
TRAFFIC IMPACT ANALYSIS

NELSON FARM DEVELOPMENT

HENRICO COUNTY, VIRGINIA

AUGUST 2022

Prepared By:



1700 Willow Lawn Drive Suite 200

Richmond, VA 23230

(804) 673-3882

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EXECUTIVE SUMMARY

The Traffic Impact Analysis (TIA) documented in this report evaluates the traffic impacts of the proposed residential development on the surrounding roadway network. The proposed development is located along the east and west sides of Willson Road generally between Towhee Lane and Willson Cove Court in Henrico County, Virginia. The proposed development will consist of approximately 450 single-family homes and 550 multifamily housing units. Vehicle access to the proposed site will be provided via three full-access driveways along Willson Road and one right-in/right-out driveway along New Market Road (Route 5).

Traffic operations were analyzed at the intersections identified below during the AM and PM peak hours using *Synchro 11TM* software for the existing 2022, projected no-build 2036, projected build 2036, and projected build with mitigation 2036 conditions. To project future traffic volumes for future year analyses, a linear growth rate of 1.0% was established through coordination with Henrico County and VDOT staff to account for historic growth trends in the project area. Additionally, traffic volumes from the proposed I-895 Distribution Center and Sauer Development were included in all future conditions analyses. The following intersections were analyzed in this traffic impact analysis:

1. New Market Road (Route 5) at Willson Road/Varina Road
2. South Laburnum Avenue at Willson Road
3. New Market Road (Route 5) at South Laburnum Avenue
4. Willson Road at West Site Access #1
5. Willson Road at West Site Access #2
6. Willson Road at East Site Access #1
7. New Market Road (Route 5) at East Site Access #2
8. New Market Road (Route 5) at Strath Road

Based on the findings of this study, off-site improvements have been identified to mitigate the proposed project traffic impacts at existing and proposed study intersections. All approaches and movements will operate at LOS D or better as a result of implementing the proposed improvements. Furthermore, the 95th percentile vehicle queues at all study intersections are anticipated to be contained within the existing turn-lane lengths under all analysis conditions.

The proposed off-site improvements are summarized below:

- Converting the intersection of South Laburnum Avenue and Willson Road from unsignalized to signalized
- Install a 100' foot southbound right-turn lane with 100' taper along Willson Road at its intersection with New Market Road (Route 5)
- Traffic signal timing optimization at all signalized intersections
- Dedicated right and left-turn lanes at all three project driveways along Willson Road, and a single dedicated right-turn lane for the project driveway along New Market Road (Route 5)

1. INTRODUCTION

1.1. PURPOSE

Kimley-Horn performed a Traffic Impact Analysis (TIA) to evaluate the traffic impacts of the proposed residential development generally located on the east and west sides of Willson Road between Towhee Lane and Willson Cove Court in Henrico County, Virginia. The proposed development will consist of approximately 450 single-family homes and 550 multifamily housing units. The purpose of this study is to determine and evaluate the potential future impact of the proposed construction of the residential development on the roadway network and to identify mitigation measures to accommodate the proposed development.

1.2. METHODOLOGY

In preparation of the TIA, Kimley-Horn coordinated with Henrico County and VDOT staff to receive concurrence on the scope of the study, the limits of the study area, and the proposed methodology which is provided for reference in the scoping form contained in **Appendix A**. As determined through coordination with Henrico County and VDOT staff, study area intersections included the following:

1. New Market Road (Route 5) at Willson Road/Varina Road
2. South Laburnum Avenue at Willson Road
3. New Market Road (Route 5) at South Laburnum Avenue
4. Willson Road at West Site Access #1
5. Willson Road at West Site Access #2
6. Willson Road at East Site Access #1
7. New Market Road (Route 5) at East Site Access #2
8. New Market Road (Route 5) at Strath Road

Intersection analyses performed using *Synchro 11TM* software included an evaluation of the existing 2022, projected no-build 2036, projected build 2036, and projected build with mitigation 2036 conditions. Existing conditions represent the roadway network at the time of this study, no-build conditions represent the future roadway network without the proposed development, build conditions represent the future roadway network with the proposed development, and build with mitigation conditions represent the future roadway network operating with proposed improvements to mitigate the proposed development traffic impacts.

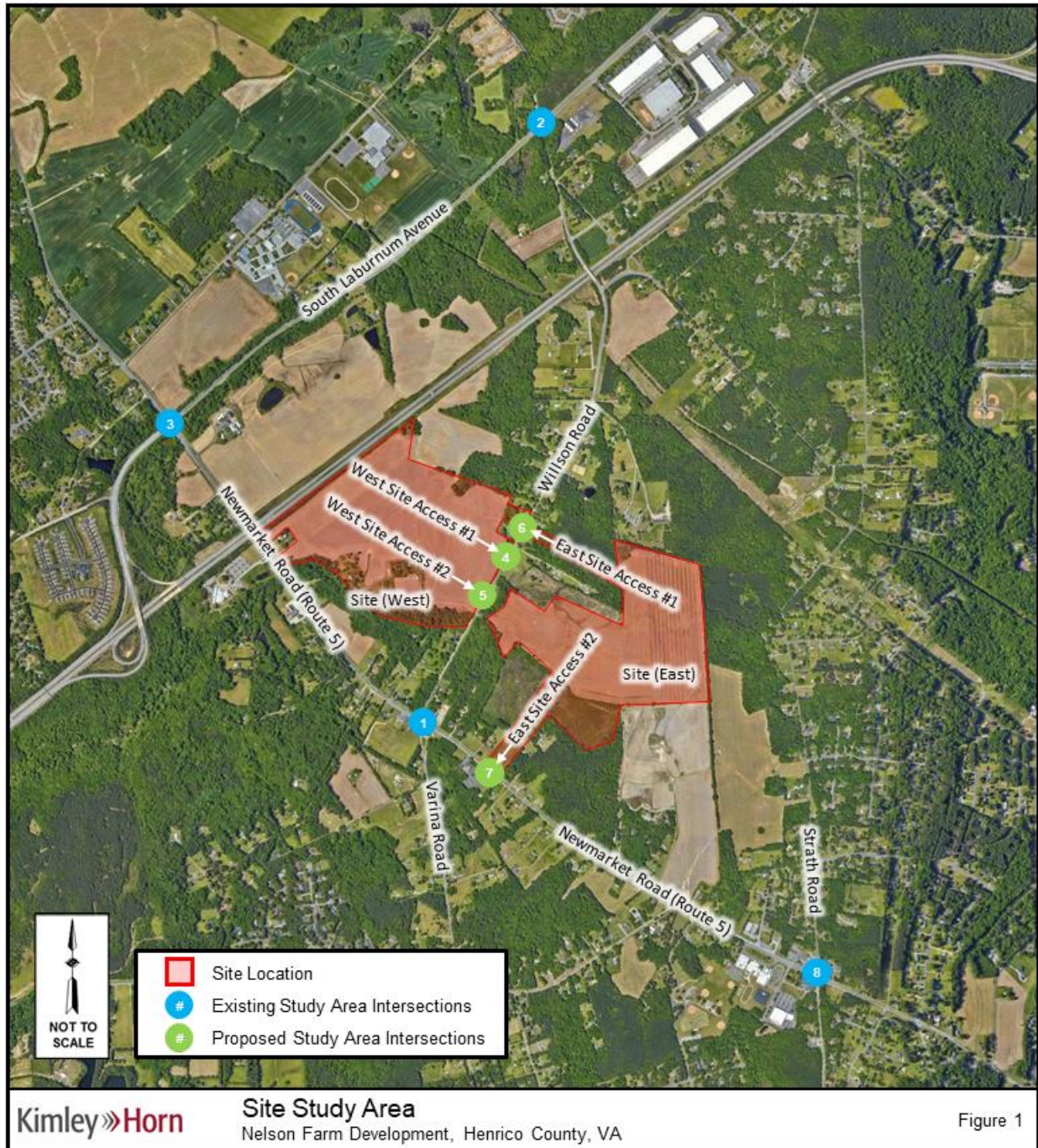
1.3. DEVELOPMENT INFORMATION

Currently, the site proposed for development is occupied by farmland. Upon full build out, the proposed development is anticipated to have a cumulative total of 1,000 housing units consisting of 450 single-family homes and 550 multifamily housing units. Based on the proposed land uses, the Institute of Transportation Engineers' (ITE) *Trip Generation Manual*, 11th Edition, was used to assign each land use for the purposes of this study.

1.4. PROJECT AREA

The project area consists of the east and west sides of Willson Road between Towhee Lane and Willson Cove Court in Henrico County, Virginia as shown in **Figure 1**.

Figure 1: Site Location



2. TRAFFIC OPERATIONAL ANALYSIS

2.1. METHODOLOGY

The traffic operational analysis performed for this study using *Synchro11TM* was conducted in accordance with VDOT's *Traffic Operations Safety Analysis Manual* (TOSAM) for deterministic, intersection capacity analyses. Consistent with prior coordination with Henrico County, queueing analyses using *Synchro11TM* 95th percentile queues were prepared.

The evaluation of traffic operations within the study area was comprised of an intersection capacity level of service (LOS) analysis of study intersections during the AM and PM peak hours as well as a queueing analysis to evaluate the need for and adequacy of turn lanes. LOS analyses were conducted using methodologies contained in the Highway Capacity Manual (HCM) reported from *Synchro11TM*. Queue analyses were conducted using 95th percentile queues reported from *Synchro11TM*. As part of the traffic operational analysis, the projected no-build condition served as the baseline for evaluating intersection delays and identifying mitigation measures under the build condition.

2.2. LEVEL OF SERVICE (LOS) ANALYSIS

Intersection capacity defines the volume of traffic that can be accommodated by a roadway at a specified level of service (LOS). Capacity is affected by various geometric factors including roadway type (e.g., divided, or undivided), number of lanes, lane widths, and grades. LOS, which is a measure of the degree of congestion, ranges from LOS A (free flowing) to LOS F (a congested, forced flow condition). Delay, measured in seconds per vehicle, and the associated LOS thresholds for signalized and unsignalized intersections based on HCM methodologies are presented in **Table 1**.

Table 1: Intersection Level of Service (LOS) Analysis Criteria

Level of Service (LOS)	Average Control Delay per Vehicle (sec/veh)		Description of Traffic Conditions
	Signalized	Unsignalized	
A	≤ 10	≤ 10	No delays at intersections with continuous flow traffic. Uncongested operations; high frequency of long gaps available for all left and right-turning traffic; no observable queues.
B	> 10 and ≤ 20	> 10 and ≤ 15	
C	> 20 and ≤ 35	> 15 and ≤ 25	Moderate delays at intersections with satisfactory to good traffic flow. Light congestion; infrequent backups on critical approaches.
D	> 35 and ≤ 55	> 25 and ≤ 35	Increased probability of delays along every approach. Significant congestion on critical approaches, but intersection functional. No long-standing lines formed.
E	> 55 and ≤ 80	> 35 and ≤ 50	Heavy traffic flow condition. Heavy delays probable. No available gaps for cross-street traffic or main street turning traffic. Limit of stable flow.
F	> 80	> 50	Unstable traffic flow. Heavy congestion. Traffic moves in forced flow condition. Average delays greater than one minute highly probable. Total breakdown.

2.3. KEY ASSUMPTIONS

The following assumptions were made as part of the traffic operational analysis:

- Flashing yellow arrows (FYA) which are anticipated to be approved by VDOT were included as part of no-build, build, and build with mitigation conditions at all signalized study intersections along New Market Road (Route 5)
- Signal timings were optimized for all signalized intersections as part of no-build, build, and build with mitigation conditions.
- For the no-build, build, and build with mitigation conditions, all signalized intersections used the existing peak hour factor of 0.88 at a minimum in accordance with TOSAM.
- All signalized intersections were evaluated using HCM 2000 reports due to *Synchro11™* software tool limitations to analyze nonstandard NEMA phasing. All unsignalized intersections were evaluated using HCM 6th TWSC.

3. EXISTING CONDITIONS

3.1. EXISTING ROADWAY CHARACTERISTICS

Roadway characteristics including geometry and posted speed limits for roadway facilities adjacent to the proposed development are summarized in **Table 2**.

Table 2: Existing Roadway Characteristics

Road	Lanes	Posted Speed (mph)	Functional Classification ¹
Willson Road	2 Lanes Undivided	45	Local Road
New Market Road (Route 5)	2 Lanes Undivided	55	Minor Arterial
South Laburnum Avenue	4 Lanes Divided	55	Principal Arterial
Strath Road	2 Lanes Undivided	45	Major Collector
Varina Road	2 Lanes Undivided	45	Major Collector

¹ As VDOT provides in the *2014 Approved Functional Classification Map*.

3.2. EXISTING TRAFFIC VOLUMES

Existing AM and PM peak hour traffic volumes were collected on June 7, 2022 (Tuesday) at the intersection of New Market Road (Route 5) at South Laburnum Avenue and New Market Road (Route 5) at Strath Road. Additionally, previously collected traffic data collected on October 27, 2021 (Wednesday) was gathered for the intersections of New Market Road (Route 5) at Willson Road/Varina Road and South Laburnum Avenue at Willson Road. Existing peak hour traffic counts are graphically presented in **Figure 2**. Traffic count data is provided in **Appendix B**.

3.3. EXISTING CONDITIONS INTERSECTION CAPACITY ANALYSIS

During the AM peak hour, all signalized intersections operate at overall LOS C or better and all approaches at all intersections operate at LOS D or better. All movements at all intersections also operate at LOS D or better with the exception of the southbound left-turn movement at the intersection of South Laburnum Avenue at New Market Road (Route 5) which operates at LOS E.

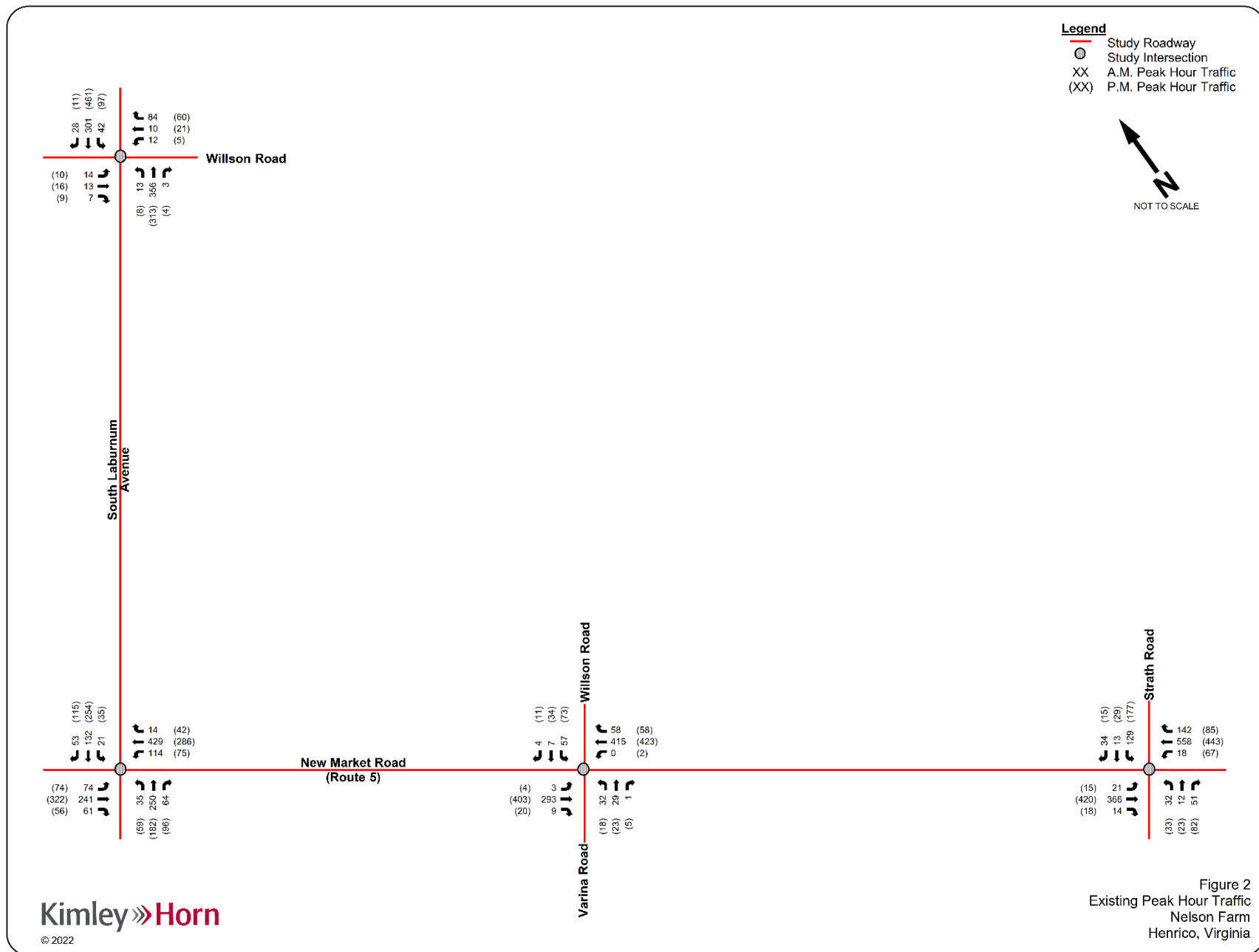
During the PM peak hour, all signalized intersections operate at overall LOS C or better and all approaches and movements at all intersections operate at LOS D or better.

Existing conditions analysis results are summarized in **Table 4** with detailed results included in **Appendix C**.

3.4. EXISTING CONDITIONS 95TH PERCENTILE QUEUEING ANALYSIS

The 2022 existing 95th percentile vehicle queue lengths were calculated by movement for each study intersection using *Synchro11TM*. Queues did not exceed available storage for any of the study intersections during both AM and PM peak hours. The results are summarized in **Table 5** following the analysis sections. The queueing analysis complete results are included in **Appendix C**.

Figure 2: Existing Peak Hour Traffic



4. NO-BUILD CONDITIONS

The projected no-build conditions represent the future roadway network and background traffic growth without the addition of the proposed development. Additional trips generated by a planned I-895 distribution center along South Laburnum Avenue between New Market Road (Route 5) and Willson Road were included in the no-build condition. The trips are based on the *Ashley Capital Warehouse, Traffic Impact Analysis*. Furthermore, trips generated by a planned development to the north of Darbytown Road were included in the no-build condition. The trips are based on the *Sauer Industrial Center, Traffic Impact Analysis*.

4.1. TRAFFIC GROWTH RATE

To project traffic growth, growth rates in the study area were analyzed. During the scoping meeting with Henrico County and VDOT staff, a linear growth rate of 1.0% was agreed to be applied to all study intersections. The scoping form is provided in **Appendix A**. No-build 2036 AM and PM peak hour traffic volumes are shown in **Figure 3**.

4.2. NO-BUILD SIGNAL OPERATION IMPROVEMENTS

Future signal improvements are proposed at the signalized intersections of New Market Road (Route 5) at Varina Road/Willson Road, New Market Road (Route 5) at Laburnum Avenue, and New Market Road (Route 5) at Strath Road. The future signal improvements were included as part of no-build conditions as they are expected to be implemented prior to the build out of the project. The signal improvements for the subject intersections include the following:

- Flashing yellow arrows for all left-turn lane movements at the intersection of New Market Road (Route 5) and South Laburnum Avenue.
- Flashing yellow arrows for the eastbound and westbound left-turn movements at the intersection of New Market Road (Route 5) and Varina Road/Willson Road.
- Flashing yellow arrows for the eastbound and westbound left-turn movements at the intersection of New Market Road (Route 5) and Strath Road.
 - Allow the signal to operate with concurrent north/south phasing at Strath Road with the flashing yellow arrow operation. Remove the existing split phase operation.
- For the three traffic signals where flashing yellow arrows were assumed to be implemented, intersection cycle lengths were optimized as a part of no-build conditions.

4.3. 2036 NO-BUILD CONDITIONS INTERSECTION CAPACITY ANALYSIS

During the AM peak hour, all signalized intersections operate at overall LOS C or better and all approaches and movements at all intersections operate at LOS D or better.

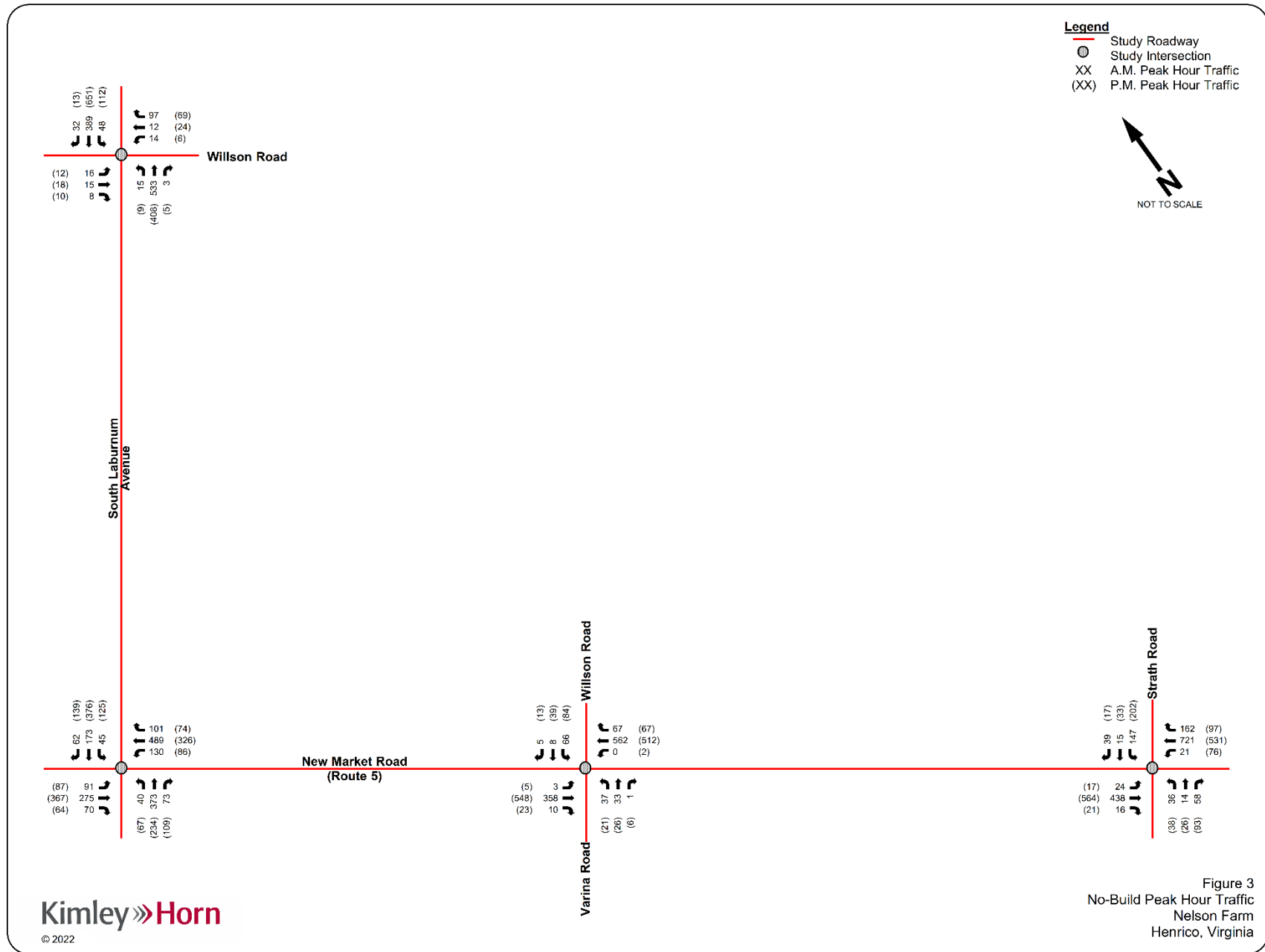
During the PM peak hour, all signalized intersections operate at overall LOS C or better and all approaches and movements at all intersections operate at LOS D or better with the exception of the eastbound approach at the unsignalized intersection of South Laburnum Avenue and Willson Road which operates at LOS E.

Results are summarized in **Table 4** and complete results included in **Appendix C**.

4.4. 2036 NO-BUILD CONDITIONS 95TH PERCENTILE QUEUEING ANALYSIS

The 2036 no-build 95th percentile vehicle queue lengths were calculated by movement for each study intersection using *Synchro11TM*. Queues did not exceed capacity for any of the intersections during both AM and PM peak hours. The results are summarized in **Table 5** following the analysis sections. The queueing analysis complete results are included in **Appendix C**.

Figure 3: Projected No-Build 2036 Peak Hour Traffic



5. BUILD CONDITIONS

The build conditions represent the future roadway network and background traffic growth with the addition of the proposed development. The build condition includes the addition of two project driveways along Willson Road to enter the west portion of the site and one project driveway on Willson Road to enter the east portion of the site. There is also one project driveway along New Market Road (Route 5) to enter the east portion of the site that operates as a right-in/right-out only driveway.

5.1. SITE TRIP GENERATION

Traffic projections were estimated for the proposed development based on the ITE *Trip Generation Manual, 11th Edition*. To estimate daily trips, AM peak hour trips, and PM peak hour trips the ITE equations and/or rates were used. **Table 3** summarizes the total number of trips that are anticipated to be generated by the proposed development during the AM and PM peak hours. The total trips represent the number of vehicles entering and exiting the proposed development to and from the adjacent street network.

Table 3: Proposed Land Uses

Description	ITE Code	Intensity	Weekday Daily	Site Designation	Weekday AM Peak Hour			Weekday PM Peak Hour		
					Total	In	Out	Total	In	Out
Single-Family Detached Housing	210	450 dwelling units	4,253	East	159	41	118	217	137	80
				West	153	40	113	209	132	77
Multifamily Housing	220	550 dwelling units	3,707	East	97	23	74	124	78	46
				West	119	29	90	154	97	57
Total			7,960	-	528	133	395	704	444	260

5.2. SITE TRIP DISTRIBUTION AND ASSIGNMENT

The distribution of traffic at study area intersections (including proposed access locations) was established based on existing traffic patterns, anticipated future traffic patterns, and traffic patterns internal to each lot. The west and east site trip distribution is shown in **Figure 4** and **Figure 5**. The applied trip assignment, based on the trip distribution and site projected volumes, is shown in **Figure 6** and **Figure 7** for the west and east site.

The assignment of traffic generated by the site was calculated by applying the distribution percentage for a specific turning movement to the total number of inbound or outbound trips generated to establish the turning movement volume at that location. The resulting build volumes for the AM and PM peak hours is shown in **Figure 8**. The build condition (2036) traffic volumes were calculated by adding the site generated trips to the projected no-build traffic volumes.

5.3. 2036 BUILD CONDITIONS INTERSECTION CAPACITY ANALYSIS

During the AM peak hour, all signalized intersections operate at overall LOS D or better with the exception of the intersection of New Market Road (Route 5) and Willson/Varina Road which operates at LOS F. All approaches and movements at all intersections also operate at LOS D or better with the exception of the following which operate at LOS E or worse:

- Southbound approach on Willson Road at New Market Road (Route 5)
 - Southbound through movement on Willson Road at New Market Road (Route 5)
- Eastbound and westbound approaches on Willson Road at South Laburnum Avenue
 - Eastbound and westbound left/through/right-turn movements on Willson Road at South Laburnum Avenue

During the PM peak hour, all signalized intersections operate at overall LOS D or better. All approaches and movements at all intersections also operate at LOS D or better with the exception of the following approaches and movements which operate at LOS E or worse:

- Southbound approach on Willson Road at New Market Road (Route 5)
 - Southbound through movement on Willson Road at New Market Road (Route 5)
- Eastbound and westbound approaches on Willson Road at South Laburnum Avenue
 - Eastbound and westbound left/through/right-turn movements on Willson Road at South Laburnum Avenue

All proposed stop-controlled project driveways contain movements that operate at LOS C or better during the AM and PM peak hours. Results are summarized in **Table 4** and complete results included in **Appendix C**.

5.4. 2036 BUILD CONDITIONS 95TH PERCENTILE QUEUEING ANALYSIS

The 2036 build 95th percentile vehicle queue lengths were calculated by movement for each study intersection using *Synchro11TM*. Queues did not exceed capacity for any of the intersections during both AM and PM peak hours. The results are summarized in **Table 5** following the analysis sections. The queueing analysis complete results are included in **Appendix C**.

Figure 4: West Site Trip Distribution

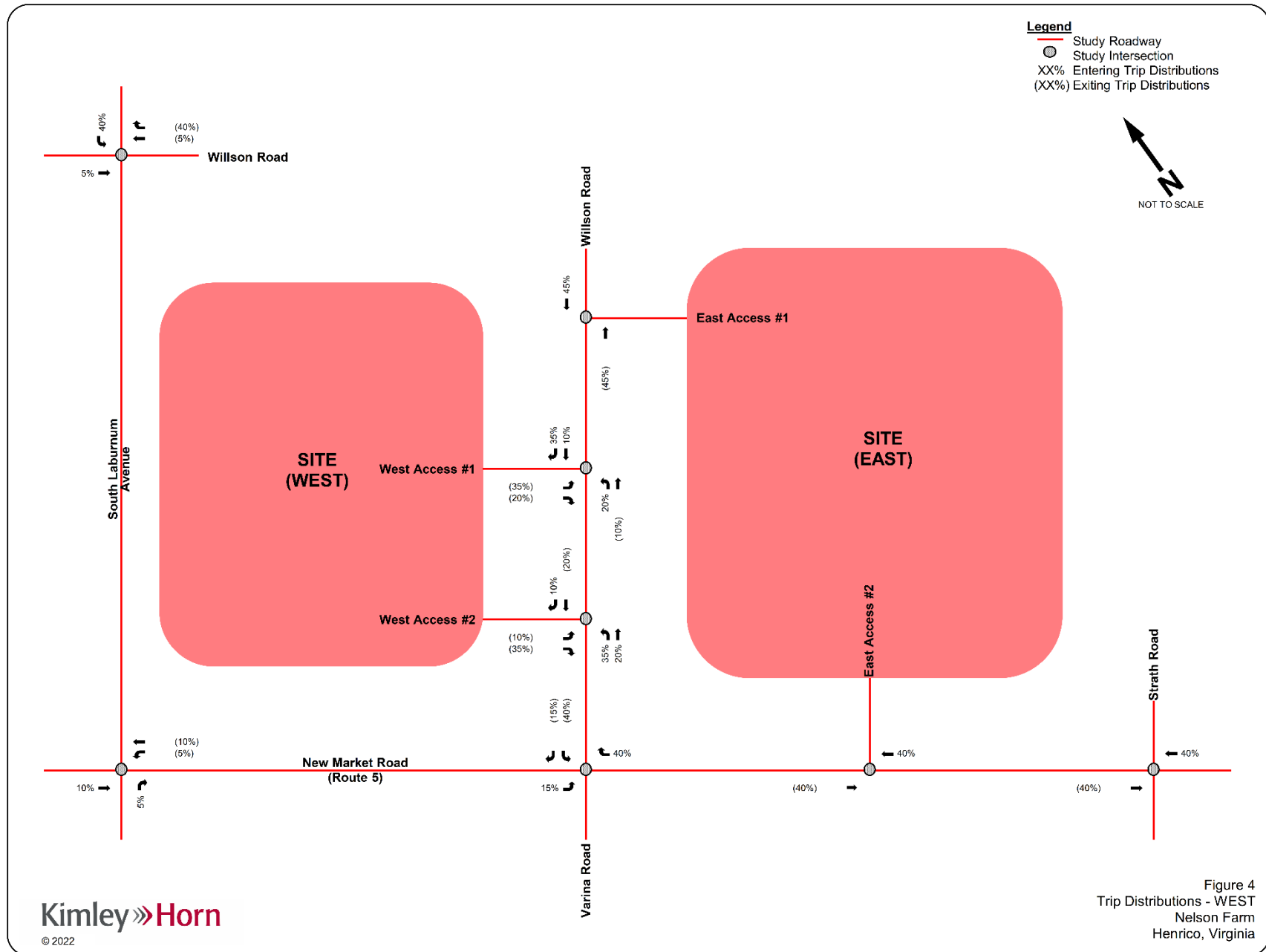


Figure 5: East Site Trip Distribution

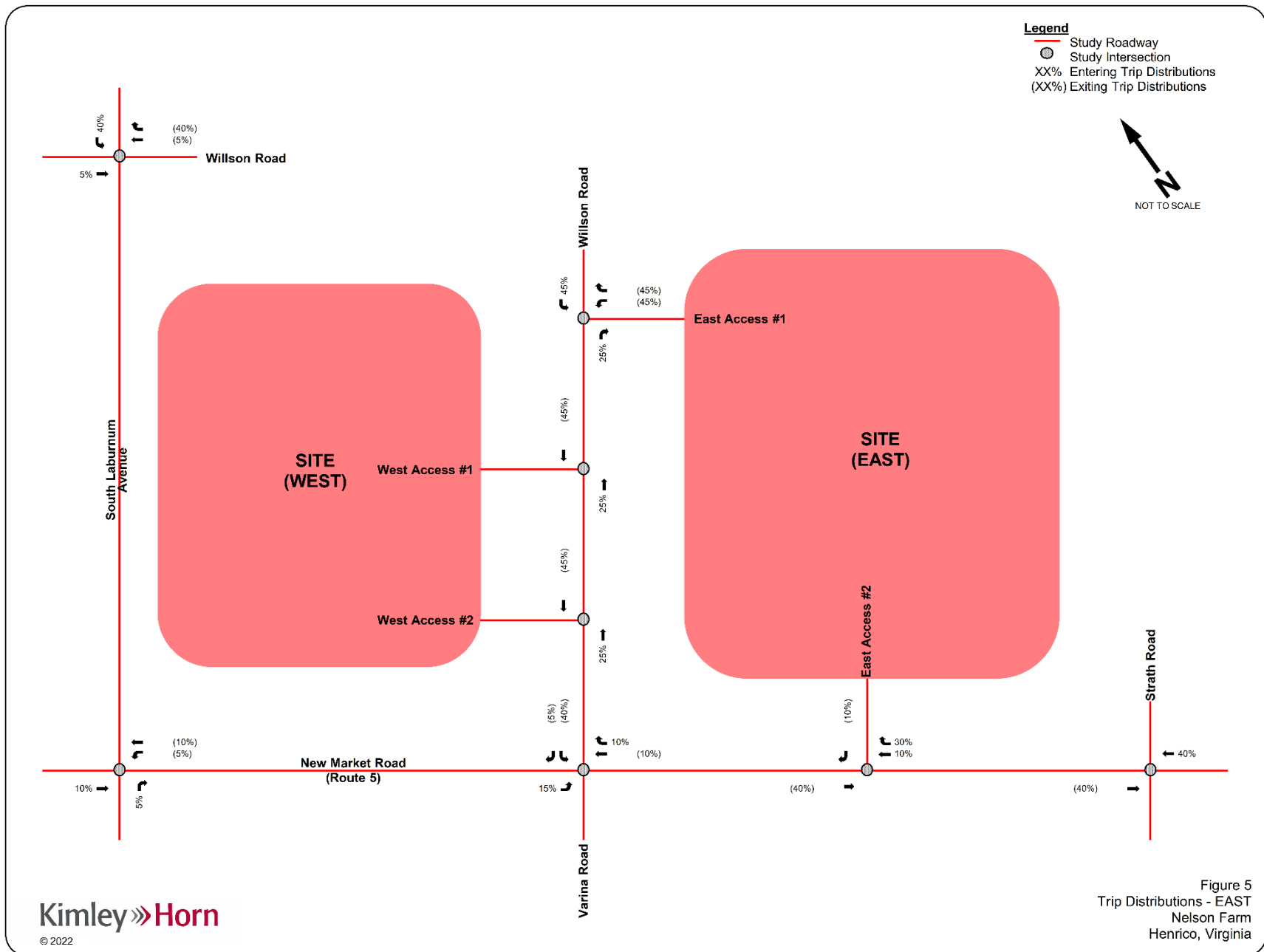


Figure 6: West Site Trip Assignment

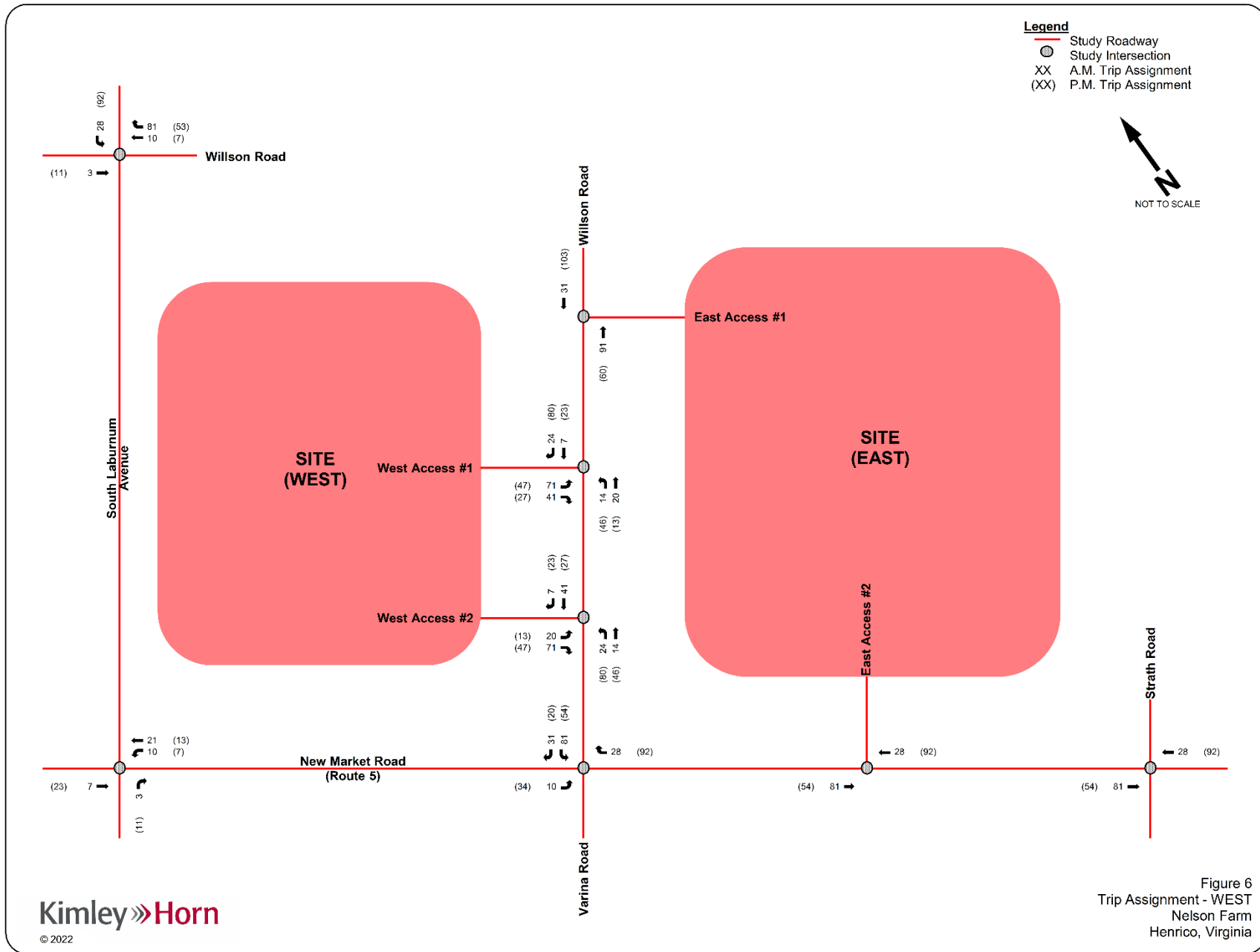


Figure 7: East Site Trip Assignment

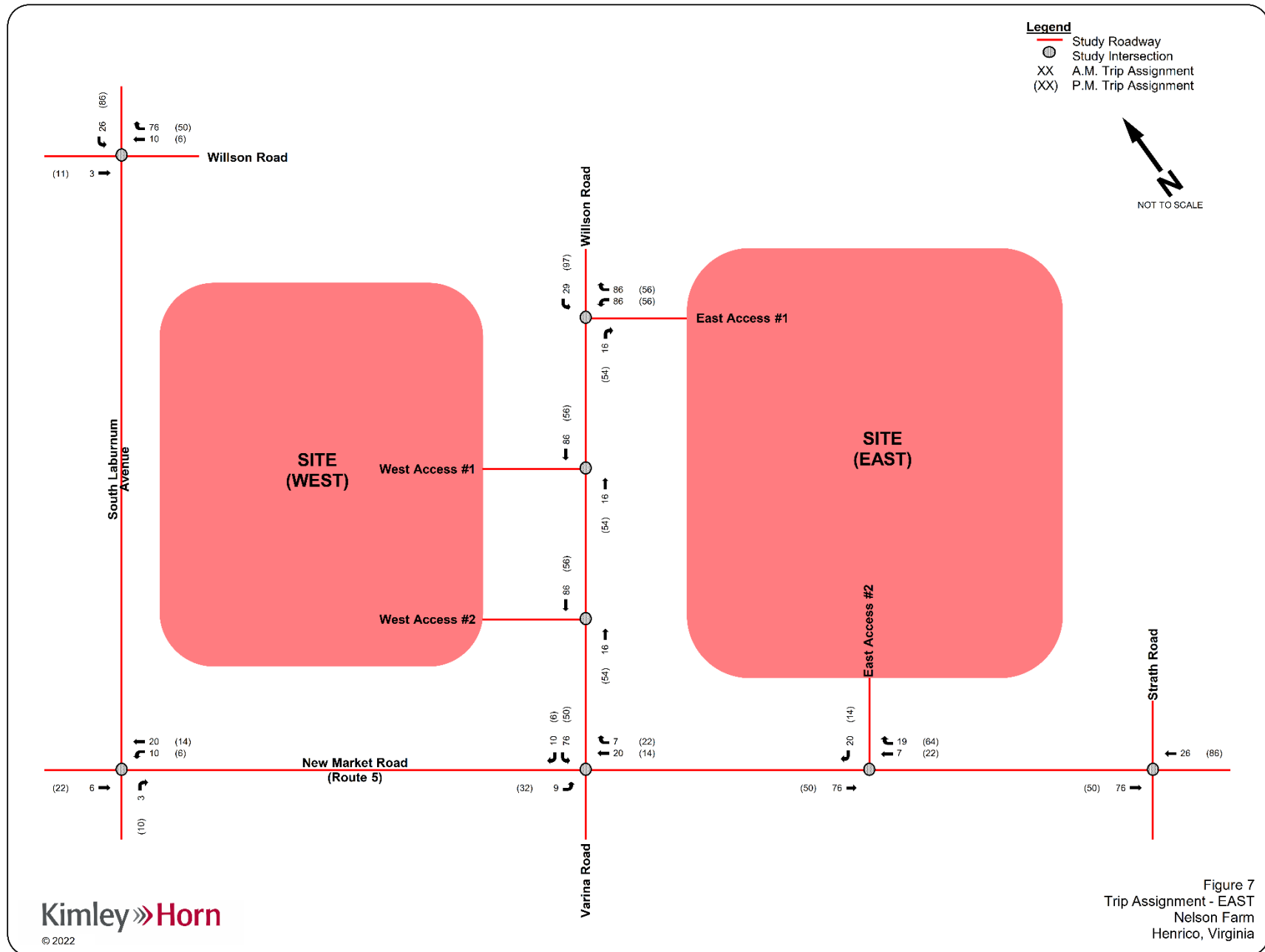
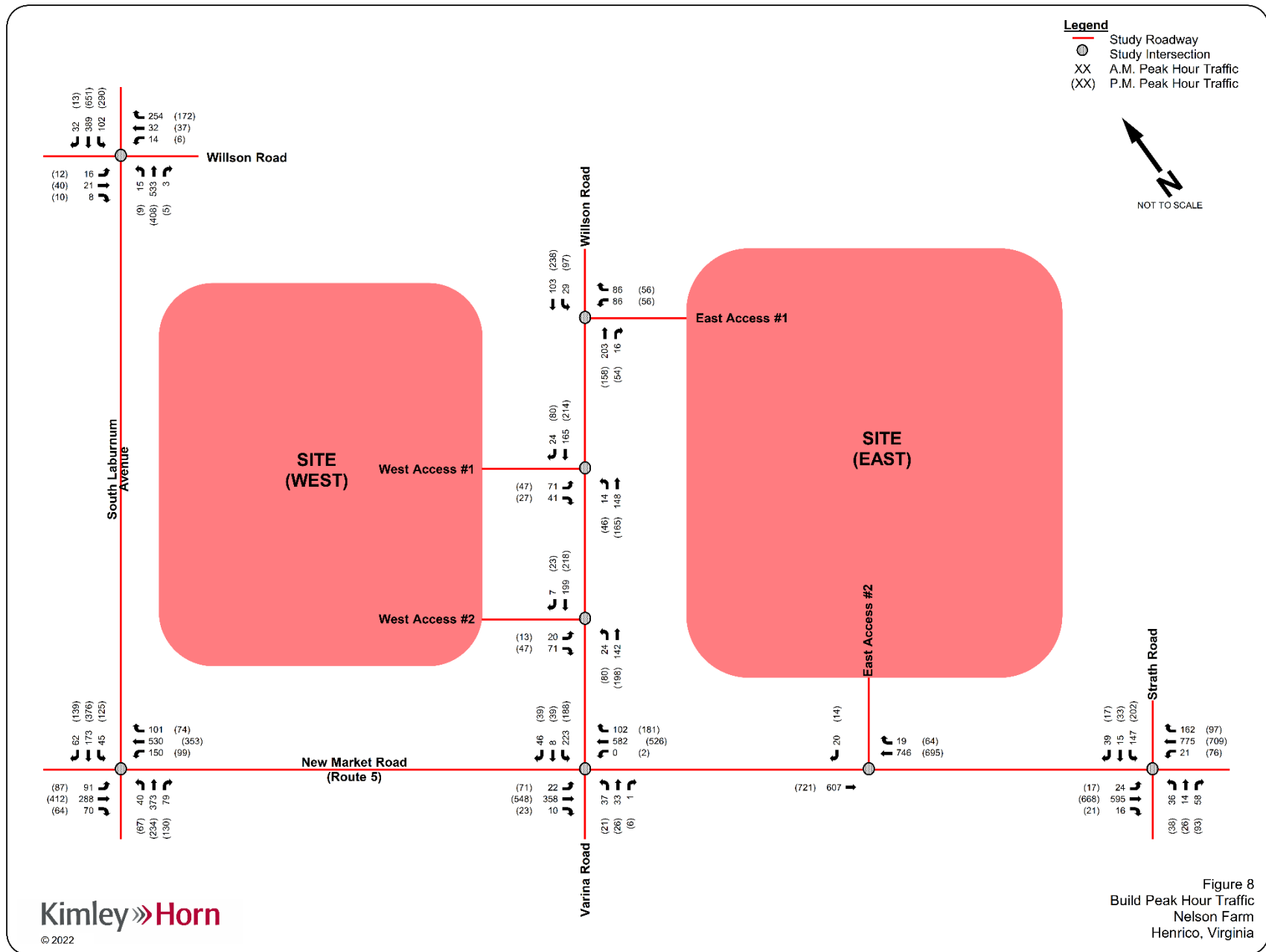


Figure 8: Projected 2036 Build Peak Hour Traffic



6. BUILD WITH MITIGATION

The build with mitigation condition applies the traffic volumes from the build condition but includes recommended roadway improvements developed to mitigate the project's traffic impact.

6.1. RECOMMENDED IMPROVEMENTS

Off-site road improvements were developed to mitigate intersection delays and queues attributable to the addition of project traffic. The following improvements were implemented to mitigate intersection delays and queues at study area intersections:

- Converting the intersection of South Laburnum Avenue and Willson Road from unsignalized to signalized
- Adding a dedicated 150 foot southbound right-turn lane along Willson Road at its intersection with New Market Road (Route 5)
- Traffic signal optimization at all signalized intersections

6.2. 2036 BUILD CONDITIONS WITH MITIGATION CAPACITY ANALYSIS

During the AM peak hour, based on the mitigation improvements proposed, all signalized intersections operate at overall LOS D or better. Furthermore, all study intersection approaches and/or movements are expected to also operate at LOS D or better.

During the PM peak hour, based on the mitigation improvements proposed, all signalized intersections operate at overall LOS D or better. Furthermore, all study intersection approaches and/or movements are expected to also operate at LOS D or better.

All proposed stop-controlled project driveways contain movements that operate at LOS C or better during the AM and PM peak hours. Results are summarized in **Table 4** and complete results included in **Appendix C**.

6.3. 2036 BUILD CONDITIONS WITH MITIGATION 95TH PERCENTILE QUEUEING ANALYSIS

The build (2036) with mitigation 95th percentile vehicle queue lengths were calculated by movement for each study intersection using *Synchro11TM*. Queues did not exceed capacity for any of the intersections during both AM and PM peak hours. The results are summarized in **Table 5** following the analysis sections. The queueing analysis results are included in **Appendix C**.

The analysis does not predict any queueing challenges at the site access entrances. The results are summarized in **Table 5** following the analysis sections. The queueing analysis complete results are included in **Appendix C**.

Table 4: LOS and Delay Summary

Intersection	Approach	Movement	2022 Existing				2036 No-Build				2036 Build				2036 Build with Mitigation			
			AM		PM		AM		PM		AM		PM		AM		PM	
			Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
1. New Market Rd (Route 5) & Willson/Varina Rd (Signalized)	Eastbound	L	42.7	D	42.0	D	12.4	B	13.8	B	15.3	B	15.5	B	19.9	B	18.2	B
		T	11.6	B	21.2	C	10.3	B	25.1	C	12.1	B	23.4	C	16.1	B	27.9	C
		R	9.2	A	14.7	B	7.7	A	13.6	B	9.0	A	13.7	B	12.0	B	15.8	B
		Approach	11.8	B	21.1	C	10.2	B	24.5	C	12.2	B	22.2	C	16.2	B	26.4	C
	Westbound	L	N/A	N/A	40.0	D	N/A	N/A	14.6	B	N/A	N/A	14.8	B	N/A	N/A	17.2	B
		T	19.7	B	21.5	C	21.5	C	22.7	C	30.8	C	27.7	C	44.5	D	33.6	C
		R	13.5	B	14.5	B	11.7	B	13.5	B	14.1	B	16.7	B	17.8	B	18.9	B
		Approach	18.9	B	20.7	C	20.5	C	21.6	C	28.4	C	24.9	C	40.5	D	29.8	C
	Northbound	LT	35.5	D	38.7	D	50.1	D	51.6	D	50.7	D	51.4	D	54.2	D	45.8	D
		R	32.4	C	35.0	C	34.8	C	36.8	D	35.3	D	41.6	D	39.9	D	42.0	D
		Approach	35.5	D	38.3	D	49.9	D	49.8	D	50.5	D	50.2	D	54.1	D	45.4	D
	Southbound	LT	35.8	D	32.3	C	50.5	D	36.9	D	337.9	F	135.0	F	53.2	D	53.9	D
		R	35.8	D	32.3	C	50.5	D	36.9	D	337.9	F	135.0	F	30.5	C	32.8	C
		Approach	35.8	D	32.3	C	50.5	D	36.9	D	337.9	F	135.0	F	49.4	D	50.8	D
	Overall Intersection		18.9	B	22.9	C	21.1	C	25.5	C	85.4	F	42.0	D	36.3	D	32.3	C
2. South Laburnum Ave & Willson Rd (Unsignalized to Signalized)	Eastbound	LTR	18.9	C	21.7	C	29.3	D	37.3	E	64.3	F	295.5	F	23.8	C	22.2	C
		Approach	18.9	C	21.7	C	29.3	D	37.3	E	64.3	F	295.5	F	23.8	C	22.2	C
	Westbound	LTR	13.0	B	15.0	C	17.8	C	21.7	C	43.6	E	107.7	F	26.9	C	23.3	C
		Approach	13.0	B	15.0	C	17.8	C	21.7	C	43.6	E	107.7	F	26.9	C	23.3	C
	Northbound	L	0.0	A	0.0	A	0.0	A	0.0	A	0.0	A	0.0	A	13.8	B	14.6	B
		TR	0.0	A	0.0	A	0.0	A	0.0	A	0.0	A	0.0	A	20.7	C	19.8	B
		Approach	0.0	A	0.0	A	0.0	A	0.0	A	0.0	A	0.0	A	20.5	C	19.7	B
	Southbound	L	0.0	A	0.0	A	0.0	A	0.0	A	0.0	A	0.0	A	15.5	B	26.2	C
		TR	0.0	A	0.0	A	0.0	A	0.0	A	0.0	A	0.0	A	17.7	B	22.1	C
		Approach	0.0	A	0.0	A	0.0	A	0.0	A	0.0	A	0.0	A	17.3	B	23.4	C
	Overall Intersection		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	20.8	C	22.4	C

Intersection	Approach	Movement	2022 Existing				2036 No-Build				2036 Build				2036 Build with Mitigation			
			AM		PM		AM		PM		AM		PM		AM		PM	
			Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
3. New Market Rd (Route 5) & South Laburnum Ave (Signalized)	Eastbound	L	47.7	D	42.6	D	15.8	B	16.3	B	16.4	B	15.9	B	16.4	B	15.9	B
		T	23.8	C	27.4	C	21.2	C	25.4	C	21.3	C	25.8	C	21.3	C	25.8	C
		R	19.4	B	20.0	C	16.8	B	17.7	B	16.8	B	17.1	B	16.8	B	17.1	B
		Approach	27.8	C	29.0	C	19.4	B	22.9	C	19.6	B	23.3	C	19.6	B	23.3	C
	Westbound	L	46.3	D	42.0	D	14.4	B	15.9	B	14.6	B	15.9	B	14.6	B	15.9	B
		T	27.2	C	27.2	C	26.7	C	25.0	C	28.3	C	24.5	C	28.3	C	24.5	C
		R	17.6	B	20.6	C	16.5	B	18.2	B	16.4	B	17.7	B	16.4	B	17.7	B
		Approach	30.9	C	29.3	C	23.0	C	22.4	C	24.1	C	22.2	C	24.1	C	22.2	C
	Northbound	L	46.9	D	39.7	D	30.4	C	25.9	C	30.9	C	27.3	C	30.9	C	27.3	C
		TR	37.1	D	29.9	C	52.1	D	33.8	C	53.7	D	35.9	D	53.7	D	35.9	D
		Approach	38.1	D	31.6	C	50.4	D	32.5	C	51.8	D	34.5	C	51.8	D	34.5	C
	Southbound	L	60.8	E	41.8	D	32.9	C	27.9	C	33.7	C	30.9	C	33.7	C	30.9	C
		T	35.3	D	32.4	C	33.9	C	34.2	C	34.4	C	36.4	D	34.4	C	36.4	D
		R	33.6	C	29.8	C	31.8	C	27.7	C	32.3	C	29.0	C	32.3	C	29.0	C
		Approach	37.4	D	32.4	C	33.3	C	31.6	C	33.8	C	33.7	C	33.8	C	33.7	C
	Overall Intersection		32.7	C	30.5	C	30.6	C	27.4	C	31.3	C	28.3	C	31.3	C	28.3	C
4. Willson Rd & West Site Access #1 (Unsignalized)	Eastbound	L	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	11.3	B	12.2	B	11.3	B	12.2	B
		R	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Approach	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	11.3	B	12.2	B	11.3	B	12.2	B
	Northbound	L	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.0	A	0.0	A	0.0	A	0.0	A
		T	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.0	A	0.0	A	0.0	A	0.0	A
	Southbound	T	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.0	A	0.0	A	0.0	A	0.0	A
		R	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.0	A	0.0	A	0.0	A	0.0	A
		Approach	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.0	A	0.0	A	0.0	A	0.0	A
	Overall Intersection		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5. Willson Rd & West Site Access #2 (Unsignalized)	Eastbound	L	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	10.5	B	11.0	B	10.5	B	11.0	B
		R	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Approach	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	10.5	B	11.0	B	10.5	B	11.0	B
	Northbound	L	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.0	A	0.0	A	0.0	A	0.0	A
		T	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.0	A	0.0	A	0.0	A	0.0	A
	Southbound	T	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.0	A	0.0	A	0.0	A	0.0	A
		R	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.0	A	0.0	A	0.0	A	0.0	A
		Approach	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.0	A	0.0	A	0.0	A	0.0	A
	Overall Intersection		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Intersection	Approach	Movement	2022 Existing				2036 No-Build				2036 Build				2036 Build with Mitigation				
			AM		PM		AM		PM		AM		PM		AM		PM		
			Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	
6. Willson Rd & East Site Access #1 (Unsignalized)	Westbound	L	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	12.2	B	13.4	B	12.2	B	13.4	B	
		R	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	12.2	B	13.4	B	12.2	B	13.4	B
		Approach	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	12.2	B	13.4	B	12.2	B	13.4	B
	Northbound	T	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.0	A	0.0	A	0.0	A	0.0	A	
		R	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.0	A	0.0	A	0.0	A	0.0	A	
		Approach	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.0	A	0.0	A	0.0	A	0.0	A
	Southbound	L	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.0	A	0.0	A	0.0	A	0.0	A	
		T	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.0	A	0.0	A	0.0	A	0.0	A	
Approach		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.0	A	0.0	A	0.0	A	0.0	A	
Overall Intersection			N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
7. New Market Rd (Route 5) & East Site Access #2 (Unsignalized)	Eastbound	T	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.0	A	0.0	A	0.0	A	0.0	A	
		Approach	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.0	A	0.0	A	0.0	A	0.0	A
	Westbound	T	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.0	A	0.0	A	0.0	A	0.0	A	
		R	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.0	A	0.0	A	0.0	A	0.0	A	
		Approach	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.0	A	0.0	A	0.0	A	0.0	A	
	Southbound	R	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	15.1	C	14.1	B	15.1	C	14.1	B	
		Approach	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	15.1	C	14.1	B	15.1	C	14.1	B	
Overall Intersection			N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
8. New Market Rd (Route 5) & Strath Rd (Signalized)	Eastbound	L	53.4	D	51.7	D	17.1	B	13.0	B	19.0	B	15.7	B	19.0	B	15.7	B	
		T	24.2	C	31.0	C	17.8	B	26.4	C	23.3	C	30.6	C	23.3	C	30.6	C	
		R	16.6	B	20.7	C	11.3	B	14.4	B	10.7	B	13.8	B	10.7	B	13.8	B	
		Approach	25.5	C	31.3	C	17.6	B	25.6	C	22.9	C	29.8	C	22.9	C	29.8	C	
	Westbound	L	52.9	D	48.5	D	11.0	B	14.7	B	12.6	B	16.6	B	12.6	B	16.6	B	
		T	38.6	D	26.5	C	41.3	D	21.2	C	51.3	D	29.2	C	51.3	D	29.2	C	
		R	17.5	B	18.1	B	12.2	B	13.1	B	12.1	B	12.5	B	12.1	B	12.5	B	
		Approach	34.8	C	27.8	C	35.4	D	19.4	B	43.9	D	26.3	C	43.9	D	26.3	C	
	Northbound	LT	45.6	D	47.0	D	27.8	C	25.0	C	29.8	C	27.9	C	29.8	C	27.9	C	
		R	42.5	D	43.5	D	26.5	C	24.0	C	28.4	C	26.8	C	28.4	C	26.8	C	
		Approach	43.9	D	44.9	D	27.1	C	24.4	C	29.0	C	27.2	C	29.0	C	27.2	C	
	Southbound	LTR	47.4	D	44.5	D	48.2	D	44.6	D	54.7	D	53.8	D	54.7	D	53.8	D	
		Approach	47.4	D	44.5	D	48.2	D	44.6	D	54.7	D	53.8	D	54.7	D	53.8	D	
	Overall Intersection			34.3	C	33.2	C	31.3	C	25.7	C	37.1	D	31.0	C	37.1	D	31.0	C

¹ Delay is in seconds.

² Delay and level of service assumed at 0.0 or A for movements with no conflicting volumes.

Table 5: 95th Queue Summary

Intersection	Approach	Movement	Effective Storage	2022 Existing		2036 No-Build		2036 Build		2036 Build with Mitigation	
				AM	PM	AM	PM	AM	PM	AM	PM
1. New Market Rd (Route 5) & Willson/Varina Rd (Signalized)	Eastbound	L	240	<25	<25	<25	<25	<25	44	<25	50
		T	N/A	180	346	172	451	172	467	235	#572
		R	415	<25	<25	<25	<25	<25	<25	<25	<25
	Westbound	L	263	N/A	<25	N/A	<25	N/A	<25	N/A	<25
		T	N/A	355	367	445	409	469	450	#651	551
		R	340	<25	<25	<25	<25	<25	28	<25	31
	Northbound	LT	N/A	82	63	#112	70	#112	68	#100	68
		R	236	<25	<25	<25	<25	<25	<25	<25	<25
	Southbound	LT	N/A	88	135	#122	#172	#476	#405	#281	#272
		R	150	N/A	N/A	N/A	N/A	N/A	N/A	<25	<25
2. South Laburnum Ave & Willson Rd (Unsignalized to Signalized)	Eastbound	LTR	N/A	<25	<25	<25	25	50	138	44	52
	Westbound	LTR	N/A	<25	<25	35	35	188	230	99	70
	Northbound	L	140	<25	<25	<25	<25	<25	<25	<25	<25
		TR	N/A	N/A	N/A	N/A	N/A	N/A	N/A	185	128
	Southbound	L	162	<25	<25	<25	<25	<25	28	64	159
		TR	N/A	N/A	N/A	N/A	N/A	N/A	N/A	142	213
3. New Market Rd (Route 5) & South Laburnum Ave (Signalized)	Eastbound	L	270	105	101	50	43	52	42	52	42
		T	N/A	201	272	185	226	199	259	199	259
		R	254	<25	<25	<25	<25	<25	<25	<25	<25
	Westbound	L	390	#180	102	68	42	79	46	79	46
		T	N/A	382	243	365	202	415	221	415	221
		R	395	<25	<25	<25	<25	<25	<25	<25	<25
	Northbound	L	271	60	83	48	66	47	71	47	71
		T	N/A	160	114	#265	#171	#257	#186	#257	#186
		R	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Southbound	L	219	42	57	53	#114	53	#134	53	#134
		T	N/A	78	133	91	#225	90	#241	90	#241
		R	170	<25	<25	<25	<25	<25	<25	<25	<25

Intersection	Approach	Movement	Effective Storage	2022 Existing		2036 No-Build		2036 Build		2036 Build with Mitigation	
				AM	PM	AM	PM	AM	PM	AM	PM
4. Willson Rd & West Site Access #1 (Unsignalized)	Eastbound	L	N/A	N/A	N/A	N/A	N/A	<25	<25	<25	<25
		R	N/A	N/A	N/A	N/A	N/A	<25	<25	<25	<25
	Northbound	L	N/A	N/A	N/A	N/A	N/A	<25	<25	<25	<25
		T	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Southbound	T	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		R	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5. Willson Rd & West Site Access #2 (Unsignalized)	Eastbound	L	N/A	N/A	N/A	N/A	N/A	<25	<25	<25	<25
		R	N/A	N/A	N/A	N/A	N/A	<25	<25	<25	<25
	Northbound	L	N/A	N/A	N/A	N/A	N/A	<25	<25	<25	<25
		T	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Southbound	T	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		R	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6. Willson Rd & East Site Access #1 (Unsignalized)	Westbound	L	N/A	N/A	N/A	N/A	N/A	28	<25	28	<25
		R	N/A	N/A	N/A	N/A	N/A	28	<25	28	<25
	Northbound	T	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		R	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Southbound	L	N/A	N/A	N/A	N/A	N/A	<25	<25	<25	<25
		T	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7. New Market Rd (Route 5) & East Site Access #2 (Unsignalized)	Eastbound	T	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Westbound	T	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		R	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Southbound	R	N/A	N/A	N/A	N/A	N/A	<25	<25	<25	<25
8. New Market Rd (Route 5) & Strath Rd (Signalized)	Eastbound	L	171	42	35	<25	<25	<25	<25	<25	<25
		T		354	418	350	469	#585	#696	#585	#696
		R	345	<25	<25	<25	<25	<25	<25	<25	<25
	Westbound	L	190	38	98	<25	45	<25	48	<25	48
		T		#669	416	#773	429	#841	#758	#841	#758
		R	260	27	<25	45	<25	46	<25	46	<25
	Northbound	LT		70	86	58	69	58	66	58	66
		R	35	<25	<25	<25	32	<25	30	<25	30
	Southbound	LTR		201	#286	198	#273	200	241	200	241

¹ # Queue is in feet.

² # 95th percentile volume exceeds capacity, queue may be longer.

7. SUPPORTING DOCUMENTATION

7.1. ACCESS MANAGEMENT

The proposed project driveway meets access management spacing requirements outlined in the *Henrico County Public Works Design Manual*. In accordance with specifications, the minimum spacing between intersecting residential and minor collector roads shall not be less than 150 feet and for major collectors and arterials shall not be less than 250 feet. Based on this criteria, all proposed access locations meet the Henrico County's spacing requirements.

7.2. RIGHT/LEFT TURN WARRANTS

Dedicated right and left-turn lanes are proposed at the project driveways along Willson Road. A right-turn lane warrant analysis was prepared for the proposed project driveway along New Market Road (Route 5) using turn lane warrant standards outlined in the *VDOT Road Design Manual*. The analysis determined that a westbound right-turn lane with taper is warranted at this location. Note that no left-turn lane analyses were conducted for the New Market Road (Route 5) driveway as it will operate as a right-in/right-out only driveway. Right-turn warrant analysis worksheets are included in **Appendix D**.

7.3. TRAFFIC SIGNAL WARRANT

Converting the unsignalized intersection of South Laburnum Avenue and Willson Road to a signalized intersection is proposed to mitigate LOS and delay for future 2036 build volumes. Using the *ITE Trip Generation Manual*, hourly trip distributions for single-family detached housing (ITE 210) and multifamily housing (ITE 220) were developed for a 14-hour period. Future 2036 build volumes were adjusted to these hourly distribution percentages and scaled down based on trip distributions found in **Figure 4** and **Figure 5** for the identified intersection. South Laburnum Avenue is the major road and Willson Road is the minor road for this intersection.

The 14-hour total future traffic volumes, including the future volumes from the proposed development, are summarized in **Table 6**.

Table 6: Total Future Traffic Volumes

Hour Start Time	Total Future (Weekday)	
	Major Street	Minor Street
6:00 AM	509	207
7:00 AM	805	340
8:00 AM	1,019	287
9:00 AM	631	186
10:00 AM	557	190
11:00 AM	674	189
12:00 PM	681	172
1:00 PM	722	222
2:00 PM	922	244
3:00 PM	1,089	230
4:00 PM	1,207	273
5:00 PM	1,175	284
6:00 PM	946	221
7:00 PM	577	140

The traffic signal warrant analysis was performed in accordance with the MUTCD, which outlines nine warrants. These warrants are summarized below:

- Warrant 1 – Eight-Hour Vehicular Volume
 - Condition A – Minimum Vehicular Volume
 - Condition B – Interruption of Continuous Traffic
 - Condition C – Combination of Warrants
- Warrant 2 – Four-Hour Vehicular Volume
- Warrant 3 – Peak Hour
 - Condition A – Peak Hour Delay
 - Condition B – Peak Hour Volume
- Warrant 4 – Pedestrian Volume
 - Condition A – Peak Hour Volume
 - Condition B – Four-Hour Volume
- Warrant 5 – School Crossing
- Warrant 6 – Coordinated Signal System
- Warrant 7 – Crash Experience
- Warrant 8 – Roadway Network
- Warrant 9 – Intersection Near a Grade (Railroad) Crossing

One or more of the nine warrants must be satisfied before a traffic signal is considered for installation. However, satisfaction of a warrant does not in itself justify the need for a new signal. A new signal should improve the overall safety and/or operation of the intersection.

MUTCD Warrants 1 (eight-hour vehicular volume), 2 (four-hour vehicular volumes) and 3 (peak hour) were evaluated for this project. Warrants 4 through 9 are either not applicable, do not meet the threshold for consideration, or data were not obtained to perform the analysis. A summary of reasoning for not analyzing these warrants is included below:

- Warrant 4: Pedestrian volumes are low in this area and at the study intersection. The traffic volume on the major street does not cause excessive delay for pedestrians crossing the street.
- Warrant 5: The study intersection is not in close proximity to any schools. No school children will be crossing the major road.
- Warrant 6: A traffic signal is not needed to maintain proper platooning of vehicles at this study intersection.
- Warrant 7: The severity and frequency of crashes at this intersection do not call for a new traffic signal. Crash experience is not the principal reason to consider installing a traffic control signal at this intersection.
- Warrant 8: The study intersection includes one major and one minor road. This warrant is to be used for intersections of two or more major routes.
- Warrant 9: This study intersection is not in close proximity to a grade crossing on an intersection approach controlled by a stop or yield sign. This warrant is intended for use at a location where none of the conditions described in the other eight traffic signal warrants are met, however that is not the case for this study intersection.

A summary of Warrants satisfied is included in **Table 7**:

Table 7: MUTCD Signal Warrant Analysis Summary

MUTCD Signal Warrants	Warrant Satisfied?	Notes
Warrant 1: Eight-Hour Vehicular Volume	Yes	11 of the 8 hours needed were met.
Warrant 2: Four-Hour Vehicular Volume	Yes	7 of the 4 hours needed were met.
Warrant 3: Peak Hour ¹	Yes	3 of the 1 hours needed were met.
Warrant 4: Pedestrian Volume	N/A	Not evaluated.
Warrant 5: School Crossing	N/A	Not evaluated.
Warrant 6: Coordinated Signal System	N/A	Not evaluated.
Warrant 7: Crash Experience ²	N/A	Not evaluated.
Warrant 8: Roadway Network	N/A	Not evaluated.
Warrant 9: Intersection Near a Grade Crossing	N/A	Not evaluated.

¹ As per MUTCD Section 4C.04, Warrant 3 shall only be applied in unusual cases, such as facilities that attract or discharge large numbers of vehicles over a short period of time.

² The Alternative Signal Warrant 7 Crash Experience documented in FHWA Interim Approval #19 (IA-19) shall be used as per the Virginia Supplement to the MUTCD and the latest edition of IIM-TE-387. The most recent available three years of available crash data shall be used.

8. CONCLUSION AND RECOMMENDATIONS

The Traffic Impact Analysis (TIA) documented in this report evaluates the traffic impacts of the proposed residential development on the surrounding roadway network. The proposed development is located along the east and west sides of Willson Road generally between Towhee Lane and Willson Cove Court in Henrico County, Virginia. The proposed development will consist of approximately 450 single-family homes and 550 multifamily housing units. Vehicle access to the proposed site will be provided via three full-access driveways along Willson Road and one right-in/right-out driveway along New Market Road (Route 5).

Traffic operations were analyzed at the intersections identified below during the AM and PM peak hours using *Synchro 11TM* software for the existing 2022, projected no-build 2036, projected build 2036, and projected build with mitigation 2036 conditions. To project future traffic volumes for future year analyses, a linear growth rate of 1.0% was established through coordination with Henrico County and VDOT staff to account for historic growth trends in the project area. Additionally, traffic volumes from the proposed I-895 Distribution Center and Sauer Development were included in all future conditions analyses. The following intersections were analyzed in this traffic impact analysis:

1. New Market Road (Route 5) at Willson Road/Varina Road
2. South Laburnum Avenue at Willson Road
3. New Market Road (Route 5) at South Laburnum Avenue
4. Willson Road at West Site Access #1
5. Willson Road at West Site Access #2
6. Willson Road at East Site Access #1
7. New Market Road (Route 5) at East Site Access #2
8. New Market Road (Route 5) at Strath Road

Based on the findings of this study, off-site improvements have been identified to mitigate the proposed project traffic impacts at existing and proposed study intersections. All approaches and movements will operate at LOS D or better as a result of implementing the proposed improvements. Furthermore, the 95th percentile vehicle queues at all study intersections are anticipated to be contained within the existing turn-lane lengths under all analysis conditions.

The proposed off-site improvements are summarized below:

- Converting the intersection of South Laburnum Avenue and Willson Road from unsignalized to signalized
- Install a 100' foot southbound right-turn lane with 100' taper along Willson Road at its intersection with New Market Road (Route 5)
- Traffic signal timing optimization at all signalized intersections
- Dedicated right and left-turn lanes at all three project driveways along Willson Road, and a single dedicated right-turn lane for the project driveway along New Market Road (Route 5)