I-95 AT ROUTE 123 INTERCHANGE ALTERNATIVES ANALYSIS

AND

ROUTE 123 AT OLD BRIDGE ROAD INTERSECTION ANALYSIS

PRINCE WILLIAM COUNTY, VIRGINIA

Draft Final Report

October 2022

STARS VDOT

I-95 at Route 123 Interchange Alternatives Analysis and Route 123 at Old Bridge Road Intersection Analysis

Prince William County, Virginia

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LIST OF ACRONYMS

AASHTO – American Association of State Highway and Transportation Officials

ADA – Americans with Disabilities Act

ADT – Average Daily Traffic

BRT – Bus Rapid Transit

C-D – Collector-Distributor

CEI – Construction Engineering and Inspection

CLRP – Constrained Long-Range Plan

CMAQ – Congestion Mitigation and Air Quality

CMF – Crash Modification Factor

CN – Construction

CTB – Commonwealth Transportation Board

DDI – Diverging Diamond Interchange

DGP – District Grants Program

FHWA – Federal Highway Administration

FI – Fatal and Injury Crashes

HCM – Highway Capacity Manual

HOV – High-Occupancy Vehicle

HPPP – High Priority Projects Program

HSIP – Highway Safety Improvement Program

HSM – Highway Safety Manual

IAR – Interchange Access Report

INFRA – Infrastructure for Rebuilding AmericaIOEP – Interstate Operations and Enhancement Program

L&D – Location and Design Division

LOS – Level of Service

LRS – Linear Referencing System

MOE – Measure of Effectiveness

MWCOG – Metropolitan Washington Council of Governments

NCHRP – National Cooperative Highway Research Program

NVTA – Northern Virginia Transportation Authority

PDO – Property Damage Only

PE – Preliminary Engineering

PSI – Potential for Safety Improvement

PWCTDM – Prince William County Travel Demand Model

RASIE – Rebuilding American Infrastructure with Sustainability and Equity

RMSE – Root Mean Square Error

S&B – Structure and Bridge Division

SPF – Safety Performance Function

STARS – Strategically Targeted Affordable Roadway Solutions

STIP – Statewide Transportation Improvement Plan

SWG – Study Work Group

SYIP – Six-Year Improvement Program

TIP – Transportation Improvement Plan

TMC – Turning Movement Count

TMPD – Transportation Mobility and Planning Division

TOSAM – Traffic Operations and Safety Analysis Manual

VDOT – Virginia Department of Transportation

VGIN – Virginia Geographic Information Network

VRE – Virginia Railway Express

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EXECUTIVE SUMMARY

Introduction

The Virginia Department of Transportation (VDOT), in cooperation with Prince William County, initiated this study to identify and evaluate potential improvements to both the I-95 at Route 123 interchange and the Route 123 at Old Bridge Road intersection. Prior to initiation of the STARS study, the I-95 at Route 123 interchange and surrounding area was identified through the I-95 Corridor Improvement Plan as needing further study for improving the interchange configuration to address safety and delay issues. The intersection of Route 123 and Old Bridge Road was also included in the STARS study given its proximity and interaction with interstate traffic.

Project Background and Study Purpose

The purpose of this study was to evaluate existing operational and safety deficiencies at the I-95 at Route 123 interchange and Route 123 at Old Bridge Road intersection to develop potential projects to improve operations, safety, and interchange and intersection geometry. Critical areas of need identified through the study were:

- Southbound I-95 bottleneck within the Route 123 interchange
- Weaving movement from southbound I-95 off-ramp to northbound left turn at Old Bridge Road
- Southbound Route 123 movement to southbound I-95
- Overcapacity intersections on Route 123 that propagate queues onto the southbound I-95 off-ramp
- Eastbound Old Bridge Road queues due to impacts of over-capacity conditions at the Route 123 and Occoquan Road intersections

The primary goal of the STARS program is to identify targeted improvements that both meet project needs and could be programmed into the VDOT Six-Year Improvement Program (SYIP). The study team considered whether the recommended improvements would perform favorably in the SMART SCALE or other transportation funding program project prioritization processes. Improvements identified for this study considered pedestrian and bicycle connectivity, transit connectivity, commuter lot access, compatibility with planned development, and growth in the study area.

The study was conducted in collaboration with a study work group (SWG) that provided input and shaped the development of the improvement alternatives. The SWG included members representing the following organizations:

- VDOT Northern Virginia District
- VDOT Central Office (Transportation Mobility and Planning Division [TMPD])
- VDOT Central Office (Location and Design Division [L&D])
- Prince William County (Department of Transportation)
- Federal Highway Administration (FHWA)
- Kimley-Horn
- RS&H

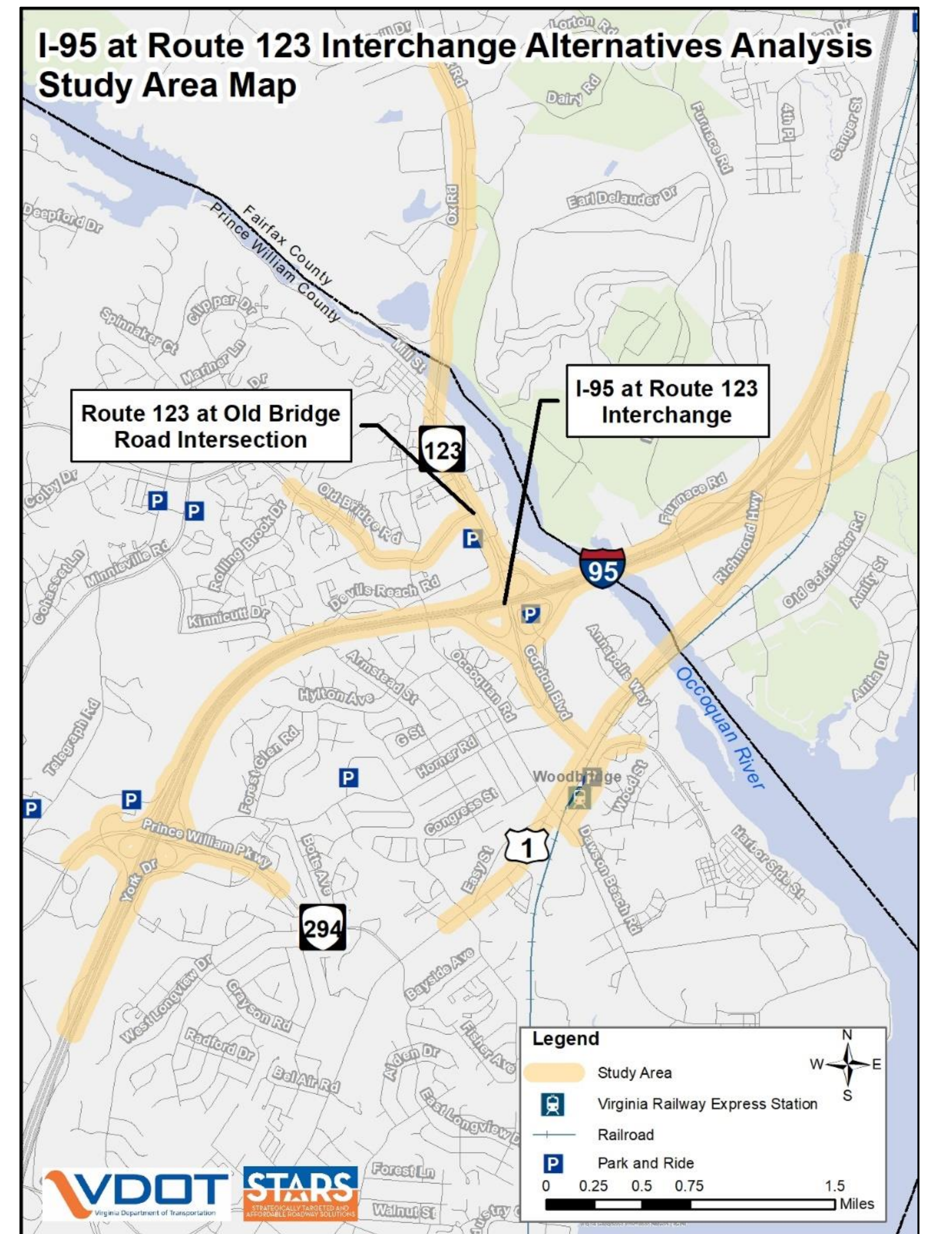
Several other stakeholders were consulted throughout the study development process including the Town of Occoquan, homeowners, civic organizations, local public transit operators, and local and state legislators.

Prior to beginning the study, a framework document was prepared that described the data collection plan, traffic operations and safety analysis methodology, traffic forecasting methodology, study horizon years, land use and background transportation improvements assumptions, and the alternatives development and evaluation process. The SWG reviewed and approved the framework document in *Appendix A*.

Study Area

A single study area that encompasses both the I-95 at Route 123 interchange and Route 123 at Old Bridge Road intersection was used, as shown in *Figure ES-1*. It includes the I-95 at Route 123 interchange (Exit 160), segments of the I-95 corridor between the adjacent interchanges at Route 1 (Exit 161, Richmond Highway) and Route 294 (Exit 158, Prince William Parkway), Route 123 from Route 1 to Commerce Street, and Old Bridge Road from Occoquan Road to Route 123, with a focus on the intersection of Route 123 at Old Bridge Road. The study area for PM peak period analyses extended further north to include southbound I-95 at its interchange with Lorton Road (Exit 163) and Fairfax County Parkway (Exit 166) due the extent of congestion. The study area also includes intersections along Route 1, overlapping with the study area of a parallel STARS study for the intersection of Route 1 and Route 123, which is documented in a separate report.

Figure ES-1: Project Study Area



Existing Conditions Analysis

Traffic operational and safety analysis was performed for the assessment of existing conditions. Detailed information on the analysis is included in ***Section 2*** of the report. The study was started and existing traffic data was collected in 2019 prior the onset of the COVID-19 pandemic. While traffic patterns and traffic volumes were dramatically impacted during the study, traffic volumes at the conclusion of the study were at or near 2019 levels on I-95 while traffic volumes on non-Interstate roads in Prince William County were over 90 percent of pre-COVID according to the VDOT COVID-19 Traffic Trend Tool.

Existing Operational Analysis

The operational analysis indicated that during the AM peak period the most prevalent congestion in the study area was present on northbound I-95 at the upstream interchange with Route 294. No ramp queuing was observed at the study interchange. In addition, congestion occurred on northbound Route 123 due to traffic signals at Old Bridge Road and Commerce Street, in the southbound Route 123 right lane approaching I-95, and on eastbound Old Bridge Road.

During the PM peak period, the most prevalent congestion in the study area was experienced on southbound I-95 and southbound Route 123. Congestion and reduced speeds on southbound I-95 originated at the Route 123 interchange and extended several miles back to the Fairfax County Parkway interchange. The congestion was attributed to multiple back-to-back merge points at the Route 123 interchange. Queuing was observed on the southbound I-95 off-ramp to northbound Route 123 caused by weaving on northbound Route 123 between the ramp and the Old Bridge Road intersection and the traffic signal at Devils Reach Road. The southbound I-95 merge from southbound Route 123 caused stop-and-go traffic and queuing on the ramp extending to southbound Route 123. Queuing also occurred on southbound Route 123 from the on-ramp to the northern end of the study area in Fairfax County, particularly in the right lanes, due to traffic destined for southbound I-95, westbound Old Bridge Road, and the intermediate traffic signals at Commerce Street and Devils Reach Road.

Two important multimodal assets exist adjacent to roadways in the study area—the Occoquan commuter lot and the I-95/Route 123 commuter lot. Transit service is provided to these lots and along Route 123, Old Bridge Road, and Route 1 by OmniRide. The most pedestrian activity occurred at the intersections of Old Bridge Road at Occoquan Road, Route 123 at Old Bridge Road, and Old Bridge Road at the commuter parking lot. More pedestrian activity was observed along the western side of Route 123 and southern side of Old Bridge Road. Low levels (less than 10 bicycles in a 14-hour period) of bicycle activity were observed in the corridor.

Existing Safety Analysis

The safety analysis showed that during the 5.5-year analysis period, there were over 4,100 crashes in the study area.

- Of the total, 831 resulted in an injury (20 percent) with seven fatal crashes.
- More severe crashes occurred on southbound I-95 than on northbound I-95. On I-95, most crashes were rear-end crashes (68 percent), sideswipe same direction crashes (18 percent), or fixed object off road crashes (9 percent). Two hot spot segments were identified on southbound I-95—at the Route 123 interchange spanning upstream of the off-ramp to northbound Route 123 and the lane drop from four to three lanes.
- The ramps with the highest number of crashes were the northbound I-95 off-ramp to northbound Route 123 and the southbound I-95 off-ramp to northbound Route 123, both with 54 crashes. Most were fixed-object crashes but the southbound off-ramp had 28 percent rear-end crashes mainly attributed to congestion along northbound Route 123.
- During the analysis period, there were 1,122 crashes at intersections. The intersections with the highest number of crashes were Route 1 at Marys Way (100 total crashes with 40 percent rear end and 40 percent angle), Route 123 at Old Bridge Road (89 total crashes with 66 percent rear end and 22 percent angle), and Route 123 at Devils Reach Road (86 total crashes with 59 percent rear end, 21 percent angle, and 13 percent sideswipe same direction).

The documented existing conditions serve as the basis for evaluating future conditions and identifying mitigation measures to address operational and safety challenges in the study area.

No-Build Conditions Analysis

Future conditions analysis considered future traffic volume growth, approved land development, and programmed or funded transportation projects for the analysis years of 2030 and 2045. Traffic forecasts for 2030 and 2045 were developed for the study area using the Prince William County travel demand model, which offered a more granular traffic analysis zone system and more detailed road network in Prince William County compared to the regional Metropolitan Washington Council of Governments (MWCOG) travel demand model while still encompassing the regional network. Detailed information on the traffic forecasts is included in ***Section 3*** of the report.

Traffic operations analysis of the future (2030 and 2045) no-build AM and PM peak hour conditions was performed to provide a general understanding of the baseline future traffic conditions as a starting point for developing future improvement strategies. Detailed information on the analysis is included in ***Section 4*** of the report.

During the 2030 and 2045 AM peak hour, both directions of I-95 are projected to operate with similar speeds and congestion levels to existing conditions because of the oversaturated conditions and capacity constraints at the Route 294 interchange. Congestion is projected to increase along both directions of Route 123 and eastbound Old Bridge Road due to overcapacity signalized intersections.

During the 2030 PM peak hour, southbound freeway operations are projected to improve compared to existing conditions due to the construction of the southbound auxiliary lane from the Route 123 interchange to the Route 294 interchange. However, congestion is projected to worsen in both directions of Route 123 and by 2030 queuing on the off-ramp to northbound Route 123 is projected to reach the mainline due to the traffic signals on Route 123 at Old Bridge Road and Devils Reach Road. Between 2030 and 2045, southbound I-95 congestion will worsen due to traffic growth. By 2045, queuing from Route 123 is projected to reach northbound I-95 and southbound I-95 Express Lanes.

Alternatives Development

Improvement concepts were identified for the I-95 at Route 123 interchange and the Route 123 at Old Bridge Road intersection to address safety, geometric, and operational deficiencies identified in the existing and no-build conditions analyses. Concepts were vetted through internal meetings, shared with the SWG at multiple concept development meetings, and then screened based on preliminary operational analyses and SWG feedback on feasibility. Based on the screening results, multiple concepts were selected by the SWG to develop alternatives for more refined analysis. Details of this process and the alternatives selected are included in ***Section 5*** of the report. ***Section 6*** includes conceptual design details, future design consideration, estimated costs, and schedules. The alternatives were shared for public input during outreach conducted in the spring and summer 2021. Over 1,900 responses and 374 comments were gathered from the public surveys.

I-95 at Route 123 Interchange

In collaboration with the SWG, the project team developed and screened six I-95 improvement concepts. Three I-95 improvement concepts—two for southbound I-95 and one for northbound I-95—were selected as alternatives for more refined analysis. During the study process and because of stakeholder and public input, one southbound I-95 alternative, Alternative 1, evolved into several variations as described below. Drawings of all alternatives can be found in *Appendix G*.

I-95 Southbound Improvement Alternative 1

Three variations of Alternative 1 were developed through the study process.

I-95 Southbound Improvement Alternative 1A

- Remove the northbound Route 123 to southbound I-95 loop ramp to eliminate a merge point
- Modify the existing Route 123 at I-95 Express Lanes ramp intersection to allow northbound Route 123 left turns to southbound I-95 and to allow southbound Route 123 right turns to bypass the traffic signal
- Widen the southbound I-95 on-ramp to two lanes and connect to the southbound I-95 auxiliary lane widening
- Relocate the southbound I-95 off-ramp to northbound Route 123 further south to increase the distance to the traffic signals at Devils Reach Road and Old Bridge Road intersections
- Add a pedestrian and bicycle connection along Route 123 through the interchange

I-95 Southbound Improvement Alternative 1B

- Same improvements as Alternative 1A, except the southbound I-95 off-ramp to northbound Route 123 remains in its existing location

I-95 Southbound Improvement Alternative 1C

Alternative 1C was developed and refined later in the study process after receiving public and stakeholder input on Alternatives 1A and 1B. It contains the features of Alternative 1A listed above with a few modifications. The shared-use path is located along northbound Route 123 through the interchange to minimize the number of uncontrolled and multi-lane ramp crossings and is also extended further south to Annapolis Way so the improvement can be implemented independently of a northbound I-95 improvement. Lastly, the location of the signalized intersection of Route 123, the southbound I-95 on-ramp, and the I-95 Express Lanes ramp is adjusted to limit impacts and potential modifications to the Express Lanes flyover bridge structure.

I-95 Southbound Improvement Alternative 2

- Remove the northbound Route 123 to southbound I-95 loop ramp to eliminate a merge point
- Modify the existing Route 123 at I-95 Express Lanes ramp intersection to allow northbound Route 123 left turns to southbound I-95 and to allow southbound Route 123 right turns to bypass the traffic signal
- Replace the I-95 Express Lanes ramp with a new flyover ramp into the I-95/Route 123 Commuter Lot, and reconfigure the lot to allow traffic to enter and exit the Express Lanes from Route 123 (i.e., Alternative 2 must be implemented with Alternative 4)
- Widen the southbound I-95 on-ramp to two lanes and connect to the southbound I-95 auxiliary lane widening
- Relocate the southbound I-95 off-ramp to northbound Route 123 further south to increase the distance to the traffic signals at Devils Reach Road and Old Bridge Road intersections
- Add a pedestrian and bicycle connection along Route 123 through the interchange

I-95 Northbound Improvement Alternative 4

- Remove the northbound I-95 to northbound Route 123 loop ramp and combine with the ramp from northbound I-95 to southbound Route 123
- Add a new traffic signal on Route 123 to maintain access to the I-95/123 Commuter Lot from northbound I-95 and southbound Route 123
- Widen the northbound I-95 on-ramp to accept two lanes of traffic for its full length
- Add a pedestrian and bicycle connection along Route 123 through the interchange

Extension of the southbound I-95 auxiliary lane between Route 123 and Route 294 further north starting at the existing lane drop at the Route 123 interchange was also considered by the SWG but not advanced. In 2018, VDOT studied two options prior to starting the auxiliary lane project: 1) construct an auxiliary lane between the on-ramp from Route 123 and off-ramp to Route 294, and 2) construct an auxiliary lane between the existing lane drop at Route 123 and the off-ramp to Route 294. Option 2 was determined to reduce peak southbound I-95 travel time compared to option 1, but consequently congestion would be shifted south between Route 123 and Route 294 and would be equally congested in terms of queue lengths and delays, or potentially worse depending on the time of day. These options were revisited during this STARS study with similar results. The auxiliary lane extension improvement was not pursued as part of the recommended improvements package in this STARS study. The feasibility of the auxiliary lane at the lane drop could be considered by VDOT as a potential component of other I-95 corridor studies or future improvements to I-95 once other improvements from this STARS study and the auxiliary lane project are completed.

Route 123 at Old Bridge Road Intersection

In collaboration with the SWG, the project team developed and screened twenty Route 123 at Old Bridge Road intersection improvement concepts. Four concepts were selected as alternatives for more refined analysis. Drawings of all alternatives can be found in *Appendix G*.

Old Bridge Road Improvement Alternative – Flyover (Outside/Outside)

- Construct a two-lane flyover ramp from the outside right lanes of northbound Route 123 to the outside right lanes of westbound Old Bridge Road for left-turn traffic and to eliminate the weaving movement from southbound I-95
- Reconfigure the signalized intersection of Old Bridge Road and the Occoquan Commuter Lot to allow vehicles into the lot from the flyover ramp
- Widen northbound Route 123 to three lanes through the Old Bridge Road intersection
- Remove the traffic signal at Devils Reach Road and close the median opening to allow right-in-right-out access; left-turn and side street through movements are rerouted as U-turns at adjacent intersections
- Close the median opening on Old Bridge Road at the Fast Fuels gas station to provide additional storage for vehicles turning left to northbound Route 123
- Construct a shared-use path along northbound Route 123 that crosses to southbound Route 123 at the intersection, and relocate the sidewalk on the north side of Old Bridge Road to north of the flyover

Old Bridge Road Improvement Alternative – Flyover (Outside/Inside)

- Construct a two-lane flyover ramp from the outside right lanes of northbound Route 123 to the inside left lanes of westbound Old Bridge Road for left-turn traffic and to eliminate the weaving movement from southbound I-95
- Reconfigure the signalized intersection of Old Bridge Road and the Occoquan commuter lot to allow vehicles into the lot from the flyover ramp
- Relocate the right turn from southbound Route 123 to Old Bridge Road to the outside of the flyover to bypass the traffic signal and reduce conflicts at the intersection of Old Bridge Road at the Occoquan commuter lot
- Widen northbound Route 123 to three lanes through the Old Bridge Road intersection
- Remove the traffic signal at Devils Reach Road and close the median opening to allow right-in-right-out access; left-turn and side street through movements are rerouted as U-turns at adjacent intersections
- Construct a shared-use path along northbound Route 123 that crosses to southbound Route 123 at the intersection, and relocate the sidewalk on the north side of Old Bridge Road to north of the flyover

Old Bridge Road Improvement Alternative – Grade Separation

- Construct a four-lane bridge (two lanes in each direction plus shoulders) over Old Bridge Road for Route 123 through traffic
- Maintain a traffic signal under the bridge for turns to and from Old Bridge Road and pedestrian crossings; all traffic from southbound I-95 must travel through the signalized intersection to eliminate the weaving movement from southbound I-95
- Remove the traffic signal at Devils Reach Road and close the median opening to allow right-in-right-out access; left-turn and side street through movements are rerouted as U-turns at adjacent intersections
- Close the median opening on Old Bridge Road at the Fast Fuels gas station to provide additional storage for vehicles turning left to northbound Route 123
- Close the median opening on Route 123 at Admiral Drive and Riverview Lane, and provide a southbound U-turn movement under the proposed bridge
- Close the existing commuter lot driveway on southbound Route 123 and reroute traffic to the driveway on Old Bridge Road
- Construct a shared-use path along northbound Route 123 that crosses to southbound Route 123 at the intersection to connect to the existing path at Commerce Street, north into Fairfax County

Old Bridge Road Improvement Alternative – Elevated Left Turns

- Construct ramps and a grade-separated intersection for left turns from northbound Route 123 to westbound Old Bridge Road and from eastbound Old Bridge Road to northbound Route 123; all traffic coming from southbound I-95 must travel through the elevated intersection to eliminate the weaving movement from southbound I-95
- Relocate the right turn from southbound Route 123 to Old Bridge Road to the outside of the elevated ramps to bypass the traffic signal
- Remove the traffic signal at Devils Reach Road and close the median opening to allow right-in-right-out access; left turn and side street through movements are rerouted as U-turns at adjacent intersections
- Close the median opening on Route 123 at Admiral Drive, and prohibit southbound left turns from Route 123 to Riverview Lane (reroute local traffic for this movement to Poplar Lane)
- Relocate the traffic signal for Old Bridge Road and the Occoquan Commuter Lot further west to a new access driveway
- Construct a shared-use path along northbound Route 123 that crosses to southbound Route 123 at the intersection to connect to the existing path at Commerce Street, north into Fairfax County
- Construct a pedestrian tunnel through the northbound elevated ramp to provide an east-west crossing of Route 123 at Old Bridge Road

Build Conditions Analysis

Future conditions analysis of the Build alternatives was conducted using the same methodology and tools used for existing and No-Build conditions analyses. The intent of the Build conditions analyses was to evaluate the effectiveness of the selected improvement alternatives and understand how they work in conjunction with one another.

For the purpose of traffic operational analysis of the Build alternatives as described in ***Section 7*** and per the study Framework Document, I-95 and Old Bridge Road alternatives were packaged into combined alternatives to include one alternative in each of the three improvement locations—southbound I-95, northbound I-95, and Old Bridge Road, however, it is anticipated that improvements at each location would be implemented independently.

All alternatives at I-95 are compatible with alternatives at Old Bridge Road except for Grade-Separated. This Old Bridge Road alternative is not compatible with I-95 Southbound Alternative 1 (1A, 1B, or 1C) because of the short lane-change distance on southbound Route 123 for traffic coming from Old Bridge Road or the Occoquan Commuter Lot and going to the northbound I-95 Express Lanes. Additionally, while southbound I-95 Alternative 2 is compatible with all Old Bridge Road alternatives, it was only paired with Grade-Separated and evaluated in one combined alternative because it was lower scoring in the concept screening phase.

Combined Alternative 1

- **Southbound I-95**: Alternative 1A
- **Northbound I-95**: Alternative 4
- **Old Bridge Road**: Flyover (Outside/Outside)

Combined Alternative 2

- **Southbound I-95**: Alternative 1A
- **Northbound I-95**: Alternative 4
- **Old Bridge Road**: Flyover (Outside/Inside)

Combined Alternative 3

- **Southbound I-95**: Alternative 2
- **Northbound I-95**: Alternative 4
- **Old Bridge Road**: Grade Separated

Combined Alternative 4

- **Southbound I-95**: Alternative 1A
- **Northbound I-95**: Alternative 4
- **Old Bridge Road**: Elevated Left Turns

In the 2030 AM peak hour, freeway operations of I-95 were similar to No-Build conditions except for a few locations. Speeds increased slightly on northbound I-95 at the Route 123 interchange from No-Build conditions to free-flow in Build conditions due to eliminating the weave area and ramp reconfiguration. Congestion increased at the merge area from northbound Route 1 due to increased throughput that reaches this point from capacity improvements on Route 123 and Old Bridge Road.

Similar freeway operations changes from No-Build conditions are expected in the 2045 AM peak hour. In addition, the queuing on the northbound off-ramp to northbound Route 123 shown in 2045 No-Build conditions was reduced from 855 feet to approximately 360 feet due to ramp reconfiguration and arterial improvements. I-95 Express Lanes operated similarly among the Build alternatives, but speed in the merge area from the Route 123 ramp decreased by approximately 10 to 15 mph with the flyover ramp relocated to connect directly to the I-95/Route 123 Commuter Lot (I-95 Southbound Alternative 2/Combined Alternative 3). This change was likely attributed to different vehicle arrival patterns compared to the existing signalized ramp intersection on Route 123.

In the 2030 and 2045 AM peak hours, arterial operations are projected to improve with all Build alternatives. Travel times decreased along Route 123, Old Bridge Road, and for all turning movements between the two roadways. Average delay at study area intersections reduced by at least 23 percent between 2030 and 2045 No-Build conditions. Combined Alternative 3, which contains the Old Bridge Road Grade-Separated alternative, showed the lowest average study area intersection delays for the AM peak hour. Congestion remained on eastbound Old Bridge Road due to traffic signals at Occoquan Road and Route 123, but throughput increased and travel time decreased compared to No-Build conditions.

In the 2030 PM peak hour, freeway operations on mainline I-95 were similar to No-Build conditions but changes to ramp operations are expected. Queuing on the southbound off-ramp to northbound Route 123 improved in Combined Alternatives 1 and 2 compared to No-Build conditions due to the flyover configurations at the Route 123 and Old Bridge Road intersection. With the Grade-Separated Old Bridge Road alternative, queues increased from 1,320 feet to 1,550 feet but did not extend onto the mainline.

In the 2045 PM peak hour, congestion is projected to remain on southbound I-95 north to the Fairfax County Parkway interchange, but greater throughput was carried on I-95 south of the Occoquan River due to a ramp reconfiguration and arterial improvements. For example, with Combined Alternative 2, southbound I-95 would increase to 360 vph (6 percent) more throughput between Route 1 and Route 123 and 550 vph (9 percent) more throughput between Route 123 and Route 294 than No-Build conditions. The queuing on the southbound off-ramp to northbound Route 123 that existed in No-Build conditions reduced in the Build alternatives—especially with Combined Alternatives 1 and 2 that include a flyover configuration at Old Bridge Road.

In the 2030 and 2045 PM peak hours, arterial operations improved with all Build alternatives. Travel times decreased along Route 123, Old Bridge Road, and for the majority of turning movement between the two roadways. Average delay at study area intersections reduced by at least 31 percent from 2030 and 2045 No-Build conditions. Combined Alternative 2, which contains the Flyover (Outside/Inside) alternative, showed the lowest average study area intersection delays in the PM peak hour. Congestion remained on eastbound Old Bridge Road due to traffic signals at Occoquan Road and Route 123, but throughput increased and travel time decreased compared to No-Build conditions. Queuing on the southbound I-95 off-ramp to northbound Route 123 was also eliminated with the two flyover alternatives and was reduced (but remains on the ramp) with the Grade-Separated and Elevated Left Turn alternatives. The queuing impacts to northbound I-95 and southbound I-95 Express Lanes seen in 2045 No-Build conditions were mitigated with all Build alternatives.

Future potential safety benefits were assessed both quantitatively and qualitatively for the improvements. Retiming arterial signals, converting the northbound left turn at Route 123 and Old Bridge Road to a flyover and adding a through lane, converting Devils Reach Road to a right-in/right-out movement, and converting the southbound I-95 on-ramp from southbound Route 123 to a free-flow right turn movement are projected to reduce approximately 37 fatal and injury crashes in the study area over a 5.5-year period.

Where quantitative safety factors were not applicable, a qualitative analysis was performed to evaluate safety impacts of Build improvements to the corridor. These benefits included removing the southbound I-95 on-ramp from northbound Route 123, converting the southbound I-95 on-ramp from southbound Route 123 to a free-flow right turn movement, removing the northbound I-95 off-ramp to northbound Route 123, and improving pedestrian safety by providing new pedestrian facilities along Route 123 and providing multimodal connectivity and access through the I-95 interchange.

Project Advancement

This study should be used as a planning tool to achieve the next steps of planning, programming, designing, and constructing the identified improvements in the study area. To continue the progress made during this study, VDOT and Prince William County should continue to coordinate to pursue the advancement and funding for preferred alternative improvements at the I-95 at Route 123 interchange and Route 123 at Old Bridge Road intersection.

I-95 at Route 123 Interchange

From the initial concept screening, the top ranked southbound I-95 improvement was Alternative 1A and the top ranked northbound I-95 improvement was Alternative 4. As the study progressed and as a result of alternatives analysis results, SWG input, and public input, a preferred alternative for the I-95 interchange was identified as Alternative 1C as shown in ***Figure ES-2***. This alternative was developed by refining Alternative 1A.

Alternative 1B was not preferred because it did not address the weave distance on northbound Route 123 at Old Bridge Road like the other southbound I-95 alternatives that included a modification of the southbound off-ramp. Alternative 2 was not preferred because of the impacts to the I-95 Express Lanes and high overall project cost relative to the other options.. This improvement would also require a northbound I-95 improvement be implemented concurrently to provide more direct access to the relocated express lanes access point and I-95/Route 123 Commuter Lot via Route 123. Alternative 4 remained a viable option for a northbound I-95 improvement to advance for project funding and development in the future.

The preferred southbound I-95 improvement, Alternative 1C, combined both southbound on-ramps from Route 123, expanding the capacity of the existing on-ramp and removing the existing loop ramp from northbound Route 123 to southbound I-95 to improve traffic flow and safety at this location. Combining the two on-ramps would reduce the number of successive merges and conflict points thereby allowing the consolidated merge to happen in the auxiliary lane between Route 123 and Route 294. Having a longer acceleration and weaving area would also make it easier for motorists to merge into and out of traffic between the ramps at Route 123 and Route 294 and create more space for through trips on southbound I-95. Reconfiguring the Route 123 intersection, the southbound I-95 on-ramp, and the I-95 Express Lanes ramp would also provide congestion relief on southbound Route 123 approaching the interchange. Modifying the southbound off-ramp to northbound Route 123 would provide additional lane-changing distance before the traffic signals at Devils Reach Road and Old Bridge Road. The alternative would also add a missing pedestrian and bicycle connection in the Route 123 corridor, providing connectivity between pedestrian and bicycle networks being considered by VDOT and Prince William County to the north and south of the interchange.

Route 123 at Old Bridge Road Intersection

Of the four Build alternatives selected by the SWG for refined analysis—Flyover (Outside/Outside), Flyover (Outside/Inside), Grade-Separated, and Elevated Left Turns—the SWG reached consensus on a preferred improvement for this location being a left-turn flyover from northbound Route 123 to westbound Old Bridge Road. The two flyover alternatives are shown in ***Figure ES-3***.

Flyover (Outside/Inside) was the highest scoring alternative based on the evaluation conducted through the STARS study while Flyover (Outside/Outside) was the second highest scoring. The Outside/Inside configuration offers several additional benefits over the Outside/Outside:

- Provides greater operational benefits to southbound Route 123, particularly by adding capacity to the right-turn to westbound Old Bridge Road

- Provides more opportunity for a direct crossing of the proposed shared-use path across Route 123 at the Old Bridge Road intersection
- Reduces conflicting high volume movements at the intersections of Old Bridge Road at Route 123 and at the Occoquan Commuter Lot driveway by separating southbound right-turn traffic
- Reduces potential right-of-way impacts by changing the location of the flyover compared to the Outside/Outside configuration.

The Grade-Separated alternative was not preferred because of its greater property impacts, right-of-way needs, and higher cost. It would also create a short weave area on southbound Route 123 approaching the ramp to southbound I-95 and the northbound I-95 Express Lanes access intersection. Multiple lane changes over a short distance (approximately 400 to 500 feet) would be needed to accessI-95 .

The Elevated Left Turns alternative was not preferred due to its greater property impacts, right-of-way needs, and cost. It was also the lowest scoring Build alternative from the public survey.

Future Steps

Projects should be advanced to the following documents.

- Constrained Long Range Transportation Plan (CLRP)
- Transportation Improvement Plan (TIP)
- Statewide Transportation Improvement Plan (STIP)

The improvements should next advance to an Interchange Access Report (IAR) and environmental assessment so a Final Preferred Alternative can be identified. VDOT and Prince William County should determine the most appropriate and efficient project delivery method. Interchange improvements to southbound I-95 at Route 123 are being advanced by VDOT through a Progressive Design-Build project.

In September 2021, the Commonwealth Transportation Board (CTB) approved and adopted the Interstate 95 Corridor Improvement Plan and thereby approved a suite of projects to be funded by the Interstate Operations and Enhancement Program (IOEP), including interchange improvements to southbound I-95 at Route 123. These improvements were incorporated into the VDOT Six Year Improvement Program (SYIP).

In November 2019, Prince William County voters approved the 2019 Mobility Bond Referendum which included $15 million for Route 123 at Old Bridge Road intersection improvements.

For potential northbound I-95 improvements at Route 123 and improvements for the Route 123 at Old Bridge Road intersection, VDOT and Prince William County should pursue funding from one or more of the following programs including:

- SMART SCALE
- Northern Virginia Transportation Authority (NVTA)
- Congestion Mitigation and Air Quality (CMAQ)
- Revenue Sharing
- Highway Safety Improvement Program (HSIP)
- Federal Grant Programs (Mega, INFRA, RAISE)

Once project applications are approved for funding through one or more of the aforementioned funding sources, the projects should be incorporated in the VDOT SYIP or one of the partner agency programs, so they can enter the project development process.

Figure ES-2: Recommended I-95 Interchange Alternative 1C

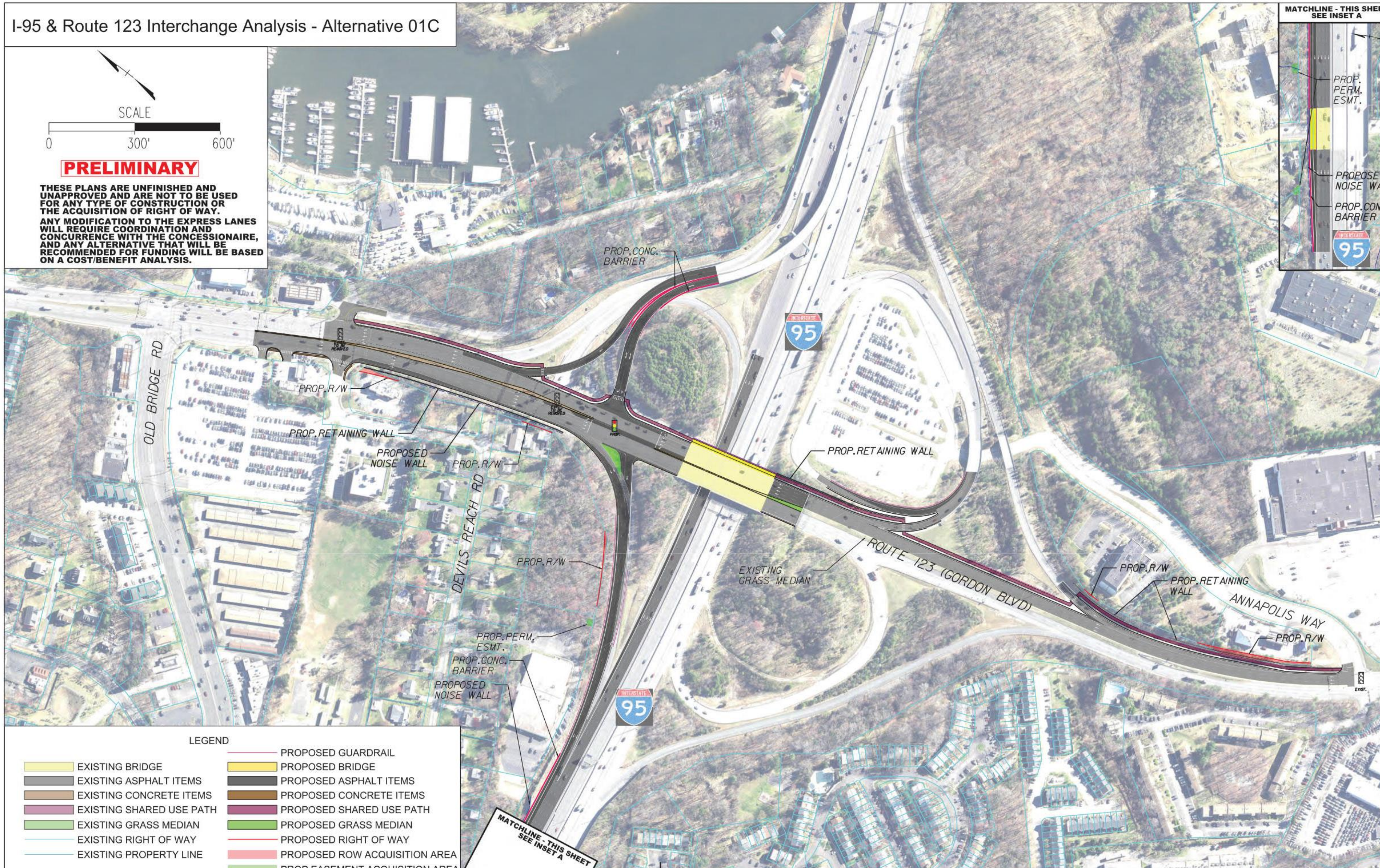
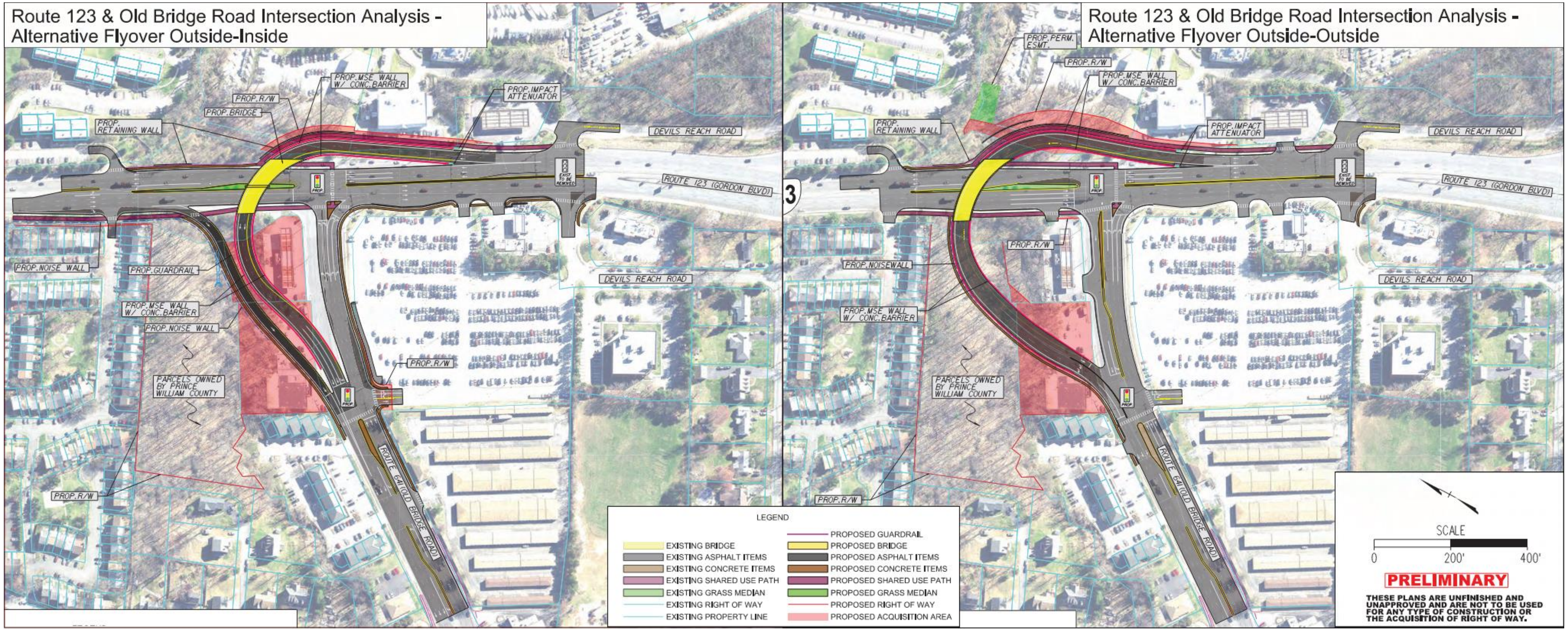


Figure ES-3: Recommended Route 123 at Old Bridge Road Alternatives



1 INTRODUCTION

1.1 Background and Study Initiation

The *Interstate 95 (I-95) Interim Corridor Improvement Plan* (2020) developed by the Virginia Department of Transportation (VDOT) identified the I-95 at Virginia State Route 123 (Route 123 or Gordon Boulevard) interchange as needing further study for improving interchange configuration to address safety and delay issues. A major adjacent intersection to the interchange, Route 123 at Virginia State Route 641 (Old Bridge Road), was also identified by VDOT and Prince William County as needing study due to its proximity and interaction with interstate traffic. As a result, VDOT identified this area of I-95, Route 123, and Old Bridge Road for study under the Strategically Targeted and Affordable Roadway Solutions (STARS) program. The STARS program uses a data-driven process to identify candidate projects with critical traffic and safety challenges. The STARS program then seeks to develop comprehensive, innovative transportation solutions to relieve congestion bottlenecks and resolve safety issues. The goals of STARS studies include:

- Develop innovative, cost-effective solutions
- Evaluate potential solutions more thoroughly
- Identify potential project risks and costs
- Build stakeholder consensus
- Improve readiness for project implementation

This report identifies and presents analysis results of potential improvements to both the I-95 at Route 123 interchange and the Route 123 at Old Bridge Road intersection. The study was conducted in parallel with a VDOT STARS study at the intersection of US Route 1 (Route 1 or Richmond Highway) and Route 123, which is documented in a separate report.

1.2 Purpose and Need of the Study

The purpose of this study was to evaluate existing operational and safety deficiencies at the I-95 at Route 123 interchange and Route 123 at Old Bridge Road intersection and to develop potential projects to improve operations, safety, and interchange geometry. Following the existing conditions analyses, critical areas of need are:

- Southbound I-95 bottleneck within the Route 123 interchange where lanes reduce from four to three
- Weaving movement from southbound I-95 off-ramp to northbound left turn at Old Bridge Road
- Southbound Route 123 movement to southbound I-95
- Overcapacity intersections on Route 123 that propagate queues onto the southbound I-95 off-ramp
- Eastbound Old Bridge Road queues due to impacts of overcapacity conditions at the Route 123 and Occoquan Road intersections

The primary goal of the STARS program is to identify targeted improvements that both meet project needs and could be programmed into the VDOT Six-Year Improvement Program (SYIP). Consideration was given to the likelihood that recommended improvements would perform favorably in the SMART SCALE project prioritization process or other transportation funding programs. Improvements identified for this study considered:

- Pedestrian, bicycle, and transit connectivity
- Park and ride access
- Compatibility with planned development and growth in the study area

The study results are documented in this memorandum to both inform the partner agencies on the outcomes and recommendations of this analysis and provide a basis for future project development efforts, including development of affordable improvements that could be programmed and implemented using a variety of funding sources; preparation of an interchange access report (IAR); and production of an environmental decision document based on the National Environmental Policy Act (NEPA).

1.3 Study Work Group

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

- VDOT Northern Virginia District
- VDOT Central Office (Transportation Mobility and Planning Division [TMPD])
- VDOT Central Office (Location and Design Division [L&D])
- Prince William County (Department of Transportation)
- Federal Highway Administration (FHWA)
- Kimley-Horn
- RS&H

1.4 Study Area

A single study area that encompasses both the I-95 at Route 123 interchange and Route 123 at Old Bridge Road intersection was used . It includes the I-95 at Route 123 interchange (Exit 160), segments of the I-95 corridor between the adjacent interchanges of Route 1 (Exit 161, Richmond Highway) and Route 294 (Exit 158, Prince William Parkway), Route 123 from Route 1 to Commerce Street, and Old Bridge Road from Occoquan Road to Route 123, with a focus on the intersection of Route 123 at Old Bridge Road. The study area for PM peak period analyses extended further north to include southbound I-95 at its interchange with Lorton Road (Exit 163) and Fairfax County Parkway (Exit 166) due the extent of congestion.

I-95, Route 123, Old Bridge Road, and Route 1 serve as important transportation corridors for Prince William County and they must continue to accommodate a wide array of users with varying trip purposes. The segment of the I-95 corridor within the study area is a major commuting route. The various trip purposes in the study area include, but are not limited to, the following:

- Employment commuting
- Local residential and shopping access
- Local business access
- Major highway access (I-95)

The study area is shown in *Figure 1*. The following intersections were included in the study area. The Existing Conditions Analysis section contains figures showing these intersection locations as *Figure 4* through *Figure 7.*

1. Route 123 at Workhouse Road (Signalized)
2. Route 123 at Workhouse Way (Unsignalized)
3. Route 123 at Occoquan Regional Park (Signalized)
4. Route 123 at Commerce Street (Signalized)
5. Route 123 at Woodlee Terrace Apartments North Driveway (Unsignalized)
6. Route 123 at Woodlee Terrace Apartments South Driveway (Unsignalized)
7. Route 123 at Riverview Lane (Unsignalized)
8. Route 123 at Flagship Drive (Unsignalized)
9. Route 123 at Admiral Drive (Unsignalized)
10. Route 123 at Old Bridge Road (Signalized)
11. Route 123 at Commuter Parking Lot (Unsignalized)
12. Route 123 at Exxon Driveway/Shell Driveway (Unsignalized)
13. Route 123 at Devils Reach Road (Signalized)
14. Route 123 at I-95 Express Lanes Ramp (Signalized)
15. Route 123 at Annapolis Way/Monroe Drive (Signalized)
16. Route 123 at Horner Road (Signalized)
17. Route 123 at Station Plaza Driveway (Unsignalized)
18. Old Bridge Road at Fast Fuels Driveway (Unsignalized)
19. Old Bridge Road at Commuter Parking Lot (Signalized)
20. Old Bridge Road at Public Storage Driveway (Unsignalized)
21. Old Bridge Road at VA Smoke Shop Driveway (Unsignalized)
22. Old Bridge Road at Occoquan Road (Signalized)
23. Route 1 at Furnace Road (Signalized)
24. Route 1 at Hassett Street (Unsignalized)
25. Route 1 at Annapolis Way (Signalized)
26. Route 1 at Route 123 (Signalized)
27. Route 1 at Occoquan Road/Dawson Beach Road (Signalized)
28. Route 1 at Easy Street North (Unsignalized)
29. Route 1 at Potomac Plaza (Unsignalized)
30. Route 1 at Easy Street South (Unsignalized)
31. Route 1 at Marys Way (Signalized)
32. Route 294 at I-95 Southbound Ramp/Commuter Lot (Signalized)
33. Route 294 at Summerland Drive/York Drive (Signalized)
34. Dawson Beach Road at Express Drive (Signalized)

1.5 Traffic Modeling Area

This study focused on the I-95 at Route 123 interchange and surrounding corridors on Route 123 and Old Bridge Road. However, additional corridor, ramps, and interchanges were included in the data collection and traffic modeling efforts to assist with the traffic modeling calibration process and to determine the impacts of future improvement scenarios. The additional interchanges, ramps, and corridors included in the traffic modeling efforts are listed below.

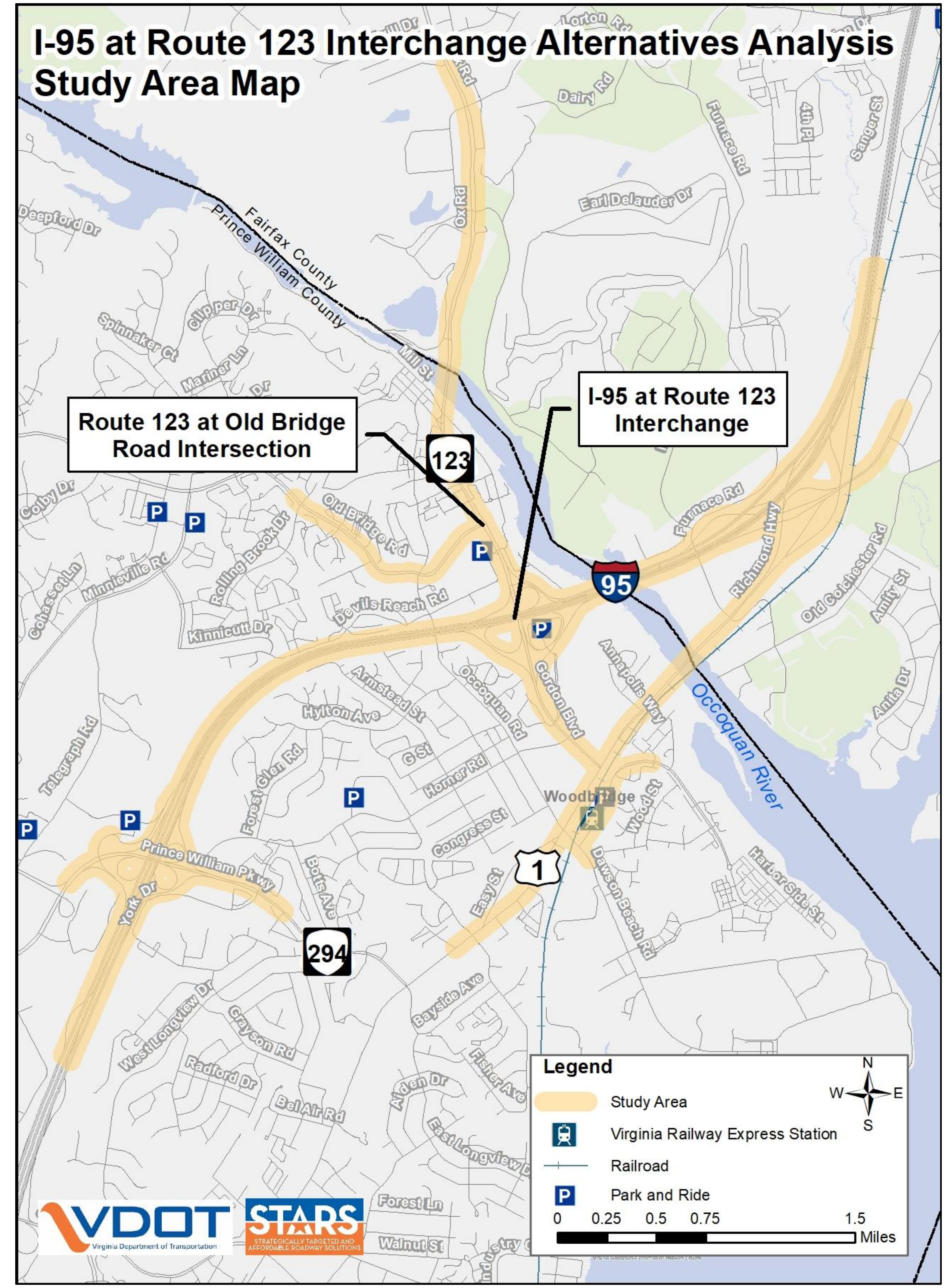
Interchanges

- Southbound I-95 at Exit 166 (Fairfax County Parkway) and related ramps (PM operational analysis only)
- Southbound I-95 at Exit 163 (Lorton Road) and related ramps (PM operational analysis only)

Arterial Corridors

- Route 123 from Workhouse Road to Commerce Street (north of Occoquan River in Fairfax County)
- Route 1 from Marys Way to Hassett Street

Figure 1: Project Study Area



2 Existing Conditions Analysis

2.1 Data Collection and Inventory

A field review of the study area was conducted on May 29-30, 2019 to observe existing geometric conditions, traffic control devices, peak period traffic conditions, and driver behavior. Existing traffic volume data was collected from a combination of turning movement counts (14-hour period between 6:00 AM and 8:00 PM) and vehicle classification tube counts (48-hour period) collected on the same dates for study area intersections along Route 123 and Old Bridge Road as well as the southbound I-95 off-ramp to northbound Route 123 and the southbound I-95 on-ramp from southbound Route 123. Traffic count data collected for this study is in ***Appendix B***.

Traffic volume data for I-95 mainline at Route 123 and north-facing ramps at the Route 294 interchange was collected from May 17-24, 2019 for the I-95 Southbound Auxiliary Lane project. Traffic volume data for other locations in the study area were collected from previous studies and historical VDOT data due to the inability to collect additional data during the COVID-19 pandemic.

The following sections of the report summarize collected data and field review observations. All assumptions about data collection and processing are based on the direction and guidance provided in the VDOT *Traffic Operations and Safety Analysis Manual* (*TOSAM*).

2.1.1 Field Review Observations

During the field review in May 2019, the following observations were made in the AM and PM peak periods.

AM Peak Period

- Northbound I-95 operated at near free-flow speeds at the Route 123 interchange. Congestion was observed at the northern and southern ends of the study area due to merging traffic at the adjacent interchanges (Richmond Highway and Route 294).
- Southbound I-95 operated at free-flow speeds through the study area.
- No queueing was observed from northbound or southbound interstate traffic onto Route 123, indicating on-ramp merging occurs without forming queues on ramps.
- Queuing was observed on northbound Route 123 in the right lanes from the Old Bridge Road traffic signal to Express Lanes ramp intersection for traffic destined to northbound Route 123. Northbound queuing also extended from the Commerce Street traffic signal to the Admiral Drive intersection.
- Heavy vehicles occasionally crossed into adjacent turn lanes when making a left turn from northbound Route 123 onto westbound Old Bridge Road.
- Queuing was observed along southbound Route 123, particularly in the right lanes, from the Old Bridge Road traffic signal past Riverview Lane. Southbound queuing also occasionally extended from the Devils Reach Road traffic signal to Old Bridge Road in the right lanes especially for traffic destined for the I-95 on-ramps.
- Heavy right lane utilization was observed along southbound Route 123 at the I-95 interchange for traffic destined to northbound I-95.
- Queuing filled the length of the southbound left-turn lane for traffic turning onto the northbound I-95 Express Lanes on-ramp.
- Eastbound Old Bridge Road congestion extended past Rolling Brook Drive, and the Occoquan Road traffic signal metered traffic heading to Route 123. Queuing is worse in the left lane for traffic destined to northbound Route 123 compared to the right lanes.

PM Peak Period

- Northbound I-95 operated at free-flow speeds through the study area.
- Southbound I-95 congestion and queuing originated at the lane drop from four to three lanes at the Route 123 interchange and extended to the vicinity of Exit 166, Fairfax County Parkway.
- Queuing was observed on the southbound I-95 off-ramp to northbound Route 123 extending approximately midway up the ramp at its maximum, however it did not impact mainline I-95 traffic flow. This queuing was caused by weaving along northbound Route 123 between the ramp and the Old Bridge Road intersection as well as the intermediate Devils Reach Road traffic signal.
- Queuing was observed along northbound Route 123 from the Old Bridge Road traffic signal to the Express Lanes ramp intersection at its maximum.
- Northbound left-turn queues from Route 123 to Old Bridge Road typically cleared during each traffic signal cycle. The right-most turn lane occasionally queued into the intersection during the green arrow due to immediate right turns into the Fast Fuels driveway.
- The southbound I-95 merge from southbound Route 123 caused stop-and-go traffic and queuing on the ramp extending to southbound Route 123. Southbound Route 123 subsequently experienced queuing in the right lanes to the Old Bridge Road intersection.
- Eastbound Old Bridge Road traffic slowed in the right lane approaching Route 123 due to queueing along southbound Route 123 from the Devils Reach Road traffic signal and I-95 interchange.
- Queuing was observed along southbound Route 123 from the Commerce Street traffic signal back to the Workhouse Road intersection north of the Occoquan River. Southbound queuing was also observed to originate from the Old Bridge Road traffic signal to Commerce Street due to a high volume of southbound right turns onto Old Bridge Road and queuing in the right lanes south of Old Bridge Road.
- Queuing was observed on westbound Old Bridge Road from the Occoquan Road traffic signal back to the Commuter Lot intersection at its maximum.

2.1.2 Existing Roadway Network and Geometries

The existing roadway geometry in the study area was observed and documented during the field review. ***Figure 2*** through ***Figure 7*** summarize the existing lane configurations for I-95 and study area intersections, including the effective storage lengths for left-and right-turn storage bays for intersections.

Interstate 95

I-95 is a north-south interstate in Virginia that continues up and down the East Coast. The segment of I-95 within this study area consists of an eight-lane divided freeway facility north of the Route 123 interchange, and a six-lane divided freeway facility south of the Route 123 interchange. The I-95 corridor also includes a three-lane reversible high-occupancy toll (express) lanes facility. This section of I-95 has a posted speed limit of 55 mph on the general-purpose lanes and 65 mph on the express lanes. The posted speed limit on the general-purpose lanes changes between the Route 123 and Route 294 interchanges from 55 mph (north) to 60 mph (south).

The express lanes are dynamically priced, can be used for free with E-ZPass Flex set to HOV mode when three or more people are in the vehicle, and operate according to the following schedule.

Weekdays

- Closed for reversal: 12 AM to 2:30 AM (except on Monday)
- Open northbound: 2:30 AM to 11 AM
- Closed for reversal: 11 AM to 1 PM
- Open southbound: 1 PM to 12 AM

Saturday

- Open southbound: 12 AM to 2 PM
- Closed for reversal: 2 PM to 4 PM
- Open northbound: 4 PM to 12 AM

Sunday

- Open northbound: 12 AM Sunday to 12 AM Monday

Route 123 (Gordon Boulevard)

Route 123 is a north-south other principal arterial that connects the Washington, DC/Virginia state line to Route 1 in Woodbridge. In the study area, Route 123 varies between a four-lane and a six-lane divided roadway with a posted speed limit of 40 mph from Route 1 to the Occoquan River, and 55 mph from the Occoquan River to Workhouse Road.

Route 1 (Richmond Highway)

Route 1 is a north-south other principal arterial that connects the Washington, DC/Virginia state line to the North Carolina state line. Within the study area, Route 1 parallels I-95 with one interchange between the two facilities. This segment of Route 1 is a four-lane roadway with a posted speed limit of 35 mph south of the interchange with I-95 and 50 mph north of the interchange with I-95. Route 1 from Annapolis Way to Marys Way is currently (2020) under construction to be widened to a six-lane divided roadway.

Route 641 (Old Bridge Road)

Old Bridge Road is an east-west other minor arterial that connects Route 294 to Route 123. In the study area, Old Bridge Road is a six-lane divided roadway with a posted speed limit of 35 mph.

Route 294 (Prince William Parkway)

Route 294 is an east-west principal arterial that connects Route 234 (Dumfries Road) in Manassas to Route 1 in Woodbridge. In the study area, Route 294 varies between a six-lane and a four-lane divided roadway and includes an interchange with I-95. The posted speed limit on this segment of Route 294 is 45 mph.

2.1.3 Land Use

The long-range land use map for Prince William County from the 2008 Comprehensive Plan is provided in ***Appendix B***. As of October 2022, Prince William County was in the process of updating its Comprehensive Plan. The map from the 2008 plan shows that most parcels surrounding the I-95 at Route 123 interchange and Route 123 at Old Bridge Road intersection are planned for general business use. Areas immediately adjacent to the interchange but accessed off Route 123 via Devil's Reach Road, Annapolis Way, and Monroe Drive are planned for residential use. Parcels along Old Bridge Road between Occoquan Road and Route 123 are also planned for general business use. Parcels along Route 123 north of Old Bridge Road are predominately planned for residential use with business use near Riverview Lane.

2.1.4 Traffic Volume Data

2.1.4.1 Traffic Volume Data Collection

Turning movement count (TMC) data and existing field observations were collected in May 2019 for a portion of the study area. This included the collection of 14-hour TMCs at 15 intersections, one-week continuous counts for four mainline I-95 and two ramp locations, 48-hour continuous counts for three arterial and two ramp locations and performing field observations for the AM and PM peak periods. Due to the ongoing COVID-19 pandemic and resulting atypical traffic conditions, additional traffic counts for the remaining locations of the study area network could not be collected as originally planned for this study. As agreed upon with the SWG, historical traffic volumes ranging from 2014 to 2019 locations were obtained from VDOT for the remaining locations, which included data from continuous count stations and previous traffic studies in the area. The remaining locations and data sources used in this study are listed below.

- Northbound I-95 ramps at Route 123 interchange (2016 I-95 Express Lanes Fredericksburg Extension study; historical counts 2014)
- I-95 at Route 1 interchange ramps (2018 traffic counts; 2016 I-95 Express Lanes Fredericksburg Extension study)
- Route 123 south of the I-95 interchange (VDOT 2015 Synchro file)
- Route 1 south of Furnace Road (VDOT 2015 Synchro file)
- Route 294 arterial intersections and south-facing I-95 Interchange ramps (VDOT 2019 Synchro file)

For locations with only available peak hour traffic count data, the one-hour traffic count was assumed to be the same peak hour determined for the study area. The 15-minute TMCs were calculated using the average distributions across the network locations with data in 15-minute intervals. Some driveway and entrance locations without available historic traffic counts were estimated using upstream and downstream volume imbalances and engineering judgment by accounting for adjacent land use information and trip generation assumptions.

The discrepancy in data from different sources and years was accounted for in the volume balancing process described in ***Section 2.1.4.5*** so that traffic volumes in the analysis models accurately reflected existing conditions.

2.1.4.2 Average Daily Traffic (ADT)

Based on the one-week (freeway) and 48 hour (arterial) continuous counts, the following ADTs were calculated for the given segments:

- I-95 general purpose lanes at Route 123 interchange: **177,700 vehicles per day**
- Route 123 between Commerce Street and Riverview Lane: **52,600 vehicles per day**
- Route 123 between southbound I-95 off-ramp and Devils Reach Road: **73,200 vehicles per day**
- Route 123 between I-95 and Route 1: **22,000 vehicles per day**
- Old Bridge Road between Occoquan Road and Route 123: **51,000 vehicles per day**

These traffic counts, along with VDOT-published 2019 traffic data, were used to report ADT for I-95 mainline and ramp segments shown in ***Figure 8***.

Figure 2: 2019 Existing Lane Configurations – I-95 (1 of 2)

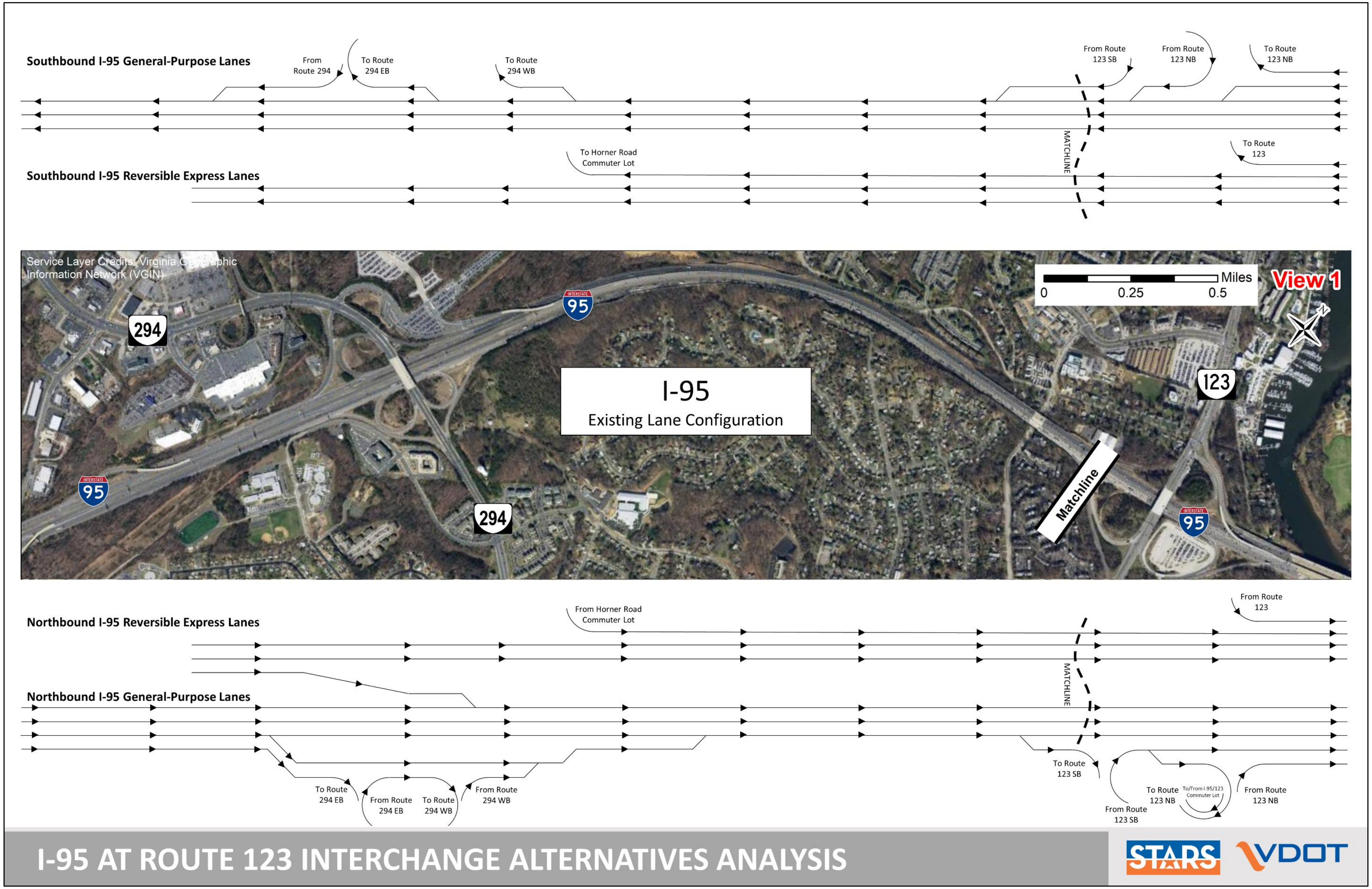


Figure 3. 2019 Existing Lane Configurations – I-95 (2 of 2)

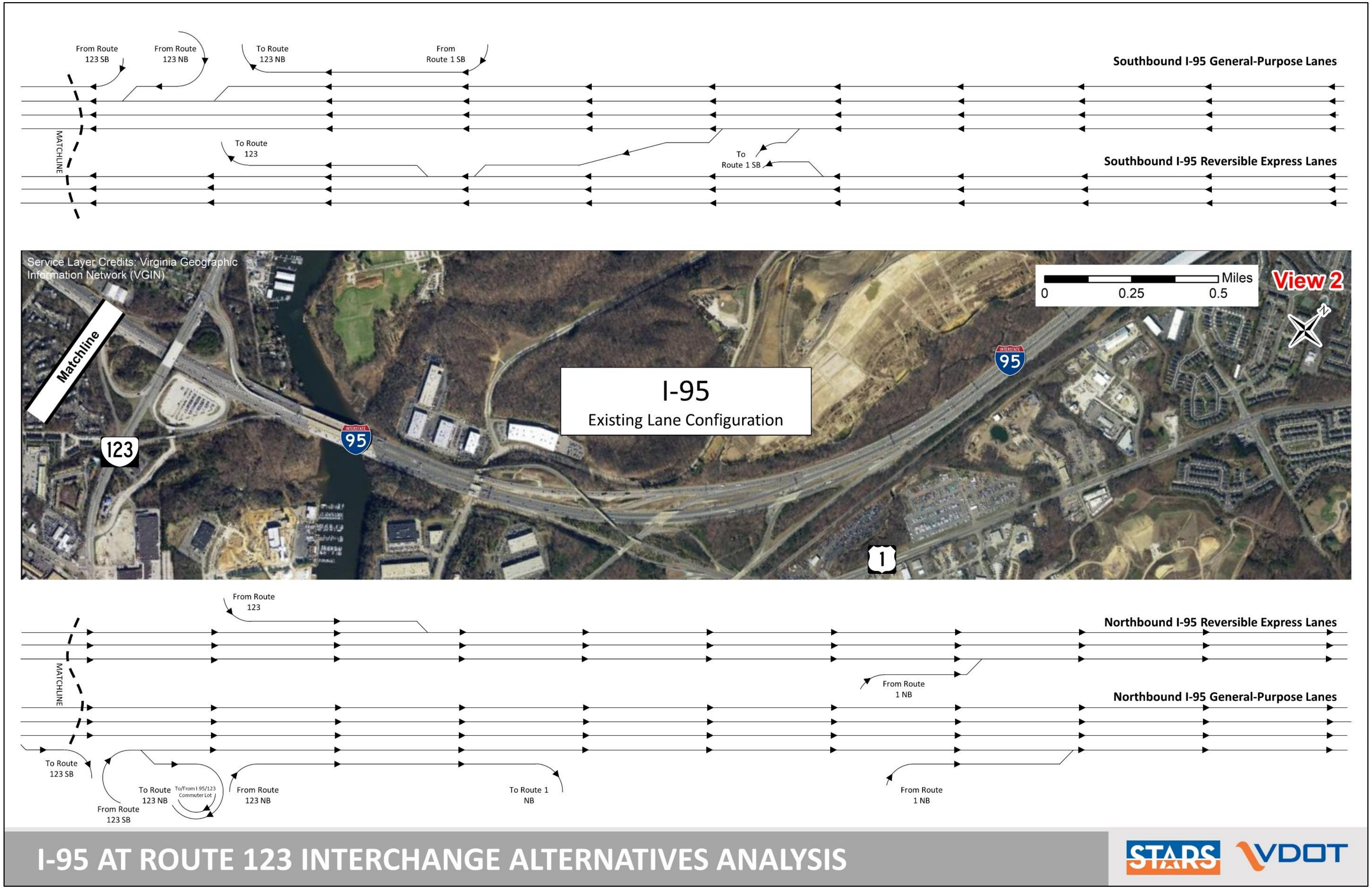


Figure 4: 2019 Existing Lane Configurations – Intersections (1 of 4)

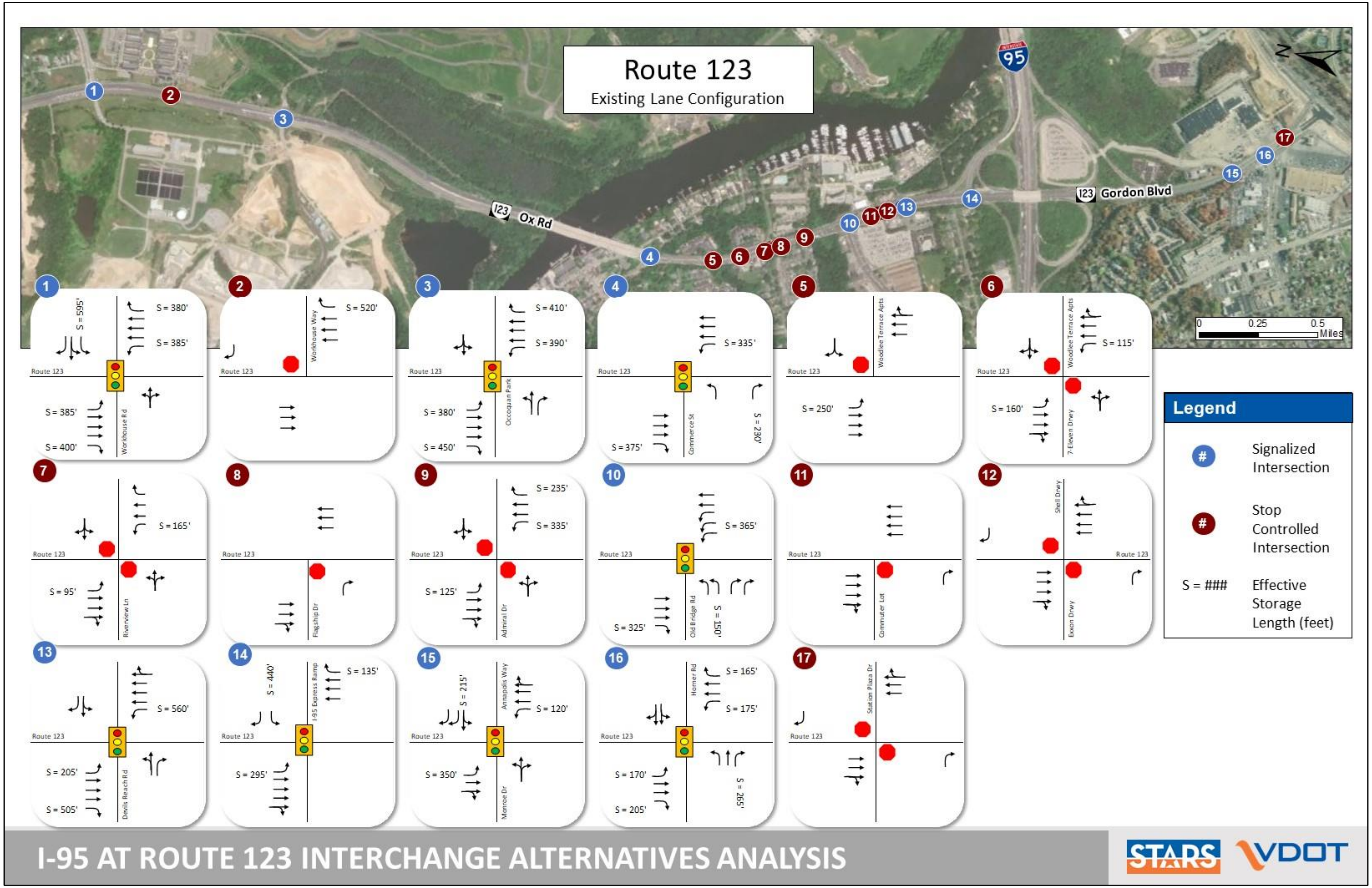


Figure 5: 2019 Existing Lane Configurations – Intersections (2 of 4)

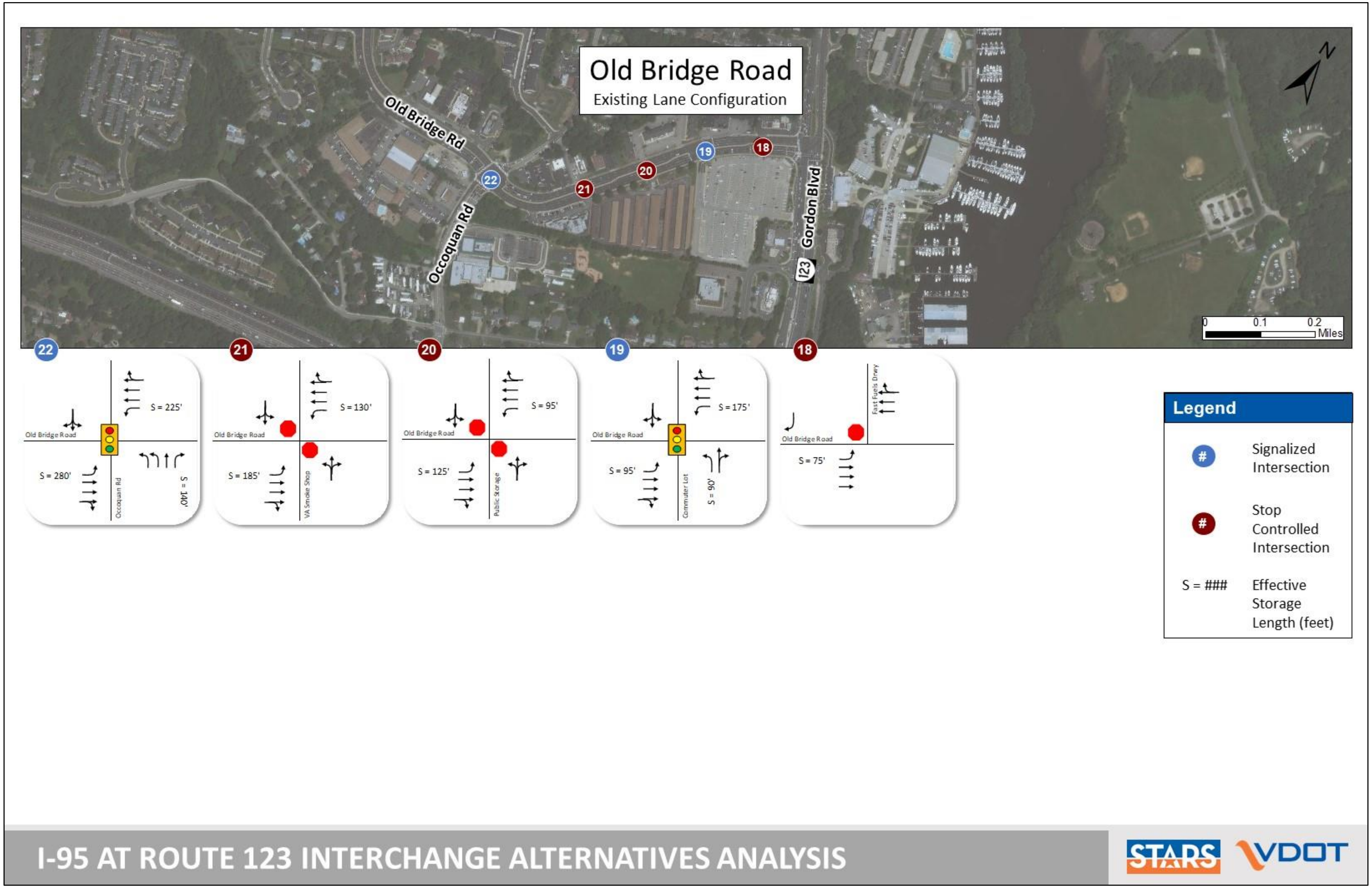
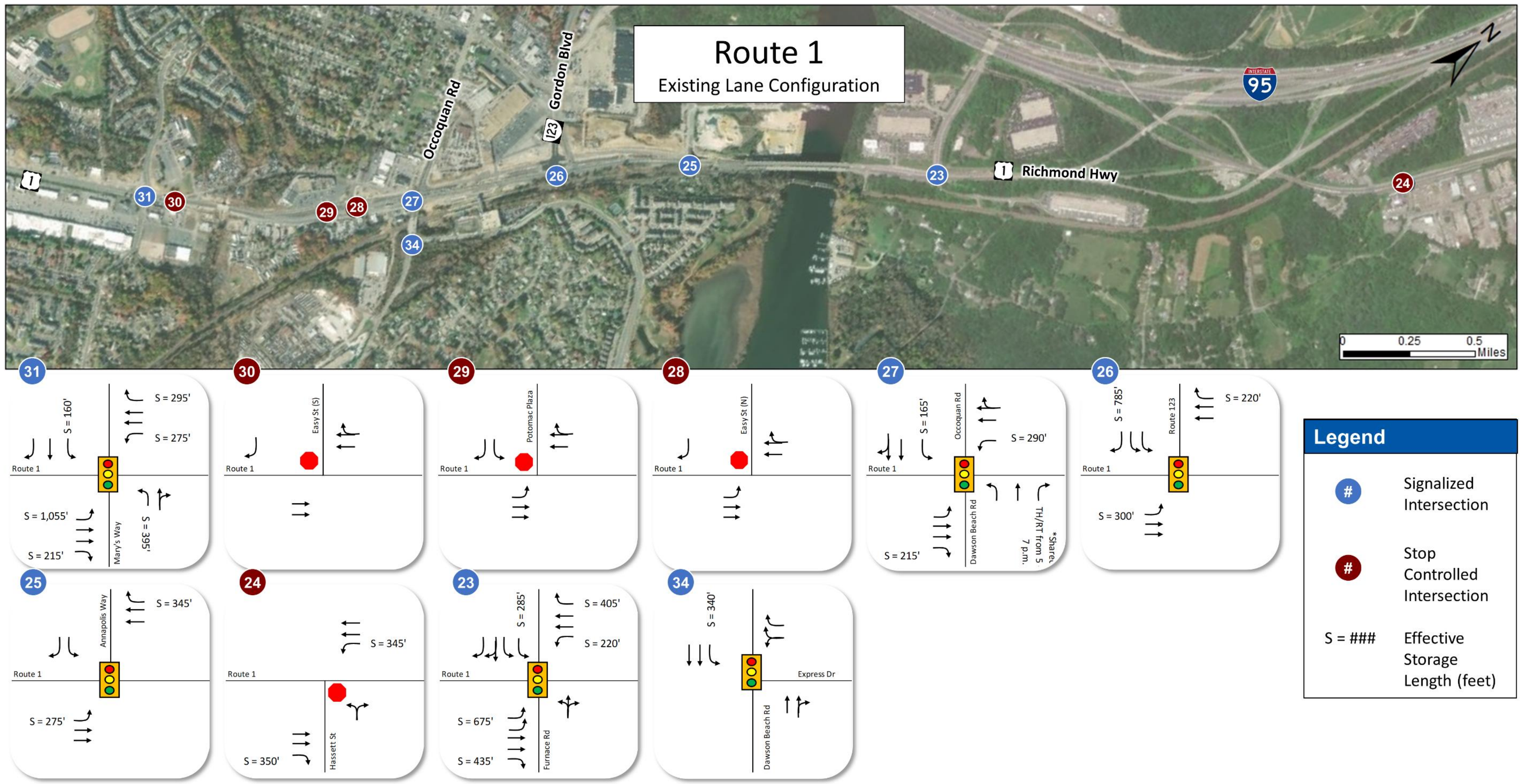


Figure 6: 2019 Existing Lane Configurations – Intersections (3 of 4)



I-95 AT ROUTE 123 INTERCHANGE ALTERNATIVES ANALYSIS

Figure 7: 2019 Existing Lane Configurations – Intersections (4 of 4)

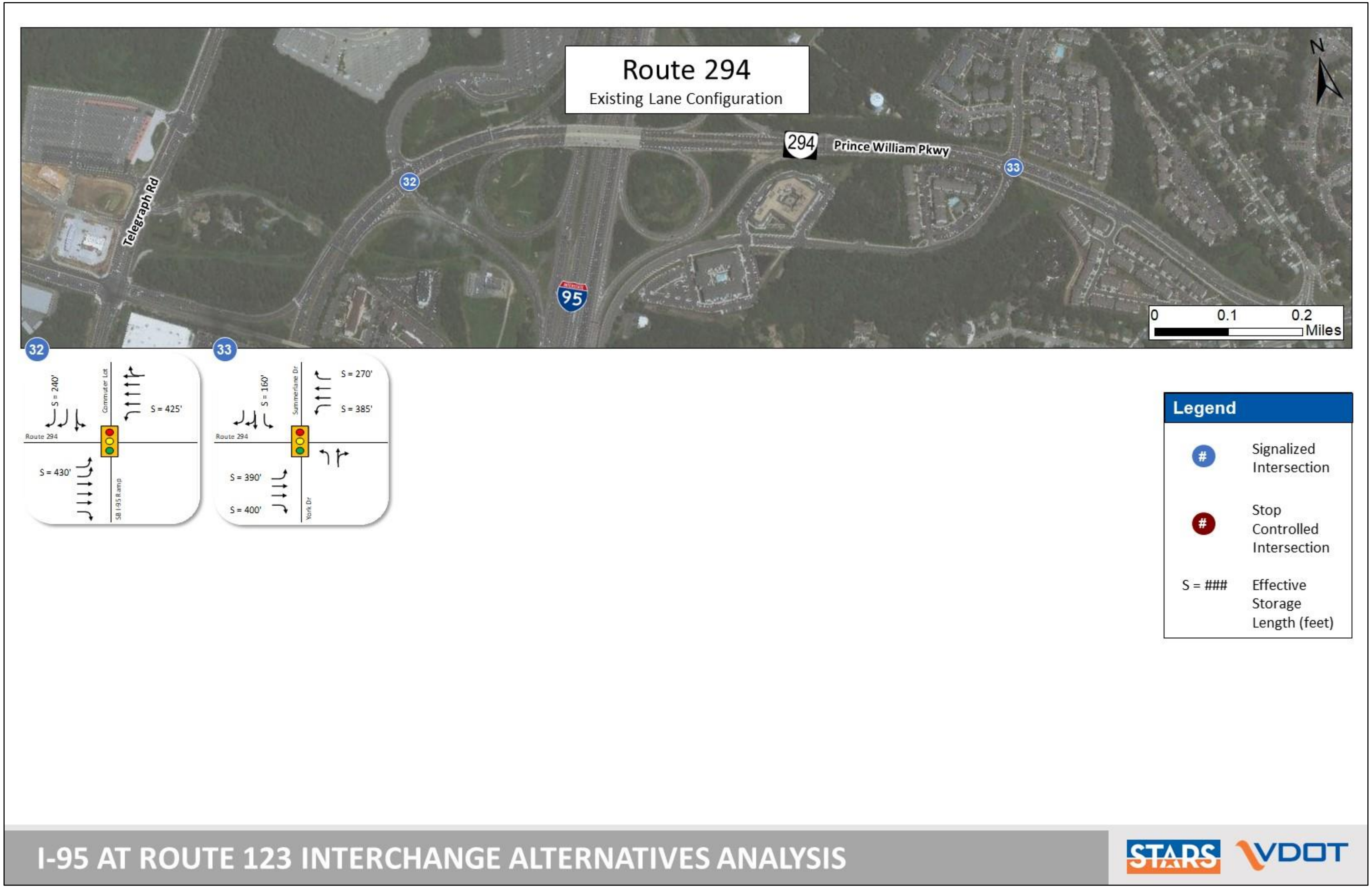
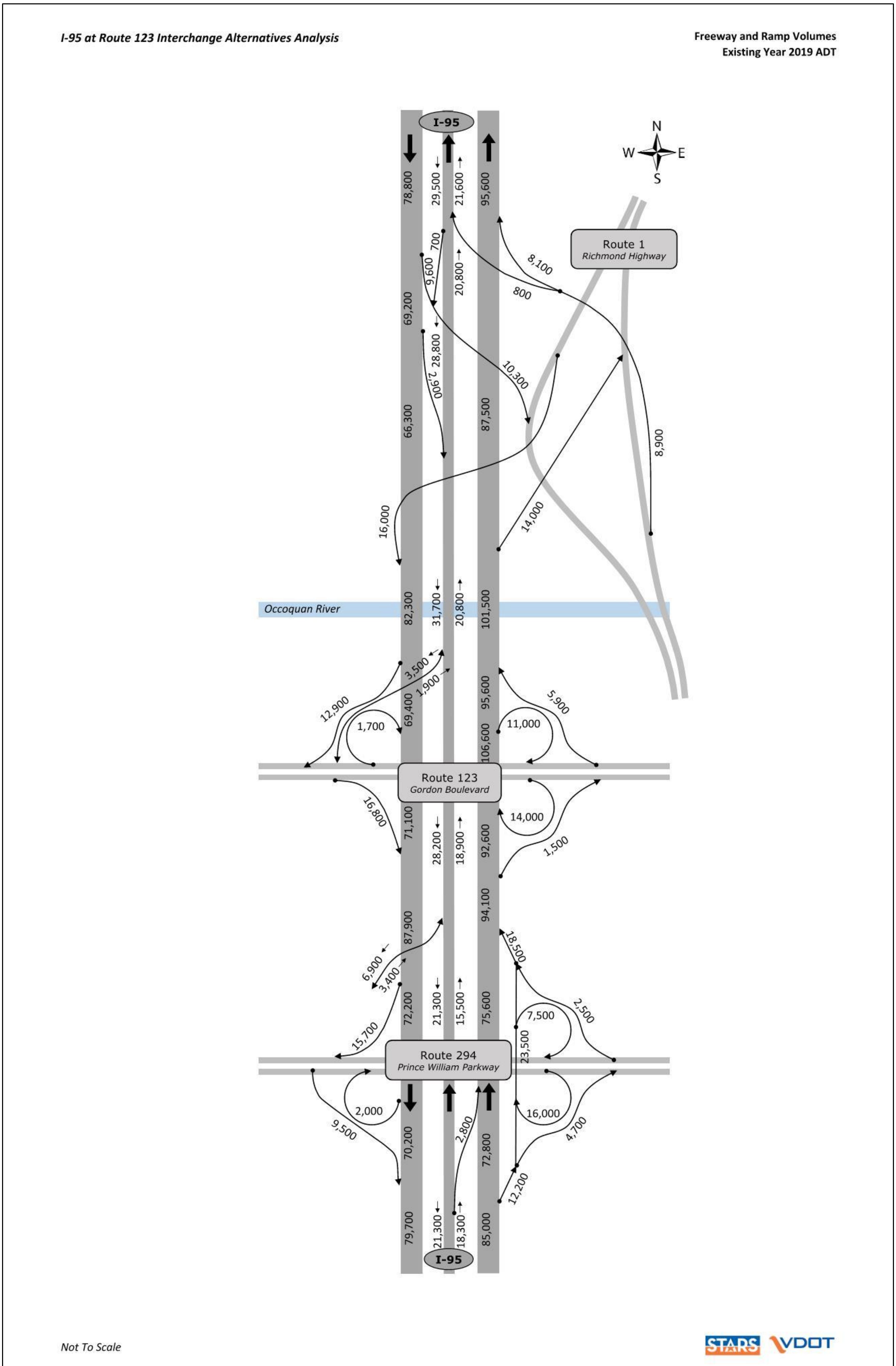


Figure 8: 2019 Existing Conditions Average Daily Traffic



2.1.4.3 Peak Hour Determination

Based on guidance provided in the *TOSAM*, common uniform AM and PM peak hours were defined throughout the entire network. The AM and PM peak hours were determined by first reviewing the individual intersection, arterial, ramp, and mainline peak hours. The peak traffic hours for each location were compared to the field observed maximum queue lengths and congestion.

The network-wide AM peak hours were determined to be 7:00 to 8:00 AM. The network-wide AM peak hour traffic volumes at intersections and on mainline I-95 occurred between 7:00 and 8:00 AM and 4:45 to 5:45 PM, respectively. During field reviews, maximum queueing was observed on the arterials between 6:45 and 7:45 AM and the slowest speeds on northbound I-95 occurred between 6:15 and 7:45 AM. Therefore, the study team selected 7:00 to 8:00 AM as the AM peak hour for analysis. The subsequent hour between 8:00 and 9:00 AM was used as a shoulder hour for use in the multi-hour traffic microsimulation analyses.

The network-wide PM peak hour was determined to be 4:45 to 5:45 PM. The network-wide PM peak hour traffic volumes at intersections and on mainline I-95 occurred between 4:45 and 5:45 PM and on I-95 ramps between 5:00 and 6:00 PM. Peak traffic volumes on mainline I-95 were highest at the onset of congestion starting at 2 PM and throughput was approximately 97 percent of the level at 2 PM from 4:45 to 5:45 PM when oversaturated conditions started. Field observations showed maximum queue levels on the interstate and the arterials between 4:45 and 6:00 PM with the lowest speeds on southbound I-95 between 4:45 and 5:45 PM. Therefore, 4:45 to 5:45 PM was selected as the PM peak hour for analysis. The subsequent hour between 5:45 and 6:45 PM was used as a shoulder hour for the traffic microsimulation analysis.

The hours that captured the highest percentage of overall traffic in the network, and accurately reflected the congestion on I-95 and the maximum queueing levels on arterials were identified as the peak hours for the study. The peak hour determination summary tables are provided in ***Appendix B***.

2.1.4.4 Heavy Vehicle Percentages

Heavy vehicle percentages were computed based on vehicle classification data for locations where traffic count data was available. ***Table 1*** summarizes heavy vehicle percentages for key corridors.

Table 1: 2019 Existing Heavy Vehicle Percentages

Location	Heavy Vehicle Percentage[1]		
	AM[2]	PM[3]	Daily
I-95 at Route 123 interchange	**7.1%**	**6.3%**	**9.5%**
Northbound	5.5%	7.1%	8.8%
Southbound	9.5%	5.5%	10.4%
Route 123 between Commerce St & Riverview Ln	**3.6%**	**1.5%**	**3.2%**
Northbound	3.1%	1.2%	3.1%
Southbound	5.0%	1.2%	3.1%
Route 123 between I-95 SB off-Ramp & Devils Reach Rd	**3.0%**	**1.7%**	**2.9%**
Northbound	4.3%	1.2%	3.0%
Southbound	2.3%	1.2%	3.0%
Old Bridge Rd east of Occoquan Rd	**2.1%**	**1.5%**	**1.9%**
Eastbound	1.6%	2.4%	1.9%
Westbound	5.1%	2.4%	1.9%

[1] Two axle, six tire and larger
[2] 6:00 - 9:00 AM period
[3] 4:00 - 7:00 PM period

2.1.4.5 Traffic Volume Balancing

Traffic volumes were compiled in 15-minute intervals throughout the study area and were balanced in 30-minute intervals. One or both 15-minute inputs were adjusted so that traffic volumes were balanced over each 30-minute period. Traffic counts from the most recent period (i.e., May 2019) were held relatively fixed during the volume balancing process. Traffic volume balancing proceed upstream and downstream from the May 2019 count locations using the proportions of the older, historical counts to bring the whole network volume to estimated May 2019 traffic levels. Traffic volumes for the locations without available historical counts were estimated using a combination of upstream and downstream traffic volume imbalances and engineering judgment using adjacent land use information.

The balanced AM and PM peak hour traffic volumes in the study area are summarized in ***Figure 9*** through ***Figure 11*** for I-95 and ***Figure 12*** through ***Figure 15*** for arterial intersections.

Figure 9: 2019 Existing Conditions AM Peak Hour Volumes – I-95

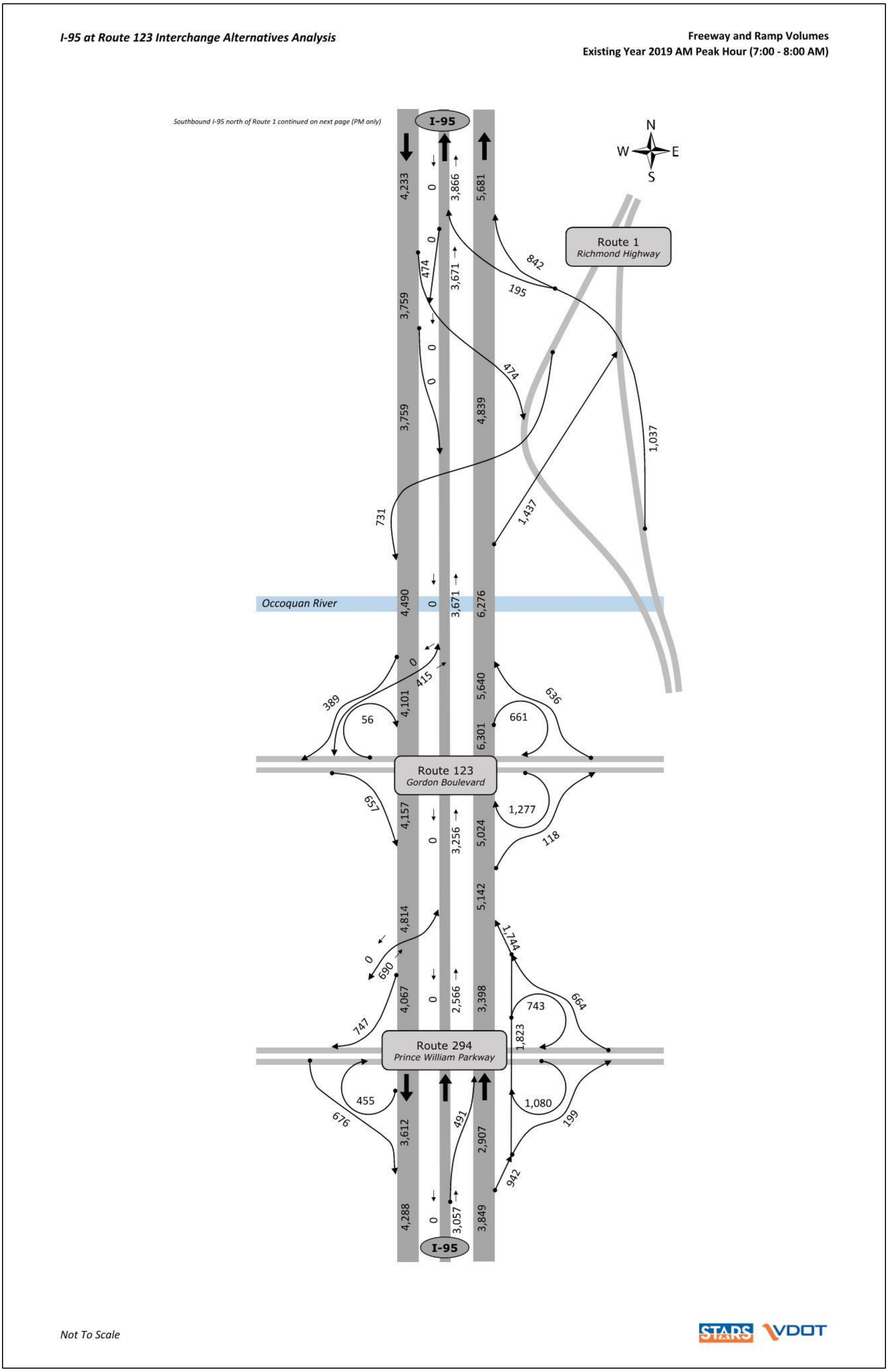


Figure 10: 2019 Existing Conditions PM Peak Hour Volumes – I-95 (1 of 2)

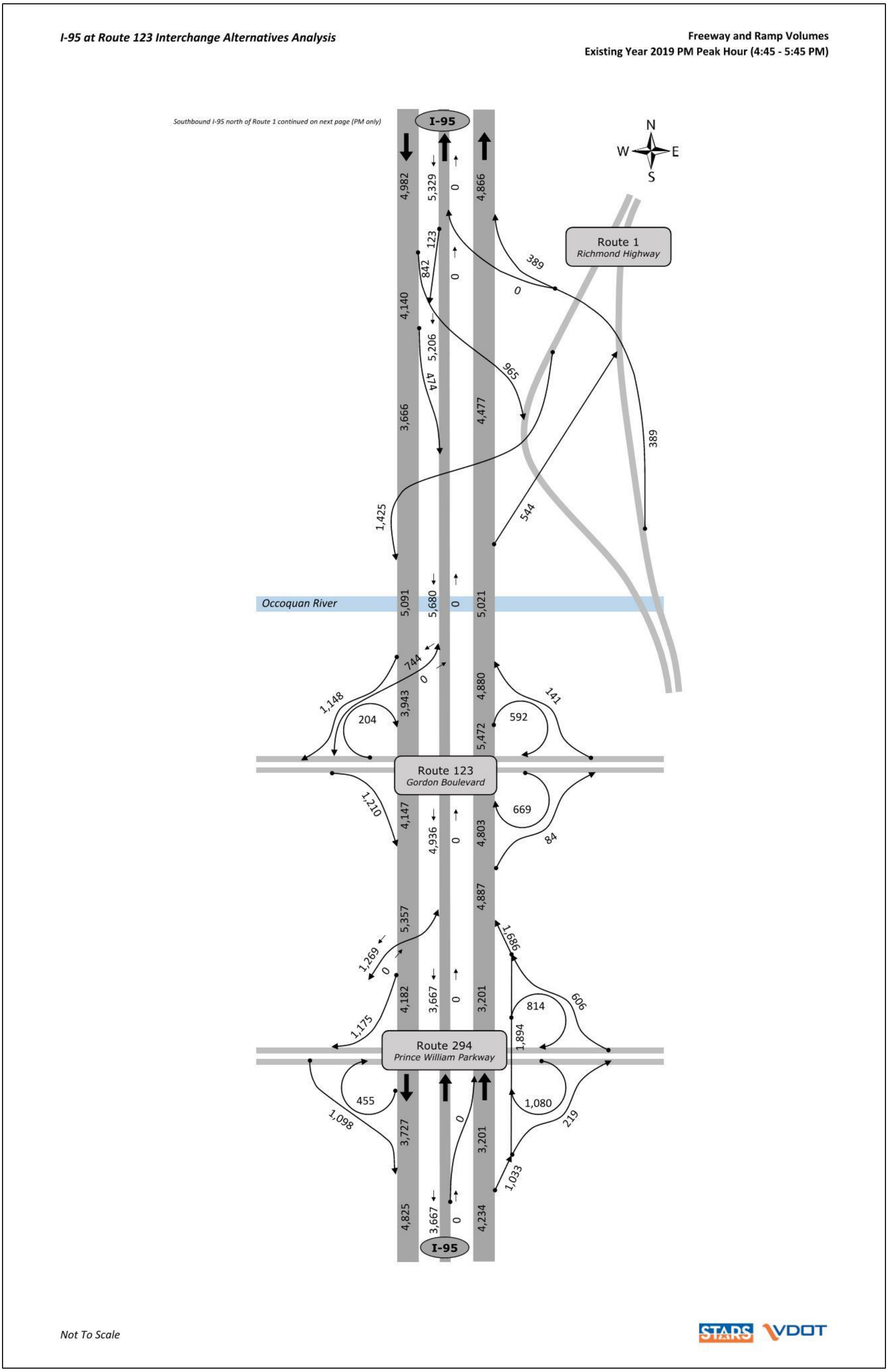


Figure 11: 2019 Existing Conditions PM Peak Hour Volumes – I-95 (2 of 2)

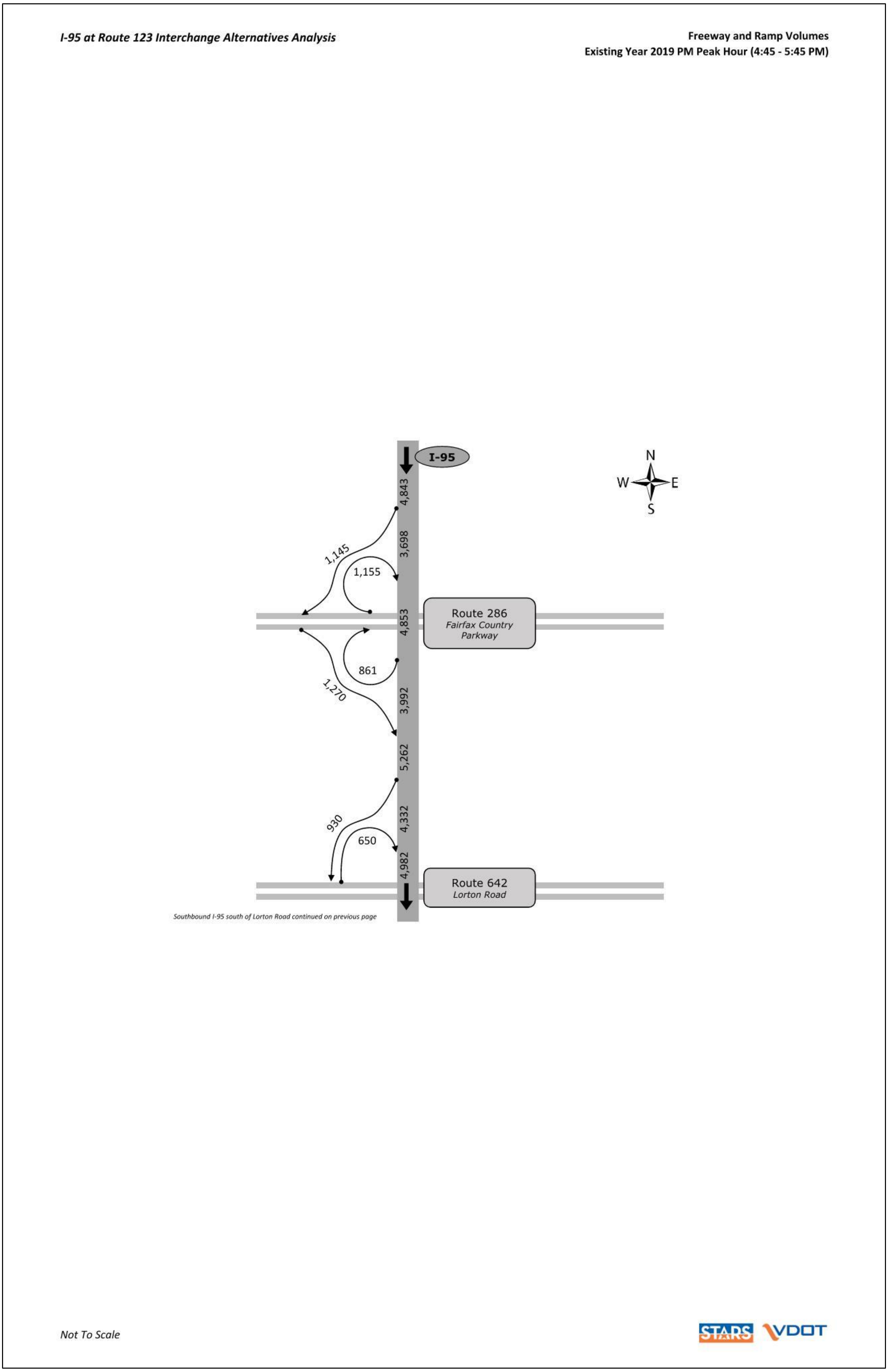


Figure 12: 2019 Existing Conditions Peak Hour Volumes – Intersections (1 of 4)

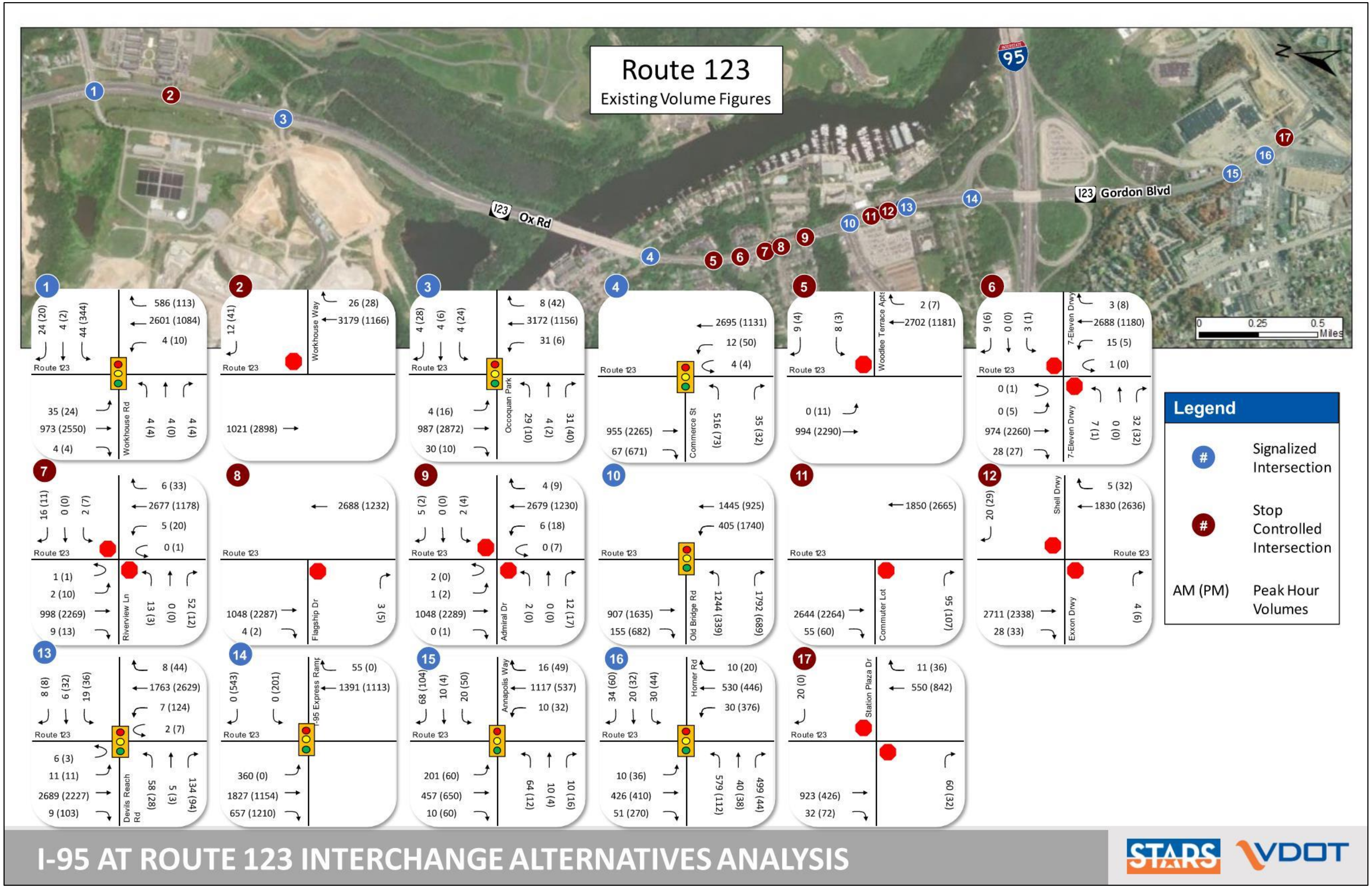


Figure 13: 2019 Existing Conditions Peak Hour Volumes – Intersections (2 of 4)

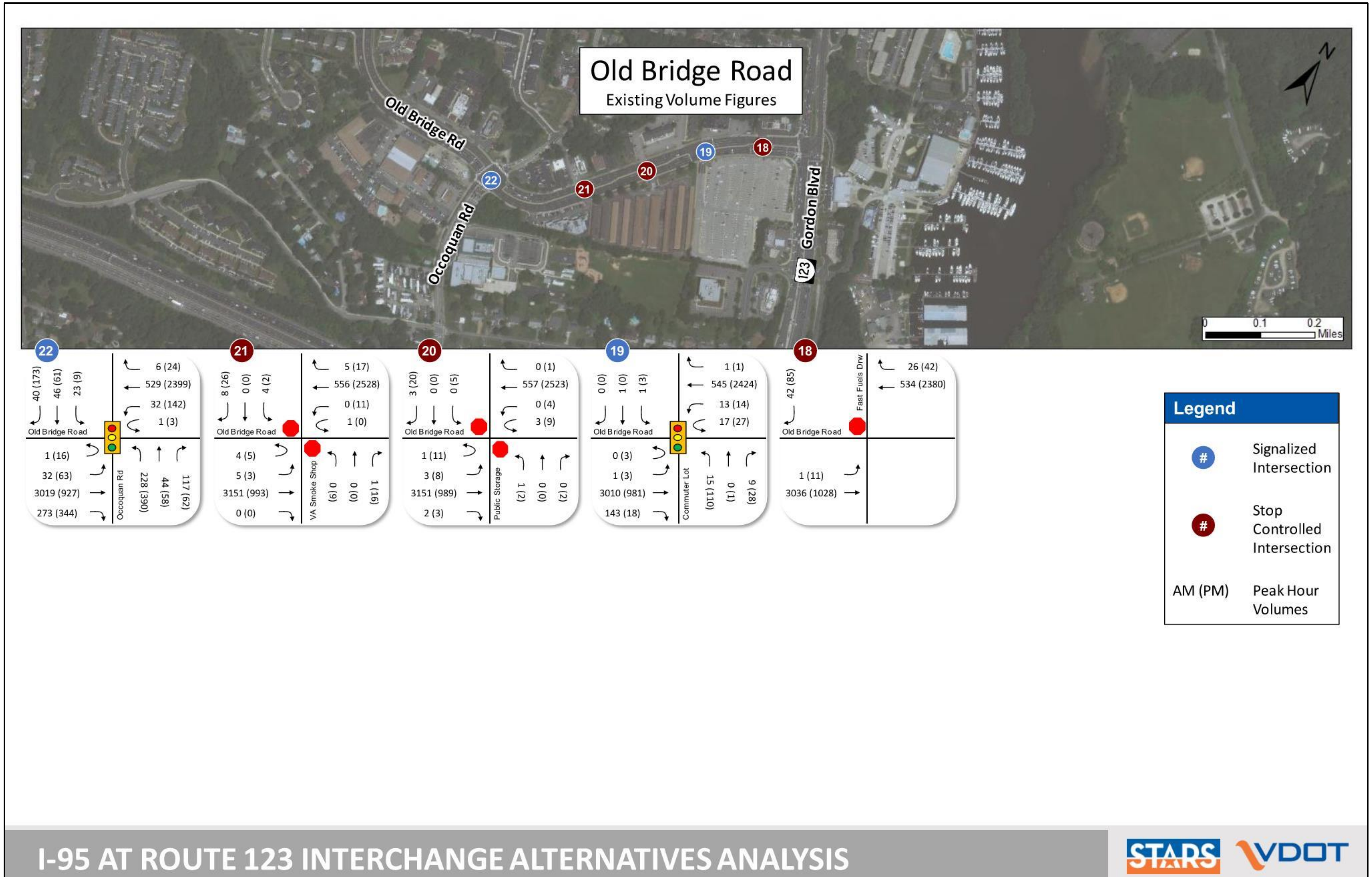


Figure 14: 2019 Existing Conditions Peak Hour Volumes – Intersections (3 of 4)

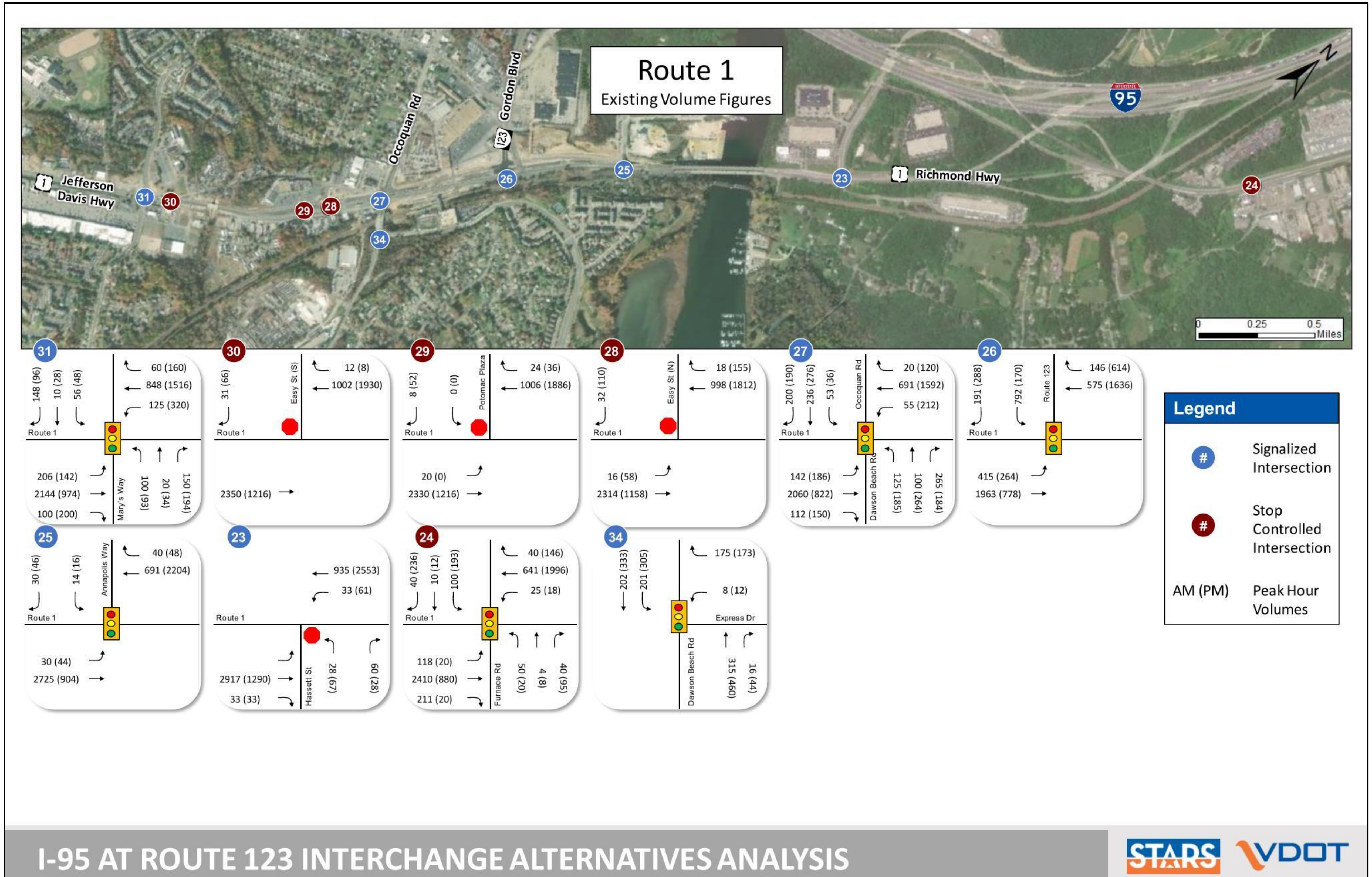
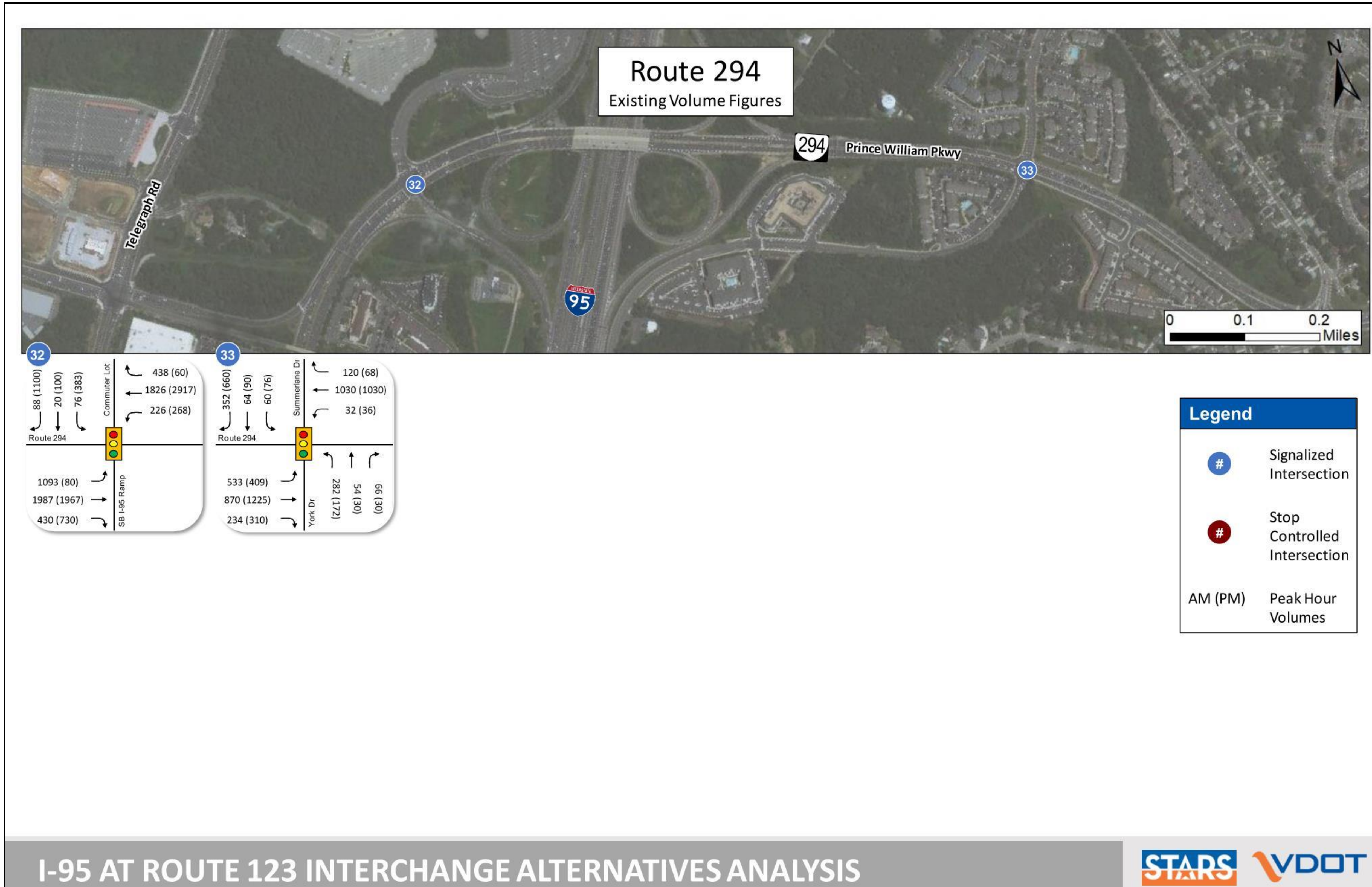


Figure 15: 2019 Existing Conditions Peak Hour Volumes – Intersections (4 of 4)



2.1.5 Pedestrian, Bicycle, and Transit Data

Traffic volume data collected on May 29-30, 2019 for intersections on Route 123 and Old Bridge Road included pedestrian and bicycle counts at each of the study area intersections. Sidewalks exist along both sides of Route 123 from Devils Reach Road to Commerce Street and along both sides of Old Bridge Road. The intersections with the greatest pedestrian activity during the 14-hour count period were Old Bridge Road at Occoquan Road (71 pedestrians), Route 123 at Old Bridge Road (42 pedestrians), and Old Bridge Road at Commuter Parking Lot (37 pedestrians). At the intersection of Route 123 at Old Bridge Road, approximately 60 percent of the counted pedestrians crossed the western leg of Old Bridge Road while 21 percent crossed the southern leg of Route 123. More pedestrian activity was observed along the western side of Route 123 and southern side of Old Bridge Road compared to the opposing sides of these roadways. Figures showing pedestrian count data, sidewalk, and crosswalk locations are included in ***Appendix B***.

Relatively low levels of bicycle activity were observed at study area intersections. The intersections with the highest activity were Old Bridge Road at Occoquan Road (9 bicycles), Route 123 at Commerce Street (8 bicycles), and Route 123 at Old Bridge Road (5 bicycles). More activity was observed in the PM hours than AM hours. A shared-use path exists at the northern end of the study area along Route 123 from Commerce Street north into Fairfax County. A shared-use path was recently constructed along the western side of Route 1 as part of the Phase 1 Widening Project between Marys Way and Annapolis Way.

The study area is served by two major public transit providers: five OmniRide bus routes and one Virginia Railway Express (VRE) commuter rail lane. Eleven bus stops exist on Route 123, Old Bridge Road, Occoquan Road, and Route 1 to serve five routes with varying service intervals. While other OmniRide Express bus routes exist in the study area on the I-95 corridor, the five routes that use the I-95 at Route 123 interchange or surrounding arterial roadways in the study area are:

- Lake Ridge OmniRide Express
- Tysons Corner OmniRide Express
- Prince William Metro Express
- Route 1 OmniRide Local
- Woodbridge/Lake Ridge OmniRide Local

The Woodbridge VRE Station is located on Express Drive and can also be accessed via Route 1 for drop off and pick up activities. Aside from the parking at the Woodbridge VRE Station, three park and ride lots are located in the study area. The I-95/Route 123 Commuter Lot is accessed via the northbound I-95 off-ramp to northbound Route 123 or Annapolis Way, and the Occoquan Commuter Lot is accessed via southbound Route 123 or Old Bridge Road. A third lot, the Horner Road Commuter Lot, is located at the Route 294 interchange and can be accessed directly from the I-95 express lanes or Route 294. ***Table 2*** shows parking capacity and average utilization of these lots according to VDOT's 2020 park and ride lot inventory. Utilization data was collected by VDOT between 2018 and 2019.

Table 2: Park and Ride Lot Capacity and Utilization

Lot Name	Total Spaces	Total Occupied Spaces	Total ADA Spaces	Total Occupied ADA Spaces
I-95/123 Commuter Lot	575	247 (43%)	18	8 (44%)
Occoquan Commuter Lot	595	437 (58%)	12	7 (58%)
Horner Road Commuter Lot	2,293	2,249 (98%)	46	45 (98%)
Woodbridge VRE	738	570 (86%)	14	12 (86%)

2.1.6 Access Spacing

Access spacing based on VDOT and American Association of State Highway and Transit Officials (AASHTO) standards was evaluated to within the study area to determine if any access spacing standards were not met. AASHTO *A Policy on Geometric Design of Highway and Streets (Green Book)* standards was used to determine the minimum spacing between the following interchanges:

- I-95 at Route 1
- I-95 at Route 123
- I-95 at Route 294

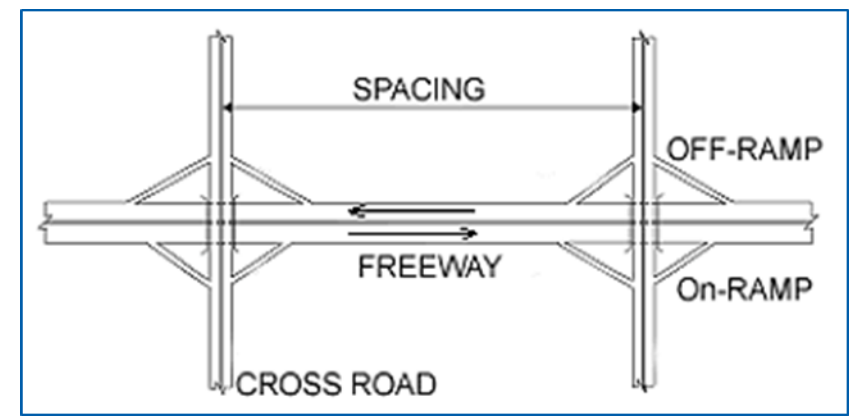
The *VDOT Road Design Manual* standards were used to determine the minimum access point spacing along the following arterials:

- Route 123
- Old Bridge Road

2.1.6.1 Interchange Spacing

According to the AASHTO *Green Book*, the general guidance for minimum interchange spacing on urban freeways is one mile. FHWA's Techbrief *Safety assessment of Interchange Spacing on Urban Freeways* (Publication Number FHWA-HRT-07-031), defines interchange spacing as the distance between interchange crossroads, as shown in ***Figure 16***.

Figure 16: Interchange Spacing Measurement



Source: FHWA Techbrief "Safety Assessment of Interchange Spacing on Urban Freeways" (Publication Number: FHWA-HRT-07-031)

Existing interchange spacing between crossroads within the study area is summarized in ***Table 3***. The study corridor meets AASHTO's one-mile interchange spacing criterion between all interchanges in the study area.

Table 3: Interchange Spacing

From	To	Interchange Spacing (Miles)
Route 1 (Exit 161)	Route 123 (Exit 160)	1.18*
Route 123 (Exit 160)	Route 294 (Exit 158)	1.87

**Note: Since Route 1 does not cross I-95 as shown in Figure 30, measurement was taken from the middle of the interchange*

Ramp acceleration and deceleration lengths for the Route 123 interchange were measured and compared to the AASHTO standard lane length (based on the *Green Book*). These values, shown in ***Table 4*** identify each acceleration lane, deceleration lane, or ramp terminal distance to major intersection that is deficient. The recommended AASHTO weaving lengths do not apply to cloverleaf interchange configurations. However, for the purpose of the existing analysis, each weave lane was treated as independent deceleration and acceleration lanes to understand potential deficiencies should individual loops be removed in the preferred alternative.

Table 4: Ramp Acceleration and Deceleration Lane Summary

Ramp	Posted or Advisory Speed (mph)	Ramp Design Speed (mph)	Lane Existing Length (feet)	Adjusted Standard Lane Length (feet)	Deficient Length (feet)
Acceleration					
Northbound I-95 on-ramp from southbound Route 123	20	25	1,170*	1,420	-250
Northbound I-95 on-ramp from northbound Route 123	40	40	2,815*	1,700	N/A
Southbound I-95 on-ramp from northbound Route 123	25	30	250	2,025	-1,175
Southbound I-95 on-ramp from southbound Route 123	30	30	865	2,160	-1,295
Northbound I-95 off-ramp to southbound Route 123	35	40	770*	1,000	-230
Northbound I-95 off-ramp to northbound Route 123	25	30	305	1,350	-1,045
Southbound I-95 off-ramp to northbound Route 123	30	35	--	1,230	--
Deceleration					
Northbound I-95 on-ramp from southbound Route 123	20	25	--	1,420	--
Northbound I-95 on-ramp from northbound Route 123	40	40	450	1,000	-550
Southbound I-95 on-ramp from northbound Route 123	25	30	770*	1,350	-580
Southbound I-95 on-ramp from southbound Route 123	30	30	85	1,215	-1,130
Northbound I-95 off-ramp to southbound Route 123	35	40	630	1,200	-570
Northbound I-95 off-ramp to northbound Route 123	25	30	1,170*	1,350	-180
Southbound I-95 off-ramp to northbound Route 123	30	35	2,010*	1,476	N/A

* *Indicates the Acceleration/Deceleration lane is part of a weaving facility and was measured from gore point to gore point.*

2.1.6.2 Arterial Spacing

The VDOT *Road Design Manual* provides access management design standards for entrances and intersection along roadways, which aim to provide access to land uses while preserving the follow of traffic. The standards are based on the functional classification and posted speed limit of the roadway. The access management standards applicable to Route 123 and Old Bridge Road in the study area are listed in ***Table 5***.

Table 5: Access Management Design Standards

Description	Minimum Spacing Standard (feet) Per Facility Type and Design Speed	
	Principle Arterial; 40 mph	**Minor Arterial; 35 mph**
Spacing between Signalized Intersection and Signalized Intersection (Type 1)	1,320	1,050
Spacing between Unsignalized Intersection/Full Median Crossover and Signalized Intersection/Unsignalized Intersection/Full Median Crossover (Type 2)	1,050	660
Spacing between Full Access Entrance or Directional Median and Any Intersection, Full Access Entrance, or Median Crossover (Type 3)	565	470
Spacing between Partial Access Entrance and Any Entrance, Intersection, or Median Crossover (Type 4)	305	250
Spacing between Start/End of Ramp Terminal and Any Intersection, Full Access Entrance, or Median Crossover	1,320	1,320
Spacing between Start/End of Ramp Terminal and Right-In/Right-Out Partial Access Entrance	750	750

Many of the access openings along Route 123 and Old Bridge Road in the study area do not meet access spacing standards. The exceptions are the following, which meet spacing standards:

- Northbound Route 123 between Sea Ray Lane and Old Bridge Road (Type 4)
- Northbound Route 123 between Route 1 and Station Plaza Driveway (Type 4)
- Southbound Route 123 between Old Bridge Road and Commuter Lot (Type 1)
- Old Bridge Road between Commuter Lot and Occoquan Road signalized intersections (Type 1)
- Route 123 between Old Bridge Road and Commerce Street signalized intersections (Type 1)
- Route 123 between Commerce Street and Occoquan Regional Park signalized intersections (Type 1)
- Route 123 between Occoquan Regional Park and Workhouse Road signalized intersections (Type 1)
- Northbound Route 123 between Occoquan Regional Park and Workhouse Way (Type 4)
- Northbound Route 123 between Workhouse Way and Workhouse Road (Type 4)

2.2 Existing Operational Analysis

Traffic operations analyses were conducted to evaluate the overall performance of the study corridor under existing (2019) AM and PM peak hour conditions. The intent of the existing conditions analyses was to provide a general understanding of the baseline traffic conditions as a starting point for developing future improvement strategies. Existing conditions were modeled using Vissim 11 microsimulation software.

2.2.1 Traffic Analysis Assumptions

The existing AM and PM Vissim models were developed based on a combination of collected data and visual field observations. Traffic volumes, travel times, and maximum queue lengths were used as calibration measures. Modeling inputs, assumptions, analysis methodologies, and calibration approaches were consistent with *TOSAM* and were documented in the calibration memorandum contained in ***Appendix C***.

The VDOT Sample Size Determination Tool was used to confirm that ten simulation runs would provide the acceptable 95 percent confidence level for both the AM and PM models. Therefore, ten simulation runs were conducted for both models using different random seeds. The results reported are an average of these runs. The Sample Size Determination results are documented in ***Appendix C***.

2.2.2 Measures of Effectiveness

The following measures of effectiveness (MOEs) were used for the operational analysis of the roadway network under existing condition.

Freeway Performance Measures

The following MOEs are provided for I-95 for the peak hours:

- Vehicle throughput (vehicles per hour [vph])
- Density (vehicles per lane per mile [vplpm])
- Speed (miles per hour [mph])
- Travel time (minutes : seconds)
- Maximum queue length (feet)

Vissim freeway MOEs are reported for each freeway segment. Methodologies for the merge, diverge, and weave segment definitions was consistent with the *Highway Capacity Manual* for the area of influence within the designated segments.

Arterial/Intersection Performance Measures

The following MOEs were use to evaluate the study area intersections and arterial segments:

- Vehicle throughput (vehicles per hour [vph])
- Microsimulation delay (seconds per vehicle [s/veh])
- Maximum queue length (feet)
- Travel time (minutes : seconds)

Intersection with side street approach volume greater than 100 vehicles per hour during the AM or PM peak hour are reported to focus the analysis on the more critical, higher volume intersections in the study area.

2.2.3 Freeway Analysis

The AM and PM peak hour average freeway segment density and speed are illustrated in ***Figure 17*** through ***Figure 22***. Additional AM and PM peak hour MOE information, including vehicle throughput, travel time and ramp queue lengths at critical locations, can be found in in ***Appendix C***.

2.2.3.1 2019 AM Peak Hour Freeway Operations

In the AM peak hour, congestion occurred in the study area along northbound I-95 at the Route 294 interchange and north of the Route 1 interchange.

The I-95 northbound C-D road and merge at the Route 294 interchange experienced average densities of 45 vplpm or greater and average speeds of 20 mph or less. The northbound I-95 on-ramps in both directions from Route 294 were the most congested ramps within the study area during the AM peak hour. Congestion also occurred as vehicles from the C-D road merged onto mainline I-95 after the interchange.

Northbound I-95 operated with average densities of 35 vplpm or less and average speeds of 50 mph or greater through the Route 123 and Route 1 interchanges. All ramps at the Route 123 interchange operated with little to no congestion in the AM peak hour.

Congestion on mainline northbound I-95 occurred north of the Route 1 interchange, with densities of 45 vplpm or greater and speeds below 30 mph. This congestion was caused by the 842 vehicles in the AM peak hour merging onto I-95 from northbound Route 1.

Southbound I-95 and the northbound I-95 reversible express lanes within the study area operated under free-flow traffic conditions with little to no congestion.

Northbound peak hour travel time from south of Route 294 to north of Route 1 was 11 minutes and 6 seconds (compared to free-flow travel time of 4 minutes and 57 seconds at the posted speed limit) and southbound peak hour travel time from north of Route 1 to south of Route 294 was 4 minutes and 12 seconds (compared to free-flow travel time of 4 minutes and 25 seconds at the posted speed limit).

2.2.3.2 2019 PM Peak Hour Freeway Operations

In the PM peak hour, congestion occurred in the study area along southbound I-95, originating at the Route 123 interchange and extending several miles back to the Fairfax County Parkway interchange.

The greatest average densities of over 100 vplpm occurred from the Route 642 (Lorton Road) interchange to the Route 1 interchange, which was the area with the slowest average speeds of less than 10 mph. Heavy average densities of 45 to 100 vplpm occurred between the Route 1 interchange through the Route 123 interchange. These conditions were most attributed to the lane drop within the Route 123 interchange that caused congestion from merging vehicles, and the weaving vehicles from southbound Route 1 onto southbound I-95. Due to this mainline congestion, the on-ramp from southbound Route 1 and on-ramps from Route 123 in both directions also operated with high densities and speeds less than 20 mph. Congestion also occurred at the merge from the on-ramp from southbound Route 123 and caused queuing onto the arterial.

Slight congestion and reduced speeds also occurred within the weaving movement on the northbound I-95 C-D road at the Route 294 interchange. Northbound I-95 and the southbound I-95 reversible express lanes within the study area operated with little to no congestion.

Northbound peak hour travel time from south of Route 294 to north of Route 1 was 4 minutes and 49 seconds (compared to free-flow travel time of 4 minutes and 57 seconds at the posted speed limit), and southbound peak hour travel time from north of Route 1 to south of Route 294 was 10 minutes and 52 seconds (compared to free-flow travel time of 4 minutes and 25 seconds at the posted speed limit). Southbound travel time from north of Fairfax County Parkway to south of Route 294 was 34 minutes and 15 seconds (compared to free-flow travel time of 11 minutes and 9 seconds at the posted speed limit).

Figure 17: Existing AM Peak Hour Mainline and Ramp Density

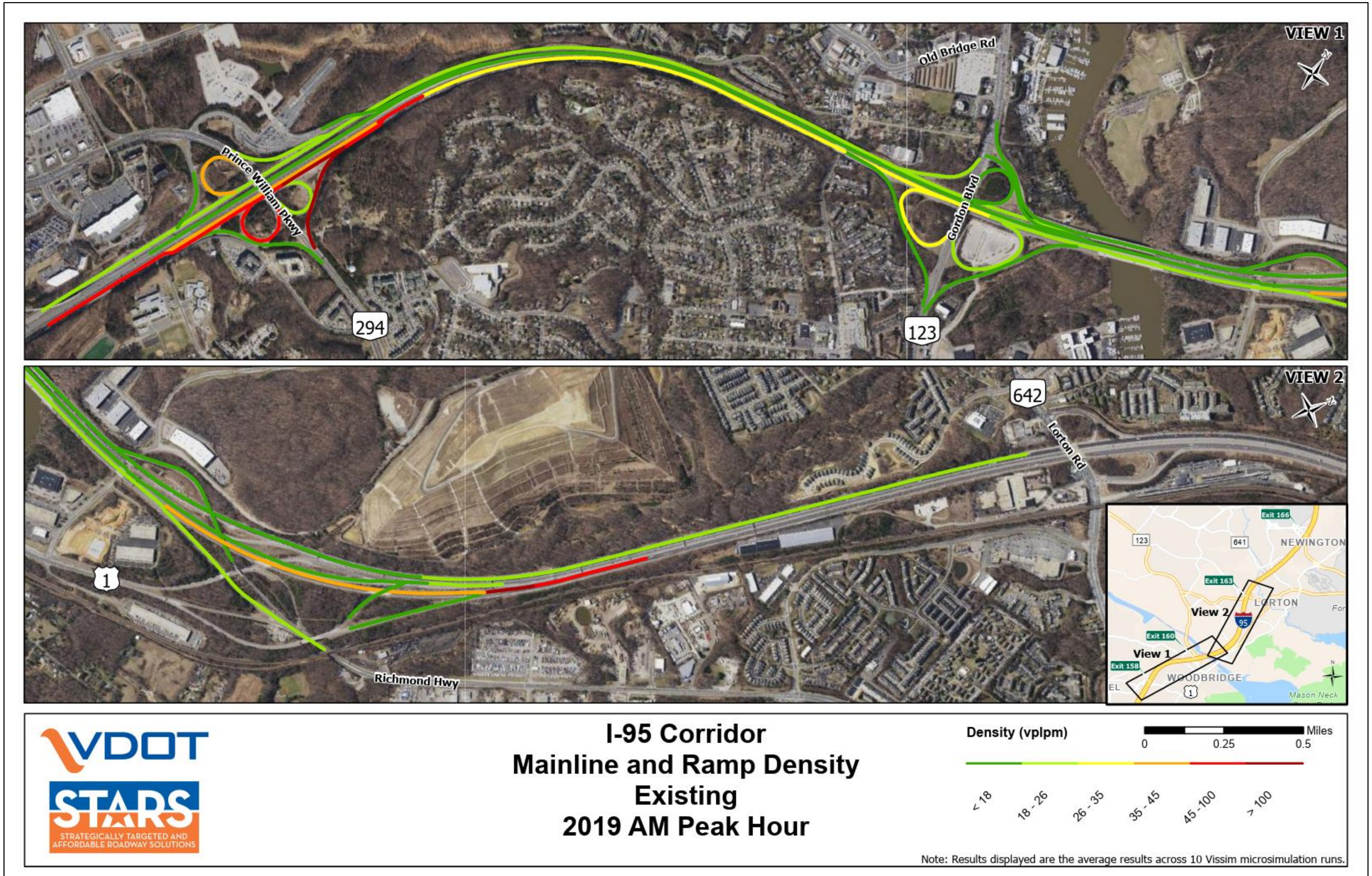


Figure 18: Existing AM Peak Hour Mainline and Ramp Speed

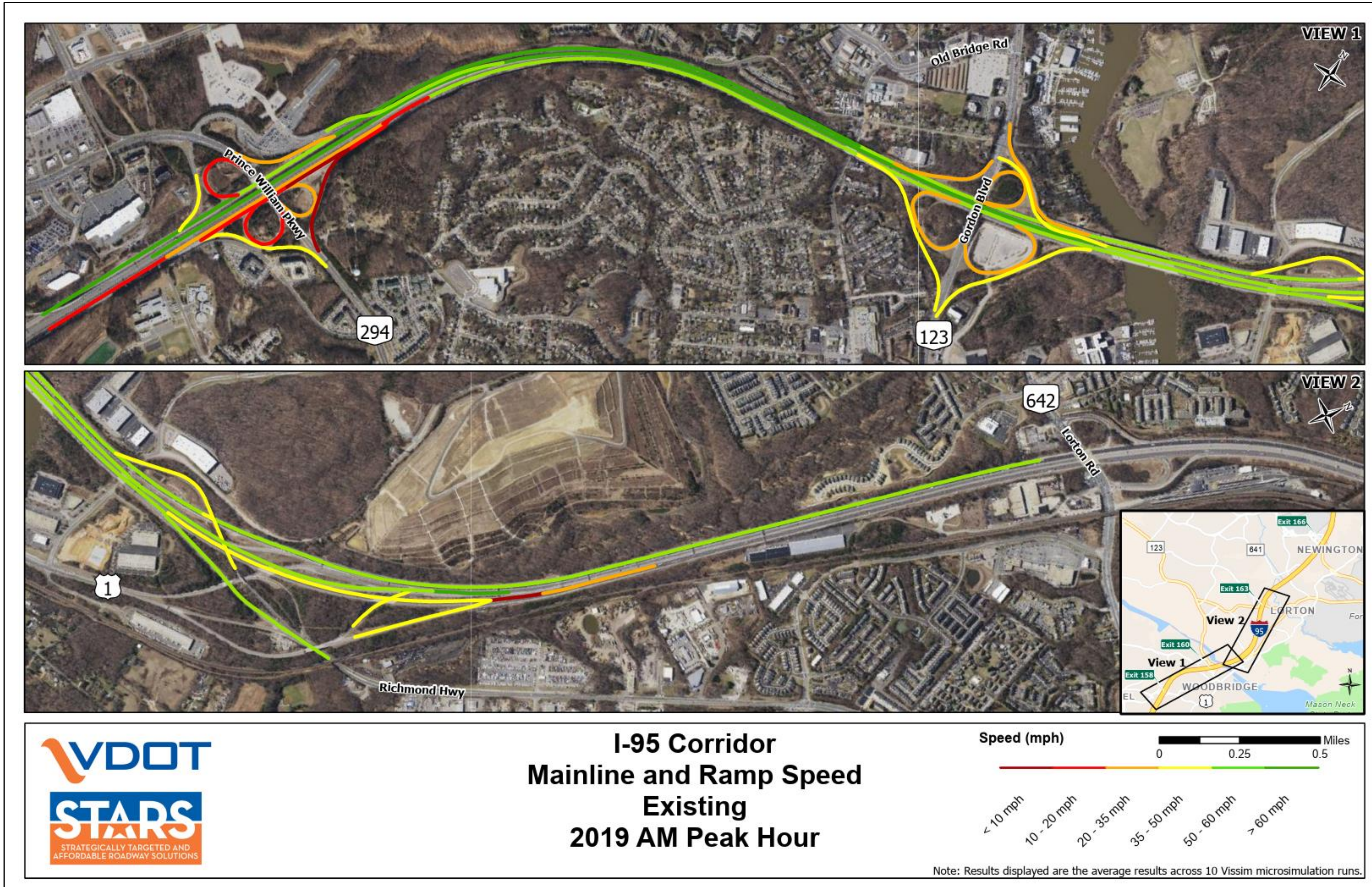


Figure 19: Existing PM Peak Hour Mainline and Ramp Density (1 of 2)

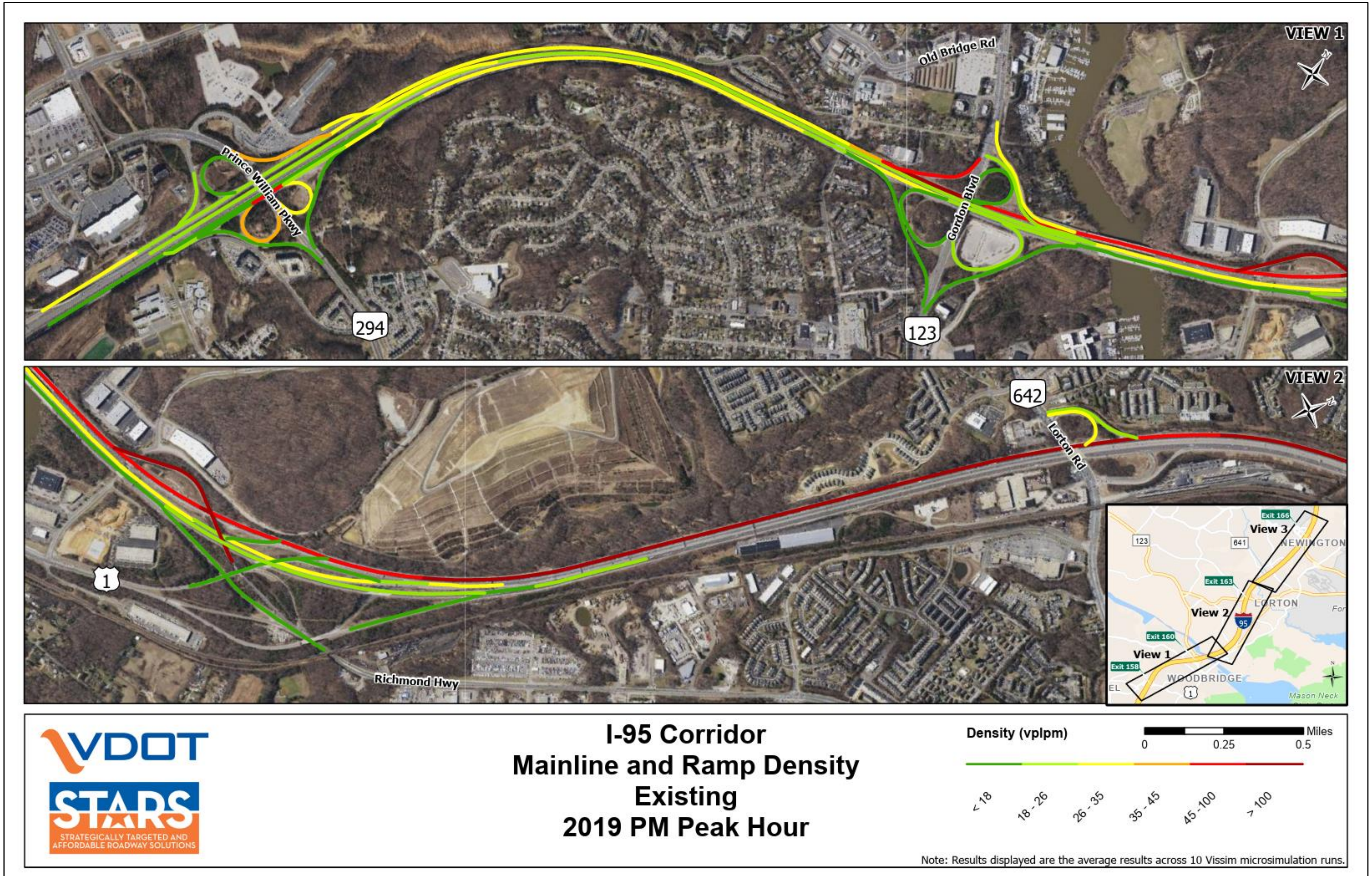


Figure 20: Existing PM Peak Hour Mainline and Ramp Density (2 of 2)

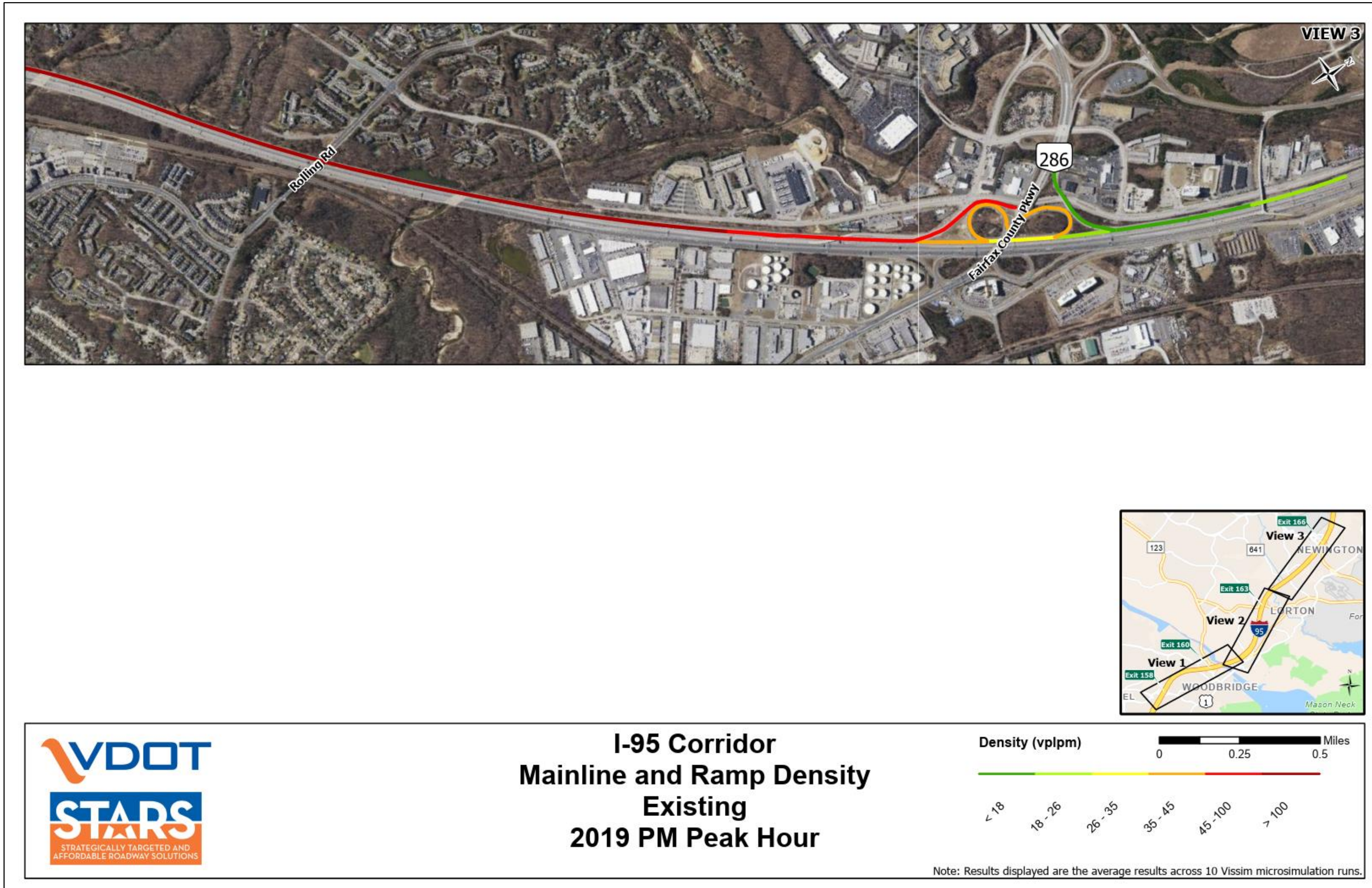


Figure 21: Existing PM Peak Hour Mainline and Ramp Speed (1 of 2)

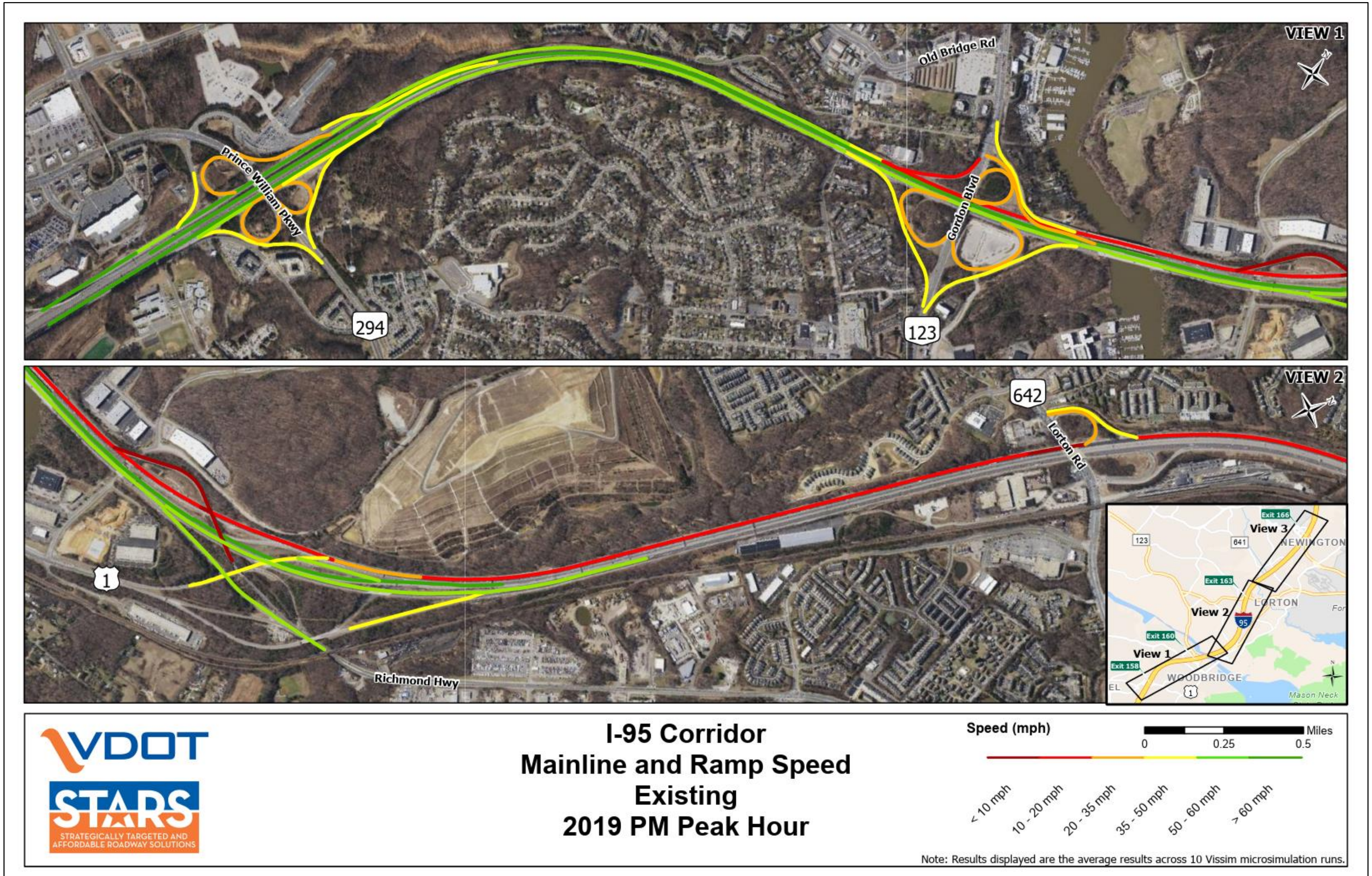
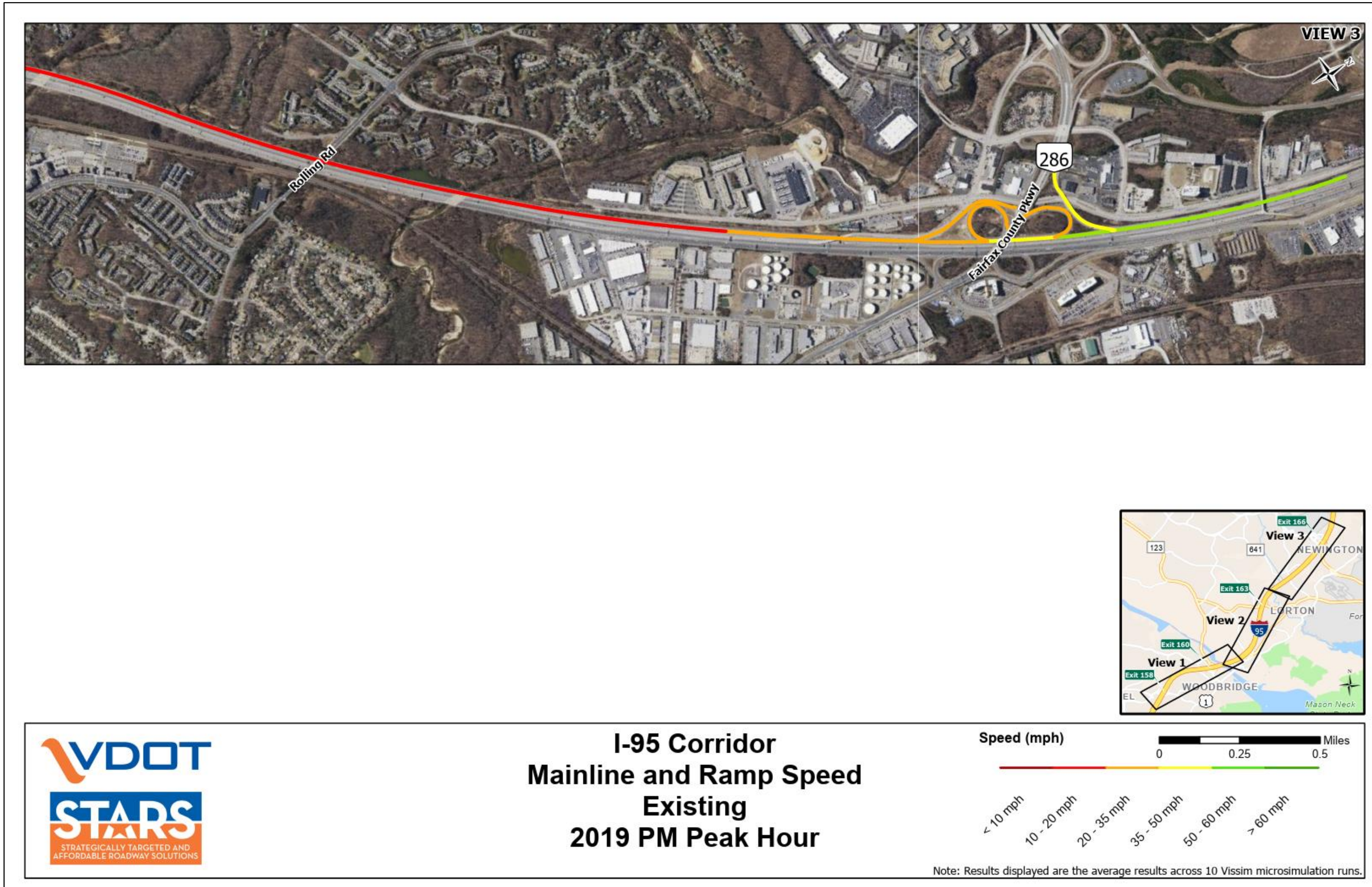


Figure 22: Existing PM Peak Hour Mainline and Ramp Speed (2 of 2)



2.2.4 Intersection Analysis

Three measures of effectiveness were selected to quantify the performance at the study area intersections:

- Vehicle throughput by movement and intersection (vehicles per hour [vph])
- Microsimulation delay by movement and intersection (seconds per vehicle)
- Maximum queue length by movement (feet)

Travel time along Route 123 and Route 1 was also used to evaluate performance of arterial segments.

TOSAM provides different definitions for intersection control delay and microsimulation delay, both of which are measured in seconds per vehicle. Microsimulation delay, which is not defined in the *Highway Capacity Manual (HCM)*, is calculated as the difference between the simulated travel time and theoretical travel time if a vehicle operates at the desired speed calculated by the microsimulation tool. Arterial intersection approach and movement delay outputs from Vissim are reported using microsimulation delay. According to *TOSAM*, level of service (LOS) shall not be used in results from microsimulation models; therefore, microsimulation delay is reported in this section in vehicles per second and color-coded in a similar fashion as analogous *HCM* delay-based LOS thresholds. ***Table*** 6 conveys the thresholds used to analyze the Vissim outputs for intersection delay.

Table 6: Criteria for Vissim Intersection Analysis

Color Scale	Intersection Average Delay (seconds per vehicle)
Green	≤ 10
Green	> 10 – 20
Green	> 20 – 35
Yellow	> 35 – 55
Orange	> 55 – 80
Red	> 80

2.2.4.1 2019 AM Peak Hour Intersection Operations

AM peak hour microsimulation delay by intersection movement are summarized in ***Figure 23*** through ***Figure 25***. Additional AM peak hour MOE information, including vehicle throughput, travel time, and queue length were documented in ***Appendix C***.

Congestion occurred along northbound Route 123, eastbound Old Bridge Road, and northbound Route 1. Many eastbound left-turn movements at intersections on Route 123 experienced delays and queuing as many vehicles exited side streets and turned left to commute north on Route 123. Consistently high delays and queuing occurred on northbound Route 1 from Marys Way through Furnace Road.

Under existing conditions during the AM peak hour, all study area intersections operated with average overall intersection delays of 55 seconds per vehicle or less except for:

- Old Bridge Road at Occoquan Road (73 seconds per vehicle)
- Route 294 at Summerland Drive/York Drive (192 seconds per vehicle)

The study intersection of Route 123 at Old Bridge Road operated with an average overall intersection delay of 40 seconds per vehicle.

While many of the intersections operated at acceptable overall delays, some individual movements were failing. Specifically, many left-turn movements operated with excessive delays in the AM peak hour due to long traffic signal cycle lengths and the need to serve major through movements at traffic signals. Cycle lengths were 240 seconds at Route 123 intersections north of I-95 and along Old Bridge Road, 110 seconds at Route 123 intersections south of I-95, and 220 seconds at Route 1 intersections. The left-turn movements at the following intersections operated with average delays over 80 seconds per vehicle:

- Eastbound left-turn movement at Route 123 at Commerce Street
- All left-turn movements at Route 123 at Devil's Reach Road
- All left-turn movements at Old Bridge Road at Occoquan Road
- Northbound, southbound, and westbound left-turn movements at Old Bridge Road at the Commuter Parking Lot
- All left-turn movements at Route 1 at Furnace Road
- Southbound and westbound left-turn movements at Route 1 at Hassett Street
- Eastbound left-turn movement at Route 1 at Annapolis Way
- Westbound left-turn movement at Route 1 at Occoquan Road/Dawson Beach Road
- Southbound, eastbound, and westbound left-turn movements at Marys Way
- Westbound left-turn movement at Route 294 at the southbound I-95 ramp
- Eastbound, westbound, and northbound left-turn movements at Route 294 at Summerland Drive/York Drive

Maximum queue lengths exceeded the effective turn lane length at the following movements:

- Northbound left turn from Route 123 to Old Bridge Road
- Eastbound left turn from Old Bridge Road to Route 123
- Northbound right turn and southbound left turn from Route 123 to I-95 express lanes ramp
- Northbound right turn from Occoquan Road to Old Bridge Road

Maximum queue lengths exceeded the effective length of adjacent turn lanes, effectively blocking access of turning vehicle during queuing conditions at the following locations:

- Northbound Route 123 at Workhouse Road, Commerce Street, Old Bridge Road, and Annapolis Way/Monroe Drive
- Southbound Route 123 at Horner Road
- Eastbound Old Bridge Road at Commuter Parking Lot
- Eastbound and westbound Old Bridge Road at Occoquan Road
- Northbound and southbound Route 1 at Furnace Road
- Northbound Route 1 at Annapolis Way
- Northbound and southbound Route 1 at Route 123
- Eastbound Occoquan Road at Route 1
- Northbound and southbound Route 1 at Marys Way
- Eastbound and westbound Route 294 at Southbound I-95 Ramp/Commuter Lot
- Eastbound and westbound Route 294 at Summerland Drive/York Drive

Maximum queue lengths extended to the next upstream signalized intersection at the following intersection approaches:

- Northbound Route 123 at Old Bridge Road
- Eastbound Old Bridge Road at Route 123
- Northbound Route 123 at Annapolis Way/Monroe Drive
- Westbound right-turn from Dawson Beach Drive to northbound Route 1
- Westbound Route 294 at Summerland Drive/York Drive

2.2.4.2 2019 PM Peak Hour Intersection Operations

PM peak hour microsimulation delay by intersection movement were summarized in ***Figure 26*** through ***Figure 28***. Additional PM peak hour MOE information, including vehicle throughput, travel time, and queue length were documented in ***Appendix C***.

Congestion occurred along northbound and southbound Route 123 and southbound Route 1. The segment of northbound Route 123 between the southbound I-95 off-ramp and the Devils Reach Road intersection through the Commerce Street intersection showed high delays and queue lengths. The heavily traveled weaving movement from southbound I-95 to westbound Old Bridge Road contributed to queues extending onto the southbound I-95 off-ramp but not impacting the mainline. Queuing occurred on southbound Route 123 from the southbound I-95 on-ramp to the northern end of the study area in Fairfax County, particularly in the right lanes, due to traffic destined for southbound I-95 and westbound Old Bridge Road as well as the intermediate traffic signals at Commerce Street and Devils Reach Road. The southbound Route 1 segment from Furnace Road to Marys Way showed consistently high delays and queue lengths on southbound Route 1 and side street movements.

Under existing conditions during the PM peak hour, all intersections within the study area operated with average overall intersection delays of 55 seconds per vehicle or less except for:

- Route 123 at Commerce Street (174 seconds)
- Old Bridge Road at Occoquan Road (58 seconds)
- Route 1 at Occoquan Road/Dawson Beach Road (56 seconds)
- Route 294 at Summerland Drive/York Drive (73 seconds)

The study intersection of Route 123 at Old Bridge Road operated with an average overall intersection delay of 44 seconds per vehicle.

While many intersections operated at acceptable overall delays, some individual movements operated at failing conditions. Specifically, many left-turn movements operated with excessive delays in the PM peak hour due to long cycle lengths and the need to serve major through movements at traffic signals. Cycle lengths were 200 seconds at Route 123 intersections north of I-95 and along Old Bridge Road, 95 seconds at Route 123 intersections south of I-95, and 190 seconds at Route 1 intersections. The left-turn movements at the following intersections operated with average delays over 80 seconds per vehicle:

- Northbound left-turn movement at Route 123 at Workhouse Road
- Eastbound left-turn movement at Route 123 at Old Bridge Road
- All left-turn movements at Route 123 at Devils Reach Road
- All left-turn movements at Old Bridge Road at Occoquan Road
- Northbound and southbound left-turn movements at Old Bridge Road at Commuter Parking Lot
- All left-turn movements at Route 1 at Furnace Road
- Southbound and westbound left-turn movements at Route 1 at Hassett Street
- Eastbound left-turn movement at Route 1 at Annapolis Way
- Eastbound left-turn movement at Route 1 at Route 123
- Southbound and westbound left-turn movements at Route 1 at Marys Way
- All left-turn movements at Route 294 at the Southbound I-95 Ramp/Commuter Lot
- Westbound, eastbound, and northbound left-turn movements at Route 294 at Summerland Drive/York Drive

Maximum queue lengths exceeded the effective turn lane length at the following movements:

- Northbound left turn from Route 123 to Old Bridge Road
- Southbound right turn from Route 123 to Old Bridge Road
- Eastbound left turn from Old Bridge Road to Route 123
- Northbound left turn from Commuter Lot to Old Bridge Road

Maximum queue lengths exceeded the effective length of adjacent turn lanes, effectively blocking access of turning vehicle during queuing conditions at the following locations:

- Southbound Route 123 at Workhouse Road and Commerce Street
- Northbound and southbound Route 123 at Old Bridge Road
- Southbound Route 123 at Devils Reach Road
- Northbound Route 123 at Annapolis Way/Monroe Drive
- Northbound and southbound Route 123 at Horner Road
- Eastbound and westbound Old Bridge Road at Commuter Parking Lot
- Eastbound and westbound Old Bridge Road at Occoquan Road
- Southbound Route 1 at Hassett Street, Furnace Road, Route 123, and Occoquan Road
- Eastbound Occoquan Road at Route 1
- Northbound and southbound Route 1 at Marys Way
- Westbound Marys Way at Route 1
- Eastbound and westbound Route 294 at Southbound I-95 Ramp/Commuter Lot and southbound Commuter Lot exit
- Eastbound and westbound Route 294 at Summerland Drive/York Drive and southbound Summerland Drive

Maximum queue lengths extended to the next upstream signalized intersection at the following intersection approaches:

- Southbound Route 123 at Commerce Street
- Southbound Route 123 at Old Bridge Road
- Northbound Route 123 at Old Bridge Road
- Westbound Old Bridge Road at Occoquan Road
- Westbound Old Bridge Road at Commuter Parking Lot
- Southbound Route 1 at Route 123
- Southbound Route 1 at Occoquan Road/Dawson Beach Road
- Westbound Dawson Beach Road at Route 1

Figure 23: 2019 Existing Conditions – AM Peak Hour Delay (1 of 3)

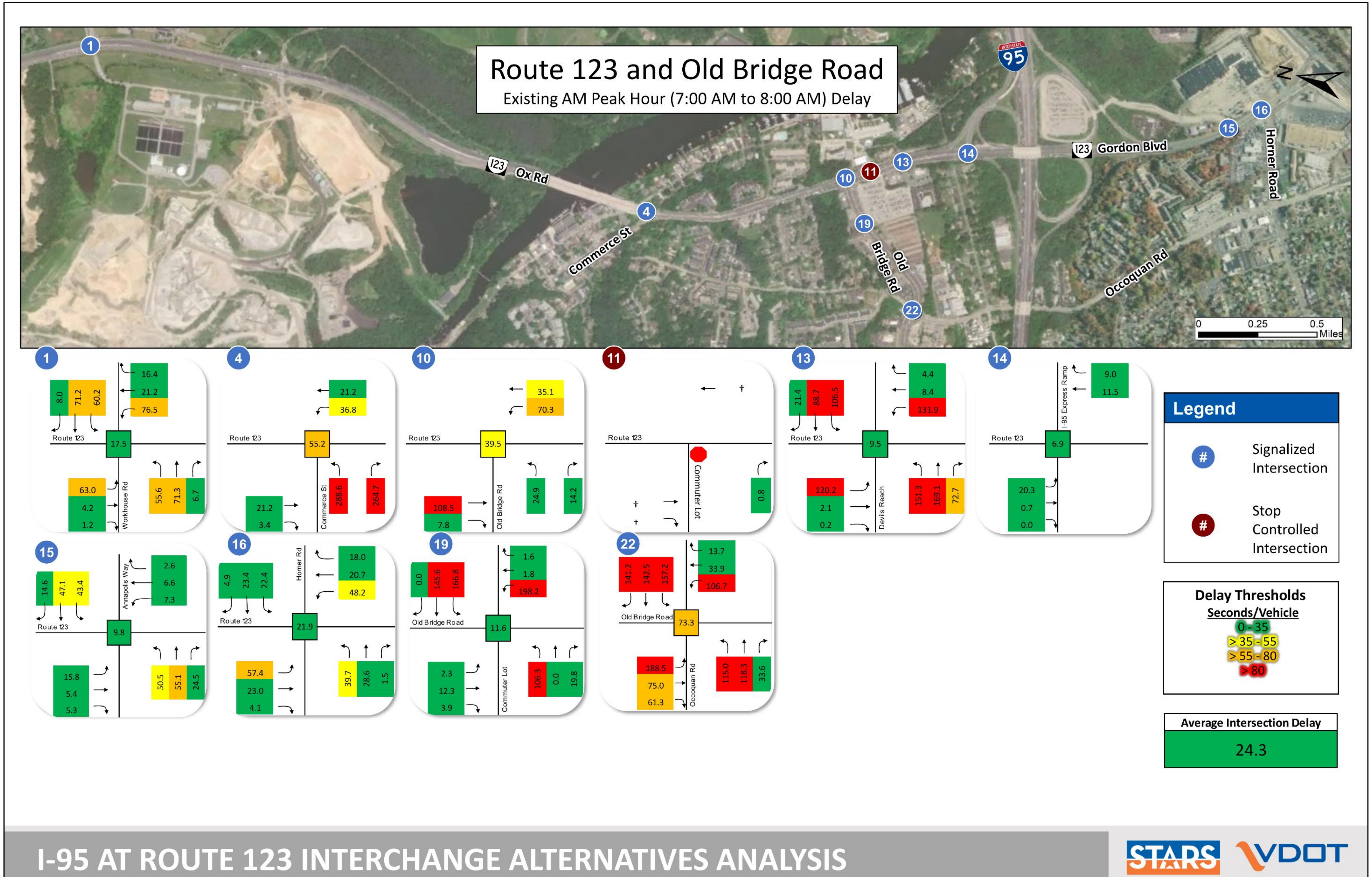


Figure 24: 2019 Existing Conditions – AM Peak Hour Delay (2 of 3)

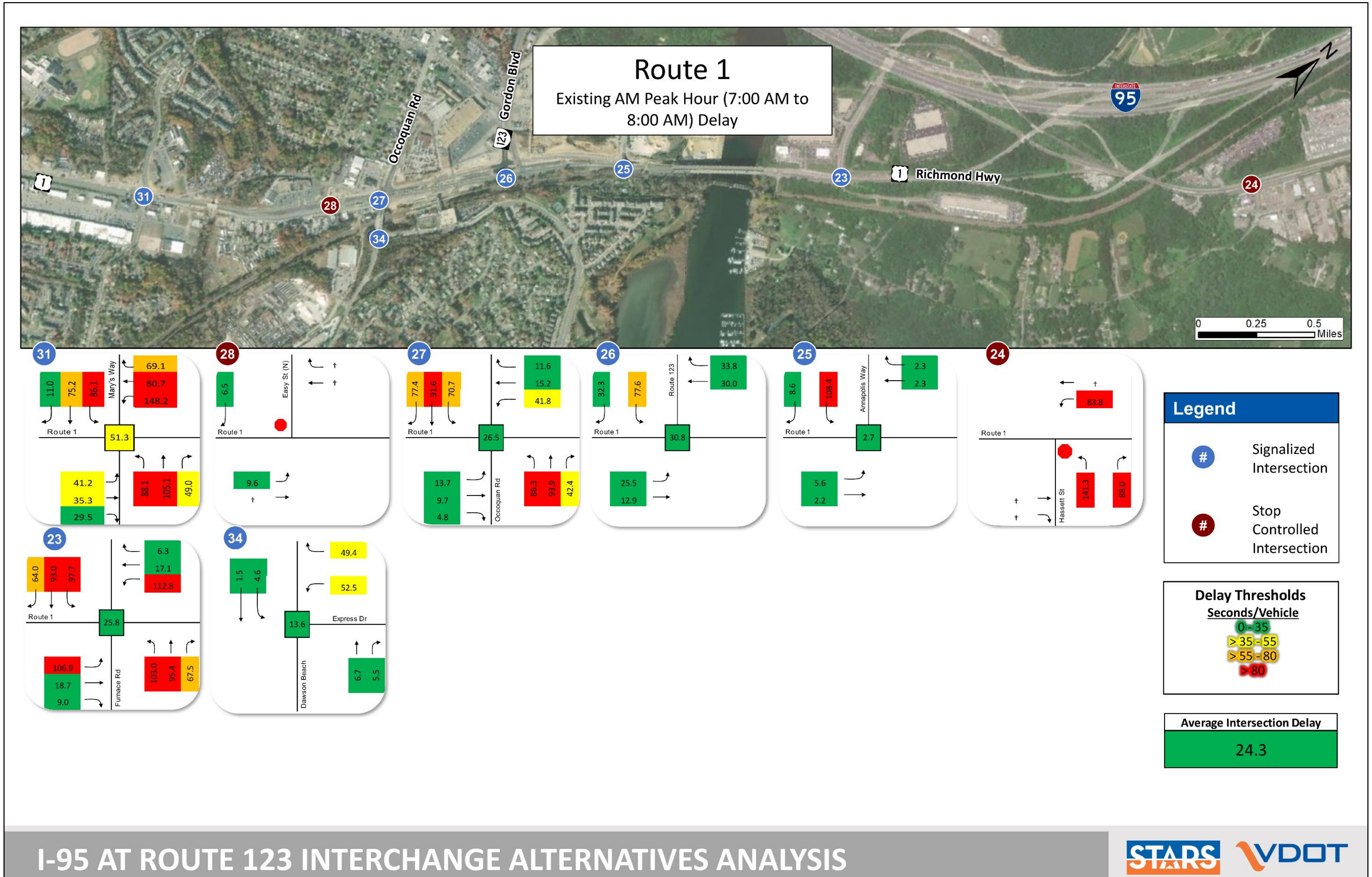


Figure 25: 2019 Existing Conditions – AM Peak Hour Delay (3 of 3)

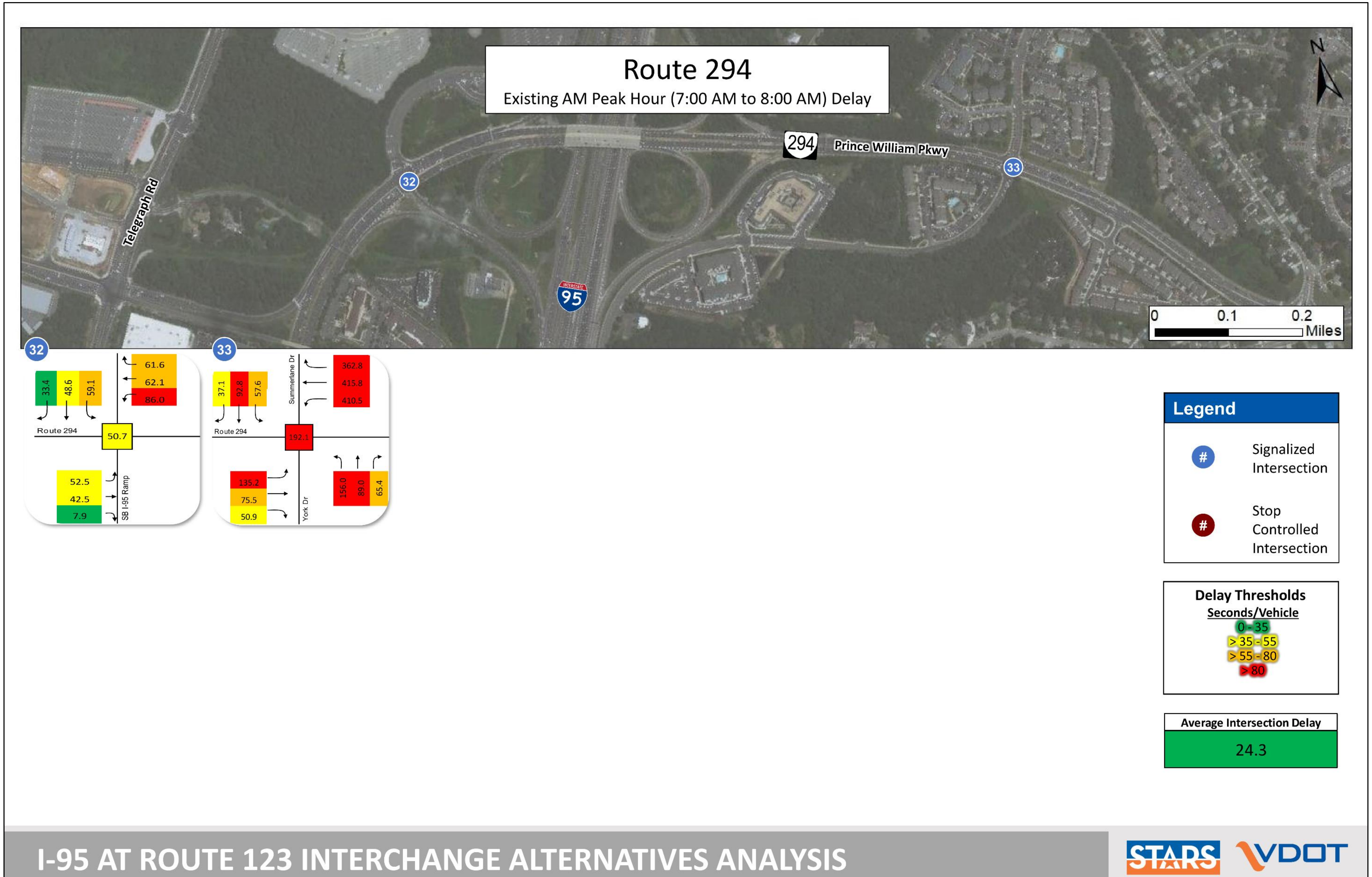


Figure 26: 2019 Existing Conditions – PM Peak Hour Delay (1 of 3)

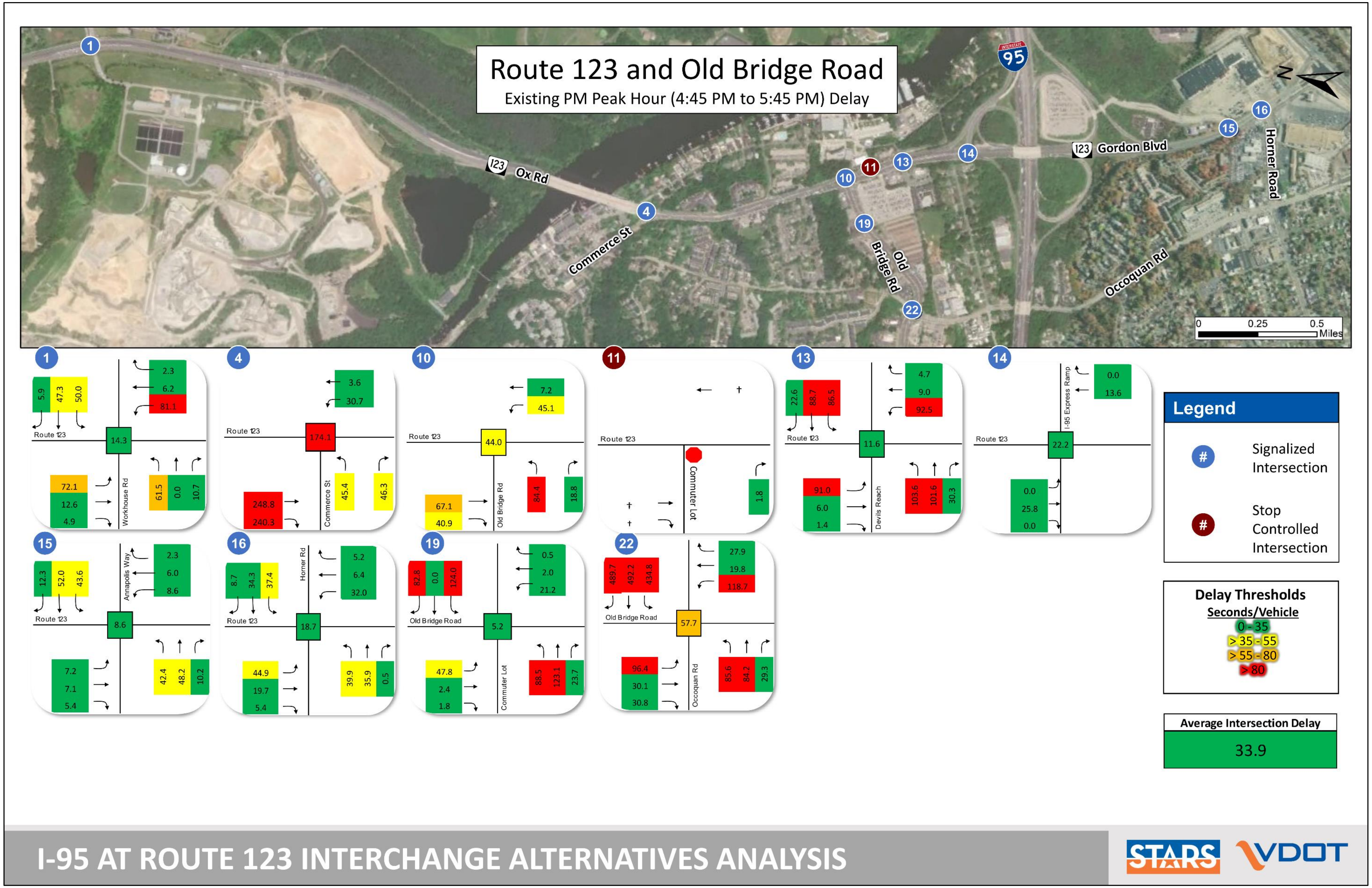


Figure 27: 2019 Existing Conditions – PM Peak Hour Delay (2 of 3)

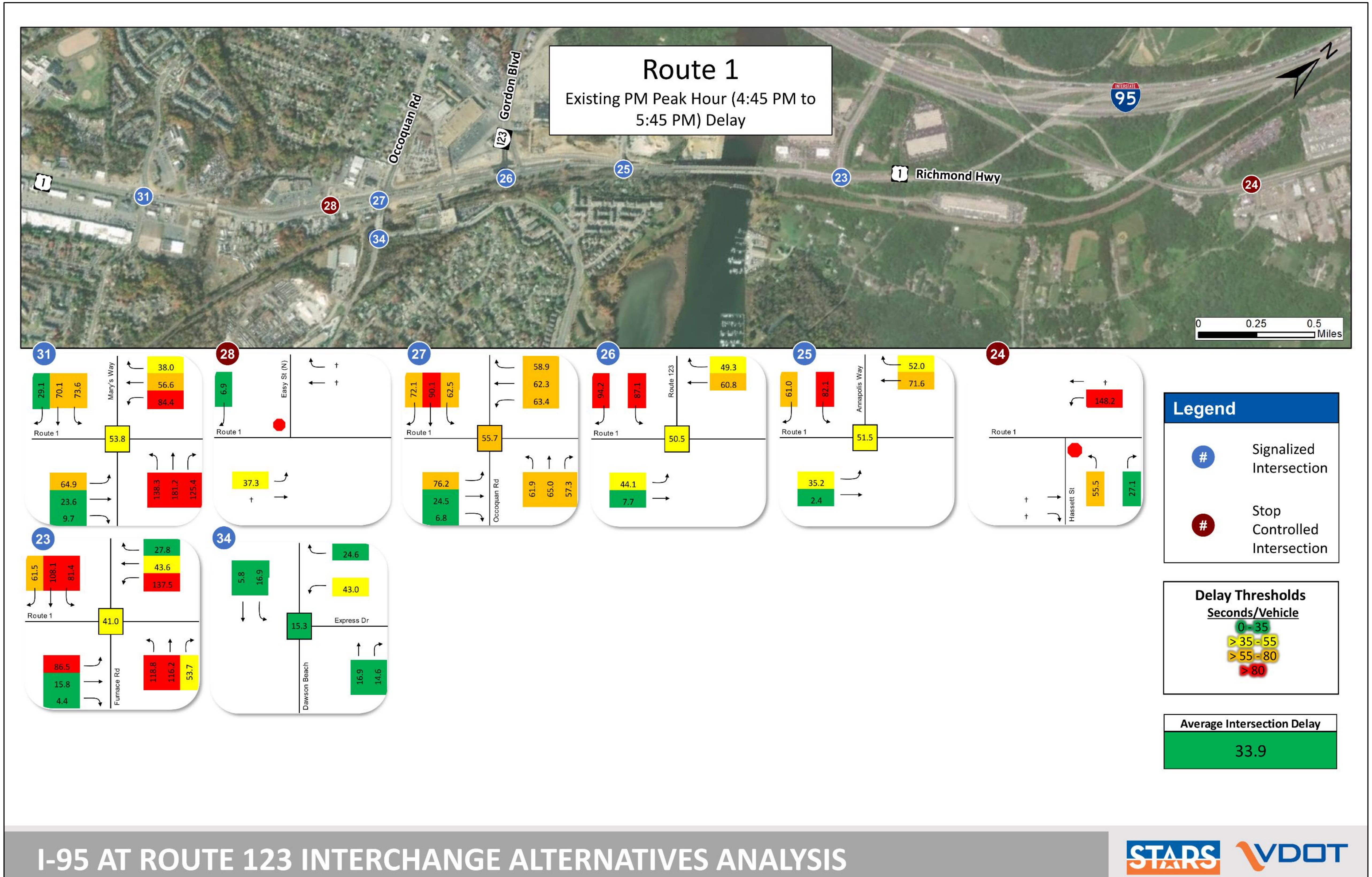
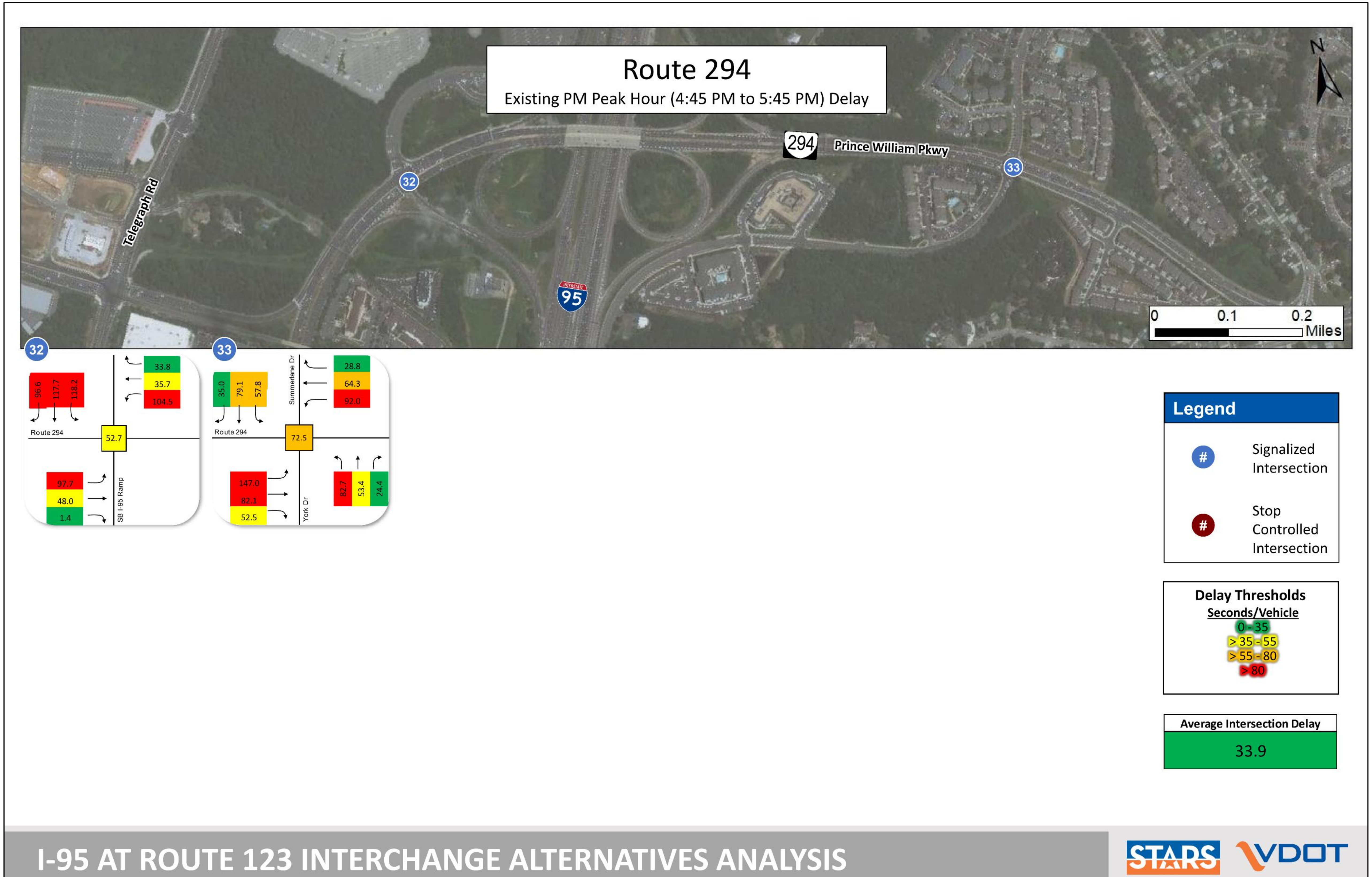


Figure 28: 2019 Existing Conditions – PM Peak Hour Delay (3 of 3)



2.3 Existing Safety Analysis

Crash data for the study area were used to evaluate safety and identify crash patterns. Data was obtained from VDOT for the latest available five and a half years of crash data (January 1, 2015 to July 31, 2020).

The crash analysis focused on the following corridors:

- I-95 general purpose lanes from south of Route 294 interchange to north of Route 1 interchange
- I-95 express lane from south of Route 294 interchange to north of Route 1 interchange
- Route 123 from north of Workhouse Road to Route 1
- Old Bridge Road from Route 123 to west of Rolling Brook Drive
- Route 1 from west of Marys Way to Furnace Road

Furthermore, the crash analysis focused on the following ramps at the study interchange:

- Northbound I-95 off-ramp to southbound Route 123
- Northbound I-95 on-ramp from southbound Route 123
- Northbound I-95 off-ramp to northbound Route 123
- Northbound I-95 on-ramp from northbound Route 123
- Southbound I-95 off-ramp to northbound Route 123
- Southbound I-95 on-ramp from northbound Route 123
- Southbound I-95 on-ramp from southbound Route 123

Additionally, the crash analysis included the evaluation of 34 intersections.

2.3.1 VDOT Potential for Safety Improvement Locations

Annually, all intersections and roadway segments within the VDOT linear referencing system (LRS) were evaluated for the potential for safety improvement (PSI) based on the Highway Safety Manual (HSM) methodology by VDOT. The crash frequency, crash severity, traffic volume, and segment length were contributing factors in the predictive analysis. Crash predictions were made for intersections and segments using the safety performance function (SPF) crash data files. The top 100 intersections and 100 miles of segments are published by VDOT for each district on an annual basis. Based on the 2016-2020 VDOT Potential for Safety Improvement (PSI) database, there were several intersections and segments identified in the study area with top potential for safety improvements.

The following intersections are within the top ranked intersections in the Northern Virginia District:

- Route 123 and Devils Reach Road (rank 27)
- Route 123 and Riverview Lane (rank 42)
- Route 123 and Old Bridge Road (rank 43)
- Route 1 and Occoquan Road/Dawson Beach Road (rank 92)

The following segments are within the top ranked in the Northern Virginia District:

- Southbound I-95 southbound between Lorton Road and on-ramp from southbound Route 123 (all segments between mile posts 164.85 and 160.98 with ranks ranging from 3 to 382; top ranking segments are south of on-ramp from Lorton Road and weaving area between Route 1 and Route 123 ramps)
- Northbound I-95 through Route 294 interchange (rank 11)
- Northbound I-95 south of collector-distributor (C-D) off-ramp to Route 294 (rank 12)
- Eastbound Old Bridge Road between Elysian Drive and Route 123 (ranks of 65 and 324 for segments east and west of Occoquan Road, respectively)
- Northbound I-95 north of collector-distributor (C-D) on-ramp from Route 294 (rank 70)
- Northbound Route 123 between ramp from northbound I-95 and Riverview Lane (ranks ranging from 82 to 369; top ranking segments are north and south of the Old Bridge Road traffic signal)
- Northbound I-95 approaching off-ramp to southbound Route 123 (rank 209)

2.3.2 Summary of All Corridor Crashes

During the 5.5-year period, there were over 4,100 crashes in the study area corridors. ***Table 7*** and ***Table 8*** are summaries of crashes in the study area by year and severity (fatal, injury, and property damage only (PDO), respectively.

Table 7: Study Area Crash Summary by Corridor and Year

Location	Number of Crashes						Total
	2015	2016	2017	2018	2019	2020*	
Northbound I-95	163	204	229	230	239	90	1,155
Southbound I-95	306	266	295	305	308	133	1,613
I-95 Reversible Express	6	8	11	16	14	3	58
Total I-95 (Excluding Ramps)	**475**	**478**	**535**	**551**	**561**	**226**	**2,826**
Northbound Route 123	24	40	26	49	34	11	184
Southbound Route 123	58	54	79	94	77	30	392
Total Route 123	**82**	**94**	**105**	**143**	**111**	**41**	**576**
Westbound Old Bridge Road	20	13	26	21	16	14	110
Eastbound Old Bridge Road	26	33	17	32	26	11	145
Total Old Bridge Road	**46**	**46**	**43**	**53**	**42**	**25**	**255**
Northbound Route 1	34	48	41	35	41	15	214
Southbound Route 1	47	46	41	42	51	24	251
Total Route 1	**81**	**94**	**82**	**77**	**92**	**39**	**465**

*Crash data for 2020 was only available up to July 31, 2020 at the time of analysis

Table 8: Study Area Crash Summary by Corridor and Severity

Location	Number of Crashes			Total
	Fatal	Injury	PDO	
Northbound I-95	0	206	949	1,155
Southbound I-95	2	263	1,348	1,613
I-95 Reversible Express	1	14	43	58
Total I-95 (Excluding Ramps)	**3**	**483**	**2,340**	**2,826**
Northbound Route 123	0	48	136	184
Southbound Route 123	3	96	293	392
Total Route 123	**3**	**144**	**429**	**576**
Westbound Old Bridge Road	0	23	87	110
Eastbound Old Bridge Road	0	26	119	145
Total Old Bridge Road	**0**	**49**	**206**	**255**
Northbound Route 1	1	80	133	214
Southbound Route 1	0	75	176	251
Total Route 1	**1**	**155**	**309**	**465**

2.3.3 I-95 Corridor Crash Summary

During the 5.5-year analysis period, the following crashes were reported on the interstate:

- Total number of reported crashes: **2,826**
- Total number of reported injury crashes: **483**
- Total number of reported fatal crashes: **3**

Two fatalities occurred along southbound I-95. One was on Tuesday, December 27, 2016 at 4:10 AM. The crash involved a pedestrian at milepost 159.47 just north of the Route 294 interchange. The driver performed no improper actions. The other fatality happened on Monday, September 2, 2019 at 7:34 PM. The crash involved a motorcycle weaving in and out traffic when it changed lanes and struck the front of a southbound passenger vehicle at milepost 160.78 just south of the Route 123 interchange.

The other fatal crash occurred along the I-95 reversible express lanes on Friday, June 30, 2017 at 5:45 AM. The collision involved a vehicle that ran off the left side of the concrete barrier wall and overturned due to the vehicle exceeding the speed limit. This collision occurred at milepost 26.73 (general purpose milepost 159), near the Route 294 interchange.

2.3.3.1 I-95 Histogram

The crash activity was summarized by quarter-mile segment of roadway, or crash density, for each corridor in the study area. Histogram graphics were created to document crash type for each quarter-mile segment of the corridor.

Critical crash density, defined as the average crash density per quarter mile plus two standard deviations, was used as an initial screening tool to identify high crash locations within the corridor. A critical crash density was calculated for each direction of travel:

- Northbound I-95 critical crash density = **92.84 crashes**
- Southbound I-95 critical crash density = **149.06 crashes**

Segments with more crashes than the critical crash density were considered crash “hot spots.” There were no segments on northbound I-95 that exceeded the critical crash density. The northbound I-95 segments with the highest crash density included the merge area from the Route 294 C-D road and the weave area within the Route 123 interchange. These areas predominately experienced rear-end collisions and sideswipe same direction due to congestion and lane change maneuvers. There were two segments above the critical crash density on southbound I-95 between mile segment 3.75 and 4.25. These segments are located at the Route 123 interchange spanning upstream of the off-ramp to northbound Route 123 and the lane drop from four to three lanes. The most rear-end collisions on I-95 in the study area occurred between these segments, which can be attributed to the bottleneck location where the lanes reduce from four lanes to three lanes.

Overall, more severe crashes occurred on southbound I-95 than in the northbound direction, which was likely attributed to the higher congestion on southbound I-95 in the study area. The highest crash frequencies were generally around the interchanges or ramps where traffic flow was disrupted due to lane changing or weaving maneuvers. Predominant crash types were rear end and sideswipe same direction.

Figure 29 and ***Figure 30*** are maps of the crash type on I-95 northbound and southbound per quarter mile. I-95 reversible express lane crashes were not included in the histogram diagram. Detailed individual I-95 northbound, southbound, and reversible express lane summary charts were included in ***Appendix D***.

2.3.3.2 I-95 Overall Summary

A summary of the I-95 crashes by type was provided in ***Table 9***. ***Figure 31*** summarizes crashes by time of day and direction. Most crashes were caused by rear-end collisions (68 percent), sideswipe same direction (18 percent), or fixed object off road (9 percent). The majority of the rear-end collisions occurred during PM peak period (40 percent) between 3:00 PM to 7:00 PM or off-peak periods (47 percent). Moreover, sideswipe same direction crashes were prevalent mostly during the off-peak (58 percent) or PM peak (30 percent) periods.

Out of the 247 fixed-object, off-road crashes, about 73 percent occurred due to the driver failing to maintain proper control. About 8 percent were due to speeding and about 14 percent were due to improper actions such as unsafe lane changes to avoiding other vehicles. An estimated 45 percent of these crashes hit concrete traffic barriers and 38 percent hit guardrail.

There were two pedestrian crashes noted in the data for southbound I-95. One was the previously mentioned fatality and the other was a severe injury that occurred on Saturday May 6, 2017 at 10:15 AM. It occurred on a rainy, daylight condition environment with wet roadway surface. The vehicle failed to maintain proper control and crashed into a pedestrian walking near milepost 159.47 just north of the Route 294 interchange and ramp to the Horner Road Commuter Lot.

Southbound I-95 experiences heavy congestion during the PM peak period that extends from the study area back to the Fairfax County Parkway interchange and originates from the bottleneck caused by the lane reduction from four to three lanes at the Route 123 interchange. To understand the crash trends caused by congestion and the bottleneck, an analysis of the crashes along I-95 southbound from Fairfax County Parkway to Route 123 bottleneck was performed. There were 2,489 crashes in the extent and about 72 percent were rear-end crashes. Other predominant crash types were sideswipe same direction (17 percent) and fixed object off road (6 percent). ***Table*** 10 summarizes the crashes by severity and year for the southbound I-95 bottleneck and ***Figure 32*** summarizes the crashes by time of day and day of week. The PDO and injury crashes have trended upward throughout the years likely due to traffic growths in the region. Most of the crashes along this segment occurred during the PM (43 percent) or the off-peak (48 percent) or PM (43 percent) periods when congestion is worse. More crashes occurred on Mondays (20 percent) than any other day of the week.

Figure 29: I-95 Crash Histogram (1 of 2)

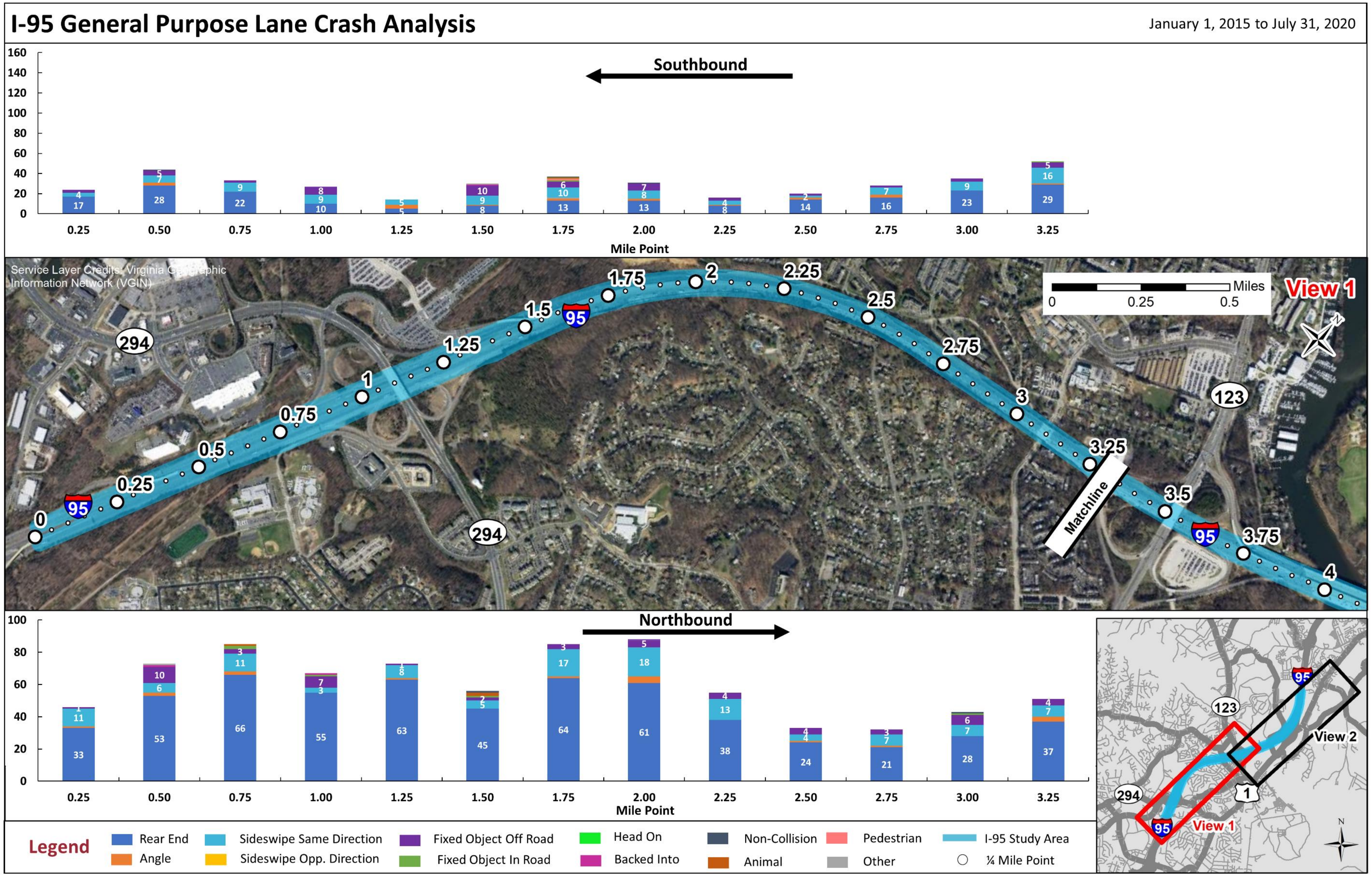


Figure 30: I-95 Crash Histogram (2 of 2)

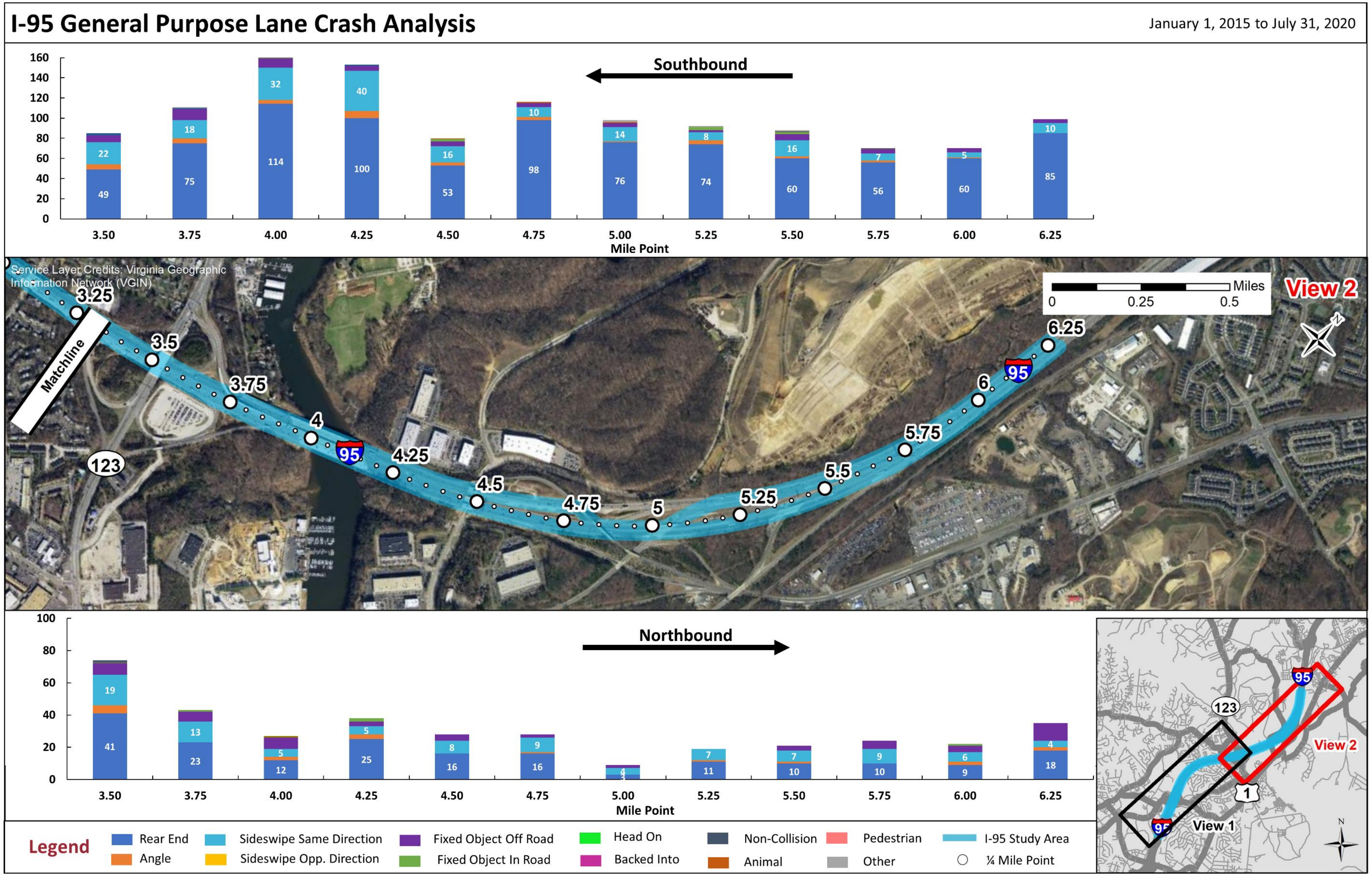


Table 9: I-95 Crashes by Collision Type and Direction

Location	Type of Collision												Total	Percent of Total Crashes
	Rear End	Angle	Head On	Sideswipe (Same)	Sideswipe (Opp.)	Non-Collision	Fixed Object (In Road)	Fixed Object (Off Road)	Deer/ Other Animal	Ped/Bike	Backed Into	Other		
Northbound I-95	782	33	0	213	0	3	9	107	4	0	3	1	**1,155**	**40.9%**
Southbound I-95	1,106	56	1	297	0	7	9	121	4	2	4	6	**1,613**	**57.1%**
I-95 Reversible Express Lanes	28	2	0	4	0	1	0	19	1	0	1	2	**58**	**2.0%**
Total	**1,916**	**91**	**1**	**514**	**0**	**11**	**18**	**247**	**9**	**2**	**8**	**9**	**2,826**	**100%**

Figure 31: I-95 Crashes by Time of Day and Direction

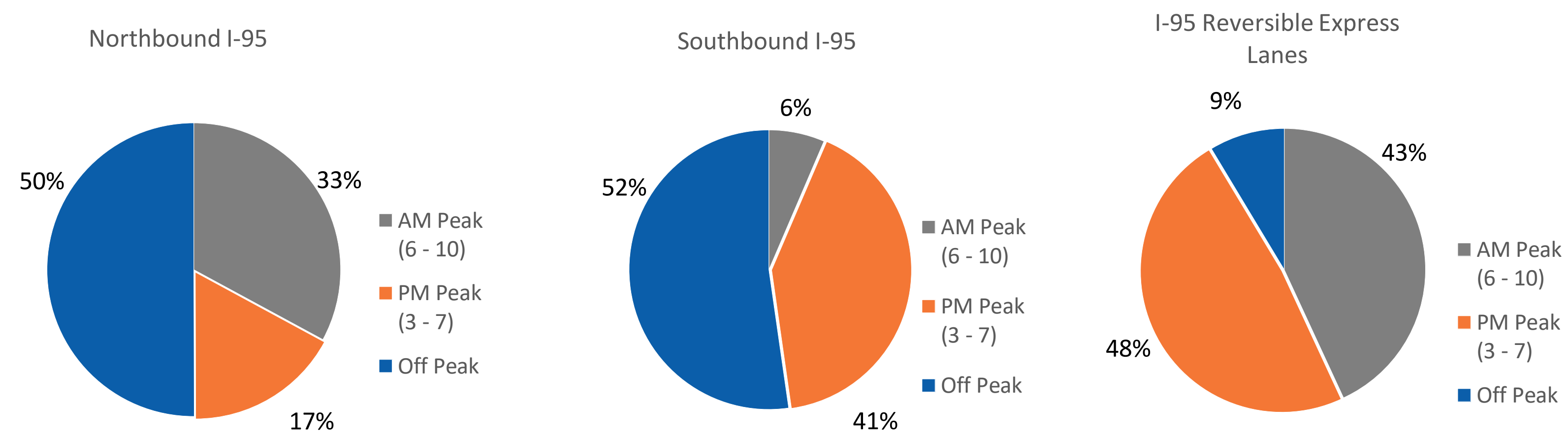


Figure 32: Southbound I-95 Crashes from Fairfax County Parkway to Route 123 by Time of Day and Day of Week

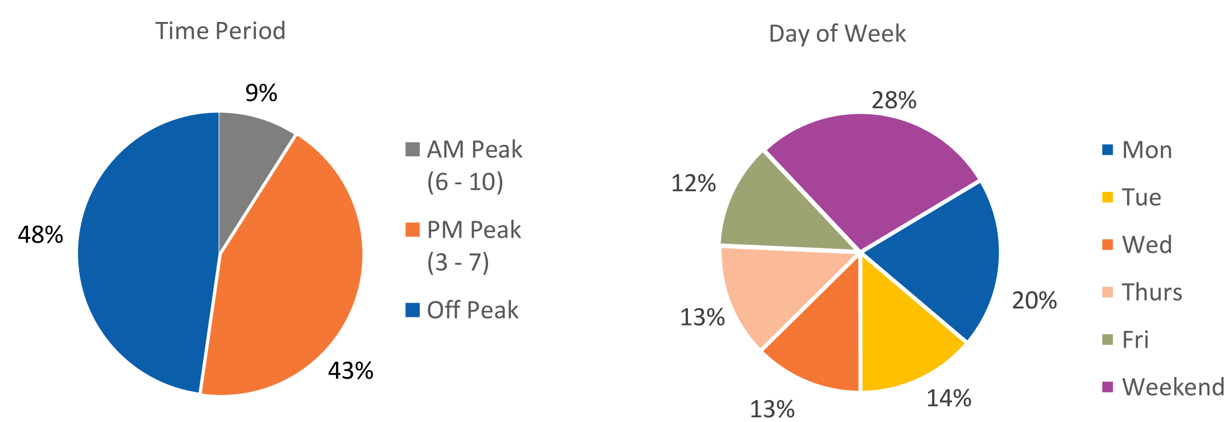


Table 10: I-95 Southbound Crashes from Fairfax County Parkway to Route 123 by Year and Severity

Year	Severity			Total
	Fatalities	Injuries	PDO	
2015	0	89	348	**437**
2016	1	87	365	**453**
2017	0	66	367	**433**
2018	0	81	380	**461**
2019	1	96	440	**537**
2020*	0	25	143	**168**
Total	**2**	**444**	**2,043**	**2,489**

2.3.4 I-95 Ramps Crash Summary

The seven ramps at the I-95 at Route 123 interchange were analyzed. The ramps with the most collisions were the northbound I-95 off-ramp to northbound Route 123 and the southbound I-95 off-ramp to northbound Route 123, both with 54 crashes. Crashes on the northbound off-ramp were predominately fixed object off-road crashes (49) and were attributed to drivers failing to maintain proper control through the loop ramp or exceeding safe speed. Crashes on the southbound off-ramp were a mix of fixed object off road (37) attributed to drivers failing to maintain proper control through the curves and rear-ends (15) attributed to downstream congestion on northbound Route 123.

There were no fatalities and most crashes resulted in property damage (86 percent). Most of the crashes occurred during the off-peak (58 percent) or PM peak (23 percent) periods. Overall, fixed object off road was the most prevalent collision type (74 percent) followed by rear-end crashes (18 percent). ***Table 11*** summarizes the ramps by severity and time of day. ***Table 12*** summarizes the ramps by collision types.

Table 11: Ramp Crashes by Severity and Time of Day

Location	Severity			Time Period			Total
	Fatal-ities	Injur-ies	PDO	AM Peak	PM Peak	Off Peak	
Northbound I-95 off-ramp to Southbound Route 123	0	1	1	1	1	0	**2**
Northbound I-95 on-ramp from Southbound Route 123	0	0	2	0	0	2	**2**
Northbound I-95 off-ramp to Northbound Route 123	0	7	47	12	16	26	**54**
Northbound I-95 on-ramp from Northbound Route 123	0	2	12	6	1	7	**14**
Southbound I-95 off-ramp to Northbound Route 123	0	7	47	5	9	40	**54**
Southbound I-95 on-ramp from Northbound Route 123	0	1	4	0	2	3	**5**
Southbound I-95 on-ramp from Southbound Route 123	0	1	5	2	2	2	**6**
Total	**0**	**19**	**118**	**26**	**31**	**80**	**137**

Table 12: Ramp Crashes by Collision Type

Location	Type of Collision					Total
	Rear End	Side-swipe (Same)	Fixed Object (In Road)	Fixed Object (Off Road)	Deer/ Other Animal	
Northbound I-95 off-ramp to Southbound Route 123	0	0	0	2	0	**2**
Northbound I-95 on-ramp from Southbound Route 123	0	0	0	1	1	**2**
Northbound I-95 off-ramp to Northbound Route 123	2	0	3	49	0	**54**
Northbound I-95 on-ramp from Northbound Route 123	5	2	0	7	0	**14**
Southbound I-95 off-ramp to Northbound Route 123	15	1	1	37	0	**54**
Southbound I-95 on-ramp from Northbound Route 123	1	1	0	3	0	**5**
Southbound I-95 on-ramp from Southbound Route 123	1	2	0	3	0	**6**
Total	**24**	**6**	**4**	**102**	**1**	**137**

2.3.5 Route 123 Corridor Crash Summary

During the 5.5-year analysis period, the following crashes were reported:

- Total number of reported crashes: **576**
- Total number of reported injury crashes: **144**
- Total number of reported fatal crashes: **3**

One of the fatal crashes occurred on Saturday May 2, 2015 at 9:05PM at the Route 123 and Horner Road intersection. This happened during a dry, clear dark night on a roadway with street lighting. The driver was eluding the police and resulted in a head on collision. The second fatality crash happened on Monday August 7, 2017 at 2:58 AM at the intersection of Route 123 and Woodlee Terrace Apartments. The motorcyclist was eluding the police and resulted in a fixed object off road collision. This intersection is unsignalized and contains medians. The third fatal crash also resulted in a fixed object off road collision due to the driver exceeding the speed limit and occurred on southbound Route 123 just north of the Occoquan River on Saturday November 10, 2018 at 9:25 AM. It was a rainy day with wet roadway conditions.

Approximately 60 percent of the total crashes along Route 123 were rear-end collisions and 23 percent were angle. The majority of the rear-end crashes occurred along southbound Route 123, encompassing about 73 percent of all rear-end crashes. Southbound Route 123 also experienced most of the angle crashes, involving 65 percent of the total angle crashes along Route 123. Like other study corridors, many of the rear-end collisions occurred during the PM peak (37 percent) or off-peak (43 percent) periods. More crashes occurred in the off-peak period than peak periods, partially due to congestion levels that extend throughout the afternoon. ***Table 13*** summarizes collision type by direction, ***Table 14*** summarizes the collision types by time of day, and ***Figure 33*** summarizes crashes by time of day and direction. Intersection crashes are described in more detail in ***Section 2.3.8***.

Table 13: Route 123 Crashes by Collision Type and Direction

Location	Type of Collision								Total
	Rear End	Angle	Side-swipe (Same)	Head On	Fixed Object (In Road)	Fixed Object (Off Road)	Animal	Other	
Northbound Route 123	94	46	22	1	2	13	2	4	**184**
Southbound Route 123	252	86	25	4	1	17	2	5	**392**
Total	**346**	**132**	**47**	**5**	**3**	**30**	**4**	**9**	**576**

Table 14: Route 123 Crashes by Collision Type and Time of Day

Time of Day	Type of Collision								Total
	Rear End	Angle	Side-swipe (Same)	Head On	Fixed Object (In Road)	Fixed Object (Off Road)	Animal	Other	
AM	68	26	11			8		1	**114**
PM	128	45	10	1		8		2	**194**
Other	150	61	26	4	3	14	4	6	**268**
Total	**346**	**132**	**47**	**5**	**3**	**30**	**4**	**9**	**576**

Figure 33: Route 123 Crashes by Time of Day and Direction

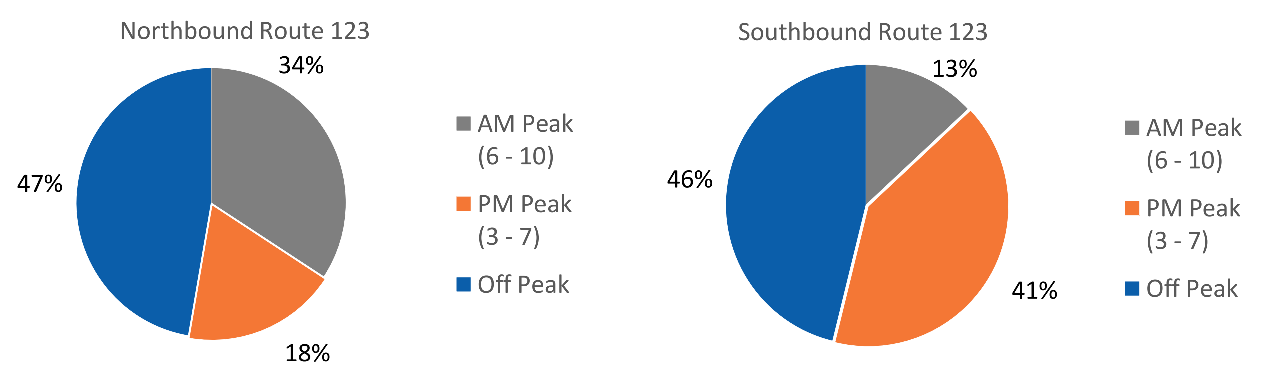


Figure 34 illustrates the locations of rear-end, fixed object, sideswipe, and angle crashes for the segment of Route 123 between I-95 and Old Bridge Road. It is evident that there are more sideswipe same direction crashes along northbound Route 123 corridor right after the I-95 off-ramp merge onto Route 123, likely attributed to the weaving movement needed to reach Old Bridge Road. Moreover, there is a high concentration of fixed object off road collisions at the beginning of the I-95 off-ramp to northbound Route 123 where the majority failed to maintain proper control during off-peak hours. The figure also shows a high concentration of southbound Route 123 rear-end and angle crashes attributed to congestion approaching I-95 and rear-end crashes on the southbound I-95 off-ramp to northbound Route 123 due to vehicles following too close and encountering queuing on northbound Route 123. ***Appendix D*** contains additional details on the Route 123 crash analysis.

2.3.6 Old Bridge Road Crash Summary

During the 5.5-year analysis period, the following crashes were reported:

- Total number of reported crashes: **255**
- Total number of reported injury crashes: **49**
- Total number of reported fatal crashes: **0**

The predominant crash type was rear end, which accounted for 43 percent of all reported crashes. Other frequent crash types were angle (35 percent), and sideswipe same direction (10 percent). Of the total rear-end crashes, about 57 percent occurred along the Old Bridge Road eastbound direction. Moreover, about 58 percent of the total angle crashes also occurred along the Old Bridge Road eastbound direction. Most of the collisions occurred during off-peak (50 percent) or AM peak (27 percent) periods.

One pedestrian crash occurred on eastbound Old Bridge Road at the Commuter Lot intersection on Wednesday September 4, 2019 at 5:48 PM. The second pedestrian crash occurred on westbound Old Bridge Road west of the Occoquan Road intersection at Wood Hollow Drive on Saturday April 2, 2016. In both cases, the drivers did not have the right of way and failed to yield to the pedestrians in the crosswalk across the southern leg of the intersections and resulted in visible injuries.

Table 15 summarizes collision type by direction, ***Table 16*** summarizes the collision types by time of day, and ***Figure*** 35 summarizes crashes by time of day and direction. ***Appendix D*** contains additional details on the Old Bridge Road crash analysis. Intersection crashes are described in more detail in ***Section 2.3.8***.

Table 15: Old Bridge Road Crashes by Collision Type and Direction

Location	Type of Collision									Total
	Rear End	Angle	Side-swipe (Same)	Side-swipe (Opp.)	Head On	Fixed Object (In Road)	Fixed Object (Off Road)	Ped	Other	
Eastbound Old Bridge Road	63	52	12	1	2	4	6	1	4	**145**
Westbound Old Bridge Road	47	38	13		1		4	1	6	**110**
Total	**110**	**90**	**25**	**1**	**3**	**4**	**10**	**2**	**10**	**255**

Table 16: Old Bridge Road Crashes by Collision Type and Time of Day

Time of Day	Type of Collision									Total
	Rear End	Angle	Side-swipe (Same)	Side-swipe (Opp.)	Head On	Fixed Object (In Road)	Fixed Object (Off Road)	Ped	Other	
AM	41	15	7				2		4	**69**
PM	26	22	6	1	1			1	2	**59**
Other	43	53	12		2	4	8	1	4	**127**
Total	**110**	**90**	**25**	**1**	**3**	**4**	**10**	**2**	**10**	**255**

Figure 34: Route 123 from I-95 to Old Bridge Road Crash Analysis

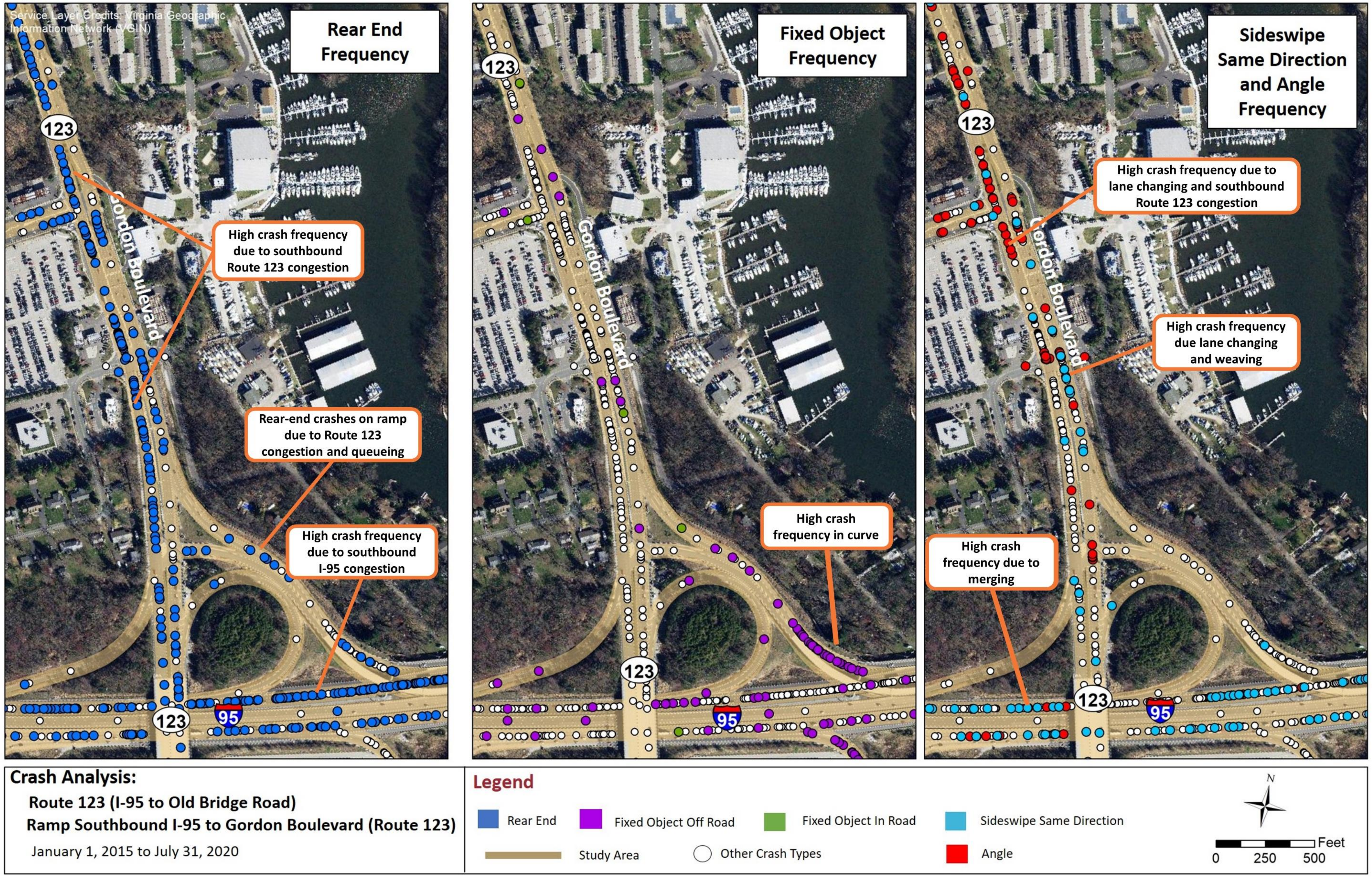
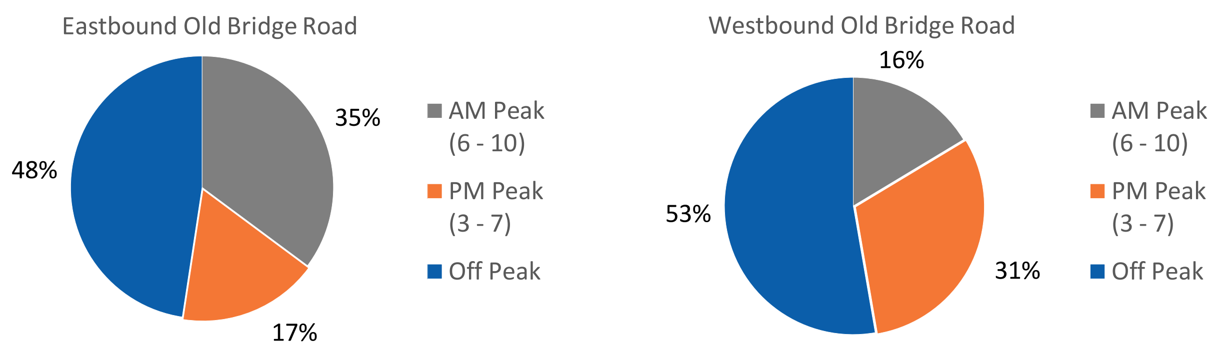


Figure 35: Old Bridge Road Crashes by Time of Day and Direction



2.3.7 Route 1 Corridor Crash Summary

During the 5.5-year analysis period, the following crashes were reported:

- Total number of reported crashes: **465**
- Total number of reported injury crashes: **155**
- Total number of reported fatal crashes: **1**

One fatal crash occurred on northbound Route 1 on Thursday April 5, 2018 at 6:11 AM, which was an angle crash on a clear, dry day at dawn. It occurred east of the Route 1 and I-95 ramps, just east of the railroad track overpass.

Along Route 1, about 47 percent crashes were due to rear-end collisions and 34 percent were angle crashes. About 60 percent of the total rear-end crashes along Route 1 occurred in the southbound direction and these types of crashes were more prevalent during the PM peak period than any other time of day. ***Table 16*** summarizes collision type by direction, ***Table 17*** summarizes collision type by time of day, and ***Figure 36*** summarizes crashes by time of day and direction. Intersection crashes are described in more detail in ***Section 2.3.8***. ***Appendix D*** contains additional details on the Route 1 crash analysis.

2.3.8 Intersection Crash Summary

The crash activity was summarized by intersection for 34 study locations. During the 5.5-year analysis period, the following crashes were reported at intersections:

- Total number of reported crashes: **1,122**
- Total number of reported injury crashes: **306**
- Total number of reported fatal crashes: **2**

The two fatalities occurred along Route 123 southbound, which were previously described in the Route 123 section of the report. The three signalized intersections with the highest number of crashes were Route 1 at Marys Way (100 crashes), Route 123 at Old Bridge Road (89 crashes), and Route 123 at Devils Reach Road (86 crashes).

The signalized intersection at Route 1 at Marys Way had 100 total crashes, 40 percent of which were rear end and another 40 percent were angle crashes. The high percentage of angle crashes are attributed to drivers not having the right of way and red light running. This intersection has protected-permissive left turns from Route 1. Additionally, this location had two pedestrian crashes. Currently, there are pedestrian push buttons and crosswalks along two sides of the intersection. Most of the collisions occurred during off-peak (57 percent) or PM peak (26 percent) periods.

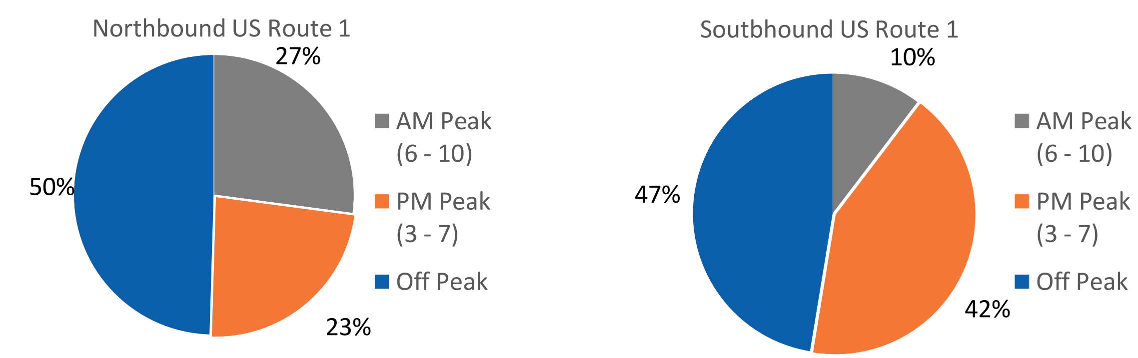
Table 17: Route 1 Crashes by Collision Type and Direction

Location	Type of Collision								Total
	Rear End	Angle	Side-swipe (Same)	Side-swipe (Opp.)	Head On	Fixed Object (Off Road)	Ped	Other	
Northbound Route 1	86	81	15	4	6	6	4	12	**214**
Southbound Route 1	132	75	20	3	6	7	0	8	**251**
Total	**218**	**156**	**35**	**7**	**12**	**13**	**4**	**20**	**465**

Table 18: Route 1 Crashes by Collision Type and Time of Day

Time of Day	Type of Collision								Total
	Rear End	Angle	Side-swipe (Same)	Side-swipe (Opp.)	Head On	Fixed Object (Off Road)	Ped	Other	
AM	36	31	9	2		3		3	**84**
PM	95	39	11		3	3	1	4	**156**
Other	87	86	15	5	9	7	3	13	**225**
Total	**218**	**156**	**35**	**7**	**12**	**13**	**4**	**20**	**465**

Figure 36: Route 1 Crashes by Time of Day and Direction



The signalized intersection with the second highest number of crashes was Route 123 at Old Bridge Road with 89 total crashes. About 66 percent of the total crashes were rear end and 22 percent were angle crashes. The angle crashes predominately occurred on southbound Route 123 due to vehicle making unsafe lane changes or cutting into queued traffic. About 28 percent of the total crashes occurred during the PM peak and 47 percent during the off-peak period.

The third highest crash location was the signalized intersection of Route 123 at Devils Reach Road with 86 crashes. Around 59 percent of the crashes were rear end, 21 percent angle, and 13 percent sideswipe same direction. Most angle crashes were due to red light running. Most crashes occurred during off-peak (51 percent) and an equal amount during AM and PM peak periods (both 25 percent). Over 73 percent of the crashes were PDO.

Other signalized intersection with a relatively high amount of angle crashes are the following:

- Route 123 at Annapolis Way/Monroe Drive: attributed to vehicles turning without right of way, protected-permissive left turns, and red light running
- Route 123 at Horner Road: attributed to red light running
- Old Bridge Road at Occoquan Road: attributed to vehicles turning without right of way and red light running
- Route 1 at Route 123: attributed to red light running
- Route 1 at Occoquan Road/Dawson Beach Road: attributed to vehicles turning without right of way, protected-permissive left turns, and red light running

Unsignalized intersection with a relatively high amount of angle crashes include Route 123 at Riverview Lane and Admiral Drive. At both location, most of the angle crashes occurred on southbound Route 123, likely due to turns from the side street or opposing left turns (Riverview Lane) conflicting with southbound traffic. A relatively high amount of rear-end crashes also occurred at these two intersections due to the southbound Route 123 queuing in the PM period.

Four pedestrian crashes occurred at intersections. One at Old Bridge Road at Commuter Lot was previously described in the Route 123 section. Two were previously described above at the Route 1 at Marys Way intersection. The fourth pedestrian crash occurred at Route 1 at Occoquan Road/Dawson Beach Road on northbound Route 1 north of the intersection. This was an alcohol-related crash resulting in severe pedestrian injuries.

The following overall crash trends were identified for study area intersections:

- Most of the crashes resulted in rear-end collisions (51 percent), angle (31 percent), or sideswipe same direction (9 percent)
- About 73 percent of the crashes resulted in PDO
- 50 percent of the crashes occurred during off-peak periods, while 29 percent happened during PM peak period

Table 19 contains a summary of the collision types by intersection and ***Table 20*** summarizes the intersections by severity and time. ***Appendix D*** provides graphical representation of the collisions at their geographic location.

Table 19: Intersection Crashes by Collision Types

	Intersection (S = Signalized, U = Unsignalized)		Type of Collision												Total
			Rear End	Angle	Head On	Side-swipe (Same)	Side-swipe (Opp.)	Non-Collision	Fixed Object (In Road)	Fixed Object (Off Road)	Deer/ Other Animal	Ped/ Bike	Backed Into	Other	
1	Route 123 at Workhouse Road	S	28	8	0	1	0	0	1	3	1	0	0	0	**42**
2	Route 123 at Workhouse Way	U	0	0	0	0	0	0	0	0	0	0	0	0	**0**
3	Route 123 at Occoquan Regional Park	S	14	3	0	0	0	0	0	2	1	0	0	0	**20**
4	Route 123 at Commerce Street	S	23	10	2	7	0	2	0	1	0	0	1	0	**46**
5	Route 123 at Woodlee Terrace Apartments N Driveway	U	1	1	0	1	0	0	0	3	0	0	0	0	**6**
6	Route 123 at Woodlee Terrace Apartments S Driveway	U	6	8	0	1	0	0	0	0	0	0	0	0	**15**
7	Route 123 at Riverview Lane	U	22	22	0	6	0	0	0	1	0	0	0	1	**52**
8	Route 123 at Flagship Drive	U	0	0	0	0	0	0	0	0	0	0	0	0	**0**
9	Route 123 at Admiral Drive	U	20	11	0	1	0	0	1	2	0	0	0	0	**35**
10	Route 123 at Old Bridge Road	S	59	20	0	6	0	0	1	2	0	0	0	1	**89**
11	Route 123 at Commuter Parking Lot	U	2	0	0	0	0	0	0	0	0	0	0	1	**3**
12	Route 123 at Exxon Driveway/Shell Driveway	U	2	2	0	1	0	0	0	0	0	0	0	0	**5**
13	Route 123 at Devils Reach Road	S	51	18	1	11	0	0	1	3	1	0	0	0	**86**
14	Route 123 at I-95 Express Lanes Ramp	S	30	7	0	3	0	0	0	1	0	0	0	0	**41**
15	Route 123 at Annapolis Way/Monroe Drive	S	7	9	0	1	0	0	0	1	0	0	0	0	**18**
16	Route 123 at Horner Road	S	8	14	2	1	0	0	0	1	0	0	0	0	**26**
17	Route 123 at Station Plaza Drive	U	0	2	0	0	0	0	0	0	0	0	0	0	**2**
18	Old Bridge Road at Fast Fuels Driveway	U	3	7	0	0	0	0	0	1	0	0	0	0	**11**
19	Old Bridge Road at Commuter Parking Lot	S	9	5	0	1	0	0	1	0	0	1	0	0	**17**
20	Old Bridge Road at Public Storage Driveway	U	2	2	0	0	0	0	0	0	0	0	0	0	**4**
21	Old Bridge Road at VA Smoke Shop Driveway	U	6	5	1	3	0	0	0	0	0	0	0	2	**17**
22	Old Bridge Road at Occoquan Road	S	30	23	1	14	0	0	1	4	0	0	0	5	**78**
23	Route 1 at Furnace Road	S	33	8	0	3	3	1	0	4	0	0	0	0	**52**
24	Route 1 at Hassett Street	U	9	9	0	4	0	0	0	1	0	0	0	4	**27**
25	Route 1 at Annapolis Way	S	22	2	0	2	0	0	0	1	0	0	0	1	**28**
26	Route 1 at Route 123	S	23	20	3	4	2	0	0	3	0	0	0	3	**58**
27	Route 1 at Occoquan Road/Dawson Beach Road	S	27	35	1	5	1	0	0	0	0	1	0	1	**71**
28	Route 1 at Easy Street N	U	2	5	0	1	1	0	0	0	0	0	0	1	**10**
29	Route 1 at Potomac Plaza	U	3	9	1	1	0	0	0	0	0	0	0	0	**14**
30	Route 1 at Easy Street S	U	3	6	0	1	0	0	0	0	0	0	0	0	**10**
31	Route 1 at Marys Way	S	40	40	5	6	2	0	0	2	0	2	0	3	**100**
32	Route 294 at I-95 Southbound Ramp/Commuter Lot	S	43	22	1	6	0	0	0	4	0	0	0	0	**76**
33	Route 294 at Summerland Drive/York Drive	S	37	12	1	5	0	0	0	0	0	0	0	3	**58**
34	Dawson Beach Road at Express Drive	S	2	2	0	0	0	0	0	0	0	0	0	1	**5**
Total			**567**	**347**	**19**	**96**	**9**	**3**	**6**	**40**	**3**	**4**	**1**	**27**	**1,122**

Table 20: Intersection Crashes by Severity and Time of Day

Intersection (S = Signalized, U = Unsignalized)			Severity			Time Period			Total
			Fatalities	Injuries	PDO	AM Peak	PM Peak	Off Peak	
1	Route 123 at Workhouse Road	S	0	10	32	9	12	21	**42**
2	Route 123 at Workhouse Way	U	0	0	0	0	0	0	**0**
3	Route 123 at Occoquan Regional Park	S	0	9	11	2	8	10	**20**
4	Route 123 at Commerce Street	S	0	15	31	9	18	19	**46**
5	Route 123 at Woodlee Terrace Apt N Driveway	U	1	2	3	0	3	3	**6**
6	Route 123 at Woodlee Terrace Apt S Driveway	U	0	7	8	0	6	9	**15**
7	Route 123 at Riverview Lane	U	0	14	38	8	15	29	**52**
8	Route 123 at Flagship Drive	U	0	0	0	0	0	0	**0**
9	Route 123 at Admiral Drive	U	0	6	29	10	5	20	**35**
10	Route 123 at Old Bridge Road	S	0	17	72	22	25	42	**89**
11	Route 123 at Commuter Parking Lot	U	0	1	2	0	2	1	**3**
12	Route 123 at Exxon Driveway/Shell Drwy	U	0	1	4	0	1	4	**5**
13	Route 123 at Devils Reach Road	S	0	23	63	21	21	44	**86**
14	Route 123 at I-95 Express Lanes Ramp	S	0	9	32	7	17	17	**41**
15	Route 123 at Annapolis Way/Monroe Drive	S	0	5	13	4	5	9	**18**
16	Route 123 at Horner Road	S	1	7	18	4	9	13	**26**
17	Route 123 at Station Plaza Drive	U	0	1	1	0	0	2	**2**
18	Old Bridge Road at Fast Fuels Driveway	U	0	3	8	1	3	7	**11**
19	Old Bridge Road at Commuter Parking Lot	S	0	3	14	5	3	9	**17**
20	Old Bridge Road at Public Storage Driveway	U	0	1	3	1	0	3	**4**
21	Old Bridge Road at VA Smoke Shop Drwy	U	0	1	16	4	6	7	**17**
22	Old Bridge Road at Occoquan Road	S	0	14	64	21	17	40	**78**
23	Route 1 at Furnace Road	S	0	11	41	7	25	20	**52**
24	Route 1 at Hassett Street	U	0	8	19	4	11	12	**27**
25	Route 1 at Annapolis Way	S	0	8	20	2	17	9	**28**
26	Route 1 at Route 123	S	0	23	35	11	12	35	**58**
27	Route 1 at Occoquan Rd/Dawson Beach Rd	S	0	30	41	16	16	39	**71**
28	Route 1 at Easy Street N	U	0	3	7	6	1	3	**10**
29	Route 1 at Potomac Plaza	U	0	4	10	3	4	7	**14**
30	Route 1 at Easy Street S	U	0	1	9	1	5	4	**10**
31	Route 1 at Marys Way	S	0	31	69	17	26	57	**100**
32	Route 294 at I-95 Southbound Ramp/Commuter Lot	S	0	22	54	22	21	33	**76**
33	Route 294 at Summerland Drive/York Drive	S	0	15	43	13	13	32	**58**
34	Dawson Beach Road at Express Drive	S	0	1	4	2	3	0	**5**
Total			**2**	**306**	**814**	**232**	**330**	**560**	**1,122**

3 Future Traffic Volumes

To understand future traffic conditions in the study area and assess the long-term benefits of proposed improvements, traffic volumes were forecasted for 2030 and 2045 traffic conditions. The following sections describe the methodology for developing traffic growth rates and projecting future traffic volumes for the study area. ***Appendix E*** contains additional details.

3.1 Traffic Forecasting Methodology

Traffic forecasts were developed to support the traffic operational analysis of the Opening Year 2030 No-Build and Design Year 2045 No-Build scenarios. Outputs from the Prince William County travel demand model (PWCTDM), which used base year data for 2015 and future year data for 2040, were adjusted using the *National Cooperative Highway Research Program (NCHRP) Report 765: Analytical Travel Forecasting Approaches for Project-Level Planning and Design* methodology. The PWCTDM offers a more granular traffic analysis zone system and more detailed road network in Prince William County compared to the regional Metropolitan Washington Council of Governments (MWCOG) travel demand model while still encompassing the regional network, which is why it was selected for use in the study.

The PWCTDM was originally developed with a future year road network reflective of Prince William County's 2030 Comprehensive Plan and a future year land use reflective of projected 2040 demographics. Therefore, the road network and future year land use inputs were adjusted to align with the assumptions of this study. The assumed road network for 2030 and 2045 scenarios contained the transportation projects shown in ***Table 21***. All projects were contained in the financially constrained long-range transportation plan (CLRP) for the National Capital Region, and these assumptions were developed in coordination with the Study Work Group (SWG). Transit routes were not explicitly defined, modeled, or assigned in the PWCTDM. The share of transit trips is a user supplied input variable based on the MWCOG model results for jurisdiction-to-jurisdiction transit share, and the total motorized person trips developed in the model are reduced by this share of transit trips.

Detailed analysis of the PWCTDM inputs and comparison to the MWCOG travel demand model can be found in ***Appendix E***.

Daily, AM peak hour, and PM peak hour traffic volumes were forecasted by applying the growth in link volumes output from the PWCTDM to the 2019 existing conditions volumes according to the methodologies in the following subsections. The decision to use different growth rates for daily (based on daily traffic growth) and peak hour (based on peak period traffic growth) forecasts was based on the following factors:

- Network supply is dynamic in the study area and changes by time of day with the reversible Express Lanes. Peak period-level forecasts provide more insight into projected growth during the AM and PM peak periods.
- The model is reasonably calibrated to provide meaningful and useful growth rates at both daily and peak period levels.
- It is logical that differential traffic growth rates will occur by time of day. For example, traffic volume on freeway segments that are highly congested during the peak periods have less room to grow during these times but have more capacity to grow at a daily level.
- Use of greater daily traffic growth rates to forecast peak hour traffic volumes may overestimate forecasts and therefore produce unrealistic results, which could result in overdesigning roadway improvements and increasing the required level of investment. The applied methodology attempts to not over-forecast traffic volume given known capacity constraints in the study area while still being realistic about potential growth.

A summary of traffic growth rates for the freeways and intersections for each future year is shown in ***Table 22***. The traffic growth rates shown in the table represent an aggregate summary and the actual traffic growth rates were computed and applied at a link level.

Table 21. Assumed Transportation Projects in Study Area

Project	Assumed Configuration	Scenario Years
Southbound I-95 Auxiliary Lane	Four southbound lanes between Route 123 (Exit 160) and Route 294 (Exit 158)	2030 and 2045
I-95 Express Lanes Fredericksburg Extension	Two reversible lanes extension from existing terminus to near Route 17	2030 and 2045
Annapolis Way Connector	Four lanes to connect Annapolis Way East with Annapolis Way West	2030 and 2045
Route 1 Widening – Phase 1	Six lanes from Annapolis Way to Marys Way	2030 and 2045
Route 1 Widening – South into Prince William County	Six lanes south of Marys Way to Bradys Hill Road	2030 and 2045
Route 1 Widening – North into Fairfax County	Six lanes from Annapolis Way to Telegraph Road	2045 only
Route 1/ Route 123 Interchange Improvements	Not assumed for No-Build analysis; analyzed in a separate STARS study	N/A
Route 123 Widening	Six lanes from US 1 to Annapolis Way	2045 only *Development Driven*

Table 22: Annual Growth Rate Summary

Location	2030 Growth Rate		2045 Growth Rate	
	AM	PM	AM	PM
Total Intersection Volumes	2.9%	2.5%	2.1%	1.9%
Northbound I-95	1.4% to 2.1%		0.8% to 1.6%	
Southbound I-95	1.1% to 2.5%		0.7% to 1.7%	
Reversible Express Lanes	1.2% to 1.6%		2.3% to 2.6%	

3.1.1 Daily Volume Forecasting Methodology

The default methodology for forecasting daily volume was to apply ADT growth rates by link to existing volumes. The ADT directional aggregate growth rate (e.g., growth rate for sum of all northbound I-95 links) was applied at locations where the 2015 base year modeled traffic volume was grossly over- or under-forecasted compared to an observed ADT (typically greater than a 50 difference) or where an unexplained negative growth rate occurred.

3.1.2 Freeway Peak Hour Volume Forecasting Methodology

The default methodology was to apply peak period traffic growth rates by link to existing volumes. In many locations, the applied peak period traffic growth rate was less than the ADT growth rate—however the difference was relatively small. This average difference in annual (linear) growth rates across all freeway links for 2030 was -0.19 percent and -0.13 percent for AM and PM peak periods, respectively. For 2045, this average difference was -0.51 percent and -0.38 percent for AM and PM peak periods, respectively. Using differential traffic growth rates by time of day are a reasonable expectation in a congested network. As peak period congestion levels increase in the study area, motorists will shift routes or change their travel time. K-factors were checked to ensure any changes from existing to future were negligible since different growth rates were used to forecast daily and peak hour volumes.

The peak period directional aggregate traffic growth rate was applied in locations where the 2015 base year modeled peak period traffic volume was grossly over- or under-forecasted compared to observed peak hour traffic volume (typically greater than a 50 difference) or where unexplained negative traffic growth occurred. In two locations where capacity constraints occurred during the AM peak period, the ADT growth rate was applied because it was lower than the peak period and peak period directional aggregate traffic growth rate, which was on the northbound I-95 on-ramp from westbound Route 294 and the northbound I-95 Express Lanes on-ramp from Horner Road Commuter Lot (parking over capacity in existing conditions). While capacity is a factor in delay and travel time calculations, regional travel demand models do not have a maximum capacity. Therefore, engineering judgment was applied in these select cases to use a slightly lower traffic growth rate resulting in a more realistic traffic forecast.

3.1.3 Arterial Peak Hour Volume Forecasting Methodology

The default traffic forecasting methodology was to apply peak period traffic growth rates by link to existing traffic volumes. In most locations, these traffic growth rates were slightly greater than the ADT growth rates. The 2030 PM peak hour was the exception in which, on average, period traffic growth rates were slightly less than ADT growth rates. This average difference in annual (linear) traffic growth rates across all arterial links for 2030 is 0.48 percent and -0.23 percent for AM and PM peak periods, respectively. For 2045, this average difference is 0.43 percent and 0.40 percent for AM and PM peak periods, respectively. The greater growth in the peak periods compared to daily can be explained by more trips staying on the arterial network in the future when the freeway is more congested during the peak periods. K-factors were checked to ensure any changes from existing to future were negligible since different growth rates were used to forecast daily and peak hour volumes.

If a minor side street is not modeled in the PWCTDM, either (1) a minimum traffic growth rate of 0.2 percent was applied to existing traffic volumes or (2) a peak period aggregate traffic growth rate was calculated from all other arterial links in the study area and applied to existing traffic volumes. The latter condition occurred at intersections where side street volumes could be reasonably assumed to grow similarly to overall study area traffic such as gas station driveways.

For a few locations where traffic volumes were expected to increase significantly from very low existing traffic volumes (i.e., Annapolis Way and Horner Road approaches into future developments), the modeled difference in peak period trips between base and future years was factored by the peak hour factors of the PWCTDM to estimate the change in peak hour traffic volume. This traffic volume difference was then added to existing traffic volumes.

The industry-standard NCHRP 765 iterative-directional method was used convert forecasted link traffic volumes into forecasted turning movement volumes for study area intersections. The resulting forecasted traffic volumes were balanced between adjacent intersections and ramps using a consistent approach for both 2030 and 2045. Ramp traffic forecasts were held constant when the arterial network was balanced.

3.2 Forecasted Traffic Volumes

Figure 37 shows balanced average daily traffic volumes for I-95 mainline and ramp segments in the study area for 2045 conditions. The balanced AM and PM peak hour traffic volumes in the study area for 2045 conditions are summarized in ***Figure 38*** through ***Figure 40*** for I-95 and ***Figure 41*** through ***Figure 44*** for arterial intersections. Traffic volume figures for 2030 conditions can be found in ***Appendix E***.

A Build conditions travel demand model scenario was prepared to determine impacts to traffic patterns and flows under the network reconfigurations evaluated for future Build conditions as described in ***Section 5*** through ***Section 7***. However, the improvements were determined to have primarily local impacts to vehicle routing rather the global travel demand changes beyond the study area. As such, traffic volumes used for future Build conditions analyses were No-Build traffic volume forecasts that underwent localized rerouting where change in access occurs from an improvement (e.g., combining interchange ramps, restricting intersection movements, etc.).

Figure 37: 2045 No-Build Average Daily Traffic

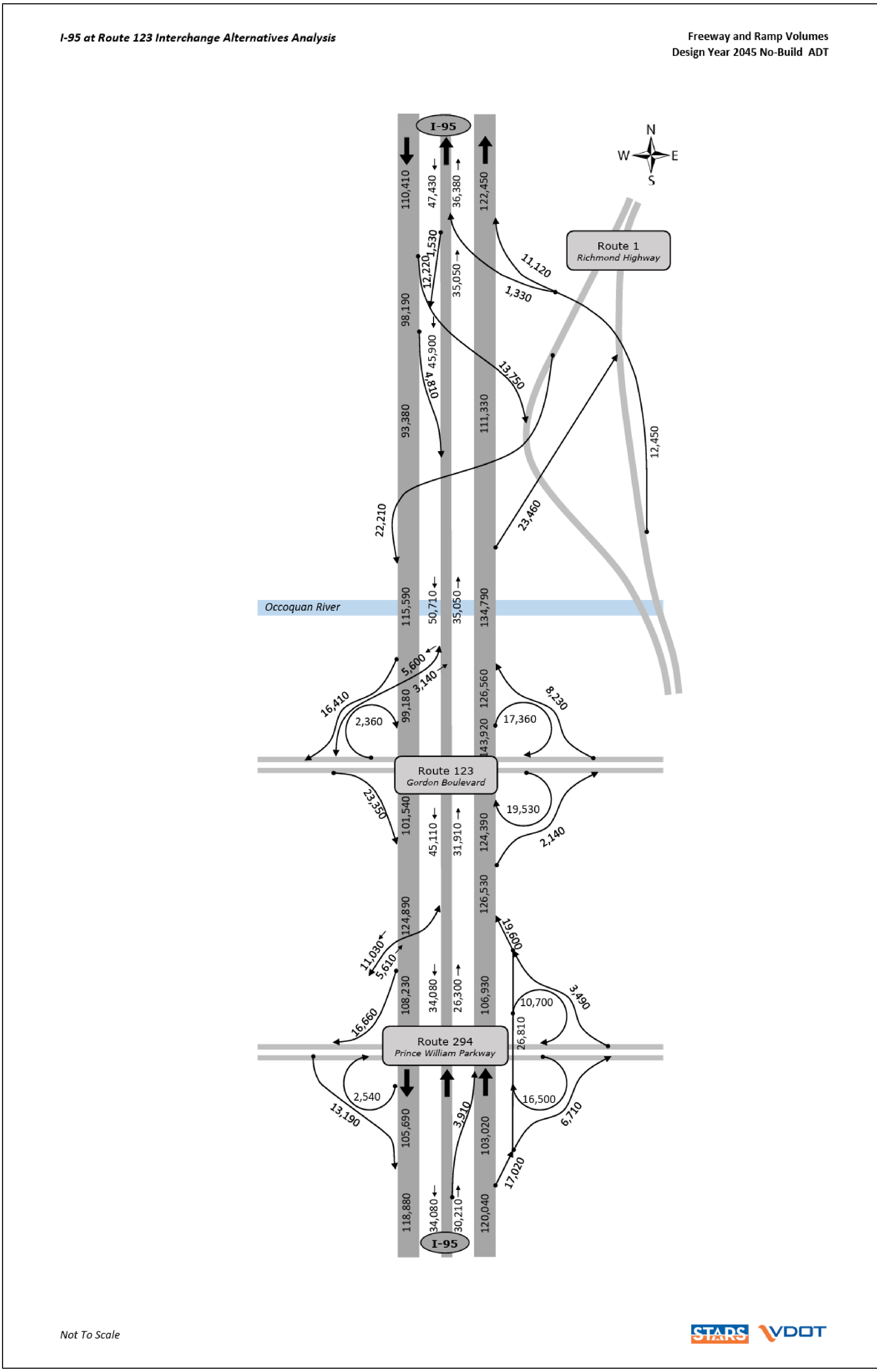


Figure 38: 2045 No-Build AM Peak Hour Volumes – I-95

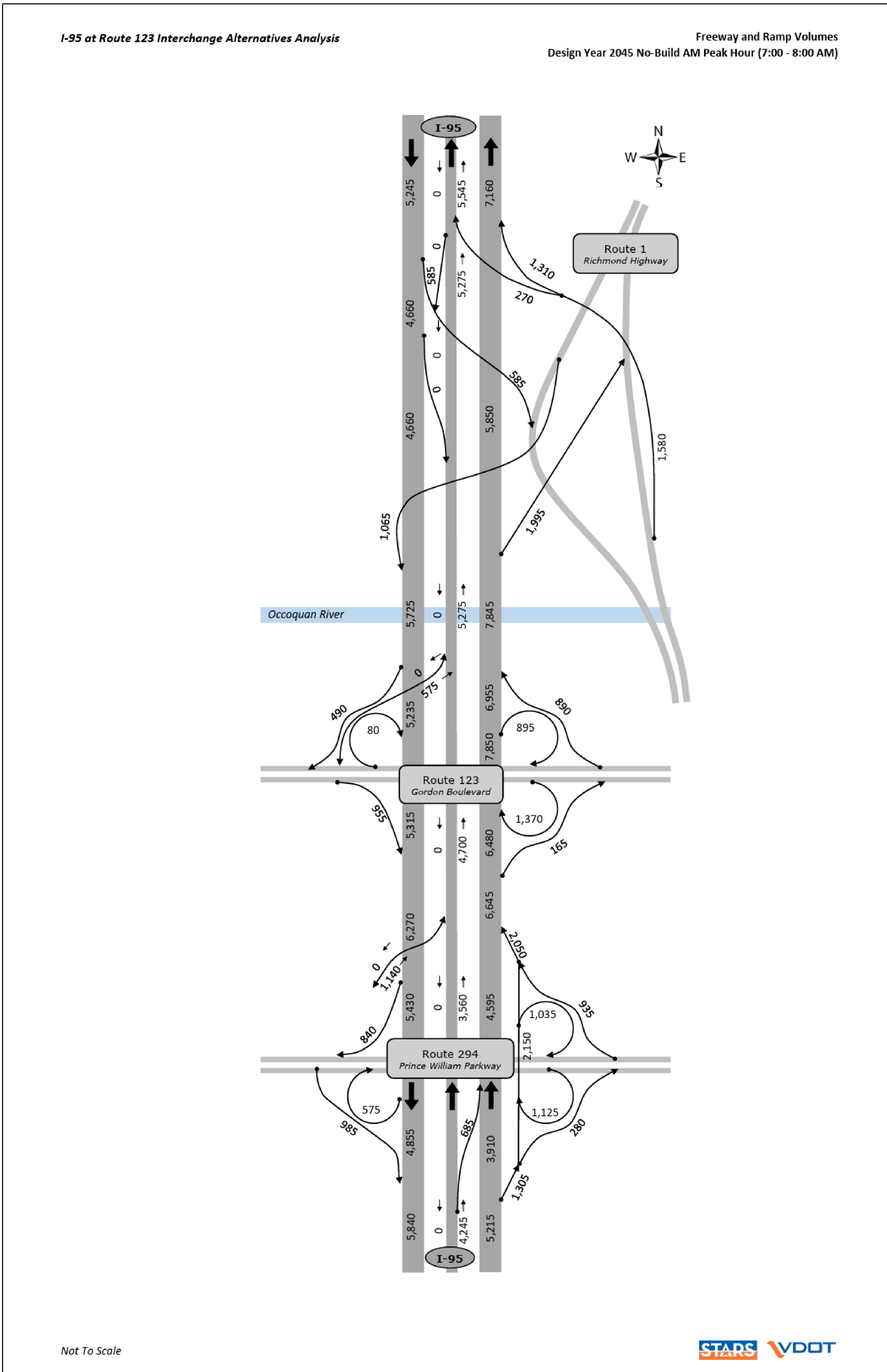


Figure 39: 2045 No-Build PM Peak Hour Volumes – I-95 (1 of 2)

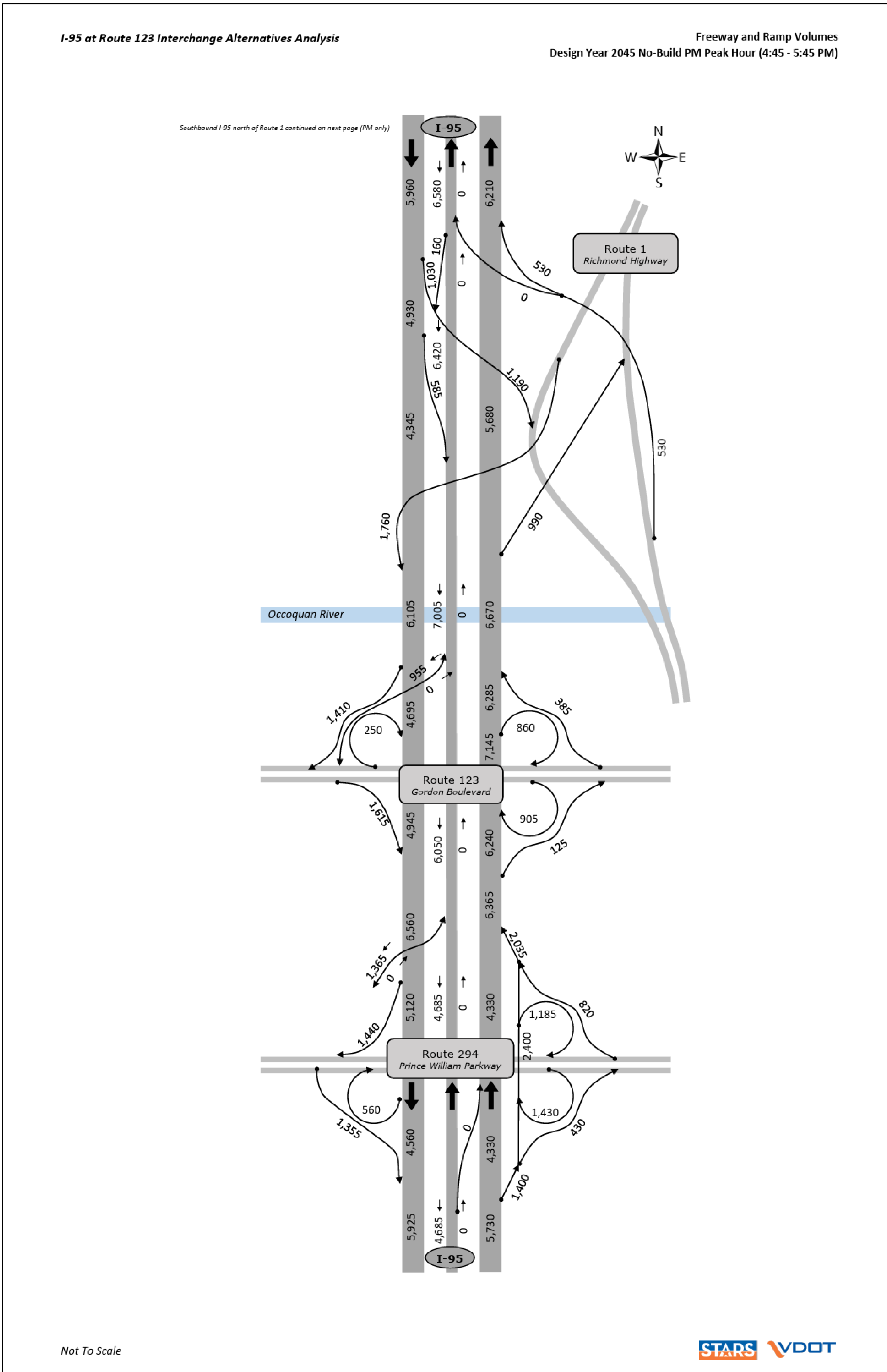
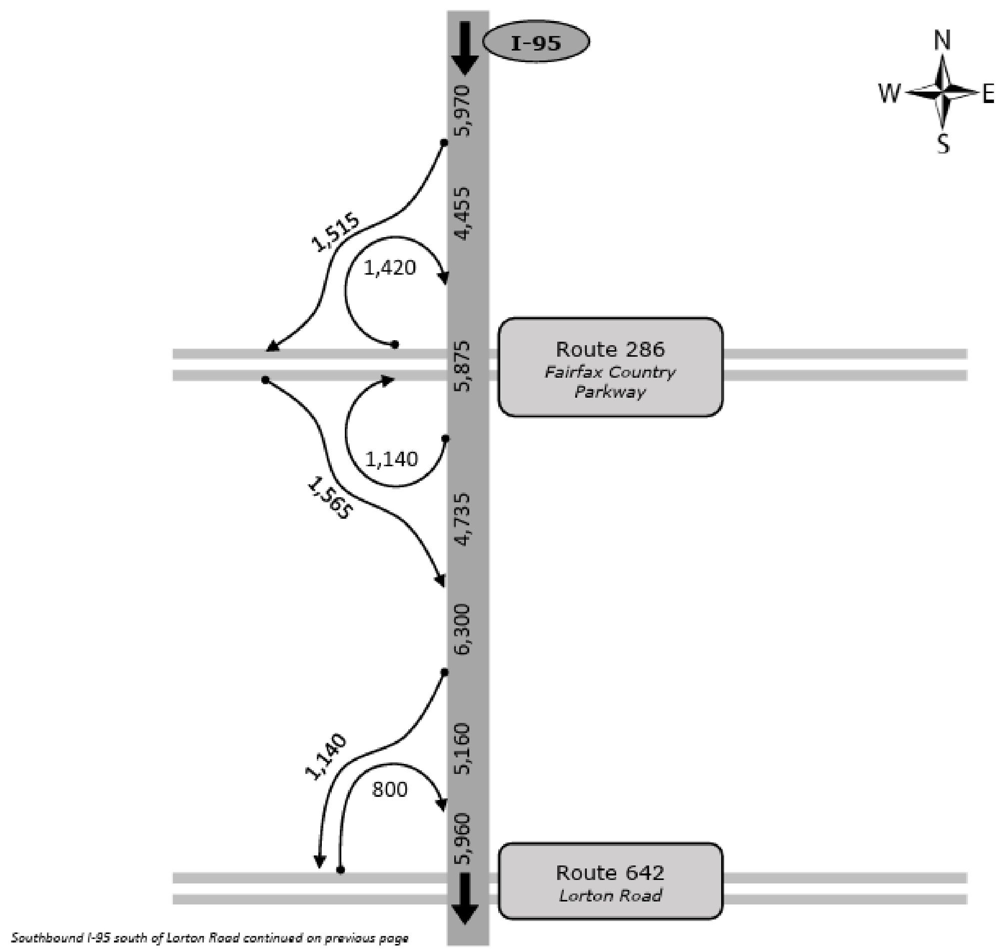


Figure 40: 2045 No-Build PM Peak Hour Volumes – I-95 (2 of 2)

I-95 at Route 123 Interchange Alternatives Analysis

Freeway and Ramp Volumes
Design Year 2045 No-Build PM Peak Hour (4:45 - 5:45 PM)



Not To Scale

Figure 41: 2045 No-Build Peak Hour Volumes – Intersections (1 of 4)

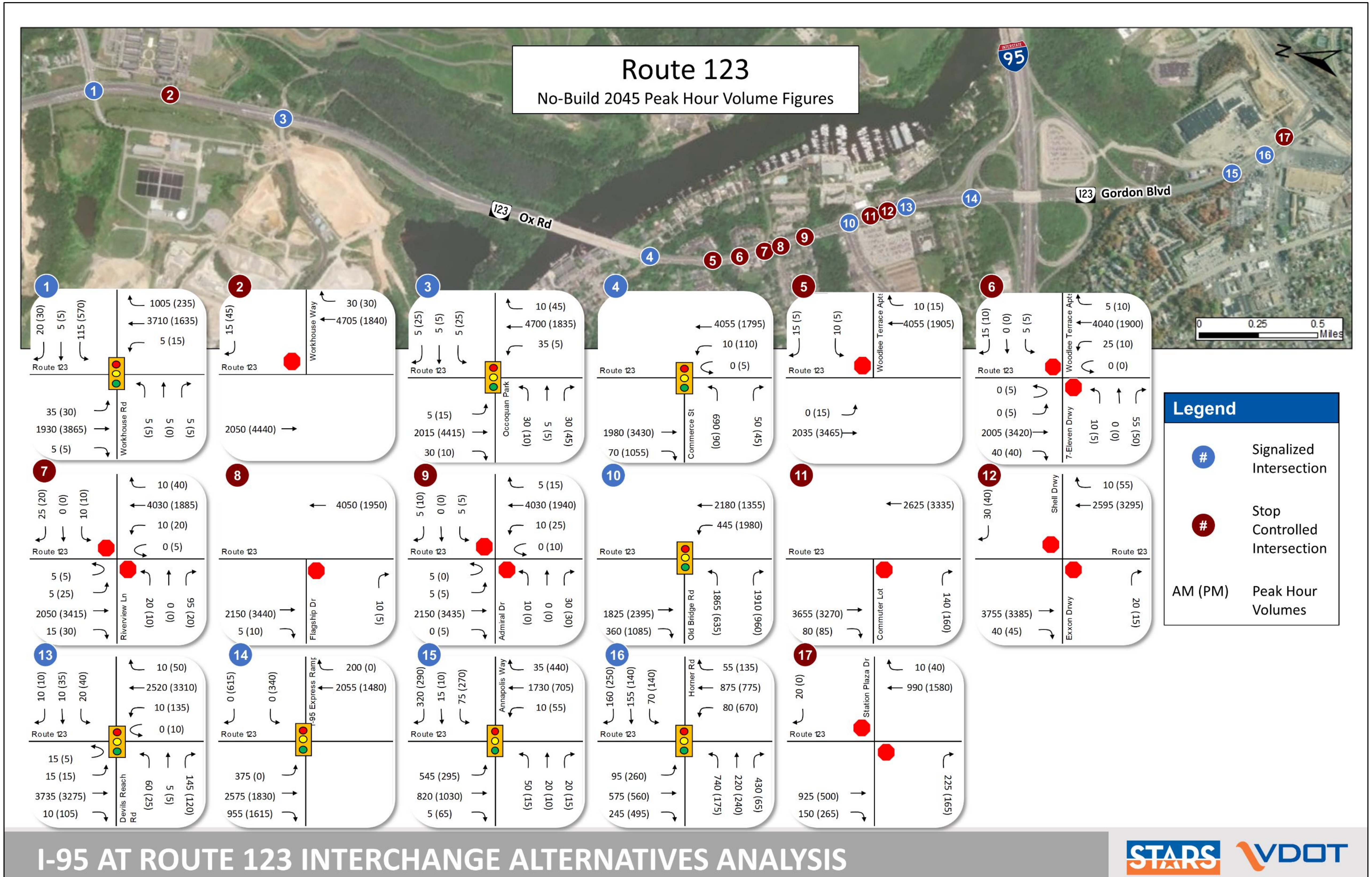
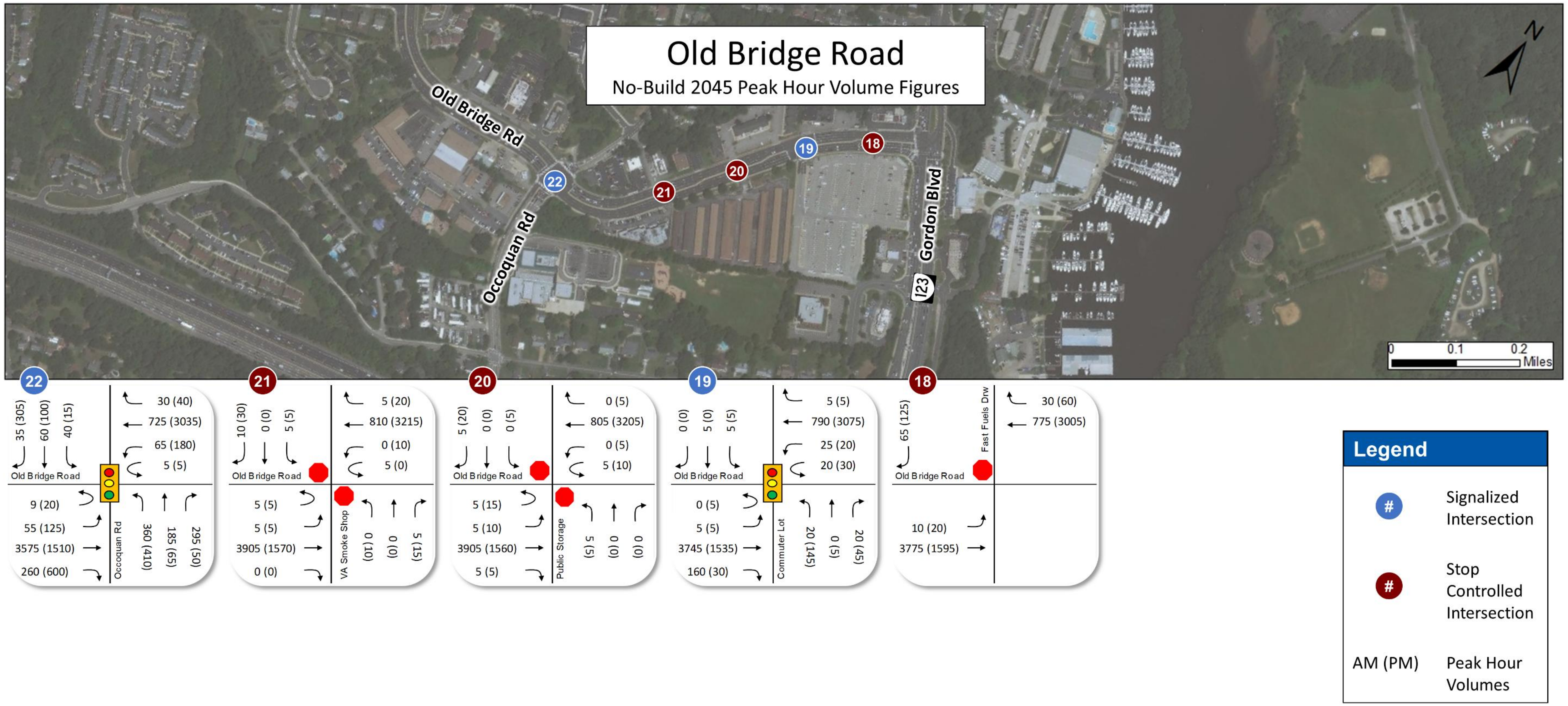


Figure 42: 2045 No-Build Peak Hour Volumes – Intersections (2 of 4)



I-95 AT ROUTE 123 INTERCHANGE ALTERNATIVES ANALYSIS

Figure 43: 2045 No-Build Peak Hour Volumes – Intersections (3 of 4)

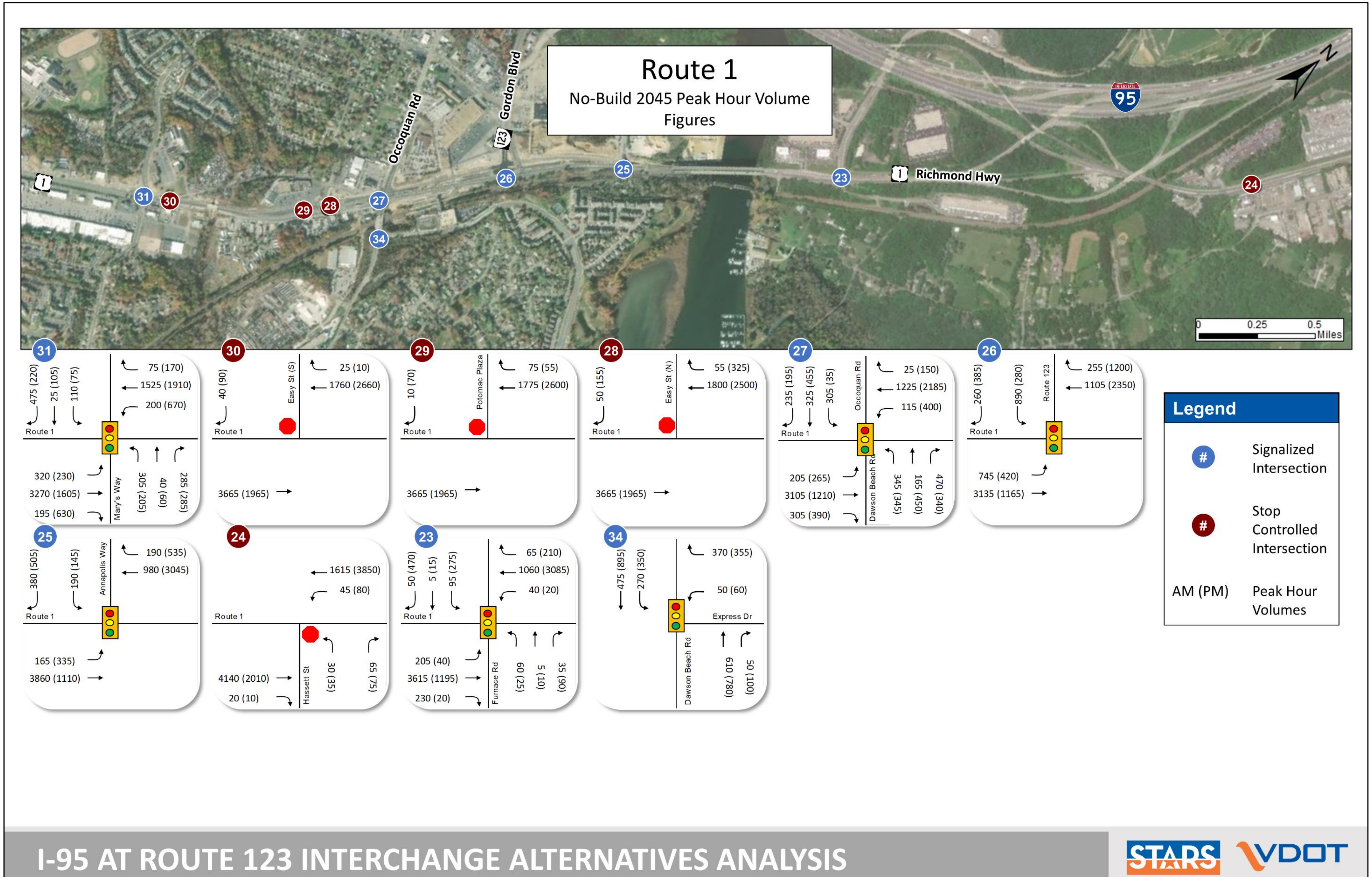
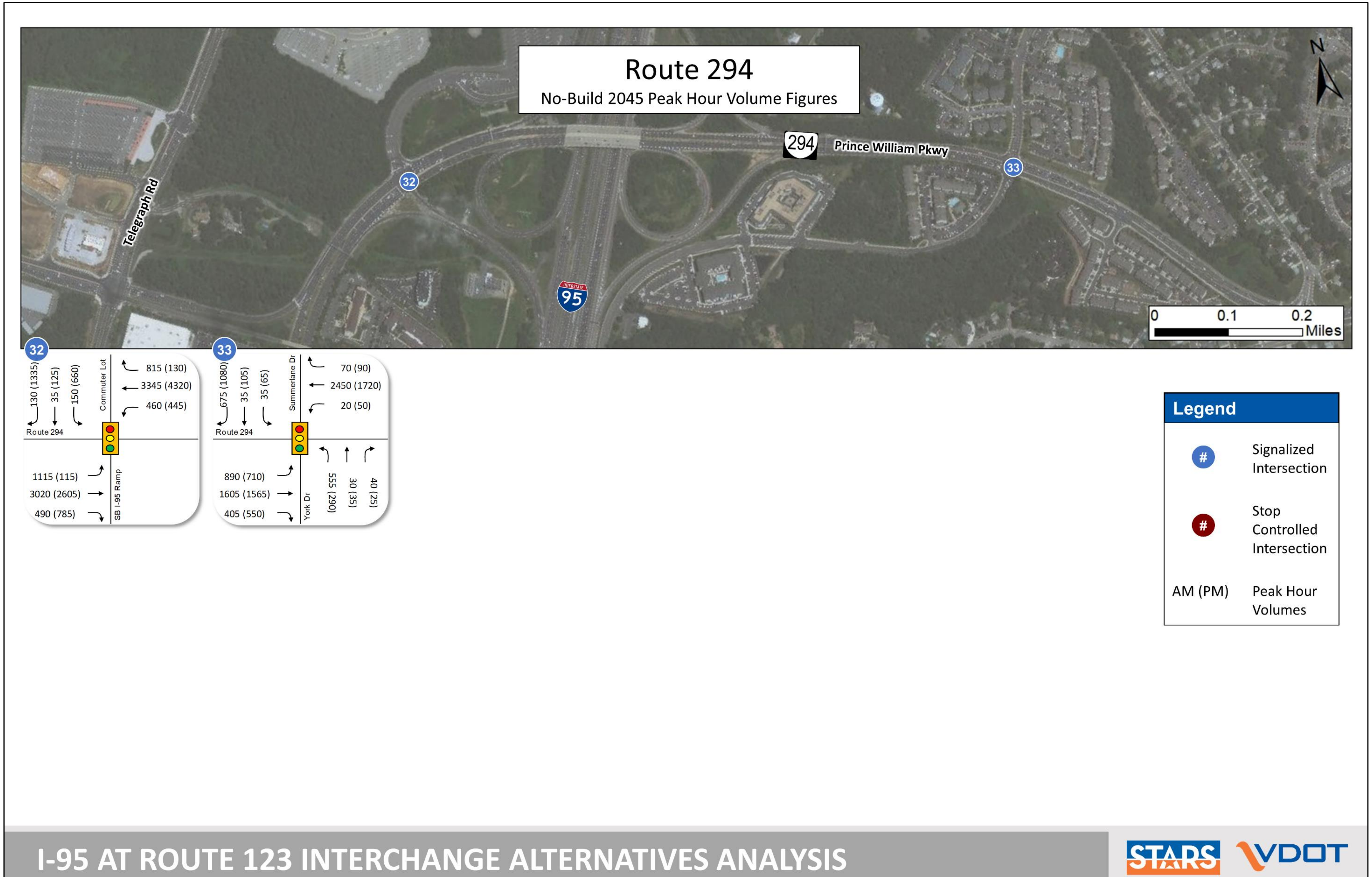


Figure 44: 2045 No-Build Peak Hour Volumes – Intersections (4 of 4)



4 No-Build Conditions Analysis

Traffic operational analyses were conducted to evaluate the overall performance of the study corridors under future (2030 and 2045) No-Build AM and PM peak hour conditions. The intent of the No-Build conditions analyses was to provide a general understanding of the baseline future traffic conditions as a starting point for developing future improvement strategies. No-Build conditions were modeled using Vissim 11, the same as for existing conditions.

4.1 Background Improvements

Planned transportation projects within the study area were included as background improvements in the 2030 and 2045 No-Build analyses. ***Table 23*** includes a list of the background improvement projects and identifies which models include each improvement.

Table 23: No Build Vissim Model Background Improvements

Project	Geometry Improvement	Scenario Years
Southbound I-95 Auxiliary Lane	Four southbound lanes between Route 123 (Exit 160) and Route 294 (Exit 158)	2030 and 2045
Route 1 Widening – Phase 1	Six lanes from Annapolis Way to Marys Way	2030 and 2045
Route 1 Widening – North into Fairfax County	Six lanes from Annapolis Way to Telegraph Road	2045 only
Route 123 Widening	Six lanes from Route 1 to Annapolis Way	2045 only *Development Driven*
Old Bridge Road at Occoquan Road Intersection Upgrades	Realigned eastbound approach; southbound right-turn lane	2030 and 2045
Route 1 Bus Rapid Transit (BRT) System	Northbound and southbound BRT routes along Route 1 from Occoquan Road into Fairfax County	2030 and 2045

4.2 Traffic Analysis Assumptions

The existing conditions Vissim models were used as the basis for developing the 2030 and 2045 AM and PM peak hour No-Build models. The geometric changes made to the models within the study area related to the background improvements are listed in ***Table 23***. In addition to the geometric changes, traffic signal timings changes were made to optimize signal operations at locations with background improvements. Traffic signal phasing changes were made along with the geometric improvements to widen Route 123 at the intersections with Horner Road and Annapolis Way. The models were updated with 2030 and 2045 No-Build forecasted traffic volumes. Inputs and analysis methodologies were consistent with the *TOSAM* 2.0 and with the existing conditions analysis.

The VDOT Sample Size Determination Tool was used to confirm that ten simulation runs would provide the acceptable 95 percent confidence level for both the No-Build AM and PM models. Therefore, ten simulation runs were completed for all models using different random number seeds and the average results were reported.

4.3 Measures of Effectiveness

The same MOEs reported for the existing conditions analysis were used for the operational analysis of the roadway network under No-Build 2030 and 2045 conditions. Vissim freeway MOEs were reported for each freeway segment. The methodology for determining the area of influence for the merge, diverge, and weave segments was consistent with the approach defined in the *Highway Capacity Manual*. Intersection results reporting and arterial MOEs were consistent with the existing conditions analysis to focus on the analyses comparing the more critical higher volume intersections in the study area.

4.4 Freeway Analysis

The No-Build (2030 and 2045) conditions freeway traffic analysis results are summarized in the following sections. The AM and PM peak hour average freeway segment densities and speeds are illustrated in ***Figure 45*** through ***Figure 56***. Additional AM and PM peak hour MOE information, including vehicle throughput, travel time, and ramp queue lengths at critical locations, were summarized in ***Appendix K***.

4.4.1 2030 and 2045 AM Peak Hour Freeway Operations

In the 2030 AM peak hour, both directions on the freeway are expected to operate with similar speeds and densities to existing conditions. The peak northbound direction does not worsen at the Route 123 interchange because of oversaturated conditions and capacity constraints at the Route 294 interchange. Queuing occurs on the northbound I-95 off-ramp to northbound Route 123 that does not occur in the existing AM peak hour due to queue spillback from northbound Route 123 traffic signals at Old Bridge Road, Devils Reach Road, and the I-95 Express Lanes ramp.

In the 2045 AM peak hour, both directions are expected to operate with similar speeds and densities to existing and 2030 No-Build conditions. Travel times on northbound I-95 in the study area are expected to increase by 21 seconds (4 percent) compared to 2030 No-Build conditions. Queuing on the northbound I-95 off-ramp to northbound Route 123 in 2030 are expected to increase to 855 feet and extend even further onto mainline I-95 after the peak hour.

4.4.2 2030 and 2045 PM Peak Hour Freeway Operations

In the 2030 PM peak hour, southbound freeway operations are expected to improve when compared to existing conditions due to the background improvements including the southbound auxiliary lane from the Route 123 interchange to the Route 294 interchange. This capacity improvement is expected to reduce queuing and increase speeds on the southbound I-95 on-ramps from both Route 123 and Route 1. The southbound I-95 mainline between Route 123 and Lorton Road is expected to remain congested, but north of Lorton Road to Fairfax County Parkway is expected to improve. Queuing on the southbound I-95 off-ramp to northbound Route 123 is expected to increase to 1,320 feet but is contained on the ramp. In the 2030 PM peak hour, northbound I-95 is expected to operate with similar speeds and densities as existing conditions.

In the 2045 PM peak hour, southbound I-95 is expected to operate with slower speeds and higher densities than 2030 No-Build conditions due to traffic growth. Southbound I-95 travel times between Backlick Road and Route 294 is expected to increase by 87 seconds (8 percent) when compared to 2030 No-Build conditions. The southbound I-95 off-ramp to northbound Route 123 is expected to operate with slower speeds and higher densities when compared to the existing and 2030 No-Build conditions. Queuing on this ramp is expected to extend to 1,930 feet, reaching the mainline, and due to the impacts of traffic signals on Route 123 at Old Bridge Road and Devils Reach Road.

In the 2045 PM peak hour, northbound I-95 is expected to operate with similar speeds and densities as existing and 2030 No-Build conditions. Queuing on the northbound I-95 off-ramp to northbound Route 123 present in the AM peak hour is expected to also be present in the PM peak hour and extend onto mainline I-95.