RICHMOND ROAD MULTIMODAL CORRIDOR STUDY

Final Report

August 2019

PREPARED FOR:

Staunton Augusta Waynesboro
Metropolitan Planning Organization

PREPARED BY:

Kimley»Horn

Table of Contents

Appendix

List of Figures

List of Tables

Executive Summary

The Richmond Road Multimodal Corridor Study was conducted by the Staunton-Augusta-Waynesboro Metropolitan Planning Organization (SAWMPO) with the City of Staunton, Augusta County, and the Virginia Department of Transportation (VDOT) to identify transportation improvements for the US 250 Corridor between Frontier Drive and the northbound I-81 ramps (Exit 222). The purpose of the study was to identify strategies to improve travel for pedestrians, cyclists, and public transit users as well as improve safety and traffic flow in the corridor. The corridor serves both local and regional traffic and has regional transportation significance as it provides the most direct connection between Staunton and Waynesboro through Augusta County. Several adjacent development projects are expected to progress in the coming years, namely Staunton Crossing and Frontier Center, which will bring more travel activity to the corridor.

Existing conditions were evaluated through field observations, an intersection capacity analysis with 2018 traffic volumes, and a safety analysis using recent crash data. There is limited pedestrian and bicycle accessibility along Richmond Road and existing bus stops do not have sidewalks or passenger waiting areas. This poses a safety concern for vulnerable road users. Several other safety issues were identified including poor access management on several approaches to the Frontier Drive intersection, a challenging weave area on westbound Richmond Road between I-81 and Crossing Way, and unsignalized left turns across high-speed traffic at the northbound I-81 ramps. The predominant crash types along the corridor is rear end and angle collisions, and the highest rate of crashes occur at the Frontier Drive and Crossing Way signalized intersections. Two crashes in the past five years involved pedestrians near the I-81 ramps.

Traffic volumes were forecasted for year 2030. By this time, all of Frontier Center, nearly half of Staunton Crossing, and additional units for the Augusta Woods Manufactured Home Park are expected to be built. An analysis of 2030 traffic operations showed that delays increase from existing conditions, particularly for left turns that conflict with higher mainline volumes, and some queues exceed available storage or block turn bay access during the PM peak hour such as westbound and southbound left turns at Frontier Drive. There will also be a greater need for pedestrian, bicycle, and transit facilities to provide connections to the new developments.

Findings from the existing and 2030 no-build analyses were used to identify improvement concepts that meet the purpose of the study. Improvements recommended in the 2009 Richmond Road Multi-Modal Corridor Study, the 2013 Staunton Crossing Traffic Impact Analysis, and the 2013 Frontier Center Traffic Analysis were taken into consideration along with new improvements not previously identified in these studies. Preliminary alternatives were vetted by the project Study Team, which included representatives from VDOT, the City of Staunton, and Augusta County. A selection of the alternatives was advanced into further analysis which included an evaluation of traffic operations and safety benefits. The public also had an opportunity to provide feedback through an informational open house. Input received from the project Study Team and public was used to select preferred alternatives.

It is recommended that the preferred improvement alternatives be implemented as multiple phased projects as funding is available and corridor development and traffic growth warrants the roadway capacity improvement projects. The recommended multimodal network is shown in **Figure ES-1**.

Nine proposed projects are recommended to implement the improvements:

- **Project 1**: Richmond Road and Crossing Way Shared Use Path
- **Project 2**: Augusta Woods Shared Use Path
- **Project 3**: Bus Stop Improvements
- **Project 4**: Frontier Drive Intersection Improvement
- **Project 5**: Frontier Drive Access Management
- **Project 6**: Frontier Center Trail Intersection Improvement
- **Project 7**: Crossing Way Intersection Improvement
- **Project 8**: Westbound Richmond Road at Southbound I-81/Crossing Way Improvement
- **Project 9**: Northbound I-81 Ramp Intersection Improvement

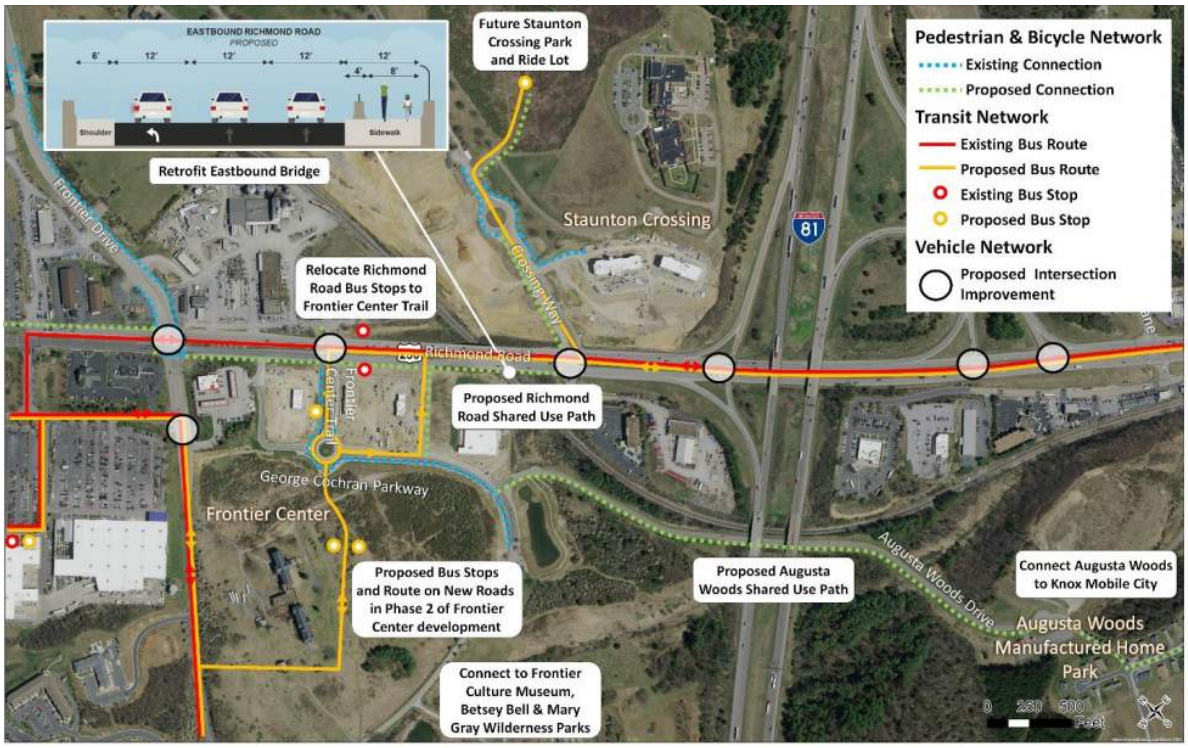


FIGURE ES-1. RECOMMENDED MULTIMODAL NETWORK

The proposed pedestrian and bicycle network will enhance connectivity, safety, and access to transit and would implement a network that is largely nonexistent. Proposed transit improvements will improve bus stop safety and provide future development connections. Proposed intersection improvements will provide safe pedestrian crossings, provide additional capacity at critical locations to accommodate future corridor growth, and reduce crashes.

The study should be used as a tool to achieve the next steps of planning, programming, designing and constructing the identified improvements in the corridor in partnership with VDOT, the City of Staunton, and Augusta County. As such, planning-level cost estimates and schedules were developed for each project and potential funding sources were identified.

1 Introduction

1.1 Purpose of Study

The Staunton-Augusta-Waynesboro MPO (SAWMPO) partnered with the City of Staunton, Augusta County, and the Virginia Department of Transportation (VDOT) to conduct a multimodal corridor study of US 250 (Richmond Road). Though officially designated as Richmond Avenue, the corridor is locally known as Richmond Road as it is referred to in this report. The purpose of the study was to identify strategies for improved multimodal connectivity (pedestrian, bicycle, and public transit), safety, and traffic operations. The study area consisted of approximately one mile of Richmond Road between Frontier Drive and the I-81 northbound on-ramp (Exit 222) and is shown in **Figure 1**.

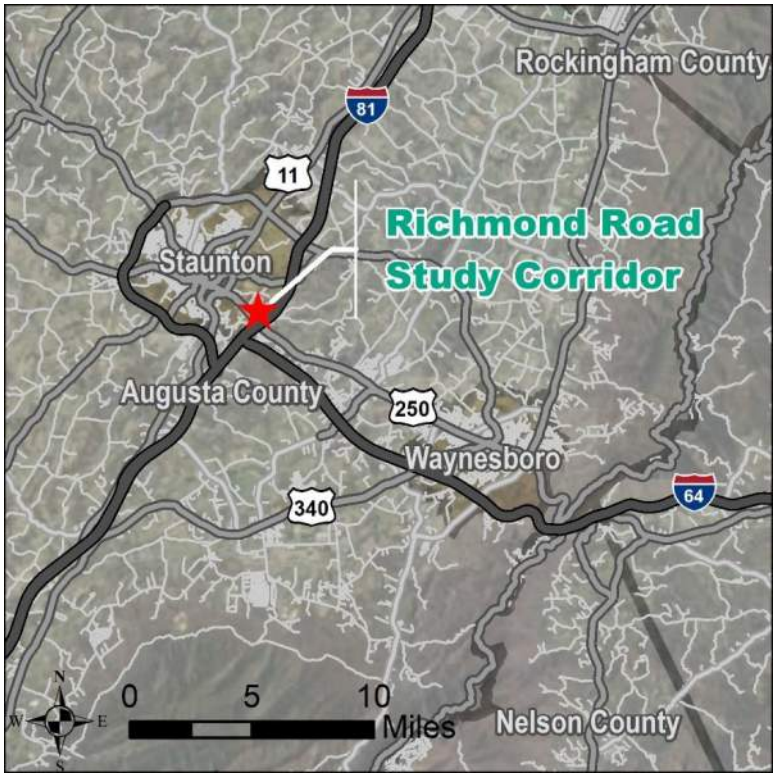


FIGURE 1. STUDY LOCATION MAP

The study area was included in a broader study of the Richmond Road corridor conducted in 2009. Since then, several adjacent development projects have progressed, namely Frontier Center and Staunton Crossing, that are bringing additional activity to the corridor with a mix of retail, restaurant, lodging, office, industrial, and residential land uses. This study builds on work from the 2009 study and addresses multimodal connectivity based on the location of new entrances and traffic signals along the corridor. With recent and upcoming development activity and continual safety concerns along the corridor, the SAWMPO intended to:

- Revisit the 2009 Richmond Road Multimodal Corridor Study between Frontier Drive and the interstate ramps to validate or revise the study recommendations along this section based on updated traffic forecasts and supporting analysis;
- Consider pedestrian and bicycle accommodations along Richmond Road with connectivity and access between and within Staunton Crossing and Frontier Center; and
- Evaluate safety improvements along the corridor with a focus on the Richmond Road and Frontier Drive intersections and the area immediately west of I-81, which are both identified by VDOT as possessing a high Potential for Safety Improvement (PSI).

The desired outcome of the study was a set of phased improvements for SAWMPO, the City of Staunton, or Augusta County to submit for funding through competitive grant programs such as SMART SCALE, the Revenue Sharing Program, the Highway Safety Improvement Program

(HSIP), the Transportation Alternatives Program (TAP), or future funding opportunities as they arise.

1.2 Study Area Roadway Network

Richmond Road is a four-lane divided principle arterial oriented generally in a northwest/southeast direction within the study area boundaries. For simplicity, it is classified as an east/west oriented corridor in this report. The corridor serves both local and regional traffic and has regional transportation significance as it provides the most direct connection between the City of Staunton and the City of Waynesboro through Augusta County. Interstate 81 has a partial cloverleaf interchange with Richmond Road at the east end of the study area. There are four signalized study intersections and two unsignalized study intersections within the study area as shown in in **Table 1**. The posted speed limit in the study area changes from 45 mph in the east to 35 mph in the west between Crossing Way and Frontier Center Trail (Old George Cochran Parkway). In 2017, Richmond Road's annual average daily traffic volume (AADT) was 26,000 according to VDOT published count data.

The corridor provides access to several commercial properties, as shown in **Figure 2.** The segment of Richmond Road between Frontier Drive and Frontier Center Trail has several right-in-right-out commercial entrances in addition to the signalized intersections. The segment of Richmond Road between Frontier Center Trail and Crossing Way has eastbound right-in-right-out access to Frontier Center and a bridge crossing over a CSX (Buckingham Branch operated) railroad corridor.

The traffic signals along Richmond Road between Statler Boulevard and Sangers Lane operate under adaptive signal control technology (ASCT), which adjusts timings in response to real-time traffic volumes to reduce congestion. The City of Staunton maintains three of the traffic signals in the study area, and VDOT maintains the traffic signal at the I-81 southbound ramps.

TABLE 1: STUDY AREA INTERSECTIONS

Intersection	Signalization
1. Richmond Road at Frontier Drive	Signalized
2. Richmond Road at Frontier Center Trail	Signalized
3. Richmond Road at Crossing Way	Signalized
4. Richmond Road at I-81 Southbound on/off ramps	Signalized*
5. Richmond Road at I-81 Northbound off-ramp	Unsignalized
6. Richmond Road at I-81 Northbound on-ramp	Unsignalized

*VDOT managed & maintained traffic signal

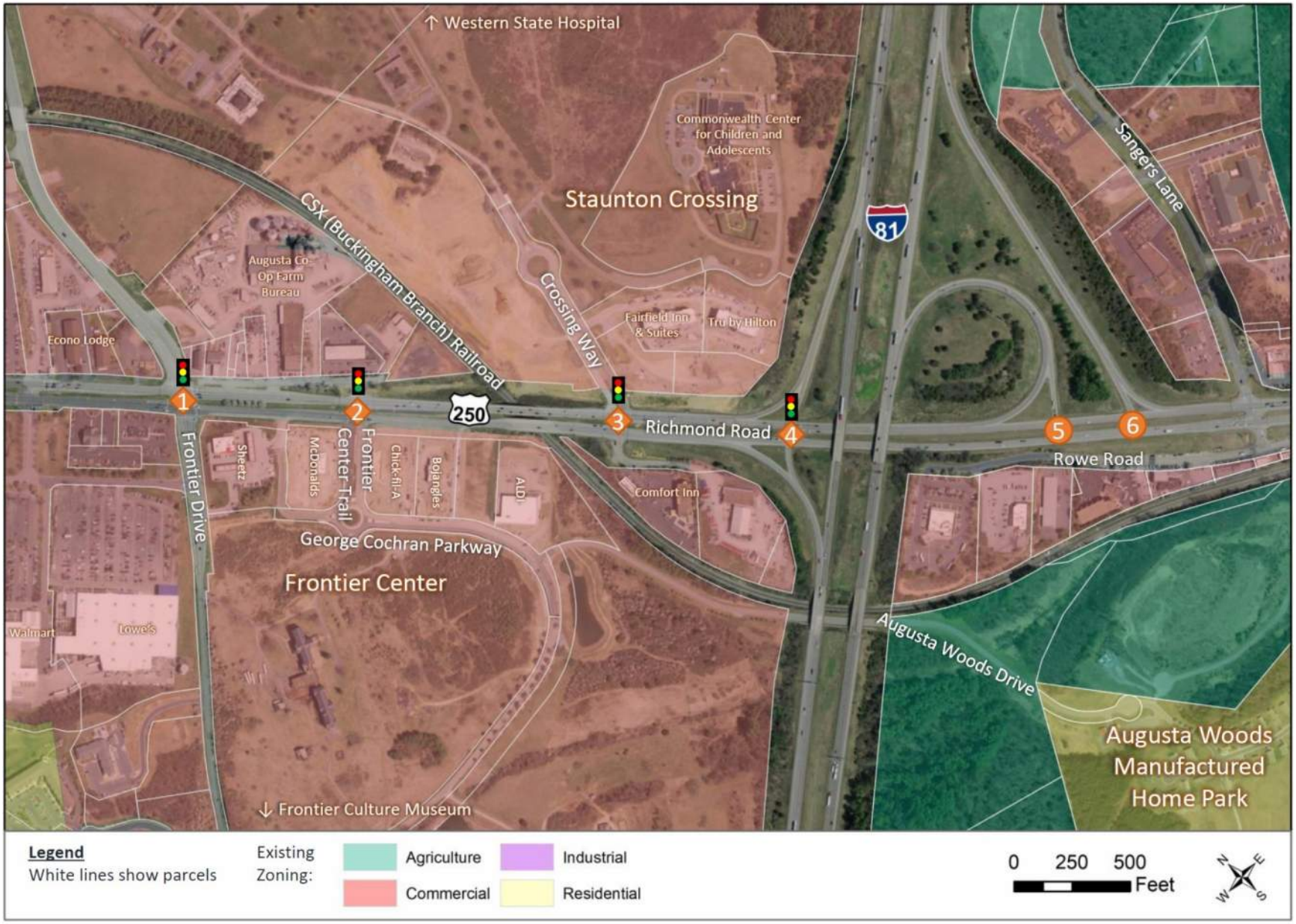


FIGURE 2. STUDY AREA ROADWAY NETWORK AND ZONING

1.3 Transit, Pedestrian, and Bicycle Facilities

Transit service is provided in the corridor with Blue Ridge Intercity Transit Express (BRITE) 250 Connector. There are two bus stops serviced by the 250 Connector at the intersection of Richmond Road and Frontier Center Trail. The 250 Connector links the cities of Staunton and Waynesboro, certain areas of Augusta County, and many of the activity centers mentioned above along the Richmond Road corridor. The route operates from 7:30 AM to 9:30 PM Monday through Friday and 8:30 AM to 7:30 PM on Saturday. No service is provided on Sunday. This corridor study was done in parallel with a CSPDC study to identify recommendations for improving the reliability of 250 Connector while planning for new transit connections to developments along the corridor.

There are few sidewalks or bicycle facilities in the study area. There are sidewalks on the northern leg of the Frontier Drive intersection and a shared use path on the southern leg of the Frontier Center Trail intersection. This is also the only intersection in the study area that has crosswalks and pedestrian push buttons, although they do not fully meet current Americans with Disabilities Act (ADA) accessibility standards for new construction or alterations. All pushbuttons are not accessible by sidewalks and curb ramps, and existing curb ramps do not have the necessary clear space or detectable warning surfaces.

1.4 Previous Planning Efforts

A review of previously completed studies was completed as part of this study to identify potential impacts to the corridor:

1. 2009 Richmond Road Multimodal Corridor Study
2. Staunton Crossing Traffic Impact Analysis and Master Plan
3. Frontier Center Traffic Analysis and Master Plan
4. Augusta Woods Manufactured Home Park Development Plan
5. City of Staunton Comprehensive Plan
6. City of Staunton Bicycle & Pedestrian Plan
7. City of Staunton Greenway Plan

1.4.1 2009 Richmond Road Multimodal Corridor Study

The 2009 Richmond Road Multimodal Corridor Study was completed by Renaissance Planning Group, in cooperation with Augusta County, the City of Staunton, and VDOT. The 2009 study limits consisted of a 3.6-mile section of Richmond Road from the intersection with Greenville Avenue (US 11) to the intersection with Desper Hollow Road and evaluated existing year and future operational conditions based on traffic growth forecasts. Study recommendations were developed based on the supporting traffic analysis and context as roadway characteristics change along the study limits.

The transportation recommendations for the Richmond Road corridor included:

- Widening from four lanes to six lanes between I-81 and Frontier Drive,
- Second southbound through and westbound left-turn lanes at Frontier Drive,
- New traffic signals at I-81 northbound on- and off-ramps,
- Three potential options for access improvements between I-81 and Frontier Drive including additional turn lanes, right-in-right-out access, and an additional bridge over the railroad and

Richmond Road to connect Staunton Crossing and Frontier Center, and

- Rails-with-trails concept along the CSX railroad corridor to provide pedestrian and bicycle connections parallel to Richmond Road.

Following the completion of the study, the corridor experienced several years of minimal growth resulting from the Great Recession. While new development has increased in recent years, including initial phases at the Staunton Crossing and Frontier Center developments, the traffic forecasts associated with the future year analysis within the study can be considered unrealistic. For example, the segment of Richmond Road between Frontier Drive and the interstate ramps had an AADT of 25,000 in 2009. The 2035 design-year of the study assumed a forecast daily traffic volume of 50,000 along this segment of the corridor. Assuming linear growth between 2009 and 2035, interpolating these volumes to existing conditions for this study (2018) would suggest an AADT of approximately 33,700; however, the most current (2017) VDOT AADT is 26,000 for the segment, indicating a much lower rate of increase in traffic volumes along the study corridor in the past nine years. Some of the recommendations from the 2009 study may need to be reevaluated and adjusted. This will be investigated and documented further in the alternatives analysis section of the Final Richmond Road Multimodal Corridor Study Report for this project.

1.4.2 Staunton Crossing Traffic Impact Analysis and Master Plan

Staunton Crossing is a 279-acre mixed-use development on the north side of Richmond Road. The Staunton Crossing Traffic Impact Analysis was completed in 2013. The analysis assumed a first phase buildout of 20 to 25 acres along Richmond Road in 2015, with full buildout of the development by 2025. The analysis results indicated that with the addition of the full buildout site-generated traffic in 2025, queue lengths are anticipated to exceed available capacity for key movements at signalized intersections and the eastbound left-turn lane at the I-81 northbound on-ramp intersection. In addition to the 2009 Richmond Road Corridor Study Recommendations, the following improvements were recommended for the Richmond Road corridor:

- Construct second eastbound and southbound left-turn lanes at Frontier Drive,
- Overlap southbound and westbound right-turn traffic signal phases at Frontier Drive,
- Construct a dedicated southbound left-turn lane at Crossing Way,
- Provide two entering lanes on Crossing Way (already constructed), and
- Overlap the westbound right-turn traffic signal phase at Crossing Way.

The first phase of the development is underway, and two hotels opened along Richmond Road on the Fall of 2018. The City of Staunton is currently developing a business strategy for the remaining development of the site. There is also a project to extend Crossing Way through the Staunton Crossing development site and connect to Valley Center Drive to the north (see **Figure 3**). This includes a 100-space park and ride facility, bus shelter, and a shared use path. The project is funded using Staunton Six Year Improvement Plan (SYIP) funds and a SMART SCALE grant. The City of Staunton now anticipates that approximately 45 percent of Staunton Crossing will be built by 2030, the planning year for this corridor study.

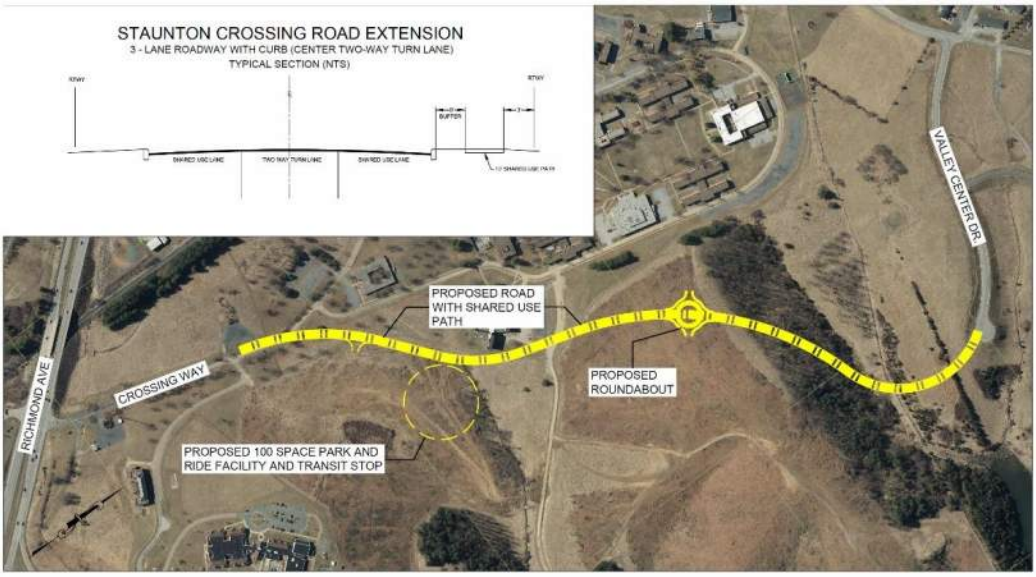


FIGURE 3. STAUNTON CROSSING ROAD EXTENSION (FROM SMART SCALE APPLICATION)

1.4.3 Frontier Center Traffic Analysis and Master Plan

Frontier Center is a 140-acre mixed-use development south of Richmond Road between Frontier Drive and George Cochran Parkway/Augusta Woods Drive. The Frontier Center Traffic Analysis was completed in 2013. The analysis assumed a first phase of five outparcels along Richmond Road open in 2015 (already constructed) and a second phase of 300,000 square feet of general retail open by 2025. The proposed access plan for Phase I has been constructed. The proposed access for Phase 2 is a new full-movement connection to Frontier Drive at the southwest end of the property. The City of Staunton anticipates that Frontier Center will be completely built by 2030.

1.4.4 Augusta Woods Manufactured Home Park Development Plan

Augusta Woods Manufactured Home Park is located southeast of the study corridor, south of Richmond Road and east of I-81. The only access to the site is via Augusta Woods Drive, which connects to George Cochran Parkway on the south side of Richmond Road. The master plan for Augusta Woods has 240 total units planned in multiple phases; the site currently contains approximately 86 units. Augusta County anticipates that 100 additional units will be added by 2030.

An undeveloped site adjacent to Augusta Woods has a future designation of multi-family residential in the County's Comprehensive Plan, but is being evaluated for potential rezoning to attached residential. At the time of this study, there are no definitive plans for the number of units, a timeline for the potential development of this site, or a traffic impact analysis.

1.4.5 City of Staunton Comprehensive Plan

The transportation goals of the 2018-2040 Comprehensive Plan update are to maintain a safe and efficient transportation network and improve safety, operations, connectivity, access, and mobility options. The plan identifies citywide transportation needs and project recommendations, including several that are relevant to the study area:

- Improve transit rider safety by adding passenger waiting shelters at key locations

- Frontier Drive to Statler Boulevard (west of study area)
  - Implement recommendations from the 2009 Richmond Road Corridor Study, and
  - Improve access management, add pedestrian facilities, improve existing pedestrian street connections, add bicycle lanes/sharrows/shared use path, and address stormwater runoff issues.
- Frontier Drive Connector
  - Construct a 3-lane roadway on a new alignment with sidewalk on one side of the road, providing the fourth leg to the roundabout at Frontier Center Trail and George Cochran Parkway, and
  - Extend roadway through the existing DeJarnette property to Frontier Drive, approximately 0.4 miles, to provide additional access to Frontier Center.

1.4.6 City of Staunton Bicycle & Pedestrian Plan

The City has developed the Staunton Bicycle & Pedestrian Plan (2018) that identifies bicycle and pedestrian needs and future routes. A pedestrian route along Richmond Road through the study area was identified as one of the critical routes in Staunton based on current pedestrian usage and need. The intersections at Frontier Drive and Frontier Center Trail were identified among those that demand the most attention with regard to upgrading inadequate or nonexistent infrastructure. The plan recommends bicycle network improvements for the study area—a future side path at Frontier Center and Staunton Crossing and consideration for future regional connections with bike route signage and a widened shoulder along Richmond Road. A side path would be shared by pedestrians and bicycles, be separated from the road by a curb, and ideally include a planted buffer strip. The plan also identified a need for a north/south bicycle facility through Staunton Crossing to Frontier Center.

1.4.7 City of Staunton Greenways Plan

A 2016 draft of the Staunton Greenways Plan identified priority trail projects. This plan is currently being redeveloped and has not been adopted. A rails-with-trail facility was recommended along the southern side of the CSX railroad from Frontier Center, through Staunton Crossing, and into Staunton via an on-street trail. An additional trail through the Frontier Culture Museum and Frontier Center development was recommended to connect Staunton Crossing to the Betsy Bell Wilderness Trail (see **Figure 4)**. These were identified as long-term priorites.

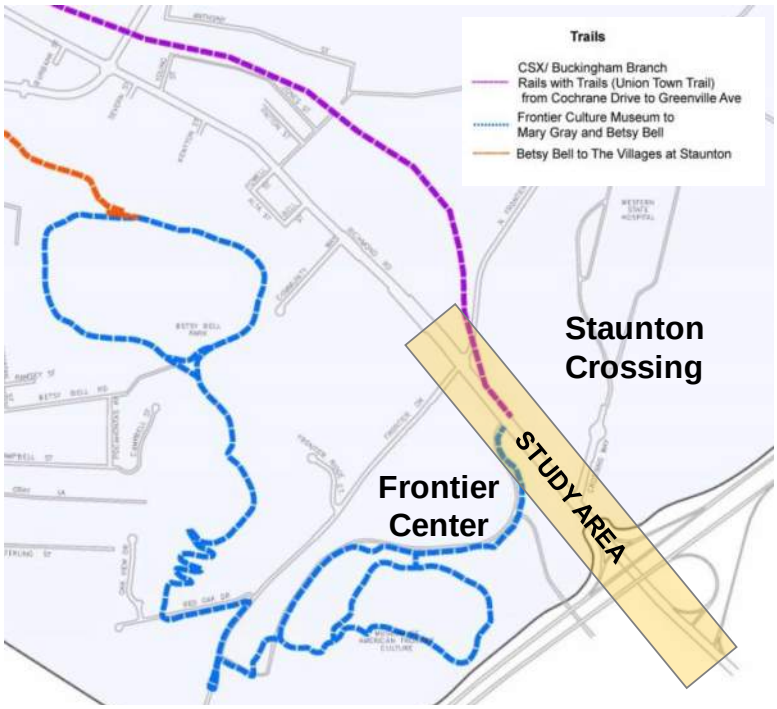


FIGURE 4. TRAIL CONCEPT (ADAPTED FROM DRAFT PLAN)

2 Project Approach

The overall project approach is summarized in **Figure 5** including inputs and outputs of each stage of the process. The approach to data collection, traffic volume forecasting, and operational analyses are described in this section.

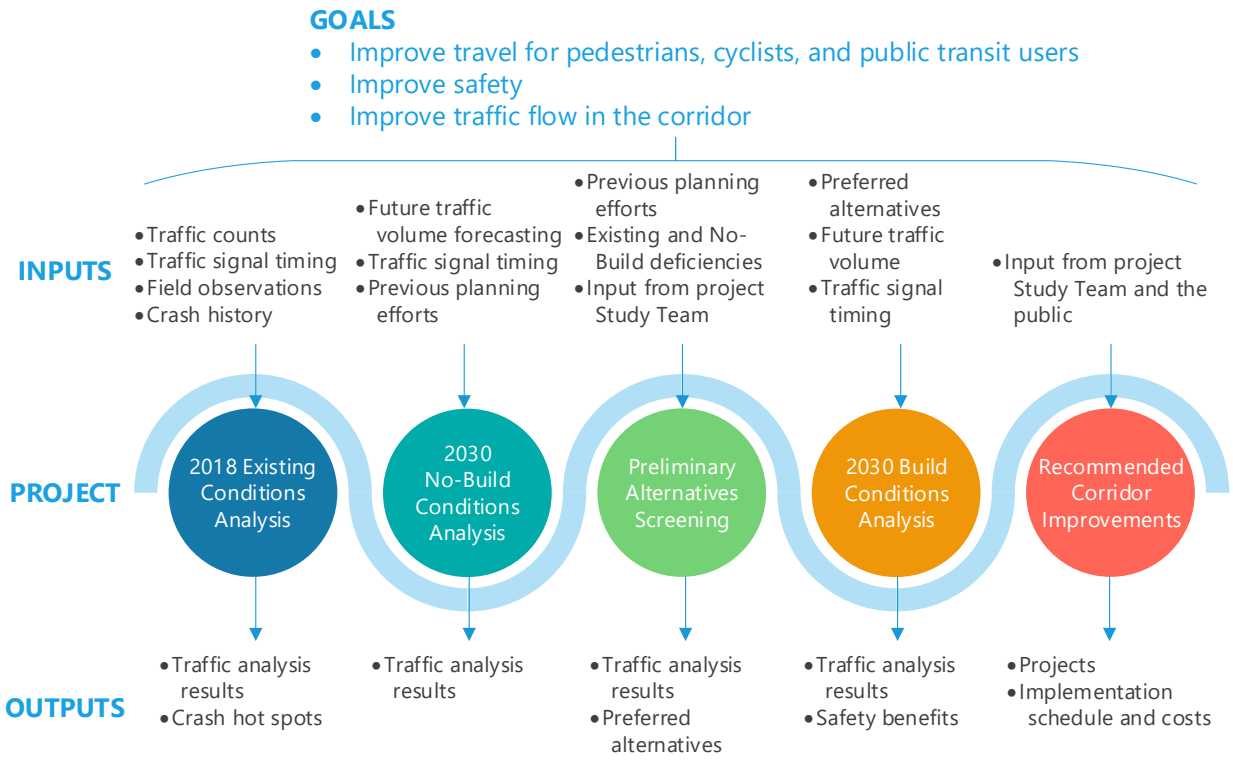


FIGURE 5. PROJECT PROCESS

2.1 Data Collection

2.1.1 Traffic Counts

Turning movement counts (TMCs) were conducted at the six study intersections on Thursday, November 29, 2018 for a period of 12 hours between 7:00 AM and 7:00 PM. The TMCs were collected after the two hotels along Richmond Road opened as part of Phase 1 of Staunton Crossing. The TMCs summarized vehicle, heavy vehicle, and pedestrian activity at each intersection in 15-minute intervals. The TMCs were used to determine the appropriate volumes for use in developing AM and PM peak hours. A network AM peak hour of 7:30 to 8:30 AM and PM peak hour of 4:30 PM to 5:30 PM was identified. **Figure 6** shows the existing peak hour volumes for the study area. Peak hour factors were determined for each intersection and heavy vehicle percentages for each movement were used in operational analyses. TMC data is provided in **Appendix A**.

Historical traffic count data was obtained from VDOT for the segment of Richmond Road from Frontier Drive to the I-81 southbound ramps. Ten years of AADT data shows daily traffic volumes ranging from 25,000 to 27,000 and generally holding steady as shown in **Table 2**.

TABLE 2. RICHMOND ROAD AADT BETWEEN FRONTIER DRIVE AND I-81

Year	AADT
2008	27,000
2009	25,000
2010	25,000
2011	26,000
2012	26,000
2013	26,000
2014	27,000
2015	27,000
2016	26,000
2017	26,000

2.1.2 Signal Timing

Existing signal timing parameters were provided by the City of Staunton and VDOT. Because the ASCT traffic signals have dynamic operations, traditional signal timing data is not available and there are no set cycle lengths, splits, or offsets for modelling purposes. Therefore, the following assumptions apply to the operational analysis in this study conducted using Synchro, a traffic capacity analysis and signal optimization software:

- Signal phase numbering, minimum green times, yellow change intervals, red clearance intervals, and passage were set according to timing data provided by the City and VDOT
- Signal timings were optimized in Synchro during each peak hour based on the traffic volume. This provides the best representation of signal operations, given that ASCT optimizes timings in real time.

The minimum split to accommodate pedestrians crossing Richmond Road at Frontier Drive was not strictly enforced during optimization for existing conditions analysis due to the low number of pedestrian actuations (three pedestrians counted during the entire day of data collection). Yellow change intervals and red clearance intervals were maintained from existing conditions in the 2030 no-build analysis because roadway geometry was not changed. Intervals were updated based on VDOT guidelines (TE-306) and proposed geometry for the 2030 build analysis. Splits were set to accommodate pedestrian crossing time at locations of proposed crossings also for the 2030 build analysis.

2.1.3 Field Observations

Field observations were conducted on Tuesday, November 27, 2018 to verify existing lane configurations and document travel patterns, operational deficiencies, and safety issues. Field observations are presented in the **2018 Existing Conditions Analysis** section.

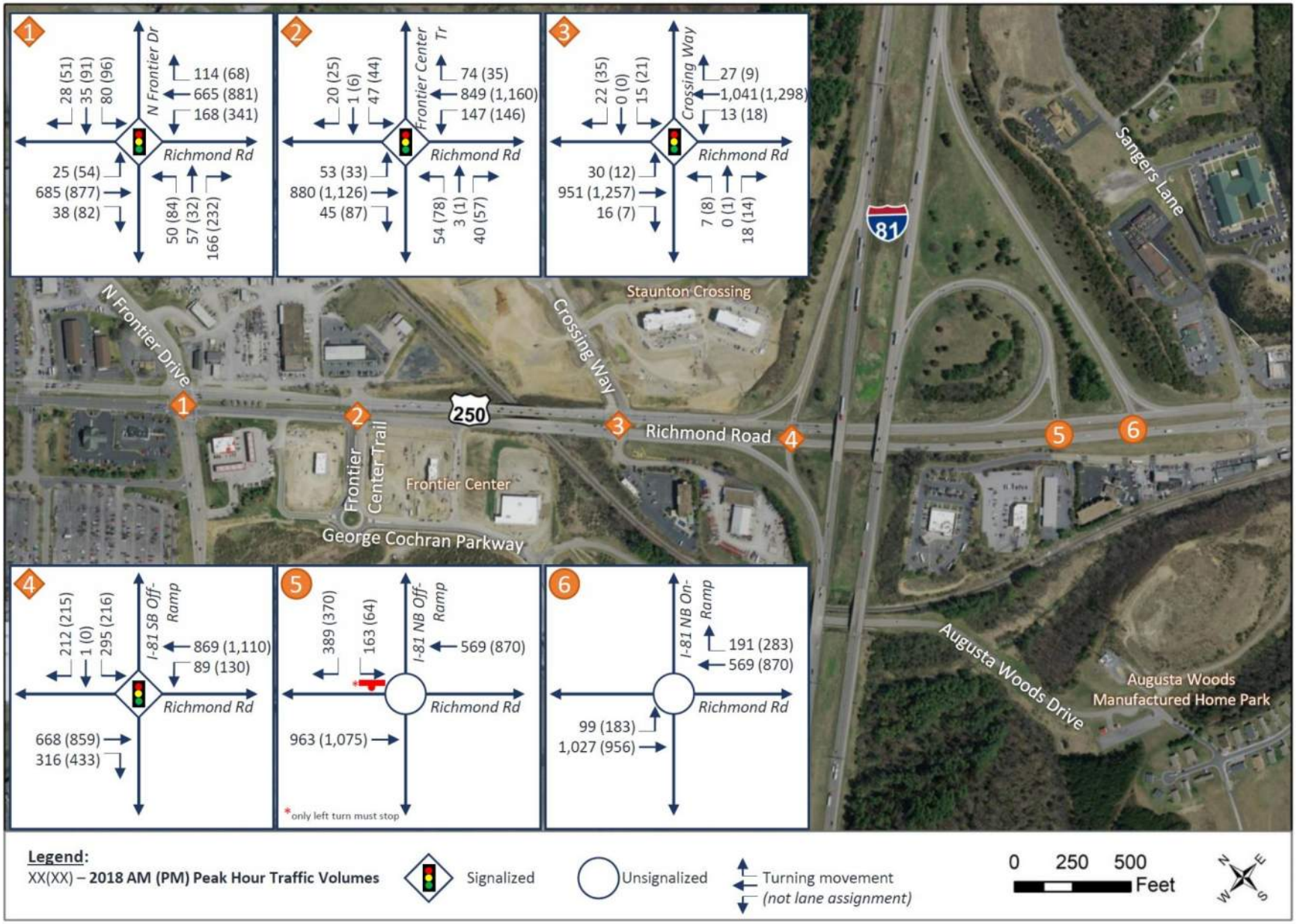
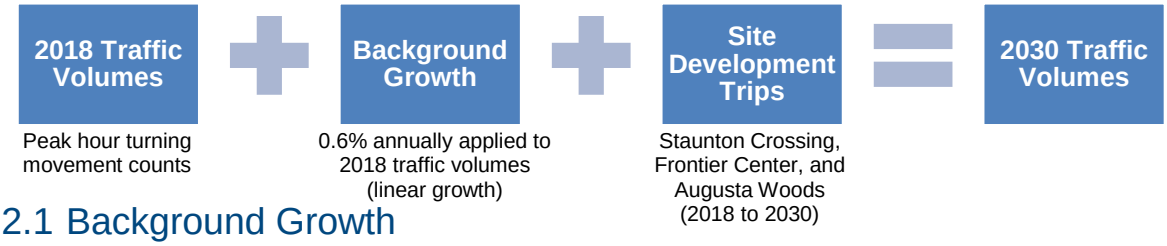


FIGURE 6: 2018 EXISTING PEAK HOUR TRAFFIC VOLUMES

2.2 Future Traffic Volume Forecasting

The planning year for the corridor study is 2030. Numerous site developments adjacent to the corridor are expected to be built by 2030 in addition to background regional growth. Future 2030 traffic volumes were determined by using both background growth and site development trips. **Figure 7** illustrates the forecasted 2030 peak hour traffic volumes. The forecasting methodology and growth rate was approved by the project Study Team prior to operational analysis. Additional details on forecasting assumptions can be found in **Appendix B**.



2.2.1 Background Growth

Ten-year historical traffic counts (2008 to 2017) from VDOT were analyzed to determine the background traffic growth rate. AADTs for the segment of Richmond Road between Frontier Drive and the eastern City line (I-81 ramps) have remained stable over the past ten years. The historical trend in AADT shows a 0.37% annual growth rate. Regional population growth was also considered in developing a background growth rate. Population growth from 2010 to 2017 is summarized in **Table 3**.

A background annual growth rate of 0.6% was used in addition to site development trips. This rate is higher than the historic traffic growth and the project Study Team agreed that it better portrayed surrounding regional activity and anticipated development of the corridor.

TABLE 3. POPULATION GROWTH

Locality	April 1, 2010 Census	July 1, 2017 Estimate	Change since 2010 Census		Annual Growth Rate
			Numeric Change	*Percent Change*	
Augusta County	73,750	75,013	1,263	1.7%	0.24%
Staunton City	23,746	24,761	1,015	4.3%	0.61%
Waynesboro City	21,006	21,955	949	4.5%	0.65%
Central Shenandoah Planning District	286,781	300,228	13,447	4.7%	0.67%

Source: Weldon Cooper Center for Public Service Demographics Research Group, with calculated Annual Growth Rate

2.2.2 Site Development Trips

The following assumptions were made for the inclusion of future site development trips:

- Forty-five percent of total development site-generated trips from the 2013 Staunton Crossing Traffic Impact Analysis, which used the Institute of Transportation Engineers (ITE) *Trip Generation Manual,* 9th Edition.
- The Phase II trips from the 2013 Frontier Center Traffic Capacity Analysis, which used the ITE *Trip Generation Manual*, 9th Edition.
- Trips generated from 100 additional units at the Augusta Woods Manufactured Home Park estimated using the ITE *Trip Generation Manual, 10th Edition*.
- The unplanned multi-family development near Augusta Woods was not included.

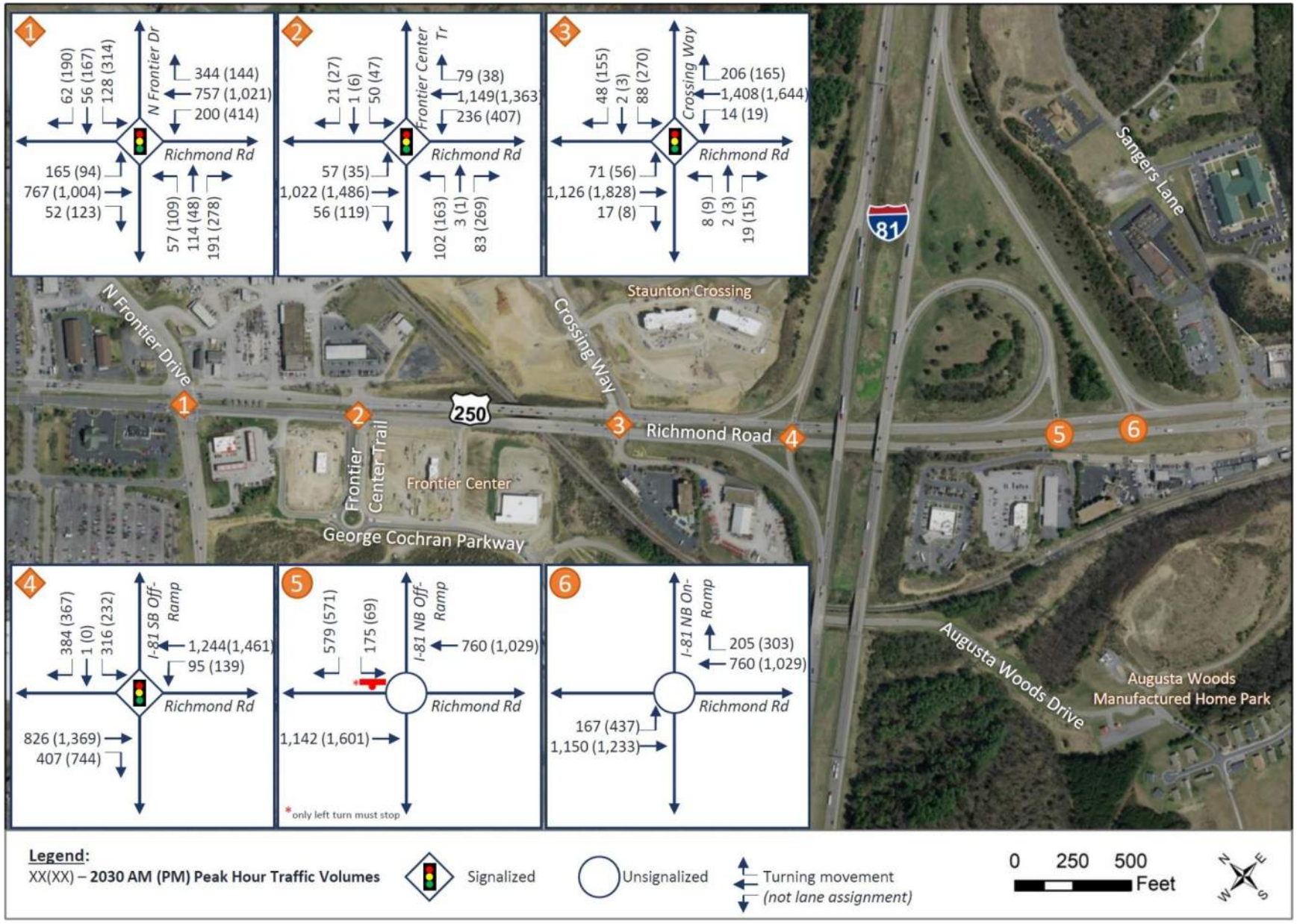


FIGURE 7: 2030 PEAK HOUR TRAFFIC VOLUME

2.3 Analysis Methodology

The following section describes the methodology for analyzing traffic operations and safety. Results of the analyses are provided in the respective sections later in the report for each scenario.

2.3.1 Intersection Delay and Level of Service

Intersection capacity analyses for 2018 existing and 2030 peak hour traffic volumes were conducted using Synchro 10.0 software, which provides an assessment of the operational conditions at each study intersection. Intersection delay, level of service (LOS), and 95th percentile queue length were used as measures of effectiveness per Highway Capacity Manual (HCM) calculations.

Level of service describes the amount of traffic congestion at an intersection or on a roadway and ranges from A to F (e.g., 'A' indicating a condition of little to no congestion and 'F' a condition with severe congestion, unstable traffic flow, and stop-and-go conditions). Intersection LOS was assessed HCM 2010 methodologies. Due to limitations within the HCM 2010 and its requirement for strict NEMA phasing, the HCM 2000 was used for some signalized intersections and the unsignalized intersections. **Table 4** illustrates ranges of delay as defined in the HCM.

TABLE 4: LEVEL OF SERVICE CRITERIA

LOS	Signalized	Unsignalized	Relative Delay
	(seconds per vehicle)		
A	≤ 10	≤ 10	Short Delays
	Free-flow traffic operations at average travel speeds. Vehicles completely unimpeded in ability to maneuver. Minimal delay at signalized intersections.		
B	> 10 – 20	> 10 – 15	
	Reasonably unimpeded traffic operations at average travel speeds. Vehicle maneuverability slightly restricted. Low traffic delays.		
C	> 20 – 35	> 15 – 25	
	Stable traffic operations. Lane changes becoming more restricted. Travel speeds reduced to half of average free flow travel speeds. Longer intersection delays.		
D	>35 – 55	> 25 – 35	Moderate Delays
	Small increases in traffic flow can cause increased delays. Delays likely attributable to increase traffic, reduced signal progression and adverse timing.		
E	>55 – 80	> 35 – 50	
	Significant delays. Travel speeds reduced to one third of average free flow travel speed.		
F	> 80	> 50	Long Delays
	Extremely low speeds. Intersection congestion. Long delays. Extensive traffic queues at intersections.		

Source: Highway Capacity Manual, Transportation Research Board, Washington, D.C., 2010

2.3.2 Queue Length

The 95th percentile queues for each movement during the AM and PM peak hours were compared to the effective storage lengths for turning movements. Effective storage lengths represent the amount of distance available for vehicles to queue without generally impacting the adjacent lanes and consist of the full width storage plus half of the taper distance.

2.3.3 Crash Assessment

A planning level crash assessment was conducted for Richmond Road between Frontier Drive and the I-81 northbound on-ramp, and along Frontier Drive from Richmond Road to the Sheetz gas station entrance. Historical crash data was used to evaluate corridor safety and identify crash patterns. Crash data was obtained from VDOT for the latest available five years of crash data (January 1, 2014 to December 31, 2018). The results of the crash analysis are presented in the **2018 Existing Conditions Analysis** section.

It is anticipated that the existing safety concerns and crashes for the study corridor will be reduced if improvements recommended in this study are implemented. The expected reduction in crashes was estimated using crash modification factors (CMF). CMFs are multiplicative factors computed using historic crash studies. A reduction in crashes is shown by factors below one. For example, a CMF of 0.85 indicates that the frequency of total crashes with the improvement is estimated to be 85 percent of the crash frequency without the improvement, or the reduction in crash frequency is 15 percent. CMFs were chosen using the Highway Safety Manual methodology, SMART SCALE planning CMFs, and the CMF Clearinghouse[1] data. Estimated safety benefits from improvements are presented in the **2030 Build Conditions Analysis** section.

[1] http://www.cmfclearinghouse.org/

3 Operational Analysis

3.1 2018 Existing Conditions Analysis

3.1.1 Field Observations

The following field observations were noted during the site visit and are shown in **Figure 8**:

- There is limited north/south and east/west pedestrian and bicycle accessibility and connectivity along Richmond Road, especially where there is a lot of commercial land use between Frontier Drive and Crossing Way. Pedestrians were observed to cross midblock across the four lanes of Richmond Road.
- There is a lack of sidewalks and curb ramps at the Frontier Drive intersection to provide access to existing pedestrian push buttons. There are no intersection pedestrian accommodations at Frontier Center Trail or Crossing Way.
- There are no pedestrian or bicycle facilities to connect Augusta Woods to Frontier Center. CSPDC and CSX reported pedestrians have been illegally crossing the railroad tracks to access Rowe Road east of the study area.
- Bus stops at Frontier Center Trail do not have sidewalks or passenger waiting areas. Buses must stop in the travel lane to serve boarding and alighting passengers. There are no crosswalks at Frontier Center Trail to cross Richmond Road.
- There is a high number of commercial entrances/driveways between Frontier Drive and Frontier Center Trail (two westbound and one eastbound)—a segment identified as a safety hot spot from crash data.
- There is a short, difficult weaving segment on westbound Richmond Road between I-81 and Crossing Way. Drivers have a hard time merging into mainline Richmond Road when exiting from I-81 due to close intersection spacing.
- The westbound merge onto Richmond Road from the northbound I-81 off-ramp can be challenging at high traffic volumes.
- The unsignalized eastbound left-turn movement to the northbound I-81 on-ramp causes some queuing due to heavy and high speed westbound traffic.

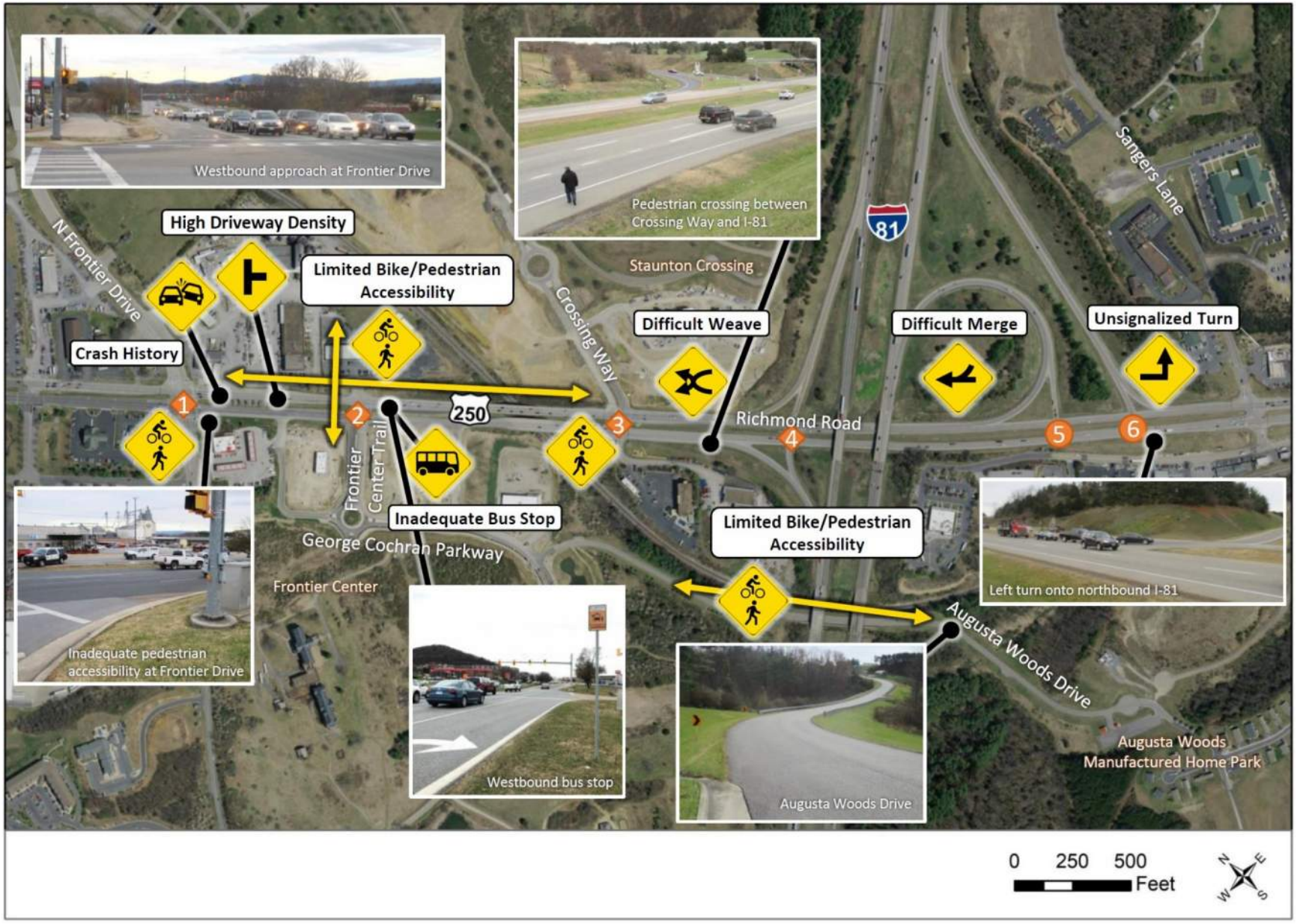


FIGURE 8: FIELD OBSERVATIONS

3.1.2 Traffic Analysis

Analysis of existing traffic operations shows the following results:

- All signalized intersections operate at an overall LOS C or better during the AM peak hour.
- I-81 northbound off-ramp traffic experiences high delays for the southbound stop-controlled left-turn movement during the AM and PM peak hours due to heavy mainline volumes.
- During the PM peak hour, all signalized intersections operate at LOS C or better.
- Most left-turn movements operate at LOS D or worse, typically ranging from 50 to 80 seconds per vehicle. This is due to protected left-turn or split phasing operations.
- Queuing is contained within storage but 95th percentile queue lengths for through movements block turn bays for eastbound left turns at Frontier Center Trail (AM peak hour) and westbound left turns at the I-81 southbound on-ramp (AM and PM peak hours).
- Side street approaches experience greater delays than eastbound and westbound Richmond Road due to heavy mainline volumes and operate at LOS D or E.

Table 5 and **Table 6** summarize the delay and LOS by approach for study intersections for AM and PM peak hours, respectively. Overall LOS is not reported for the unsignalized intersections because delays for uncontrolled movements cannot be calculated by Synchro. Movement delay and LOS tables as well as 95th percentile queue length comparisons can be found in **Appendix D**. The Synchro HCM reports can be found in **Appendix E**.

TABLE 5. EXISTING AM PEAK HOUR DELAY (SECONDS PER VEHICLE) AND LOS

Intersection	1. Frontier Drive	2. Frontier Center Trail	3. Crossing Way	4. I-81 SB Ramps	5. I-81 NB Off-Ramp	6. I-81 NB On-Ramp
Approach	*2018*	*2018*	*2018*	*2018*	*2018*	*2018*
Eastbound Richmond Rd	B (17.3)	B (12.6)	A (1.7)	C (23.7)	†	A (9.6)††
Westbound Richmond Road	B (11.8)	B (10.8)	A (2.8)	B (11.9)	†	†
Northbound	D (46.6)	D (46.3)	D (53.3)			
Southbound	D (53.6)	D (46.7)	D (48.9)	D (47.6)	D (25.6)	
Overall	**C (21.1)**	**B (14.3)**	**A (3.7)**	**C (21.5)**		

† Synchro does not provide LOS or delay for movements with no conflicting volumes

†† Eastbound left-turn movement results presented

TABLE 6. EXISTING PM PEAK HOUR DELAY (SECONDS PER VEHICLE) AND LOS

Intersection	1. Frontier Drive	2. Frontier Center Trail	3. Crossing Way	4. I-81 SB Ramps	5. I-81 NB Off-Ramp	6. I-81 NB On-Ramp
Approach	*2018*	*2018*	*2018*	*2018*	*2018*	*2018*
Eastbound Richmond Road	D (36.5)	A (5.8)	A (1.1)	A (0.7)	†	B (11.5)††
Westbound Richmond Road	B (17.4)	B (12.3)	A (1.5)	B (11.9)	†	†
Northbound	D (54.5)	D (51.4)	E (58.5)			
Southbound	D (54.6)	D (52.1)	D (54.5)	D (52.3)	D (25.6)	
Overall	**C (31.6)**	**B (12.3)**	**A (2.9)**	**B (11.5)**		

† Synchro does not provide LOS or delay for movements with no conflicting volumes

†† Eastbound left-turn movement results presented

3.1.3 Crash Analysis

Over the five-year period for which crash data was collected, there were a total of 204 crashes within the study area—195 on Richmond Road and 9 along Frontier Drive. There were 70 property damage only (PDO) crashes, 134 injury crashes, and zero fatalities. A summary of the corridor crashes is shown in **Table 7**.

TABLE 7: CRASH SEVERITY PER YEAR

Year	Total Crashes	Severity		
		Fatalities	Injuries	PDO
2014	35	0	24	11
2015	38	0	22	16
2016	37	0	23	14
2017	49	0	36	13
2018	45	0	29	16
TOTAL	**204**	**0**	**134**	**70**

The overall crash data analysis indicated that the majority of the crashes happened during PM and off-peak hours under clear, daylight weekday condition. Moreover, the majority of collision types are rear end crashes, which indicates that crashes can be linked to congestion or traffic signals. **Figure 9** displays the breakdown per collision type for all 204 crashes analyzed. Additional trends are shown by **Figure 10.**

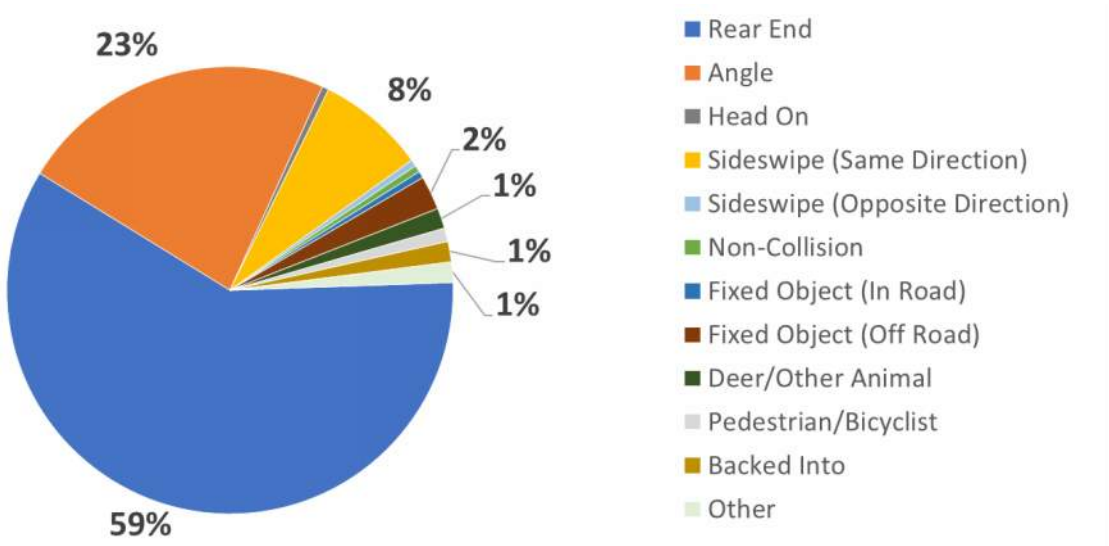


FIGURE 9: COLLISION TYPES

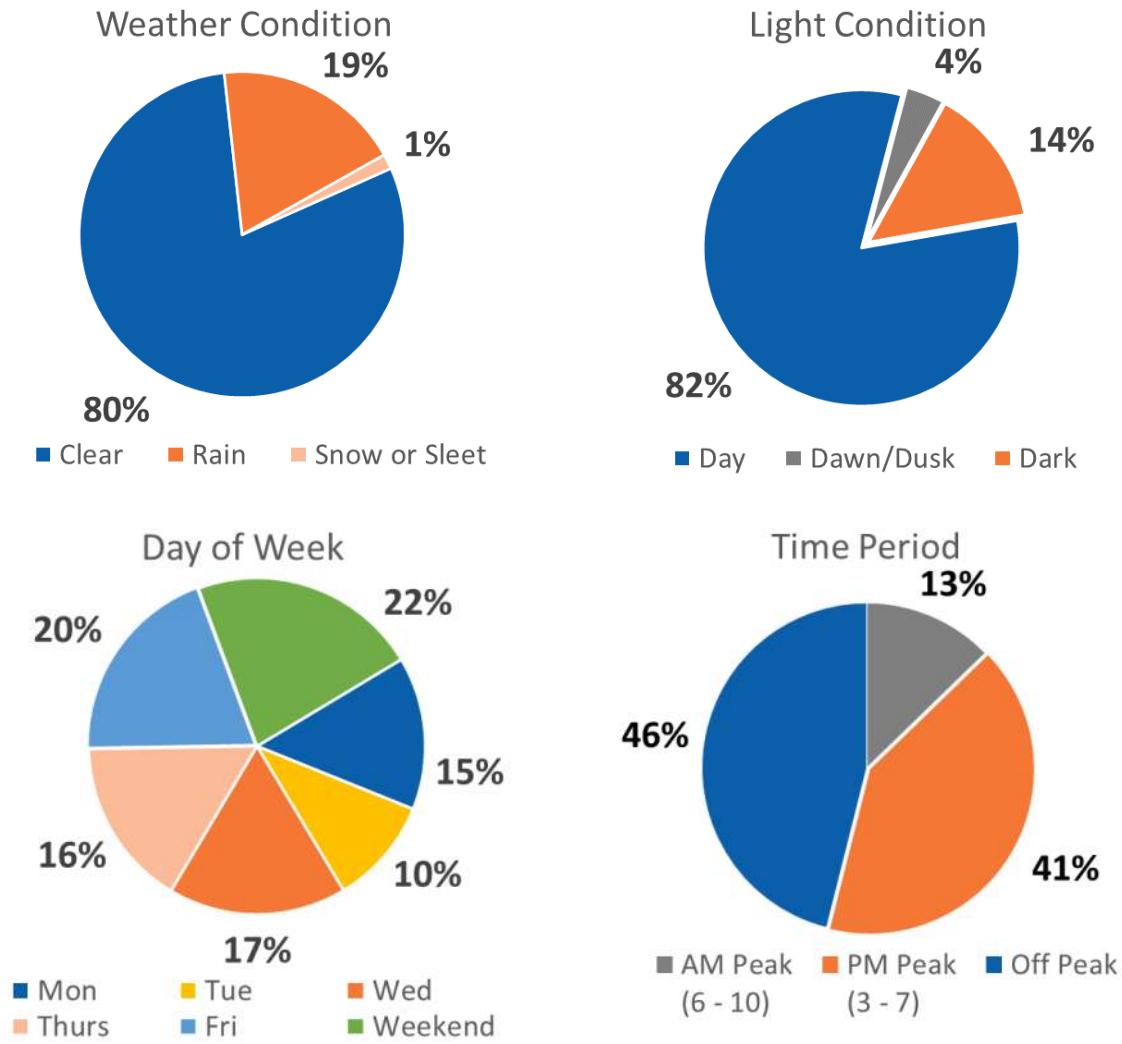


FIGURE 10: CRASH ANALYSIS TRENDS

A corridor crash analysis was performed to identify crash hot spot locations. A histogram of crashes was developed considering mainline Richmond Road crashes (195 crashes) as shown in **Figure 11**. The segment with the highest crashes was just east of Frontier Drive. This is a signalized intersection experiencing a high number of rear end (35 crashes), angle (9 crashes), and sideswipe-same direction (9 crashes) collision types. The second highest number of crashes occurred at the signalized intersection of Frontier Center Trail. This segment experienced many rear end (19 crashes) and angle (8 crashes) collision types. The third highest number of crashes occurred at the signalized intersection of Crossing Way. There were 20 rear end crashes and 4 angle crashes at this location. The crashes along Frontier Drive from Richmond Road to the Sheetz gas station entrance indicated a high number of angle crashes (5), followed by a few rear end crashes (2). Two pedestrian crashes resulting in injury were recorded in the corridor, both crossing midblock near the I-81 ramps. Additional data from the crash analysis is provided in **Appendix C**.

A more detailed crash analysis was completed for the Frontier Drive intersection to identify crash trends. This intersection ranked fourth in the VDOT Staunton District as having a high potential for safety improvement. There was a total of 80 crashes within the intersection influence area of Frontier Drive and Richmond Road: 28 crashes were in the westbound direction, 24 in the eastbound direction, 7 in the northbound direction, 2 in the southbound direction, 10 in the center of the intersection, and about 9 in the receiving lanes. Most of the collision types were rear end crashes (46 crashes) leading to the intersection and angle crashes at the center of the intersection (6 crashes). There were more crashes during the PM (3 PM to 7 PM) and off-peak periods than during the AM peak period (6 AM to 10 AM) for the intersection. This is expected because of higher PM period traffic volume. **Table 8** and **Table 9** summarize the crash trends for this intersection.

Using the police crash descriptions, it was concluded that about 39% of crashes involved drivers failing to stop fast enough and hitting the car in front of them, 27% of crashes were due to distracted drivers not having their full attention on the road (cell phones, GPS, reading signs), 19% crashes were due to drivers changing lanes (mainly to the right), and 15% of crashes were due to other driver errors. A breakdown of crash causes is shown in **Table 10**.

Retroflective signal backplates are already installed at the intersection, and additional short-term safety recommendations were identified through this study as described in the **Recommendations** section.

TABLE 8: FRONTIER DRIVE INTERSECTION COLLISION TYPES

Direction	Rear End	Angle	Head On	Sideswipe - Same Direction	Fixed Object - Off Road	Backed Into	Other
Westbound	19	1		6	1	1	
Eastbound	19		1	3		1	
Northbound	5			2			
Southbound		1		1			
Center	3	6					1

TABLE 9. FRONTIER DRIVE INTERSECTION CRASH DAY AND TIME PERIOD

	Day		Time Period		
Direction	Weekday	Weekend	AM	PM	Other
Westbound	21	7	3	13	12
Eastbound	20	4	5	9	10
Northbound	5	2	1	1	5
Southbound	2	0	0	2	0
Center	8	2	1	3	6

TABLE 10: FRONTIER DRIVE INTERSECTION CRASHES CAUSES

Causes	Number	Percent
Cell Phone	3	4%
Distracted Driver (GPS, reading road signs, dashboard)	19	23%
Right Lane Change	8	10%
Left Lane Change	1	1%
Unidentified Direction Lane Change	6	8%
Failed to Stop (may be due to driver driving too fast, following too close, or distracted)	32	40%
Sudden Stop	1	1%
Seizure	1	1%
Right on Red	1	1%
Other Driver Error (no right-of-way, improper backing, disregarding red light)	9	11%

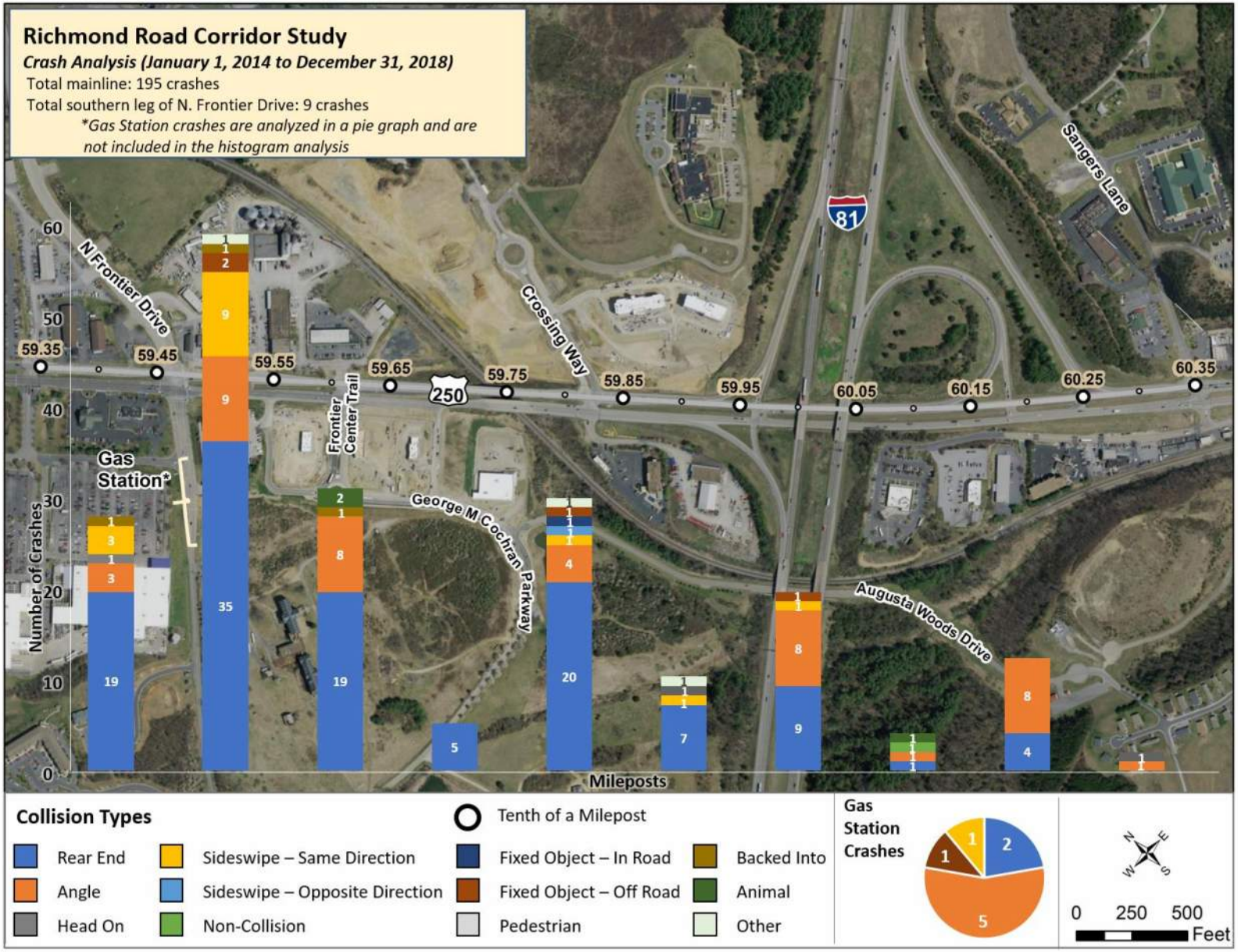


FIGURE 11: CORRIDOR CRASH ANALYSIS

3.2 2030 No-Build Conditions Analysis

3.2.1 Traffic Analysis

Analysis of 2030 traffic operations shows the following changes compared to existing conditions:

- Overall delay at signalized intersections increases at nearly all intersections due to increased traffic volumes.
- Delays increase and LOS degrades at Frontier Drive in both peak hours for most of the movements due to heavy mainline volume and protected left-turn operations. Most left-turning movements operate at LOS E or LOS F, and the westbound and southbound left-turn queues exceed effective storage lengths during the PM peak hour.
- Delays at Frontier Center Trail have greater increases during the PM peak hour due to increased traffic entering and exiting Frontier Center. Northbound and southbound approaches experience delays of 62 seconds per vehicle and 106 seconds per vehicle due to split phasing operations. Westbound left-turn queues exceed the effective storage length during the PM peak hour.
- Overall intersection delays at Crossing Way increase primarily due to the southbound approach exiting Staunton Crossing. Southbound left turns operate at LOS E in the AM and PM peak hours. Eastbound and westbound through queues block the left-turn bays during the PM peak hour.
- The intersection with the I-81 southbound ramps operates at a worse level of service compared to PM existing conditions. Weaving issues are expected to increase on westbound Richmond Road between I-81 and Crossing Way due to the increased number of trips accessing both Staunton Crossing (westbound right turn at Crossing Way) and Frontier Center (westbound left turn at Frontier Center Trail) from I-81 and the east. Westbound through queues continue to block the left-turn bay during the PM peak hour.
- Delay for the southbound left turn from the northbound I-81 off-ramp increases during both peak hours, operating at LOS F in the AM peak hour and LOS E in the PM peak hour. This is due to higher mainline volumes and fewer gaps in traffic.
- Delays for the eastbound left turn to northbound I-81 increase. Operations diminish from LOS B to LOS C during the PM peak hour due to the higher mainline volumes and fewer gaps in traffic.

Table 11 and **Table 12** summarize the delay and LOS by approach for study intersections for existing conditions and 2030 no-build AM and PM peak hours, respectively. The no-build is a scenario with 2030 future traffic volumes and the existing roadway network configuration. It serves as a baseline for comparison against recommended improvements. Movement delay and LOS tables as well as 95th percentile queue length comparisons can be found in **Appendix D**. The Synchro HCM reports can be found in **Appendix E**. **Figure 12** compares the number of intersection movements at each LOS for the existing and no-build conditions.

TABLE 11. AM PEAK HOUR DELAY (SECONDS PER VEHICLE) AND LOS COMPARISON (EXISTING AND NO-BUILD)

Intersection	1. Frontier Drive		2. Frontier Center Trail		3. Crossing Way		4. I-81 SB Ramps		5. I-81 NB Off-Ramp		6. I-81 NB On-Ramp	
Approach	*2018*	*2030*	*2018*	*2030*	*2018*	*2030*	*2018*	*2030*	*2018*	*2030*	*2018*	*2030*
Eastbound Richmond Rd	B (17.3)	D (37.7)	B (12.6)	B (17.2)	A (1.7)	A (5.2)	C (23.7)	B (17.0)	†	†	A (9.6)††	B (11.3)††
Westbound Richmond Road	B (11.8)	B (14.9)	B (10.8)	B (10.7)	A (2.8)	A (1.7)	B (11.9)	B (13.8)	†	†	†	†
Northbound	D (46.6)	D (44.3)	D (46.3)	D (46.8)	D (53.3)	D (53.1)						
Southbound	D (53.6)	D (50.6)	D (46.7)	D (47.3)	D (48.9)	D (47.5)	D (47.6)	D (43.2)	D (25.6)††	F (53.3)††		
Overall	**C (21.1)**	**C (29.4)**	**B (14.3)**	**B (16.6)**	**A (3.7)**	**A (5.7)**	**C (21.5)**	**B (18.6)**				

† Synchro does not provide LOS or delay for movements with no conflicting volumes

†† Left-turn movement results presented

TABLE 12. PM PEAK HOUR DELAY (SECONDS PER VEHICLE) AND LOS COMPARISON (EXISTING AND NO-BUILD)

Intersection	1. Frontier Drive		2. Frontier Center Trail		3. Crossing Way		4. I-81 SB Ramps		5. I-81 NB Off-Ramp		6. I-81 NB On-Ramp	
Approach	*2018*	*2030*	*2018*	*2030*	*2018*	*2030*	*2018*	*2030*	*2018*	*2030*	*2018*	*2030*
Eastbound Richmond Road	D (36.5)	E (57.3)	A (5.8)	C (25.4)	A (1.1)	A (3.3)	A (0.7)	C (30.1)	†	†	B (11.5)††	C (23.2)††
Westbound Richmond Road	B (17.4)	D (38.1)	B (12.3)	A (4.8)	A (1.5)	C (49.4)	B (11.9)	B (14.9)	†	†	†	†
Northbound	D (54.5)	E (60.9)	D (51.4)	E (61.8)	E (58.5)	E (64.0)						
Southbound	D (54.6)	E (70.0)	D (52.1)	F (105.6)	D (54.5)	E (56.7)	D (52.3)	E (58.5)	D (25.6)††	E (39.8)††		
Overall	**C (31.6)**	**D (52.1)**	**B (12.3)**	**C (21.6)**	**A (2.9)**	**C (29.3)**	**B (11.5)**	**C (24.6)**				

† Synchro does not provide LOS or delay for movements with no conflicting volumes

†† Left-turn movement results presented

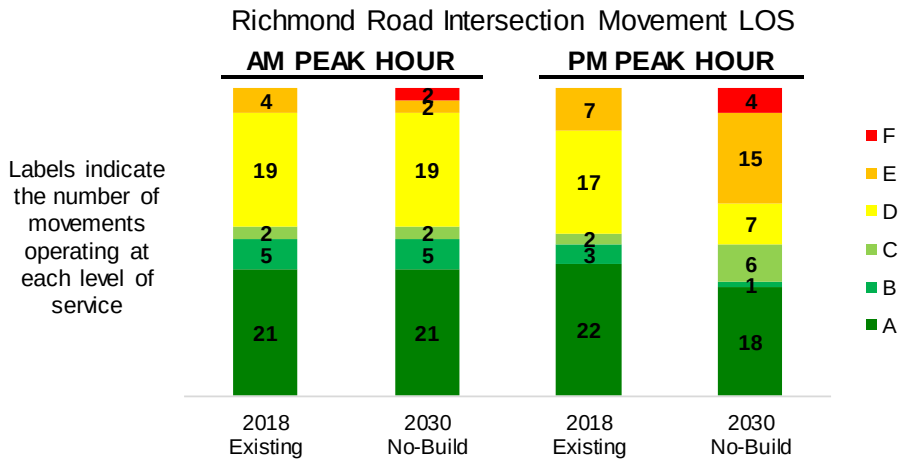


FIGURE 12. INTERSECTION MOVEMENT LOS COMPARISON (EXISTING AND NO-BUILD)

4 Corridor Improvements

Findings from the existing and 2030 no-build analyses were used to identify improvement concepts. Improvements recommended in the 2009 Richmond Road Multi-Modal Corridor Study, the 2013 Staunton Crossing Traffic Impact Analysis, and the 2013 Frontier Center Traffic Analysis were taken into consideration along with new improvements not previously identified in these studies. The goals of the improvements are to enhance multimodal access and connectivity, safety and traffic operations in the Richmond Road corridor.

4.1 Alternatives Development and Screening

Table 13 shows the alternatives developed and screened. Preliminary alternatives were vetted by the project Study Team, which included representatives from VDOT, the City of Staunton, Augusta County, and CSPDC, at a review meeting on March 27, 2019. Conceptual drawings of all alternatives can be referenced in **Appendix F.** Innovative intersections such as a partial bowtie intersection, median U-turn intersections, and restricted crossing U-turn intersections were also considered for the corridor. These were determined to be infeasible at this time due to identified right-of-way constraints, insufficient median width for U-turns and heavy vehicles, grading or utility constraints for U-turn bulb-outs, or lack of local stakeholder support.

A selection of the alternatives was advanced into further analysis which included an evaluation of traffic operations and safety benefits. Results of the 2030 build conditions analysis and input from the Study Team and the public through an informational open house on April 10, 2019 were used to arrive at a set of preferred alternatives. Details of the preferred alternatives are provided in the **Recommendations** section including a one-page graphical summary with a description and conceptual drawing of the improvement, expected benefits, summary of operational analysis results, planning-level cost estimate, and schedule.

TABLE 13. IMPROVEMENT ALTERNATIVES CONSIDERED

Location	Alternative Name	Advanced to Analysis	Preferred Alternative
1. Richmond Road/ Crossing Way	Richmond Road and Crossing Way Shared Use Path	✓	✓
2. Augusta Woods Drive	Augusta Woods Shared Use Path	✓	✓
3. Entire Study Area	Transit Improvements - Near-Term	✓	✓
	Transit Improvements - Future	✓	Long-term
4. Frontier Drive Intersection	Option A - Add Turn Lanes	✓	✓
	Option B - Northbound Frontier Drive Access Management	✓	Long-term
	Option - Partial Bowtie	✓	
5. Frontier Drive (Sheetz/Lowes)	Option A - Eliminated Eastbound Left Turns	✓	✓
	Option B - Eliminate Eastbound, Westbound, and Southbound Left Turns	✓	Long-term
6. Frontier Center Trail Intersection	Intersection Improvement	✓	✓
7. Crossing Way Intersection	Intersection Improvement	✓	✓
8. Westbound Richmond Road at Southbound I-81/Crossing Way	Option A - Channelized Right Turns (Signal)	✓	✓
	Option B - Signalize Right Turns	✓	
	Option - Channelized Right Turns (Yield)		
	Option - Free-Flow Lane		
	Option - Widen		
9. Northbound I-81 Ramp Intersections	Option A - One Signalized Intersection	✓	
	Option B - Split Signalized Intersection	✓	✓
	Option - Restricted Crossing U-Turn (RCUT)	✓	

4.2 2030 Build Conditions Analysis

4.2.1 Traffic Analysis

The change in 2030 peak hour operational conditions for the alternatives was evaluated using Synchro software and compared against no-build conditions. The analysis of traffic operations with improvements shows the following changes:

- **Frontier Drive Intersection Improvement**: Both options A and B show similar improvements over no-build conditions. Eastbound, westbound, and southbound left turns experience less delay and, in some cases, improved LOS from additional capacity of second turn lanes. The greatest improvements are for eastbound left turns in AM (67 second reduction), westbound left turns in PM (23 second reduction), and southbound left turns in PM (44 second reduction). Right turn delay is also reduced with proposed right turn signal overlaps. The northbound through movement has a negligible increase in delay with the reduction of one lane in Option B in conjunction the Frontier Drive access management improvement.
- **Frontier Center Trail Intersection Improvement:** The improvement results in an increase in overall intersection delay for AM and PM peak hours because of the increase in side street signal green time required to accommodate new pedestrian crossings. This results in

a slight increase in mainline delay.

- **Crossing Way Intersection Improvement:** The improvement results in an increase in overall intersection delay for AM but a reduction for PM. The AM delay increase is due to the increase in side street signal green time required to accommodate new pedestrian crossings, resulting in increased mainline delays. The PM southbound approach delay is reduced by approximately 43 seconds due to the additional capacity of a second southbound left-turn lane.
- **Westbound Richmond Road at Southbound I-81/Crossing Way Improvement:** Signalizing the southbound right turns results in approximately 36 seconds of AM peak hour delay and 50 seconds of PM peak hour delay for the movement that is free flowing under existing conditions. Overall intersection delays do not increase significantly from no-build conditions though. The approximately 9 second reduction of PM intersection delay is not attributed to the improvement and is due to better eastbound signal coordination. Both options show similar southbound delays and queuing. Southbound queues on the off-ramp are less than 300 feet in both peak hours.
- **Northbound I-81 Ramp Intersection Improvement:** Since overall intersection LOS is not reported by Synchro for unsignalized intersections, the comparison with signal improvements was focused on the southbound left turns at the northbound I-81 off-ramp and eastbound left turns at the northbound I-81 on-ramp. Southbound left turn delay decreases from no-build conditions in the AM for both options and increase in PM. Eastbound left turn delays increase in both AM and PM. All delay increases, which are due to signalizing the movements, are less than 20 seconds but result in a safer crossing movement. Eastbound and westbound through movements operate at LOS B or better in both AM and PM with less than 20 seconds of delay. Option B has lower delays than Option A because of the signal phase overlaps that can be provided with a split intersection. A signal warrant analysis was also prepared for this location using estimated 2030 traffic volumes and is provided in **Appendix G.**

Table 14 summarizes the LOS and delay for study area intersections for existing condition, 2030 no-build, and 2030 build AM and PM peak hours. Build Option A and Option B are reported separately for applicable intersection improvements. Movement delay and LOS tables as well as 95th percentile queue length comparisons can be found in **Appendix D**. The Synchro HCM reports can be found in **Appendix E**. **Figure 13** compares the number of intersection movements at each LOS for the existing, no-build conditions, and build conditions (preferred alternatives), and shows a decrease in the number of movements at LOS E or F with the improvements.

TABLE 14. PEAK HOUR DELAY (SECONDS PER VEHICLE) AND LOS COMPARISON (EXISTING, NO-BUILD, AND BUILD)

	Scenario	1. Frontier Drive	2. Frontier Center Trail	3. Crossing Way	4. I-81 SB Ramps	5. I-81 NB Off-Ramp (SBL only)	6. I-81 NB On-Ramp (EBL only)
AM Peak Hour	2018 Existing	C (21.1)	B (14.3)	A (3.7)	C (21.5)	D (25.6)	A (9.6)
	2030 No-Build	C (29.4)	B (16.6)	A (5.7)	B (18.6)	F (53.3)	B (11.3)
	Change from Existing	**+8.3**	**+2.3**	**+2.0**	**-2.9**	**+21.0**	**+1.7**
	2030 Build Option A	C (24.1)*	C (20.6)	B (12.1)	B (19.6)*	D (51.0)	C (27.3)
	Change from No-Build	**-5.3**	**+4.0**	**+6.4**	**+1.0**	**-2.3**	**+16.0**
	2030 Build Option B	B (24.5)	N/A	N/A	B (19.6)	D (43.8)*	B (19.6)*
	Change from No-Build	**-4.9**			**+1.0**	**-9.5**	**+8.3**
PM Peak Hour	2018 Existing	C (31.6)	B (12.3)	A (2.9)	B (11.5)	D (25.6)	B (11.5)
	2030 No-Build	D (52.1)	C (21.6)	C (29.3)	C (24.6)	E (39.8)	C (23.2)
	Change from Existing	**+20.5**	**+9.3**	**+26.4**	**+13.1**	**+14.2**	**+11.7**
	2030 Build Option A	D (35.3)*	C (23.4)	B (18.6)	B (15.4)*	E (56.4)	C (30.6)
	Change from No-Build	**-16.8**	**+1.8**	**-10.7**	**-9.2**	**+16.6**	**+7.4**
	2030 Build Option B	D (35.3)	N/A	N/A	B (15.1)	D (52.8)*	C (28.4)*
	Change from No-Build	**-16.8**			**-9.5**	**+13.0**	**+5.2**

*Indicates preferred alternative for intersections w ith multiple improvement options analyzed

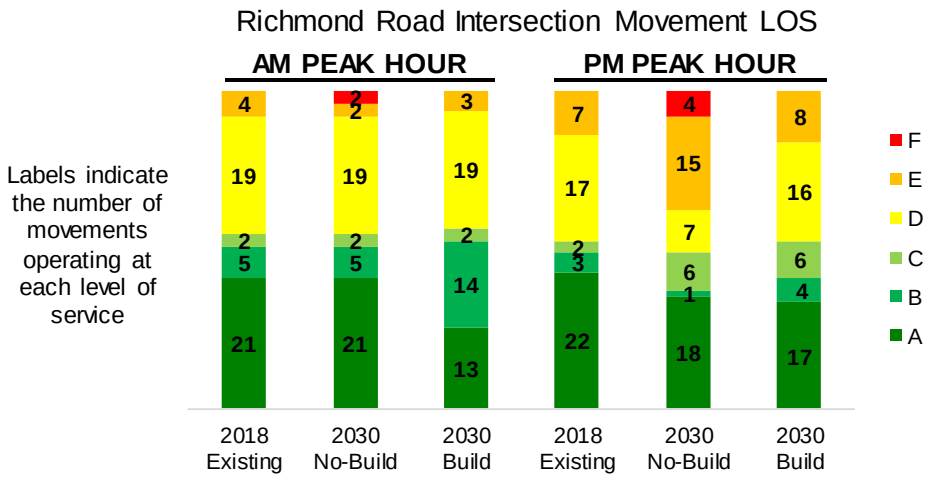


FIGURE 13. INTERSECTION MOVEMENT LOS COMPARISON (EXISTING, NO-BUILD, AND BUILD)

4.2.2 Crash Analysis

It is anticipated that the existing safety concerns and crashes for the study corridor will be reduced if the proposed improvements are implemented. The expected reduction in crashes was estimated using crash modification factors—multiplicative factors computed using historic crash studies. A reduction in crashes is shown by factors below one. For example, a CMF of 0.85 indicates that the frequency of total crashes with the improvement is estimated to be 85 percent of the crash frequency without the improvement, or the reduction in crash frequency is 15 percent. Using the Highway Safety Manual methodology, SMART SCALE planning CMFs, and the CMF Clearinghouse data, the following CMFs were obtained as listed in **Table 15**.

SMART SCALE planning CMFs for each of the alternatives were applied to the related historical crashes within each of the crash influence areas associated with a given improvement. If SMART SCALE planning CMFs were unavailable, the highest quality CMF value from the Clearinghouse was applied. This crash analysis methodology differs slightly from the methodology used by VDOT in the first three rounds of SMART SCALE, in which the best CMF of all intersection improvements is applied to the total intersection crashes. While the methodology utilized in this study represents a more accurate expectation of crash reductions, the reductions are lower than what would be anticipated in SMART SCALE scoring.

The estimated reduction in crash frequency for the improvements are identified for each intersection in **Table 16**. The location numbers correspond to the location numbers and alternatives in **Table 13.**

TABLE 15. CRASH MODIFICATION FACTORS

Improvement	Crash Modification Factor	Location					
		4. Frontier Dr	5. Frontier Dr (Sheetz/Lowes)	6. Frontier Center Tr	7. Crossing Way	8. WB Richmond Rd	9. NB I-81 Ramp
Add second turn lane	0.97	X			X		X
Add new turn lane	0.85					X	
Improve access management	0.75	X					
Add sidewalk	0.90	X		X	X		
Improve pedestrian at-grade crossing	0.85	X		X	X		
Add separate 10' mixed-use trail	0.80	X		X	X		
Remove minor approach left turns	0.65		X				
Add stop control	0.78			X			
Convert stop/yield control to signal	0.65					X	
Signalize intersections	0.65						X
Enhance signal conspicuity	0.85	X			X		

TABLE 16. ESTIMATED CRASH REDUCTIONS WITH PROPOSED IMPROVEMENTS

Intersection	5-Year Average Crash Frequency (crashes/year)	Estimated Annual Crash Reduction (crashes/year)
Frontier Drive	16.0	1.1
Sheetz/Lowes Driveway	1.8	0.4/0.6[1]
Frontier Center Trail	7.2	-
Crossing Way	7.8	0.3
Southbound I-81 Ramps	4.6	1.1[2,3]
Northbound I-81 Ramps	3.4	1.2[3]

[1]Option A/Option B
[2]Includes westbound Richmond Road improvement between I-81 and Crossing Way; the westbound approach at Crossing Way has a crash frequency of 3 crashes per year.
[3]Options A and B expected to have similar crash reductions

All the proposed improvements are expected to provide reduction in crash frequency. The Frontier Center Trail intersection did not have five-year historical crashes in the improvement influence areas (pedestrian crossings and frontage road intersection) so a reduction was not calculated using the CMF methodology. The greatest reductions are seen with the intersection improvements for the I-81 southbound and northbound ramps. The other location that is anticipated to have notable reductions in crashes is the Sheetz and Lowes driveways with improved access management. These three locations have improvements that reduce conflict points in intersections and provide safer turns across opposing traffic. The improvements on Frontier Drive are mainly focused on capacity issues and therefore, the reduction is not as significant. Nonetheless, all countermeasures are considered as benefits when it comes to safety improvement.

Potential short-term safety improvements were identified for the Frontier Drive intersection due the high number crashes at this location relative to the rest of the corridor. These are listed below in addition to CMFs, as available, and estimated reduction of westbound approach crashes. Retroflective signal backplates are already installed at this intersection.

- Add a fourth westbound signal head over the right lane to provide one signal head per approach lane and increase conspicuity
  (CMF = 0.85; reduction of 0.8 crashes per year)
- Add advanced intersection lane control signs to indicate configuration of lanes ahead
- Add “Frontier Drive Next Signal” guide sign on westbound Richmond Road just west of the Frontier Center Trail Intersection
  (CMF = 0.98; reduction of 0.1 crashes per year)
- Add radar speed/driver feedback sign to the 35-mph speed limit sign on westbound Richmond Road west of the railroad crossing bridge to reduce speeds
  (CMF = 0.95; reduction of speed-related crashes)
- Close the two frontage road driveways
  (*CMF = 0.75; reduction of 0.2 crashes per year)*

- Restripe the westbound intersection approach (possibly in conjunction with the closure of the frontage road driveways)—the solid left-turn lane striping for the entire block length may be causing driver confusion
- Install high-friction surface (approximately 300 feet in advance) of the intersection approach *(CMF = 0.75; reduction of 1.4 crashes per year)*
- Investigate performance of adaptive signal control system to ensure adequate progression is provided to eastbound and westbound approaches, particularly westbound in the PM peak period
  (CMF = 0.92; reduction of 0.4 crashes per year)

4.3 Recommendations

It is recommended that the preferred alternatives be implemented as multiple phased projects as funding is available and corridor development and traffic growth warrants the roadway capacity improvement projects. The recommended multimodal network is shown is **Figure 14**.

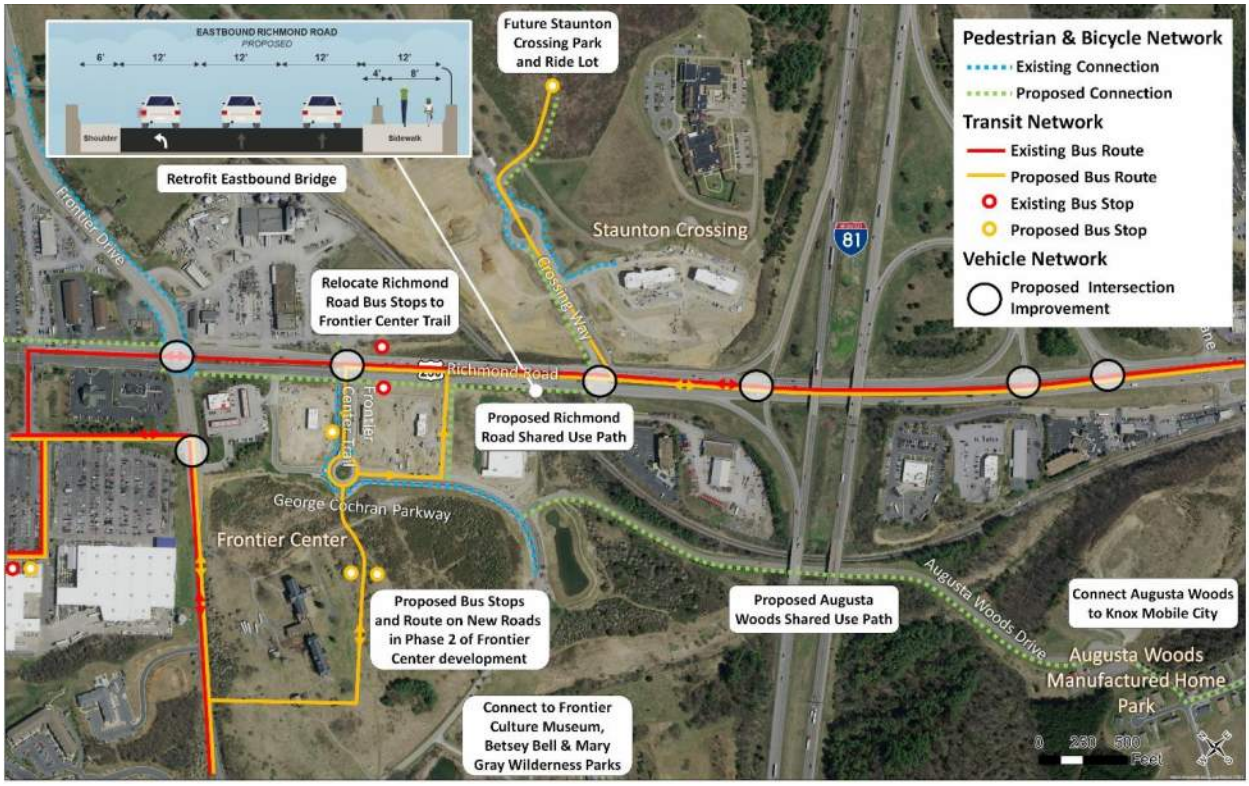


FIGURE 14. RECOMMENDED MULTIMODAL NETWORK

4.3.1 Projects

This section contains summary sheet with a description and conceptual drawing of the project, location map, expected benefits, implementation considerations, operational analysis results, planning-level cost estimate, and schedule for each improvement project. The nine projects recommended for implementation are:

- **Project 1**: Richmond Road and Crossing Way Shared Use Path
- **Project 2**: Augusta Woods Shared Use Path
- **Project 3**: Bus Stop Improvements
- **Project 4**: Frontier Drive Intersection Improvement
- **Project 5**: Frontier Drive Access Management
- **Project 6**: Frontier Center Trail Intersection Improvement
- **Project 7**: Crossing Way Intersection Improvement
- **Project 8**: Westbound Richmond Road at Southbound I-81/Crossing Way Improvement
- **Project 9**: Northbound I-81 Ramp Intersection Improvement

Project 1: Richmond Road and Crossing Way Shared Use Path

Project Description

This project improves pedestrian and bicycle connectivity along Richmond Road and Crossing Way. The following improvements are to be made:

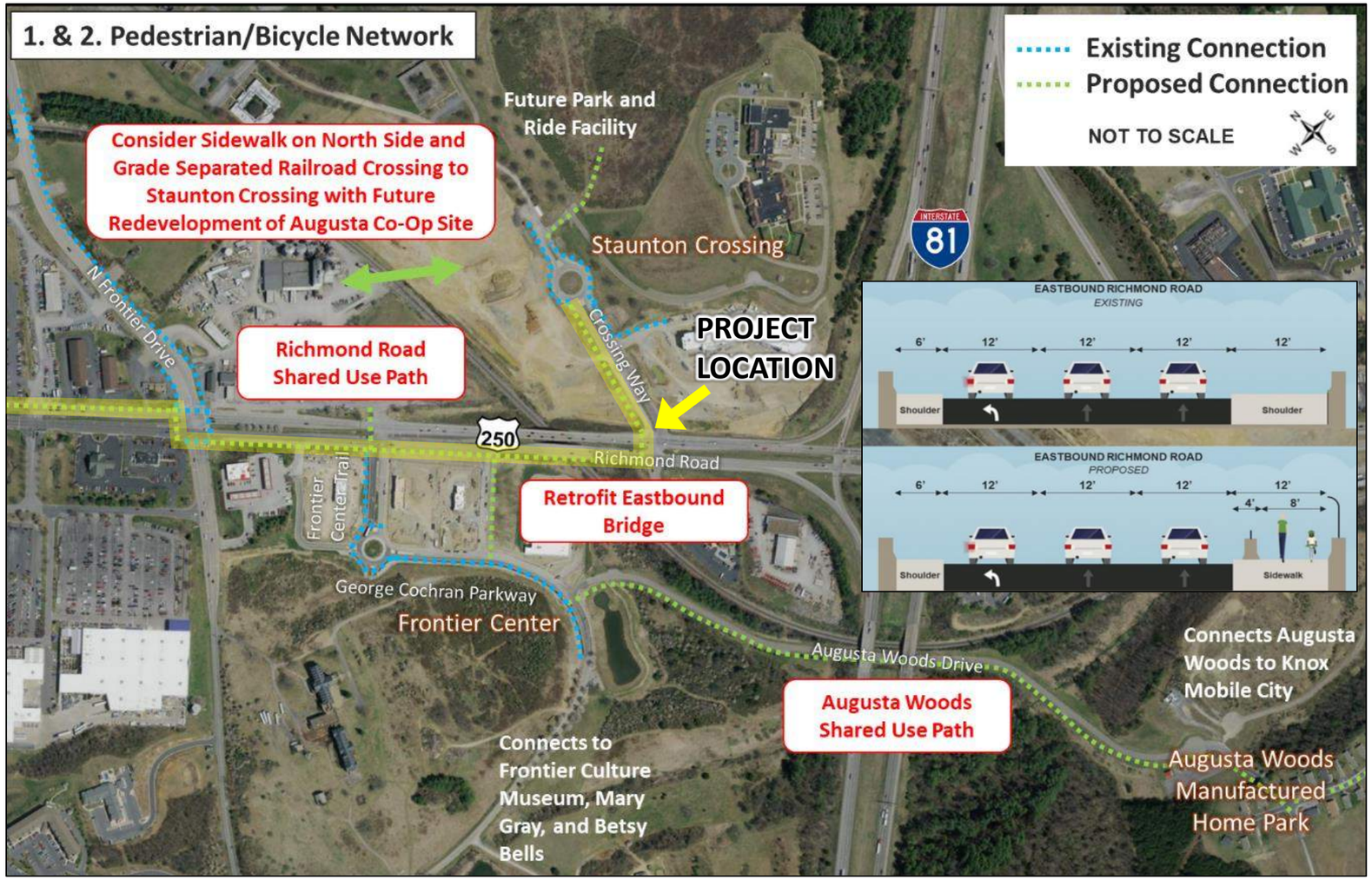
- Construct a 10-foot wide shared use path along the south side of Richmond Road from Frontier Drive to Crossing Way and along Crossing Way to the existing roundabout.
- Retrofit eastbound bridge by installing concrete barrier and fencing on the right shoulder to separate pedestrians and cyclists from the traffic lanes.
- Extend the existing sidewalk along the north side of Richmond Road from Community Way to Frontier Drive.
- Crosswalks are included in separate intersection improvement projects. Two-stage crossings are proposed across Richmond Road. All crosswalks are proposed to be high visibility with accessible pedestrian signals, push buttons, and pedestrian countdown signal heads.

Project Benefits

- Increased safety and connectivity for pedestrians and cyclists
- Improved transit access by walking and biking

Considerations

- The south side of Richmond Road was selected due to available right-of-way, proximity to Frontier Center businesses, and wider eastbound bridge deck
- The bridge will need a structural analysis to determine if it can support the additional loads required for the concrete barrier and fencing
- A design exception would be needed for narrower eastbound shoulders over the bridge



Safety Improvements

Crash Modification Factors (CMF)		Existing Crash Frequency	Estimated Crash Reduction
Add sidewalk	0.90	**One pedestrian crash reported near the Crossing Way intersection**	**0.2 crashes per year**
Improve pedestrian at-grade crossing	0.85		
Add separate 10' mixed-use trail	0.80		

Crash frequency is 5-year average for 2014 to 2018

Schedule (Entering Project Development)

Medium-Term (4-6 years)

Planning-Level Cost Estimate

Note: Cost estimates are reported in 2019 dollars and include 30% contingency on each phase

Phase	Cost
Preliminary Engineering	$269,000
ROW and Utilities	$376,000
Construction	$1,074,000
Total Cost	**$1,719,000**

Project 2: Augusta Woods Drive Shared Use Path

Project Description

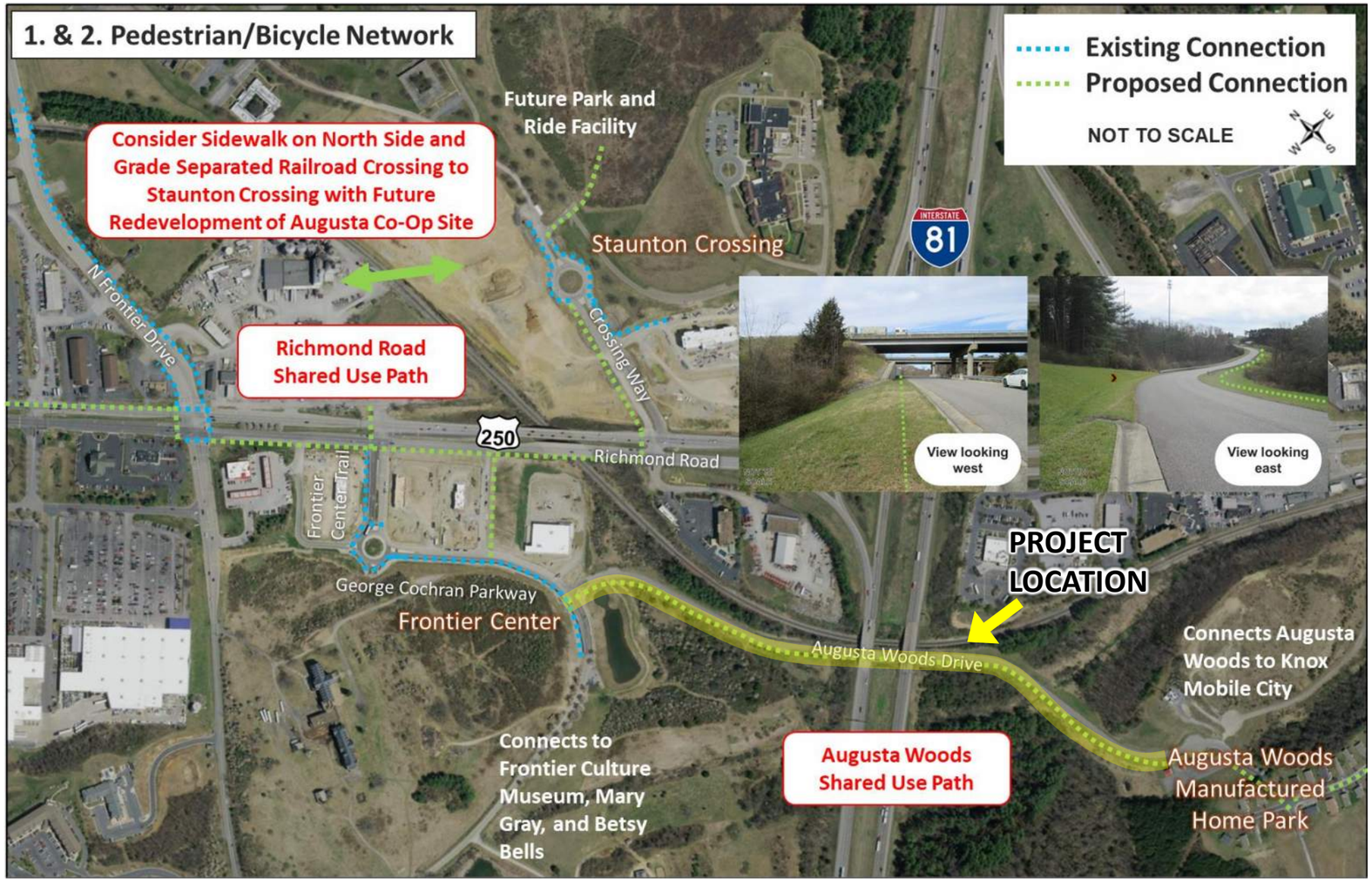
This project constructs a 10-foot wide shared use path along the south side of Augusta Woods Drive between George Cochran Parkway and Augusta Woods Manufactured Home Park to provide east-west pedestrian and bicycle connectivity.

Project Benefits

- Increased safety and connectivity for pedestrians and cyclists
- Improved transit access by walking and biking

Considerations

- The south side of Augusta Woods Drive was selected to provide separation between pedestrians and the railroad tracks on the north side of the road
- While outside of the study area, a pedestrian and bicycle connection should be considered between Augusta Woods Manufactured Home Park and Knox Mobile City along the recently constructed emergency access road
- The shared use path along Augusta Woods Drive is anticipated to require a lot of grading given existing terrain



Safety Improvements

Crash Modification Factors (CMF)		Existing Crash Frequency	Estimated Crash Reduction
Add separate 10' mixed-use trail	0.80	**No pedestrian crashes reported along Augusta Wood Drive**	**N/A**

Crash frequency is 5-year average for 2014 to 2018

Schedule (Entering Project Development)

Long-Term (7-10 years)

Planning-Level Cost Estimate

Note: Cost estimates are reported in 2019 dollars and include 30% contingency on each phase

Phase	Cost
Preliminary Engineering	$688,000
ROW and Utilities	$688,000
Construction	$2,752,000
Total Cost	**$4,128,000**

Project 3: Transit Bus Stop Improvements

Project Description

Transit improvements are recommended in multiple phases:

Near Term Improvements:

- Relocate Richmond Road bus stops to Frontier Center Trail between Richmond Road and the roundabout and install a shelter and bench along the existing sidewalk.
- Routes traveling eastbound and westbound on Richmond Road would enter Frontier Center to serve the stop. Eastbound routes would continue along George Cochran Parkway and use the right-in/right-out road to return to eastbound Richmond Road.

Long Term Improvements:

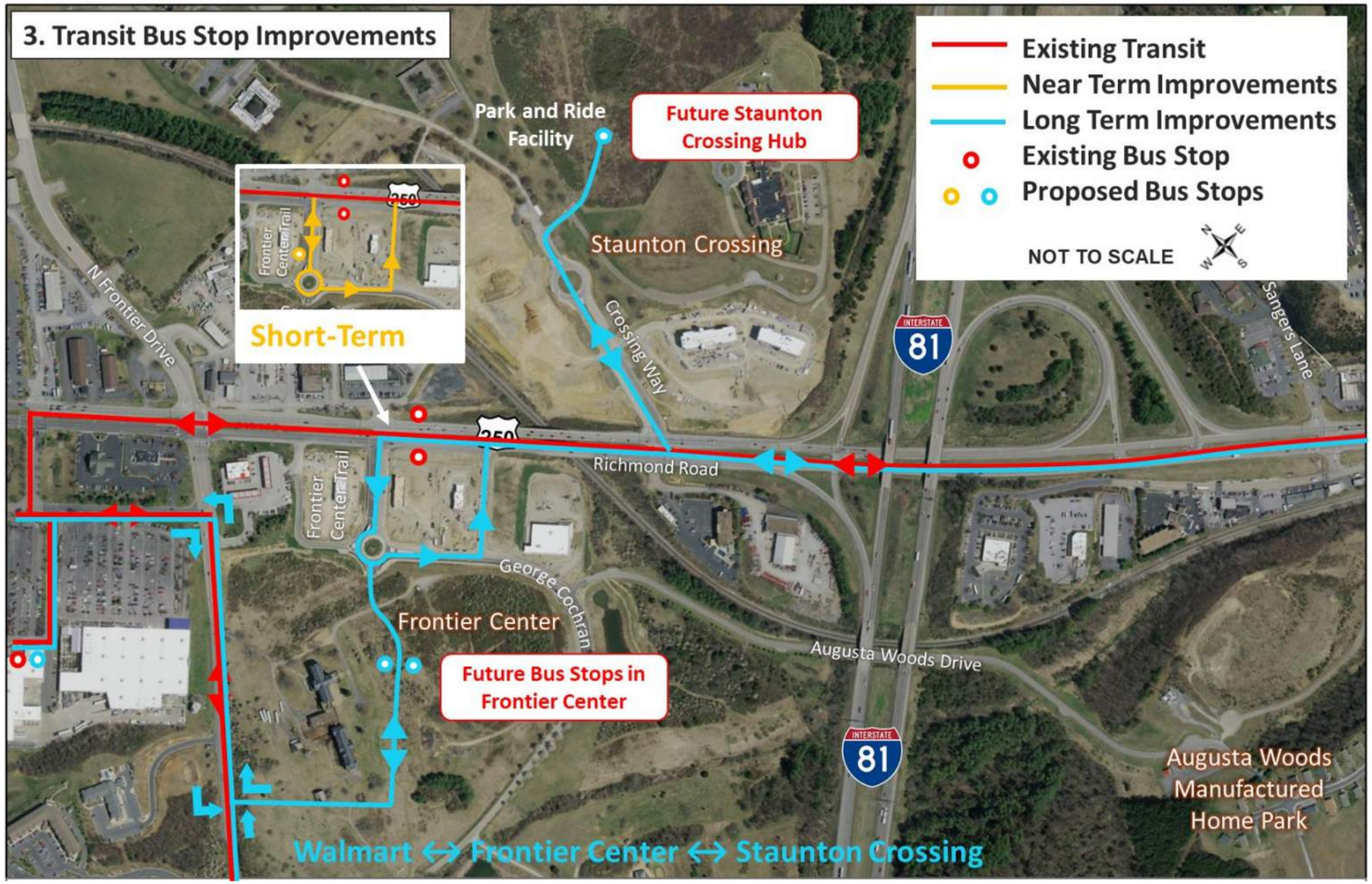
- Relocate transit stops to within the Frontier Center Phase 2 development on the new road constructed from the fourth leg of the existing roundabout.
- Transit routes would travel from Walmart, through Frontier Center, and to the future hub at the Staunton Crossing park and ride.

Project Benefits

- Increased safety for transit riders by providing a bus stop amenities/facilities
- Improved transit accessibility by locating bus stop near existing sidewalks
- Improved intercity and interregional transit connectivity at a new future hub in Staunton Crossing

Considerations

- The near-term improvement is prior to the construction of Frontier Center Phase 2 and the Staunton Crossing park and ride lot (included in SMART SCALE project to extend Crossing Way)
- CSPDC has planned phased improvements to the BRITE 250 Connector route to improve reliability and connect to new developments in the corridor in the future



Safety Improvements

Crash Modification Factors (CMF)	Existing Crash Frequency	Estimated Crash Reduction
No CMFs for Transit Improvements	**N/A**	**N/A**

Crash frequency is 5-year average for 2014 to 2018

Schedule (Entering Project Development)

Short-Term (1-3 years)

Long-Term (7-10 years)

Planning-Level Cost Estimate

Note: Cost estimates are reported in 2019 dollars and include 30% contingency on each phase. Changes to transit operating costs not considered here.

Phase	Short-Term Cost
Preliminary Engineering	$6,000
ROW and Utilities	$6,000
Construction	$23,000
Total Cost	**$35,000**

Project 4: Frontier Drive Intersection Improvement

Project Description

Frontier Drive is a signalized intersection that is expected to approach or exceed capacity for left-turn movements with future traffic growth.

Geometric improvements

- Consolidate/close driveways between Frontier Drive and Frontier Center Trail
- Add second eastbound, westbound, and southbound left-turn lanes

Signal improvements

- Add right turn overlap phases on all approaches

Pedestrian and bicycle improvements

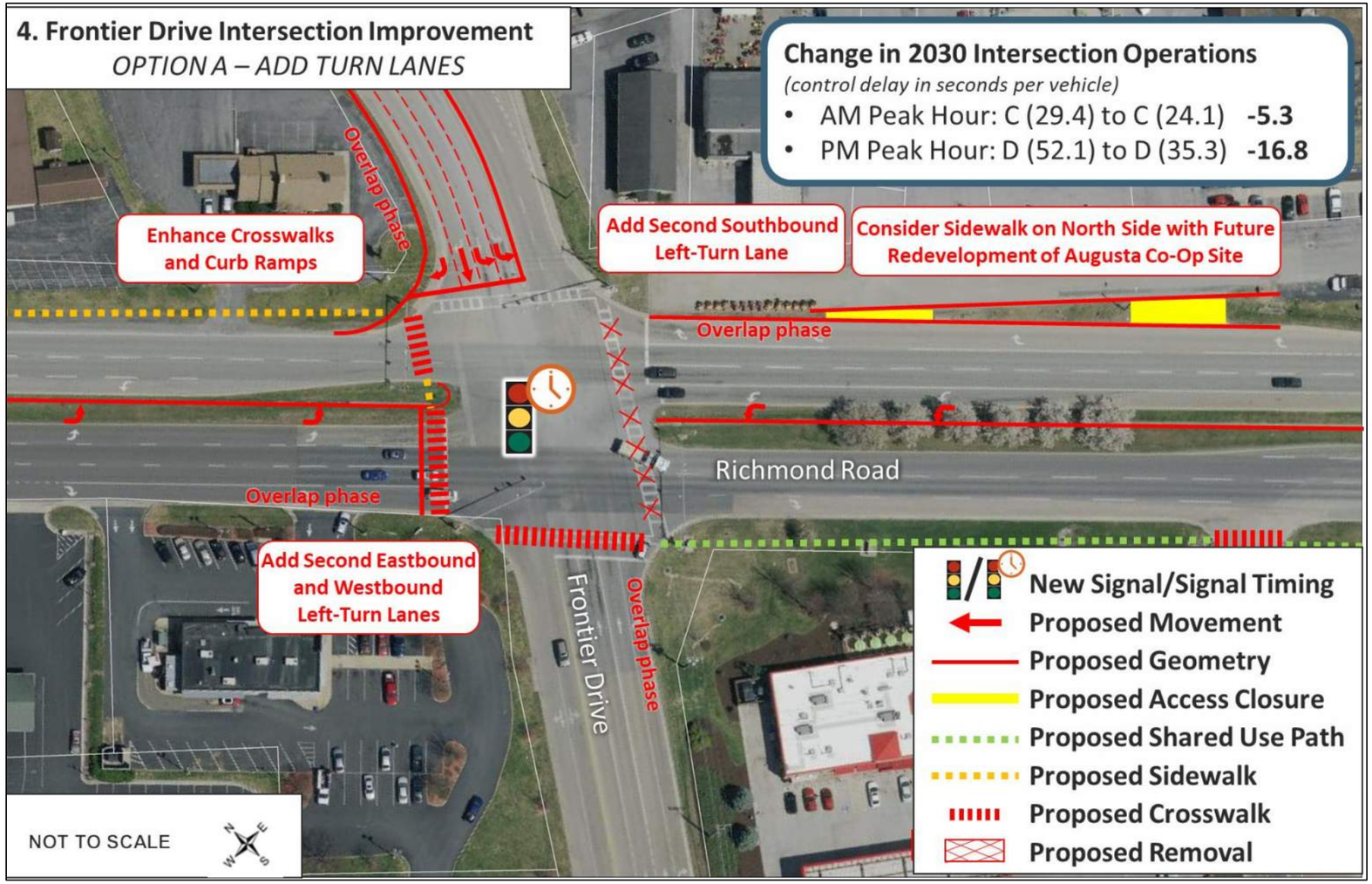
- Upgrade existing crosswalks and curb ramps to connect Frontier Drive sidewalks with proposed east/west shared use path along Richmond Road. Remove and relocate north/south crosswalk to the western leg.

Project Benefits

- Increased safety and crash reduction with additional turn lanes and closed driveways
- Increased safety and connectivity for pedestrians and cyclists
- Left turn queues contained within storage and reduced intersection delay

Considerations

- The southbound leg should be widened along the west side of the intersection to avoid costly impacts to overhead utilities along the east side. Widening the southbound leg will impact the northwest portion of the parking lot of LoanMax (two parking spaces) and the signal pole foundation.
- High visibility crosswalks are proposed with a two-stage N/S crossing. Accessible pedestrian signals with push buttons and pedestrian countdown signal heads are recommended.
- Growth in southbound and eastbound right turns (driven by Staunton Crossing) and westbound left turns (driven Frontier Center) will increase the need for improvements at this location.



Safety Improvements

Crash Modification Factors (CMF)		Existing Crash Frequency	Estimated Crash Reduction
Add second turn lane	0.97	**16 crashes per year**	**1.1 crashes per year**
Improve access management	0.75		
Add sidewalk	0.90		
Improve pedestrian at-grade crossing	0.85		
Add separate 10' mixed-use trail	0.80		
Enhance signal conspicuity	0.85		

Crash frequency is 5-year average for 2014 to 2018
Change in traffic operations from 2030 no-build to build conditions shown on concept sketch

Schedule (Entering Project Development)

Medium-Term (4-6 years)

Planning-Level Cost Estimate

Note: Cost estimates are reported in 2019 dollars and include 30% contingency on each phase

Phase	Cost
Preliminary Engineering	$186,000
ROW and Utilities	$260,000
Construction	$743,000
Total Cost	**$1,189,000**

Project 5: Frontier Drive Access Management

Project Description

Two offset driveway along Frontier Drive provide access to Lowes Home Improvement Warehouse to the west and to Sheetz gas station to the east. The geometry leads to many vehicles having to maneuver through several lanes and opposing traffic when entering and exiting the two sites. There are two proposed improvements for the Frontier Drive offset driveways:

Option A (Short-Term)

- Eliminate the eastbound left-turn from the Lowes' access road and install a raised median island to prevent traffic from turning left at the intersection.

Option B (Long-Term)

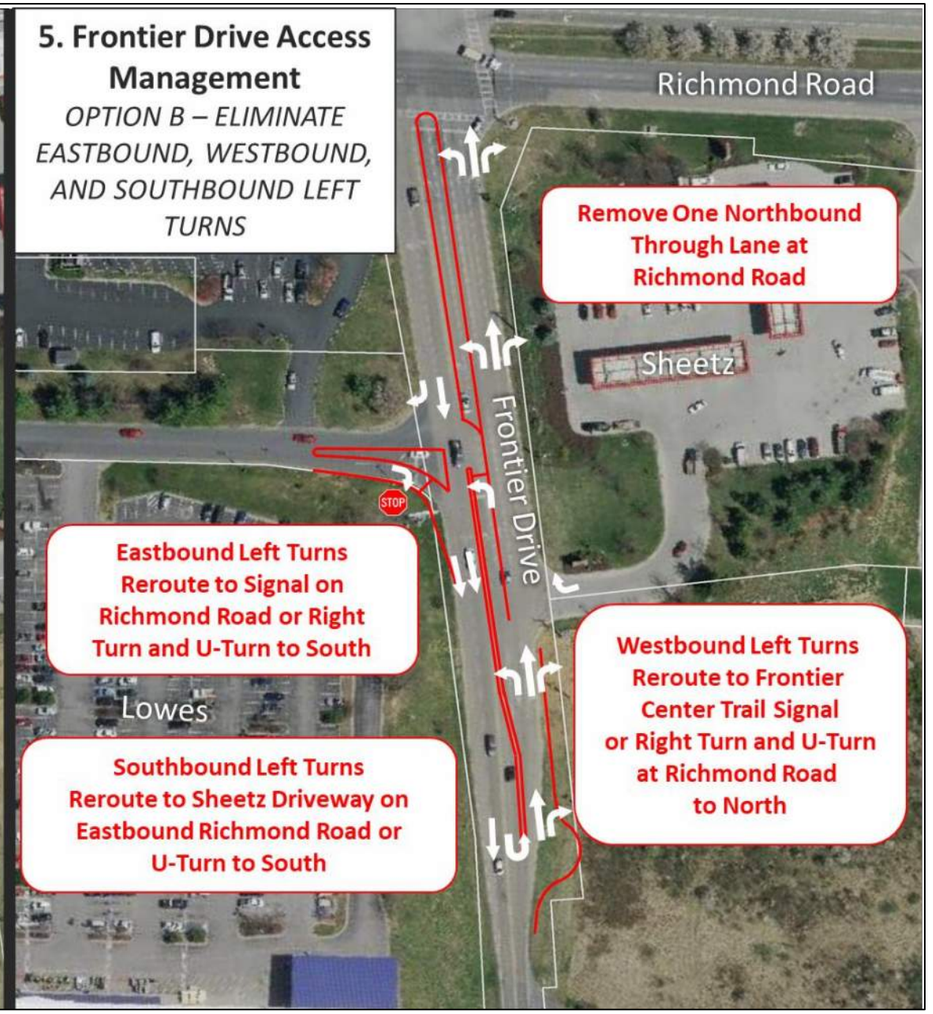
- Eliminate the eastbound left turn from the Lowes' access road and install a raised median island to prevent traffic from turning left at the intersection.
- The southbound approach would have a southbound right-turn lane and a through lane
- Eliminate southbound and westbound left turns at the Sheetz driveway
- Construct a raised median in the existing left-turn lane and repurpose one northbound through lane for the left-turn lane. This median width will facilitate northbound U-turns.
- Construct a bulb-out south of Sheetz to facilitate southbound U-turns

Project Benefits

- Decreased conflict points, increased safety, and crash reduction
- Improved access management

Considerations

- Traffic from the eastbound leg of the intersection wanting to travel eastbound onto Richmond Road would be rerouted to the signal at Richmond Road to the northwest or allowed to make a U-turn to the south after turning right



Safety Improvements

Crash Modification Factors (CMF)		Existing Crash Frequency	Estimated Crash Reduction
Remove minor approach left turns	0.65	**1.8 crashes per year**	**Project 5A: 0.4** **Project 5B: 0.6 crashes per year**

Crash frequency is 5-year average for 2014 to 2018
Change in traffic operations from 2030 no-build to build conditions shown on concept sketch

Schedule (Entering Project Development)

Project 5A: Short-Term (1-3 years)
Project 5B: Long-Term (7-10 years)

Planning-Level Cost Estimate

Note: Cost estimates are reported in 2019 dollars and include 30% contingency on each phase

Phase	5A Cost	5B Cost
Preliminary Engineering	$8,000	$85,000
ROW and Utilities	$8,000	$119,000
Construction	$30,000	$340,000
Total Cost	**$46,000**	**$544,000**

Project 6: Frontier Center Trail Intersection Improvement

Project Description

Frontier Center Trail is a signalized intersection that connects with a frontage road along the north side of the intersection and Frontier Center to the south. The following improvements are to be made:

Geometric improvements

- Add stop signs along Frontage Road to reduce confusion with traffic flow
- Add 3-WAY plaques on existing stop signs on the Sheetz and McDonalds driveways to reduce confusion with traffic flow

Signal improvements

- Improve signal detection of southbound frontage road approach

Pedestrian and bicycle improvements

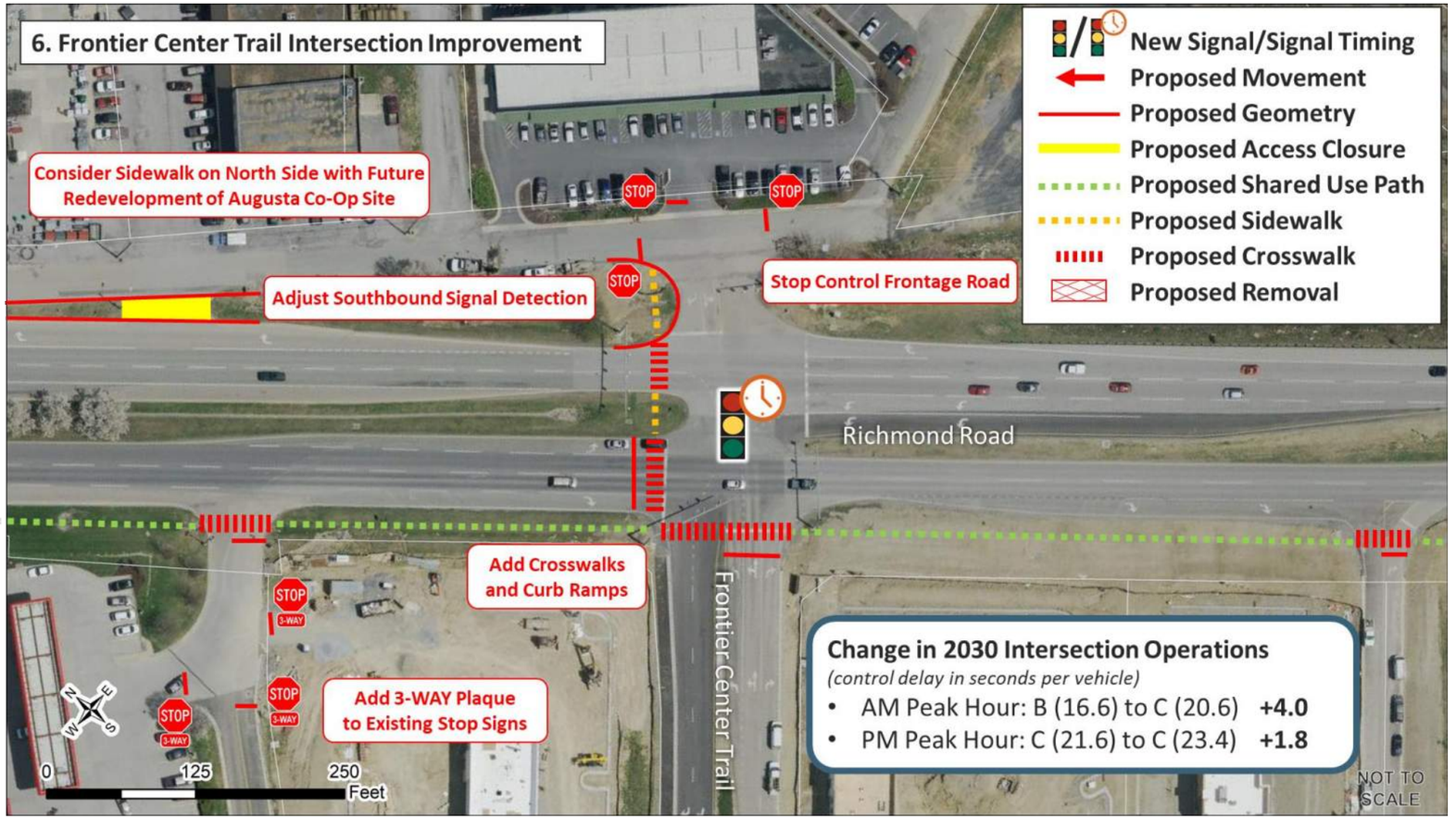
- Add north/south and east/west crosswalks, curb ramps, and pedestrian signals to connect Frontier Center sidewalks with proposed east/west shared use path along Richmond Road

Project Benefits

- Increased safety and reduced crash risk with additional stop signs on the frontage road
- Increased safety and connectivity for pedestrians and cyclists

Considerations

- The frontage road is necessary to continue to provide access to businesses on the north side of Richmond Road and could be realigned to provide internal site circulation and access with future redevelopment.
- High visibility crosswalks are proposed with a two-stage N/S crossing. Accessible pedestrian signals with push buttons and pedestrian countdown signal heads are recommended.



Note: Peak hour delay increases due to the increase in side street green time required to accommodate new pedestrian crossings, resulting in increased mainline delays.

Safety Improvements

Crash Modification Factors (CMF)		Existing Crash Frequency	Estimated Crash Reduction
Add sidewalk	0.90	**7.2 crashes per year**	**N/A No crashes reported in the frontage road influence area**
Improve pedestrian at-grade crossing	0.85		
Add separate 10' mixed-use trail	0.80		
Add stop control	0.78		

Crash frequency is 5-year average for 2014 to 2018
Change in traffic operations from 2030 no-build to build conditions shown on concept sketch

Schedule (Entering Project Development)

Medium-Term (4-6 years)

Planning-Level Cost Estimate

Note: Cost estimates are reported in 2019 dollars and include 30% contingency on each phase

Phase	Cost
Preliminary Engineering	$27,000
ROW and Utilities	$27,000
Construction	$107,000
Total Cost	**$161,000**

Project 7: Crossing Way Intersection Improvement

Project Description

Crossing Way is a signalized intersection that will reach capacity for the southbound left-turn movement due to increased traffic growth in the future. The following improvements are to be made:

Geometric improvements

- Add a second southbound left-turn lane

Signal improvements

- Add right turn overlap phases for the southbound movements and the westbound right movement

Pedestrian and bicycle improvements

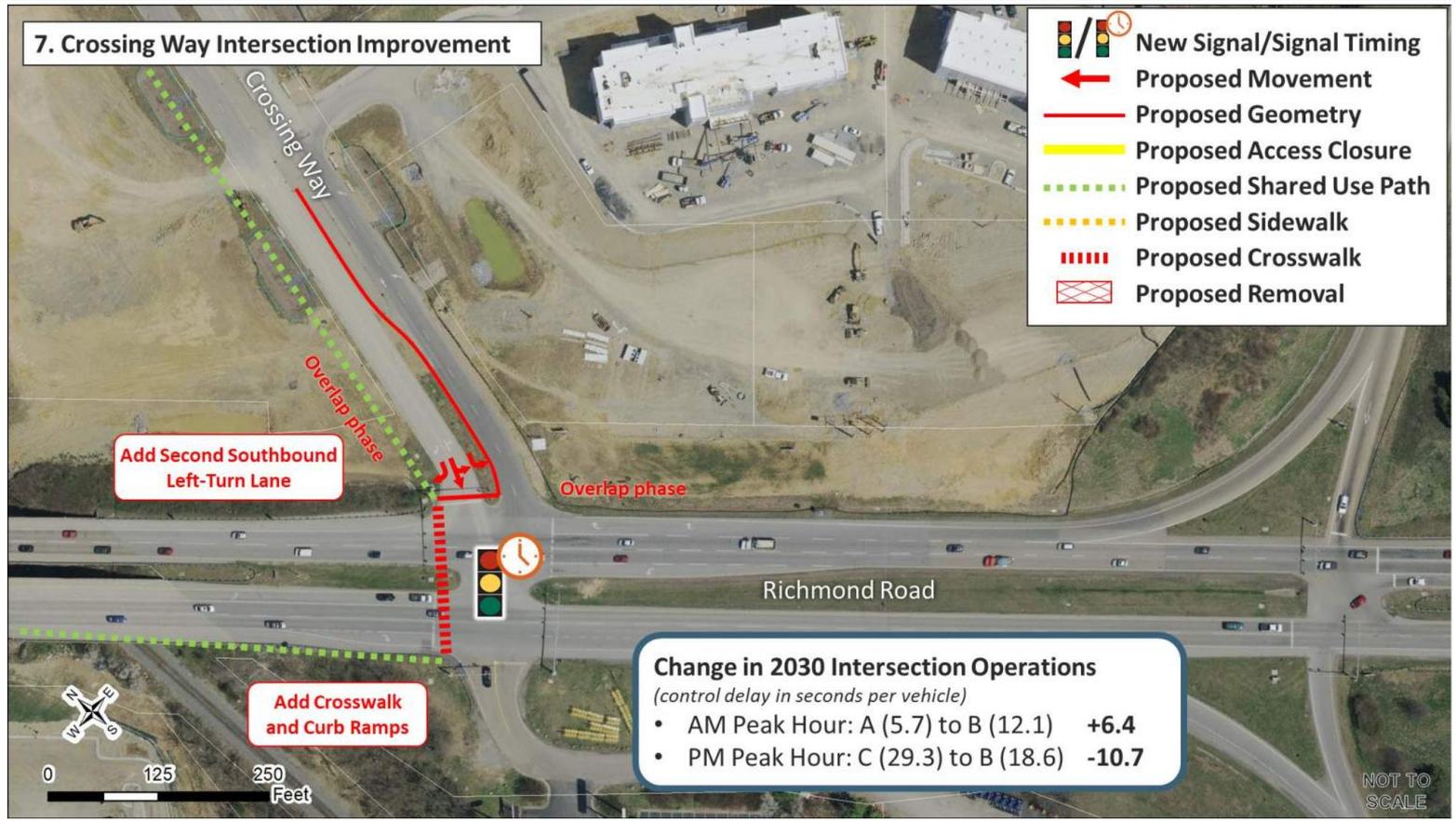
- Add north/south and east/west crosswalks to connect the proposed shared use path along Crossing Way with proposed east/west shared use path along Richmond Road

Project Benefits

- Increased safety and connectivity for pedestrians and cyclists
- Reduced southbound delay and queuing
- Accommodate growth in traffic for Staunton Crossing

Considerations

- The additional southbound left-turn lane would be constructed within the 16-foot-wide median
- The need for the southbound left-turn lane improvement is dependent on traffic growth from Staunton Crossing
- A high visibility crosswalk is proposed with a two-stage crossing. Accessible pedestrian signals with push buttons and pedestrian countdown signal heads are recommended.



Note: AM peak hour delay increases due to the increase in side street green time required to accommodate new pedestrian crossings, resulting in increased mainline delays.

Safety Improvements

Crash Modification Factors (CMF)		Existing Crash Frequency	Estimated Crash Reduction
Add second turn lane	0.97	**7.8 crashes per year**	**0.3 crashes per year**
Add sidewalk	0.90		
Improve pedestrian at-grade crossing	0.85		
Add separate 10' mixed-use trail	0.80		
Enhance signal conspicuity	0.85		

Crash frequency is 5-year average for 2014 to 2018
Change in traffic operations from 2030 no-build to build conditions shown on concept sketch

Schedule (Entering Project Development)

Long-Term (7-10 years)

Planning-Level Cost Estimate

Note: Cost estimates are reported in 2019 dollars and include 30% contingency on each phase

Phase	Cost
Preliminary Engineering	$63,000
ROW and Utilities	$63,000
Construction	$250,000
Total Cost	**$376,000**

Project 8: Westbound Richmond Road at Southbound I-81/Crossing Way Improvement

Project Description

The westbound weave between the southbound I-81 off-ramp and Crossing Way is challenging to maneuver due to close intersection spacing and traffic patterns. The following improvements are to be made:

- Signalize southbound right turns at the I-81 ramp intersection in a channelized dual right turn and remove the existing free-flow channelized right turn. The rightmost turn lane would be received into the right-turn only lane to Crossing Way
- Widen the southbound I-81 off-ramp and install overhead guide signs for Crossing Way, westbound Richmond Road, and eastbound Richmond Road
- Signalization provides gaps in westbound traffic for easier lane change movements and eliminates the weave

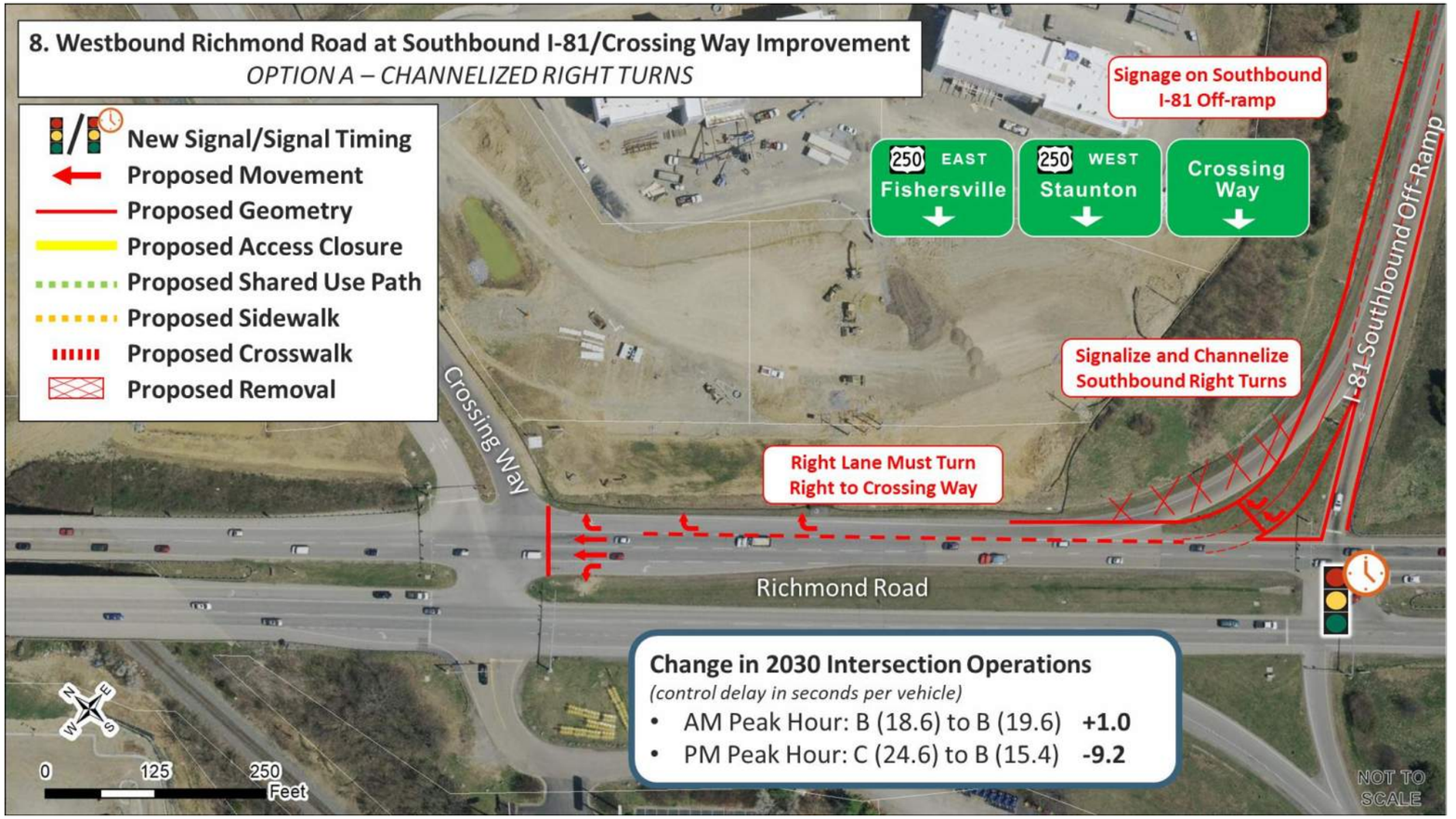
Traffic from the ramp wanting to turn left at the Crossing Way intersection (particularly heavy vehicles) could use the left right-turn lane to reduce the number of lane changed required compared to existing conditions.

Project Benefits

- Reduction in vehicle merging and weaving that can lead to crashes
- More gaps in westbound traffic for lane change movements with signalization of southbound right turns

Considerations

- Growth in southbound right turns, westbound through, and westbound right turns will increase the need for improvements at this location.



Safety Improvements

Crash Modification Factors (CMF)		Existing Crash Frequency	Estimated Crash Reduction
Convert stop/yield control to signal	0.65	**4.6 crashes per year**	**1.1 crashes per year***

*Also includes crash reduction on the westbound approach of the Crossing Way intersection, which has an existing crash frequency of 3 crashes per year
Crash frequency is 5-year average for 2014 to 2018
Change in traffic operations from 2030 no-build to build conditions shown on concept sketch

Schedule (Entering Project Development)

Short-Term (1-3 years)

Planning-Level Cost Estimate

Note: Cost estimates are reported in 2019 dollars and include 30% contingency on each phase

Phase	Cost
Preliminary Engineering	$392,000
ROW and Utilities	$157,000
Construction	$1,569,000
Total Cost	**$2,118,000**

Project 9: Northbound I-81 Ramp Intersection Improvement

Project Description

The northbound I-81 ramp intersection experiences delays for the unsignalized eastbound and southbound left-turn movements. Finding gaps between mainline traffic on Richmond Road is difficult during peak hours. The following improvements are to be made:

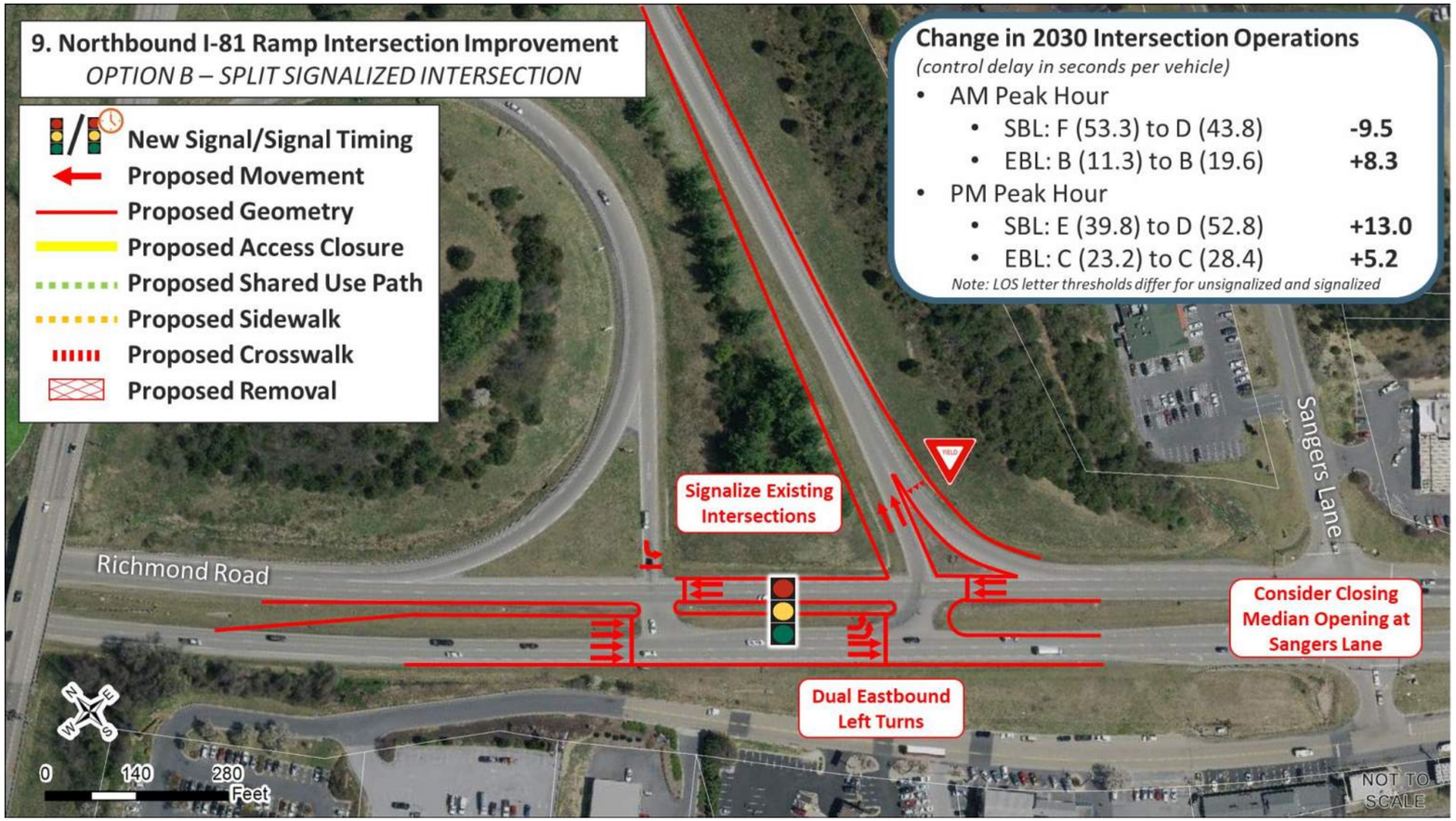
- Signalize the northbound I-81 off-ramp and on-ramp intersections, maintaining the existing intersection geometry
- Add dual eastbound left-turn lanes to northbound I-81 ramps

Project Benefits

- Improved safety and crash reduction by eliminating unsignalized movements
- Accommodate growth in traffic for Staunton Crossing and Frontier Center

Considerations

- The cost of earthwork was considered when choosing the split signal over the single intersection option
- While outside of the study area, closing the median opening and removing the signal at Sangers Lane should be considered as recommended in the 2009 Multimodal Corridor Study for additional safety benefits
- The design should accommodate future widening of the southbound left-turn lane to two lanes
- A signal is warranted based on forecasted 2030 traffic volumes. Growth in conflicting eastbound left-turn and westbound through volume from existing conditions throughout the day will trigger the need for a future signal.



Safety Improvements

Crash Modification Factors (CMF)		Existing Crash Frequency	Estimated Crash Reduction
Signalize Intersection	0.65	**3.4 crashes per year**	**1.2 crashes per year**

Crash frequency is 5-year average for 2014 to 2018
Change in traffic operations from 2030 no-build to build conditions shown on concept sketch

Schedule (Entering Project Development)

Long-Term (7-10 years)

Planning-Level Cost Estimate

Note: Cost estimates are reported in 2019 dollars and include 30% contingency on each phase

Phase	Cost
Preliminary Engineering	$259,000
ROW and Utilities	N/A
Construction	$875,000
Total Cost	**$1,293,000**

4.3.2 Implementation

The study should be used as a tool to achieve the next steps of planning, programming, designing and constructing the identified improvements in the corridor. Projects were assigned a near-term (1-3 years), mid-term (4-6 years), or long-term (7-10 years) schedule. This is the timeframe for when the project is recommended to enter the project development process. Budgeting or applications for funding would be developed prior to these implementation windows. SAWMPO should work with VDOT, the City of Staunton, and Augusta County on implementation and prioritizing improvements. The need for roadway capacity related improvements will be triggered by growth in traffic volumes, which should be monitored as commercial development continues in the corridor. Short-term safety and multimodal network improvement projects could be advanced on a more flexible and independent schedule as funding is available.

Planning-level cost estimates were developed using the VDOT Project Cost Estimating System (PCES) and average Staunton District bid tabulations as resources for calculating construction costs. A 30% contingency applied to the construction costs. In addition to the construction costs, 25% of the construction cost was included for the preliminary engineering (PE) phase of each project. The projects were developed in a manner to minimize the impacts to right-of-way (ROW) and utilities, but an additional amount (typically 25% to 35% of the construction costs depending on the anticipated impact) was included for potential right-of-way and utility relocation. All cost estimates are reported in 2019 dollars. A more detailed summary of costs is provided in **Appendix H** in addition to the high-level summaries provided on each project summary sheet.

Potential funding sources for improvements include:

- City of Staunton Capital Improvements Plan (CIP) for small-scale improvements.
- **VDOT SMART SCALE**: Transportation projects are funded based on a scoring process that evaluates and ranks projects based on congestion mitigation (15%), economic development (25%), accessibility (25%), safety (25%), environmental quality (10%) factors. All proposed improvement projects are candidate projects for SMART SCALE funding.
- **Revenue Sharing:** Revenue sharing is a program that provides a dollar for dollar state match to local funds for transportation projects. Projects eligible for Revenue Sharing funds include construction, reconstruction, improvement, and maintenance projects. All proposed improvement projects are candidate projects for Revenue Sharing.
- **Highway Safety Improvement Program:** HSIP provides funding for improvements that correct or improve safety on a section of roadway or intersection with a high incidence of crashes. Candidate improvement projects for HSIP funding include **Project 4**: Frontier Drive Intersection Improvement as well as the proposed short-term safety improvements to this intersection, **Project 5**: Frontier Drive Access Management, **Project 8**: Westbound Richmond Road at Southbound I-81/Crossing Way Improvement, and **Project 9**: Northbound I-81 Ramp Intersection Improvement
- **Transportation Alternatives**: The Transportation Alternative Set-aside program is intended to fund projects to expand non-motorized travel choices and enhance pedestrian and bicycle facilities. A local match contribution of 20% or more is required to pay the remaining project

costs after the federal allocation. **Project 1**: Richmond Road and Crossing Way Shared Use Path and **Project 2**: Augusta Woods Shared Use Path are candidates for Transportation Alternatives funding.