TRAFFIC IMPACT ASSESSMENT

351 SUMMER STREET
SOMERVILLE, MA

JUNE, 2010

Prepared for

Strategic Capital Partners, LLC

Prepared by

Design Consultants, Inc.

265 Medford Street **Tel. # (617) 776-3350**
Somerville, MA 02143

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Executive Summary

This report assesses the traffic impacts associated with the proposed development of 31 residential condominiums to be located at 351 Summer Street in Somerville, MA. The report evaluates the projects traffic impacts on the following study area intersections:

- Summer Street/Site Driveways
- Summer Street/Cutter Avenue
- Summer Street/Willow Avenue
- Willow Avenue/Highland Avenue

The study includes an inventory and analysis of existing conditions, an estimation of site generated traffic and an evaluation of future 2014 design year 'No-Build' and 'Build' conditions at the studied intersections.

The proposed development will generate 20 vehicle trips in the AM peak hour, 22 in the PM peak hour and 225 trips daily. This includes trips generated by the potential office use for the space vacated by the Dilboy Post at 361 Summer Street. The peak hour trips have been distributed onto the study area based upon existing peak hour travel patterns and the desire to reach surrounding major routes.

The relatively low volumes generated by the proposed development during the peak hours will have little measureable impacts on traffic flows along Summer Street and the surrounding roadways. No changes in Level of Service will occur at the study area intersections. Analysis shows that the increase in average delays will be one second or less for all traffic movements.

Peak hour directional site traffic (12 vehicles per hour) will amount to approximately one vehicle every five minutes along Summer Street for the proposed residential use. It should also be noted that these peak hour site trips are expected to be reduced due to the nearby MBTA Red Line station at Davis Square that will encourage both residents and workers at the site to use transit for their commute trips.

1.0 Introduction

This report assesses the traffic impacts associated with the proposed development of 31 residential condominiums to be located at 351 Summer Street in Somerville, MA (see Figure 1 - Locus Plan). Institute of Transportation Engineers (ITE) trip generation rates and standard traffic engineering practice and procedures have been utilized in this traffic impact study.

2.0 Methodology

This traffic assessment has been prepared in accordance with the ITE's Traffic Impact Analyses for Site Development. (An ITE recommended practice).

The study includes the following:

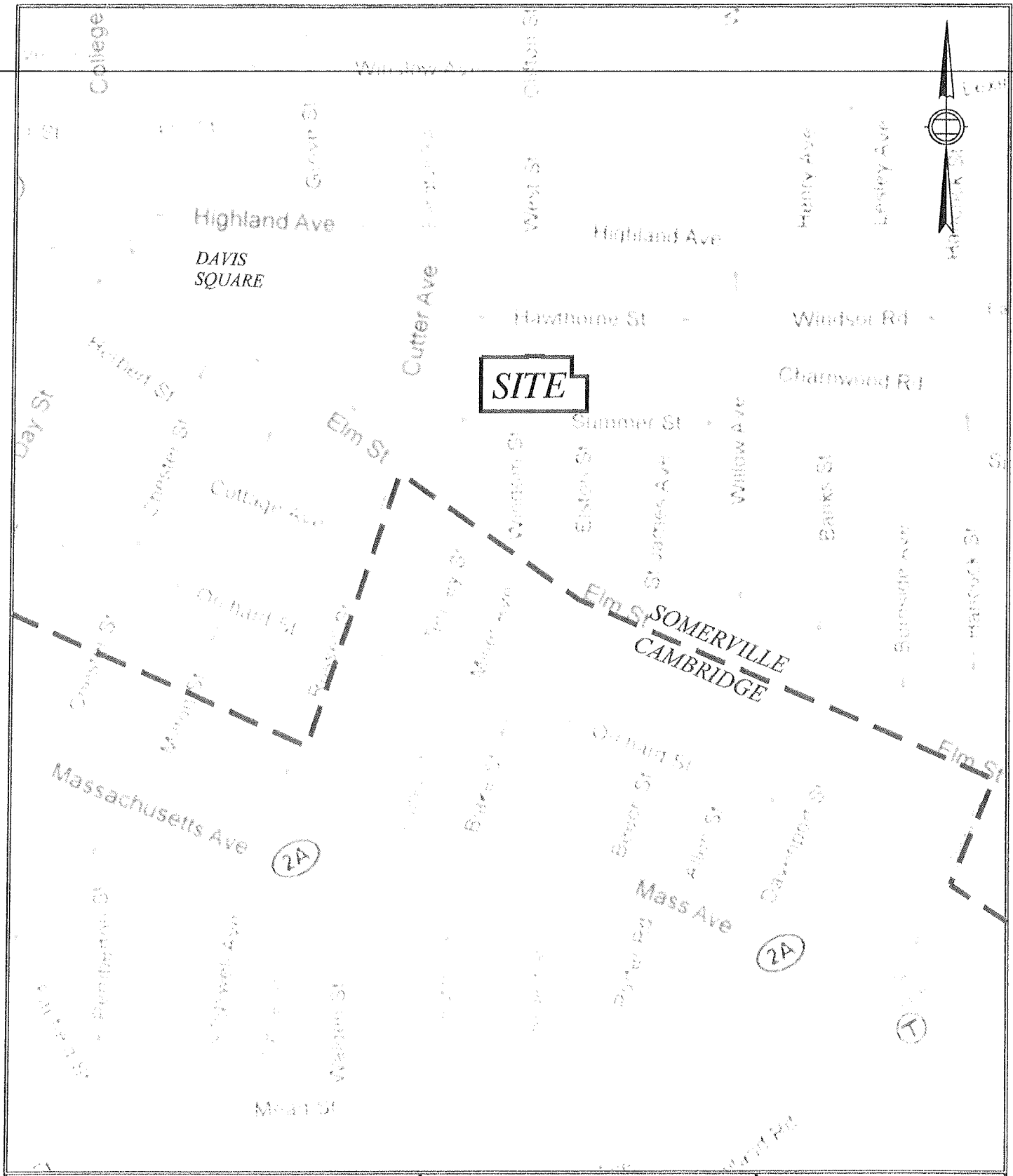
- An inventory and analysis of existing conditions for the study area intersections
- An estimation of daily and peak hour trips generated by the proposed development
- The distribution of AM and PM peak hour site generated traffic at the study area intersections
- An evaluation of future 2014 'No-Build' and 'Build' conditions at the study area intersections

3.0 Proposed Development

The project proponent proposes to construct 31 residential condominiums located on the north side of Summer Street, east of Cutter Avenue in Somerville, MA. (See Figure 1 – Locus Map). The development site consists of two lots. The new development will be constructed on the west lot that is currently used for parking by the George Dilboy VFW Post (at adjacent 371 Summer Street). Development on the east lot (currently vacant) will include a new parking area and building for the relocated George Dilboy VFW Post. It is therefore expected that current activities for the parking lot in relation to the surrounding street network will remain unchanged.

The proposed development plan provides for three separate curb cuts onto Summer Street as follows:

- West Driveway accessing underground resident parking – a total of 45 parking stalls.
- East Driveway accessing rear surface parking on the west lot – a total of 44 parking spaces (for combined Dilboy Post, commercial users and resident visitors) and accessing 19 parking spaces for the new Dilboy Post building on the east lot.



Design Consultants, Inc. Consulting Engineers and Surveyors DESIGN CONSULTANTS BUILDING 265 MEDFORD STREET SOMERVILLE, MA 02143 (617) 776-3350	351 SUMMER ST SOMERVILLE, MA	LOCUS PLAN FIGURE 1

The post runs approximately 170 events per year in their hall (which translates to an average of 14 events per month). These events range from community service fundraisers (like Habitat for Humanity and Avon walk for cancer) to birthday parties, christenings, communions, graduations, reunions, and funerals to a once a year beer and honk festival. The hall is also a polling station. Except for very few annually scheduled events, the rest are all booked on a first-come-first serve basis, a few weeks or a few days in advance. The great majority of event have no more than 80 guests, but they range from 20 to over 100 guests. The Post also runs a club where members gather for cards and other games. The club is frequented every day almost without exception by small gatherings. They have a license to serve liquor.

Closing time is 1 AM, but most often they close earlier.

Parking for the existing Dilboy Post is provided on the west lot with entries/exits via the existing 2 driveways off Summer Street. The relocated facility will continue to have access off Summer Street only.

4.0 Study Area

The study area for this traffic assessment includes the following intersections:

- Summer Street/Site Driveways
- Summer Street/Cutter Avenue
- Summer Street/Willow Street
- Willow Street/Highland Avenue

The Summer Street/Site Driveway intersections are unsignalized while the three off-site locations are traffic signal controlled. See Figure 2 for study area intersections.

5.0 Roadway Network

Highland Avenue is a two-lane undivided minor arterial with on-street parking that provides an east-west connection through the City of Somerville between Davis Square and Route 28/McGrath Highway. In Davis Square, Highland Avenue is one-way westbound, beginning at its intersection with Cutter Avenue.

Elm Street is a two-lane undivided major collector roadway with on-street parking that extends southeast from Davis Square connecting to Somerville Avenue, a distance of about one mile. The street is also one-way in Davis Square, allowing for southeast movements to its intersection with Cutter Avenue.

Cutter Avenue is a one-way collector roadway that provides for northbound traffic circulation between Elm Street and Highland Avenue, as well as metered parking on both sides of the street (due to the proximity of Davis Square).

Willow Avenue is a one-way collector roadway that similarly provides for northbound traffic circulation between Elm Street and Highland Avenue, as well as residential parking on both sides of the street. Willow Avenue extends north as a two-way collector, connecting to Broadway.

Summer Street is a collector street that extends easterly as a one-way street from Elm Street to Willow Avenue, with metered parking on both sides. East of Willow Avenue Summer Street extends as a two-way local/collector, connecting to Bow Street in Union Square, as distance of about 1 ¼ miles. At the project site, Summer Street is 29 feet wide with 7 to 8 foot wide sidewalks on both sides. The posted speed limit is 25 mph.

All of the above-noted streets are under the jurisdiction of the City of Somerville.

Existing West Site Driveway

Approximately 225 feet east of the proposed access to the project site is the Summer Street/Cutter Avenue intersection. This 4-legged intersection of two one-way streets is traffic signal controlled. Summer Street is 24 feet wide west of the intersection, providing for a separate left turn movement onto Cutter Avenue. The Cutter Avenue approach is 27 feet wide, allowing for separate through and right turn movements. Signal phasing is two phase for vehicles and an exclusive pedestrian crossing phase. Abutting land uses are mixed with a pizza outlet on the southeast corner, bank on the northeast corner, a proposed mixed use site on the northwest corner and a municipal parking lot (metered) on the southwest corner. The signal timing is pre-timed and interconnected with the nearby traffic signal at Elm and Cutter Avenue.

Existing East Site Driveway

Approximately 500 feet east of the proposed east site drive is the Summer Street/Willow Avenue intersection. This 4-legged intersection is traffic signal controlled. Signal phasing is two phase (pre-timed) for vehicles and an exclusive pedestrian crossing phase. The eastbound Summer Street approach is 30 feet wide, allowing for a separate through and left turn lane. The Willow Avenue approach is 33 feet wide, providing for a single approach and departure lane with parking on both sides. The Summer Street westbound approach allows for right turns only. Land use is the vicinity is residential.

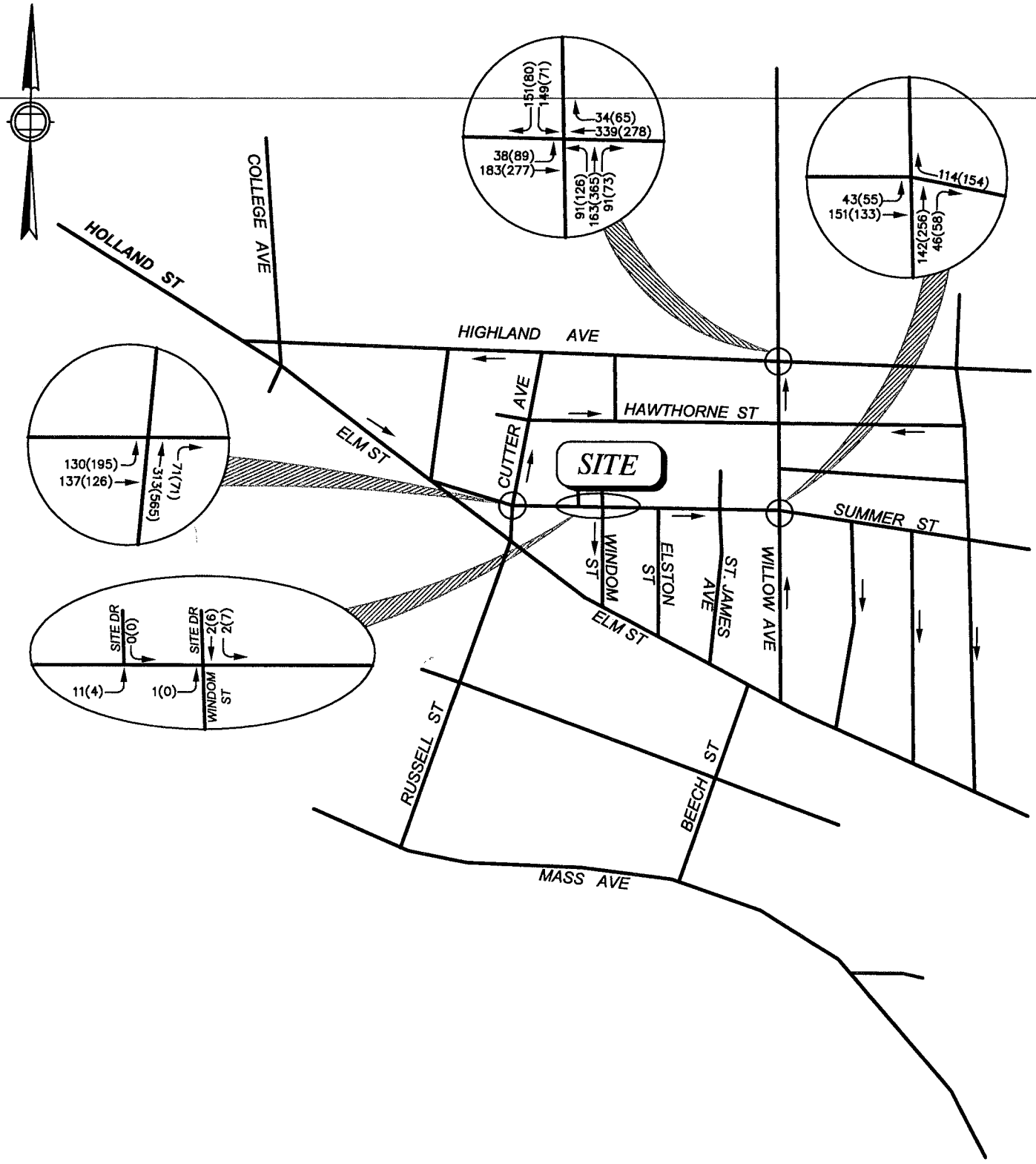
Summer Street @ Cutter Avenue

Approximately 400 feet north of the Summer Street/Willow Avenue intersection is the intersection of Willow Avenue with Highland Avenue. This 4-way intersection is signalized and provides for one general purpose lane for the northbound Willow Avenue approach due to adjacent curbed parking near the intersection. Each of the Highland Street approaches similarly allow for a single general-purpose lane. The southbound Willow Avenue approach is a single lane allowing left or right turn movements. Signal phasing is two phase (actuated) for vehicles and an exclusive pedestrian crossing phase. Land use along Highland Street is mainly commercial while Willow Avenue is residential.

6.0 Traffic Volumes

Traffic volumes were recorded at the study area intersections from 7-9 AM and 4-6 PM on typical weekdays during the month of July, 2009. Verification counts were undertaken in February, 2010, as well as supplemental bicycle/pedestrian counts in June, 2010. This count data is provided in Appendix A.

The recorded summer peak hour volumes were adjusted for the peak fall season when students (as well as most workers) are in the city. The resulting 2009 peak hour volumes are shown in Figure 2. They reflect a 10% increase over the summer season counts for the Summer Street intersections and the higher February, 2010 count for the intersection of Willow and Highland Avenue. This represents a conservative 'worst case' for analysis as requested by the Somerville Traffic and Parking Department.



Design Consultants, Inc. Consulting Engineers and Surveyors DESIGN CONSULTANTS BUILDING 265 MEDFORD STREET SOMERVILLE, MA 02143 (617) 776-3350	351 SUMMER ST SOMERVILLE, MA	EXIST 2009 PEAK HOUR TRAFFIC VOLUME AM(PM) FIGURE 2

7.0 Existing Traffic Operations

DCI has performed capacity analyses to determine traffic operations (Levels-of-Service) at the study area intersections under existing 2009 peak hour conditions. Level-of-Service (LOS) is the standard technique used in traffic engineering to measure traffic flows and delays at intersections. Levels-of-Service are given letter designations with 'A' at best, with little or no delays to 'F' at worst, with forced flow conditions. Levels-of-Service were determined by performing capacity analyses utilizing SYNCHRO and HCS analysis software.

Definitions of Levels-of-Service at signalized and unsignalized intersections are presented in the 2000 Highway Capacity Manual and the following tables define the relationship between Level-of-Service and control delay.

Level of Service Criteria for Signalized Intersections

Level of Service	Control Delay per Vehicle (sec)	Qualitative Description
A	≤ 10	Good progression, few stops and short cycle lengths.
B	> 10-20	Good progression and/or short cycle lengths; more vehicle stops.
C	> 20-35	Fair progression and/or longer cycle lengths; some cycle failures; significant portion of vehicles must stop.
D	> 35-55	Congestion becomes noticeable; high-volume-to-capacity ratio; longer delays; noticeable cycle failures.
E	> 55-80	At or beyond limit of acceptable delay; poor progression; long cycles; high volumes; long queues.
F	> 80	Unacceptable to drivers. Arrival volumes greater than discharge capacity; long cycle lengths; unstable-unpredictable flows.

SOURCE: Transportation Research Board 2000.

Level of Service Criteria for Unsignalized Intersections

Level of Service	Average Control Delay per Vehicle (sec)	Impact on Minor Street Traffic
A	≤ 10	Little or no delay
B	> 10-15	Short traffic delays
C	> 15-25	Average traffic delays
D	> 25-35	Long traffic delays
E	> 35-50	Very long traffic delays
F	> 50	Unacceptable traffic delays to most drivers

SOURCE: Transportation Research Board 2000.

Delays and Levels-of-Service for study area intersections are in the following Table 'A'.

TABLE A
EXISTING CONDITIONS

UNSIGNALIZED INTERSECTIONS						
Location/Movement	Existing Condition					
	AM Peak Hour			PM Peak Hour		
	Delay (2)	LOS (3)		Delay	LOS	
Summer/West Site Dr						
Driveway exit	10.0-	A		9.7	A	
Summer/East Site Dr						
Driveway exit	9.8	A		9.9	A	
SIGNALIZED INTERSECTIONS						
	V/C	Delay	LOS	V/C	Delay	LOS
Summer/Cutter						
Summer EB Left/Thru	.33	31.8	C	.36	31.5	C
Cutter NB Thru/Right	.28	8.0	A	.51	10.5	B
OVERALL	.29	17.8	B	.45	17.6	B
Summer/Willow						
Summer EB Left/Thru	.21	7.4	A	.18	7.2	A
Summer WB Right	.15	19.0	B	.24	19.0	B
Willow NB Thru/Right	.27	8.1	A	.45	9.7	A
OVERALL	.24	10.3	B	.32	11.2	B
Willow/Highland						
Highland EB Left/Thru	.46	14.2	B	.82	29.9	C
Highland WB LTR	.68	18.0	B	.58	14.4	B
Willow NB LTR	.44	7.8	A	.72	15.3	B
Willow SB Left/Right	.43	5.8	A	.24	4.6	A
OVERALL	.52	10.5	B	.76	15.0	B

(1) Volume/Capacity Ratio
(2) Control Delay in Seconds
(3) Level-of-Service

As indicated in Table A, the unsignalized site drive intersections on Summer Street operate at a Level-of-Service 'A' in the AM and PM peak hours.

At the signalized intersections within the study area, all traffic movements are LOS 'B' or better with the exception of the following approach locations/peak hour time periods:

- The eastbound approach along Summer Street at Cutter Avenue operates at LOS 'C' during the AM and PM peak hours.

- The eastbound approach along Highland Avenue at Willow Avenue operates at LOS 'C' during the PM peak hour.

8.0 Accident Data

Accident data for the 3-year period from 07/13/2006 to 07/13/2009 was obtained from the Somerville Police Department as follows:

Location	No. of Accidents	Crash Rate[1]
Summer St./Cutter Ave.	0	0.00
Summer St./Willow Ave.	2	0.28
Willow Ave./Highland Ave.	6	0.40

The MHD crash rate formula was used to calculate crash rates for the study area intersections. This crash rate is expressed in Million Entering Vehicles, which is standard to the Traffic Engineering profession. The District 4 average crash rate for signalized intersections is 0.88 and 0.63 for unsignalized locations. The crash rates for the study area intersections are lower than average and therefore do not indicate a safety concern.

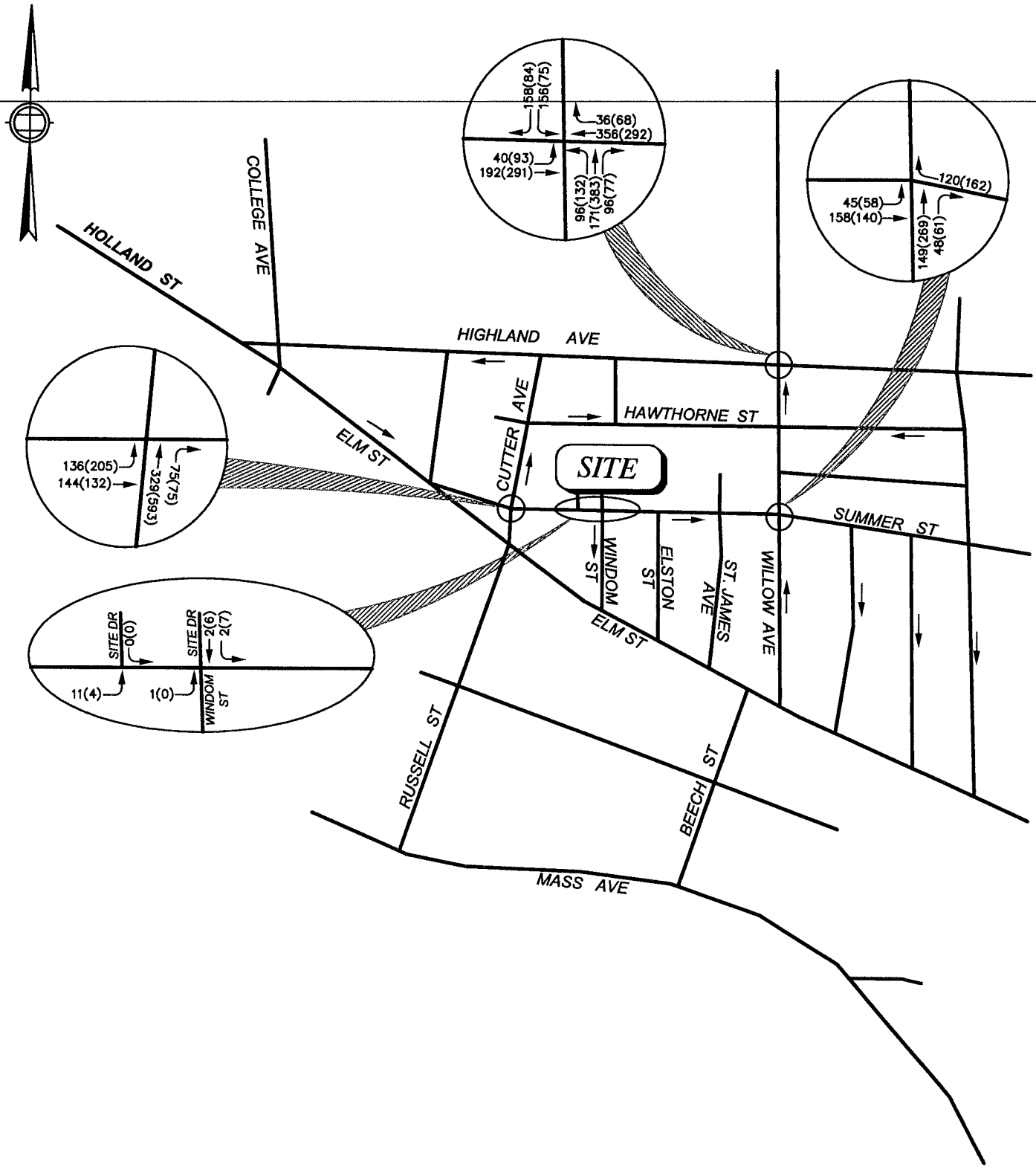
9.0 Future Traffic Volumes

The existing 2009 study area peak hour volumes have been increased by an annual growth factor of 1% per year to account for general background traffic growth to develop future 2014 peak hour volumes (five-year projection). This conservative assumption accounts for the peak hour traffic volumes generated by the nearby 16,000 SF mixed-use development at the northwest corner of Summer Street and Cutter Avenue. No other planned developments were identified for the study area. The projected 2014 'No-Build' condition is shown on Figure 3.

10.0 Trip Generation and Distribution

DCI has estimated the daily and peak hour site generated trips based upon trip rates presented in the Institute of Transportation Engineers (ITE) Trip Generation Manual – 8th Edition. The information in this document has been obtained from the research and experiences of transportation engineering and planning professionals. The data is based on more than 4,800 trip generation studies submitted to ITE by public agencies; consulting firms; universities and colleges; developers; associations; and local sections, districts and student chapters of ITE. The published rates are intended for planners, transportation professionals, zoning boards and others who are interested in estimated the number of vehicle trips generated by a proposed development.

[1] Based on peak hour count and 3 year crash data.



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2014 NO-BUILD PEAK HOUR TRAFFIC VOLUME AM(PM)

FIGURE 3

For a specific land use, the Trip Generation Manual provides trip generation rates and equations for daily and peak hour time periods for the generator and the traditional commuting peak hours of the adjacent street traffic (that is, 7:00 AM to 9:00 AM and 4:00 PM to 6:00 PM on weekdays). The average trips generation rates represent weighed averages from studies conducted throughout the United States and Canada since the 1960's. Data was primarily collected at suburban locations having little or no transit service, nearby pedestrian amenities, or travel demand management (TDM) programs. The rates may be modified to reflect the presence of public transportation service, ridesharing, or other TDM measures; enhanced pedestrian and bicycle trip-making opportunities; or other special characteristics of the site or surrounding area.

For this residential project, ITE Land Use 230 for Residential Condominium/Townhouse was used. The data is a combination of condominiums/townhouses that are low-rise or high-rise development. The number of dwelling uses is the independent variable of choice because it is readily available, easy to project and has a high correlation with average weekday vehicle trip ends. The peak hour of the generator typically coincides with the peak hour of the adjacent street traffic. The ITE data was based on surveys between the mid-1970s and the 2000s throughout the United States and Canada.

The following table identifies the trip generation for the proposed 31 residential condominium units. The data reflects use of the average rate versus a fitted curve equation. The fitted curve equation is typically applied for larger size developments (the average size of development for Land Use 230 is 179 dwelling units for weekday trips, higher for peak hour trips).

31 Units **Residential Condominium/Townhouse** Land Use 230		
Daily	AM Peak Hour	PM Peak Hour
In – 91	In – 2	In – 11
Out – 91	Out – 12	Out – 5
Total – 182	Total – 14	Total – 16

The development plan calls for relocation of the existing Dilboy Post that currently occupies approximately 3,911 GSF of space at 361 Summer Street. Since this area has the potential of being occupied as office space within current zoning, the future development condition has considered this additional component. If needed, parking for this use would use designated Dilboy stalls under the proposed development plan that would be available for daytime use. The following tables identify the Trip Generation for this future potential use (ITE Land Use 710) and the total development scenario.

Potential Future Use 3,911 SF General Office Building Land Use 710		
Daily	AM Peak Hour	PM Peak Hour
In – 22	In – 5	In – 1
Out – 21	Out – 1	Out – 5
Total – 43	Total – 6	Total – 6

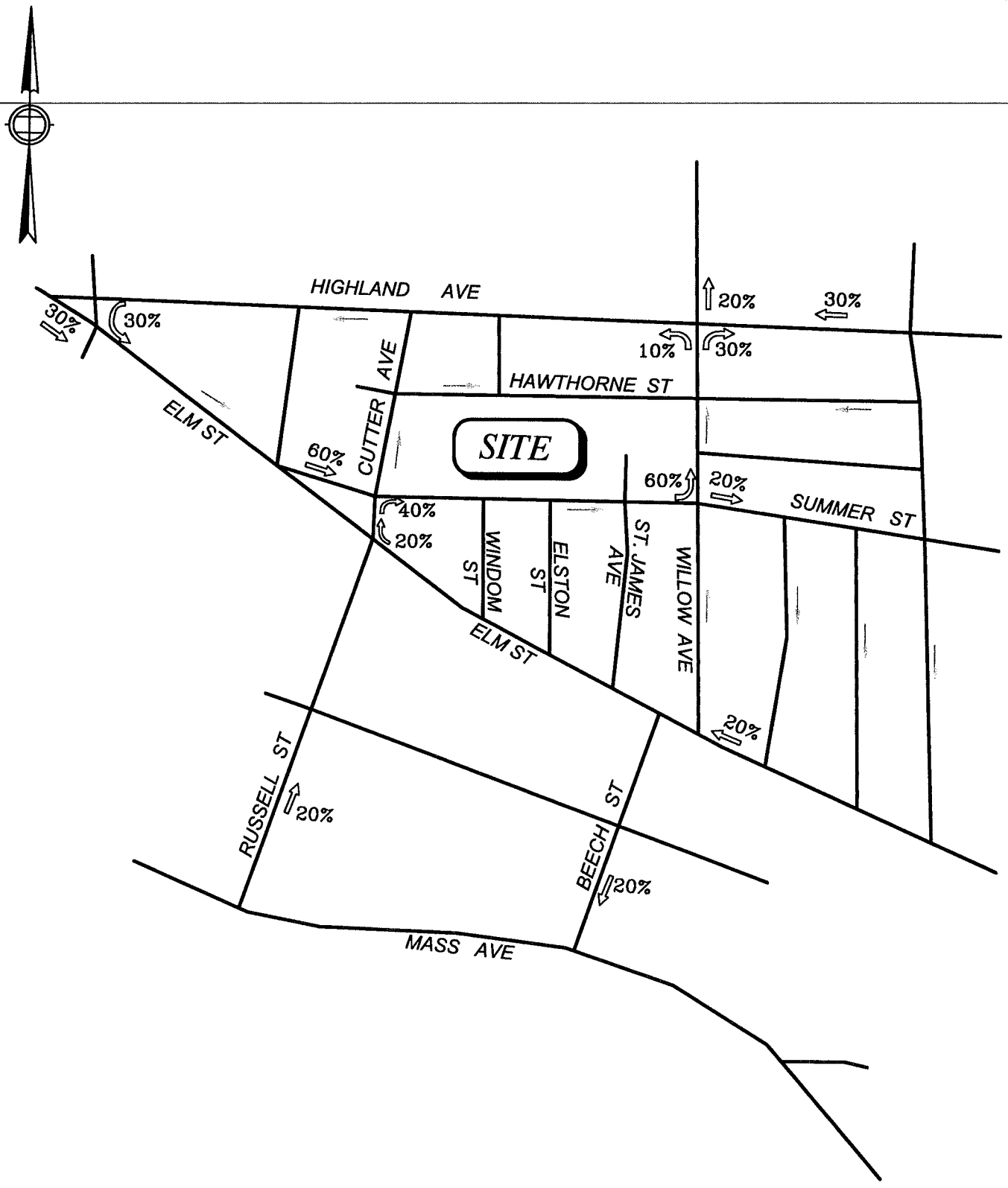
TOTAL SITE 31 Residential Units and 3,911 SF Office		
Daily	AM Peak Hour	PM Peak Hour
In – 113	In – 7	In – 12
Out –112	Out – 13	Out – 10
Total – 225	Total – 20	Total – 22

The site-generated trips have not been reduced due to other modes of transportation (such as walking, transit or bicycling) in order to present a conservative analysis for potential traffic impact. Otherwise, a reduction would be appropriate due to the proximity of Davis Square and the MBTA Red Line Station.

The site generated peak hour trips have been distributed on the study area intersections based upon existing travel patterns within the study area and routes to major arterials in the area (see Figure 4). The site generated peak hour trips are shown in Figure 5. The site generated peak hour trips have been added to the 2014 No-Build volumes and the resulting 2014 Build peak hour volumes are shown in Figure 6.

11.0 Traffic Impacts

In order to evaluate the traffic impacts associated with the proposed development, it is necessary to compute and compare delays and Levels-of-Service for 2012 'No-Build' and 'Build' scenarios. This is shown on the following Table B.



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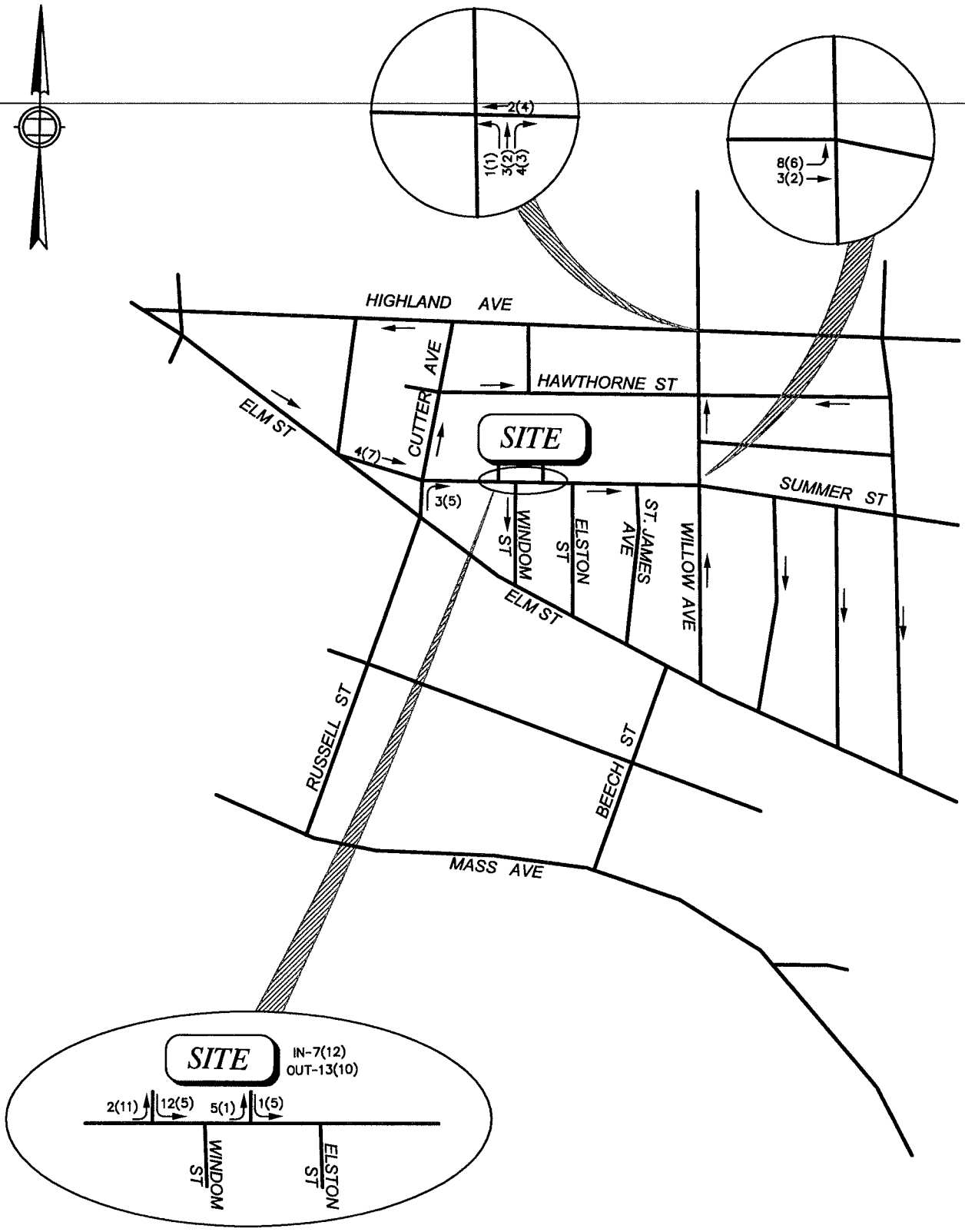
DISTRIBUTION OF SITE-GENERATED TRIPS

FIGURE 4



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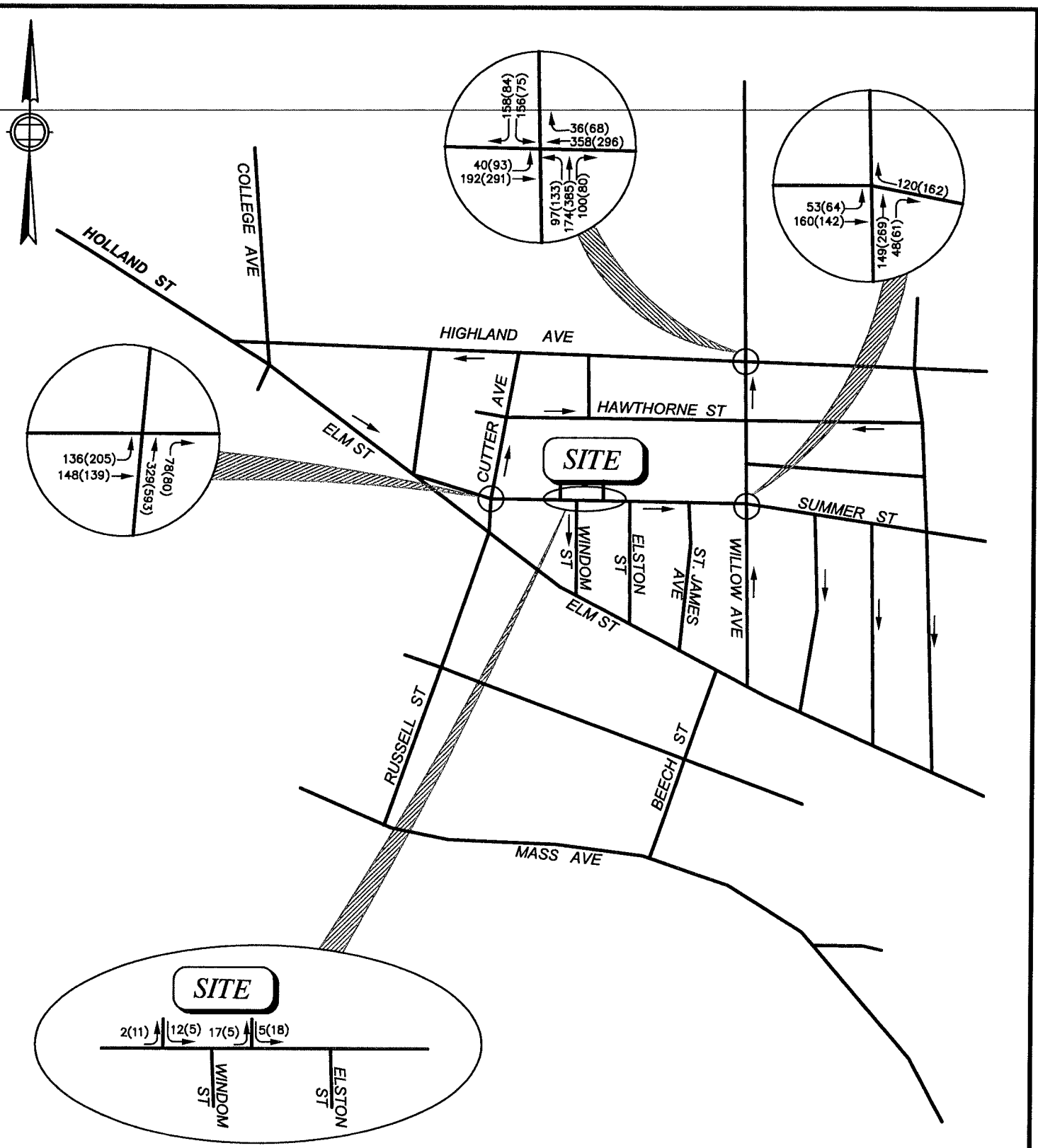
SITE-GENERATED PEAK HOUR TRIPS AM(PM)

FIGURE 5



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2014 BUILD PEAK HOUR TRIPS AM(PM)

FIGURE 6

TABLE B

LEVEL OF SERVICE
UNSIGNALIZED INTERSECTIONS

Location/ Movement	2014 No-Build				2014 Build			
	AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
	Delay (2)	LOS (3)	Delay	LOS	Delay	LOS	Delay	LOS
Summer/West Dr								
Driveway exit	9.9	A	9.7	A	9.9	A	10.0-	A
Summer/East Dr								
Driveway exit	10.0+	B	10.0+	B	10.1	B	9.8	A

SIGNALIZED INTERSECTIONS												
	V/C	Delay	LOS	V/C	Delay	LOS	V/C	Delay	LOS	V/C	Delay	LOS
Summer/Cutter												
Summer EB	.34	32.0	C	.37	31.6	C	.35	32.1	C	.37	31.8	C
Cutter NB	.30	8.2	A	.54	10.9	B	.30	8.1	A	.54	10.9	B
OVERALL	.31	17.9	B	.47	17.8	B	.31	18.0	B	.48	17.9	B
Summer/Willow												
Summer EB	.22	7.5	A	.19	7.3	A	.22	7.5	A	.20	7.3	A
Summer WB	.16	19.0	B	.26	19.0	B	.16	19.0	B	.26	19.0	B
Willow NB	.28	8.2	A	.47	10.0	A	.28	8.2	A	.47	10.0	A
OVERALL	.25	10.4	B	.33	11.3	B	.25	10.3	B	.33	11.3	B
Willow/Highland												
Highland EB	.50	14.8	B	.87	34.5	C	.50	14.8	B	.87	34.9	C
Highland WB	.70	18.7	B	.59	14.7	B	.70	18.7	B	.60	14.8	B
Willow NB	.47	8.4	A	.76	17.6	B	.47	8.4	A	.78	18.3	B
Willow SB	.46	6.3	A	.25	4.7	A	.46	6.3	A	.25	4.8	A
OVERALL	.55	10.9	B	.80	16.9	B	.55	11.0	B	.81	17.2	B

(1) Volume/Capacity Ratio
(2) Control Delay in Seconds
(3) Level-of-Service

As seen on Table B, no changes in Level-of-Service occur at the study intersections from No-Build to Build conditions. The results show that the increase in average delays will be one second or less for all traffic movements.

12.0 Sight Distance

Sight distances along Summer Street at the proposed site drive intersection were field measured to and from the point where vehicles will stop prior to entering the Summer Street traffic flows. Safe stopping distance enables a driver on the major road to perceive and react accordingly to a vehicle moving from the minor road to the major road. The values are based upon driver perception and reaction time and the braking distance for wet level pavement. Stopping sight distance is measured from an eye height of 3.5 feet to an object (vehicle) in the roadway. The AASHTO (1) safe stopping distance requirement is 150 feet for the 25 mph operating speed along Summer Street.

Sight distance at both site driveways will be well in excess of the minimum 150 foot stopping sight distance for Summer Street. This is due to the straight horizontal and relatively flat vertical alignment of Summer Street along the site frontage, combined with the 10 foot setback of the proposed residential building from the back of sidewalk.

13.0 Conclusions

The proposed residential site development, combined with the potential future office use at 361 Summer Street will generate 20 vehicle trips in the AM peak hour, 22 trips in the PM peak hour and 225 trips per day.

The low volumes generated by the proposed development during the peak hours will have little measureable impacts on traffic flows along Summer Street and the surrounding roadways. Peak hour directional site traffic (12 vehicles per hour) will amount to approximately one vehicle every five minutes at the residential driveway connecting to the underground garage. It should also be noted that these peak hour site trips are expected to be reduced due to the nearby MBTA Red Line station at Davis Square that will encourage both residents and workers at the site to use transit for their work commute.

Trip generation studies published by ITE show that peak hour rates for residential and office development coincide with the peak commute periods of adjacent traffic from 7:00 to 9:00 AM and 4:00 to 6:00 PM. Site traffic during off-peak periods will therefore be somewhat lower throughout the day and also reflect the lower traffic volumes on the adjacent roadways (typically about one half of peak hour activity).

The Dilboy Post will continue activities at its new location along Summer Street, with peak traffic activity occurring during off-peak hours that can be well accommodated by the surrounding street network.

(1) American Association of State and Highway Transportation Officials

APPENDIX

A – Traffic Count Data
B – Synchro Analysis
    1. 2009 Existing Conditions
    2. 2014 No-Build Conditions
    3. 2014 Build Conditions
C – HCS Unsignalized Analysis
D – MHD Crash Rate Sheets
E – Trip Generation

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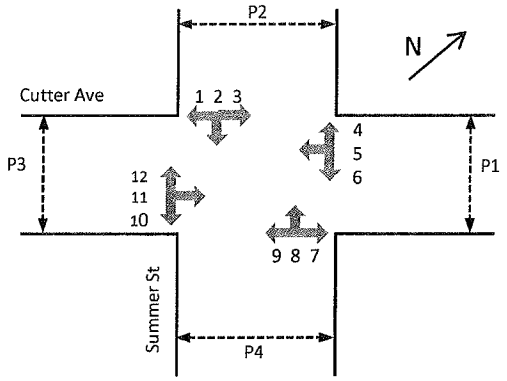
LOCATION:	Summer St / Cutter Ave	PROJ NO.:	2008-038
TIME:	7am - 9am	SHEET NO:	5
DATE:	7/7/2009, *6/3/2010	CALCULATED BY:	S.Wen, S. Kenney
WEATHER:	Cloudy	NOTES:	

TIME	1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
7:15 AM	0	14	19	0	0	0	0	0	0	5	37	0	75
7:30 AM	0	19	22	0	0	0	0	0	0	6	41	0	88
7:45 AM	0	11	25	0	0	0	0	0	0	7	51	0	94
8:00 AM	0	22	29	0	0	0	0	0	0	10	51	0	112
8:15 AM	0	17	27	0	0	0	0	0	0	18	51	0	113
8:30 AM	0	26	28	0	0	0	0	0	0	14	79	0	147
8:45 AM	0	28	28	0	0	0	0	0	0	13	83	0	152
9:00 AM	0	34	35	0	0	0	0	0	0	13	72	0	154
Peak Hour	**0**	**105**	**118**	**0**	**0**	**0**	**0**	**0**	**0**	**58**	**285**	**0**	**566**

(8:00am - 9:00am)



	*Pedestrians	*Bicycles
P1	9	16
P2	12	0
P3	41	1
P4	16	3

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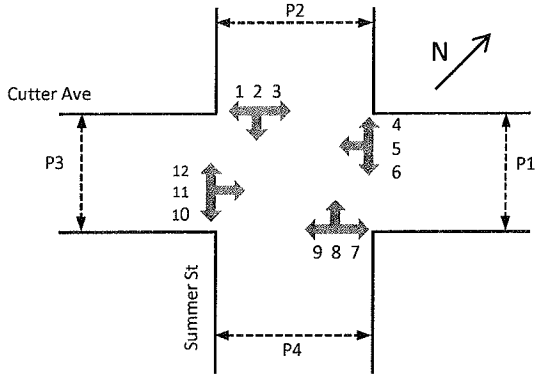
LOCATION: Summer St / Cutter Ave
PROJ NO.: 2008-038
TIME: 4pm - 6pm
SHEET NO: 6
DATE: 7/7/2009, *6/3/2010
CALCULATED BY: S.Wen, S. Kenney
WEATHER: Cloudy
NOTES:

TIME	1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
4:15 PM	0	20	31	0	0	0	0	0	0	16	108	0	175
4:30 PM	0	21	53	0	0	0	0	0	0	26	104	0	204
4:45 PM	0	26	41	0	0	0	0	0	0	22	119	0	208
5:00 PM	0	19	28	0	0	0	0	0	0	20	133	0	200
5:15 PM	0	28	51	0	0	0	0	0	0	17	136	0	232
5:30 PM	0	22	41	0	0	0	0	0	0	17	128	0	208
5:45 PM	0	28	44	0	0	0	0	0	0	17	122	0	211
6:00 PM	0	30	41	0	0	0	0	0	0	14	128	0	213
Peak Hour	**0**	**108**	**177**	**0**	**0**	**0**	**0**	**0**	**0**	**65**	**514**	**0**	**864**

(5:00pm - 6:00pm)



	*Pedestrians	*Bicycles
P1	65	0
P2	11	8
P3	18	39
P4	12	3

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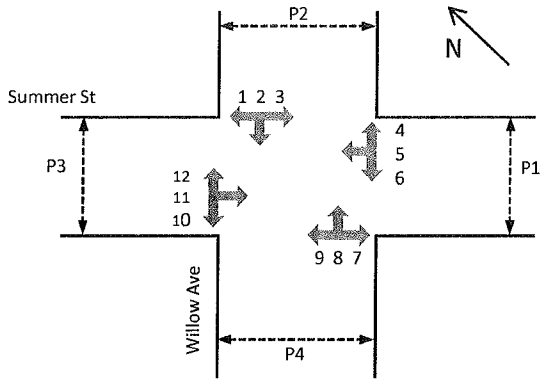
265 MEDFORD ST · SOMERVILLE, ME 02147 · (617) 776-3350

LOCATION: Summer St / Willow Ave
PROJ NO.: 2008-038
TIME: 7am - 9am
SHEET NO: 1
DATE: 7/14/2009
CALCULATED BY: M.Buono
WEATHER: Clear 70°
NOTES:

TIME	1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
7:15 AM	0	0	0	11	0	0	10	17	0	0	14	1	53
7:30 AM	0	0	0	6	0	0	17	27	0	0	24	0	74
7:45 AM	0	0	0	15	0	0	16	31	0	0	22	5	89
8:00 AM	0	0	0	28	0	0	13	36	0	0	35	10	122
8:15 AM	0	0	0	21	0	0	11	29	0	0	29	4	94
8:30 AM	0	0	0	19	0	0	6	24	0	0	28	7	84
8:45 AM	0	0	0	26	0	0	16	39	0	0	43	11	135
9:00 AM	0	0	0	38	0	0	9	37	0	0	37	17	138
Peak Hour	**0**	**0**	**0**	**104**	**0**	**0**	**42**	**129**	**0**	**0**	**137**	**39**	**451**

(8:00am - 9:00am)



	Pedestrians	Bicycles
P1	38	10
P2	19	2
P3	29	13
P4	20	5

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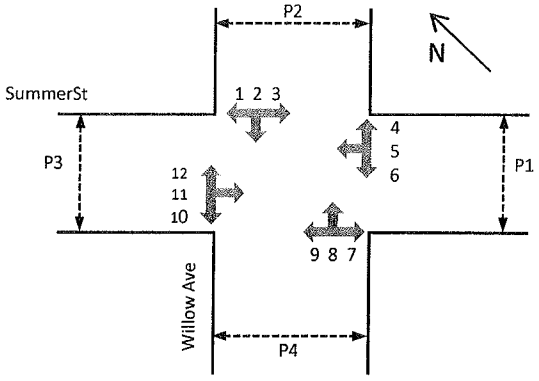
265 MEDFORD ST · SOMERVILLE, ME 02147 · (617) 776-3350

LOCATION: Summer St / Willow Ave
PROJ NO.: 2008-038
TIME: 4pm - 6pm
SHEET NO: 2
DATE: 7/14/2009
CALCULATED BY: M.Buono
WEATHER: Clear 70°
NOTES:

TIME	1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
4:15 PM	0	0	0	31	0	0	14	56	0	0	35	15	151
4:30 PM	0	0	0	32	0	0	13	62	0	0	30	13	150
4:45 PM	0	0	0	32	0	0	15	46	0	0	37	11	141
5:00 PM	0	0	0	20	0	0	13	39	0	0	36	13	121
5:15 PM	0	0	0	40	0	0	12	72	0	0	35	12	171
5:30 PM	0	0	0	48	0	0	13	76	0	0	13	14	164
5:45 PM	0	0	0	15	0	0	12	57	0	0	43	8	135
6:00 PM	0	0	0	17	0	0	13	54	0	0	33	11	128
Peak Hour	**0**	**0**	**0**	**140**	**0**	**0**	**53**	**233**	**0**	**0**	**121**	**50**	**597**

(4:30pm - 5:30pm)



	Pedestrians	Bicycles
P1	19	33
P2	13	2
P3	18	5
P4	7	5

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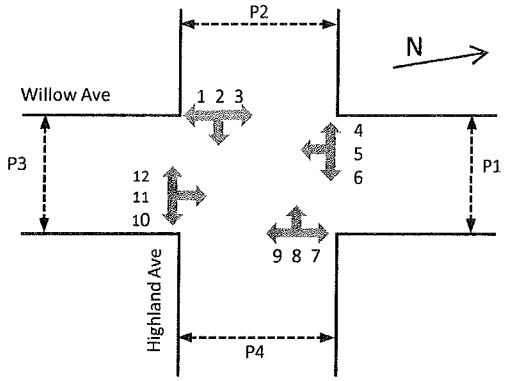
265 MEDFORD ST · SOMERVILLE, ME 02147 · (617) 776-3350

LOCATION: Highland Ave/ Willow Ave
PROJ NO.: 2008-038
TIME: 7am - 9am
SHEET NO: 3
DATE: 7/14/2009, *6/2/2010
CALCULATED BY: M.Buono, S. Wen, S. Kenney
WEATHER: Clear 70°, Cloudy 70°
NOTES:

TIME	1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
7:15 AM	0	22	3	13	0	19	1	54	0	10	17	15	154
7:30 AM	0	27	5	19	0	28	7	56	0	12	20	24	198
7:45 AM	0	35	4	27	0	31	5	84	0	24	25	30	265
8:00 AM	0	31	6	30	0	18	5	71	0	20	31	17	229
8:15 AM	0	40	7	24	0	28	8	71	0	15	25	16	234
8:30 AM	0	34	7	29	0	31	8	67	0	20	43	26	265
8:45 AM	0	26	13	33	0	28	8	76	0	15	42	24	265
9:00 AM	0	45	11	22	0	27	1	55	0	20	33	18	232
Peak Hour	**0**	**145**	**38**	**108**	**0**	**114**	**25**	**269**	**0**	**70**	**143**	**84**	**996**

(8:00am - 9:00am)



	*Pedestrians	*Bicycles
P1	39	30
P2	12	1
P3	28	14
P4	27	14

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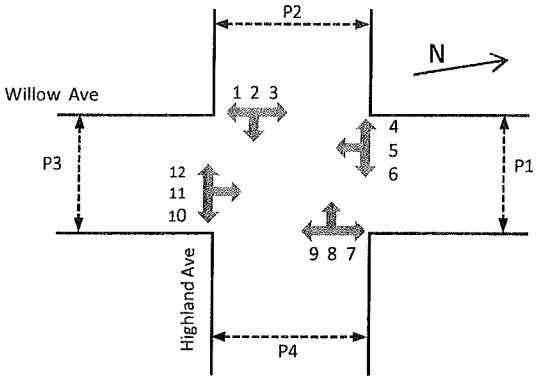
265 MEDFORD ST · SOMERVILLE, ME 02147 · (617) 776-3350

LOCATION: Highland Ave/ Willow Ave
PROJ NO.: 2008-038
TIME: 4pm - 6pm
SHEET NO: 4
DATE: 7/14/2009, *6/2/2010
CALCULATED BY: M.Buono, S. Wen, S. Kenney
WEATHER: Clear 70°, Cloudy 70°
NOTES:

TIME	1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
4:15 PM	0	47	14	12	0	1	8	76	0	8	67	18	251
4:30 PM	0	44	20	12	0	12	17	61	0	13	71	28	278
4:45 PM	0	42	9	7	0	13	6	77	0	9	65	16	244
5:00 PM	0	43	19	10	0	18	13	53	0	18	62	24	260
5:15 PM	0	54	15	8	0	13	20	54	0	14	78	28	284
5:30 PM	0	73	26	6	0	17	11	70	0	21	85	29	338
5:45 PM	0	62	27	22	0	11	22	119	0	8	38	28	337
6:00 PM	0	39	22	16	0	13	12	58	0	7	52	27	246
Peak Hour	**0**	**232**	**87**	**46**	**0**	**59**	**66**	**296**	**0**	**61**	**263**	**109**	**1219**

(4:45pm - 5:45pm)



	*Pedestrians	*Bicycles
P1	47	72
P2	42	7
P3	42	12
P4	23	12

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265 MEDFORD ST · SOMERVILLE, ME 02147 · (617) 776-3350

LOCATION: WILLOW AVENUE AT SUMMER ST

PROJ NO.: 2008-038.20

SHEET NO: 1 of 2

TIME: 7:AM-7:45AM

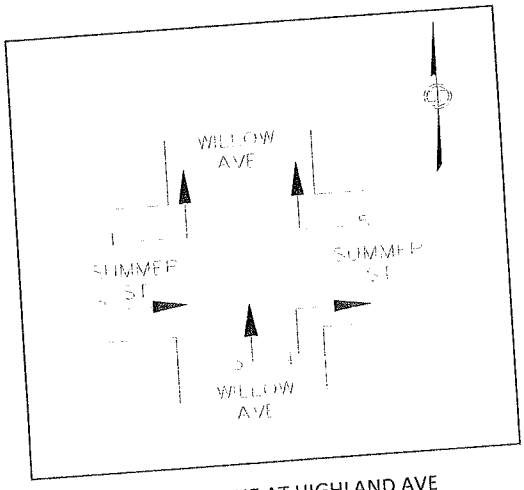
CALCULATED BY: SMK

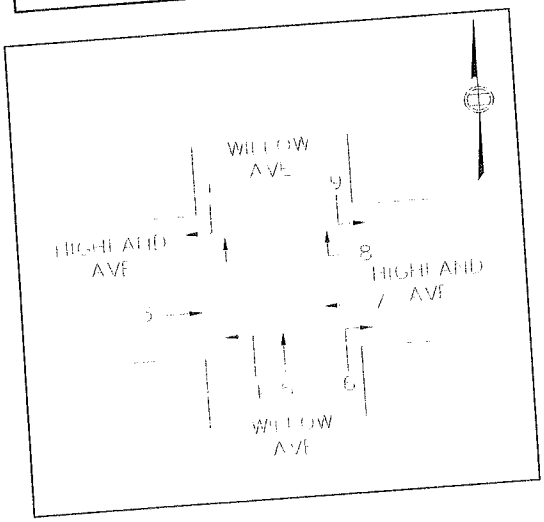
DATE: 2/3/2010

NOTES:

WEATHER: 25°, LIGHT SNOW

TIME	1	2	3	4	5	TOTAL
7:00 AM	2	14	18	3	20	57
7:15 AM		1B				
7:15 AM	1	0	32	8	20	61
7:30 AM			1B			
7:30 AM	4	14	35	8	17	78
7:45 AM						
					TOTAL	196





LOCATION: WILLOW AVENUE AT HIGHLAND AVE

TIME: 8:00AM-9:00AM

DATE: 2/3/2010

WEATHER: 28°, LIGHT SNOW

TIME	1	2	3	4	5	6	7	8	9	TOTAL
8:00 AM	35	4	45	18	46	18	86	16	44	268
8:15 AM										
8:15 AM	32	10	56	34	47	26	88	8	40	301
8:30 AM										
8:30 AM	43	14	42	17	36	12	75	5	35	244
8:45 AM										
8:45 AM	41	10	40	22	34	16	90	5	30	258
9:00 AM										
									TOTAL	1,071

Design Consultants, Inc.
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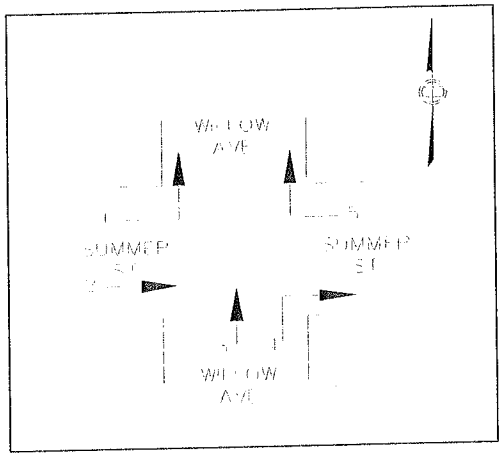
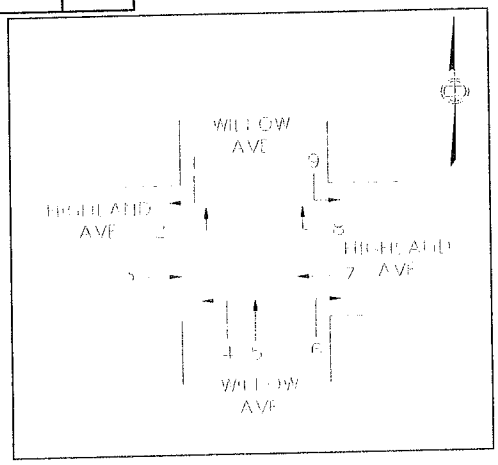
265 MEDFORD ST · SOMERVILLE, ME 02147 · (617) 776-3350

LOCATION: WILLOW AVENUE AT SUMMER ST
TIME: 4:00PM-4:45PM
DATE: 2/2/2010
WEATHER: 30°, PARTLY CLOUDY

PROJ NO.: 2008-038.20
SHEET NO: 2 of 2
CALCULATED BY: SMK
NOTES:

TIME	1	2	3	4	5	TOTAL
4:00 PM	6	29	68	21	37	124
4:15 PM		1B				
4:15 PM	14	33	75	15	34	137
4:30 PM						
4:30 PM	7	40	80	13	26	140
4:45 PM						
					TOTAL	401





LOCATION: WILLOW AVENUE AT HIGHLAND AVE
TIME: 5:00PM-6:00PM
DATE: 2/2/2010
WEATHER: 30°, PARTLY CLOUDY

TIME	1	2	3	4	5	6	7	8	9	TOTAL
5:00 PM	19	23	61	31	77	19	72	11	15	313
5:15 PM			2B				1B			
5:15 PM	20	19	65	31	94	14	67	19	13	329
5:30 PM			1B				1B			
5:30 PM	15	23	50	30	93	16	72	18	17	317
5:45 PM			1B				1B			
5:45 PM	26	24	71	34	101	24	67	17	26	364
6:00 PM							1B			
									TOTAL	1,323

Lane Group	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	240	405	375	326
v/c Ratio	0.46	0.68	0.44	0.43
Control Delay	14.2	18.0	7.8	5.8
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	14.2	18.0	7.8	5.8
Queue Length 50th (ft)	43	76	39	19
Queue Length 95th (ft)	87	143	100	65
Internal Link Dist (ft)	730	1353	144	546
Turn Bay Length (ft)				
Base Capacity (vph)	671	767	846	751
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.36	0.53	0.44	0.43

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	38	183	0	0	339	34	91	163	91	149	0	151
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		3.0			3.0			3.0			3.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		1.00			0.99			0.96			0.93	
Flt Protected		0.99			1.00			0.99			0.98	
Satd. Flow (prot)		1847			1840			1773			1694	
Flt Permitted		0.87			1.00			0.85			0.73	
Satd. Flow (perm)		1624			1840			1533			1267	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	41	199	0	0	368	37	99	177	99	162	0	164
RTOR Reduction (vph)	0	0	0	0	9	0	0	26	0	0	73	0
Lane Group Flow (vph)	0	240	0	0	396	0	0	349	0	0	253	0
Turn Type	Perm						Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4						2			6		
Actuated Green, G (s)		13.2			13.2			22.1			22.1	
Effective Green, g (s)		13.2			13.2			22.1			22.1	
Actuated g/C Ratio		0.32			0.32			0.54			0.54	
Clearance Time (s)		3.0			3.0			3.0			3.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		519			588			820			678	
v/s Ratio Prot					c0.22							
v/s Ratio Perm		0.15						c0.23			0.20	
v/c Ratio		0.46			0.67			0.43			0.37	
Uniform Delay, d1		11.2			12.2			5.8			5.6	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.7			3.0			1.6			1.6	
Delay (s)		11.9			15.2			7.4			7.1	
Level of Service		B			B			A			A	
Approach Delay (s)		11.9			15.2			7.4			7.1	
Approach LOS		B			B			A			A	

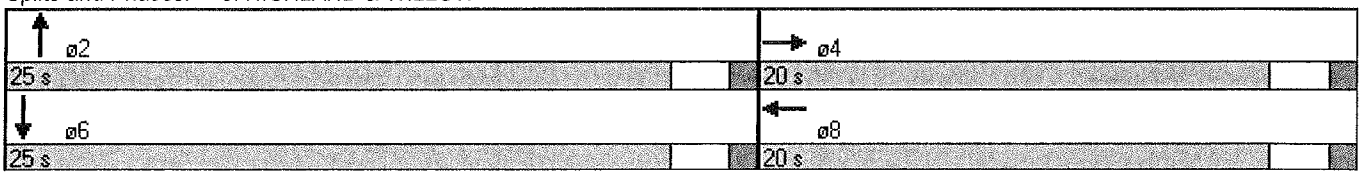
Intersection Summary			
HCM Average Control Delay	10.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.52		
Actuated Cycle Length (s)	41.3	Sum of lost time (s)	6.0
Intersection Capacity Utilization	73.3%	ICU Level of Service	D
Analysis Period (min)	15		

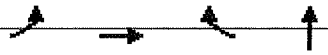
c Critical Lane Group

Phase Number	2	4	6	8
Movement	NBTL	EBTL	SBTL	WBT
Lead/Lag				
Lead-Lag Optimize				
Recall Mode	Max	None	Max	None
Maximum Split (s)	25	20	25	20
Maximum Split (%)	55.6%	44.4%	55.6%	44.4%
Minimum Split (s)	17	9	17	9
Yellow Time (s)	2	2	2	2
All-Red Time (s)	1	1	1	1
Minimum Initial (s)	4	4	4	4
Vehicle Extension (s)	3	3	3	3
Minimum Gap (s)	3	3	3	3
Time Before Reduce (s)	0	0	0	0
Time To Reduce (s)	0	0	0	0
Walk Time (s)				
Flash Dont Walk (s)				
Dual Entry	Yes	Yes	Yes	Yes
Inhibit Max	Yes	Yes	Yes	Yes
Start Time (s)	0	25	0	25
End Time (s)	25	0	25	0
Yield/Force Off (s)	22	42	22	42
Yield/Force Off 170(s)	22	42	22	42
Local Start Time (s)	0	25	0	25
Local Yield (s)	22	42	22	42
Local Yield 170(s)	22	42	22	42

Intersection Summary	
Cycle Length	45
Control Type	Actuated-Uncoordinated
Natural Cycle	40

Splits and Phases: 3: HIGHLAND & WILLOW





Lane Group	EBL	EBT	WBR	NBT
Lane Group Flow (vph)	47	164	124	204
v/c Ratio	0.06	0.21	0.15	0.27
Control Delay	6.9	7.9	0.4	8.4
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	6.9	7.9	0.4	8.4
Queue Length 50th (ft)	5	20	0	26
Queue Length 95th (ft)	17	44	0	54
Internal Link Dist (ft)		537		508
Turn Bay Length (ft)	100			
Base Capacity (vph)	745	784	815	758
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.06	0.21	0.15	0.27

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	43	151	0	0	0	114	0	142	46	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0				4.0		3.0				
Lane Util. Factor	1.00	1.00				1.00		1.00				
Frt	1.00	1.00				0.86		0.97				
Flt Protected	0.95	1.00				1.00		1.00				
Satd. Flow (prot)	1770	1863				1611		1801				
Flt Permitted	0.95	1.00				1.00		1.00				
Satd. Flow (perm)	1770	1863				1611		1801				
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	47	164	0	0	0	124	0	154	50	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	124	0	0	0	0	0	0
Lane Group Flow (vph)	47	164	0	0	0	0	0	204	0	0	0	0
Turn Type	Perm					NA						
Protected Phases		4						2				
Permitted Phases	4											
Actuated Green, G (s)	16.0	16.0				0.0		16.0				
Effective Green, g (s)	16.0	16.0				0.0		16.0				
Actuated g/C Ratio	0.42	0.42				0.00		0.42				
Clearance Time (s)	3.0	3.0						3.0				
Lane Grp Cap (vph)	745	784				0		758				
v/s Ratio Prot		c0.09						c0.11				
v/s Ratio Perm	0.03											
v/c Ratio	0.06	0.21				0.00		0.27				
Uniform Delay, d1	6.5	7.0				19.0		7.2				
Progression Factor	1.00	1.00				1.00		1.00				
Incremental Delay, d2	0.2	0.6				0.0		0.9				
Delay (s)	6.7	7.6				19.0		8.1				
Level of Service	A	A				B		A				
Approach Delay (s)		7.4			19.0			8.1			0.0	
Approach LOS		A			B			A			A	

Intersection Summary			
HCM Average Control Delay	10.3	HCM Level of Service	B
HCM Volume to Capacity ratio	0.24		
Actuated Cycle Length (s)	38.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	30.7%	ICU Level of Service	A
Analysis Period (min)	15		

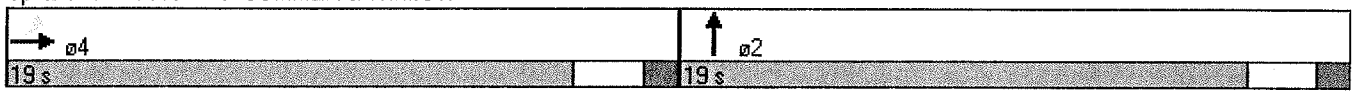
c Critical Lane Group

Phase Number	2	4
Movement	NBT	EBTL
Lead/Lag		
Lead-Lag Optimize		
Recall Mode	Max	Max
Maximum Split (s)	19	19
Maximum Split (%)	50.0%	50.0%
Minimum Split (s)	19	19
Yellow Time (s)	2	2
All-Red Time (s)	1	1
Minimum Initial (s)	1	1
Vehicle Extension (s)	3	3
Minimum Gap (s)	3	3
Time Before Reduce (s)	0	0
Time To Reduce (s)	0	0
Walk Time (s)	5	5
Flash Dont Walk (s)	11	11
Dual Entry	Yes	Yes
Inhibit Max	Yes	Yes
Start Time (s)	0	19
End Time (s)	19	0
Yield/Force Off (s)	16	35
Yield/Force Off 170(s)	5	24
Local Start Time (s)	0	19
Local Yield (s)	16	35
Local Yield 170(s)	5	24

Intersection Summary	
Cycle Length	38
Control Type	Pretimed
Natural Cycle	40

Offset: 0 (0%), Referenced to phase 2:NBT and 6:, Start of Green

Splits and Phases: 6: SUMMER & WILLOW



Lane Group	EBL	EBT	NET	NER
Lane Group Flow (vph)	141	149	340	77
v/c Ratio	0.26	0.33	0.28	0.07
Control Delay	6.7	34.0	8.5	1.7
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	6.7	34.0	8.5	1.7
Queue Length 50th (ft)	0	80	87	0
Queue Length 95th (ft)	47	136	130	15
Internal Link Dist (ft)		92	704	
Turn Bay Length (ft)				
Base Capacity (vph)	540	457	1205	1051
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.26	0.33	0.28	0.07

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	130	137	0	0	0	0	0	313	71	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5						5.5	5.5			
Lane Util. Factor	1.00	1.00						1.00	1.00			
Frt	1.00	1.00						1.00	0.85			
Flt Protected	0.95	1.00						1.00	1.00			
Satd. Flow (prot)	1770	1863						1863	1583			
Flt Permitted	0.95	1.00						1.00	1.00			
Satd. Flow (perm)	1770	1863						1863	1583			
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	141	149	0	0	0	0	0	340	77	0	0	0
RTOR Reduction (vph)	106	0	0	0	0	0	0	0	27	0	0	0
Lane Group Flow (vph)	35	149	0	0	0	0	0	340	50	0	0	0
Turn Type	Perm								Perm			
Protected Phases		4						2				
Permitted Phases	4								2			
Actuated Green, G (s)	25.0	25.0						66.0	66.0			
Effective Green, g (s)	25.0	25.0						66.0	66.0			
Actuated g/C Ratio	0.25	0.25						0.65	0.65			
Clearance Time (s)	5.5	5.5						5.5	5.5			
Lane Grp Cap (vph)	434	457						1205	1024			
v/s Ratio Prot		c0.08						c0.18				
v/s Ratio Perm	0.02								0.03			
v/c Ratio	0.08	0.33						0.28	0.05			
Uniform Delay, d1	29.6	31.6						7.8	6.6			
Progression Factor	1.00	1.00						1.00	1.00			
Incremental Delay, d2	0.4	1.9						0.6	0.1			
Delay (s)	30.0	33.5						8.4	6.6			
Level of Service	C	C						A	A			
Approach Delay (s)		31.8			0.0			8.0			0.0	
Approach LOS		C			A			A			A	

Intersection Summary			
HCM Average Control Delay	17.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.29		
Actuated Cycle Length (s)	102.0	Sum of lost time (s)	11.0
Intersection Capacity Utilization	32.9%	ICU Level of Service	A
Analysis Period (min)	15		

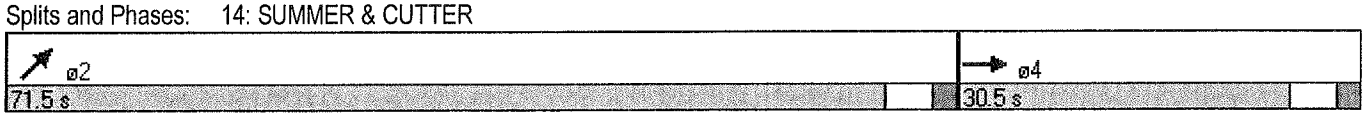
c Critical Lane Group

Phase Number	2	4
Movement	NET	EBTL
Lead/Lag		
Lead-Lag Optimize		
Recall Mode	Max	Max
Maximum Split (s)	71.5	30.5
Maximum Split (%)	70.1%	29.9%
Minimum Split (s)	25	21.5
Yellow Time (s)	3.5	3.5
All-Red Time (s)	2	2
Minimum Initial (s)	4	4
Vehicle Extension (s)	3	3
Minimum Gap (s)	3	3
Time Before Reduce (s)	0	0
Time To Reduce (s)	0	0
Walk Time (s)	5	5
Flash Dont Walk (s)	11	11
Dual Entry	Yes	Yes
Inhibit Max	Yes	Yes
Start Time (s)	0	71.5
End Time (s)	71.5	0
Yield/Force Off (s)	66	96.5
Yield/Force Off 170(s)	55	85.5
Local Start Time (s)	0	71.5
Local Yield (s)	66	96.5
Local Yield 170(s)	55	85.5

Intersection Summary	
Cycle Length	102
Control Type	Pretimed
Natural Cycle	50

Offset: 0 (0%), Referenced to phase 2:NET and 6:, Start of Green

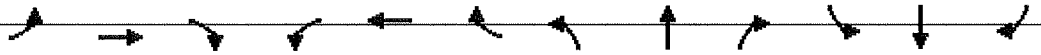
Splits and Phases: 14: SUMMER & CUTTER



Lane Group	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	398	373	613	164
v/c Ratio	0.82	0.58	0.72	0.24
Control Delay	29.9	14.4	15.3	4.6
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	29.9	14.4	15.3	4.6
Queue Length 50th (ft)	85	65	110	10
Queue Length 95th (ft)	#204	125	#267	33
Internal Link Dist (ft)	730	1353	144	546
Turn Bay Length (ft)				
Base Capacity (vph)	557	739	856	692
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.71	0.50	0.72	0.24

Intersection Summary

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



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	89	277	0	0	278	65	126	365	73	71	0	80
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		3.0			3.0			3.0			3.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		1.00			0.97			0.98			0.93	
Flt Protected		0.99			1.00			0.99			0.98	
Satd. Flow (prot)		1840			1815			1810			1690	
Flt Permitted		0.75			1.00			0.90			0.73	
Satd. Flow (perm)		1401			1815			1642			1265	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	97	301	0	0	302	71	137	397	79	77	0	87
RTOR Reduction (vph)	0	0	0	0	20	0	0	11	0	0	42	0
Lane Group Flow (vph)	0	398	0	0	353	0	0	602	0	0	122	0
Turn Type	Perm						Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4						2			6		
Actuated Green, G (s)		14.8			14.8			22.1			22.1	
Effective Green, g (s)		14.8			14.8			22.1			22.1	
Actuated g/C Ratio		0.34			0.34			0.52			0.52	
Clearance Time (s)		3.0			3.0			3.0			3.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		483			626			846			652	
v/s Ratio Prot					0.19							
v/s Ratio Perm		c0.28						c0.37			0.10	
v/c Ratio		0.82			0.56			0.71			0.19	
Uniform Delay, d1		12.9			11.4			8.0			5.6	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		10.9			1.2			5.0			0.6	
Delay (s)		23.8			12.6			13.0			6.2	
Level of Service		C			B			B			A	
Approach Delay (s)		23.8			12.6			13.0			6.2	
Approach LOS		C			B			B			A	

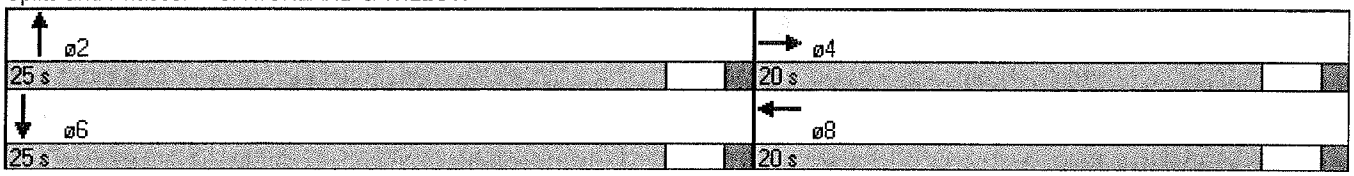
Intersection Summary			
HCM Average Control Delay	15.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.76		
Actuated Cycle Length (s)	42.9	Sum of lost time (s)	6.0
Intersection Capacity Utilization	80.7%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Phase Number	2	4	6	8
Movement	NBTL	EBTL	SBTL	WBT
Lead/Lag				
Lead-Lag Optimize				
Recall Mode	Max	None	Max	None
Maximum Split (s)	25	20	25	20
Maximum Split (%)	55.6%	44.4%	55.6%	44.4%
Minimum Split (s)	17	9	17	9
Yellow Time (s)	2	2	2	2
All-Red Time (s)	1	1	1	1
Minimum Initial (s)	4	4	4	4
Vehicle Extension (s)	3	3	3	3
Minimum Gap (s)	3	3	3	3
Time Before Reduce (s)	0	0	0	0
Time To Reduce (s)	0	0	0	0
Walk Time (s)				
Flash Dont Walk (s)				
Dual Entry	Yes	Yes	Yes	Yes
Inhibit Max	Yes	Yes	Yes	Yes
Start Time (s)	0	25	0	25
End Time (s)	25	0	25	0
Yield/Force Off (s)	22	42	22	42
Yield/Force Off 170(s)	22	42	22	42
Local Start Time (s)	0	25	0	25
Local Yield (s)	22	42	22	42
Local Yield 170(s)	22	42	22	42

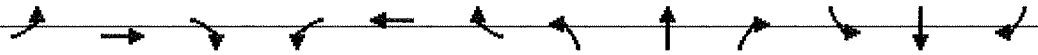
Intersection Summary	
Cycle Length	45
Control Type	Actuated-Uncoordinated
Natural Cycle	45

Splits and Phases: 3: HIGHLAND & WILLOW



Lane Group	EBL	EBT	WBR	NBT
Lane Group Flow (vph)	60	145	167	341
v/c Ratio	0.08	0.18	0.24	0.45
Control Delay	7.0	7.7	0.8	10.2
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	7.0	7.7	0.8	10.2
Queue Length 50th (ft)	7	18	0	47
Queue Length 95th (ft)	20	40	0	91
Internal Link Dist (ft)		537		508
Turn Bay Length (ft)	100			
Base Capacity (vph)	745	784	688	765
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.08	0.18	0.24	0.45

Intersection Summary



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	55	133	0	0	0	154	0	256	58	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0				4.0		3.0				
Lane Util. Factor	1.00	1.00				1.00		1.00				
Frt	1.00	1.00				0.86		0.98				
Flt Protected	0.95	1.00				1.00		1.00				
Satd. Flow (prot)	1770	1863				1611		1816				
Flt Permitted	0.95	1.00				1.00		1.00				
Satd. Flow (perm)	1770	1863				1611		1816				
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	60	145	0	0	0	167	0	278	63	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	167	0	0	0	0	0	0
Lane Group Flow (vph)	60	145	0	0	0	0	0	341	0	0	0	0
Turn Type	Perm					NA						
Protected Phases		4						2				
Permitted Phases	4											
Actuated Green, G (s)	16.0	16.0				0.0		16.0				
Effective Green, g (s)	16.0	16.0				0.0		16.0				
Actuated g/C Ratio	0.42	0.42				0.00		0.42				
Clearance Time (s)	3.0	3.0						3.0				
Lane Grp Cap (vph)	745	784				0		765				
v/s Ratio Prot		c0.08						c0.19				
v/s Ratio Perm	0.03											
v/c Ratio	0.08	0.18				0.00		0.45				
Uniform Delay, d1	6.6	6.9				19.0		7.8				
Progression Factor	1.00	1.00				1.00		1.00				
Incremental Delay, d2	0.2	0.5				0.0		1.9				
Delay (s)	6.8	7.4				19.0		9.7				
Level of Service	A	A				B		A				
Approach Delay (s)		7.2			19.0			9.7			0.0	
Approach LOS		A			B			A			A	

Intersection Summary			
HCM Average Control Delay	11.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.32		
Actuated Cycle Length (s)	38.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	39.9%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*DI*
Agency/Co.	*DCI*
Date Performed	*6/7/2010*
Analysis Time Period	*PM Peak*

Site Information

Intersection	*West Site Drive/Summer St*
Jurisdiction	*Somerville*
Analysis Year	*2014*
Project ID	*351 Summer Street - Projected 2014 Build Conditions*

East/West Street: *Summer Street*

North/South Street: *West Site Drive*

Intersection Orientation: *East-West*

Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	*11*	*213*	*0*	*0*	*0*	*0*
Peak-Hour Factor, PHF	*0.90*	*0.90*	*1.00*	*1.00*	*1.00*	*1.00*
Hourly Flow Rate, HFR	*12*	*236*	*0*	*0*	*0*	*0*
Percent Heavy Vehicles	*1*	--	--	*0*	--	--
Median Type	*Undivided*					
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*0*	*0*	*0*
Configuration	*LT*					
Upstream Signal		*1*			*0*	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	*0*	*0*	*0*	*5*	*0*	*0*
Peak-Hour Factor, PHF	*1.00*	*1.00*	*1.00*	*0.90*	*0.90*	*1.00*
Hourly Flow Rate, HFR	*0*	*0*	*0*	*5*	*0*	*0*
Percent Heavy Vehicles	*0*	*0*	*0*	*0*	*0*	*0*
Percent Grade (%)		*0*			*0*	
Flared Approach		*N*			*N*	
Storage		*0*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*0*	*0*	*0*	*1*	*0*
Configuration				*LT*		

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	*LT*					*LT*		
v (vph)	*12*					*5*		
C (m) (vph)	*1630*					*728*		
v/c	*0.01*					*0.01*		
95% queue length	*0.02*					*0.02*		
Control Delay	*7.2*					*10.0-*		
LOS	*A*					*A*		
Approach Delay	--	--				*10.0-*		
Approach LOS	--	--				*A*		

TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*DI*
Agency/Co.	*DCI*
Date Performed	*6/7/2010*
Analysis Time Period	*AM Peak*

Site Information

Intersection	*West Site Drive/Summer St*
Jurisdiction	*Somerville*
Analysis Year	*2014*
Project ID	*351 Summer Street - Projected 2014 Build Conditions*

East/West Street: *Summer Street* | North/South Street: *West Site Drive*

Intersection Orientation: *East-West* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	*2*	*221*	*0*	*0*	*0*	*0*
Peak-Hour Factor, PHF	*0.90*	*0.90*	*1.00*	*1.00*	*1.00*	*1.00*
Hourly Flow Rate, HFR	*2*	*245*	*0*	*0*	*0*	*0*
Percent Heavy Vehicles	*1*	--	--	*0*	--	--
Median Type	*Undivided*					
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*0*	*0*	*0*
Configuration	*LT*					
Upstream Signal		*1*			*0*	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	*0*	*0*	*0*	*12*	*0*	*0*
Peak-Hour Factor, PHF	*1.00*	*1.00*	*1.00*	*0.90*	*0.90*	*1.00*
Hourly Flow Rate, HFR	*0*	*0*	*0*	*13*	*0*	*0*
Percent Heavy Vehicles	*0*	*0*	*0*	*0*	*0*	*0*
Percent Grade (%)		*0*			*0*	
Flared Approach		*N*			*N*	
Storage		*0*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*0*	*0*	*0*	*1*	*0*
Configuration				*LT*		

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	*LT*					*LT*		
v (vph)	*2*					*13*		
C (m) (vph)	*1630*					*743*		
v/c	*0.00*					*0.02*		
95% queue length	*0.00*					*0.05*		
Control Delay	*7.2*					*9.9*		
LOS	*A*					*A*		
Approach Delay	--	--				*9.9*		
Approach LOS	--	--				*A*		

TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*DI*
Agency/Co.	*DCI*
Date Performed	*6/7/2010*
Analysis Time Period	*PM Peak*

Site Information

Intersection	*East Site Drive/Summer St*
Jurisdiction	*Somerville*
Analysis Year	*2014*
Project ID	*351 Summer Street - Project 2014 No-Build Conditions*

East/West Street: *Summer Street*
North/South Street: *East Site Drive*
Intersection Orientation: *East-West*
Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	*0*	*181*	*20*	*0*	*0*	*0*
Peak-Hour Factor, PHF	*0.90*	*0.90*	*1.00*	*1.00*	*1.00*	*1.00*
Hourly Flow Rate, HFR	*0*	*201*	*20*	*0*	*0*	*0*
Percent Heavy Vehicles	*1*	--	--	*0*	--	--
Median Type	*Undivided*					
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*0*	*0*	*0*
Configuration	*LTR*					
Upstream Signal		*1*			*0*	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	*0*	*0*	*0*	*7*	*6*	*0*
Peak-Hour Factor, PHF	*1.00*	*1.00*	*1.00*	*0.90*	*0.90*	*1.00*
Hourly Flow Rate, HFR	*0*	*0*	*0*	*7*	*6*	*0*
Percent Heavy Vehicles	*0*	*0*	*0*	*0*	*0*	*0*
Percent Grade (%)	*0*			*0*		
Flared Approach		*N*			*N*	
Storage		*0*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*0*	*0*	*0*	*1*	*0*
Configuration				*LT*		

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	*LTR*					*LT*		
v (vph)	*0*					*13*		
C (m) (vph)	*1630*					*732*		
v/c	*0.00*					*0.02*		
95% queue length	*0.00*					*0.05*		
Control Delay	*7.2*					*10.0+*		
LOS	*A*					*B*		
Approach Delay	--	--				*10.0+*		
Approach LOS	--	--				*B*		

TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	DI
Agency/Co.	DCI
Date Performed	6/7/2010
Analysis Time Period	AM Peak

Site Information

Intersection	East Site Drive/Summer St
Jurisdiction	Somerville
Analysis Year	2014
Project ID	351 Summer Street - Project 2014 No-Build Conditions

East/West Street: *Summer Street* | North/South Street: *East Site Drive*

Intersection Orientation: *East-West* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	1	200	4	0	0	0
Peak-Hour Factor, PHF	0.90	0.90	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	1	222	4	0	0	0
Percent Heavy Vehicles	1	--	--	0	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	0	0	0
Configuration	LTR					
Upstream Signal		1			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	0	0	0	2	2	0
Peak-Hour Factor, PHF	1.00	1.00	1.00	0.90	0.90	1.00
Hourly Flow Rate, HFR	0	0	0	2	2	0
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)	0			0		
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	0	1	0
Configuration				LT		

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LTR					LT		
v (vph)	1					4		
C (m) (vph)	1630					718		
v/c	0.00					0.01		
95% queue length	0.00					0.02		
Control Delay	7.2					10.0+		
LOS	A					B		
Approach Delay	--	--				10.0+		
Approach LOS	--	--				B		

TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	DI
Agency/Co.	DCI
Date Performed	6/7/2010
Analysis Time Period	PM Peak

Site Information

Intersection	East Site Drive/Summer St
Jurisdiction	Somerville
Analysis Year	2014
Project ID	351 Summer Street - Project 2014 Build Conditions

East/West Street: *Summer Street* | North/South Street: *East Site Drive*

Intersection Orientation: *East-West* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	5	192	0	0	0	0
Peak-Hour Factor, PHF	0.90	0.90	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	5	213	0	0	0	0
Percent Heavy Vehicles	1	--	--	0	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	0	0	0
Configuration	LT					
Upstream Signal		1			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	0	0	0	18	0	0
Peak-Hour Factor, PHF	1.00	1.00	1.00	0.90	0.90	1.00
Hourly Flow Rate, HFR	0	0	0	20	0	0
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	0	1	0
Configuration				LT		

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LT					LT		
v (vph)	5					20		
C (m) (vph)	1630					768		
v/c	0.00					0.03		
95% queue length	0.01					0.08		
Control Delay	7.2					9.8		
LOS	A					A		
Approach Delay	--	--				9.8		
Approach LOS	--	--				A		

TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*DI*
Agency/Co.	*DCI*
Date Performed	*6/7/2010*
Analysis Time Period	*AM Peak*

Site Information

Intersection	*East Site Drive/Summer St*
Jurisdiction	*Somerville*
Analysis Year	*2014*
Project ID	*351 Summer Street - Project 2014 Build Conditions*

East/West Street: *Summer Street* | North/South Street: *East Site Drive*

Intersection Orientation: *East-West* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	*17*	*210*	*0*	*0*	*0*	*0*
Peak-Hour Factor, PHF	*0.90*	*0.90*	*1.00*	*1.00*	*1.00*	*1.00*
Hourly Flow Rate, HFR	*18*	*233*	*0*	*0*	*0*	*0*
Percent Heavy Vehicles	*1*	--	--	*0*	--	--
Median Type	*Undivided*					
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*0*	*0*	*0*
Configuration	*LT*					
Upstream Signal		*1*			*0*	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	*0*	*0*	*0*	*5*	*0*	*0*
Peak-Hour Factor, PHF	*1.00*	*1.00*	*1.00*	*0.90*	*0.90*	*1.00*
Hourly Flow Rate, HFR	*0*	*0*	*0*	*5*	*0*	*0*
Percent Heavy Vehicles	*0*	*0*	*0*	*0*	*0*	*0*
Percent Grade (%)		*0*			*0*	
Flared Approach		*N*			*N*	
Storage		*0*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*0*	*0*	*0*	*1*	*0*
Configuration				*LT*		

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	*LT*					*LT*		
v (vph)	*18*					*5*		
C (m) (vph)	*1630*					*717*		
v/c	*0.01*					*0.01*		
95% queue length	*0.03*					*0.02*		
Control Delay	*7.2*					*10.1*		
LOS	*A*					*B*		
Approach Delay	--	--				*10.1*		
Approach LOS	--	--				*B*		