PROJECT PIPELINE

SA-23-07: Town of Christiansburg
ROUTE 11/460 BUS (ROANOKE STREET)

DRPT Office of INTERMODAL Planning and Investment VDOT

Route 11/Route 460 BUS (Roanoke Street) – From Falling Branch Road to Tower Road

Final Report

July 2024

Prepared for

VDOT Virginia Department of Transportation

Prepared by

WRA

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Chapter 1:

Needs Evaluation and Diagnosis

Introduction:

Project Pipeline is a performance-based planning program to identify cost-effective solutions to multimodal transportation needs in Virginia. Through this planning process, projects and solutions may be considered for funding through programs, including SMART SCALE, revenue sharing, interstate funding, and others. Visit the Project Pipeline webpage for additional information: vaprojectpipeline.org.

This study focuses on concepts targeting identified needs including congestion mitigation, safety improvement, pedestrian and bicycle infrastructure along the corridor, and transit access. The objectives of Project Pipeline are shown below in **Figure 1.**

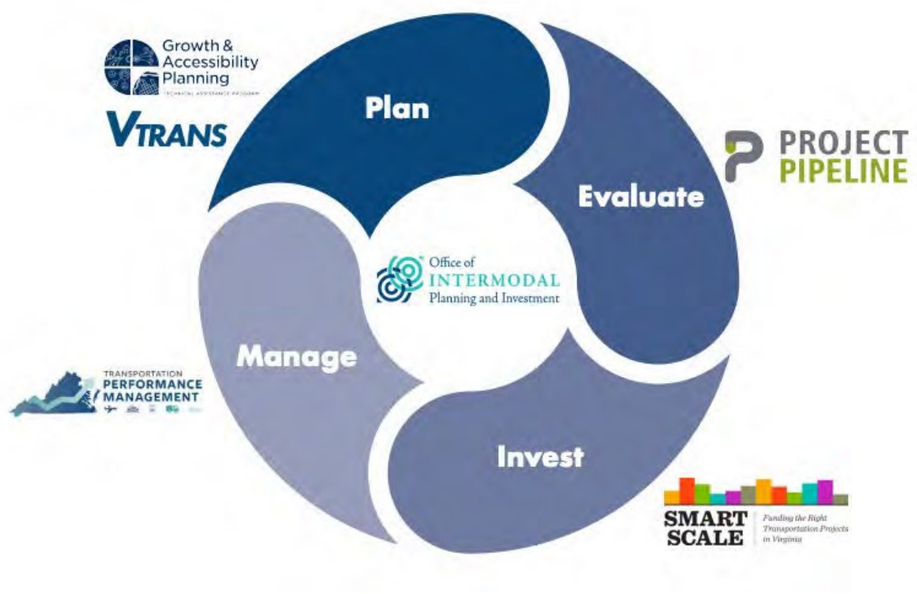


Figure 1: Project Pipeline Objectives

Background

The Office of Intermodal Planning and Investment (OIPI) prepared the VTrans Virginia's statewide transportation plan for the Commonwealth Transportation Board (CTB) in which mid-term needs (0 - 10 years) were identified for different categories listed in **Table 1**. This study focuses on addressing needs identified in VTrans, and those previously identified by the localities.

Table 1: List of VTrans Needs

VTrans Needs
Safety Improvement
Transportation Demand Management
Congestion Mitigation
Pedestrian Safety Improvement
Transit Access
Capacity Preservation
Bicycle Access

Methodology

The study is broken down into three phases. Phase I is the problem diagnosis and brainstorming alternatives, Phase II is the alternative evaluation and sketch level analysis, and Phase III is the investment strategy and cost estimates. Details on methods and solutions for each study phase are outlined below in **Figure 2**.

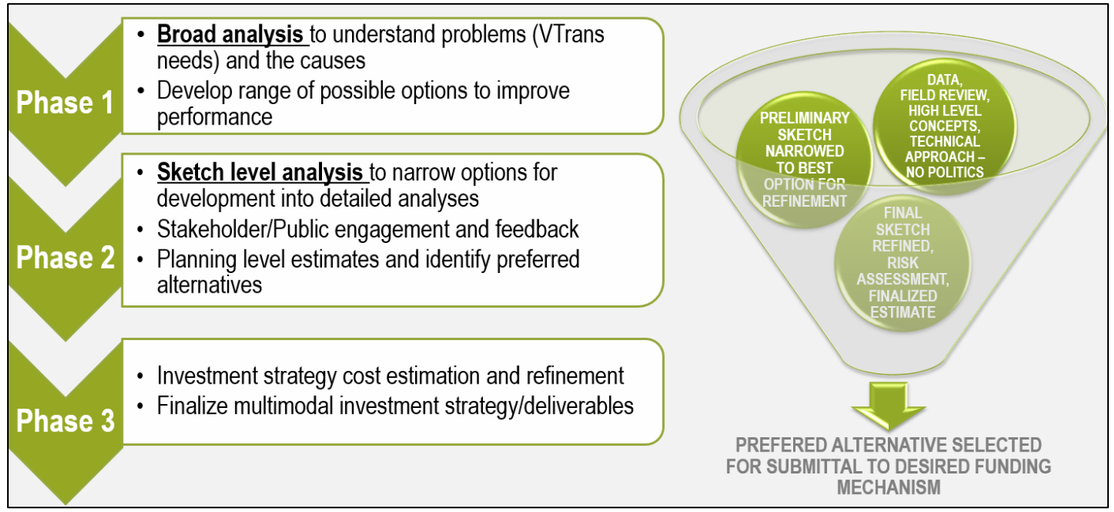


Figure 2: Study Phase Methods and Solutions

The study team is broken down into Technical Teams to improve the efficiency and effectiveness of the study process through extensive collaboration and synchronicity. To achieve the intended efficiency and consistency, it is generally expected that the same Technical Team will be responsible for all studies within a district for the duration of the cycle.

Each Technical Team will include certain leadership and technical roles that will be needed for each study, including the following:

- VDOT District Planning Project Manager – Provides leadership and direction; has overall responsibility for the study progress and outcomes.
- Consultant Team Manager – Provides direct support to the VDOT District Planning Project Manager; coordinates the work and technical efforts of consultant staff.
- District Planning Staff – Provides technical input regarding capacity, forecasting, land use, multimodal, and planning.
- District Traffic Engineering Staff – Provide technical input regarding safety and operations.
- Consultant Team Technical Staff – Provides multidisciplinary input, analysis, technical support, and expertise for the identified VTrans need categories.

A sample organizational chart, including the roles, responsibilities, and structure of a Technical Team is shown below in **Figure 3**.

Figure 3: Structure of a Technical Team

Additional team members and roles should be considered where appropriate. Certain roles may not be necessary for all studies. However, the following roles may contribute to study success during different stages and/or for different types of study areas, as shown in **Table 2**.

Table 2. Roles and Responsibilities for the Technical Team and SWGs

Phase	Responsibility	Role					
		OIPI/Program Support	District	Consultant	DRPT	Locality	VDOT Central Office
Study Selection & Initiation	Identify Study Needs and Priorities		X		X	X	
	Coordinate with CTB Members	X	X				
	Approve final study locations	X					
	Data Collection Planning		X				
	Data Dashboards	X					
	Assign Consultants & Issue Consultant Task Orders	X					X
Phase 1	Initiate Study & Hold Kickoff Meeting		X	X	X		
	Prepare Framework Document		X	X			
	Approve Framework Document		X		X	X	
	Provide Existing Data		X		X	X	
	Collect New Data			X			
	Coordinate with local leaders					X	
	Conduct & Support Initial Public Outreach (if desired)	X	X	X		X	X
	Diagnose Existing Needs			X			
	Brainstorm & Develop Preliminary Alternatives		X	X	X		X
	Present Diagnosis & Alternatives to SWG			X			
	Provide Feedback and Input on Analysis & Alternatives					X	
	Develop Phase 2 Scope of Work			X			
	Approve Scope & Issue Consultant Task Orders	X					X
Phase 2	Conduct Detailed Analysis of Alternatives			X			
	Develop Refinements to Alternatives		X	X	X		X
	Present Alternative Analysis Findings to SWG		X	X			
	Provide Feedback on Alternatives				X	X	X
	Prepare Planning Level Cost Estimates			X			
	Conduct & Support Public Outreach on Alternatives	X	X	X		X	
	Concurrence on Preferred Alternative(s)		X		X	X	X
	Develop Phase 3 Scope of Work			X			
	Approve Scope & Issue Consultant Task Orders	X					X
Phase 3	Conduct Alternative Risk Assessment		X	X			X
	Develop Practical Concept Design & Address Risk of Preferred Alternative		X	X			
	Prepare Cost Estimate with Workbook			X			
	Document Assumptions & Basis of Cost			X			
	Review & Concur with Concept & Estimate		X		X		X
Investment, Application, & Closeout	Prepare Final Study Deliverables, Design Packages, and Estimates			X			
	Apply for Funding of Preferred Alternative(s)				X	X	
	Application Support	X	X	X			
	Submit and Documentation and All Related Work			X			
	Review and approve final deliverables for public visibility		X		X		
	Program Closeout and Summary	X					

Study Area

The Roanoke Street (Route 11/460 BUS) study corridor from Falling Branch Road to Tower Road is located in the Town of Christiansburg, Virginia. Route 11/460 BUS (Roanoke Street) is classified as a principal arterial road within the study area. The posted speed limit is 35 MPH. A map detailing the study area is shown in **Figure 4.**

Figure 4: Study Area Map

VTrans is Virginia's statewide transportation plan. It identifies and prioritizes locations with transportation needs using data-informed transparent processes. The policy for identifying VTrans mid-term needs establishes multimodal need categories that correspond to the Commonwealth Transportation Board-adopted VTrans visions, goals, and objectives.[1] Each need category has one or more performance measures and thresholds to identify one or more needs. Visit the VTrans policy guide for additional information: https://vtrans.org/resources/VTrans_Policy_Guide_v6.pdf.

The mid-term needs, as identified in VTrans for the Roanoke Street study corridor, were 'Very High' for IEDA (UDA) Access, Safety Improvement, Reliability, and Transportation Demand Management, 'Medium' for Bicycle Access and 'Low' for Congestion Mitigation, Pedestrian Access, and Transit Access, as presented in **Table 3.**

Table 3: VTrans Needs in Study Area

VTRANS IDENTIFIED NEEDS	PRIORITIES
Bicycle Access	Medium
Capacity Preservation	None
Congestion Mitigation	Low
IEDA (UDA) Access	Very High
Pedestrian Access	Low
Safety Improvement	Very High
Pedestrian Safety Improvement	None
Reliability	Very High
Rail on-time Performance	None
Transit Access	Low
Transit Access for Equity Emphasis Areas	None
Transportation Demand Management	Very High

These mid-term needs, identified in VTrans, are prioritized on a tier from 1 to 4, with 1 being the most critical and 4 being the least critical. The segments ranked as "Priority 1" represent those with multiple categories identified as high in need. **Figure 5** presents a map of the study area with the 2019 VTrans mid-term needs prioritized for district construction. **Figure 6** and **Figure 7** presents an overview of this project.

[1] Commonwealth Transportation Board, Actions to Approve the 2019 VTrans Vision, Goals, Objectives, Guiding Principles and the 2019 Mid-term Needs Identification Methodology and Accept the 2019 Mid-term Needs, January 15, 2020

Figure 5: 2019 VTrans Prioritized Mid-term Needs in the Study Area

Purpose, Goals, & Objectives

The purpose of this study is to identify recommendations with a focus on improving roadway safety, reliability, IEDA access, multi-modal accessibility/connectivity and TDM needs along the Roanoke Street corridor.

Identify cost-effective improvement alternatives that address the identified transportation needs.

Existing Issues in the Study Area

- Significant number of entrances and poor access management contribute to safety concerns at many locations
- Lack of sidewalks and pedestrian amenities throughout the corridor
- Difficulty making left turns at many locations
- Poor coordination between traffic signals

Study Summary	
VDOT District	Salem
Locality	Town of Christiansburg
Length	1.41 mile
Study Limits	From Falling Branch Road to Tower Road
Functional Classification	Principal arterial / Corridor of Statewide Significance
Speed Limit	35 MPH

VTrans Needs	
NEED	**PRIORITY**
IEDA (UDA) Access	Very High
Safety Improvement	Very High
Reliability	Very High
Transportation Demand Management	Very High
Bicycle Access	Medium

Figure 6: Study Overview

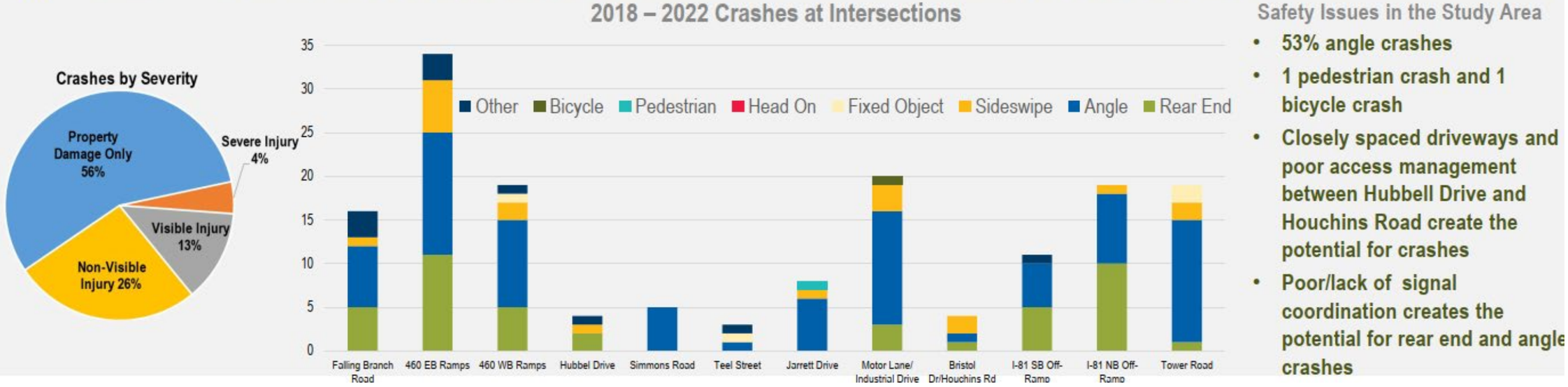


Figure 7: Safety Overview

FHWA Screening Tool for Equity Analysis of Projects (STEAP)

The Federal Highway (FHWA) Screening for Equity Analysis of Projects (STEAP) Tool was reviewed for the study area and surrounding locations. The tool allows you to compare the population to evaluate the metrics and needs of the study area to a city, town, county, or the State of Virginia. The tool is used to elevate consciousness of equity desires in the selection of alternatives. The data source used for the analysis was the American Community Survey 2016 – 2020 and a 0.5-mile radius was used for the analysis buffer. The results of the STEAP Tool analysis are shown in **Figures 8-12** and presented below:

- There is a moderate personal vehicle ownership, with 24% of households owning three or more vehicles, while 5% of the study area does not have a personal vehicle as shown in **Figure 8.**
- The majority of households contain two members and only 4% has more than six members of the household as shown in **Figure 9.**
- Of all the households in the study area, 64% of households make at least $50,000 in annual income. However, 11% of households make less than $15,000 as shown in **Figure 10.**
- When compared to the State of Virginia and Montgomery County, the study area has a higher average of households without computer access at 12.4% as shown in **Figure 11.**
- The study area has a higher percentage of veterans (9%) and lower percentage of people with disabilities (4.6%) compared to Montgomery County, as shown in **Figure 12.**

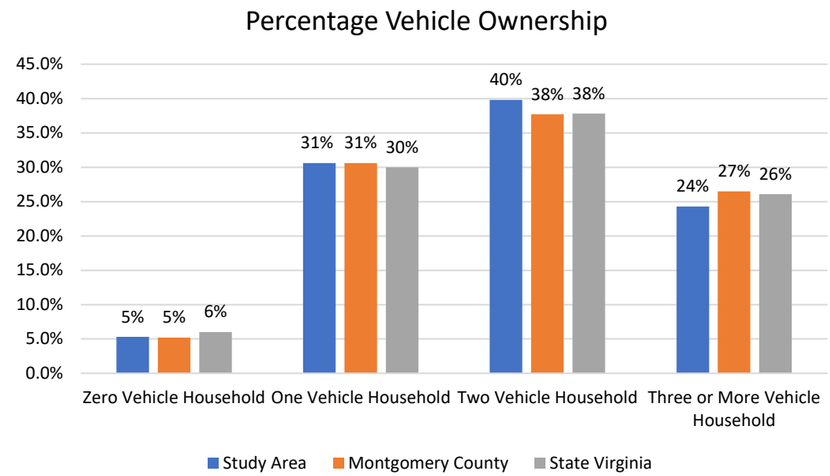


Figure 8: STEAP Tool Analysis Vehicle Ownership

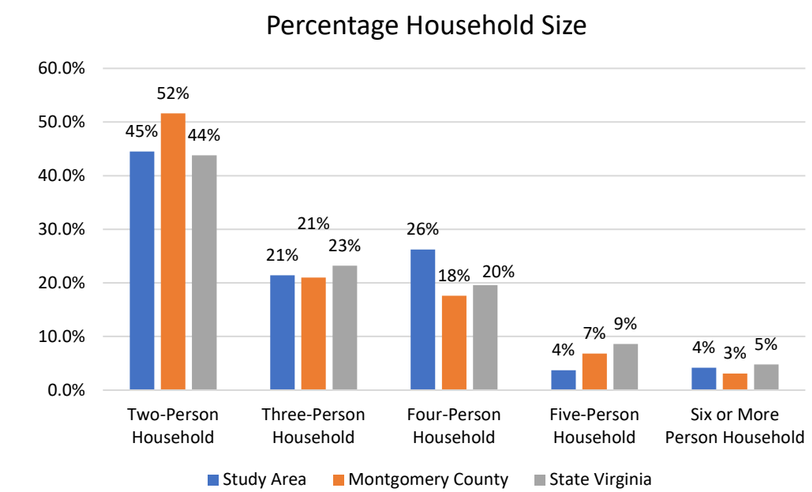


Figure 9: STEAP Tool Analysis Household Size

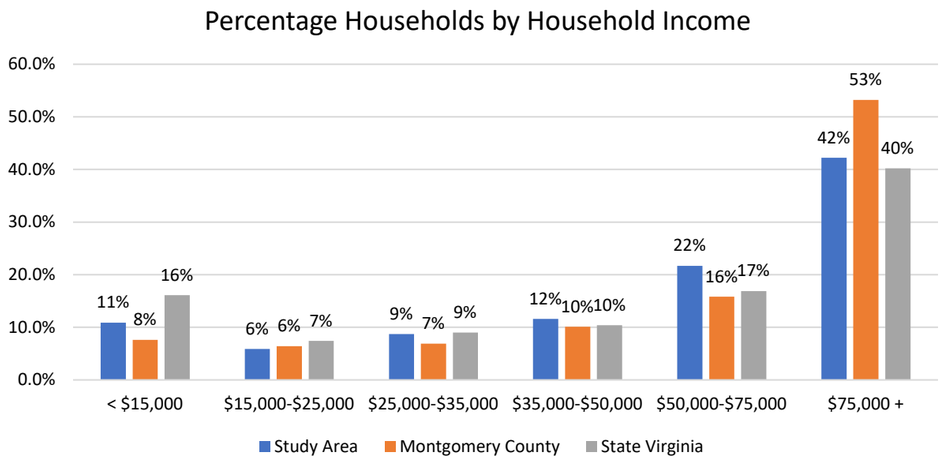


Figure 10: STEAP Tool Analysis Household Income

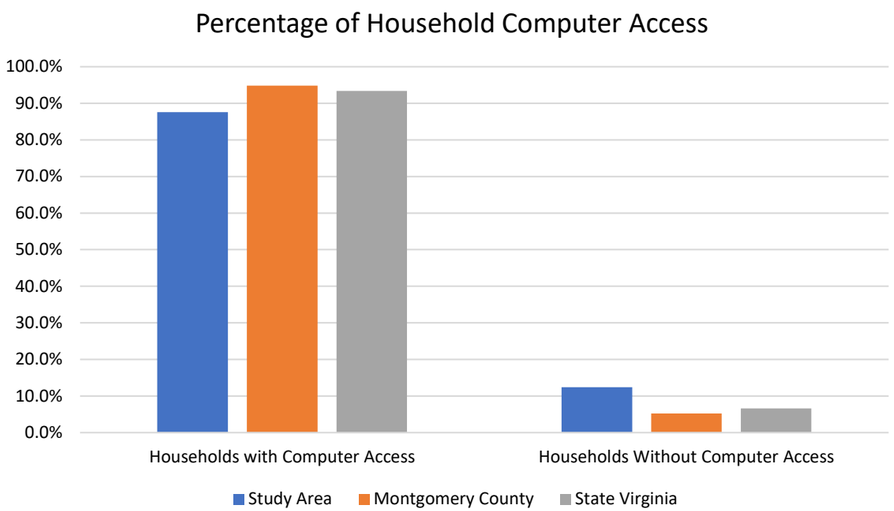


Figure 11: STEAP Tool Analysis Household Computer Access

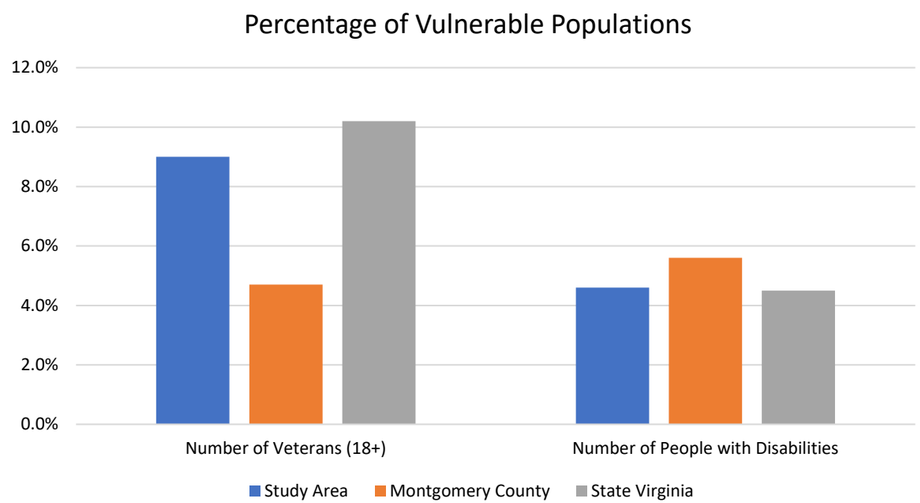


Figure 12: STEAP Tool Analysis Vulnerable Populations

Funded / Completed Projects

Pedestrian Improvements – Completed in 2023

The Town of Christiansburg recently completed a pedestrian access project in the vicinity of the Route 460 Bypass interchange with Roanoke Street connecting with new sidewalk recently completed as a part of the Falling Branch Road intersection improvements which were completed in 2020. The improvements included:

- New sidewalk along the north side of Roanoke Street from approximately 100 feet west of the US 460 Bypass EB off-ramp to the Hubbell Drive intersection
- Signalized pedestrian crossings of the US 460 Bypass EB off-ramp and the US 460 Bypass WB on-ramp

Phase 1 Existing Conditions Public Outreach

Initial public outreach was conducted to inform the public of the study efforts and goals and solicit feedback on what the public's priorities and perceptions of the corridor are in the evaluation of potential alternatives. The survey was conducted through PublicInput.com and there were 111 participants. The detailed summary of the public survey is included in **Appendix A**.

The survey shows that the major needs of the corridor include safety and transportation demand management as shown in **Figure 13**.

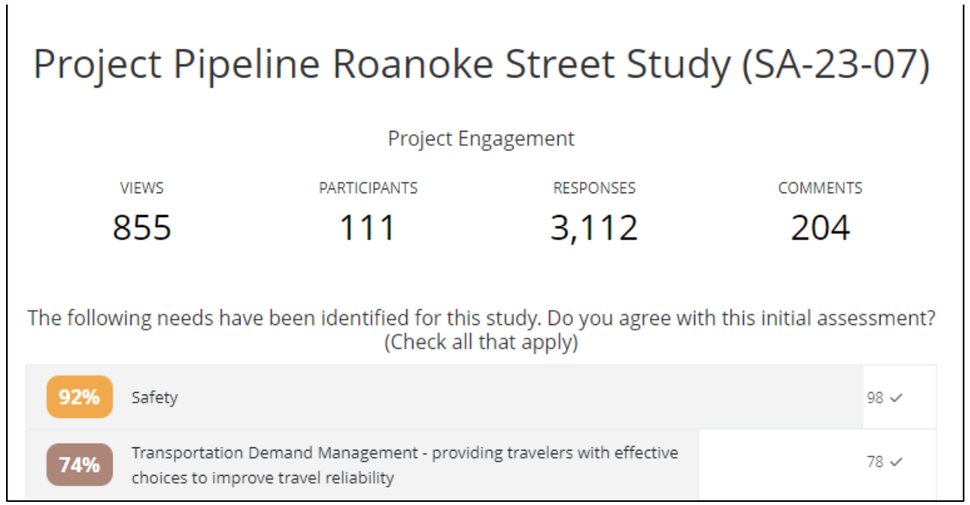


Figure 13: Public Input Survey Results

Figure 14 shows the most important issues along the study corridor including corridor/intersection safety, reducing traffic congestion, pedestrian safety and accessibility, and speeding/aggressive driving.

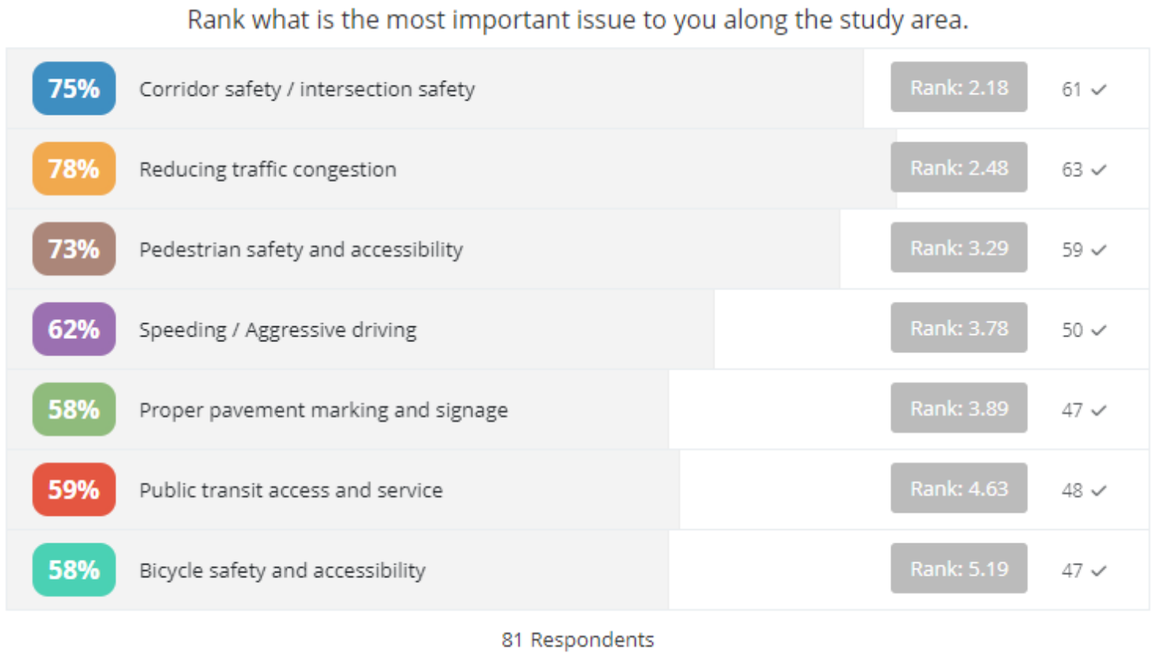


Figure 14: Public Input Survey Results

The notable comments from the survey responses are summarized below:

- Too many access points for Sheetz
- Requests for more sidewalks/crosswalks
- Drainage issues causing flooding on roadway
- Requests for road paving
- Poor signal phasing at the 460 bypass interchanges
- More turn lanes along the corridor to reduce congestion and enhance safety
- Requests for a traffic light at Houchins Road intersection

Traffic Operations and Accessibility:

The initial traffic operational analysis was performed using Synchro 11 software for the study intersections along the Roanoke Street corridor. Inputs and analysis methodologies are consistent with the VDOT Traffic Operations and Safety Analysis Manual (TOSAM) guidelines. Both AM and PM peak hour analyses were performed for the existing year (2023) and for the 2050 design year under No Build and build conditions.

Traffic Data

Turning movement counts were performed in April 2023 by Peggy Malone and Associates (PMA). Additional turning movement counts were also performed in September 2023 by PMA. The AM and PM weekday peak hours were identified as 7:30 - 8:30 AM and 4:00 – 5:00 PM, respectively. The existing intersection peak hour volumes are shown in **Figure 15**. The raw turning movement counts are provided in **Appendix B**.

Measures of Effectiveness

There are many measures of effectiveness (MOE) in traffic operations analysis to quantify operational and safety objectives and provide a basis for evaluating the performance of a transportation network. Several MOEs for intersection analyses can be reported from Synchro/SimTraffic. For this study, guidance for reporting MOEs for signalized and unsignalized intersections was obtained from Chapter 4 of the VDOT TOSAM Version 2.0. A summary of the MOEs evaluated for the study intersections is presented below:

- Control Delay (measured in seconds per vehicle – sec/veh)
- Level of service (LOS)
- Maximum queue Length from SimTraffic (measured in feet – ft)

Future Traffic Forecasting

In order to develop volume forecasts for the future 2050 design year volumes, background linear traffic growth rates were developed in conjunction with VDOT Salem District Planning using the Statewide Planning System data and projections for the study area. **Table 4** presents the annual linear growth rates along Roanoke Street and the study area roadways. The growth rates were applied to the existing traffic volumes to develop the 2050 design year traffic volumes. Future traffic volumes were re-balanced as necessary through the study area. 2050 design year traffic volumes are included in **Figure 16.**

Table 4: Growth Rate Summary

Facility	From	To	Pathways for Planning Data				Recommended Growth Rate
			Existing ADT		2050 ADT	Linear Annual Growth Rate	
			Year	ADT			
Roanoke Street	West of 460	460 SB Off Ramp	2022	14701	16759	0.5%	0.5%
Roanoke Street	460 SB Off Ramp	I-81 NB Off Ramp	2022	15937	18168	0.5%	0.5%
Roanoke Street	I-81 NB Off Ramp	East of Tower Road	2022	9414	10732	0.5%	0.5%
460 SB On Ramp	Roanoke Street	Route 460	2022	2653	3024	0.5%	0.5%
460 NB On Ramp	Roanoke Street	Route 460	2022	7532	8586	0.5%	0.5%
I-81 SB On Ramp	Roanoke Street	Interstate 81	2022	1016	1158	0.5%	0.5%
I-81 SB Off Ramp	Interstate 81	Roanoke Street	2022	1605	1830	0.5%	0.5%
I-81 SB On-Ramp Loop	Roanoke Street	Interstate 81	2022	1490	1699	0.5%	0.5%
I-81 NB On-Ramp Loop	Roanoke Street	Interstate 81	2022	880	1003	0.5%	0.5%
I-81 NB Off Ramp	Roanoke Street	Interstate 81	2022	2406	2743	0.5%	0.5%
I-81 NB On-Ramp	Roanoke Street	Interstate 81	2022	258	294	0.5%	0.5%

Existing and No Build Traffic Operations Analysis Results

Table 5 depicts queue lengths, Levels of Service, and delays for intersections within the study area, for the AM and PM peak hours under 2023 existing conditions. During the peak hours, the signalized intersections along Roanoke Street operate at LOS C or better, with all movements and approaches operating at LOS D or better.

Turning movements at unsignalized intersections operate at LOS C or better. Traffic queues occasionally spill back between intersections in the area of the Route 460 Bypass interchange, particularly in the eastbound direction in the PM peak hour, where queues for left-turn traffic to Route 460 Bypass WB extend beyond the Route 460 Bypass EB off-ramp intersection. Detailed analysis results for both signalized and unsignalized intersections are contained in **Appendix C**.

The 2050 No Build analysis has been included for evaluation as a benchmark for the comparison of future conditions and impacts. The No Build analysis retains the same geometry as existing conditions.

Table 6 depicts queue lengths, Levels of Service, and delays for intersections along Roanoke Street for the AM and PM peak hours for 2050 No Build conditions. By 2050, intersection delays and queues are projected to increase throughout the study area, with worsening levels of service. During the peak hours, the signalized intersections along Roanoke Street are projected to continue operating at LOS C or better, with all movement projected to continue operating at LOS D or better except for the Route 460 Bypass EB off-ramp right-turn and the Route 460 Bypass WB off-ramp right-turn, both to westbound Roanoke Street, which are projected to degrade to LOS E in the PM peak hour.

Turning movements at unsignalized intersections are projected to continue operating at LOS C or better, except for the northbound left turn from Simmons Road to westbound Roanoke Street, which is projected to degrade to LOS D in the PM peak hour. Traffic queues spillbacks between intersections in the area of the Route 460 Bypass interchange are projected to continue under 2050 No Build conditions, particularly during the PM peak hour. Detailed analysis results for both signalized and unsignalized intersections are contained in **Appendix C**.

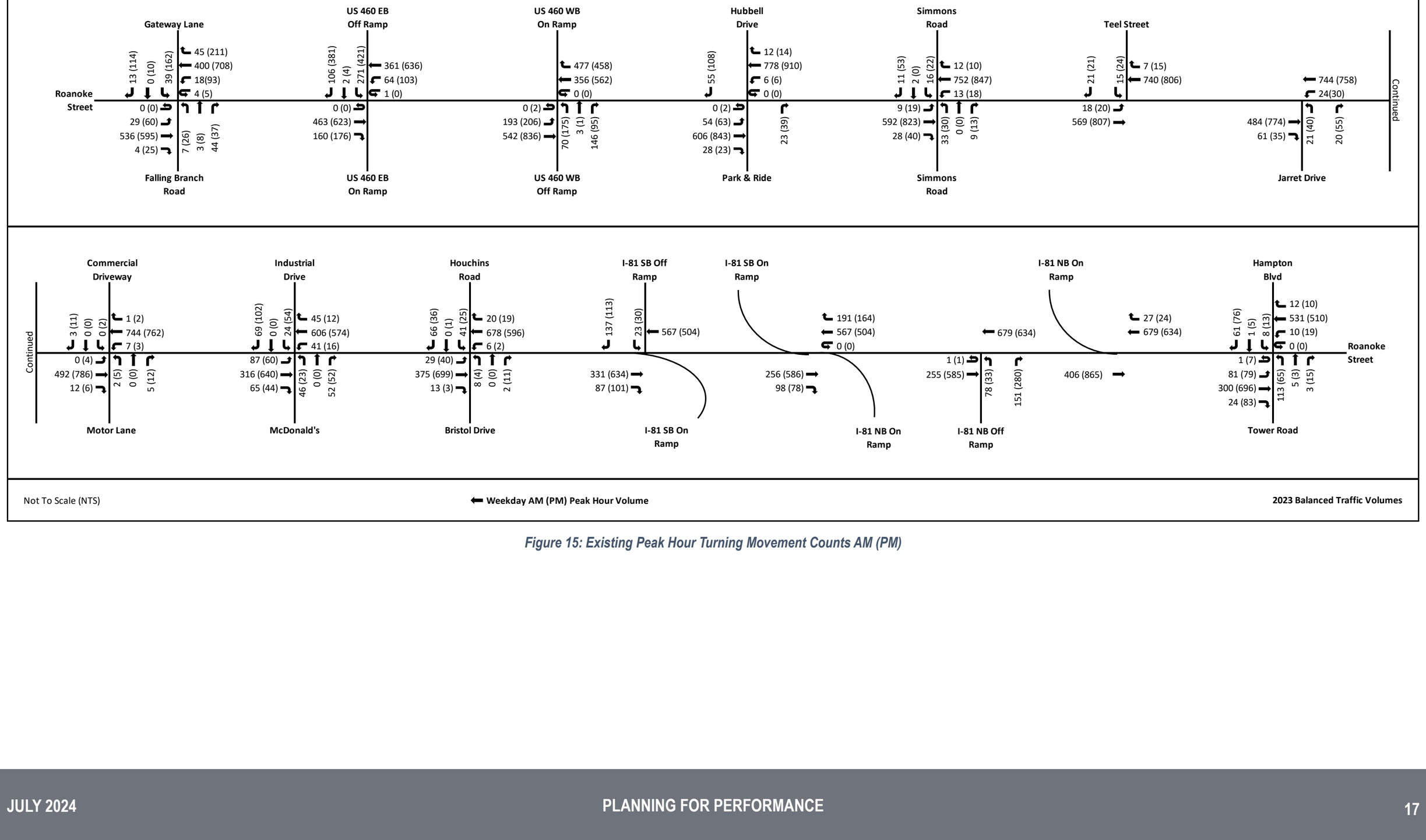


Figure 15: Existing Peak Hour Turning Movement Counts AM (PM)

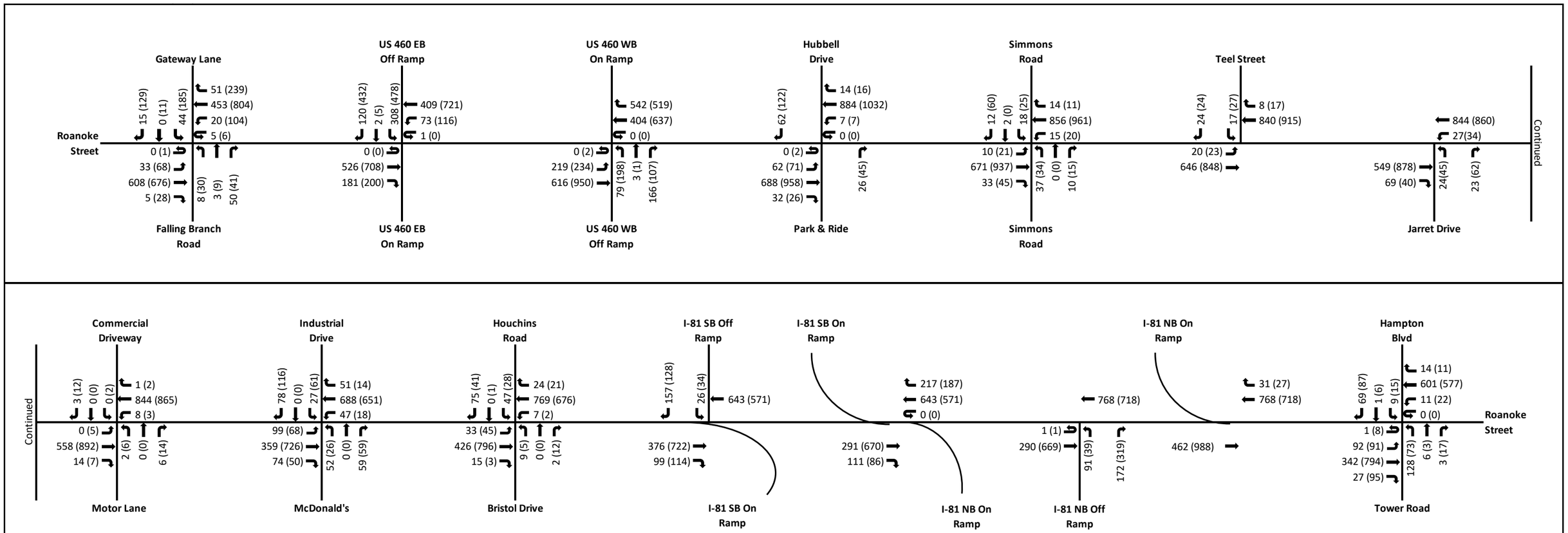


Figure 16:2050 Peak Hour Turning Movement Counts AM (PM)

Table 5: 2023 Existing Conditions Traffic Analysis Results Summary

Intersection	Approach	Movement	Existing AM							Existing PM						
			Queue Length (ft)	Movement LOS	Approach LOS	Overall LOS	Delays (sec)	Approach Delay (sec)	Overall Delay (sec)	Queue Length (ft)	Movement LOS	Approach LOS	Overall LOS	Delays (sec)	Approach Delay (sec)	Overall Delay (sec)
Roanoke Street & Falling Branch Road Signalized	EB	L	46	B	B	B	14.0	18.3	19.4	83	B	C	C	18.7	27.8	28.3
		T	168	B			18.6			231	C			29.2		
		R	19	B			12.0			48	B			17.1		
	WB	L	50	B	B		14.0	17.8		209	B	C		18.9	26.2	
		T	162	B			18.5			374	C			30.3		
		R	64	B			12.8			175	B			15.7		
	NB	L-T-R	63	C	C		33.1	33.1		100	D	D		39.6	39.6	
	SB	L-T	72	C	C		33.4	32.3		140	D	C		37.6	34.1	
		R	52	C			29.0			92	C			28.7		
Roanoke Street & US 460 EB Off-Ramp Signalized	EB	T	224	B	B	B	18.6	13.8	19.4	344	C	B	C	23.0	18.0	27.2
		R	0	A			0.2			217	A			0.2		
	WB	L	94	B	B		12.9	13.5		135	C	B		18.4	16.7	
		T	96	B			13.6			172	B			16.5		
	SB	L-T	214	D	D		36.6	35.0		949	D	D		47.6	46.0	
		R	133	C			31.2			210	D			44.5		
Roanoke Street & US 460 WB Off-Ramp Signalized	EB	L	135	B	A	A	17.3	7.8	8.5	156	C	A	B	24.2	8.8	12.6
		T	170	A			4.5			214	A			5.0		
	WB	T	140	B	A		16.9	7.6		291	B	B		18.5	10.4	
		R	0	A			0.7			0	A			0.5		
	NB	L-T	110	D	B		42.0	14.1		230	D	D		54.8	35.5	
		R	28	A			0.2			125	A			0.1		
Roanoke Street & Hubbell Drive Unsignalized	EB	L	60	B	-	-	10.6	-	-	67	B	-	-	11.1	-	-
		T	-	-			-			-	-			-		
		R	-	-			-			-	-			-		
	WB	L	20	A	-		9.3	-		18	A	-		9.5	-	
		T	-	-			-			-	-			-		
		R	6	-			-			4	-			-		
	NB	R	6	B	B		10.4	10.4		8	A	A		10.0	10.0	
	SB	R	31	B	B		12.5	12.5		90	B	B		14.4	14.4	
Roanoke Street & Simmons Road Unsignalized	EB	L	43	B	-	-	10.7	-	-	30	A	-	-	10.0	-	-
		T-R	2	-			-			22	-			-		
	WB	L	34	A	-		9.4	-		36	A	-		9.8	-	
		T	10	-			-			20	-			-		
		R	-	-			-			2	-			-		
	NB	L	62	C	C		18.0	16.3		82	C	C		21.0	17.8	

Intersection	Approach	Movement	Existing AM							Existing PM						
			Queue Length (ft)	Movement LOS	Approach LOS	Overall LOS	Delays (sec)	Approach Delay (sec)	Overall Delay (sec)	Queue Length (ft)	Movement LOS	Approach LOS	Overall LOS	Delays (sec)	Approach Delay (sec)	Overall Delay (sec)
		T-R	52	B			10.6			61	B			10.2		
	SB	L-T-R	56	C	C		17.2	17.2		75	C	C		16.2	16.2	
Roanoke Street & Teel Street Unsignalized	EB	L	41	A	-		9.8	-		50	A	-		9.9	-	
		T	33	-			-			31	-			-		
	WB	T-R	-	-	-	-	-	-	-	2	-	-	-	-	-	-
	SB	L-R	69	B	B		14.1	14.1		78	B	B		14.8	14.8	
Roanoke Street & Jarrett Drive Unsignalized	EB	T-R	7	-	-		-	-		9	-	-		-	-	
	WB	L	34	A	-		8.9	-		45	A	-		9.6	-	
		T	12	-			-			43	-			-		
	NB	L-R	68	B	B		12.6	12.6		121	C	C		15.1	15.1	
Roanoke Street & Motor Lane Unsignalized	EB	L	0	A	-		0.0	-		30	A	-		9.4	-	
		T-R	3	-			-			68	-			-		
	WB	L	30	A	-		8.5	-		23	A	-		9.5	-	
		T-R	-	-			-			7	-			-		
	NB	L-T-R	34	B	B		11.1	11.1		40	B	B		13.1	13.1	
	SB	L-T-R	30	B	B		11.0	11.0		35	B	B		12.0	12.0	
Roanoke Street & Industrial Drive Unsignalized	EB	L	60	A	-		9.8	-		63	A	-		9.7	-	
		T-R	83	-			-			96	-			-		
	WB	L	38	A	-		8.3	-		32	A	-		9.2	-	
		T-R	26	-			-			12	-			-		
	NB	L-T-R	101	C	C		17.0	17.0		85	C	C		15.5	15.5	
	SB	L-T-R	143	C	C		16.4	16.4		157	C	C		16.9	16.9	
Roanoke Street & Bristol Drive Unsignalized	EB	L	41	A	-		9.7	-		34	A	-		9.1	-	
		T-R	10	-			-			18	-			-		
	WB	L	30	A	-		8.2	-		18	A	-		9.3	-	
		T	-	-			-			2	-			-		
		R	-	-			-			8	-			-		
	NB	L-T-R	30	B	B		13.4	13.4		31	B	B		12.9	12.9	
	SB	L-T	83	B	B		13.8	13.8		54	B	B		13.4	13.4	
		R	62	B			13.8			51	B			13.4		
Roanoke Street & I-81 SB Off-Ramp Unsignalized	EB	T	-	-	-		-	-		-	-	-		-	-	
	WB	T	-	-	-		-			-	-	-		-		
	SB	L	62	B	B		13.1	13.1		54	B	B		13.6	13.6	
		R	48	B			13.1			38	B			13.6		
	EB	T	2	-	-	-	-	-	-	3	-	-	-	-	-	-
	WB	T	7	-	-		-	-		-	-	-		-	-	

Intersection	Approach	Movement	Existing AM							Existing PM						
			Queue Length (ft)	Movement LOS	Approach LOS	Overall LOS	Delays (sec)	Approach Delay (sec)	Overall Delay (sec)	Queue Length (ft)	Movement LOS	Approach LOS	Overall LOS	Delays (sec)	Approach Delay (sec)	Overall Delay (sec)
Roanoke Street & I-81 NB Off-Ramp Unsignalized	NB	L	87	B	B		11.1	11.1		107	C	C		16.2	16.2	
		R	44	B			11.1			76	C			16.2		
Roanoke Street & Tower Road Signalized	EB	L	88	A	A	B	8.2	9.0	14.7	112	A	B	B	7.5	10.2	12.7
		T-R	105	A			9.2			170	B			10.5		
	WB	L	51	A	B		7.7	12.7		52	A	B		7.3	11.9	
		T	165	B			12.9			158	B			12.1		
		R	47	B			10.6			30	A			9.9		
	NB	L-T	144	D	D		37.1	36.8		105	C	C		30.7	29.7	
		R	62	C			24.3			33	C			25.2		
	SB	L-T-R	71	C	C		24.7	24.7		88	C	C		25.9	25.9	

Table 6: 2050 No Build Conditions Traffic Analysis Results Summary

Intersection	Approach	Movement	2050 No Build AM							2050 No Build PM						
			Queue Length (ft)	Movement LOS	Approach LOS	Overall LOS	Delays (sec)	Approach Delay (sec)	Overall Delay (sec)	Queue Length (ft)	Movement LOS	Approach LOS	Overall LOS	Delays (sec)	Approach Delay (sec)	Overall Delay (sec)
Roanoke Street & Falling Branch Road Signalized	EB	L	42	B	B	B	13.9	18.4	19.4	79	B	C	C	19.8	29.2	30.0
		T	170	B			18.6			303	C			30.7		
		R	18	B			11.9			26	B			17.0		
	WB	L	42	B	B		13.9	17.7		280	B	C		19.8	27.5	
		T	178	B			18.4			442	C			32.1		
		R	124	B			12.7			175	B			15.6		
	NB	L-T-R	65	C	C		33.4	33.4		154	D	D		44.0	44.0	
	SB	L-T	59	C	C		33.6	32.5		154	D	D		41.2	37.3	
		R	31	C			29.3			101	C			31.4		
Roanoke Street & US 460 EB Off-Ramp Signalized	EB	T	292	B	B	B	18.4	13.7	19.4	530	C	C	C	25.8	20.1	31.8
		R	0	A			0.2			290	A			0.2		
	WB	L	105	B	B		12.9	13.4		143	C	B		21.8	19.7	
		T	116	B			13.5			181	B			19.4		
	SB	L-T	262	D	D		37.0	35.5		2646	D	D		52.8	54.5	
		R	201	C			31.7			210	E			56.7		
Roanoke Street & US 460 WB Off-Ramp Signalized	EB	L	153	B	A	A	17.7	8.0	8.6	157	D	B	B	39.2	11.5	14.6
		T	190	A			4.5			219	A			4.7		
	WB	T	162	B	A		17.2	7.7		322	B	B		18.3	10.4	
		R	0	A			0.7			37	A			0.6		
	NB	L-T	117	D	B		42.7	14.2		232	E	D		66.0	42.8	
		R	66	A			0.2			139	A			0.1		
Roanoke Street & Hubbell Drive Unsignalized	EB	L	65	B	-	-	10.7	-	-	90	B	-	-	11.8	-	-
		T	-	-			-			1	-			-		
		R	-	-			-			-	-			-		
	WB	L	23	A	-	-	9.0	-	-	29	A	-	-	9.9	-	-
		T	2	-			-			3	-			-		
		R	8	-			-			20	-			-		
	NB	R	1	A	A		9.9	9.9		5	A	A		10.3	10.3	
	SB	R	40	B	B		12.8	12.8		158	C	C		15.8	15.8	
Roanoke Street & Simmons Road Unsignalized	EB	L	26	A	-	-	10.0	-	-	29	A	-	-	10.6	-	-
		T-R	11	-			-			16	-			-		
	WB	L	34	A	-	-	9.4	-	-	40	A	-	-	10.4	-	-
		T	5	-			-			31	-			-		
		R	-	-			-			4	-			-		
	NB	L	79	C	C		18.4	16.8		83	D	C		25.1	20.6	

Intersection	Approach	Movement	2050 No Build AM							2050 No Build PM						
			Queue Length (ft)	Movement LOS	Approach LOS	Overall LOS	Delays (sec)	Approach Delay (sec)	Overall Delay (sec)	Queue Length (ft)	Movement LOS	Approach LOS	Overall LOS	Delays (sec)	Approach Delay (sec)	Overall Delay (sec)
		T-R	66	B			10.7			62	B			10.4		
	SB	L-T-R	69	C	C		18.0	18.0		108	C	C		18.8	18.8	
Roanoke Street & Teel Street Unsignalized	EB	L	38	A	-		10.0	-		46	A	-		10.4	-	
		T	24	-			-			49	-			-		
	WB	T-R	-	-	-	-	-	-	-	6	-	-	-	-	-	-
	SB	L-R	65	B	B		14.1	14.1		81	C	C		16.3	16.3	
Roanoke Street & Jarrett Drive Unsignalized	EB	T-R	25	-	-		-	-		14	-	-		-	-	
	WB	L	35	A	-		8.9	-		45	B	-		10.2	-	
		T	21	-		-	-		-	43	-		-	-		-
	NB	L-R	77	B	B		12.8	12.8		138	C	C		17.1	17.1	
Roanoke Street & Motor Lane Unsignalized	EB	L	0	A	-		0.0	-		27	A	-		9.8	-	
		T-R	3	-			-			3	-			-		
	WB	L	30	A	-		8.7	-		17	A	-		9.9	-	
		T-R	16	-			-			18	-			-		
	NB	L-T-R	32	B	B		11.3	11.3		43	B	B		14.3	14.3	
	SB	L-T-R	30	B	B		11.4	11.4		36	B	B		12.7	12.7	
Roanoke Street & Industrial Drive Unsignalized	EB	L	71	B	-		10.9	-		66	B	-		10.1	-	
		T-R	105	-			-			86	-			-		
	WB	L	42	A	-		8.4	-		36	A	-		9.6	-	
		T-R	47	-			-			16	-			-		
	NB	L-T-R	132	C	C		18.9	18.9		98	C	C		17.8	17.8	
	SB	L-T-R	145	C	C		16.2	16.2		183	C	C		20.4	20.4	
Roanoke Street & Bristol Drive Unsignalized	EB	L	41	A	-		9.8	-		43	A	-		9.4	-	
		T-R	46	-			-			42	-			-		
	WB	L	31	A	-		8.3	-		15	A	-		9.6	-	
		T	6	-			-			2	-			-		
		R	4	-			-			-	-			-		
	NB	L-T-R	43	B	B		14.5	14.5		39	B	B		14.1	14.1	
	SB	L-T	99	C	C		15.2	15.2		69	B	B		14.3	14.3	
		R	81	C			15.2			66	B			14.3		
Roanoke Street & I-81 SB Off-Ramp Unsignalized	EB	T	-	-	-		-	-		-	-	-		-	-	
	WB	T	-	-	-		-			-	-	-		-		
	SB	L	54	B	B		14.3	14.3		53	C	C		15.2	15.2	
		R	56	B			14.3			50	C			15.2		
	EB	T	11	-	-	-	-	-	-	3	-	-	-	-	-	-
	WB	T	-	-	-		-	-		-	-	-		-	-	

Intersection	Approach	Movement	2050 No Build AM							2050 No Build PM						
			Queue Length (ft)	Movement LOS	Approach LOS	Overall LOS	Delays (sec)	Approach Delay (sec)	Overall Delay (sec)	Queue Length (ft)	Movement LOS	Approach LOS	Overall LOS	Delays (sec)	Approach Delay (sec)	Overall Delay (sec)
Roanoke Street & I-81 NB Off-Ramp Unsignalized	NB	L	104	B	B		11.7	11.7		120	C	C		18.5	18.5	
		R	69	B			11.7			87	C			18.5		
Roanoke Street & Tower Road Signalized	EB	L	90	B	B	B	10.2	11.0	15.9	97	A	B	B	7.8	11.7	13.7
		T-R	102	B			11.3			187	B			12.2		
	WB	L	45	A	B		9.3	15.8		69	A	B		7.7	12.4	
		T	172	B			16.0			168	B			12.7		
		R	30	B			12.6			24	B			10.1		
	NB	L-T	156	C	C		29.4	29.2		102	C	C		31.0	29.9	
		R	32	C			22.1			74	C			24.8		
	SB	L-T-R	72	C	C		22.5	22.5		91	C	C		25.6	25.6	

Safety and Reliability

For the analysis of existing safety conditions, the VDOT Crash Analysis PowerBI Tool was utilized to determine the crash history at the study intersections and along the study corridor. Crash data was collected and analyzed for five years from January 2018 to December 2022. For the purposes of this analysis, "injury crashes" is defined as the sum of type A (severe injury), B (visible injury), and C (non-visible injury) crashes.

The crash severity within the study area is summarized by year and type in **Table 7** and **Table 8**, respectively. A summary of the crash severity and crash type by intersection is shown in **Table 9** and **Table 10**, respectively. A summary of the safety needs and diagnosis is illustrated in **Figure 7.**

Table 7: Study Area Crash Severity by Year

Crash Year and Severity	K. Fatal Injury	A. Severe Injury	B. Visible Injury	C. Nonvisible Injury	PDO. Property Damage Only	Total
2018	0	1	9	9	19	**38**
2019	0	2	6	12	27	**47**
2020	0	1	1	5	13	**20**
2021	0	2	6	7	15	**30**
2022	0	2	1	14	26	**43**
Total	**0**	**8**	**23**	**47**	**100**	**178**

Table 8: Study Area Crash Severity by Type

Collision Type and Crash Severity	K. Fatal Injury	A. Severe Injury	B. Visible Injury	C. Nonvisible Injury	PDO. Property Damage Only	Total
Rear End	0	1	8	15	21	**45**
Angle	0	3	8	25	59	**95**
Sideswipe – Same Direction	0	0	4	3	13	**20**
Fixed Object – Off Road	0	0	0	1	3	**4**
Non-Collision	0	1	1	0	0	**2**
Pedestrian	0	1	0	0	0	**1**
Head On	0	0	0	0	0	**0**
Sideswipe – Opposite Direction	0	0	0	1	1	**2**
Fixed Object in Road	0	0	0	0	0	**0**
Deer	0	0	0	0	2	**2**
Bicyclist	0	1	0	0	0	**1**
Other	0	1	2	2	1	**6**
Total	**0**	**8**	**23**	**47**	**100**	**178**

Table 9: Study Area Crash Severity by Intersection

Collision Type and Crash Severity	K. Fatal Injury	A. Severe Injury	B. Visible Injury	C. Nonvisible Injury	PDO. Property Damage Only	Total
Food Lion	0	0	1	2	1	**4**
Falling Branch Road	0	1	3	5	7	**16**
460 EB Ramps	0	2	6	11	15	**34**
460 WB Ramps	0	0	3	4	12	**19**
Hubbel Drive	0	0	1	0	3	**4**
Simmons Road	0	0	0	1	4	**5**
Teel Street	0	0	0	1	2	**3**
Jarrett Drive	0	1	0	1	6	**8**
Motor Lane	0	1	2	4	13	**20**
Bristol Dr/Houchins Rd	0	0	0	1	3	**4**
I-81 SB Off-Ramp	0	1	2	2	6	**11**
I-81 NB Off-Ramp	0	0	2	7	10	**19**
Tower Road	0	1	1	5	12	**19**
Total	**0**	**7**	**21**	**44**	**94**	**166**

Table 10: Study Area Crash Types by Intersection

Collision Type and Crash Types	Rear End	Angle	Sideswipe	Fixed Object	Head On	Pedestrian	Bicycle	Other	Total
Food Lion	0	3	1	0	0	0	0	0	**4**
Falling Branch Road	5	7	1	0	0	0	0	3	**16**
460 EB Ramps	11	14	6	0	0	0	0	3	**34**
460 WB Ramps	5	10	2	1	0	0	0	1	**19**
Hubbel Drive	2	0	1	0	0	0	0	1	**4**
Simmons Road	0	5	0	0	0	0	0	0	**5**
Teel Street	0	1	0	1	0	0	0	1	**3**
Jarrett Drive	0	6	1	0	0	1	0	0	**8**
Motor Lane	3	13	3	0	0	0	1	0	**20**
Bristol Dr/Houchins Rd	1	1	2	0	0	0	0	0	**4**
I-81 SB Off-Ramp	5	5	0	0	0	0	0	1	**11**
I-81 NB Off-Ramp	10	8	1	0	0	0	0	0	**19**
Tower Road	1	14	2	2	0	0	0	0	**19**
Total	**43**	**87**	**20**	**4**	**0**	**1**	**1**	**10**	166

A total of 178 crashes were reported within the Roanoke Street study area during the five-year study period. Key findings from the crash data are as follows:

1. Crash frequency varies each year with the highest number of crashes (47) occurring in 2019, followed by 43 crashes in 2022 and 38 crashes in 2018 as shown in Error! Reference source not found..
2. The approximate average number of reported crash incidents per year is 35.6.
3. The majority of reported crash incidents within the corridor are angle crashes. These crashes account for 53% of all crashes in the study area.
4. A total of 78 crash incidents were associated with injuries, which account for approximately 44% of the total reported crashes within the corridor.

The collision diagram is presented in **Figure 17** and detailed collision diagrams for each study intersection are included in **Appendix A.**

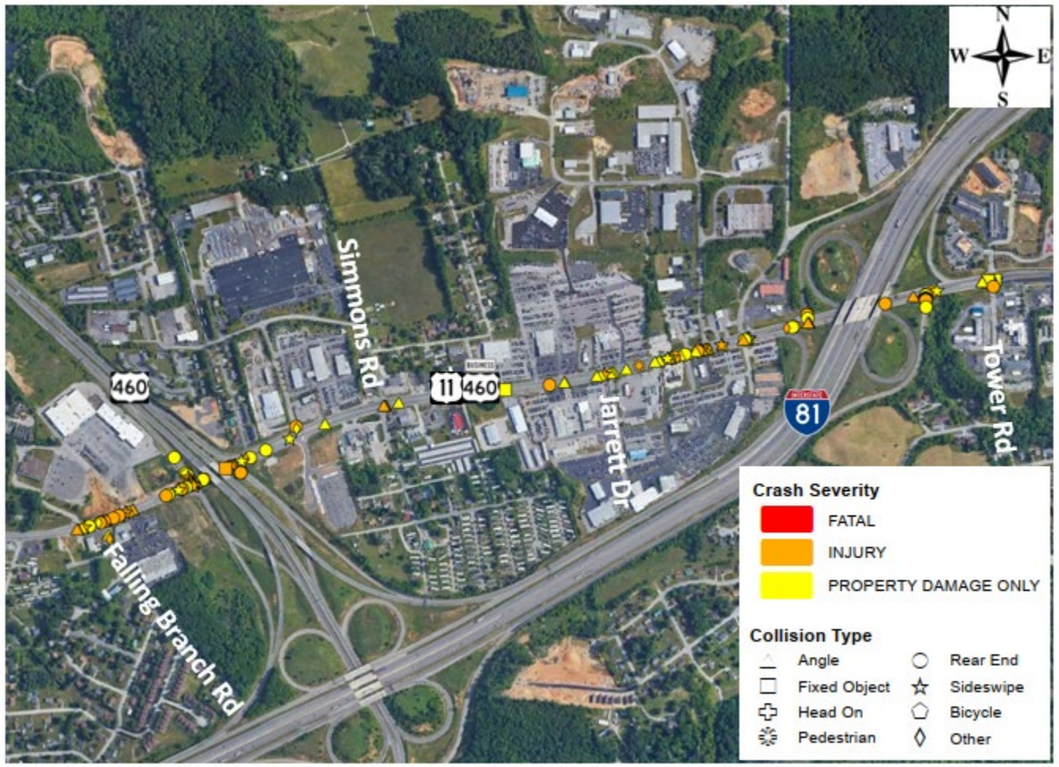


Figure 17: Collision Diagram

The locations of the pedestrian and bicycle crashes are depicted in **Figure 18** in addition to the locations of the Pedestrian Safety Action Plan (PSAP) corridors.

Figure 18: Pedestrian and Bicycle Crash Locations and PSAP Corridors

The locations of the Potential for Safety Improvement (PSI) intersections and segments for the Salem District are depicted in **Figure 19**.

Figure 19: Potential for Safety Improvement (PSI) Locations

Chapter 2:

Alternative Development and Refinement

Alternative Development and Screening

In order to develop alternative concepts to address the needs and incorporate diagnosis identified in Chapter 1, a thorough review of the existing conditions data was conducted. A screening-level analysis was performed to identify potential improvements along Roanoke Street. Intersection improvements were identified at each study intersection as described in the following sections. A more detailed evaluation of operational and safety benefits is included in the Stakeholder Working Group Meeting #3 presentation included in **Appendix A**.

Roanoke Street at US 460 Bypass Ramps

The extension of the eastbound and westbound Roanoke street left-turn lanes through the upstream interchange signals at the US 460 Bypass ramps was considered (see **Figure 20**). This improvement would address currently observed queue spillback that occurs regularly during the PM peak hour due to the heavy eastbound left-turn volume from Roanoke Street to northbound US 460 Bypass and the closely spaced interchange ramps. This improvement will reduce queues, increase the signal capacity and efficiency as well as reduce the blockage of the inside through lanes and the potential for rear end crashes. In addition, the installation of a crosswalk with pedestrian signalization and push buttons is proposed on the east leg of the intersection to provide a crossing of Roanoke Street

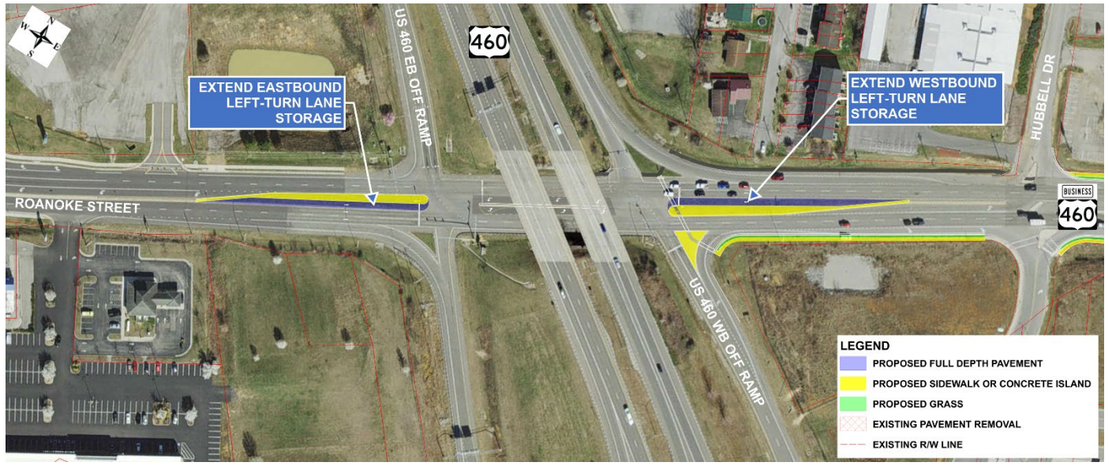


Figure 20: Roanoke Street at US 460 Bypass Ramps

Roanoke Street from Hubbell Drive to Houchins Road

Both access management and pedestrian improvements were considered for Roanoke Street between Hubbell Drive and Houchins Road where there is a five-lane section with a wide (18-foot) two-way left-turn lane and numerous commercial driveways. The following improvements were considered and evaluated:

- Construction of a raised median with a series of left turn lanes, RCUTs, and a partial Thru-Cut as shown in **Figures 21** and **22**.
- Closure of several commercial driveways to improve access management where businesses have more than one access point.
- Construction of a southbound right-turn lane from Industrial Drive to Roanoke Street.
- Construction of sidewalk along both the north and south sides of Roanoke Street from Hubbell Drive to Industrial Drive where they are not currently present.

Significant safety benefits are expected for replacing conventional intersections with RCUTs and Thru-Cuts by reducing the number of conflict points thereby reducing the potential for crashes, particularly angle crashes which typically lead to the most severe injuries; however, based on SWG concerns regarding planned development along Houchins Road that will greatly increase traffic volumes traveling to and from Houchins Road, it was recommended that the raised median, left-turn lanes, RCUTs, and partial Thru-Cut not be pursued at this time and investigated further in the future when a more comprehensive solution can be developed in conjunction with proposed development activity.

Figure 21: Roanoke Street from Hubbell Drive to Houchins Road

Figure 22: Roanoke Street from of Jarrett Drive to Houchins Road

Roanoke Street at I-81 Northbound Off-Ramp

To address the northbound rear end crash problem in the channelized right turn from the I-81 northbound off-ramp to eastbound Roanoke Street, revising the striping on eastbound Roanoke Street to designate the right lane as a lane drop onto northbound I-81 and modifying the off-ramp to all for a free flow right turn from the northbound I-81 off-ramp was considered by the SWG (see **Figure 23**). To address concerns regarding the weave from the right turn from the ramp to Hampton Boulevard, the concept was revised to accommodate hard right turns from the shared left-turn/right-turn lane to the left of the island. Signing would be provided to direct motorists on the ramp that are destined for Hampton Boulevard to stay to the left of the channelizing island. In addition to reducing the potential for rear end crashes during both typical conditions and when traffic volumes are significantly higher during an I-81 detour condition, this improvement would improve sight distance for left turns from the northbound I-81 off-ramp by allowing the stop bar to be moved farther forward.

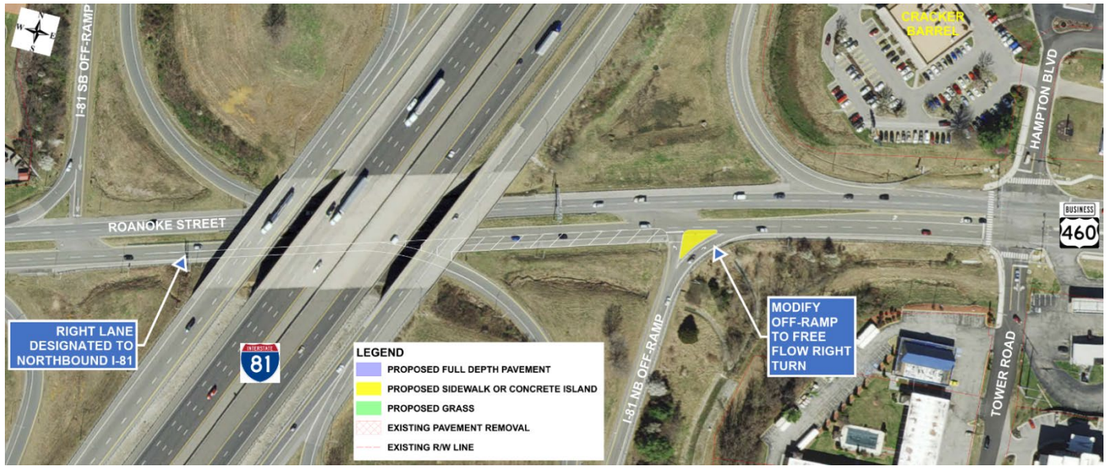


Figure 23: Roanoke Street at I-81 Northbound Off Ramp Preliminary Option

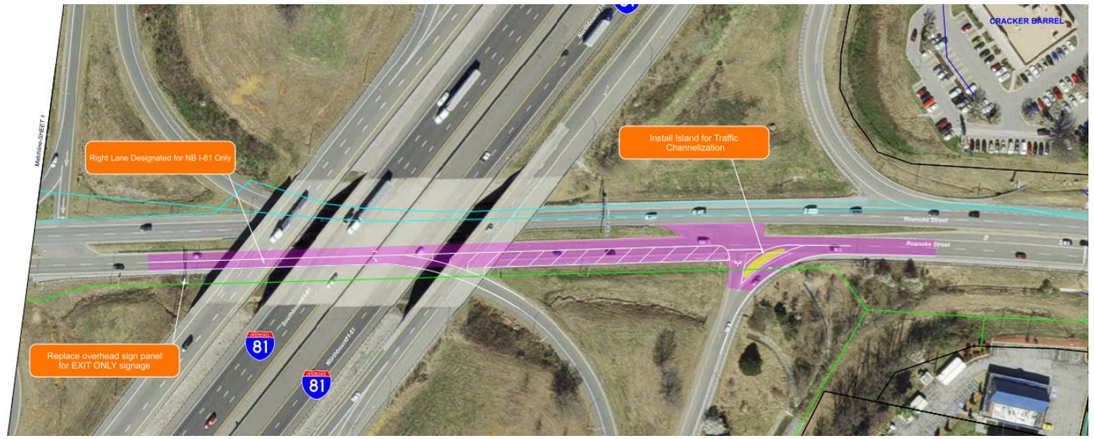


Figure 24: Roanoke Street at I-81 Northbound Off Ramp Refined Option

Preferred Alternative:

The Preferred Alternative option was developed for the study area based on the results of a screening-level Synchro analysis as discussed in the previous *Alternative Development and Screening* section as well as through stakeholder meetings to gauge general interest. The proposed improvements and analyses performed for the Preferred Alternative are discussed in greater detail in the following section.

Summary of Preferred Alternative

A summary of the proposed improvements included in the Preferred Alternative is shown in **Table 11** and a detailed concept is included in **Appendix D**.

Table 11: List of Preferred Alternative Improvements

Location	Proposed Improvement	Improvement Categories
Roanoke Street at US 460 EB Ramps	Add EB through lane	Congestion Mitigation Safety Improvement
Roanoke Street at US 460 WB Ramps	Install ADA-compliant ramps, pedestrian signals and crosswalks on the east leg of the intersection	Pedestrian Access Pedestrian Safety Improvement
	Add WB through lane	Congestion Mitigation Safety Improvement
Roanoke Street at Industrial Drive	Add SB right-turn lane	Capacity Preservation Congestion Mitigation Safety Improvement
Sidewalks from Hubbell Drive to Industrial Drive	Install new sidewalk & tie into existing sidewalk along the north and south sides of Roanoke Street	Pedestrian Access Pedestrian Safety Improvement
Roanoke Street at I-81 NB Off-Ramp	Improve angle of NB right-turn lane	Congestion Mitigation Safety Improvement

Traffic Operations Analysis

Following the alternatives development process and the selection of preferred improvements, the 2050 No Build Synchro traffic analysis network files were updated to reflect the recommended improvements proposed for intersections within the study area. Traffic signal timings and coordination plans were also updated to reflect the proposed improvements. The results of the Synchro traffic analysis and SimTraffic microsimulation are documented for the measures of effectiveness (MOEs) in accordance with the TOSAM.

Table 12 depicts queue lengths, Levels of Service, and delays for signalized and unsignalized intersections along the study corridor for the AM and PM peak hours for 2050 Build conditions. During the AM and PM peak hours, the signalized intersections along Roanoke Street are generally projected to experience reduced overall delays and congestion, with all intersections projected to operate at LOS C or better with reduced delays and queues along Roanoke Street in the area of Falling Branch Road and the Route 460 Bypass interchange due to additional left-turn lane storage at the interchange and signal coordination efforts between the closely-spaced intersections. However, several side street movements are projected to experience increased delays as a result of signal coordination efforts, with multiple turning movements at Falling Branch Road and at the Route 460 Bypass Ramps projected to operate at LOS E.

Turning movements at unsignalized intersections are also projected to operate at LOS C or better under 2050 No Build conditions, except for the northbound left turn from Simmons Road and the northbound left-turn from the I-81 NB off-ramp, both of which are projected to operate at LOS D. Additionally, queues along southbound Industrial Drive and the northbound I-81 off-ramp are projected to decrease under 2050 Build conditions with the proposed improvements. Detailed analysis results for both signalized and unsignalized intersections are contained in **Appendix C**.

Table 12: 2050 Build Conditions Traffic Analysis Results Summary

Intersection	Approach	Movement	2050 Build AM							2050 Build PM						
			Queue Length (ft)	Movement LOS	Approach LOS	Overall LOS	Delays (sec)	Approach Delay (sec)	Overall Delay (sec)	Queue Length (ft)	Movement LOS	Approach LOS	Overall LOS	Delays (sec)	Approach Delay (sec)	Overall Delay (sec)
Roanoke Street & Falling Branch Road Signalized	EB	L	54	A	B	B	9.4	13.4	16.9	83	B	C	C	14.1	20.6	27.6
		T	180	B			13.7			293	C			21.7		
		R	14	A			8.4			45	B			12.1		
	WB	L	42	A	B		8.9	12.4		94	B	B		13.3	19.2	
		T	93	B			13.0			181	C			21.7		
		R	27	A			9.1			134	B			13.4		
	NB	L-T-R	102	E	E		55.7	55.7		148	E	E		70.5	70.5	
	SB	L-T	78	E	D		56.5	54.7		210	E	E		69.4	63.4	
		R	33	D			49.2			128	D			31.4		
Roanoke Street & US 460 EB Off-Ramp Signalized	EB	T	140	B	B	C	10.5	7.8	20.5	558	C	C	C	17.1	13.3	31.1
		R	11	A			0.2			261	A			0.2		
	WB	L	102	B	B		11.4	12.3		175	C	B		21.9	22.4	
		T	105	B			12.5			186	C			22.5		
	SB	L-T	261	D	D		53.2	50.5		2656	D	E		53.2	56.8	
		R	196	D			43.5			210	E			61.0		
Roanoke Street & US 460 WB Off-Ramp Signalized	EB	L	158	B	A	A	18.4	9.1	8.7	191	D	B	B	39.6	10.9	14.3
		T	178	A			5.8			187	A			3.8		
	WB	T	123	B	A		12.7	5.8		424	B	A		15.5	8.8	
		R	187	A			0.7			222	A			0.6		
	NB	L-T	111	E	B		56.3	18.7		439	E	D		75.1	48.7	
		R	59	A			0.2			140	A			0.1		
Roanoke Street & Hubbell Drive Unsignalized	EB	L	72	B	-	-	10.7	-	-	100	B	-	-	11.8	-	-
		T	-	-			-			8	-			-		
		R	-	-			-			2	-			-		
	WB	L	23	A	-		9.1	-		21	A	-		10.0	-	
		T	-	-			-			46	-			-		
		R	6	-			-			10	-			-		
	NB	R	6	B	B		10.2	10.2		16	A	A		10.5	10.5	
	SB	R	40	B	B		12.8	12.8		144	C	C		15.8	15.8	
	EB	L	28	A	-	-	10.0	-	-	29	A	-	-	10.6	-	-
		T-R	11	-			-			11	-			-		

Intersection	Approach	Movement	2050 Build AM							2050 Build PM						
			Queue Length (ft)	Movement LOS	Approach LOS	Overall LOS	Delays (sec)	Approach Delay (sec)	Overall Delay (sec)	Queue Length (ft)	Movement LOS	Approach LOS	Overall LOS	Delays (sec)	Approach Delay (sec)	Overall Delay (sec)
Roanoke Street & Simmons Road Unsignalized	WB	L	33	A	-		9.4	-		36	A	-		10.4	-	
		T	15	-			-			23	-			-		
		R	-	-			-			2	-			-		
	NB	L	69	C	C		18.5	16.8		101	D	C		25.4	20.9	
		T-R	61	B			10.7			67	B			10.5		
	SB	L-T-R	61	C	C		18.0	18.0		95	C	C		18.9	18.9	
Roanoke Street & Teel Street Unsignalized	EB	L	39	A	-	-	10.0	-	-	47	A	-	-	10.4	-	-
		T	15	-			-			48	-			-		
	WB	T-R	2	-	-		-	-		11	-	-		-	-	
	SB	L-R	72	B	B		14.1	14.1		75	C	C		16.3	16.3	
Roanoke Street & Jarrett Drive Unsignalized	EB	T-R	33	-	-	-	-	-	-	7	-	-	-	-	-	-
	WB	L	40	A	-		8.9	-		47	B	-		10.2	-	
		T	-	-			-			53	-			-		
	NB	L-R	78	B	B		12.8	12.8		182	C	C		17.1	17.1	
Roanoke Street & Motor Lane Unsignalized	EB	L	0	A	-	-	0.0	-	-	29	A	-	-	9.8	-	-
		T-R	5	-			-			26	-			-		
	WB	L	29	A	-		8.7	-		26	A	-		9.9	-	
		T-R	-	-			-			31	-			-		
	NB	L-T-R	30	B	B		11.3	11.3		45	B	B		14.3	14.3	
	SB	L-T-R	27	B	B		11.4	11.4		39	B	B		12.7	12.7	
Roanoke Street & Industrial Drive Unsignalized	EB	L	78	B	-	-	10.9	-	-	66	B	-	-	10.1	-	-
		T-R	136	-			-			109	-			-		
	WB	L	49	A	-		8.4	-		34	A	-		9.6	-	
		T-R	30	-			-			26	-			-		
	NB	L-T-R	140	C	C		17.5	17.5		118	C	C		17.1	17.1	
	SB	L-T	57	B	B		14.5	14.5		110	C	C		16.0	16.0	
		R	69	B			14.5			85	C			16.0		
Roanoke Street & Bristol Drive Unsignalized	EB	L	54	A	-	-	9.8	-	-	35	A	-	-	9.4	-	-
		T-R	3	-			-			28	-			-		
	WB	L	25	A	-		8.3	-		20	A	-		9.6	-	
		T	36	-			-			2	-			-		
		R	8	-			-			11	-			-		
	NB	L-T-R	34	B	B		14.5	14.5		41	B	B		14.1	14.1	

Intersection	Approach	Movement	2050 Build AM							2050 Build PM						
			Queue Length (ft)	Movement LOS	Approach LOS	Overall LOS	Delays (sec)	Approach Delay (sec)	Overall Delay (sec)	Queue Length (ft)	Movement LOS	Approach LOS	Overall LOS	Delays (sec)	Approach Delay (sec)	Overall Delay (sec)
	SB	L-T	95	C	C		15.2	15.2		66	B	B		14.3	14.3	
		R	88	C			15.2			63	B			14.3		
Roanoke Street & I-81 SB Off-Ramp Unsignalized	EB	T	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	WB	T	4	-	-		-			-	-	-		-		
	SB	L	59	B	B		14.3	14.3		69	C	C		15.2	15.2	
		R	55	B			14.3			44	C			15.2		
Roanoke Street & I-81 NB Off-Ramp Unsignalized	EB	T	13	-	-	-	-	-	-	8	-	-	-	-	-	-
	WB	T	-	-	-		-	-		-	-	-		-	-	
	NB	L	80	B	-		13.0	-		79	D	-		26.1	-	
		R	51	A			0.0			60	A			0.0		
Roanoke Street & Tower Road Signalized	EB	L	88	B	B	B	10.2	11.0	15.9	115	A	B	B	7.8	11.7	13.7
		T-R	118	B			11.3			219	B			12.2		
	WB	L	45	A	B		9.3	15.8		67	A	B		7.7	12.4	
		T	178	B			16.0			158	B			12.7		
		R	35	B			12.6			44	B			10.1		
	NB	L-T	149	C	C		29.4	29.2		91	C	C		31.0	29.9	
		R	28	C			22.1			52	C			24.8		
	SB	L-T-R	77	C	C		22.5	22.5		90	C	C		25.6	25.6	

Expected Crash Reduction

A Crash Modification Factor (CMF) is used to determine the expected number of crashes after implementing a countermeasure on a road or intersection. CMFs for the various improvements under consideration were applied to the relevant crash history to evaluate the expected crash reduction. CMFs were obtained from Virginia State Preferred CMF List or the Crash Modification Factors Clearinghouse, which provides a searchable database of CMFs along with a five-star quality rating. **Table 13** presents the CMF value used for each crash severity type to calculate the crash reduction expected from the installation of the various safety improvements.

Table 13: Recommended Improvement CMFs by Crash Severity

Location	Proposed Improvement	Applicable Crash Type	K	A	B C	O
Roanoke St at US 460 EB Ramps	Add EB through lane	All	0.87	0.87	0.87	0.87
Roanoke St at US 460 WB Ramps	Add WB through lane	All	0.90	0.90	0.90	0.90
Roanoke St at US 460 WB Ramps	Install ADA-compliant ramps, pedestrians signals and crosswalks on the east leg of the intersection	Pedestrian	0.30	0.30	0.30	0.30
Roanoke St at Industrial Drive	Add SB right-turn lane	All	0.96	0.96	0.96	0.96
Sidewalks from Hubbell Drive to Industrial Drive	Install new sidewalk & tie into existing sidewalk along the north and south sides of Roanoke Street	Pedestrian	0.60	0.60	0.60	0.60
Roanoke St at I-81 NB Off-Ramp	Improve angle of NB right turn lane	All	0.56	0.56	0.56	0.56

CMFs for total crashes were applied to the total number of crashes during the 5-year study period to determine the expected crash reductions within the study area. CMFs for fatal and injury crashes were applied to the type K (fatal), A (severe injury), B (visible injury), and C (non-visible injury) crashes. **Table 14** summarizes the expected crash reductions for each crash severity and the overall crashes.

Table 14: Total Expected Number of Crashes and % Crash Reduction (2018 – 2022)

Location		K	A	B C	O	Total
Roanoke St at US 460 EB Ramps	Total Crashes	0	2	17	15	34
	Total Expected Crashes	0.0	1.7	14.8	13.1	29.6
	Change in Crashes	0.0	-0.3	-2.2	-2.0	-4.4
Roanoke St at US 460 WB Ramps	Total Crashes	0	0	7	12	19
	Total Expected Crashes	0.0	0.0	6.3	10.8	17.1
	Change in Crashes	0.0	0.0	-0.7	-1.2	-1.9
Roanoke St at US 460 WB Ramps	Pedestrian Crashes	0	0	0	0	0
	Total Expected Crashes	0.0	0.0	0.0	0.0	0.0
	Change in Crashes	0.0	0.0	0.0	0.0	0.0
Roanoke St at Industrial Drive	Total Crashes	0	1	4	8	13
	Total Expected Crashes	0.0	1.0	3.8	7.7	12.5
	Change in Crashes	0.0	0.0	-0.2	-0.3	-0.5
Sidewalk from Hubbell Drive to Industrial Drive	Pedestrian Crashes	0	1	0	0	1
	Total Expected Crashes	0.0	0.6	0.0	0.0	0.6
	Change in Crashes	0.0	-0.4	0.0	0.0	-0.4
Roanoke St at I-81 NB Off-Ramp	Total Crashes	0	0	9	10	19
	Total Expected Crashes	0.0	0.0	5.1	5.6	10.7
	Change in Crashes	0.0	0.0	-3.9	-4.4	-8.3
Total Crashes Associated with Improvements Influence Area		**0**	**4**	**37**	**45**	**86**
Total Expected Crashes After Improvements		**0.0**	**3.3**	**30.0**	**37.2**	**70.5**
Change in Crashes (Expected - Total)		***0.0***	***-0.7***	***-7.0***	***-7.8***	***-15.5***
Percent Crash Reduction After Improvements		**N/A**	**18%**	**19%**	**17%**	**18%**

*Total expected number of crashes is rounded to the nearest tenth

Key findings from the expected crash analysis are as follows:

- An annual crash reduction of 3 crashes is expected along Roanoke Street from Falling Branch Road to Tower Road, which is equivalent to an approximately 18% reduction in crashes
- Approximately 19% of injury-related crashes where improvements are proposed are expected to be reduced along Roanoke Street from Falling Branch Road to Tower Road

A sketch depicting the Preferred Build Alternative is shown in **Appendix D**.

Chapter 3:

Public and Stakeholder Outreach and Feedback

Public Involvement

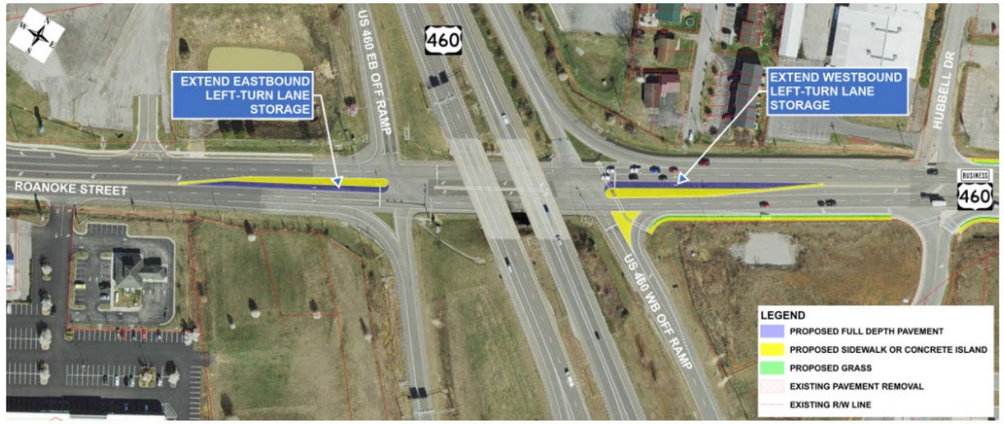
Following the development and analysis of the build alternatives, a public involvement survey was developed using the PublicInput survey tool to determine the public's response to the improvements and what they perceived as the relevant issues within the study area. The survey was available online for 14 days from March 1 – March 15, 2024.

Overall, the survey is divided into three sections, which include the following:

1. Introduction with overview of the project and study area
2. Recommended improvements in the corridor
3. Wrap up with demographic questions

For the recommended improvement concepts, participants were asked to provide a rating based on their opinion from one to five, with one being strongly opposed to the concept and 5 being strongly support the concept. Respondents were also provided with an option to provide comments or concerns. At the end of the survey, the participants were asked demographic questions. There were a total of 814 participants and 669 comments were provided. **Figure 25** presents an example of one of the rating screens from the survey.

Roanoke Street at US 460 Bypass Ramps - Interchange Improvements



Click the image to see the proposed recommendation

Additional storage for both the eastbound and westbound left-turn lanes to the US 460 Bypass ramps is proposed along Roanoke Street. This improvement will reduce the potential for traffic to back up through upstream intersections and improve traffic operations and safety.

	1. Strongly oppose	2. Somewhat oppose	3. Neutral	4. Somewhat support	5. Strongly support
Rate the concept on a scale of 1 to 5. (1 = Strongly oppose; 5 = Strongly support)	○	○	○	○	○

Figure 25: Public Survey Layout

Survey Questions and Results

Adding additional storage for both the eastbound and westbound Roanoke Street left-turn lanes to the US 460 Bypass received an average rating of 4.090 (see **Figure 26**).

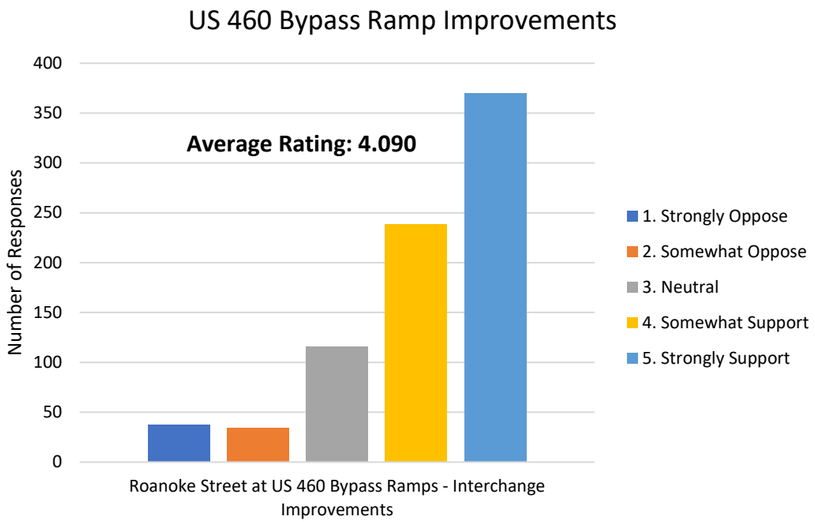


Figure 26: US 460 Bypass Ramps Survey Results

Seven improvements were presented from east of the US 460 Bypass to Houchins Road (see **Figure 27**). The closing of commercial entrances in the area received an average rating of 3.768. The RCUT at the Houchins Road intersection had the lowest rating of 3.349. The partial Thru-Cut at the Roanoke Street at Industrial Drive received the average rating of 3.656. The proposed right-turn lane from Industrial Drive to Roanoke Street received one of the higher average ratings in the corridor with a score of 4.043. Providing raised medians from west of Motor Lane to Houchins Road scored an average rating of 3.437. The highest average rating of 4.111 was given for the new sidewalk along the north and south sides of Roanoke Street. The signalized pedestrian crosswalk at the US 460 Bypass Westbound Ramps received an average rating of 3.777.

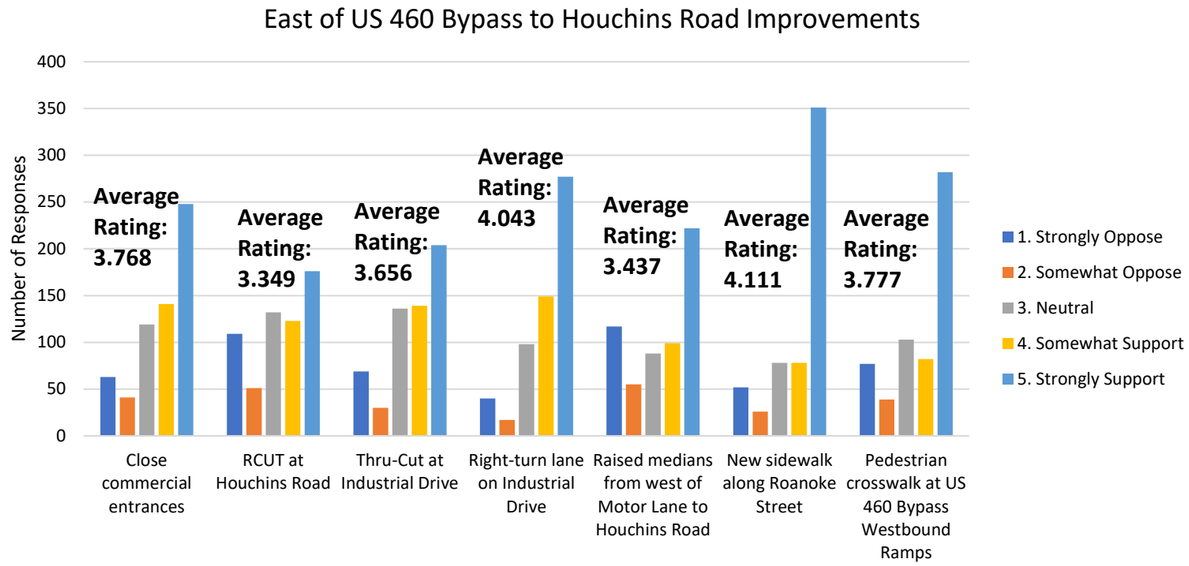


Figure 27: East of US 460 Bypass to Houchins Road Survey Results

The reconfiguration of the I-81 northbound off-ramp to Roanoke Street received an average rating of 3.934 (see **Figure 28**).

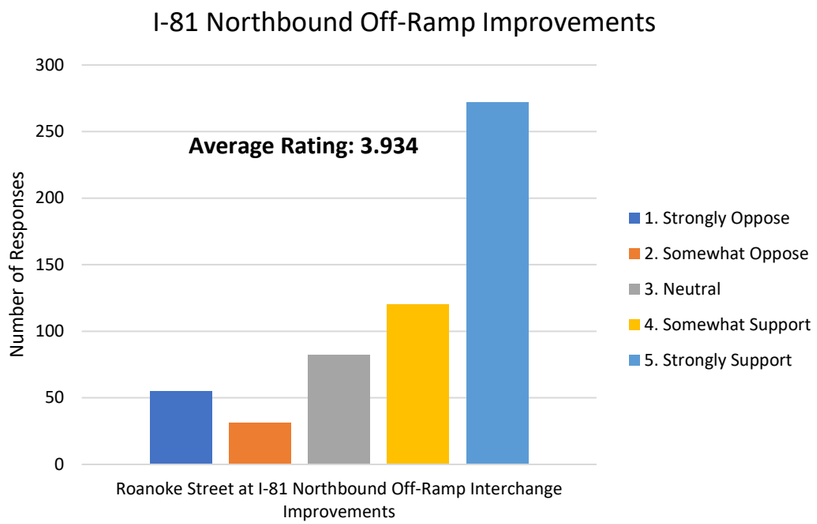


Figure 28: I-81 Northbound Off-Ramp Survey Results

Chapter 4:

Preferred Alternative Design Refinement & Investment Strategy

Investment Strategy

This study should be used as a planning tool to achieve the next steps of planning, programming, designing, and constructing the identified improvements along study corridor. To build upon the efforts of this study, VDOT Salem District should continue to coordinate with the Town of Christiansburg and other stakeholders.

Improvement projects should be prioritized on a local and regional level. Prior to submitting funding applications, the applicant must have inclusion or proven consistency with the Constrained Long-Range Transportation Plan (CLRP) or resolution of support from a governing body.

Preferred Alternative

Throughout the study process, proposed improvements were presented for stakeholder and public engagement, refined based on feedback, and analyzed in detail to verify that they met both safety and operational needs. As of the completion of this report, the concept plan displayed in **Appendix D** is the final recommended preferred alternative. This conceptual design was developed in accordance with the following applicable guidelines:

- A Policy on Geometric Design of Highways and Streets (AASHTO 2018)
- VDOT Road Design Manual (Issued January 2005, Revised June 2022)
- VDOT Road and Bridge Standards (VDOT 2016, latest revisions)
- Manual on Uniform Traffic Control Devices (MUTCD 2009)
- 2011 Virginia Supplement to the MUTCD

Design criteria and guidance from these documents were applied to roadways within the project limits based on functional classification and roadway design speeds.

Planning-Level Cost Estimates

An engineer's preliminary opinion of probable cost was created for construction costs, right of way acquisition costs, and utility relocation costs for the preferred alternative using Version 3.1 of the Cost Estimate Workbook (CEWB) as shown in **Table 15. Appendix E** includes detailed cost estimates.

Table 15: Planning Level Cost Estimates for the Preferred Alternative

Phase Description	Budget*
Preliminary Engineering	$4,289,587
Right of Way and Utility Relocation	$6,927,705
Construction	$30,013,282
Total Project Budget	$41,230,574

*Estimate as of July 26, 2024

Project Risks

The project team worked with VDOT staff to identify potential project risks, discuss mitigation strategies and determine risk items which needed additional contingencies carried with the project estimate. The Salem District Scope of Work document identifies project risks (see **Appendix F**).

Possible Funding Sources

The development of this study and the preferred alternative were conducted in accordance with eligibility criteria for SMART SCALE, a competitive funding program that allocates funding from the construction District Grants Program (DGP) and High-Priority Projects Program (HPPP) to transportation projects. SMART SCALE uses a scoring process that evaluates, scores, and ranks project applications based on six measures: congestion mitigation, economic development, accessibility, safety, environmental quality, and land use. The Town of Christiansburg submitted the proposed roadway improvements for SMART SCALE Round 6 funding consideration.

Other funding sources that may be considered for the proposed roadway improvements identified in this study include:

- **Revenue Sharing:** a competitive funding program providing 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.
- **Congestion Mitigation and Air Quality (CMAQ):** a competitive funding program allocating funds to surface transportation projects that improve air quality by reducing congestion.
- **Highway Safety Improvement Program (HSIP):** a competitive funding program providing funds for improvements that correct or improve safety on a section of roadway or intersection with a high incidence of crashes.