PROJECT PIPELINE

VA-36 / Winston Churchill Drive
City of Hopewell

From Miles Avenue to High Avenue

DRPT Virginia Department of Rail and Public Transportation

Office of INTERMODAL Planning and Investment

VDOT Virginia Department of Transportation

December 2024

PLANNING FOR PERFORMANCE

DRPT Virginia Department of Rail and Public Transportation

Office of INTERMODAL Planning and Investment

VDOT Virginia Department of Transportation

PROJECT PIPELINE

VA-36 (Winston Churchill Avenue) from Miles Avenue to High Avenue

Final Report

December 2024

Prepared for

VDOT Virginia Department of Transportation

Prepared by

Jacobs

2551 Dulles View Drive, Suite 700

Herndon, VA 20171

In collaboration with

wsp

277 Bendix Road, Suite 300

Virginia Beach, Virginia 23452

TABLE OF CONTENTS

APPENDICES

TABLE OF FIGURES

TABLES

PROJECT PIPELINE

Chapter 1: Needs Evaluation and Diagnosis

DRPT Virginia Department of Rail and Public Transportation

Office of INTERMODAL Planning and Investment

VDOT Virginia Department of Transportation

1.1 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 SMARTSCALE, revenue sharing, interstate funding, and others. Visit the Project Pipeline website 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 1-1.**

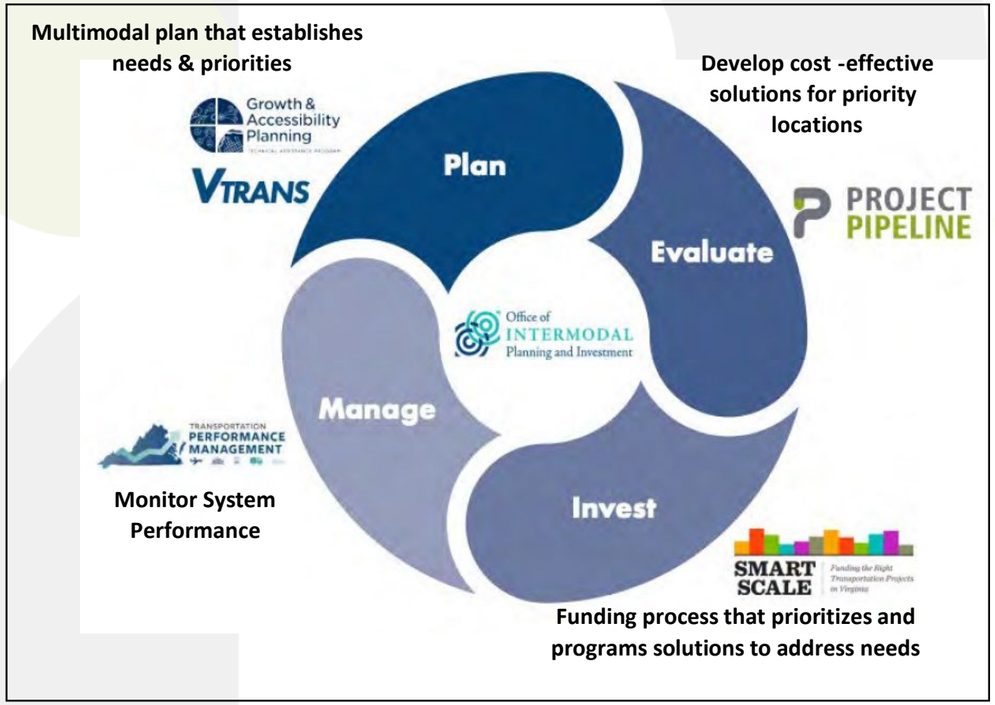


Figure 1-1. Objectives of Project Pipeline

1.2 Methodology

The study is broken down into three phases.

- Phase I consists of the local problem diagnosis and brainstorming of alternatives.
- Phase II includes the alternative evaluation and sketch level analysis.
- Phase III is the investment strategy and cost estimates.

Details on methods and solutions for each study phase are outlined in **Figure 1-2.**

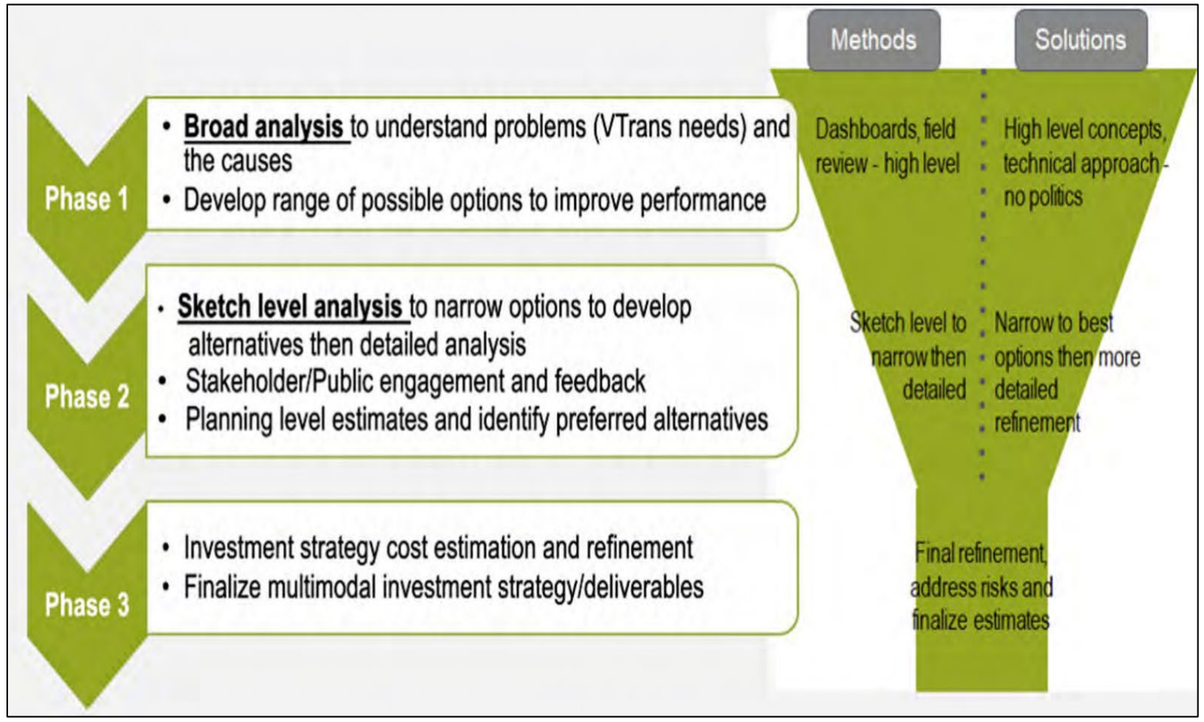


Figure 1-2. Study phase methods and solutions

1.3 Study Corridor

The study corridor is defined as VA 36 (Winston Churchill Drive) from High Avenue to Miles Avenue in the City of Hopewell. **Figure 1-3** shows the location of the VA 36 (Winston Churchill Drive) corridor within study limits. VA 36 (Winston Churchill Drive) is a four-lane divided roadway with a posted speed limit of 35 miles per hour (mph). The roadway is classified as "Other Principal Arterial" per the Virginia Department of Transportation (VDOT) Roadway Classification. Land use immediately adjacent to VA-36 is residential and commercial. Based on the VDOT's published 2021 Average Annual Daily Traffic (AADT) estimates, Winston Churchill Drive carried an AADT of 14,000 vpd. For this study, VA 36 (Winston Churchill Drive) is assumed to be oriented in a north-south direction.

The study corridor includes five (5) signalized and three (3) unsignalized intersections.

1. VA-36 / Winston Churchill Drive at Miles Avenue – Signalized
2. VA-36 / Winston Churchill Drive at Roanoke Avenue – Unsignalized
3. VA-36 / Winston Churchill Drive at Sunnyside Avenue – Signalized
4. VA-36 / Winston Churchill Drive at Liberty Avenue – Unsignalized
5. VA-36 / Winston Churchill Drive at High Avenue – Signalized
6. Oak Lawn Boulevard at High Avenue – Signalized

1.4 Study Work Group

The Study Work Group (SWG) includes local and regional stakeholders, who provide local and institutional knowledge of the corridor, review study goals and methodologies, provide input on key assumptions, and review and approve proposed improvement concepts developed through the study process.

The key members of the SWG include:

- VDOT Richmond District
- Office of Intermodal Planning and Investment (OIPI)
- Federal Highway Administration (FHWA)
- City of Hopewell
- Tri-Cities Area Metropolitan Planning Organization (MPO)
- Petersburg Area Transit (PAT)
- Virginia Department of Rail and Public Transportation (DRPT)
- WSP Consultant Team
- Jacobs Inc.

Figure 1-3: Study Location Map

1.5 VTrans Needs

VTrans is Virginia's statewide transportation plan. It is prepared for the Commonwealth Transportation Board (CTB) by the Office of Intermodal Planning and Investment (OIPI). VTrans lays out the overarching vision and goals for transportation in the Commonwealth and plans to achieve those goals. The CTB's identified Mid-term Needs (0 - 10 years) are used to screen funding applications for the SMART SCALE program and prioritize funding requests received for VDOT's Revenue Sharing Program. The CTB has established prioritized locations based on the identified Mid-term Needs. OIPI, VDOT, and DRPT, in collaboration with local and regional partners, develop solutions for Priority 1 and 2 locations.

a. 2019 Mid-term District Level VTrans Priority Needs

The VTRANS needs for the VA-36 / Winston Churchill Drive corridor are presented in **Table 1-1**. Bicycle access, safety, and Transportation Demand Management (TDM) are categorized as very high priority needs. Congestion mitigation is categorized as moderate need, while transit access, transit access for equity emphasis areas and reliability are considered as a low priority need. **Figure 1-4** presents the summary of the 2019 mid-term District Level VTrans Priority Needs for VA-36 / Winston Churchill corridor.

VTRANS IDENTIFIED NEEDS	PRIORITIES	OPTIONS
Bicycle Access	Very High	RN
Capacity Preservation	None	CoSS/RN
Congestion Mitigation	Medium	RN
IEDA (UDA) Access	None	Statewide
Pedestrian Access	None	RN
Safety Improvement	Very High	Construction District
Pedestrian Safety Improvement	None	Statewide
Reliability	Low	RN
Rail On-time Performance	None	CoSS
Transit Access	Low	RN
Transit Access for Equity Emphasis Areas	Low	RN
Transportation Demand Management	Very High	RN

Table 1-1: VA-36 Winston Churchill Drive - VTrans Priority Needs

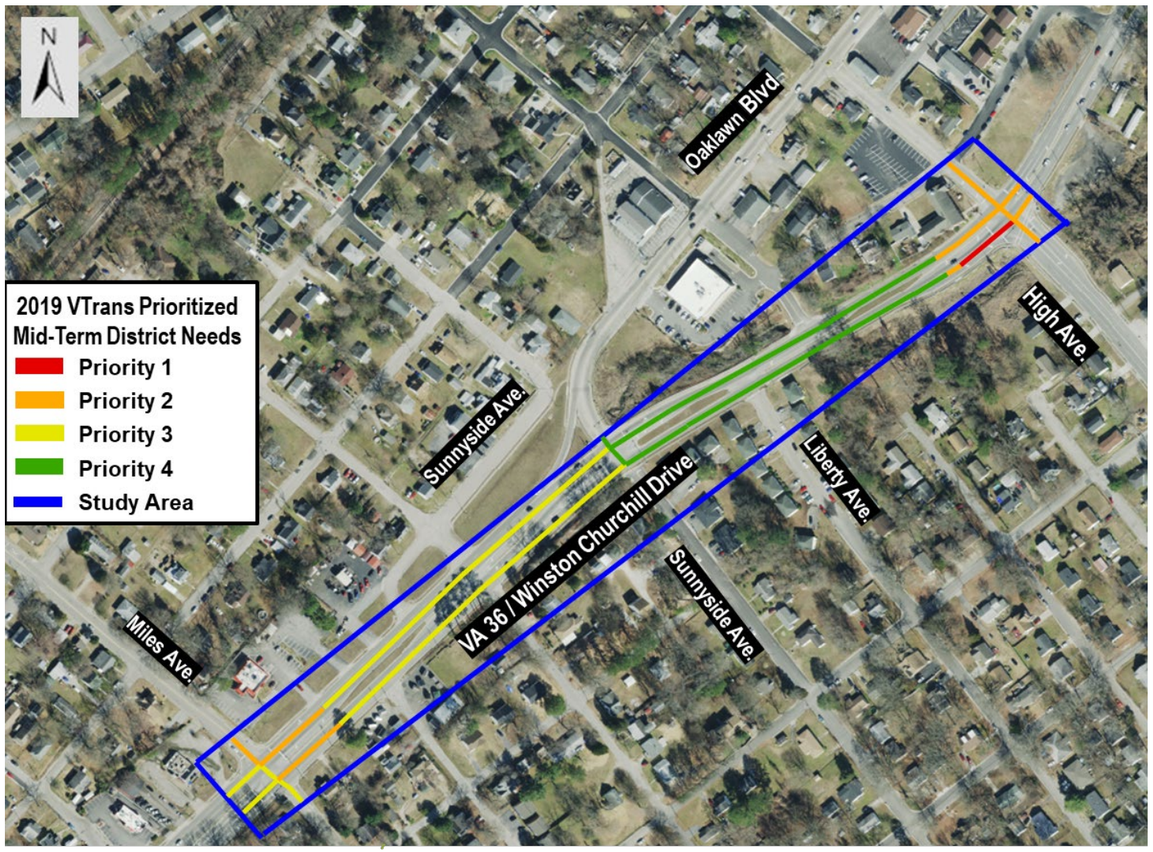


Figure 1-4. 2019 Mid-Term District Level Construction VTrans Priority Needs

b. Bicycle Access

The Bicycle Access VTrans Need is based on "Applicable roadway segments within biking distance (seven miles) of VTrans Activity Centers, fixed-guideway transit stations, or BRT lines". As shown in **Figure 1-5,** the VTrans bicycle access need along northbound VA-36 / Winston Churchill Drive, south of Sunnyside Avenue is identified as very high – Priority 1. Majority of the rest of the study corridor is identified as high – Priority 2. Oaklawn Boulevard has a medium – Priority 3 need for bicycle access.

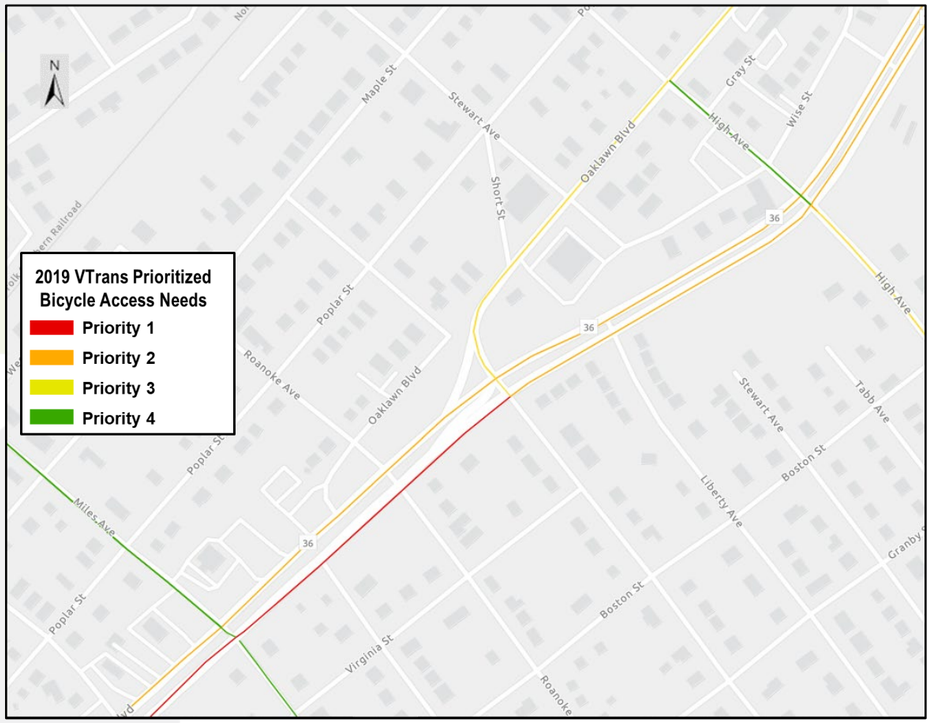


Figure 1-5. 2019 Mid-Term District Level VTrans Bicycle Access Priority Needs

c. Roadway Safety

The roadway safety VTrans Need is based on "For each Construction District, includes VDOT Top 100 Potential for Safety Improvement (PSI) Intersections and Segments, and PSI locations with three or more fatal or injury crashes at the intersection or segment over the last 5 years". As shown in **Figure 1-6**, the VTrans safety need along VA 36/ Winston Churchill Drive, south of Sunnyside Avenue is identified as medium – Priority 3. However, two PSI intersections are identified along the study corridor.

- VA 36/ Winston Churchill Avenue at Miles Avenue – VTrans Safety Need is High – Priority 2
- VA 36/ Winston Churchill Avenue at High Avenue – VTrans Safety Need is Very High – Priority 1

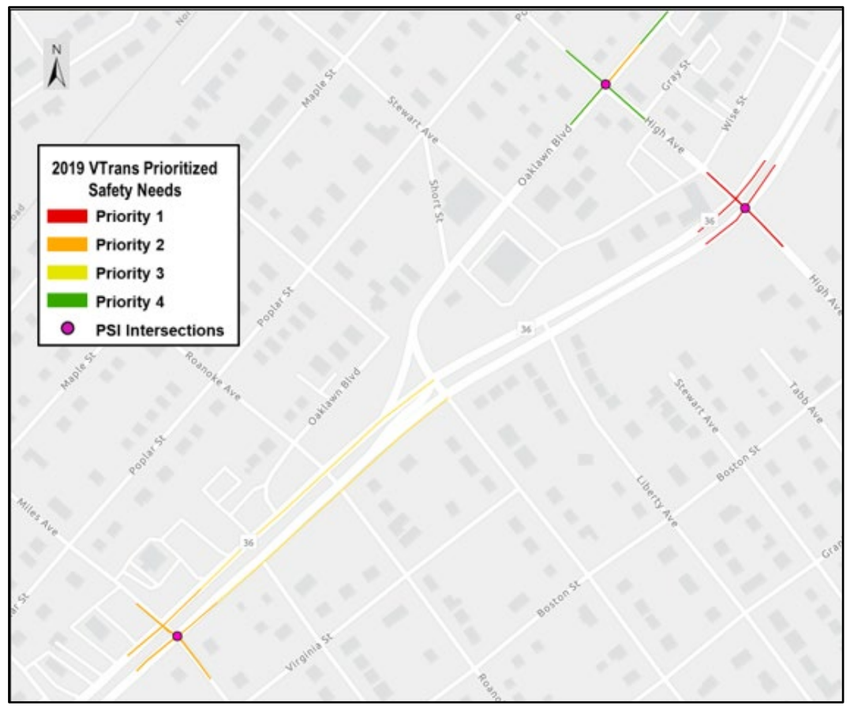


Figure 1-6. 2019 Mid-Term District Level VTrans Safety Priority Needs

d. Transit Access

The Transit Access VTrans Need is based on "The number of workers that can access a given VTrans Activity Center via public transit within 45 minutes versus a private automobile. Any transit deficit greater than zero constitutes a need". As shown in **Figure 1-7** the VTrans transit access need along both directions of VA 36/ Winston Churchill Drive is identified as low – Priority 4.

Figure 1-7. 2019 Mid-Term District Level VTrans Transit Access Priority Needs

e. Traffic Demand Management (TDM)

The TDM VTrans Need is based on "Roadway segments where TDM strategies such as new or expanded public transportation services/facilities, new or expanded bicycle and pedestrian facilities, or coordination of commuter assistance programs can be beneficial to reduce vehicle miles traveled". As shown in **Figure 1-8**, the VTrans TDM need along VA-36 / Winston Churchill Drive is identified as very low – Priority 4, except the northbound approach at the intersection of VA-36 / Winston Churchill Drive and High Avenue where the VTrans TDM need is very high – Priority 1.

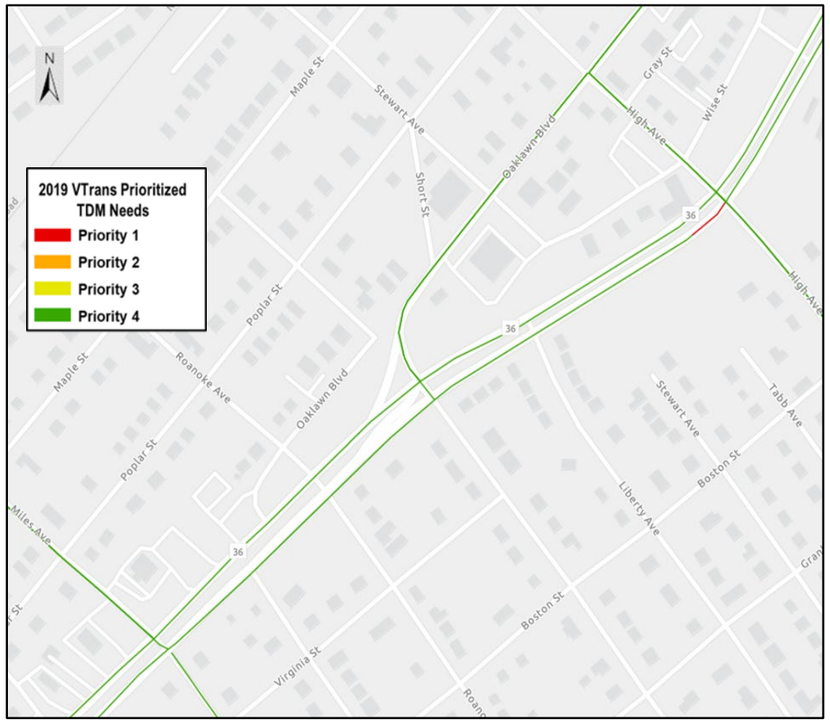


Figure 1-8. 2019 Mid-Term District Level VTrans TDM Priority Needs

f. Congestion Mitigation

The congestion mitigation VTrans Need is based on "At least 2% of the average travel takes place in the excessively congested condition, defined as travel speed below 75% of posted speed limit". As shown in **Figure 1-9,** the congestion mitigation VTrans need at the intersection of VA 36/ Winston Churchill Drive at High Avenue is identified as medium – Priority 3 along northbound approach and low – Priority 4, along westbound approach. No congestion mitigation needs are identified along the rest of the study corridor.

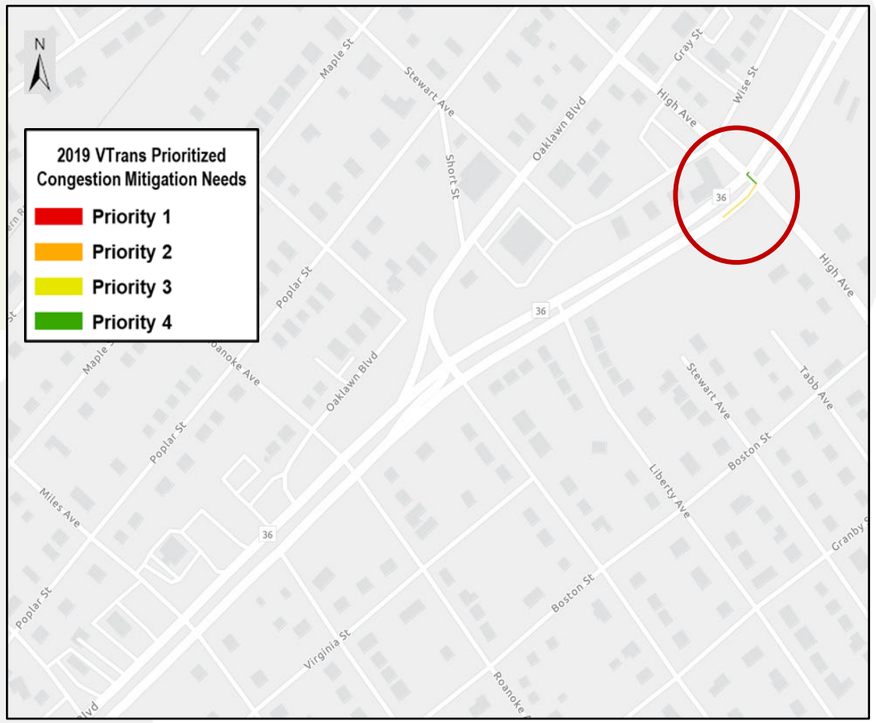


Figure 1-9. 2019 Mid-Term District Level VTrans Congestion Mitigation Needs

g. Reliability

The reliability VTrans Need is based on Level of Travel Time Reliability (LOTTR) 1.5 or higher for at least one hour". As shown in **Figure 1-10**, the reliability VTrans need at the intersection of VA 36/ Winston Churchill Drive at High Avenue is identified as low – Priority 4, along westbound approach. No reliability needs are identified along the rest of the study corridor.

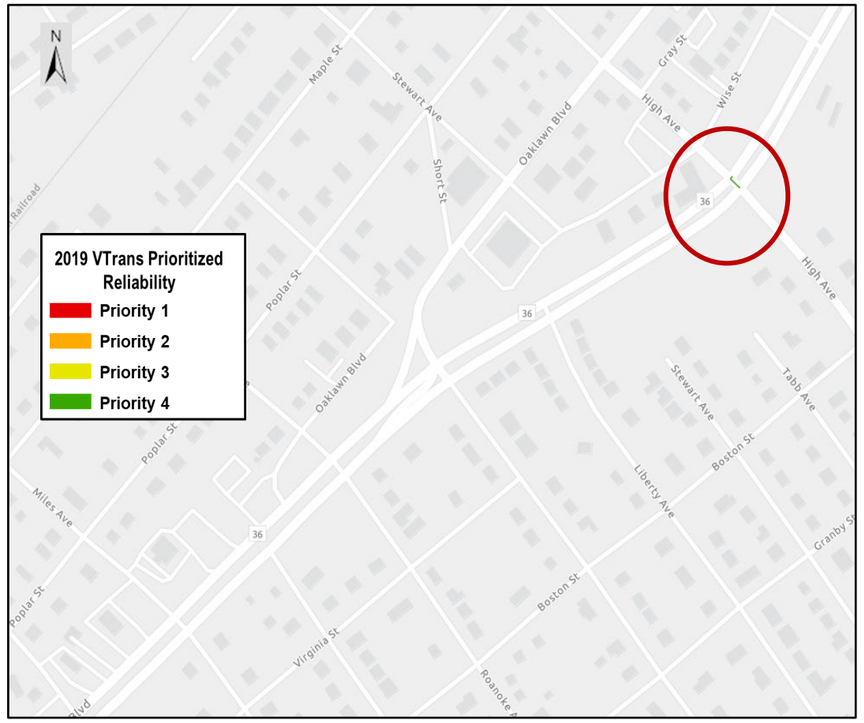


Figure 1-10. 2019 Mid-Term District Level VTrans Reliability Needs

1.6 Existing Traffic Operational Analysis

Existing conditions evaluations were performed for the VA-36/ Winston Churchill Drive study corridor by the study team to identify safety, operations and mobility related issues and deficiencies that could be addressed as part of the Pipeline initiative. The key roadways in the study network are listed below and summarized below:

- Winston Churchill Drive is a six-lane divided roadway with a posted speed limit of 35 miles per hour (MPH). The roadway is classified as "Other Principal Arterial" per the 2014 VDOT Roadway Classification[1]. VA-36 is a six-lane divided roadway from Miles Avenue to Oaklawn Boulevard / Sunnyside Avenue, where it becomes a four-lane divided roadway. Land use immediately adjacent to VA-36 is residential and commercial. Based on the VDOT's published 2021 Average Annual Daily Traffic (AADT) estimates, Winston Churchill Drive carried an AADT of 14,000 vpd. For this study, Winston Churchill Drive is assumed to be oriented in a north-south direction.
- Miles Avenue is a two-lane undivided roadway with a posted speed limit of 35 MPH. The roadway is classified as "Major Collector" per the 2014 VDOT Roadway Classification. The roadway terrain approaching the Winston Churchill Drive intersection is flat. For this study, Miles Avenue is assumed to be oriented in east-west direction.
- Oaklawn Boulevard / Sunnyside Avenue is a two-lane undivided "Minor Arterial" with a posted speed limit of 35 MPH. The roadway terrain is flat approaching the Winston Churchill Drive intersection. For this study, Oaklawn Boulevard / Sunnyside Avenue is assumed to be oriented in east-west direction.
- High Avenue is a two-lane undivided "Major Collector" on the west leg, and a four-lane undivided "Minor Arterial" on the east leg with a posted speed limit of 35 MPH. The roadway terrain is flat approaching the Winston Churchill Drive intersection. For this study, High Avenue is assumed to be oriented in east-west direction.

a. Traffic Data Collection

Existing conditions peak hour turning movement counts (TMC) were collected at each study intersection in May 2023. **Figure 1-11** presents the key data collection plan map. AM peak hour

Turning movement counts (TMCs) were collected between 6:30 AM and 10:30 AM and PM peak hour TMC were collected between 3:00 PM and 7:00 PM. TMC were summarized in 15-minute increments, allowing for calculating the AM and PM system peak hours. The AM peak hour was calculated as 7:30 AM to 8:30 AM and the PM peak hour was calculated as 4:30 PM to 5:30 PM. Peak hour were collected during the same time intervals. 48-hour tube counts were also collected for Winston Churchill Drive segment between High Avenue and Stewart Avenue. The average weekday traffic was calculated as 12,900 vpd. The existing AM and PM peak hour volumes at the key intersections are presented in **Figure 1-12**. The traffic data collected for this project is included in **Appendix A**.

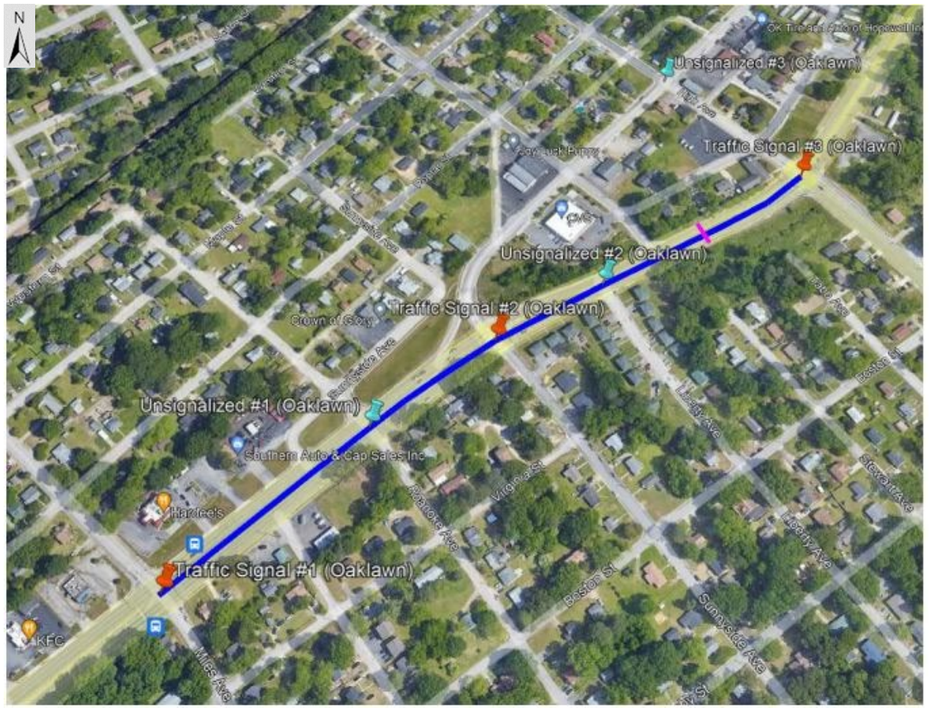
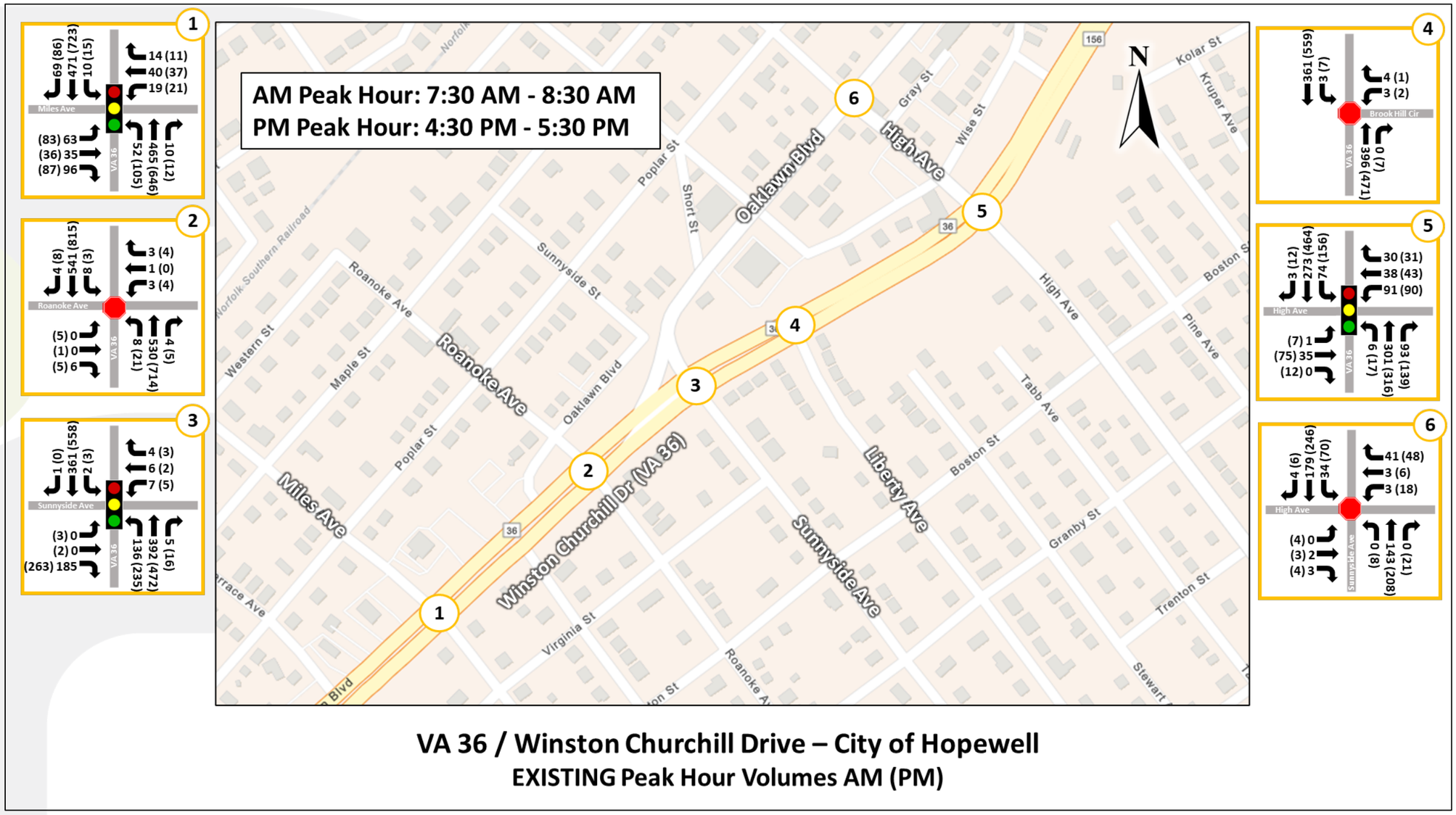


Figure 1-11. Traffic Data Collection Map

[1] *1Virginia Department of Transportation (VDOT) 2014 Approved Functional Classification, ArcGIS - Functional Classification Web Map*



VA 36 / Winston Churchill Drive – City of Hopewell
EXISTING Peak Hour Volumes AM (PM)

Figure 1-12. 2023 Existing Peak hour Volumes AM (PM))

b. Field Visit Summary

A field visit to the project corridor was performed on Wednesday, June 28, 2023, to identify any predominant traffic patterns, observe pedestrian activity, and identify transit and bicycle access. The field observations were summarized in this sub-section.

Intersection #1: VA-36 (Winston Churchill Drive) at Miles Avenue

At the signalized intersection of Winston Churchill Drive and Miles Avenue, there is currently a crosswalk across the east leg of Miles Avenue. However, there are no pedestrian push-buttons were available. During the field visit, pedestrian activities were observed as two pedestrians attempted to cross from the west leg of Miles Avenue to the east, as shown **Figure 1-13**.

Looking WB along Miles Ave

Pedestrians crossing Winston Churchill Drive

Figure 1-13. Field Observations at Winston Churchill Drive/Miles Avenue

Additionally, community members were observed sitting on the curb while waiting for the bus to arrive due to the lack of benches or bus shelters, at the of two Hopewell Circulator bus stops as shown in **Figure 1-14**, along the study corridor.

Figure 1-14. Bus-Stops Locations at Winston Churchill Drive/ Miles Avenue

Intersection #3: VA-36 (Winston Churchill Dr) and Oaklawn Boulevard/Sunnyside Avenue

The signalized intersection of Winston Churchill Drive and Oaklawn Boulevard/Sunnyside Avenue has a cross walk across the west leg of the intersection. The staff from the City of Hopewell expressed that there has been some concern from the public regarding the lack of warning for the through lane continuing as an exclusive left-turn lane for the northbound left turn onto Oaklawn Boulevard.

The right turn from eastbound Oaklawn Boulevard onto Winston Churchill Drive is a channelized right turn, which is the heaviest movement of that approach; however, no congestion or safety issues were observed at this merge. The channelized right turn is illustrated in **Figure 1-15.**

At the intersection, there is currently a crosswalk on the west leg of Oaklawn Boulevard, as well as a crosswalk on the channelized right turn lane, however the pavement markings are visibly faded. Pedestrian push-buttons are not available at the intersection.

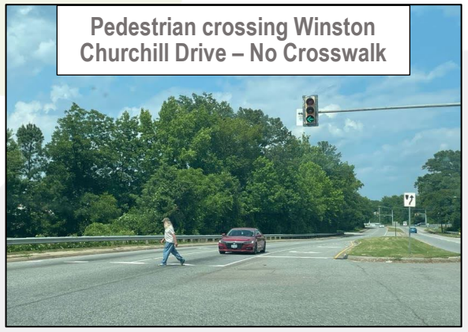


Figure 1-15. Intersection of Winston Churchill Drive and Oaklawn Boulevard/Sunnyside Avenue

Intersection #5: VA-36 (Winston Churchill Dr) and High Avenue

At the signalized intersection of Winston Churchill Drive and High Avenue, **Figure 1-16** shows the bike lanes along High Avenue in both directions, installed in April 2023. Along eastbound High Avenue, past the intersection of Winston Churchill Drive, the bike lanes continue as Sharrows. The staff from the City of Hopewell indicated that there is a "pushback" from the public on these bicycle lanes as they were installed as part of a road-diet approach by re-purposing the existing travel lanes and by removing the on-street parking. The northbound right-turn has also been a point of concern for the community as the vehicles have to take a wider turn due to the bicycle lane. A narrow right-turning vehicle may end up in the new bike lane and the buffer. The intersection has one crosswalk on the east leg of High Avenue; however, there are no pedestrian push-buttons or ADA ramps. The intersection lighting has been upgraded recently which could help reduce the night-time crashes.

Figure 1-16. Intersection of Winston Churchill Drive and High Avenue

c. Analysis Tool and Measures of Effectiveness (MOEs)

Traffic Software Synchro (Version 11) was utilized to identify operational issues at the key intersections in the study area. Measures of effectiveness (MOEs) were assumed to be the average intersection delay per vehicle and level of service (LOS). The LOS thresholds established in the HCM 2000 and HCM 2010 methodologies are shown in **Table 1-2.** Signal timing information for the three signalized intersections was provided by City of Hopewell.

Table 1-2: Level of Service (LOS) threshold – HCM 2000/ HCM 2010

LOS	Congestion Level	HCM 2000 and HCM 2010	
		Signalized Intersections	Two-Way Stop Control Intersections
		Average Delay (sec/veh)	
A	Light Traffic	<=10	<= 10
B		>10-20	>10-15
C		>20-35	>15-25
D	Moderate Traffic	>35-55	>25-35
E	Heavily Congested Traffic	>55-80	>35-50
F	Severely Congested Traffic	>80	>50

d. Traffic Operational Analysis Results

The Synchro analysis results for the existing conditions, presented in **Table 1-3** and **Figure 1-17,** indicate that all study intersections operate at acceptable overall intersection LOS D or better. Operations at each key intersection are summarized below:

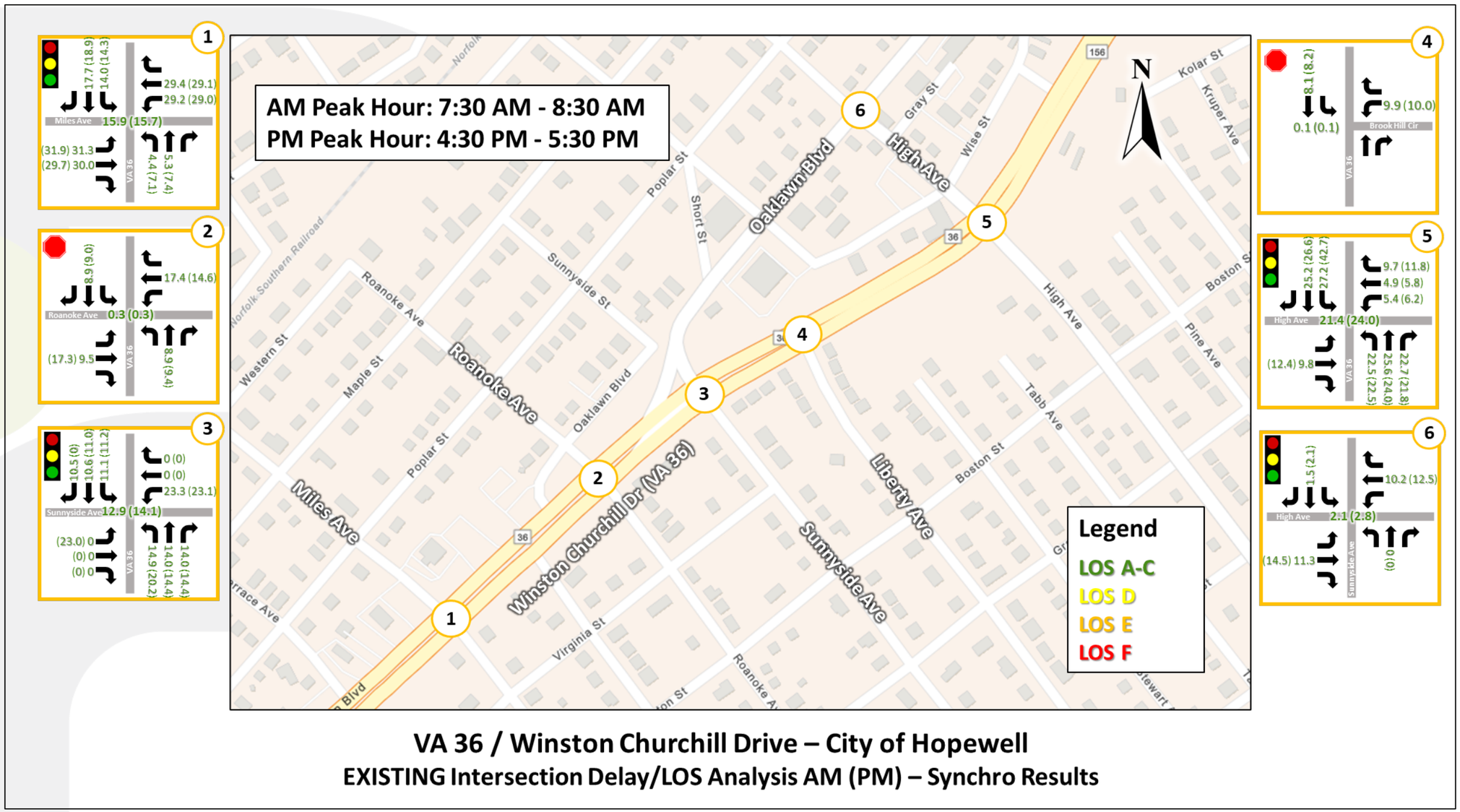
- The VA-36/Winston Churchill Drive and Miles Avenue intersection operates, overall, at the level of service (LOS) B during the AM / PM peak hours. The eastbound and westbound left-turn and through movements operate at LOS C during both the AM and PM peak hour. The existing storage lengths of all turn lanes accommodate the 95th-percentile queues lengths on all approaches.
- The VA-36 and Roanoke Avenue (two-way stop-controlled) intersection operates, overall, at LOS A during the AM / PM peak hours. The westbound through movement operates at LOS C during the AM peak hour. The eastbound through movement operates at LOS C during the PM peak hour.
- The VA-36 and Sunnyside Avenue / Oaklawn Boulevard intersection operates, overall, at LOS B during both AM and PM peak hours. The westbound left-turn movement operates at LOS C during the AM / PM peak hours, and the eastbound left-turn movement operates at LOS C during the PM peak hour.
- The VA-36 and Liberty Avenue (stop-controlled) intersection operates, overall, at LOS A during both AM and PM peak hours. The westbound movements operate at LOS B during the PM peak hour.
- The VA-36 and High Avenue intersection operates, overall, at LOS C during the AM / PM peak hours. Northbound and Southbound left-turn movements along Winston Churchill Drive experience delays of 25 sec/veh, operating at acceptable LOS C. The existing storage length of the southbound left-turn lane is slightly shorter than the 95th-percentile queue length for the subject movement, indicating that there could be a potential spillover into through lane and it may take more than one cycle length for vehicles to clear the intersection. All other turn lanes are longer than the 95th-percentile queue length for the respective turn movement.
- The High Avenue and Oaklawn Boulevard intersection operates, overall, at LOS A during both AM and PM peak hours. The eastbound and westbound through movements operate LOS B during both AM and PM peak hours.

Synchro analysis reports are included in **Appendix B** along with the signal timing information.

Table 1-3: Existing Intersection Operational Analysis AM/ PM Peak Hours – Delay and LOS

Intersection Number	Intersection Name	Movement	Storage length (ft)	AM									PM								
					Movement				Approach		Intersection			Movement				Approach		Intersection	
				Volume	Average Queue (ft)	95th Percentile Queue (ft)	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Volume	Average Queue (ft)	95th Percentile Queue (ft)	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
1	Winston Churchill Drive & Miles Avenue	EBL	80	63	30	67	31.3	C	30.4	C	15.9	B	83	38	79	31.9	C	30.6	C	15.7	B
		EBT		35	16	64	30	C					36	16	61	29.7	C				
		EBR		96									87								
		WBL	80	19	9	28	29.2	C	29.4	C			21	9	29	29	C	29.1	C		
		WBT		40	19	50	29.4	C					37	16	45	29.1	C				
		WBR		14									11								
		NBL	200	52	8	20	4.4	A	6.8	A			105	16	36	5.3	A	7.1	A		
		NBT		465	28	75	7.1	A					646	38	101	7.4	A				
		NBR		10									12								
		SBL	130	10	2	6	14	B	17.6	B			15	2	9	14.3	B	18.8	B		
		SBT		471	72	105	17.7	B					723	111	157	18.9	B				
		SBR		69									86								
2	Winston Churchill Drive & Roanoke Avenue	EBL		0					9.5	A	0.3	A	5					17.3	C	0.3	A
		EBT		0			9.5	A					1			17.3	C				
		EBR		6									5								
		WBL		3					17.4	C			4					14.6	B		
		WBT		1			17.4	C					0			14.6	B				
		WBR		3									4								
		NBL	100	8					0.1				21					0.3			
		NBT		530			8.9	A					714			9.4	A				
		NBR		4									5								
		SBL	80	8					0.1				3					0			
		SBT		541			8.9	A					815			9	A				
		SBR		4									8								
3	Winston Churchill Drive & Sunnyside Avenue	EBL	90	0	0	0	0	A	0		12.9	B	3	0	0	23	C	23		14.1	B
		EBT		0	0	0	0	A					2	2	11	0	A				
		EBR		185	0	0	0						263	0	56	0					
		WBL		7	0	0	23.3	C	23.3	C			5	0	0	23.1	C	23.1	C		
		WBT		6	6	23	0	A					2	3	15	0	A				
		WBR		4	0	0	0	A					3	0	0	0	A				
		NBL		136	44	122	14.9	B	14.2	B			235	87	#259	20.2	C	16.2	B		
		NBT		392	65	134	14	B					472	76	153	14.4	B				
		NBR		5	0	0	14	B					16	0	0	14.4	B				
		SBL	100	2	1	3	11.1	B	10.6	B			3	1	5	11.2	B	11	B		
		SBT		361	58	84	10.6	B					558	90	122	11	B				
		SBR		1	0	0	10.5	B					0	0	0	0	A				

Intersection Number	Intersection Name	Movement	Storage length (ft)	AM									PM								
				Volume	Movement				Approach		Intersection		Volume	Movement				Approach		Intersection	
					Average Queue (ft)	95th Percentile Queue (ft)	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS		Average Queue (ft)	95th Percentile Queue (ft)	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
4	Winston Churchill Drive & Liberty Avenue	WBL		3					9.9	A	0.1	A	2					10	B	0.1	A
		WBT		0			9.9	A					0			10	B				
		WBR		4									1								
		NBL		0					0				0					0			
		NBT		396									471								
		NBR		0									7								
		SBL	170	3					0.1				7					0.1			
		SBT		361			8.1	A					559			8.2	A				
		SBR		0									0								
5	Winston Churchill Drive & High Avenue	EBL		1					9.8	A	21.4	C	7					12.3	B	24.0	C
		EBT		35	9	29	9.8	A					75	26	54	0.1	12.4				
		EBR	70	0									12								
		WBL		91	14	36	5.4	A	6.1	A			90	18	36	0.1	6.2	7.2	A		
		WBT	500	38	6	18	4.9	A					43	8	20	0.1	5.8				
		WBR	100	30	0	0	9.7	A					31	0	0	0	11.8				
		NBL	175	6	2	12	22.5	C	24.9	C			17	7	23	0.8	22.5	23.3	C		
		NBT		301	65	101	25.6	C					316	70	106	0.6	24				
		NBR	200	93	0	34	22.7	C					139	0	40	0.2	21.8				
		SBL	155	74	30	69	27.2	C	25.7	C			156	74	#167	16.6	42.7	30.6	C		
		SBT		273	58	92	25.2	C					464	112	158	1.8	26.6				
		SBR		3									12								
6	Oaklawn Boulevard and High Avenue	EBL		0					11.3	B	2.1	A	4					14.5	B	2.8	A
		EBT		2			11.3	B					3			14.5	B				
		EBR		3									4								
		WBL		3					10.2	B			18					12.5	B		
		WBT		3			10.2	B					6			12.5	B				
		WBR		41									48								
		NBL		0					0				8					0.3			
		NBT		143			0						208			0.3	A				
		NBR		0									21								
		SBL		34					1.5				70					2.1			
		SBT		179			1.5	A					246			2.1	A				
		SBR		4									6								



VA 36 / Winston Churchill Drive – City of Hopewell
EXISTING Intersection Delay/LOS Analysis AM (PM) – Synchro Results

Figure 1-17: 2023 Existing Intersection Capacity Analysis AM (PM) – Synchro Results

1.7 Existing Safety Analysis

a. Corridor Safety Analysis Results

An 8-year (2015 - 2022) safety analysis for the study area was conducted using the VDOT's Pipeline Program Crash Data Dashboard. During the study period, two-hundred and five (205) crashes were reported in the study area. Out of the total crashes, one-hundred and ninety-nine crashes (199) occurred within 250-feet of a study intersection. Crash summary map by type of crash along the study corridor is presented in **Figure 1-18**. The reported crash history included twenty-six (26) Property Damage Only (PDO) related incidents, ten (10) severe injury, eighty-two (82) visible injury, and eighty-seven (87) nonvisible injury incidents. **Table 1-4** presents a crash summary by severity.

Table 1-4: VA 36/ Winston Churchill Drive Crash Summary by Severity

Severity	Number of Crashes per Year								8 Year Total Crashes	Average Crashes Per Year	%
	2015	2016	2017	2018	2019	2020	2021	2022			
A. Severe Injury	0	0	4	2	0	2	0	2	10	1.3	5%
B. Visible Injury	9	7	10	12	17	6	11	10	82	10.3	40%
C. Nonvisible Injury	11	9	6	15	11	9	15	11	87	10.9	42%
PDO. Property Damage Only	1	3	7	2	3	3	3	4	26	3.3	13%
Total	**21**	**19**	**27**	**31**	**31**	**20**	**29**	**27**	**205**	**25.6**	**100%**

- The reported crashes include: one-hundred and nineteen (119) angle collisions, forty-two (42) rear-end collisions, and fifteen (15) sideswipe – same direction collisions.
- Seventeen (17) occurred in raining conditions, six (6) occurred in mist conditions, one (1) occurred during blowing sand, soil, dirt, or snow conditions, and one-hundred and eighty-one (181) occurred during no adverse conditions (clear/cloudy).
- Below is a breakdown of crashes along VA-36 and each of the corresponding side-street approaches:
  - VA-36 Crashes – 188
  - Miles Avenue Crashes – 6
  - Oaklawn Boulevard / Sunnyside Avenue Crashes – 4
  - High Avenue Crashes – 7
- Four (4) crashes occurred during dawn, one-hundred and twenty (120) occurred during daylight, and eleven (11) occurred during dusk. Seventy (70) crashes occurred during darkness, with sixty (60) being while the road was lighted, and ten (10) being while the road was not lighted. **Table 1-5** presents a crash summary by type of lighting condition. Seventy (70) crashes occurred at nighttime and twenty (20) crashes were attributed to speeding.

Table 1-5: VA 36 /Winston Churchill Drive Summary by Lighting Conditions

Lighting Conditions	Number of Crashes per Year								8 Year Total Crashes	Average Crashes Per Year	%
	2015	2016	2017	2018	2019	2020	2021	2022			
Dawn	0	0	1	2	0	0	0	1	4	0.5	2%
Daylight	15	11	20	16	20	11	14	13	120	15.0	59%
Dusk	0	4	0	1	0	2	3	1	11	1.4	5%
Darkness - Road Lighted	6	3	6	12	9	6	9	9	60	7.5	29%
Darkness - Road Not Lighted	0	1	0	0	2	1	3	3	10	1.3	5%
Total	**21**	**19**	**27**	**31**	**31**	**20**	**29**	**27**	**205**	**25.6**	**100%**

b. Intersection Safety Analysis Results

Intersection related crashes were identified as the crashes that occurred within 250 ft along all approaches of the intersection. The crash summary by intersection is presented in **Figure 1-19**.

Crash Type	Number of Crashes per Year								8 Year Total Crashes	Average Crashes Per Year	%
	2015	2016	2017	2018	2019	2020	2021	2022			
1. Rear End	6	3	6	4	9	5	4	5	42	5.3	20%
2. Angle	9	12	18	21	15	10	18	16	119	14.9	58%
3. Head On	0	1	0	0	1	1	0	0	3	0.4	1%
4. Sideswipe - Same Direction	1	1	1	4	1	2	3	2	15	1.9	7%
5. Sideswipe - Opposite Direction	0	1	0	0	0	0	0	0	1	0.1	0%
6. Fixed Object in Road	0	0	0	0	0	0	1	2	3	0.4	1%
8. Non-Collision	1	0	0	0	0	0	0	1	2	0.3	1%
9. Fixed Object - Off Road	2	0	1	0	4	1	2	0	10	1.3	5%
12. Pedestrian	0	1	0	0	0	0	0	0	1	0.1	0%
15. Backed Into	1	0	0	0	0	0	0	0	1	0.1	0%
16. Other	1	0	1	2	1	1	1	1	8	1.0	4%
Total Crashes	21	19	27	31	31	20	29	27	205	25.6	100%

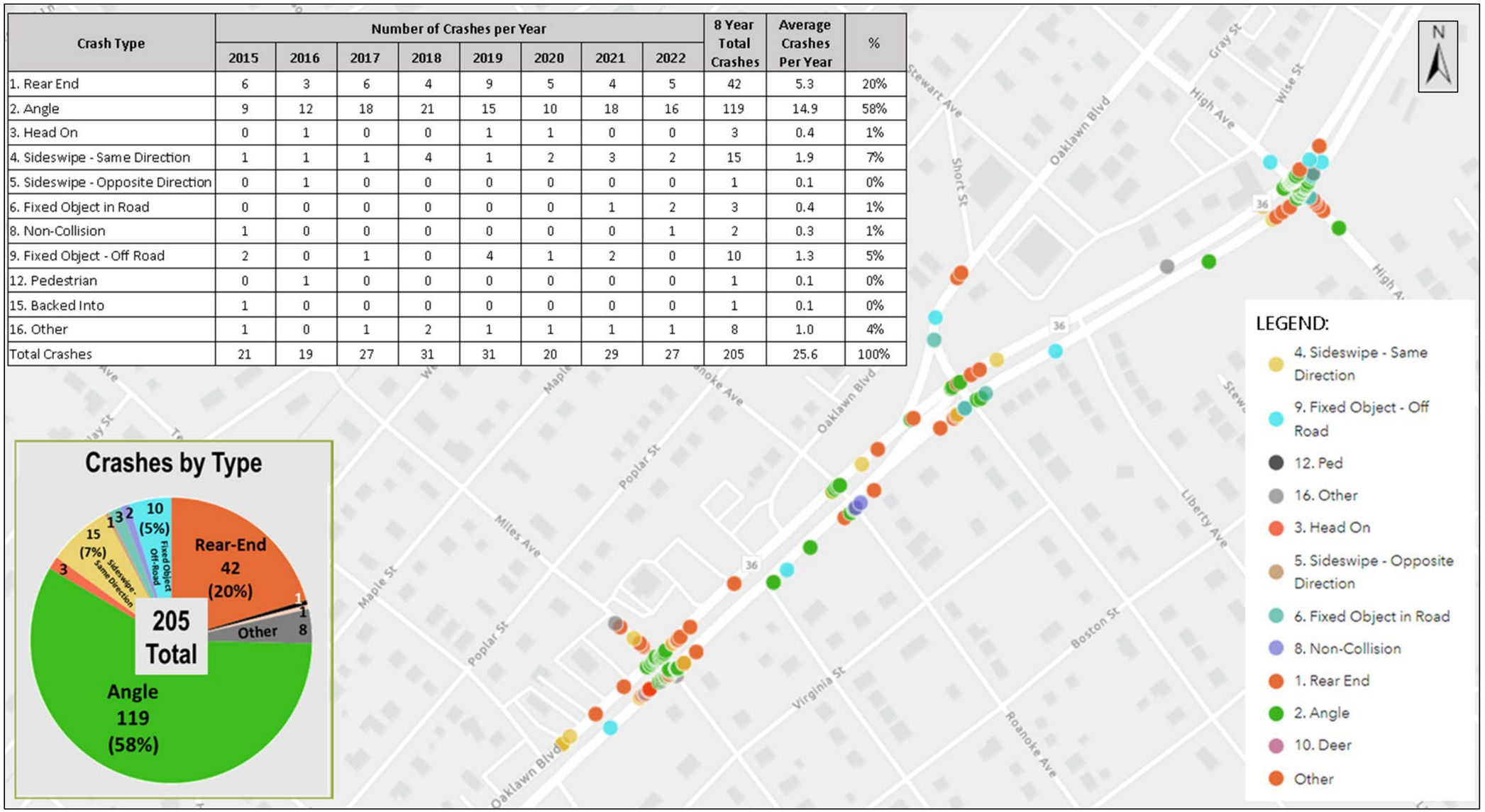


Figure 1-18. VA 36 / Winston Churchill Drive Corridor Crash Summary Map

Intersection	Crash Type											8 Year Total Crashes	Average Crashes Per Year	%
	1. Rear End	2. Angle	3. Head On	4. Sideswipe - Same Direction	5. Sideswipe - Opposite Direction	6. Fixed Object in Road	8. Non-Collision	9. Fixed Object - Off Road	12. Ped	15. Backed Into	16. Other			
Miles Avenue	19	37	2	5	1	1	0	1	0	1	6	73	9.1	37%
Roanoke Avenue	3	10	0	2	0	0	2	1	1	0	0	19	2.4	10%
Sunnyside Avenue/ Oaklawn Boulevard	7	6	1	2	0	2	0	2	0	0	0	20	2.5	10%
Liberty Avenue	0	0	0	0	0	0	0	1	0	0	1	2	0.3	1%
High Avenue	10	66	0	3	0	0	0	5	0	0	1	85	10.6	43%
Total Crashes	39	119	3	12	1	3	2	10	1	1	8	199	24.9	100%

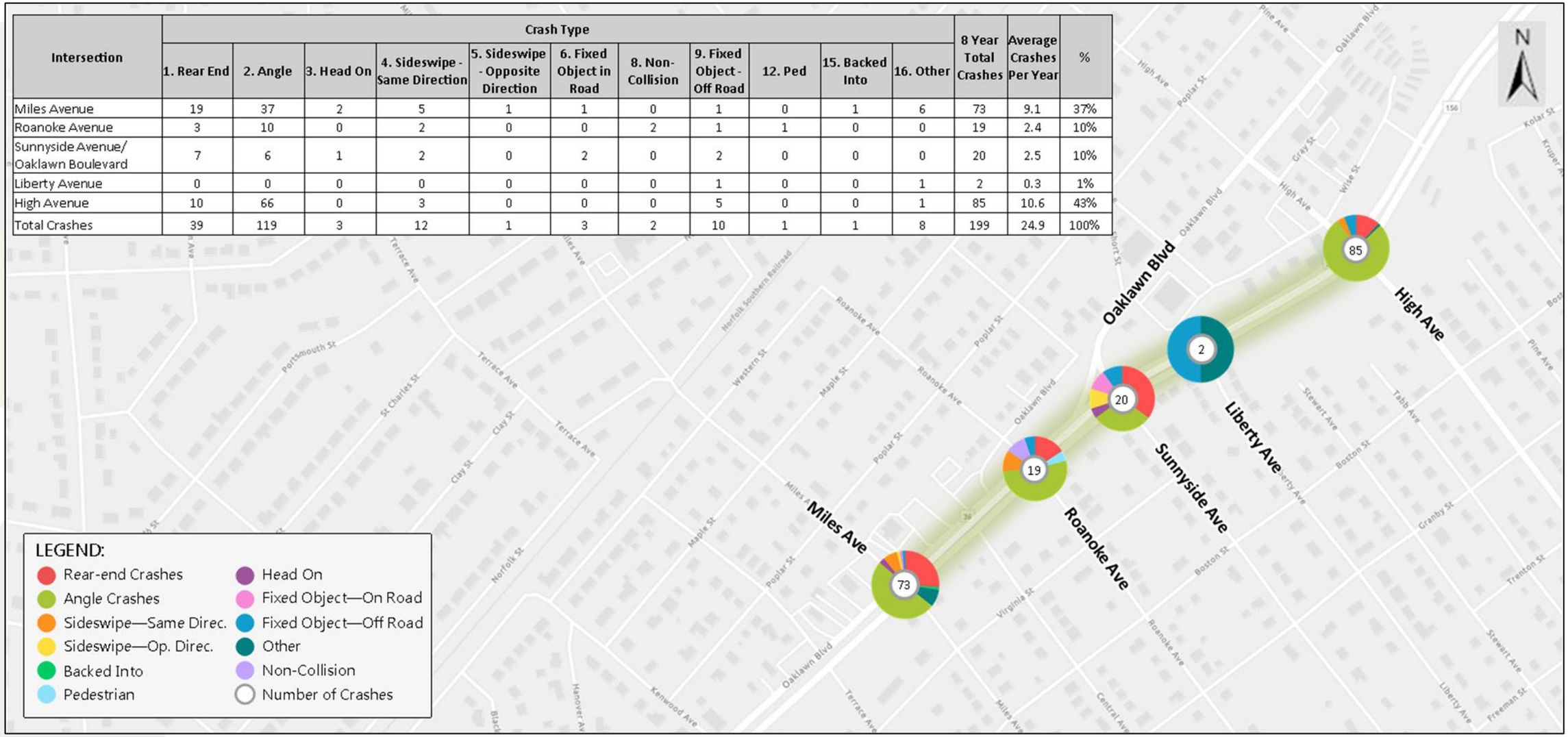


Figure 1-19. VA 36 / Winston Churchill Drive Crash Summary by Intersection

- For the intersection of ***Winston Churchill Drive at Miles Avenue***, a total of seventy-three (73) crashes, including eight (8) PDO and sixty-five (65) injury-related crashes were reported at this signalized intersection. Angle crashes were reported as the most prominent crash type (37), followed by rear-end crashes (19). Majority of crashes occurred under no adverse conditions (89%), and 25% occurred at night-time. **Table 1-6** presents a crash summary for the intersection of Winston Churchill Drive and Miles Avenue.

Table 1-6: VA 36 /Winston Churchill Drive at Miles Avenue – Crash Summary

Crash Type	Number of Crashes per Year								8 Year Total Crashes	Average Crashes Per Year	%
	2015	2016	2017	2018	2019	2020	2021	2022			
1. Rear End	2	0	3	2	3	4	2	3	19	2.4	26%
2. Angle	5	1	6	8	5	2	3	7	37	4.6	51%
3. Head On	0	1	0	0	1	0	0	0	2	0.3	3%
4. Sideswipe - Same Direction	0	0	0	2	1	1	0	1	5	0.6	7%
5. Sideswipe - Opposite Direction	0	1	0	0	0	0	0	0	1	0.1	1%
6. Fixed Object in Road	0	0	0	0	0	0	1	0	1	0.1	1%
9. Fixed Object - Off Road	0	0	0	0	1	0	0	0	1	0.1	1%
15. Backed Into	1	0	0	0	0	0	0	0	1	0.1	1%
16. Other	0	0	1	1	1	1	1	1	6	0.8	8%
Severity											
A. Severe Injury	0	0	1	2	0	0	0	2	5	0.6	7%
B. Visible Injury	2	2	4	3	6	3	1	6	27	3.4	37%
C. Nonvisible Injury	5	1	2	7	5	5	5	3	33	4.1	45%
PDO. Property Damage Only	1	0	3	1	1	0	1	1	8	1.0	11%
Total Crashes	8	3	10	13	12	8	7	12	73	9.1	100%

- For the intersection of ***Winston Churchill Drive at Roanoke Avenue***, a total of nineteen (19) crashes, including four (4) PDO and fifteen (15) injury-related crashes were reported at this unsignalized intersection. Angle crashes were reported as the most prominent crash type (10), followed by rear-end crashes (3). Majority of the crashes occurred under no adverse conditions (80%), and 42% occurred at night-time. **Table 1-7** presents a crash summary for the intersection of Winston Churchill Drive and Roanoke Avenue.

Table 1-7: VA 36 /Winston Churchill Drive at Roanoke Avenue – Crash Summary

Crash Type	Number of Crashes per Year								8 Year Total Crashes	Average Crashes Per Year	%
	2015	2016	2017	2018	2019	2020	2021	2022			
1. Rear End	0	1	0	1	1	0	0	0	3	0.4	16%
2. Angle	0	1	1	0	1	4	2	1	10	1.3	53%
4. Sideswipe – Same Direction	0	1	0	0	0	0	0	1	2	0.3	11%
8. Non-Collision	1	0	0	0	0	0	0	1	2	0.3	11%
9. Fixed Object - Off Road	0	0	0	0	0	1	0	0	1	0.1	5%
12. Ped	0	1	0	0	0	0	0	0	1	0.1	5%
Severity											
B. Visible Injury	1	0	1	0	0	1	2	1	6	32%	8%
C. Nonvisible Injury	0	3	0	1	1	3	0	1	9	47%	12%
PDO. Property Damage Only	0	1	0	0	1	1	0	1	4	21%	5%
Total Crashes	1	4	1	1	2	5	2	3	19	100%	26%

- For the intersection of ***Winston Churchill Drive at Oaklawn Boulevard / Sunnyside Avenue***, a total of twenty (20) crashes, including two (2) PDO and eighteen (18) injury-related crashes were reported at this signalized intersection. Rear-end crashes were reported as the most prominent crash type (7), followed by angle crashes (6). Majority of the crashes occurred under no adverse conditions (90%), and 40% occurred at night-time. **Table 1-8** presents a crash summary for the intersection of Winston Churchill Drive and Oaklawn Boulevard/Sunnyside Avenue.

Table 1-8: VA 36 /Winston Churchill Drive at Oaklawn Boulevard/Sunnyside Avenue

Crash Type	Number of Crashes per Year								8 Year Total Crashes	Average Crashes Per Year	%
	2015	2016	2017	2018	2019	2020	2021	2022			
1. Rear End	1	0	1	0	2	1	2	0	7	0.9	35%
2. Angle	0	2	0	1	0	0	3	0	6	0.8	30%
3. Head On	0	0	0	0	0	1	0	0	1	0.1	5%
4. Sideswipe - Same Direction	1	0	0	1	0	0	0	0	2	0.3	10%
6. Fixed Object in Road	0	0	0	0	0	0	0	2	2	0.3	10%
9. Fixed Object - Off Road	1	0	0	0	0	0	1	0	2	0.3	10%
Severity											
B. Visible Injury	1	2	0	1	2	1	1	0	8	1.0	40%
C. Nonvisible Injury	2	0	0	1	0	1	5	1	10	1.3	50%
PDO. Property Damage Only	0	0	1	0	0	0	0	1	2	0.3	10%
Total Crashes	3	2	1	2	2	2	6	2	20	2.5	100%

- For the intersection of ***Winston Churchill Drive at Liberty Avenue***, a total of two (2) crashes, both of which were nonvisible injury related crashes, were reported at this unsignalized intersection. One (1) of the crashes was classified as other, with the second being classified as a fixed object – off road crash. **Table 1-9** presents a crash summary for the intersection of Winston Churchill Drive and Liberty Avenue.

Table 1-9: VA 36 /Winston Churchill Drive at Liberty Avenue

Crash Type	Number of Crashes per Year								8 Year Total Crashes	Average Crashes Per Year	%
	2015	2016	2017	2018	2019	2020	2021	2022			
9. Fixed Object - Off Road	0	0	0	0	1	0	0	0	1	0.1	50%
16. Other	0	0	0	1	0	0	0	0	1	0.1	50%
Severity											
C. Nonvisible Injury	0	0	0	1	1	0	0	0	2	0.3	100%
Total Crashes	0	0	0	1	1	0	0	0	2	0.3	100%

- For the intersection of ***Winston Churchill Drive at High Avenue***, a total of eighty-five (85) crashes, including eleven (11) PDO and seventy-four (74) injury-related crashes were reported at this signalized intersection. Angle crashes were reported as the most prominent crash type (66), followed by rear-end crashes (10). Majority of the crashes occurred under no adverse conditions (88%), and 39% occurred at night-time. **Table 1-10** presents a crash summary for the intersection of Winston Churchill Drive and High Avenue.

Table 1-10: VA 36 /Winston Churchill Drive at High Avenue

Crash Type	Number of Crashes per Year								8 Year Total Crashes	Average Crashes Per Year	%
	2015	2016	2017	2018	2019	2020	2021	2022			
1. Rear End	2	2	1	1	2	0	0	2	10	1.3	12%
2. Angle	4	8	11	12	9	4	10	8	66	8.3	78%
4. Sideswipe – Same Direction	0	0	0	1	0	1	1	0	3	0.4	4%
9. Fixed Object - Off Road	1	0	1	0	2	0	1	0	5	0.6	6%
16. Other	1	0	0	0	0	0	0	0	1	0.1	1%
Severity											
A. Severe Injury	0	0	3	0	0	2	0	0	5	0.6	6%
B. Visible Injury	5	3	5	8	8	1	6	3	39	4.9	46%
C. Nonvisible Injury	3	5	3	5	4	0	4	6	30	3.8	35%
PDO. Property Damage Only	0	2	2	1	1	2	2	1	11	1.4	13%
Total Crashes	8	10	13	14	13	5	12	10	85	10.6	100%

1.8 Existing Bicycle and Pedestrian Facilities

To identify the needs with respect to accessibility, the study team reviewed existing conditions for pedestrian and bicycle accommodations. Sidewalks are available on both sides of the study corridor. However, crosswalks are only provided at one leg at three intersections along the study corridor, as shown in **Figure 1-20.** No bicycle lanes are available along Winston Churchill Drive. The closest bicycle network is along north leg of Miles Avenue at the Winston Churchill Drive/Miles Avenue and High Avenue. Addition of new crosswalks at the intersections of Winston Churchill Drive at Miles Avenue would provide a safer option for pedestrians accessing the nearest bus-stops. Similarly, addition of new crosswalks at the intersection of Winston Churchill Drive at High Avenue would provide another layer of safety for bicyclists using the existing bicycle lanes and crossing the subject intersection.

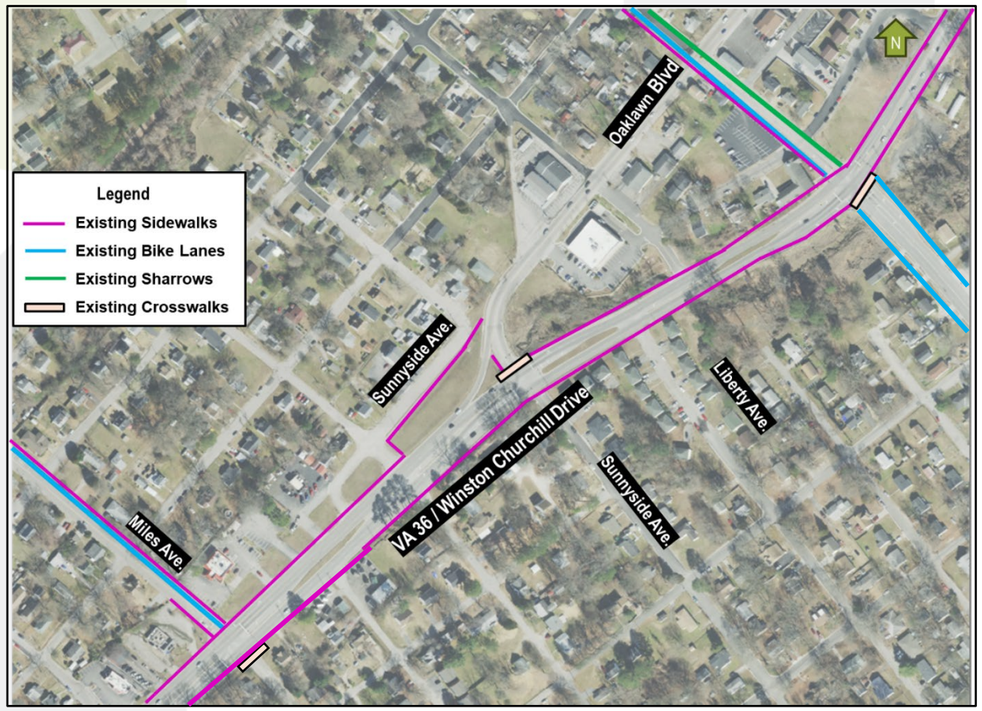


Figure 1-20. Bicycle and Pedestrian Facilities

1.9 Existing Transit/TDM Facilities

To identify the needs with respect to accessibility, the study team reviewed existing conditions for Transit and TDM accommodations. The Hopewell Circulator, a bus route with 13 daily trips during weekdays and 12 daily trips during weekends is operated Petersburg Area Transit (PAT), runs along Winston Churchill Drive as shown in the **Figure 1-21**. The two bus stops are located at the intersection of Winston Churchill Drive at Miles Avenue. Bus-stops are well connected with sidewalks. However, the lack of crosswalks across Winston Churchill Drive contributes to un-safe crossings by pedestrians to access the bus-stops. No benches or shelters are available at the bus-stops. There are no park and ride facilities within the vicinity of the study corridor.

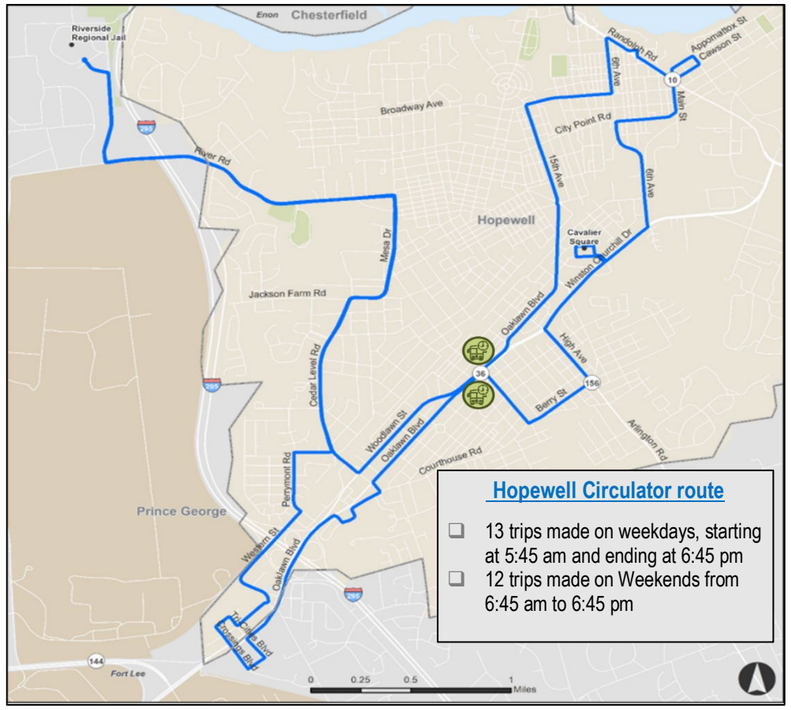


Figure 1-21. Transit Facilities

1.10 Equity Analysis

The Screening Tool for Equity Analysis of Projects (STEAP) is an extension of FHWA's HEPGIS web application that permits rapid screening of potential project locations anywhere in the United States to support Title VI, environment justice (EJ) & other socioeconomic data analyses. The tool provides estimates of the socioeconomic characteristics of the resident population surrounding a project location. The STEAP is directly accessible at HEPGIS Title VI Tool (dot.gov)[2] to identify the locations of underserved communities and facilitate conversations around the distribution of impacts and benefits from transportation projects.

Buffer analysis was performed for a half-mile radius to the project. The buffer area map is shown in **Figure 1-22** user-friendly formatted reports are included in **Appendix C**.

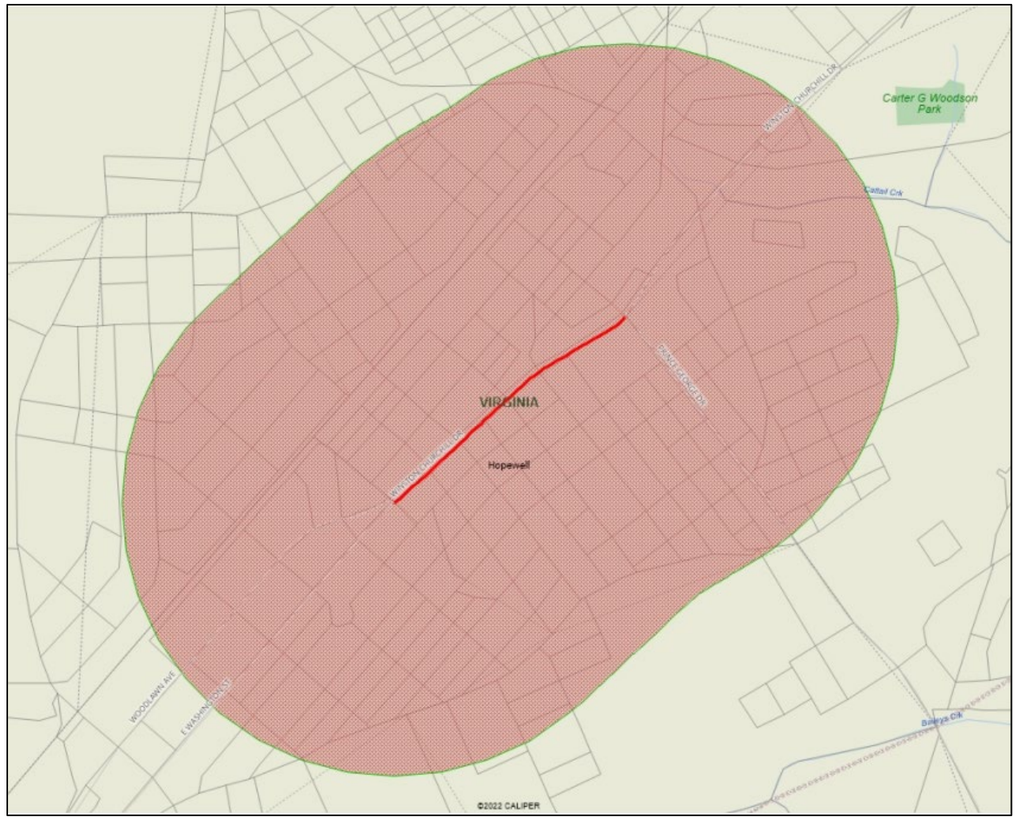


Figure 1-22. 0.5-mile Buffer Area for STEAP Analysis

[2] https://hepgis.fhwa.dot.gov/fhwagis/BufferTool/

1.11 Environmental Input

The environmental forms provide initial input into Project Pipeline project. It is to be noted that It does not represent the conclusion of environmental input for the given project but is designed to provide initial feedback and identify any resources, risks, or issues that the project team should be aware of early on.

During the initial input, no risks were identified. The environmental input forms signed by the District Environmental Manager are included in **Appendix D**.

Chapter 2: Alternative Development and Refinement

2.1 Traffic Forecasting

a. Background

The study corridor is defined as VA-36 (Winston Churchill Drive) from Miles Avenue to High Avenue in the City of Hopewell**. Figure 2-1** shows the location of the VA-36 / Winston Churchill Drive corridor within study limits. VA-36 (Winston Churchill Drive) is a four-lane divided roadway with a posted speed limit of 35 miles per hour (mph). The roadway is classified as "Other Principal Arterial" per the Virginia Department of Transportation (VDOT) Roadway Classification. The corridor provides access to numerous businesses and residential areas. Based on the VDOT's published 2021 Average Annual Daily Traffic (AADT) estimates, VA-36 (Winston Churchill Drive) carried an AADT of 14,000 vpd. For this study, VA-36 (Winston Churchill Drive) is assumed to be oriented in a north-south direction.

The study corridor includes three (3) signalized and three (3) unsignalized intersections.

1. VA-36 / Winston Churchill Drive at Miles Avenue – Signalized
2. VA-36 / Winston Churchill Drive at Roanoke Avenue – Unsignalized
3. VA-36 / Winston Churchill Drive at Sunnyside Avenue – Signalized
4. VA-36 / Winston Churchill Drive at Liberty Avenue – Unsignalized
5. VA-36 / Winston Churchill Drive at High Avenue – Signalized
6. Oaklawn Boulevard at High Avenue – Unsignalized

Existing condition analysis was conducted as a part of Phase 1 of the study, where the corridors existing conditions traffic operations and safety analysis were evaluated considering VTRANS needs. The next step in this study is to evaluate future conditions. Existing year (2023) traffic volumes will be projected for the future conditions analysis.

b. Traffic Forecasting Methodology

Projecting the traffic volumes at the study intersections to the design year with an appropriate growth rate is the first step in developing future conditions analysis. The methodology that was followed for development of this growth rate and recommendation of a future year is discussed below.

The following sources were reviewed to determine the growth rates to apply to the existing traffic volumes and grow to the future design year:

- *Pathways for Planning (P4P)*

The Pathways for Planning (P4P) is an internal VDOT database maintained by the Transportation Mobility and Planning Division (TMPD). P4P is easy-to-use with interactive mapping and data analysis web tool, which shows a variety of data including route classification systems, traffic characteristics, safety, improvements, and forecasts. Outputs from Pathways for Planning include historic data from 2009 through 2019 and projected future year volume data from 2030 to 2045 in 5-year increments. Historic Data was filtered to exclude 2020 through 2022 due to the Covid pandemic impacting traffic patterns and volumes. Linear growth rates for the study area were developed using the adjusted future year (2023-2045), and existing available count data.

- *Richmond/Tri-Cities (RTC) Regional Travel Demand Model*

The outputs from the RTC regional travel demand model, which used base year data for 2017 and future data for 2045, were utilized in combination with the National Cooperative Highway Research Program (NCHRP) Report 765: Analytical Travel Forecasting Approaches for Project-Level Planning and Design Methodology to develop annual growth rate. The RTC model was developed with a future year road network in cooperation with the PlanRVA (formerly Richmond Regional Planning District Commission (RRPDC) and the Tri-Cities Area Metropolitan Planning Organization (formerly Crater Planning District Commission (CPDC) to support the PlanRVA's 2045 Long Range Transportation Plan and other efforts.

- *Relevant Studies*

The adjacent studies were also taken into consideration for recommending growth rate for this study.

- *Existing Traffic Count Data*

Existing traffic data was collected in May of 2023. Turning movement counts were collected at every intersection along VA-36 (Winston Churchill Drive) between Miles Avenue and High Avenue, and tube counts were captured along the Study Corridor, between High Avenue and Stewart Avenue.

c. Future Year

The future design year is based on the purpose of the project. VDOT Traffic Forecasting Guidebook, Section 3.2 was used to recommend future year for this study. Per the guidance provided in this guidebook, projects that are potentially seeking funding from Virginia's SMART SCALE, the future horizon year needs to be selected considering the anticipated time frame for the project to enter the Six-Year Improvement Program (SYIP), plus the time for project design advertisement and construction. The future design year was determined by considering the following guidance provided in the Traffic Forecasting Guidebook as well as other considerations:

- For Corridor Studies the typical forecast horizon is 15-25 years.

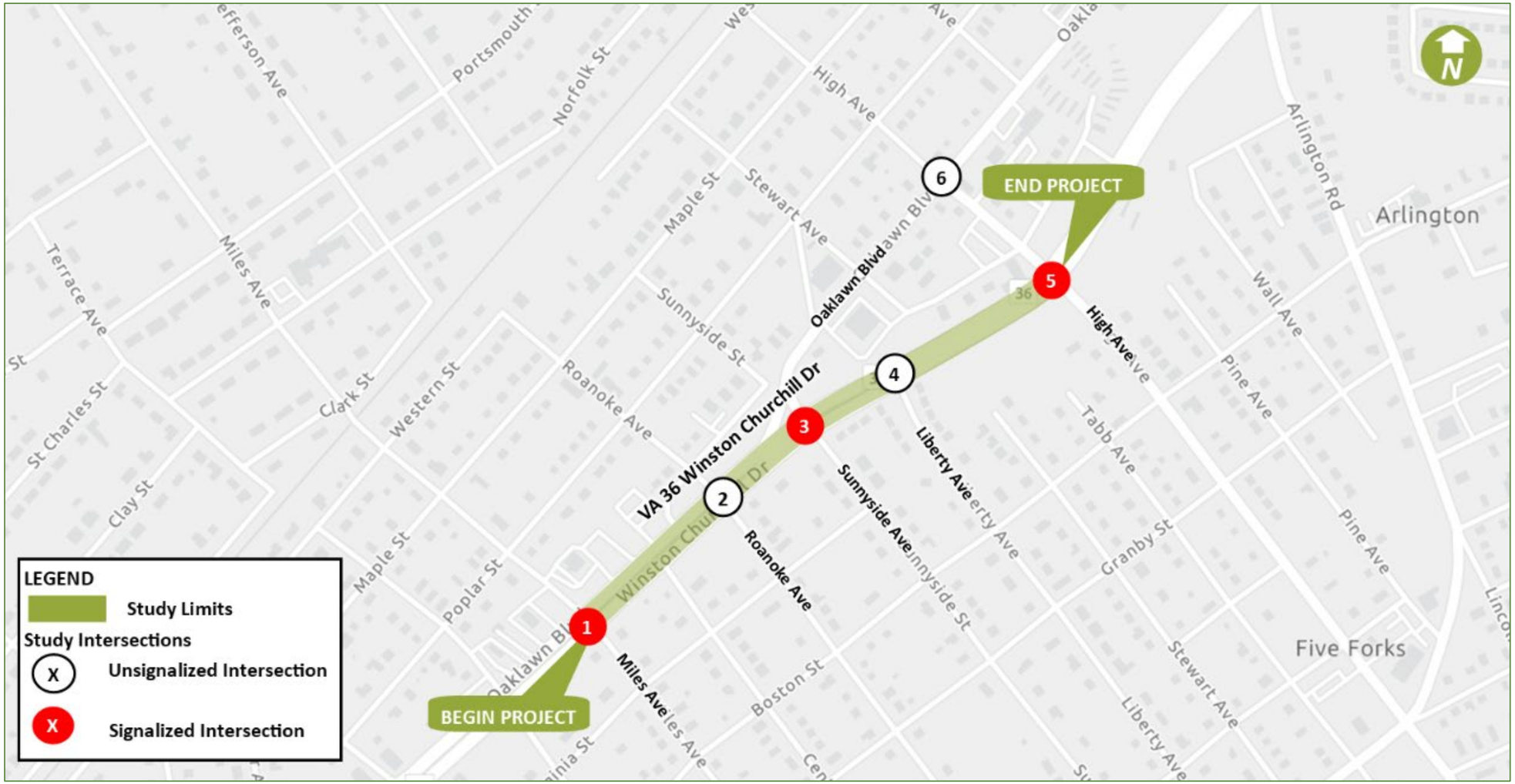


Figure 2-1: Study Area Map

d. Average Annual Growth Rate (AAGR)

Pathways for Planning (P4P):

The annual historical volumes were analyzed in VDOT Pathways for Planning (P4P) tool from 2009 through 2019 to determine the annual average growth rate. Historic volumes for years 2020 through 2022 were excluded from this analysis to account for the effects of Covid pandemic on traffic patterns and volumes. The trend of historic volumes is illustrated in **Figure 2-2**.

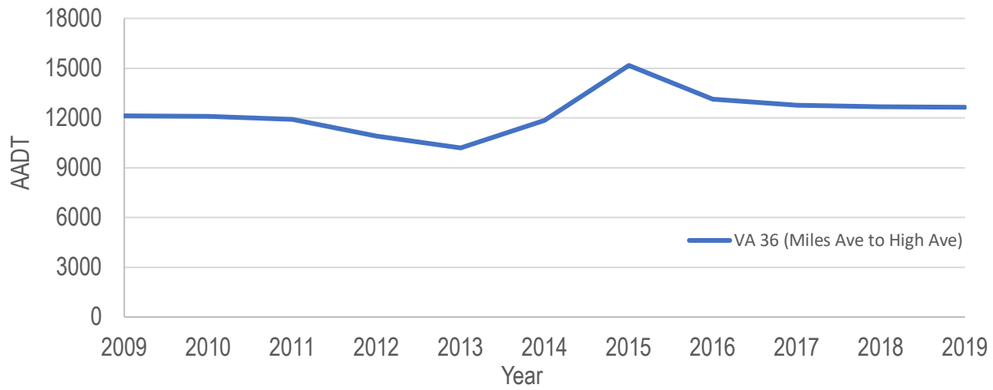


Figure 2-2: Historical Traffic Volumes (2009-2019)

Table 2-1 shows the annual average growth rate obtained from the VDOT P4P tool for the study corridor.

Table 2-1: VDOT P4P Growth Rate

Roadway Segment	Annual Average Growth Rate
VA-36 / Winston Churchill Drive (Miles Avenue to High Avenue)	**1.32%**

The analysis of the trend of historic volumes along VA-36 (Winston Churchill Drive) suggests the following:

- Positive growth along the study corridor (1.32%).
- The side streets exhibited a minimal growth in traffic volumes over the period.
- The highest volumes were recorded south of Miles Avenue and the lowest volumes were recorded north of High Avenue.

RTC Regional Travel Demand Model:

The all-day traffic volumes extracted from the RTC model within the study corridor were checked for adequacy and post-process to eliminate any inconsistencies. The adjusted growth rates were calculated using the Ratio and Difference (or Delta) method according to VDOT Traffic Forecasting Guidebook Version 1.1. **Table 2-2** shows the adjusted growth rates obtained using the Ratio and Delta method from RTC model outputs.

Table 2-2: RTC Regional Travel Demand Model Adjusted Growth Rate

Roadway		2017 AADT (VDOT)	TDM Output		Difference	Annual Growth Rate (Raw)	2045 Adjusted			Difference	Adjusted Growth Rate
From	To		2017	2045	(2045-2017)	Linear	Δ	Ratio	AADT	(2045-2017)	Linear
VA-36 (Winston Churchill Dr) between											
Miles Ave	Central Ave	12770	14,000	15,200	1,200	0.31%	13,970	13865	13,917	1,147	**0.32%**
Central Ave	Oaklawn Blvd	12770	13,800	14,800	1,000	0.26%	13,770	13695	13,733	963	**0.27%**
Oaklawn Blvd	High Ave	12770	9,400	10,500	1,100	0.42%	13,870	14264	14,067	1,297	**0.36%**

Based on the TDM outputs as shown in **Table 2-2**, positive growth is predicted along the study corridor. However, the TDM growth rates are significantly lower than the growth rate observed from historic volumes analyzed from VDOT P4P.

Relevant Studies:

In addition, approved adjacent STARS study, Oaklawn Boulevard/Route 36 Corridor Improvement study from Route 36 & Route 144/Temple Avenue Off-Ramp to Route 36 & Jefferson Park Road located in both the City of Hopewell and Prince George County was also taken into consideration for recommending growth rate. The growth rate of 2.5% was applied to the Route 36 corridor for forecasting future traffic volumes.

e. Recommendations

Future Year: Based on VDOT Traffic Forecasting Guidebook Section 3.2, Pathways for Planning, and similar planning studies in the City of Hopewell, the study team recommends using 2052 as the future design year.

Annual Average Growth Rate:
The growth rates determined from VDOT P4P, TDM, and the growth rate applied in the adjacent study, Oaklawn Boulevard/Route 36 Corridor Improvement Study are significantly different. The land use between the adjacent study and the study corridor is completely different. Land use for Route 36 in the adjacent study is commercial land use, while the VA-36 (Winston Churchill Drive) corridor is residential land use, therefore the growth rate cannot be directly adopted. The recommended growth rate was determined based on the observed trends in historic volumes, TDM adjusted growth rates, and approved relevant studies in the area. The recommended growth rate is 1.0% to be more conservative in forecasting the annual traffic growth for the study corridor.

- **VA-36 (Winston Churchill Drive): Miles Avenue to High Avenue 1.0%**

Using the recommended design year of 2052 and the recommended growth rate of 1.0%, the existing 2023 and projected 2052 AADTs are summarized in **Table 2-3.**

Table 2-3: Existing Tube Counts and Projected AADTs

Roadway Segment	AADT	
	Existing 2023 AADT	Future 2052 AADT
VA-36 / Winston Churchill Drive (Miles Avenue to High Avenue)	12,867	17,171

f. Future Year 2052 Forecast

Design year volumes were calculated by applying the recommended growth rate to the existing volumes and balanced through the corridor. The volume diagram for 2052 is attached in **Appendix E**.

2.2 Alternative Development and Refinement

In order to develop alternative concepts to address the needs and incorporate the diagnosis identified in Chapter 1, a thorough review of the existing conditions data was conducted. For the signalized intersection, a VDOT's Junction Screening Tool (VJuST) was utilized to evaluate innovative intersection configurations along the study corridor. VJuST is a screening tool that helps in the decision-making process of identifying innovative intersection and interchange configurations that are most appropriate in reducing congestion (measured in volume/capacity ratio) and improving safety (measured in conflict points) to advance to further study, analysis, and design. Pedestrian and safety considerations were evaluated along the study corridor.

a. Future Year 2052 No-Build Operational Analysis

A future year 2052 no-build analysis was performed for the VA-36 / Winston Churchill Drive corridor utilizing the 2052 volumes developed in Section 2.1. Synchro 11 was utilized to evaluate the average intersection delay per vehicle, level of service (LOS), and queue lengths. **Appendix F** provides the Synchro output reports. For the future no-build conditions, cycle length, splits, and offsets were optimized. The Synchro analysis results for the 2052 no-build conditions, presented in **Table 2-4**, indicate that:

1. VA-36 / Winston Churchill Drive at Miles Avenue will operate, overall, at LOS B during both the AM and PM peak hours. All eastbound and westbound movements will operate at LOS C during both the AM and PM peak hours.
2. VA-36 / Winston Churchill Drive at Roanoke Avenue will operate, overall, at LOS C for both the AM and PM peak hours. Westbound movements will operate at LOS C / B during the AM / PM peak hours, respectively. Eastbound movements will operate at LOS C during the PM peak hours.
3. VA-36 / Winston Churchill Drive at Sunnyside Avenue will operate, overall, at LOS B during both the AM and PM peak hours. The westbound movements operate, overall, at LOS C during both the AM and PM peak hours. The northbound movements operate at LOS B / C during the AM / PM peak hours, respectively.
4. VA-36 / Winston Churchill Drive at Liberty Avenue operates, overall, at LOS B during both the AM and PM peak hours. Westbound movements operate at LOS B during both the AM and PM peak hours.
5. VA-36 / Winston Churchill Drive at High Avenue operates, overall, at LOS C / D during the AM / PM peak hours, respectively. The southbound left turn movement operates at LOS F during the PM peak hours. All northbound movements operate at LOS C during both the AM and PM peak hours.
6. High Avenue at Oaklawn Boulevard operates, overall, at LOS B / C during the AM / PM peak hours, respectively. Both the eastbound and westbound movements operate at LOS B / C during the AM / PM peak hours, respectively.

Table 2-4: VA-36 / Winston Churchill Drive- 2052 No Build Conditions Intersection Analysis Results

Intersection Number	Intersection Name	Movement	Storage length (ft)	AM									PM								
				Volume	Movement				Approach		Intersection		Volume	Movement				Approach		Intersection	
					Average Queue (ft)	95th Percentile Queue (ft)	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS		Average Queue (ft)	95th Percentile Queue (ft)	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
1	VA-36 / Winston Churchill Drive & Miles Avenue ***(Signalized)***	EBL	80	80	39	80	31.9	C	30.7	C	16.8	B	105	50	97	32.2	C	30.5	C	17.5	B
		EBT		45	21	75	30.2	C					45	20	69	29.3	C				
		EBR		125									110								
		WBL	80	25	12	34	29.5	C	29.4	C			25	11	32	28.5	C	28.6	C		
		WBT		50	24	59	29.4	C					50	22	55	28.6	C				
		WBR		20									15								
		NBL	200	65	10	28	5.1	A	7.5	A			135	20	51	7.1	A	9	A		
		NBT		600	38	108	7.7	A					835	52	145	9.3	A				
		NBR		15									15								
		SBL	130	15	2	10	14.6	B	19.1	B			20	3	12	13.8	B	21.3	C		
		SBT		610	100	150	19.2	B					930	153	225	21.4	C				
		SBR		90									110								
2	VA-36 / Winston Churchill Drive & Roanoke Avenue ***(Stop Controlled)***	EBL		0					9.8	A	17.8	C	5					15.9	C	15.9	C
		EBT		0		1	9.8	A					0		2	15.9	C				
		EBR		10									5								
		WBL		5					17.8	C			5					14.5	B		
		WBT		0		3	17.8	C					0		2	14.5	B				
		WBR		5									5								
		NBL	100	10					0.1				25					0.3			
		NBT		685		1	9.5	A					925		3	10.2	B				
		NBR		5									5								
		SBL	80	10					0.1				5					0			
		SBT		700		1	9.3	A					1050		0	9.5	A				
		SBR		5									10								

Intersection Number	Intersection Name	Movement	Storage length (ft)	AM									PM								
				Volume	Movement				Approach		Intersection		Volume	Movement				Approach		Intersection	
					Average Queue (ft)	95th Percentile Queue (ft)	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS		Average Queue (ft)	95th Percentile Queue (ft)	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
3	VA-36 / Winston Churchill Drive & Sunnyside Avenue ***(Signalized)***	EBL	90	0	0	0	0	A					5	0	0	23.1	C				
		EBT		0	0	23	0	A	0				5	86	181	0	A	23.1			
		EBR		240	0	0	0						340	0	0	0					
		WBL		10	0	0	23.5	C					5	0	0	23.2	C				
		WBT		10	9	30	0	A	23.5	C			5	4	19	0	A	23.2	C		
		WBR		5	0	0	0	A					5	0	0	0	A				
		NBL		180	65	180	17.8	B					305	148	#400	40.4	D				
		NBT		505	87	174	15.4	B	16	B	14.1	B	610	103	202	15.5	B	23.7	C	18.6	B
		NBR		5	0	0	15.4	B					20	0	0	15.5	B				
		SBL	100	5	2	7	11.5	B					5	1	6	11.6	B				
		SBT		465	78	108	10.9	B	10.9	B			720	124	163	11.9	B	11.9	B		
		SBR		0	0	0	0	A					0	0	0	0	A				
4	VA-36 / Winston Churchill Drive & Liberty Avenue ***(Stop Controlled)***	EBL		0									0								
		EBT		0									0								
		EBR		0									0								
		WBL		5									5								
		WBT		0		1	10.2	B	10.2	B			0		1	10.9	B	10.9	B		
		WBR		5									0								
		NBL		0							10.2	B	0							10.9	B
		NBT		510					0				610					0			
		NBR		0									10								
		SBL	170	5									10								
		SBT		465		0	8.4	A	0.1				720		1	8.5	A	0.1			
		SBR		0									0								

Intersection Number	Intersection Name	Movement	Storage length (ft)	AM								PM							
				Volume	Movement				Approach		Intersection		Volume	Movement				Approach		Intersection	
					Average Queue (ft)	95th Percentile Queue (ft)	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS		Average Queue (ft)	95th Percentile Queue (ft)	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
5	VA-36 / Winston Churchill Drive & High Avenue *(Signalized)*	EBL		0					10.5	B	22.5	C	10					13.2	B	38	D
		EBT		50	15	37	10.5	B					95	34	68	13.3	B				
		EBR	70	0									15			12.3	B				
		WBL		115	21	44	5.9	A	6.6	A			115	23	44	6.7	A	7.7	A		
		WBT	500	50	9	22	5.4	A					55	11	24	6.2	A				
		WBR	100	40	0	1	10.3	B					40	0	2	12.5	B				
		NBL	175	10	4	16	22.4	C	25.5	C			20	8	28	24.2	C	23.8	C		
		NBT		385	86	128	26.5	C					410	95	137	24.7	C				
		NBR	200	120	0	38	22.5	C					180	0	45	21.7	C				
		SBL	155	95	41	#96	34.1	C	27.6	C			200	~127	#252	151.7	F	60	E		
		SBT		355	79	119	25.9	C					600	155	212	30.4	C				
		SBR		5									20								
6	High Avenue & Oaklawn Boulevard *(Stop Controlled)*	EBL		0					13.3	B	13.3	B	5					18.7	C	18.7	C
		EBT		5		2	13.3	B					5		4	18.7	C				
		EBR		5									5								
		WBL		5					11.2	B			25					16	C		
		WBT		5		11	11.2	B					10		23	16	C				
		WBR		55									60								
		NBL		0					0				10					0.4			
		NBT		185		0	0						270		1	0.4	A				
		NBR		0									25								
		SBL		45					1.5				90					2.4			
		SBT		255		3	1.5	A					315		6	2.4	A				
		SBR		5									10								

b. VJuST Screening

VDOT has established the Virginia Intersection and Interchange Control Assessment Program (iCAP) to efficiently and holistically screen intersection and interchange alternatives. Virginia iCAP provides the framework to determine the type of intersection or interchange configuration that provides the best value to enhance traffic operations, improve safety, access management, and accommodate all modes of travel. The program brings consistency, transparency, and objectivity to the decision-making process.

As part of iCAP screening, VDOT's Junction Screening Tool (VJuST) was used to evaluate innovative intersection configurations at specific locations along the study corridor. The intent of using this tool was to identify innovative intersection configurations that have the potential for reducing congestion and improving safety. Congestion results are based on existing peak hour volumes and the number of lanes and lane configurations, while safety results are based on conflict points. Results from the tool are not meant to replicate results obtained from more detailed traffic operations, safety, and design analyses.

Given the operational and safety needs of the study corridor, multiple innovative designs were screened using the VJuST screening tool. The results, presented in **Table 2-5, Table 2-6**, and **Table 2-7**, indicate that:

- The VA-36 / Winston Churchill Drive at Miles Avenue intersection is expected to operate better as a Full Displaced Left Turn, Median U-Turn, Partial Displaced Left Turn, Partial Median U-Turn, and Restricted Crossing U-Turn than as a conventional intersection. Additionally, 2 of these alternatives will have a positive impact in pedestrian accommodation levels.
- The VA-36 / Winston Churchill Drive at Sunnyside Avenue intersection is expected to operate better as a Full Displaced U-Turn, Restricted Crossing U-Turn, and Thru-Cut than as a conventional intersection.
- The VA-36 / Winston Churchill Drive at High Avenue intersection is expected to operate better as a Partial Displaced Left Turn, Partial Median U-Turn, and Restricted Crossing U-Turn than as a conventional intersection. A Median U-Turn and Partial Median U-Turn will have a positive impact in pedestrian accommodation levels, whereas a Partial Displaced Left Turn will have a negative impact.

Table 2-5: VA-36 / Winston Churchill Drive at Miles Avenue VJuST Analysis Results

Type	Dir	Maximum V/C	Accommodation Compared to Conventional	Weighted Total Conflict Points
Conventional	-	0.45		48
Full Displaced Left Turn	-	0.40	-	40
Median U-Turn	-	0.43	+	20
Partial Displaced Left Turn	-	0.40	-	44
Partial Median U-Turn	-	0.39	+	28
Restricted Crossing U-Turn	-	0.33		20
Thru-Cut	-	0.86		28
Roundabout	-	0.50		8

Table 2-6: VA-36 / Winston Churchill Drive at Sunnyside Avenue VJuST Analysis Results

Type	Dir	Maximum V/C	Accommodation Compared to Conventional	Weighted Total Conflict Points
Conventional	-	0.45		48
Full Displaced Left Turn	-	0.44	-	40
Median U-Turn	-	0.61	+	20
Partial Displaced Left Turn	-	0.49	-	44
Partial Median U-Turn	-	0.48	+	28
Restricted Crossing U-Turn	-	0.44		20
Thru-Cut	-	0.26		28
Roundabout	-	0.48		8

Table 2-7: VA-36 / Winston Churchill Drive at High Avenue VJuST Analysis Results

Type	Dir	Maximum V/C	Accommodation Compared to Conventional	Weighted Total Conflict Points
Conventional	-	0.45		48
Median U-Turn	-	0.46	+	20
Partial Displaced Left Turn	-	0.30	-	44
Partial Median U-Turn	-	0.39	+	28
Restricted Crossing U-Turn	-	0.43		20
Thru-Cut	-	0.56		28
Roundabout	-	0.82		8

c. Build Concepts

Based on the findings from the existing conditions assessment performed for the study area and VJuST analysis completed for the intersections, potential options were developed, and a screen-level analysis were performed at the study corridor. Options were selected based on how well they addressed specific operational, queueing, and safety issues. All the options include elements such as bike lane, sidewalk, and high-visibility crosswalks that would improve pedestrian and bicycle safety and accessibility in the study area. The build concepts are included in **Appendix G**.

Option 1 consists of conventional improvements for all intersections. Specifics are as follows:

1. VA-36 / Winston Churchill Drive and Miles Avenue – Signal timing improvements, crosswalks on all approaches, pedestrian push buttons and pedestrian intervals, enhanced intersection lighting.
2. VA-36 / Winston Churchill Drive and Roanoke Avenue – Right-in/right-out, crosswalks along VA-36, ADA compliant ramps, enhanced intersection lighting.
3. VA-36 / Winston Churchill Drive and Sunnyside Avenue – Signal timing improvements, crosswalks on all approaches, pedestrian push buttons and pedestrian intervals, enhanced intersection lighting.
4. VA-36 / Winston Churchill Drive and Liberty Avenue – Right-in/right-out, crosswalks along VA-36, ADA compliant ramps, enhanced intersection lighting.
5. VA-36 / Winston Churchill Drive and High Avenue – Signal timing improvements, crosswalks on all approaches, pedestrian push buttons and pedestrian intervals.
6. High Avenue and Oaklawn Boulevard – Improved crosswalks across Oaklawn Boulevard, ADA compliant ramps, enhanced intersection lighting.

Option 2 is as follows:

1. VA-36 / Winston Churchill Drive and Miles Avenue – Median U-Turn along Winston Churchill Drive (NB/SB) only.
2. VA-36 / Winston Churchill Drive and Roanoke Avenue – Same as Option 1
3. VA-36 / Winston Churchill Drive and Sunnyside Avenue – Roundabout, pedestrian crossings across all legs, ADA compliant ramps, Rectangular Rapid Flashing Beacon (RRFB).
4. VA-36 / Winston Churchill Drive and Liberty Avenue – Same as Option 1
5. VA-36 / Winston Churchill Drive and High Avenue – Median U-Turn along Winston Churchill Drive (NB/SB) only.
6. High Avenue and Oaklawn Boulevard – Same as Option 1

Option 3 is as follows:

1. VA-36 / Winston Churchill Drive and Miles Avenue – Roundabout, pedestrian crossings across all legs, ADA compliant ramps, RRFB.
2. VA-36 / Winston Churchill Drive and Roanoke Avenue – Same as Option 1
3. VA-36 / Winston Churchill Drive and Sunnyside Avenue – Median U-Turn along Winston Churchill Drive (NB/SB) only.
4. VA-36 / Winston Churchill Drive and Liberty Avenue – Same as Option 1
5. VA-36 / Winston Churchill Drive and High Avenue – Roundabout, pedestrian crossings across all legs, ADA compliant ramps, RRFB.
6. High Avenue and Oaklawn Boulevard – Roundabout, pedestrian crossings across all legs, ADA compliant ramps, RRFB.

d. Build Operational Analysis

Synchro 11 was utilized to evaluate the average intersection delay per vehicle, level of service (LOS) and queue lengths. The Synchro output reports are provided in **Appendix H.** The 2052 no-build model was modified to develop the build concepts in Synchro. Cycle lengths, offsets, and phase splits were optimized as deemed necessary.

The operational analysis results for **Build Option 1**, presented in **Table 2-8** below, can be summarized as follows:

1. The intersection of VA-36 / Winston Churchill Drive and Miles Avenue will not improve when compared to the no-build, it will operate at LOS C rather than LOS B. All the left turn movements, for both AM and PM will operate at LOS D or E. East and westbound thru movements will continue to operate at LOS C.
2. The intersection of VA-36 / Winston Churchill Drive and Roanoke Avenue will now operate at LOS B during both the AM and PM peak hours, rather than LOS C. All the delays decrease when comparing this option to the no-build. For example, the delay of the eastbound thru movement during the PM peak hours will decrease from 15.9 sec/veh to 10.9 sec/veh.
3. The intersection of VA-36 / Winston Churchill Drive and Sunnyside Avenue will operate at LOS C rather than LOS B. The northbound and southbound left-turn movements will now operate at LOS D or E.
4. The intersection of VA-36 / Winston Churchill Drive and Liberty Avenue will continue to operate at LOS B for both AM and PM peak hours.
5. The intersection of VA-36 / Winston Churchill Drive and High Avenue will operate at LOS C during both the AM and PM peal hours. This is an improvement from the intersection operating at LOS D during PM peak hours. The southbound left-turn movement delay during the PM peak hours will be reduced 151.7 sec/veh to 47.6 sec/veh, therefore changing the LOS from F to D.
6. The intersection of High Avenue and Oaklawn Boulevard will continue to operate at LOS B during AM and LOS C during PM Peak hours. The delays will remain relatively unchanged.

Table 2-8: VA-36 / Winston Churchill Drive - 2052 Build Option 1 Intersection Analysis Results

Intersection Number	Intersection Name	Movement	Storage length (ft)	AM								PM							
				Volume	Movement				Approach		Intersection		Volume	Movement				Approach		Intersection	
					Average Queue (ft)	95th Percentile Queue (ft)	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS		Average Queue (ft)	95th Percentile Queue (ft)	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
1	VA-36 / Winston Churchill Drive & Miles Avenue ***(Signalized)***	EBL	80	80	41	105	42.1	D	27.6	C	23.3	C	105	59	134	53.5	D	37.1	D	26.6	C
		EBT		45	15	70	20.8	C					45	17	71	26	C				
		EBR		125									110								
		WBL	80	25	13	44	44.9	D	29.1	C			25	14	46	51.2	D	35.8	D		
		WBT		50	23	59	23.4	C					50	27	62	29.9	C				
		WBR		20									15								
		NBL	200	65	33	89	38.9	D	20	C			135	74	163	41.6	D	21.4	C		
		NBT		600	68	178	18.1	B					835	96	238	18.2	B				
		NBR		15									15								
		SBL	130	15	7	31	66.1	E	24.2	C			20	11	39	47.8	D	28	C		
		SBT		610	110	200	23.3	C					930	187	319	27.6	C				
		SBR		90									110								
2	VA-36 / Winston Churchill Drive & Roanoke Avenue ***(Stop-Controlled)***	EBL		0					8.7	A	12.2	B	5					10.9	B	10.9	B
		EBT		0		1	8.7	A					0		1	10.9	B				
		EBR		10									5								
		WBL		5					12.2	B			5					10.2	B		
		WBT		0		2	12.2	B					0		1	10.2	B				
		WBR		5									5								
		NBL	100	10					0.1				25					0.2			
		NBT		685		1	9.1	A					925		2	9.2	A				
		NBR		5									5								
		SBL	80	10					0.1				5					0			
		SBT		700		1	8.8	A					1050		0	9.1	A				
		SBR		5									10								

Intersection Number	Intersection Name	Movement	Storage length (ft)	AM									PM								
				Volume	Movement				Approach		Intersection		Volume	Movement				Approach		Intersection	
					Average Queue (ft)	95th Percentile Queue (ft)	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS		Average Queue (ft)	95th Percentile Queue (ft)	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
3	VA-36 / Winston Churchill Drive & Sunnyside Avenue ***(Signalized)***	EBL	90	0	0	0	0	0	18.5	B	27.9	C	5	0	0	0	0	23.3	C	32.4	C
		EBT		0	0	0	0	0					5	4	15	21.3	C				
		EBR		240	0	0	18.5	B					340	0	57	23.3	C				
		WBL		10	0	0	0	0	17.3	B			5	0	0	0	0	21.4	C		
		WBT		10	7	22	17.3	B					5	4	17	21.4	C				
		WBR		5	0	0	0	0					5	0	0	0	0				
		NBL		180	98	#209	67.4	E	31.7	C			305	177	#322	68.9	E	34.2	C		
		NBT		505	92	187	19.1	B					610	110	212	17.4	B				
		NBR		5	0	0	0	0					20	0	0	0	0				
		SBL	100	5	3	14	43.1	D	27.6	C			5	3	13	47.6	D	34.8	C		
		SBT		465	121	173	27.4	C					720	216	#312	34.7	C				
		SBR		0	0	0	0	0					0	0	0	0	0				
4	VA-36 / Winston Churchill Drive & Liberty Avenue ***(Stop-Controlled)***	EBL		0							10.1	B	0							11.3	B
		EBT		0									0								
		EBR		0									0								
		WBL		5					10.1	B			5					11.3	B		
		WBT		0		1	10.1	B					0		1	11.3	B				
		WBR		5									0								
		NBL		0					0				0					0			
		NBT		510									610								
		NBR		0									10								
		SBL	170	5					0.1				10					0.1			
		SBT		465		0	8.3	A					720		1	8.5	A				
		SBR		0									0								

Intersection Number	Intersection Name	Movement	Storage length (ft)	AM								PM							
				Volume	Movement				Approach		Intersection		Volume	Movement				Approach		Intersection	
					Average Queue (ft)	95th Percentile Queue (ft)	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS		Average Queue (ft)	95th Percentile Queue (ft)	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
5	VA-36 / Winston Churchill Drive & High Avenue ***(Signalized)***	EBL		0					30.8	C	30.8	C	10					32.4	C	24.9	C
		EBT		50	27	54	30.8	C					95	51	100	32.9	C				
		EBR	70	0									15	0	0	29	C				
		WBL		115	55	126	31	C	22.8	C			115	61	#157	34.8	C	26.8	C		
		WBT	500	50	15	37	12.4	B					55	19	45	17.3	B				
		WBR	100	40	0	0	12.1	B					40	0	0	16.8	B				
		NBL	175	10	6	24	61.7	E	36.1	D			20	10	37	59.3	E	28	C		
		NBT		385	112	160	37	D					410	102	170	28	C				
		NBR	200	120	0	39	30.8	C					180	0	51	24.4	C				
		SBL	155	95	58	#137	40.4	D	28.4	C			200	106	#263	32.9	C	20.9	C		
		SBT		355	81	145	25.2	C					600	107	227	17.1	B				
		SBR		5									20								
6	High Avenue & Oaklawn Boulevard ***(Stop-Controlled)***	EBL		0					13.3	B	13.3	B	5					18.6	C	18.6	C
		EBT		5		2	13.3	B					5		4	18.6	C				
		EBR		5									5								
		WBL		5					11.3	B			25					16.2	C		
		WBT		5		11	11.3	B					10		24	16.2	C				
		WBR		55									60								
		NBL		0					0				10					0.4			
		NBT		185		0	0	0					270		1	0.4	A				
		NBR		0									25								
		SBL		45					1.5				90					2.4			
		SBT		255		3	1.5	A					315		6	2.4	A				
		SBR		5									10								

The operational analysis results for **Build Option 2**, presented in **Table 2-9** below, can be summarized as follows:

1. The intersection of VA-36 / Winston Churchill Drive and Miles Avenue will continue to operate at LOS B. The westbound left-turn movement will operate at LOS D for both the AM and PM peak hours. East and westbound thru movements will improve to operating at LOS B.
2. The intersection of VA-36 / Winston Churchill Drive and Roanoke Avenue will now operate at LOS B during both the AM and PM peak hours, rather than LOS C. All the delays decrease when comparing this option to the no-build. For example, the delay of the westbound thru movement during the AM peak hours will decrease from 17.8 sec/veh to 8.7 sec/veh.
3. The intersection of VA-36 / Winston Churchill Drive and Sunnyside Avenue will operate at LOS A rather than LOS B. The northbound left-turn movement will no longer operate at LOS D, but rather LOS B during the PM peak hours. The delay for that movement will decrease from 40.4 sec/veh to 10.5 sec/veh.
4. The intersection of VA-36 / Winston Churchill Drive and Liberty Avenue will continue to operate at LOS B for both the AM and PM peak hours.
5. The intersection of VA-36 / Winston Churchill Drive and High Avenue will operate at LOS C during both the AM and PM peak hours. This is an improvement from the intersection operating at LOS D during the PM peak hour. The westbound left-turn movement will now operate at LOS D during the PM peak hours.
6. The intersection of High Avenue and Oaklawn Boulevard will continue to operate at LOS B / C during the AM / PM peak hours, respectively. The delays will remain relatively unchanged.

Table 2-9: VA-36 / Winston Churchill Drive - 2052 Build Option 2 Intersection Analysis Results

Intersection Number	Intersection Name	Movement	Storage length (ft)	AM									PM								
				Volume	Movement				Approach		Intersection		Volume	Movement				Approach		Intersection	
					Average Queue (ft)	95th Percentile Queue (ft)	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS		Average Queue (ft)	95th Percentile Queue (ft)	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
1	VA-36 / Winston Churchill Drive & Miles Avenue *(Signalized)*	EBL	80	80	27	77	27	C	16.4	B	18.3	B	105	42	103	35.3	D	23.4	C	17.9	B
		EBT		45	8	44	11.5	B					45	10	50	15.3	B				
		EBR		125									110								
		WBL	80	25	9	35	37.5	D	20.2	C			25	10	37	48.2	D	26.8	C		
		WBT		50	14	39	14	B					50	17	44	18.7	B				
		WBR		20									15								
		NBL	200	0	0	0	0	0	17.7	B			0	0	0	0	0	16.3	B		
		NBT		665	74	145	17.7	B					970	112	201	16.3	B				
		NBR		30									35								
		SBL	130	0	0	0	0	0	19.2	B			0	0	0	0	0	17.4	B		
		SBT		635	77	154	19.2	B					950	121	220	17.4	B				
		SBR		155									245								
2	VA-36 / Winston Churchill Drive & Roanoke Avenue *(Stop-Controlled)*	EBL		0					10	B	10	B	0					10.9	B	10.9	B
		EBT		0		1	10	B					0		1	10.9	B				
		EBR		10									10								
		WBL		0					8.7	A			0					8.7	A		
		WBT		0		1	8.7	A					0		1	8.7	A				
		WBR		10									10								
		NBL	100	0					0				0					0			
		NBT		695		0	0	0					950		0	0	0				
		NBR		5									5								
		SBL	80	0					0				0					0			
		SBT		715		0	0	0					1050		0	0	0				
		SBR		5									35								

Intersection Number	Intersection Name	Movement	Storage length (ft)	AM									PM								
				Volume	Movement				Approach		Intersection		Volume	Movement				Approach		Intersection	
					Average Queue (ft)	95th Percentile Queue (ft)	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS		Average Queue (ft)	95th Percentile Queue (ft)	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
3	VA-36 / Winston Churchill Drive & Sunnyside Avenue ***(Roundabout)***	EBL	90	0		46.4	8.6	A	4.2	A	2.1	A	5		82.9	10.5	B	6.1	A	2.7	A
		EBT		10		46.4	7	A					10		82.9	8.9	A				
		EBR		240		46.4	4.1	A					340		82.9	6	A				
		WBL		10		3.6	13.4	B	9.5	A			0		1.9	13	B	8.7	A		
		WBT		10		3.6	6.8	A					5		1.9	6.5	A				
		WBR		5		3.6	6.9	A					10		1.9	6.6	A				
		NBL		180		36.1	11.7	B	1.6	A			305		54.2	12.2	B	2.1	A		
		NBT		515		36.4	1.5	A					610		55.7	2	A				
		NBR		5		36.4	2.3	A					20		55.7	2.8	A				
		SBL	100	0		49.8	5.2	A	1.4	A			5		62	5.2	A	1.8	A		
		SBT		465		50	0	A					720		62.6	0.1	A				
		SBR		0		50	3.9	A					0		62.6	3.9	A				
4	VA-36 / Winston Churchill Drive & Liberty Avenue ***(Stop-Controlled)***	EBL		0							10	B	0							10.5	B
		EBT		0									0								
		EBR		0									0								
		WBL		0					10.4	B			5					10.5	B		
		WBT		0		1	10.4	B					0		1	10.5	B				
		WBR		10									0								
		NBL		0					0				0					0			
		NBT		515									610								
		NBR		10									10								
		SBL	170	0					0				10					0			
		SBT		470		0	0	0					720		0	0	0				
		SBR		0									0								

Intersection Number	Intersection Name	Movement	Storage length (ft)	AM									PM								
				Volume	Movement				Approach		Intersection		Volume	Movement				Approach		Intersection	
					Average Queue (ft)	95th Percentile Queue (ft)	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS		Average Queue (ft)	95th Percentile Queue (ft)	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
5	VA-36 / Winston Churchill Drive & High Avenue *(Signalized)*	EBL		0					15.4	B	25.5	C	10					17.9	B	25	C
		EBT		50	14	34	15.4	B					95	45	83	18.1	B				
		EBR	70	0									15	0	0	16.8	B				
		WBL		115	52	#113	25.8	C	16.9	B			115	66	121	52.1	D	32.9	C		
		WBT	500	50	9	21	5.4	A					55	16	34	9.8	A				
		WBR	100	40	0	10	5.3	A					40	0	15	9.5	A				
		NBL	175	0	0	0	0	0	27.8	C			0	0	0	0	0	20.9	C		
		NBT		405	83	126	27.1	C					450	90	132	20.4	C				
		NBR	200	215	0	50	29.3	C					380	0	44	21.5	C				
		SBL	155	0	0	0	0	0	27.2	C			0	0	0	0	0	28.1	C		
		SBT		450	98	146	27.2	C					800	221	290	28.1	C				
		SBR		15									40								
6	High Avenue & Oaklawn Boulevard *(Stop-Controlled)*	EBL		0					13.3	B	13	B	5					18.6	C	18.6	C
		EBT		5		2	13.3	B					5		4	18.6	C				
		EBR		5									5								
		WBL		5					11.3	B			25					16.2	C		
		WBT		5		11	11.3	B					10		24	16.2	C				
		WBR		55									60								
		NBL		0					0				10					0.4			
		NBT		185		0	0	0					270		1	0.4	A				
		NBR		0									25								
		SBL		45					1.5				90					2.4			
		SBT		255		3	1.5	A					315		6	2.4	A				
		SBR		5									10								

The operational analysis results for **Build Option 3**, presented in **Table 2-10** below, can be summarized as follows:

1. The intersection of VA-36 / Winston Churchill Drive and Miles Avenue will operate at LOS A rather than LOS B. All westbound movements will operate at LOS A during both the AM and PM peak hours. The delays will drop significantly for all movements. The overall delays for the AM / PM peak hours will drop from 16.8 sec/veh / 17.5 sec/veh to 2.7 sec/veh / 2.9 sec/veh, respectively. This is an 84% reduction in the delays for both peak periods.
2. The intersection of VA-36 / Winston Churchill Drive and Roanoke Avenue will operate at LOS C / D during the AM / PM peak hours, respectively. Westbound movements will now operate at LOS D rather than LOS B in the PM peak hours.
3. The intersection of VA-36 / Winston Churchill Drive and Sunnyside Avenue will operate at LOS A / B for the AM / PM peak hours, respectively. This is an improvement from the LOS B operation during the AM peak hours.
4. The intersection of VA-36 / Winston Churchill Drive and Liberty Avenue will now operate at LOS A for both the AM and PM peak hours, rather than LOS B.
5. The intersection of VA-36 / Winston Churchill Drive and High Avenue will operate at LOS A during both the AM and PM peak hours. This is an improvement from the intersection operating at LOS C / D during the AM / PM peak hours, respectively. The southbound left-turn movement will no longer operate at LOS F during the PM peak hours, but rather at LOS B, with the delay dropping from 151.7 sec/veh to 12.5 sec/veh.
6. The intersection of High Avenue and Oaklawn Boulevard will now operate at LOS B during both peak hours, rather than LOS B / C during the AM / PM peak hours, respectively. Every movement operates at LOS A, except for the southbound left turn movement in the AM peak hours, and eastbound and southbound left turn movements in the PM peak hours operating at LOS B.

Table 2-10: VA-36 / Winston Churchill Drive - 2052 Build Option 3 Intersection Analysis Results

Intersection Number	Intersection Name	Movement	Storage length (ft)	AM									PM								
				Volume	Movement				Approach		Intersection		Volume	Movement				Approach		Intersection	
					Average Queue (ft)	95th Percentile Queue (ft)	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS		Average Queue (ft)	95th Percentile Queue (ft)	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
1	VA-36 / Winston Churchill Drive & Miles Avenue ***(Roundabout)***	EBL	80	80		54.7	9.8	A	7.3	A	2.7	A	105		64.7	11.1	B	9	A	2.9	A
		EBT		45		54.7	8.2	A					45		64.7	9.5	A				
		EBR		125		54.7	5.4	A					110		64.7	6.7	A				
		WBL	80	25		16.8	13.6	B	8.8	A			25		17.5	14.3	B	9.6	A		
		WBT		50		16.8	7.1	A					50		17.5	7.7	A				
		WBR		20		16.8	7.2	A					15		17.5	7.8	A				
		NBL	200	65		58.5	11.2	B	1.4	A			135		85.9	11.7	B	1.8	A		
		NBT		600		59.2	1.1	A					835		87.9	1.5	A				
		NBR		15		59.2	1.9	A					15		87.9	2.3	A				
		SBL	130	15		60	6.3	A	1.6	A			20		81.4	6.4	A	1.9	A		
		SBT		620		61.1	1.1	A					930		83.6	1.1	A				
		SBR		90		61.1	4.9	A					110		83.6	4.9	A				
2	VA-36 / Winston Churchill Drive & Roanoke Avenue ***(Stop-Controlled)***	EBL		0					10.8	B	22.8	C	5					22.9	C	26.7	D
		EBT		0		1	10.8	B					0		4	22.9	C				
		EBR		10									5								
		WBL		5					22.8	C			5					26.7	D		
		WBT		0		4	22.8	C					0		4	26.7	D				
		WBR		5									5								
		NBL	100	10					0.1				25					0.3			
		NBT		685		1	9.6	A					925		3	10.2	B				
		NBR		5									5								
		SBL	80	0					0				0					0			
		SBT		710		0	0	0					1050		0	0	0				
		SBR		5									10								

Intersection Number	Intersection Name	Movement	Storage length (ft)	AM									PM								
				Volume	Movement				Approach		Intersection		Volume	Movement				Approach		Intersection	
					Average Queue (ft)	95th Percentile Queue (ft)	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS		Average Queue (ft)	95th Percentile Queue (ft)	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
3	VA-36 / Winston Churchill Drive & Sunnyside Avenue ***(Signalized)***	EBL	90	0	0	0	0	0	11.8	B	9.5	A	5	0	0	0	0	14.8	B	12.4	B
		EBT		10	1	8	9.9	A					5	2	8	10.4	B				
		EBR		240	21	59	11.9	B					340	65	126	14.9	B				
		WBL		10	0	0	0	0	10.0	B			5	0	0	0	0	10.4	B		
		WBT		10	3	13	10	B					5	2	10	10.4	B				
		WBR		5	0	0	0	0					5	0	0	0	0				
		NBL		0	0	0	0	0	8.0	A			0	0	0	0	0	10.4	B		
		NBT		685	48	#175	8	A					925	90	230	10.4	B				
		NBR		10	0	0	0	0					30	0	0	0	0				
		SBL	100	0	0	0	0	0	10.1	B			0	0	0	0	0	13.4	B		
		SBT		470	51	156	10.1	B					735	95	#271	13.4	B				
		SBR		185	0	0	0	0					305	0	0	0	0				
4	VA-36 / Winston Churchill Drive & Liberty Avenue ***(Stop-Controlled)***	EBL		0							9.1	A	0							9.3	A
		EBT		0									0								
		EBR		0									0								
		WBL		0					9.1	A			0					9.3	A		
		WBT		0		1	9.1	A					0		1	9.3	A				
		WBR		10									10								
		NBL		0					0				0					0			
		NBT		690									925								
		NBR		0									10								
		SBL	170	0					0				0					0			
		SBT		655		0	0	0					1040		0	0	0				
		SBR		0									0								

Intersection Number	Intersection Name	Movement	Storage length (ft)	AM									PM								
				Volume	Movement				Approach		Intersection		Volume	Movement				Approach		Intersection	
					Average Queue (ft)	95th Percentile Queue (ft)	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS		Average Queue (ft)	95th Percentile Queue (ft)	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
5	VA-36 / Winston Churchill Drive & High Avenue ***(Roundabout)***	EBL		0		0.3	8.4	A	6.8	A	3.9	A	10		24.3	9.2	A	7.4	A	4.6	A
		EBT		50		0.3	6.8	A					95		24.3	7.6	A				
		EBR	70	0		0.3	3.9	A					15		24.3	4.7	A				
		WBL		115		31.2	12.4	A	9.6	A			115		35.4	12.5	B	9.6	A		
		WBT	500	50		31.2	5.9	A					55		35.4	6	A				
		WBR	100	40		31.2	6	A					40		35.4	6.1	A				
		NBL	175	10		1.3	11.2	B	3.2	A			20		2.7	11.5	B	3.8	A		
		NBT		385		1.3	1	A					425		2.8	1.3	A				
		NBR	200	120		1.3	1.9	A					180		2.8	2.1	A				
		SBL	155	95		1.4	6.3	B	2.1	A			200		50.2	7.3	A	3.3	A		
		SBT		355		1.4	1.1	A					600		51.9	2.1	A				
		SBR		5		1.4	4.9	A					20		51.9	5.6	A				
6	High Avenue & Oaklawn Boulevard ***(Roundabout)***	EBL		0		2.2	7.8	A	5.1	A	11.7	B	5		2.9	8.3	A	6.3	A	11.6	B
		EBT		5		2.2	6.2	A					5		2.9	6.7	A				
		EBR		5		2.2	3.5	A					5		2.9	4	A				
		WBL		5		14.4	11.7	B	6.2	A			25		15	11.6	B	7.2	A		
		WBT		5		14.4	5.6	A					10		15	5.6	A				
		WBR		55		14.4	5.7	A					60		15	5.7	A				
		NBL		0		58.3	9.9	A	1.7	A			10		67.6	10.1	B	2.6	A		
		NBT		185		58.3	0.2	A					270		67.6	0.5	A				
		NBR		0		58.3	1.2	A					25		67.6	1.4	A				
		SBL		45		29.4	5.8	A	0.6	A			90		44.7	6.1	A	1.3	A		
		SBT		255		29.4	0.5	A					315		44.7	0.8	A				
		SBR		5		29.4	4.3	A					10		44.7	4.6	A				

e. Build Safety Analysis

Table 2-11 summarizes the **safety analysis** and expected crash reductions for each crash severity and the overall crashes for **Build Option 1**. A crash modification factor (CMF) is used to determine the expected crash reduction after implementing a countermeasure on a road or intersection. CMFs for the proposed improvements were applied to the relevant crash history to evaluate the expected crash reduction. CMFs for the proposed improvements are based on VDOT SMART SCALE Round 5 and Virginia State Preferred CMF List.

CMFs for the total crashes were applied to the total number of crashes to determine the expected crash reduction along the study corridor. CMFs for the fatal and injury crashes were applied to the type K (fatal), A (severe injury), B (visible injury), and C (non-visible injury) crashes.

Table 2-11: VA-36 / Winston Churchill Drive - Build Option 1 Expected Crash Reduction

Intersection	Expected Crash Reduction	K	A	BC	O	Total
1. VA-36 / Winston Churchill Drive at Miles Ave	Total Crashes	0	5	60	8	73
	Total Expected Crashes	0	3.4	40.9	6.2	50.5
	% Crash Reduction	-	**32%**	**32%**	**23%**	**31%**
2. VA-36 / Winston Churchill Drive at Roanoke Avenue	Total Crashes	0	0	15	4	19
	Total Expected Crashes	0	0	13.2	3.5	16.7
	% Crash Reduction	-	-	**12%**	**12%**	**12%**
3. VA-36 / Winston Churchill Drive at Sunnyside Avenue	Total Crashes	0	0	18	2	20
	Total Expected Crashes	0	0	12.3	1.5	13.8
	% Crash Reduction	-	-	**32%**	**23%**	**31%**
4. VA-36 / Winston Churchill Drive at Liberty Avenue	Total Crashes	0	0	2	0	2
	Total Expected Crashes	0	0	1.8	0	1.8
	% Crash Reduction	-	-	**12%**	**-**	**12%**
5. VA-36 / Winston Churchill Drive at High Avenue	Total Crashes	0	5	69	11	85
	Total Expected Crashes	0	3.9	53.4	9.6	66.8
	% Crash Reduction	-	**23%**	**23%**	**13%**	**21%**
6. High Avenue at Oaklawn Boulevard	Total Crashes	0	0	0	0	0
	Total Expected Crashes	0	0	0	0	0
	% Crash Reduction	-	-	-	-	-

The conventional improvements recommended in Option 1 showed a significant crash reduction along the corridor. Approximately between 12% and 32% of injury-related crashes are expected to be reduced throughout the corridor.

Table 2-12 summarizes the **safety analysis** and expected crash reductions for each crash severity and the overall crashes for **Build Option 2**. The improvements recommended in Option 2 showed a significant crash reduction along the study corridor and are listed as follows:

- Conversion of conventional intersection to Median U-Turn along VA-36 / Winston Churchill Drive at Miles Avenue and High Avenue is expected to reduce approximately 36% of injury-related crashes.
- Conversion of conventional intersection to roundabout at Sunnyside Avenue is expected to reduce approximately 78% of injury related crash.

Table 2-12: VA-36 / Winston Churchill Drive - Build Option 2 Expected Crash Reduction

Intersection	Expected Crash Reduction	K	A	BC	O	Total
1. VA-36 / Winston Churchill Drive at Miles Ave	Total Crashes	0	5	60	8	73
	Total Expected Crashes	0	3.2	38.2	6.6	48
	% Crash Reduction	-	**36%**	**36%**	**17%**	**34%**
2. VA-36 / Winston Churchill Drive at Roanoke Avenue	Total Crashes	0	0	15	4	19
	Total Expected Crashes	0	0	13.2	3.5	16.7
	% Crash Reduction	-	-	**12%**	**12%**	**12%**
3. VA-36 / Winston Churchill Drive at Sunnyside Avenue	Total Crashes	0	0	18	2	20
	Total Expected Crashes	0	0	4	1	5
	% Crash Reduction	-	-	**78%**	**48%**	**75%**
4. VA-36 / Winston Churchill Drive at Liberty Avenue	Total Crashes	0	0	2	0	2
	Total Expected Crashes	0	0	1.8	0	1.8
	% Crash Reduction	-	-	**12%**	-	**12%**
5. VA-36 / Winston Churchill Drive at High Avenue	Total Crashes	0	5	69	11	85
	Total Expected Crashes	0	3.2	44	9.1	56.2
	% Crash Reduction	-	**36%**	**36%**	**17%**	**34%**
6. High Avenue at Oaklawn Boulevard	Total Crashes	0	0	0	0	0
	Total Expected Crashes	0	0	0	0	0
	% Crash Reduction	-	-	-	-	-

Table 2-13 summarizes the **safety analysis** and expected crash reductions for crash severity and the overall crashes for **Build Option 3**. Accordingly, the improvements recommended in Option 3 showed a significant crash reduction along the study corridor and are listed as follows:

- Conversion of conventional intersection along VA-36 / Winston Churchill Drive at Miles Avenue and High Avenue is expected to reduce approximately 78% of injury related crash.
- Conversion of conventional intersection to Median U-Turn along VA-36 / Winston Churchill Drive at Sunnyside Avenue is expected to reduce approximately 36% of injury-related crashes.

Table 2-13: VA-36 / Winston Churchill Drive- Build Option 3 Expected Crash Reduction

Intersection	Expected Crash Reduction	K	A	BC	O	Total
1. VA-36 / Winston Churchill Drive at Miles Ave	Total Crashes	0	5	60	8	73
	Total Expected Crashes	0	1.1	13.2	4.2	18.5
	% Crash Reduction	-	**78%**	**78%**	**48%**	**75%**
2. VA-36 / Winston Churchill Drive at Roanoke Avenue	Total Crashes	0	0	15	4	19
	Total Expected Crashes	0	0	13.2	3.5	16.7
	% Crash Reduction	-	-	**12%**	**12%**	**12%**
3. VA-36 / Winston Churchill Drive at Sunnyside Avenue	Total Crashes	0	0	18	2	20
	Total Expected Crashes	0	0	11.5	1.7	13.1
	% Crash Reduction	-	-	**36%**	**17%**	**34%**
4. VA-36 / Winston Churchill Drive at Liberty Avenue	Total Crashes	0	0	2	0	2
	Total Expected Crashes	0	0	1.8	0	1.8
	% Crash Reduction	-	-	**12%**	-	**12%**
5. VA-36 / Winston Churchill Drive at High Avenue	Total Crashes	0	5	69	11	85
	Total Expected Crashes	0	1.1	15.2	5.7	22
	% Crash Reduction	-	**78%**	**78%**	**48%**	**74%**
6. High Avenue at Oaklawn Boulevard	Total Crashes	0	0	0	0	0
	Total Expected Crashes	0	0	0	0	0
	% Crash Reduction	-	-	-	-	-

2.3 Preferred Alternative

The preferred alternative was developed based on the recommendation from the Stakeholder Working Group (SWG) meeting and the results of the analysis as discussed in the previous "Alternative Development and Refinement" section. The preferred alternative concept consists of the following improvements and is shown in **Figure 2-3.**

1. VA-36 / Winston Churchill Drive and Miles Avenue – Option 3, Roundabout
2. VA-36 / Winston Churchill Drive and Roanoke Avenue – Option 1, Conventional Improvements
3. VA-36 / Winston Churchill Drive and Sunnyside Avenue – Option 2, Roundabout
4. VA-36 / Winston Churchill Drive and Liberty Avenue – Option 1, Conventional Improvements
5. VA-36 / Winston Churchill Drive and High Avenue – Option 3, Roundabout
6. High Avenue and Oaklawn Boulevard – Option 1, Conventional Improvements

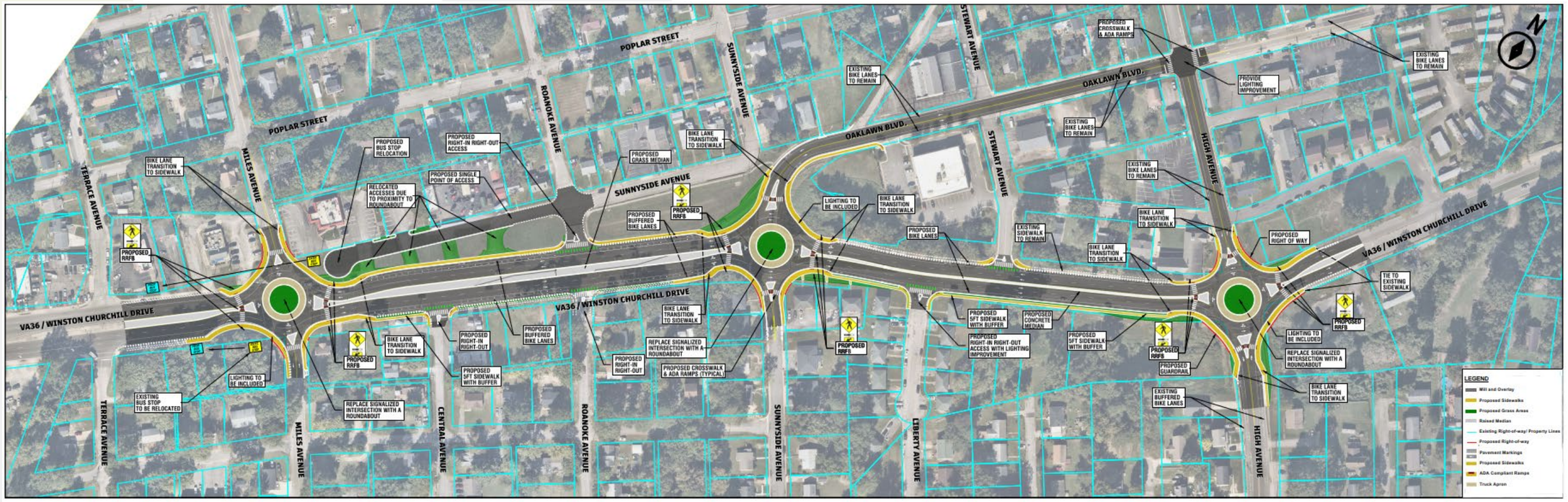


Figure 2-3: Proposed Preferred Alternative Concept for VA-36 / Winston Churchill Drive

a. Preferred Alternative Operational Analysis

The analysis results for Preferred Alternative, presented in **Table 2-15** below, can be summarized as follows:

1. The intersection of VA-36 / Winston Churchill Drive and Miles Avenue will operate at LOS A rather than LOS B. All westbound movements will operate at LOS A during both the AM and PM peak hours. The delays will drop significantly for all movements. The overall delays for the AM / PM peak hours will drop from 16.8 sec/veh / 17.5 sec/veh to 2.8 sec/veh / 3.0 sec/veh, respectively. This is an 84% reduction in the delays for both peak periods.
2. The intersection of VA-36 / Winston Churchill Drive and Roanoke Avenue will now operate at LOS B during both the AM and PM peak hours, rather than LOS C. All the delays decrease when comparing this option to the no-build. For example, the delay of the eastbound thru movement during the PM peak hours will decrease from 15.9 sec/veh to 10.9 sec/veh.
3. The intersection of VA-36 / Winston Churchill Drive and Sunnyside Avenue will operate at LOS A rather than LOS B. The northbound left-turn movement will no longer operate at LOS D, but rather LOS A during the PM peak hours.
4. The intersection of VA-36 / Winston Churchill Drive and Liberty Avenue will continue to operate at LOS B for both AM and PM peak hours.
5. The intersection of VA-36 / Winston Churchill Drive and High Avenue will operate at LOS A during both the AM and PM peak hours. This is an improvement from the intersection operating at LOS C / D during the AM / PM peak hours, respectively. The southbound left-turn movement will no longer operate at LOS F during the PM peak hours, but rather operates at LOS B.
6. The intersection of High Avenue and Oaklawn Boulevard will continue to operate at LOS B during AM and LOS C during PM Peak hours. The delays will remain relatively unchanged.

b. Preferred Alternative Safety Analysis

Table 2-14 summarizes the expected crash reductions for crash severity and the overall crashes for Preferred Alternative. The improvements recommended showed a significant crash reduction along the study corridor.

- Implementing roundabout along VA-36 / Winston Churchill Drive at Miles Avenue, Sunnyside Avenue and High Avenue is expected to reduce approximately 78% of injury-related crash.
- Eliminating left-turns along VA-36 / Winston Churchill Drive from Roanoke Avenue and Liberty Avenue is expected to reduce approximately 12% of injury-related crash.

Table 2-14: VA-36 / Winston Churchill Drive - Preferred Alternative Predicted Crash Reduction

ID	Intersection	Expected Crash Reduction	K	A	BC	O	Total
1	VA-36 / Winston Churchill Drive at Miles Ave	Total Crashes	0	5	60	8	73
		Total Expected Crashes	0	1.1	13.2	4.2	18.5
		% Crash Reduction	-	78%	78%	48%	75%
2	VA-36 / Winston Churchill Drive at Roanoke Avenue	Total Crashes	0	0	15	4	19
		Total Expected Crashes	0	0	13	3.5	16.7
		% Crash Reduction	-	-	12%	12%	12%
3	VA-36 / Winston Churchill Drive at Sunnyside Avenue	Total Crashes	0	0	18	2	20
		Total Expected Crashes	0	0	3.96	1.04	5
		% Crash Reduction	-	-	78%	48%	75%
4	VA-36 / Winston Churchill Drive at Liberty Avenue	Total Crashes	0	0	2	0	2
		Total Expected Crashes	0	0	1.8	0	1.8
		% Crash Reduction	-	-	12%	-	12%
5	VA-36 / Winston Churchill Drive at High Avenue	Total Crashes	0	5	69	11	85
		Total Expected Crashes	0	1.1	15.2	5.7	22
		% Crash Reduction	-	78%	78%	48%	74%
6	High Avenue at Oaklawn Boulevard	Total Crashes	0	0	0	0	0
		Total Expected Crashes	0	0	0	0	0
		% Crash Reduction	-	-	-	-	-

Table 2-15: VA-36 / Winston Churchill Drive - Proposed Preferred Alternative Concept Intersection Analysis Results

Intersection Number	Intersection Name	Movement	Storage length (ft)	AM									PM								
				Volume	Movement				Approach		Intersection		Volume	Movement				Approach		Intersection	
					Average Queue (ft)	95th Percentile Queue (ft)	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS		Average Queue (ft)	95th Percentile Queue (ft)	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
1	VA-36 / Winston Churchill Drive & Miles Avenue **(Roundabout)**	EBL	80	80		55.3	9.9	A	7.4	A	2.8	A	105		65.5	11.2	B	9.0	A	3.0	A
		EBT		45		55.3	8.3	A					45		65.5	9.6	A				
		EBR		125		55.3	5.4	A					110		65.5	6.8	A				
		WBL	80	25		17.0	13.7	B	8.9	A			25		17.7	14.3	B	9.6	A		
		WBT		50		17.0	7.1	A					50		17.7	7.8	A				
		WBR		20		17.0	7.2	A					15		17.7	7.9	A				
		NBL	200	65		60.1	6.4	A	1.7	A			135		81.6	6.5	A	2.0	A		
		NBT		600		61.2	1.1	A					835		83.7	1.2	A				
		NBR		15		61.2	4.9	A					15		83.7	4.9	A				
		SBL	130	15		59.4	11.3	B	1.5	A			20		87.4	11.7	B	1.9	A		
		SBT		610		60.2	1.1	A					930		89.4	1.5	A				
		SBR		90		60.2	1.9	A					110		89.4	2.3	A				
2	VA-36 / Winston Churchill Drive & Roanoke Avenue **(Stop-Controlled)**	EBL		0					11.2	B	11.5	B	5					12.8	B	12.8	B
		EBT		0		1	11.2	B					0		2	12.8	B				
		EBR		10									5								
		WBL		5					11.5	B			5					12.0	B		
		WBT		0		1	11.5	B					0		1	12.0	B				
		WBR		5									5								
		NBL	100	10					0				25					0	0		
		NBT		685		0	0	0					925		0	0	0				
		NBR		5									5								
		SBL	80	10					0				5					0	0		
		SBT		700		0	0	0					1050		0	0	0				
		SBR		5									10								

Intersection Number	Intersection Name	Movement	Storage length (ft)	AM									PM								
				Volume	Movement				Approach		Intersection		Volume	Movement				Approach		Intersection	
					Average Queue (ft)	95th Percentile Queue (ft)	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS		Average Queue (ft)	95th Percentile Queue (ft)	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
3	VA-36 / Winston Churchill Drive & Sunnyside Avenue **(Roundabout)**	EBL	90	0		47.4	8.7	A	4.3	A	2.3	A	5		85.7	10.8	B	6.4	A	3.1	A
		EBT		0		47.4	7.2	A					5		85.7	9.2	A				
		EBR		240		47.4	4.3	A					340		85.7	6.3	A				
		WBL		10		3.7	13.4	B	9.5	A			5		2.0	13.1	B	8.8	A		
		WBT		10		3.7	6.9	A					5		2.0	6.6	A				
		WBR		5		3.7	7	A					5		2.0	6.7	A				
		NBL		180		52.1	5.2	A	1.7	A			305		62.5	5.3	A	2.2	A		
		NBT		505		52.6	0.1	A					610		63.0	0.1	A				
		NBR		5		52.6	3.9	A					20		63.0	3.9	A				
		SBL	100	5		37.3	11.8	B	1.8	A			5		57.3	12.5	B	2.4	A		
		SBT		465		37.8	1.6	A					720		59.2	2.2	A				
		SBR		0		37.8	2.4	A					0		59.2	3	A				
4	VA-36 / Winston Churchill Drive & Liberty Avenue **(Stop-Controlled)**	EBL		0							10.4	B	0							10.5	B
		EBT		0									0								
		EBR		0									0								
		WBL		5					10.4	B			5					10.5	B		
		WBT		0		1	10.4	B					0		1	10.5	B				
		WBR		5									0								
		NBL		0									0								
		NBT		510									610								
		NBR		0									10								
		SBL	170	5					0	0			10					0	0		
		SBT		465		0	0	0					720		0	0	0				
		SBR		0									0								

Intersection Number	Intersection Name	Movement	Storage length (ft)	AM									PM								
				Volume	Movement				Approach		Intersection		Volume	Movement				Approach		Intersection	
					Average Queue (ft)	95th Percentile Queue (ft)	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS		Average Queue (ft)	95th Percentile Queue (ft)	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
5	VA-36 / Winston Churchill Drive & High Avenue **(Roundabout)**	EBL		0		8.9	8.4	A	6.8	A	4.0	A	10		24.5	9.2	A	7.4	A	4.6	A
		EBT		50		8.9	6.9	A					95		24.5	7.6	A				
		EBR	70	0		8.9	4.0	A					15		24.5	4.8	A				
		WBL		115		31.3	12.4	B	9.6	A			115		35.8	12.6	B	9.6	A		
		WBT	500	50		31.3	5.9	A					55		35.8	6.0	A				
		WBR	100	40		31.3	6.0	A					40		35.8	6.2	A				
		NBL	175	10		39.9	6.3	A	2.2	A			20		51.8	7.3	A	3.4	A		
		NBT		385		40.3	1.1	A					410		53.7	2.1	A				
		NBR	200	120		40.3	4.9	A					180		53.7	5.7	A				
		SBL	155	95		33.7	11.3	B	6.8	A			200		70.0	11.5	B	3.9	A		
		SBT		355		34.4	1.1	A					600		71.8	1.3	A				
		SBR		5		34.4	1.9	A					20		71.8	2.2	A				
6	High Avenue & Oaklawn Boulevard **(Stop-Controlled)**	EBL		0					13.3	B	13.3	B	5					18.6	C	18.6	C
		EBT		5		2	13.3	B					5		4	18.6	C				
		EBR		5									5								
		WBL		5					11.3	B			25					16.2	C		
		WBT		5		11	11.3	B					10		24	16.2	C				
		WBR		55									60								
		NBL		0					0				10					0.4			
		NBT		185		0	0	A					270		1	0.4	A				
		NBR		0									25								
		SBL		45					1.5	A			90					2.4			
		SBT		255		3	1.5	A					315		6	2.4	A				
		SBR		5									10								

PROJECT PIPELINE

Chapter 3: Public Outreach and Feedback

3.1 Stakeholder Coordination and Public Outreach

The Project Pipeline process involved targeted outreach and stakeholder input for the alternative concepts in the study area. The study team developed concept sketches, prepared presentation materials, and created a public survey to meet the public engagement needs for this study.

Stakeholder engagement plays a key role in the success of the study recommendations. The stakeholders provide regional and local knowledge about the study area and help guide the study direction. The project stakeholders identified in **Chapter 1.4** were involved in all steps of the Project Pipeline process and assisted in the decision making regarding the recommended concepts.

A MetroQuest survey was available from March 20, 2024, to April 10, 2024, to collect feedback on potential improvements within the study corridor. The survey provided the study team, the City of Hopewell, and VDOT with an understanding of how the public viewed the concept at each intersection before recommending a preferred option.

The online survey presented the community with the improvements described under the Preferred Alternative Section 1.1, at six (6) locations along the VA-36 / Winston Churchill Drive corridor. The public was asked to rank these concepts by assigning a rating one (1) through five (5); with one (1) representing strong opposition and five (5) for strong support. The survey included improvements at the following locations:

1. VA-36 / Winston Churchill Drive at Miles Avenue – Signalized
2. VA-36 / Winston Churchill Drive at Roanoke Avenue – Unsignalized
3. VA-36 / Winston Churchill Drive at Sunnyside Avenue – Signalized
4. VA-36 / Winston Churchill Drive at Liberty Avenue – Unsignalized
5. VA-36 / Winston Churchill Drive at High Avenue – Signalized
6. Oaklawn Boulevard at High Avenue – Unsignalized
7. VA-36 / Winston Churchill Drive Corridor Wide Improvements

Overall, the improvements to the intersections were widely supported by the public, with the roundabouts being the main improvement that was strongly opposed**. Figure 3-1** presents the average rating of improvements at each study intersection and other corridor-wide improvements. A rating of 5.0 represents a strongly favored concept and a rating of 1.0 represents a strongly unfavorable concept. A summary of the MetroQuest survey is included in **Appendix I**.

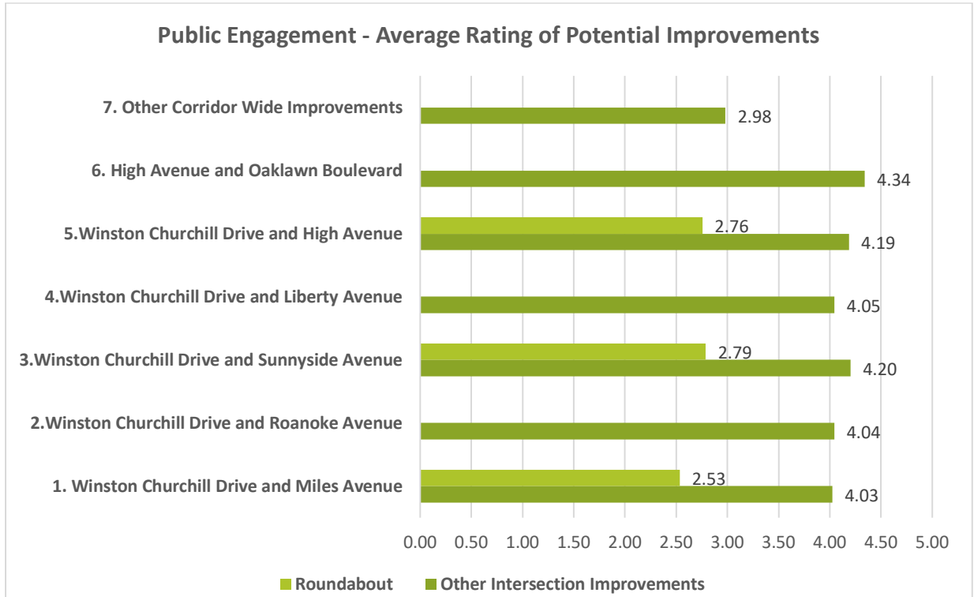


Figure 3-1: MapQuest Survey Results - VA-36 / Winston Churchill Drive

PROJECT PIPELINE

Chapter 4: Preferred Alternative Design Refinement & Investment Strategy

4.1 Intent of Phase 3

Based on the feedback received from the MetroQuest survey (from March 20, 2024, to April 10, 2024), the SWG agreed to the preferred Alternative concept to finalize the detailed concept of the Preferred Alternative that will carry through to funding applications and project validation. The goal is to ensure that projects are defined to the maximum extent possible and to identify and mitigate potential risks. Utilizing technical resources of both VDOT and consultant teams, a multidisciplinary design approach is part of the overall effort that provides the needed input and problem-solving to ensure funding applications are thoroughly vetted and taken past a planning level sketch and estimate.

The technical Team developed the design, deliverables, and documentation that will serve as the basis for future Preliminary Engineering work on the projects. At the conclusion of this exercise, projects should achieve a solid foundation of understanding from a planning and preliminary engineering focus that will ensure applications are well validated, reasonably scoped, meet the needs originally established in studies, and have a high probability of success. This chapter summarizes the assumptions, detailed final preferred alternative concept, and cost estimates.

4.2 Major Design Features

Major design features associated with the current project along VA 36/ Winston Churchill Drive include:

- Replacing existing signalized intersection at the 3 main intersections with a multi-lane roundabout.
- Consolidation of existing driveways approaching the proposed South Roundabout and Provide a Single point of access connected to Roanoke Avenue
- Install a cul-de-sac on the south end of Sunnyside Avenue to allow turning movements and emergency vehicles.
- Upgrade sidewalks/curb ramps in accordance with Americans with Disabilities Act (ADA) and Public Right-Of-Way Accessibility Guidelines (PROWAG)
- Provide bike lanes along Winston Churchill Drive
  - Buffered bike lanes between Miles Avenue and Oaklawn Boulevard
  - Regular bike lanes between Oaklawn Boulevard, and Hight Avenue
- Intersection 1 - VA 36 (Winston Churchill Dr.) at Miles Avenue.
  - Crosswalks on all approaches
  - Pedestrian push buttons and pedestrian intervals
  - Enhanced intersection lighting
- Intersection 2 - VA 36 (Winston Churchill Drive) at Roanoke Avenue.
  - Right-in/Right-out
  - Crosswalks for Roanoke Avenue (east and west legs)
  - Enhanced intersection lighting
- Intersection 3 - VA 36 (Winston Churchill Drive) at Sunnyside Lane
  - Replace existing signalized intersection with a multi-lane roundabout.
- Intersection 4 - VA 36 (Winston Churchill Drive) at Liberty Avenue
  - Right-in/ Right-out
  - Crosswalks on Liberty Avenue (east leg)
  - Enhanced intersection lighting
- Intersection 5 - VA 36 (Winston Churchill Drive) at High Avenue.
  - Replace existing conventional intersection with a multi-lane roundabout.
- Intersection 6 - Oaklawn Boulevard at High Avenue
  - Crosswalks across Oaklawn Boulevard (north and south legs)
  - Enhanced intersection lighting
- Oaklawn Boulevard. – Between High Ave and Winston Churchill Drive.
  - Upgrade bike lanes and transition to proposed roundabout.

The following studies, efforts and analyses have been conducted to develop design alternatives, select a preferred alternative, refine concept designs, and develop cost estimates:

- Field visits – Teams of traffic engineers, roadway engineers and hydraulic engineers conducted site visits with Study Work Group (SWG) to better ascertain existing conditions.
- Stakeholder coordination – Multiple stakeholder coordination meetings were held during the project development process to gain input/feedback, validate designs, and identify issues/risks.
- Public Survey – Two public input surveys was conducted and asked respondents to identify items such as their preferred mode of travel, suggested safety and operational improvements, and feedback on proposed improvements.
- Traffic Operational Analysis – A traffic operational analysis was completed for the study corridor, as part of Pipeline Phase 1 and Phase 2, to address VTRANS needs and to develop and evaluate design alternatives. Both AM and PM peak hour traffic volumes were analyzed for existing analysis year 2023 and future design year 2052.
- Safety Analysis - A safety analysis was completed for the study corridor to identify crash trends, and potential contributing causes to develop and evaluate design alternatives.
- Concept Development Pipeline Process – Pipeline Phase I-initially developed high-level options to improve performance; Pipeline Phase II- narrowed down options, more detailed concepts,

detailed analysis, stakeholder/public engagement, planning level estimates and identify the preferred alternative; Pipeline Phase III-concept refinement, more detailed engineering, identify risks and contingencies, detailed cost estimation.

4.3 Design Information

a. Design Criteria

Following is the main design criteria and basic project information. Please see **Appendix J** for a more detailed list of design criteria:

- VA36/ (Winston Churchill Drive): Functional Classification – Other Principal Arterial (GS-5)
  - Average Annual Daily Traffic (AADT) 2021 – 14,000 VPD.
  - Design Speed – 40 MPH
  - Lane Width – 12 Feet
- Miles Avenue: Functional Classification – Minor Arterial (GS-6)
  - Average Annual Daily Traffic (AADT) – 3,600 VPD.
  - Design Speed – 30 MPH
  - Lane Width – 12 Feet
- Oaklawn Boulevard: Functional Classification – Minor Arterial (GS-6)
  - Average Annual Daily Traffic (AADT) – 6,900 VPD.
  - Design Speed – 40 MPH
  - Lane Width – 12 Feet
- High Avenue: Functional Classification –Major Collector (GS-7)
  - Average Annual Daily Traffic (AADT) – 9,500 VPD.
  - Design Speed – 40 MPH
  - Lane Width – 12 Feet

b. Data Sources

The following data sources were collected/review and informed the project design and analysis work:

- In lieu of detailed topographic survey, publicly available GIS data inclusive right-of-way parcel lines and utility data was utilized.
- Field Visits
- Site Photos
- Materials reports

The SWG conducted a field visit on June 5, 2024 (see **Appendix K** for site photos), consisting of roadway engineers as well as traffic engineers who looked at key aspects of the project, including potential impacts and risks:

- Right-of-way impacts on adjacent properties.
- Access management, including intersection and entrance spacing.
- Grading was evaluated to identify locations of potential retaining walls.
- Impact to adjacent parking and residential properties to minimize property impacts.
- Pedestrian accommodations to meet Public Rights-of-Way Accessibility Guidelines (PROWAG) and provide connectivity through the corridor.
- Hydraulics and potential stormwater management locations and constraints.
- Existing utilities including overhead lines, pole locations, culverts, and storm systems.

The design concept was developed in accordance with the requirements of the following references:

- AASHTO “A Policy on Geometric Design of Highway and Streets” 2018, 7th Edition.
- AASHTO “Roadside Design Guide” 2011, 4th Edition.
- 2009 MUTCD with Revisions
- Public Rights-of-Way Accessibility Guidelines (PROWAG)
- VDOT Road and Design Manual, Rev. July 2021, Rev. August 2023
- VDOT Instructional and Information Memorandum for all VDOT Divisions.
- VDOT Road and Bridge Standards, 2016, Rev. September 2022
- VDOT Cost Estimating Manual Version 2.0
- VDOT Right of Way Cost Estimate Guide
- SMART SCALE Technical Guide for Round 6
- Design Waiver/Exception Policy for SMART SCALE Applications.
- IIM-LD-255 - Practical Design Flexibility in the Project Development Process.

4.4 Design Approach

a. Assumptions

The following are key design assumptions that informed the concept development and cost estimate preparation:

- Roadway geometry – The 3 signalized intersections (at Miles Ave, Oaklawn and High Ave.) are to be replaced with 3 multi-lane roundabouts. The design assumes complete resurfacing within the project limits and full pavement reconstruction around the proposed roundabout areas with concrete medians. The roadway geometry was established in accordance with *VDOT Roadway Design Manual (RDM) Appendix A* using a ULS design criteria. Existing driveways approaching the proposed South Roundabout are consolidated to a proposed single point of access connected to Roanoke Avenue. With a cul-de-sac. Right-in/Right-out and enhance lighting are proposed at the intersections and roundabouts within the project limits.

- Pedestrian accommodations – All sidewalks within project limits and along Winston Churchill are proposed for upgrade, with new curb ramps in accordance with Americans with Disabilities Act (ADA) and Public Right-Of-Way Accessibility Guidelines (PROWAG) and crosswalks are proposed on all approaches of the roundabouts and intersections Buffered bike lanes between Miles Avenue and Oaklawn Blvd and designated bike lanes (no-buffer) between Oaklawn Blvd, and Hight Avenue. Upgraded bike lanes with new stripping on Oaklawn Blvd. – Between High Ave and Winston Churchill Drive

- Hydraulics - Median inlets and drop inlets will be added with the proposed curb and gutter along Winston Churchill Drive and mainly around the new roundabouts.

- Stormwater Management – Potential Stormwater Management location has been identified on the concept.

- Right-of-way - The proposed improvements will involve acquiring partial right of way and easements on three commercial parcels, 8 residential and 3 vacant parcels. The 3 commercial properties include a church and the north end at the corner of High Avenue, a Hardee's and a BTJ Wings at the south end of the project along Miles Avenue. Additionally, the project is proposing to remove and consolidating 4 existing commercial entrances along VA36-Winston Churchill, close to the southern roundabout, belonging to Hardee's and other businesses. Refer to the concept design exhibits and Right of Way Data Sheet for more details.

b. Design Waivers/Exceptions

A design waiver will be required for the lack of adequate sidewalk buffer widths for the proposed sidewalk along VA36 -Winston Churchill Drive between Miles Avenue roundabout and Stewart Avenue (left) due to site grade constraints and existing conditions. Another design waiver will be needed further long VA36-Winston Churchill Drive just north of the High Avenue roundabout, as a result of transition to an existing substandard sidewalk buffer width and right-of-way restriction.

c. Environmental Considerations

The level of environmental documentation anticipated is a Categorical Exclusion, either a PCE or a CE depending on final project impacts/scope.

d. Right of Way & Utilities

District will prepare right-of-way and utility estimates.

e. Constructability & Maintenance of Traffic Assessment

At this stage, no MOT plans have been developed; the MOT is expected to be complex in this area, so a MLE for pre-scoping is recommended. Construction of the roundabout will significantly disrupt traffic in the area, although it is anticipated that construction will be phased.

Appendix L includes the final concept plans for the study corridor.

4.5 Risk Assessment/Contingency

The project is considered Moderately Complex and at a Pre-Scoping Phase. However, the level of concept design development is relatively detailed (between a Pre-Scoping and PFI level of design); therefore, the Most Likely Estimate (MLE) contingency would be more accurate at the 35% to 45% range. Project specific risks were identified and assessed based on data collected, GIS information, field visit, stakeholder input and concept design development. In addition, other typical project risks were assessed as applicable. Risks were organized by broad categories including Maintenance of Traffic, Roadway Design, Right of Way, Utilities, Mobilization/Construction Survey, Hydraulics, Traffic, Structures/Bridge Design, Geotechnical, and Environmental. Each individual risk was "scored" based on probability, cost impact and time impact (See attached Cost Estimate Contingency Worksheet). Scoring was used to assign contingencies per risk line item. These line-item risk contingencies were then aggregated to determine a contingency amount per category:

- Preliminary Engineering: 30%.
- Mobilization/Construction Survey = 40 %
- Roadway Design = 35%. Although survey is not available, the concept was developed with a good level of detail based on GIS data and site visit observations. The estimate quantified most of the roadway items.
- Maintenance of Traffic = 45%. MOT plans have not been developed at this stage; the MOT is anticipated to be complex and the MLE for pre-scoping is recommended.
- Hydraulics = 40%. The hydraulic design is based on general field conditions and record plans. The design is based on the flat terrain through the project and accounts for the challenges to construct an underground storm drain system. Drainage calculations have not been performed and pipe sizes are based on engineering judgement. Risks to the budget are additional drainage structures and outfalls required to provide positive drainage through the site.
- Traffic = 35%. The traffic design has been developed in coordination with VDOT traffic. The design team has identified potential locations for the traffic signals. The traffic estimate includes signal interconnect and ITS equipment replacement along US Route 11. The largest risk is associated with potential signal improvements at Crown Lane due to the new park and ride lot.
- Right-of-Way = 50%. Right-of-way impacts are at a preliminary engineering stage, and there is a potential for additional easement requirements than what is included in the concept plans.
- In-Plan Utilities = 40%.
- Structures/Bridge Design = 40%. Based on field observations and site conditions, a couple of small retaining wall will be required to avoid impacts on adjacent properties around the proposed roundabouts.
- Earthwork/Geotechnical = 50%. Earthwork quantities are based on GIS and site visit. Survey is not yet available.
- Environmental = 40%

A Risk Analysis Matrix was also developed to summarize and justify the risk assessment by category and identify mitigation strategies (see **Appendix M**).

4.6 Cost Estimate

a. Methodology

The project cost estimate was developed using the following methodology:

- Understanding the scope of improvements and design to be implemented.
- Gathering and reviewing information about the project including site visits and stakeholder input.
- Performing quantity take offs from the detailed design concept and identifying unit prices based on VDOT Bid Tab, and historical VDOT Cost data (2-year District and Statewide average).
- Developing allowance costs for some elements based on potential impacts and design complexity. Allowances for the elements are based on percentage of the base construction cost.
  - Maintenance of Traffic 25% Allowance
  - Erosion and Sediment Control 6% Allowance
  - Utility Relocations 5% Allowance
  - Traffic Items 3% Allowance
  - Seeding/Roadside/Landscaping 5% Allowance
  - Lighting 20% Allowance
- Identifying proposed property impacts, developing a Right of Way Data Sheet, and coordinating with VDOT to develop Right-of-Way costs. Note, 14 parcels are anticipated to be impacted (13 with Fee Taking and easements, and only 1 with just easements)
- Performing a risk assessment as outlined above and identifying appropriate contingency percentages by category.
- Developing Preliminary Engineering costs by category based on a percentage of the Construction cost (See the Cost Estimate for more details)

b. Cost Estimate Breakdown

The total 2024 project cost is estimated to be $24,910,832 (see **Appendix N** for detailed cost estimate information) and broken down by Phase/Major area as follows:

- Preliminary Engineering Phase $ 3,792,400
- Right of Way Phase $ 260,114
- Construction Phase $ 16,796,023
- CEI $ 4,062,294

4.7 Additional Study/Analysis Needs

a. Recommendations for Next Steps

Future work must include a detailed topographic survey and utility designation (Level B) with test pits (Level A) at potential utility conflict locations.

Future work would also include design development phases such as:

- Scoping Phase – Preliminary Field Inspection (PFI) Plans.
- Preliminary Design Phase – Public Hearing (PH) Plans
- Detailed Design Phase – Field Inspection (FI) Plans, utility field inspection, final environmental documentation.
- Final Design Phase – Right of Way (RW) Plans and acquisition, Pre-Advertisement Conference (PAC) Plans.

PROJECT PIPELINE

Appendix

PROJECT PIPELINE

Appendix A: Traffic Counts

DRPT Virginia Department of Rail and Public Transportation

Office of INTERMODAL Planning and Investment

VDOT Virginia Department of Transportation

PROJECT PIPELINE

Appendix B: Synchro Reports

DRPT Virginia Department of Rail and Public Transportation

Office of INTERMODAL Planning and Investment

VDOT Virginia Department of Transportation

PROJECT PIPELINE

Appendix C: STEAP Reports

DRPT Virginia Department of Rail and Public Transportation

Office of INTERMODAL Planning and Investment

VDOT Virginia Department of Transportation

PROJECT PIPELINE

Appendix D: Environmental Input Forms

DRPT Virginia Department of Rail and Public Transportation

Office of INTERMODAL Planning and Investment

VDOT Virginia Department of Transportation

Appendix E: 2052 Build Volume Figure

PROJECT PIPELINE

Appendix F: No-Build Synchro Reports

Virginia Department of Rail and Public Transportation

Office of INTERMODAL Planning and Investment

Virginia Department of Transportation

PROJECT PIPELINE

Appendix G: Build Concepts

DRPT Virginia Department of Rail and Public Transportation

Office of INTERMODAL Planning and Investment

VDOT Virginia Department of Transportation

PROJECT PIPELINE

Appendix H: Build Synchro Reports

DRPT Virginia Department of Rail and Public Transportation

Office of INTERMODAL Planning and Investment

VDOT Virginia Department of Transportation

PROJECT PIPELINE

Appendix I: Public Survey Results

Virginia Department of Rail and Public Transportation

Office of INTERMODAL Planning and Investment

Virginia Department of Transportation

PROJECT PIPELINE

Appendix J: Design Criteria

DRPT Virginia Department of Rail and Public Transportation

Office of INTERMODAL Planning and Investment

VDOT Virginia Department of Transportation

PROJECT PIPELINE

Appendix K: Site Photos

PROJECT PIPELINE

Appendix L: Concept Plans

DRPT Virginia Department of Rail and Public Transportation

Office of INTERMODAL Planning and Investment

VDOT Virginia Department of Transportation

PROJECT PIPELINE

Appendix M: Risk Assessment

DRPT Virginia Department of Rail and Public Transportation

Office of INTERMODAL Planning and Investment

VDOT Virginia Department of Transportation

PROJECT PIPELINE

Appendix N: Cost Estimate

DRPT Virginia Department of Rail and Public Transportation

Office of INTERMODAL Planning and Investment

VDOT Virginia Department of Transportation