PROJECT PIPELINE

RI-23-11: Hanover County
US 301 (Chamberlayne Road)

From I-295 to VA-638 (Atlee Road)

DRPT Virginia Department of Rail and Public Transportation

Office of INTERMODAL Planning and Investment

VDOT Virginia Department of Transportation

PROJECT PIPELINE

US 301 (Chamberlayne Road) from I-295 to VA-638 (Atlee Road)

Final Report

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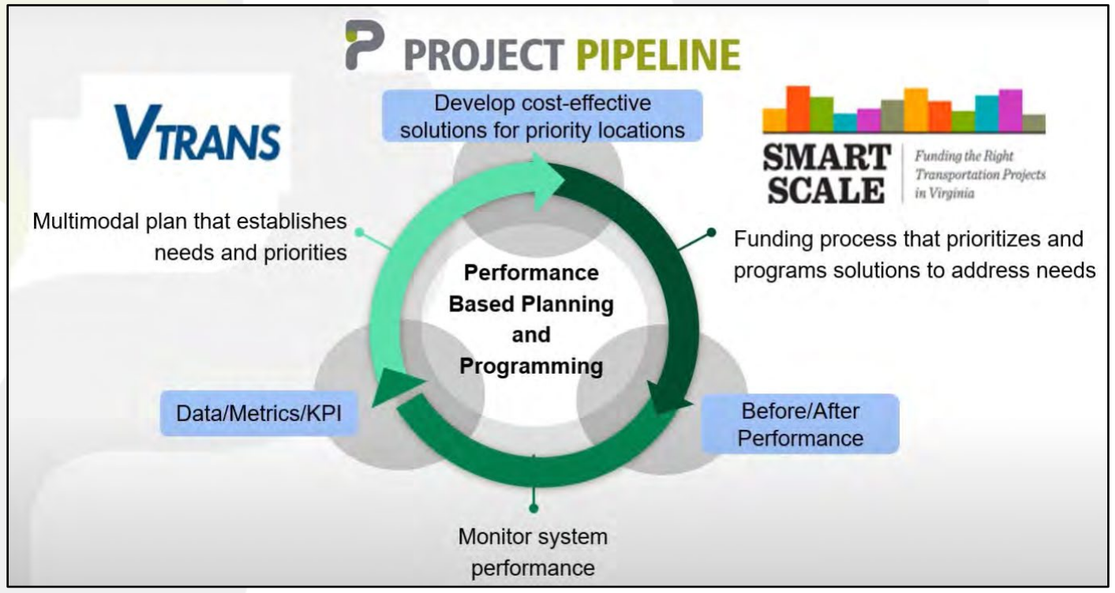
Chapter 1: Needs and Evaluation Diagnosis

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: https://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. PROJECT PIPELINE OBJECTIVES



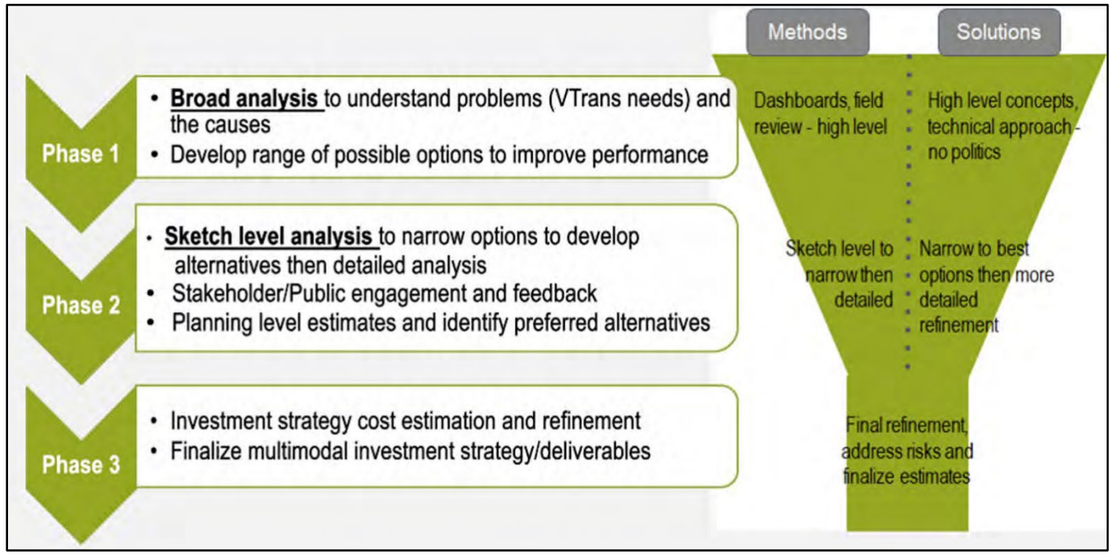
1.2. Methodology

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, and
- 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

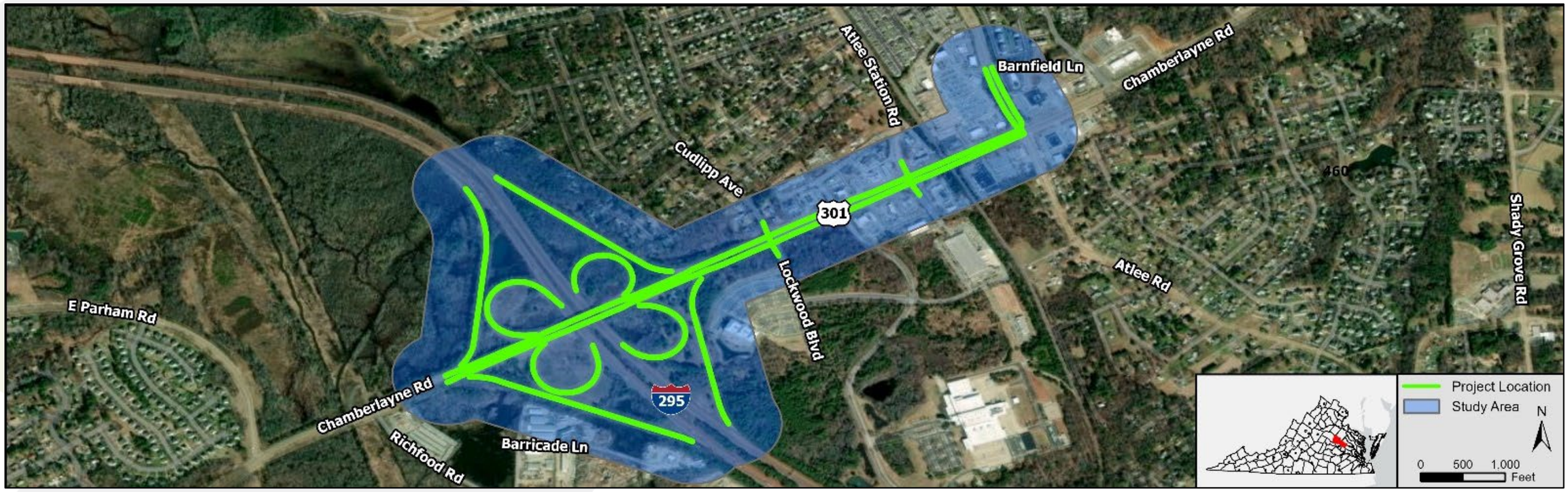


1.3. Study Area

The US 301 (Chamberlayne Road) study corridor between the southern I-295 ramps and VA-638 (Atlee Road) is located in Hanover County, Virginia. This segment is approximately 1.2 miles in length and also includes an additional 0.1 mile segment of VA-638 (Atlee Road) between US 301 (Chamberlayne Road) and Barnfield Lane.

The study corridor is classified as an Other Principal Arterial to the south of the I-295 bridge, and as Minor Arterial to the north with a posted speed limit of 45 miles per hour. The corridor provides access to numerous businesses and residential areas in Hanover County. Within the study area, US 301 (Chamberlayne Road) varies from a four to six-lane divided roadway with a 40-feet wide grass median. The area immediately surrounding the study corridor is primarily mixed-use residential and commercial businesses including grocery stores, numerous restaurants, gas stations, banks, and various others. The study area includes four signalized intersections, eight merge/diverge ramps from I-295, and other unsignalized access driveways along US 301 (Chamberlayne Road). In addition, the study area includes the unsignalized intersection of VA-638 (Atlee Road) and Barnfield Lane. A map detailing the extents of the study corridor and surrounding area is shown in **Figure 1.3**.

FIGURE 1.3. STUDY AREA



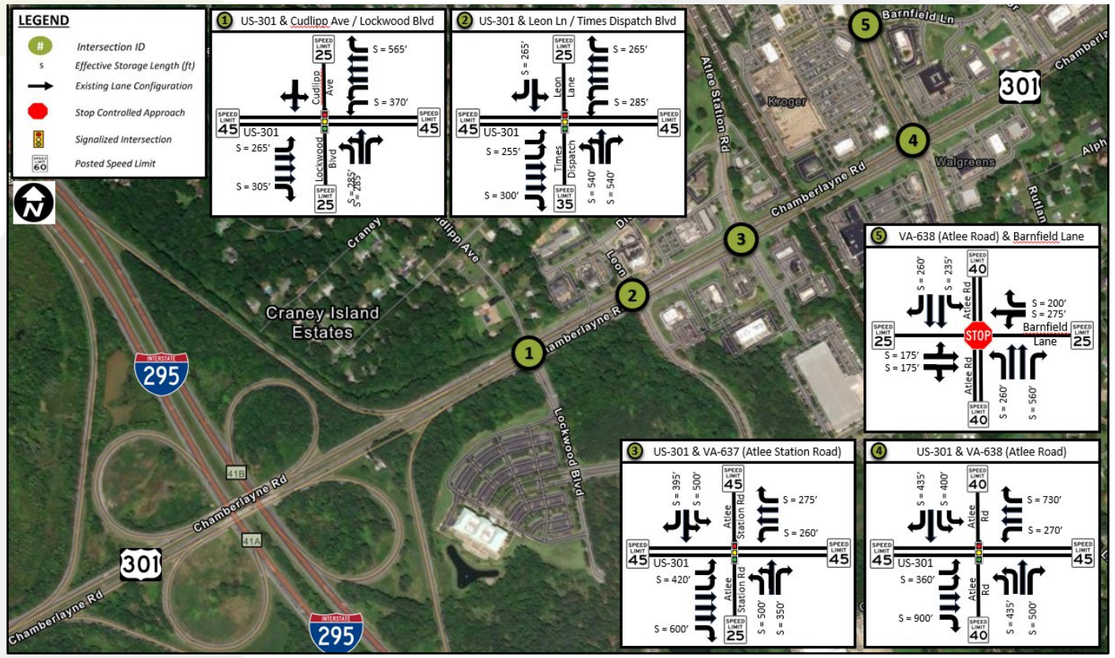
1.3.1. Study Area Intersections

Although the study area includes the I-295 interchange, the interchange itself was not analyzed as part of this study. The US 301 (Chamberlayne Road) study corridor includes five study intersections, four signalized and one unsignalized. These intersections are:

1. US 301 (Chamberlayne Road) & Cudlipp Avenue / Lockwood Boulevard (Signalized),
2. US 301 (Chamberlayne Road) & Leon Lane / Times Dispatch Boulevard (Signalized),
3. US 301 (Chamberlayne Road) & VA-637 (Atlee Station Road) (Signalized),
4. US 301 (Chamberlayne Road) & VA-638 (Atlee Road) (Signalized), and
5. VA-638 (Atlee Road) & Barnfield Lane (Unsignalized).

For the purposes of this study, US 301 is considered to be a north-south roadway. Streets intersecting US 301 are considered to be east-west, and roads running parallel to US 301 are considered to be north-south. Existing intersection lane configurations and speed limits for each of these locations are summarized in **Figure 1.4**.

FIGURE 1.4. EXISTING LANE CONFIGURATIONS & SPEED LIMITS



1.4. Project Background

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

1.4.1. 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)
- Hanover County
- Henrico County
- Richmond Regional Transportation Planning Organization (RRTPO)
- PlanRVA
- Virginia Department of Rail and Public Transportation (DRPT)
- WSP Consultant Team

1.4.2. Needs Diagnosis

The Office of Intermodal Planning and Investment (OIPI) prepared the VTrans Virginia's statewide transportation plan for the Commonwealth Transportation Board (CTB) in which mid-term needs (0 - 10 years) were identified for different categories listed in **Table 1.1**. This study focuses on addressing transportation needs identified in VTrans, and those previously identified by the localities.

TABLE 1.1. LIST OF VTRANS NEEDS & SYMBOLOGY

At the VDOT Construction District level, each identified need location is assigned a priority level from Low to Very High, with Very High representing the most critical needs and Low representing the least critical. The mid-term needs, as identified in VTrans for the study corridor, include:

- 'Very High" for Safety Improvement, Transit Access, and Transportation Demand Management (TDM),
- 'High' for Capacity Preservation, and
- 'Medium' for Bicycle Access.

The segments ranked as "Very High Priority" represent those with multiple categories identified as high in need. Items that identify as "None" indicate essentially no improvement need or demand need in the project area. A general Priority number is additionally assigned to the qualitative priority level. VTrans needs have been grouped based on their focus, as identified in **Table 1.2**.

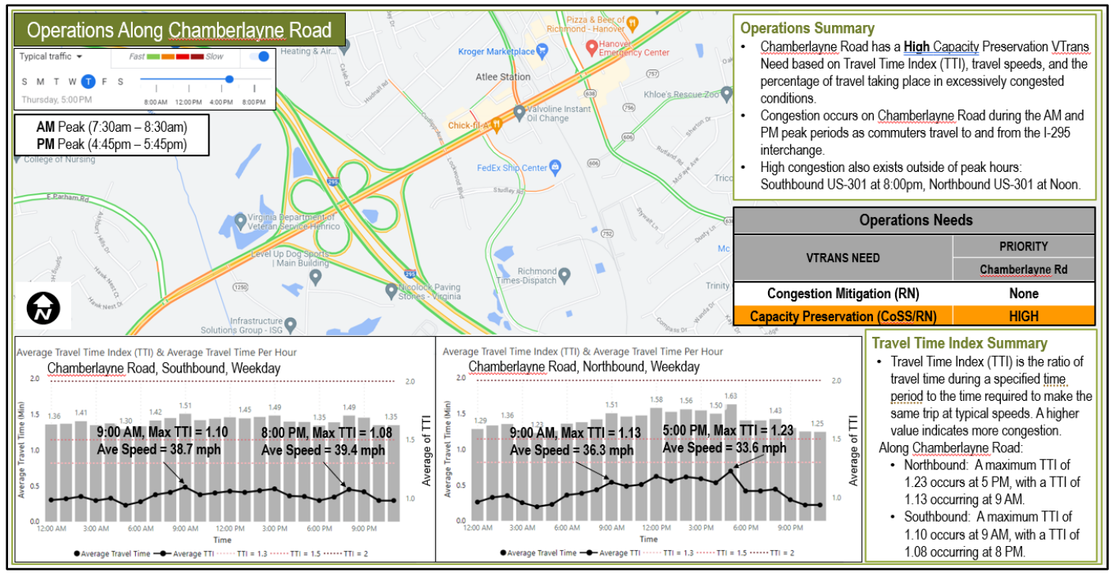
TABLE 1.2. VTRANS NEEDS IN THE STUDY AREA

Focus Area	VTrans Need Category	Priority	Priority Level
Operations	Capacity Preservation	High	2
	Congestion Mitigation	None	---
Pedestrian / Bicycle Access	Pedestrian Access	None	---
	Bicycle Access	Medium	3
	IEDA (UDA) Access	None	---
Safety & Reliability	Safety Improvement	Very High	1
	Pedestrian Safety Improvement	None	---
	Reliability	None	---
Transit / TDM / Rail	Rail On-time Performance	None	--
	Transit Access	Very High	1
	Transit Access for Equity Emphasis Areas	None	---
	Transportation Demand Management (TDM)	Very High	1

Figure 1.5 presents a map of the study area with roadway segments shown by their 2019 VTrans Richmond Construction District overall priority levels. Although there are no key intersections along the side streets except for the intersection of Atlee Road and Barnfield Lane, Atlee Station Road is identified below with a priority level for VTRans needs based on the interaction between the Atlee Station intersections at US 301 and at Dickey Drive intersection. A high-level analysis was conducted for the intersection at Dickey Drive to complement the evaluation at US 301.

FIGURE 1.5. VTRANS 2019 MID-TERM NEEDS BY CONSTRUCTION DISTRICT PRIORITY

FIGURE 1.6. HIGH-LEVEL VTRANS OPERATIONS NEEDS SUMMARY



1.4.3. Operations Needs

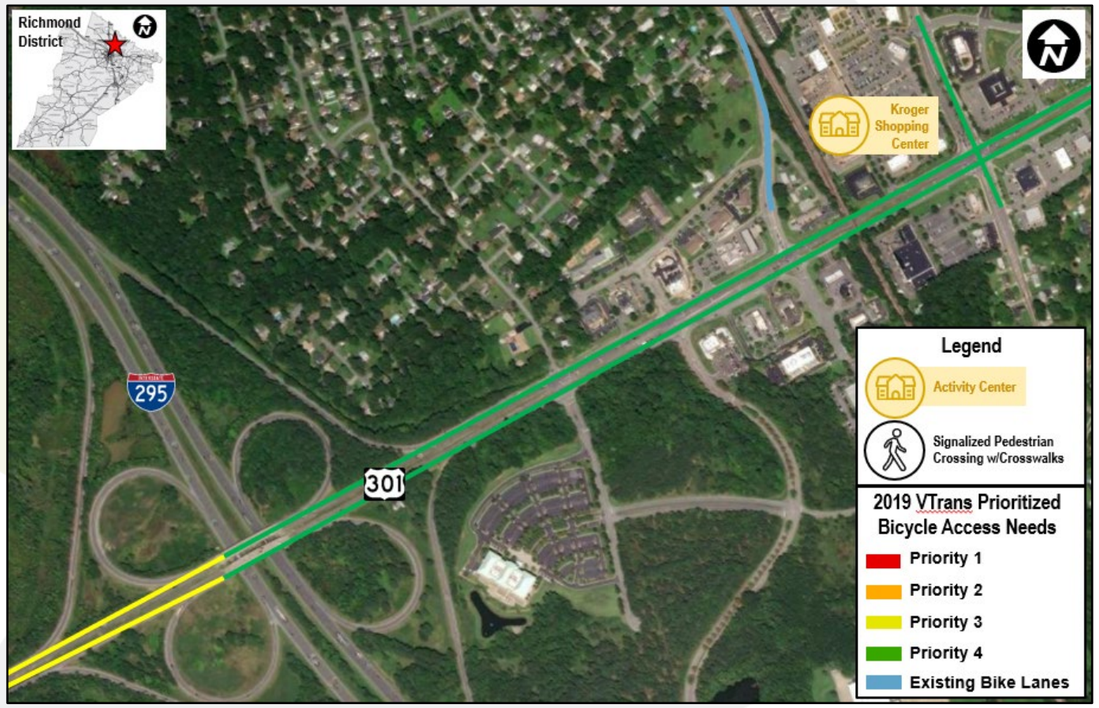
The ***operational*** issues intended to be addressed by this study include a 'High' Capacity Preservation VTrans need, which is based on the Travel Time Index (TTI), travel speeds, and the proportion of travel taking place during excessively congested conditions. No Congestion Mitigation VTrans need was identified within the study area. The 'High' priority capacity preservation needs are primarily located in the vicinity of the I-295 interchange. Congestion typically occurs during the AM and PM peak hours as commuters travel to and from the I-295 interchange. These high-level analyses informed the Study Work Group (SWG) of the most significant congestion hot spots in the study area. **Figure 1.6** includes additional details from the high-level operations need diagnosis. The SWG further investigated the operational needs by conducting existing traffic counts, future traffic demand volume forecasts, and operational analysis of existing and future no-build conditions using *Synchro/SimTraffic*.

1.4.4. Pedestrian / Bicycle Access Needs

The ***pedestrian and bicycle*** access needs intended to be addressed by this study include a 'Medium' Bicycle Access VTrans Need, which is based on the proximity to activity centers, fixed-guideway transit stations, or Bus Rapid Transit (BRT) lines. While no Pedestrian Access VTrans need was identified within the study area, pedestrian needs were still assessed to address 'Very High' priority Transportation Demand Management. The 'Medium' priority bicycle access needs are primarily located to the south of I-295 with the remainder of the study area considered a 'Low' priority bicycle access need as shown in **Figure 1.7**. The study area offers opportunities for connectivity across US 301 along US Bicycle Route-76 with enhanced bicycle accommodations, and connection to the existing bicycle lanes along VA-637 (Atlee Station Road). The SWG further investigated pedestrian and bicycle access needs by identifying existing

pedestrian and bicycle facilities in the study area and exploring improvements or expansion including adding sidewalks, shared-use paths, bicycle lanes, and/or ADA-compliant pedestrian facilities.

FIGURE 1.7. HIGH-LEVEL VTRANS BICYCLE ACCESS NEEDS SUMMARY



1.4.5. Safety and Reliability Needs

The study area has a 'Very High' ***safety improvement*** VTrans need. The SWG reviewed VDOT crash data from 2015-2022 to identify high-level crash trends in the study corridor. In total, 380 crashes were reported in the study area during this eight-year period with zero fatalities, 114 injury crashes, and 266 involving property damage only (PDO). Most crashes were either rear-end (55%) or angle (26%). **Figure 1.8** shows additional details regarding crashes within the study area which includes two 'Potential for Safety Improvement' (PSI) Intersections and one PSI Segment.

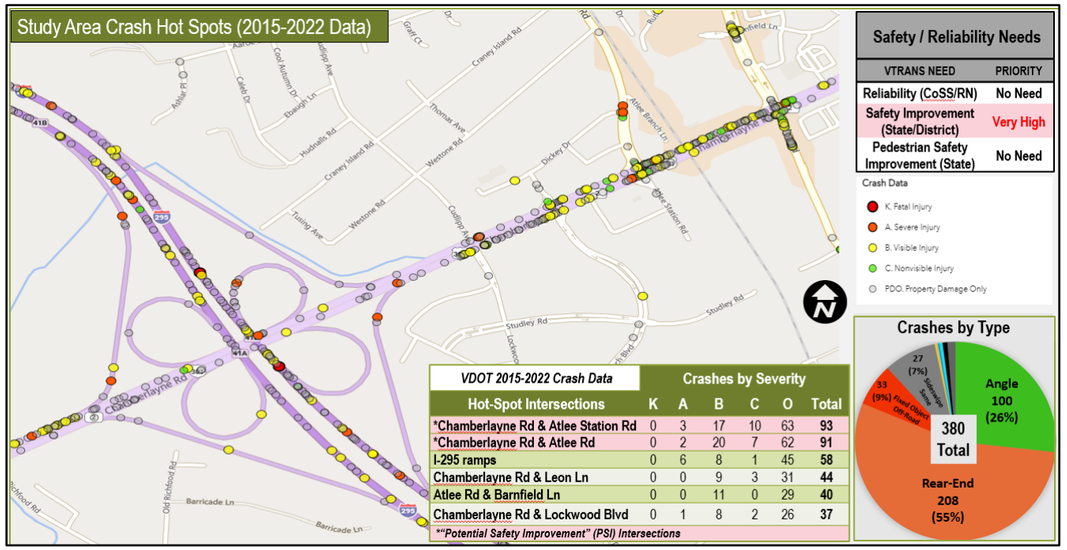
- US 301 & VA-637 (Atlee Station Road) is a PSI Intersection,
- US 301 & VA-638 (Atlee Road) is a PSI Intersection, and
- US 301 between these intersections is a PSI Segment.

Local stakeholders also brought safety concerns at two additional intersections to the attention of the SWG:

- VA-638 (Atlee Road) & Barnfield Lane, and
- VA-637 (Atlee Station Road) & Dickey Drive.

The SWG further investigated these crash hot spot locations with respect to vehicles, pedestrians, and cyclists and recommended safety improvements by evaluating crash patterns and existing roadway conditions.

FIGURE 1.8. HIGH-LEVEL VTRANS SAFETY IMPROVEMENT NEEDS SUMMARY

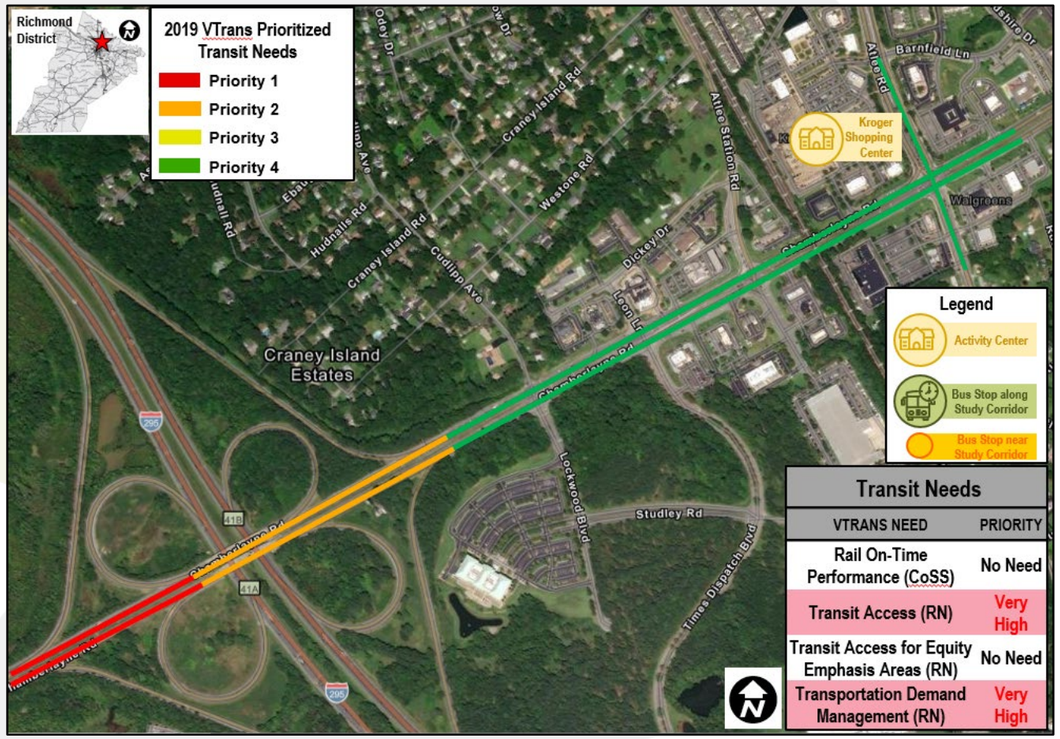


1.4.6. Transit Access / TDM / Rail Needs

The ***transit access*** needs intended to be addressed by this study include a 'Very High' Transit Access VTrans Need, particularly south of I-295, which is based on the number of workers that can access activity centers via public transit within 45 minutes versus via private automobile. Currently, there are no public transit services available along the corridor. The transit access needs are summarized in **Figure 1.9**. In addition, the study corridor includes a 'Very High' Transportation Demand Management (TDM) VTrans Need with no existing park-and-ride nor other intermodal facilities located along or near the study area. The only existing options available are ride-sharing services such as Uber and Lyft. The SWG will work with the Greater Richmond Transit Company (GRTC) and the Virginia Department of Rail and Public Transportation (DRPT) to mitigate these identified needs, the solutions for which may include expanded public

transportation services, new park-and-ride facilities, expanded multimodal accessibility, and commuter assistance programs.

FIGURE 1.9. HIGH-LEVEL VTRANS TRANSIT ACCESS NEEDS SUMMARY



1.5. Existing Traffic Operations Analysis

The SWG performed additional traffic operations analyses to further quantify the existing conditions and needs in the study area. Traffic operational analysis was performed using *Synchro/SimTraffic 11* software for all study intersections along the US 301 corridor. Inputs and analysis methodologies are consistent with the VDOT *Traffic Operations and Safety Analysis Manual (TOSAM)*, Version 2.0 guidelines. Both AM and PM peak hour analyses were performed to further evaluate the existing conditions and the overall performance of the study corridor.

1.5.1. Traffic Data

Existing traffic volume data along the study corridor was collected in May 2023. Eight-hour turning movement classification counts were collected from 6:30 AM to 10:30 AM and 3:00 PM to 7:00 PM at the following intersections:

1. US 301 (Chamberlayne Road) & E. Parham Road [Signalized],
2. US 301 (Chamberlayne Road) & Route 1250 (Richfood Road) [Signalized],
3. US 301 (Chamberlayne Road) & Lockwood Boulevard / Cudlipp Avenue [Signalized],
4. US 301 (Chamberlayne Road) & Times Dispatch Boulevard / Leon Lane [Signalized], and
5. US 301 (Chamberlayne Road) & VA-637 (Atlee Station Road) [Signalized].

In addition, 48-hour classification tube counts were collected at the following locations:

1. US 301 (Chamberlayne Road) / I-295 Interchange – All Ramps (8 movements),
2. US 301 (Chamberlayne Road) between Route 1250 (Richfood Road) & I-295 EB Ramps,
3. US 301 (Chamberlayne Road) between I-295 WB Ramps & Lockwood Boulevard / Cudlipp Avenue

Count data for the following intersections was provided by VDOT:

1. US 301 (Chamberlayne Road) & VA-638 (Atlee Road) [Signalized].
2. VA-638 (Atlee Road) & Barnfield Lane [Unsignalized].

1.5.1. Analysis Peak Periods

Weekday peak periods were identified from the count data for the arterial and for each study intersection. The common AM and PM peak hours for the overall network were determined based on the hourly variations in traffic volumes at each intersection, travel patterns along the study corridor, and percentage of traffic during the highest hour. The AM peak hour was determined to be between 7:30 and 8:30 AM, while the PM peak hour was determined to be between 4:45 and 5:45 PM. The raw turning movement counts are provided in **Appendix A**.

Peak Hour Factors (PHFs) were calculated at each intersection for the AM and PM peak hours using the turning movement count data. Similarly, heavy vehicle percentages were calculated for the AM and

PM peak hours per movement at each study intersection. *Synchro/SimTraffic* roadway speeds were set equal to the posted speed limit and roadway geometry was set up similar to that at the time of data collection. Existing traffic signal timing data was received from VDOT and used in the existing conditions model.

The raw traffic counts were balanced throughout the network. Traffic volume balancing was required considering individual peak hours and the resulting volume variations observed throughout the corridor. Intersection volumes were adjusted so that volumes between adjacent intersections were within 10% for most movements. This 10% threshold was allowed to be exceeded only where a significant number of access points (traffic generators or sinks) were located between the intersections.

1.5.1. Analysis Tool

Traffic operational analysis was performed using *Synchro/SimTraffic 11* software for all study intersections. Inputs and analysis methodologies are consistent with the *VDOT Traffic Operations and Safety Analysis Manual (TOSAM) Version 2* guidelines.

1.5.2. Measures of Effectiveness

There are many measures of effectiveness (MOEs) in traffic operations analysis to quantify operational objectives and provide a basis for evaluating the performance of a transportation network. Several MOEs for intersection analyses can be reported from *Synchro/SimTraffic*, *VJuST*, and *SIDRA*.

For the purposes of this study, guidance for reporting MOEs for signalized and unsignalized intersections was obtained from VDOT *TOSAM*, Version 2.0. A summary of the MOEs evaluated for the study intersections is presented below:

- Intersection Control Delay (measured in seconds per vehicle – sec/veh)
- Maximum Queue Lengths via *SimTraffic* (measured in feet – ft)

Level of Service (LOS) is a graded scale used to represent intersection delay (the delay associated with vehicles slowing in advance of an intersection, the time spent stopped on an intersection approach, the time spent as vehicles move up in the queue, and the time needed for vehicles to accelerate to their desired speed). It is important to point out that delay calculations from the Highway Capacity Manual (HCM, 7th edition – Transportation Research Board) methodology (deterministic) and simulation (stochastic) are different, especially for congested conditions (e.g., queue spillover between intersections, etc.). Therefore, the LOS represented in the results tables does not necessarily provide information on congestion resulting from complicated interactions between intersections. To provide a measurement/threshold for intersection operations, microsimulation delay has been translated to the same levels of service used by the HCM methodology. LOS is measured on a scale of "A" through "F," with LOS A representing the best operating conditions and LOS F representing the worst, based on the delay experienced at the intersection during the analysis period.

As indicated in the Highway Capacity Manual, LOS at an intersection is based upon the average amount of delay (seconds/vehicle) experienced by vehicles approaching the intersection. LOS thresholds for signalized and unsignalized intersections are shown in **Table 1.3**.

TABLE 1.3. LEVEL OF SERVICE DELAY THRESHOLDS

LOS	Signalized Delay (sec/veh)	Unsignalized Delay (sec/veh)	Traffic Flow Conditions
A	≤ 10	≤ 10	Free-flow
B	10-20	10-15	Reasonably Free-flow
C	20-35	15-25	Stable/Near Free-flow
D	35-55	25-35	Near Unstable
E	55-80	35-50	Unstable
F	≥ 80	≥ 50	Congested

1.5.1. Base Model Development

SYNCHRO/SIMTRAFFIC MODEL PARAMETERS AND INPUTS

AM and PM peak hour base *Synchro/SimTraffic* models were developed using the data discussed in this section, geometry at the time of data collection, and existing signal timing data from Hanover County. The SimTraffic input parameters were in accordance with Section 7.6.1 of VDOT TOSAM and included one 60-minute seed interval and four 15-minute recording intervals. To account for simulation variance, ten simulation runs were conducted and averaged together. The simulation settings generally remained at the default settings.

To provide a more accurate representation of field conditions, the existing conditions SimTraffic models were calibrated to reasonably replicate balanced field observed traffic volumes and travel times. This calibration process is an essential part of the model development as it ensures that the simulation reasonably replicates existing field conditions and can be used as the base for the evaluation of future scenarios.

A summary of the volume and travel time calibration is provided in **Table 1.4**, with supporting documentation in the Appendix.

TABLE 1.4. VOLUME CALIBRATION SUMMARY

Peak Period	Calibration Measure	Evaluation	Criteria	Total Number Evaluated	Total Number Met	Percent Met	Target Criteria	Target Met
AM	Volume (vph)	All Movements	Within ± 20% for < 100 vph Within ± 15% for ≥ 100 vph to < 300 vph Within ± 10% for ≥ 300 vph to < 1000 vph Within ± 5% for ≥ 1000 vph	313	294	94%	85%	Yes
PM	Volume (vph)	All Movements	Within ± 20% for < 100 vph Within ± 15% for ≥ 100 vph to < 300 vph Within ± 10% for ≥ 300 vph to < 1000 vph Within ± 5% for ≥ 1000 vph	333	291	87%	85%	Yes

MICROSIMULATION SAMPLE SIZE

In addition to conducting proper model calibration, determining and applying an appropriate number of microsimulation runs is an important step in developing accurate microsimulation results. WSP followed the guidelines provided in Section 5.4 of the VDOT *TOSAM* and utilized the macro-enabled VDOT *Sample Size Determination Tool* to finalize the number of *SimTraffic* runs necessary for correctly reporting arterial and intersection MOEs. Ten *SimTraffic* microsimulation runs were initially recorded following the guidelines for *SimTraffic* Input Parameters found in Section 7.6 of the VDOT *TOSAM*. The MOE, Average Travel Speed obtained from each of these ten runs was then input into the VDOT *Sample Size Determination Tool* to verify that MOEs from these runs meet the required tolerance error and confidence interval. Appendix B shows a screen capture of the VDOT Sample Size Determination Tool.

VOLUME CALIBRATION

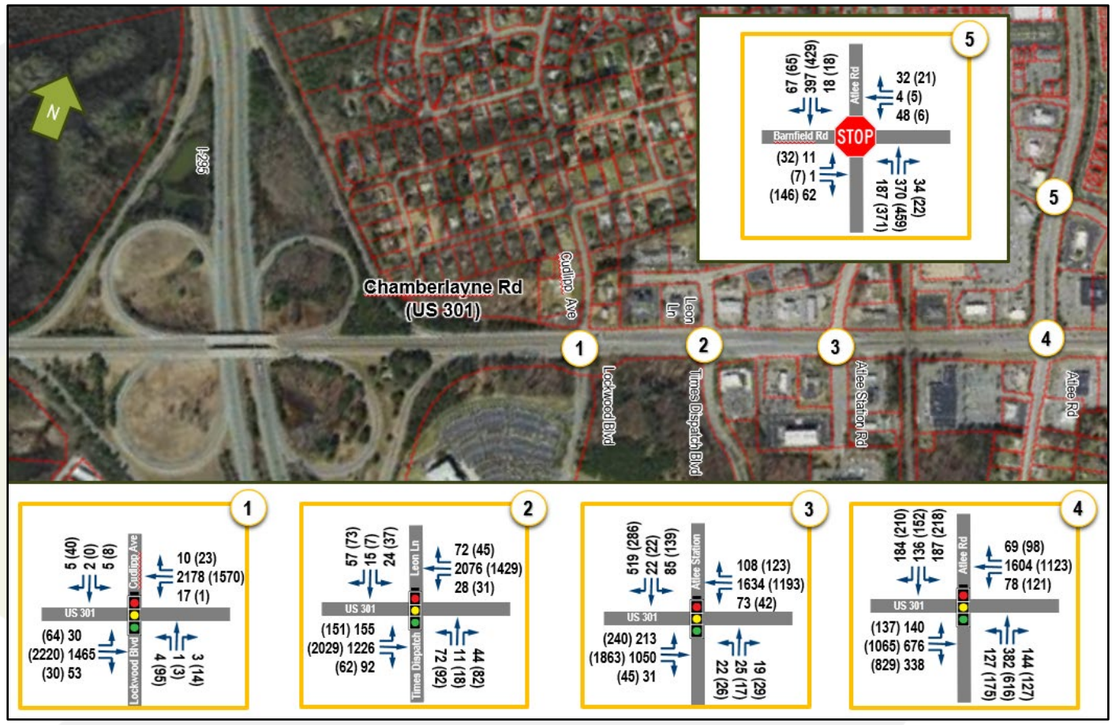
The volume calibration results summary in **Table 1.4** shows that the calibration parameters are met for both the AM and PM models. The full *SimTraffic* volume calibration results table is shown in the Appendix. The volume calibration includes a comparison between simulated volumes (the average of 10 runs) and balanced field counts modeled in *Synchro/SimTraffic* for the AM and PM peak hours. The tables show the difference and percentage difference between field counts and the average volume from the simulation runs.

TRAVEL TIME CALIBRATION

The travel time calibration meets the calibration parameters for both AM and PM models. The full *SimTraffic* travel time calibration results table is shown in the Appendix. The travel time calibration includes a comparison between theoretical (simulated) travel times obtained from an average of 10 simulation runs and the field measured travel times during the AM and PM peak hours.

The existing (2023) balanced AM and PM peak hour volumes are summarized in **Figure 1.10**.

FIGURE 1.10. EXISTING AM (PM) PEAK HOUR BALANCED VOLUMES



1.5.2. Existing Traffic Operations Analysis Results

In an effort to further examine the operational and accessibility needs along the study corridor, *SimTraffic* analysis was performed for the existing year 2023. Analysis was completed for the AM and PM peak hours for the existing conditions.

Delay in sec/veh was reported from SimTraffic for all signalized and unsignalized intersections. **Table 1.5** presents the AM and PM peak hour *SimTraffic* analysis delay and LOS summary for the existing conditions. The *SimTraffic* reports are included in **Appendix B**.

The operational analysis shows that all study intersections operate at an overall Level of Service (LOS) C or better during both AM and PM peak hours, except for the intersection of US 301 and VA-638 (Atlee Road), which operates at a LOS D overall during the PM peak hour and LOS F overall during the AM peak hour. All mainline US 301 (Chamberlayne Road) approaches operate at LOS C or better for all intersections except for the intersection with VA-638 (Atlee Road), where the northbound approach operates at LOS D during the PM peak hour and LOS F during the AM peak hour. Overall, the side streets along US 301 (Chamberlayne Road) operate at LOS D or better, with two exceptions. The westbound approach at VA-637 (Atlee Station Road) operates at LOS E during the AM peak hour, and the westbound approach at VA-638 (Atlee Road) operates at LOS F during both the AM and PM peak hours.

The analysis shows that all left-turn movements along US 301 experience congestion during both peak periods operating at LOS E or worse, except for the northbound left-turn movement from US 301 at Cudlipp Avenue / Lockwood Boulevard, which operates at LOS D during the PM peak hour. However, all through movements along US 301 operate at LOS C or better except for the US 301 northbound through movement at the intersection of VA-638 (Atlee Road) which operates at LOS F during the AM peak hour and LOS D during the PM peak hour.

Queue length, or the distance to which stopped vehicles accumulate in a lane at an intersection, is another performance measure of intersection operation. Lengthy queues may be indicative of intersection capacity or operational issues, such as absence of or insufficient length of dedicated turn lanes, inefficient signal timings or inappropriate signal phasing. When reporting queue length results from *HCS* or *Synchro/SimTraffic*, 95th percentile queue lengths are recorded. This queue length has only a five percent chance of being exceeded during a given analysis period. When reporting queue length results from *SimTraffic* or *Vissim*, maximum queue lengths are recorded. The maximum queue length is the longest queue length observed or simulated during a given analysis period.

A queuing analysis was completed for the study intersections during the AM and PM peak hours. **Table 1.6** provides a summary of the maximum queue lengths during the AM and PM peak hours as compared to the available storage bay lengths. The highlighted queue lengths in **Table 1.6** are the movements where the reported maximum queue length value equals or exceeds the existing available storage length for that turning movement. The *SimTraffic* output reports, including maximum queue lengths, are included in **Appendix B**.

The queueing analysis results indicate extensive queuing northbound and westbound at the intersection of US 301 (Chamberlayne Road) and VA-638 (Atlee Road) during both the AM and PM peak hours. Along northbound US 301 (Chamberlayne Road), the left-turn lane length is not long enough to support the demand during both the AM and PM peak hours. During the AM peak hour, the northbound right-turn lane is not long enough to support demand and through queues also extend past the upstream intersection (Rutlandshire Drive). In addition, the westbound left- and right-turn lanes along VA-638 (Atlee Road) are not long enough to support the demand during both the AM and PM peak hours.

The queuing analysis also revealed that the northbound right-turn lane along US 301 (Chamberlayne Road) is not of sufficient length to support demand during the PM peak hour at the intersection of VA-637 (Atlee Station Road).

TABLE 1.5. EXISTING CONDITIONS SIMTRAFFIC ANALYSIS DELAY & LOS RESULTS

Intersection Number and Description	Type of Control	Lane Group	Southbound		Northbound		Westbound		Eastbound		Overall	
			AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
			Delay (s)	Delay (s)	Delay (s)	Delay (s)	Delay (s)	Delay (s)	Delay (s)	Delay (s)	Delay (s)	Delay (s)
1: Lockwood Boulevard / Rte 1206 (Cudlipp Avenue) & US 301 (Chamberlayne Road)	Roadway		US 301		US 301		Lockwood Boulevard		Cudlipp Avenue		Intersection	
	Signal	Left	70.0	64.3	62.4	52.4	65.8	60.5	81.7	64.0	5.5	9.4
		Through	2.8	7.9	6.1	8.5	37.8	55.9	55.5	0.0		
		Right	1.1	2.7	2.2	2.2	10.6	18.8	19.0	14.6		
		Approach	*3.9*	*7.7*	*6.5*	*8.5*	*34.7*	*54.6*	*48.4*	*22.9*		
2: Times Dispatch Boulevard / Leon Lane & US 301 (Chamberlayne Road)	Roadway		US 301		US 301		Times Dispatch Boulevard		Leon Lane		Intersection	
	Signal	Left	65.2	69.2	72.9	57.2	61.3	60.0	65.6	65.3	21.7	17.4
		Through	9.8	10.7	24.9	18.4	69.8	66.5	70.5	57.4		
		Right	2.5	4.0	12.0	6.9	1.8	1.9	1.1	1.1		
		Approach	*15.1*	*14.6*	*25.1*	*19.0*	*41.3*	*35.1*	*27.4*	*23.4*		
3: VA-637 (Atlee Station Road) & US 301 (Chamberlayne Road)	Roadway		US 301		US 301		Atlee Station Road		Atlee Station Road		Intersection	
	Signal	Left	121.5	81.0	66.3	64.1	63.4	60.4	1.4	52.0	26.2	22.6
		Through	9.9	12.4	22.0	25.4	63.3	62.4	55.9	52.6		
		Right	3.3	4.2	9.6	11.8	35.6	31.2	19.7	4.7		
		Approach	*28.8*	*20.0*	*23.0*	*25.3*	*56.0*	*49.2*	*26.5*	*22.6*		
4: VA-638 (Atlee Road) & US 301 (Chamberlayne Road)	Roadway		US 301		US 301		Atlee Road		Atlee Road		Intersection	
	Signal	Left	66.8	62.3	332.5	130.1	140.7	166.8	56.8	52.5	170.8	53.9
		Through	18.0	23.2	314.4	40.6	241.5	326.8	66.4	56.9		
		Right	4.7	24.4	230.6	5.1	44.4	54.7	3.6	3.8		
		Approach	*20.0*	*26.2*	*312.2*	*45.8*	*179.2*	*261.6*	*40.6*	*36.2*		
5: VA-638 (Atlee Road) & Barnfield Lane	Roadway		Barnfield Lane		Shopping Center		Atlee Road		Atlee Road		Intersection	
	Side-Street Stop	Left	18.6	24.3	19.6	22.0	9.5	10.3	2.8	2.0	3.7	4.2
		Through	9.2	25.5	24.4	28.2	2.5	2.2	0.5	0.7		
		Right	4.1	4.8	4.2	3.4	2.2	1.9	0.2	0.2		
		Approach	*6.3*	*9.1*	*13.7*	*10.0*	*4.7*	*5.8*	*0.5*	*0.6*		

TABLE 1.6. EXISTING CONDITIONS SIMTRAFFIC ANALYSIS MAXIMUM QUEUE LENGTH RESULTS

Intersection Number and Description	Type of Control	Lane Group	Southbound			Northbound			Westbound			Eastbound		
			Storage Length [ft]	AM Max Queue [ft]	PM Max Queue [ft]	Storage Length [ft]	AM Max Queue [ft]	PM Max Queue [ft]	Storage Length [ft]	AM Max Queue [ft]	PM Max Queue [ft]	Storage Length [ft]	AM Max Queue [ft]	PM Max Queue [ft]
1: Lockwood Boulevard / Rte 1206 (Cudlipp Avenue) & US 301 (Chamberlayne Road)			Roadway	US 301 (Chamberlayne Road)		US 301 (Chamberlayne Road)			Lockwood Boulevard			Rte 1206 (Cudlipp Avenue)		
	Signal	Left	265	79	127	370	51	16	285	39	100	---	41	77
		Through	---	136	264	570	387	298	285	39	135			
		Right	305	31	63	570	9	19	285	41	32			
2: Times Dispatch Boulevard / Leon Lane & US 301 (Chamberlayne Road)			Roadway	US 301 (Chamberlayne Road)		US 301 (Chamberlayne Road)			Times Dispatch Boulevard			Leon Lane		
	Signal	Left	255	170	159	285	175	59	540	107	115	195	106	113
		Through	575	246	294	595	458	307	---	132	144			
		Right	300	58	51	265	243	43	---	0	0	165	13	6
3: VA-637 (Atlee Station Road) & US 301 (Chamberlayne Road)			Roadway	US 301 (Chamberlayne Road)		US 301 (Chamberlayne Road)			VA-637 (Atlee Station Road)			VA-637 (Atlee Station Road)		
	Signal	Left	420	297	234	260	206	172	500	75	60	500	113	138
		Through	615	258	355	1,080	442	412	500	112	95	500	363	162
		Right	600	3	0	275	212	275	350	65	79	395	380	199
4: VA-638 (Atlee Road) & US 301 (Chamberlayne Road)			Roadway	US 301 (Chamberlayne Road)		US 301 (Chamberlayne Road)			VA-638 (Atlee Road)			VA-638 (Atlee Road)		
	Signal	Left	360	152	133	270	270	270	435	435	435	400	164	166
		Through	1,100	240	330	835	2,454	603	---	651	631	695	271	238
		Right	925	123	436	730	730	132	500	500	500	435	0	71
5: VA-638 (Atlee Road) & Barnfield Lane			Roadway	Barnfield Lane		Barnfield Lane			VA-638 (Atlee Road)			VA-638 (Atlee Road)		
	Side-Street Stop	Left	175	28	65	275	77	27	260	150	139	235	38	25
		Through							685	0	2	510	8	7
		Right	175	44	79	200	46	26	600	0	0	260	20	21

1.6. Existing Pedestrian and Bicycle Facilities

To assess existing conditions with respect to accessibility, the study team reviewed existing facilities for pedestrian and bicycle accommodations.

1.6.1. Pedestrian Access

While there was no Pedestrian Access VTrans Need identified along the study corridor, pedestrian access was assessed due to the presence of some existing facilities within the study area and the potential to expand the pedestrian network along with addressing the Bicycle Access VTrans Need. The findings regarding existing pedestrian facilities are as follows:

- There are no existing sidewalks along US 301 (Chamberlayne Road) in the study area.
- There are existing sidewalks located along both sides of VA-638 (Atlee Road). These sidewalks are located along both the east and west legs at the intersection with US 301 (Chamberlayne Road) and extend to the west, through the intersection with Barnfield Lane. However, there are no marked crosswalks or pedestrian signals to provide connectivity across US 301 or across Barnfield Lane.
- The intersection of VA-638 (Atlee Road) and Barnfield Lane does include an unsignalized marked crosswalk across the east leg of the intersection, crossing VA-638 (Atlee Road).
- There are no other existing marked crosswalks or pedestrian signals located in the study area.
- There were no reported crashes involving pedestrians between 2015 and 2022.

1.6.2. Bicycle Access

There is a 'Medium' Bicycle Access VTrans Need identified along the study corridor, and the findings regarding existing bicycle facilities are as follows:

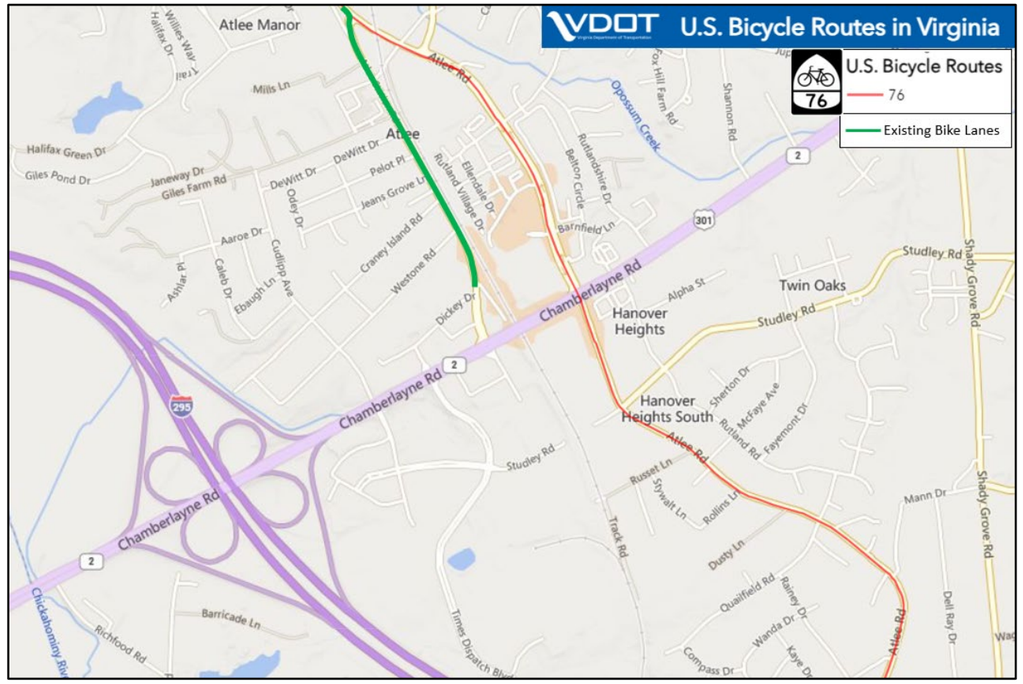
- There are no existing bicycle lanes or shared-use paths along US 301 (Chamberlayne Road) in the study area.
- There are existing bicycle lanes located along both sides of VA-637 (Atlee Station Road) which begin just west of Giles Farm Road and extend to the west. These bicycle lanes are assumed to be separate from US Bike Route 76.
- There were no reported crashes involving bicyclists between 2015 and 2022.

The study area offers opportunities for connectivity along the designated US-76 Bicycle Route with enhanced bicycle accommodations, and connection to the existing bicycle lanes along VA-637 (Atlee Station Road).

US Bicycle Route 76, a part of the TransAmerica Trail, runs from the Kansas-Missouri border to Yorktown, VA. Along with US Bicycle Route 1, it is one of the two original US Bicycle Routes established by AASHTO. The current alignment of US Bicycle Route 76 is approximately 533 miles long and crosses 38 Virginia localities, including 23 counties, four independent cities, and 11 incorporated towns.

In the study area, US Bicycle Route 76 is designated to run along VA-638 (Atlee Road) as shown in **Figure 1.11**. However, besides the existing bicycle lanes along VA-637 (Atlee Station Road), there are no bicycle facilities to accommodate the bike route. During the Project Pipeline Kickoff Meeting held on July 10, 2023, Hanover County stakeholders pointed out that the VDOT Map shown in **Figure 1.11** is inaccurate and needs to be updated showing that the route follows the existing bike lanes along VA-637 (Atlee Station Road), then follows US 301 (Chamberlayne Road) back to VA-638 (Atlee Road). The updated route has yet to be confirmed by Hanover County and an updated US Bicycle Route 76 Map has not yet been provided to the SWG. Still, this study presents an opportunity to provide bicycle facility connections to continue the US Bicycle Route 76 network across US 301.

FIGURE 1.11. US BICYCLE ROUTE 76 STUDY AREA MAP



Note: Southern terminus of existing field-verified Marked bicycle lanes on Atlee Station Road is Giles Farm Road

1.1. Existing Transit / TDM / Rail

There are no existing fixed route transit facilities present within the corridor. The closest fixed-route transit service in the study area is GRTC Route 1 (Chamberlayne/Downtown) running mainly along Chamberlayne Road and terminating approximately four miles through the southern end of the study area. GRTC Route 1 buses operate every thirty minutes Monday thru Saturday from 6:00 a.m. until 7:00 p.m. and has no Sunday service. GRTC operates their LINK Azalea zone-based service near but not within the study corridor. Hanover County operates their DASH zoned-based on-demand service in the area, provided for specialized needs.

There are no existing park-and-ride nor other intermodal facilities located along or near the study area. The only existing options available are ride-sharing services such as Uber and Lyft. There are limited pedestrian and bicycle facilities in the area to encourage multimodal trip options.

1.1. Equity Analysis

An equity analysis was performed along the study area corridor to determine the demographics of the population around the project area. This equity analysis was performed using the Federal Highway Administration (FHWA) online tool - Screening Tool for Equity Analysis of Projects (STEAP). This tool assesses a geographic area of 0.5 miles on each side of the corridor and utilizes survey data between 2016 and 2020 to report demographics of the corridor area as compared to the city and state. The result of the study area's population by race and household income are:

- Population by Race
  - White: 82%
  - Black: 11%
  - Asian: 3%
  - American Indian: 0%
  - Other: 1%
  - Two or more Races: 4%

- Household Annual Income
  - > $75,000: 65%
  - $50,000 - $75,000: 17%
  - $35,000 - $50,000: 7%
  - $25,000 - $35,000: 5%
  - $15,000 - $25,000: 3%
  - < $15,000: 2%

The full analysis report is included in **Appendix C**.

1.2. Safety Analysis

For the existing analysis, the VDOT Project Pipeline Data Dashboard Tool was utilized to determine the reported crash history at the study intersections and along the US 301 (Chamberlayne Road) study corridor. Crash data was collected and analyzed for an eight-year period spanning from January 2015 to December 2022 to determine specific reported crash trends and "hot spot" areas for consideration in developing alternative safety improvement concepts. For the purposes of this analysis, "injury crashes" are defined as the sum of type A (severe injury), B (visible injury), and C (non-visible injury) crashes on the KABCO scale per the Federal Highway Administration.

1.2.1. Safety Analysis Results

A total of 380 crashes were reported along US 301 (Chamberlayne Road) within the study area during the eight-year study period with zero fatal crashes. The severity of crashes within the study area are summarized by year in **Table 1.5**, and by crash type in **Table 1.6**, respectively.

Key takeaways from the crash data are as follows:

- Twelve crashes (3.1%) were reported as severe (A) injury crashes, including seven rear-end collisions, four fixed-object off road crashes, and one angle crash.
- A total of 114 crashes resulted in injuries, which account for 30% of the total reported crashes along the study corridor. These crashes include 71 rear-end crashes, 32 angle crashes, six fixed-object off-road crashes, three sideswipe same-direction collisions, one head-on collision, and one "non-crash".
- The majority of reported crashes within the study corridor are rear-end (54.5%) and angle (26.3%) crashes. Combined, these two crash types constitute approximately 80% of the total crashes.

1.2.1. Intersection Safety Analysis Results

The study corridor includes two 'Potential for Safety Improvement' (PSI) Intersections, and two additional intersections where concerns were raised by local stakeholders. These "hot spot" intersections were examined in more detail to determine any existing reported crash patterns for consideration in developing alternative safety improvement concepts.

TABLE 1.7. CRASH SEVERITY BY YEAR

Crash Year	A. Severe Injury	B. Visible Injury	C. Nonvisible Injury	O. Property Damage Only	*Total*
2015	2	12	7	31	***52***
2016	2	4	6	29	***41***
2017	3	11	3	27	***44***
2018	2	11	5	48	***66***
2019	1	8	1	28	***38***
2020	0	6	1	26	***33***
2021	0	13	1	38	***52***
2022	2	12	1	39	***54***
Total	***12 (3.1%)***	***77 (20.3%)***	***25 (6.6%)***	***266 (70.0%)***	***380***

TABLE 1.8. CRASH TYPES BY SEVERITY LEVEL

Crash Type	A. Severe Injury	B. Visible Injury	C. Nonvisible Injury	O. Property Damage Only	*Total (Percent)*
Rear End	7	43	21	136	***207 (54.47%)***
Angle	1	28	3	68	***100 (26.32%)***
Fixed Object – Off Road	4	2	0	27	***33 (8.68%)***
Sideswipe – Same Direction	0	2	1	24	***27 (7.11%)***
Non-Collision	0	1	0	3	***4 (1.05%)***
Deer	0	0	0	4	***4 (1.05%)***
Head On	0	1	0	1	***2 (0.53%)***
Other	0	0	0	2	***2 (0.53%)***
Sideswipe – Opposite Direction	0	0	0	1	***1 (0.26%)***
Total	***12***	***77***	***25***	***266***	***380***

In the crash diagrams below, the dots on the map correspond to the severity level indicated in the key on the top left of each diagram. The collision type chart corresponds to the color legend immediately adjacent to the chart.

1.2.2. US 301 (Chamberlayne Road) & VA-637 (Atlee Station Road)

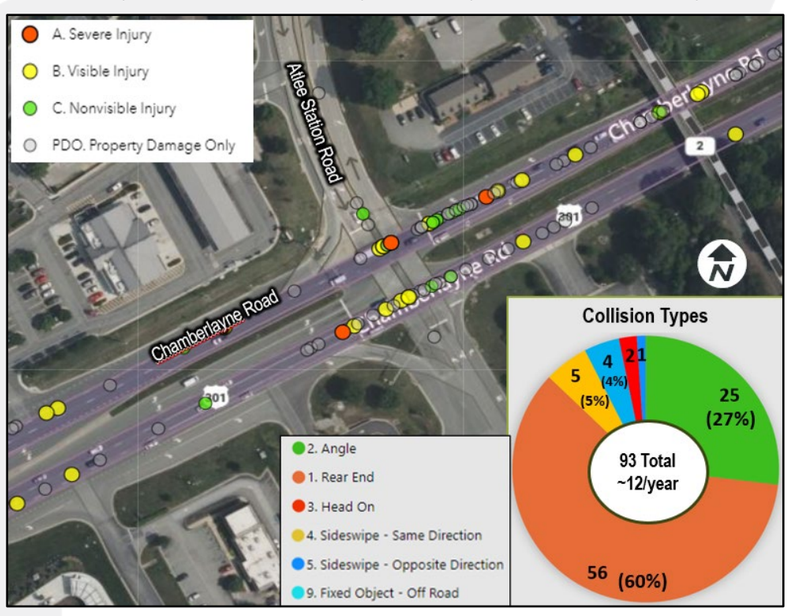
The intersection of US 301 (Chamberlayne Road) and VA-637 (Atlee Station Road) is a PSI Intersection which experienced 93 total crashes, an average of 12 crashes per year, over the eight-year period spanning from 2015 through 2022. A more detailed collision diagram for this intersection is shown in **Figure 1.12**.

60 percent of all crashes at this intersection were rear-end collisions, with 71 percent of the rear-end crashes occurring along northbound US 301 (Chamberlayne Road), most likely resulting from traffic congestion. The operational analysis showed the northbound US 301 approach operating at LOS C in both the AM and PM peak hours, but the left turn movement operates at LOS E during both peak hours and right-turn lane with excessive queuing during the PM peak hour.

27 percent of crashes at this intersection were angle collisions. Because this is a signalized intersection, these collisions are likely the result of red light running or permitted right-turns on red. The existing signal phasing includes protected left turns from US 301.

68 percent of crashes were property damage only (PDO) and, 32 percent resulting in injury crashes, which is in line with the crash severity patterns of the overall study corridor.

FIGURE 1.12. US 301 (CHAMBERLAYNE ROAD) & VA-637 (ATLEE STATION ROAD) CRASH DIAGRAM



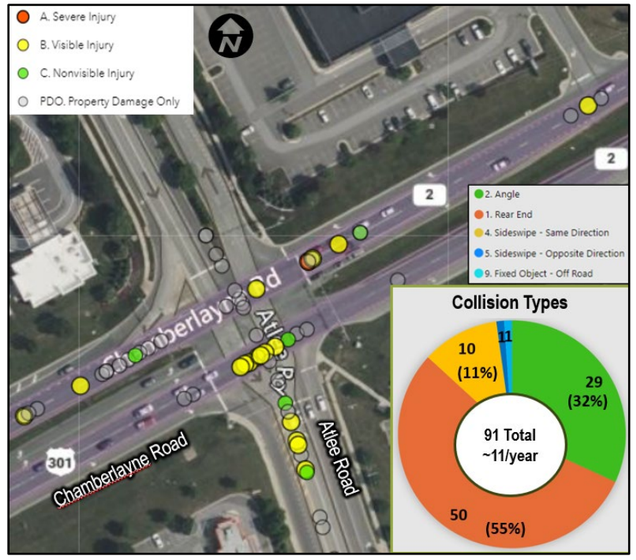
1.2.3. US 301 (Chamberlayne Road) & VA-638 (Atlee Road)

The intersection of US 301 (Chamberlayne Road) and VA-638 (Atlee Road) is a PSI Intersection which experienced 91 total crashes, an average of 11 crashes per year, over the eight-year period from 2015 through 2022. A more detailed collision diagram for this intersection is shown in **Figure 1.13**. 32 percent of collisions resulted in an injury, which is in line with the crash severity patterns for the overall corridor.

55 percent of crashes at this intersection were rear-end collisions, with 64 percent of the rear-end crashes occurring along northbound US 301 (Chamberlayne Road), and 22 percent occurring along westbound VA-638 (Atlee Road), most likely resulting from traffic congestion. The operational analysis showed the northbound US 301 (Chamberlayne Road) approach operating at LOS F during the AM peak hour and LOS D during the PM peak hour. All northbound US 301 movements operate at LOS F in the AM peak hour with excessive queues for all movements. During the PM peak hour, the northbound left-turn movement operates at LOS F with excessive queues. In addition, the westbound VA-638 (Atlee Road) approach operates at LOS F during both the AM and PM peak hours with excessive left- and right-turn queue lengths.

32 percent of crashes at this intersection were angle collisions. Because this is a signalized intersection, these collisions are likely the result of red light running or permitted right-turns on red. The existing signal phasing includes protected left turns from US 301.

FIGURE 1.13. US 301 (CHAMBERLAYNE ROAD) & VA-638 (ATLEE ROAD) CRASH DIAGRAM



1.2.4. VA-638 (Atlee Road) & Barnfield Lane

The intersection of VA-638 (Atlee Road) and Barnfield Lane was identified as a location with traffic safety concerns by local stakeholders, experiencing 40 total crashes, an average of five crashes per year, over the eight-year period from 2015 through 2022. A more detailed collision diagram for this intersection is shown in **Figure 1.14**. 27 percent of crashes resulted in an injury, which is in line with the crash severity patterns for the study area.

90 percent of crashes at this intersection were angle collisions with 66 percent of those angle crashes involving a vehicle traveling westbound along VA-638 (Atlee Road). This is a two-way stop-controlled intersection with the stop control along the Barnfield Lane and shopping center approaches. According to a 2019 VDOT study, it does not meet traditional traffic signal warrants per the Manual on Uniform Traffic Control Devices (MUTCD). Both Barnfield Lane approaches have two lanes; however, the southbound approach has no lane markings.

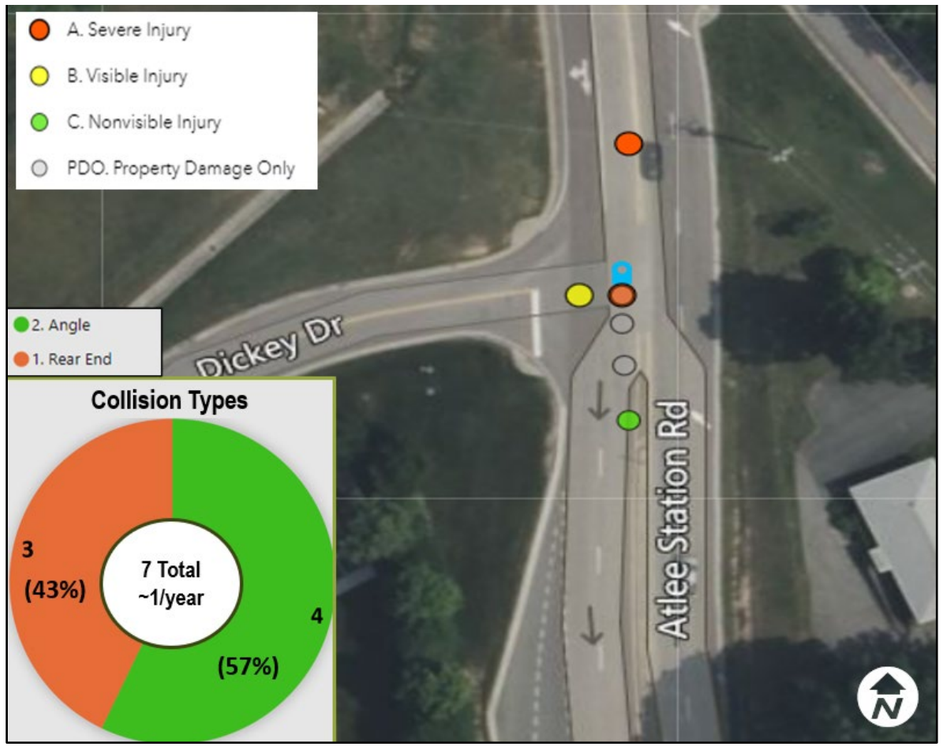
FIGURE 1.14. VA-638 (ATLEE ROAD) & BARNFIELD LANE CRASH DIAGRAM

1.2.5. VA-637 (Atlee Station Road) & Dickey Drive

The intersection of VA-637 (Atlee Station Road) and Dickey Drive was identified as a location with traffic safety concerns by local stakeholders, experiencing 7 total crashes, an average of slightly less than one crash per year, over the eight-year period from 2015 through 2022. 57 percent of these crashes resulted in an injury. A more detailed collision diagram for this intersection is shown in **Figure 1.15**.

57 percent of crashes at this intersection were angle collisions and the other 43 percent rear-end. This is a three-legged intersection with stop control on Dickey Drive. VA-637 (Atlee Station Road) transitions from one to two through lanes in the eastbound direction just prior to the intersection. Along westbound VA-637 (Atlee Station Road), the roadway reduces from two through lanes to one through lane immediately west of the intersection, which may contribute to some of the safety concerns and reported crashes at the intersection.

FIGURE 1.15. VA-637 (ATLEE STATION ROAD) & DICKEY DRIVE CRASH DIAGRAM



1.3. Future Traffic Volumes

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

1.3.1. Traffic Forecasting Methodology

The following sources were reviewed to determine the growth rates to apply to the existing traffic volumes and grow to the future design year, based upon the guidance in the National Cooperative Highway Research Program (NCHRP) Report 765: *Analytical Travel Forecasting Approaches for Project-Level Planning and Design Methodology*:

- ***Pathways for Planning (P4P)***
  Pathways for Planning (P4P) is an interactive mapping and data analysis tool, that 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 from 2020 through 2022 was considered in context based on impacts to traffic patterns and volumes from the Covid pandemic. 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 uses base year data for 2017 and future data for 2045. 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.

It is important to note that traffic counts were collected in May 2023. Intersection peak hour counts, and tube counts were performed along the study corridor, with intersection data being collected at every intersection along Chamberlayne Road between Cudlipp Road / Lockwood Boulevard and Atlee Road and at the Atlee Road / Barnfield Lane intersection. Tube counts were collected on all ramps at the I-295 / US 301 interchange and on Chamberlayne Road between Cudlipp Avenue / Lockwood Boulevard and the I-295 WB ramps.

1.3.2. Future Design Year

The future design year is based on the purpose of the project. *VDOT Traffic Forecasting Guidebook, Section 3.2* was used to recommend the 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 timeframe 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.
- Similar Project Pipeline projects having a future design year of 2052. This allows for a SMART SCALE funding year of 2026-2027, with a potential opening year of 2032 and design year of 2052.

1.3.3. Annual Average Growth Rate (AAGR)

PATHWAYS FOR PLANNING (P4P)

Annual historical volumes were analyzed in *VDOT Pathways for Planning (VDOT P4P)* 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. **Table 1.7** shows the annual average growth rates obtained from the *VDOT P4P* tool for the selected segments. The trend of historic volumes is illustrated in **Figure 1.16**. The analysis of the trend of historic volumes for the Chamberlayne Road study suggests a need to consider several growth rates throughout the study area.

RTC REGIONAL TRAVEL DEMAND MODEL (TDM)

The model forecasts were checked for adequacy. It was determined that TDM results should not be applied to this study based on the quality of the data – the 2017 AADTs from the TDM along both Chamberlayne Road and Atlee Road were at least 38% higher than the actual 2017 AADTs, some being more than 300% (three times) higher. Since the model outputs showed more than 30% deviation from field counts, TDM data was not considered in determination of the growth rate for this study. The model outputs are included in Appendix A for information purpose only.

RELEVANT STUDIES

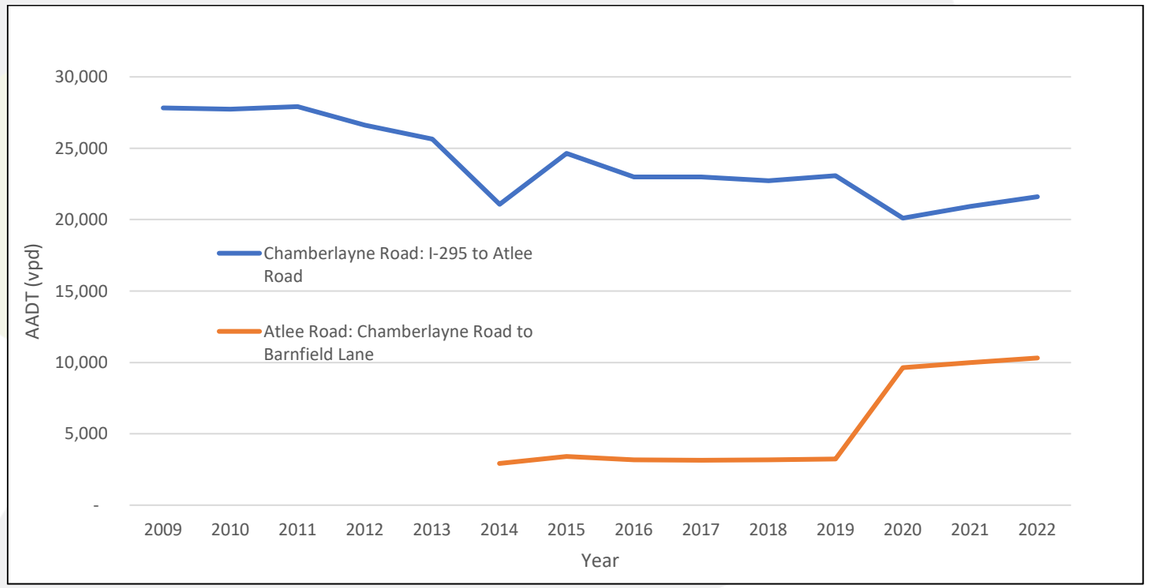
In addition, WSP searched for any recently completed relevant studies that can be used to get the recommended growth rates in the vicinity of study area. No study was found for the Chamberlayne Road corridor. However, a recently completed STARS study on US Route 1 (Brook Road) and E Parham Road in Henrico County was taken into consideration for recommending growth rates. The study recommends a growth rate of 0.93% for E Parham Road. Although E Parham Road is not within the study area, its intersection with Chamberlayne Road is less than one mile from the southern limit of the study corridor, and it generates significant amount of trips that directly impact travel along Chamberlayne Road.

TABLE 1.9. *VDOT P4P* Growth Rate Summary

Roadway Segment	Annual Average Growth Rate		
	2009-2019	2009-2022	2020-2022
Chamberlayne Road – I-295 to Atlee Road	-2.18%	-2.07%	3.73%
Atlee Road – Chamberlayne Road to Barnfield Lane*	0.70%	80.16%	3.57%

*2019 applied as existing since 2023 data was unavailable at the time of the analysis

FIGURE 1.16. HISTORIC VOLUMES (2009-2019)



Source: VDOT Pathways for Planning

1.3.4. Summary of Future Traffic Volume Projections

FUTURE DESIGN YEAR

Based on *VDOT Traffic Forecasting Guidebook Section 3.2, Pathways for Planning* and similar planning studies in the Richmond District, the study team recommends using **2052** as the future design year.

BACKGROUND ANNUAL AVERAGE GROWTH RATE

Based on the observed trends in historic volumes and relevant studies, WSP recommends the background AAGR for the study area as shown in **Table 1.10.**

With volumes on Chamberlayne Road decreasing notably on an annual average through 2020 and then increasing substantially through 2022, a positive growth rate should be applied. However, the growth rate from 2020-2022 of 3.73% is not considered to be sustainable long-term, so it is expected that this rate will remain positive but reduce over the next several years.

The spike in volumes along Atlee Road starting in 2020 are attributed to its connection to Atlee Road in March 2020. This new connection is expected to contribute to notable growth along the roadway in future years, but the rates found from the P4P data are not appropriate – a rate of 0.7% is expected to be too low based on growth potential, yet rates of 3.57% and above are not considered sustainable. It is expected that growth rates will remain positive, reducing over the next several years, but remaining higher than that for Chamberlayne Road.

PROJECTED FUTURE VOLUMES

Using the recommended design year of 2052 and the recommended background growth rates, and anticipated major development traffic, the projected 2052 AADTs are summarized in **Table 1.10.**

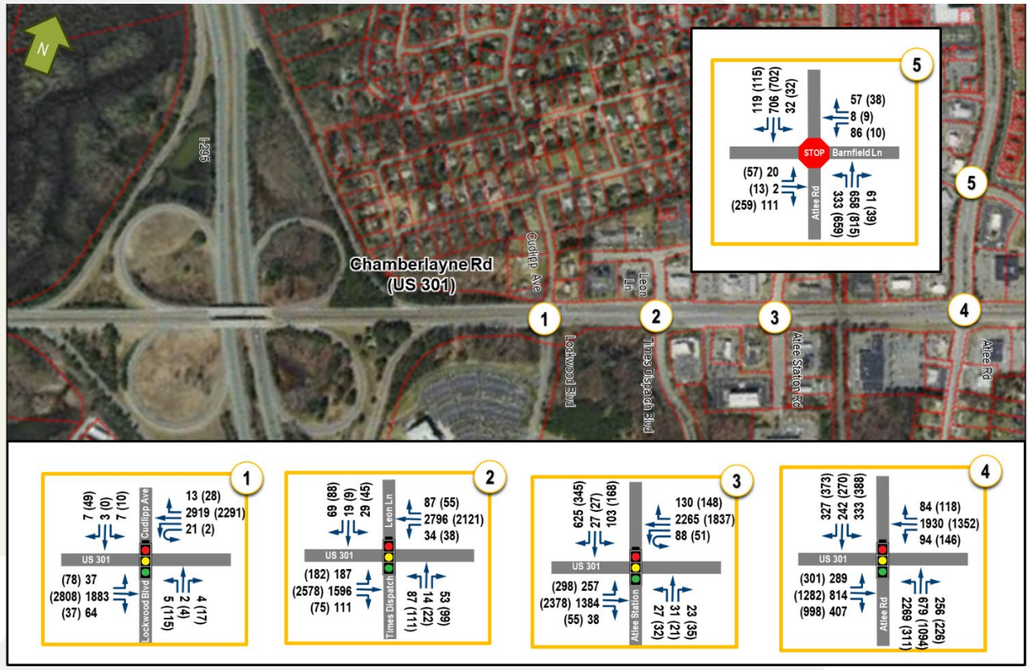
TABLE 1.10. EXISTING 2023 VOLUMES AND PROJECTED ADTS

Roadway	Roadway Segment	Recommended Background Growth Rate	AADT (vpd)	
			Existing 2023 AADT	Future 2052 AADT
Chamberlayne Road	I-295 to Atlee Station Road	0.64%	18,437	22,184
Atlee Road	Chamberlayne Road to Barnfield Lane*	2.00%	10,309	18,307

*2022 applied as existing since 2023 data was unavailable at the time of the analysis.

The future (2052) balanced AM and PM peak hour volumes are summarized in **Figure 1.17**.

FIGURE 1.17. FUTURE (2052) AM (PM) PEAK HOUR BALANCED VOLUMES



1.4. Future No-Build Traffic Operational Analysis

Operational analysis was performed at each of the study intersections for the Future 2052 No-Build Conditions scenario. **Table 1.8** summarizes the average AM and PM peak hour delay and LOS for each movement for the study intersections under Future 2052 No-Build conditions. *SimTraffic* output sheets are provided in **Appendix**.

The results show that the intersections of Chamberlayne Road and Cudlipp Avenue / Lockwood Boulevard, Leon Lane / Times Dispatch Boulevard, and Atlee Station Road operate at acceptable overall levels of service of C or better for both AM and PM peak periods. Overall intersections operating at LOS E or worse were found during the AM and PM peaks at the intersections of Chamberlayne Road at Atlee Road and Atlee Road at Barnfield Lane.

TABLE 1.11. FUTURE 2052 NO-BUILD CONDITIONS

Intersection Number and Description	Type of Control	Lane Group	Southbound		Northbound		Westbound		Eastbound		*Overall*	
			AM	PM	AM	PM	AM	PM	AM	PM	*AM*	*PM*
			Delay (s)	Delay (s)	Delay (s)	Delay (s)	Delay (s)	Delay (s)	Delay (s)	Delay (s)	*Delay (s)*	*Delay (s)*
1: US 301 (Chamberlayne Road) & Cudlipp Avenue / Lockwood Boulevard	**Roadway**		**US 301**		**US 301**		**Lockwood Boulevard**		**Cudlipp Avenue**		*Intersection*	
	Signal	Left	76.2	65.9	69.5	77.3	71.1	59.2	84.7	63.4	*8.6*	*15.7*
		Through	7.3	9.9	7.8	18.9	81.4	58.3	85.8	0.0		
		Right	2.1	3.5	4.7	3.9	15.6	21.7	33.3	30.4		
		Approach	*8.3*	*11.1*	*8.2*	*18.8*	*45.0*	*54.5*	*60.6*	*37.8*		
2: US 301 (Chamberlayne Road) & Leon Lane / Times Dispatch Boulevard	**Roadway**		**US 301**		**US 301**		**Times Dispatch**		**Leon Lane**		*Intersection*	
	Signal	Left	76.5	75.7	64.7	63.1	63.1	66.4	111.6	63.6	*28.9*	*19.8*
		Through	17.1	12.5	32.9	21.2	63.4	67.0	110.4	65.8		
		Right	3.8	6.0	16.7	10.8	1.8	1.9	1.2	1.2		
		Approach	*22.2*	*16.4*	*32.8*	*21.7*	*41.3*	*39.6*	*46.4*	*22.8*		
3: US 301 (Chamberlayne Road) & Atlee Station Road	**Roadway**		**US 301**		**US 301**		**Atlee Station Road**		**Atlee Station Road**		*Intersection*	
	Signal	Left	242.8	83.8	73.9	96.5	64.4	60.7	58.1	52.6	*37.9*	*45.6*
		Through	11.6	20.7	40.3	86.0	62.3	59.5	58.7	51.1		
		Right	4.8	6.5	4.4	10.4	32.0	30.1	4.5	3.0		
		Approach	*46.1*	*27.1*	*39.8*	*80.6*	*9.2*	*48.0*	*73.1*	*20.9*		
4: US 301 (Chamberlayne Road) & Atlee Road	**Roadway**		**US 301**		**US 301**		**Atlee Road**		**Atlee Road**		*Intersection*	
	Signal	Left	77.2	58.5	412.8	468.5	140.8	171.1	105.4	58.8	*203.8*	*154.1*
		Through	21.6	32.8	419.4	359.5	245.6	333.4	327.1	87.0		
		Right	7.0	37.3	326.0	260.6	50.1	59.0	73.0	5.7		
		Approach	*28.0*	*37.4*	*415.1*	*362.8*	*184.0*	*268.4*	*155.9*	*48.7*		
5: Atlee Road at Barnfield Lane	**Roadway**		**Barnfield Lane**		**Shopping Center**		**Atlee Road**		**Atlee Road**		*Intersection*	
	Side-Street Stop	Left	141.3	2020.4	980.6	1405.2	44.6	90.2	1.5	3.3	*80.5*	*89.4*
		Through	125.9	1195.3	638.0	1562.9	2.6	3.7	36.9	1.0		
		Right	696.0	517.5	330.0	171.3	2.2	2.2	6.4	0.6		
		Approach	*609.8*	*897.9*	*755.4*	*649.7*	*15.8*	*39.4*	*30.4*	*1.0*		

Chapter 2: Alternative Development and Refinement

2.1. Preliminary Alternatives Development

During Phase 1 of the study, the study team developed preliminary alternative concepts along the study area to address the VTrans needs identified in Chapter 1; improve pedestrian access and safety, and reduce vehicular congestion in the study area. Throughout this process, the preliminary alternatives were either marked for removal from further study, subjected to additional refinement, or progressed for further analysis.

CHAMBERLAYNE ROAD AT CUDLIPP AVENUE / LOCKWOOD BOULEVARD

Under existing conditions, the intersection of Chamberlayne Road at Cudlipp Avenue / Lockwood Boulevard is considered a hot-spot intersection with 37 total crashes over an eight-year period and has a Medium Safety Improvement CoSS need. The preliminary alternatives were developed to address the safety need of the intersection and include conventional improvements and a thru-cut intersection. The thru-cut intersection, illustrated in **Figure 2.1**, removes through movements from the minor street and redirects them to the major arterial. The through movements can be completed by making U-turns at adjacent intersections or by using the local road network. This design enables left turns from Cudlipp Avenue and Lockwood Boulevard to operate concurrently. The conventional improvement alternative includes restriping the westbound Lockwood Boulevard approach to have one left-turn lane, one through-lane, and one right-turn lane and modifying signal phasing to permissive for the westbound and eastbound left-turn movements.

FIGURE 2.1. CHAMBERLAYNE ROAD AT CUDLIPP AVENUE / LOCKWOOD BOULEVARD THRU-CUT IMPROVEMENT

CHAMBERLAYNE ROAD AT LEON LANE / TIMES DISPATCH BOULEVARD

The intersection of Chamberlayne Road at Leon Lane / Times Dispatch Boulevard is considered a hot-spot intersection with 44 total crashes over an eight-year period. The preliminary alternatives were developed to address safety needs of the study corridor and include conventional improvements and a thru-cut intersection. The thru-cut intersection, illustrated in **Figure 2.2**, removes through movements from the minor street and redirects them to the major arterial. The through movements can be completed by making U-turns at adjacent intersections or by using the local road network. This design enables the left-turn movement from Leon Lane and Times Dispatch Boulevard to operate concurrently. The conventional improvement alternative includes restriping the westbound Times Dispatch Boulevard to have one left-turn lane, one through-lane, and one right-turn lane and modifying the signal timings to permissive for the westbound and eastbound left-turn movements.

FIGURE 2.2. CHAMBERLAYNE ROAD AT LEON LANE / TIMES DISPATCH BOULEVARD THRU-CUT IMPROVEMENT

CHAMBERLAYNE ROAD AT ATLEE STATION ROAD

The intersection of Chamberlayne Road at Atlee Station Road is a PSI intersection with 93 total crashes over an eight-year period and has a Very High Safety Improvement CoSS need. Under existing conditions, the northbound Chamberlayne Road right turn lane experiences excessive queuing. The preliminary alternatives were developed to address safety needs of the intersection and include conventional improvements and a thru-cut intersection. The thru-cut intersection removes through movements from the minor street and redirects them to the major arterial. The through movements can be completed by making U-turns at adjacent intersections or by using the local road network. This design enables protected left turns from Atlee Station Road to operate concurrently. The conventional improvement alternative, illustrated in **Figure 2.3** includes restriping westbound and eastbound Atlee Station Road approaches to have one left-turn lane, one through-lane, and one right-turn lane and modifying the signal phasing to permissive for the westbound and eastbound left-turn movements. The conventional improvements also include restriping westbound Atlee Station Road at Dickey Dr to a left-turn lane and a thru lane.

FIGURE 2.3. CHAMBERLAYNE ROAD AT ATLEE STATION ROAD CONVENTIONAL IMPROVEMENT

CHAMBERLAYNE ROAD AT ATLEE ROAD

The intersection of Chamberlayne Road at Atlee Road is a PSI intersection with 91 total crashes over an eight-year period. Under existing conditions, the intersection experiences excessive queuing in the northbound and westbound directions. The left and right turn storage bays for both directions provide insufficient length to support the demand, and the southbound through traffic along Chamberlayne Road backs up through the intersection of Rutlandshire Dr. The preliminary alternative, illustrated in **Figure 2.4**, involves restriping westbound Atlee Road to have one left-turn lane, two through-lanes, and one right-turn lane and adding a second northbound right-turn lane.

FIGURE 2.4. CHAMBERLAYNE ROAD AT ATLEE ROAD IMPROVEMENTS

ATLEE ROAD AT BARNFIELD LANE

The intersection of Atlee Road at Barnfield Lane is considered a hot-spot intersection with 40 total crashes over an eight-year period. The preliminary alternatives were developed to address safety needs of the intersection and include conventional improvements and a roundabout. The roundabout alternative converts the intersection from stop-controlled to yield-controlled with two eastbound/westbound circulating lanes and one northbound/southbound circulating lane. The conventional improvement alternative, illustrated in **Figure 2.5**, converts the intersection from stop-controlled to signalized. This alternative does not meet MUTCD warrants under the traditional method, however the high left turn and opposing traffic volumes meet warrants per MUTCD Section 4C.01, Paragraph 13. Further analysis (including number of lanes on the minor street and posted speed limit) would be required to progress the conventional improvement alternative.

FIGURE 2.5. ATLEE ROAD AT BARNFIELD LANE IMPROVEMENTS

CORRIDOR PEDESTRIAN / MULTIMODAL IMPROVEMENTS

Alternatives addressing bicycle and pedestrian access included marking additional bike lanes along Atlee Station Road to extend US Bicycle Route 76 to Chamberlayne Road and installing shared-use paths along Chamberlayne Road and Atlee Road. These facilities will allow for greater connectivity throughout the area.

This study also recommends constructing a park and ride facility on the southeast quadrant of the Chamberlayne Road at Times Dispatch Boulevard intersection. These facilities will expand public transit services and offer additional transportation alternatives for commuters.

2.1.1. Preliminary Alternatives Refinement

Table 2.1 presents the refined list of improvement alternatives developed in Phase 1 and **Table 2.2** summarizes the associated needs addressed by each alternative. **Figure 2.6** shows the preliminary alternatives graphically categorized by needs addressed by the alternative.

TABLE 2.1. PRELIMINARY ALTERNATIVES REFINEMENT SUMMARY

Intersection	Option 1	Option 2
Chamberlayne Road at Cudlipp Avenue / Lockwood Boulevard	Revise WB Lockwood Boulevard lane use – left, thru, right	Thru-cut intersection
	Modify signal phasing – permissive for WB and EB left turns	--
Chamberlayne Road at Leon Lane / Times Dispatch Boulevard	Revise WB Times Dispatch Boulevard lane use – left, thru, right	Thru-cut intersection
	Modify signal phasing – permissive for WB and EB left turns	--
Chamberlayne Road at Atlee Station Road	Revise EB/WB Atlee Station Road lane use – left, thru, right	Thru-cut intersection
	Modify signal phasing – permissive for EB and WB left turns	--
	Revise WB Atlee Station Road lane use at Dickey Drive – left, thru	--
Chamberlayne Road at Atlee Road	Revise WB Atlee Road lane use – left, thru, thru, right	Revise WB Atlee Road lane use – left, thru, thru, right
	Install second NB right-turn lane	Install second NB right-turn lane
	--	Extend NB double left-turn lanes by 225'
	--	Provide third SB through lane from Atlee Road to Leon Lane
	--	Add SB right-turn lane
	--	Remove acceleration/weaving area for EB right turns
Atlee Road at Barnfield Road	Install a full-color traffic signal	Roundabout with two EB/WB circulating lanes and one NB/SB circulating lane
Corridor-wide Bicycle and Pedestrian Improvements	Shared-use path along Chamberlayne Road and Atlee Road	--
	Bike lanes along Atlee Station Road	--
Corridor-wide Transit and TDM Improvements	Park-and-ride facility on the SE quadrant of Chamberlayne Road at Times Dispatch Boulevard	--

TABLE 2.2. PHASE 1 ALTERNATIVE NEEDS ADDRESSED

Intersection	Improvement	Safety Improvement Need	Capacity Preservation Need	Pedestrian Need	Bicyclist Need	Transit/TDM Need
Chamberlayne Road at Cudlipp Avenue / Lockwood Boulevard	Option 1 – Conventional Improvements		✓			
	Option 2 – Thru-cut	✓	✓			
	Install shared-use path along the west side of Chamberlayne Road	✓	✓	✓	✓	
Chamberlayne Road at Leon Lane / Times Dispatch Boulevard	Option 1 – Conventional Improvements		✓			
	Option 2 – Thru-cut	✓	✓			
	Install shared-use path along the west side of Chamberlayne Road	✓	✓	✓	✓	
	Construct park and ride on the SW quadrant		✓	✓	✓	✓
Chamberlayne Road at Atlee Station Road	Option 1 – Conventional Improvements		✓			
	Option 2 – Thru-cut	✓	✓			
	Install shared-use path along the west side of Chamberlayne Road	✓	✓	✓	✓	
	Provide dedicated facilities for bicyclists along Atlee Station Road	✓	✓		✓	
Chamberlayne Road at Atlee Road	Option 1 – Conventional Improvements		✓			
	Install shared-use path along the west side of Chamberlayne Road	✓	✓	✓	✓	
	Install shared-use path along the south side of Atlee Road	✓	✓	✓	✓	
Atlee Road at Barnfield Road	Option 1 – Conventional Improvements		✓			
	Option 2 – Roundabout	✓	✓			
	Install shared-use path along the south side of Atlee Road	✓	✓	✓	✓	

Legend | ✓ Need is addressed

FIGURE 2.6. PHASE 1 SCOPING-LEVEL IMPROVEMENT ALTERNATIVES

Legend: VTrans Needs Addressed

Bicycle Access	Capacity Preservation
Transit and TDM	Safety Improvement

Transit Improvements

- Coordinate with GRTC and Hanover County for feasibility of new/extended fixed-route service

TDM Improvements

- Add new Park-and-Ride near corridor
- Add pedestrian and bicycle facilities

Safety and Operations Improvements

1. Conventional
2. *Thru-Cut
3. *Roundabout
4. Signal

Bicycle Improvements

A. Add bike lane

B. Add shared-use path

Corridor-Wide Safety and Operations Improvements

- Access Management Review
- Turn Lane Analysis
- Signal Timing and Phasing Review
- Additional Signal Heads
- Signing and Marking Review
- Intersection and Interchange Lighting

* Denotes an innovative intersection concept. More information on innovative intersections and real-world examples can be found at https://www.virginiadot.org/innovativeintersections/

2.2. Refined Alternatives

The study team evaluated and refined the Phase 1 preliminary alternatives based on potential safety benefits, traffic operations, multimodal access, and input from the SWG. The study team conducted a traffic operations analysis in using *Synchro/SimTraffic 11* for each operational improvement alternative in Phase 2 of the study. The study team also conducted a safety analysis to identify potential crash reductions for each safety improvement.

The study team met with the Study Work Group on September 27, 2023, to discuss each alternative with regards to impacts to safety, traffic operations, and overall benefits. The SWG selected five intersection alternatives and two corridor-wide improvement concepts to move into more refined design and the future 2052 build conditions analysis to present to the public.

The planning level conceptual layouts for each of these refined alternatives are summarized in **Table 2.3** and discussed and evaluated below.

TABLE 2.3. REFINED ALTERNATIVES

Intersection	Concept	Advance for further evaluation?	Notes
Chamberlayne Road at Cudlipp Avenue / Lockwood Boulevard	Option 1	Yes	
	Option 2	No	Improvements redirect traffic to already heavy mainline left-turn movements.
Chamberlayne Road at Leon Lane / Times Dispatch Boulevard	Option 1	Yes	
	Option 2	No	Does not meet objective to minimize cost.
Chamberlayne Road at Atlee Station Road	Option 1	Yes	
	Option 2	No	Does not meet objective to minimize cost.
Chamberlayne Road at Atlee Road	Option 1	No	
	Option 2	Yes	
Atlee Road at Barnfield Road	Option 1	No	Concerns for effects as a result of signalization due to the existing demand for westbound left-turn movements
	Option 2	Yes	
Corridor-wide Bicycle and Pedestrian Improvements	Option 1	Yes	Meets pedestrian and bicycle access need.
Corridor-wide Transit and TDM Improvements	Option 2	Yes	Meets transportation demand need.

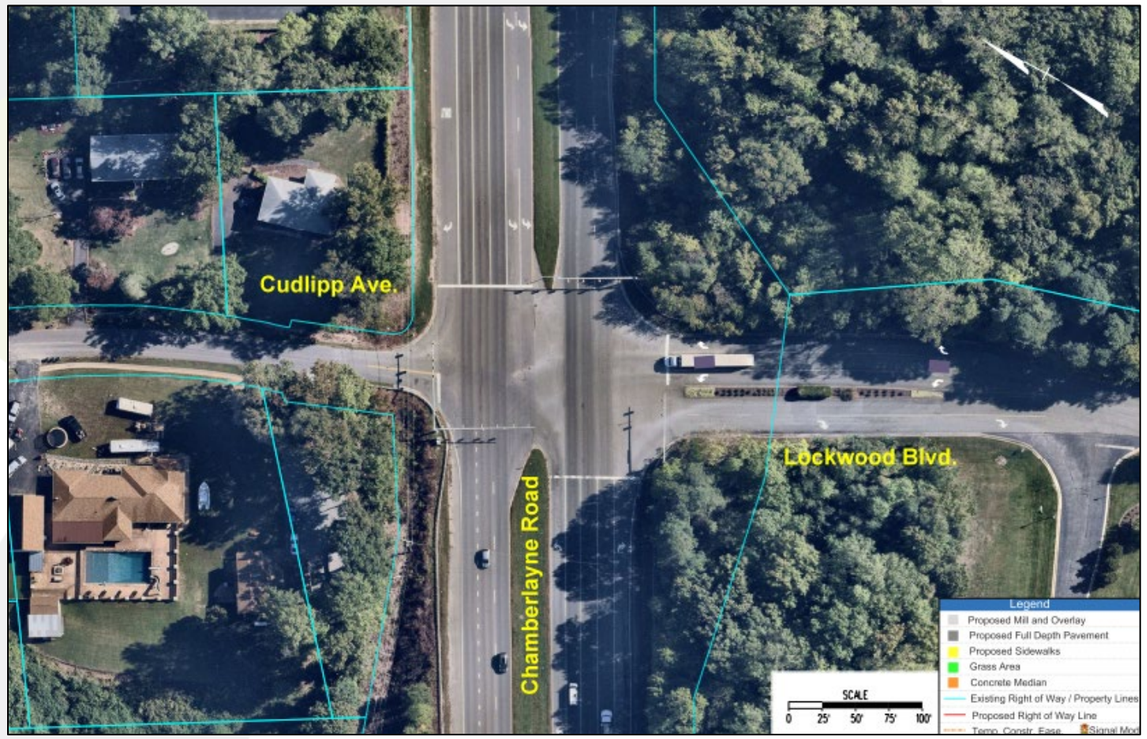
CHAMBERLAYNE ROAD AT CUDLIPP AVENUE / LOCKWOOD BOULEVARD

The conventional improvement alternative includes:

- Restripe westbound Lockwood Boulevard approach to have one left-turn lane, one through-lane, and one right-turn lane.
- Modify signal phasings to permissive for the westbound and eastbound left-turn movements.

Figure 2.7 presents the conceptual sketch for the alternative. Geometrics would remain unchanged. The concept sketch does not reflect changes to signal equipment under this alternative, but the arrow pavement markings on the westbound Lockwood Boulevard approach would be modified.

FIGURE 2.7. CHAMBERLAYNE ROAD AT CUDLIPP AVENUE / LOCKWOOD BOULEVARD IMPROVEMENTS



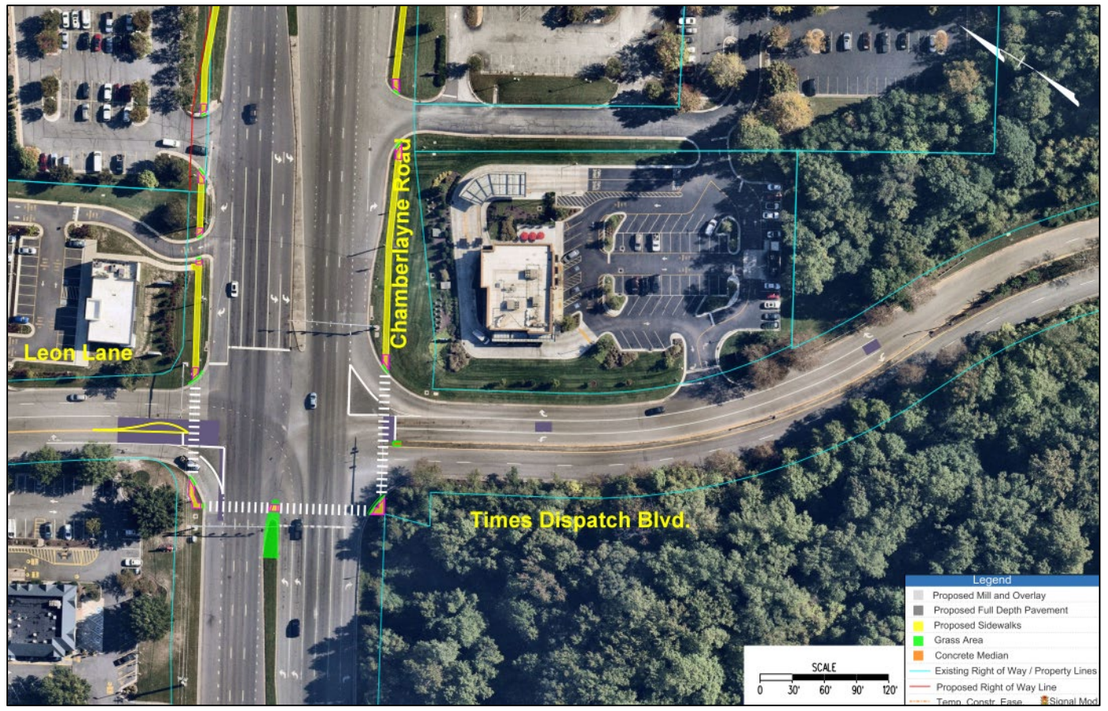
CHAMBERLAYNE ROAD AT LEON LANE / TIMES DISPATCH BOULEVARD

The conventional improvement alternative includes:

- Restripe westbound Times Dispatch Boulevard approach to have one left-turn lane, one through-lane, and one right-turn lane.
- Modify signal phasing to permissive for the westbound and eastbound left-turn movements.
- Provide marked and signalized crossings for three legs of the intersection.
- Extend the stop line across the eastbound and westbound right-turn lanes (note that this is not shown in Figure 2.8, but the channelizing islands can remain if needed with the stop line in place)Figure 2.8. Chamberlayne Road at Leon Lane / Times Dispatch Boulevard Improvements.

Figure 2.8 presents the conceptual sketch for the alternative.

FIGURE 2.8. CHAMBERLAYNE ROAD AT LEON LANE / TIMES DISPATCH BOULEVARD IMPROVEMENTS



CHAMBERLAYNE ROAD AT ATLEE STATION ROAD

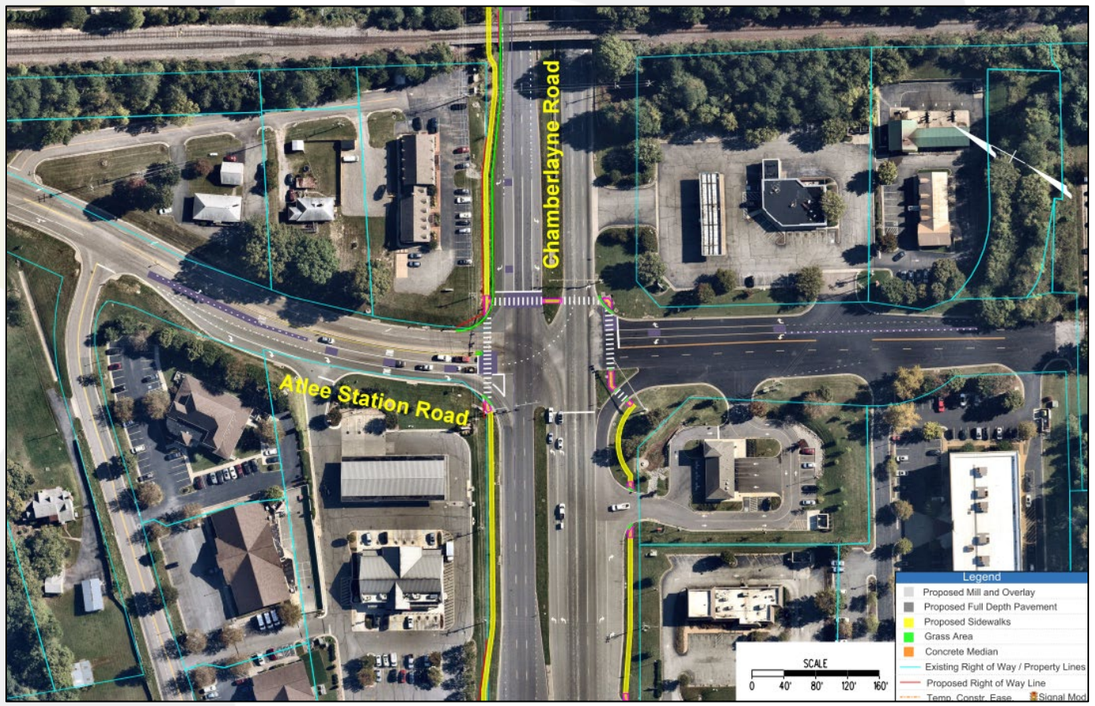
The conventional improvement alternative includes:

- Restripe westbound and eastbound Atlee Station Road approaches to have one left-turn, one thru, and one right-turn lane.

- Modify signal phasing to provide permissive westbound and eastbound left-turn movements.
- Provide marked and signalized pedestrian crossings for three legs of the intersection.
- Extend the stop line across the eastbound right-turn lane (note that this is not shown in Figure 2.9, but the island can remain if needed with the stop line in place).
- Continue a third southbound through lane through the intersection and add a new southbound right-turn lane.

Figure 2.9 presents the conceptual sketch for the alternative.

FIGURE 2.9. CHAMBERLAYNE ROAD AT ATLEE STATION ROAD IMPROVEMENTS



CHAMBERLAYNE ROAD AT ATLEE ROAD

The improvement alternative includes:

- Restripe westbound Atlee Road approach to have one left-turn lane, two thru lanes, and one right-turn lane.
- Install a second northbound right turn lane with channelization and signalization.
- Install a third southbound thru lane starting south of Rutlandshire Drive and extending to Leon Lane and add a new southbound right turn lane.
- Remove acceleration/weaving area for eastbound right-turn lane.
- Provide marked and signalized crossings for all legs of the intersection.
- Extend storage of the northbound double left-turn lane by 225 feet.

Figure 2.10 presents the conceptual sketch for the alternative.

FIGURE 2.10. CHAMBERLAYNE ROAD AT ATLEE ROAD IMPROVEMENTS

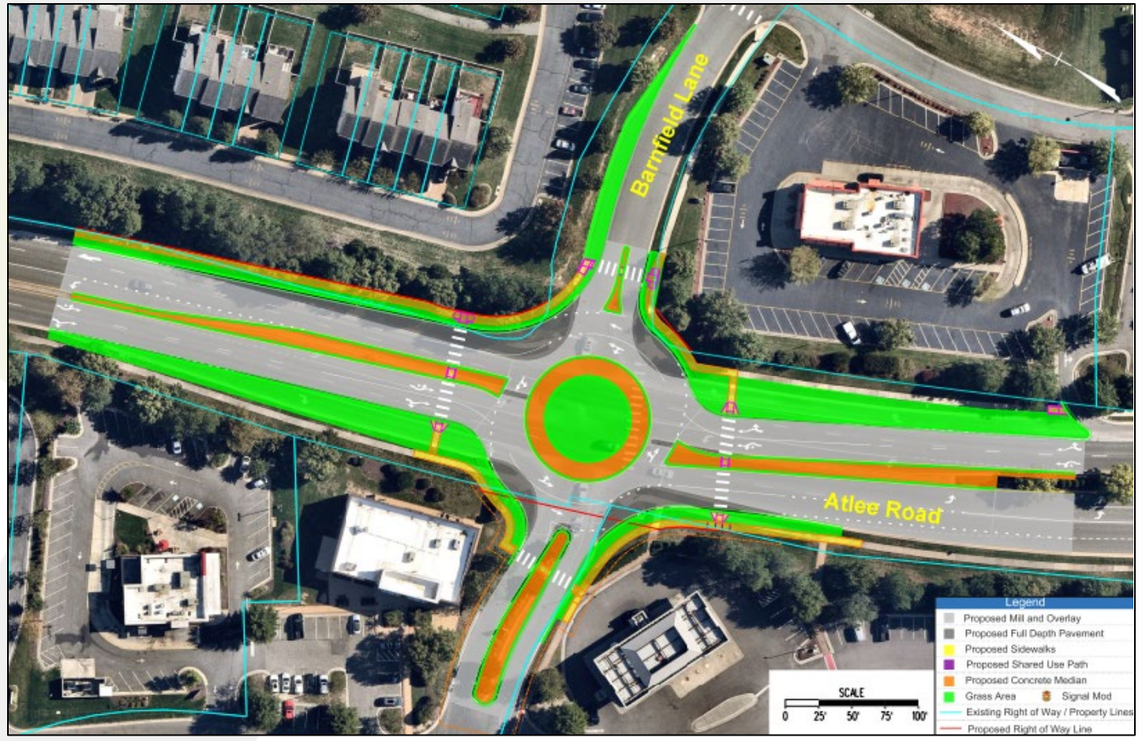
ATLEE ROAD AT BARNFIELD LANE

The improvement alternative includes:

- Convert the intersection to a roundabout with two eastbound/westbound circulating lanes and one northbound/southbound circulating lane.

Figure 2.11 presents the conceptual sketch for the alternative.

FIGURE 2.11. ATLEE ROAD AT BARNFIELD LANE IMPROVEMENTS



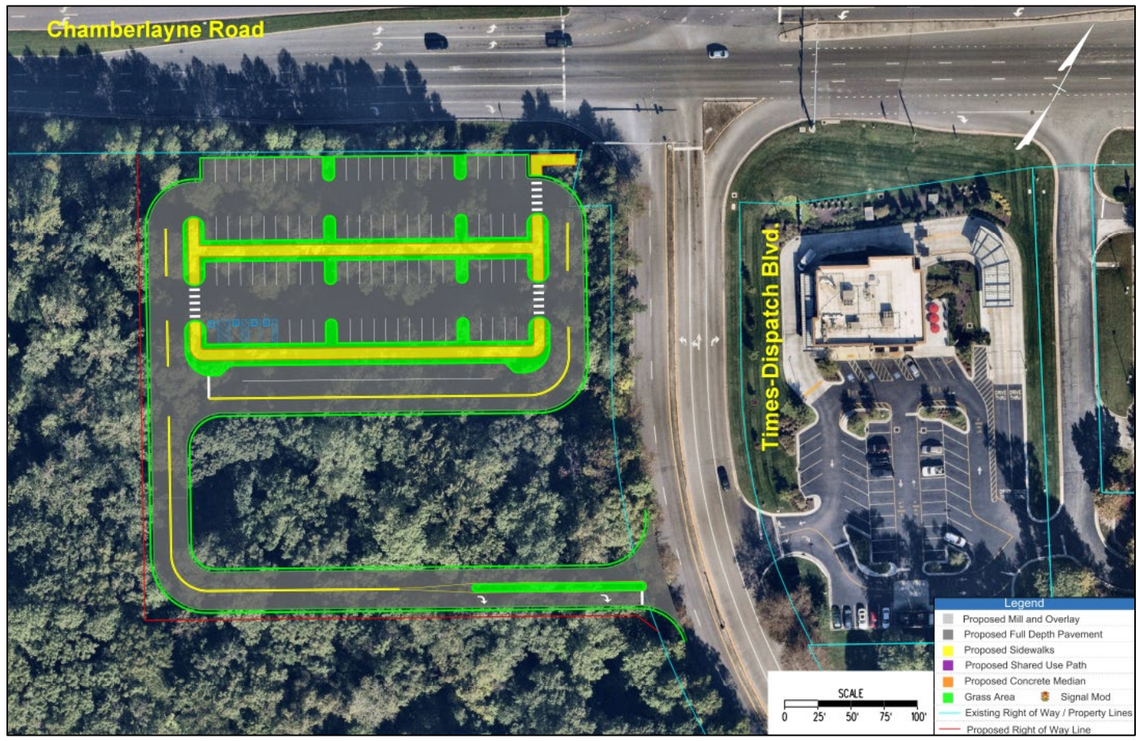
CORRIDOR-WIDE TRANSIT AND TDM IMPROVEMENTS

The improvement alternative includes:

- Provide a park-and-ride facility on the southeast quadrant of the Chamberlayne Road intersection at Times Dispatch Boulevard.
- Provide sidewalk connection to the park-and-ride facility from the intersection.

Figure 2.12 presents the conceptual sketch for the alternative.

FIGURE 2.12. PARK-AND-RIDE FACILITY TRANSIT AND TDM IMPROVEMENT



CORRIDOR-WIDE BICYCLE AND PEDESTRIAN IMPROVEMENTS

The multimodal improvement alternative includes:

- Convert existing sidewalk along south side of Atlee Road to shared-use path from railroad overpass to Chamberlayne Road, filling in gaps (coordinate with roundabout at Barnfield Lane)
- Install sidewalk along west side of Chamberlayne Road from Rutlandshire Drive to Leon Lane.
- Install sidewalk along east side of Chamberlayne Road from Times Dispatch Blvd to Atlee Station Road.

Figure 2.13 and **Figure 2.14** present the conceptual sketches for the alternative.

FIGURE 2.13. CHAMBERLAYNE ROAD MULTIMODAL IMPROVEMENTS

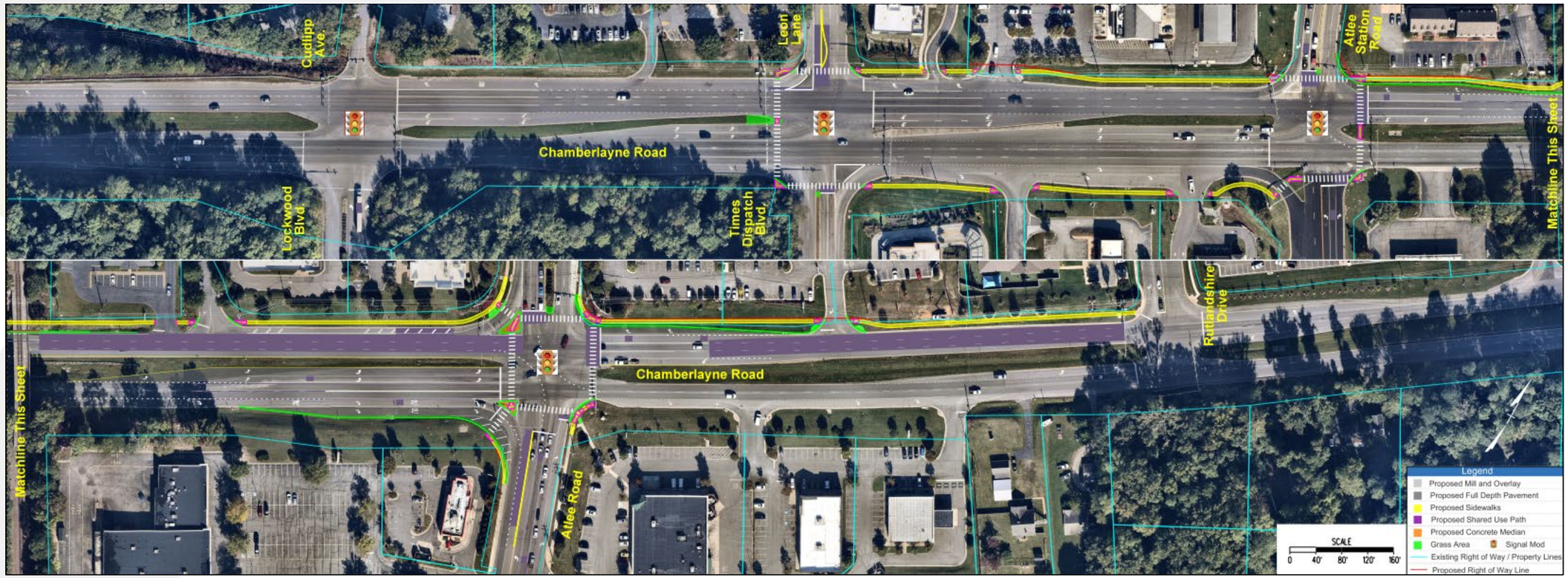


FIGURE 2.14. ATLEE ROAD MULTIMODAL IMPROVEMENTS

2.1. Build Traffic Operational Analysis

The refined alternatives selected from the development exercise were distributed among the members of SWG for feedback. Their feedback was further discussed, vetted and included in the final alternative conceptual layouts. These alternatives were modeled in *Synchro/SimTraffic* for the Future 2052 Build condition traffic operations.

Operational analysis was performed at each of the study intersections for the 2052 Future Build condition. The *Synchro/SimTraffic* models were developed to test the

combination of alternatives for the entire corridor. **Table 2.4** summarizes the average AM and PM peak hour delay for each movement for the study intersections along the corridor under Future 2052 Build conditions.

The results show that the intersections of Chamberlayne Road and Cudlipp Avenue / Lockwood Boulevard, Leon Lane / Times Dispatch Boulevard, and Atlee Station Road operate at acceptable overall levels of service of C or better for both AM and PM peak periods. The intersections of Chamberlayne Road at Atlee Road and Atlee Road at Barnfield Lane show improvements in delay compared to Future 2052 No-build conditions.

TABLE 2.4. FUTURE 2052 BUILD CONDITIONS PEAK HOUR DELAY

Intersection Number and Description	Type of Control	Lane Group	Southbound		Northbound		Westbound		Eastbound		Overall	
			AM Delay (s)	PM Delay (s)	AM Delay (s)	PM Delay (s)	AM Delay (s)	PM Delay (s)	AM Delay (s)	PM Delay (s)	*AM Delay (s)*	*PM Delay (s)*
1: US 301 (Chamberlayne Rd) & Cudlipp Ave / Lockwood Blvd		**Roadway**	**US 301**		**US 301**		**Lockwood Boulevard**		**Cudlipp Avenue**		***Intersection***	
		Left	69.9	63.5	95.9	82.8	74.0	69.4	80.3	66.8	***21.1***	***16.1***
		Through	14.6	10.0	28.6	16.6	102.5	52.4	75.6	0.0		
		Right	9.5	5.8	6.6	4.7	22.7	16.0	38.6	38.4		
		Approach	*15.0*	*10.0*	*29*	*18.1*	*48.7*	*61.9*	*58.8*	*43.7*		
2: US 301 (Chamberlayne Rd) & Leon Ln / Times Dispatch Blvd		**Roadway**	**US 301**		**US 301**		**Times Dispatch Boulevard**		**Leon Lane**		***Intersection***	
		Left	69.9	56.6	74.5	68.3	71.0	64.3	66.4	63.1	***26.7***	***20.6***
		Through	22.7	11.2	31.8	24.8	55.1	58.2	71.1	71.0		
		Right	13.6	7.9	2.6	4.6	1.8	2.0	2.2	1.8		
		Approach	*23.0*	*11.8*	*34.3*	*27.0*	*45.8*	*37.9*	*9.7*	*10.9*		
3: US 301 (Chamberlayne Rd) & Atlee Station Rd		**Roadway**	**US 301**		**US 301**		**Atlee Station Road**		**Atlee Station Road**		***Intersection***	
		Left	54.5	76.3	293.2	196.4	65.9	54.5	68.4	73.1	***41.9***	***35.9***
		Through	25.1	26.9	28.0	23.0	56.8	48.7	57.4	40.8		
		Right	26.7	35.1	3.4	4.7	12.6	28.2	18.0	7.1		
		Approach	*26.2*	*28.6*	*67.3*	*40.9*	*47.7*	*43.0*	*31.7*	*39.7*		
4: US 301 (Chamberlayne Rd) & Atlee Rd		**Roadway**	**US 301**		**US 301**		**Atlee Road**		**Atlee Road**		***Intersection***	
		Left	202.5	687.7	273.0	232.4	100.2	120.6	286.9	405.2	***126.1***	***128.4***
		Through	148.9	87.0	35.1	69.5	175.9	219.4	132.6	125.1		
		Right	117.2	46.8	9.4	24.9	29.0	39.0	38.6	52.5		
		Approach	*150.2*	*137.5*	*72.1*	*71.7*	*130.4*	*177.0*	*157.9*	*207.3*		
5: Atlee Rd at Barnfield Ln		**Roadway**	**Barnfield Lane**		**Shopping Center**		**Atlee Road**		**Atlee Road**		***Intersection***	
	Roundabout	Left	10.6	29.5	7.3	12.5	10.8	13.6	9.8	22.4	***8.5***	***17.8***
		Through	9.8	26.4	6.8	11.5	10.8	13.6	9.8	22.4		
		Right	8.9	23.5	5.9	10.4	10.8	13.6	9.8	22.4		
		Approach	*9.7*	*26.2*	*6.9*	*11.9*	*10.8*	*13.6*	*9.8*	*22.4*		

2.2. Build Safety Analysis

The potential safety benefit and crash reduction for each improvement was determined by identifying the appropriate crash modification factors (CMFs). **Table 2.5** summarizes the CMFs for each improvement, their application, and number / percent of applicable crashes. CMFs for this analysis were identified in the following order:

- *VDOT HSIP's* Preferred CMF List (default in Table 2.5)
- *FHWA CMF Clearinghouse* (called out in Table 2.5 if used)
- *SMARTSCALE Round 5 CMFs* (called out in Table 2.5 if used)
- *FHWA* Crash Reduction Factors (CRFs)

TABLE 2.5. PHASE 2 ALTERNATIVE CMF AND CRASH REDUCTION SUMMARY

Intersection	Improvement	Crash Modification Factor (VDOT HSIP, Clearinghouse, or FHWA CRF)	Types of Crashes Considered for Application of CMF Values	Percent of Applicable Crashes to Apply CMF Value	Notes/Quality
Chamberlayne Road at Cudlipp Avenue / Lockwood Boulevard	Option 1 – Restripe westbound Lockwood Boulevard – left, thru, right[1]	1.0	All crashes along the east leg	5%	Applicable Crashes (2 of 37)
	Option 1 – Modify eastbound/westbound phasing from split to permissive[2]	1.0	All crashes along the east and west legs	11%	Applicable Crashes (4 of 37)
	Option 2 – Convert existing signal to thru-cut	0.91	All crashes at the intersection	100%	Applicable Crashes (37 of 37)
	Optimize signal timing	0.91	All crashes at the intersection	100%	Applicable Crashes (37 of 37)
Chamberlayne Road at Leon Lane / Times Dispatch Boulevard	Option 1 – Restripe westbound Times Dispatch Boulevard – left, thru, right[1]	1.0	All crashes along the east leg	7%	Applicable Crashes (3 of 44)
	Option 1 – Modify eastbound/westbound phasing from split to permissive[2]	1.0	All crashes along the east and west legs	18%	Applicable Crashes (8 of 44)
	Option 2 – Convert existing signal to thru-cut	0.91	All crashes at the intersection	100%	Applicable Crashes (44 of 44)
	Optimize signal timing	0.91	All crashes at the intersection	100%	Applicable Crashes (44 of 44)

1. No CMF exists but modifying lane uses may reduce crash risk on applicable approaches.
2. No CMF exists but changes to signal phasing and/or timings may reduce risk of some crashes.
3. FHWA CMF Clearinghouse.
4. VDOT SmartScale Round 5 CMF.
5. Would also reduce crash risk for pedestrians on future sidewalk (not reflected in CMF).

TABLE 2.5. PHASE 2 ALTERNATIVE CMF AND CRASH REDUCTION SUMMARY (CONTINUED)

Intersection	Improvement	Crash Modification Factor (VDOT HSIP, Clearinghouse, or FHWA CRF)	Types of Crashes Considered for Application of CMF Values	Percent of Applicable Crashes to Apply CMF Value	Notes/Quality
Chamberlayne Road at Atlee Station Road	Option 1 – Restripe westbound Atlee Station Road – left, thru, thru, right[1]	1.0	All crashes along the east leg	4%	Applicable Crashes (6 of 93)
	Option 1 – Modify eastbound/westbound phasing from split to permissive[2]	1.0	All crashes along the east and west legs	16%	Applicable Crashes (15 of 93)
	Option 2 – Convert existing signal to thru-cut	0.91	All crashes at the intersection	100%	Applicable Crashes (93 of 93)
	Optimize signal timing	0.91	All crashes at the intersection	100%	Applicable Crashes (93 of 93)
	Remove acceleration/weaving area for eastbound channelized right turn[5]	1.0	All crashes for eastbound right turns	4%	Applicable Crashes (6 of 93)
Chamberlayne Road at Atlee Road	Restripe westbound Atlee Road – left, thru, thru, right[1]	1.0	All crashes along the east leg	25%	Applicable Crashes (23 of 91)
	Add 2nd northbound right-turn lane[3]	-1.88	Sideswipe crashes for northbound right turns	0%	Applicable Crashes (0 of 91)
	Add 2nd northbound right-turn lane[4]	0.97	All crashes along the south leg	4%	Applicable Crashes (4 of 91)
	Optimize signal timing	0.92	All crashes at the intersection	100%	Applicable Crashes (91 of 91)
	Extend northbound left turn bay length	0.95	All crashes along the south leg	4%	Applicable Crashes (4 of 91)
	Add southbound through lane[5]	0.76	All crashes along the north leg	20%	Applicable Crashes (18 of 91)
	Remove acceleration/weaving area for eastbound channelized right turn[5]	1.0	All crashes for eastbound right turns	10%	Applicable Crashes (9 of 91)
Atlee Road at Barnfield Road	Option 1 – Install signal	0.64	All crashes at the stop-controlled intersection	100%	Applicable Crashes (40 of 40)
	Option 2 – Install roundabout	0.56	All crashes at the stop-controlled intersection	100%	Applicable Crashes (40 of 40)

1. No CMF exists but modifying turn lanes may reduce crash risk on applicable approaches.
2. No CMF exists but changes to signal phasing and/or timings may reduce risk of some crashes.
3. FHWA CMF Clearinghouse.
4. VDOT SmartScale Round 5 CMF.
5. Would also reduce crash risk for pedestrians on future sidewalk (not reflected in CMF).

Chapter 3: Public and Stakeholder Outreach and Feedback

3.1. Stakeholder Coordination

Stakeholder engagement is a key part in making the recommendations of the study comprehensively successful. The stakeholders provide regional and local knowledge about the study area and help guide the study direction. The project stakeholders identified in **Chapter 1** were involved in all steps of the Project Pipeline process and assisted in making decisions regarding which concepts to move forward to public engagement.

3.2. Public Involvement

Two public involvement surveys were developed to gather the public's insight of the overall study and the recommended improvements.

3.2.1. Summer 2023 – Survey #1

The first survey was developed to determine the public's perception of relevant issues within the study area and was available online for 28 days spanning from August 14 to August 28, 2023, with 295 unique participants.

The survey provided the study team, Hanover County, and VDOT with an understanding of how the public viewed each identified need before developing alternatives. 99% of respondents indicated that they normally travel through the study area by personal vehicle. 64% of respondents agreed with identified operations needs, and 63% of respondents experienced mobility issues due to poor signal coordination. Public comments submitted with the survey generally indicated unfavourability towards existing signal operations. **Figures 3.1**, **3.2**, **3.3**, **3.4**, **and 3.5** summarize the survey results for each identified need presented.

Following the summer 2023 outreach survey, the study team presented to the local governing bodies to provide an update on the study, an overview of existing conditions, and forecasted no-build conditions.

FIGURE 3.1. SURVEY #1 IDENTIFIED NEEDS PUBLIC ENGAGEMENT RESULTS

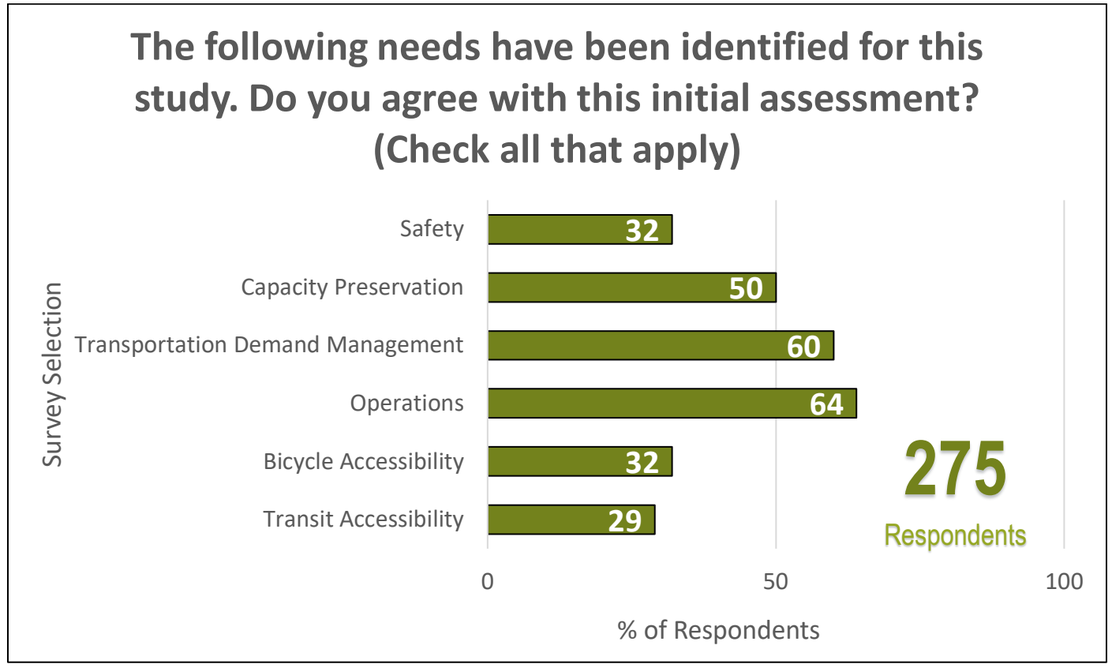


FIGURE 3.2. SURVEY #1 MODE OF TRAVEL PUBLIC ENGAGEMENT RESULTS

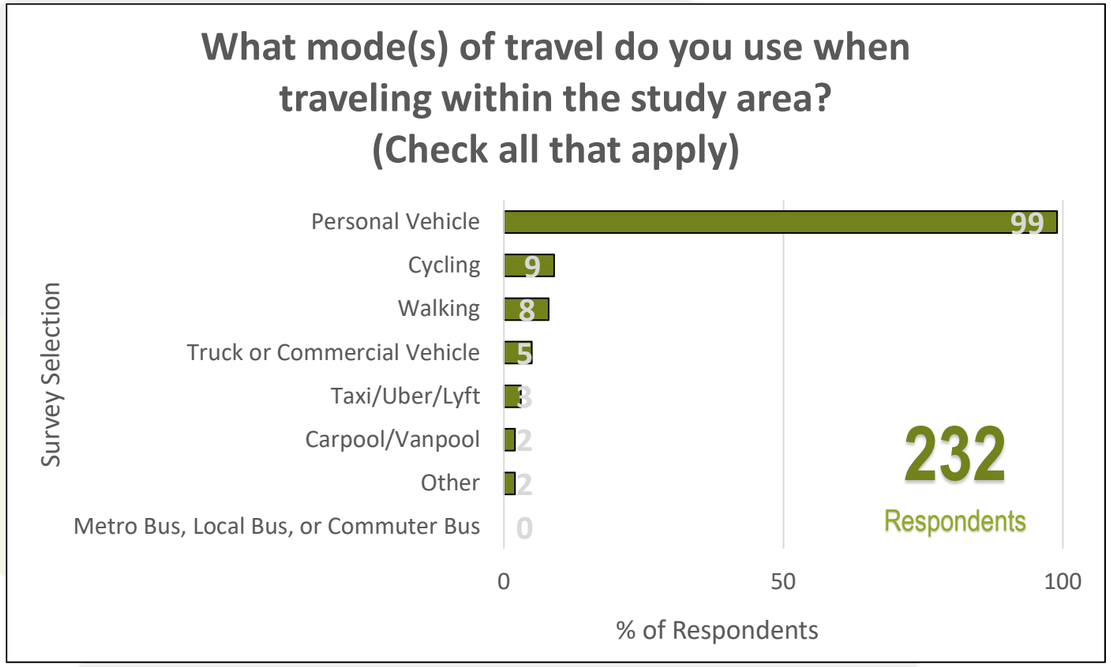


FIGURE 3.3. SURVEY #1 MULTIMODAL PUBLIC ENGAGEMENT RESULTS

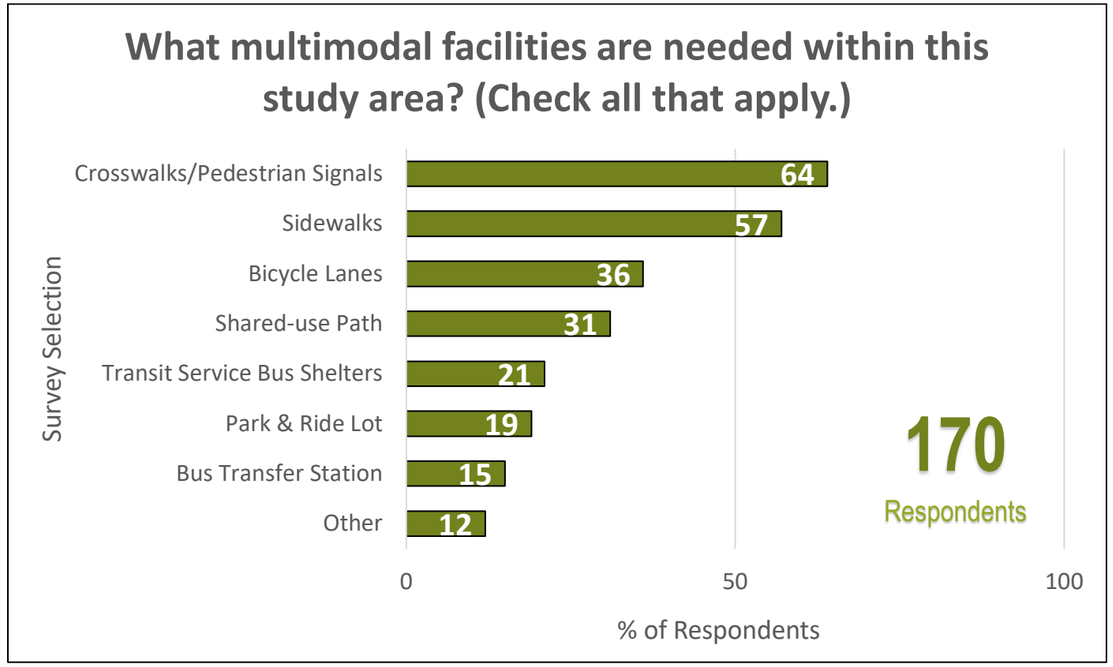


FIGURE 3.4. SURVEY #1 MOBILITY ISSUES PUBLIC ENGAGEMENT RESULTS

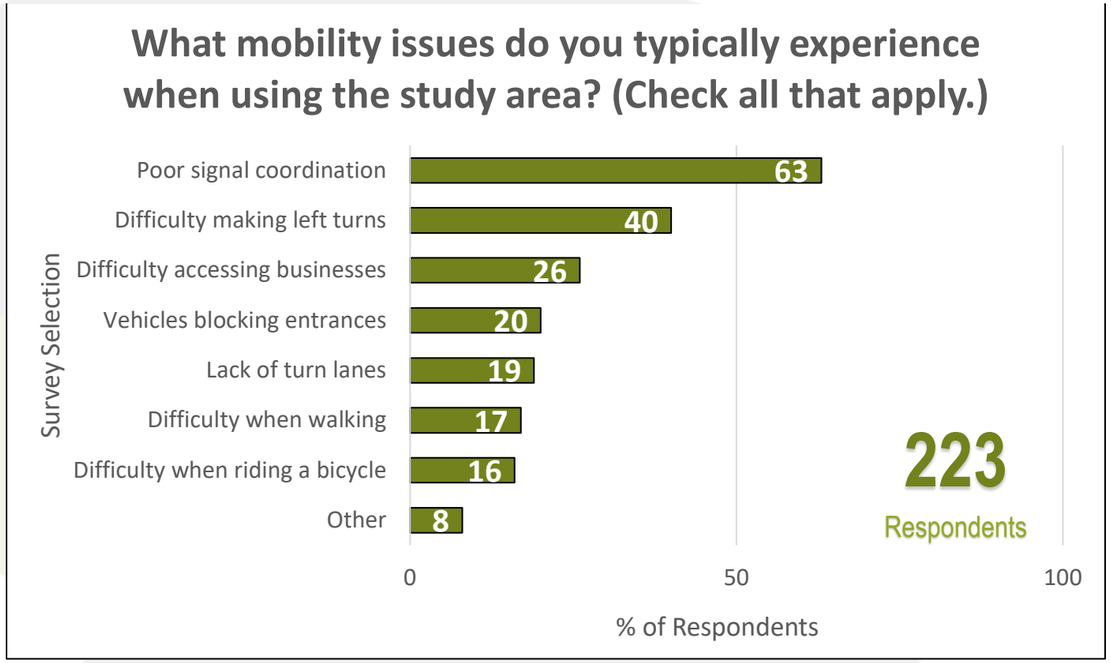
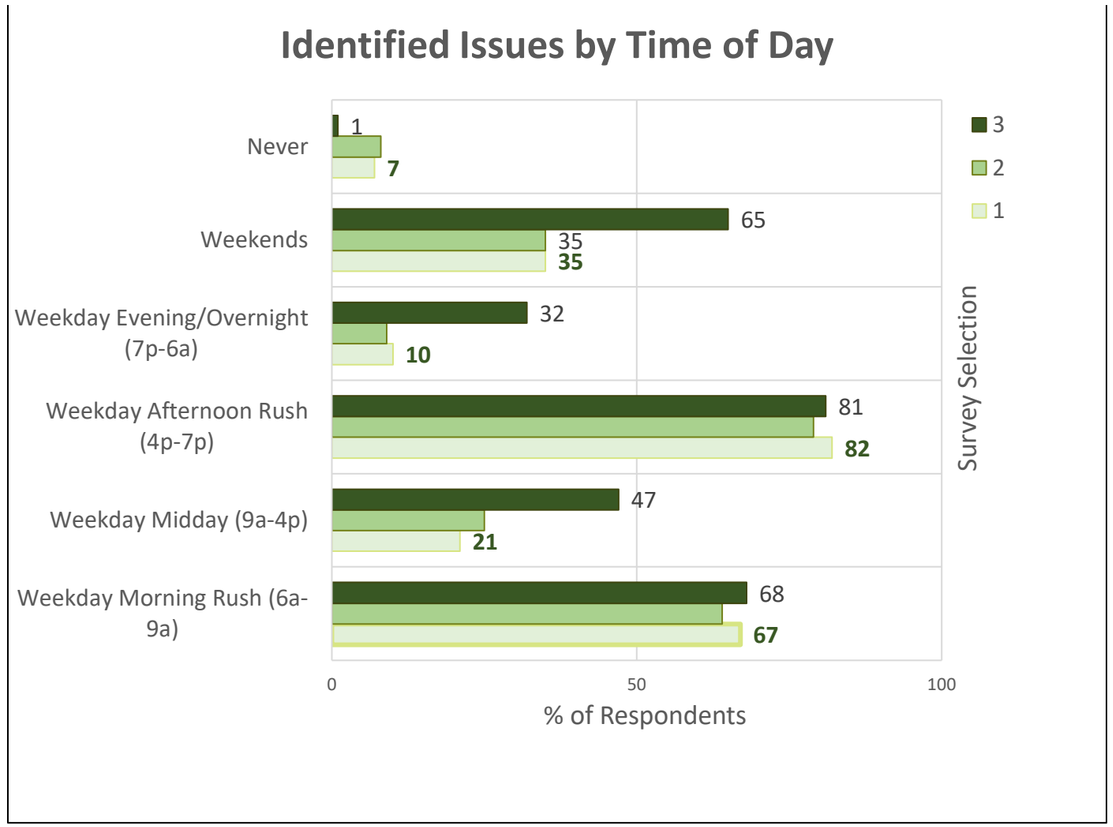


FIGURE 3.5. SURVEY #1 IDENTIFIED ISSUES BY TIME OF DAY PUBLIC ENGAGEMENT RESULTS



1. Do you experience congestion when traveling along the study area? If so, when? (Check all that apply)
2. When do you typically experience mobility issues in the study area? (Check all that apply)
3. When do you typically travel in the study area? (Check all that apply)

3.2.2. Spring 2024 – Survey #2

Following the development and analysis of the preferred alternatives, a second public involvement survey was developed to determine the public's response. This survey was available online for 15 days spanning from April 29 to May 13, 2024, with 1300 unique participants.

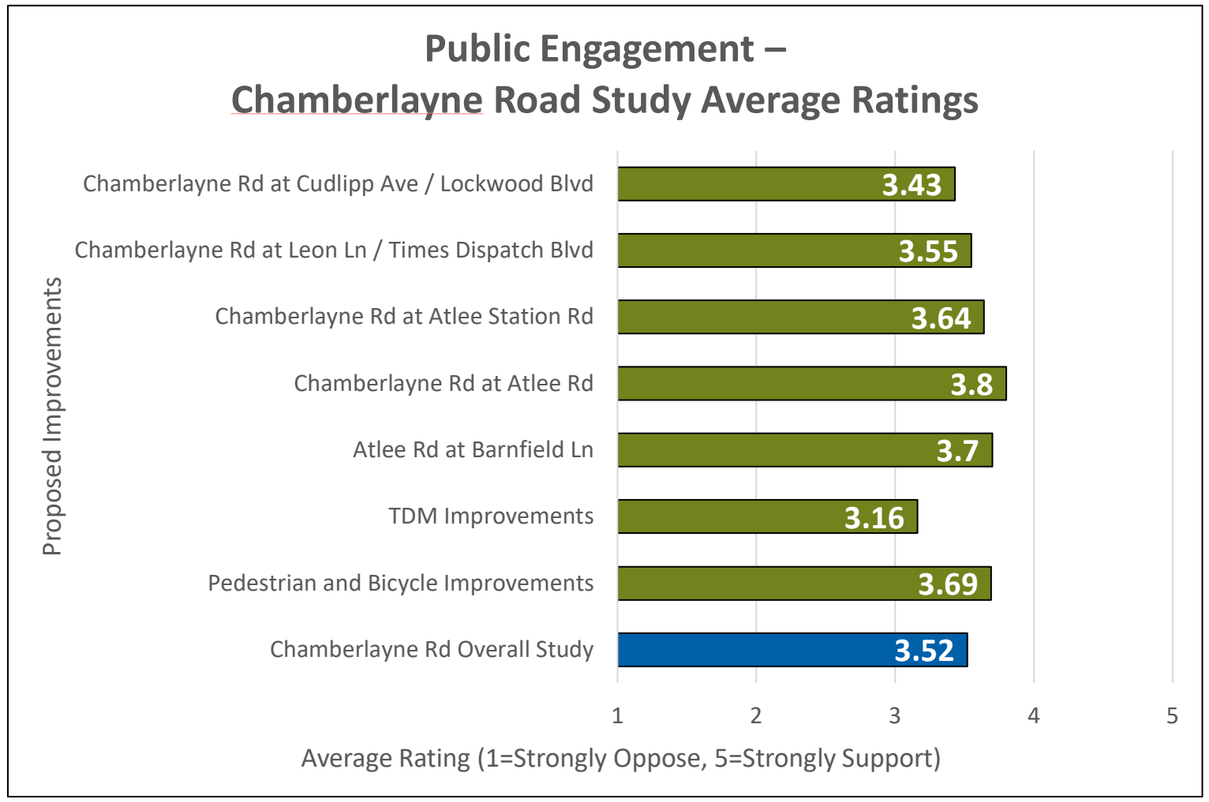
The survey provided the study team, Hanover County, and VDOT with an understanding of how the public viewed the individual recommendation elements for each intersection, the pedestrian and bicycle improvements for the corridors, and TDM improvements overall. Each element was ranked on a score of 1-5, with 5 being the most favorable.

CHAMBERLAYNE ROAD OVERALL STUDY

Each proposed improvement received a score above three (3) with an overall score of 3.52 for the study area. Public comments submitted with the survey generally indicated firm endorsements for all recommended pedestrian improvements to be installed within the study area.

Figure 3.6 summarizes the average rating for each intersection overall along with the corridor pedestrian/bicycle and TDM recommendations.

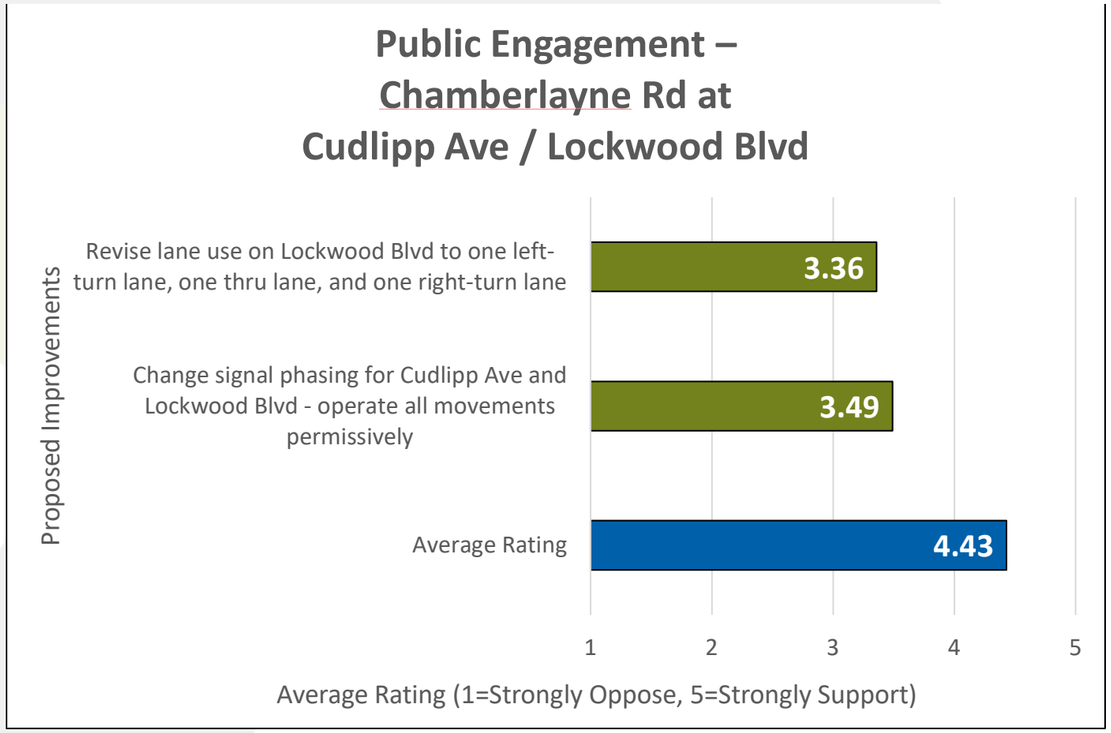
FIGURE 3.6. SURVEY #2 PUBLIC ENGAGEMENT RESULTS SUMMARY



CHAMBERLAYNE ROAD AT CUDLIPP AVENUE AND LOCKWOOD BOULEVARD

The alternative for Chamberlayne Road at Cudlipp Avenue and Lockwood Boulevard received an overall score of 3.36. **Figure 3.7** summarizes the average rating for each improvement.

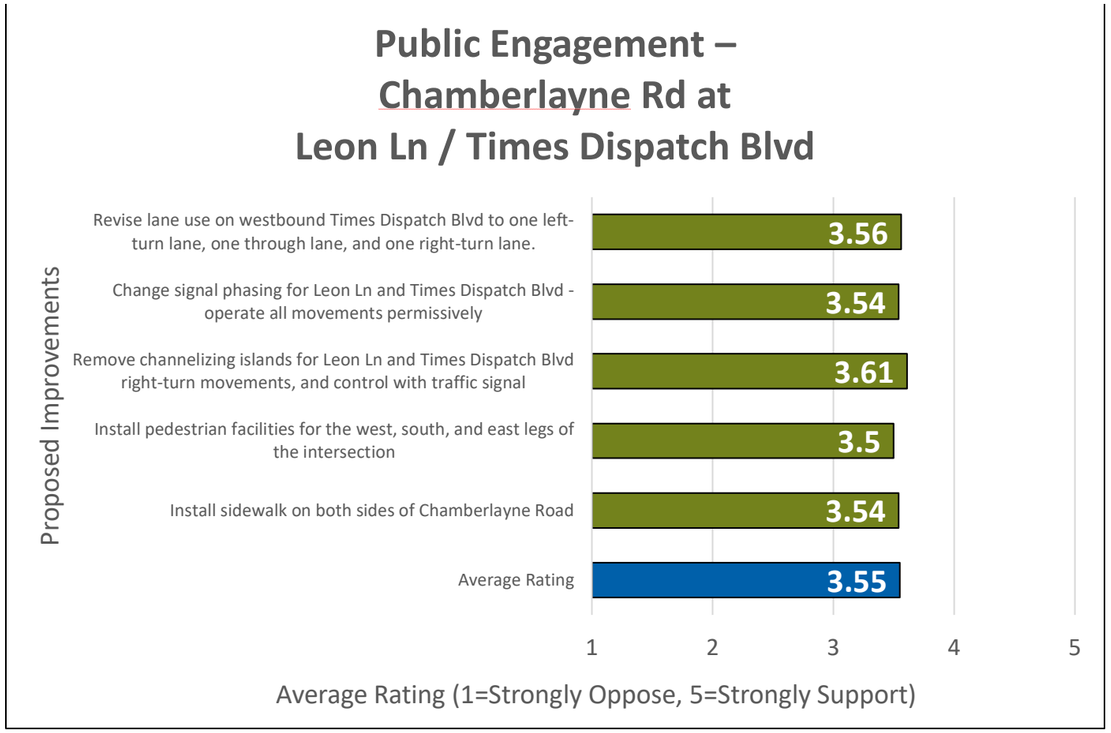
FIGURE 3.7. CHAMBERLAYNE ROAD AT CUDLIPP AVENUE AND LOCKWOOD BOULEVARD PUBLIC ENGAGEMENT RATING



CHAMBERLAYNE ROAD AT LEON LANE AND TIMES DISPATCH BOULEVARD

The alternative for Chamberlayne Road at Leon Lane and Times Dispatch Boulevard received an overall score of 3.55. **Figure 3.8** summarizes the average rating for each improvement overall.

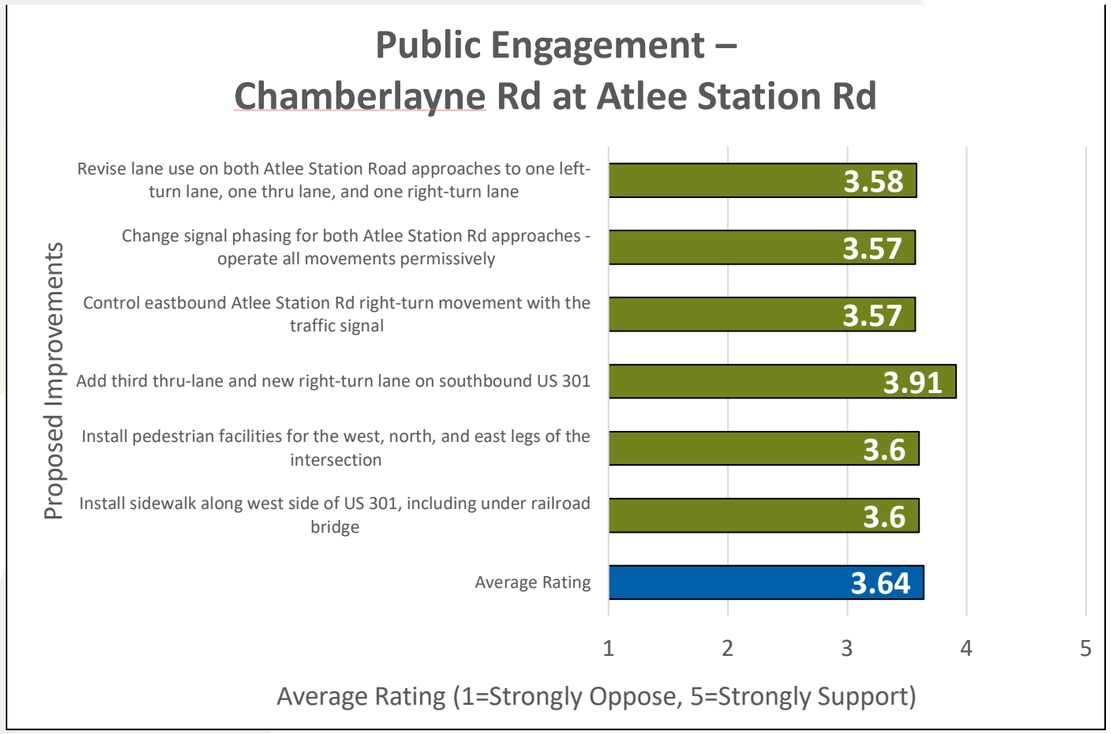
FIGURE 3.8. CHAMBERLAYNE ROAD AT LEON LANE AND TIMES DISPATCH BOULEVARD PUBLIC ENGAGEMENT RATING



CHAMBERLAYNE ROAD AT ATLEE STATION ROAD

The alternative for Chamberlayne Road at Atlee Station Road received an overall score of 3.64. **Figure 3.9** summarizes the average rating for each improvement overall.

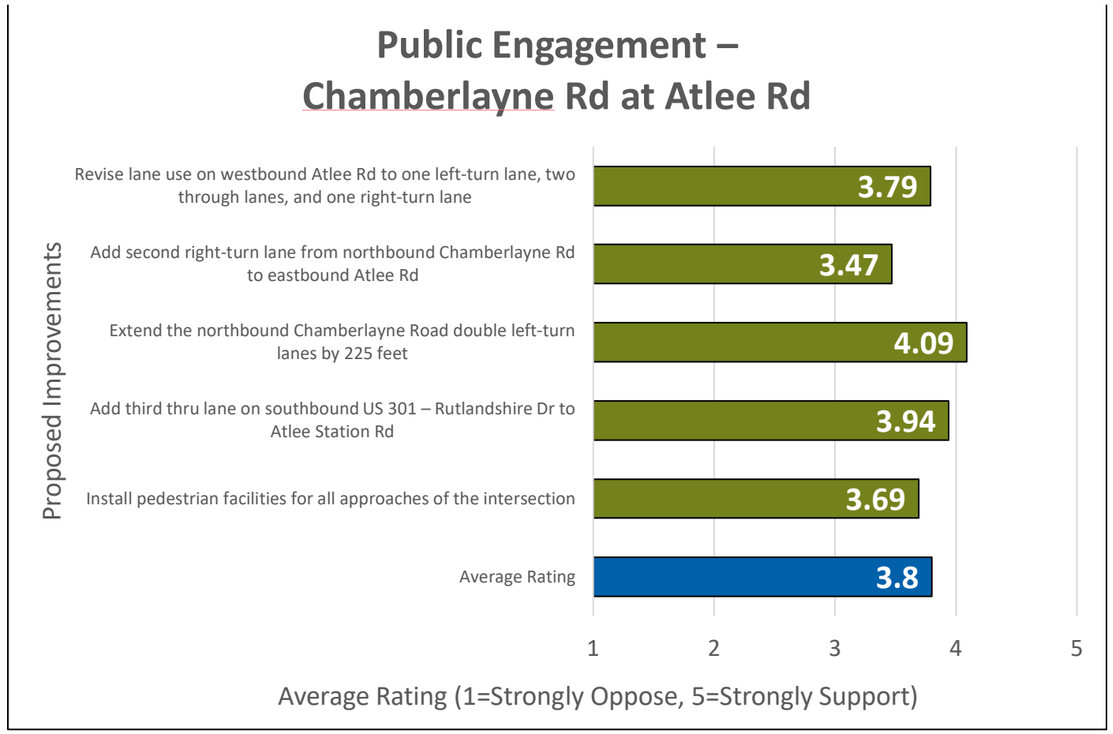
FIGURE 3.9. CHAMBERLAYNE ROAD AT ATLEE STATION ROAD PUBLIC ENGAGEMENT RATING



CHAMBERLAYNE ROAD AT ATLEE ROAD

The alternative for Chamberlayne Road at Atlee Road received an overall score of 3.80. **Figure 3.10** summarizes the average rating for each improvement overall.

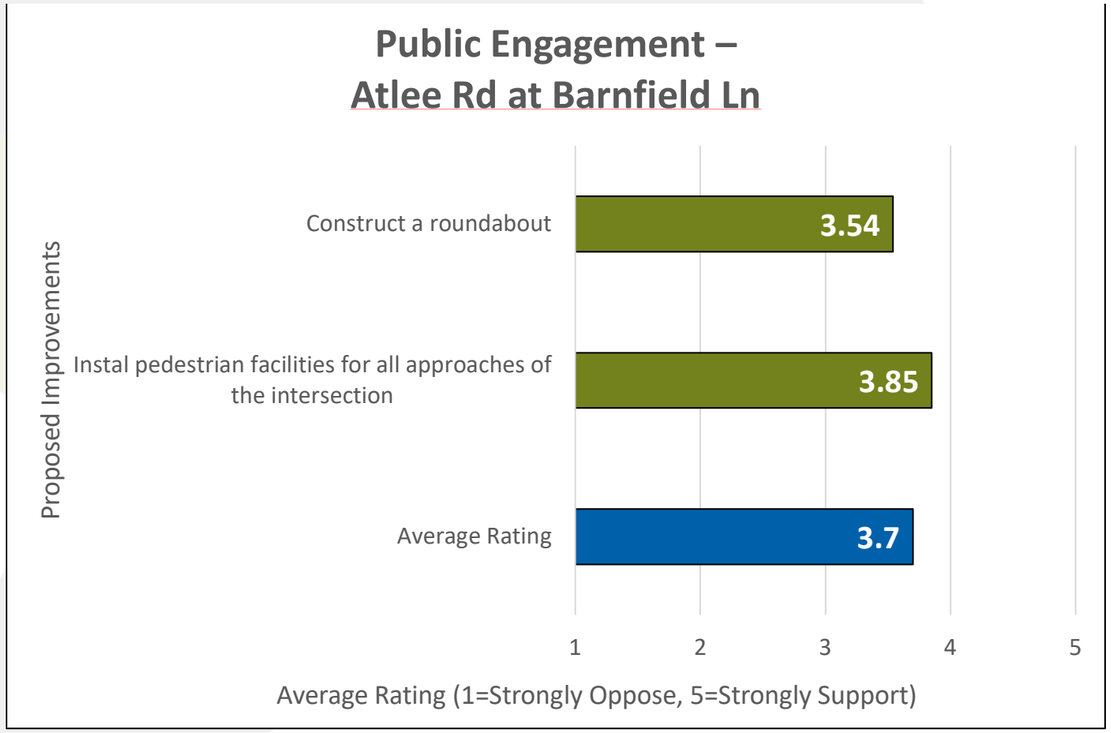
FIGURE 3.10. CHAMBERLAYNE ROAD AT ATLEE ROAD PUBLIC ENGAGEMENT RATING



ATLEE ROAD AT BARNFIELD LANE

The alternative for Atlee Road at Barnfield Lane received an overall score of 3.70. **Figure 3.11** summarizes the average rating for each improvement overall.

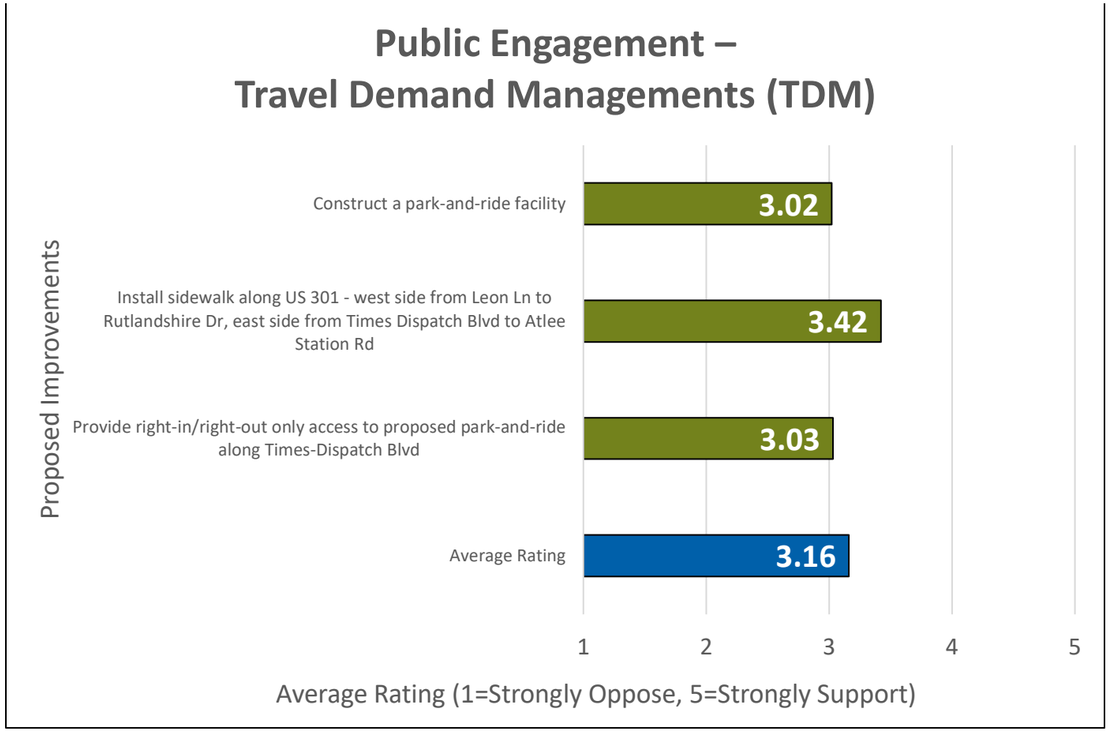
FIGURE 3.11. ATLEE ROAD AT BARNFIELD LANE PUBLIC ENGAGEMENT RATING



TRAVEL DEMAND MANAGEMENT IMPROVEMENTS

The Travel Demand Management (TDM) improvements received an overall score of 3.16. **Figure 3.12** summarizes the average rating for each improvement overall.

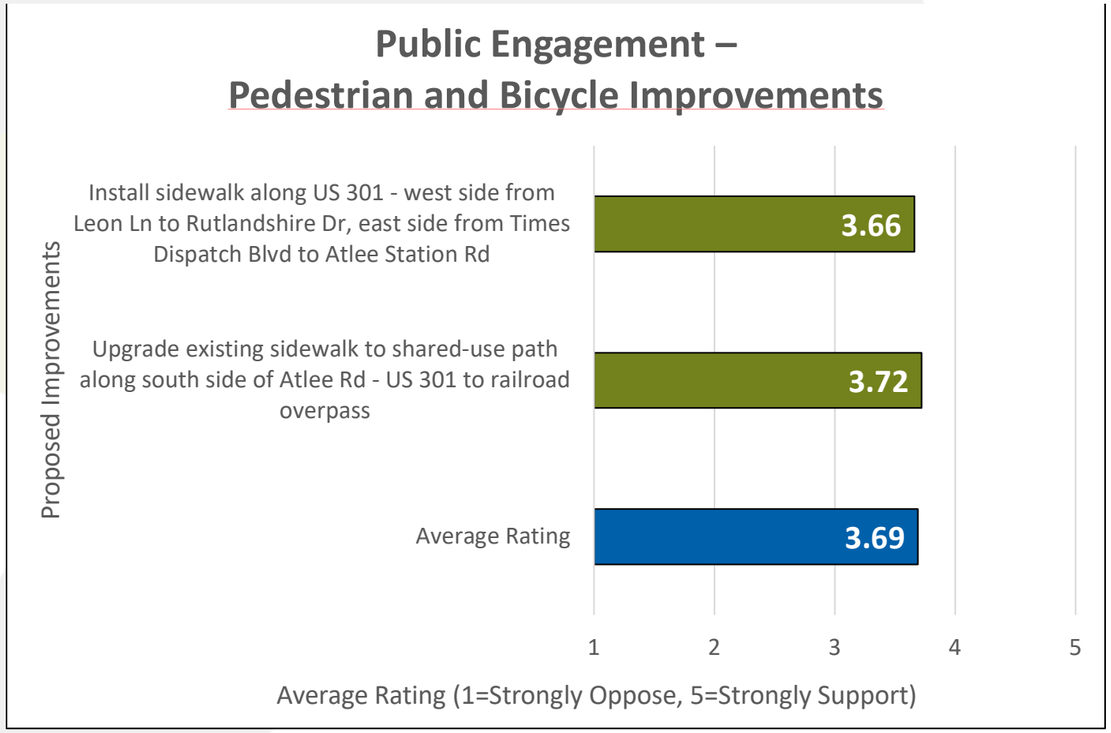
FIGURE 3.12. TRAVEL DEMAND MANAGEMENT IMPROVEMENTS PUBLIC ENGAGEMENT RATING



PEDESTRIAN AND BICYCLE ACCESS IMPROVEMENTS

The Pedestrian and Bicycle Access improvements received an overall score of 3.69. **Figure 3.13** summarizes the average rating for each improvement overall.

FIGURE 3.13. PEDESTRIAN AND BICYCLE ACCESS IMPROVEMENTS PUBLIC ENGAGEMENT RATING



Chapter 4: Preferred Alternative Design Refinement & Investment Strategy

4.1. Preferred Alternative

The Preferred Alternative was developed for the study area based on the results of the analysis as discussed in the previous Alternative Development and Screening section (Chapter 2), and Public and Stakeholders Feedback (Chapter 3). A summary of the elements of the Preferred Alternative is provided in Error! Reference source not found..

TABLE 4.1. PREFERRED ALTERNATIVE SUMMARY

Intersection	Preferred Alternative Elements
Chamberlayne Rd at Cudlipp Ave / Lockwood Blvd	Revise WB Lockwood Boulevard lane use – left, thru, right
	Modify signal phasing – permissive for WB and EB left turns
Chamberlayne Rd at Leon Ln / Times Dispatch Blvd	Revise WB Times Dispatch Boulevard lane use – left, thru, right
	Modify signal phasing – permissive for WB and EB left turns
Chamberlayne Road at Atlee Station Road	Revise EB/WB Atlee Station Road lane use – left, thru, right
	Modify signal phasing – permissive for EB and WB left turns
Chamberlayne Road at Atlee Road	Revise WB Atlee Road lane use – left, thru, thru, right
	Install second NB right turn lane
	Extend NB double left-turn lanes by 225'
	Provide third SB through lane from Atlee Road to Leon Lane
	Add SB right-turn lane
	Remove acceleration/weaving area for EB right turns
Atlee Road at Barnfield Lane	Roundabout – two EB/WB circulating lanes and one NB/SB circulating lane
Corridor-wide Bicycle and Pedestrian Improvements	Sidewalks along Chamberlayne Road with signalized crossings
	Shared-use path along Atlee Road with new crossings
Corridor-Wide Transit and TDM Improvements	Park-and-ride facility on the SE quadrant of Chamberlayne Road at Times Dispatch Boulevard

4.2. Intent of Phase 3

Phase 3 of the Pipeline Effort is intended to develop detailed concepts of the Phase 2 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 goal is to develop more detailed, quantity based, deterministic estimates and designs paired with thoughtful risk assessment and mitigation. The team will use practical design and common-sense engineering methods to document the assumptions and approaches that lead to the most efficient and effective project scopes. The effort maintains focus on the purpose and needs identified through Phase 1 and 2 that address the VTRANS priorities.

Technical resources utilize Phase 3 for thorough communication and collaboration with District, Central Office, FHWA, or other key partners and stakeholders that may have decision making authority or input on final designs if projects are selected for funding. An intended outcome is that projects, if funded, will have the documentation and support for innovation and flexibility that may be necessary to achieve success.

The Phase 3 Technical Team developed the analysis, design, deliverables, and documentation that will serve as the basis for future Preliminary Engineering work on the projects. At the conclusion of Phase 3, 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.

4.3. Assumptions

The following are key design assumptions that informed the concept development.

- US 301 (Chamberlayne Road) and Cudlipp Avenue / Lockwood Boulevard
  - Traffic: The existing traffic signal will need to be modified to accommodate modifications to phasing – signal head replacements and mast-arm mounted lane use signs will be revised. Pavement markings and ground-mounted signs associated with changes in westbound lane use will be needed.

- US 301 (Chamberlayne Road) and Leon Lane / Times Dispatch Boulevard
  - Roadway Geometry: The footprint of the intersection will remain mostly unchanged, with only minor modifications needed. The south leg median nose will be extended northward to provide a median refuge for the south leg pedestrian crossing. The existing channelizing islands for eastbound and westbound right turns will be removed to change the operations to signalized for those movements – the corner radii should be reduced accordingly.
  - Traffic: The existing traffic signal will need to be modified to accommodate modifications to phasing – signal head replacements and mast-arm mounted lane use signs will be revised. Pavement markings and ground-mounted signs associated with changes to westbound lane use will be needed. Crosswalk markings will be installed for the three new pedestrian crossings, along with accessible and countdown pedestrian signals.
  - Pedestrian Accommodations: New sidewalk will be constructed along both sides of Chamberlayne Road, including connects for the 3 planned marked crosswalks and a connection to the proposed park-and-ride lot.
  - Utility Impacts: Some utility poles at the intersection and along US 301 may be impacted to accommodate pedestrian facilities.
- US 301 (Chamberlayne Road) and Atlee Station Road
  - Roadway Geometry: The existing channelizing islands for eastbound right turns will be removed to change the operations to signalized for that movement – the corner radii should be reduced accordingly. The removal of the island will help accommodate the continuation of the 3rd southbound through lane through the intersection.
  - Traffic: The existing traffic signal will need to be modified to accommodate modifications to phasing – signal head replacements and mast-arm mounted lane use signs will be revised. Existing traffic signal poles may be impacted by the provision of sidewalks. Pavement markings and ground-mounted signs associated with changes to side side street use will be needed. Crosswalk markings will be installed for the three new pedestrian crossings, along with accessible and countdown pedestrian signals.
  - Pedestrian Accommodations: New sidewalk will be constructed along both sides of Chamberlayne Road, including connections for the 3 planned marked crosswalks. Sidewalk will be constructed across the north leg median nose and the channelizing island for northbound right turns.
- US 301 (Chamberlayne Road) and Atlee Road
  - Roadway Geometry: The footprint of the intersection will be modified. The extension of the northbound double left-turn lane will require impacts to the existing median along US 301. Adding a second northbound right turn lane will require widening to the outside of the northbound approach, and the southeast corner radius will need to be increased to accommodate the double right-turn movement and a channelizing island. The channelizing island for eastbound right turns will be pulled back in order to accommodate a 3rd southbound through lane. Widening will be required to the outside on the southbound approach to accommodate a new right-turn lane in addition to the new southbound through lane. The west and north leg median noses will need to be pulled back to accommodate the new marked crosswalks.
  - Traffic: The existing traffic signal will need to be modified to accommodate the widened intersection. Pavement markings, signal-mounted signs, and ground-mounted signs associated with changes to lane use will be needed. Crosswalk markings will be installed for four new pedestrian crossings, along with accessible and countdown pedestrian signals.
  - Pedestrian Accommodations: New sidewalk will be constructed along the southbound side of Chamberlayne Road, including connections for all four new marked and signalized crossings. Impacts are expected to existing crosswalks and curb ramps on the southeast and northeast corners to accommodate intersection widening and alignment of crosswalks.
  - Structural Impacts: The new sidewalk along southbound US 301 would extend through existing railroad underpass. Impacts to the structure will be required to accommodate it.
- Atlee Road and Barnfield Lane
  - Roadway Geometry: The intersection will be reconfigured to accommodate a roundabout. Widening will in the intersection area to provide the circulatory roadway and interior island. The median on the south leg will be widened to clearly delineate one northbound and one southbound lane, and a new median island will be provided on the north leg to accommodate the same goal. The median along Atlee Road will be widened to accommodate two approach lanes in each direction, with the existing left-turn lanes being removed.
  - Traffic: Existing signs and pavement markings will be modified to reflect the change from two-way stop control to a roundabout with marked crossings for all legs of the intersection.
  - Pedestrian Accommodations: Existing sidewalks along Atlee Road, Barnfield Lane, and the shopping center approach will be realigned and reconstructed to accommodate the roundabout. Small segments of new sidewalk will be constructed on the northwest and southwest corners to provide full connections for all new marked crossings, and median refuges will be provided for all crossings.

  - Right-of-Way: Widening the intersection to accommodate a roundabout will require acquiring right-of-way on all four corners, but no impacts are anticipated to existing structures.
  - Utilities: Existing pedestrian-level lighting on the northwest corner will be impacted by the widening. New intersection lighting will be provided for all marked crossings.
- Park-and-Ride Lot
  - Roadway Geometry: A new access point will be constructed along eastbound Times Dispatch Boulevard to enter and exit the lot.
  - Environmental impacts: The new lot will be constructed on the site of an existing wooded area.
  - Pedestrian Accommodations: A new sidewalk will be constructed from the northwest corner of the lot to the planned sidewalk on the southeast corner of the intersection of Chamberlayne Road and Times Dispatch Boulevard.
- Atlee Road Pedestrian and Bicycle Facilities
  - Traffic: New marked and signed crosswalks will be provided, and existing crossings will be modified and upgraded to accommodate the new path.
  - Roadway Geometry: Several existing median noses will need to be pulled back to accommodate path crossings.
  - Pedestrian Accommodations: New curb ramps will be installed to accommodate new sections of the path. The existing sidewalk on the south side of Atlee Road will be upgraded to a shared use path – existing curb ramps will be modified to align with the path and create clearly separate ramps between crossings of side streets and of Atlee Road.

4.4. Risk Assessment/Contingency

As part of the risk assessment process, a risk register was developed to identify major/high impact project risk elements. The guidance provided in VDOT's Cost Estimating Manual (Chapter 5) and IIM PMO-15.0 was followed and identified after assessing collected data, field visits, stakeholder input, and concept development. 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. The major risks identified in this project include:

- Adjustment of design based on field survey requires additional impacts
- MOT design requires additional phasing to maintain traffic, increasing project duration and cost
- Development of the sidewalk under the existing CSX rail bridge requires coordination with CSX
- Project specific geotechnical exploration identifies poor soils, requiring ground improvements

The project is considered Moderately Complex. However, the level of concept design development is relatively detailed (between Pre-Scoping and PFI level of design), therefore the Most Likely Estimate (MLE) contingency would be more accurately in the 35% to 40% range. Each individual risk was "scored" based on probability, cost impacts, and time impacts. 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 to include preliminary engineering, right-of-way and utilities, mobilization/construction survey, maintenance of traffic (MOT), roadway design, hydraulics, traffic, and earthwork/geotechnical.

4.5. Cost Estimate

The project cost estimate was developed using the following methodology:

- Understanding the goals of the project and scope of the improvements to be implemented.
- Gathering and reviewing as much information about the project as possible, including site visits and stakeholder input.
- Establishing design criteria and developing a design concept.
- Performing quantity take-offs and identifying unit prices based on Bid Express and historical VDOT cost data (2-year District and Statewide average) to develop "defined costs".
- Developing "allowance costs" for some elements based on potential impacts and complexity. Allowances add costs for elements based on percentage of the base construction cost.
- Identifying appropriate contingency percentages by category.
- Developing Preliminary Engineering costs by category based on a percentage of the Construction cost.

The total project cost is estimated to be $33,509,940 and broken down by Phase/Major area as shown in **Table 4.2** below. This cost includes contingencies and represents uninflated 2024 dollars.

TABLE 4.2. COST ESTIMATE BREAKDOWN

Phase	US 301 Intersection Improvements	Atlee Rd at Barnfield Ln Roundabout	Atlee Rd Shared-Use Path	Park-and-Ride Facility	*Total*
Preliminary Engineering	$1,259,000	$823,000	$1,035,000	$1,205,000	*$4,322,000*

Right-of-Way and Utilities	$691,000	$1,220,000	$2,155,000	$9,802,000	*$13,868,000*
Construction	$3,125,000	$2,968,000	$3,184,000	$3,706,000	*$12,983,000*
CEI	$562,500	$534,240	$573,120	$667,080	*$2,336,940*
Total	**$5,637,500**	**$5,545,240**	**$6,947,120**	**$15,380,080**	***$33,509,940***

4.6. Concept Revisions and Final Estimate

Based on VDOT and Stakeholder input from Phase 2, the site visit performed at the commencement of Phase 3, and additional information from VDOT, the concept was advanced, refining key elements of the preferred alternative.

VDOT plans to relocate approximately 500 staff to an existing facility accessed from Lockwood Boulevard. This added traffic will require modifications to the preferred alternative to appropriately manage the traffic demand added to the road network. It was assumed that all 500 staff would arrive at and depart the facility within the AM and PM peak hours, respectively, and all new trips would originate from US 301 south of the Lockwood Blvd intersection.

As the design progressed, several elements were altered from the concept that resulted from Phase 2 to include:

- Changing lane use on the westbound Lockwood Boulevard approach to US 301: The modified configuration would include two left-turn lanes and a shared through/right-turn lane.
- Changing signal phasing for the westbound Lockwood Boulevard approach to US 301: With the modified lane use on this approach, permissive phasing on the side streets from the preferred alternative is not feasible. Instead, the westbound Lockwood Boulevard left-turn movement will operate under exclusive phasing, and all other side street movements will operate under permissive phasing.

Figures Figure 4.1, Figure 4.2, Figure 4.3, Figure 4.4, and Figure 4.5 show the updated concepts.

The cost estimate provided in Section 4.5 remained unchanged after incorporating the concept revision at US 301 / Cudlipp Avenue / Lockwood Boulevard.

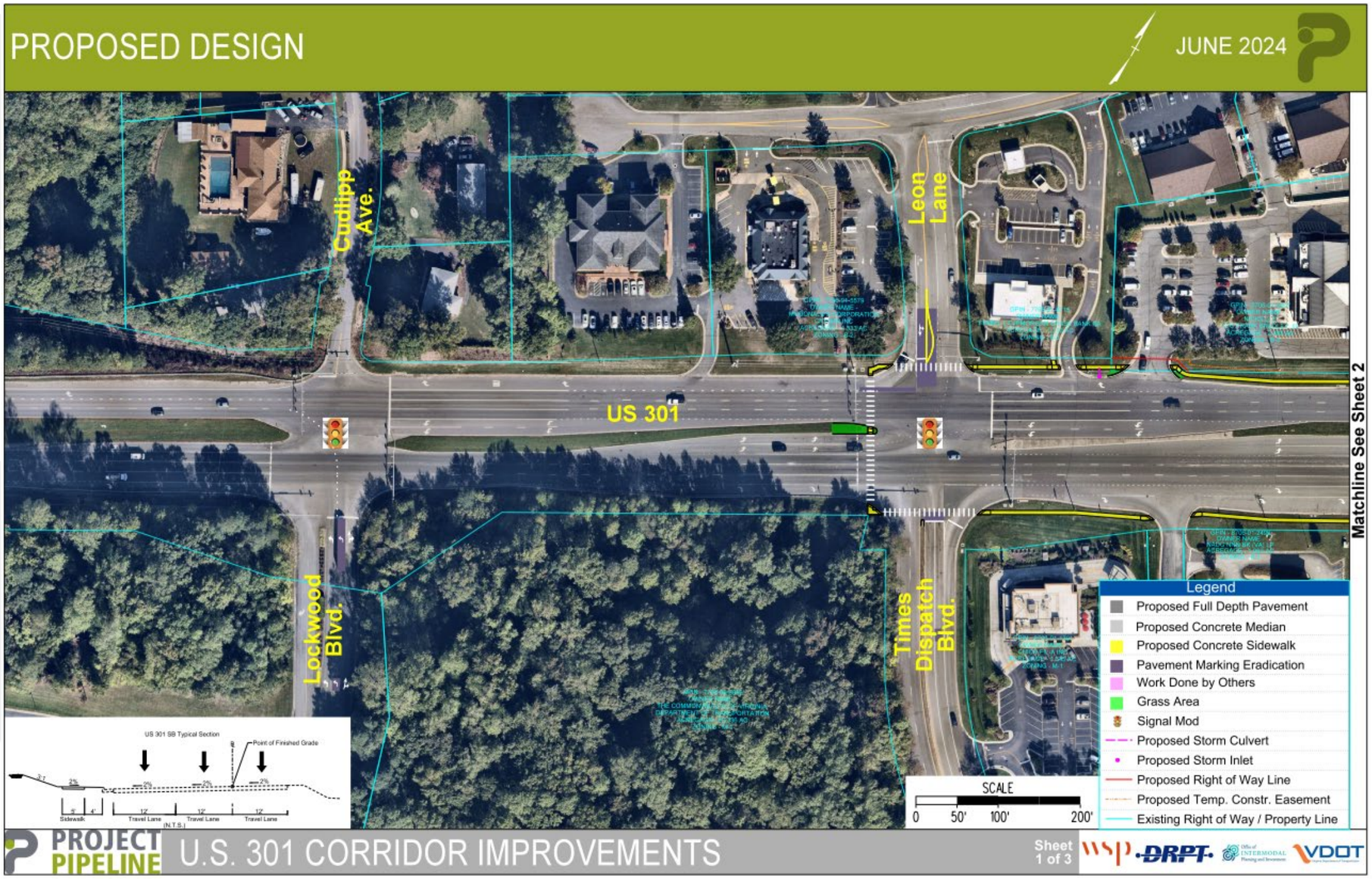


FIGURE 4.1: UPDATED CONCEPT - US 301 FROM CUDLIPP AVE / LOCKWOOD BLVD TO NORTH OF LEON LN / TIMES DISPATCH BLVD

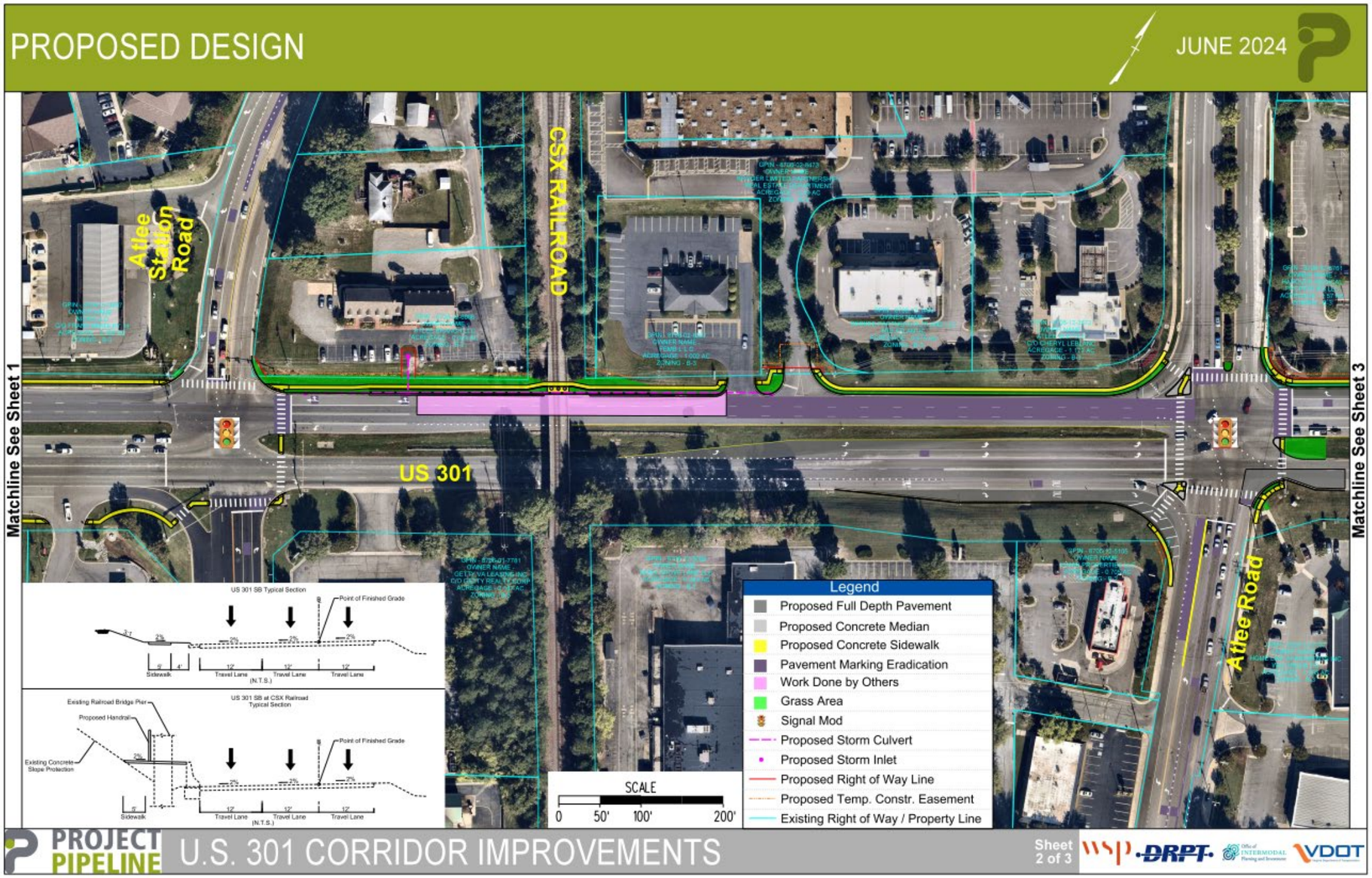


FIGURE 4.2: UPDATED CONCEPT - US 301 FROM SOUTH OF ATLEE STATION ROAD TO ATLEE ROAD

FIGURE 4.3: UPDATED CONCEPT - US 301 FROM ATLEE ROAD TO RUTLANDSHIRE DRIVE

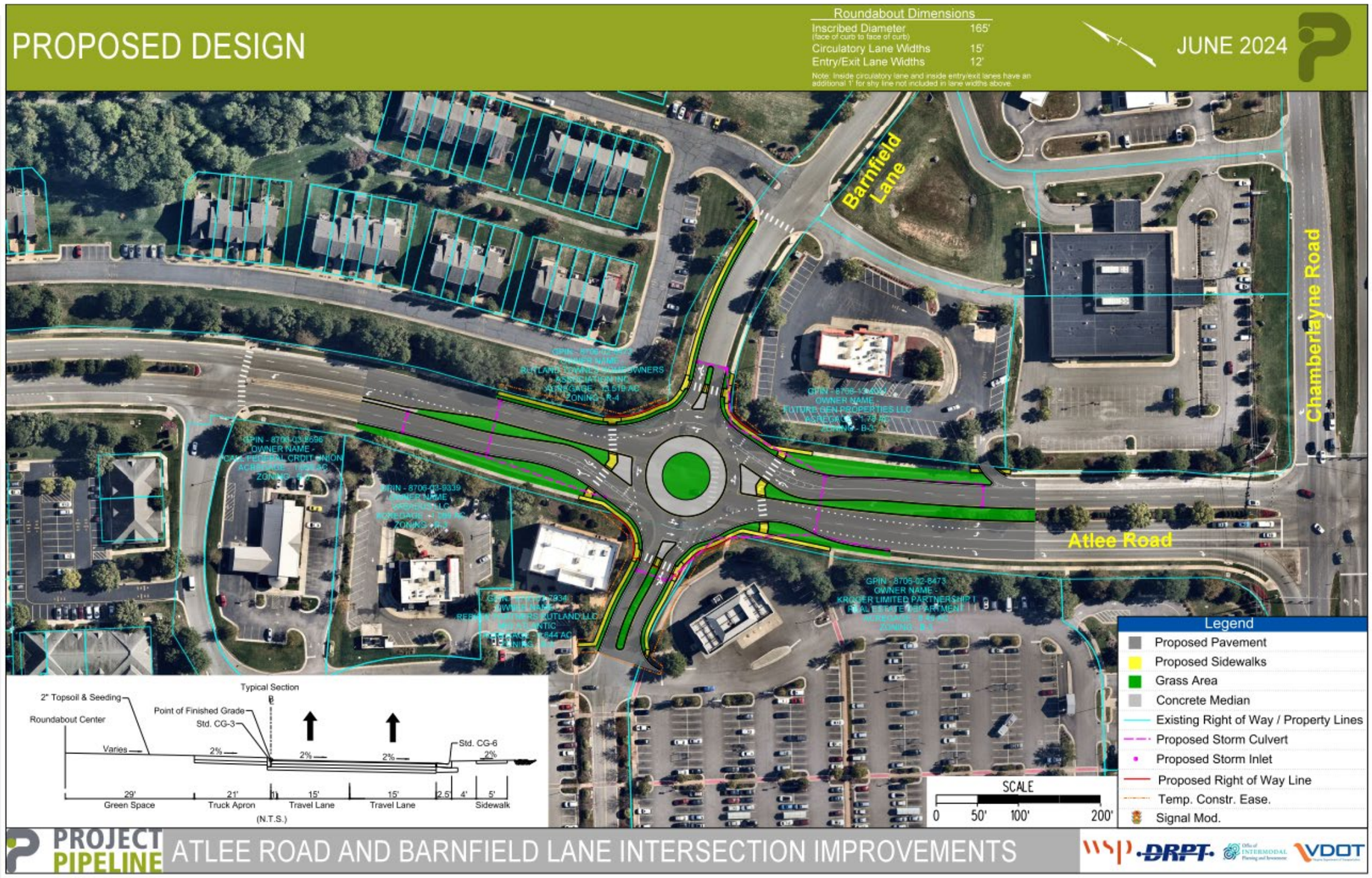


FIGURE 4.4: UPDATED CONCEPT - ATLEE ROAD AT BARNFIELD LANE

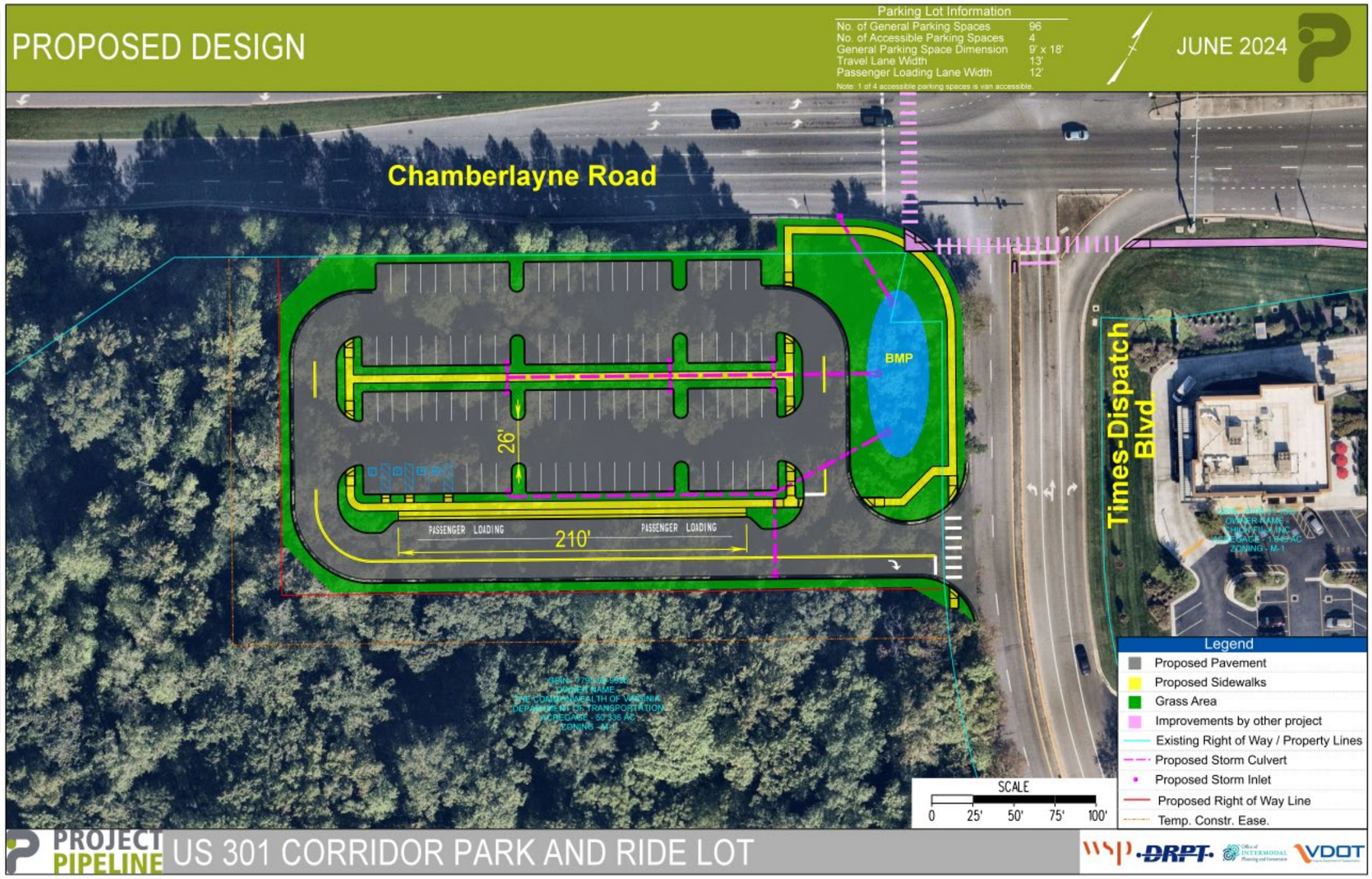


FIGURE 4.5: UPDATED CONCEPT - PARK-AND-RIDE LOT

4.7. Phase 3 Refined SimTraffic Operations Analysis

After completion of the SimTraffic microsimulation analysis performed during the Alternative Development phase detailed in **Chapter 2** of this document, an additional level of SimTraffic microsimulation analysis was performed during design refinement of the Preferred Alternative. This additional level of analysis focused primarily on testing operations at the intersection of US 301 and Cudlipp Avenue / Lockwood Boulevard with the changes to lane use and signal phasing, but also on associated network-level signal timing changes needed.

The SimTraffic reports for the future Refined Preferred Build scenario is provided in Appendix B. A summary of results is shown in **Table 4.3**. Results for the intersection of Atlee Road and Barnfield Lane are not provided since the intersection will not be signalized, thus operations are expected to remain unchanged.

Compared to the preferred alternative, the most notable changes would occur at the intersection of US 301 and Cudlipp Avenue / Lockwood Boulevard since it will experience the increase in demand. Several movements would experience increases in delay in the PM peak, but some would experience decreases in the AM peak. Overall intersection delay at Cudlipp Ave / Lockwood Blvd is lower in the AM but higher in the PM. Changes in delay at the movement, approach, and overall intersection level at the other signalized intersections are relatively small.

TABLE 4.3: UPDATED CONCEPT BUILD CONDITION PEAK HOUR DELAY

Intersection Number and Description	Type of Control	Lane Group	Eastbound		Westbound		Northbound		Southbound		Overall	
			AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
			Delay (s)	Delay (s)	Delay (s)	Delay (s)	Delay (s)	Delay (s)	Delay (s)	Delay (s)	Delay (s)	Delay (s)
1: US 301 & Cudlipp Ave / Lockwood Blvd		Roadway	Cudlipp Ave		Lockwood Blvd		US 301		US 301		Intersection	
	Signal	Left	75.7	81.8	70.0	136.1	76.6	107.1	71.9	89.4	12.3	49.1
		Through	61.3	0.0	62.0	58.8	9.8	38.6	13.8	40.2		
		Right	47.8	48.1	15.2	31.9	5.7	11.5	7.5	9.7		
		Approach	*60.9*	*54.2*	*43.6*	*133.2*	*9.8*	*39.9*	*14.1*	*39.9*		
2: US 301 & Leon Ln / Times Dispatch Blvd		Roadway	Time Dispatch		Leon Lane		US 301		US 301		Intersection	
	Signal	Left	67.0	62.6	71.2	67.0	56.4	67.4	70.5	60.8	22.6	26.5
		Through	66.0	72.4	56.8	59.1	12.7	27.7	27.9	23.6		
		Right	2.2	1.8	1.8	2.0	2.1	6.2	14.8	17.8		
		Approach	*8.8*	*12.0*	*46.8*	*37.4*	*16.4*	*29.6*	*28.1*	*24*		
3: US 301 & Atlee Station Rd		Roadway	Atlee Station Rd		Atlee Station Rd		US 301		US 301		Intersection	
	Signal	Left	67.9	77.2	61.3	55.6	210.2	202.7	53.2	86.6	34.2	33.8
		Through	53.4	42.4	56.7	55.4	16.2	19.2	25.9	24.8		
		Right	17.2	8.7	10.8	26.6	3.0	4.2	24.8	28.0		
		Approach	*42.7*	*41.2*	*9.4*	*44.9*	*222.8*	*38.2*	*293.5*	*26.2*		
4: US 301 & Atlee Rd		Roadway	Atlee Rd		Atlee Rd		US 301		US 301		Intersection	
	Signal	Left	295.2	376.1	131.9	160.4	271.8	196.2	210.7	681.0	130.4	130.3
		Through	88.2	60.7	228.2	274.5	26.6	70.2	155.8	104.4		
		Right	13.0	11.6	27.3	38.8	8.6	31.0	122.7	57.0		
		Approach	*137.7*	*165.6*	*167.4*	*222.5*	*66.8*	*69.5*	*157.0*	*150.6*		

4.8. SMART SCALE, Fiscal Year 2028

Based on public comments, *Synchro/SimTraffic* analysis of each alternative for the controlling peak hour, and safety analysis, the study team decided to advance the proposed intersection,

pedestrian/bicycle, and TDM improvements for fiscal year 2028 SMART SCALE funding consideration. Because this is a targeted series of improvements with both safety and operational benefits, the SMART SCALE Program is a logical first option. A SMART SCALE application was prepared for this project and submitted by Hanover County on August 1st, 2024, for the fiscal year 2028 SMART SCALE cohort. If selected, this project would receive full funding by Virginia fiscal year 2030.

Appendix A:

Counts

Appendix A-1:

Existing Turning Movement Counts

Appendix A-2:

48-Hour Tube Counts

Appendix B:

SimTraffic Reports

PROJECT PIPELINE

Appendix C:

STEAP Analysis Report

Appendix D:

VJuST Reports

PROJECT PIPELINE

Appendix E:

SIDRA Reports

PROJECT PIPELINE

Appendix F:

Risk Register