



# PROJECT PIPELINE

**US 460/US 13 (S Military Highway) and  
US 17 (George Washington Highway)**

**HR-23-07  
Final Report**





# Project Pipeline – Hampton Roads

## HR-23-07 US 460/US 13 (S Military Highway) at US 17 (George Washington Highway) | July 2024



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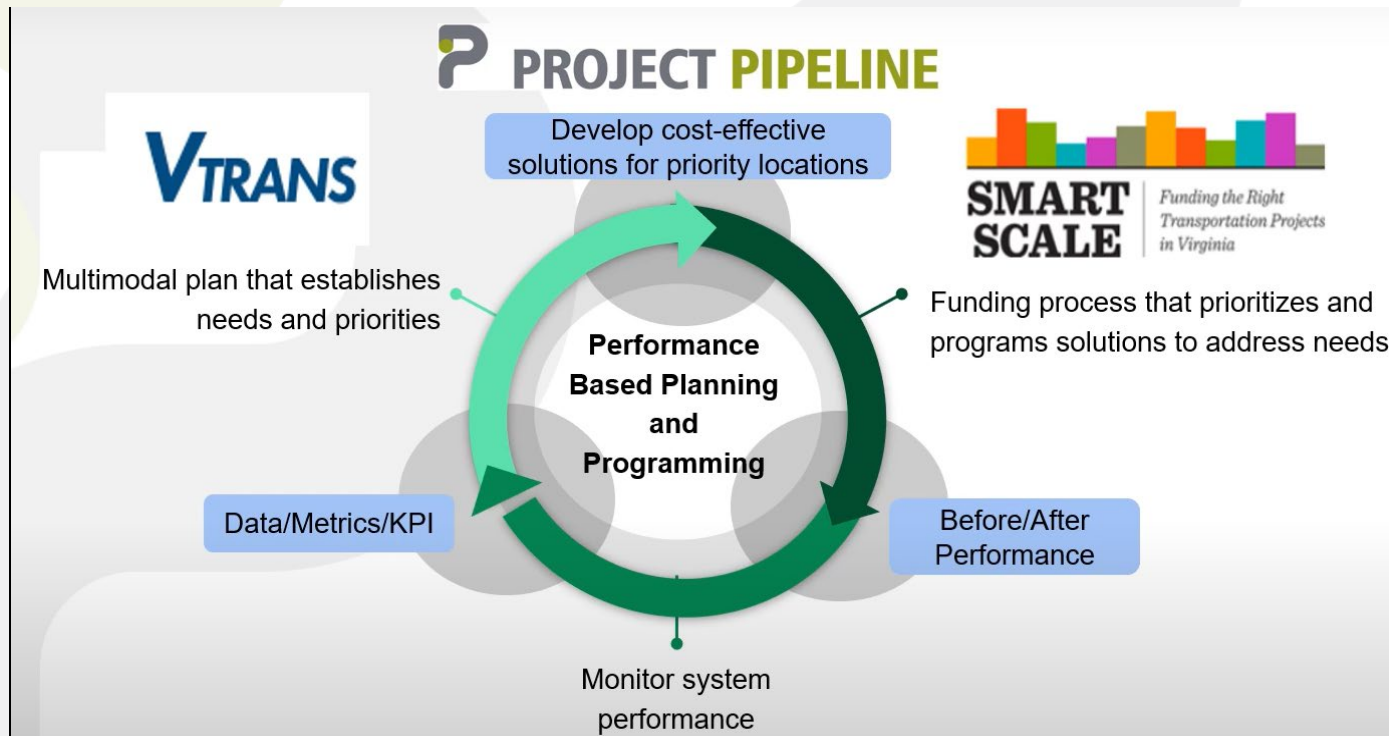
# 1 Needs Evaluation & Diagnosis

## 1.1 Introduction

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

This study is entitled HR-23-07 - US 460/US 13 (S Military Highway) at US 17 (George Washington Highway) and will be referred to as the Study in this report. This study focuses on concepts targeting identified needs including congestion mitigation, safety and reliability improvements, pedestrian and bicycle infrastructure along the corridor, and transit and transportation demand management (TDM) access. The objectives of Project Pipeline are shown in Figure 1.

Figure 1: Project Pipeline Objectives

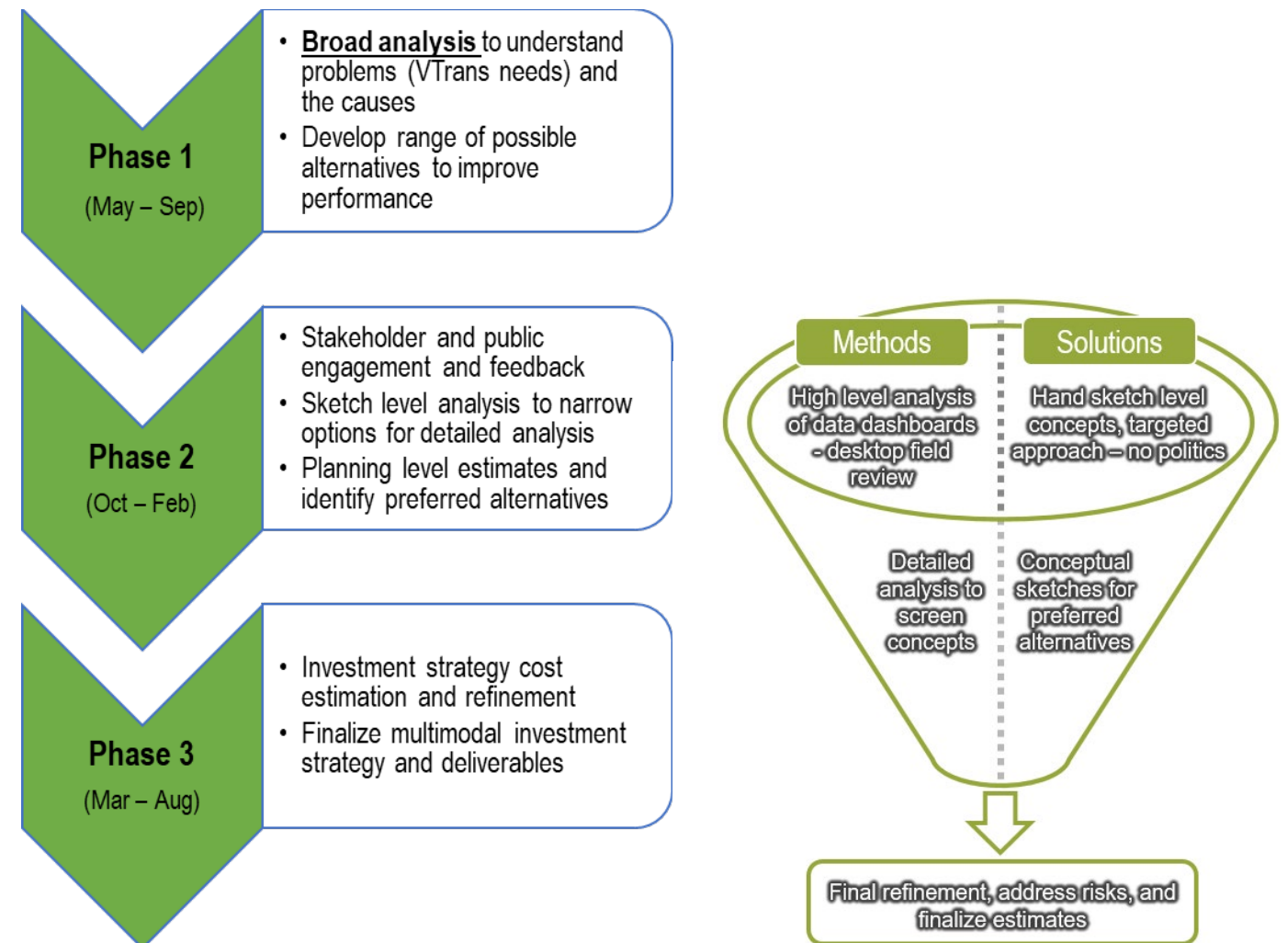


## 1.2 Methodology

The Project Pipeline study process consists of three phases, further detailed in Figure 2:

- **Phase 1:** Problem Diagnosis and Alternative Brainstorming
- **Phase 2:** Alternative Evaluation and Sketch-Level Analysis
- **Phase 3:** Investment Strategy and Cost Estimate

Figure 2: Study Phase Methods and Solutions



## 1.3 Study Background

A study work group (SWG) was formed for this Study to capture input from local stakeholders and shape the development of potential improvements. The SWG provided local and institutional knowledge of the corridor, reviewed study methodologies, provided input on key assumptions, and reviewed and approved proposed improvements developed through the study process. The SWG included members representing the following organizations:

- Virginia Department of Transportation (VDOT)
- Office of Intermodal Planning and Investment (OIPI)
- City of Chesapeake
- Hampton Roads Transportation Planning Organization (HRTPO)
- Department of Rail and Public Transportation (DRPT)
- Kimley-Horn

The study area along S Military Highway extends from an industrial driveway to the west and Baugher Avenue to the east. The study area along George Washington Highway extends from Yadkin Road to the south and Townhouse Lane to the north. S Military Highway is a four-lane divided roadway classified as an “Other Principal Arterial,” with a 50-mph posted speed limit within the study area. George Washington Highway is classified as an “Other Principal Arterial.” It is a two-lane undivided roadway north of S Military Highway, with a 35-mph posted speed limit, and a four-lane divided highway south of S Military Highway, with a 45-mph posted speed limit.

The study area is in northwestern City of Chesapeake between I-64 and the Gilmerton Bridge. The roadway network serves as an alternate route for commuter and regional travel on the Hampton Roads Beltway, especially during incidents. Commercial and industrial developments border the study area, with residential development to the north and southeast of the study area. Hampton Roads Transit (HRT) Routes 41 and 57 operate north of the study area.

The study area includes nine at-grade intersections, two signalized intersections and seven unsignalized intersections. The following nine intersections are shown in **Figure 3**.

1. S Military Highway at George Washington Highway (signalized)
2. S Military Highway at Strickland Brothers Driveway (unsignalized)
3. S Military Highway at Yadkin Road/Deep Creek Boulevard (Frontage Road) (unsignalized)
4. S Military Highway at Butler Street (unsignalized)
5. S Military Highway at Deep Creek Plaza (unsignalized)
6. S Military Highway at Baugher Ave (unsignalized)
7. George Washington Highway at Deep Creek Boulevard (Frontage Road) (unsignalized)

8. George Washington Highway at Yadkin Road/Old George Washington Highway (signalized)
9. Deep Creek Boulevard at Deep Creek Boulevard (Frontage Road) (unsignalized)

The study team collected data including traffic counts, traffic signal timings, and pedestrian and bicycle counts to assist with the transportation analysis in the study area.

A framework document was developed prior to commencing the study which outlined the study methods and assumptions. The signed framework document is in **Appendix A**. A kickoff meeting with the SWG was held on June 6, 2023. The kickoff meeting materials are in **Appendix A**.

Figure 3: Project Study Area



## 1.4 VTrans Needs

Project Pipeline follows a performance-based planning approach to identify solutions that address VTrans Mid-Term needs. VTrans Mid-Term needs were identified from a data-informed process and were used as a primary source Project Pipeline study corridors selection. **Table 1** outlines the VTrans needs at the S Military Highway and George Washington Highway study area.

**Table 1: VTrans Needs Identified in the Study Area**

VTrans 2019 Mid-Term Need	Priority
Bicycle Access	High
Capacity Preservation	None
Congestion Mitigation	Medium
IEDA (UDA) Access	None
Pedestrian Access	None
Safety Improvement	Very High
Pedestrian Safety Improvement	Low
Reliability	Low
Rail On-Time Performance	None
Transit Access	High
Transit Access for Equity Emphasis Areas	High
Transportation Demand Management	Very High

The S Military Highway and George Washington Highway intersection was selected as a Project Pipeline study location due to the presence of overlapping VTrans needs. The project team took the following steps to confirm and evaluate the VTrans needs identified in the study area.

- Reviewed the Project Pipeline data dashboard to identify issues and transportation trends in the study area
- Conducted a field review of the study area to observe issues and document existing conditions
- Collected traffic counts at the study area intersections
- Reviewed relevant studies and plans near the study area to inform the alternative development
- Conducted detailed existing conditions and no-build conditions traffic operation analyses using Synchro and SimTraffic
- Assessed existing transit service, multimodal infrastructure, and the suitability for additional transit service within the study area

## 1.5 High-Level Needs Diagnosis

The data dashboard was developed by OIPI and VDOT to centralize data collection and leverage big data sources to streamline VTrans needs and problem diagnosis across all Project Pipeline studies as well as identifying the core issues and patterns identified in the framework document.

The data dashboard contains performance measures including VDOT crash data, travel time index data, level of travel time reliability (LOTTR) data, speed data, and StreetLight data for each study area. The results of this analysis are summarized in the Phase 1 Executive Summary in **Appendix B**.

The study team reviewed the dashboard performance measures in addition to other sources to validate the presence of VTrans needs and identify the most effective improvements within the study area.

### 1.5.1 Operations and Access Needs

The study area has a medium Congestion Mitigation VTrans need, which is based on the Travel Time Index (TTI) and the proportion of travel taking place during excessively congested conditions.

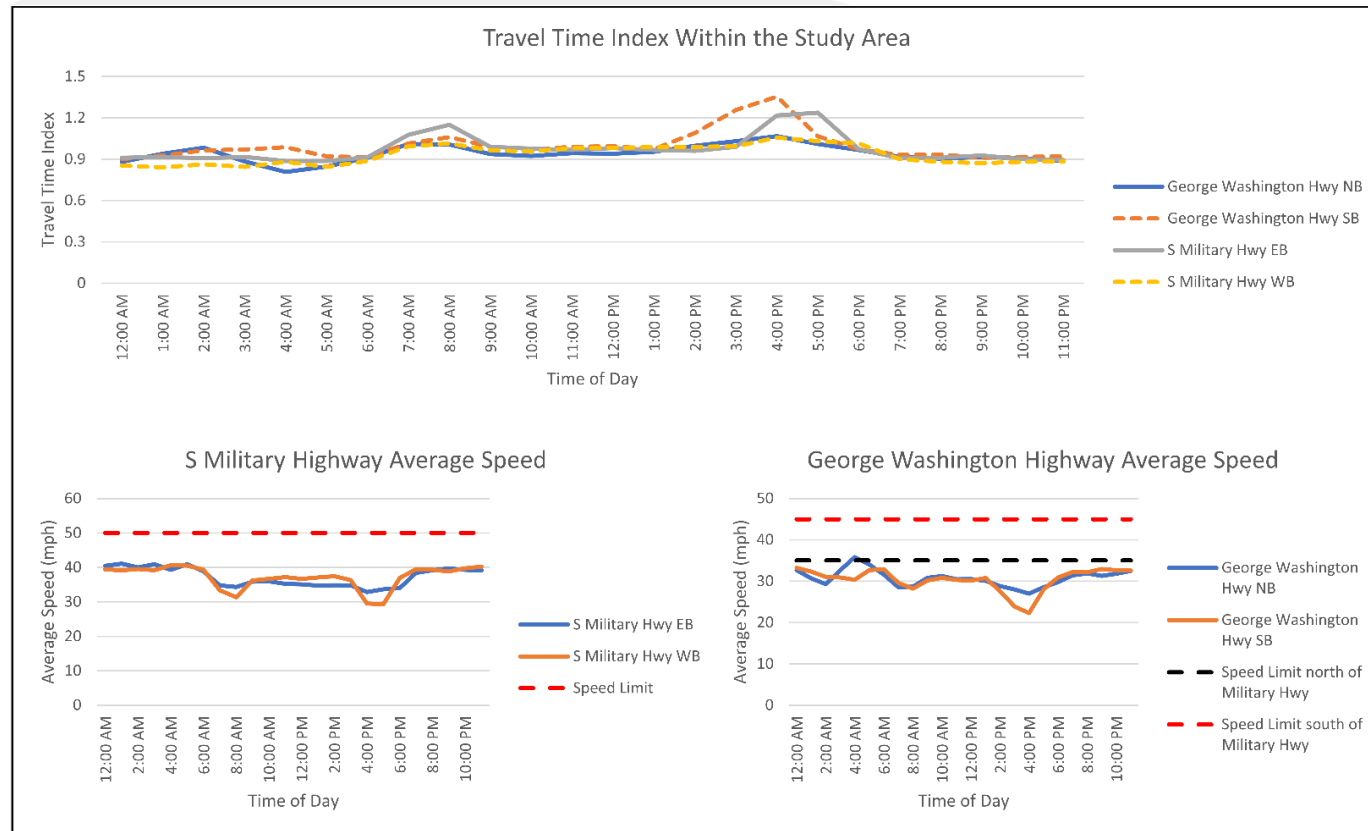
The greatest impact to TTI occurs on southbound George Washington Highway and eastbound S Military Highway during the PM peak hour. Speed data showed that S Military Highway operates 20 mph below the speed limit and George Washington Highway operates more than 20 mph below the speed limit during the PM peak period. **Figure 4** includes additional details from the operations needs diagnosis.

Typical Traffic data from Google Maps showed congestion occurring along S Military Highway during the weekday AM peak period and along S Military Highway and George Washington Highway during the weekday PM peak period. During the AM peak period, congestion begins to form on westbound S Military Highway at George Washington Highway and extends past Baugher Avenue. In the eastbound direction, congestion forms at George Washington Highway and extends approximately a half mile.

In the PM peak period, congestion begins to form on southbound George Washington Highway at S Military Highway and extends to Woodland Terrace Drive. In the southbound direction, congestion forms on George Washington Highway at the intersection of S Military Highway and extends past Yadkin Road/Old George Washington Highway. Congestion along westbound S Military Highway is like the AM peak period, while eastbound congestion extends past the Strickland Brothers Driveway.



Figure 4: High-Level Operations Needs Summary



The study team used StreetLight data to better understand travel patterns throughout the study corridor. StreetLight is a transportation data analytics platform that leverages anonymized location-based data to provide on-demand insights into travel patterns for various travel modes. The data revealed that most drivers use Canal Drive to bypass the intersection of S Military Highway and George Washington Highway during the AM and PM peak periods, as summarized in **Table 2**.

These high-level analyses informed the study team of the most significant congestion hot spots in the study area and the impact of closely spaced intersections on traffic operations.

The study area also has a high Bicycle Access VTrans need due to its proximity to activity areas including residential and businesses along S Military Highway and George Washington Highway. The study area offers opportunity for connectivity across George Washington Highway on S Military Highway with enhanced pedestrian and bicycle accommodations. Bicycle and pedestrian infrastructure is further supported in the City of Chesapeake 2035 Comprehensive Plan.

Table 2: StreetLight Analysis

Origin	Destination	AM Peak Period via Canal Rd	AM Peak Period via George Washington Hwy and S Military Hwy	PM Peak Period via Canal Rd	PM Peak Period via George Washington Hwy and S Military Hwy
Southbound George Washington Hwy	Eastbound S Military Hwy	98.87%	1.13%	98.23%	1.77%
Westbound S Military Hwy	Northbound George Washington Hwy	99.36%	0.64%	99.05%	0.95%

### 1.5.2 Safety and Reliability Needs

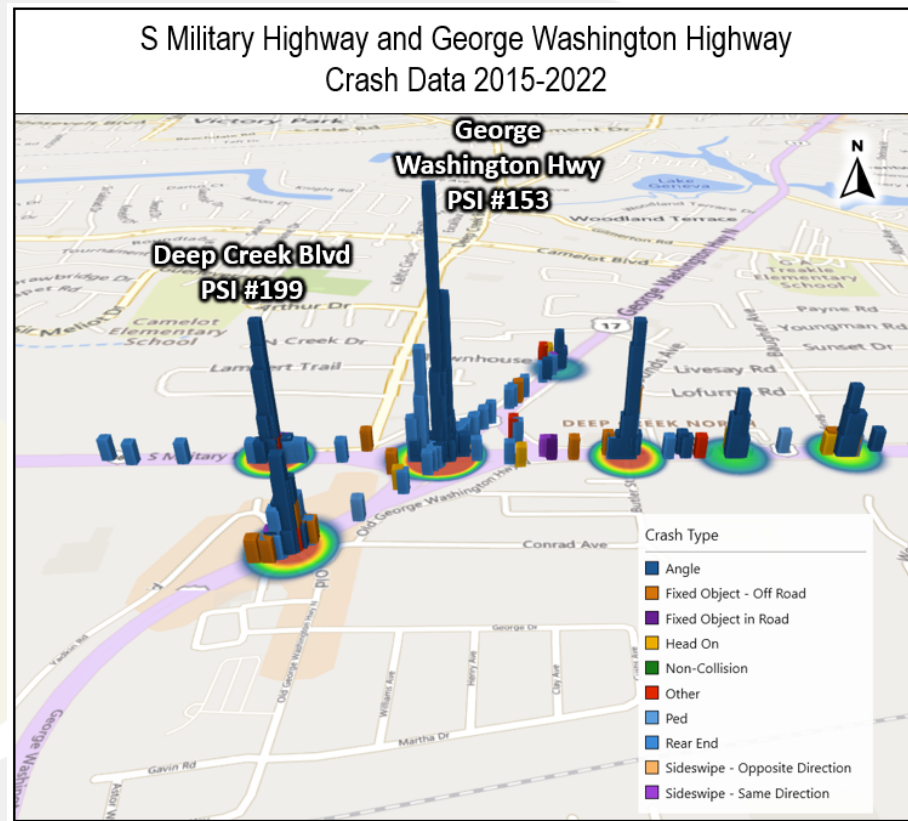
The study area has Very High Statewide Safety Improvement and Low Pedestrian Safety Improvement VTrans needs. The study team reviewed the VDOT crash data from 2015-2022 to identify high-level crash trends in the study corridor.

In total, 270 crashes were reported in the study area including two fatalities, 157 injury crashes, and 111 crashes involving property damage only (PDO). Most crashes in the study area were either angle (56%) or rear-end (25%) crashes. **Figure 5** shows additional details regarding crashes in the study area.

S Military Highway and George Washington Highway are VDOT Pedestrian Safety Action Plan (PSAP) priority corridors and are in the statewide top 5% of corridors. The S Military Highway Corridor Study, whose recommendations are included in the City of Chesapeake 2035 Comprehensive Plan, recommended separate bike facilities be included along S Military Highway from the I-664/Bower's Hill Interchange in the west to the Bainbridge Boulevard interchange in the east as well as a Class 1 multi-purpose path along the core area.

The study area has a Low Reliability VTrans need, which is measured by variability in travel time along a corridor and impacted by factors such as incidents, weather, construction, and changes in demand.

Figure 5: High-Level Safety Needs Summary (2015-2022)



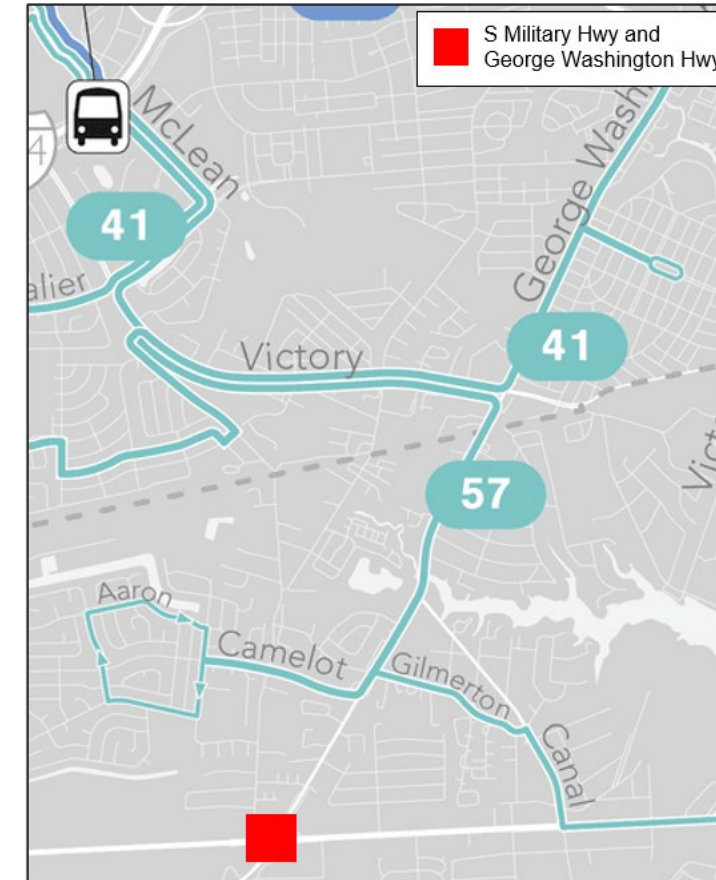
### 1.5.3 Transit and Transportation Demand Management Needs

The study area has a High Transit Access VTrans need and a High Transit Access for Equity Emphasis Areas VTrans need. The study team reviewed existing Hampton Roads Transit (HRT) bus and Traffic (HRT Transportation Demand Management) services in the study area. There is a lack of transit access south of the existing HRT Routes 41 and 57, as shown in Figure 6.

During a meeting on July 5, 2023, HRT staff confirmed that they are not planning on extending service south towards S Military Highway and George Washington Highway. TDM options within or near the study area include commuter and rideshare services through Traffic, and standard Transportation Network Companies (TNC) availability (e.g., Uber, Lyft). The nearest Park-and-Ride is the Portsmouth Park & Ride, located ten miles north of the study area.

The study area also has a Very High Transportation Demand Management (TDM) VTrans need. This VTrans need informed the development of potential TDM improvements.

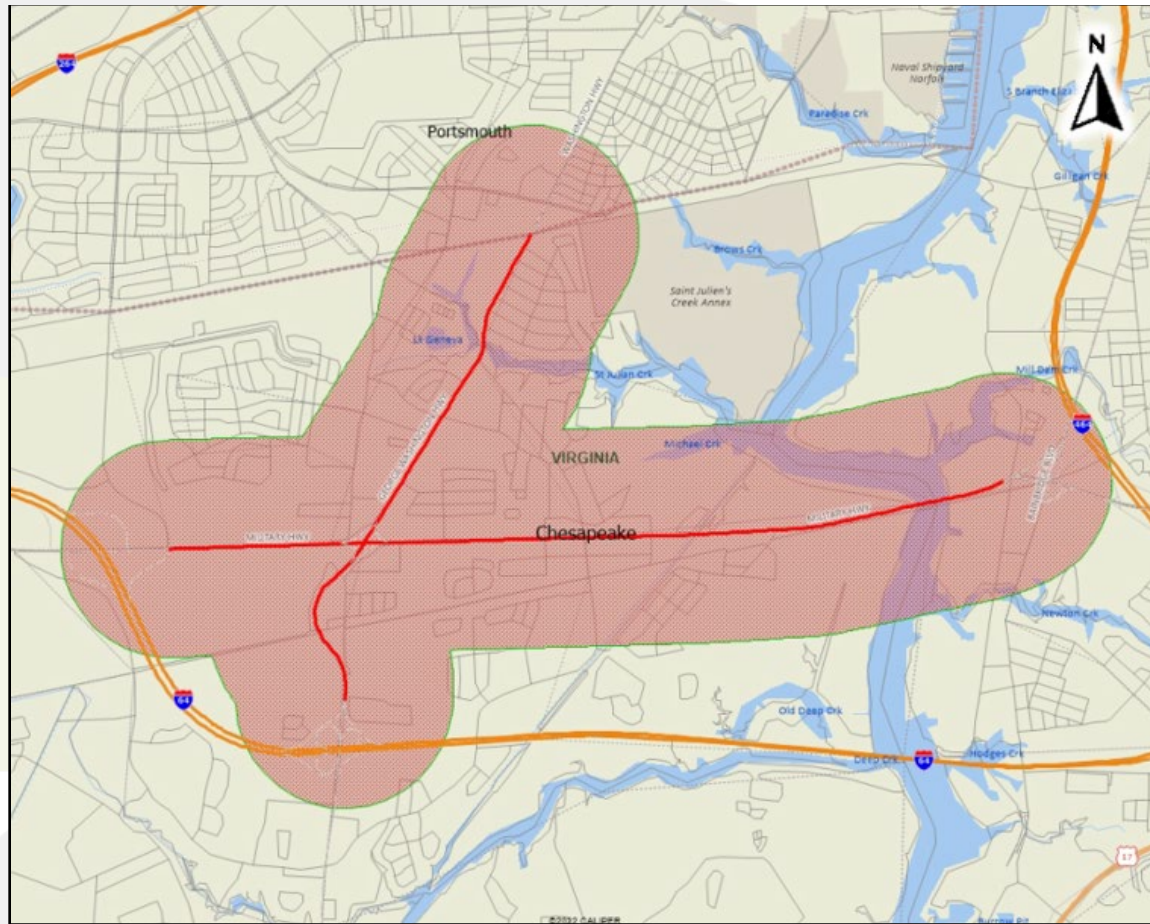
Figure 6: High-Level Transit Access Needs Diagnosis Summary



### 1.5.4 Environmental Justice

The Screening Tool for Equity Analysis of Projects (STEAP) tool is a web application that permits rapid screening of potential project locations anywhere in the United States to support the analyses of Title VI, environmental justice, and other socioeconomic data. It provides estimates of socioeconomic characteristics of the resident population surrounding a project location, based on the latest American Community Survey (2016-2020) and on the 2020 Decennial Census Redistricting data. An equity analysis project profile report for the study area was generated by selecting the study area corridors and applying a half-mile buffer. The study area is shown in Figure 7.

Figure 7: STEAP Analysis Study Area



The results show that 42% of the population within the study area is black, compared to 19% within the state of Virginia. Fifty-two percent of the study area population is minority, listing their racial status as a race other than white alone. Nine percent of the study area is reported to have Limited English Proficiency and 14% of the study area is considered low-income and considered in poverty. Additionally, 6% of households own zero vehicles and 13% of households report no internet connection. Based on this data, there are low-income and minority populations present that should be considered as environmental justice populations and should be considered when developing and screening transportation improvement concepts.

## 1.6 Detailed Needs Validation

The study team performed additional traffic operations and safety analyses to further quantify the existing and anticipated needs within the study area. Results from these analyses were used as a baseline when comparing the conditions of proposed improvements to the existing and anticipated no-build conditions.

### 1.6.1 Existing Conditions Traffic Operations and Safety Analysis

The study team conducted a multifaceted analysis of the existing conditions of the study corridor, which included reviewing previous studies, conducting a safety analysis, conducting a preliminary field review, analyzing traffic operations using Synchro and SimTraffic, and reviewing of pedestrian, bicycle, and transit activity. Preliminary Synchro results of the existing conditions analysis and preliminary brainstorming concepts were presented to the Study Work Group during a Technical Team Workshop on July 28, 2023. The presentation is provided for reference in **Appendix C**.

### Relevant Studies, Plans, and Projects

Information for the following studies, plans, and projects was collected and reviewed to identify previous or ongoing recommendations in and adjacent to the study area:

- Route 460 and Route 17 Intersection Improvement Memo (Michael Baker)
  - Traffic memo used for FY2024 SMART SCALE Application 9281: 17/460 Intersection Improvement Project
  - Recommended improvement was a partial displaced left-turn
  - Application was not funded
- US 17 Widening
  - Widening US 17 to a four-lane divided roadway from Yadkin Road to Canal Drive
  - Enhance three signalized intersections
  - Includes new pedestrian facilities and a stormwater drainage system
  - Projected design completion expected Spring 2028
- I-64 Southside Widening and High Rise Bridge
  - Add one lane in each direction, replace drawbridge with a high-level, fixed span bridge
  - Project completion expected Summer 2023

## Safety Analysis

A safety analysis was conducted using crash data from the VDOT Crash Database over an eight-year period (January 1, 2015 – December 31, 2022). In total, 270 crashes were reported in the study area, including two fatalities. Summaries of crashes in the study area by severity and type are shown in **Table 3** and **Table 4**, respectively. **Appendix C** includes a detailed crash summary for the study area.

Crash severity is coded using the KABCO scale, which is defined using the following classifications:

- K – Fatality
- A – Suspected Serious Injury
- B – Suspected Minor Injury
- C – Possible Injury
- PDO – Property Damage Only

The study team identified left turns at the intersection of S Military Highway and George Washington Highway as a crash hot spot with 51 crashes involving a left-turning vehicle. Over 50% of those crashes were in the westbound direction and around 25% occurred during 2020. The left turn signal heads at the intersection were upgraded from doghouse signals to a flashing yellow arrow signals in late 2022.

The intersection of George Washington Highway and Yadkin Road/Old George Washington Highway had 36 total crashes between 2015 and 2022. Three crashes were due to right turn on red movements, five were caused by red light running, and nine occurred due to a failure to yield right of way during permitted green phases on the northbound and southbound approaches. The intersection has since been modified with flashing yellow arrow signal heads.

Table 3: Study Area Crashes by Crash Severity

Intersection	# of Crashes – K	# of Crashes – A	# of Crashes – B	# of Crashes – C	# of Crashes – PDO	Total
S Military Highway and George Washington Highway	0	11	37	6	35	89
S Military Highway and Strickland Brothers Driveway	0	0	0	0	1	1
S Military Highway and Deep Creek Boulevard (Frontage Road)/Yadkin Road	1	2	16	3	12	34
S Military Highway and Butler Street	0	2	13	1	19	35
S Military Highway and Deep Creek Plaza Driveway	0	3	5	0	8	16
S Military Highway and Baugher Avenue	0	0	18	0	5	23
George Washington Highway and Deep Creek Boulevard (Frontage Road)	0	0	3	0	2	5
George Washington Highway and Yadkin Road/Old George Washington Highway	0	2	19	1	14	36
Deep Creek Boulevard and Deep Creek Boulevard (Frontage Road)	0	0	1	0	0	1
Rest of Corridor	1	1	12	1	15	30
<b>Total</b>	<b>2 (1%)</b>	<b>21 (8%)</b>	<b>124 (46%)</b>	<b>12 (4%)</b>	<b>111 (41%)</b>	<b>270</b>

**Table 4: Study Area Crash by Crash Type**

Intersection	# of Crashes - Angle	# of Crashes - Rear End	# of Crashes - Head-On	# of Crashes - Fixed Object	# of Crashes - Side-swipe	# of Crashes - Pedestrian	# of Crashes - Bicycle	# of Crashes - Other	# of Crashes - Total
S Military Highway and George Washington Highway	45	34	6	1	1	0	0	2	89
S Military Highway and Strickland Brothers Driveway	0	1	0	0	0	0	0	0	1
S Military Highway and Deep Creek Boulevard (Frontage Road)/Yadkin Road	27	4	0	0	1	0	1	2)	34
S Military Highway and Butler Street	25)	4	1	2	1)	1	0	0	35
S Military Highway and Deep Creek Plaza Driveway	10	1	2	0	1	1	0	1	16
S Military Highway and Baugher Avenue	18	0	2	1	0	1	0	1	23
George Washington Highway and Deep Creek Boulevard (Frontage Road)	2	2	0	0	1	0	0	0	5
George Washington Highway and Yadkin Road/Old George Washington Highway	17	8	2	2	2	1	0	4	36
Deep Creek Boulevard and Deep Creek Boulevard (Frontage Road)	0	0	0	1	0	0	0	0	1
Rest of Corridor	6	13	3	5	1	1	0	1	30
<b>Total</b>	<b>150 (56%)</b>	<b>67 (25%)</b>	<b>16 (6%)</b>	<b>12 (4%)</b>	<b>8 (3%)</b>	<b>5 (2%)</b>	<b>1 (0%)</b>	<b>11 (4%)</b>	<b>270</b>

A total of five pedestrian crashes and two bicycle crashes occurred in the study area which included one pedestrian fatality and one bicycle fatality. Of the seven total pedestrian and bicycle crashes, five involved the pedestrian or cyclist attempting to cross the street. A summary of the pedestrian and bicycle crashes is shown in **Figure 8**.

**Figure 8: 2015 – 2022 Pedestrian and Bicycle Crash Map**



All intersection and roadway segments within the VDOT linear referencing system (LRS) are evaluated annually for the potential for safety improvement (PSI) based on the Highway Safety Manual (HSM) methodology by VDOT. The crash frequency, severity of crashes, volume, and length of segment are contributing factors in the predicative analysis. Crash predictions, based on the safety performance function (SPF) crash data files, are made for intersection and segments. The top 100 intersections and 100 miles of segments are published by VDOT for each district on an annual basis. VDOT also identifies Targeted Safety Need (TSN) locations, which are intersections or segments that have been identified as PSI locations for three or more of the last five years.

S Military Highway at Deep Creek Boulevard and S Military Highway at George Washington Highway were identified as 2020 PSI intersections with rankings of 199 and 153 within the Hampton Roads District, respectively.

## Field Review Observations

A preliminary field review of the study area was conducted on Wednesday, June 7, 2023, to verify existing conditions, confirm traffic control devices and lane configurations, and observe peak hour traffic conditions and driver behavior. The existing lane configurations and speed limits in the study area are summarized in **Figure 9** and **Figure 10**.

The following observations were made at the intersection of S Military Highway and George Washington Highway during the field review:

### Eastbound S Military Highway

- Queues extended back to Green Clean Express Auto Wash (AM and PM peak periods)
- Queues mostly stack in left-most through lane (AM peak period)
- Protected left turn phase would allow between two to five vehicles through before switching to FYA. Left turn queue was often 10+ vehicles, with a maximum observed queue of 25 vehicles (PM peak period).
- Left-turning vehicles would sit in the middle of the intersection during the FYA phase (AM and PM peak periods)
- High number of heavy vehicles (AM peak period)

### Westbound S Military Highway

- Frequent foot traffic on Service Road (AM peak period)
- Queues extended back to Comfort Inn (PM peak period)
- Queues mostly stack in inner-most through lane (PM peak period)
- Left-turning vehicles would sit in the middle of the intersection during the FYA phase (AM and PM peak periods)

### Northbound George Washington Highway

- Queues extended back to Yadkin Road/Old George Washington Highway (AM and PM peak periods)
- Higher through volume during AM peak period and higher left-turn volume during PM peak period
- Vehicle ran a red light (PM peak period)
- Multiple school busses observed (AM and PM peak periods)

### Southbound George Washington Highway

- Queues consistently backed up to the channelized right turn lane (PM peak period)
- Rolling queue would occasionally extend back to Townhouse Lane (PM peak period)
- Large gaps between vehicles and long start-up times (PM peak period)
- Pedestrian observed walking southbound (PM peak period)

Additional observations in the study area include:

- Multiple pedestrians and cyclists were seen traveling along and crossing S Military Highway (AM and PM peak periods)
- S Military Highway and Yadkin Road saw a steady stream of vehicles entering and exiting due to the Wawa (AM and PM peak periods)
- Heavy turning movements at the intersection of George Washington Highway and Townhouse Lane (PM peak period)

Figure 9: 2023 Existing Lane Configurations and Speed Limits (1)

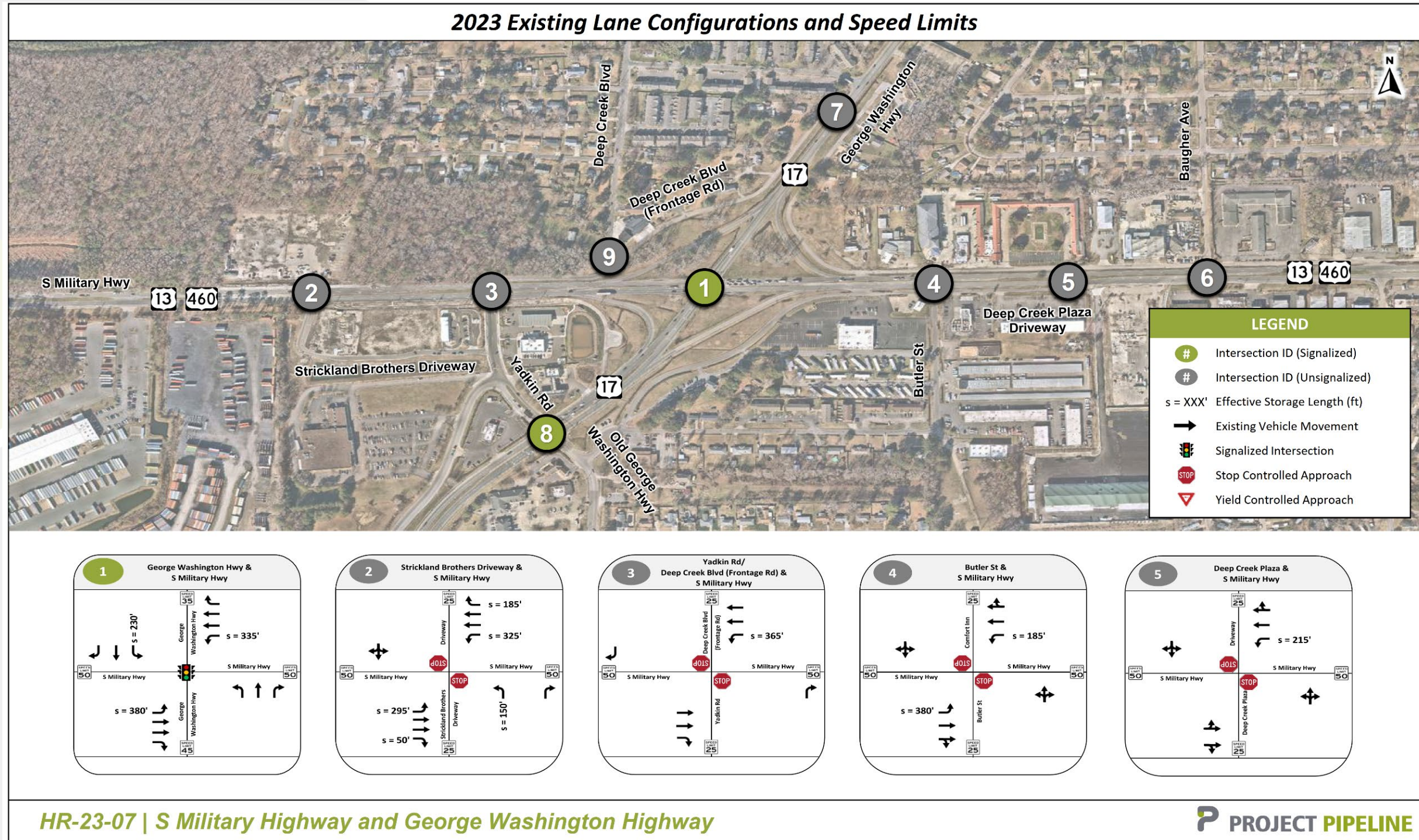
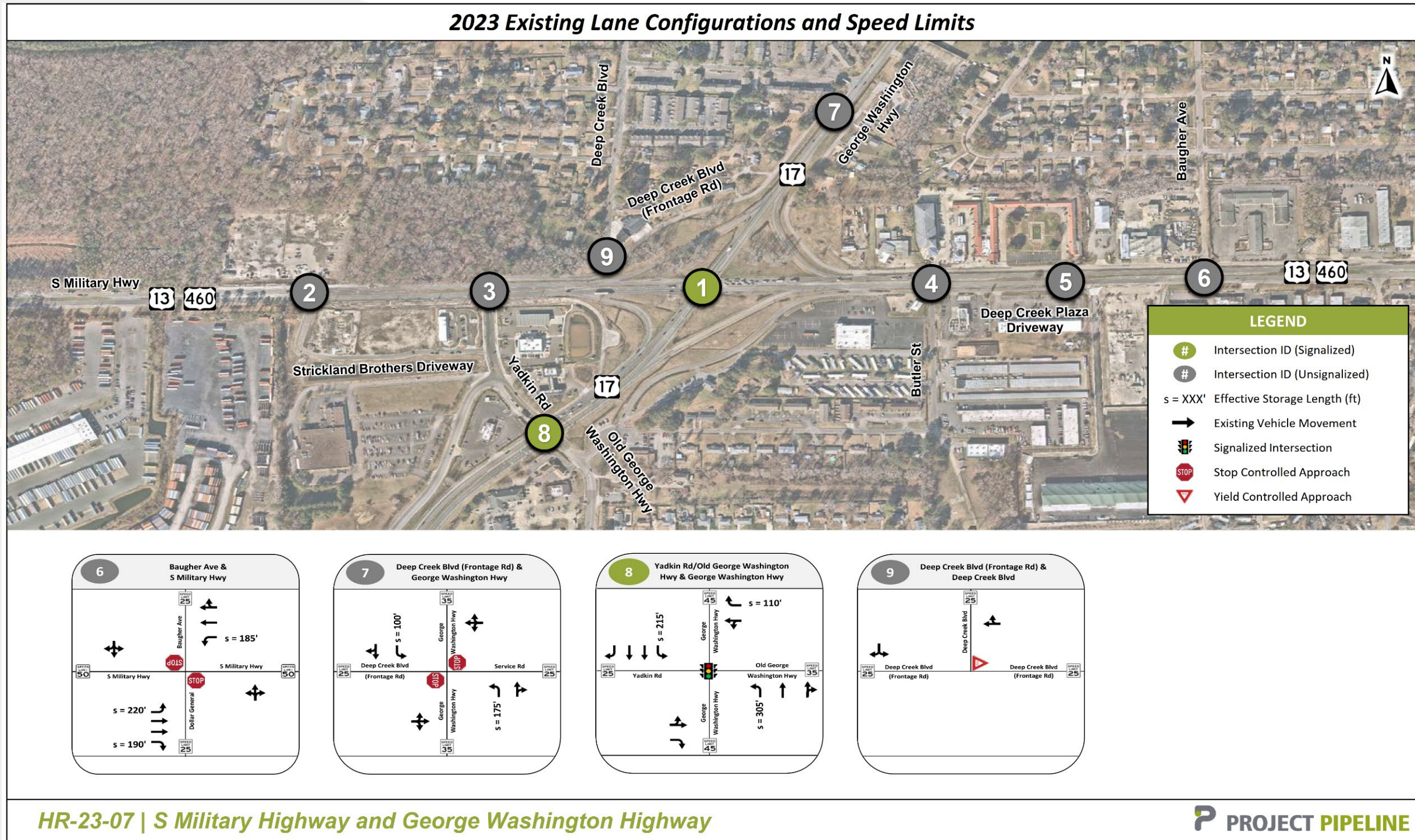


Figure 10: 2023 Existing Lane Configurations and Speed Limits (2)

**2023 Existing Lane Configurations and Speed Limits**





## Synchro and SimTraffic Analysis

A traffic operations analysis was conducted to evaluate the overall performance of the study corridor under existing (2023) AM and PM peak hour conditions. Existing conditions were modeled using Synchro 11 and SimTraffic 11.

The existing AM and PM Synchro models were developed based on the existing roadway geometry and collected traffic count data. Inputs and analysis methodologies were consistent with the VDOT *Traffic Operations and Safety Analysis Manual (TOSAM)*, Version 2.0. **Appendix C** includes the SimTraffic Calibration Memo detailing the refinements made to the Synchro and SimTraffic models to reflect observed conditions.

### Traffic Data

Fourteen-hour vehicular turning movement, pedestrian, and bicycle count data was collected at the nine study intersections on Tuesday, May 24, 2023; Wednesday, May 25, 2023; and Tuesday, May 30, 2023. The AM and PM peak hours were determined to be 7:15 AM – 8:15 AM and 4:00 – 5:00 PM. Raw traffic data can be found in **Appendix C**.

Due to traffic data being collected on different days, the study team balanced up when balancing traffic volumes. In some cases, volumes differed between intersections by more than 10%. The resulting balanced volumes were used as existing volumes that formed the basis of this study and are shown in **Figure 11** and **Figure 12**. Heavy vehicle percentages and peak hour factors are included in **Figure 13** and **Figure 14**.

### Level of Service (LOS) Criteria

The intersection Level of Service (LOS) is a qualitative measure that describes a driver’s perception of the operating conditions. LOS ratings range from A to F. LOS A indicates little or no congestion and LOS F indicates severe congestion, unstable traffic flow, and/or stop-and-go conditions.

**Table 5** summarizes the LOS corresponding to the delay at unsignalized and signalized intersections as specified in the HCM. The delay criteria for LOS differs slightly for unsignalized and signalized intersections due to driver expectations and behavior. For signalized intersections, LOS is calculated as the lost travel time caused by vehicles waiting at a traffic signal. For unsignalized intersections, LOS and corresponding delay is calculated by determining the number of gaps that are available in the conflicting traffic stream, since the LOS analysis assumes that the traffic on the mainline is not affected by the traffic on the side street.

Table 5: Level of Service Criteria

Level of Service	Control Delay (seconds/vehicle) - Signalized Intersection	Control Delay (seconds/vehicle) - Unsignalized Intersection
A	≤ 10.0	≤ 10.0
B	> 10.0 to 20.0	> 10.0 to 15.0
C	> 20.0 to 35.0	> 15.0 to 25.0
D	> 35.0 to 55.0	> 25.0 to 35.0
E	> 55.0 to 80.0	> 35.0 to 50.0
F	≥ 80.0	≥ 50.0

Figure 11: 2023 Existing Peak Hour Vehicle Volumes (1)

2023 Existing Peak Hour Vehicle Volumes

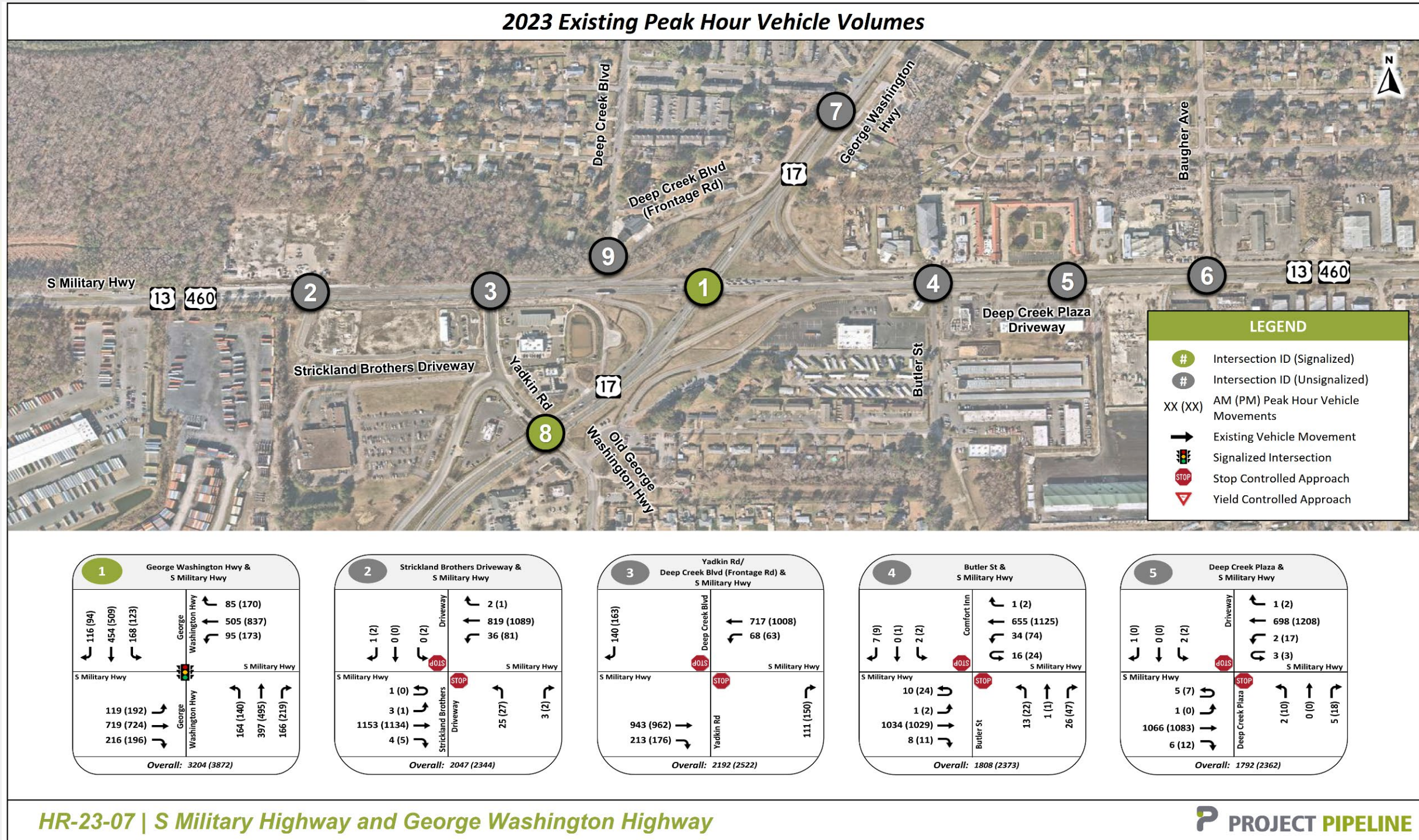
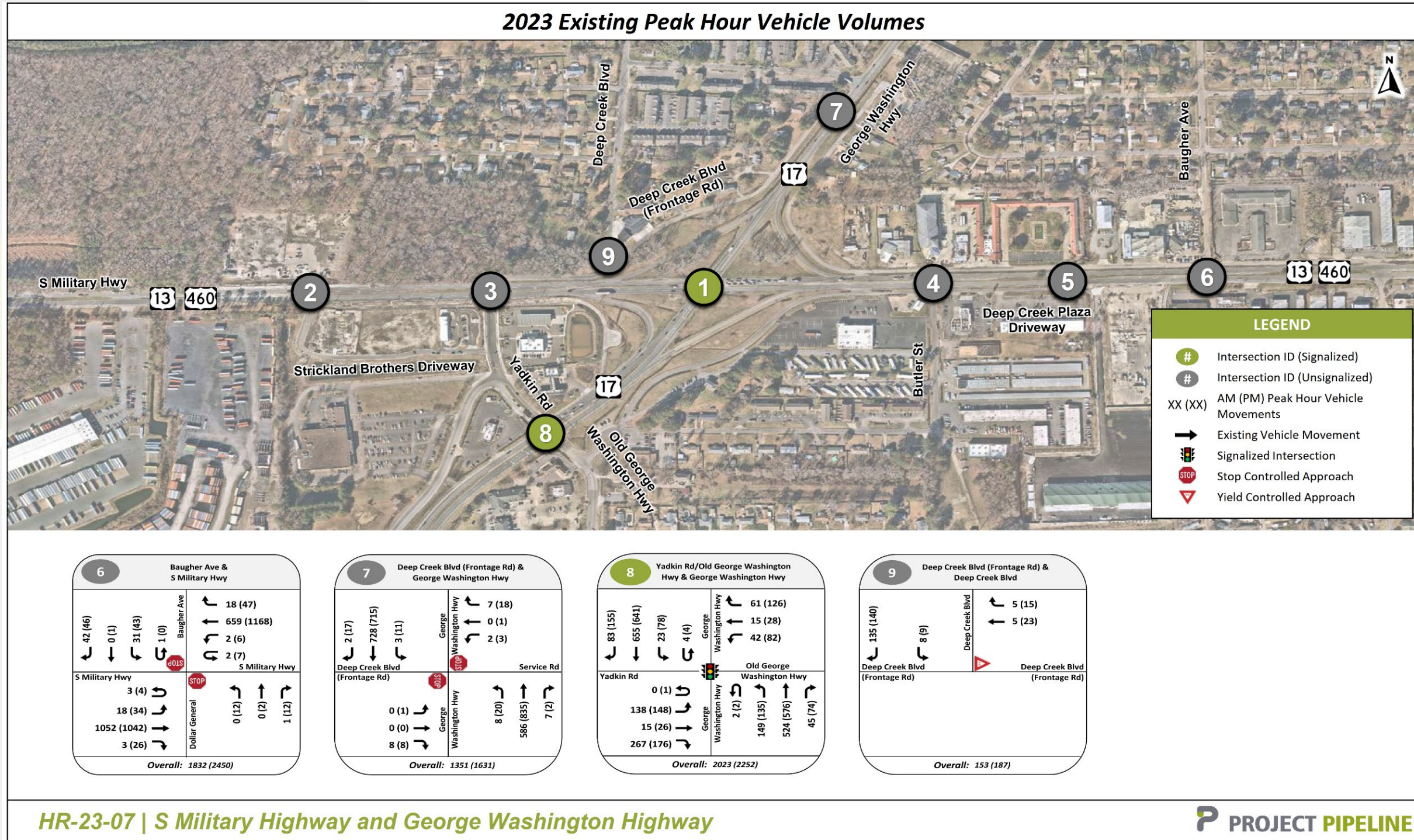


Figure 12: 2023 Existing Peak Hour Vehicle Volumes (2)

**2023 Existing Peak Hour Vehicle Volumes**



HR-23-07 | S Military Highway and George Washington Highway

Figure 13: 2023 Existing Heavy Vehicle Percentages and Peak Hour Factors (1)

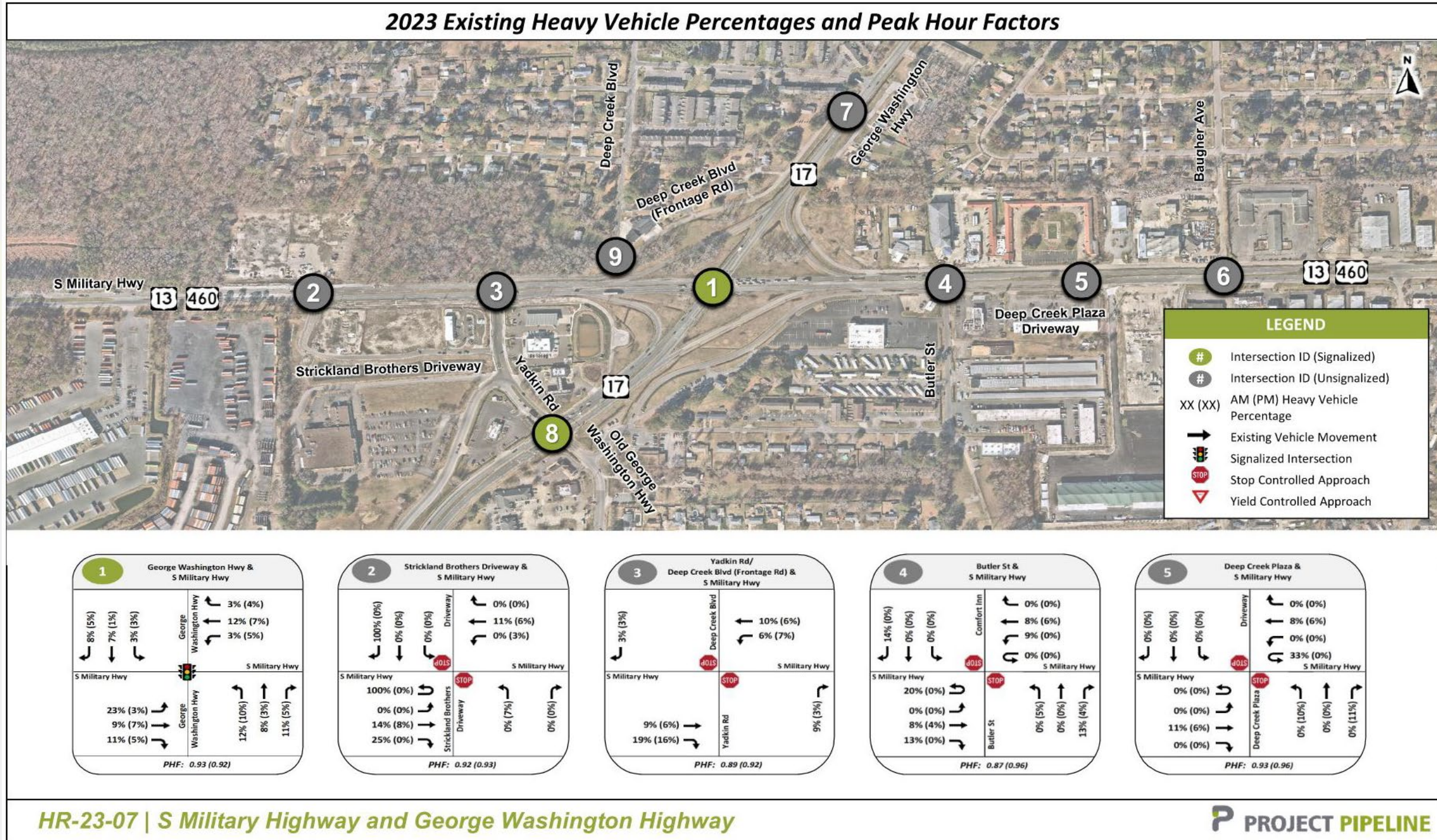
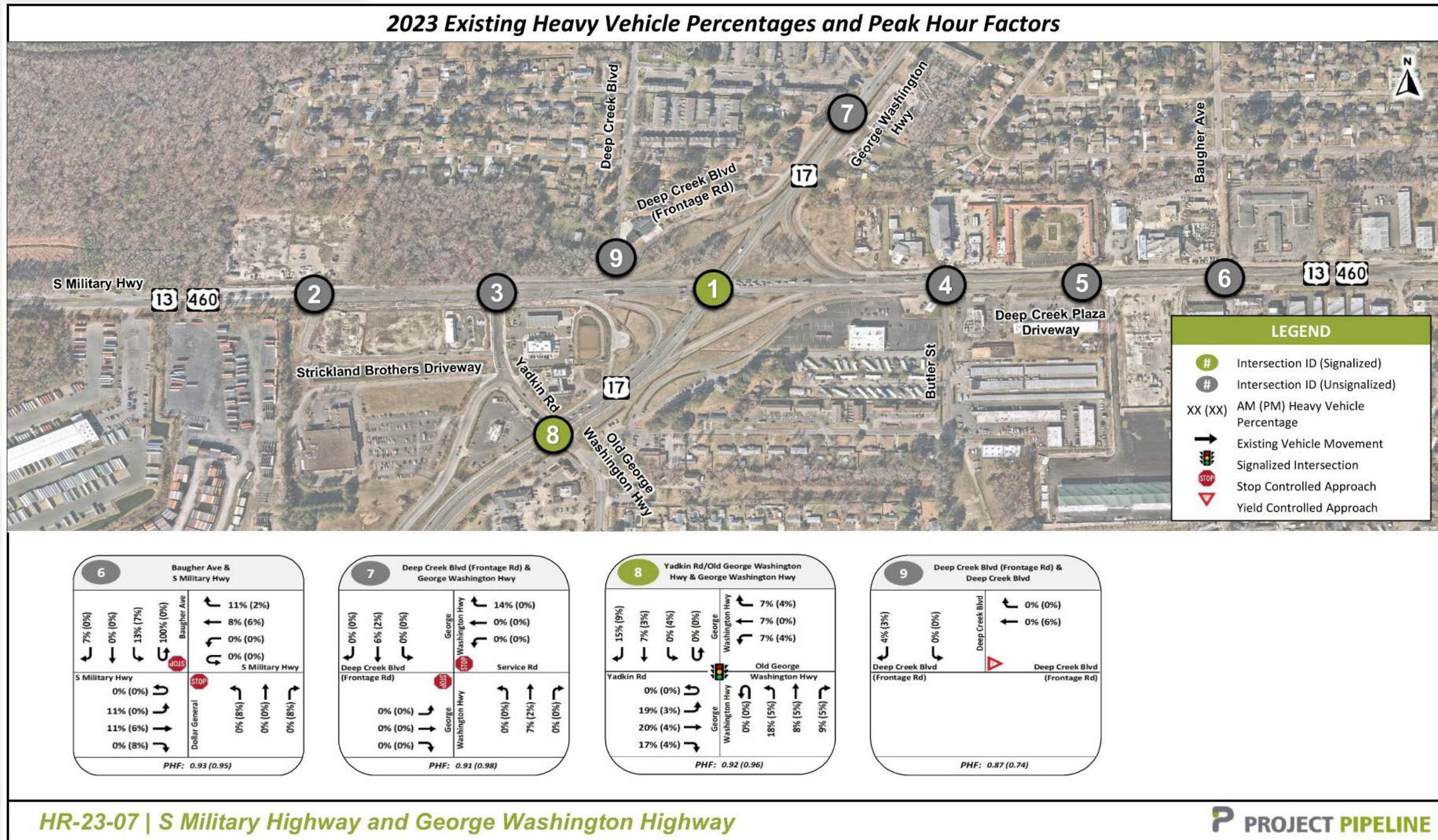


Figure 14: 2023 Existing Heavy Vehicle Percentages and Peak Hour Factors (2)



### Traffic Analysis Results

Control delay (seconds per vehicle), LOS, and maximum queue length (feet) were selected as measures of effectiveness to quantitatively report the performance of each study intersection. **Table 6** summarizes the preliminary Synchro reports used to determine control delay for each intersection.

Ten simulations were conducted for both the AM and PM models. The VDOT *Sample Size Determination Tool* was used to confirm the number of SimTraffic model runs necessary. The full Synchro and SimTraffic reports are included in **Appendix C**. Synchro results for the existing condition models are included in **Table 7** and **Table 8**. SimTraffic queuing results are shown in **Table 9** and **Table 10**.

**Table 6: Synchro Report for Control Delay**

Intersection Name	Synchro Report for Control Delay
S Military Highway and George Washington Highway	HCM 2000 Signalized
S Military Highway and Strickland Brothers Driveway	HCM 6th TWSC
S Military Highway and Deep Creek Boulevard (Frontage Road)/Yadkin Road	HCM 6th TWSC
S Military Highway and Butler Street	HCM 6th TWSC
S Military Highway and Deep Creek Plaza Driveway	HCM 6th TWSC
S Military Highway and Baugher Avenue	HCM 6th TWSC
George Washington Highway and Deep Creek Boulevard (Frontage Road)	HCM 6th TWSC
George Washington Highway and Yadkin Road/Old George Washington Highway	HCM 2000 Signalized
Deep Creek Boulevard and Deep Creek Boulevard (Frontage Road)	HCM 2000 Unsignalized

Under existing conditions, the intersection of S Military Highway and George Washington Highway operated at LOS D in the AM peak hour and LOS E in the PM peak hour. Multiple individual movements also operated at LOS E in the AM and PM peak hours with a max delay of 55.1 seconds per vehicle for the eastbound through movement in the AM peak hour and 74.7 seconds per vehicle for the westbound through movement in the PM peak hour.

The intersection of George Washington Highway and Yadkin Road/Old George Washington Highway operated at LOS C in the AM and PM peak hours. The westbound approach operated at LOS E in the AM peak hour with a max delay of 59.0 seconds per vehicle for the left-through movement. The eastbound approach operated at LOS D in the AM peak hour but experienced a max delay of 57.8 seconds per vehicle for the left-through movement. The eastbound and westbound approaches operated at LOS D in the PM peak hour with a max delay of 51.2 seconds per vehicle for the left-through movement.

The northbound approaches at the minor street intersections of the Strickland Brothers Driveway and Butler Street/Comfort Inn operated at LOS F during the AM peak hour due to heavy eastbound and westbound volume along S Military Highway. The minor streets along S Military Highway operated at LOS F during the PM peak hour, except for the Yadkin Road/Deep Creek Boulevard (Frontage Road) minor approaches, which operated at LOS C, due to heavy eastbound and westbound volume along S Military Highway.

The following trends were observed under existing conditions.

#### AM Peak Hour

- All approaches at the intersection of S Military Highway and George Washington Highway operated at LOS D
- The northbound approach at the intersection of Strickland Brothers Driveway and S Military Highway experienced the highest approach delay (128.3 seconds)
- The highest signalized approach delay occurred in the westbound direction at the intersection of Yadkin Road/Old George Washington Highway and George Washington Highway (55.3 seconds)
- The eastbound queue at the intersection of S Military Highway and George Washington Highway extended beyond the left turn storage bay and channelized right turn for over 30% of the analysis period
- The southbound queue at the intersection of S Military Highway and George Washington Highway extended beyond the left turn storage bay and channelized right turn for 15% of the analysis period
- The longest queue was the eastbound through movement at the intersection of S Military Highway and George Washington Highway at 710 feet

### PM Peak Hour

- All approaches at the intersection of S Military Highway and George Washington Highway operated at LOS E
- The highest signalized approach delay occurred on the westbound approach at the intersection of S Military Highway and George Washington Highway (63.5 seconds)
- The northbound approach at the intersection of Baugher Avenue and S Military Highway experienced the highest approach delay (128.3 seconds)
- The minor street approaches along S Military Highway all operated at LOS F except for the minor street approaches at Yadkin Road/Deep Creek Boulevard and S Military Highway, which operated at LOS C and the minor street approaches at S Military Highway and George Washington Highway which operated at LOS E
- At the intersection of S Military Highway and George Washington Highway, the eastbound, westbound, and southbound queues extended beyond the left turn bays and channelized right turns for 20%, 27%, and 32% of the analysis period, respectively
- The longest queue was the northbound through movement at the intersection of S Military Highway and George Washington Highway which extended back 750 feet

### 1.6.2 Phase 1 Public Outreach

The Phase 1 PublicInput survey was held from August 24, 2023 to September 11, 2023 to collect feedback on existing traffic, safety, transit, and bicycle and pedestrian issues within the study area. The online survey had a total of 267 participants and received 331 comments. Participants ranked reducing traffic congestion and corridor safety/intersection safety as the two most important issues in the study area. Speeding/aggressive driving and lack of sidewalks/missing sidewalks were identified as the greatest safety issues. Detailed results from the Phase 1 public outreach efforts can be found in **Appendix C**.

Common themes among written comments included the following:

- People run red lights due to insufficient green time for left turns
- Flashing yellow arrows cause people to sit in the middle of the intersection
- Consider closing service roads because they are confusing and cause safety issues
- Need additional left turn lanes
- Consider closing S Military Highway access from Deep Creek Boulevard
- Merging is difficult
- Flooding and drainage issues exist throughout the study area
- No infrastructure exists for cyclists and pedestrians to cross the street

Table 7: 2023 Existing Conditions Peak Hour Control Delay and LOS (1)

Intersection Number and Description	Type of Control	Lane Group	Eastbound				Westbound				Northbound				Southbound				Overall	
			AM		PM		AM		PM		AM		PM		AM		PM		AM	PM
			Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS		
1 S Military Hwy and George Washington Hwy	Signalized		S Military Hwy				S Military Hwy				George Washington Hwy				George Washington Hwy				Intersection	
		Left	29.3	C	51.3	D	31.2	C	36.6	D	42.1	D	34.4	C	25.9	C	31.1	C	Delay	Delay
		Through	55.1	E	67.6	E	43.0	D	74.7	E	33.6	C	62.0	E	48.6	D	67.6	E	42.7	60.3
		Right	34.8	C	36.3	D	33.4	C	35.9	D	0.0	A	0.0	A	0.0	A	0.0	A	LOS	LOS
		Approach	48.0	D	59.3	E	40.2	D	63.5	E	36.1	D	55.9	E	42.4	D	60.5	E	D	E
2 S Military Hwy and Strickland Brothers Driveway	Unsignalized		S Military Hwy				S Military Hwy				Strickland Brothers Driveway				Driveway				Intersection	
		Left	13.3	B	11.0	B	11.9	B	12.6	B	142.1	F	346.5	F	15.1	C	66.3	F	Delay	Delay
		Through	†	†	†	†	†	†	†	†										
		Right	†	†	†	†	†	†	†	†	13.4	B	13.2	B					LOS	LOS
		Approach	0.0	A	0.0	A	0.5	A	0.9	A	128.3	F	323.5	F	15.1	C	66.3	F	-	-
3 S Military Hwy and Yadkin Rd/Deep Creek Blvd (Frontage Rd)	Unsignalized		S Military Hwy				S Military Hwy				Yadkin Rd				Deep Creek Blvd (Frontage Rd)				Intersection	
		Left					13.3	B	12.8	B									Delay	Delay
		Through	†	†	†	†	†	†	†	†									-	-
		Right	†	†	†	†					15.2	C	15.8	C	13.2	B	16.9	C	LOS	LOS
		Approach	0.0	A	0.0	A	1.2	A	0.8	A	15.2	C	15.8	C	13.2	B	16.9	C	-	-
4 S Military Hwy and Butler St	Unsignalized		S Military Hwy				S Military Hwy				Butler St				Comfort Inn				Intersection	
		Left	13.5	B	19.9	C	16.1	C	14.4	B	53.8	F	191.8	F	22.3	C	57.4	F	Delay	Delay
		Through	†	†	†	†	†	†	†											
		Right	†	†	†	†													LOS	LOS
		Approach	0.1	A	0.5	A	1.1	A	1.2	A	53.8	F	191.8	F	22.3	C	57.4	F	-	-
5 S Military Hwy and Deep Creek Plaza Driveway	Unsignalized		S Military Hwy				S Military Hwy				Deep Creek Plaza				Driveway				Intersection	
		Left	12.0*	B	21.2*	C	18.4	C	12.3	B	24.8	C	58.1	F	30.4	D	102.5	F	Delay	Delay
		Through	0.4	A	1.8	A	†	†	†	†										
		Right	†	†	†	†													LOS	LOS
		Approach	0.5	A	1.9	A	0.1	A	0.2	A	24.8	C	58.1	F	30.4	D	102.5	F	-	-

- Denotes the overall intersection is stop controlled and no level of service or delay is reported  
 † SYNCHRO does not provide level of service or delay for movements with no conflicting volumes  
 \* Lane group is a shared left/through movement



Table 8: 2023 Existing Conditions Peak Hour Control Delay and LOS (2)

Intersection Number and Description	Type of Control	Lane Group	Eastbound				Westbound				Northbound				Southbound				Overall	
			AM		PM		AM		PM		AM		PM		AM		PM		AM	PM
			Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS		
6 S Military Hwy and Baugher Ave	Unsignalized	S Military Hwy		S Military Hwy		Dollar General				Baugher Ave				Intersection						
		Left	10.0	A	13.5	B	14.5	B	14.8	B	12.6	B	113.5	F	37.2	E	439.4	F	Delay	Delay
		Through	†	†	†	†	†	†	†	†									-	-
		Right	†	†	†	†	†	†	†	†	LOS	LOS								
		Approach	0.2	A	0.5	A	0.1	A	0.2	A	12.6	B	113.5	F	37.2	E	439.4	F	-	-
7 George Washington Hwy and Deep Creek Blvd (Frontage Rd)	Unsignalized	Deep Creek Blvd (Frontage Rd)		Service Rd		George Washington Hwy				George Washington Hwy				Intersection						
		Left	14.5	B	18.8	C	19.6	C	23.4	C	9.4	A	9.2	A	8.8	A	9.6	A	Delay	Delay
		Through									†	†	†	†	†	†	†	-	-	
		Right	LOS	LOS																
		Approach	14.5	B	18.8	C	19.6	C	23.4	C	0.1	A	0.2	A	0.0	A	0.1	A	-	-
8 George Washington Hwy and Yadkin Rd/Old George Washington Hwy	Signalized	Yadkin Rd		Old George Washington Hwy		George Washington Hwy				George Washington Hwy				Intersection						
		Left	57.8	E	47.1	D	59.0	E	51.2	D	12.2	B	14.8	B	12.4	B	16.6	B	Delay	Delay
		Through									16.4	B	23.0	C	14.9	B	25.1	C	24.8	28.3
		Right	44.9	D	38.5	D	51.7	D	43.8	D	17.8	B	20.7	C	LOS	LOS				
		Approach	49.6	D	42.8	D	55.3	E	47.2	D	15.6	B	21.5	C	15.1	B	23.6	C	C	C
9 Deep Creek Blvd and Deep Creek Blvd (Frontage Rd)	Unsignalized	Deep Creek Blvd (Frontage Rd)		Deep Creek Blvd (Frontage Rd)		Deep Creek Blvd				Deep Creek Blvd				Intersection						
		Left	8.9	A	9.4	A	8.9	A	9.4	A	†	†	†	†	Delay	Delay				
		Through									-	-								
		Right	LOS	LOS																
		Approach	8.9	A	9.4	A	†	†	†	†	-	-								

- Denotes the overall intersection is stop controlled and no level of service or delay is reported  
† SYNCHRO does not provide level of service or delay for movements with no conflicting volumes  
\* Lane group is a shared left/through movement

Table 9: 2023 Existing Conditions Peak Hour Maximum Queues (1)

Intersection Number and Description		Type of Control	Lane Group	Eastbound		Westbound		Northbound		Southbound	
				AM	PM	AM	PM	AM	PM	AM	PM
1	S Military Hwy and George Washington Hwy	Signal	S Military Hwy		S Military Hwy		George Washington Hwy		George Washington Hwy		
			Left	*(31%)**(31%)	*(2%)(20%)	170	** (27%)	260	305	** (15%)	** (32%)
			Through	710	690	300	740	370	750	680	575
			Right	** (35%)	** (22%)	0	225	115	445	100	100
2	S Military Hwy and Strickland Brothers Driveway	Signal	S Military Hwy		S Military Hwy		Strickland Brothers Driveway		Driveway		
			Left	30	5	50	95	70	105	35	25
			Through	†	†	†	†	25	20	35	25
			Right	†	†	†	†	25	20	35	25
3	S Military Hwy and Yadkin Rd/Deep Creek Blvd (Frontage Rd)	Signal	S Military Hwy		S Military Hwy		Yadkin Rd		Deep Creek Blvd (Frontage Rd)		
			Left			125	115				
			Through	†	†	†	†				
			Right	†	†			220	200	100	145
4	S Military Hwy and Butler St	Signal	S Military Hwy		S Military Hwy		Butler St		Comfort Inn		
			Left	40	65	80	** (4%)	90	185	55	50
			Through	†	†	†	†	90	185	55	50
			Right	†	†	†	†	90	185	55	50
5	S Military Hwy and Deep Creek Plaza Driveway	Signal	S Military Hwy		S Military Hwy		Deep Creek Plaza		Driveway		
			Left	50	135	25	60	35	85	35	35
			Through	†	†	†	†	35	85	35	35
			Right	†	†	†	†	35	85	35	35

† No queue reported. Movement does not have conflicting volumes

\*(X%) - Maximum queue extends full length of storage bay for X% of the analysis period

\*\* (Y%) - Queue in lane adjacent to storage bay extends beyond end of storage bay for Y% of the analysis period

^(Z%) - Maximum queue extends back to the upstream intersection for Z% of the analysis period

Table 10: 2023 Existing Conditions Peak Hour Maximum Queues (2)

Intersection Number and Description		Type of Control	Lane Group	Eastbound		Westbound		Northbound		Southbound	
				AM	PM	AM	PM	AM	PM	AM	PM
6	S Military Hwy and Baugher Ave	Signal	S Military Hwy		S Military Hwy		Dollar General		Baugher Ave		
			Left	55	60	25	40	20	80	95	175
			Through	†	†	†	†	20	80	95	175
			Right	†	†	†	†	20	80	95	175
7	George Washington Hwy and Deep Creek Blvd (Frontage Rd)	Signal	Deep Creek Blvd (Frontage Rd)		Service Rd		George Washington Hwy		George Washington Hwy		
			Left	30	35	60	55	30	40	20	^(2%)
			Through	30	35	60	55	†	†	†	†
			Right	30	35	60	55	†	†	†	†
8	George Washington Hwy and Yadkin Rd/Old George Washington Hwy	Signal	Yadkin Rd		Old George Washington Hwy		George Washington Hwy		George Washington Hwy		
			Left	275	240	140	290	205	155	45	170
			Through	275	240	140	290	270	415	170	295
			Right	235	140	105	110	270	415	60	85
9	Deep Creek Blvd and Deep Creek Blvd (Frontage Rd)	Signal	Deep Creek Blvd (Frontage Rd)		Deep Creek Blvd (Frontage Rd)		Deep Creek Blvd		Deep Creek Blvd		
			Left			25	45			†	†
			Through								
			Right			25	45			†	†

† No queue reported. Movement does not have conflicting volumes

\*(X%) - Maximum queue extends full length of storage bay for X% of the analysis period

\*\*\*(Y%) - Queue in lane adjacent to storage bay extends beyond end of storage bay for Y% of the analysis period

^(Z%) - Maximum queue extends back to the upstream intersection for Z% of the analysis period

### 1.6.3 No-Build Conditions Traffic Operations Analysis

#### No-Build 2045 Volume Development

Traffic operational analyses were conducted to evaluate the overall performance of the study corridor under No-Build (2045) AM and PM peak hour conditions. The intent of the no-build conditions analyses is to provide a general understanding of the baseline future traffic conditions as a starting point for developing improvement concepts.

The following sources were reviewed to determine the growth rates to apply to existing traffic volumes to forecast future (2045) traffic volumes.

- Hampton Roads Regional Travel Demand Model (TDM)**  
 Outputs from the Hampton Roads Regional TDM, which included base year data from 2017 and future year data from 2045, were adjusted using NCHRP-765 methodologies that incorporate project-specific and VDOT project traffic count data to adjust future volume projections. Using the adjusted future year (2045) TDM output and existing available count data, linear growth rates for the study area were developed.
- Historical traffic count data**  
 Historical traffic count data were sourced primarily from official VDOT historical annual average daily traffic (AADT) counts. Significant development and regression trends between years were identified, outliers were removed, and a linear regression analysis was performed to produce linear growth rates for segments throughout the study area.
- Socioeconomic data**  
 Population and employment data from traffic analysis zones (TAZ) in the 2017-2045 Hampton Roads Regional TDM were reviewed and compared to the linear traffic growth rates developed with the 2017-2045 Richmond TPO Regional TDM.
- Previous study**  
 Growth rates from the Route 460 and Route 17 Intersection Improvement Memo were reviewed and compared to the other sources.

**Table 11** and **Figure 15** present recommended linear growth rates and the growth rates determined from historical volume and the HRPTO TDM. Based on VDOT guidance, TDM growth rates for several locations in the study area were excluded because the percent difference between TDM AADT and VDOT historical AADT was more than +/-30%. Due to the significant number of locations with deviations more than +/-30%, a flat growth rate of 0.75% was agreed upon for the entire study area. Traffic forecasting growth rate development was presented in a stakeholder meeting on July 21, 2023. The full presentation is included in **Appendix D**. The no-build (2045) AM and PM peak hour volumes are shown in **Figure 16** and **Figure 17**.

Table 11: Linear Growth Rate Development Summary

ID	Segment	Historical Linear Growth Rate	Projected TDM Linear Growth Rate	Previous Study Growth Rate	Recommended Linear Growth Rate
1	S Military Highway west of George Washington Highway	0.77%	0.59%	1.00%	0.75%
2	S Military Highway east of George Washington Highway	0.32%	0.18%	2.00%	0.75%
3	George Washington Highway south of S Military Highway	-0.42%	0.63%	0.50%	0.75%
4	George Washington Highway north of S Military Highway	-1.36%	1.97%	0.50%	0.75%
5	Deep Creek Boulevard	--	-0.75%	--	0.75%

Figure 15: Study Area Linear Growth Rate Segment IDs



Figure 16: 2045 No-Build Peak Hour Volumes (1)

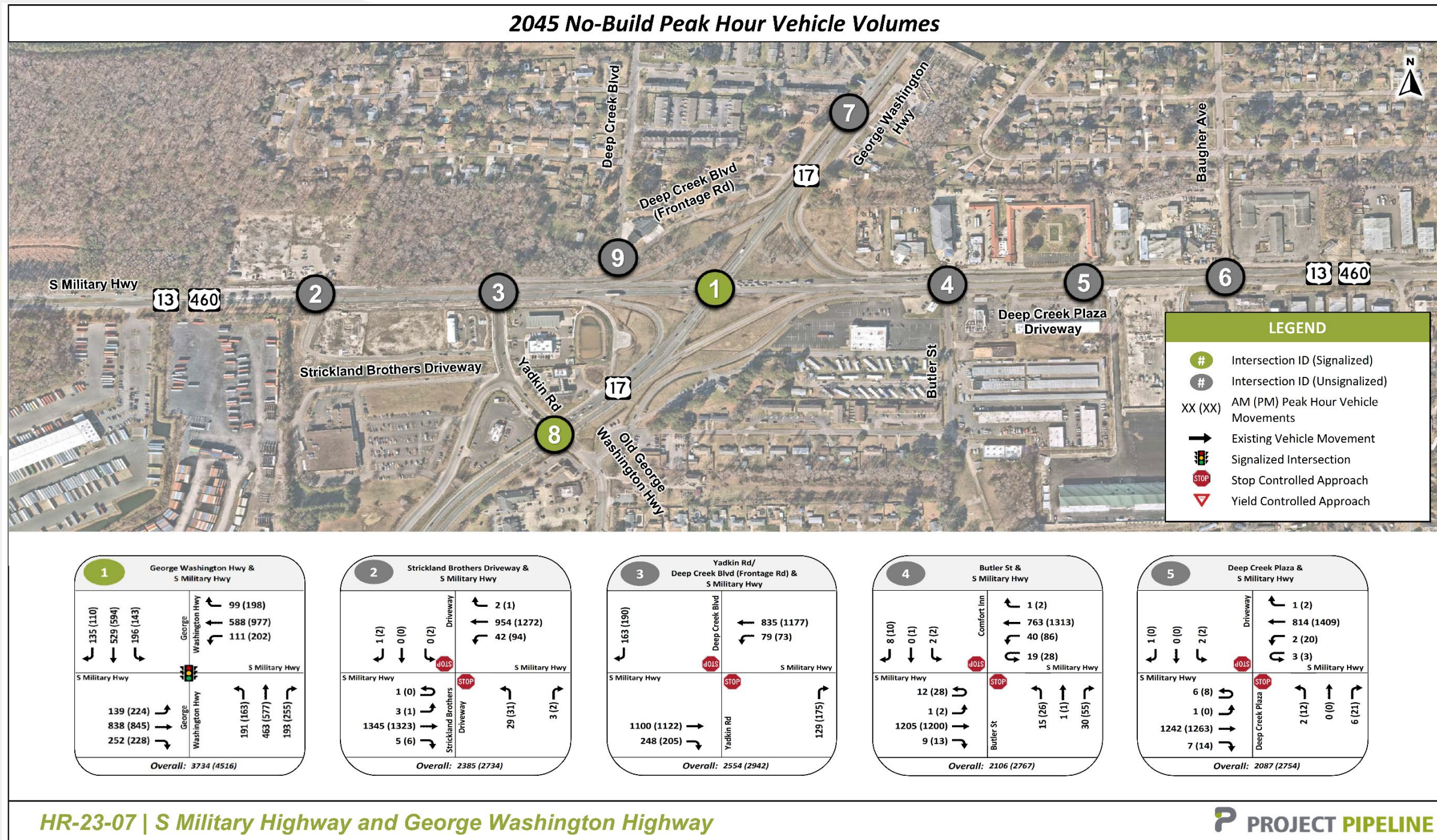
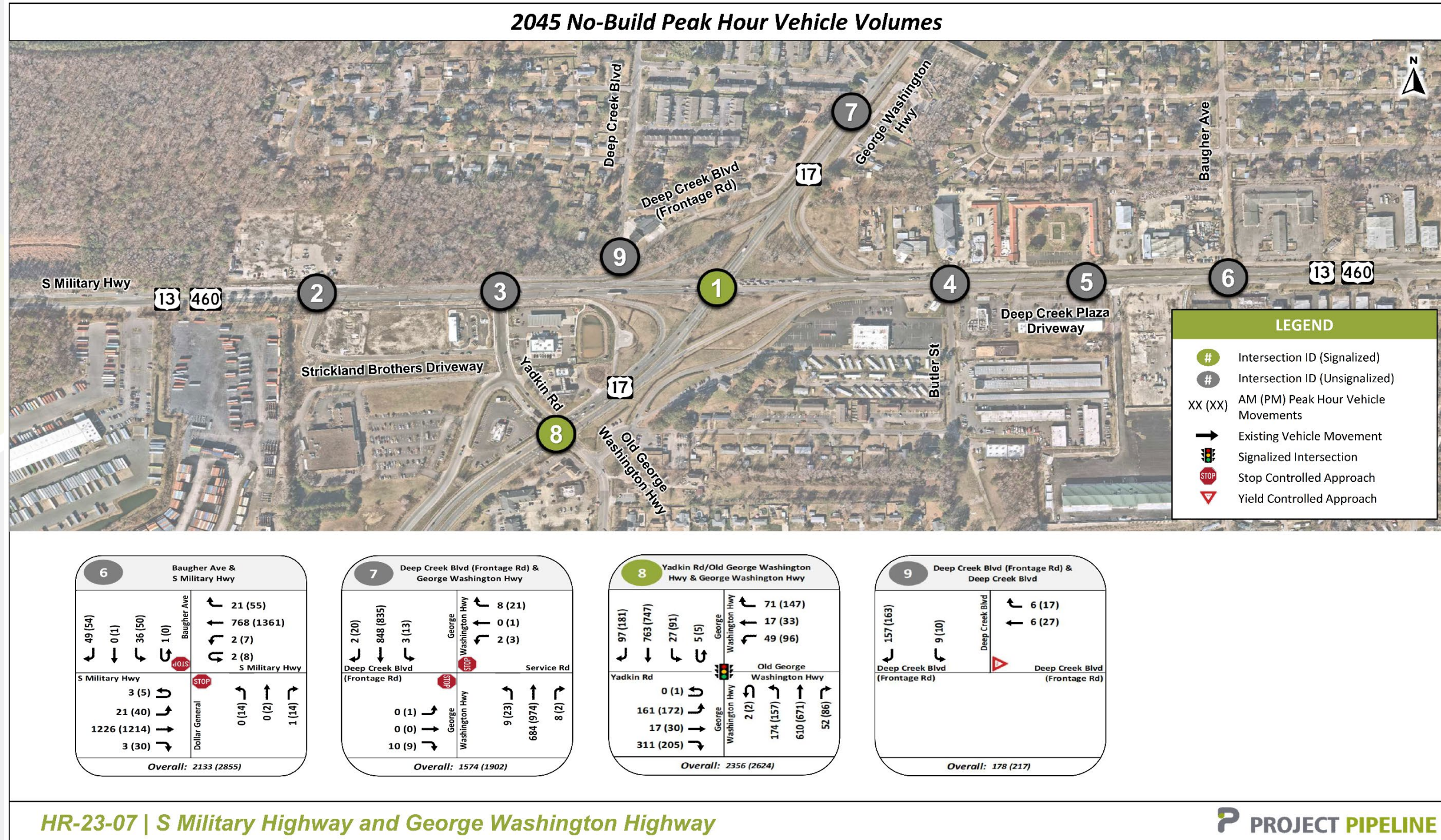


Figure 17: 2045 No-Build Peak Hour Volumes (2)



## Synchro and SimTraffic Analysis

Traffic operational analyses were conducted to evaluate the overall performance of the study intersections under No-Build (2045) AM and PM peak hour conditions. The intent of no-build conditions analyses was to provide a general understanding of the baseline future traffic conditions as a starting point for developing improvement alternatives. no-build conditions were modeled using Synchro 11 and SimTraffic 11 for the entire study area.

The existing conditions Synchro models were used as a basis to develop the No-Build models for the AM and PM peak hour conditions. The models were updated with the projected 2045 No-Build traffic volumes and the anticipated widening of George Washington Highway, which adds a second northbound and southbound through lane in each direction in the project area. Traffic signal cycle lengths were assumed to be consistent with existing conditions, while splits and offsets were optimized. No-Build inputs and analysis methodologies were applied consistently with TOSAM.

Ten simulations were conducted for both the AM and PM No-Build SimTraffic models. Control delay (seconds per vehicle), LOS, and maximum queue length (feet) were selected as measures of effectiveness to quantitatively report the performance of each study intersection. Synchro reports used for control delay were consistent with existing conditions and summarized in **Table 6**. The full Synchro and SimTraffic reports are included in **Appendix D** and shown in **Table 12** through **Table 15**.

Similar trends in delay and queuing were observed under no-build conditions as observed in Existing conditions. Under no-build conditions, all signalized intersections operated at LOS D in both AM and PM peak hours except for the intersection of Yadkin Road/Old George Washington Highway and George Washington Highway, which operated at LOS C in the PM peak hour. Multiple individual minor street approaches also operated at LOS F in both AM and PM peak hours at the unsignalized intersections along S Military Highway.

LOS and queue data showed that there are significant operational deficiencies for minor streets along S Military Highway. LOS and delay improved at the intersection of S Military Highway and George Washington Highway as a result of the anticipated widening of George Washington Highway.

The following trends were observed under no-build conditions:

### AM Peak Hour

- The northbound and southbound approaches at the intersection of S Military Highway and George Washington Highway experienced higher delay than the eastbound and westbound approaches by approximately 50%, with a delay of 48 seconds for the northbound approach and 47 seconds for the southbound approach.

- The highest signalized approach delay occurred on the westbound approach at the intersection of Yadkin Road/Old George Washington Highway and George Washington Highway (51.2 seconds)
- The highest unsignalized minor street delay occurred on the northbound approach at the intersection of Strickland Brothers Driveway and S Military Highway (380.7 seconds)
- The westbound left turn queue at the intersection of Yadkin Road/Old S Military Highway and George Washington Highway extended beyond the storage bay 8% of the analysis period
- The longest queue at the intersection of S Military Highway and George Washington Highway occurred on the eastbound approach (460 feet)

### PM Peak Hour

- The northbound and southbound approaches at the intersection of S Military Highway and George Washington Highway experienced higher delay than the eastbound and westbound approaches by approximately 66%, with a delay of 63 seconds for the northbound approach and 57 seconds for the southbound approach.
- The unsignalized minor street approaches along S Military Highway all operated at LOS F except for the minor street approaches at Yadkin Road/Deep Creek Boulevard and S Military Highway, which operated at LOS C
- The highest signalized approach delay occurred on the northbound approach at the intersection of S Military Highway and George Washington Highway (62.5 seconds)
- All queues at the intersection of S Military Highway and George Washington Highway extend beyond the left turn storage bays – 5% for the eastbound approach, 20% for the westbound approach, 4% for the northbound approach, and 20% for the southbound approach
- The eastbound and southbound left-turn queues at the intersection of S Military Highway and George Washington Highway extend beyond the left turn bay 3% and 6% of the analysis period, respectively
- The longest queue occurred for the westbound approach at the intersection of S Military Highway and George Washington Highway which extended back 760 feet

Table 12: 2045 No-Build Conditions Peak Hour Control Delay and LOS (1)

Intersection Number and Description	Type of Control	Lane Group	Eastbound				Westbound				Northbound				Southbound				Overall	
			AM		PM		AM		PM		AM		PM		AM		PM		AM	PM
			Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS		
1 S Military Hwy and George Washington Hwy	Signalized		S Military Hwy				S Military Hwy				George Washington Hwy				George Washington Hwy				Intersection	
		Left	21.7	C	51.1	D	27.2	C	33.2	C	55.7	E	72.1	E	33.8	C	46.7	D	Delay	Delay
		Through	35.3	D	34.2	C	33.0	C	39.9	D	45.3	D	59.8	E	51.2	D	59.7	E	38.0	44.6
		Right	25.6	C	24.7	C	26.1	C	25.2	C	0.0	A	0.0	A	0.0	A	0.0	A	LOS	LOS
		Approach	31.8	C	35.4	D	31.4	C	36.8	D	48.3	D	62.5	E	46.5	D	57.2	E	D	D
2 S Military Hwy and Strickland Brothers Driveway	Unsignalized		S Military Hwy				S Military Hwy				Strickland Brothers Driveway				Driveway				Intersection	
		Left	15.3	C	12.1	B	13.6	B	14.8	B	418.6	F	993.7	F	16.6	C	125.7	F	Delay	Delay
		Through	†	†	†	†	†	†	†	†										
		Right	†	†	†	†	†	†	†	†	14.8	B	14.6	B					LOS	LOS
		Approach	0.0	A	0.0	A	0.6	A	1.0	A	380.7	F	934.4	F	16.6	C	125.7	F	-	-
3 S Military Hwy and Yadkin Rd/Deep Creek Blvd (Frontage Rd)	Unsignalized		S Military Hwy				S Military Hwy				Yadkin Rd				Deep Creek Blvd (Frontage Rd)				Intersection	
		Left					15.2	C	14.9	B									Delay	Delay
		Through	†	†	†	†	†	†	†	†									-	-
		Right	†	†	†	†					17.5	C	19.6	C	14.6	B	21.9	C	LOS	LOS
		Approach	0.0	A	0.0	A	1.3	A	0.9	A	17.5	C	19.6	C	14.6	B	21.9	C	-	-
4 S Military Hwy and Butler St	Unsignalized		S Military Hwy				S Military Hwy				Butler St				Comfort Inn				Intersection	
		Left	14.7	B	26.5	D	18.7	C	18.4	C	91.6	F	830.0	F	26.2	D	131.2	F	Delay	Delay
		Through	†	†	†	†	†	†	†											
		Right	†	†	†	†													LOS	LOS
		Approach	0.2	A	0.6	A	1.3	A	1.5	A	91.6	F	830.0	F	26.2	D	131.2	F	-	-
5 S Military Hwy and Deep Creek Plaza Driveway	Unsignalized		S Military Hwy				S Military Hwy				Deep Creek Plaza				Driveway				Intersection	
		Left	13.4*	B	27.5	D	23.0	C	13.9	B	32.6	D	155.3	F	43.0	E	204.9	F	Delay	Delay
		Through	1.0	A	5.1	A	†	†	†	†										
		Right	†	†	†	†													LOS	LOS
		Approach	1.1	A	5.2	A	0.1	A	0.2	A	32.6	D	155.3	F	43.0	E	204.9	F	-	-

- Denotes the overall intersection is stop controlled and no level of service or delay is reported  
 † SYNCHRO does not provide level of service or delay for movements with no conflicting volumes  
 \* Lane group is a shared left/through movement



Table 13: 2045 No-Build Conditions Peak Hour Control Delay and LOS (2)

Intersection Number and Description	Type of Control	Lane Group	Eastbound				Westbound				Northbound				Southbound				Overall	
			AM		PM		AM		PM		AM		PM		AM		PM		AM	PM
			Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
6 S Military Hwy and Baugher Ave	Unsignalized	S Military Hwy		S Military Hwy		Dollar General		Baugher Ave		Intersection		Delay		Delay		Delay		Delay		
		Left	10.7	B	16.4	C	17.1	C	17.7	C	13.8	B	356.1	F	77.1	F	1419.1	F	-	-
		Through	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†
		Right	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†
		Approach	0.2	A	0.6	A	0.1	A	0.2	A	13.8	B	356.1	F	77.1	F	1419.1	F	-	-
7 George Washington Hwy and Deep Creek Blvd (Frontage Rd)	Unsignalized	Deep Creek Blvd (Frontage Rd)		Service Rd		George Washington Hwy		George Washington Hwy		Intersection		Delay		Delay		Delay		Delay		
		Left	11.7	B	15.1	C	15.7	C	19.8	C	9.9	A	9.8	A	9.2	A	10.2	B	-	-
		Through	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†
		Right	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†
		Approach	11.7	B	15.1	C	15.7	C	19.8	C	0.1	A	0.2	A	0.0	A	0.2	A	-	-
8 George Washington Hwy and Yadkin Rd/Old George Washington Hwy	Signalized	Yadkin Rd		Old George Washington Hwy		George Washington Hwy		George Washington Hwy		Intersection		Delay		Delay		Delay		Delay		
		Left	44.6	D	46.7	D	53.6	D	48.7	D	21.7	C	22.1	C	18.8	B	13.8	B	36.1	29.8
		Through	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†
		Right	38.6	D	38.9	D	48.9	D	43.7	D	25.6	C	33.7	C	47.6	D	21.7	C	3.6	A
		Approach	40.8	D	42.8	D	51.2	D	46.0	D	24.8	C	31.7	C	41.8	D	18.5	B	D	C
9 Deep Creek Blvd and Deep Creek Blvd (Frontage Rd)	Unsignalized	Deep Creek Blvd (Frontage Rd)		Deep Creek Blvd (Frontage Rd)		Deep Creek Blvd		Deep Creek Blvd		Intersection		Delay		Delay		Delay		Delay		
		Left	9.0	A	9.4	A	9.0	A	9.4	A	†	†	†	†	†	†	†	†	-	-
		Through	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†
		Right	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†
		Approach	9.0	A	9.4	A	9.0	A	9.4	A	†	†	†	†	†	†	†	†	-	-

- Denotes the overall intersection is stop controlled and no level of service or delay is reported  
 † SYNCHRO does not provide level of service or delay for movements with no conflicting volumes  
 \* Lane group is a shared left/through movement

Table 14: 2045 No-Build Conditions Peak Hour Maximum Queues (1)

Intersection Number and Description		Type of Control	Lane Group	Eastbound		Westbound		Northbound		Southbound	
				AM	PM	AM	PM	AM	PM	AM	PM
1	S Military Hwy and George Washington Hwy	Signal	S Military Hwy		S Military Hwy		George Washington Hwy		George Washington Hwy		
			Left	290	*(3%)**(5%)	190	** (20%)	250	** (4%)	245	*(6%)** (20%)
			Through	460	480	290	760	335	350	315	540
			Right	0	0	0	55	220	255	120	135
2	S Military Hwy and Strickland Brothers Driveway	Signal	S Military Hwy		S Military Hwy		Strickland Brothers Driveway		Driveway		
			Left	20	10	80	130	100	*(5%)	35	25
			Through	†	†	†	†	25	85	35	25
			Right	†	†	†	†	25	85	35	25
3	S Military Hwy and Yadkin Rd/Deep Creek Blvd (Frontage Rd)	Signal	S Military Hwy		S Military Hwy		Yadkin Rd		Deep Creek Blvd (Frontage Rd)		
			Left			130	115				
			Through	†	†	†	†				
			Right	†	†			130	130	110	175
4	S Military Hwy and Butler St	Signal	S Military Hwy		S Military Hwy		Butler St		Comfort Inn		
			Left	60	65	90	120	110	295	60	60
			Through	†	†	†	†	110	295	60	60
			Right	†	†	†	†	110	295	60	60
5	S Military Hwy and Deep Creek Plaza Driveway	Signal	S Military Hwy		S Military Hwy		Deep Creek Plaza		Driveway		
			Left	55	145	30	45	40	105	35	35
			Through	†	†	†	†	40	105	35	35
			Right	†	†	†	†	40	105	35	35

† No queue reported. Movement does not have conflicting volumes

\*(X%) - Maximum queue extends full length of storage bay for X% of the analysis period

\*\* (Y%) - Queue in lane adjacent to storage bay extends beyond end of storage bay for Y% of the analysis period

^(Z%) - Maximum queue extends back to the upstream intersection for Z% of the analysis period

Table 15: 2045 No-Build Conditions Peak Hour Maximum Queues (2)

Intersection Number and Description		Type of Control	Lane Group	Eastbound		Westbound		Northbound		Southbound	
				AM	PM	AM	PM	AM	PM	AM	PM
6	S Military Hwy and Baugher Ave	Signal	S Military Hwy		S Military Hwy		Dollar General		Baugher Ave		
			Left	50	70	25	35	15	110	135	395
			Through	†	†	†	†	15	110	135	395
			Right	†	†	†	†	15	110	135	395
7	George Washington Hwy and Deep Creek Blvd (Frontage Rd)	Signal	Deep Creek Blvd (Frontage Rd)		Service Rd		George Washington Hwy		George Washington Hwy		
			Left	30	35	55	55	35	40	25	30
			Through	30	35	55	55	†	†	†	†
			Right	30	35	55	55	†	†	†	†
8	George Washington Hwy and Yadkin Rd/Old George Washington Hwy	Signal	Yadkin Rd		Old George Washington Hwy		George Washington Hwy		George Washington Hwy		
			Left	295	285	*(8%)	460	290	255	** (3%)	** (2%)
			Through	295	285	240	460	400	345	400	400
			Right	295	185	110	110	305	345	75	75
9	Deep Creek Blvd and Deep Creek Blvd (Frontage Rd)	Signal	Deep Creek Blvd (Frontage Rd)		Deep Creek Blvd (Frontage Rd)		Deep Creek Blvd		Deep Creek Blvd		
			Left			25	40			†	†
			Through								
			Right			25	40			†	†

† No queue reported. Movement does not have conflicting volumes

\*(X%) - Maximum queue extends full length of storage bay for X% of the analysis period

\*\* (Y%) - Queue in lane adjacent to storage bay extends beyond end of storage bay for Y% of the analysis period

^(Z%) - Maximum queue extends back to the upstream intersection for Z% of the analysis period

## 2 Alternatives Development & Refinement

The study team developed alternative concepts along S Military Highway and George Washington Highway to enhance multimodal access and address safety, geometric, and operational deficiencies in the study area.

The study team screened alternatives based on anticipated safety benefits, operational performance, multimodal access, constructability, and input from the SWG. A SWG meeting was held on July 28, 2023 to review preliminary alternatives. The meeting materials can be found in **Appendix E**. The study team selected five alternatives to present to the public and gather feedback. For more information on how the following concepts operate, visit [VDOT's Innovative Intersection website](#).

### 2.1 Phase 1 Alternative Development

The study team developed preliminary alternatives in parallel with the high-level needs diagnosis efforts documented in **Chapter 1.5**. The proposed Phase 1 alternatives were developed to meet the following criteria:

- Improve operations at intersections in the study area
- Mitigate safety issues for the turning movements onto S Military Highway and George Washington Highway
- Enhance bike and pedestrian access throughout the study area

The following sections describe the process used to develop Phase 1 alternatives encompassing various categories of needs.

#### 2.1.1 Alternatives Addressing Traffic Operations and Safety Needs

The study team conducted a high-level traffic operations and safety analysis of the intersection of S Military Highway and George Washington Highway following the Virginia Intersection and Interchange Control Assessment Program (iCAP) process.

In existing conditions, the intersection of S Military Highway and George Washington Highway experiences heavy queueing in the northbound direction during the AM peak hour and the northbound, eastbound, and westbound directions during the PM peak hour. It was observed that vehicles tend to stack in a single lane in the eastbound and westbound directions which contributes to significant queueing in the eastbound and westbound directions. The eastbound and westbound left-turn lane

offsets contribute to sight distance issues. Over 50% of crashes at the intersection of S Military Highway and George Washington Highway were caused by vehicles making a left turn. Almost 90% of crashes at this intersection were either angle crashes or rear end crashes.

Intersection alternatives were initially developed to address these issues and improve traffic operations and safety. The Virginia Junction Screening Tool (VJuST) and iCAP tools, which is used to screen intersection and interchange alternatives based on impacts to traffic operations, pedestrian accommodations, safety, and cost; were used to narrow down initial alternatives to a list of six alternatives to move forward for further refinement. The six alternatives included:

- Dual eastbound left turns
- Partial displaced left-turn
- Bowtie
- Quadrant roadway
- Median U-turn
- Partial median U-turn

**Figure 18** shows the iCAP Stage 1 results for the PM peak hour for all alternatives analyzed, including the six alternatives chosen to move forward for further refinement.

Figure 18: iCAP Stage 1 Results – PM Peak Hour

Metric Weighting (Based on Purpose and Need)		Traffic Operations		Pedestrian		Safety		Stage 1 Cost		Total Possible Score	
		Traffic Operations Weight		Pedestrian Weight		Safety Weight		Stage 1 Cost Weight		9	
		3		2		3		1			
Alternatives		VJuST Maximum V/C Ratio	Traffic Operations Metric MOE Score	VJuST Accommodation Compared to Conventional	Pedestrian Metric MOE Score	VJuST Weighted Total Conflict Points	Safety Metric MOE Score	VJuST Planning Level Cost Category	Stage 1 Cost Metric MOE Score	Total Stage 1 Score	
Existing	Conventional	0.82	--	0	--	48	--		--		
Alternative 1	Partial Median U-Turn NB-SB	0.69	0.8	+	1.0	28	0.7	\$\$	0.5	7 out of 9	<div style="width: 77.8%;"></div>
Alternative 2*	Bowtie NB-SB	0.72	0.6	+	1.0	24	0.9	\$\$\$	0.3	6.8 out of 9	<div style="width: 75.6%;"></div>
Alternative 3*	Conventional	0.75	0.4	0	0.5	48	0.0	\$	1.0	3.2 out of 9	<div style="width: 35.6%;"></div>
Alternative 4*	Median U-Turn EB-WB	0.76	0.4	+	1.0	20	1.0	\$\$	0.5	6.7 out of 9	<div style="width: 74.4%;"></div>
Alternative 5*	Partial Displaced Left Turn EB-WB	0.67	0.9	-	0.0	44	0.1	\$\$\$	0.3	3.3 out of 9	<div style="width: 36.7%;"></div>
Alternative 6*	Partial Median U-Turn EB-WB	0.73	0.6	+	1.0	28	0.7	\$\$	0.5	6.4 out of 9	<div style="width: 71.1%;"></div>
Alternative 7*	Quadrant Roadway N-E	0.67	0.9	0	0.5	40	0.3	\$\$\$	0.3	4.9 out of 9	<div style="width: 54.4%;"></div>
Alternative 8	Quadrant Roadway N-W	0.68	0.9	0	0.5	40	0.3	\$\$\$	0.3	4.9 out of 9	<div style="width: 54.4%;"></div>
Alternative 9	Quadrant Roadway S-E	0.66	1.0	0	0.5	40	0.3	\$\$\$	0.3	5.2 out of 9	<div style="width: 57.8%;"></div>
Alternative 10	Quadrant Roadway S-W	0.67	0.9	0	0.5	40	0.3	\$\$\$	0.3	4.9 out of 9	<div style="width: 54.4%;"></div>

\*Alternative carried forward to Stage 2

### Dual Left Turns

Figure 19 shows the addition of two eastbound left-turn lanes. Intersection skew, spacing, and limited median width creates limits on dual left turns for the eastbound and westbound approaches. Dual left turns were only considered for the eastbound left-turn. The concept widens the left-turn pocket to two eastbound left-turn pockets and maintains the adjacent through and through/right lanes. All other approach laneage would remain the same.

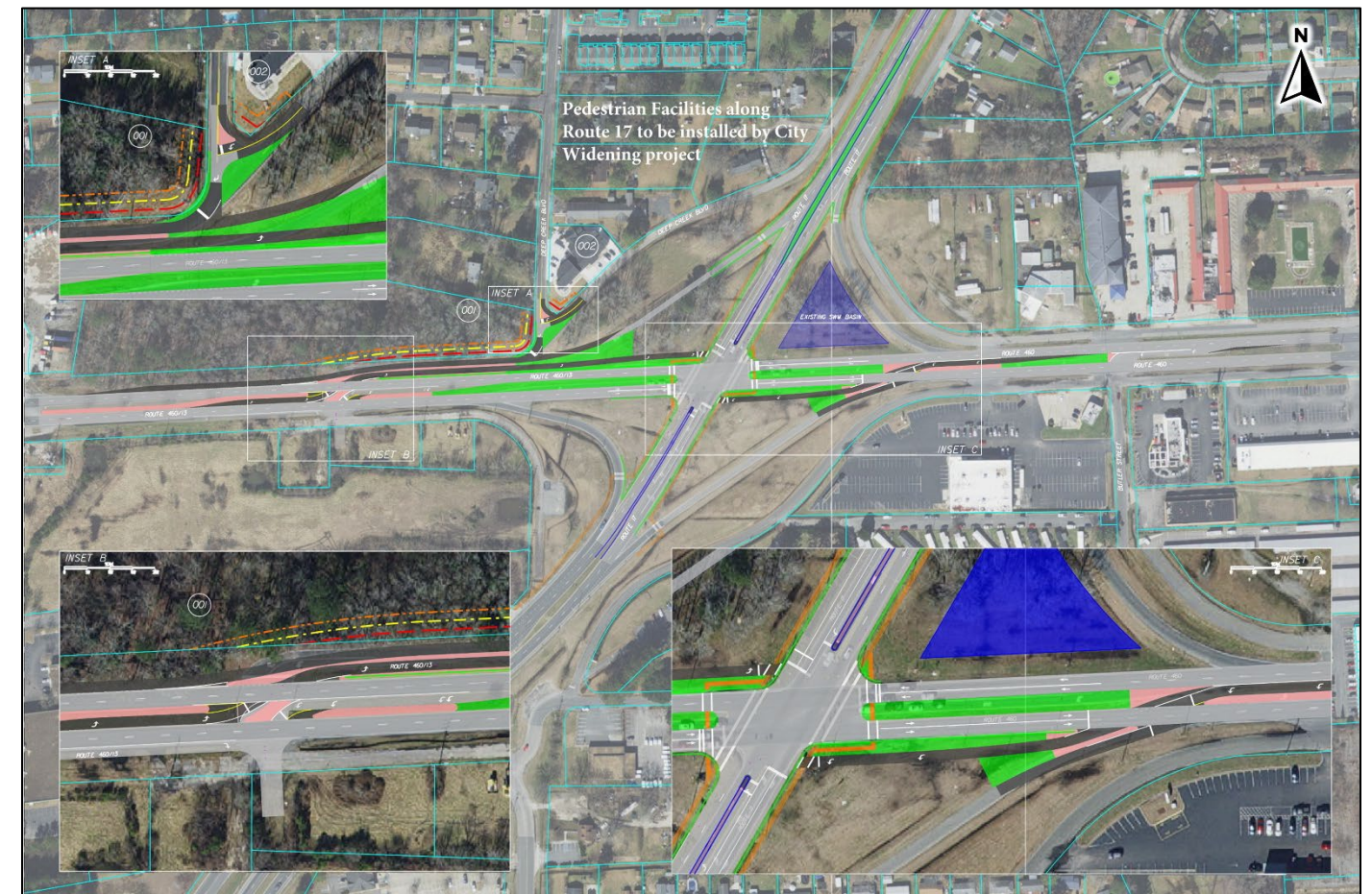
Figure 19: Phase 1 Alternative – Dual Left Turns



### Partial Displaced Left Turn

Figure 20 shows a partial displaced left turn concept sketch that was developed in 2022 by Michael Baker as part of an intersection improvement study for S Military Highway and George Washington Highway. The partial displaced left turn concept displaces the eastbound and westbound left-turns in advance of the main intersection at two new signalized intersections. The concept would also include general access management improvements along the S Military Highway frontage road and geometry improvements at the Deep Creek Boulevard and Deep Creek Boulevard Frontage Road intersection to accommodate the displaced left-turn lanes approaching the main intersection.

Figure 20: Phase 1 Alternative – Partial Displaced Left Turn



**Bowtie**

**Figure 21** shows a bowtie concept which would reroute all left-turn movements to roundabouts on George Washington Highway to the north and south. The northern roundabout would be located at Townhouse Lane and the southern roundabout would be located at Yadkin Road/Old George Washington Highway. The eastbound and westbound channelized right turn lanes would be removed with right turns allowed at the main intersection.

**Figure 21: Phase 1 Alternative – Bowtie**



**Quadrant Roadway (Northeast)**

**Figure 22** shows the northeast quadrant roadway concept which would reroute all left-turn movements at S Military Highway and George Washington Highway to adjacent intersections via a connector roadway on the northeast corner. The northeast quadrant was selected due to intersection spacing and congestion concerns at other quadrants. The secondary intersections at each end of the connector roadway would be signalized. The westbound channelized right turn lane would be removed with vehicles completing right-turn movements via the connector road. While Canal Drive already acts as a quadrant roadway, there is potential for improved traffic signal operations with a more local quadrant.

**Figure 22: Phase 1 Alternative – Quadrant Roadway (Northeast)**



### Median U-Turn

**Figure 23** shows the median U-turn concept where all left-turning vehicles at S Military Highway and George Washington Highway would make U-turns at dedicated median openings along S Military Highway to the east and west. Due to right-of-way limitations on George Washington Highway, the median U-turns were placed on S Military Highway. The median openings would be signalized to accommodate the rerouted left-turn volume. All channelized right-turn lanes would be removed to allow right turns at the main intersection. This concept may be challenging due to the high presence of heavy vehicles.

**Figure 23: Phase 1 Alternative – Median U-Turn**



### Partial Median U-Turn

**Figure 24** shows the partial median U-turn concept. Similar to the median U-turn, left-turning vehicles at S Military Highway and George Washington Highway would make U-turns at median openings along S Military Highway. However, in this concept, only the eastbound and westbound left-turn vehicles are rerouted to the dedicated median openings; northbound and southbound vehicles will still make left turns at the main intersection. The median openings to the east and west would be signalized to accommodate left-turn volume. Due to right-of-way limitations on George Washington Highway, the median U-turns were placed on S Military Highway. Eastbound and westbound channelized right turn lanes would also be removed to allow right turns at the main intersection. This concept may be challenging due to the high presence of heavy vehicles.

**Figure 24: Phase 1 Alternative – Partial Median U-Turn**





### 2.1.2 Alternatives Addressing Bicycle and Pedestrian Access and Safety

Alternatives addressing bicycle and pedestrian access included adding a shared-use path along the south side of S Military Highway. The shared-use path will allow for greater bicycle and pedestrian connectivity throughout the area. The concepts that proposed innovative intersections benefit bicycles and pedestrians due to the reduction of signal phases. A reduction of signal phases allows for the possibility of median refuge islands and shortens the distance bicycles and pedestrians must traverse through the intersection.

### 2.1.3 Phase 1 Alternatives Summary

**Table 16** includes a refined list of the alternatives considered in Phase 1 and the associated needs addressed by the alternative. **Figure 25** shows the preliminary alternatives graphically categorized by the needs addressed by the alternative. The study team discussed further details of the Phase 1 improvement alternatives during the Phase 1 Brainstorming meeting held with the SWG on July 28, 2023. The SWG agreed to modify the dual eastbound left turn lane concept to also include dual westbound left turn lanes and update the phasing from FYA to protect. The SWG also agreed to remove the median U-turn concept from the list of alternatives due to the high number of left turns that would be rerouted to U-turns.

**Table 16: Phase 1 Alternatives and Anticipated Needs Addressed**

Improvement	Safety Need	Congestion Need	Pedestrian Need	Bike Need
Dual Left Turns	●	●	●	●
Partial Displaced Left Turn	●	●	●	●
Bowtie	●	●	●	●
Quadrant Roadway (Northeast)	●	●	●	●
Partial Median U-Turn	●	●	●	●

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

## 2.2 Phase 2 Alternatives Analysis and Refinement

The study team conducted a screening-level traffic operations analysis using Synchro 11 on a series of intersection improvement alternatives. Improvement alternatives were further screened to aid in selecting a preferred alternative using the iCAP screening tool to rank each alternative based on traffic operations, safety, pedestrian accommodations, and cost.

The iCAP Stage 2 results showed the dual left turns having the highest ranking among all alternatives, with a total score of 7.4 out of 9. While the dual left turns concept did not rank highest in traffic operations and pedestrian accommodations, there was not a significant difference among scores in these categories and the dual left turns concept significantly outperformed all other alternatives in the safety and cost categories.

A SWG meeting was held on January 9, 2024 to share the draft concept sketches and iCAP results, and gather feedback on the alternatives. An additional SWG meeting was held on February 7, 2024 to review the revised concepts and to share the concept screening results in advance of public outreach. During the concept screening results meeting, the study team discussed each alternative based on impacts to safety, traffic operations, cost, and right-of-way impacts. Both presentations, along with the detailed concept benefits, are included in **Appendix E**.

Figure 25: Phase 1 Scoping Level Improvement Alternatives

**Legend: VTrans Needs Addressed**

Congestion Mitigation	Pedestrian and Bicycle Access
Safety Improvement	Pedestrian Safety Improvement

**Operations Improvements**

- 1 Dual Left Turns
- 2 Partial Displaced Left-Turn\*

**Safety Improvements**

- 1 Protected Left Turns
- 2 Bowtie\*
- 3 Quadrant\*
- 4 Median U-Turn\*
- 5 Partial Median U-Turn\*

**Pedestrian and Bike Improvements**

- 1 Shared-Use Path to connect to pedestrian and bike improvements included in the US-17 widening project

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



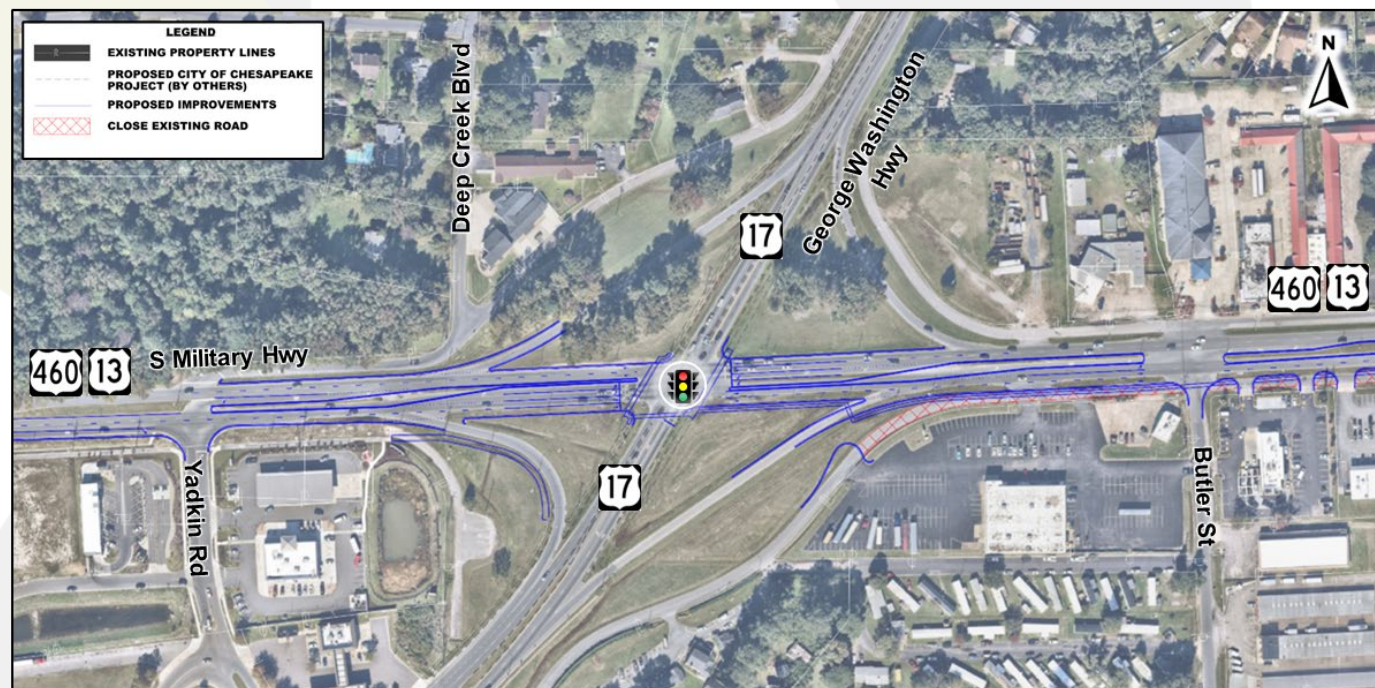
## 2.2.1 Intersection Alternatives Analysis

The following sections present the details for each alternative analyzed during Phase 2.

### Dual Left Turns

In addition to the two eastbound left turn lanes proposed in Section 2.1, the dual left turns concept was modified to also include two westbound left turn lanes at S Military Highway and George Washington Highway and include updating the eastbound and westbound left turns to protected phasing. The northbound and southbound left turns will maintain a Flashing Yellow Arrow (FYA). This concept would provide a shared-use path and remove the service road along the south side of S Military Highway. **Figure 26** presents a conceptual sketch of the alternative.

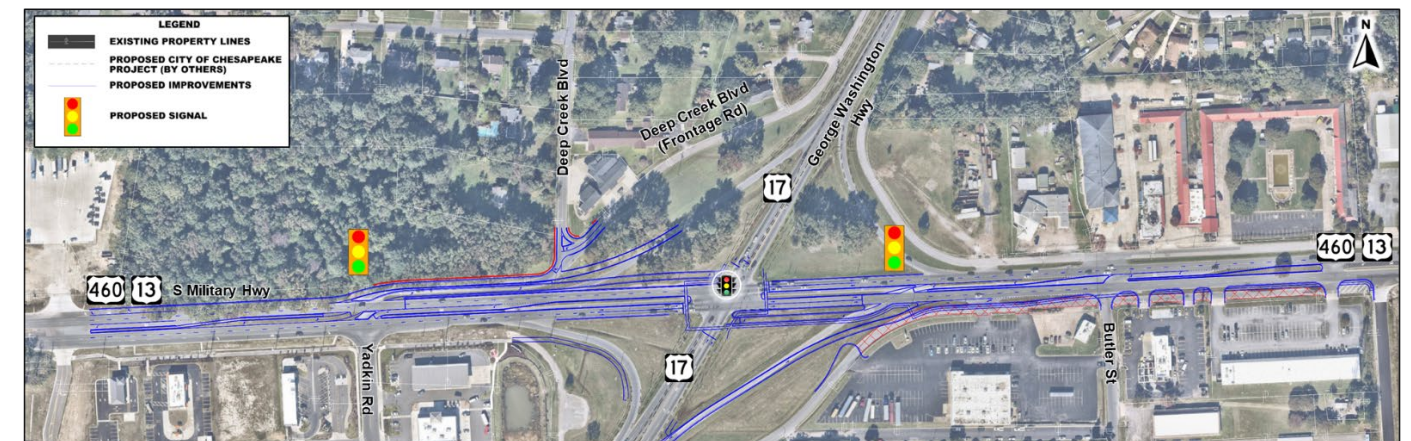
Figure 26: Phase 2 Alternative – Dual Left Turns



### Partial Displaced Left Turn

This concept would allow left turns and through movements on S Military Highway to occur simultaneously by displacing the left turn movements. Two additional signals would be constructed along S Military Highway to accommodate the left turn movements. Left turns from George Washington Highway would still be permitted. This concept would provide a shared-use path and remove the service road along the south side of S Military Highway. **Figure 27** presents a conceptual sketch of the alternative.

Figure 27: Phase 2 Alternative – Partial Displaced Left-Turn



### Bowtie

This concept would reroute all left turn movements at the intersection of S Military Highway and George Washington Highway to roundabouts along George Washington Highway at Yadkin Road and Townhouse Lane. The northern roundabout was shifted to the northwest to provide better access to the police station (east leg of the roundabout) which increases ROW impacts on the northwest parcel of the roundabout. This concept also removes the service road on the south side of S Military Highway. **Figure 28** presents a conceptual sketch of the alternative.

Figure 28: Phase 2 Alternative – Bowtie



### Quadrant Roadway (Northeast)

The quadrant would reroute all left turn movements at S Military Highway and George Washington Highway to two adjacent signalized intersections – one along George Washington Highway to the north and one along S Military Highway to the east – via a connector roadway on the northeast corner of the main intersection. The signalized intersection along S Military Highway was shifted slightly to the west to avoid conflicts with the hotel. The intersection of S Military Highway and George Washington Highway would be reduced to two phases which would help alleviate the southbound queueing. This concept would also remove the service road on the north and south side of S Military Highway. **Figure 29** presents a conceptual sketch of the alternative.

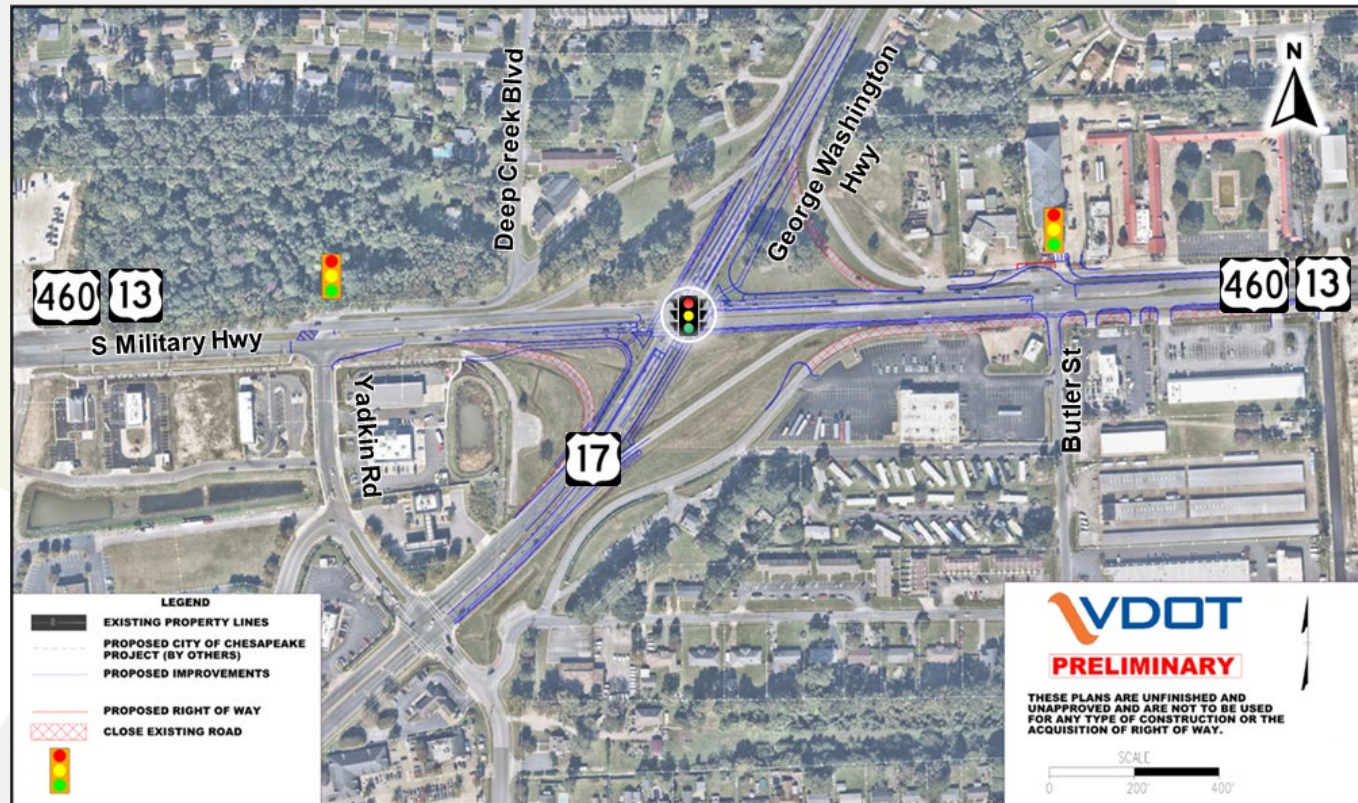
Figure 29: Phase 2 Alternative – Quadrant Roadway (Northeast)



### Partial Median U-Turn

This concept reroutes S Military Highway left turns at the intersection of S Military Highway and George Washington Highway to two signalized intersections at Yadkin Road and Butler Street. This concept also removes the service road on the south side of S Military Highway. **Figure 30** presents a conceptual sketch of the alternative.

Figure 30: Phase 2 Alternative – Partial Median U-Turn



### Anticipated Crash Reduction for Alternatives

The study team reviewed crash modification factors (CMFs) to determine the potential safety benefits for each alternative. CMFs were selected from the SMART SCALE Planning Level CMF List from Round 5. The CMF resulting in the highest anticipated crash reduction was applied to fatal and injury crashes within the influence area of each intersection, as shown in **Table 17**. While there is no CMF for the quadrant roadway improvement on the approved list of CMFs, it is expected to improve safety. A CMF for the quadrant roadway improvement was manually calculated based on the reduction in number of conflict points from existing roadway geometry.

The dual left Turns improvement annual crash reduction is determined by using two CMFs. The first is the CMF for adding a turn lane to an existing turn lane and the second is the CMF for converting

Flashing Yellow Arrow (FYA) phasing to protected left-turn phasing, the latter being from the VDOT State Preferred CMF list. Converting a protected left-turn to FYA has a CMF of 2.242 and applies only to angle crashes. Since this concept converts a FYA to protected left-turn, the inverse of the CMF was applied to fatal and injury angle crashes at the intersection of S Military Highway and George Washington Highway and added to the reduction in total number of fatal and injury crashes from 1 at the intersection.

Table 17: CMF and Crash Reduction Summary

Alternative	F+I CMF	Annual Crash Reduction (F+I)
Dual Left Turns	0.97	2.3*
Partial Displaced Left Turn	0.81	1.3
Bowtie	0.77	1.6
Quadrant Roadway (Northeast)	0.85**	1.0
Partial Median U-Turn	0.88	0.8

\*Annual crash reduction also includes reduction in angle crashes due to conversion of FYA to protected left-turn phasing

\*\*No CMF exists; manually calculated based on reduction in conflict points

### 2.2.2 Phase 2 Alternative Screening Summary

The primary goal of the Phase 2 alternatives development effort was to prepare a refined set of alternatives to present to the public and solicit feedback. The study team compared each alternative across several metrics using the iCAP screening tool including traffic operations, safety, pedestrian and bicycle access, and cost to determine the refined list of concepts to present to the public. The iCAP Stage 2 results are shown in **Figure 31** and **Figure 32**.

Figure 31: iCAP Stage 2 Results – AM Peak Hour

Alternative	Traffic Operations Metric			Pedestrian Metric Score	Safety Metric		Stage 2 Cost Metric		Total Stage 2 Score
	MOE 1 Score	MOE 2 Score	Total Score		Annual F+I Crash Reduction	Score	VJuST-C Cost Estimate	Score	
Bowtie NB-SB	0.7		0.7	1.0	1.55	0.7	\$38,800,000	0.3	6.5 out of 9
Dual Lefts	0.8		0.8	0.5	2.28	1.0	\$ 11,600,000	1.0	7.4 out of 9
Partial Displaced Left Turn EB-WB	1.0		1.0	0.0	1.28	0.6	\$ 19,100,000	0.6	5.4 out of 9
Partial Median U-Turn EB-WB	1.0		1.0	1.0	0.81	0.4	\$ 18,600,000	0.6	6.8 out of 9
Quadrant Roadway N-E	0.7		0.7	0.5	1.01	0.4	\$ 20,100,000	0.6	4.9 out of 9
<b>Metric Weighting</b>	<b>3</b>			<b>2</b>	<b>3</b>		<b>1</b>		

Figure 32: iCAP Stage 2 Results – PM Peak Hour

Alternative	Traffic Operations Metric			Pedestrian Metric Score	Safety Metric		Stage 2 Cost Metric		Total Stage 2 Score
	MOE 1 Score	MOE 2 Score	Total Score		Annual F+I Crash Reduction	Score	VJuST-C Cost Estimate	Score	
Bowtie NB-SB	0.7		0.7	1.0	1.55	0.7	\$38,800,000	0.3	6.5 out of 9
Dual Lefts	0.8		0.8	0.5	2.28	1.0	\$ 11,600,000	1.0	7.4 out of 9
Partial Displaced Left Turn EB-WB	1.0		1.0	0.0	1.28	0.6	\$ 19,100,000	0.6	5.4 out of 9
Partial Median U-Turn EB-WB	0.9		0.9	1.0	0.81	0.4	\$ 18,600,000	0.6	6.5 out of 9
Quadrant Roadway N-E	0.8		0.8	0.5	1.01	0.4	\$ 20,100,000	0.6	5.2 out of 9
<b>Metric Weighting</b>	<b>3</b>			<b>2</b>	<b>3</b>		<b>1</b>		

# 3 Public & Stakeholder Outreach & Feedback

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

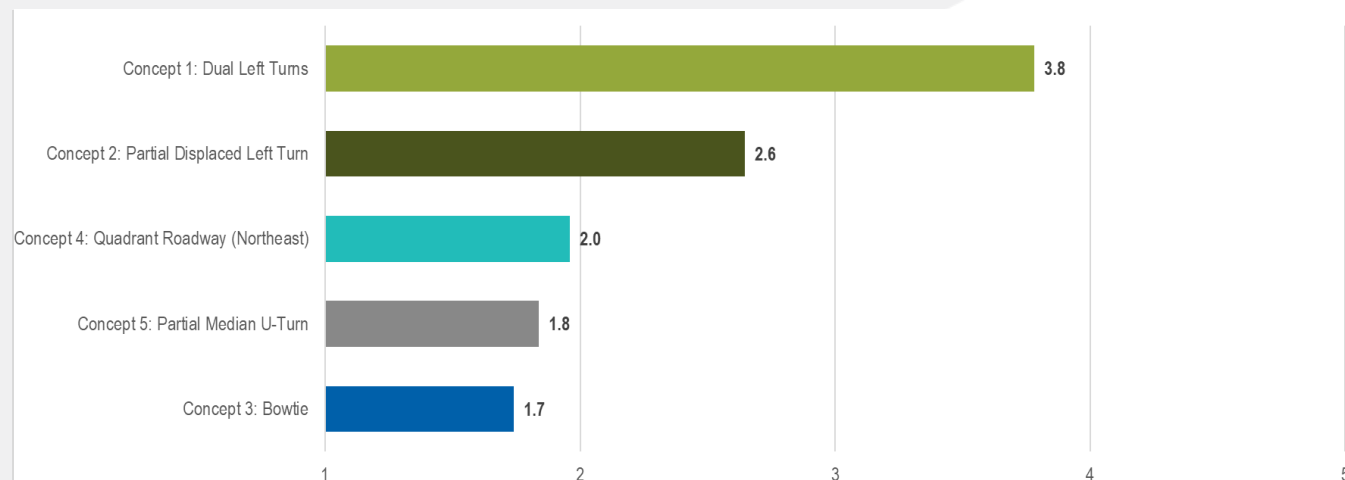
## 3.1 Stakeholder Coordination

Stakeholder engagement is a key part in making the recommendations successful since the stakeholders provide regional and local knowledge about the study area and help guide the study direction. The project stakeholders identified in **Chapter 1.3** were involved in all steps of the Project Pipeline process and assisted in making decisions about which concepts to move forward to public engagement.

## 3.2 Public Involvement

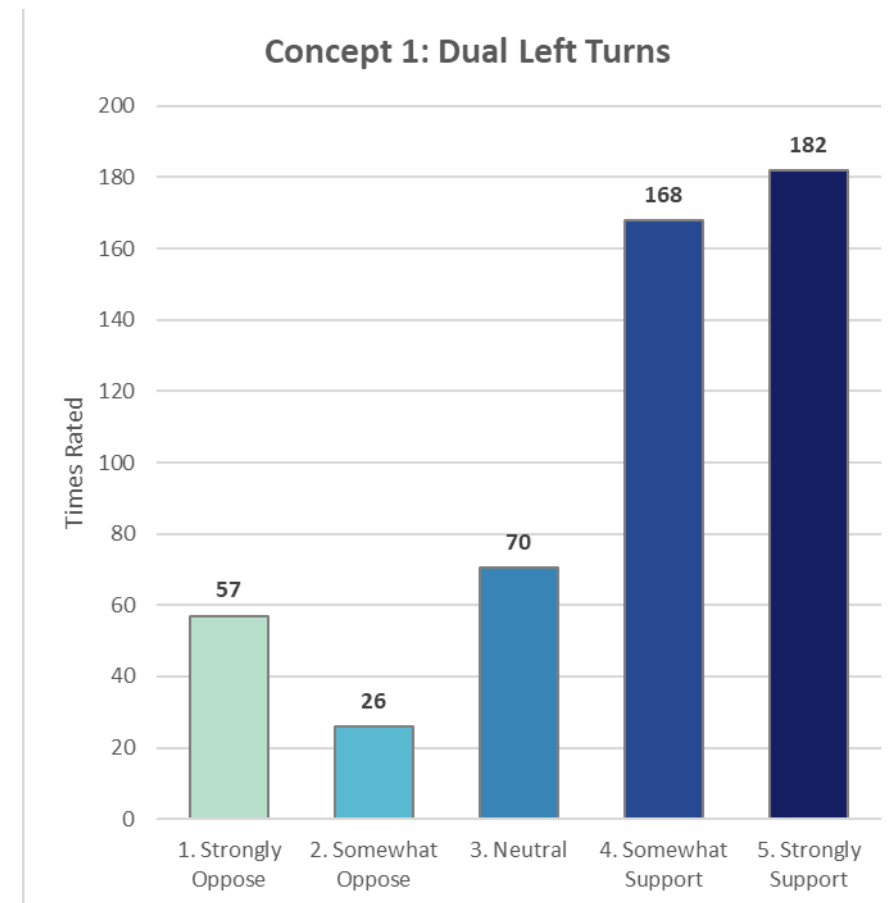
A PublicInput survey was held from March 6 to March 20, 2024, to collect feedback on the potential improvements within the study corridor. The survey provided Kimley-Horn, the City of Chesapeake, and VDOT with an understanding of how the public viewed each concept before selecting a preferred option. **Figure 33** summarizes the average ranking for each alternative presented in the survey at the intersection of S Military Highway and George Washington Highway. A rating of 5.0 represents a strongly supported concept and a rating of 1.0 represents a strongly opposed concept.

**Figure 33: Public Engagement – Average Rating of Alternatives**



As shown in **Figure 33**, the public's most highly supported alternative was the dual left turns concept with an average rating of 3.8. **Figure 34** summarizes the public's rating on the dual left turns concept. Of the 503 respondents, 70% were in support of this concept. Many respondents expressed support for the concept because of its simplicity and expressed concern with other innovative intersection concepts due to their complexity and possible confusion it would cause roadway users. Detailed survey results are shown in **Appendix E**.

**Figure 34: Public Engagement – Dual Left Turns Concept Ratings**



The study team incorporated input from the survey to finalize the preferred alternative. Rankings from the public involvement survey were in line with the preferences of the study work group.

Kimley-Horn presented the PublicInput survey results to the study work group on March 20, 2024. During this meeting, Kimley-Horn suggested a set of alternatives to advance towards the development of a preferred alternative as outlined in **Chapter 2.2**. After reviewing the survey results, iCAP Stage 2 results, and further discussing the concepts, the study group decided to move forward with the dual left turns concept as the preferred alternative. Along with the addition of the dual left turn lanes in the eastbound and westbound directions, conversion of the flashing yellow arrow (FYA) to protected phasing, removal of the service road along the southside of S Military Highway, and the addition of a shared-use path along the southside of S Military Highway, the study work group decided to remove all channelized right-turn lanes and route them to the main intersection, as shown in **Figure 35**.

**Appendix E** includes presentation materials from the Preferred Alternatives meeting and the Phase 2 Executive Summary.

**Figure 35: Dual Left Turns Concept – Preferred Alternative**





## 4 Preferred Alternative & Investment Strategy

Phase 3 of the study included a detailed design, cost estimate, risk assessment, and further operations assessment of the selected preferred alternative.

### 4.1 Preferred Alternative Selection

The SWG selected the preferred alternative during the Preferred Alternatives meeting held on March 20, 2024. During the meeting, the SWG refined the dual left turns concept to tie the channelized right turn lanes into the intersection. The northbound and southbound channelized right turn lanes will be signalized while the eastbound and westbound channelized right turn lanes will remain yield controlled. **Appendix E** includes presentation materials from the Preferred Alternatives meeting.

A Risk Evaluation meeting was held on June 12, 2024. The SWG decided to include a four-foot raised median at the approaches to S Military Highway along George Washington Highway to match the George Washington Highway widening project. The SWG also agreed to add porkchop islands to the eastbound and westbound right turns which will create a pedestrian refuge on the eastbound porkchop to connect to the proposed shared-use path along the south side of S Military Highway. A Final Review meeting was held on July 10, 2024 to review the final preferred alternative.

**Figure 36** presents the preferred alternative planning level sketch. **Appendix F** includes presentation materials from the Risk Evaluation meeting and Final Review meeting.

### 4.2 Operational Analysis

Once the preferred alternative was selected, the study team conducted Synchro and SimTraffic analyses to refine the geometry of the preferred alternative and quantify the anticipated future traffic operations. The Build Synchro and SimTraffic models include the anticipated widening of George Washington Highway, which adds a second northbound and southbound through lane in each direction in the project area. Traffic signal cycle lengths were assumed to be consistent with No-Build conditions, while splits and offsets were optimized.

Build conditions analyses were conducted for the AM and PM peak periods. **Table 18** through **Table 23** summarize the control delay and SimTraffic maximum queue lengths measures of effectiveness and compare the Build conditions results against the No-Build conditions results.

In the AM and PM peak hours, the overall delay at the intersection of S Military Highway and George Washington Highway was comparable to No-Build conditions. For both peak hours, the eastbound and

westbound approach delays increased by less than five seconds, each. The increase in delay can be attributed to the conversion of eastbound and westbound left-turn phasing from flashing yellow arrow (FYA) to protected phasing. In the PM peak hour, delay results showed that the northbound and southbound approaches improved by almost ten seconds, each. The decrease in delay results from the northbound and southbound approaches receiving additional green time due to the eastbound and westbound dual left turn lane conversion.

Queue results showed significant improvements in Build conditions compared to No-Build conditions. In the AM peak hour, the westbound left-turn queue had a reduction of 70 feet which can be attributed to the additional left-turn lane providing more left-turn storage space. In the PM peak hour, the eastbound, westbound, and southbound approach queues improved by 100 feet to over 300 feet. The decrease in queue resulted from the additional left-turn lanes and southbound approach receiving additional green time. **Appendix F** includes the full Synchro and SimTraffic results from the analysis.

#### 4.2.1 Sensitivity Analysis

The George Washington Highway widening project is in HRTPO's 2045 Long-Range Transportation Plan (LRTP) and is included in the Build conditions analysis; however, the project is currently not fully funded. The study team conducted an additional analysis to show that the preferred dual left turn concept can operate independently of the George Washington Highway widening.

In the AM peak hour, the overall delay at the intersection of S Military Highway and George Washington Highway decreased by three seconds. Eastbound delay increased by almost six seconds; however, all other approaches decreased in delay by 15 seconds or less. In the PM peak hour, the overall delay was comparable to No-Build conditions. The eastbound and westbound delays increased by almost ten seconds or less; however, the northbound and southbound delays decreased by almost ten seconds, each.

In the AM peak hour, the southbound right-turn delay at the intersection of Yadkin Road/Old George Washington Highway and George Washington Highway performed at LOS F. This was caused by an increase in the movement's Synchro-calculated progression factor when the offsets were optimized. The study team observed the SimTraffic model and the southbound right turn appeared to operate acceptably. The maximum queue is projected to be 100 feet.

Queue results showed improvements for most approaches in Build conditions without the widening compared to No-Build conditions without the widening. In the AM peak hour, all approach through movements decreased in queue by 20 feet to over 300 feet. However, the northbound left-turn queue increased by almost 300 feet. In the PM peak hour, the eastbound, westbound, and southbound queues decreased by almost 300 feet to over 650 feet. The northbound left-turn queue was similar in Build conditions and No-Build conditions.

**Appendix F** includes the summary tables for control delay and SimTraffic maximum queue lengths and the full Synchro and SimTraffic results from the sensitivity Build analysis.

Figure 36: Preferred Alternative Planning Level Sketch

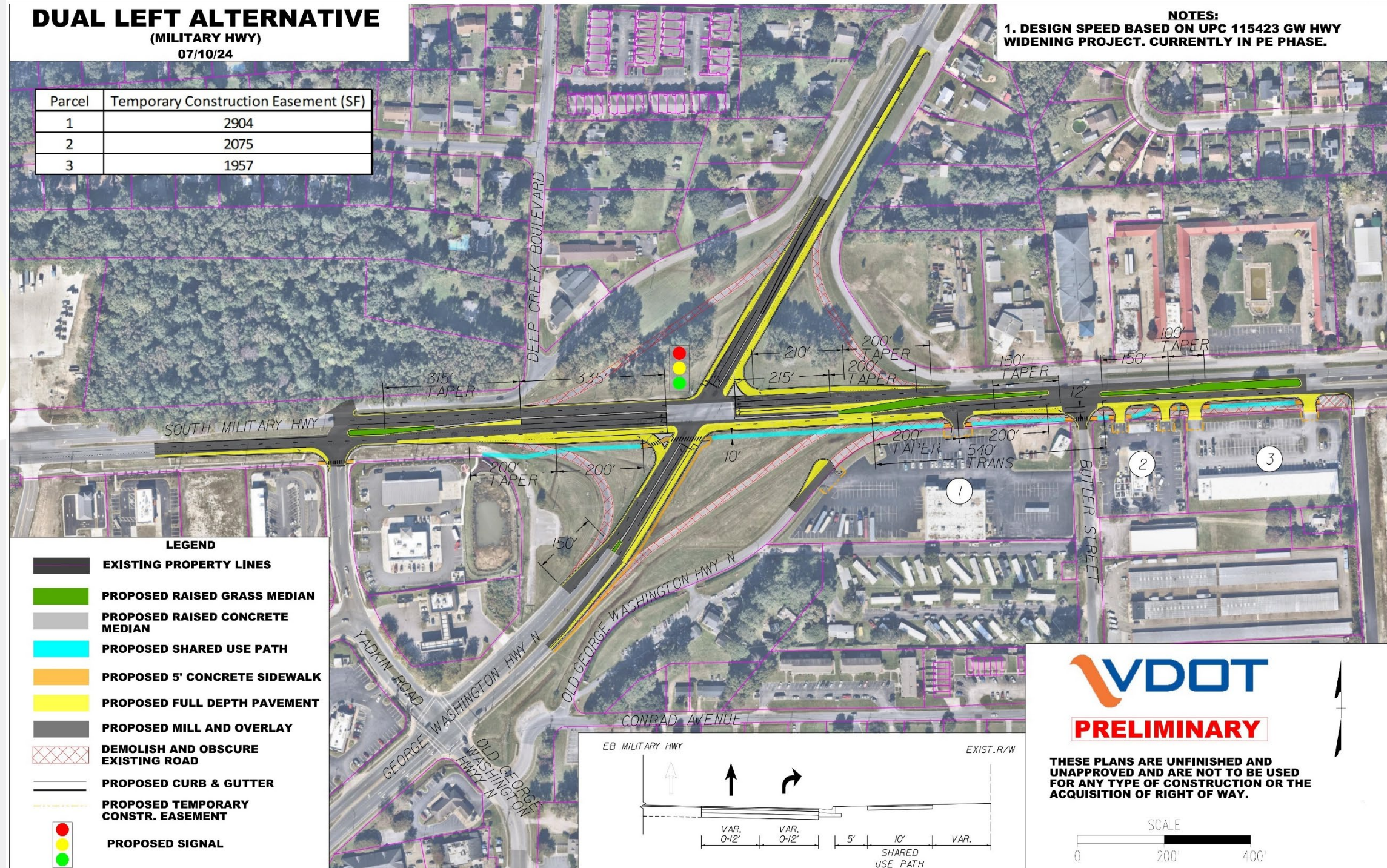


Table 18: 2045 Preferred Alternative AM Peak Hour Control Delay and LOS (1)

Intersection Number and Description	Type of Control	Lane Group	Eastbound				Westbound				Northbound				Southbound				Overall		
			No-Build		Build		No-Build		Build		No-Build		Build		No-Build		Build		No-Build	Build	
			Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	
1 S Military Hwy and George Washington Hwy	Signalized	S Military Hwy		S Military Hwy		George Washington Hwy		George Washington Hwy		Intersection		Delay		Delay		Delay		Delay			
		Left	21.7	C	56.5	E	27.2	C	62.7	E	55.7	E	54.6	D	33.8	C	33.9	C	38.0	41.3	
		Through	35.3	D	35.4	D	33.0	C	33.0	C	45.3	D	52.6	D	51.2	D	51.2	D	LOS	LOS	
		Right	25.6	C	25.7	C	26.1	C	26.1	C	0.0	A	44.8	D	0.0	A	29.9	C	D	D	
		Approach	31.8	C	35.8	D	31.4	C	36.3	D	48.3	D	51.3	D	46.5	D	43.9	D			
2 S Military Hwy and Strickland Brothers Driveway	Unsignalized	S Military Hwy		S Military Hwy		Strickland Brothers Driveway		Driveway		Intersection		Delay		Delay		Delay		Delay			
		Left	15.3	C	15.3	C	13.6	B	13.6	B	418.6	F	418.6	F	16.6	C	16.6	C	-	-	
		Through	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†
		Right	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†
		Approach	0.0	A	0.0	A	0.6	A	0.6	A	380.7	F	380.7	F	16.6	C	16.6	C	-	-	
3 S Military Hwy and Yadkin Rd/Deep Creek Blvd (Frontage Rd)	Unsignalized	S Military Hwy		S Military Hwy		Yadkin Rd		Deep Creek Blvd (Frontage Rd)		Intersection		Delay		Delay		Delay		Delay			
		Left	†	†	†	†	15.2	C	15.2	C	†	†	†	†	†	†	†	†	†	†	
		Through	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	
		Right	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	
		Approach	0.0	A	0.0	A	1.3	A	1.3	A	17.5	C	17.5	C	14.6	B	14.6	B	LOS	LOS	
4 S Military Hwy and Butler St	Unsignalized	S Military Hwy		S Military Hwy		Butler St		Comfort Inn		Intersection		Delay		Delay		Delay		Delay			
		Left	14.7	B	14.7	B	18.7	C	18.7	C	91.6	F	91.6	F	26.2	D	26.2	D	-	-	
		Through	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	
		Right	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	
		Approach	0.2	A	0.2	A	1.3	A	1.3	A	91.6	F	91.6	F	26.2	D	26.2	D	-	-	
5 S Military Hwy and Deep Creek Plaza Driveway	Unsignalized	S Military Hwy		S Military Hwy		Deep Creek Plaza		Driveway		Intersection		Delay		Delay		Delay		Delay			
		Left	13.4*	B	13.4*	B	23.0	C	23.0	C	32.6	D	32.6	D	43.0	E	43.0	E	-	-	
		Through	1.0	A	1.0	A	†	†	†	†	†	†	†	†	†	†	†	†	†	†	
		Right	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	
		Approach	1.1	A	1.1	A	0.1	A	0.1	A	32.6	D	32.6	D	43.0	E	43.0	E	-	-	

- Denotes the overall intersection is stop controlled and no level of service or delay is reported  
 † SYNCHRO does not provide level of service or delay for movements with no conflicting volumes  
 \* Lane group is a shared left/through movement

Table 19: 2045 Preferred Alternative AM Peak Hour Control Delay and LOS (2)

Intersection Number and Description	Type of Control	Lane Group	Eastbound				Westbound				Northbound				Southbound				Overall	
			No-Build		Build		No-Build		Build		No-Build		Build		No-Build		Build		No-Build	Build
			Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
6 S Military Hwy and Baugher Ave	Unsignalized	S Military Hwy		S Military Hwy		Dollar General		Baugher Ave		Intersection		Delay		Delay		-		-		
		Left	10.7	B	10.7	B	17.1	C	17.1	C	13.8	B	13.8	B	77.1	F	77.1	F	LOS	LOS
		Through	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†
		Right	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†
		Approach	0.2	A	0.2	A	0.1	A	0.1	A	13.8	B	13.8	B	77.1	F	77.1	F	-	-
7 George Washington Hwy and Deep Creek Blvd (Frontage Rd)	Unsignalized	Deep Creek Blvd (Frontage Rd)		Service Rd		George Washington Hwy		George Washington Hwy		Intersection		Delay		Delay		-		-		
		Left	11.7	B	11.7	B	15.7	C	15.7	C	9.9	A	9.9	A	9.2	A	9.2	A	LOS	LOS
		Through	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†
		Right	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†
		Approach	11.7	B	11.7	B	15.7	C	15.7	C	0.1	A	0.1	A	0.0	A	0.0	A	-	-
8 George Washington Hwy and Yadkin Rd/Old George Washington Hwy	Signalized	Yadkin Rd		Old George Washington Hwy		George Washington Hwy		George Washington Hwy		Intersection		Delay		Delay		36.1		35.2		
		Left	44.6	D	44.6	D	53.6	D	53.6	D	21.7	C	21.7	C	18.8	B	13.7	B	LOS	LOS
		Through	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†
		Right	38.6	D	38.6	D	48.9	D	48.9	D	25.6	C	25.6	C	47.6	D	44.4	D	LOS	LOS
		Approach	40.8	D	40.8	D	51.2	D	51.2	D	24.8	C	24.8	C	41.8	D	39.4	D	D	D
9 Deep Creek Blvd and Deep Creek Blvd (Frontage Rd)	Unsignalized	Deep Creek Blvd (Frontage Rd)		Deep Creek Blvd		Deep Creek Blvd		Deep Creek Blvd		Intersection		Delay		Delay		-		-		
		Left	9.0	A	9.0	A	9.0	A	9.0	A	†	†	†	†	†	†	†	†	LOS	LOS
		Through	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†
		Right	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†
		Approach	9.0	A	9.0	A	9.0	A	9.0	A	†	†	†	†	†	†	†	†	-	-

- Denotes the overall intersection is stop controlled and no level of service or delay is reported  
 † SYNCHRO does not provide level of service or delay for movements with no conflicting volumes  
 \* Lane group is a shared left/through movement

Table 20: 2045 Preferred Alternative PM Peak Hour Control Delay and LOS (1)

Intersection Number and Description	Type of Control	Lane Group	Eastbound				Westbound				Northbound				Southbound				Overall	
			No-Build		Build		No-Build		Build		No-Build		Build		No-Build		Build		AM	PM
			Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS		
1 S Military Hwy and George Washington Hwy	Signalized	S Military Hwy		S Military Hwy		George Washington Hwy		George Washington Hwy		Intersection		Delay		Delay						
		Left	51.1	D	63.6	E	33.2	C	67.0	E	72.1	E	58.2	E	46.7	D	41.5	D	44.6	44.9
		Through	34.2	C	35.4	D	39.9	D	39.8	D	59.8	E	56.0	E	59.7	E	56.0	E	LOS	LOS
		Right	24.7	C	25.3	C	25.2	C	25.2	C	0.0	A	43.4	D	0.0	A	30.3	C	D	D
		Approach	35.4	D	38.5	D	36.8	D	41.7	D	62.5	E	53.1	D	57.2	E	50.3	D		
2 S Military Hwy and Strickland Brothers Driveway	Unsignalized	S Military Hwy		S Military Hwy		Strickland Brothers Driveway		Driveway		Intersection		Delay		Delay						
		Left	12.1	B	12.1	B	14.8	B	14.8	B	993.7	F	993.7	F	125.7	F	125.7	F	-	-
		Through	†	†	†	†	†	†	†	†									LOS	LOS
		Right	†	†	†	†	†	†	†	†	14.6	B	14.6	B					-	-
		Approach	0.0	A	0.0	A	1.0	A	1.0	A	934.4	F	934.4	F	125.7	F	125.7	F		
3 S Military Hwy and Yadkin Rd/Deep Creek Blvd (Frontage Rd)	Unsignalized	S Military Hwy		S Military Hwy		Yadkin Rd		Deep Creek Blvd (Frontage Rd)		Intersection		Delay		Delay						
		Left					14.9	B	14.9	B									-	-
		Through	†	†	†	†	†	†	†	†									LOS	LOS
		Right	†	†	†	†					19.6	C	19.6	C	21.9	C	21.9	C	-	-
		Approach	0.0	A	0.0	A	0.9	A	0.9	A	19.6	C	19.6	C	21.9	C	21.9	C		
4 S Military Hwy and Butler St	Unsignalized	S Military Hwy		S Military Hwy		Butler St		Comfort Inn		Intersection		Delay		Delay						
		Left	26.5	D	26.5	D	18.4	C	18.4	C	830.0	F	830.0	F	131.2	F	131.2	F	-	-
		Through	†	†	†	†	†	†	†	†									LOS	LOS
		Right	†	†	†	†													-	-
		Approach	0.6	A	0.6	A	1.5	A	1.5	A	830.0	F	830.0	F	131.2	F	131.2	F		
5 S Military Hwy and Deep Creek Plaza Driveway	Unsignalized	S Military Hwy		S Military Hwy		Deep Creek Plaza		Driveway		Intersection		Delay		Delay						
		Left	27.5*	D	27.5*	D	13.9	B	13.9	B	155.3	F	155.3	F	204.9	F	204.9	F	-	-
		Through	5.1	A	5.1	A	†	†	†	†									LOS	LOS
		Right	†	†	†	†													-	-
		Approach	5.2	A	5.2	A	0.2	A	0.2	A	155.3	F	155.3	F	204.9	F	204.9	F		

- Denotes the overall intersection is stop controlled and no level of service or delay is reported  
 † SYNCHRO does not provide level of service or delay for movements with no conflicting volumes  
 \* Lane group is a shared left/through movement

Table 21: 2045 Preferred Alternative PM Peak Hour Control Delay and LOS (2)

Intersection Number and Description	Type of Control	Lane Group	Eastbound				Westbound				Northbound				Southbound				Overall		
			No-Build		Build		No-Build		Build		No-Build		Build		No-Build		Build		AM	PM	
			Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS			
6 S Military Hwy and Baugher Ave	Unsignalized	S Military Hwy		S Military Hwy		Dollar General		Baugher Ave		Intersection		Delay		Delay							
		Left	16.4	C	16.4	C	17.7	C	17.7	C	356.1	F	356.1	F	1419.1	F	1419.1	F	-	-	
		Through	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†
		Right	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†
		Approach	0.6	A	0.6	A	0.2	A	0.2	A	356.1	F	356.1	F	1419.1	F	1419.1	F	-	-	
7 George Washington Hwy and Deep Creek Blvd (Frontage Rd)	Unsignalized	Deep Creek Blvd (Frontage Rd)		Service Rd		George Washington Hwy		George Washington Hwy		Intersection		Delay		Delay							
		Left	15.1	C	15.1	C	19.8	C	19.8	C	9.8	A	9.8	A	10.2	B	10.2	B	-	-	
		Through	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†
		Right	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†
		Approach	15.1	C	15.1	C	19.8	C	19.8	C	0.2	A	0.2	A	0.2	A	0.2	A	-	-	
8 George Washington Hwy and Yadkin Rd/Old George Washington Hwy	Signalized	Yadkin Rd		Old George Washington Hwy		George Washington Hwy		George Washington Hwy		Intersection		Delay		Delay							
		Left	46.7	D	46.7	D	48.7	D	48.7	D	22.1	C	22.1	C	13.8	B	9.2	A	29.8	28.0	
		Through	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†
		Right	38.9	D	38.9	D	43.7	D	43.7	D	33.7	C	33.7	C	8.1	A	9.3	A	LOS	LOS	
		Approach	42.8	D	42.8	D	46.0	D	46.0	D	31.7	C	31.7	C	18.5	B	13.9	B	C	C	
9 Deep Creek Blvd and Deep Creek Blvd (Frontage Rd)	Unsignalized	Deep Creek Blvd (Frontage Rd)		Deep Creek Blvd		Deep Creek Blvd		Deep Creek Blvd		Intersection		Delay		Delay							
		Left	9.4	A	9.4	A	9.4	A	9.4	A	†	†	†	†	†	†	†	†	-	-	
		Through	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†
		Right	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†
		Approach	9.4	A	9.4	A	9.4	A	9.4	A	†	†	†	†	†	†	†	†	-	-	

- Denotes the overall intersection is stop controlled and no level of service or delay is reported  
 † SYNCHRO does not provide level of service or delay for movements with no conflicting volumes  
 \* Lane group is a shared left/through movement

Table 22: 2045 Preferred Alternative AM Peak Hour Maximum Queues (1)

Intersection Number and Description		Type of Control	Lane Group	Eastbound		Westbound		Northbound		Southbound	
				No-Build	Build	No-Build	Build	No-Build	Build	No-Build	Build
1	S Military Hwy and George Washington Hwy	Signal	S Military Hwy		S Military Hwy		George Washington Hwy		George Washington Hwy		
			Left	290	** (1%)	190	120	250	*(1%)** (1%)	245	** (2%)
			Through	460	415	290	285	335	325	315	340
			Right	0	** (2%)	0	135	220	195	120	** (1%)
2	S Military Hwy and Strickland Brothers Driveway	Signal	S Military Hwy		S Military Hwy		Strickland Brothers Driveway		Driveway		
			Left	20	30	80	60	100	*(1%)	35	30
			Through	†	†	†	†	25	** (1%)	35	30
			Right	†	15	†	†	25	** (1%)	35	30
3	S Military Hwy and Yadkin Rd/Deep Creek Blvd (Frontage Rd)	Signal	S Military Hwy		S Military Hwy		Yadkin Rd		Deep Creek Blvd (Frontage Rd)		
			Left			130	125				
			Through	†	†	†	†				
			Right	†	†			130	120	110	110
4	S Military Hwy and Butler St	Signal	S Military Hwy		S Military Hwy		Butler St		Comfort Inn		
			Left	60	55	90	80	110	95	60	50
			Through	†	†	†	†	110	95	60	50
			Right	†	†	†	†	110	95	60	50
5	S Military Hwy and Deep Creek Plaza Driveway	Signal	S Military Hwy		S Military Hwy		Deep Creek Plaza		Driveway		
			Left	55	60	30	35	40	35	35	35
			Through	†	†	†	†	40	35	35	35
			Right	†	†	†	†	40	35	35	35

† No queue reported. Movement does not have conflicting volumes

\*(X%) - Maximum queue extends full length of storage bay for X% of the analysis period

\*\* (Y%) - Queue in lane adjacent to storage bay extends beyond end of storage bay for Y% of the analysis period

^(Z%) - Maximum queue extends back to the upstream intersection for Z% of the analysis period

Table 23: 2045 Preferred Alternative AM Peak Hour Maximum Queues (2)

Intersection Number and Description		Type of Control	Lane Group	Eastbound		Westbound		Northbound		Southbound	
				No-Build	Build	No-Build	Build	No-Build	Build	No-Build	Build
6	S Military Hwy and Baugher Ave	Signal	S Military Hwy		S Military Hwy		Dollar General		Baugher Ave		
			Left	50	45	25	25	15	15	135	155
			Through	†	†	†	†	15	15	135	155
			Right	†	†	†	†	15	15	135	155
7	George Washington Hwy and Deep Creek Blvd (Frontage Rd)	Signal	Deep Creek Blvd (Frontage Rd)		Service Rd		George Washington Hwy		George Washington Hwy		
			Left	30	30	55	55	35	35	25	25
			Through	30	30	55	55	†	†	†	†
			Right	30	30	55	55	†	†	†	†
8	George Washington Hwy and Yadkin Rd/Old George Washington Hwy	Signal	Yadkin Rd		Old George Washington Hwy		George Washington Hwy		George Washington Hwy		
			Left	295	^(7%)	*(8%)	230	290	270	** (3%)	** (4%)
			Through	295	^(7%)	240	230	400	305	400	410
			Right	295	^(2%)	110	** (8%)	305	310	75	185
9	Deep Creek Blvd and Deep Creek Blvd (Frontage Rd)	Signal	Deep Creek Blvd (Frontage Rd)		Deep Creek Blvd (Frontage Rd)		Deep Creek Blvd		Deep Creek Blvd		
			Left			25	25			†	†
			Through								
			Right			25	25			†	†

† No queue reported. Movement does not have conflicting volumes

\*(X%) - Maximum queue extends full length of storage bay for X% of the analysis period

\*\* (Y%) - Queue in lane adjacent to storage bay extends beyond end of storage bay for Y% of the analysis period

^(Z%) - Maximum queue extends back to the upstream intersection for Z% of the analysis period



Table 24: 2045 Preferred Alternative PM Peak Hour Maximum Queues (1)

Intersection Number and Description		Type of Control	Lane Group	Eastbound		Westbound		Northbound		Southbound	
				No-Build	Build	No-Build	Build	No-Build	Build	No-Build	Build
1	S Military Hwy and George Washington Hwy	Signal	S Military Hwy		S Military Hwy		George Washington Hwy		George Washington Hwy		
			Left	*(3%)*(5%)	** (1%)	** (20%)	** (3%)	** (4%)	** (2%)	*(6%)*(20%)	** (2%)
			Through	480	380	760	450	350	310	540	330
			Right	0	** (1%)	55	** (4%)	255	265	135	150
2	S Military Hwy and Strickland Brothers Driveway	Signal	S Military Hwy		S Military Hwy		Strickland Brothers Driveway		Driveway		
			Left	10	5	130	115	*(5%)	*(5%)*(2%)	25	35
			Through	†	†	†	†	85	^(4%)	25	35
			Right	†	†	†	†	85	^(4%)	25	35
3	S Military Hwy and Yadkin Rd/Deep Creek Blvd (Frontage Rd)	Signal	S Military Hwy		S Military Hwy		Yadkin Rd		Deep Creek Blvd (Frontage Rd)		
			Left			115	105				
			Through	†	†	†	†				
			Right	†	†			130	130	175	180
4	S Military Hwy and Butler St	Signal	S Military Hwy		S Military Hwy		Butler St		Comfort Inn		
			Left	65	70	120	120	295	^(29%)	60	60
			Through	†	†	†	†	295	^(29%)	60	60
			Right	†	†	†	†	295	^(29%)	60	60
5	S Military Hwy and Deep Creek Plaza Driveway	Signal	S Military Hwy		S Military Hwy		Deep Creek Plaza		Driveway		
			Left	145	155	45	50	105	120	35	30
			Through	†	†	†	†	105	120	35	30
			Right	†	†	†	†	105	120	35	30

† No queue reported. Movement does not have conflicting volumes

\*(X%) - Maximum queue extends full length of storage bay for X% of the analysis period

\*\* (Y%) - Queue in lane adjacent to storage bay extends beyond end of storage bay for Y% of the analysis period

^(Z%) - Maximum queue extends back to the upstream intersection for Z% of the analysis period

Table 25: 2045 Preferred Alternative PM Peak Hour Maximum Queues (2)

Intersection Number and Description		Type of Control	Lane Group	Eastbound		Westbound		Northbound		Southbound	
				No-Build	Build	No-Build	Build	No-Build	Build	No-Build	Build
6	S Military Hwy and Baugher Ave	Signal	S Military Hwy		S Military Hwy		Dollar General		Baugher Ave		
			Left	70	65	35	45	110	100	395	^(1%)
			Through	†	†	†	†	110	100	395	^(1%)
			Right	†	†	†	†	110	100	395	^(1%)
7	George Washington Hwy and Deep Creek Blvd (Frontage Rd)	Signal	Deep Creek Blvd (Frontage Rd)		Service Rd		George Washington Hwy		George Washington Hwy		
			Left	35	35	55	45	40	35	30	35
			Through	35	35	55	45	†	†	†	†
			Right	35	35	55	45	†	†	†	†
8	George Washington Hwy and Yadkin Rd/Old George Washington Hwy	Signal	Yadkin Rd		Old George Washington Hwy		George Washington Hwy		George Washington Hwy		
			Left	285	^(11%)	460	415	255	** (1%)	** (2%)	** (2%)
			Through	285	^(11%)	460	415	345	390	400	345
			Right	185	^(1%)	110	*(1%)** (23%)	345	390	75	90
9	Deep Creek Blvd and Deep Creek Blvd (Frontage Rd)	Signal	Deep Creek Blvd (Frontage Rd)		Deep Creek Blvd (Frontage Rd)		Deep Creek Blvd		Deep Creek Blvd		
			Left			40	45			†	†
			Through								
			Right			40	45			†	†

† No queue reported. Movement does not have conflicting volumes

\*(X%) - Maximum queue extends full length of storage bay for X% of the analysis period

\*\* (Y%) - Queue in lane adjacent to storage bay extends beyond end of storage bay for Y% of the analysis period

^(Z%) - Maximum queue extends back to the upstream intersection for Z% of the analysis period

### 4.3 Planning-Level Sketch and Cost Estimates

Appendix F includes the Basis of Design Memo detailing the established project design criteria, field review notes, risk assessment, and assumptions made during the design effort.

An engineer’s preliminary opinion of probable cost was created for construction costs, right of way acquisition costs, and utility relocation costs for the preferred alternative. These cost opinions established the project budget, in FY2024 dollars, as shown in Table 26. Detailed cost estimates are included in Appendix F.

Table 26: HR-23-07 Preferred Alternative Improvements

Phase Description	Budget (FY2024)
Preliminary Engineering	\$ 2,150,000
Right of Way and Utility Relocation	\$ 450,000
Construction	\$15,840,000
<b>Total Project Budget</b>	<b>\$18,440,000</b>

### 4.4 Schedule Estimates

A schedule estimate was developed for the preferred alternative. Table 27 summarizes the projected timeframes for the preliminary engineering (PE), right of way (RW), and construction (CN) phases.

Table 27: Schedule Estimate

Estimated Schedule by Phase (months)	PE	RW	CN	Total
Preferred Concept (all inclusive)	33	13	31	77

### 4.5 Project Risks

All projects have risks; however, some projects may have more significant risks than others due to technical complexity, funding, financing, and stakeholder acceptance. Risk management generally involves the process of anticipating what risks a project may face, mitigating them to the extent reasonably possible, and having a plan to react to them if and when they occur. This is recognized in VDOT guidance regarding the analysis of and mitigation of risks.

The following is a list the most notable potential issues that may affect project development, risks faced by the project, and risk mitigation strategies to be applied to manage and minimize risks throughout project development. Appendix F includes the risk analysis matrix with details on the risk assessment and mitigation strategy.

#### Risk/Issue: Roadway Design

The posted speed limit of 45 is used as the proposed design speed to align with adjacent City widening projects and provide more positive protection for shared use path.

#### Risk/Issue: Right of Way

Three parcels will be impacted along S Military Highway for access improvements. All impacts will require a temporary construction easement to tie in the proposed improvements to the existing conditions. There are two access points being removed for access management to parcel 1 that may increase costs during negotiations.

#### Risk/Issue: Environmental

Based on the desktop environmental review, the following areas may require additional studies or data analysis: (1) The study area is located within northern long-eared bat (NLEB) year-round preservation area; however, there is no tree clearing anticipated based on the proposed improvements; (2) active registered petroleum tanks are located within the study area that may require Phase I and Phase II testing; and (3) a noise analysis may be required.

#### Rise/Issue: Utilities

There were above ground appurtenances observed during the field visit signifying the presence of underground utilities such as fiber optic communication lines, gas, water, and sewer (force main and gravity). Based on observed above ground appurtenances and available GIS data, there are areas of fiber optic communication lines, overhead power poles, light poles, water, sewer force main and gravity sewer identified to be relocated to avoid impacts with proposed widening, storm drain system, curb and gutter, and shared use path.

#### Risk/Issue: Geotechnical

Areas of unsuitable material have been assumed and are undefined without a geotechnical report.

#### Risk/Issue: Drainage

There were several junction boxes observed within the widening footprint that will need to be modified and/or replaced in addition to several drop inlet tops that will need to be reset.

#### Risk/Issue: Coordination with other Ongoing Projects

The proposed improvements will likely require coordination with the City of Chesapeake based on plans currently under development for widening of the George Washington Highway corridor that extends beyond the limits of the preferred alternative.

#### **Risk/Issue: Additional Issues**

There are speed cameras owned by a third party within the project limits that will be impacted and require additional coordination. The City of Chesapeake would like to replace the existing lighting that is impacted with the preferred alternative. No other lighting analysis is anticipated.

### **4.6 Possible Funding Sources**

The City of Chesapeake elected to submit the preferred alternative for SMART SCALE funding, which includes dual left turn lanes in the eastbound and westbound directions, conversion of the flashing yellow arrow (FYA) to protected phasing, removal of the service road along the southside of S Military Highway, and the addition of a shared-use path along the southside of S Military Highway. The channelized right-turn lanes were also removed and placed at the main intersection. The widening of George Washington Highway to be completed by others will be funded separately from the SMART SCALE application.