

Traffic Impact Analysis

JDA - Musselman Road

Stafford County, Virginia

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Executive Summary

This report presents the findings of a Traffic Impact Analysis (TIA) conducted for the proposed development site which is generally situated in the southwest quadrant of Musselman Road at Thomas Lane in Stafford County, Virginia.

This study was developed in accordance with the Virginia Department of Transportation (VDOT) and Stafford County (the County) transportation impact analysis guidelines. The document was prepared in accordance with best professional practices and standards that assess the impact of a proposed development on the transportation system. Traffic operational analyses, as presented in this TIA, involve the evaluation of anticipated roadway conditions with and without the proposed development.

Description of Proposed Development

The site is situated across nine parcels that can be identified on Stafford County GIS with the following Property ID #: 45-37G, 45C-1-7, 45C-1-8, 45C-1-9, 45C-1-10, 45C-1-11, 45C-1-14, 45C-1-16, and 45C-1-17. The property totals approximately 21.052 acres and is currently zoned as a mix of B-2 (Urban Commercial) and R-1 (Suburban Residential).

The Applicant is proposing a zoning reclassification to the M-1 (Industrial Light) zone to construct approximately 218,400 square feet of warehouse/industrial uses. The development is anticipated to be complete and in operation by 2027.

Access to the site will be provided via one full-movement entrance along Musselman Road (forming the fourth leg at the existing intersection across Thomas Lane).

This report analyzes the trips generated by the JDA - Musselman Road development and its impact on traffic operations on the surrounding road network.

Principal Findings and Conclusions

Discussions regarding the study assumptions and relevant background information were held with VDOT and County staff during February 2023. A finalized scope was agreed upon and signed on March 20, 2023. This scope details the study assumptions and relevant background information discussed in the meetings and correspondence. A copy of the scoping document is included in Appendix A.

The analysis contained herein presents the 2023 Existing Conditions, 2027 Future Conditions without Development, and 2027 Future Conditions with Development.

The analysis presented in this report supports the following assumptions and major findings:

Analysis Components

- 2023 existing peak hour volumes were derived via turning movement counts collected at intersections within the study area in February 2023.
- As determined based on the discussions and scoping document with VDOT and the County, an inherent regional growth of 2% per year was applied to through movements at Warrenton Road and Olde Forge Drive study intersections for the period between 2023 and 2027 to account for future conditions.
- Background development trips were estimated based on the Institute of Transportation Engineers' (ITE) Trip Generation Manual, 11th Edition publication for the nearby approved but unbuilt uses.
- The trip generation associated with the Site was based on the ITE Trip Generation Manual, 11th Edition publication. The Site in total is expected to generate approximately 74 new trips during the AM peak hour, 74 new trips during the PM peak hour, and 1,409 new daily trips on a typical weekday.
- Intersection capacity and queuing analyses were performed for all analysis scenarios at the study area intersections during the weekday morning (AM) and weekday afternoon (PM) peak hours. *Synchro / SimTraffic*, version 11, was used to analyze the study intersections with results based on the Transportation Research Board's (TRB) Highway Capacity Manual (HCM)

methodology and analysis guidelines provided in VDOT's [Traffic Operations and Safety Analysis Manual](#) (TOSAM) (version 2). The analysis herein includes the level of service (LOS), delay, and queue length comparisons for the turning movements analyzed.

Analysis Results

2023 Existing Conditions

- Based on the capacity analysis of existing conditions, the signalized study intersection currently operates at overall acceptable levels of service during the AM and PM peak hours. All approaches at all study intersections operate at acceptable levels of service during the AM and PM peak hours except for the northbound approach at the intersection of Warrenton Road and Olde Forge Drive during the PM peak hour.
- Based on the analysis of the average maximum queue lengths from *SimTraffic*, all turning movements have queue lengths that were accommodated within the available storage length of the turn bays.

2027 Future Conditions without Development

- Based on the capacity analysis of future conditions without development, the signalized study intersection is anticipated to operate at overall acceptable levels of service during the AM and PM peak hours, similar to existing conditions. All approaches to all study intersections are anticipated to operate at acceptable levels of service during the AM and PM peak hours except for the northbound approach at the intersection of Warrenton Road and Olde Forge Drive during the PM peak hour.
- Based on the analysis of the average maximum queue lengths from *SimTraffic*, all turning movements are anticipated to have queue lengths that are accommodated within the available storage length of the turn bays.

2027 Future Conditions with Development

- Based on the capacity analysis of future conditions with the Musselman Road property development, the signalized study intersection is anticipated to operate at overall acceptable levels of service during the AM and PM peak hours, similar to existing conditions. All approaches to all study intersections are anticipated to operate at acceptable levels of service during the AM and PM peak hours except for the northbound approach at the intersection of Warrenton Road and Olde Forge Drive during the PM peak hour.
- Based on the analysis of the maximum queue lengths from *SimTraffic* all turning movements are anticipated to have queues that are accommodated within the available storage length of the turn bays.

Overall Conclusion

Based on the capacity and queueing analysis results, the proposed JDA - Musselman Road development will not have a substantial impact on the surrounding transportation and roadway network. Minor signal timing adjustments, which would also minimize approach delays without the proposed development, are recommended to optimize operations at the intersection of Warrenton Road and Olde Forge Drive.

Introduction

This report presents the findings of a Traffic Impact Analysis (TIA) for the proposed JDA - Musselman Road development (the Site / the Development / the Property) in Stafford County, Virginia. The proposed site is generally situated on the southwest quadrant of Musselman Road at Thomas Lane.

The site is situated across nine parcels that can be identified on Stafford County GIS with the following Property ID #s: 45-37G, 45C-1-7, 45C-1-8, 45C-1-9, 45C-1-10, 45C-1-11, 45C-1-14, 45C-1-16, and 45C-1-17. The property totals approximately 21.052 acres and is currently zoned as a mix of B-2 (Urban Commercial) and R-1 (Suburban Residential).

The Applicant is proposing a zoning reclassification to the M-1 (Industrial Light) zone to construct approximately 218,400 square feet of warehouse/industrial uses. The development is anticipated to be complete and in operation by 2027.

Access to the site will be provided via one full-movement entrance along Musselman Road (forming the fourth leg at the existing intersection across Thomas Lane).

This report analyzes the trips generated by the JDA - Musselman Road development and its impact on traffic operations on the surrounding road network.

The following tasks were completed as part of this study effort:

- Scoping discussions were held with the Virginia Department of Transportation (VDOT) and Stafford County (the County) staff on the parameters of this study as well as any relevant background information during February 2023. A finalized scope was agreed upon on March 20, 2023. A copy of the scoping document is included in Appendix A.
- Existing conditions were observed in the field to verify roadway geometry, pedestrian and bicycle infrastructure, and traffic flow characteristics.
- In order to determine the weekday morning and afternoon peak hour turning movement traffic volumes, traffic counts were conducted on February 01, 2023.
- The 2027 Future Conditions without Development scenario was projected based on the existing traffic volumes, an inherent growth to account for regional growth on the roadway network, approved background developments, and roadway improvements.
- Proposed site traffic volumes were derived based on the methodology outlined in ITE's Trip Generation Manual, 11th Edition, publication and were assigned to the road network based on the agreed-upon direction of approach discussed during the aforementioned scoping meeting.
- The 2027 Future Conditions with Development scenario was projected based on the existing traffic volumes, regional growth, approved background developments, roadway improvements, and plans for the proposed development.
- Intersection capacity and queueing analyses were performed for the identified study intersections for the 2023 Existing Conditions, 2027 Future Conditions without Development, and 2027 Future Conditions with Development scenarios during the weekday morning (AM), and weekday afternoon (PM) peak hours.
- Intersection capacity and queueing analyses were performed using *Synchro / SimTraffic*, version 11, with results based on the Transportation Research Board's (TRB) Highway Capacity Manual, Sixth Edition (HCM 6) methodology and in following VDOT's Traffic Operations and Safety Manual (TOSAM) (version 2).

Sources of data for this study include the Institute of Transportation Engineers (ITE), VDOT, Stafford County (the County), and the office files and field reconnaissance efforts of Gorove Slade.

Background Information: Proposed Development (Site & Nearby)

Description of the Existing Site

Site Location

The proposed development is generally situated in the southwest quadrant of Musselman Road at Thomas Lane in Stafford County, Virginia.

An aerial of the study vicinity of provided in Figure 1.

A description of the proposed development is provided in the *Introduction* section of this report.

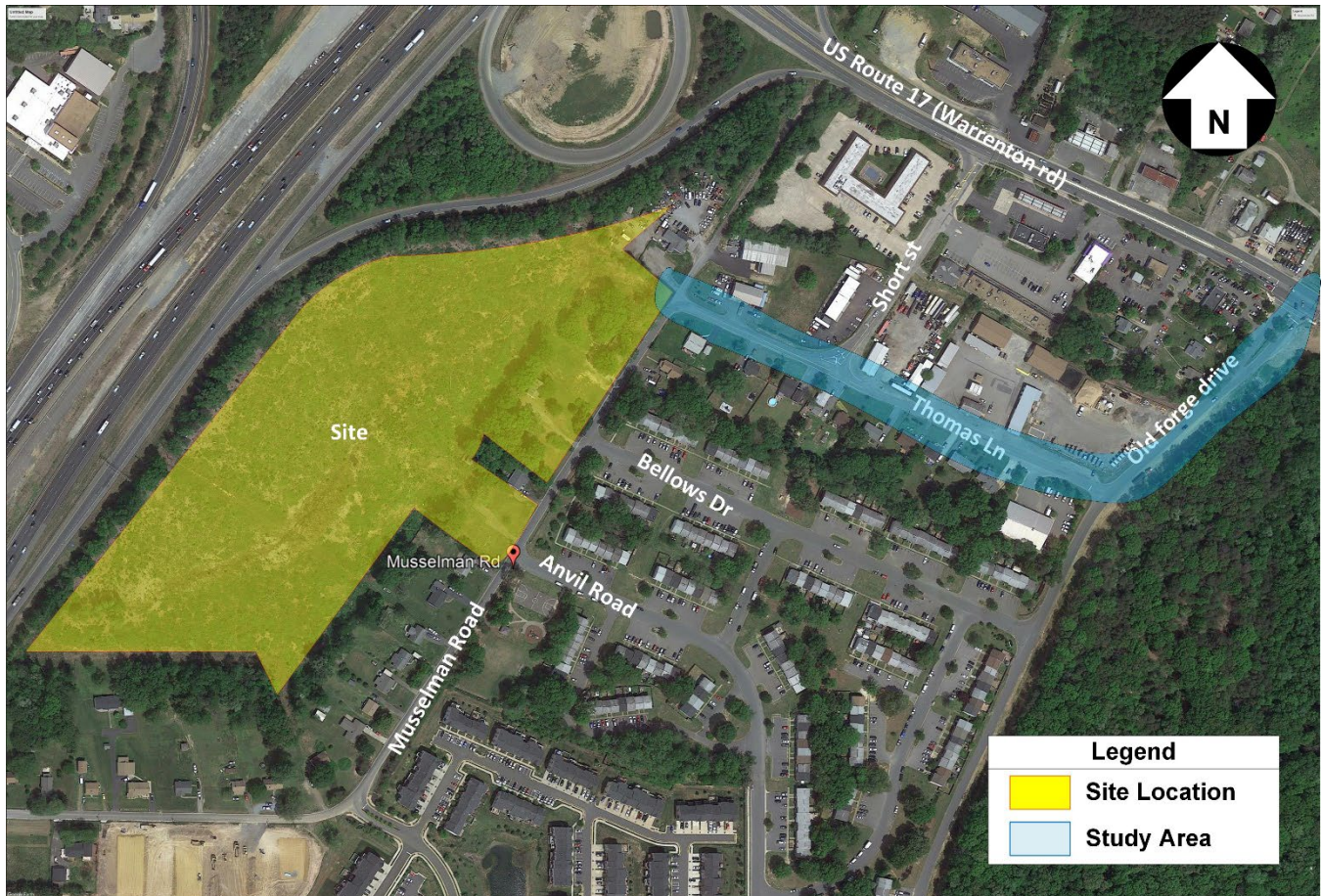


Figure 1: Site Location

Location within Jurisdiction and Region

The Site is located to the west of Musselman Road, east of Route I-95, and south of US Route 17. A regional aerial of the Site is provided in Figure 2.

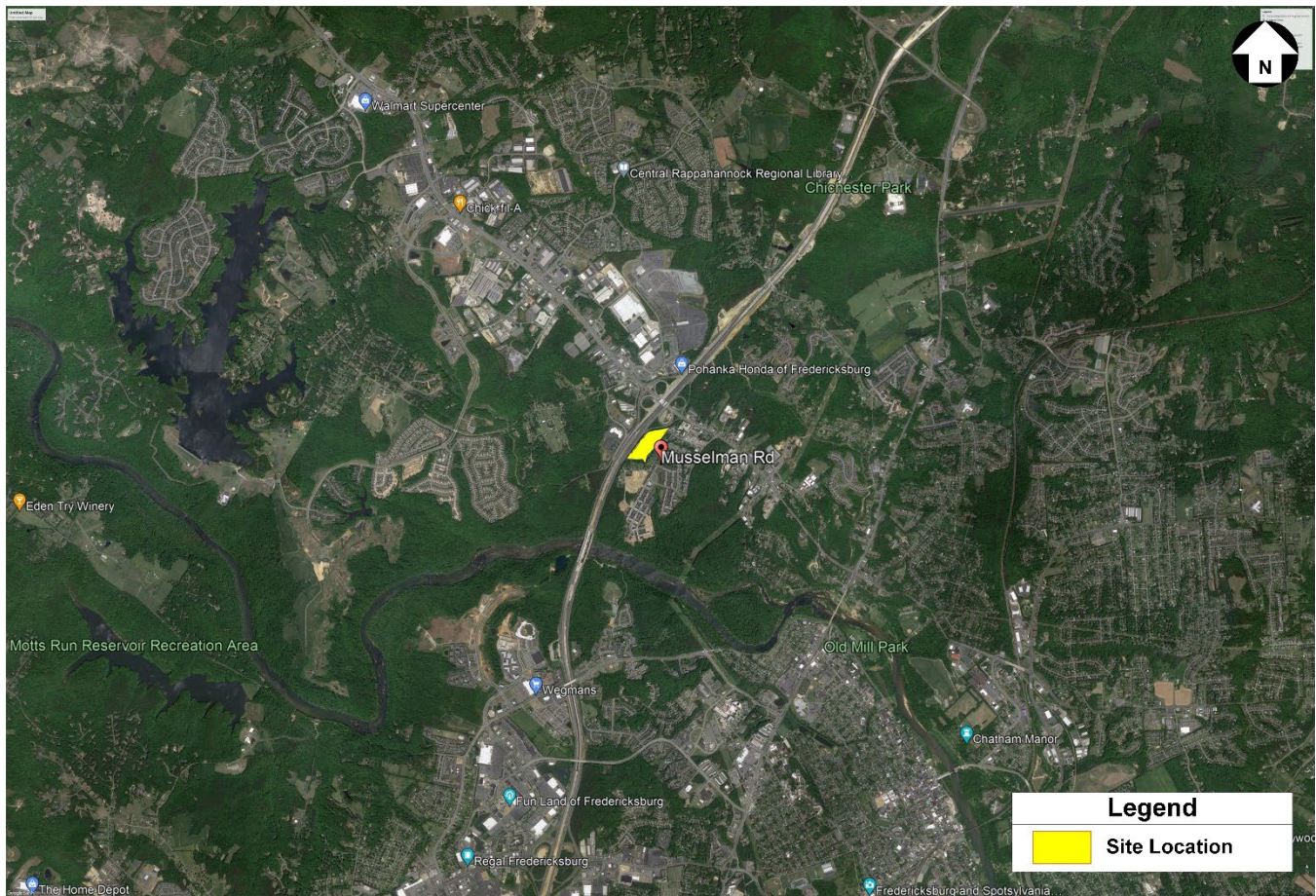


Figure 2: Regional Location

Description of the Parcel

The site is situated across nine parcels that can be identified on Stafford County GIS with the following Property ID #s: 45-37G, 45C-1-7, 45C-1-8, 45C-1-9, 45C-1-10, 45C-1-11, 45C-1-14, 45C-1-16, and 45C-1-17. The property totals approximately 21.052 acres and is currently zoned as a mix of B-2 (Urban Commercial) and R-1 (Suburban Residential) as illustrated in Figure 3.



Figure 3: Stafford County GIS Parcel Map
(Parcels source: Stafford County GIS, <https://gismapping.stafford.va.us/>)

Existing Zoning and Future Land-Use

The Site is currently zoned as a mix of B-2 (Agricultural) and R1 (Suburban Residential). For future land use, the Site parcels are part of the Falmouth Gateway Targeted Development Area (TDA), with a specific recommended future land use focus on Urban Commercial.

The existing zoning is presented in Figure 4.



Figure 4: Stafford County Zoning Map
(Zoning Source: <https://gismapping.stafford.va.us/>)

Descriptions of Geographic Scope of Study and Limits of the Study Area

The proposed development site is generally situated in the southwest quadrant of Musselman Road at Thomas Lane in Stafford County, Virginia. The geographic scope of the study area was developed in accordance with VDOT and County guidance. The vehicular study area includes the following four (4) study intersections. The study intersections are as follows:

- Intersection 1:** US Route 17 BUS (Warrenton Road) at Olde Forge Drive [existing full movement, signalized],
- Intersection 2:** Thomas Lane at Olde Forge Drive [existing full movement, unsignalized],
- Intersection 3:** Thomas Lane at Short Street [existing full movement, unsignalized],
- Intersection 4:** Musselman Road at Thomas Lane / Future Access [existing full movement, unsignalized]

Study intersection 4 provides a full movement access point to the development.

An aerial of the study intersections is provided in Figure 5.



Figure 5: Aerial of Study Boundaries (Study Intersections)

Existing Roadway Network

A description of the major roadways within the immediate vicinity of the Site is presented below.

US Route 17 (Warrenton Road) is a four-lane divided on the east side of I-95 and a six-lane divided on the west side of I-95 near the vicinity of the Site in Stafford County. It is classified as a principal arterial by both VDOT and Stafford County. The posted speed limit is 45 mph.

Olde Forge Drive is a two-lane road that runs from US Route 17 (Warrenton Road) to Middle run drive in Stafford County. It is classified as a local road by VDOT and a secondary road by Stafford County. The posted speed limit is 25 mph.

Short Street is a two-lane road that runs from US Route 17 (Warrenton Road) to Thomas Lane in Stafford County. It is classified as a collector by both VDOT and Stafford County. The posted speed limit is 25 mph.

Thomas Lane is a two-lane road that runs from Musselman Road to Olde Forge Drive in Stafford County. It is classified as a local road by VDOT and a secondary road by Stafford County. The posted speed limit is 25 mph.

Musselman Road is a two-lane road that runs from US Route 17 (Warrenton Road) to Krieger Lane in Stafford County. It is classified as a local road by VDOT and a secondary road by Stafford County. The posted speed limit is 25 mph.

Analysis of 2023 Existing Traffic Volumes

In order to determine the weekday morning (AM) and weekday afternoon (PM) peak hour turning movement traffic volumes, turning movement counts (TMC) were collected at the study intersections on Wednesday, February 01, 2023. The referenced turning movement counts were collected from the hours of 6:00 AM to 9:00 AM and 4:00 PM to 7:00 PM:

- Study Intersection 1: US Route 17 BUS (Warrenton Road) at Olde Forge Drive
- Study Intersection 2: Thomas Lane at Olde Forge Drive
- Study Intersection 3: Thomas Lane at Short Street
- Study Intersection 4: Musselman Road at Thomas Lane / Future Access
- From the turning movement counts, the following system peak hours were determined.
 - AM Peak Hour: 7:30 AM to 8:30 AM
 - PM Peak Hour: 4:30 PM to 5:30 PM

The 2023 existing road network configuration is presented in Figure 6. The existing weekday AM and PM peak hour traffic volumes for the existing study intersections are shown in Figure 7. The system peak hour volumes were used for the analysis. A k-factor of 0.0979 was used for US Route 17 (Warrenton Road) and a k-factor of 0.1 was used for the other streets. The raw existing traffic count data is provided in Appendix B.

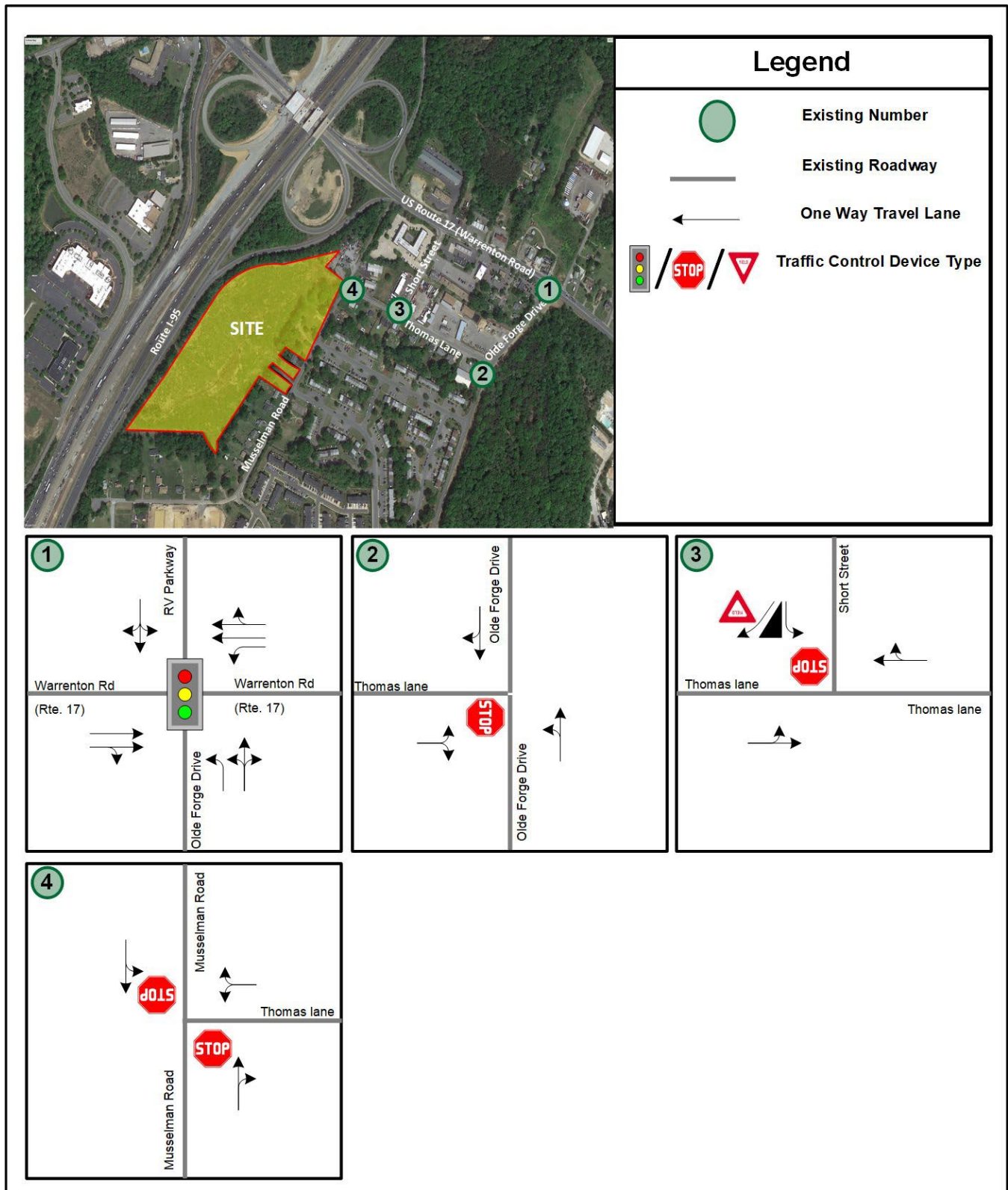


Figure 6: 2023 Existing Conditions – Roadway Network Geometric Configuration and Traffic Control Devices

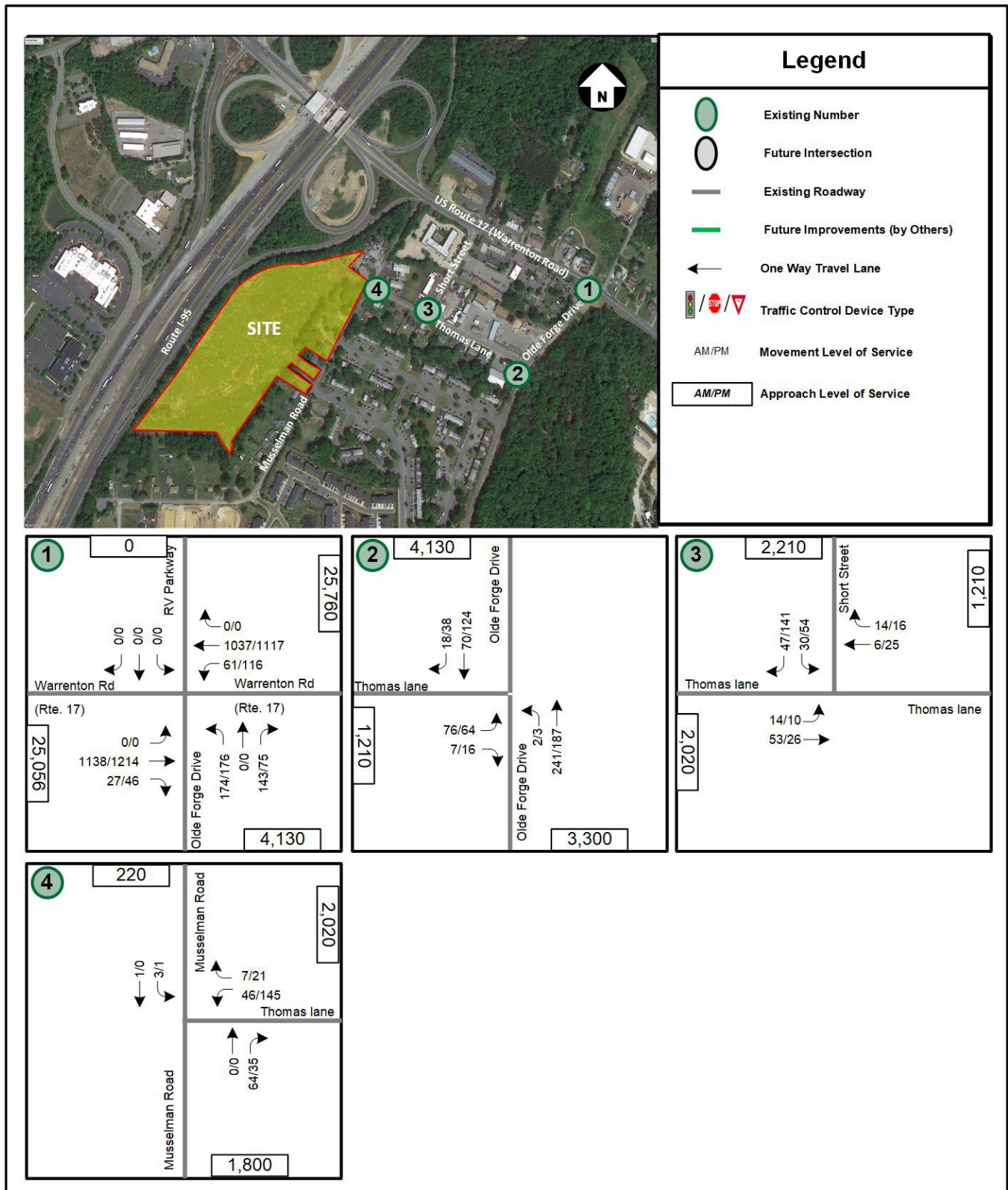


Figure 7: 2023 Existing Conditions – Peak Hour Vehicular Traffic Volumes

Existing Intersection Capacity and Queueing Analysis

Intersection capacity and queueing analyses were performed for the 2023 Existing Conditions scenario at the study area intersections during AM and PM peak hours, in accordance with VDOT's *TOSAM* (version 2) guidelines. *Synchro / SimTraffic*, version 11, was used to analyze the study intersections with results based on the Transportation Research Board's (TRB) Highway Capacity Manual (HCM)¹ 6th Edition methodology and include the level of service (LOS), delay, and queue length comparisons for the turning movements analyzed. Lane configurations at study intersections along the road network were field-verified, and the existing traffic volumes discussed in the aforementioned section as well as other relevant data were entered into the analysis models.

For this analysis, the existing peak hour factors (PHF) utilized in the analysis of existing conditions were based on the traffic count data collected and were modeled in the *Synchro / SimTraffic* network on a by-intersection basis. PHF in the range of 0.85 to 1.00 was used for the existing scenario, as agreed to in the scoping document. The heavy vehicle percentages (HV%) utilized per movement were based on the existing traffic counts collected.

Stafford County's desired level of service is LOS C, while Appendix C of VDOT's Road Design Manual sets a minimum level of service standard of LOS D and includes provisions to modify that standard. Therefore, for the purposes of this study, it was considered acceptable and/or desirable to achieve an approach LOS D or better for traffic operations at the intersection along the primary corridor (Warrenton Road) and LOS C or better for the remaining intersections, using HCM methodology. The results of the intersection capacity from *Synchro* are presented in Table 2 and graphically in Figure 8. The results are expressed in LOS and delay (seconds per vehicle) for overall signalized/all-way stop control intersections and per approach and lane group for all study intersections. Any overall signalized intersection or approach that operates at LOS E or F is displayed in red.

The description of different LOS and delays are included in Appendix C. The detailed analysis worksheets of 2023 Existing Conditions are contained in Appendix D.

Existing Road Network Simulation Analysis

For this analysis, the road network was simulated for the AM and PM peak hours. The simulation was based on *SimTraffic*, version 11, using the same network files that were used in the intersection capacity analysis.

Consistent with the guidelines outlined in VDOT's Traffic Operations and Safety Analysis Manual (TOSAM) (version 2), Table 1 below shows the parameters that were used for the simulation. Per Section 7.6 of the TOSAM, all other parameters not addressed in the table should not be modified from the default values.¹

Table 1: SimTraffic Analysis Input Parameters (Per VDOT TOSAM)

SimTraffic (Ver. 11) Analysis Input Parameters	
Number of Intervals	One (1) Seeding Interval and Four (4) Recording Intervals
Seeding and Recording Interval Duration	15-minutes (each)
Peak Hour Factor (PHF) Adjustment	Selected "Yes" to One of the Four (1 of 4) Recording Intervals Selected "No" for all Other Intervals
Anti-PHF Adjustment	Selected "Yes" for Three (3) Recording Intervals, where PHF Adjustment is set to "No" Selected "No" for the seeding and recording intervals, where PHF Adjustment is set to "Yes"
Number of Runs	Based on the Microsimulation Sample Size Direction Guidance

For this analysis, a seeding period was necessary. A seeding period ensures that the results obtained are not skewed, as the network is void of any vehicles before seeding. Foregoing seeding would lead to lower travel times and delays for the traffic at

¹ It should be noted that HCM 2000 methodology was used in lieu of HCM 6 if the HCM 6 methodology was not applicable. HCM 6 could not be applicable in such cases as nonstandard National Electrical Manufacturers Association (NEMA) configurations, shared lane configurations, placement of loop detectors, U-turns, etc.

the beginning of the simulation. The network reaches a normal state during the seeding period without affecting the results of the simulation.

The results of the simulation are included in Table 2. Of note, for this analysis, ten model runs were conducted. Hence, the results presented in Table 2 are the average results of the ten runs for the peak period scenario. The maximum queue results are expressed in feet. The lane groups where the maximum queue length exceeded the available storage are displayed in red.

The *SimTraffic* worksheets for the 2023 Existing Conditions are contained in Appendix E.

Table 2: 2023 Existing Conditions – Intersection Capacity Analysis Results

No.	Intersection (Movement)	Effective Storage Length (ft.) [1]	AM Peak Hour			PM Peak Hour		
			LOS	Delay (sec/veh)	Ave. Max Queue (ft.) [2]	LOS	Delay (sec/veh)	Ave. Max Queue (ft.) [2]
			Synchro		SimTraffic	Synchro		SimTraffic
1	Warrenton Road (E/W) and Olde Forge Dr / RV Pkwy (N/S) Overall Intersection (Signalized) (MIT: Adjust Signal Timing and Offset)		B	18.0		B	16.2	
	Eastbound Approach		A	9.7		A	4.9	
	Eastbound Left		A	0.0	0	A	0.0	0
	Eastbound Thru/Right		A	9.7	180	A	4.9	178
	Westbound Approach		B	16.2		B	18.3	
	Westbound Left	300	E	62.9	128	F	95.6	293
	Westbound Thru/Right		B	13.4	282	B	10.2	346
	Northbound Approach		D	54.8		E	62.8	
	Northbound Left/Thru/Right		D	54.8	376	E	62.8	315
	Southbound Approach		A	0.0		A	0.0	
	Southbound Left/Thru/Right		A	0.0	0	A	0.0	0
2	Olde Forge Dr / RV Pkwy (N/S) and Thomas Ln (E/W) Overall Intersection (TWSC)							
	Eastbound Approach		B	11.9		B	12.1	
	Eastbound Left/Right		B	11.9	82	B	12.1	73
	Northbound Approach							
3	Thomas Ln (E/W) and Short St (N/S) Overall Intersection (TWSC)							
	Eastbound Approach							
	Eastbound Left/Thru		A	7.3	9	A	7.3	15
	Southbound Approach		A	7.2		A	7.9	
4	Thomas Ln / Site Access (E/W) and Musselman Rd (N/S) Overall Intersection (AWSC)							
	Northbound Approach		A	8.7		A	8.4	
	Northbound Left/Thru/Right		A	8.7	72	A	8.4	36
	Southbound Approach		A	10.0		B	11.9	
	Southbound Left/Thru/Right		A	10.0	31	B	11.9	22

NOTES:

[1] Effective storage length is based on the storage length plus one-half of the taper length per TOSAM guidelines.

[2] Max queues are based on results from *SimTraffic*. Per TOSAM guidelines, the queues are based on the average to 10 simulations.

Based on the capacity analysis of existing conditions, the signalized study intersection is anticipated to operate at overall acceptable levels of service during the AM and PM peak hours. All approaches at all study intersections operate at acceptable levels of service during the AM and PM peak hours except for the northbound approach at the intersection of Warrenton Road and Olde Forge Drive during the PM peak hour.

Based on the simulation analysis performed for existing conditions, the turning movements at the study intersections have maximum queues that are accommodated within the available storage lengths of the turn bays.

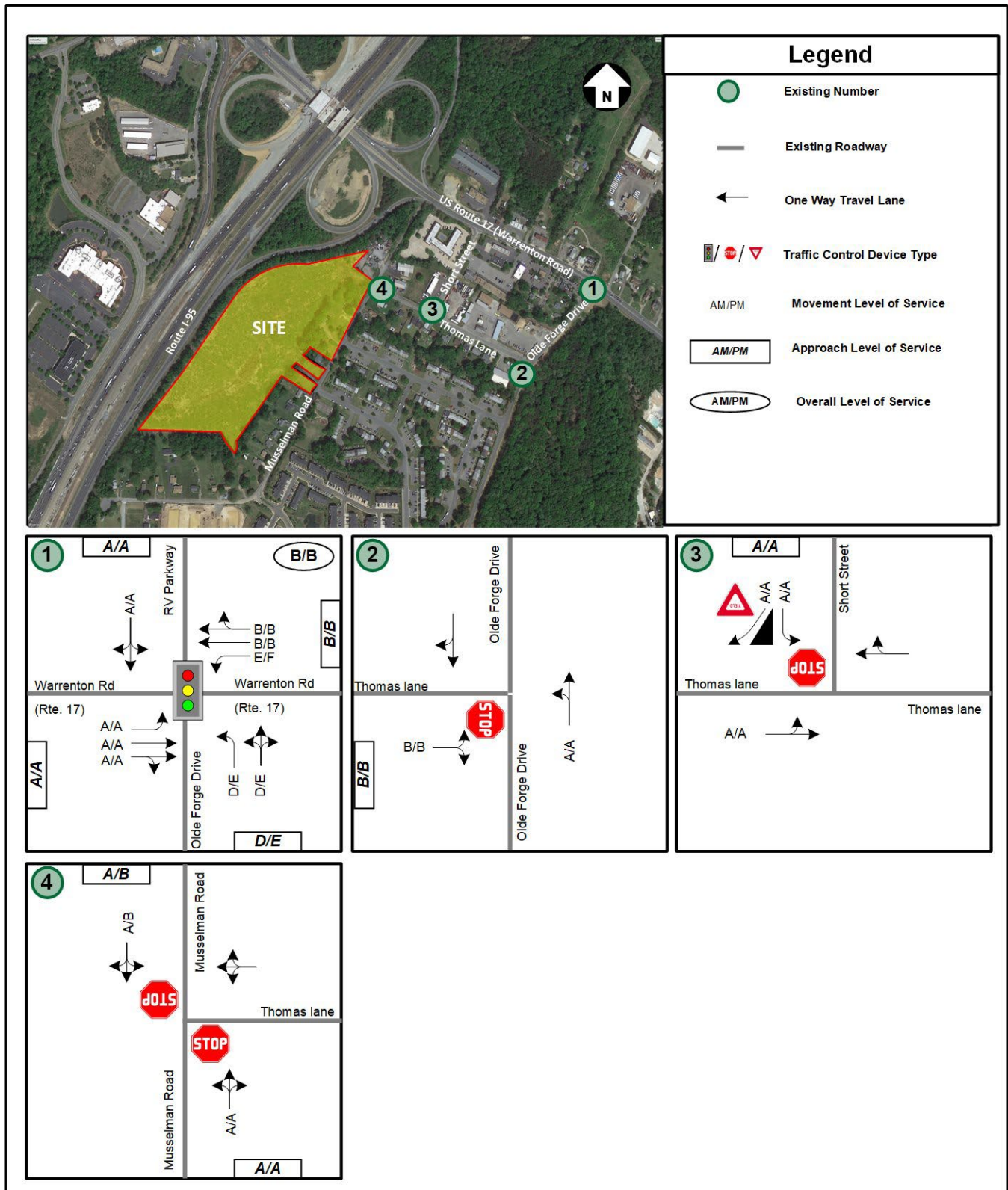


Figure 8: 2023 Existing Conditions – Level of Service Results

Analysis of 2027 Future Conditions Without Development

For the purposes of this study, the Development is anticipated to be constructed by 2027; this scenario analyzes the future without development conditions for the year 2027.

Future without Development Traffic Volumes

The derivation of future without development traffic volumes was based on assumptions and parameters discussed with VDOT and the County during the scoping process for this study. The future conditions include anticipated inherent regional growth, any potential background developments in the pipeline around the vicinity of the Site, and any anticipated roadway improvements.

Inherent Regional Growth

The development is anticipated to be complete in 2027. In order to account for the increased demand on the traffic network between 2023 and 2027, an inherent growth rate was applied to future scenarios. The inherent growth was anticipated to account for any potential background developments unaccounted for within the vicinity of the study area. To be noted, the Applicant anticipates that the development will be complete by mid-2025 but consistent with the scoping document and to present a conservative analysis, year 2027 was used for the analysis.

As agreed upon in the scope of this study, to account for 2027 future conditions, an inherent growth rate of 2%, compounded annually over four years, between 2023 to 2027 was applied to the Warrenton Road mainline through movements at the intersection of Warrenton Road at Olde Forge Drive.

The inherent regional growth volumes (for the period between 2023 and 2027) are illustrated in Figure 11.

Potential Background Development(s)

In addition to the applied inherent regional growth reflecting increased regional traffic demand, a total of three (3) “background” developments within the vicinity of the site, with their locations depicted in Figure 9, were identified in the meeting with VDOT and Stafford County staff for inclusion in this study. The background developments included are as follows:

1. Cherry View Residential

- Located generally south of the development, Cherry View Residential is anticipated to consist of a total of 71 townhomes out of which 39 townhomes are already built and occupied.
- The projected trip generation for the Cherry View Residential Development is depicted in Table 3. The ITE Trip Generation Manual, 11th Edition, the publication was used to determine the total trips going into and out of the subject study site during the AM and PM peak hours as well as the typical number of weekday daily trips.

2. Rappahannock Landing Residential

- Located generally south of the development, Rappahannock Landing Residential is anticipated to consist of a total of 51 single-family homes. The projected trip generation for the Rappahannock Landing Residential Development is depicted in Table 3. The ITE Trip Generation Manual, 11th Edition, the publication was used to determine the total trips going into and out of the subject study site during the AM and PM peak hours as well as the typical number of weekday daily trips.

3. The Renaissance at Falmouth

- Located on the northern side of US 17 Business (Warrenton Road) at the intersection with Glenalice Lane the Renaissance at Falmouth development consisted of 264 apartment units and 114 single-family attached units.

The traffic assignments were directly used from the study named *TIA The Renaissance at Falmouth* dated June 01, 2020. Excerpts from the study are provided in Appendix F.

Table 3: Background Development Trip Generation (Peak Hour of the Adjacent Street; ITE 11th Ed.)

Land Use	ITE Code	Size	----- W e e k d a y -----						
			AM Peak Hour			PM Peak Hour			Daily
			In	Out	Total	In	Out	Total	Total
(a) Single-Family Detached Housing	210	51 DU	10	30	40	33	20	53	543
(b) Multifamily Housing (Mid-Rise)	221	32 DU	0	2	2	8	5	13	106
		83 DU	10	32	42	41	25	66	649

a. Cherryview Landing = 32 townhomes (71 total minus the 39 that are already built and occupied)

b. Rappahannock Landing = 51 single family homes

The assignment of the background trips to the road network is depicted in Figure 12.

Potential Roadway Improvement(s)

As discussed during the scoping meeting, the roadway improvements associated with the I-95 and Warrenton Road interchange ramp improvements were included in future scenarios. It should be noted that since the ramps were not part of the study area, roadway improvement was considered in the *Synchro* files but isn't reflected in this report. No other roadway improvements near or within the vicinity of the site are either fully funded or would be completely constructed by 2027. Thus, no other roadway improvements are anticipated to significantly affect future roadway conditions on the road network by 2027.

The roadway improvements associated with the interchange ramps are illustrated in Figure 10.



Figure 9: Location of Background Developments

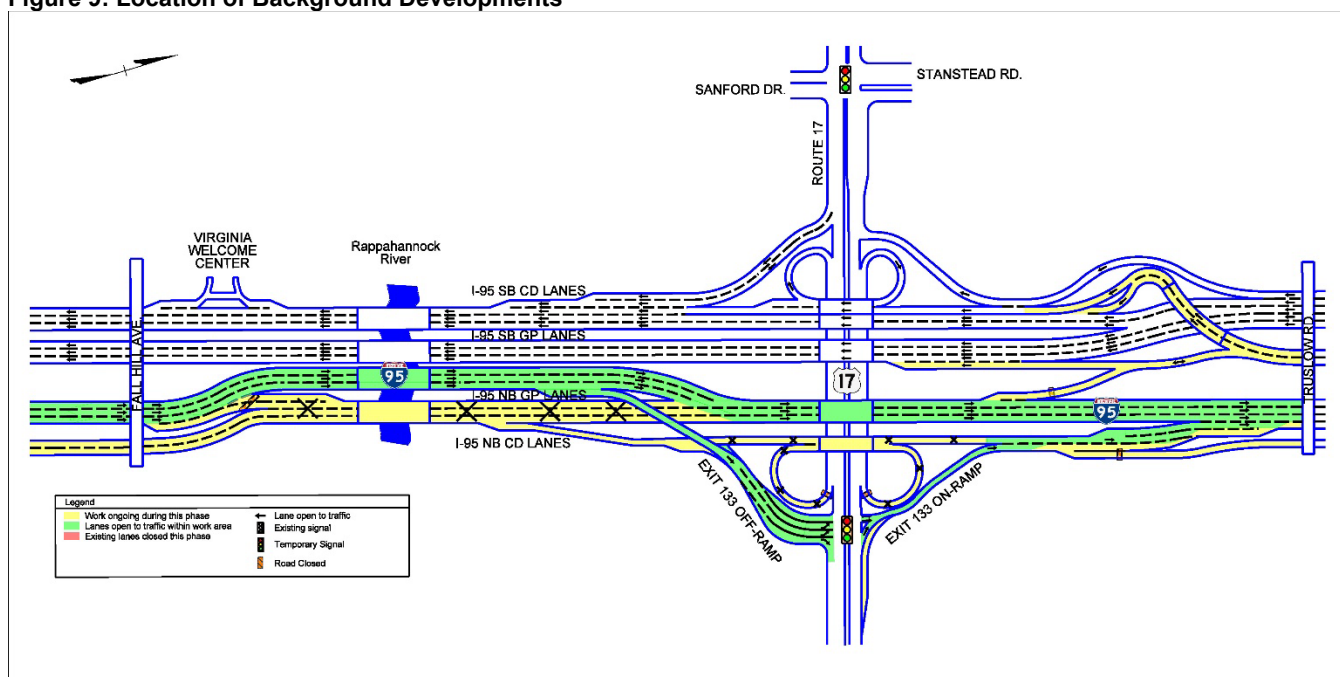


Figure 10: Roadway Improvement (Under Construction)

Future without Development Traffic Volumes

In order to forecast future roadway traffic volumes for the year 2027, the 2023 existing traffic volumes were combined with the inherent regional growth traffic volumes, background developments' traffic volumes, and associated background development roadway improvement traffic volumes. The 2027 future conditions without Development traffic volumes are illustrated in Figure 13

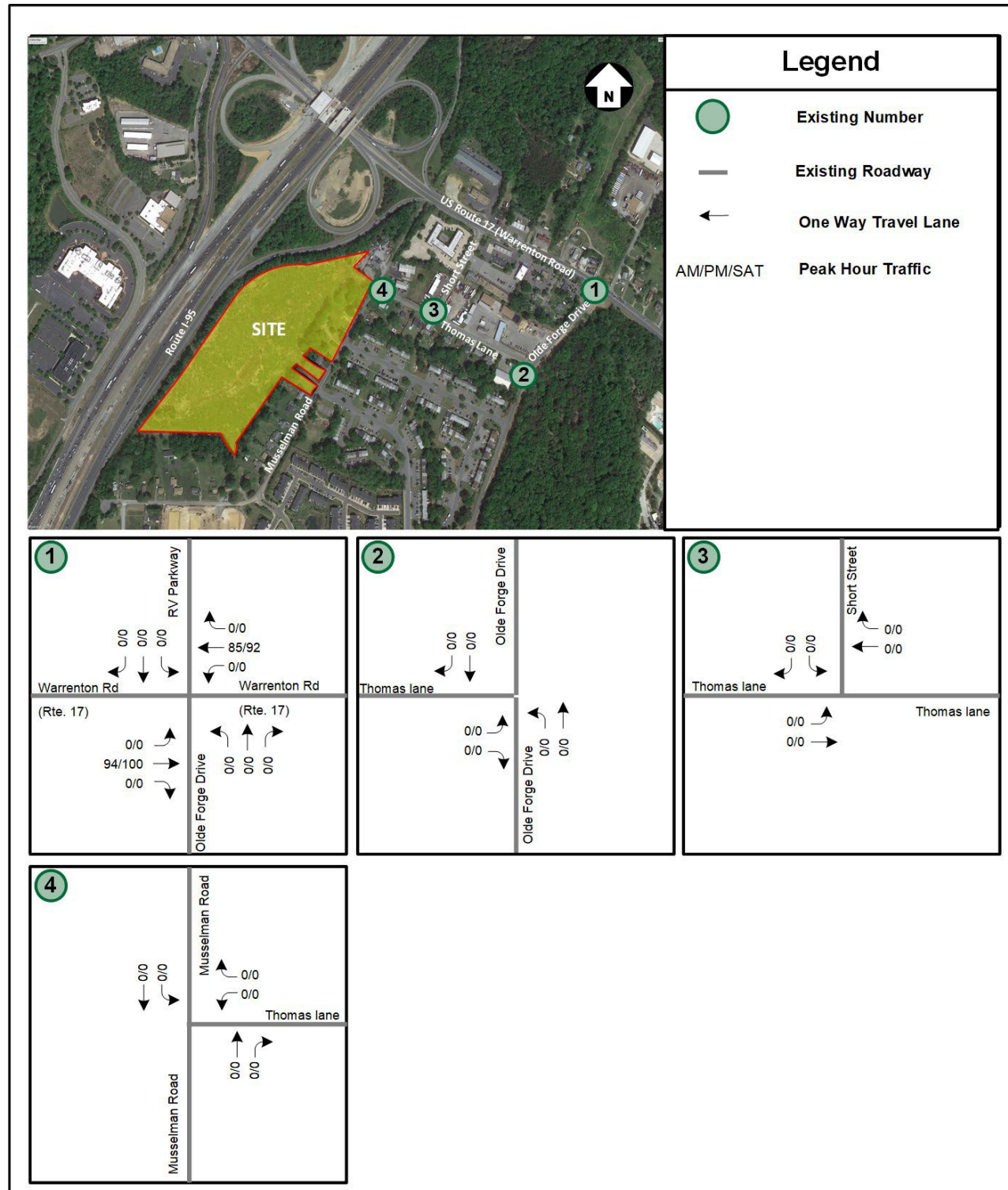


Figure 11: Projected Inherent Regional Growth Traffic Volumes (2023 to 2027)

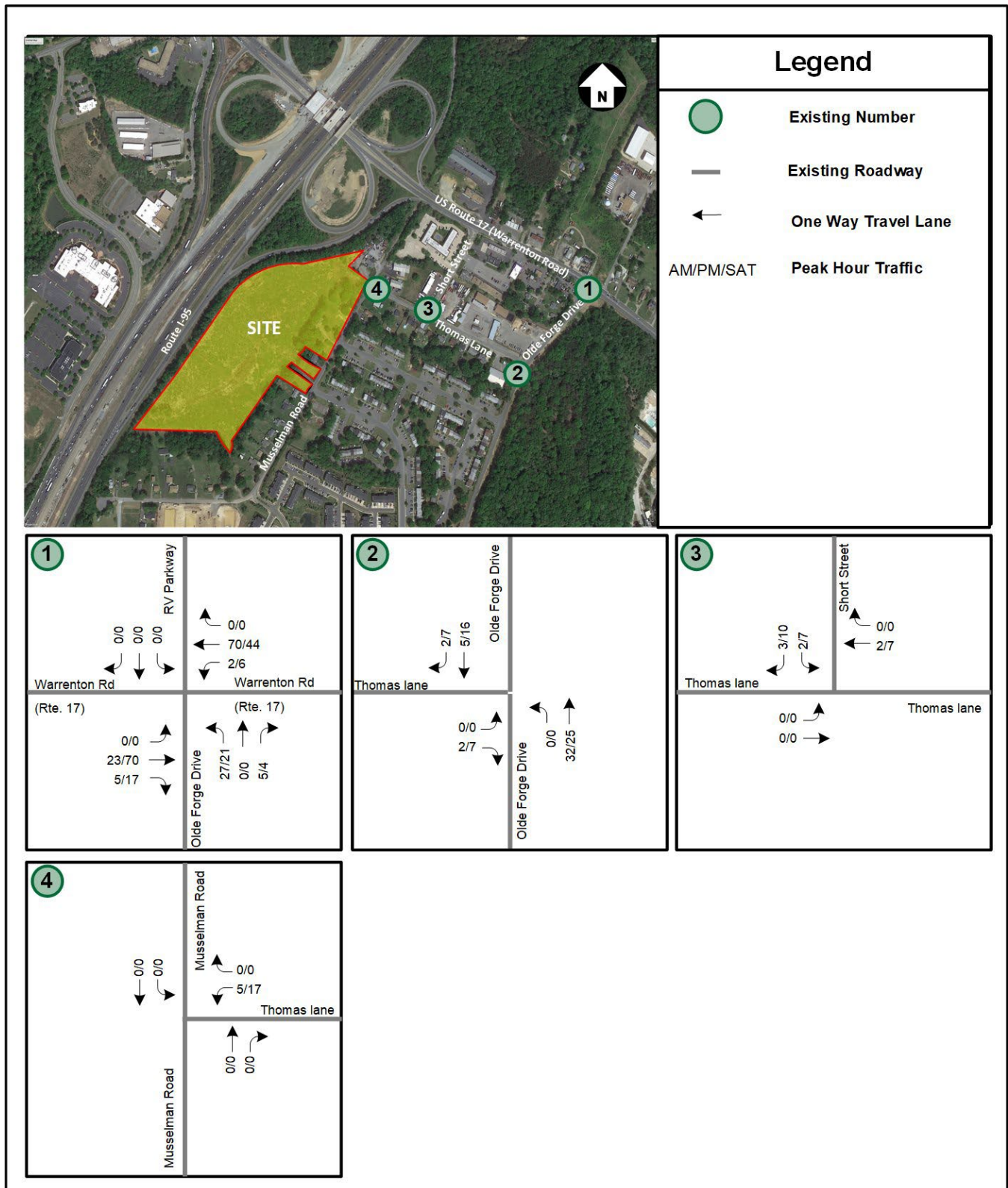


Figure 12: Combined Background Developments Traffic Assignment

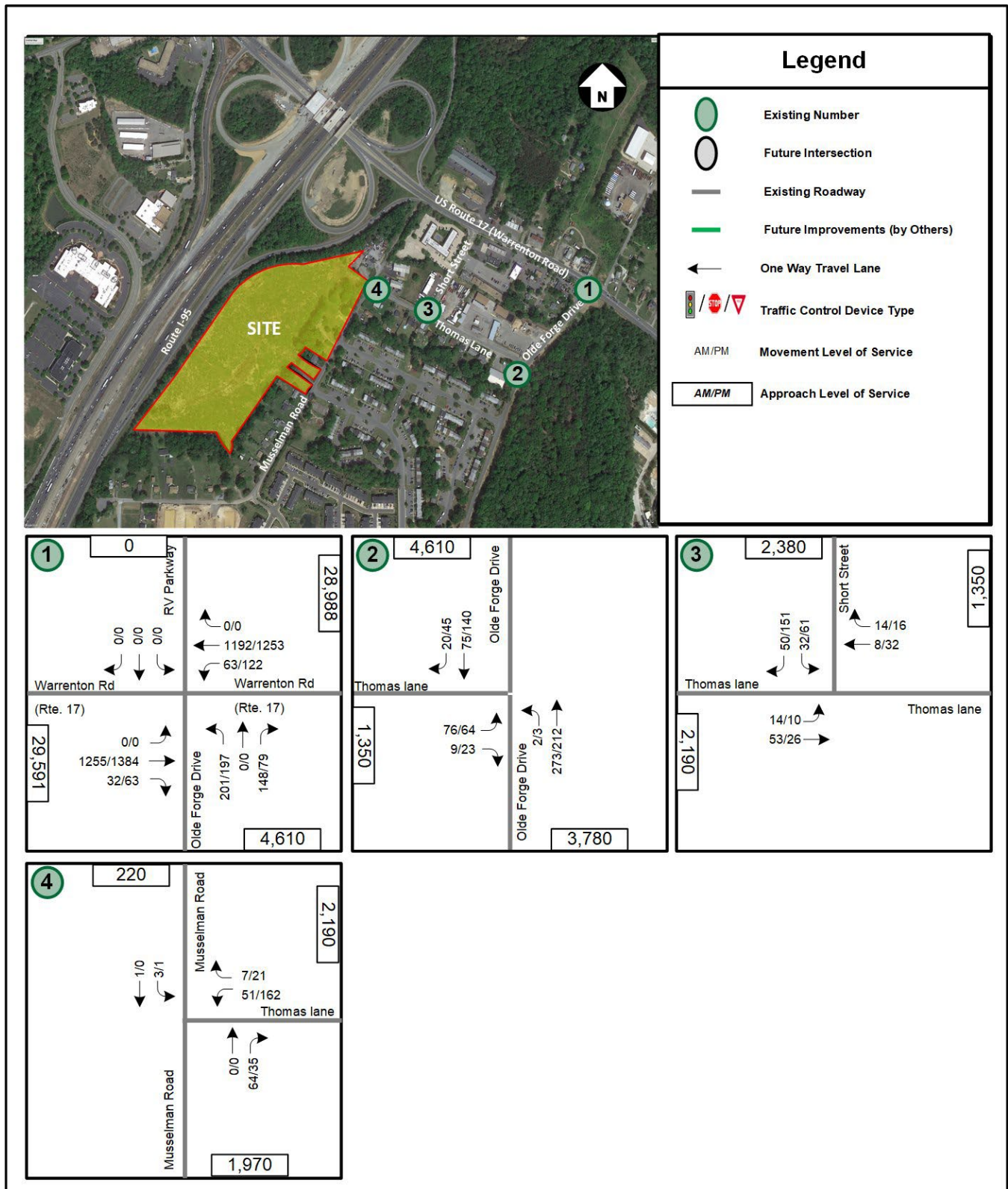


Figure 13: 2027 Future Conditions without Development – Vehicular Traffic Volumes

Future without Development Intersection Capacity and Queuing Analysis

Intersection capacity and queuing analyses were performed for the 2027 Future Conditions without Development scenario at the study area intersections during the AM and PM peak hours, in accord with VDOT's *TOSAM* (version 2) guidelines. *Synchro* / *SimTraffic*, version 11, was used to analyze the study intersections with results based on TRB's HCM 6th Edition methodology and include LOS, delay, and queue length comparisons for the turning movements analyzed.

For this analysis, the intersection PHF utilized in the analysis of future conditions was determined based on the 2023 existing traffic counts, with a minimum of 0.92 as agreed to in the scoping document. The HV% were based on the existing conditions scenario.

As mentioned previously, it would be considered acceptable and/or desirable to achieve an approach LOS D or better for traffic operations at the intersection along the primary corridor (Warrenton Road) and LOS C or better for the remaining intersections, using HCM methodology. The results of the intersection capacity and queuing analyses from *Synchro* / *SimTraffic* are presented in Table 4 and graphically in Figure 14. The results are expressed in LOS and delay (seconds per vehicle) for overall signalized intersections and per approach and lane group for all study intersections. Any overall signalized intersection or approach that operates at LOS E or F is displayed in red.

The scope calls for maximum queues determined from *SimTraffic* to be provided in addition to the capacity analysis. The lane groups where the queue lengths exceeded the available storage lengths of future turn lanes are displayed in red.

The detailed analysis worksheets of the 2027 Future Conditions without Development are contained in Appendix G.

Table 4: 2027 Future Conditions without Development – Intersection Capacity Analysis Results

No.	Intersection (Movement)	Effective Storage Length (ft.) [1]	AM Peak Hour			PM Peak Hour		
			LOS	Delay (sec/veh)	Ave. Max Queue (ft.) [2]	LOS	Delay (sec/veh)	Ave. Max Queue (ft.) [2]
			Synchro		SimTraffic	Synchro		SimTraffic
1	Warrenton Road (EW) and Olde Forge Dr / RV Pkwy (N/S)							
	Overall Intersection (Signalized)		C	22.2		C	21.5	
	Eastbound Approach		B	18.4		B	15.5	
	Eastbound Left		A	0.0	0	A	0.0	0
	Eastbound Thru/Right		B	18.4	464	B	15.5	479
	Westbound Approach		B	17.1		B	19.2	
	Westbound Left	300	E	62.9	140	F	103.5	309
	Westbound Thru/Right		B	14.7	335	B	11.0	576
	Northbound Approach		D	54.7		E	64.3	
	Northbound Left/Thru/Right		D	54.7	423	E	64.3	324
1	Warrenton Road (EW) and Olde Forge Dr / RV Pkwy (N/S)							
	Overall Intersection (Signalized) (MIT: Adjust Signal Timing and Offset)		C	23.5		C	22.2	
	Eastbound Approach		C	20.4		B	17.6	
	Eastbound Left		A	0.0	0	A	0.0	0
	Eastbound Thru/Right		C	20.4	460	B	17.6	380
	Westbound Approach		B	18.3		B	19.3	
	Westbound Left	300	E	63.2	229	F	82.9	250
	Westbound Thru/Right		B	15.9	359	B	13.1	332
	Northbound Approach		D	54.1		E	60.6	
	Northbound Left/Thru/Right		D	54.1	398	E	60.6	327
2	Olde Forge Dr / RV Pkwy (N/S) and Thomas Ln (E/W)							
	Overall Intersection (TWSC)							
	Eastbound Approach		B	12.3		B	12.1	
	Eastbound Left/Right		B	12.3	86	B	12.1	77
	Northbound Approach							
	Northbound Left/Thru		A	7.4	55	A	7.6	43
	Thomas Ln (E/W) and Short St (N/S)							
	Overall Intersection (TWSC)							
	Eastbound Approach							
	Eastbound Left/Thru		A	7.3	6	A	7.3	15
3	Thomas Ln (E/W) and Short St (N/S)							
	Overall Intersection (TWSC)							
	Eastbound Approach							
	Eastbound Left/Thru		A	7.3	6	A	7.3	15
	Southbound Approach		A	7.2		A	7.9	
	Southbound Left/Right		A	7.2	53	A	7.9	7
	Thomas Ln / Site Access (E/W) and Musselman Rd (N/S)							
	Overall Intersection (AWSC)							
	Northbound Approach		A	8.6		A	8.4	
	Northbound Left/Thru/Right		A	8.6	68	A	8.4	34
4	Thomas Ln / Site Access (E/W) and Musselman Rd (N/S)							
	Overall Intersection (AWSC)							
	Northbound Approach		A	8.6		A	8.4	
	Northbound Left/Thru/Right		A	8.6	68	A	8.4	34
	Southbound Approach		B	10.0		B	12.2	
	Southbound Left/Thru/Right		B	10.0	31	B	12.2	22

NOTES:

[1] Effective storage length is based on the storage length plus one-half of the taper length per TOSAM guidelines.

[2] Max queues are based on results from SimTraffic. Per TOSAM guidelines, the queues are based on the average to 10 simulations.

With the addition of regional growth and the background development trips, delays for westbound left turning movement and the northbound approach at the intersection of Warrenton Road and Olde Forge Drive increase. In order to reduce these delays for future conditions, both with and without the proposed development,

an adjustment in the signal timings and offset at the intersection of Warrenton Road and Olde Forge Drive is recommended.

Based on the capacity analysis of 2027 Future Conditions without Development with mitigations, the signalized study intersection is anticipated to operate at overall acceptable levels of service during the AM and PM peak hours, similar to existing conditions. All approaches to all study intersections are anticipated to operate at acceptable levels of service during the AM and PM peak hours except for the northbound approach at the intersection of Warrenton Road and Olde Forge Drive during the PM peak hour.

Based on the simulation analysis performed for 2027 Future Conditions without Development with mitigations, the turning movements at the study intersections are anticipated to have maximum queues that were accommodated within the available storage lengths of the turn bays.

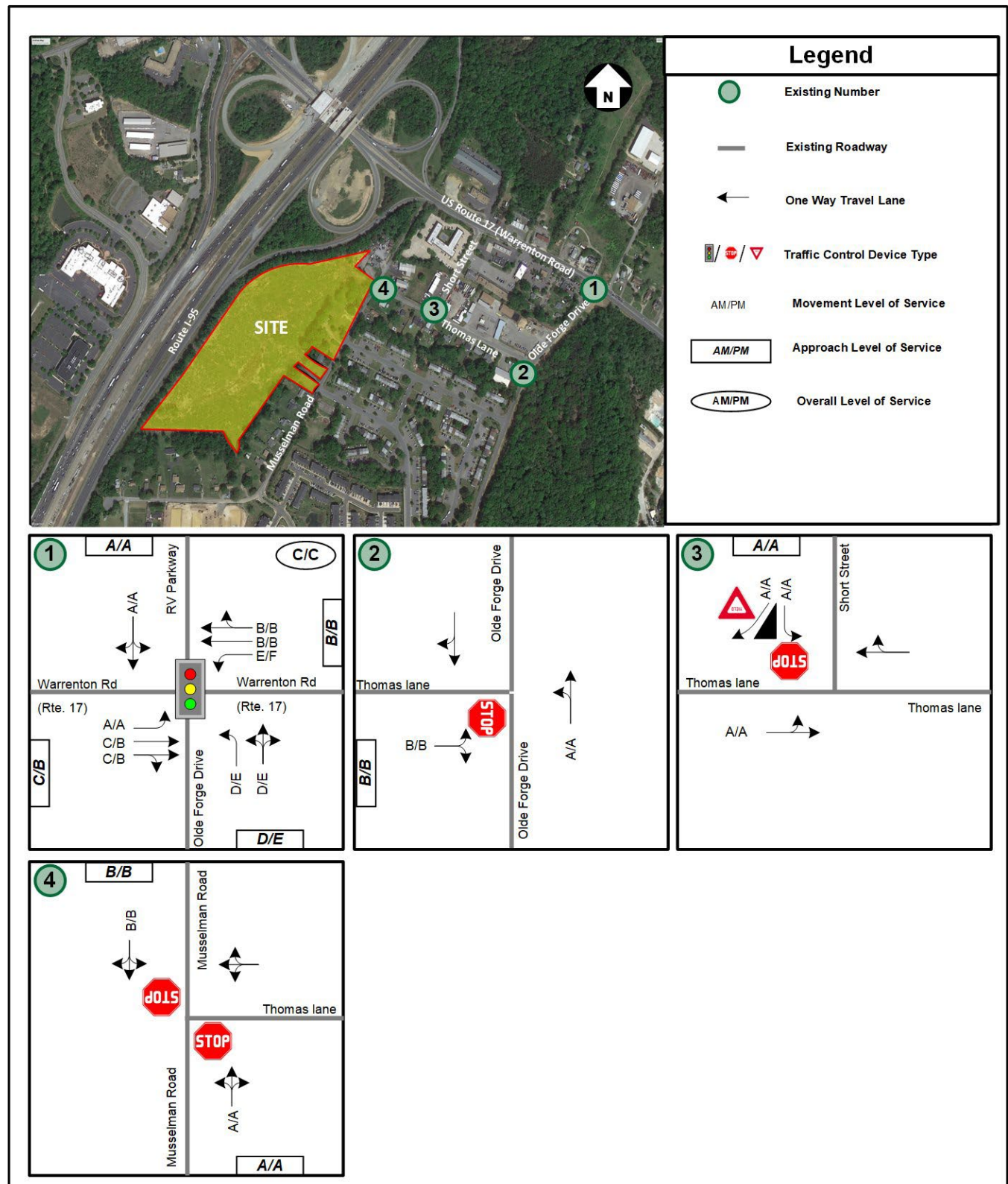


Figure 14: 2027 Future Conditions without Development – Level of Service Results

Analysis of 2027 Future Conditions with Development

For the purposes of this study, the Development is anticipated to be constructed by 2027; this scenario analyzes the future with development conditions for the year 2027.

Site Description

The site is situated across nine parcels that can be identified on Stafford County GIS with the following Property ID #s: 45-37G, 45C-1-7, 45C-1-8, 45C-1-9, 45C-1-10, 45C-1-11, 45C-1-14, 45C-1-16, and 45C-1-17. The property totals approximately 21.052 acres and is currently zoned as a mix of B-2 (Urban Commercial) and R-1 (Suburban Residential).

The Applicant is proposing to a zoning reclassification to the M-1 (Industrial Light) zone to construct in order to construct approximately 218,400 square feet of warehouse/industrial uses. The development is anticipated to be complete and in operation by 2027. A concept plan of the development is shown on

Proposed Site Access

Assess to the site will be provided via one proposed full-movement entrance along Musselman Road (forming the fourth leg of the existing intersection at Thomas Lane).

Projected Site Trip Generation

In order to calculate the trips generated by the proposed Development, the Institute of Transportation Engineers' (ITE) Trip Generation Manual, 11th Edition, the publication was used to determine the total trips going into and out of the subject study site during the AM and PM peak hours as well as the typical number of weekday daily trips. The projected trip generation for the proposed development, conservatively assumed as Industrial Park, is depicted in Table 5. Of note, as agreed to in the scoping document, no internal capture or pass-by trip reductions were assumed with respect to the proposed development, and therefore are not assumed within the table.

Table 5: Site Trip Generation (Peak Hour of the Adjacent Street; ITE 11th Ed.)

Land Use	ITE Code	Size	----- Week day -----					
			AM Peak Hour			PM Peak Hour		
			In	Out	Total	In	Out	Total
Industrial Park	130	218.4 kSF of GFA	60	14	74	16	58	74
Total			60	14	74	16	58	74

As illustrated in the table above, the Site is expected to generate approximately 74 new trips during the AM peak hour, 74 new trips during the PM peak hour, and 1,409 new daily trips on a typical weekday.

Distribution and Assignment of Site Traffic

The distribution and assignment of the site generated trips were based on the existing traffic patterns, engineering judgment, the nature of the proposed development, and with the guidance and input from the VDOT and the County staff. The site direction of approach and trip distribution is illustrated in Figure 15. A generalized development plan is shown in Figure 16.



Figure 15: Global Vehicular Direction of Approach (Site Trip Distribution)



In order to project future traffic volumes on the roadways in the vicinity of the development, trips generated from the development were assigned to the road network based on the previously mentioned direction of approach. The site traffic assignment is illustrated for the AM and PM peak hours in Figure 17.

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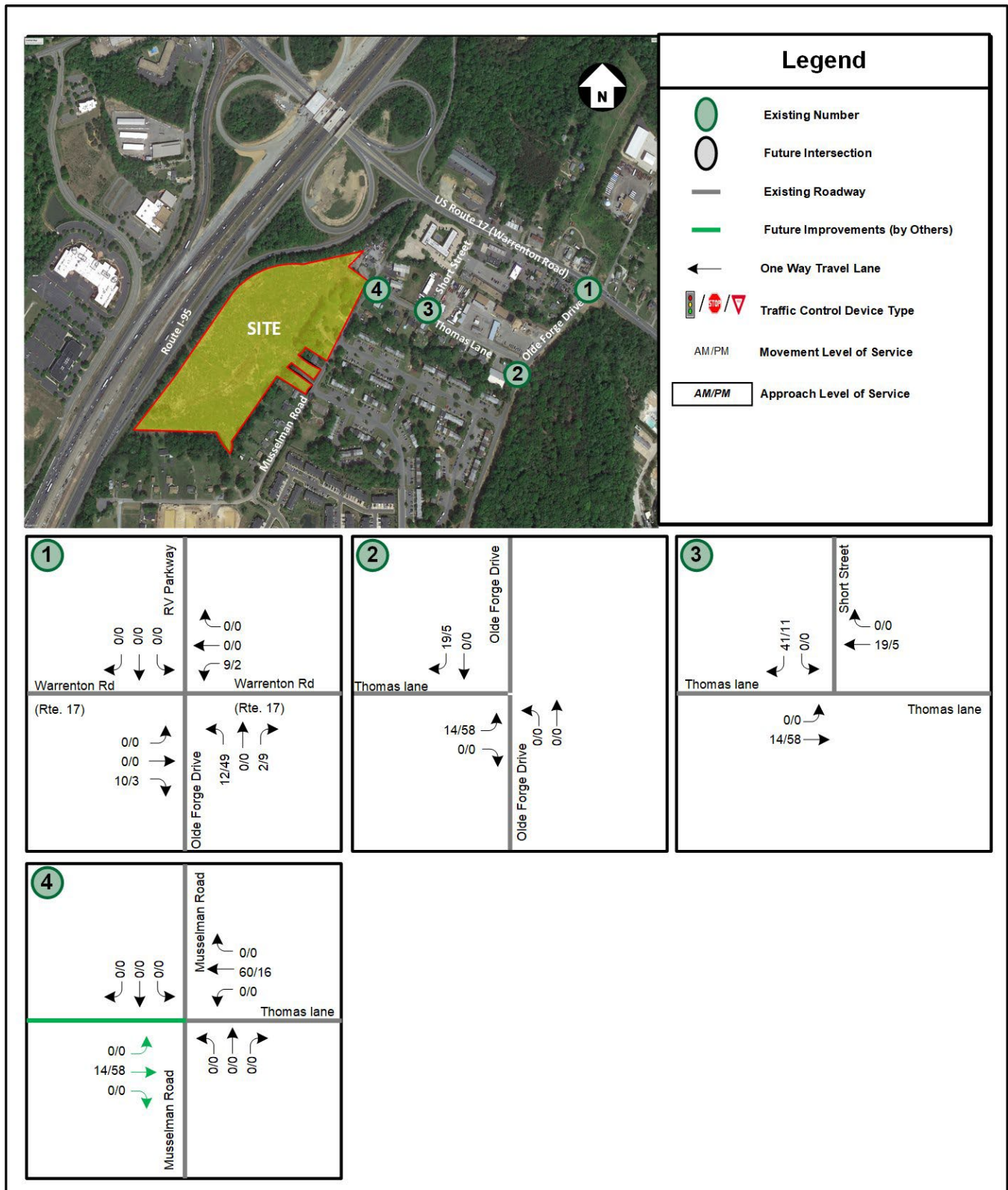


Figure 17: Site Generated Trip Assignment

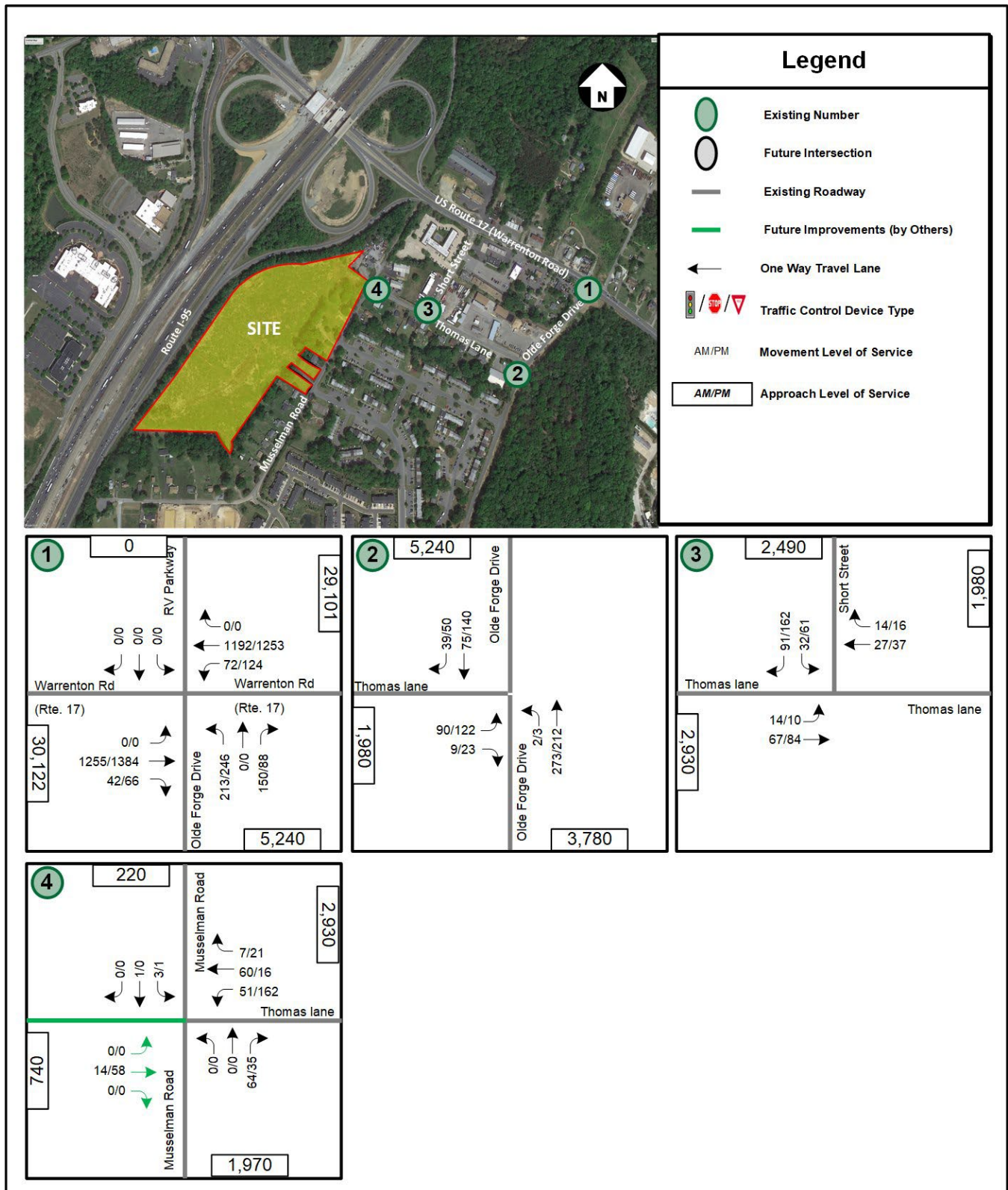


Figure 18: 2027 Future Conditions with Development

Future with Development Intersection Capacity and Queuing Analysis

Intersection capacity and queuing analyses were performed for the 2027 Future Conditions with Development scenario at the study area intersections during the AM and PM peak hours, in accord with VDOT's *TOSAM* (version 2) guidelines. *Synchro* / *SimTraffic*, version 11, was used to analyze the study intersections with results based on TRB's HCM 6th Edition methodology and include LOS, delay, and queue length comparisons for the turning movements analyzed.

For the purposes of this analysis, the intersection PHF utilized in the analysis of future conditions was determined based on the 2023 existing traffic counts, with a minimum of 0.92 as agreed to in the scoping document. The HV% were based on the existing conditions scenario, with any new approaches utilizing a default *Synchro* / *SimTraffic* value of 2.0% per movement.

As mentioned previously, it would be considered acceptable and/or desirable to achieve an approach LOS D or better for traffic operations at the intersection along the primary corridor (Warrenton Road) and LOS C or better for the remaining intersections, using HCM methodology.. The results of the intersection capacity and queuing analyses from *Synchro* / *SimTraffic* are presented in Table 6 and graphically in Figure 19. The results are expressed in LOS and delay (seconds per vehicle) for overall signalized intersections and per approach and lane group for all study intersections. The overall signalized intersections and any approaches that operate at LOS E or F are displayed in red.

The scope calls for maximum queues determined from *SimTraffic* to be provided in addition to the capacity analysis. The lane groups where the queue lengths exceeded the available storage lengths of future turn lanes are displayed in red.

The detailed analysis worksheets of the 2027 Future Conditions with Development scenario are contained in Appendix H.

Table 6: 2027 Future Conditions with Development– Intersection Capacity Analysis Results

No.	Intersection (Movement)	Effective Storage Length (ft.) [1]	AM Peak Hour			PM Peak Hour		
			LOS	Delay (sec/veh)	Ave. Max Queue (ft.) [2]	LOS	Delay (sec/veh)	Ave. Max Queue (ft.) [2]
			Synchro		SimTraffic	Synchro		SimTraffic
1	Warrenton Road (EW) and Olde Forge Dr / RV Pkwy (N/S) Overall Intersection (Signalized)		C	23.0		C	23.2	
	Eastbound Approach		B	19.5		B	15.6	
	Eastbound Left		A	0.0	0	A	0.0	0
	Eastbound Thru/Right		B	19.5	457	B	15.6	420
	Westbound Approach		B	17.4		B	19.6	
	Westbound Left	300	E	63.4	191	F	106.8	304
	Westbound Thru/Right		B	14.7	342	B	11.0	551
	Northbound Approach		D	54.6		E	70.6	
	Northbound Left/Thru/Right		D	54.6	477	E	70.6	520
	Southbound Approach		A	0.0		A	0.0	
1	Warrenton Road (EW) and Olde Forge Dr / RV Pkwy (N/S) Overall Intersection (Signalized) (MIT: Adjust Signal Timing and Offset)		C	24.3		C	23.8	
	Eastbound Approach		C	21.5		B	18.6	
	Eastbound Left		A	0.0	0	A	0.0	0
	Eastbound Thru/Right		C	21.5	486	B	18.6	388
	Westbound Approach		B	18.6		B	20.0	
	Westbound Left	300	E	64.1	200	F	84.2	266
	Westbound Thru/Right		B	15.9	365	B	13.6	353
	Northbound Approach		D	54.0		E	61.6	
	Northbound Left/Thru/Right		D	54.0	414	E	61.6	449
	Southbound Approach		A	0.0		A	0.0	
2	Olde Forge Dr / RV Pkwy (N/S) and Thomas Ln (E/W) Overall Intersection (TWSC)		B	12.7		B	13.6	
	Eastbound Approach		B	12.7	102	B	13.6	166
	Eastbound Left/Right							
	Northbound Approach							
	Northbound Left/Thru		A	7.4	69	A	7.6	97
	Thomas Ln (E/W) and Short St (N/S) Overall Intersection (TWSC)							
	Eastbound Approach							
	Eastbound Left/Thru		A	7.4	22	A	7.3	18
	Southbound Approach		A	7.9		A	8.1	
	Southbound Left/Right		A	7.9	71	A	8.1	2
4	Thomas Ln / Site Access (E/W) and Musselman Rd (N/S) Overall Intersection (AWSC)		A	7.7		A	8.2	
	Eastbound Approach		A	7.3		A	7.6	
	Eastbound Left/Thru/Right		A	7.3	43	A	7.6	61
	Westbound Approach		A	8.2		A	8.6	
	Westbound Left/Thru/Right		A	8.2	78	A	8.6	75
	Northbound Approach		A	6.9		A	7.1	
	Northbound Left/Thru/Right		A	6.9	82	A	7.1	35
	Southbound Approach		A	7.5		A	7.8	
	Southbound Left/Thru/Right		A	7.5	26	A	7.8	16

NOTES:

[1] Effective storage length is based on the storage length plus one-half of the taper length per TOSAM guidelines.

[2] Max queues are based on results from SimTraffic. Per TOSAM guidelines, the queues are based on the average to 10 simulations.

Based on the capacity analysis of 2027 Future Conditions with Development, the signalized study intersection is anticipated to operate at overall acceptable levels of service during the AM and PM peak hours, similar to existing conditions. All approaches to all study intersections are anticipated to operate at acceptable levels of service during the AM and PM peak hours except for the northbound approach at the intersection of Warrenton Road and Olde Forge Drive during the PM peak hour.

Based on the simulation analysis performed for 2027 Future Conditions with Development with mitigations, the turning movements at the study intersections are anticipated to have maximum queues that were accommodated within the available storage lengths of the turn bays.

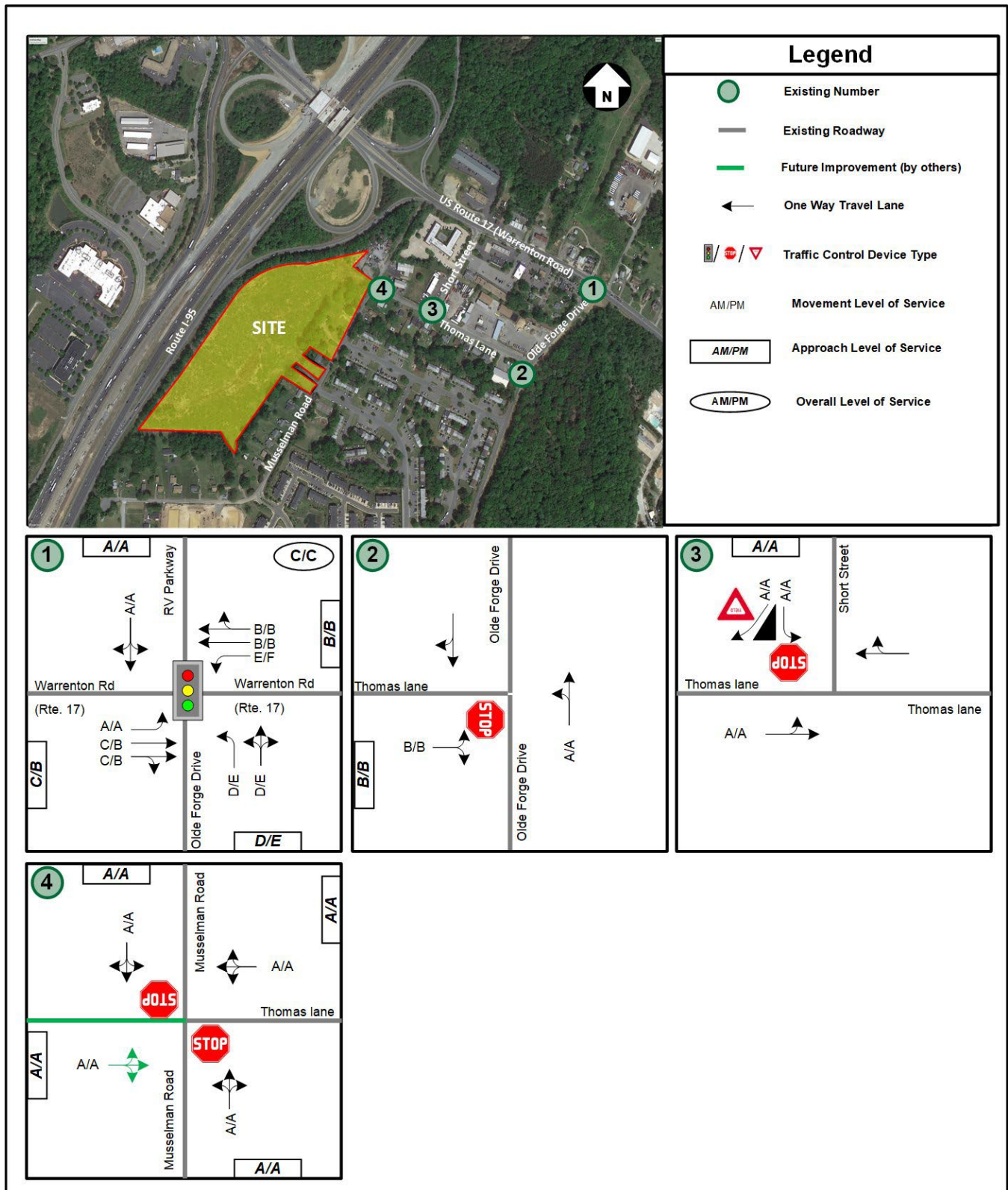


Figure 19: 2027 Future Conditions with Development and with Potential Mitigation – Level of Service Results

Conclusions

This report presents the findings of a Traffic Impact Analysis (TIA) for the proposed site development which is generally situated in the southwest quadrant of Musselman Road at Thomas Lane in Stafford County, Virginia.

The Applicant is proposing a zoning reclassification to the M-1 (Industrial Light) zone to construct approximately 218,400 square feet of warehouse/industrial uses. The development is anticipated to be complete and in operation by 2027.

Access to the site will be provided via one full-movement entrance along Musselman Road (forming the fourth leg at the existing intersection across Thomas Lane).

The analysis presented in this report supports the following assumptions and major findings:

Analysis Components

- 2023 existing peak hour volumes were derived via turning movement counts collected at intersections within the study area in February 2023.
- As determined based on the discussions and scoping document with VDOT and the County, an inherent regional growth of 2% per year was applied to through movements at Warrenton Road and Olde Forge Drive study intersections for the period between 2023 and 2027 to account for future conditions.
- Background development trips were estimated based on the Institute of Transportation Engineers' (ITE) Trip Generation Manual, 11th Edition publication for the nearby approved but unbuilt uses.
- The trip generation associated with the Site was based on the ITE Trip Generation Manual, 11th Edition publication. The Site in total is expected to generate approximately 74 new trips during the AM peak hour, 74 new trips during the PM peak hour, and 1,409 new daily trips on a typical weekday.
- Intersection capacity and queuing analyses were performed for all analysis scenarios at the study area intersections during the weekday morning (AM) and weekday afternoon (PM) peak hours. *Synchro / SimTraffic*, version 11, was used to analyze the study intersections with results based on the Transportation Research Board's (TRB) Highway Capacity Manual (HCM) methodology and analysis guidelines provided in VDOT's Traffic Operations and Safety Analysis Manual (TOSAM) (version 2). The analysis herein includes the level of service (LOS), delay, and queue length comparisons for the turning movements analyzed.

Analysis Results

2023 Existing Conditions

- Based on the capacity analysis of existing conditions, the signalized study intersection currently operates at overall acceptable levels of service during the AM and PM peak hours. All approaches at all study intersections operate at acceptable levels of service during the AM and PM peak hours except for the northbound approach at the intersection of Warrenton Road and Olde Forge Drive during the PM peak hour.
- Based on the analysis of the average maximum queue lengths from *SimTraffic*, all turning movements have queue lengths that were accommodated within the available storage length of the turn bays.

2027 Future Conditions without Development

- Based on the capacity analysis of future conditions without development, the signalized study intersection is anticipated to operate at overall acceptable levels of service during the AM and PM peak hours, similar to existing conditions. All approaches to all study intersections are anticipated to operate at acceptable levels of service during the AM and PM peak hours except for the northbound approach at the intersection of Warrenton Road and Olde Forge Drive during the PM peak hour.

- Based on the analysis of the average maximum queue lengths from *SimTraffic*, all turning movements are anticipated to have queue lengths that are accommodated within the available storage length of the turn bays.

2027 Future Conditions with Development

- Based on the capacity analysis of future conditions with the Musselman Road property development, the signalized study intersection is anticipated to operate at overall acceptable levels of service during the AM and PM peak hours, similar to existing conditions. All approaches to all study intersections are anticipated to operate at acceptable levels of service during the AM and PM peak hours except for the northbound approach at the intersection of Warrenton Road and Olde Forge Drive during the PM peak hour.
- Based on the analysis of the maximum queue lengths from *SimTraffic* all turning movements are anticipated to have queues that are accommodated within the available storage length of the turn bays.

Overall Conclusion

Based on the capacity and queueing analysis results, the proposed JDA - Musselman Road development will not have a substantial impact on the surrounding transportation and roadway network. Minor signal timing adjustments, which would also minimize approach delays without the proposed development, are recommended to optimize operations at the intersection of Warrenton Road and Olde Forge Drive.

Transportation Technical Appendix

JDA - Musselman Road

Stafford County, VA

April 07, 2023

GOROVE SLADE
Transportation Planners and Engineers

TABLE OF CONTENTS

Appendix A – Signed Scoping Document

Appendix B – 2023 Turning Movement Counts Data

Appendix C – HCM Level of Service Definitions

Appendix D – 2023 Existing Conditions – Capacity Analysis Worksheets

Appendix E – 2023 Existing Conditions – Simulation Analysis Worksheets

Appendix F – Excerpts from Background Development Studies

Appendix G –2027 Future Conditions without Development– Capacity and Simulation Analysis Worksheets

Appendix H –2027 Future Conditions with Development– Capacity and Simulation Analysis Worksheets

Appendix A – Signed Scoping Document

THIS IS NOT A CHAPTER 870 STUDY



PRE-SCOPE OF WORK MEETING FORM

Information on the Project Traffic Impact Analysis Base Assumptions

The applicant is responsible for entering the relevant information and submitting the form to VDOT and the locality no less than three (3) business days prior to the meeting. If a form is not received by this deadline, the scope of work meeting may be postponed.

Contact Information

Consultant Name: Kevin Sitzman, Gorove Slade Associates, Inc.
Tele: 703.787.9595
E-mail: ksitzman@goroveslade.com

Developer/Owner Name: Tripp Bailey
Tele:
E-mail: tbailey@johnsondevelopment.net

Project Information

Project Name: Musselman Road Property Locality/County: Stafford County

Project Location:
(Attach regional and site specific location map)
The proposed development site is generally situated in the southwest quadrant of Musselman Road at Thomas Lane in Stafford County, Virginia.

Submission Type
Comp Plan ☐ REZ/CUP ☒ Site Plan ☐ Subd Plat ☐

Project Description:
(Including details on the land use, acreage, phasing, access location, etc. Attach additional sheet if necessary)
The site is situated across eight parcels that can be identified on Stafford County Tax Maps with the following Tax Map ID #s: 45-37G 45C-1-17 45C-1-16 45C-1-14 45C-1-12 45C-1-11 45C-1-10 45C-1-9 and 45C-1-8. The property totals approximately 17.35 acres and is currently zoned as B-2 (Urban Commercial).
The Applicant is proposing to rezone the parcels to M-1 (Industrial Light) in order to construct approximately 218,400 square feet of industrial uses. The development is anticipated to be complete and in operation by 2027.
Assess to the site will be provided via one proposed full-movement entrance along Musselman Road (forming the fourth leg of the existing intersection at Thomas Lane).

Residential ☐ Commercial ☐ Mixed Use ☐ Other ☒

Proposed Use(s):
(Check all that apply; attach additional pages as necessary)
Residential Uses(s)
ITE LU Code(s):
Number of Units:
Commercial Use(s)
ITE LU Code(s):
Square Ft or Other Variable:
Other Use(s)
ITE LU Code(s): 130
Square Ft or Other Variable:
218.4 kSF

Total Peak Hour Trip Projection:
Less than 100 ☒ 100 – 499 ☐ 500 – 999 ☐ 1,000 or more ☐

It is important for the applicant to provide sufficient information to county and VDOT staff so that questions regarding geographic scope, alternate methodology, or other issues can be answered at the scoping meeting.

Traffic Impact Analysis Assumptions					
Study Period	Existing Year: 2023		Build-out Year: 2027		Design Year: N/A
Study Area Boundaries (Attach map)	North: I-95 Northbound Off-Ramp			South: Musselman Road	
	West: I-95			East: Musselman Road	
External Factors That Could Affect Project (Planned road improvements, other nearby developments)	1. The Renaissance at Falmouth 2. Cherry View Residential 3. Rappahannock Landing Residential				
Consistency With Comprehensive Plan (Land use, transportation plan)	Yes				
Available Traffic Data (Historical, forecasts)	2023 TMCs VDOT Historical AADT Data				
Trip Distribution (Please refer to attached Figure 2 in Supplement.)	Road Name: I-95 (to/from the North) – 35%			Road Name: I-95 (to/from the South) – 35%	
	Road Name: US Route 17 BUS (to/from the West) – 15%			Road Name: US Route 17 BUS (to/from the East) – 15%	
Annual Vehicle Trip Growth Rate: (See Note 4.)	2.0%/yr. (2023-2027)	Peak Period for Study (check all that apply)		<input checked="" type="checkbox"/> AM <input checked="" type="checkbox"/> PM <input type="checkbox"/> SAT	
		Peak Hour of the Adj. (to be used in study)		AM: 74 / PM: 74 / Daily: 1,409	
Study Intersections and/or Road Segments (Attach additional sheets as necessary) (Please refer to attached Figure 1 in Supplement.)	1.	US Route 17 BUS (Warrenton Road) at Old Forge Drive		7.	
	2.	Thomas Lane at Old Forge Drive		8.	
	3.	Thomas Lane at Short Street		9.	
	4.	Musselman Road at Thomas Lane / Future Access		10.	
	5.			11.	
	6.			12.	
Trip Adjustment Factors	Internal allowance Reduction: <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No			Pass-by allowance Reduction: <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Software Methodology	<input checked="" type="checkbox"/> Synchro <input type="checkbox"/> HCS (v.2000/+) <input type="checkbox"/> SIDRA <input type="checkbox"/> CORSIM <input type="checkbox"/> Other ____				
Traffic Signal Proposed or Affected	Existing traffic signals that could be affected: 1. US Route 17 BUS (Warrenton Road) at Old Forge Drive				

It is important for the applicant to provide sufficient information to county and VDOT staff so that questions regarding geographic scope, alternate methodology, or other issues can be answered at the scoping meeting.

(Analysis software to be used, progression speed, cycle length)	Analysis Software: Synchro version 11 Results: HCM 6 Methodology (See Note 9.) Queue Lengths to be Reported: SimTraffic Max Queues
Improvement(s) Assumed or to be Considered	Interchange ramp improvements to be included in model only (no analysis)
Background Traffic Studies Considered	The Renaissance at Falmouth TIA (June 2020)
Plan Submission	<input type="checkbox"/> Master Development Plan (MDP) <input checked="" type="checkbox"/> Generalized Development Plan (GDP) <input type="checkbox"/> Preliminary/Sketch Plan <input type="checkbox"/> Other Plan type (Final Site, Subd. Plan)
Additional Issues to be Addressed	<input checked="" type="checkbox"/> Queuing analysis <input type="checkbox"/> Actuation/Coordination <input type="checkbox"/> Weaving analysis <input type="checkbox"/> Merge analysis <input type="checkbox"/> Bike/Ped Accommodations <input checked="" type="checkbox"/> Intersection(s) <input type="checkbox"/> TDM Measures <input type="checkbox"/> Other (_____)

It is important for the applicant to provide sufficient information to county and VDOT staff so that questions regarding geographic scope, alternate methodology, or other issues can be answered at the scoping meeting.

NOTES on ASSUMPTIONS:

1. Synchro files/signal timings will be obtained from VDOT.
2. The scenarios to be included in the study are 2023 Existing Conditions, 2027 Future Conditions without Development, and 2027 Future Conditions with Development. The study will analyze AM and PM peak hours for all above scenarios.
3. Existing turning movement counts will be collected and utilized to develop baseline conditions.
4. In order to project 2027 future conditions, a regional growth rate of 2.0% (compounded per year) will be applied to the Warrenton Road mainline through movements at the intersection of Warrenton Road at Old Forge Drive for the period between 2023 and 2027. The growth volumes will be balanced along the road network by increasing the maline through movements at subsequent study intersections along the road network where applicable.
5. Existing peak hour factors will be based on the traffic counts and utilized on a by-intersection basis. Peak hours factors by intersection in the range of 0.85 to 1.00 will be used for existing scenario. Peak hour factors of 0.92 will be used for all future scenarios if the existing peak hour factor by intersection is less than 0.92, and for all new intersections.
6. Heavy vehicle percentages (HV%) will be based on existing counts. For any new intersection and at site entrances, the HV% will be based on existing counts and the Site truck trip generation, per movement.
7. Based on the County comp plan, for any approach, a level of service (LOS) C or better would be considered as acceptable/desirable for traffic operations. VDOT considers LOS D or better as acceptable/desirable. For all approaches, the projected future conditions without development LOS and delay will be maintained in the future with development condition. Will show intersection, approach, and movement LOS.
8. Maximum queue lengths will be provided in addition to the capacity analyses. The queue lengths will be determined from *SimTraffic*.
9. HCM 6 methodology will be utilized in the capacity analyses where applicable; HCM 2000 methodology will be utilized if HCM 6 methodology is not applicable.
10. Preliminary access management and turn lanes will be assessed at the proposed site entrances.

SIGNED:  DATE: 03/20/2023
Applicant or Consultant

PRINT NAME: Kevin Sitzman, PE
Applicant or Consultant

SIGNED:  Digitally signed by Carolyn Oster
Date: 2023.04.11 10:26:39 -04'00' DATE: 4/11/23
VDOT Representative

PRINT NAME: Carolyn Oster, P.E.
VDOT Representative

SIGNED:  DATE: 4/18/2023
Local Government Representative

PRINT NAME: MICHAEL ZURAF
Local Government Representative

Table 1: Historic Growth (Based on VDOT Traffic Data)

Road Segment:	From:	To:	Published VDOT AADT					Growth Rate			
			2015	2016	2017	2018	2019	2015 - 2019	2016 - 2019	2017 - 2019	2018 - 2019
US 17 BUS (Warrenton Road)	US 1 Jefferson Davis Highway	I-95, US 17	32,000	32,000	32,000	34,000	39,000	5%	7%	10%	15%
Short Street	Musselman Road	US 17 BUS (Warrenton Road)	2,000	2,000	2,000	2,800	2,900	10%	13%	20%	4%
Musselman Road	Bellows Avenue	Short Street	1,600	1,600	1,600	2,300	2,300	9%	13%	20%	0%
Bellows Avenue	Musselman Road	Manor Lane	600	600	600	420	420	-9%	-11%	-16%	0%
Anvil Road	Manor Lane	Musselman Road	660	660	660	550	550	-4%	-6%	-9%	0%



Figure 1: Site Location and Study Intersections



Figure 2: Direction of Approach

Table 2: Trip Generation – Peak Hour of the Adjacent Street (ITE 11th Edition)

Land Use	ITE Code	Size	----- Week day -----						Daily Total
			AM Peak Hour			PM Peak Hour			
			In	Out	Total	In	Out	Total	
Industrial Park	130	218.4 kSF of GFA	60	14	74	16	58	74	1,409
Total			60	14	74	16	58	74	1,409

Appendix B – 2023 Turning Movement Counts Data

National Data & Surveying ServicesIntersection Turning Movement Count

Location: Olde Forge Dr & US 17/Warrenton Rd
City: Fredericksburg
Control: Signalized

Project ID: 23-260019-001
Date: 2/1/2023

Data - Total

NS/EW Streets:	Olde Forge Dr				Olde Forge Dr				US 17/Warrenton Rd				US 17/Warrenton Rd				
AM	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				TOTAL
	1.5 NL	0 NT	0.5 NR	0 NU	0 SL	0 ST	0 SR	0 SU	1 EL	1.5 ET	0.5 ER	0 EU	1 WL	2 WT	0 WR	0 WU	
6:00 AM	32	0	12	0	0	0	0	0	0	93	3	0	3	177	0	0	320
6:15 AM	45	0	13	0	0	0	0	0	0	150	1	0	5	173	0	0	387
6:30 AM	41	0	21	0	0	0	0	0	0	153	4	0	13	189	0	0	421
6:45 AM	46	0	25	1	0	0	0	0	0	230	4	0	13	234	0	0	553
7:00 AM	55	0	20	0	0	0	0	0	0	186	5	1	14	230	0	0	511
7:15 AM	45	0	17	0	0	0	1	0	1	238	4	0	8	269	0	0	583
7:30 AM	41	0	37	0	0	0	0	0	0	243	7	0	8	287	0	0	623
7:45 AM	36	0	43	0	0	0	0	0	0	289	6	0	20	261	0	0	655
8:00 AM	56	0	39	0	0	0	0	0	0	301	9	0	9	228	0	0	642
8:15 AM	41	0	24	0	0	0	0	0	0	305	5	0	24	261	0	0	660
8:30 AM	48	0	21	0	0	0	0	0	1	276	11	0	17	219	0	0	593
8:45 AM	37	0	27	0	0	0	0	0	0	247	4	0	12	233	0	0	560
TOTAL VOLUMES :	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
APPROACH %'s :	523	0	299	1	0	0	1	0	2	2711	63	1	146	2761	0	0	6508
PEAK HR :	63.55%	0.00%	36.33%	0.12%	0.00%	0.00%	100.00%	0.00%	0.07%	97.62%	2.27%	0.04%	5.02%	94.98%	0.00%	0.00%	
PEAK HR :	07:30 AM - 08:30 AM																TOTAL
PEAK HR VOL :	174	0	143	0	0	0	0	0	0	1138	27	0	61	1037	0	0	2580
PEAK HR FACTOR :	0.777	0.000	0.831	0.000	0.000	0.000	0.000	0.000	0.000	0.933	0.750	0.000	0.635	0.903	0.000	0.000	0.977
	0.834								0.940				0.931				

PM	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				TOTAL
	1.5 NL	0 NT	0.5 NR	0 NU	0 SL	0 ST	0 SR	0 SU	1 EL	1.5 ET	0.5 ER	0 EU	1 WL	2 WT	0 WR	0 WU	
4:00 PM	34	0	26	0	0	0	0	0	0	274	13	0	31	276	0	0	654
4:15 PM	41	0	12	0	0	0	0	0	0	230	16	0	27	236	0	0	562
4:30 PM	54	0	17	0	0	0	0	0	0	268	4	0	22	273	0	0	638
4:45 PM	28	0	17	0	0	0	0	0	0	314	15	0	25	284	0	0	683
5:00 PM	42	0	23	0	0	0	0	0	0	317	15	0	39	271	0	0	707
5:15 PM	52	0	18	0	0	0	0	0	0	315	12	0	30	289	0	0	716
5:30 PM	44	0	22	0	0	0	0	0	0	309	25	1	14	228	0	0	643
5:45 PM	50	0	19	0	1	0	0	0	0	282	13	0	25	241	0	0	631
6:00 PM	50	0	19	0	0	0	0	0	0	249	16	0	28	189	0	0	551
6:15 PM	31	0	12	0	0	0	0	0	0	273	9	1	20	233	0	0	579
6:30 PM	39	0	16	0	0	0	0	0	0	231	25	0	20	180	0	0	511
6:45 PM	46	0	21	0	0	0	0	0	0	212	14	0	28	152	0	0	473
TOTAL VOLUMES :	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
APPROACH %'s :	511	0	222	0	1	0	0	0	0	3274	177	2	309	2852	0	0	7348
PEAK HR :	69.71%	0.00%	30.29%	0.00%	100.00%	0.00%	0.00%	0.00%	0.00%	94.82%	5.13%	0.06%	9.78%	90.22%	0.00%	0.00%	
PEAK HR :	04:45 PM - 05:45 PM																TOTAL
PEAK HR VOL :	166	0	80	0	0	0	0	0	0	1255	67	1	108	1072	0	0	2749
PEAK HR FACTOR :	0.798	0.000	0.870	0.000	0.000	0.000	0.000	0.000	0.000	0.990	0.670	0.250	0.692	0.927	0.000	0.000	0.960
	0.879								0.987				0.925				

National Data & Surveying ServicesIntersection Turning Movement Count

Location: Olde Forge Dr & US 17/Warrenton Rd
City: Fredericksburg
Control: Signalized

Project ID: 23-260019-001
Date: 2/1/2023

Data - HT

NS/EW Streets:	Olde Forge Dr				Olde Forge Dr				US 17/Warrenton Rd				US 17/Warrenton Rd				
AM	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				TOTAL
	1.5 NL	0 NT	0.5 NR	0 NU	0 SL	0 ST	0 SR	0 SU	1 EL	1.5 ET	0.5 ER	0 EU	1 WL	2 WT	0 WR	0 WU	
6:00 AM	1	0	0	0	0	0	0	0	0	3	0	0	0	7	0	0	11
6:15 AM	2	0	0	0	0	0	0	0	0	4	0	0	0	6	0	0	12
6:30 AM	2	0	2	0	0	0	0	0	0	6	0	0	4	10	0	0	24
6:45 AM	2	0	3	0	0	0	0	0	0	11	1	0	1	15	0	0	33
7:00 AM	2	0	1	0	0	0	0	0	0	14	0	0	2	28	0	0	47
7:15 AM	0	0	2	0	0	0	0	0	0	10	0	0	1	12	0	0	25
7:30 AM	0	0	2	0	0	0	0	0	0	14	2	0	1	12	0	0	31
7:45 AM	1	0	3	0	0	0	0	0	0	20	1	0	6	21	0	0	52
8:00 AM	3	0	2	0	0	0	0	0	0	23	1	0	2	31	0	0	62
8:15 AM	1	0	3	0	0	0	0	0	0	29	0	0	3	36	0	0	72
8:30 AM	5	0	3	0	0	0	0	0	0	15	1	0	4	26	0	0	54
8:45 AM	1	0	3	0	0	0	0	0	0	16	2	0	1	19	0	0	42
TOTAL VOLUMES :	NL 20	NT 0	NR 24	NU 0	SL 0	ST 0	SR 0	SU 0	EL 0	ET 165	ER 8	EU 0	WL 25	WT 223	WR 0	WU 0	TOTAL 465
APPROACH %'s :	45.45%	0.00%	54.55%	0.00%					0.00%	95.38%	4.62%	0.00%	10.08%	89.92%	0.00%	0.00%	
PEAK HR :	07:30 AM - 08:30 AM																
PEAK HR VOL :	5	0	10	0	0	0	0	0	0	86	4	0	12	100	0	0	217
PEAK HR FACTOR :	0.417	0.000	0.833	0.000	0.000	0.000	0.000	0.000	0.000	0.741	0.500	0.000	0.500	0.694	0.000	0.000	0.753
			0.750								0.776				0.718		

PM	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				TOTAL
	1.5 NL	0 NT	0.5 NR	0 NU	0 SL	0 ST	0 SR	0 SU	1 EL	1.5 ET	0.5 ER	0 EU	1 WL	2 WT	0 WR	0 WU	
4:00 PM	2	0	4	0	0	0	0	0	0	11	0	0	4	14	0	0	35
4:15 PM	2	0	2	0	0	0	0	0	0	8	0	0	3	11	0	0	26
4:30 PM	4	0	1	0	0	0	0	0	0	12	0	0	3	11	0	0	31
4:45 PM	0	0	2	0	0	0	0	0	0	14	0	0	0	11	0	0	27
5:00 PM	0	0	0	0	0	0	0	0	0	10	0	0	1	7	0	0	18
5:15 PM	2	0	0	0	0	0	0	0	0	14	0	0	1	9	0	0	26
5:30 PM	3	0	0	0	0	0	0	0	0	7	3	0	0	7	0	0	20
5:45 PM	1	0	1	0	0	0	0	0	0	9	0	0	0	2	0	0	13
6:00 PM	1	0	1	0	0	0	0	0	0	5	0	0	2	7	0	0	16
6:15 PM	0	0	0	0	0	0	0	0	0	5	0	0	0	5	0	0	10
6:30 PM	0	0	2	0	0	0	0	0	0	5	0	0	0	3	0	0	10
6:45 PM	0	0	0	0	0	0	0	0	0	2	0	0	0	5	0	0	7
TOTAL VOLUMES :	NL 15	NT 0	NR 13	NU 0	SL 0	ST 0	SR 0	SU 0	EL 0	ET 102	ER 3	EU 0	WL 14	WT 92	WR 0	WU 0	TOTAL 239
APPROACH %'s :	53.57%	0.00%	46.43%	0.00%					0.00%	97.14%	2.86%	0.00%	13.21%	86.79%	0.00%	0.00%	
PEAK HR :	04:45 PM - 05:45 PM																
PEAK HR VOL :	5	0	2	0	0	0	0	0	0	45	3	0	2	34	0	0	91
PEAK HR FACTOR :	0.417	0.000	0.250	0.000	0.000	0.000	0.000	0.000	0.000	0.804	0.250	0.000	0.500	0.773	0.000	0.000	0.843
			0.583								0.857				0.818		

National Data & Surveying ServicesIntersection Turning Movement Count

Location: Olde Forge Dr & Thomas Ln
City: Fredericksburg
Control: 1-Way Stop(EB)

Project ID: 23-260019-002
Date: 2/1/2023

Data - Total

NS/EW Streets:	Olde Forge Dr				Olde Forge Dr				Thomas Ln				Thomas Ln				
AM	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				TOTAL
	0 NL	1 NT	0 NR	0 NU	0 SL	1 ST	0 SR	0 SU	0 EL	1 ET	0 ER	0 EU	0 WL	0 WT	0 WR	0 WU	
6:00 AM	0	37	0	0	0	4	1	0	5	0	1	0	0	0	0	0	48
6:15 AM	0	43	0	0	0	4	2	0	12	0	0	0	0	0	0	0	61
6:30 AM	1	56	0	0	0	9	6	0	12	0	0	0	0	0	0	0	84
6:45 AM	1	61	0	1	0	10	5	0	15	0	1	0	0	0	0	0	94
7:00 AM	0	56	0	0	0	11	6	0	17	0	0	0	0	0	0	0	90
7:15 AM	0	44	0	0	0	10	3	0	13	0	0	0	0	0	0	0	70
7:30 AM	0	66	0	0	0	12	1	0	14	0	3	0	0	0	0	0	96
7:45 AM	0	58	0	0	0	14	10	0	22	0	1	0	0	0	0	0	105
8:00 AM	2	67	0	0	0	9	5	0	24	0	1	0	0	0	0	0	108
8:15 AM	0	47	0	0	0	30	2	0	16	0	2	0	0	0	0	0	97
8:30 AM	0	54	0	0	0	20	4	0	15	0	1	0	0	0	0	0	94
8:45 AM	0	46	0	0	0	15	4	0	15	0	3	0	0	0	0	0	83
TOTAL VOLUMES :	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
APPROACH %'s :	4	635	0	1	0	148	49	0	180	0	13	0	0	0	0	0	1030
PEAK HR :	0.63%	99.22%	0.00%	0.16%	0.00%	75.13%	24.87%	0.00%	93.26%	0.00%	6.74%	0.00%	0	0	0	0	
PEAK HR :	07:30 AM - 08:30 AM																TOTAL
PEAK HR VOL :	2	238	0	0	0	65	18	0	76	0	7	0	0	0	0	0	406
PEAK HR FACTOR :	0.250	0.888	0.000	0.000	0.000	0.542	0.450	0.000	0.792	0.000	0.583	0.000	0.000	0.000	0.000	0.000	0.940
	0.870				0.648				0.830								
PM	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				TOTAL
	0 NL	1 NT	0 NR	0 NU	0 SL	1 ST	0 SR	0 SU	0 EL	1 ET	0 ER	0 EU	0 WL	0 WT	0 WR	0 WU	
4:00 PM	0	33	0	0	0	37	6	0	22	0	2	0	0	0	0	0	100
4:15 PM	0	41	0	0	0	31	10	0	14	0	5	0	0	0	0	0	101
4:30 PM	1	46	0	0	0	21	4	0	20	0	3	0	0	0	0	0	95
4:45 PM	0	34	0	0	0	28	9	0	7	0	3	0	0	0	0	0	81
5:00 PM	0	45	0	0	0	41	10	1	17	0	6	0	0	0	0	0	120
5:15 PM	2	48	0	0	0	34	7	0	20	0	4	0	0	0	0	0	115
5:30 PM	0	37	0	0	0	25	5	1	22	0	6	0	0	0	0	0	96
5:45 PM	0	42	0	0	0	31	5	0	20	0	3	0	0	0	0	0	101
6:00 PM	3	55	0	0	0	31	10	1	15	0	3	0	0	0	0	0	118
6:15 PM	0	33	0	0	0	19	8	0	8	0	3	0	0	0	0	0	71
6:30 PM	2	29	0	0	0	34	6	0	27	0	3	0	0	0	0	0	101
6:45 PM	0	41	0	0	0	30	7	1	20	0	2	0	0	0	0	0	101
TOTAL VOLUMES :	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
APPROACH %'s :	8	484	0	0	0	362	87	4	212	0	43	0	0	0	0	0	1200
PEAK HR :	1.63%	98.37%	0.00%	0.00%	0.00%	79.91%	19.21%	0.88%	83.14%	0.00%	16.86%	0.00%	0	0	0	0	
PEAK HR :	05:00 PM - 06:00 PM																TOTAL
PEAK HR VOL :	2	172	0	0	0	131	27	2	79	0	19	0	0	0	0	0	432
PEAK HR FACTOR :	0.250	0.896	0.000	0.000	0.000	0.799	0.675	0.500	0.898	0.000	0.792	0.000	0.000	0.000	0.000	0.000	0.900
	0.870				0.769				0.875								

National Data & Surveying ServicesIntersection Turning Movement Count

Location: Olde Forge Dr & Thomas Ln
City: Fredericksburg
Control: 1-Way Stop(EB)

Project ID: 23-260019-002
Date: 2/1/2023

Data - HT

NS/EW Streets:	Olde Forge Dr				Olde Forge Dr				Thomas Ln				Thomas Ln				
AM	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				TOTAL
	0 NL	1 NT	0 NR	0 NU	0 SL	1 ST	0 SR	0 SU	0 EL	1 ET	0 ER	0 EU	0 WL	0 WT	0 WR	0 WU	
6:00 AM	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2
6:15 AM	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
6:30 AM	0	4	0	0	0	1	3	0	0	0	0	0	0	0	0	0	8
6:45 AM	0	4	0	0	0	2	0	0	1	0	0	0	0	0	0	0	7
7:00 AM	0	0	0	0	0	1	1	0	3	0	0	0	0	0	0	0	5
7:15 AM	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
7:30 AM	0	1	0	0	0	3	1	0	1	0	0	0	0	0	0	0	6
7:45 AM	0	2	0	0	0	4	3	0	2	0	1	0	0	0	0	0	12
8:00 AM	0	1	0	0	0	2	1	0	4	0	0	0	0	0	0	0	8
8:15 AM	0	2	0	0	0	2	1	0	2	0	0	0	0	0	0	0	7
8:30 AM	0	5	0	0	0	2	2	0	4	0	0	0	0	0	0	0	13
8:45 AM	0	2	0	0	0	2	2	0	1	0	0	0	0	0	0	0	7
TOTAL VOLUMES :	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
APPROACH %'s :	0	24	0	0	0	19	14	0	20	0	1	0	0	0	0	0	78
PEAK HR :	07:30 AM - 08:30 AM																TOTAL
PEAK HR VOL :	0	6	0	0	0	11	6	0	9	0	1	0	0	0	0	0	33
PEAK HR FACTOR :	0.000	0.750	0.000	0.000	0.000	0.688	0.500	0.000	0.563	0.000	0.250	0.000	0.000	0.000	0.000	0.000	0.688
	0.750				0.607				0.625								
PM	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				TOTAL
	0 NL	1 NT	0 NR	0 NU	0 SL	1 ST	0 SR	0 SU	0 EL	1 ET	0 ER	0 EU	0 WL	0 WT	0 WR	0 WU	
4:00 PM	0	2	0	0	0	3	1	0	4	0	0	0	0	0	0	0	10
4:15 PM	0	3	0	0	0	2	1	0	1	0	0	0	0	0	0	0	7
4:30 PM	0	2	0	0	0	0	3	0	3	0	0	0	0	0	0	0	8
4:45 PM	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2
5:00 PM	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	2
5:15 PM	0	1	0	0	0	1	0	0	2	0	0	0	0	0	0	0	4
5:30 PM	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	4
5:45 PM	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
6:00 PM	0	1	0	0	0	1	1	0	1	0	0	0	0	0	0	0	4
6:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:30 PM	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2
6:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL VOLUMES :	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
APPROACH %'s :	0	13	0	0	0	10	7	0	14	0	0	0	0	0	0	0	44
PEAK HR :	05:00 PM - 06:00 PM																TOTAL
PEAK HR VOL :	0	3	0	0	0	4	1	0	3	0	0	0	0	0	0	0	11
PEAK HR FACTOR :	0.000	0.375	0.000	0.000	0.000	0.500	0.250	0.000	0.375	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.688
	0.375				0.625				0.375								

National Data & Surveying ServicesIntersection Turning Movement Count

Location: Short St & Thomas Ln
City: Fredericksburg
Control: 1-Way (Short St)

Project ID: 23-260019-003
Date: 2/1/2023

Data - Total

NS/EW Streets	Short St				Short St				Thomas Ln				Thomas Ln				TOTAL
	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				
AM	NL	NT	NR	NW	SL	ST	SR	SW	STL	EL	ET	ER	EW	WT	WR	WW	TOTAL
6:00 AM	0	0	0	0	5	0	2	0	0	1	0	0	0	1	0	0	14
6:15 AM	0	0	0	0	7	0	0	0	0	2	2	0	0	0	1	0	19
6:30 AM	0	0	0	0	4	0	0	0	0	1	5	0	0	0	1	0	21
6:45 AM	0	0	0	0	7	0	0	0	0	1	6	0	0	0	1	0	21
7:00 AM	0	0	0	0	3	0	11	0	0	3	12	0	0	0	2	1	32
7:15 AM	0	0	0	0	3	0	12	0	0	1	10	0	0	0	2	1	38
7:30 AM	0	0	0	0	7	0	6	0	0	2	10	0	0	0	0	0	30
7:45 AM	0	0	0	0	6	0	6	0	0	2	6	2	0	0	1	0	31
8:00 AM	0	0	0	0	6	0	11	0	0	5	12	0	0	0	0	3	40
8:15 AM	0	0	0	0	7	0	16	0	0	1	7	0	0	0	1	1	35
8:30 AM	0	0	0	0	8	0	12	0	0	3	10	0	0	0	3	2	38
8:45 AM	0	0	0	0	17	0	13	0	0	7	5	0	0	0	1	1	36
TOTAL VOLUMES	NL	NT	NR	NW	SL	ST	SR	SW	STL	EL	ET	ER	EW	WT	WR	WW	TOTAL
APPROACH %	0	0	0	0	34.7%	0.00%	13.13%	0.00%	0.00%	37.39%	77.61%	0.00%	0.00%	0.00%	18.47%	55.26%	5.26%
PEAK HR	0	0	0	0	31	0	13	0	0	15	41	0	0	7	3	3	144
PEAK HR FACTOR	0.000	0.000	0.000	0.000	0.775	0.000	0.750	0.000	0.000	0.625	0.854	0.000	0.000	0.000	0.583	0.625	0.939

PM	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				TOTAL
	NL	NT	NR	NW	SL	ST	SR	SW	STL	EL	ET	ER	EW	WT	WR	WW	
4:00 PM	0	0	0	0	1	0	0	0	0	2	13	0	0	0	2	3	52
4:15 PM	0	0	0	0	16	0	0	0	0	3	5	0	0	0	2	4	70
4:30 PM	0	0	0	0	15	0	0	0	0	1	7	0	0	0	1	2	41
4:45 PM	0	0	0	0	14	0	0	0	0	3	1	0	0	0	3	5	28
5:00 PM	0	0	0	0	14	0	0	0	0	1	6	0	0	0	1	2	43
5:15 PM	0	0	0	0	11	0	43	0	0	1	6	0	0	0	1	6	66
5:30 PM	0	0	0	0	17	0	24	0	0	7	16	0	0	0	1	4	60
5:45 PM	0	0	0	0	17	0	41	0	0	1	3	0	0	0	1	1	54
6:00 PM	0	0	0	0	17	0	43	0	0	2	5	0	0	0	1	4	71
6:15 PM	0	0	0	0	11	0	34	0	0	3	2	0	0	0	2	4	56
6:30 PM	0	0	0	0	9	0	30	0	0	4	7	0	0	0	2	3	65
6:45 PM	0	0	0	0	10	0	36	0	0	1	5	0	0	0	1	5	38
TOTAL VOLUMES	NL	NT	NR	NW	SL	ST	SR	SW	STL	EL	ET	ER	EW	WT	WR	WW	TOTAL
APPROACH %	0.00%	0.00%	0.00%	0.00%	26.33%	0.00%	73.33%	0.00%	0.00%	38.87%	71.13%	0.00%	0.00%	1.49%	29.85%	68.66%	0.00%
PEAK HR	0	0	0	0	57	0	149	0	0	6	24	0	0	0	6	17	260
PEAK HR FACTOR	0.000	0.000	0.000	0.000	0.838	0.000	0.866	0.000	0.250	0.750	0.600	0.000	0.000	0.000	0.500	0.708	0.915

Explanation for extra leg movements

Movements entering the extra leg

ST2: Movements coming from SB on Short St enter the Extra Leg (House Driv)

Untitled Map

Write a description for your map.



National Data & Surveying ServicesIntersection Turning Movement Count

Location: Short St & Thomas Ln
City: Fredericksburg
Control: 1-Way Stop(SB)

Project ID: 23-260019-003
Date: 2/1/2023

Data - HT

NS/EW Streets:	Short St				Short St					Thomas Ln				Thomas Ln				
AM	NORTHBOUND				SOUTHBOUND					EASTBOUND				WESTBOUND				TOTAL
	0 NL	0 NT	0 NR	0 NU	1 SL	0 ST	1 SR	0 SU	0 ST2	0 EL	1 ET	0 ER	0 EU	0 WL	1 WT	0 WR	0 WU	
6:00 AM	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2
6:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
6:30 AM	0	0	0	0	1	0	2	0	0	0	0	0	0	0	2	1	0	6
6:45 AM	0	0	0	0	0	0	2	0	0	0	1	0	0	0	0	0	0	3
7:00 AM	0	0	0	0	0	0	1	0	0	0	2	0	0	0	0	0	0	3
7:15 AM	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
7:30 AM	0	0	0	0	1	0	3	0	0	0	0	0	0	0	0	0	0	4
7:45 AM	0	0	0	0	1	0	0	0	0	1	1	0	0	0	2	1	0	6
8:00 AM	0	0	0	0	0	0	1	0	0	0	3	0	0	0	0	0	0	4
8:15 AM	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	1	2	5
8:30 AM	0	0	0	0	2	0	0	0	0	0	1	0	0	0	1	2	0	6
8:45 AM	0	0	0	0	1	0	0	0	0	0	1	0	0	0	1	0	0	3
TOTAL VOLUMES : APPROACH %'s :	NL 0	NT 0	NR 0	NU 0	SL 9	ST 0	SR 10	SU 0	ST2 0	EL 1	ET 10	ER 0	EU 0	WL 0	WT 6	WR 6	WU 2	TOTAL 44
PEAK HR :	07:45 AM - 08:45 AM				47.37%	0.00%	52.63%	0.00%	0.00%	9.09%	90.91%	0.00%	0.00%	0.00%	42.86%	42.86%	14.29%	TOTAL 21 0.875
PEAK HR VOL : PEAK HR FACTOR :	0 0.000	0 0.000	0 0.000	0 0.000	4 0.500	0 0.000	1 0.250	0 0.000	0 0.000	1 0.250	6 0.500	0 0.000	0 0.000	0 0.000	3 0.375	4 0.500	2 0.250	

PM	NORTHBOUND				SOUTHBOUND					EASTBOUND				WESTBOUND				TOTAL
	0 NL	0 NT	0 NR	0 NU	1 SL	0 ST	1 SR	0 SU	0 ST2	0 EL	1 ET	0 ER	0 EU	0 WL	1 WT	0 WR	0 WU	
4:00 PM	0	0	0	0	0	0	1	0	0	1	2	0	0	0	0	0	0	4
4:15 PM	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0	3
4:30 PM	0	0	0	0	4	0	0	0	0	0	0	0	0	0	1	1	0	6
4:45 PM	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
5:00 PM	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	2
5:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:45 PM	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	2
6:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
6:15 PM	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
6:30 PM	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
6:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL VOLUMES : APPROACH %'s :	NL 0	NT 0	NR 0	NU 0	SL 7	ST 0	SR 5	SU 0	ST2 0	EL 2	ET 3	ER 0	EU 0	WL 0	WT 3	WR 1	WU 0	TOTAL 21
PEAK HR :	05:15 PM - 06:15 PM				58.33%	0.00%	41.67%	0.00%	0.00%	40.00%	60.00%	0.00%	0.00%	0.00%	75.00%	25.00%	0.00%	TOTAL 3 0.375
PEAK HR VOL : PEAK HR FACTOR :	0 0.000	0 0.000	0 0.000	0 0.000	1 0.250	0 0.000	1 0.250	0 0.000	0 0.000	0 0.000	0 0.000	0 0.000	0 0.000	0 0.000	1 0.250	0 0.000	0 0.000	

National Data & Surveying ServicesIntersection Turning Movement Count

Location: CR 657/Musselman Rd & Thomas Ln
City: Fredericksburg
Control: 2-Way Stop(NB/SB)

Project ID: 23-260019-004
Date: 2/1/2023

Data - Total

NS/EW Streets:		CR 657/Musselman Rd				CR 657/Musselman Rd				Thomas Ln				Thomas Ln				
AM		NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				TOTAL
		0 NL	1 NT	0 NR	0 NU	0 SL	1 ST	0 SR	0 SU	0 EL	1 ET	0 ER	0 EU	0 WL	1 WT	0 WR	0 WU	
	6:00 AM	0	0	4	0	0	0	0	0	0	0	0	0	1	1	0	0	6
	6:15 AM	0	0	5	0	0	0	0	0	0	1	0	0	7	0	1	0	14
	6:30 AM	0	0	10	0	0	0	0	0	0	0	0	0	7	1	0	0	18
	6:45 AM	0	0	13	0	0	0	0	0	0	0	0	0	10	0	0	0	23
	7:00 AM	0	0	13	0	0	0	0	0	0	2	0	0	12	1	0	0	28
	7:15 AM	0	0	11	0	0	0	0	0	0	0	0	0	11	0	0	0	22
	7:30 AM	0	0	12	0	0	1	0	0	0	0	0	0	11	0	2	0	26
	7:45 AM	0	0	17	0	1	0	0	0	0	0	0	0	6	0	2	0	26
	8:00 AM	0	0	16	0	1	0	0	0	0	0	0	0	13	0	0	0	30
	8:15 AM	0	0	6	0	1	0	0	0	0	0	0	0	16	0	2	0	25
	8:30 AM	0	0	12	0	0	0	0	0	0	1	0	0	14	0	1	0	28
	8:45 AM	0	0	5	0	1	0	0	0	1	0	0	0	14	0	0	0	21
TOTAL VOLUMES :		NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
APPROACH %'s :		0	0	124	0	4	1	0	0	1	4	0	0	122	3	8	0	267
PEAK HR :		07:45 AM - 08:45 AM																TOTAL 109 0.908
PEAK HR VOL :		0	0	51	0	3	0	0	0	0	1	0	0	49	0	5	0	
PEAK HR FACTOR :		0.000	0.000	0.750	0.000	0.750	0.000	0.000	0.000	0.000	0.250	0.000	0.000	0.766	0.000	0.625	0.000	
		0.750				0.750				0.250				0.750				

PM		NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				TOTAL
		0 NL	1 NT	0 NR	0 NU	0 SL	1 ST	0 SR	0 SU	0 EL	1 ET	0 ER	0 EU	0 WL	1 WT	0 WR	0 WU	
	4:00 PM	0	0	14	0	1	0	0	0	0	0	0	0	33	0	1	0	49
	4:15 PM	0	0	6	0	0	0	0	0	0	0	0	0	40	0	1	0	47
	4:30 PM	0	0	9	0	0	0	0	0	0	0	0	0	37	0	0	0	46
	4:45 PM	0	0	4	0	0	0	0	0	0	0	0	0	35	0	0	0	39
	5:00 PM	0	0	6	0	1	0	0	0	0	0	0	0	31	0	0	0	38
	5:15 PM	0	0	6	0	0	0	0	0	0	0	0	0	42	0	0	0	48
	5:30 PM	0	0	11	0	1	0	0	0	0	0	0	0	25	0	0	0	37
	5:45 PM	0	0	4	0	0	0	0	0	0	0	0	0	42	0	0	0	46
	6:00 PM	0	0	6	0	0	0	0	0	0	0	0	0	46	1	0	0	53
	6:15 PM	0	0	5	0	0	0	0	0	0	0	0	0	34	0	0	0	39
	6:30 PM	0	0	10	0	0	0	0	0	0	0	0	0	42	0	0	0	52
	6:45 PM	0	0	6	0	0	0	0	0	0	0	0	0	37	0	0	0	43
TOTAL VOLUMES :		NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
APPROACH %'s :		0	0	87	0	3	0	0	0	0	0	0	0	444	1	2	0	537
PEAK HR :		05:45 PM - 06:45 PM																TOTAL 190 0.896
PEAK HR VOL :		0	0	25	0	0	0	0	0	0	0	0	0	164	1	0	0	
PEAK HR FACTOR :		0.000	0.000	0.625	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.891	0.250	0.000	0.000	
		0.625												0.878				

National Data & Surveying ServicesIntersection Turning Movement Count

Location: CR 657/Musselman Rd & Thomas Ln
City: Fredericksburg
Control: 2-Way Stop(NB/SB)

Project ID: 23-260019-004
Date: 2/1/2023

Data - HT

NS/EW Streets:		CR 657/Musselman Rd				CR 657/Musselman Rd				Thomas Ln				Thomas Ln				
AM		NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				TOTAL
		0 NL	1 NT	0 NR	0 NU	0 SL	1 ST	0 SR	0 SU	0 EL	1 ET	0 ER	0 EU	0 WL	1 WT	0 WR	0 WU	
	6:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	6:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	6:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	3
	6:45 AM	0	0	1	0	0	0	0	0	0	0	0	0	2	0	0	0	3
	7:00 AM	0	0	0	0	0	0	0	0	0	2	0	0	1	0	0	0	3
	7:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	7:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	4
	7:45 AM	0	0	2	0	0	0	0	0	0	0	0	0	2	0	0	0	4
	8:00 AM	0	0	3	0	0	0	0	0	0	0	0	0	1	0	0	0	4
	8:15 AM	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	8:30 AM	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	2
	8:45 AM	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	2
TOTAL VOLUMES :		NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
APPROACH %'s :		0	0	9	0	0	0	0	0	0	2	0	0	15	0	0	0	26
PEAK HR :		07:45 AM - 08:45 AM																TOTAL 11
PEAK HR VOL :		0	0	7	0	0	0	0	0	0	0	0	0	4	0	0	0	
PEAK HR FACTOR :		0.000	0.000	0.583	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.500	0.000	0.000	0.000	0.688
		0.583												0.500				
PM		NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				TOTAL
		0 NL	1 NT	0 NR	0 NU	0 SL	1 ST	0 SR	0 SU	0 EL	1 ET	0 ER	0 EU	0 WL	1 WT	0 WR	0 WU	
	4:00 PM	0	0	3	0	0	0	0	0	0	0	0	0	1	0	0	0	4
	4:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
	4:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
	4:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
	5:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
	5:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	5:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	5:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
	6:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
	6:15 PM	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	6:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	6:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL VOLUMES :		NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
APPROACH %'s :		0	0	4	0	0	0	0	0	0	0	0	0	7	0	0	0	11
PEAK HR :		05:45 PM - 06:45 PM																TOTAL 3
PEAK HR VOL :		0	0	1	0	0	0	0	0	0	0	0	0	2	0	0	0	
PEAK HR FACTOR :		0.000	0.000	0.250	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.500	0.000	0.000	0.000	0.750
		0.250												0.500				

Appendix C – HCM Level of Service Definitions

TECHNICAL MEMORANDUM

Subject: Level of Service Definitions

Introduction

The purpose of this memorandum is to define the level of service (LOS) metric that commonly used as a measure of effectiveness (MOE) for traffic operations.

All capacity analyses are based on the procedures specified by the Transportation Research Board's (TRB) Highway Capacity Manual (HCM), which is currently on its sixth edition. Level of service ranges from A to F. A brief description of each level of service for signalized and unsignalized intersections is provided below.

Signalized Intersections

Level of service is based upon the traffic volume present in each lane on the roadway, the capacity of each lane at the intersection and the delay associated with each directional movement. The levels of service for signalized intersections are defined below:

- **Level of Service A** describes operations with very low average delay per vehicle, i.e., less than 10.0 seconds. This occurs when progression is extremely favorable, and most vehicles arrive during the green phase. Most vehicles do not stop. Short signal cycle lengths may also contribute to low delay.
- **Level of Service B** describes operations with average delay in the range of 10.1 to 20.0 seconds per vehicle. This generally occurs with good progression and/or short cycle lengths. More vehicles stop than for LOS A, causing higher levels of average delay.
- **Level of Service C** describes operations with delay in the range of 20.1 to 35.0 seconds per vehicle. These higher delays may result from fair progression and/or longer cycle lengths. Individual cycle failures may begin to appear at this level. The number of vehicles stopping is significant at this level although many still pass through the intersection without stopping. This is generally considered the lower end of the range of the acceptable level of service in rural areas.
- **Level of Service D** describes operations with delay in the range of 35.1 to 55.0 seconds per vehicle. At LOS D, the influence of congestion becomes more noticeable. Longer delays may result from some combination of unfavorable progression, long cycle lengths, and/or high traffic volumes as compared to the roadway capacity. Many vehicles are required to stop and the number of vehicles that do not have to stop declines. Individual signal cycle failures, where all waiting vehicles do not clear the intersection during a single green time, are noticeable. This is generally considered the lower end of the range of the acceptable level of service in urban areas.
- **Level of Service E** describes operations with delay in the range of 55.1 to 80.0 seconds per vehicle. These higher delay values generally indicate poor progression, long cycle lengths, and high traffic volumes. Individual cycle failures are frequent occurrences. LOS E has been set as the limit of acceptable conditions.
- **Level of Service F** describes operations with average delay in excess of 80.0 seconds per vehicle. This is considered to be unacceptable to most drivers. This condition often occurs with over-saturation, i.e., when traffic arrives at a flow rate that exceeds the capacity of the intersection. It may also occur at high volumes with many individual cycle failures. Poor progression and long cycle lengths may also contribute to such delays.

Unsignalized Intersections

At an unsignalized intersection, the major street through traffic and right-turns are assumed to operate unimpeded and therefore receive no level of service rating. The level of service for the minor street and the major street left-turn traffic is dependent on the volume and capacity of the available lanes, and, the number and frequency of acceptable gaps in the major street traffic to make a conflicting turn. The level of service grade is provided for each conflicting movement at an unsignalized intersection and is based on the total average delay experienced by each vehicle. The delay includes the time it takes a vehicle to move from the back of a queue through the intersection.

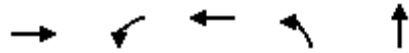
The unsignalized intersection level of service analysis does not account for variations in driver behavior or the effects of nearby traffic signals. Therefore, the results from this analysis usually indicate worse levels of service than may be experienced in the field. The unsignalized intersection level of service descriptions are provided below:

- **Level of Service A** describes operations where there is very little to no conflicting traffic for a minor side street movement, i.e., an average total delay of less than 10.0 seconds per vehicle.
- **Level of Service B** describes operations with average total delay in the range of 10.1 to 15.0 seconds per vehicle.
- **Level of Service C** describes operations with average total delay in the range of 15.1 to 25.0 second per vehicle.
- **Level of Service D** describes operations with average total delay in the range of 25.1 to 35.0 seconds per vehicle.
- **Level of Service E** describes operations with average total delay in the range of 35.1 to 50.0 seconds per vehicle.
- **Level of Service F** describes operations with average total delay of 50 seconds per vehicle. LOS F exists when there are insufficient gaps of suitable size to allow a side street demand to cross safely through or enter a major street traffic stream. This level of service is generally evident from extremely long total delays experienced by side street traffic and by queuing on the minor approaches. It is important to note that LOS F may not always result in long queues but may result in adjustments to normal driver behavior.

Appendix D – 2023 Existing Conditions – Capacity Analysis Worksheets

Queues









1: Olde Forge Drive/RV Parkway & Warrenton Rd (Rte.17)/Warrenton Rd (Rte.17 Bus.) 04/18/2023



Lane Group	EBT	WBL	WBT	NBL	NBT
Lane Group Flow (vph)	1189	62	1058	130	194
v/c Ratio	0.68	0.41	0.50	0.54	0.45
Control Delay	9.6	66.6	13.6	63.4	4.7
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	9.6	66.6	13.6	63.4	4.7
Queue Length 50th (ft)	50	54	244	116	0
Queue Length 95th (ft)	530	100	295	182	18
Internal Link Dist (ft)	816		1016		577
Turn Bay Length (ft)		300		150	
Base Capacity (vph)	1752	191	2126	309	485
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	0.68	0.32	0.50	0.42	0.40
Intersection Summary					




HCM Signalized Intersection Capacity Analysis

1: Olde Forge Drive/RV Parkway & Warrenton Rd (Rte.17)/Warrenton Rd (Rte.17 Bus.) 04/18/2023

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	1138	27	61	1037	0	174	0	143	0	0	0
Future Volume (vph)	0	1138	27	61	1037	0	174	0	143	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		-1%			1%			0%			0%	
Total Lost time (s)		3.8		7.1	3.8		4.0	4.0				
Lane Util. Factor		0.95		1.00	0.95		0.95	0.95				
Frt		1.00		1.00	1.00		1.00	0.89				
Flt Protected		1.00		0.95	1.00		0.95	0.99				
Satd. Flow (prot)		3342		1497	3265		1665	1492				
Flt Permitted		1.00		0.95	1.00		0.95	0.99				
Satd. Flow (perm)		3342		1497	3265		1665	1492				
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	0	1161	28	62	1058	0	178	0	146	0	0	0
RTOR Reduction (vph)	0	1	0	0	0	0	0	166	0	0	0	0
Lane Group Flow (vph)	0	1188	0	62	1058	0	130	28	0	0	0	0
Heavy Vehicles (%)	0%	8%	15%	20%	10%	0%	3%	0%	7%	0%	0%	0%
Turn Type	Prot	NA		Prot	NA		Split	NA				
Protected Phases	1	6		5	2		4	4			9	
Permitted Phases										9		
Actuated Green, G (s)		68.4		9.7	88.2		16.2	16.2				
Effective Green, g (s)		71.4		12.7	91.2		20.2	20.2				
Actuated g/C Ratio		0.51		0.09	0.65		0.14	0.14				
Clearance Time (s)		6.8		10.1	6.8		8.0	8.0				
Vehicle Extension (s)		3.0		3.0	3.0		3.0	3.0				
Lane Grp Cap (vph)		1704		135	2126		240	215				
v/s Ratio Prot		c0.36		0.04	c0.32		c0.08	0.02				
v/s Ratio Perm												
v/c Ratio		0.70		0.46	0.50		0.54	0.13				
Uniform Delay, d1		26.1		60.4	12.6		55.6	52.2				
Progression Factor		0.30		1.00	1.00		1.00	1.00				
Incremental Delay, d2		2.0		2.5	0.8		2.5	0.3				
Delay (s)		9.7		62.9	13.4		58.1	52.5				
Level of Service		A		E	B		E	D				
Approach Delay (s)		9.7			16.2			54.8			0.0	
Approach LOS		A			B			D			A	
Intersection Summary												
HCM 2000 Control Delay			18.0			HCM 2000 Level of Service			B			
HCM 2000 Volume to Capacity ratio			0.58									
Actuated Cycle Length (s)			140.0			Sum of lost time (s)			21.2			
Intersection Capacity Utilization			58.3%			ICU Level of Service			B			
Analysis Period (min)			15									
c Critical Lane Group												




HCM 6th TWSC
2: Olde Forge Drive & Thomas Ln

04/18/2023

Intersection						
Int Delay, s/veh	2.4					
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	76	7	2	241	70	18
Future Vol, veh/h	76	7	2	241	70	18
Conflicting Peds, #/hr	53	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	94	94	94	94	94	94
Heavy Vehicles, %	12	14	0	3	17	33
Mvmt Flow	81	7	2	256	74	19
Major/Minor	Minor2	Major1		Major2		
Conflicting Flow All	397	84	93	0	-	0
Stage 1	84	-	-	-	-	-
Stage 2	313	-	-	-	-	-
Critical Hdwy	6.52	6.34	4.1	-	-	-
Critical Hdwy Stg 1	5.52	-	-	-	-	-
Critical Hdwy Stg 2	5.52	-	-	-	-	-
Follow-up Hdwy	3.608	3.426	2.2	-	-	-
Pot Cap-1 Maneuver	589	943	1514	-	-	-
Stage 1	915	-	-	-	-	-
Stage 2	719	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	588	943	1514	-	-	-
Mov Cap-2 Maneuver	588	-	-	-	-	-
Stage 1	913	-	-	-	-	-
Stage 2	719	-	-	-	-	-
Approach	EB	NB		SB		
HCM Control Delay, s	11.9	0.1		0		
HCM LOS	B					
Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR	
Capacity (veh/h)	1514	-	607	-	-	
HCM Lane V/C Ratio	0.001	-	0.145	-	-	
HCM Control Delay (s)	7.4	0	11.9	-	-	
HCM Lane LOS	A	A	B	-	-	
HCM 95th %tile Q(veh)	0	-	0.5	-	-	

Intersection

Int Delay, s/veh 4

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	14	53	6	14	30	47
Future Vol, veh/h	14	53	6	14	30	47
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	Yield
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	89	89	89	89	89	89
Heavy Vehicles, %	7	12	50	25	10	9
Mvmt Flow	16	60	7	16	34	53

Major/Minor	Major1	Major2	Minor2
Conflicting Flow All	23	0	0 107 15
Stage 1	-	-	- 15 -
Stage 2	-	-	- 92 -
Critical Hdwy	4.17	-	- 6.5 6.29
Critical Hdwy Stg 1	-	-	- 5.5 -
Critical Hdwy Stg 2	-	-	- 5.5 -
Follow-up Hdwy	2.263	-	- 3.59 3.381
Pot Cap-1 Maneuver	1560	-	- 872 1045
Stage 1	-	-	- 987 -
Stage 2	-	-	- 912 -
Platoon blocked, %	-	-	-
Mov Cap-1 Maneuver	1560	-	- 862 1045
Mov Cap-2 Maneuver	-	-	- 862 -
Stage 1	-	-	- 976 -
Stage 2	-	-	- 912 -










Approach	EB	WB	SB
HCM Control Delay, s	1.5	0	7.2
HCM LOS			A

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1560	-	-	-	1712
HCM Lane V/C Ratio	0.01	-	-	-	0.051
HCM Control Delay (s)	7.3	0	-	-	7.2
HCM Lane LOS	A	A	-	-	A
HCM 95th %tile Q(veh)	0	-	-	-	0.2

HCM Unsignalized Intersection Capacity Analysis

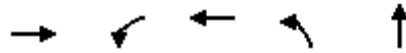
4: Musselman Rd & Thomas Ln

04/18/2023

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	46	7	0	64	3	1
Future Volume (Veh/h)	46	7	0	64	3	1
Sign Control	Free		Stop		Stop	
Grade	0%		0%		0%	
Peak Hour Factor	0.89	0.89	0.89	0.89	0.89	0.89
Hourly flow rate (vph)	52	8	0	72	3	1
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	0		112	0	180	108
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	0		112	0	180	108
tC, single (s)	4.2		6.5	6.3	7.1	6.5
tC, 2 stage (s)						
tF (s)	2.3		4.0	3.4	3.5	4.0
p0 queue free %	97		100	93	100	100
cM capacity (veh/h)	1542		756	1056	714	759
Direction, Lane #	WB 1	NB 1	SB 1			
Volume Total	60	72	4			
Volume Left	52	0	3			
Volume Right	8	72	0			
cSH	1542	1056	725			
Volume to Capacity	0.03	0.07	0.01			
Queue Length 95th (ft)	3	5	0			
Control Delay (s)	6.5	8.7	10.0			
Lane LOS	A	A	A			
Approach Delay (s)	6.5	8.7	10.0			
Approach LOS		A	A			
Intersection Summary						
Average Delay			7.7			
Intersection Capacity Utilization			14.0%		ICU Level of Service	
					A	
Analysis Period (min)			15			

Queues

1: Olde Forge Drive/RV Parkway & Warrenton Rd (Rte.17)/Warrenton Rd (Rte.17 Bus.) 04/18/2023











Lane Group	EBT	WBL	WBT	NBL	NBT
Lane Group Flow (vph)	1313	121	1164	134	127
v/c Ratio	0.66	0.82	0.47	0.63	0.31
Control Delay	4.9	104.4	10.4	75.0	2.0
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	4.9	104.4	10.4	75.0	2.0
Queue Length 50th (ft)	44	119	241	130	0
Queue Length 95th (ft)	57	#233	284	209	0
Internal Link Dist (ft)	816		1016		577
Turn Bay Length (ft)		300		150	
Base Capacity (vph)	1999	148	2468	233	422
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	0.66	0.82	0.47	0.58	0.30

Intersection Summary

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

HCM Signalized Intersection Capacity Analysis

1: Olde Forge Drive/RV Parkway & Warrenton Rd (Rte.17)/Warrenton Rd (Rte.17 Bus.) 04/18/2023




												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	1214	46	116	1117	0	176	0	75	0	0	0
Future Volume (vph)	0	1214	46	116	1117	0	176	0	75	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		-1%			1%			0%			0%	
Total Lost time (s)		3.8		7.1	3.8		4.0	4.0				
Lane Util. Factor		0.95		1.00	0.95		0.95	0.95				
Frt		0.99		1.00	1.00		1.00	0.91				
Flt Protected		1.00		0.95	1.00		0.95	0.98				
Satd. Flow (prot)		3474		1727	3487		1665	1552				
Flt Permitted		1.00		0.95	1.00		0.95	0.98				
Satd. Flow (perm)		3474		1727	3487		1665	1552				
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	0	1265	48	121	1164	0	183	0	78	0	0	0
RTOR Reduction (vph)	0	2	0	0	0	0	0	111	0	0	0	0
Lane Group Flow (vph)	0	1311	0	121	1164	0	134	16	0	0	0	0
Heavy Vehicles (%)	0%	4%	0%	4%	3%	0%	3%	0%	4%	0%	0%	0%
Turn Type	Prot	NA		Prot	NA		Split	NA				
Protected Phases	1	6		5	2		4	4			9	
Permitted Phases										9		
Actuated Green, G (s)		83.2		9.9	103.2		15.3	15.3				
Effective Green, g (s)		86.2		12.9	106.2		19.3	19.3				
Actuated g/C Ratio		0.57		0.09	0.71		0.13	0.13				
Clearance Time (s)		6.8		10.1	6.8		8.0	8.0				
Vehicle Extension (s)		3.0		3.0	3.0		3.0	3.0				
Lane Grp Cap (vph)		1996		148	2468		214	199				
v/s Ratio Prot		c0.38		c0.07	0.33		c0.08	0.01				
v/s Ratio Perm												
v/c Ratio		0.66		0.82	0.47		0.63	0.08				
Uniform Delay, d1		21.8		67.4	9.6		61.9	57.5				
Progression Factor		0.16		1.00	1.00		1.00	1.00				
Incremental Delay, d2		1.3		28.2	0.6		5.6	0.2				
Delay (s)		4.9		95.6	10.2		67.5	57.7				
Level of Service		A		F	B		E	E				
Approach Delay (s)		4.9			18.3			62.8			0.0	
Approach LOS		A			B			E			A	
Intersection Summary												
HCM 2000 Control Delay			16.2			HCM 2000 Level of Service			B			
HCM 2000 Volume to Capacity ratio			0.61									
Actuated Cycle Length (s)			150.0			Sum of lost time (s)			21.2			
Intersection Capacity Utilization			61.2%			ICU Level of Service			B			
Analysis Period (min)			15									
c Critical Lane Group												

HCM 6th TWSC
2: Olde Forge Drive & Thomas Ln

04/18/2023

Intersection

Int Delay, s/veh 2.3

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	64	16	3	187	124	38
Future Vol, veh/h	64	16	3	187	124	38
Conflicting Peds, #/hr	53	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	86	86	86	86	86	86
Heavy Vehicles, %	9	0	0	2	2	13
Mvmt Flow	74	19	3	217	144	44

Major/Minor	Minor2	Major1	Major2
Conflicting Flow All	442	166	188
Stage 1	166	-	-
Stage 2	276	-	-
Critical Hdwy	6.49	6.2	4.1
Critical Hdwy Stg 1	5.49	-	-
Critical Hdwy Stg 2	5.49	-	-
Follow-up Hdwy	3.581	3.3	2.2
Pot Cap-1 Maneuver	560	884	1398
Stage 1	847	-	-
Stage 2	755	-	-
Platoon blocked, %			
Mov Cap-1 Maneuver	559	884	1398
Mov Cap-2 Maneuver	559	-	-
Stage 1	845	-	-
Stage 2	755	-	-

Approach	EB	NB	SB
HCM Control Delay, s	12.1	0.1	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1398	-	603	-	-
HCM Lane V/C Ratio	0.002	-	0.154	-	-
HCM Control Delay (s)	7.6	0	12.1	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0	-	0.5	-	-




HCM 6th TWSC
3: Thomas Ln & Short St

04/18/2023

Intersection

Int Delay, s/veh 5.9

Movement EBL EBT WBT WBR SBL SBR

Lane Configurations						
Traffic Vol, veh/h	10	26	25	16	54	141
Future Vol, veh/h	10	26	25	16	54	141
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	Yield
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	94	94	94	94	94	94
Heavy Vehicles, %	0	5	17	6	7	1
Mvmt Flow	11	28	27	17	57	150

Major/Minor Major1 Major2 Minor2

Conflicting Flow All	44	0	-	0	86	36
Stage 1	-	-	-	-	36	-
Stage 2	-	-	-	-	50	-
Critical Hdwy	4.1	-	-	-	6.47	6.21
Critical Hdwy Stg 1	-	-	-	-	5.47	-
Critical Hdwy Stg 2	-	-	-	-	5.47	-
Follow-up Hdwy	2.2	-	-	-	3.563	3.309
Pot Cap-1 Maneuver	1577	-	-	-	903	1039
Stage 1	-	-	-	-	974	-
Stage 2	-	-	-	-	960	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1577	-	-	-	897	1039
Mov Cap-2 Maneuver	-	-	-	-	897	-
Stage 1	-	-	-	-	967	-
Stage 2	-	-	-	-	960	-

Approach EB WB SB

HCM Control Delay, s	2	0	7.9
HCM LOS			A










Minor Lane/Major Mvmt EBL EBT WBT WBR SBLn1

Capacity (veh/h)	1577	-	-	-	1437
HCM Lane V/C Ratio	0.007	-	-	-	0.144
HCM Control Delay (s)	7.3	0	-	-	7.9
HCM Lane LOS	A	A	-	-	A
HCM 95th %tile Q(veh)	0	-	-	-	0.5

HCM Unsignalized Intersection Capacity Analysis

4: Musselman Rd & Thomas Ln

04/18/2023

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	145	21	0	35	1	0
Future Volume (Veh/h)	145	21	0	35	1	0
Sign Control	Free		Stop			Stop
Grade	0%		0%			0%
Peak Hour Factor	0.89	0.89	0.89	0.89	0.89	0.89
Hourly flow rate (vph)	163	24	0	39	1	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	0		350	0	377	338
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	0		350	0	377	338
tC, single (s)	4.1		6.5	6.2	7.1	6.5
tC, 2 stage (s)						
tF (s)	2.2		4.0	3.3	3.5	4.0
p0 queue free %	90		100	96	100	100
cM capacity (veh/h)	1623		517	1091	520	528
Direction, Lane #	WB 1	NB 1	SB 1			
Volume Total	187	39	1			
Volume Left	163	0	1			
Volume Right	24	39	0			
cSH	1623	1091	520			
Volume to Capacity	0.10	0.04	0.00			
Queue Length 95th (ft)	8	3	0			
Control Delay (s)	6.6	8.4	11.9			
Lane LOS	A	A	B			
Approach Delay (s)	6.6	8.4	11.9			
Approach LOS		A	B			
Intersection Summary						
Average Delay			6.9			
Intersection Capacity Utilization			19.3%	ICU Level of Service		A
Analysis Period (min)			15			

Appendix E – 2023 Existing Conditions – Simulation Analysis Worksheets

Queuing and Blocking Report
2023 EX AM

04/18/2023

Intersection: 1: Olde Forge Drive/RV Parkway & Warrenton Rd (Rte.17)/Warrenton Rd (Rte.17 Bus.)

Movement	EB	EB	WB	WB	WB	NB	NB
Directions Served	T	TR	L	T	TR	L	LTR
Maximum Queue (ft)	172	180	128	282	265	175	376
Average Queue (ft)	79	87	42	162	155	103	195
95th Queue (ft)	145	153	102	254	242	201	329
Link Distance (ft)	811	811		1005	1005		570
Upstream Blk Time (%)							
Queuing Penalty (veh)							
Storage Bay Dist (ft)			300			150	
Storage Blk Time (%)	2			0		0	22
Queuing Penalty (veh)	0			0		1	19

Intersection: 2: Olde Forge Drive & Thomas Ln

Movement	EB	NB	SB
Directions Served	LR	LT	TR
Maximum Queue (ft)	82	51	40
Average Queue (ft)	39	5	2
95th Queue (ft)	71	27	19
Link Distance (ft)	650	498	570
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 3: Thomas Ln & Short St

Movement	EB	SB
Directions Served	LT	LR
Maximum Queue (ft)	9	56
Average Queue (ft)	0	18
95th Queue (ft)	7	45
Link Distance (ft)	376	547
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 4: Musselman Rd & Thomas Ln

Movement	NB	SB
Directions Served	TR	LT
Maximum Queue (ft)	72	31
Average Queue (ft)	34	4
95th Queue (ft)	64	20
Link Distance (ft)	324	474
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Zone Summary

Zone wide Queuing Penalty: 20

Queuing and Blocking Report
2023 EX PM

04/18/2023

Intersection: 1: Olde Forge Drive/RV Parkway & Warrenton Rd (Rte.17)/Warrenton Rd (Rte.17 Bus.)

Movement	EB	EB	WB	WB	WB	NB	NB
Directions Served	T	TR	L	T	TR	L	LTR
Maximum Queue (ft)	160	178	293	346	333	174	315
Average Queue (ft)	63	82	176	167	174	91	153
95th Queue (ft)	126	148	314	373	355	184	260
Link Distance (ft)	814	814		1005	1005		573
Upstream Blk Time (%)							
Queuing Penalty (veh)							
Storage Bay Dist (ft)			300			150	
Storage Blk Time (%)	1		8	0		0	15
Queuing Penalty (veh)	0		44	0		1	13

Intersection: 2: Olde Forge Drive & Thomas Ln

Movement	EB	NB	SB
Directions Served	LR	LT	TR
Maximum Queue (ft)	73	65	80
Average Queue (ft)	34	6	9
95th Queue (ft)	60	33	45
Link Distance (ft)	650	498	573
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 3: Thomas Ln & Short St

Movement	EB	WB	SB
Directions Served	LT	TR	LR
Maximum Queue (ft)	15	2	64
Average Queue (ft)	1	0	26
95th Queue (ft)	8	2	51
Link Distance (ft)	376	650	547
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 4: Musselman Rd & Thomas Ln

Movement	NB	SB
Directions Served	TR	LT
Maximum Queue (ft)	36	22
Average Queue (ft)	22	1
95th Queue (ft)	46	10
Link Distance (ft)	324	474
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Zone Summary

Zone wide Queuing Penalty: 58

Appendix F – Excerpts from Background Development Studies

Traffic Impact Analysis

The Renaissance at Falmouth

Stafford County, Virginia

Prepared: June 1st, 2020

Prepared for:



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Executive Summary

This report summarizes the findings of the Traffic Impact Analysis (TIA) performed by Bowman Consulting Group (BCG) for the proposed Development (Renaissance at Falmouth) located in Stafford County, Virginia.

The purpose of this study is to determine the potential impact (if any) to the existing traffic operations within the surrounding roadway network caused by the proposed development.

The proposed development is to be located on the northern side of US 17 Business (Warrenton Road) at the intersection with Glenalice Lane. The proposed development will consist of the following land uses:

- 264 Apartments
- 114 Single-Family Attached Units

A Pre-Scoping meeting was held with representatives from Stafford County and the Virginia Department of Transportation (VDOT) – Fredericksburg District at the VDOT Fredericksburg Residency on December 16, 2019. The purpose of this meeting was to discuss and agree upon major components of this study. During the meeting, items discussed included (but were not limited to) intersections to be analyzed, arrival/departure trip distribution, traffic growth factor, build out year, and background traffic.

Access to the site will be provided via the existing intersection of US 17 Business (Warrenton Road) and Glenalice Lane.

The Renaissance at Falmouth Development is expected to generate 143 trips (35 in and 108 out) during the morning peak hour and 178 trips (109 in and 69 out) during the evening peak hour.

The following intersections were evaluated in this study:

- US 17 Business and Olde Forge Drive/RV Parkway
- US 17 Business and Glenalice Lane
- US 17 Business and Solomon Drive/Lendall Lane

For the purposes of this analysis, it is anticipated that The Renaissance at Falmouth Development will be constructed and fully operational by year 2025. The following scenarios were evaluated as part of this study:

- Existing Conditions (2020)
- Future Conditions (2025) without the proposed development (No Build)
- Future Conditions (2025) with the proposed development (Build)

The capacity analysis results indicate the following:

- At US 17 Business and Olde Forge Drive/RV Parkway, the overall intersection level of service (“C” during the morning peak hour and “D” during the evening peak hour) is not projected to change from 2025 No Build to 2025 Build Conditions. The overall intersection delay is projected to increase by 0.3 seconds during the morning peak hour and 3.4 seconds during the evening peak hour with the addition of the proposed development’s site traffic. The levels of service for all turning movements and approaches are not projected to change from No Build to Build Conditions.
- At US 17 Business and Glenalice Lane, the overall intersection level of service (“A” during the morning and evening peak hours) is not projected to change from 2025 No Build to 2025 Build Conditions. The overall intersection delay is projected to increase by 1.5 seconds during the morning peak hour and 1.3 seconds during the evening peak hour with the addition of the proposed development’s site traffic. The southbound approach is projected to degrade under Build Conditions from a LOS D during the morning and evening peak hours to a LOS E during the morning peak hour and a LOS F during the evening peak hour.
 - The southbound approach is anticipated to only serve the proposed development, and these conditions are typical for left-turning traffic entering a major corridor from a minor street at an unsignalized intersection. The traffic signals at US 17 Business/Olde Forge Dr/RV Pkwy and US 17 Business/Solomon Dr/Lendall Ln could potentially be used as a metering system to improve the levels of service for this approach by creating gaps along the mainline traffic.
 - An additional solution to improve queuing at the southbound approach could be to re-stripe the intersection to allow southbound vehicles to perform a two-stage left turn to exit Glenalice Lane onto US 17 Business. A two-stage left turn at this location would allow exiting vehicles to wait for westbound traffic to clear, then maneuver into the center lane of US 17 Business, and then wait for eastbound traffic to clear before merging into the traffic stream.

The existing two-way left turn lane along US 17 Business at this location could be re-stripped to accommodate this layout. Therefore, additional right-of-way would not be required. Additionally, delineators could be installed to enhance safety and driver expectation at this location.

- At US 17 Business and Solomon Drive/Lendall Lane, the overall intersection level of service (“C” during the morning and evening peak hours) is not projected to change from 2025 No Build to 2025 Build Conditions. The overall intersection delay is projected to increase by 0.4 seconds during the morning peak hour and 0.7 seconds during the evening peak hour with the addition of the proposed development’s site traffic. The levels of service for all turning movements and approaches are not projected to change from No Build to Build Conditions.
- Queuing analyses were conducted under the 2025 Build Conditions with a two-stage left turn in place at US 17 Business and Glenalice Lane. The results of the queuing analyses indicate that the projected southbound queue at this location would be reduced from Build Conditions by 266 feet during the morning peak hour and 36 feet during the evening peak hour.

Based on coordination with VDOT, there are planned improvements at the I-95 and Warrenton Road interchange, including a proposed traffic signal at the exit ramps. These improvements would require traffic signal retiming at several locations along the US 17 Business corridor, including the study intersections evaluated in this report. These timing changes should help facilitate traffic operations throughout the US 17 Business corridor.

The results of the right turn lane warrant analysis indicate that the installation of a westbound right turn taper from US 17 Business onto Glenalice Lane is warranted during both the morning and evening peak periods under full build out of the proposed development.

The capacity analysis results indicate that the addition of the site traffic associated with the proposed development is not expected to adversely impact the existing roadway network.



Figure 6. US 17 Business and Solomon Drive/Lendall Lane

The eastbound and westbound approaches consist of an exclusive left turn lane, two through lanes, and an exclusive right turn lane. The northbound approach consists of a shared left turn/through/right turn lane. The southbound approach consists of an exclusive left turn lane, a through lane, and an exclusive right turn lane.

Data Collection

Field inspections were conducted to obtain an inventory of existing roadway geometry, traffic control devices, and location of adjacent intersections.

As previously mentioned, traffic data for the study area was extracted from the approved Rappahannock Landing Apartments TIA prepared by BCG in March of 2018. The traffic counts are included in **Appendix D** of this report.

Traffic Forecast and Background Traffic

For the purposes of this analysis, it is anticipated that The Renaissance at Falmouth Development will be constructed and fully operational by year 2025. The following scenarios were evaluated as part of this study:

- Existing Conditions (2020)
- Future Conditions (2025) without the proposed development (No Build)
- Future Conditions (2025) with the proposed development (Build)

The 2018 traffic volumes from the Rappahannock Landing Apartments TIA are depicted on **Exhibit 1** in **Appendix E**. These traffic volumes were grown to 2020 using a 2.0% growth rate. The 2020 Existing Traffic Volumes are depicted on **Exhibit 2** in **Appendix E**.

The 2020 traffic volumes were then projected an additional five (5) years to the 2025 Background Traffic Volumes using the 2.0% growth rate. The 2025 Background Traffic Volumes are depicted on **Exhibit 3** in **Appendix E**.

During the Pre-Scope meeting with VDOT and Stafford County, three (3) projects were identified to have been approved since the completion of the Rappahannock Landing Apartments TIA, and therefore should be included in the analysis. The projects discussed are as follows:

- Rappahannock Landing Sections 2-4
- Cherryview Landing
- Dunkin Donuts

The traffic volume projection figures were extracted from these approved studies and are contained in **Appendix F** of this report for informational purposes.

The Total Background Development Traffic Volumes for use in this study are depicted on **Exhibit 4** in **Appendix E**.

There is currently vehicular traffic accessing Glenalice Lane that will be removed from the roadway network upon construction of The Renaissance at Falmouth Development. These traffic volumes are depicted on **Exhibit 5** in **Appendix E**.

The existing Glenalice Lane Traffic Volumes were subtracted, and the Total Background Development Traffic Volumes were added to the 2025 Background Traffic Volumes to create the 2025 No Build Traffic Volumes, which are depicted on **Exhibit 6** in **Appendix E**.

Proposed Development (The Renaissance at Falmouth)

The applicant is proposing to develop the site with a mix of residential land uses. The proposed development will consist of the following land uses:

- 264 Apartments
- 114 Single-Family Attached Units

Trip Generation

The Institute of Transportation Engineers (ITE) *Trip Generation Manual*, 10th Edition was used to determine the number of trips generated by the proposed land uses. **Table 1** displays the trip generation for the proposed land uses and includes the morning peak hour, evening peak hour, and daily trips.

Table 1. Site Trip Generation Analysis

Land Use ⁽¹⁾	Land Use Code	Size	Units	AM Peak Hour			PM Peak Hour			Weekday		
				In	Out	Total	In	Out	Total	In	Out	Total
Multifamily Housing (Low-Rise)	220	114	D.U.	12	42	54	41	25	66	410	411	821
Multifamily Housing (Mid-Rise)	221	264	D.U.	23	66	89	68	44	112	718	719	1437
Total, Average Weekday	--	--	--	35	108	143	109	69	178	1128	1130	2258

These traffic volumes were then distributed to the roadway system in accordance with a site traffic distribution pattern agreed upon at the Pre-Scope meeting with VDOT and Stafford County. The site distribution is depicted on **Exhibit 7** in **Appendix E**. The projected site trips were applied to the trip distribution, and are depicted on **Exhibit 8** in **Appendix E**.

The projected site trips were then added to the 2025 No Build Traffic Volumes to create the 2025 Build Traffic Volumes. The 2025 Build Traffic Volumes are depicted on **Exhibit 9** in **Appendix E**.

Capacity Analysis

The study intersections were analyzed for each scenario using the 2010 Edition of the Highway Capacity Manual (HCM) methodologies using the computer software package Synchro 10 with SimTraffic. The analysis uses capacity, Level of Service (LOS), control delay, and queuing as the criteria for the performance of the intersections.

Capacity, as defined by the HCM, is a measure of the maximum number of vehicles in an hour that can travel through an intersection or section of roadway under typical conditions. Level of Service (LOS) is a marker of the driving conditions and perception of drivers while traveling during the given time period. LOS ranges from LOS "A" which represents free flow conditions, to LOS "F" which represents breakdown conditions. **Table 2** shows the LOS for intersections as defined by the HCM.

Table 2. HCM Level of Service Criteria

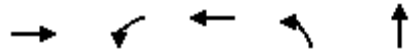
Unsignalized Intersections		Signalized Intersections	
Level of Service	Average Control Delay (sec/veh)	Level of Service	Average Control Delay (sec/veh)
A	≤10	A	≤10
B	>10 and ≤15	B	>10 and ≤20
C	>15 and ≤25	C	>20 and ≤35
D	>25 and ≤35	D	>35 and ≤55
E	>35 and ≤50	E	>55 and ≤80
F	>50	F	>80

Typically, LOS "A" through "D" is considered acceptable, while LOS "E" and "F" are considered failing or unacceptable. Control delay is a measure of the total amount of delay experienced by an individual vehicle and includes delay related to deceleration, queue delay, stopped delay, and acceleration. **Table 2** shows the amount of control delay (in seconds per vehicle) that corresponds to the LOS for signalized and unsignalized intersections.

Appendix G –2027 Future Conditions without Development– Capacity and Simulation Analysis Worksheets

Queues




















1: Olde Forge Drive/RV Parkway & Warrenton Rd (Rte.17)/Warrenton Rd (Rte.17 Bus.)04/18/2023



Lane Group	EBT	WBL	WBT	NBL	NBT
Lane Group Flow (vph)	1314	64	1216	150	206
v/c Ratio	0.75	0.42	0.57	0.59	0.46
Control Delay	18.3	66.9	14.9	64.3	5.4
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	18.3	66.9	14.9	64.3	5.4
Queue Length 50th (ft)	194	56	303	134	0
Queue Length 95th (ft)	246	103	363	207	29
Internal Link Dist (ft)	816		1016		577
Turn Bay Length (ft)		300		150	
Base Capacity (vph)	1749	191	2126	309	486
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	0.75	0.34	0.57	0.49	0.42
Intersection Summary					

HCM Signalized Intersection Capacity Analysis

1: Olde Forge Drive/RV Parkway & Warrenton Rd (Rte.17)/Warrenton Rd (Rte.17 Bus.) 04/18/2023




												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	1255	32	63	1192	0	201	0	148	0	0	0
Future Volume (vph)	0	1255	32	63	1192	0	201	0	148	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		-1%			1%			0%			0%	
Total Lost time (s)		3.8		7.1	3.8		4.0	4.0				
Lane Util. Factor		0.95		1.00	0.95		0.95	0.95				
Frt		1.00		1.00	1.00		1.00	0.89				
Flt Protected		1.00		0.95	1.00		0.95	0.99				
Satd. Flow (prot)		3341		1497	3265		1665	1497				
Flt Permitted		1.00		0.95	1.00		0.95	0.99				
Satd. Flow (perm)		3341		1497	3265		1665	1497				
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	0	1281	33	64	1216	0	205	0	151	0	0	0
RTOR Reduction (vph)	0	1	0	0	0	0	0	175	0	0	0	0
Lane Group Flow (vph)	0	1313	0	64	1216	0	150	31	0	0	0	0
Heavy Vehicles (%)	0%	8%	15%	20%	10%	0%	3%	0%	7%	0%	0%	0%
Turn Type	Prot	NA		Prot	NA		Split	NA				
Protected Phases	1	6		5	2		4	4			9	
Permitted Phases										9		
Actuated Green, G (s)		68.3		9.8	88.2		17.4	17.4				
Effective Green, g (s)		71.3		12.8	91.2		21.4	21.4				
Actuated g/C Ratio		0.51		0.09	0.65		0.15	0.15				
Clearance Time (s)		6.8		10.1	6.8		8.0	8.0				
Vehicle Extension (s)		3.0		3.0	3.0		3.0	3.0				
Lane Grp Cap (vph)		1701		136	2126		254	228				
v/s Ratio Prot		c0.39		0.04	c0.37		c0.09	0.02				
v/s Ratio Perm												
v/c Ratio		0.77		0.47	0.57		0.59	0.14				
Uniform Delay, d1		27.8		60.4	13.6		55.2	51.3				
Progression Factor		0.56		1.00	1.00		1.00	1.00				
Incremental Delay, d2		2.9		2.6	1.1		3.6	0.3				
Delay (s)		18.4		62.9	14.7		58.9	51.6				
Level of Service		B		E	B		E	D				
Approach Delay (s)		18.4			17.1			54.7			0.0	
Approach LOS		B			B			D			A	
Intersection Summary												
HCM 2000 Control Delay			22.2			HCM 2000 Level of Service			C			
HCM 2000 Volume to Capacity ratio			0.65									
Actuated Cycle Length (s)			140.0			Sum of lost time (s)			21.2			
Intersection Capacity Utilization			62.6%			ICU Level of Service			B			
Analysis Period (min)			15									
c Critical Lane Group												

HCM 6th TWSC
2: Olde Forge Drive & Thomas Ln

04/18/2023

Intersection

Int Delay, s/veh 2.4

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	76	9	2	273	75	20
Future Vol, veh/h	76	9	2	273	75	20
Conflicting Peds, #/hr	53	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	94	94	94	94	94	94
Heavy Vehicles, %	12	14	0	3	17	33
Mvmt Flow	81	10	2	290	80	21




Major/Minor	Minor2	Major1	Major2
Conflicting Flow All	438	91	101
Stage 1	91	-	-
Stage 2	347	-	-
Critical Hdwy	6.52	6.34	4.1
Critical Hdwy Stg 1	5.52	-	-
Critical Hdwy Stg 2	5.52	-	-
Follow-up Hdwy	3.608	3.426	2.2
Pot Cap-1 Maneuver	558	935	1504
Stage 1	908	-	-
Stage 2	694	-	-
Platoon blocked, %			
Mov Cap-1 Maneuver	557	935	1504
Mov Cap-2 Maneuver	557	-	-
Stage 1	906	-	-
Stage 2	694	-	-

Approach	EB	NB	SB
HCM Control Delay, s	12.3	0.1	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1504	-	582	-	-
HCM Lane V/C Ratio	0.001	-	0.155	-	-
HCM Control Delay (s)	7.4	0	12.3	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0	-	0.5	-	-

Intersection

Int Delay, s/veh 4

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	14	53	8	14	32	50
Future Vol, veh/h	14	53	8	14	32	50
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	Yield
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	7	12	50	25	10	9
Mvmt Flow	15	58	9	15	35	54

Major/Minor	Major1	Major2	Minor2
Conflicting Flow All	24	0	0 105 17
Stage 1	-	-	- 17 -
Stage 2	-	-	- 88 -
Critical Hdwy	4.17	-	- 6.5 6.29
Critical Hdwy Stg 1	-	-	- 5.5 -
Critical Hdwy Stg 2	-	-	- 5.5 -
Follow-up Hdwy	2.263	-	- 3.59 3.381
Pot Cap-1 Maneuver	1559	-	- 874 1042
Stage 1	-	-	- 985 -
Stage 2	-	-	- 916 -
Platoon blocked, %	-	-	-
Mov Cap-1 Maneuver	1559	-	- 865 1042
Mov Cap-2 Maneuver	-	-	- 865 -
Stage 1	-	-	- 975 -
Stage 2	-	-	- 916 -










Approach	EB	WB	SB
HCM Control Delay, s	1.5	0	7.2
HCM LOS			A

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1559	-	-	-	1709
HCM Lane V/C Ratio	0.01	-	-	-	0.052
HCM Control Delay (s)	7.3	0	-	-	7.2
HCM Lane LOS	A	A	-	-	A
HCM 95th %tile Q(veh)	0	-	-	-	0.2

HCM Unsignalized Intersection Capacity Analysis

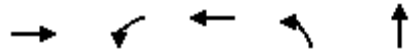
4: Musselman Rd & Thomas Ln

04/18/2023

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	51	7	0	64	3	1
Future Volume (Veh/h)	51	7	0	64	3	1
Sign Control	Free		Stop		Stop	
Grade	0%		0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	55	8	0	70	3	1
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	0		118	0	184	114
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	0		118	0	184	114
tC, single (s)	4.2		6.5	6.3	7.1	6.5
tC, 2 stage (s)						
tF (s)	2.3		4.0	3.4	3.5	4.0
p0 queue free %	96		100	93	100	100
cM capacity (veh/h)	1542		748	1056	710	752
Direction, Lane #	WB 1	NB 1	SB 1			
Volume Total	63	70	4			
Volume Left	55	0	3			
Volume Right	8	70	0			
cSH	1542	1056	720			
Volume to Capacity	0.04	0.07	0.01			
Queue Length 95th (ft)	3	5	0			
Control Delay (s)	6.5	8.6	10.0			
Lane LOS	A	A	B			
Approach Delay (s)	6.5	8.6	10.0			
Approach LOS		A	B			
Intersection Summary						
Average Delay			7.7			
Intersection Capacity Utilization			14.0%	ICU Level of Service		A
Analysis Period (min)			15			

Queues

1: Olde Forge Drive/RV Parkway & Warrenton Rd (Rte.17)/Warrenton Rd (Rte.17 Bus.) 04/18/2023






















Lane Group	EBT	WBL	WBT	NBL	NBT
Lane Group Flow (vph)	1508	127	1305	150	137
v/c Ratio	0.76	0.86	0.53	0.68	0.33
Control Delay	15.7	110.6	11.2	78.2	2.2
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	15.7	110.6	11.2	78.2	2.2
Queue Length 50th (ft)	220	125	288	148	0
Queue Length 95th (ft)	283	#247	337	232	0
Internal Link Dist (ft)	816		1016		577
Turn Bay Length (ft)		300		150	
Base Capacity (vph)	1996	148	2468	233	423
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	0.76	0.86	0.53	0.64	0.32

Intersection Summary

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

HCM Signalized Intersection Capacity Analysis

1: Olde Forge Drive/RV Parkway & Warrenton Rd (Rte.17)/Warrenton Rd (Rte.17 Bus.) 04/18/2023




												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	1384	63	122	1253	0	197	0	79	0	0	0
Future Volume (vph)	0	1384	63	122	1253	0	197	0	79	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		-1%			1%			0%			0%	
Total Lost time (s)		3.8		7.1	3.8		4.0	4.0				
Lane Util. Factor		0.95		1.00	0.95		0.95	0.95				
Frt		0.99		1.00	1.00		1.00	0.91				
Flt Protected		1.00		0.95	1.00		0.95	0.98				
Satd. Flow (prot)		3471		1727	3487		1665	1555				
Flt Permitted		1.00		0.95	1.00		0.95	0.98				
Satd. Flow (perm)		3471		1727	3487		1665	1555				
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	0	1442	66	127	1305	0	205	0	82	0	0	0
RTOR Reduction (vph)	0	2	0	0	0	0	0	119	0	0	0	0
Lane Group Flow (vph)	0	1506	0	127	1305	0	150	18	0	0	0	0
Heavy Vehicles (%)	0%	4%	0%	4%	3%	0%	3%	0%	4%	0%	0%	0%
Turn Type	Prot	NA		Prot	NA		Split	NA				
Protected Phases	1	6		5	2		4	4			9	
Permitted Phases										9		
Actuated Green, G (s)		83.2		9.9	103.2		15.8	15.8				
Effective Green, g (s)		86.2		12.9	106.2		19.8	19.8				
Actuated g/C Ratio		0.57		0.09	0.71		0.13	0.13				
Clearance Time (s)		6.8		10.1	6.8		8.0	8.0				
Vehicle Extension (s)		3.0		3.0	3.0		3.0	3.0				
Lane Grp Cap (vph)		1994		148	2468		219	205				
v/s Ratio Prot		c0.43		c0.07	0.37		c0.09	0.01				
v/s Ratio Perm												
v/c Ratio		0.76		0.86	0.53		0.68	0.09				
Uniform Delay, d1		24.0		67.6	10.2		62.1	57.2				
Progression Factor		0.56		1.00	1.00		1.00	1.00				
Incremental Delay, d2		2.1		35.8	0.8		8.6	0.2				
Delay (s)		15.5		103.5	11.0		70.7	57.4				
Level of Service		B		F	B		E	E				
Approach Delay (s)		15.5			19.2			64.3			0.0	
Approach LOS		B			B			E			A	
Intersection Summary												
HCM 2000 Control Delay			21.5			HCM 2000 Level of Service			C			
HCM 2000 Volume to Capacity ratio			0.70									
Actuated Cycle Length (s)			150.0			Sum of lost time (s)			21.2			
Intersection Capacity Utilization			67.5%			ICU Level of Service			C			
Analysis Period (min)			15									
c Critical Lane Group												

HCM 6th TWSC
2: Olde Forge Drive & Thomas Ln

04/18/2023

Intersection

Int Delay, s/veh 2.2

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	64	23	3	212	140	45
Future Vol, veh/h	64	23	3	212	140	45
Conflicting Peds, #/hr	53	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	9	0	0	2	2	13
Mvmt Flow	70	25	3	230	152	49

Major/Minor	Minor2	Major1	Major2
Conflicting Flow All	466	177	201
Stage 1	177	-	-
Stage 2	289	-	-
Critical Hdwy	6.49	6.2	4.1
Critical Hdwy Stg 1	5.49	-	-
Critical Hdwy Stg 2	5.49	-	-
Follow-up Hdwy	3.581	3.3	2.2
Pot Cap-1 Maneuver	542	871	1383
Stage 1	837	-	-
Stage 2	744	-	-
Platoon blocked, %			
Mov Cap-1 Maneuver	541	871	1383
Mov Cap-2 Maneuver	541	-	-
Stage 1	835	-	-
Stage 2	744	-	-

Approach	EB	NB	SB
HCM Control Delay, s	12.1	0.1	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1383	-	601	-	-
HCM Lane V/C Ratio	0.002	-	0.157	-	-
HCM Control Delay (s)	7.6	0	12.1	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0	-	0.6	-	-

HCM 6th TWSC
3: Thomas Ln & Short St

04/18/2023

Intersection

Int Delay, s/veh 5.9

Movement EBL EBT WBT WBR SBL SBR

Lane Configurations 

Traffic Vol, veh/h 10 26 32 16 61 151

Future Vol, veh/h 10 26 32 16 61 151

Conflicting Peds, #/hr 0 0 0 0 0 0

Sign Control Free Free Free Free Stop Stop

RT Channelized - None - None - Yield

Storage Length - - - - 0 -

Veh in Median Storage, # - 0 0 - 0 -

Grade, % - 0 0 - 0 -

Peak Hour Factor 94 94 94 94 94 94

Heavy Vehicles, % 0 5 17 6 7 1

Mvmt Flow 11 28 34 17 65 161

Major/Minor Major1 Major2 Minor2

Conflicting Flow All 51 0 - 0 93 43

Stage 1 - - - - 43 -

Stage 2 - - - - 50 -

Critical Hdwy 4.1 - - - 6.47 6.21

Critical Hdwy Stg 1 - - - - 5.47 -

Critical Hdwy Stg 2 - - - - 5.47 -

Follow-up Hdwy 2.2 - - - 3.563 3.309

Pot Cap-1 Maneuver 1568 - - - 895 1030

Stage 1 - - - - 967 -

Stage 2 - - - - 960 -

Platoon blocked, % - - - -

Mov Cap-1 Maneuver 1568 - - - 889 1030

Mov Cap-2 Maneuver - - - - 889 -

Stage 1 - - - - 960 -

Stage 2 - - - - 960 -

Approach EB WB SB

HCM Control Delay, s 2 0 7.9

HCM LOS A

Minor Lane/Major Mvmt EBL EBT WBT WBR SBLn1

Capacity (veh/h) 1568 - - - 1446

HCM Lane V/C Ratio 0.007 - - - 0.156

HCM Control Delay (s) 7.3 0 - - 7.9










HCM Lane LOS A A - - A

HCM 95th %tile Q(veh) 0 - - - 0.6

HCM Unsignalized Intersection Capacity Analysis

4: Musselman Rd & Thomas Ln

04/18/2023

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	162	21	0	35	1	0
Future Volume (Veh/h)	162	21	0	35	1	0
Sign Control	Free		Stop			Stop
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	176	23	0	38	1	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	0		375	0	402	364
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	0		375	0	402	364
tC, single (s)	4.1		6.5	6.2	7.1	6.5
tC, 2 stage (s)						
tF (s)	2.2		4.0	3.3	3.5	4.0
p0 queue free %	89		100	97	100	100
cM capacity (veh/h)	1623		496	1091	498	506
Direction, Lane #	WB 1	NB 1	SB 1			
Volume Total	199	38	1			
Volume Left	176	0	1			
Volume Right	23	38	0			
cSH	1623	1091	498			
Volume to Capacity	0.11	0.03	0.00			
Queue Length 95th (ft)	9	3	0			
Control Delay (s)	6.7	8.4	12.2			
Lane LOS	A	A	B			
Approach Delay (s)	6.7	8.4	12.2			
Approach LOS		A	B			
Intersection Summary						
Average Delay			7.0			
Intersection Capacity Utilization			20.3%	ICU Level of Service		A
Analysis Period (min)			15			

Queuing and Blocking Report
2027 FB AM

04/18/2023

Intersection: 1: Olde Forge Drive/RV Parkway & Warrenton Rd (Rte.17)/Warrenton Rd (Rte.17 Bus.)

Movement	EB	EB	WB	WB	WB	NB	NB
Directions Served	T	TR	L	T	TR	L	LTR
Maximum Queue (ft)	458	464	140	335	311	175	423
Average Queue (ft)	284	295	41	188	186	128	228
95th Queue (ft)	432	443	109	291	282	215	377
Link Distance (ft)	813	813		1005	1005		571
Upstream Blk Time (%)							0
Queuing Penalty (veh)							0
Storage Bay Dist (ft)			300			150	
Storage Blk Time (%)	35			1		1	31
Queuing Penalty (veh)	0			0		2	31

Intersection: 2: Olde Forge Drive & Thomas Ln

Movement	EB	NB	SB
Directions Served	LR	LT	TR
Maximum Queue (ft)	86	55	60
Average Queue (ft)	40	5	4
95th Queue (ft)	72	30	25
Link Distance (ft)	650	498	571
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 3: Thomas Ln & Short St

Movement	EB	SB
Directions Served	LT	LR
Maximum Queue (ft)	6	53
Average Queue (ft)	0	20
95th Queue (ft)	3	46
Link Distance (ft)	376	547
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 4: Musselman Rd & Thomas Ln

Movement	NB	SB
Directions Served	TR	LT
Maximum Queue (ft)	68	31
Average Queue (ft)	33	5
95th Queue (ft)	61	24
Link Distance (ft)	324	474
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Zone Summary

Zone wide Queuing Penalty: 33

Queuing and Blocking Report
2027 FB PM

04/18/2023

Intersection: 1: Olde Forge Drive/RV Parkway & Warrenton Rd (Rte.17)/Warrenton Rd (Rte.17 Bus.)

Movement	EB	EB	WB	WB	WB	NB	NB
Directions Served	T	TR	L	T	TR	L	LTR
Maximum Queue (ft)	465	479	309	576	568	175	324
Average Queue (ft)	262	276	221	304	296	102	164
95th Queue (ft)	410	421	372	699	648	194	278
Link Distance (ft)	812	812		1005	1005		571
Upstream Blk Time (%)							
Queuing Penalty (veh)							
Storage Bay Dist (ft)			300			150	
Storage Blk Time (%)	29		29	1		1	19
Queuing Penalty (veh)	0		184	1		2	19

Intersection: 2: Olde Forge Drive & Thomas Ln

Movement	EB	NB	SB
Directions Served	LR	LT	TR
Maximum Queue (ft)	77	43	82
Average Queue (ft)	35	5	10
95th Queue (ft)	63	26	45
Link Distance (ft)	650	498	571
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 3: Thomas Ln & Short St

Movement	EB	WB	SB
Directions Served	LT	TR	LR
Maximum Queue (ft)	15	7	67
Average Queue (ft)	1	0	28
95th Queue (ft)	8	5	52
Link Distance (ft)	376	650	547
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 4: Musselman Rd & Thomas Ln

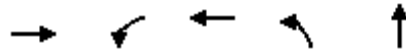
Movement	NB	SB
Directions Served	TR	LT
Maximum Queue (ft)	34	22
Average Queue (ft)	22	1
95th Queue (ft)	46	11
Link Distance (ft)	324	474
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Zone Summary

Zone wide Queuing Penalty: 206

Queues

1: Olde Forge Drive/RV Parkway & Warrenton Rd (Rte.17)/Warrenton Rd (Rte.17 Bus.) 04/18/2023






















Lane Group	EBT	WBL	WBT	NBL	NBT
Lane Group Flow (vph)	1508	127	1305	150	137
v/c Ratio	0.81	0.75	0.55	0.62	0.32
Control Delay	17.8	92.1	13.2	71.4	1.9
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	17.8	92.1	13.2	71.4	1.9
Queue Length 50th (ft)	489	123	318	146	0
Queue Length 95th (ft)	190	#224	373	225	0
Internal Link Dist (ft)	816		1016		577
Turn Bay Length (ft)		300		150	
Base Capacity (vph)	1862	171	2375	277	458
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	0.81	0.74	0.55	0.54	0.30

Intersection Summary

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

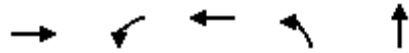
HCM Signalized Intersection Capacity Analysis

1: Olde Forge Drive/RV Parkway & Warrenton Rd (Rte.17)/Warrenton Rd (Rte.17 Bus.) 04/18/2023

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	1384	63	122	1253	0	197	0	79	0	0	0
Future Volume (vph)	0	1384	63	122	1253	0	197	0	79	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		-1%			1%			0%			0%	
Total Lost time (s)		3.8		7.1	3.8		4.0	4.0				
Lane Util. Factor		0.95		1.00	0.95		0.95	0.95				
Frt		0.99		1.00	1.00		1.00	0.91				
Flt Protected		1.00		0.95	1.00		0.95	0.98				
Satd. Flow (prot)		3471		1727	3487		1665	1555				
Flt Permitted		1.00		0.95	1.00		0.95	0.98				
Satd. Flow (perm)		3471		1727	3487		1665	1555				
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	0	1442	66	127	1305	0	205	0	82	0	0	0
RTOR Reduction (vph)	0	2	0	0	0	0	0	117	0	0	0	0
Lane Group Flow (vph)	0	1506	0	127	1305	0	150	20	0	0	0	0
Heavy Vehicles (%)	0%	4%	0%	4%	3%	0%	3%	0%	4%	0%	0%	0%
Turn Type	Prot	NA		Prot	NA		Split	NA				
Protected Phases	1	6		5	2		4	4			9	
Permitted Phases										9		
Actuated Green, G (s)		77.4		11.7	99.2		17.8	17.8				
Effective Green, g (s)		80.4		14.7	102.2		21.8	21.8				
Actuated g/C Ratio		0.54		0.10	0.68		0.15	0.15				
Clearance Time (s)		6.8		10.1	6.8		8.0	8.0				
Vehicle Extension (s)		3.0		3.0	3.0		3.0	3.0				
Lane Grp Cap (vph)		1860		169	2375		241	225				
v/s Ratio Prot		c0.43		c0.07	0.37		c0.09	0.01				
v/s Ratio Perm												
v/c Ratio		0.81		0.75	0.55		0.62	0.09				
Uniform Delay, d1		28.5		65.9	12.2		60.2	55.5				
Progression Factor		0.51		1.00	1.00		1.00	1.00				
Incremental Delay, d2		3.0		17.0	0.9		4.9	0.2				
Delay (s)		17.6		82.9	13.1		65.2	55.7				
Level of Service		B		F	B		E	E				
Approach Delay (s)		17.6			19.3			60.6			0.0	
Approach LOS		B			B			E			A	
Intersection Summary												
HCM 2000 Control Delay			22.2			HCM 2000 Level of Service				C		
HCM 2000 Volume to Capacity ratio			0.70									
Actuated Cycle Length (s)			150.0			Sum of lost time (s)			21.2			
Intersection Capacity Utilization			67.5%			ICU Level of Service			C			
Analysis Period (min)			15									
c Critical Lane Group												

Queues









1: Olde Forge Drive/RV Parkway & Warrenton Rd (Rte.17)/Warrenton Rd (Rte.17 Bus.) 04/18/2023



Lane Group	EBT	WBL	WBT	NBL	NBT
Lane Group Flow (vph)	1314	64	1216	150	206
v/c Ratio	0.77	0.43	0.58	0.58	0.46
Control Delay	20.2	67.6	16.1	63.2	5.3
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	20.2	67.6	16.1	63.2	5.3
Queue Length 50th (ft)	204	56	317	134	0
Queue Length 95th (ft)	268	104	380	204	29
Internal Link Dist (ft)	816		1016		577
Turn Bay Length (ft)		300		150	
Base Capacity (vph)	1706	180	2080	333	504
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	0.77	0.36	0.58	0.45	0.41
Intersection Summary					

HCM Signalized Intersection Capacity Analysis

1: Olde Forge Drive/RV Parkway & Warrenton Rd (Rte.17)/Warrenton Rd (Rte.17 Bus.) 04/18/2023

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	1255	32	63	1192	0	201	0	148	0	0	0
Future Volume (vph)	0	1255	32	63	1192	0	201	0	148	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		-1%			1%			0%			0%	
Total Lost time (s)		3.8		7.1	3.8		4.0	4.0				
Lane Util. Factor		0.95		1.00	0.95		0.95	0.95				
Frt		1.00		1.00	1.00		1.00	0.89				
Flt Protected		1.00		0.95	1.00		0.95	0.99				
Satd. Flow (prot)		3341		1497	3265		1665	1497				
Flt Permitted		1.00		0.95	1.00		0.95	0.99				
Satd. Flow (perm)		3341		1497	3265		1665	1497				
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	0	1281	33	64	1216	0	205	0	151	0	0	0
RTOR Reduction (vph)	0	1	0	0	0	0	0	174	0	0	0	0
Lane Group Flow (vph)	0	1313	0	64	1216	0	150	32	0	0	0	0
Heavy Vehicles (%)	0%	8%	15%	20%	10%	0%	3%	0%	7%	0%	0%	0%
Turn Type	Prot	NA		Prot	NA		Split	NA				
Protected Phases	1	6		5	2		4	4			9	
Permitted Phases										9		
Actuated Green, G (s)		66.5		9.6	86.2		17.8	17.8				
Effective Green, g (s)		69.5		12.6	89.2		21.8	21.8				
Actuated g/C Ratio		0.50		0.09	0.64		0.16	0.16				
Clearance Time (s)		6.8		10.1	6.8		8.0	8.0				
Vehicle Extension (s)		3.0		3.0	3.0		3.0	3.0				
Lane Grp Cap (vph)		1658		134	2080		259	233				
v/s Ratio Prot		c0.39		0.04	c0.37		c0.09	0.02				
v/s Ratio Perm												
v/c Ratio		0.79		0.48	0.58		0.58	0.14				
Uniform Delay, d1		29.2		60.6	14.7		54.8	51.0				
Progression Factor		0.58		1.00	1.00		1.00	1.00				
Incremental Delay, d2		3.3		2.7	1.2		3.1	0.3				
Delay (s)		20.4		63.2	15.9		58.0	51.3				
Level of Service		C		E	B		E	D				
Approach Delay (s)		20.4			18.3			54.1			0.0	
Approach LOS		C			B			D			A	
Intersection Summary												
HCM 2000 Control Delay			23.5			HCM 2000 Level of Service			C			
HCM 2000 Volume to Capacity ratio			0.65									
Actuated Cycle Length (s)			140.0			Sum of lost time (s)			21.2			
Intersection Capacity Utilization			62.6%			ICU Level of Service			B			
Analysis Period (min)			15									

c Critical Lane Group

Intersection: 1: Olde Forge Drive/RV Parkway & Warrenton Rd (Rte.17)/Warrenton Rd (Rte.17 Bus.)

Movement	EB	EB	WB	WB	WB	NB	NB
Directions Served	T	TR	L	T	TR	L	LTR
Maximum Queue (ft)	380	371	250	316	332	175	327
Average Queue (ft)	207	219	110	166	185	101	172
95th Queue (ft)	336	335	225	266	293	191	283
Link Distance (ft)	812	812		1005	1005		571
Upstream Blk Time (%)							
Queuing Penalty (veh)							
Storage Bay Dist (ft)			300			150	
Storage Blk Time (%)	25		0	0		1	19
Queuing Penalty (veh)	0		2	0		1	19

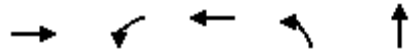
Intersection: 1: Olde Forge Drive/RV Parkway & Warrenton Rd (Rte.17)/Warrenton Rd (Rte.17 Bus.)

Movement	EB	EB	WB	WB	WB	NB	NB
Directions Served	T	TR	L	T	TR	L	LTR
Maximum Queue (ft)	444	460	229	359	330	175	398
Average Queue (ft)	294	304	51	206	198	124	206
95th Queue (ft)	430	437	141	312	296	208	346
Link Distance (ft)	813	813		1005	1005		571
Upstream Blk Time (%)							
Queuing Penalty (veh)							
Storage Bay Dist (ft)			300			150	
Storage Blk Time (%)	38			1		1	25
Queuing Penalty (veh)	0			1		1	26

Appendix H –2027 Future Conditions with Development– Capacity and Simulation Analysis Worksheets

Queues




















1: Olde Forge Drive/RV Parkway & Warrenton Rd (Rte.17)/Warrenton Rd (Rte.17 Bus.)04/18/2023



Lane Group	EBT	WBL	WBT	NBL	NBT
Lane Group Flow (vph)	1324	73	1216	158	212
v/c Ratio	0.76	0.46	0.57	0.61	0.47
Control Delay	19.3	68.0	14.9	64.7	5.8
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	19.3	68.0	14.9	64.7	5.8
Queue Length 50th (ft)	203	63	303	142	0
Queue Length 95th (ft)	266	115	363	217	35
Internal Link Dist (ft)	816		1016		577
Turn Bay Length (ft)		300		150	
Base Capacity (vph)	1735	191	2126	309	486
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	0.76	0.38	0.57	0.51	0.44
Intersection Summary					




HCM Signalized Intersection Capacity Analysis

1: Olde Forge Drive/RV Parkway & Warrenton Rd (Rte.17)/Warrenton Rd (Rte.17 Bus.) 04/18/2023

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	1255	42	72	1192	0	213	0	150	0	0	0
Future Volume (vph)	0	1255	42	72	1192	0	213	0	150	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		-1%			1%			0%			0%	
Total Lost time (s)		3.8		7.1	3.8		4.0	4.0				
Lane Util. Factor		0.95		1.00	0.95		0.95	0.95				
Frt		1.00		1.00	1.00		1.00	0.89				
Flt Protected		1.00		0.95	1.00		0.95	0.99				
Satd. Flow (prot)		3336		1497	3265		1665	1499				
Flt Permitted		1.00		0.95	1.00		0.95	0.99				
Satd. Flow (perm)		3336		1497	3265		1665	1499				
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	0	1281	43	73	1216	0	217	0	153	0	0	0
RTOR Reduction (vph)	0	1	0	0	0	0	0	179	0	0	0	0
Lane Group Flow (vph)	0	1323	0	73	1216	0	158	33	0	0	0	0
Heavy Vehicles (%)	0%	8%	15%	20%	10%	0%	3%	0%	7%	0%	0%	0%
Turn Type	Prot	NA		Prot	NA		Split	NA				
Protected Phases	1	6		5	2		4	4			9	
Permitted Phases										9		
Actuated Green, G (s)		67.8		10.3	88.2		17.9	17.9				
Effective Green, g (s)		70.8		13.3	91.2		21.9	21.9				
Actuated g/C Ratio		0.51		0.10	0.65		0.16	0.16				
Clearance Time (s)		6.8		10.1	6.8		8.0	8.0				
Vehicle Extension (s)		3.0		3.0	3.0		3.0	3.0				
Lane Grp Cap (vph)		1687		142	2126		260	234				
v/s Ratio Prot		c0.40		0.05	c0.37		c0.09	0.02				
v/s Ratio Perm												
v/c Ratio		0.78		0.51	0.57		0.61	0.14				
Uniform Delay, d1		28.3		60.3	13.6		55.0	50.9				
Progression Factor		0.58		1.00	1.00		1.00	1.00				
Incremental Delay, d2		3.1		3.1	1.1		4.0	0.3				
Delay (s)		19.5		63.4	14.7		59.0	51.2				
Level of Service		B		E	B		E	D				
Approach Delay (s)		19.5			17.4			54.6			0.0	
Approach LOS		B			B			D			A	
Intersection Summary												
HCM 2000 Control Delay			23.0			HCM 2000 Level of Service			C			
HCM 2000 Volume to Capacity ratio			0.67									
Actuated Cycle Length (s)			140.0			Sum of lost time (s)			21.2			
Intersection Capacity Utilization			63.3%			ICU Level of Service			B			
Analysis Period (min)			15									
c Critical Lane Group												

HCM 6th TWSC
2: Olde Forge Drive & Thomas Ln

04/18/2023

Intersection						
Int Delay, s/veh	2.6					
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	90	9	2	273	75	39
Future Vol, veh/h	90	9	2	273	75	39
Conflicting Peds, #/hr	53	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	94	94	94	94	94	94
Heavy Vehicles, %	12	14	0	3	17	33
Mvmt Flow	96	10	2	290	80	41




Major/Minor	Minor2	Major1	Major2			
Conflicting Flow All	448	101	121	0	-	0
Stage 1	101	-	-	-	-	-
Stage 2	347	-	-	-	-	-
Critical Hdwy	6.52	6.34	4.1	-	-	-
Critical Hdwy Stg 1	5.52	-	-	-	-	-
Critical Hdwy Stg 2	5.52	-	-	-	-	-
Follow-up Hdwy	3.608	3.426	2.2	-	-	-
Pot Cap-1 Maneuver	550	923	1479	-	-	-
Stage 1	899	-	-	-	-	-
Stage 2	694	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	549	923	1479	-	-	-
Mov Cap-2 Maneuver	549	-	-	-	-	-
Stage 1	897	-	-	-	-	-
Stage 2	694	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	12.7	0.1	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1479	-	570	-	-
HCM Lane V/C Ratio	0.001	-	0.185	-	-
HCM Control Delay (s)	7.4	0	12.7	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0	-	0.7	-	-

Intersection

Int Delay, s/veh 4.4

















Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	14	67	27	14	32	91
Future Vol, veh/h	14	67	27	14	32	91
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	Yield
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	7	12	50	25	10	9
Mvmt Flow	15	73	29	15	35	99

Major/Minor	Major1	Major2	Minor2
Conflicting Flow All	44	0	0 140 37
Stage 1	-	-	- 37 -
Stage 2	-	-	- 103 -
Critical Hdwy	4.17	-	- 6.5 6.29
Critical Hdwy Stg 1	-	-	- 5.5 -
Critical Hdwy Stg 2	-	-	- 5.5 -
Follow-up Hdwy	2.263	-	- 3.59 3.381
Pot Cap-1 Maneuver	1533	-	- 834 1016
Stage 1	-	-	- 965 -
Stage 2	-	-	- 902 -
Platoon blocked, %	-	-	-
Mov Cap-1 Maneuver	1533	-	- 826 1016
Mov Cap-2 Maneuver	-	-	- 826 -
Stage 1	-	-	- 955 -
Stage 2	-	-	- 902 -

Approach	EB	WB	SB
HCM Control Delay, s	1.3	0	7.9
HCM LOS			A

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1533	-	-	-	1373
HCM Lane V/C Ratio	0.01	-	-	-	0.097
HCM Control Delay (s)	7.4	0	-	-	7.9
HCM Lane LOS	A	A	-	-	A
HCM 95th %tile Q(veh)	0	-	-	-	0.3

04/18/2023

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	0	14	0	51	60	7	0	0	64	3	1	0
Future Volume (vph)	0	14	0	51	60	7	0	0	64	3	1	0
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 (vph)	0	15	0	55	65	8	0	0	70	3	1	0
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total (vph)	15	128	70	4								
Volume Left (vph)	0	55	0	3								
Volume Right (vph)	0	8	70	0								
Hadj (s)	0.09	0.20	-0.40	0.15								
Departure Headway (s)	4.3	4.3	3.8	4.4								
Degree Utilization, x	0.02	0.15	0.07	0.00								
Capacity (veh/h)	819	826	898	777								
Control Delay (s)	7.3	8.0	7.1	7.5								
Approach Delay (s)	7.3	8.0	7.1	7.5								
Approach LOS	A	A	A	A								
Intersection Summary												
Delay				7.7								
Level of Service				A								
Intersection Capacity Utilization				23.7%	ICU Level of Service	A						
Analysis Period (min)				15								

Intersection

Intersection Delay, s/veh	7.7
Intersection LOS	A

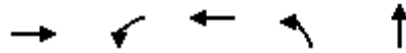
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	0	14	0	51	60	7	0	0	64	3	1	0
Future Vol, veh/h	0	14	0	51	60	7	0	0	64	3	1	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	5	5	5	15	5	0	5	0	12	0	0	5
Mvmt Flow	0	15	0	55	65	8	0	0	70	3	1	0
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	1
HCM Control Delay	7.3	8.2	6.9	7.5
HCM LOS	A	A	A	A

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	0%	0%	43%	75%
Vol Thru, %	0%	100%	51%	25%
Vol Right, %	100%	0%	6%	0%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	64	14	118	4
LT Vol	0	0	51	3
Through Vol	0	14	60	1
RT Vol	64	0	7	0
Lane Flow Rate	70	15	128	4
Geometry Grp	1	1	1	1
Degree of Util (X)	0.069	0.018	0.155	0.005
Departure Headway (Hd)	3.552	4.213	4.347	4.355
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	990	845	826	809
Service Time	1.64	2.264	2.367	2.451
HCM Lane V/C Ratio	0.071	0.018	0.155	0.005
HCM Control Delay	6.9	7.3	8.2	7.5
HCM Lane LOS	A	A	A	A
HCM 95th-tile Q	0.2	0.1	0.5	0

Queues

1: Olde Forge Drive/RV Parkway & Warrenton Rd (Rte.17)/Warrenton Rd (Rte.17 Bus.) 04/18/2023






















Lane Group	EBT	WBL	WBT	NBL	NBT
Lane Group Flow (vph)	1511	129	1305	187	161
v/c Ratio	0.76	0.87	0.53	0.82	0.38
Control Delay	15.8	112.9	11.2	89.1	2.8
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	15.8	112.9	11.2	89.1	2.8
Queue Length 50th (ft)	222	127	288	189	0
Queue Length 95th (ft)	289	#253	337	#321	0
Internal Link Dist (ft)	816		1016		577
Turn Bay Length (ft)		300		150	
Base Capacity (vph)	1996	148	2468	233	423
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	0.76	0.87	0.53	0.80	0.38

Intersection Summary

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




HCM Signalized Intersection Capacity Analysis

1: Olde Forge Drive/RV Parkway & Warrenton Rd (Rte.17)/Warrenton Rd (Rte.17 Bus.) 04/18/2023

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	1384	66	124	1253	0	246	0	88	0	0	0
Future Volume (vph)	0	1384	66	124	1253	0	246	0	88	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		-1%			1%			0%			0%	
Total Lost time (s)		3.8		7.1	3.8		4.0	4.0				
Lane Util. Factor		0.95		1.00	0.95		0.95	0.95				
Frt		0.99		1.00	1.00		1.00	0.91				
Flt Protected		1.00		0.95	1.00		0.95	0.98				
Satd. Flow (prot)		3471		1727	3487		1665	1560				
Flt Permitted		1.00		0.95	1.00		0.95	0.98				
Satd. Flow (perm)		3471		1727	3487		1665	1560				
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	0	1442	69	129	1305	0	256	0	92	0	0	0
RTOR Reduction (vph)	0	2	0	0	0	0	0	139	0	0	0	0
Lane Group Flow (vph)	0	1509	0	129	1305	0	187	22	0	0	0	0
Heavy Vehicles (%)	0%	4%	0%	4%	3%	0%	3%	0%	4%	0%	0%	0%
Turn Type	Prot	NA		Prot	NA		Split	NA				
Protected Phases	1	6		5	2		4	4			9	
Permitted Phases										9		
Actuated Green, G (s)		83.2		9.9	103.2		16.7	16.7				
Effective Green, g (s)		86.2		12.9	106.2		20.7	20.7				
Actuated g/C Ratio		0.57		0.09	0.71		0.14	0.14				
Clearance Time (s)		6.8		10.1	6.8		8.0	8.0				
Vehicle Extension (s)		3.0		3.0	3.0		3.0	3.0				
Lane Grp Cap (vph)		1994		148	2468		229	215				
v/s Ratio Prot		c0.43		c0.07	0.37		c0.11	0.01				
v/s Ratio Perm												
v/c Ratio		0.76		0.87	0.53		0.82	0.10				
Uniform Delay, d1		24.0		67.7	10.2		62.8	56.5				
Progression Factor		0.56		1.00	1.00		1.00	1.00				
Incremental Delay, d2		2.1		39.0	0.8		19.7	0.2				
Delay (s)		15.6		106.8	11.0		82.5	56.7				
Level of Service		B		F	B		F	E				
Approach Delay (s)		15.6			19.6			70.6			0.0	
Approach LOS		B			B			E			A	
Intersection Summary												
HCM 2000 Control Delay			23.2			HCM 2000 Level of Service			C			
HCM 2000 Volume to Capacity ratio			0.72									
Actuated Cycle Length (s)			150.0			Sum of lost time (s)			21.2			
Intersection Capacity Utilization			69.3%			ICU Level of Service			C			
Analysis Period (min)			15									
c Critical Lane Group												

HCM 6th TWSC
2: Olde Forge Drive & Thomas Ln

04/18/2023

Intersection						
Int Delay, s/veh	3.6					
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	122	23	3	212	140	50
Future Vol, veh/h	122	23	3	212	140	50
Conflicting Peds, #/hr	53	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	9	0	0	2	2	13
Mvmt Flow	133	25	3	230	152	54

Major/Minor	Minor2	Major1	Major2
Conflicting Flow All	468	179	206
Stage 1	179	-	-
Stage 2	289	-	-
Critical Hdwy	6.49	6.2	4.1
Critical Hdwy Stg 1	5.49	-	-
Critical Hdwy Stg 2	5.49	-	-
Follow-up Hdwy	3.581	3.3	2.2
Pot Cap-1 Maneuver	541	869	1377
Stage 1	835	-	-
Stage 2	744	-	-
Platoon blocked, %			
Mov Cap-1 Maneuver	540	869	1377
Mov Cap-2 Maneuver	540	-	-
Stage 1	833	-	-
Stage 2	744	-	-

Approach	EB	NB	SB
HCM Control Delay, s	13.6	0.1	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1377	-	575	-	-
HCM Lane V/C Ratio	0.002	-	0.274	-	-
HCM Control Delay (s)	7.6	0	13.6	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0	-	1.1	-	-




HCM 6th TWSC
3: Thomas Ln & Short St

04/18/2023

Intersection

Int Delay, s/veh 5.1

Movement EBL EBT WBT WBR SBL SBR

Lane Configurations						
Traffic Vol, veh/h	10	84	37	16	61	162
Future Vol, veh/h	10	84	37	16	61	162
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	Yield
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	94	94	94	94	94	94
Heavy Vehicles, %	0	5	17	6	7	1
Mvmt Flow	11	89	39	17	65	172

Major/Minor Major1 Major2 Minor2

Conflicting Flow All	56	0	-	0	159	48
Stage 1	-	-	-	-	48	-
Stage 2	-	-	-	-	111	-
Critical Hdwy	4.1	-	-	-	6.47	6.21
Critical Hdwy Stg 1	-	-	-	-	5.47	-
Critical Hdwy Stg 2	-	-	-	-	5.47	-
Follow-up Hdwy	2.2	-	-	-	3.563	3.309
Pot Cap-1 Maneuver	1562	-	-	-	821	1024
Stage 1	-	-	-	-	962	-
Stage 2	-	-	-	-	901	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1562	-	-	-	815	1024
Mov Cap-2 Maneuver	-	-	-	-	815	-
Stage 1	-	-	-	-	955	-
Stage 2	-	-	-	-	901	-

Approach EB WB SB

HCM Control Delay, s	0.8	0	8.1
HCM LOS			A

















Minor Lane/Major Mvmt EBL EBT WBT WBR SBLn1

Capacity (veh/h)	1562	-	-	-	1410
HCM Lane V/C Ratio	0.007	-	-	-	0.168
HCM Control Delay (s)	7.3	0	-	-	8.1
HCM Lane LOS	A	A	-	-	A
HCM 95th %tile Q(veh)	0	-	-	-	0.6

HCM Unsignalized Intersection Capacity Analysis

4: Musselman Rd & Thomas Ln

04/18/2023

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	0	58	0	162	16	21	0	0	35	1	0	0
Future Volume (vph)	0	58	0	162	16	21	0	0	35	1	0	0
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 (vph)	0	63	0	176	17	23	0	0	38	1	0	0
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total (vph)	63	216	38	1								
Volume Left (vph)	0	176	0	1								
Volume Right (vph)	0	23	38	0								
Hadj (s)	0.08	0.14	-0.60	0.20								
Departure Headway (s)	4.3	4.2	3.9	4.8								
Degree Utilization, x	0.07	0.25	0.04	0.00								
Capacity (veh/h)	821	849	853	700								
Control Delay (s)	7.6	8.6	7.1	7.8								
Approach Delay (s)	7.6	8.6	7.1	7.8								
Approach LOS	A	A	A	A								
Intersection Summary												
Delay				8.2								
Level of Service				A								
Intersection Capacity Utilization				27.8%	ICU Level of Service	A						
Analysis Period (min)				15								

Intersection	
Intersection Delay, s/veh	8.2
Intersection LOS	A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	0	58	0	162	16	21	0	0	35	1	0	0
Future Vol, veh/h	0	58	0	162	16	21	0	0	35	1	0	0
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
Heavy Vehicles, %	5	5	5	2	5	2	5	2	0	0	0	5
Mvmt Flow	0	63	0	176	17	23	0	0	38	1	0	0
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	1
HCM Control Delay	7.6	8.6	7.1	7.8
HCM LOS	A	A	A	A

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	0%	0%	81%	100%
Vol Thru, %	0%	100%	8%	0%
Vol Right, %	100%	0%	11%	0%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	35	58	199	1
LT Vol	0	0	162	1
Through Vol	0	58	16	0
RT Vol	35	0	21	0
Lane Flow Rate	38	63	216	1
Geometry Grp	1	1	1	1
Degree of Util (X)	0.042	0.074	0.249	0.001
Departure Headway (Hd)	3.952	4.217	4.15	4.761
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	912	842	865	756
Service Time	1.952	2.281	2.181	2.763
HCM Lane V/C Ratio	0.042	0.075	0.25	0.001
HCM Control Delay	7.1	7.6	8.6	7.8
HCM Lane LOS	A	A	A	A
HCM 95th-tile Q	0.1	0.2	1	0

Queuing and Blocking Report
2027 TF AM

04/18/2023

Intersection: 1: Olde Forge Drive/RV Parkway & Warrenton Rd (Rte.17)/Warrenton Rd (Rte.17 Bus.)

Movement	EB	EB	WB	WB	WB	NB	NB
Directions Served	T	TR	L	T	TR	L	LTR
Maximum Queue (ft)	457	447	191	342	338	175	477
Average Queue (ft)	275	283	58	182	182	128	250
95th Queue (ft)	417	421	145	289	294	218	416
Link Distance (ft)	813	813		1005	1005		571
Upstream Blk Time (%)							0
Queuing Penalty (veh)							2
Storage Bay Dist (ft)			300			150	
Storage Blk Time (%)	36		0	0		1	35
Queuing Penalty (veh)	0		0	0		3	38

Intersection: 2: Olde Forge Drive & Thomas Ln

Movement	EB	NB	SB
Directions Served	LR	LT	TR
Maximum Queue (ft)	102	69	68
Average Queue (ft)	42	8	5
95th Queue (ft)	76	41	34
Link Distance (ft)	650	498	571
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 3: Thomas Ln & Short St

Movement	EB	SB
Directions Served	LT	LR
Maximum Queue (ft)	22	71
Average Queue (ft)	1	20
95th Queue (ft)	12	48
Link Distance (ft)	375	547
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 4: Musselman Rd & Thomas Ln

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (ft)	43	78	82	26
Average Queue (ft)	12	39	32	4
95th Queue (ft)	37	64	60	18
Link Distance (ft)	217	375	325	467
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Zone Summary

Zone wide Queuing Penalty: 42

Queuing and Blocking Report
2027 TF PM

04/18/2023

Intersection: 1: Olde Forge Drive/RV Parkway & Warrenton Rd (Rte.17)/Warrenton Rd (Rte.17 Bus.)

Movement	EB	EB	WB	WB	WB	NB	NB
Directions Served	T	TR	L	T	TR	L	LTR
Maximum Queue (ft)	406	420	304	551	506	175	520
Average Queue (ft)	235	249	232	282	266	143	320
95th Queue (ft)	364	375	378	636	576	219	566
Link Distance (ft)	812	812		1005	1005		571
Upstream Blk Time (%)							5
Queuing Penalty (veh)							18
Storage Bay Dist (ft)			300			150	
Storage Blk Time (%)	26		27	0		5	54
Queuing Penalty (veh)	0		170	1		12	66

Intersection: 2: Olde Forge Drive & Thomas Ln

Movement	EB	NB	SB
Directions Served	LR	LT	TR
Maximum Queue (ft)	166	97	91
Average Queue (ft)	64	18	11
95th Queue (ft)	161	84	51
Link Distance (ft)	650	498	571
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 3: Thomas Ln & Short St

Movement	EB	WB	SB
Directions Served	LT	TR	LR
Maximum Queue (ft)	18	2	73
Average Queue (ft)	1	0	26
95th Queue (ft)	9	2	52
Link Distance (ft)	375	650	547
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 4: Musselman Rd & Thomas Ln

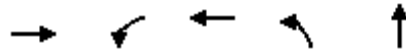
Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (ft)	61	75	35	16
Average Queue (ft)	29	42	21	1
95th Queue (ft)	53	66	42	8
Link Distance (ft)	217	375	325	467
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Zone Summary

Zone wide Queuing Penalty: 267

Queues




















1: Olde Forge Drive/RV Parkway & Warrenton Rd (Rte.17)/Warrenton Rd (Rte.17 Bus.) 04/18/2023



Lane Group	EBT	WBL	WBT	NBL	NBT
Lane Group Flow (vph)	1324	73	1216	158	212
v/c Ratio	0.78	0.47	0.58	0.60	0.47
Control Delay	21.2	68.9	16.1	63.5	5.7
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	21.2	68.9	16.1	63.5	5.7
Queue Length 50th (ft)	212	63	317	142	0
Queue Length 95th (ft)	287	116	380	213	34
Internal Link Dist (ft)	816		1016		577
Turn Bay Length (ft)		300		150	
Base Capacity (vph)	1695	180	2080	333	504
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	0.78	0.41	0.58	0.47	0.42
Intersection Summary					

HCM Signalized Intersection Capacity Analysis

1: Olde Forge Drive/RV Parkway & Warrenton Rd (Rte.17)/Warrenton Rd (Rte.17 Bus.) 04/18/2023

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	1255	42	72	1192	0	213	0	150	0	0	0
Future Volume (vph)	0	1255	42	72	1192	0	213	0	150	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		-1%			1%			0%			0%	
Total Lost time (s)		3.8		7.1	3.8		4.0	4.0				
Lane Util. Factor		0.95		1.00	0.95		0.95	0.95				
Frt		1.00		1.00	1.00		1.00	0.89				
Flt Protected		1.00		0.95	1.00		0.95	0.99				
Satd. Flow (prot)		3336		1497	3265		1665	1499				
Flt Permitted		1.00		0.95	1.00		0.95	0.99				
Satd. Flow (perm)		3336		1497	3265		1665	1499				
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	0	1281	43	73	1216	0	217	0	153	0	0	0
RTOR Reduction (vph)	0	2	0	0	0	0	0	178	0	0	0	0
Lane Group Flow (vph)	0	1322	0	73	1216	0	158	34	0	0	0	0
Heavy Vehicles (%)	0%	8%	15%	20%	10%	0%	3%	0%	7%	0%	0%	0%
Turn Type	Prot	NA		Prot	NA		Split	NA				
Protected Phases	1	6		5	2		4	4			9	
Permitted Phases										9		
Actuated Green, G (s)		66.1		10.0	86.2		18.3	18.3				
Effective Green, g (s)		69.1		13.0	89.2		22.3	22.3				
Actuated g/C Ratio		0.49		0.09	0.64		0.16	0.16				
Clearance Time (s)		6.8		10.1	6.8		8.0	8.0				
Vehicle Extension (s)		3.0		3.0	3.0		3.0	3.0				
Lane Grp Cap (vph)		1646		139	2080		265	238				
v/s Ratio Prot		c0.40		0.05	c0.37		c0.09	0.02				
v/s Ratio Perm												
v/c Ratio		0.80		0.53	0.58		0.60	0.14				
Uniform Delay, d1		29.8		60.6	14.7		54.7	50.6				
Progression Factor		0.61		1.00	1.00		1.00	1.00				
Incremental Delay, d2		3.5		3.6	1.2		3.6	0.3				
Delay (s)		21.5		64.1	15.9		58.2	50.9				
Level of Service		C		E	B		E	D				
Approach Delay (s)		21.5			18.6			54.0			0.0	
Approach LOS		C			B			D			A	
Intersection Summary												
HCM 2000 Control Delay			24.3			HCM 2000 Level of Service				C		
HCM 2000 Volume to Capacity ratio			0.67									
Actuated Cycle Length (s)			140.0			Sum of lost time (s)			21.2			
Intersection Capacity Utilization			63.3%			ICU Level of Service			B			
Analysis Period (min)			15									

c Critical Lane Group

Queues

1: Olde Forge Drive/RV Parkway & Warrenton Rd (Rte.17)/Warrenton Rd (Rte.17 Bus.) 04/18/2023











Lane Group	EBT	WBL	WBT	NBL	NBT
Lane Group Flow (vph)	1511	129	1305	187	161
v/c Ratio	0.82	0.76	0.55	0.71	0.36
Control Delay	18.9	93.1	13.8	74.4	2.4
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	18.9	93.1	13.8	74.4	2.4
Queue Length 50th (ft)	465	125	326	182	0
Queue Length 95th (ft)	198	#230	382	274	0
Internal Link Dist (ft)	816		1016		577
Turn Bay Length (ft)		300		150	
Base Capacity (vph)	1838	171	2352	288	467
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	0.82	0.75	0.55	0.65	0.34

Intersection Summary

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

HCM Signalized Intersection Capacity Analysis

1: Olde Forge Drive/RV Parkway & Warrenton Rd (Rte.17)/Warrenton Rd (Rte.17 Bus.) 04/18/2023

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	1384	66	124	1253	0	246	0	88	0	0	0
Future Volume (vph)	0	1384	66	124	1253	0	246	0	88	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		-1%			1%			0%			0%	
Total Lost time (s)		3.8		7.1	3.8		4.0	4.0				
Lane Util. Factor		0.95		1.00	0.95		0.95	0.95				
Frt		0.99		1.00	1.00		1.00	0.91				
Flt Protected		1.00		0.95	1.00		0.95	0.98				
Satd. Flow (prot)		3471		1727	3487		1665	1560				
Flt Permitted		1.00		0.95	1.00		0.95	0.98				
Satd. Flow (perm)		3471		1727	3487		1665	1560				
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	0	1442	69	129	1305	0	256	0	92	0	0	0
RTOR Reduction (vph)	0	2	0	0	0	0	0	135	0	0	0	0
Lane Group Flow (vph)	0	1509	0	129	1305	0	187	26	0	0	0	0
Heavy Vehicles (%)	0%	4%	0%	4%	3%	0%	3%	0%	4%	0%	0%	0%
Turn Type	Prot	NA		Prot	NA		Split	NA				
Protected Phases	1	6		5	2		4	4			9	
Permitted Phases										9		
Actuated Green, G (s)		76.4		11.7	98.2		19.9	19.9				
Effective Green, g (s)		79.4		14.7	101.2		23.9	23.9				
Actuated g/C Ratio		0.53		0.10	0.67		0.16	0.16				
Clearance Time (s)		6.8		10.1	6.8		8.0	8.0				
Vehicle Extension (s)		3.0		3.0	3.0		3.0	3.0				
Lane Grp Cap (vph)		1837		169	2352		265	248				
v/s Ratio Prot		c0.43		c0.07	0.37		c0.11	0.02				
v/s Ratio Perm												
v/c Ratio		0.82		0.76	0.55		0.71	0.10				
Uniform Delay, d1		29.4		66.0	12.7		59.7	53.9				
Progression Factor		0.52		1.00	1.00		1.00	1.00				
Incremental Delay, d2		3.2		18.3	0.9		8.3	0.2				
Delay (s)		18.6		84.2	13.6		68.0	54.1				
Level of Service		B		F	B		E	D				
Approach Delay (s)		18.6			20.0			61.6			0.0	
Approach LOS		B			B			E			A	
Intersection Summary												
HCM 2000 Control Delay			23.8			HCM 2000 Level of Service			C			
HCM 2000 Volume to Capacity ratio			0.72									
Actuated Cycle Length (s)			150.0			Sum of lost time (s)			21.2			
Intersection Capacity Utilization			69.3%			ICU Level of Service			C			
Analysis Period (min)			15									
c Critical Lane Group												

Intersection: 1: Olde Forge Drive/RV Parkway & Warrenton Rd (Rte.17)/Warrenton Rd (Rte.17 Bus.)

Movement	EB	EB	WB	WB	WB	NB	NB
Directions Served	T	TR	L	T	TR	L	LTR
Maximum Queue (ft)	472	486	200	365	353	175	414
Average Queue (ft)	298	310	66	207	202	121	218
95th Queue (ft)	442	451	159	329	320	214	363
Link Distance (ft)	813	813		1005	1005		571
Upstream Blk Time (%)							0
Queuing Penalty (veh)							0
Storage Bay Dist (ft)			300			150	
Storage Blk Time (%)	40		0	1		1	27
Queuing Penalty (veh)	0		0	1		2	29

Intersection: 1: Olde Forge Drive/RV Parkway & Warrenton Rd (Rte.17)/Warrenton Rd (Rte.17 Bus.)

Movement	EB	EB	WB	WB	WB	NB	NB
Directions Served	T	TR	L	T	TR	L	LTR
Maximum Queue (ft)	380	388	266	352	353	175	449
Average Queue (ft)	208	223	132	171	193	125	218
95th Queue (ft)	331	343	260	294	313	212	377
Link Distance (ft)	812	812		1005	1005		571
Upstream Blk Time (%)							0
Queuing Penalty (veh)							1
Storage Bay Dist (ft)			300			150	
Storage Blk Time (%)	25		2	0		2	28
Queuing Penalty (veh)	0		10	0		4	34