Vanasse & Associates inc
Transportation Engineers & Planners

35 New England Business Center Drive
Suite 140
Andover, MA 01810

Ref: 9677

September 17, 2024

Ms. Jacki Byerley, AICP, Town Planner
Town of Andover
Planning & Economic Development
36 Bartlett Street
Andover, MA 01810

Re: Transportation Peer Review Response No.2 to the GPI Letter dated September 10, 2024
Proposed P&G Andover Manufacturing Center Enhancement Project
Andover, Massachusetts

Dear Ms. Byerley:

Vanasse & Associates, Inc. (VAI) has provided responses to the comments that were raised in the September 10, 2024, peer review comments letter prepared by Greenman-Pedersen, Inc. (GPI). For ease of review, we have reproduced the initial comments and responses with their corresponding numbers from GPI. This is followed by the second round of comments from GPI (highlighted in bold) and responses from VAI. It is important to note that the first round of responses that did not receive further comments are not included in this letter.

Study Area

Comment No. 2: *The Traffic Impact Assessment (TIA) estimates that 77 percent of site-generated passenger vehicle trips and 100 percent of site-generated truck trips will travel to/from the south on River Street; however, the Applicant has not include any intersections to the south within the study area for the TIA. GPI recommends that the Applicant extend the study area to include the intersection of Ballardvale Street (Route 125) / Andover Bypass Street (Route 125) as the proposed development is anticipated to result in increases of 89 to 145 vehicle trips through this intersection during the weekday AM and PM peak hours, respectively.*

VAI Response: The intersection of Ballardvale Street and Route 125 was added to the study area.

GPI Comment: **GPI recommends the Applicant evaluate whether signal timing modifications at this location can improve the operations of these movements during these time periods. This intersection is under the jurisdiction of the Massachusetts Department of Transportation (MassDOT). Therefore, any improvements at this location will require review and approval by MassDOT, as well as subject the project to the MassDOT Access Permit Application process.**

VAI Response: It is important to note that under the No-Build (without the Project site traffic), these movements were already operating at poor conditions LOS E and LOS F. Movements experiencing LOS F conditions are more susceptible to further increases in delays when subjected to additional traffic volumes. However, a sensitivity analysis was

conducted, focused on optimizing the signal timing and phasing at this intersection to evaluate potential improvements. Table A-1 presents a summary of the optimization results compared with the Build condition results provided in the July 31, 2024, response to comment letter No.1 prepared by VAI.

Table A-1
SIGNALIZED INTERSECTION CAPACITY ANALYSIS SUMMARY

Signalized Intersection/ Peak Hour/Movement	2031 Build Condition V/C	Delay	LOS	Queue Avg/95th	2031 Build Condition Optimize V/C	Delay	LOS	Queue Avg/95th
Route 125 at Ballardvale Street								
Weekday Morning:								
Route 125 EB LT	1.06	76.3	E	20/22	1.06	76.3	E	20/22
Route 125 EB TH	0.64	3.4	A	2/3	0.63	3.1	A	2/2
Route 125 WB TH/RT	1.07	82.1	F	25/31	1.05	73.9	E	25/30
Ballardvale Street SB LT	0.35	52.1	D	2/4	0.37	53.9	D	2/4
Ballardvale Street SB RT	0.29	20.8	C	3/4	0.29	21.4	C	3/4
Overall	--	**56.5**	**E**	--	--	**53.4**	**D**	--
Weekday Evening:								
Route 125 EB LT	0.61	35.8	D	5/6	0.61	35.8	D	5/6
Route 125 EB TH	1.09	63.4	E	30/34	1.14	82.1	F	31/35
Route 125 WB TH/RT	1.00	51.4	D	13/17	1.08	76.5	E	15/18
Ballardvale Street SB LT	1.13	119.7	F	9/15	1.00	76.8	E	8/14
Ballardvale Street SB RT	1.26	148.9	F	19/23	1.19	117.9	F	16/22
Overall	--	**88.6**	**F**	--	--	**87.1**	**F**	--

As shown on Table A-1, by providing additional cycle time to the Route 125 westbound through/right movement during the weekday morning peak hour, the level of service for this movement improves to LOS E, while the overall LOS improves to LOS D. During the weekday evening peak hour, more time was allocated to the Ballardvale southbound movement. The only improvement during this peak hour was for the Ballardvale southbound left-turn movement, which improved from LOS F to LOS E. However, the Route 125 eastbound and westbound through movements degrade under the optimized condition. Overall, to further improve the intersection delays specifically at the Route 125 eastbound Left turn lane, more green time would need to be shifted from the Route 125 approach phase. As shown, only minor improvements in delay are possible through retiming, and these may conflict with MassDOT interests in maximizing green time for Route 125 which would deteriorate.

Comment No. 3: **The Applicant has not provided the signal timing input data in the Synchro worksheets to verify the inputs of the analysis.**

VAI Response: Traffic Signal input data in a graphical format has been provided in the Appendix to this letter, which supplements the signal input data previously provided on the capacity analysis worksheet pages.

Traffic Volumes

Comment No. 6: *The Applicant has grown traffic volumes to a seven-year design horizon using an annual growth rate of 1.5 percent per year based on permanent count station data*

available within the Town of Andover. Two of these count stations are located on Interstate 93 and may not be representative of traffic growth on more arterial roadways like River Street. There is an additional permanent count station located on Route 125 in Wilmington (Station #5127), which may provide a better representation of traffic growth in this area. GPI reviewed the count data from Count Station #5127 and noted that this location experienced a significant increase in traffic from 2015 to 2016, but traffic volumes have otherwise remained relatively constant from 2010 – 2019. The increase in volumes from 2015 to 2016 may have been the result of construction in the surrounding area, including the reconstruction of the I-93 interchange at Route 125. Therefore, GPI believes that the 1.5 percent growth rate utilized by VAI will result in a conservative (worse than expected) estimated of 2031 No-Build traffic volume conditions. Further, the over-estimation of annual growth will far offset the under-estimation of seasonal variation.

VAI Response: Noted. To provide a conservative assessment, the 1.5 percent growth rate was retained in subsequent analyses.

GPI Comment: The Applicant's response notes that five developments were identified, and the traffic generated by these developments has been included in the 2031 No-Build analysis conditions. No information was provided in the Response to Traffic Peer Review Letter #1 (RTC) to indicate the traffic attributable to each of the background developments identified. **The Applicant should provide this information for review and verification.**

VAI Response: Traffic volume networks associated with the five identified background developments are provided in the appendix of this letter.

Sight Distances

Comment No. 10: *The Applicant has not provided an assessment of available sight distances at the proposed site driveways or study area intersections within the TIA, although the Conclusions stated that landscaping and signage adjacent to the site driveways should kept low enough or sufficiently set back from the roadway so as not to impeded sight lines. GPI recommends the Applicant provide an assessment of the available sight lines at the proposed site driveways, as well as at the River Street intersections with Lowell Junction Road and Connector Road. The assessment should evaluate the adequacy of sight lines for both passenger vehicles and trucks due to the high number of truck trips that could be generated by the proposed use.*

VAI Response: As requested, VAI has provided the requested sight line assessment at the site driveway intersections, as well as at the River Street intersections with Connector Road and Lowell Junction Road.

Comment 10a: The ISD to the south appears to have been calculated based on the 85th percentile speed of 38 miles per hour (MPH) traveling northbound on River Street. However, the ISD to the north of 375 feet appears to be a typographical error as this is the distance that would be required for a southbound travel speed of 39 MPH. However, the 85th percentile speed on River Street southbound was 34 MPH, which would result in an ISD of 325 feet being required to the north of the Connector Road and Lowell Junction Road.

VAI Response: Sight distance analysis tables for the intersection of River Street with Connector Road and Lowell Junction Road have been calculated based the 85th percentile speed of 34 mph for the southbound direction and 38 mph for the northbound direction. As summarized on the table provided in previous response the sight distances required for vehicles looking north are 375-ft based on the speed of 34 mph and 420 ft based on the speed of 38 mph. Both dimensions were calculated based on AASHOT - *Case B1, Left turn from Stop.* Therefore, the results presented in the previous response are still valid.

Comment 10b: Based on the posted speed of 35 MPH on River Street, a desirable ISD of 335 feet to the north and 390 feet to the south would be required at the River Street intersections with Connector Road and Lowell Junction Road.

VAI Response: Based on the posted speed limit of 35 mph, a desirable ISD of 390 feet is required for both north and south directions. A distance of 335 feet is sufficient for vehicles turning right onto River Street. However, for vehicles turning left and looking north, the required distance is 390 feet.

Comment 10c: All of the available sight lines will meet or exceed AASHTO recommendations for safe SSD and ISD with the exception of looking north exiting the Connector Road onto River Street. The ISD in this direction is restricted by a utility pole, trees, and boulders placed along the westerly edge of River Street north of Connector Road. The majority of the vegetation and boulders appear to be located on private property. **Therefore, a sight line easement may be required from the property at 10 Connector Road to clear or trim vegetation and remove or relocate these boulders.**

VAI Response: VAI has prepared a plan (Figure 1) which graphically depicts the existing property boundaries and the sight triangle for drivers looking north when exiting Connector Road at the intersection of River Street and Connector Road. Figure 1 shows that the existing utility pole and vegetation within the sight triangle are located within the town's right-of-way. The desirable ISD triangle slightly encroaches on the property line at 10 Connector Road to the north. However, since the obstructions are within the town's property, no sight line easement is required.

It is also important to note that, although sight restrictions exist when looking north at this intersection, most traffic will be turning right toward the south on River Street. As indicated by the traffic counts, only 2 to 4 vehicles were observed turning left to River Street from Connector Road, confirming that these sight restrictions are not likely to impact the majority of drivers. Given that this is a pre-existing condition, and no motor vehicle crashes have been identified in this area in the past 5 years period reviewed, the impact of the sight restrictions is considered minimal.

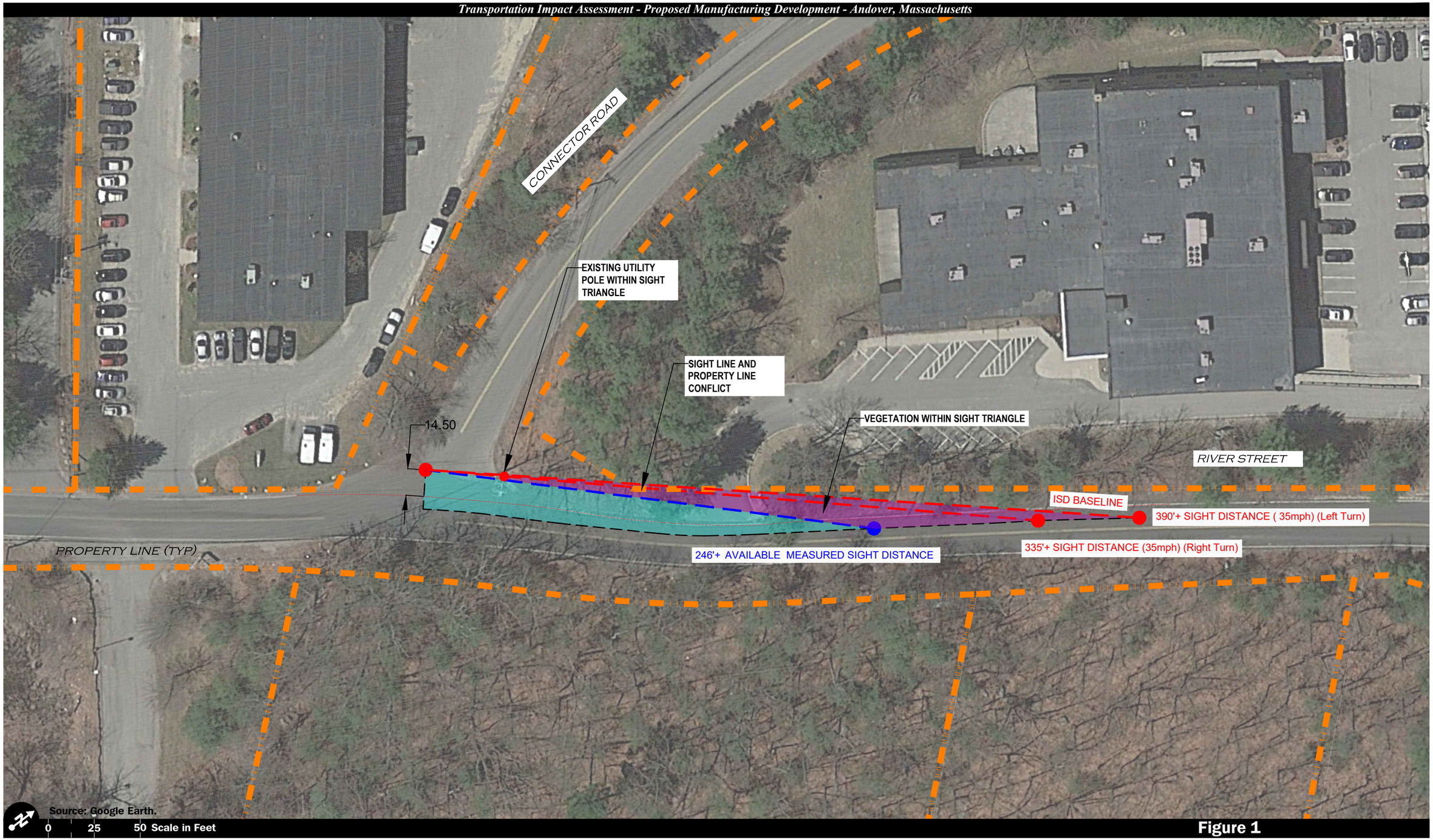

Figure 1

Intersection Sight Triangle Distances
River Street at Connector Road

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Trip Generation

Comment No. 11 - 15: *Based on ITE trips rates for LUC 140 – Manufacturing for a 201,460 SF expansion, the proposed development would be anticipated to generate 957 vehicle trips (478 entering and 479 exiting) on a weekday, 137 vehicle trips (104 entering and 33 exiting) during the weekday AM peak hour, and 149 vehicle trips (46 entering and 103 exiting) during the weekday PM peak hour.*

VAI Response: It was determined early in the process that trip generation based on the number of employees and shift times would better reflect the effect that the Project would have on study area roadways. VAI concurs with the results calculated by GPI for the ITE-based trip generation.

GPI Comment: **GPI recommends the Applicant update the analysis of the weekday AM peak hour based on ITE trip rates to account for potential future changes in employment numbers, employee shift changes, technological advances, delivery truck schedules, and/or tenant changes.**

VAI Response: As per GPI request, the analysis of the weekday morning peak hour has been updated to reflect ITE projections. Table A-3 summarizes and compares the ITE projections with previous estimates.

Table A-3
PROPOSED SITE TRIP-GENERATION COMPARISON

Time Period/ Directional Distribution	Employee Trips[a] (A)	ITE Trips (B)	Difference in Trips (C = B – A)
Weekday Morning Peak Hour:			
Entering	108	104	-4
Exiting	7	33	26
Total	115	137	22

[a]Based on 339 employees (Office, A, and C shift plus 5% Office drop-offs).
[b]Based on ITE LUC 140, *Manufacturing;* 201,460 sf.

As shown in Table A-3, based on ITE rates and compared to previous projections, the proposed development is expected to generate approximately 22 vehicle trips (4 fewer entering and 26 additional exiting). The updated weekday morning peak-hour traffic volume networks, along with the traffic operations analysis for all study intersections for this time period are provided in the appendix of this letter. Table A-4A and Table A-4B summarize the results of the analyses and these are provided below.

Table A-4A
SIGNALIZED INTERSECTION CAPACITY ANALYSIS SUMMARY

Signalized Intersection/ Peak Hour/Movement	2031 Build V/C[a]	2031 Build Delay[b]	2031 Build LOS[c]	2031 Build Queue[d] Avg/95th	2031 Build ITE V/C	2031 Build ITE Delay	2031 Build ITE LOS	2031 Build ITE Queue Avg/95th
Route 125 at Ballardvale Street								
Weekday Morning:								
Route 125 EB LT	1.06	77.2	E	20/22	1.06	76.3	E	20/22
Route 125 EB TH	0.64	3.4	A	2/3	0.64	3.4	A	2/3
Route 125 WB TH/RT	1.07	82.1	F	25/31	1.07	82.1	F	25/31
Ballardvale Street SB LT	0.34	51.9	D	2/4	0.35	52.1	D	2/4
Ballardvale Street SB RT	0.28	20.6	C	3/4	0.29	20.8	C	3/4
Overall	--	**56.8**	**E**	--	--	**56.5**	**E**	--
Route 125 at I-93 NB Off-Ramp and I-93 NB On-Ramp								
Weekday Morning:								
Route 125 EB TH/RT	0.55	15.1	B	8/9	0.55	15.1	B	8/9
Route 125 WB TH	0.47	14.2	B	11/10	0.48	14.1	B	11/11
Route 125 WB RT	0.16	0.1	A	0/0	0.16	0.1	A	0/0
I-93 NB Off-Ramp NB LT	0.04	38.7	D	1/1	0.04	38.7	D	1/1
I-93 NB Off-Ramp NB RT	1.04	77.0	E	19/25	1.03	76.0	E	19/25
Overall	--	**33.6**	**C**	--	--	**33.2**	**C**	--
Route 125 at I-93 SB Ramps								
Weekday Morning:								
Route 125 EB LT	0.07	19.6	B	1/1	0.07	19.6	B	1/1
Route 125 EB TH	0.47	25.6	C	8/12	0.47	25.6	C	8/12
Route 125 WB TH	0.31	24.5	C	4/6	0.32	24.5	C	4/6
Route 125 WB RT	0.65	3.3	A	8/9	0.66	3.4	A	8/9
I-93 SB Ramps SB LT	0.41	22.5	C	6/8	0.41	22.5	C	6/8
I-93 SB Ramps SB RT	0.05	1.1	A	0/0	0.05	1.1	A	0/0
Overall	--	**14.0**	**B**	--	--	**14.0**	**B**	--

[a]Volume-to-capacity ratio.
[b]Control (signal) delay per vehicle in seconds.
[c]Level of service.
[d]Queue length in vehicles.

Table A-4B
UNSIGNALIZED INTERSECTION CAPACITY ANALYSIS SUMMARY

Unsignalized Intersection/ Critical Movement/Peak Hour	2031 Build Demand[a]	2031 Build Delay[b]	2031 Build LOS[c]	2031 Build Maximum Queue[d]	2031 Build ITE Demand	2031 Build ITE Delay	2031 Build ITE LOS	2031 Build ITE Maximum Queue
River Street at Lowell Junction Road								
Weekday Morning:								
Lowell Junction Road LT/RT	49	15.0	C	1	61	15.3	C	1
Connector Road at Lowell Junction Road								
Weekday Morning:								
Connector Road LT/RT	311	36.9	E	8	308	38.7	E	8
River Street at Connector Road								
Weekday Morning:								
Connector Road LT/RT	64	13.0	B	1	78	12.9	B	1
Gillette Way at Lowell Junction Road								
Weekday Morning:								
Gillette Way LT/RT	27	11.7	B	1	25	12.0	B	1
Andover Street at River Street and Private Driveway								
Weekday Morning:								
River Street LT/TH/RT	86	47.2	E	3	98	54.5	F	4
Private Driveway LT/TH/RT	2	10.3	B	0	2	10.3	B	0

[a]Demand in vehicles per hour.
[b]Delay in seconds per vehicle.
[c]Level of service.
[d]95th percentile queue length (veh).
LT = left-turning movements; TH = through movements; RT = right-turning movements.

As noted, results using the ITE data are generally consistent with the results using the empirical data from the previous analyses. One change is at the Andover Street at River Street and Private Driveway intersection; however, mitigation is proposed to address this condition.

Capacity and Queue Analysis

Comment No. 19: *The Synchro analysis worksheets contained in the Appendix did not provide heavy vehicle percentages used in the analysis. Therefore, GPI was not able to verify the heavy vehicles included in the analysis. The Applicant should provide updated Synchro analysis worksheets with this input information.*

VAI Response: Worksheets with the heavy vehicle percentage visible are provided in the Technical Appendix to this letter.

GPI Comment: **While the Applicant has provided updated Synchro analysis worksheets indicating the percent heavy vehicles on each movement, the updated worksheets do not provide the signal timing data for the signalized intersections. The Applicant should provide updated worksheets with this input information.**

VAI Response: See response to Comment No. 3.

Comment No. 20a: The Applicant notes that Option 3 – installing a traffic signal was dismissed as the traffic volumes through the intersection meet only the peak hour signal warrant and that typically traffic volumes must meet a 4-hour or 8-hour warrant for a signal to be installed. **GPI recommends the Applicant perform a signal warrant analysis to assess whether any of the warranting conditions will be met at this intersection under Build conditions.**

VAI Response: A Traffic Signal Warrant Analysis (TSWA) at the intersection of Andover Street at River Street/Private Driveway was previously conducted in response to GPI's initial comment, and the results are provided below in Table A-5. Eight hours of intersection count data was not able to be collected prior to this writing; therefore, the traffic-volume-related signal warrants reviewed were the peak-hour and 4-hour warrant.

Table A-5
TRAFFIC SIGNAL WARRANTS ANALYSIS RESULTS[a]

Warrant No.	Description	Satisfied for 2031 No-Build Year Conditions	Satisfied for 2031 Build Year Conditions
1	Eight-Hour Vehicular Volume	NR	NR
2	Four-Hour Vehicular Volume	No	No
3	Peak Hour	Yes	Yes
4	Pedestrian Volume	No	No
5	School Crossing	No	No
6	Coordinated Signal System	No	No
7	Crash Experience	No	No
8	Roadway Network	No	No
9	Grade Crossing	No	No

[a]TSWA based on counts conducted in February 2024.
NR = Not reviewed due to lack of data for this time period.

As shown on Table A-5, future condition traffic volumes exceed the threshold levels for the peak-hour traffic-volume warrants but not for the 4-hour warrant. Since the 8-hour warrant is more conservative than the 4-hour or peak-hour warrant, it is unlikely the intersection will meet the 8-hour warrant threshold.

Warrant 4 is related to pedestrian volume at an intersection. This warrant requires a minimum of 75 pedestrians per hour for each four hours or a minimum of 93 pedestrians per hour for a peak hour. This intersection had 16 pedestrians during the peak hour; therefore, this warrant is not met.

Warrant 5 is related to street crossings by schoolchildren, including elementary through high school students. This warrant requires a minimum of 20 schoolchildren crossing during the highest crossing hour. This intersection had 16 pedestrians during the peak hour which occurred from 4:00 to 5:00 PM. Due to the time of the peak hour being outside of school dismissal window, it is unlikely that 20 of those pedestrians were school children; therefore, this warrant is not met.

Warrant 6 is related to the potential installation of a traffic signal at an intersection in the middle of a coordinated signal system to improve progressive traffic movement on a corridor. The intersection is not in a coordinated signal system; therefore, this warrant is not met.

Warrant 7 is related to crash experience and involves adequate trial of alternatives with no reduction in outcome of crashes and five or more reported crashes of a type that could be corrected by a traffic control signal have occurred within a twelve-month period. A review of crash history at the intersection, as shown in the Transportation Impact Assessment from April 2024, indicates 1 crash or less per year were observed that would be correctable with traffic signal installation between 2017 to 2021; therefore, this warrant is not met.

Warrant 8 is related to the installation of a signal to encourage concentration and organization of traffic flow on a roadway network. As with Warrant 6, the intersection is not part of a coordinated signal system and is also not at the intersection of two major routes that might benefit from organization of traffic flows; therefore, this warrant is not met.

Warrant 9 is related to the installation of a signal at an intersection near a railroad grade crossing, where none of the other warrants are met, but the proximity of the intersection to a railroad grade crossing is the principal reason to consider installation of signal control. While the MBTA commuter rail line does intersect Andover Street approximately 400 feet from the intersection, the Andover Street eastbound approach is not under STOP- or YIELD-sign control. Therefore, there is minimal chance that traffic queues will extend back to the rail crossing. Accordingly, this warrant is not met.

Comment No. 20a2: GPI recommends the Applicant perform an evaluation of the sight lines at this intersection with the proposed Option 2 in place to assess whether adequate sight lines will be provided for all movements through the intersection prior to providing a recommendation for the preferred alternative.

VAI Response: As requested by GPI, sight distance measurements were performed at River Street at Andover Street intersection with Option 2 in place. During this review, it was determined that the new location for the Andover Street crosswalk required relocation closer to the bridge to provide adequate sight distance. Figure 2 and Figure 3 graphically depict the sight lines for motorists to see pedestrians in the crosswalk and when exiting the east leg of Andover Street.

Additionally, the location of the proposed sidewalk has been adjusted to enhance safety for pedestrians crossing Andover Street. A Rectangular Rapid-Flashing Beacon (RRFB) has also been included as requested by the Planning Board. The updated conceptual plan for Option 2 is depicted in Figure 4.

Comment No. 20b: Implementation of either Option 2 or 3 will likely require private property easements and significant work beyond the scope of the proposed development to construct. **Therefore, the Town should consider requiring the Applicant to provide a contribution to the Town of Andover to be placed in an escrow account and to be used toward future improvements at this location within a set timeframe. The**

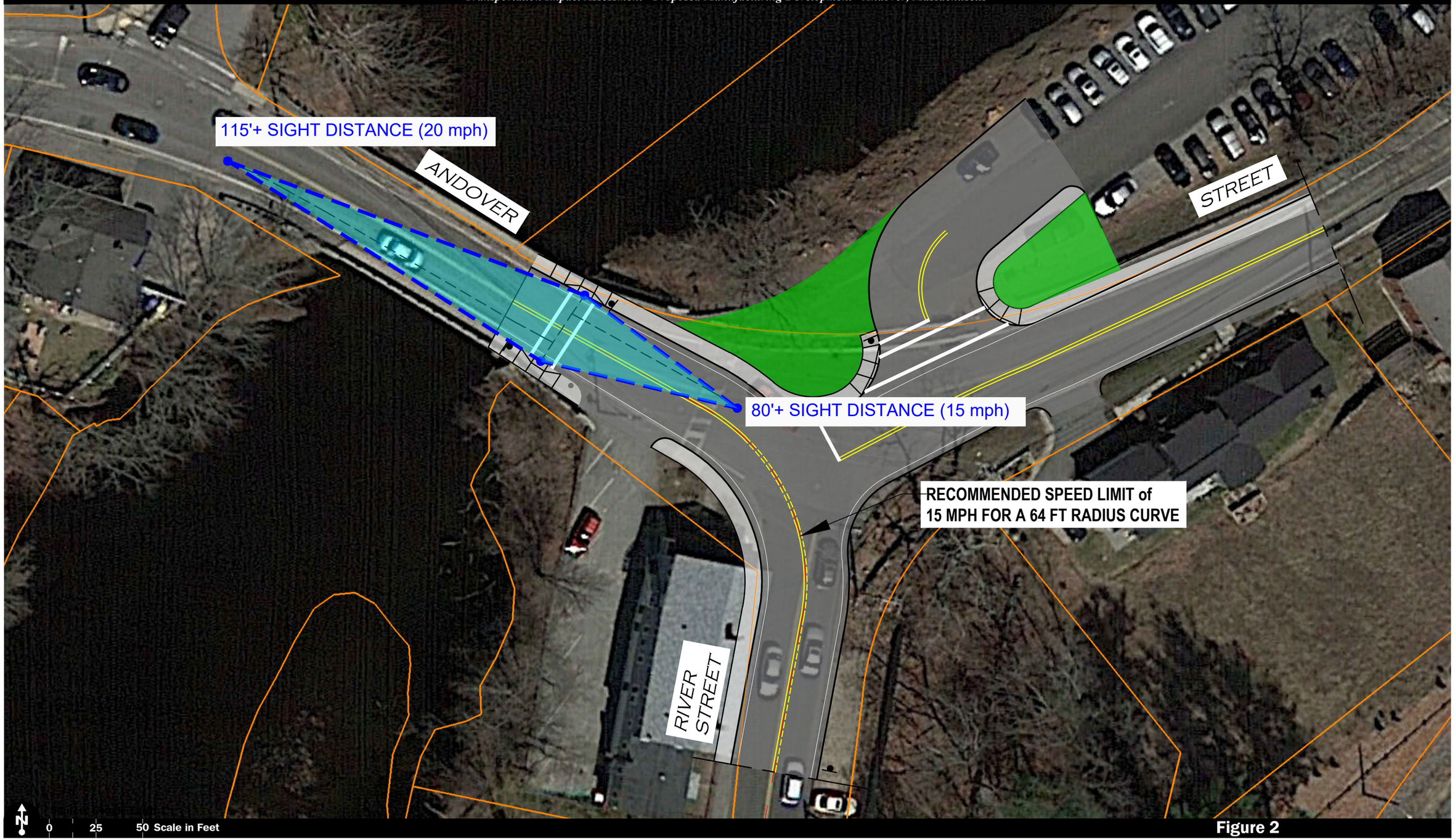

Figure 2

Intersection Sight Triangle
Proposed Sidewalk
Andover Street at River Street

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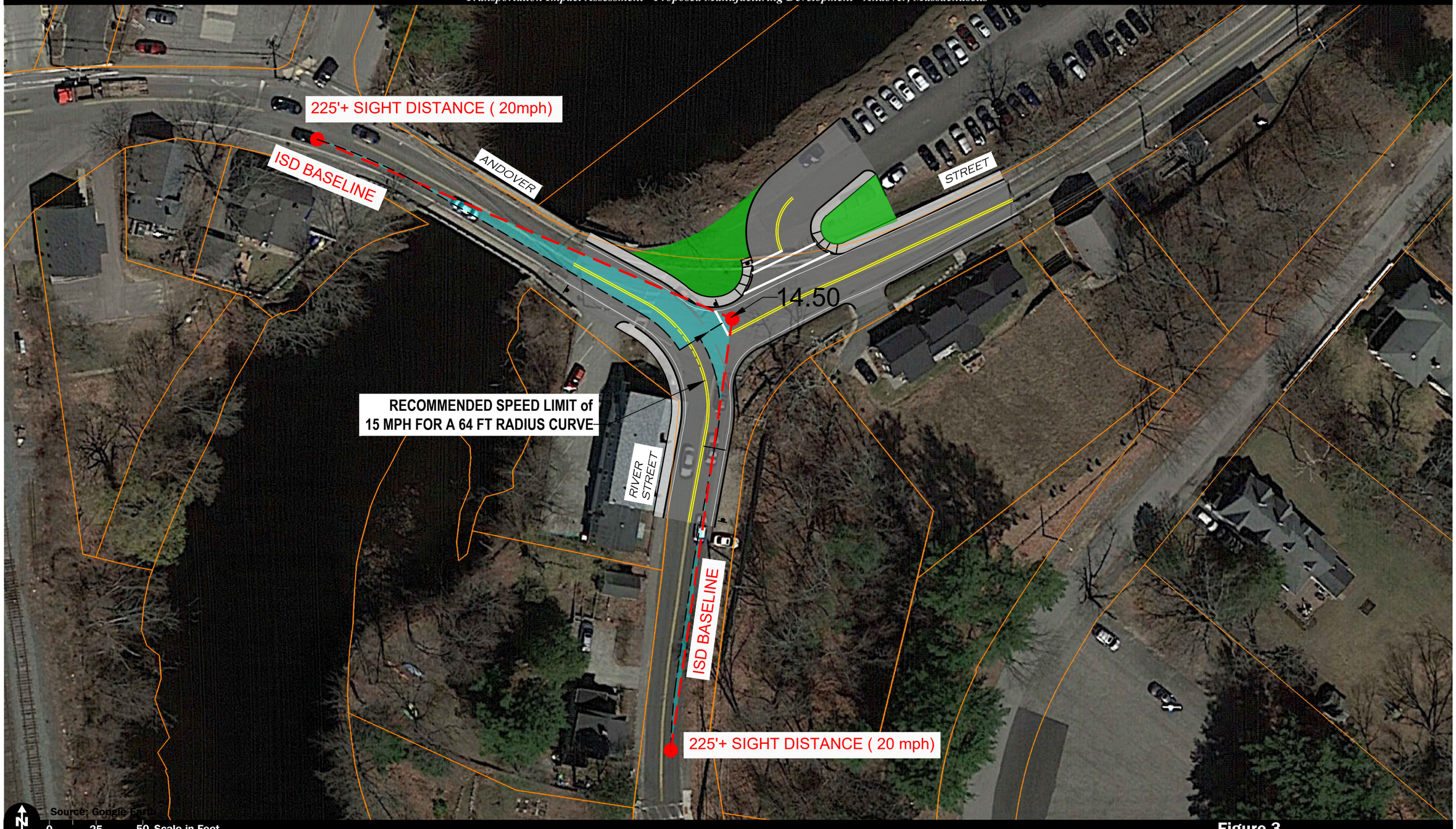

Figure 3

Intersection Sight Triangle Distances
Andover Street at River Street

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ANDOVER

W1-1R
W13-1

PROPOSED RRFB

LIMIT OF WORK
MEET EXISTING

PROPOSED WHEELCHAIR RAMP (TYP,)

PROPOSED 5.5' SIDEWALK (TYP.)

STREET

LIMIT OF WORK
MEET EXISTING

R1-1

R1-1

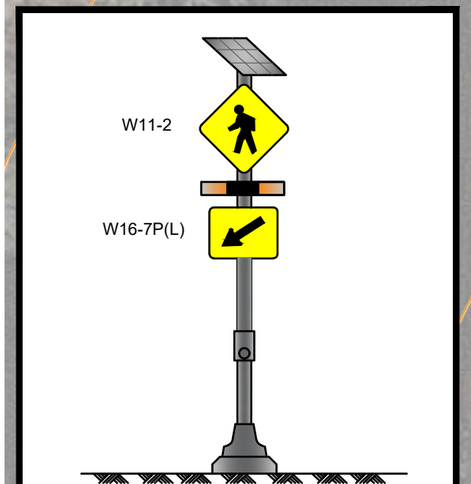
REALIGN ANDOVER STREET AND
PLACE UNDER STOP CONTROL

RECOMMENDED SPEED LIMIT of
15 MPH FOR A 64 FT RADIUS CURVE

RIVER
STREET

W1-1L
W13-1

LIMIT OF WORK
MEET EXISTING



PROPOSED RECTANGULAR RAPID FLASHING BEACON (RRFB)
NOT TO SCALE

SIGN LEGEND	
R1–1	STOP
W1–1	
W13–1	15 M.P.H.

Source: Google Earth.

0 15 30 Scale in Feet

Figure 4

Option 2
Updated Conceptual Plan
Andover Street at River Street

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funds could be utilized for either the design or construction of the improvements and would be returned to the Applicant if a project has not been significantly advanced at this location within the designated time frame.

VAI Response: The Applicant is willing to provide a contribution to the Town of Andover for improvements at this intersection as noted above.

Comment No. 20c: Table A-7 of the RTC provides an analysis of the impact of implementing an AWSC at the Connector Road / Lowell Junction Road intersection, which indicates that all movements would operate at LOS C or better under Build conditions with the AWSC in place. GPI concurs that an AWSC would provide a safety and traffic operations benefit to this intersection. The Applicant has offered to contribute towards the signage need to make this modification. **GPI recommends that the Applicant install the pavement markings and signage required to convert this intersection to AWSC, including any necessary advance warning signage of the STOP condition ahead.**

VAI Response: The Applicant is willing to install the pavement markings and signage required at this intersection as noted above, but also see Response to Comment No. 33.

Parking

Comment No. 24: *The Applicant has established a future reserve parking garage on the site to accommodate 1,619 parking spaces in the event additional parking is required on the site. As a condition of approval of the development, the Applicant should be required to conduct annual parking occupancy monitoring studies beginning 6 months following initial occupancy of the proposed expansion and should be required to construct the reserve parking garage once the available parking supply reaches 90 percent occupancy.*

VAI Response: The Applicant will monitor the availability of parking supply and make adjustments to employee shift times if the parking demand is observed to approach the maximum supply. The Applicant will employ active management of shifts and populations on site in order to maximize the efficiency of the parking facilities rather than commit additional resources to build a parking garage that may only be used sporadically or not at all.

GPI Comment: **GPI continues to recommend that the Applicant perform a post occupancy monitoring study to assess the occupancy of the available parking and evaluate whether any of the 1,619 reserve parking spaces need to be constructed.**

VAI Response: The Applicant is willing to conduct a post-occupancy monitoring study as indicated. In addition, the Applicant's site engineer has reviewed the parking design using compact spaces for a portion of the parking requirement. This has resulted in the addition of 13 parking spaces for a total of 667 parking spaces on site. As compared with the maximum demand of 598 spaces identified in the parking analysis, this brings the demand below 90 percent as requested by GPI.

Comment No. 25: *The Applicant should clarify whether the proposed reserve parking garage can be constructed in phases to allow one or more tiers to be constructed at a time, as needed.*

VAI Response: Details on the reserve parking garage construction have not progressed to address constructability and whether the construction can be phased and/or constructed in a modular arrangement.

GPI Comment: **GPI recommends the Applicant consider a design that allows the construction to be phased in order to right-size the parking provided on the site to accommodate actual parking demands and not over-construct parking.**

VAI Response: Based on the parking analysis, the Applicant expects to have a maximum parking demand of 598 parking spaces. As compared with the newly developed supply of 667 spaces, this equates to a demand rate under 90 percent for 2 hours out of a given weekday, and significantly less throughout the other hours of the day. This would render the need to construct the parking garage unnecessary. As noted above, the Applicant will conduct a monitoring study at full occupancy in order to confirm the adequacy of the parking supply.

Mitigation

Comment No. 33: The Applicant's September 3, 2024 letter from Greenberg Traurig to the Andover Planning Board describes that the Applicant is committed to providing the following funding to the Town of Andover to offset the project's impacts of the surrounding roadway network:

i. $5,000 toward implementation of an All-Way STOP Control at Lowell Junction Road / Connector Road;
ii. $20,000 toward installation of one Rectangular Rapid Flash Beacon along River Street at a location of the Town's choosing; and
iii. $100,000 toward reconfiguration of the Andover Street / River Street intersection.

GPI concurs with the first two commitments by the Applicant for funding toward an AWSC at Lowell Junction Road / Connector Road and an RRFB on River Street. However, GPI recommends that the contribution for the Andover Street / River Street intersection be at least as much as the higher of:

a. The cost associated with implementing the Applicant's initially recommended option of Option 2 - Intersection Reconfiguration (including design and construction);
b. The cost of the design of a traffic control signal at the intersection; OR
c. 10 percent of the total cost of design and construction of a traffic control signal at the intersection (proportional to the Applicant's percent increase in trips through the intersection during the peak hour).

GPI recommends that the Applicant perform an estimate of the survey, design, and construction costs associated with implementing each of the alternatives and identify a contribution equivalent to the highest of the three conditions above to be provided to the Town for future improvements at this location. These funds should be placed in an escrow account prior to the issuance of a building permit for the proposed development and should remain within the escrow account until such time as the Town advances a project at the intersection. If design of improvements has not been completed within five years following issuance of a

Certificate of Occupancy on the expansion project, the funds will be returned to the Applicant.

Response: Estimates of Option 2 and Option 3 have been prepared and are included in the Appendix to this letter. The overall construction costs are provided below, including estimates for traffic details, mobilization, survey and engineering (design):

- Option 2 – Andover Street/River Street realignment cost w/RRFB $235,000
- Option 3 – Andover Street/River Street signal installation cost $500,000

With respect to the items requested by GPI above:

a. Option 2 cost = $235,000
b. Design cost of a traffic control signal = $65,000 (including survey)
c. 10 percent of total design and construction cost of Option 3 = $50,000

In addition, due to recent cost increases for RRFB's, the contribution towards the River Street RRFB was increased from $20,000 to $25,000. This increase has also been accounted for in the cost estimate for Option 2.

It should be noted that the Applicant's percentage increase in trips through the intersection during the peak hour ranges between 5.2 percent during the weekday morning peak hour and 6.2 percent during the weekday evening peak hour. However, the Applicant is willing to contribute funds as requested by the Town in a manner commensurate with the impacts, recognizing the existing deficiencies of the intersection but also wanting to be a good neighbor to the Town.

I trust that this information is responsive to the comments that were identified in the September 10, 2024 comment letter prepared by GPI. Please feel free to contact me at *sthornton@rdva.com* to discuss any aspects of this letter.

Sincerely,

VANASSE & ASSOCIATES, INC.

Scott W. Thornton

Scott W. Thornton, P.E.
Partner

Attachments: Technical Appendix

APPENDIX

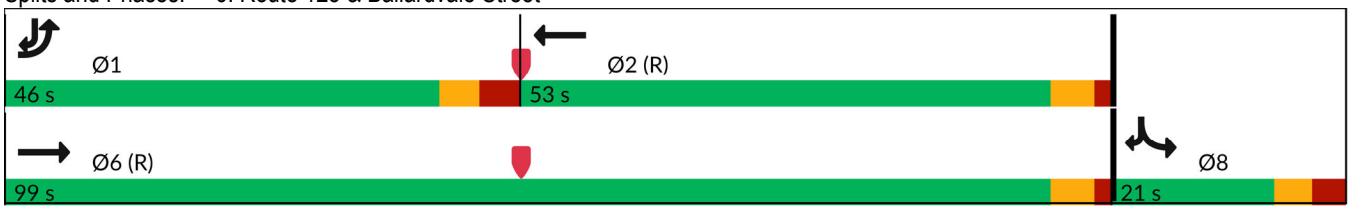
TRAFFIC SIGNAL TIMING OPTIMIZATION
CAPACITY ANALYSIS
BACKGROUND DEVELOPMENTS FIGURES
TRIP GENERATION DATA
UPDATED SITE-GENERATED AND 2031 BUILD WEEKDAY MORNING ITE BASIS
TRAFFIC SIGNAL WARRANT ANALYSIS
COST ESTIMATES

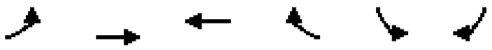
TRAFFIC SIGNAL TIMING OPTIMIZATION

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Approach Delay (s/veh)		43.9	71.9		22.5	
Approach LOS		D	E		C	
Queue Length 50th (ft)	~494	44	~616		53	68
Queue Length 95th (ft)	m#540	m59	#757		102	103
Internal Link Dist (ft)		1039	766		272	
Turn Bay Length (ft)	275				255	125
Base Capacity (vph)	1073	1389	1355		196	1180
Starvation Cap Reductn	0	0	0		0	0
Spillback Cap Reductn	0	0	0		0	0
Storage Cap Reductn	0	0	0		0	0
Reduced v/c Ratio	1.06	0.63	1.05		0.37	0.28

Intersection Summary			
Area Type:	Other		
Cycle Length: 120			
Actuated Cycle Length: 120			
Offset: 21 (18%), Referenced to phase 2:WBT and 6:EBT, Start of Green			
Natural Cycle: 100			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 1.06			
Intersection Signal Delay (s/veh): 52.0		Intersection LOS: D	
Intersection Capacity Utilization 89.5%		ICU Level of Service E	
Analysis Period (min) 15			
~ Volume exceeds capacity, queue is theoretically infinite.			
Queue shown is maximum after two cycles.			
# 95th percentile volume exceeds capacity, queue may be longer.			
Queue shown is maximum after two cycles.			
m Volume for 95th percentile queue is metered by upstream signal.			

Splits and Phases: 6: Route 125 & Ballardvale Street





Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	1113	864	1003	314	69	310
Future Volume (vph)	1113	864	1003	314	69	310
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	12	11	12	12	12	13
Total Lost time (s)	7.0	5.5	5.5		6.5	7.0
Lane Util. Factor	0.97	1.00	0.95		1.00	0.88
Frt	1.00	1.00	0.96		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	3303	1783	3362		1626	2313
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	3303	1783	3362		1626	2313
Peak-hour factor, PHF	0.98	0.98	0.93	0.93	0.94	0.94
Adj. Flow (vph)	1136	882	1078	338	73	330
RTOR Reduction (vph)	0	0	25	0	0	27
Lane Group Flow (vph)	1136	882	1391	0	73	303
Heavy Vehicles (%)	6%	3%	4%	2%	11%	27%
Turn Type	Prot	NA	NA		Prot	pt+ov
Protected Phases	1	6	2		8	1 8
Permitted Phases						
Actuated Green, G (s)	39.0	93.5	47.5		14.5	60.0
Effective Green, g (s)	39.0	93.5	47.5		14.5	53.5
Actuated g/C Ratio	0.33	0.78	0.40		0.12	0.45
Clearance Time (s)	7.0	5.5	5.5		6.5	
Vehicle Extension (s)	3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)	1073	1389	1330		196	1031
v/s Ratio Prot	c0.34	0.49	c0.41		c0.04	0.13
v/s Ratio Perm						
v/c Ratio	1.06	0.63	1.05		0.37	0.29
Uniform Delay, d1	40.5	5.8	36.3		48.6	21.2
Progression Factor	0.94	0.31	1.00		1.00	1.00
Incremental Delay, d2	38.2	1.3	37.6		5.3	0.2
Delay (s)	76.3	3.1	73.9		53.9	21.4
Level of Service	E	A	E		D	C
Approach Delay (s/veh)		44.3	73.9		27.3	
Approach LOS		D	E		C	

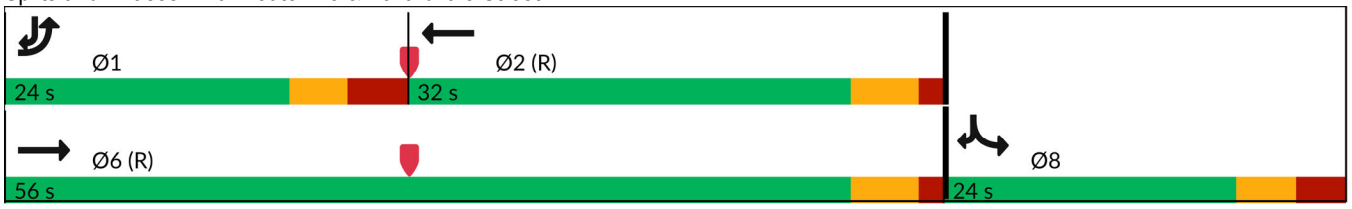
Intersection Summary			
HCM 2000 Control Delay (s/veh)	53.4	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.95		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	19.0
Intersection Capacity Utilization	89.5%	ICU Level of Service	E
Analysis Period (min)	15		

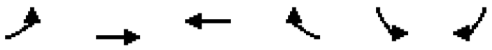
c Critical Lane Group

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Recall Mode	None	C-Max	C-Max		None	
Act Effct Green (s)	17.0	50.5	26.5		17.5	41.0
Actuated g/C Ratio	0.21	0.63	0.33		0.22	0.51
v/c Ratio	0.61	1.14	1.08		1.00	1.01
Control Delay (s/veh)	38.0	86.6	77.1		79.7	45.7
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay (s/veh)	38.0	86.6	77.1		79.7	45.7
LOS	D	F	E		E	D
Approach Delay (s/veh)		74.7	77.1		52.7	
Approach LOS		E	E		D	
Queue Length 50th (ft)	115	~787	~374		196	~402
Queue Length 95th (ft)	150	#883	#446		#346	#544
Internal Link Dist (ft)		1276	719		8125	
Turn Bay Length (ft)	275				255	125
Base Capacity (vph)	695	1147	1173		390	1483
Starvation Cap Reductn	0	0	0		0	0
Spillback Cap Reductn	0	0	0		0	0
Storage Cap Reductn	0	0	0		0	0
Reduced v/c Ratio	0.61	1.14	1.08		1.00	1.01

Intersection Summary			
Area Type:	Other		
Cycle Length: 80			
Actuated Cycle Length: 80			
Offset: 0 (0%), Referenced to phase 2:WBT and 6:EBT, Start of Green			
Natural Cycle: 120			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 1.14			
Intersection Signal Delay (s/veh): 66.9		Intersection LOS: E	
Intersection Capacity Utilization 85.6%		ICU Level of Service E	
Analysis Period (min) 15			
~ 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.			

Splits and Phases: 6: Route 125 & Ballardvale Street





Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	350	1084	963	98	335	1282
Future Volume (vph)	350	1084	963	98	335	1282
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	12	11	12	12	12	13
Total Lost time (s)	7.0	5.5	5.5		6.5	7.0
Lane Util. Factor	0.97	1.00	0.95		1.00	0.88
Frt	1.00	1.00	0.99		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	3273	1818	3515		1787	2880
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	3273	1818	3515		1787	2880
Peak-hour factor, PHF	0.83	0.83	0.84	0.84	0.86	0.86
Adj. Flow (vph)	422	1306	1146	117	390	1491
RTOR Reduction (vph)	0	0	9	0	0	9
Lane Group Flow (vph)	422	1306	1254	0	390	1482
Heavy Vehicles (%)	7%	1%	1%	4%	1%	2%
Turn Type	Prot	NA	NA		Prot	pt+ov
Protected Phases	1	6	2		8	1 8
Permitted Phases						
Actuated Green, G (s)	17.0	50.5	26.5		17.5	41.0
Effective Green, g (s)	17.0	50.5	26.5		17.5	34.5
Actuated g/C Ratio	0.21	0.63	0.33		0.22	0.43
Clearance Time (s)	7.0	5.5	5.5		6.5	
Vehicle Extension (s)	3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)	695	1147	1164		390	1242
v/s Ratio Prot	0.13	c0.72	0.36		0.22	c0.51
v/s Ratio Perm						
v/c Ratio	0.61	1.14	1.08		1.00	1.19
Uniform Delay, d1	28.5	14.8	26.8		31.3	22.8
Progression Factor	1.22	0.76	1.00		1.00	1.00
Incremental Delay, d2	1.1	70.8	49.7		45.6	95.1
Delay (s)	35.8	82.1	76.5		76.8	117.9
Level of Service	D	F	E		E	F
Approach Delay (s/veh)		70.8	76.5		109.3	
Approach LOS		E	E		F	

Intersection Summary			
HCM 2000 Control Delay (s/veh)	87.1	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.28		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	19.0
Intersection Capacity Utilization	85.6%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

CAPACITY ANALYSIS

2024 Baseline Weekday Morning Peak Hour
2024 Baseline Weekday Evening Peak Hour
2031 No-Build Weekday Morning Peak Hour
2031 No-Build Weekday Evening Peak Hour
2031 Build Weekday Morning Peak Hour
2031 Build Weekday Evening Peak Hour

2024 Baseline Weekday Morning Peak Hour

Movement	EBL	EBR	NEL	NET	SWT	SWR
Lane Configurations						
Traffic Volume (veh/h)	35	0	0	31	302	315
Future Volume (Veh/h)	35	0	0	31	302	315
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.88	0.88	0.60	0.60	0.92	0.92
Hourly flow rate (vph)	40	0	0	52	328	342
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	551	499	670			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	551	499	670			
tC, single (s)	6.5	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.6	3.3	2.2			
p0 queue free %	92	100	100			
cM capacity (veh/h)	480	576	930			

Direction, Lane #	EB 1	NE 1	SW 1
Volume Total	40	52	670
Volume Left	40	0	0
Volume Right	0	0	342
cSH	480	930	1700
Volume to Capacity	0.08	0.00	0.39
Queue Length 95th (ft)	7	0	0
Control Delay (s/veh)	13.2	0.0	0.0
Lane LOS	B		
Approach Delay (s/veh)	13.2	0.0	0.0
Approach LOS	B		

Intersection Summary			
Average Delay	0.7		
Intersection Capacity Utilization	45.2%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	30	45	16	299	205	5
Future Volume (Veh/h)	30	45	16	299	205	5
Sign Control	Free			Free	Yield	
Grade	0%			0%	0%	
Peak Hour Factor	0.69	0.69	0.89	0.89	0.79	0.79
Hourly flow rate (vph)	43	65	18	336	259	6
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						2
Median type	None			None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			43		415	43
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			43		415	43
tC, single (s)			4.2		6.5	6.2
tC, 2 stage (s)						
tF (s)			2.3		3.6	3.3
p0 queue free %			99		55	99
cM capacity (veh/h)			1498		577	1033

Direction, Lane #	EB 1	EB 2	WB 1	NB 1
Volume Total	43	65	354	265
Volume Left	0	0	18	259
Volume Right	0	65	0	6
cSH	1700	1700	1498	591
Volume to Capacity	0.03	0.04	0.01	0.45
Queue Length 95th (ft)	0	0	1	58
Control Delay (s/veh)	0.0	0.0	0.5	16.0
Lane LOS			A	C
Approach Delay (s/veh)	0.0		0.5	16.0
Approach LOS				C

Intersection Summary			
Average Delay	6.1		
Intersection Capacity Utilization	41.3%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	NBL	NBT	SBT	SBR	SEL	SER
Lane Configurations						
Traffic Volume (veh/h)	188	31	287	13	2	48
Future Volume (Veh/h)	188	31	287	13	2	48
Sign Control		Free	Free		Yield	
Grade		0%	0%		0%	
Peak Hour Factor	0.88	0.88	0.90	0.90	0.74	0.74
Hourly flow rate (vph)	214	35	319	14	3	65
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	333				789	326
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	333				789	326
tC, single (s)	4.2				6.4	6.7
tC, 2 stage (s)						
tF (s)	2.3				3.5	3.8
p0 queue free %	82				99	89
cM capacity (veh/h)	1199				298	610

Direction, Lane #	NB 1	SB 1	SE 1
Volume Total	249	333	68
Volume Left	214	0	3
Volume Right	0	14	65
cSH	1199	1700	583
Volume to Capacity	0.18	0.20	0.12
Queue Length 95th (ft)	16	0	10
Control Delay (s/veh)	7.7	0.0	12.0
Lane LOS	A		B
Approach Delay (s/veh)	7.7	0.0	12.0
Approach LOS			B

Intersection Summary			
Average Delay	4.2		
Intersection Capacity Utilization	41.3%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	49	1	28	470	6	16
Future Volume (Veh/h)	49	1	28	470	6	16
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.83	0.83	0.89	0.89	0.61	0.61
Hourly flow rate (vph)	59	1	31	528	10	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			60		650	60
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			60		650	60
tC, single (s)			4.2		6.6	6.3
tC, 2 stage (s)						
tF (s)			2.3		3.7	3.4
p0 queue free %			98		98	97
cM capacity (veh/h)			1512		403	976

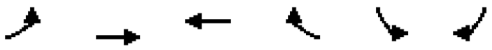
Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	60	559	36
Volume Left	0	31	10
Volume Right	1	0	26
cSH	1700	1512	700
Volume to Capacity	0.04	0.02	0.05
Queue Length 95th (ft)	0	2	4
Control Delay (s/veh)	0.0	0.6	10.4
Lane LOS		A	B
Approach Delay (s/veh)	0.0	0.6	10.4
Approach LOS			B

Intersection Summary			
Average Delay	1.1		
Intersection Capacity Utilization	43.0%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	3	243	422	69	194	4	55	0	13	0	0	2
Future Volume (Veh/h)	3	243	422	69	194	4	55	0	13	0	0	2
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.83	0.83	0.83	0.86	0.86	0.86	0.86	0.86	0.86	0.50	0.50	0.50
Hourly flow rate (vph)	4	293	508	80	226	5	64	0	15	0	0	4
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	231			801			948	946	547	959	1198	229
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	231			801			948	946	547	959	1198	229
tC, single (s)	4.1			4.1			7.2	6.5	6.3	7.1	6.5	6.7
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.6	4.0	3.4	3.5	4.0	3.8
p0 queue free %	100			90			70	100	97	100	100	99
cM capacity (veh/h)	1349			831			215	237	525	214	169	705

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	805	311	79	4
Volume Left	4	80	64	0
Volume Right	508	5	15	4
cSH	1349	831	242	705
Volume to Capacity	0.00	0.10	0.33	0.01
Queue Length 95th (ft)	0	8	34	0
Control Delay (s/veh)	0.1	3.3	26.9	10.1
Lane LOS	A	A	D	B
Approach Delay (s/veh)	0.1	3.3	26.9	10.1
Approach LOS			D	B

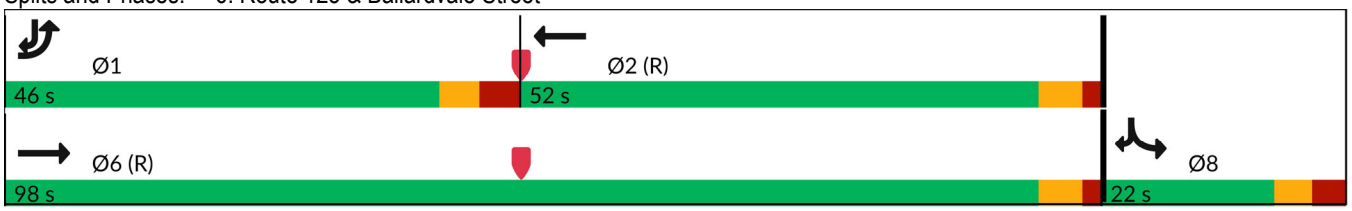
Intersection Summary				
Average Delay	2.7			
Intersection Capacity Utilization	73.6%	ICU Level of Service	D	
Analysis Period (min)	15			

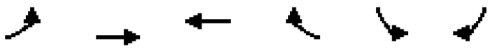


Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Approach Delay (s/veh)		27.7	36.7		21.5	
Approach LOS		C	D		C	
Queue Length 50th (ft)	337	45	433		45	47
Queue Length 95th (ft)	409	56	#594		87	73
Internal Link Dist (ft)		1178	828		293	
Turn Bay Length (ft)	275				255	125
Base Capacity (vph)	1097	1433	1457		210	1089
Starvation Cap Reductn	0	0	0		0	0
Spillback Cap Reductn	0	0	0		0	0
Storage Cap Reductn	0	0	0		0	0
Reduced v/c Ratio	0.84	0.47	0.83		0.29	0.25

Intersection Summary			
Area Type:	Other		
Cycle Length: 120			
Actuated Cycle Length: 120			
Offset: 21 (18%), Referenced to phase 2:WBT and 6:EBT, Start of Green			
Natural Cycle: 80			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.88			
Intersection Signal Delay (s/veh): 30.5		Intersection LOS: C	
Intersection Capacity Utilization 78.2%		ICU Level of Service D	
Analysis Period (min) 15			
# 95th percentile volume exceeds capacity, queue may be longer.			
Queue shown is maximum after two cycles.			

Splits and Phases: 6: Route 125 & Ballardvale Street





Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	907	657	867	263	57	254
Future Volume (vph)	907	657	867	263	57	254
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	12	11	12	12	12	13
Total Lost time (s)	7.0	5.5	5.5		6.5	7.0
Lane Util. Factor	0.97	1.00	0.95		1.00	0.88
Frt	1.00	1.00	0.97		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	3303	1783	3365		1626	2295
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	3303	1783	3365		1626	2295
Peak-hour factor, PHF	0.98	0.98	0.93	0.93	0.94	0.94
Adj. Flow (vph)	926	670	932	283	61	270
RTOR Reduction (vph)	0	0	22	0	0	44
Lane Group Flow (vph)	926	670	1193	0	61	226
Heavy Vehicles (%)	6%	3%	4%	2%	11%	28%
Turn Type	Prot	NA	NA		Prot	pt+ov
Protected Phases	1	6	2		8	1 8
Permitted Phases						
Actuated Green, G (s)	38.3	96.5	51.2		11.5	56.3
Effective Green, g (s)	38.3	96.5	51.2		11.5	49.8
Actuated g/C Ratio	0.32	0.80	0.43		0.10	0.42
Clearance Time (s)	7.0	5.5	5.5		6.5	
Vehicle Extension (s)	3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)	1054	1433	1435		155	952
v/s Ratio Prot	c0.28	0.38	c0.35		c0.04	0.10
v/s Ratio Perm						
v/c Ratio	0.88	0.47	0.83		0.39	0.24
Uniform Delay, d1	38.6	3.7	30.6		51.0	22.8
Progression Factor	0.97	0.33	1.00		1.00	1.00
Incremental Delay, d2	6.9	0.9	5.7		1.6	0.1
Delay (s)	44.4	2.1	36.3		52.6	22.9
Level of Service	D	A	D		D	C
Approach Delay (s/veh)		26.6	36.3		28.4	
Approach LOS		C	D		C	

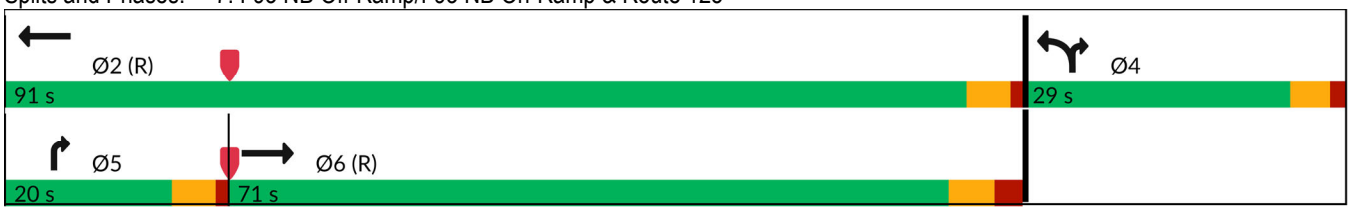
Intersection Summary			
HCM 2000 Control Delay (s/veh)	30.6	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	19.0
Intersection Capacity Utilization	78.2%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay (s/veh)		13.3			10.1			30.9				
Approach LOS		B			B			C				
Queue Length 50th (ft)		147			204	0	8		247			
Queue Length 95th (ft)		183			287	m0	26		327			
Internal Link Dist (ft)		1461			1178			695			385	
Turn Bay Length (ft)						350			150			
Base Capacity (vph)		1971			2447	1476	361		1145			
Starvation Cap Reductn		0			0	0	0		0			
Spillback Cap Reductn		0			0	0	0		0			
Storage Cap Reductn		0			0	0	0		0			
Reduced v/c Ratio		0.42			0.41	0.13	0.04		0.77			

Intersection Summary			
Area Type:	Other		
Cycle Length: 120			
Actuated Cycle Length: 120			
Offset: 0 (0%), Referenced to phase 2:WBT and 6:EBT, Start of Green, Master Intersection			
Natural Cycle: 40			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.82			
Intersection Signal Delay (s/veh): 17.4		Intersection LOS: B	
Intersection Capacity Utilization 60.3%		ICU Level of Service B	
Analysis Period (min) 15			
m Volume for 95th percentile queue is metered by upstream signal.			

Splits and Phases: 7: I-93 NB Off-Ramp/I-93 NB On-Ramp & Route 125



Lane Group	Ø5
Approach Delay (s/veh)	
Approach LOS	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	707	38	0	937	184	13	0	857	0	0	0
Future Volume (vph)	0	707	38	0	937	184	13	0	857	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	16	12	12	16	12	12	12	12	12	12
Total Lost time (s)		6.5			5.0	4.0	5.0		5.0			
Lane Util. Factor		0.95			0.95	1.00	1.00		0.88			
Frt		0.99			1.00	0.85	1.00		0.85			
Flt Protected		1.00			1.00	1.00	0.95		1.00			
Satd. Flow (prot)		3446			3406	1476	1805		2682			
Flt Permitted		1.00			1.00	1.00	0.95		1.00			
Satd. Flow (perm)		3446			3406	1476	1805		2682			
Peak-hour factor, PHF	0.91	0.91	0.91	0.94	0.94	0.94	0.97	0.97	0.97	0.92	0.92	0.92
Adj. Flow (vph)	0	777	42	0	997	196	13	0	884	0	0	0
RTOR Reduction (vph)	0	3	0	0	0	0	0	0	192	0	0	0
Lane Group Flow (vph)	0	816	0	0	997	196	13	0	692	0	0	0
Heavy Vehicles (%)	0%	4%	3%	0%	6%	24%	0%	0%	6%	2%	2%	2%
Turn Type		NA			NA	Free	Prot		custom			
Protected Phases		6			2		4		4 5			
Permitted Phases						Free						
Actuated Green, G (s)		68.6			86.3	120.0	23.7		39.9			
Effective Green, g (s)		68.6			86.3	120.0	23.7		39.9			
Actuated g/C Ratio		0.57			0.72	1.00	0.20		0.33			
Clearance Time (s)		6.5			5.0		5.0					
Vehicle Extension (s)		3.0			3.0		3.0					
Lane Grp Cap (vph)		1969			2449	1476	356		891			
v/s Ratio Prot		0.24			c0.29		0.01		c0.26			
v/s Ratio Perm						0.13						
v/c Ratio		0.41			0.41	0.13	0.04		0.78			
Uniform Delay, d1		14.4			6.7	0.0	38.9		36.0			
Progression Factor		0.85			1.71	1.00	1.00		1.00			
Incremental Delay, d2		0.6			0.4	0.1	0.0		4.3			
Delay (s)		12.8			11.8	0.1	39.0		40.4			
Level of Service		B			B	A	D		D			
Approach Delay (s/veh)		12.8			9.9			40.3			0.0	
Approach LOS		B			A			D			A	

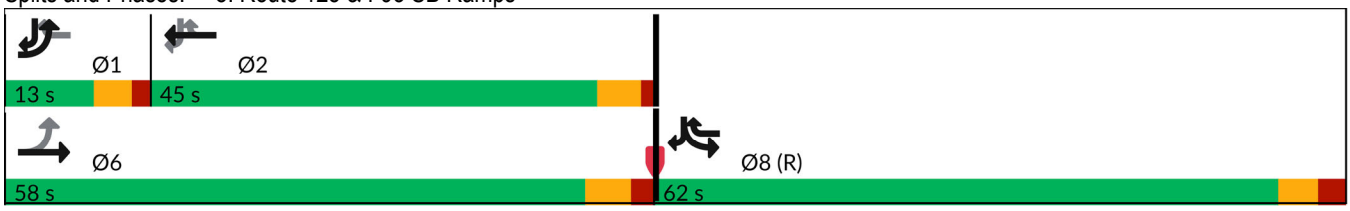
Intersection Summary			
HCM 2000 Control Delay (s/veh)	20.1	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.58		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	60.3%	ICU Level of Service	B
Analysis Period (min)	15		

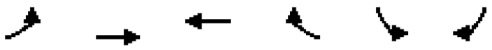
c Critical Lane Group

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Approach Delay (s/veh)		24.4	8.7		18.1	
Approach LOS		C	A		B	
Queue Length 50th (ft)	13	160	82	151	121	0
Queue Length 95th (ft)	32	235	143	203	160	0
Internal Link Dist (ft)		801	1461		1046	
Turn Bay Length (ft)	165				125	200
Base Capacity (vph)	500	807	655	1711	1527	1779
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.06	0.38	0.27	0.52	0.32	0.04

Intersection Summary			
Area Type:	Other		
Cycle Length: 120			
Actuated Cycle Length: 120			
Offset: 113 (94%), Referenced to phase 8:SBL, Start of Green			
Natural Cycle: 40			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.52			
Intersection Signal Delay (s/veh): 14.1		Intersection LOS: B	
Intersection Capacity Utilization 62.4%		ICU Level of Service B	
Analysis Period (min) 15			

Splits and Phases: 8: Route 125 & I-93 SB Ramps





Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	28	279	157	793	466	72
Future Volume (vph)	28	279	157	793	466	72
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	16	12	16
Total Lost time (s)	5.0	6.0	5.0	6.0	6.0	5.0
Lane Util. Factor	1.00	1.00	1.00	1.00	0.97	1.00
Frt	1.00	1.00	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1805	1863	1810	1711	3273	1812
Flt Permitted	0.53	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1013	1863	1810	1711	3273	1812
Peak-hour factor, PHF	0.90	0.90	0.89	0.89	0.94	0.94
Adj. Flow (vph)	31	310	176	891	496	77
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	31	310	176	891	496	77
Heavy Vehicles (%)	0%	2%	5%	7%	7%	1%
Turn Type	pm+pt	NA	NA	custom	Prot	pt+ov
Protected Phases	1	6	2	8	8	1 8
Permitted Phases	6			1 2		2
Actuated Green, G (s)	53.0	53.0	43.4	109.0	55.0	110.0
Effective Green, g (s)	53.0	53.0	43.4	104.0	55.0	104.0
Actuated g/C Ratio	0.44	0.44	0.36	0.87	0.46	0.87
Clearance Time (s)	5.0	6.0	5.0	6.0	6.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	484	822	654	1568	1500	1721
v/s Ratio Prot	0.00	0.17	0.10	c0.26	0.15	0.02
v/s Ratio Perm	0.03			0.26		0.02
v/c Ratio	0.06	0.38	0.27	0.57	0.33	0.04
Uniform Delay, d1	19.3	22.4	27.1	2.1	20.7	1.1
Progression Factor	1.00	1.00	0.95	1.00	1.00	1.00
Incremental Delay, d2	0.1	1.3	0.2	0.4	0.6	0.0
Delay (s)	19.4	23.8	25.9	2.6	21.3	1.1
Level of Service	B	C	C	A	C	A
Approach Delay (s/veh)		23.4	6.4		18.6	
Approach LOS		C	A		B	

Intersection Summary			
HCM 2000 Control Delay (s/veh)	12.9	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.60		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	62.4%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

2024 Baseline Weekday Evening Peak Hour

Movement	EBL	EBR	NEL	NET	SWT	SWR
Lane Configurations						
Traffic Volume (veh/h)	250	1	0	250	53	31
Future Volume (Veh/h)	250	1	0	250	53	31
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.91	0.91	0.89	0.89	0.87	0.87
Hourly flow rate (vph)	275	1	0	281	61	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	360	79	97			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	360	79	97			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	57	100	100			
cM capacity (veh/h)	641	987	1509			

Direction, Lane #	EB 1	NE 1	SW 1
Volume Total	276	281	97
Volume Left	275	0	0
Volume Right	1	0	36
cSH	642	1509	1700
Volume to Capacity	0.43	0.00	0.06
Queue Length 95th (ft)	54	0	0
Control Delay (s/veh)	14.8	0.0	0.0
Lane LOS	B		
Approach Delay (s/veh)	14.8	0.0	0.0
Approach LOS	B		

Intersection Summary			
Average Delay	6.2		
Intersection Capacity Utilization	33.7%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	232	204	3	28	22	19
Future Volume (Veh/h)	232	204	3	28	22	19
Sign Control	Free			Free	Yield	
Grade	0%			0%	0%	
Peak Hour Factor	0.93	0.93	0.70	0.70	0.71	0.71
Hourly flow rate (vph)	249	219	4	40	31	27
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						2
Median type	None			None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			249		297	249
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			249		297	249
tC, single (s)			4.1		6.6	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.7	3.3
p0 queue free %			100		95	97
cM capacity (veh/h)			1328		650	795

Direction, Lane #	EB 1	EB 2	WB 1	NB 1
Volume Total	249	219	44	58
Volume Left	0	0	4	31
Volume Right	0	219	0	27
cSH	1700	1700	1328	1217
Volume to Capacity	0.15	0.13	0.00	0.05
Queue Length 95th (ft)	0	0	0	4
Control Delay (s/veh)	0.0	0.0	0.7	10.3
Lane LOS			A	B
Approach Delay (s/veh)	0.0		0.7	10.3
Approach LOS				B

Intersection Summary			
Average Delay	1.1		
Intersection Capacity Utilization	22.6%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	NBL	NBT	SBT	SBR	SEL	SER
Lane Configurations						
Traffic Volume (veh/h)	29	239	59	3	4	228
Future Volume (Veh/h)	29	239	59	3	4	228
Sign Control		Free	Free		Yield	
Grade		0%	0%		0%	
Peak Hour Factor	0.87	0.87	0.90	0.90	0.87	0.87
Hourly flow rate (vph)	33	275	66	3	5	262
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	69				409	68
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	69				409	68
tC, single (s)	4.4				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.5				3.5	3.3
p0 queue free %	98				99	74
cM capacity (veh/h)	1366				588	993

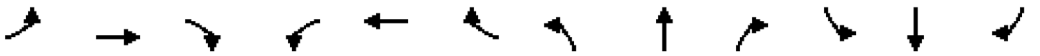
Direction, Lane #	NB 1	SB 1	SE 1
Volume Total	308	69	267
Volume Left	33	0	5
Volume Right	0	3	262
cSH	1366	1700	980
Volume to Capacity	0.02	0.04	0.27
Queue Length 95th (ft)	2	0	28
Control Delay (s/veh)	1.0	0.0	10.0
Lane LOS	A		B
Approach Delay (s/veh)	1.0	0.0	10.0
Approach LOS			B

Intersection Summary			
Average Delay	4.7		
Intersection Capacity Utilization	41.8%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	377	0	9	39	1	51
Future Volume (Veh/h)	377	0	9	39	1	51
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.91	0.91	0.75	0.75	0.77	0.77
Hourly flow rate (vph)	414	0	12	52	1	66
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			414		490	414
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			414		490	414
tC, single (s)			4.8		6.4	6.3
tC, 2 stage (s)						
tF (s)			2.8		3.5	3.4
p0 queue free %			99		100	90
cM capacity (veh/h)			868		534	630

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	414	64	67
Volume Left	0	12	1
Volume Right	0	0	66
cSH	1700	868	628
Volume to Capacity	0.24	0.01	0.11
Queue Length 95th (ft)	0	1	9
Control Delay (s/veh)	0.0	1.8	11.4
Lane LOS		A	B
Approach Delay (s/veh)	0.0	1.8	11.4
Approach LOS			B

Intersection Summary			
Average Delay	1.6		
Intersection Capacity Utilization	29.8%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	3	149	50	15	161	0	467	0	47	8	0	25
Future Volume (Veh/h)	3	149	50	15	161	0	467	0	47	8	0	25
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.87	0.87	0.87	0.82	0.82	0.82	0.90	0.90	0.90	0.38	0.38	0.38
Hourly flow rate (vph)	3	171	57	18	196	0	519	0	52	21	0	66
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	196			228			504	438	200	490	466	196
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	196			228			504	438	200	490	466	196
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			99			0	100	94	95	100	92
cM capacity (veh/h)	1389			1352			439	508	847	457	489	840

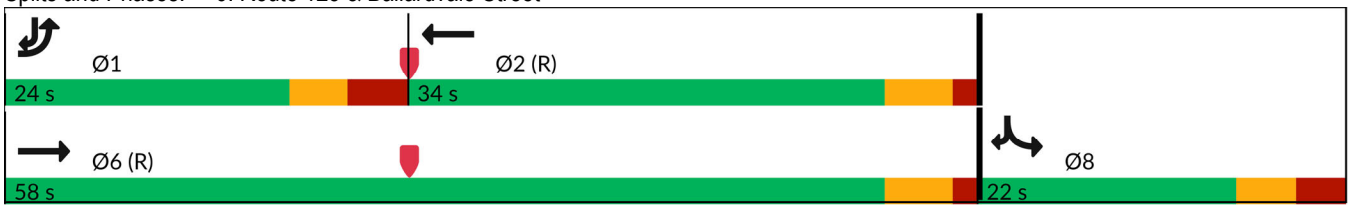
Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	231	214	571	87
Volume Left	3	18	519	21
Volume Right	57	0	52	66
cSH	1389	1352	459	699
Volume to Capacity	0.00	0.01	1.24	0.12
Queue Length 95th (ft)	0	1	581	11
Control Delay (s/veh)	0.1	0.8	153.9	10.9
Lane LOS	A	A	F	B
Approach Delay (s/veh)	0.1	0.8	153.9	10.9
Approach LOS			F	B

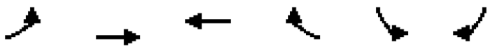
Intersection Summary				
Average Delay	80.7			
Intersection Capacity Utilization	59.4%	ICU Level of Service	B	
Analysis Period (min)	15			

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Approach Delay (s/veh)		28.5	27.7		34.8	
Approach LOS		C	C		C	
Queue Length 50th (ft)	90	514	224		164	278
Queue Length 95th (ft)	123	#684	269		#298	351
Internal Link Dist (ft)		1213	793		282	
Turn Bay Length (ft)	275				255	125
Base Capacity (vph)	695	1193	1267		346	1437
Starvation Cap Reductn	0	0	0		0	0
Spillback Cap Reductn	0	0	0		0	0
Storage Cap Reductn	0	0	0		0	0
Reduced v/c Ratio	0.49	0.94	0.78		0.95	0.86

Intersection Summary			
Area Type:	Other		
Cycle Length: 80			
Actuated Cycle Length: 80			
Offset: 0 (0%), Referenced to phase 2:WBT and 6:EBT, Start of Green			
Natural Cycle: 90			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.95			
Intersection Signal Delay (s/veh): 30.8		Intersection LOS: C	
Intersection Capacity Utilization 74.6%		ICU Level of Service D	
Analysis Period (min) 15			
# 95th percentile volume exceeds capacity, queue may be longer.			
Queue shown is maximum after two cycles.			

Splits and Phases: 6: Route 125 & Ballardvale Street





Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	282	930	749	81	283	1059
Future Volume (vph)	282	930	749	81	283	1059
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	12	11	12	12	12	13
Total Lost time (s)	7.0	5.5	5.5		6.5	7.0
Lane Util. Factor	0.97	1.00	0.95		1.00	0.88
Frt	1.00	1.00	0.99		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	3273	1818	3512		1787	2880
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	3273	1818	3512		1787	2880
Peak-hour factor, PHF	0.83	0.83	0.84	0.84	0.86	0.86
Adj. Flow (vph)	340	1120	892	96	329	1231
RTOR Reduction (vph)	0	0	10	0	0	39
Lane Group Flow (vph)	340	1120	978	0	329	1192
Heavy Vehicles (%)	7%	1%	1%	4%	1%	2%
Turn Type	Prot	NA	NA		Prot	pt+ov
Protected Phases	1	6	2		8	1 8
Permitted Phases						
Actuated Green, G (s)	16.9	52.5	28.6		15.5	38.9
Effective Green, g (s)	16.9	52.5	28.6		15.5	32.4
Actuated g/C Ratio	0.21	0.66	0.36		0.19	0.41
Clearance Time (s)	7.0	5.5	5.5		6.5	
Vehicle Extension (s)	3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)	691	1193	1255		346	1166
v/s Ratio Prot	0.10	c0.62	0.28		0.18	c0.41
v/s Ratio Perm						
v/c Ratio	0.49	0.94	0.78		0.95	1.02
Uniform Delay, d1	27.8	12.3	22.9		31.9	23.8
Progression Factor	1.24	0.87	1.00		1.00	1.00
Incremental Delay, d2	0.5	13.2	4.8		37.4	32.1
Delay (s)	35.0	23.9	27.7		69.3	55.9
Level of Service	C	C	C		E	E
Approach Delay (s/veh)		26.5	27.7		58.7	
Approach LOS		C	C		E	

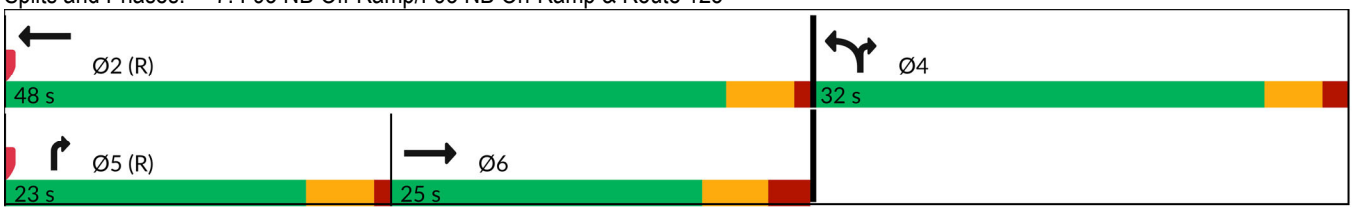
Intersection Summary			
HCM 2000 Control Delay (s/veh)	39.3	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.07		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	19.0
Intersection Capacity Utilization	74.6%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay (s/veh)		27.4			8.3			9.7				
Approach LOS		C			A			A				
Queue Length 50th (ft)		78			245	0	63		112			
Queue Length 95th (ft)		120			356	m0	95		141			
Internal Link Dist (ft)		1476			1213			764			389	
Turn Bay Length (ft)						350			150			
Base Capacity (vph)		798			2146	1794	609		1834			
Starvation Cap Reductn		0			0	0	0		0			
Spillback Cap Reductn		0			0	0	0		0			
Storage Cap Reductn		0			0	0	0		0			
Reduced v/c Ratio		0.46			0.67	0.31	0.26		0.60			

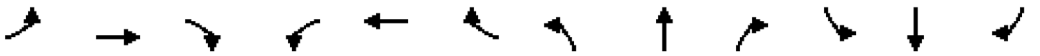
Intersection Summary			
Area Type:	Other		
Cycle Length: 80			
Actuated Cycle Length: 80			
Offset: 0 (0%), Referenced to phase 2:WBT and 5:NBR, Start of Green, Master Intersection			
Natural Cycle: 40			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.67			
Intersection Signal Delay (s/veh): 10.8		Intersection LOS: B	
Intersection Capacity Utilization 51.0%		ICU Level of Service A	
Analysis Period (min) 15			
m Volume for 95th percentile queue is metered by upstream signal.			

Splits and Phases: 7: I-93 NB Off-Ramp/I-93 NB On-Ramp & Route 125



Lane Group	Ø5
Approach Delay (s/veh)	
Approach LOS	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	

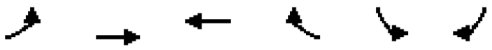
Intersection Summary



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	302	38	0	1305	503	134	0	910	0	0	0
Future Volume (vph)	0	302	38	0	1305	503	134	0	910	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	16	12	12	16	12	12	12	12	12	12
Total Lost time (s)		6.5			5.0	4.0	5.0		5.0			
Lane Util. Factor		0.95			0.95	1.00	1.00		0.88			
Frt		0.98			1.00	0.85	1.00		0.85			
Flt Protected		1.00			1.00	1.00	0.95		1.00			
Satd. Flow (prot)		3398			3574	1794	1805		2760			
Flt Permitted		1.00			1.00	1.00	0.95		1.00			
Satd. Flow (perm)		3398			3574	1794	1805		2760			
Peak-hour factor, PHF	0.93	0.93	0.93	0.91	0.91	0.91	0.83	0.83	0.83	0.92	0.92	0.92
Adj. Flow (vph)	0	325	41	0	1434	553	161	0	1096	0	0	0
RTOR Reduction (vph)	0	12	0	0	0	0	0	0	114	0	0	0
Lane Group Flow (vph)	0	354	0	0	1434	553	161	0	982	0	0	0
Heavy Vehicles (%)	0%	5%	0%	0%	1%	2%	0%	0%	3%	2%	2%	2%
Turn Type		NA			NA	Free	Prot		custom			
Protected Phases		6			2		4		4 5			
Permitted Phases						Free						
Actuated Green, G (s)		18.5			48.0	80.0	22.0		50.0			
Effective Green, g (s)		18.5			48.0	80.0	22.0		50.0			
Actuated g/C Ratio		0.23			0.60	1.00	0.28		0.63			
Clearance Time (s)		6.5			5.0		5.0					
Vehicle Extension (s)		3.0			3.0		3.0					
Lane Grp Cap (vph)		785			2144	1794	496		1725			
v/s Ratio Prot		0.10			c0.40		0.09		c0.36			
v/s Ratio Perm						0.31						
v/c Ratio		0.45			0.67	0.31	0.32		0.57			
Uniform Delay, d1		26.4			10.7	0.0	23.1		8.7			
Progression Factor		1.00			0.88	1.00	1.00		1.00			
Incremental Delay, d2		0.4			0.9	0.2	0.4		0.4			
Delay (s)		26.8			10.3	0.2	23.5		9.2			
Level of Service		C			B	A	C		A			
Approach Delay (s/veh)		26.8			7.5			11.0			0.0	
Approach LOS		C			A			B			A	

Intersection Summary			
HCM 2000 Control Delay (s/veh)	10.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	51.0%	ICU Level of Service	A
Analysis Period (min)	15		

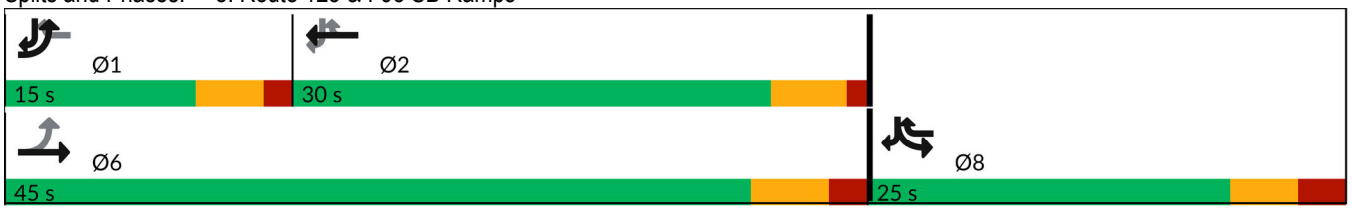
c Critical Lane Group

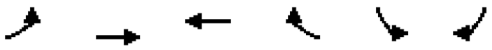


Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Approach Delay (s/veh)		7.7	6.9		12.1	
Approach LOS		A	A		B	
Queue Length 50th (ft)	4	38	163	0	29	0
Queue Length 95th (ft)	13	70	272	0	51	0
Internal Link Dist (ft)		757	1476		887	
Turn Bay Length (ft)	165				125	200
Base Capacity (vph)	508	1101	875	1756	907	1778
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.05	0.18	0.58	0.60	0.19	0.07

Intersection Summary			
Area Type:	Other		
Cycle Length: 70			
Actuated Cycle Length: 67.4			
Natural Cycle: 50			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.59			
Intersection Signal Delay (s/veh): 7.7		Intersection LOS: A	
Intersection Capacity Utilization 73.7%		ICU Level of Service D	
Analysis Period (min) 15			

Splits and Phases: 8: Route 125 & I-93 SB Ramps





Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	23	187	464	975	153	113
Future Volume (vph)	23	187	464	975	153	113
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	16	12	16
Total Lost time (s)	5.0	6.0	5.0	6.0	6.0	5.0
Lane Util. Factor	1.00	1.00	1.00	1.00	0.97	1.00
Frt	1.00	1.00	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1805	1900	1881	1794	3213	1830
Flt Permitted	0.28	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	538	1900	1881	1794	3213	1830
Peak-hour factor, PHF	0.93	0.93	0.92	0.92	0.88	0.88
Adj. Flow (vph)	25	201	504	1060	174	128
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	25	201	504	1060	174	128
Heavy Vehicles (%)	0%	0%	1%	2%	9%	0%
Turn Type	pm+pt	NA	NA	custom	Prot	pt+ov
Protected Phases	1	6	2	8	8	1 8
Permitted Phases	6			1 2		2
Actuated Green, G (s)	40.2	40.2	31.4	57.5	16.3	58.5
Effective Green, g (s)	40.2	40.2	31.4	52.5	16.3	52.5
Actuated g/C Ratio	0.59	0.59	0.46	0.77	0.24	0.77
Clearance Time (s)	5.0	6.0	5.0	6.0	6.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	404	1115	862	1532	764	1669
v/s Ratio Prot	0.00	0.11	0.27	c0.16	0.05	0.02
v/s Ratio Perm	0.03			0.43		0.05
v/c Ratio	0.06	0.18	0.58	0.69	0.23	0.08
Uniform Delay, d1	7.5	6.5	13.7	4.0	21.0	2.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.1	0.4	1.0	1.4	0.2	0.0
Delay (s)	7.6	6.9	14.7	5.3	21.2	2.0
Level of Service	A	A	B	A	C	A
Approach Delay (s/veh)		7.0	8.4		13.1	
Approach LOS		A	A		B	

Intersection Summary			
HCM 2000 Control Delay (s/veh)	8.9	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.77		
Actuated Cycle Length (s)	68.5	Sum of lost time (s)	16.0
Intersection Capacity Utilization	73.7%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

2031 No-Build Weekday Morning Peak Hour

Movement	EBL	EBR	NEL	NET	SWT	SWR
Lane Configurations						
Traffic Volume (veh/h)	46	0	0	36	342	374
Future Volume (Veh/h)	46	0	0	36	342	374
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.88	0.88	0.60	0.60	0.92	0.92
Hourly flow rate (vph)	52	0	0	60	372	407
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	636	576	779			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	636	576	779			
tC, single (s)	6.5	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.6	3.3	2.2			
p0 queue free %	88	100	100			
cM capacity (veh/h)	428	521	847			

Direction, Lane #	EB 1	NE 1	SW 1
Volume Total	52	60	779
Volume Left	52	0	0
Volume Right	0	0	407
cSH	428	847	1700
Volume to Capacity	0.12	0.00	0.46
Queue Length 95th (ft)	10	0	0
Control Delay (s/veh)	14.6	0.0	0.0
Lane LOS	B		
Approach Delay (s/veh)	14.6	0.0	0.0
Approach LOS	B		

Intersection Summary			
Average Delay	0.8		
Intersection Capacity Utilization	50.9%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	40	55	18	356	244	6
Future Volume (Veh/h)	40	55	18	356	244	6
Sign Control	Free			Free	Yield	
Grade	0%			0%	0%	
Peak Hour Factor	0.69	0.69	0.89	0.89	0.79	0.79
Hourly flow rate (vph)	58	80	20	400	309	8
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						2
Median type	None			None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			58		498	58
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			58		498	58
tC, single (s)			4.2		6.5	6.2
tC, 2 stage (s)						
tF (s)			2.3		3.6	3.3
p0 queue free %			99		40	99
cM capacity (veh/h)			1479		516	1014

Direction, Lane #	EB 1	EB 2	WB 1	NB 1
Volume Total	58	80	420	317
Volume Left	0	0	20	309
Volume Right	0	80	0	8
cSH	1700	1700	1479	527
Volume to Capacity	0.03	0.05	0.01	0.60
Queue Length 95th (ft)	0	0	1	98
Control Delay (s/veh)	0.0	0.0	0.5	21.6
Lane LOS			A	C
Approach Delay (s/veh)	0.0		0.5	21.6
Approach LOS				C

Intersection Summary			
Average Delay	8.1		
Intersection Capacity Utilization	46.6%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	NBL	NBT	SBT	SBR	SEL	SER
Lane Configurations						
Traffic Volume (veh/h)	225	36	325	14	2	58
Future Volume (Veh/h)	225	36	325	14	2	58
Sign Control		Free	Free		Yield	
Grade		0%	0%		0%	
Peak Hour Factor	0.88	0.88	0.90	0.90	0.74	0.74
Hourly flow rate (vph)	256	41	361	16	3	78
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	377				922	369
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	377				922	369
tC, single (s)	4.2				6.4	6.7
tC, 2 stage (s)						
tF (s)	2.3				3.5	3.8
p0 queue free %	78				99	86
cM capacity (veh/h)	1155				235	575

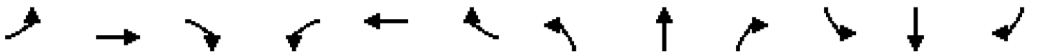
Direction, Lane #	NB 1	SB 1	SE 1
Volume Total	297	377	81
Volume Left	256	0	3
Volume Right	0	16	78
cSH	1155	1700	546
Volume to Capacity	0.22	0.22	0.15
Queue Length 95th (ft)	21	0	13
Control Delay (s/veh)	8.0	0.0	12.7
Lane LOS	A		B
Approach Delay (s/veh)	8.0	0.0	12.7
Approach LOS			B

Intersection Summary			
Average Delay	4.5		
Intersection Capacity Utilization	46.0%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	66	1	31	562	7	18
Future Volume (Veh/h)	66	1	31	562	7	18
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.83	0.83	0.89	0.89	0.61	0.61
Hourly flow rate (vph)	80	1	35	631	11	30
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			81		782	81
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			81		782	81
tC, single (s)			4.2		6.6	6.3
tC, 2 stage (s)						
tF (s)			2.3		3.7	3.4
p0 queue free %			98		97	97
cM capacity (veh/h)			1486		335	950

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	81	666	41
Volume Left	0	35	11
Volume Right	1	0	30
cSH	1700	1486	636
Volume to Capacity	0.05	0.02	0.06
Queue Length 95th (ft)	0	2	5
Control Delay (s/veh)	0.0	0.7	11.0
Lane LOS		A	B
Approach Delay (s/veh)	0.0	0.7	11.0
Approach LOS			B

Intersection Summary			
Average Delay	1.1		
Intersection Capacity Utilization	48.0%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	3	270	493	82	215	4	68	0	15	0	0	2
Future Volume (Veh/h)	3	270	493	82	215	4	68	0	15	0	0	2
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.83	0.83	0.83	0.86	0.86	0.86	0.86	0.86	0.85	0.50	0.50	0.50
Hourly flow rate (vph)	4	325	594	95	250	5	79	0	18	0	0	4
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	255			919			1077	1075	622	1091	1370	253
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	255			919			1077	1075	622	1091	1370	253
tC, single (s)	4.1			4.1			7.2	6.5	6.3	7.1	6.5	6.7
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.6	4.0	3.4	3.5	4.0	3.8
p0 queue free %	100			87			54	100	96	100	100	99
cM capacity (veh/h)	1322			751			171	193	476	168	129	682

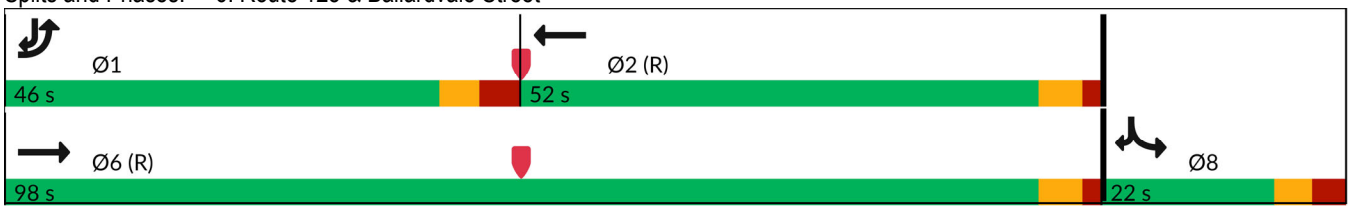
Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	923	350	97	4
Volume Left	4	95	79	0
Volume Right	594	5	18	4
cSH	1322	751	194	682
Volume to Capacity	0.00	0.13	0.50	0.01
Queue Length 95th (ft)	0	11	62	0
Control Delay (s/veh)	0.1	4.0	40.8	10.3
Lane LOS	A	A	E	B
Approach Delay (s/veh)	0.1	4.0	40.8	10.3
Approach LOS			E	B

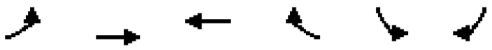
Intersection Summary			
Average Delay	4.0		
Intersection Capacity Utilization	82.1%	ICU Level of Service	E
Analysis Period (min)	15		

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Approach Delay (s/veh)		36.4	77.4		21.9	
Approach LOS		D	E		C	
Queue Length 50th (ft)	~425	49	~621		51	64
Queue Length 95th (ft)	m#521	m95	#762		98	96
Internal Link Dist (ft)		1039	766		272	
Turn Bay Length (ft)	275				255	125
Base Capacity (vph)	1073	1374	1327		210	1188
Starvation Cap Reductn	0	0	0		0	0
Spillback Cap Reductn	0	0	0		0	0
Storage Cap Reductn	0	0	0		0	0
Reduced v/c Ratio	1.01	0.64	1.06		0.34	0.26

Intersection Summary			
Area Type:	Other		
Cycle Length: 120			
Actuated Cycle Length: 120			
Offset: 21 (18%), Referenced to phase 2:WBT and 6:EBT, Start of Green			
Natural Cycle: 90			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 1.06			
Intersection Signal Delay (s/veh): 50.3		Intersection LOS: D	
Intersection Capacity Utilization 87.8%		ICU Level of Service E	
Analysis Period (min) 15			
~ Volume exceeds capacity, queue is theoretically infinite.			
Queue shown is maximum after two cycles.			
# 95th percentile volume exceeds capacity, queue may be longer.			
Queue shown is maximum after two cycles.			
m Volume for 95th percentile queue is metered by upstream signal.			

Splits and Phases: 6: Route 125 & Ballardvale Street





Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	1063	864	1003	306	67	294
Future Volume (vph)	1063	864	1003	306	67	294
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	12	11	12	12	12	13
Total Lost time (s)	7.0	5.5	5.5		6.5	7.0
Lane Util. Factor	0.97	1.00	0.95		1.00	0.88
Frt	1.00	1.00	0.96		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	3303	1783	3365		1626	2295
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	3303	1783	3365		1626	2295
Peak-hour factor, PHF	0.98	0.98	0.93	0.93	0.94	0.94
Adj. Flow (vph)	1085	882	1078	329	71	313
RTOR Reduction (vph)	0	0	24	0	0	24
Lane Group Flow (vph)	1085	882	1383	0	71	289
Heavy Vehicles (%)	6%	3%	4%	2%	11%	28%
Turn Type	Prot	NA	NA		Prot	pt+ov
Protected Phases	1	6	2		8	1 8
Permitted Phases						
Actuated Green, G (s)	39.0	92.5	46.5		15.5	61.0
Effective Green, g (s)	39.0	92.5	46.5		15.5	54.5
Actuated g/C Ratio	0.33	0.77	0.39		0.13	0.45
Clearance Time (s)	7.0	5.5	5.5		6.5	
Vehicle Extension (s)	3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)	1073	1374	1303		210	1042
v/s Ratio Prot	c0.33	0.49	c0.41		c0.04	0.13
v/s Ratio Perm						
v/c Ratio	1.01	0.64	1.06		0.34	0.28
Uniform Delay, d1	40.5	6.2	36.8		47.6	20.5
Progression Factor	0.96	0.34	1.00		1.00	1.00
Incremental Delay, d2	24.1	1.4	43.0		4.3	0.1
Delay (s)	62.9	3.5	79.8		51.9	20.6
Level of Service	E	A	E		D	C
Approach Delay (s/veh)		36.3	79.8		26.4	
Approach LOS		D	E		C	

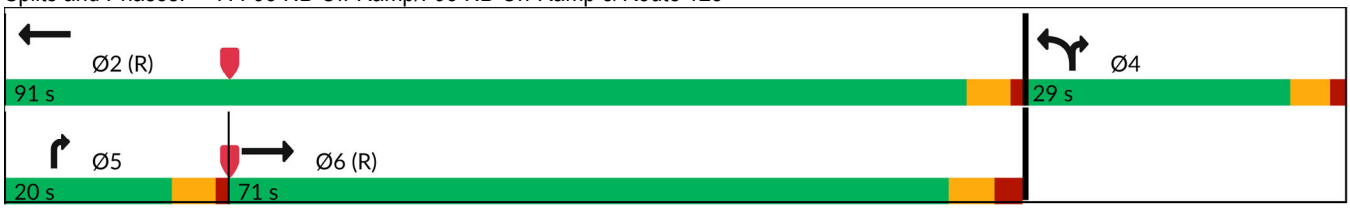
Intersection Summary			
HCM 2000 Control Delay (s/veh)	51.5	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.93		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	19.0
Intersection Capacity Utilization	87.8%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay (s/veh)		15.1			11.9			55.7				
Approach LOS		B			B			E				
Queue Length 50th (ft)		196			264	0	9		410			
Queue Length 95th (ft)		231			m262	m0	28		#581			
Internal Link Dist (ft)		1673			1039			832			438	
Turn Bay Length (ft)						350			150			
Base Capacity (vph)		1856			2440	1476	361		1096			
Starvation Cap Reductn		0			0	0	0		0			
Spillback Cap Reductn		0			0	0	0		0			
Storage Cap Reductn		0			0	0	0		0			
Reduced v/c Ratio		0.54			0.47	0.16	0.04		0.99			

Intersection Summary			
Area Type:	Other		
Cycle Length: 120			
Actuated Cycle Length: 120			
Offset: 0 (0%), Referenced to phase 2:WBT and 6:EBT, Start of Green, Master Intersection			
Natural Cycle: 55			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.99			
Intersection Signal Delay (s/veh): 26.6		Intersection LOS: C	
Intersection Capacity Utilization 71.9%		ICU Level of Service C	
Analysis Period (min) 15			
# 95th percentile volume exceeds capacity, queue may be longer.			
Queue shown is maximum after two cycles.			
m Volume for 95th percentile queue is metered by upstream signal.			

Splits and Phases: 7: I-93 NB Off-Ramp/I-93 NB On-Ramp & Route 125



Lane Group	Ø5
Approach Delay (s/veh)	
Approach LOS	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	878	42	0	1075	222	14	0	1049	0	0	0
Future Volume (vph)	0	878	42	0	1075	222	14	0	1049	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	16	12	12	16	12	12	12	12	12	12
Total Lost time (s)		6.5			5.0	4.0	5.0		5.0			
Lane Util. Factor		0.95			0.95	1.00	1.00		0.88			
Frt		0.99			1.00	0.85	1.00		0.85			
Flt Protected		1.00			1.00	1.00	0.95		1.00			
Satd. Flow (prot)		3449			3406	1476	1805		2682			
Flt Permitted		1.00			1.00	1.00	0.95		1.00			
Satd. Flow (perm)		3449			3406	1476	1805		2682			
Peak-hour factor, PHF	0.91	0.91	0.91	0.94	0.94	0.94	0.97	0.97	0.97	0.92	0.92	0.92
Adj. Flow (vph)	0	965	46	0	1144	236	14	0	1081	0	0	0
RTOR Reduction (vph)	0	3	0	0	0	0	0	0	113	0	0	0
Lane Group Flow (vph)	0	1008	0	0	1144	236	14	0	968	0	0	0
Heavy Vehicles (%)	0%	4%	3%	0%	6%	24%	0%	0%	6%	2%	2%	2%
Turn Type		NA			NA	Free	Prot		custom			
Protected Phases		6			2		4		4 5			
Permitted Phases						Free						
Actuated Green, G (s)		64.5			86.0	120.0	24.0		44.0			
Effective Green, g (s)		64.5			86.0	120.0	24.0		44.0			
Actuated g/C Ratio		0.54			0.72	1.00	0.20		0.37			
Clearance Time (s)		6.5			5.0		5.0					
Vehicle Extension (s)		3.0			3.0		3.0					
Lane Grp Cap (vph)		1853			2440	1476	361		983			
v/s Ratio Prot		c0.29			0.34		0.01		c0.36			
v/s Ratio Perm						0.16						
v/c Ratio		0.54			0.47	0.16	0.04		0.99			
Uniform Delay, d1		18.1			7.3	0.0	38.7		37.7			
Progression Factor		0.77			1.91	1.00	1.00		1.00			
Incremental Delay, d2		1.1			0.3	0.1	0.0		24.9			
Delay (s)		15.0			14.1	0.1	38.7		62.5			
Level of Service		B			B	A	D		E			
Approach Delay (s/veh)		15.0			11.7			62.2			0.0	
Approach LOS		B			B			E			A	

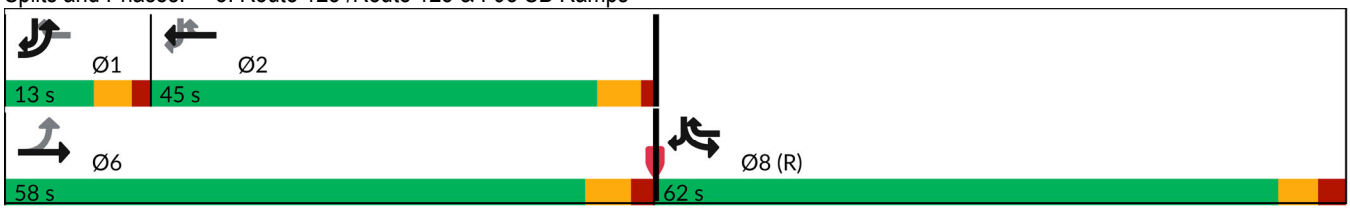
Intersection Summary			
HCM 2000 Control Delay (s/veh)	28.6	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.76		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	71.9%	ICU Level of Service	C
Analysis Period (min)	15		

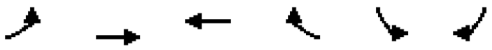
c Critical Lane Group

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Approach Delay (s/veh)		26.1	9.9		19.3	
Approach LOS		C	A		B	
Queue Length 50th (ft)	15	208	104	200	156	0
Queue Length 95th (ft)	35	297	153	222	202	0
Internal Link Dist (ft)		782	1673		852	
Turn Bay Length (ft)	165				125	200
Base Capacity (vph)	474	807	653	1711	1527	1778
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.07	0.47	0.32	0.59	0.40	0.05

Intersection Summary			
Area Type:	Other		
Cycle Length: 120			
Actuated Cycle Length: 120			
Offset: 113 (94%), Referenced to phase 8:SBL, Start of Green			
Natural Cycle: 45			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.59			
Intersection Signal Delay (s/veh): 15.6		Intersection LOS: B	
Intersection Capacity Utilization 69.4%		ICU Level of Service C	
Analysis Period (min) 15			

Splits and Phases: 8: Route 125 /Route 125 & I-93 SB Ramps





Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	31	345	183	906	575	80
Future Volume (vph)	31	345	183	906	575	80
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	16	12	16
Total Lost time (s)	5.0	6.0	5.0	6.0	6.0	5.0
Lane Util. Factor	1.00	1.00	1.00	1.00	0.97	1.00
Frt	1.00	1.00	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1805	1863	1810	1711	3273	1812
Flt Permitted	0.50	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	945	1863	1810	1711	3273	1812
Peak-hour factor, PHF	0.90	0.90	0.89	0.89	0.94	0.94
Adj. Flow (vph)	34	383	206	1018	612	85
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	34	383	206	1018	612	85
Heavy Vehicles (%)	0%	2%	5%	7%	7%	1%
Turn Type	pm+pt	NA	NA	custom	Prot	pt+ov
Protected Phases	1	6	2	8	8	1 8
Permitted Phases	6			1 2		2
Actuated Green, G (s)	53.0	53.0	43.4	109.0	55.0	110.0
Effective Green, g (s)	53.0	53.0	43.4	104.0	55.0	104.0
Actuated g/C Ratio	0.44	0.44	0.36	0.87	0.46	0.87
Clearance Time (s)	5.0	6.0	5.0	6.0	6.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	457	822	654	1568	1500	1721
v/s Ratio Prot	0.00	0.21	0.11	c0.30	0.19	0.02
v/s Ratio Perm	0.03			0.30		0.02
v/c Ratio	0.07	0.47	0.31	0.65	0.41	0.05
Uniform Delay, d1	19.5	23.6	27.6	2.4	21.7	1.1
Progression Factor	1.00	1.00	0.87	1.00	1.00	1.00
Incremental Delay, d2	0.1	1.9	0.3	0.9	0.8	0.0
Delay (s)	19.6	25.4	24.4	3.3	22.5	1.1
Level of Service	B	C	C	A	C	A
Approach Delay (s/veh)		25.0	6.8		19.9	
Approach LOS		C	A		B	

Intersection Summary			
HCM 2000 Control Delay (s/veh)	14.0	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	69.4%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

2031 No-Build Weekday Evening Peak Hour

Movement	EBL	EBR	NEL	NET	SWT	SWR
Lane Configurations						
Traffic Volume (veh/h)	301	1	0	283	61	44
Future Volume (Veh/h)	301	1	0	283	61	44
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.91	0.91	0.89	0.89	0.87	0.87
Hourly flow rate (vph)	331	1	0	318	70	51
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	414	96	121			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	414	96	121			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	45	100	100			
cM capacity (veh/h)	597	967	1479			

Direction, Lane #	EB 1	NE 1	SW 1
Volume Total	332	318	121
Volume Left	331	0	0
Volume Right	1	0	51
cSH	598	1479	1700
Volume to Capacity	0.56	0.00	0.07
Queue Length 95th (ft)	85	0	0
Control Delay (s/veh)	18.3	0.0	0.0
Lane LOS	C		
Approach Delay (s/veh)	18.3	0.0	0.0
Approach LOS	C		

Intersection Summary			
Average Delay	7.9		
Intersection Capacity Utilization	38.3%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	281	242	3	41	29	21
Future Volume (Veh/h)	281	242	3	41	29	21
Sign Control	Free			Free	Yield	
Grade	0%			0%	0%	
Peak Hour Factor	0.93	0.93	0.70	0.70	0.71	0.71
Hourly flow rate (vph)	302	260	4	59	41	30
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						2
Median type	None			None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			302		369	302
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			302		369	302
tC, single (s)			4.1		6.6	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.7	3.3
p0 queue free %			100		93	96
cM capacity (veh/h)			1270		590	742

Direction, Lane #	EB 1	EB 2	WB 1	NB 1
Volume Total	302	260	63	71
Volume Left	0	0	4	41
Volume Right	0	260	0	30
cSH	1700	1700	1270	1021
Volume to Capacity	0.18	0.15	0.00	0.07
Queue Length 95th (ft)	0	0	0	6
Control Delay (s/veh)	0.0	0.0	0.5	10.9
Lane LOS			A	B
Approach Delay (s/veh)	0.0		0.5	10.9
Approach LOS				B

Intersection Summary			
Average Delay	1.2		
Intersection Capacity Utilization	25.0%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	NBL	NBT	SBT	SBR	SEL	SER
Lane Configurations						
Traffic Volume (veh/h)	37	271	67	3	4	269
Future Volume (Veh/h)	37	271	67	3	4	269
Sign Control		Free	Free		Yield	
Grade		0%	0%		0%	
Peak Hour Factor	0.87	0.87	0.90	0.90	0.87	0.87
Hourly flow rate (vph)	43	311	74	3	5	309
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	77				473	76
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	77				473	76
tC, single (s)	4.4				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.5				3.5	3.3
p0 queue free %	97				99	69
cM capacity (veh/h)	1357				536	983

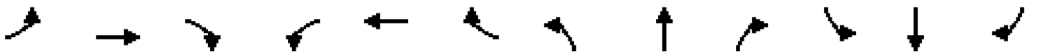
Direction, Lane #	NB 1	SB 1	SE 1
Volume Total	354	77	314
Volume Left	43	0	5
Volume Right	0	3	309
cSH	1357	1700	970
Volume to Capacity	0.03	0.05	0.32
Queue Length 95th (ft)	2	0	35
Control Delay (s/veh)	1.2	0.0	10.5
Lane LOS	A		B
Approach Delay (s/veh)	1.2	0.0	10.5
Approach LOS			B

Intersection Summary			
Average Delay	5.0		
Intersection Capacity Utilization	46.5%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	458	0	10	58	1	57
Future Volume (Veh/h)	458	0	10	58	1	57
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.91	0.91	0.75	0.75	0.77	0.77
Hourly flow rate (vph)	503	0	13	77	1	74
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			503		606	503
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			503		606	503
tC, single (s)			4.8		6.4	6.3
tC, 2 stage (s)						
tF (s)			2.8		3.5	3.4
p0 queue free %			98		100	87
cM capacity (veh/h)			797		456	561

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	503	90	75
Volume Left	0	13	1
Volume Right	0	0	74
cSH	1700	797	559
Volume to Capacity	0.30	0.02	0.13
Queue Length 95th (ft)	0	1	12
Control Delay (s/veh)	0.0	1.5	12.4
Lane LOS		A	B
Approach Delay (s/veh)	0.0	1.5	12.4
Approach LOS			B

Intersection Summary			
Average Delay	1.6		
Intersection Capacity Utilization	34.4%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	3	165	65	19	179	0	543	0	57	8	0	25
Future Volume (Veh/h)	3	165	65	19	179	0	543	0	57	8	0	25
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.87	0.87	0.87	0.82	0.82	0.82	0.90	0.90	0.90	0.38	0.38	0.38
Hourly flow rate (vph)	3	190	75	23	218	0	603	0	63	21	0	66
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	218			265			564	498	228	561	535	218
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	218			265			564	498	228	561	535	218
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			98			0	100	92	95	100	92
cM capacity (veh/h)	1364			1311			398	468	817	401	445	817

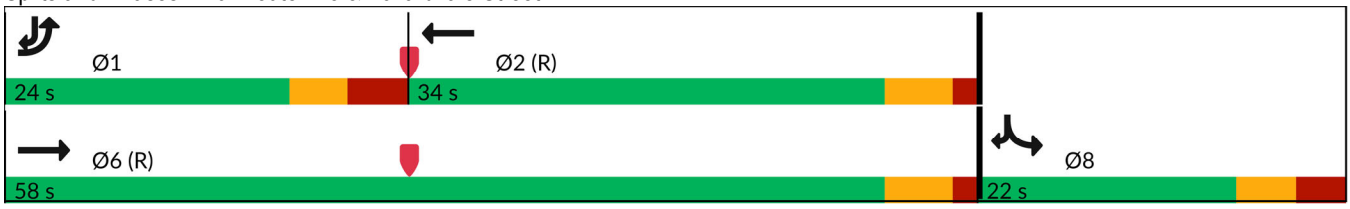
Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	268	241	666	87
Volume Left	3	23	603	21
Volume Right	75	0	63	66
cSH	1364	1311	418	654
Volume to Capacity	0.00	0.02	1.59	0.13
Queue Length 95th (ft)	0	1	940	11
Control Delay (s/veh)	0.1	0.9	301.4	11.4
Lane LOS	A	A	F	B
Approach Delay (s/veh)	0.1	0.9	301.4	11.4
Approach LOS			F	B

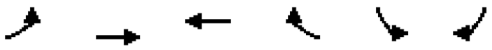
Intersection Summary			
Average Delay	160.0		
Intersection Capacity Utilization	68.0%	ICU Level of Service	C
Analysis Period (min)	15		

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Recall Mode	None	C-Max	C-Max		None	
Act Effct Green (s)	17.0	52.5	28.5		15.5	39.0
Actuated g/C Ratio	0.21	0.66	0.36		0.19	0.49
v/c Ratio	0.57	1.09	1.00		1.10	1.01
Control Delay (s/veh)	37.3	67.7	51.8		110.9	48.1
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay (s/veh)	37.3	67.7	51.8		110.9	48.1
LOS	D	E	D		F	D
Approach Delay (s/veh)		60.6	51.8		61.3	
Approach LOS		E	D		E	
Queue Length 50th (ft)	107	~762	322		~219	~392
Queue Length 95th (ft)	138	#857	#419		#358	#526
Internal Link Dist (ft)		1276	719		8125	
Turn Bay Length (ft)	275				255	125
Base Capacity (vph)	695	1193	1262		346	1415
Starvation Cap Reductn	0	0	0		0	0
Spillback Cap Reductn	0	0	0		0	0
Storage Cap Reductn	0	0	0		0	0
Reduced v/c Ratio	0.57	1.09	1.00		1.10	1.01

Intersection Summary			
Area Type:	Other		
Cycle Length: 80			
Actuated Cycle Length: 80			
Offset: 0 (0%), Referenced to phase 2:WBT and 6:EBT, Start of Green			
Natural Cycle: 120			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 1.10			
Intersection Signal Delay (s/veh): 58.5		Intersection LOS: E	
Intersection Capacity Utilization 85.2%		ICU Level of Service E	
Analysis Period (min) 15			
~ 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.			

Splits and Phases: 6: Route 125 & Ballardvale Street





Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	328	1084	963	95	327	1228
Future Volume (vph)	328	1084	963	95	327	1228
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	12	11	12	12	12	13
Total Lost time (s)	7.0	5.5	5.5		6.5	7.0
Lane Util. Factor	0.97	1.00	0.95		1.00	0.88
Frt	1.00	1.00	0.99		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	3273	1818	3517		1787	2880
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	3273	1818	3517		1787	2880
Peak-hour factor, PHF	0.83	0.83	0.84	0.84	0.86	0.86
Adj. Flow (vph)	395	1306	1146	113	380	1428
RTOR Reduction (vph)	0	0	9	0	0	14
Lane Group Flow (vph)	395	1306	1250	0	380	1414
Heavy Vehicles (%)	7%	1%	1%	4%	1%	2%
Turn Type	Prot	NA	NA		Prot	pt+ov
Protected Phases	1	6	2		8	1 8
Permitted Phases						
Actuated Green, G (s)	17.0	52.5	28.5		15.5	39.0
Effective Green, g (s)	17.0	52.5	28.5		15.5	32.5
Actuated g/C Ratio	0.21	0.66	0.36		0.19	0.41
Clearance Time (s)	7.0	5.5	5.5		6.5	
Vehicle Extension (s)	3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)	695	1193	1252		346	1170
v/s Ratio Prot	0.12	c0.72	0.36		0.21	c0.49
v/s Ratio Perm						
v/c Ratio	0.57	1.09	1.00		1.10	1.21
Uniform Delay, d1	28.2	13.8	25.7		32.3	23.8
Progression Factor	1.22	0.76	1.00		1.00	1.00
Incremental Delay, d2	0.8	53.2	25.1		77.4	102.2
Delay (s)	35.1	63.6	50.8		109.7	125.9
Level of Service	D	E	D		F	F
Approach Delay (s/veh)		57.0	50.8		122.5	
Approach LOS		E	D		F	

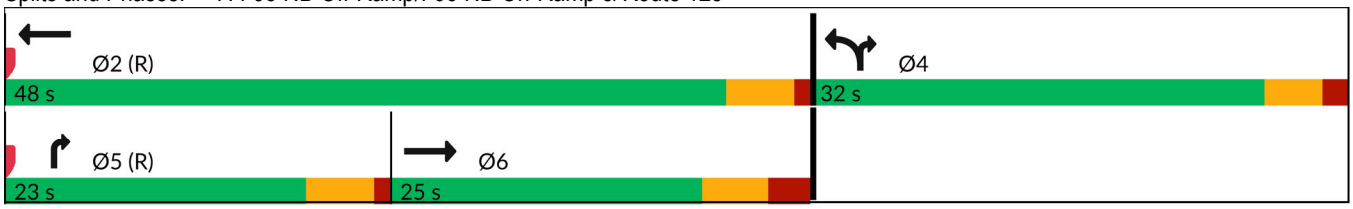
Intersection Summary			
HCM 2000 Control Delay (s/veh)	80.2	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.25		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	19.0
Intersection Capacity Utilization	85.2%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Recall Mode		None			C-Max		None					
Act Effct Green (s)		18.5			44.7	80.0	25.3		50.0			
Actuated g/C Ratio		0.23			0.56	1.00	0.32		0.63			
v/c Ratio		0.56			0.87	0.38	0.32		0.70			
Control Delay (s/veh)		29.3			16.7	0.1	21.9		10.7			
Queue Delay		0.0			0.0	0.0	0.0		0.0			
Total Delay (s/veh)		29.3			16.7	0.1	21.9		10.7			
LOS		C			B	A	C		B			
Approach Delay (s/veh)		29.3			12.0			12.1				
Approach LOS		C			B			B				
Queue Length 50th (ft)		100			374	0	65		176			
Queue Length 95th (ft)		146			m373	m0	105		210			
Internal Link Dist (ft)		1444			1276			618			383	
Turn Bay Length (ft)						350			150			
Base Capacity (vph)		797			1997	1794	609		1775			
Starvation Cap Reductn		0			0	0	0		0			
Spillback Cap Reductn		0			0	0	0		0			
Storage Cap Reductn		0			0	0	0		0			
Reduced v/c Ratio		0.56			0.87	0.38	0.30		0.71			

Intersection Summary			
Area Type:	Other		
Cycle Length: 80			
Actuated Cycle Length: 80			
Offset: 0 (0%), Referenced to phase 2:WBT and 5:NBR, Start of Green, Master Intersection			
Natural Cycle: 40			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.87			
Intersection Signal Delay (s/veh): 13.8		Intersection LOS: B	
Intersection Capacity Utilization 59.3%		ICU Level of Service B	
Analysis Period (min) 15			
m Volume for 95th percentile queue is metered by upstream signal.			

Splits and Phases: 7: I-93 NB Off-Ramp/I-93 NB On-Ramp & Route 125



Lane Group	Ø5
Recall Mode	C-Max
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay (s/veh)	
Queue Delay	
Total Delay (s/veh)	
LOS	
Approach Delay (s/veh)	
Approach LOS	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	370	42	0	1576	615	149	0	1042	0	0	0
Future Volume (vph)	0	370	42	0	1576	615	149	0	1042	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	16	12	12	16	12	12	12	12	12	12
Total Lost time (s)		6.5			5.0	4.0	5.0		5.0			
Lane Util. Factor		0.95			0.95	1.00	1.00		0.88			
Frt		0.98			1.00	0.85	1.00		0.85			
Flt Protected		1.00			1.00	1.00	0.95		1.00			
Satd. Flow (prot)		3402			3574	1794	1805		2760			
Flt Permitted		1.00			1.00	1.00	0.95		1.00			
Satd. Flow (perm)		3402			3574	1794	1805		2760			
Peak-hour factor, PHF	0.93	0.93	0.93	0.91	0.91	0.91	0.83	0.83	0.83	0.92	0.92	0.92
Adj. Flow (vph)	0	398	45	0	1732	676	180	0	1255	0	0	0
RTOR Reduction (vph)	0	11	0	0	0	0	0	0	74	0	0	0
Lane Group Flow (vph)	0	432	0	0	1732	676	180	0	1182	0	0	0
Heavy Vehicles (%)	0%	5%	0%	0%	1%	2%	0%	0%	3%	2%	2%	2%
Turn Type		NA			NA	Free	Prot		custom			
Protected Phases		6			2		4		4 5			
Permitted Phases						Free						
Actuated Green, G (s)		18.5			44.7	80.0	25.3		50.0			
Effective Green, g (s)		18.5			44.7	80.0	25.3		50.0			
Actuated g/C Ratio		0.23			0.56	1.00	0.32		0.63			
Clearance Time (s)		6.5			5.0		5.0					
Vehicle Extension (s)		3.0			3.0		3.0					
Lane Grp Cap (vph)		786			1996	1794	570		1725			
v/s Ratio Prot		0.13			c0.48		0.10		c0.43			
v/s Ratio Perm						0.38						
v/c Ratio		0.55			0.87	0.38	0.32		0.68			
Uniform Delay, d1		27.1			15.1	0.0	20.8		9.8			
Progression Factor		1.00			0.97	1.00	1.00		1.00			
Incremental Delay, d2		0.8			0.5	0.1	0.3		1.1			
Delay (s)		27.9			15.2	0.1	21.1		11.0			
Level of Service		C			B	A	C		B			
Approach Delay (s/veh)		27.9			11.0			12.2			0.0	
Approach LOS		C			B			B			A	

Intersection Summary			
HCM 2000 Control Delay (s/veh)	13.2	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.91		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	59.3%	ICU Level of Service	B
Analysis Period (min)	15		

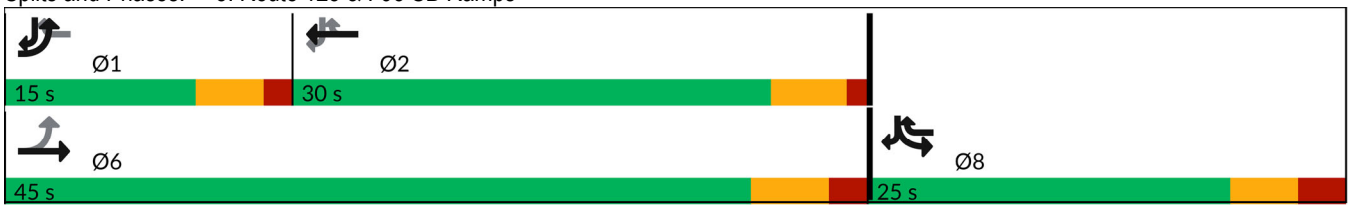
c Critical Lane Group

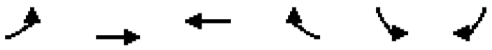
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Recall Mode	None	Max	None	None	None	
Act Effct Green (s)	40.0	39.0	31.2	69.0	18.0	69.0
Actuated g/C Ratio	0.58	0.57	0.45	1.00	0.26	1.00
v/c Ratio	0.08	0.22	0.70	0.71	0.26	0.08
Control Delay (s/veh)	7.1	8.4	22.8	2.4	21.0	0.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay (s/veh)	7.1	8.4	22.8	2.4	21.0	0.1
LOS	A	A	C	A	C	A
Approach Delay (s/veh)		8.3	8.9		12.7	
Approach LOS		A	A		B	
Queue Length 50th (ft)	5	47	211	0	37	0
Queue Length 95th (ft)	14	82	#383	0	62	0
Internal Link Dist (ft)		783	1444		1069	
Turn Bay Length (ft)	165				125	200
Base Capacity (vph)	425	1074	850	1787	885	1804
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.07	0.22	0.70	0.72	0.25	0.08

Intersection Summary			
Area Type:	Other		
Cycle Length: 70			
Actuated Cycle Length: 69			
Natural Cycle: 60			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.71			
Intersection Signal Delay (s/veh): 9.4		Intersection LOS: A	
Intersection Capacity Utilization 86.2%		ICU Level of Service E	
Analysis Period (min) 15			

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

Splits and Phases: 8: Route 125 & I-93 SB Ramps





Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	26	221	548	1177	191	125
Future Volume (vph)	26	221	548	1177	191	125
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	16	12	16
Total Lost time (s)	5.0	6.0	5.0	6.0	6.0	5.0
Lane Util. Factor	1.00	1.00	1.00	1.00	0.97	1.00
Frt	1.00	1.00	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1805	1900	1881	1794	3213	1830
Flt Permitted	0.20	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	378	1900	1881	1794	3213	1830
Peak-hour factor, PHF	0.93	0.93	0.92	0.92	0.88	0.88
Adj. Flow (vph)	28	238	596	1279	217	142
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	28	238	596	1279	217	142
Heavy Vehicles (%)	0%	0%	1%	2%	9%	0%
Turn Type	pm+pt	NA	NA	custom	Prot	pt+ov
Protected Phases	1	6	2	8	8	1 8
Permitted Phases	6			1 2		2
Actuated Green, G (s)	40.1	40.1	31.2	59.1	18.0	60.1
Effective Green, g (s)	40.1	40.1	31.2	54.1	18.0	54.1
Actuated g/C Ratio	0.57	0.57	0.45	0.77	0.26	0.77
Clearance Time (s)	5.0	6.0	5.0	6.0	6.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	315	1086	837	1538	825	1673
v/s Ratio Prot	0.01	0.13	0.32	c0.21	0.07	0.03
v/s Ratio Perm	0.04			0.50		0.05
v/c Ratio	0.09	0.22	0.71	0.83	0.26	0.08
Uniform Delay, d1	9.3	7.3	15.8	5.1	20.8	2.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.1	0.5	2.9	4.0	0.2	0.0
Delay (s)	9.4	7.8	18.7	9.1	20.9	2.0
Level of Service	A	A	B	A	C	A
Approach Delay (s/veh)		8.0	12.1		13.4	
Approach LOS		A	B		B	

Intersection Summary			
HCM 2000 Control Delay (s/veh)	11.9	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.92		
Actuated Cycle Length (s)	70.1	Sum of lost time (s)	16.0
Intersection Capacity Utilization	86.2%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

2031 Build Weekday Morning Peak Hour

Movement	EBL	EBR	NEL	NET	SWT	SWR
Lane Configurations						
Traffic Volume (veh/h)	61	0	0	36	342	420
Future Volume (Veh/h)	61	0	0	36	342	420
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.88	0.88	0.60	0.60	0.92	0.92
Hourly flow rate (vph)	69	0	0	60	372	457
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	661	601	829			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	661	601	829			
tC, single (s)	6.5	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.6	3.3	2.2			
p0 queue free %	84	100	100			
cM capacity (veh/h)	418	504	811			

Direction, Lane #	EB 1	NE 1	SW 1
Volume Total	69	60	829
Volume Left	69	0	0
Volume Right	0	0	457
cSH	418	811	1700
Volume to Capacity	0.16	0.00	0.49
Queue Length 95th (ft)	15	0	0
Control Delay (s/veh)	15.3	0.0	0.0
Lane LOS	C		
Approach Delay (s/veh)	15.3	0.0	0.0
Approach LOS	C		

Intersection Summary			
Average Delay	1.1		
Intersection Capacity Utilization	53.8%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	55	73	18	402	302	6
Future Volume (Veh/h)	55	73	18	402	302	6
Sign Control	Free			Free	Yield	
Grade	0%			0%	0%	
Peak Hour Factor	0.69	0.69	0.89	0.89	0.79	0.79
Hourly flow rate (vph)	80	106	20	452	382	8
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						2
Median type	None			None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			80		572	80
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			80		572	80
tC, single (s)			4.2		6.5	6.2
tC, 2 stage (s)						
tF (s)			2.3		3.6	3.3
p0 queue free %			99		18	99
cM capacity (veh/h)			1451		468	986

Direction, Lane #	EB 1	EB 2	WB 1	NB 1
Volume Total	80	106	472	390
Volume Left	0	0	20	382
Volume Right	0	106	0	8
cSH	1700	1700	1451	475
Volume to Capacity	0.05	0.06	0.01	0.82
Queue Length 95th (ft)	0	0	1	197
Control Delay (s/veh)	0.0	0.0	0.5	38.7
Lane LOS			A	E
Approach Delay (s/veh)	0.0		0.5	38.7
Approach LOS				E

Intersection Summary			
Average Delay	14.6		
Intersection Capacity Utilization	52.2%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	NBL	NBT	SBT	SBR	SEL	SER
Lane Configurations						
Traffic Volume (veh/h)	283	36	325	14	2	76
Future Volume (Veh/h)	283	36	325	14	2	76
Sign Control		Free	Free		Yield	
Grade		0%	0%		0%	
Peak Hour Factor	0.88	0.88	0.90	0.90	0.74	0.74
Hourly flow rate (vph)	322	41	361	16	3	103
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	377				1054	369
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	377				1054	369
tC, single (s)	4.2				6.4	6.6
tC, 2 stage (s)						
tF (s)	2.3				3.5	3.7
p0 queue free %	72				98	83
cM capacity (veh/h)	1160				182	598

Direction, Lane #	NB 1	SB 1	SE 1
Volume Total	363	377	106
Volume Left	322	0	3
Volume Right	0	16	103
cSH	1160	1700	562
Volume to Capacity	0.28	0.22	0.19
Queue Length 95th (ft)	29	0	17
Control Delay (s/veh)	8.5	0.0	12.9
Lane LOS	A		B
Approach Delay (s/veh)	8.5	0.0	12.9
Approach LOS			B

Intersection Summary			
Average Delay	5.3		
Intersection Capacity Utilization	50.3%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	99	1	31	666	7	18
Future Volume (Veh/h)	99	1	31	666	7	18
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.83	0.83	0.89	0.89	0.61	0.61
Hourly flow rate (vph)	119	1	35	748	11	30
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			120		938	120
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			120		938	120
tC, single (s)			4.2		6.6	6.3
tC, 2 stage (s)						
tF (s)			2.3		3.7	3.4
p0 queue free %			98		96	97
cM capacity (veh/h)			1437		269	903

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	120	783	41
Volume Left	0	35	11
Volume Right	1	0	30
cSH	1700	1437	554
Volume to Capacity	0.07	0.02	0.07
Queue Length 95th (ft)	0	2	6
Control Delay (s/veh)	0.0	0.7	12.0
Lane LOS		A	B
Approach Delay (s/veh)	0.0	0.7	12.0
Approach LOS			B

Intersection Summary			
Average Delay	1.1		
Intersection Capacity Utilization	53.4%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	3	270	532	89	215	4	81	0	17	0	0	2
Future Volume (Veh/h)	3	270	532	89	215	4	81	0	17	0	0	2
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.83	0.83	0.83	0.86	0.86	0.86	0.86	0.86	0.86	0.50	0.50	0.50
Hourly flow rate (vph)	4	325	641	103	250	5	94	0	20	0	0	4
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	255			966			1116	1115	646	1132	1433	253
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	255			966			1116	1115	646	1132	1433	253
tC, single (s)	4.1			4.1			7.2	6.5	6.3	7.1	6.5	6.7
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.6	4.0	3.4	3.5	4.0	3.8
p0 queue free %	100			86			41	100	96	100	100	99
cM capacity (veh/h)	1322			721			159	179	463	155	116	682

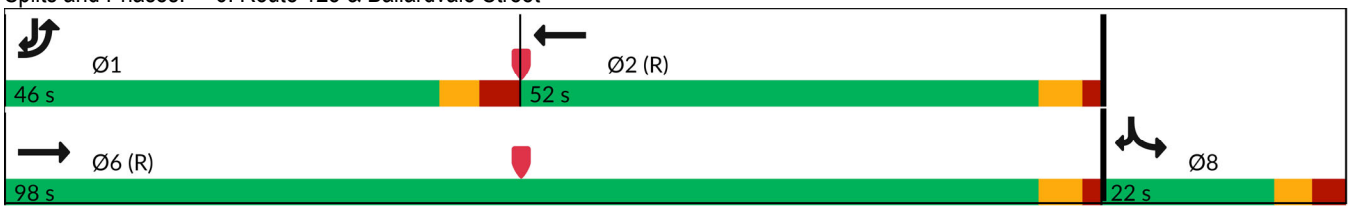
Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	970	358	114	4
Volume Left	4	103	94	0
Volume Right	641	5	20	4
cSH	1322	721	180	682
Volume to Capacity	0.00	0.14	0.63	0.01
Queue Length 95th (ft)	0	12	90	0
Control Delay (s/veh)	0.1	4.4	54.5	10.3
Lane LOS	A	A	F	B
Approach Delay (s/veh)	0.1	4.4	54.5	10.3
Approach LOS			F	B

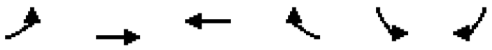
Intersection Summary				
Average Delay	5.5			
Intersection Capacity Utilization	85.7%	ICU Level of Service	E	
Analysis Period (min)	15			

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Approach Delay (s/veh)		44.1	79.6		22.0	
Approach LOS		D	E		C	
Queue Length 50th (ft)	~494	47	~628		52	68
Queue Length 95th (ft)	m#540	m86	#769		101	102
Internal Link Dist (ft)		1039	766		272	
Turn Bay Length (ft)	275				255	125
Base Capacity (vph)	1073	1374	1327		210	1197
Starvation Cap Reductn	0	0	0		0	0
Spillback Cap Reductn	0	0	0		0	0
Storage Cap Reductn	0	0	0		0	0
Reduced v/c Ratio	1.06	0.64	1.07		0.35	0.28

Intersection Summary			
Area Type:	Other		
Cycle Length: 120			
Actuated Cycle Length: 120			
Offset: 21 (18%), Referenced to phase 2:WBT and 6:EBT, Start of Green			
Natural Cycle: 100			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 1.07			
Intersection Signal Delay (s/veh): 54.9		Intersection LOS: D	
Intersection Capacity Utilization 89.5%		ICU Level of Service E	
Analysis Period (min) 15			
~ Volume exceeds capacity, queue is theoretically infinite.			
Queue shown is maximum after two cycles.			
# 95th percentile volume exceeds capacity, queue may be longer.			
Queue shown is maximum after two cycles.			
m Volume for 95th percentile queue is metered by upstream signal.			

Splits and Phases: 6: Route 125 & Ballardvale Street





Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	1113	864	1003	314	69	310
Future Volume (vph)	1113	864	1003	314	69	310
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	12	11	12	12	12	13
Total Lost time (s)	7.0	5.5	5.5		6.5	7.0
Lane Util. Factor	0.97	1.00	0.95		1.00	0.88
Frt	1.00	1.00	0.96		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	3303	1783	3362		1626	2313
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	3303	1783	3362		1626	2313
Peak-hour factor, PHF	0.98	0.98	0.93	0.93	0.94	0.94
Adj. Flow (vph)	1136	882	1078	338	73	330
RTOR Reduction (vph)	0	0	25	0	0	24
Lane Group Flow (vph)	1136	882	1391	0	73	306
Heavy Vehicles (%)	6%	3%	4%	2%	11%	27%
Turn Type	Prot	NA	NA		Prot	pt+ov
Protected Phases	1	6	2		8	1 8
Permitted Phases						
Actuated Green, G (s)	39.0	92.5	46.5		15.5	61.0
Effective Green, g (s)	39.0	92.5	46.5		15.5	54.5
Actuated g/C Ratio	0.33	0.77	0.39		0.13	0.45
Clearance Time (s)	7.0	5.5	5.5		6.5	
Vehicle Extension (s)	3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)	1073	1374	1302		210	1050
v/s Ratio Prot	c0.34	0.49	c0.41		c0.04	0.13
v/s Ratio Perm						
v/c Ratio	1.06	0.64	1.07		0.35	0.29
Uniform Delay, d1	40.5	6.2	36.8		47.6	20.6
Progression Factor	0.94	0.33	1.00		1.00	1.00
Incremental Delay, d2	38.2	1.3	45.4		4.5	0.2
Delay (s)	76.3	3.4	82.1		52.1	20.8
Level of Service	E	A	F		D	C
Approach Delay (s/veh)		44.4	82.1		26.4	
Approach LOS		D	F		C	

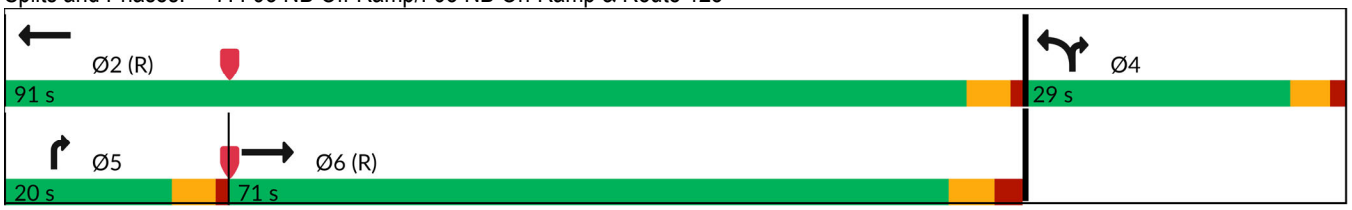
Intersection Summary			
HCM 2000 Control Delay (s/veh)	56.5	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	0.95		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	19.0
Intersection Capacity Utilization	89.5%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay (s/veh)		15.2			11.9			67.2				
Approach LOS		B			B			E				
Queue Length 50th (ft)		198			270	0	9		~480			
Queue Length 95th (ft)		234			m266	m0	28		#628			
Internal Link Dist (ft)		1673			1039			832			438	
Turn Bay Length (ft)						350			150			
Base Capacity (vph)		1856			2440	1476	361		1094			
Starvation Cap Reductn		0			0	0	0		0			
Spillback Cap Reductn		0			0	0	0		0			
Storage Cap Reductn		0			0	0	0		0			
Reduced v/c Ratio		0.55			0.48	0.16	0.04		1.03			

Intersection Summary			
Area Type:	Other		
Cycle Length: 120			
Actuated Cycle Length: 120			
Offset: 0 (0%), Referenced to phase 2:WBT and 6:EBT, Start of Green, Master Intersection			
Natural Cycle: 55			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 1.03			
Intersection Signal Delay (s/veh): 30.6		Intersection LOS: C	
Intersection Capacity Utilization 73.6%		ICU Level of Service D	
Analysis Period (min) 15			
~ Volume exceeds capacity, queue is theoretically infinite.			
Queue shown is maximum after two cycles.			
# 95th percentile volume exceeds capacity, queue may be longer.			
Queue shown is maximum after two cycles.			
m Volume for 95th percentile queue is metered by upstream signal.			

Splits and Phases: 7: I-93 NB Off-Ramp/I-93 NB On-Ramp & Route 125



Lane Group	Ø5
Approach Delay (s/veh)	
Approach LOS	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	883	42	0	1091	222	14	0	1094	0	0	0
Future Volume (vph)	0	883	42	0	1091	222	14	0	1094	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	16	12	12	16	12	12	12	12	12	12
Total Lost time (s)		6.5			5.0	4.0	5.0		5.0			
Lane Util. Factor		0.95			0.95	1.00	1.00		0.88			
Frt		0.99			1.00	0.85	1.00		0.85			
Flt Protected		1.00			1.00	1.00	0.95		1.00			
Satd. Flow (prot)		3449			3406	1476	1805		2682			
Flt Permitted		1.00			1.00	1.00	0.95		1.00			
Satd. Flow (perm)		3449			3406	1476	1805		2682			
Peak-hour factor, PHF	0.91	0.91	0.91	0.94	0.94	0.94	0.97	0.97	0.97	0.92	0.92	0.92
Adj. Flow (vph)	0	970	46	0	1161	236	14	0	1128	0	0	0
RTOR Reduction (vph)	0	3	0	0	0	0	0	0	111	0	0	0
Lane Group Flow (vph)	0	1013	0	0	1161	236	14	0	1017	0	0	0
Heavy Vehicles (%)	0%	4%	3%	0%	6%	24%	0%	0%	6%	2%	2%	2%
Turn Type		NA			NA	Free	Prot		custom			
Protected Phases		6			2		4		4 5			
Permitted Phases						Free						
Actuated Green, G (s)		64.5			86.0	120.0	24.0		44.0			
Effective Green, g (s)		64.5			86.0	120.0	24.0		44.0			
Actuated g/C Ratio		0.54			0.72	1.00	0.20		0.37			
Clearance Time (s)		6.5			5.0		5.0					
Vehicle Extension (s)		3.0			3.0		3.0					
Lane Grp Cap (vph)		1853			2440	1476	361		983			
v/s Ratio Prot		c0.29			0.34		0.01		c0.38			
v/s Ratio Perm						0.16						
v/c Ratio		0.55			0.48	0.16	0.04		1.03			
Uniform Delay, d1		18.2			7.3	0.0	38.7		38.0			
Progression Factor		0.77			1.89	1.00	1.00		1.00			
Incremental Delay, d2		1.1			0.3	0.1	0.0		38.0			
Delay (s)		15.1			14.1	0.1	38.7		76.0			
Level of Service		B			B	A	D		E			
Approach Delay (s/veh)		15.1			11.8			75.6			0.0	
Approach LOS		B			B			E			A	

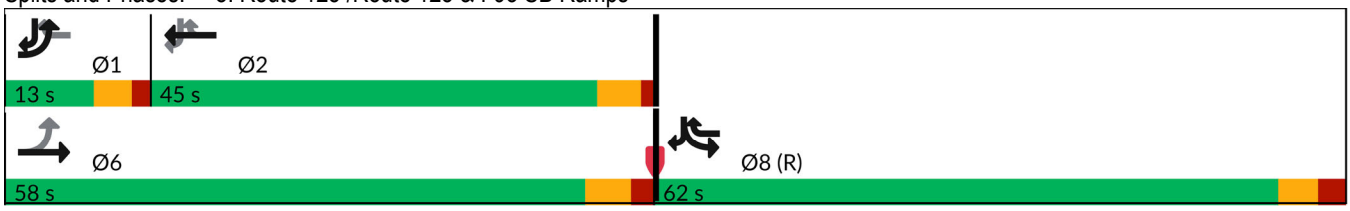
Intersection Summary			
HCM 2000 Control Delay (s/veh)	33.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	73.6%	ICU Level of Service	D
Analysis Period (min)	15		

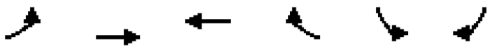
c Critical Lane Group

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Approach Delay (s/veh)		26.3	10.1		19.3	
Approach LOS		C	B		B	
Queue Length 50th (ft)	15	212	106	207	156	0
Queue Length 95th (ft)	35	302	155	228	202	0
Internal Link Dist (ft)		782	1673		852	
Turn Bay Length (ft)	165				125	200
Base Capacity (vph)	472	807	653	1711	1527	1778
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.07	0.48	0.32	0.60	0.40	0.05

Intersection Summary			
Area Type:	Other		
Cycle Length: 120			
Actuated Cycle Length: 120			
Offset: 113 (94%), Referenced to phase 8:SBL, Start of Green			
Natural Cycle: 45			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.60			
Intersection Signal Delay (s/veh): 15.7		Intersection LOS: B	
Intersection Capacity Utilization 70.3%		ICU Level of Service C	
Analysis Period (min) 15			

Splits and Phases: 8: Route 125 /Route 125 & I-93 SB Ramps





Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	31	350	185	920	575	80
Future Volume (vph)	31	350	185	920	575	80
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	16	12	16
Total Lost time (s)	5.0	6.0	5.0	6.0	6.0	5.0
Lane Util. Factor	1.00	1.00	1.00	1.00	0.97	1.00
Frt	1.00	1.00	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1805	1863	1810	1711	3273	1812
Flt Permitted	0.50	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	941	1863	1810	1711	3273	1812
Peak-hour factor, PHF	0.90	0.90	0.89	0.89	0.94	0.94
Adj. Flow (vph)	34	389	208	1034	612	85
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	34	389	208	1034	612	85
Heavy Vehicles (%)	0%	2%	5%	7%	7%	1%
Turn Type	pm+pt	NA	NA	custom	Prot	pt+ov
Protected Phases	1	6	2	8	8	1 8
Permitted Phases	6			1 2		2
Actuated Green, G (s)	53.0	53.0	43.4	109.0	55.0	110.0
Effective Green, g (s)	53.0	53.0	43.4	104.0	55.0	104.0
Actuated g/C Ratio	0.44	0.44	0.36	0.87	0.46	0.87
Clearance Time (s)	5.0	6.0	5.0	6.0	6.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	455	822	654	1568	1500	1721
v/s Ratio Prot	0.00	0.21	0.11	c0.30	0.19	0.02
v/s Ratio Perm	0.03			0.30		0.02
v/c Ratio	0.07	0.47	0.32	0.66	0.41	0.05
Uniform Delay, d1	19.5	23.6	27.6	2.5	21.7	1.1
Progression Factor	1.00	1.00	0.88	1.00	1.00	1.00
Incremental Delay, d2	0.1	2.0	0.3	0.9	0.8	0.0
Delay (s)	19.6	25.6	24.5	3.4	22.5	1.1
Level of Service	B	C	C	A	C	A
Approach Delay (s/veh)		25.1	6.9		19.9	
Approach LOS		C	A		B	

Intersection Summary			
HCM 2000 Control Delay (s/veh)	14.0	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.70		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	70.3%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

2031 Build Weekday Evening Peak Hour

Movement	EBL	EBR	NEL	NET	SWT	SWR
Lane Configurations						
Traffic Volume (veh/h)	336	1	0	283	61	58
Future Volume (Veh/h)	336	1	0	283	61	58
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.91	0.91	0.89	0.89	0.87	0.87
Hourly flow rate (vph)	369	1	0	318	70	67
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	422	104	137			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	422	104	137			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	38	100	100			
cM capacity (veh/h)	591	957	1459			

Direction, Lane #	EB 1	NE 1	SW 1
Volume Total	370	318	137
Volume Left	369	0	0
Volume Right	1	0	67
cSH	591	1459	1700
Volume to Capacity	0.63	0.00	0.08
Queue Length 95th (ft)	108	0	0
Control Delay (s/veh)	20.7	0.0	0.0
Lane LOS	C		
Approach Delay (s/veh)	20.7	0.0	0.0
Approach LOS	C		

Intersection Summary			
Average Delay	9.3		
Intersection Capacity Utilization	40.2%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	328	304	3	60	54	21
Future Volume (Veh/h)	328	304	3	60	54	21
Sign Control	Free			Free	Yield	
Grade	0%			0%	0%	
Peak Hour Factor	0.93	0.93	0.70	0.70	0.71	0.71
Hourly flow rate (vph)	353	327	4	86	76	30
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						2
Median type	None			None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			353		447	353
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			353		447	353
tC, single (s)			4.1		6.5	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.6	3.3
p0 queue free %			100		86	96
cM capacity (veh/h)			1217		546	695

Direction, Lane #	EB 1	EB 2	WB 1	NB 1
Volume Total	353	327	90	106
Volume Left	0	0	4	76
Volume Right	0	327	0	30
cSH	1700	1700	1217	761
Volume to Capacity	0.21	0.19	0.00	0.14
Queue Length 95th (ft)	0	0	0	12
Control Delay (s/veh)	0.0	0.0	0.4	12.0
Lane LOS			A	B
Approach Delay (s/veh)	0.0		0.4	12.0
Approach LOS				B

Intersection Summary			
Average Delay	1.5		
Intersection Capacity Utilization	28.8%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	NBL	NBT	SBT	SBR	SEL	SER
Lane Configurations						
Traffic Volume (veh/h)	62	271	67	3	4	331
Future Volume (Veh/h)	62	271	67	3	4	331
Sign Control		Free	Free		Yield	
Grade		0%	0%		0%	
Peak Hour Factor	0.87	0.87	0.90	0.90	0.87	0.87
Hourly flow rate (vph)	71	311	74	3	5	380
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	77				529	76
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	77				529	76
tC, single (s)	4.3				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.4				3.5	3.3
p0 queue free %	95				99	61
cM capacity (veh/h)	1415				488	983

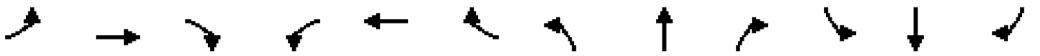
Direction, Lane #	NB 1	SB 1	SE 1
Volume Total	382	77	385
Volume Left	71	0	5
Volume Right	0	3	380
cSH	1415	1700	970
Volume to Capacity	0.05	0.05	0.40
Queue Length 95th (ft)	4	0	48
Control Delay (s/veh)	1.8	0.0	11.1
Lane LOS	A		B
Approach Delay (s/veh)	1.8	0.0	11.1
Approach LOS			B

Intersection Summary			
Average Delay	5.9		
Intersection Capacity Utilization	51.7%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	565	0	11	101	1	59
Future Volume (Veh/h)	565	0	11	101	1	59
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.91	0.91	0.75	0.75	0.77	0.77
Hourly flow rate (vph)	621	0	15	135	1	77
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			621		786	621
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			621		786	621
tC, single (s)			4.8		6.4	6.3
tC, 2 stage (s)						
tF (s)			2.8		3.5	3.4
p0 queue free %			98		100	84
cM capacity (veh/h)			702		356	475

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	621	150	78
Volume Left	0	15	1
Volume Right	0	0	77
cSH	1700	702	473
Volume to Capacity	0.37	0.02	0.16
Queue Length 95th (ft)	0	2	15
Control Delay (s/veh)	0.0	1.2	14.1
Lane LOS		A	B
Approach Delay (s/veh)	0.0	1.2	14.1
Approach LOS			B

Intersection Summary			
Average Delay	1.5		
Intersection Capacity Utilization	40.1%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	3	165	81	22	179	0	583	0	64	8	0	25
Future Volume (Veh/h)	3	165	81	22	179	0	583	0	64	8	0	25
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.87	0.87	0.87	0.82	0.82	0.82	0.90	0.90	0.90	0.38	0.38	0.38
Hourly flow rate (vph)	3	190	93	27	218	0	648	0	71	21	0	66
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	218			283			581	515	237	586	561	218
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	218			283			581	515	237	586	561	218
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			98			0	100	91	94	100	92
cM capacity (veh/h)	1364			1291			387	456	807	381	429	817

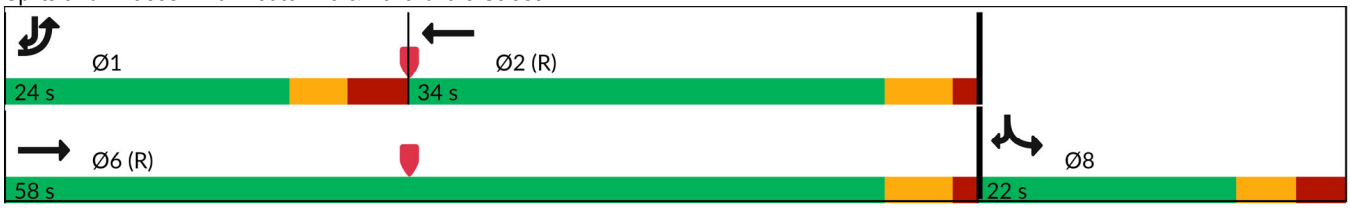
Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	286	245	719	87
Volume Left	3	27	648	21
Volume Right	93	0	71	66
cSH	1364	1291	408	640
Volume to Capacity	0.00	0.02	1.76	0.14
Queue Length 95th (ft)	0	2	1123	12
Control Delay (s/veh)	0.1	1.0	376.5	11.5
Lane LOS	A	A	F	B
Approach Delay (s/veh)	0.1	1.0	376.5	11.5
Approach LOS			F	B

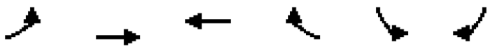
Intersection Summary				
Average Delay	203.4			
Intersection Capacity Utilization	72.9%	ICU Level of Service	C	
Analysis Period (min)	15			

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Recall Mode	None	C-Max	C-Max		None	
Act Effct Green (s)	17.0	52.5	28.5		15.5	39.0
Actuated g/C Ratio	0.21	0.66	0.36		0.19	0.49
v/c Ratio	0.61	1.09	1.00		1.13	1.05
Control Delay (s/veh)	38.0	67.5	52.8		120.4	61.5
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay (s/veh)	38.0	67.5	52.8		120.4	61.5
LOS	D	E	D		F	E
Approach Delay (s/veh)		60.3	52.8		73.7	
Approach LOS		E	D		E	
Queue Length 50th (ft)	115	~762	~324		~229	~467
Queue Length 95th (ft)	150	#858	#421		#370	#564
Internal Link Dist (ft)		1276	719		8125	
Turn Bay Length (ft)	275				255	125
Base Capacity (vph)	695	1193	1261		346	1415
Starvation Cap Reductn	0	0	0		0	0
Spillback Cap Reductn	0	0	0		0	0
Storage Cap Reductn	0	0	0		0	0
Reduced v/c Ratio	0.61	1.09	1.00		1.13	1.05

Intersection Summary			
Area Type:	Other		
Cycle Length: 80			
Actuated Cycle Length: 80			
Offset: 0 (0%), Referenced to phase 2:WBT and 6:EBT, Start of Green			
Natural Cycle: 120			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 1.13			
Intersection Signal Delay (s/veh): 63.5		Intersection LOS: E	
Intersection Capacity Utilization 85.6%		ICU Level of Service E	
Analysis Period (min) 15			
~ 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.			

Splits and Phases: 6: Route 125 & Ballardvale Street





Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	350	1084	963	98	335	1282
Future Volume (vph)	350	1084	963	98	335	1282
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	12	11	12	12	12	13
Total Lost time (s)	7.0	5.5	5.5		6.5	7.0
Lane Util. Factor	0.97	1.00	0.95		1.00	0.88
Frt	1.00	1.00	0.99		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	3273	1818	3515		1787	2880
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	3273	1818	3515		1787	2880
Peak-hour factor, PHF	0.83	0.83	0.84	0.84	0.86	0.86
Adj. Flow (vph)	422	1306	1146	117	390	1491
RTOR Reduction (vph)	0	0	10	0	0	14
Lane Group Flow (vph)	422	1306	1253	0	390	1477
Heavy Vehicles (%)	7%	1%	1%	4%	1%	2%
Turn Type	Prot	NA	NA		Prot	pt+ov
Protected Phases	1	6	2		8	1 8
Permitted Phases						
Actuated Green, G (s)	17.0	52.5	28.5		15.5	39.0
Effective Green, g (s)	17.0	52.5	28.5		15.5	32.5
Actuated g/C Ratio	0.21	0.66	0.36		0.19	0.41
Clearance Time (s)	7.0	5.5	5.5		6.5	
Vehicle Extension (s)	3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)	695	1193	1252		346	1170
v/s Ratio Prot	0.13	c0.72	0.36		0.22	c0.51
v/s Ratio Perm						
v/c Ratio	0.61	1.09	1.00		1.13	1.26
Uniform Delay, d1	28.5	13.8	25.8		32.3	23.8
Progression Factor	1.22	0.76	1.00		1.00	1.00
Incremental Delay, d2	1.1	53.0	25.7		87.4	125.2
Delay (s)	35.8	63.4	51.4		119.7	148.9
Level of Service	D	E	D		F	F
Approach Delay (s/veh)		56.7	51.4		142.9	
Approach LOS		E	D		F	

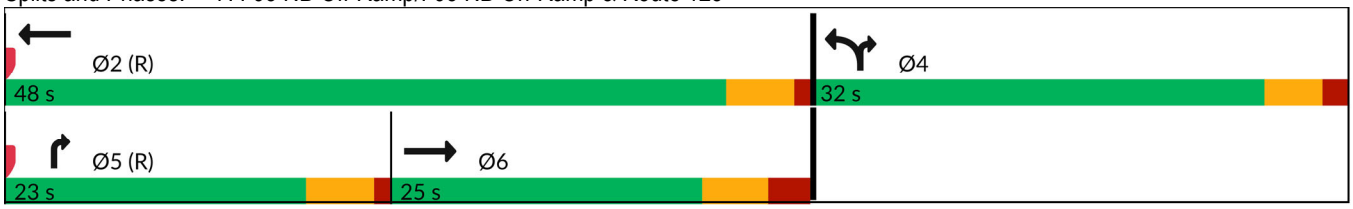
Intersection Summary			
HCM 2000 Control Delay (s/veh)	88.6	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.26		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	19.0
Intersection Capacity Utilization	85.6%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Recall Mode		None			C-Max		None					
Act Effct Green (s)		18.5			44.4	80.0	25.6		50.0			
Actuated g/C Ratio		0.23			0.56	1.00	0.32		0.63			
v/c Ratio		0.56			0.90	0.38	0.31		0.71			
Control Delay (s/veh)		29.4			17.7	0.1	21.8		11.1			
Queue Delay		0.0			0.0	0.0	0.0		0.0			
Total Delay (s/veh)		29.4			17.7	0.1	21.8		11.1			
LOS		C			B	A	C		B			
Approach Delay (s/veh)		29.4			12.9			12.4				
Approach LOS		C			B			B				
Queue Length 50th (ft)		100			391	0	65		184			
Queue Length 95th (ft)		146			m379	m0	105		219			
Internal Link Dist (ft)		1444			1276			618			383	
Turn Bay Length (ft)						350			150			
Base Capacity (vph)		797			1984	1794	609		1769			
Starvation Cap Reductn		0			0	0	0		0			
Spillback Cap Reductn		0			0	0	0		0			
Storage Cap Reductn		0			0	0	0		0			
Reduced v/c Ratio		0.56			0.90	0.38	0.30		0.72			

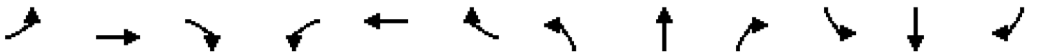
Intersection Summary			
Area Type:	Other		
Cycle Length: 80			
Actuated Cycle Length: 80			
Offset: 0 (0%), Referenced to phase 2:WBT and 5:NBR, Start of Green, Master Intersection			
Natural Cycle: 50			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.90			
Intersection Signal Delay (s/veh): 14.4		Intersection LOS: B	
Intersection Capacity Utilization 60.8%		ICU Level of Service B	
Analysis Period (min) 15			
m Volume for 95th percentile queue is metered by upstream signal.			

Splits and Phases: 7: I-93 NB Off-Ramp/I-93 NB On-Ramp & Route 125



Lane Group	Ø5
Recall Mode	C-Max
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay (s/veh)	
Queue Delay	
Total Delay (s/veh)	
LOS	
Approach Delay (s/veh)	
Approach LOS	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	

Intersection Summary



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	372	42	0	1630	615	149	0	1062	0	0	0
Future Volume (vph)	0	372	42	0	1630	615	149	0	1062	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	16	12	12	16	12	12	12	12	12	12
Total Lost time (s)		6.5			5.0	4.0	5.0		5.0			
Lane Util. Factor		0.95			0.95	1.00	1.00		0.88			
Frt		0.98			1.00	0.85	1.00		0.85			
Flt Protected		1.00			1.00	1.00	0.95		1.00			
Satd. Flow (prot)		3402			3574	1794	1805		2760			
Flt Permitted		1.00			1.00	1.00	0.95		1.00			
Satd. Flow (perm)		3402			3574	1794	1805		2760			
Peak-hour factor, PHF	0.93	0.93	0.93	0.91	0.91	0.91	0.83	0.83	0.83	0.92	0.92	0.92
Adj. Flow (vph)	0	400	45	0	1791	676	180	0	1280	0	0	0
RTOR Reduction (vph)	0	11	0	0	0	0	0	0	73	0	0	0
Lane Group Flow (vph)	0	434	0	0	1791	676	180	0	1207	0	0	0
Heavy Vehicles (%)	0%	5%	0%	0%	1%	2%	0%	0%	3%	2%	2%	2%
Turn Type		NA			NA	Free	Prot		custom			
Protected Phases		6			2		4		4 5			
Permitted Phases						Free						
Actuated Green, G (s)		18.5			44.4	80.0	25.6		50.0			
Effective Green, g (s)		18.5			44.4	80.0	25.6		50.0			
Actuated g/C Ratio		0.23			0.55	1.00	0.32		0.63			
Clearance Time (s)		6.5			5.0		5.0					
Vehicle Extension (s)		3.0			3.0		3.0					
Lane Grp Cap (vph)		786			1983	1794	577		1725			
v/s Ratio Prot		0.13			c0.50		0.10		c0.44			
v/s Ratio Perm						0.38						
v/c Ratio		0.55			0.90	0.38	0.31		0.70			
Uniform Delay, d1		27.1			15.9	0.0	20.5		10.0			
Progression Factor		1.00			0.97	1.00	1.00		1.00			
Incremental Delay, d2		0.8			0.7	0.1	0.3		1.3			
Delay (s)		27.9			16.2	0.1	20.9		11.3			
Level of Service		C			B	A	C		B			
Approach Delay (s/veh)		27.9			11.8			12.4			0.0	
Approach LOS		C			B			B			A	

Intersection Summary			
HCM 2000 Control Delay (s/veh)	13.6	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.94		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	60.8%	ICU Level of Service	B
Analysis Period (min)	15		

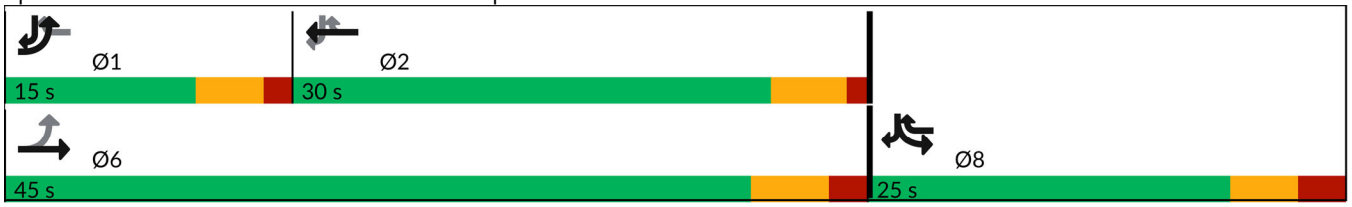
c Critical Lane Group

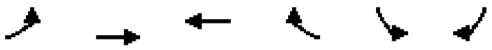
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Recall Mode	None	Max	None	None	None	
Act Effct Green (s)	40.0	39.0	31.2	69.2	18.2	69.2
Actuated g/C Ratio	0.58	0.56	0.45	1.00	0.26	1.00
v/c Ratio	0.08	0.22	0.71	0.74	0.26	0.08
Control Delay (s/veh)	7.1	8.4	23.2	2.8	21.0	0.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay (s/veh)	7.1	8.4	23.2	2.8	21.0	0.1
LOS	A	A	C	A	C	A
Approach Delay (s/veh)		8.3	9.1		12.7	
Approach LOS		A	A		B	
Queue Length 50th (ft)	5	48	214	0	37	0
Queue Length 95th (ft)	14	83	#387	0	62	0
Internal Link Dist (ft)		783	1444		1069	
Turn Bay Length (ft)	165				125	200
Base Capacity (vph)	421	1071	847	1783	882	1799
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.07	0.22	0.71	0.75	0.25	0.08

Intersection Summary			
Area Type:	Other		
Cycle Length: 70			
Actuated Cycle Length: 69.2			
Natural Cycle: 50			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.74			
Intersection Signal Delay (s/veh): 9.6		Intersection LOS: A	
Intersection Capacity Utilization 89.2%		ICU Level of Service E	
Analysis Period (min) 15			

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

Splits and Phases: 8: Route 125 & I-93 SB Ramps



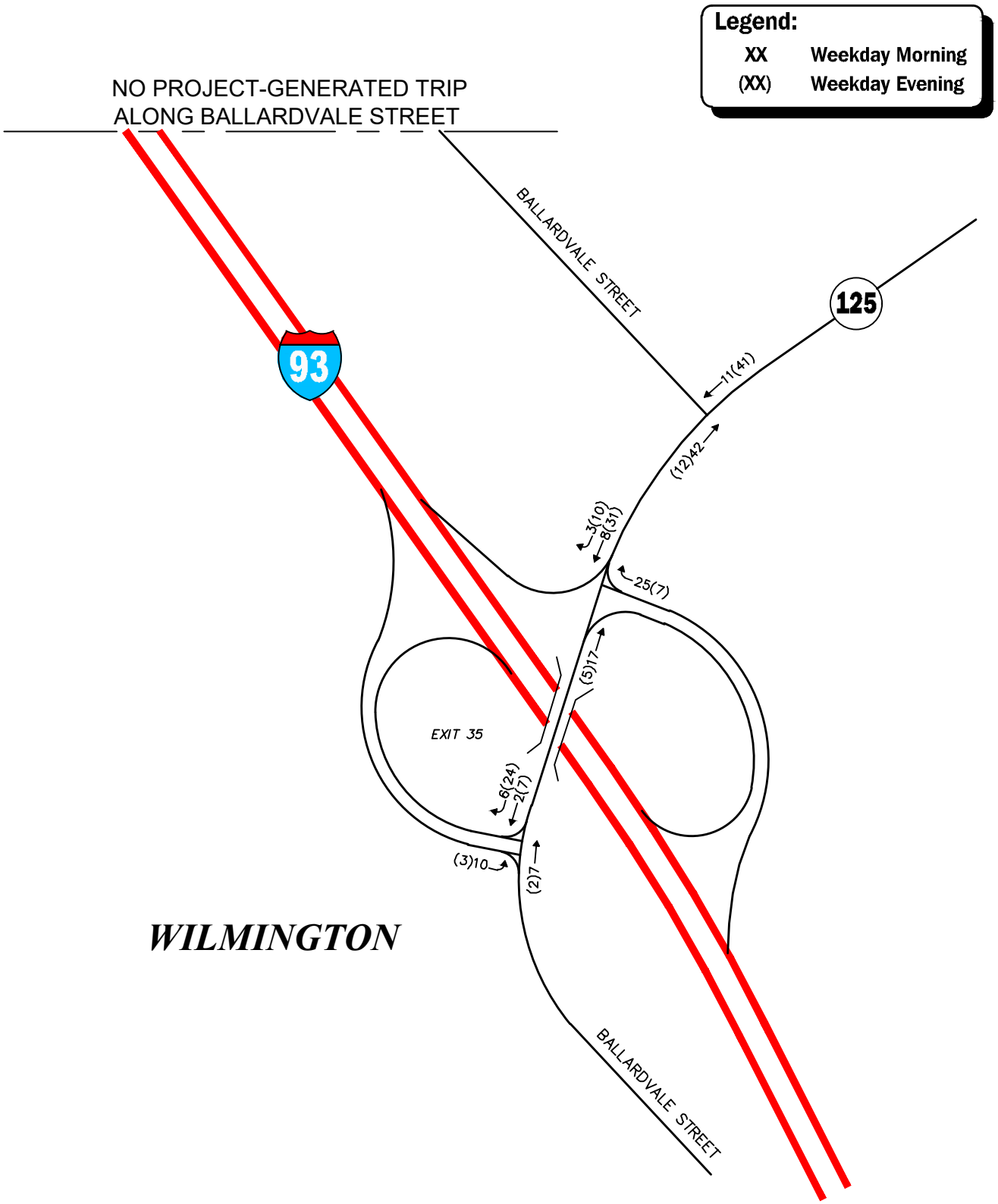


Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	26	223	553	1226	191	125
Future Volume (vph)	26	223	553	1226	191	125
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	16	12	16
Total Lost time (s)	5.0	6.0	5.0	6.0	6.0	5.0
Lane Util. Factor	1.00	1.00	1.00	1.00	0.97	1.00
Frt	1.00	1.00	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1805	1900	1881	1794	3213	1830
Flt Permitted	0.19	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	368	1900	1881	1794	3213	1830
Peak-hour factor, PHF	0.93	0.93	0.92	0.92	0.88	0.88
Adj. Flow (vph)	28	240	601	1333	217	142
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	28	240	601	1333	217	142
Heavy Vehicles (%)	0%	0%	1%	2%	9%	0%
Turn Type	pm+pt	NA	NA	custom	Prot	pt+ov
Protected Phases	1	6	2	8	8	1 8
Permitted Phases	6			1 2		2
Actuated Green, G (s)	40.1	40.1	31.2	59.3	18.2	60.3
Effective Green, g (s)	40.1	40.1	31.2	54.3	18.2	54.3
Actuated g/C Ratio	0.57	0.57	0.44	0.77	0.26	0.77
Clearance Time (s)	5.0	6.0	5.0	6.0	6.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	310	1083	834	1538	831	1673
v/s Ratio Prot	0.01	0.13	0.32	c0.22	0.07	0.03
v/s Ratio Perm	0.05			0.52		0.05
v/c Ratio	0.09	0.22	0.72	0.87	0.26	0.08
Uniform Delay, d1	9.4	7.4	16.0	5.5	20.7	1.9
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.1	0.5	3.1	5.4	0.2	0.0
Delay (s)	9.5	7.9	19.1	10.9	20.9	2.0
Level of Service	A	A	B	B	C	A
Approach Delay (s/veh)		8.1	13.5		13.4	
Approach LOS		A	B		B	

Intersection Summary			
HCM 2000 Control Delay (s/veh)	12.9	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.96		
Actuated Cycle Length (s)	70.3	Sum of lost time (s)	16.0
Intersection Capacity Utilization	89.2%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

BACKGROUND DEVELOPMENTS FIGURES

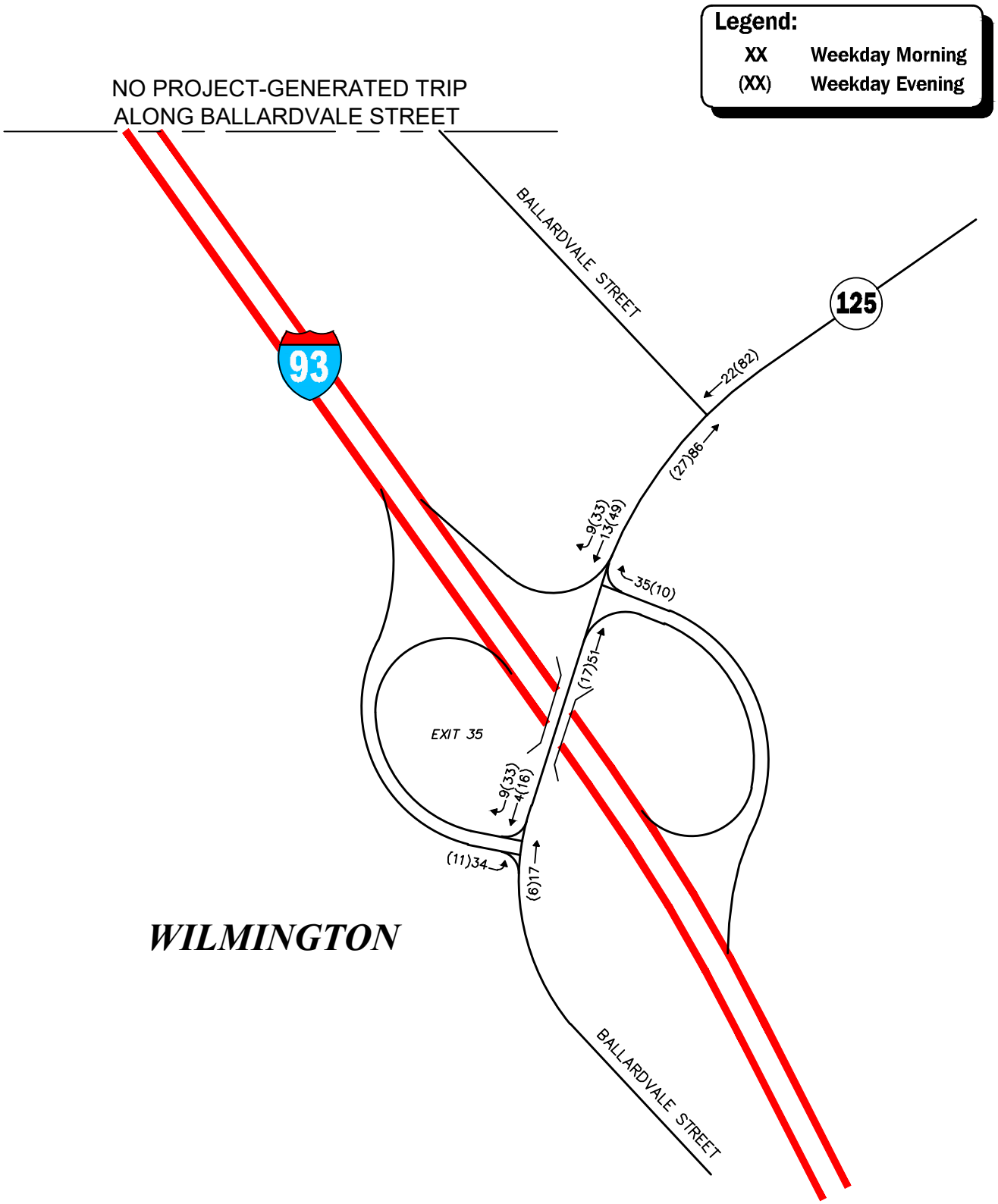


Not To Scale

Figure A-1

30 Upton Drive
Project-Generated
Peak-Hour Traffic Volumes

Vanasse & Associates inc

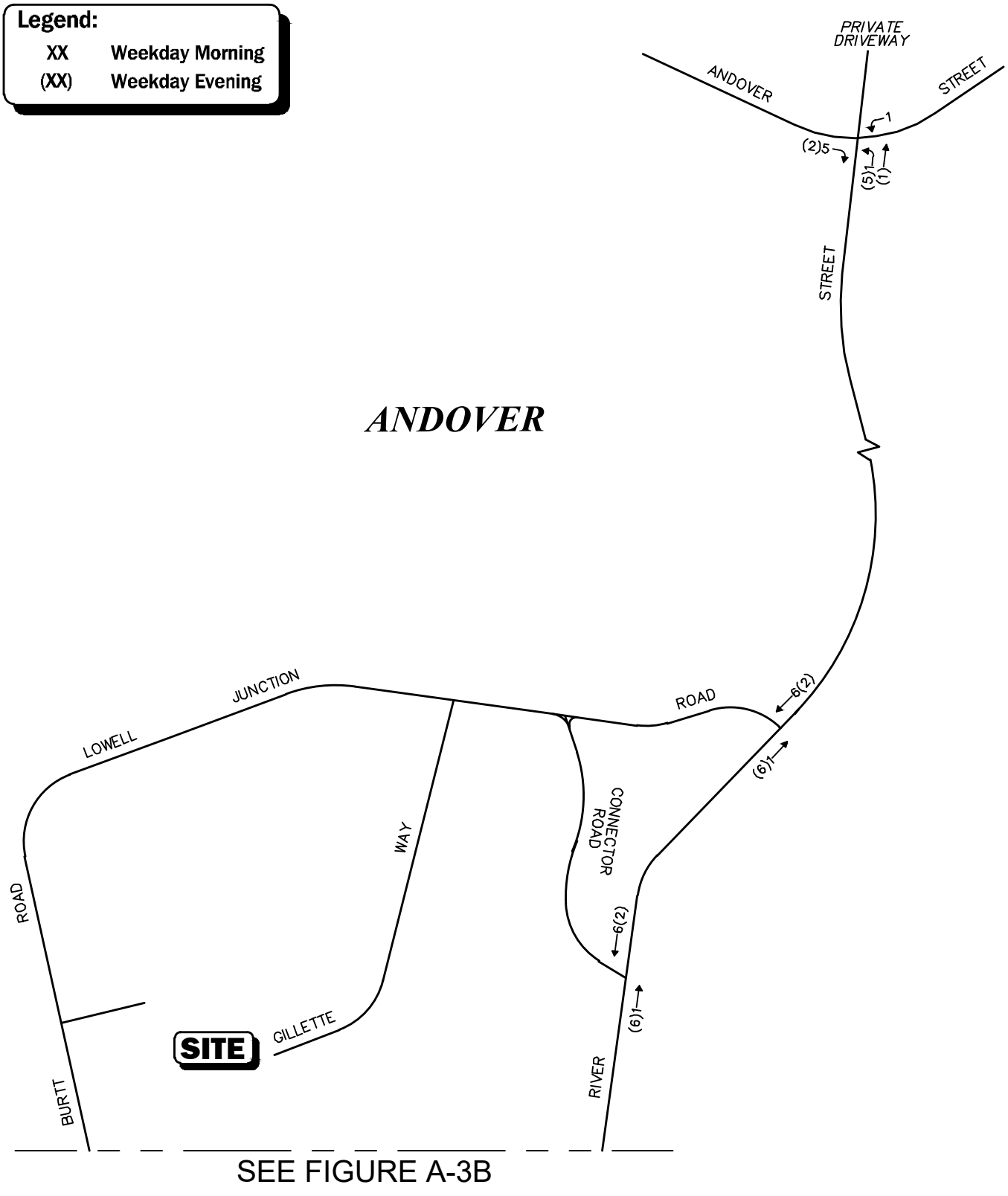


Not To Scale

Figure A-2

38 Upton Drive
Project-Generated
Peak-Hour Traffic Volumes

Vanasse & Associates inc

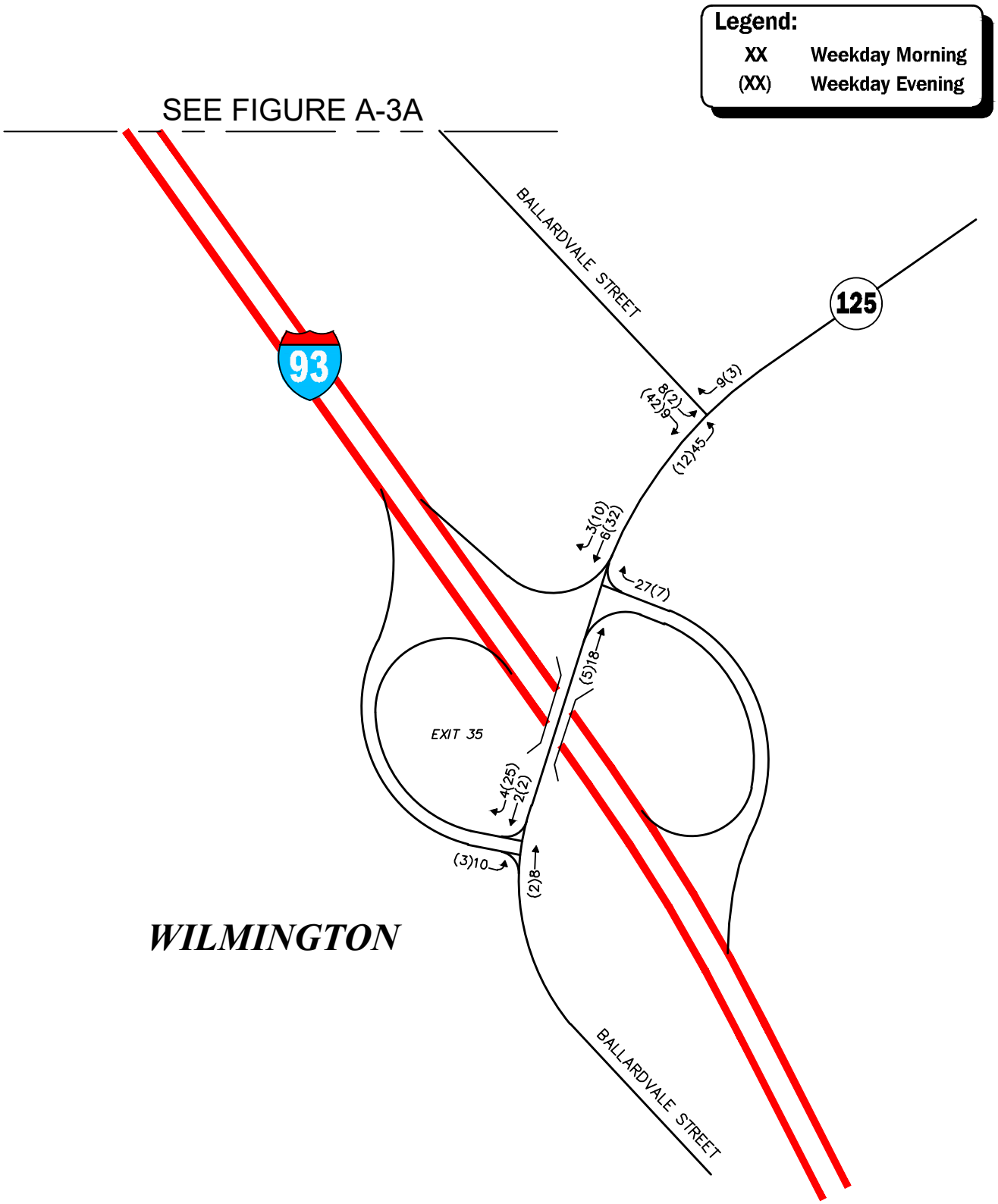


Not To Scale

Figure A-3A

181-187 Ballardvale Street
Project-Generated
Peak-Hour Traffic Volumes

Vanasse & Associates inc

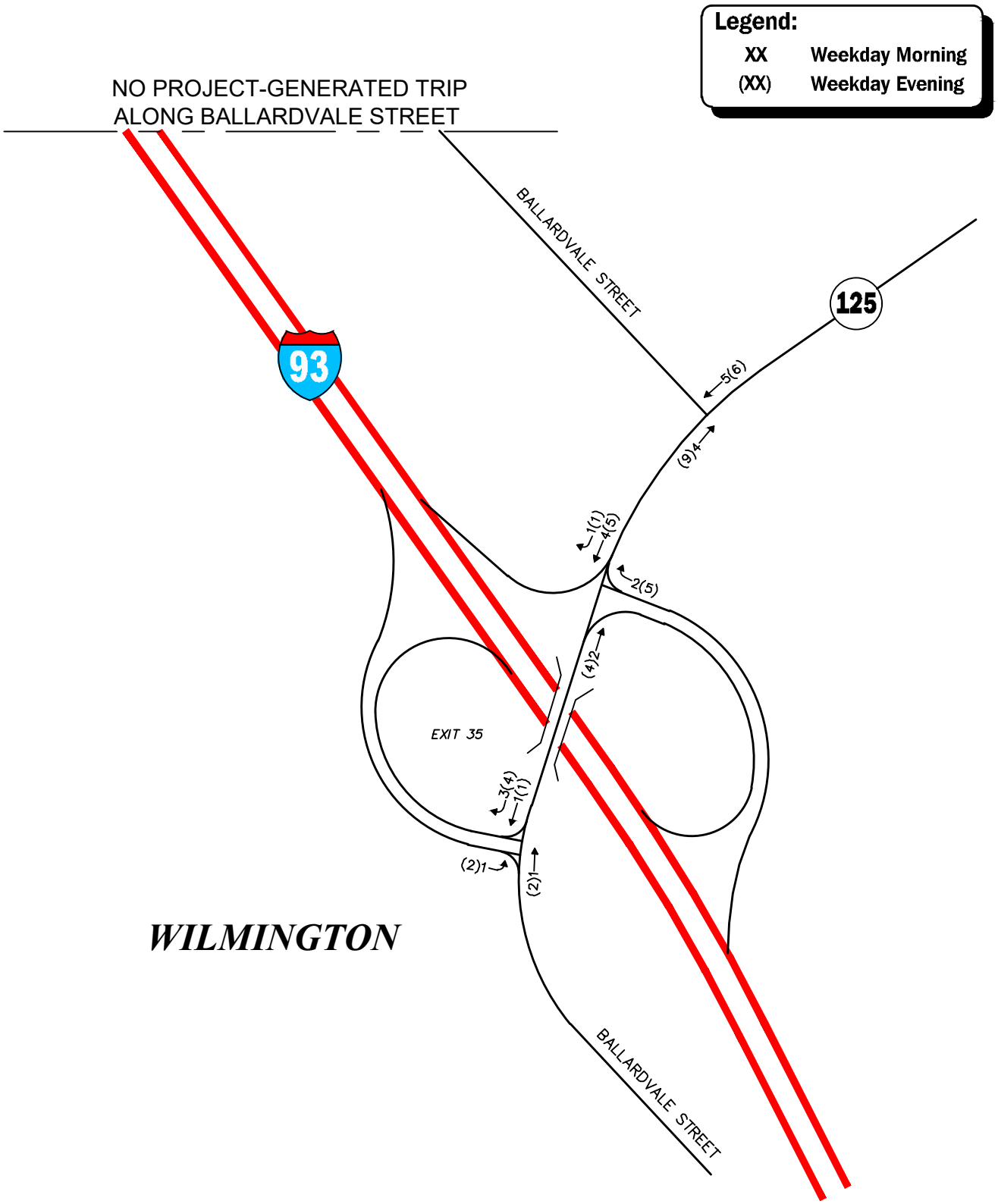


Not To Scale

Figure A-3B

181-187 Ballardvale Street
Project-Generated
Peak-Hour Traffic Volumes

Vanasse & Associates inc

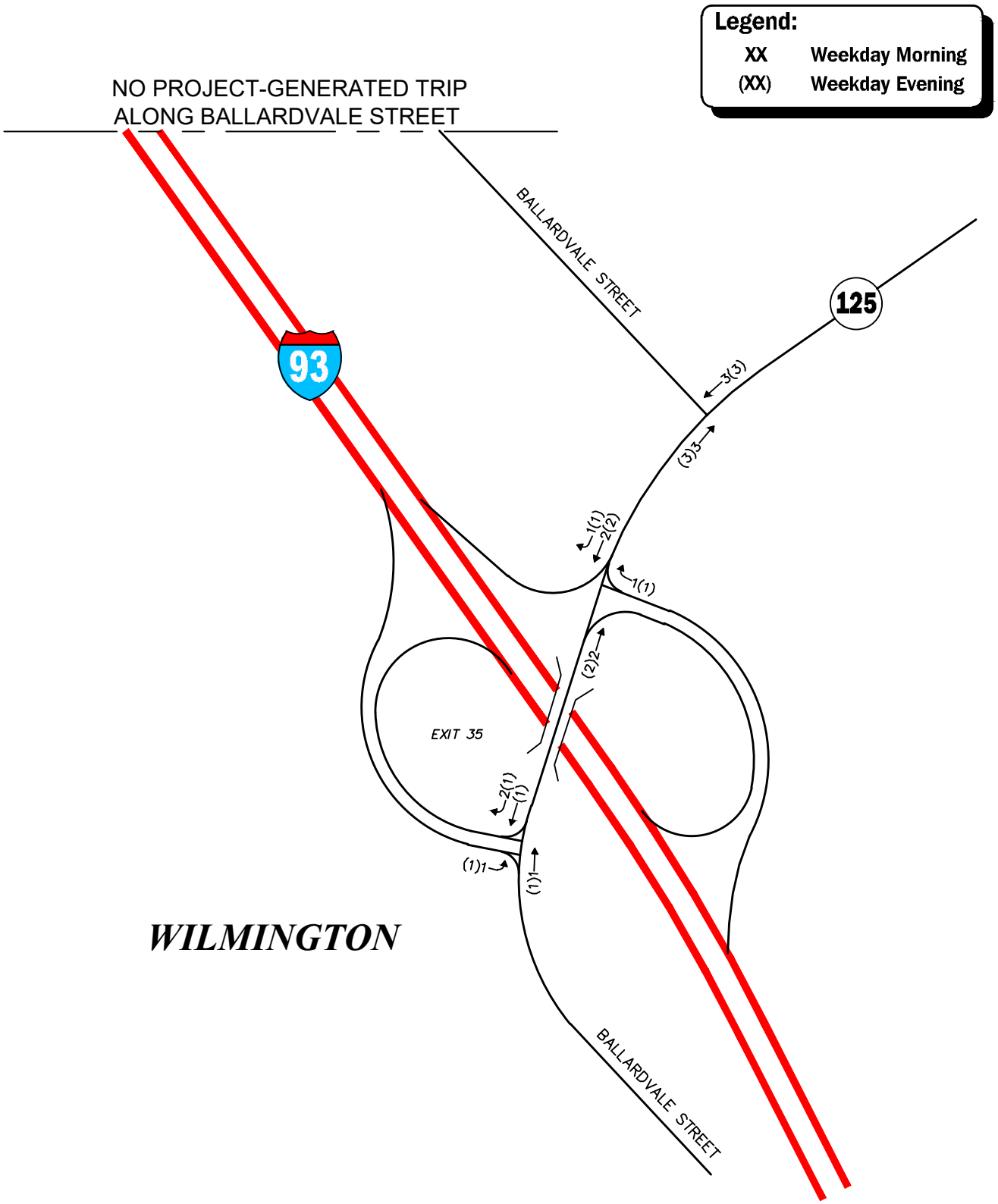


Not To Scale

Figure A-4

225 Andover Street
Project-Generated
Peak-Hour Traffic Volumes

Vanasse & Associates inc



Not To Scale

Figure A-5

250 Andover Street
Project-Generated
Peak-Hour Traffic Volumes

Vanasse & Associates inc

TRIP GENERATION DATA

Institute of Transportation Engineers (ITE)
Trip Generation, 11th Edition
Land Use Code (LUC) 140 - Manufacturing

Average Vehicle Trips Ends vs: 1000 Sq. Feet Gross Floor Area
Independent Variable (X): 201.46

AVERAGE WEEKDAY DAILY

T = 4.75 * (X)
T = 4.75 * 201.46
T = 956.94
T = 956 vehicle trips
with 50% (478 vph) entering and 50% (478 vph) exiting.

WEEKDAY MORNING PEAK HOUR OF ADJACENT STREET TRAFFIC

T = 0.68 * (X)
T = 0.68 * 201.46
T = 136.99
T = 137 vehicle trips
with 76% (104 vph) entering and 23% (33 vph) exiting.

WEEKDAY EVENING PEAK HOUR OF ADJACENT STREET TRAFFIC

T = 0.74 * (X)
T = 0.74 * 201.46
T = 149.08
T = 149 vehicle trips
with 31% (46 vph) entering and 69% (103 vph) exiting.

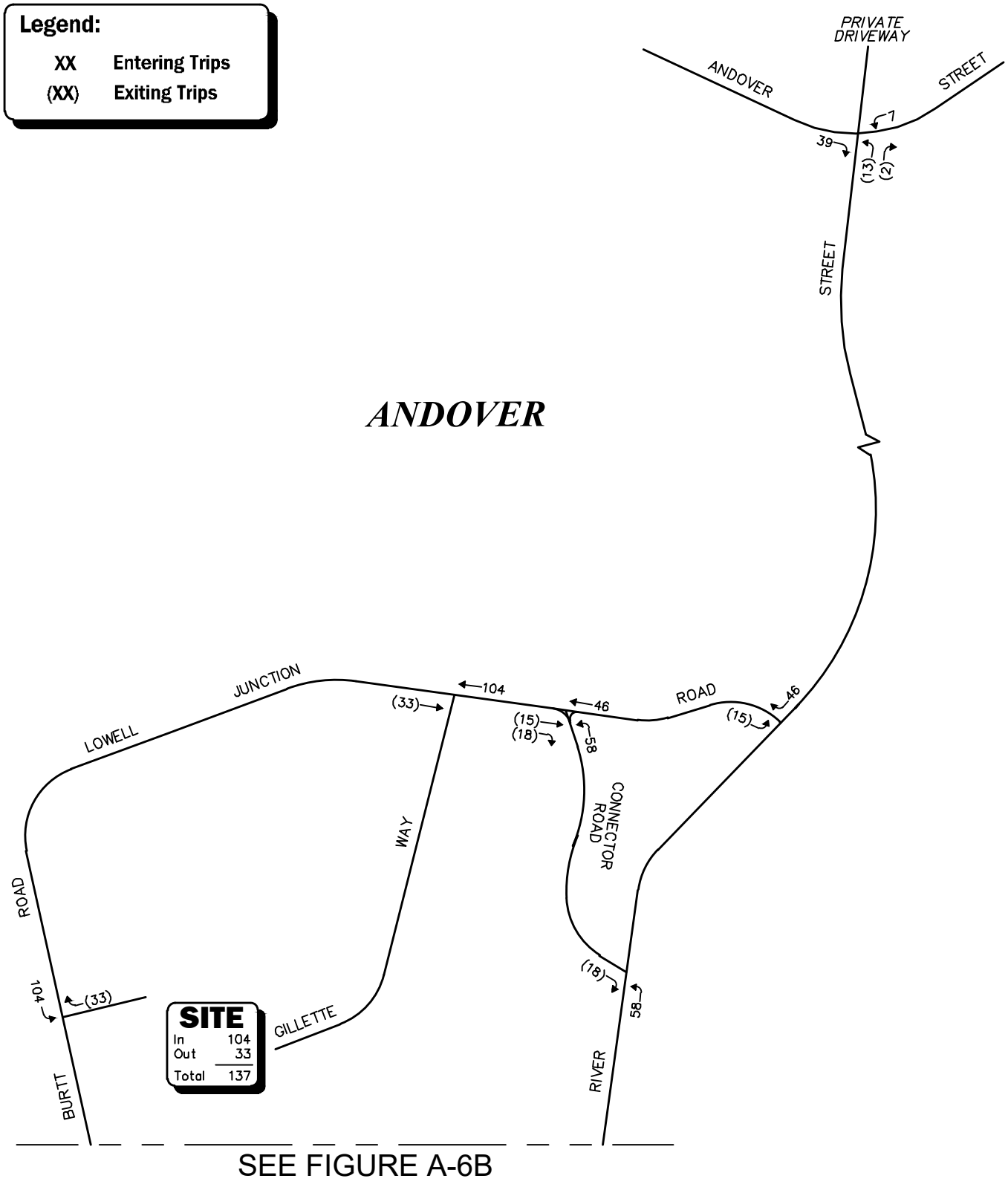
SATURDAY DAILY

T = 1.49 * (X)
T = 1.49 * 201.46
T = 300.18
T = 300 vehicle trips
with 50% (150 vph) entering and 50% (150 vph) exiting.

SATURDAY MIDDAY PEAK HOUR OF GENERATOR

T = 0.18 * (X)
T = 0.18 * 201.46
T = 36.26
T = 36 vehicle trips
with 52% (19 vph) entering and 48% (17 vph) exiting.

UPDATED SITE-GENERATED AND 2031 BUILD WEEKDAY MORNING ITE BASIS

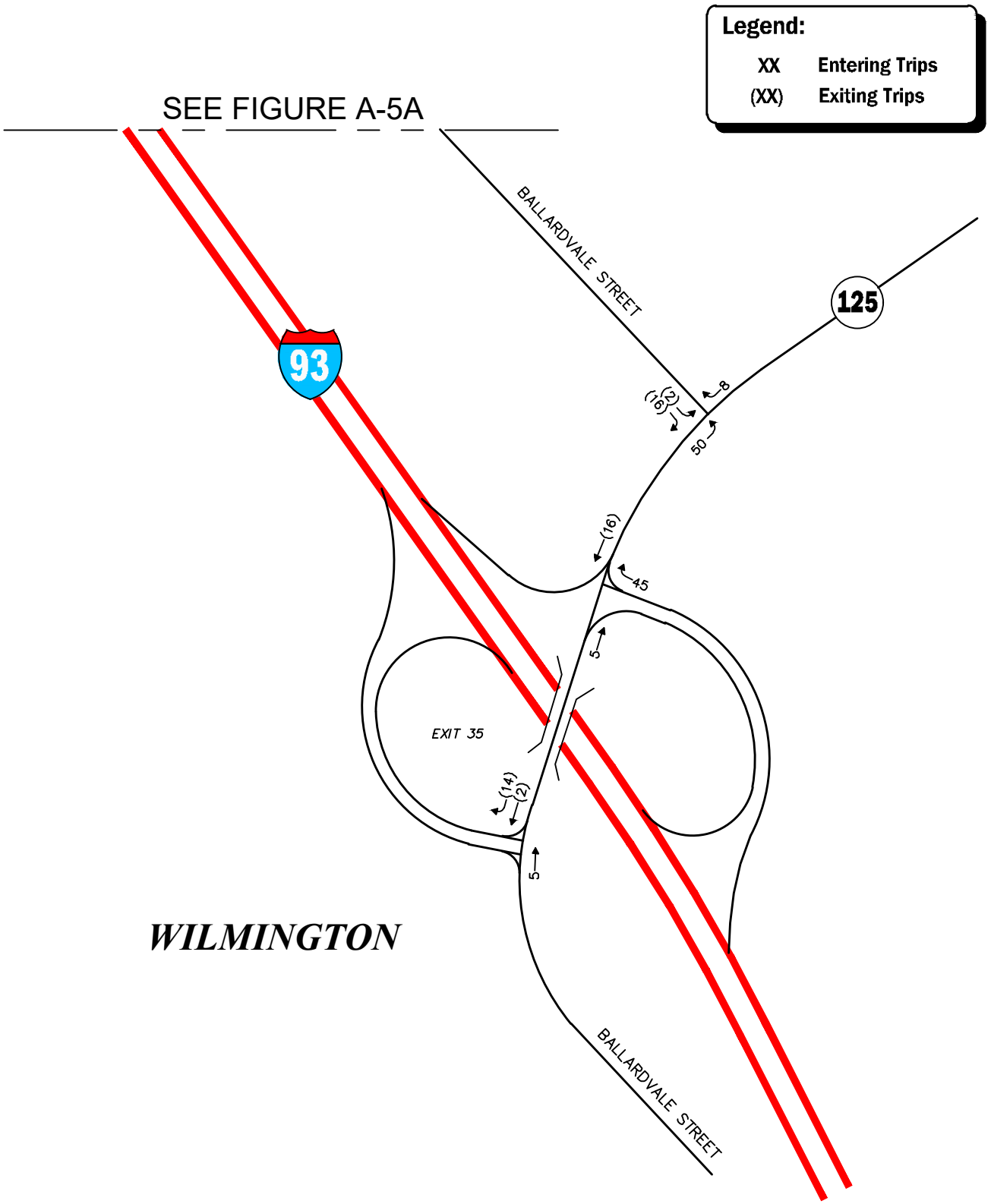


Not To Scale

Figure A-6A

Site-Generated - ITE Basis
Weekday Morning
Peak-Hour Traffic Volumes

Vanasse & Associates inc

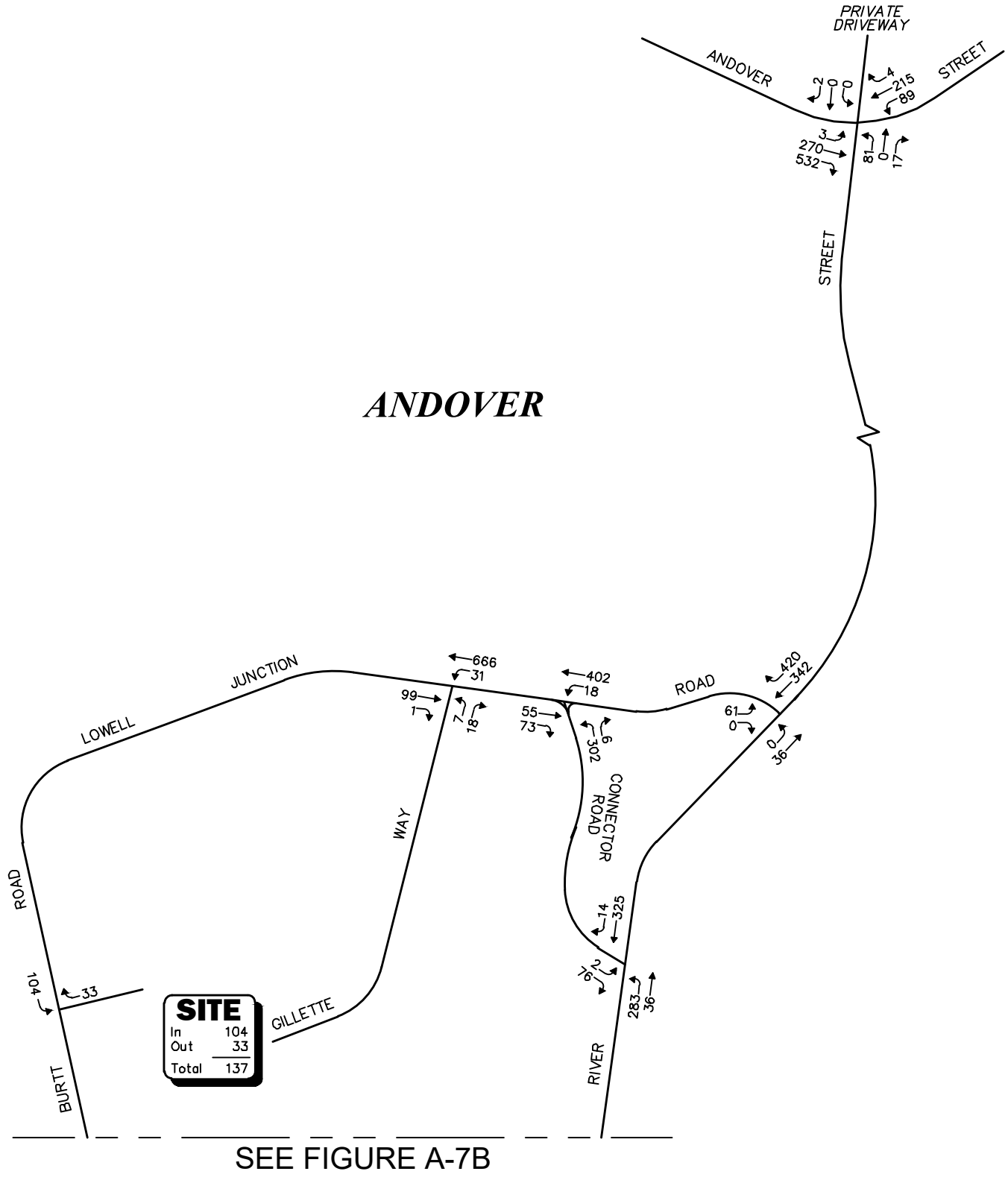


Not To Scale

Figure A-6B

Site-Generated - ITE Basis
Weekday Morning
Peak-Hour Traffic Volumes

Vanasse & Associates inc

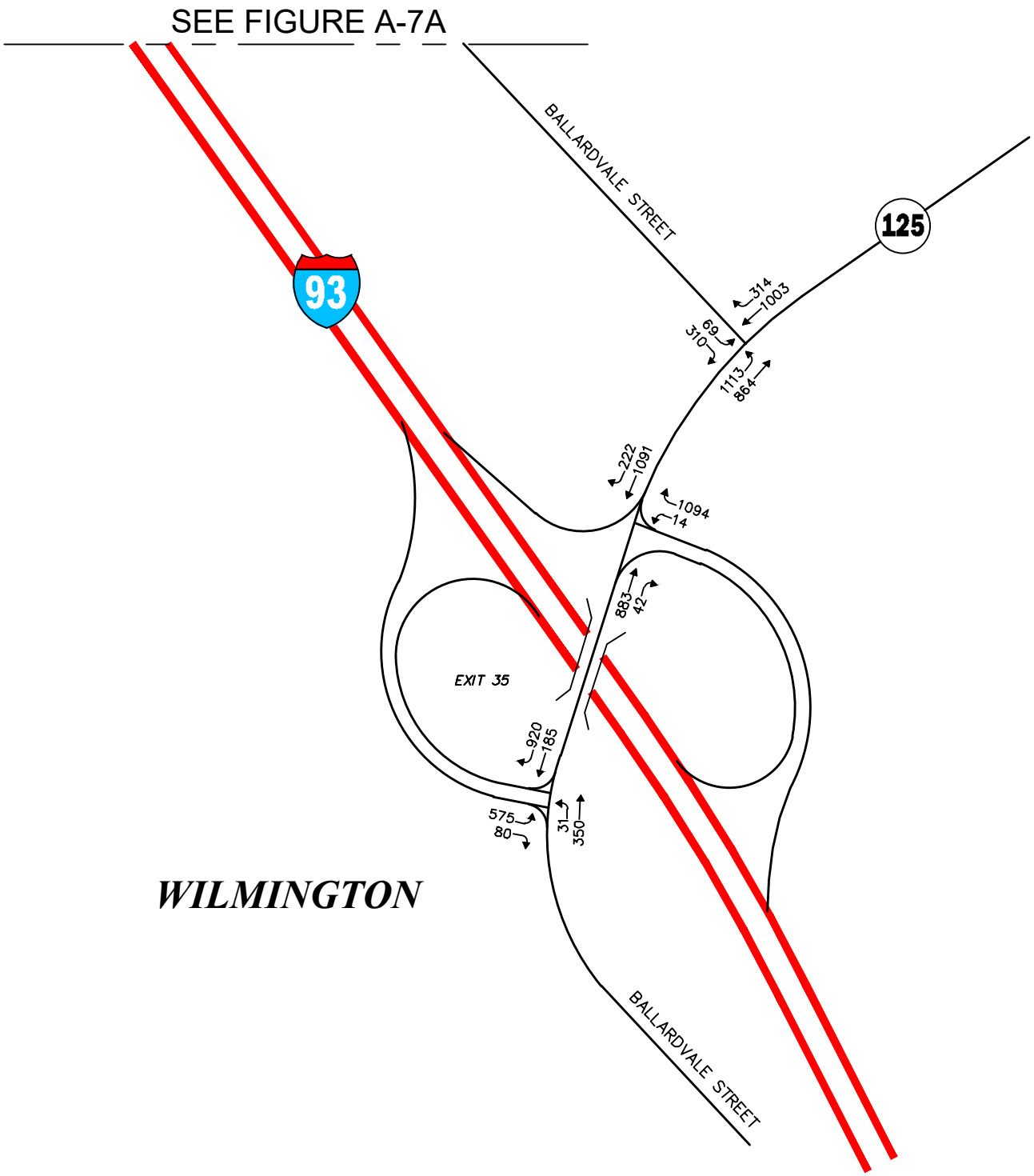


Not To Scale

Figure A-7A

2031 Build - ITE Basis
Weekday Morning
Peak-Hour Traffic Volumes

Vanasse & Associates inc



Not To Scale

Figure A-7B

2031 Build - ITE Basis
Weekday Morning
Peak-Hour Traffic Volumes

Vanasse & Associates inc

TRAFFIC SIGNAL WARRANT ANALYSIS

Warrants Analysis

File Name:	TSWA 2031 No-Build Andover at River Peak Hour.xsw
Analyst:	TJH
Agency:	VAI
Date Performed:	07/26/2024
Time Analyzed:	7-9 AM, 4-6 PM
Jurisdiction:	
Analysis Year:	2031
Project Description:	9677 2031 No-Build Andover Street at River Street Peak Hour
Units:	U.S. Customary

General

Major Street Direction: East-West	Population <10,000: No
Starting Time Interval: 7	Coordinated Signal System: No
Median Type: Undivided	Crashes Per Year: 0
Major Street Speed (mi/h): 35	Adequate Trials of Crash Experience Alternatives: No
Nearest Signal (ft): 0	

School Crossing and Roadway Network

Number of Students in Highest Hour: 0	Two or More Major Routes: No
Number of Adequate Gaps in Period: 0	Weekend Count: No
Number of Minutes in Period: 0	5-year Growth Factor (%): 0

Railroad Crossing

Grade Crossing Approach: None	Rail Traffic (trains/day): 0
Highest Volume Hour with Trains: Unknown	High Occupancy Buses (%): 0
Distance to Stop Line (ft): -	Tractor-Trailer Trucks (%): 10

Geometry and Traffic

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
Lane Usage		LTR			LTR			LTR			LTR	

Traffic Volumes (veh/h)

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Hour												
07 - 08	3	270	493	82	215	4	68	0	15	0	0	2
08 - 09	0	0	0	0	0	0	0	0	0	0	0	0
09 - 10	0	0	0	0	0	0	0	0	0	0	0	0
10 - 11	0	0	0	0	0	0	0	0	0	0	0	0
11 - 12	0	0	0	0	0	0	0	0	0	0	0	0
12 - 13	0	0	0	0	0	0	0	0	0	0	0	0
13 - 14	0	0	0	0	0	0	0	0	0	0	0	0
14 - 15	0	0	0	0	0	0	0	0	0	0	0	0
15 - 16	0	0	0	0	0	0	0	0	0	0	0	0
16 - 17	3	165	65	19	179	0	543	0	57	8	0	25
17 - 18	0	0	0	0	0	0	0	0	0	0	0	0
18 - 19	0	0	0	0	0	0	0	0	0	0	0	0

Pedestrian Volumes and Gaps (Per Hour)

	Eastbound		Westbound		Northbound		Southbound	
	Gaps	Volume	Gaps	Volume	Gaps	Volume	Gaps	Volume
Hour								
07 - 08	0	0	0	0	0	0	0	0
08 - 09	0	0	0	0	0	0	0	0
09 - 10	0	0	0	0	0	0	0	0
10 - 11	0	0	0	0	0	0	0	0
11 - 12	0	0	0	0	0	0	0	0
12 - 13	0	0	0	0	0	0	0	0
13 - 14	0	0	0	0	0	0	0	0
14 - 15	0	0	0	0	0	0	0	0
15 - 16	0	0	0	0	0	0	0	0
16 - 17	0	0	0	0	0	0	0	0
17 - 18	0	0	0	0	0	0	0	0
18 - 19	0	0	0	0	0	0	0	0

Delay

Hour	Eastbound secs/veh	Eastbound veh-hrs	Westbound secs/veh	Westbound veh-hrs	Northbound secs/veh	Northbound veh-hrs	Southbound secs/veh	Southbound veh-hrs
07 - 08	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
08 - 09	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
09 - 10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10 - 11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11 - 12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12 - 13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13 - 14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14 - 15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15 - 16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16 - 17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17 - 18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18 - 19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Summary

Hour	Major Volume	Minor Volume	Total Volume	1A 100%	1A 80%	1B 100%	1B 80%	2 100%	3A 100%	3B 80%	4A 100%	4B 80%
07 - 08	1067	83	1152	No	No	Yes	Yes	No	No	No	No	No
08 - 09	0	0	0	No	No	No	No	No	No	No	No	No
09 - 10	0	0	0	No	No	No	No	No	No	No	No	No
10 - 11	0	0	0	No	No	No	No	No	No	No	No	No
11 - 12	0	0	0	No	No	No	No	No	No	No	No	No
12 - 13	0	0	0	No	No	No	No	No	No	No	No	No
13 - 14	0	0	0	No	No	No	No	No	No	No	No	No
14 - 15	0	0	0	No	No	No	No	No	No	No	No	No
15 - 16	0	0	0	No	No	No	No	No	No	No	No	No
16 - 17	431	600	1064	No	Yes	No	No	Yes	No	Yes	No	No
17 - 18	0	0	0	No	No	No	No	No	No	No	No	No
18 - 19	0	0	0	No	No	No	No	No	No	No	No	No
Total	1498	683	2216	0	1	1	1	1	0	1	0	0

Results

Warrant 1: Eight-Hour Vehicular Volume [ ]
- A. Minimum Vehicular Volumes [ ]
- B. Interruption of Continuous Traffic [ ]
- 80% Vehicular --and-- Interruption Volumes [ ]

Warrant 2: Four-Hour Vehicular Volume [ ]
- Four-Hour Vehicular Volumes [ ]

Warrant 3: Peak Hour [X]
- A. Peak-Hour Conditions [ ]
- B. Peak-Hour Vehicular Volume Hours Met [X]

Warrant 4: Pedestrian Volume [ ]
- A. Four Hour Volumes [ ]
- B. One-Hour Volumes [ ]

Warrant 5: School Crossing [ ]
- Gaps Same Period [ ]
- Student Volumes [ ]
- Nearest Traffic Control Signal [ ]

Warrant 6: Coordinated Signal System [ ]
- Degree of Platooning [ ]

Warrant 7: Crash Experience [ ]
- A. Adequate Trials of Alternatives [ ]
- B. Reported Crashes [ ]
- C. 80% Volumes for Warrants 1A, 1B --or-- 4 [ ]

Warrant 8: Roadway Network [ ]
- A. Weekday Volume [ ]
- B. Weekend Volume [ ]

Warrant 9: Grade Crossing [ ]
   A. Grade Crossing within 140 ft --and-- [ ]
   B. Peak-Hour Vehicular Volumes [ ]

This text report was created in HCS™ Warrants Version 2024 on 9/17/2024 3:57:53 PM

Warrants Analysis

File Name:	TSWA 2031 No-Build Andover at River 4 hrs.xsw
Analyst:	TJH
Agency:	VAI
Date Performed:	07/26/2024
Time Analyzed:	7-9 AM, 4-6 PM
Jurisdiction:	
Analysis Year:	2031
Project Description:	9677 2031 No-Build Andover Street at River Street 4 Hours
Units:	U.S. Customary

General

Major Street Direction: East-West	Population <10,000: No
Starting Time Interval: 7	Coordinated Signal System: No
Median Type: Undivided	Crashes Per Year: 0
Major Street Speed (mi/h): 35	Adequate Trials of Crash Experience Alternatives: No
Nearest Signal (ft): 0	

School Crossing and Roadway Network

Number of Students in Highest Hour: 0	Two or More Major Routes: No
Number of Adequate Gaps in Period: 0	Weekend Count: No
Number of Minutes in Period: 0	5-year Growth Factor (%): 0

Railroad Crossing

Grade Crossing Approach: None	Rail Traffic (trains/day): 0
Highest Volume Hour with Trains: Unknown	High Occupancy Buses (%): 0
Distance to Stop Line (ft): -	Tractor-Trailer Trucks (%): 10

Geometry and Traffic

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
Lane Usage		LTR			LTR			LTR			LTR	

Traffic Volumes (veh/h)

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Hour												
07 - 08	2	184	475	65	128	4	67	0	12	0	0	1
08 - 09	6	238	442	85	242	1	64	1	23	0	2	3
09 - 10	0	0	0	0	0	0	0	0	0	0	0	0
10 - 11	0	0	0	0	0	0	0	0	0	0	0	0
11 - 12	0	0	0	0	0	0	0	0	0	0	0	0
12 - 13	0	0	0	0	0	0	0	0	0	0	0	0
13 - 14	0	0	0	0	0	0	0	0	0	0	0	0
14 - 15	0	0	0	0	0	0	0	0	0	0	0	0
15 - 16	0	0	0	0	0	0	0	0	0	0	0	0
16 - 17	3	165	61	18	179	0	531	0	55	8	0	25
17 - 18	0	148	76	20	206	1	342	0	53	1	1	3
18 - 19	0	0	0	0	0	0	0	0	0	0	0	0

Pedestrian Volumes and Gaps (Per Hour)

	Eastbound		Westbound		Northbound		Southbound	
	Gaps	Volume	Gaps	Volume	Gaps	Volume	Gaps	Volume
Hour								
07 - 08	0	0	0	0	0	0	0	0
08 - 09	0	0	0	0	0	0	0	0
09 - 10	0	0	0	0	0	0	0	0
10 - 11	0	0	0	0	0	0	0	0
11 - 12	0	0	0	0	0	0	0	0
12 - 13	0	0	0	0	0	0	0	0
13 - 14	0	0	0	0	0	0	0	0
14 - 15	0	0	0	0	0	0	0	0
15 - 16	0	0	0	0	0	0	0	0
16 - 17	0	0	0	0	0	0	0	0
17 - 18	0	0	0	0	0	0	0	0
18 - 19	0	0	0	0	0	0	0	0

Delay

Hour	Eastbound secs/veh	Eastbound veh-hrs	Westbound secs/veh	Westbound veh-hrs	Northbound secs/veh	Northbound veh-hrs	Southbound secs/veh	Southbound veh-hrs
07 - 08	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
08 - 09	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
09 - 10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10 - 11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11 - 12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12 - 13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13 - 14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14 - 15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15 - 16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16 - 17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17 - 18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18 - 19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Summary

Hour	Major Volume	Minor Volume	Total Volume	1A 100%	1A 80%	1B 100%	1B 80%	2 100%	3A 100%	3B 80%	4A 100%	4B 80%
07 - 08	858	79	938	No	No	Yes	Yes	No	No	No	No	No
08 - 09	1014	88	1107	No	No	Yes	Yes	No	No	No	No	No
09 - 10	0	0	0	No	No	No	No	No	No	No	No	No
10 - 11	0	0	0	No	No	No	No	No	No	No	No	No
11 - 12	0	0	0	No	No	No	No	No	No	No	No	No
12 - 13	0	0	0	No	No	No	No	No	No	No	No	No
13 - 14	0	0	0	No	No	No	No	No	No	No	No	No
14 - 15	0	0	0	No	No	No	No	No	No	No	No	No
15 - 16	0	0	0	No	No	No	No	No	No	No	No	No
16 - 17	426	586	1045	No	Yes	No	No	Yes	No	Yes	No	No
17 - 18	451	395	851	No	Yes	No	No	Yes	No	No	No	No
18 - 19	0	0	0	No	No	No	No	No	No	No	No	No
Total	2749	1148	3941	0	2	2	2	2	0	1	0	0

Results

Warrant 1: Eight-Hour Vehicular Volume [ ]
- A. Minimum Vehicular Volumes [ ]
- B. Interruption of Continuous Traffic [ ]
- 80% Vehicular --and-- Interruption Volumes [ ]

Warrant 2: Four-Hour Vehicular Volume [ ]
- Four-Hour Vehicular Volumes [ ]

Warrant 3: Peak Hour [X]
- A. Peak-Hour Conditions [ ]
- B. Peak-Hour Vehicular Volume Hours Met [X]

Warrant 4: Pedestrian Volume [ ]
- A. Four Hour Volumes [ ]
- B. One-Hour Volumes [ ]

Warrant 5: School Crossing [ ]
- Gaps Same Period [ ]
- Student Volumes [ ]
- Nearest Traffic Control Signal [ ]

Warrant 6: Coordinated Signal System [ ]
- Degree of Platooning [ ]

Warrant 7: Crash Experience [ ]
- A. Adequate Trials of Alternatives [ ]
- B. Reported Crashes [ ]
- C. 80% Volumes for Warrants 1A, 1B --or-- 4 [ ]

Warrant 8: Roadway Network [ ]
- A. Weekday Volume [ ]
- B. Weekend Volume [ ]

Warrant 9: Grade Crossing [ ]
   A. Grade Crossing within 140 ft --and-- [ ]
   B. Peak-Hour Vehicular Volumes [ ]

This text report was created in HCS™ Warrants Version 2024 on 9/17/2024 3:54:35 PM

Warrants Analysis

File Name:	TSWA 2031 Build Andover at River Peak Hour.xsw
Analyst:	TJH
Agency:	VAI
Date Performed:	09/17/2024
Time Analyzed:	7-9 AM, 4-6 PM
Jurisdiction:	
Analysis Year:	2031
Project Description:	9677 2031 Build Andover Street at River Street Peak Hour
Units:	U.S. Customary

General

Major Street Direction: East-West	Population <10,000: No
Starting Time Interval: 7	Coordinated Signal System: No
Median Type: Undivided	Crashes Per Year: 0
Major Street Speed (mi/h): 35	Adequate Trials of Crash Experience Alternatives: No
Nearest Signal (ft): 0	

School Crossing and Roadway Network

Number of Students in Highest Hour: 0	Two or More Major Routes: No
Number of Adequate Gaps in Period: 0	Weekend Count: No
Number of Minutes in Period: 0	5-year Growth Factor (%): 0

Railroad Crossing

Grade Crossing Approach: None	Rail Traffic (trains/day): 0
Highest Volume Hour with Trains: Unknown	High Occupancy Buses (%): 0
Distance to Stop Line (ft): -	Tractor-Trailer Trucks (%): 10

Geometry and Traffic

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
Lane Usage		LTR			LTR			LTR			LTR	

Traffic Volumes (veh/h)

	Eastbound			Westbound			Northbound			Southbound		
Hour	L	T	R	L	T	R	L	T	R	L	T	R
07 - 08	3	270	532	89	215	4	81	0	17	0	0	2
08 - 09	0	0	0	0	0	0	0	0	0	0	0	0
09 - 10	0	0	0	0	0	0	0	0	0	0	0	0
10 - 11	0	0	0	0	0	0	0	0	0	0	0	0
11 - 12	0	0	0	0	0	0	0	0	0	0	0	0
12 - 13	0	0	0	0	0	0	0	0	0	0	0	0
13 - 14	0	0	0	0	0	0	0	0	0	0	0	0
14 - 15	0	0	0	0	0	0	0	0	0	0	0	0
15 - 16	0	0	0	0	0	0	0	0	0	0	0	0
16 - 17	3	165	81	22	179	0	583	0	64	8	0	25
17 - 18	0	0	0	0	0	0	0	0	0	0	0	0
18 - 19	0	0	0	0	0	0	0	0	0	0	0	0

Pedestrian Volumes and Gaps (Per Hour)

	Eastbound		Westbound		Northbound		Southbound	
	Gaps	Volume	Gaps	Volume	Gaps	Volume	Gaps	Volume
Hour								
07 - 08	0	0	0	0	0	0	0	0
08 - 09	0	0	0	0	0	0	0	0
09 - 10	0	0	0	0	0	0	0	0
10 - 11	0	0	0	0	0	0	0	0
11 - 12	0	0	0	0	0	0	0	0
12 - 13	0	0	0	0	0	0	0	0
13 - 14	0	0	0	0	0	0	0	0
14 - 15	0	0	0	0	0	0	0	0
15 - 16	0	0	0	0	0	0	0	0
16 - 17	0	0	0	0	0	0	0	0
17 - 18	0	0	0	0	0	0	0	0
18 - 19	0	0	0	0	0	0	0	0

Delay

Hour	Eastbound secs/veh	Eastbound veh-hrs	Westbound secs/veh	Westbound veh-hrs	Northbound secs/veh	Northbound veh-hrs	Southbound secs/veh	Southbound veh-hrs
07 - 08	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
08 - 09	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
09 - 10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10 - 11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11 - 12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12 - 13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13 - 14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14 - 15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15 - 16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16 - 17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17 - 18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18 - 19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Summary

Hour	Major Volume	Minor Volume	Total Volume	1A 100%	1A 80%	1B 100%	1B 80%	2 100%	3A 100%	3B 80%	4A 100%	4B 80%
07 - 08	1113	98	1213	No	No	Yes	Yes	Yes	No	No	No	No
08 - 09	0	0	0	No	No	No	No	No	No	No	No	No
09 - 10	0	0	0	No	No	No	No	No	No	No	No	No
10 - 11	0	0	0	No	No	No	No	No	No	No	No	No
11 - 12	0	0	0	No	No	No	No	No	No	No	No	No
12 - 13	0	0	0	No	No	No	No	No	No	No	No	No
13 - 14	0	0	0	No	No	No	No	No	No	No	No	No
14 - 15	0	0	0	No	No	No	No	No	No	No	No	No
15 - 16	0	0	0	No	No	No	No	No	No	No	No	No
16 - 17	450	647	1130	No	Yes	No	No	Yes	No	Yes	No	No
17 - 18	0	0	0	No	No	No	No	No	No	No	No	No
18 - 19	0	0	0	No	No	No	No	No	No	No	No	No
Total	1563	745	2343	0	1	1	1	2	0	1	0	0

Results

Warrant 1: Eight-Hour Vehicular Volume [ ]
   A. Minimum Vehicular Volumes [ ]
   B. Interruption of Continuous Traffic [ ]
   80% Vehicular --and-- Interruption Volumes [ ]

Warrant 2: Four-Hour Vehicular Volume [ ]
   Four-Hour Vehicular Volumes [ ]

Warrant 3: Peak Hour [X]
   A. Peak-Hour Conditions [ ]
   B. Peak-Hour Vehicular Volume Hours Met [X]

Warrant 4: Pedestrian Volume [ ]
   A. Four Hour Volumes [ ]
   B. One-Hour Volumes [ ]

Warrant 5: School Crossing [ ]
   Gaps Same Period [ ]
   Student Volumes [ ]
   Nearest Traffic Control Signal [ ]

Warrant 6: Coordinated Signal System [ ]
   Degree of Platooning [ ]

Warrant 7: Crash Experience [ ]
   A. Adequate Trials of Alternatives [ ]
   B. Reported Crashes [ ]
   C. 80% Volumes for Warrants 1A, 1B --or-- 4 [ ]

Warrant 8: Roadway Network [ ]
   A. Weekday Volume [ ]
   B. Weekend Volume [ ]

Warrant 9: Grade Crossing [ ]
   A. Grade Crossing within 140 ft --and-- [ ]
   B. Peak-Hour Vehicular Volumes [ ]

This text report was created in HCS™ Warrants Version 2024 on 9/17/2024 4:11:45 PM

Warrants Analysis

File Name:	TSWA 2031 Build Andover at River 4 hrs.xsw
Analyst:	TJH
Agency:	VAI
Date Performed:	09/17/2024
Time Analyzed:	7-9 AM, 4-6 PM
Jurisdiction:	
Analysis Year:	2031
Project Description:	9677 2031 Build Andover Street at River Street 4 Hours
Units:	U.S. Customary

General

Major Street Direction: East-West	Population <10,000: No
Starting Time Interval: 7	Coordinated Signal System: No
Median Type: Undivided	Crashes Per Year: 0
Major Street Speed (mi/h): 35	Adequate Trials of Crash Experience Alternatives: No
Nearest Signal (ft): 0	

School Crossing and Roadway Network

Number of Students in Highest Hour: 0	Two or More Major Routes: No
Number of Adequate Gaps in Period: 0	Weekend Count: No
Number of Minutes in Period: 0	5-year Growth Factor (%): 0

Railroad Crossing

Grade Crossing Approach: None	Rail Traffic (trains/day): 0
Highest Volume Hour with Trains: Unknown	High Occupancy Buses (%): 0
Distance to Stop Line (ft): -	Tractor-Trailer Trucks (%): 10

Geometry and Traffic

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
Lane Usage		LTR			LTR			LTR			LTR	

Traffic Volumes (veh/h)

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Hour												
07 - 08	2	184	514	72	128	4	80	0	14	0	0	1
08 - 09	6	238	442	85	242	1	64	1	23	0	2	3
09 - 10	0	0	0	0	0	0	0	0	0	0	0	0
10 - 11	0	0	0	0	0	0	0	0	0	0	0	0
11 - 12	0	0	0	0	0	0	0	0	0	0	0	0
12 - 13	0	0	0	0	0	0	0	0	0	0	0	0
13 - 14	0	0	0	0	0	0	0	0	0	0	0	0
14 - 15	0	0	0	0	0	0	0	0	0	0	0	0
15 - 16	0	0	0	0	0	0	0	0	0	0	0	0
16 - 17	3	165	76	21	179	0	571	0	62	8	0	25
17 - 18	0	148	76	20	206	1	342	0	53	1	1	3
18 - 19	0	0	0	0	0	0	0	0	0	0	0	0

Pedestrian Volumes and Gaps (Per Hour)

	Eastbound		Westbound		Northbound		Southbound	
	Gaps	Volume	Gaps	Volume	Gaps	Volume	Gaps	Volume
Hour								
07 - 08	0	0	0	0	0	0	0	0
08 - 09	0	0	0	0	0	0	0	0
09 - 10	0	0	0	0	0	0	0	0
10 - 11	0	0	0	0	0	0	0	0
11 - 12	0	0	0	0	0	0	0	0
12 - 13	0	0	0	0	0	0	0	0
13 - 14	0	0	0	0	0	0	0	0
14 - 15	0	0	0	0	0	0	0	0
15 - 16	0	0	0	0	0	0	0	0
16 - 17	0	0	0	0	0	0	0	0
17 - 18	0	0	0	0	0	0	0	0
18 - 19	0	0	0	0	0	0	0	0

Delay

Hour	Eastbound secs/veh	Eastbound veh-hrs	Westbound secs/veh	Westbound veh-hrs	Northbound secs/veh	Northbound veh-hrs	Southbound secs/veh	Southbound veh-hrs
07 - 08	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
08 - 09	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
09 - 10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10 - 11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11 - 12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12 - 13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13 - 14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14 - 15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15 - 16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16 - 17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17 - 18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18 - 19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Summary

Hour	Major Volume	Minor Volume	Total Volume	1A 100%	1A 80%	1B 100%	1B 80%	2 100%	3A 100%	3B 80%	4A 100%	4B 80%
07 - 08	904	94	999	No	No	Yes	Yes	No	No	No	No	No
08 - 09	1014	88	1107	No	No	Yes	Yes	No	No	No	No	No
09 - 10	0	0	0	No	No	No	No	No	No	No	No	No
10 - 11	0	0	0	No	No	No	No	No	No	No	No	No
11 - 12	0	0	0	No	No	No	No	No	No	No	No	No
12 - 13	0	0	0	No	No	No	No	No	No	No	No	No
13 - 14	0	0	0	No	No	No	No	No	No	No	No	No
14 - 15	0	0	0	No	No	No	No	No	No	No	No	No
15 - 16	0	0	0	No	No	No	No	No	No	No	No	No
16 - 17	444	633	1110	No	Yes	No	No	Yes	No	Yes	No	No
17 - 18	451	395	851	No	Yes	No	No	Yes	No	No	No	No
18 - 19	0	0	0	No	No	No	No	No	No	No	No	No
Total	2813	1210	4067	0	2	2	2	2	0	1	0	0

Results

Warrant 1: Eight-Hour Vehicular Volume [ ]
- A. Minimum Vehicular Volumes [ ]
- B. Interruption of Continuous Traffic [ ]

80% Vehicular --and-- Interruption Volumes [ ]

Warrant 2: Four-Hour Vehicular Volume [ ]
- Four-Hour Vehicular Volumes [ ]

Warrant 3: Peak Hour [X]
- A. Peak-Hour Conditions [ ]
- B. Peak-Hour Vehicular Volume Hours Met [X]

Warrant 4: Pedestrian Volume [ ]
- A. Four Hour Volumes [ ]
- B. One-Hour Volumes [ ]

Warrant 5: School Crossing [ ]
- Gaps Same Period [ ]
- Student Volumes [ ]
- Nearest Traffic Control Signal [ ]

Warrant 6: Coordinated Signal System [ ]
- Degree of Platooning [ ]

Warrant 7: Crash Experience [ ]
- A. Adequate Trials of Alternatives [ ]
- B. Reported Crashes [ ]
- C. 80% Volumes for Warrants 1A, 1B --or-- 4 [ ]

Warrant 8: Roadway Network [ ]
- A. Weekday Volume [ ]
- B. Weekend Volume [ ]

Warrant 9: Grade Crossing [ ]
   A. Grade Crossing within 140 ft --and-- [ ]
   B. Peak-Hour Vehicular Volumes [ ]

This text report was created in HCS™ Warrants Version 2024 on 9/17/2024 4:09:48 PM

COST ESTIMATES

PRELIMINARY CONSTRUCTION COST ESTIMATE

SHEET 1 OF 1

PROJECT
Proposed Warehouse Development

LOCATION
Andover, Massachusetts

Vanasse & Associates, Inc.

BASIS FOR ESTIMATE
[X] STUDY
[ ] FINAL DESIGN
OTHER (SPECIFY)

DEPARTMENT	ESTIMATOR		CHECKED BY	DATE
HIGHWAY	IJS		JPC	17-Sep-24

SUBJECT
ESTIMATE - Option 2: Reconfiguration of Andover Street at River Street - Figure A-1

FILE USED:
R:/9677/HWY/EST/2024_0903 Qty Estimate

ITEM NO	ITEM DESCRIPTION	UNIT	UNIT PRICE	QUANTITY	TOTAL COST
1	CLEAR & GRUB	AC	$55,000.00	0	$0
2	EARTH WORK (LEDGE NOT INCLUDED)	CY	$65.00	100	$6,500
3	FULL DEPTH PVMT (8"+ 4" SUB, 4" BASE, 2" BINDER, 2" TOP)	SY	$153.00	20	$3,060
4	PAVEMENT MILLING	SY	$11.00	1400	$15,400
5	2" OVERLAY (DOES NOT INCLUDE FULL DEPTH AREAS)	SY	$20.00	1400	$28,000
6	VERTICAL GRANITE CURB - TYPE VB (NEW)	LF	$66.00	420	$27,720
7	VERTICAL GRANITE CURB (R&R)	LF	$45.00	0	$0
8	SLOPED GRANITE EDGING	LF	$59.00	0	$0
9	HOT MIX ASPHALT CURB	LF	$14.00	300	$4,200
10	DRAINAGE	LS	$20,000.00	1	$20,000
11	5' HMA SIDEWALK	LF	$54.00	390	$21,060
12	5' CEM. CONC. SIDEWALK	LF	$91.00	0	$0
13	WHEEL CHAIR RAMPS	EA	$2,400.00	4	$9,600
14	EROSION CONTROL	LF	$18.00	300	$5,400
15	LOAM & SEED	SY	$12.00	270	$3,240
16	GUARD RAIL ($28 for W BEAM, $36 for THRIE BEAM)	LF	$36.00	0	$0
17	REINFORCED CONCRETE WALLS	SF	$150.00	0	$0
18	BRIDGE STRUCTURES	SF	$400.00	0	$0
19	WATER LINE (TRENCH PAVING NOT INCLUDED)	LS	$21,000.00	0	$0
20	TRAFFIC SIGNAL (NEW)	LS	$180,000.00	0	$0
21	TRAFFIC SIGNAL (UPGRADE)	LS	$85,000.00	0	$0
22	SIGNAL COORDINATION (NOT INC. SURFACE TREATMENT)	LF	$79.00	0	$0
23	PERMANENT PAVEMENT MARKINGS	LS	$3,500.00	1	$3,500
24	SIGNS (REGULATORY w/ BREAKAWAY POST)	LS	$3,500.00	1	$3,500
25	UTILITY POLES (RELOCATE)	EA	$20,000.00	0	$0
26	RECTANGULAR RAPID FLASHING BEACONS (RRFB)	LS	$25,000.00	1	$25,000
				SUB-TOTAL	$176,180
	MAINTENANCE OF TRAFFIC (10%)				$17,618
	MOBILIZATION (5%)				$8,809
				SUB-TOTAL	$202,607
	SURVEY & ENGINEERING (15%)				$30,391
				SUB-TOTAL	$232,998
				SAY	$235,000

PRELIMINARY CONSTRUCTION COST ESTIMATE

SHEET 1 OF 1

PROJECT
Proposed Warehouse Development

LOCATION
Andover, Massachusetts

Vanasse & Associates, Inc.

BASIS FOR ESTIMATE
[X] STUDY
[ ] FINAL DESIGN
OTHER (SPECIFY)

DEPARTMENT	ESTIMATOR		CHECKED BY	DATE
HIGHWAY	IJS		JPC	13-Sep-24

SUBJECT
ESTIMATE - Option 3: Signalization of Andover Street at River Street - Figure A-2

FILE USED:
R:/9677/HWY/EST/2024_0903 Qty Estimate

ITEM NO	ITEM DESCRIPTION	UNIT	UNIT PRICE	QUANTITY	TOTAL COST
1	CLEAR & GRUB	AC	$55,000.00	0	$0
2	EARTH WORK (LEDGE NOT INCLUDED)	CY	$65.00	100	$6,500
3	FULL DEPTH PVMT (8"+ 4" SUB, 4" BASE, 2" BINDER, 2" TOP)	SY	$153.00	60	$9,180
4	PAVEMENT MILLING	SY	$11.00	1500	$16,500
5	2" OVERLAY (DOES NOT INCLUDE FULL DEPTH AREAS)	SY	$20.00	1500	$30,000
6	VERTICAL GRANITE CURB - TYPE VB (NEW)	LF	$66.00	490	$32,340
7	VERTICAL GRANITE CURB (R&R)	LF	$45.00	0	$0
8	SLOPED GRANITE EDGING	LF	$59.00	0	$0
9	HOT MIX ASPHALT CURB	LF	$14.00	250	$3,500
10	DRAINAGE	LS	$20,000.00	1	$20,000
11	5' HMA SIDEWALK	LF	$54.00	490	$26,460
12	5' CEM. CONC. SIDEWALK	LF	$91.00	0	$0
13	WHEEL CHAIR RAMPS	EA	$2,400.00	4	$9,600
14	EROSION CONTROL	LF	$18.00	300	$5,400
15	LOAM & SEED	SY	$12.00	210	$2,520
16	GUARD RAIL ($28 for W BEAM, $36 for THRIE BEAM)	LF	$36.00	0	$0
17	REINFORCED CONCRETE WALLS	SF	$150.00	0	$0
18	BRIDGE STRUCTURES	SF	$400.00	0	$0
19	WATER LINE (TRENCH PAVING NOT INCLUDED)	LS	$21,000.00	0	$0
20	TRAFFIC SIGNAL (NEW)	LS	$210,000.00	1	$210,000
21	TRAFFIC SIGNAL (UPGRADE)	LS	$85,000.00	0	$0
22	SIGNAL COORDINATION (NOT INC. SURFACE TREATMENT)	LF	$79.00	0	$0
23	PERMANENT PAVEMENT MARKINGS	LS	$4,500.00	1	$4,500
24	SIGNS (REGULATORY w/ BREAKAWAY POST)	LS	$3,500.00	0	$0
25	UTILITY POLES (RELOCATE)	EA	$20,000.00	0	$0
26	RECTANGULAR RAPID FLASHING BEACONS (RRFB)	LS	$25,000.00	0	$0.00
				SUB-TOTAL	$376,500
	MAINTENANCE OF TRAFFIC (10%)				$37,650
	MOBILIZATION (5%)				$18,825
				SUB-TOTAL	$432,975
	SURVEY & ENGINEERING (15%)				$64,946
				SUB-TOTAL	$497,921
				SAY	$500,000