.0	C	0	12	19.4	C	1
Blue Hill Avenue NB LT/TH	482	0.3	A	0	535	0.3	A	0	585	0.3	A	0
Blue Hill Avenue SB TH/RT	557	0.0	A	0	622	0.0	A	0	662	0.0	A	0
Saturday Midday:												
Aberdeen Road EB LT/RT	6	13.8	B	0	6	14.7	B	0	7	15.1	C	0
Blue Hill Avenue NB LT/TH	331	0.2	A	0	368	0.2	A	0	401	0.2	A	0
Blue Hill Avenue SB TH/RT	412	0.0	A	0	452	0.0	A	0	489	0.0	A	0
Blue Hill Avenue at Concord Avenue and Project Driveway												
Weekday Evening:												
Concord Avenue EB LT/TH/RT	4	25.6	D	1	4	32.7	D	1	5	>50.0	F	1
Project Driveway WB LT/TH/RT	--	--	--	--	--	--	--	--	127	>50.0	F	7
Blue Hill Avenue NB LT/TH/RT	490	0.1	A	0	543	0.1	A	0	584	0.1	A	0
Blue Hill Avenue SB LT/TH/RT	549	1.2	A	0	613	1.3	A	0	654	2.8	A	1
Saturday Midday:												
Concord Avenue EB LT/TH/RT	5	13.8	B	0	5	14.9	B	0	6	19.4	C	0
Project Driveway WB LT/TH/RT	--	--	--	--	--	--	--	--	97	25.6	D	1
Blue Hill Avenue NB LT/TH/RT	334	0.1	A	0	371	0.1	A	0	406	0.1	A	0
Blue Hill Avenue SB LT/TH/RT	409	0.1	A	0	449	0.1	A	0	487	1.8	A	1

See notes at end of table.

Table 6 (Continued)
UNSIGNALIZED INTERSECTION LEVEL-OF-SERVICE AND VEHICLE QUEUE SUMMARY

	2009 Existing				2014 No-Build				2014 Build			
Unsignalized Intersection/Peak Hour/Movement	Demand[a]	Delay[b]	LOS[c]	Queue[d] 95th	Demand	Delay	LOS	Queue 95th	Demand	Delay	LOS	Queue 95th
Blue Hill Avenue at the Site Exit Driveway												
Weekday Evening:												
Site Exit Driveway WB LT/RT	4	13.4	B	0	4	14.9	B	0	--	--	--	--
Blue Hill Avenue NB TH	487	0.0	A	0	540	0.0	A	0	--	--	--	--
Blue Hill Avenue SB TH	500	0.0	A	0	564	0.0	A	0	--	--	--	--
Saturday Midday:												
Site Exit Driveway WB LT/RT	4	13.9	B	0	4	15.1	C	0	--	--	--	--
Blue Hill Avenue NB TH	333	0.0	A	0	370	0.0	A	0	--	--	--	--
Blue Hill Avenue SB TH	404	0.0	A	0	444	0.0	A	0	--	--	--	--
Blue Hill Avenue at Amor Road and Hudson Street												
Weekday Evening:												
Amor Road EB LT/TH/RT	48	29.5	D	2	50	42.5	E	2	51	>50.0	F	3
Hudson Street WB LT/TH/RT	9	24.6	C	1	9	30.9	D	1	9	34.2	D	1
Blue Hill Avenue NB LT/TH/RT	518	0.3	A	0	573	0.4	A	0	594	0.4	A	0
Blue Hill Avenue SB LT/TH/RT	541	0.1	A	0	607	0.1	A	0	628	0.1	A	0
Saturday Midday:												
Amor Road EB LT/TH/RT	24	19.0	C	1	25	22.3	C	1	26	24.4	C	1
Hudson Street WB LT/TH/RT	7	21.2	C	0	7	24.6	C	1	7	26.6	D	1
Blue Hill Avenue NB LT/TH/RT	346	0.3	A	0	383	0.3	A	0	401	0.3	A	0
Blue Hill Avenue SB LT/TH/RT	445	0.0	A	0	487	0.0	A	0	505	0.0	A	0
Decker Street at Crown Street												
Weekday Evening:												
Decker Street EB TH/RT	11	0.0	A	0	12	0.0	A	0	14	0.0	A	0
Decker Street WB LT/TH	9	2.4	A	0	9	2.4	A	0	11	1.3	A	0
Crown Street NB LT/RT	15	8.8	A	0	16	8.9	A	0	4	8.7	A	0
Saturday Midday:												
Decker Street EB TH/RT	8	0.0	A	0	8	0.0	A	0	6	0.0	A	0
Decker Street WB LT/TH	10	0.7	A	0	10	0.7	A	0	11	0.0	A	0
Crown Street NB LT/RT	2	8.7	A	0	2	8.7	A	0	2	8.6	A	0
Crown Street at the Temple Shalom North Driveway												
Weekday Evening:												
Temple Shalom North Driveway EB LT	11	8.6	A	0	11	8.6	A	0	--	--	--	--
Temple Shalom North Driveway EB RT	3	8.4	A	0	3	8.4	A	0	--	--	--	--
Crown Street NB LT/TH	4	0.0	A	0	5	0.0	A	0	--	--	--	--
Crown Street SB TH/RT	3	0.0	A	0	3	0.0	A	0	--	--	--	--
Saturday Midday:												
Temple Shalom North Driveway EB LT	0	0.0	A	0	0	0.0	A	0	--	--	--	--
Temple Shalom North Driveway EB RT	0	0.0	A	0	0	0.0	A	0	--	--	--	--
Crown Street NB LT/TH	2	0.0	A	0	2	0.0	A	0	--	--	--	--
Crown Street SB TH/RT	4	0.0	A	0	4	0.0	A	0	--	--	--	--

See notes at end of table.

Table 6 (Continued)
UNSIGNALIZED INTERSECTION LEVEL-OF-SERVICE AND VEHICLE QUEUE SUMMARY

	2009 Existing				2014 No-Build				2014 Build			
Unsignalized Intersection/Peak Hour/Movement	Demand[a]	Delay[b]	LOS[c]	Queue[d] 95th	Demand	Delay	LOS	Queue 95th	Demand	Delay	LOS	Queue 95th
Crown Street at the Temple Shalom South Driveway												
Weekday Evening:												
Temple Shalom South Driveway EB LT/RT	3	8.5	A	0	3	8.5	A	0	--	--	--	--
Crown Street NB LT/TH	5	2.9	A	0	6	2.4	A	0	--	--	--	--
Crown Street SB TH/RT	5	0.0	A	0	5	0.0	A	0	--	--	--	--
Saturday Midday:												
Temple Shalom South Driveway EB LT/RT	0	0.0	A	0	0	0.0	A	0	--	--	--	--
Crown Street NB LT/TH	2	0.0	A	0	2	0.0	A	0	--	--	--	--
Crown Street SB TH/RT	2	0.0	A	0	2	0.0	A	0	--	--	--	--
Blue Hills Parkway at Churchill Street and Kahler Avenue												
Weekday Evening:												
Churchill Street EB LT/TH/RT	17	14.3	B	1	17	14.8	B	1	21	15.8	C	1
Kahler Avenue WB LT/TH/RT	58	15.4	C	1	61	16.1	C	1	65	16.7	C	1
Blue Hills Parkway NB LT/TH/RT	335	1.0	A	0	352	1.0	A	0	361	1.0	A	0
Blue Hills Parkway SB LT/TH/RT	490	0.5	A	0	516	0.5	A	0	537	0.5	A	0
Saturday Midday:												
Churchill Street EB LT/TH/RT	7	10.4	B	0	7	10.5	B	0	10	11.0	B	0
Kahler Avenue WB LT/TH/RT	20	10.8	B	0	20	10.9	B	0	23	11.2	B	1
Blue Hills Parkway NB LT/TH/RT	232	0.3	A	0	243	0.3	A	0	243	0.3	A	0
Blue Hills Parkway SB LT/TH/RT	201	0.7	A	0	211	0.6	A	0	229	0.6	A	0
Blue Hills Parkway at Blue Hill Terrace Street												
Weekday Evening:												
Blue Hill Terrace Street EB LT/RT	138	16.6	C	2	145	17.6	C	2	161	18.6	C	2
Blue Hills Parkway NB LT/TH	361	3.7	A	0	379	3.8	A	0	387	4.2	A	1
Blue Hills Parkway SB TH/RT	594	0.0	A	0	624	0.0	A	0	632	0.0	A	0
Saturday Midday:												
Blue Hill Terrace Street EB LT/RT	64	10.7	B	1	68	10.9	B	1	82	11.1	B	1
Blue Hills Parkway NB LT/TH	219	2.4	A	0	230	2.4	A	0	237	3.0	A	0
Blue Hills Parkway SB TH/RT	225	0.0	A	0	237	0.0	A	0	244	0.0	A	0

[a]Demand in vehicles per hour.
[b]Average control delay per vehicle (in seconds).
[c]Level-of-Service.
[d]Queue length in vehicles.
[e]NC = Not calculated.
EB = eastbound; WB = westbound; NB = northbound; SB = southbound; LT = left-turning movements; TH = through movements; RT = right-turning movements.

Table 7
SIGNALIZED INTERSECTION LEVEL-OF-SERVICE AND VEHICLE QUEUE SUMMARY

	2009 Existing				2014 No-Build				2014 Build			
Signalized Intersection/Peak Hour/Movement	V/C[a]	Delay[b]	LOS[c]	Queue[d] Avg/95th	V/C	Delay	LOS	Queue Avg./95th	V/C	Delay	LOS	Queue Avg./95th
Blue Hill Avenue at Cheever Street and Blue Hill Terrace Street												
Weekday Evening:												
Cheever Street EB LT/TH/RT	0.46	31.0	C	1/2	0.32	29.1	C	1/2	0.33	29.2	C	1/2
Blue Hill Terrace Street WB LT/TH/RT	0.47	25.6	C	1/3	0.51	28.2	C	2/3	0.59	30.8	C	2/4
Blue Hill Avenue NB LT/TH/RT	0.66	13.3	B	4/15	0.72	15.3	B	9/17	0.75	16.5	B	9/18
Blue Hill Avenue SB LT/TH/RT	0.61	12.2	B	4/12	0.67	14.1	B	8/15	0.77	17.2	B	9/18
Overall	**0.62**	**14.4**	**B**	--	**0.65**	**16.2**	**B**	--	**0.69**	**18.4**	**B**	--
Saturday Midday:												
Cheever Street EB LT/TH/RT	0.31	24.4	C	0/1	0.33	25.9	C	1/1	0.36	28.0	C	1/1
Blue Hill Terrace Street WB LT/TH/RT	0.43	22.6	C	1/2	0.47	24.3	C	1/2	0.37	23.2	C	1/2
Blue Hill Avenue NB LT/TH/RT	0.45	9.9	A	2/7	0.47	9.8	A	3/8	0.50	10.8	B	3/8
Blue Hill Avenue SB LT/TH/RT	0.55	10.8	B	3/9	0.57	10.8	B	3/10	0.64	12.8	B	4/11
Overall	**0.51**	**11.8**	**B**	--	**0.54**	**11.8**	**B**	--	**0.57**	**13.4**	**B**	--

[a]Volume-to-capacity ratio.
[b]Control (signal) delay per vehicle in seconds.
[c]Level-of-Service.
[d]Queue length in vehicles.
EB = eastbound; WB = westbound; NB = northbound; NEB = northeastbound; SB = southbound; LT = left-turning movements; TH = through movements; RT = right-turning movements.

SIGHT DISTANCE EVALUATION

Sight distance measurements were performed at the Project driveway intersection with Blue Hill Avenue in accordance with MassDOT and American Association of State Highway and Transportation Officials (AASHTO)[5] requirements. Both stopping sight distance (SSD) and intersection sight distance (ISD) measurements were performed. In brief, SSD is the distance required by a vehicle traveling at the design speed of a roadway, on wet pavement, to stop prior to striking an object in its travel path. ISD or corner sight distance (CSD) is the sight distance required by a driver entering or crossing an intersecting roadway to perceive an on-coming vehicle and safely complete a turning or crossing maneuver with on-coming traffic. In accordance with AASHTO and MassDOT standards, at a minimum, sufficient SSD must be provided at an intersection. Table 8 presents the measured SSD and ISD at the subject intersection.

Table 8
SIGHT DISTANCE MEASUREMENTS

Intersection/Sight Distance Measurement	Required Minimum (Feet)[a]	ISD[a]	Measured (Feet)
Blue Hill Avenue at the Project Driveway			
Stopping Sight Distance:			
Blue Hill Avenue approaching from the north	360	--	650+
Blue Hill Avenue approaching from the south	360	--	500
Intersection Sight Distance:			
Looking to the north from the Project driveway	360	430/500[b]	650+
Looking to the south from the Project driveway	360	430/500[b]	580

[a]Recommended minimum values obtained from *A Policy on Geometric Design of Highways and Streets,* Fifth Edition; American Association of State Highway and Transportation Officials (AASHTO); 2004; and based on a 45 mph approach speed on Blue Hill Avenue.

[b]Values shown are the intersection sight distance for a vehicle turning right/left exiting a roadway under STOP control such that motorists approaching the intersection on the major street should not need to adjust their travel speed to less than 70 percent of their initial approach speed.

As can be seen in Table 8, the available lines of sight for motorists traveling along Blue Hill Avenue approaching the Project driveway (SSD) and for motorists exiting the Project (ISD) were found to exceed the recommended minimum sight distance requirements for a 45 mph approach speed along Blue Hill Avenue, consistent with the measured 85th percentile vehicle travel speed along this roadway and 10 mph above the posted speed limit (35 mph).

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[5]*A Policy on Geometric Design of Highways and Streets*, Fifth Edition; American Association of State Highway and Transportation Officials (AASHTO); 2004.

PROJECTED PARKING DEMAND

The Project will provide 141 parking spaces to be shared between the uses within the development. Based on Town of Milton Zoning requirements, 152 parking spaces are required for the Project. In order to evaluate the projected parking demands for the Project, a detailed shared parking analysis was completed using the methodology outlined in the Urban Land Institute's (ULI) *Shared Parking* manual.[6]

Shared Parking Analysis

Methodology

The ULI has established a defined procedure for the completion of a shared parking analysis based on a scientific method that incorporates data and research for mixed-use developments. The underlying methods and data have been continuously updated and refined over the past 22 years. The ULI shared parking methodology is based on a general six (6) step approach that was applied to the Project as follows:

1. ***Data Collection and Project Review.*** The components of the Project were identified with respect to specific land use categories and sizes as follows: Temple with 200 seats; preschool with two (2) instructional rooms; 13,013± sf pharmacy (gross building area); and 10,000± sf other market/retail space.

2. ***Development of base parking demands for each land use.*** The base parking demand for the Project was calculated using Town of Milton Zoning requirements for each of the land uses to be located within the Project. This approach to establishing a base parking ratio results in a conservative (high) analysis scenario as the zoning base parking ratio is typically higher than the actual parking demand for a specific use. Table 9 summarizes the base parking demand ratios that were used for the Project.

Table 9
BASE PARKING DEMAND RATIOS

Land Use	Base Parking Demand Ratio (Spaces Required)	Independent Variable	Project Component Size
Place of Worship	1.0	per 4 seats	200 seats
Preschool	3.0	per 2 instructional rooms	7 rooms
Pharmacy	1.0	per 250 sf gba	13,013 sf gba
Grocery Store	1.0	per 250 sf gba	10,000 sf gba

gba = gross building area.

[6] *Shared Parking*, Second Edition; Urban Land Institute; Washington, D.C.; 2005.

3. ***Application of monthly adjustment factors to the base parking demand for each land use.*** Monthly adjustment factors account for the variation in parking demand for specific land uses that occur over the course of a year on a monthly basis. By way of example, retail peak parking demands occur in December (100 percent), with the demand for parking in January approximately 50 percent of the December demand. The monthly adjustment factors are applied to the calculated base parking demand for each land use and were obtained from the recommended values contained in the ULI *Shared Parking* manual. Monthly adjustment factor data for the Temple and preschool are not available through the ULI. As such, adjustment factors were developed based on a review of the existing activity schedules for these uses.

4. ***Application of time-of-day adjustment factors to the monthly adjusted parking demand.*** Time of day adjustment factors account for the variation in parking demands that occur for a specific land use over the course of the day. By way of example, for a retail use, the peak parking demand (100 percent) occurs around 1:00 PM, with the demand for parking at 8:00 AM approximately 15 percent of the peak demand. The time-of-day adjustment factors are applied to the monthly adjusted parking ratios and were obtained from the recommended values contained in the ULI *Shared Parking* manual. Similar to the monthly adjustment factors, time of day adjustment factors for the Temple and preschool were not available through the ULI and were developed based on a review of the existing activity schedules for these uses.

5. ***Application of modal split and vehicle occupancy ratio adjustments to the adjusted parking demand.*** Mode split adjustment factors are used to account for the reduction in parking demand that is associated with the use of alternative modes of transportation that may be available to a mixed-use development such as public transportation, car/vanpools, and pedestrian/bicycle travel. A standard (unadjusted) vehicle occupancy ratio of one (1) person per vehicle was assumed for the Project as the use of car/vanpools, public transportation and modes of travel other than private automobiles is reflected in the mode split adjustment described below. A 90 percent automobile/10 percent pedestrian/bicycle/public transportation mode split was applied to the retail components of the Project, with a 100 percent automobile use assumed for the Temple and preschool components of the Project.

6. ***Application of noncaptive adjustment factors to the adjusted parking demand.*** Noncaptive adjustment factors are applied to account for the use of parking within a mixed-use development for a single purpose or land use. By way of example, if a 90 percent noncaptive adjustment factor were applied to the parking demand for the pharmacy, it is assumed that 10 percent of the parking demands associated with the pharmacy are reflected in the parking demands for another use within the Project, such as the grocery store. In such an instance, the remaining 10 percent of the parking demand for the pharmacy would be accounted for in the calculated parking demand for the grocery store. The noncaptive adjustment factors were developed based on engineering judgment and are reflective of the anticipated nature of the traffic characteristics of the various components of the Project. Table 10 summarizes the noncaptive adjustment factors that were applied to the individual components of the Project.

Table 10
NONCAPTIVE PARKING ADJUSTMENT FACTORS

Land Use	Noncaptive Parking Adjustment Factor (Percent)
Place of Worship	100
Preschool	100
Pharmacy	90
Grocery Store	90

Using the above methodology, parking ratios and adjustment factors, a shared parking analysis was completed for the Project in order to identify the peak parking demand period and requisite number of parking spaces necessary to accommodate the identified demand.

Results

Pursuant to the ULI shared parking analysis methodology, the parking demands for the Project were modeled for a 12-month period, with separate assessments completed for "peak December" (defined as the peak customer period for retail uses) and "late December" (defined as the period from December 25 through December 31). The shared parking model produces the projected parking demand over a continuous 19-hour period (6:00 AM to 12:00 AM) for both weekdays and weekends over the 12-month, "peak December" and "late December" periods.

The overall peak parking demand for the Project was identified to occur at 12:00 PM (noon) on a weekend during the "peak December" period, with a projected parking demand of 121 spaces. Weekday parking demands for the Project were found to be lower than those on a weekend due to the fact that the Temple has limited services on weekdays and those services are not coincidental with the retail peak parking demand periods. In all instances, the 141 parking spaces proposed for the Project were found to adequately accommodate the anticipated demand. The detailed parking demand analysis worksheets are provided in the Appendix.

CONCLUSIONS

VAI has prepared a TIA in order to determine the potential traffic impacts associated with the construction of a proposed commercial development to be situated on the site of Temple Shalom of Milton located at 180 Blue Hill Avenue (Route 138) in Milton, Massachusetts. This study has been prepared in advance of a formal TIAS for the purpose of determining: access requirements; projected parking demands; potential off-site improvements; and safety considerations. The formal TIAS will be completed in support of the subsequent Planning Board approval process for the Project and will expand upon the elements of this TIA with specific regard to the identified off-site roadway and intersection improvements.

Based on a review of the findings of this TIA, we have concluded the following with respect to the Project:

1. The focus of the Project as a neighborhood retail center serves to reduce trips from outside the immediate proximity of the Project (typically defined as trips originating within a 1-mile radius of the Project), with the potential for further reductions through pedestrian and bicycle trips to/from the neighborhood;

2. The Project is expected to result in a measureable but minor impact on motorist delays and vehicle queuing over Existing or anticipated future conditions without the Project (the No-Build condition);

3. The Project access is appropriately located to afford maximum lines of sight along Blue Hill Avenue that exceed the requirements for the measured travel speed along this roadway;

4. The proposed parking supply for the Project, while below Town Zoning requirements in aggregate for the proposed uses, is sufficient to accommodate the projected peak parking demands of the Project; and

5. The Project can be accommodated within the confines of the transportation infrastructure in a safe and efficient manner with the implementation of defined roadway, intersection and neighborhood focused improvements that are detailed in the next section.

RECOMMENDATIONS

A detailed transportation improvement program has been developed for the Project that is designed to provide safe and efficient access to the Project while minimizing impacts to motorists traveling along adjacent roadways and address deficiencies found at the off-site locations evaluated in conjunction with this study. The following improvements have been recommended as a part of this evaluation and include measures that are designed to encourage the use of alternative modes of travel to single-occupant vehicles. These measures will be refined in conjunction with the formal TIAS to be completed as a part of the Planning Board approval process for the Project.

Project Access

Access to the Project will be provided by way of a full-access driveway that will intersect the east side of Blue Hill Avenue opposite Concord Avenue. A Traffic Signal Warrants Analysis (TSWA) was completed at the intersection of Blue Hill Avenue at Concord Avenue and the Project driveway as specified in the *Manual on Uniform Traffic Control Devices* (MUTCD).[7] The TSWA indicates that traffic volumes at the intersection will meet the necessary warrants for the installation of a traffic control signal under 2014 Build traffic volume conditions with the addition of Project-related traffic (Warrants 1, 2 and 3 based on the criteria for an approach speed above 40 mph on the major street). As such, it is recommended that the intersection of Blue Hill Avenue at Concord Avenue and the Project driveway be placed under traffic signal control with associated geometric improvements. In conjunction with the installation of a traffic control signal, the following recommendations are offered with respect to design and operation of the Project driveway intersection:

- Pedestrian and bicycle accommodations should be included at the Blue Hill Avenue access to the Project by way of crosswalks, pedestrian pushbuttons and bicycle detection;
- The existing pedestrian traffic signal located on Blue Hill Avenue between Aberdeen Road and Decker Street should be removed;
- The proposed traffic signal should be interconnected and coordinated with the existing traffic signal at the Blue Hill Avenue/Cheever Street/Blue Hill Terrace intersection;
- The Blue Hill Avenue southbound approach should be restriped/modified to provide a left-turn lane and a through travel lane approaching the Project driveway;
- The Project driveway should be a minimum of 24-feet in width, accommodating 12-foot wide entering and exiting travel lanes separated by a double-yellow centerline; and
- Signs and landscaping adjacent to the Project driveway and within the Project should be designed and maintained so as not to restrict lines of sight.

Figure 12 depicts the recommended improvements to be completed at the intersection of Blue Hill Avenue at Concord Avenue and Project driveway, with Table 11 summarizing the improved operating conditions attained at the intersection as a result of the recommended improvements. As can be seen in Table 11, with the installation of a traffic control signal and associated geometric improvements, the signalized intersection was shown to operate at an overall LOS A during both peak periods. In addition, it is recommended that a bus stop be provided along the Project frontage on Blue Hill Avenue designed and located in consultation with MassDOT and JBL Bus Lines/MBTA.

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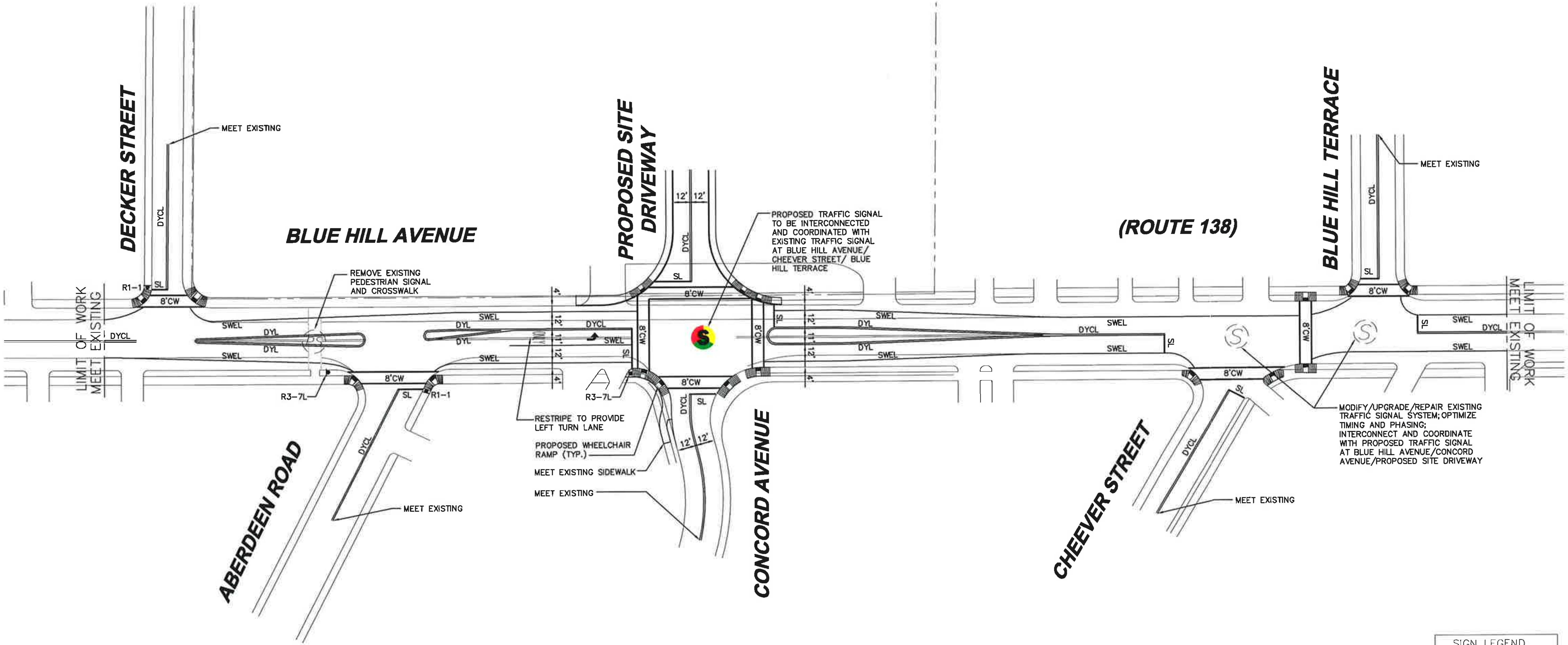
[7] *Manual on Uniform Traffic Control Devices* (MUTCD); Federal Highway Administration; Washington, DC; 2003.



STRIPING LEGEND	
DYCL	DOUBLE YELLOW CENTER LINE
DYL	DOUBLE YELLOW LINE
SWEL	SOLID WHITE EDGE LINE
SWLL	SOLID WHITE LANE LINE
SL	STOP LINE
CW	CROSS WALK

SIGN LEGEND	
R1-1	STOP
R3-7L	LEFT LANE MUST TURN LEFT

NOTES:
1. THIS PLAN IS FOR REVIEW PURPOSES ONLY AND IS NOT INTENDED FOR CONSTRUCTION.
2. BASE PLAN INFORMATION OBTAINED FROM BOHLER ENGINEERING, MASSGIS AND FIELD MEASUREMENTS BY VAI.

0 35 70 Scale in Feet

Vanasse & Associates, Inc.
Transportation Engineers & Planners

Figure 12

Conceptual Improvement Plan Blue Hill Avenue at Concord Avenue and the Proposed Site Driveway

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Table 11
MITIGATED SIGNALIZED INTERSECTION LEVEL-OF-SERVICE AND VEHICLE QUEUE SUMMARY

	2014 No-Build				2014 Build with Pharmacy and Grocery Store				2014 Build with Mitigation			
Signalized Intersection/Peak Hour/Movement	V/C[a]	Delay[b]	LOS[c]	Queue[d] Avg/95th	V/C	Delay	LOS	Queue Avg./95th	V/C	Delay	LOS	Queue Avg./95th
Blue Hill Avenue at Cheever Street and Blue Hill Terrace Street												
Weekday Evening:												
Cheever Street EB LT/TH/RT	0.32	29.1	C	1/2	0.33	29.2	C	1/2	0.23	34.5	C	1/2
Blue Hill Terrace Street WB LT/TH/RT	0.51	28.2	C	2/3	0.59	30.8	C	2/4	0.50	34.7	C	2/4
Blue Hill Avenue NB LT/TH/RT	0.72	15.3	B	9/17	0.75	16.5	B	9/18	0.69	18.1	B	12/19
Blue Hill Avenue SB LT/TH/RT	0.67	14.1	B	8/15	0.77	17.2	B	9/18	0.70	16.3	B	12/19
Overall	**0.65**	**16.2**	**B**	--	**0.69**	**18.4**	**B**	--	**0.61**	**19.3**	**B**	--
Saturday Midday:												
Cheever Street EB LT/TH/RT	0.33	25.9	C	1/1	0.36	28.0	C	1/1	0.18	34.7	C	1/1
Blue Hill Terrace Street WB LT/TH/RT	0.47	24.3	C	1/2	0.37	23.2	C	1/2	0.35	34.0	C	1/3
Blue Hill Avenue NB LT/TH/RT	0.47	9.8	A	3/8	0.50	10.8	B	3/8	0.41	12.0	B	6/9
Blue Hill Avenue SB LT/TH/RT	0.57	10.8	B	3/10	0.64	12.8	B	4/11	0.53	11.2	B	8/12
Overall	**0.54**	**11.8**	**B**	--	**0.57**	**13.4**	**B**	--	**0.46**	**14.2**	**B**	--
Blue Hill Avenue at Concord Avenue and the Project Driveway												
Weekday Evening:												
Concord Avenue EB LT/TH/RT									0.39	46.8	D	1/1
Project Driveway WB LT/TH/RT									0.62	42.9	D	2/5
Blue Hill Avenue NB LT/TH/RT									0.60	6.0	A	2/4
Blue Hill Avenue SB LT	See Table 6 (Unsignalized Intersection Analysis)				See Table 6 (Unsignalized Intersection Analysis)				0.20	5.3	A	1/2
Blue Hill Avenue SB TH/RT									0.44	6.0	A	3/9
Overall									**0.60**	**9.8**	**A**	--
Saturday Midday:												
Concord Avenue EB LT/TH/RT									0.27	44.6	D	0/1
Project Driveway WB LT/TH/RT									0.46	37.4	D	1/3
Blue Hill Avenue NB LT/TH/RT									0.42	3.0	A	1/2
Blue Hill Avenue SB LT									0.10	4.2	A	1/1
Blue Hill Avenue SB TH/RT									0.37	5.3	A	3/7
Overall									**0.43**	**7.8**	**A**	--

[a]Volume-to-capacity ratio.
[b]Control (signal) delay per vehicle in seconds.
[c]Level-of-Service.
[d]Queue length in vehicles.
EB = eastbound; WB = westbound; NB = northbound; NEB = northeastbound; SB = southbound; LT = left-turning movements; TH = through movements; RT = right-turning movements.

Off-Site

The following general off-site roadway and intersection improvements are suggested in order to address current and projected future operational deficiencies identified within the study area as a part of this assessment and will be refined as a part of the subsequent TIAS to be prepared in support of the Project.

- *Blue Hill Avenue/ Cheever Street/Blue Hill Terrace Street* - Modify, upgrade, and/or repair the existing traffic signal system at the Blue Hill Avenue/Cheever Street/Blue Hill Terrace Street intersection; optimize timing and phasing; interconnect and coordinate with proposed traffic signal at Blue Hill Avenue/Concord Avenue/Project driveway intersection; install a double-yellow centerline along Cheever Street approaching Blue Hill Avenue to separate the directions of travel; and install/upgrade/replace pedestrian traffic signal equipment and bicycle detection. As can be seen in Table 11, operating conditions at the Blue Hill Avenue/Cheever Street/ Blue Hill Terrace Street intersection were shown to continue at LOS B during both peak periods.

- *Blue Hill Avenue/Decker Street* – Install a STOP-sign and STOP-line on the Decker Street approach to the intersection in accordance with the installation requirements of the MUTCD.

- *Blue Hill Avenue/Tucker Street/Churchill Street* - Review, upgrade/replace signs and pavement markings; improve lines of sight through implementation of parking restrictions within 20-feet (minimum) of the intersection.

- *Amor Road/Hudson Street* – Review, upgrade/replace signs and pavement markings.

- *Decker Street/Crown Street* – Review, upgrade/replace signs and pavement markings; install an intersection ahead warning sign on Decker Street approaching Crown Street from the east.

- *Blue Hills Parkway/Blue Hill Terrace Street* - Review, upgrade/replace signs and pavement markings.

It should be noted that the installation of a traffic control signal at the Project driveway intersection in conjunction with the traffic signal timing improvements to be completed at the Blue Hill Avenue/ Cheever Street/Blue Hill Terrace Street intersection will have the added benefit of introducing gaps in the flow of traffic along Blue Hill Avenue that will allow motorists to exit intersecting roadways and driveways with less delay that currently experienced.

Traffic Calming Measures

A comprehensive traffic calming plan should be implemented within the Churchill Street/ Decker Street/Blue Hill Terrace Street neighborhood area and along neighborhood streets between Blue Hill Avenue and Brush Hill Road/Truman Highway. Typical measures may include: raised intersections; speed humps or lumps; roundabouts; chicanes (roadway alignment variations); neckdowns (roadway narrowing); landscaped medians; sign and pavement marking treatments; one-way traffic patterns; rumble strips; and road closures. These measures may be supplemented with landscaping features, sidewalks and bicycle accommodations where space permits. It is typical that a combination of these traffic calming measures be applied in order to produce the desired effect and to be conducive to the specific roadway topography and adjacent land use. Table 12 defines the benefits and design considerations associated with the identified potential traffic calming measures.

Table 12
TRAFFIC CALMING MEASURE SUMMARY

Traffic Calming Measure	Description	Benefits	Design Considerations
Raised Intersection	3 in. vertical deflection (raising) of pavement within the intersection area; transition ramps (up/down) on intersection approaches.	– Speed reduction of 10 to 15 mph – Potential traffic volume reduction through induced delay	– Emergency vehicle response times – Noise – Drainage considerations – Snow plowing/maintenance
Speed Hump/Speed Table	3 in. vertical deflection (raising) of pavement at a mid-block location; transition ramps (up/down) on approaches.	– Speed reduction of 10 to 15 mph – Potential traffic volume reduction through induced delay	– Emergency vehicle response times – Noise – Drainage considerations – Snow plowing/maintenance
Speed Lump	Segregated 3 in. vertical deflection (raising) of pavement at a mid-block location; transition ramps (up/down) on approaches; cut-outs provided for emergency vehicle through travel.	– Speed reduction of 10 to 15 mph – Potential traffic volume reduction through induced delay – Negligible increase in emergency response times for fire/ambulance	– Noise – Drainage considerations – Snow plowing/maintenance
Modern Roundabout	Circular intersection that requires drivers to yield upon entry at reduced travel speeds; may include a raised center island.	– Reduction in number of conflict points – Speed reduction – Reduced motorist delay and vehicle queuing – Minimal increase in emergency response times	– Available right-of-way – Truck/bus accommodations – Bicycle accommodations – Drainage considerations – Snow plowing/maintenance
Chicane	Change in the horizontal alignment of a roadway within a short segment that requires drivers to slow and alter linear travel path.	– Speed reduction – Potential traffic volume reduction through induced delay	– Truck/bus accommodations – Drainage considerations – Bicycle accommodations – Snow plowing/maintenance – Passage width
Neckdown	Reduction in the width of the travelled-way at a defined point; includes corner bump-outs at intersections	– Speed reduction – Potential traffic volume reduction through induced delay – Reduced pedestrian crossing distance	– Truck/bus accommodations – Drainage considerations – Bicycle accommodations – Snow plowing/maintenance
Median	Raised center island or median (extended island); may include landscaping.	– Potential speed reduction – Potential traffic volume reduction	– Available right-of-way – Truck/bus accommodations – Drainage considerations

Table 12 (Continued)
TRAFFIC CALMING MEASURE SUMMARY

Traffic Calming Measure	Description	Benefits	Design Considerations
Textured Pavement/Rumble Strip	Longitudinal and/or transverse serrations or patterns within the pavement surface.	– Speed reduction	– Noise – Maintenance
Sign/Pavement Marking Treatments	Installation of signs and pavement marking treatments that are implemented alone or in combination to reduce travel speeds through traffic control (all-way STOP, turn restrictions, etc.) and visual elements (longitudinal and transverse pavement markings, edgelines, marked on-street parking, etc.)	– Potential speed reduction – Potential traffic volume reduction through induced delay and turn restrictions – No impact on emergency response	– Traffic control devices must be warranted – Maintenance (pavement marking treatments) – Turn restriction impacts on access to abutting properties
One-Way Street Network	One-way street grid within a series of interconnected or parallel roadways designed to produce a defined traffic pattern.	– Potential volume reduction – Efficient traffic flow – Potential for on-street parking on narrow roadways	– May increase travel speeds absent other traffic calming measures – Emergency response routes should be considered – Access to abutting properties may become circuitous
Road Closure	Closure of a roadway through the installation of a physical barrier; may include the installation of an emergency vehicle gate system or other such device.	– Traffic volume reduction – Speed reduction – Cut-through traffic eliminated	– Emergency vehicle access must be maintained – Turning traffic (errant vehicles) at closure must be accommodated – Truck/bus accommodations at closure – Impact of redistributed traffic – Snow plowing/maintenance

With the proper design and application of traffic calming measures, traffic volumes, vehicle travel speeds and neighborhood cut-through traffic can and will be managed and reduced. These measures will be reviewed in a coordinated effort with the Town (Planning, Police, Fire and Public Works Departments) for implementation as a part of the Project.

With the implementation of the above recommendations, safe and efficient access will be provided to the Project and the Project can be constructed with minimal impact on the roadway system.

cc: BG, LAS, File