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Traffic Impact Study

Prepared For

Whitney Street Home Builders

Multifamily Residential Development

Located at

15-17 Rice Road
Millbury, Massachusetts

March 2021

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INTRODUCTION

Whitney Street Home Builders, hereafter referred to as the applicant, is proposing the development of a parcel of land totaling 15.6 acres to construct a multifamily residential development. The proposed development is located on the north side of Rice Road, between the Providence & Worcester Railroad Company railroad tracks and power line easement. The applicant is proposing to evaluate the traffic impact of this development on area roadways and consider any improvements that may be necessary in order to make this development feasible and acceptable. This traffic study is prepared in order to make this evaluation. The purpose of this traffic study is to develop an understanding of existing traffic operations and concerns, forecast future site generated traffic, assess the adequacy of the existing roadway system to accommodate the proposed development into the future, and to identify and recommend appropriate mitigation strategies, should any be deemed necessary.

Project description

The applicant proposes to develop a 15.6-acre parcel of land and build 26 duplexes totaling 52 units of housing. The duplexes will be two-story structures comprised of two to three bedrooms in each unit.

The site will be accessed directly from Rice Road via a single driveway that is 175' in length and is located approximately 800' west of the Providence Street intersection, or directly across from Thomas Hill Road, thus creating a four-legged intersection. The site driveway after approximately 975' loops around the proposed development back to Rice Road. This entrance driveway has a 24' paved surface. The entire site driveway including those on both sides of the loop will be private driveways. They connect the proposed duplexes and their associated parking spaces to the individual units' driveways. The proposed site driveway provides entry to all off-street parking spaces for each unit. These individual units will each have a driveway with a pavement width of 20'. Each unit will have off-street parking for up to four vehicles, two inside garages and two outside in each driveway. The proposed site is located in a R-1 zoning district and is currently vacant as its approximate location is shown in the aerial photograph in Figure 1.

As stated herein above, the housing units are designed and situated in such a way that they will all have access to off-street parking. This will eliminate the potential for on-street parking activities alongside the entrance driveway, thus maintaining optimum safety for residents driving through the development.

Figure 1 - Proposed Multi Family Development Site

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EXISTING CONDITIONS

Evaluation of the transportation impacts associated with the proposed multi-family residential development project requires a thorough understanding of the existing transportation system in the immediate vicinity of the site. Evaluating existing roadway network operating conditions necessitates an examination of existing roadway traffic volumes, geometric features, and local community traffic-related issues. Each of these elements is described below.

Study Area Roadway Network

The study area for this traffic impact report has been defined to include the evaluation of the following intersections located within 1,000 feet of the proposed site driveway.

- Rice Road at Providence Street (Route 122A)
- Rice Road at Thomas Hill Road
- Rice Road at South Main Street

South Main Street is a two-way roadway with one travel lane in each direction. The roadway width is approximately 26' near its intersection with Rice Road. It provides sidewalks on one side of the street north of the Rice Road intersection. South Main Street intersects with Rice Road at an acute angle. However, the intersection is treated with a traffic island that creates a nearly 90 degree turn into and out of Rice Road for left-turn traffic. It is a suburban roadway with predominately residential land use. It traverses in northerly and southerly general directions and provides access to the center of Millbury to the north and it becomes Dudley Road and connects with Route 146 to the south. Daily traffic volumes in both directions for South Main Street in the vicinity of where its name changes to Dudley Road was obtained from the Massachusetts Department of Transportation (*massDOT*) website. In 2019, the Annual Average Daily Traffic (AADT) on South Main Street from permanent counting station #240695 was 930 vehicles per day at a point approximately a half mile south of the Rice Road intersection. South Main Street intersects with Rice Road, Woodland Street, Sycamore Street, Maple Street, and finally, Elm Street in the center of Millbury.

Rice Road is also a residential street that traverses in the easterly and westerly directions. Its pavement width varies from 20' to 22', except at/near its intersection with South Main Street where the roadway width increases to 36'+ for a distance of approximately 95' to accommodate a right-turn only when leaving Rice Road and a traffic island separating traffic entering Rice Road from those leaving it and destined for points south. Rice Road also crosses the Providence & Worcester Railroad Company railroad tracks near its easterly terminus and connects South Main Street to Providence Street (Route 122A) at its easterly terminus. There are no speed limit

signs posted on Rice Road.

Providence Street (Route 122A) is a rural arterial street and is also a state numbered highway. It traverses in the northerly and southerly general directions. It connects to Grafton Street in the center of Millbury to the north, and to Wilkinsonville and Saundersville, and eventually intersecting Providence Road (Route 122) to the south in South Grafton. Its pavement width ranges from 36' to 38' near its intersection with Rice Road. Providence Street in the area near the Rice Road intersection is posted with 30 miles per hour speed limit signs. In 2019, the AADT along Providence Street from permanent counting station #240693 was 6,284 vehicles per day at a point approximately a half mile south of the Rice Road intersection. Finally, land use along Providence Street in this area is primarily commercial/business which also includes the Town of Millbury Department of Public Works facilities.

Intersection of South Main Street and Rice Road also known as Victor Pelletier Square is a three-legged "T" intersection with a two-lane approach for the westbound traffic. It provides a westbound right-turn only lane to form the second lane. As stated earlier, Rice Road has an acute angle of intersection towards South Main Street, however, the last 95' of the approach is realigned to form an angle much closer to 90 degrees for traffic entering and those exiting Rice Road heading to points south. The South Main Street approaches of this intersection have one lane each. Finally, the westbound right-turn lane is posted with a stop sign, but no stop signs were observed for the westbound left-turn lane.

Intersection of Providence Street and Rice Road is also a three-legged intersection with one lane in each direction for its approaches. The Rice Road approach of this intersection forms a "Y" intersection due to the acute angle of intersect. There is no stop or yield control sign posted for the eastbound approach of Rice Road at this intersection.

Traffic Volumes

Due to the reductions in traffic volumes caused by the Covid-19 pandemic, taking new traffic counts in 2021 may undercount the baseline for which future years are based. Therefore, the peak hour traffic counts were adjusted to pre-Covid-19 conditions using *massDOT* historic traffic data and guidelines.

The new peak hour turning movement counts were collected on Tuesday, March 2, 2021, during two-hour periods between the hours of 7-9 AM and 4-6 PM at peak commuter periods in order to identify the critical peak hour.

To establish the present baseline volumes, the new intersection turning movement counts were adjusted and normalized into the present year (baseline) utilizing the *massDOT* factor as described below. The adjusted peak hour turning movement counts are summarized in the following Table 1. They are also depicted in the following Figure 2.

Table 1
Covid Adjusted and Normalized Peak Hour Turning Movement Counts

	S Main St at Rice Rd						Rice Rd at Thomas Hill Rd						Providence St at Rice Rd					
	NB T	NB R	SB L	SB T	WB L	WB R	NB L	NB R	EB T	EB R	WB L	WB T	EB L	EB R	NB L	NB T	SB T	SB R
AM Peak	22	3	10	30	3	8	3	4	11	5	3	7	8	4	2	197	145	5
PM Peak	30	3	12	49	8	10	3	1	7	3	5	12	5	3	6	191	240	10

A more concise method is using the *massDOT* guidance as prescribed in an engineering directive. The *massDOT* Yearly Growth Rates data from 2014 -2019 are shown in the Technical Appendix. The growth rates go back to 2014, and therefore, the rates were averaged and then expanded to a two-year period to adjust for the Covid-19 pandemic and then a five-year period to account for the future no-build and build conditions. The average annual growth rate was calculated at 0.0034. This rate was multiplied by two to get the total increase rate of 0.0068 for the Covid-19 adjustment and then multiplied by five to get the total increase rate of 0.0175 for future conditions. Therefore, the turning movement counts were increased by these factors. Again, as per *massDOT* guidance, this increase also accounts for all future traffic from any other additional developments that may take place in the general area of the proposed development site between now and the year 2026.

Additionally, the *massDOT* Highway Division provides statewide traffic data collection that includes weekday seasonal factors. To evaluate the potential for seasonal fluctuation of traffic volumes on roadways near the proposed site, weekday seasonal factors were obtained from the *massDOT* Statewide Traffic Data Collection. The data indicated that the seasonal factor for traffic collected during the month of March is 1.11 for R4-7 category roadways. Usually, the TMCs are multiplied by the factor of 1.11 to reflect those of the yearly average. Therefore, the extrapolated data were further adjusted to reflect those of an average year. A copy of adjustment factors is presented in the Technical Appendix section of this report. The seasonally adjusted turning movement counts are shown in Figure 3.

Typically, the PM peak period has the higher volumes, and is considered the critical peak. As is the case here, higher traffic volumes also occur during the PM peak period at these intersections. Percentage of truck traffic at permanent counting station #240695 along South Main Street was recorded by the *massDOT* at 1.7%. This rate includes all vehicles having three axles, some of which provide services to the residential properties along South Main Street. This rate is considered average to slightly below average for roadways having similar characteristics. Again, Figure 3 depicts the base line turning movement counts that were adjusted to reflect an average year for the year 2021.

Figure 2
Existing Turning Movement Counts COVID Adjusted

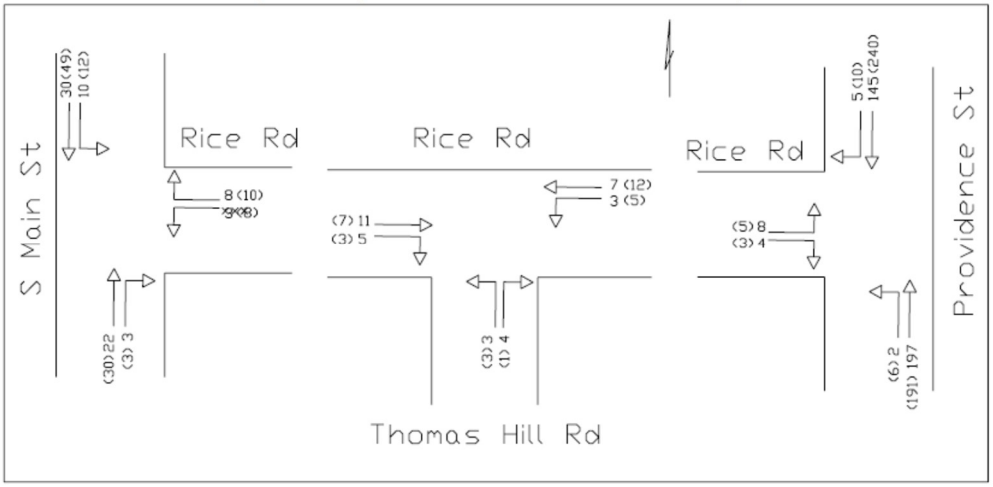
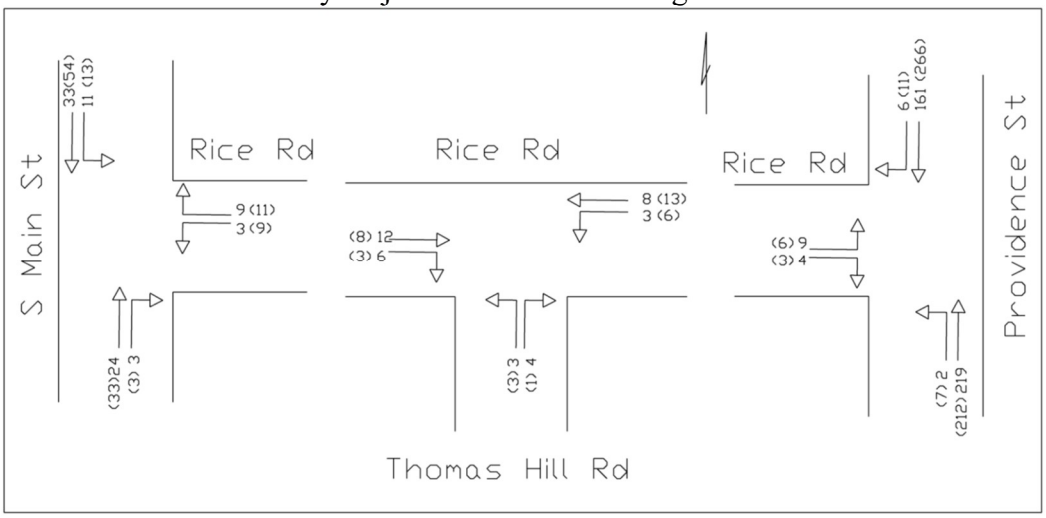


Figure 3
Seasonally Adjusted Baseline Turning Movements



Safety Concerns

Sight Distances: The sight distances for vehicles leaving the site via the proposed driveway to the right (west) and left (east) of the proposed site driveway were measured in the field. The measured distances are those from a point 5' back of a stop bar (approximately 15' from the street line) and 3.5' above grade to represent drivers' eye height to an object 3.5' above roadway grade. The field review of Rice Road showed that the available sight line for the traffic coming out of the proposed site driveway is approximately 500'+ to the right (west) and 350’ to the left (east). As stated earlier, no speed limit signs are posted on Rice Road. Therefore, the statutory prima facie speed limit of 30 miles per hour applies.

Based on Basic Design Controls for roadway design, the Stopping Sight Distance is calculated using the formula d=(V*V)/(30*f), plus the time required for perception and reaction by a driver (2.5 seconds). V is approach speed in mph, and f=0.28-0.35. The stopping sight distances are calculated and are provided in Exhibit 3-8 of the 2006 *massDOT* Project Development and Design Guide. A copy of this exhibit is presented in the Technical Appendix section of this report. The required stopping sight distance for 30 miles per hour on Rice Road is 200'.

The following photographs illustrate the available sight distances visually for both directions of Rice Road at the proposed site driveway. Clearly, utility pole #6 (not shown in photo) will be removed from the proposed site entrance and relocated.

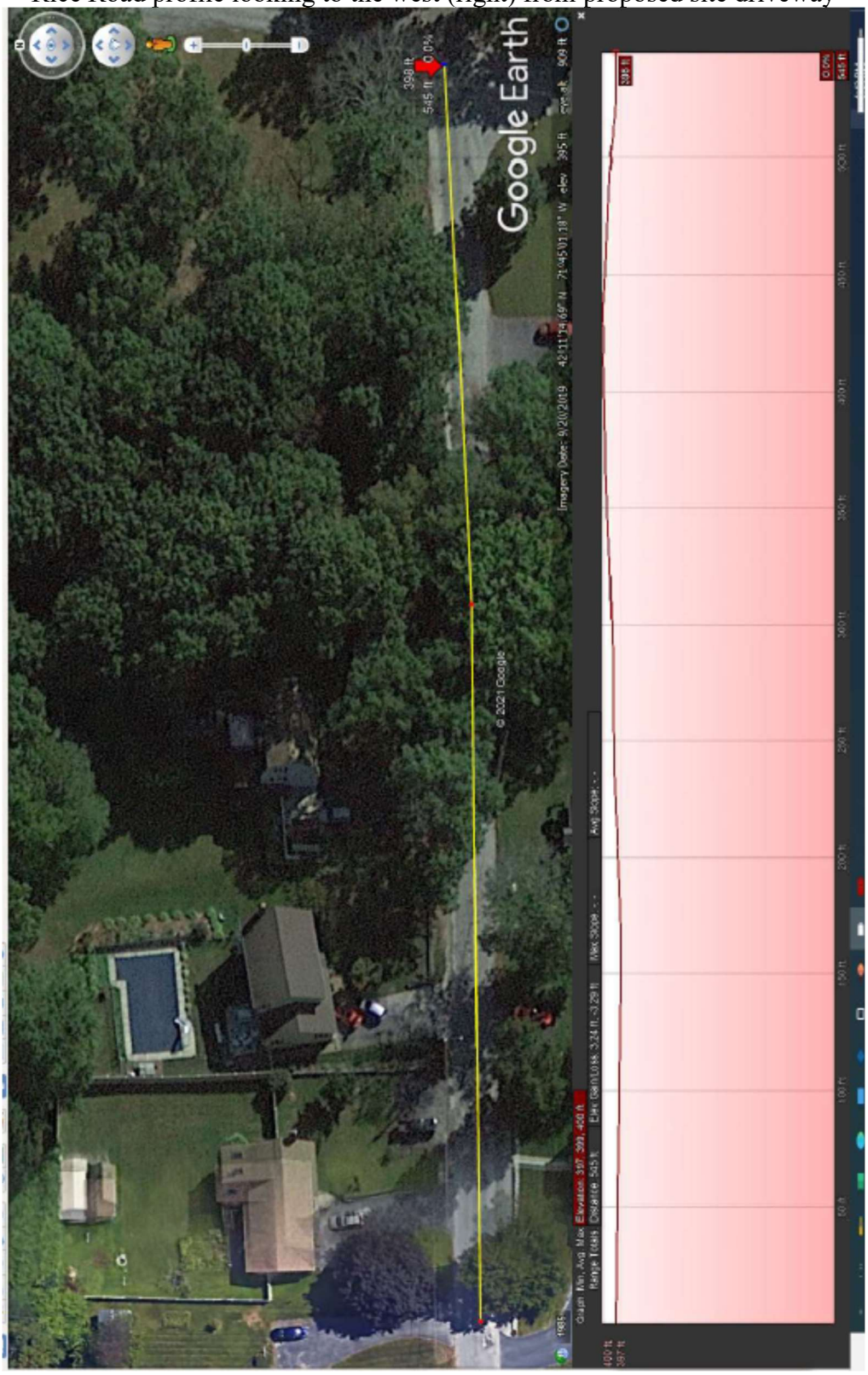
The sight distances were examined both horizontally and vertically. The following Google Earth aerials show the grade profile of Rice Road in respect to the proposed site driveway in both directions.

From proposed Driveway looking to the right (west)

From proposed Driveway looking to the left (east)

Rice Road profile looking to the east (left) from proposed site driveway

Rice Road profile looking to the west (right) from proposed site driveway



As demonstrated herein above, available sight distances are significantly greater than the required values. Therefore, proper sight distances in both directions will be provided along Rice Road for vehicles entering and exiting the proposed site.

Accidents: The latest accident data compiled by the *massDOT* were obtained and reviewed for a three-year period of 2018-2020. This review revealed that no accidents were reported for any of these intersections during this three-year period. Therefore, it is concluded that no safety issues could be associated with these intersections. There was one accident recorded in front of #9 Rice Road that is approximately 400' west of the proposed site driveway. This accident occurred on March 17, 2019 at 3:00 PM and it involved a single vehicle backing out and hitting a parked car. This accident involved no injuries.

Existing Conditions Summary

Rice Road can be characterized as a two-way roadway with one travel lane in each direction along its length in the vicinity of the proposed multifamily residential development site. However, Rice Road at its intersections with South Main Street has a dedicated right-turn lane and a left-turn lane separated by a triangular traffic island. The roadway width varies from 20' to 22', and it is approximately 1,700' in length. It connects South Main Street to Providence Street. It is a residential roadway and has a combination of gentle horizontal and vertical curves on either side of the proposed site driveway.

The current land use designation for the proposed multifamily development site is R-1, and the site is currently undeveloped.

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FUTURE CONDITIONS

Where possible, traffic volumes in the study area are projected to post-development levels. Projected traffic volumes include the existing traffic data obtained from the turning movement counts, adjusted and normalized into the year 2021 to account for the Covid-19 pandemic and to represent the baseline, then projected into the future no build (year 2026) to reflect increases due to future area projects, and finally, added to the new traffic expected to be generated by the proposed multifamily residential development to represent future build conditions.

Site-Generated Traffic

The magnitude of traffic volumes that will be generated by the proposed development was projected by using the *Trip Generation*[1] *Manual* published by the Institute of Transportation Engineers (ITE) and its computer software.

Based on the ITE *Trip Generation Manual*, the rates at which the proposed land use generates traffic vary depending upon the time of day. These rates were used to calculate the number of trips expected to be generated by the proposed multifamily residential development during an average weekday morning and afternoon peak traffic periods. To obtain the most accurate forecast and to be consistent with the requirements of the *massDOT* guidelines, when available, the fitted curves in the *Trip Generation Manual* were used to forecast trips to and from the proposed site for daily and both peak hours. The ITE trip tabulations outputs are presented in the Technical Appendix section ofthis report. The resulting trips and their directional distribution for this site are shown in the following Table 2.

TABLE 2
ITE Trip Generation for Multi-Family Development
52 Units Multifamily Condo Housing-Attached LU Code 220

Daily	%In	%Out	AM Pk	%In	%Out	PM Pk	%In	%Out
7.32	50%	50%	0.46	23%	77%	0.56	63%	37%
381	190	191	26*	6*	20*	33*	21*	12*

* *Fitted Curve values were used as they were greater than Average values*

As can be seen in Table 2 above, the total number of new trips expected to be generated by the proposed multifamily residential development results in the highest traffic during PM peak period, thus making the PM peak hour the critical peak. In standard traffic engineering practice, the critical peak period trips are usually used to evaluate the worst-case scenario. However, both the AM and

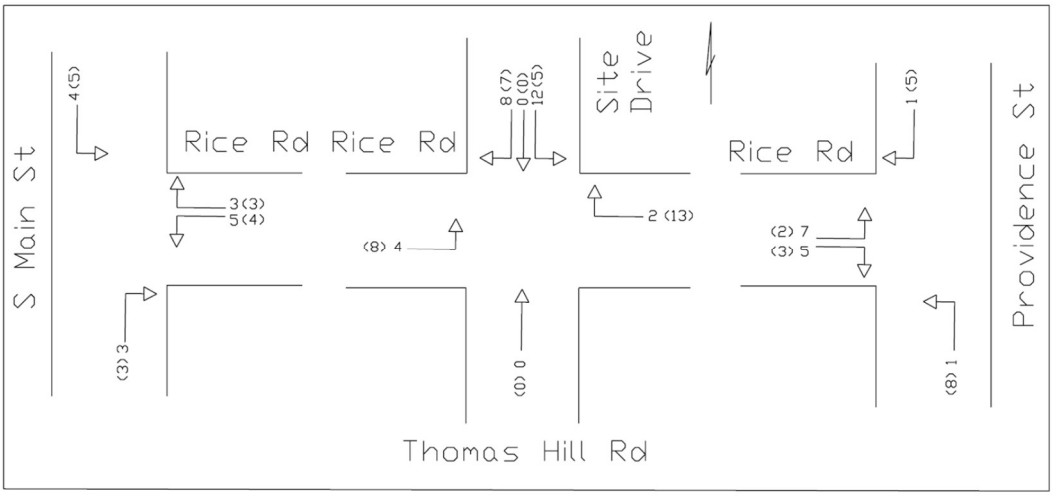
PM peak traffic periods were evaluated for all three intersections.

Trip Distribution and Assignment

Because such factors as population density, land use, availability of major highways in the area, and other demographics that make up the traffic patterns within a community, the directional distribution of the projected site-generated trips to and from the proposed multifamily residential development site was based on the existing traffic patterns within the immediate vicinity of the site and based on the knowledge of local traffic patterns. The turning movement traffic counts for the intersection of Rice Road with South Main Street, Thomas Hill Road, and Providence Street are good indicators of the traffic patterns in this area.

Using this information, the projected new site-generated trips from Table 2 are proportionally assigned to each approach of these intersections. As shown in Table 2 above and Figure 4 below, during AM peak period, a sum of six vehicles would be arriving at the proposed development site and 20 vehicles would be departing from the site in both directions along Rice Road via the proposed site driveway. During PM peak period, a total of 21 vehicles are expected to arrive at and 12 vehicles would depart from the proposed site via the proposed site driveway. Finally, a total of 190 vehicles will be arriving at and 91 vehicles will be departing from the proposed site during a 24-hour period on an average day.

Figure 4
Trip Generation and Distribution



[1] *Trip Generation, 10th Edition,* Institute of Transportation Engineers; Washington,

Site Access and Circulation

Site access and internal traffic circulation was evaluated as part of assessing the proposed residential development site. Access to the proposed site is achieved through a driveway located directly opposite Thomas Hill Road, forming a four-legged intersection. The proposed site driveway provides full access to all condominium units. This driveway is intended to accommodate all traffic to and from the proposed development leading up to the individual units in a safe and efficient manner. The site driveway is 24' in width for its entire length.

The site driveway provides connection from Rice Road to all units and their driveways and garages. The individual condominium driveways' pavement width is 20' to accommodate two-car garages, as well as parking outside for two vehicles.

Also, as stated earlier, each unit will have off-street parking for four vehicles, two in garages and two in driveways. This will eliminate the potential for on-street parking activities alongside the site driveway, thus maintaining optimum safety for residents driving through the development. Additionally, the proposed site provides 10 extra off-street parking spaces strategically located for guests. This translates into 4.2 parking spaces per unit.

The magnitude of parking spaces that will be required by the proposed residential development was forecasted by using the *Parking Generation*[1] document published by the Institute of Transportation Engineers (ITE).

Based on the ITE Parking Generation document, the rates at which Residential Condominiums/Townhouses (land use 230) generate demand for parking vary depending upon the location of the project. The demand for off-street parking is greatest for residences located in suburban areas primarily due to the lack of public transportation and long distances from daily conveniences. The 85th percentile or peak period parking demand rate for residential condominiums/townhouses located in suburban areas is 1.68 parking spaces per unit. Not accounting for parking in individual driveways, this translates into 30% more parking spaces than will be needed during an average weekday peak period. Accounting for parking within individual driveways will result in 150% more parking than demand during peak.

[1] *Parking Generation,* Institute of Transportation Engineers; Washington, DC

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TRAFFIC OPERATIONS

Measuring existing traffic volumes and projecting future traffic volumes quantify traffic flow within the study area. To assess the quality of traffic flow, intersection capacity analyses were performed to measure existing baseline conditions and for projected future design year (2026) conditions with and without the implementation of the proposed residential development project. Intersection capacity analyses provide an indication of how well roadway facilities and their components serve the traffic demands placed upon them. This section includes potential on-site and off-site mitigation improvements should any be deemed necessary to minimize the impact of the proposed multifamily development on the surrounding roadways.

Traffic operations measures

Level of service (LOS) is the term used to demonstrate the different operating conditions which occur on a given roadway segment or at an intersection under different traffic volume conditions. LOS is a qualitative measure of the effect of several other factors including roadway geometry, speed, travel delay, signal timing, freedom to maneuver and safety. The criteria used to analyze the intersections within 1,000' of the proposed development site are based on the Highway Capacity Manual and its computer software, Synchro. The computer output sheets are presented in the Technical Appendix section of this report.

The LOS concept is an indicator of the operational qualities of a roadway or an intersection. Six LOSs are defined for each type of facility. They are given letter designations from "A" to "F". LOS "A" represents the best operating conditions, while LOS "F" represents the worst. Typically, LOS "D" is considered acceptable during peak hour conditions, but LOS "E" may also be acceptable under some circumstances.

The LOS designation is reported differently for signalized and unsignalized intersections. For signalized intersections, the analysis considers the operation of all traffic entering the intersection, and a LOS designation can be calculated for overall conditions at the intersection. For an unsignalized intersection, however, the analysis assumes that through traffic on major roadways is not affected by traffic on side streets (streets with lower volumes and/or ones under stop sign control). Therefore, a LOS designation is typically calculated for the controlled movements (minor street approaches and major street left-turn movements). As described in the following paragraphs, capacity or LOS analyses were considered for year 2021 existing, year 2026 future no build, and year 2026 future build conditions for morning and evening peak hour periods at the above-mentioned intersections, including the proposed site driveway.

Existing Conditions

Intersection capacity analyses were performed for all three intersections during morning and evening peak traffic periods. These intersections are the only locations within 1,000', or the immediate vicinity of the proposed development site that may be affected by the traffic expected to be generated by the proposed residential development.

The analysis concluded that LOS "A" is calculated for all approaches of these intersections during AM and PM peak periods, except for the eastbound approach of Rice Road at Providence Street which is operating at LOS "B" during both AM and PM peak periods. A summary of intersection analyses results for existing conditions is shown below in Table 3.

Future Conditions

Capacity analyses for the future year peak hour traffic operations were performed for the year 2026 volumes during both peak periods with and without the proposed multifamily development project in place. A summary of intersection analyses results for both future no-build and future build conditions is also shown below in Table 3.

As noted earlier in this report, in projecting the year 2026 future no-build traffic volumes, the latest *massDOT* available statistics were used. As stated earlier under the Traffic Volumes section, the growth rates that go back to 2014 were averaged and then applied to expand to a five-year period in order to represent the buildout year. The average annual growth rate over the past five-year period was calculated at 0.0034. Therefore, the baseline volumes were increased by that rate over five years. Figure 5 shows the volumes for the future no-build conditions for all three intersections within the study area. The projected future no build year (2026) traffic should account for any future developments in the general area of the proposed site.

Build traffic volumes were determined by projecting site-generated traffic volumes and distributing those volumes over the intersections within the study area, and finally, adding them to the future no-build conditions volumes. Figure 6 shows future build conditions traffic volumes for all three intersections, including the proposed site driveway that forms the fourth leg of the intersection of Rice Road and Thomas Hill Road.

Figure 5
Turning Movement Counts, Future No Build Conditions

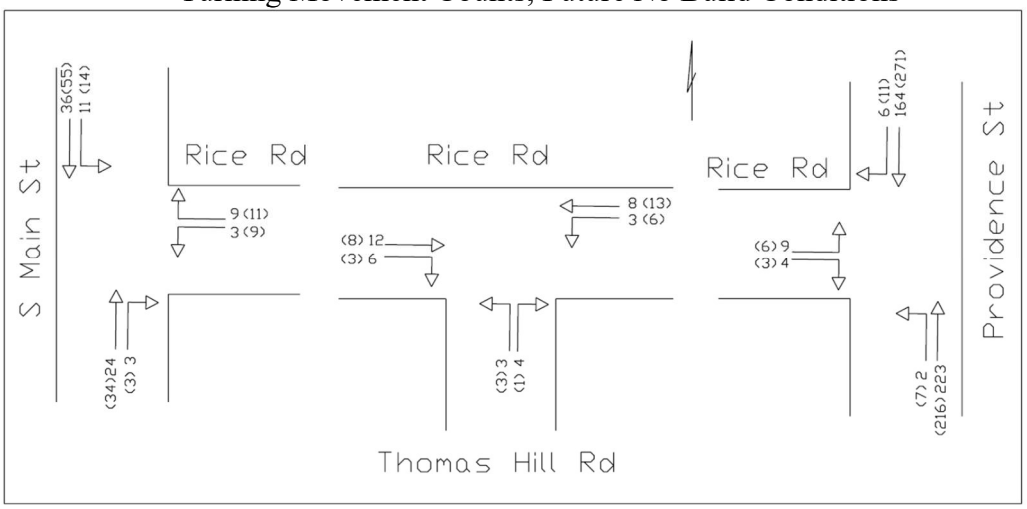
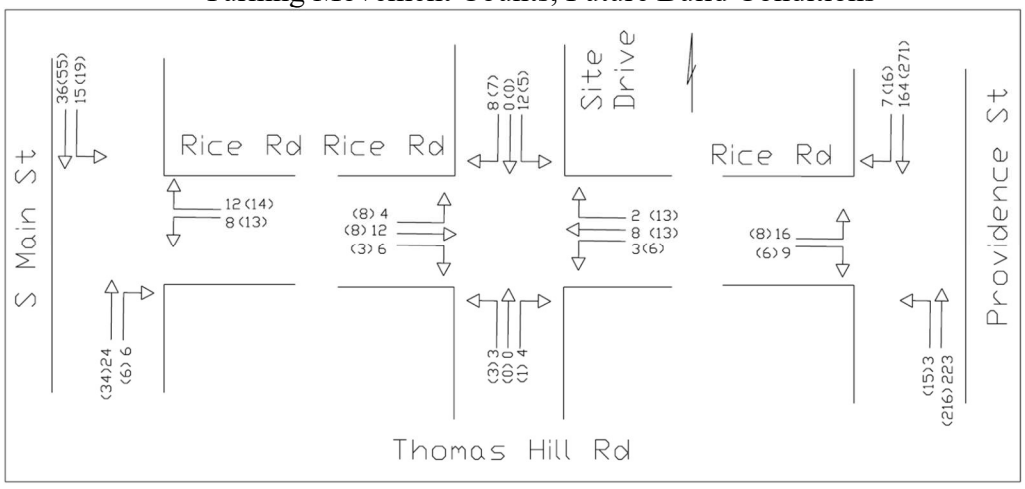


Figure 5
Turning Movement Counts, Future Build Conditions



The intersection LOSs for the year 2026 no-build conditions were calculated for the approaches of these intersections and are expected to be "A" during both peak periods except the eastbound approach of Rice Road at its intersection with Providence Street which will be operating at LOS "B", signifying no increase in vehicular delays.

To assess the potential traffic impact of the proposed development on these intersections, all traffic from the site was distributed along Rice Road and its three intersections. This will result in the assessment of these intersections under worst-case scenario. The above Figures 3, 4 and 5 show the traffic volumes at all intersections for the AM and PM peak hours under existing, future no-build, and future build conditions.

The intersection analysis for the year 2026 build conditions were performed for approaches of all three intersections including the site driveway. The analysis revealed that under future build

conditions, all three existing intersections will continue to operate the same as the future no-build with LOS "A" except for the eastbound approach of Rice Road at Providence Street which, again will be operating at LOS "B".

Again, the above-mentioned LOSs "A" and "B" for all existing intersections for future no-build and build conditions are indicative of no impact associated with the development of the proposed multifamily project.

A summary of intersection analyses for all three intersections, including the proposed driveway that forms the fourth leg of the intersection of Rice Road and Thomas Hill Road is also provided herein below in Table 3.

Table 3
Level Of Service Analysis Results Summary

South Main Street at Rice Road AM Peak									
	Existing 2021			No Build 2026			Build 2026		
Approach	SB L	WB L	WB R	SB L	WB L	WB R	SB L	WB L	WB R
App Delay	1.9	9	8.5	1.7	9	8.5	2.2	9.1	8.5
v/c	0.01	0.00	0.01	0.01	0.00	0.01	0.01	0.01	0.01
App LOS	A	A	A	A	A	A	A	A	A
Int Av Dela	2.2			2.2			2.8		
Int LOS	A			A			A		

Rice Road at Thomas Hill Road AM Peak										
	Existing 2021			No Build 2026			Build 2026			
Approach	EB	WB	NB	EB	WB	NB	EB	WB	NB	SB
App Delay	0	2	8.5	0.0	2	8.5	1.3	1.7	8.6	8.7
v/c	0.01	0.00	0.01	0.01	0.00	0.01	0.00	0.00	0.01	0.2
App LOS		A	A		A	A	A	A	A	A
Int Av Dela	2.3			2.3			4.6			
Int LOS	A			A			A			

PM Peak	Existing 2021			No Build 2026			Build 2026		
Approach	SB L	WB L	WB R	SB L	WB L	WB R	SB L	WB L	WB R
App Delay	1.5	9.2	8.6	1.5	9.2	8.5	2	9.4	8.5
v/c	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01
App LOS	A	A	A	A	A	A	A	A	A
Int Sig Dela	2.2			2.2			2.7		
Int LOS	A			A			A		

PM Peak	Rice Road at Thomas Hill Road PM Peak									
	Existing 2021			No Build 2026			Build 2026			
Approach	EB	WB	NB	EB	WB	NB	EB	WB	NB	SB
App Delay	0	2.3	8.6	0.0	2.3	8.6	1.3	1.4	8.8	8.7
v/c	0.01	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.01
App LOS		A	A		A	A	A	A	A	A
Int Av Dela	2.3			2.3			3.6			
Int LOS	A			A			A			

Providence Street at Rice Road AM Peak									
	Existing 2021			No Build 2026			Build 2026		
Approach	NB L	SB R	EB	NB L	SB R	EB	NB L	SB R	EB
App Delay	0.1	0	10.6	0.1	0	10.7	0.1	0	10.7
v/c	0	0.11	0.02	0.0	0.11	0.02	0	0.11	0.4
App LOS	A		B	A		B	A		B
Int Av Dela	0.4			0.4			0.7		
ICU LOS	A			A			A		

PM Peak	Existing 2021			No Build 2026			Build 2026		
Approach	NB L	SB R	EB	NB L	SB R	EB	NB L	SB R	EB
App Delay	0.3	0	11.5	0.3	0	11.6	0.6	0	11.6
v/c	0.01	0.18	0.02	0.01	0.18	0.02	0.01	0.18	0.3
App LOS	A		B	A		B	A		B
Int Sig Dela	0.3			0.3			0.6		
Int LOS	A			A			A		

Finally, the computer printout of the above-mentioned analysis are presented and included in the Technical Appendix of this report.

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FINDINGS

This traffic study has been conducted to evaluate the potential traffic impacts associated with the proposed multifamily residential development site located north of Rice Road in Millbury, Massachusetts. This study includes the evaluation of three unsignalized intersections in proximity of the proposed site which are likely to be impacted by traffic from the proposed development project. Evaluation of the area to identify capacity constraints was performed for existing, future no-build, and future build conditions. Future analyses have determined that the site-generated traffic volumes are not significant and they can safely be accommodated with the existing roadways and the proposed site driveway. These analyses demonstrated that with the additional traffic volumes associated with the proposed multifamily development, the intersection LOSs would be "B" or better. The analysis showed that the intersection of Rice Road, Thomas Hill Road and the site driveway will be operating at LOS "A" during both AM and PM peak periods.

As stated earlier, the percentage of truck traffic at permanent counting station #3989 along South Main Street was recorded by the *massDOT* at 1.7%. This value is considered average to slightly below average for roadways having similar characteristics.

Conclusion & Recommendations

It is concluded that the area roadways within the vicinity of the proposed development site have enough capacity to safely serve the anticipated additional traffic associated with the proposed multifamily development. The level of service evaluation presented herein above is an indicator of the quality of traffic flow through the area. This evaluation indicates that the LOSs are not expected to change and will not fall below "B" at the intersections studied.

It should be noted that, the applicant will need to make an effort to trim vegetation along the frontage of the proposed site along Rice Road, particularly to the west, in order to further enhance the sight distances for vehicles leaving the site.

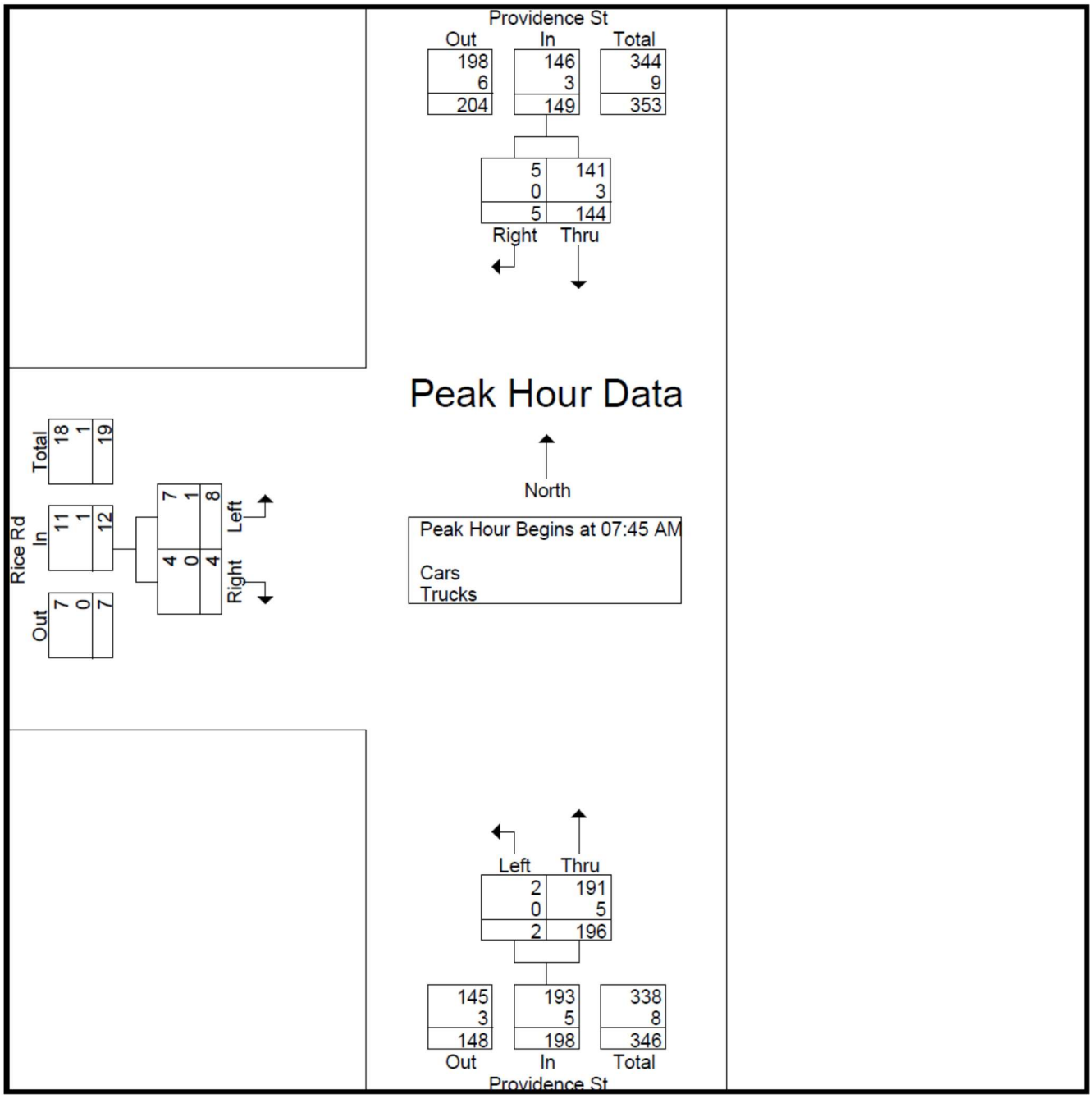
Therefore, to maintain optimum safety and efficiency, the following improvements are recommended.

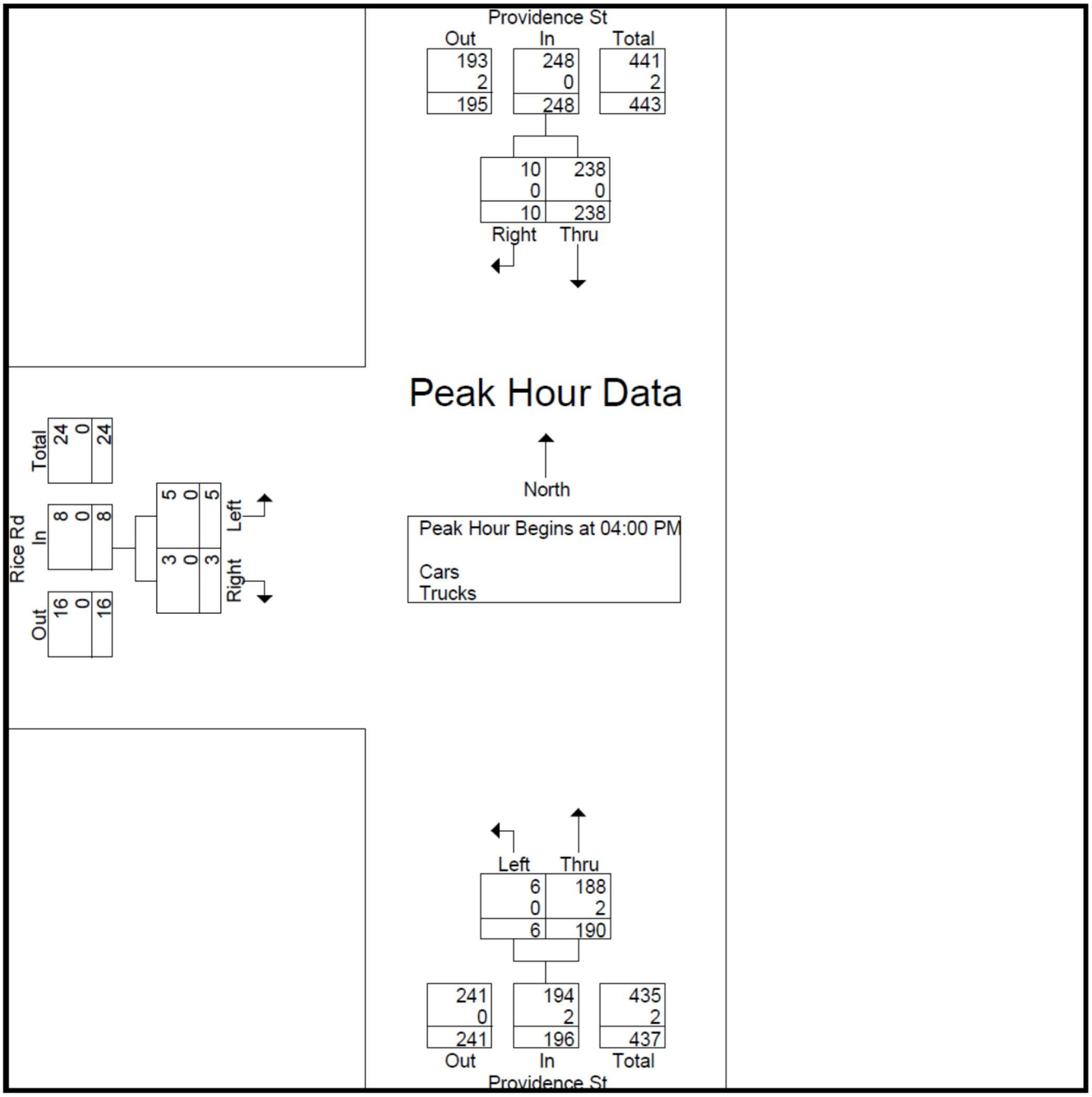
1. The site frontage on the north side of Rice Road to the west of the intersection of Rice Road and the access driveway should be graded and cleared of tall vegetation to further improve the sight distance to the west (right).
2. Any landscaping along the frontage of the proposed site on Rice Road should be limited to vegetation variety that does not grow higher than 2.5' to ensure best sight distances are provided.
3. It is recommended that stop signs be installed for both the northbound approach of Thomas

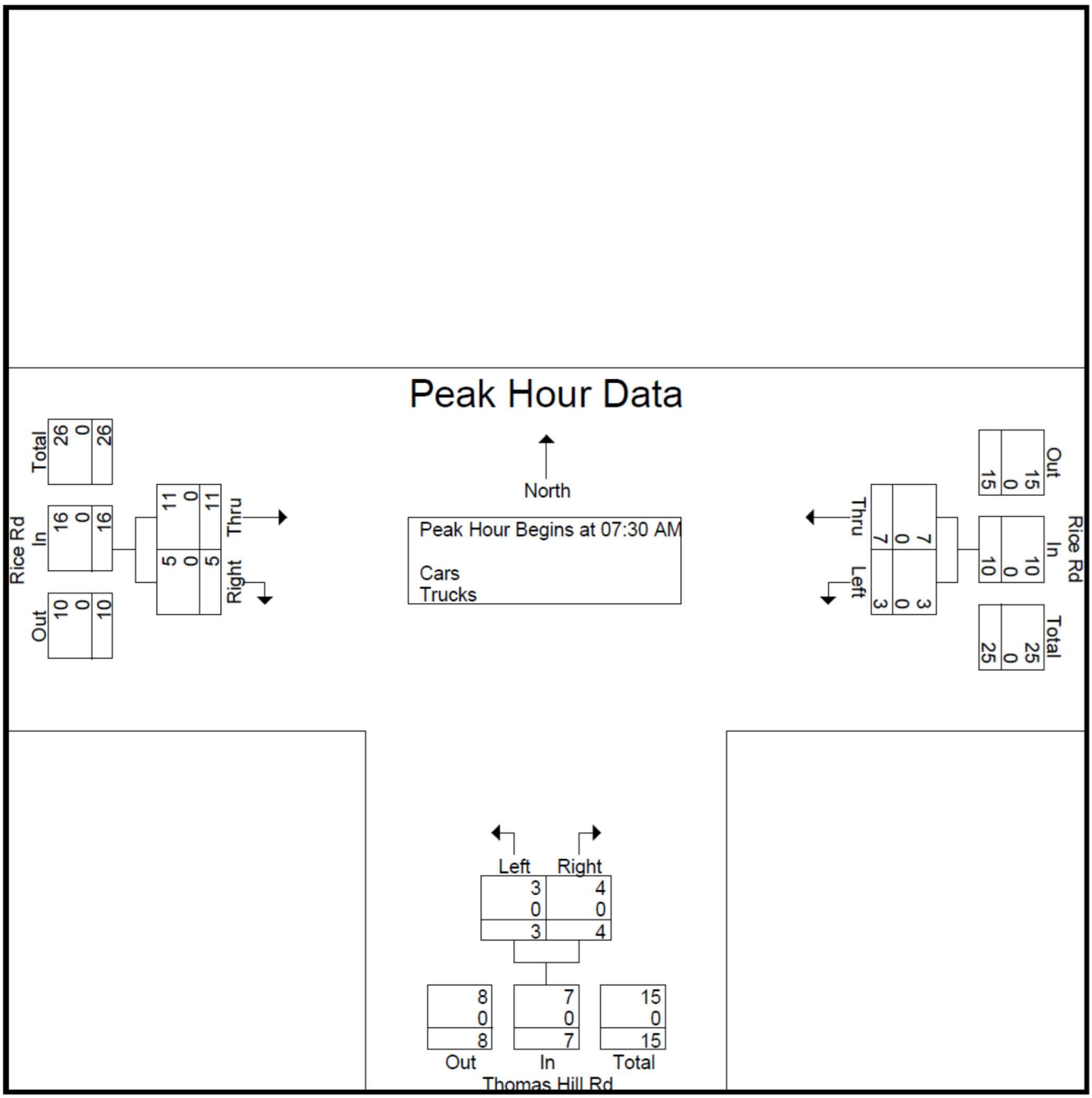
Hill Road and the southbound approach of the proposed site driveway at Rice Road.

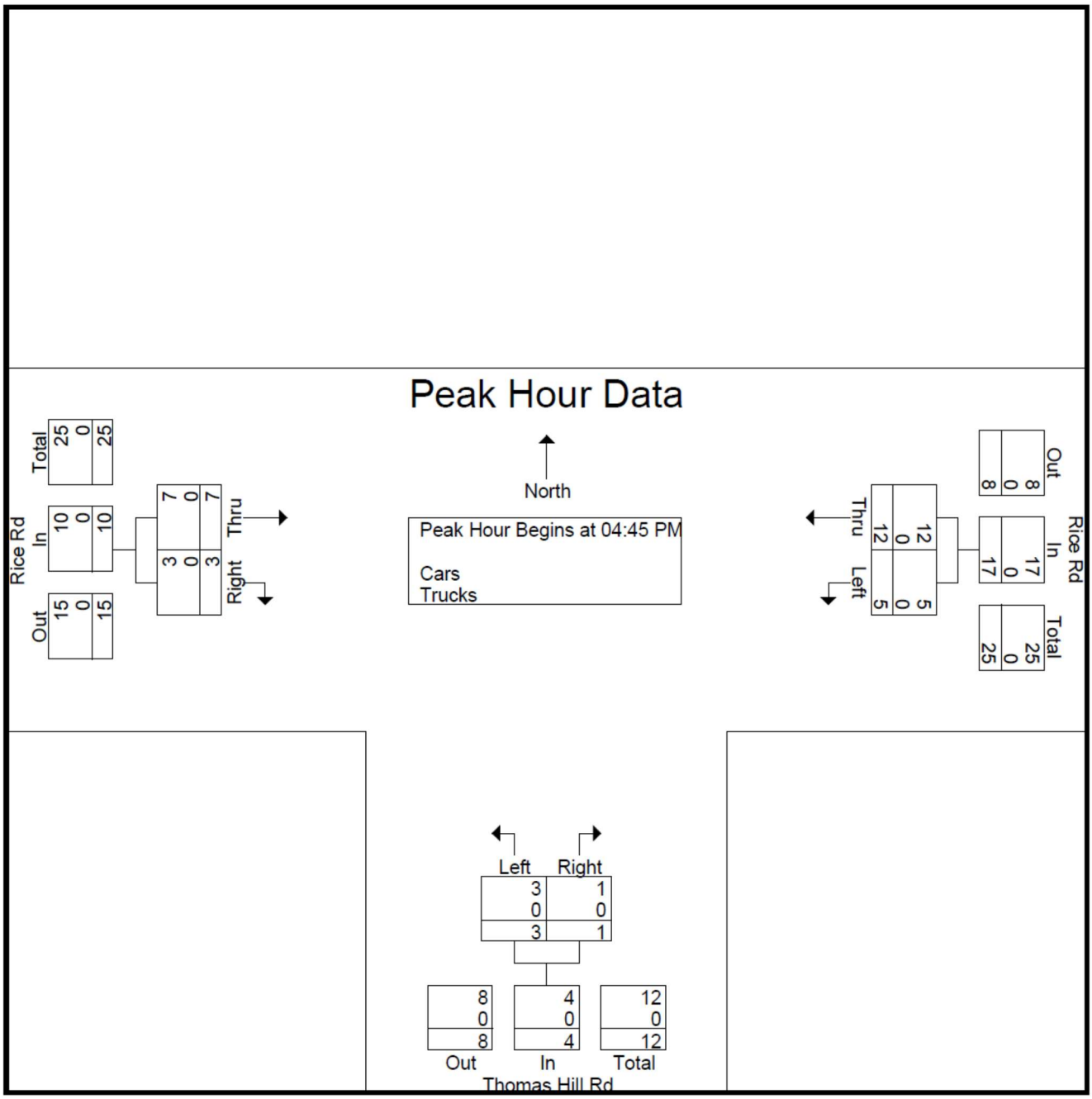
4. Finally, it is recommended that a stop sign be installed for the eastbound approach of Rice Road at its intersection with Providence Street.

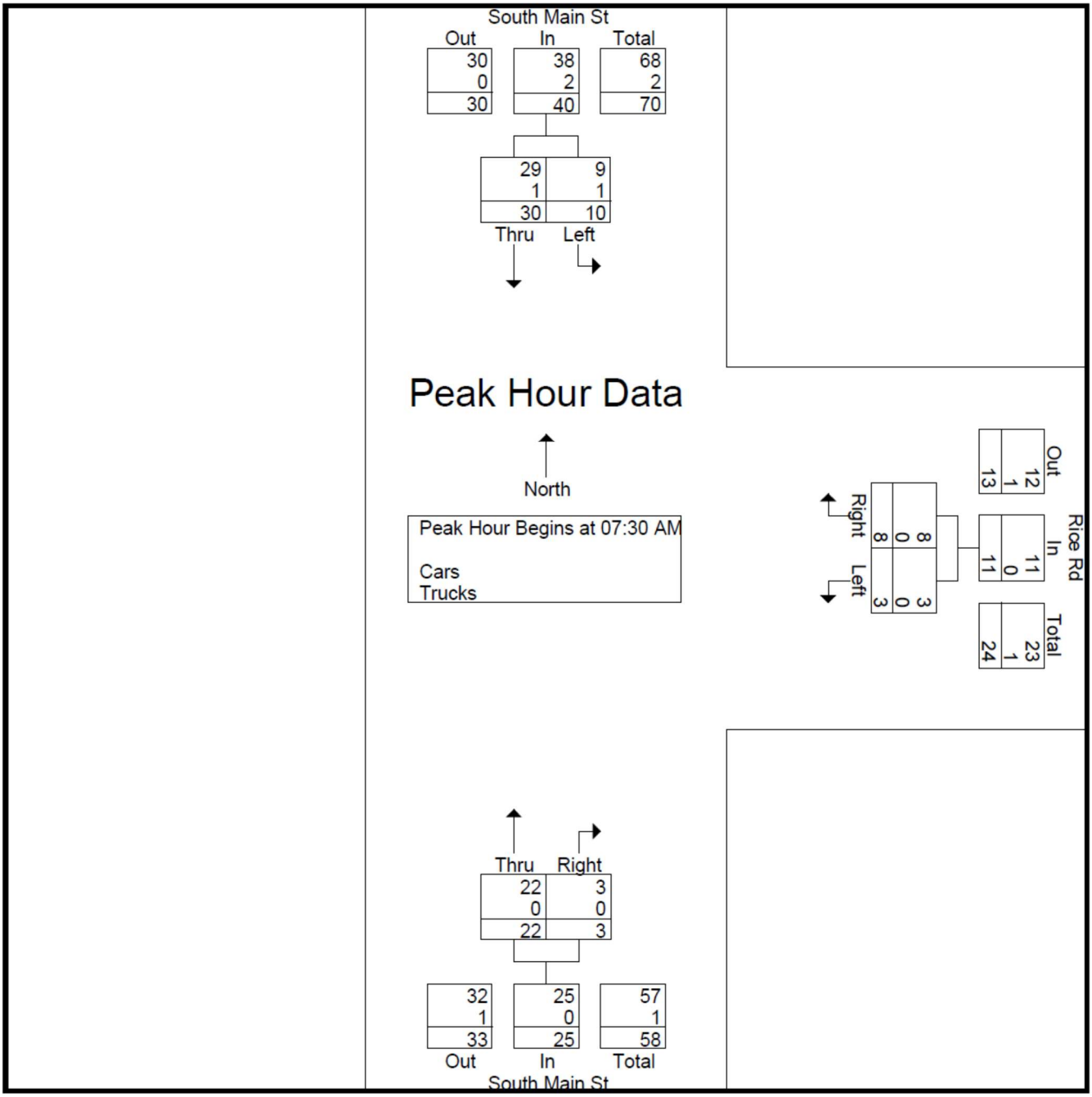
Technical Appendix


Providence St
Out In Total
198 146 344
6 3 9
204 149 353
5 141
0 3
5 144
Right Thru
Peak Hour Data
North
Peak Hour Begins at 07:45 AM
Cars
Trucks
Rice Rd
Total 18 1 19
In 11 1 12
Out 7 0 7
7 1 8
4 0 4
Left
Right
Left Thru
2 191
0 5
2 196
145 193 338
3 5 8
148 198 346
Out In Total
Providence St


Providence St
Out In Total
193 248 441
2 0 2
195 248 443
10 238
0 0
10 238
Right Thru
Peak Hour Data
North
Peak Hour Begins at 04:00 PM
Cars
Trucks
Rice Rd
Total 24 0 24
In 8 0 8
Out 16 0 16
5 0 5 Left
3 0 3 Right
Left Thru
6 188
0 2
6 190
241 194 435
0 2 2
241 196 437
Out In Total
Providence St


Peak Hour Data
North
Peak Hour Begins at 07:30 AM
Cars
Trucks
Rice Rd
Total
26
0
26
In
16
0
16
Out
10
0
10
Thru
11
0
11
Right
5
0
5
Rice Rd
Out
15
0
15
In
10
0
10
Total
25
0
25
Thru
7
0
7
Left
3
0
3
Left
Right
3
0
3
4
0
4
Out
8
0
8
In
7
0
7
Total
15
0
15
Thomas Hill Rd


Peak Hour Data
North
Peak Hour Begins at 04:45 PM
Cars
Trucks
Rice Rd
Total
25
0
25
In
10
0
10
Out
15
0
15
7
0
7
Thru
3
0
3
Right
Thru
12
0
12
Left
5
0
5
Out
8
0
8
In
17
0
17
Total
25
0
25
Left
Right
3
0
3
1
0
1
8
0
8
4
0
4
12
0
12
Out
In
Total
Thomas Hill Rd


South Main St
Out In Total
30 38 68
0 2 2
30 40 70
29 9
1 1
30 10
Thru Left
Peak Hour Data
North
Peak Hour Begins at 07:30 AM
Cars
Trucks
Out
12
1
13
Right
8
0
8
In
11
0
11
Rice Rd
Left
3
0
3
Total
23
1
24
Thru Right
22 3
0 0
22 3
32 25 57
1 0 1
33 25 58
Out In Total
South Main St

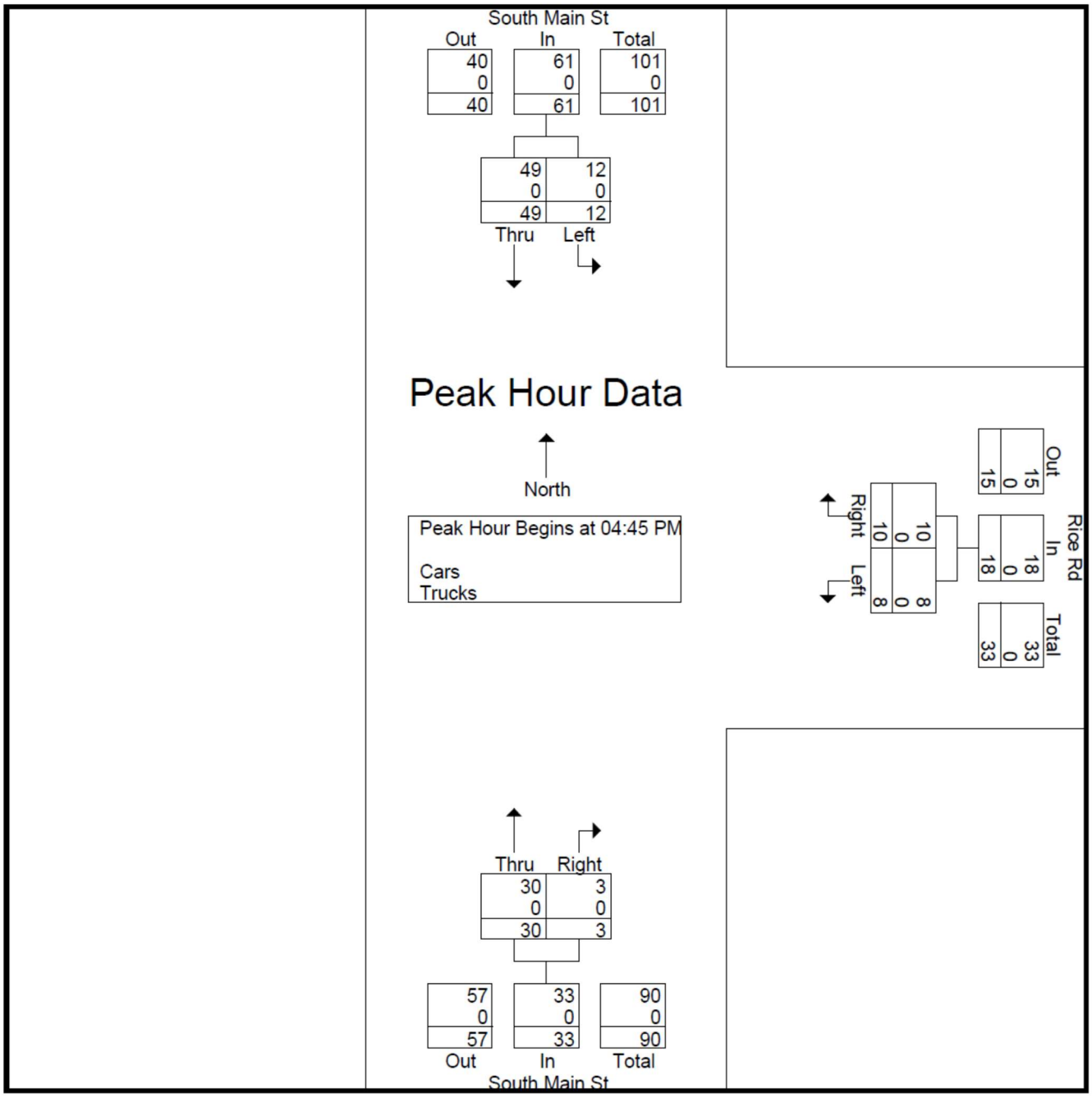

South Main St
Out In Total
40 61 101
0 0 0
40 61 101
49 12
0 0
49 12
Thru Left
Peak Hour Data
North
Peak Hour Begins at 04:45 PM
Cars
Trucks
Out
15
0
15
Right
10
0
10
Left
8
0
8
Rice Rd
In
18
0
18
Total
33
0
33
Thru Right
30 3
0 0
30 3
57 33 90
0 0 0
57 33 90
Out In Total
South Main St

Exhibit 3-8
Motor Vehicle Stopping Sight Distances

	Stopping Sight Distance (ft) by Percent Grade (%)						
		Downgrade			Upgrade		
Design Speed	0	3	6	9	3	6	9
20	115	116	120	126	109	107	104
25	155	158	165	173	147	143	140
30	200	205	215	227	200	184	179
35	250	257	271	287	237	229	222
40	305	315	333	354	289	278	269
45	360	378	400	427	344	331	320
50	425	446	474	507	405	388	375
55	495	520	553	593	469	450	433
60	570	598	638	686	538	515	495
65	645	682	728	785	612	584	561
70	730	771	825	891	690	658	631
75	820	866	927	1003	772	736	704

Source: A Policy on Geometric Design of Streets and Highways, AASHTO, Washington DC, 2004. Chapter 3 Elements of Design

MassDOT Yearly Growth Rates

Data from 2014 to 2018

Growth Factors					
Group	Grow 2014 to 2015	Grow 2015 to 2016	Grow 2016 to 2017	Grow 2017 to 2018	Grow 2018 to 2019
R1	0	0.023	0.004	0.018	0.016
R2	0.05	0.068	0.004	0.014	0.014
R3	-0.038	0.002	0.008	0.011	0.06
R4-7	-0.01	0.003	0.001	0.011	0.012
Rec - East		0.032	0.02	0.041	0.025
Rec - West		0.051	-0.008	0.029	0
U1-Boston	0.061	0.07	-0.003	0.012	0.006
U1-Essex	0.024	0.025	0.007	0.014	0.011
U1-Southeast	0.05	0.062	0.021	0.014	0
U1-West	0.03	-0.027	0.02	0.028	0.013
U1-Worcester	0.042	0.005	0.018	0.01	0.01
U2	0.04	0.048	0.008	0.01	0.02
U3	0.011	0.013	0.011	0.014	0.004
U4-7	0.023	0.062	0.017	0.003	-0.004

updated
5/1/2020

Massachusetts Highway Department
Statewide Traffic Data Collection
2019 Weekday Seasonal Factors

Factor Group	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Axle Factor
R1	1.22	1.14	1.12	1.06	1.00	0.96	0.87	0.85	0.96	0.99	1.04	1.12	0.85
R2	0.95	0.96	0.98	0.97	0.97	0.93	0.97	0.94	0.96	0.90	0.92	0.93	0.96
R3	1.15	1.06	1.07	1.00	0.89	0.88	0.89	0.89	0.95	0.92	1.02	1.01	0.97
R4-R7	1.09	1.09	1.11	1.02	0.96	0.92	0.89	0.89	0.99	0.98	1.09	1.13	0.98
U1-Boston	1.03	1.01	0.98	0.94	0.94	0.92	0.95	0.93	0.94	0.94	0.97	1.04	0.96
U1-Essex	1.09	1.06	1.03	0.99	0.94	0.90	0.88	0.86	0.93	0.94	0.99	1.06	0.93
U1-Southeast	1.06	1.05	1.01	0.97	0.95	0.93	0.93	0.90	0.94	0.94	0.98	1.04	0.98
U1-West	1.19	1.14	1.09	0.95	0.92	0.89	0.89	0.86	0.91	0.95	0.97	1.07	0.84
U1-Worcester	1.02	1.04	0.97	0.94	0.93	0.91	0.95	0.91	0.93	0.92	0.95	1.10	0.88
U2	1.01	1.00	0.94	0.93	0.91	0.89	0.93	0.90	0.90	0.91	0.94	1.02	0.99
U3	1.06	1.03	0.98	0.94	0.93	0.91	0.95	0.91	0.92	0.93	0.97	1.00	0.98
U4-U7	1.01	1.00	0.95	0.92	0.88	0.86	0.92	0.91	0.92	0.94	0.99	1.04	0.99
Rec - East	1.04	1.16	1.12	0.98	0.92	0.88	0.77	0.81	0.94	1.02	1.08	1.12	0.99
Rec - West	1.30	1.23	1.32	1.18	0.95	0.82	0.70	0.69	0.97	0.96	1.16	1.15	0.98

Round off:
0-999 = 10
>1000 = 100

U = Urban
R = Rural

1 - Interstate
2 - Freeway and Expressway
3 - Other Principal Arterial
4 - Minor Arterial
5 - Major Collector
6 - Minor Collector
7 - Local Road and Street

Recreational - East Group - Cape Cod (all towns) including the town of Plymouth south of Route 3A (stations 7014,7079,7080,7090,7091,7092,7093,7094,7095,7096,7097,7108 and 7178), Martha's Vineyard and Nantucket.
Recreational - West Group - Continuous Stations 2 and 189 including stations 1066,1067,1083,1084,1085,1086,1087,1088,1089,1090,1091,1092,1093,1094,1095,1096,1097,1098,1099,1100,1101,1102,1103,1104,1105,1106,1107,1108,1113,1114, 1116,2196,2197 and 2198.

ITE Trip Generation Data

DATA STATISTICS

Land Use:
Multifamily Housing (Low-Rise) (220)
Click for more details

Independent Variable:
Dwelling Units

Time Period:
Weekday

Setting/Location:
General Urban/Suburban

Trip Type:
Vehicle

Number of Studies:
29

Avg. Num. of Dwelling Units:
168

Average Rate:
7.32

Range of Rates:
4.45 - 10.97

Standard Deviation:
1.31

Fitted Curve Equation:
T = 7.56(X) - 40.86

R^2:
0.96

Directional Distribution:
50% entering, 50% exiting

Calculated Trip Ends:
Average Rate: 381 (Total), 190 (Entry), 191 (Exit)
Fitted Curve: 352 (Total), 176 (Entry), 176 (Exit)

Land Use:
Multifamily Housing (Low-Rise) (220)
Click for more details

Independent Variable:
Dwelling Units

Time Period:
Weekday
Peak Hour of Adjacent Street Traffic
One Hour Between 7 and 9 a.m.

Setting/Location:
General Urban/Suburban

Trip Type:
Vehicle

Number of Studies:
42

Avg. Num. of Dwelling Units:
199

Average Rate:
0.46

Range of Rates:
0.18 - 0.74

Standard Deviation:
0.12

Fitted Curve Equation:
Ln(T) = 0.95 Ln(X) - 0.51

R^2:
0.90

Directional Distribution:
23% entering, 77% exiting

Calculated Trip Ends:
Average Rate: 24 (Total), 6 (Entry), 18 (Exit)
Fitted Curve: 26 (Total), 6 (Entry), 20 (Exit)

Land Use:
Multifamily Housing (Low-Rise) (220)
Click for more details

Independent Variable:
Dwelling Units

Time Period:
Weekday
Peak Hour of Adjacent Street Traffic
One Hour Between 4 and 6 p.m.

Setting/Location:
General Urban/Suburban

Trip Type:
Vehicle

Number of Studies:
50

Avg. Num. of Dwelling Units:
187

Average Rate:
0.56

Range of Rates:
0.18 - 1.25

Standard Deviation:
0.16

Fitted Curve Equation:
Ln(T) = 0.89 Ln(X) - 0.02

R^2:
0.86

Directional Distribution:
63% entering, 37% exiting

Calculated Trip Ends:
Average Rate: 29 (Total), 18 (Entry), 11 (Exit)
Fitted Curve: 33 (Total), 21 (Entry), 12 (Exit)

S Main at Rice AM Peak Existing

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	3	9	24	3	11	33
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (veh/h)	3	10	26	3	12	36
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
vC, conflicting volume	88	28			29	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	99			99	
cM capacity (veh/h)	907	1048			1584	

Direction, Lane #	WB 1	WB 2	NB 1	SB 1
Volume Total	3	10	29	48
Volume Left	3	0	0	12
Volume Right	0	10	3	0
cSH	907	1048	1700	1584
Volume to Capacity	0.00	0.01	0.02	0.01
Queue Length (ft)	0	1	0	1
Control Delay (s)	9.0	8.5	0.0	1.9
Lane LOS	A	A		A
Approach Delay (s)	8.6		0.0	1.9
Approach LOS	A			

Intersection Summary			
Average Delay	2.2		
Intersection Capacity Utilization	13.3%	ICU Level of Service	A

S Main at Rice AM Peak Future No Build

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	3	9	24	3	11	36
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (veh/h)	3	10	26	3	12	39
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
vC, conflicting volume	91	28			29	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	99			99	
cM capacity (veh/h)	903	1048			1584	

Direction, Lane #	WB 1	WB 2	NB 1	SB 1
Volume Total	3	10	29	51
Volume Left	3	0	0	12
Volume Right	0	10	3	0
cSH	903	1048	1700	1584
Volume to Capacity	0.00	0.01	0.02	0.01
Queue Length (ft)	0	1	0	1
Control Delay (s)	9.0	8.5	0.0	1.7
Lane LOS	A	A		A
Approach Delay (s)	8.6		0.0	1.7
Approach LOS	A			

Intersection Summary			
Average Delay	2.2		
Intersection Capacity Utilization	13.3%	ICU Level of Service	A

S Main at Rice AM Peak Future Build

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	8	12	24	6	15	36
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (veh/h)	9	13	26	7	16	39
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
vC, conflicting volume	101	29			33	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	99	99			99	
cM capacity (veh/h)	888	1045			1579	

Direction, Lane #	WB 1	WB 2	NB 1	SB 1
Volume Total	9	13	33	55
Volume Left	9	0	0	16
Volume Right	0	13	7	0
cSH	888	1045	1700	1579
Volume to Capacity	0.01	0.01	0.02	0.01
Queue Length (ft)	1	1	0	1
Control Delay (s)	9.1	8.5	0.0	2.2
Lane LOS	A	A		A
Approach Delay (s)	8.7		0.0	2.2
Approach LOS	A			

Intersection Summary			
Average Delay	2.8		
Intersection Capacity Utilization	13.3%	ICU Level of Service	A

S Main at Rice PM Peak Existing

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	9	11	33	3	13	54
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (veh/h)	10	12	36	3	14	59
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
vC, conflicting volume	124	38			39	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	99	99			99	
cM capacity (veh/h)	863	1035			1571	

Direction, Lane #	WB 1	WB 2	NB 1	SB 1
Volume Total	10	12	39	73
Volume Left	10	0	0	14
Volume Right	0	12	3	0
cSH	863	1035	1700	1571
Volume to Capacity	0.01	0.01	0.02	0.01
Queue Length (ft)	1	1	0	1
Control Delay (s)	9.2	8.5	0.0	1.5
Lane LOS	A	A		A
Approach Delay (s)	8.8		0.0	1.5
Approach LOS	A			

Intersection Summary			
Average Delay	2.2		
Intersection Capacity Utilization	14.0%	ICU Level of Service	A

S Main at Rice PM Peak Future No Build

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	9	11	34	3	14	55
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (veh/h)	10	12	37	3	15	60
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
vC, conflicting volume	129	39			40	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	99	99			99	
cM capacity (veh/h)	857	1033			1569	

Direction, Lane #	WB 1	WB 2	NB 1	SB 1
Volume Total	10	12	40	75
Volume Left	10	0	0	15
Volume Right	0	12	3	0
cSH	857	1033	1700	1569
Volume to Capacity	0.01	0.01	0.02	0.01
Queue Length (ft)	1	1	0	1
Control Delay (s)	9.2	8.5	0.0	1.5
Lane LOS	A	A		A
Approach Delay (s)	8.9		0.0	1.5
Approach LOS	A			

Intersection Summary			
Average Delay	2.2		
Intersection Capacity Utilization	14.2%	ICU Level of Service	A

S Main at Rice PM Peak Future Build

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	13	14	34	6	19	55
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (veh/h)	14	15	37	7	21	60
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
vC, conflicting volume	141	40			43	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	98	99			99	
cM capacity (veh/h)	840	1031			1565	

Direction, Lane #	WB 1	WB 2	NB 1	SB 1
Volume Total	14	15	43	80
Volume Left	14	0	0	21
Volume Right	0	15	7	0
cSH	840	1031	1700	1565
Volume to Capacity	0.02	0.01	0.03	0.01
Queue Length (ft)	1	1	0	1
Control Delay (s)	9.4	8.5	0.0	2.0
Lane LOS	A	A		A
Approach Delay (s)	8.9		0.0	2.0
Approach LOS	A			

Intersection Summary				
Average Delay		2.7		
Intersection Capacity Utilization		14.8%	ICU Level of Service	A

Rice at Thomas Hill AM Peak Existing

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	12	6	3	8	3	4
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (veh/h)	13	7	3	9	3	4
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
vC, conflicting volume			20		32	16
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	100
cM capacity (veh/h)			1597		980	1063

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	20	12	8
Volume Left	0	3	3
Volume Right	7	0	4
cSH	1700	1597	1026
Volume to Capacity	0.01	0.00	0.01
Queue Length (ft)	0	0	1
Control Delay (s)	0.0	2.0	8.5
Lane LOS		A	A
Approach Delay (s)	0.0	2.0	8.5
Approach LOS			A

Intersection Summary			
Average Delay	2.3		
Intersection Capacity Utilization	13.3%	ICU Level of Service	A

Rice at Thomas Hill AM Peak Future No Build

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	12	6	3	8	3	4
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (veh/h)	13	7	3	9	3	4
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
vC, conflicting volume			20		32	16
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	100
cM capacity (veh/h)			1597		980	1063

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	20	12	8
Volume Left	0	3	3
Volume Right	7	0	4
cSH	1700	1597	1026
Volume to Capacity	0.01	0.00	0.01
Queue Length (ft)	0	0	1
Control Delay (s)	0.0	2.0	8.5
Lane LOS		A	A
Approach Delay (s)	0.0	2.0	8.5
Approach LOS			A

Intersection Summary			
Average Delay		2.3	
Intersection Capacity Utilization		13.3%	ICU Level of Service

Rice at Thomas Hill AM Peak Future Build

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Volume (veh/h)	4	12	6	3	8	2	3	0	4	12	0	8
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (veh/h)	4	13	7	3	9	2	3	0	4	13	0	9
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
vC, conflicting volume	11			20			50	42	16	46	45	10
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
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			100			100	100	100	99	100	99
cM capacity (veh/h)	1608			1597			939	846	1063	949	843	1072

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	24	14	8	22
Volume Left	4	3	3	13
Volume Right	7	2	4	9
cSH	1608	1597	1006	994
Volume to Capacity	0.00	0.00	0.01	0.02
Queue Length (ft)	0	0	1	2
Control Delay (s)	1.3	1.7	8.6	8.7
Lane LOS	A	A	A	A
Approach Delay (s)	1.3	1.7	8.6	8.7
Approach LOS			A	A

Intersection Summary				
Average Delay			4.6	
Intersection Capacity Utilization			13.3%	ICU Level of Service		A

Rice at Thomas Hill PM Peak Existing

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	8	3	6	13	3	1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (veh/h)	9	3	7	14	3	1
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
vC, conflicting volume			12		38	10
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	100
cM capacity (veh/h)			1607		971	1071

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	12	21	4
Volume Left	0	7	3
Volume Right	3	0	1
cSH	1700	1607	994
Volume to Capacity	0.01	0.00	0.00
Queue Length (ft)	0	0	0
Control Delay (s)	0.0	2.3	8.6
Lane LOS		A	A
Approach Delay (s)	0.0	2.3	8.6
Approach LOS			A

Intersection Summary				
Average Delay		2.3		
Intersection Capacity Utilization		13.3%	ICU Level of Service	A

Rice at Thomas Hill PM Peak Future No Build

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	8	3	6	13	3	1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (veh/h)	9	3	7	14	3	1
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
vC, conflicting volume			12		38	10
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	100
cM capacity (veh/h)			1607		971	1071

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	12	21	4
Volume Left	0	7	3
Volume Right	3	0	1
cSH	1700	1607	994
Volume to Capacity	0.01	0.00	0.00
Queue Length (ft)	0	0	0
Control Delay (s)	0.0	2.3	8.6
Lane LOS		A	A
Approach Delay (s)	0.0	2.3	8.6
Approach LOS			A

Intersection Summary			
Average Delay		2.3	
Intersection Capacity Utilization		13.3%	ICU Level of Service

Rice at Thomas Hill PM Peak Future Build

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Volume (veh/h)	8	8	3	6	13	13	3	0	1	5	0	7
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (veh/h)	9	9	3	7	14	14	3	0	1	5	0	8
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
vC, conflicting volume	28			12			70	69	10	63	64	21
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
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 %	99			100			100	100	100	99	100	99
cM capacity (veh/h)	1585			1607			909	814	1071	924	819	1056

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	21	35	4	13
Volume Left	9	7	3	5
Volume Right	3	14	1	8
cSH	1585	1607	945	997
Volume to Capacity	0.01	0.00	0.00	0.01
Queue Length (ft)	0	0	0	1
Control Delay (s)	3.1	1.4	8.8	8.7
Lane LOS	A	A	A	A
Approach Delay (s)	3.1	1.4	8.8	8.7
Approach LOS			A	A

Intersection Summary				
Average Delay	3.6			
Intersection Capacity Utilization	13.3%	ICU Level of Service	A	

Providence at Rice AM Peak Existing

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	9	4	2	219	161	6
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (veh/h)	10	4	2	238	175	7
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
vC, conflicting volume	421	178	182			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	98	99	100			
cM capacity (veh/h)	588	865	1394			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	14	240	182
Volume Left	10	2	0
Volume Right	4	0	7
cSH	653	1394	1700
Volume to Capacity	0.02	0.00	0.11
Queue Length (ft)	2	0	0
Control Delay (s)	10.6	0.1	0.0
Lane LOS	B	A	
Approach Delay (s)	10.6	0.1	0.0
Approach LOS	B		

Intersection Summary			
Average Delay	0.4		
Intersection Capacity Utilization	23.0%	ICU Level of Service	A

Providence at Rice AM Peak Future No Build

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	9	4	2	223	164	6
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (veh/h)	10	4	2	242	178	7
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
vC, conflicting volume	428	182	185			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	98	99	100			
cM capacity (veh/h)	583	861	1390			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	14	245	185
Volume Left	10	2	0
Volume Right	4	0	7
cSH	647	1390	1700
Volume to Capacity	0.02	0.00	0.11
Queue Length (ft)	2	0	0
Control Delay (s)	10.7	0.1	0.0
Lane LOS	B	A	
Approach Delay (s)	10.7	0.1	0.0
Approach LOS	B		

Intersection Summary			
Average Delay	0.4		
Intersection Capacity Utilization	23.2%	ICU Level of Service	A

Providence at Rice AM Peak Future Build

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	16	9	3	223	164	7
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (veh/h)	17	10	3	242	178	8
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
vC, conflicting volume	431	182	186			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	97	99	100			
cM capacity (veh/h)	580	860	1389			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	27	246	186
Volume Left	17	3	0
Volume Right	10	0	8
cSH	657	1389	1700
Volume to Capacity	0.04	0.00	0.11
Queue Length (ft)	3	0	0
Control Delay (s)	10.7	0.1	0.0
Lane LOS	B	A	
Approach Delay (s)	10.7	0.1	0.0
Approach LOS	B		

Intersection Summary			
Average Delay	0.7		
Intersection Capacity Utilization	23.5%	ICU Level of Service	A

Providence at Rice PM Peak Existing

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	6	3	7	212	266	11
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (veh/h)	7	3	8	230	289	12
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
vC, conflicting volume	541	295	301			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	99	100	99			
cM capacity (veh/h)	499	744	1260			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	10	238	301
Volume Left	7	8	0
Volume Right	3	0	12
cSH	561	1260	1700
Volume to Capacity	0.02	0.01	0.18
Queue Length (ft)	1	0	0
Control Delay (s)	11.5	0.3	0.0
Lane LOS	B	A	
Approach Delay (s)	11.5	0.3	0.0
Approach LOS	B		

Intersection Summary			
Average Delay		0.3	
Intersection Capacity Utilization		25.9%	ICU Level of Service A

Providence at Rice PM Peak Future No Build

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	6	3	7	216	271	11
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (veh/h)	7	3	8	235	295	12
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
vC, conflicting volume	551	301	307			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	99	100	99			
cM capacity (veh/h)	493	739	1254			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	10	242	307
Volume Left	7	8	0
Volume Right	3	0	12
cSH	554	1254	1700
Volume to Capacity	0.02	0.01	0.18
Queue Length (ft)	1	0	0
Control Delay (s)	11.6	0.3	0.0
Lane LOS	B	A	
Approach Delay (s)	11.6	0.3	0.0
Approach LOS	B		

Intersection Summary			
Average Delay		0.3	
Intersection Capacity Utilization		26.2%	ICU Level of Service A

Providence at Rice PM Peak Future Build

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	8	6	15	216	271	16
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (veh/h)	9	7	16	235	295	17
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
vC, conflicting volume	571	303	312			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	98	99	99			
cM capacity (veh/h)	476	736	1248			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	15	251	312
Volume Left	9	16	0
Volume Right	7	0	17
cSH	561	1248	1700
Volume to Capacity	0.03	0.01	0.18
Queue Length (ft)	2	1	0
Control Delay (s)	11.6	0.6	0.0
Lane LOS	B	A	
Approach Delay (s)	11.6	0.6	0.0
Approach LOS	B		

Intersection Summary			
Average Delay	0.6		
Intersection Capacity Utilization	27.0%	ICU Level of Service	A