PROJECT PIPELINE

S Crater Road (VA 301)
City of Petersburg

From Wagner Road to Rives Road
RI-23-06

S Crater Road (VA 301) from Wagner Road to Rives Road

Final Report

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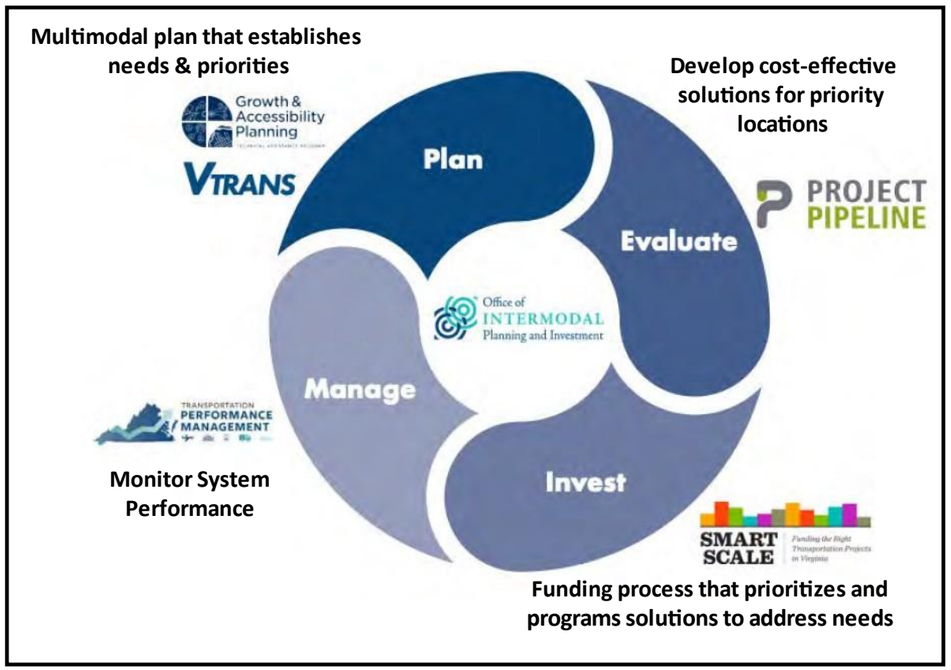
1.1. Introduction

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

This study focuses on concepts targeting identified needs including congestion mitigation, safety improvement, pedestrian and bicycle infrastructure along the corridor, and transit access. The objectives of Project Pipeline are shown in **Figure 1.1.**

FIGURE 1.1. PROJECT PIPELINE OBJECTIVES



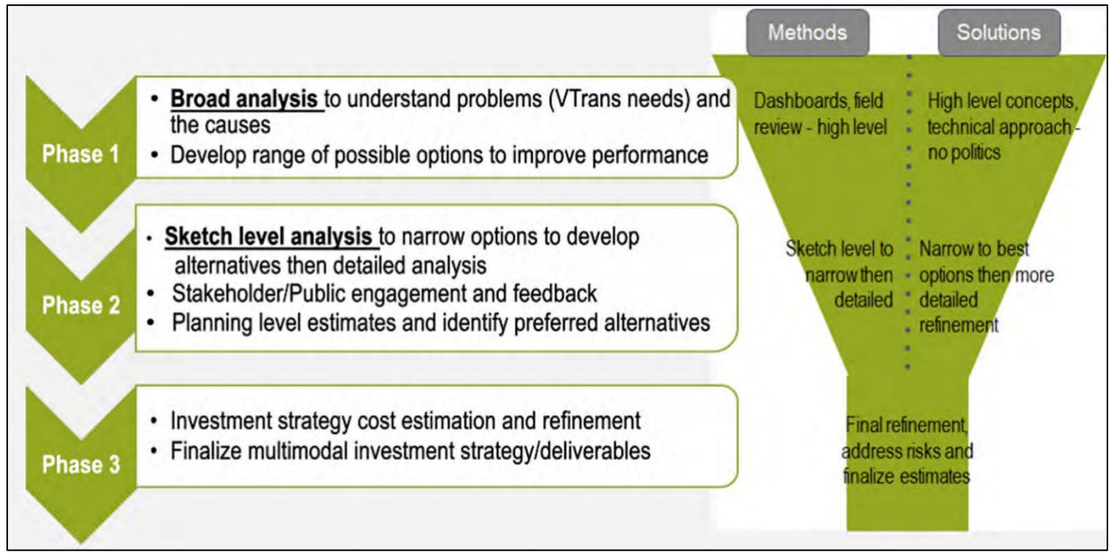
1.2. Methodology

The study is broken down into three phases.

- Phase I consists of identifying existing conditions, diagnosing local issues and concerns, and brainstorming alternatives.
- Phase II includes the alternative evaluation and sketch level analysis
- Phase III includes the investment strategy and cost estimates for final alternatives.

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 S Crater Road (VA 301) project area consists of three segments of roadway in the City of Petersburg, Virginia:

1. Wagner Road from S Crater Road to Normandy Drive
2. S Crater Road from Wagner Road to Rives Road (VA 629)
3. Rives Road from S Crater Road to Old Wagner Frontage Road

The entire study length is approximately 2.3 miles. A map detailing the extents of the study corridor and surrounding area is shown below in **Figure 1.3**.The corridor provides access to numerous businesses and residential areas. The area immediately surrounding the study corridor is primarily mixed-use residential and commercial business including grocery stores, a medical center, numerous restaurants, gas stations, and various other businesses. The study corridor includes six (6) signalized and five (5) unsignalized intersections.

1.3.1. Study Area Intersections

1. Wagner Road and Brasfield Parkway/Medical Park Boulevard (Signalized)
2. S Crater Road and Wagner Road (Signalized)
3. S Crater Road and Seylor Drive (Unsignalized)
4. S Crater Road and Crater Circle (Signalized)
5. S Crater Road and Medical Park Boulevard (Signalized)
6. S Crater Road and S Walmart Access (Signalized)
7. S Crater Road and Lakewood Drive (Unsignalized)
8. S Crater Road and Rives Road (Signalized)
9. Rives Road and I-95 Southbound Ramp (Unsignalized)
10. Rives Road and I-95 Northbound Ramp (Unsignalized)
11. Rives Road and Old Wagner Frontage Road (Unsignalized)

FIGURE 1.3. STUDY AREA

INTERSECTION 1: WAGNER ROAD AND BRASFIELD PARKWAY/MEDICAL PARK BOULEVARD

Wagner Road is a four-lane divided highway classified as Other Principal Arterial per *VDOT Functional Classification.* Brasfield Parkway/Medical Park Boulevard is classified as Minor Collector per *VDOT Functional Classification.* The intersection of Wagner Road at Brasfield Parkway/Medical Park Boulevard is a 4-leg signalized intersection. The posted speed limit along Brasfield Parkway is 25 miles per hour and 35 miles per hour along Medical Park Boulevard. The eastbound approach of Wagner Road has one left-turn lane, two through lanes, and one right-turn lane. The westbound approach has two left-turn lanes, two through lanes, and one right-turn lane. The northbound approach of Medical Park Boulevard has one left-turn lane, one shared thru-left lane, and one right-turn lane. The southbound approach of Brasfield Parkway has one left-turn lane, one through lane, and one right-turn lane. The signal operations include protected left turns for all approaches. The eastbound/westbound through movements are coordinated with adjacent signalized intersections. Sidewalks, pedestrian ramps, and pedestrian signals are present at the intersection. Crosswalks for all movements are provided, but pavement markings are faded. **Figure 1.4** shows an aerial of the intersection.

FIGURE 1.4. WAGNER ROAD AND BRASFIELD PARKWAY/MEDICAL PARK BOULEVARD

Source: Google Imagery

INTERSECTION 2: S CRATER ROAD AND WAGNER ROAD

Wagner Road is a four-lane divided highway classified as Other Principal Arterial per *VDOT Functional Classification.* S Crater Road is a four-lane divided highway classified as Other Principal Arterial per *VDOT Functional Classification.* A shared left turn lane is located on S Crater Road between Wagner Road and Seylor Drive. The intersection of Wagner Road at S Crater Road is a 3-leg signalized intersection on the northbound, southbound, and westbound approaches and stop controlled on the eastbound approach. The posted speed limit along Wagner Road is 40 miles per hour and 35 miles per hour along S Crater Road. The eastbound approach of the business driveway has one shared left-thru-right lane. The westbound approach of Wagner Road has two left-turn lanes and one right-turn lane. The northbound approach of S Crater Road has one left-turn lane, one through lane, and one right-turn lane. The southbound approach has one left-turn lane, one through lane, and one shared thru-right lane. The signal operations include protected left turns for all approaches. The eastbound/westbound through movements are coordinated with adjacent signalized intersections. While sidewalks and pedestrian ramps are present at the intersection, no marked crosswalks or pedestrian signals are provided. **Figure 1.5** shows an aerial of the intersection.

FIGURE 1.5. S CRATER ROAD AND WAGNER ROAD

Source: Google Imagery

INTERSECTION 3: S CRATER ROAD AND SEYLOR DRIVE

The intersection of S Crater Road at Seylor Drive is a 3-leg unsignalized intersection. The posted speed limit along Seylor Drive is 25 miles per hour. The westbound approach of Seylor Drive is stop-controlled while the northbound and southbound approaches of S Crater Road are free-flow. The westbound approach has one shared left-right turn lane. The northbound approach of S Crater Road has one through lane and one shared thru-right lane. The southbound approach has one left-turn lane and two through lanes. While a sidewalk is provided along the west of the intersection, no other pedestrian facilities are present at the intersection. **Figure 1.6** shows an aerial of the intersection.

FIGURE 1.6. S CRATER ROAD AND SEYLOR DRIVE

Source: Google Imagery

INTERSECTION 4: S CRATER ROAD AND CRATER CIRCLE

The intersection of S Crater Road at Crater Circle is a 4-leg signalized intersection. The posted speed limit along Crater Circle is 25 miles per hour. The eastbound approach of Crater Circle has one left-turn lane and one shared left-thru-right lane. The westbound approach of Crater Circle has one shared left-thru-right lane. The northbound approach of S Crater Road has one left-turn lane, one through lane, and one shared thru-right lane. The southbound approach has one left-turn lane, two through lanes, and one right-turn lane. The signal operations include protected left turns for all approaches. The northbound/southbound through movements are coordinated with adjacent signalized intersections. While a sidewalk is provided along the northwest quadrant of the intersection, no other pedestrian facilities are present at the intersection. **Fi Figure 1.7** shows an aerial of the intersection.

FIGURE 1.7. S CRATER ROAD AND CRATER CIRCLE

Source: Google Imagery

INTERSECTION 5: S CRATER ROAD AND MEDICAL PARK BOULEVARD

The intersection of S Crater Road at Medical Park Boulevard is a 4-leg signalized intersection. The posted speed limit along Medical Park Boulevard is 35 miles per hour. The eastbound approach of South Crater Square has one shared thru-left lane and one right-turn lane. The westbound approach of Medical Park Blvd has one left-turn lane and one shared thru-right lane. The northbound approach of S Crater Road has one left-turn lane, two through lanes, and one right-turn lane. The southbound approach has one left-turn lane, two through lanes, and one right-turn lane. The signal operations include protected left turns for all approaches. The northbound/southbound through movements are coordinated with adjacent signalized intersections. Crosswalks, pedestrian ramps, and pedestrian signals for all movements are present at the intersection. A sidewalk is provided along the northeast and southeast quadrants of the intersection. **Figure 1.8** shows an aerial of the intersection.

FIGURE 1.8. S CRATER ROAD AND MEDICAL PARK BOULEVARD

Source: Google Imagery

INTERSECTION 6: S CRATER ROAD AND S WALMART ACCESS

The intersection of S Crater Road at S Walmart Access is a 4-leg signalized intersection. No speed limit is posted along S Walmart Access. The eastbound approach has one left-turn lane and one right-turn lane. The westbound approach of the business driveway has one shared left-thru-right lane. The northbound approach of S Crater Road has one left-turn lane and two through lanes. The southbound approach has one left-turn lane and two through lanes. The signal operations include protected left turns for all approaches. The northbound/southbound through movements are coordinated with adjacent signalized intersections. No pedestrian facilities are present at the intersection. **Figure 1.9** shows an aerial of the intersection.

FIGURE 1.9. S CRATER ROAD AND S WALMART ACCESS

Source: Google Imagery

INTERSECTION 7: S CRATER ROAD AND LAKEWOOD DRIVE

The intersection of S Crater Road at Lakewood Drive is a 3-leg unsignalized intersection. The posted speed limit along Lakewood Drive is 25 miles per hour. The westbound approach of Lakewood Drive is stop-controlled while the northbound and southbound approaches of S Crater Road are free-flow. The westbound approach has one shared left-right turn lane. The northbound approach of S Crater Road has one left/U-turn lane, one through lane and one shared thru-right lane. The southbound approach has one left-turn lane and two through lanes. No pedestrian facilities are present at the intersection. **Figure 1.10** shows an aerial of the intersection.

FIGURE 1.10. S CRATER ROAD AND LAKEWOOD DRIVE

Source: Google Imagery

INTERSECTION 8: S CRATER ROAD AND RIVES ROAD/N PLAINS DRIVE

The intersection of S Crater Road at Rives Road/N Plains Drive is a 4-leg signalized intersection. The posted speed limit along Rives Road is 35 miles per hour. The posted speed limit along N Plains Drive is 25 miles per hour. The eastbound approach of N Plains Drive has one shared left-thru-right lane. The westbound approach of Rives Road has one shared left-thru lane and one right-turn lane. The northbound approach of S Crater Road has one left-turn lane, one through lane, and one shared thru-right lane. The southbound approach one left-turn lane, one through lane, and one shared thru-right lane. The signal operations include protected left turns for all approaches. The northbound/southbound through movements are coordinated with adjacent signalized intersections. No pedestrian facilities are present at the intersection. **Figure 1.11** shows an aerial of the intersection.

FIGURE 1.11. S CRATER ROAD AND RIVES ROAD/N PLAINS DRIVE

Source: Google Imagery

INTERSECTION 9: RIVES ROAD AND I-95 SOUTHBOUND RAMP

The intersection of Rives Road at the I-95 southbound ramp is a 4-leg unsignalized intersection. The posted speed limit along the I-95 southbound ramp is 35 miles per hour. The approach of the I-95 southbound ramp is stop-controlled while the eastbound and westbound approaches of Rives Road are free-flow. The eastbound approach has one shared thru-right lane. The westbound approach has one shared thru-left lane. The southbound approach has one shared left-thru-right lane. The south leg has one receiving lane. No pedestrian facilities are present at the intersection. **Figure 1.12** shows an aerial of the intersection.

FIGURE 1.12. RIVES ROAD AND I-95 SOUTHBOUND RAMP

Source: Google Imagery

INTERSECTION 10: RIVES ROAD AND I-95 NORTHBOUND RAMP

The intersection of Rives Road at the I-95 northbound ramp is a 4-leg unsignalized intersection. The posted speed limit along the I-95 northbound ramp is 35 miles per hour. The approach of the I-95 northbound ramp is stop-controlled while the eastbound and westbound approaches of Rives Road are free-flow. The eastbound approach has one shared thru-left lane. The westbound approach has one shared thru-right lane. The northbound approach has one shared left-thru-right lane. The north leg has one receiving lane. No pedestrian facilities are present at the intersection. **Figure 1.13** shows an aerial of the intersection.

FIGURE 1.13. RIVES ROAD AND I-95 NORTHBOUND RAMP

Source: Google Imagery

INTERSECTION 11: RIVES ROAD AND OLD WAGNER FRONTAGE ROAD

The intersection of Rives Road at Old Wagner Frontage Road is a 4-leg unsignalized intersection. The posted speed limit along the I-95 northbound ramp is 35 miles per hour. The approach of the I-95 northbound ramp is stop-controlled while the eastbound and westbound approaches of Rives Road are free-flow. The eastbound approach has one shared thru-left lane. The westbound approach has one shared thru-right lane. The northbound approach has one shared left-thru-right lane. The north leg has one receiving lane. No pedestrian facilities are present at the intersection. **Figure 1.14** shows an aerial of the intersection.

FIGURE 1.14. RIVES RD AND OLD WAGNER FRONTAGE ROAD

Source: Google Imagery

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. Each need category has one or more performance measures and thresholds to identify one or more needs. The Study Work Group (SWG) will work to examine and mitigate these identified needs within the study area.

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)
- City of Petersburg
- Prince George County
- Tri-Cities Area Metropolitan Planning Organization (MPO)
- Petersburg Area Transit (PAT)
- 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.

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 segments ranked as "Very High Priority" represent those with multiple categories identified as high in need. The mid-term needs, as identified in VTrans for the study corridor, are presented in **Table 2** and include:

- 'Very High' for Safety Improvement and Transportation Demand Management,
- 'High' for Bicycle Access,
- 'Medium' for Congestion Mitigation,
- 'Low' for Pedestrian Access and Transit Access,

Table 2 also identifies a Priority Level associated with the VTrans identified needs. Essentially, items identified as "Low Priority" are still priorities, just not to the extent of a "High Priority" need. A general Priority number is assigned to the qualitative priority level. Items that identify as "None" indicate essentially no improvement need or demand need in the project area. VTrans needs have been grouped based on their focus, as identified in **Table 1.2**.

TABLE 1.1. LIST OF VTRANS NEEDS & SYMBOLOGY

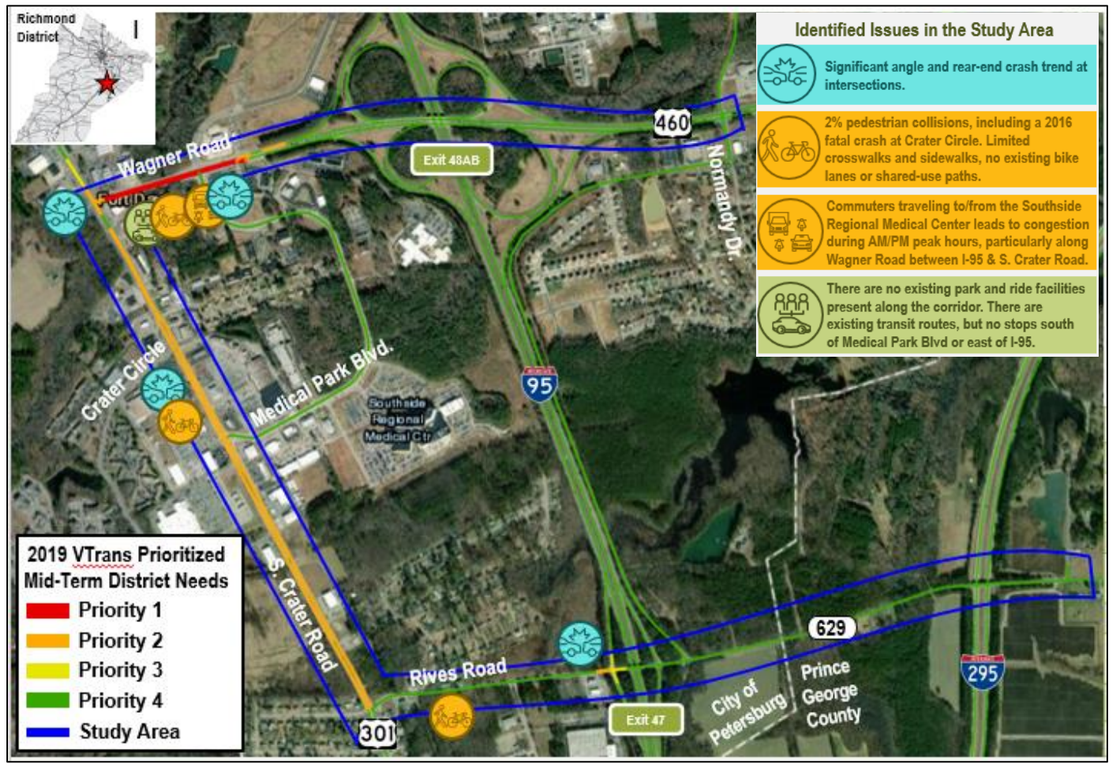
VTrans Needs
Transportation Demand Management
Congestion Mitigation
Safety Improvement
Transit Access
Capacity Preservation
Bicycle Access
Pedestrian Safety Improvement

TABLE 1.2. VTRANS NEEDS IN THE STUDY AREA

	VTrans Identified Needs	Priorities	Priority Level
Operations	Capacity Preservation	None	--
	Congestion Mitigation	Medium	3
Pedestrian / Bicycle Access	IEDA (UDA) Access	None	--
	Bicycle Access	High	2
	Pedestrian Access	Low	4
Safety & Reliability	Safety Improvement	Very High	1
	Pedestrian Safety Improvement	None	--
	Reliability	None	--
Transit / TDM / Rail	Rail On-time Performance	None	--
	Transit Access	Low	4
	Transit Access for Equity	None	--
	Transportation Demand	Very High	1

Figure 1.15 presents a map of the study area with 2019 VTrans mid-term need locations by overall priority level.

FIGURE 1.15. VTRANS 2019 PRIORITIZED MID-TERM NEEDS



1.4.3. Operations Needs

The ***operational*** issues intended to be addressed by this study include existing and future projected congestion within the corridor. Medium Priority VTRANS Congestion Needs exist along the study corridor. The identified locations include:

- Medium Priority on Wagner Road from I-95 to S Crater Road

1.4.4. Pedestrian / Bicycle Access Needs

The ***pedestrian and bicycle*** access needs intended to be addressed by this study include identification of areas that need the addition of or improvement to pedestrian or bicycle facilities, including adding sidewalks, bicycle lanes, providing ADA-compliant pedestrian facilities. VTrans pedestrian and bicycle needs are identified as:

- High Bicycle and Low Pedestrian Priority on S Crater Road from Wagner Road to Rives Road
- High Bicycle and Low Pedestrian Priority on Wagner Road from S Crater Road to I-95 ramps
- High Bicycle and Low Pedestrian Priority on Rives Road from S Crater Road to I-95 ramps

1.4.5. Safety and Reliability Needs

This study also intends to address existing and future ***safety*** concerns within the study corridor, which is identified as a Priority 2 District Safety Need area. During the recent seven-year period (2015-2022), 384 crashes resulting in 36 visible injuries were reported within this corridor. The types of crashes frequently reported include rear-end and angle. The VTrans Safety Improvement Needs include:

- Very High Safety Need at S Crater Road and Wagner Road
- High Safety Need on Wagner Road from Poplar Dr to S Crater Road
- High Safety Need on S Crater Road from Wagner Road to Rives Road
- High Safety Need at Rives Road and I-95 southbound ramps

There are 2 Potential for Safety Improvement (PSI) Intersections in the study area:

1. S Crater Road (US 301) & Wagner Road
2. Rives Road (VA 629) & I-95 SB Off-Ramp

Safety analysis will be performed using the most recent 5 years of crash data from VDOT's Project Pipeline Dashboard '23 and VDOT's most recent *Potential Safety Improvement (PSI*) information available at *VDOT's Pathways for Planning* website. Crash Modification Factors (CMFs), conflict point analysis, and a *Safe Systems* approach will be used to compare the safety improvement of potential project recommendations.

1.4.6. Transit / TDM / Rail Needs

Very High Priority TDM Needs and Low Priority Transit Access Needs exist along this study corridor. The corridor has a need, the solution for which may include expanded public transportation services, new park and ride facilities, bicycle and pedestrian facilities, and commuter assistance programs. Petersburg Area Transit (PAT) will play a vital role in identifying needs, providing existing ridership data, and determining solutions along the corridor.

1.5. Existing Traffic Operational Analysis

Traffic operations analyses were conducted to evaluate overall performance of the study intersections within the study corridor for the Existing 2023 Conditions scenario.

1.5.1. Traffic Data

Existing traffic volume data was collected in May 2023 at locations shown in **Figure 1.16**.

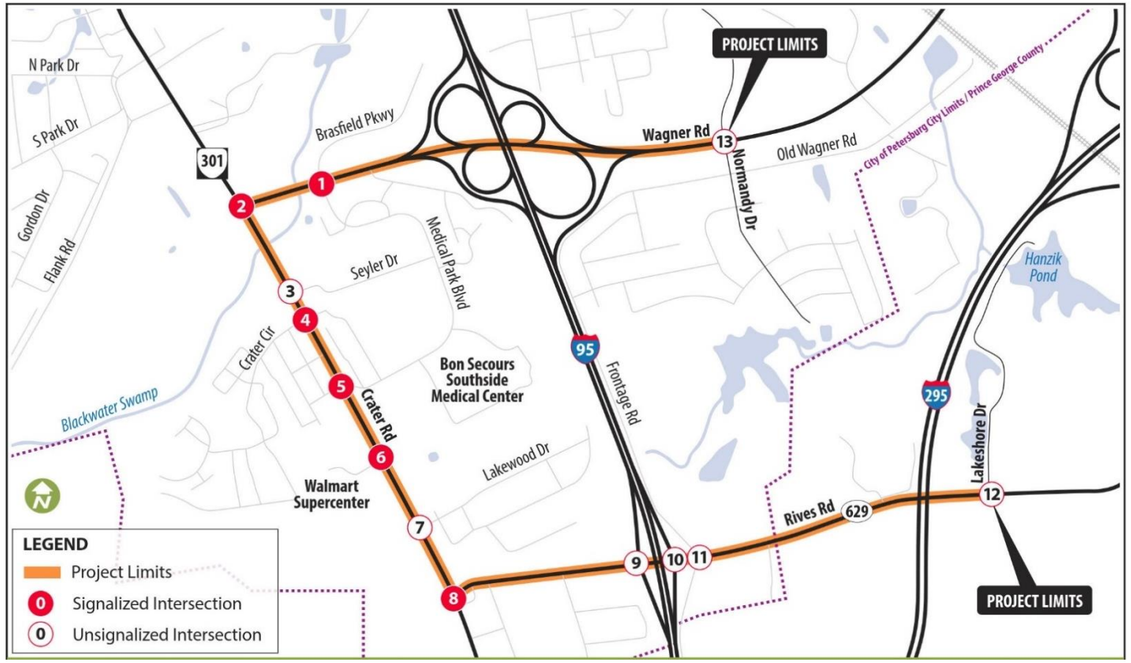
8-hour turning movement classification counts were collected from 6:30 AM – 9:30 AM, 11:00 AM – 2:00 PM and 3:00 PM – 7:00 PM at the following intersections:

1. Wagner Road and Brasfield Parkway/Medical Park Blvd
2. S Crater Road and Wagner Road
3. S Crater Road and Seylor Drive
4. S Crater Road and Crater Circle
5. S Crater Road and Medical Park Boulevard
6. S Crater Road and S Walmart Access
7. S Crater Road and Lakewood Drive
8. S Crater Road and Rives Road
9. Rives Road and I-95 Southbound Ramp
10. Rives Road and I-95 Northbound Ramp

Rives Road and Old Wagner Frontage Road48-hour classification tube counts were collected at the following locations:

- Rives Road and I-95 Interchange – All Ramps (4 movements)
- S Crater Road at Blackwater Swamp crossing
- S Crater Road between Lakewood Drive and Rives Road
- Rives Road West of Corporate Road
- Wagner Road and I-95 Interchange – All Ramps (8 movements)

FIGURE 1.16. INTERSECTION COUNT LOCATIONS



1.5.2. Analysis Peak Periods

Weekday peak periods were identified from the count data for the arterial segments and for each study intersection. The common AM, Mid-day 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. Based upon a review of the traffic count data, the following peak hours were identified for this study:

- AM Peak: 7:30 AM – 8:30 AM
- Mid-day Peak: 12:45 PM – 1:45 PM
- PM Peak: 4:00 PM – 5:00 PM

Wagner Road experiences higher volumes during the AM and PM peaks due to commuter traffic traveling to and from the interstate, whereas S Crater Road experiences more of a Mid-day and PM peak due to the types of retail and medical businesses along the corridor.

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

The raw traffic counts were balanced throughout the network considering individual intersection peak hours and the resulting volume variations observed throughout the corridor. The peak hour traffic volumes were balanced using an iterative process of adjusting intersection approach and departure volumes until intersection volumes were within 10% for most movements. This 10% threshold was allowed to be exceeded for links with a significant number of access points (traffic generators or sinks) between the intersections. The field counts are enclosed with this report in the **Appendix**.

1.5.3. Analysis Tool

Traffic operational analysis was performed using *Synchro 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.

1.5.4. Measures of Effectiveness

The Measures of Effectiveness (MOEs) quantify the traffic flow through intersections and provides a basis for evaluating the performance of a transportation network. MOEs are reported based on the type of facility, as well as the analysis software utilized. Reported MOEs are consistent with VDOT *TOSAM* guidance for *Synchro* software, and include:

- Average HCM Delay (seconds/vehicle)
- 95th Percentile Queue Length (feet)

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*) 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 caused by complicated interactions between intersections. 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 *2010 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

Source: 2010 Highway Capacity Manual

1.5.5. Base Model Development

SYNCHRO MODEL PARAMETERS AND INPUTS

AM, Mid-day and PM peak hour base *Synchro* models were developed using the data discussed this section, geometry at the time of data collection, and existing signal timing data from City of Petersburg.

All parameters in *Synchro* remained as default, with the exception of the southbound I-95 ramp at Rives Road. Previous VDOT comments on a preceding Traffic Impact Analysis (Rives Road Industrial Site TIA at VA 629 (Rives Road) & I-95 Interchange, Green Light Solutions, Inc, March 2023) indicated that the southbound ramp typically queues nearly to the ramp gore in the PM peak. This was confirmed in the "Typical Traffic" level in Google, which shows slowing/congestion along the ramp in the PM peak. Since this is an unsignalized intersection, the only parameter to calibrate this movement included the (TURN GAP) time. This value was modified to indicate a 95% queue approximating the length of the ramp to accurately represent the identified queuing in this location.

The existing (2023) balanced peak hour volumes are summarized in **Figure 1.17**, **Figure 1.18**, and **Figure 1.19**.

FIGURE 1.17. EXISTING AM PEAK HOUR VOLUMES

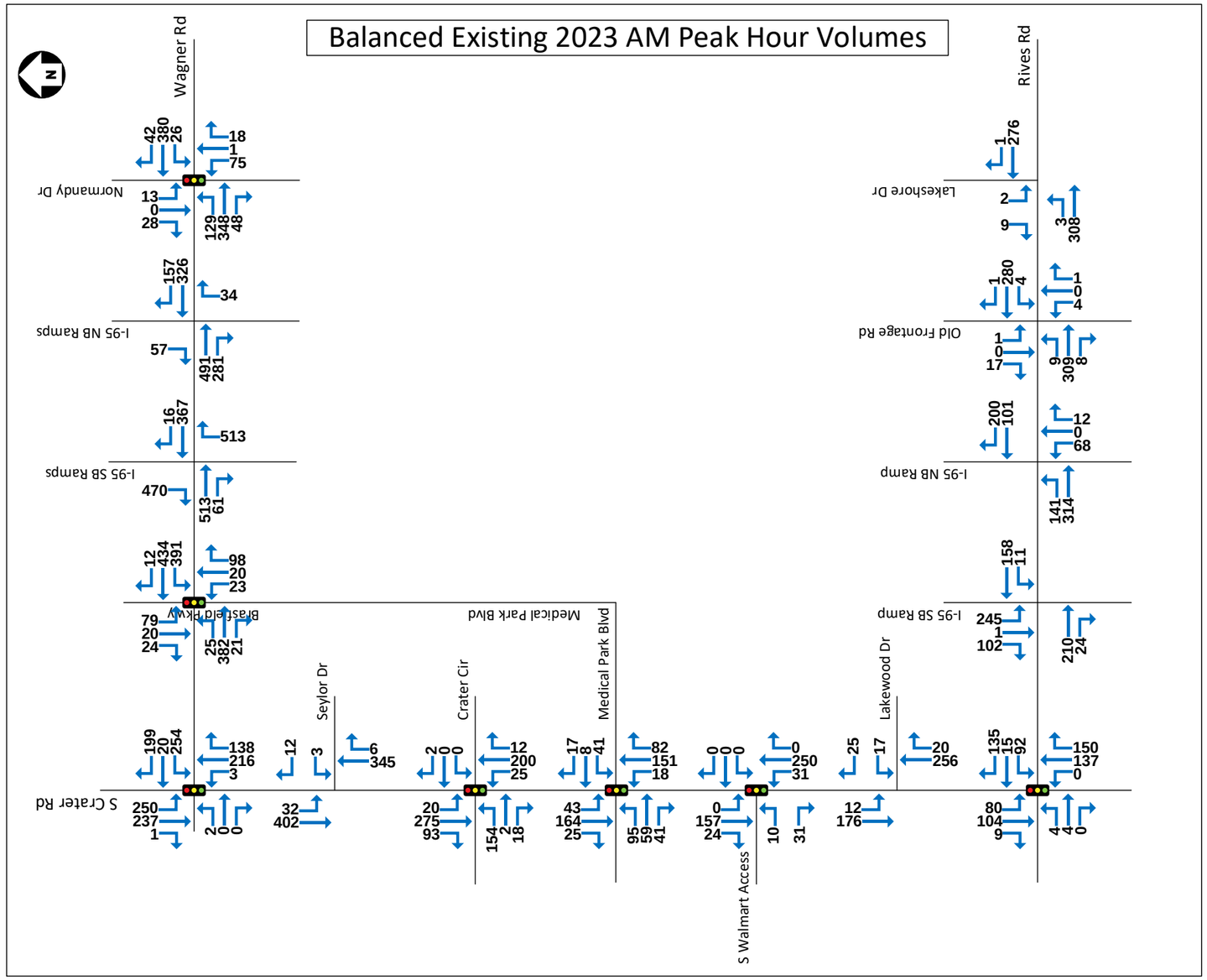


FIGURE 1.18. EXISTING MID-DAY PEAK HOUR VOLUMES

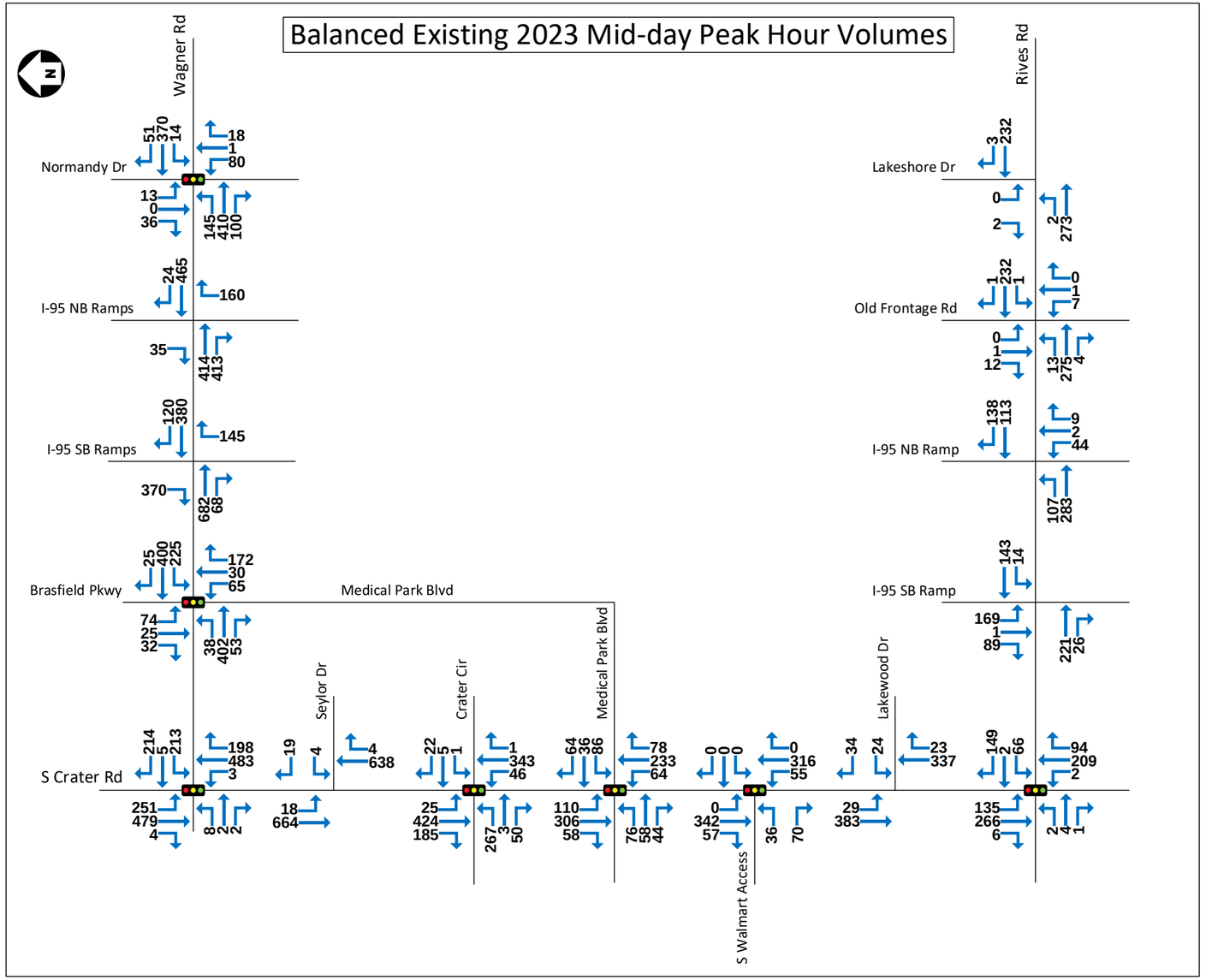
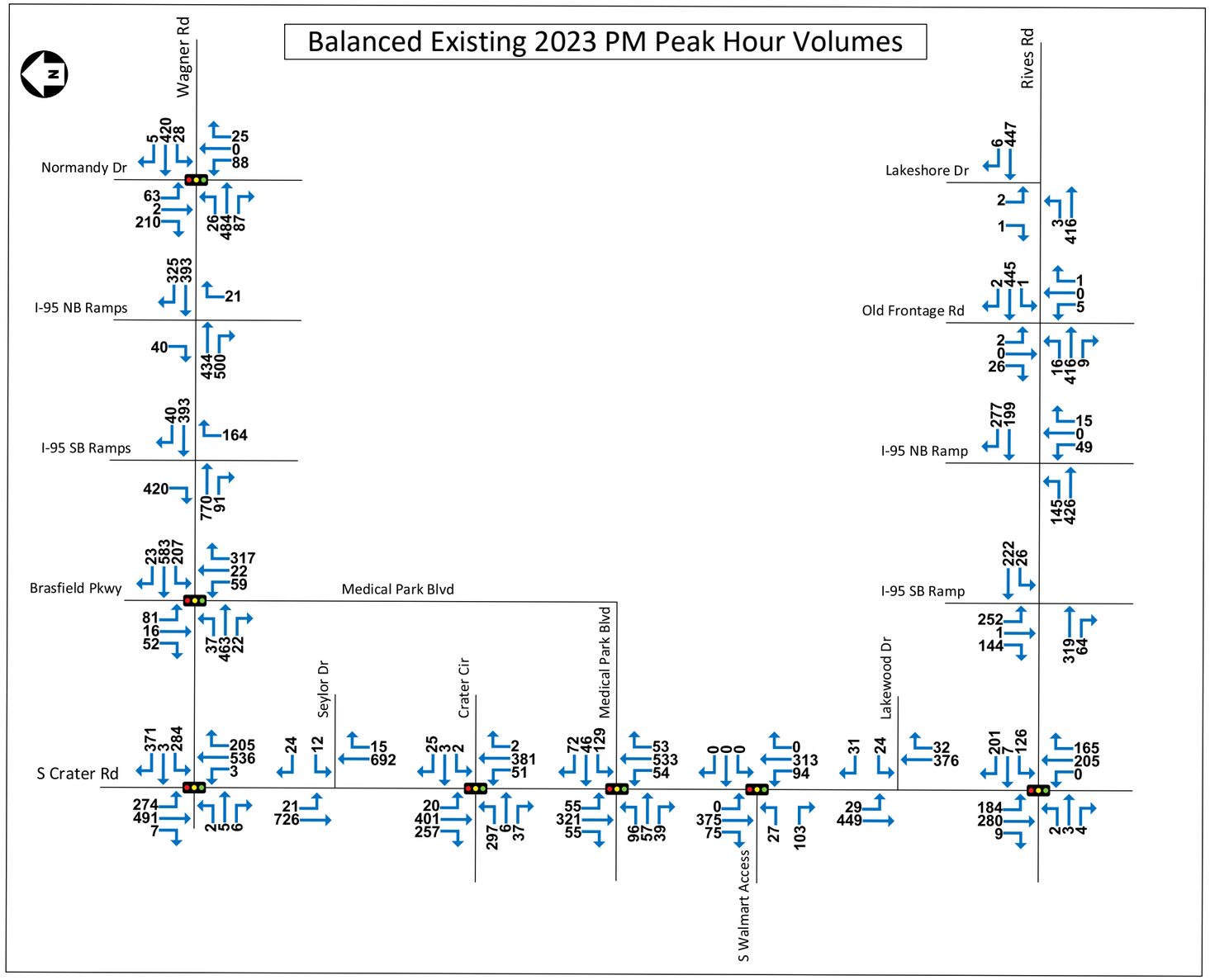


FIGURE 1.19. EXISTING PM PEAK HOUR VOLUMES



1.5.6. Existing Traffic Operational Analysis Results

In an effort to identify operational and accessibility needs along the study corridor, a *Synchro* analysis was performed for the existing year 2023 for the AM, Mid-day and PM peak hours.

Delay is reported from *Synchro* using *HCM 2010* methodology for the signalized intersections, *while HCM 2000* methodology results were reported for all unsignalized intersections and several signalized intersections that did not comply with standard NEMA phasing. **Figure 1.20 and Figure 1.21** summarize the AM, Mid-day and PM peak hour level of service results for each intersection under Existing 2023 conditions. **Table 1.4** summarizes the AM, Mid-day and PM peak hour delay for each movement for the study intersections along the study corridor under Existing 2023 conditions. *Synchro* output sheets are provided in the **Appendix**.

The operational analysis shows that all study intersections operate at a Level of Service (LOS) D or better during each AM, Mid-day, and PM peak hour other than the intersection of Rives Road and I-95 southbound ramps, which operates at a LOS E and F for the AM and PM Peak hour, respectively. All mainline Wagner Road approaches operate at an LOS D or better for all intersections other than the intersection of Wagner Road and S Crater Road, where the westbound approach operates at LOS E and F for the AM and PM peak hour, respectively and eastbound operates at LOS E Mid-day. All mainline S Crater Road approaches operate at Level of Service C or better for all intersections. Overall, the stop-controlled side streets along the study corridor operate at LOS C or better with the exception of the I-95 South ramp at Rives Road.

The left-turn movements along the study corridor experience excessive delays during all peak periods, with most mainline left turn lanes operating at LOS D or E. For all signalized intersections, the analysis results show excessive delays for the side street approaches for all peak hours. At the unsignalized Rives Road at I-95 ramp intersections, the southbound off-ramp approach operates at LOS F during the AM and PM peak periods while the northbound off-ramp approach operates at LOS D for the PM peak period.

The results suggest that the following intersections operate with an overall delay value that exceeds 35 sec/veh (a LOS D threshold), which indicates that the intersection has the potential to increase to unacceptable delays in the future year conditions. Note that intersection delay is reported for each node back to the upstream node in each direction. For closely-spaced intersections, delays may be limited due to the short distance between nodes/intersections.

- Intersection 2: S Crater Road and Wagner Road; delay of 43.5 during the PM peak hour
- Intersection 4: S Crater Road and Crater Cir; delay of 42.6 during the AM peak hour
- Intersection 9: Rives Road and I-95 SB Ramps; delay of 47.8 during the AM and 118.2 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 dedicated turn lanes, inefficient signal timings or phasing. A queuing analysis was completed for the study intersections during the AM, Mid-day and PM peak hours. **Table 1.5** provides a summary of the 95th percentile queue lengths during the AM, Mid-day and PM peak hours as compared to the available storage bay lengths. The highlighted queue lengths in Table 5 are the movements where the reported 95th percentile queue length value approximates or exceeds the storage length available for that turning movement. The *Synchro* output sheets including the queue lengths are included in the **Appendix**.

The operations analysis results indicate moderate queuing at the intersections along Wagner Road, notably along S. Crater Road and Wagner Road, with the westbound approach queuing beyond the available storage during all peak periods. The Rives Road and I-95 SB ramp experienced excessive queuing of 633 feet during the PM peak hour.

FIGURE 1.20. EXISTING AM / PM LEVEL OF SERVICE

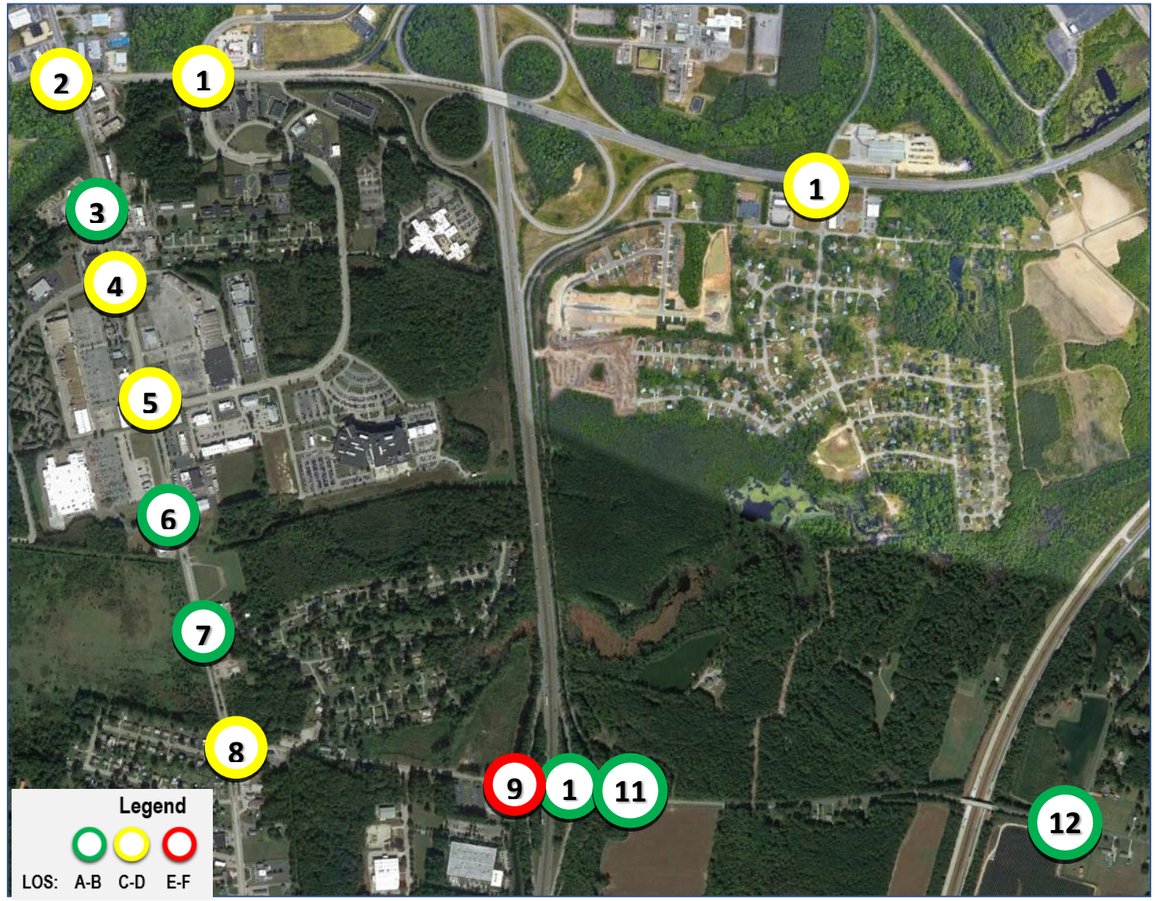


FIGURE 1.21. EXISTING MID-DAY LEVEL OF SERVICE

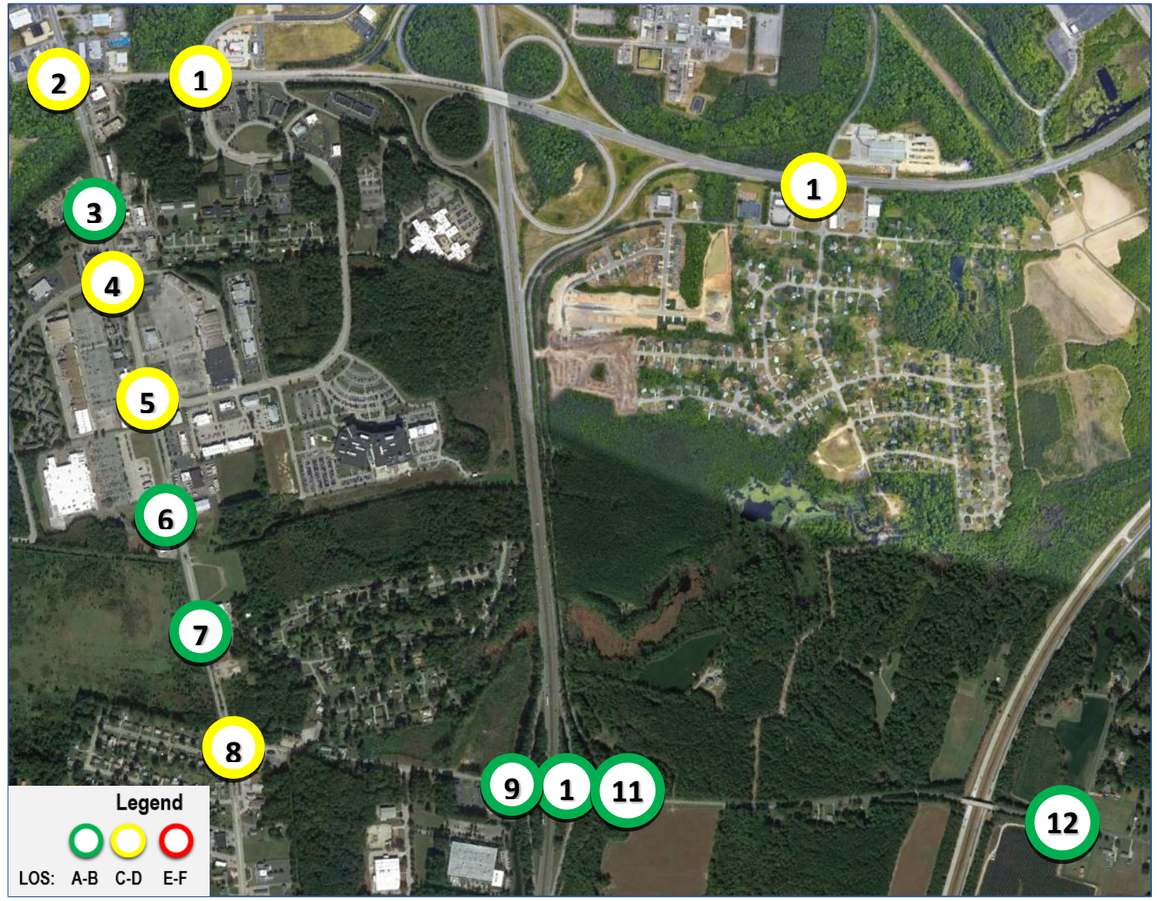


TABLE 1.4. EXISTING CONDITIONS PEAK HOUR DELAY AND LOS

	Intersection	Control	Overall Delay (LOS)	Average Delay (sec/veh) and Level of Service											
				Eastbound			Westbound			Northbound			Southbound		
				LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
1	Wagner Rd & Brasfield Pkwy / Medical Park Blvd	Signal	**AM Peak Hour**												
			27.1 (C)	18.4 (B)			29.4 (C)			24.2 (C)			45.6 (D)		
				59.6	15.6	20.2	45	15.8	13.5	43.4	43.3	15.7	47.7	42.3	41.5
				E	B	C	D	B	B	D	D	B	D	D	D
			MID Peak Hour												
			30 (C)	25 (C)			25.5 (C)			42.9 (D)			45.0 (D)		
				44.6	24.1	17.5	44.1	15.8	13.9	44	44.1	42.2	46.9	43	42
				D	C	B	D	B	B	D	D	D	D	D	D
			PM Peak Hour												
			29.6 (C)	16.9 (B)			23.1 (C)			48 (D)			59.8 (E)		
				62.7	13.3	15.4	48.3	14.6	12.1	48.7	48.7	47.8	69.6	48.9	48
				E	B	B	D	B	B	D	D	D	E	D	D
2	Wagner Rd & S. Crater Rd	Signal	**AM Peak Hour**												
			15.4 (B)	42.5 (D)			23.2 (C)			11.7 (B)			10.4 (B)		
				42.5			33.2	32.9	9.6	45.3	11.4		10.2	10.7	
				D			C	C	A	D	B		B	B	
			MID Peak Hour												
			20.5 (B)	40.0 (D)			33.4 (C)			22.3 (C)			10.8 (B)		
				40.0			60.9	60.8	5.4	46.7	22.2		12.5	10.0	
				D			E	E	A	D	C		B	A	
			PM Peak Hour												
			23.3 (C)	36.9 (D)			34.8 (C)			23.9 (C)			12.6 (B)		
				36.9			48.8	49.4	23.8	47	23.8		14.4	11.6	
				D			D	D	C	D	C		B	B	
3	S. Crater Rd & Seyler Dr	Stop	**AM Peak Hour**												
			0.5 (A)				9.8 (A)			0.0 (A)			0.6 (A)		
							9.8			0.0			8.4	0	
							A			A			A	A	
			MID Peak Hour												
			0.3 (A)				10.9 (B)			0.0 (A)			0.2 (A)		
							10.9			0			8.8	0	
							B			A			A	A	
			PM Peak Hour												
			0.4 (A)				11.4 (B)			0.0 (A)			0.2 (A)		
							11.4			0			8.9	0	
							B			A			A	A	

TABLE 1.4. EXISTING CONDITIONS PEAK HOUR DELAY AND LOS (CONTINUED)

	Intersection	Control	Overall Delay (LOS)	Average Delay (sec/veh) and Level of Service											
				Eastbound			Westbound			Northbound			Southbound		
				LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
4	S. Crater Rd & Crater Circle	Signal	**AM Peak Hour**												
			20.9 (C)	42.6 (D)			48.0 (D)			11.0 (B)			17.0 (B)		
				42.9	42.3		48.0			54.6	5.8		47.3	17.2	10.2
				D	D		D			D	A		D	B	B
			MID Peak Hour												
			22.3 (C)	43.2 (D)			44.7 (D)			13.3 (B)			16.4 (B)		
				44.5	41.8		44.7			50.8	8.3		49.7	13.5	18.4
				D	D		D			D	A		D	B	B
			PM Peak Hour												
			26.3	50.4 (D)			49.7 (D)			15.5 (B)			20.1 (C)		
				54.6	49.1		49.7			57.5	9.9		64.0	18.1	20
			C	D	D		D			E	A		E	B	B
5	S. Crater Rd & Crater Square Shop Ctr / Medical Park Blvd	Signal	**AM Peak Hour**												
			26.8 (C)	45.0 (D)			44.8 (D)			17.1 (B)			16.8 (B)		
				47.2		37.1	45.7		43.3	54.6	14.1	14.5	69.4	4.5	6.8
				D		D	D		D	D	B	B	E	A	A
			MID Peak Hour												
			28.7 (C)	45.3 (D)			42.8 (D)			22.8 (C)			21.7 (C)		
				47.5		38.6	44.0		41.7	57.7	14.8	18.2	61.3	9	13.6
				D		D	D		D	E	B	B	E	A	B
			PM Peak Hour												
			30.5 (C)	48 (D)			52.4 (D)			22 (C)			16.9 (B)		
				49.9		41.0	57.3		47.1	62.2	13.8	17.0	65.8	8.7	16.5
				D		D	E		D	E	B	B	E	A	B
6	S. Crater Rd & Walmart Shop Ctr	Signal	**AM Peak Hour**												
			8.0 (A)	44.0 (D)						7.2 (A)			1.2 (A)		
				44.5		43.9				52.4	1.6		0.9		2.7
				D		D				D	A		A		A
			MID Peak Hour												
			11.3 (B)	44 (D)						8.7 (A)			5.0 (A)		
				45.4		43.2				40.7	3.1		5.8		0.0
				D		D				D	A		A		A
			PM Peak Hour												
			12.0 (B)	47.3 (D)						12.2 (B)			1.6 (A)		
				48.3		47.1				15.1	2.3		1.9		0.1
				D		D				D	A		A		A

TABLE 1.4. EXISTING CONDITIONS PEAK HOUR DELAY AND LOS (CONTINUED)

	Intersection	Control	Overall Delay (LOS)	Average Delay (sec/veh) and Level of Service											
				Eastbound			Westbound			Northbound			Southbound		
				LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
7	S. Crater Rd & Lakewood Dr	Stop	**AM Peak Hour**												
			1.1 (A)				10.4 (B)			0.0 (A)			0.5 (A)		
							10.4			0.0			7.9	0	
							B			A			A	A	
			MID Peak Hour												
			1.1 (A)				12.0 (B)			0.0 (A)			0.6 (A)		
							12.0			0.00			8.1	0	
							B			A			A	A	
			PM Peak Hour												
			1.0 (A)				12.9		B	0.0 (A)			0.5 (A)		
							12.9			0.0			8.3	0	
							B			A			A	A	
8	S. Crater Rd & Rives Rd	Signal	**AM Peak Hour**												
			22.0 (C)	58.4 (E)			35.9 (D)			12.6 (B)			17.3 (B)		
				58.4			46.3		27.7		12.6		36.7	3.6	
				E			D		C		B		D	A	
			MID Peak Hour												
			22.4 (C)	56.7 (E)			36.6 (D)			12.1 (B)			22 (C)		
				56.7			47.4		31.6	49.9	11.9		55.9	4.5	
				E			D		C	D	B		D	A	
			PM Peak Hour												
			26.3 (C)	59.4 (E)			37.0 (C)			16.7 (B)			25.7 (C)		
				59.4			50.9		27.7		16.7		63.3	1.7	
				E			D		C		B		E	A	
9	Rives Rd & I-95 Southbound Ramps	Stop	**AM Peak Hour**												
			47.8 (E)	0.0 (A)			0.6 (A)						102.9 (F)		
				0			0.6						102.9		
				A			A						F		
			MID Peak Hour												
			12.3 (B)	0.0 (A)			0.8 (A)						31.0 (D)		
				0.0			0.8						31.0		
				A			A						D		
			PM Peak Hour												
			118.2 (F)	0.0 (A)			1.1 (A)						305.6 (F)		
				0			1.1						305.6		
				A			A						F		

TABLE 1.4. EXISTING CONDITIONS PEAK HOUR DELAY AND LOS (CONTINUED)

	Intersection	Control	Overall Delay (LOS)	Average Delay (sec/veh) and Level of Service											
				Eastbound			Westbound			Northbound			Southbound		
				LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
10	Rives Rd & I-95 Northbound Ramps	Stop	**AM Peak Hour**												
			4.2 (A)	3.5 (A)			0.0 (A)			23.8 (C)					
				3.5			0.0			23.8					
				A			A			C					
			MID Peak Hour												
			3.0 (A)	2.9 (A)			0.0 (A)			17.5 (C)					
				2.9			0.0			17.5					
				A			A			C					
			PM Peak Hour												
			3.8 (A)	3.7 (A)			0.0 (A)			32.7 (D)					
				3.7			0.0			32.7					
				A			A			D					
11	Rives Rd & Timber Rd / Old Wagner Rd	Stop	**AM Peak Hour**												
			0.7 (A)	0.3 (A)			0.2 (A)			15.4 (C)			10.6 (B)		
				0.3			0.2			15.4			10.6		
				A			A			C			B		
			MID Peak Hour												
			0.7 (A)	0.5 (A)			0.0 (A)			16.1 (C)			10.2 (B)		
				0.5			0			16.1			10.2		
				A			A			C			B		
			PM Peak Hour												
			0.7 (A)	0.5 (A)			0.0 (A)			22.3 (C)			12.1 (B)		
				0.5			0			22.3			12.1		
				A			A			C			B		
12	Rives Rd & Lakeshore Dr	Stop	**AM Peak Hour**												
			0.3 (A)	0.1 (A)			0.0 (A)						10.7 (B)		
				0.1			0						10.7		
				A			A						B		
			MID Peak Hour												
			0.1 (A)	0.1 (A)			0.0 (A)						9.6 (A)		
				0.1			0						9.6		
				A			A						A		
			PM Peak Hour												
			0.1 (A)	0.1 (A)			0.0 (A)						15.4 (B)		
				0.1			0						15.4		
				A			A						B		

TABLE 1.4. EXISTING CONDITIONS PEAK HOUR DELAY AND LOS (CONTINUED)

Intersection		Control	Overall Delay (LOS)	Average Delay (sec/veh) and Level of Service											
				Eastbound			Westbound			Northbound			Southbound		
				LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
13	Wagner Rd & Normandy Dr	Signal	**AM Peak Hour**												
			22.5 (C)	19.3 (B)			18.5 (B)			50.5 (D)			42.5 (D)		
				43.6	12.1	7.0	47.8	17.3	11.1	50.5			42.5		
				D	B	A	D	B	B	D			D		
			MID Peak Hour												
			21.9 (C)	18.4 (B)			19.5 (B)			44.8 (D)			42.6 (D)		
				43.6	12.4	6.4	50.0	19.3	12.6	44.8			42.6		
				D	B	A	D	B	B	D			D		
			PM Peak Hour												
			26.3 (C)	20.6 (C)			21.6 (C)			40.9 (D)			40.4 (D)		
				47.8	20.7	12.1	47.9	20.1	7.6	40.9			40.4		
				D	C	B	D	C	A	D			D		

TABLE 1.5. EXISTING CONDITIONS 95TH PERCENTILE QUEUE LENGTHS

	Intersection	Control	Peak Hour	95th Percentile Queue (ft)											
				Eastbound			Westbound			Northbound			Southbound		
				LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
1	Wagner Rd & Brasfield Pkwy/Medical Park Blvd	Signal	AM	49	120	m0	#220	158	0	41	43	24	100	35	0
			MID	m45	204	m2	113	141	0	70	72	42	92	41	0
			PM	m56	89	m0	111	183	0	67	68	91	#128	34	0
2	Wagner Rd & S. Crater Rd	Signal	AM	--	8	--	***149***	148	149	m9	81	--	149	88	--
			MID	--	26	--	***132***	132	118	m9	231	--	143	171	--
			PM	--	24	--	***181***	184	281	m9	340	--	156	174	--
3	S. Crater Rd & Seyler Dr	Signal	AM	--	--	--	--	2	--	--	0	0	3	0	--
			MID	--	--	--	--	3	--	--	0	0	2	0	--
			PM	--	--	--	--	5	--	--	0	0	2	0	--
4	S. Crater Rd & Crater Circle	Signal	AM	107	98	--	--	0	--	--	m31	55	m34	78	42
			MID	170	151	--	--	31	--	--	m58	83	m38	142	36
			PM	203	189	--	--	33	--	--	m81	95	m39	91	9
5	S. Crater Rd & Crater Sq Shop Ctr/ Medical Park Blvd	Signal	AM	--	169	0	59	31	--	37	48	0	67	15	0
			MID	--	148	0	104	72	--	84	52	0	137	27	0
			PM	--	172	0	#169	102	--	83	63	0	m81	48	m0
6	S. Crater Rd & Walmart Shop Ctr	Signal	AM	23	--	0	--	--	--	53	31	--	--	5	0
			MID	54	--	0	--	--	--	74	62	--	--	42	0
			PM	49	--	25	--	--	--	104	20	--	--	18	m0
7	S. Crater Rd & Lakewood Dr	Signal	AM	--	--	--	--	5	--	--	0	0	1	0	--
			MID	--	--	--	--	9	--	--	0	0	2	0	--
			PM	--	--	--	--	10	--	--	0	0	2	0	--

TABLE 1.5. EXISTING CONDITIONS 95TH PERCENTILE QUEUE LENGTHS (CONTINUED)

	Intersection	Control	Peak Hour	95th Percentile Queue (ft)											
				Eastbound			Westbound			Northbound			Southbound		
				LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
8	S. Crater Rd & Rives Rd	Signal	AM	--	19	--	--	#130	36		56	--	36	6	--
			MID	--	18	--	--	89	46	8	74	--	161	33	--
			PM	--	20	--	--	158	42		96	--	220	18	--
9	Rives Rd & I-95 Southbound Ramps	Signal	AM	--	0	--	--	1	--	--	--	--	--	345	--
			MID	--	0	--	--	1	--	--	--	--	--	119	--
			PM	--	0	--	--	2	--	--	--	--	--	***633***	--
10	Rives Rd & I-95 Northbound Ramps	Signal	AM	--	11	--	--	0	--	--	32	--	--	--	--
			MID	--	7	--	--	0	--	--	15	--	--	--	--
			PM	--	13	--	--	0	--	--	36	--	--	--	--
11	Rives Rd & Timber Rd / Old Wagner Rd	Signal	AM	--	1	--	--	0	--	--	1	--	--	2	--
			MID	--	1	--	--	0	--	--	2	--	--	2	--
			PM	--	1	--	--	0	--	--	2	--	--	4	--
12	Rives Rd & Lakeshore Dr	Signal	AM	--	0	--	--	0	--	--	--	--	--	2	--
			MID	--	0	--	--	0	--	--	--	--	--	0	--
			PM	--	0	--	--	0	--	--	--	--	--	1	--
13	Wagner Rd & Normandy Dr	Signal	AM	138	108	5	44	140	0	--	110	--	--	0	--
			MID	152	124	18	29	139	0	--	115	--	--	0	--
			PM	44	189	25	46	163	0	--	30	--	--	182	--

1.6. Existing Pedestrian and Bicycle Facilities

In an effort to identify the needs with respect to accessibility, the study team reviewed existing conditions for pedestrian and bicycle accommodations. The study area includes a sparse, inconsistent network of sidewalks. There are very few accommodations that meet ADA requirements within the corridor.

There are no accommodations specific to cyclists along the study corridor. The closest bikeways are at least 4 miles from the corridor and include the Appomattox River Trail and the future Fall Line Trail.

Pedestrian signals and crosswalks are present at the following signalized intersections:

1. Wagner Road and Brasfield Pkwy/Medical Park Blvd
2. S Crater Road and Medical Park Blvd

Pedestrian signals and crosswalks are not provided at the following signalized intersections:

1. S Crater Road and Wagner Road
2. S Crater Road and Crater Circle
3. S Crater Road and S Walmart Access
4. S Crater Road and Rives Road

Figure 1.22 identifies the locations of existing pedestrian, bicycle and transit facilities along the corridor, including sidewalks, crosswalks, pedestrian signals and transit stops.

FIGURE 1.22. EXISTING PEDESTRIAN, BICYCLE & TRANSIT FACILITIES

1.7. Existing Transit / TDM / Rail

There are no existing park and ride facilities or rail lines present within the corridor. There are existing transit routes, but no stops south of Medical Park Blvd or east of I-95. Transit service in the study area is provided by Petersburg Area Transit (PAT) via the County Drive (460) Route and South Crater Road Route.

- Petersburg Area Transit buses generally operate Monday through Friday from 5:45 am until 6:15 pm, and on Saturday from 7:15 am until 6:15 pm
- The County Drive (460) Route runs hourly between 5:45 am and 5:45 pm Monday through Friday and Saturday from 7:15 am until 6:15 pm
- The South Crater Road Route runs hourly between 6:15 am and 6:15 pm Monday through Friday and Saturday from 7:15 am until 6:15 pm

Bus stops are located within the study area as follows:

- Two stops along S Crater Road (US 301)
- One stop along WB Wagner Road
- Multiple other stops along Medical Park Blvd, Crater Cir, Poplar Drive, and S Normandy Drive

The three bus stops located along the study corridor lack shelters and benches. Two of the three stops along the study corridor lack sidewalks approaching the stop. **Figure 1.23** identifies the transit routes in the study area.

FIGURE 1.23. EXISTING TRANSIT ROUTES IN THE STUDY AREA

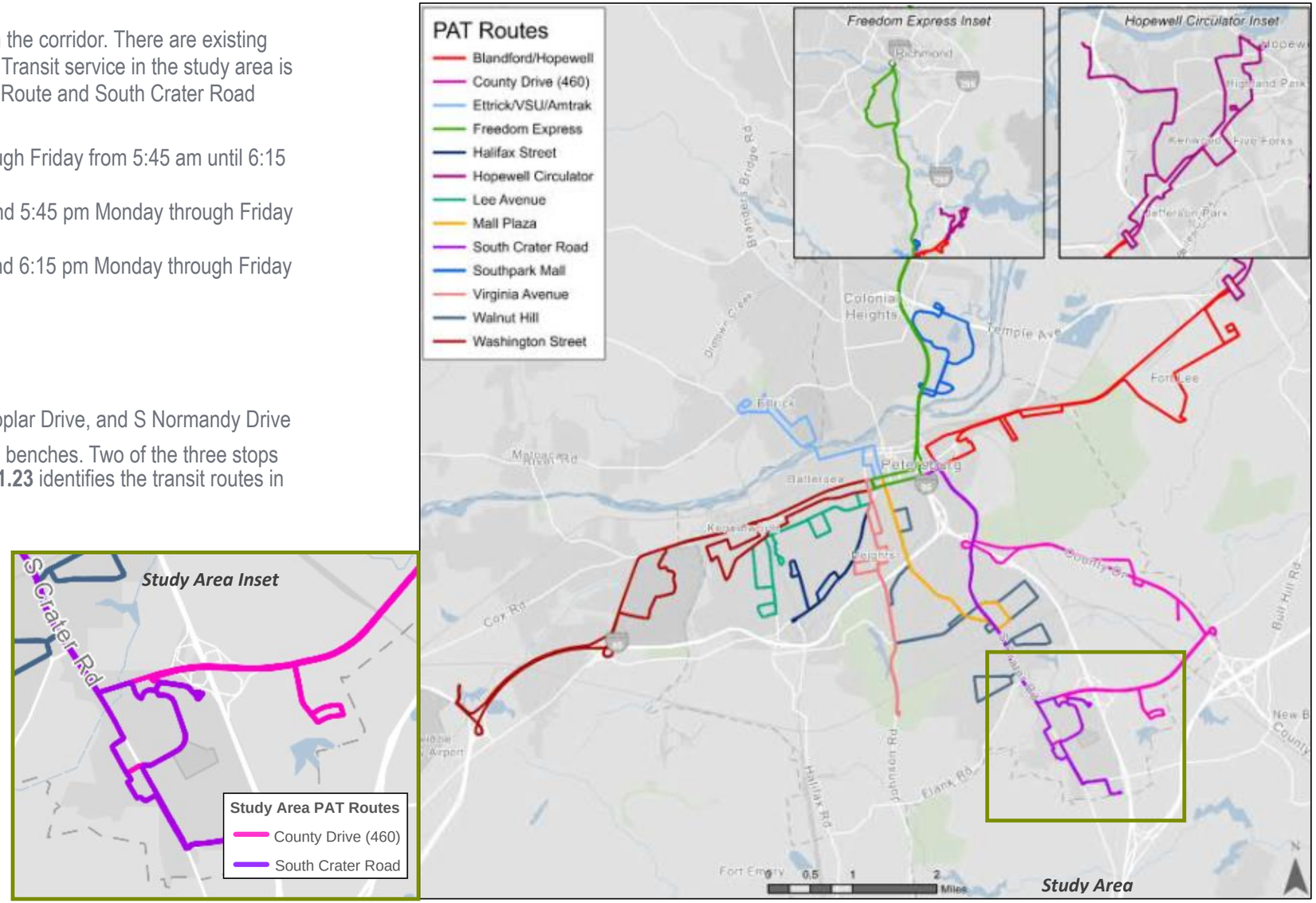
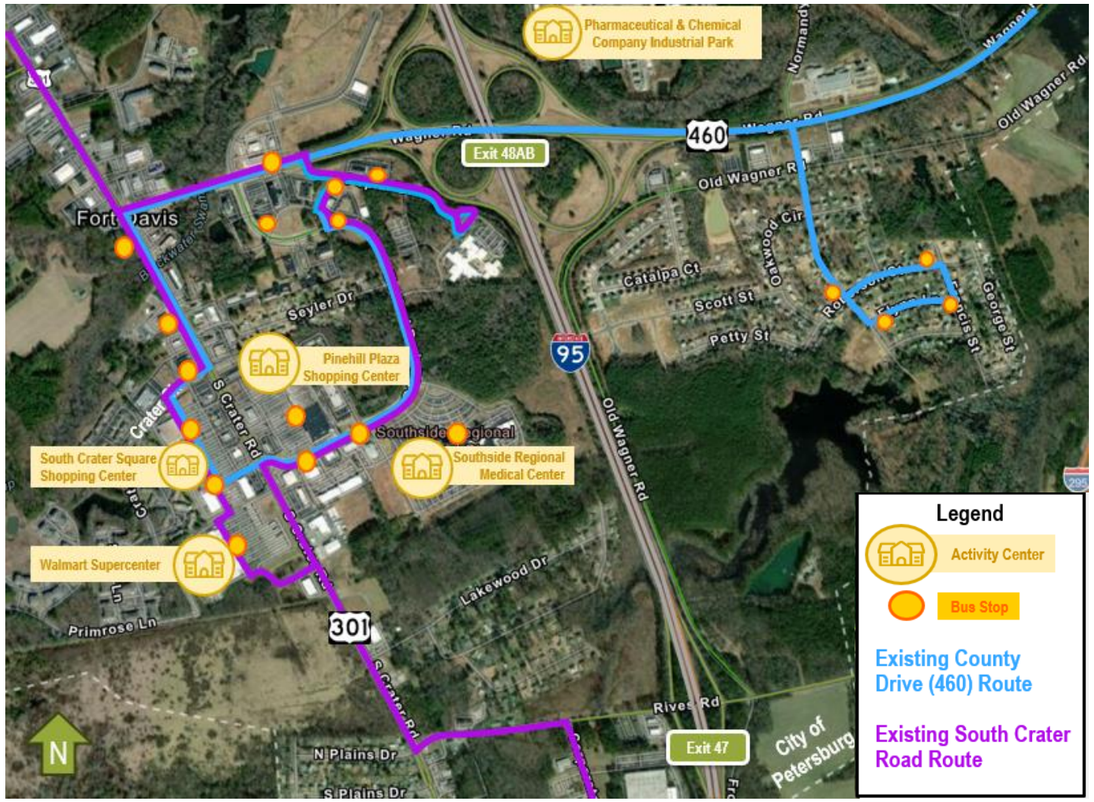


Figure 1.24 identifies the transit stops and routes along and in the vicinity of corridor roadways as well as the existing activity center areas within and in close proximity to the study area.

FIGURE 1.24. EXISTING TRANSIT STOPS & ROUTES IN THE STUDY AREA



1.8. 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. *STEAP* results are included in the **Appendix**.

1.9. Safety Analysis

Crash data was collected and analyzed from the Data Dashboard for an eight-year period spanning from January 2015 through December 2022. The crash data analysis and field review data were used to identify factors that could potentially contribute to crashes and to make recommendations regarding safety improvements that could mitigate future crashes. The crash data were evaluated to identify crash locations and patterns, severity of crashes, and likely causes for crashes. For the purposes of this analysis, "injury crashes" is defined by this study as the sum of type A (severe injury), B (visible injury), and C (non-visible injury) crashes.

1.9.1. Crash Data Analysis

Crash Data is summarized by year and by crash type in **Table 1.6** and **Table 1.7**, respectively. Key takeaways from the crash data are as follows:

1. A total of 384 crashes were reported within the study area during the eight-year study period.
2. Nine crashes were reported as fatal (K) or severe (A) injury crashes
3. The majority of reported crashes within the corridor are rear-end and angle crashes. Combined, these constitute approximately 70% of the total crashes.
4. A total of 138 crashes resulted in injuries, which account for approximately 36% of the total reported crashes within the corridor.
5. A significant concentration of crashes was reported at the intersections, with few crashes occurring on the segments between intersections.

TABLE 1.6. CRASHES BY SEVERITY

Intersection and Severity	K. Fatality	A. Severe Injury	B. Visible Injury	C. Nonvisible Injury	O. Property Damage Only	Total
Wagner Rd & Medical Park Blvd	0	2	5	17	25	49
S Crater Road & Crater Cir	1	0	4	12	11	28
S Crater Road & Rives Road	0	0	4	5	6	15
Rives Road & I-95 NB Ramps	0	1	0	4	14	19

* PSI Intersection

TABLE 1.7. CRASHES BY COLLISION TYPE

Intersection and Collision Type	Angle	Rear-End	Head-On	Sideswipe – Same Direction	Sideswipe – Opposite Direction	Fixed Object – Off Road	Pedestrian	Other	Total
S Crater Road & Wagner Rd *	32	24	6	3	3	2	1	6	77
Rives Road & I-95 SB Ramps *	26	9	1	0	3	2	0	1	42

* PSI Intersection

Figure 1.25 identifies the hot spots for crashes located throughout the corridor, designated by collision types. Overall collision types are shown graphically in **Figure 1.26**. **Figure 1.27**, **Figure 1.28**, **Figure 1.29**, and **Figure 1.30** provide more detailed assessments of the top four crash locations in the study area.

FIGURE 1.25. CRASH LOCATIONS BY COLLISION TYPE

FIGURE 1.26. OVERALL CRASHES BY COLLISION TYPE

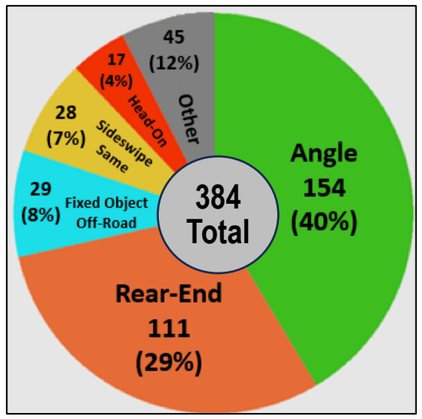
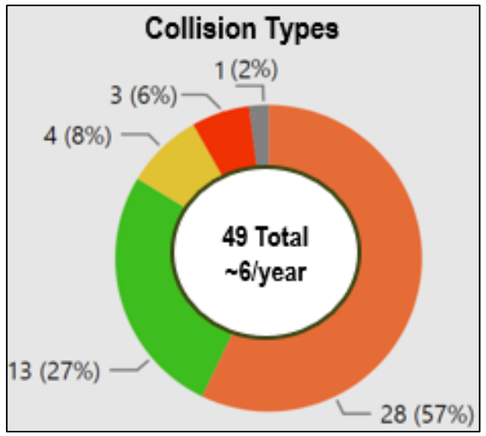
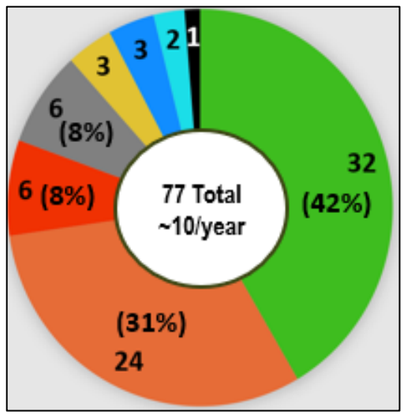


FIGURE 1.27. WAGNER RD & MEDICAL PARK BLVD DETAILED INTERSECTION CRASH ANALYSIS



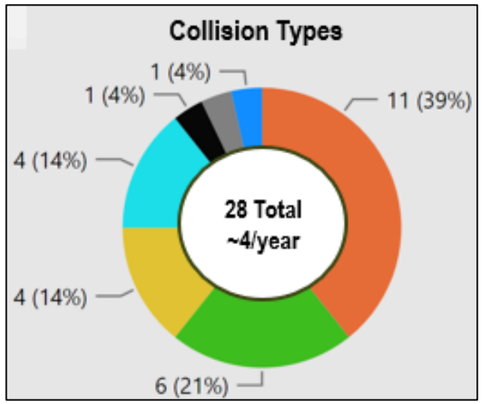
- 57% of crashes were rear-end collisions, 27% of crashes were angle collisions
- 50% of rear-end collisions occurred along WB Wagner Road, 39% EB
- Other Trends: 86% No Adverse Conditions, 20% Night-time, 2% Speeding, 2% Alcohol

FIGURE 1.28. S CRATER RD & WAGNER RD DETAILED INTERSECTION CRASH ANALYSIS



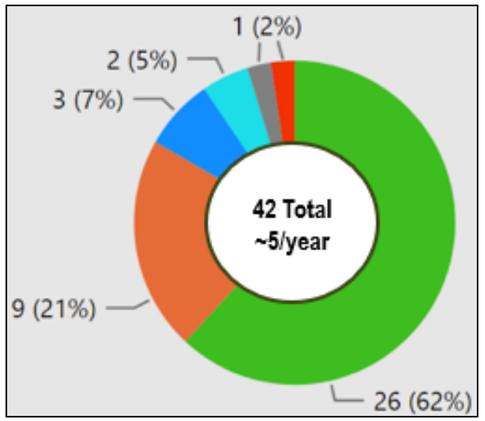
- 42% of crashes were angle collisions, 31% of crashes were rear-end collisions
- 63% of angle collisions involved a NB vehicle on S Crater Road, 37% SB
- 46% of rear-end collisions occurred along S Crater Road, 25% NB
- Other Trends: 82% No Adverse Conditions, 27% Night-time, 8% Speeding, 3% Alcohol

FIGURE 1.29. S CRATER RD & CRATER CIRCLE DETAILED INTERSECTION CRASH ANALYSIS

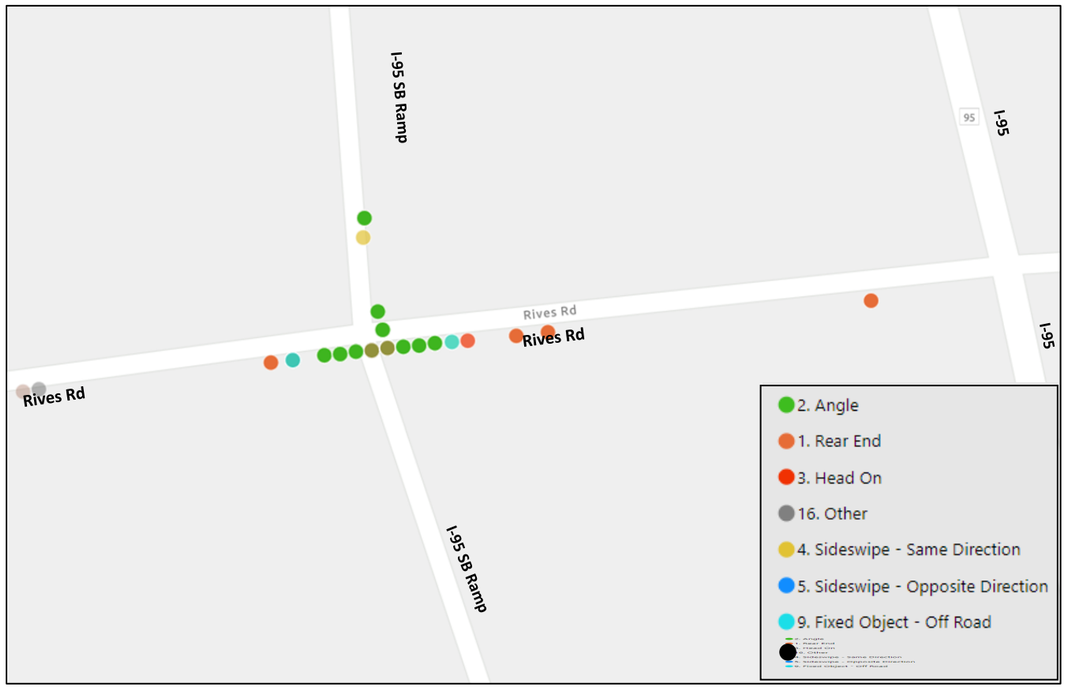


- 39% of crashes were rear-end collisions, 21% of crashes were angle collisions
- 46% of rear-end collisions occurred along NB S. Crater Road, 36% SB
- 60% of angle collisions involved a vehicle along SB S. Crater Road, 40% NB
- Other Trends: 82% No Adverse Conditions, 32% Night-time, 7% Speeding, 4% Alcohol

FIGURE 1.30. RIVES RD & I-95 SOUTHBOUND RAMP DETAILED INTERSECTION CRASH ANALYSIS



- 62% of crashes were angle collisions, 21% of crashes were rear-end collisions
- 44% of rear-end collisions occurred along WB Rives Road, 33% EB
- Other Trends: 90% No Adverse Conditions, 14% Night-time, 10% Speeding, 2% Alcohol
- Intersection sight distance is an issue due to roadway grade and foliage



1.9.2. Field Review

An inventory of the existing roadway condition was prepared along the study corridor based on field reviews. During the field review, the following data was collected and documented via digital photographs, videos and observation:

- Roadway geometry to include lane configuration, lane/shoulder widths
- Signs and pavement markings
- Posted speed limits
- Sight distance issues
- Safety concerns
- Existing driveway locations
- Observation of traffic operations (traffic mix, congestion, driver behavior)
- Inventory of existing roadway conditions to determine potential for safety improvements
- Inventory of intersection operations (signal phasing, queuing)

Field observations were conducted at the project study area on July 15, 2023 during the peak periods to assess traffic operations, roadway geometrics, safety, queuing, vehicle interaction conflicts, and existing signage. In addition, AM and PM peak hour conditions were observed to evaluate traffic operations, queuing, vehicle interaction conflicts, and human factors within the field. Field reviews involved particular focus on the crash patterns to evaluate conditions in the field that could be influencing the crash locations from the crash data. It should be noted, that while collision data was utilized to determine crash patterns and areas of focus within the field, other recommendations and/or observations were noted that may not be directly related to crash patterns. However, it was important to record all field recommendations and/or observations since they could potentially lead to improved safety conditions for road users.

GENERAL OBSERVATIONS

1. Pavement markings are faded
2. Pedestrian facilities are not provided at four signalized intersections
3. Tactile domes/ramps do not comply with ADA standards
4. Three signals are span wire configuration
5. Yellow retroreflective backplates are not present on signal heads
6. Street name signs are not uniform at intersections
7. Overhead roadway lighting is not present at some intersections

WAGNER ROAD AND BRASFIELD PARKWAY/MEDICAL PARK BOULEVARD

1. Street name signs are provided for all approaching vehicles on the signal mast arms. The street signs are nonstandard and installed between the signal heads above the receiving lanes.
2. The signal heads for all approaches have backplates but do not have yellow retroreflective borders.This is the first signal after the interstate free-flow ramps.
3. Pedestrian crosswalk pavement markings are faded along all approaches of the intersection.
4. ADA compliant curb ramps are provided for each crosswalk; however, no sidewalk is provided on the northwest quadrant.
5. The eastbound approach has dual left-turn lanes; however, no pavement markings are provided for guidance to the receiving lanes.
6. Traffic weaving was observed between the I-95 southbound off-ramp and the Wagner Road at Brasfield Parkway/Medical Park Boulevard intersection for vehicles proceeding to Brasfield Parkway and Medical Park Boulevard. The I-95 southbound off-ramp to Wagner Road (prior to the merge point) provides a slip lane and signage (i.e., “Hospital” and “DMV” service signs with directional arrow) for exiting vehicles.

S CRATER ROAD AND WAGNER ROAD

1. Street sign posts are provided on the northeast corner of the intersection on the signal pole for all approaching vehicles. These street signs are small and difficult to see for approaching vehicles.
2. The signal heads for all approaches have backplates but do not have yellow retroreflective borders.
3. Existing signal heads are installed on span wire.
4. Currently, ramps are provided for pedestrians; however, they are not ADA compliant.
5. Pedestrian crosswalks or pedestrian signals are not provided at the intersection.

S CRATER ROAD AND CRATER CIRCLE

1. Street sign posts are provided on the southwest corner of the intersection. These street signs are small and difficult to see for approaching vehicles.
2. The signal heads for all approaches have backplates but do not have yellow retroreflective borders.
3. Existing signal heads are installed on span wire.
4. Pedestrian crosswalks or pedestrian signals or ramps are not provided at the intersection.

S CRATER ROAD AND MEDICAL PARK BOULEVARD

1. Pedestrian crosswalks and signals are present, but are not ADA compliant.
2. The signal heads for all approaches have backplates but do not have yellow retroreflective borders.

S CRATER ROAD AND S WALMART ACCESS

1. Pedestrian crosswalks or pedestrian signals or ramps are not provided at the intersection.
2. The signal heads for all approaches have backplates but do not have yellow retroreflective borders.

S CRATER ROAD AND RIVES ROAD

1. Pedestrian crosswalks or pedestrian signals or ramps are not provided at the intersection.
2. The signal heads for all approaches have backplates but do not have yellow retroreflective borders.
3. Street sign posts are provided on the northeast and southwest corners of the intersection.These street signs are small and difficult to see for approaching vehicles.

RIVES ROAD AND I-95 SOUTHBOUND RAMP

1. Sight distance is limited due to vertical curvature of bridge and foliage.
2. Closely spaced driveway to the interstate off-ramp (170 feet center-to-center)
3. Heavy truck traffic to and from the interstate
4. One streetlight located close to the gas station entrance
5. Vehicles using off-ramp shoulder for right turns onto Rives Road

RIVES ROAD AND I-95 NORTHBOUND RAMP

1. Sight distance is limited due to vertical curvature of bridge and foliage.
2. Heavy truck traffic to and from the interstate
3. One streetlight located close to the gas station entrance

WAGNER ROAD AND NORMANDY DRIVE

1. The signal heads for all approaches have backplates but do not have yellow retroreflective borders installed. This is the first signal after the interstate free-flow ramps.
2. Southbound approach as a small section of widened pavement for southbound right turns (40 feet) with a well-worn gravel shoulder that is used for right turns if the throughs and lefts back up at the signal.
3. Street sign posts are provided on the northwest corner of the intersection.These street signs are small and difficult to see for approaching vehicles

1.10. 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.

1.10.1. 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 was filtered to exclude 2020 through 2022 due to the Covid pandemic impacting traffic patterns and volumes. Linear growth rates for the study area were developed using the adjusted future year (2023-2045), and existing available count data.
- **Richmond/Tri-Cities (RTC) Regional Travel Demand Model**
  The outputs from the RTC regional travel demand model, which 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.

1.10.2. 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 with design year of 2052.

1.10.3. 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 1.8** 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 1.31.**

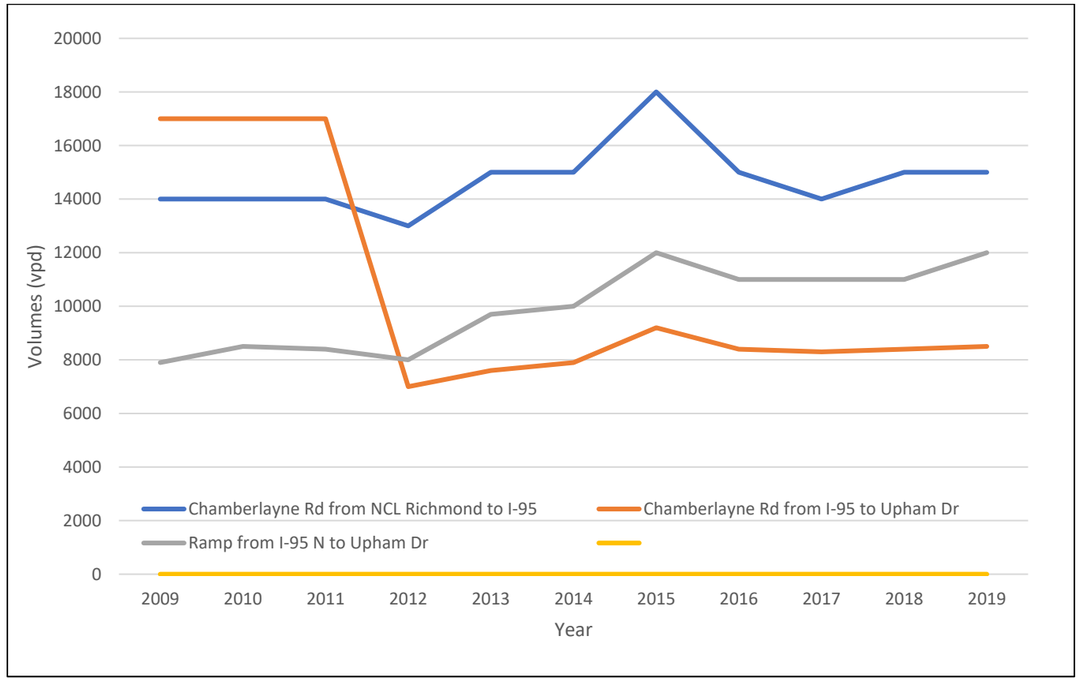
The analysis of the trend of historic volumes for the S Crated Rd study suggests the following:

- Negative growth (reduction) along Wagner Road from I-95 to Normandy Drive (-0.31%)
- Positive growth along Wagner Road from S Crater Rd to I-95 (0.02%)
- Positive growth along S Crater Rd from Rives Road to Wagner Road (0.45%);
- Negative growth (reduction) along Rives Road from S Crater Rd to I-95 (-0.10%);
- Positive growth along Rives Road from I-95 to Lakeshore Drive (4.41%);
- Positive growth along I-95 from Rives Road to Wagner Road (3.55% NB, 3.22% SB);
- The trend in historic volumes suggests a need to consider several growth rates throughout the study area.

TABLE 1.8. *VDOT P4P* Growth Rate Summary

Roadway	Roadway Segment	Average P4P Link Growth Rate
Wagner Rd	I-95 to Normandy Dr	-0.31%
	S Crater Rd to I-95	0.02%
S Crater Rd	Rives Rd to Wagner Rd	0.45%
Rives Rd	S Crater Rd to I-95	-0.10%
	I-95 to Lakeshore Dr	4.41%
I-95 NB	Rives Rd to Wagner Rd	3.55%
I-95 SB	Rives Rd to Wagner Rd	3.22%

FIGURE 1.31. HISTORIC VOLUMES (2009-2019)



Source: VDOT Pathways for Planning

TRAVEL DEMAND MODEL (TDM)

VDOT TMPD provided volume outputs from the Richmond Regional Transportation Planning Organization (RRTPO) Travel Demand Model (TDM*)* for years 2017 and 2045, with output included in the **Appendix**. The TDM was analyzed between 2017 to 2045 to determine an estimated future growth rate based on land use and socioeconomic projections. The TDM future growth rate between 2017 to 2045 is generally comparable to the *P4P* historical growth rate, with the exception of Rives Rd between I-95 to Lakeshore Drive. In this area, the TDM growth rate was less than one percent, whereas the *P4P* historical growth rate was over three percent.

Table 1.9 shows the TDM growth rates along sections of Wagner Road, S Crater Road, Rives Road and I-95 NB and I-95 SB.

The analysis of the trend of growth in the TDM for the S Crated Rd study suggests the following:

- Positive growth along Wagner Road from I-95 to Normandy Drive (0.52%)
- Negative growth (reduction) along Wagner Road from S Crater Rd to I-95 (-0.05%)
- Negative growth (reduction) along S Crater Rd from Rives Road to Wagner Road (-0.36%);
- Positive growth along Rives Road from S Crater Rd to I-95 (0.53%);
- Positive growth along Rives Road from I-95 to Lakeshore Drive (0.15%);
- Positive growth along I-95 from Rives Road to Wagner Road (0.60% NB, 0.69% SB);
- The trend in historic volumes suggests a uniform growth rate of 0.50% throughout the study area.

OTHER STUDIES

There have been several other studies/Traffic Impact Analyses (TIAs) in the area that are referenced in the table to assist in identifying the growth rate in the area:

1. A TIA and Turn Lane Warrant Analysis for a tractor trailer truck storage facility off Rives Road west of the I-95 interchange references a background growth rate of 2% on Rives Road (Kimley-Horn, May 2022 and Gorove Slade, November 2022)
2. A TIA for a Rives Road Industrial Site east of the I-95 interchange references a background growth rate of 2% on Rives Road (Green Light Solutions, Inc. March 2023).
3. The current, ongoing I-95/I-85 Interchange STARS study identifies a growth rate of 1.25% on I-95 just north of the Project Pipeline study area (Kimley-Horn, Draft Existing Conditions and Traffic Forecasting, June 2023).

TABLE 1.9. TDM GROWTH RATE SUMMARY

Roadway		2017 AADT	TDM Volumes		2017 model to ADT Δ	Difference	Annual Growth Rate 2045-2017		2045 Adjusted 2045-2017			Difference	Linear Adjusted Growth Rate
From	To	VDOT	2017	2045	%	2045-2017	Comp	Linear	Δ	Ratio	AADT	2045-2017	2045-2017
Wagner Road													
County Dr/ Bus US460	I-95 Ramp Terminal	10124	9,700	11,150	3.0%	1,450	0.50%	0.53%	11,574	11637	11,606	1,482	**0.52%**
I-95 Ramp Terminal	S Crater Rd	15083	9,200	9,050	38.7%	-150	-0.06%	-0.06%	14,933	14837	14,885	-198	**-0.05%**
S Crater Road													
Wagner Rd	Rives Rd	9794	10,850	9,700	-10.7%	-1,150	-0.40%	-0.38%	8,644	8756	8,700	-1,094	**-0.40%**
Rives Road													
S. Crater Rd	I-95 Ramp Terminal	6364	5,800	6,700	9.4%	900	0.52%	0.55%	7,264	7352	7,308	944	**0.53%**
I-95 Ramp Terminal	Lakeshore Dr	7591	12,000	12,400	-62.2%	400	0.12%	0.12%	7,991	7844	7,918	327	**0.15%**
I-95 Northbound													
Rives Rd	Wagner Rd	19,000	21,400	24,800	-12.6%	3,400	0.53%	0.57%	22,400	22019	22,209	3,209	**0.60%**
I-295	Rives Rd	16,000	13,900	17,300	13.1%	3,400	0.78%	0.87%	19,400	19914	19,657	3,657	**0.82%**
I-95 Southbound													
Rives Rd	Wagner Rd	20,000	19,500	23,300	2.5%	3,800	0.64%	0.70%	23,800	23897	23,849	3,849	**0.69%**
I-295	Rives Rd	17,000	14,400	18,200	15.3%	3,800	0.84%	0.94%	20,800	21486	21,143	4,143	**0.87%**

Note: Shading indicates TDM model with link volume delta greater than 30% compared to VDOT ADT data for the same year. This value is not to be explicitly used in forecasting as it may not be a reliable source of volume forecast

1.10.4. Potential Additional Major Development

After the conclusion of the Phase 1 analysis and initial concept development, there has been recent discussion of a major development off Rives Road east of the I-95 interchange as shown in **Figure 1.32**. Due to the anticipated impact on traffic, VDOT has requested that this development be considered in the development of future traffic volumes and future concepts at the Rives Road interchange.

Based on *Institute of Transportation Engineers (ITE*) methodology, the major development Trip Generation traffic will be added directly to the background volumes in the design year after establishing the background growth rates and background volumes.

While the specific development, a mega-retail/fueling facility, is not specifically identified in the ITE Trip Generation Manual, there have been prior studies to identify the specific trip generation for this type of facility. This mega-retail/fueling facility is anticipated to be 74,000 SF with 120 fuel pumps plus 25 Electric Vehicle charging stations (for a total of 145 fuel/charging stations). Based upon Trip Generation estimates from other similar developments, this mega-retail/fueling facility is anticipated to draw approximately 20,000 vehicles per weekday, with 800 trips in the AM peak and 1300 trips in the PM peak.

The closest ITE Land Use Code (LUC) to the mega-retail/fueling facility is likely LUC 853, Convenience Market with Gasoline. Pass-by rates are not explicitly identified for LUC 853 in the ITE Trip Generation Manual, therefore, the pass-by rate was assessed for several retail / convenience / gasoline-related land uses, resulting in a rounded average pass-by rate of 60%.

- LUC 821 Shopping Plaza (40-150k): Weekday pass-by 40%
- LUC 944 Gasoline Service Station: Weekday PM pass-by 57%
- LUC 945 Convenience Store/Gas Station: Weekday PM pass-by 75%

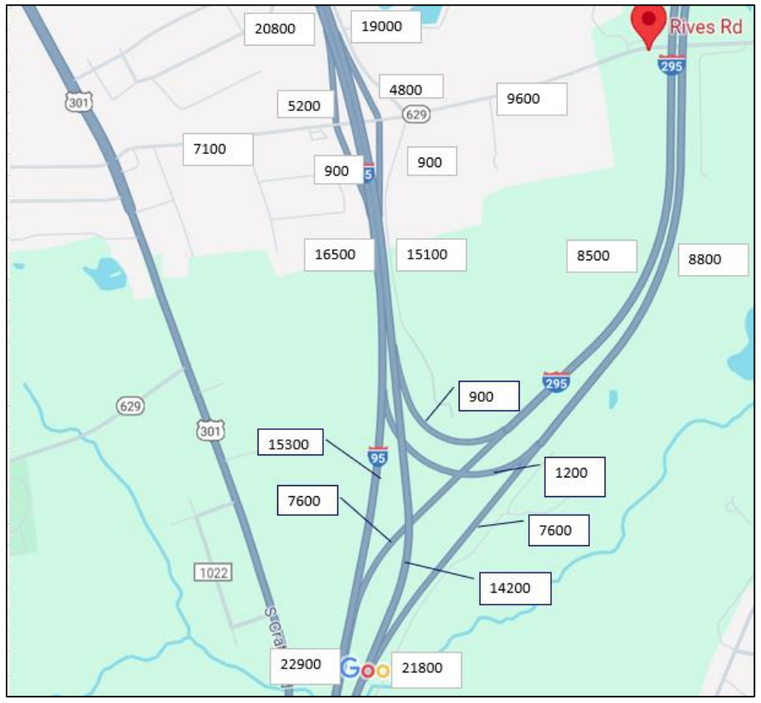
FIGURE 1.32. MAJOR DEVELOPMENT AREA

Source: Google Earth

The existing traffic distribution within the area of the major development is shown in **Figure 1.33**, with the existing traffic distribution shown as:

- 34% - I-95 to the north
- 37% - I-95 to the south
- 14% - I-295 to the north
- 6% - Rives Road to the west
- 8% - Rives Road to the east

FIGURE 1.33. EXISTING 2023 TRAFFIC DISTRIBUTION (VPD) IN RIVES RD AREA NEAR FUTURE MAJOR DEVELOPMENT



Based on the traffic distribution, trip generation and pass-by rates, the following added daily traffic volumes are expected on area roadways, shown in **Table 1.10**.

TABLE 1.10. ADDED DEVELOPMENT VOLUMES

	Vpd	%	Notes
Development Traffic	20000	trips	
		60%	pass by from I-95/I-295
	8000		new trips on I-95/I-295
	12000		pass by trips on I-95/I-295
Added trips	2750	34%	I-95 to the north
	2980	37%	I-95 to the south
	1150	14%	I-295 to the north
	470	6%	Rives Rd to the west
	640	8%	Rives Rd to the east
At site on Rives Rd from I-95 to site	20000		At site
	6880	34%	total to/from north ramps
	10340	52%	total to/from south ramps
	1180	6%	total to/from west
	1600	8%	total to/from east
	18400		Rives Rd - from I-95 to site

1.10.5. Summary of Future Traffic Recommendations

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

Per the guidance provided in *VDOT P4P*, the minimum growth rate irrespective of the observed historic trends for a corridor shall be 0.5%. Based on this guidance, observed trends in historic volumes along the study corridor, the RRTPO TDM growth rate, and an understanding of the planned developments in the area, WSP recommends the following background AAGR for the study area as shown in **Table 1.11**:

TABLE 1.11. RECOMMENDED BACKGROUND GROWTH RATES

Roadway	Roadway Segment	Growth Rate			
		P4P	TDM	Other Studies	Recommended Background Growth Rate
Wagner Rd	I-95 to Normandy Dr	**-0.31%**	**0.52%**		**0.50%**
	S Crater Rd to I-95	**0.02%**	**-0.05%**		**0.50%**
S Crater Rd	Rives Rd to Wagner Rd	**0.45%**	**-0.40%**		**0.50%**
Rives Rd	S Crater Rd to I-95	**-0.10%**	**0.53%**	**2% (1)**	**0.50%**
	I-95 to Lakeshore Dr	**4.41%**	**0.15%**	**2% (2)**	**0.50%**
I-95 NB	Rives Rd to Wagner Rd	**3.55%**	**0.60%**	**1.25% (3)**	**1.25%**
	I-295 to Rives Rd	**3.55%**	**0.82%**	**1.25% (3)**	**1.25%**
I-95 SB	Rives Rd to Wagner Rd	**3.22%**	**0.69%**	**1.25% (3)**	**1.25%**
	I-295 to Rives Rd	**3.22%**	**0.87%**	**1.25% (3)**	**1.25%**

1) TIA and Turn Lane Warrant Analysis for a tractor trailer truck storage facility off of Rives Road west of the I-95 interchange references a background growth rate of 2% on Rives Road (Kimley-Horn, May 2022 and Gorove Slade, November 2022)
2) TIA for a Rives Road Industrial Site east of the I-95 interchange references a background growth rate of 2% on Rives Road (Green Light Solutions, Inc. March 2023).
3) The current, ongoing I-95/I-85 Interchange STARS study identifies a growth rate of 1.25% on I-95 just north of the Project Pipeline study area (Kimley-Horn, Draft Existing Conditions and Traffic Forecasting, June 2023).

Note: Shading indicates TDM model with link volume delta greater than 30% compared to VDOT ADT data for the same year. This value is not to be explicitly used in forecasting as it may not be a reliable source of volume forecast.

POTENTIAL ADDITIONAL MAJOR DEVELOPMENT

The additional major development trips are then added to the recommended background growth in order to determine the future ADTs for study area roadways.

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 1.12**.

TABLE 1.12. EXISTING 2023 VOLUMES AND PROJECTED ADTS

Roadway	Roadway Segment	Recommended Background Growth Rate	AADT (vpd)		
			Existing 2023 AADT	Add Rives development	Future 2052 AADT
Wagner Rd	I-95 to Normandy Dr	**0.50%**	15,800		18,300
	S Crater Rd to I-95	**0.50%**	15,100		17,400
S Crater Rd	Rives Rd to Wagner Rd	**0.50%**	9,500	200	11,200
Rives Rd	S Crater Rd to I-95	**0.50%**	7,100	470	8,700
	I-95 to I-295	**0.50%**	9,600	18,400	29,500
I-95 NB	Rives Rd to Wagner Rd	**1.25%**	20,500	1,375	30,800
	I-295 to Rives Rd	**1.25%**	15100	2065	23,700
I-95 SB	Rives Rd to Wagner Rd	**1.25%**	20,800	1,375	31,200
	I-295 to Rives Rd	**1.25%**	16500	2065	25700

These future AADT values equate to an overall growth factor of 1.16 on Wagner Road, 1.18 on S Crater Rd, 1.23 on Rives Rd west of I-95, 3.07 east of I-95, as well as 1.53 on I-95.

1.11. 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 1.13** summarizes the average AM and PM peak hour delay and LOS for each movement for the study intersections under Future 2052 No Build conditions. **Figure 1.34** summarizes the overall intersection delay graphically. *Synchro* output sheets are provided in **Appendix**.

The results in show that most intersections are operating at acceptable overall levels of service of C or better for both AM and PM peak periods. The intersection of Rives Road and southbound I-95 ramps operate at an overall LOS of F for the AM and PM peak period and a LOS of D for the mid-day peak period. Movements operating at LOS D or below were found during all peak hours at the following intersections:

- Wagner Rd & Brasfield Pkwy/ Medical Park Blvd
- Wagner Rd & S Crater Rd
- S Crater Rd& Crater Cir
- S Crater Rd & Medical Park Blvd
- S Crater Rd & Walmart Shopping Center
- S Crater Rd & Rives Rd
- Rives Rd & I-95 SB ramps
- Rives Rd & I-95 NB ramps
- Wagner Rd & Normandy Dr

TABLE 1.13. FUTURE (2052) NO BUILD CONDITIONS PEAK HOUR DELAY AND LOS

	Intersection	Control	Overall Delay (LOS)	Average Delay (sec/veh) and Level of Service											
				Eastbound			Westbound			Northbound			Southbound		
				LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
1	Wagner Rd & Brasfield Pkwy / Medical Park Blvd	Signal	**AM Peak Hour**												
			29.5 (C)	20.1 (C)			29.5 (C)			42.9 (D)			46.5 (D)		
				58.5	17.5	22.1	44.3	16.6	13.9	43.5	43.4	42.6	49.3	41.9	41.0
				E	B	C	D	B	B	D	D	D	D	D	D
			MID Peak Hour												
			30.5 (C)	25.3 (C)			26.3 (C)			43.0 (D)			45.8 (D)		
				48.6	24.1	18.3	44.9	16.5	14.2	44.3	44.3	42.2	48.6	42.7	41.6
				D	C	B	D	B	B	D	D	D	D	D	D
			PM Peak Hour												
			29.6 (C)	18.5 (B)			25.1 (C)			48 (D)			54.7 (D)		
				61.3	15.2	17.0	48.4	17.3	13.9	49.0	49.0	50.1	61.5	47.2	46.5
				E	B	B	D	B	B	D	D	D	E	D	D
2	Wagner Rd & S. Crater Rd	Signal	**AM Peak Hour**												
			34.8 (C)	49.9 (D)			70.5 (C)			18.5 (B)			12.1 (B)		
				49.9			28.6	28.3	128.4	57.9	18.1		11.0	13.2	
				D			C	C	B	D	B		A	B	
			MID Peak Hour												
			35.0 (C)	50.4 (D)			64.2 (E)			34.0 (C)			18.4 (B)		
				50.4			57.2	57.2	71.4	58.1	33.9		25.8	14.5	
				D			E	E	E	E	C		C	B	
			PM Peak Hour												
			41.4 (D)	53.8 (D)			81.3 (F)			26.9 (C)			18.5 (B)		
				53.8			45	44.2	109.7	55.5	29.5		25.7	14.6	
				D			D	D	F	E	C		C	B	
3	S. Crater Rd & Seyler Dr	Stop	**AM Peak Hour**												
			0.5 (A)				10.0 (A)			0.0 (A)			0.6 (A)		
							10			0.0			8.6	0	
							A			A			A	A	
			MID Peak Hour												
			0.3 (A)				11.0 (B)			0.0 (A)			0.3 (A)		
							11			0			9.7	0	
							B			A			A	A	
			PM Peak Hour												
			0.4 (A)				12.4 (B)			0.0 (A)			0.3 (A)		
							12.4			0			10.2	0	
							B			A			A	A	

TABLE 1.13. FUTURE (2052) NO BUILD CONDITIONS PEAK HOUR DELAY AND LOS (CONTINUED)

	Intersection	Control	Overall Delay (LOS)	Average Delay (sec/veh) and Level of Service											
				Eastbound			Westbound			Northbound			Southbound		
				LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
4	S. Crater Rd & Crater Circle	Signal	**AM Peak Hour**												
			20.6 (C)	42.8 (D)			48.0 (D)			11.5 (B)			16.4 (B)		
				42.8	42.2		48.0			55.3	6.3		46.4	17.1	7.6
				D	D		D			E	A		D	B	A
			MID Peak Hour												
			23.7 (C)	44.0 (D)			44.8 (D)			14.1 (B)			18.3 (B)		
				44.6	42.4		44.8			47.6	9.6		43.2	16.3	19.6
				D	D		D			D	A		D	B	B
			PM Peak Hour												
			26.9 (C)	52.7(D)			49.8 (D)			16.0 (B)			20.1 (C)		
				54	51.3		49.8			57.5	10.5		64.1	18.2	19.6
				D	D		D			E	A		E	B	B
5	S. Crater Rd & Crater Square Shop Ctr / Medical Park Blvd	Signal	**AM Peak Hour**												
			27.7 (C)	46.8 (D)			44.8 (D)			18.7 (B)			16.8 (B)		
				49.5		36.4	45.9	43.1		54.2	15.8	16.3	64.2	5.8	7
				D		D	D	D		D	B	B	E	A	A
			MID Peak Hour												
			29.1 (C)	47.3 (D)			43.3 (D)			24.0 (C)			20.9 (C)		
				50.3		38.1	44.7	42		62.3	15.1	19	64.5	7.6	8.1
				D		D	D	D		E	B	B	E	A	B
			PM Peak Hour												
			32.4 (C)	49.4 (D)			56.7 (D)			22.8 (C)			18.5 (B)		
				51.8		40.1	64.8	48		63.2	14.6	17.9	66.1	10	20.6
				D		D	E	D		E	B	B	E	B	C
6	S. Crater Rd & Walmart Shop Ctr	Signal	**AM Peak Hour**												
			8.0 (A)	44.1 (D)						7.2 (A)			1.2 (A)		
				44.6		43.9				53.0	1.6		0.9		2.8
				D		D				D	A		A		A
			MID Peak Hour												
			11.4 (B)	44.0 (D)						9.0 (A)			5.0 (A)		
				45.6		43.1				40.7	3.5		5.9		0.0
				D		D				D	A		A		A
			PM Peak Hour												
			11.9 (B)	47.3 (D)						11.7 (B)			1.9 (A)		
				48.5		47.0				43.0	2.2		2.3		0.1
				D		D				D	A		A		A

TABLE 1.13. FUTURE (2052) NO BUILD CONDITIONS PEAK HOUR DELAY AND LOS (CONTINUED)

	Intersection	Control	Overall Delay (LOS)	Average Delay (sec/veh) and Level of Service											
				Eastbound			Westbound			Northbound			Southbound		
				LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
7	S. Crater Rd & Lakewood Dr	Stop	**AM Peak Hour**												
			1.1 (A)				10.9 (B)			0.0 (A)			0.5 (A)		
							10.9			0.0			8.0	0.0	
							B			A			A	A	
			MID Peak Hour												
			1.2 (A)				13.5 (B)			0.0 (A)			0.6 (A)		
							13.5			0.00			8.4	0.0	
							B			A			A	A	
			PM Peak Hour												
			1.1 (A)				14.1 (B)			0.0 (A)			0.5 (A)		
							14.1			0.0			8.6	0.0	
							B			A			A	A	
8	S. Crater Rd & Rives Rd	Signal	**AM Peak Hour**												
			22.8 (C)	62.3 (E)			35.8 (D)			13.7 (B)			18.6 (B)		
				62.3			46.7	27.3		13.7			39.0	4.1	
				E			D	C		B			D	A	
			MID Peak Hour												
			22.8 (C)	56.8 (E)			36.6 (D)			13.0 (B)			22.2 (C)		
				56.8			49.6	30.8		49.9	12.8		56.4	5.2	
				E			D	C		D	B		E	A	
			PM Peak Hour												
			26.7 (C)	61.0 (E)			37.0 (C)			18.6 (B)			25.3 (C)		
				61.0			53.1	26.4		18.6			61.6	2.0	
				E			D	C		B			E	A	
9	Rives Rd & I-95 Southbound Ramps	Stop	**AM Peak Hour**												
			178.0 (F)	0.0 (A)			0.7 (A)						336.0 (F)		
				0			0.7						336.0		
				A			A						F		
			MID Peak Hour												
			40.5 (D)	0.0 (A)			1.0 (A)						88.1 (F)		
				0.0			1.0						88.1		
				A			A						F		
			PM Peak Hour												
			325.8 (F)	0.0 (A)			1.5 (A)						716.7 (F)		
				0			1.5						716.7		
				A			A						F		

TABLE 1.13. FUTURE (2052) NO BUILD CONDITIONS PEAK HOUR DELAY AND LOS (CONTINUED)

Intersection		Control	Overall Delay (LOS)	Average Delay (sec/veh) and Level of Service											
				Eastbound			Westbound			Northbound			Southbound		
				LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
10	Rives Rd & I-95 Northbound Ramps	Stop	**AM Peak Hour**												
			8.3 (A)	4.7 (A)			0.0 (A)			53.9 (F)					
				4.7			0.0			53.9					
				A			A			F					
			MID Peak Hour												
			4.3 (A)	3.7 (A)			0.0 (A)			24.7 (C)					
				3.7			0.0			24.7					
				A			A			C					
			PM Peak Hour												
			8.9 (A)	5.4 (A)			0.0 (A)			92.7 (F)					
				5.4			0.0			92.7					
				A			A			F					
11	Rives Rd & Timber Rd / Old Wagner Rd	Stop	**AM Peak Hour**												
			0.7 (A)	0.3 (A)			0.2 (A)			18.3 (C)			11.3 (B)		
				0.3			0.2			18.3			11.3		
				A			A			C			B		
			MID Peak Hour												
			0.6 (A)	0.6 (A)			0.0 (A)			23.2 (C)			12.1 (B)		
				0.6			0.0			23.2			12.1		
				A			A			C			B		
			PM Peak Hour												
			0.8 (A)	0.5 (A)			0.0 (A)			29.4 (C)			13.4 (B)		
				0.5			0.0			29.4			13.4		
				A			A			C			B		
12	Rives Rd & Lakeshore Dr	Stop	**AM Peak Hour**												
			0.3 (A)	0.1 (A)			0.0 (A)						11.5 (B)		
				0.1			0						11.5		
				A			A						B		
			MID Peak Hour												
			0.1 (A)	0.1 (A)			0.0 (A)						9.9 (A)		
				0.1			0						9.9		
				A			A						A		
			PM Peak Hour												
			0.1 (A)	0.1 (A)			0.0 (A)						18.4 (B)		
				0.1			0						18.4		
				A			A						B		

TABLE 1.13. FUTURE (2052) NO BUILD CONDITIONS PEAK HOUR DELAY AND LOS (CONTINUED)

Intersection		Control	Overall Delay (LOS)	Average Delay (sec/veh) and Level of Service											
				Eastbound			Westbound			Northbound			Southbound		
				LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
13	Wagner Rd & Normandy Dr	Signal	**AM Peak Hour**												
			23.8 (C)	20.3 (B)			18.5 (B)			43.0 (D)			43.4 (D)		
				43.9	14.0	7.4	48.6	20.2	12.7	43.3	39.6		43.3		
				D	B	A	D	C	B	D	D		D		
			MID Peak Hour												
			23.2 (C)	19.3 (B)			21.5 (C)			43.3 (D)			43.4 (D)		
				43.9	14.0	7.5	47.8	21	13.4	44.7	39.5		43.4		
				D	B	A	D	C	B	D	D		D		
			PM Peak Hour												
			30.2 (C)	24.7 (C)			26.4(C)			40.7 (D)			43.8 (D)		
				48.1	26.8	14.7	45.8	24.4	9.1	42.0	37.7		43.8		
				D	C	B	D	C	A	D	D		D		

Chapter 2: Alternatives 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 improve vehicular congestion in the study area. These preliminary alternatives were eventually designated as removed from further study, additional refinement, or moved forward for analysis over the course of this process.

WAGNER ROAD AT MEDICAL PARK BLVD / BRASFIELD PKWY

The intersection of Wagner Road and Medical Park Blvd/Brasfield Pkwy experiences moderate congestion and is considered a crash hot-spot intersection with 49 total crashes over an 8-year period. The majority of crashes at the intersection are rear-end and angle crashes.

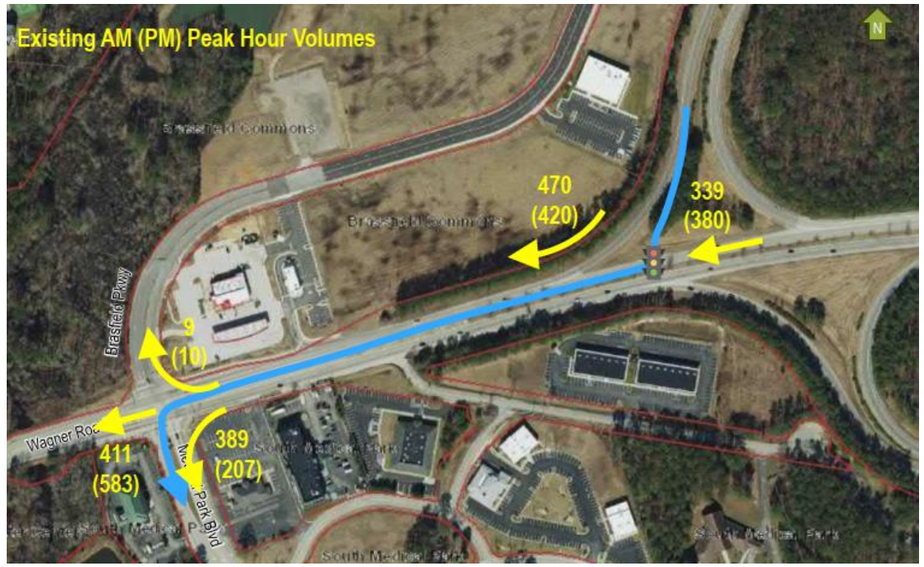
The preliminary alternative, illustrated in **Figure 2.1**, includes restriping the southbound Brasfield Pkwy to a left, left/thru, right lane configuration, optimizing the signal timings, safety improvements such as an activated “Red Signal Ahead” warning sign and signal equipment improvements intended to improve visibility of the traffic signals.

FIGURE 2.1. PRELIMINARY ALTERNATIVE - WAGNER ROAD AT MEDICAL PARK BLVD / BRASFIELD PKWY

Note: Modified/refined in Phase 2.

Two additional preliminary alternative concepts were developed as well, which were eventually removed from further study. Option 1 involves realignment of the I-95 southbound to westbound Wagner Road off-ramp to include a 2-phase signal at Wagner Road for traffic originating from I-95 southbound and turning left onto Medical Park Blvd. This Option 1 is shown in **Figure 2.2** and would eliminate weaving along westbound Wagner Road, particularly in the AM peak hour.

FIGURE 2.2. PRELIMINARY ALTERNATIVE OPTION 1 - WAGNER ROAD AT I-95 SB OFF-RAMP



Option 2 involves realignment of the I-95 southbound to westbound Wagner Road off-ramp to include a jughandle roadway for traffic originating from I-95 southbound and turning left onto Medical Park Blvd. That traffic would turn right, utilizing Brasfield Parkway to head southbound on Medical Park Boulevard. This Option 2 is shown in **Figure 2.3** and would also eliminate weaving along westbound Wagner Road, particularly in the AM peak hour.

FIGURE 2.3. PRELIMINARY ALTERNATIVE OPTION 2 - WAGNER ROAD AT I-95 SB OFF-RAMP

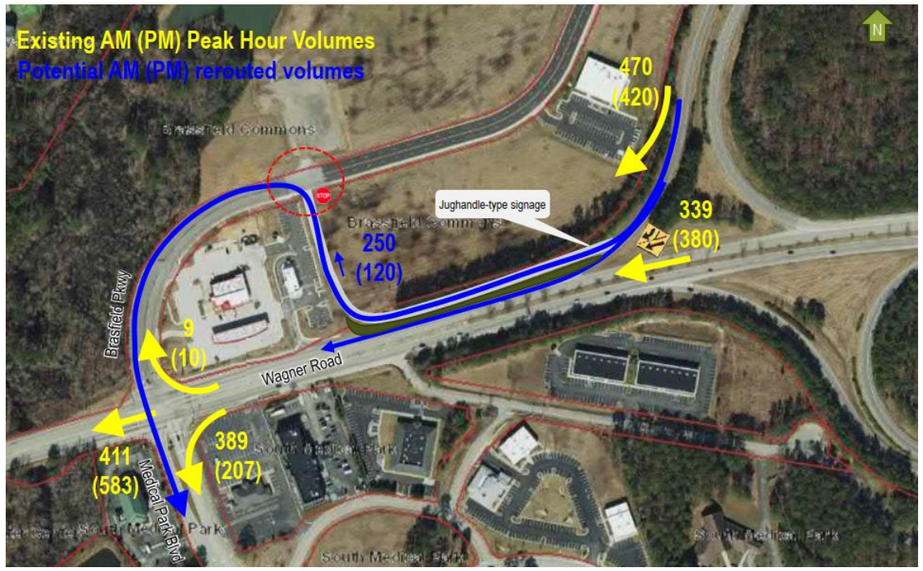


FIGURE 2.4. PRELIMINARY ALTERNATIVE - S CRATER ROAD AT WAGNER ROAD

Note: Modified/refined in Phase 2.

S CRATER ROAD AT WAGNER ROAD

The intersection of Wagner Road at S Crater Road is considered a crash hot-spot intersection and has experienced 77 total crashes over an 8-year period. Most of the reported crashes are angle and rear-end crashes. The intersection has both congestion and safety needs.

The preliminary alternative, illustrated in Figure 2.4**,** includes adding a northbound right turn bay on S Crater Road, replacing the span wire signal with a mast arm signal, improving signal equipment, optimizing signal timings, and closing or restricting access points to Subway, Enterprise, and Wawa.

S CRATER ROAD AT CRATER CIRCLE

The intersection of S Crater Road at Crater Circle is considered a hot-spot intersection with 28 total crashes over an 8-year period, including 3 pedestrian crashes in the vicinity of the intersection. The majority of reported crashes are rear-end and angle crashes.

The preliminary alternative, illustrated in **Figure 2.5**, includes extending the median to the existing stop bar, replacing the span wire signal with a mast arm signal, and improving signal equipment. Only one alternative was considered here due to the minor improvements needed to improve safety here.

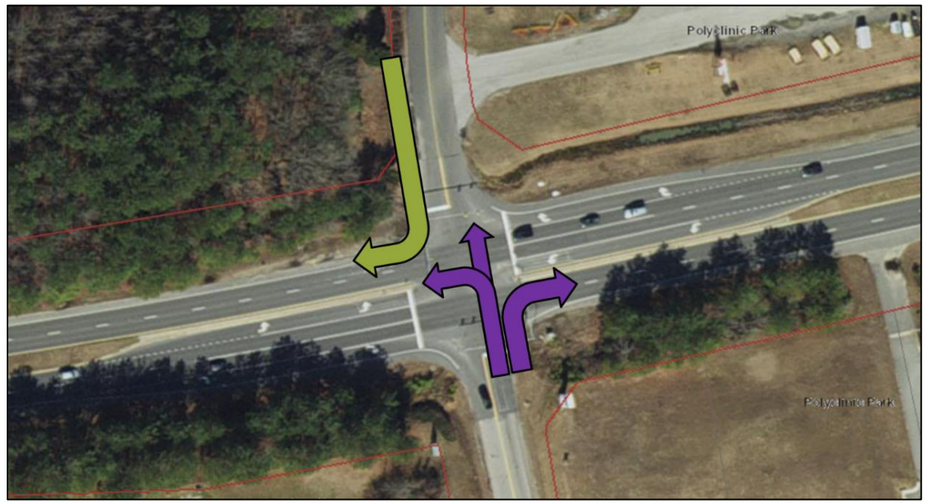
FIGURE 2.5. PRELIMINARY ALTERNATIVE - S CRATER ROAD AT CRATER CIRCLE IMPROVEMENTS

Note: Moved forward in Phase 2.

WAGNER ROAD AT NORMANDY DRIVE

This intersection experiences moderate congestion and has experienced recent and planned development both north and south of the intersection. The preliminary alternative, illustrated in **Figure 2.6**, involves adding a southbound right turn bay. Additional improvements to be completed by others including adding a northbound right turn lane and extending the east and westbound turn lanes. Only one alternative was considered here due to the additional improvements already to be completed by others.

FIGURE 2.6. PRELIMINARY ALTERNATIVE - WAGNER ROAD AT NORMANDY DRIVE IMPROVEMENTS



Note: Moved forward in Phase 2.

I-95 / RIVES ROAD INTERCHANGE

The intersection of Rives Road at the southbound I-95 interchange ramp is considered a crash hot-spot intersection with 42 total crashes over an 8-year period. Most of the crashes at the intersection were rear-end and angle crashes. The southbound off-ramp experiences significant congestion and queuing.

Two concepts have been proposed for this location. Option 1, illustrated in **Figure 2.7**, includes adding roundabouts to the north and south ramp intersections and installing a southbound right turn bay. The roundabouts would convert the intersection from stop-controlled to yield-controlled. Option 2, illustrated in **Figure 2.8**, includes adding a traffic signal to the south ramp intersection and installing a southbound right turn bay. This would convert the intersection from stop-controlled to signal-controlled.

FIGURE 2.7. PRELIMINARY ALTERNATIVE - OPTION 1 - I-95 / RIVES ROAD INTERCHANGE

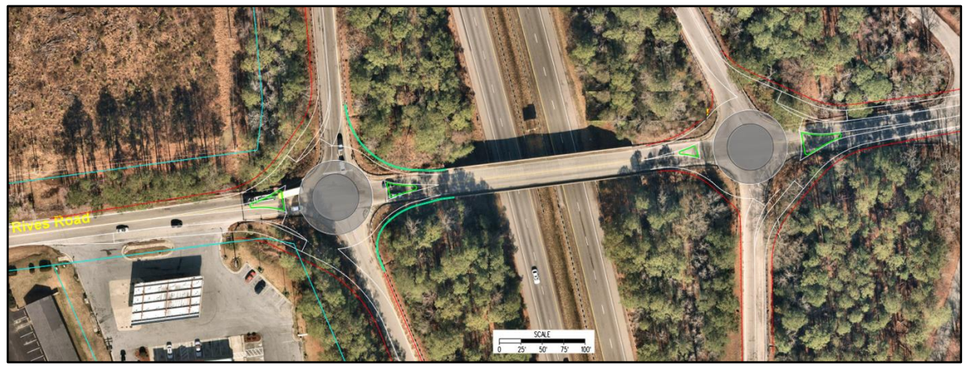


FIGURE 2.8. PRELIMINARY ALTERNATIVE - OPTION 2 - I-95 / RIVES ROAD INTERCHANGE

CORRIDOR PEDESTRIAN / MULTIMODAL IMPROVEMENTS

There have been five pedestrian crashes along S Crater Road over an 8-year period. This concept addresses bicycle and pedestrian access and safety and includes adding sidewalk to fill in any gaps along both sides of S Crater Road from Wagner Road to Rives Road, as well as the south side of Wagner Road from S Crater Road to Medical Park Blvd. The concept includes adding pedestrian signals and crosswalks to S Crater Road/Wagner Road, S Crater Road/ Crater Circle, and S Crater Road/Walmart driveway. These facilities will allow for greater multimodal connectivity throughout the area.

This study also recommends implementation of the Petersburg Area Transit Plan recommendations, including route modifications and increased service times for the S Crater Road routes. This plan also indicates improvements to existing bus stop amenities such as benches or shelters based on ridership demand.

2.1.1. Preliminary Alternatives Summary

Table 2.1 includes a list of the alternatives identified in Phase 1 and the VTrans needs addressed by each item. **Figure 2.9** graphically shows the preliminary alternatives throughout the study area identified by their needs and location.

TABLE 2.1. PRELIMINARY PHASE 1 ALTERNATIVES AND ANTICIPATED NEEDS ADDRESSED

Intersection	Improvement	Safety Need	Congestion Need	Pedestrian Need	Bike Need	Transit/TDM Need
Wagner Road at Medical Park Blvd/Brasfield Pkwy	Restripe southbound Brasfield Pkwy – left, left/thru, right	○	●	○	○	○
	Optimize signal timings	●	●	●	●	○
	Restripe crosswalks with high visibility markings	●	○	●	●	○
	Install yellow reflective plates on signal heads	●	○			○
	Install dynamic advanced warning signs	●	○			○
S Crater Road at Wagner Road	Add northbound right turn bay on S Crater Road	○	●	○	○	○
	Optimize signal timings	●	●	●	●	○
	Access Management - Close Subway and Enterprise driveways. Restrict lefts out of Wawa.	●	●	●	●	○
	Convert from span wire mounted signal to mast arm mounted signal	●	○	●	●	○
	Install yellow reflective plates on signal heads	●	○			○
	Restripe crosswalks with high visibility markings	●	○	●	●	○
	Install pedestrian signals	●	○	●	●	○
S Crater Road at Crater Circle	Extend median to the stop bar	●	○	●	●	○
	Optimize signal timings	●	●	●	●	○
	Convert from span wire mounted signal to mast arm mounted signal	●	○	●	●	○
	Install yellow reflective plates on signal heads	●	○			○
	Install pedestrian signals	●	○	●	●	○
	Add intersection lighting	●	○	●	●	○
Wagner Road at Normandy Drive	Add southbound right turn bay	○	●	○	○	
	Improvements by others – add northbound right turn lane, extend east and westbound turn lanes.	○	●	○	○	
	Add intersection lighting	●	○	●	●	
I-95/Rives Road Interchange	Option 1 - Add roundabout to northbound and southbound ramps	●	●	○	○	
	Option 2 - Add signal to southbound intersection	●	●	○	○	
	Add southbound right turn bay	○	●	○	○	
	Add intersection lighting	●	○	○	○	
	Install dynamic advanced warning signs	●	○	○	○	

Legend | ● Need exists and is addressed ○ Need exists and is not addressed If no circle present, need is not present

FIGURE 2.9. PRELIMINARY PHASE 1 SCOPING-LEVEL IMPROVEMENT ALTERNATIVES

Legend: VTrans Needs Addressed

Pedestrian/Bicycle Access	Transit / TDM
Congestion Mitigation	Safety Improvement

Pedestrian Improvements

- A Add crosswalks & pedestrian signals
- B Improve crosswalks & pedestrian signals
- C Add Shared Use Path

Corridor Wide Pedestrian Improvements

- Add sidewalks to complete sidewalk network (see Pedestrian Access slide)

Transit and TDM Improvements

- Add new bus stops
- Improve existing bus stop amenities (install benches, shelters, etc.)
- Implement PAT Transit Strategic Plan (Dec. 2021)

Safety and Operations Improvements

1. Lane addition or re-arrangement
2. Access management
3. Trim foliage to improve sight distance
4. Install dynamic advanced intersection warning signs
5. Flashing Yellow Arrow signal head
6. Roundabout
7. Add lighting
8. Reconstruct span wire signals with mast arm signals

Corridor Wide Safety and Operations Improvements

- Refresh or improve pavement markings
- Optimize signal timing and phasing
- Install yellow reflective backplates on signal heads
- Install uniform street name signs

2.2. Preferred 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* 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 SWG on February 14, 2024 to discuss each concept with regard to impacts to safety, traffic operations and overall benefits. The SWG selected six intersection alternatives and one corridor-wide improvement concept to move into more refined design to present to City Council and to the public. The study team presented the improvement alternatives during the Petersburg City Council Work Session meeting held on March 5, 2024, and a list of refined alternatives were selected to move forward for the Future 2030 Build conditions analysis.

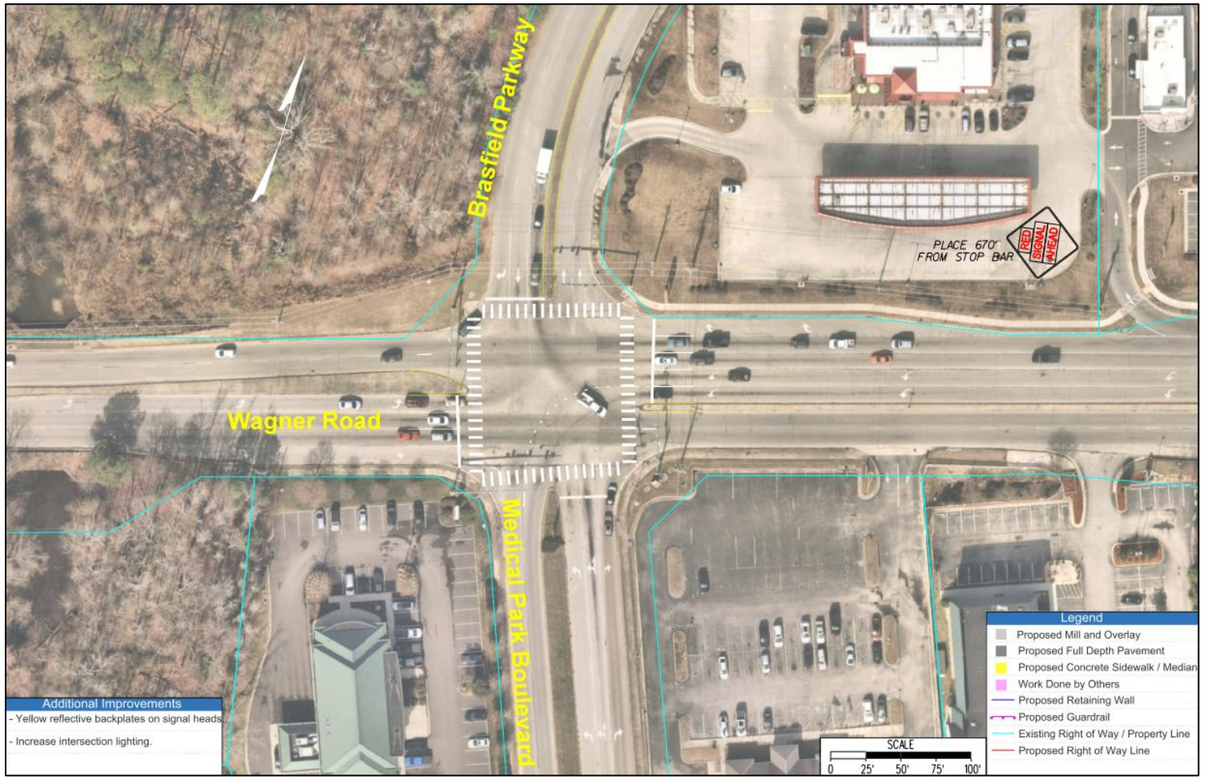
The planning level conceptual layouts for each of these preferred alternatives are discussed and evaluated below.

WAGNER ROAD AT MEDICAL PARK BLVD / BRASFIELD PKWY

The improvements, as shown in **Figure 2.10** will improve pedestrian and vehicular safety by increasing the visibility of traffic signals and their indication to prepare incoming traffic to slow as they approach a red traffic signal.

- Install an LED signal-activated RED SIGNAL AHEAD sign on the westbound Wagner Rd approach
- Install yellow reflective backplates on signal heads
- Increase intersection lighting
- Improve existing crosswalks with high visibility crosswalks
- Add lane extension pavement marking guidance for dual lefts

FIGURE 2.10. WAGNER ROAD AT MEDICAL PARK BLVD / BRASFIELD PKWY

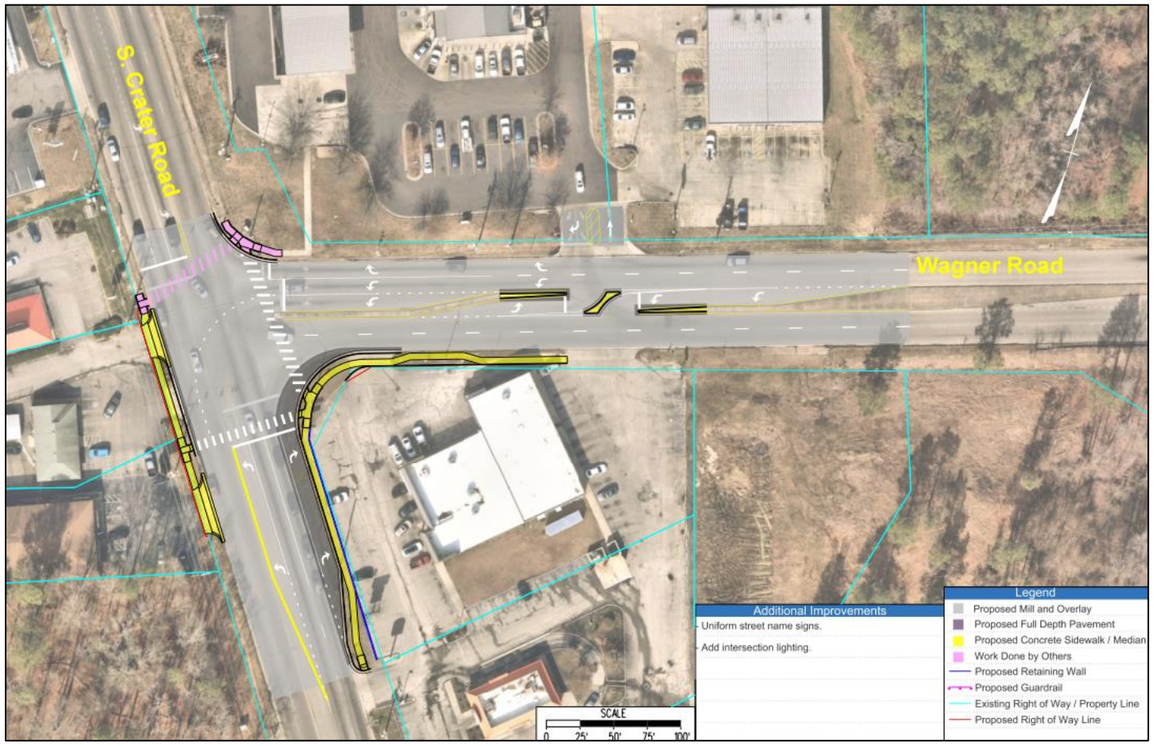


S CRATER ROAD AT WAGNER ROAD

The improvements, as shown in **Figure 2.11** will improve congestion as well as vehicular and pedestrian safety by reducing conflict points and providing improved higher visibility signal equipment and pedestrian accommodations.

- Construct northbound right turn bay along S Crater Road
- Restrict access points along Wagner Road and S Crater Road to reduce conflict points
    - Install a directional median along Wagner Road to prohibit left turns out of Wawa
    - Close the Subway and Enterprise driveways that are located within 50 ft of the intersection (alternate access remains open for both businesses).
- Replace existing span wire signal with mast arm signals (as part of another project by others)
    - Add pedestrian signals and high visibility crosswalks
    - Improve signal equipment for safety /visibility (yellow reflective backplates)
    - Improve signal phasing
- Provide additional signal improvements
    - Add additional pedestrian signals and high visibility crosswalks (south leg)
    - Optimize signal timings
    - Install uniform street name signs
- Add intersection lighting
- Add lane extension pavement marking guidance for dual lefts
- Install sidewalk surrounding intersection (will impact existing right-of-way)

FIGURE 2.11. S CRATER ROAD AT WAGNER ROAD IMPROVEMENTS

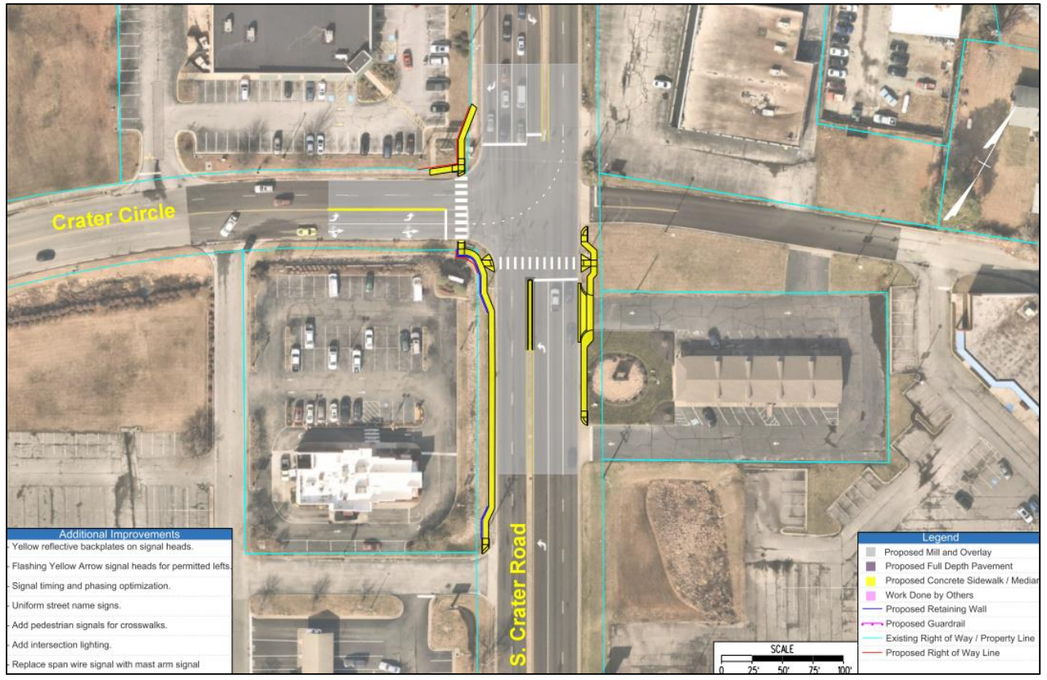


S CRATER ROAD AT CRATER CIRCLE

The improvements, as shown in **Figure 2.12** will improve congestion as well as vehicular and pedestrian safety by reducing conflict points and providing higher visibility signal equipment and pedestrian accommodations.

- Extend the northbound median to existing stop bar
- Optimize signal timings and add pedestrian signal phases
- Replace existing span wire signal with mast arm signal
    - Add pedestrian signals and high visibility crosswalks
    - Improve signal equipment for safety / visibility (yellow reflective backplates)
    - Optimize signal timing
    - Install uniform street name signs
- Add intersection lighting
- Install sidewalk surrounding intersection (will impact existing right-of-way)
- Add lane extension pavement marking guidance for dual lefts

FIGURE 2.12. S CRATER ROAD AT CRATER CIRCLE IMPROVEMENTS

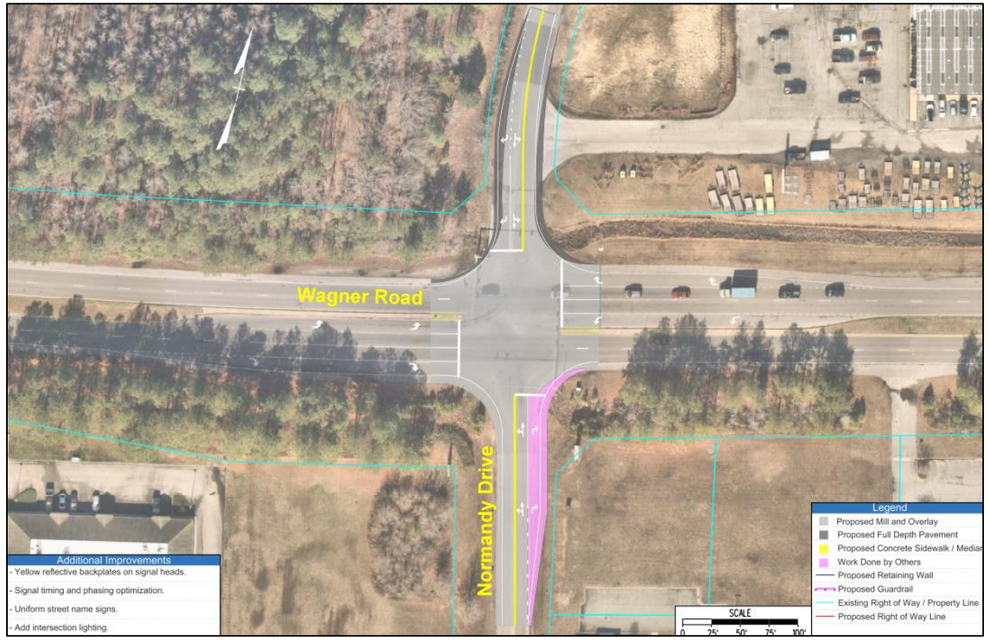


WAGNER ROAD AT NORMANDY DRIVE

The improvements, as shown in **Figure 2.13** will improve congestion as well as vehicular and pedestrian safety.

- Construct a southbound right turn bay
- Add intersection lighting
- Install yellow reflective backplates on signal heads
- Install uniform street name signs
- Improvements completed by others:
    - Add a northbound right turn lane.
    - Extend the eastbound right turn and westbound left turn lanes.

FIGURE 2.13. WAGNER ROAD AT NORMANDY DRIVE IMPROVEMENTS

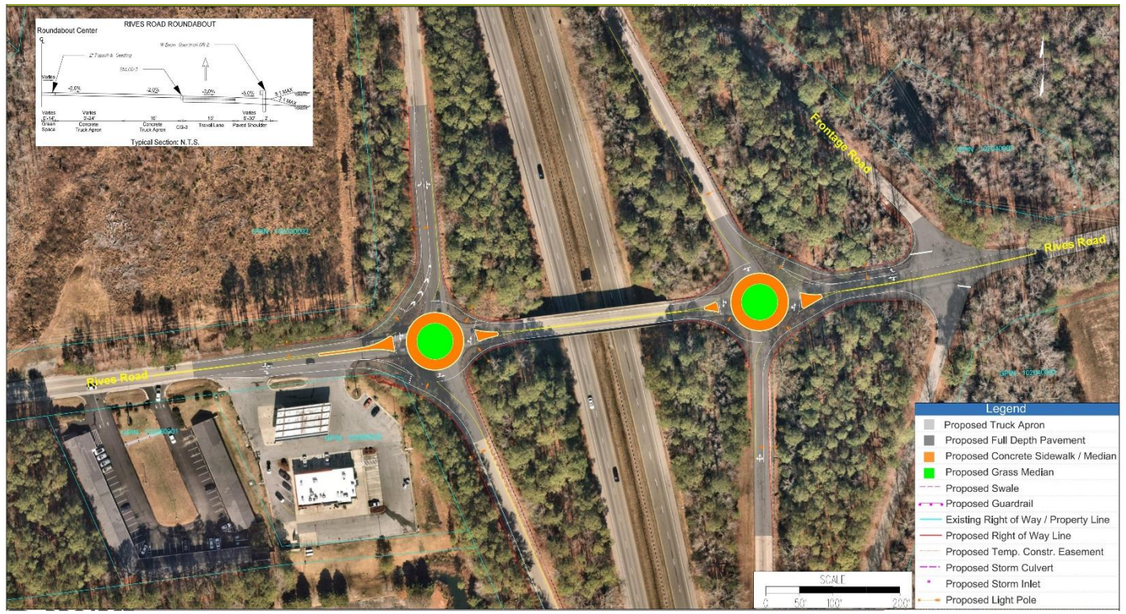


I-95/RIVES ROAD INTERCHANGE – OPTION 1 ROUNDABOUTS

The improvements, as shown in **Figure 2.14** will improve congestion for both southbound and northbound ramps and will improve vehicular safety. A roundabout will improve safety by reducing conflict points and angle (left turn related) collisions at both intersections and slowing vehicle speeds on Rives Road.

- Install roundabouts at both the southbound and northbound ramps
- Add intersection lighting

FIGURE 2.14. I-95/RIVES ROAD INTERCHANGE OPTION 1 ROUNDABOUTS

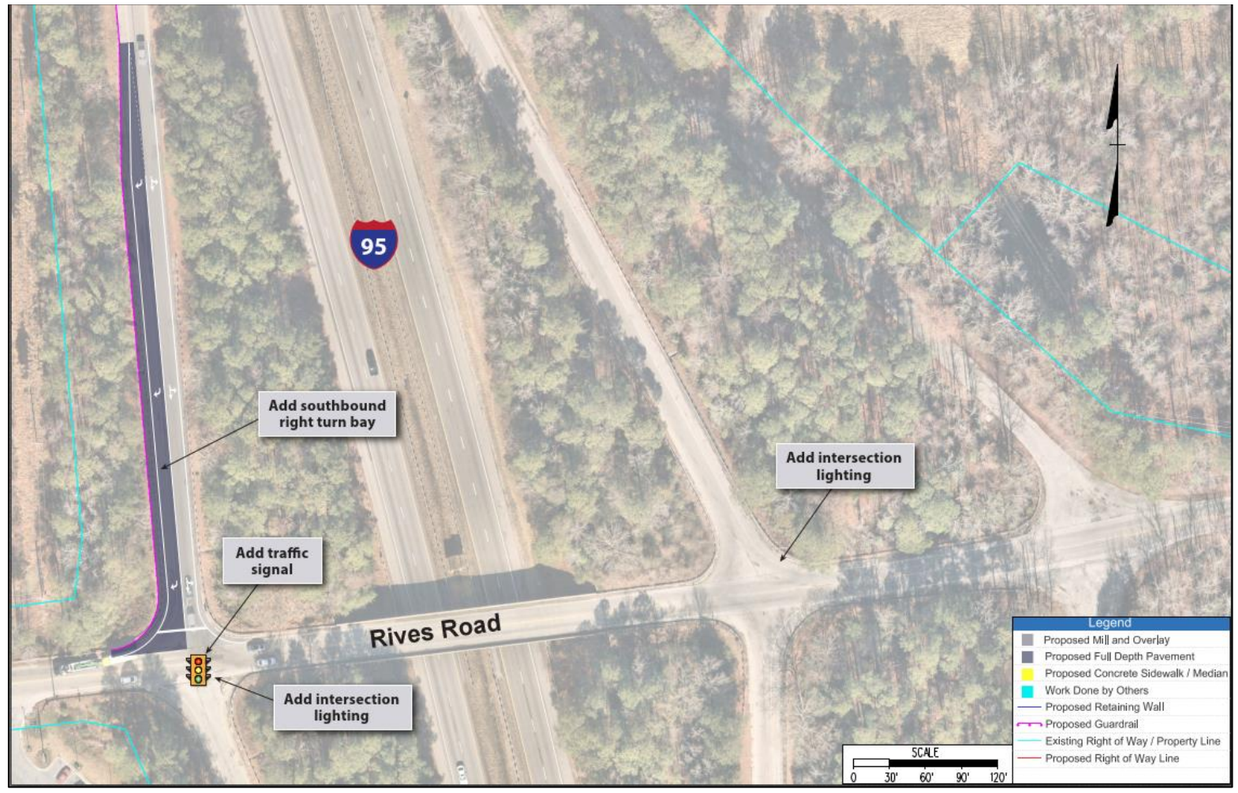


I-95/RIVES ROAD INTERCHANGE – OPTION 2 TRAFFIC SIGNAL

The improvements, as shown in **Figure 2.15** will improve congestion for both southbound and northbound ramps and will improve vehicular safety. A signal will improve safety for turning vehicles by designating a protected movement for left turns from the southbound off-ramp.

- Install a traffic signal at the southbound ramps
- Add a southbound right turn bay at the southbound ramps
- Add intersection lighting

FIGURE 2.15. I-95/RIVES ROAD INTERCHANGE OPTION 2 TRAFFIC SIGNAL



STUDY AREA-WIDE PEDESTRIAN AND BICYCLE ACCESS IMPROVEMENTS

The improvements, as shown in Figure 2.16 and **Figure 2.17** will improve pedestrian safety by providing connectivity and accessibility for pedestrians and bicyclists along the corridor.

- Install sidewalk to fill in gaps along both sides of S Crater Road to provide a continuous sidewalk along the entire corridor from Wagner Road to N Plains Road
    - Right-of-way will be required at various points along the corridor
    - A section of retaining wall will be required at the Crater Circle intersection
    - A shared use-path south of Walmart is anticipated to be completed by others
- Install sidewalk along the south side of Wagner Road from S Crater Road to Medical Park Blvd
    - Right-of-way will be required at various points along the corridor
    - A section of retaining wall and guardrail will be required west of Medical Park Blvd
- Provide high visibility crosswalks and pedestrian signals at the intersections of Wagner Rd, Crater Circle, and Walmart.

FIGURE 2.16. CORRIDOR-WIDE SIDEWALK IMPROVEMENTS

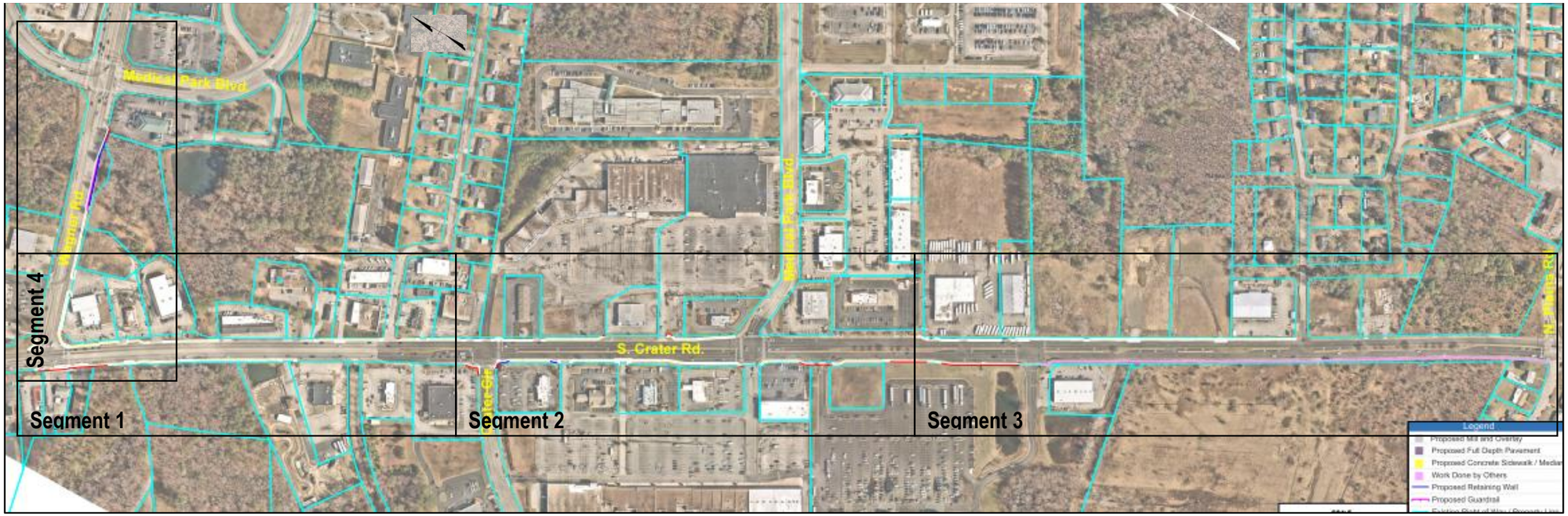
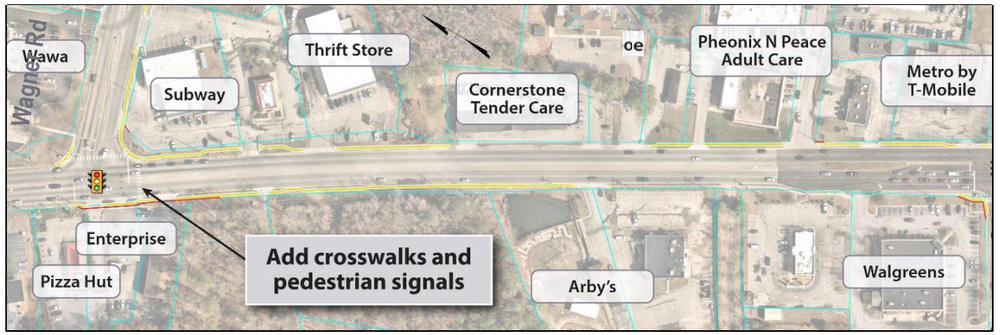
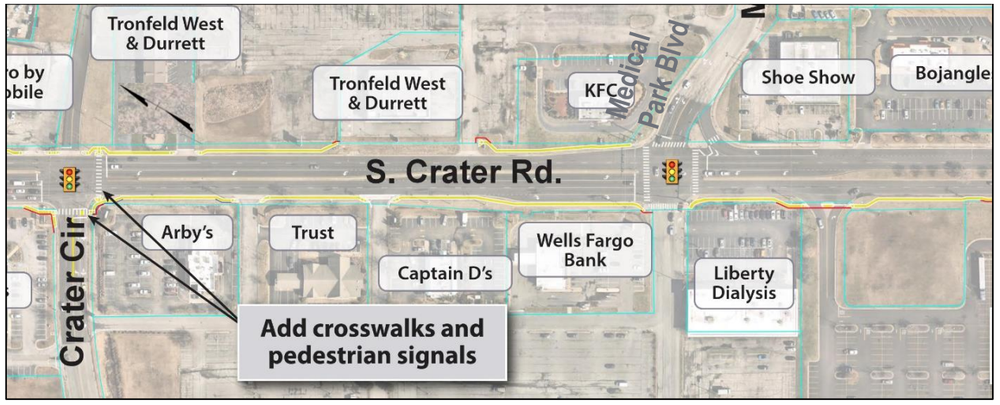


FIGURE 2.17. CORRIDOR-WIDE SIDEWALK IMPROVEMENTS BY SEGMENT

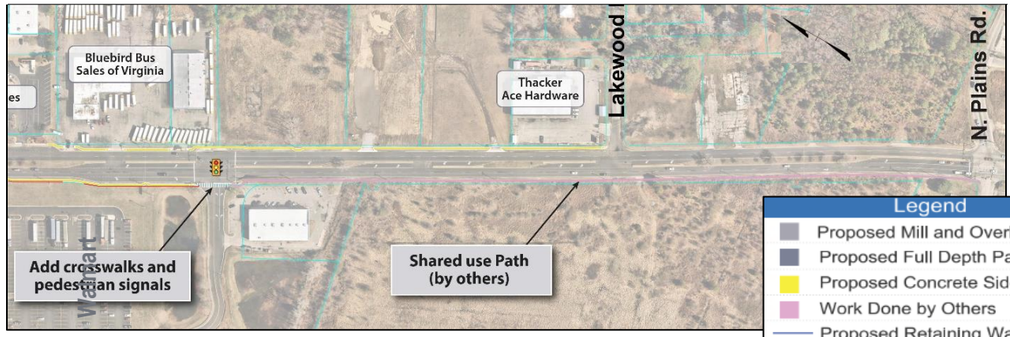
SEGMENT 1



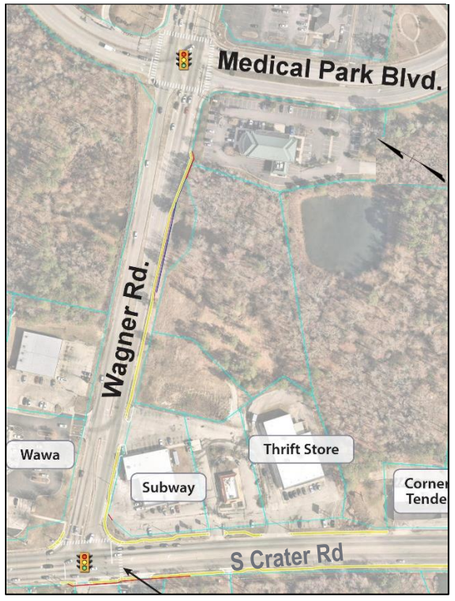
SEGMENT 2



SEGMENT 3



SEGMENT 4



2.3. 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 layouts were modeled in *Synchro* to test the combination of alternatives within the entire corridor under Future 2052 Build condition traffic operations.

Operational analysis was performed on the *Synchro* model at each of the study intersections. **Table 2.2** summarizes the average AM and PM peak hour delay for each movement for the study intersections along the corridor under Future 2052 Build conditions.

Results of the Build conditions *Synchro* analysis suggests the following changes in overall intersection delays:

WAGNER RD & S CRATER RD

- Microsimulation delay of 40.9 sec/veh (LOS D) during the AM peak hour (2052 No Build delays: 34.8 sec/veh (LOS C))
- Microsimulation delay of 30.2 sec/veh (LOS C) during the Mid-day peak hour (2052 No Build delays: 35.0 sec/veh (LOS C))
- Microsimulation delay of 38.1 sec/veh (LOS D) during the PM peak hour (2052 No Build delays: 41.4 sec/veh (LOS D))

S CRATER RD & CRATER CIR

- Microsimulation delay of 20.8 sec/veh (LOS C) during the AM peak hour (2052 No Build delays: 20.6 sec/veh (LOS C))
- Microsimulation delay of 22.8 sec/veh (LOS C) during the Mid-day peak hour (2052 No Build delays: 23.7 sec/veh (LOS C))
- Microsimulation delay of 24.2 sec/veh (LOS C) during the PM peak hour (2052 No Build delays: 26.9 sec/veh (LOS C))

RIVES RD & I-95 SB RAMPS

- Microsimulation delay of 10.4 sec/veh (LOS A) during the AM peak hour (2052 No Build delays: 178.0 sec/veh (LOS F))
- Microsimulation delay of 9.0 sec/veh (LOS A) during the Mid-day peak hour (2052 No Build delays: 40.5 sec/veh (LOS D))
- Microsimulation delay of 11.2 sec/veh (LOS B) during the PM peak hour (2052 No Build delays: 325.8 sec/veh (LOS F))

WAGNER RD & NORMANDY DR

- Microsimulation delay of 23.7 sec/veh (LOS C) during the AM peak hour (2052 No Build delays: 23.8 sec/veh (LOS C))
- Microsimulation delay of 23.0 sec/veh (LOS C) during the Mid-day peak hour (2052 No Build delays: 23.2 sec/veh (LOS C))
- Microsimulation delay of 24.9 sec/veh (LOS C) during the PM peak hour (2052 No Build delays: 30.2 sec/veh (LOS C))

Results of the *Synchro* analysis indicate that the overall delay will get worse for the following intersections under 2052 Build conditions:

WAGNER RD & BRASFIELD PKWY/MEDICAL PARK BLVD

- Microsimulation delay of 29.7 sec/veh (LOS C) during the AM peak hour (2052 No Build delays: 29.5 sec/veh (LOS C))
- Microsimulation delay of 31.7 sec/veh (LOS C) during the Mid-day peak hour (2052 No Build delays: 30.5 sec/veh (LOS C))
- Microsimulation delay of 34.8 sec/veh (LOS C) during the PM peak hour (2052 No Build delays: 29.6 sec/veh (LOS C))

S CRATER RD & MEDICAL PARK BLVD

- Microsimulation delay of 27.6 sec/veh (LOS C) during the AM peak hour (2052 No Build delays: 27.7 sec/veh (LOS C))
- Microsimulation delay of 29.3 sec/veh (LOS C) during the Mid-day peak hour (2052 No Build delays: 29.1 sec/veh (LOS C))
- Microsimulation delay of 33.7 sec/veh (LOS C) during the PM peak hour (2052 No Build delays: 32.4 sec/veh (LOS C))

It should be noted that although delays may increase at these two intersections, the improvements address safety benefits for each. Any delay increase experienced are relatively minimal compared to No Build conditions.

TABLE 2.2. BUILD CONDITIONS PEAK HOUR DELAY AND LOS

	Intersection	Control	Overall Delay (LOS)	Average Delay (sec/veh) and Level of Service											
				Eastbound			Westbound			Northbound			Southbound		
				LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
1	Wagner Rd & Brasfield Pkwy / Medical Park Blvd	Signal	**AM Peak Hour**												
			29.7 (C)	26.9 (C)			27.1 (C)			42.9 (D)			41.9 (D)		
				52.8	25.3	26.4	36.2	19.2	16.1	43.5	43.4	42.6	43.2	39.8	39.1
				D	C	C	D	B	B	D	D	D	D	D	D
			MID Peak Hour												
			31.7 (C)	30.3 (C)			25.8 (C)			42.1 (D)			44.8 (D)		
				37.4	30.7	22.4	37.1	19.9	17.1	43.2	43.3	41.5	47.2	42.3	41.3
				D	C	C	D	B	B	D	D	D	D	D	D
			PM Peak Hour												
			34.8 (C)	25.5 (C)			30.5 (C)			50.4 (D)			49.3 (D)		
				67.2	22.3	22.2	51.2	23.6	18.9	40.4	40.4	53	52.7	45.7	45.1
				E	C	C	D	C	B	D	D	D	D	D	D
2	Wagner Rd & S. Crater Rd	Signal	**AM Peak Hour**												
			40.9 (D)	49.9 (D)			82.1 (F)			26.0 (B)			11.8 (B)		
				49.9			27.2	26.8	157.9	14.1	17.2	40	10.5	13.2	
				D			C	C	F	B	B	D	B	B	
			MID Peak Hour												
			30.2 (C)	51.8 (D)			53.7 (D)			31.4 (C)			15.0 (B)		
				51.8			64.6	64.3	42.6	20.0	25.3	46.5	15.4	14.7	
				D			E	E	B	B	C	A	B	B	
			PM Peak Hour												
			38.1 (D)	53.8 (D)			72.5 (F)			31.1 (C)			15.3 (B)		
				53.8			38.0	37.4	99.4	21.9	26.3	43.9	15.2	15.3	
				D			D	D	F	C	C	D	B	B	
3	S. Crater Rd & Seyler Dr	Stop	**AM Peak Hour**												
			0.5 (A)				10.0 (B)			0.0 (A)			0.6 (A)		
							10			0.0			8.6	0	
							B			A			A	A	
			MID Peak Hour												
			0.3 (A)				11.0 (B)			0.0 (A)			0.3 (A)		
							11			0			9.7	0	
							B			A			A	A	
			PM Peak Hour												
			0.4 (A)				12.3 (B)			0.0 (A)			0.3 (A)		
							12.3			0			10.1	0	
							B			A			B	A	

TABLE 2.2. BUILD CONDITIONS PEAK HOUR DELAY AND LOS (CONTINUED)

	Intersection	Control	Overall Delay (LOS)	Average Delay (sec/veh) and Level of Service											
				Eastbound			Westbound			Northbound			Southbound		
				LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
4	S. Crater Rd & Crater Circle	Signal	**AM Peak Hour**												
			20.8 (C)	42.5 (D)			48.4 (D)			11.3 (B)			16.9 (B)		
				42.8	42.2		48.4			54.4	6.2		47	17.4	8.7
				D	D		D			D	A		D	B	A
			MID Peak Hour												
			22.8 (C)	42.5 (D)			46.0 (D)			14.0 (B)			17.2 (B)		
				43.9	41.2		46			48.3	9.4		42.8	14.4	20.2
				D	D		D			D	A		D	B	C
			PM Peak Hour												
			24.2 (C)	45.3 (D)			50.9 (D)			16.1 (B)			17.8 (C)		
				46.1	44.6		50.9			56.0	10.8		63.9	18.4	13.3
				D	D		D			E	B		E	B	B
5	S. Crater Rd & Crater Square Shop Ctr / Medical Park Blvd	Signal	**AM Peak Hour**												
			27.6 (C)	46.8 (D)			44.8 (D)			18.7 (B)			16.3 (B)		
				46.8	36.4		45.9	43.1		54.2	15.8	16.3	65	4.8	7
				D	D		D	D		D	B	B	E	A	A
			MID Peak Hour												
			29.3 (C)	47.3 (D)			43.3 (D)			24.0 (C)			21.3 (C)		
				50.3	38.1		44.7	42		62.3	15.1	19	64.4	8.6	7.2
				D	D		D	D		E	B	B	E	A	B
			PM Peak Hour												
			33.7 (C)	50.0 (D)			57.6 (D)			23.1 (C)			21.0 (C)		
				52.5	40.1		66.4	48		64	14.7	18.1	67.2	11	33
				D	D		E	D		E	B	B	E	B	C
6	S. Crater Rd & Walmart Shop Ctr	Signal	**AM Peak Hour**												
			8.0 (A)	44.1 (D)						7.2 (A)			1.2 (A)		
				44.6		43.9				53	1.6		0.9		2.8
				D		D				D	A		A		A
			MID Peak Hour												
			11.4 (B)	44 (D)						9.0 (A)			5.0 (A)		
				45.6		43.1				40.7	3.5		5.9		0.0
				D		D				D	A		A		A
			PM Peak Hour												
			12.0 (B)	47.3 (D)						11.7 (B)			2.2 (A)		
				48.5		47				43	2.2		2.6		0.4
				D		D				D	A		A		A

TABLE 2.2. BUILD CONDITIONS PEAK HOUR DELAY AND LOS (CONTINUED)

	Intersection	Control	Overall Delay (LOS)	Average Delay (sec/veh) and Level of Service											
				Eastbound			Westbound			Northbound			Southbound		
				LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
7	S. Crater Rd & Lakewood Dr	Stop	**AM Peak Hour**												
			1.1 (A)				10.9 (B)			0.0 (A)			0.5 (A)		
							10.9			0.0			8	0	
							B			A			A	A	
			MID Peak Hour												
			1.2 (A)				13.5 (B)			0.0 (A)			0.6 (A)		
							13.5			0.00			8.4	0	
							B			A			A	A	
			PM Peak Hour												
			1.1 (A)				14.1 (B)			0.0 (A)			0.5 (A)		
							14.1			0.0			8.6	0	
							B			A			A	A	
8	S. Crater Rd & Rives Rd	Signal	**AM Peak Hour**												
			22.9 (C)	62.3 (E)			36.7 (D)			13.7 (B)			17.9 (B)		
				62.3			46.7		28.8	13.7			37.4	4.0	
				E			D		C	B			D	A	
			MID Peak Hour												
			22.6 (C)	56.8 (E)			36.3 (D)			13.0 (B)			21.9 (C)		
				56.8			49.5		30.3	49.9		12.8	56.9	4.5	
				E			D		C	D		B	E	A	
			PM Peak Hour												
			26.8 (C)	61.0 (E)			37.2 (C)			18.6 (B)			25.3 (C)		
				61.0			53.2		26.6	18.6			61.7	2.1	
				E			D		C	B			E	A	
9	Rives Rd & I-95 Southbound Ramps	Signal	**AM Peak Hour**												
			10.4 (B)	12.4 (B)			11.6 (B)						8.9 (A)		
				12.4			11.6						9.6	7.1	
				B			B						A	A	
			MID Peak Hour												
			9.0 (A)	9.4 (A)			8.9 (A)						8.8 (A)		
				9.4			8.9						9.3	7.9	
				B			A						A	A	
			PM Peak Hour												
			11.2 (B)	9.6 (A)			8.6 (A)						13.7 (B)		
				9.6			8.6						15.1	11.2	
				A			A						B	B	

TABLE 2.2. BUILD CONDITIONS PEAK HOUR DELAY AND LOS (CONTINUED)

	Intersection	Control	Overall Delay (LOS)	Average Delay (sec/veh) and Level of Service											
				Eastbound			Westbound			Northbound			Southbound		
				LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
10	Rives Rd & I-95 Northbound Ramps	Stop	**AM Peak Hour**												
			8.3 (A)	4.7 (A)			0(A)			53.9 (F)					
				4.7			0.0			53.9					
				A			A			F					
			MID Peak Hour												
			4.3 (A)	3.7 (A)			0.0 (A)			24.7 (C)					
				3.7			0.0			24.7					
				A			A			C					
			PM Peak Hour												
			8.9 (A)	5.4 (A)			0.0 (A)			92.7 (F)					
				5.4			0.0			92.7					
				A			A			F					
11	Rives Rd & Timber Rd / Old Wagner Rd	Stop	**AM Peak Hour**												
			0.7 (A)	0.3 (A)			0.2 (A)			18.3 (C)			11.3 (B)		
				0.3			0.2			18.3			11.3		
				A			A			C			B		
			MID Peak Hour												
			0.7 (A)	0.6 (A)			0.0 (A)			23.2 (C)			12.1 (B)		
				0.6			0			23.2			12.1		
				A			A			C			B		
			PM Peak Hour												
			0.8 (A)	0.5 (A)			0.0 (A)			29.4 (D)			13.4 (B)		
				0.5			0			29.4			13.4		
				A			A			D			B		
12	Rives Rd & Lakeshore Dr	Stop	**AM Peak Hour**												
			0.3 (A)	0.1 (A)			0.0 (A)						11.5 (B)		
				0.1			0						11.5		
				A			A						B		
			MID Peak Hour												
			0.1 (A)	0.1 (A)			0.0 (A)						9.9 (A)		
				0.1			0						9.9		
				A			A						A		
			PM Peak Hour												
			0.1 (A)	0.1 (A)			0.0 (A)						17.0 (B)		
				0.1			0						17		
				A			A						B		

TABLE 2.2. BUILD CONDITIONS PEAK HOUR DELAY AND LOS (CONTINUED)

Intersection		Control	Overall Delay (LOS)	Average Delay (sec/veh) and Level of Service											
				Eastbound			Westbound			Northbound			Southbound		
				LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
13	Wagner Rd & Normandy Dr	Signal	**AM Peak Hour**												
			23.7 (C)	20.2 (B)			21.4 (B)			43.0 (D)			42.8 (D)		
				43.9	13.8	7.3	48.6	20.0	12.7	44.3	39.6		43.4	42.5	
				D	B	A	D	C	B	D	D		D	D	
			MID Peak Hour												
			23.0 (C)	19.2 (B)			21.3 (C)			43.3 (D)			42.8 (D)		
				43.9	13.8	7.3	47.8	20.8	13.4	44.7	39.5		43.4	42.5	
				D	B	A	D	C	B	D	D		D	D	
			PM Peak Hour												
			24.9 (C)	17.9 (B)			19.6 (B)			44.1 (D)			40.6 (D)		
				48.1	18.5	10.4	45.8	16.7	8.2	46.0	39.6		42.1	40.1	
				D	B	B	D	B	A	D	D		D	D	

2.4. Build Safety Analysis

The potential safety benefit and crash reduction for each improvement was determined by identifying the appropriate crash modification factors (CMFs). **Table 2.3** summarizes the CMFs for each improvement, their application and number / percent of applicable crashes. CMFs for this analysis were identified in the following order:

- CMFs from *VDOT HSIP's* Preferred CMF list
- *FHWA CMF Clearinghouse*
- *FHWA* Crash Reduction Factors (CRFs)

TABLE 2.3. CMF AND CRASH REDUCTION SUMMARY

Intersection	Improvement	Crash Modification Factor (*VDOT HSIP, Clearinghouse*, or *FHWA* CRF)	Types of Crashes Considered for Application of CRF Values	Percent of Applicable Crashes to Apply CRF Value	Notes/Quality
Wagner Road at Medical Park Blvd / Brasfield Pkwy	Restripe crosswalks with high visibility markings	0.63	All vehicle to pedestrian crashes	2%	Applicable Crashes (1 of 48)
	Install yellow reflective plates on signal heads	0.85	All crashes	100%	Applicable Crashes (48 of 48)
	Install dynamic advanced warning signs	0.814	All crashes at stop-controlled intersection	100%	Applicable Crashes (48 of 48)
S Crater Road at Wagner Road	Add northbound right turn bay on S Crater Road	0.96^(# lanes)	All crashes of NB approach	25%	Applicable Crashes (34 of 136)
	Change from protected left turn to flashing yellow arrow	2.42	All left turn crashes	1%	Applicable Crashes (1 of 136)
	Access Management - Close Subway and Enterprise driveways. Restrict lefts out of Wawa.	e^0.0232(# closures)	All crashes on roadway	80%	Applicable Crashes (109 of 136)
	Convert from span wire mounted signal to mast arm mounted signal	0.98	All crashes	100%	Applicable Crashes (136 of 136)
	Install yellow reflective plates on signal heads	0.85	All crashes	100%	Applicable Crashes (136 of 136)
	Restripe crosswalks with high visibility markings	0.63	All vehicle to pedestrian crashes	1%	Applicable Crashes (1 of 136)
	Install pedestrian signals	0.92	All pedestrian crashes	1%	Applicable Crashes (1 of 136)
S Crater Road at Crater Circle	Restripe crosswalks with high visibility markings	0.63	All vehicle to pedestrian crashes	5%	Applicable Crashes (2 of 37)
	Convert from span wire mounted signal to mast arm mounted signal	0.98	All crashes	100%	Applicable Crashes (37 of 37)
	Install yellow reflective plates on signal heads	0.85	All crashes	100%	Applicable Crashes (37 of 37)
	Install pedestrian signals	0.92	All pedestrian crashes	5%	Applicable Crashes (2 of 37)
	Add intersection lighting	0.881	All night-time crashes	24%	Applicable Crashes (9 of 37)

TABLE 2.3. CMF AND CRASH REDUCTION SUMMARY (CONTINUED)

Intersection	Improvement	Crash Modification Factor (*VDOT HSIP, Clearinghouse*, or *FHWA* CRF)	Types of Crashes Considered for Application of CRF Values	Percent of Applicable Crashes to Apply CRF Value	Notes/Quality
Wagner Road at Normandy Drive	Add southbound right turn bay	0.96^(# lanes)	All crashes of SB approach	9%	Applicable Crashes (2 of 22)
	Add intersection lighting	0.881	All night-time crashes	36%	Applicable Crashes (8 of 22)
I-95 / Rives Road Interchange Southbound and Northbound Ramps	OPTION 1 - Add roundabout to northbound and southbound ramps	0.56	All crashes at stop-controlled intersection	100%	Applicable Crashes (56 of 56 SB, 22 of 22 NB)
	OPTION 2 - Add signal to southbound intersection	0.639	All crashes at stop-controlled intersection	100%	Applicable Crashes (56 of 56)
	Add southbound right turn bay	0.96^(# lanes)	All crashes of SB approach	7%	Applicable Crashes (4 of 56)
	Add intersection lighting	0.881	All night-time crashes	18%	Applicable Crashes (10 of 56)
Corridor-wide Pedestrian Improvements	1. Wagner/Brasfield: Restripe Crosswalk with high visibility markings	0.63	All Vehicle to Pedestrian Crashes	2%	Applicable crashes (1 of 48)
	2. Wagner/Crater: Restripe Crosswalk with high visibility markings	0.63	All Vehicle to Pedestrian Crashes	1%	Applicable crashes (1 of 136)
	3. Wagner/Crater: Install Pedestrian Signals	0.92	All Pedestrian Crashes	1%	Applicable crashes (1 of 136)
	4. Crater/Crater Circle: Restripe Crosswalk with high visibility markings	0.63	All Vehicle to Pedestrian Crashes	5%	Applicable crashes (2 of 37)
	5. Crater/Crater Circle: Install Pedestrian Signals	0.92	All Pedestrian Crashes	5%	Applicable crashes (2 of 37)
	6. Crater/Medical Park: Restripe Crosswalk with high visibility markings	0.63	All Vehicle to Pedestrian Crashes	5%	Applicable crashes (1 of 19)
	7. Crater/Medical Park: Install Pedestrian Signals	0.92	All Pedestrian Crashes	5%	Applicable crashes (1 of 19)
	8. Crater/Walmart: Restripe Crosswalk with high visibility markings	0.63	All Vehicle to Pedestrian Crashes	0%	Applicable crashes (0 of 6)
	9. Crater/Walmart: Install Pedestrian Signals	0.92	All Pedestrian Crashes	0%	Applicable crashes (0 of 6)
	10. Add/connect sidewalk along Wagner and Crater Road	0.12	All Vehicle to Pedestrian Crashes	2%	Applicable crashes (6 of 280)

2.4.1. Overall Alternatives Evaluation Summary

Table 2.4 provides a summary of the alternatives evaluation with an assessment of metrics including traffic operations, safety, pedestrian and bicycle access, and cost to determine the refined list of concepts to present to the public.

TABLE 2.4. REFINED ALTERNATIVE EVALUATION SUMMARY

Intersection		*Synchro* Operations (Δ in delay from No-Build)		Safety	Ped/Bike Access	Preliminary Construction Cost Estimate	Advance to Public Engagement
Wagner Road at Medical Park Blvd / Brasfield Pkwy		EB Wagner Road Approach: AM: +6.8s delay PM:+7.0s delay	WB Wagner Road Approach: AM: -2.4s delay PM: +5.4s delay	+	+		Yes
S Crater Road at Wagner Road		NB S Crater Road Approach: AM: +7.5s delay PM: +4.2s delay	WB Wagner Road Approach: AM: -4.6s delay PM: -5.4s delay	+	+		Yes
S Crater Road at Crater Circle		NB S Crater Road Approach: AM: -0.2s delay PM: +0.1s delay	SB S Crater Road Approach: AM: +0.5s delay PM: -2.3s delay	+	+		Yes
Wagner Road at Normandy Drive		EB Wagner Road Approach: AM: -0.1s delay PM: -6.8s delay	WB Wagner Road Approach: AM: +2.9s delay PM: -6.8s delay	+	+		Yes
I-95/Rives Road Interchange	**Option 1**	NB I-95 Approach Ramp: PM: -705.1s delay	SB I-95 Approach Ramp: PM: -83.5s delay	+	**0**		Yes
	Option 2	NB I-95 Approach Ramp: AM: 0.0s delay PM: 0.0s delay	SB I-95 Approach Ramp: AM: -327.1s delay PM: -703.0s delay	+	**0**		Yes
Corridor-wide Sidewalk Improvements		---	---	+	+		Yes

LEGEND

Rating	**Safety:** Anticipated Safety Impact Compared to No-Build	**Ped/Bike Access:** Alternative Bike/Ped Accommodations Compared to No-Build
-	Anticipated Reduction to Safety	Negative Impact
0	No Benefit/Reduction Anticipated	Neutral Impact
+	Anticipated Safety Benefit	Positive Impact

Chapter 3:
Public and Stakeholder Outreach and Feedback

3.1. Stakeholder Coordination

The Study Work Group, as defined in Chapter 1, 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 SWG was actively involved in the project process and decision-making through milestone meetings and email communication.

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 9 to September 6, 2023, with 161 unique participants.

The survey provided the study team, the City of Petersburg, and VDOT with an understanding of how the public viewed each identified need before selecting a preferred option. 98% of respondents indicated that they normally travel through the study area by personal vehicle. **Table 3.1** summarizes the average ranking for each identified need presented. 89% of respondents agreed with identified safety needs and 71% agreed with identified congestion mitigation needs.

Following the summer 2023 public survey, the study team presented the findings to the SWG along with the summary of the existing conditions evaluation.

TABLE 3.1. PUBLIC ENGAGEMENT SURVEY #1 RESULTS SUMMARY

The following needs have been identified for this study. Do you agree with this initial assessment?	
Safety	89%
Congestion Mitigation	71%
Transportation Demand Management	49%
Bike & Pedestrian Access & Mobility	45%
Transit Accessibility	43%
Operations	42%
What mode(s) of travel do you use when traveling along the study area?	
Personal Vehicle	98%
Walking	10%
Truck or commercial vehicle	9%
Cycling	8%
Metro bus, local bus, or commuter bus	4%
Taxi / Uber / Lyft	3%
Other	2%
Carpool / Vanpool	1%

SPRING 2024 – SURVEY #2

A second public involvement survey was developed to provide the study team insight into the public perception of each potential alternative proposed for the study area before finalizing the preferred alternatives. This survey was available online for 15 days spanning from April 15 through April 29, 2024.

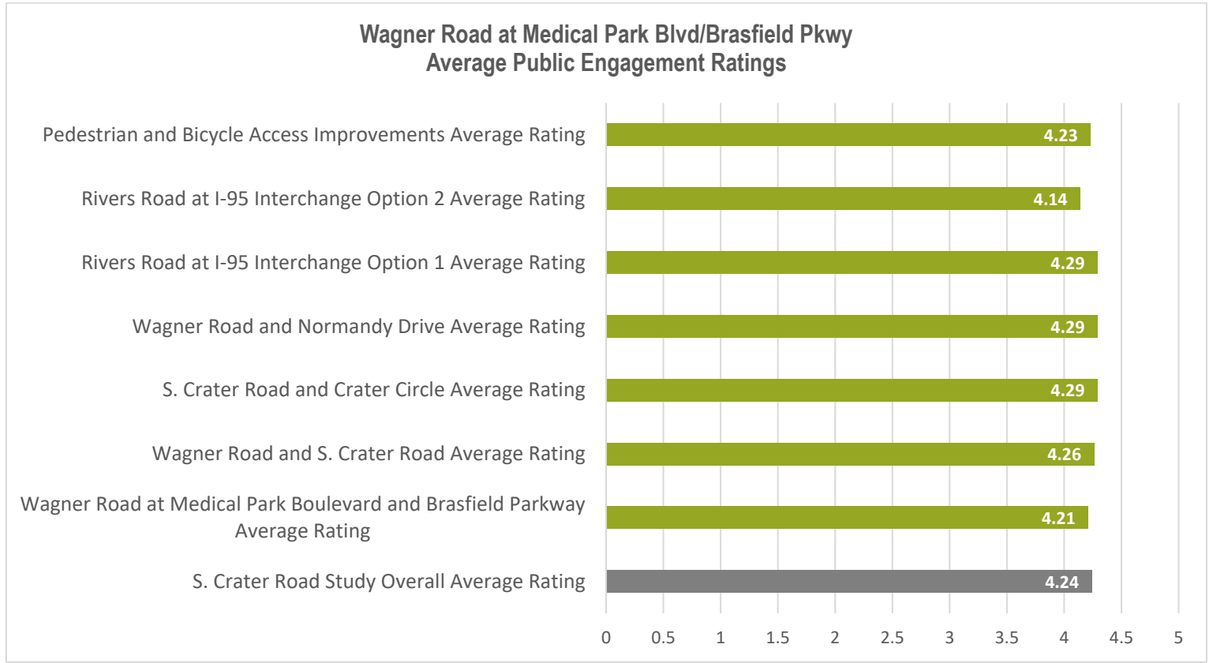
The following alternatives were presented to the public for feedback:

- Pedestrian and Bicycle Access Improvements
- Rives Road at I-95 Interchange Option 2
- Rives Road at I-95 Interchange Option 1
- Wagner Road at Normandy Drive
- S Crater Road and Crater Circle
- Wagner Road and S Crater Road
- Wagner Road at Medical Park Boulevard and Brasfield Parkway

Table 3.2 summarizes the average ranking for each potential alternative presented. A rating of 5.0 represents strong support and a rating of 1.0 represents strong opposition. Each proposed alternative received a rating above 4.00 and an average rating of 4.24. The Rives Road at I-95 Interchange Option 1, Wagner Road and Normandy Drive, and S Crater Road and Crater Circle alternatives received the highest ratings of 4.29. Public comments submitted with the survey generally indicated firm endorsements for all improvements to be installed within the study area.

Detailed survey results for the proposed improvements of each alternative are available in the **Appendix**.

TABLE 3.2. PUBLIC ENGAGEMENT SURVEY #2 RESULTS SUMMARY



Chapter 4: Preferred Alternative Refinement

4.1. Preferred Alternative

The Preferred Alternatives were 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). The intersection of Wagner Road at Medical Park Boulevard/Brasfield Parkway and the Corridor Wide Sidewalk improvements will be maintained as preferred alternatives but were not included in Chapter 4. No further refinement of the detailed cost estimate or the risk assessment were considered necessary due to the minor nature of the improvements at these locations. A summary of the elements of the Preferred Alternatives are provided in **Table 4.1**.

TABLE 4.1. PREFERRED ALTERNATIVE SUMMARY

Intersection	Preferred Alternative Elements
S Crater Rd at Wagner Rd	Provide northbound right turn bay along S Crater Road
	Install a directional median along Wagner Road
	Add pedestrian signals
	Install sidewalk
S Crater Rd at Crater Circle	Add pedestrian signals
	Install sidewalk
Wagner Rd at Normandy Dr	Add a southbound right turn bay
I-95 at Rives Road Interchange	Install teardrop roundabouts at both ramp intersections

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.

- S Crater Road at Wagner Rd (**Figure 4.1**)
  - Roadway Geometry: The footprint of the intersection will extend to add a northbound right turn bay along S Crater Road.
  - Traffic: The existing traffic signal will need to be modified to accommodate modifications to phasing. Reflective back plates will be added to the existing signals head replacements and mast-arm mounted lane use signs will be revised. Pavement markings and ground-mounted signs associated with changes will be needed in addition to the installation of uniform street name signs. Existing traffic signal poles may be impacted by the provision of sidewalks.
  - Pedestrian Accommodations: New high-visibility crosswalks will be added across Wagner Road and the south leg on S. Crater Road along with pedestrian signals. Sidewalks will be installed surrounding the intersection
  - Utility Impacts: New intersection lighting will be provided. The existing utility poles maybe impacted by adding sidewalk surrounding the intersection
  - Structural Impacts: A directional median along Wagner Road will need to be installed to prohibit left turns out of the local businesses. Sidewalk surrounding the intersection will be installed

- S Crater Road and Crater Circle (**Figure 4.2**)
    - Roadway Geometry: The existing northbound median will be extended to the stop bar. Lane extension pavement markings
    - Traffic: The existing traffic signal will need to be modified to accommodate modifications to phasing. The existing span wire signals will be replaced with mast arms and reflective backplates will be added to the signal heads. Pavement markings and ground-mounted signs associated with changes will be needed in addition to the installation of uniform street name signs.
    - Pedestrian Accommodations: New sidewalk will be constructed surrounding the intersection. High visibility crosswalks will be installed along the south leg of S Crater Road and west leg of Crater Circle.
    - Utility Impacts: New intersection lighting will be provided. The existing utility poles maybe impacted by adding sidewalk surrounding the intersection and the replacement of span wire signals with mast arms.
    - Structural Impacts: The new sidewalk surrounding the intersection will require new right of way and impact structures in its vicinity.
- Wagner Road and Normandy Drive (**Figure 4.3**)
    - Roadway Geometry: The footprint of the intersection will be modified to add southbound right turn bay, northbound right turn lane and extension of eastbound right turn and westbound left turn lanes.
    - Traffic: The existing traffic signal will need to be modified to accommodate modifications to phasing due to changes in lane configurations. Reflective backplates will be added to the existing signal heads. Pavement markings and ground-mounted signs associated with changes will be needed in addition to installing uniform street name signs.
    - Utility Impacts: New intersection lighting will be provided. Addition of new lane might impact the existing utility poles.
    - Structural Impacts: The addition of lanes and storage bays will impact structures in the vicinity.
- I-95/Rives Road Interchange (**Figure 4.4**)
    - Roadway Geometry: Both ramp terminal intersections will be reconfigured to accommodate teardrop roundabouts. Widening within the intersection area to provide the circulatory roadway and interior island. The roundabout island on the east leg of the southbound ramp intersection and the west leg of the northbound ramp intersection will be extended to restrict complete circulatory movement forming a double teardrop roundabout design.
    - Traffic: Existing signs and pavement markings will be modified to reflect the change from two-way stop control to roundabouts.
    - Utilities: New intersection lighting will be provided for all marked crossings.

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:

- FHWA approval that would be required due to impacts to the interstate ramps;
- OSAR or IAR that would be required could impact the overall project schedule; and
- Fill slope impacts existing power pole line
- Maintenance of traffic difficult due to large project footprint
- Discovery of unknown utility conflicts
- Future development impacts alignment, requiring design changes and additional right-of-way impacts
- Commercial access in close proximity to the intersections

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.

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 concepts were advanced, refining key elements of the preferred alternative. As the design progressed and with the conclusion of the Operational and Safety Analysis Report (OSAR) at the I-95 at Rives Road interchange, it was decided that a Double Teardrop Roundabout would be the preferred alternative at this location as shown in **Figure 4.4**. The Double Teardrop Roundabout scenario produces similar results as the Double Roundabout scenario in terms of reducing delay and queuing, especially for the southbound movement on the I-95 off-ramp west roundabout. However, the Teardrop configuration provides a smaller footprint and, in turn, a smaller impact to right-of-way, potentially a lower cost of construction, and further reduces conflict points by eliminating the possibility of circulating completely around the roundabout.

The total project cost is estimated to be $41,326,277 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	I-95 at Rives Rd Exit Roundabouts	S Crater Rd at Crater Circle and Wagner Rd	S Crater Rd at Normandy Dr	*Total*
Preliminary Engineering	$2,739,150	$1,977,750	$481,950	*$5,198,850*
Right-of-Way and Utilities	$1,185,000	$1,612,800	$241,250	*$3,039,050*
Construction	$18,805,249	$7,602,233	$1,459,013	*$27,866,495*
CEI	$3,498,651	$1,414,369	$308,662	*$5,221,682*
Total	**$26,228,050**	**$12,607,152**	**$2,490,875**	***$41,326,277***

FIGURE 4.1. S CRATER ROAD AT WAGNER ROAD IMPROVEMENTS

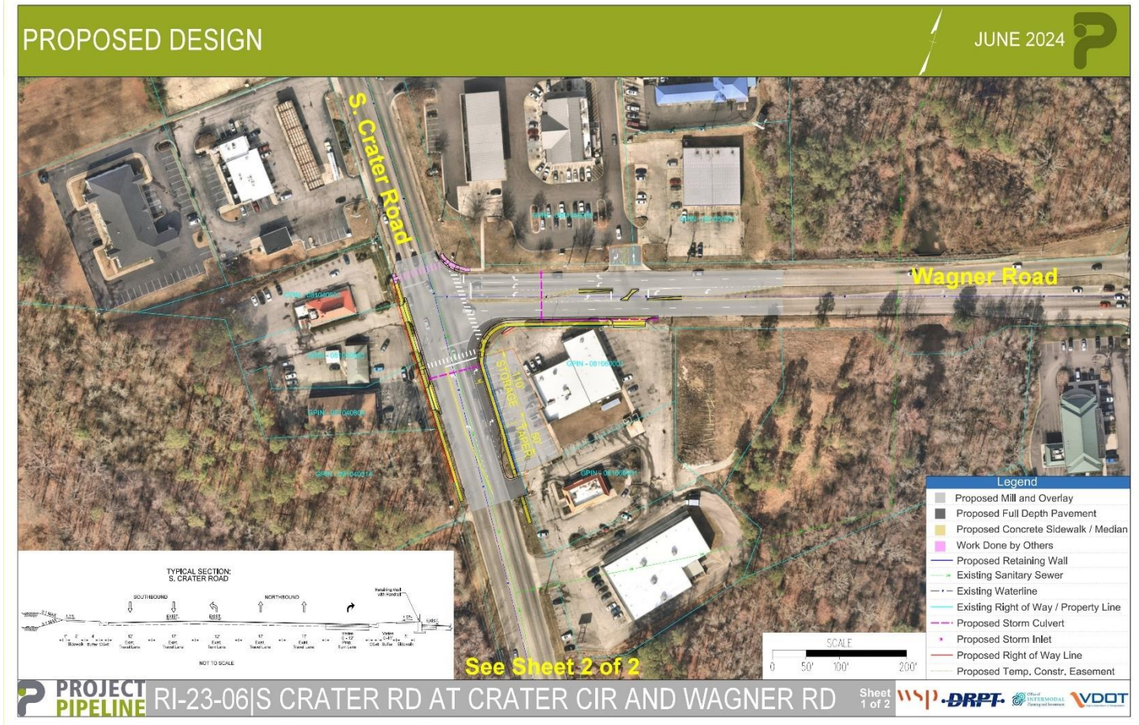


FIGURE 4.2. S CRATER ROAD AT CRATER CIRCLE IMPROVEMENTS

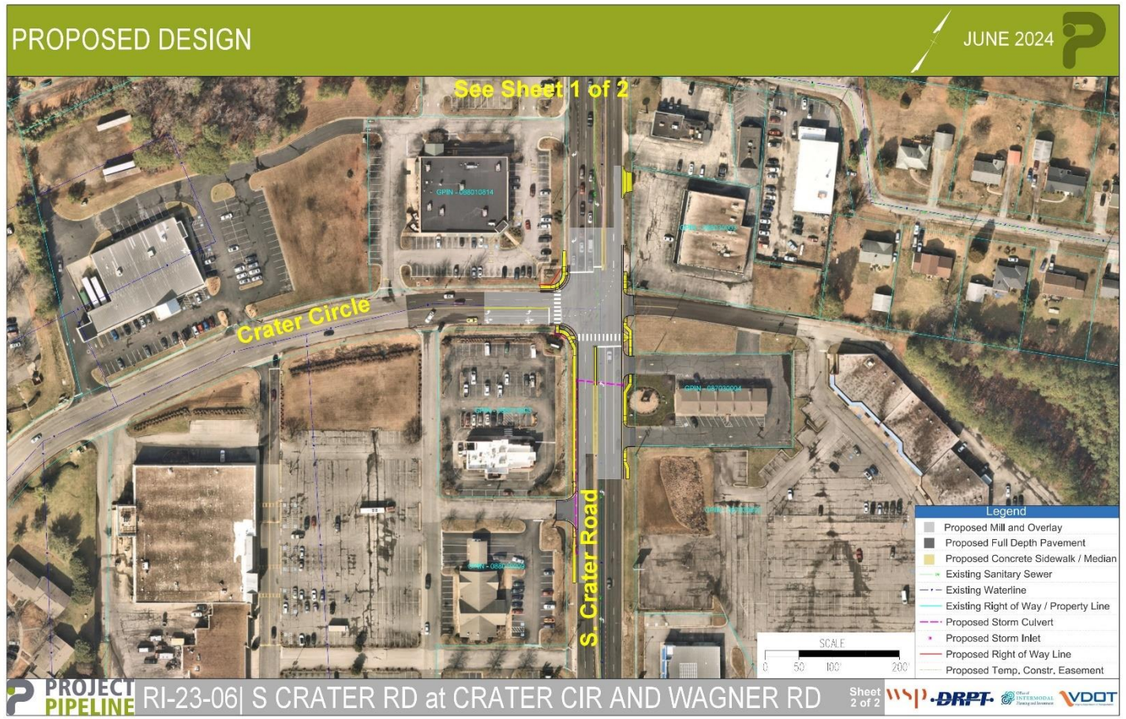


FIGURE 4.3. WAGNER ROAD AT NORMANDY DRIVE IMPROVEMENTS

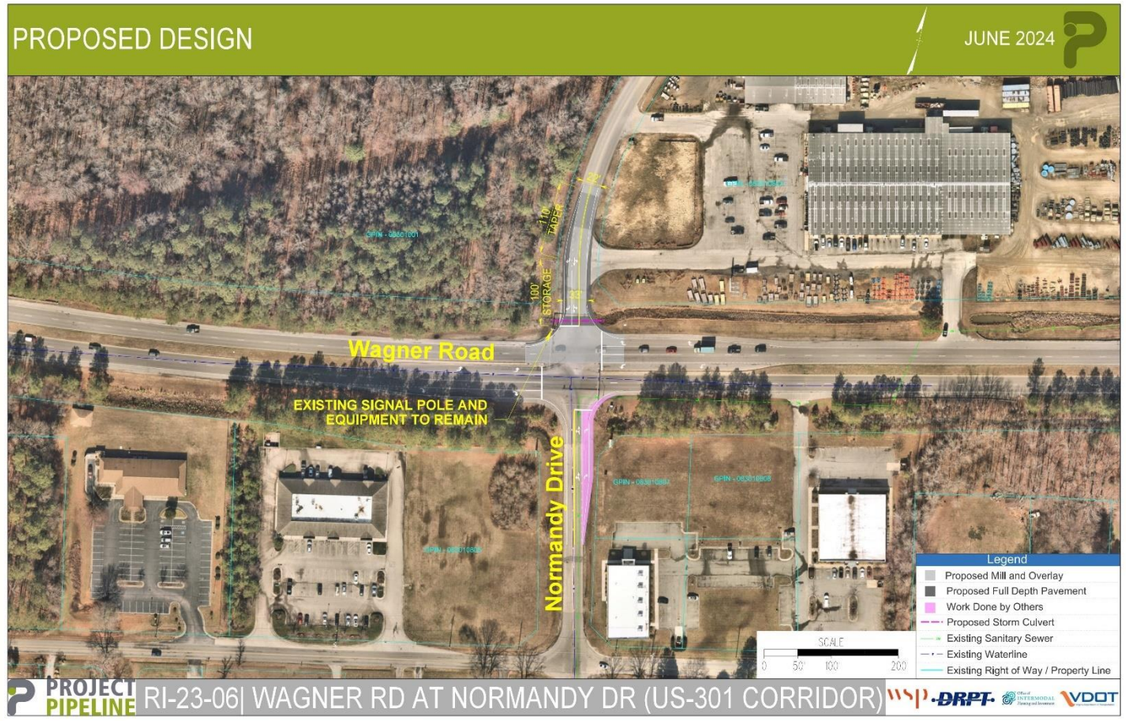
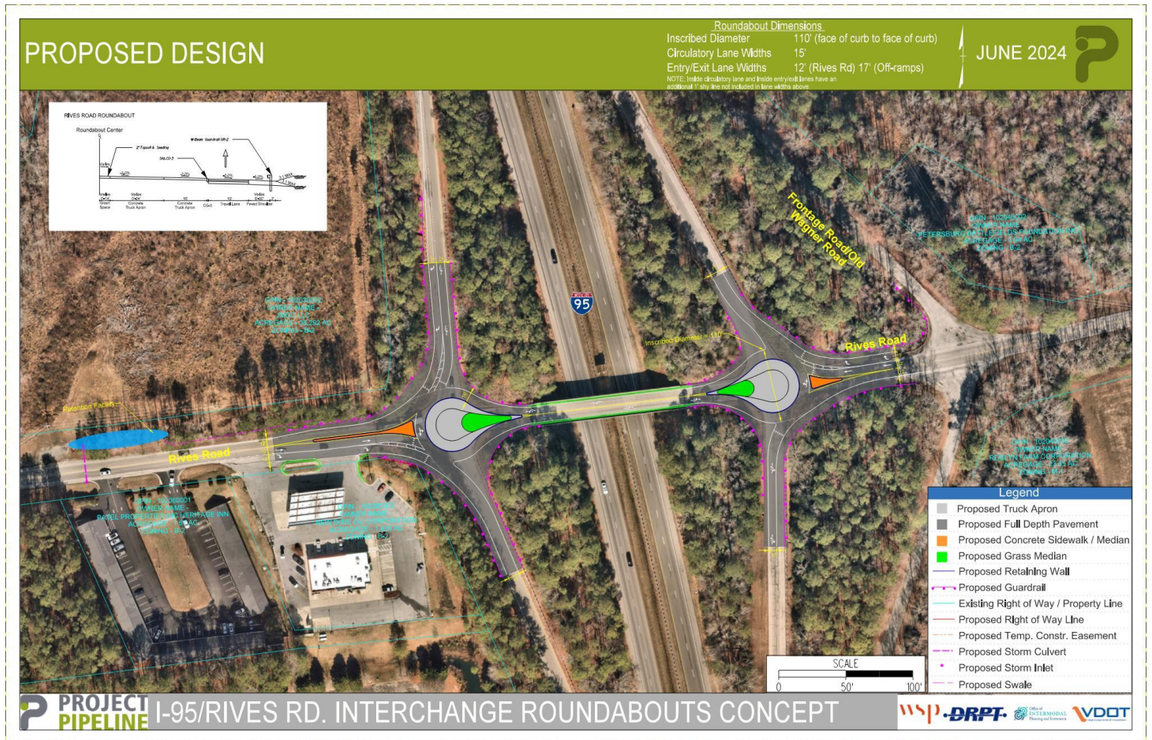


FIGURE 4.4. I-95/RIVES ROAD INTERCHANGE OPTION 3 DOUBLE TEARDROP ROUNDABOUT



4.7. Phase 3 Refined Synchro Operations Analysis

Because there were no further refinements to the preferred alternatives from Phase 2, no further Synchro analysis was performed. However, an Operational and Safety Analysis Report (OSAR) was completed for the I-95 and Rives Road interchange and SimTraffic and SIDRA analysis was performed on the preferred alternatives at this location. The results of the SimTraffic and SIDRA analysis at this interchange can be found in the *I-95 and Rives Road Operational and Safety Analysis Report (OSAR) (WSP, Ongoing)* report which is included in the Appendix.

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:
Existing Turning Movement Counts

Appendix B: *Synchro* Reports

Appendix C:
FHWA STEAP Results

Appendix D: Travel Demand Model Results

Appendix E:
Public Survey Results

Appendix F: Environmental Input

Appendix G: I-95 and Rives Road Operational and Safety Analysis Report (OSAR)