Halifax Transportation Safety & Operations Study

August 2022

Michael Baker INTERNATIONAL

VDOT Virginia Department of Transportation

Halifax Transportation Safety & Operation Study

Halifax, Virginia
August 2022

Prepared for:

Prepared by:

Table of Contents

1. Introduction **6**

1.1 Introduction 6

1.2 Study Area and Stakeholders 6

2. Existing conditions **7**

2.1 Traffic Conditions and Data 7

2.2 Crash Analysis 11

2.3 Detailed Existing Conditions Overview 12

3 Future Traffic Conditions **19**

3.1 Future Growth 19

3.2 Funded Traffic Improvements 22

3.3 Future No Improvement Traffic Operations 22

4. Alternatives Analysis **24**

4.1 US 501 (Halifax Road) at Sunshine Drive 24

4.2 US 501 (Halifax Road) at Greens Folly Road 25

4.3 Mountain Road at Sinai Road 26

4.4 Greens Folly Road at Sinai Road / River Road 27

5. Proposed Pedestrian Improvements **28**

5.1 VA 360 (Mountain Road) Sidewalk Improvements 28

5.2 Pedestrian Improvements in Downtown Halifax 30

5.3 Sinai Road Sidewalk Improvements 32

5.4 Greens Folly Road Sidewalk Improvements 33

6. Public Involvement Results **34**

6.1 Summary of Pedestrian Improvements 34

6.2 VA 360 (Mountain Road) at Sinai Road 34

6.3 Sinai Road at Greens Folly Road / River Road 34

6.4 US 501 (Halifax Road) at Golf Course Road 34

6.5 US 501 (Halifax Road) at Greens Folly Road 34

6.6 US 501 (Halifax Road) at Sunshine Drive 34

7. Preferred Alternatives and Costs **36**

Figures

Figure 1. Study Area 6
Figure 2. Existing Turn Movement Volumes A 8
Figure 3. Existing Turn Movement Volumes B 9
Figure 4. Crash Density 11
Figure 5. Crash Severity 11
Figure 6. Bethel Rd and Howard P. Anderson Rd Intersection 12
Figure 7. Bethel Rd and Howard P. Anderson Rd Crashes 12
Figure 8. US 501 (Bailey & Main) and VA 360 (Bethel) Intersection 13
Figure 9. US 501 and VA 360 Crashes 13
Figure 10. US 501 (Main) and VA 360 (Mountain) Intersection 14
Figure 11. US 501 (Main) and VA 360 (Mountain) Crashes 14
Figure 12. US 501 (Halifax) and VA 1349 (Sunshine) Intersection 15
Figure 13. US 501 (Halifax) and VA 1349 (Sunshine) Crashes 15
Figure 14. US 501 (Halifax) and VA 654 (Greens Folly) Intersection 16
Figure 15. US 501 (Halifax) and VA 654 (Greens Folly) Crashes 16
Figure 16. VA 654 (Greens Folly/Sinai) and VA 659 (River) Intersection 17
Figure 17. VA 654 (Greens Folly/Sinai) and VA 659 (River) Crashes 17
Figure 18. VA 360 (Mountain) and VA 654 (Sinai) Intersection 18
Figure 19. VA 360 (Mountain) and VA 654 (Sinai) Crashes 18
Figure 20. Future Turn Movement Volumes A 20
Figure 21. Future Turn Movement Volumes B 21
Figure 22. Sunshine Dr Realignment Concept 24
Figure 23. Halifax Rd at Greens Folly Rd Turn Lane Concept 25
Figure 24. Mountain Rd at Sinai Rd Turn Lane Concept 26
Figure 25. Mountain Rd at Sinai Rd Roundabout Concept 26
Figure 26. Greens Folly Rd at Sinai Rd Turn Lane Concept 27
Figure 27. Greens Folly Rd at Sinai Rd Roundabout Concept 27
Figure 28. Mountain Road Sidewalk Improvements A 29
Figure 29. Mountain Road Sidewalk Improvements B 29
Figure 30. Mountain Road Sidewalk Improvements Concept C 29
Figure 31. Downtown Halifax Crosswalks Concept 30
Figure 32. Downtown Halifax Curb Extensions Concept 31
Figure 33. Downtown Halifax Refugee Island Concept 31
Figure 34. Sinai Rd Sidewalk Improvement Concept A 32
Figure 35. Sinai Rd Sidewalk Improvement Concept B 32
Figure 36. Sinai Rd Sidewalk Improvement Concept C 32
Figure 37. Greens Folly Rd Sidewalk Improvement Concept A 33
Figure 38. Greens Folly Rd Sidewalk Improvement Concept B 33
Figure 39. Greens Folly Rd Sidewalk Improvement Concept C 33

Tables

Table 1.1. Existing Synchro Analysis 10

Table 1.2. Existing Synchro Analysis 10

Table 2.1. No Build Synchro Analysis 22

Table 2.2. No Build Synchro Analysis 22

Table 2.3. No Build Synchro Analysis 23

Table 3. Sunshine Build Analysis 24

Table 4. Halifax Rd at Greens Folly Rd Build Analysis 25

Table 5. Mountain Rd at Sinai Rd Build Analysis 26

Table 6. Greens Folly Rd at Sinai Rd Build Analysis 27

Table 7. Public Survey Results 35

Table 8. Build Synchro Analysis Summary 36

Table 9. Preferred Alternative Costs 37

Appendices

Appendix A: 2020 Halifax Existing Turn Movement Counts 37

Appendix B: Synchro Reports 219

Appendix C: Concepts 274

Appendix D: SIDRA Reports 291

1. INTRODUCTION

1.1 Introduction

The Town of Halifax is located at the convergence of two major corridors: US Route 501 and Virginia Route 360. This presents a unique situation for the town. Through this study, this intersection and other locations were reviewed extensively to identify and evaluate solutions that would address the safety issues throughout the study area and to implement solutions that support local and regional goals.

1.2 Study Area and Stakeholders

The study area, as identified in Figure 1, includes the following segments:

- US 501 (Halifax Road) from US 501 / VA Route 360 intersection to Route 654 (Greens Folly Road)
- Virginia Route 360 (Mountain Road) from Route 654 (Sinai Road) to Route 615 (Howard P. Anderson Road)
- Route 654 (Greens Folly Road) from US 501 (Halifax Road) to Sinai Road

The intersections that were evaluated for safety and operational improvements as part of this study include:

- US 501 (LP Bailey Memorial Highway/Main St) and VA 360 (Bethel Road)
- US 501 (Main St) and VA 360 (Mountain Road)
- US 501 (Halifax Road) and VA 1349 (Sunshine Drive)
- US 501 (Halifax Road) and VA 654 (Greens Folly Road)
- VA 360 (Mountain Road) and VA 654 (Sinai Road)
- VA 360 (Bethel Road) and VA 615 (Howard P. Anderson Road)
- VA 659 (River Road) and VA 654 (Greens Folly Road/Sinai Road)

Additionally, US 501 within the Town of Halifax was evaluated for corridor-level improvements at appropriate locations, including:

- Bicycle and pedestrian accommodations
- Traffic calming
- Upgrading to an urban four-lane divided cross-section

The study included a diverse stakeholder group that represents local, regional, and state goals for Halifax County. These members included:

- Town of Halifax
- Halifax County
- Southside Planning District Commission
- Virginia Department of Transportation (VDOT)
- Michael Baker International (MBI)

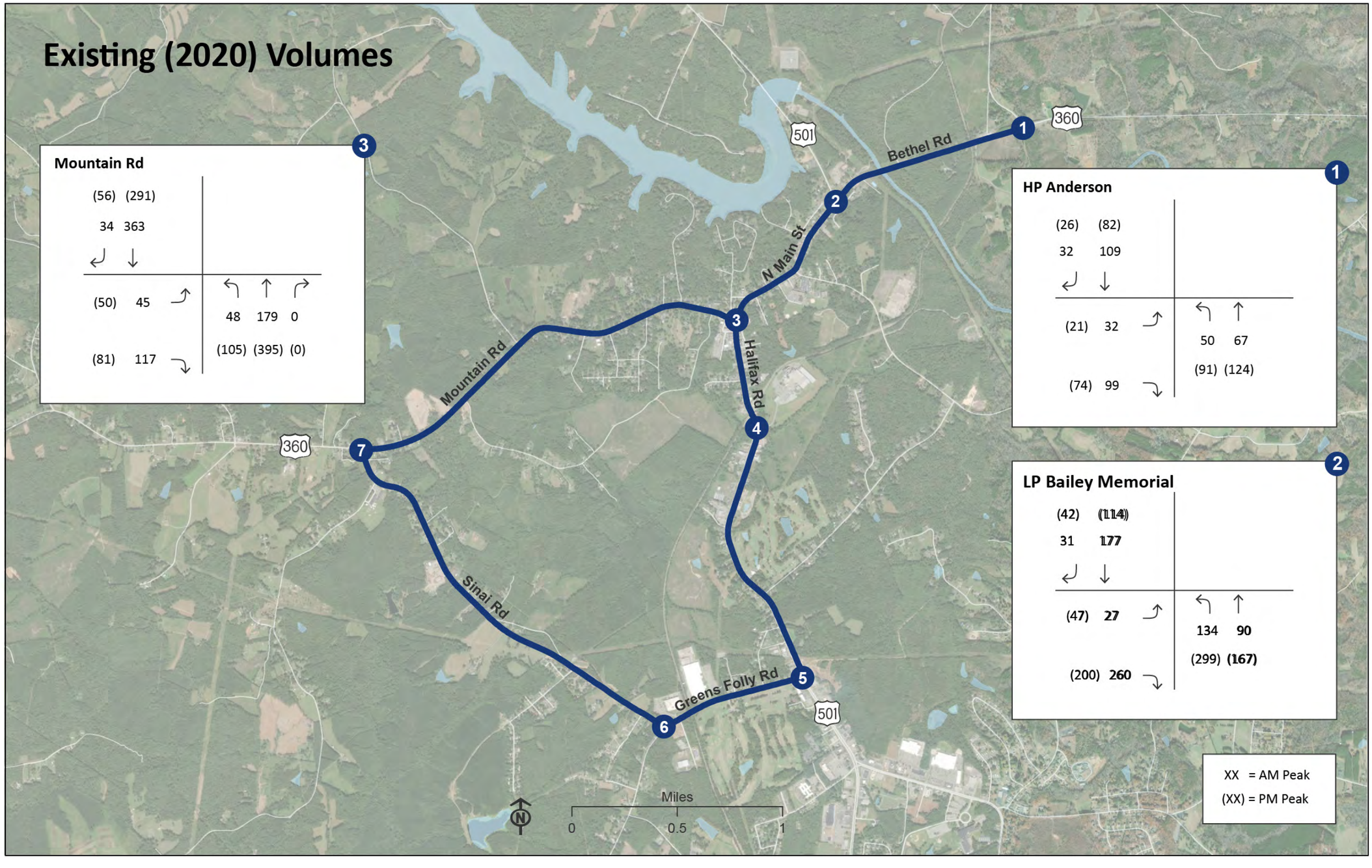
Figure 1. Study Area

2. EXISTING CONDITIONS

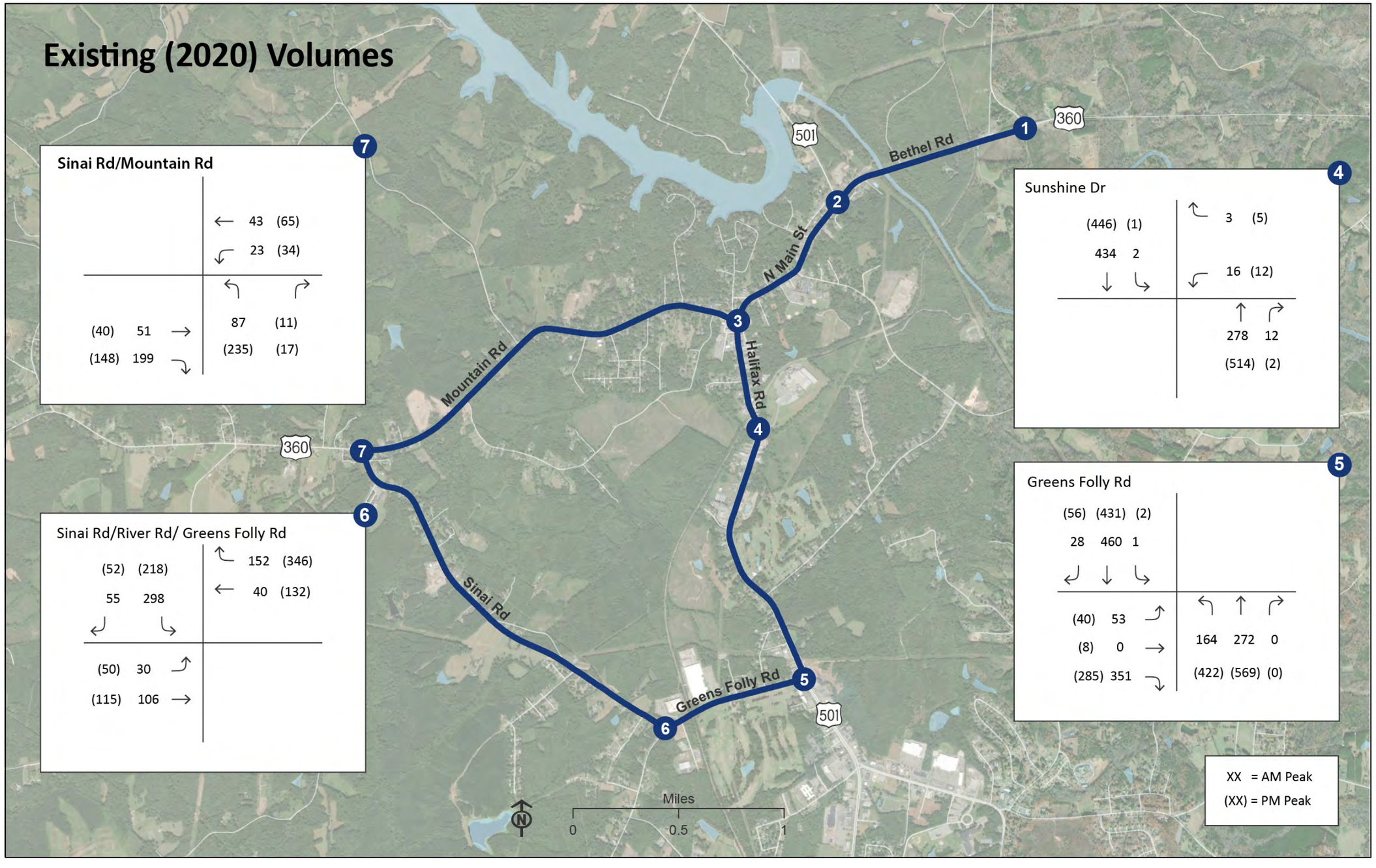
2.1 Traffic Conditions and Data

Existing conditions of the study area were evaluated for the year 2020. A field visit was performed on September 8, 2020, to verify operational and safety concerns. Data collection included obtaining turning movement counts, collected on October 20, 2020, and 2015-2019 crash data from VDOT.

It should be noted that the volumes and surveys collected occurred during the COVID-19 lockdowns of 2020. Therefore, collected volumes needed to be validated with previous data. VDOT Lynchburg District and MBI calibrated the volumes to create a base year (2019) existing condition. This process can be found in Appendix A. The existing year turn movement volumes for this study are summarized in Figures 2 and 3.


Existing (2020) Volumes
Mountain Rd
(56) (291)
34 363
(50) 45
48 179 0
(105) (395) (0)
(81) 117
HP Anderson
(26) (82)
32 109
(21) 32
50 67
(91) (124)
(74) 99
LP Bailey Memorial
(42) (114)
31 177
(47) 27
134 90
(299) (167)
(200) 260
Bethel Rd
N Main St
Halifax Rd
Mountain Rd
Sinai Rd
Greens Folly Rd
360
501
1
2
3
4
5
6
7
XX = AM Peak
(XX) = PM Peak
Miles
0
0.5
1

Existing (2020) Volumes



Finally, traffic operations were analyzed in accordance with the Traffic Operations and Safety Analysis Manual 2.0 (TOSAM). The study team developed Synchro models using the base year volumes for peak hours between 7:15 to 8:15 AM and 4:30 to 5:30 PM. Measures of effectiveness (MOE) for intersections include Highway Capacity Manual (HCM) delay (seconds per vehicle) and Synchro 95th percentile queue length. Tables 1.1 and 1.2 summarize the intersection level of service (LOS) for each of the study intersections.

Table 1.1. Existing Synchro Analysis

Direction	Lane Group	AM Peak Hour		PM Peak Hour	
		Delay (Sec/veh)	LOS	Delay (Sec/veh)	LOS
VA Route 360 (Bethel Road) & Route 626 (HP Anderson Hwy)					
VA Route 360 Eastbound	Left	8.0	A	7.7	A
	Through	0.0	A	0.0	A
VA Route 360 Westbound	Through	0.0	A	0.0	A
	Right	0.0	A	0.0	A
HP Anderson Hwy Southbound	Left	10.1	B	10.2	B
	Right	10.1	B	10.2	B
Overall		4.4	A	4.0	A
US Route 501 (LP Bailey Mem. Hwy) & VA Route 360 (Bethel Road)					
US 501 Southbound	Left	11.9	B	29.4	D
	Right	11.9	B	29.4	D
VA Route 360 Eastbound	Left	8.3	A	8.4	A
	Through	0.0	A	0.0	A
VA Route 360 Westbound	Through	0.0	A	0.0	A
	Right	0.0	A	0.0	A
Overall		6.3	A	6.8	A
US Route 501 (Main Street) & VA Route 360 (Mountain Road)					
US 501 Northbound	Left	3.7	A	3.2	A
	Through	3.5	A	3.9	B
US 501 Southbound	Through	9.9	A	9.2	A
	Right	6.9	A	7.1	A
VA Route 360 Eastbound	Left	48.2	D	51.2	D
	Right	45.3	D	46.8	D
Overall		15.4	B	11.5	B

Table 1.2. Existing Synchro Analysis

Direction	Lane Group	AM Peak Hour		PM Peak Hour	
		Delay (Sec/veh)	LOS	Delay (Sec/veh)	LOS
US Route 501 (Halifax Road) & Sunshine Drive					
US 501 Northbound	Through	0.0	A	0.0	A
	Right	0.0	A	0.0	A
US 501 Southbound	Left	8.0	A	9.8	A
	Through	0.0	A	0.0	A
Sunshine Drive Westbound	Left	14.2	B	20.5	C
	Right	14.2	B	20.5	C
Overall		0.4	A	0.4	A
US Route 501 (Halifax Road) & Greens Folly Road					
US 501 Northbound	Left	6.8	A	8.3	A
	Through	10.1	B	8.0	A
US 501 Southbound	Through	18.6	B	18.1	B
	Right	15.4	B	15.3	B
"Greens Folly Road Eastbound"	Left	26.4	C	32.3	C
	Right	26.7	C	18.2	B
Overall		17.8	B	12.8	B
Greens Folly Road & Sinai Road / River Road					
River Road Eastbound	Left	11.9	B	7.6	A
	Through	11.9	B	7.6	A
Greens Folly Road Westbound	Through	11.0	B	11.0	B
	Right	11.0	B	11.0	B
Sinai Road Southbound	Left	12.9	B	37.9	D
	Right	12.9	B	37.9	D
Overall		12.1	B	18.4	B
VA Route 360 (Mountain Road) & Sinai Road					
VA Route 360 Eastbound	Through	0.0	A	0.0	A
	Right	0.0	A	0.0	A
VA Route 360 Westbound	Left	3.1	A	3.0	A
	Through	3.1	A	3.0	A
"Woody's Lake Road Westbound"	Left	10.8	B	12.4	B
	Right	10.8	B	12.4	B

2.2 Crash Analysis

The study team collected crash data from VDOT between 2015 and 2019. Crash data analyses included review of time of day, weather conditions, crash severity, and crash type. Crashes were weighted by severity using the Equivalent Property Damage Only (EPDO) based on the SMART SCALE weights but including property damage only crashes as well. Figure 4 displays the density of crashes throughout the study area, while Figure 5 summarizes the severity of each of the crashes in the study area.

The Section 2 sub-sections provide a detailed analysis for each broken-out segment. A figure summarizing the detailed crash history at each intersection is provided before any discussion. Operational results for analyzed intersections are also provided, when applicable.

Figure 4. Crash Density

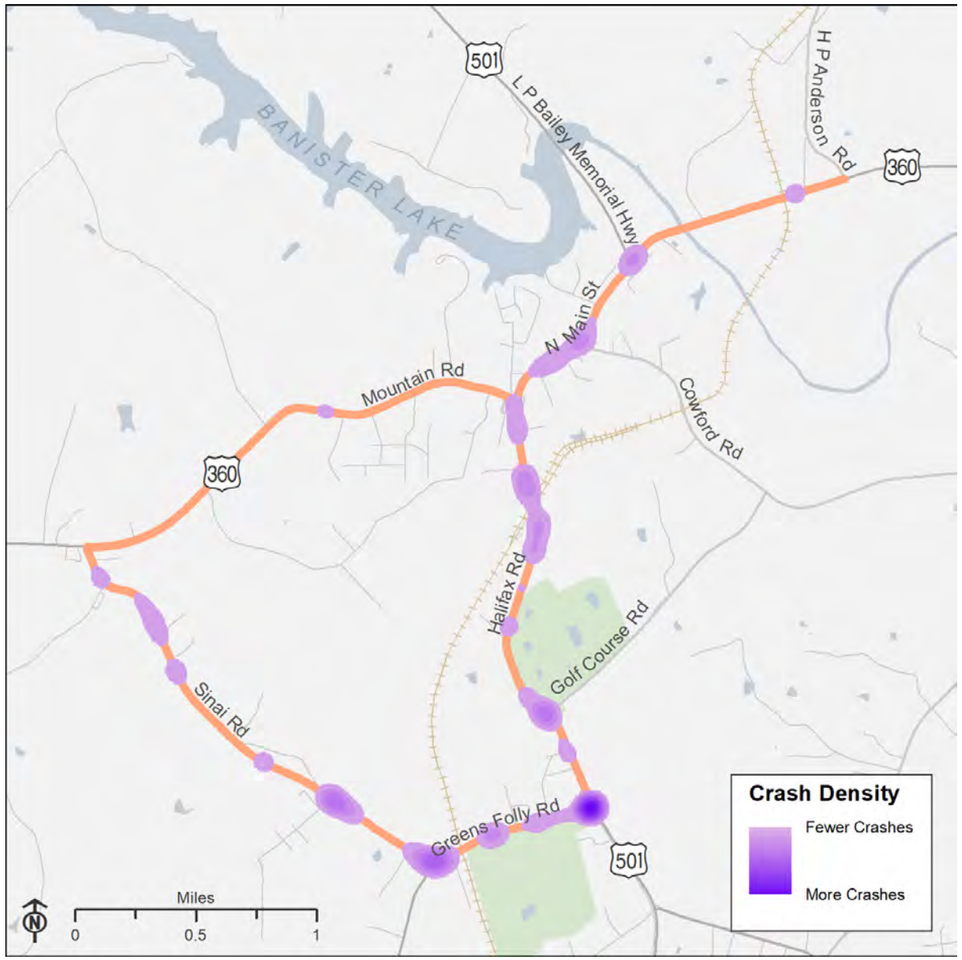
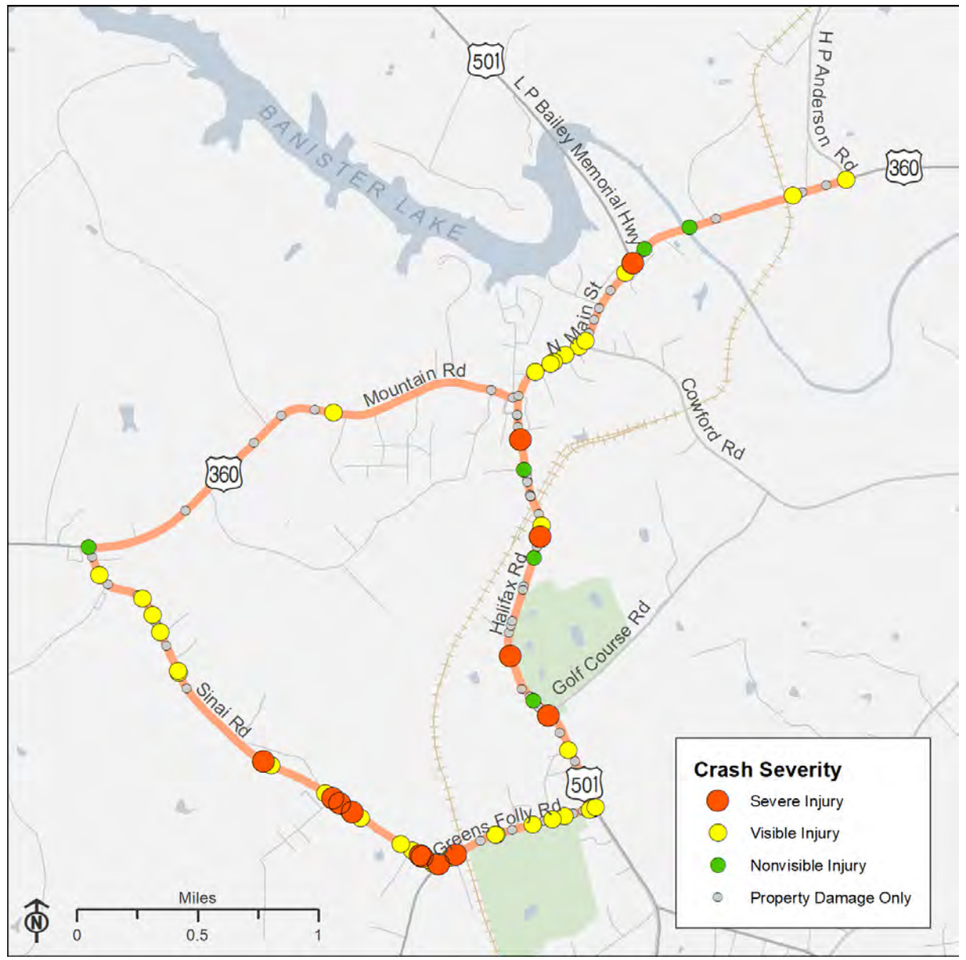


Figure 5. Crash Severity



2.3 Detailed Existing Conditions Overview

2.3.1 VA 360 (Bethel Road) and VA 615 (Howard P. Anderson Road)

Figure 6. Bethel Rd and Howard P. Anderson Rd Intersection

The intersection of Bethel Road and Howard P. Anderson Road is an unsignalized T-intersection, with Howard P. Anderson Road being stop-controlled. Bethel Road is classified as a Minor Arterial, while HP Anderson Road is a Major Collector. Turn lanes exist along all three approaches. Sight-distance appears adequate despite the intersection being situated at the crest of a vertical curve. There were two crashes reported within the influence area of the intersection; both are classified as angle crashes. Crash summary results can be found in Figure 7.

Operationally, the intersection experiences more delay in the AM peak period (4.4 seconds) than the PM peak period (4.0 seconds). This is a result of higher volumes along both the westbound Bethel Road and HP Anderson Road approaches during the AM peak.

Figure 7. Bethel Rd and Howard P. Anderson Rd Crashes

2.3.2 US 501 (LP Bailey Memorial Highway/Main St) and VA 360 (Bethel Road)

Figure 8. US 501 (Bailey & Main) and VA 360 (Bethel) Intersection

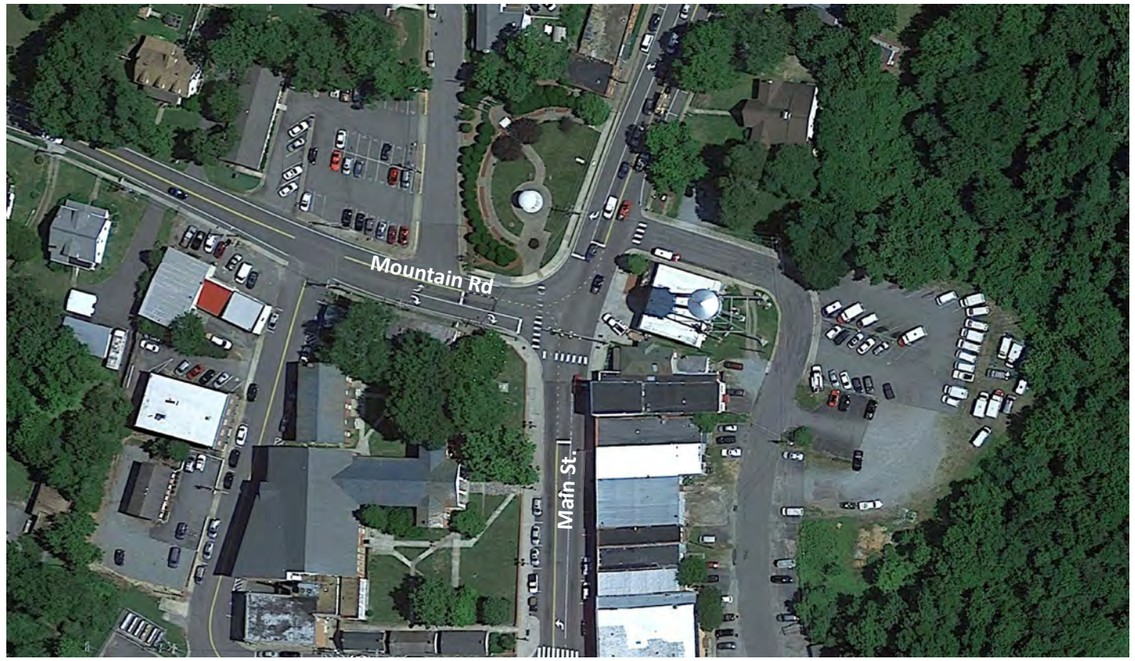
LP Bailey Memorial Highway, functionally classified as a Minor Arterial, operates under stop-control at this unsignalized T-intersection. Turn lanes exist along all three approaches. Angle crashes are the most prevalent crash type with two (2) such crashes, including one severe injury involving the left turn from LP Bailey Memorial Highway to Bethel Road.

Operationally, the intersection operates at LOS A in both peak periods. This intersection will be converted to a four-way single-lane roundabout through SMART SCALE funding; operations and safety should be monitored once the project is completed.

Figure 9. US 501 and VA 360 Crashes

2.3.3 US 501 (Main St) and VA 360 (Mountain Road)

Figure 10. US 501 (Main) and VA 360 (Mountain) Intersection



This T-intersection is the convergence of two Minor Arterials, with all approaches under signal control. A recent sidewalk project has been completed, with new ramps along the western side of the intersection. The intersection operates at LOS B in both the AM and PM peak periods, with delays of 18 seconds and 12.7 seconds respectively. One crash occurred at the intersection in the past five years of crash data – a rear-end crash along the southbound approach.

Figure 11. US 501 (Main) and VA 360 (Mountain) Crashes

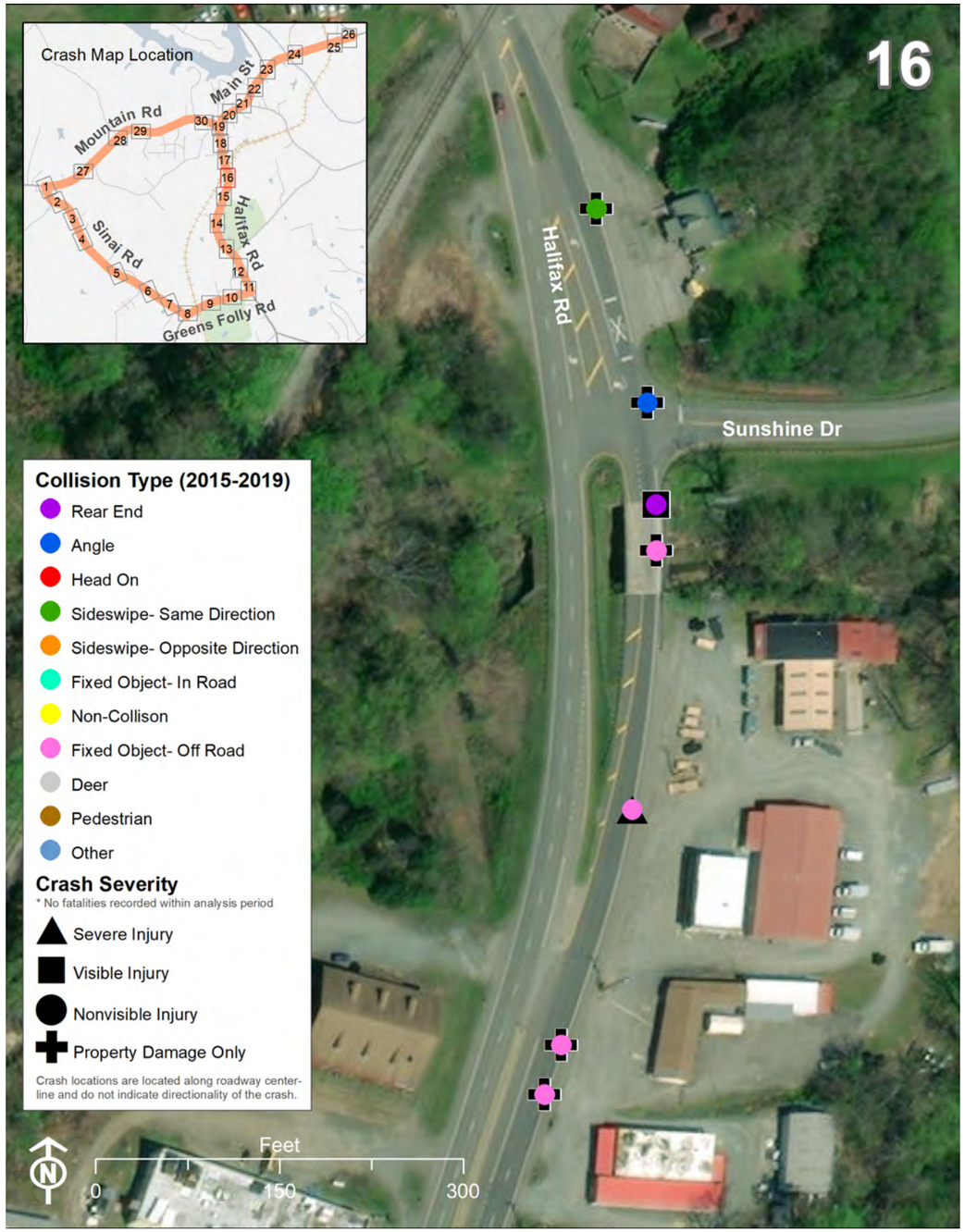
2.3.4 US 501 (Halifax Rd) and VA 1349 (Sunshine Dr)

Figure 12. US 501 (Halifax) and VA 1349 (Sunshine) Intersection

This is a three-legged intersection with Sunshine Drive, a Local Road, operating under stop control. A noted issue at this intersection is the radius at the northbound approach to Sunshine Drive; the radius is less than the desired 50 foot minimum. It was observed in the field that heavy vehicles, when performing the right turn from northbound US 501 onto Sunshine Drive, were encroaching into the westbound approach lane, which has the potential for crashes. A review of the crash data reveals that one (1) angle, one (1) rear-end, and one (1) roadway departure have occurred at this intersection within the past five (5) years of available data. Sunshine Drive functions as an exclusive entrance to a manufacturing plant; because of this, there are low volumes entering and exiting during the peak periods.

Operations at this intersection are exceptional, with overall intersection delays of 0.3 seconds and 0.4 seconds in the AM and PM peak periods, respectively. The Sunshine Drive approach operates at LOS B (13.8 seconds) in the AM, and LOS C (23.5 seconds) in the PM.

Figure 13. US 501 (Halifax) and VA 1349 (Sunshine) Crashes



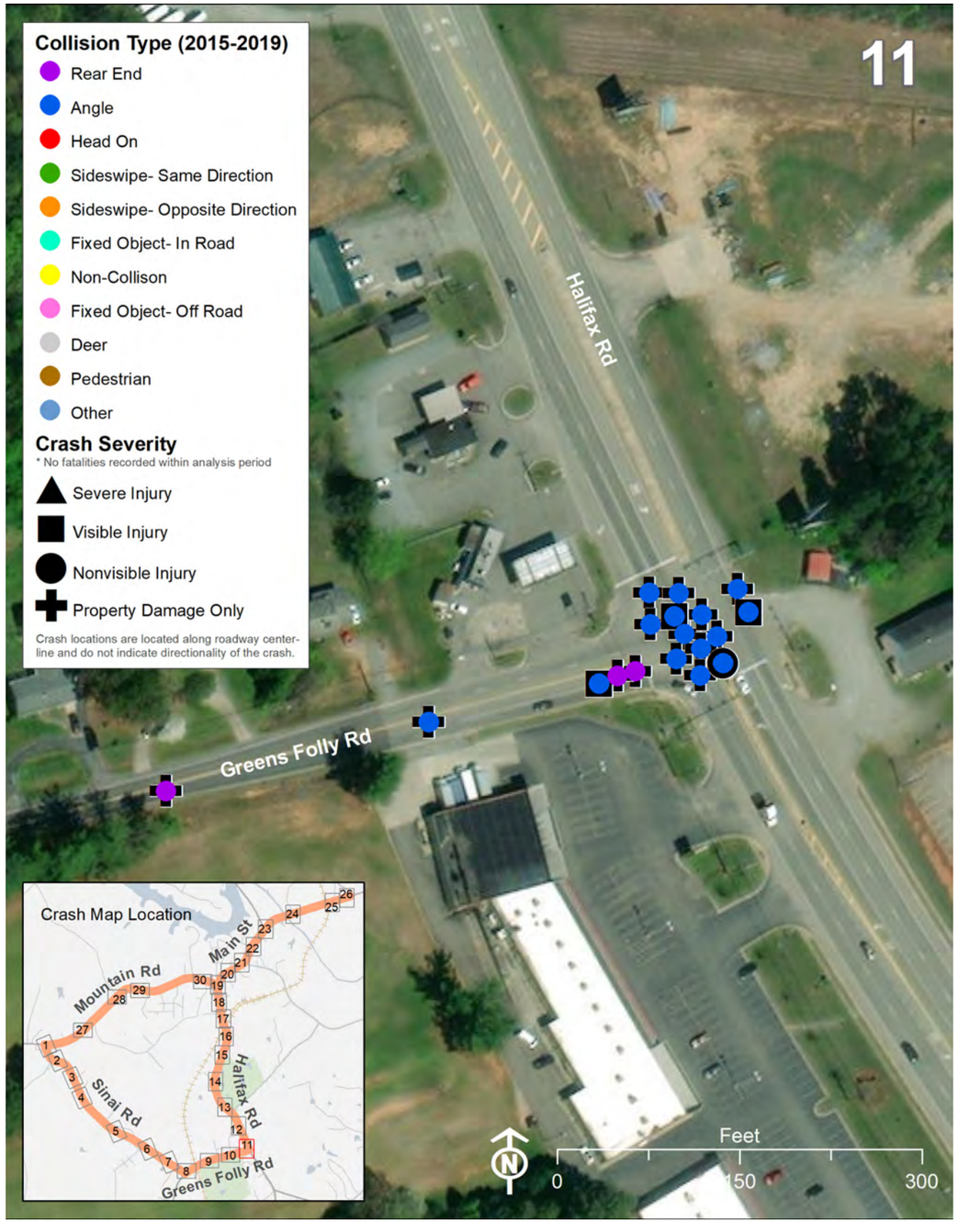
2.3.5 US 501 (Halifax Rd) and VA 654 (Greens Folly Rd)

Figure 14. US 501 (Halifax) and VA 654 (Greens Folly) Intersection

This intersection currently operates under signal control, except for the eastern (westbound) approach, which is a commercial entrance. Like Halifax Road, Greens Folly Road is classified as a Minor Arterial. The northbound and southbound approaches both feature protective-permissive phasing for left turns. Operations observed in the field indicated acceptable operations, which was verified via Synchro. The delay for the intersection was worse during the AM peak (17.8 seconds) than the PM peak (12.8 seconds); in both scenarios, the eastbound approach experienced the greatest delay, 26.6 seconds in the AM peak and 20 seconds in the PM peak.

There have been several crashes at this intersection over the last five (5) years, with angle crashes being the predominant crash type with fifteen (15) such crashes. 11 of those 15 involved the northbound left-turn movement conflicting with the southbound through movements. Due to the protected-permissive phasing of the left turn, it is possible that drivers selected insufficient gaps to perform the left turns during the permissive phase, leading to several crashes. There were also four (4) rear-end crashes, with two of those in the northbound left-turn lane. With commercial entrances within the influence area of the intersection, it is likely that some of the other angle crashes involved vehicles attempting to exit from said entrances.

Figure 15. US 501 (Halifax) and VA 654 (Greens Folly) Crashes



2.3.6 VA 654 (Greens Folly Rd/Sinai Rd) at VA 659 (River Rd)

Figure 16. VA 654 (Greens Folly/Sinai) and VA 659 (River) Intersection

VA 654 changes from Sinai Road to Greens Folly Road at the signalized intersection with River Road. All approaches are single-lane, with the eastbound River Road approach featuring protect-permissive phasing for left turns. During the AM and PM peak periods, the intersection operates at LOS B with delays of 12.1 seconds and 18.4 seconds, respectively. During the PM peak, the southbound Sinai Road approach experiences delays in excess of 35 seconds (37.9), which equates to LOS D.

Regarding safety, it was observed that sight distance leading up to the intersection is limited along the eastbound and southbound approaches due to horizontal and vertical curves. While there were no crashes along the eastbound River Road approach, along southbound Sinai Road there were five (5) rear-end crashes, with the furthest crash occurring approximately 320 feet north of the stop bar. A possible contributor to these crashes could be a lack of visibility of the signal heads due to the vertical curves. Several rear-end crashes occurred along the westbound Greens Folly Road approach, although it is possible that these crashes involved the private entrances leading up to the intersection. Two angle crashes occurred at the signal, with both crashes resulting in injuries.

Figure 17. VA 654 (Greens Folly/Sinai) and VA 659 (River) Crashes

2.3.7 VA 360 (Mountain Rd) at VA 654 (Sinai Rd)

Figure 18. VA 360 (Mountain) and VA 654 (Sinai) Intersection

Sinai Road, a Major Collector, begins at a three-way intersection with Mountain Road (classified as a Minor Arterial), with the Sinai Road approach operating under stop-control. All approaches at this intersection are single lane only. The eastbound approach features a large right-turn radius, allowing right-turn vehicles to execute this movement at higher speeds, clearing them from the eastbound through lane without causing delay for the eastbound through movement. The Synchro analysis reports that overall intersection LOS is A for both peak periods, with the mainline experiencing minimal delay. The northbound Sinai Road approach experienced delays of 10.8 seconds and 12.4 seconds in the AM and PM peaks respectively. While the Synchro reports queue lengths of 17 feet and 44 feet, the queue lengths observed in the field were longer. This is partially attributable to the high percentage of heavy vehicles; indeed, a logging contractor's property exists just south of the intersection.

There is limited crash history at this intersection; only an animal crash and a separate roadway departure crash were reported within the last five years of available data.

Figure 19. VA 360 (Mountain) and VA 654 (Sinai) Crashes

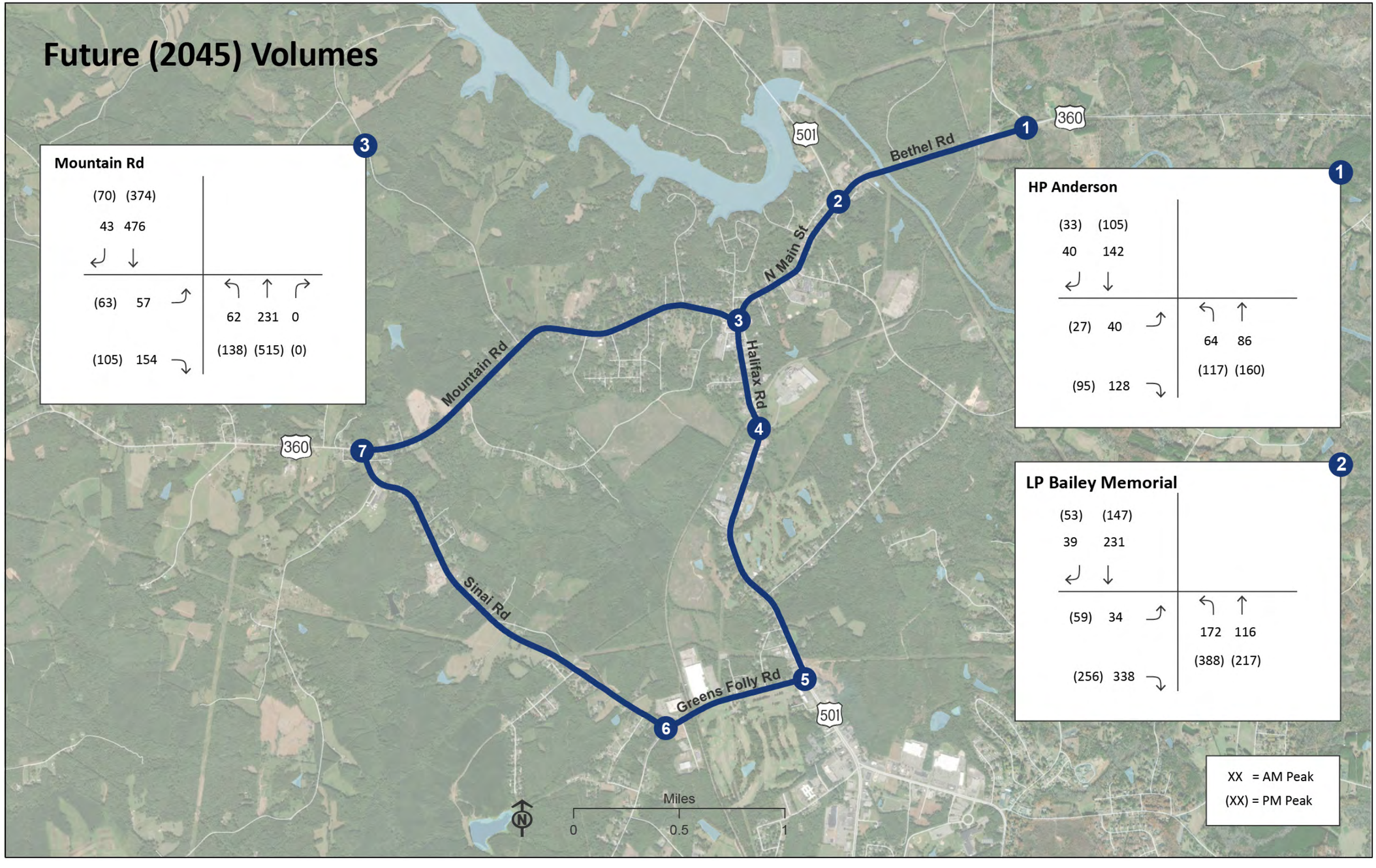
3 FUTURE TRAFFIC CONDITIONS

3.1 Future Growth

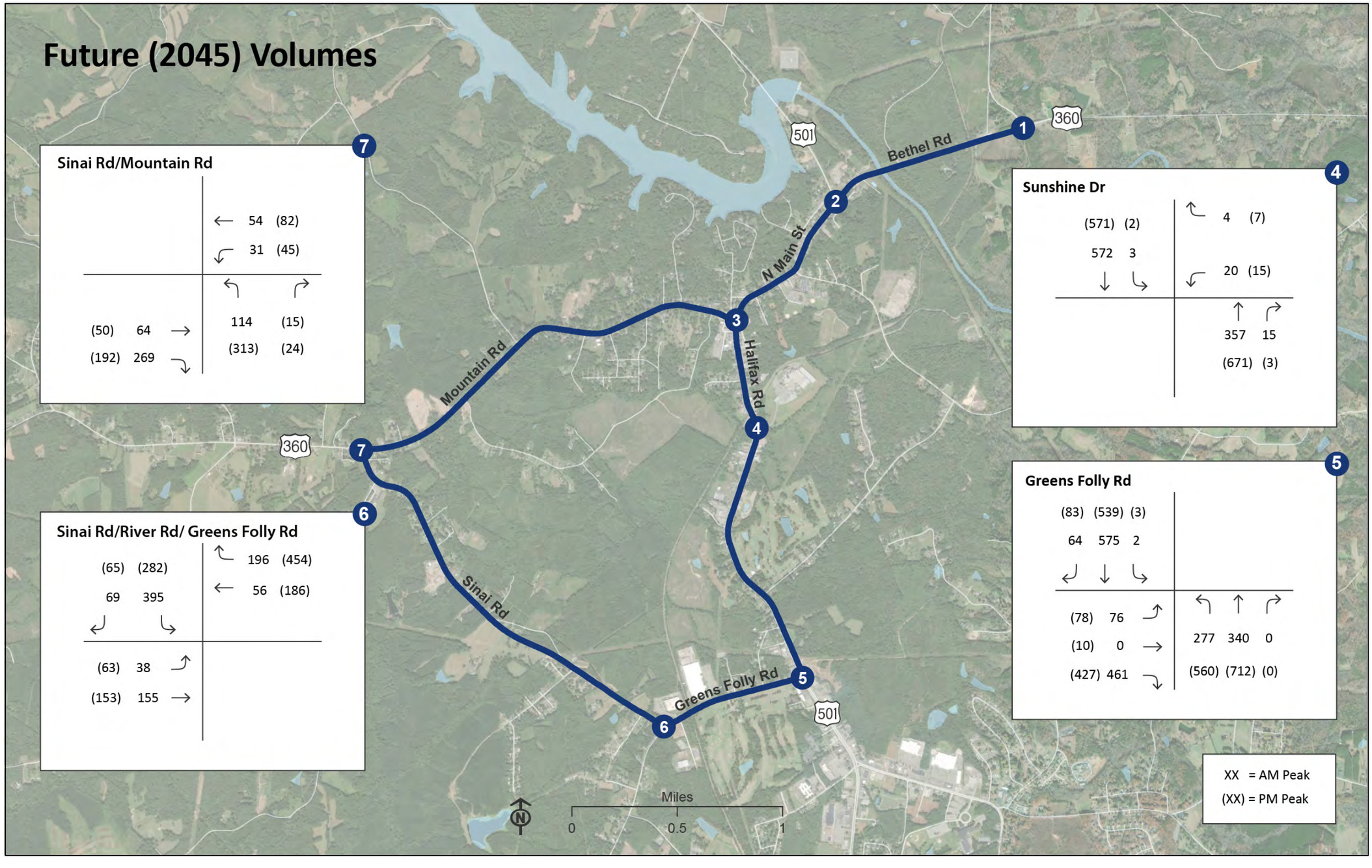
The stakeholder group agreed on a 2045 forecast year to evaluate future operations of the study intersections. The growth rates were based on VDOT's Statewide Travel Demand Model, historical volumes, and funded developments. The growth rates were approved by VDOT and the stakeholder group on June 10, 2021. The 2045 volumes, provided in Figures 20 and 21, were developed based on the following assumptions:

- 1% background linear growth rate applied to all Existing (2020) volumes
- Site Traffic ITE Calculation for the anticipated warehouse along Greens Folly Road

Future (2045) Volumes



Future (2045) Volumes



Sinai Rd/Mountain Rd (7)

	← 54 (82)	
	↰ 31 (45)	
	↰	↱
(50) 64 →	114	(15)
(192) 269 ↘	(313)	(24)

Sunshine Dr (4)

(571) (2)	↰ 4 (7)	
572 3	↰ 20 (15)	
↓	↓	↘
	357	15
	(671)	(3)

Sinai Rd/River Rd/ Greens Folly Rd (6)

(65) (282)	↰ 196 (454)	
69 395	← 56 (186)	
↲	↓	↘
(63) 38 ↱		
(153) 155 →		

Greens Folly Rd (5)

(83) (539) (3)		
64 575 2		
↲	↓	↘
	↰	↑ ↱
(78) 76 ↱	277	340 0
(10) 0 →	(560)	(712) (0)
(427) 461 ↘		

3.2 Funded Traffic Improvements

Multiple improvements on the Route 256 corridor have been funded and are expected to be completed before the analysis year. The intersection of US 501 and Route 360 will be converted from two-way stop control to a single-lane roundabout. A fourth leg will be added to this intersection after Back Street is realigned. These improvements have been funded and are anticipated to be built prior to the analysis year.

3.3 Future No Improvement Traffic Operations

The Synchro models were updated with 2045 volumes, the funded improvements, and optimized signal timings. Tables 2.1, 2.2, and 2.3 summarize the future no-improvement conditions throughout the study area.

Table 2.1. No Build Synchro Analysis

Direction	Lane Group	AM Peak Hour		PM Peak Hour	
		Delay (Sec/veh)	LOS	Delay (Sec/veh)	LOS
VA Route 360 (Bethel Road) & Route 626 (HP Anderson Hwy)					
VA Route 360 Eastbound	Left	8.1	A	7.9	A
	Through	0.0	A	0.0	A
VA Route 360 Westbound	Through	0.0	A	0.0	A
	Right	0.0	A	0.0	A
HP Anderson Hwy Southbound	Left	10.7	B	10.9	B
	Right	10.7	B	10.9	B
Overall		4.6	A	4.2	A
US Route 501 (LP Bailey Mem. Hwy) & VA Route 360 (Bethel Road)					
Back Street Northbound	Left	7.6	A	10.3	A
	Through	2.3	A	5.0	A
	Right	3.3	A	6.0	A
US 501 Southbound	Left	12.9	B	10.6	B
	Through	4.9	A	4.0	A
	Right	5.5	A	4.6	A
VA Route 360 Eastbound	Left	9.3	A	9.5	A
	Through	3.2	A	3.6	A
	Right	3.4	A	3.9	A
VA Route 360 Westbound	Left	10.2	B	11.8	B
	Through	4.5	A	6.8	A
	Right	6.2	A	7.3	A
Overall		6.0	A	6.9	A

Table 2.2. No Build Synchro Analysis

Direction	Lane Group	AM Peak Hour		PM Peak Hour	
		Delay (Sec/veh)	LOS	Delay (Sec/veh)	LOS
US Route 501 (Main Street) & VA Route 360 (Mountain Road)					
US 501 Northbound	Left	4.8	A	4.5	A
	Through	4.0	A	5.5	B
US 501 Southbound	Through	11.6	A	11.9	A
	Right	7.4	A	8.5	A
VA Route 360 Eastbound	Left	48.4	D	48.2	D
	Right	44.9	D	44.5	D
Overall		16.3	B	12.8	B
US Route 501 (Halifax Road) & Sunshine Drive					
US 501 Northbound	Through	0.0	A	0.0	A
	Right	0.0	A	0.0	A
US 501 Southbound	Left	8.1	A	10.4	B
	Through	0.0	A	0.0	A
Sunshine Drive Westbound	Left	16.3	C	26.2	D
	Right	16.3	C	26.2	D
Overall		0.4	A	0.5	A
US Route 501 (Halifax Road) & Greens Folly Road					
US 501 Northbound	Left	7.1	A	40.4	D
	Through	8.1	A	9.4	A
US 501 Southbound	Through	19.0	B	19.9	B
	Right	15.3	B	16.3	B
Greens Folly Road Eastbound	Left	33.5	C	33.4	C
	Right	37.6	D	24.4	C
Overall		20.4	C	22.6	C
Greens Folly Road & Sinai Road / River Road					
River Road Eastbound	Left	14.6	B	9.6	A
	Through	14.6	B	9.6	A
Greens Folly Road Westbound	Through	13.4	B	15.5	B
	Right	13.4	B	15.5	B
Sinai Road Southbound	Left	15.8	C	41.6	D
	Right	15.8	C	41.6	D
Overall		14.9	B	22.0	C

Table 2.3. No Build Synchro Analysis

Direction	Lane Group	AM Peak Hour		PM Peak Hour	
		Delay (Sec/veh)	LOS	Delay (Sec/veh)	LOS
VA Route 360 (Mountain Road) & Sinai Road					
VA Route 360 Eastbound	Through	0.0	A	0.0	A
	Right	0.0	A	0.0	A
VA Route 360 Westbound	Left	3.2	A	3.3	A
	Through	3.2	A	3.3	A
Woody's Lake Road Westbound	Left	10.9	B	14.8	B
	Right	10.9	B	14.8	B
Overall		3.1	A	7.6	A

In general, all intersections' operational delays worsen by 2045, relative to existing conditions. Although operations at each intersection are projected to deteriorate, most of the study intersections are anticipated to operate exceptionally (LOS B or better), with minimal queueing. However, the following intersections are projected to have excessive delays and queues for certain movements:

- US 501 (Halifax Road) and VA 654 (Greens Folly Road)
  - Northbound left turn movement increases 487% from 8.3 seconds in existing conditions to 40.4 seconds in the no-build condition during the PM peak
  - Queues are also projected to increase from 139 feet in existing conditions to 404 feet in the no-build condition during the PM peak
- VA 360 (Mountain Road) and VA 654 (Sinai Road)
  - While the intersection is expected to operate at LOS A during both AM and PM peak periods according to the Synchro model, it should be noted that during the field review queues during the PM peak were observed to be more than 300 feet along the Sinai Road approach. It is expected as the traffic volumes increase, the queue lengths will continue to increase further along this approach
- VA 654/659 (Greens Folly Road/River Road) and VA 654 (Sinai Road)
  - During the PM peak hour, the queue lengths along the Greens Folly Road approach are projected to increase from 182 feet in existing conditions to 330 feet in the no-build condition
  - According to the Synchro report, the 95th percentile volume along the River Road approach exceeds capacity, so the queue lengths may be longer than the calculated back-up of 291 feet

4. ALTERNATIVES ANALYSIS

The stakeholder group determined to move forward with further analysis to develop recommendations at the following locations:

- Intersection of Halifax Road and Sunshine Drive
- Intersection of Halifax Road and Greens Folly Road
- Intersection of Mountain Road and Sinai Road
- Intersection of Sinai Road and Greens Folly Road/River Road

The study team evaluated multiple options that addressed context, operations, and safety when developing alternatives for each intersection. A preliminary analysis was performed using the VDOT Junction Screening Tool (VJuST) to evaluate volume-to-capacity (V/C) ratios (when applicable) and conflict points to help screen initial ideas. Following the initial screening, an alternatives analysis was performed using Synchro HCM overall intersection results for the PM peak hour (controlling hour), estimated right-of-way impacts, and crash modification factors as accepted by VDOT. All alternatives were discussed with the stakeholder group and advanced to the public.

4.1 US 501 (Halifax Road) at Sunshine Drive

4.1.1 Sunshine Drive Realignment

Due to the aforementioned difficulty of heavy vehicles performing a right turn onto Sunshine Drive, several alternatives were discussed, including the replacement of the existing bridge structure. The alternative that was brought forward for Synchro analysis was the realignment of Sunshine Drive to the north and reconfiguration of the intersection to a "Turbo-T" intersection. With the inclusion of a median along the southbound US 501 approach, left-turning vehicles from Sunshine Drive will be able to merge onto southbound US 501 without conflict from the opposing southbound through movement. The conversion of the intersection to a Turbo-T is projected to reduce the risk of angle crashes by 15%. A concept sketch of this alternative is shown in Figure 22.

Figure 22. Sunshine Dr Realignment Concept

Table 3. Sunshine Build Analysis

Scenario	PM Intersection Operations (Seconds per Vehicle)	Expected Total Crash Reduction
No Build	0.4 - A	0%
Turbo-T Intersection	0.6 - A	15%

4.2 US 501 (Halifax Road) at Greens Folly Road

4.2.1 Northbound Dual Left-Turn Lanes

This alternative would add another left-turn lane for northbound US 501 left turns onto Greens Folly Road. This alternative would accommodate the projected left-turn volume while removing the protected-permissive phasing for left-turns, which, according to the crash history, may have been a contributing factor in a majority of the crashes at this location. To make this alternative feasible, the second receiving lane along Greens Folly Road would have to be extended approximately 600 feet. This improvement would also extend the southbound US 501 right-turn lane and close or restrict access points within the influence area of the intersection. This alternative would reduce overall intersection delay by 62% while decreasing the queue lengths for the northbound left turn from 404 feet to 228 feet. A concept sketch of this alternative is shown in Figure 23.

Figure 23. Halifax Rd at Greens Folly Rd Turn Lane Concept

Table 4. Halifax Rd at Greens Folly Rd Build Analysis

Scenario	PM Intersection Operations (Seconds per Vehicle)	Expected Total Crash Reduction
No Build	22.6 - C	0%
Dual Northbound Left-Turn Lane	18.4 - B	3%

4.3 Mountain Road at Sinai Road

Two (2) alternatives were considered at this intersection and brought forward for public input: the addition of turn lanes to all approaches or conversion to a single-lane roundabout. Table 5 summarizes the results and concepts for each alternative reviewed.

Table 5. Mountain Rd at Sinai Rd Build Analysis

Scenario	PM Intersection Operations (Seconds per Vehicle)	Expected Total Crash Reduction
No Build	7.6 - A	0%
Single-Lane Roundabout	5.7 - A	80%
Additional Turn Lanes	7.6 - A	15%

4.3.1 Addition of Turn Lanes

To separate left-turning traffic from the westbound through movement, a left-turn lane along westbound Mountain Road is proposed. Additionally, extending the eastbound right-turn lane to include a 100’ taper and 100’ of storage is proposed. Due to right-of-way constraints, the addition of turn lanes for the Sinai Road approach was deemed unfeasible. Nevertheless, this improvement is expected to reduce delay by 25% and the risk of crashes by up to 15%.

Figure 24. Mountain Rd at Sinai Rd Turn Lane Concept

4.3.2 Single-Lane Roundabout

This alternative would convert the existing unsignalized intersection to a single-lane roundabout. The roundabout would be designed for WB-62 (Interstate Semitrailer) vehicles, as heavy vehicles frequent the intersection. An 80% reduction in crashes and a 25% decrease in overall intersection delay in the PM peak hour are anticipated. Queue lengths along the Sinai Road approach are projected to be reduced from 71 feet to 48 feet in the PM peak period.

Figure 25. Mountain Rd at Sinai Rd Roundabout Concept

4.4 Greens Folly Road at Sinai Road / River Road

Two alternatives were considered at this intersection and brought forward for public input: the addition of turn lanes to all approaches or a conversion to a single-lane roundabout. Table 5 summarizes the results and concepts for each alternative reviewed.

Table 6. Greens Folly Rd at Sinai Rd Build Analysis

Scenario	PM Intersection Operations (Seconds per Vehicle)	Expected Total Crash Reduction
No Build	22.0 - C	0%
Roundabout	9.3 - A	60%
Additional Turn Lanes	14.9 - B	15%

4.4.1 Addition of Turn Lanes

The intersection of Greens Folly Road at Sinai Road / River Road has a history of rear-end crashes. To address this pattern, the addition of turn lanes along all three approaches of the intersection was proposed as an alternative. The safety benefit of the additional turn lanes is a 15% reduction in crashes. Operationally, the turn lanes are projected to decrease overall intersection delay by 32% in the PM peak hour. The queue length along Sinai Road is projected to be reduced from 291 feet to 216 feet and on the Greens Folly Road approach from 330 feet to 144 feet.

Figure 26. Greens Folly Rd at Sinai Rd Turn Lane Concept

4.4.2 Single-Lane Roundabout

This alternative would convert the existing signalized intersection to a single-lane roundabout. The roundabout would be designed for WB-62 (Interstate Semitrailer) vehicles, as heavy vehicles frequent the intersection. A 60% reduction in crashes is anticipated, along with a projected 72% decrease in overall intersection delay. Queue lengths along the Greens Folly Road approach are projected to be reduced from 330 feet to 174 feet; queues along Sinai Road are expected to reduce from 291 feet to 65 feet. These numbers are from the PM peak hour analysis.

Figure 27. Greens Folly Rd at Sinai Rd Roundabout Concept

5. PROPOSED PEDESTRIAN IMPROVEMENTS

In addition to the development of intersection improvement concepts, Michael Baker International was tasked with developing bicycle and pedestrian improvements in accordance with the Southside PDC 2045 Rural Long-Range Transportation Plan. The proposed improvements were aimed at completing or extending the existing sidewalk network along key corridors within the study area, as well as identifying locations in the downtown area where traffic calming measures could be implemented. The following alternatives were proposed to, and discussed by, the stakeholder group.

5.1 VA 360 (Mountain Road) Sidewalk Improvements

The Southside PDC's 2045 Long-Range Transportation Plan for Halifax includes completion of the sidewalk network along Mountain Road from Main Street to Ball Park Loop. There are existing segments along Mountain Road beginning at the Main Street intersection, but the network terminates approximately a quarter mile east of Ball Park Loop. Several recommendations along Mountain Road were proposed:

- Due to the pedestrian generators and attractors near Academy Lane, it was proposed to extend the existing sidewalk network to the intersection with Route 349 (Edmunds Boulevard), with two pedestrian crossings near Academy Lane and the Saint John's Episcopal and Halifax United Methodist Churches.
- The northern sidewalk segment terminates near Woodview Road. To provide pedestrians a high-visibility crosswalk to access the sidewalk along the southern flank of Mountain Road, a realignment of the existing sidewalk near Woodview Road was proposed.
- As stated previously, the existing sidewalk network terminates 0.22 miles east of Ball Park Loop. A sidewalk extension and a high-visibility crosswalk at the Ball Park Loop intersection were proposed. The sidewalk would feature a 12' buffer space to tie-in with the existing network but would be tapered to 4' buffer space to avoid conflicts with the existing overhead utilities.

The concept sketches for these improvements are shown in Figure 28, 29, and 30 on the following page.

Figure 28. Mountain Road Sidewalk Improvements A

Figure 29. Mountain Road Sidewalk Improvements B

Figure 30. Mountain Road Sidewalk Improvements Concept C

5.2 Pedestrian Improvements in Downtown Halifax

Any proposed improvements in the downtown area were aimed at facilitating pedestrian traffic while providing access management and traffic calming techniques to slow traffic, as the stakeholder group expressed concerns regarding the safety of pedestrians crossing US 501 (Main Street). After discussions with the stakeholder group, the following improvements were carried forward for public input:

- To facilitate pedestrian traffic at the US 501 (Main Street) and VA 360 (Mountain Road) intersection, an Actuated Pedestrian Signal (APS) system was recommended to provide protected crossings without conflict from vehicular traffic. Additionally, a delineated crossing was proposed along the southbound approach of Main Street for pedestrians wishing to visit the Halifax Veterans Memorial. A concept sketch is shown below.

Figure 31. Downtown Halifax Crosswalks Concept

- At the Cemetery Street intersection, the crosswalk along the southbound Main Street approach conflicts with the left-turn lane. To improve the safety of pedestrians crossing at the intersection, a new crosswalk was proposed along the northbound Main Street approach and would feature curb extensions. A new crosswalk in front of the Halifax Post Office would include a curb extension as well. Curb extensions have been proven by FHWA to slow vehicular turning speeds, shorten pedestrian crossing distance, and increase pedestrian visibility.

Figure 32. Downtown Halifax Curb Extensions Concept

- Towards the southern end of the downtown area, a pedestrian fatality occurred near the local gas station when the pedestrian attempted to cross Main Street. With several pedestrian attractors and generators in this area, providing a dedicated crossing location was deemed imperative by stakeholders. To address this issue along with a history of angle crashes at a commercial entrance, a median refuge concept was proposed. This alternative would combine the use of curb extensions with a median island, which would provide shorter crossing distances and a midpoint shelter for pedestrians attempting to cross Main Street. The location of the refuge island would preclude vehicles from making left-turns from the commercial entrance.

Figure 33. Downtown Halifax Refugee Island Concept

5.3 Sinai Road Sidewalk Improvements

VDOT constructed a temporary paved walkway along Sinai Road from Westside Drive to Greens Folly Road in late 2020 to provide a dedicated route for pedestrians to access the local businesses in the area. VDOT requested that Michael Baker International examine a long-term pedestrian accommodation. A shared-use path was considered, but right-of-way concerns made the alternative financially prohibitive. Taking advantage of the existing right-of-way, a sidewalk network was recommended instead. The sidewalk would feature a length of 0.50 miles and would incorporate the existing mid-block crossing located near Sunny Quik Shop. The sidewalk would also be designed based upon the intersection configuration at Greens Folly Road, should this intersection be converted to a roundabout as well.

The concept sketches for these improvements are shown in Figure 34, 35, and 36.

Figure 34. Sinai Rd Sidewalk Improvement Concept A

Figure 35. Sinai Rd Sidewalk Improvement Concept B

Figure 36. Sinai Rd Sidewalk Improvement Concept C

5.4 Greens Folly Road Sidewalk Improvements

To connect the existing sidewalk network along US 501 near the Town of South Boston with the Sinai Road network, a 0.68-mile sidewalk is recommended for construction along the north side of Greens Folly Road. This concept would include an APS system at the US 501 and Greens Folly Road intersection to facilitate pedestrian crossings. An anticipated challenge associated with this alternative is the railroad line that passes under Greens Folly Road. A pedestrian bridge is recommended to be installed over the railroad line.

The concept sketches for these improvements are shown in Figure 37, 38, and 39.

Figure 37. Greens Folly Rd Sidewalk Improvement Concept A

Figure 38. Greens Folly Rd Sidewalk Improvement Concept B

Figure 39. Greens Folly Rd Sidewalk Improvement Concept C

6. PUBLIC INVOLVEMENT RESULTS

Community feedback was requested via a virtual survey. The virtual survey was conducted between February 11, 2022 and February 25, 2022, asking participants to rate the proposed improvements on a scale from 1 to 5. During this period, 309 participants completed the survey. Below is a summary of the public comments:

- 309 responses were received for the virtual survey
  - 47% of respondents live within the study area
  - 17% worked within five miles of the study area
  - 23% both lived and worked within five miles of the study area
- Community feedback indicated general agreement with the issues identified by the study team
- Most respondents agreed that making no improvements was not acceptable

6.1 Summary of Pedestrian Improvements

All proposed pedestrian improvements scored favorably among participants, with average scores of 3.42 or greater. The crosswalk at the intersection of US 501 (Main Street) and VA 360 (Mountain Road) received the highest average score, with a rating of 3.95. Comments received expressed approval for the recommendations, but with concerns raised regarding ADA accessibility and the inclusion of pedestrian signals at certain locations. Table 7 shows the summary of the average scores for the pedestrian improvements.

6.2 VA 360 (Mountain Road) at Sinai Road

Participants were asked to provide feedback on the two (2) alternatives: Turn-lane improvements or a roundabout. The turn lanes received a score of 4.00, with one comment in agreement that this alternative would improve operations at the intersection. The roundabout option received a score of 3.02, with most comments expressing negative views toward this recommendation. It should be noted that, historically, proposed roundabouts tend to be met with such skepticism, especially in areas where roundabouts are not common. Table 7 shows the summary of the average ratings.

6.3 Sinai Road at Greens Folly Road / River Road

Similar to Mountain Road and Sinai Road, participants were invited to rate the proposed roundabout and turn lane alternatives. The turn lanes received an average rating of 3.78, with a comment responding positively to the alternative, stating that it would improve operations at the intersection. The roundabout option received a score of 3.10, again with most comments expressing negative views toward this recommendation. Table 7 summarizes the ratings.

6.4 US 501 (Halifax Road) at Golf Course Road

Although the intersection with Golf Course Road was not scoped for operational analysis, a crash analysis indicated a pattern of angle crashes at this intersection. To address this issue, two alternatives were introduced: enhancements to the signage at the intersection through the use of oversized, double-mounted warning signs or implementation of an Intersection Conflict Warning System (ICWS). MetroQuest participants gave the Enhanced Signage option a score of 3.53, while the ICWS received a rating of 3.67. Participants agreed that either alternative would improve safety and operations at this intersection. Table 7 summarizing the average ratings.

6.5 US 501 (Halifax Road) at Greens Folly Road

Participants were asked to provide feedback on the proposed additional northbound left-turn lane onto Greens Folly Road. The alternative received an average rating of 3.91, with the sole comment expressing concern that this alternative would increase congestion. Table 7 shows the summary of the average ratings.

6.6 US 501 (Halifax Road) at Sunshine Drive

The realignment of Sunshine Drive received the highest rating of all the alternatives in the survey, with an average rating of 4.05. There were no comments, but the rating indicates approval of the alternative. Table 7 presents the average ratings.

Table 7. Public Survey Results

Recommendation	Ranking (Out of 5)
Pedestrian Improvements	
Mountain Road Crosswalk	**3.95**
Cemetery Street Curb Extension	3.76
Downtown Median Refuge Island	3.42
Mountain Road Sidewalk Extension	3.59
Sinai Road Sidewalk	3.68
Greens Folly Road Sidewalk	3.68
Mountain Road at Sinai Road	
Alternative 1: Install Turn Lanes	4.00
Alternative 2: Single-Lane Roundabout	3.02
Sinai Road at Greens Folly Road / River Road	
Alternative 1: Install Turn Lanes	3.78
Alternative 2: Single-Lane Roundabout	3.10
Halifax Road at Golf Course Road	
Alternative 1: Enhanced Signage	3.53
Alternative 2: Activated Dynamic Warning Signs	3.67
Halifax Road at Greens Folly Road	
Install Turn Lanes	4.00
Halifax Road at Sunshine Drive	
Turbo-T Intersection	4.05

7. PREFERRED ALTERNATIVES AND COSTS

Following the public survey, the stakeholder team reviewed the feedback and selected a preferred alternative for each location. The following recommendations were advanced for refinement of concepts and development of cost estimates:

- US 501 at Sunshine Drive “Turbo-T” realignment
- US 501 at Greens Folly Road Dual Northbound Left Turn Addition
- Greens Folly Road at Sinai Road / River Road Roundabout
- VA 360 at Sinai Road Roundabout
- Mountain Road Sidewalk Extension
- Mountain Road at Main Street Crosswalk Improvements
- Curb Extension Installations in the Downtown Area
- Median Refuge Island Installation near Craddock Street

Table 8 summarizes the future Build conditions for the preferred alternatives, while Table 9 on the following page summarizes the preferred alternatives’ operations, safety benefit, and construction costs. Appendix C has the detailed figures for each recommendation.

All costs were developed using VDOT district and statewide averages. Right-of-way and utilities costs were developed in the Project Cost Estimate System workbook and are based on available parcel data from VDOT and aerial photography.

Table 8. Build Synchro Analysis Summary

Direction	Lane Group	AM Peak Hour		PM Peak Hour	
		Delay (Sec/veh)	LOS	Delay (Sec/veh)	LOS
US Route 501 (Main Street) & VA Route 360 (Mountain Road)					
US 501 Northbound	Through	0.0	A	0.0	A
	Right	0.0	A	0.0	A
US 501 Southbound	Left	8.1	A	10.4	B
	Through	0.0	A	0.0	A
Sunshine Drive Westbound	Left	12.1	B	18.9	C
	Right	12.1	B	18.9	C
Overall		0.8	A	0.6	A
US Route 501 (Halifax Road) & Greens Folly Road					
US 501 Northbound	Left	21.6	C	25.5	C
	Through	4.3	A	4.9	A
US 501 Southbound	Through	25.5	C	23.9	C
	Right	19.5	B	19.0	B
Greens Folly Road Eastbound	Left	34.1	C	33.5	C
	Right	27.5	C	22.2	C
Overall		21.5	C	18.4	B
Greens Folly Road & Sinai Road / River Road					
River Road Eastbound	Left	7.6	A	6.6	A
	Through	8.3	A	6.7	A
Greens Folly Road Westbound	Through	5.5	A	11.2	B
	Right	5.4	A	11.2	B
Sinai Road Southbound	Left	7.9	A	7.4	A
	Right	7.9	A	7.5	A
Overall		7.3	A	9.3	A
VA Route 360 (Mountain Road) & Sinai Road					
VA Route 360 Eastbound	Through	6.1	A	5.1	A
	Right	6.3	A	5.1	A
VA Route 360 Westbound	Left	4.5	A	8.2	A
	Through	4.2	A	5.6	A
Woody's Lake Road Westbound	Left	4.6	A	5.7	A
	Right	5.4	A	5.7	A
Overall		5.6	A	5.7	A

Table 9. Preferred Alternative Costs

Recommendation	Preliminary Engineering Phase	Right-of-Way/ Utility Phase	Construction Phase	Total
Mountain Road at Sinai Road Roundabout	$563,750	$422,000	$2,255,000	$3,240,750
Sinai Road at Greens Folly Road Roundabout	$558,750	$414,000	$2,235,000	$3,207,750
Halifax Road at Greens Folly Road Dual Northbound Left-Turn Lanes	$632,750	$97,000	$2,531,000	$3,260,750
Halifax Road at Sunshine Drive Turbo-T	$551,000	$511,524	$1,763,123	$2,825,647
Mountain Road Crosswalk	$10,000	$-	$63,610	$73,610
Curb Extensions near Cemetery Street	$15,000	$50,000	$237,500	$302,500
Median Refuge Island near Craddock Street	$15,000	$80,000	$135,560	$230,560
Sinai Road Sidewalk	$662,794	$836,887	$3,009,659	$4,509,340
Greens Folly Road Sidewalk	$873,875	$344,000	$3,495,500	$4,713,375
Mountain Road Sidewalk Extension	$135,000	$634,165	$283,102	$1,052,267