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Mr. Jeffrey Wheeler, AICP
Planning Coordinator
Office of Community Development
Town of Belmont
19 Moore Street
Belmont, MA 02478

December 7, 2012

TEC Ref. T0376.01

RE: Cushing Village Redevelopment Project - Trapelo Road and Common Street, Belmont, MA
Response to Comments from Howard/Stein-Hudson Associates, Inc.

Dear Mr. Wheeler,

On behalf of Smith Legacy Partners, LLC, TEC, Inc. has prepared the following response to comments received from the Town of Belmont's peer review consultant, Howard/Stein-Hudson Associates, Inc. (HSH), on the proposed Cushing Village Redevelopment Project at the corner of Trapelo Road and Common Street in Belmont, MA. The bold text is from HSH's memorandum, and the italicized text is TEC's response.

HSH requests that the Applicant do the following:

- 1. Provide the data for MassDOT count station #4049 so that HSH can verify the seasonal factor to determine whether seasonal adjustment should be applied.**

The traffic volume and seasonal adjustment data for MassDOT count station #4049 was inadvertently cropped from the season adjustment data provided in the Appendix of the Traffic Impact, Access, and Parking Study (TIAPS) for Cushing Village. This data has been provided as Attachment A. Consistent with the remaining count station locations included in the TIAPS, station #4049 indicates that traffic volumes in June are approximately 6.8 percent above average conditions. Therefore, the traffic volumes contained within the TIAPS represent a conservative (worse case) analysis condition.

- 2. Clarify whether a system peak hour or individual intersection peak hours were used in the analysis.**

A system peak hour is often used for traffic networks where intersections are closely spaced so that traffic volumes are anticipated to balance between intersections, or for coordinated traffic signal systems. The study area intersections are not contained within coordinated traffic signal systems. In addition, numerous curb cuts and on-street parking between intersections result in imbalances of traffic volumes between intersections. Therefore, in order to provide a worse case analysis of each individual intersection, the individual peak hours of each intersection were evaluated in the capacity and queue analysis.

- 3. Provide sight distance calculations for the proposed driveway locations**

TEC performed sight distance calculations based on the site plans prepared by Allen & Major Associates, Inc. dated September 2012. The available sight distances were compared to minimum

requirements established by the American Association of State Highway and Transportation Officials (AASHTO).

Sight distance represents the length of roadway that is visible to a driver traveling within the roadway. Two types of sight distance are typically evaluated for driveways and intersections: stopping sight distance (SSD) and intersection sight distance (ISD). SSD is the minimum distance required for a driver traveling along a roadway to perceive an object in the roadway and stop safely in advance of the object when traveling on a wet pavement surface. SSD is measured from an eye height of 3.5 feet to an object height of 2 feet above the ground, which is equivalent to a driver viewing the taillight of a vehicle ahead. SSD is measured along the centerline of the travel lane approaching the driveway or intersection.

ISD represents the length of the roadway visible to a driver waiting to exit a driveway or minor street. Minimum ISD requirements are based on the distance required for a driver to exit a minor street onto a major street without requiring an approaching vehicle to reduce its speed from the design speed to less than 70 percent of the design speed. ISD is measured from an eye height of 3.5 feet to an object height of 3.5 feet, and is measured from a distance 15 feet off the edge of the travel-way of the major roadway to represent a driver waiting to exit a driveway or minor roadway.

SSD is typically considered the critical sight distance, as it represents the minimum distance required for safe stopping, while ISD represents an acceptable speed reduction for approaching vehicles. The ISD, however, must be at least equal to the minimum required SSD in order to prevent a driver from entering the roadway when an approaching vehicle is too close to safely stop. The guidance provided by AASHTO states:

“If the available sight distance for an entering or crossing vehicle is at least equal to the appropriate stopping sight distance for the major road, then drivers have sufficient sight distance to anticipate and avoid collisions. However, in some cases, this may require a major-road vehicle to stop or slow to accommodate the maneuver by a minor-road vehicle. To enhance traffic operations, intersection sight distances that exceed stopping sight distances are desirable along the major road.”

The available SSD and ISD at the proposed site driveway intersections along Trapelo Road and Common Street were measured and compared to AASHTO’s minimum requirements based on an 85th percentile speed of approximately 30 miles per hour (mph). Table 1 provides a summary of the available sight distances at the study intersections.

Table 1 - Sight Distance Measurements

Approach/Direction	Minimum Required	Measured	
		Stopping Sight Distance	Intersection Sight Distance
Common Street at Site Driveway:			
North of Site Driveway	200 ft	+400 feet	62 feet
South of Site Driveway	200 ft	+400 feet	145 feet
Trapelo Road at Site Driveway:			
East of Site Driveway	200 ft	+400 feet	+400 feet
West of Site Driveway	200 ft	+400 feet	73 feet

As shown in Table 1, the SSD at the proposed site driveways along Common Street and Trapelo Road will exceed AASHTO’s minimum recommendations for safe operations. In addition, the ISD to the

east of the Trapelo Road driveway will exceed AASHTO's recommendations for safe operations. Although the ISD to the north of the Common Street driveway and to the east and west of the Trapelo Road driveway will not meet AASHTO recommendations due to on-street parking along these roadways, the proposed sight distances will be similar or longer than existing sight distances exiting Horne Road onto Common Street and exiting the existing Starbucks driveway onto Trapelo Road. The Crash History Analysis contained in the TIAPS indicates that no noticeable collision trend exists at either of these existing intersections. All signage and vegetation near the site driveways should be kept low to the ground or sufficiently set back so as not to impede sight distances.

4. Update the No Build traffic volumes using a 0.5% per year growth rate.

TEC has updated the No Build traffic volumes to reflect an annual growth rate of 0.5% per year. The updated traffic volumes are provided in Figure A-2.

5. Apply the multi-use trip generation principle to the re-use trip generation calculation for consistency of methodology.

The mix of proposed uses within the Cushing Village Development, as well as the layout and connectivity of the site, encourages sharing of trips between multiple uses on the site. For example, residents living within the development may also choose to shop or dine on-site. Therefore, a multi-use credit was applied to the site-generated traffic volumes for the proposed Cushing Village Development.

The existing land uses contain mainly retail uses, which provide fewer opportunities for sharing of trips between multiple uses on the site. In addition, the parking lots of the existing land uses are not connected and pedestrian connections are not provided without walking along Trapelo Road or Common Street. As such, sharing of trips between existing land uses may be low and no multi-use trip credit was applied for the existing or reoccupied land uses on the site. As some sharing of trips may occur between some existing or reoccupied retail tenants, TEC has provided an updated analysis which applies a multi-use credit to the existing and reoccupancy trip generation calculations. The updated trip generation calculations are included in Attachment B and the updated No Build traffic volumes are shown in Figure A-2.

6. Reanalyze No Build Conditions using the revised No Build volumes.

TEC has prepared an updated analysis of the No Build conditions using a 0.5% annual growth rate and applying a multi-use trip credit to the reoccupancy trip generation calculations. The updated analysis worksheets are included in Attachment C and the results are summarized in Tables 3 and 4.

7. Review and confirm the land uses, square footages, passby trip rates and calculations, multi-use trip calculations, etc. in the trip generation calculations for consistency;

The proposed Cushing Village Development project has undergone multiple iterations of development programs since first proposed to the Town of Belmont. Some of the square footages listed for the development program contained within the Updated Trip Generation Assessment memorandum dated October 24, 2012 contained values from previous iterations of this project. However, the calculations of site-generated trips and all analysis were based on the correct floor areas as described in the TIAPS for this project. The proposed land uses and floor areas are described in Table 2.

Table 2. Land Use Summary

Land Use	Development Size	ITE Land Use for Analysis
<i>Existing / Reoccupancy Conditions</i>		
CVS Pharmacy	6,200 SF	LUC 881 – Pharmacy with Drive-Thru
Starbucks	2,430 SF	LUC 936– Coffee/Donut Shop without Drive-Thru
Specialty Retail / Restaurant	15,655 SF	LUC 814
<i>Proposed Conditions</i>		
Starbucks	2,000 SF	LUC 936– Coffee/Donut Shop without Drive-Thru
Quality Restaurant	5,000 SF	LUC 931 – Quality Restaurant
Fitness Club	3,300 SF	LUC 492 – Health and Fitness Club
Retail	27,200 SF	LUC 820 – Shopping Center
Apartments	118 units	LUC 220 - Apartments

8. Revise the Build traffic analysis as necessary as a result of changes to the No Build and Build volumes;

The Build traffic volume networks have been updated based on the revisions discussed above and are shown graphically in Figure A-11. An updated capacity and queuing analysis has been prepared based on the revised Build traffic volumes. The detailed analysis worksheets are provided as Attachment C and the results are summarized in Tables 3 and 4.

9. Provide traffic analysis of the potential full build out of Cushing Square, including trip generation for weekday daily, weekday PM peak hour, and Saturday daily conditions. The Applicant should also detail what percentage of the potential full build out traffic the Applicant is contributing in each time period.

This level of traffic analysis is typically included as part of a large-scale planning effort by municipalities when developing an overlay district and appropriate zoning regulations for the overlay district. This type of planning analysis is not typically required of developers to evaluate the impacts of an individual project as it requires highly subjective assumptions regarding potential future development. Currently, there are no other approved or proposed development projects within Cushing Square. Therefore, the Applicant has not provided an analysis of the full build out of Cushing Village. As future projects are developed within Cushing Village, these projects will be required to prepared traffic impact studies to assess their project-related impacts and identify appropriate mitigation.

10. Perform an inventory of existing curbside regulations, including the municipal parking lot; and

BSC Group prepared a Municipal Parking Study for the Town of Belmont, which is available of the Town's website, and included an inventory of existing parking spaces and regulations for on- and off-street parking spaces in multiple commercial districts in the Town, including Cushing Square. To avoid duplicating efforts, an additional parking inventory was not collected with the exception of survey of existing parking spaces along Trapelo Road, Belmont Street, and Common Street fronting the project to assess the impact of the project to on-street parking supply.

11. Perform parking turnover of the same study area as the occupancy study;

As noted above, BSC Group prepared a Municipal Parking Study for the Town of Belmont, which evaluated turnover of parking spaces within Cushing Village. This parking study is available for review on the Town's website.

12. Assess the proposed parking supply if the utilization of the municipal parking spaces were significantly lower because more than half of the spaces would be located in the underground parking structure.

The BSC Group's Municipal Parking Study mentioned above documents that drivers are parking an average of 4 hours in the existing municipal parking lot on Williston Road, and approximately 36 percent of vehicles are parked longer than four hours within this lot. This type of long-term parking is consistent with typical parking duration and turnover of structured parking facilities. Drivers are generally more receptive to parking below ground or in structured parking facilities and walking further to their destination when making longer trips. Therefore, TEC does not anticipate that the location of the municipal parking spaces within an underground parking facility will have a noticeable impact on the utilization of these parking spaces provided adequate wayfinding signs direct drivers to these parking spaces.

The proposed surface parking spaces on the site are intended to be for shorter-term parking where patrons may be making short trips and will want to park close to the entrances of their destination. For example, patrons of the Starbucks or proposed market will desire parking spaces located close to the entrance to make short trips. As such, surface parking spaces typically experience shorter durations and higher turnovers than structured parking facilities. To manage these parking spaces, it is recommended that parking restrictions be implemented during regular business hours to limit surface parking spaces off Trapelo Road to 30 minute to 1 hour parking time limits. Two- to four-hour parking time limits may be appropriate for commercial parking spaces off Common Street that are further from the entrances of high-turnover retail uses.

TEC recommends the following management of parking spaces on the site:

- **Residential Parking** – As residential parking will be long-term in nature, these parking spaces will be located within the underground structured parking lot and will be designated for residential parking only. A transponder or key card-activated gate system may be installed to segregate this parking from the remaining parking spaces on the site. A monthly fee may be assessed for use of these parking spaces to promote alternative transportation modes.

Residents with more than one vehicle or who do not wish to pay the monthly parking fee for reserved parking spaces, may be allowed to park within the public and commercial parking spaces during the evening. Overnight parking in these spaces could be managed by requiring residents to have a resident permit to park overnight on the site or by limiting parking restrictions to only during hours of operation of the commercial and retail uses on the site.

- **Retail Patron Parking** – Retail patrons will consist of a mix of short-term trips to the Starbucks and proposed market, and longer-term trips to the restaurant or other retail uses in the Cushing Square neighborhood. As such, varying parking restrictions should be implemented to manage retail parking. Surface parking spaces located near entrances, particularly the entrances to Starbucks and the proposed market should contain parking time limits of 30 minutes to 1 hour during regular business hours. Parking spaces located further from the entrances and within the structured parking should have time limits of 2- to 4-hours during regular business hours to

avoid residents and employees parking in these spaces long-term. Outside of regular business hours, parking restrictions may be waived to allow overnight parking by residents in these spaces.

Retail parking spaces on the site will not be designated for use strictly by patrons of Cushing Village. These spaces will be open to patrons of all retail tenants in the Cushing Square neighborhood to encourage sharing of trips between multiple retailers in the neighborhood.

- **Retail Employee Parking** – *As employee parking will be more long-term than retail patron parking, employee parking should be located within the underground parking structure. These spaces could be designated as employee parking or could be left without parking restrictions implemented as the location of these spaces may reduce their use by retail patrons.*

13. Consider again the mitigation upon completion of the updated Build analysis.

The updated capacity and queue analysis summarized in Tables 3 and 4 provides similar results to those included in the original TIAPS, and indicates that the proposed redevelopment project is not anticipated to increase overall intersection delay by more than three seconds per vehicle or increase queues by more than three vehicles at any of the signalized intersections within the study area. In addition, all movements at all of the unsignalized intersections within the study area are anticipated to operate at acceptable levels of service (LOS C or better) during all time periods under 2017 Build conditions with queues not exceeding three vehicles and volume-to-capacity (v/c) ratios well below 1.00, indicating there will be adequate capacity to accommodate the anticipated traffic volumes.

Table 3 – Unsignalized Intersection Capacity and Queue Analysis Summary

Intersection / Lane Group	2010 Existing				2017 No-Build				2017 Build			
	V/C ^a	Delay ^b	LOS ^c	Queue ^d	V/C	Delay	LOS	Queue	V/C	Delay	LOS	Queue
Trapelo Road / Williston Road												
<i>Weekday Morning</i>												
Trapelo Road WB approach	0.04	1.8	A	<25	0.04	1.1	A	<25	0.01	0.3	A	<25
Williston Road NB approach	0.12	17.8	C	<25	0.24	33.9	D	<25	0.03	19.6	C	<25
<i>Weekday Evening</i>												
Trapelo Road WB approach	0.02	0.7	A	<25	0.02	0.5	A	<25	0.02	0.6	A	<25
Williston Road NB approach	0.07	12.4	B	<25	0.21	30.7	D	25	0.06	24.7	C	<25
<i>Saturday Midday</i>												
Trapelo Road WB approach	0.04	1.9	A	<25	0.04	1.1	A	<25	0.02	0.6	A	<25
Williston Road NB approach	0.11	13.5	B	<25	0.20	21.5	C	<25	0.06	16.0	C	<25
Common Street / Horne Road / Site Driveway												
<i>Weekday Morning</i>												
Horne Road EB approach	0.05	10.1	B	<25	0.06	10.4	B	<25	0.23	12.8	B	<25
Common Street NB approach	0.01	0.5	A	<25	0.01	0.4	A	<25	0.01	0.4	A	<25
<i>Weekday Evening</i>												
Horne Road EB approach	0.04	10.0	A	<25	0.06	10.6	B	<25	0.31	14.9	B	32
Common Street NB approach	0.01	0.3	A	<25	0.01	0.3	A	<25	0.06	1.7	A	<25
<i>Saturday Midday</i>												
Horne Road EB approach	0.07	10.9	B	<25	0.08	10.7	B	<25	0.51	20.1	C	71
Common Street NB approach	0.02	0.6	A	<25	0.02	0.7	A	<25	0.06	1.9	A	<25
Horne Road / Williston Road												
<i>Weekday Morning</i>												
Horne Road EB approach	0.01	3.7	A	<25	0.01	3.5	A	<25	0.01	4.9	A	<25
Williston Road SB approach	0.05	8.9	A	<25	0.05	8.9	A	<25	0.03	8.5	A	<25
<i>Weekday Evening</i>												
Horne Road EB approach	0.01	5.1	A	<25	0.01	4.7	A	<25	0.01	6.3	A	<25
Williston Road SB approach	0.04	8.8	A	<25	0.04	8.8	A	<25	0.03	8.5	A	<25
<i>Saturday Midday</i>												
Horne Road EB approach	0.01	5.6	A	<25	0.01	5.2	A	<25	0.01	7.2	A	<25
Williston Road SB approach	0.08	8.9	A	<25	0.08	9.0	A	<25	0.04	8.5	A	<25

Table 3 Continued – Unsignalized Intersection Capacity and Queue Analysis Summary

Intersection / Lane Group	2010 Existing				2017 No-Build				2017 Build			
	V/C ^a	Delay ^b	LOS ^c	Queue ^d	V/C	Delay	LOS	Queue	V/C	Delay	LOS	Queue
Poplar Street / Horne Road												
<i>Weekday Morning</i>												
Horne Road WB approach	0.03	9.3	A	<25	0.03	9.3	A	<25	0.03	9.3	A	<25
Poplar Street SB approach	0.00	1.6	A	<25	0.00	1.5	A	<25	0.00	0.8	A	<25
<i>Weekday Evening</i>												
Horne Road WB approach	0.04	8.9	A	<25	0.04	8.9	A	<25	0.05	8.9	A	<25
Poplar Street SB approach	0.00	0.9	A	<25	0.00	0.9	A	<25	0.00	0.6	A	<25
<i>Saturday Midday</i>												
Horne Road WB approach	0.06	9.0	A	<25	0.06	9.0	A	<25	0.06	9.0	A	<25
Poplar Street SB approach	0.00	0.0	A	<25	0.00	0.0	A	<25	0.00	0.0	A	<25
Trapelo Road / Site Driveway												
<i>Weekday Morning</i>												
Trapelo Road WB approach	-	-	-	-	-	-	-	-	0.07	1.8	A	<25
Site Driveway NB approach	-	-	-	-	-	-	-	-	0.13	12.6	B	<25
<i>Weekday Evening</i>												
Trapelo Road WB approach	-	-	-	-	-	-	-	-	0.05	1.3	A	<25
Site Driveway NB approach	-	-	-	-	-	-	-	-	0.04	10.9	B	<25
<i>Saturday Midday</i>												
Trapelo Road WB approach	-	-	-	-	-	-	-	-	0.06	1.6	A	<25
Site Driveway NB approach	-	-	-	-	-	-	-	-	0.07	10.8	B	<25

^a Volume-to-capacity ratio

^b Delay expressed in seconds per vehicle (average)

^c Level of service

^d 95th Percentile Queue (in feet)

Table 4 – Signalized Intersection Capacity and Queue Analysis Summary

Intersection / Lane Group	2010 Existing				2017 No-Build				2017 Build			
	V/C ^a	Delay ^b	LOS ^c	Queue ^d	V/C	Delay	LOS	Queue	V/C	Delay	LOS	Queue
Trapelo Road / Common Street / Cushing Avenue												
<i>Weekday Morning</i>												
Trapelo Road EB approach	0.77	25.3	C	228/344	-	-	-	-	-	-	-	-
Trapelo Road EB LT	-	-	-	-	0.50	21.4	C	32/67	0.42	20.3	C	34/70
Trapelo Road EB TH / RT	-	-	-	-	1.07	81.3	F	479/935	1.06	94.4	F	640/959
Trapelo Road WB approach	0.46	18.3	B	127/172	-	-	-	-	-	-	-	-
Trapelo Road WB LT	-	-	-	-	0.30	26.9	C	<25/<25	0.42	27.1	C	<25/33
Trapelo Road WB TH / RT	-	-	-	-	0.85	37.4	D	336/471	0.78	32.5	C	328/454
Common Street NB LT / TH	0.56	37.8	D	108/151	-	-	-	-	-	-	-	-
Common Street NB RT	0.03	32.4	C	<25/<25	-	-	-	-	-	-	-	-
Common Street NB LT	-	-	-	-	0.26	51.8	D	<25/37	0.52	48.3	D	72/114
Common Street NB TH / RT	-	-	-	-	0.51	39.5	D	122/166	0.65	45.9	D	147/189
Common Street SB LT	0.54	32.8	C	134/234	0.86	68.3	E	162/331	0.87	69.0	E	175/345
Common Street SB TH / RT	0.81	46.3	D	195/388	-	-	-	-	-	-	-	-
Common Street SB TH	-	-	-	-	0.48	30.7	C	123/245	0.67	42.8	D	170/265
Common Street SB RT	-	-	-	-	0.11	26.8	C	<25/59	0.15	34.5	C	24/65
Overall Intersection	0.74	28.5	C	-	0.86	54.1	D	-	0.87	53.3	D	-
<i>Weekday Evening</i>												
Trapelo Road EB approach	-	-	-	-	-	-	-	-	-	-	-	-
Trapelo Road EB LT	0.44	22.6	C	42/77	0.71	37.8	D	41/121	0.72	38.6	D	42/123
Trapelo Road EB TH / RT	0.80	32.3	C	321/473	0.76	28.8	C	379/597	0.80	32.4	C	393/626
Trapelo Road WB approach	0.94	52.4	D	290/434	-	-	-	-	-	-	-	-
Trapelo Road WB LT	-	-	-	-	0.12	21.0	C	<25/25	0.23	21.0	C	<25/41
Trapelo Road WB TH / RT	-	-	-	-	1.20	135.9	F	814/1061	1.19	133.0	F	803/1051
Common Street NB LT / TH	0.85	55.8	E	216/363	-	-	-	-	-	-	-	-
Common Street NB RT	0.07	32.8	C	<25/39	-	-	-	-	-	-	-	-
Common Street NB LT	-	-	-	-	0.50	51.5	D	60/105	0.69	57.4	E	106/178
Common Street NB TH / RT	-	-	-	-	0.80	52.7	D	236/348	0.85	57.1	E	257/378
Common Street SB LT	0.34	34.7	C	80/140	0.64	53.7	D	106/171	0.68	56.5	E	108/178
Common Street SB TH / RT	0.99	86.0	F	244/447	-	-	-	-	-	-	-	-
Common Street SB TH	-	-	-	-	0.67	42.4	D	194/299	0.75	48.4	D	201/294
Common Street SB RT	-	-	-	-	0.16	32.0	C	29/72	0.18	34.0	C	33/75
Overall Intersection	0.93	50.7	D	-	1.01	72.0	E	-	1.04	72.0	E	-

Table 4 Continued – Signalized Intersection Capacity and Queue Analysis Summary

Intersection / Lane Group	2010 Existing				2017 No-Build				2017 Build			
	V/C ^a	Delay ^b	LOS ^c	Queue ^d	V/C	Delay	LOS	Queue	V/C	Delay	LOS	Queue
Trapelo Road / Common Street / Cushing Avenue (continued)												
<i>Saturday Midding</i>												
Trapelo Road EB approach	0.69	24.5	C	143/218	-	-	-	-	-	-	-	-
Trapelo Road EB LT	-	-	-	-	0.55	20.2	C	37/70	0.55	21.0	C	41/72
Trapelo Road EB TH / RT	-	-	-	-	0.72	24.8	C	253/399	0.78	28.6	C	280/416
Trapelo Road WB approach	0.49	20.4	B	121/180	-	-	-	-	-	-	-	-
Trapelo Road WB LT	-	-	-	-	0.15	19.0	B	<25/26	0.37	19.9	B	25/49
Trapelo Road WB TH / RT	-	-	-	-	0.82	32.6	C	282/445	0.81	31.6	C	284/420
Common Street NB LT / TH	0.62	34.1	C	120/234	-	-	-	-	-	-	-	-
Common Street NB RT	0.10	27.6	C	<25/52	-	-	-	-	-	-	-	-
Common Street NB LT	-	-	-	-	0.45	40.5	D	46/101	0.72	45.9	D	113/251
Common Street NB TH / RT	-	-	-	-	0.62	34.8	C	141/253	0.71	37.8	D	165/323
Common Street SB LT	0.27	25.8	C	54/116	0.55	39.9	D	73/136	0.54	39.0	D	75/136
Common Street SB TH / RT	0.74	36.5	D	153/313	-	-	-	-	-	-	-	-
Common Street SB TH	-	-	-	-	0.49	30.1	C	111/189	0.64	36.1	D	126/207
Common Street SB RT	-	-	-	-	0.16	27.1	C	<25/59	0.20	30.1	C	24/65
Overall Intersection	0.69	26.8	C	-	0.78	30.1	C	-	0.73	32.7	C	-
Common Street / Belmont Street												
<i>Weekday Morning</i>												
Belmont Street EB approach	0.62	6.2	A	124/260	0.66	7.5	A	138/356	0.68	8.0	A	148/381
Belmont Street WB LT / TH	0.32	4.0	A	51/102	0.34	4.5	A	56/135	0.34	4.6	A	58/139
Belmont Street WB RT	0.01	3.0	A	<25/<25	0.01	3.3	A	<25/<25	0.01	3.4	A	<25/<25
Belmont Street NB LT / TH	0.46	27.5	C	57/57	0.58	30.3	C	61/61	0.65	33.2	C	64/64
Belmont Street NB RT	0.01	24.4	C	<25/<25	0.01	24.0	C	<25/<25	0.01	23.9	C	<25/<25
Common Street SB LT / TH	0.31	26.5	C	31/65	-	-	-	-	-	-	-	-
Common Street SB RT	0.15	25.3	C	<25/46	-	-	-	-	-	-	-	-
Common Street SB LT	-	-	-	-	0.15	25.0	C	<25/30	0.18	25.1	C	<25/34
Common Street SB TH / RT	-	-	-	-	0.52	28.2	C	43/107	0.53	28.3	C	44/110
Overall Intersection	0.59	11.3	B	-	0.64	12.7	B	-	0.67	13.4	B	-

Table 4 Continued – Signalized Intersection Capacity and Queue Analysis Summary

Intersection / Lane Group	2010 Existing				2017 No-Build				2017 Build			
	V/C ^a	Delay ^b	LOS ^c	Queue ^d	V/C	Delay	LOS	Queue	V/C	Delay	LOS	Queue
Common Street / Belmont Street (continued)												
<i>Weekday Evening</i>												
Belmont Street EB approach	0.58	8.5	A	124/263	0.69	12.7	B	166/377	0.81	18.6	B	203/510
Belmont Street WB LT / TH	0.52	7.6	A	115/241	0.57	9.9	A	145/316	0.58	10.6	B	151/329
Belmont Street WB RT	0.02	4.8	A	<25/<25	0.02	6.0	A	<25/<25	0.04	6.5	A	<25/<25
Belmont Street NB LT / TH	0.67	28.3	C	122/182	0.68	27.9	C	131/192	0.68	27.8	C	137/199
Belmont Street NB RT	0.08	20.7	C	<25/29	0.07	19.8	B	<25/30	0.07	19.5	B	<25/30
Common Street SB LT / TH	0.56	25.3	C	87/149	-	-	-	-	-	-	-	-
Common Street SB RT	0.17	21.3	C	<25/49	-	-	-	-	-	-	-	-
Common Street SB LT	-	-	-	-	0.12	20.3	C	<25/<25	0.22	21.0	C	<25/37
Common Street SB TH / RT	-	-	-	-	0.74	30.8	C	135/222	0.76	31.5	C	147/237
Overall Intersection	0.61	14.8	B	-	0.71	17.9	B	-	0.79	20.1	C	-
<i>Saturday Midday</i>												
Belmont Street EB approach	0.55	8.9	A	54/145	0.57	10.2	B	69/189	0.60	11.6	B	89/229
Belmont Street WB LT / TH	0.35	7.5	A	33/91	0.36	8.4	A	41/116	0.34	8.9	A	48/125
Belmont Street WB RT	0.01	6.1	A	<25/<25	0.01	6.8	A	<25/<25	0.02	7.3	A	<25/<25
Belmont Street NB LT / TH	0.32	9.9	A	31/92	0.31	10.7	B	38/103	0.33	12.2	B	48/124
Belmont Street NB RT	0.03	8.6	A	<25/<25	0.03	9.3	A	<25/<25	0.03	10.6	B	<25/<25
Common Street SB LT / TH	0.40	10.4	B	35/97	-	-	-	-	-	-	-	-
Common Street SB RT	0.10	8.9	A	<25/28	-	-	-	-	-	-	-	-
Common Street SB LT	-	-	-	-	0.09	9.6	A	<25/<25	0.15	11.3	B	<25/36
Common Street SB TH / RT	-	-	-	-	0.50	12.0	B	54/134	0.56	14.4	B	73/171
Overall Intersection	0.48	9.0	A	-	0.54	10.2	B	-	0.58	11.7	B	-

^a Volume-to-capacity ratio

^b Delay expressed in seconds per vehicle (average)

^c Level of service

^d 50th / 95th Percentile Queue (in feet)

* Trapelo Road EB analyzed as an exclusive left-turn lane and shared through/right-turn lane due to de facto left-turn lane on this approach during the weekday evening peak period.

14. Provide information regarding the expected amount and management of construction traffic.

The phasing of construction of the project has not yet been identified and will be identified by the construction contractor as the project undergoes final design and construction. Therefore, no analysis has been provided of the construction management at this time. However, the Starbucks and the 50 municipal parking spaces will remain open on the site throughout the duration of the construction, although the location of these facilities will shift during various construction phases.

15. Provide information regarding how the Applicant will handle loading activities such as deliveries, trash/recycling pickup, and move-in/move-out activities.

Allen & Major Associates, Inc. has prepared truck turning templates to demonstrate the circulation of delivery trucks, trash/recycling trucks, and fire trucks throughout the site. These truck turning templates will be provided as a separate document.

Move-in/move-out activities will be managed by the property manager, and residents will be required to schedule move-in/move-out activities with the property manager to ensure they do not conflict with other on-site activities and circulation. Two designated areas will be provided for moving vehicle parking. Moving vehicles for the Hyland Building will park along the trash pick-up area on the northwest corner of the building. Moving vehicles for the Winslow and Pomona Buildings will park in the four surface parking spaces located in the northeast corner of the parking lot between these buildings. The property manager will be responsible for reserving these parking spaces for the pre-scheduled time of move-in/move-out. Move-in/move-out parking will be limited to two-hour time intervals to occur during off-peak periods to ensure adequate parking is provided for the commercial and retail uses on the site during peak periods.

Conclusions

An updated capacity and queuing analysis has been prepared to address comments raised by HSH on the Traffic Impact, Access, and Parking Study prepared for Cushing Village. This updated analysis indicates that the proposed redevelopment project will have minimal impact on the operations of the study area intersections, as evidenced by the less than three second increase in overall intersection delay per vehicle at any of the study area intersections and increases in queues of less than three vehicles. The mitigation measures proposed within the original TIAPS will improve the safety of the Common Street / Belmont Street intersection and will be sufficient to mitigate the limited traffic impacts of this redevelopment project.

We hope that this analysis adequately addresses your comments. Please do not hesitate to contact me at the office at (978) 794-1792 x145 if you have any questions regarding our response. Thank you for your consideration.

Sincerely,
TEC, Inc.



Rebecca L. Brown, PE
Senior Transportation Engineer

cc: Keri Pyke, Howard/Stein-Hudson Associates, Inc.
Steve Heiken, ICON Architecture, Inc.



Not to Scale

Cushing Village Redevelopment - Belmont, Massachusetts

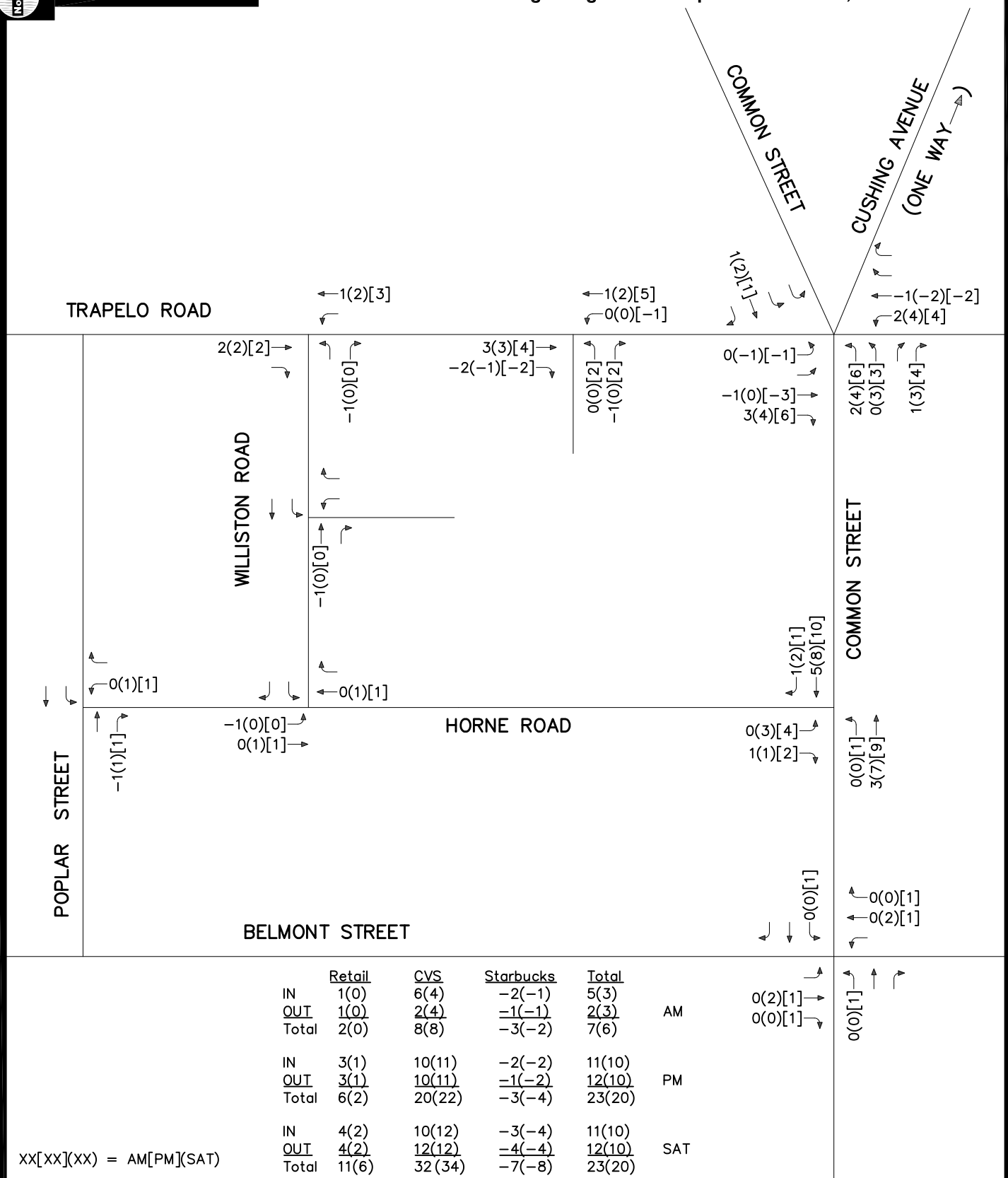


Figure A-1

Re-Occupancy of Vacant Space
Weekday Morning,
Weekday Evening, and
Saturday Midday
Peak Hour Traffic Volumes





Not to Scale

Cushing Village Redevelopment - Belmont, Massachusetts

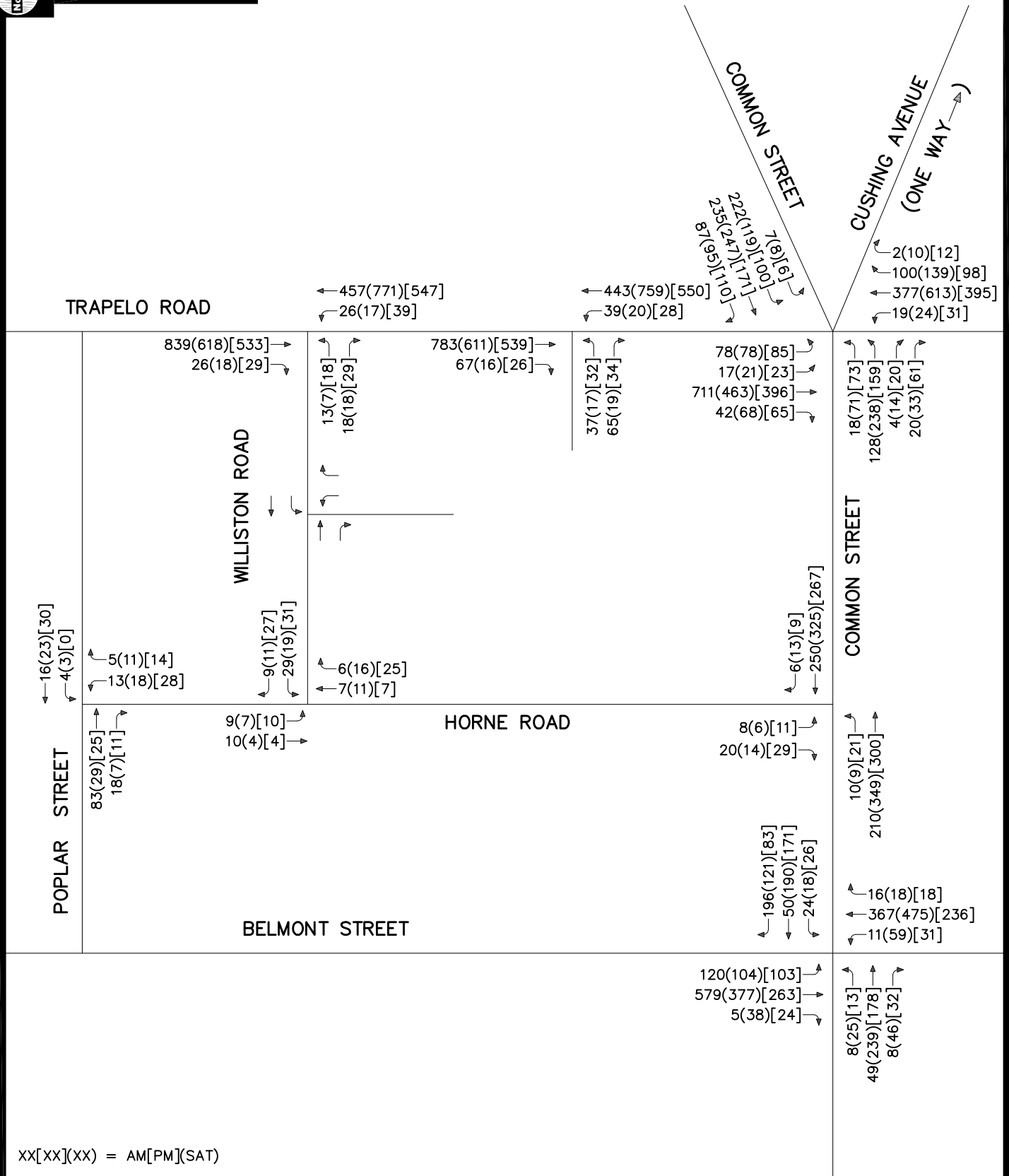


Figure A-2

2017 No-Build Conditions
Weekday Morning,
Weekday Evening, and
Saturday Midday
Peak Hour Traffic Volumes

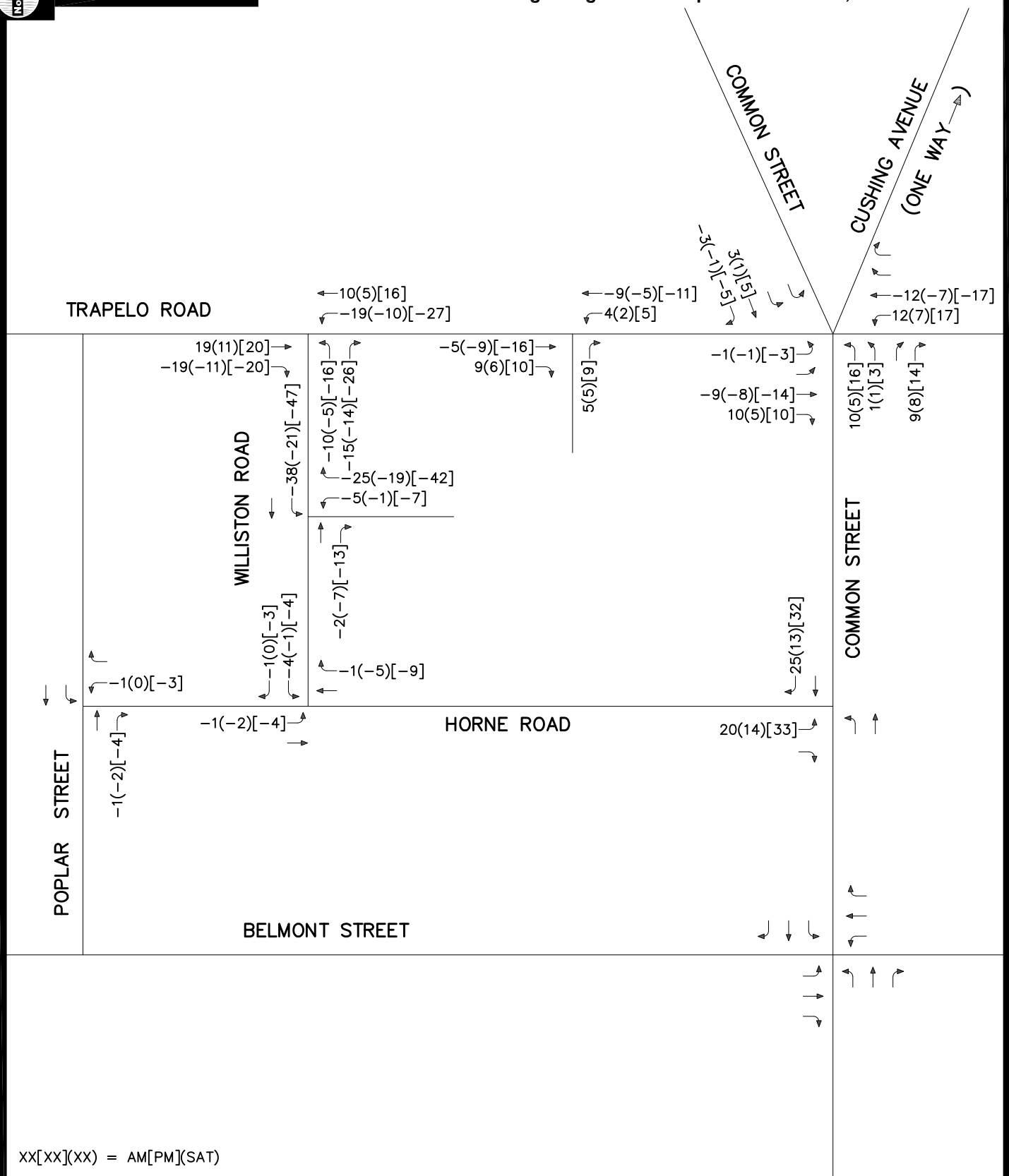


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Not to Scale

Cushing Village Redevelopment - Belmont, Massachusetts



XXXX = AM[PM](SAT)



TEC, Inc.

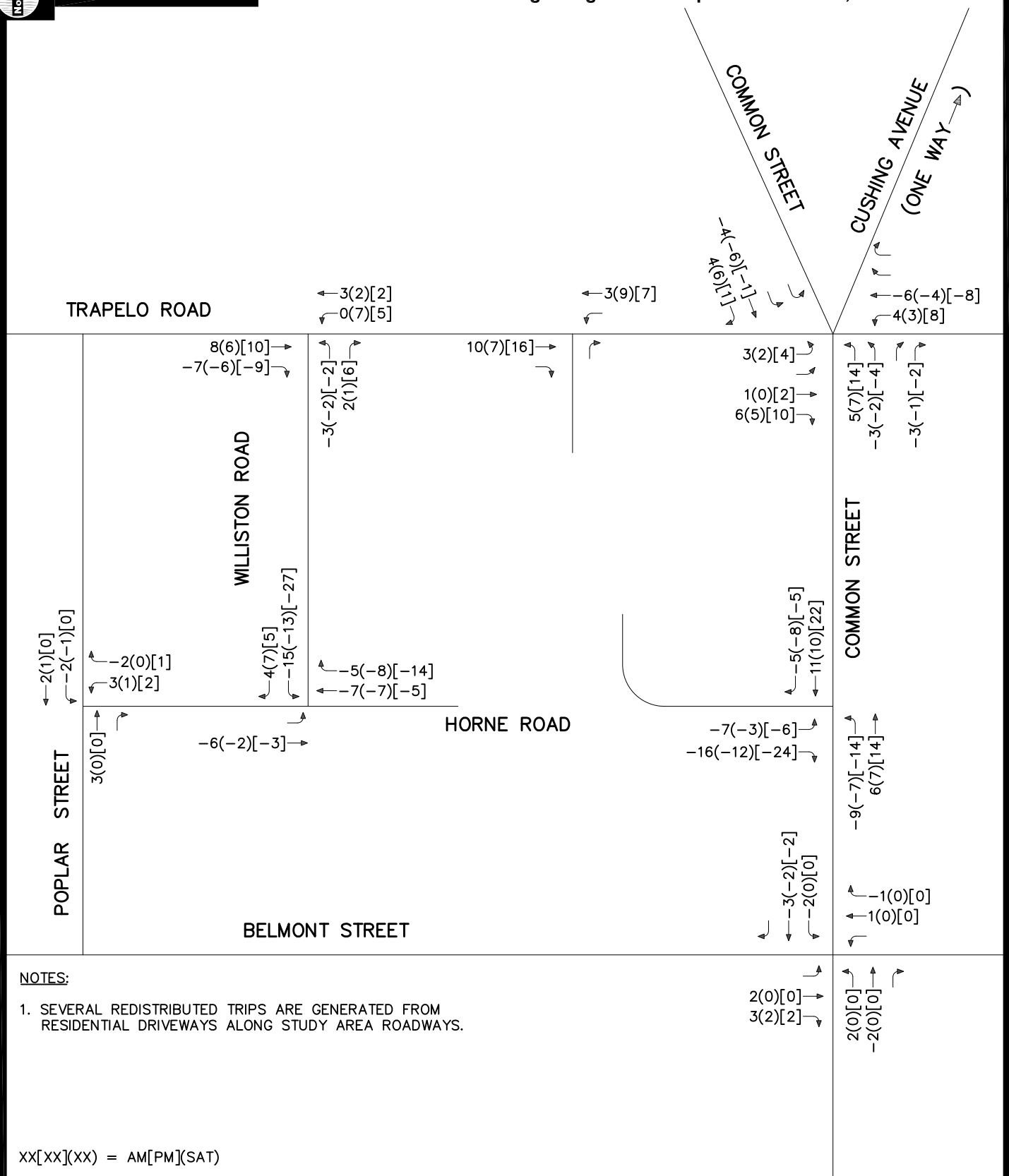
Figure A-3

Municipal Lot Closure Redistribution
Weekday Morning,
Weekday Evening, and
Saturday Midday
Peak Hour Traffic Volumes



Not to Scale

Cushing Village Redevelopment - Belmont, Massachusetts



TEC, Inc.

Figure A-4

**Horne Road Closure Redistribution
Weekday Morning,
Weekday Evening, and
Saturday Midday
Peak Hour Traffic Volumes**



Not to Scale

Cushing Village Redevelopment - Belmont, Massachusetts

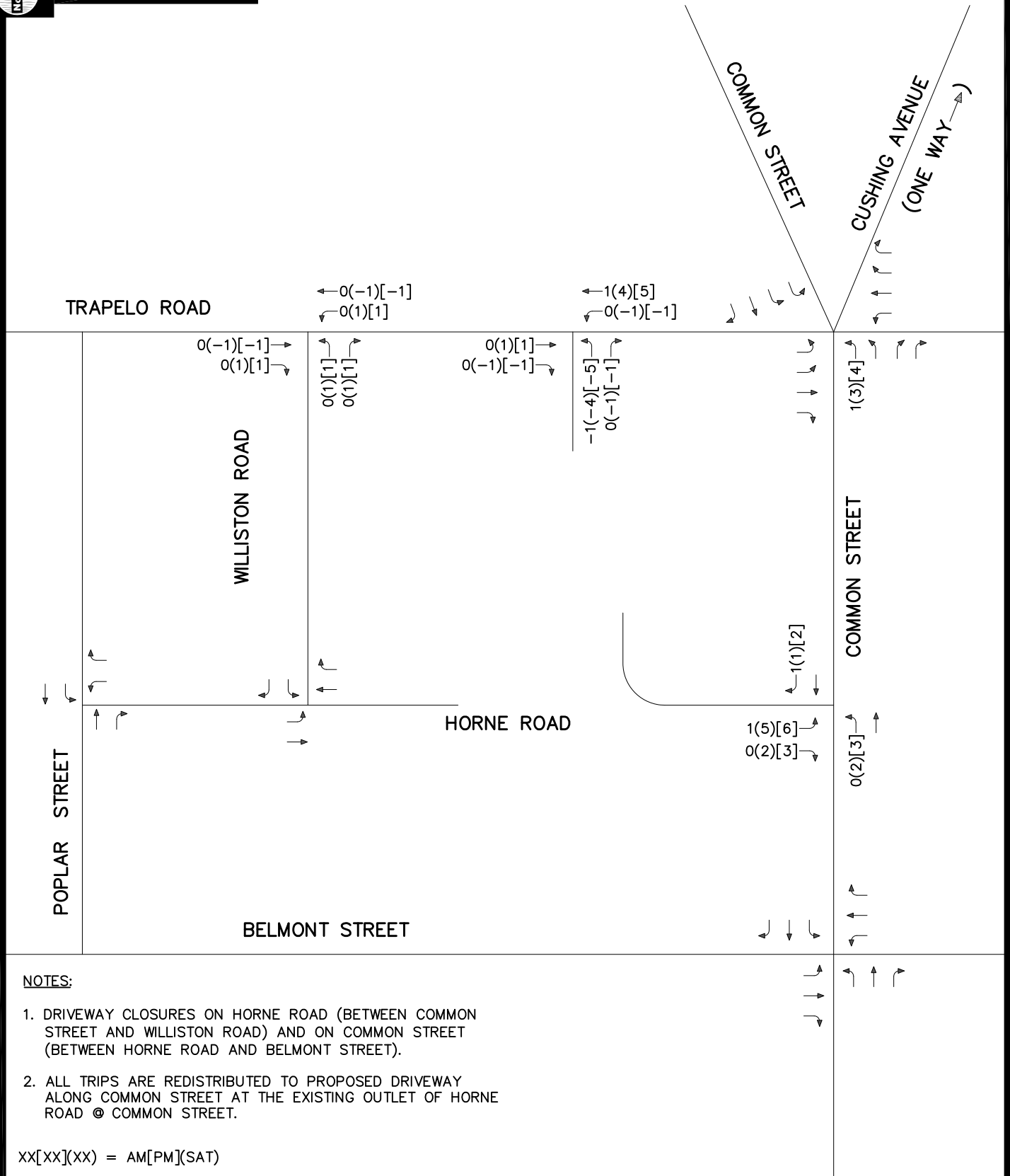


Figure A-5

Existing Retail Trip Redistribution
Weekday Morning,
Weekday Evening, and
Saturday Midday
Peak Hour Traffic Volumes





Not to Scale

Cushing Village Redevelopment - Belmont, Massachusetts

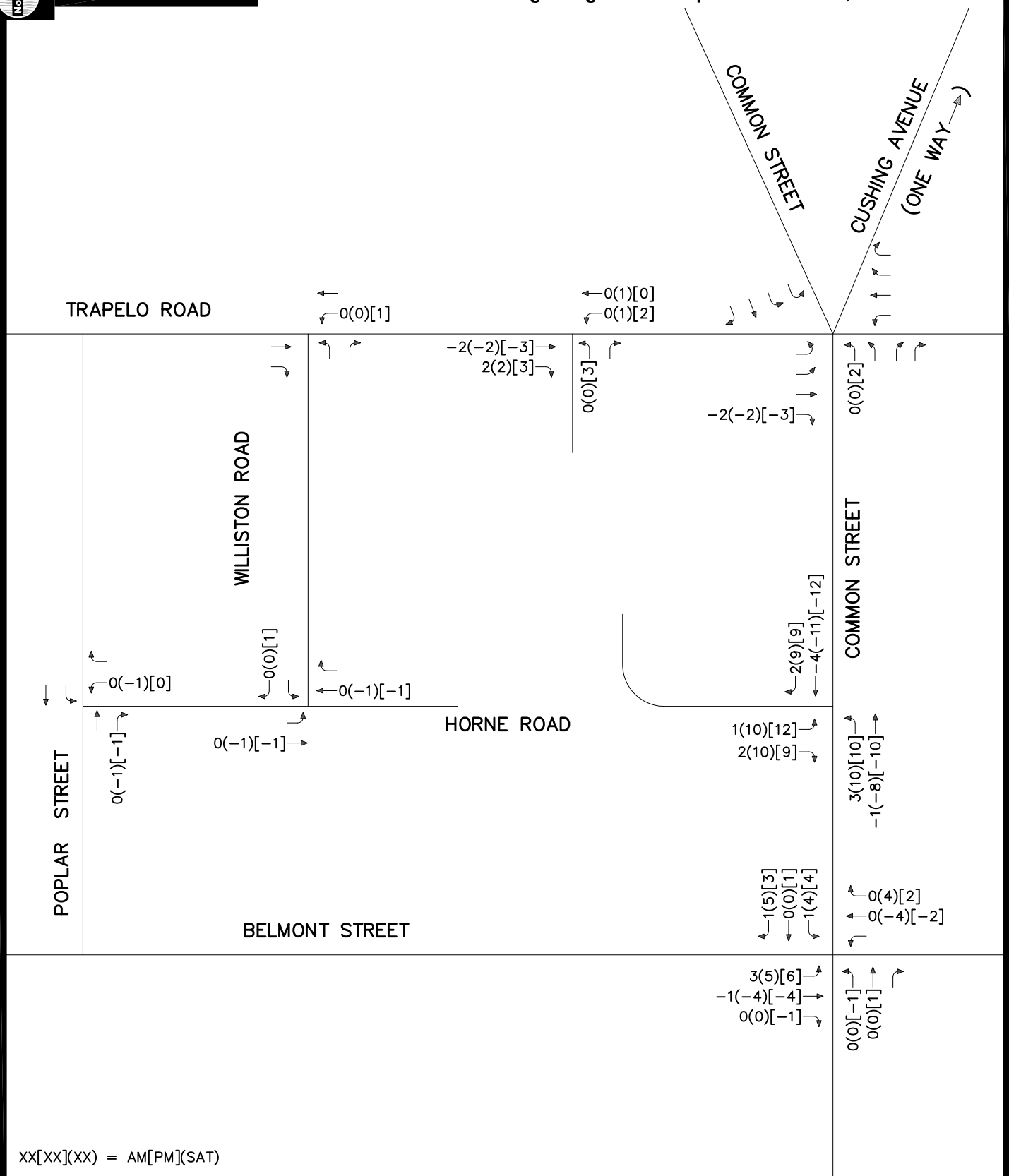


Figure A-6

Re-Occupancy Trip Redistribution
Weekday Morning,
Weekday Evening, and
Saturday Midday
Peak Hour Traffic Volumes





Not to Scale

Cushing Village Redevelopment - Belmont, Massachusetts

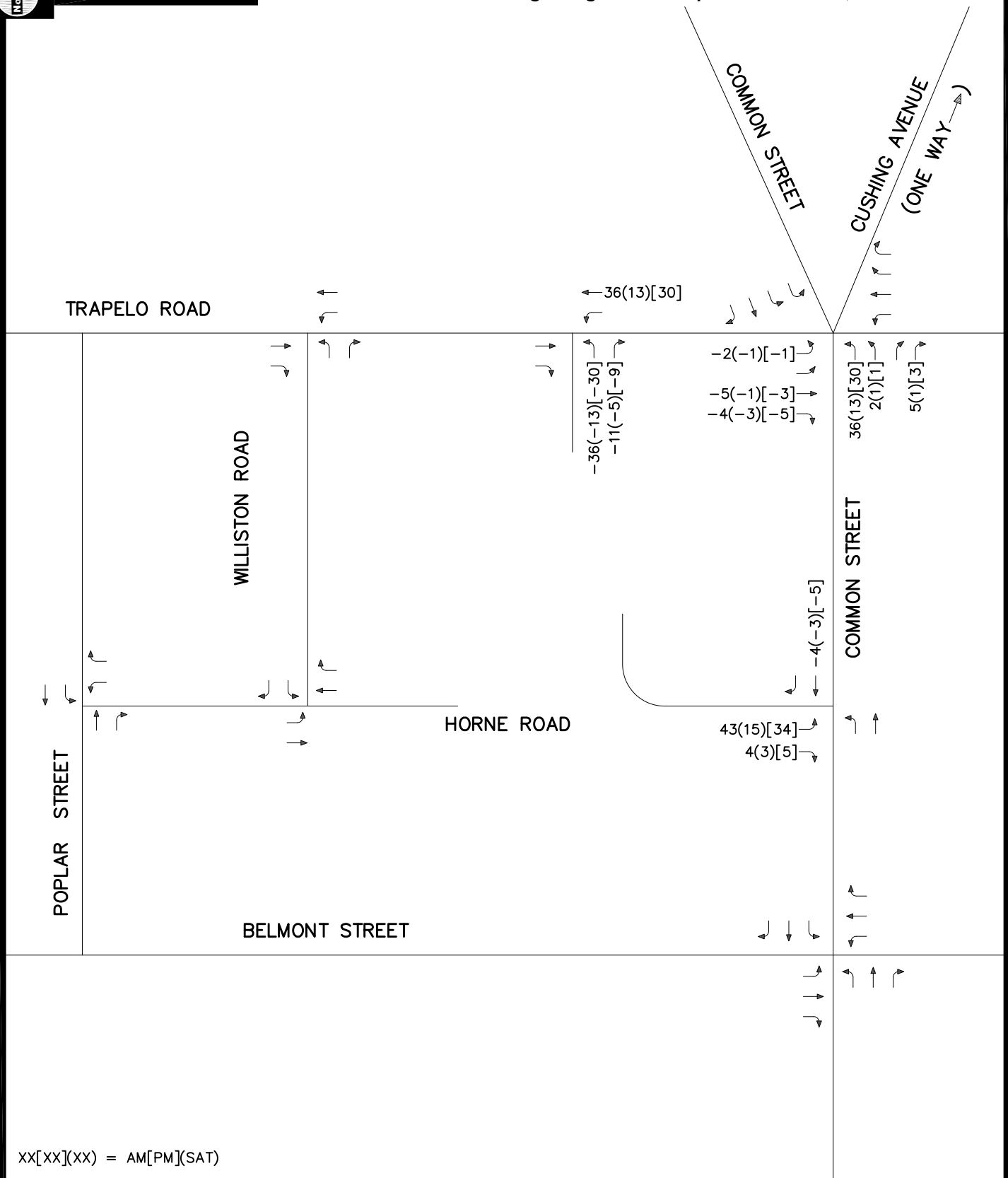


Figure A-7

Trapelo Road Driveway Redistribution
Weekday Morning,
Weekday Evening, and
Saturday Midday
Peak Hour Traffic Volumes



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Not to Scale

Cushing Village Redevelopment - Belmont, Massachusetts

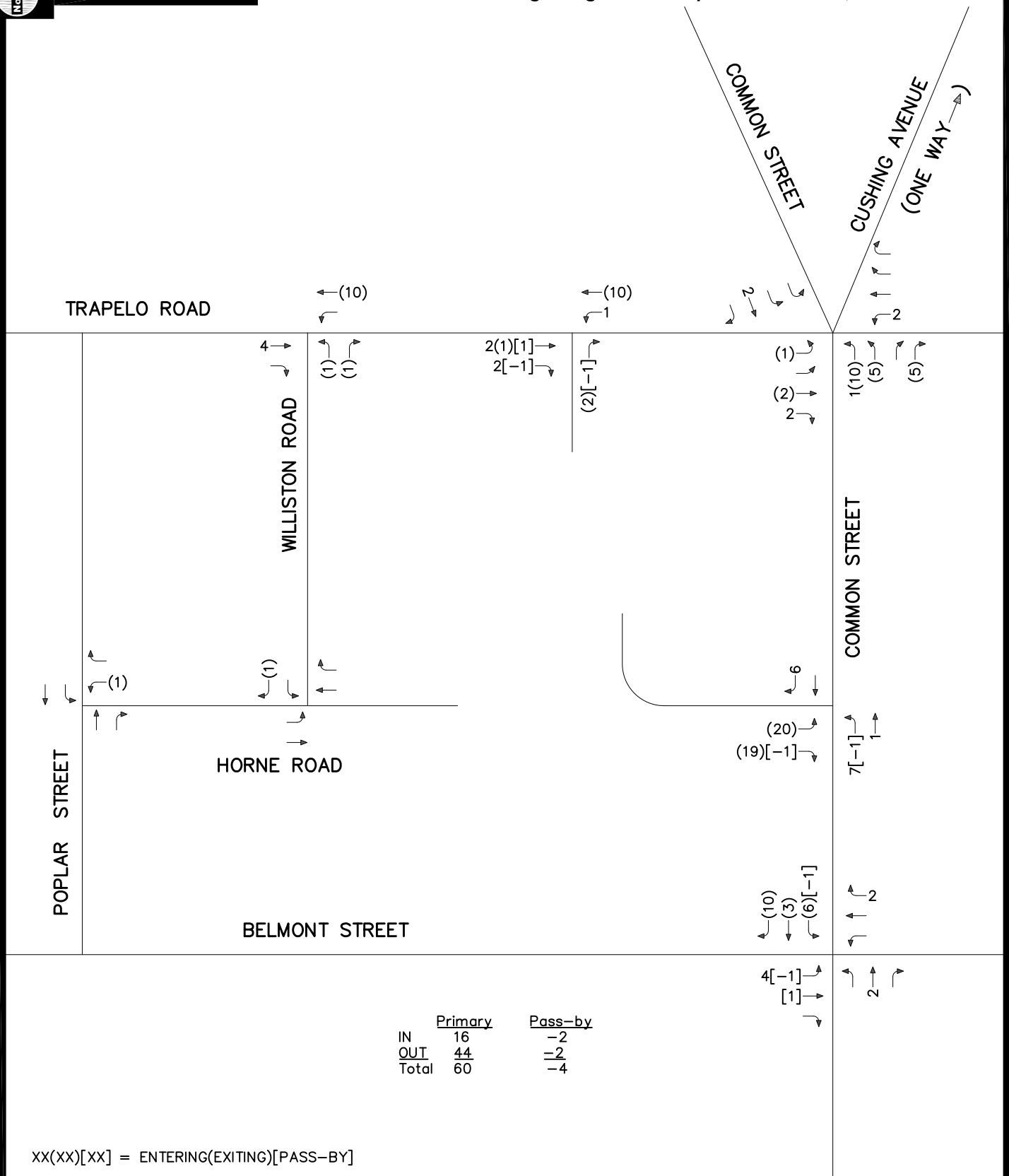


Figure A-8

Site Generated Trip Assignment
Weekday Morning
Peak Hour Traffic Volumes



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Cushing Village Redevelopment - Belmont, Massachusetts

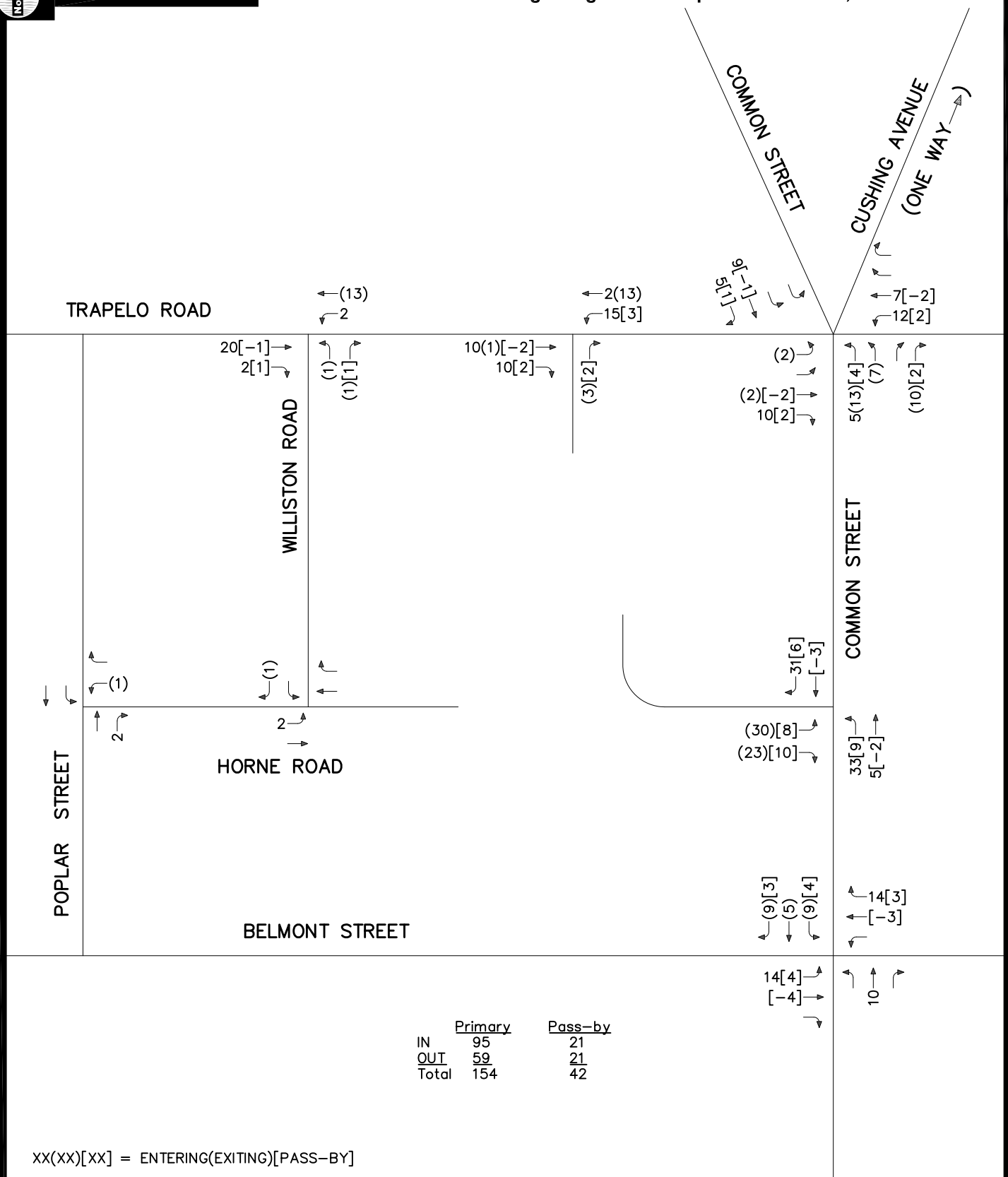


Figure A-9

Site Generated Trip Assignment
Weekday Evening
Peak Hour Traffic Volumes



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Not to Scale

Cushing Village Redevelopment - Belmont, Massachusetts

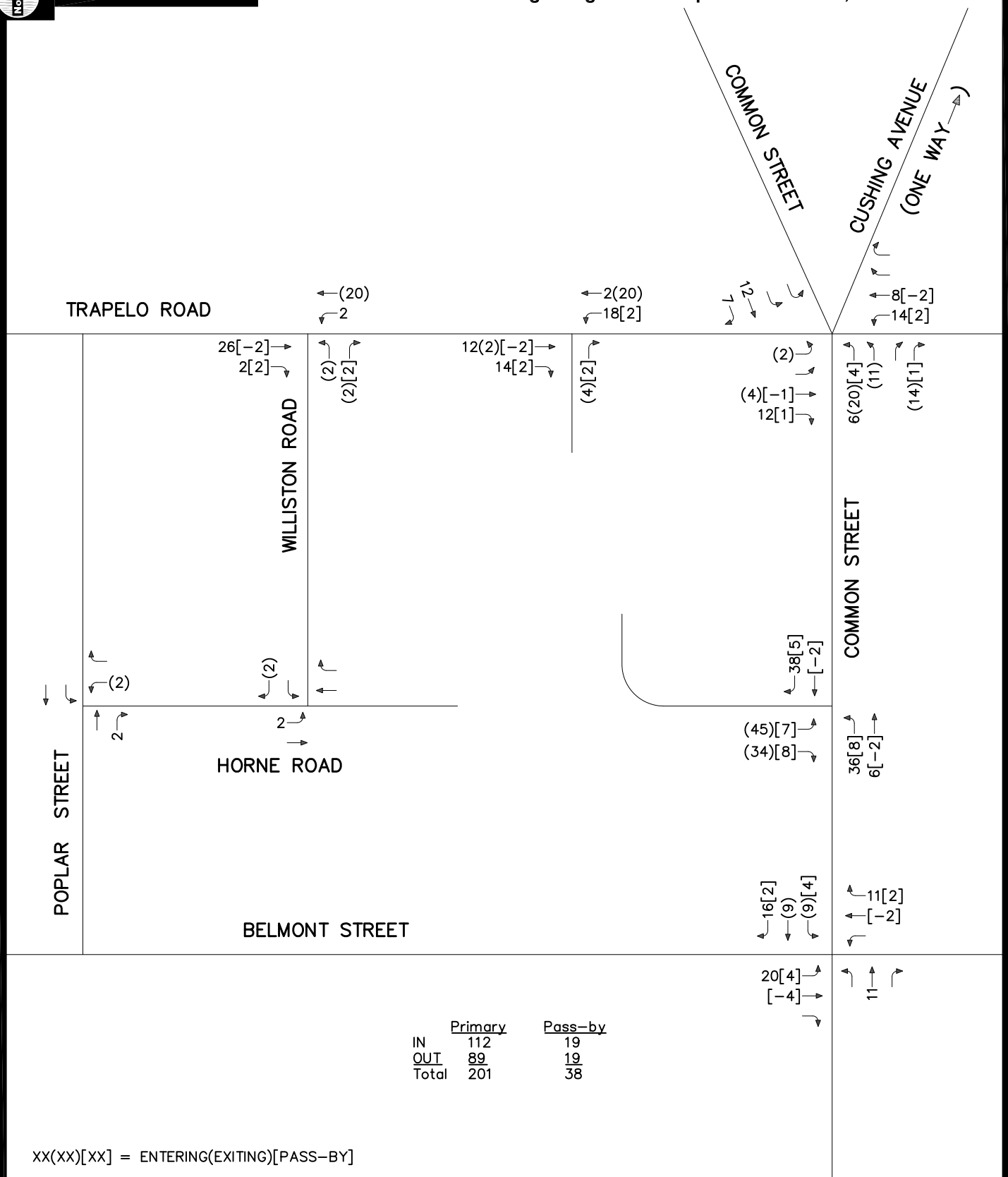


Figure A-10

Site Generated Trip Assignment
Saturday Midday
Peak Hour Traffic Volumes





Not to Scale

Cushing Village Redevelopment - Belmont, Massachusetts

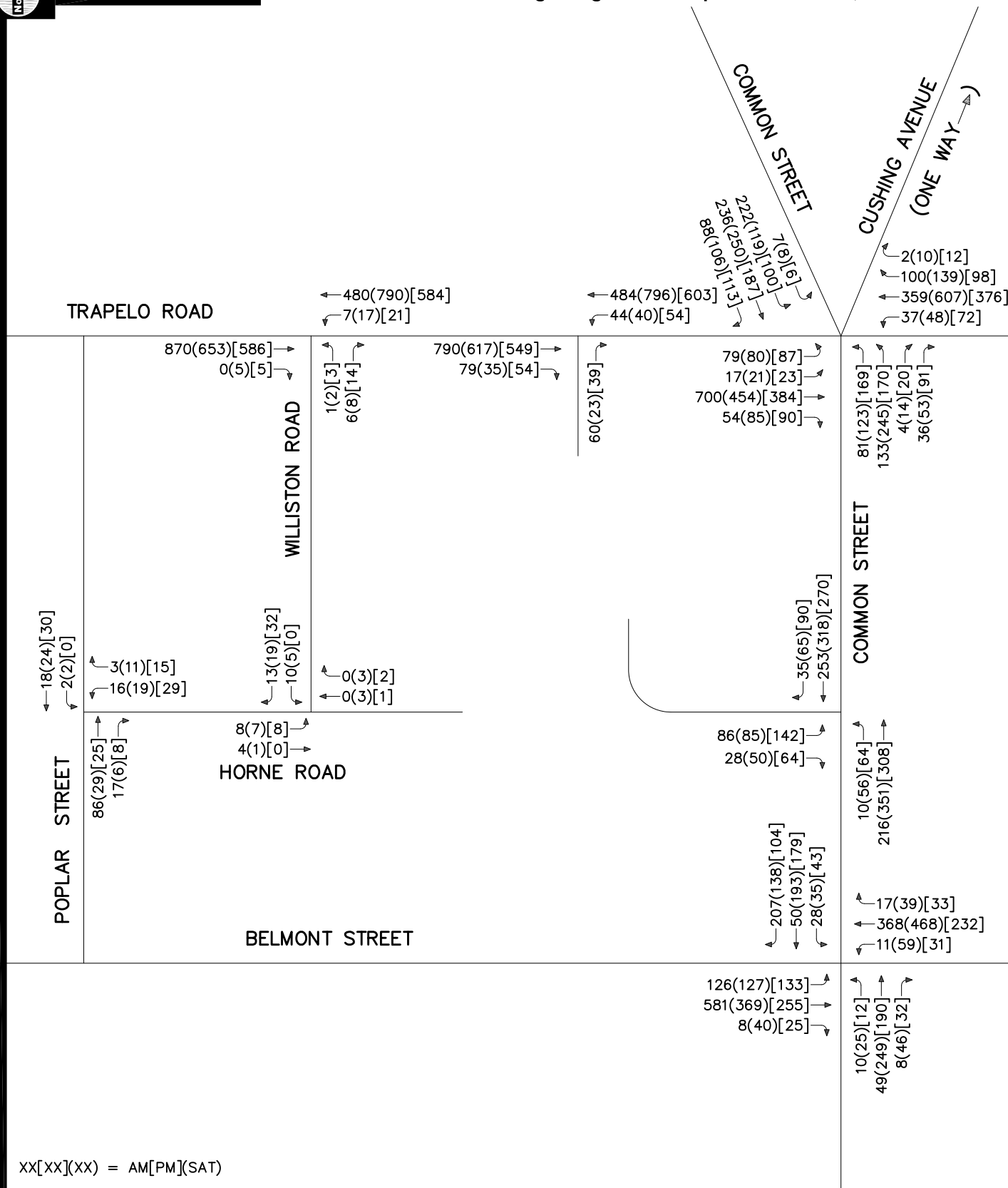


Figure A-11

2017 Build Conditions
Weekday Morning,
Weekday Evening, and
Saturday Midday
Peak Hour Traffic Volumes



Attachment A

Seasonal Adjustment Data

Seasonal Adjustment Data

Project: T0376.01 - Cushing Village Redevelopment - Belmont, Massachusetts
 Date: November 25, 2011
 Analyst: TEC, Inc. / Samuel W. Gregorio, E.I.T. / Rebecca L. Brown, P.E.
 Source: MassDOT Permanent Count Stations 8011, 8096, 8099, 4118, 415, 4165

STATION 8011 - MEDFORD - RTE.I-93 - SOUTH OF RTE.60 ROTARY

YR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR	Seasonal Adjustment
02	164,243	163,488	167,345	165,332	167,299	169,679	158,062	168,477	163,546	169,482	159,763	159,000	164,643	-3.1%
	0%	0%	-1%	0%	0%	-9%	-3%	2%	4%	1%	1%	-4%	-1%	
03	165,000	164,000	166,000	165,000	167,046	154,806	153,332	171,344	170,575	171,255	161,099	152,609	163,506	5.3%
	-4%	0%	0%	4%	4%	3%	4%	1%	1%	0%	1%	5%	2%	
04	158,239	164,783	166,777	172,245	173,440	160,130	159,678	172,261	172,000	171,000	162,525	160,000	166,090	3.6%
	2%	-1%	0%	-2%	-2%	10%	13%	4%	-6%	-3%	3%	3%	2%	
05	162,000	162,551	167,171	169,535	170,629	175,742	179,680	179,000	162,138	165,888	168,032	164,539	168,909	-4.0%
	2%	3%	6%	2%	1%	1%	-6%	-1%	7%	4%	1%	2%	2%	
06	165,031	167,769	176,861	173,376	172,542	177,409	168,404	176,868	172,923	173,259	169,804	167,711	171,830	-3.2%

Average Adj. = -0.3%

STATION 8096 - MEDFORD - RTE.I-93 - SOUTH OF ROOSEVELT CIRCLE

YR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR	Seasonal Adjustment
02	167,389	172,728	176,198	181,836	180,668	179,678	177,860	181,260	173,522	174,603	166,610	161,938	174,524	-3.0%
	-8%	-7%	-6%	-4%	-3%	-2%	-1%	-1%	2%	-2%	-7%	-4%	-3%	
03	154,385	161,180	165,000	175,031	175,831	176,000	176,125	178,546	176,575	171,710	155,392	156,245	168,502	-4.5%
	6%	4%	6%	-1%	-3%	0%	-6%	1%	-1%	0%	0%	-1%	0%	
04	163,135	167,877	174,090	172,903	171,236	175,882	165,862	179,550	175,643	171,000	156,000	155,000	169,015	-4.1%
	10%	4%	12%	5%	6%	3%	7%	3%	2%	0%	0%	0%	4%	
06	178,971	174,967	194,569	181,604	180,703	181,955	177,027	184,113	179,274	171,000	156,000	155,000	176,265	-3.2%

Average Adj. = -3.7%

STATION 8099 - MEDFORD - RTE.I-93 - BTWN. HARVARD ST. & RTE.38 CONN.

YR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR	Seasonal Adjustment
02	159,458	166,003	171,231	174,247	173,731	170,244	170,111	174,404	166,219	165,000	161,907	158,655	167,601	-1.6%
	-1%	-6%	-3%	-3%	-3%	3%	1%	-3%	2%	2%	-1%	0%	-1%	
03	157,515	155,383	165,494	169,528	168,810	175,056	171,745	169,548	169,428	167,909	160,816	159,000	165,853	-5.5%
	-2%	2%	8%	5%	5%	4%	-3%	5%	4%	5%	0%	1%	3%	
04	154,511	159,006	178,402	177,767	176,834	181,421	166,386	178,419	176,250	175,886	160,459	160,000	170,445	-6.4%
	4%	2%	-6%	-4%	-3%	-2%	4%	0%	-4%	-4%	5%	3%	-1%	
05	161,000	162,130	167,164	171,321	170,941	176,970	173,685	177,967	170,052	169,317	168,188	165,012	169,479	-4.4%
	-2%	-7%	-4%	-7%	-8%	-9%	-9%	0%	3%	2%	3%	2%	-3%	
06	158,110	151,006	160,948	158,960	157,381	160,208	157,798	177,781	174,685	174,529	171,580	168,139	164,260	2.5%

Average Adj. = -3.1%

STATION 4118 - LEXINGTON - RTE.I-95 - NORTH OF RTE. 2A

YR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR	Seasonal Adjustment
06	156,000	158,000	158,611	157,414	160,279	161,390	159,906	164,944	165,971	164,465	158,286	151,556	159,735	-1.0%

Average Adj. = -1.0%

STATION 415 - NEWTON - RTE.I-95 (128) - SOUTH OF RTE.I-90

YR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR	Seasonal Adjustment
02	135,484	138,523	138,077	146,761	150,834	151,321	147,085	149,436	149,028	151,095	148,920	136,396	145,247	-4.2%
	-7%	-8%	-1%	-7%	-7%	-6%	-8%	-4%	-5%	-7%	-7%	-2%	-6%	
06	126,000	126,906	136,149	136,322	140,602	142,863	135,563	142,863	140,973	141,211	138,206	133,710	136,781	-4.4%

Average Adj. = -4.3%

STATION 4165 - NEWTON - RTE.I-95 (128) - NORTH OF RTE.16

YR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR	Seasonal Adjustment
02	130,921	130,600	139,873	148,909	151,439	152,620	149,953	155,246	152,030	153,522	148,263	142,276	146,304	-4.3%

Average Adj. = -4.3%

STATION 4049 - WOBURN - RTE. I-95(128) - SOUTH OF RTE. I-93

YR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR	Seasonal Adjustment
05	158,569	166,301	169,015	176,496	175,709	184,466	176,850	184,221	173,725	171,623	169,000	167,000	172,748	-6.8%

-6.8%

Whereas the average traffic volumes for June is higher than the yearly average, no seasonal adjustment will be taken for a more conservative analysis.

Attachment B

Site Trip Generation Calculations

Trip Generation Assessment - Existing vs. Re-Occupied Uses

Project: Proposed Mixed Use Development - Belmont, Massachusetts
 Date: November 27, 2012
 Analyst: TEC, Inc. / Samuel W. Gregorio, E.I.T.
 Source: Institute of Transportation Engineers - Trip Generation - 8th Ed.

Re-Occupancy Uses

6,200 SF Pharmacy/Drugstore without Drive-Thru Window (ITE LUC 880)

Size:	6.2 KSF													
	Total Trips		Total Trips	% Distribution		Multi-Use Trips		Total New Pass-by Trips	Total New Primary Trips	# Passby Trips		# Primary Trips		
	IN	OUT		IN	OUT	IN	OUT			IN	OUT	IN	OUT	
	Weekday Daily	277	277	554	50%	50%	0	0	294	260	147	147	130	130
	Weekday AM PH	12	8	20	59%	41%	2	2	8	8	4	4	6	2
	Weekday PM PH	26	26	52	50%	50%	5	5	22	20	11	11	10	10
	Saturday Daily	354	354	708	49%	51%	0	0	376	332	188	188	166	166
	Sat Midday PH	32	34	66	49%	51%	10	10	24	22	12	12	10	12

Interpolated Saturday Daily from Weekday PM PH

Assumed 53% passby rate (Trip Generation Handbook, 2nd Edition).

12,065 SF Specialty Retail (ITE LUC 814)

Size:	12.065	KSF												
	Total Trips		Total Trips	% Distribution		Multi-Use Trips		Total New Pass-by Trips	Total New Primary Trips	# Passby Trips		# Primary Trips		
	IN	OUT		IN	OUT	IN	OUT			IN	OUT	IN	OUT	
	Weekday Daily	268	267	535	50%	50%	0	0	140	395	70	70	198	197
	Weekday AM PH	5	4	9	61%	39%	1	1	2	5	1	1	3	2
	Weekday PM PH	15	18	33	44%	56%	3	4	8	18	4	4	8	10
	Saturday Daily	254	253	507	50%	50%	0	0	132	375	66	66	188	187
	Sat Midday PH	26	24	50	52%	48%	8	7	10	25	5	5	13	12

Interpolated Weekday AM PH from Weekday AM PH LUC 820 - Shopping Center

Assumed 34% pass-by rate for weekday PM and 26% pass-by rate for all others (LUC 820 - Shopping Center - Trip Generation Handbook, 2nd Edition).

1,800 SF Starbucks (ITE LUC 936)

Size:	1.8 KSF													
	Total Trips		Total Trips	% Distribution		Multi-Use Trips		Total New Pass-by Trips	Total New Primary Trips	# Passby Trips		# Primary Trips		
	IN	OUT		IN	OUT	IN	OUT			IN	OUT	IN	OUT	
	Weekday Daily	867	866	1733	50%	50%	0	0	866	867	433	433	434	433
	Weekday AM PH	119	115	234	51%	49%	3	3	112	116	56	56	60	56
	Weekday PM PH	41	41	82	50%	50%	6	5	36	35	18	18	17	18
	Saturday Daily	842	841	1683	50%	50%	0	0	842	841	421	421	421	420
	Sat Midday PH	63	69	132	48%	52%	12	13	54	53	27	27	24	29

Assumed 49% pass-by rate for weekday AM and 50% pass-by rate for all others (LUC 934 - Fast-Food Restaurant with Drive Through - Trip Generation Handbook, 2nd Edition).

Trip Generation Assessment - Existing vs. Re-Occupied Uses

Project: Proposed Mixed Use Development - Belmont, Massachusetts
 Date: November 27, 2012
 Analyst: TEC, Inc. / Samuel W. Gregorio, E.I.T.
 Source: Institute of Transportation Engineers - Trip Generation - 8th Ed.

Existing Uses

0 SF Pharmacy/Drugstore without Drive-Thru Window (ITE LUC 880)

Size:	0 KSF													
	Total Trips		Total Trips	% Distribution		Multi-Use Trips		Total New Pass-by Trips	Total New Primary Trips	# Passby Trips		# Primary Trips		
	IN	OUT		IN	OUT	IN	OUT			IN	OUT	IN	OUT	
	Weekday Daily	0	0	0	50%	50%	0	0	0	0	0	0	0	0
	Weekday AM PH	0	0	0	59%	41%	0	0	0	0	0	0	0	0
	Weekday PM PH	0	0	0	50%	50%	0	0	0	0	0	0	0	0
	Saturday Daily	0	0	0	49%	51%	0	0	0	0	0	0	0	0
	Sat Midday PH	0	0	0	49%	51%	0	0	0	0	0	0	0	0

Interpolated Saturday Daily from Weekday PM PH

Assumed 53% passby rate (Trip Generation Handbook, 2nd Edition).

8,135 SF Specialty Retail (ITE LUC 814)

Size:	8,135 KSF												
	Total Trips		Total Trips	% Distribution		Multi-Use Trips		Total New Pass-by Trips	Total New Primary Trips	# Passby Trips		# Primary Trips	
	IN	OUT		IN	OUT	IN	OUT			IN	OUT	IN	OUT
Weekday Daily	181	180	361	50%	50%	0	0	94	267	47	47	134	133
Weekday AM PH	4	2	6	61%	39%	1	0	2	3	1	1	2	1
Weekday PM PH	10	12	22	44%	56%	2	2	6	12	3	3	5	7
Saturday Daily	171	171	342	50%	50%	0	0	88	254	44	44	127	127
Sat Midday PH	17	16	33	52%	48%	5	5	6	17	3	3	9	8

Interpolated Weekday AM PH from Weekday AM PH LUC 820 - Shopping Center

Assumed 34% pass-by rate for weekday PM and 26% pass-by rate for all others (LUC 820 - Shopping Center - Trip Generation Handbook, 2nd Edition).

1,800 SF Starbucks (ITE LUC 936)

Size:	1.8 KSF												
	Total Trips		Total Trips	% Distribution		Multi-Use Trips		Total New Pass-by Trips	Total New Primary Trips	# Passby Trips		# Primary Trips	
	IN	OUT		IN	OUT	IN	OUT			IN	OUT	IN	OUT
Weekday Daily	867	866	1733	50%	50%	0	0	866	867	433	433	434	433
Weekday AM PH	119	115	234	51%	49%	0	1	114	119	57	57	62	57
Weekday PM PH	41	41	82	50%	50%	2	2	40	38	20	20	19	19
Saturday Daily	842	841	1683	50%	50%	0	0	842	841	421	421	421	420
Sat Midday PH	63	69	132	48%	52%	5	5	62	60	31	31	27	33

Assumed 49% pass-by rate for weekday AM and 50% pass-by rate for all others (LUC 934 - Fast-Food Restaurant with Drive Through - Trip Generation Handbook, 2nd Edition).

Net Increase	Total Trips			Total Multi-Use Trips		Total New Pass-by Trips	Total New Primary Trips	Total Pass-by Trips		Total Primary Trips	
				In	Out			In	Out	In	Out
Weekday Daily	728			0	0	340	388	170	170	194	194
Weekday AM Peak Hour	23			5	5	6	7	3	3	5	2
Weekday PM Peak Hour	63			10	10	20	23	10	10	11	12
Saturday Daily	873			0	0	420	453	210	210	227	226
Sat Midday Peak Hour	83			20	20	20	23	10	10	11	12

Site Generated Trip Assessment - EXISTING

Project: Proposed Mixed Use Development - Belmont, Massachusetts
Date: October 1, 2012
Analyst: TEC, Inc. / Samuel W. Gregorio, E.I.T.
Source: Institute of Transportation Engineers - Trip Generation - 8th Ed.

Institute of Transportation Engineers (ITE)

Land Use Code (LUC) 880 - Pharmacy/Drugstore without Drive-Through Window

Average Vehicle Trips vs: 1,000 Sq. Feet Gross Floor Area
Independent Variable (X): 0.000

AVERAGE WEEKDAY DAILY

$$\ln(T) = 0.99 \ln(X) + 4.51$$

$$\ln(T) = 0.99 * \ln(0.00) + 4.51$$

$$\ln(T) = 0.00$$

$$T = \boxed{0} \text{ vehicle trips} \\ \text{with 50\% (} 0 \text{) entering trips \& (} 0 \text{ vpd) exiting.}$$

WEEKDAY MORNING PEAK HOUR OF ADJACENT STREET TRAFFIC

$$T = 3.20 * (X)$$

$$T = 3.20 * 0.00$$

$$T = \boxed{0} \text{ vehicle trips} \\ \text{with 59\% (} 0 \text{) entering trips \& (} 0 \text{ vph) exiting.}$$

WEEKDAY EVENING PEAK HOUR OF ADJACENT STREET TRAFFIC

$$T = 8.42 * (X)$$

$$T = 8.42 * 0.00$$

$$T = \boxed{0} \text{ vehicle trips} \\ \text{with 50\% (} 0 \text{) entering trips \& (} 0 \text{ vph) exiting.}$$

SATURDAY DAILY

$$\frac{\text{ITE LUC 880 Weekday Daily Trip Rate}}{\text{ITE LUC 880 Weekday Evening Trip Rate}} = \frac{\text{ITE LUC 880 Saturday Daily Trip Rate}}{\text{ITE LUC 880 Saturday Midday Trip Rate}}$$

$$\frac{90.06}{8.42} = \frac{(Y)}{10.68} \quad Y = 114.2329$$

$$T = Y * 0.000$$

$$T = \boxed{0} \text{ vehicle trips} \\ \text{with 50\% (} 0 \text{ vph) entering and 50\% (} 0 \text{ vph) exiting.}$$

(same distribution split as ITE LUC 880 during the weekday daily)

SATURDAY MIDDAY PEAK HOUR OF GENERATOR

$$T = 10.68 * (X)$$

$$T = 10.68 * 0.00$$

$$T = \boxed{0} \text{ vehicle trips} \\ \text{with 49\% (} 0 \text{) entering trips \& (} 0 \text{ vph) exiting.}$$

Site Generated Trip Assessment - RE-OCCUPANCY

Project: Proposed Mixed Use Development - Belmont, Massachusetts
Date: October 1, 2012
Analyst: TEC, Inc. / Samuel W. Gregorio, E.I.T.
Source: Institute of Transportation Engineers - Trip Generation - 8th Ed.

Institute of Transportation Engineers (ITE)

Land Use Code (LUC) 880 - Pharmacy/Drugstore without Drive-Through Window

Average Vehicle Trips vs: 1,000 Sq. Feet Gross Floor Area
Independent Variable (X): 6.200

AVERAGE WEEKDAY DAILY

$$\ln(T) = 0.99 \ln(X) + 4.51$$

$$\ln(T) = 0.99 * \ln(6.20) + 4.51$$

$$\ln(T) = 6.32$$

$$T = \boxed{554} \text{ vehicle trips}$$

with 50% (277) entering trips & (277 vpd) exiting.

WEEKDAY MORNING PEAK HOUR OF ADJACENT STREET TRAFFIC

$$T = 3.20 * (X)$$

$$T = 3.20 * 6.20$$

$$T = \boxed{20} \text{ vehicle trips}$$

with 59% (12) entering trips & (8 vph) exiting.

WEEKDAY EVENING PEAK HOUR OF ADJACENT STREET TRAFFIC

$$T = 8.42 * (X)$$

$$T = 8.42 * 6.20$$

$$T = \boxed{52} \text{ vehicle trips}$$

with 50% (26) entering trips & (26 vph) exiting.

SATURDAY DAILY

$$\frac{\text{ITE LUC 880 Weekday Daily Trip Rate}}{\text{ITE LUC 880 Weekday Evening Trip Rate}} = \frac{\text{ITE LUC 880 Saturday Daily Trip Rate}}{\text{ITE LUC 880 Saturday Midday Trip Rate}}$$

$$\frac{90.06}{8.42} = \frac{(Y)}{10.68} \quad Y = 114.2329$$

$$T = Y * 6.200$$

$$T = \boxed{708} \text{ vehicle trips}$$

with 50% (354 vph) entering and 50% (354 vph) exiting.

(same distribution split as ITE LUC 880 during the weekday daily)

SATURDAY MIDDAY PEAK HOUR OF GENERATOR

$$T = 10.68 * (X)$$

$$T = 10.68 * 6.20$$

$$T = \boxed{66} \text{ vehicle trips}$$

with 49% (32) entering trips & (34 vph) exiting.

Site Generated Trip Assessment - EXISTING

Project: Proposed Mixed Use Development - Belmont, Massachusetts
Date: October 1, 2012
Analyst: TEC, Inc. / Samuel W. Gregorio, E.I.T.
Source: Institute of Transportation Engineers - Trip Generation - 8th Ed.

Institute of Transportation Engineers (ITE) Land Use Code (LUC) 814 - Specialty Retail

Average Vehicle Trips vs: 1,000 Sq. Feet Gross Leasable Area
Independent Variable (X): 8.135

AVERAGE WEEKDAY DAILY

$T = 44.32 * (X)$
 $T = 44.32 * 8.135$
 $T = \boxed{361}$ vehicle trips
with 50% (181 vpd) entering and 50% (180 vpd) exiting.

WEEKDAY MORNING PEAK HOUR OF ADJACENT STREET TRAFFIC

$\frac{\text{ITE LUC 820 Weekday Morning Trip Rate}}{\text{ITE LUC 820 Weekday Evening Trip Rate}} = \frac{\text{ITE LUC 814 Weekday Morning Trip Rate}}{\text{ITE LUC 814 Weekday Evening Trip Rate}}$

$$\frac{1.00}{3.73} = \frac{(Y)}{2.71} \quad Y = 0.7265416$$

$T = Y * 8.135$
 $T = \boxed{6}$ vehicle trips
with 61% (4 vph) entering and 39% (2 vph) exiting.
(same distribution split as ITE LUC 820 during the weekday morning peak hour of adjacent street traffic)

WEEKDAY EVENING PEAK HOUR OF ADJACENT STREET TRAFFIC

$T = 2.71 * (X)$
 $T = 2.71 * 8.135$
 $T = \boxed{22}$ vehicle trips
with 44% (10 vph) entering and 56% (12 vph) exiting.

SATURDAY DAILY

$T = 42.04 * (X)$
 $T = 42.04 * 8.135$
 $T = \boxed{342}$ vehicle trips
with 50% (171 vpd) entering and 50% (171 vpd) exiting.

SATURDAY MIDDAY PEAK HOUR

$\frac{\text{ITE LUC 820 Saturday Midday Trip Rate}}{\text{ITE LUC 820 Saturday Daily Trip Rate}} = \frac{\text{ITE LUC 814 Saturday Midday Trip Rate}}{\text{ITE LUC 814 Saturday Daily Trip Rate}}$

$$\frac{4.89}{49.97} = \frac{(Y)}{42.04} \quad Y = 4.1139804$$

$T = Y * 8.135$
 $T = \boxed{33}$ vehicle trips
with 52% (17 vph) entering and 48% (16 vph) exiting.
(same distribution split as ITE LUC 820 during the Saturday midday peak hour of generator)

Site Generated Trip Assessment - RE-OCCUPANCY

Project: Proposed Mixed Use Development - Belmont, Massachusetts
Date: October 1, 2012
Analyst: TEC, Inc. / Samuel W. Gregorio, E.I.T.
Source: Institute of Transportation Engineers - Trip Generation - 8th Ed.

Institute of Transportation Engineers (ITE) Land Use Code (LUC) 814 - Specialty Retail

Average Vehicle Trips vs: 1,000 Sq. Feet Gross Leasable Area
Independent Variable (X): 12.065

AVERAGE WEEKDAY DAILY

$T = 44.32 * (X)$
 $T = 44.32 * 12.065$
 $T = \boxed{535}$ vehicle trips
with 50% (268 vpd) entering and 50% (267 vpd) exiting.

WEEKDAY MORNING PEAK HOUR OF ADJACENT STREET TRAFFIC

$\frac{\text{ITE LUC 820 Weekday Morning Trip Rate}}{\text{ITE LUC 820 Weekday Evening Trip Rate}} = \frac{\text{ITE LUC 814 Weekday Morning Trip Rate}}{\text{ITE LUC 814 Weekday Evening Trip Rate}}$

$$\frac{1.00}{3.73} = \frac{(Y)}{2.71} \quad Y = 0.7265416$$

$T = Y * 12.065$
 $T = \boxed{9}$ vehicle trips
with 61% (5 vph) entering and 39% (4 vph) exiting.
(same distribution split as ITE LUC 820 during the weekday morning peak hour of adjacent street traffic)

WEEKDAY EVENING PEAK HOUR OF ADJACENT STREET TRAFFIC

$T = 2.71 * (X)$
 $T = 2.71 * 12.065$
 $T = \boxed{33}$ vehicle trips
with 44% (15 vph) entering and 56% (18 vph) exiting.

SATURDAY DAILY

$T = 42.04 * (X)$
 $T = 42.04 * 12.065$
 $T = \boxed{507}$ vehicle trips
with 50% (254 vpd) entering and 50% (253 vpd) exiting.

SATURDAY MIDDAY PEAK HOUR

$\frac{\text{ITE LUC 820 Saturday Midday Trip Rate}}{\text{ITE LUC 820 Saturday Daily Trip Rate}} = \frac{\text{ITE LUC 814 Saturday Midday Trip Rate}}{\text{ITE LUC 814 Saturday Daily Trip Rate}}$

$$\frac{4.89}{49.97} = \frac{(Y)}{42.04} \quad Y = 4.1139804$$

$T = Y * 12.065$
 $T = \boxed{50}$ vehicle trips
with 52% (26 vph) entering and 48% (24 vph) exiting.
(same distribution split as ITE LUC 820 during the Saturday midday peak hour of generator)

Site Generated Trip Assessment - Existing

Project: Proposed Mixed Use Development - Belmont, Massachusetts
Date: October 1, 2012
Analyst: TEC, Inc. / Samuel W. Gregorio, E.I.T.
Source: Institute of Transportation Engineers - Trip Generation - 8th Ed.

Institute of Transportation Engineers (ITE)

Land Use Code (LUC) 936 - Coffee/Donut Shop without Drive-Through Window

Average Vehicle Trips vs: 1,000 Sq. Feet Gross Floor Area
Independent Variable (X): 2.000

WEEKDAY DAILY

$$\frac{\text{ITE LUC 937 Weekday Daily Trip Rate}}{\text{ITE LUC 937 Weekday Morning Trip Rate}} = \frac{\text{ITE LUC 936 Weekday Daily Trip Rate}}{\text{ITE LUC 936 Weekday Morning Trip Rate}}$$

$$\frac{818.58}{110.75} = \frac{(Y)}{117.23} \quad Y = 866.47525$$

$$T = Y * 2.000$$
$$T = \boxed{1733} \text{ vehicle trips}$$

with 50% (867 vph) entering and 50% (866 vph) exiting.

WEEKDAY MORNING PEAK HOUR OF ADJACENT STREET TRAFFIC

$$T = 117.23 * (X)$$
$$T = 117.23 * 2.000$$
$$T = \boxed{234} \text{ vehicle trips}$$

with 51% (119 vph) entering and 49% (115 vph) exiting.

WEEKDAY EVENING PEAK HOUR OF ADJACENT STREET TRAFFIC

$$T = 40.75 * (X)$$
$$T = 40.75 * 2.00$$
$$T = \boxed{82} \text{ vehicle trips}$$

with 50% (41 vph) entering and 50% (41 vph) exiting.

SATURDAY DAILY

$$\frac{\text{ITE LUC 933 Saturday Daily Trip Rate}}{\text{ITE LUC 933 Saturday Midday Trip Rate}} = \frac{\text{ITE LUC 936 Saturday Daily Trip Rate}}{\text{ITE LUC 933 Saturday Midday Trip Rate}}$$

$$\frac{696.00}{54.55} = \frac{(Y)}{65.96} \quad Y = 841.57947$$

$$T = Y * 2.000$$
$$T = \boxed{1683} \text{ vehicle trips}$$

with 50% (842 vph) entering and 50% (841 vph) exiting.

SATURDAY MIDDAY PEAK HOUR OF GENERATOR

$$T = 65.96 * (X)$$
$$T = 65.96 * 2.000$$
$$T = \boxed{132} \text{ vehicle trips}$$

with 48% (63 vph) entering and 52% (69 vph) exiting.

Site Generated Trip Assessment - RE-OCCUPANCY

Project: Proposed Mixed Use Development - Belmont, Massachusetts
Date: October 1, 2012
Analyst: TEC, Inc. / Samuel W. Gregorio, E.I.T.
Source: Institute of Transportation Engineers - Trip Generation - 8th Ed.

Institute of Transportation Engineers (ITE)

Land Use Code (LUC) 936 - Coffee/Donut Shop without Drive-Through Window

Average Vehicle Trips vs: 1,000 Sq. Feet Gross Floor Area
Independent Variable (X): 2.000

WEEKDAY DAILY

$$\frac{\text{ITE LUC 937 Weekday Daily Trip Rate}}{\text{ITE LUC 937 Weekday Morning Trip Rate}} = \frac{\text{ITE LUC 936 Weekday Daily Trip Rate}}{\text{ITE LUC 936 Weekday Morning Trip Rate}}$$

$$\frac{818.58}{110.75} = \frac{(Y)}{117.23} \quad Y = 866.47525$$

$$T = Y * 2.000$$
$$T = \boxed{1733} \text{ vehicle trips}$$

with 50% (867 vph) entering and 50% (866 vph) exiting.

WEEKDAY MORNING PEAK HOUR OF ADJACENT STREET TRAFFIC

$$T = 117.23 * (X)$$
$$T = 117.23 * 2.000$$
$$T = \boxed{234} \text{ vehicle trips}$$

with 51% (119 vph) entering and 49% (115 vph) exiting.

WEEKDAY EVENING PEAK HOUR OF ADJACENT STREET TRAFFIC

$$T = 40.75 * (X)$$
$$T = 40.75 * 2.00$$
$$T = \boxed{82} \text{ vehicle trips}$$

with 50% (41 vph) entering and 50% (41 vph) exiting.

SATURDAY DAILY

$$\frac{\text{ITE LUC 933 Saturday Daily Trip Rate}}{\text{ITE LUC 933 Saturday Midday Trip Rate}} = \frac{\text{ITE LUC 936 Saturday Daily Trip Rate}}{\text{ITE LUC 933 Saturday Midday Trip Rate}}$$

$$\frac{696.00}{54.55} = \frac{(Y)}{65.96} \quad Y = 841.57947$$

$$T = Y * 2.000$$
$$T = \boxed{1683} \text{ vehicle trips}$$

with 50% (842 vph) entering and 50% (841 vph) exiting.

SATURDAY MIDDAY PEAK HOUR OF GENERATOR

$$T = 65.96 * (X)$$
$$T = 65.96 * 2.000$$
$$T = \boxed{132} \text{ vehicle trips}$$

with 48% (63 vph) entering and 52% (69 vph) exiting.

Trip Generation Assessment - Cushing Square Development Re-Occupancy

Project: Proposed Mixed Use Development - Belmont, Massachusetts
 Date: November 27, 2012
 Analyst: TEC, Inc. / Samuel W. Gregorio, E.I.T.
 Source: Institute of Transportation Engineers - Trip Generation- 8th Ed.

Proposed Development

6,200 SF Pharmacy/Drugstore without Drive-Through

Size:	6.2 KSF							
	Total Trips		Potential Multi-Use Trips		Retail-Retail Trips		Remaining Trips	
	IN	OUT	IN	OUT	IN	OUT	IN	OUT
Weekday Daily	277	277	78	83	0	0	277	277
Weekday AM PH	12	8	2	2	2	2	10	6
Weekday PM PH	26	26	5	5	5	5	21	21
Saturday Daily	354	354	99	106	0	0	354	354
Sat MIDDAY PH	32	34	10	10	10	10	22	24

Interpolated Saturday Daily from Weekday PM PH

Assumed 53% passby rate (Trip Generation Handbook, 2nd Edition).

12,065 SF Specialty Retail (ITE LUC 814)

Size:	12.065 KSF							
	Total Trips		Potential Multi-Use Trips		Retail-Retail Trips		Remaining Trips	
	IN	OUT	IN	OUT	IN	OUT	IN	OUT
Weekday Daily	268	267	75	80	0	0	268	267
Weekday AM PH	5	4	1	1	1	1	4	3
Weekday PM PH	15	18	3	4	3	4	12	14
Saturday Daily	254	253	71	76	0	0	254	253
Sat MIDDAY PH	26	24	8	7	8	7	18	17

1,800 SF Starbucks (ITE LUC 936)

Size:	1.8 KSF							
	Total Trips		Potential Multi-Use Trips		Retail-Retail Trips		Remaining Trips	
	IN	OUT	IN	OUT	IN	OUT	IN	OUT
Weekday Daily	867	866	243	260	0	0	867	866
Weekday AM PH	119	115	24	23	3	3	116	112
Weekday PM PH	41	41	8	8	6	5	35	36
Saturday Daily	842	841	236	252	0	0	842	841
Sat MIDDAY PH	63	69	20	20	12	13	51	56

Assumed 44% passby rate (Trip Generation Handbook, 2nd Edition).

Total 'Retail Uses'

	Total Trips				Retail-Retail Trips		Remaining Trips	
	IN	OUT			IN	OUT	IN	OUT
Weekday Daily	1412	1410			0	0	1412	1410
Weekday AM PH	136	127			6	6	130	121
Weekday PM PH	82	85			14	14	68	71
Saturday Daily	1450	1448			0	0	1450	1448
Sat MIDDAY PH	121	127			30	30	91	97

Maximum Shared Retail to Retail

Development Type	880	814	936
Weekday Daily			
IN			
OUT			
Total			
Weekday Morning			
IN	2	1	24
OUT	2	1	23
Total	4	2	47
Weekday Evening			
IN	5	3	8
OUT	5	4	8
Total	10	7	16
Saturday Daily			
IN			
OUT			
Total			
Saturday MIDDAY			
IN	10	8	20
OUT	10	7	20
Total	20	15	40

Key	
	Most Critical Volume
	↓
	Least Critical Volume

Weekday Daily

	To			
From	880	814	936	Total
880				
814				
936				
Total				

Weekday Morning

	To			
From	880	814	936	Total
880	0	0	2	2
814	0	0	1	1
936	2	1	0	3
Total	2	1	3	6

Weekday Evening

	To			
From	880	814	936	Total
880	0	1	4	5
814	2	0	2	4
936	3	2	0	5
Total	5	3	6	14

Saturday Daily

	To			
From	880	814	936	Total
880				
814				
936				
Total				

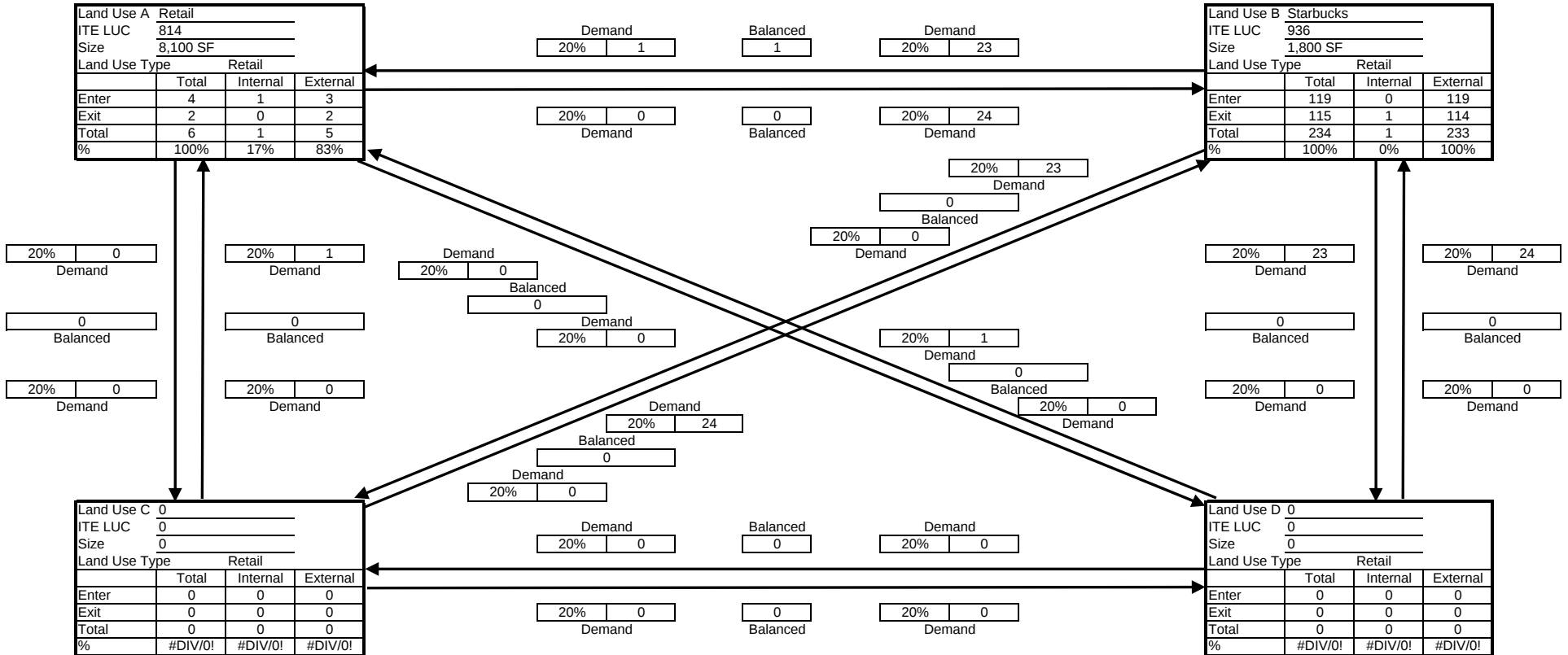
Saturday MIDDAY

	To			
From	880	814	936	Total
880	0	3	7	10
814	2	0	5	7
936	8	5	0	13
Total	10	8	12	30

Multi-Use Trip Generation Calculation

Analyst: TEC, Inc. / Samuel W. G
Date: 11/27/2012

Project Name: Cushing Village
Time Period: Weekday AM Peak Hour



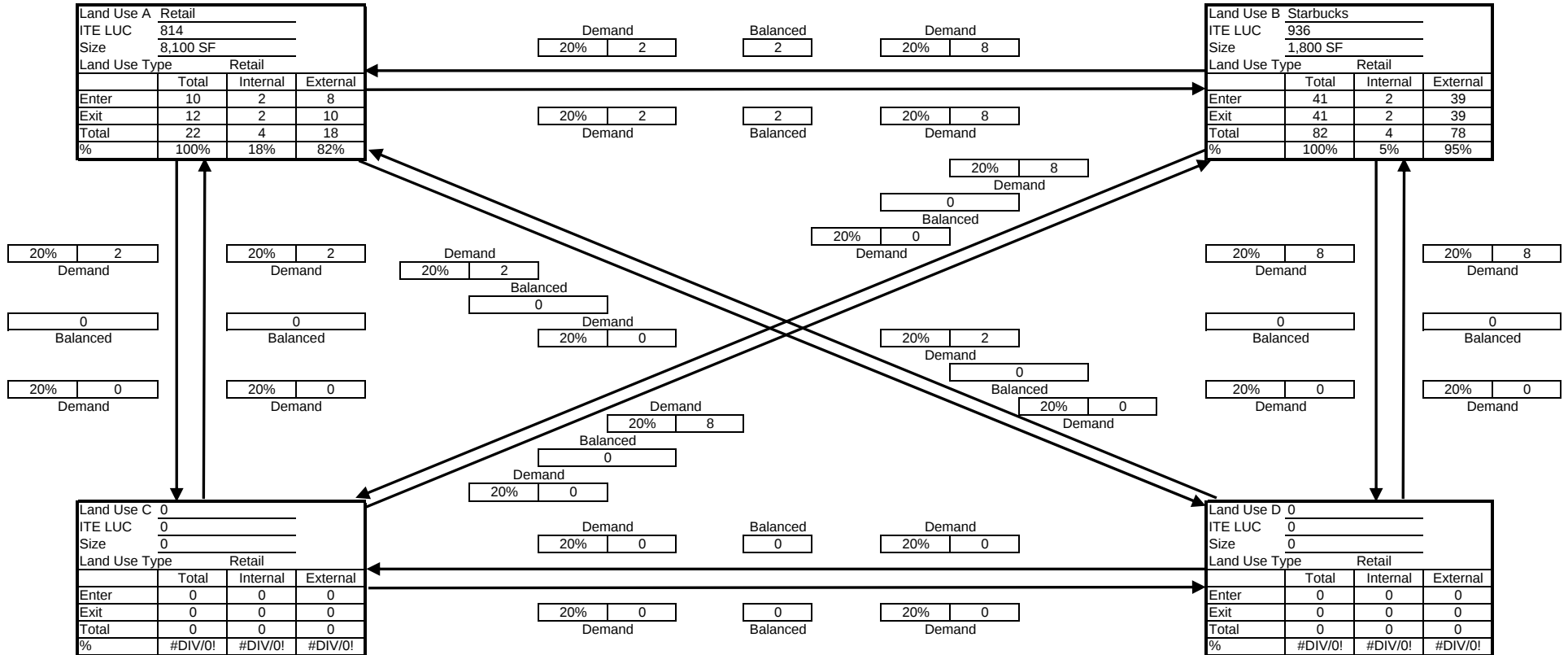
Net External Trips for Multi-Use Development					
Land Use	A	B	C	D	Total
Enter	3	119	0	0	122
Exit	2	114	0	0	116
Total External Trips	5	233	0	0	238
Single-Use Trip Gen. Est.	6	234	0	0	240
Net Internal Trips	1	1	0	0	2

Internal Capture 1%

Multi-Use Trip Generation Calculation

Analyst: TEC, Inc. / Samuel W. G
Date: 11/27/2012

Project Name: Cushing Village
Time Period: Weekday PM Peak Hour



Net External Trips for Multi-Use Development					
Land Use	A	B	C	D	Total
Enter	8	39	0	0	47
Exit	10	39	0	0	49
Total External Trips	18	78	0	0	96
Single-Use Trip Gen. Est.	22	82	0	0	104
Net Internal Trips	4	4	0	0	8

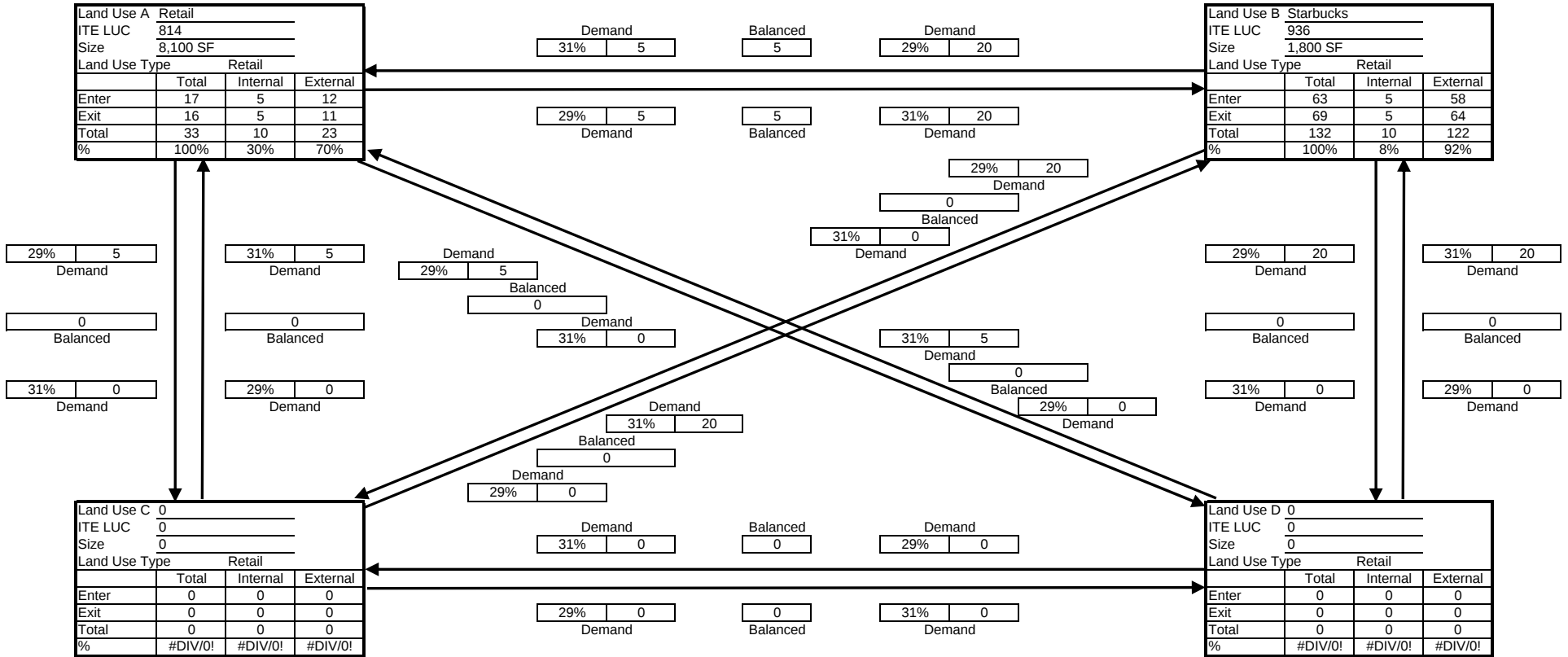
Internal Capture

8%

Multi-Use Trip Generation Calculation

Analyst: TEC, Inc. / Samuel W. G
Date: 11/27/2012

Project Name: Cushing Village
Time Period: Saturday MIDDAY



Net External Trips for Multi-Use Development					
Land Use	A	B	C	D	Total
Enter	12	58	0	0	70
Exit	11	64	0	0	75
Total External Trips	23	122	0	0	145
Single-Use Trip Gen. Est.	33	132	0	0	165
Net Internal Trips	10	10	0	0	20

Internal Capture 12%

Trip Generation Assessment - Proposed Uses vs. Existing / Re-Occupied Uses

Project: Proposed Mixed Use Development - Belmont, Massachusetts
 Date: November 27, 2012
 Analyst: TEC, Inc. / Samuel W. Gregorio, E.I.T.
 Source: Institute of Transportation Engineers - Trip Generation - 8th Ed.

Proposed Development

118 Unit Apartment (ITE LUC 220)

Units:	118 Units													
	Total Trips		Total Trips	% Distribution		Multi-Use Trips		Total New Pass-by Trips	Total New Primary Trips	# Passby Trips		# Primary Trips		
	IN	OUT		IN	OUT	IN	OUT			IN	OUT	IN	OUT	
	Weekday Daily	393	392	785	50%	50%	130	149	0	506	0	0	263	243
	Weekday AM PH	12	48	60	20%	80%	4	12	0	44	0	0	8	36
	Weekday PM PH	47	26	73	65%	35%	15	14	0	44	0	0	32	12
	Saturday Daily	377	377	754	50%	50%	124	143	0	487	0	0	253	234
	Sat Midday PH	31	30	61	50%	50%	11	10	0	40	0	0	20	20

27,200 SF Shopping Center (ITE LUC 820)

Size:	27.2 KSF												
	Total Trips		Total Trips	% Distribution		Multi-Use Trips		Total New Pass-by Trips	Total New Primary Trips	# Passby Trips		# Primary Trips	
	IN	OUT		IN	OUT	IN	OUT			IN	OUT	IN	OUT
	1302	1302	2604	50%	50%	411	379	472	1342	236	236	655	687
	38	24	62	61%	39%	11	6	12	33	6	6	21	12
	118	121	239	49%	51%	19	25	66	129	33	33	66	63
	1807	1806	3613	50%	50%	413	383	732	2085	366	366	1028	1057
	171	158	329	52%	48%	34	38	66	191	33	33	104	87

Assumed 34% pass-by rate for weekday PM and 26% pass-by rate for all others (LUC 820 - Shopping Center - Trip Generation Handbook, 2nd Edition).

3,300 SF Health/Fitness Club (ITE LUC 492)

Size:	3.3 KSF													
	Total Trips		Total Trips	% Distribution		Multi-Use Trips		Total New Pass-by Trips	Total New Primary Trips	# Passby Trips		# Primary Trips		
	IN	OUT		IN	OUT	IN	OUT			IN	OUT	IN	OUT	
	55	54	109	50%	50%	18	19	0	72	0	0	37	35	
	2	3	5	45%	55%	0	0	0	5	0	0	2	3	
	7	5	12	57%	43%	2	1	0	9	0	0	5	4	
	35	34	69	50%	50%	12	11	0	46	0	0	23	23	
	4	5	9	45%	55%	1	1	0	7	0	0	3	4	

Trip Generation Assessment - Proposed Uses vs. Existing / Re-Occupied Uses

Project: Proposed Mixed Use Development - Belmont, Massachusetts
 Date: November 27, 2012
 Analyst: TEC, Inc. / Samuel W. Gregorio, E.I.T.
 Source: Institute of Transportation Engineers - Trip Generation - 8th Ed.

5,000 SF Quality Restaurant (ITE LUC 931)

Size:	5 KSF													
	Total Trips		Total Trips	% Distribution		Multi-Use Trips		Total New Pass-by Trips	Total New Primary Trips	# Passby Trips		# Primary Trips		
	IN	OUT		IN	OUT	IN	OUT			IN	OUT	IN	OUT	
	Weekday Daily	225	225	450	50%	50%	76	79	130	165	65	65	84	81
	Weekday AM PH	2	2	4	50%	50%	0	0	2	2	1	1	1	1
	Weekday PM PH	25	12	37	67%	33%	7	3	12	15	6	6	12	3
	Saturday Daily	220	219	439	50%	50%	72	74	128	165	64	64	84	81
	Sat Midday PH	32	22	54	59%	41%	11	7	16	20	8	8	13	7

Assumed 44% passby rate (Trip Generation Handbook, 2nd Edition).

2,000 SF Starbucks (ITE LUC 936)

Size:	2 KSF												
	Total Trips		Total Trips	% Distribution		Multi-Use Trips		Total New Pass-by Trips	Total New Primary Trips	# Passby Trips		# Primary Trips	
	IN	OUT		IN	OUT	IN	OUT			IN	OUT	IN	OUT
Weekday Daily	867	866	1733	50%	50%	295	304	568	566	284	284	288	278
Weekday AM PH	119	115	234	51%	49%	14	11	104	105	52	52	53	52
Weekday PM PH	41	41	82	50%	50%	11	11	30	30	15	15	15	15
Saturday Daily	842	841	1683	50%	50%	274	284	562	563	281	281	287	276
Sat Midday PH	63	69	132	48%	52%	22	23	44	43	22	22	19	24

Assumed 49% pass-by rate for weekday AM and 50% pass-by rate for all others (LUC 934 - Fast-Food Restaurant with Drive Through - Trip Generation Handbook, 2nd Edition).

Total Proposed

Size:	KSF												
	Total Trips		Total Trips	% Distribution		Multi-Use Trips		Total New Pass-by Trips	Total New Primary Trips	# Passby Trips		# Primary Trips	
	IN	OUT		IN	OUT	IN	OUT			IN	OUT	IN	OUT
Weekday Daily	2842	2839	5681	50%	50%	930	930	1170	2651	585	585	1327	1324
Weekday AM PH	173	192	365	47%	53%	29	29	118	189	59	59	85	104
Weekday PM PH	238	205	443	54%	46%	54	54	108	227	54	54	130	97
Saturday Daily	3281	3277	6558	50%	50%	895	895	1422	3346	711	711	1675	1671
Sat Midday PH	301	284	585	51%	49%	79	79	126	301	63	63	159	142

Full Re-Occupied Uses

6,200 SF Pharmacy/Drugstore without Drive-Thru Window (ITE LUC 880)

Size:	6.2 KSF												
	Total Trips		Total Trips	% Distribution		Multi-Use Trips		Total New Pass-by Trips	Total New Primary Trips	# Passby Trips		# Primary Trips	
	IN	OUT		IN	OUT	IN	OUT			IN	OUT	IN	OUT
Weekday Daily	277	277	554	50%	50%	0	0	294	260	147	147	130	130
Weekday AM PH	12	8	20	59%	41%	2	2	8	8	4	4	6	2
Weekday PM PH	26	26	52	50%	50%	5	5	22	20	11	11	10	10
Saturday Daily	354	354	708	49%	51%	0	0	376	332	188	188	166	166
Sat Midday PH	32	34	66	49%	51%	10	10	24	22	12	12	10	12

Interpolated Saturday Daily from Weekday PM PH

Trip Generation Assessment - Proposed Uses vs. Existing / Re-Occupied Uses

Project: Proposed Mixed Use Development - Belmont, Massachusetts
 Date: November 27, 2012
 Analyst: TEC, Inc. / Samuel W. Gregorio, E.I.T.
 Source: Institute of Transportation Engineers - Trip Generation - 8th Ed.

12,065 SF Specialty Retail (ITE LUC 814)

Size:	12.065 KSF													
	Total Trips		Total Trips	% Distribution		Multi-Use Trips		Total New Pass-by Trips	Total New Primary Trips	# Passby Trips		# Primary Trips		
	IN	OUT		IN	OUT	IN	OUT			IN	OUT	IN	OUT	
	Weekday Daily	268	267	535	50%	50%	0	0	140	395	70	70	198	197
	Weekday AM PH	5	4	9	61%	39%	1	1	2	5	1	1	3	2
	Weekday PM PH	15	18	33	44%	56%	3	4	8	18	4	4	8	10
	Saturday Daily	254	253	507	50%	50%	0	0	132	375	66	66	188	187
	Sat Midday PH	26	24	50	52%	48%	8	7	10	25	5	5	13	12

Interpolated Weekday AM PH from Weekday AM PH LUC 820 - Shopping Center

Assumed 34% pass-by rate for weekday PM and 26% pass-by rate for all others (LUC 820 - Shopping Center - Trip Generation Handbook, 2nd Edition).

1,800 SF Starbucks (ITE LUC 936)

Size:	1.8	KSF												
	Total Trips		Total Trips	% Distribution		Multi-Use Trips		Total New Pass-by Trips	Total New Primary Trips	# Passby Trips		# Primary Trips		
	IN	OUT		IN	OUT	IN	OUT			IN	OUT	IN	OUT	
	Weekday Daily	867	866	1733	50%	50%	0	0	866	867	433	433	434	433
	Weekday AM PH	119	115	234	51%	49%	3	3	112	116	56	56	60	56
	Weekday PM PH	41	41	82	50%	50%	6	5	36	35	18	18	17	18
	Saturday Daily	842	841	1683	50%	50%	0	0	842	841	421	421	421	420
	Sat Midday PH	63	69	132	48%	52%	12	13	54	53	27	27	24	29

Assumed 49% pass-by rate for weekday AM and 50% pass-by rate for all others (LUC 934 - Fast-Food Restaurant with Drive Through - Trip Generation Handbook, 2nd Edition).

Total Reoccupancy

Size:	20.065 KSF													
	Total Trips		Total	% Distribution		Multi-Use Trips		Total New	Total New	# Passby Trips		# Primary Trips		
	IN	OUT	Trips	IN	OUT	IN	OUT	Pass-by Trips	Primary Trips	IN	OUT	IN	OUT	
	Weekday Daily	1412	1410	2822	50%	50%	0	0	1300	1522	650	650	762	760
	Weekday AM PH	136	127	263	52%	48%	6	6	122	129	61	61	69	60
	Weekday PM PH	82	85	167	49%	51%	14	14	66	73	33	33	35	38
	Saturday Daily	1450	1448	2898	50%	50%	0	0	1350	1548	675	675	775	773
	Sat Midday PH	121	127	248	49%	51%	30	30	88	100	44	44	47	53

Net Increase	Total Trips			Total Multi-Use Trips		Total New Pass-by Trips	Total New Primary Trips	Total Pass-by Trips		Total Primary Trips	
				In	Out			In	Out	In	Out
Weekday Daily	2859			930	930	-130	1129	-65	-65	565	564
Weekday AM Peak Hour	102			23	23	-4	60	-2	-2	16	44
Weekday PM Peak Hour	276			40	40	42	154	21	21	95	59
Saturday Daily	3660			895	895	72	1798	36	36	900	898
Sat Midday Peak Hour	337			49	49	38	201	19	19	112	89

Trip Generation Assessment - Cushing Square Development

Project: Proposed Mixed Use Development - Belmont, Massachusetts
 Date: November 27, 2012
 Analyst: TEC, Inc. / Samuel W. Gregorio, E.I.T.
 Source: Institute of Transportation Engineers - Trip Generation - 8th Ed.

Proposed Development

27,200 SF Shopping Center (ITE LUC 820)

Size:	27.2 KSF							
	Total Trips		Potential Multi-Use Trips		Retail-Retail Trips		Remaining Trips	
	IN	OUT	IN	OUT	IN	OUT	IN	OUT
Weekday Daily	1302	1302	365	391	330	307	972	995
Weekday AM PH	38	24	8	5	8	5	30	19
Weekday PM PH	118	121	24	24	11	14	107	107
Saturday Daily	1807	1806	506	542	320	300	1487	1506
Sat MIDDAY PH	171	158	53	46	27	31	144	127

Interpolated Saturday Daily from Weekday PM PH
 Assumed 53% passby rate (Trip Generation Handbook, 2nd Edition).

3,300 SF Health/Fitness Club (ITE LUC 492)

Size:	3.3 KSF							
	Total Trips		Potential Multi-Use Trips		Retail-Retail Trips		Remaining Trips	
	IN	OUT	IN	OUT	IN	OUT	IN	OUT
Weekday Daily	55	54	15	16	15	16	40	38
Weekday AM PH	2	3	0	1	0	0	2	3
Weekday PM PH	7	5	1	1	1	1	6	4
Saturday Daily	35	34	10	10	10	10	25	24
Sat MIDDAY PH	4	5	1	1	1	1	3	4

5,000 SF Quality Restaurant (ITE LUC 931)

Size:	5 KSF							
	Total Trips		Potential Multi-Use Trips		Retail-Retail Trips		Remaining Trips	
	IN	OUT	IN	OUT	IN	OUT	IN	OUT
Weekday Daily	225	225	63	68	63	68	162	157
Weekday AM PH	2	2	0	0	0	0	2	2
Weekday PM PH	25	12	5	2	5	2	20	10
Saturday Daily	220	219	62	66	62	66	158	153
Sat MIDDAY PH	32	22	10	6	10	6	22	16

Assumed 44% passby rate (Trip Generation Handbook, 2nd Edition).

2,000 SF Starbucks (ITE LUC 936)

Size:	2 KSF							
	Total Trips		Potential Multi-Use Trips		Retail-Retail Trips		Remaining Trips	
	IN	OUT	IN	OUT	IN	OUT	IN	OUT
Weekday Daily	867	866	243	260	243	260	624	606
Weekday AM PH	119	115	24	23	5	8	114	107
Weekday PM PH	41	41	8	8	8	8	33	33
Saturday Daily	842	841	236	252	236	252	606	589
Sat MIDDAY PH	63	69	20	20	20	20	43	49

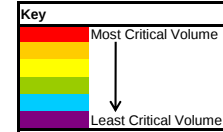
Assumed 34% pass-by rate for weekday PM and 26% pass-by rate for all others (LUC 820 - Shopping Center - Trip Generation Handbook, 2nd Edition).

Total 'Retail Uses'

	Total Trips				Retail-Retail Trips		Remaining Trips	
	IN	OUT			IN	OUT	IN	OUT
Weekday Daily	2449	2447			651	651	1798	1796
Weekday AM PH	161	144			13	13	148	131
Weekday PM PH	191	179			25	25	166	154
Saturday Daily	2904	2900			628	628	2276	2272
Sat MIDDAY PH	270	254			58	58	212	196

Maximum Shared Retail to Retail

Development Type	820	492	931/936
Weekday Daily			
	IN 365	15	306
	OUT 391	16	328
	Total 756	31	634
Weekday Morning			
	IN 8	0	24
	OUT 5	1	23
	Total 13	1	47
Weekday Evening			
	IN 24	1	13
	OUT 24	1	10
	Total 48	2	23
Saturday Daily			
	IN 506	10	298
	OUT 542	10	318
	Total 1,048	20	616
Saturday MIDDAY			
	IN 53	1	30
	OUT 46	1	26
	Total 99	2	56



Weekday Daily

	To			
From	820	492	931/936	Total
820	0	8	299	307
492	9	0	7	16
931/936	321	7	0	328
Total	330	15	306	651

Weekday Morning

	To			
From	820	492	931/936	Total
820	0	0	5	5
492	0	0	0	0
931/936	8	0	0	8
Total	8	0	5	13

Weekday Evening

	To			
From	820	492	931/936	Total
820	0	1	13	14
492	1	0	0	1
931/936	10	0	0	10
Total	11	1	13	25

Saturday Daily

	To			
From	820	492	931/936	Total
820	0	6	294	300
492	6	0	4	10
931/936	314	4	0	318
Total	320	10	298	628

Saturday MIDDAY

	To			
From	820	492	931/936	Total
820	0	1	30	31
492	1	0	0	1
931/936	26	0	0	26
Total	27	1	30	58

Site Generated Trip Assessment - PROPOSED

Project: Proposed Mixed Use Development - Belmont, Massachusetts
Date: October 1, 2012
Analyst: TEC, Inc. / Samuel W. Gregorio, E.I.T.
Source: Institute of Transportation Engineers - Trip Generation - 8th Ed.

Institute of Transportation Engineers (ITE) Land Use Code (LUC) 220 - Apartment

Average Vehicle Trips vs: Dwelling Units
Independent Variable (X): 118

AVERAGE WEEKDAY DAILY

$$\begin{aligned}T &= 6.65 * (X) \\T &= 6.65 * 118 \\T &= \boxed{785} \text{ vehicle trips} \\&\text{with 50\% (393 vpd) entering and 50\% (392 vpd) exiting.}\end{aligned}$$

WEEKDAY MORNING PEAK HOUR OF ADJACENT STREET TRAFFIC

$$\begin{aligned}T &= 0.51 * (X) \\T &= 0.51 * 118 \\T &= \boxed{60} \text{ vehicle trips} \\&\text{with 20\% (12 vph) entering and 80\% (48 vph) exiting.}\end{aligned}$$

WEEKDAY EVENING PEAK HOUR OF ADJACENT STREET TRAFFIC

$$\begin{aligned}T &= 0.62 * (X) \\T &= 0.62 * 118 \\T &= \boxed{73} \text{ vehicle trips} \\&\text{with 65\% (47 vph) entering and 35\% (26 vph) exiting.}\end{aligned}$$

SATURDAY DAILY

$$\begin{aligned}T &= 6.39 * (X) \\T &= 6.39 * 118 \\T &= \boxed{754} \text{ vehicle trips} \\&\text{with 50\% (377 vpd) entering and 50\% (377 vpd) exiting.}\end{aligned}$$

SATURDAY MIDDAY PEAK HOUR OF GENERATOR

$$\begin{aligned}T &= 0.52 * (X) \\T &= 0.52 * 118 \\T &= \boxed{61} \text{ vehicle trips} \\&\text{with 50\% (31 vph) entering and 50\% (30 vph) exiting.}\end{aligned}$$

Site Generated Trip Assessment - RE-OCCUPIED

Project: Proposed Mixed Use Development - Belmont, Massachusetts
Date: October 1, 2012
Analyst: TEC, Inc. / Samuel W. Gregorio, E.I.T.
Source: Institute of Transportation Engineers - Trip Generation - 8th Ed.

Institute of Transportation Engineers (ITE)

Land Use Code (LUC) 880 - Pharmacy/Drugstore without Drive-Through Window

Average Vehicle Trips vs: 1,000 Sq. Feet Gross Floor Area
Independent Variable (X): 6.200

AVERAGE WEEKDAY DAILY

$$\ln(T) = 0.99 \ln(X) + 4.51$$

$$\ln(T) = 0.99 * \ln(6.20) + 4.51$$

$$\ln(T) = 6.32$$

$$T = \boxed{554} \text{ vehicle trips}$$

with 50% (277) entering trips & (277 vpd) exiting.

WEEKDAY MORNING PEAK HOUR OF ADJACENT STREET TRAFFIC

$$T = 3.20 * (X)$$

$$T = 3.20 * 6.20$$

$$T = \boxed{20} \text{ vehicle trips}$$

with 59% (12) entering trips & (8 vph) exiting.

WEEKDAY EVENING PEAK HOUR OF ADJACENT STREET TRAFFIC

$$T = 8.42 * (X)$$

$$T = 8.42 * 6.20$$

$$T = \boxed{52} \text{ vehicle trips}$$

with 50% (26) entering trips & (26 vph) exiting.

SATURDAY DAILY

$$\frac{\text{ITE LUC 880 Weekday Daily Trip Rate}}{\text{ITE LUC 880 Weekday Evening Trip Rate}} = \frac{\text{ITE LUC 880 Saturday Daily Trip Rate}}{\text{ITE LUC 880 Saturday Midday Trip Rate}}$$

$$\frac{90.06}{8.42} = \frac{(Y)}{10.68} \quad Y = 114.2329$$

$$T = Y * 6.200$$

$$T = \boxed{708} \text{ vehicle trips}$$

with 50% (354 vph) entering and 50% (354 vph) exiting.

(same distribution split as ITE LUC 880 during the weekday daily)

SATURDAY MIDDAY PEAK HOUR OF GENERATOR

$$T = 10.68 * (X)$$

$$T = 10.68 * 6.20$$

$$T = \boxed{66} \text{ vehicle trips}$$

with 49% (32) entering trips & (34 vph) exiting.

Site Generated Trip Assessment - PROPOSED

Project: Proposed Mixed Use Development - Belmont, Massachusetts
Date: October 1, 2012
Analyst: TEC, Inc. / Samuel W. Gregorio, E.I.T.
Source: Institute of Transportation Engineers - Trip Generation - 8th Ed.

Institute of Transportation Engineers (ITE) Land Use Code (LUC) 492 - Health/Fitness Club

Average Vehicle Trips vs: 1,000 Sq. Feet Gross Floor Area
Independent Variable (X): 3.300

AVERAGE WEEKDAY DAILY

$$T = 32.93 * (X)$$

$$T = 32.93 * 3.300$$

$$T = \boxed{109} \text{ vehicle trips}$$

with 50% (55 vpd) entering and 50% 54 vpd) exiting.

WEEKDAY MORNING PEAK HOUR OF ADJACENT STREET TRAFFIC

$$T = 1.38 * (X)$$

$$T = 1.38 * 3.300$$

$$T = \boxed{5} \text{ vehicle trips}$$

with 45% (2 vph) entering and 55% 3 vph) exiting.

WEEKDAY EVENING PEAK HOUR OF ADJACENT STREET TRAFFIC

$$T = 3.53 * (X)$$

$$T = 3.53 * 3.30$$

$$T = \boxed{12} \text{ vehicle trips}$$

with 57% (7 vph) entering and 43% 5 vph) exiting.

SATURDAY DAILY

$$T = 20.87 * (X)$$

$$T = 20.87 * 3.30$$

$$T = \boxed{69} \text{ vehicle trips}$$

with 50% (35 vpd) entering and 50% 34 vpd) exiting.

SATURDAY MIDDAY PEAK HOUR OF GENERATOR

$$T = 2.87 * (X)$$

$$T = 2.87 * 3.300$$

$$T = \boxed{9} \text{ vehicle trips}$$

with 45% (4 vph) entering and 55% 5 vph) exiting.

Site Generated Trip Assessment - PROPOSED

Project: Proposed Mixed Use Development - Belmont, Massachusetts
Date: October 1, 2012
Analyst: TEC, Inc. / Samuel W. Gregorio, E.I.T.
Source: Institute of Transportation Engineers - Trip Generation - 8th Ed.

Institute of Transportation Engineers (ITE) Land Use Code (LUC) 931 - Quality Restaurant

Average Vehicle Trips vs: 1,000 Sq. Feet Gross Floor Area
Independent Variable (X): 5.000

AVERAGE WEEKDAY DAILY

$$T = 89.95 * (X)$$
$$T = 89.95 * 5.000$$
$$T = \boxed{450} \text{ vehicle trips}$$

with 50% (225 vpd) entering and 50% 225 vpd) exiting.

WEEKDAY MORNING PEAK HOUR OF ADJACENT STREET TRAFFIC

$$T = 0.81 * (X)$$
$$T = 0.81 * 5.000$$
$$T = \boxed{4} \text{ vehicle trips}$$

with 50% (2 vph) entering and 50% 2 vph) exiting.

WEEKDAY EVENING PEAK HOUR OF ADJACENT STREET TRAFFIC

$$T = 7.49 * (X)$$
$$T = 7.49 * 5.00$$
$$T = \boxed{37} \text{ vehicle trips}$$

with 67% (25 vph) entering and 33% 12 vph) exiting.

SATURDAY DAILY

$$\ln(T) = 1.04 \ln(X) + 4.41$$
$$\ln(T) = 1.04 * \ln(5.00) + 4.41$$
$$\ln(T) = 6.08$$
$$T = \boxed{439} \text{ vehicle trips}$$

with 50% (220 vpd) entering and 50% 219 vpd) exiting.

SATURDAY MIDDAY PEAK HOUR OF GENERATOR

$$T = 10.82 * (X)$$
$$T = 10.82 * 5.000$$
$$T = \boxed{54} \text{ vehicle trips}$$

with 59% (32 vph) entering and 41% 22 vph) exiting.

Site Generated Trip Assessment - RE-OCCUPIED

Project: Proposed Mixed Use Development - Belmont, Massachusetts
Date: October 1, 2012
Analyst: TEC, Inc. / Samuel W. Gregorio, E.I.T.
Source: Institute of Transportation Engineers - Trip Generation - 8th Ed.

Institute of Transportation Engineers (ITE) Land Use Code (LUC) 814 - Specialty Retail

Average Vehicle Trips vs: 1,000 Sq. Feet Gross Leasable Area
Independent Variable (X): 12.065

AVERAGE WEEKDAY DAILY

$T = 44.32 * (X)$
 $T = 44.32 * 12.065$
 $T = \boxed{535}$ vehicle trips
with 50% (268 vpd) entering and 50% (267 vpd) exiting.

WEEKDAY MORNING PEAK HOUR OF ADJACENT STREET TRAFFIC

$\frac{\text{ITE LUC 820 Weekday Morning Trip Rate}}{\text{ITE LUC 820 Weekday Evening Trip Rate}} = \frac{\text{ITE LUC 814 Weekday Morning Trip Rate}}{\text{ITE LUC 814 Weekday Evening Trip Rate}}$

$$\frac{1.00}{3.73} = \frac{(Y)}{2.71} \quad Y = 0.7265416$$

$T = Y * 12.065$
 $T = \boxed{9}$ vehicle trips
with 61% (5 vph) entering and 39% (4 vph) exiting.
(same distribution split as ITE LUC 820 during the weekday morning peak hour of adjacent street traffic)

WEEKDAY EVENING PEAK HOUR OF ADJACENT STREET TRAFFIC

$T = 2.71 * (X)$
 $T = 2.71 * 12.065$
 $T = \boxed{33}$ vehicle trips
with 44% (15 vph) entering and 56% (18 vph) exiting.

SATURDAY DAILY

$T = 42.04 * (X)$
 $T = 42.04 * 12.065$
 $T = \boxed{507}$ vehicle trips
with 50% (254 vpd) entering and 50% (253 vpd) exiting.

SATURDAY MIDDAY PEAK HOUR

$\frac{\text{ITE LUC 820 Saturday Midday Trip Rate}}{\text{ITE LUC 820 Saturday Daily Trip Rate}} = \frac{\text{ITE LUC 814 Saturday Midday Trip Rate}}{\text{ITE LUC 814 Saturday Daily Trip Rate}}$

$$\frac{4.89}{49.97} = \frac{(Y)}{42.04} \quad Y = 4.1139804$$

$T = Y * 12.065$
 $T = \boxed{50}$ vehicle trips
with 52% (26 vph) entering and 48% (24 vph) exiting.
(same distribution split as ITE LUC 820 during the Saturday midday peak hour of generator)

Site Generated Trip Assessment - PROPOSED

Project: Proposed Mixed Use Development - Belmont, Massachusetts
Date: October 1, 2012
Analyst: TEC, Inc. / Samuel W. Gregorio, E.I.T.
Source: Institute of Transportation Engineers - Trip Generation - 8th Ed.

Institute of Transportation Engineers (ITE) ITE Land Use Code (LUC) 820 - Shopping Center

Average Vehicle Trips vs: 1,000 Sq. Feet Gross Floor Area
Independent Variable (X): **37.5** **27.2**

AVERAGE WEEKDAY DAILY

$$\ln T = 0.65 * \ln(X) + 5.83$$

$$\ln T = 0.65 * \ln(37.500) + 5.83$$

$$\ln T = 8.19$$

$$T = \begin{matrix} \mathbf{3,590} \\ \text{with 50\% (1,795 vpd) entering and 50\% (1,795 vpd) exiting.} \end{matrix} \begin{matrix} \text{vehicle trips} \\ \mathbf{2604} \\ \mathbf{1,302} \end{matrix}$$

WEEKDAY MORNING PEAK HOUR OF ADJACENT STREET TRAFFIC

$$\ln T = 0.59 * \ln(X) + 2.32$$

$$\ln T = 0.59 * \ln(37.500) + 2.32$$

$$\ln T = 4.46$$

$$T = \begin{matrix} \mathbf{86} \\ \text{with 61\% (52 vph) entering and 39\% (34 vph) exiting.} \end{matrix} \begin{matrix} \text{vehicle trips} \\ \mathbf{62} \\ \mathbf{38} \end{matrix}$$

WEEKDAY EVENING PEAK HOUR OF ADJACENT STREET TRAFFIC

$$\ln T = 0.67 * \ln(X) + 3.37$$

$$\ln T = 0.67 * \ln(37.50) + 3.37$$

$$\ln T = 5.80$$

$$T = \begin{matrix} \mathbf{330} \\ \text{with 49\% (162 vph) entering and 51\% (168 vph) exiting.} \end{matrix} \begin{matrix} \text{vehicle trips} \\ \mathbf{239} \\ \mathbf{118} \end{matrix}$$

SATURDAY DAILY

$$\ln T = 0.63 * \ln(X) + 6.23$$

$$\ln T = 0.63 * \ln(37.50) + 6.23$$

$$\ln T = 8.51$$

$$T = \begin{matrix} \mathbf{4,981} \\ \text{with 50\% (2,491 vpd) entering and 50\% (2,490 vpd) exiting.} \end{matrix} \begin{matrix} \text{vehicle trips} \\ \mathbf{3613} \\ \mathbf{1,807} \end{matrix}$$

SATURDAY MIDDAY PEAK HOUR OF GENERATOR

$$\ln T = 0.65 * \ln(X) + 3.76$$

$$\ln T = 0.65 * \ln(37.500) + 3.76$$

$$\ln T = 6.12$$

$$T = \begin{matrix} \mathbf{453} \\ \text{with 52\% (236 vph) entering and 48\% (217 vph) exiting.} \end{matrix} \begin{matrix} \text{vehicle trips} \\ \mathbf{329} \\ \mathbf{171} \end{matrix}$$

Site Generated Trip Assessment - RE-OCCUPIED

Project: Proposed Mixed Use Development - Belmont, Massachusetts
Date: November 28, 2012
Analyst: TEC, Inc. / Samuel W. Gregorio, E.I.T.
Source: Institute of Transportation Engineers - Trip Generation - 8th Ed.

Institute of Transportation Engineers (ITE)

Land Use Code (LUC) 936 - Coffee/Donut Shop without Drive-Through Window

Average Vehicle Trips vs: 1,000 Sq. Feet Gross Floor Area
Independent Variable (X): 2.000

WEEKDAY DAILY

$$\frac{\text{ITE LUC 937 Weekday Daily Trip Rate}}{\text{ITE LUC 937 Weekday Morning Trip Rate}} = \frac{\text{ITE LUC 936 Weekday Daily Trip Rate}}{\text{ITE LUC 936 Weekday Morning Trip Rate}}$$

$$\frac{818.58}{110.75} = \frac{(Y)}{117.23} \quad Y = 866.47525$$

$$T = Y * 2.000$$
$$T = \boxed{1733} \text{ vehicle trips}$$

with 50% (867 vph) entering and 50% (866 vph) exiting.

WEEKDAY MORNING PEAK HOUR OF ADJACENT STREET TRAFFIC

$$T = 117.23 * (X)$$
$$T = 117.23 * 2.000$$
$$T = \boxed{234} \text{ vehicle trips}$$

with 51% (119 vph) entering and 49% (115 vph) exiting.

WEEKDAY EVENING PEAK HOUR OF ADJACENT STREET TRAFFIC

$$T = 40.75 * (X)$$
$$T = 40.75 * 2.00$$
$$T = \boxed{82} \text{ vehicle trips}$$

with 50% (41 vph) entering and 50% (41 vph) exiting.

SATURDAY DAILY

$$\frac{\text{ITE LUC 933 Saturday Daily Trip Rate}}{\text{ITE LUC 933 Saturday Midday Trip Rate}} = \frac{\text{ITE LUC 936 Saturday Daily Trip Rate}}{\text{ITE LUC 933 Saturday Midday Trip Rate}}$$

$$\frac{696.00}{54.55} = \frac{(Y)}{65.96} \quad Y = 841.57947$$

$$T = Y * 2.000$$
$$T = \boxed{1683} \text{ vehicle trips}$$

with 50% (842 vph) entering and 50% (841 vph) exiting.

SATURDAY MIDDAY PEAK HOUR OF GENERATOR

$$T = 65.96 * (X)$$
$$T = 65.96 * 2.000$$
$$T = \boxed{132} \text{ vehicle trips}$$

with 48% (63 vph) entering and 52% (69 vph) exiting.

Site Generated Trip Assessment - PROPOSED

Project: Proposed Mixed Use Development - Belmont, Massachusetts
Date: October 1, 2012
Analyst: TEC, Inc. / Samuel W. Gregorio, E.I.T.
Source: Institute of Transportation Engineers - Trip Generation - 8th Ed.

Institute of Transportation Engineers (ITE)

Land Use Code (LUC) 936 - Coffee/Donut Shop without Drive-Through Window

Average Vehicle Trips vs: 1,000 Sq. Feet Gross Floor Area
Independent Variable (X): 2.000

WEEKDAY DAILY

$$\frac{\text{ITE LUC 937 Weekday Daily Trip Rate}}{\text{ITE LUC 937 Weekday Morning Trip Rate}} = \frac{\text{ITE LUC 936 Weekday Daily Trip Rate}}{\text{ITE LUC 936 Weekday Morning Trip Rate}}$$

$$\frac{818.58}{110.75} = \frac{(Y)}{117.23} \quad Y = 866.47525$$

$$T = Y * 2.000$$
$$T = \boxed{1733} \text{ vehicle trips}$$

with 50% (867 vph) entering and 50% (866 vph) exiting.

WEEKDAY MORNING PEAK HOUR OF ADJACENT STREET TRAFFIC

$$T = 117.23 * (X)$$
$$T = 117.23 * 2.000$$
$$T = \boxed{234} \text{ vehicle trips}$$

with 51% (119 vph) entering and 49% (115 vph) exiting.

WEEKDAY EVENING PEAK HOUR OF ADJACENT STREET TRAFFIC

$$T = 40.75 * (X)$$
$$T = 40.75 * 2.00$$
$$T = \boxed{82} \text{ vehicle trips}$$

with 50% (41 vph) entering and 50% (41 vph) exiting.

SATURDAY DAILY

$$\frac{\text{ITE LUC 933 Saturday Daily Trip Rate}}{\text{ITE LUC 933 Saturday Midday Trip Rate}} = \frac{\text{ITE LUC 936 Saturday Daily Trip Rate}}{\text{ITE LUC 933 Saturday Midday Trip Rate}}$$

$$\frac{696.00}{54.55} = \frac{(Y)}{65.96} \quad Y = 841.57947$$

$$T = Y * 2.000$$
$$T = \boxed{1683} \text{ vehicle trips}$$

with 50% (842 vph) entering and 50% (841 vph) exiting.

SATURDAY MIDDAY PEAK HOUR OF GENERATOR

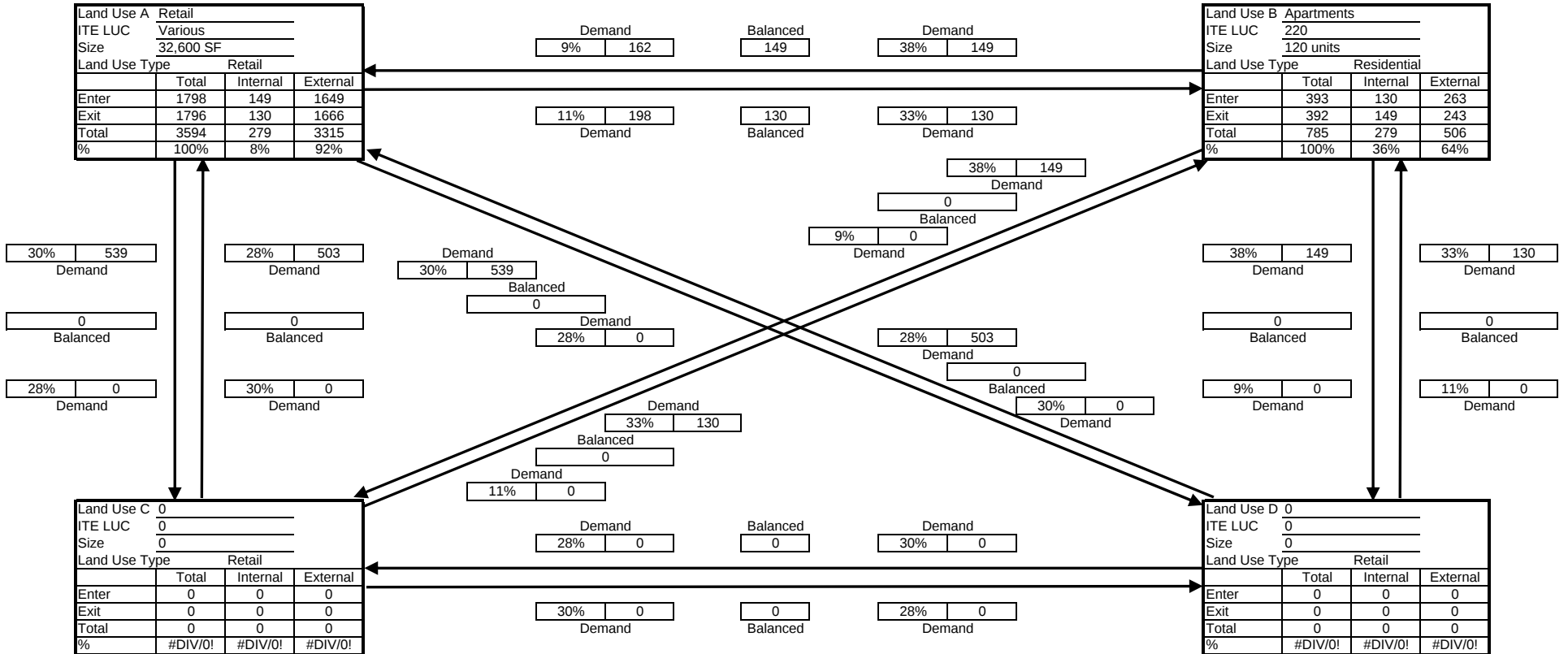
$$T = 65.96 * (X)$$
$$T = 65.96 * 2.000$$
$$T = \boxed{132} \text{ vehicle trips}$$

with 48% (63 vph) entering and 52% (69 vph) exiting.

Multi-Use Trip Generation Calculation

Analyst: TEC, Inc. / Samuel W. G
Date: 10/1/2012

Project Name: Cushing Village
Time Period: Weekday Daily



Net External Trips for Multi-Use Development					
Land Use	A	B	C	D	Total
Enter	1649	263	0	0	1912
Exit	1666	243	0	0	1909
Total External Trips	3315	506	0	0	3821
Single-Use Trip Gen. Est.	3594	785	0	0	4379
Net Internal Trips	279	279	0	0	558

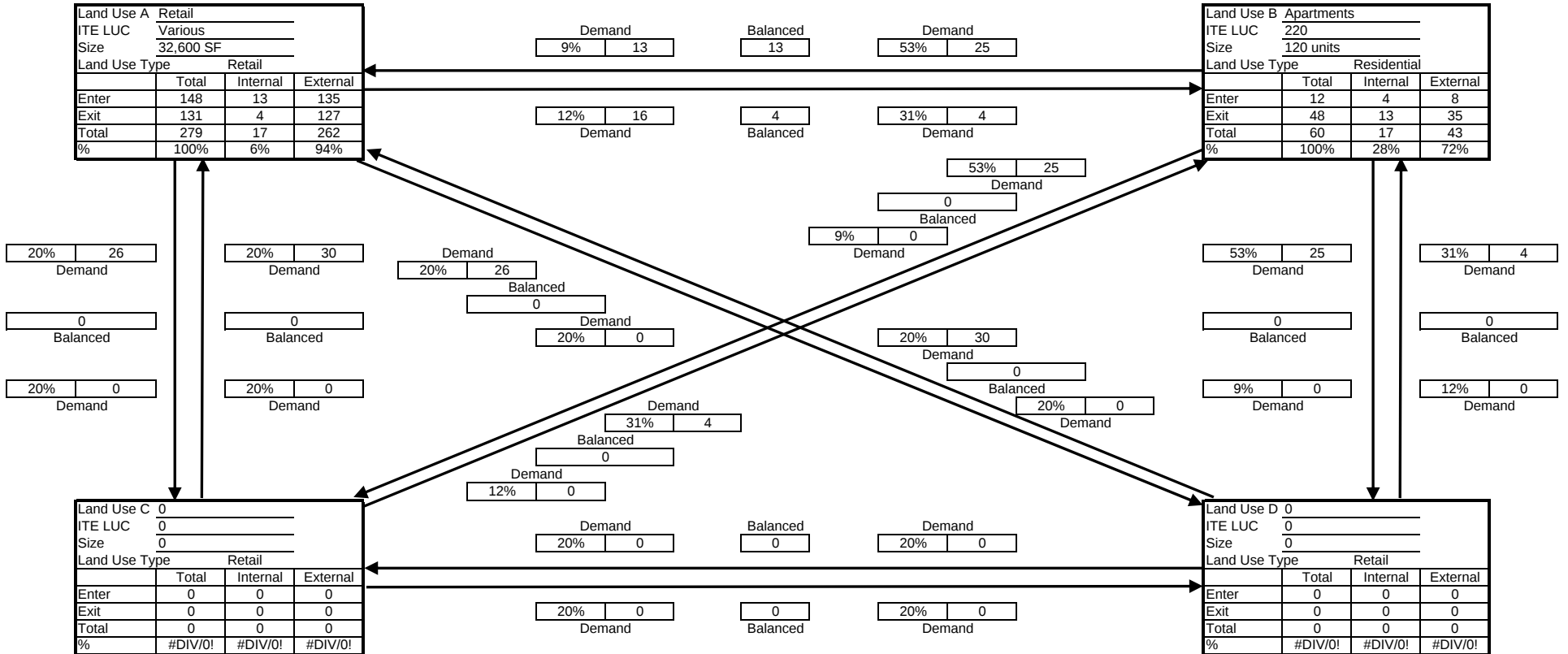
Internal Capture

13%

Multi-Use Trip Generation Calculation

Analyst: TEC, Inc. / Samuel W. G
Date: 10/1/2012

Project Name: Cushing Village
Time Period: Weekday AM Peak Hour



Net External Trips for Multi-Use Development					
Land Use	A	B	C	D	Total
Enter	135	8	0	0	143
Exit	127	35	0	0	162
Total External Trips	262	43	0	0	305
Single-Use Trip Gen. Est.	279	60	0	0	339
Net Internal Trips	17	17	0	0	34

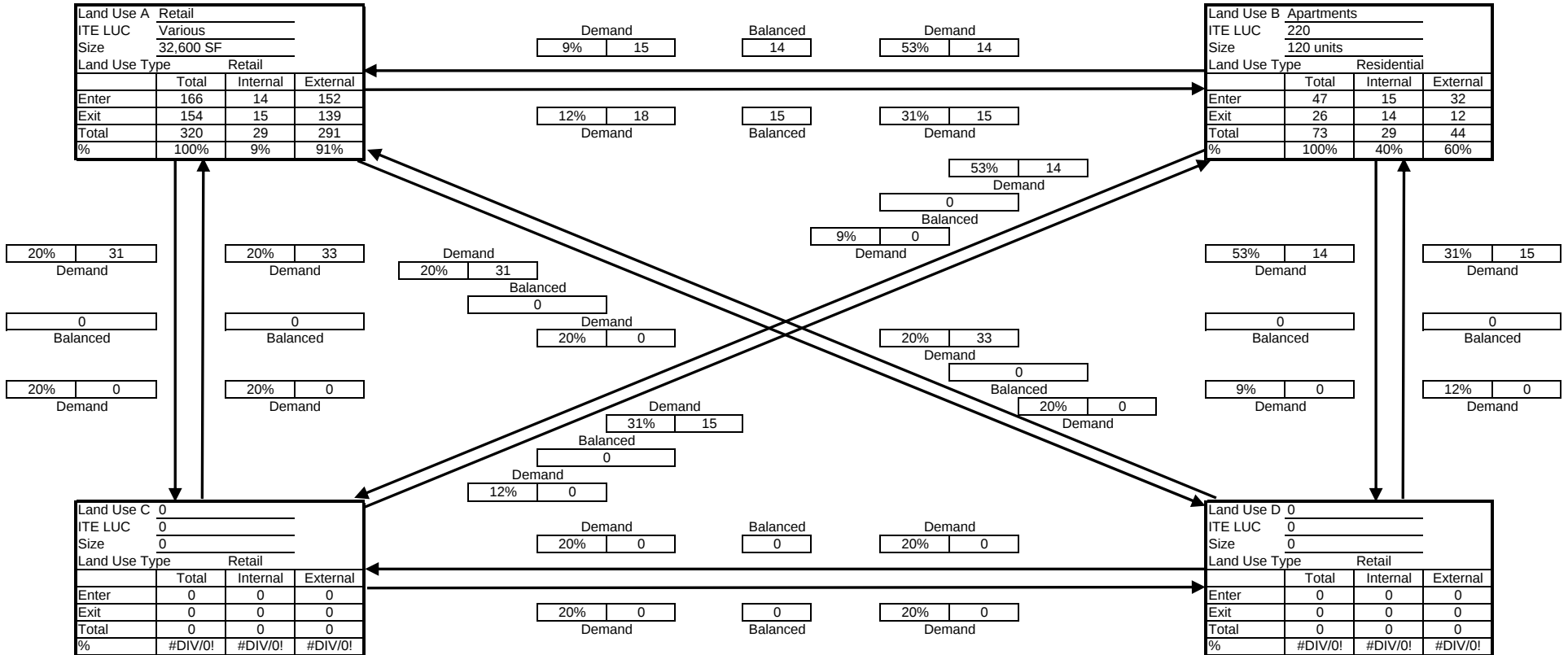
Internal Capture

10%

Multi-Use Trip Generation Calculation

Analyst: TEC, Inc. / Samuel W. G
Date: 10/1/2012

Project Name: Cushing Village
Time Period: Weekday PM Peak Hour



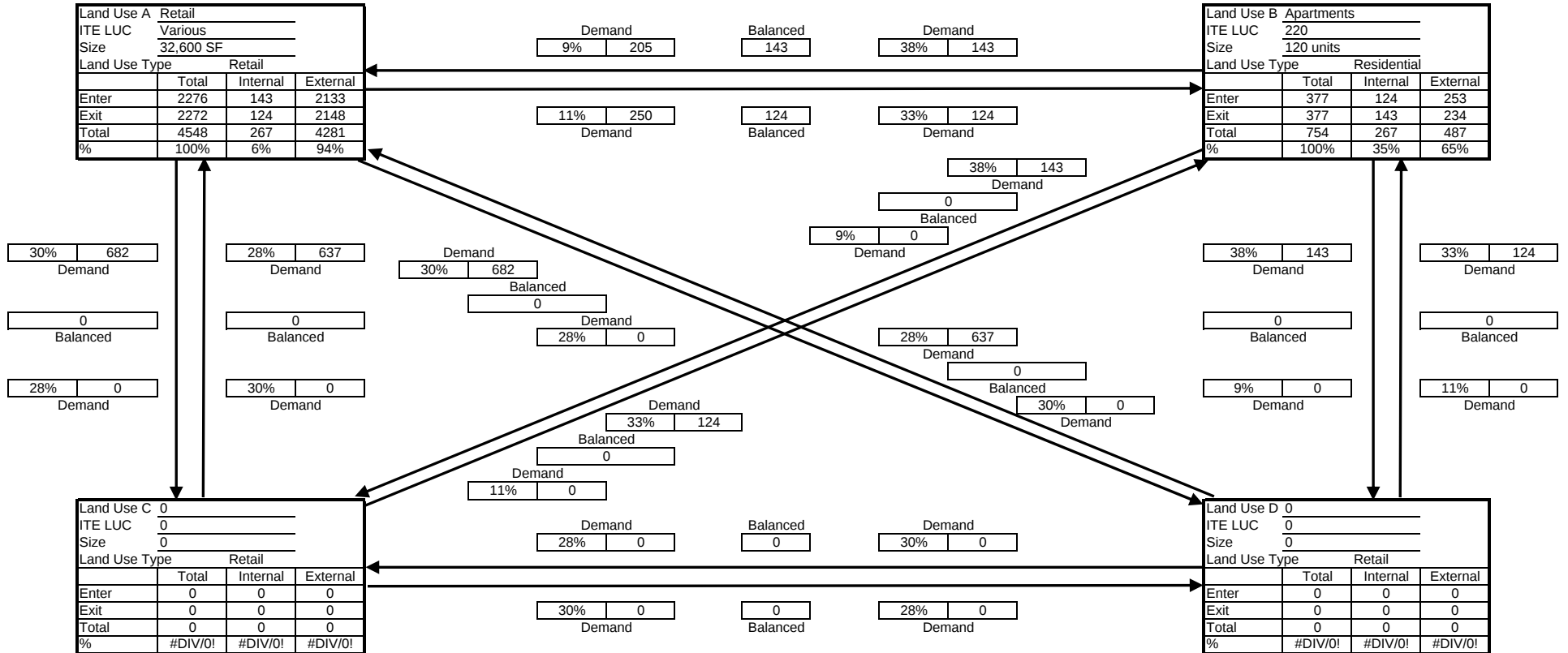
Net External Trips for Multi-Use Development					
Land Use	A	B	C	D	Total
Enter	152	32	0	0	184
Exit	139	12	0	0	151
Total External Trips	291	44	0	0	335
Single-Use Trip Gen. Est.	320	73	0	0	393
Net Internal Trips	29	29	0	0	58

Internal Capture 15%

Multi-Use Trip Generation Calculation

Analyst: TEC, Inc. / Samuel W. G
Date: 10/1/2012

Project Name: Cushing Village
Time Period: Saturday Daily



Net External Trips for Multi-Use Development					
Land Use	A	B	C	D	Total
Enter	2133	253	0	0	2386
Exit	2148	234	0	0	2382
Total External Trips	4281	487	0	0	4768
Single-Use Trip Gen. Est.	4548	754	0	0	5302
Net Internal Trips	267	267	0	0	534

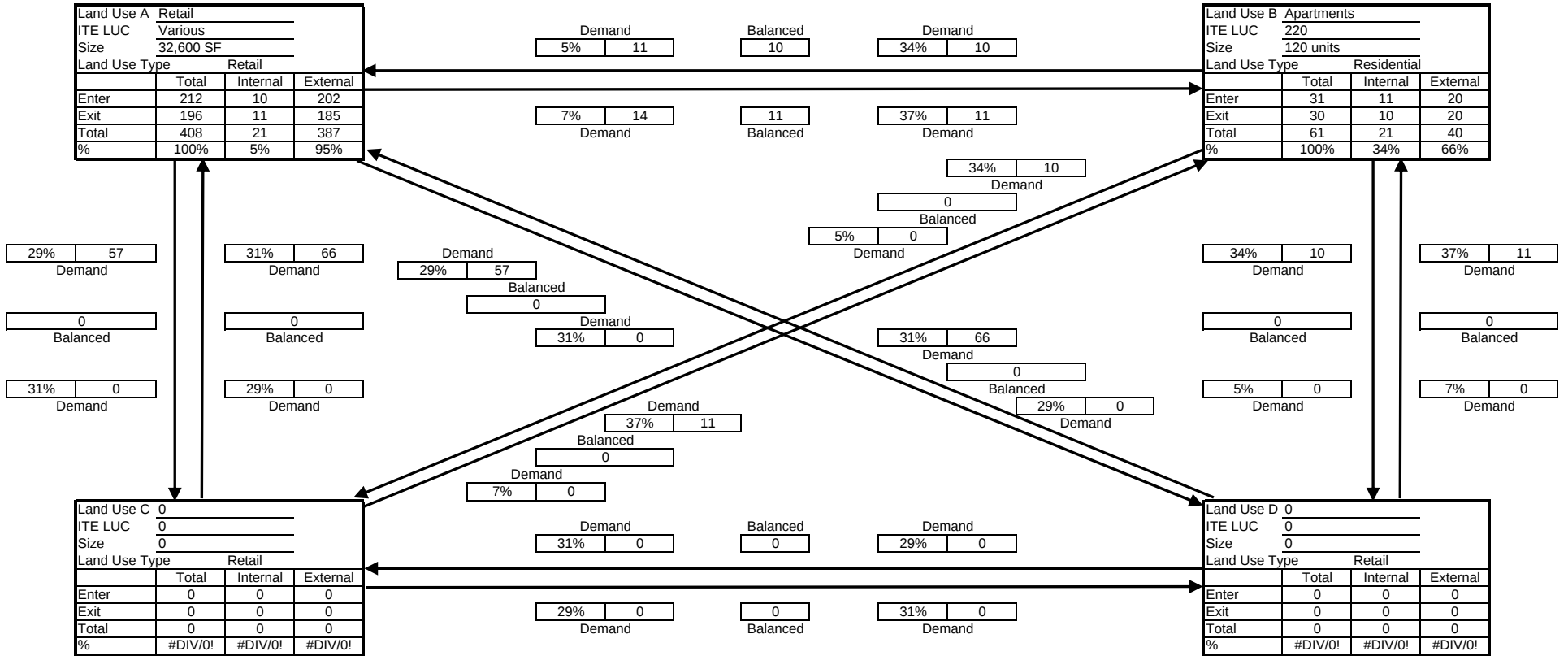
Internal Capture

10%

Multi-Use Trip Generation Calculation

Analyst: TEC, Inc. / Samuel W. G
Date: 10/1/2012

Project Name: Cushing Village
Time Period: Saturday Middy



Net External Trips for Multi-Use Development					
Land Use	A	B	C	D	Total
Enter	202	20	0	0	222
Exit	185	20	0	0	205
Total External Trips	387	40	0	0	427
Single-Use Trip Gen. Est.	408	61	0	0	469
Net Internal Trips	21	21	0	0	42

Internal Capture

9%

Attachment C

Intersection Capacity Analyses

2017 No-Build

Lanes, Volumes, Timings
1: Trapelo Road & Cushing Avenue

2017 No-Build Conditions

Weekday Morning

												
Lane Group	EBL2	EBL	EBT	EBR	WBL	WBT	WBR	WBR2	NBL	NBT	NBR	NBR2
Lane Configurations												
Volume (vph)	78	17	711	42	19	377	100	2	18	128	4	20
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	10	10	11	11	10	11	11	11	10	11	11	11
Storage Length (ft)		0		0	105		0		0		0	
Storage Lanes		1		0	1		0		1		0	
Taper Length (ft)		25		25	25		25		25		25	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.992			0.968				0.976		
Flt Protected		0.950			0.950				0.950			
Satd. Flow (prot)	0	1671	1560	0	1685	1528	0	0	1685	1763	0	0
Flt Permitted		0.185			0.086				0.950			
Satd. Flow (perm)	0	325	1560	0	153	1528	0	0	1685	1763	0	0
Right Turn on Red				Yes				Yes				Yes
Satd. Flow (RTOR)			3							6		
Link Speed (mph)			30			30				30		
Link Distance (ft)			300			221				274		
Travel Time (s)			6.8			5.0				6.2		
Peak Hour Factor	0.95	0.95	0.95	0.95	0.82	0.82	0.82	0.82	0.77	0.77	0.77	0.77
Heavy Vehicles (%)	1%	0%	2%	5%	0%	2%	1%	0%	0%	2%	0%	0%
Parking (#/hr)			5	5		5	5	5				
Shared Lane Traffic (%)												
Turn Type	pm+pt	pm+pt			pm+pt				Prot			
Protected Phases	5	5	2		1	6			3	8		
Permitted Phases	2	2			6							
Detector Phase	5	5	2		1	6			3	8		
Switch Phase												
Minimum Initial (s)	3.0	3.0	12.0		3.0	12.0			6.0	12.0		
Minimum Split (s)	6.0	6.0	30.0		6.0	30.0			13.0	28.5		
Total Split (s)	8.0	8.0	56.0	0.0	8.0	56.0	0.0	0.0	22.0	34.0	0.0	0.0
Total Split (%)	6.7%	6.7%	46.7%	0.0%	6.7%	46.7%	0.0%	0.0%	18.3%	28.3%	0.0%	0.0%
Maximum Green (s)	5.0	5.0	49.0		5.0	49.0			15.0	27.0		
Yellow Time (s)	3.0	3.0	4.0		3.0	4.0			3.5	3.5		
All-Red Time (s)	0.0	0.0	3.0		0.0	3.0			3.5	3.5		
Lost Time Adjust (s)	1.0	1.0	-3.0	0.0	1.0	-3.0	0.0	0.0	-3.0	-3.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lead	Lag		Lead	Lag			Lead	Lag		
Lead-Lag Optimize?	Yes	Yes	Yes		Yes	Yes			Yes	Yes		
Vehicle Extension (s)	2.0	2.0	2.0		2.0	2.0			2.0	2.0		
Recall Mode	None	None	Min		None	Min			None	None		
Walk Time (s)			7.0			7.0				7.0		
Flash Dont Walk (s)			16.0			16.0				14.5		
Pedestrian Calls (#/hr)			0			0				0		

Intersection Summary

Area Type: Other
Cycle Length: 120
Actuated Cycle Length: 106
Natural Cycle: 120

Lanes, Volumes, Timings
1: Trapelo Road & Cushing Avenue

2017 No-Build Conditions

Weekday Morning

				
Lane Group	SBL2	SBL	SBT	SBR
Lane Configurations				
Volume (vph)	7	222	235	87
Ideal Flow (vphpl)	1900	1900	1900	1900
Lane Width (ft)	11	11	11	16
Storage Length (ft)		0		50
Storage Lanes		1		1
Taper Length (ft)		25		25
Lane Util. Factor	1.00	1.00	1.00	1.00
Frt				0.850
Flt Protected		0.950		
Satd. Flow (prot)	0	1745	1618	1629
Flt Permitted		0.950		
Satd. Flow (perm)	0	1745	1618	1629
Right Turn on Red				Yes
Satd. Flow (RTOR)				49
Link Speed (mph)			30	
Link Distance (ft)			873	
Travel Time (s)			19.8	
Peak Hour Factor	0.94	0.94	0.94	0.94
Heavy Vehicles (%)	0%	0%	1%	0%
Parking (#/hr)			2	2
Shared Lane Traffic (%)				
Turn Type	Prot	Prot		pm+ov
Protected Phases	7	7	4	5
Permitted Phases				4
Detector Phase	7	7	4	5
Switch Phase				
Minimum Initial (s)	6.0	6.0	12.0	3.0
Minimum Split (s)	13.0	13.0	28.5	6.0
Total Split (s)	22.0	22.0	34.0	8.0
Total Split (%)	18.3%	18.3%	28.3%	6.7%
Maximum Green (s)	15.0	15.0	27.0	5.0
Yellow Time (s)	3.5	3.5	3.5	3.0
All-Red Time (s)	3.5	3.5	3.5	0.0
Lost Time Adjust (s)	-3.0	-3.0	-3.0	1.0
Total Lost Time (s)	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lead	Lag	Lead
Lead-Lag Optimize?	Yes	Yes	Yes	Yes
Vehicle Extension (s)	2.0	2.0	2.0	2.0
Recall Mode	None	None	None	None
Walk Time (s)			7.0	
Flash Dont Walk (s)			14.5	
Pedestrian Calls (#/hr)			0	
Intersection Summary				

Lanes, Volumes, Timings
 1: Trapelo Road & Cushing Avenue

2017 No-Build Conditions
 Weekday Morning

Control Type: Actuated-Uncoordinated

Splits and Phases: 1: Trapelo Road & Cushing Avenue

 ø1	 ø2		 ø3		 ø4	
8 s	56 s		22 s		34 s	
 ø5	 ø6		 ø7		 ø8	
8 s	56 s		22 s		34 s	

Queues

2017 No-Build Conditions

1: Trapelo Road & Cushing Avenue

Weekday Morning

									
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	100	792	23	584	23	197	243	250	93
v/c Ratio	0.46	1.01	0.18	0.84	0.15	0.60	0.82	0.45	0.13
Control Delay	21.3	61.8	15.9	38.6	49.4	46.9	66.0	33.0	12.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	21.3	61.8	15.9	38.6	49.4	46.9	66.0	33.0	12.9
Queue Length 50th (ft)	32	479	7	336	15	122	162	123	16
Queue Length 95th (ft)	67	#935	20	471	37	166	#331	245	59
Internal Link Dist (ft)		220		141		194		793	
Turn Bay Length (ft)			105						50
Base Capacity (vph)	219	787	133	753	288	506	298	552	708
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.46	1.01	0.17	0.78	0.08	0.39	0.82	0.45	0.13

Intersection Summary

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

HCM Signalized Intersection Capacity Analysis

2017 No-Build Conditions

1: Trapelo Road & Cushing Avenue

Weekday Morning

												
Movement	EBL2	EBL	EBT	EBR	WBL	WBT	WBR	WBR2	NBL	NBT	NBR	NBR2
Lane Configurations												
Volume (vph)	78	17	711	42	19	377	100	2	18	128	4	20
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	10	10	11	11	10	11	11	11	10	11	11	11
Total Lost time (s)		4.0	4.0		4.0	4.0			4.0	4.0		
Lane Util. Factor		1.00	1.00		1.00	1.00			1.00	1.00		
Frt		1.00	0.99		1.00	0.97			1.00	0.98		
Flt Protected		0.95	1.00		0.95	1.00			0.95	1.00		
Satd. Flow (prot)		1671	1560		1685	1529			1685	1764		
Flt Permitted		0.18	1.00		0.09	1.00			0.95	1.00		
Satd. Flow (perm)		325	1560		153	1529			1685	1764		
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.82	0.82	0.82	0.82	0.77	0.77	0.77	0.77
Adj. Flow (vph)	82	18	748	44	23	460	122	2	23	166	5	26
RTOR Reduction (vph)	0	0	2	0	0	0	0	0	0	5	0	0
Lane Group Flow (vph)	0	100	790	0	23	584	0	0	23	192	0	0
Heavy Vehicles (%)	1%	0%	2%	5%	0%	2%	1%	0%	0%	2%	0%	0%
Parking (#/hr)			5	5		5	5	5				
Turn Type	pm+pt	pm+pt			pm+pt				Prot			
Protected Phases	5	5	2		1	6			3	8		
Permitted Phases	2	2			6							
Actuated Green, G (s)		55.3	50.4		49.2	47.3			2.8	20.9		
Effective Green, g (s)		53.4	53.4		47.2	50.3			5.8	23.9		
Actuated g/C Ratio		0.48	0.48		0.42	0.45			0.05	0.21		
Clearance Time (s)		3.0	7.0		3.0	7.0			7.0	7.0		
Vehicle Extension (s)		2.0	2.0		2.0	2.0			2.0	2.0		
Lane Grp Cap (vph)		202	742		77	685			87	375		
v/s Ratio Prot		c0.02	c0.51		0.00	0.38			0.01	0.11		
v/s Ratio Perm		0.22			0.12							
v/c Ratio		0.50	1.07		0.30	0.85			0.26	0.51		
Uniform Delay, d1		20.7	29.4		26.2	27.7			51.2	39.1		
Progression Factor		1.00	1.00		1.00	1.00			1.00	1.00		
Incremental Delay, d2		0.7	51.8		0.8	9.7			0.6	0.5		
Delay (s)		21.4	81.3		26.9	37.4			51.8	39.5		
Level of Service		C	F		C	D			D	D		
Approach Delay (s)			74.6			37.0				40.8		
Approach LOS			E			D				D		
Intersection Summary												
HCM Average Control Delay			54.1			HCM Level of Service				D		
HCM Volume to Capacity ratio			0.86									
Actuated Cycle Length (s)			112.3			Sum of lost time (s)				12.0		
Intersection Capacity Utilization			79.3%			ICU Level of Service				D		
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

1: Trapelo Road & Cushing Avenue

2017 No-Build Conditions

Weekday Morning

				
Movement	SBL2	SBL	SBT	SBR
Lane Configurations				
Volume (vph)	7	222	235	87
Ideal Flow (vphpl)	1900	1900	1900	1900
Lane Width	11	11	11	16
Total Lost time (s)		4.0	4.0	4.0
Lane Util. Factor		1.00	1.00	1.00
Frt		1.00	1.00	0.85
Flt Protected		0.95	1.00	1.00
Satd. Flow (prot)		1745	1618	1629
Flt Permitted		0.95	1.00	1.00
Satd. Flow (perm)		1745	1618	1629
Peak-hour factor, PHF	0.94	0.94	0.94	0.94
Adj. Flow (vph)	7	236	250	93
RTOR Reduction (vph)	0	0	0	33
Lane Group Flow (vph)	0	243	250	60
Heavy Vehicles (%)	0%	0%	1%	0%
Parking (#/hr)			2	2
Turn Type	Prot	Prot	pm+ov	
Protected Phases	7	7	4	5
Permitted Phases				4
Actuated Green, G (s)		15.1	33.2	38.2
Effective Green, g (s)		18.1	36.2	36.2
Actuated g/C Ratio		0.16	0.32	0.32
Clearance Time (s)		7.0	7.0	3.0
Vehicle Extension (s)		2.0	2.0	2.0
Lane Grp Cap (vph)		281	522	525
v/s Ratio Prot		c0.14	c0.15	0.00
v/s Ratio Perm				0.03
v/c Ratio		0.86	0.48	0.11
Uniform Delay, d1		45.9	30.5	26.8
Progression Factor		1.00	1.00	1.00
Incremental Delay, d2		22.4	0.3	0.0
Delay (s)		68.3	30.7	26.8
Level of Service		E	C	C
Approach Delay (s)			45.7	
Approach LOS			D	
Intersection Summary				

Lanes, Volumes, Timings
3: Trapelo Road & Williston Road

2017 No-Build Conditions
Weekday Morning

						
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	839	26	26	457	13	18
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	16	16	11	11	13	13
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.996				0.922	
Flt Protected				0.997	0.979	
Satd. Flow (prot)	1872	0	0	1614	1713	0
Flt Permitted				0.997	0.979	
Satd. Flow (perm)	1872	0	0	1614	1713	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	121			300	276	
Travel Time (s)	2.8			6.8	6.3	
Peak Hour Factor	0.94	0.94	0.89	0.89	0.78	0.78
Heavy Vehicles (%)	2%	0%	0%	1%	0%	6%
Parking (#/hr)	2	2	2	2		
Shared Lane Traffic (%)						
Sign Control	Free			Free	Stop	
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					

HCM Unsignalized Intersection Capacity Analysis

3: Trapelo Road & Williston Road

2017 No-Build Conditions

Weekday Morning

						
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	839	26	26	457	13	18
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.94	0.94	0.89	0.89	0.78	0.78
Hourly flow rate (vph)	893	28	29	513	17	23
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (ft)				300		
pX, platoon unblocked					0.71	
vC, conflicting volume			920		1478	906
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			920		1469	906
tC, single (s)			4.1		6.4	6.3
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.4
p0 queue free %			96		83	93
cM capacity (veh/h)			750		97	329
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	920	543	40			
Volume Left	0	29	17			
Volume Right	28	0	23			
cSH	1700	750	164			
Volume to Capacity	0.54	0.04	0.24			
Queue Length 95th (ft)	0	3	23			
Control Delay (s)	0.0	1.1	33.9			
Lane LOS		A	D			
Approach Delay (s)	0.0	1.1	33.9			
Approach LOS			D			
Intersection Summary						
Average Delay			1.3			
Intersection Capacity Utilization			55.7%	ICU Level of Service		B
Analysis Period (min)			15			

Lanes, Volumes, Timings
4: Horne Road & Common Street

2017 No-Build Conditions
Weekday Morning

						
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	8	20	10	210	250	6
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	11	16	16	11	11
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.903				0.997	
Flt Protected	0.986			0.998		
Satd. Flow (prot)	1635	0	0	1886	1598	0
Flt Permitted	0.986			0.998		
Satd. Flow (perm)	1635	0	0	1886	1598	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	310			211	274	
Travel Time (s)	7.0			4.8	6.2	
Peak Hour Factor	0.65	0.65	0.88	0.88	0.82	0.82
Heavy Vehicles (%)	0%	0%	10%	1%	2%	0%
Parking (#/hr)			2	2	2	2
Shared Lane Traffic (%)						
Sign Control	Stop			Free	Free	
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					

HCM Unsignalized Intersection Capacity Analysis

4: Horne Road & Common Street

2017 No-Build Conditions

Weekday Morning

						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	8	20	10	210	250	6
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.65	0.65	0.88	0.88	0.82	0.82
Hourly flow rate (vph)	12	31	11	239	305	7
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage (veh)						
Upstream signal (ft)				211	274	
pX, platoon unblocked	0.91	0.89	0.89			
vC, conflicting volume	570	309	312			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	365	155	159			
tC, single (s)	6.4	6.2	4.2			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.3			
p0 queue free %	98	96	99			
cM capacity (veh/h)	575	794	1216			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	43	250	312			
Volume Left	12	11	0			
Volume Right	31	0	7			
cSH	716	1216	1700			
Volume to Capacity	0.06	0.01	0.18			
Queue Length 95th (ft)	5	1	0			
Control Delay (s)	10.4	0.4	0.0			
Lane LOS	B	A				
Approach Delay (s)	10.4	0.4	0.0			
Approach LOS	B					
Intersection Summary						
Average Delay			0.9			
Intersection Capacity Utilization			29.2%	ICU Level of Service		A
Analysis Period (min)			15			

Lanes, Volumes, Timings
5: Horne Road & Williston Road

2017 No-Build Conditions
Weekday Morning

						
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	9	10	7	6	29	9
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	10	10	10	10	10	10
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.939		0.968	
Flt Protected		0.977			0.963	
Satd. Flow (prot)	0	1472	1482	0	1471	0
Flt Permitted		0.977			0.963	
Satd. Flow (perm)	0	1472	1482	0	1471	0
Link Speed (mph)		30	30		30	
Link Distance (ft)		596	310		276	
Travel Time (s)		13.5	7.0		6.3	
Peak Hour Factor	0.83	0.83	0.65	0.65	0.77	0.77
Heavy Vehicles (%)	10%	0%	0%	0%	0%	0%
Parking (#/hr)	2	2	2	2	2	2
Shared Lane Traffic (%)						
Sign Control		Free	Free		Stop	
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					

HCM Unsignalized Intersection Capacity Analysis

5: Horne Road & Williston Road

2017 No-Build Conditions

Weekday Morning

						
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	9	10	7	6	29	9
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.83	0.83	0.65	0.65	0.77	0.77
Hourly flow rate (vph)	11	12	11	9	38	12
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	20				49	15
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	20				49	15
tC, single (s)	4.2				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.3				3.5	3.3
p0 queue free %	99				96	99
cM capacity (veh/h)	1546				958	1070
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	23	20	49			
Volume Left	11	0	38			
Volume Right	0	9	12			
cSH	1546	1700	983			
Volume to Capacity	0.01	0.01	0.05			
Queue Length 95th (ft)	1	0	4			
Control Delay (s)	3.5	0.0	8.9			
Lane LOS	A		A			
Approach Delay (s)	3.5	0.0	8.9			
Approach LOS			A			
Intersection Summary						
Average Delay			5.6			
Intersection Capacity Utilization			17.7%	ICU Level of Service		A
Analysis Period (min)			15			

Lanes, Volumes, Timings
6: Horne Road & Poplar Street

2017 No-Build Conditions
Weekday Morning

						
Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	13	5	83	18	4	16
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	10	10	12	12	12	12
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.961		0.976			
Flt Protected	0.966					0.990
Satd. Flow (prot)	1465	0	1633	0	0	1674
Flt Permitted	0.966					0.990
Satd. Flow (perm)	1465	0	1633	0	0	1674
Link Speed (mph)	30		30			30
Link Distance (ft)	596		290			271
Travel Time (s)	13.5		6.6			6.2
Peak Hour Factor	0.75	0.75	0.77	0.77	0.68	0.68
Heavy Vehicles (%)	0%	0%	0%	6%	0%	0%
Parking (#/hr)	2	2	2	2	2	2
Shared Lane Traffic (%)						
Sign Control	Stop		Free			Free

Intersection Summary

Area Type: Other
Control Type: Unsignalized

HCM Unsignalized Intersection Capacity Analysis

6: Horne Road & Poplar Street

2017 No-Build Conditions
Weekday Morning

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	13	5	83	18	4	16
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.75	0.75	0.77	0.77	0.68	0.68
Hourly flow rate (vph)	17	7	108	23	6	24
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	155	119			131	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	155	119			131	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	98	99			100	
cM capacity (veh/h)	838	938			1467	
Direction, Lane #	WB 1	NB 1	SB 1			
Volume Total	24	131	29			
Volume Left	17	0	6			
Volume Right	7	23	0			
cSH	863	1700	1467			
Volume to Capacity	0.03	0.08	0.00			
Queue Length 95th (ft)	2	0	0			
Control Delay (s)	9.3	0.0	1.5			
Lane LOS	A		A			
Approach Delay (s)	9.3	0.0	1.5			
Approach LOS	A					
Intersection Summary						
Average Delay			1.4			
Intersection Capacity Utilization			15.5%	ICU Level of Service		A
Analysis Period (min)			15			

Lanes, Volumes, Timings
7: Belmont Street & Common Street

2017 No-Build Conditions

Weekday Morning

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	120	579	5	11	367	16	8	49	8	24	50	196
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	11	11	11	12	12	12	10	11	11
Storage Length (ft)	0		0	0		80	0		60	50		0
Storage Lanes	0		0	0		1	0		1	1		1
Taper Length (ft)	25		25	25		25	25		25	25		25
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.999				0.850			0.850		0.880	
Flt Protected		0.992			0.999			0.993		0.950		
Satd. Flow (prot)	0	1883	0	0	1817	1561	0	1871	1615	1499	1427	0
Flt Permitted		0.858			0.980			0.705		0.603		
Satd. Flow (perm)	0	1629	0	0	1783	1561	0	1328	1615	952	1427	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						11			21		179	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		736			971			731			211	
Travel Time (s)		16.7			22.1			16.6			4.8	
Peak Hour Factor	0.94	0.94	0.94	0.89	0.89	0.89	0.39	0.39	0.39	0.86	0.86	0.86
Heavy Vehicles (%)	0%	0%	0%	0%	1%	0%	0%	1%	0%	0%	0%	1%
Parking (#/hr)										2	2	2
Shared Lane Traffic (%)												
Turn Type	Perm			Perm		Prot	Perm		Prot	Perm		
Protected Phases		4			8	8		2	2		6	
Permitted Phases	4			8			2			6		
Detector Phase	4	4		8	8	8	2	2	2	6	6	
Switch Phase												
Minimum Initial (s)	10.0	10.0		10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	
Minimum Split (s)	15.0	15.0		15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	
Total Split (s)	55.0	55.0	0.0	55.0	55.0	55.0	35.0	35.0	35.0	35.0	35.0	0.0
Total Split (%)	50.0%	50.0%	0.0%	50.0%	50.0%	50.0%	31.8%	31.8%	31.8%	31.8%	31.8%	0.0%
Maximum Green (s)	50.0	50.0		50.0	50.0	50.0	30.0	30.0	30.0	30.0	30.0	
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
All-Red Time (s)	1.0	1.0		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
Lost Time Adjust (s)	-1.0	-1.0	0.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Recall Mode	Min	Min		Min	Min	Min	None	None	None	None	None	
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Intersection Summary												
Area Type:	Other											
Cycle Length: 110												
Actuated Cycle Length: 73.1												
Natural Cycle: 90												

Lanes, Volumes, Timings
7: Belmont Street & Common Street

2017 No-Build Conditions
Weekday Morning

Lane Group ø9

Lane Configurations

Volume (vph)

Ideal Flow (vphpl)

Lane Width (ft)

Storage Length (ft)

Storage Lanes

Taper Length (ft)

Lane Util. Factor

Frt

Flt Protected

Satd. Flow (prot)

Flt Permitted

Satd. Flow (perm)

Right Turn on Red

Satd. Flow (RTOR)

Link Speed (mph)

Link Distance (ft)

Travel Time (s)

Peak Hour Factor

Heavy Vehicles (%)

Parking (#/hr)

Shared Lane Traffic (%)

Turn Type

Protected Phases 9

Permitted Phases

Detector Phase

Switch Phase

Minimum Initial (s) 4.0

Minimum Split (s) 20.0

Total Split (s) 20.0

Total Split (%) 18%

Maximum Green (s) 14.0

Yellow Time (s) 4.0

All-Red Time (s) 2.0

Lost Time Adjust (s)

Total Lost Time (s)

Lead/Lag

Lead-Lag Optimize?

Vehicle Extension (s) 3.0

Recall Mode None

Walk Time (s) 7.0

Flash Dont Walk (s) 7.0

Pedestrian Calls (#/hr) 0

Intersection Summary

Lanes, Volumes, Timings
 7: Belmont Street & Common Street

2017 No-Build Conditions
 Weekday Morning

Control Type: Actuated-Uncoordinated

Splits and Phases: 7: Belmont Street & Common Street

 ø2	 ø4	 ø9
35 s	55 s	20 s
 ø6	 ø8	
35 s	55 s	

Queues

2017 No-Build Conditions

7: Belmont Street & Common Street

Weekday Morning

							
Lane Group	EBT	WBT	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	749	424	18	147	21	28	286
v/c Ratio	0.66	0.34	0.02	0.58	0.06	0.15	0.69
Control Delay	10.5	5.8	3.1	36.4	10.9	26.1	19.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	10.5	5.8	3.1	36.4	10.9	26.1	19.8
Queue Length 50th (ft)	138	56	1	61	0	11	43
Queue Length 95th (ft)	356	135	8	44	3	30	107
Internal Link Dist (ft)	656	891		651			131
Turn Bay Length (ft)			80		60	50	
Base Capacity (vph)	1140	1247	1095	565	699	405	710
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.66	0.34	0.02	0.26	0.03	0.07	0.40
Intersection Summary							

HCM Signalized Intersection Capacity Analysis

2017 No-Build Conditions

7: Belmont Street & Common Street

Weekday Morning

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	120	579	5	11	367	16	8	49	8	24	50	196
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	11	11	11	12	12	12	10	11	11
Total Lost time (s)		4.0			4.0	4.0		4.0	4.0	4.0	4.0	
Lane Util. Factor		1.00			1.00	1.00		1.00	1.00	1.00	1.00	
Frt		1.00			1.00	0.85		1.00	0.85	1.00	0.88	
Flt Protected		0.99			1.00	1.00		0.99	1.00	0.95	1.00	
Satd. Flow (prot)		1882			1816	1561		1870	1615	1499	1428	
Flt Permitted		0.86			0.98	1.00		0.71	1.00	0.60	1.00	
Satd. Flow (perm)		1629			1782	1561		1329	1615	952	1428	
Peak-hour factor, PHF	0.94	0.94	0.94	0.89	0.89	0.89	0.39	0.39	0.39	0.86	0.86	0.86
Adj. Flow (vph)	128	616	5	12	412	18	21	126	21	28	58	228
RTOR Reduction (vph)	0	0	0	0	0	3	0	0	17	0	145	0
Lane Group Flow (vph)	0	749	0	0	424	15	0	147	4	28	141	0
Heavy Vehicles (%)	0%	0%	0%	0%	1%	0%	0%	1%	0%	0%	0%	1%
Parking (#/hr)										2	2	2
Turn Type	Perm			Perm		Prot	Perm		Prot	Perm		
Protected Phases		4			8	8		2	2		6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		50.1			50.1	50.1		12.9	12.9	12.9	12.9	
Effective Green, g (s)		51.1			51.1	51.1		13.9	13.9	13.9	13.9	
Actuated g/C Ratio		0.70			0.70	0.70		0.19	0.19	0.19	0.19	
Clearance Time (s)		5.0			5.0	5.0		5.0	5.0	5.0	5.0	
Vehicle Extension (s)		3.0			3.0	3.0		3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		1140			1247	1093		253	308	181	272	
v/s Ratio Prot						0.01			0.00		0.10	
v/s Ratio Perm		c0.46			0.24			c0.11		0.03		
v/c Ratio		0.66			0.34	0.01		0.58	0.01	0.15	0.52	
Uniform Delay, d1		6.1			4.3	3.3		26.9	24.0	24.6	26.5	
Progression Factor		1.00			1.00	1.00		1.00	1.00	1.00	1.00	
Incremental Delay, d2		1.4			0.2	0.0		3.4	0.0	0.4	1.7	
Delay (s)		7.5			4.5	3.3		30.3	24.0	25.0	28.2	
Level of Service		A			A	A		C	C	C	C	
Approach Delay (s)		7.5			4.4			29.5			27.9	
Approach LOS		A			A			C			C	
Intersection Summary												
HCM Average Control Delay			12.7				HCM Level of Service			B		
HCM Volume to Capacity ratio			0.64									
Actuated Cycle Length (s)			73.0				Sum of lost time (s)			8.0		
Intersection Capacity Utilization			82.0%				ICU Level of Service			E		
Analysis Period (min)			15									
c Critical Lane Group												

Lanes, Volumes, Timings
1: Trapelo Road & Cushing Avenue

2017 No-Build Conditions

Weekday Evening

												
Lane Group	EBL2	EBL	EBT	EBR	WBL	WBT	WBR	WBR2	NBL	NBT	NBR	NBR2
Lane Configurations												
Volume (vph)	78	21	463	68	24	613	139	10	71	238	14	33
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	10	10	11	11	10	11	11	11	10	11	11	11
Storage Length (ft)		0		0	105		0		0		0	
Storage Lanes		1		0	1		0		1		0	
Taper Length (ft)		25		25	25		25		25		25	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.981			0.971				0.975		
Flt Protected		0.950			0.950				0.950			
Satd. Flow (prot)	0	1671	1563	0	1685	1548	0	0	1685	1776	0	0
Flt Permitted		0.075			0.257				0.950			
Satd. Flow (perm)	0	132	1563	0	456	1548	0	0	1685	1776	0	0
Right Turn on Red				Yes				Yes				Yes
Satd. Flow (RTOR)			8			1				5		
Link Speed (mph)			30			30				30		
Link Distance (ft)			300			221				274		
Travel Time (s)			6.8			5.0				6.2		
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.87	0.87	0.87	0.87
Heavy Vehicles (%)	1%	0%	1%	0%	0%	1%	0%	0%	0%	1%	0%	0%
Parking (#/hr)			5	5		5	5	5				
Shared Lane Traffic (%)												
Turn Type	pm+pt	pm+pt			pm+pt				Prot			
Protected Phases	5	5	2		1	6			3	8		
Permitted Phases	2	2			6							
Detector Phase	5	5	2		1	6			3	8		
Switch Phase												
Minimum Initial (s)	3.0	3.0	12.0		3.0	12.0			6.0	12.0		
Minimum Split (s)	6.0	6.0	30.0		6.0	30.0			13.0	28.5		
Total Split (s)	11.0	11.0	56.0	0.0	11.0	56.0	0.0	0.0	21.0	32.0	0.0	0.0
Total Split (%)	9.2%	9.2%	46.7%	0.0%	9.2%	46.7%	0.0%	0.0%	17.5%	26.7%	0.0%	0.0%
Maximum Green (s)	8.0	8.0	49.0		8.0	49.0			14.0	25.0		
Yellow Time (s)	3.0	3.0	4.0		3.0	4.0			3.5	3.5		
All-Red Time (s)	0.0	0.0	3.0		0.0	3.0			3.5	3.5		
Lost Time Adjust (s)	1.0	1.0	-3.0	0.0	1.0	-3.0	0.0	0.0	-3.0	-3.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lead	Lag		Lead	Lag			Lead	Lag		
Lead-Lag Optimize?	Yes	Yes	Yes		Yes	Yes			Yes	Yes		
Vehicle Extension (s)	2.0	2.0	2.0		2.0	2.0			2.0	2.0		
Recall Mode	None	None	Min		None	Min			None	None		
Walk Time (s)			7.0			7.0				7.0		
Flash Dont Walk (s)			16.0			16.0				14.5		
Pedestrian Calls (#/hr)			0			0				0		

Intersection Summary

Area Type: Other
Cycle Length: 120
Actuated Cycle Length: 115.7
Natural Cycle: 110

Lanes, Volumes, Timings
1: Trapelo Road & Cushing Avenue

2017 No-Build Conditions

Weekday Evening

				
Lane Group	SBL2	SBL	SBT	SBR
Lane Configurations				
Volume (vph)	8	119	247	95
Ideal Flow (vphpl)	1900	1900	1900	1900
Lane Width (ft)	11	11	11	16
Storage Length (ft)		0		50
Storage Lanes		1		1
Taper Length (ft)		25		25
Lane Util. Factor	1.00	1.00	1.00	1.00
Frt				0.850
Flt Protected		0.950		
Satd. Flow (prot)	0	1745	1618	1613
Flt Permitted		0.950		
Satd. Flow (perm)	0	1745	1618	1613
Right Turn on Red				Yes
Satd. Flow (RTOR)				51
Link Speed (mph)			30	
Link Distance (ft)			873	
Travel Time (s)			19.8	
Peak Hour Factor	0.88	0.88	0.88	0.88
Heavy Vehicles (%)	0%	0%	1%	1%
Parking (#/hr)			2	2
Shared Lane Traffic (%)				
Turn Type	Prot	Prot		pm+ov
Protected Phases	7	7	4	5
Permitted Phases				4
Detector Phase	7	7	4	5
Switch Phase				
Minimum Initial (s)	6.0	6.0	12.0	3.0
Minimum Split (s)	13.0	13.0	28.5	6.0
Total Split (s)	21.0	21.0	32.0	11.0
Total Split (%)	17.5%	17.5%	26.7%	9.2%
Maximum Green (s)	14.0	14.0	25.0	8.0
Yellow Time (s)	3.5	3.5	3.5	3.0
All-Red Time (s)	3.5	3.5	3.5	0.0
Lost Time Adjust (s)	-3.0	-3.0	-3.0	1.0
Total Lost Time (s)	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lead	Lag	Lead
Lead-Lag Optimize?	Yes	Yes	Yes	Yes
Vehicle Extension (s)	2.0	2.0	2.0	2.0
Recall Mode	None	None	None	None
Walk Time (s)			7.0	
Flash Dont Walk (s)			14.5	
Pedestrian Calls (#/hr)			0	
Intersection Summary				

Lanes, Volumes, Timings
 1: Trapelo Road & Cushing Avenue

2017 No-Build Conditions
 Weekday Evening

Control Type: Actuated-Uncoordinated

Splits and Phases: 1: Trapelo Road & Cushing Avenue

 ø1	 ø2	 ø3	 ø4
11 s	56 s	21 s	32 s
 ø5	 ø6	 ø7	 ø8
11 s	56 s	21 s	32 s

Queues

2017 No-Build Conditions

1: Trapelo Road & Cushing Avenue

Weekday Evening

									
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	109	584	26	838	82	328	144	281	108
v/c Ratio	0.68	0.75	0.10	1.20	0.43	0.83	0.63	0.65	0.18
Control Delay	40.9	32.4	14.6	134.4	55.8	60.8	61.0	47.9	16.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	40.9	32.4	14.6	134.4	55.8	60.8	61.0	47.9	16.3
Queue Length 50th (ft)	41	379	9	~814	60	236	106	194	29
Queue Length 95th (ft)	#121	#597	24	#1061	105	#348	171	#299	72
Internal Link Dist (ft)		220		141		194		793	
Turn Bay Length (ft)			105						50
Base Capacity (vph)	164	783	308	698	249	435	257	430	615
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.66	0.75	0.08	1.20	0.33	0.75	0.56	0.65	0.18

Intersection Summary

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

HCM Signalized Intersection Capacity Analysis

2017 No-Build Conditions

1: Trapelo Road & Cushing Avenue

Weekday Evening

												
Movement	EBL2	EBL	EBT	EBR	WBL	WBT	WBR	WBR2	NBL	NBT	NBR	NBR2
Lane Configurations												
Volume (vph)	78	21	463	68	24	613	139	10	71	238	14	33
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	10	10	11	11	10	11	11	11	10	11	11	11
Total Lost time (s)		4.0	4.0		4.0	4.0			4.0	4.0		
Lane Util. Factor		1.00	1.00		1.00	1.00			1.00	1.00		
Frt		1.00	0.98		1.00	0.97			1.00	0.98		
Flt Protected		0.95	1.00		0.95	1.00			0.95	1.00		
Satd. Flow (prot)		1671	1563		1685	1547			1685	1776		
Flt Permitted		0.07	1.00		0.26	1.00			0.95	1.00		
Satd. Flow (perm)		132	1563		455	1547			1685	1776		
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.87	0.87	0.87	0.87
Adj. Flow (vph)	86	23	509	75	26	674	153	11	82	274	16	38
RTOR Reduction (vph)	0	0	4	0	0	1	0	0	0	4	0	0
Lane Group Flow (vph)	0	109	580	0	26	837	0	0	82	324	0	0
Heavy Vehicles (%)	1%	0%	1%	0%	0%	1%	0%	0%	0%	1%	0%	0%
Parking (#/hr)			5	5		5	5	5				
Turn Type	pm+pt	pm+pt			pm+pt				Prot			
Protected Phases	5	5	2		1	6			3	8		
Permitted Phases	2	2			6							
Actuated Green, G (s)		61.1	54.7		53.8	50.4			8.6	24.1		
Effective Green, g (s)		60.1	57.7		51.8	53.4			11.6	27.1		
Actuated g/C Ratio		0.51	0.49		0.44	0.45			0.10	0.23		
Clearance Time (s)		3.0	7.0		3.0	7.0			7.0	7.0		
Vehicle Extension (s)		2.0	2.0		2.0	2.0			2.0	2.0		
Lane Grp Cap (vph)		154	762		224	698			165	407		
v/s Ratio Prot		c0.04	0.37		0.00	c0.54			0.05	c0.18		
v/s Ratio Perm		0.32			0.05							
v/c Ratio		0.71	0.76		0.12	1.20			0.50	0.80		
Uniform Delay, d1		26.3	24.7		20.9	32.5			50.6	43.0		
Progression Factor		1.00	1.00		1.00	1.00			1.00	1.00		
Incremental Delay, d2		11.5	4.1		0.1	103.4			0.9	9.7		
Delay (s)		37.8	28.8		21.0	135.9			51.5	52.7		
Level of Service		D	C		C	F			D	D		
Approach Delay (s)			30.2			132.4				52.5		
Approach LOS			C			F				D		
Intersection Summary												
HCM Average Control Delay			72.0			HCM Level of Service			E			
HCM Volume to Capacity ratio			1.01									
Actuated Cycle Length (s)			118.4			Sum of lost time (s)			20.0			
Intersection Capacity Utilization			82.6%			ICU Level of Service			E			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

1: Trapelo Road & Cushing Avenue

2017 No-Build Conditions

Weekday Evening

				
Movement	SBL2	SBL	SBT	SBR
Lane Configurations				
Volume (vph)	8	119	247	95
Ideal Flow (vphpl)	1900	1900	1900	1900
Lane Width	11	11	11	16
Total Lost time (s)		4.0	4.0	4.0
Lane Util. Factor		1.00	1.00	1.00
Frt		1.00	1.00	0.85
Flt Protected		0.95	1.00	1.00
Satd. Flow (prot)		1745	1618	1613
Flt Permitted		0.95	1.00	1.00
Satd. Flow (perm)		1745	1618	1613
Peak-hour factor, PHF	0.88	0.88	0.88	0.88
Adj. Flow (vph)	9	135	281	108
RTOR Reduction (vph)	0	0	0	37
Lane Group Flow (vph)	0	144	281	71
Heavy Vehicles (%)	0%	0%	1%	1%
Parking (#/hr)			2	2
Turn Type	Prot	Prot	pm+ov	
Protected Phases	7	7	4	5
Permitted Phases				4
Actuated Green, G (s)		12.2	27.7	35.4
Effective Green, g (s)		15.2	30.7	33.4
Actuated g/C Ratio		0.13	0.26	0.28
Clearance Time (s)		7.0	7.0	3.0
Vehicle Extension (s)		2.0	2.0	2.0
Lane Grp Cap (vph)		224	420	455
v/s Ratio Prot		c0.08	c0.17	0.01
v/s Ratio Perm				0.04
v/c Ratio		0.64	0.67	0.16
Uniform Delay, d1		49.0	39.3	31.9
Progression Factor		1.00	1.00	1.00
Incremental Delay, d2		4.7	3.1	0.1
Delay (s)		53.7	42.4	32.0
Level of Service		D	D	C
Approach Delay (s)			43.3	
Approach LOS			D	
Intersection Summary				

Lanes, Volumes, Timings
3: Trapelo Road & Williston Road

2017 No-Build Conditions
Weekday Evening

						
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	618	18	17	771	7	18
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	16	16	11	11	13	13
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.996				0.901	
Flt Protected				0.999	0.987	
Satd. Flow (prot)	1890	0	0	1617	1746	0
Flt Permitted				0.999	0.987	
Satd. Flow (perm)	1890	0	0	1617	1746	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	121			300	276	
Travel Time (s)	2.8			6.8	6.3	
Peak Hour Factor	0.91	0.91	0.95	0.95	0.67	0.67
Heavy Vehicles (%)	1%	0%	0%	1%	0%	0%
Parking (#/hr)	2	2	2	2		
Shared Lane Traffic (%)						
Sign Control	Free			Free	Stop	
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					

HCM Unsignalized Intersection Capacity Analysis

3: Trapelo Road & Williston Road

2017 No-Build Conditions

Weekday Evening

						
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	618	18	17	771	7	18
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.91	0.91	0.95	0.95	0.67	0.67
Hourly flow rate (vph)	679	20	18	812	10	27
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (ft)				300		
pX, platoon unblocked					0.57	
vC, conflicting volume			699		1536	689
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			699		1564	689
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			98		85	94
cM capacity (veh/h)			907		69	449
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	699	829	37			
Volume Left	0	18	10			
Volume Right	20	0	27			
cSH	1700	907	177			
Volume to Capacity	0.41	0.02	0.21			
Queue Length 95th (ft)	0	2	19			
Control Delay (s)	0.0	0.5	30.7			
Lane LOS		A	D			
Approach Delay (s)	0.0	0.5	30.7			
Approach LOS			D			
Intersection Summary						
Average Delay			1.0			
Intersection Capacity Utilization			64.2%	ICU Level of Service		C
Analysis Period (min)			15			

Lanes, Volumes, Timings
4: Horne Road & Common Street

2017 No-Build Conditions
Weekday Evening

						
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	6	14	9	349	325	13
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	11	16	16	11	11
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.906				0.995	
Flt Protected	0.985			0.999		
Satd. Flow (prot)	1639	0	0	1896	1611	0
Flt Permitted	0.985			0.999		
Satd. Flow (perm)	1639	0	0	1896	1611	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	310			211	274	
Travel Time (s)	7.0			4.8	6.2	
Peak Hour Factor	0.57	0.57	0.87	0.87	0.91	0.91
Heavy Vehicles (%)	0%	0%	0%	1%	1%	0%
Parking (#/hr)			2	2	2	2
Shared Lane Traffic (%)						
Sign Control	Stop			Free	Free	
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					

HCM Unsignalized Intersection Capacity Analysis

4: Horne Road & Common Street

2017 No-Build Conditions

Weekday Evening

						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	6	14	9	349	325	13
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.57	0.57	0.87	0.87	0.91	0.91
Hourly flow rate (vph)	11	25	10	401	357	14
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage (veh)						
Upstream signal (ft)				211	274	
pX, platoon unblocked	0.92	0.85	0.85			
vC, conflicting volume	786	364	371			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	395	170	179			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	98	97	99			
cM capacity (veh/h)	561	751	1204			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	35	411	371			
Volume Left	11	10	0			
Volume Right	25	0	14			
cSH	682	1204	1700			
Volume to Capacity	0.05	0.01	0.22			
Queue Length 95th (ft)	4	1	0			
Control Delay (s)	10.6	0.3	0.0			
Lane LOS	B	A				
Approach Delay (s)	10.6	0.3	0.0			
Approach LOS	B					
Intersection Summary						
Average Delay			0.6			
Intersection Capacity Utilization			35.6%	ICU Level of Service		A
Analysis Period (min)			15			

Lanes, Volumes, Timings
5: Horne Road & Williston Road

2017 No-Build Conditions
Weekday Evening

						
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	7	4	11	16	19	11
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	10	10	10	10	10	10
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.920		0.951	
Flt Protected		0.969			0.969	
Satd. Flow (prot)	0	1529	1452	0	1454	0
Flt Permitted		0.969			0.969	
Satd. Flow (perm)	0	1529	1452	0	1454	0
Link Speed (mph)		30	30		30	
Link Distance (ft)		596	310		276	
Travel Time (s)		13.5	7.0		6.3	
Peak Hour Factor	0.63	0.63	0.63	0.63	0.73	0.73
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%
Parking (#/hr)	2	2	2	2	2	2
Shared Lane Traffic (%)						
Sign Control		Free	Free		Stop	

Intersection Summary

Area Type: Other
Control Type: Unsignalized

HCM Unsignalized Intersection Capacity Analysis

5: Horne Road & Williston Road

2017 No-Build Conditions

Weekday Evening

						
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	7	4	11	16	19	11
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.63	0.63	0.63	0.63	0.73	0.73
Hourly flow rate (vph)	11	6	17	25	26	15
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	43				59	30
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	43				59	30
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	99				97	99
cM capacity (veh/h)	1579				947	1050
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	17	43	41			
Volume Left	11	0	26			
Volume Right	0	25	15			
cSH	1579	1700	982			
Volume to Capacity	0.01	0.03	0.04			
Queue Length 95th (ft)	1	0	3			
Control Delay (s)	4.7	0.0	8.8			
Lane LOS	A		A			
Approach Delay (s)	4.7	0.0	8.8			
Approach LOS			A			
Intersection Summary						
Average Delay			4.4			
Intersection Capacity Utilization			16.4%	ICU Level of Service		A
Analysis Period (min)			15			

Lanes, Volumes, Timings
6: Horne Road & Poplar Street

2017 No-Build Conditions
Weekday Evening

						
Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	18	11	29	7	3	23
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	10	10	12	12	12	12
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.949		0.974			
Flt Protected	0.970					0.994
Satd. Flow (prot)	1453	0	1595	0	0	1681
Flt Permitted	0.970					0.994
Satd. Flow (perm)	1453	0	1595	0	0	1681
Link Speed (mph)	30		30			30
Link Distance (ft)	596		290			271
Travel Time (s)	13.5		6.6			6.2
Peak Hour Factor	0.68	0.68	0.77	0.77	0.63	0.63
Heavy Vehicles (%)	0%	0%	4%	0%	0%	0%
Parking (#/hr)	2	2	2	2	2	2
Shared Lane Traffic (%)						
Sign Control	Stop		Free			Free

Intersection Summary

Area Type: Other
Control Type: Unsignalized

HCM Unsignalized Intersection Capacity Analysis

6: Horne Road & Poplar Street

2017 No-Build Conditions
Weekday Evening

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	18	11	29	7	3	23
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.68	0.68	0.77	0.77	0.63	0.63
Hourly flow rate (vph)	26	16	38	9	5	37
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	88	42			47	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	88	42			47	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	97	98			100	
cM capacity (veh/h)	915	1034			1574	
Direction, Lane #	WB 1	NB 1	SB 1			
Volume Total	43	47	41			
Volume Left	26	0	5			
Volume Right	16	9	0			
cSH	957	1700	1574			
Volume to Capacity	0.04	0.03	0.00			
Queue Length 95th (ft)	3	0	0			
Control Delay (s)	8.9	0.0	0.9			
Lane LOS	A		A			
Approach Delay (s)	8.9	0.0	0.9			
Approach LOS	A					
Intersection Summary						
Average Delay			3.2			
Intersection Capacity Utilization			13.7%	ICU Level of Service		A
Analysis Period (min)			15			

Lanes, Volumes, Timings
7: Belmont Street & Common Street

2017 No-Build Conditions

Weekday Evening

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	104	377	38	59	475	18	25	239	46	18	190	121
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	11	11	11	12	12	12	10	11	11
Storage Length (ft)	0		0	0		80	0		60	50		0
Storage Lanes	0		0	0		1	0		1	1		1
Taper Length (ft)	25		25	25		25	25		25	25		25
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.990				0.850			0.850		0.942	
Flt Protected		0.990			0.994			0.995		0.950		
Satd. Flow (prot)	0	1862	0	0	1810	1561	0	1874	1615	1499	1534	0
Flt Permitted		0.737			0.895			0.856		0.375		
Satd. Flow (perm)	0	1386	0	0	1629	1561	0	1612	1615	592	1534	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		4				8			29		31	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		736			971			731			211	
Travel Time (s)		16.7			22.1			16.6			4.8	
Peak Hour Factor	0.89	0.89	0.89	0.94	0.94	0.94	0.84	0.84	0.84	0.89	0.89	0.89
Heavy Vehicles (%)	0%	0%	0%	0%	1%	0%	0%	1%	0%	0%	0%	1%
Parking (#/hr)										2	2	2
Shared Lane Traffic (%)												
Turn Type	Perm			Perm		Prot	Perm		Prot	Perm		
Protected Phases		4			8	8		2	2		6	
Permitted Phases	4			8			2			6		
Detector Phase	4	4		8	8	8	2	2	2	6	6	
Switch Phase												
Minimum Initial (s)	10.0	10.0		10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	
Minimum Split (s)	15.0	15.0		15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	
Total Split (s)	50.0	50.0	0.0	50.0	50.0	50.0	40.0	40.0	40.0	40.0	40.0	0.0
Total Split (%)	45.5%	45.5%	0.0%	45.5%	45.5%	45.5%	36.4%	36.4%	36.4%	36.4%	36.4%	0.0%
Maximum Green (s)	45.0	45.0		45.0	45.0	45.0	35.0	35.0	35.0	35.0	35.0	
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
All-Red Time (s)	1.0	1.0		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
Lost Time Adjust (s)	-1.0	-1.0	0.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Recall Mode	Min	Min		Min	Min	Min	None	None	None	None	None	
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Intersection Summary												
Area Type:	Other											
Cycle Length: 110												
Actuated Cycle Length: 76.3												
Natural Cycle: 100												

Lanes, Volumes, Timings
7: Belmont Street & Common Street

2017 No-Build Conditions
Weekday Evening

Lane Group ø9

Lane Configurations

Volume (vph)

Ideal Flow (vphpl)

Lane Width (ft)

Storage Length (ft)

Storage Lanes

Taper Length (ft)

Lane Util. Factor

Frt

Flt Protected

Satd. Flow (prot)

Flt Permitted

Satd. Flow (perm)

Right Turn on Red

Satd. Flow (RTOR)

Link Speed (mph)

Link Distance (ft)

Travel Time (s)

Peak Hour Factor

Heavy Vehicles (%)

Parking (#/hr)

Shared Lane Traffic (%)

Turn Type

Protected Phases 9

Permitted Phases

Detector Phase

Switch Phase

Minimum Initial (s) 4.0

Minimum Split (s) 20.0

Total Split (s) 20.0

Total Split (%) 18%

Maximum Green (s) 14.0

Yellow Time (s) 4.0

All-Red Time (s) 2.0

Lost Time Adjust (s)

Total Lost Time (s)

Lead/Lag

Lead-Lag Optimize?

Vehicle Extension (s) 3.0

Recall Mode None

Walk Time (s) 7.0

Flash Dont Walk (s) 7.0

Pedestrian Calls (#/hr) 0

Intersection Summary

Lanes, Volumes, Timings
 7: Belmont Street & Common Street

2017 No-Build Conditions
 Weekday Evening

Control Type: Actuated-Uncoordinated

Splits and Phases: 7: Belmont Street & Common Street

 ø2	 ø4	 ø9
40 s	50 s	20 s
 ø6	 ø8	
40 s	50 s	

Queues
7: Belmont Street & Common Street

2017 No-Build Conditions
Weekday Evening

							
Lane Group	EBT	WBT	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	584	568	19	315	55	20	349
v/c Ratio	0.69	0.58	0.02	0.68	0.11	0.12	0.75
Control Delay	17.6	13.4	6.3	31.6	11.4	20.7	32.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	17.6	13.4	6.3	31.6	11.4	20.7	32.9
Queue Length 50th (ft)	166	145	2	131	9	7	135
Queue Length 95th (ft)	#377	316	12	192	30	23	222
Internal Link Dist (ft)	656	891		651			131
Turn Bay Length (ft)			80		60	50	
Base Capacity (vph)	842	987	949	765	781	281	744
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.69	0.58	0.02	0.41	0.07	0.07	0.47

Intersection Summary

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

HCM Signalized Intersection Capacity Analysis

2017 No-Build Conditions

7: Belmont Street & Common Street

Weekday Evening

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	104	377	38	59	475	18	25	239	46	18	190	121
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	11	11	11	12	12	12	10	11	11
Total Lost time (s)		4.0			4.0	4.0		4.0	4.0	4.0	4.0	
Lane Util. Factor		1.00			1.00	1.00		1.00	1.00	1.00	1.00	
Frt		0.99			1.00	0.85		1.00	0.85	1.00	0.94	
Flt Protected		0.99			0.99	1.00		1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1862			1810	1561		1874	1615	1499	1533	
Flt Permitted		0.74			0.89	1.00		0.86	1.00	0.37	1.00	
Satd. Flow (perm)		1386			1629	1561		1612	1615	591	1533	
Peak-hour factor, PHF	0.89	0.89	0.89	0.94	0.94	0.94	0.84	0.84	0.84	0.89	0.89	0.89
Adj. Flow (vph)	117	424	43	63	505	19	30	285	55	20	213	136
RTOR Reduction (vph)	0	2	0	0	0	3	0	0	21	0	22	0
Lane Group Flow (vph)	0	582	0	0	568	16	0	315	34	20	327	0
Heavy Vehicles (%)	0%	0%	0%	0%	1%	0%	0%	1%	0%	0%	0%	1%
Parking (#/hr)										2	2	2
Turn Type	Perm			Perm		Prot	Perm		Prot	Perm		
Protected Phases		4			8	8		2	2		6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		45.3			45.3	45.3		21.0	21.0	21.0	21.0	
Effective Green, g (s)		46.3			46.3	46.3		22.0	22.0	22.0	22.0	
Actuated g/C Ratio		0.61			0.61	0.61		0.29	0.29	0.29	0.29	
Clearance Time (s)		5.0			5.0	5.0		5.0	5.0	5.0	5.0	
Vehicle Extension (s)		3.0			3.0	3.0		3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		841			989	947		465	466	170	442	
v/s Ratio Prot						0.01			0.02		c0.21	
v/s Ratio Perm		c0.42			0.35			0.20		0.03		
v/c Ratio		0.69			0.57	0.02		0.68	0.07	0.12	0.74	
Uniform Delay, d1		10.2			9.1	6.0		24.0	19.7	20.0	24.6	
Progression Factor		1.00			1.00	1.00		1.00	1.00	1.00	1.00	
Incremental Delay, d2		2.5			0.8	0.0		3.9	0.1	0.3	6.4	
Delay (s)		12.7			9.9	6.0		27.9	19.8	20.3	30.9	
Level of Service		B			A	A		C	B	C	C	
Approach Delay (s)		12.7			9.7			26.7			30.4	
Approach LOS		B			A			C			C	
Intersection Summary												
HCM Average Control Delay			17.9				HCM Level of Service			B		
HCM Volume to Capacity ratio			0.71									
Actuated Cycle Length (s)			76.3				Sum of lost time (s)		8.0			
Intersection Capacity Utilization			99.6%				ICU Level of Service		F			
Analysis Period (min)			15									
c Critical Lane Group												

Lanes, Volumes, Timings
1: Trapelo Road & Cushing Avenue

2016 No-Build Conditions

Saturday MIDDAY

												
Lane Group	EBL2	EBL	EBT	EBR	WBL	WBT	WBR	WBR2	NBL	NBT	NBR	NBR2
Lane Configurations												
Volume (vph)	85	23	396	65	31	395	98	12	73	159	20	61
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	10	10	11	11	10	11	11	11	10	11	11	11
Storage Length (ft)		0		0	105		0		0		0	
Storage Lanes		1		0	1		0		1		0	
Taper Length (ft)		25		25	25		25		25		25	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.979			0.967				0.949		
Flt Protected		0.950			0.950				0.950			
Satd. Flow (prot)	0	1685	1560	0	1685	1551	0	0	1652	1743	0	0
Flt Permitted		0.198			0.289				0.950			
Satd. Flow (perm)	0	351	1560	0	512	1551	0	0	1652	1743	0	0
Right Turn on Red				Yes				Yes				Yes
Satd. Flow (RTOR)			10			2				14		
Link Speed (mph)			30			30				30		
Link Distance (ft)			300			221				274		
Travel Time (s)			6.8			5.0				6.2		
Peak Hour Factor	0.91	0.91	0.91	0.91	0.94	0.94	0.94	0.94	0.91	0.91	0.91	0.91
Heavy Vehicles (%)	0%	0%	1%	0%	0%	0%	1%	0%	2%	0%	0%	0%
Parking (#/hr)			5	5		5	5	5				
Shared Lane Traffic (%)												
Turn Type	pm+pt	pm+pt			pm+pt				Prot			
Protected Phases	5	5	2		1	6			3	8		
Permitted Phases	2	2			6							
Detector Phase	5	5	2		1	6			3	8		
Switch Phase												
Minimum Initial (s)	3.0	3.0	12.0		3.0	12.0			6.0	12.0		
Minimum Split (s)	6.0	6.0	30.0		6.0	30.0			13.0	28.5		
Total Split (s)	8.0	8.0	55.0	0.0	8.0	55.0	0.0	0.0	18.5	28.5	0.0	0.0
Total Split (%)	7.3%	7.3%	50.0%	0.0%	7.3%	50.0%	0.0%	0.0%	16.8%	25.9%	0.0%	0.0%
Maximum Green (s)	5.0	5.0	48.0		5.0	48.0			11.5	21.5		
Yellow Time (s)	3.0	3.0	4.0		3.0	4.0			3.5	3.5		
All-Red Time (s)	0.0	0.0	3.0		0.0	3.0			3.5	3.5		
Lost Time Adjust (s)	1.0	1.0	-3.0	0.0	1.0	-3.0	0.0	0.0	-3.0	-3.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lead	Lag		Lead	Lag			Lead	Lag		
Lead-Lag Optimize?	Yes	Yes	Yes		Yes	Yes			Yes	Yes		
Vehicle Extension (s)	2.0	2.0	2.0		2.0	2.0			2.0	2.0		
Recall Mode	None	None	Min		None	Min			None	None		
Walk Time (s)			7.0			7.0				7.0		
Flash Dont Walk (s)			16.0			16.0				14.5		
Pedestrian Calls (#/hr)			0			0				0		

Intersection Summary

Area Type: Other
Cycle Length: 110
Actuated Cycle Length: 92.6
Natural Cycle: 90

Lanes, Volumes, Timings
1: Trapelo Road & Cushing Avenue

2016 No-Build Conditions

Saturday MIDDAY

				
Lane Group	SBL2	SBL	SBT	SBR
Lane Configurations				
Volume (vph)	6	100	171	110
Ideal Flow (vphpl)	1900	1900	1900	1900
Lane Width (ft)	11	11	11	16
Storage Length (ft)		0		50
Storage Lanes		1		1
Taper Length (ft)		25		25
Lane Util. Factor	1.00	1.00	1.00	1.00
Frt				0.850
Flt Protected		0.950		
Satd. Flow (prot)	0	1745	1635	1629
Flt Permitted		0.950		
Satd. Flow (perm)	0	1745	1635	1629
Right Turn on Red				Yes
Satd. Flow (RTOR)				89
Link Speed (mph)			30	
Link Distance (ft)			873	
Travel Time (s)			19.8	
Peak Hour Factor	0.82	0.82	0.82	0.82
Heavy Vehicles (%)	0%	0%	0%	0%
Parking (#/hr)			2	2
Shared Lane Traffic (%)				
Turn Type	Prot	Prot		pm+ov
Protected Phases	7	7	4	5
Permitted Phases				4
Detector Phase	7	7	4	5
Switch Phase				
Minimum Initial (s)	6.0	6.0	12.0	3.0
Minimum Split (s)	13.0	13.0	28.5	6.0
Total Split (s)	18.5	18.5	28.5	8.0
Total Split (%)	16.8%	16.8%	25.9%	7.3%
Maximum Green (s)	11.5	11.5	21.5	5.0
Yellow Time (s)	3.5	3.5	3.5	3.0
All-Red Time (s)	3.5	3.5	3.5	0.0
Lost Time Adjust (s)	-3.0	-3.0	-3.0	1.0
Total Lost Time (s)	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lead	Lag	Lead
Lead-Lag Optimize?	Yes	Yes	Yes	Yes
Vehicle Extension (s)	2.0	2.0	2.0	2.0
Recall Mode	None	None	None	None
Walk Time (s)			7.0	
Flash Dont Walk (s)			14.5	
Pedestrian Calls (#/hr)			0	
Intersection Summary				

Lanes, Volumes, Timings
 1: Trapelo Road & Cushing Avenue

2016 No-Build Conditions
 Saturday MIDDAY

Control Type: Actuated-Uncoordinated

Splits and Phases: 1: Trapelo Road & Cushing Avenue

 ø1	 ø2	 ø3	 ø4
8 s	55 s	18.5 s	28.5 s
 ø5	 ø6	 ø7	 ø8
8 s	55 s	18.5 s	28.5 s

Queues

2016 No-Build Conditions

1: Trapelo Road & Cushing Avenue

Saturday MIDDAY

									
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	118	506	33	537	80	264	129	209	134
v/c Ratio	0.52	0.70	0.12	0.83	0.37	0.67	0.53	0.47	0.21
Control Delay	22.7	27.3	13.1	36.7	46.6	42.6	49.2	37.5	11.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	22.7	27.3	13.1	36.7	46.6	42.6	49.2	37.5	11.9
Queue Length 50th (ft)	37	253	10	282	46	141	73	111	19
Queue Length 95th (ft)	70	399	26	445	101	253	136	189	59
Internal Link Dist (ft)		220		141		194		793	
Turn Bay Length (ft)			105						50
Base Capacity (vph)	229	893	288	884	267	487	283	466	642
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.52	0.57	0.11	0.61	0.30	0.54	0.46	0.45	0.21
Intersection Summary									

HCM Signalized Intersection Capacity Analysis

2016 No-Build Conditions

1: Trapelo Road & Cushing Avenue

Saturday MIDDAY

												
Movement	EBL2	EBL	EBT	EBR	WBL	WBT	WBR	WBR2	NBL	NBT	NBR	NBR2
Lane Configurations												
Volume (vph)	85	23	396	65	31	395	98	12	73	159	20	61
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	10	10	11	11	10	11	11	11	10	11	11	11
Total Lost time (s)		4.0	4.0		4.0	4.0			4.0	4.0		
Lane Util. Factor		1.00	1.00		1.00	1.00			1.00	1.00		
Frt		1.00	0.98		1.00	0.97			1.00	0.95		
Flt Protected		0.95	1.00		0.95	1.00			0.95	1.00		
Satd. Flow (prot)		1685	1560		1685	1552			1652	1744		
Flt Permitted		0.20	1.00		0.29	1.00			0.95	1.00		
Satd. Flow (perm)		350	1560		512	1552			1652	1744		
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.94	0.94	0.94	0.94	0.91	0.91	0.91	0.91
Adj. Flow (vph)	93	25	435	71	33	420	104	13	80	175	22	67
RTOR Reduction (vph)	0	0	6	0	0	1	0	0	0	11	0	0
Lane Group Flow (vph)	0	118	500	0	33	536	0	0	80	253	0	0
Heavy Vehicles (%)	0%	0%	1%	0%	0%	0%	1%	0%	2%	0%	0%	0%
Parking (#/hr)			5	5		5	5	5				
Turn Type	pm+pt	pm+pt			pm+pt				Prot			
Protected Phases	5	5	2		1	6			3	8		
Permitted Phases	2	2			6							
Actuated Green, G (s)		44.6	39.4		39.6	36.9			7.3	19.3		
Effective Green, g (s)		42.6	42.4		37.6	39.9			10.3	22.3		
Actuated g/C Ratio		0.45	0.44		0.39	0.42			0.11	0.23		
Clearance Time (s)		3.0	7.0		3.0	7.0			7.0	7.0		
Vehicle Extension (s)		2.0	2.0		2.0	2.0			2.0	2.0		
Lane Grp Cap (vph)		215	694		223	650			179	408		
v/s Ratio Prot		c0.02	0.32		0.00	c0.35			0.05	c0.15		
v/s Ratio Perm		0.22			0.06							
v/c Ratio		0.55	0.72		0.15	0.82			0.45	0.62		
Uniform Delay, d1		18.6	21.6		18.9	24.6			39.8	32.7		
Progression Factor		1.00	1.00		1.00	1.00			1.00	1.00		
Incremental Delay, d2		1.5	3.1		0.1	8.0			0.6	2.1		
Delay (s)		20.2	24.8		19.0	32.6			40.5	34.8		
Level of Service		C	C		B	C			D	C		
Approach Delay (s)			23.9			31.8				36.1		
Approach LOS			C			C				D		
Intersection Summary												
HCM Average Control Delay			30.1			HCM Level of Service				C		
HCM Volume to Capacity ratio			0.78									
Actuated Cycle Length (s)			95.3			Sum of lost time (s)			24.0			
Intersection Capacity Utilization			66.0%			ICU Level of Service			C			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

1: Trapelo Road & Cushing Avenue

2016 No-Build Conditions

Saturday MIDDAY

				
Movement	SBL2	SBL	SBT	SBR
Lane Configurations				
Volume (vph)	6	100	171	110
Ideal Flow (vphpl)	1900	1900	1900	1900
Lane Width	11	11	11	16
Total Lost time (s)		4.0	4.0	4.0
Lane Util. Factor		1.00	1.00	1.00
Frt		1.00	1.00	0.85
Flt Protected		0.95	1.00	1.00
Satd. Flow (prot)		1745	1635	1629
Flt Permitted		0.95	1.00	1.00
Satd. Flow (perm)		1745	1635	1629
Peak-hour factor, PHF	0.82	0.82	0.82	0.82
Adj. Flow (vph)	7	122	209	134
RTOR Reduction (vph)	0	0	0	66
Lane Group Flow (vph)	0	129	209	68
Heavy Vehicles (%)	0%	0%	0%	0%
Parking (#/hr)			2	2
Turn Type	Prot	Prot	pm+ov	
Protected Phases	7	7	4	5
Permitted Phases				4
Actuated Green, G (s)		9.9	21.9	27.1
Effective Green, g (s)		12.9	24.9	25.1
Actuated g/C Ratio		0.14	0.26	0.26
Clearance Time (s)		7.0	7.0	3.0
Vehicle Extension (s)		2.0	2.0	2.0
Lane Grp Cap (vph)		236	427	429
v/s Ratio Prot		c0.07	c0.13	0.01
v/s Ratio Perm				0.03
v/c Ratio		0.55	0.49	0.16
Uniform Delay, d1		38.5	29.8	27.0
Progression Factor		1.00	1.00	1.00
Incremental Delay, d2		1.4	0.3	0.1
Delay (s)		39.9	30.1	27.1
Level of Service		D	C	C
Approach Delay (s)			31.9	
Approach LOS			C	
Intersection Summary				

Lanes, Volumes, Timings
3: Trapelo Road & Williston Road

2016 No-Build Conditions
Saturday MIDDAY

						
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	533	29	39	547	18	29
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	16	16	11	11	13	13
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.993				0.917	
Flt Protected				0.997	0.981	
Satd. Flow (prot)	1885	0	0	1615	1766	0
Flt Permitted				0.997	0.981	
Satd. Flow (perm)	1885	0	0	1615	1766	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	121			300	276	
Travel Time (s)	2.8			6.8	6.3	
Peak Hour Factor	0.93	0.93	0.95	0.95	0.87	0.87
Heavy Vehicles (%)	1%	0%	0%	1%	0%	0%
Parking (#/hr)	2	2	2	2		
Shared Lane Traffic (%)						
Sign Control	Free			Free	Stop	
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					

HCM Unsignalized Intersection Capacity Analysis

3: Trapelo Road & Williston Road

2016 No-Build Conditions

Saturday MIDDAY

						
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	533	29	39	547	18	29
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.93	0.93	0.95	0.95	0.87	0.87
Hourly flow rate (vph)	573	31	41	576	21	33
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (ft)				300		
pX, platoon unblocked					0.74	
vC, conflicting volume			604		1247	589
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			604		1158	589
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			96		87	93
cM capacity (veh/h)			983		155	512
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	604	617	54			
Volume Left	0	41	21			
Volume Right	31	0	33			
cSH	1700	983	272			
Volume to Capacity	0.36	0.04	0.20			
Queue Length 95th (ft)	0	3	18			
Control Delay (s)	0.0	1.1	21.5			
Lane LOS		A	C			
Approach Delay (s)	0.0	1.1	21.5			
Approach LOS			C			
Intersection Summary						
Average Delay			1.4			
Intersection Capacity Utilization			70.9%	ICU Level of Service		C
Analysis Period (min)			15			

Lanes, Volumes, Timings
4: Horne Road & Common Street

2016 No-Build Conditions
Saturday MIDDAY

						
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	11	29	21	300	267	9
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	11	16	16	11	11
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.902				0.996	
Flt Protected	0.986			0.997		
Satd. Flow (prot)	1633	0	0	1893	1628	0
Flt Permitted	0.986			0.997		
Satd. Flow (perm)	1633	0	0	1893	1628	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	310			211	274	
Travel Time (s)	7.0			4.8	6.2	
Peak Hour Factor	0.69	0.69	0.93	0.93	0.89	0.89
Heavy Vehicles (%)	0%	0%	0%	1%	0%	0%
Parking (#/hr)			2	2	2	2
Shared Lane Traffic (%)						
Sign Control	Stop			Free	Free	
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					

HCM Unsignalized Intersection Capacity Analysis

4: Horne Road & Common Street

2016 No-Build Conditions

Saturday MIDDAY

						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	11	29	21	300	267	9
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.69	0.69	0.93	0.93	0.89	0.89
Hourly flow rate (vph)	16	42	23	323	300	10
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage (veh)						
Upstream signal (ft)				211	274	
pX, platoon unblocked	0.93	0.90	0.90			
vC, conflicting volume	673	305	310			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	467	177	183			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	97	95	98			
cM capacity (veh/h)	512	787	1269			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	58	345	310			
Volume Left	16	23	0			
Volume Right	42	0	10			
cSH	686	1269	1700			
Volume to Capacity	0.08	0.02	0.18			
Queue Length 95th (ft)	7	1	0			
Control Delay (s)	10.7	0.7	0.0			
Lane LOS	B	A				
Approach Delay (s)	10.7	0.7	0.0			
Approach LOS	B					
Intersection Summary						
Average Delay			1.2			
Intersection Capacity Utilization			43.0%	ICU Level of Service		A
Analysis Period (min)			15			

Lanes, Volumes, Timings
5: Horne Road & Williston Road

2016 No-Build Conditions
Saturday MIDDAY

						
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	10	4	7	25	31	27
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	10	10	10	10	10	10
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.894		0.938	
Flt Protected		0.966			0.974	
Satd. Flow (prot)	0	1525	1411	0	1442	0
Flt Permitted		0.966			0.974	
Satd. Flow (perm)	0	1525	1411	0	1442	0
Link Speed (mph)		30	30		30	
Link Distance (ft)		596	310		276	
Travel Time (s)		13.5	7.0		6.3	
Peak Hour Factor	0.65	0.65	0.63	0.63	0.74	0.74
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%
Parking (#/hr)	2	2	2	2	2	2
Shared Lane Traffic (%)						
Sign Control		Free	Free		Stop	
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					

HCM Unsignalized Intersection Capacity Analysis

5: Horne Road & Williston Road

2016 No-Build Conditions

Saturday MIDDAY

						
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	10	4	7	25	31	27
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.65	0.65	0.63	0.63	0.74	0.74
Hourly flow rate (vph)	15	6	11	40	42	36
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	51				68	31
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	51				68	31
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	99				96	97
cM capacity (veh/h)	1568				933	1049
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	22	51	78			
Volume Left	15	0	42			
Volume Right	0	40	36			
cSH	1568	1700	984			
Volume to Capacity	0.01	0.03	0.08			
Queue Length 95th (ft)	1	0	6			
Control Delay (s)	5.2	0.0	9.0			
Lane LOS	A		A			
Approach Delay (s)	5.2	0.0	9.0			
Approach LOS			A			
Intersection Summary						
Average Delay			5.4			
Intersection Capacity Utilization			17.5%	ICU Level of Service		A
Analysis Period (min)			15			

Lanes, Volumes, Timings
6: Horne Road & Poplar Street

2016 No-Build Conditions
Saturday MIDDAY

						
Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	28	14	25	11	0	30
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	10	10	12	12	12	12
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.954		0.959			
Flt Protected	0.968					
Satd. Flow (prot)	1457	0	1622	0	0	1691
Flt Permitted	0.968					
Satd. Flow (perm)	1457	0	1622	0	0	1691
Link Speed (mph)	30		30			30
Link Distance (ft)	596		290			271
Travel Time (s)	13.5		6.6			6.2
Peak Hour Factor	0.71	0.71	0.77	0.77	0.66	0.66
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%
Parking (#/hr)	2	2	2	2	2	2
Shared Lane Traffic (%)						
Sign Control	Stop		Free			Free
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					

HCM Unsignalized Intersection Capacity Analysis

6: Horne Road & Poplar Street

2016 No-Build Conditions

Saturday MIDDAY

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	28	14	25	11	0	30
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.71	0.71	0.77	0.77	0.66	0.66
Hourly flow rate (vph)	39	20	32	14	0	45
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	85	40			47	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	85	40			47	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	96	98			100	
cM capacity (veh/h)	921	1038			1574	
Direction, Lane #	WB 1	NB 1	SB 1			
Volume Total	59	47	45			
Volume Left	39	0	0			
Volume Right	20	14	0			
cSH	957	1700	1574			
Volume to Capacity	0.06	0.03	0.00			
Queue Length 95th (ft)	5	0	0			
Control Delay (s)	9.0	0.0	0.0			
Lane LOS	A					
Approach Delay (s)	9.0	0.0	0.0			
Approach LOS	A					
Intersection Summary						
Average Delay			3.5			
Intersection Capacity Utilization			13.3%	ICU Level of Service		A
Analysis Period (min)			15			

Lanes, Volumes, Timings
7: Belmont Street & Common Street

2016 No-Build Conditions

Saturday MIDDAY

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	103	263	24	31	236	18	13	178	32	26	171	83
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	11	11	11	12	12	12	10	11	11
Storage Length (ft)	0		0	0		80	0		60	50		0
Storage Lanes	0		0	0		1	0		1	1		1
Taper Length (ft)	25		25	25		25	25		25	25		25
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.992				0.850			0.850		0.951	
Flt Protected		0.987			0.994			0.997		0.950		
Satd. Flow (prot)	0	1860	0	0	1810	1561	0	1877	1615	1499	1555	0
Flt Permitted		0.843			0.931			0.971		0.625		
Satd. Flow (perm)	0	1589	0	0	1695	1561	0	1828	1615	986	1555	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		4				18			26		22	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		736			971			731			211	
Travel Time (s)		16.7			22.1			16.6			4.8	
Peak Hour Factor	0.94	0.94	0.94	0.96	0.96	0.96	0.90	0.90	0.90	0.84	0.84	0.84
Heavy Vehicles (%)	0%	0%	0%	0%	1%	0%	0%	1%	0%	0%	0%	0%
Parking (#/hr)										2	2	2
Shared Lane Traffic (%)												
Turn Type	Perm			Perm		Prot	Perm		Prot	Perm		
Protected Phases		4			8	8		2	2		6	
Permitted Phases	4			8			2			6		
Detector Phase	4	4		8	8	8	2	2	2	6	6	
Switch Phase												
Minimum Initial (s)	10.0	10.0		10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	
Minimum Split (s)	15.0	15.0		15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	
Total Split (s)	55.0	55.0	0.0	55.0	55.0	55.0	35.0	35.0	35.0	35.0	35.0	0.0
Total Split (%)	50.0%	50.0%	0.0%	50.0%	50.0%	50.0%	31.8%	31.8%	31.8%	31.8%	31.8%	0.0%
Maximum Green (s)	50.0	50.0		50.0	50.0	50.0	30.0	30.0	30.0	30.0	30.0	
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
All-Red Time (s)	1.0	1.0		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
Lost Time Adjust (s)	-1.0	-1.0	0.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Recall Mode	Min	Min		Min	Min	Min	None	None	None	None	None	
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Intersection Summary												
Area Type:	Other											
Cycle Length: 110												
Actuated Cycle Length: 46.8												
Natural Cycle: 65												

Lanes, Volumes, Timings
7: Belmont Street & Common Street

2016 No-Build Conditions
Saturday MIDDAY

Lane Group ø9

Lane Configurations

Volume (vph)

Ideal Flow (vphpl)

Lane Width (ft)

Storage Length (ft)

Storage Lanes

Taper Length (ft)

Lane Util. Factor

Frt

Flt Protected

Satd. Flow (prot)

Flt Permitted

Satd. Flow (perm)

Right Turn on Red

Satd. Flow (RTOR)

Link Speed (mph)

Link Distance (ft)

Travel Time (s)

Peak Hour Factor

Heavy Vehicles (%)

Parking (#/hr)

Shared Lane Traffic (%)

Turn Type

Protected Phases 9

Permitted Phases

Detector Phase

Switch Phase

Minimum Initial (s) 4.0

Minimum Split (s) 20.0

Total Split (s) 20.0

Total Split (%) 18%

Maximum Green (s) 14.0

Yellow Time (s) 4.0

All-Red Time (s) 2.0

Lost Time Adjust (s)

Total Lost Time (s)

Lead/Lag

Lead-Lag Optimize?

Vehicle Extension (s) 3.0

Recall Mode None

Walk Time (s) 7.0

Flash Dont Walk (s) 7.0

Pedestrian Calls (#/hr) 0

Intersection Summary

Lanes, Volumes, Timings
 7: Belmont Street & Common Street

2016 No-Build Conditions
 Saturday MIDDAY

Control Type: Actuated-Uncoordinated

Splits and Phases: 7: Belmont Street & Common Street

 ø2	 ø4	 ø9
35 s	55 s	20 s
 ø6	 ø8	
35 s	55 s	

Queues

2016 No-Build Conditions

7: Belmont Street & Common Street

Saturday MIDDAY

							
Lane Group	EBT	WBT	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	416	278	19	212	36	31	303
v/c Ratio	0.58	0.36	0.03	0.32	0.06	0.09	0.52
Control Delay	13.7	10.5	4.7	13.5	6.9	12.3	15.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	13.7	10.5	4.7	13.5	6.9	12.3	15.7
Queue Length 50th (ft)	69	41	0	38	2	5	54
Queue Length 95th (ft)	189	116	10	103	18	22	134
Internal Link Dist (ft)	656	891		651			131
Turn Bay Length (ft)			80		60	50	
Base Capacity (vph)	1498	1598	1472	1299	1156	701	1112
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.28	0.17	0.01	0.16	0.03	0.04	0.27
Intersection Summary							

HCM Signalized Intersection Capacity Analysis

2016 No-Build Conditions

7: Belmont Street & Common Street

Saturday MIDDAY

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	103	263	24	31	236	18	13	178	32	26	171	83
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	11	11	11	12	12	12	10	11	11
Total Lost time (s)		4.0			4.0	4.0		4.0	4.0	4.0	4.0	
Lane Util. Factor		1.00			1.00	1.00		1.00	1.00	1.00	1.00	
Frt		0.99			1.00	0.85		1.00	0.85	1.00	0.95	
Flt Protected		0.99			0.99	1.00		1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1859			1810	1561		1876	1615	1499	1555	
Flt Permitted		0.84			0.93	1.00		0.97	1.00	0.63	1.00	
Satd. Flow (perm)		1589			1695	1561		1827	1615	987	1555	
Peak-hour factor, PHF	0.94	0.94	0.94	0.96	0.96	0.96	0.90	0.90	0.90	0.84	0.84	0.84
Adj. Flow (vph)	110	280	26	32	246	19	14	198	36	31	204	99
RTOR Reduction (vph)	0	2	0	0	0	10	0	0	16	0	14	0
Lane Group Flow (vph)	0	414	0	0	278	9	0	212	20	31	289	0
Heavy Vehicles (%)	0%	0%	0%	0%	1%	0%	0%	1%	0%	0%	0%	0%
Parking (#/hr)										2	2	2
Turn Type	Perm			Perm		Prot	Perm		Prot	Perm		
Protected Phases		4			8	8		2	2		6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		20.1			20.1	20.1		16.0	16.0	16.0	16.0	
Effective Green, g (s)		21.1			21.1	21.1		17.0	17.0	17.0	17.0	
Actuated g/C Ratio		0.46			0.46	0.46		0.37	0.37	0.37	0.37	
Clearance Time (s)		5.0			5.0	5.0		5.0	5.0	5.0	5.0	
Vehicle Extension (s)		3.0			3.0	3.0		3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		727			776	714		674	596	364	573	
v/s Ratio Prot						0.01			0.01		c0.19	
v/s Ratio Perm		c0.26			0.16			0.12		0.03		
v/c Ratio		0.57			0.36	0.01		0.31	0.03	0.09	0.50	
Uniform Delay, d1		9.2			8.1	6.8		10.4	9.3	9.5	11.3	
Progression Factor		1.00			1.00	1.00		1.00	1.00	1.00	1.00	
Incremental Delay, d2		1.0			0.3	0.0		0.3	0.0	0.1	0.7	
Delay (s)		10.2			8.4	6.8		10.7	9.3	9.6	12.0	
Level of Service		B			A	A		B	A	A	B	
Approach Delay (s)		10.2			8.3			10.5			11.8	
Approach LOS		B			A			B			B	
Intersection Summary												
HCM Average Control Delay			10.2		HCM Level of Service					B		
HCM Volume to Capacity ratio			0.54									
Actuated Cycle Length (s)			46.1		Sum of lost time (s)					8.0		
Intersection Capacity Utilization			66.7%		ICU Level of Service					C		
Analysis Period (min)			15									
c Critical Lane Group												

2017 Build

Lanes, Volumes, Timings
1: Trapelo Road & Cushing Avenue

2017 Build Conditions

Weekday Morning

												
Lane Group	EBL2	EBL	EBT	EBR	WBL	WBT	WBR	WBR2	NBL	NBT	NBR	NBR2
Lane Configurations												
Volume (vph)	79	17	700	54	37	359	100	2	81	133	4	36
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	10	10	11	11	10	11	11	11	10	11	11	11
Storage Length (ft)		0		0	105		0		0		0	
Storage Lanes		1		0	1		0		1		0	
Taper Length (ft)		25		25	25		25		25		25	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.989			0.967				0.965		
Flt Protected		0.950			0.950				0.950			
Satd. Flow (prot)	0	1671	1555	0	1685	1527	0	0	1685	1746	0	0
Flt Permitted		0.235			0.081				0.950			
Satd. Flow (perm)	0	413	1555	0	144	1527	0	0	1685	1746	0	0
Right Turn on Red				Yes				Yes				Yes
Satd. Flow (RTOR)			4							10		
Link Speed (mph)			30			30				30		
Link Distance (ft)			157			221				274		
Travel Time (s)			3.6			5.0				6.2		
Peak Hour Factor	0.95	0.95	0.95	0.95	0.82	0.82	0.82	0.82	0.77	0.77	0.77	0.77
Heavy Vehicles (%)	1%	0%	2%	5%	0%	2%	1%	0%	0%	2%	0%	0%
Parking (#/hr)			5	5		5	5	5				
Shared Lane Traffic (%)												
Turn Type	pm+pt	pm+pt			pm+pt				Prot			
Protected Phases	5	5	2		1	6			3	8		
Permitted Phases	2	2			6							
Detector Phase	5	5	2		1	6			3	8		
Switch Phase												
Minimum Initial (s)	3.0	3.0	12.0		3.0	12.0			6.0	12.0		
Minimum Split (s)	6.0	6.0	30.0		6.0	30.0			13.0	28.5		
Total Split (s)	8.0	8.0	58.0	0.0	8.0	58.0	0.0	0.0	20.0	32.0	0.0	0.0
Total Split (%)	6.7%	6.7%	48.3%	0.0%	6.7%	48.3%	0.0%	0.0%	16.7%	26.7%	0.0%	0.0%
Maximum Green (s)	5.0	5.0	51.0		5.0	51.0			13.0	25.0		
Yellow Time (s)	3.0	3.0	4.0		3.0	4.0			3.5	3.5		
All-Red Time (s)	0.0	0.0	3.0		0.0	3.0			3.5	3.5		
Lost Time Adjust (s)	1.0	1.0	-3.0	0.0	1.0	-3.0	0.0	0.0	-3.0	-3.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lead	Lag		Lead	Lag			Lead	Lag		
Lead-Lag Optimize?	Yes	Yes	Yes		Yes	Yes			Yes	Yes		
Vehicle Extension (s)	2.0	2.0	2.0		2.0	2.0			2.0	2.0		
Recall Mode	None	None	Min		None	Min			None	None		
Walk Time (s)			7.0			7.0				7.0		
Flash Dont Walk (s)			16.0			16.0				14.5		
Pedestrian Calls (#/hr)			0			0				0		

Intersection Summary

Area Type: Other
Cycle Length: 120
Actuated Cycle Length: 112.3
Natural Cycle: 120

Lanes, Volumes, Timings
1: Trapelo Road & Cushing Avenue

2017 Build Conditions

Weekday Morning

				
Lane Group	SBL2	SBL	SBT	SBR
Lane Configurations				
Volume (vph)	7	222	236	88
Ideal Flow (vphpl)	1900	1900	1900	1900
Lane Width (ft)	11	11	11	16
Storage Length (ft)		0		50
Storage Lanes		1		1
Taper Length (ft)		25		25
Lane Util. Factor	1.00	1.00	1.00	1.00
Frt				0.850
Flt Protected		0.950		
Satd. Flow (prot)	0	1745	1618	1629
Flt Permitted		0.950		
Satd. Flow (perm)	0	1745	1618	1629
Right Turn on Red				Yes
Satd. Flow (RTOR)				49
Link Speed (mph)			30	
Link Distance (ft)			873	
Travel Time (s)			19.8	
Peak Hour Factor	0.94	0.94	0.94	0.94
Heavy Vehicles (%)	0%	0%	1%	0%
Parking (#/hr)			2	2
Shared Lane Traffic (%)				
Turn Type	Prot	Prot		pm+ov
Protected Phases	7	7	4	5
Permitted Phases				4
Detector Phase	7	7	4	5
Switch Phase				
Minimum Initial (s)	6.0	6.0	12.0	3.0
Minimum Split (s)	13.0	13.0	28.5	6.0
Total Split (s)	22.0	22.0	34.0	8.0
Total Split (%)	18.3%	18.3%	28.3%	6.7%
Maximum Green (s)	15.0	15.0	27.0	5.0
Yellow Time (s)	3.5	3.5	3.5	3.0
All-Red Time (s)	3.5	3.5	3.5	0.0
Lost Time Adjust (s)	-3.0	-3.0	-3.0	1.0
Total Lost Time (s)	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lead	Lag	Lead
Lead-Lag Optimize?	Yes	Yes	Yes	Yes
Vehicle Extension (s)	2.0	2.0	2.0	2.0
Recall Mode	None	None	None	None
Walk Time (s)			7.0	
Flash Dont Walk (s)			14.5	
Pedestrian Calls (#/hr)			0	
Intersection Summary				

Lanes, Volumes, Timings 1: Trapelo Road & Cushing Avenue

2017 Build Conditions
Weekday Morning

Control Type: Actuated-Uncoordinated

Splits and Phases: 1: Trapelo Road & Cushing Avenue

 ø1	 ø2	 ø3	 ø4
8 s	58 s	20 s	34 s
 ø5	 ø6	 ø7	 ø8
8 s	58 s	22 s	32 s

Queues

2017 Build Conditions

1: Trapelo Road & Cushing Avenue

Weekday Morning

									
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	101	794	45	562	105	225	243	251	94
v/c Ratio	0.39	1.05	0.36	0.79	0.52	0.65	0.86	0.66	0.18
Control Delay	19.5	78.1	21.5	35.6	57.0	49.5	76.1	49.3	16.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	19.5	78.1	21.5	35.6	57.0	49.5	76.1	49.3	16.6
Queue Length 50th (ft)	34	~640	15	328	72	147	175	170	24
Queue Length 95th (ft)	70	#959	33	454	114	189	#345	265	65
Internal Link Dist (ft)		77		141		194		793	
Turn Bay Length (ft)			105						50
Base Capacity (vph)	256	754	128	738	241	445	281	434	531
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.39	1.05	0.35	0.76	0.44	0.51	0.86	0.58	0.18

Intersection Summary

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

HCM Signalized Intersection Capacity Analysis

2017 Build Conditions

1: Trapelo Road & Cushing Avenue

Weekday Morning

												
Movement	EBL2	EBL	EBT	EBR	WBL	WBT	WBR	WBR2	NBL	NBT	NBR	NBR2
Lane Configurations												
Volume (vph)	79	17	700	54	37	359	100	2	81	133	4	36
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	10	10	11	11	10	11	11	11	10	11	11	11
Total Lost time (s)		4.0	4.0		4.0	4.0			4.0	4.0		
Lane Util. Factor		1.00	1.00		1.00	1.00			1.00	1.00		
Frt		1.00	0.99		1.00	0.97			1.00	0.97		
Flt Protected		0.95	1.00		0.95	1.00			0.95	1.00		
Satd. Flow (prot)		1671	1555		1685	1527			1685	1746		
Flt Permitted		0.23	1.00		0.08	1.00			0.95	1.00		
Satd. Flow (perm)		413	1555		144	1527			1685	1746		
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.82	0.82	0.82	0.82	0.77	0.77	0.77	0.77
Adj. Flow (vph)	83	18	737	57	45	438	122	2	105	173	5	47
RTOR Reduction (vph)	0	0	2	0	0	0	0	0	0	8	0	0
Lane Group Flow (vph)	0	101	792	0	45	562	0	0	105	217	0	0
Heavy Vehicles (%)	1%	0%	2%	5%	0%	2%	1%	0%	0%	2%	0%	0%
Parking (#/hr)			5	5		5	5	5				
Turn Type	pm+pt	pm+pt			pm+pt				Prot			
Protected Phases	5	5	2		1	6			3	8		
Permitted Phases	2	2			6							
Actuated Green, G (s)		56.2	51.2		54.0	50.1			10.5	18.6		
Effective Green, g (s)		54.2	54.2		52.0	53.1			13.5	21.6		
Actuated g/C Ratio		0.48	0.48		0.46	0.47			0.12	0.19		
Clearance Time (s)		3.0	7.0		3.0	7.0			7.0	7.0		
Vehicle Extension (s)		2.0	2.0		2.0	2.0			2.0	2.0		
Lane Grp Cap (vph)		243	747		106	719			202	334		
v/s Ratio Prot		c0.01	c0.51		0.01	0.37			0.06	0.12		
v/s Ratio Perm		0.18			0.18							
v/c Ratio		0.42	1.06		0.42	0.78			0.52	0.65		
Uniform Delay, d1		19.2	29.3		24.7	25.0			46.6	42.1		
Progression Factor		1.00	1.00		1.00	1.00			1.00	1.00		
Incremental Delay, d2		0.4	50.0		1.0	5.1			0.9	3.2		
Delay (s)		19.6	79.3		25.7	30.1			47.5	45.4		
Level of Service		B	E		C	C			D	D		
Approach Delay (s)			72.6			29.8				46.1		
Approach LOS			E			C				D		
Intersection Summary												
HCM Average Control Delay			53.3			HCM Level of Service				D		
HCM Volume to Capacity ratio			0.87									
Actuated Cycle Length (s)			112.8			Sum of lost time (s)				8.0		
Intersection Capacity Utilization			79.5%			ICU Level of Service				D		
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

1: Trapelo Road & Cushing Avenue

2017 Build Conditions

Weekday Morning

				
Movement	SBL2	SBL	SBT	SBR
Lane Configurations				
Volume (vph)	7	222	236	88
Ideal Flow (vphpl)	1900	1900	1900	1900
Lane Width	11	11	11	16
Total Lost time (s)		4.0	4.0	4.0
Lane Util. Factor		1.00	1.00	1.00
Frt		1.00	1.00	0.85
Flt Protected		0.95	1.00	1.00
Satd. Flow (prot)		1745	1618	1629
Flt Permitted		0.95	1.00	1.00
Satd. Flow (perm)		1745	1618	1629
Peak-hour factor, PHF	0.94	0.94	0.94	0.94
Adj. Flow (vph)	7	236	251	94
RTOR Reduction (vph)	0	0	0	38
Lane Group Flow (vph)	0	243	251	56
Heavy Vehicles (%)	0%	0%	1%	0%
Parking (#/hr)			2	2
Turn Type	Prot	Prot	pm+ov	
Protected Phases	7	7	4	5
Permitted Phases				4
Actuated Green, G (s)		15.1	23.2	28.2
Effective Green, g (s)		18.1	26.2	26.2
Actuated g/C Ratio		0.16	0.23	0.23
Clearance Time (s)		7.0	7.0	3.0
Vehicle Extension (s)		2.0	2.0	2.0
Lane Grp Cap (vph)		280	376	378
v/s Ratio Prot		c0.14	c0.16	0.01
v/s Ratio Perm				0.03
v/c Ratio		0.87	0.67	0.15
Uniform Delay, d1		46.2	39.3	34.4
Progression Factor		1.00	1.00	1.00
Incremental Delay, d2		22.8	3.5	0.1
Delay (s)		69.0	42.8	34.5
Level of Service		E	D	C
Approach Delay (s)			52.3	
Approach LOS			D	
Intersection Summary				

Lanes, Volumes, Timings
2: Trapelo Road & Site Driveway

2017 Build Conditions
Weekday Morning

						
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	790	79	44	484	0	60
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	11	12	12	12	12
Lane Util. Factor	0.95	0.95	1.00	1.00	1.00	1.00
Frt	0.986					0.865
Flt Protected				0.996		
Satd. Flow (prot)	3373	0	0	1872	0	1611
Flt Permitted				0.996		
Satd. Flow (perm)	3373	0	0	1872	0	1611
Link Speed (mph)	30			30	30	
Link Distance (ft)	143			157	134	
Travel Time (s)	3.3			3.6	3.0	
Peak Hour Factor	0.94	0.94	0.89	0.89	0.85	0.85
Heavy Vehicles (%)	2%	2%	2%	1%	2%	2%
Shared Lane Traffic (%)						
Sign Control	Free			Free	Stop	
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					

HCM Unsignalized Intersection Capacity Analysis

2: Trapelo Road & Site Driveway

2017 Build Conditions

Weekday Morning

						
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	790	79	44	484	0	60
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.94	0.94	0.89	0.89	0.85	0.85
Hourly flow rate (vph)	840	84	49	544	0	71
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)				157		
pX, platoon unblocked					0.72	
vC, conflicting volume			924		1525	462
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			924		1535	462
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			93		100	87
cM capacity (veh/h)			735		72	546
Direction, Lane #	EB 1	EB 2	WB 1	NB 1		
Volume Total	560	364	593	71		
Volume Left	0	0	49	0		
Volume Right	0	84	0	71		
cSH	1700	1700	735	546		
Volume to Capacity	0.33	0.21	0.07	0.13		
Queue Length 95th (ft)	0	0	5	11		
Control Delay (s)	0.0	0.0	1.8	12.6		
Lane LOS			A	B		
Approach Delay (s)	0.0		1.8	12.6		
Approach LOS				B		
Intersection Summary						
Average Delay			1.2			
Intersection Capacity Utilization			58.9%		ICU Level of Service	B
Analysis Period (min)			15			

Lanes, Volumes, Timings
3: Trapelo Road & Williston Road

2017 Build Conditions
Weekday Morning

						
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	870	0	7	480	1	6
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	16	16	11	11	13	13
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt					0.882	
Flt Protected				0.999	0.994	
Satd. Flow (prot)	1879	0	0	1617	1688	0
Flt Permitted				0.999	0.994	
Satd. Flow (perm)	1879	0	0	1617	1688	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	121			143	276	
Travel Time (s)	2.8			3.3	6.3	
Peak Hour Factor	0.94	0.94	0.89	0.89	0.85	0.85
Heavy Vehicles (%)	2%	2%	2%	1%	2%	2%
Parking (#/hr)	2	2	2	2		
Shared Lane Traffic (%)						
Sign Control	Free			Free	Stop	
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					

HCM Unsignalized Intersection Capacity Analysis

3: Trapelo Road & Williston Road

2017 Build Conditions

Weekday Morning

						
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	870	0	7	480	1	6
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.94	0.94	0.89	0.89	0.85	0.85
Hourly flow rate (vph)	926	0	8	539	1	7
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (ft)				300		
pX, platoon unblocked					0.80	
vC, conflicting volume			926		1481	926
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			926		1476	926
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			99		99	98
cM capacity (veh/h)			738		110	326
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	926	547	8			
Volume Left	0	8	1			
Volume Right	0	0	7			
cSH	1700	738	254			
Volume to Capacity	0.54	0.01	0.03			
Queue Length 95th (ft)	0	1	3			
Control Delay (s)	0.0	0.3	19.6			
Lane LOS		A	C			
Approach Delay (s)	0.0	0.3	19.6			
Approach LOS			C			
Intersection Summary						
Average Delay			0.2			
Intersection Capacity Utilization			55.8%	ICU Level of Service		B
Analysis Period (min)			15			

Lanes, Volumes, Timings
4: Site Driveway & Common Street

2017 Build Conditions
Weekday Morning

						
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	86	28	10	216	253	35
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	11	16	16	11	11
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.967				0.984	
Flt Protected	0.964			0.998		
Satd. Flow (prot)	1679	0	0	1893	1577	0
Flt Permitted	0.964			0.998		
Satd. Flow (perm)	1679	0	0	1893	1577	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	139			211	274	
Travel Time (s)	3.2			4.8	6.2	
Peak Hour Factor	0.85	0.85	0.88	0.88	0.82	0.82
Heavy Vehicles (%)	2%	2%	2%	1%	2%	2%
Parking (#/hr)			2	2	2	2
Shared Lane Traffic (%)						
Sign Control	Stop			Free	Free	
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					

HCM Unsignalized Intersection Capacity Analysis

4: Site Driveway & Common Street

2017 Build Conditions

Weekday Morning

						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	86	28	10	216	253	35
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.85	0.85	0.88	0.88	0.82	0.82
Hourly flow rate (vph)	101	33	11	245	309	43
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage (veh)						
Upstream signal (ft)				211	274	
pX, platoon unblocked	0.89	0.87	0.87			
vC, conflicting volume	598	330	351			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	375	152	176			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	82	96	99			
cM capacity (veh/h)	552	776	1215			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	134	257	351			
Volume Left	101	11	0			
Volume Right	33	0	43			
cSH	594	1215	1700			
Volume to Capacity	0.23	0.01	0.21			
Queue Length 95th (ft)	22	1	0			
Control Delay (s)	12.8	0.4	0.0			
Lane LOS	B	A				
Approach Delay (s)	12.8	0.4	0.0			
Approach LOS	B					
Intersection Summary						
Average Delay			2.5			
Intersection Capacity Utilization			32.6%	ICU Level of Service		A
Analysis Period (min)			15			

Lanes, Volumes, Timings
5: Horne Road & Williston Road

2017 Build Conditions
Weekday Morning

						
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	8	4	0	0	10	13
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	10	10	10	10	10	10
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt					0.924	
Flt Protected		0.968			0.979	
Satd. Flow (prot)	0	1432	1578	0	1428	0
Flt Permitted		0.968			0.979	
Satd. Flow (perm)	0	1432	1578	0	1428	0
Link Speed (mph)		30	30		30	
Link Distance (ft)		596	108		276	
Travel Time (s)		13.5	2.5		6.3	
Peak Hour Factor	0.83	0.83	0.65	0.65	0.77	0.77
Heavy Vehicles (%)	10%	0%	0%	0%	0%	0%
Parking (#/hr)	2	2	2	2	2	2
Shared Lane Traffic (%)						
Sign Control		Free	Free		Stop	
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					

HCM Unsignalized Intersection Capacity Analysis

5: Horne Road & Williston Road

2017 Build Conditions

Weekday Morning

						
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	8	4	0	0	10	13
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.83	0.83	0.65	0.65	0.77	0.77
Hourly flow rate (vph)	10	5	0	0	13	17
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	0				24	0
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	0				24	0
tC, single (s)	4.2				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.3				3.5	3.3
p0 queue free %	99				99	98
cM capacity (veh/h)	1572				991	1091
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	14	0	30			
Volume Left	10	0	13			
Volume Right	0	0	17			
cSH	1572	1700	1045			
Volume to Capacity	0.01	0.00	0.03			
Queue Length 95th (ft)	0	0	2			
Control Delay (s)	4.9	0.0	8.5			
Lane LOS	A		A			
Approach Delay (s)	4.9	0.0	8.5			
Approach LOS			A			
Intersection Summary						
Average Delay			7.4			
Intersection Capacity Utilization			13.3%	ICU Level of Service		A
Analysis Period (min)			15			

Lanes, Volumes, Timings
6: Horne Road & Poplar Street

2017 Build Conditions
Weekday Morning

						
Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	16	3	86	17	2	18
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	10	10	12	12	12	12
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.978		0.978			
Flt Protected	0.960					0.995
Satd. Flow (prot)	1482	0	1638	0	0	1683
Flt Permitted	0.960					0.995
Satd. Flow (perm)	1482	0	1638	0	0	1683
Link Speed (mph)	30		30			30
Link Distance (ft)	596		290			271
Travel Time (s)	13.5		6.6			6.2
Peak Hour Factor	0.75	0.75	0.77	0.77	0.68	0.68
Heavy Vehicles (%)	0%	0%	0%	6%	0%	0%
Parking (#/hr)	2	2	2	2	2	2
Shared Lane Traffic (%)						
Sign Control	Stop		Free			Free
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					

HCM Unsignalized Intersection Capacity Analysis

6: Horne Road & Poplar Street

2017 Build Conditions

Weekday Morning

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	16	3	86	17	2	18
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.75	0.75	0.77	0.77	0.68	0.68
Hourly flow rate (vph)	21	4	112	22	3	26
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	155	123			134	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	155	123			134	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	97	100			100	
cM capacity (veh/h)	839	934			1463	
Direction, Lane #	WB 1	NB 1	SB 1			
Volume Total	25	134	29			
Volume Left	21	0	3			
Volume Right	4	22	0			
cSH	853	1700	1463			
Volume to Capacity	0.03	0.08	0.00			
Queue Length 95th (ft)	2	0	0			
Control Delay (s)	9.3	0.0	0.8			
Lane LOS	A		A			
Approach Delay (s)	9.3	0.0	0.8			
Approach LOS	A					
Intersection Summary						
Average Delay			1.4			
Intersection Capacity Utilization			15.6%	ICU Level of Service		A
Analysis Period (min)			15			

Lanes, Volumes, Timings
7: Belmont Street & Common Street

2017 Build Conditions

Weekday Morning

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	126	581	8	11	368	17	10	49	8	28	50	207
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	11	11	11	12	12	12	10	11	11
Storage Length (ft)	0		0	0		80	0		60	50		0
Storage Lanes	0		0	0		1	0		1	1		1
Taper Length (ft)	25		25	25		25	25		25	25		25
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.998				0.850			0.850		0.879	
Flt Protected		0.991			0.999			0.992		0.950		
Satd. Flow (prot)	0	1879	0	0	1817	1561	0	1869	1615	1499	1425	0
Flt Permitted		0.853			0.979			0.639		0.593		
Satd. Flow (perm)	0	1617	0	0	1781	1561	0	1204	1615	936	1425	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		1				11			21		189	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		736			971			731			211	
Travel Time (s)		16.7			22.1			16.6			4.8	
Peak Hour Factor	0.94	0.94	0.94	0.89	0.89	0.89	0.39	0.39	0.39	0.86	0.86	0.86
Heavy Vehicles (%)	0%	0%	0%	0%	1%	0%	0%	1%	0%	0%	0%	1%
Parking (#/hr)										2	2	2
Shared Lane Traffic (%)												
Turn Type	Perm			Perm		Prot	Perm		Prot	Perm		
Protected Phases		4			8	8		2	2		6	
Permitted Phases	4			8			2			6		
Detector Phase	4	4		8	8	8	2	2	2	6	6	
Switch Phase												
Minimum Initial (s)	10.0	10.0		10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	
Minimum Split (s)	15.0	15.0		15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	
Total Split (s)	55.0	55.0	0.0	55.0	55.0	55.0	35.0	35.0	35.0	35.0	35.0	0.0
Total Split (%)	50.0%	50.0%	0.0%	50.0%	50.0%	50.0%	31.8%	31.8%	31.8%	31.8%	31.8%	0.0%
Maximum Green (s)	50.0	50.0		50.0	50.0	50.0	30.0	30.0	30.0	30.0	30.0	
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
All-Red Time (s)	1.0	1.0		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
Lost Time Adjust (s)	-1.0	-1.0	0.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Recall Mode	Min	Min		Min	Min	Min	None	None	None	None	None	
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Intersection Summary												
Area Type:	Other											
Cycle Length: 110												
Actuated Cycle Length: 73.4												
Natural Cycle: 90												

Lanes, Volumes, Timings
7: Belmont Street & Common Street

2017 Build Conditions
Weekday Morning

Lane Group ø9

Lane Configurations

Volume (vph)

Ideal Flow (vphpl)

Lane Width (ft)

Storage Length (ft)

Storage Lanes

Taper Length (ft)

Lane Util. Factor

Frt

Flt Protected

Satd. Flow (prot)

Flt Permitted

Satd. Flow (perm)

Right Turn on Red

Satd. Flow (RTOR)

Link Speed (mph)

Link Distance (ft)

Travel Time (s)

Peak Hour Factor

Heavy Vehicles (%)

Parking (#/hr)

Shared Lane Traffic (%)

Turn Type

Protected Phases 9

Permitted Phases

Detector Phase

Switch Phase

Minimum Initial (s) 4.0

Minimum Split (s) 20.0

Total Split (s) 20.0

Total Split (%) 18%

Maximum Green (s) 14.0

Yellow Time (s) 4.0

All-Red Time (s) 2.0

Lost Time Adjust (s)

Total Lost Time (s)

Lead/Lag

Lead-Lag Optimize?

Vehicle Extension (s) 3.0

Recall Mode None

Walk Time (s) 7.0

Flash Dont Walk (s) 7.0

Pedestrian Calls (#/hr) 0

Intersection Summary

Lanes, Volumes, Timings
 7: Belmont Street & Common Street

2017 Build Conditions
 Weekday Morning

Control Type: Actuated-Uncoordinated

Splits and Phases: 7: Belmont Street & Common Street

 ø2	 ø4	 ø9
35 s	55 s	20 s
 ø6	 ø8	
35 s	55 s	

Queues

2017 Build Conditions

7: Belmont Street & Common Street

Weekday Morning

							
Lane Group	EBT	WBT	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	761	425	19	152	21	33	299
v/c Ratio	0.68	0.34	0.02	0.65	0.06	0.18	0.70
Control Delay	11.2	6.0	3.2	40.6	10.6	26.5	19.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	11.2	6.0	3.2	40.6	10.6	26.5	19.7
Queue Length 50th (ft)	148	58	1	64	0	13	44
Queue Length 95th (ft)	381	139	8	45	3	34	110
Internal Link Dist (ft)	656	891		651			131
Turn Bay Length (ft)			80		60	50	
Base Capacity (vph)	1126	1240	1090	510	696	396	712
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.68	0.34	0.02	0.30	0.03	0.08	0.42
Intersection Summary							

HCM Signalized Intersection Capacity Analysis

2017 Build Conditions

7: Belmont Street & Common Street

Weekday Morning

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	126	581	8	11	368	17	10	49	8	28	50	207
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	11	11	11	12	12	12	10	11	11
Total Lost time (s)		4.0			4.0	4.0		4.0	4.0	4.0	4.0	
Lane Util. Factor		1.00			1.00	1.00		1.00	1.00	1.00	1.00	
Frt		1.00			1.00	0.85		1.00	0.85	1.00	0.88	
Flt Protected		0.99			1.00	1.00		0.99	1.00	0.95	1.00	
Satd. Flow (prot)		1880			1816	1561		1868	1615	1499	1426	
Flt Permitted		0.85			0.98	1.00		0.64	1.00	0.59	1.00	
Satd. Flow (perm)		1618			1782	1561		1205	1615	937	1426	
Peak-hour factor, PHF	0.94	0.94	0.94	0.89	0.89	0.89	0.39	0.39	0.39	0.86	0.86	0.86
Adj. Flow (vph)	134	618	9	12	413	19	26	126	21	33	58	241
RTOR Reduction (vph)	0	0	0	0	0	3	0	0	17	0	152	0
Lane Group Flow (vph)	0	761	0	0	425	16	0	152	4	33	147	0
Heavy Vehicles (%)	0%	0%	0%	0%	1%	0%	0%	1%	0%	0%	0%	1%
Parking (#/hr)										2	2	2
Turn Type	Perm			Perm		Prot	Perm		Prot	Perm		
Protected Phases		4			8	8		2	2		6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		50.1			50.1	50.1		13.3	13.3	13.3	13.3	
Effective Green, g (s)		51.1			51.1	51.1		14.3	14.3	14.3	14.3	
Actuated g/C Ratio		0.70			0.70	0.70		0.19	0.19	0.19	0.19	
Clearance Time (s)		5.0			5.0	5.0		5.0	5.0	5.0	5.0	
Vehicle Extension (s)		3.0			3.0	3.0		3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		1126			1241	1087		235	315	183	278	
v/s Ratio Prot						0.01			0.00		0.10	
v/s Ratio Perm		c0.47			0.24			c0.13		0.04		
v/c Ratio		0.68			0.34	0.01		0.65	0.01	0.18	0.53	
Uniform Delay, d1		6.4			4.4	3.4		27.2	23.9	24.7	26.5	
Progression Factor		1.00			1.00	1.00		1.00	1.00	1.00	1.00	
Incremental Delay, d2		1.6			0.2	0.0		6.0	0.0	0.5	1.8	
Delay (s)		8.0			4.6	3.4		33.2	23.9	25.1	28.3	
Level of Service		A			A	A		C	C	C	C	
Approach Delay (s)		8.0			4.6			32.1			28.0	
Approach LOS		A			A			C			C	
Intersection Summary												
HCM Average Control Delay			13.4				HCM Level of Service			B		
HCM Volume to Capacity ratio			0.67									
Actuated Cycle Length (s)			73.4				Sum of lost time (s)			8.0		
Intersection Capacity Utilization			83.4%				ICU Level of Service			E		
Analysis Period (min)			15									
c Critical Lane Group												

Lanes, Volumes, Timings
1: Trapelo Road & Cushing Avenue

2017 Build Conditions

Weekday Evening

												
Lane Group	EBL2	EBL	EBT	EBR	WBL	WBT	WBR	WBR2	NBL	NBT	NBR	NBR2
Lane Configurations												
Volume (vph)	80	21	454	85	48	607	139	10	123	245	14	53
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	10	10	11	11	10	11	11	11	10	11	11	11
Storage Length (ft)		0		0	105		0		0		0	
Storage Lanes		1		0	1		0		1		0	
Taper Length (ft)		25		25	25		25		25		25	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.976			0.970				0.968		
Flt Protected		0.950			0.950				0.950			
Satd. Flow (prot)	0	1671	1555	0	1685	1546	0	0	1685	1764	0	0
Flt Permitted		0.078			0.224				0.950			
Satd. Flow (perm)	0	137	1555	0	397	1546	0	0	1685	1764	0	0
Right Turn on Red				Yes				Yes				Yes
Satd. Flow (RTOR)			10			1				8		
Link Speed (mph)			30			30				30		
Link Distance (ft)			157			221				274		
Travel Time (s)			3.6			5.0				6.2		
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.87	0.87	0.87	0.87
Heavy Vehicles (%)	1%	0%	1%	0%	0%	1%	0%	0%	0%	1%	0%	0%
Parking (#/hr)			5	5		5	5	5				
Shared Lane Traffic (%)												
Turn Type	pm+pt	pm+pt			pm+pt				Prot			
Protected Phases	5	5	2		1	6			3	8		
Permitted Phases	2	2			6							
Detector Phase	5	5	2		1	6			3	8		
Switch Phase												
Minimum Initial (s)	3.0	3.0	12.0		3.0	12.0			6.0	12.0		
Minimum Split (s)	6.0	6.0	30.0		6.0	30.0			13.0	28.5		
Total Split (s)	11.0	11.0	56.0	0.0	11.0	56.0	0.0	0.0	19.0	34.0	0.0	0.0
Total Split (%)	9.2%	9.2%	46.7%	0.0%	9.2%	46.7%	0.0%	0.0%	15.8%	28.3%	0.0%	0.0%
Maximum Green (s)	8.0	8.0	49.0		8.0	49.0			12.0	27.0		
Yellow Time (s)	3.0	3.0	4.0		3.0	4.0			3.5	3.5		
All-Red Time (s)	0.0	0.0	3.0		0.0	3.0			3.5	3.5		
Lost Time Adjust (s)	1.0	1.0	-3.0	0.0	1.0	-3.0	0.0	0.0	-3.0	-3.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lead	Lag		Lead	Lag			Lead	Lag		
Lead-Lag Optimize?	Yes	Yes	Yes		Yes	Yes			Yes	Yes		
Vehicle Extension (s)	2.0	2.0	2.0		2.0	2.0			2.0	2.0		
Recall Mode	None	None	Min		None	Min			None	None		
Walk Time (s)			7.0			7.0				7.0		
Flash Dont Walk (s)			16.0			16.0				14.5		
Pedestrian Calls (#/hr)			0			0				0		

Intersection Summary

Area Type: Other
Cycle Length: 120
Actuated Cycle Length: 116.7
Natural Cycle: 120

Lanes, Volumes, Timings
1: Trapelo Road & Cushing Avenue

2017 Build Conditions

Weekday Evening

				
Lane Group	SBL2	SBL	SBT	SBR
Lane Configurations				
Volume (vph)	8	119	250	106
Ideal Flow (vphpl)	1900	1900	1900	1900
Lane Width (ft)	11	11	11	16
Storage Length (ft)		0		50
Storage Lanes		1		1
Taper Length (ft)		25		25
Lane Util. Factor	1.00	1.00	1.00	1.00
Frt				0.850
Flt Protected		0.950		
Satd. Flow (prot)	0	1745	1618	1613
Flt Permitted		0.950		
Satd. Flow (perm)	0	1745	1618	1613
Right Turn on Red				Yes
Satd. Flow (RTOR)				58
Link Speed (mph)			30	
Link Distance (ft)			873	
Travel Time (s)			19.8	
Peak Hour Factor	0.88	0.88	0.88	0.88
Heavy Vehicles (%)	0%	0%	1%	1%
Parking (#/hr)			2	2
Shared Lane Traffic (%)				
Turn Type	Prot	Prot		pm+ov
Protected Phases	7	7	4	5
Permitted Phases				4
Detector Phase	7	7	4	5
Switch Phase				
Minimum Initial (s)	6.0	6.0	12.0	3.0
Minimum Split (s)	13.0	13.0	28.5	6.0
Total Split (s)	19.0	19.0	34.0	11.0
Total Split (%)	15.8%	15.8%	28.3%	9.2%
Maximum Green (s)	12.0	12.0	27.0	8.0
Yellow Time (s)	3.5	3.5	3.5	3.0
All-Red Time (s)	3.5	3.5	3.5	0.0
Lost Time Adjust (s)	-3.0	-3.0	-3.0	1.0
Total Lost Time (s)	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lead	Lag	Lead
Lead-Lag Optimize?	Yes	Yes	Yes	Yes
Vehicle Extension (s)	2.0	2.0	2.0	2.0
Recall Mode	None	None	None	None
Walk Time (s)			7.0	
Flash Dont Walk (s)			14.5	
Pedestrian Calls (#/hr)			0	
Intersection Summary				

Lanes, Volumes, Timings 1: Trapelo Road & Cushing Avenue

2017 Build Conditions
Weekday Evening

Control Type: Actuated-Uncoordinated

Splits and Phases: 1: Trapelo Road & Cushing Avenue

 ø1	 ø2	 ø3	 ø4
11 s	56 s	19 s	34 s
 ø5	 ø6	 ø7	 ø8
11 s	56 s	19 s	34 s

Queues

2017 Build Conditions

1: Trapelo Road & Cushing Avenue

Weekday Evening

									
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	111	592	53	831	141	359	144	284	120
v/c Ratio	0.69	0.80	0.21	1.20	0.68	0.85	0.68	0.74	0.21
Control Delay	42.2	37.2	16.1	135.5	67.5	60.6	66.7	54.1	16.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	42.2	37.2	16.1	135.5	67.5	60.6	66.7	54.1	16.0
Queue Length 50th (ft)	42	393	19	~803	106	257	108	201	33
Queue Length 95th (ft)	#123	#626	41	#1051	#178	#378	#178	294	75
Internal Link Dist (ft)		77		141		194		793	
Turn Bay Length (ft)			105						50
Base Capacity (vph)	164	741	278	691	217	460	225	417	572
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.68	0.80	0.19	1.20	0.65	0.78	0.64	0.68	0.21

Intersection Summary

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

HCM Signalized Intersection Capacity Analysis

2017 Build Conditions

1: Trapelo Road & Cushing Avenue

Weekday Evening

												
Movement	EBL2	EBL	EBT	EBR	WBL	WBT	WBR	WBR2	NBL	NBT	NBR	NBR2
Lane Configurations												
Volume (vph)	80	21	454	85	48	607	139	10	123	245	14	53
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	10	10	11	11	10	11	11	11	10	11	11	11
Total Lost time (s)		4.0	4.0		4.0	4.0			4.0	4.0		
Lane Util. Factor		1.00	1.00		1.00	1.00			1.00	1.00		
Frt		1.00	0.98		1.00	0.97			1.00	0.97		
Flt Protected		0.95	1.00		0.95	1.00			0.95	1.00		
Satd. Flow (prot)		1671	1556		1685	1547			1685	1764		
Flt Permitted		0.08	1.00		0.22	1.00			0.95	1.00		
Satd. Flow (perm)		137	1556		397	1547			1685	1764		
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.87	0.87	0.87	0.87
Adj. Flow (vph)	88	23	499	93	53	667	153	11	141	282	16	61
RTOR Reduction (vph)	0	0	5	0	0	1	0	0	0	6	0	0
Lane Group Flow (vph)	0	111	587	0	53	830	0	0	141	353	0	0
Heavy Vehicles (%)	1%	0%	1%	0%	0%	1%	0%	0%	0%	1%	0%	0%
Parking (#/hr)			5	5		5	5	5				
Turn Type	pm+pt	pm+pt			pm+pt				Prot			
Protected Phases	5	5	2		1	6			3	8		
Permitted Phases	2	2			6							
Actuated Green, G (s)		60.0	52.3		55.2	49.9			11.2	24.7		
Effective Green, g (s)		58.0	55.3		53.2	52.9			14.2	27.7		
Actuated g/C Ratio		0.49	0.47		0.45	0.45			0.12	0.24		
Clearance Time (s)		3.0	7.0		3.0	7.0			7.0	7.0		
Vehicle Extension (s)		2.0	2.0		2.0	2.0			2.0	2.0		
Lane Grp Cap (vph)		155	732		227	696			204	416		
v/s Ratio Prot		c0.04	0.38		0.01	c0.54			c0.08	c0.20		
v/s Ratio Perm		0.31			0.10							
v/c Ratio		0.72	0.80		0.23	1.19			0.69	0.85		
Uniform Delay, d1		26.3	26.4		20.8	32.3			49.5	42.9		
Progression Factor		1.00	1.00		1.00	1.00			1.00	1.00		
Incremental Delay, d2		12.3	6.0		0.2	100.7			7.9	14.3		
Delay (s)		38.6	32.4		21.0	133.0			57.4	57.1		
Level of Service		D	C		C	F			E	E		
Approach Delay (s)			33.4			126.3				57.2		
Approach LOS			C			F				E		
Intersection Summary												
HCM Average Control Delay			72.0			HCM Level of Service			E			
HCM Volume to Capacity ratio			1.04									
Actuated Cycle Length (s)			117.5			Sum of lost time (s)			20.0			
Intersection Capacity Utilization			83.9%			ICU Level of Service			E			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

1: Trapelo Road & Cushing Avenue

2017 Build Conditions
Weekday Evening

				
Movement	SBL2	SBL	SBT	SBR
Lane Configurations				
Volume (vph)	8	119	250	106
Ideal Flow (vphpl)	1900	1900	1900	1900
Lane Width	11	11	11	16
Total Lost time (s)		4.0	4.0	4.0
Lane Util. Factor		1.00	1.00	1.00
Frt		1.00	1.00	0.85
Flt Protected		0.95	1.00	1.00
Satd. Flow (prot)		1745	1618	1613
Flt Permitted		0.95	1.00	1.00
Satd. Flow (perm)		1745	1618	1613
Peak-hour factor, PHF	0.88	0.88	0.88	0.88
Adj. Flow (vph)	9	135	284	120
RTOR Reduction (vph)	0	0	0	43
Lane Group Flow (vph)	0	144	284	77
Heavy Vehicles (%)	0%	0%	1%	1%
Parking (#/hr)			2	2
Turn Type	Prot	Prot	pm+ov	
Protected Phases	7	7	4	5
Permitted Phases				4
Actuated Green, G (s)		11.2	24.7	32.4
Effective Green, g (s)		14.2	27.7	30.4
Actuated g/C Ratio		0.12	0.24	0.26
Clearance Time (s)		7.0	7.0	3.0
Vehicle Extension (s)		2.0	2.0	2.0
Lane Grp Cap (vph)		211	381	417
v/s Ratio Prot		0.08	0.18	0.01
v/s Ratio Perm				0.04
v/c Ratio		0.68	0.75	0.18
Uniform Delay, d1		49.5	41.6	33.9
Progression Factor		1.00	1.00	1.00
Incremental Delay, d2		7.1	6.8	0.1
Delay (s)		56.5	48.4	34.0
Level of Service		E	D	C
Approach Delay (s)			47.4	
Approach LOS			D	
Intersection Summary				

Lanes, Volumes, Timings
2: Trapelo Road & Site Driveway

2017 Build Conditions
Weekday Evening

						
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	617	35	40	796	0	23
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	11	12	12	12	12
Lane Util. Factor	0.95	0.95	1.00	1.00	1.00	1.00
Frt	0.992					0.865
Flt Protected				0.998		
Satd. Flow (prot)	3426	0	0	1877	0	1611
Flt Permitted				0.998		
Satd. Flow (perm)	3426	0	0	1877	0	1611
Link Speed (mph)	30			30	30	
Link Distance (ft)	143			157	134	
Travel Time (s)	3.3			3.6	3.0	
Peak Hour Factor	0.91	0.91	0.95	0.95	0.85	0.85
Heavy Vehicles (%)	1%	2%	2%	1%	2%	2%
Shared Lane Traffic (%)						
Sign Control	Free			Free	Stop	
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					

HCM Unsignalized Intersection Capacity Analysis

2: Trapelo Road & Site Driveway

2017 Build Conditions

Weekday Evening

						
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	617	35	40	796	0	23
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.91	0.91	0.95	0.95	0.85	0.85
Hourly flow rate (vph)	678	38	42	838	0	27
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (ft)				157		
pX, platoon unblocked					0.56	
vC, conflicting volume			716		1619	358
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			716		1712	358
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			95		100	96
cM capacity (veh/h)			880		44	638
Direction, Lane #	EB 1	EB 2	WB 1	NB 1		
Volume Total	452	264	880	27		
Volume Left	0	0	42	0		
Volume Right	0	38	0	27		
cSH	1700	1700	880	638		
Volume to Capacity	0.27	0.16	0.05	0.04		
Queue Length 95th (ft)	0	0	4	3		
Control Delay (s)	0.0	0.0	1.3	10.9		
Lane LOS			A	B		
Approach Delay (s)	0.0		1.3	10.9		
Approach LOS				B		
Intersection Summary						
Average Delay			0.9			
Intersection Capacity Utilization			68.9%	ICU Level of Service	C	
Analysis Period (min)			15			

Lanes, Volumes, Timings
3: Trapelo Road & Williston Road

2017 Build Conditions
Weekday Evening

						
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	653	5	17	790	2	8
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	16	16	11	11	13	13
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.999				0.890	
Flt Protected				0.999	0.991	
Satd. Flow (prot)	1895	0	0	1616	1698	0
Flt Permitted				0.999	0.991	
Satd. Flow (perm)	1895	0	0	1616	1698	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	121			143	276	
Travel Time (s)	2.8			3.3	6.3	
Peak Hour Factor	0.91	0.91	0.95	0.95	0.85	0.85
Heavy Vehicles (%)	1%	2%	2%	1%	2%	2%
Parking (#/hr)	2	2	2	2		
Shared Lane Traffic (%)						
Sign Control	Free			Free	Stop	
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					

HCM Unsignalized Intersection Capacity Analysis

3: Trapelo Road & Williston Road

2017 Build Conditions

Weekday Evening

						
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	653	5	17	790	2	8
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.91	0.91	0.95	0.95	0.85	0.85
Hourly flow rate (vph)	718	5	18	832	2	9
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (ft)				300		
pX, platoon unblocked					0.58	
vC, conflicting volume			723		1588	720
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			723		1652	720
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			98		96	98
cM capacity (veh/h)			879		61	428
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	723	849	12			
Volume Left	0	18	2			
Volume Right	5	0	9			
cSH	1700	879	195			
Volume to Capacity	0.43	0.02	0.06			
Queue Length 95th (ft)	0	2	5			
Control Delay (s)	0.0	0.6	24.7			
Lane LOS		A	C			
Approach Delay (s)	0.0	0.6	24.7			
Approach LOS			C			
Intersection Summary						
Average Delay			0.5			
Intersection Capacity Utilization			65.2%	ICU Level of Service		C
Analysis Period (min)			15			

Lanes, Volumes, Timings
4: Site Driveway & Common Street

2017 Build Conditions
Weekday Evening

						
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	85	50	56	351	318	65
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	11	16	16	11	11
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.950				0.977	
Flt Protected	0.970			0.993		
Satd. Flow (prot)	1659	0	0	1882	1579	0
Flt Permitted	0.970			0.993		
Satd. Flow (perm)	1659	0	0	1882	1579	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	139			211	274	
Travel Time (s)	3.2			4.8	6.2	
Peak Hour Factor	0.85	0.85	0.87	0.87	0.91	0.91
Heavy Vehicles (%)	2%	2%	2%	1%	1%	2%
Parking (#/hr)			2	2	2	2
Shared Lane Traffic (%)						
Sign Control	Stop			Free	Free	
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					

HCM Unsignalized Intersection Capacity Analysis

4: Site Driveway & Common Street

2017 Build Conditions

Weekday Evening

						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	85	50	56	351	318	65
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.85	0.85	0.87	0.87	0.91	0.91
Hourly flow rate (vph)	100	59	64	403	349	71
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage (veh)						
Upstream signal (ft)				211	274	
pX, platoon unblocked	0.92	0.85	0.85			
vC, conflicting volume	917	385	421			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	522	183	225			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	78	92	94			
cM capacity (veh/h)	445	727	1137			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	159	468	421			
Volume Left	100	64	0			
Volume Right	59	0	71			
cSH	520	1137	1700			
Volume to Capacity	0.31	0.06	0.25			
Queue Length 95th (ft)	32	4	0			
Control Delay (s)	14.9	1.7	0.0			
Lane LOS	B	A				
Approach Delay (s)	14.9	1.7	0.0			
Approach LOS	B					
Intersection Summary						
Average Delay			3.0			
Intersection Capacity Utilization			60.0%	ICU Level of Service		B
Analysis Period (min)			15			

Lanes, Volumes, Timings
5: Horne Road & Williston Road

2017 Build Conditions
Weekday Evening

						
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	7	1	3	3	5	19
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	10	10	10	10	10	10
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.932		0.894	
Flt Protected		0.959			0.990	
Satd. Flow (prot)	0	1514	1471	0	1397	0
Flt Permitted		0.959			0.990	
Satd. Flow (perm)	0	1514	1471	0	1397	0
Link Speed (mph)		30	30		30	
Link Distance (ft)		596	108		276	
Travel Time (s)		13.5	2.5		6.3	
Peak Hour Factor	0.63	0.63	0.63	0.63	0.73	0.73
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%
Parking (#/hr)	2	2	2	2	2	2
Shared Lane Traffic (%)						
Sign Control		Free	Free		Stop	
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					

HCM Unsignalized Intersection Capacity Analysis

5: Horne Road & Williston Road

2017 Build Conditions

Weekday Evening

						
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	7	1	3	3	5	19
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.63	0.63	0.63	0.63	0.73	0.73
Hourly flow rate (vph)	11	2	5	5	7	26
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	10				31	7
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	10				31	7
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	99				99	98
cM capacity (veh/h)	1623				981	1081
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	13	10	33			
Volume Left	11	0	7			
Volume Right	0	5	26			
cSH	1623	1700	1059			
Volume to Capacity	0.01	0.01	0.03			
Queue Length 95th (ft)	1	0	2			
Control Delay (s)	6.3	0.0	8.5			
Lane LOS	A		A			
Approach Delay (s)	6.3	0.0	8.5			
Approach LOS			A			
Intersection Summary						
Average Delay			6.5			
Intersection Capacity Utilization			16.0%	ICU Level of Service		A
Analysis Period (min)			15			

Lanes, Volumes, Timings
6: Horne Road & Poplar Street

2017 Build Conditions
Weekday Evening

						
Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	19	11	29	6	2	24
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	10	10	12	12	12	12
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.951		0.977			
Flt Protected	0.969					0.996
Satd. Flow (prot)	1454	0	1599	0	0	1684
Flt Permitted	0.969					0.996
Satd. Flow (perm)	1454	0	1599	0	0	1684
Link Speed (mph)	30		30			30
Link Distance (ft)	596		290			271
Travel Time (s)	13.5		6.6			6.2
Peak Hour Factor	0.68	0.68	0.77	0.77	0.63	0.63
Heavy Vehicles (%)	0%	0%	4%	0%	0%	0%
Parking (#/hr)	2	2	2	2	2	2
Shared Lane Traffic (%)						
Sign Control	Stop		Free			Free
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					

HCM Unsignalized Intersection Capacity Analysis

6: Horne Road & Poplar Street

2017 Build Conditions
Weekday Evening

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	19	11	29	6	2	24
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.68	0.68	0.77	0.77	0.63	0.63
Hourly flow rate (vph)	28	16	38	8	3	38
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	86	42			45	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	86	42			45	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	97	98			100	
cM capacity (veh/h)	918	1035			1575	
Direction, Lane #	WB 1	NB 1	SB 1			
Volume Total	44	45	41			
Volume Left	28	0	3			
Volume Right	16	8	0			
cSH	958	1700	1575			
Volume to Capacity	0.05	0.03	0.00			
Queue Length 95th (ft)	4	0	0			
Control Delay (s)	8.9	0.0	0.6			
Lane LOS	A		A			
Approach Delay (s)	8.9	0.0	0.6			
Approach LOS	A					
Intersection Summary						
Average Delay			3.2			
Intersection Capacity Utilization			13.3%	ICU Level of Service		A
Analysis Period (min)			15			

Lanes, Volumes, Timings
7: Belmont Street & Common Street

2017 Build Conditions

Weekday Evening

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	127	369	40	59	468	39	25	249	46	35	193	138
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	11	11	11	12	12	12	10	11	11
Storage Length (ft)	0		0	0		80	0		60	50		0
Storage Lanes	0		0	0		1	0		1	1		1
Taper Length (ft)	25		25	25		25	25		25	25		25
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.990				0.850			0.850		0.937	
Flt Protected		0.988			0.994			0.995		0.950		
Satd. Flow (prot)	0	1858	0	0	1810	1561	0	1873	1615	1499	1525	0
Flt Permitted		0.665			0.890			0.844		0.371		
Satd. Flow (perm)	0	1251	0	0	1620	1561	0	1589	1615	586	1525	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		5				17			28		35	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		736			971			731			211	
Travel Time (s)		16.7			22.1			16.6			4.8	
Peak Hour Factor	0.89	0.89	0.89	0.94	0.94	0.94	0.84	0.84	0.84	0.89	0.89	0.89
Heavy Vehicles (%)	0%	0%	0%	0%	1%	0%	0%	1%	0%	0%	0%	1%
Parking (#/hr)										2	2	2
Shared Lane Traffic (%)												
Turn Type	Perm			Perm		Prot	Perm		Prot	Perm		
Protected Phases		4			8	8		2	2		6	
Permitted Phases	4			8			2			6		
Detector Phase	4	4		8	8	8	2	2	2	6	6	
Switch Phase												
Minimum Initial (s)	10.0	10.0		10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	
Minimum Split (s)	15.0	15.0		15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	
Total Split (s)	50.0	50.0	0.0	50.0	50.0	50.0	40.0	40.0	40.0	40.0	40.0	0.0
Total Split (%)	45.5%	45.5%	0.0%	45.5%	45.5%	45.5%	36.4%	36.4%	36.4%	36.4%	36.4%	0.0%
Maximum Green (s)	45.0	45.0		45.0	45.0	45.0	35.0	35.0	35.0	35.0	35.0	
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
All-Red Time (s)	1.0	1.0		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
Lost Time Adjust (s)	-1.0	-1.0	0.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Recall Mode	Min	Min		Min	Min	Min	None	None	None	None	None	
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Intersection Summary												
Area Type:	Other											
Cycle Length: 110												
Actuated Cycle Length: 77.8												
Natural Cycle: 120												

Lanes, Volumes, Timings
7: Belmont Street & Common Street

2017 Build Conditions
Weekday Evening

Lane Group ø9

Lane Configurations

Volume (vph)

Ideal Flow (vphpl)

Lane Width (ft)

Storage Length (ft)

Storage Lanes

Taper Length (ft)

Lane Util. Factor

Frt

Flt Protected

Satd. Flow (prot)

Flt Permitted

Satd. Flow (perm)

Right Turn on Red

Satd. Flow (RTOR)

Link Speed (mph)

Link Distance (ft)

Travel Time (s)

Peak Hour Factor

Heavy Vehicles (%)

Parking (#/hr)

Shared Lane Traffic (%)

Turn Type

Protected Phases 9

Permitted Phases

Detector Phase

Switch Phase

Minimum Initial (s) 4.0

Minimum Split (s) 20.0

Total Split (s) 20.0

Total Split (%) 18%

Maximum Green (s) 14.0

Yellow Time (s) 4.0

All-Red Time (s) 2.0

Lost Time Adjust (s)

Total Lost Time (s)

Lead/Lag

Lead-Lag Optimize?

Vehicle Extension (s) 3.0

Recall Mode None

Walk Time (s) 7.0

Flash Dont Walk (s) 7.0

Pedestrian Calls (#/hr) 0

Intersection Summary

Lanes, Volumes, Timings
 7: Belmont Street & Common Street

2017 Build Conditions
 Weekday Evening

Control Type: Actuated-Uncoordinated

Splits and Phases: 7: Belmont Street & Common Street

 ø2	 ø4	 ø9
40 s	50 s	20 s
 ø6	 ø8	
40 s	50 s	

Queues

2017 Build Conditions

7: Belmont Street & Common Street

Weekday Evening

							
Lane Group	EBT	WBT	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	603	561	41	326	55	39	372
v/c Ratio	0.81	0.58	0.04	0.68	0.11	0.22	0.77
Control Delay	25.1	14.4	6.2	31.3	11.3	22.8	33.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	25.1	14.4	6.2	31.3	11.3	22.8	33.3
Queue Length 50th (ft)	203	151	4	137	9	14	147
Queue Length 95th (ft)	#510	329	21	199	30	37	237
Internal Link Dist (ft)	656	891		651			131
Turn Bay Length (ft)			80		60	50	
Base Capacity (vph)	746	964	936	740	767	273	729
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.81	0.58	0.04	0.44	0.07	0.14	0.51

Intersection Summary

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

HCM Signalized Intersection Capacity Analysis

7: Belmont Street & Common Street

2017 Build Conditions

Weekday Evening

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	127	369	40	59	468	39	25	249	46	35	193	138
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	11	11	11	12	12	12	10	11	11
Total Lost time (s)		4.0			4.0	4.0		4.0	4.0	4.0	4.0	
Lane Util. Factor		1.00			1.00	1.00		1.00	1.00	1.00	1.00	
Frt		0.99			1.00	0.85		1.00	0.85	1.00	0.94	
Flt Protected		0.99			0.99	1.00		1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1859			1810	1561		1874	1615	1499	1526	
Flt Permitted		0.66			0.89	1.00		0.84	1.00	0.37	1.00	
Satd. Flow (perm)		1250			1621	1561		1590	1615	585	1526	
Peak-hour factor, PHF	0.89	0.89	0.89	0.94	0.94	0.94	0.84	0.84	0.84	0.89	0.89	0.89
Adj. Flow (vph)	143	415	45	63	498	41	30	296	55	39	217	155
RTOR Reduction (vph)	0	2	0	0	0	7	0	0	20	0	24	0
Lane Group Flow (vph)	0	601	0	0	561	34	0	326	35	39	348	0
Heavy Vehicles (%)	0%	0%	0%	0%	1%	0%	0%	1%	0%	0%	0%	1%
Parking (#/hr)										2	2	2
Turn Type	Perm			Perm		Prot	Perm		Prot	Perm		
Protected Phases		4			8	8		2	2		6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		45.3			45.3	45.3		22.4	22.4	22.4	22.4	
Effective Green, g (s)		46.3			46.3	46.3		23.4	23.4	23.4	23.4	
Actuated g/C Ratio		0.60			0.60	0.60		0.30	0.30	0.30	0.30	
Clearance Time (s)		5.0			5.0	5.0		5.0	5.0	5.0	5.0	
Vehicle Extension (s)		3.0			3.0	3.0		3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		745			966	930		479	486	176	460	
v/s Ratio Prot						0.02			0.02		c0.23	
v/s Ratio Perm		c0.48			0.35			0.21		0.07		
v/c Ratio		0.81			0.58	0.04		0.68	0.07	0.22	0.76	
Uniform Delay, d1		12.2			9.7	6.5		23.9	19.4	20.3	24.6	
Progression Factor		1.00			1.00	1.00		1.00	1.00	1.00	1.00	
Incremental Delay, d2		6.4			0.9	0.0		4.0	0.1	0.6	6.9	
Delay (s)		18.6			10.6	6.5		27.8	19.5	21.0	31.5	
Level of Service		B			B	A		C	B	C	C	
Approach Delay (s)		18.6			10.3			26.6			30.5	
Approach LOS		B			B			C			C	
Intersection Summary												
HCM Average Control Delay			20.1				HCM Level of Service			C		
HCM Volume to Capacity ratio			0.79									
Actuated Cycle Length (s)			77.7				Sum of lost time (s)		8.0			
Intersection Capacity Utilization			100.7%				ICU Level of Service		G			
Analysis Period (min)			15									
c Critical Lane Group												

Lanes, Volumes, Timings
1: Trapelo Road & Cushing Avenue

2017 Build Conditions
Saturday MIDDAY

												
Lane Group	EBL2	EBL	EBT	EBR	WBL	WBT	WBR	WBR2	NBL	NBT	NBR	NBR2
Lane Configurations												
Volume (vph)	87	23	384	90	72	376	98	12	169	170	20	91
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	10	10	11	11	10	11	11	11	10	11	11	11
Storage Length (ft)		0		0	105		0		0		0	
Storage Lanes		1		0	1		0		1		0	
Taper Length (ft)		25		25	25		25		25		25	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.971			0.966				0.941		
Flt Protected		0.950			0.950				0.950			
Satd. Flow (prot)	0	1685	1548	0	1685	1549	0	0	1652	1728	0	0
Flt Permitted		0.215			0.244				0.950			
Satd. Flow (perm)	0	381	1548	0	433	1549	0	0	1652	1728	0	0
Right Turn on Red				Yes				Yes				Yes
Satd. Flow (RTOR)			14			2				20		
Link Speed (mph)			30			30				30		
Link Distance (ft)			157			221				274		
Travel Time (s)			3.6			5.0				6.2		
Peak Hour Factor	0.91	0.91	0.91	0.91	0.94	0.94	0.94	0.94	0.91	0.91	0.91	0.91
Heavy Vehicles (%)	0%	0%	1%	0%	0%	0%	1%	0%	2%	0%	0%	0%
Parking (#/hr)			5	5		5	5	5				
Shared Lane Traffic (%)												
Turn Type	pm+pt	pm+pt			pm+pt				Prot			
Protected Phases	5	5	2		1	6			3	8		
Permitted Phases	2	2			6							
Detector Phase	5	5	2		1	6			3	8		
Switch Phase												
Minimum Initial (s)	3.0	3.0	12.0		3.0	12.0			6.0	12.0		
Minimum Split (s)	6.0	6.0	30.0		6.0	30.0			13.0	28.5		
Total Split (s)	8.0	8.0	55.0	0.0	8.0	55.0	0.0	0.0	19.0	28.5	0.0	0.0
Total Split (%)	7.3%	7.3%	50.0%	0.0%	7.3%	50.0%	0.0%	0.0%	17.3%	25.9%	0.0%	0.0%
Maximum Green (s)	5.0	5.0	48.0		5.0	48.0			12.0	21.5		
Yellow Time (s)	3.0	3.0	4.0		3.0	4.0			3.5	3.5		
All-Red Time (s)	0.0	0.0	3.0		0.0	3.0			3.5	3.5		
Lost Time Adjust (s)	1.0	1.0	-3.0	0.0	1.0	-3.0	0.0	0.0	-3.0	-3.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lead	Lag		Lead	Lag			Lead	Lag		
Lead-Lag Optimize?	Yes	Yes	Yes		Yes	Yes			Yes	Yes		
Vehicle Extension (s)	2.0	2.0	2.0		2.0	2.0			2.0	2.0		
Recall Mode	None	None	Min		None	Min			None	None		
Walk Time (s)			7.0			7.0				7.0		
Flash Dont Walk (s)			16.0			16.0				14.5		
Pedestrian Calls (#/hr)			0			0				0		

Intersection Summary

Area Type: Other
Cycle Length: 110
Actuated Cycle Length: 93.9
Natural Cycle: 90

Lanes, Volumes, Timings
1: Trapelo Road & Cushing Avenue

2017 Build Conditions

Saturday MIDDAY

				
Lane Group	SBL2	SBL	SBT	SBR
Lane Configurations				
Volume (vph)	6	100	187	113
Ideal Flow (vphpl)	1900	1900	1900	1900
Lane Width (ft)	11	11	11	16
Storage Length (ft)		0		50
Storage Lanes		1		1
Taper Length (ft)		25		25
Lane Util. Factor	1.00	1.00	1.00	1.00
Frt				0.850
Flt Protected		0.950		
Satd. Flow (prot)	0	1745	1635	1629
Flt Permitted		0.950		
Satd. Flow (perm)	0	1745	1635	1629
Right Turn on Red				Yes
Satd. Flow (RTOR)				84
Link Speed (mph)			30	
Link Distance (ft)			873	
Travel Time (s)			19.8	
Peak Hour Factor	0.82	0.82	0.82	0.82
Heavy Vehicles (%)	0%	0%	0%	0%
Parking (#/hr)			2	2
Shared Lane Traffic (%)				
Turn Type	Prot	Prot		pm+ov
Protected Phases	7	7	4	5
Permitted Phases				4
Detector Phase	7	7	4	5
Switch Phase				
Minimum Initial (s)	6.0	6.0	12.0	3.0
Minimum Split (s)	13.0	13.0	28.5	6.0
Total Split (s)	18.5	18.5	28.0	8.0
Total Split (%)	16.8%	16.8%	25.5%	7.3%
Maximum Green (s)	11.5	11.5	21.0	5.0
Yellow Time (s)	3.5	3.5	3.5	3.0
All-Red Time (s)	3.5	3.5	3.5	0.0
Lost Time Adjust (s)	-3.0	-3.0	-3.0	1.0
Total Lost Time (s)	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lead	Lag	Lead
Lead-Lag Optimize?	Yes	Yes	Yes	Yes
Vehicle Extension (s)	2.0	2.0	2.0	2.0
Recall Mode	None	None	None	None
Walk Time (s)			7.0	
Flash Dont Walk (s)			14.5	
Pedestrian Calls (#/hr)			0	
Intersection Summary				

Lanes, Volumes, Timings
 1: Trapelo Road & Cushing Avenue

2017 Build Conditions
 Saturday MIDDAY

Control Type: Actuated-Uncoordinated

Splits and Phases: 1: Trapelo Road & Cushing Avenue

 ø1	 ø2	 ø3	 ø4
8 s	55 s	19 s	28 s
 ø5	 ø6	 ø7	 ø8
8 s	55 s	18.5 s	28.5 s

Queues

2017 Build Conditions

1: Trapelo Road & Cushing Avenue

Saturday MIDDAY

									
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	121	521	77	517	186	309	129	228	138
v/c Ratio	0.52	0.78	0.31	0.82	0.72	0.72	0.53	0.63	0.25
Control Delay	23.2	32.7	16.5	37.1	57.6	43.8	49.6	44.0	13.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	23.2	32.7	16.5	37.1	57.6	43.8	49.6	44.0	13.5
Queue Length 50th (ft)	41	280	25	284	113	165	75	126	24
Queue Length 95th (ft)	72	416	49	420	#251	#323	136	207	65
Internal Link Dist (ft)		77		141		194		793	
Turn Bay Length (ft)			105						50
Base Capacity (vph)	232	869	249	864	271	477	277	429	559
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.52	0.60	0.31	0.60	0.69	0.65	0.47	0.53	0.25

Intersection Summary

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

HCM Signalized Intersection Capacity Analysis

2017 Build Conditions

1: Trapelo Road & Cushing Avenue

Saturday MIDDAY

												
Movement	EBL2	EBL	EBT	EBR	WBL	WBT	WBR	WBR2	NBL	NBT	NBR	NBR2
Lane Configurations												
Volume (vph)	87	23	384	90	72	376	98	12	169	170	20	91
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	10	10	11	11	10	11	11	11	10	11	11	11
Total Lost time (s)		4.0	4.0		4.0	4.0			4.0	4.0		
Lane Util. Factor		1.00	1.00		1.00	1.00			1.00	1.00		
Frt		1.00	0.97		1.00	0.97			1.00	0.94		
Flt Protected		0.95	1.00		0.95	1.00			0.95	1.00		
Satd. Flow (prot)		1685	1549		1685	1549			1652	1728		
Flt Permitted		0.22	1.00		0.24	1.00			0.95	1.00		
Satd. Flow (perm)		381	1549		432	1549			1652	1728		
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.94	0.94	0.94	0.94	0.91	0.91	0.91	0.91
Adj. Flow (vph)	96	25	422	99	77	400	104	13	186	187	22	100
RTOR Reduction (vph)	0	0	8	0	0	1	0	0	0	15	0	0
Lane Group Flow (vph)	0	121	513	0	77	516	0	0	186	294	0	0
Heavy Vehicles (%)	0%	0%	1%	0%	0%	0%	1%	0%	2%	0%	0%	0%
Parking (#/hr)			5	5		5	5	5				
Turn Type	pm+pt	pm+pt			pm+pt				Prot			
Protected Phases	5	5	2		1	6			3	8		
Permitted Phases	2	2			6							
Actuated Green, G (s)		42.1	37.0		39.5	35.7			11.7	19.4		
Effective Green, g (s)		40.1	40.0		37.5	38.7			14.7	22.4		
Actuated g/C Ratio		0.43	0.43		0.40	0.41			0.16	0.24		
Clearance Time (s)		3.0	7.0		3.0	7.0			7.0	7.0		
Vehicle Extension (s)		2.0	2.0		2.0	2.0			2.0	2.0		
Lane Grp Cap (vph)		219	658		209	637			258	411		
v/s Ratio Prot		c0.02	0.33		0.01	c0.33			c0.11	c0.17		
v/s Ratio Perm		0.21			0.14							
v/c Ratio		0.55	0.78		0.37	0.81			0.72	0.71		
Uniform Delay, d1		19.3	23.3		19.5	24.5			37.7	32.9		
Progression Factor		1.00	1.00		1.00	1.00			1.00	1.00		
Incremental Delay, d2		1.7	5.3		0.4	7.1			8.1	4.9		
Delay (s)		21.0	28.6		19.9	31.6			45.9	37.8		
Level of Service		C	C		B	C			D	D		
Approach Delay (s)			27.2			30.0				40.8		
Approach LOS			C			C				D		
Intersection Summary												
HCM Average Control Delay			32.7			HCM Level of Service				C		
HCM Volume to Capacity ratio			0.73									
Actuated Cycle Length (s)			94.1			Sum of lost time (s)			12.0			
Intersection Capacity Utilization			67.5%			ICU Level of Service			C			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

1: Trapelo Road & Cushing Avenue

2017 Build Conditions

Saturday MIDDAY

				
Movement	SBL2	SBL	SBT	SBR
Lane Configurations				
Volume (vph)	6	100	187	113
Ideal Flow (vphpl)	1900	1900	1900	1900
Lane Width	11	11	11	16
Total Lost time (s)		4.0	4.0	4.0
Lane Util. Factor		1.00	1.00	1.00
Frt		1.00	1.00	0.85
Flt Protected		0.95	1.00	1.00
Satd. Flow (prot)		1745	1635	1629
Flt Permitted		0.95	1.00	1.00
Satd. Flow (perm)		1745	1635	1629
Peak-hour factor, PHF	0.82	0.82	0.82	0.82
Adj. Flow (vph)	7	122	228	138
RTOR Reduction (vph)	0	0	0	66
Lane Group Flow (vph)	0	129	228	72
Heavy Vehicles (%)	0%	0%	0%	0%
Parking (#/hr)			2	2
Turn Type	Prot	Prot	pm+ov	
Protected Phases	7	7	4	5
Permitted Phases				4
Actuated Green, G (s)		9.9	17.6	22.7
Effective Green, g (s)		12.9	20.6	20.7
Actuated g/C Ratio		0.14	0.22	0.22
Clearance Time (s)		7.0	7.0	3.0
Vehicle Extension (s)		2.0	2.0	2.0
Lane Grp Cap (vph)		239	358	358
v/s Ratio Prot		0.07	0.14	0.01
v/s Ratio Perm				0.04
v/c Ratio		0.54	0.64	0.20
Uniform Delay, d1		37.8	33.4	30.0
Progression Factor		1.00	1.00	1.00
Incremental Delay, d2		1.2	2.7	0.1
Delay (s)		39.0	36.1	30.1
Level of Service		D	D	C
Approach Delay (s)			35.2	
Approach LOS			D	
Intersection Summary				

Lanes, Volumes, Timings
2: Trapelo Road & Site Driveway

2017 Build Conditions
Saturday MIDDAY

						
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	549	54	54	603	0	39
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	11	12	12	12	12
Lane Util. Factor	0.95	0.95	1.00	1.00	1.00	1.00
Frt	0.987					0.865
Flt Protected				0.996		
Satd. Flow (prot)	3407	0	0	1872	0	1611
Flt Permitted				0.996		
Satd. Flow (perm)	3407	0	0	1872	0	1611
Link Speed (mph)	30			30	30	
Link Distance (ft)	143			157	129	
Travel Time (s)	3.3			3.6	2.9	
Peak Hour Factor	0.93	0.93	0.95	0.95	0.85	0.85
Heavy Vehicles (%)	1%	2%	2%	1%	2%	2%
Shared Lane Traffic (%)						
Sign Control	Free			Free	Stop	
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					

HCM Unsignalized Intersection Capacity Analysis

2: Trapelo Road & Site Driveway

2017 Build Conditions
Saturday MIDDAY

						
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	549	54	54	603	0	39
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.93	0.93	0.95	0.95	0.85	0.85
Hourly flow rate (vph)	590	58	57	635	0	46
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (ft)				157		
pX, platoon unblocked					0.74	
vC, conflicting volume			648		1368	324
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			648		1321	324
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			94		100	93
cM capacity (veh/h)			933		103	672
Direction, Lane #	EB 1	EB 2	WB 1	NB 1		
Volume Total	394	255	692	46		
Volume Left	0	0	57	0		
Volume Right	0	58	0	46		
cSH	1700	1700	933	672		
Volume to Capacity	0.23	0.15	0.06	0.07		
Queue Length 95th (ft)	0	0	5	5		
Control Delay (s)	0.0	0.0	1.6	10.8		
Lane LOS			A	B		
Approach Delay (s)	0.0		1.6	10.8		
Approach LOS				B		
Intersection Summary						
Average Delay			1.1			
Intersection Capacity Utilization			58.3%	ICU Level of Service		B
Analysis Period (min)			15			

Lanes, Volumes, Timings
3: Trapelo Road & Williston Road

2017 Build Conditions
Saturday MIDDAY

						
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	586	5	21	584	3	14
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	16	16	11	11	13	13
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.999				0.892	
Flt Protected				0.998	0.990	
Satd. Flow (prot)	1895	0	0	1615	1700	0
Flt Permitted				0.998	0.990	
Satd. Flow (perm)	1895	0	0	1615	1700	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	121			143	276	
Travel Time (s)	2.8			3.3	6.3	
Peak Hour Factor	0.93	0.93	0.95	0.95	0.85	0.85
Heavy Vehicles (%)	1%	2%	2%	1%	2%	2%
Parking (#/hr)	2	2	2	2		
Shared Lane Traffic (%)						
Sign Control	Free			Free	Stop	
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					

HCM Unsignalized Intersection Capacity Analysis

3: Trapelo Road & Williston Road

2017 Build Conditions
Saturday MIDDAY

						
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	586	5	21	584	3	14
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.93	0.93	0.95	0.95	0.85	0.85
Hourly flow rate (vph)	630	5	22	615	4	16
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (ft)				300		
pX, platoon unblocked					0.80	
vC, conflicting volume			635		1292	633
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			635		1239	633
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			98		98	97
cM capacity (veh/h)			948		151	480
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	635	637	20			
Volume Left	0	22	4			
Volume Right	5	0	16			
cSH	1700	948	346			
Volume to Capacity	0.37	0.02	0.06			
Queue Length 95th (ft)	0	2	5			
Control Delay (s)	0.0	0.6	16.0			
Lane LOS		A	C			
Approach Delay (s)	0.0	0.6	16.0			
Approach LOS			C			
Intersection Summary						
Average Delay			0.6			
Intersection Capacity Utilization			57.7%	ICU Level of Service		B
Analysis Period (min)			15			

Lanes, Volumes, Timings
4: Site Driveway & Common Street

2017 Build Conditions
Saturday MIDDAY

						
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	142	64	64	308	270	90
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	11	16	16	11	11
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.958				0.966	
Flt Protected	0.967			0.991		
Satd. Flow (prot)	1668	0	0	1877	1571	0
Flt Permitted	0.967			0.991		
Satd. Flow (perm)	1668	0	0	1877	1571	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	139			211	274	
Travel Time (s)	3.2			4.8	6.2	
Peak Hour Factor	0.85	0.85	0.93	0.93	0.89	0.89
Heavy Vehicles (%)	2%	2%	2%	1%	0%	2%
Parking (#/hr)			2	2	2	2
Shared Lane Traffic (%)						
Sign Control	Stop			Free	Free	
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					

HCM Unsignalized Intersection Capacity Analysis

4: Site Driveway & Common Street

2017 Build Conditions

Saturday MIDDAY

						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	142	64	64	308	270	90
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.85	0.85	0.93	0.93	0.89	0.89
Hourly flow rate (vph)	167	75	69	331	303	101
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage (veh)						
Upstream signal (ft)				211	274	
pX, platoon unblocked	0.91	0.88	0.88			
vC, conflicting volume	823	354	404			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	578	192	249			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	59	90	94			
cM capacity (veh/h)	410	745	1153			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	242	400	404			
Volume Left	167	69	0			
Volume Right	75	0	101			
cSH	476	1153	1700			
Volume to Capacity	0.51	0.06	0.24			
Queue Length 95th (ft)	71	5	0			
Control Delay (s)	20.1	1.9	0.0			
Lane LOS	C	A				
Approach Delay (s)	20.1	1.9	0.0			
Approach LOS	C					
Intersection Summary						
Average Delay			5.4			
Intersection Capacity Utilization			61.2%	ICU Level of Service		B
Analysis Period (min)			15			

Lanes, Volumes, Timings
5: Horne Road & Williston Road

2017 Build Conditions
Saturday MIDDAY

						
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	8	0	1	2	0	32
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	10	10	10	10	10	10
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.919		0.865	
Flt Protected		0.950				
Satd. Flow (prot)	0	1499	1450	0	1365	0
Flt Permitted		0.950				
Satd. Flow (perm)	0	1499	1450	0	1365	0
Link Speed (mph)		30	30		30	
Link Distance (ft)		596	108		276	
Travel Time (s)		13.5	2.5		6.3	
Peak Hour Factor	0.65	0.65	0.63	0.63	0.74	0.74
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%
Parking (#/hr)	2	2	2	2	2	2
Shared Lane Traffic (%)						
Sign Control		Free	Free		Stop	
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					

HCM Unsignalized Intersection Capacity Analysis

5: Horne Road & Williston Road

2017 Build Conditions

Saturday MIDDAY

						
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	8	0	1	2	0	32
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.65	0.65	0.63	0.63	0.74	0.74
Hourly flow rate (vph)	12	0	2	3	0	43
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	5				28	3
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	5				28	3
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	99				100	96
cM capacity (veh/h)	1630				985	1087
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	12	5	43			
Volume Left	12	0	0			
Volume Right	0	3	43			
cSH	1630	1700	1087			
Volume to Capacity	0.01	0.00	0.04			
Queue Length 95th (ft)	1	0	3			
Control Delay (s)	7.2	0.0	8.5			
Lane LOS	A		A			
Approach Delay (s)	7.2	0.0	8.5			
Approach LOS			A			
Intersection Summary						
Average Delay			7.5			
Intersection Capacity Utilization			16.6%	ICU Level of Service		A
Analysis Period (min)			15			

Lanes, Volumes, Timings
6: Horne Road & Poplar Street

2017 Build Conditions
Saturday MIDDAY

						
Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	29	15	25	8	0	30
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	10	10	12	12	12	12
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.954		0.968			
Flt Protected	0.968					
Satd. Flow (prot)	1457	0	1637	0	0	1691
Flt Permitted	0.968					
Satd. Flow (perm)	1457	0	1637	0	0	1691
Link Speed (mph)	30		30			30
Link Distance (ft)	596		290			271
Travel Time (s)	13.5		6.6			6.2
Peak Hour Factor	0.71	0.71	0.77	0.77	0.66	0.66
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%
Parking (#/hr)	2	2	2	2	2	2
Shared Lane Traffic (%)						
Sign Control	Stop		Free			Free
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					

HCM Unsignalized Intersection Capacity Analysis

6: Horne Road & Poplar Street

2017 Build Conditions
Saturday MIDDAY

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	29	15	25	8	0	30
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.71	0.71	0.77	0.77	0.66	0.66
Hourly flow rate (vph)	41	21	32	10	0	45
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	83	38			43	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	83	38			43	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	96	98			100	
cM capacity (veh/h)	924	1040			1579	
Direction, Lane #	WB 1	NB 1	SB 1			
Volume Total	62	43	45			
Volume Left	41	0	0			
Volume Right	21	10	0			
cSH	960	1700	1579			
Volume to Capacity	0.06	0.03	0.00			
Queue Length 95th (ft)	5	0	0			
Control Delay (s)	9.0	0.0	0.0			
Lane LOS	A					
Approach Delay (s)	9.0	0.0	0.0			
Approach LOS	A					
Intersection Summary						
Average Delay			3.7			
Intersection Capacity Utilization			13.3%	ICU Level of Service		A
Analysis Period (min)			15			

Lanes, Volumes, Timings
7: Belmont Street & Common Street

2017 Build Conditions

Saturday MIDDAY

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	133	255	25	31	232	33	12	190	32	43	179	104
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	11	11	11	12	12	12	10	11	11
Storage Length (ft)	0		0	0		80	0		60	50		0
Storage Lanes	0		0	0		1	0		1	1		1
Taper Length (ft)	25		25	25		25	25		25	25		25
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.992				0.850			0.850		0.945	
Flt Protected		0.984			0.994			0.997		0.950		
Satd. Flow (prot)	0	1855	0	0	1810	1561	0	1877	1615	1499	1545	0
Flt Permitted		0.808			0.929			0.974		0.595		
Satd. Flow (perm)	0	1523	0	0	1691	1561	0	1833	1615	939	1545	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		4				32			25		27	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		736			971			731			211	
Travel Time (s)		16.7			22.1			16.6			4.8	
Peak Hour Factor	0.94	0.94	0.94	0.96	0.96	0.96	0.90	0.90	0.90	0.84	0.84	0.84
Heavy Vehicles (%)	0%	0%	0%	0%	1%	0%	0%	1%	0%	0%	0%	0%
Parking (#/hr)										2	2	2
Shared Lane Traffic (%)												
Turn Type	Perm			Perm		Prot	Perm		Prot	Perm		
Protected Phases		4			8	8		2	2		6	
Permitted Phases	4			8			2			6		
Detector Phase	4	4		8	8	8	2	2	2	6	6	
Switch Phase												
Minimum Initial (s)	10.0	10.0		10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	
Minimum Split (s)	15.0	15.0		15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	
Total Split (s)	55.0	55.0	0.0	55.0	55.0	55.0	35.0	35.0	35.0	35.0	35.0	0.0
Total Split (%)	50.0%	50.0%	0.0%	50.0%	50.0%	50.0%	31.8%	31.8%	31.8%	31.8%	31.8%	0.0%
Maximum Green (s)	50.0	50.0		50.0	50.0	50.0	30.0	30.0	30.0	30.0	30.0	
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
All-Red Time (s)	1.0	1.0		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
Lost Time Adjust (s)	-1.0	-1.0	0.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Recall Mode	Min	Min		Min	Min	Min	None	None	None	None	None	
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												

Intersection Summary

Area Type: Other
Cycle Length: 110
Actuated Cycle Length: 53.9
Natural Cycle: 75

Lanes, Volumes, Timings
7: Belmont Street & Common Street

2017 Build Conditions
Saturday MIDDAY

Lane Group ø9

Lane Configurations

Volume (vph)

Ideal Flow (vphpl)

Lane Width (ft)

Storage Length (ft)

Storage Lanes

Taper Length (ft)

Lane Util. Factor

Frt

Flt Protected

Satd. Flow (prot)

Flt Permitted

Satd. Flow (perm)

Right Turn on Red

Satd. Flow (RTOR)

Link Speed (mph)

Link Distance (ft)

Travel Time (s)

Peak Hour Factor

Heavy Vehicles (%)

Parking (#/hr)

Shared Lane Traffic (%)

Turn Type

Protected Phases 9

Permitted Phases

Detector Phase

Switch Phase

Minimum Initial (s) 4.0

Minimum Split (s) 20.0

Total Split (s) 20.0

Total Split (%) 18%

Maximum Green (s) 14.0

Yellow Time (s) 4.0

All-Red Time (s) 2.0

Lost Time Adjust (s)

Total Lost Time (s)

Lead/Lag

Lead-Lag Optimize?

Vehicle Extension (s) 3.0

Recall Mode None

Walk Time (s) 7.0

Flash Dont Walk (s) 7.0

Pedestrian Calls (#/hr) 0

Intersection Summary

Lanes, Volumes, Timings
 7: Belmont Street & Common Street

2017 Build Conditions
 Saturday MIDDAY

Control Type: Actuated-Uncoordinated

Splits and Phases: 7: Belmont Street & Common Street

 ø2	 ø4	 ø9
35 s	55 s	20 s
 ø6	 ø8	
35 s	55 s	

Queues

2017 Build Conditions

7: Belmont Street & Common Street

Saturday MIDDAY

							
Lane Group	EBT	WBT	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	439	274	34	224	36	51	337
v/c Ratio	0.61	0.34	0.05	0.33	0.06	0.15	0.58
Control Delay	15.5	11.1	4.3	15.3	7.9	14.7	18.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	15.5	11.1	4.3	15.3	7.9	14.7	18.4
Queue Length 50th (ft)	89	48	0	48	2	10	73
Queue Length 95th (ft)	229	125	14	124	20	36	171
Internal Link Dist (ft)	656	891		651			131
Turn Bay Length (ft)			80		60	50	
Base Capacity (vph)	1353	1502	1390	1150	1023	589	979
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.32	0.18	0.02	0.19	0.04	0.09	0.34
Intersection Summary							

HCM Signalized Intersection Capacity Analysis

7: Belmont Street & Common Street

2017 Build Conditions

Saturday MIDDAY

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	133	255	25	31	232	33	12	190	32	43	179	104
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	11	11	11	12	12	12	10	11	11
Total Lost time (s)		4.0			4.0	4.0		4.0	4.0	4.0	4.0	
Lane Util. Factor		1.00			1.00	1.00		1.00	1.00	1.00	1.00	
Frt		0.99			1.00	0.85		1.00	0.85	1.00	0.94	
Flt Protected		0.98			0.99	1.00		1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1854			1810	1561		1877	1615	1499	1544	
Flt Permitted		0.81			0.93	1.00		0.97	1.00	0.60	1.00	
Satd. Flow (perm)		1522			1691	1561		1833	1615	940	1544	
Peak-hour factor, PHF	0.94	0.94	0.94	0.96	0.96	0.96	0.90	0.90	0.90	0.84	0.84	0.84
Adj. Flow (vph)	141	271	27	32	242	34	13	211	36	51	213	124
RTOR Reduction (vph)	0	2	0	0	0	17	0	0	16	0	17	0
Lane Group Flow (vph)	0	437	0	0	274	17	0	224	20	51	320	0
Heavy Vehicles (%)	0%	0%	0%	0%	1%	0%	0%	1%	0%	0%	0%	0%
Parking (#/hr)										2	2	2
Turn Type	Perm			Perm		Prot	Perm		Prot	Perm		
Protected Phases		4			8	8		2	2		6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		24.3			24.3	24.3		18.7	18.7	18.7	18.7	
Effective Green, g (s)		25.3			25.3	25.3		19.7	19.7	19.7	19.7	
Actuated g/C Ratio		0.48			0.48	0.48		0.37	0.37	0.37	0.37	
Clearance Time (s)		5.0			5.0	5.0		5.0	5.0	5.0	5.0	
Vehicle Extension (s)		3.0			3.0	3.0		3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		727			807	745		681	600	349	574	
v/s Ratio Prot						0.01			0.01		c0.21	
v/s Ratio Perm		c0.29			0.16			0.12		0.05		
v/c Ratio		0.60			0.34	0.02		0.33	0.03	0.15	0.56	
Uniform Delay, d1		10.2			8.6	7.3		11.9	10.6	11.1	13.2	
Progression Factor		1.00			1.00	1.00		1.00	1.00	1.00	1.00	
Incremental Delay, d2		1.4			0.3	0.0		0.3	0.0	0.2	1.2	
Delay (s)		11.6			8.9	7.3		12.2	10.6	11.3	14.4	
Level of Service		B			A	A		B	B	B	B	
Approach Delay (s)		11.6			8.7			12.0			14.0	
Approach LOS		B			A			B			B	
Intersection Summary												
HCM Average Control Delay			11.7				HCM Level of Service			B		
HCM Volume to Capacity ratio			0.58									
Actuated Cycle Length (s)			53.0				Sum of lost time (s)		8.0			
Intersection Capacity Utilization			76.0%				ICU Level of Service		D			
Analysis Period (min)			15									
c Critical Lane Group												