



TRAFFIC IMPACT ANALYSIS

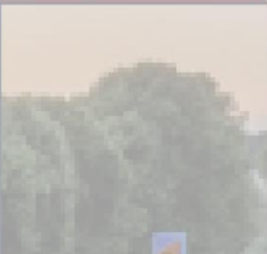
FOR

ZEBULON MIXED-USE

LOCATED
IN
ZEBULON, NC

Prepared For:

WENDELL ESTATES, LLC
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Morrisville, NC 27560



DECEMBER 2024

DRMP Project No. 24572

Prepared By: GB

Reviewed By: CC



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ANALYSIS
FOR
ZEBULON MIXED-USE
LOCATED IN
ZEBULON, NC**



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TRAFFIC IMPACT ANALYSIS ZEBULON MIXED-USE

Zebulon, North Carolina

EXECUTIVE SUMMARY

1. Development Overview

A Traffic Impact Analysis (TIA) was conducted for the proposed Zebulon Mixed-Use development in accordance with the Town of Zebulon Unified Development Ordinance (UDO) and North Carolina Department of Transportation (NCDOT) capacity analysis guidelines. The proposed Zebulon Mixed-Use development to be located east of Zebulon Road and south of Pippin Road in Zebulon, North Carolina. The proposed development, anticipated to be completed in 2028, is assumed to consist of the following land uses: 240 apartments, 26,000 square feet (s.f.) retail, 5,500 s.f. high-turnover restaurant, 600 s.f. coffee shop with drive-through. In accordance with the Town UDO the study will utilize a build+1 for future year traffic conditions. Site access is proposed via one full-movement driveway along Zebulon Road across from Bobbfield Way and one right-in/right-out (RIRO) access along Zebulon Road.

2. Existing Traffic Conditions

The study area for the TIA was determined through coordination with the North Carolina Department of Transportation (NCDOT) and the Zebulon (Town) and consists of the following existing intersections:

- NC 96 and Pippin Road (Signalized)
- NC 96 and Riley Hill Road (Unsignalized)
- NC 96 and Green Pace Road (Signalized)
- NC 96 and Pearces Road (Signalized)

Existing peak hour traffic volumes were determined based on traffic counts conducted at the study intersection listed above, in September of 2024 by DRMP during a typical weekday AM (7:00 AM – 9:00 AM) and PM (4:00 PM – 6:00 PM) peak periods. Traffic volumes were balanced between study intersections, where appropriate.

3. Future Traffic Conditions

Through coordination with the NCDOT and the Town, it was determined that an annual growth rate of 1% would be used to generate 2029 (build+1) projected weekday AM and PM peak hour traffic volumes.

4. Site Trip Generation

Average weekday daily, AM peak hour, and PM peak hour trips for the proposed development were estimated using methodology contained within the ITE Trip Generation Manual, 11.1th Edition. Table E-1 provides a summary of the trip generation potential for the site.

Table E-1: Site Trip Generation

Land Use (ITE Code)	Intensity	Daily Traffic (vpd)	Weekday AM Peak Hour Trips (vph)			Weekday PM Peak Hour Trips (vph)		
			Enter	Exit	Total	Enter	Exit	Total
Apartments (220)	240 Units	1,614	23	74	97	78	46	124
Strip Retail (822)	26,000 s.f.	1,416	37	24	61	86	85	171
High-Turnover Restaurant (932)	5,500 s.f.	590	29	24	53	31	19	50
Coffee Shop with Drive- Through (937)	600 s.f.	320	27	25	52	12	11	23
Total Trips		3,940	116	147	263	207	161	368
<i>Internal Capture* (15% AM, 16% PM)</i>			-17	-23	-40	-34	-25	-59
External Trips			99	124	223	173	136	309
<i>Pass-By Trips (Shopping Center: 29% PM)</i>			-	-	-	-21	-21	-42
<i>Pass-By Trips (High-Turnover Restaurant: 43% PM)</i>			-	-	-	-9	-9	-18
<i>Pass-By Trips (Coffee Shop with Drive-Through: 90% AM, 98% PM)</i>			-20	-20	-40	-9	-9	-18
Primary Trips			79	104	183	134	97	231

To estimate traffic conditions with the site fully built-out, the total site trips were added to the 2029 no-build traffic volumes to determine the 2029 build traffic volumes. The study analyzes traffic conditions during the weekday AM and PM peak hours for the following scenarios:

- 2024 Existing Traffic Conditions
- 2029 No-Build Traffic Conditions
- 2029 Build Traffic Conditions

5. Capacity Analysis Summary

The analysis considered weekday AM and PM peak hour traffic for 2024 existing, 2029 no-build, and 2029 build conditions. Refer to Section 7 of the TIA for the capacity analysis summary performed at each study intersection.

6. Recommendations

Based on the findings of this study, specific geometric and traffic control improvements have been identified at study intersections. The improvements are summarized below and are illustrated in Figure E-1.

Future Traffic Improvements

NC 96 & Pearces Road

- Construct an additional southbound through lane.
- Restripe the existing westbound right-turn lane to a shared left-right turn lane.
- Signal timing modifications.

Recommended Improvements by Developer

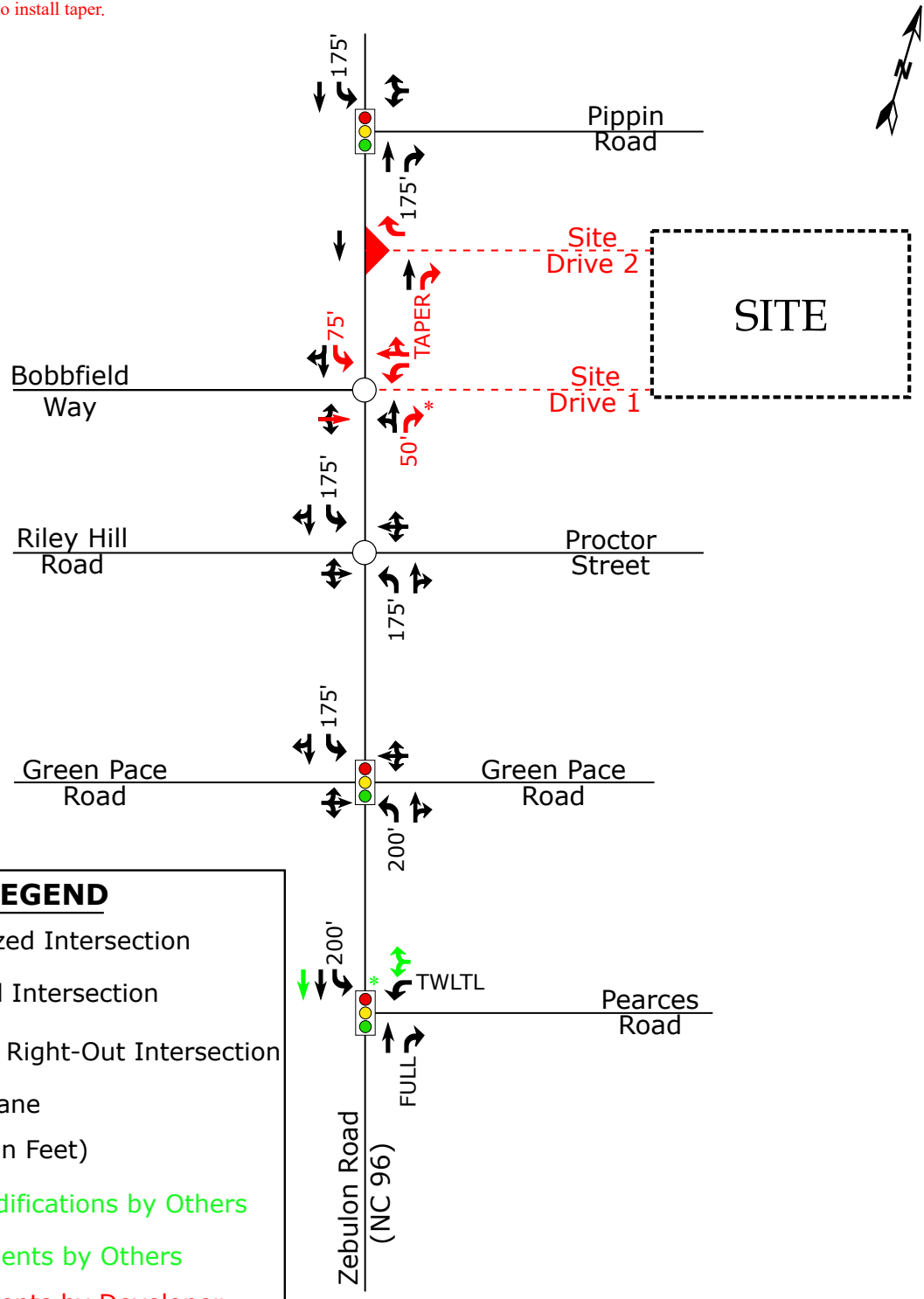
NC 96 & Bobbfield Way/Access 1

- Construct the westbound approach with at least one ingress lane and two egress lanes striped as a left-turn lane and a shared through-right turn lane.
- Provide stop control for the westbound approach.
- Construct a northbound right-turn lane with at least 50 feet of storage and appropriate taper, it should be noted that right-of-way might be limited. If so a taper is recommended.
- Construct a southbound left-turn lane with at least 75 feet of storage and appropriate taper.

NC 96 & Access 2

- Construct the westbound approach with at least one ingress lane and one egress lane striped as a right-out.
- Provide stop control for the westbound approach.
- Construct a northbound right-turn taper.

*Potential ROW impacts. If so install taper.



LEGEND

- Unsignalized Intersection
- 🚦 Signalized Intersection
- ▲ Right-In / Right-Out Intersection
- ➡ Existing Lane
- X' Storage (In Feet)
- * Signal Modifications by Others
- ➡ Improvements by Others
- ➡ Improvements by Developer



Zebulon Road Mixed-Use
Zebulon, NC

Recommended Lane
Configurations

Scale: Not to Scale Figure E-1

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Appendix A:	Scoping Documentation
Appendix B:	Traffic Counts
Appendix C:	Signal Plans
Appendix D:	Capacity Calculations – NC 96 & Pippin Road
Appendix E:	Capacity Calculations – NC 96 & Riley Hill Road
Appendix F:	Capacity Calculations – NC 96 & Green Pace Road
Appendix G:	Capacity Calculations – NC 96 & Pearces Road
Appendix H:	Capacity Calculations – NC 96 & Access 1
Appendix I:	Capacity Calculations – NC 96 & Access 2
Appendix J:	Sim Traffic Queueing Analysis

TRAFFIC IMPACT ANALYSIS

ZEBULON MIXED-USE Zebulon, North Carolina

1. INTRODUCTION

The contents of this report present the findings of the Traffic Impact Analysis (TIA) conducted for the proposed Zebulon Mixed-Use development to be located east of Zebulon Road and south of Pippin Road in Zebulon, North Carolina. The purpose of this study is to determine the potential impacts to the surrounding transportation system created by traffic generated by the proposed development, as well as recommend improvements to mitigate the impacts.

The proposed development, anticipated to be completed in 2028, is assumed to consist of the following uses:

- 240 apartments
- 26,000 square feet (s.f.) retail
- 5,500 s.f. high-turnover restaurant
- 600 s.f. coffee shop with drive-through

In accordance with the Town UDO the future scenarios will be studied with a build+1. The study analyzes traffic conditions during the weekday AM and PM peak hours for the following scenarios:

- 2024 Existing Traffic Conditions
- 2029 No-Build Traffic Conditions
- 2029 Build Traffic Conditions

1.1. Site Location and Study Area

The development is proposed to be located east of Zebulon Road and south of Pippin Road in Zebulon, North Carolina. Refer to Figure 1 for the site location map.

The study area for the TIA was determined through coordination with the North Carolina Department of Transportation (NCDOT) and the Zebulon (Town) and consists of the following existing intersections:

- NC 96 and Pippin Road (Signalized)
- NC 96 and Riley Hill Road (Unsignalized)
- NC 96 and Green Pace Road (Unsignalized)
- NC 96 and Pearces Road (Signalized)

1.2. Proposed Land Use and Site Access

The proposed development, anticipated to be completed in 2028, is assumed to consist of the following uses:

- 240 apartments
- 26,000 square feet (s.f.) retail
- 5,500 s.f. high-turnover restaurant
- 600 s.f. coffee shop with drive-through

Site access is proposed via one full-movement driveway along Zebulon Road across from Bobbfield Way and one right-in/right-out (RIRO) access along Zebulon Road. Refer to Figure 2 for a copy of the preliminary site plan.

1.3. Adjacent Land Uses

The proposed development is located in an area consisting of undeveloped land, commercial development and residential development.

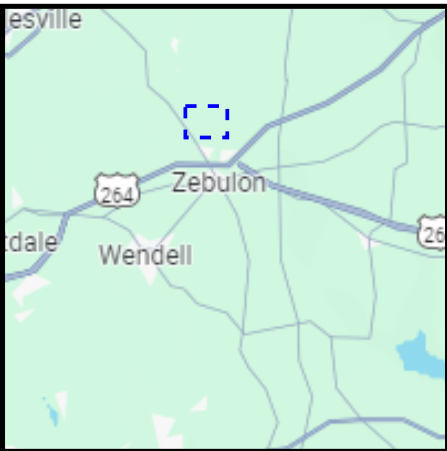
1.4. Existing Roadways

Existing lane configurations (number of traffic lanes on each intersection approach), speed limits, storage capacities, and other intersection and roadway information within the study area are shown in Figure 3. Table 1 provides a summary of this information, as well.

Table 1: Existing Roadway Inventory

Road Name	Route Number	Typical Cross Section	Speed Limit	2023 AADT (vpd)
Zebulon Road	NC 96	2-lane undivided	45 mph	11,000
Pippin Road	CR 2337	2-lane undivided	35 mph	3,100*
Riley Hill Road/Proctor Street	CR 2320	2-lane undivided	45 mph/35 mph	2,400
Pearces Road	N/A	2-lane undivided	35 mph	7,600*
Green Pace Road	CR 2368	2-lane undivided	Not Posted	3,800

*ADT based on the traffic counts from 2024 and assuming the weekday PM peak hour volume is 10% of the average daily traffic.



LEGEND

- Study Intersection
- ▭ Study Area
- Proposed Site Drive



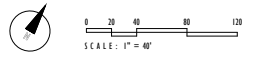
Zebulon Road Mixed-Use
Zebulon, NC

Site Location Map

Scale: Not to Scale | Figure 1



PROJECT DATA TABLE							11.7.2024
Site Area						14,546 Ac	
OUTPARCEL RETAIL							
Lot	Lot Area	Bldg SF	Max. Scats	#'kg Provided	Drive-Thru		
OP-1	39,418 sf	3,230 sf	144	36	Dual / 283 SF		
OP-2	30,519 sf	2,146 sf	88	22	Dual / 248 SF		
OP-3	14,522 sf	576 sf	0	6	Single / 157 SF		
MIXED - USE RETAIL							
Bldg	Stories	Floorplate	Leasable SF	#'kg Required	#'kg Provided		
MU-1	1	10,656 sf	9,482 sf	37	37		
MU-2	1	10,656 sf	9,482 sf	37	37		
MIXED - USE APARTMENTS							
Bldg	Stories	1 BR	2 BR	3 BR	Total Units		
MU-1	3	24	0	0	30		
MU-2	3	24	0	0	30		
APARTMENTS							
Bldg	Stories	1 BR	2 BR	3 BR	Total Units		
A	4	16	36	0	52		
B	3	0	24	6	30		
C	3	12	9	12	33		
D	3	0	24	6	30		
Totals		36	105	24	223		
Mix %		42.2%	47.1%	10.8%			
Parking							
Resident Pkg (1.5 per unit)	141	157.5	36	334.5			
Visitor Pkg (0.25 per unit)	23.5	26.25	6	56.75			
Total Base Parking	164.5	183.75	42	391.25			
Total Required Parking - Mixed Use & Apts	464.25						
20% Parking Reduction	371.4						
Total Parking Provided	354						
Proposed Shared Parking	17						



NOVEMBER 2024
 Highway 96 Property | Zebulon, North Carolina

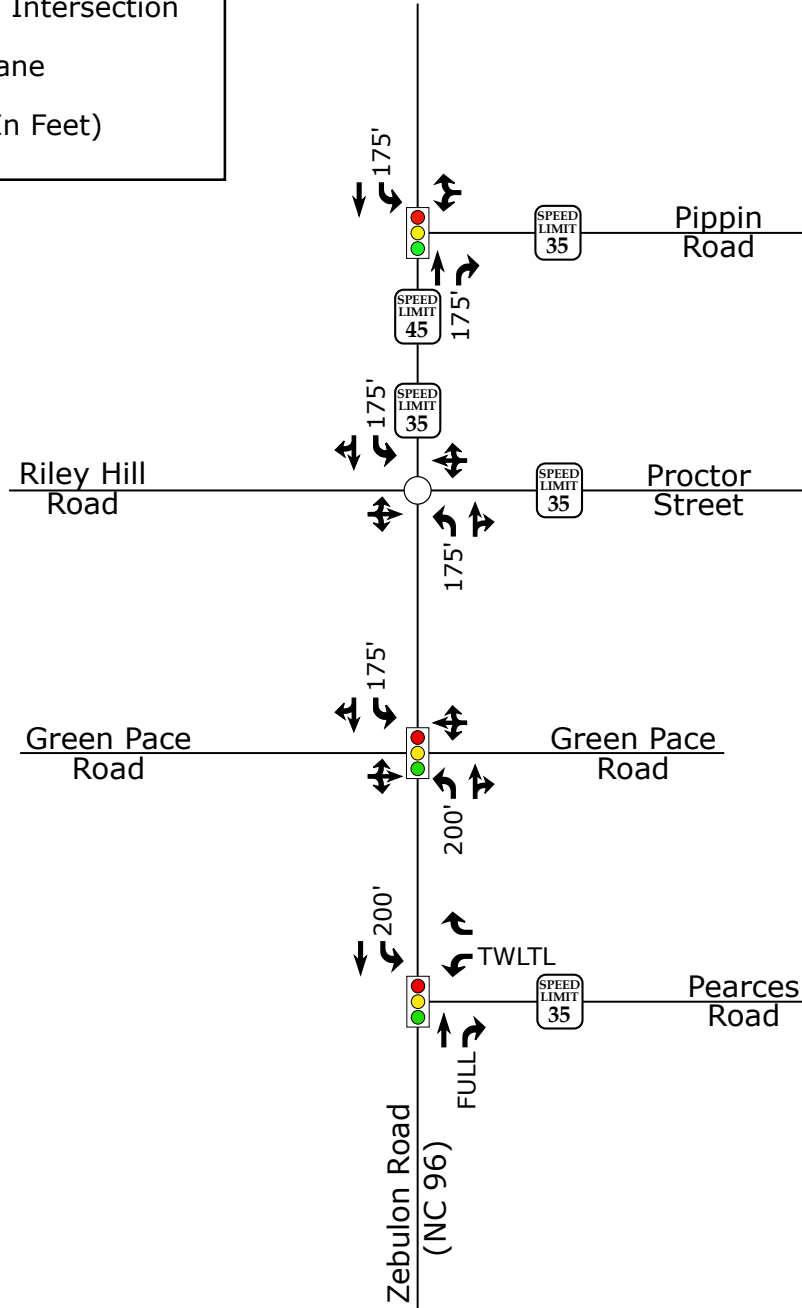


project
 master plan



LEGEND

- Unsignalized Intersection
- ⬆️⬆️⬆️ Signalized Intersection
- ➡️ Existing Lane
- x' Storage (In Feet)



Zebulon Road Mixed-Use
Zebulon, NC

2024 Existing
Lane Configurations

Scale: Not to Scale Figure 3

2. 2024 EXISTING PEAK HOUR CONDITIONS

2.1. 2024 Existing Peak Hour Traffic Volumes

Existing peak hour traffic volumes were determined based on traffic counts conducted at the study intersections listed below, in September by DRMP during a typical weekday AM (7:00 AM – 9:00 AM) and PM (4:00 PM – 6:00 PM) peak periods:

- NC 96 and Pippin Road (Signalized)
- NC 96 and Riley Hill Road (Unsignalized)
- NC 96 and Green Pace Road (Unsignalized)
- NC 96 and Pearces Road (Signalized)

Refer to Figure 4 for 2024 existing weekday AM and PM peak hour traffic volumes. A copy of the count data is located in Appendix B of this report.

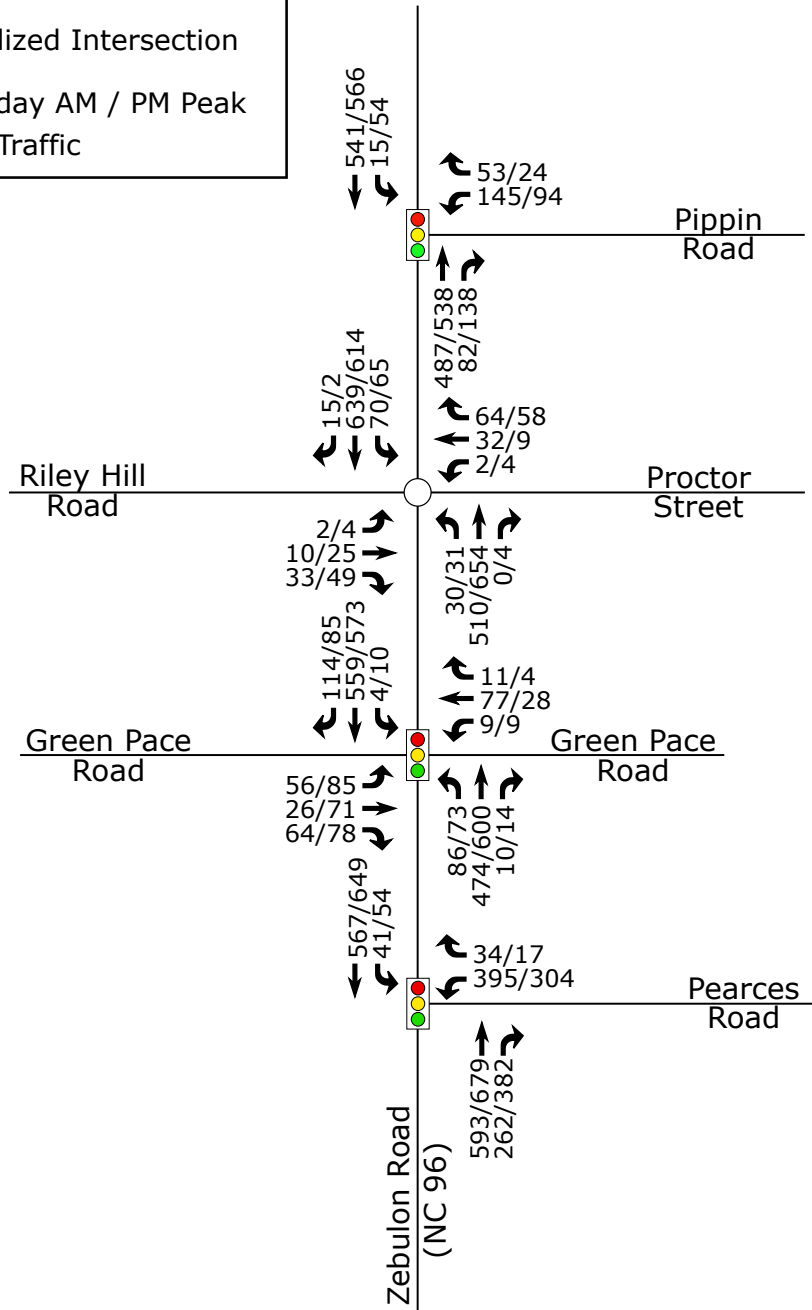
2.2. Analysis of 2024 Existing Peak Hour Traffic Conditions


The 2024 existing weekday AM and PM peak hour traffic volumes were analyzed to determine the current levels of service at the study intersections under existing roadway conditions. Signal information was obtained from NCDOT and is included in Appendix C. The results of the analysis are presented in Section 7 of this report.



LEGEND

- Unsignalized Intersection
- ⬆️⬆️⬆️ Signalized Intersection
- X / Y → Weekday AM / PM Peak Hour Traffic



	Zebulon Road Mixed-Use Zebulon, NC	2024 Existing Peak Hour Traffic	
		Scale: Not to Scale	Figure 4

3. 2029 NO-BUILD PEAK HOUR CONDITIONS

In order to account for growth of traffic and subsequent traffic conditions at a future year, no-build traffic projections are needed. No-build traffic is the component of traffic due to the growth of the community and surrounding area that is anticipated to occur regardless of whether or not the proposed development is constructed. No-build traffic is comprised of existing traffic growth within the study area and additional traffic created as a result of adjacent approved developments.

3.1. Ambient Traffic Growth

Through coordination with the NCDOT and the Town, it was determined that an annual growth rate of 1% would be used to generate 2029 projected weekday AM and PM peak hour traffic volumes.

3.2. Adjacent Development Traffic

Based on coordination with the NCDOT and the Town, it was determined there were no adjacent developments to consider with this study.

3.3. Future Roadway Improvements

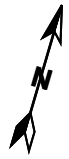
Based on coordination with the NCDOT and the Town, it was determined that the intersection of NC 96 and Pearces Road in future traffic conditions is expected to add an additional southbound through lane, restriping the westbound right-turn lane to a shared left-right turn lane, and adding signal timing modifications.

3.4. 2029 No-Build Peak Hour Traffic Volumes

The 2029 no-build traffic volumes were determined by projecting the 2024 existing peak hour traffic to the year 2024. Refer to Figure 5 for an illustration of the 2029 no-build peak hour traffic volumes at the study intersections.

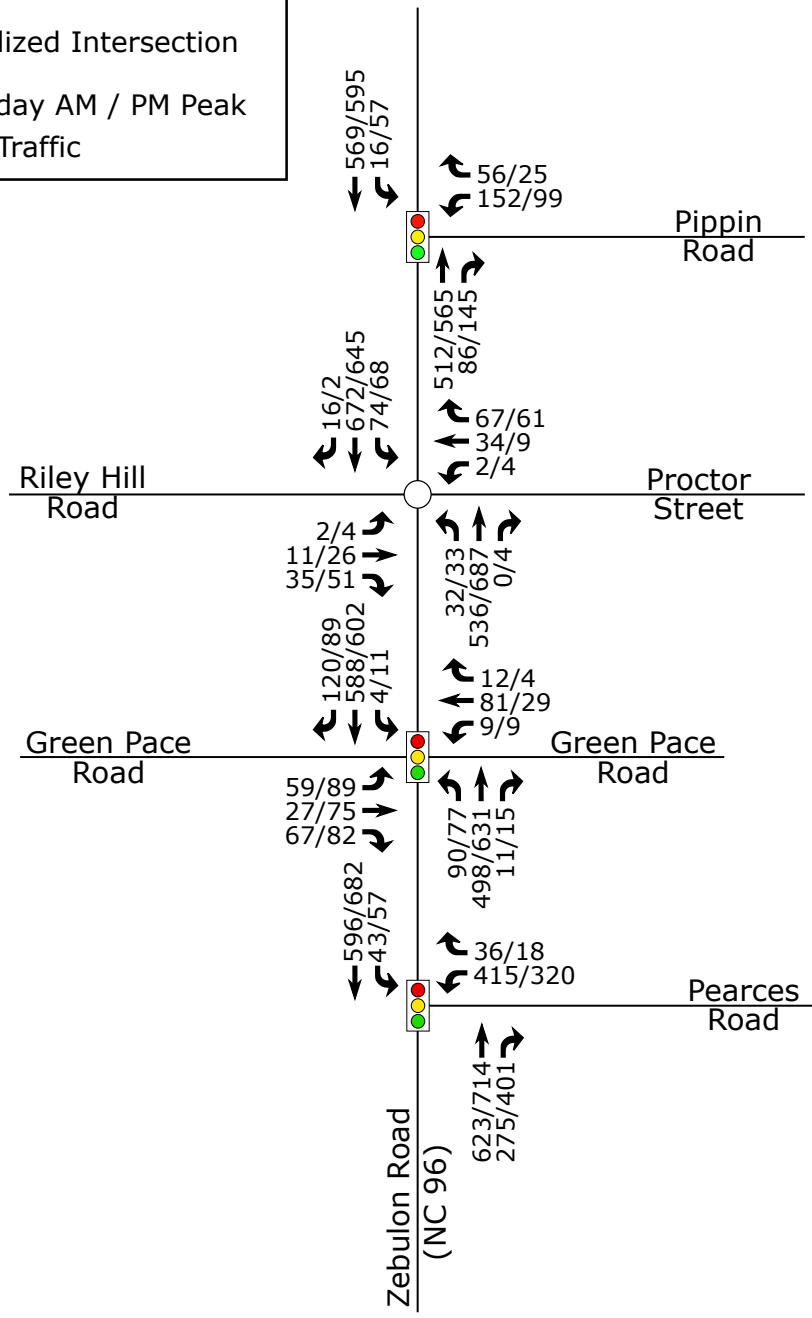
3.5. Analysis of 2029 No-Build Peak Hour Traffic Conditions

The 2024 no-build AM and PM peak hour traffic volumes at the study intersections were analyzed with existing geometric roadway conditions and traffic control. The analysis results are presented in Section 7 of this report.



LEGEND

- Unsignalized Intersection
- 🚦 Signalized Intersection
- X / Y → Weekday AM / PM Peak Hour Traffic



	Zebulon Road Mixed-Use Zebulon, NC	2029 No-Build Peak Hour Traffic
	Scale: Not to Scale Figure 5	

4. SITE TRIP GENERATION AND DISTRIBUTION

4.1. Trip Generation

Average weekday daily, AM peak hour, and PM peak hour trips for the proposed development were estimated using methodology contained within the ITE *Trip Generation Manual*, 11.1 Edition. Table 2 provides a summary of the trip generation potential for the site.

Table 2: Trip Generation Summary

Land Use (ITE Code)	Intensity	Daily Traffic (vpd)	Weekday AM Peak Hour Trips (vph)			Weekday PM Peak Hour Trips (vph)		
			Enter	Exit	Total	Enter	Exit	Total
Apartments (220)	240 Units	1,614	23	74	97	78	46	124
Strip Retail (822)	26,000 s.f.	1,416	37	24	61	86	85	171
High-Turnover Restaurant (932)	5,500 s.f.	590	29	24	53	31	19	50
Coffee Shop with Drive- Through (937)	600 s.f.	320	27	25	52	12	11	23
Total Trips		3,940	116	147	263	207	161	368
<i>Internal Capture*</i> (15% AM, 16% PM)			-17	-23	-40	-34	-25	-59
External Trips			99	124	223	173	136	309
<i>Pass-By Trips</i> (Shopping Center: 29% PM)			-	-	-	-21	-21	-42
<i>Pass-By Trips</i> (High-Turnover Restaurant: 43% PM)			-	-	-	-9	-9	-18
<i>Pass-By Trips</i> (Coffee Shop with Drive-Through: 90% AM, 98% PM)			-20	-20	-40	-9	-9	-18
Primary Trips			79	104	183	134	97	231

*Utilizing methodology contained in the NCHRP Report 684.

It is estimated that the proposed development will generate approximately 3,940 total site trips on the roadway network during a typical 24-hour weekday period. Of the daily traffic volume, it is anticipated that 263 trips (116 entering and 147 exiting) will occur during the weekday AM peak hour and 368 trips (207 entering and 161 exiting) will occur during the weekday PM peak hour.

Internal capture of trips between the residential and retail uses was considered in this study. Internal capture is the consideration for trips that will be made within the site between different land uses, so the vehicle technically never leaves the internal site but can still be considered as a trip to that specific land use. Internal capture typically only considers trips between residential, office, and retail/restaurant land uses. Based on NCHRP Report 684 methodology, a weekday AM peak hour internal capture rate of 15% and a weekday PM peak hour internal capture rate of 16% was applied to the total trips. The internal capture reductions are expected to account for approximately 40 trips (17 entering and 23 exiting) during the weekday AM peak hour and 59 trips (34 entering and 25 exiting) during the weekday PM peak hour.

Pass-by trips were also taken into consideration in this study. Pass-by trips are made by the traffic already using the adjacent roadway, entering the site as an intermediate stop on their way to another destination. Pass-by percentages are applied to site trips after adjustments for internal capture. Pass-by trips are expected to account for approximately 40 trips (20 entering and 20 exiting) during the weekday AM peak hour and approximately 78 trips (39 entering and 39 exiting) during the weekday PM peak hour. It should be noted that the pass-by trips were balanced, as it is likely that these trips would enter and exit in the same hour.

The total primary site trips are the calculated site trips after the reduction for internal capture and pass-by trips. Primary site trips are expected to generate approximately 183 trips (79 entering and 104 exiting) during the weekday AM peak hour and 231 trips (134 entering and 97 exiting) during the weekday PM peak hour.

4.2. Site Trip Distribution and Assignment

Trip distribution percentages used in assigning site traffic for this development were estimated based on a combination of existing traffic patterns, population centers adjacent to the study area, and engineering judgment.

It is estimated that the residential site trips will be regionally distributed as follows:

- 45% to/from the south via Zebulon Road
- 30% to/from the north via Zebulon Road
- 10% to/from the east via Pearces Road
- 5% to/from the east via Proctor Street
- 5% to/from the east via Pippin Road
- 5% to/from the west via Green Pace Road

A summary of the overall commercial distributions is below:

- 50% to/from the south via Zebulon Road
- 35% to/from the north via Zebulon Road
- 10% to/from the east via Pearces Road
- 5% to/from the east via Proctor Street

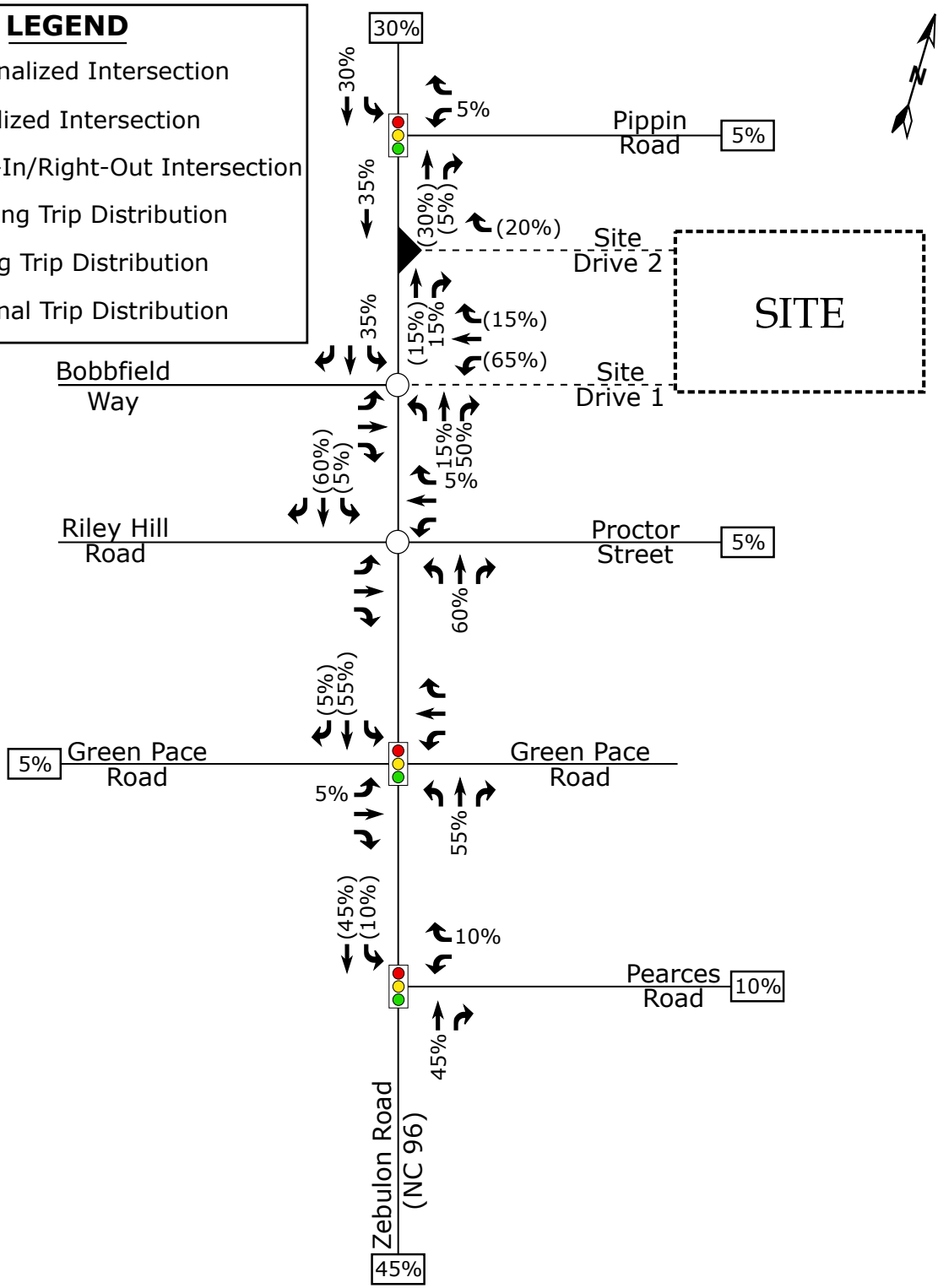
The residential site trip distribution is shown in Figure 6a and the primary commercial site trip distribution is shown in Figure 6b. Refer to Figure 7a for the residential site trip assignment and Figure 7b for the primary commercial site trip assignment.


The pass-by site trips were distributed based on existing traffic patterns with consideration given to the proposed driveway access and site layout. Refer to Figure 8 for the pass-by site trip distribution. Pass-by site trips are shown in Figure 9.

The total site trips were determined by adding the primary site trips and the pass-by site trips. Refer to Figure 10 for the total peak hour site trips at the study intersections.

LEGEND

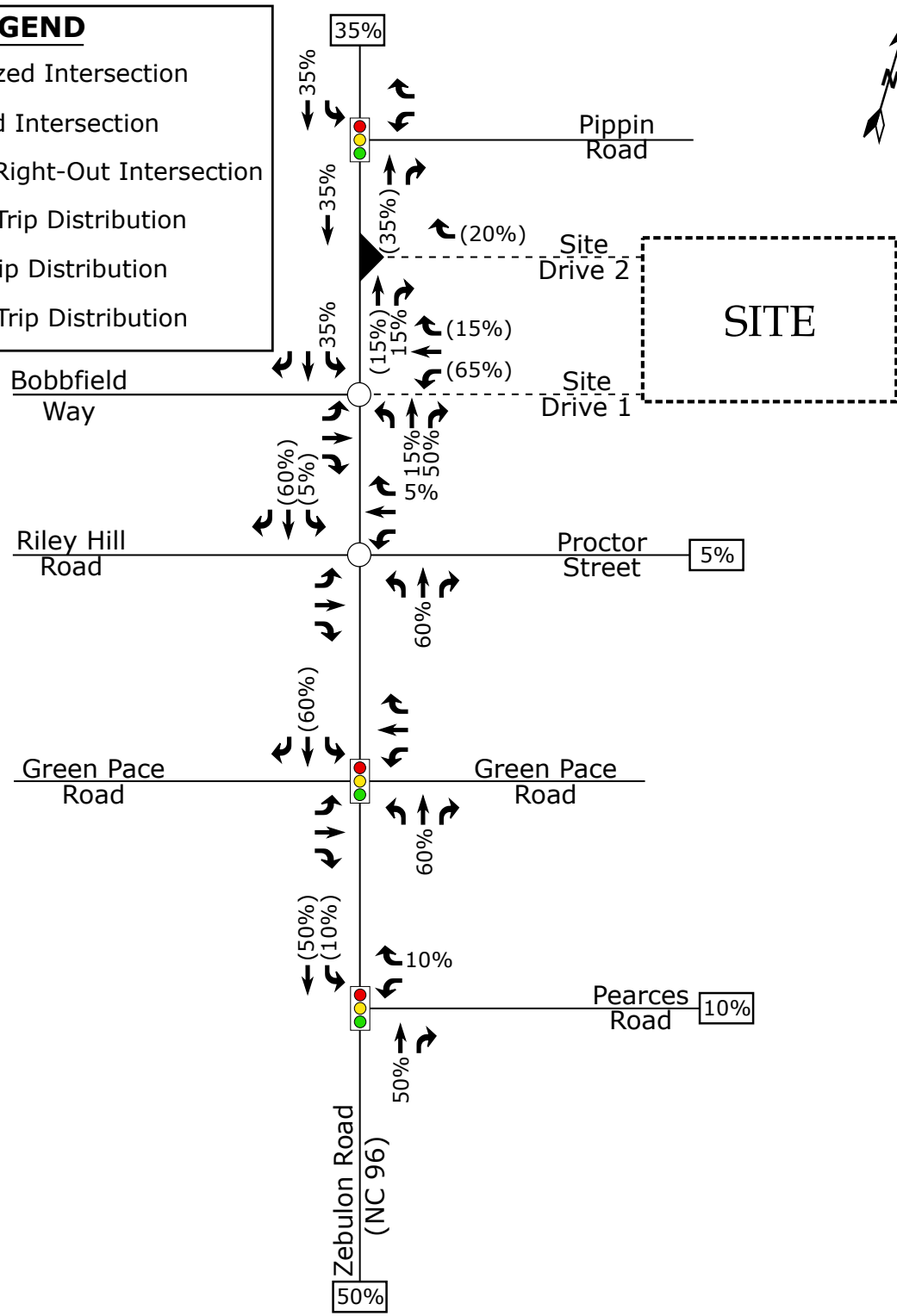
- Unsignalized Intersection
- ◫ Signalized Intersection
- ▲ Right-In/Right-Out Intersection
- X% → Entering Trip Distribution
- (Y%) → Exiting Trip Distribution
- XX% Regional Trip Distribution




	Zebulon Road Mixed-Use Zebulon, NC	Residential Site Trip Distribution	
		Scale: Not to Scale	Figure 6a

LEGEND

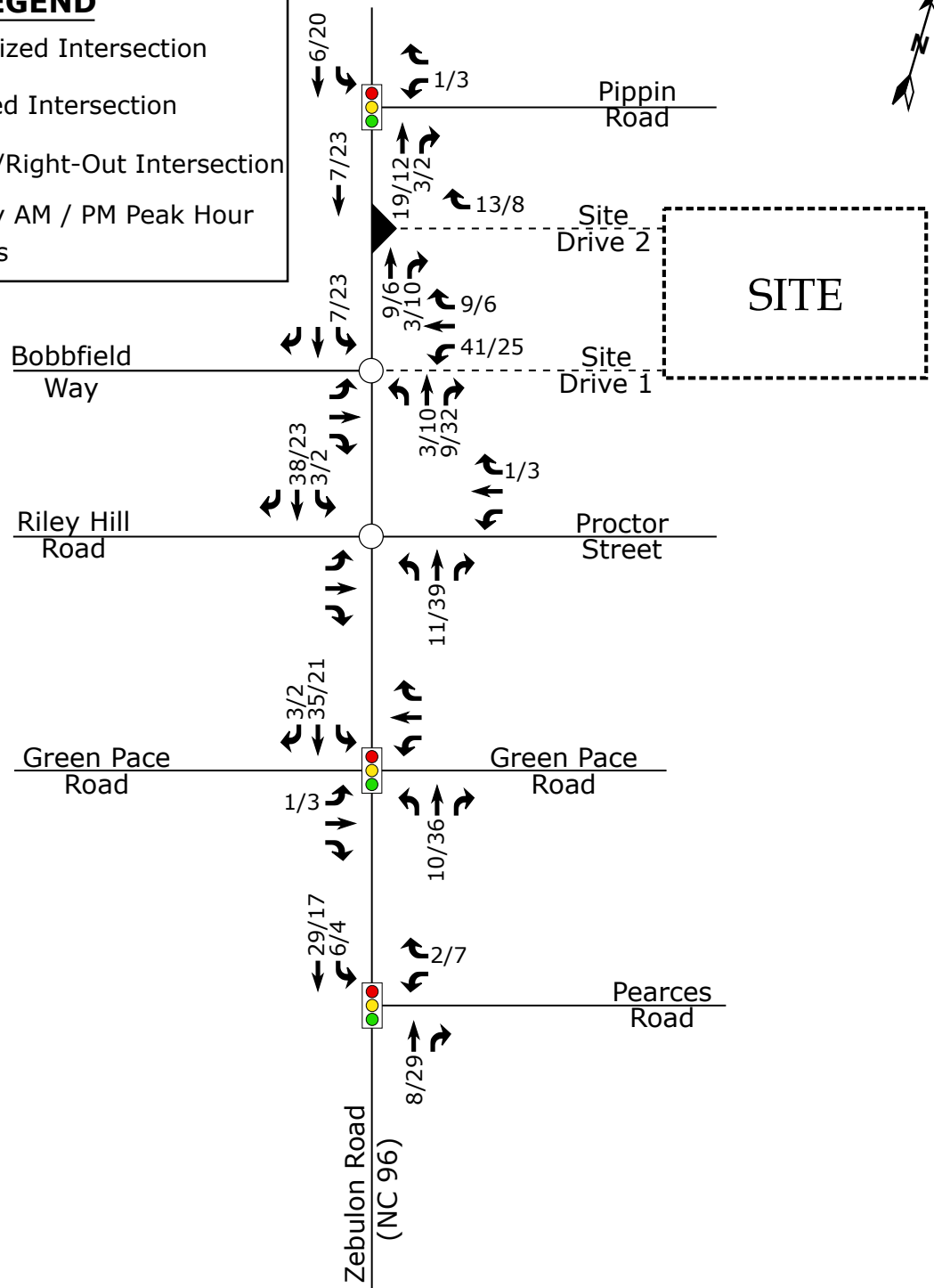
- Unsignalized Intersection
- ◫ Signalized Intersection
- ▲ Right-In/Right-Out Intersection
- X% → Entering Trip Distribution
- (Y%) → Exiting Trip Distribution
- XX% Regional Trip Distribution



	Zebulon Road Mixed-Use Zebulon, NC	Commercial Site Trip Distribution	
		Scale: Not to Scale	Figure 6b

LEGEND

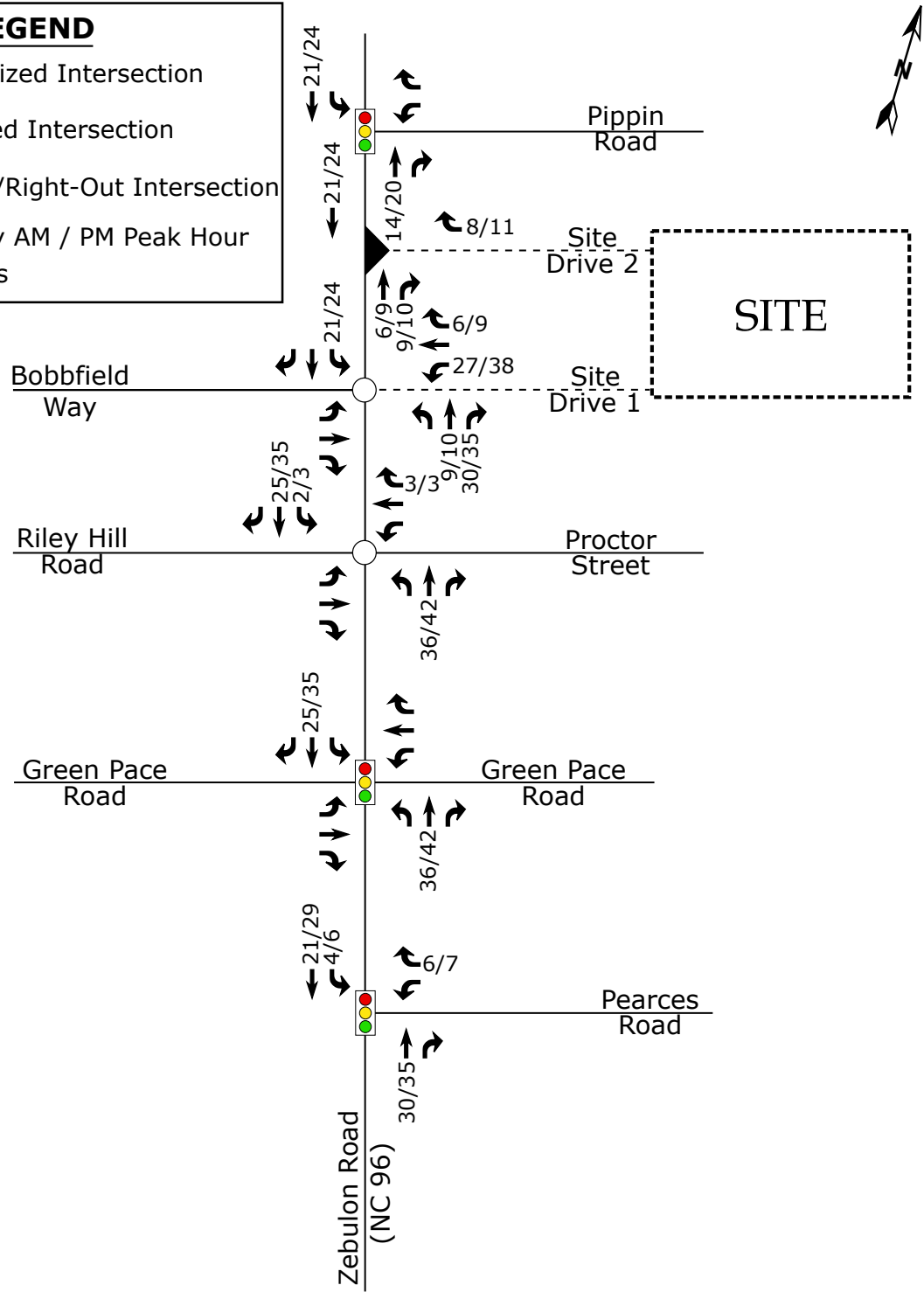
- Unsignalized Intersection
- 🚦 Signalized Intersection
- ▲ Right-In/Right-Out Intersection
- X / Y → Weekday AM / PM Peak Hour Site Trips




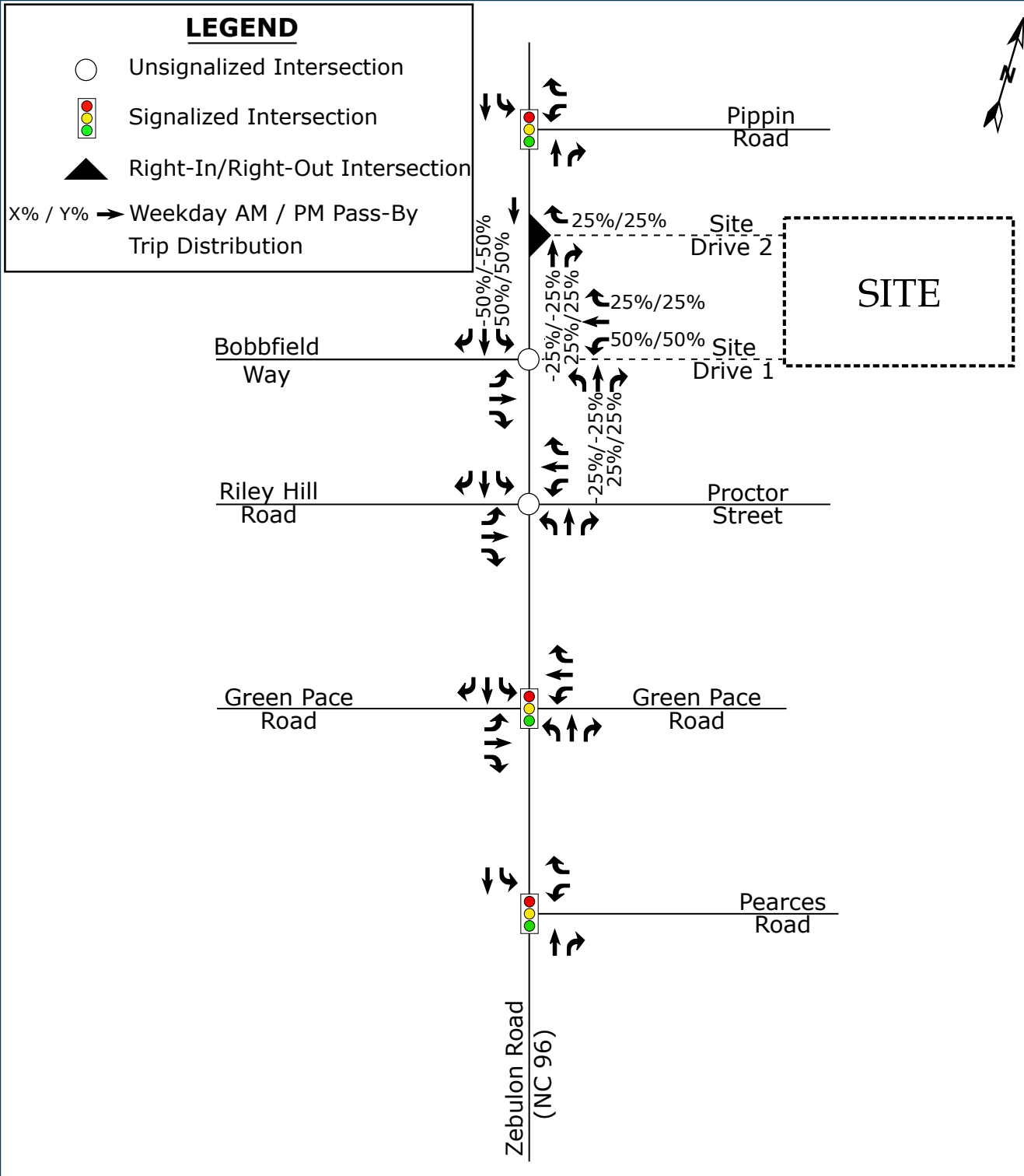
	Zebulon Road Mixed-Use Zebulon, NC	Residential Site Trip Assignment	
		Scale: Not to Scale	Figure 7a


LEGEND

- Unsignalized Intersection
- 🚦 Signalized Intersection
- ▲ Right-In/Right-Out Intersection
- X / Y → Weekday AM / PM Peak Hour Site Trips



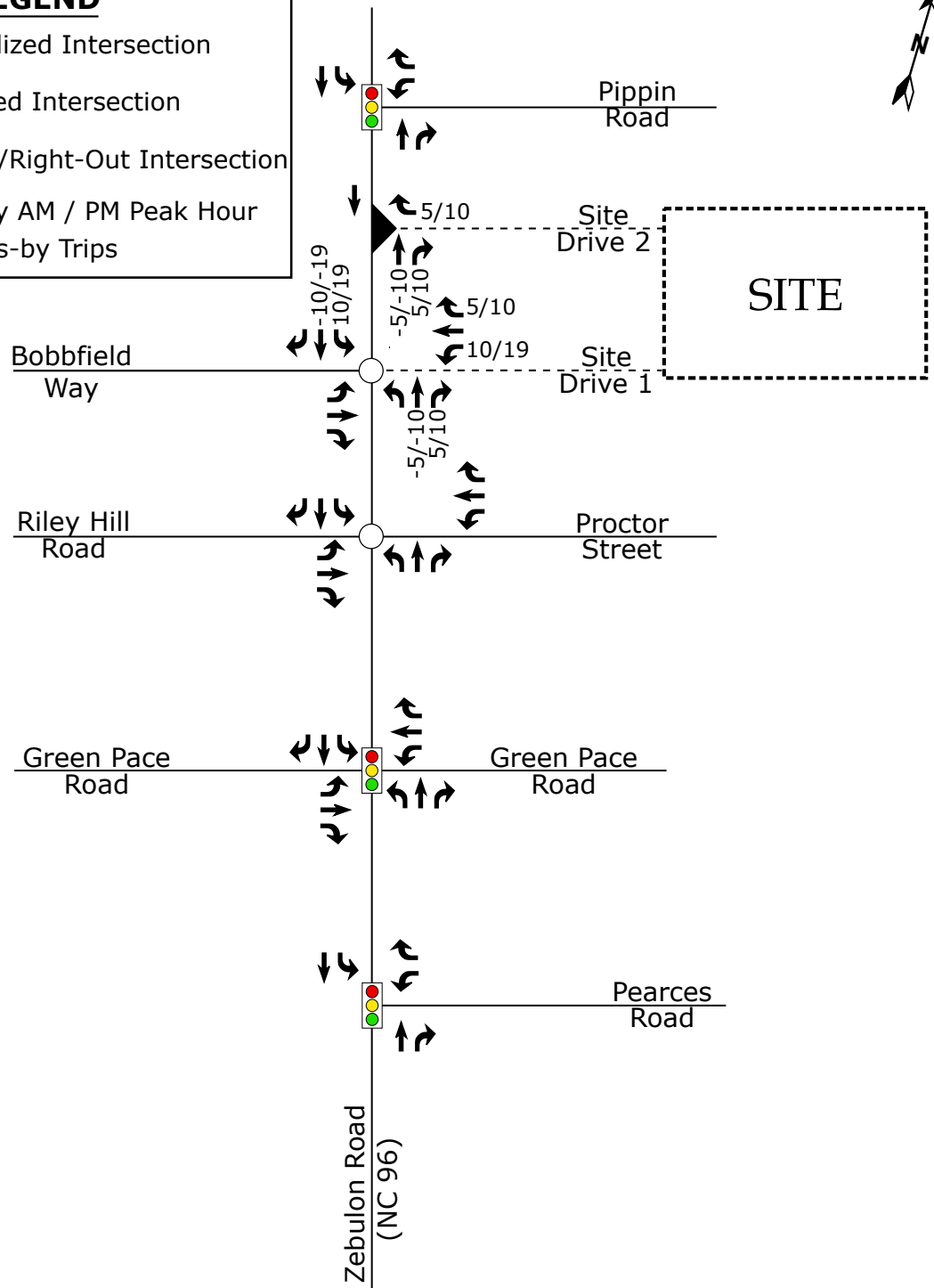
	Zebulon Road Mixed-Use Zebulon, NC	Commercial Site Trip Assignment	
		Scale: Not to Scale	Figure 7b



	Zebulon Road Mixed-Use Zebulon, NC	Pass-By Site Trip Distribution	
		Scale: Not to Scale	Figure 8

LEGEND

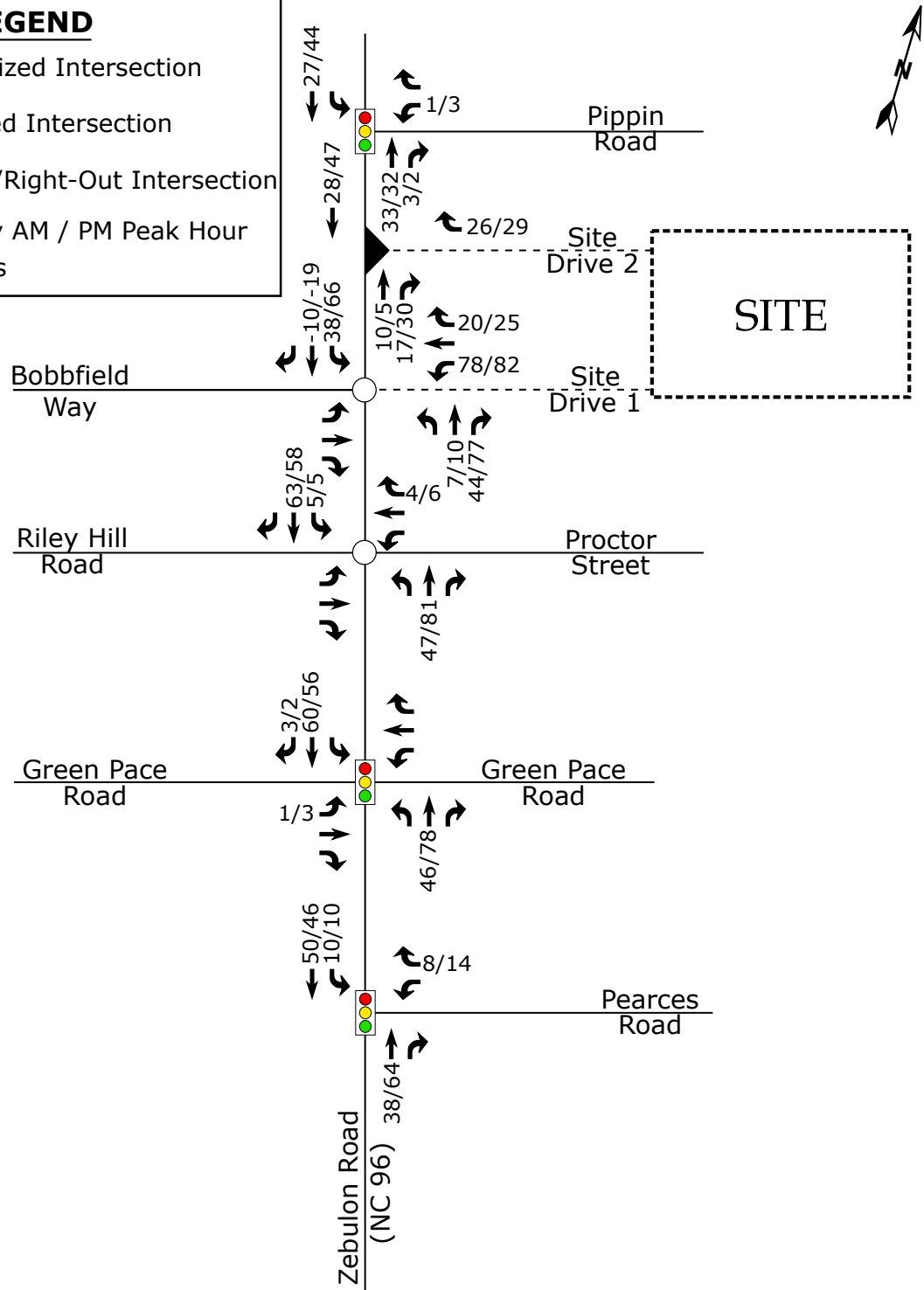
- Unsignalized Intersection
- 🚦 Signalized Intersection
- ▲ Right-In/Right-Out Intersection
- X / Y → Weekday AM / PM Peak Hour Site Pass-by Trips




	Zebulon Road Mixed-Use Zebulon, NC	Pass-By Site Trip Assignment	
		Scale: Not to Scale	Figure 9

LEGEND

- Unsignalized Intersection
- 🚦 Signalized Intersection
- ▲ Right-In/Right-Out Intersection
- X / Y → Weekday AM / PM Peak Hour Site Trips



	Zebulon Road Mixed-Use Zebulon, NC	Total Site Trip Assignment	
		Scale: Not to Scale	Figure 10

5. 2029 BUILD TRAFFIC CONDITIONS

5.1. 2029 Build Peak Hour Traffic Volumes

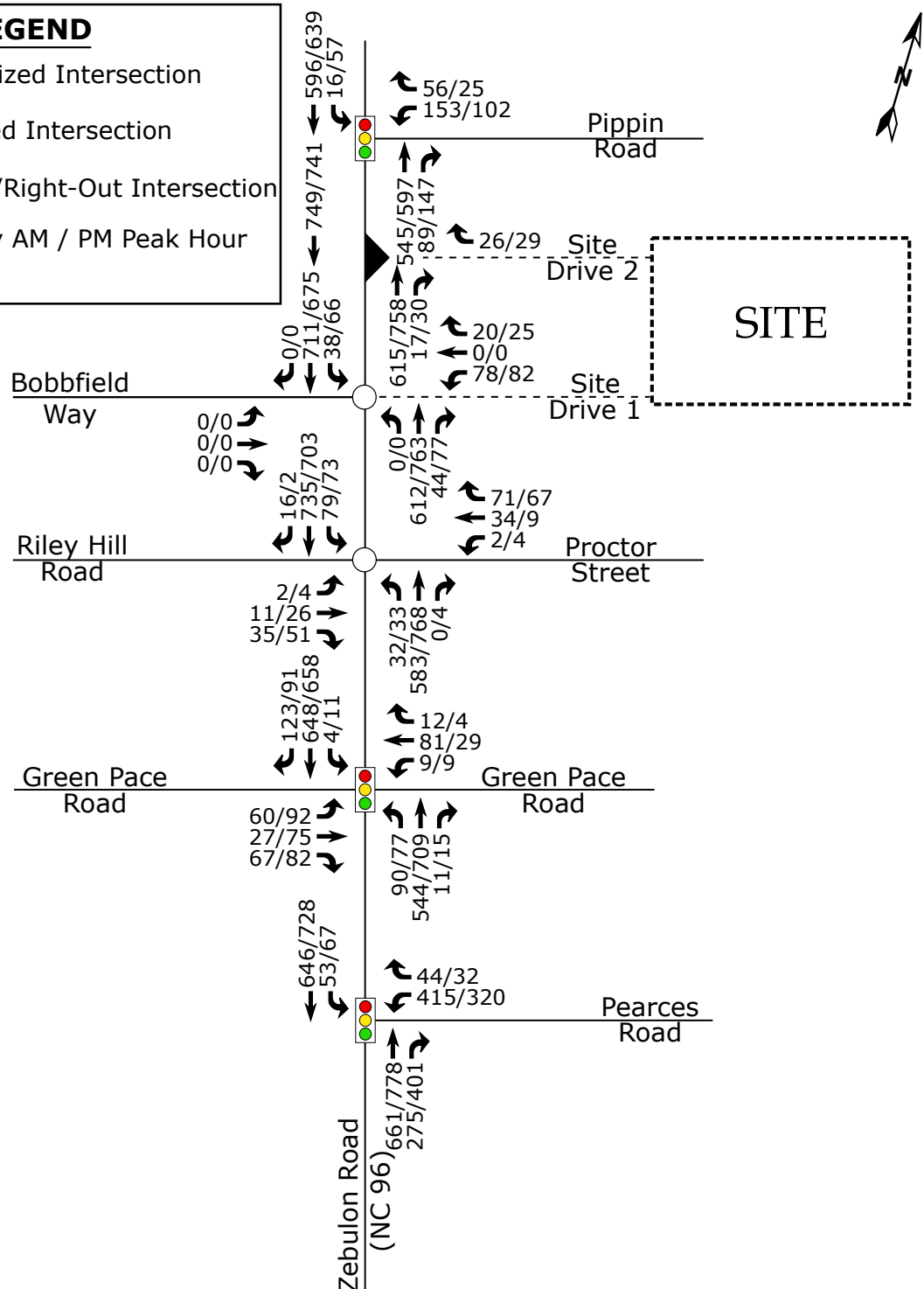
To estimate traffic conditions with the site fully built-out, the total site trips were added to the 2029 no-build traffic volumes to determine the 2029 build traffic volumes. Refer to Figure 11 for an illustration of the 2029 build peak hour traffic volumes with the proposed site fully developed.

5.2. Analysis of 2029 Build Peak Hour Traffic Conditions

Study intersections were analyzed with the 2029 build traffic volumes using the same methodology previously discussed for existing and no-build traffic conditions. Intersections were analyzed with improvements necessary to accommodate future traffic volumes. The results of the capacity analysis for each intersection are presented in Section 7 of this report.

LEGEND

- Unsignalized Intersection
- 🚦 Signalized Intersection
- ▲ Right-In/Right-Out Intersection
- X / Y → Weekday AM / PM Peak Hour Traffic



Note: Based on NCDOT Congestion Management guidelines, a volume of 4 vehicles per hour (vph) was analyzed for any movement with less than 4 vph.

	Zebulon Road Mixed-Use Zebulon, NC	2029 Build Peak Hour Traffic	
		Scale: Not to Scale	Figure 11

6. TRAFFIC ANALYSIS PROCEDURE

Study intersections were analyzed using the methodology outlined in the *Highway Capacity Manual* (HCM), 6th Edition published by the Transportation Research Board. Capacity and level of service are the design criteria for this traffic study. A computer software package, Synchro (Version 11.1), was used to complete the analyses for the study area intersections. Please note that the unsignalized capacity analysis does not provide an overall level of service for an intersection; only delay for an approach with a conflicting movement.

The HCM defines capacity as “the maximum hourly rate at which persons or vehicles can reasonably be expected to traverse a point or uniform section of a lane or roadway during a given time period under prevailing roadway, traffic, and control conditions.” Level of service (LOS) is a term used to represent different driving conditions and is defined as a “qualitative measure describing operational conditions within a traffic stream, and their perception by motorists and/or passengers.” Level of service varies from Level “A” representing free flow, to Level “F” where breakdown conditions are evident. Refer to Table 3 for HCM levels of service and related average control delay per vehicle for both signalized and unsignalized intersections. Control delay as defined by the HCM includes “initial deceleration delay, queue move-up time, stopped delay, and final acceleration delay”. An average control delay of 50 seconds at a signalized intersection results in LOS “D” operation at the intersection.

Table 3: Highway Capacity Manual – Levels-of-Service and Delay

UNSIGNALIZED INTERSECTION		SIGNALIZED INTERSECTION	
LEVEL OF SERVICE	AVERAGE CONTROL DELAY PER VEHICLE (SECONDS)	LEVEL OF SERVICE	AVERAGE CONTROL DELAY PER VEHICLE (SECONDS)
A	0-10	A	0-10
B	10-15	B	10-20
C	15-25	C	20-35
D	25-35	D	35-55
E	35-50	E	55-80
F	>50	F	>80

6.1. Adjustments to Analysis Guidelines

Capacity analysis at all study intersections was completed according to the NCDOT Congestion Management Guidelines.

7. CAPACITY ANALYSIS

The following study intersections were analyzed under 2024 existing, 2029 no-build, and 2029 build traffic conditions:

- NC 96 and Pippin Road
- NC 96 and Riley Hill Road
- NC 96 and Green Pace Road
- NC 96 and Pearces Road
- NC 96 and Bobbfield Way/Access 1
- NC 96 and Access 2

All proposed site driveways were analyzed under 2029 build traffic conditions. Refer to Tables 4-9 for a summary of capacity analysis results. Refer to Appendices D-J for the Synchro capacity analysis reports and SimTraffic queueing reports.

7.1. NC 96 & Pippin Road

Refer to the table below for a summary of the capacity analysis of the subject intersection during the analysis scenarios.

Table 4: Analysis Summary of NC 96 & Pippin Road

ANALYSIS SCENARIO	A P P R O A C H	LANE CONFIGURATIONS	WEEKDAY AM PEAK HOUR LEVEL OF SERVICE		WEEKDAY PM PEAK HOUR LEVEL OF SERVICE	
			Approach	Overall (seconds)	Approach	Overall (seconds)
2024 Existing	WB	1 LT-RT	C	B (13)	C	B (13)
	NB	1 TH, 1 RT	B		B	
	SB	1 LT, 1 TH	B		B	
2029 No-Build	WB	1 LT-RT	C	B (14)	C	B (14)
	NB	1 TH, 1 RT	B		B	
	SB	1 LT, 1 TH	B		B	
2029 Build	WB	1 LT-RT	C	B (15)	C	B (15)
	NB	1 TH, 1 RT	B		B	
	SB	1 LT, 1 TH	B		B	

Capacity analysis indicates that the intersection is expected to operate at an overall LOS B during both the weekday AM and PM peak hours under all scenarios analyzed. When comparing the no-build and build traffic conditions queuing is not expected to increase significantly at the intersection.

7.2. NC 96 & Riley Hill Road

Refer to the table below for a summary of the capacity analysis of the subject intersection during the analysis scenarios.

Table 5: Analysis Summary of NC 96 & Riley Hill Road

ANALYSIS SCENARIO	APPROACH	LANE CONFIGURATIONS	WEEKDAY AM PEAK HOUR LEVEL OF SERVICE		WEEKDAY PM PEAK HOUR LEVEL OF SERVICE	
			Approach	Overall (seconds)	Approach	Overall (seconds)
2024 Existing	EB	1 LT-TH-RT	D ²	N/A	E ²	N/A
	WB	1 LT-TH-RT	E ²		D ²	
	NB	1 LT, 1 TH-RT	A ¹		A ¹	
	SB	1 LT, 1 TH-RT	A ¹		A ¹	
2029 No-Build	EB	1 LT-TH-RT	E ²	N/A	F ²	N/A
	WB	1 LT-TH-RT	F ²		E ²	
	NB	1 LT, 1 TH-RT	A ¹		A ¹	
	SB	1 LT, 1 TH-RT	A ¹		A ¹	
2029 Build	EB	1 LT-TH-RT	F ²	N/A	F ²	N/A
	WB	1 LT-TH-RT	F ²		F ²	
	NB	1 LT, 1 TH-RT	A ¹		A ¹	
	SB	1 LT, 1 TH-RT	A ¹		B ¹	

1. Level of service for major-street left-turn movement.
2. Level of service for minor-street approach.

Capacity analysis indicates that the major-street left-turn movements are expected to operate at LOS B or better during both the weekday AM and PM peak hours under all scenarios analyzed. The minor-street approaches are expected to operate at LOS F or better during both the weekday AM and PM peak hours under all scenarios analyzed. Queueing along the minor-street approaches is expected to increase when comparing the no-build and build traffic conditions. It is important to note that the proposed development is only accounting for less than 9% of the traffic at the intersection overall, primarily along the mainline through movements during both the weekday AM and PM peak hours. The proposed development is expected to only account for less than 6% of the traffic along the westbound approach during both the weekday AM and PM peak hours.

It is also important to note that it is not uncommon for minor-street approaches to experience higher delays and levels of service at unsignalized intersections due to heavier mainline traffic volumes. The intersection to the south, NC 96 and Green Pace Road, is

signalized, which is expected to provide gaps in the mainline traffic which will allow traffic from the minor-street approaches to be able to flow into mainline traffic or cross the intersection. Traffic from the westbound approach can also utilize the intersection of NC 96 and Green Pace Road via the intersection of Proctor Street and Green Pace Road, providing an alternative route to Riley Hill Road or NC 96.

7.3. NC 96 & Green Pace Road

Refer to the table below for a summary of the capacity analysis of the subject intersection during the analysis scenarios.

Table 6: Analysis Summary of NC 96 & Green Pace Road

ANALYSIS SCENARIO	APPROACH	LANE CONFIGURATIONS	WEEKDAY AM PEAK HOUR LEVEL OF SERVICE		WEEKDAY PM PEAK HOUR LEVEL OF SERVICE	
			Approach	Overall (seconds)	Approach	Overall (seconds)
2024 Existing	EB	1 LT-TH-RT	C	B (11)	C	B (16)
	WB	1 LT-TH-RT	B			
	NB	1 LT, 1 TH-RT	A			
	SB	1 LT, 1 TH-RT	B			
2029 No-Build	EB	1 LT-TH-RT	C	B (12)	C	B (17)
	WB	1 LT-TH-RT	B			
	NB	1 LT, 1 TH-RT	A			
	SB	1 LT, 1 TH-RT	B			
2029 Build	EB	1 LT-TH-RT	C	B (12)	C	B (19)
	WB	1 LT-TH-RT	C			
	NB	1 LT, 1 TH-RT	A			
	SB	1 LT, 1 TH-RT	B			

Capacity analysis indicates that the intersection is expected to operate at an overall LOS B during both the weekday AM and PM peak hours under all scenarios analyzed. When comparing the no-build and build traffic conditions queuing at the intersection is not expected to increase significantly.

7.4. NC 96 & Pearces Road

Refer to the table below for a summary of the capacity analysis of the subject intersection during the analysis scenarios.

Table 7: Analysis Summary of NC 96 & Pearces Road

ANALYSIS SCENARIO	A P P R O A C H	LANE CONFIGURATIONS	WEEKDAY AM PEAK HOUR LEVEL OF SERVICE		WEEKDAY PM PEAK HOUR LEVEL OF SERVICE	
			Approach	Overall (seconds)	Approach	Overall (seconds)
2024 Existing	WB NB SB	1 LT, 1 RT 1 TH, 1 RT 1 LT, 1 TH	C B B	B (17)	C B B	B (15)
2029 No-Build	WB NB SB	1 LT, <u>1 LT-RT</u> 1 TH, 1 RT 1 LT, <u>2 TH</u>	B B A	B (11)	B B A	B (11)
2029 Build	WB NB SB	1 LT, <u>1 LT-RT</u> 1 TH, 1 RT 1 LT, <u>2 TH</u>	B B A	B (12)	C B A	B (12)

Future improvements to lane configurations shown underlined.

Capacity analysis indicates that the intersection is expected to operate at an overall LOS B during both the weekday AM and PM peak hours under the existing traffic condition. Under the future traffic conditions the intersection was analyzed with an additional southbound through lane, restriping of the westbound right-turn lane into a shared left-right turn lane, and signal timing modifications based on an updated signal plan. Under the future traffic conditions the intersection is expected to operate at LOS B during both the weekday AM and PM peak hours. When comparing the no-build and build traffic conditions queuing at the intersection is not expected to increase significantly.

7.5. NC 96 & Bobbfield Way/Access 1

Refer to the table below for a summary of the capacity analysis of the subject intersection during the analysis scenarios.

Table 8: Analysis Summary of NC 96 & Bobbfield Way/Access 1

ANALYSIS SCENARIO	APPROACH	LANE CONFIGURATIONS	WEEKDAY AM PEAK HOUR LEVEL OF SERVICE		WEEKDAY PM PEAK HOUR LEVEL OF SERVICE	
			Approach	Overall (seconds)	Approach	Overall (seconds)
2029 Build	EB WB NB SB	1 LT-TH-RT 1 LT, 1 TH-RT 1 LT-TH, 1 RT 1 LT, 1 TH-RT	E ² F ² A ¹ A ¹	N/A	F ² F ² A ¹ B ¹	N/A

Improvements to lane configurations are shown in bold.

1. Level of service for major-street left-turn movement.
2. Level of service for minor-street approach.

Capacity analysis indicates that the major-street left-turn movements are expected to operate at LOS B or better during both the weekday AM and PM peak hour. The minor-street approaches are expected to operate at LOS F during both the weekday AM and PM peak hours. It is important to note that it is not uncommon for minor-street approaches at unsignalized intersections to experience higher delays and levels of service due to heavier mainline traffic volumes. It is also important to note that the intersection to the north, NC 96 and Pippin Road, is signalized, which is expected to provide gaps in the mainline traffic which will allow traffic from the minor-street approaches to be able to flow into mainline. Queueing for the westbound left-turn movement is expected to be significant and queueing for the through-right movement is not expected to exceed 64 feet (approximately 3 vehicles).

A northbound right-turn lane and a southbound left-turn lane were considered based on the NCDOT *Policy on Street and Driveway Access to North Carolina Highways* and are recommended.

The intersection was studied utilizing the NCDOT congestion management guidelines which provide a more conservative analysis adding 4's where traffic volumes are less than

4. Cross traffic between the proposed development and Bobbfield Way is not expected during the weekday AM and PM peak hours.

Although a right-turn lane with 50 feet of storage is warranted, a right-turn lane may impact the driveway to the business to the south of the development. If significant impacts to the business would occur, a right-turn taper in lieu of a full turn lane is recommended.

7.6. NC 96 & Access 2

Refer to the table below for a summary of the capacity analysis of the subject intersection during the analysis scenarios.

Table 9: Analysis Summary of NC 96 & Access 2

ANALYSIS SCENARIO	A P P R O A C H	LANE CONFIGURATIONS	WEEKDAY AM PEAK HOUR LEVEL OF SERVICE		WEEKDAY PM PEAK HOUR LEVEL OF SERVICE	
			Approach	Overall (seconds)	Approach	Overall (seconds)
2029 Build	WB NB SB	1 RT 1 TH- RT 1 TH	B ¹ -- --	N/A	C ¹ -- --	N/A

Improvements to lane configurations are shown in bold.

1. Level of service for minor-street approach.

Capacity analysis indicates that the minor-street approach is expected to operate at LOS C or better during both the weekday AM and PM peak hours. Queueing along the minor-street approach is not expected to exceed 48 feet (approximately 2 vehicles).

A northbound right-turn lane was considered based on the NCDOT *Policy on Street and Driveway Access to North Carolina Highways* and was found to not be warranted; however, a northbound taper is warranted.

8. CONCLUSIONS

This Traffic Impact Analysis was conducted to determine the potential traffic impacts of the Zebulon Mixed-Use development to be located east of Zebulon Road and south of Pippin Road in Zebulon, North Carolina. The proposed development, anticipated to be completed in 2028, is assumed to consist of 200 apartments, 19,500 square feet (s.f.) retail, 9,500 s.f. high-turnover restaurant, 2,000 s.f. coffee shop with drive-through. In accordance with the Town UDO the study will utilize a build+1 for future year traffic conditions. Site access is proposed via one full-movement driveway along Zebulon Road across from Bobbfield Way and one right-in/right-out (RIRO) access along Zebulon Road.

The study analyzes traffic conditions during the weekday AM and PM peak hours for the following scenarios:

- 2024 Existing Traffic Conditions
- 2029 No-Build Traffic Conditions
- 2029 Build Traffic Conditions

Trip Generation

Primary site trips are expected to generate approximately 214 trips (97 entering and 117 exiting) during the weekday AM peak hour and 184 trips (109 entering and 75 exiting) during the weekday PM peak hour.

Adjustments to Analysis Guidelines

Capacity analysis at all study intersections was completed according to NCDOT Congestion Management Guidelines. Refer to section 6.1 of this report for a detailed description of any adjustments to these guidelines made throughout the analysis.

Intersection Capacity Analysis Summary

All the study area intersections (including the proposed site driveways) are expected to operate at acceptable levels-of-service under existing and future year conditions with the exception of the intersections listed below. A summary of the study area intersections that are expected to need improvements are as follows:

NC 96 & Riley Hill Road

The minor-street approaches are expected to operate at LOS F during both the weekday AM and PM peak hours. It is important to note that the proposed development is only expected to account for less than 8% of the traffic at the intersection, primarily the mainline through traffic. The proposed development is expected to only account for less than 6% of the traffic along the westbound approach during both the weekday AM and PM peak hours.

The intersection to the south, NC 96 and Green Pace Road, is signalized, which is expected to provide gaps in the mainline traffic which will allow traffic from the minor-street approaches to be able to flow into mainline traffic or cross the intersection. Traffic from the westbound approach can also utilize the intersection of NC 96 and Green Pace Road via the intersection of Proctor Street and Green Pace Road, providing an alternative route to Riley Hill Road or NC 96.

NC 96 & Bobbfield Way/Access 1

The minor-street approaches are expected to operate at LOS F during both the weekday AM and PM peak hours. It is important to note that the intersection to the north, NC 96 and Pippin Road, is signalized, which is expected to provide gaps in the mainline traffic which will allow traffic from the minor-street approaches to be able to flow into mainline.

A northbound right-turn lane and a southbound left-turn lane were considered based on the NCDOT *Policy on Street and Driveway Access to North Carolina Highways* and are recommended. It should be noted that a right-turn lane may impact the driveway for the business to the south of the development. If significant impacts to the business would occur, a right-turn lane taper in lieu of a full turn lane is recommended.

NC 96 & Access 2

The minor-street approach is expected to operate at LOS C or better during both the weekday AM and PM peak hours. Queueing at the minor-street approach is not expected to exceed 71 feet (approximately 3 vehicles).

A northbound right-turn lane was considered based on the NCDOT *Policy on Street and Driveway Access to North Carolina Highways* and was found to not be recommended; however, a northbound right-turn taper is warranted and is recommended.

9. RECOMMENDATIONS

Based on the findings of this study, specific geometric improvements have been identified and are recommended to accommodate future traffic conditions. See a more detailed description of the recommended improvements below. Refer to Figure 12 for an illustration of the recommended lane configuration for the proposed development.

Future Traffic Improvements

NC 96 & Pearces Road

- Construct an additional southbound through lane.
- Restripe the existing westbound right-turn lane to a shared left-right turn lane.
- Signal timing modifications.

Recommended Improvements by Developer

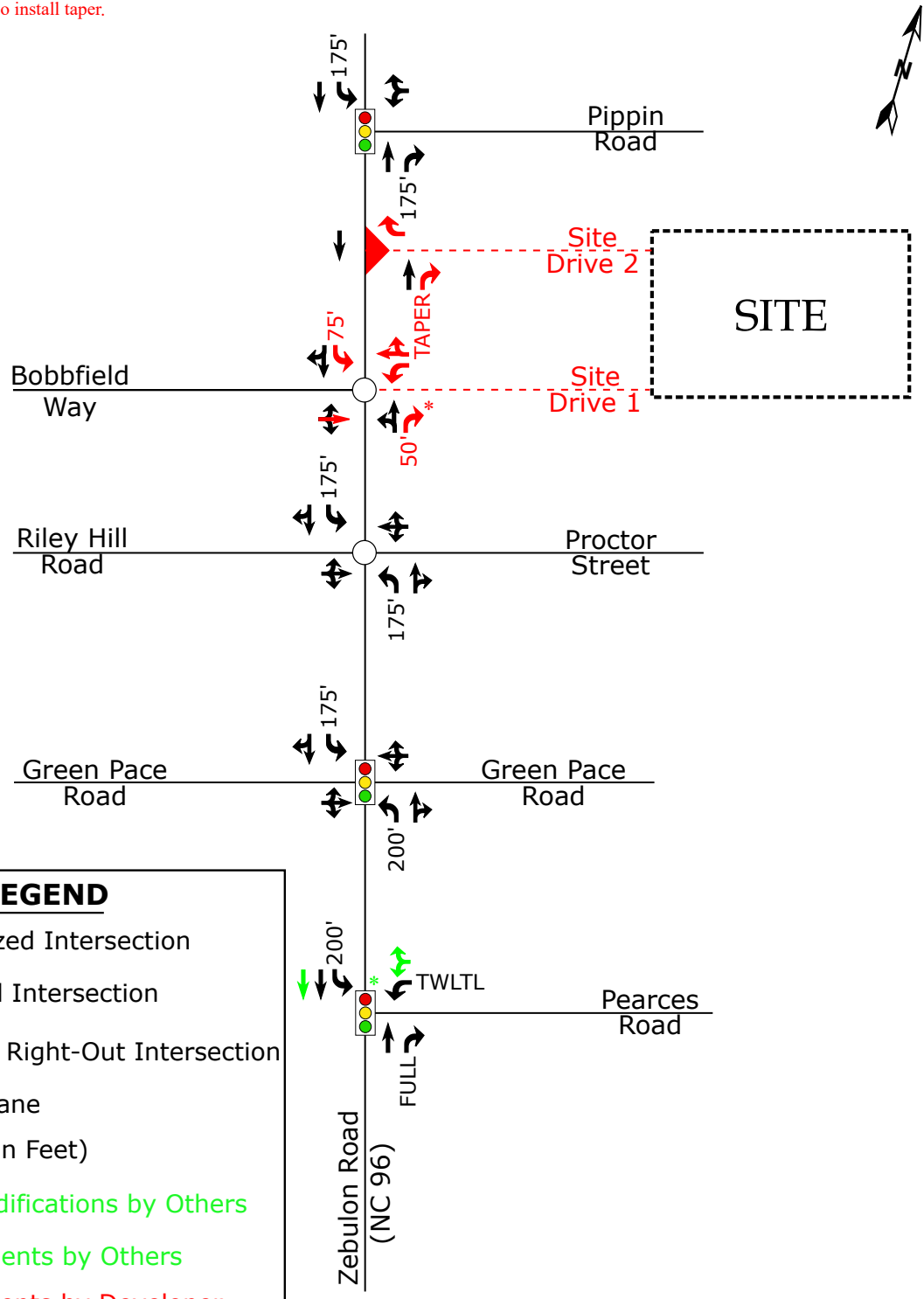
NC 96 & Bobbfield Way/Access 1

- Construct the westbound approach with at least one ingress lane and two egress lanes striped as a left-turn lane and a shared through-right turn lane.
- Provide stop control for the westbound approach.
- Construct a northbound right-turn lane with at least 50 feet of storage and appropriate taper, it should be noted that right-of-way might be limited. If so a taper is recommended.
- Construct a southbound left-turn lane with at least 75 feet of storage and appropriate taper.

NC 96 & Access 2

- Construct the westbound approach with at least one ingress lane and one egress lane striped as a right-out.
- Provide stop control for the westbound approach.
- Construct a northbound right-turn taper.

*Potential ROW impacts. If so install taper.



LEGEND

- Unsignalized Intersection
- ⦿ Signalized Intersection
- ▲ Right-In / Right-Out Intersection
- Existing Lane
- x' Storage (In Feet)
- * Signal Modifications by Others
- ➔ Improvements by Others
- ➔ Improvements by Developer



Zebulon Road Mixed-Use
Zebulon, NC

Recommended Lane
Configurations

Scale: Not to Scale Figure 12