VDOT

ENVIRONMENTAL ASSESSMENT

Traffic and Transportation Technical Report

February 2020

495 ExpressLanes NORTHERN EXTENSION

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EXECUTIVE SUMMARY

ES.1 INTRODUCTION

The Virginia Department of Transportation (VDOT), in coordination with the Federal Highway Administration (FHWA) as the lead federal agency, is evaluating an extension of the Interstate 495 (I-495) Express Lanes along approximately three miles of I-495, also referred to as the Capital Beltway, from their current northern terminus in the vicinity of the Old Dominion Drive overpass to the George Washington Memorial Parkway (GWMP) in the McLean area of Fairfax County, Virginia. The project location is shown in the vicinity map in **Figure ES-1**. Pursuant to the National Environmental Policy Act (NEPA) of 1969, as amended, and in accordance with FHWA regulations[1], an Environmental Assessment (EA) is being prepared to analyze the potential social, economic, and environmental effects associated with the improvements being evaluated. As part of the EA being prepared, VDOT is evaluating in detail the environmental consequences of the No Build Alternative and one Build Alternative.

To support the EA, the purpose of this Traffic and Transportation Technical Report is to document:

- Existing traffic operations and safety conditions within the study area.
- Forecasted traffic volumes for future scenarios under No Build and Build conditions.
- Technical analysis and information in support of the development of alternatives.
- Traffic data needed for noise and air quality analysis to support the NEPA efforts.
- Future traffic operations and safety conditions under No Build and Build scenarios.

ES.1.1 Project Description and Location

The project extends from approximately south of the Dulles Toll Road / Route 267 interchange to the GWMP in the vicinity of the American Legion Memorial Bridge (ALMB). Although the proposed lanes would terminate at the GWMP, and the interchange provides a logical northern terminus for this study, additional improvements are anticipated to extend approximately 0.3 miles north of the GWMP to provide a tie-in to the existing road. The project also includes access ramp improvements and lane reconfigurations along portions of the Dulles Toll Road and the Dulles International Airport Access Highway, on either side of the Capital Beltway, from the Spring Hill Road Interchange to the Route 123 interchange. The proposed improvements entail new and reconfigured express lane ramps and general purpose lane ramps at the Dulles Interchange and tie-in connections to the Route 123/I-495 interchange. The project has independent utility since it would provide a usable facility and be a reasonable expenditure of funds even if no additional transportation improvements in the area are made.

In order to assess and document relevant resources that may be affected by the proposed project, the study area for the EA extends beyond the immediate area of the proposed improvements described above. The study area for the EA includes approximately four miles along I-495 between the Route 123 interchange and the ALMB at the Maryland state line. The study area also extends approximately 2,500 feet east along the GWMP. Intersecting roadways and interchanges are also included in the study area, as well as adjacent areas within 600 feet of the existing edge of pavement**.** The study area is a buffer around the road corridor

[1] NEPA and FHWA's regulations for Environmental Impact and Related Procedures can be found at 42 USC § 4332(c), as amended, and 23 CFR § 771, respectively.

that includes all natural, cultural, and physical resources that are analyzed in the EA. It does not represent the limits of disturbance (LOD) of the project nor imply right-of-way acquisition or construction impact, but rather extends beyond the project footprint to tie into the surrounding network, including tying into future network improvements. **Figure ES-2** depicts the project termini, study area, and LOD.

The existing I-495 facility within the study area currently has four northbound and four southbound general purpose (GP) lanes, supplemented in several locations by auxiliary lanes[2], acceleration/deceleration lanes at on- and off-ramps, and collector-distributor roadways[3]. Grade-separated interchanges provide access to and from I-495 and the Jones Branch Connector; Chain Bridge Road (Route 123); the Dulles Toll Road (DTR) and Dulles Airport Access Road (DAAR), collectively referred to as Route 267; Georgetown Pike (Route 193); and the GWMP. North of the study area, I-495 at the ALMB is a total of 10 lanes, including eight GP through lanes and two auxiliary lanes that connect to Clara Barton Parkway in Maryland and the GWMP in Virginia.

The southbound entrance onto the existing I-495 Express Lanes and northbound exit from the I-495 Express Lanes occur within the study area, approximately 2,000 feet south of Old Dominion Drive, as shown in **Figure ES-2**. However, drivers are permitted to use the northbound inside shoulder of the GP lanes during peak travel periods (6 AM - 11 AM and 2 PM - 8 PM Mon - Fri). The shoulder lane terminates by merging into the GP lanes just before reaching the GWMP interchange. All buses and vehicles with two axles can access the I-495 Express Lanes 24 hours a day, seven days a week. The I-495 Express Lanes operate as high-occupancy toll (HOT) lanes where vehicles with three or more occupants are not charged a toll. Trucks are currently prohibited from using the I-495 Express Lanes.

The southern portion of the study area surrounding the Route 267 interchange is surrounded by high-density commercial and residential development associated with the Tysons area. The study area between the Route 267 interchange and GWMP is comprised of suburban neighborhoods and supporting recreational areas that border the interstate, with direct access to I-495 limited to Route 193. North of the GWMP approaching the Maryland state line at the ALMB over the Potomac River is primarily open federal parkland associated with the GWMP to the east and Scotts Run Nature Preserve to the west.

Traffic Operations Study Area

Figure ES-3 shows the various components of the project Study Area for the I-495 NEXT Project:

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[2] An auxiliary lane is defined by the American Association of State Highway and Transportation Officials (AASHTO) as the portion of the roadway adjoining the traveled way for speed change, turning, weaving, truck climbing, maneuvering of entering and leaving traffic, and other purposes supplementary to through-traffic movement. Auxiliary lanes are used to balance the traffic load and maintain a more uniform level of service on the highway. They facilitate the positioning of drivers at exits and the merging of drivers at entrances (AASHTO, 2018).

[3] Collector-distributor (C-D) roadways are supplemental facilities parallel to freeway mainlines that serve primarily to move weaving and lane-changing associated with closely-spaced on- and off-ramps away from the freeway mainline. C-D roadways are typically located at freeway interchanges where ramp-to-ramp weaving occurs or where closely-spaced major arterials are present and there is minimal room for multiple freeway mainline entrance and exit ramps.

- **Yellow – Project Footprint Study Area.** The I-495 NEXT Project Footprint Study Area includes I-495 from the Route 267 interchange to the ALMB, including all ramp termini of interchanges over that section.
- **Blue – Traffic Operations Analysis Study Area.** The Traffic Operations Analysis Study Area includes the full extent of the Project Footprint Study Area as well as one interchange north and south on I-495, and a number of additional intersections and interchanges which directly affect and/or are affected by operations on I-495 within the Project Footprint Study Area.

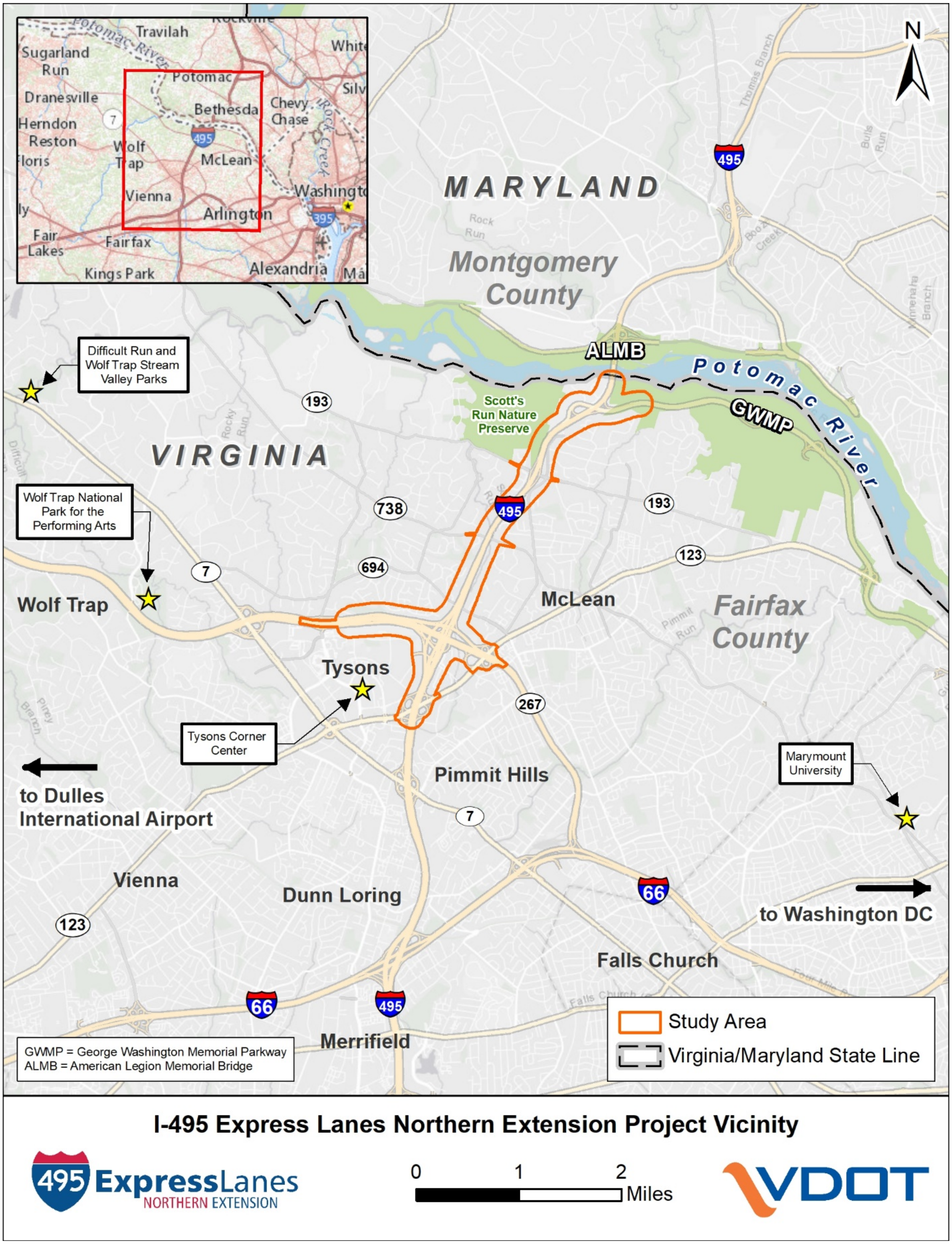


Figure ES-1. I-495 Express Lanes Northern Extension Vicinity

Figure ES-2. I-495 Express Lanes Northern Extension Project Limits

Figure ES-3. Traffic Operations Analysis Study Area

ES.1.2 Purpose and Need for Action

The purpose and need for the extension of Express Lanes on I-495 between Route 267 and the GWMP is to:

- **Reduce congestion** – Regional travel demand forecasting shows increased traffic volumes and travel demands as population and employment continue to grow within the region;
- **Provide additional travel choices** – Access to high-occupancy travel modes encourages drivers to choose alternatives to single-occupancy travel as well as provides an option to single-occupancy drivers to use the Express Lanes, freeing up capacity on the GP lanes; and
- **Improve travel reliability** – Duration and extent of congestion is expected to increase along with population and employment growth resulting in the need for commuters to spend additional time traveling to work. Travel times in the GP lanes are expected to continue to be increasingly unreliable, with median peak period travel times being several multiples of free-flow travel times and 95th percentile peak period travel times extending much longer. Express Lanes are designed to keep traffic flowing at 45 miles per hour or faster by dynamically adjusting tolls, allowing transit, high-occupancy, and toll-paying vehicles to have a much more reliable trip.

A detailed description of the purpose and need for the proposed project is provided in Chapter 1 of the EA.

ES.2 ANALYSIS METHODOLOGY

This section details the methodology for assessing traffic operations and safety impacts associated with the I-495 NEXT project. Detailed information on the analysis methodology is included in **Chapter 2.**

ES.2.1 Analysis Years and Scenarios

Traffic operations analysis consisted of an evaluation of existing conditions (2018), No Build conditions (2025 and 2045), and Build conditions (2025 and 2045):

- No Build conditions assume the completion of programmed transportation improvements consistent with the regional Constrained Long-Range Plan (CLRP) but without the I-495 Express Lanes Northern Extension project in place.
- Build conditions assume the incorporation of the project Preferred Alternative, which includes two Express Lanes in each direction along I-495 between Route 267 (Dulles Toll Road) and the GWMP, along with four general purpose (GP) lanes in each direction along the I-495 mainline and an auxiliary lane in each direction between Route 267 and Route 193 (Georgetown Pike). The construction of the Preferred Alternative is assumed to take place in phases, with the most critical components constructed first.

ES.2.2 Traffic Operations Analysis Methodology

Traffic Operations Data Collection

In support of the project, an extensive data collection effort and subsequent data review was completed during May and June 2018, including traffic counts, travel times, average freeway speeds from INRIX, queue length measurements, origin-destination (O-D) data from StreetLight Data, and signal timings.

Travel Demand Forecasting and Development of Future Traffic Volumes

Forecasts for future traffic demand were developed using the MWCOG travel demand model (version 2.3.75 using Round 9.1 Cooperative Forecasts for socioeconomic data). The MWCOG model was modified and validated to reflect existing conditions (year 2018) in the Study Area following guidance from FHWA and VDOT. Outputs from travel demand model runs were used to estimate growth on area roadway facilities and at intersections. Origin-destination (O-D) routes were developed from the model and used in the VISSIM traffic simulation models (described in the next section) to capture freeway weaving, merging, and diverging interactions.

Traffic Analysis Tools

VISSIM Version 9.0 was used for a comprehensive network traffic analysis for the freeways, interchanges, and adjacent intersections within the Traffic Operations Study Area limits. Surface street intersection operations were evaluated through a combination of Synchro 10 (to develop preliminary optimization for phasing and signal timing) and VISSIM (for microsimulation and analysis). The expanded arterial network beyond intersections immediately adjacent to freeway interchanges in the corridor was evaluated solely through Synchro. The VISSIM model was calibrated to reflect existing real-world conditions according to VDOT requirements in the *Traffic Operations and Safety Analysis Manual* (TOSAM) (VDOT, 2015).

Traffic Operations Analysis Measure of Effectiveness

The following measures of effectiveness (MOEs) were used for the operational analysis of the roadway network under existing and future Build and No Build conditions.

Freeway Performance Measures

- Simulated Average Speed (mph)
- Simulated Average Density (simulated vehicles per lane per mile)
- Simulated Volume (vehicles per hour)
- Percent of Demand Served: simulated volume (*processed volumes*) divided by actual volume (*input volumes*).
- Simulated Ramp Queue Length: reported average and maximum queue lengths (feet).
- Simulated Travel Time: reported for select network origin-destination travel paths (seconds).
- Congestion *Heat Maps*: incremental speeds reported for aggregated lanes, by time interval (mph).

Arterial/Intersection Performance Measures

- Control delay (Synchro) or microsimulation delay (VISSIM)
- Queue length (feet)

ES.2.3 Safety and Crash Analysis Methodology

A safety analysis was conducted consistent with VDOT requirements. It included an analysis of existing highway safety conditions and reported motor vehicle crashes on roads in the Study Area for a period of five years, as well as the development of qualitative and quantitative measures to evaluate future proposed alternatives and assess the safety effects of interstate access modifications on I-495 and the adjacent arterial network within the Study Area.

Safety Data Collection

Data for the safety analysis consisted of the following:

- Crash data from VDOT, Maryland SHA (MDSHA), and NPS for the previous five years (2013-2017)
- Traffic data in the form of Average Annual Daily Traffic (AADT) from VDOT for the previous five years as well as future daily traffic projections developed as part of the traffic operations analysis
- Roadway inventory data including geometric data from existing conditions as well as proposed future design concept plans

Existing Conditions Safety Analysis Methodology

The existing conditions quantitative safety analysis utilized historical crash data from the most recently-available five years' worth of data (2013-2017). It included the development of the following measures:

- Crash density and severity histograms (developed for the mainline);
- Crash heat maps for various crash types (developed for the mainline);
- Crash density maps (developed for the mainlines); and
- Crash rates (fatal, injury, property damage only (PDO) and total) (developed for the mainline and intersections).

Future Conditions Safety Analysis Methodology

For the purposes of future alternatives analysis on the I-495 corridor, a combination of three quantitative tools were employed:

- **Enhanced Interchange Safety Analysis Tool (ISATe)** for assessing general purpose freeway segments and interchanges
- **Project-Developed Express Lane Safety Performance Function (SPF)** for estimating future-year crashes in Express Lanes segments
- **Extended Highway Safety Manual (HSM) Spreadsheets** for estimating future-year crashes at arterial intersections

These tools were used to estimate the number of future-year crashes for the No Build and Build Alternatives to allow for comparison and estimate potential safety benefits.

ES.3 SUMMARY OF FINDINGS

This section provides highlights of the detailed traffic analysis and operations study that was performed for the assessment of existing and future conditions, including a project No Build and Build Alternative. Detailed information on the analysis is included in **Chapters 4** (Existing Traffic Operational Conditions), **7** (Future Scenarios Operational Conditions), and **8** (Existing and Future Safety Analysis).

ES.3.1 Existing Travel Patterns

Although traffic has distinctive peak periods along the I-495 corridor, increasing congestion has prolonged these peak periods and spilled queued traffic to parallel routes such as the GWMP, Route 193, and Route 123. A typical commuting pattern might show a morning peak in one direction and an afternoon peak in the opposite direction; however, the I-495 NEXT Study Area experiences congestion in both directions in both peak periods, with the most severe congestion along northbound I-495 due to a bottleneck at the ALMB.

From 2002 to 2017, the AADT for I-495 at the ALMB grew by 18 percent, with the transportation infrastructure expanding alongside this traffic growth to include the existing I-495 Express Lanes as well as a hard shoulder open to northbound traffic in the study area during periods of high demand. Projected population and employment growth, particularly in Tysons, is forecasted to significantly increase in future years and additionally strain highway capacity.

An analysis of travel patterns along I-495 using StreetLight Data, a provider of anonymized mobile device analytics to support transportation studies, shows that trips have a wide-ranging set of origins and destinations well outside the study area. Many trips within the study area originate in Tysons and in locations further to the south or west, such as Dulles International Airport (IAD) and Prince William County, and are destined for Maryland, especially areas along the I-270 corridor. A significant amount of travel across the ALMB is originating from or destined for jurisdictions beyond Fairfax County and Montgomery County (the two jurisdictions directly connected by the bridge). The bridge carries a significant amount of regional and inter-state travel. The ALMB and the I-95/I-495 Woodrow Wilson Bridge south of Washington, D.C. are the only two river crossings directly between Virginia and Maryland within the vicinity of Washington, D.C. As a result, they each carry very heavy traffic volumes exceeding 200,000 vehicles per day.

ES.3.2 Existing Conditions Traffic Operations

Peak Periods and Peak Hours

Due to the oversaturated conditions and historical trends within the study area, it was determined that the traffic analysis periods should be based upon the periods of heaviest congestion and slowest speeds along the northbound I-495 GP lanes as shown in the INRIX speed heat map in **Exhibit 4-1** in the main body of the report**.**

- For the AM peak period from 6:45 a.m. to 9:45 a.m., the network representative hour (peak hour) occurs between **7:45 a.m. and 8:45 a.m.** Queue spillback is tied to the on-ramp from GWMP and the weave across the ALMB, with the slowest speeds and longest queues occurring during the representative hour.
- For the PM peak period from 2:45 p.m. to 5:45 p.m., the network representative hour (peak hour) occurs between **3:45 p.m. and 4:45 p.m.** During the early afternoon hours between approximately 2:00 p.m. and 3:30 p.m., queue spillback and congestion along northbound I-495 is again tied to the on-ramp from GWMP and the weave across the ALMB. During the later afternoon hours after approximately 3:30 p.m., queues from downstream congestion in Maryland spill back across the ALMB, resulting in a single continuous queue. At this point, the back of the queue stabilizes for several hours, suggesting that demand is not increasing and is being processed at the same rate as it arrives.

Summary of Existing Operational Deficiencies

Based on the traffic simulation results, the travel demand is higher than the existing capacity for much of the study area under existing conditions. This is reflected in the high densities and low speeds found in many segments in the peak directions. General characteristics of congestion on the corridor include:

- **Substantial multi-hour queues in both directions.**
  - Bottlenecks created by major merge areas, as experienced in the northern terminus of the study area.
  - Congestion from downstream impacting study area network, including areas in Maryland north of the ALMB and congestion in Tysons south of the study area.
  - Bottlenecks created due to lane drops, such as the I-495 northbound GP merge where the shoulder lane terminates.
  - Bi-directional demand and weaving result in congestion in both directions during both peak periods, such as weaving along the I-495 northbound GP lanes between the on-ramp from Route 193 and the off-ramp to GWMP.
  - The on-ramp from the GWMP to I-495 northbound frequently queues back onto the GWMP outbound/westbound mainline for several miles to as far back as the GWMP/Route 123 interchange.
  - As shown in **Exhibit 4-1** in the main body of the report, in the northbound direction along I-495, the AM peak period lasts almost four hours, and the PM peak period lasts for more than six hours. In the southbound direction, the AM peak period lasts approximately two hours and the PM peak period lasts for approximately five hours.
- **Heavy volumes entering and exiting I-495 at the Route 267 interchange affect traffic in both directions for extended periods.**
  - Heavy demand from Route 267 entering an already congested segment of I-495 results in more congestion and queue spill-backs. The I-495 northbound GP on-ramp from DTR/DAAR eastbound frequently spills back to the DTR/DAAR mainlines due to heavy demand and congestion along I-495 northbound GP.
  - The I-495 southbound GP on-ramp from DTR/DAAR eastbound creates weaving issues along I-495 southbound, as the off-ramp to Route 123 and destinations in Tysons is just downstream of this location.
- **Cut-through traffic on local parallel arterials creates more disturbance along mainline.**
  - Vehicles detouring to avoid I-495 congestion create more disturbance to the flow of traffic by exiting to use parallel arterial facilities, such as Balls Hill Road and Swinks Mill Road, and then entering again at downstream locations along I-495, such as at Route 193.
- **High-Occupancy Toll (HOT) traffic to and from the I-495 Express Lanes and weaving in and out from GP lanes results in severe congestion.**
  - The speed differential as well as weaving in and out from the I-495 Express Lanes that have ingress and egress just north of the Route 267 interchange create congestion in the GP lanes.

ES.3.3 Overview of No Build and Build Alternative

No Build Alternative

The No Build Alternative includes recent improvements and planned projects. Notable regional projects outside of the study area that impact travel patterns within the study area were also included in developing traffic forecasts for future-year scenarios. **Table ES-1** provides a summary of projects included as background improvements for both No Build and Build conditions for I-495 Project NEXT traffic analysis.

All projects noted for completion by 2025 are included as part of 2025 No Build conditions; otherwise, the improvements are only included for 2045 No Build conditions.

Table ES-1. Summary of Background Transportation Projects

Project	Description	Completion / Opening Year
Jones Branch Connector / Scotts Crossing Road Extension	Construction of a four-lane roadway across I-495 connecting to Route 123; includes expansion of traffic signal with I-495 Express Lanes ramps and new traffic signals east of I-495 and west of Route 123	2019
Transform I-66 Inside the Beltway: Eastbound Widening	Construction of additional eastbound lane along I-66 eastbound between Dulles Connector Road (Route 267) and Exit 71/Glebe Road (Route 120)	2021
Route 123 Widening	Widening of Route 123 between Route 7 and I-495 to four through lanes in each direction	2021
Georgetown Pike/Balls Hill Road Intersection Improvements	Dedicated northbound left-turn lane and updates to signal phasing	2019
Transform I-66 Outside the Beltway	Construction of two Express Lanes in each direction (along with three remaining GP lanes) between I-495 and University Boulevard; improved bus service and transit routes, including park-and-ride lot expansions; interchange improvements and auxiliary lanes between interchanges	2022
I-495 Managed Lanes in Maryland	Construction of two tolled lanes in each direction across the ALMB, around I-495 in Maryland, and along I-270. Includes north-facing ramp connections to GWMP (GWMP westbound to I-495 northbound managed lanes and I-495 southbound managed lanes to GWMP eastbound).	2025[4]
Dulles Interchange Master Plan	Construction of new direct access ramps from I-495 northbound and southbound GP lanes to DAAR westbound; reconstruction of several existing ramp movements at interchange including C-D roads along eastbound DTR and southbound I-495; auxiliary lanes along I-495 GP between Route 267 and Route 193	2030[5]

[4] A sensitivity analysis has been conducted assessing the impacts of a No Build and Build condition for Project NEXT if the I-495 Maryland managed lanes system is not yet complete by 2025. This analysis is included as **Appendix I.**

[5] I-495 northbound GP auxiliary lane between Route 267 and Route 193 assumed to be in place by 2025.

Project	Description	Completion / Opening Year
Dulles Toll Road All-Electronic Tolling	Conversion to high-speed all-electronic tolling and removal of existing toll booths	2030
Dulles Toll Road Urban Frontage Road west of Spring Hill Road	Construction of two-lane frontage road outside of DTR mainline between Route 7 and Spring Hill Road; includes new direct connections from frontage road to Tyco Road	2037
Transform I-66 Inside the Beltway: Both Directions Express Lanes Operations	Both directions of I-66 east of I-495 operated as Express Lanes across all lanes (HOV-3 free with EZ-Pass switched to HOV-3 mode; tolled for all other vehicles) during both peak periods.	2040

Build Alternative

The Build Alternative will consist of the following elements:

- Extending the existing four I-495 Express Lanes from their current terminus between the I-495/Route 267 interchange and the Old Dominion Drive overpass north approximately 1.6 miles to the GWMP interchange, at which point the Express Lanes would seamlessly tie into the Maryland managed lane system. In order to reduce the LOD, the extended Express Lanes would be separated from the GP lanes by flexible delineators, consistent with the configuration of the existing I-495 Express Lanes, requiring approximately an additional 8 feet. This eliminates the need to provide full shoulders and concrete barrier separation in each direction, which would require an additional 56 feet in comparison. **Figure ES-4** shows a typical section for I-495, with two Express Lanes in either direction separated by flexible delineators.
- Additional GP auxiliary lanes between the Route 267 and Route 193 interchanges. North of the Route 193 interchange, an auxiliary lane is already provided in the northbound direction; in the southbound direction, a C-D road will take the place of an auxiliary lane. Through the entire project area, the Build Alternative would retain the existing number of GP lanes in each direction between the I-495/Route 267 interchange and the GWMP.
- Additional access to the Express Lanes network (described further in this section).
- Improvements to I-495 interchanges between Route 123 and GWMP (described further in this section)
- Reconstruction of I-495 overpasses in the study area: Old Dominion Drive and Live Oak Drive (described further in this section)

<u>Proposed Access to the Express Lanes</u>

The Build Alternative would provide the following access to and from the Express Lanes:

- Flyover exchange ramps to provide access from the northbound I-495 GP lanes to the northbound I-495 Express Lanes, and from the southbound I-495 Express Lanes to the southbound I-495 GP lanes. These exchange ramps would be located at the Route 267 interchange.

- New Express Lanes access to and from Route 267:
  - Eastbound Route 267 (DTR) to northbound I-495 Express
  - Westbound Route 267 (Dulles Connector Road) to northbound I-495 Express
  - Southbound I-495 Express to eastbound Route 267 (DCR). This movement would tie into an eastbound C-D road along Route 267 at the Route 267/Route 123 interchange, allowing access to both the eastbound Dulles Connector Road and Route 123.
  - Note that the southbound I-495 Express to westbound Route 267 (DTR) movement is already provided today; additionally, the northbound I-495 Express to westbound Route 267 (DTR) and eastbound Route 267 (DTR) to southbound I-495 Express movements are also provided today.
- New Express Lanes access to and from GWMP:
  - Northbound I-495 Express to GWMP
  - GWMP to southbound I-495 Express
  - Note that the Maryland managed lanes system (assumed to be in place under No Build conditions) would provide access to the movements from GWMP to northbound I-495 Maryland managed lanes and from southbound I-495 Maryland managed lanes to GWMP.

Route 267 Interchange

The Build Alternative includes significant modifications to the I-495/Route 267 interchange, including modifications to several of the GP ramp connections. Individual Ramp movements are discussed in detail below and can be seen in **Exhibit 6-2a** in the main body of the report. Modified Access refers to movements which are provided under the existing interchange configuration, while Additional Access refers to movements which are not provided under the existing interchange configuration. All access provided in the existing interchange configuration is maintained in some form through all phases of the Build Alternative.

- **GX:** Ramp GX is a one-lane ramp which provides Additional Access from northbound I-495 GP lanes, from and Route 123 at the I-495/Route 123 interchange, to northbound I-495 Express Lanes. Ramp GX would be provided via a connection from ramp G2 to ramp E1.
- **XG:** Ramp XG is a one- lane ramp which provides Additional Access from southbound I-495 Express Lanes to southbound I-495 GP lanes. Ramp XG would be provided via flyover ramp connecting ramp E2 to ramp D1.
- **E1:** Ramp E1 provides Modified Access from eastbound DTR and eastbound DAAR to northbound and southbound I-495 Express Lanes, with one lane of capacity to each Express Lane facility. Modified Access from eastbound DTR and eastbound DAAR would be provided via a C-D road which collects traffic from the DTR and DAAR upstream of the Route 267 interchange and then flies over eastbound DTR.
- **E2:** Ramp E2 is a one-lane ramp which provides Additional Access from southbound I-495 Express Lanes to eastbound DTR.
- **E3:** Ramp E3 is a one-lane ramp which provides Additional Access from westbound DCR to northbound I-495 Express Lanes. Ramp E3 merges with ramp E1 before tying into northbound I-495 Express Lanes.
- **G1:** Ramp G1 is a one-lane ramp which provides Modified Access from southbound I-495 GP lanes to eastbound DTR. Ramp G1 also provides access to Route 123 at the Route 267/Route 123 interchange via a connection to ramp D2 and subsequent connection to ramp G4.

- **G2:** Ramp G2 provides Modified Access from northbound I-495 to westbound DTR with one lane of capacity. Ramp G2 also provides access from Route 123 at the I-495/Route 123 interchange via the proposed C-D road system at that interchange.
- **G3:** Ramp G3 is a two-lane ramp which provides Modified Access from eastbound DTR to northbound I-495 GP lanes. Ramp G3 will be extended to combine with ramps G10 and G9 about before tying into northbound I-495 GP lanes about 0.6 miles downstream of the existing tie in point.
- **G4:** Ramp G4 provides Modified Access from eastbound DTR to the Route 123 C-D road at the Route 267/Route 123 interchange. Ramp G4 also provides access to the Route 123 C-D from eastbound DAAR via a connection from ramp D2.
- **G5:** Ramp G5 is a two-lane ramp which provides Modified Access from southbound I-495 GP lanes to westbound DTR.
- **G6:** Ramp G6 provides Modified Access from southbound I-495 GP lanes to the proposed Route 123 C-D road at the I-495/Route 123 interchange with one lane of capacity.
- **G7:** Ramp G7 is a one-lane ramp which provides Modified Access from eastbound DTR to the propose Route 123 C-D road at the I-495/Route 123 interchange.
- **G8:** Ramp G8 is a one-lane ramp which provides Modified Access from eastbound DTR to southbound I-495 GP lanes.
- **G9:** Ramp G9 is a one-lane ramp which provides Modified Access from the Route 123 C-D road at the I-495/Route 123 interchange to northbound I-495 GP lanes (provided access to the northbound GP lanes from Route 123). Ramp G9 is provided via a connection from ramp G2 to combined ramps G3 and G10.
- **G10:** Ramp G10 is a one-lane ramp which provides Modified Access from westbound DTR to northbound I-495. Ramp G10 is provided via a connection from the westbound DTR mainline to ramp G3.
- **D1:** Ramp D1 provides Modified Access from eastbound DAAR (indirectly via eastbound DTR) to southbound I-495 GP lanes with one lane of capacity.
- **D2:** Ramp D2 provides Modified Access from eastbound DAAR to northbound I-495 GP lanes with one lane of capacity.
- **D3:** Ramp D3 is a one-lane ramp which provides Additional Access from southbound I-495 GP lanes to westbound DAAR.
- **D4:** Ramp D4 is a one-lane ramp which provides Additional Access from northbound I-495 GP lanes to westbound DAAR.

GWMP Interchange

The Build Alternative also includes modifications to the GWMP interchange, the northernmost interchange on I-495 in Virginia. These modifications can be seen in **Exhibit 6-2e** in the main body of the report**.** All existing GP movements at the GWMP would be maintained under the Build Alternative but would be modified to accommodate additional access between I-495 Express Lanes and the GWMP provided under the Build Alternative.

Build Alternative Phasing

The Build Alternative would be implemented in multiple phases. Opening Year improvements (assumed to be in place by 2025 for traffic operations analysis) would include:

- The extension of the I-495 Express Lanes from the Route 267 interchange to the GWMP interchange, at which point the Express Lanes would seamlessly tie into the Maryland managed lanes system.
- Improvements to the Route 267 interchange, including connections from the Dulles Toll Road (both eastbound and westbound) to northbound I-495 Express and enhancements to the ramp from eastbound DTR to northbound I-495 GP.
- Improvements to the GWMP interchange, including connections from northbound I-495 Express to GWMP and from GWMP to southbound I-495 Express, and a new collector-distributor (C-D) road design along southbound I-495 GP between the GWMP and Route 193 interchanges.
- A new northbound I-495 GP auxiliary lane between the Route 267 and Route 193.
- Rebuilding of the Route 738 (Old Dominion Drive) overpass, the Live Oak Drive overpass, and the Route 193 interchange in order to accommodate the expanded cross-section of the I-495 mainline.
- A parallel bicycle/pedestrian trail between Route 694 (Lewinsville Road) and the GWMP.

Exhibits 6-1a through **6-1e** contain the concept plan sheets for the Build Alternative showing Opening Year improvements in place. Further improvements would be implemented between 2025 (Opening Year) and 2045 (Design Year) culminating into the Ultimate Build Configuration, which would include additional improvements at the Route 267 interchange and improvements to the Route 123 interchanges with both I-495 and Route 267. All improvements associated with the Build Alternative are assumed to be in place by 2045. **Exhibits 6-2a** through **6-2e** contain the concept plan sheets for the Build Alternative showing all improvements in place.

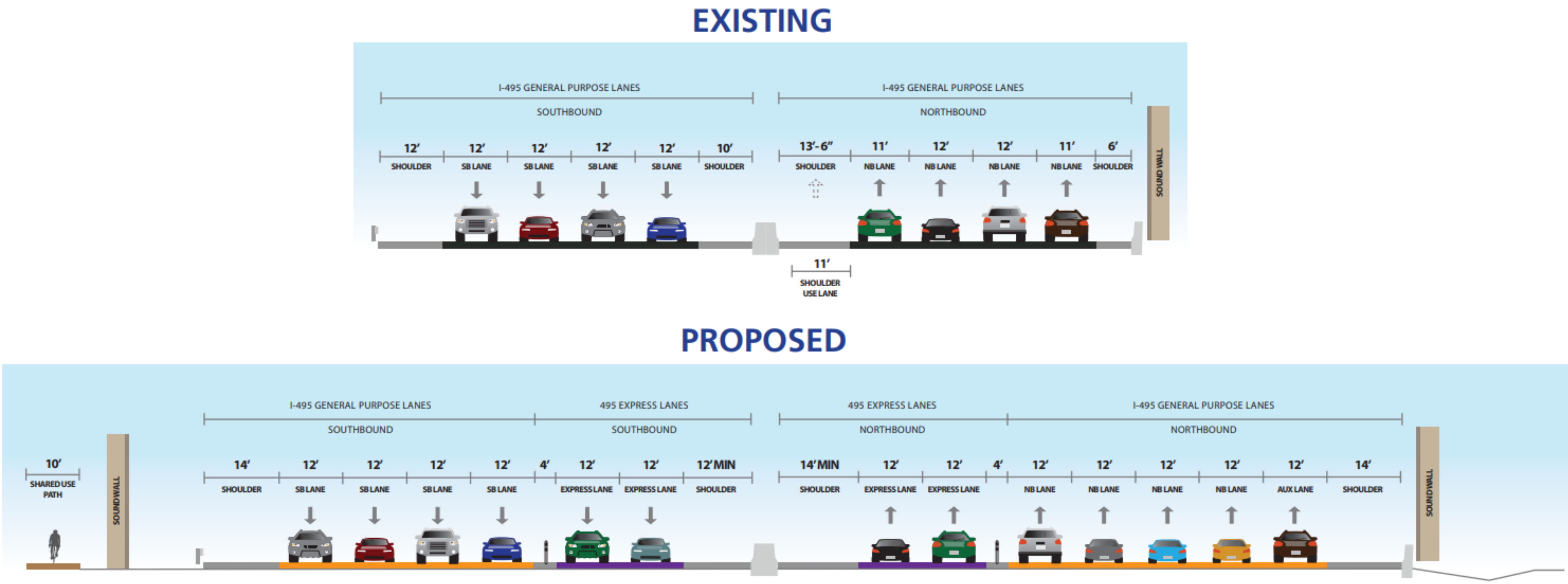


Figure ES-4. Existing and Build Alternative Typical Sections

ES.3.4 Future Conditions Traffic Operations

2025 AM Peak Period Summary

- Total demand along I-495 (GP plus Express) is forecasted to increase in the Build scenario along the length of the I-495 corridor. The greatest increases in demand are in the segments between Route 267 and GWMP, where Express Lanes are only present in the Build scenario and thus represent a substantial capacity increase from No Build conditions. Peak hour volumes are forecasted to increase in the Build scenario by between 2 to 9 percent in the northbound direction and between 2 to 6 percent in the southbound direction.
- **Figure ES-5** provides a "heat map" comparison of average speeds between 2025 No Build and Build conditions for the AM peak period along the I-495 GP lanes. Time of day during the peak period is provided on the horizontal axis while location along the corridor is provided along the vertical axis; the colors signify average speeds for each scenario. The figure indicates a more significant presence of congestion in the No Build scenario in both directions of the I-495 GP lanes as compared to the Build scenario.
- In the northbound direction along the I-495 GP lanes, congestion is observed under No Build conditions between Route 267 and Clara Barton Parkway (across the ALMB) due to heavy merging and weaving volumes on and near the bridge. Under Build conditions, a significant reduction in congestion is observed due to the additional capacity provided by the Express Lanes and the reduced weaving due to the continuity of the Express Lanes. The average travel time in the northbound GP lanes improves by approximately 3 minutes (a 24 percent improvement) in the Build condition.
- In the southbound direction along the I-495 GP lanes, congestion is observed under No Build conditions south of the ALMB and north of Route 267 due to weaving approaching the entrance to the Express Lanes system as well as merging from vehicles exiting the Maryland managed lanes system south of the ALMB. This congestion is largely mitigated under Build conditions. The average travel time in the southbound GP lanes improves by approximately 1.5 minutes (an 11 percent improvement).
- Both directions of the Express Lanes operate at or near the posted speed limit. To travel the length of the corridor via Express Lanes under No Build conditions, vehicles must utilize the congested GP lanes between Route 267 and GWMP as Express Lanes are not present.
- Along eastbound Route 267 (DTR) there is 47 percent improvement in travel time. With the improved operations along northbound I-495, the ramp from eastbound DTR to northbound I-495 does not spill back to eastbound DTR, improving operations along eastbound DTR. Travel times along the westbound DTR remain unchanged.
- Over the course of the AM peak period, total persons moved along I-495 are forecasted to increase from No Build to Build conditions by between 4 and 17 percent in the northbound direction (see **Figure ES-6**) and between 6 and 21 percent in the southbound direction (see **Figure ES-7**), depending upon location along the corridor.
- Arterial intersection operations are largely consistent between No Build and Build conditions, as both scenarios see the same percentage of intersections operating under failing conditions. These failing intersections are in the Tysons area and see continued growth in demand tied to commercial and residential growth in Tysons.

Table ES-2 presents an overall performance comparison table for the Build alternative versus the No Build alternative for 2025 AM conditions. The table shows that the Build alternative improves overall operations along the I-495 corridor given the improvement in travel times, reduction in congestion, and increase in persons moved.

Figure ES-5. 2025 No Build and Build – AM Peak Period Average Speeds, I-495 GP Lanes

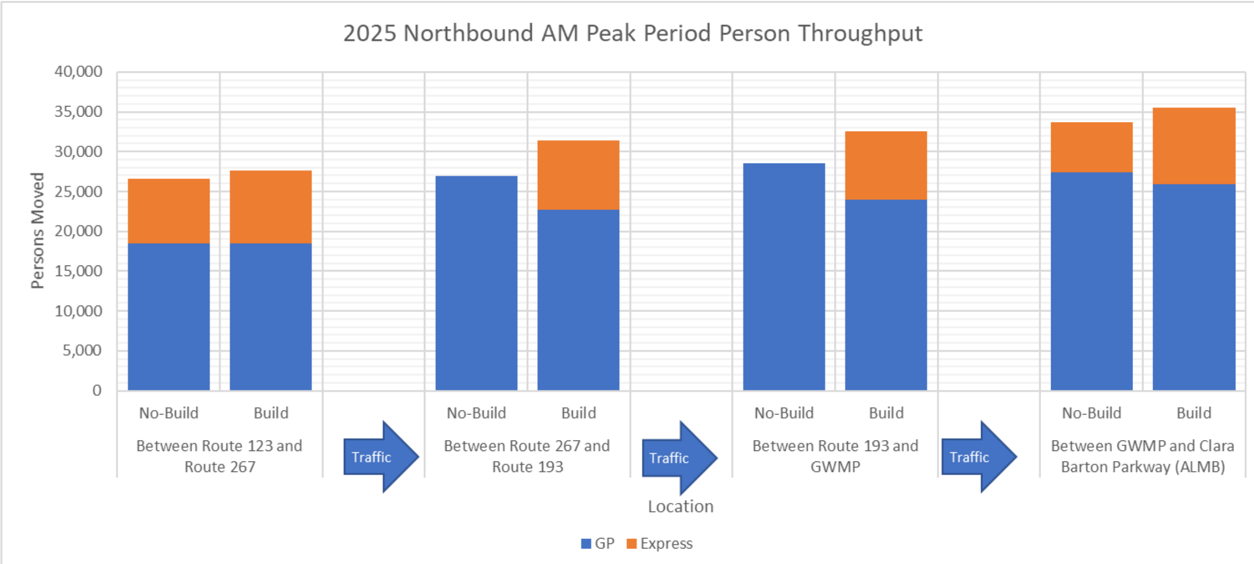


Figure ES-6. 2025 No Build and Build – AM Peak Period Person Throughput, I-495 Northbound

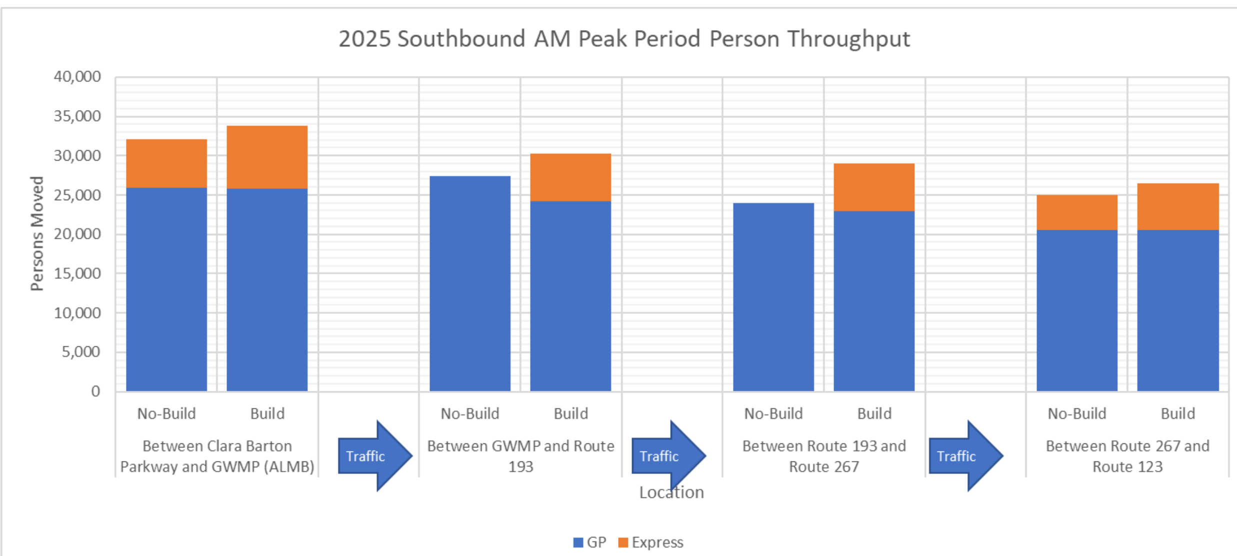
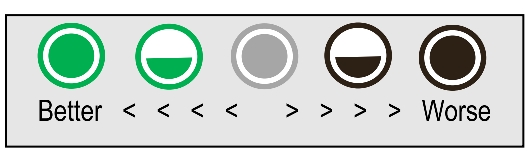


Figure ES-7. 2025 No Build and Build – AM Peak Period Person Throughput, I-495 Southbound

Table ES-2. Overall Performance Comparison for 2025 AM No Build and Build Alternative

Measure of Effectiveness	Description	Facility	2025 AM No Build Value	2025 AM Build Value	Build Performance Compared to No Build
Travel Times	End-to-end travel time along the facility through the Traffic Operations Study Area, measured in Minutes	I-495 NB GP	10	7	●
		I-495 NB Express	8	6	●
		I-495 SB GP	8	7	◒
		I-495 SB Express	7	6	◒
		Dulles Toll Road EB	3	2	●
		Dulles Toll Road WB	2	2	○
Extent and Duration of Congestion	Visual assessment of freeway mainline queue length and duration of congestion	I-495 NB GP			●
		I-495 SB GP			●
Person Throughput	Additional persons moved during peak period of Build condition and percentage increase	I-495 NB (All)	+4,500 (17%)		◒
		I-495 SB (All)	+5,000 (21%)		●
Arterial Operations	Number of intersections operating at LOS F	Entire Study Area	7	7	○
	Number of intersections operating at LOS D or better		19	17	◓



2025 PM Peak Period Summary

- Total demand along I-495 (GP plus Express) is forecasted to increase in the Build scenario along the length of the I-495 corridor. The greatest increases in demand are in the segments between Route 267 and GWMP, where Express Lanes are only present in the Build scenario and thus represent a substantial capacity increase from No Build conditions. Peak hour volumes are forecasted to increase in the Build scenario by between 10 to 29 percent in the northbound direction and between 7 to 12 percent in the southbound direction.
- **Figure ES-8** provides a "heat map" comparison of average speeds between 2025 No Build and Build conditions for the PM peak period along the I-495 GP lanes. Time of day during the peak period is provided on the horizontal axis while location along the corridor is provided along the vertical axis; the colors signify average speeds for each scenario. The figure indicates a more significant presence of congestion in the No Build scenario in both directions of the I-495 GP lanes as compared to the Build scenario.
- In the northbound direction along the I-495 GP lanes, congestion is observed under No Build conditions between Route 267 and Clara Barton Parkway (across the ALMB) due to heavy merging and weaving volumes on and near the bridge, especially early in the peak period. Under Build conditions, a significant reduction in congestion is observed due to the additional capacity provided by the Express Lanes and the reduced weaving due to the continuity of the Express Lanes. The average travel time in the northbound GP lanes improves by approximately 4 minutes (a 36 percent improvement) in the Build condition.
- In the southbound direction along the I-495 GP lanes, congestion is observed under No Build conditions south of the ALMB and north of Route 267 due to weaving approaching the left-side entrance to the southbound Express Lanes (between Route 193 and Route 267) and downstream right-side exit to westbound DTR, as both of these movements have heavy volumes. This congestion is also worsened in the No Build scenario due to the southbound Maryland managed lanes system terminating near the GWMP interchange, creating a merge that spills back upstream in the GP lanes across the ALMB. This congestion is largely mitigated under Build conditions. The average travel time in the southbound GP lanes improves by nearly 8 minutes (a 49 percent improvement).
- Both directions of the Express Lanes operate at or near the posted speed limit. To travel the length of the corridor via Express Lanes under No Build conditions, vehicles must utilize the congested GP lanes between Route 267 and GWMP as Express Lanes are not present.
- Along eastbound and westbound Route 267 (DTR), travel times are essentially identical between No Build and Build.
- Over the course of the PM peak period, total persons moved along I-495 are forecasted to increase from No Build to Build conditions by between 8 and 37 percent in the northbound direction (see **Figure ES-9**) and between 10 and 47 percent in the southbound direction (see **Figure ES-10**), depending upon location along the corridor.
- Arterial intersection operations see an improvement under Build conditions, as the percentage of intersections operating at failing conditions drops from 43 percent (No Build) to 33 percent (Build), and more than half of all intersections are LOS D or better in the Build condition, while only 33 percent are at LOS D or better in the No Build condition. Most of the failing intersections are in the Tysons area and see continued growth in demand tied to commercial and residential growth in Tysons.

Table ES-3 presents an overall performance comparison table for the Build alternative versus the No Build alternative for 2025 PM conditions. The table shows that the Build alternative improves overall operations along the I-495 corridor given the improvement in travel times, reduction in congestion, and increase in persons moved. Arterial operations are also shown to improve in the PM peak hour under the Build alternative.

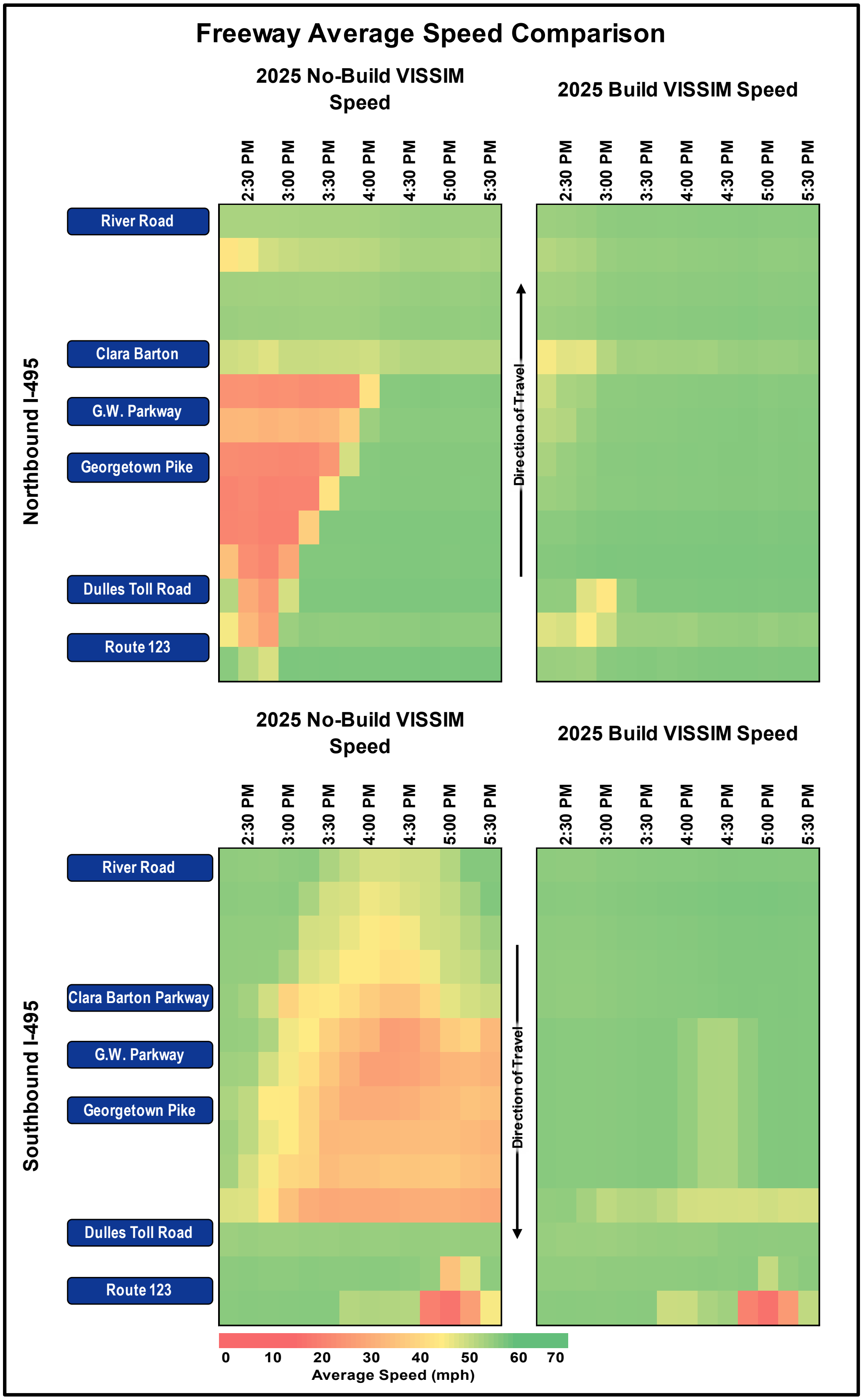


Figure ES-8. 2025 No Build and Build – PM Peak Period Average Speeds, I-495 GP Lanes

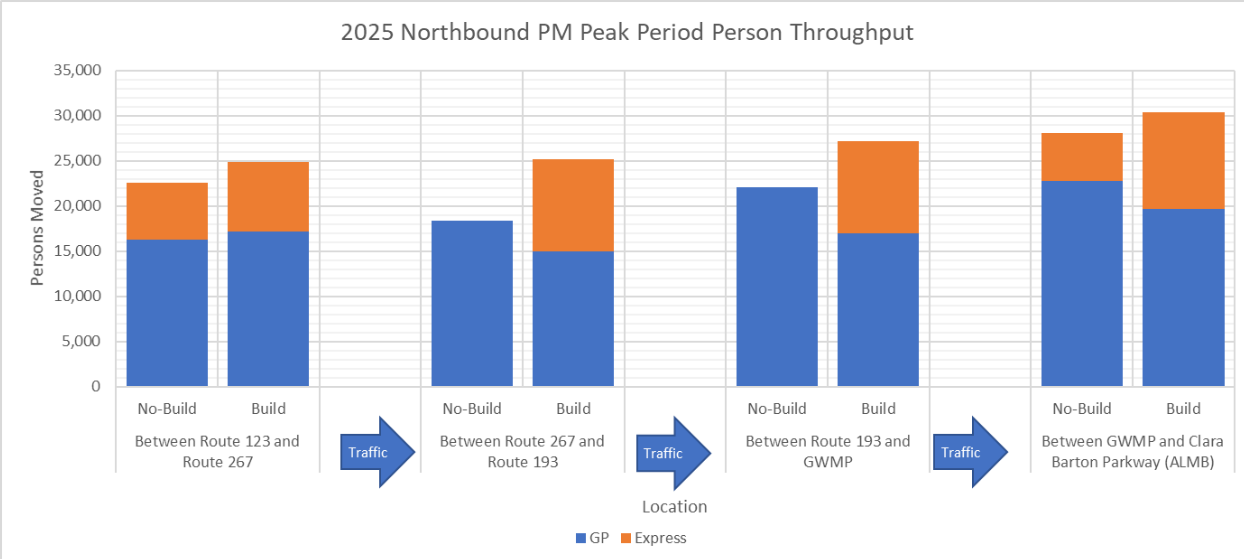


Figure ES-9. 2025 No Build and Build – PM Peak Period Person Throughput, I-495 Northbound

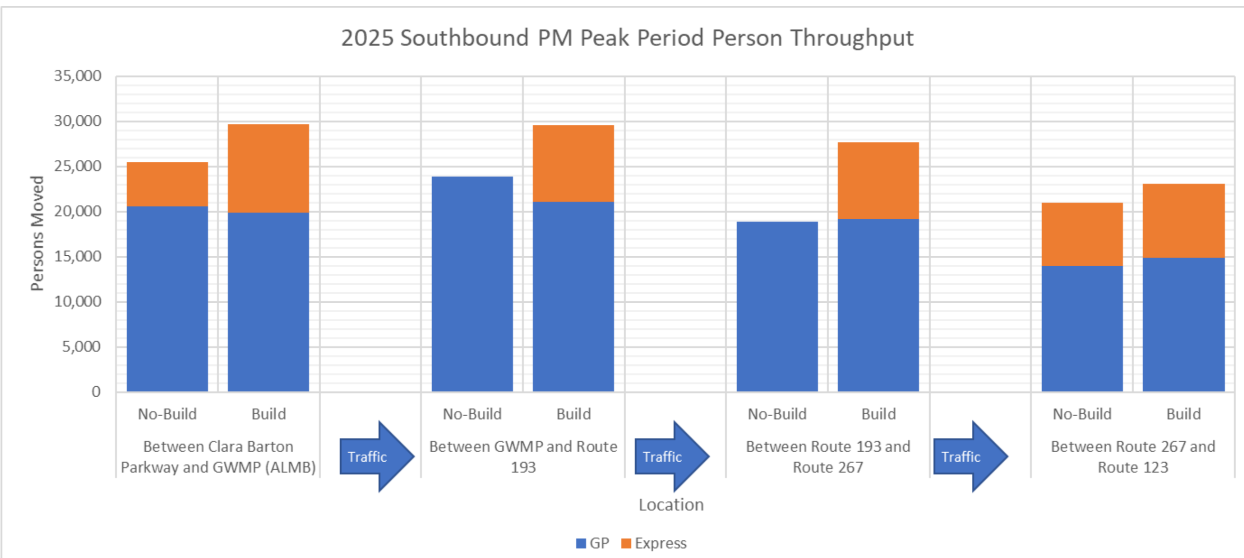
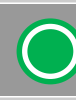
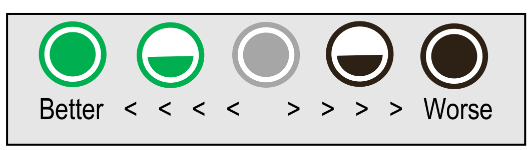


Figure ES-10. 2025 No Build and Build – PM Peak Period Person Throughput, I-495 Southbound

Table ES-3. Overall Performance Comparison for 2025 PM No Build and Build Alternative

Measure of Effectiveness	Description	Facility	2025 AM No Build Value	2025 AM Build Value	Build Performance Compared to No Build
Travel Times	End-to-end travel time along the facility through the Traffic Operations Study Area, measured in Minutes	I-495 NB GP	11	7	
		I-495 NB Express	8	6	
		I-495 SB GP	16	8	
		I-495 SB Express	8	6	
		Dulles Toll Road EB	2	2	
		Dulles Toll Road WB	2	2	
Extent and Duration of Congestion	Visual assessment of freeway mainline queue length and duration of congestion	I-495 NB GP			
		I-495 SB GP			
Person Throughput	Additional persons moved during peak period of Build condition and percentage increase	I-495 NB (All)	+6,800 (37%)		
		I-495 SB (All)	+8,800 (47%)		
Arterial Operations	Number of intersections operating at LOS F	Entire Study Area	12	10	
	Number of intersections operating at LOS D or better		13	17	



2045 AM Peak Period Summary

- Total demand along I-495 (GP plus Express) is forecasted to increase in the Build scenario along the length of the I-495 corridor. The greatest increases in demand are in the segments between Route 267 and GWMP, where Express Lanes are only present in the Build scenario and thus represent a substantial capacity increase from No Build conditions. Peak hour volumes are forecasted to increase in the Build scenario by between 3 to 11 percent in the northbound direction and between 4 to 6 percent in the southbound direction.
- **Figure ES-11** provides a "heat map" comparison of average speeds between 2045 No Build and Build conditions for the AM peak period along the I-495 GP lanes. Time of day during the peak period is provided on the horizontal axis while location along the corridor is provided along the vertical axis; the colors signify average speeds for each scenario. The figure indicates a more significant presence of congestion in the No Build scenario in both directions of the I-495 GP lanes as compared to the Build scenario.
- In the northbound direction along the I-495 GP lanes, congestion is observed under No Build conditions between Route 267 and Clara Barton Parkway (across the ALMB) due to heavy merging and weaving volumes on and near the bridge. Under Build conditions, a significant reduction in congestion is observed due to the additional capacity provided by the Express Lanes and the reduced weaving due to the continuity of the Express Lanes. The average travel time in the northbound GP lanes improves by approximately 4 minutes (a 33 percent improvement) in the Build condition.
- In the southbound direction along the I-495 GP lanes, severe congestion is observed under No Build conditions north of Route 193 through the northern extents of the Traffic Operations Study Area due to queue spillback from the merge at the southern Terminus of the Maryland managed lanes system. This congestion is significantly alleviated under Build conditions. The average travel time in the southbound GP lanes improves by nearly 9 minutes (a 54 percent improvement).
- Both directions of the Express Lanes operate at or near the posted speed limit, with the exceptions of the termini segments in the No Build conditions due to the merge of the Express Lanes into the GP lanes. To travel the length of the corridor via Express Lanes under No Build conditions, vehicles must utilize the congested GP lanes between Route 267 and GWMP, as Express Lanes are not present.
- Along eastbound Route 267 (DTR) there is 75 percent improvement in travel time. With the improved operations along northbound I-495, the ramp from eastbound DTR to northbound I-495 does not spill back to eastbound DTR, improving operations along eastbound DTR. Travel times along the westbound DTR remain unchanged.
- Over the course of the AM peak period, total persons moved along I-495 are forecasted to increase from No Build to Build conditions by between 6 and 33 percent in the northbound direction (see **Figure ES-12**) and between 29 and 35 percent in the southbound direction (see **Figure ES-13**), depending upon location along the corridor.
- Arterial intersection operations see an improvement under Build conditions, as the percentage of intersections operating at failing conditions drops from 33 percent (No Build) to 29 percent (Build), and more than half of all intersections are LOS D or better in the Build condition, while only 48 percent are at LOS D or better in the No Build condition. Most of the failing intersections are in the Tysons area and see continued growth in demand tied to commercial and residential growth in

Tysons. Improved arterial operations are observed along Route 193, most notably at the intersection with Balls Hill Road, where the northbound approach sees a significant improvement in operations.

Table ES-4 presents an overall performance comparison table for the Build alternative versus the No Build alternative for 2045 AM conditions. The table shows that the Build alternative improves overall operations along the I-495 corridor given the improvement in travel times, reduction in congestion, and increase in persons moved.

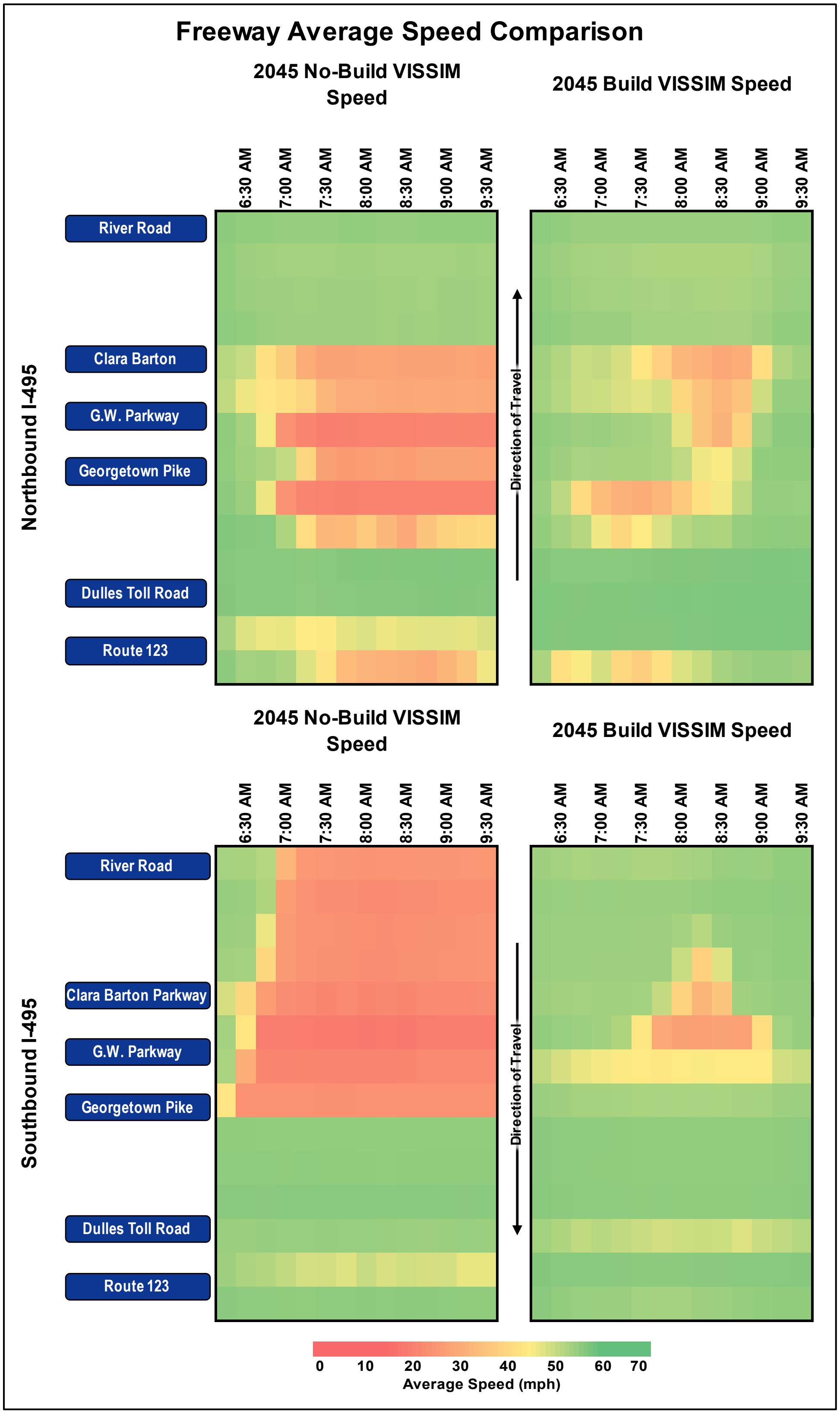


Figure ES-11. 2045 No Build and Build – AM Peak Period Average Speeds, I-495 GP Lanes

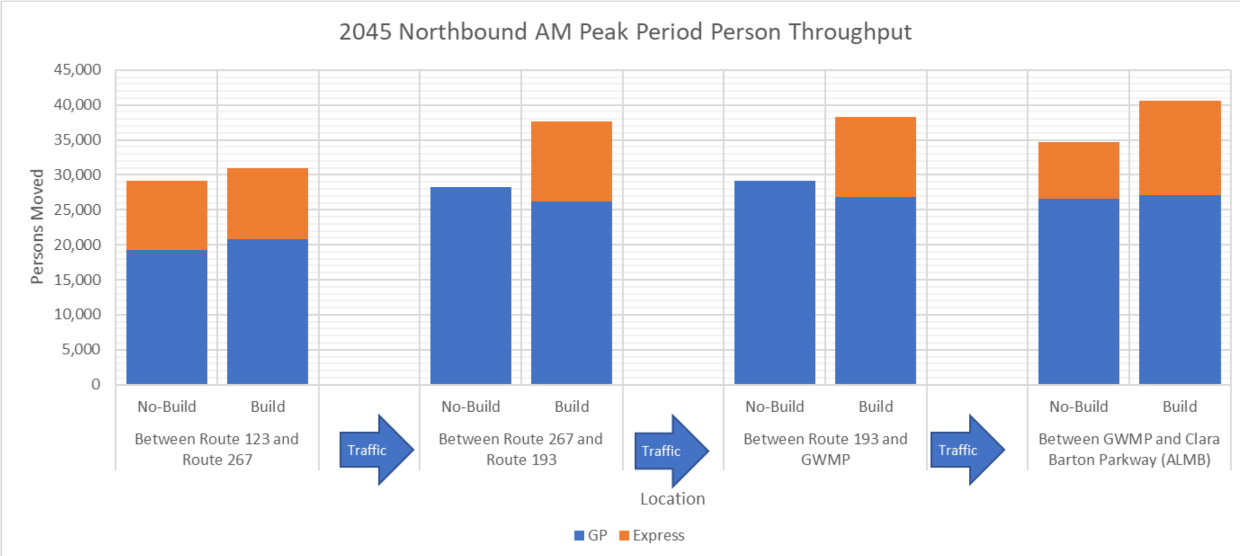


Figure ES-12. 2045 No Build and Build – AM Peak Period Person Throughput, I-495 Northbound

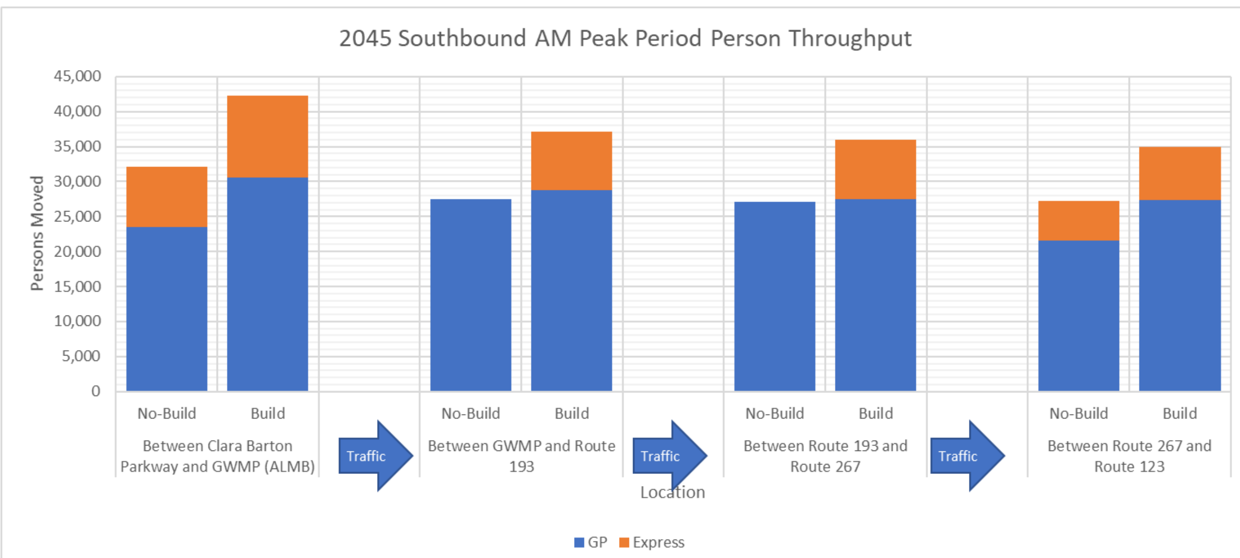
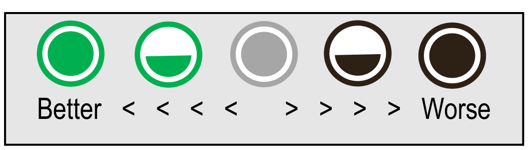


Figure ES-13. 2045 No Build and Build – AM Peak Period Person Throughput, I-495 Southbound

Table ES-4. Overall Performance Comparison for 2045 AM No Build and Build Alternative

Measure of Effectiveness	Description	Facility	2025 AM No Build Value	2025 AM Build Value	Build Performance Compared to No Build
Travel Times	End-to-end travel time along the facility through the Traffic Operations Study Area, measured in Minutes	I-495 NB GP	12	8	
		I-495 NB Express	10	6	
		I-495 SB GP	16	8	
		I-495 SB Express	8	6	
		Dulles Toll Road EB	7	2	
		Dulles Toll Road WB	2	2	
Extent and Duration of Congestion	Visual assessment of freeway mainline queue length and duration of congestion	I-495 NB GP			
		I-495 SB GP			
Person Throughput	Additional persons moved during peak period of Build condition and percentage increase	I-495 NB (All)	+9,300 (33%)		
		I-495 SB (All)	+9,600 (35%)		
Arterial Operations	Number of intersections operating at LOS F	Entire Study Area	10	10	
	Number of intersections operating at LOS D or better		16	20	



2045 PM Peak Period Summary

- Total demand along I-495 (GP plus Express) is forecasted to increase in the Build scenario along the length of the I-495 corridor. The greatest increases in demand are in the segments between Route 267 and GWMP, where Express Lanes are only present in the Build scenario and thus represent a substantial capacity increase from No Build conditions. Peak hour volumes are forecasted to increase in the Build scenario by between 3 to 20 percent in the northbound direction and between 7 to 12 percent in the southbound direction.
- **Figure ES-14** provides a "heat map" comparison of average speeds between 2045 No Build and Build conditions for the PM peak period along the I-495 GP lanes. Time of day during the peak period is provided on the horizontal axis while location along the corridor is provided along the vertical axis; the colors signify average speeds for each scenario. The figure indicates a more significant presence of congestion in the No Build scenario in both directions of the I-495 GP lanes as compared to the Build scenario. In the northbound direction, congestion remains in the Build scenario, but the extent and duration is lessened as compared to the No Build scenario.
- In the northbound direction along the I-495 GP lanes, severe congestion is observed under No Build conditions spilling back from the ALMB through the Route 267 interchange and essentially through the extents of the Traffic Operations Study Area; this congestion is worsened by spillback from the northbound GP lanes in Maryland later in the peak period, creating a single continuous area of congestion through the corridor. In the Build condition, the congestion in Maryland remains generally unchanged, but the extent of the queue spillback and duration on the Virginia side, especially south of Route 193, is not as significant as the No Build condition. This is attributable to the additional capacity provided by the Express Lanes and reduced weaving due to the continuity of the Express Lanes system. The average travel time in the northbound GP lanes improves by approximately 4.5 minutes (a 16 percent improvement) in the Build condition.
- In the southbound direction along the I-495 GP lanes, severe congestion is observed under No Build conditions north of Route 193 through the northern extents of the Traffic Operations Study Area due to queue spillback from the merge at the southern Terminus of the Maryland managed lanes system. This congestion is significantly alleviated under Build conditions. The average travel time in the southbound GP lanes improves by approximately 7.5 minutes (a 49 percent improvement).
- Both directions of the Express Lanes operate at or near the posted speed limit, with the exceptions of the termini segments in the No Build conditions due to the merge of the Express Lanes into the GP lanes. To travel the length of the corridor via Express Lanes under No Build conditions, vehicles must utilize the congested GP lanes between Route 267 and GWMP as Express Lanes are not present.
- Along eastbound and westbound Route 267 (DTR), travel times are essentially identical between No Build and Build.
- Over the course of the PM peak period, total persons moved along I-495 are forecasted to increase from No Build to Build conditions by between 10 and 35 percent in the northbound direction (see **Figure ES-15**) and between 16 and 32 percent in the southbound direction (see **Figure ES-16**), depending upon location along the corridor.
- Arterial intersection operations see an improvement under Build conditions, as the percentage of intersections operating at failing conditions drops from 43 percent (No Build) to 33 percent (Build), and 46 percent of intersections are LOS D or better in the Build condition, while only 33 percent are at LOS D or better in the No Build condition. Most of the failing intersections are in the Tysons

area and see continued growth in demand tied to commercial and residential growth in Tysons. Along Route 193, the signalized intersections all operate at LOS E or better under No Build and Build conditions; in the Build condition, a significant improvement in operations is realized along the northbound approach from Balls Hill Road at Route 193, which is failing under No Build conditions.

Table ES-5 presents an overall performance comparison table for the Build alternative versus the No Build alternative for 2045 PM conditions. The table shows that the Build alternative improves overall operations along the I-495 corridor given the improvement in travel times, reduction in congestion, and increase in persons moved. Arterial operations are also shown to improve in the PM peak hour under the Build alternative.

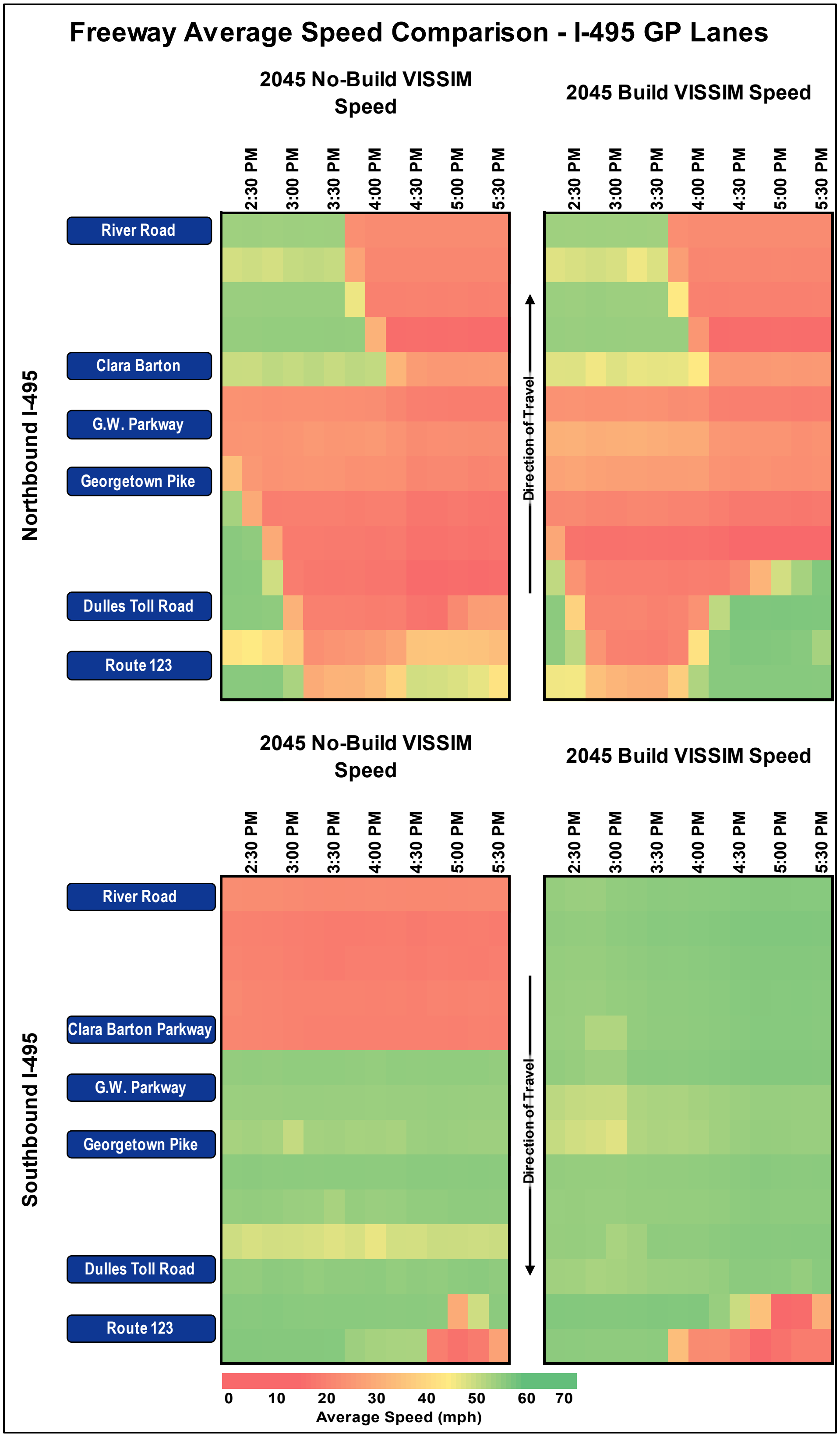


Figure ES-14. 2045 No Build and Build – PM Peak Period Average Speeds, I-495 GP Lanes

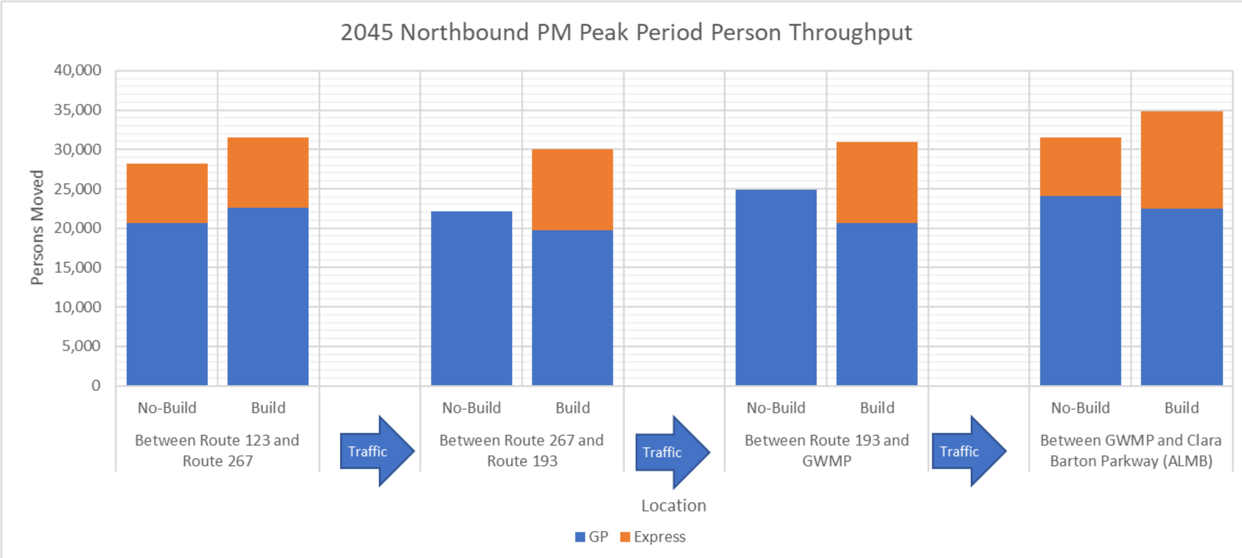


Figure ES-15. 2045 No Build and Build – PM Peak Period Person Throughput, I-495 Northbound

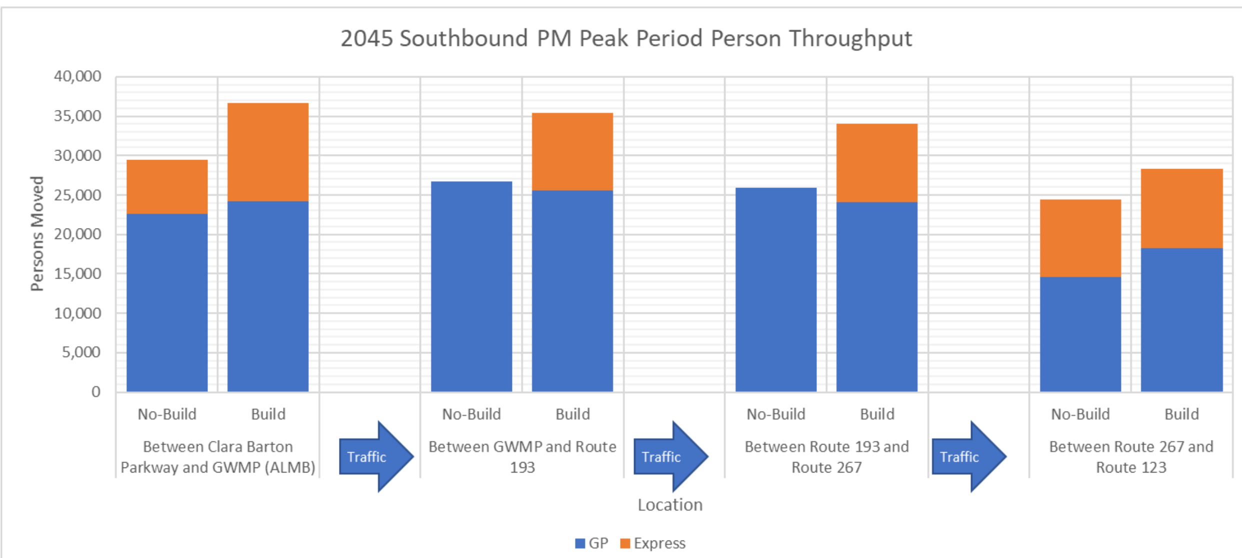
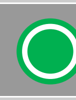
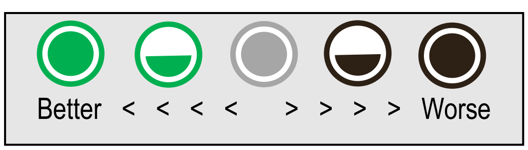


Figure ES-16. 2045 No Build and Build – PM Peak Period Person Throughput, I-495 Southbound

Table ES-5. Overall Performance Comparison for 2045 PM No Build and Build Alternative

Measure of Effectiveness	Description	Facility	2025 AM No Build Value	2025 AM Build Value	Build Performance Compared to No Build
Travel Times	End-to-end travel time along the facility through the Traffic Operations Study Area, measured in Minutes	I-495 NB GP	28	24	
		I-495 NB Express	16	6	
		I-495 SB GP	15	8	
		I-495 SB Express	7	6	
		Dulles Toll Road EB	2	2	
		Dulles Toll Road WB	2	2	
Extent and Duration of Congestion	Visual assessment of freeway mainline queue length and duration of congestion	I-495 NB GP			
		I-495 SB GP			
Person Throughput	Additional persons moved during peak period of Build condition and percentage increase	I-495 NB (All)	+7,800 (35%)		
		I-495 SB (All)	+8,700 (32%)		
Arterial Operations	Number of intersections operating at LOS F	Entire Study Area	11	10	
	Number of intersections operating at LOS D or better		14	18	



ES.3.5 Existing and Future Conditions Safety Analysis

Existing Conditions Crash History

Over the five-year period analysis period (2013-2017), there were a total of 1,736 crashes reported on the 4.6-mile section of I-495 (northbound and southbound) between the Route 7 interchange and the ALMB over the Potomac River. This section of I-495 includes the I-495 GP lanes, approximately 2.85 miles of the I-495 Express Lanes between Route 7 and the current northern terminus north of the Dulles Toll Road interchange, and approximately 22 ramps to and from I-495. During this five-year period, there were no fatal crashes, 455 injury crashes, and 1,281 property damage only (PDO) crashes reported in the freeway corridor.

Of the 1,736 of crashes reported within the study area between 2013 and 2017, the predominant crash type along the I-495 corridor is Rear-End-type crashes. Approximately 59 percent of all crashes were Rear-End collisions, compared to 22 percent Side-Swipe (same direction) crashes, 8 percent Angle crashes, 8 percent Run-Off-Road crashes, and 3 percent Other crashes.

Northbound I-495 GP Lanes

The crash rate for northbound I-495 from Route 7 to the ALMB is worse than the southbound crash rate between the same termini. Moreover, the crash rate for this northbound section is approximately 100 percent higher than the statewide crash rate. The injury crash rate is 25 percent higher than the statewide injury crash rate. The predominant type of crashes in the northbound GP lanes are Rear-End and Same-Direction Side-Swipe crashes. Traffic congestion in the study area significantly influences the safety conditions. Rear-End and Side-Swipe crashes tend to typically be prominent in congested corridors.

The following three segments of I-495 experience the highest number of Rear-End crashes:

- Northbound I-495 from Route 267 to Route 193, with 145 crashes;
- Northbound I-495 from the off-ramp to Route 193 to the on-ramp from Route 193, with 67 crashes
- Northbound I-495 from the off-ramp to GWMP to the on-ramp from GWMP, with 60 crashes.

Northbound I-495 Express Lanes

Compared to the statewide average crash rates from 2013 through 2017 for interstate facilities within Virginia, the crash rate for the northbound Express Lanes section of I-495, exclusive of the existing northern terminus and the transition section to the GP lanes, was approximately 17 percent lower. The injury crash rate is 71 percent lower than the statewide injury crash rate. This can be attributed to the reduced congestion and improved level of service offered to commuters using the Express Lanes.

Southbound I-495 GP Lanes

Compared with the statewide average crash rates from 2013 through 2017 for interstate facilities within Virginia, the southbound section of I-495 between the ALMB and Route 7 exhibited an approximately 11 percent lower crash rate. The injury crash rate is 42 percent lower than the statewide injury crash rate. The predominant types of crashes in the southbound GP lanes are Rear-End and Same-Direction Side-Swipe crashes. This implies that, in addition to the congestion, merging and lane-changing maneuvers executed influence traffic safety in the study area.

Southbound I-495 Express Lanes

Compared with the statewide average crash rates from 2013 through 2017 for interstate facilities within Virginia, the southbound Express Lanes section of I-495 exhibited an approximately 27 percent lower crash rate. The injury crash rate is 55 percent lower than the statewide injury crash rate. This can again be attributed to the reduced congestion and improved level offered to commuters using the Express Lanes.

Route 267

During the data collection period, there were 181 reported crashes on the Dulles Toll Road/Dulles Connector Road (DTR/DCR) mainline, 61 crashes reported on the eastbound ramps to I-495, and 10 crashes reported on the westbound off-ramp to I-495 northbound.

From the analysis, five "Hot Spots" were identified which in total account for 44 percent of crashes along the DTR/DCR study area:

- Hot Spot 1: westbound approach to the DTR mainline toll plaza
- Hot Spot 2: westbound weave area between the I-495 and Spring Hill interchanges
- Hot Spot 3: diverge area of the eastbound DTR exit ramps to I-495
- Hot Spot 4: eastbound weave area between the on-ramp from southbound I-495 and off-ramps to Route 123
- Hot Spot 5: diverge area along the eastbound DTR ramps to I-495 where drivers must properly lane position for the exit onto either northbound or southbound I-495

GWMP

Crash data obtained from NPS indicates two primary areas of significant crash activity: the ramps to and from the Turkey Run turnaround and the gore area for westbound GWMP to the I-495 ramps. The crash frequency of the Turkey Run Ramps is likely due to limited geometrics and very short acceleration and deceleration lanes. The crash activity at the gore area may be due to late lane changes or unsafe diverging maneuvers by motorists.

Future Conditions Crash Predictions

In **Table ES-6**, the crash frequency results from the 2025 No Build and Build conditions are compared with the crash frequency results from the 2045 No Build and Build conditions. These numbers represent the total predicted crashes in the Traffic Operations Study Area, including GP lanes, Express Lanes, and arterials. The total number of predicted crashes per year is anticipated to decrease in the 2045 No Build case compared to the 2025 No Build case due to CLRP improvements included within the study area (including the Maryland Traffic Relief Plan). Similarly, the total number of predicted crashes per year is anticipated to decrease in the 2045 Build case compared to the 2025 Build case.

For the 2025 No Build and Build scenarios, no improvements to I-495 on the Maryland side of the Potomac River (the Maryland Traffic Relief Plan) were assumed to be included. This represents a conservative (worst-case) assessment of safety conditions for 2025. The improvements to I-495 on the Maryland side of the river were assumed to be in place for both No Build and Build conditions for 2045.

Table ES-6. Total I-495 Traffic Operations Study Area Predicted Crash Frequency Summary

Year	Scenario	Total General Purpose, Express, and Arterial Intersection Predicted Crash Frequency (crashes/year)		
		KABC	PDO	Total
2025	No Build	278.1	583.3	861.4
	Build	280.2	588.2	868.4
2045	No Build	254.9	563.2	818.1
	Build	226.8	426.1	652.9

Under analyzed 2025 conditions, the Build condition has positive safety impacts on the I-495 corridor as well as the surrounding arterial network as compared to No Build conditions by improving throughput and reducing congestion in both directions of the I-495 corridor. However, if no improvements are constructed or undertaken in Maryland at the Express Lanes northern terminus of the I-495 NEXT project, it is anticipated there will be some potential safety concerns by introducing additional merge and diverge conflicts into the currently congested area of the GWMP and ALMB.

For 2045 conditions, the Build condition produces significant overall safety benefits as compared to No Build conditions by efficiently moving a greater volume of traffic with significantly reduced congestion in both directions of the I-495 corridor. With the full Express Lanes network extended into Maryland, it is anticipated that the corridor will operate at a much-improved level of safety as compared to No Build conditions. Comprehensively, the project is a significant improvement in overall safety.

CHAPTER 1.0 INTRODUCTION AND ORGANIZATION

The Virginia Department of Transportation (VDOT), in coordination with the Federal Highway Administration (FHWA) as the lead federal agency, is evaluating an extension of the Interstate 495 (I-495) Express Lanes along approximately three miles of I-495, also referred to as the Capital Beltway, from their current northern terminus in the vicinity of the Old Dominion Drive overpass to the George Washington Memorial Parkway (GWMP) in the McLean area of Fairfax County, Virginia. The project location is shown in the vicinity map in **Figure 1-1**. Pursuant to the National Environmental Policy Act (NEPA) of 1969, as amended, and in accordance with FHWA regulations[1], an Environmental Assessment (EA) is being prepared to analyze the potential social, economic, and environmental effects associated with the improvements being evaluated. As part of the EA being prepared, VDOT is evaluating in detail the environmental consequences of the No Build Alternative and one Build Alternative.

To support the EA, the purpose of this Traffic and Transportation Technical Report is to document:

- Existing traffic operations and safety conditions within the study area.
- Forecasted traffic volumes for future scenarios under No Build and Build conditions.
- Technical analysis and information in support of the development of alternatives.
- Traffic data needed for noise and air quality analysis to support the NEPA efforts.
- Future traffic operations and safety conditions under No Build and Build scenarios.

1.1 PROJECT LIMITS

The project extends from approximately south of the Dulles Toll Road / Route 267 interchange to the GWMP in the vicinity of the American Legion Memorial Bridge (ALMB). Although the proposed lanes would terminate at the GWMP, and the interchange provides a logical northern terminus for this study, additional improvements are anticipated to extend approximately 0.3 miles north of the GWMP to provide a tie-in to the existing road. The project also includes access ramp improvements and lane reconfigurations along portions of the Dulles Toll Road and the Dulles International Airport Access Highway, on either side of the Capital Beltway, from the Spring Hill Road Interchange to the Route 123 interchange. The proposed improvements entail new and reconfigured express lane ramps and general purpose lane ramps at the Dulles Interchange and tie-in connections to the Route 123/I-495 interchange. The project has independent utility since it would provide a usable facility and be a reasonable expenditure of funds even if no additional transportation improvements in the area are made.

1.2 STUDY AREA

In order to assess and document relevant resources that may be affected by the proposed project, the study area for the EA extends beyond the immediate area of the proposed improvements described above. The study area for the EA includes approximately four miles along I-495 between the Route 123 interchange and the ALMB at the Maryland state line. The study area also extends approximately 2,500 feet east along the GWMP. Intersecting roadways and interchanges are also included in the study area, as well as adjacent areas within 600 feet of the existing edge of pavement**.** The study area is a buffer around the road corridor

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[1] NEPA and FHWA's regulations for Environmental Impact and Related Procedures can be found at 42 USC § 4332(c), as amended, and 23 CFR § 771, respectively.

that includes all natural, cultural, and physical resources that are analyzed in the EA. It does not represent the limits of disturbance (LOD) of the project nor imply right-of-way acquisition or construction impact, but rather extends beyond the project footprint to tie into the surrounding network, including tying into future network improvements. **Figure 1-2** depicts the project termini, study area, and LOD.

The existing I-495 facility within the study area currently has four northbound and four southbound general purpose (GP) lanes, supplemented in several locations by auxiliary lanes[2], acceleration/deceleration lanes at on- and off-ramps, and collector-distributor (C-D) roadways[3]. Grade-separated interchanges provide access to and from I-495 and the Jones Branch Connector; Chain Bridge Road (Route 123); the Dulles Toll Road (DTR), Dulles Airport Access Road (DAAR), and Dulles Connector Road (DCR), collectively referred to as Route 267; Georgetown Pike (Route 193); and the GWMP. North of the study area, I-495 at the ALMB is a total of 10 lanes, including eight GP through lanes and two auxiliary lanes that connect to Clara Barton Parkway in Maryland and the GWMP in Virginia.

The southbound entrance onto the existing I-495 Express Lanes and northbound exit from the I-495 Express Lanes occur within the study area, approximately 2,000 feet south of Old Dominion Drive, as shown in **Figure 1-2**. Drivers are permitted to use the northbound inside shoulder of the GP lanes during peak travel periods (6 AM - 11 AM and 2 PM - 8 PM Mon - Fri). The shoulder lane terminates by merging into the GP lanes just before reaching the GWMP interchange. All buses and vehicles with two axles can access the I-495 Express Lanes 24 hours a day, seven days a week. The I-495 Express Lanes operate as high-occupancy toll (HOT) lanes where vehicles with three or more occupants are not charged a toll. Trucks are currently prohibited from using the I-495 Express Lanes.

The southern portion of the study area surrounding the Route 267 interchange is surrounded by high-density commercial and residential development associated with the Tysons area. The study area between the Route 267 interchange and GWMP is comprised of suburban neighborhoods and supporting recreational areas that border the interstate, with direct access to I-495 limited to Route 193. North of the GWMP approaching the Maryland state line at the ALMB over the Potomac River is primarily open federal parkland associated with the GWMP to the east and Scotts Run Nature Preserve to the west.

The extended study areas for traffic operations and safety analysis are discussed in detail in **Chapter 2**.

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[2] An auxiliary lane is defined by the American Association of State Highway and Transportation Officials (AASHTO) as the portion of the roadway adjoining the traveled way for speed change, turning, weaving, truck climbing, maneuvering of entering and leaving traffic, and other purposes supplementary to through-traffic movement. Auxiliary lanes are used to balance the traffic load and maintain a more uniform level of service on the highway. They facilitate the positioning of drivers at exits and the merging of drivers at entrances (AASHTO, 2018).

[3] Collector-distributor (C-D) roadways are supplemental facilities parallel to freeway mainlines that serve primarily to move weaving and lane-changing associated with closely-spaced on- and off-ramps away from the freeway mainline. C-D roadways are typically located at freeway interchanges where ramp-to-ramp weaving occurs or where closely-spaced major arterials are present and there is minimal room for multiple freeway mainline entrance and exit ramps.

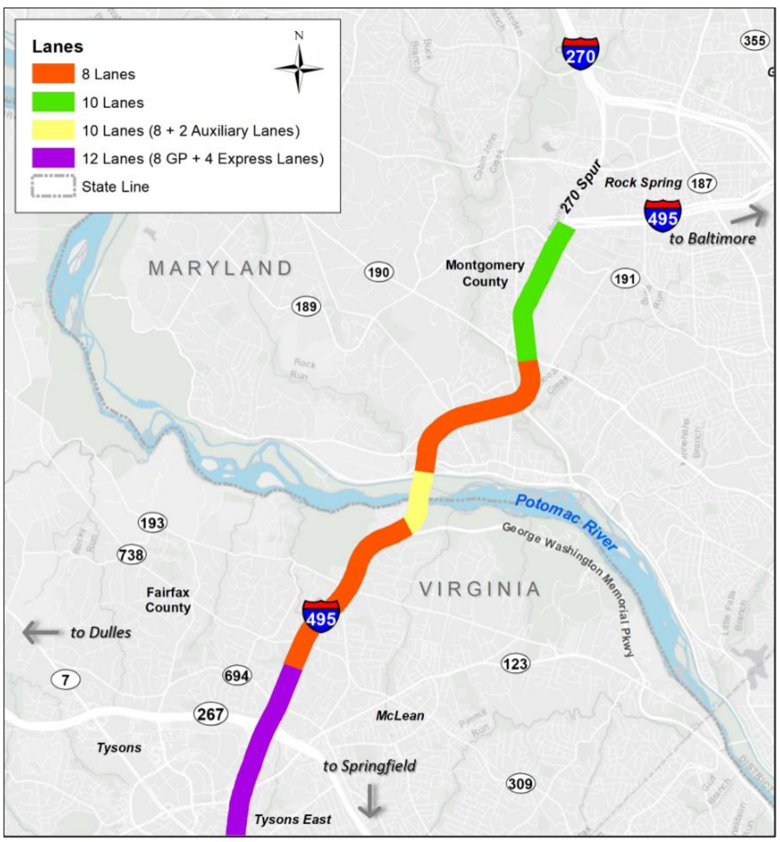
Figure 1-1. I-495 Express Lanes Northern Extension Project Vicinity

Figure 1-2. I-495 Express Lanes Northern Extension Project Limits

1.3 HISTORY OF I-495 AND PROJECT HISTORY

I-495 (also known as the Capital Beltway) is a 64-mile, multi-lane, circumferential freeway centered around Washington, D.C. and passing through Maryland and Virginia. The Virginia portion of I-495 is 22 miles, extending from the Woodrow Wilson Bridge in the City of Alexandria to the ALMB in Fairfax County.

Initial planning for I-495 began in 1950 with the publication of the 1950 Comprehensive Plan for the Washington area (NCPPC, 1952). Construction of I-495 began in 1957 and was completed in 1964. Originally, I-495 consisted of six lanes for most of its length except for 14.5 miles between the northern Potomac crossing (now the ALMB) and Interstate 95 (I-95) in Springfield, which was four lanes. Since its completion in 1964, many modifications and improvements have been implemented, such as the addition of lanes, construction or modification of interchanges, and safety improvements. In 1977, the Virginia side of I-495 was widened from four to eight lanes up to Route 193 (Georgetown Pike). In 1992, a portion of I-495 between Route 193 and the Interstate 270 (I-270) spur in Maryland was widened to eight lanes, and the ALMB was widened to 10 lanes (eight through lanes and two auxiliary lanes), as shown in **Figure 1-3**.



Service Layer Credits: Esri, HERE, Garmin, © OpenStreetMap contributors, and the GIS user community

Figure 1-3. Current I-495 Lane Segments

In January 1997, a Major Investment Study (MIS) was completed to evaluate a range of strategies for dealing with transportation deficiencies along the Capital Beltway corridor. The conclusion of the MIS was that highway improvements promoting high-occupancy vehicle (HOV) use, such as designated, non-tolled HOV lanes for vehicles with at least three occupants, would be the most effective transportation investment to serve current and future travel demand on the Capital Beltway (VDOT/FHWA, 2006).

In 1998, following the completion of the MIS, FHWA and VDOT launched preliminary location and environmental studies to evaluate the recommended improvements to the Capital Beltway, including widening for the addition of HOV lanes. Initially, an EA was prepared to determine if preparation of an Environmental Impact Statement (EIS) would be warranted. FHWA and VDOT subsequently determined that due to the large footprint of the project and the potential for environmental consequences, an EIS would be necessary. A Notice of Intent to prepare an EIS was published in the *Federal Register* in June 2000 (VDOT/FHWA, 2006).

FHWA and VDOT prepared the Capital Beltway Study Draft EIS in 2002 to evaluate the expansion and reconfiguration of I-495 from the ALMB to the I-95/I-495/I-395 interchange in Springfield. Initially, only HOV alternatives were proposed: the Concurrent HOV Alternative, in which one HOV lane would be added in each direction with no additional GP lanes; the Express/Local with HOV Alternative, which would separate short- and long-distance trips and provide one HOV lane in each direction; and the Barrier-Separated HOV Alternative, which would provide 12 through lanes in a 4-2-2-4 configuration, with four outer GP lanes and two barrier-separated inner HOV lanes in each direction. In addition, options for interchange configurations and direct access points for HOV traffic to the HOV lanes were evaluated for each alternative. During the public comment period for the Draft EIS, the alternatives were met with opposition from local governments and the general public due to excessive right-of-way acquisition and the displacement of as many as 294 residential properties (VDOT/FHWA, 2006).

Following publication of the Capital Beltway Study Draft EIS in March 2002, VDOT received a proposal pursuant to the Virginia Public-Private Transportation Act (PPTA), which allows for private entities to solicit VDOT to develop and/or operate and maintain transportation facilities that VDOT determines demonstrate a public need and benefit. The PPTA proposal included a plan to add four HOT lanes to 14.5 miles of I-495 between the existing GP lanes from the ALMB to the I-95/I-495/I-395 interchange in Springfield. This option required less right-of-way than the alternatives in the Draft EIS and would substantially reduce relocation impacts. Based on comments received on the Draft EIS and following the submittal of the PPTA proposal for HOT lanes, the three original Build Alternatives and interchange options were substantially revised and re-evaluated with both HOV and HOT lane options, resulting in six "refined" alternatives. Two of these refined alternatives were chosen for further development and more detailed study: the 12-Lane HOT / Managed Lanes Alternative, developed from the Barrier-Separated HOV Alternative presented in the Draft EIS; and a Revised 10-Lane Concurrent HOV Alternative. In January 2005, the Commonwealth Transportation Board (CTB) selected the 12-Lane HOT / Managed Lanes Alternative as the Preferred Alternative to be carried forward in the Final EIS (VDOT/FHWA, 2006). The Final EIS was completed and published in April 2006. FHWA issued a Record of Decision (ROD) in June 2006, approving the selection of the 12-Lane HOT / Managed Lanes Alternative as the Selected Action (FHWA, 2006).

In May 2007, it was determined that a change in the northern project limits was necessary to allow for a transition area between the entrance/exit to the HOT lanes and the ALMB (VDOT, 2007). A NEPA re-evaluation and an Interchange Justification Report (IJR) were completed in 2007 to include design updates and related impacts, and to modify the northern terminus of the HOT lanes from the ALMB to the current terminus south of Old Dominion Drive. Other NEPA re-evaluations were completed in June 2008, December 2008, May 2009, and July 2009 to account for minor design refinements.

Construction of the I-495 Express Lanes commenced in 2008, and the I-495 Express Lanes opened to traffic in November 2012.

In 2009, while construction was underway for the I-495 Express Lanes, the Metropolitan Washington Airports Authority (MWAA) developed the Dulles Interchange Long-Range Plan for the I-495/Route 267 interchange to determine what, if any, changes to the then-current plan for the interchange under the I-495 Express Lanes project may be necessary to accommodate other future interchange improvements. The Long-Range Plan determined that up to 11 additional ramp movements would be necessary to improve I-495 connections to and from the DAAR and DTR. VDOT in partnership with MWAA signed a Memorandum of Understanding (MOA) in May 2009 to incorporate three of these additional ramps into the I-495 Express Lanes project. Specifically, these ramps provided movements for southbound I-495 GP lanes to westbound DAAR; eastbound DAAR to southbound I-495 GP; and eastbound DAAR to northbound I-495 GP (VDOT/MWAA, 2009). A NEPA Re-evaluation of the Capital Beltway Study EIS was conducted, and the additional ramps were found to be consistent with the findings of the Final EIS (FHWA, 2009). An IJR for the Dulles Interchange was prepared and approved in December 2009 (VDOT, 2009). The ramps were constructed as part of the I-495 Express Lanes project and opened to traffic in September 2012.

1.4 PURPOSE AND NEED

The purpose and need for the extension of Express Lanes on I-495 between Route 267 and the GWMP is to:

- **Reduce congestion** – Regional travel demand forecasting shows increased traffic volumes and travel demands as population and employment continue to grow within the region;
- **Provide additional travel choices** – Access to high-occupancy travel modes encourages drivers to choose alternatives to single-occupancy travel as well as provides an option to single-occupancy drivers to use the Express Lanes, freeing up capacity on the GP lanes, and the addition of north-south pedestrian and bike facilities, which are currently lacking, improves travel choice; and
- **Improve travel reliability** – Duration and extent of congestion is expected to increase along with population and employment growth resulting in the need for commuters to spend additional time traveling to work. Travel times in the GP lanes are expected to continue to be increasingly unreliable, with median peak period travel times being several multiples of free-flow travel times and 95th percentile peak period travel times extending much longer. Express Lanes are designed to keep traffic flowing at 45 miles per hour or faster by dynamically adjusting tolls, allowing transit, high-occupancy, and toll-paying vehicles to have a much more reliable trip.

A detailed description of the purpose and need for the proposed project is provided in Chapter 1.0 of the EA.

1.5 REPORT ORGANIZATION

The organization of this report proceeds through the following chapters:

1. **Introduction and Organization**: describes project history, problem statement and study area.
2. **Methodology:** identifies data collection, assumptions, alternative development and scenarios that drive the travel demand forecasting steps, traffic operational analysis, and safety and crash analysis.
3. **Existing Transportation Networks**: presents the transportation infrastructure and options currently available along the corridor.

4. **Existing Traffic Operational Conditions**: provides an understanding of existing traffic and travel patterns as well as the performance of traffic operations. Note that this chapter is a condensed summary of material provided in the supplemental Existing Conditions Technical Report (VDOT, 2020x) associated with the EA.
5. **Background (No Build) Transportation Network:** documents assumptions for background improvements to the transportation network included as elements of future No Build conditions, including future planned projects.
6. **Build Transportation Network:** presents the elements included in the Build Alternative, including phasing of improvements.
7. **Future Scenarios Operational Conditions:** presents the details on the development of future traffic demand for 2025 and 2045 analysis years along with the operational results and findings of No Build and Build scenarios.
8. **Existing and Future Safety and Crash Analysis**: presents the existing conditions safety analysis and crash history as well as an assessment of projected future conditions using quantitative modeling techniques.
9. **References**: provides a list of references for this report.

CHAPTER 2.0 METHODOLOGY

This chapter details the methodology for assessing traffic operations and safety impacts associated with the I-495 NEXT project. It provides an overview of the scenarios, data collection, travel demand forecasting, traffic analysis tools and measures of effectiveness, and safety analysis methodology. It also provides an overview of traffic data prepared for the noise and air quality analysis associated with this project.

This methodology is consistent with and references the *I-495 NEXT Project Scoping Framework Document*, which was published on November 15, 2018 and is provided as **Appendix A**. The project framework document and its supplementary memoranda provide a much more detailed documentation of the methodology summarized in this chapter.

2.1 SCENARIOS AND ASSUMPTIONS

2.1.1 Analysis Years and Scenarios

Traffic operations analysis consisted of an evaluation of existing conditions (2018), No Build conditions (2025 and 2045), and Build conditions (2025 and 2045):

- The existing conditions transportation network is described in detail in **Chapter 3**. Operational analysis results for existing conditions are summarized in **Chapter 4.** An assessment of safety for existing conditions is provided in **Chapter 8.**
- No Build conditions assume the completion of programmed transportation improvements consistent with the regional Constrained Long-Range Plan (CLRP) but without the I-495 Express Lanes Northern Extension project in place. The roadway network associated with these background improvements is described in **Chapter 5**.
- Build conditions assume the incorporation of the project Preferred Alternative, which includes two Express Lanes in each direction along I-495 between Route 267 (Dulles Toll Road) and the GWMP, along with four general purpose (GP) lanes in each direction along the I-495 mainline and an auxiliary lane in each direction between Route 267 and Route 193 (Georgetown Pike). The construction of the Preferred Alternative is assumed to take place in phases, with the most critical components constructed first. The roadway network associated with the Build improvements, including the phasing of these improvements, is described in **Chapter 6**.

Operational analysis results comparing No Build and Build conditions are provided in **Chapter 7**. An assessment of safety for No Build and Build conditions is provided in **Chapter 8**.

Sensitivity Analysis for Future Traffic Operations prior to Maryland Managed Lanes Project

To understand the impacts and operational benefits or constraints of the I-495 NEXT project operations prior to the adjacent Maryland managed lanes system being in place (described in **Chapter 5**), a sensitivity analysis was performed for the 2025 analysis year. This sensitivity analysis included travel demand model runs, traffic volume forecasting, and traffic operations in VISSIM and Synchro. The results of this sensitivity analysis are provided in **Appendix I**.

2.1.2 Roadway Network Scope for Traffic Analysis

Figure 2-1 shows the various components of the project Study Area for the I-495 NEXT project:

- **Yellow – Project Footprint Study Area.** The I-495 NEXT Project Footprint Study Area includes I-495 from the Route 267 interchange to the ALMB, including all ramp termini of interchanges over that section.
- **Blue – Traffic Operations Analysis Study Area.** The Traffic Operations Analysis Study Area includes the full extent of the Project Footprint Study Area as well as one interchange north and south on I-495, and a number of additional intersections and interchanges which directly affect and/or are affected by operations on I-495 within the Project Footprint Study Area.

Figure 2-1: Project Study Area and Traffic Operations Analysis Study Area

2.2 DATA COLLECTION

In support of the project, an extensive data collection effort and subsequent data review was completed during May and June 2018.

- **Traffic counts:** intersection turning movement counts (TMC) and average daily traffic (ADT) counts were collected at 122 locations as shown in **Figure 2-2**.
- **Travel times:** travel time data was collected on the two major freeway corridors within the Study Area: I-495 (northbound and southbound directions; General Purpose lanes only) and Route 267 (eastbound and westbound directions; both Dulles Toll Road (DTR) and Dulles Airport Access Road (DAAR)) as well as select "system-to-system" routes that capture congestion experienced along ramps connecting one facility to another**.**
- **Freeway speeds:** INRIX speeds and travel times for both corridors, including both the existing I-495 Express Lanes south of the Study Area and the DAAR were obtained through RITIS.
- **Queues:** queueing data was collected at targeted critical locations; freeway mainline congestion and queues were reviewed against speed heat maps provided by INRIX and Google Maps' typical traffic.
- **Origin-destination (O-D) data:** O-D, used for routing vehicles through the traffic network within the traffic simulation data, was reviewed from StreetLight Data and Metropolitan Washington Council of Governments (MWCOG), where StreetLight Data was used as the basis for O-D routing for the existing conditions traffic analysis and the MWCOG matrices were used as the basis for vehicle routing in future analysis year scenarios.
- **Signal timings:** Synchro models, provided by VDOT, were the source for signal timing data and the initial determination of unsignalized intersections. Some of the individual timing plans in the original Synchro files were revised and updated based on field observations.

A detailed review of data collected for the project is provided in the *I-495 Express Lanes Northern Extension Existing Conditions Technical Report* (VDOT, 2019a) as an associated technical report with the EA.

Figure 2-2. Traffic Count Locations

2.3 TRAVEL DEMAND FORECASTING AND DEVELOPMENT OF FUTURE TRAFFIC VOLUMES

Forecasts for future traffic demand were developed using the MWCOG travel demand model (version 2.3.75 using Round 9.1 Cooperative Forecasts for socioeconomic data). The MWCOG model was modified and developed to reflect existing conditions (year 2018) in the Study Area. This included existing conditions network modifications to reflect current traffic volumes, and these modifications were carried into subsequent 2025- and 2045-year I-495 NEXT model scenarios. Strategic modifications included highway network edits to better represent Study Area facilities as they exist (including micro-coding of ramps), modification to centroid connectors to improve loading of traffic, modifications to the default speed and capacity of certain facilities, and enhancements to penalties for crossing the Potomac River. Calibration of the model was based on guidance from the FHWA Transportation Model Improvement Program (TMIP) *Travel Model Validation and Reasonableness Checking Manual* (FHWA, 2010) and the Virginia *Travel Demand Modeling Policies and Procedures Manual* (VDOT, 2014). Updates to the model were validated by comparing daily counts versus model forecasts, peak period traffic counts to modeled data during the same periods, and AM and PM observed speeds and travel times to model speeds and travel times within the I-495 traffic operations analysis Study Area.

A detailed overview of travel demand modeling methodology is provided as **Appendix B**. A memorandum detailing the modifications made to the MWCOG model to better reflect existing conditions, including validation metrics, is provided as **Appendix C**.

Post-Processing of Model Results

Relevant edits to the calibrated existing conditions model network and scripts were carried forward to all future scenarios, including separate model scenarios for No Build and Build conditions as well as model scenarios developed for the various sensitivity tests. Outputs from these models were used to estimate growth on Study Area roadway links using National Cooperative Highway Research Program (*NCHRP 765)* industry-standard practices (Transportation Research Board, 2014). The *NCHRP 765* iterative-directional method was used to convert forecasted link volumes into forecasted turning movement volumes for arterial intersections. All traffic volumes on freeways and arterials were balanced.

Origin-Destination Routing for Traffic Analysis

Origin-destination (O-D) routing was used in the VISSIM traffic simulation models (described in the next section). In order to produce these O-D routes, a seeding O-D matrix was developed using a combination of StreetLight Data and MWCOG model subarea matrix outputs. This seeding matrix and balanced, post-processed volume targets were then imported into PTV VISUM travel demand modeling software for each scenario. An adjusted final matrix was developed using VISUM's TFlowFuzzy methodology with the seeding O-D matrix and volume targets. The final O-D matrices were disaggregated into two vehicles classes (auto and truck) for routing in the traffic analysis microsimulation models.

2.4 TRAFFIC ANALYSIS TOOLS AND METHODOLOGY

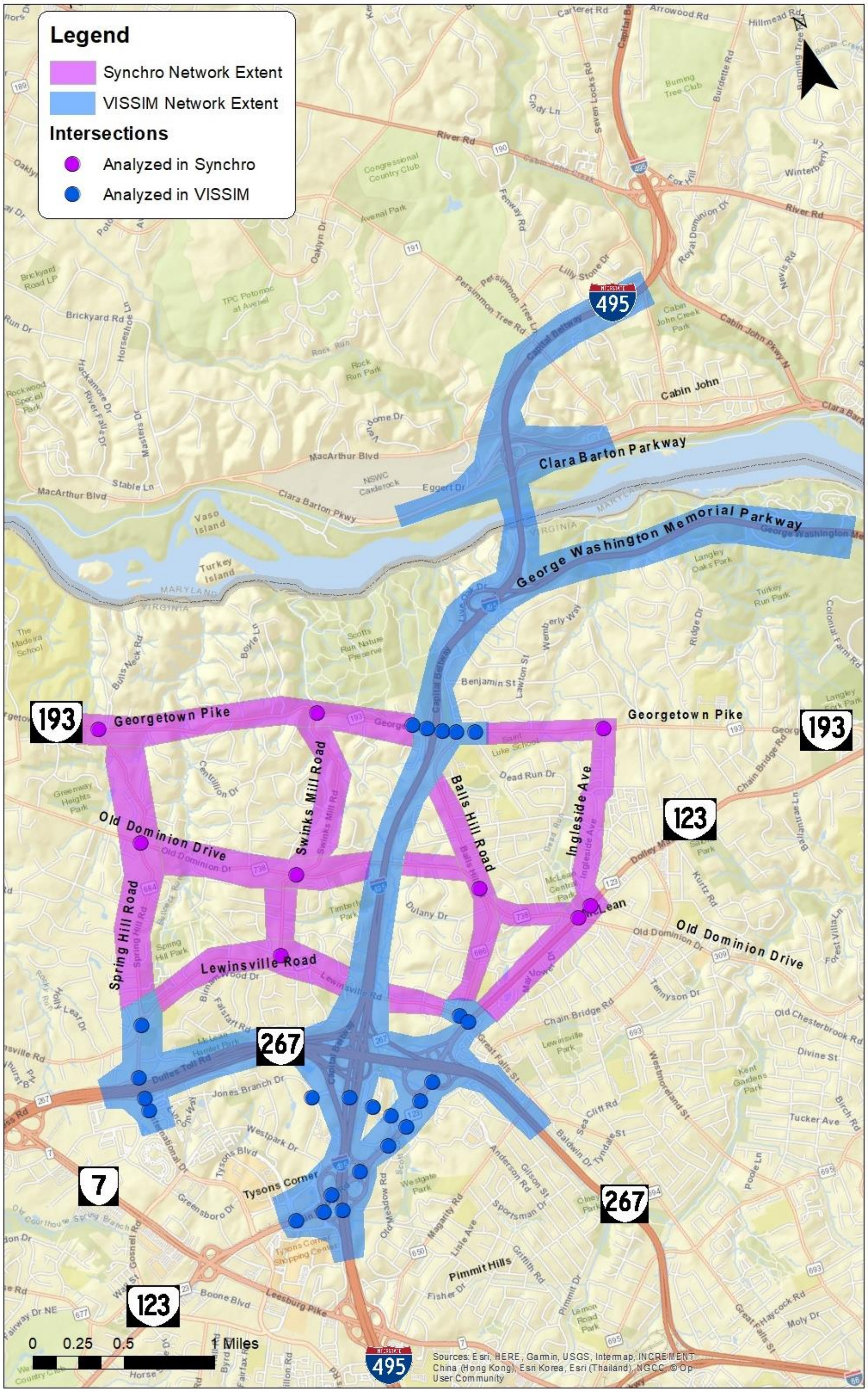
2.4.1 Traffic Analysis Tools

VISSIM Version 9.0 was used for a comprehensive network traffic analysis for the freeways, interchanges, and adjacent intersections within the traffic operations analysis area limits[1]. Surface street intersection operations were evaluated through a combination of Synchro 10 (in order to develop preliminary optimization for phasing and signal timing) and VISSIM (for microsimulation and analysis). The expanded arterial network beyond intersections immediately adjacent to freeway interchanges in the corridor was evaluated solely through Synchro. **Figure 2-3** provides a map of the network links and intersections that were analyzed using VISSIM versus Synchro, respectively.

Transit routes and stops were coded into the Study Area VISSIM network where they affect, or could affect, I-495 and related facility operations.

[1] The analysis tool selection matrix can be found within the VDOT *Traffic Operations and Safety Analysis Manual (TOSAM), Version 1.0* (VDOT, 2014).

Figure 2-3: Traffic Operations VISSIM and Synchro Analysis Areas



2.4.2 Measure of Effectiveness

The following measures of effectiveness (MOEs) were used for the operational analysis of the roadway network under existing and future Build and No Build conditions.

Freeway Performance Measures

- Simulated Average Speed (mph)
- Simulated Average Density (simulated vehicles per lane per mile but not reported as LOS)
- Simulated Volume (vehicles per hour)
- Percent of Demand Served: simulated volume (*processed volumes*) divided by actual volume (*input volumes*).
- Simulated Ramp Queue Length: reported average and maximum queue lengths (feet).
- Simulated Travel Time: reported for select network origin-destination travel paths (seconds).
- Congestion *Heat Maps*: incremental speeds reported for aggregated lanes, by time interval (mph).

Arterial/Intersection Performance Measures

Since VISSIM was used to evaluate intersections immediately adjacent to the Study Area freeway network while Synchro was used to evaluate the expanded arterial network, outputs have been reported differently for intersections, depending on which software analysis tool was used.

Synchro reports arterial intersection approach and movement delay outputs using control delay, while VISSIM reports these outputs using microsimulation delay. VDOT's TOSAM provides separate definitions for intersection control delay and microsimulation delay, both of which are measured in seconds per vehicle:

- **Control delay**: *delay associated with vehicles slowing in advance of an intersection, the time spent stopped on an intersection approach, the time spent as vehicles move up in the queue, and the time needed for vehicles to accelerate to their desired speed.* Highway Capacity Manual (HCM), 2010.
- **Microsimulation delay**[2]: *the difference between the simulated travel time and theoretical travel time if a vehicle was operating at the desired speed calculated by the microsimulation tool.*

Because VDOT's TOSAM recommends that LOS not be used to support microsimulation model results, microsimulation delay is reported and color-coded in the same way as HCM delay-based LOS and noted as "HCM-Analogous LOS." **Table 2-1** shows level of service (LOS) criteria for signalized and unsignalized intersections (both all-way and two-way, stop-controlled) as described in the HCM 2010.

Table 2-1. Level of Service Criteria for Intersections (HCM 2010)

LOS	Signalized Intersection (seconds)	Unsignalized Intersection (seconds)
A	≤10	≤10
B	10–20	10–15
C	20–35	15–25
D	35–55	25–35
E	55–80	35–50
F	≥80	≥50

[2] The HCM 2010 does not provide a definition, but microsimulation delay is calculated as described above.

2.4.3 Simulation Model Parameters

The simulation analysis periods, approved by the VDOT Northern Virginia District Traffic Engineer, are listed below. These periods were analyzed using a 30-minute seeding period for the AM VISSIM models and a 60-minute period for the PM models.

- AM peak: 6:45 a.m. to 9:45 a.m. (peak hour 7:45 a.m. to 8:45 a.m.).
- PM peak: 2:45 p.m. to 5:45 p.m. (peak hour 3:45 p.m. to 4:45 p.m.).

The simulation periods were determined based on a review of INRIX speed data, which showed the slowest speeds and heaviest queues during both the AM and PM peak periods as being along I-495 northbound. For each model scenario, 10 simulation runs were conducted, with the number of runs determined using the VDOT Sample Size Determination Tool. Further details on the development of the simulation analysis period can be found in the Framework Document in **Appendix A**. Further details on the number of simulation runs can be found in **Appendix D.**

2.4.4 Calibration of Existing VISSIM Models

The purpose of a simulation model is to investigate the effects of improvement alternatives. Simulation models are an efficient tool for evaluating improvements but are most effective when the base model matches real-world conditions. VISSIM, like other simulation software tools, was designed to be flexible enough that an analyst can calibrate the network to match the local conditions at a reasonably accurate level. It is well established that calibration is essential. The VDOT TOSAM provides detailed calibration criteria and acceptance targets for VISSIM models. The TOSAM was used in developing calibration criteria, which are described in greater detail in the *I-495 NEXT VISSIM Calibration Memorandum* which was approved and signed by the VDOT Northern Virginia District Traffic Engineer on July 27, 2018 and is provided in **Appendix D**. This memorandum includes detailed descriptions of the calibration process, edits made to the VISSIM models to achieve calibration, and comparisons of results with field observations.

2.5 SAFETY AND CRASH ANALYSIS METHODOLOGY

A safety analysis was conducted consistent with VDOT IIM-LD-200.9 (VDOT, 2017). It included an analysis of existing highway safety conditions and reported motor vehicle crashes on roads in the Study Area for a period of five years. It also included the development of qualitative and quantitative measures to evaluate future proposed alternatives and assess the safety effects of interstate access modifications on I-495 and the adjacent arterial network within the Study Area.

- Quantitative measures include the number of police-reported crashes (for existing conditions); annual crash frequencies expressed in terms of crashes per year; and reported crash rates expressed in terms of reported crashes per million vehicle miles traveled for roadway segments or million vehicles entering for intersections. Quantitative tools, which use multiple years of crash and traffic volume data, assist in the determination of crash patterns at specific locations and crash trends over time. They can also be used to assist in the identification of locations with relatively lower safety performance.
- Qualitative assessments assist in the identification of locations where roadway geometric conditions may pose significant demands on drivers and may contribute to potential driver errors that can result in crashes. Qualitative assessments are useful in identifying safety risks that can be addressed during the development of alternatives.

The following sections describe in more detail the methodology used to evaluate safety for existing conditions and future No Build and Build conditions. This chapter also describes data collected for use in the safety analysis. This methodology follows the safety analysis methodology described in the project Framework Document provided as **Appendix A**.

Safety analysis results for both existing and future conditions are described in **Chapter 8** of this document. Further detailed information regarding existing conditions safety is also provided in the associated *Existing Conditions Technical Report* (VDOT, 2019a) provided as a supplemental technical report with this EA.

2.5.1 Existing Conditions Safety Analysis Methodology

The existing conditions quantitative safety analysis utilized historical crash data from the most recently-available five years' worth of data (2013-2017). It included the development of the following measures:

- Crash density and severity histograms (developed for the mainline);
- Crash heat maps for various crash types (developed for the mainline);
- Crash density maps (developed for the mainlines); and
- Crash rates (fatal, injury, property damage only (PDO) and total) (developed for the mainline and intersections).

2.5.2 Future Conditions Safety Analysis Methodology

Qualitative Analysis

The qualitative analysis relied on a review of existing geometry, traffic conditions, a human factor approach to assess the driving task, consideration of driver expectancies, and where the potential was high for driver expectancy violations to occur. The qualitative assessment focused on locations there were identified high crash frequencies, high crash rates, or specific crash patterns based on an analysis of crash and traffic data from the latest available five full calendar years (i.e., 2013-2017). This included a review of the following:

- Proposed roadway signing and pavement marking plans
- Proposed new roadway and ramp alignments
- Long-range planned projects and roadway improvements

Concept plans have been reviewed and potential safety issues that warrant mitigation were identified. Extensive use has been made of relevant documents, positive guidance principles, human factors manuals, guidelines and processes for highway engineers and geometric design, and NCHRP and FHWA reports on safety effects related to interchanges, intersections, freeways, arterials, and ramp junctions. Notable documents include NCHRP Report 600, *Application of Human Factor Guidelines for Road Systems* (Transportation Research Board, 2012), AASHTO's *Highway Safety Design and Operations Guide* (i.e., the old AASHTO Yellow Book) (AASHTO, 1997), ITE's "Human Factors Issues in Intersection Safety" (ITE, 2004), FHWA reports such as *Driver Expectations When Navigating Complex Interchanges* (FHWA, 2013), materials cited in the National Highway Institute's "Human Factors for Transportation Engineers" and other relevant literature, such as *Human Factors Associated with Interchange Design Features* (TRB, 1993). Drivers often have difficulties following through the sequence of driving tasks, which leads to driving errors.

The objective of the qualitative safety analysis is to assess the relative level of safety that is likely to result from proposed improvements by considering the potential effect of the following on driver expectancies, the demands on and capabilities of the driver to perform all subtasks of the driving tasks, driver information processing capabilities, and driver decision-making capabilities, especially at route choice decision points:

- Geometric characteristics, including grades, vertical alignment, horizontal alignment, cross-sections,
- Roadside features.
- Conflict points
- Traffic operations, including weaving, lane changing, merging, diverging and stopping
- Relative safety hazards

Quantitative Analysis

Highway safety and design professionals use the AASHTO *Highway Safety Manual* (HSM) (AASHTO, 2010) as a resource to inform project development, design, and decision making so that resources can be allocated towards design features with the greatest potential to benefit safety and not purely for the sake of meeting design standards. The crash prediction methods identified in the HSM use, as basic input, geometric data that is key to roadway design and traffic data that is fundamental to project development. These safety analysis tools allow for the evaluation of existing conditions and the comparison of potential alternatives. They permit safety professionals to predict the number of crashes on the facility based on the roadway geometric features similar to how Highway Capacity Software is used to predict how a facility will function from an operational standpoint. Safety measures can now be used, along with other design considerations such as level of service, right-of-way, environmental impacts, and cost, as a quantified evaluation factor for design-related decisions and for balancing trade-offs between evaluation criteria.

Several quantitative analysis tools exist for use in applying the HSM Part C: Predictive Methods. These quantitative analysis tools use a combination of historical crash data and detailed geometric features of the roadway. For the purposes of future alternatives analysis on the I-495 corridor, a combination of three quantitative tools were employed:

- **Enhanced Interchange Safety Analysis Tool (ISATe).** ISATe is a safety analysis tool used to evaluate freeway and interchange systems. ISATe predicts crashes by crash location, i.e., mainline freeway segments, ramp segments, and ramp terminals. Inputs to the tool include both geometric and operational characteristics of roadway and ramp facilities. ISATe also analyzes ramp terminal crossroad intersections based on the number of lanes and arrangement of lanes and type of traffic control. For the purposes of mainline and interchange safety analysis and conditions on the I-495 corridor, ISATe was used to evaluate the 2025 No Build, 2025 Build, 2045 No Build, and 2045 Build Alternatives with the exception of the Existing and Proposed Express Lanes. The Express Lanes were analyzed using the safety performance function (SPF) tool developed for this project and described later in this section.
- **Developed Express Lane Safety Performance Function (SPF).** As the HSM (First Edition) does not have a crash prediction methodology for estimating the safety performance of separated/managed lanes, additional SPF development was necessary to fully assess the project Build Alternative. Using historical and available crash data, as well as traffic volume data and roadway geometric data for the existing segments of I-495 Express Lanes, an I-495 Express Lanes-specific SPF was developed. The SPF allows for estimation of future-year crashes for both existing Express Lane sections on I-495 (included in the No Build Alternative) and for new Express Lane sections that will be included in the Build Alternative.

- **Extended HSM Spreadsheets.** Extended HSM Spreadsheets were used to conduct safety analysis for arterial intersections within the Traffic Operations Study Area. The HSM spreadsheets are applicable for Rural Two-Lane, Two-Way Roads (HSM Chapter 10); Rural Multilane Highways (HSM Chapter 11); and Urban and Suburban Arterials (HSM Chapter 12). The tool predicts crashes by roadway segment and intersection.

The HSM methodologies also predict crash severity for each crash type using the KABCO scale (K – fatal crashes; A, B, C – injury crashes of decreasing severity; O – Property Damage Only (PDO) crashes); in some cases, crashes are also predicted by single vehicle and multiple vehicle crash types.

The safety analysis tools use crash prediction methods outlined in Part C: Predictive Methods (Volume 2) of the HSM. HSM safety prediction relies on SPFs, which express the predicted crash frequency for a basic roadway element (i.e., freeway or ramp segment, roadway segment, or intersection) defined by a specific volume, set of base geometric conditions, and in the case of intersections, traffic control conditions. Crash modification factors (CMF) express the relative change in crash frequency that could be expected with a change in one of the base geometric or traffic control conditions for the alternative being analyzed.

HSM Part C: Predictive Methods estimates the long-term crash frequency of a No Build or proposed Build Alternative. The first step in the predictive safety analysis process is predicting the number of crashes that will occur at a location based on the SPFs and CMFs. The incorporation of historical crash data, when available, is the second step in the predictive safety analysis process, resulting in the expected crash frequency. This process is known as the Empirical Bayes (EB) method. The expected crash frequency is the estimate of long-term average crash frequency of a segment, intersection, or network under a given set of geometric conditions and traffic volumes (e.g., Average Annual Daily Traffic (AADT)). If the expected crash frequency is greater than the predicted crash frequency, the crash location has potential for safety improvement (PSI) or an expected excess average crash frequency.

If reported crash data are either not available or not applicable, then the EB method is not used. This will be the case in situations where traffic volume, traffic control type, or geometric configuration at a site changes significantly over time so the historical crash data would no longer adequately represent the proposed condition. In this situation, an estimate of expected average crash frequency would not be calculated, so the evaluation of the safety condition would be limited to the evaluation of the estimate of predicted average crash frequency using the predictive crash models.

To be used most effectively, quantitative safety analysis tools require calibration on a state-by-state basis to accurately represent the number of crashes that can be reasonably expected on a roadway corridor. However, even lacking such calibration, the HSM tools can be used for relative evaluation of the predicted-to-expected crash frequency for existing conditions and also for comparisons between the predicted crash frequencies of design alternatives. Uncalibrated safety models were used to analyze safety in the I-495 corridor; calibration factors are not yet available for Virginia roadways. Therefore, a comparative approach using uncalibrated results was used to assess design alternatives from a safety perspective. HSM tools are limited to general purpose facilities, and tools to predict crash frequencies on Express Lanes have not yet been developed. Therefore, as noted, the project team developed crash prediction SPFs for Express Lanes using volume and geometry data from existing Express Lanes facilities in the region.

A summary of the different analysis tools and scenarios described above is shown in **Table 2-2**.

Table 2-2. Quantitative Safety Analysis Tool Summary

	2025 & 2045 No Build			***2025 & 2045 Build***		
Network Component	*Freeway*	*Express Lanes*	*Arterial*	*Freeway*	*Express Lanes*	*Arterial*
Tool	*ISATe*	*Developed SPFs*	*HSM*	*ISATe*	*Developed SPFs*	*HSM*
Measure(s) of Effectiveness (MOEs)	*Predicted Crash Frequency and Crash Rates*					

2.5.3 Safety Data Collection

Data for the safety analysis consisted of crash data, traffic data, and roadway inventory data. The sources of these data are described in the following sections.

Crash Data Collection

One of the primary measures to assess safety conditions of existing roads is related to the frequency and rate of reported crashes. VDOT maintains a clearinghouse of data for police-reported traffic crashes on roads maintained by VDOT. The tool used to extract crash data is known as the VDOT Crash Analysis Tool (Tableau) (VDOT, 2019b). The Tableau tool was developed by the Highway Safety Section of VDOT for the purpose of crash analysis. VDOT receives crash information from the Department of Motor Vehicles (DMV) through the DMV Traffic Records Electronic Data System. After VDOT has reviewed and processed the information from the DMV, which includes the addition of supplemental location data, the crash data is uploaded and made available via the VDOT Tableau tool on VDOT's website.

To compliment the crash data from VDOT, crash data were solicited and obtained from MDSHA and the National Parks Service (NPS) for roads under their jurisdiction, including sections of Clara Barton Parkway in Maryland and the GWMP. Crash data for the section of I-495 in Maryland from and including the ALMB to the Seven Locks Road overpass were obtained from MDSHA crash data inventory. The crash data from MDSHA and NPS did not have the same level of detail as the VDOT data; therefore, they were analyzed qualitatively.

The safety analysis was largely based on historic crash data from the VDOT Crash Analysis Tool for freeway segments, arterial segments, and intersections in the study area. Crash data was gathered for the five-year period from January 1, 2013 to December 31, 2017. Historic crash data was collected for the Express Lanes mainline, merge, and diverge segments in both directions between Route 7 and the terminus north of DTR interchange. Similar data was collected for GP lanes between Route 7 in Virginia to Clara Barton Parkway in Maryland. A total of 28 intersections or ramp terminals in or around the study area were investigated.

Traffic Data Collection

Traffic and roadway data were obtained to assist in documentation of existing safety conditions. VDOT maintains a clearinghouse of Average Annual Daily Traffic (AADT) count data for interstate, primary, and secondary roads in Virginia (VDOT, 2019c). Data is accessible for approximately the last 15 years. Consistent with conventional traffic and safety analysis, AADT data for the previous five years (2013-2017) were compiled for freeway segments and intersections in the study area. Traffic data was solicited from and obtained from the VDOT, Transurban (which operates and maintains the I-495 Express Lanes), MDSHA, and NPS.

The AADT was used to determine crash rates for freeway segments, ramps, and intersections within the study area. These rates were then compared to average local, state, and nationwide crash rates for similar highway facilities. This comparison provides a picture of the relative safety conditions within the study area.

Average Daily Traffic (ADT) was provided for the future scenarios using volume forecasts developed by the study team.

Roadway Inventory Data

Existing geometric information, which includes the number of travel lanes, among other elements, for the freeways, ramps, roadways and intersections in the study was collected for the quantitative assessment and evaluation of future geometric modification and predictive crash analysis. The numerical values of those geometric features were gathered using Google Earth Pro™.

Quantitative safety analyses require additional data that is not typically collected during the qualitative crash data collection process. The quantitative crash analysis tool for freeways and interchanges requires the collection and use of detailed design-level factors for freeway facilities, such as:

- Lane widths, in feet
- Shoulder widths (inside and outside), in feet
- Distance to barrier (freeway/ramps), in feet
- Median width, in feet
- Clear zone width, in feet
- Horizontal curve radius (especially on ramps), in feet
- Presence of shoulder rumble strips, yes or no
- Weaving length, in feet
- Location of ramp, left-hand or right-hand
- Ramp entrance and exit

For arterial intersections, in addition to projected volumes, both geometry and societal factors are taken into account, such as:

- Nearby schools, bus stops, and alcohol sales establishments
- Presence of red light cameras
- Presence of intersection lighting
- Intersection control type and signal phasing where applicable
- Approach lanes and lane types

Roadway inventory data for the I-495 mainline facility was collected from multiple sources. Existing and No-Build conditions roadway data elements were collected using Google Earth Pro™. For proposed future conditions, roadway data was obtained from the roadway design files prepared by the study team. Where specific design details for the future conditions were unknown, the study team made assumptions based on an assessment of existing conditions and preferred design standards for the design element in question.

2.6 TRAFFIC DATA FOR NOISE AND AIR QUALITY ANALYSIS

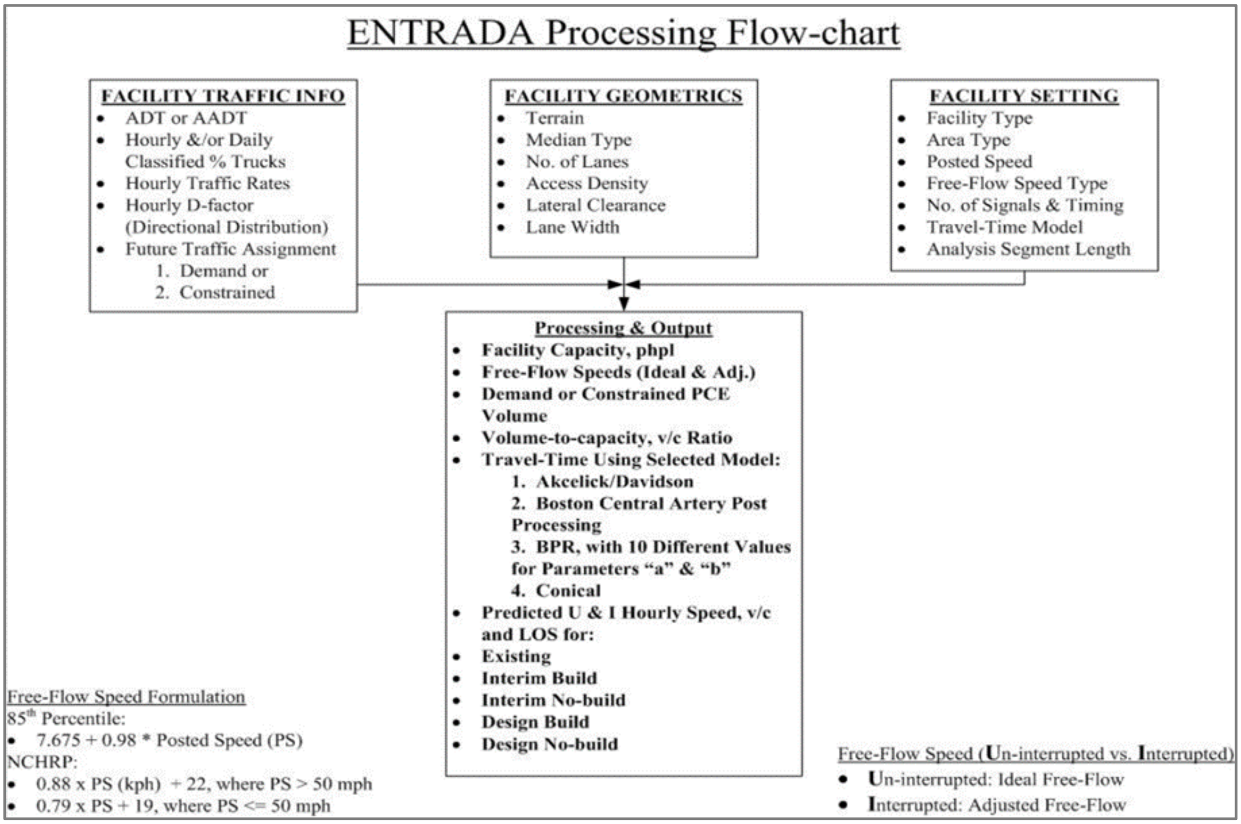
Travel demand forecasts developed as outlined in this chapter were post-processed using *NCHRP 765* guidelines. These outputs were combined with existing traffic count data and traffic operational modeling (from both Synchro and VISSIM) to determine the traffic data for the noise and air analysis. The following is a general list of overall post-processed traffic data provided for project-level noise and air analysis:

- AADT, average annual truck traffic (AATT), and capacity-constrained peak-period volumes as well as operating, posted, and congested speeds for each link in the project area.
- Hourly traffic distribution (K-factor), hourly directional distributions, hourly distribution of percent trucks with two axles and six tires, and percent trucks with three or more axles.
- Directional volumes, including turning or ramp movements (vehicles/hr/link) for the mainline roadway, study interchanges, affected intersections, and parallel facilities.
- Signal timings (cycle lengths and phasing, approach splits), as well as level of service based on control delay (includes intersection and approach delays and average queue lengths).
- Travel demand model outputs for all scenarios and years.
- GIS shapefiles with all roadway link identifiers and associated traffic data.
- Lane configuration diagrams for each mainline roadway and intersection/interchange within the project corridor showing through and turn lanes.

2.6.1 Traffic Data for Project-Level Noise Analysis

Traffic data needed for project-level noise analysis was developed using VDOT's Environmental Traffic Data Abstract (ENTRADA) tool, Version 2018-09, which is a program that standardizes the production of environmental traffic data. As per FHWA and VDOT policy, the traffic data used in the noise analysis must produce sound levels that are representative of the worst (loudest) hour of the day. In addition to the traffic data listed above, information about the corridor including facility geometry, access locations, and facility setting were also used as input for the ENTRADA tool. An overall process flowchart for the ENTRADA tool, along with input and output data, is illustrated in **Figure 2-4**.

Figure 2-4: ENTRADA Processing Flow Chart



For every roadway or ramp segment, a corresponding ENTRADA spreadsheet is developed with data compiled for both the existing and design year (No Build and Build scenarios). Lane configuration diagrams for each mainline roadway and intersection/interchange within the project corridor showing all through and turn lanes are included to show the roadway segmentation.

The following characteristics and inputs for each specific segment are developed for the creation of the ENTRADA files:

- **Segment length (miles):** The segment length corresponding to the length of the segment in the 2045 design year.
- **Area type:** Verified by field observations and confirmed with VDOT.
- **Directional percent hourly truck traffic:** From existing traffic count data, MWCOG model, and consistent with the peak-hour characteristics being modeled in VISSIM.
- **Existing hourly speeds by direction:** Consistent with the peak-hour characteristics modeled in VISSIM
- **Capacity** (per hour per lane).
- **Facility type.**
- **ADT:** Verified with existing traffic data.
- **Hour-by-hour percent trucks of the ADT:** Derived from existing traffic classification count data.
- **Hour-by-hour K-factors:** Derived from existing traffic data as a basis and adjusted for future conditions based on factors used for the MWCOG model.

- **Hour-by-hour directional split (D-factor):** Verified with existing traffic data and derived from MWCOG model outputs for future conditions.

The following physical characteristics were collected and entered as input (by individual segment) for each Build/No Build scenario for the creation of the ENTRADA files. For locations where limited data was available, existing physical conditions were assumed unless changes are being made in future scenarios:

- Cross section
- Number of lanes
- Outside shoulder width (feet)
- Inside shoulder width (feet)
- Lane width (feet)
- Terrain - consistent with GIS topo and verified with field observations
- Interchange/access density (per mile)
- Posted speed (miles per hour)
- Number of signals (in length of facility)

The following characteristics of a signalized facility were collected and entered as input (by individual segment) for the existing scenario for the creation of ENTRADA files:

- Signal cycle length.
- Signal green time.
- Segment delay adjustment factor.

A master database was developed to store input data for every roadway segment. A spreadsheet-based macro was also developed to automatically read the information from the database and create ENTRADA spreadsheets for every single identified segment. To ensure that ENTRADA produced reasonable results, hourly speed distribution outputs for the existing year were compared to available speed data (INRIX or field-collected) to determine the appropriate calibration parameter values.

2.6.2 Traffic Data for Project-Level Air Quality Analysis

Traffic data required to support air quality analysis for CO (Carbon Dioxide) screening analyses and Mobile Source Air Toxins (MSAT) were provided in consultation with VDOT. Below is a list of traffic data that was used for air quality analysis:

- **Existing raw traffic count information** (including intersection turning movement counts and detailed bus/truck data) by time period. This is primarily to evaluate existing heavy-duty diesel activity – an observation included in the MSAT documentation.
- **Travel Demand Model outputs for all scenarios** – loaded networks including ADT, percent trucks, vehicle miles travelled (VMT), peak/off-peak period factors for AM, midday, PM, and nighttime periods:
  - Existing (2018)
  - 2025 No Build
  - 2025 Build
  - 2045 No Build

  - 2045 Build

- **Refined traffic volume plots for existing and forecasted, build and No Build conditions,** primarily to inform the level of MSAT analysis required – determined to be Quantitative – and potentially CO analyses (should the mainline or interchange volumes prove to be of concern.) These plots will also be included in the Air Quality documentation for reference.
- **Highway Capacity Manual (HCM) Measures of Effectiveness (MOE)** on all approaches for all intersection evaluated – both those evaluated in VISSIM and those only evaluated in Synchro, in a single table, for supporting the CO screening analyses. Where actual HCM MOEs where unavailable, surrogate values available were provided.

Carbon Monoxide (CO)

While the CO air quality conformity requirements under the Clean Air Act (CAA) and its amendments expired in the NOVA region, a screening analysis is still required under the NEPA environmental rules in Virginia. A worst-case screening analysis at the most problematic intersections forecasted was performed by using operational summary data described above combined with MOVES-developed emission rates. Only the lowest performing locations (3 or more) are analyzed so a table listing appropriate HCM MOE was provided to identify the locations of interest and to be used as basic inputs into the CO screening analyses. Note that geometric data (intersection layouts and approach grades) were also provided for the locations of interest identified.

Mobile Source Air Toxics (MSAT)

To support the project-level air quality analysis, regional travel demand modeling output files encompassing the project corridor and "affected transportation network" were used for the base year and for the Build and No Build scenarios for the interim and design years for each alternative to support the quantitative MSAT analysis.

Travel Demand Model output files (loaded networks) were used to prepare a quantitative MSAT analysis for each alternative within the I-495 study corridor for the existing (2018), interim year (2025, No Build and Build), and design year (2045, No Build and Build). For purposes of the MSAT analysis, the development of the affected transportation network was based on FHWA training materials on the topic, as detailed in the air quality report.

CHAPTER 3.0 EXISTING TRANSPORTATION NETWORKS

This chapter provides an overview of the transportation facilities that currently exist within the project Traffic Operations Study Area, including roadway, transit, bicycle, and pedestrian facilities.

3.1 ROADWAY NETWORK

To assess the traffic impacts of the proposed project from the current northern termini of the existing I-495 Express Lanes to the ALMB, a Traffic Operations Study Area was defined to include the I-495 corridor between Route 123 in Tysons to and the I-495 overpass over Seven Locks Road in Montgomery County, Maryland.

In addition to the sections of the I-495 GP lanes and the sections of the I-495 Express Lanes, the traffic operations Study Area includes:

- Segments of the GWMP and the Clara Barton Parkway, which are under the responsibility of the National Park Service;
- Segments of the DTR and DAAR, which are under control of the Metropolitan Washington Airports Authority;
- Segments of the DCR, under the responsibility of VDOT; and
- Nine (9) interchanges.

The Traffic Operations Study Area also includes segments of primary and selected secondary roads that lie within the corridor.

A map of the project footprint area and the project Traffic Operations Study Area was previously provided in Chapter 2 as **Figure 2-1.** These facilities are described in more detail in the following sections.

3.1.1 I-495

The section of I-495 within the Study Area comprises a portion of the Capital Beltway. The entire Capital Beltway is a circumferential interstate highway of approximately 66 miles around Washington, D.C. and the core of the metropolitan region. I-495 is classified as an urban interstate by FHWA.

The segment of I-495 within the project footprint runs from just south of the Route 123 interchange to just north of the GWMP interchange at the ALMB (the Maryland state line). The I-495 GP lanes generally carry four through lanes in each direction, with a 12-foot paved right shoulder. South of Old Dominion Drive, to the left of the GP lanes in each direction are the I-495 Express Lanes, which are separated from the GP lanes by flexible bollards in most locations in the Study Area. The northern terminus of the Express Lanes is located just to the south of Old Dominion Drive. North of this location, the I-495 GP lanes remain four lanes in each direction south of Route 193, although a hard shoulder lane is open to traffic in the northbound direction during weekday peak periods. This single left-side shoulder lane, which began operations in 2015, is open to all traffic Monday through Friday from 6:00 AM to 11:00 AM and 2:00 PM to 8:00 PM.

Additional capacity is provided along I-495 between Route 193 and GWMP. In the northbound direction, a fifth auxiliary lane is provided along the right side between the on-ramp from Route 193 and the off-ramp to GWMP, in addition to the left-side hard shoulder lane, which terminates at the GWMP interchange. In the southbound direction, a C-D road is provided between the GWMP and Route 193 interchanges; all southbound traffic wishing to access either of these interchanges must exit north of the GWMP interchange. The C-D road carries two lanes plus an auxiliary lane between the on-ramp from GWMP and the off-ramp to Route 193; it then splits into a two-lane off-ramp to Route 193 and a single-lane on-ramp to the I-495 southbound mainline. During congested periods along the I-495 southbound mainline, counts indicate that the C-D road is often used to bypass traffic along the mainline.

3.1.2 I-495 Express Lanes

The existing I-495 Express Lanes opened in 2012 and feature two through lanes running in the median of I-495 in each direction at the south end of the Study Area. These lanes are separated from the GP lanes via flexible bollards. The Express Lanes are dynamically-priced, high-occupancy toll (HOT) lanes designed to increase capacity and travel time reliability by allowing transit and high occupancy vehicles (HOVs) to use the facility for free while tolling the excess capacity for single-occupancy vehicles (SOVs). Within the Study Area, ingress and egress to the northbound and southbound existing I-495 Express Lanes are provided at Westpark Drive and Jones Branch Drive in Tysons, with exclusive ramps that intersect the cross streets at signal-controlled intersections. Access is also provided from the northbound existing I-495 Express Lanes to DTR westbound, from the southbound existing I-495 Express Lanes to DTR westbound, and from DTR eastbound to the southbound existing I-495 Express Lanes.

The northern entrance to the southbound existing I-495 Express Lanes is from the left side of the southbound I-495 GP lanes, south of the Route 193 interchange and beginning just south of the bridge carrying Old Dominion Drive over I-495. The northern exit from the northbound existing I-495 Express Lanes merges onto the left side of the northbound I-495 GP lanes near this same location. At this point, the previously-mentioned left-side shoulder use lane begins.

3.1.3 Interchanges and Intersecting Roadways

The interchanges, excluding those that provide access to and from the existing I-495 Express Lanes, within the traffic operations analysis Study Area include the following:

- I-495/Route 123 interchange – a full cloverleaf interchange with access provided in all directions
- I-495/Route 267 interchange – a complex interchange with a variety of ramps providing access in certain directions, including the following:
    - From northbound I-495 GP lanes to westbound DTR
    - From northbound existing I-495 Express Lanes to westbound DTR
    - From southbound I-495 GP lanes to eastbound and westbound DTR
    - From southbound existing I-495 Express Lanes to westbound DTR
    - From the eastbound DTR to northbound and southbound I-495 GP lanes
    - From the eastbound DTR to southbound existing I-495 Express Lanes
    - From the eastbound DAAR to the I-495 GP lanes
    - From westbound DCR to northbound I-495 GP lanes
- I-495/Route 193 interchange – a conventional diamond interchange, with a C-D road along southbound I-495 that connects both the GWMP interchange and the Route 193 interchange.
- I-495/GWMP interchange – a trumpet-type, three-legged interchange providing access to and from both directions of I-495 and GWMP to the east of I-495.
- I-495/Clara Barton Parkway interchange – a hybrid interchange that features directional ramps provided for certain movements in each direction.
- Route 267/Spring Hill Road interchange – a conventional diamond with access provided in all directions.

- Route 267/Route 123 interchange – a hybrid partial cloverleaf interchange providing access in all directions, except for Route 123 northbound to Route 267 westbound.

Additionally, the following interchanges that provide access to and from the existing I-495 Express Lanes within the traffic operations analysis Study Area are included:

- I-495 Express Lanes and Westpark Drive
- I-495 Express Lanes and Jones Branch Connector
- I-495 Express Lanes and Route 267, which currently includes the following connections:
    - I-495 northbound Express to westbound DTR
    - I-495 southbound Express to westbound DTR
    - Eastbound DTR to I-495 southbound Express

3.1.4 Major Traffic Operations Study Area Arterials

The major non-freeway roads in the Study Area include the several arterials and collector streets, described below:

- Route 193 (Georgetown Pike) – Route 193 is a primary highway in Virginia that provides access from origins in western Fairfax County and eastern Loudoun County to I-495, destinations in McLean, including the Central Intelligence Agency, and destinations in Washington, D.C. via the GWMP and Chain Bridge over the Potomac River. It is a two-lane road for most of its length, with narrow or no shoulder along much of the route. Auxiliary turn lanes exist at the I-495 interchange areas.
- Dolley Madison Boulevard/Chain Bridge Road (Route 123) – Route 123 is a six-to-eight-lane major arterial and primary highway within the Study Area. It has multiple turn lanes at several major signal-controlled intersections.
- Spring Hill Road (Route 684) – the section of Spring Hill Road varies in cross section. At the south end of the Study Area, Spring Hill Road is a multilane highway, serving traffic in the Tysons area and providing a primary access to the DTR at an interchange. The section north of the DTR is largely a two-lane road, with some turn lanes at major intersections.
- Old Dominion Drive (Route 738) – the section of Old Dominion Drive in the Study Area is predominantly a two-lane road that provides a roadway connection between Route 123 and Spring Hill Road, with additional turn lanes provided at its intersection with Route 123. It passes through residential areas, crossing I-495 and connecting to Swinks Mill Road as well.
- Swinks Mill Road (Route 685) – the section of Swinks Mill Road in the Study Area is a two-lane street through a residential area with numerous driveways. It provides a roadway connection between Lewinsville Road and Route 193 and parallels I-495 just to the west. It primarily serves local traffic, although commuters do use this route during peak periods.
- Balls Hill Road (Route 686) – the section of Balls Hill Road in the Study Area provides a roadway connection from Route 123 and Route 193. Similar to Swinks Mill Road, it runs parallel to I-495 just to the east, and it is a two-lane street that serves the local community. During peak periods, commuters use Balls Hill Road to bypass the congested I-495 northbound GP lanes.
- Lewinsville Road (Route 694) – the section of Lewinsville Road in the Study Area is largely a two-lane street that functions as a major collector for residential and commuter traffic west of I-495. East of I-495, it is a multi-lane road with turn lanes at major intersections serving a large campus

with several office buildings. It parallels the DTR to the north and is also used by commuters during peak periods.

- Ingleside Avenue/Douglas Street – the sections of Ingleside Avenue and Douglas Street within the study are two-lane streets that provide access to the McLean Library and the McLean Community Center and primarily serves local residents. Together, they form a road connection between Route 123 and Route 193 in the McLean area, running parallel and to the east of Balls Hill Road.

3.2 HOV AND TRANSIT FACILITIES

The Study Area currently has in place the following HOV and transit facilities in place to serve commuters.

3.2.1 HOV Facilities

HOV-3 vehicles may ride in the I-495 Express Lanes for free using an EZ-Pass transponder that is switched to "HOV-3" mode. There are no HOV lanes along the I-495 GP mainline.

Within the traffic operations analysis Study Area, an HOV-2 lane heading westbound along the DTR is provided. This HOV-2 lane starts directly west of the DTR main toll plaza and is exclusive to HOV-2 traffic during the evening peak period (4:00 p.m. - 6:30 p.m., Monday – Friday). There is a corresponding eastbound HOV-2 lane along the DTR but terminates prior to Leesburg Pike which is outside of the I-495 NEXT traffic operations analysis Study Area.

Existing Conditions HOV Usage

As noted in Chapter 1 of the EA, according to a commuting survey conducted by MWCOG in 2016, nearly half (48 percent) of those surveyed who use HOV/Express Lanes for commuting said availability of the lanes influenced their mode choice decision. The survey also indicated that the presence of Express Lanes encourages the use of carpooling and vanpooling; nine percent of commuters who had access to an HOV/Express Lane reported carpooling or vanpooling as their primary mode choice, compared with five percent of commuters who did not have access. The existing I-495 and I-95 Express Lanes create a 40-mile HOV and bus network in northern Virginia and provide additional travel choices for a variety of users. However, because the existing Express Lanes end at Old Dominion Drive, travel choices for all northbound travelers are limited. No commuter bus service is offered within the Study Area or over the ALMB due to the absence of dedicated or managed lanes that would allow buses to travel more efficiently. Both HOV and single-occupant vehicles choosing to use the existing Express Lanes are forced to rejoin the GP lanes north of Old Dominion Drive with no options to bypass congestion or bottlenecks. Therefore, there is little or reduced advantage or incentive for travelers to choose carpooling, vanpooling, or transit options because these options are no more efficient than driving alone from this point to the north. Without dedicated transit or HOV/HOT lanes, single-occupant vehicle travel is the dominant mode choice within the corridor. Additionally, there is no opportunity to attract users away from the congested GP lanes, which would reduce the overall trip demand and congestion in the GP lanes. There is a need to provide options for and incentivize high-occupancy travel modes to reduce overall vehicle trips, particularly single-occupancy vehicles, in accordance with TPB recommendations.

Commuter choices are also affected by access. The northbound and southbound I-495 Express Lanes are accessible in both directions from Westpark Boulevard and Jones Branch Drive. From Route 7 and eastbound DTR/DAAR, only the southbound Express Lanes are accessible. There is currently no direct access to the northbound Express Lanes from the DTR, the DAAR, or Route 7. Given that the Express Lanes terminate to the south of GWMP, there is also no direct access to and from the Express Lanes in either direction from GWMP. Users are less likely to use the Express Lanes if the access points are inconvenient and insufficient for their needs.

3.2.2 Bus Transit

No commuter bus service is offered within the Study Area or over the ALMB, in part due to the absence of dedicated or managed lanes that would allow buses to travel more efficiently.

Currently three transit service providers operate bus service in areas adjacent to the corridor, along the routes listed below and identified in **Figure 3-1**:

Fairfax Connector Service

- Route 401/402: Backlick – Gallows
- Route 422: Boone Boulevard – Howard Avenue
- Route 423: Park Run – Westpark
- Route 424: Jones Branch Drive
- Route 432: Old Courthouse Beulah
- Route 442: Boone Boulevard – Howard Avenue
- Route 462: Dunn Loring – Navy Federal – Tysons
- Route 463: Maple Avenue – Vienna
- Route 494: Lorton – Springfield – Tysons
- Route 495: Burke Centre – Tysons
- Route 574: Reston – Tysons
- Route 599: Pentagon – Crystal City Express
- Route 721: Chain Bridge Road – McLean
- Route 724: Lewinsville Road

Potomac and Rappahannock Transportation Commission (PRTC) Service

- Linton Hall Metro Express: Gainesville – Tysons Corner
- Manassas Metro Express: Old Town Manassas – Tysons Corner
- Tysons Corner: Woodbridge - Tysons Corner

Washington Metropolitan Area Transit Authority (WMATA) Metrobus Service

- 23T: McLean – Crystal City
- 3T: Pimmit Hills
- 5A: Dulles – Washington, D.C.

3.2.3 Metrorail

The Study Area is served by the Silver Line Metrorail which opened in 2014 with five stations. Four of the five Silver Line Metrorail stations are in the vicinity of the I-495 Express Lanes Northern Extension Project; these include:

- McLean
- Tysons Corner
- Greensboro
- Spring Hill

The Metrorail service and stations in the Study Area are also shown in **Figure 3-1.**

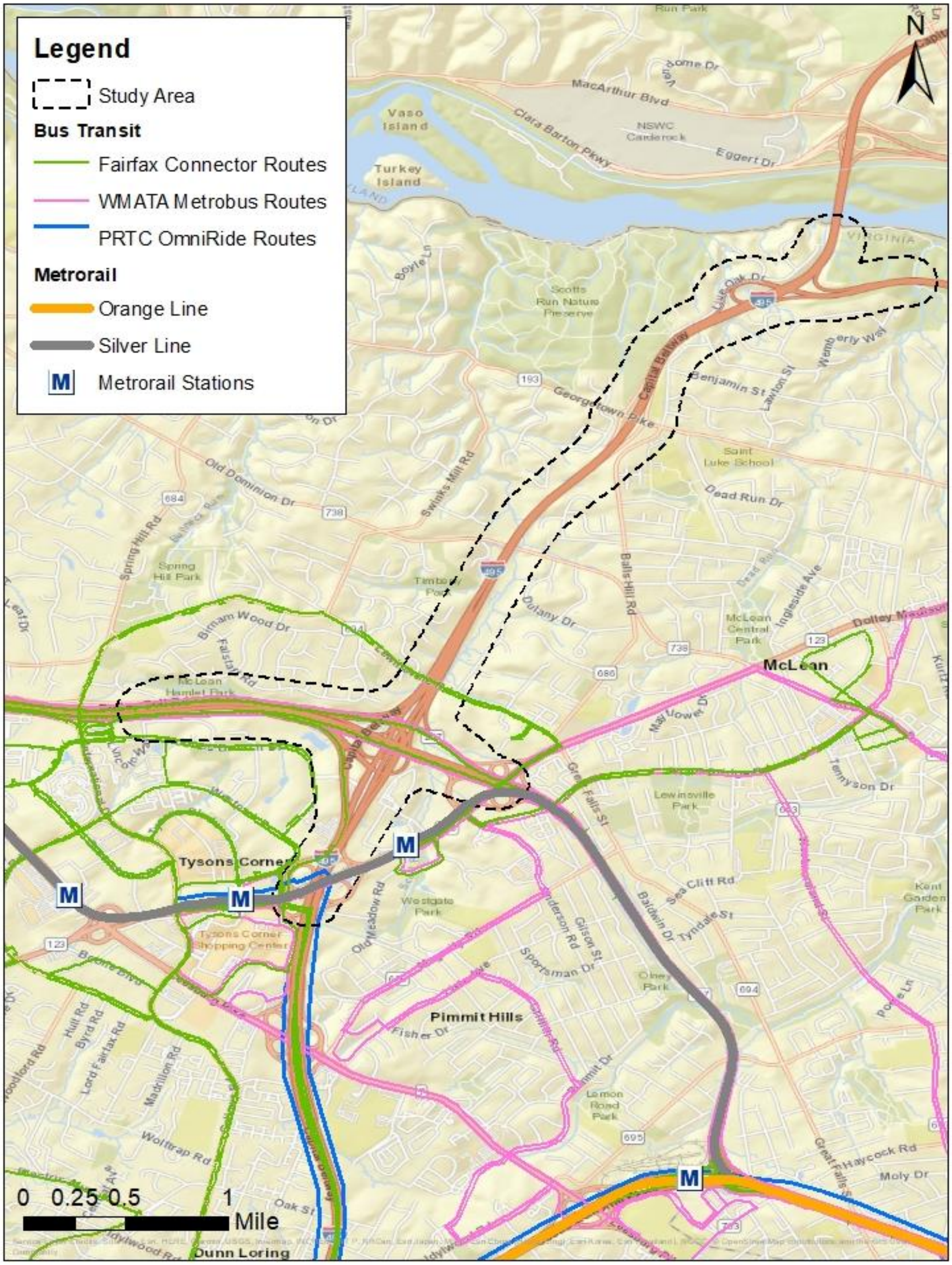
3.3 BICYCLE AND PEDESTRIAN FACILITIES

Bicycle and pedestrian facilities in the traffic operations analysis Study Area mainly consist of facilities along streets that cross I-495 on bridges.

Along Live Oak Drive and Route 738 (Old Dominion Drive), bicyclists must use the sidewalk or share the road with cars along the overpasses of I-495. Along Route 694 (Lewinsville Road), exclusive bike lanes are provided in each direction along the overpass across I-495.

Along Route 123, no bicycle or pedestrian facilities are currently provided crossing I-495.

Figure 3-1: Bus and Rail Transit Service in I-495 NEXT Project Area



CHAPTER 4.0 EXISTING TRAFFIC OPERATIONAL CONDITIONS

4.1 HISTORICAL TRAFFIC TRENDS ON I-495 CORRIDOR

Although traffic has distinctive peak periods along the I-495 corridor, increasing congestion has prolonged these peak periods and spilled queued traffic to parallel routes such as the GWMP, Route 193, and Route 123. A typical commuting pattern might show a morning peak in one direction and an afternoon peak in the opposite direction; however, the I-495 NEXT study area experiences congestion in both directions in both peak periods, with the most severe congestion along northbound I-495 due to a bottleneck at the ALMB.

From 2002 to 2017, the AADT for I-495 at the ALMB grew by 18 percent, with the transportation infrastructure expanding alongside this traffic growth to include Express Lanes as well as a hard shoulder open to northbound traffic in the study area during peak periods. Projected population and employment growth, particularly in Tysons, is forecasted to significantly increase in future years and additionally strain highway capacity.

Traffic counts from recent years reflect existing network capacity constraints. **Figure 4-1** and **Figure 4-2** compare the AADTs along northbound and southbound I-495, respectively, between 2013 and 2017 for five locations within the study area. These volumes are estimates from VDOT's historic traffic count books (VDOT, 2017). As shown, traffic volumes have been essentially stagnant the past few years, likely due to persisting capacity constraints along the corridor throughout the day.

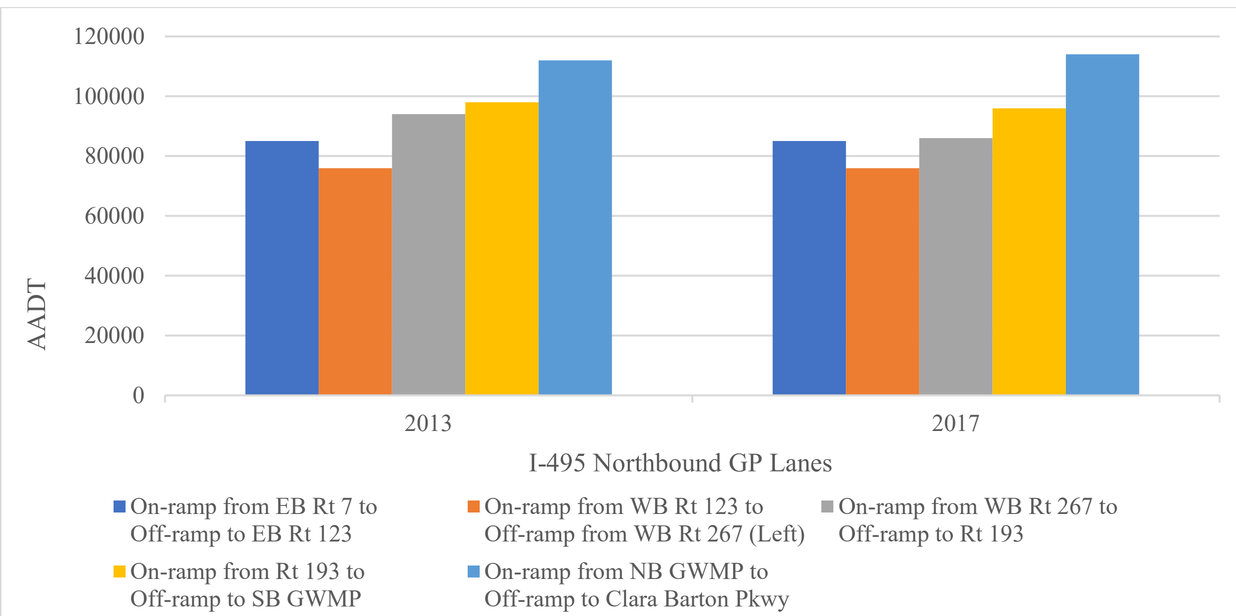


Figure 4-1. Recent Traffic Growth Along Northbound I-495

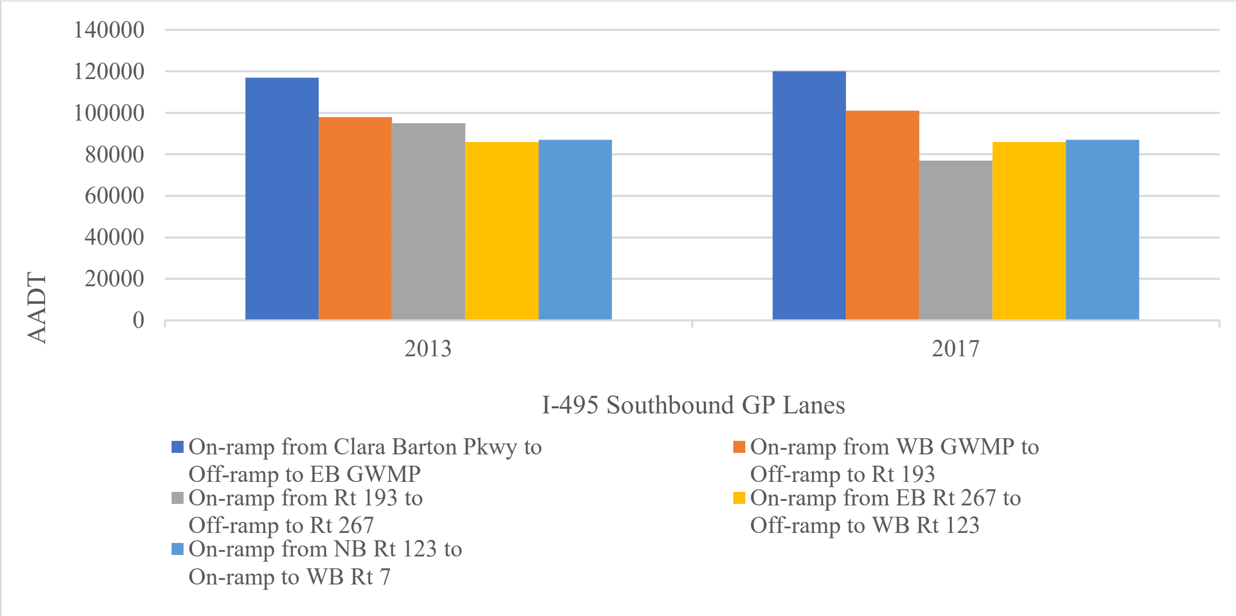


Figure 4-2. Recent Traffic Growth Along Southbound I-495

4.2 EXISTING TRAFFIC VOLUMES

4.2.1 Peaking Patterns and Existing Peak-Hour Volumes

Traffic conditions in the study area are severely oversaturated during the weekday AM and PM peak periods, with several hours of congestion in both directions, especially along northbound I-495 approaching the ALMB. Data collection verified that a single peak hour for the entire system does not exist due to low speeds. This constrains traffic throughput across several hours, often leading to lower flow rates during peak periods. **Figure 4-3** shows this pattern for the northbound I-495 GP lanes: traffic counts decrease starting around 2:00 p.m. and are lower than those observed during the early afternoon (when, during the early evening hours, the facility should theoretically be carrying higher volumes). Due to the oversaturated conditions and historical trends within the study area, it was determined that the traffic analysis periods should be based upon the periods of heaviest congestion and slowest speeds along the northbound I-495 GP lanes as shown in the INRIX speed heat map in **Exhibit 4-1.**

- For the AM peak period from 6:45 a.m. to 9:45 a.m., the network representative hour (peak hour) occurs between **7:45 a.m. and 8:45 a.m.** Queue spillback is tied to the on-ramp from GWMP and the weave across the ALMB, with the slowest speeds and longest queues occurring during the representative hour.
- For the PM peak period from 2:45 p.m. to 5:45 p.m., the network representative hour (peak hour) occurs between **3:45 p.m. and 4:45 p.m.** During the early afternoon hours between approximately 2:00 p.m. and 3:30 p.m., queue spillback and congestion along northbound I-495 is again tied to the on-ramp from GWMP and the weave across the ALMB. During the later afternoon hours after approximately 3:30 p.m., queues from downstream congestion in Maryland spill back across the ALMB, resulting in a single continuous queue. At this point, the back of the queue stabilizes for several hours, suggesting that demand is not increasing and is being processed at the same rate as it arrives.

After the AM and PM network peak hours were determined, existing traffic volumes were developed and balanced along freeway ramps and mainline segments, beginning with the I-495 GP segments and moving out to the connecting freeway system. Freeway ramp volumes were then held fixed and turning movement counts (TMCs) were balanced along arterial roadways. These balanced counts were compared to raw traffic counts and adjusted as necessary. As multi-hour simulation analysis requires the VISSIM network to be populated with traffic volumes beyond the network peak hour, input volumes were developed for each entry link into the network according to 15-minute flow rates observed in the traffic count data.

Peak hour volumes for the AM are provided for the I-495 (GP and Express) mainline and Route 267 mainline in **Exhibit 4-2a** and **Exhibit 4-2b** respectively. Peak hour volumes for the PM are provided for the I-495 mainline and Route 267 mainline in **Exhibit 4-3a** and **Exhibit 4-3b** respectively. Peak hour volumes for the arterial network are provided in **Exhibit 4-4a** through **Exhibit 4-4e.**

4.2.2 Existing Daily Traffic Volumes

Existing average weekday daily traffic (AWDT) volumes were estimated from traffic counts conducted in May and June 2018. AWDT in this report represents the average of data collected on a Tuesday, Wednesday, and Thursday. These data were additionally adjusted to balance traffic volumes in the study area. Average daily traffic (AWDT) volumes within the study area are provided in **Exhibit 4-5a** and **Exhibit 4-5b**.

Sample count data along four successive I-495 GP segments are shown in **Figure 4-3** and **Figure 4-4**, representing the average weekday hourly volumes at each location in the northbound and southbound directions, respectively. The daily curves indicate the expected volume distribution during an average weekday, with the highest throughput volumes observed during the AM peak period in both directions. Note that especially in the northbound direction, traffic volumes decrease through the AM and PM peak periods, as congestion constrains throughput along the corridor. This is particularly notable during the PM peak period, where actual throughput along I-495 is much lower than its hypothetical capacity (approximately 1,800 to 2,000 vehicles per hour per lane). This phenomenon is primarily in the northbound direction due to the bottleneck at the ALMB as opposed to the southbound direction, which, while there is still congestion present, contains multiple departure points for traffic to exit the facility (e.g. Route 267, Route 123).

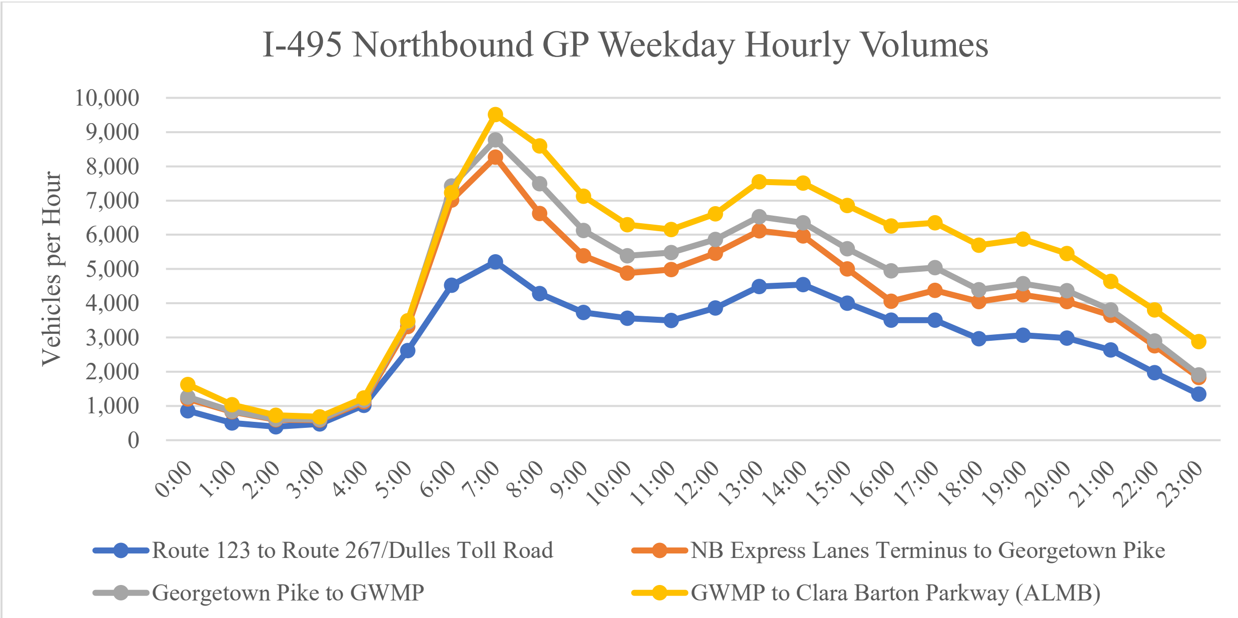


Figure 4-3. Average Weekday Hourly Volumes along Northbound I-495 GP Lanes

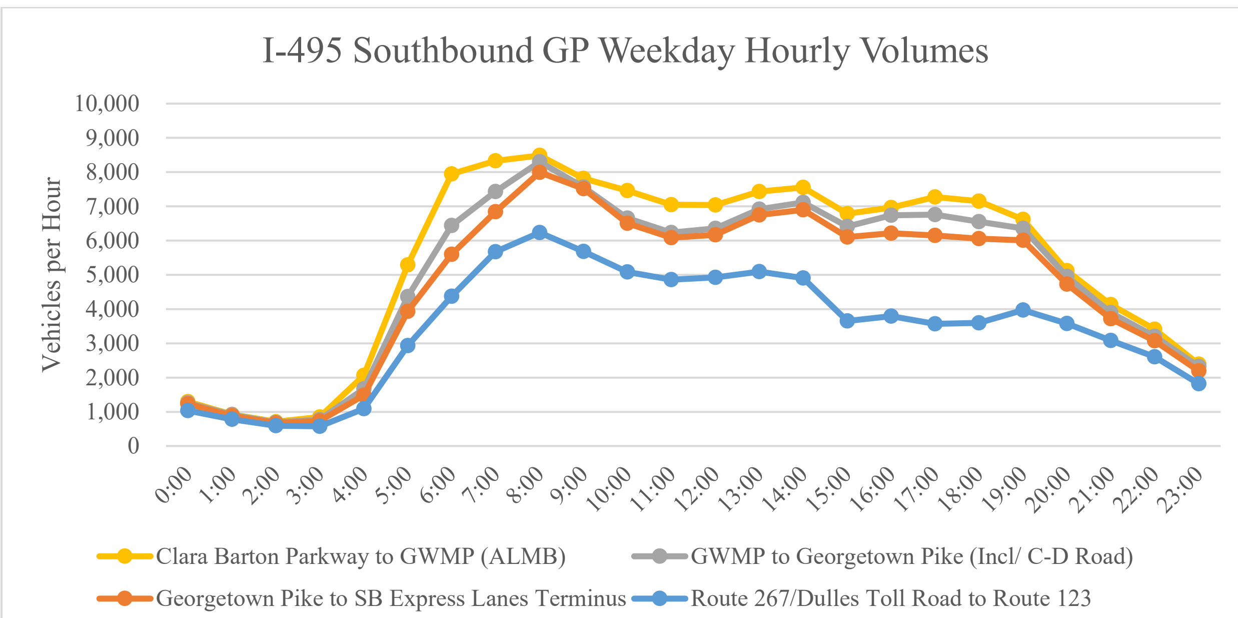


Figure 4-4. Average Weekday Hourly Volumes along Southbound I-495 GP Lanes

4.2.3 Vehicle Occupancy Data

The following assumptions were made regarding vehicle occupancy, which was used to estimate person throughput as a measure of effectiveness for existing conditions and future No Build No Build No Build and Build conditions:

- GP lanes: 1.1 persons/vehicle assumed. This is based on average non-HOV lane occupancy data for the region from a 2014 MWCOG study (MWCOG, 2014) as observed on various facilities in northern Virginia (I-395, I-95, I-66, and Dulles Toll Road).
- Express Lanes: 1.44 persons/vehicle assumed. This is derived from an assumption 18 percent of vehicles during the peak period operating as HOV-3 (3 persons/vehicle) based on available data for the existing I-495 Express Lanes through Tysons; the remaining 82 percent of vehicles (toll-paying) are assumed to have the same non-HOV auto occupancy as the GP lanes.

4.3 ORIGIN-DESTINATION (O-D) PATTERNS

The study area is located at a crossroads important to both the greater Washington, D.C. region and the East Coast as a whole. The Interstate 95 (I-95) corridor, the main freeway route for the eastern United States, splits into two parallel freeways around Washington, D.C. I-95 is signed for the north/south freeway running around the east side of Washington, D.C., while I-495 serves as a parallel route around the west side. Additionally, I-495 carries travel from Interstate 66 (I-66), the Dulles Toll Road (DTR), and Interstate 270 (I-270) to and from points adjacent to the study area in Maryland and Virginia. Within the study area is Tysons, the rapidly-growing central business and shopping district for Fairfax County. It contains the largest concentration of commercial office space in the Washington, D.C. region, and I-495 provides the main north-south link in and out of Tysons to other parts of the region. **Figure 4-5** shows the study area in the context of regional travel patterns.

An analysis of travel patterns along I-495 using StreetLight Data, a provider of anonymized mobile device analytics to support transportation studies, shows that trips have a wide-ranging set of origins and destinations well outside the study area. **Figure 4-6** and **Figure 4-7** provide maps of the most common trip origins and destinations, respectively, for trips carried along northbound I-495 between the DTR and Route 193. These maps show that many trips within the study area originate in Tysons and in locations further to the south or west, such as Dulles International Airport (IAD) and Prince William County, and are destined for Maryland, especially areas along the I-270 corridor.

Figure 4-8 shows the estimated average daily traffic volumes at all Potomac River crossings in the region. The I-495 ALMB at the north end of the study area and the I-95/I-495 Woodrow Wilson Bridge south of Washington, D.C. are the only two river crossings directly between Virginia and Maryland within the vicinity of Washington, D.C. As a result, they carry very heavy traffic volumes exceeding 200,000 vehicles per day. Error! Reference source not found. and Error! Reference source not found. break down the origin and destination jurisdictions (also provided by StreetLight Data), respectively, for AWDT crossing the ALMB along northbound I-495.

Figure 4-5. Study Area in the Context of Regional Travel Patterns

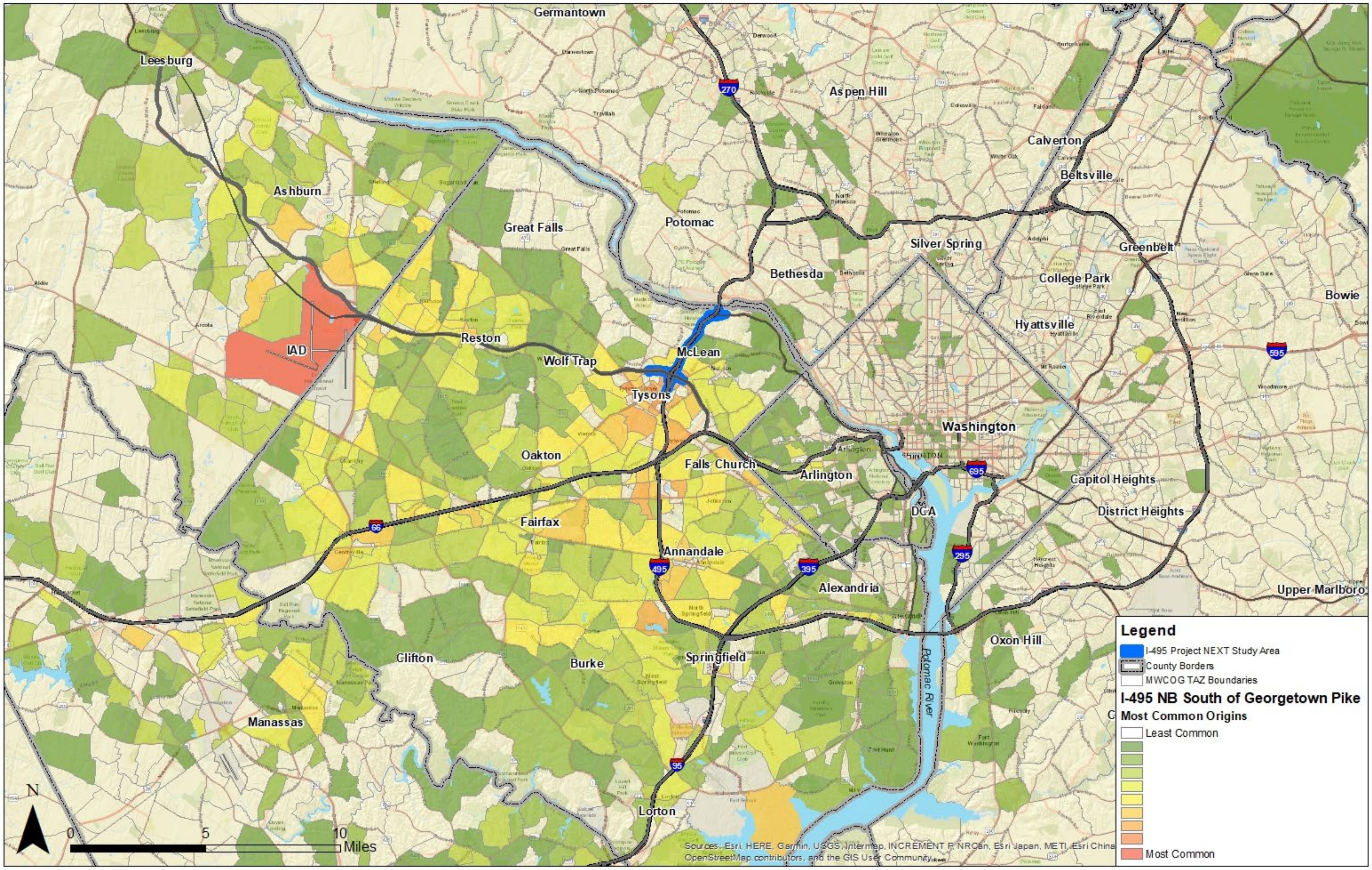


Figure 4-6. Trip Origins along Northbound I-495 between the DTR and Route 193

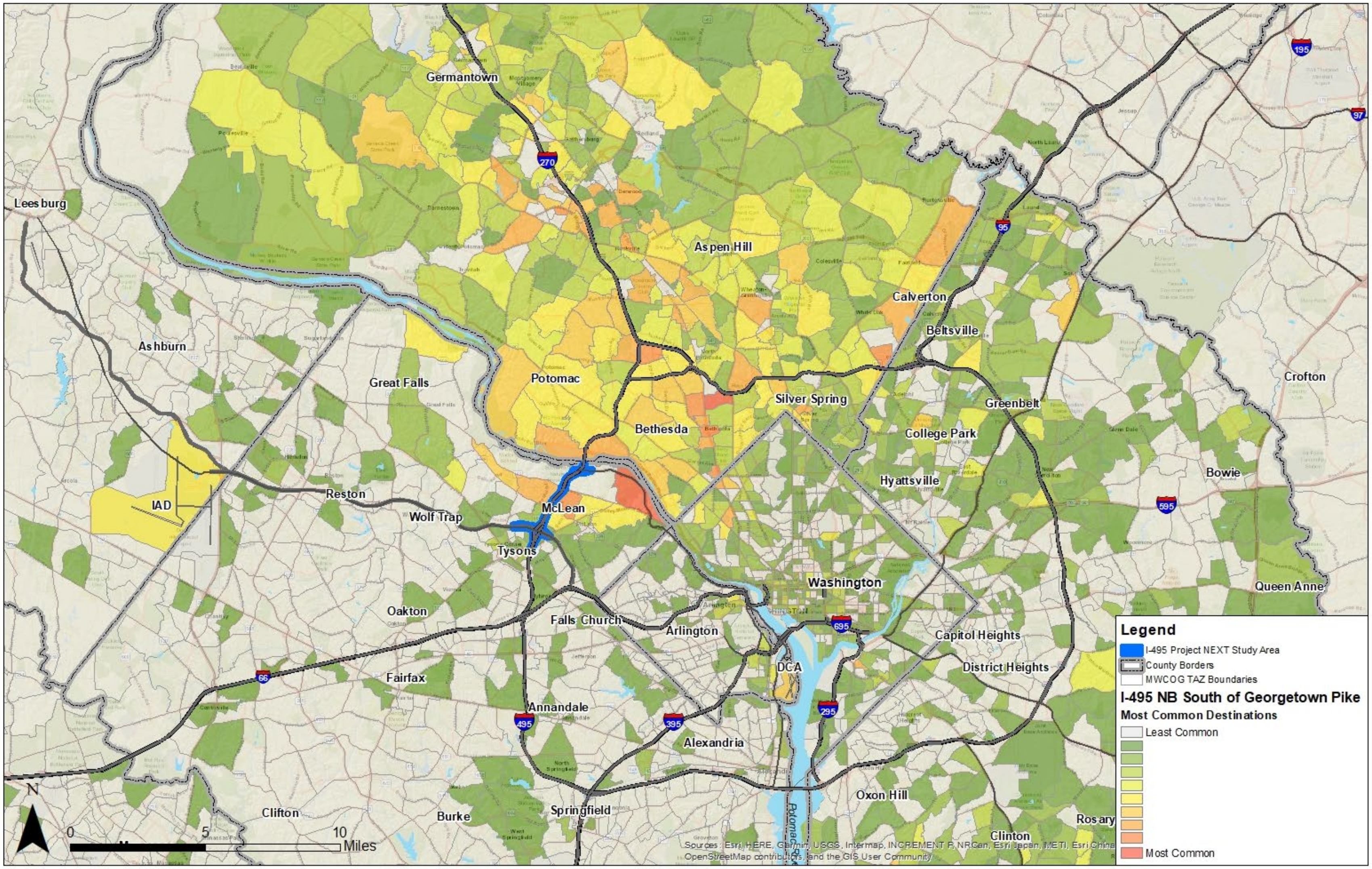


Figure 4-7. Trip Destinations along Northbound I-495 between the DTR and Route 193

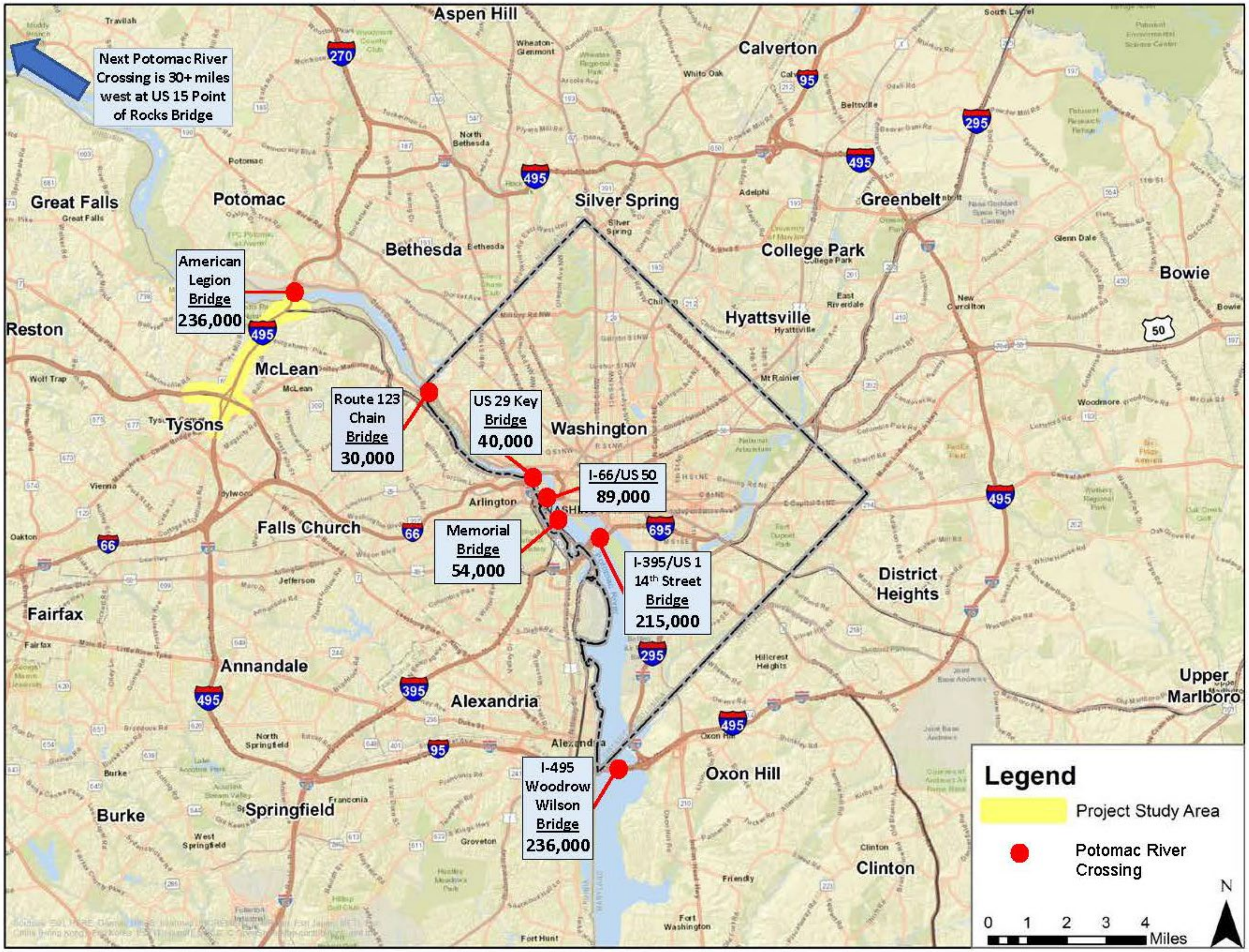


Figure 4-8. Average Daily Traffic Volumes at Potomac River Crossings in the Washington, D.C. Area

Table 4-1. Origin Jurisdiction for AWDT Along Northbound I-495 at the ALMB

Origin Jurisdiction	Percent Contribution to Traffic on ALMB (Northbound)
Fairfax County/Fairfax City/Falls Church	56.1%
Loudoun County	10.6%
Arlington County	8.7%
District of Columbia	8.7%
Prince William County/Manassas/Manassas Park	6.1%
City of Alexandria	3.1%
Other	6.6%

Table 4-2. Destination Jurisdiction for AWDT Along Northbound I-495 at the ALMB

Destination Jurisdiction	Percent Contribution to Traffic on ALMB (Northbound)
Montgomery County	68.5%
Prince George's County	12.6%
District of Columbia	7.2%
Frederick County	4.2%
Other	7.5%

4.4 EXISTING TRAFFIC OPERATIONS AND LEVELS OF SERVICE

4.4.1 Baseline VISSIM Model Development and Calibration

Calibration of the project existing conditions VISSIM models relied on guidance from the VDOT TOSAM (VDOT, 2015) and was previously described in **Chapter 2**; a detailed overview of the calibration process and measures is further provided as **Appendix D**. The complexity of the proposed project's VISSIM analysis network due to its existing operational deficiencies impacted the calibration target criteria selected for this study. These selected criteria include traffic volumes, speeds, travel times, and queue lengths. Since freeway congestion significantly impacts corridor operations, the calibration measures focused primarily on freeway operations. However, arterial throughputs and queue lengths at key intersections' critical movements were also compared to field observations during the calibration.

As also noted in **Chapter 2**, VISUM planning software was used to create origin-destination (O-D) matrices that reflect regional trip patterns based on data from StreetLight and MWCOG. These O-D matrices were merged with balanced freeway and ramp demand as well as balanced intersection turning movements to develop an O-D matrix reflecting travel patterns within the study area.

Simulation analysis periods were chosen and approved by the VDOT Northern Virginia District Traffic Engineer to cover the AM and PM peak periods (6:45 a.m. to 9:45 a.m. and 2:45 p.m. to 5:45 p.m., respectively). A 30-minute seeding period was used for the AM VISSIM models, while a 60-minute seeding period was used for the PM models. As VISSIM microsimulation models have random elements in the vehicle mix and other components, multiple runs of the model for each scenario are required to develop a statistically valid result. VDOT's Sample Size Determination tool was used to determine that 10 model runs were sufficient to obtain a statistically valid result. This calculation is provided in **Appendix D**.

4.4.2 Existing AM Freeway Operations

Exhibits 4-6a through **4-6c** and **Exhibits 4-7a** through **4-7c** illustrate the density and speed results, respectively, from the VISSIM models for the I-495 and Route 267 mainline segments in the study area for the AM peak period. In each figure, the centerline diagram laid over the aerial depicts the average densities or speeds during the peak hour from 7:45 a.m. to 8:45 a.m. in both directions along the mainline segments. The average densities and speeds are color-coded based on the congestion levels and ranges of speeds as depicted in the legend. The boxes on the top and bottom depict the densities and speeds in each direction for the entire peak period from 6:45 a.m. to 9:45 a.m., including the shoulder periods before and after the peak hour. Detailed tabular results can be found in **Appendix E.**

Density

In the AM peak period, northbound I-495 approaching the ALMB experiences congested-to-severely congested conditions for the entire peak period, beginning at the weave on the ALMB and continuing to the DTR interchange. At the interchange of Route 123 and I-495, the Route 123 eastbound off-ramp spills back to the northbound I-495 mainline.

Southbound I-495 between River Road and Route 193 experiences heavy congestion in the peak hour and in the shoulder hour with some segments operating under congested to severely congested levels. Congestion during the shoulder hour worsens compared to the peak hour as congestion clears upstream and more demand reaches the study area.

Speeds

Average VISSIM speeds show similar patterns as seen in the density diagrams, with speeds along northbound I-495 starting to break down approaching the ALMB and spill back to the Route 267 interchange. Average speeds in this segment are below 35 mph with some segments operating below 20 mph (queue condition). Average speeds along southbound I-495 range from 50 to 55 mph during the peak hour. In the shoulder hour, speeds drop below 35 mph in some segments between River Road and Clara Barton Parkway.

Simulated Volumes

Figure 4-9 shows the comparison between simulated vehicle throughput and the balanced traffic counts along northbound I-495 during the AM peak hour. As shown in the figure, most segments along northbound I-495 were able to process the balanced counts for the peak hour. It should be noted that balanced counts are those that have been post-processed from field counts and may not reflect collected, in-field traffic volumes due to capacity constraints.

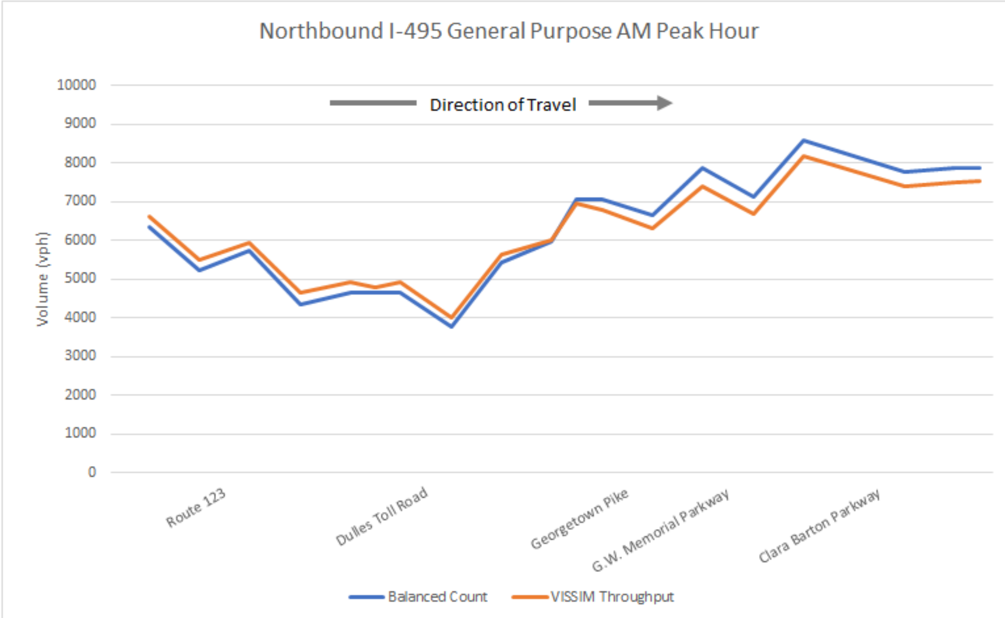


Figure 4-9. AM Peak Hour Balanced Count vs. Simulated Throughput – Northbound I-495

4.4.3 Existing PM Freeway Operations

Exhibits 4-8a through **4-8c** and **Exhibits 4-9a** through **4-9c** illustrate the density and speed results, respectively, from the VISSIM models for the I-495 and Route 267 mainline segments in the study area for the PM peak period. Similar to the AM peak figures, the centerline diagram depicts the average densities or speeds during the peak hour from 3:45 p.m. to 4:45 p.m. in both directions along the mainline segments. The average densities and speeds are color-coded based on the congestion levels and ranges of speeds as depicted in the legend. The boxes on the top and bottom depict the densities and speeds in each direction for the entire peak period from 2:45 p.m. to 5:45 p.m. Detailed tabular results can be found in **Appendix E**.

Density

In the PM peak period, northbound I-495 is severely congested due to two points of congestion. The first congestion point is located outside of the study area at I-270 in Maryland, and the second point is located between the Route 193 and the GWMP interchanges where the part-time shoulder lane drops on the left side while vehicles from the Route 193 interchange are also merging onto northbound I-495 on the right side. This pinch from both sides creates friction in the through lanes and worsens as the slowdown from I-270 in Maryland merges to this location. The resulting queue extends beyond the Route 123 interchange. The corridor operates under severe congestion, not only during the peak hour, but for the entire peak period.

Similarly, along southbound I-495, segments between River Road and the Route 267 interchange operate under severe congestion. The remaining segments between the Route 123 and Route 267 interchanges operate under light-to-moderate density levels.

Speeds

Average VISSIM speeds show similar patterns as seen in the density diagrams with speeds below 25 mph along northbound I-495 throughout the study area. Some segments operate below 20 mph (queue condition). The speeds are lower for the entire peak period for all northbound I-495 segments. Average speeds along southbound I-495 range from 10 to 35 mph between the Route 267 interchange and River Road.

Simulated Volumes

Figure 4-10 shows the comparison between simulated vehicle throughput and the balanced traffic counts along northbound I-495 during the PM peak hour. Similar to the AM peak hour, most northbound I-495 segments were able to process the balanced counts for the PM peak hour. All segments along northbound I-495 have unserved volumes of less than five percent except for a few between the Route 267 interchange and Route 193 interchange which have unserved demands of eight to nine percent. It should be noted that balanced counts are those that have been post-processed from field counts and may not reflect collected, in-field traffic volumes due to capacity constraints.

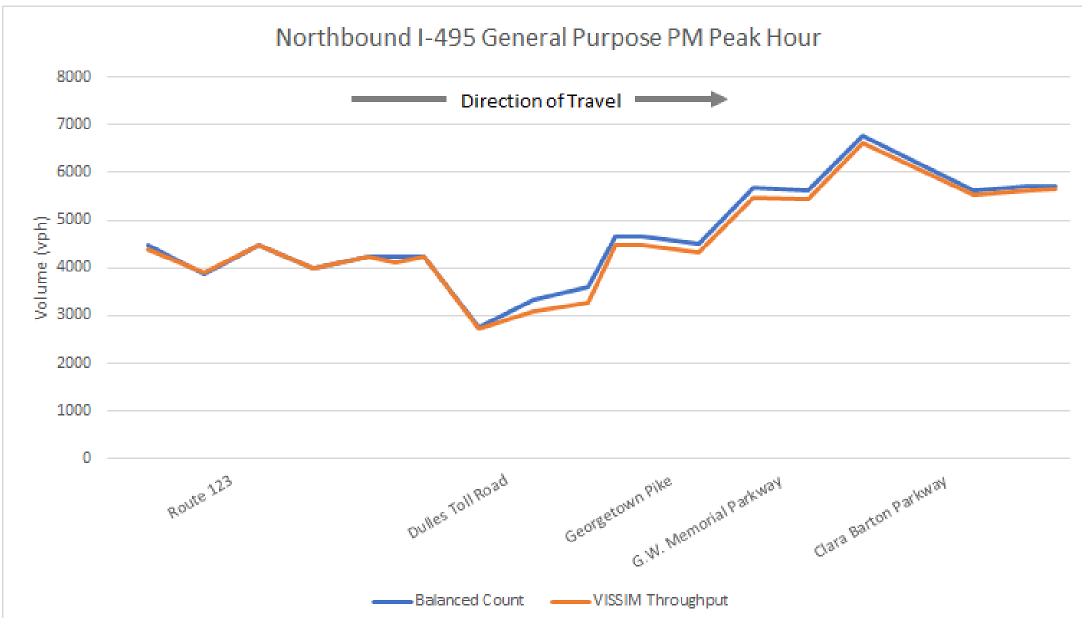


Figure 4-10. PM Peak Hour Balanced Count vs. Simulated Throughput – Northbound I-495

4.4.4 Existing Arterial Operations

AM Arterial Operations

Intersections Evaluated in VISSIM

With the exception of three intersections that operate at LOS F and one that operates at LOS E, almost 80 percent of the intersections within the study area operate at an adequate LOS during the AM peak hour from 7:45 a.m. – 8:45 a.m. as indicated in **Figure 4-11** and in **Table 4-3**. It is important to note that while many of these intersections operate at adequate overall microsimulation LOS, many of the individual approaches operate at failing conditions (see **Appendix F** for arterial intersection delay and LOS details).

Intersections Evaluated in Synchro

The expanded arterial network beyond intersections immediately adjacent to freeway interchanges in the corridor was evaluated solely through Synchro. With the exception of the Old Dominion Drive and Balls

Hill Road intersection which operates at LOS F, all intersections operate at an adequate LOS (LOS D or better) during the AM peak as indicated in **Table 4-4**.

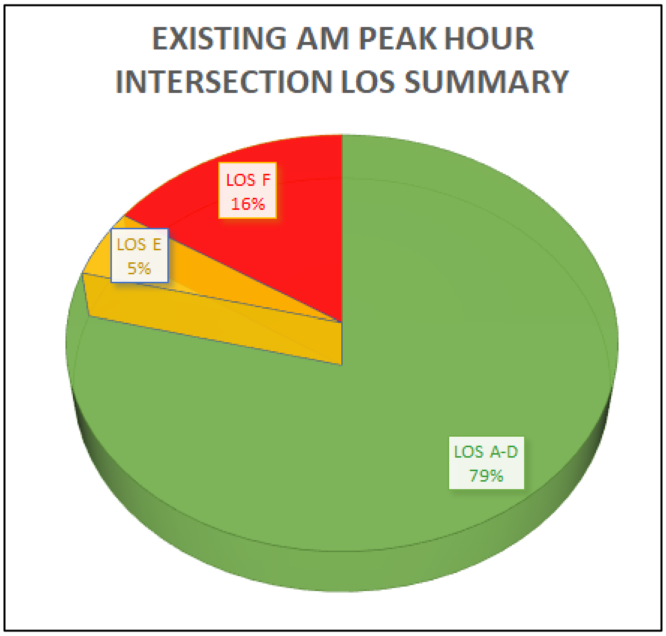


Figure 4-11. Summary of Arterial HCM-Analogous LOS for AM Existing Conditions

Table 4-3. VISSIM Intersection Microsimulation Delay and HCM-Analogous LOS – Existing AM Peak Hour

Intersection	Approach	Average Approach Microsimulation Delay (seconds/vehicle)	Approach HCM-Analogous LOS	Intersection Microsimulation Delay (seconds/vehicle)	Intersection HCM-Analogous LOS
Route 123 and Tysons Boulevard	NB	24.0	C	30.6	C
	SB	26.8	C		
	EB	64.1	E		
	WB	47.6	D		
Westpark Drive and Tysons Connector	NB	16.9	B	17.2	B
	SB	12.3	B		
	WB	19.1	B		
Tysons Connector and Express Lanes Ramps	NB	16.1	B	13.5	B
	SB	11.4	B		
	EB	9.8	A		
Route 123 and Capital One Tower Drive/Old Meadow Road	NB	119.0	F	74.3	E
	SB	19.7	B		
	EB	149.9	F		
	WB	59.6	E		
Route 123 and Scotts Crossing Boulevard/Colshire Drive	NB	16.1	B	19.7	B
	SB	19.1	B		
	EB	39.5	D		
	WB	61.3	E		
Route 123 and Route 267 Eastbound Off-Ramp/Anderson Road	NB	42.5	D	46.8	D
	SB	44.9	D		
	EB	43.7	D		
	WB	77.2	E		
Route 123 and Lewinsville Road/Great Falls Street	NB	124.0	F	100.9	F
	SB	78.4	E		
	EB	54.0	D		
	WB	122.2	F		
Lewinsville Road and Balls Hill Road	SB	167.4	F	26.5	C
	EB	23.7	C		
	WB	4.3	A		
Jones Branch Drive and Jones Branch Connector	NB	19.9	B	14.5	B
	SB	8.3	A		
	WB	15.4	B		
Jones Branch Connector and Express Lanes Ramps	NB	13.2	B	11.4	B
	SB	11.0	B		
	EB	10.1	B		
International Drive and Spring Hill Road/Jones Branch Drive	NB	53.7	D	48.0	D
	SB	42.2	D		
	EB	54.5	D		
	WB	64.5	E		

Intersection	Approach	Average Approach Microsimulation Delay (seconds/vehicle)	Approach HCM-Analogous LOS	Intersection Microsimulation Delay (seconds/vehicle)	Intersection HCM-Analogous LOS
Spring Hill Road and DTR Eastbound Ramps	NB	27.4	C	168.0	F
	SB	51.8	D		
	EB	311.4	F		
Spring Hill Road and DTR Westbound Ramps	NB	13.3	B	32.5	C
	SB	19.5	B		
	WB	74.6	E		
Spring Hill Road and Lewinsville Road	NB	60.4	E	52.4	D
	SB	80.7	F		
	EB	52.7	D		
	WB	33.3	C		
Route 193 and Helga Place/Linganore Drive	NB	6.7	A	56.1	F
	SB	56.1	F		
	EB	44.0	E		
	WB	0.5	A		
Route 193 and I-495 Southbound Ramps	SB	25.1	C	24.3	C
	EB	24.7	C		
	WB	22.5	C		
Route 193 and I-495 Northbound Ramps	NB	83.2	F	27.8	C
	EB	15.3	B		
	WB	19.7	B		
Route 193 and Balls Hill Road	NB	58.8	E	27.8	C
	SB	26.3	C		
	EB	19.3	B		
	WB	17.9	B		
Route 193 and Dead Run Drive	NB	8.7	A	9.3	A
	EB	1.0	A		
	WB	0.8	A		

Table 4-4. Synchro Intersection Delay and LOS – Existing AM Peak Hour

Intersection	Approach	Approach Delay (s/veh)	Approach LOS	Intersection Delay (s/veh)	Intersection LOS
Old Dominion Drive at Spring Hill Road	NB	21.5	C	13.9	B
	SB	26	C		
	EB	11.9	B		
	WB	7.9	A		
Old Dominion Drive at Swinks Mill Road	NB	48.9	D	29.3	C
	SB	38	D		
	EB	25	C		
	WB	8.5	A		

Intersection	Approach	Approach Delay (s/veh)	Approach LOS	Intersection Delay (s/veh)	Intersection LOS
Old Dominion Drive at Balls Hill Road	NB	121	F	101.9	F
	SB	112	F		
	EB	82.1	F		
	WB	113.3	F		
Route 123 at Old Dominion Drive	NB	17.6	B	39.5	D
	SB	29.4	C		
	EB	81.7	F		
	WB	77.7	E		
Georgetown Pike at Swinks Mill Road	NB	106.9	F	33.1	D
	SB	0.0	A		
	EB	0	A		
	WB	3.4	A		
Georgetown Pike at Spring Hill Road	NB	18.2	A	1.1	A
	EB	0	A		
	WB	1.2	A		
Lewinsville Road at Swinks Mill Road	SB	40.6	E	6.1	A
	EB	2.6	A		
	WB	0	A		
Route 123 at Ingleside Avenue	NB	0.3	A	0.9	A
	SB	0.6	A		
	EB	13.5	B		
	WB	10.4	B		
Douglass Drive at Route 193 (Georgetown Pike)	NB	36.8	E	7.4	A
	SB	24.8	C		
	EB	0.6	A		
	WB	1.9	A		

PM Arterial Operations

Intersections Evaluated in VISSIM

As shown in **Figure 4-12** and in **Table 4-5**, there are more intersections that operate at failing conditions during the PM peak hour from 3:45 p.m. to 4:45 p.m. than during the AM peak hour. Out of the total 19 intersections evaluated, five operate at failing conditions of LOS F, while three intersections operate at near-failing conditions of LOS E. The remaining intersections operate at an acceptable LOS D or better during the PM peak hour. It is important to note that while many of these intersections operate at adequate overall control LOS, many of the individual approaches operate at failing conditions. Additional detail on arterial traffic operations, including intersection approach delay and LOS is summarized in **Appendix F**.

Intersections Evaluated in Synchro

The expanded arterial network beyond intersections immediately adjacent to freeway interchanges in the corridor was evaluated solely through Synchro. As during the AM peak hour, only the Old Dominion Drive and Balls Hill Road intersection operates at LOS F, as indicated in **Table 4-6**. The remaining intersections operate at an adequate LOS (LOS D or better) during the PM peak hour. Although the intersections operate at an adequate overall control LOS, many of the individual approaches operate at failing conditions.

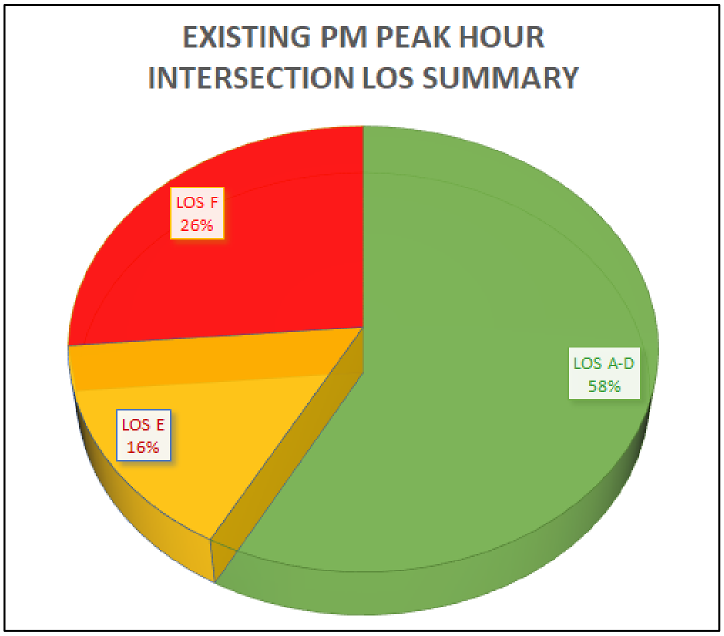


Figure 4-12. Summary of Arterial HCM-Analogous LOS for PM Existing Conditions

Table 4-5. VISSIM Intersection Microsimulation Delay and HCM-Analogous LOS – Existing PM Peak Hour

Intersection	Approach	Average Approach Microsimulation Delay (seconds/vehicle)	Approach HCM-Analogous LOS	Intersection Microsimulation Delay (seconds/vehicle)	Intersection HCM-Analogous LOS
Route 123 and Tysons Boulevard	NB	73.5	E	73.9	E
	SB	45.4	D		
	EB	96.9	F		
	WB	151.8	F		
Westpark Drive and Tysons Connector	NB	5.3	A	5.7	A
	SB	5.3	A		
	WB	12.0	B		
Tysons Connector and Express Lanes Ramps	NB	14.8	B	5.8	A
	SB	5.7	A		
	EB	5.1	A		
Route 123 and Capital One Tower Drive/Old Meadow Road	NB	39.7	D	39.8	D
	SB	22.0	C		
	EB	64.6	E		
	WB	84.8	F		
Route 123 and Scotts Crossing Boulevard/Colshire Drive	NB	8.9	A	18.9	B
	SB	17.2	B		
	EB	27.3	C		
	WB	88.3	F		
Route 123 and Route 267 Eastbound Off-Ramp/Anderson Road	NB	26.5	C	37.2	D
	SB	27.3	C		
	EB	50.6	D		
	WB	125.9	F		
Route 123 and Lewinsville Road/Great Falls Street	NB	80.6	F	91.9	F
	SB	117.5	F		
	EB	53.3	D		
	WB	111.8	F		
Lewinsville Road and Balls Hill Road	SB	45.7	D	113.9	F
	EB	225.9	F		
	WB	7.3	A		
Jones Branch Drive and Jones Branch Connector	NB	11.3	B	7.0	A
	SB	3.2	A		
	WB	15.7	B		
Jones Branch Connector and Express Lanes Ramps	NB	11.9	B	12.2	B
	SB	9.6	A		
	EB	12.5	B		
International Drive and Spring Hill Road/Jones Branch Drive	NB	67.2	E	60.9	E
	SB	62.7	E		
	EB	55.5	E		
	WB	59.1	E		
Spring Hill Road and DTR Eastbound Ramps	NB	7.6	A	14.8	B
	SB	4.6	A		
	EB	75.6	E		

Intersection	Approach	Average Approach Microsimulation Delay (seconds/vehicle)	Approach HCM-Analogous LOS	Intersection Microsimulation Delay (seconds/vehicle)	Intersection HCM-Analogous LOS
Spring Hill Road and DTR Westbound Ramps	NB	27.5	C	28.9	C
	SB	21.7	C		
	WB	56.1	E		
Spring Hill Road and Lewinsville Road	NB	82.4	F	62.4	E
	SB	74.2	E		
	EB	63.4	E		
	WB	40.3	D		
Route 193 and Helga Place/Linganore Drive	NB	0.0	A	245.1	F
	SB	245.1	F		
	EB	54.9	F		
	WB	0.7	A		
Route 193 and I-495 Southbound Ramps	SB	29.6	C	33.7	C
	EB	46.3	D		
	WB	28.1	C		
Route 193 and I-495 Northbound Ramps	NB	290.7	F	52.4	D
	EB	16.3	B		
	WB	45.3	D		
Route 193 and Balls Hill Road	NB	1,028.7	F	210.7	F
	SB	20.0	B		
	EB	7.7	A		
	WB	130.4	F		
Route 193 and Dead Run Drive	NB	140.4	F	141.4	F
	EB	0.2	A		
	WB	463.6	F		

Table 4-6. Synchro Intersection Delay and LOS – Existing PM Peak Hour

Intersection	Approach	Approach Delay (s/veh)	Approach Delay (s/veh)	Intersection Delay (s/veh)	Intersection LOS
Old Dominion Drive at Spring Hill Road	NB	28.5	C	16.5	B
	SB	19.1	B		
	EB	9.9	A		
	WB	15.7	B		
Old Dominion Drive at Swinks Mill Road	NB	31.2	C	19.2	B
	SB	21.9	C		
	EB	13.4	B		
	WB	17.1	B		
Old Dominion Drive at Balls Hill Road	NB	135	F	167.5	F
	SB	247.8	F		
	EB	179.1	F		
	WB	115.8	F		

Intersection	Approach	Approach Delay (s/veh)	Approach Delay (s/veh)	Intersection Delay (s/veh)	Intersection LOS
Route 123 at Old Dominion Drive	NB	27	C	47.3	D
	SB	40.2	D		
	EB	77.2	E		
	WB	86.1	F		
Georgetown Pike at Swinks Mill Road	NB	14.1	B	3.8	A
	SB	0	A		
	EB	0	A		
	WB	2.4	A		
Georgetown Pike at Spring Hill Road	NB	13.2	B	1.3	A
	EB	0	A		
	WB	1.2	A		
Lewinsville Road at Swinks Mill Road	SB	68.2	F	9.3	A
	EB	2.8	A		
	WB	0	A		
Route 123 at Ingleside Avenue	NB	3.3	A	2.6	A
	SB	0.2	A		
	EB	23.2	C		
	WB	10.7	A		
Douglass Drive at Route 193 (Georgetown Pike)	NB	104.5	F	20.3	C
	SB	42.6	E		
	EB	0.5	A		
	WB	3.7	A		

4.5 SUMMARY OF EXISTING OPERATIONAL DEFICIENCIES

Based on the traffic simulation results, the travel demand is higher than the existing capacity for much of the study area under existing conditions. This is reflected in the high densities and low speeds found in many segments in the peak directions. General characteristics of congestion on the corridor include:

- **Substantial multi-hour queues in both directions**.
  - Bottlenecks created by major merge areas, as experienced in the northern terminus of the study area.
  - Congestion from downstream impacting study area network, including areas in Maryland north of the ALMB and congestion in Tysons south of the study area.
  - Bottlenecks created due to lane drops, such as the I-495 northbound GP merge where the shoulder lane terminates.
  - Bi-directional demand and weaving result in congestion in both directions during both peak periods, such as weaving along I-495 northbound GP between the on-ramp from Route 193 and the off-ramp to GWMP.
  - The on-ramp from the GWMP to I-495 northbound frequently queues back onto the GWMP outbound/westbound mainline for several miles to as far back as the GWMP/Route 123 interchange.
  - As shown in **Exhibit 4-1**, in the northbound direction along I-495, the AM peak period lasts almost four hours, and the PM peak period lasts for more than six hours. In the

southbound direction, the AM peak period lasts approximately two hours and the PM peak period lasts for approximately five hours.

- **Heavy volumes entering and exiting I-495 at the Route 267 interchange affect traffic in both directions for extended periods**.
  - Heavy demand from Route 267 entering an already congested segment of I-495 results in more congestion and queue spill-backs. The I-495 northbound GP on-ramp from DTR/DAAR eastbound frequently spills back to the DTR/DAAR mainlines due to heavy demand and congestion along I-495 northbound GP. The I-495 southbound GP on-ramp from DTR/DAAR eastbound creates weaving issues along I-495 southbound, as the off-ramp to Route 123 and destinations in Tysons is just downstream of this location.
- **Cut-through traffic on local parallel arterials creates more disturbance along mainline.**
  - Vehicles detouring to avoid I-495 congestion create more disturbance to the flow of traffic by exiting to use parallel arterial facilities, such as Balls Hill Road and Swinks Mill Road, and then entering again at downstream locations along I-495, such as at Route 193.
- **High-Occupancy Toll (HOT) traffic to and from the I-495 Express Lanes and weaving in and out from GP lanes results in congestion.**
  - The speed differential as well as weaving in and out from the I-495 Express Lanes that have ingress and egress just north of the Route 267 interchange create congestion in the GP lanes.

4.5.1 Major Points of Congestion

- Northbound I-495
  - Hours of congestion: 7:00 a.m. to 11:00 a.m. and 1:30 p.m. to 8:00 p.m.
  - Congestion within the study area is largely due to downstream congestion from beyond the ALMB and starts between Route 193 and GWMP where the part-time shoulder lane drops on the left side and vehicles from Route 193 are merging on the right side. The slowdown from the Clara Barton Parkway interchange also impacts this segment.
  - Queues spill back beyond the DTR interchange in the AM and PM peak periods. Cut-through traffic trying to avoid I-495 congestion by entering from the Route 193 ramp creates congestion that starts as early as 1:30 p.m.
  - After 3 p.m., congestion from I-270 in Maryland starts to spill back and worsen existing queues, extending back to beyond the Route 123 interchange, where queues then generally stabilize and are sustained through the peak period.
  - Route 267, Route 193, and GWMP experience queuing on ramps, mainline segments, and arterial intersections due to northbound I-495 congestion, sometimes extending for miles in the case of GWMP.
- Southbound I-495
  - Hours of congestion: 8:00 a.m. to 10:00 a.m. and 2:00 p.m. to 7:00 p.m.
  - In the AM peak period, congestion begins at the Route 193 ramp where the C-D road from the GWMP merges on to southbound I-495 and is also used as a bypass lane for through traffic.
  - In the PM peak period, multiple localized bottlenecks combined with downstream congestion cause queue spillbacks in Tysons back to the DTR interchange. The traffic weaving between the on-ramp from eastbound Route 267 and the off-ramps to Route 123

adds to this congestion, resulting in congestion spilling back onto the Route 267 ramps and mainline.

- Route 193 ramp congestion due to the C-D road merge happens independently and starts earlier in the PM peak period, creating a separate bottleneck along southbound I-495. Vehicles merging on the right from the GWMP and Route 193 that weave across to access the I-495 Express Lanes add to this congestion. Downstream congestion causes more vehicles to try to enter the Express Lanes, resulting in more congestion upstream of the Express Lanes.

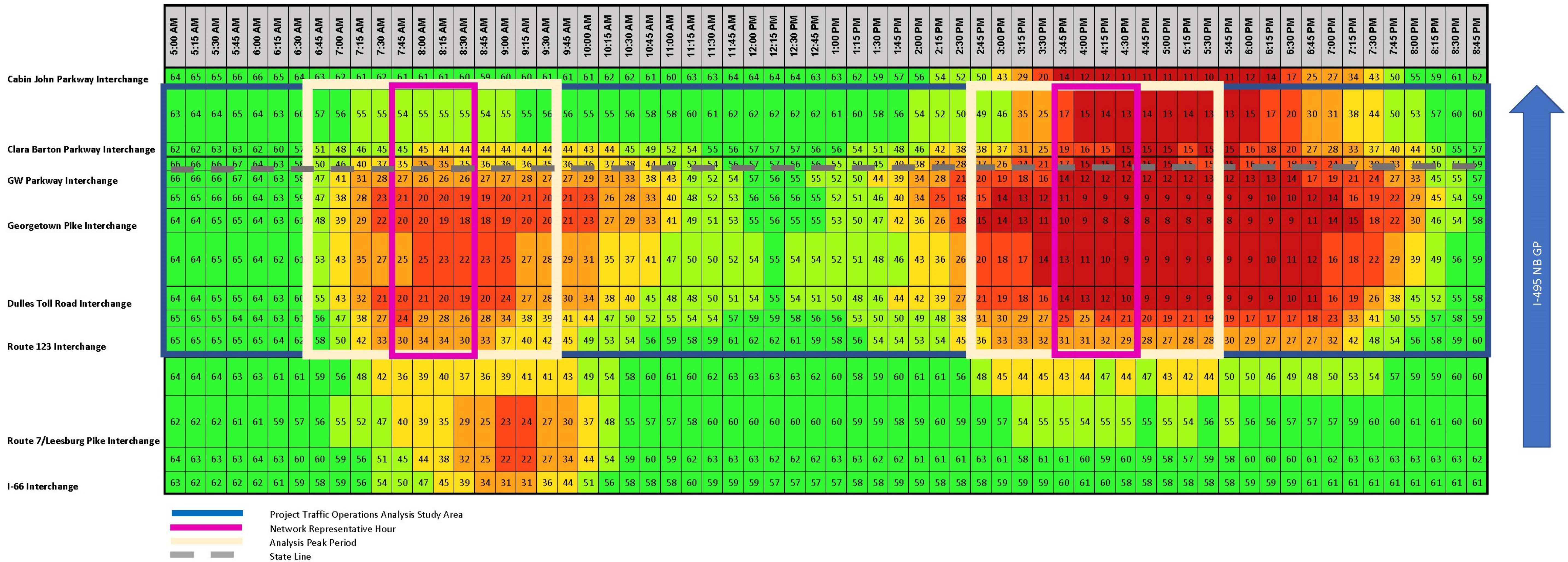


Exhibit 4-1. Definition of Peak Periods and Representative Hours – Northbound I-495

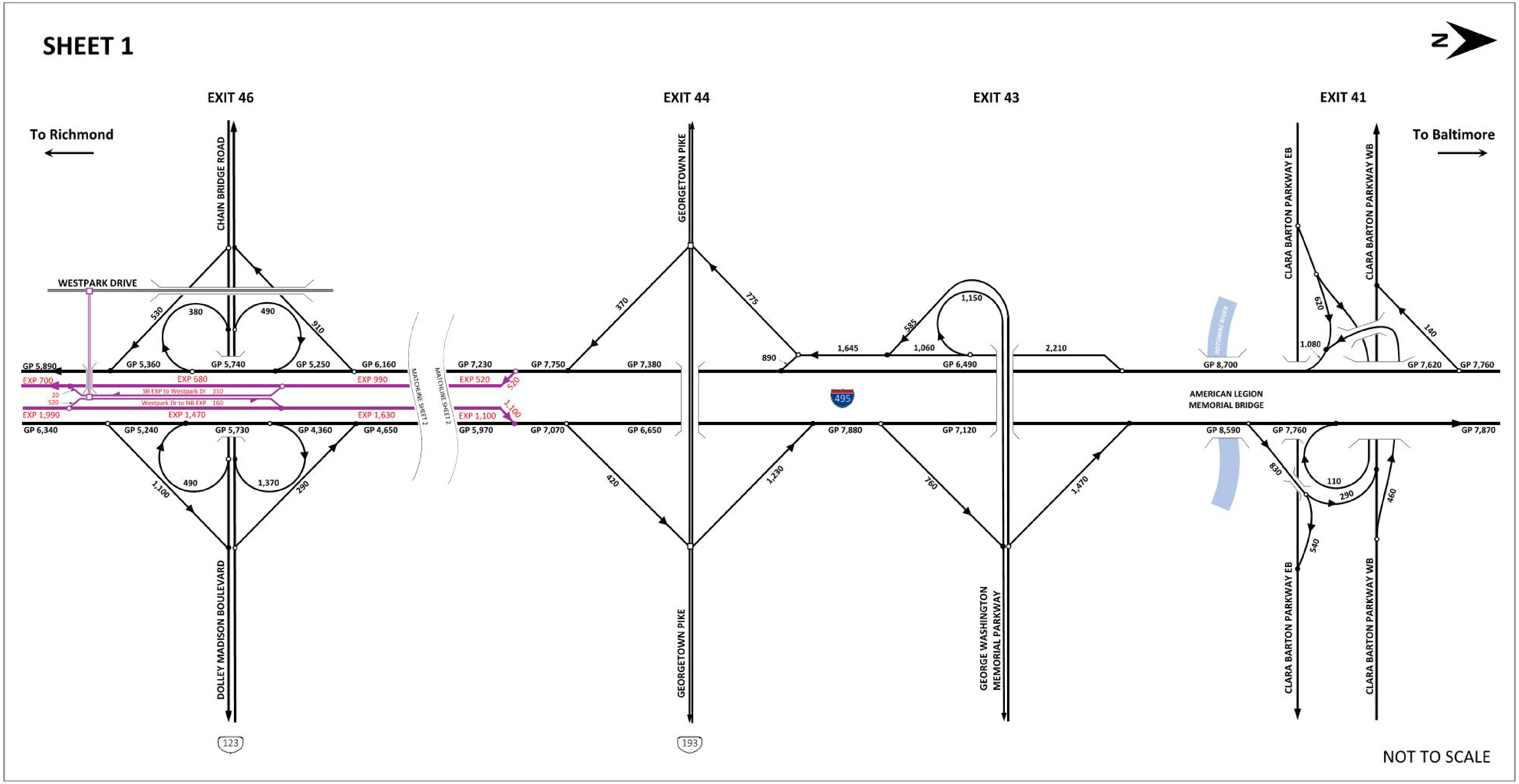


Exhibit 4.2a. Freeway Existing (2018) AM Peak Hour Volume – I-495

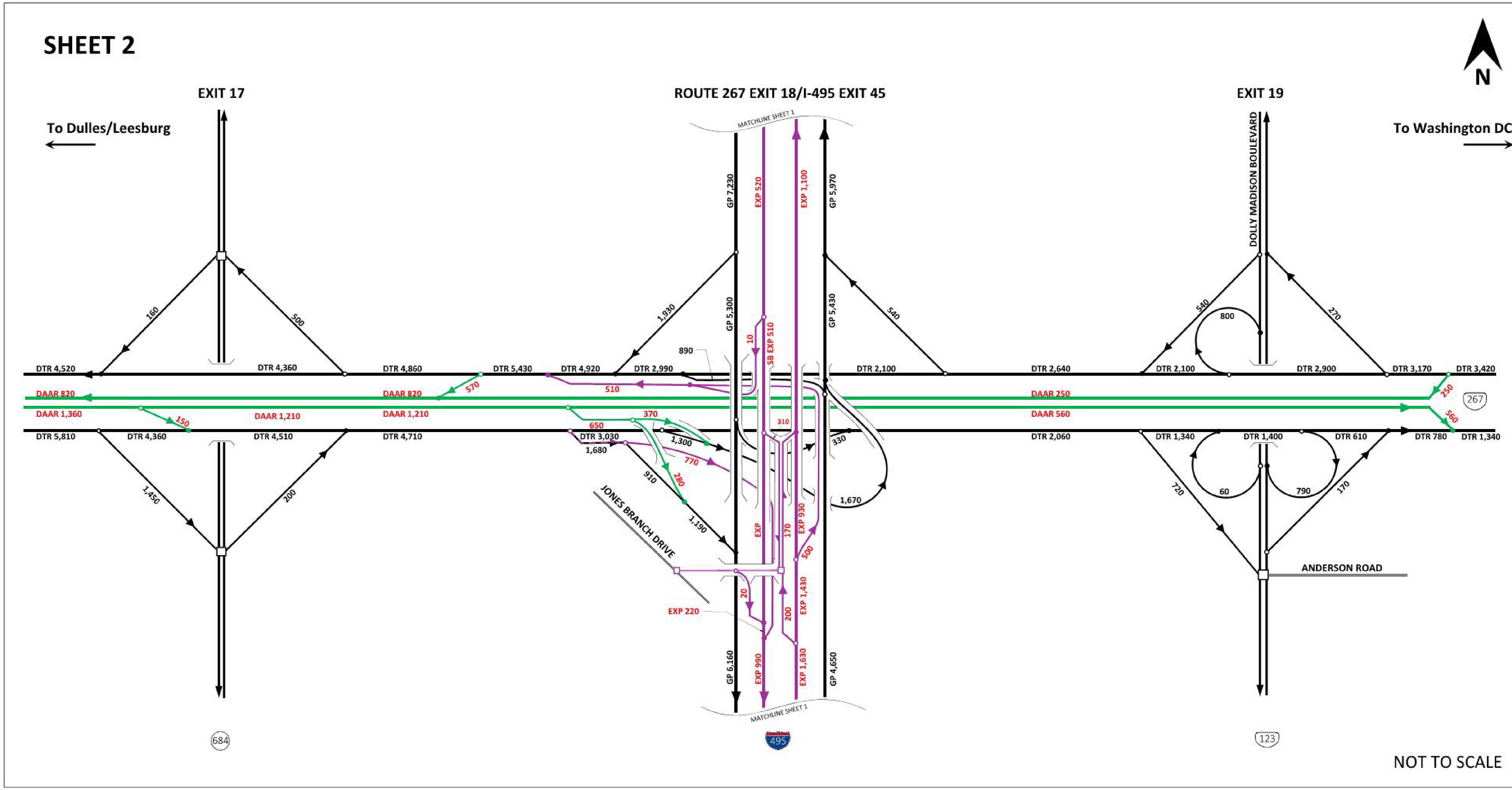


Exhibit 4.2b Freeway Existing (2018) AM Peak Hour Volume – Route 267

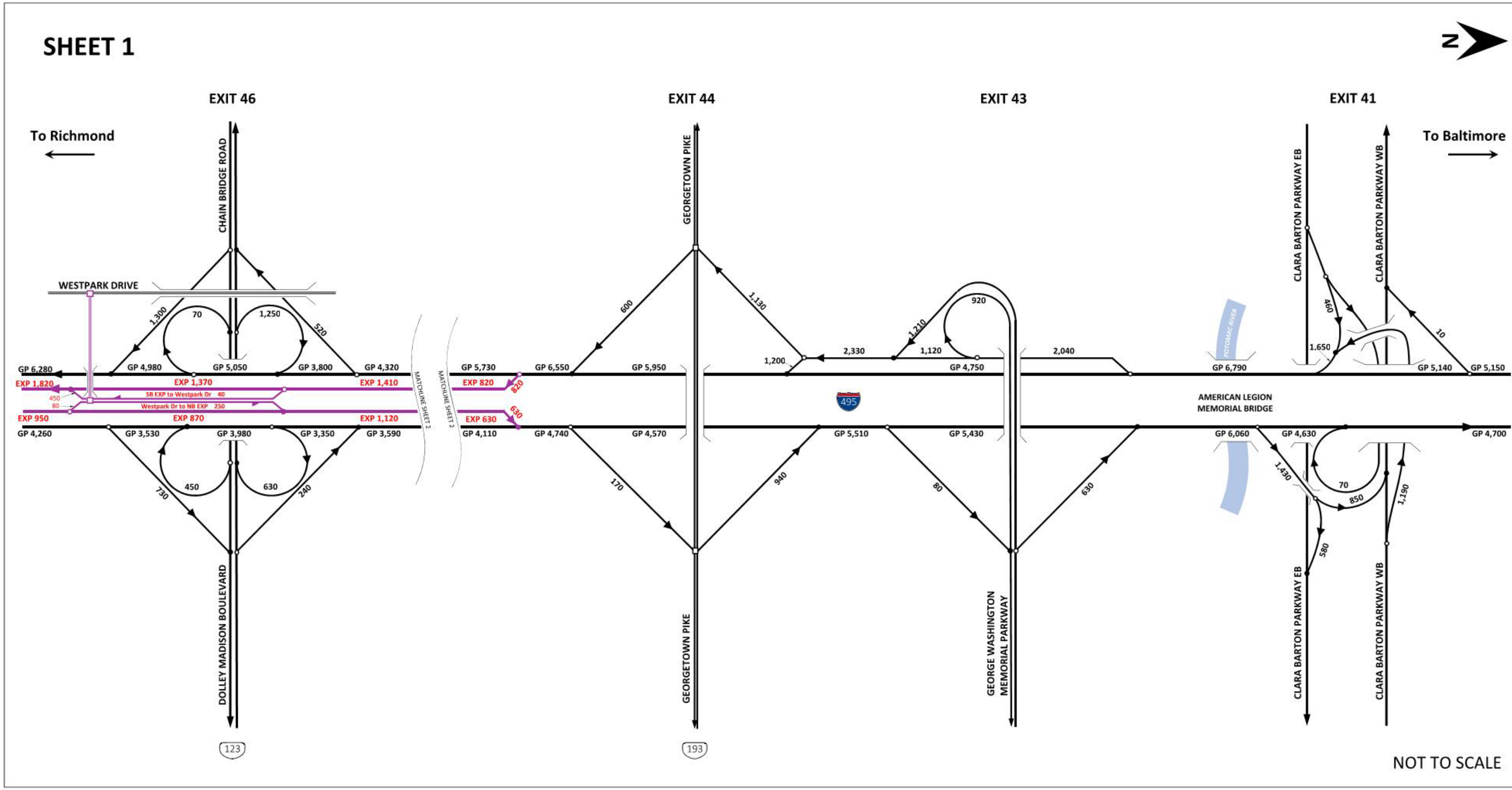


Exhibit 4.3a Freeway Existing (2018) PM Peak Hour Volume – I-495

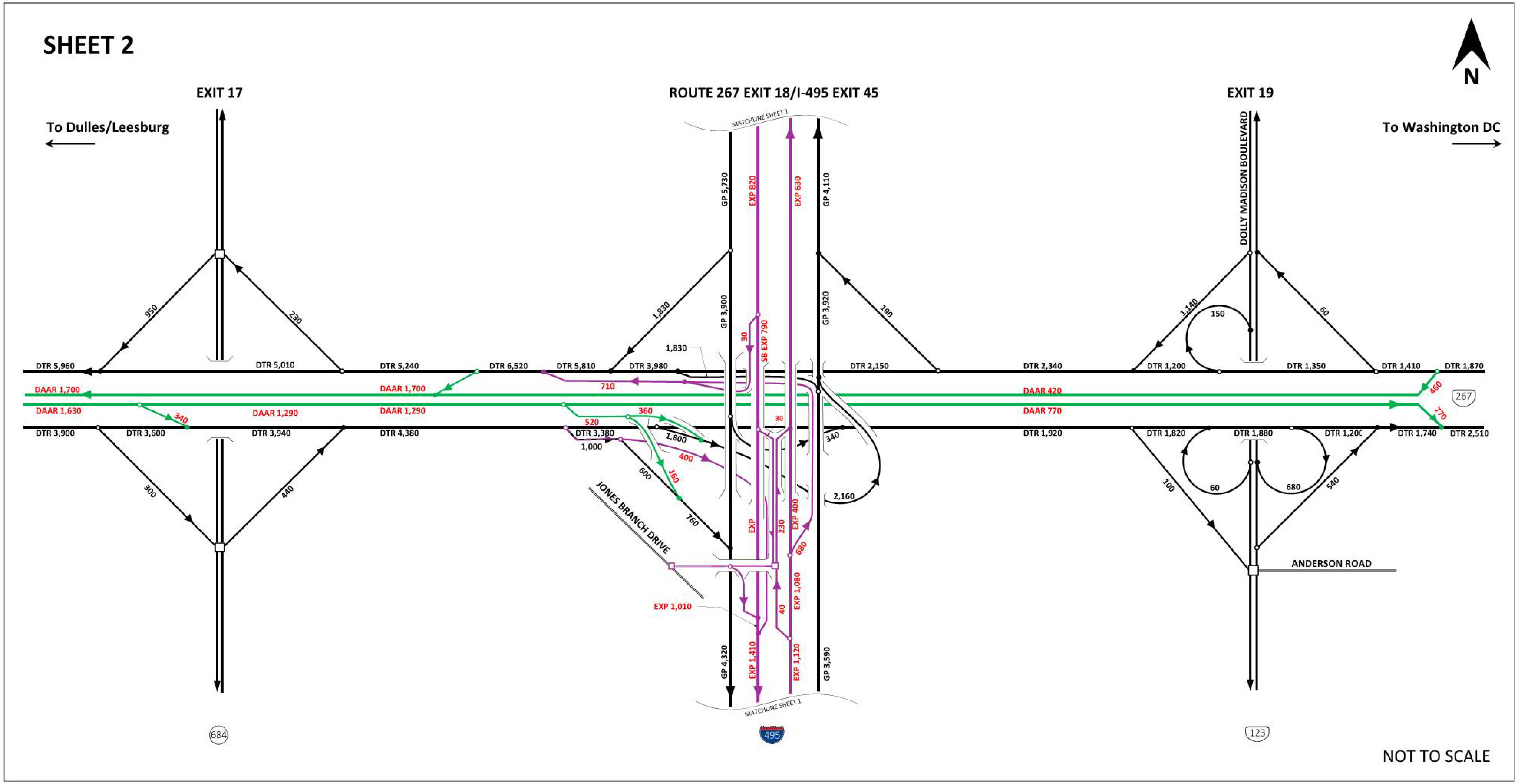


Exhibit 4.3b Freeway Existing (2018) PM Peak Hour Volume – Route 267

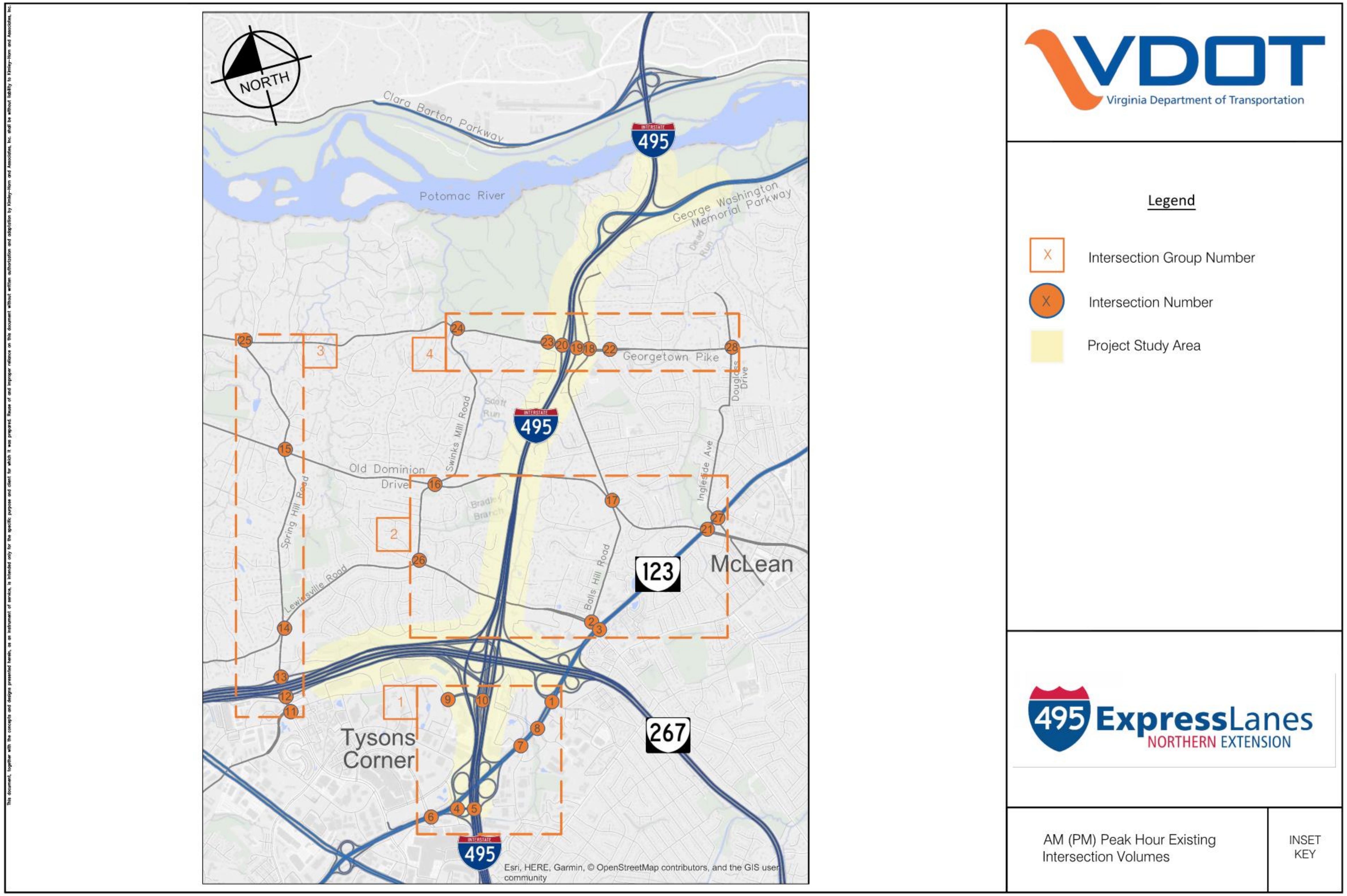


Exhibit 4-4a. Arterial Existing (2018) Peak Hour Turning Movement Volumes – Figure Key

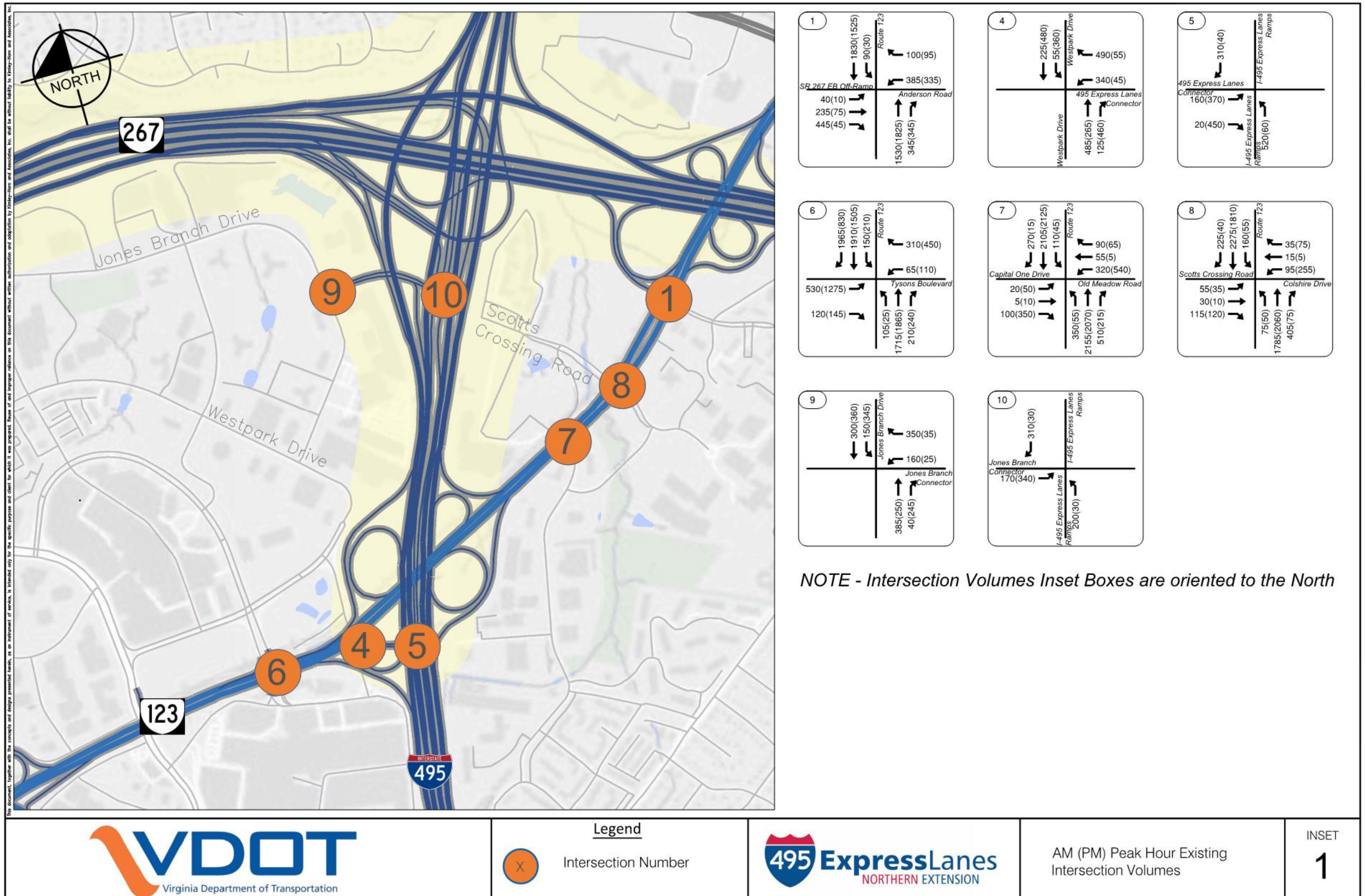


Exhibit 4-4b. Arterial Existing (2018) Peak Hour Turning Movement Volumes – Location 1

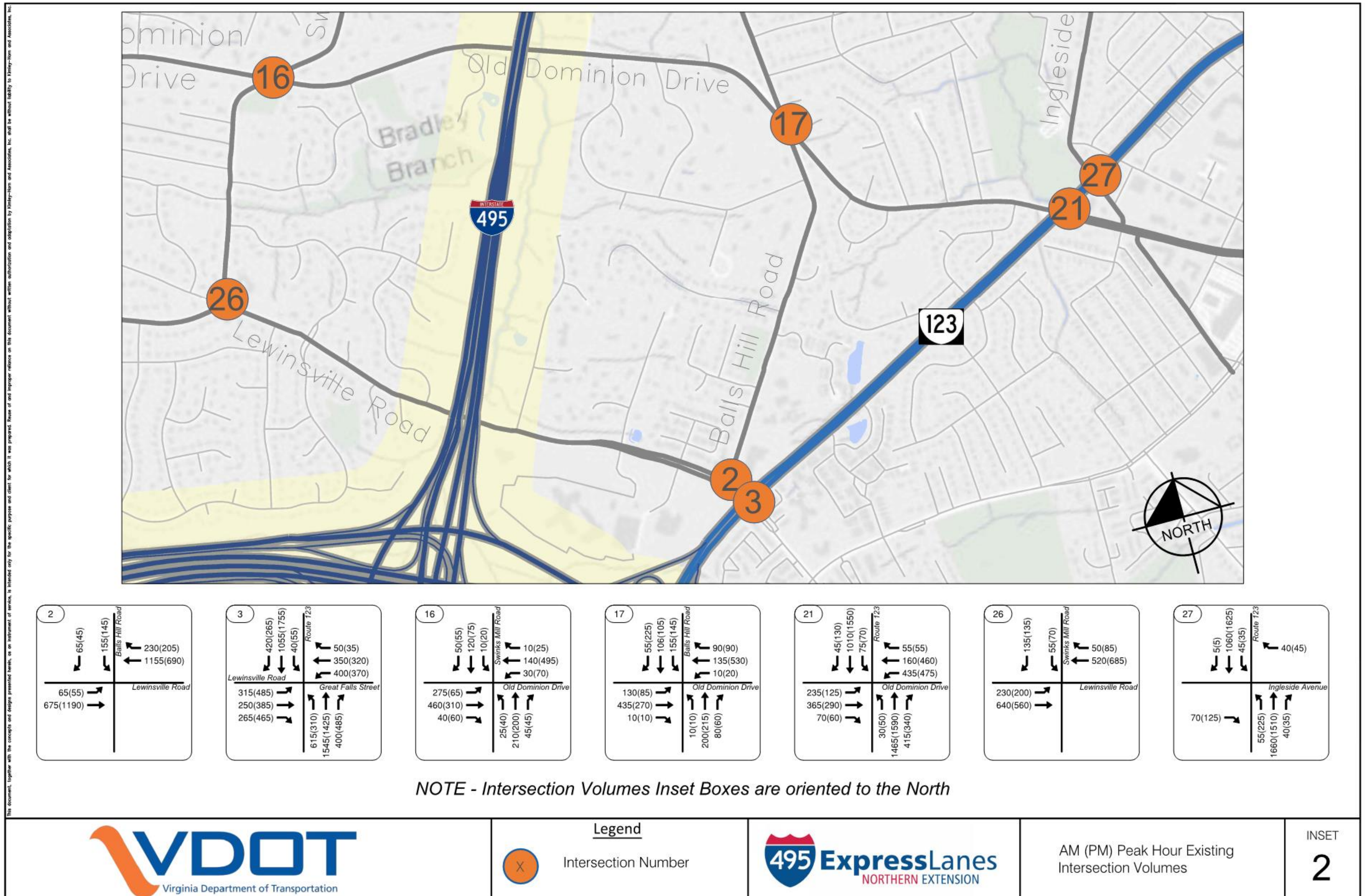


Exhibit 4-4c. Arterial Existing (2018) Peak Hour Turning Movement Volumes – Location 2

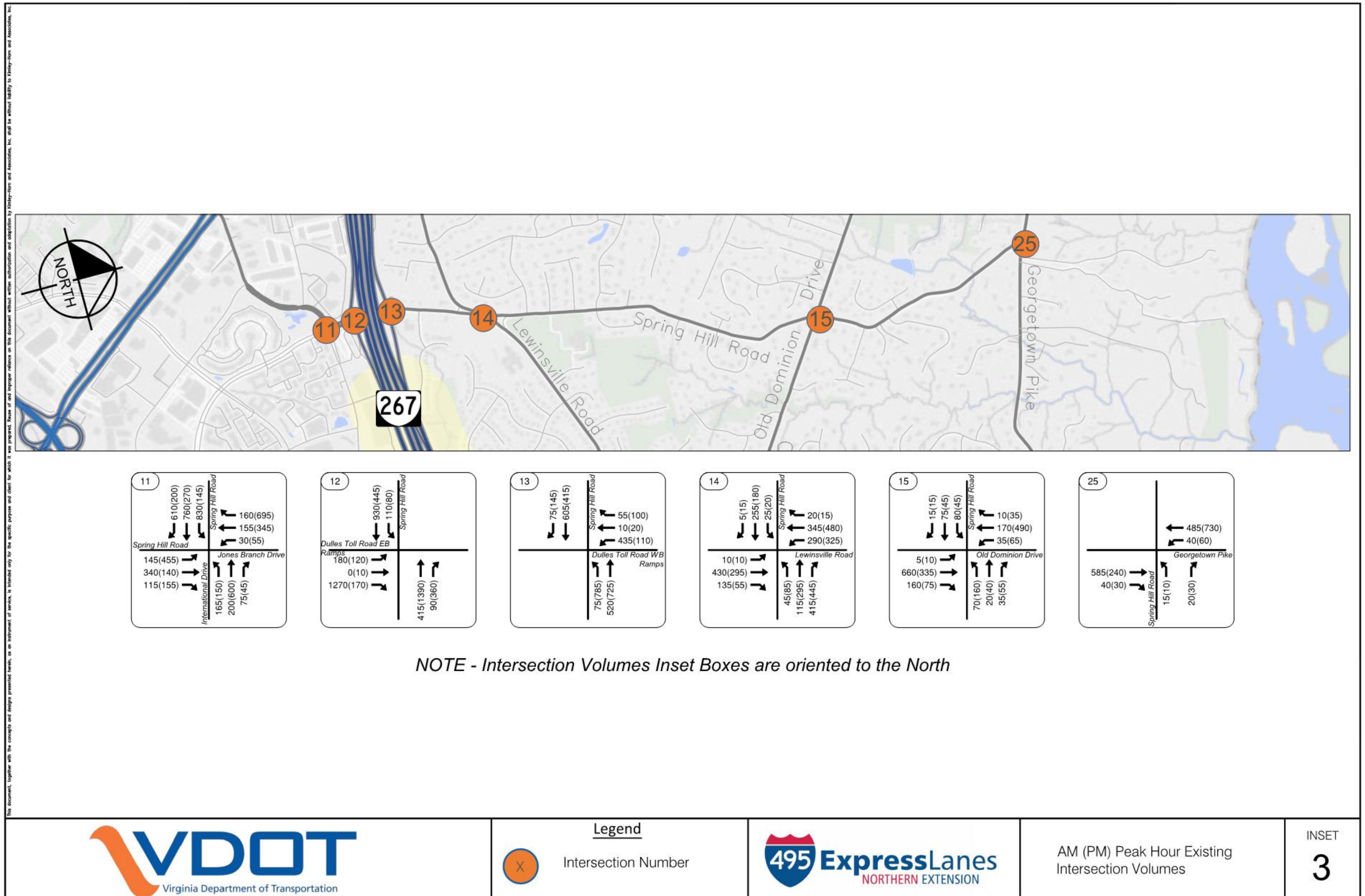


Exhibit 4-4d. Arterial Existing (2018) Peak Hour Turning Movement Volumes – Location 3

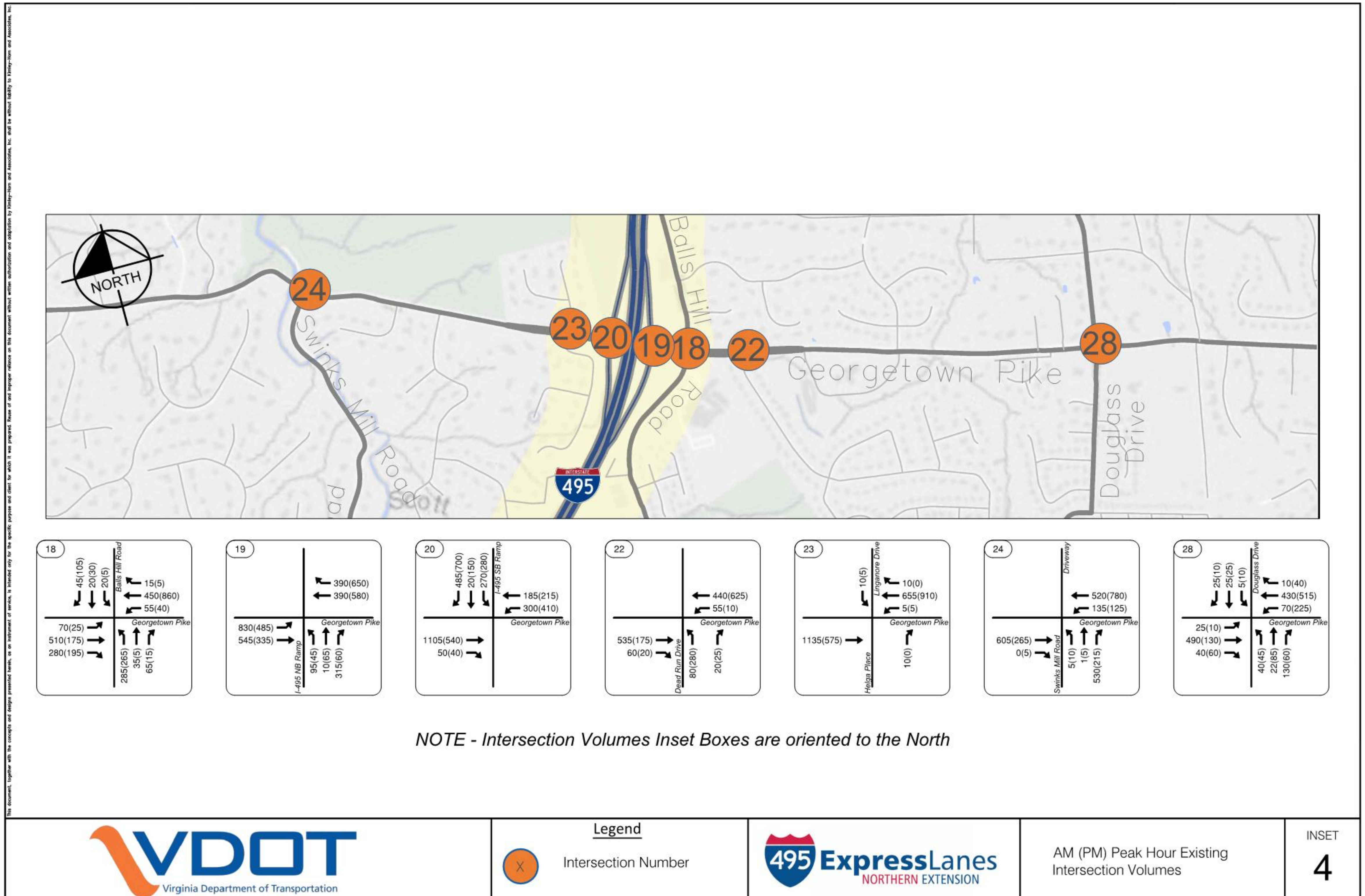


Exhibit 4-4e. Arterial Existing (2018) Peak Hour Turning Movement Volumes – Location 4

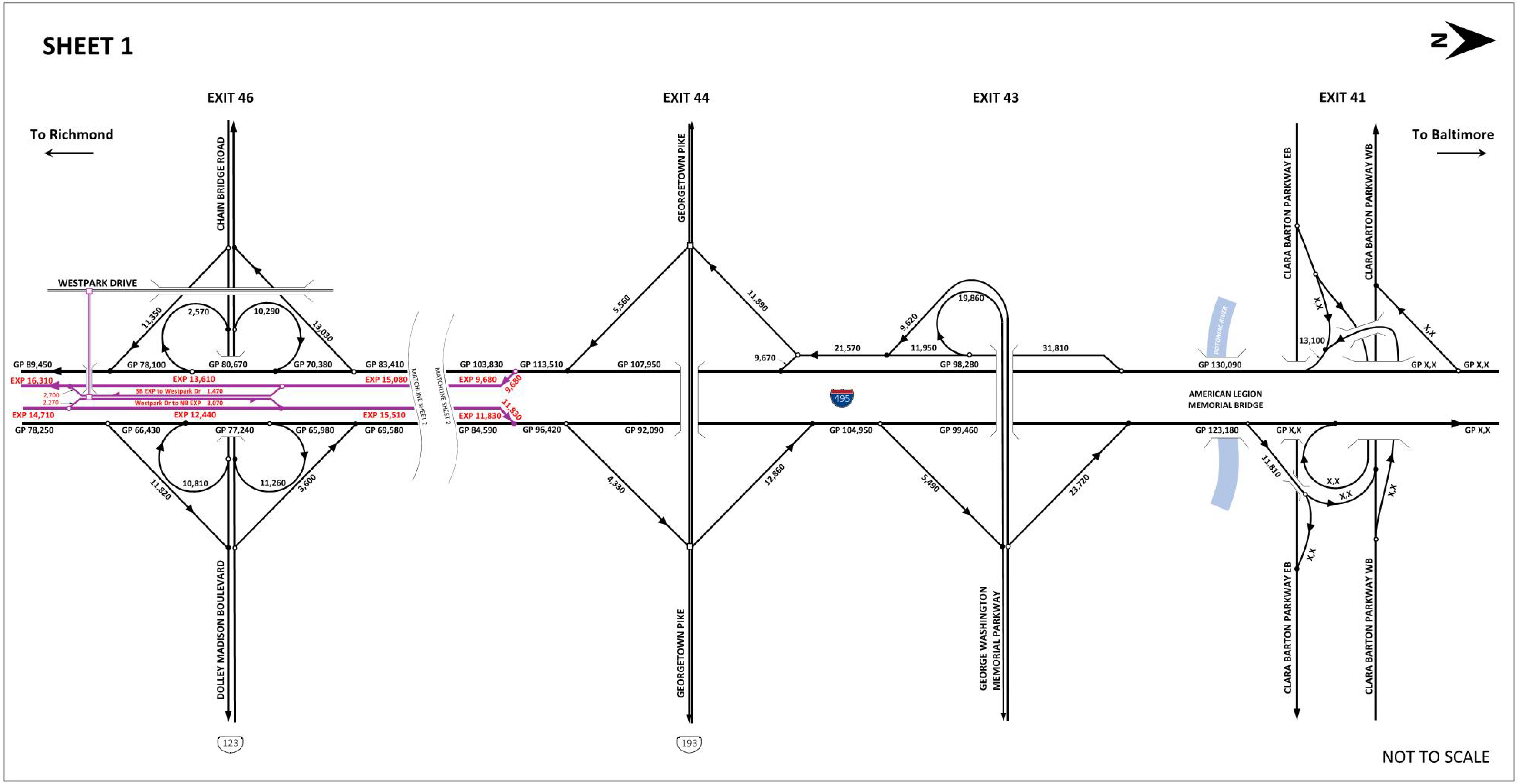


Exhibit 4.5a Freeway Existing (2018) ADT – I-495

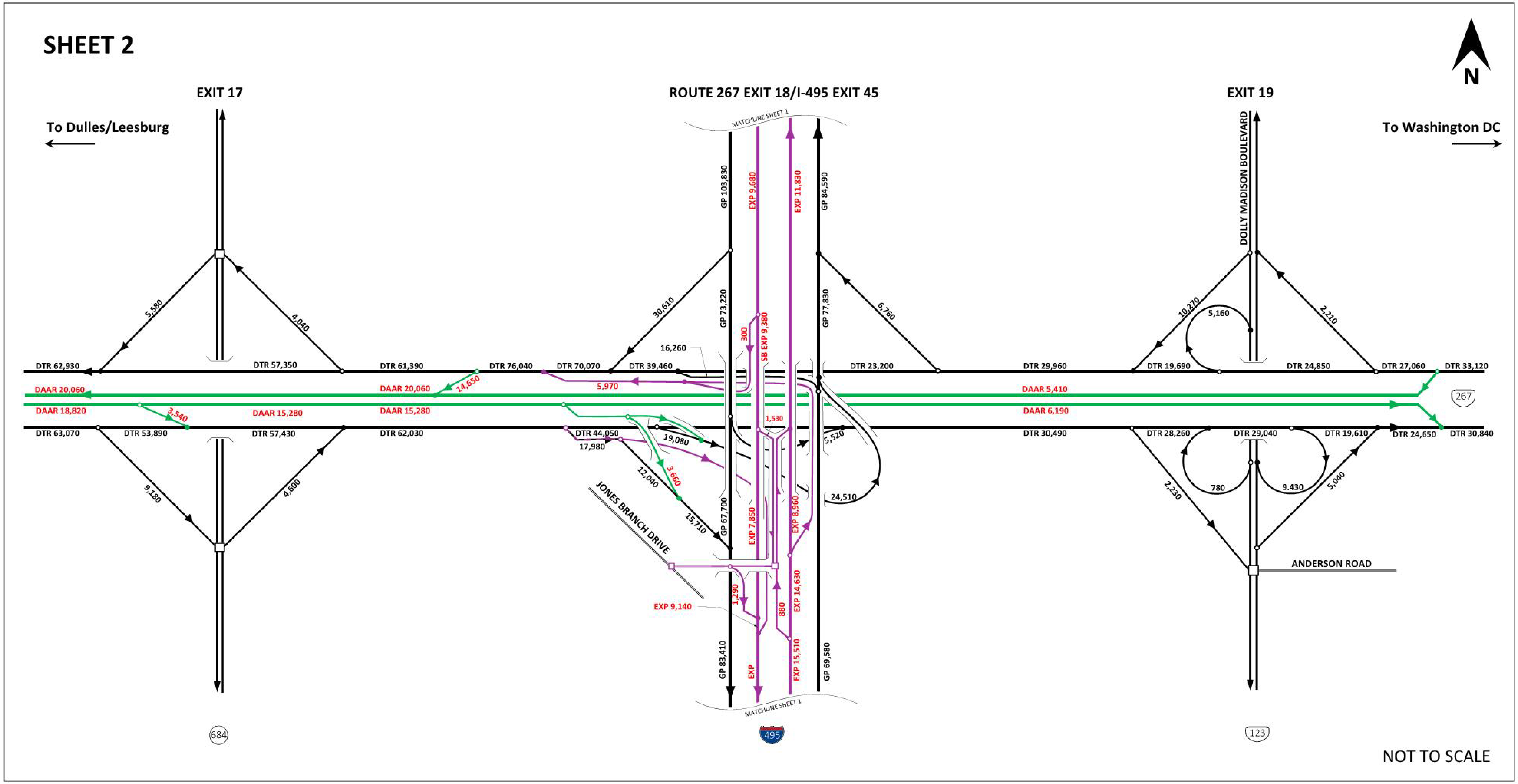


Exhibit 4.5b. Freeway Existing (2018) ADT – Route 267

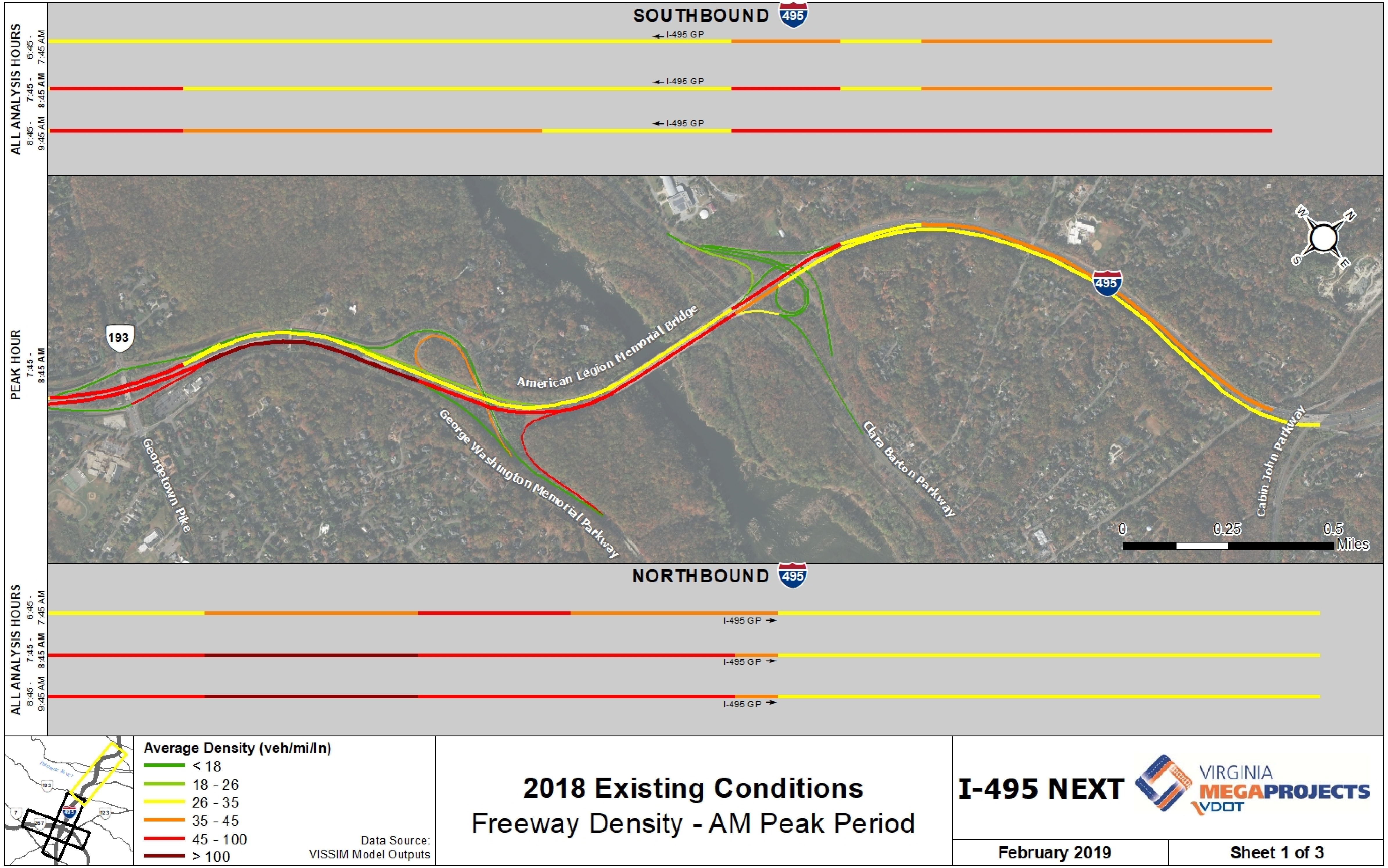


Exhibit 4-6a. I-495 AM Peak Period Average Densities – Georgetown Pike to Northern Terminus

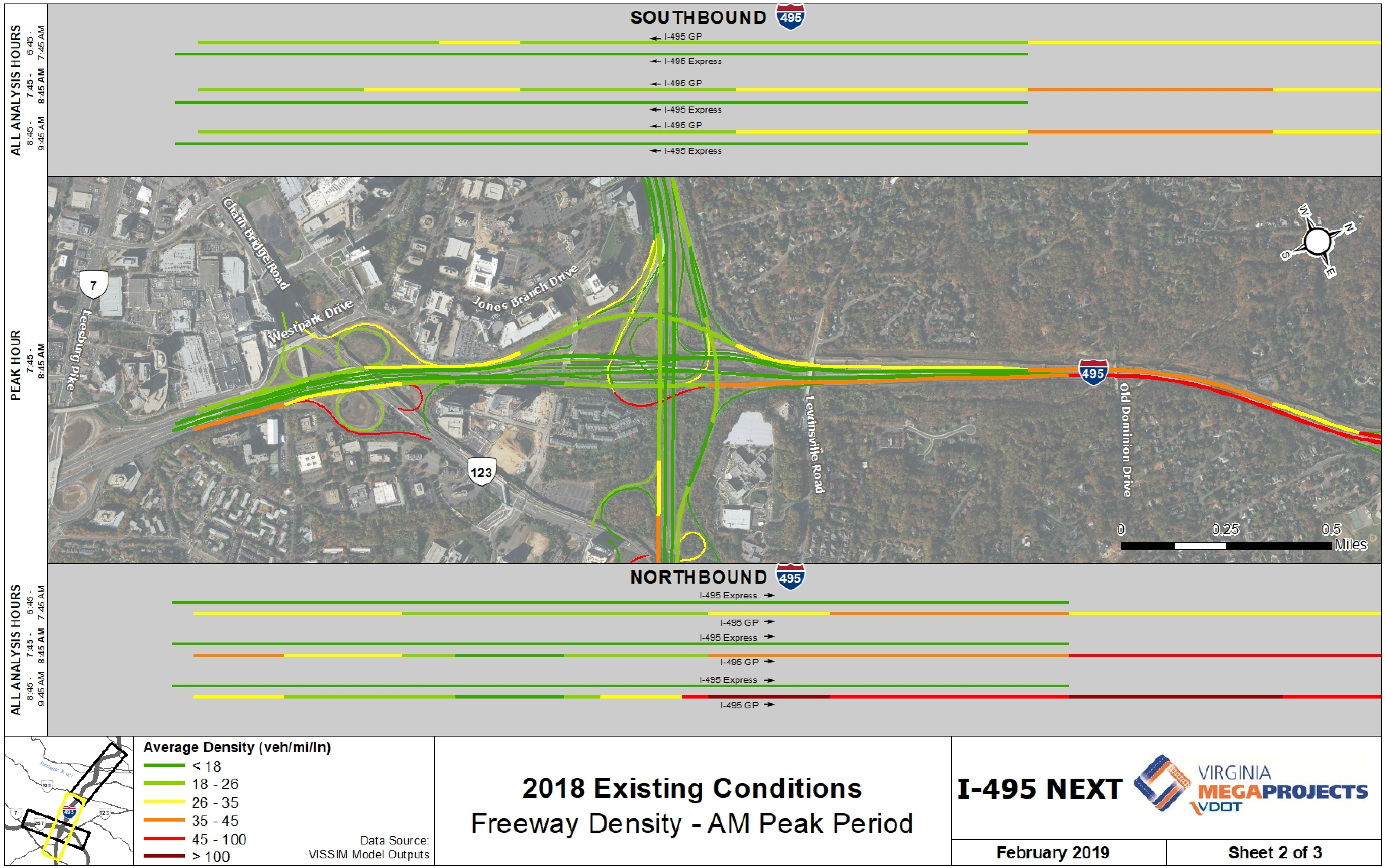


Exhibit 4-6b. I-495 AM Peak Period Average Densities – Southern Terminus through Old Dominion Drive

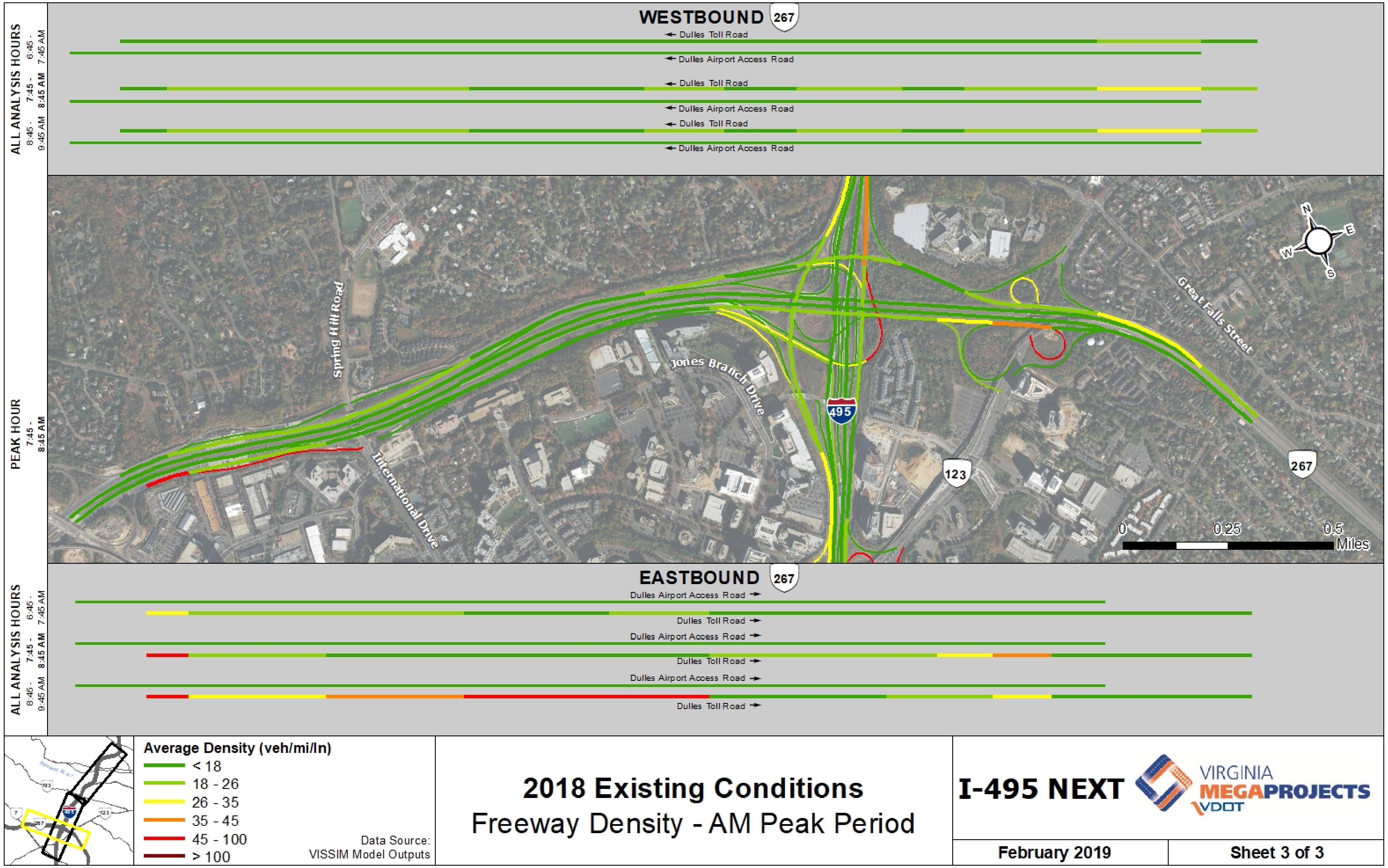


Exhibit 4-6c. Route 267 AM Peak Period Average Densities

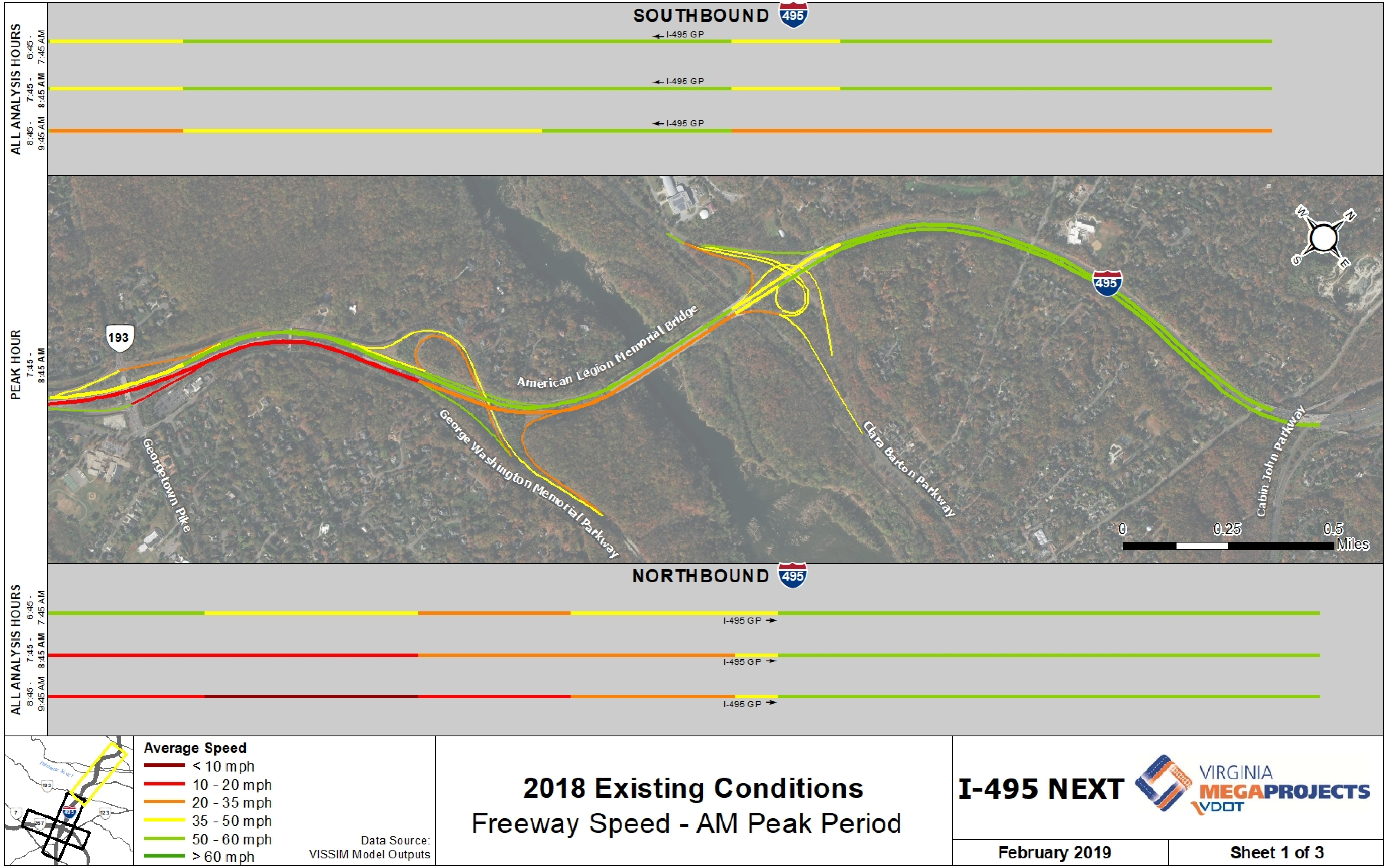


Exhibit 4-7a. I-495 AM Peak Period Average Speeds – Georgetown Pike to Northern Terminus

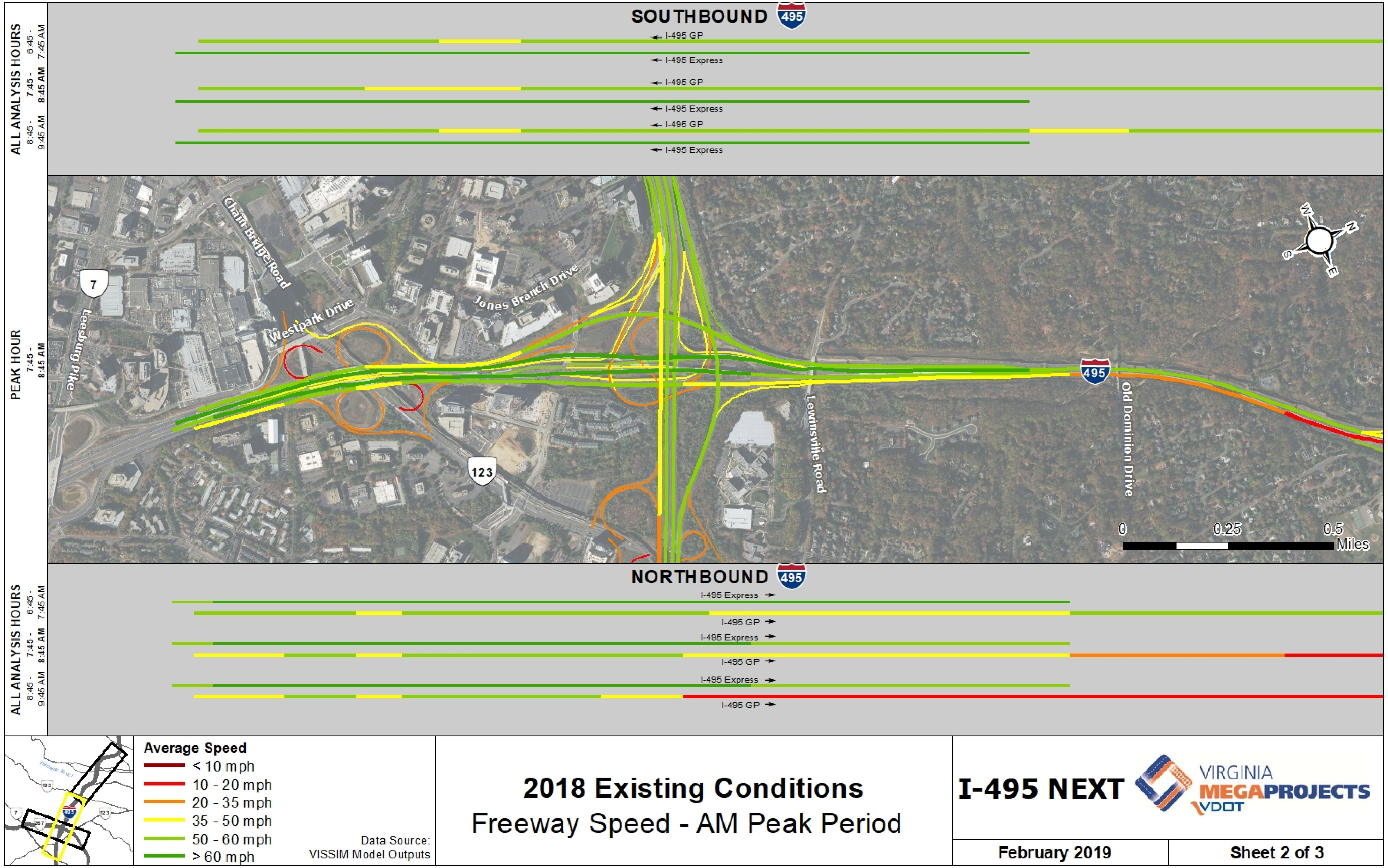


Exhibit 4-7b. I-495 AM Peak Period Average Speeds – Southern Terminus through Old Dominion Drive

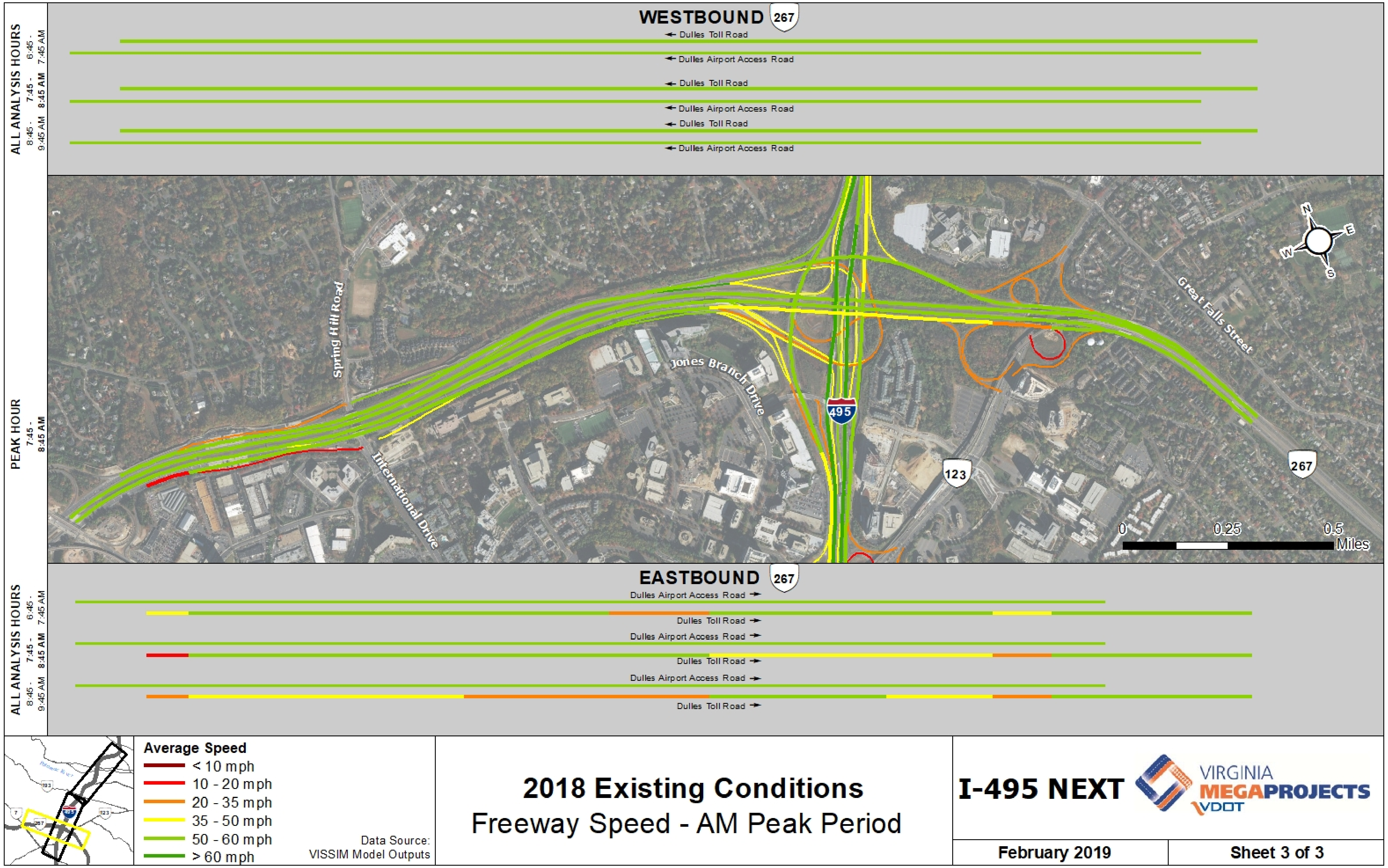


Exhibit 4-7c. Route 267 AM Peak Period Average Speeds

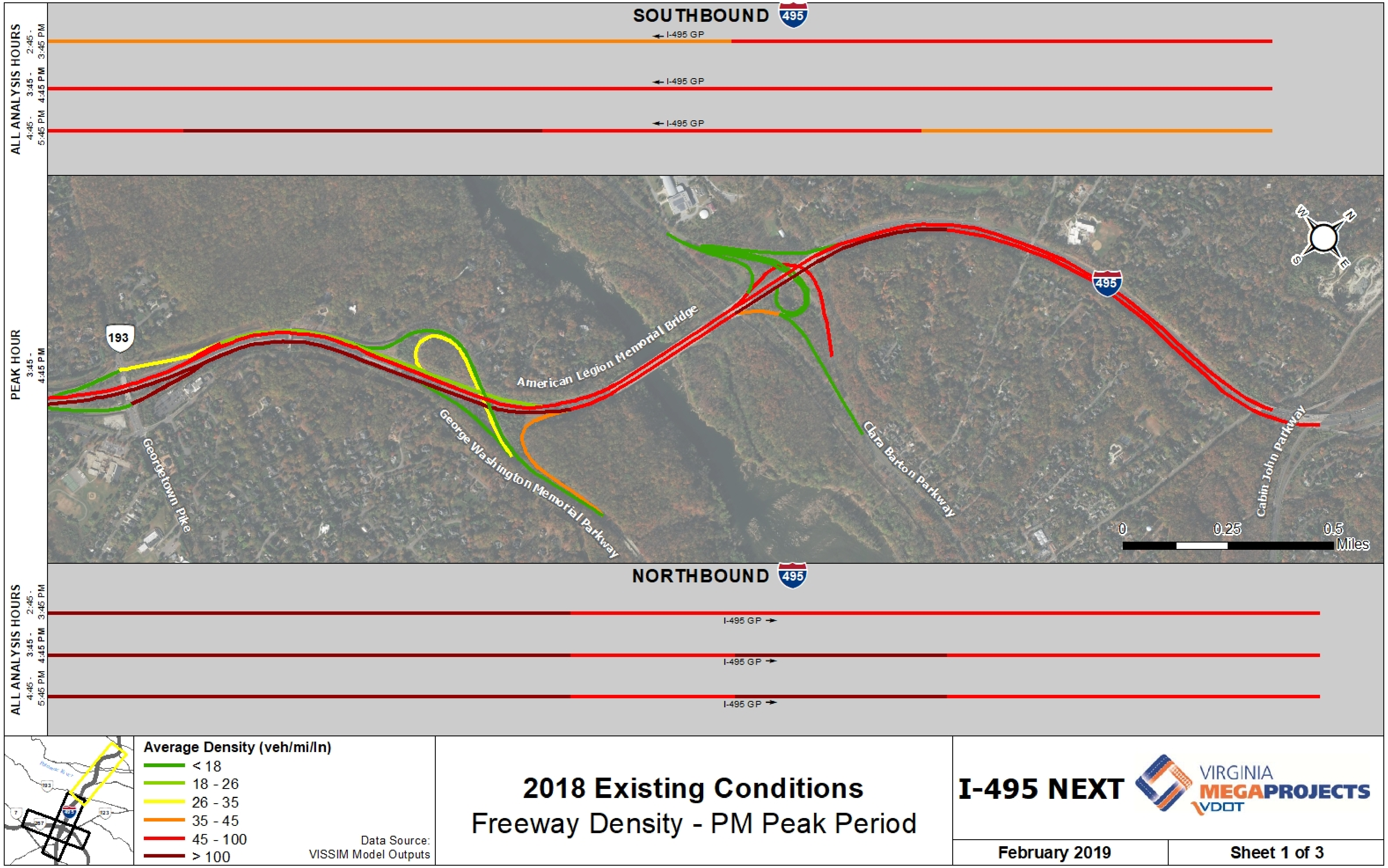


Exhibit 4-8a. I-495 PM Peak Period Average Densities – Georgetown Pike to Northern Terminus

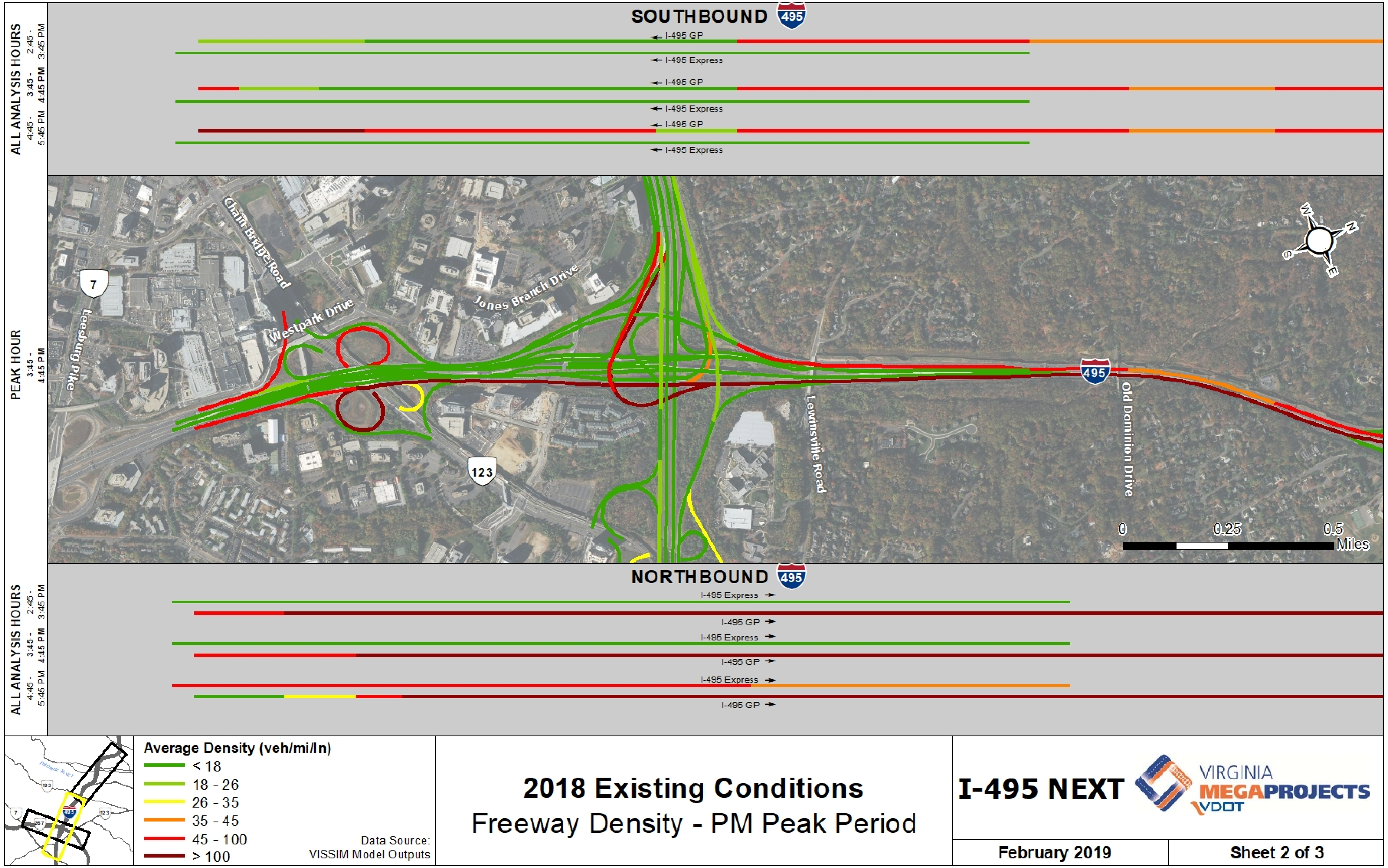


Exhibit 4-8b. I-495 PM Peak Period Average Densities – Southern Terminus through Old Dominion Drive

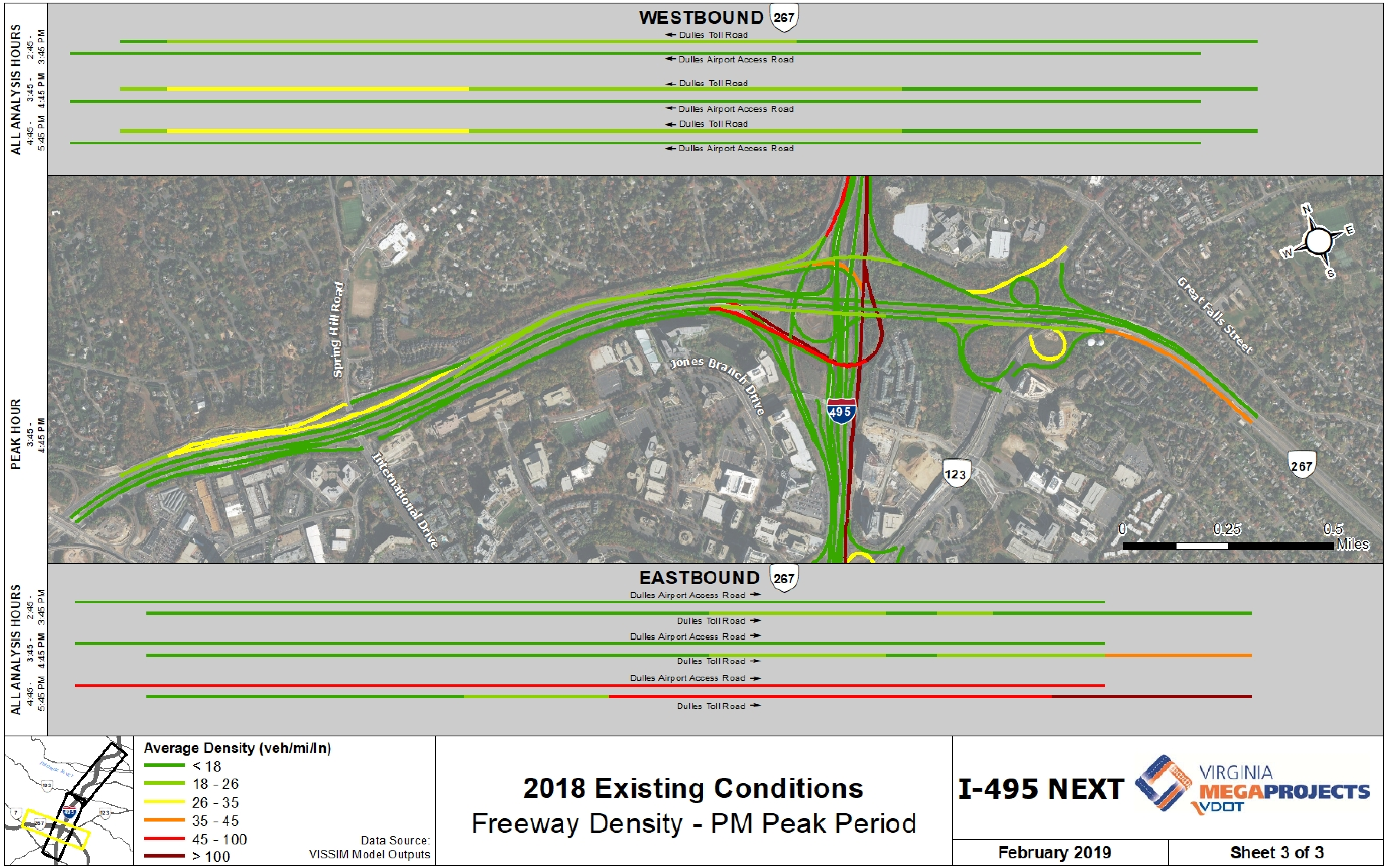


Exhibit 4-8c. Route 267 PM Peak Period Average Densities

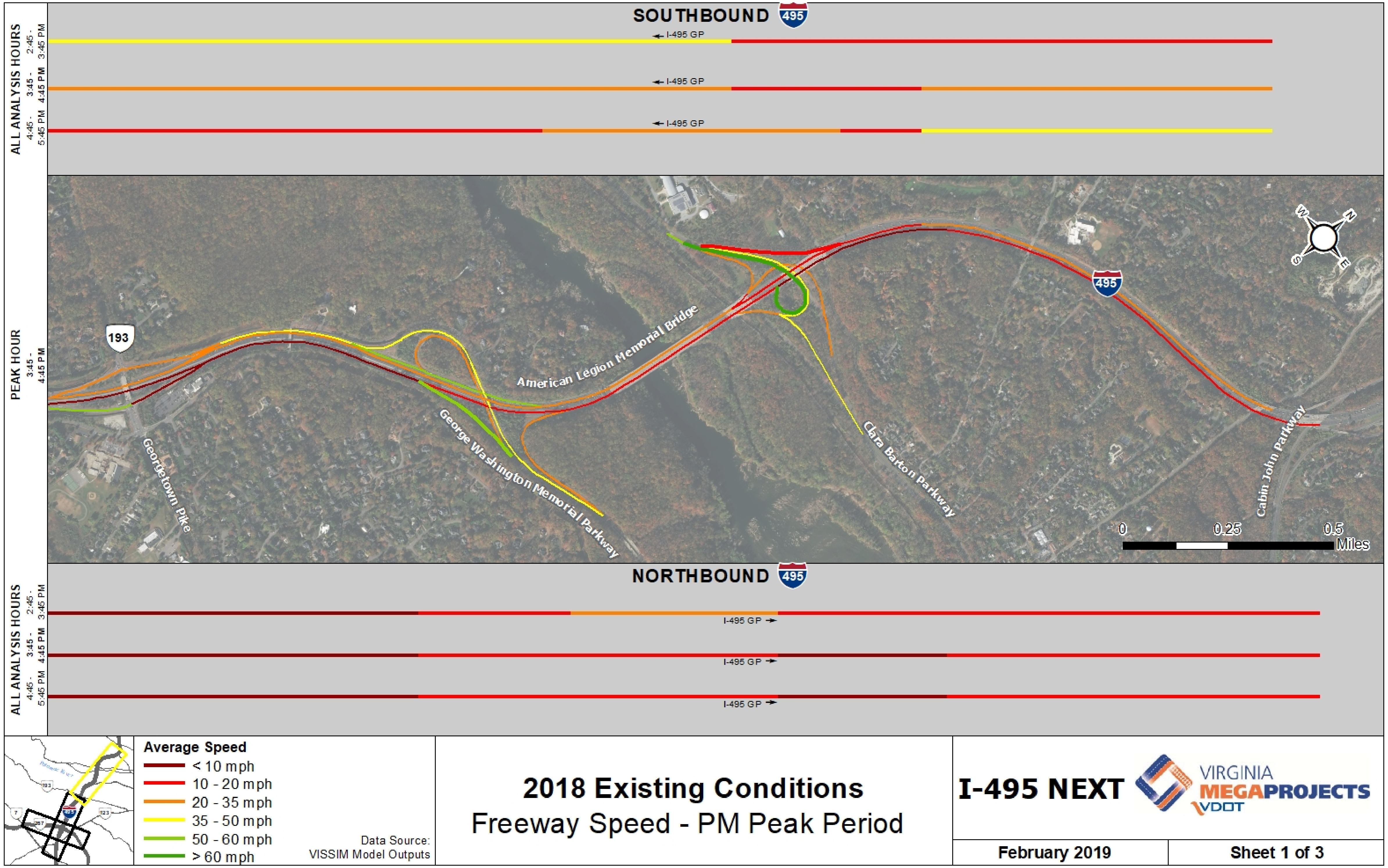


Exhibit 4-9a. I-495 PM Peak Period Average Speeds – Georgetown Pike to Northern Terminus

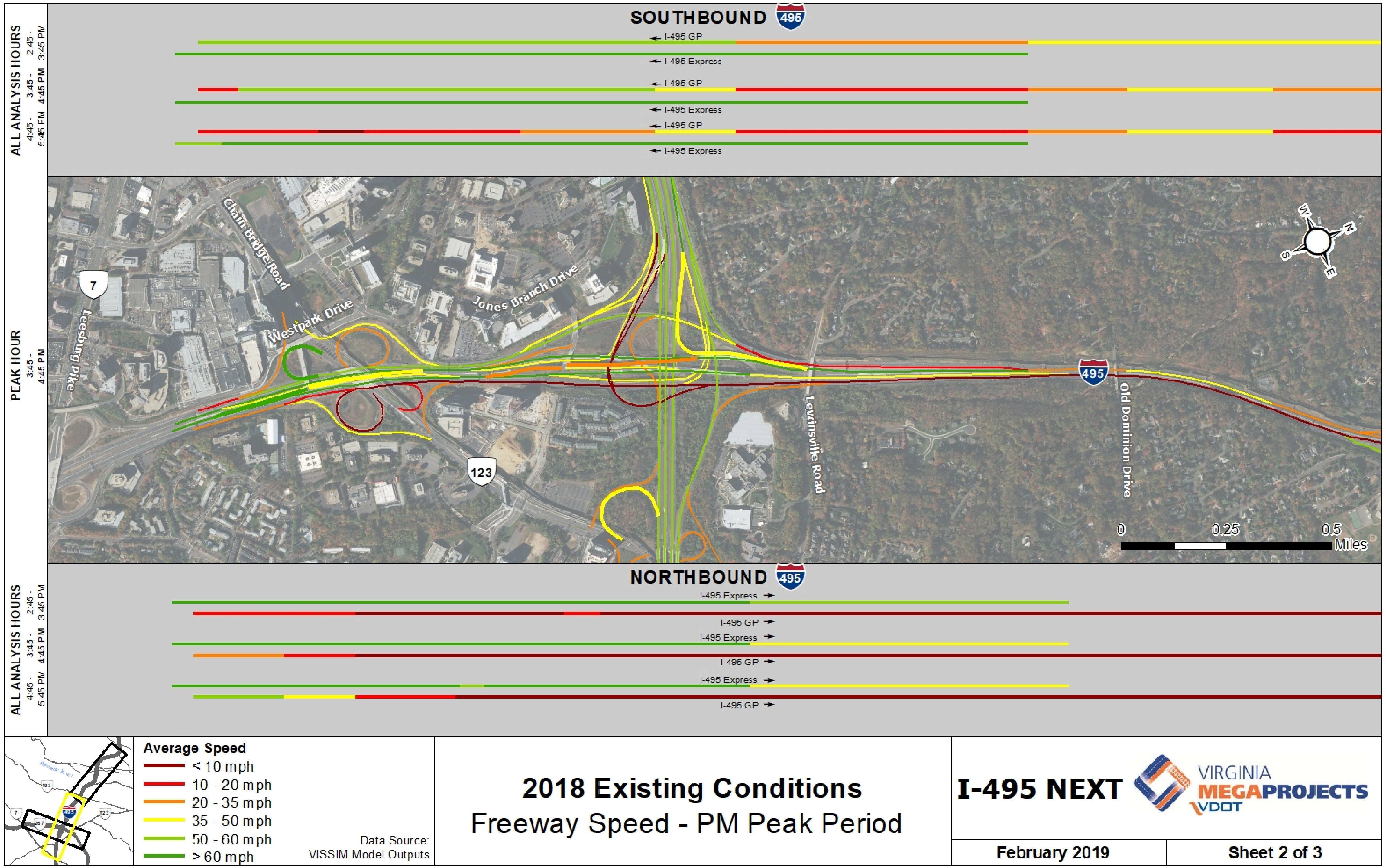


Exhibit 4-9b. I-495 PM Peak Period Average Speeds – Southern Terminus through Old Dominion Drive

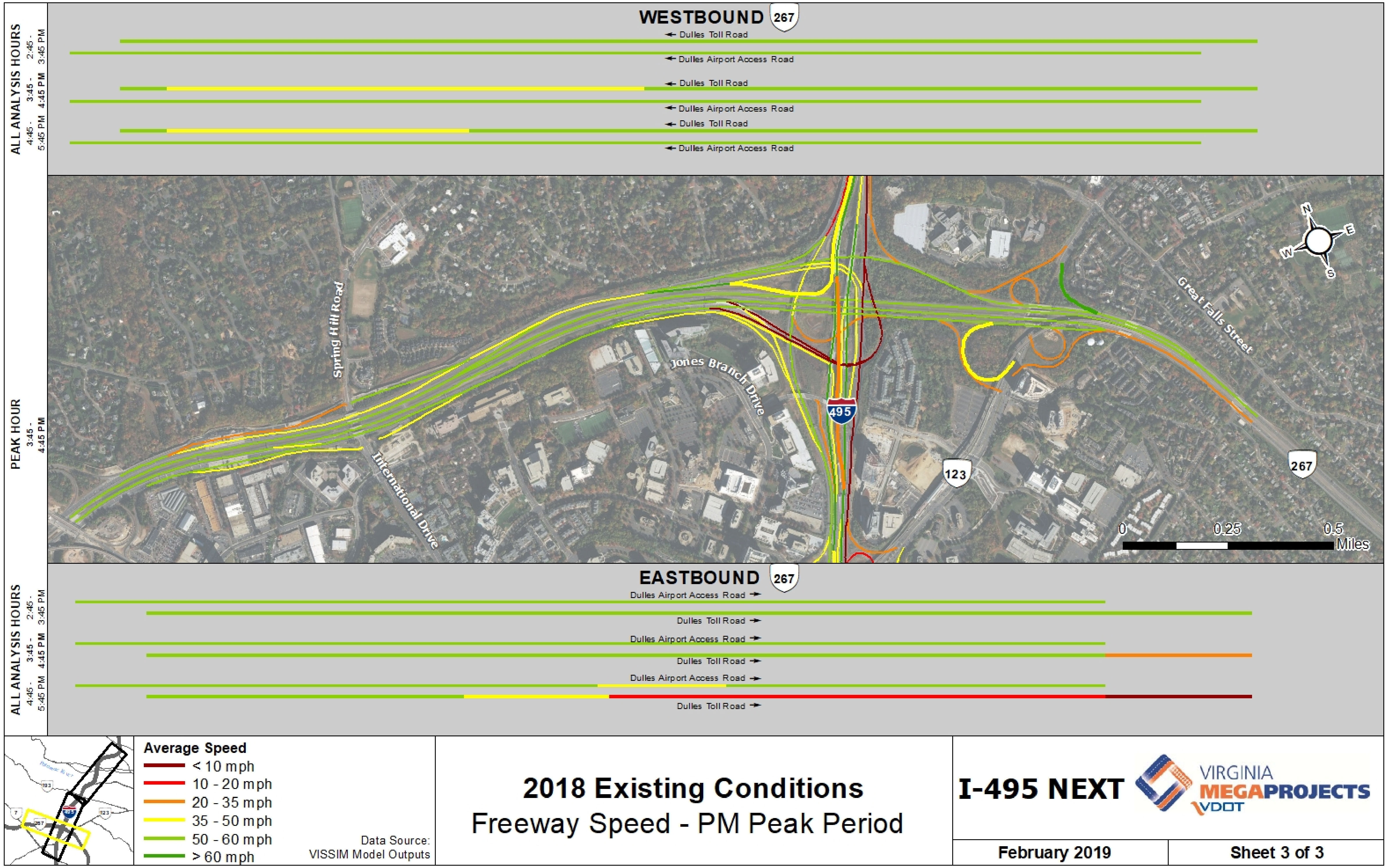


Exhibit 4-9c. Route 267 PM Peak Period Average Speeds

CHAPTER 5.0 BACKGROUND (NO BUILD) TRANSPORTATION NETWORK

This chapter details assumptions for background improvements to the transportation network included as elements of future No Build conditions, including recent improvements and future planned projects. Notable regional projects outside of the project study area that impact travel patterns within the study area are also included.

5.1 RECENT AND PLANNED IMPROVEMENTS IN FAIRFAX COUNTY

5.1.1 Jones Branch Connector/Scotts Crossing Road

At the time of the project existing conditions analysis (2018), the Jones Branch Connector carried traffic between Jones Branch Drive and the I-495 Express Lanes ramps, with an extension under construction to connect across I-495 to the east and meet Route 123 via a signalized intersection. This connection is now open and it provides an alternative east-west route between Route 123 and points in Tysons west of I-495, bypassing the I-495/Route 123 interchange. This extension is four lanes (two through lanes in each direction) and is referred to as Scotts Crossing Road. The signalized intersection with the I-495 Express Lanes ramps has been reconfigured to accommodate this new access to and from the east. **Figure 5-1** provides a map and concept for the Jones Branch Connector / Scotts Crossing Road project (Fairfax County, 2018).

Note that between the signal for the I-495 Express Lanes ramps and the signal where Scotts Crossing Road meets Route 123, two new signalized intersections are being constructed. These new signalized intersections provide access to existing and planned future developments, including the Capital One headquarters complex to the south of Scotts Crossing Road and west of Route 123. These two intersections have been included in all future traffic analysis scenarios; traffic volumes assumed for trips in and out of the Capital One complex have been developed in coordination with Fairfax County. These improvements are all assumed to be in place by 2025.

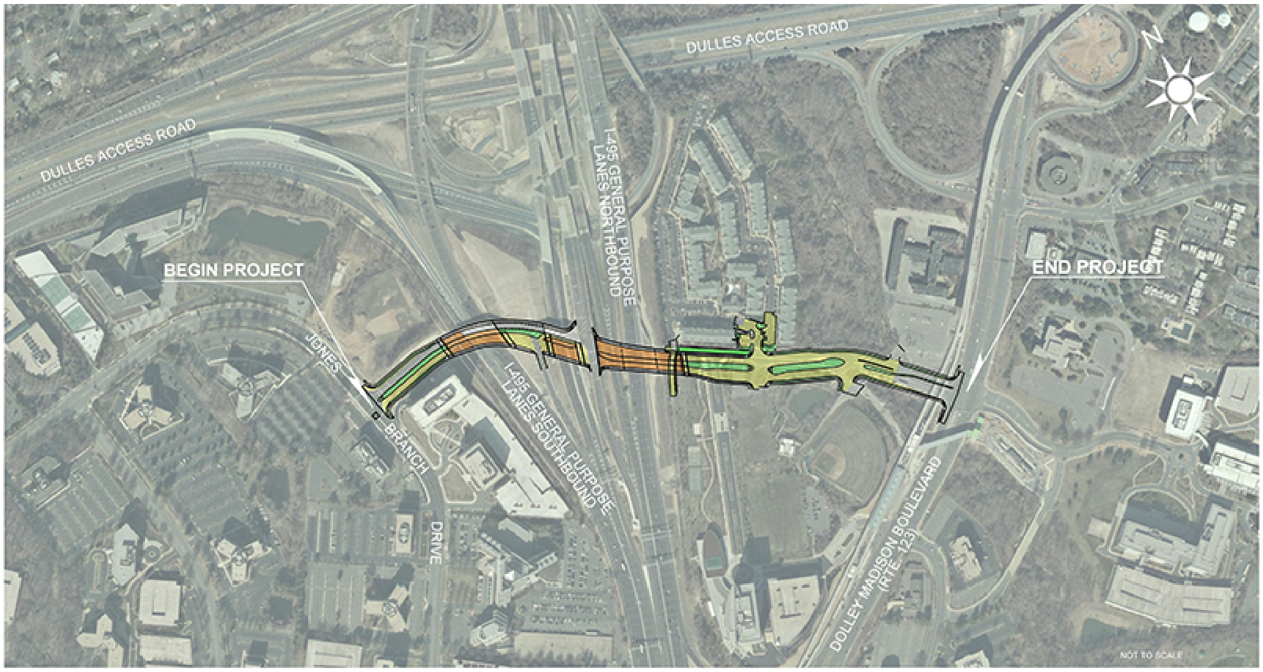


Figure 5-1. Jones Branch Connector Project (source: Fairfax County)

5.1.2 Planned Spot Improvements in Study Area

- **Balls Hill Road and Route 193 (Georgetown Pike)** – at the current signalized intersection of Balls Hill Road and Georgetown Pike, VDOT, in coordination with Fairfax County, recently completed the implementation of geometric and signal improvements to address capacity constraints (WSP USA, 2019). A dedicated northbound left-turn lane has been provided, and new signal heads have been installed to allow for eight-phase operations at the traffic signal. **Figure 5-2** provides a concept for these intersection improvements. These improvements are assumed to be in place by 2025.
- **All-electronic tolling at Dulles Toll Road main toll plaza** – removal of the main toll plaza; to be replaced by gantries allowing all traffic to pass through without slowing down (speed limit posted at 55 mph). This improvement is assumed to be in place by 2045 but not in place for 2025.

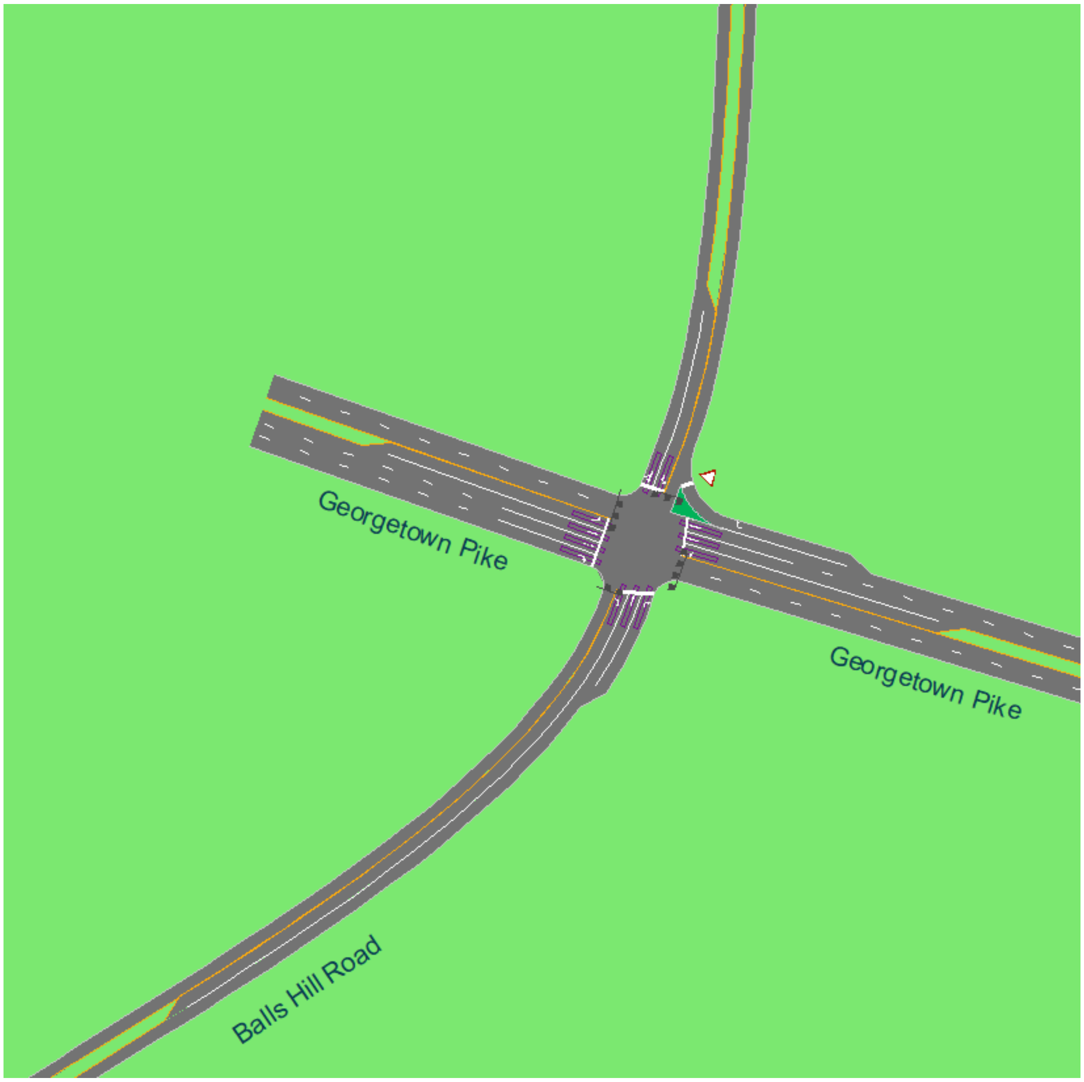


Figure 5-2. Georgetown Pike and Balls Hill Road Lane Configuration (source: WSP)

5.2 MARYLAND TRAFFIC RELIEF PLAN (TRP) AND I-495/I-270 P3 PROGRAM

The Maryland Department of Transportation State Highway Administration's (MDOT SHA) TRP was announced in 2017 by Maryland's Governor Larry Hogan. The TRP is a planned private-public partnership aimed at mitigating congestion along Maryland's most congested roads. The largest initiative in the TRP evaluates improvements for the I-495 and I-270 corridors in the Washington, DC, region.

The TRP is comprised of three parts which are outlined in MDOT SHA's Fact Sheet (MD SHA, 2017) found on their website. Part I, the most pertinent to the I-495 NEXT project, plans to add capacity to the Capital Beltway between the ALMB and Woodrow Wilson Bridge (the length of I-495 in Maryland). As part of that plan, I-495 will have managed lanes added for its entire length Maryland. This will include the area directly north of the proposed study area. **Figure 5-3** provides a map of the Maryland TRP and shows its adjacency to the VDOT I-495 NEXT project.

The Maryland TRP is included within the overall Regional Constrained Long-Range Plan (CLRP), which is discussed in further detail in the next section. Significant coordination between VDOT and MDOT has occurred throughout the planning process for the I-495 NEXT project to maintain consistency with elements of the TRP in the I-495 NEXT transportation operations analysis study area. These elements include the following:

- Two managed lanes in each direction over the ALMB and along I-495 into Maryland through the northern extents of the transportation operations analysis study area (just south of Cabin John Parkway / River Road).
- Connections between the Maryland managed lanes system and the GWMP, including a ramp from the southbound Maryland managed lanes to GWMP eastbound (inbound) and from GWMP westbound (outbound) to the northbound Maryland managed lanes.
- In the I-495 NEXT project No Build scenario, the Maryland managed lanes are assumed to terminate just south of the ALMB in Virginia in the vicinity of the GWMP interchange. **Exhibit 5-1** provides a concept for how this terminus would potentially be configured:
  - In the northbound direction, a left-side slip ramp from the GP lanes would be provided to develop one of the two northbound managed lanes into Maryland; the second northbound managed lane would be provided by the on-ramp from the GWMP westbound.
  - In the southbound direction, the two managed lanes leaving Maryland would split, with one lane becoming the off-ramp to the GWMP eastbound and the other lane merging into the I-495 southbound GP lanes.

Note that in the I-495 Project NEXT Build scenario, described in the next chapter, the Maryland managed lanes and Virginia Express Lanes form a continuous, seamless system through the study area with two barrier-separated lanes in each direction. In the Project NEXT No Build condition, the Maryland managed lanes system is assumed to be in place, leaving a gap section without Express Lanes between the Dulles Toll Road and the ALMB.

Within the Maryland managed lanes system in the traffic operations analysis study area, no further connections with the GP lanes or arterial network are assumed (e.g. no Express connections to or from Clara Barton Parkway). All connections to or from the managed lanes in Maryland are assumed to be located north of and outside the I-495 NEXT traffic operations analysis study area.

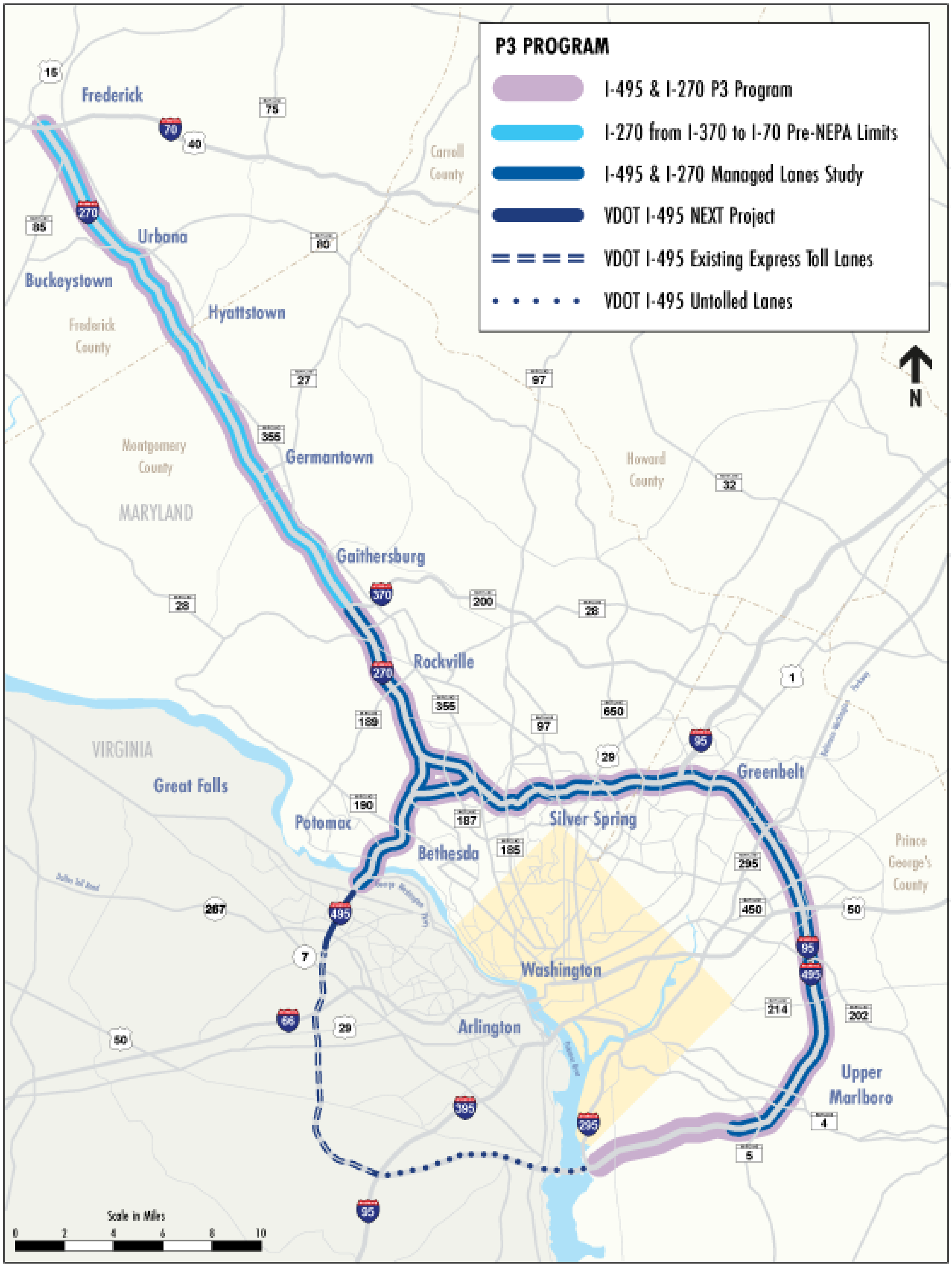


Figure 5-3. Maryland Traffic Relief Program

5.3 REGIONAL CONSTRAINED LONG-RANGE PLAN (CLRP): VISUALIZE 2045

Visualize 2045 is the federally-mandated constrained long-range transportation plan (CLRP) for the National Capital Region (NCR) (MWCOG, 2018). It identifies all regionally significant transportation investments planned through 2045. It was developed by the Transportation Planning Board (TPB) at MWCOG and was approved on October 17, 2018. Per federal NEPA regulations, all regional transportation projects included in the CLRP are included as background projects for I-495 Project NEXT, including incorporation in project travel demand models and traffic analysis simulation models where appropriate.

5.3.1 Route 123 Widening

Route 123 is programmed in the CLRP to be widened to four through lanes in each direction between Route 7 and I-495. This project is assumed to be in place for both 2025 and 2045 conditions. No widening is currently programmed along Route 123 east of I-495.

5.3.2 Dulles Interchange Master Plan

In 2009, while construction was underway for the I-495 Express Lanes, the Metropolitan Washington Airports Authority (MWAA) developed the Dulles Interchange Long-Range Plan for the I-495/Route 267 interchange to determine what, if any, changes to the then-current plan for the interchange under the I-495 Express Lanes project may be necessary to accommodate other future interchange improvements. The Long-Range Plan determined that up to 11 additional ramp movements would be necessary to improve I-495 connections to and from the DAAR and DTR. VDOT in partnership with MWAA signed a Memorandum of Understanding (MOA) in May 2009 to incorporate three of these additional ramps into the I-495 Express Lanes project. Specifically, these ramps provided movements for southbound I-495 GP Lanes to westbound DAAR; eastbound DAAR to southbound I-495 GP; and eastbound DAAR to northbound I-495 GP (VDOT/MWAA, 2009). A NEPA Re-evaluation of the Capital Beltway Study EIS was conducted, and the additional ramps were found to be consistent with the findings of the Final EIS (FHWA, 2009). An IJR for the Dulles Interchange was prepared and approved in December 2009 (VDOT, 2009). The ramps were constructed as part of the I-495 Express Lanes project and opened to traffic in September 2012.

The Dulles Interchange Master Plan, which is included in the regional CLRP, contains a series of proposed improvements to the I-495/Route 267 interchange. This plan includes the following elements to be constructed independent of I-495 Project NEXT:

- **New direct ramp connections**, including the following:
    - I-495 northbound GP lanes to westbound Dulles Airport Access Road (DAAR)
    - I-495 southbound GP lanes to westbound DAAR
- **New right-side flyover ramp from I-495 northbound GP lanes to westbound Dulles Toll Road**, eliminating the existing left-side ramp from I-495 northbound GP.
- **Capacity enhancements to ramp from eastbound Dulles Toll Road to I-495 northbound GP lanes** – widening this ramp to two lanes until it joins the I-495 mainline, at which point the two lanes merge into a single auxiliary lane.
- **Auxiliary lanes along I-495 north of Dulles Interchange** – an auxiliary lane will be provided in each direction between the Dulles Interchange and Georgetown Pike to improve the capacity of the GP lanes. The northbound auxiliary lane is assumed to be in place by 2025 while the southbound auxiliary lane is assumed to be in place by 2045.

- **C-D road system along I-495 between Route 123 and Dulles Interchange** – due to the short weaving areas between these two interchanges, a C-D road system is included within the Dulles Interchange Master Plan to improve capacity and reduce conflicting movements. Note that under Project NEXT No Build conditions, a C-D road is only shown for southbound I-495. These improvements are assumed to be in place by 2045.
- **C-D road system along Dulles Toll Road between Route 123 and Dulles Interchange** – due to the short weaving areas between these two interchanges, an eastbound C-D road system along the Dulles Toll Road is included within the Dulles Interchange Master Plan to improve capacity and reduce conflicting movements. These improvements are assumed to be in place by 2045.

Exhibits 5-2a through **5-2c** provide a concept for the Dulles Interchange assumed for I-495 NEXT No Build conditions for 2045. Note that the I-495 NEXT Build concept relocates and reconfigures several of these ramp connections.

5.3.3 Maryland Managed Lanes System

As noted in **Section 5.2**, as part of the Maryland TRP, managed lanes across the ALMB and in Maryland are assumed to be in place as a background project, as the TRP is contained within the regional CLRP. This includes north-facing managed lanes ramp connections at the GWMP interchange (westbound GWMP to northbound I-495 Maryland managed lanes and southbound I-495 Maryland managed lanes to eastbound GWMP).

To understand the impacts and operational benefits or constraints of Project NEXT operations prior to the Maryland managed lanes system being in place, a sensitivity analysis was performed for the 2025 analysis year. This sensitivity analysis included travel demand model runs, traffic volume forecasting, and traffic operations analysis in VISSIM and Synchro. The results of this sensitivity analysis are provided in **Appendix I.**

5.3.4 Dulles Toll Road and Tysons Improvements

Separate from the Dulles Interchange Master Plan improvements, the CLRP includes improvements to the west of the I-495/Route 267 interchange along the Dulles Toll Road to improve connectivity to Tysons. While Fairfax County is still determining which specific improvements will be implemented, upon coordination with the County, the following improvements were assumed and incorporated into the Project NEXT travel demand forecast models and traffic microsimulation models (where appropriate):

- New urban frontage road system along the Dulles Toll Road between Route 7 and Spring Hill Road. The east-facing ramps for this C-D road (eastbound on-ramp and westbound off-ramp) have been included in the microsimulation models.
- Two new connections from this C-D road to Tysons connecting to Tyco Road between Route 7 and Spring Hill Road. These connections are expected to relieve congestion at the Spring Hill Road interchange, especially the west-facing ramps (eastbound Dulles Toll Road to Spring Hill Road and Spring Hill Road to westbound Dulles Toll Road).

Exhibit 5-3 provides a VISSIM screen capture of the urban frontage road concept that was incorporated into the traffic analysis for I-495 NEXT. Note that in the CLRP, a connection to the east of Spring Hill Road providing direct access from the Dulles Toll Road to Jones Branch Drive is also noted. However, upon coordination with Fairfax County and noting the proximity to the I-495/Route 267 interchange, this improvement was not included as a background project.

These improvements along the Dulles Toll Road are not included for I-495 Project NEXT No Build conditions for 2025 but are included for 2045.

5.3.5 Transform I-66

The Transform I-66 project is located entirely outside of the project traffic operations analysis study area but is anticipated to impact travel within the study area. The following elements of the Transform I-66 project are noted:

- **Inside the Beltway** – east of I-495, I-66 was changed in 2017 to operate as an Express facility (only toll-paying and HOV-3 vehicles, which may ride free) across all lanes in the eastbound direction during the AM peak (5:30-9:30 AM) and westbound direction during the PM peak (3:00-7:00 PM) (VDOT, 2019d).
    - By 2025, I-66 eastbound will be widened to have a third through lane between the Dulles Connector Road and Glebe Road (VDOT, 2019e), improving eastbound capacity and ideally reducing queue spillback onto the Dulles Connector Road, which currently spills back into the project traffic operations analysis study area during the AM and PM peak periods.
    - By 2045, both I-66 eastbound and westbound are assumed to be operated as an Express facility in both directions during both peak periods according to the CLRP.
- **Outside the Beltway** – west of I-66 and including the I-66/I-495 interchange, I-66 is currently being reconstructed and widened to consist of three GP lanes and two Express Lanes in each direction (VDOT, 2019f). Several interchanges are being reconstructed to improve capacity, and an additional auxiliary GP lane is provided between most interchanges. The project will also feature new and improved bus service and transit routes, coupled with new and expanded park-and-ride lots to access the Express Lanes including more than 4,000 new park-and-ride spaces. Consistent with the regional Express network along I-495, I-95/I-395, and I-66 Inside the Beltway, the I-66 Express Lanes system will be free to HOV-3 vehicles (using an EZ-Pass transponder switched to "HOV-3" mode) and also allow toll-paying vehicles. This project, which is anticipated to be in place and operating prior to 2025, is anticipated to increase the capacity of I-66, impacting travel demand along I-495 as well.

5.4 STATEWIDE LONG-RANGE PLAN (VTRANS)

VTrans is Virginia's multimodal transportation plan developed by the Commonwealth Transportation Board (CTB) every four years. VTrans lays out the overarching vision and goals for transportation in the Commonwealth, identifies transportation investment priorities, and provides direction on implementation strategies and programs to the CTB and agencies such as VDOT. This plan is mandated both federally and at the state level and is used to guide investment decisions such as the Six Year Improvement Program (SYIP), including the SMART SCALE funding program.

The most recent edition of VTrans, VTrans 2040, was completed in January 2018 (Virginia OIPI, 2018). VTrans 2040 is comprised of a Vision Plan and Needs Assessment. The Needs Assessment is further comprised of the following:

- Corridor of Statewide Significance (CoSS) Needs Assessment
- Regional Network Needs Assessment
- Urban Development Area Needs Assessment

- Statewide Safety Needs Assessment

VTrans2040 also includes a set of recommendations highlighting critical projects for the next 10 years that address the VTrans vision, goals, and objectives within Virginia's most significant transportation needs. These recommendations are broken down to the project level. The recommendations included for Northern Virginia include several relevant background projects described in the previous sections including the funded Transform I-66 Inside and Outside the Beltway projects.

5.5 SUMMARY OF BACKGROUND TRANSPORTATION PROJECTS

Table 5-1 provides a summary of the projects previously described in this chapter, including anticipated project opening year. These projects have been included as background improvements for both No Build and Build conditions for I-495 Project NEXT traffic analysis. All projects noted for completion by 2025 are included as part of 2025 No Build conditions; otherwise, the improvements are only included for 2045 No Build conditions.

Table 5-1. Summary of Background Transportation Projects

Project	Description	Completion / Opening Year
Jones Branch Connector / Scotts Crossing Road Extension	Construction of a four-lane roadway across I-495 connecting to Route 123; includes expansion of traffic signal with I-495 Express Lanes ramps and new traffic signals east of I-495 and west of Route 123	2019
Transform I-66 Inside the Beltway: Eastbound Widening	Construction of additional eastbound lane along I-66 eastbound between Dulles Connector Road (Route 267) and Exit 71/Glebe Road (Route 120)	2021
Route 123 Widening	Widening of Route 123 between Route 7 and I-495 to four through lanes in each direction	2021
Georgetown Pike/Balls Hill Road Intersection Improvements	Dedicated northbound left-turn lane and updates to signal phasing	2019
Transform I-66 Outside the Beltway	Construction of two Express Lanes in each direction (along with three remaining GP lanes) between I-495 and University Boulevard; improved bus service and transit routes, including park-and-ride lot expansions; interchange improvements and auxiliary lanes between interchanges	2022
I-495 Managed Lanes in Maryland	Construction of two tolled lanes in each direction across the ALMB, around I-495 in Maryland, and along I-270. Includes north-facing ramp connections to GWMP (GWMP westbound to I-495 northbound managed lanes and I-495 southbound managed lanes to GWMP eastbound).	2025[i]

Project	Description	Completion / Opening Year
Dulles Interchange Master Plan	Construction of new direct access ramps from I-495 northbound and southbound GP lanes to DAAR westbound; reconstruction of several existing ramp movements at interchange including C-D roads along eastbound DTR and southbound I-495; auxiliary lanes along I-495 GP between Route 267 and Route 193	2030[ii]
Dulles Toll Road All-Electronic Tolling	Conversion to high-speed all-electronic tolling and removal of existing toll booths	2030
Dulles Toll Road Urban Frontage Road west of Spring Hill Road	Construction of two-lane frontage road outside of DTR mainline between Route 7 and Spring Hill Road; includes new direct connections from frontage road to Tyco Road	2037
Transform I-66 Inside the Beltway: Both Directions Express Lanes Operations	Both directions of I-66 east of I-495 operated as Express Lanes across all lanes (HOV-3 free with EZ-Pass switched to HOV-3 mode; tolled for all other vehicles) during both peak periods.	2040

[i] A sensitivity analysis has been conducted assessing the impacts of a No Build and Build condition for Project NEXT if the I-495 Maryland managed lanes system is not complete by 2025. This analysis is included as **Appendix I.**

[ii] I-495 northbound GP auxiliary lane between Route 267 and Route 193 assumed to be in place by 2025.

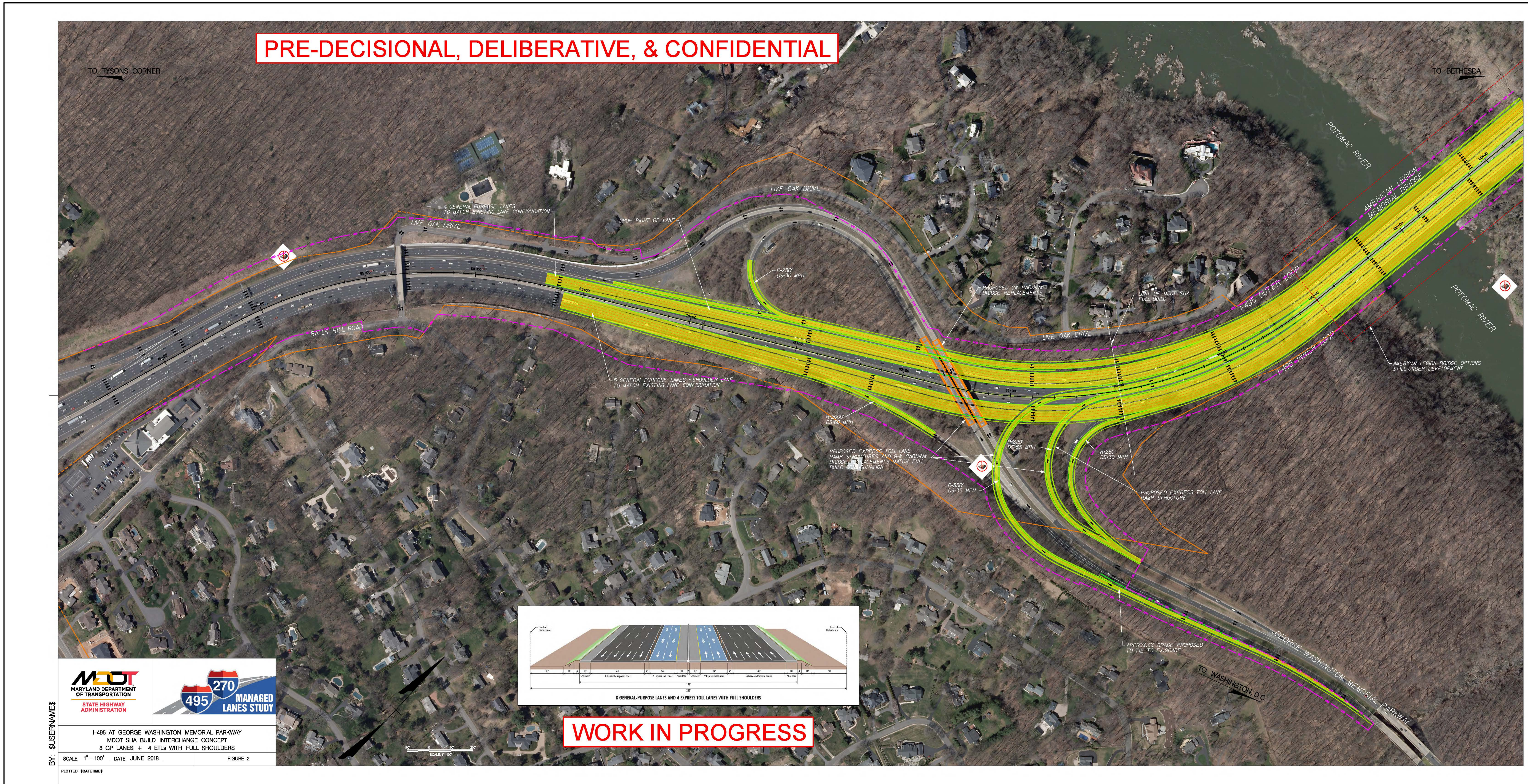


Exhibit 5-1. Project NEXT No-Build Geometry at GWMP Interchange and Maryland Express Lanes in Place

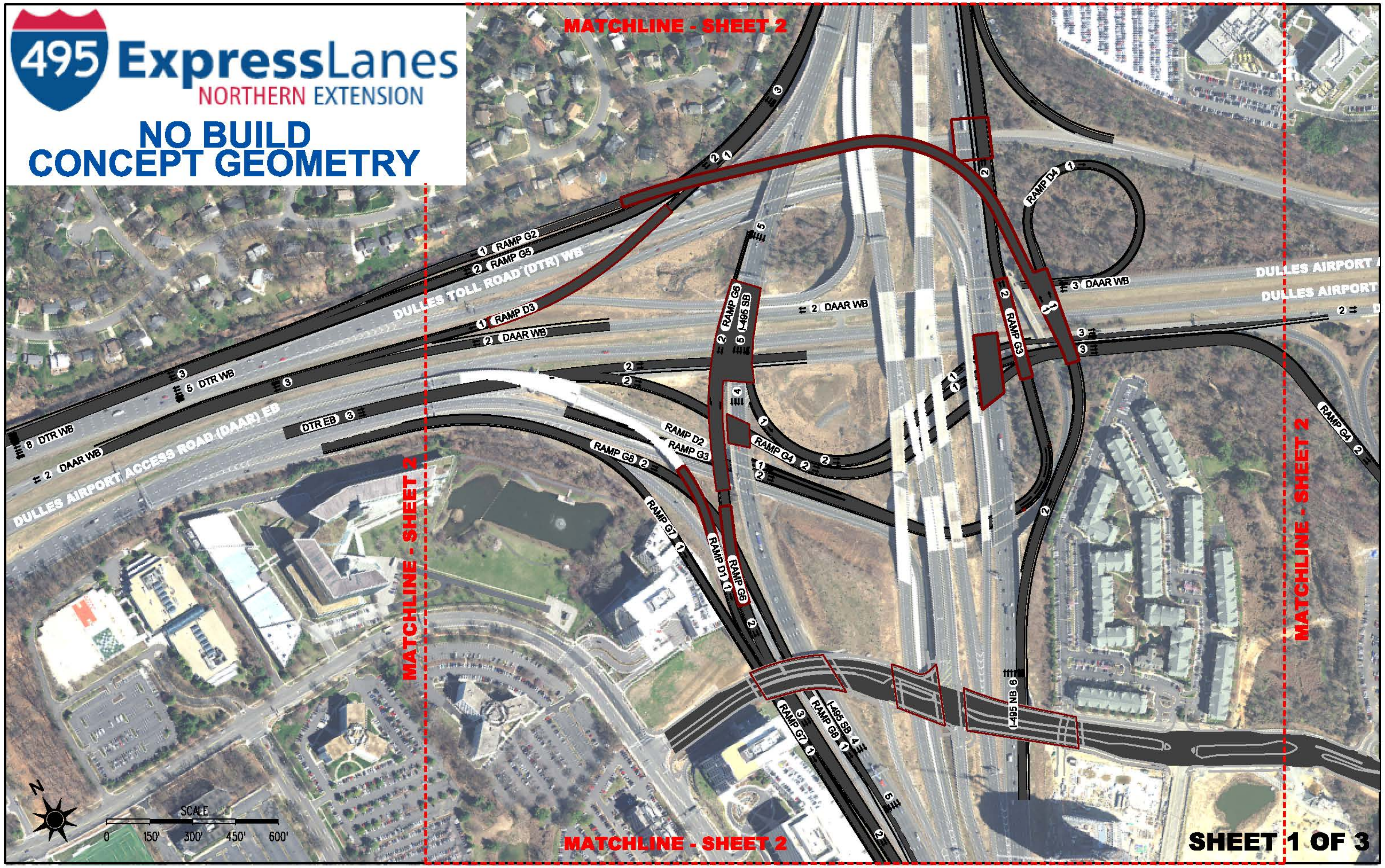


Exhibit 5-2a. Project NEXT No-Build Geometry at Route 267 Interchange (Sheet 1 of 3)

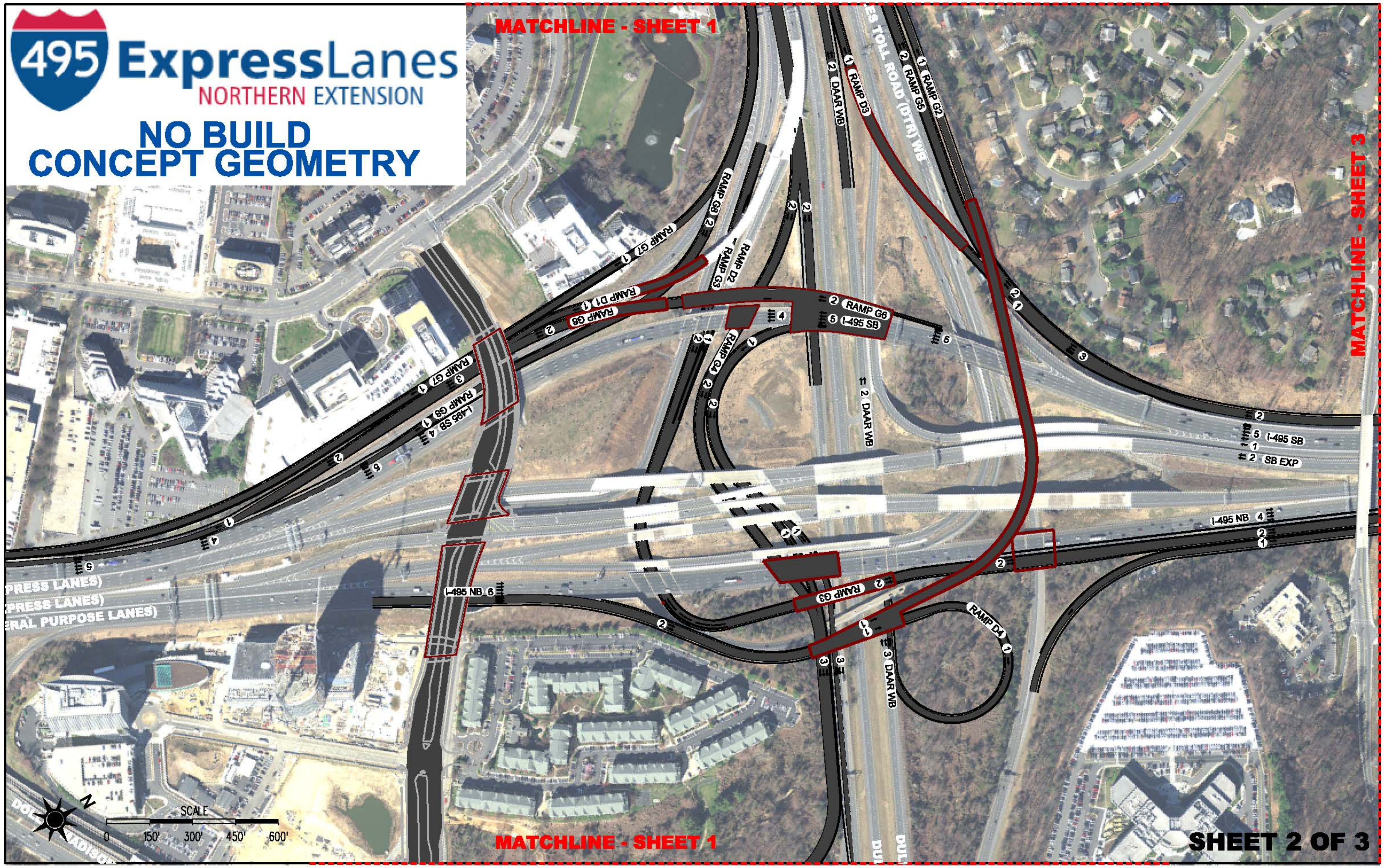


Exhibit 5-2b. Project NEXT No-Build Geometry at Route 267 Interchange (Sheet 2 of 3)

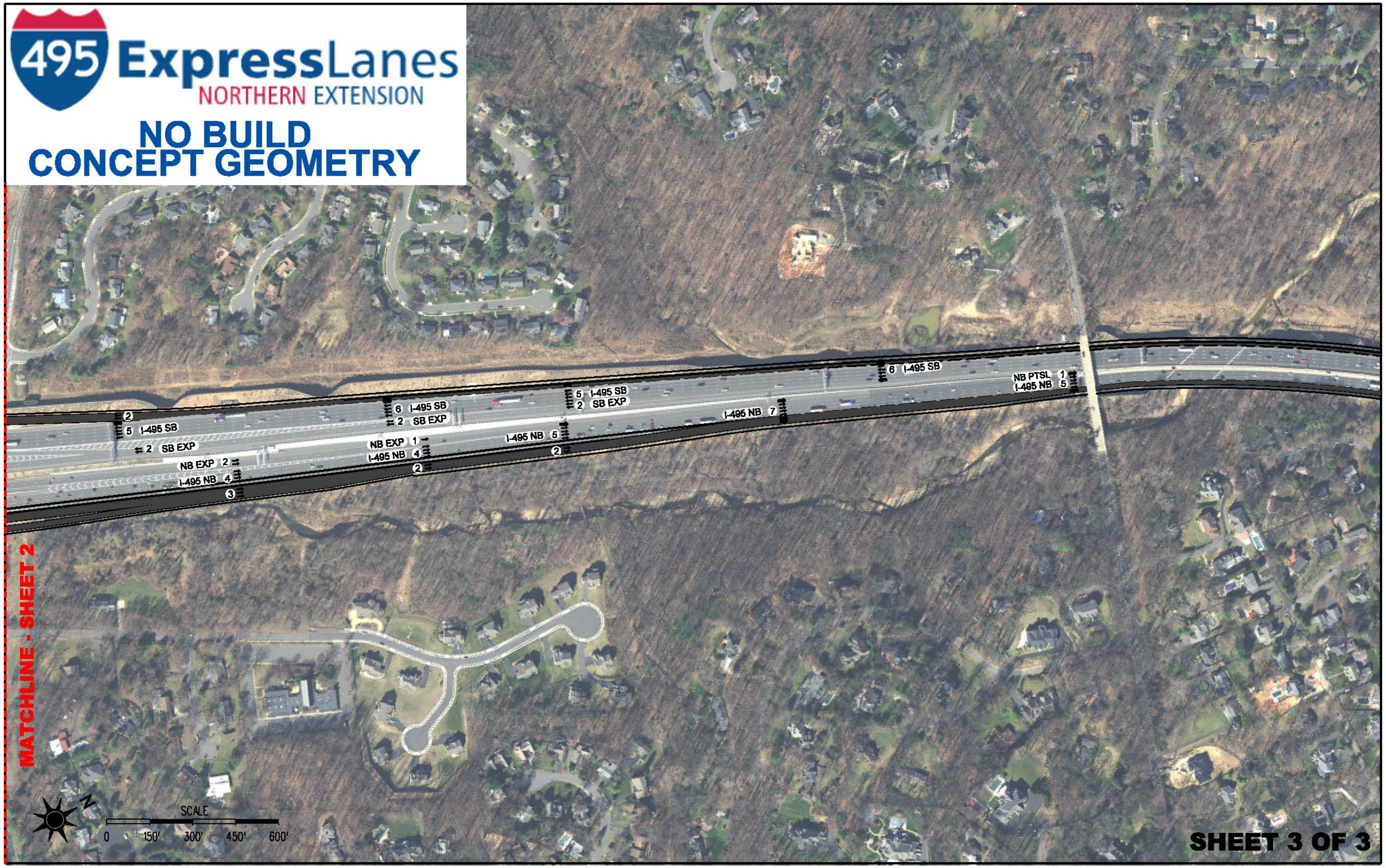


Exhibit 5-2c. Project NEXT No-Build Geometry at Route 267 Interchange (Sheet 3 of 3)

Exhibit 5-3. Route 267 Urban Frontage Road Concept (Assumed for Year 2045 Traffic Modeling and Analysis)

CHAPTER 6.0 BUILD TRANSPORTATION NETWORK

VDOT, in coordination with FHWA, local governments, regulatory agencies, and stakeholders considered a range of options that would reduce congestion, provide new travel choices, and improve travel reliability along I-495. These efforts resulted in the development of a single conceptual alternative (the Build Alternative) that includes extending the Express Lane system on I-495 north to the GWMP. The following factors were considered in the development of the alternative:

- The logical termini of the proposed project would connect with an existing Express Lane system to the south and a proposed Express Lane system to the north as programmed in the federally-approved 2045 CLRP for the region (the managed lanes system in Maryland as part of the Maryland Traffic Relief Plan; see **Chapter 5** for more details). As such, the only appropriate alternative to consider would be one that provides a seamless network of barrier-separate managed lanes between these termini;
- The proposed project is identified as a public-private partnership (P3) project, and the funding and implementation of the project would make other alternatives inappropriate for addressing project Purpose and Need, due to system continuity and operational consistency issues; and,
- The National Capital Region Transportation Planning Board (NCRTPB), which is the designated Metropolitan Planning Organization for the Washington, D.C. region under the Metropolitan Washington Council of Governments (MWCOG), established Express Lanes as an integral part of the system network of the National Capital Region.

The Build Alternative would be implemented in multiple phases. Opening Year improvements (assumed to be in place by 2025 for traffic operations analysis) would include:

- The extension of the I-495 Express Lanes from the Route 267 interchange to the GWMP interchange, at which point the Express Lanes would seamlessly tie into the Maryland managed lanes system.
- Improvements to the Route 267 interchange, including connections from the Dulles Toll Road (both eastbound and westbound) to northbound I-495 Express and enhancements to the ramp from eastbound DTR to northbound I-495 GP.
- Improvements to the GWMP interchange, including connections from northbound I-495 Express to GWMP and from GWMP to southbound I-495 Express, and a new collector-distributor (C-D) road design along southbound I-495 GP between the GWMP and Route 193 interchanges.
- A new northbound I-495 GP auxiliary lane between the Route 267 and Route 193.
- Rebuilding of the Route 738 (Old Dominion Drive) overpass, the Live Oak Drive overpass, and the Route 193 interchange in order to accommodate the expanded cross-section of the I-495 mainline.
- A parallel bicycle/pedestrian trail between Route 694 (Lewinsville Road) and the GWMP.

Exhibits 6-1a through **6-1e** contain the concept plan sheets for the Build Alternative showing Opening Year improvements in place. Further improvements would be implemented between 2025 (Opening Year) and 2045 (Design Year) culminating into the Ultimate Build Configuration, which would include additional improvements at the Route 267 interchange and improvements to the Route 123 interchanges with both I-495 and Route 267. All improvements associated with the Build Alternative are assumed to be in place by

2045. **Exhibits 6-2a** through **6-2e** contain the concept plan sheets for the Build Alternative showing all improvements in place.

Parallel to these efforts, the Maryland Project would be designed and implemented, under the direction of the Maryland State Highway Association (MDSHA) and through coordination with VDOT, to be completed by 2025 as stated in the CLRP. The Maryland project would include, among other improvements;

- The development of two new managed lanes in each direction on I-495 for approximately 0.4 miles from the GWMP to the ALMB.
- The redevelopment of the American Legion Memorial Bridge, which shall include managed lanes in each direction.
- Managed lanes continuing north into Maryland to I-270.

Due to its ability to address the needs of the project, establish connections and overpasses along the corridor, and accommodate future connections in the CLRP, including those connections to the planned managed lane network in Maryland, extending the Express Lane system on I-495 north to the GWMP along the existing alignment was deemed the single alternative retained for detailed study.

6.1 BUILD ALTERNATIVE: MAINLINE I-495

The Build Alternative would be implemented in multiple phases, although most improvements to the mainline I-495 cross-section will be complete in the Opening Year of 2025:

- In the Opening Year, the Build Alternative would extend the existing four I-495 Express Lanes from their current terminus between the I-495/Route 267 interchange and the Old Dominion Drive Overpass north approximately 1.6 miles to the GWMP interchange, at which point the Express Lanes would seamlessly tie into the Maryland managed lane system. In order to reduce the LOD, the extended Express Lanes would be separated from the GP lanes by flexible delineators, consistent with the configuration of the existing I-495 Express Lanes, requiring approximately an additional 8 feet. This eliminates the need to provide full shoulders and concrete barrier separation in each direction, which would require an additional 56 feet in comparison. **Figure 6-1** shows a typical section for I-495 with two Express Lanes in either direction separated by flexible delineators.
- In the Opening Year, the Build Alternative would also add a northbound GP auxiliary lane between the on-ramp from the various Route 267 interchange ramps (which tie in together before joining the I-495 mainline) and the off-ramp to Route 193. An auxiliary lane is already provided between the Route 193 and GWMP interchange today in the northbound direction; in the southbound direction, a C-D road will take the place of an auxiliary lane.

A southbound GP auxiliary lane between the on-ramp from Route 193 and the off-ramp to Route 267 would be provided as a part of the Ultimate Configuration by the Design Year of 2045.

Through the entire project area, the Build Alternative would retain the existing number of GP lanes in each direction between the I-495/Route 267 interchange and the GWMP, provide additional access to the Express Lane network, and improve the Route 267, Route 123, and GWMP interchanges. Details of specific design features included in the Build Alternative at these interchanges are discussed in the following sections.

The Build Alternative was developed using current design guidelines including the American Association of State Highway and Transportation Officials' (AASHTO) *A Policy on the Geometric Design of Highways and Streets,* also known as the Green Book, (AASHTO, 2018); AASHTO's *A Policy on Design Standards, Interstate System* (AASHTO, 2016); and the VDOT Road Design Manual (VDOT, 2019g). The design criteria used for this study are based on the functional classification of the roadways within the project study area. A descriptive list of the design waivers and design exceptions for the geometric elements of the Build Alternative that do not meet state and federal requirements can be found in the Interchange Justification Report (IJR) (VDOT, 2020).

A discussion of specific design features of the Build Alternative and how these features are addressed are included in the associated IJR (VDOT, 2020). The LOD is based on preliminary engineering and design, which has been developed to include both temporary and permanent impacts, including stormwater management facilities and construction access. As the project advances into the detailed stages of engineering and design, the anticipated impacts may be subject to change as opportunities to avoid or minimize impacts to resources or reduce cost are recognized.

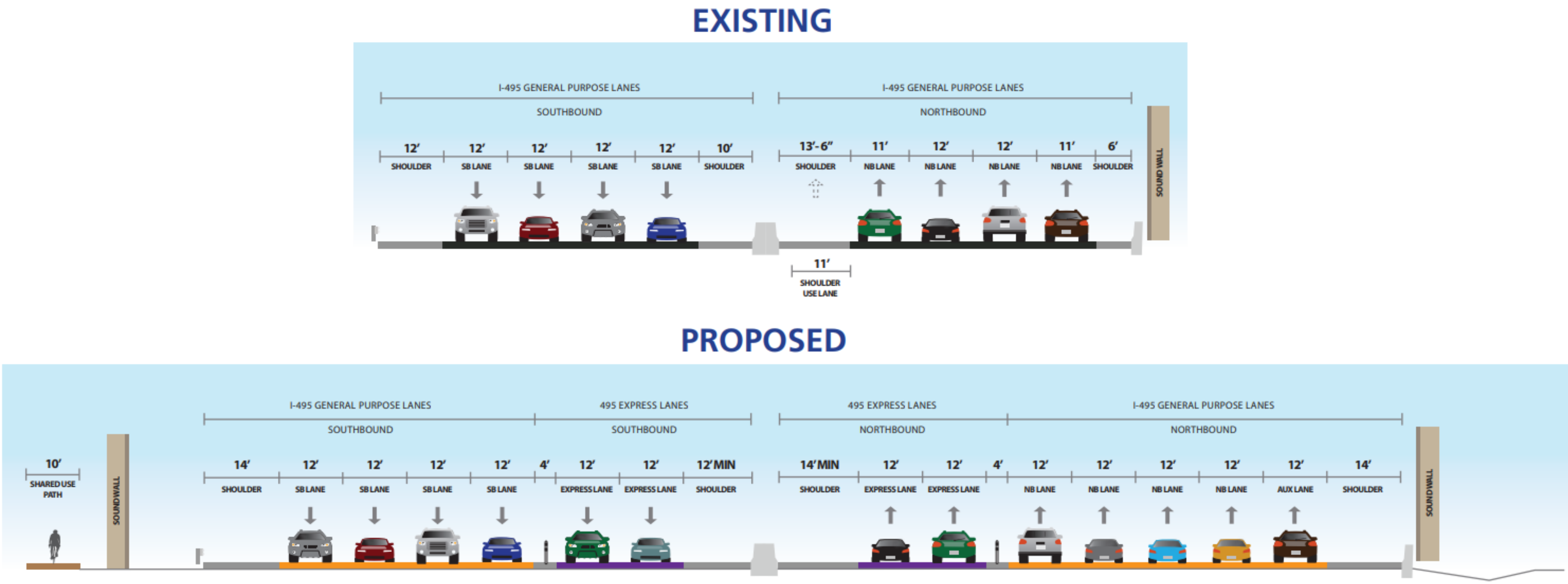


Figure 6-1. Existing and Build Alternative Typical Sections

6.2 PROPOSED ACCESS TO THE EXPRESS LANES

Table 6-1 summarizes the proposed Express Lanes access modifications within the I-495 study area. All existing access points at the I-495/Route 267 interchange would be maintained; however, the geometric configurations of these access points would change to accommodate additional movements. Access to and from the Express Lanes at the current Express Lane terminus (north of the Route 267 interchange) would be eliminated as the Express Lanes would be extended up to connect directly with the Maryland managed lanes facility at the GWMP. The managed lanes facility on I-495 in Maryland, which would extend south over the ALMB to GWMP is currently being planned by MDSHA.

6.2.1 Express Lanes Access in 2025 (Opening Year)

In the Opening Year of the Build Alternative, direct access from the northbound I-495 Express Lanes to the northbound I-495 GP lanes and from the southbound I-495 GP lanes to the southbound I-495 Express Lanes as provided at the current Express Lanes terminus (north of the Route 267 interchange) would be eliminated. This provides for the continuation of the Express Lanes system north through the current terminus of the Maryland system at the GWMP.

New access to and from the I-495 Express Lanes system would be provided via the following movements in the Opening Year:

- Eastbound Route 267 (DTR) to northbound I-495 Express
- Westbound Route 267 (Dulles Connector Road) to northbound I-495 Express
- Northbound I-495 Express to GWMP
- GWMP to southbound I-495 Express

Note that the current Express Lanes system already provides the southbound I-495 Express to westbound Route 267 (DTR) movement, which would be retained. The southbound I-495 Express to eastbound Route 267 (Dulles Connector Road) movement would not be provided in the Opening Year.

Also note that, as described in **Chapter 5**, the Maryland managed lanes system (assumed to be in place under No-Build conditions) would provide access to the following movements:

- GWMP to northbound I-495 Express
- Southbound I-495 Express to GWMP

Existing access at GWMP would be modified to accommodate the new Express Lanes access while minimizing the additional right-of-way required.

6.2.2 Express Lanes Access in 2045 (Design Year)

The Ultimate Configuration of the Build Alternative, to be completed by the Design Year of 2045, would include flyover exchange ramps to provide access from the northbound I-495 GP lanes to the northbound I-495 Express Lanes, and from the southbound I-495 Express Lanes to the southbound I-495 GP lanes. These exchange ramps would be located at the Route 267 interchange.

Additional access to the Express Lane facility would be provided at the Route 267 interchange via direct access from the southbound I-495 Express Lanes to eastbound Route 267 (Dulles Connector Road). This movement would tie into an eastbound C-D road along Route 267 at the Route 267/Route 123 interchange, allowing access to both the eastbound Dulles Connector Road and Route 123.

Finally, direct access from the eastbound DAAR to the northbound I-495 Express Lanes would be provided via an eastbound C-D road between eastbound DTR and eastbound DAAR east of Spring Hill Road.

Table 6-1. Express Lane Access Point Modifications

Access Point	Access		
	Existing	*Build Alternative 2025 (Opening Year)*	*Build Alternative 2045 (Design Year)*
Exchange Ramps	Current Express Lanes Terminus	(None provided)	• NB I-495 GP to NB I-495 Express Lanes (EXP) at the Route 267 interchange • SB I-495 EXP to SB I-495 GP at the Route 267 interchange
I-495/Route 267 Interchange	• NB I-495 EXP to WB Route 267 • SB I-495 EXP to WB Route 267 • NB I-495 EXP to Jones Branch Connector (JBC) • SB I-495 EXP to JBC • EB Route 267 to SB I-495 EXP • JBC to NB I-495 EXP • JBC to SB I-495 EXP	• All Access points provided under Existing Conditions • EB DTR to NB I-495 EXP • WB DTR to NB I-495 EXP	• All Access Points provided under Build Alternative Opening Year • SB I-495 EXP to EB Dulles Connector Road (including Route 123) • EB DAAR to NB I-495 EXP
George Washington Parkway	GP only; no EXP	• NB I-495 EXP to EB GWMP • WB GWMP to SB I-495 EXP • SB I-495 EXP to EB GWMP (Maryland system) • WB GWMP to NB I-495 EXP (Maryland system)	• All Access Points provided under Build Alternative Opening Year

6.3 ROUTE 267 INTERCHANGE

The Build Alternative includes significant modifications to the I-495/Route 267 interchange, including modifications to several of the GP ramp connections. This interchange is a critical component of the I-495 Express Lane network as it is adjacent to the rapidly growing Tysons area and provides direct access to and from Washington Dulles International Airport (IAD) via the DAAR. The I-495/Route 267 interchange is also close to several stops on the Metro's Silver Line, a major commuter line currently being extended to provide service to and from IAD.

Exhibit 6-2a illustrates the proposed Build Alternative Design at the Route 267 interchange. Individual Ramp movements are discussed in detail below. Modified Access refers to movements which are provided under the existing interchange configuration, while Additional Access refers to movements which are not provided under the existing interchange configuration. All access provided in the existing interchange configuration is maintained in some form through all phases of the Build Alternative.

6.3.1 Route 267 Interchange in 2025 (Opening Year)

The following improvements are assumed to be completed at the Route 267 by 2025:

- **G3:** Ramp G3 is a two-lane ramp which provides Modified Access from eastbound DTR to northbound I-495 GP lanes. In the Opening Year, ramp G3 will tie into northbound I-495 GP lanes at the same location as the existing ramp movement from eastbound DTR to northbound I-495. Note that by the Design Year, ramp G3 will be extended to combine with ramps G10 and G9 about before tying into northbound I-495 GP lanes about 0.6 miles downstream of the existing tie in point.
- **E1:** Ramp E1 provides Modified Access from eastbound DTR and eastbound DAAR to northbound and southbound I-495 Express Lanes, with one lane of capacity to each direction of the Express Lanes facility. In the Opening Year, ramp E1 would utilize the existing off-ramp from eastbound DTR, which is indirectly accessible from eastbound DAAR via an upstream slip ramp, leading to the newly constructed two-lane ramp which splits to provide one lane to southbound I-495 Express Lanes (an existing ramp) while the second lane continues under mainline I-495 and then flies over Route 267 where it merges with ramp E3 before tying into the northbound I-495 Express Lanes. By the Design Year, access from eastbound DTR and eastbound DAAR would be provided via a C-D road which collects traffic from the DTR and DAAR upstream of the Route 267 interchange, flies over eastbound DTR, and then ties into the portion of ramp E1 which would be constructed by the Opening Year of the Build Alternative.
- **E3:** Ramp E3 is a one-lane ramp which provides Additional Access from westbound DCR to northbound I-495 Express Lanes. Ramp E3 merges with ramp E1 before tying into northbound I-495 Express Lanes.

6.3.2 Route 267 Interchange in 2045 (Design Year)

The following improvements are assumed to be completed at the Route 267 interchange by 2045:

- **GX:** Ramp GX is a one-lane ramp which provides Additional Access from northbound I-495 GP lanes, from and Route 123 at the I-495/Route 123 interchange, to northbound I-495 Express Lanes. Ramp GX would be provided via a connection from ramp G2 to ramp E1.
- **XG:** Ramp XG is a one- lane ramp which provides Additional Access from southbound I-495 Express Lanes to southbound I-495 GP lanes. Ramp XG would be provided via flyover ramp connecting ramp E2 to ramp D1.
- **E2:** Ramp E2 is a one-lane ramp which provides Additional Access from southbound I-495 Express Lanes to eastbound DTR.
- **G1:** Ramp G1 is a one-lane ramp which provides Modified Access from southbound I-495 GP lanes to eastbound DTR. Ramp G1 also provides access to Route 123 at the Route 267/Route 123 interchange via a connection to ramp D2 and subsequent connection to ramp G4.

- **G2:** Ramp G2 provides Modified Access from northbound I-495 to westbound DTR with one lane of capacity. Ramp G2 also provides access from Route 123 at the I-495/Route 123 interchange via the proposed C-D road system at that interchange.
- **G3:** Ramp G3 is a two-lane ramp which provides Modified Access from eastbound DTR to northbound I-495 GP lanes. In the Opening Year, ramp G3 will tie into northbound I-495 GP lanes at the same location as the existing ramp movement from eastbound DTR to northbound I-495. By the Design Year, ramp G3 will be extended to combine with ramps G10 and G9 about before tying into northbound I-495 GP lanes about 0.6 miles downstream of the existing tie in point.
- **G4:** Ramp G4 provides Modified Access from eastbound DTR to the Route 123 C-D road at the Route 267/Route 123 interchange. Ramp G4 also provides access to the Route 123 C-D from eastbound DAAR via a connection from ramp D2.
- **G5:** Ramp G5 is a two-lane ramp which provides Modified Access from southbound I-495 GP lanes to westbound DTR.
- **G6:** Ramp G6 provides Modified Access from southbound I-495 GP lanes to the proposed Route 123 C-D road at the I-495/Route 123 interchange with one lane of capacity.
- **G7:** Ramp G7 is a one-lane ramp which provides Modified Access from eastbound DTR to the propose Route 123 C-D road at the I-495/Route 123 interchange.
- **G8:** Ramp G8 is a one-lane ramp which provides Modified Access from eastbound DTR to southbound I-495 GP lanes.
- **G9:** Ramp G9 is a one-lane ramp which provides Modified Access from the Route 123 C-D road at the I-495/Route 123 interchange to northbound I-495 GP lanes (provided access to the northbound GP lanes from Route 123). Ramp G9 is provided via a connection from ramp G2 to combined ramps G3 and G10.
- **G10:** Ramp G10 is a one-lane ramp which provides Modified Access from westbound DTR to northbound I-495. Ramp G10 to provided via a connection from the westbound DTR mainline to ramp G3.
- **D1:** Ramp D1 provides Modified Access from eastbound DAAR (indirectly via eastbound DTR) to southbound I-495 GP lanes with one lane of capacity.
- **D2:** Ramp D2 provides Modified Access from eastbound DAAR to northbound I-495 GP lanes with one lane of capacity.
- **D3:** Ramp D3 is a one-lane ramp which provides Additional Access from southbound I-495 GP lanes to westbound DAAR.
- **D4:** Ramp D4 is a one-lane ramp which provides Additional Access from northbound I-495 GP lanes to westbound DAAR.

6.4 GEORGE WASHINGTON MEMORIAL PARKWAY INTERCHANGE

The Build Alternative also includes modifications to the GWMP interchange, the northernmost interchange on I-495 in Virginia. Extending from I-495 just south of the ALMB east to Alexandria, the GWMP acts as a major commuter route for vehicles going to and from Northern Virginia, Maryland, and Washington, D.C.

Exhibit 6-2e illustrates the GWMP interchange under the Build Alternative. All existing GP movements at the GWMP would be maintained under the Build Alternative, but would be modified to accommodate additional access between I-495 Express Lanes and the GWMP provided under the Build Alternative. The

Opening Year (2025) of the Build Alternative would include two south facing ramps which would provide access from northbound I-495 Express Lanes to eastbound GWMP, and from westbound GWMP to southbound I-495 Express Lanes, while the Maryland Traffic Relief Plan project (also planned to be completed by 2025) would include two north facing ramps which would provide access from southbound I-495 managed lanes to eastbound GWMP, and from westbound GWMP to northbound I-495 managed lanes.

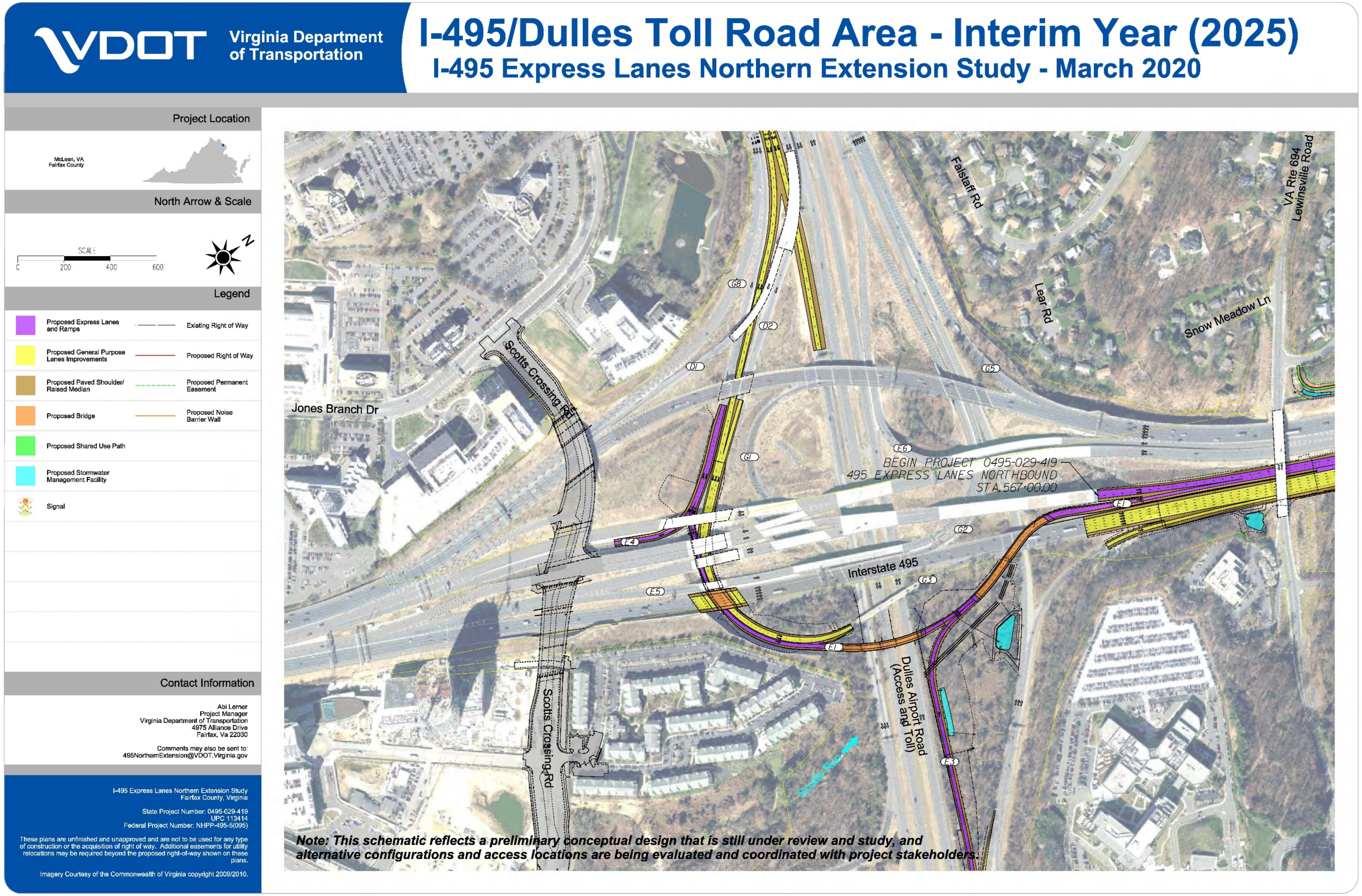


Exhibit 6-1a. Build Alternative Opening Year Improvements Concept Design (Sheet 1 of 5)

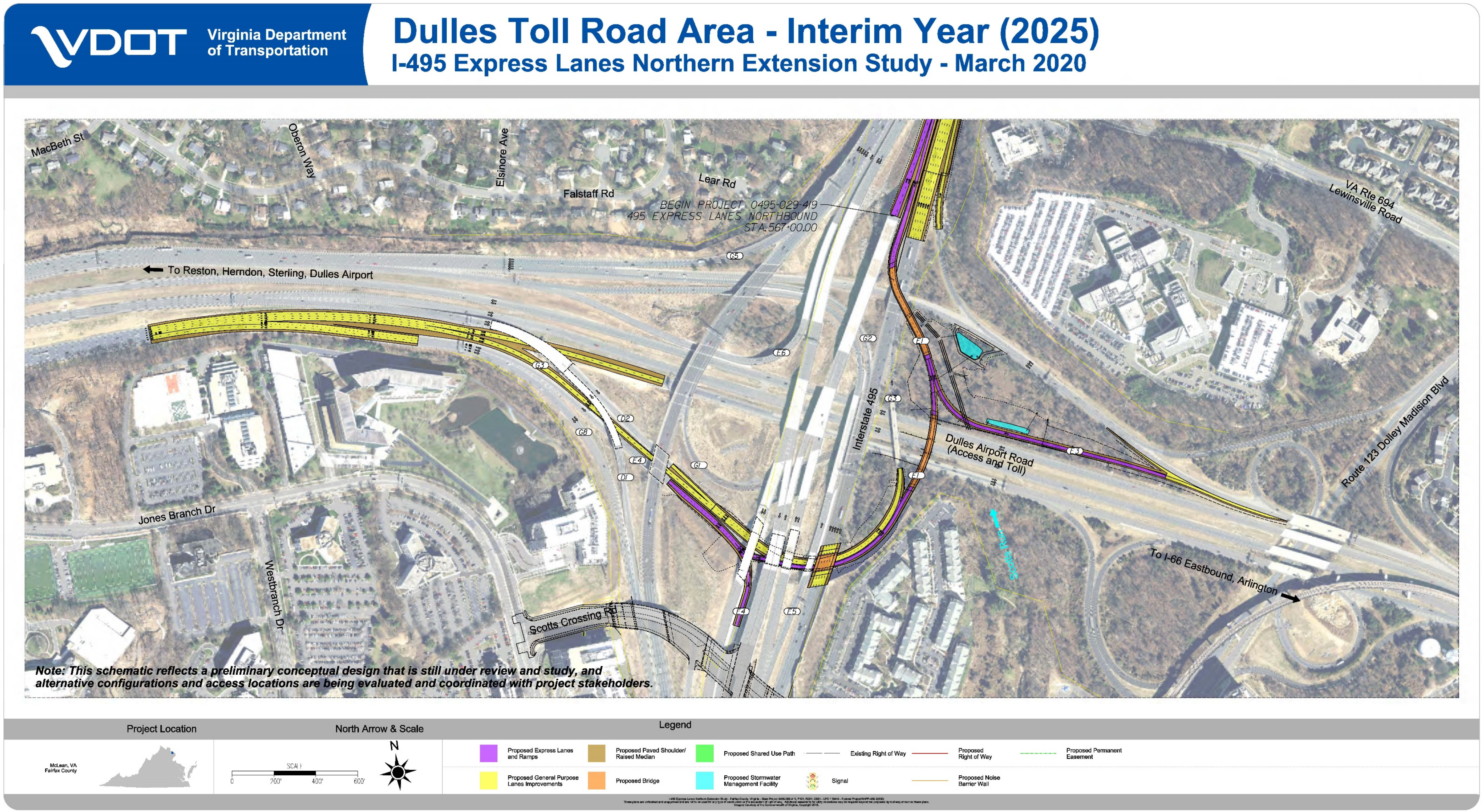


Exhibit 6-1b. Build Alternative Opening Year Improvements Concept Design (Sheet 2 of 5)

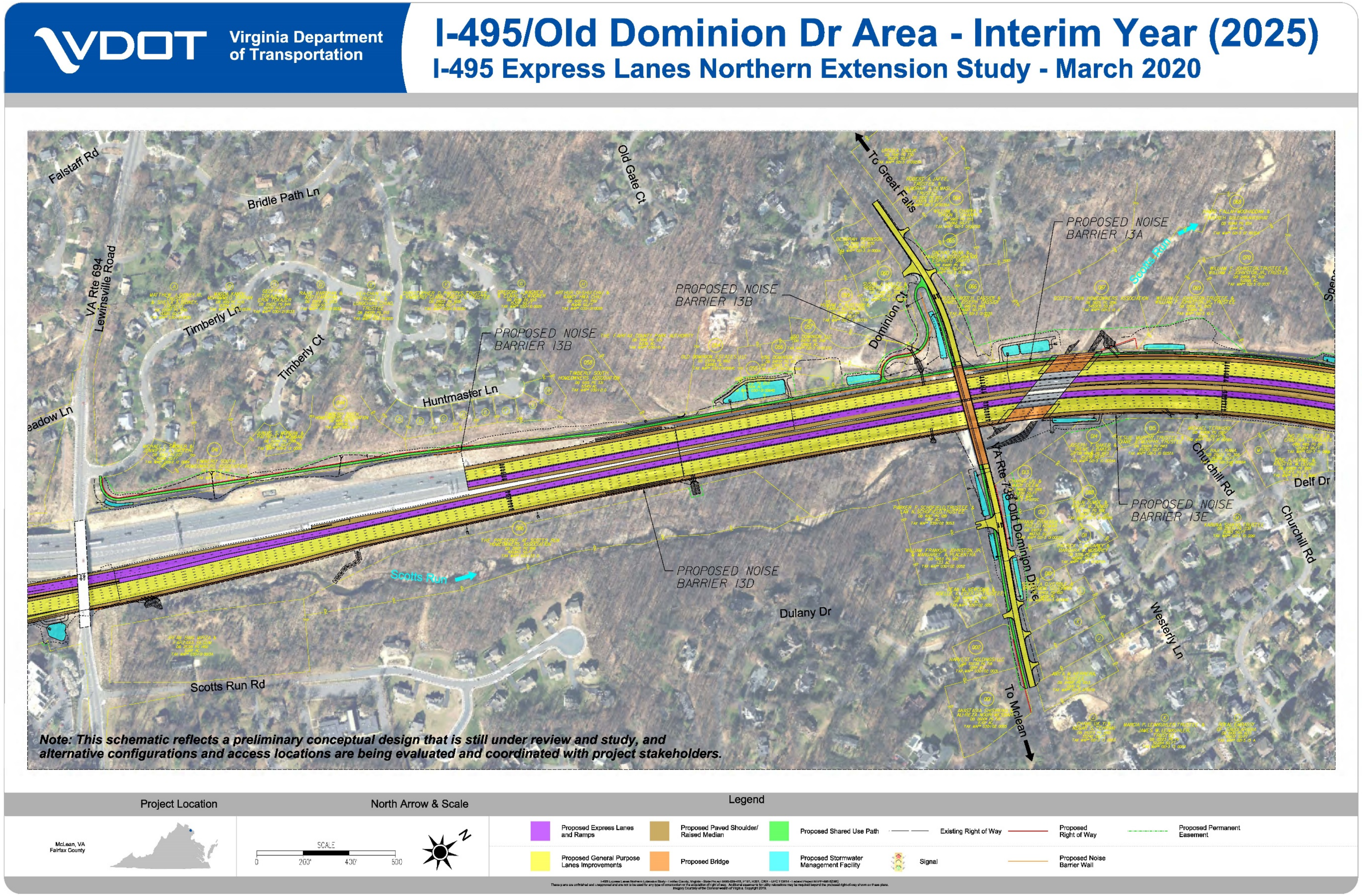


Exhibit 6-1c. Build Alternative Opening Year Improvements Concept Design (Sheet 3 of 5)

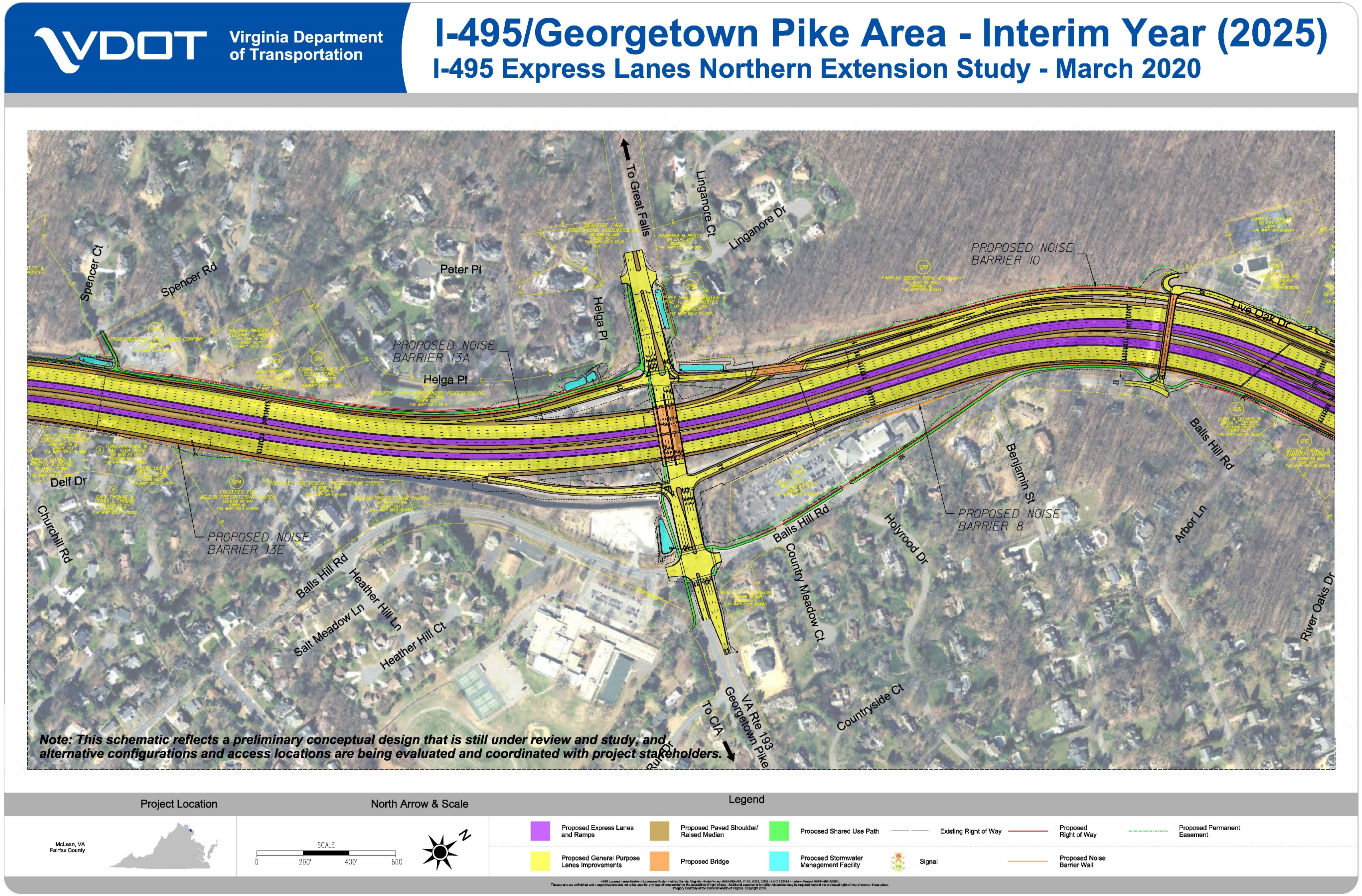


Exhibit 6-1d. Build Alternative Opening Year Improvements Concept Design (Sheet 4 of 5)

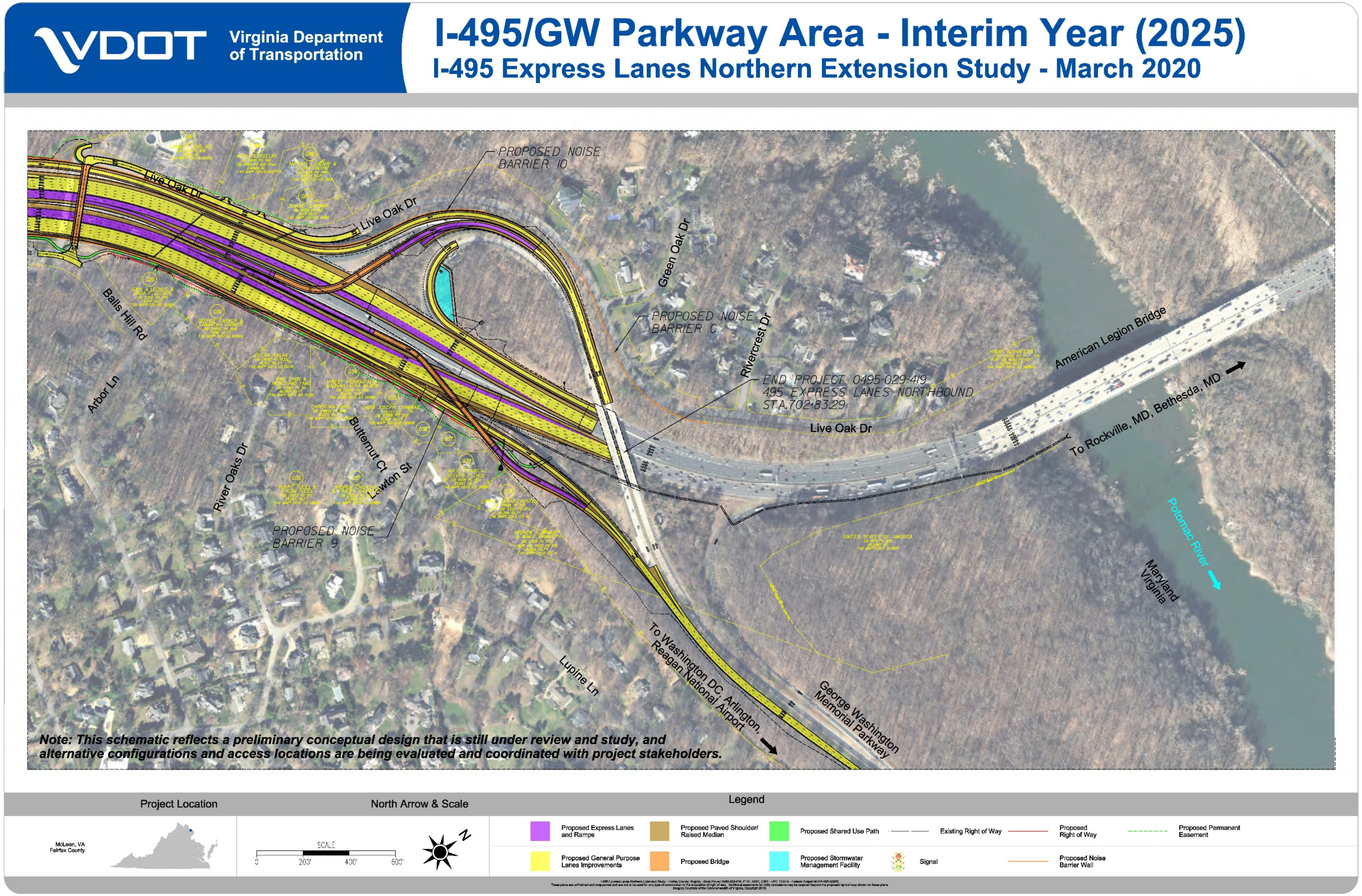


Exhibit 6-1e. Build Alternative Opening Year Improvements Concept Design (Sheet 5 of 5)

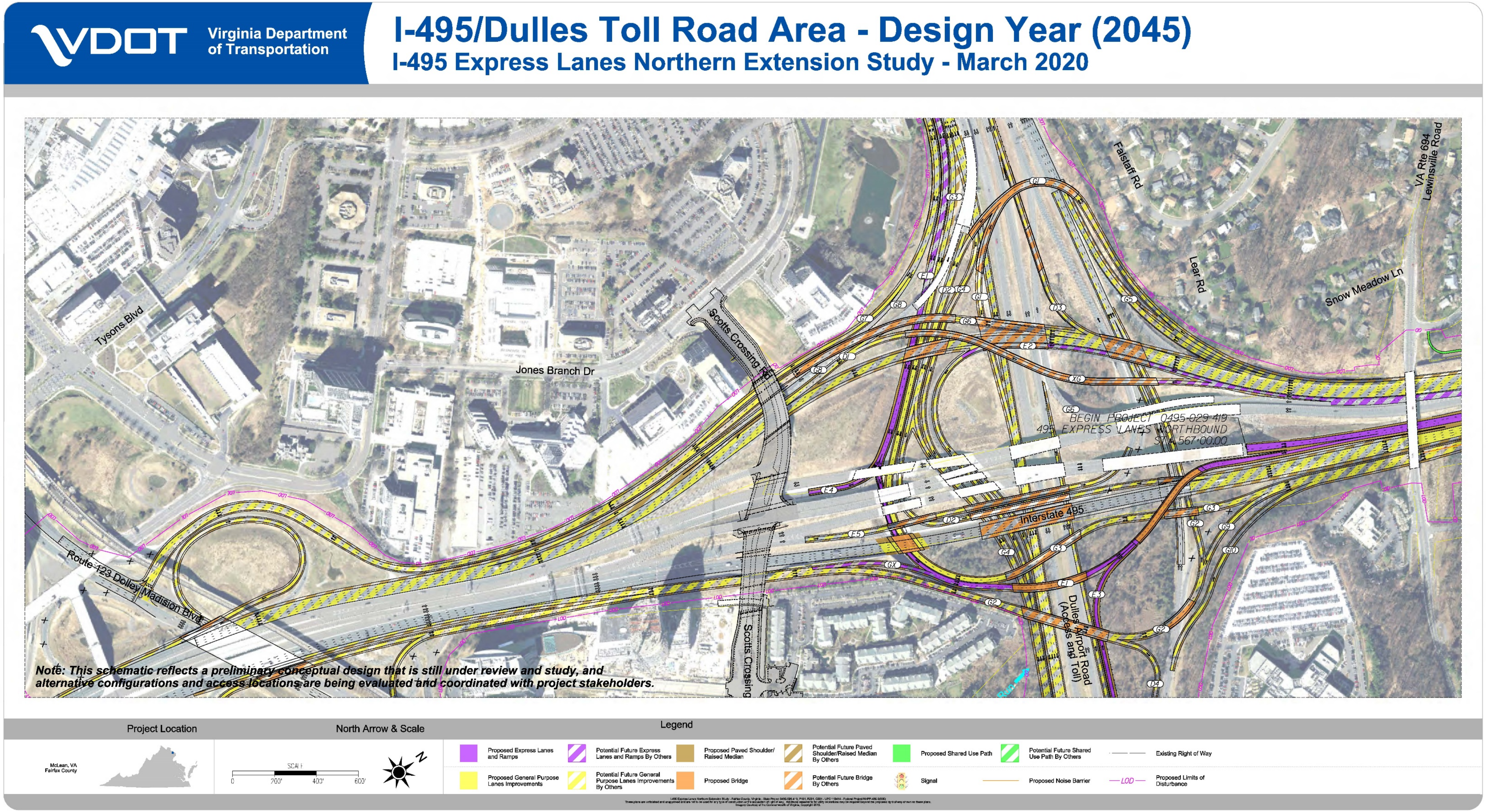


Exhibit 6-2a. Build Alternative Ultimate Configuration (Not to Preclude) Improvements Concept Design (Sheet 1 of 5)

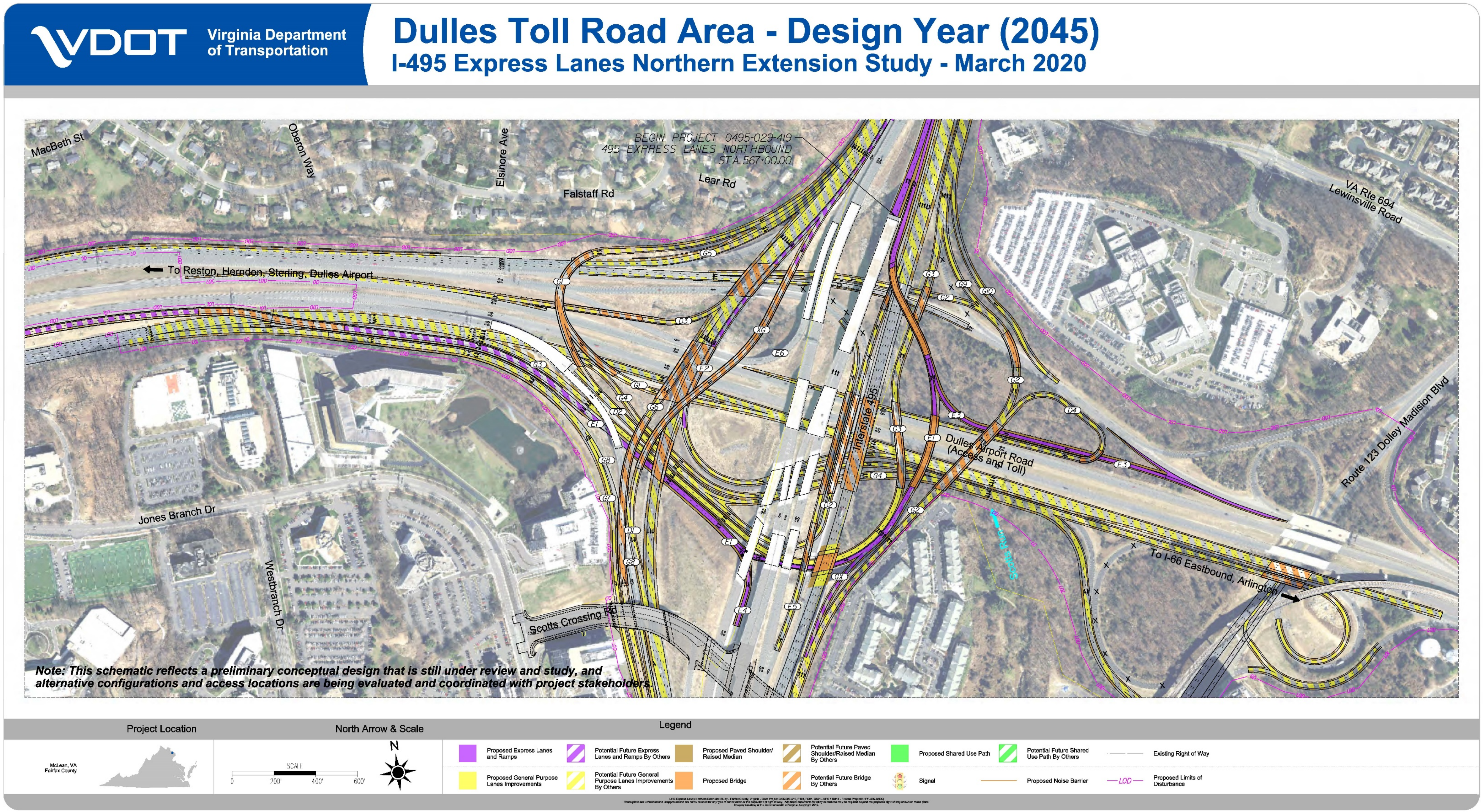


Exhibit 6-2b. Build Alternative Ultimate Configuration (Not to Preclude) Concept Design (Sheet 2 of 5)

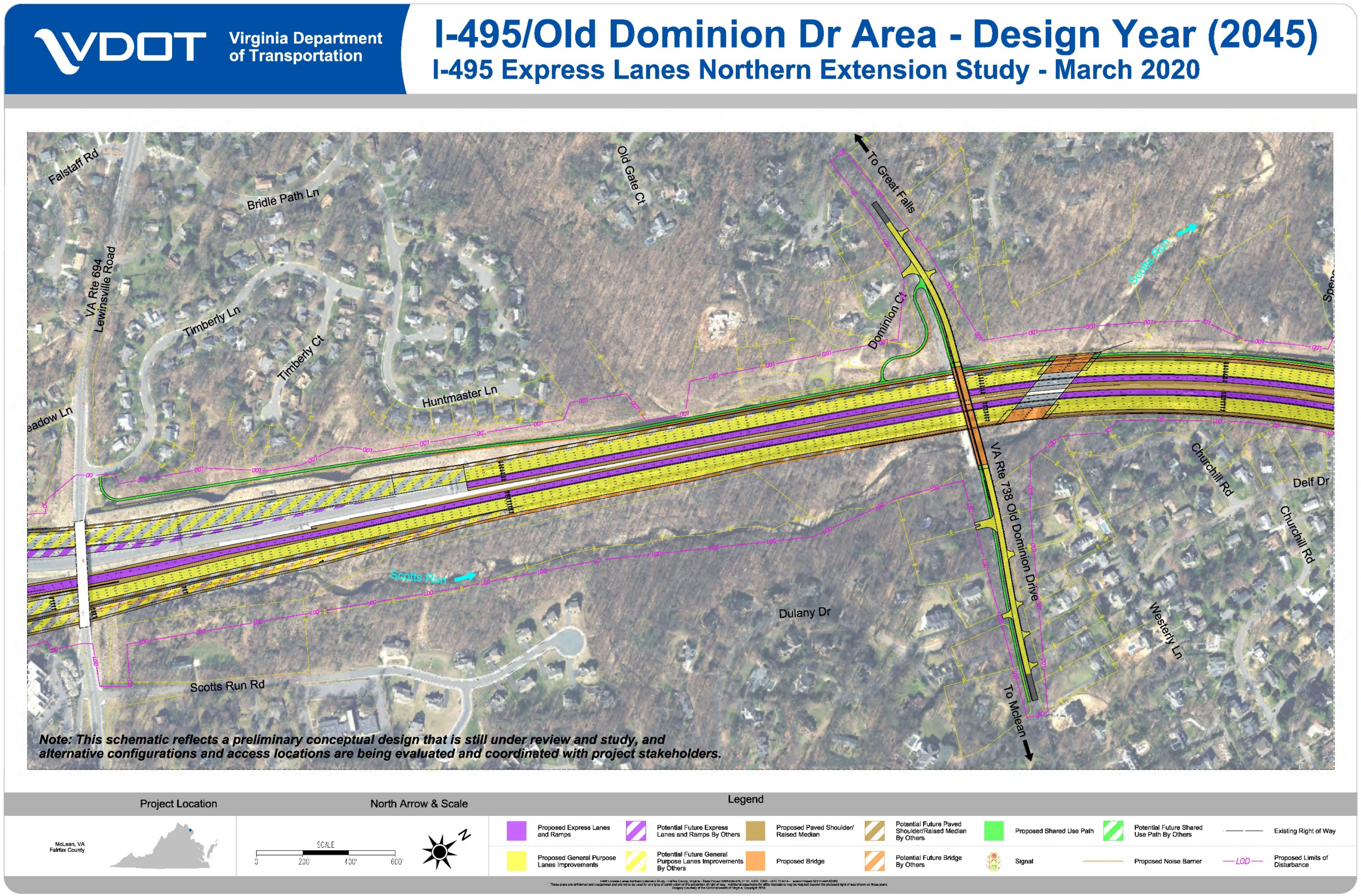


Exhibit 6-2c. Build Alternative Ultimate Configuration (Not to Preclude) Concept Design (Sheet 3 of 5)

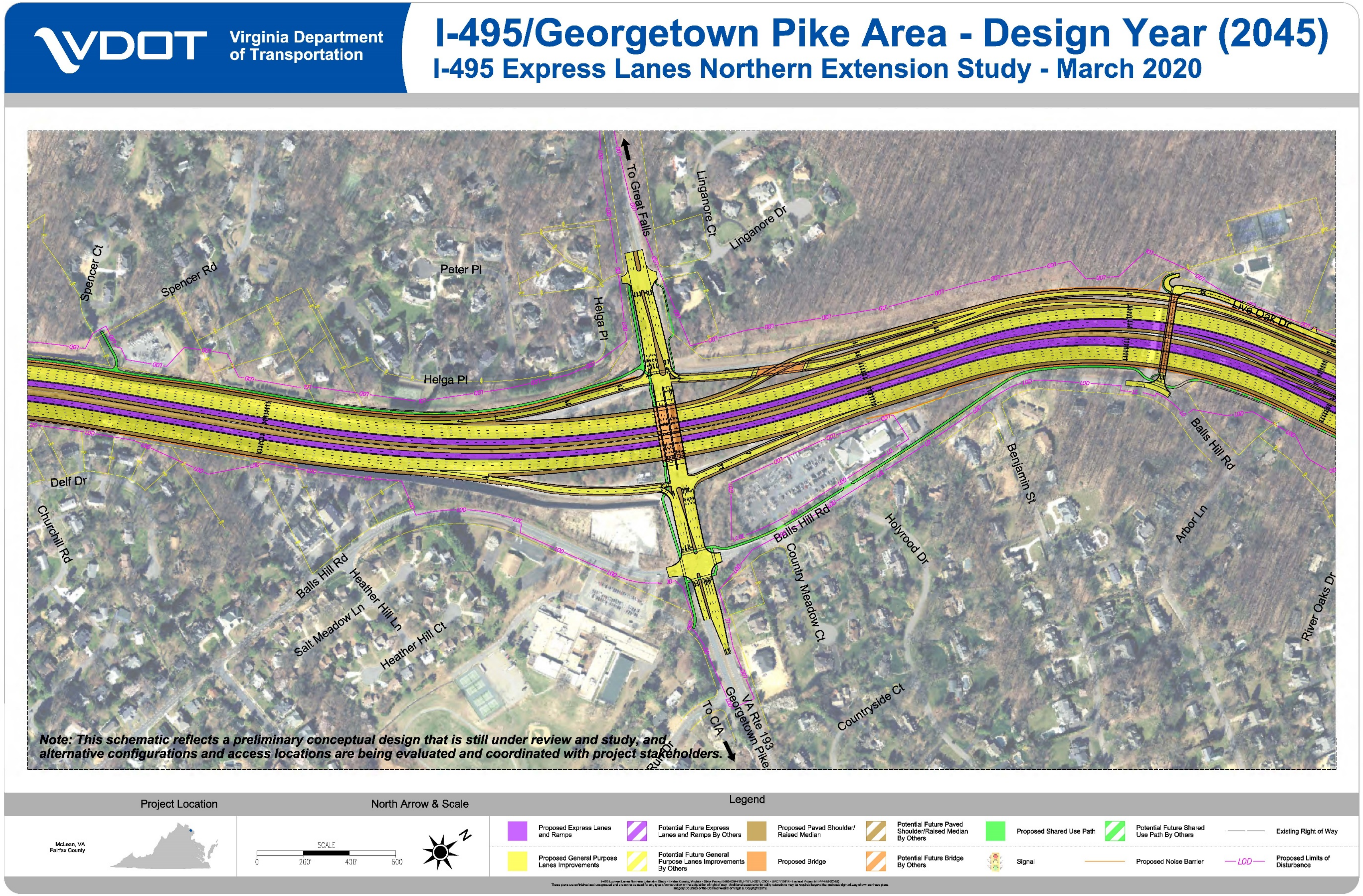


Exhibit 6-2d. Build Alternative Ultimate Configuration (Not to Preclude) Concept Design (Sheet 4 of 5)

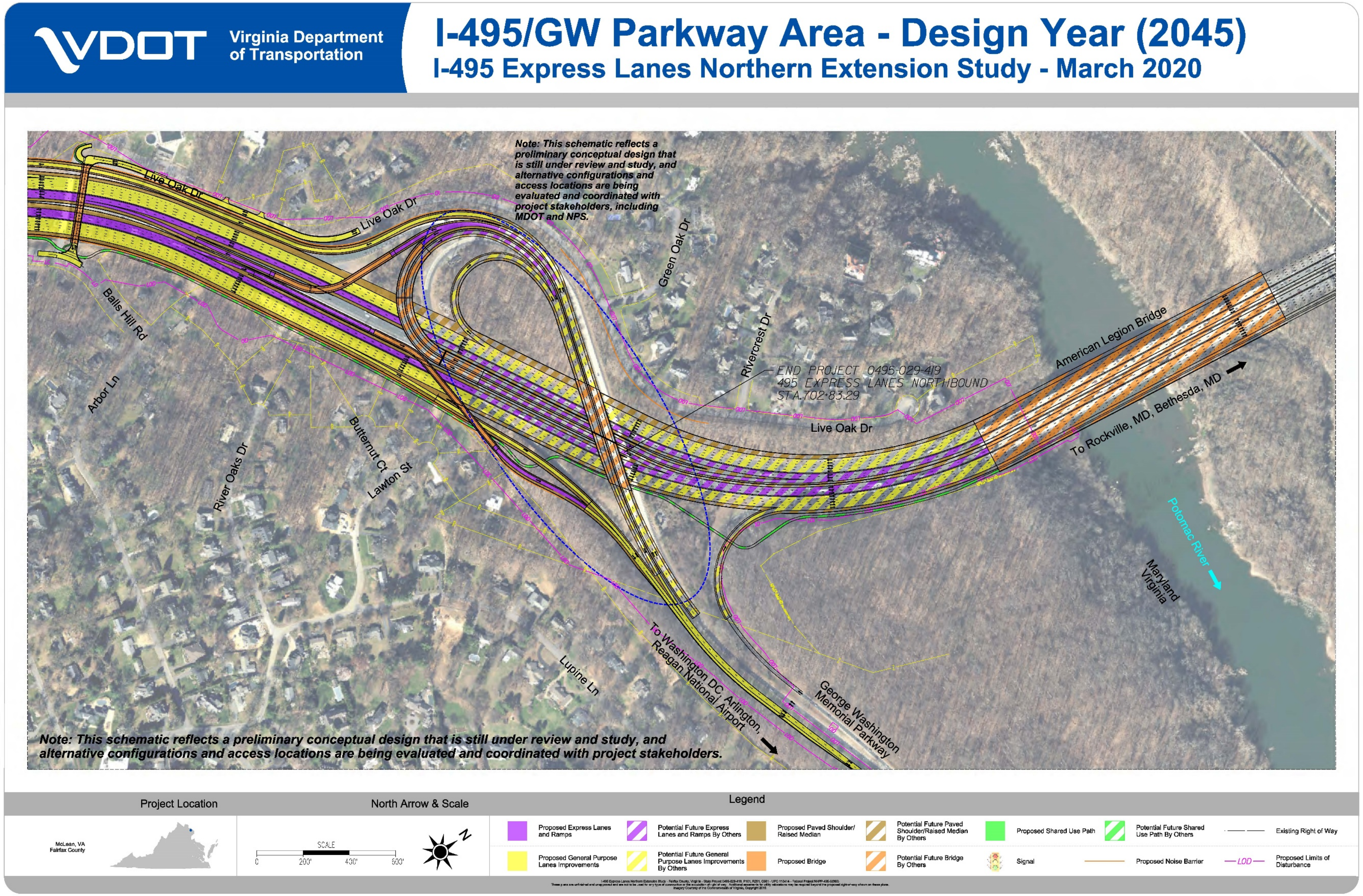


Exhibit 6-2e. Build Alternative Ultimate Configuration (Not to Preclude) Concept Design (Sheet 5 of 5)

CHAPTER 7.0 FUTURE SCENARIOS OPERATIONAL CONDITIONS

7.1 OVERVIEW OF NO BUILD AND BUILD OPERATIONS ANALYSIS

This chapter compares traffic operations for No Build and Build conditions for a 2025 interim year and 2045 design year. No Build traffic operations were analyzed according to the network described in **Chapter 5** while Build traffic operations were analyzed according to the network described in **Chapter 6**. Note that for both No Build and Build conditions, differences exist between the 2025 and 2045 networks. Traffic volumes also differ between the No Build and Build conditions for the same analysis years. Traffic volumes for each scenario were developed according to the methodology described in **Chapter 2**. These volumes and associated traffic operational impacts are described in the following sections.

Sensitivity Analysis for Future Traffic Operations prior to Maryland Managed Lanes Project
To understand the impacts and operational benefits or constraints of the I-495 NEXT project operations prior to the adjacent Maryland managed lanes system being in place (described in **Chapter 5**), a sensitivity analysis was performed for the 2025 analysis year. This sensitivity analysis included travel demand model runs, traffic volume forecasting, and traffic operations in VISSIM and Synchro. The results of this sensitivity analysis are provided in **Appendix I**.

7.2 2025 OPENING YEAR ANALYSIS

7.2.1 2025 Traffic Volumes

This section describes forecasted traffic volumes for the study area for 2025 No Build and Build conditions; the following sections detail the differences in traffic operations analysis results between the two conditions.

Peak hour freeway forecast volumes for 2025 conditions are provided in the following exhibits:

- **Exhibits 7-1a** and **7-1b** show 2025 No Build AM peak hour freeway volumes for the I-495 and Route 267 corridors, respectively.
- **Exhibits 7-2a** and **7-2b** show 2025 Build AM peak hour freeway volumes for the I-495 and Route 267 corridors, respectively.
- **Exhibits 7-3a** and **7-3b** show 2025 No Build PM peak hour freeway volumes for the I-495 and Route 267 corridors, respectively.
- **Exhibits 7-4a** and **7-4b** show 2025 Build PM peak hour freeway volumes for the I-495 and Route 267 corridors, respectively.

Arterial turning movement volumes for 2025 conditions are provided in the following exhibits:

- **Exhibits 7-5a** through **7-5e** show 2025 No Build AM and PM peak hour arterial turning movement volumes.
- **Exhibits 7-6a** through **7-6e** show 2025 Build AM and PM peak hour arterial turning movement volumes.

Average daily traffic forecast volumes for 2025 conditions are provided in the following exhibits:

- **Exhibits 7-7a** and **7-7b** show 2025 No Build ADT freeway volumes for the I-495 and Route 267 corridors, respectively.
- **Exhibits 7-8a** and **7-8b** show 2025 Build ADT freeway volumes for the I-495 and Route 267 corridors, respectively.

Peak Hour Traffic Volumes and Peaking Patterns

Figure 7-1 and **Figure 7-2** compare 2025 No Build and Build AM forecast peak hour mainline volumes with existing conditions along northbound and southbound I-495 (GP and Express combined), respectively.

- In the northbound direction, the highest traffic volumes in all scenarios are between the GWMP and Clara Barton Parkway (across the ALMB). The increases in volume from No Build to Build range from 200 vph to 700 vph (2 percent to 9 percent) across the four segments, with the largest increases in the segments between Route 267 and GWMP where the Build Alternative adds capacity from the Express Lanes.
- In the southbound direction, the highest traffic volumes in all scenarios are again between the Clara Barton Parkway and GWMP (across the ALMB). The increases in volume from No Build to Build range from 170 vph to 550 vph (2 percent to 6 percent) across the four segments, with the largest increase in the segments between GWMP and Route 267 where the Build Alternative adds capacity from the Express Lanes.

Figure 7-3 and **Figure 7-4** compare 2025 No Build and Build PM forecast peak hour mainline volumes with existing conditions along northbound and southbound I-495 (GP and Express combined), respectively.

- In the northbound direction, the highest traffic volumes in all scenarios are between the GWMP and Clara Barton Parkway (across the ALMB). The increases in volume from No Build to Build range from 730 vph to 1,540 vph (10 percent to 29 percent) across the four segments, with the largest increases in the segments between Route 267 and GWMP where the Build Alternative adds capacity from the Express Lanes.
- In the southbound direction, the highest traffic volumes in all scenarios are again between the Clara Barton Parkway and GWMP (across the ALMB). The increases in volume from No Build to Build range from 380 vph to 850 vph (7 percent to 12 percent) across the four segments, with the largest increase in the segments between GWMP and Route 267 where the Build Alternative adds capacity from the Express Lanes.

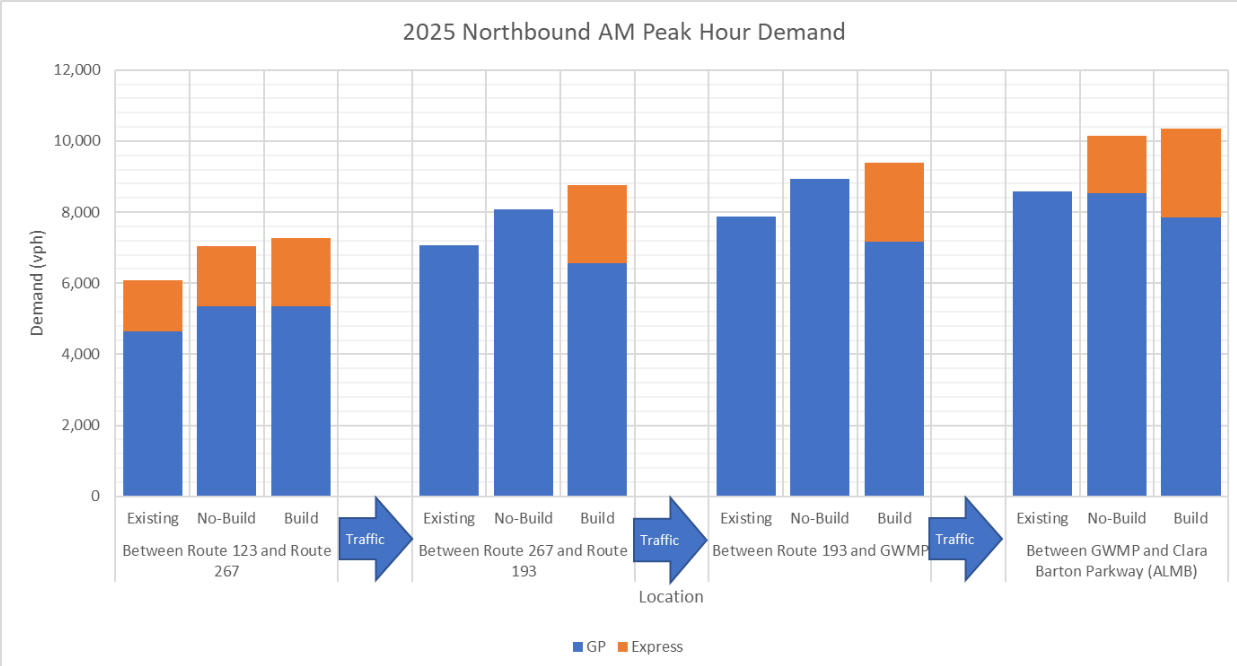


Figure 7-1: Existing and 2025 No Build AM Peak Hour Volumes - Northbound I-495

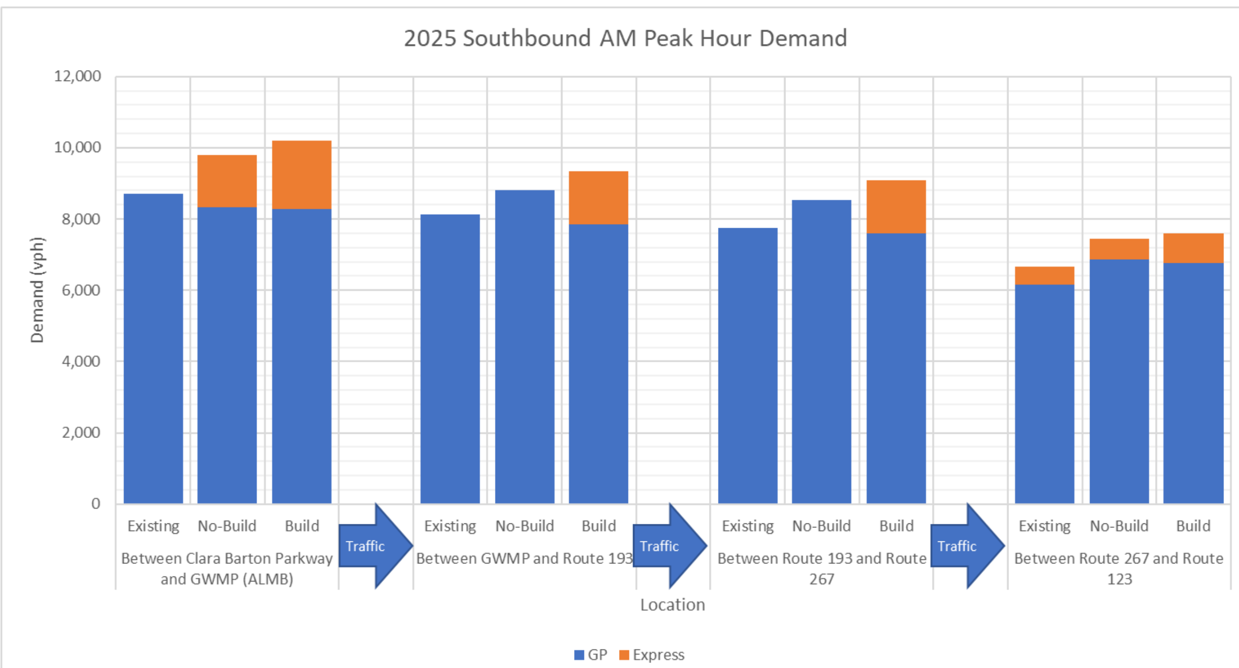


Figure 7-2: Existing and 2025 No Build AM Peak Hour Volumes - Southbound I-495

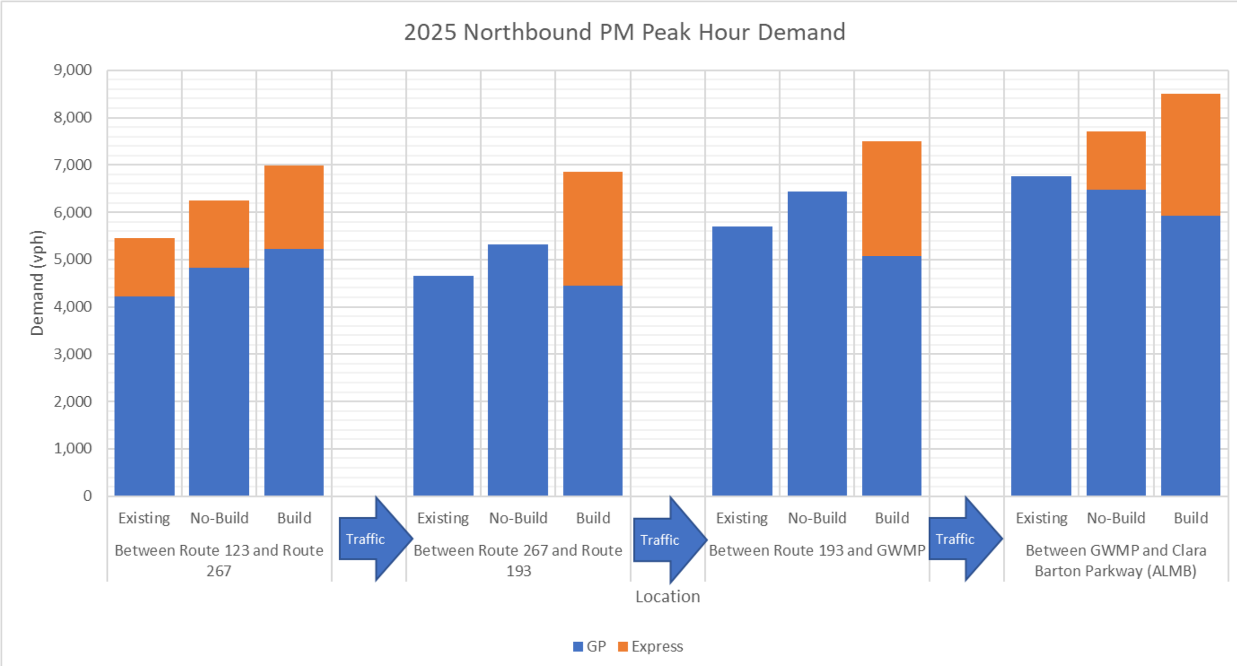


Figure 7-3: Existing and 2025 No Build PM Peak Hour Volumes - Northbound I-495

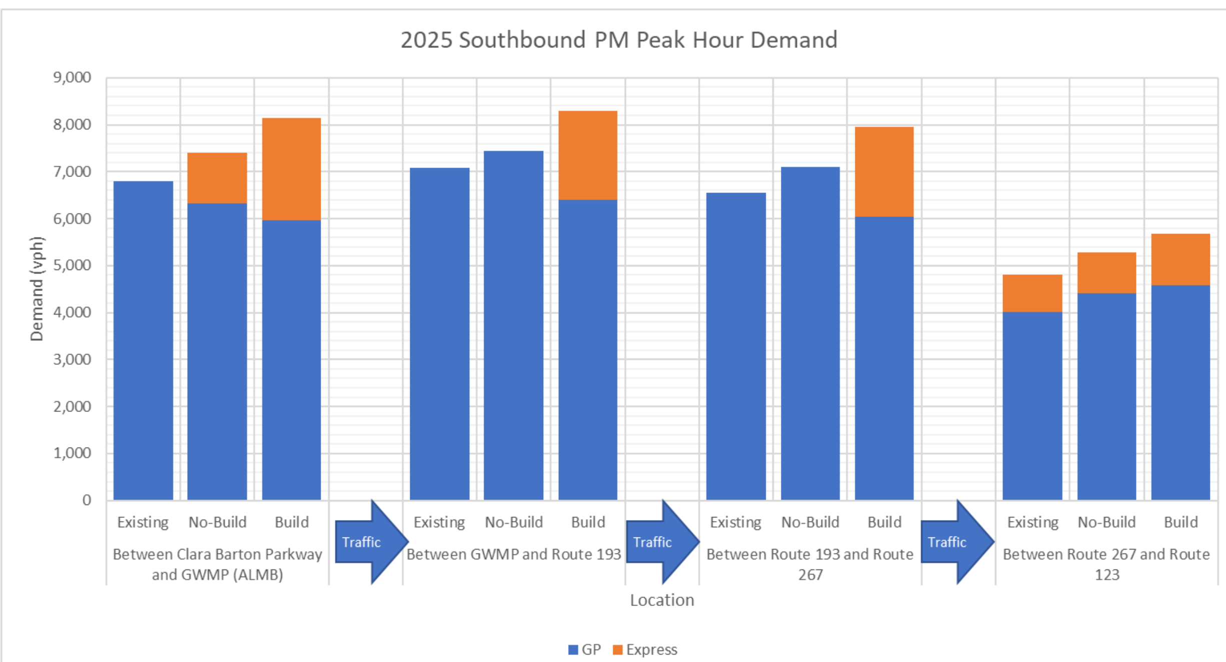


Figure 7-4: Existing and 2025 No Build PM Peak Hour Volumes - Southbound I-495

7.2.2 2025 No Build vs Build AM Freeway Operations

Exhibits 7-9 through **7-12** illustrate the density and speed results from the VISSIM models for the I-495 and Route 267 mainline segments in the study area for the AM peak period:

- **Exhibits 7-9a** through **7-9c** show 2025 No Build AM peak period freeway densities.
- **Exhibits 7-10a** through **7-10c** show 2025 Build AM peak period freeway densities.
- **Exhibits 7-11a** through **7-11c** show 2025 No Build AM peak period freeway speeds.
- **Exhibits 7-12a** through **7-12c** show 2025 Build AM peak period freeway speeds.

In each figure, the centerline diagram laid over the aerial depicts the average densities or speeds during the peak hour from 7:45 a.m. to 8:45 a.m. in both directions along the mainline segments. The average densities and speeds are color-coded based on the congestion levels and ranges of speeds as depicted in the legend. The boxes on the top and bottom depict the densities and speeds in each direction for the entire peak period from 6:45 a.m. to 9:45 a.m., including the shoulder periods before and after the peak hour. Detailed tabular results can be found in **Appendix G.**

Density

In the AM peak period, it can be seen from the exhibits that in the northbound GP lanes most segments in the Build condition operate under light-to-heavy density traffic for the entire study corridor, which represents a significant improvement over the No Build condition, in which segments between Route 267 and Clara Barton Parkway operate under significant congestion. With the proposed project (Build Alternative), the Express Lanes are continuous which helps with the operations along the corridor as it reduces traffic on the GP lanes and eliminates the friction between left side merges and diverges. **Figure 7-5** summarizes various densities along the northbound I-495 GP lanes. As can be seen in the figure, 43 percent of the freeway segments operate under congested to severe congestion in the No Build condition compared to 10 percent in the Build condition. All the segments along the northbound Express Lanes operate under light to moderate traffic congestion in both the scenarios.

In the southbound GP lanes, most segments operate under light to heavy traffic conditions for the entire corridor in the Build condition, as compared to several segments operating under severe congestion between Clara Barton Parkway and GWMP in the No-Build condition. The proposed project connects the Maryland managed lanes with the existing southbound Express Lanes in Virginia. This helps with the traffic operations in the Build as it eases congestion along the GP lanes; whereas in the No-Build condition, all Maryland managed lanes traffic must merge with the GP lanes near the GWMP interchange, creating a bottleneck. As seen in **Figure 7-6**, 35 percent of the segments operate under congested to severe congestion along the southbound I-495 GP lanes in the No Build condition compared to 12 percent operating under congested condition in the Build condition. All the segments along the southbound Express Lanes operate under light to moderate traffic congestion in both the scenarios.

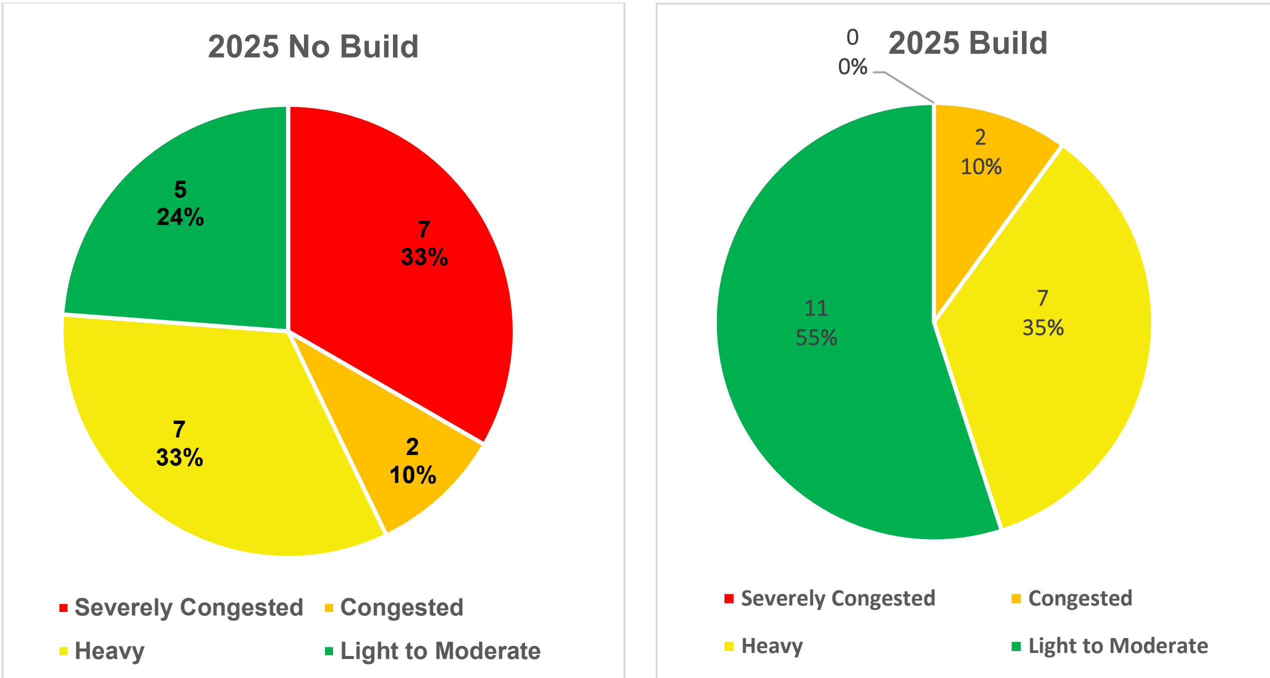


Figure 7-5: 2025 AM Freeway Segment Densities for I-495 Northbound GP Lanes

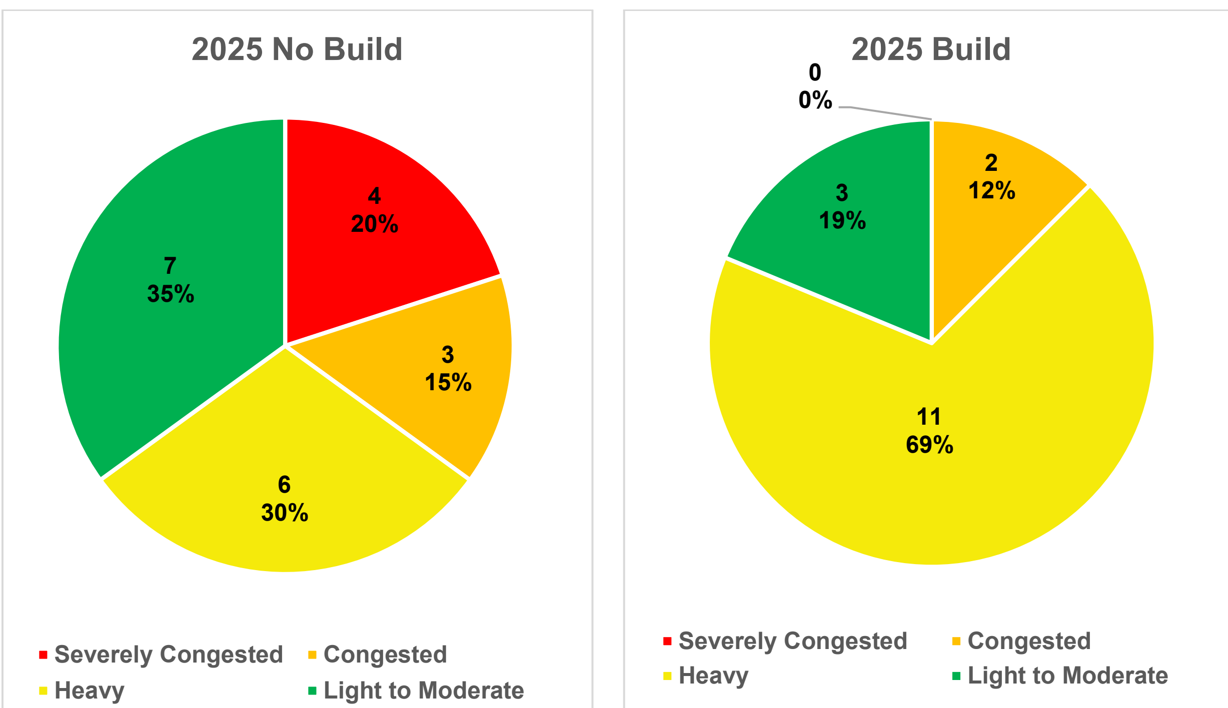


Figure 7-6: 2025 AM Freeway Segment Densities for I-495 Southbound GP Lanes

Speeds

As illustrated in **Exhibits 7-11** and **7-12**, the diagrams for average speeds in the AM peak period show similar patterns as seen in the density diagrams. Average speeds for the Build scenario in the GP lanes during the AM peak period in the northbound direction are at or near the posted speed limit, with a slight slowdown across the ALMB. In the No Build condition, however there is significant congestion between northbound Express Lanes terminus and ALMB. Consistent with the high-density levels, speeds range between 25 and 35 mph in those segments. In both the No Build and Build conditions, speeds are much higher north of the ALMB due to congestion relief provided by the Maryland managed lanes system.

In the southbound direction, all GP segments operate at free-flow conditions for most of the study corridor in the Build condition, with the exception of a slight slowdown near the Route 123 interchange. In the No Build condition, there is a slowdown north of the entrance to the southbound Express Lanes (between Route 193 and Route 267) due to weaving approaching the Express Lanes. Furthermore, in the No Build condition, due to the southbound Maryland managed lanes system terminating near the GWMP interchange, a merge bottleneck is created that spills back upstream in the southbound GP lanes across the ALMB.

Both directions of the Express Lanes operate at or near the posted speed limit.

Figure 7-7 provides a "heat map" comparison of average speeds between 2025 No Build and Build conditions for the AM peak period along the I-495 GP lanes. Time of day during the peak period is provided on the horizontal axis while location along the corridor is provided along the vertical axis; the colors signify average speeds for each scenario. The figure is consistent with the speed Exhibits and indicates a more significant presence of congestion in the No Build scenario in both directions of the I-495 GP lanes as compared to the Build scenario.

Figure 7-7: 2025 No Build and Build – AM Peak Period Average Speeds, I-495 GP Lanes

Travel Time

A comparison of AM peak period travel times for 2025 No Build and 2025 Build scenarios is shown in **Table 7-1**. Travel time measurements have been aggregated by direction of travel and facility type.

Table 7-1. 2025 AM Peak Period Travel Time Comparison

Route	GP Travel Times (Minutes: Seconds)		Express Lanes Travel Times (Minutes: Seconds)	
	2025 No Build	2025 Build	2025 No Build	2025 Build
Northbound I-495 (Route 123 to River Road)	9:37	6:53	7:43	6:12
Southbound I-495 (River Road to Route 123)	7:49	6:56	7:00	6:07
Eastbound Route 267 (Spring Hill Road to Route 123)	3:23	1:49	-	-
Westbound Route 267 (Route 123 to Spring Hill Road)	1:55	1:55	-	-

2025 Build AM peak period travel times improve or remain consistent as compared to No Build across all freeway facilities in the Traffic Operations Study Area.

- The average travel time in the northbound GP lanes improves by approximately 3 minutes (a 24 percent improvement) in the Build condition. The majority of the travel time savings are between Old Dominion Drive and Clara Barton Parkway, which is consistent with the speed results shown in the previous section.
- Vehicles traveling in the northbound Express Lanes see a 20 percent travel time improvement in the Build condition. The travel time improvement in the Build condition is between Lewinsville Road and GWMP, where in the No Build condition, vehicles need to travel on the congested GP lanes.
- In the southbound direction, GP travel times in the Build improve by 11 percent and Express Lanes travel time improve by 13 percent. Similar to northbound, providing a continuous Express Lanes system helps with the traffic operations.
- Along eastbound Route 267 (DTR) there is 47 percent improvement in travel time. With the improved operations along northbound I-495, the ramp from eastbound DTR to northbound I-495 does not spill back to eastbound DTR, improving operations along eastbound DTR.
- In the westbound direction, travel times along Route 267 (DTR) are essentially identical between No Build and Build.

Simulated Volumes and Demand Served

Figure 7-8 shows the comparison of unserved demand (vehicular throughput as compared to vehicular demand) between No Build and Build conditions for the AM peak hour in the northbound direction. As can be seen in the figure, all demand is served in the Build condition during the AM peak hour. In the No Build condition, the unserved demand is generally within 3 percent, and all segments with the unserved demand are located between Route 193 and River Road. The improved throughput in the Build condition can be attributed to the continuous Express Lanes system.

Figure 7-9 shows the comparison of unserved demand between No Build and Build conditions for the AM peak hour in the southbound direction. As can be seen in the figure, the unserved demand is within 3 percent in the Build compared to 6 percent in the No Build. The increased in the throughput in the Build condition can be attributed to the reduced congestion between Route 193 and Route 267 due to the new Express Lanes system being in place. The proposed project alleviates congestion in this segment, thus reducing the unserved demand.

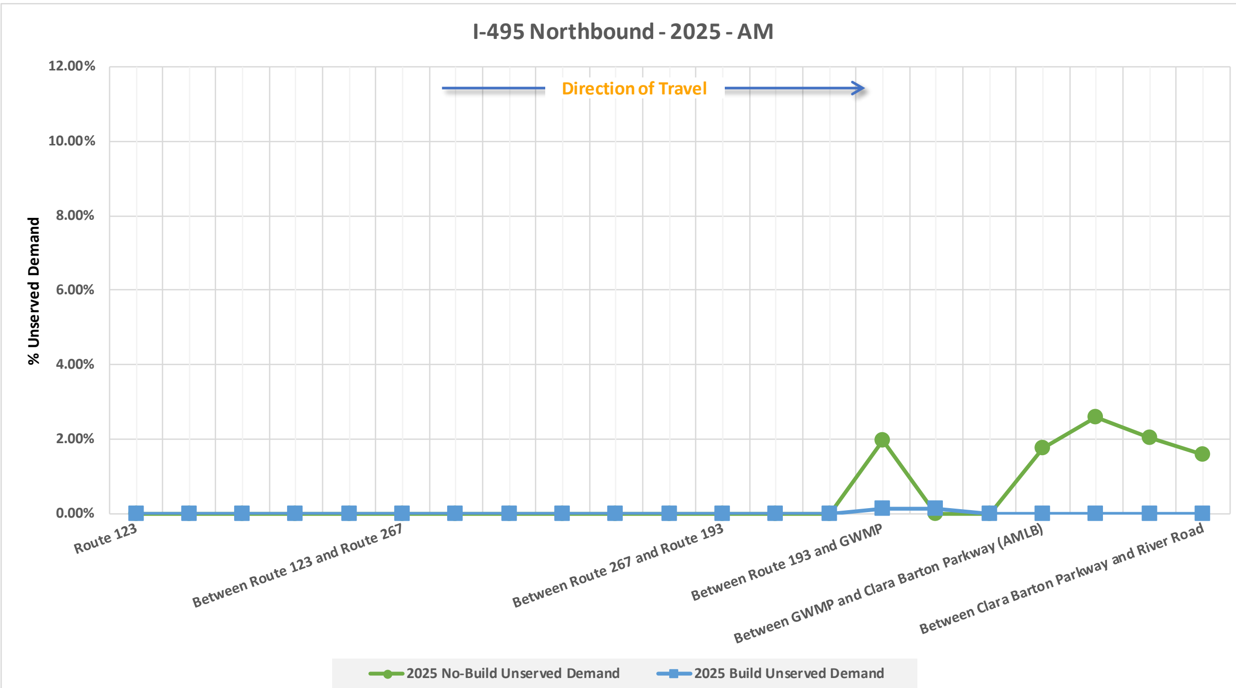


Figure 7-8. 2025 No Build and Build – AM Peak Hour Unserved Demand, I-495 Northbound

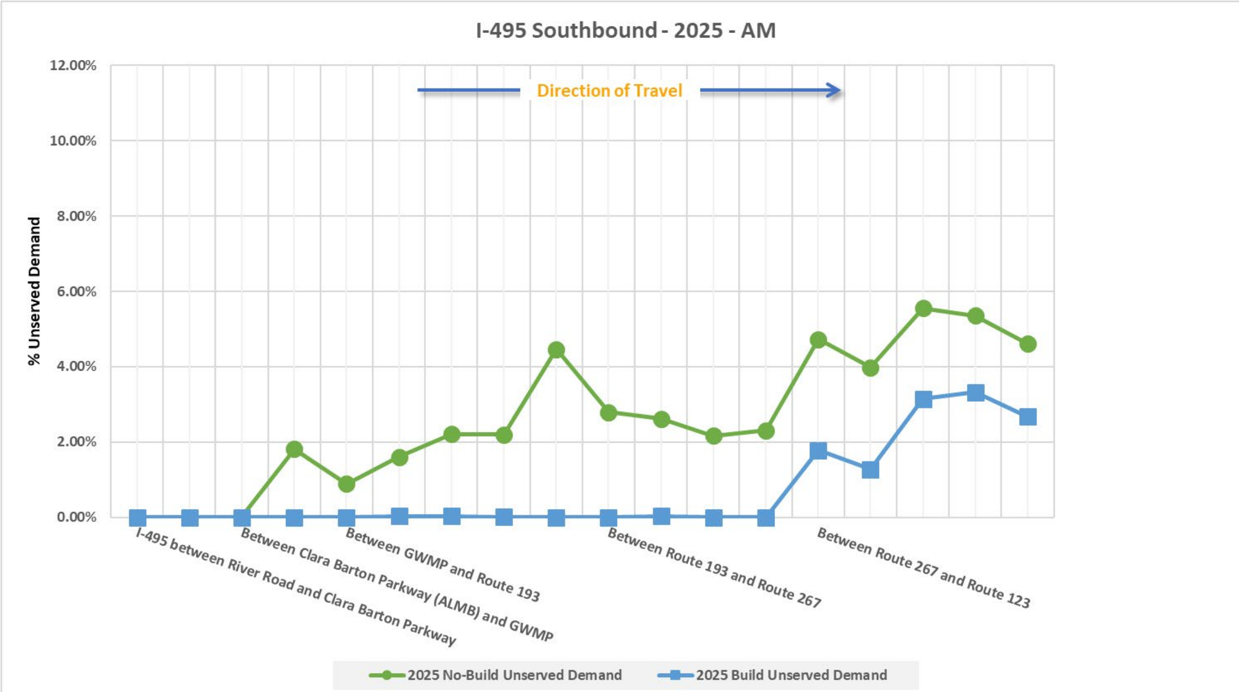


Figure 7-9. 2025 No Build and Build – AM Peak Hour Unserved Demand, I-495 Southbound

Person Throughput

Figure 7-10 and **Figure 7-11** display AM peak period person throughput along I-495 northbound and southbound, respectively (GP and Express combined). These figures show the estimated number of persons moved across a three-hour period based on simulated vehicle throughput and assumed vehicle occupancies for GP and Express Lanes. GP lanes are assumed to carry 1.1 persons per vehicle, based on the estimated non-HOV lane auto occupancy MWCOG has estimated across various interstate facilities in Northern Virginia (MWCOG, 2014). Express Lanes are assumed to carry 1.44 person per vehicle, based on a historic 18 percent HOV-3 utilization in the existing I-495 Express Lanes and assuming the remaining 82 percent of vehicles take on the non-HOV lane auto occupancy. These figures show that person throughput increases in the Build scenario across the length of the I-495 corridor in both directions due to the added capacity from the Express Lanes and increased occupancy of vehicles in those lanes.

- In the northbound direction, the highest person throughputs are across the ALMB. Increases in throughput from No Build to Build range from 4 to 17 percent, with the greatest increase in the segments between Route 267 and GWMP where the new Express Lanes significantly add capacity.
- In the southbound direction, the highest person throughputs are again across the ALMB. Increases in throughput from No Build to Build range from 6 to 21 percent, with the greatest increases again in the segments between GWMP and Route 267 where the new Express Lanes significantly add capacity.

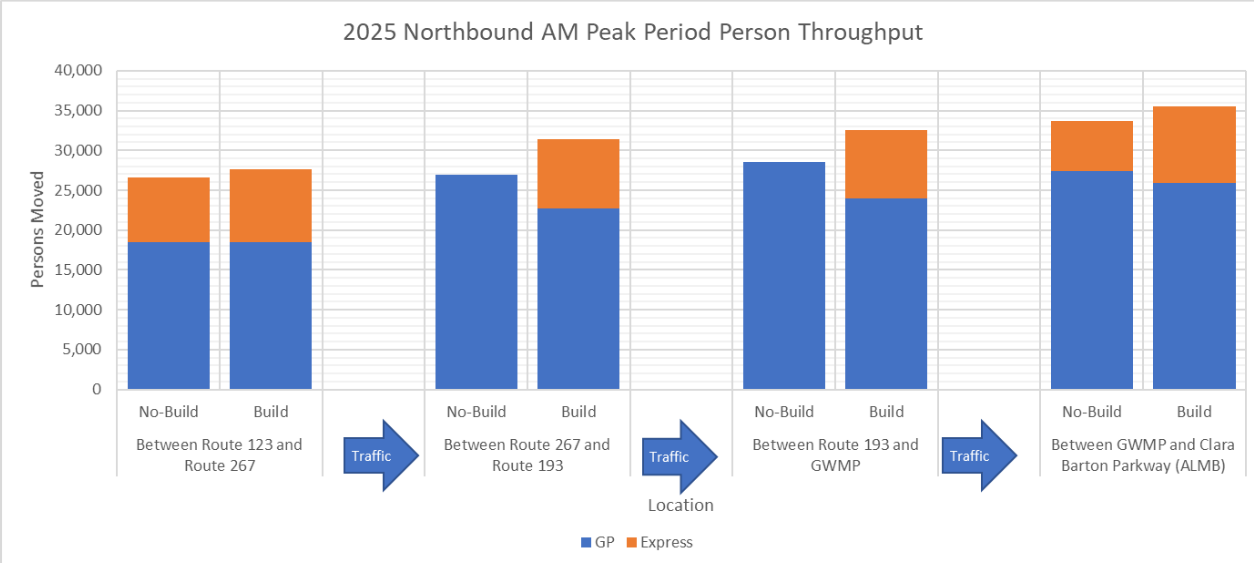


Figure 7-10. 2025 No Build and Build – AM Peak Period Person Throughput, I-495 Northbound

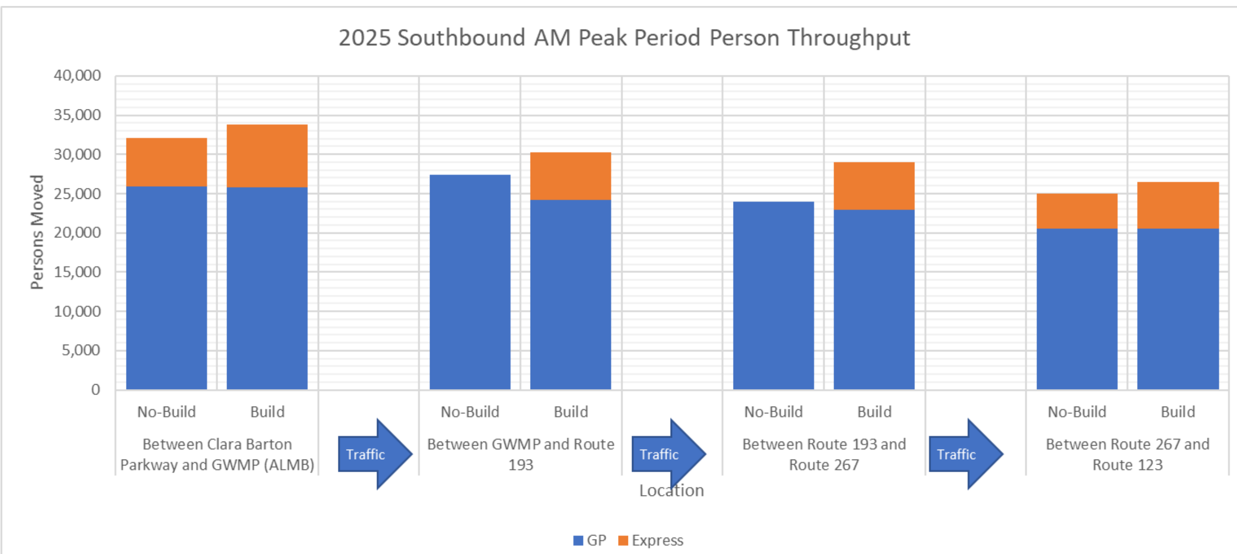


Figure 7-11. 2025 No Build and Build – AM Peak Period Person Throughput, I-495 Southbound

7.2.3 2025 No Build vs Build PM Freeway Operations

Exhibits 7-13 through **7-16** illustrate the density and speed results from the VISSIM models for the I-495 and Route 267 mainline segments in the study area for the PM peak period:

- **Exhibits 7-13a** through **7-13c** show 2025 No Build PM peak period freeway densities.
- **Exhibits 7-14a** through **7-14c** show 2025 Build PM peak period freeway densities.
- **Exhibits 7-15a** through **7-15c** show 2025 No Build PM peak period freeway speeds.
- **Exhibits 7-16a** through **7-16c** show 2025 Build PM peak period freeway speeds.

In each figure, the centerline diagram laid over the aerial depicts the average densities or speeds during the peak hour from 3:45 p.m. to 4:45 p.m. in both directions along the mainline segments. The average densities and speeds are color-coded based on the congestion levels and ranges of speeds as depicted in the legend. The boxes on the top and bottom depict the densities and speeds in each direction for the entire peak period from 2:45 p.m. to 5:45 p.m., including the shoulder periods before and after the peak hour. Detailed tabular results can be found in **Appendix G.**

Density

In the PM peak period, it can be seen from the exhibits that in the northbound GP lanes, all of the segments in the Build condition operate under light-to-moderate density traffic for the entire study corridor, which represents an improvement over the No Build condition. In the No Build condition, with the background projects in place including the Maryland managed lanes, there is still a significant improvement in operations along northbound I-495 compared to existing conditions; with the proposed project in the Build condition, there is further improvement. As seen in **Figure 7-12**, 100 percent of the segments operate at a light to moderate traffic conditions in the Build condition compared to 81 percent in the No Build condition.

In the southbound GP lanes, with the exception of one segment near Route 123 in Tysons, all of the freeway segments in the Build condition operate under light-to-congested traffic conditions, which represents a significant improvement over the No Build condition. The Build condition provide a continuous Express Lane system, which increases capacity and improves traffic operations. Also, in the Build condition, there is some shift in demand from GP to Express Lanes for the southbound I-495 to westbound DTR movement. This shift in the volume also helps in relieving the congestion experienced along southbound I-495 in the No Build. As seen in **Figure 7-13**, 87 percent segments operate at light to heavy traffic conditions in the Build compared to only 35 percent in the No Build.

Northbound and southbound Express Lanes segments operate under light to moderate traffic conditions in both the No Build and Build conditions.

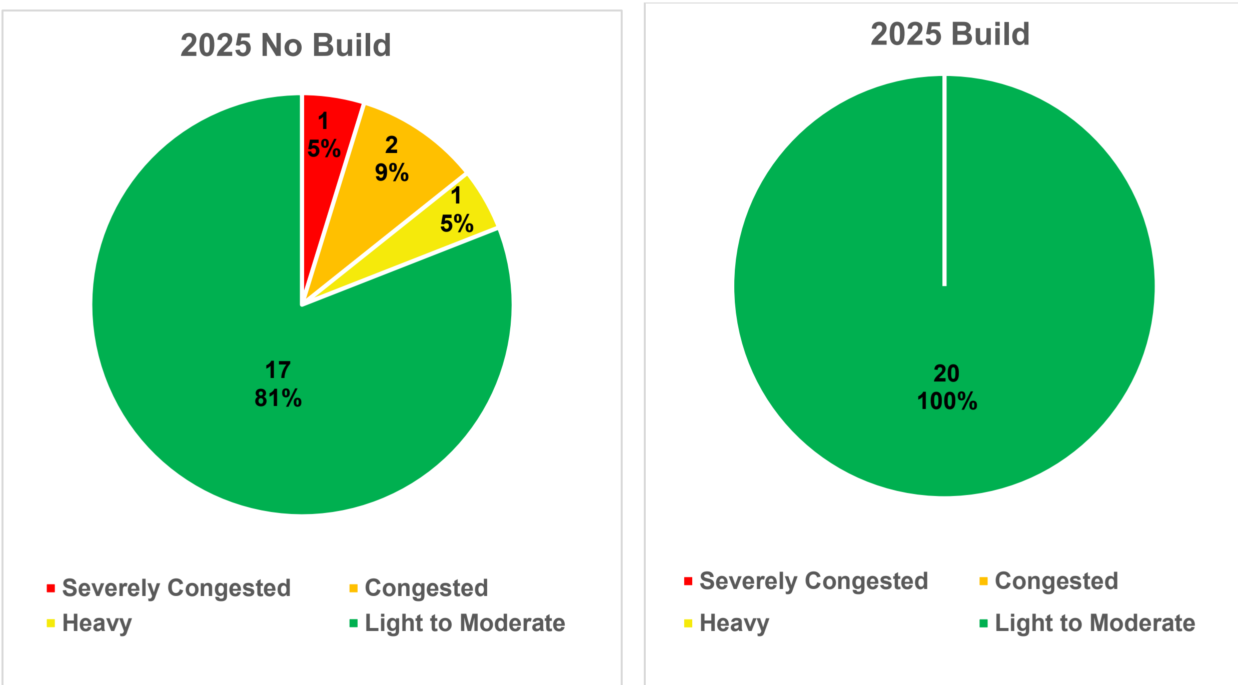


Figure 7-12: 2025 PM Freeway Segment Densities for I-495 Northbound GP Lanes

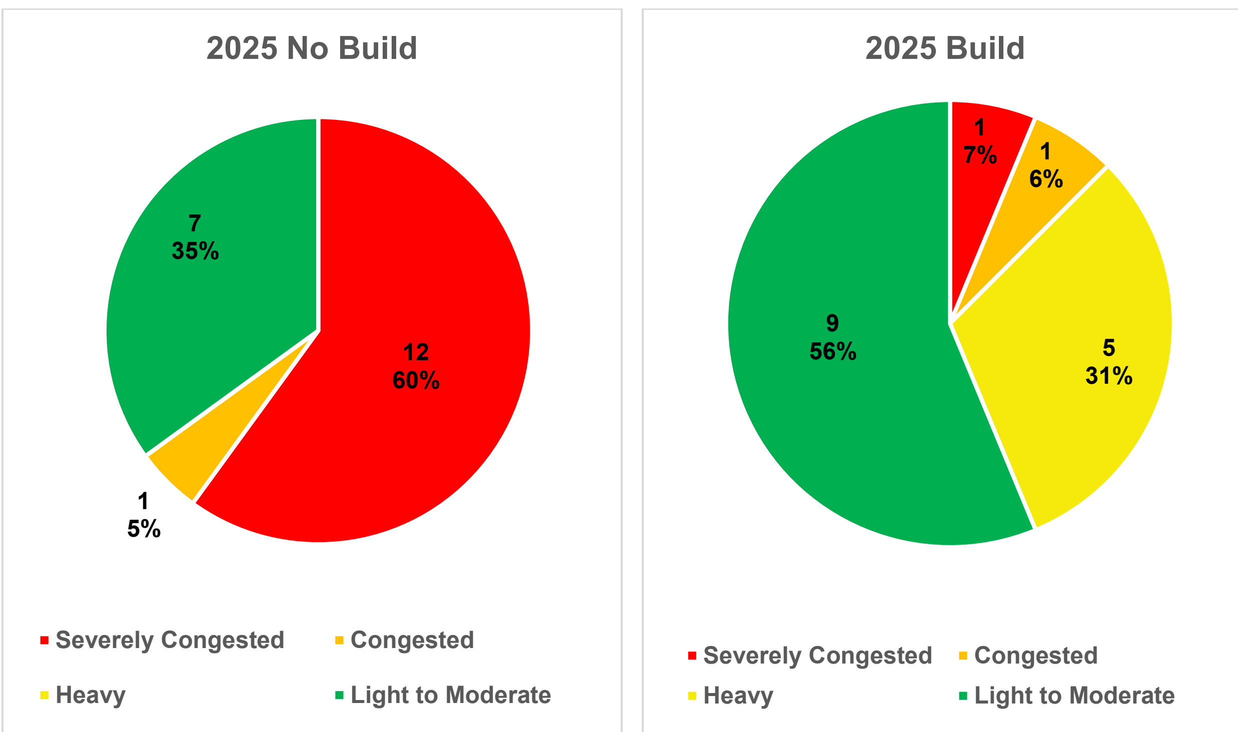


Figure 7-13: 2025 PM Freeway Segment Densities for I-495 Southbound GP Lanes

Speeds

As illustrated in **Exhibits 7-15** and **7-16**, the diagrams for average speeds in the PM peak period show similar patterns as seen in the density diagrams. Average speeds for the Build scenario in the GP lanes during the PM peak period in the northbound direction are at or near the posted speed limit. In the No Build condition, however there is significant congestion between northbound Express Lanes terminus and ALMB, at which point the Maryland managed lanes system begins. Consistent with the high density levels for these segments in the No Build condition, speeds range between 25 and 35 mph in these segments in the No Build condition. In both the No Build and Build conditions, speeds are much higher north of the ALMB due to congestion relief provided by the Maryland managed lanes system.

In the southbound direction, most GP segments operate at near free-flow conditions for most of the study corridor in the Build condition, with the exception of a slight slowdown near the Route 123 interchange due to congestion in Tysons. In the No Build condition, there is a slowdown north of the left-side entrance to the southbound Express Lanes (between Route 193 and Route 267) and downstream right-side exit to westbound DTR due to weaving approaching both the Express Lanes and DTR, as both of these movements have heavy volumes. This congestion is also worsened in the No Build scenario due to the southbound Maryland managed lanes system terminating near the GWMP interchange, creating a merge that spills back upstream in the GP lanes across the ALMB.

Both directions of the Express Lanes operate at or near the posted speed limit.

Figure 7-14 provides a "heat map" comparison of average speeds between 2025 No Build and Build conditions for the PM peak period along the I-495 GP lanes. Time of day during the peak period is provided on the horizontal axis while location along the corridor is provided along the vertical axis; the colors signify average speeds for each scenario. The figure is consistent with the speed Exhibits and indicates a more significant presence of congestion in the No Build scenario in both directions of the I-495 GP lanes.

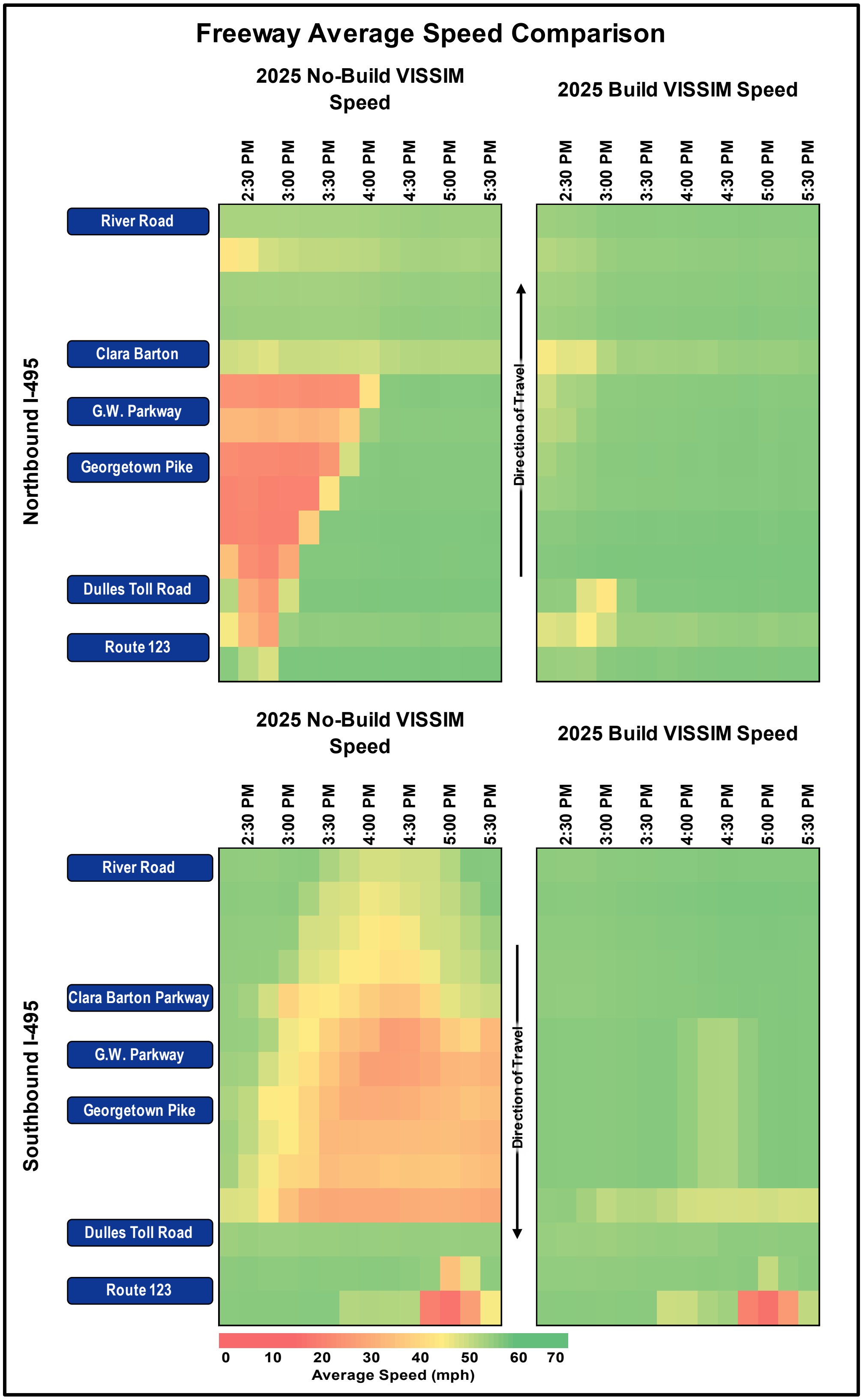


Figure 7-14: 2025 No Build and Build – PM Peak Period Average Speeds, I-495 GP Lanes

Travel Time

A comparison of PM peak period travel times for 2025 No Build and 2025 Build scenarios is shown in **Table 7-2**. Travel time measurements have been aggregated by direction of travel and facility type.

Table 7-2. 2025 PM Peak Period Travel Time Comparison

Route	GP Travel Times (Minutes: Seconds)		Express Lanes Travel Times (Minutes: Seconds)	
	2025 No Build	2025 Build	2025 No Build	2025 Build
Northbound I-495 (Route 123 to River Road)	10:36	6:45	8:02	6:05
Southbound I-495 (River Road to Route 123)	15:59	8:05	8:11	6:09
Eastbound Route 267 (Spring Hill Road to Route 123)	1:49	1:49	-	-
Westbound Route 267 (Route 123 to Spring Hill Road)	1:50	1:50	-	-

2025 Build PM peak period travel times improve or remain consistent as compared to No Build across all freeway facilities in the Traffic Operations Study Area.

- The average travel time in the northbound GP lanes improves by nearly 4 minutes (a 36 percent improvement). The majority of the travel time savings are between Old Dominion Drive and Clara Barton Parkway, which is consistent with the speed results shown in the previous section.
- Vehicles traveling on the northbound Express Lanes see a 24 percent travel time improvement. The travel time improvement in the Build condition is between Lewisville Road and GWMP, where in the No Build condition, vehicles need to travel on the congested GP lanes.
- In the southbound direction, GP travel times in the Build improve by nearly 8 minutes (49 percent) and Express Lanes travel time improve by 11 percent. Providing a continuous Express Lanes system, as well as some shift in the volume for the southbound I-495 to westbound DTR movement from GP lanes to Express Lanes, helps relieve the congestion.
- Along eastbound and westbound Route 267 (DTR), travel times are essentially identical between No Build and Build.

Simulated Volumes and Demand Served

Figure 7-15 shows the comparison of unserved demand (vehicular throughput as compared to vehicular demand) between No Build and Build conditions for the PM peak hour in the northbound direction. The figure suggests that the No Build condition does not have unserved demand north of GWMP during the PM peak hour; what this actually represents is unserved throughput from the previous hour(s), which are congested as shown in the speed heat map. As that throughput is now being served during the peak hour as opposed to the prior hour, the total peak hour throughput is equivalent to or exceeding the forecasted peak hour demand. In the Build condition, upstream of GWMP, the percent of unserved demand is generally consistent with the No Build condition. This unserved demand in both scenarios is attributable to heavy congestion along arterials in Tysons (such as Route 123) metering demand onto I-495.

Figure 7-16 shows the comparison of unserved demand between No Build and Build conditions for the PM peak hour in the southbound direction. As can be seen in the figure, the percentage of unserved demand is lower in the Build scenario along the length of the corridor. The increased in the throughput in the Build condition can be attributed to the reduced congestion between Route 193 and Route 267 due to the new Express Lanes system being in place. The proposed project alleviates congestion in this segment, thus reducing the unserved demand. South of Route 267, congestion along I-495 and along arterials in Tysons constrains demand in both the No Build and Build condition, thus increasing the percentage of unserved demand.

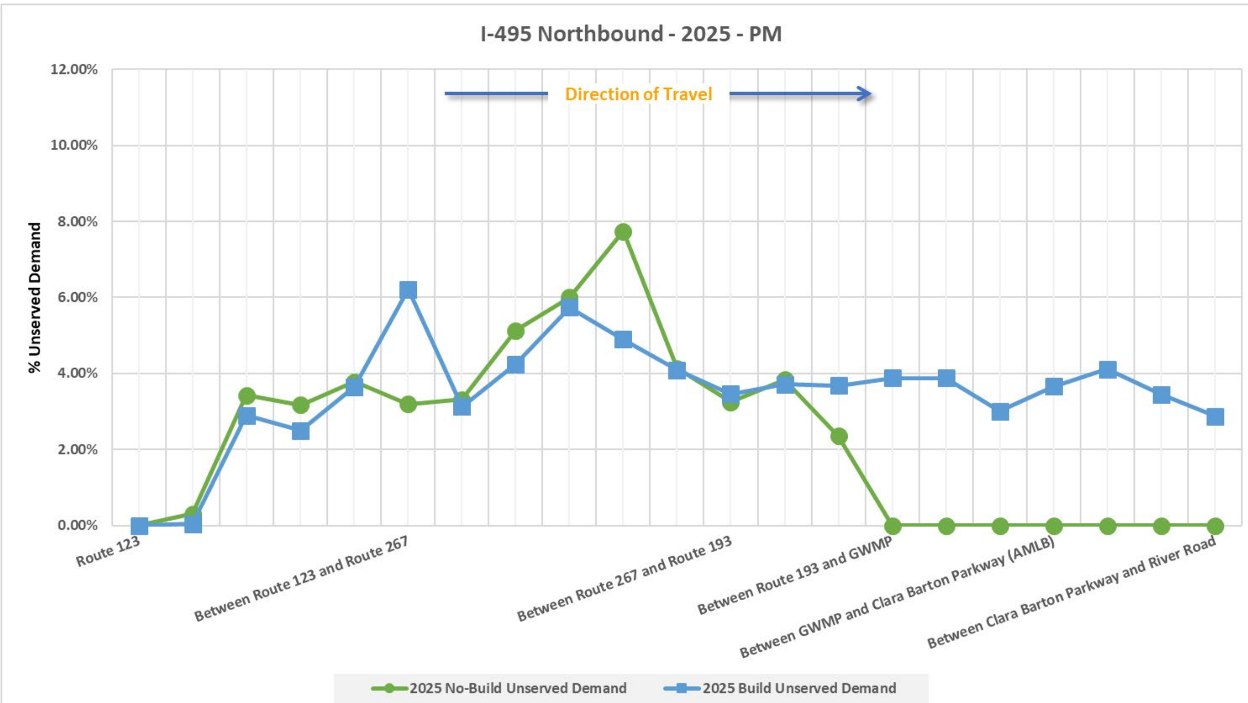


Figure 7-15. 2025 No Build and Build – PM Peak Hour Unserved Demand, I-495 Northbound

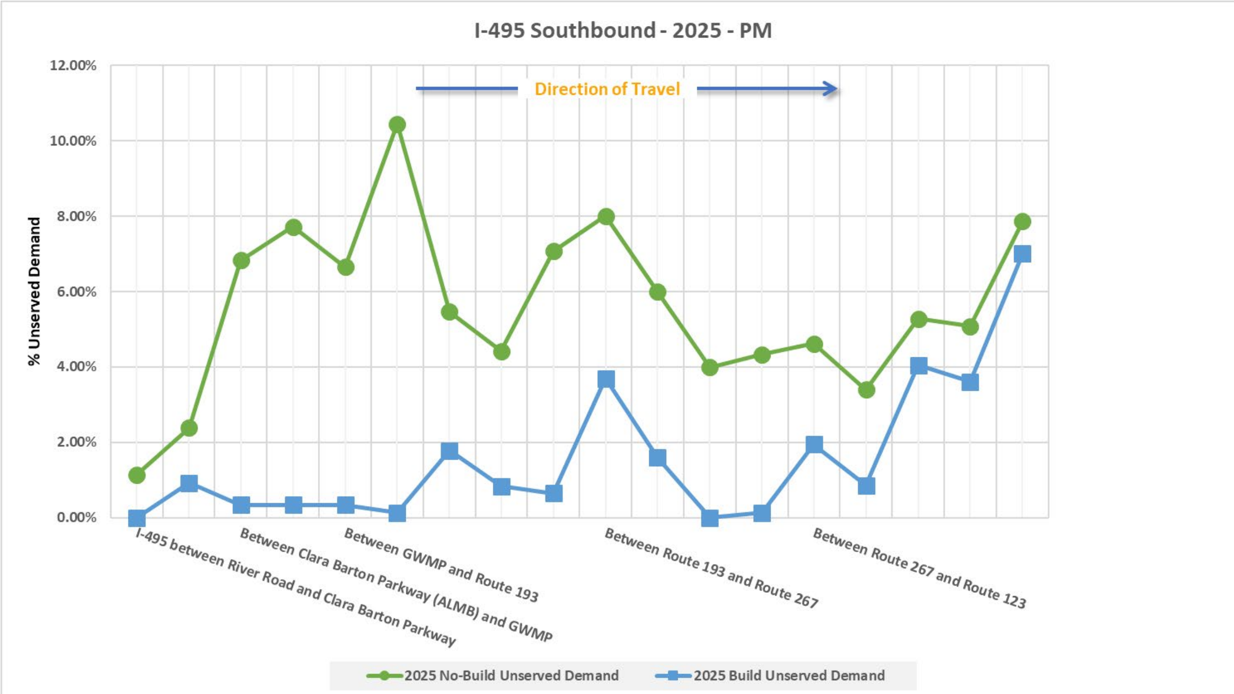


Figure 7-16. 2025 No Build and Build – PM Peak Hour Unserved Demand, I-495 Southbound

Person Throughput

Figure 7-17 and **Figure 7-18** display PM peak period person throughput along I-495 northbound and southbound, respectively (GP and Express combined). These figures show the estimated number of persons moved across a three-hour period based on simulated vehicle throughput and assumed vehicle occupancies for GP and Express Lanes. GP lanes are assumed to carry 1.1 persons per vehicle, based on the estimated non-HOV lane auto occupancy MWCOG has estimated across various interstate facilities in Northern Virginia (MWCOG, 2014). Express Lanes are assumed to carry 1.44 person per vehicle, based on a historic 18 percent HOV-3 utilization in the existing I-495 Express Lanes and assuming the remaining 82 percent of vehicles take on the non-HOV lane auto occupancy. These figures show that person throughput increases in the Build scenario across the length of the I-495 corridor in both directions due to the added capacity from the Express Lanes and increased occupancy of vehicles in those lanes.

- In the northbound direction, the highest person throughputs are across the ALMB. Increases in throughput from No Build to Build range from 8 to 37 percent, with the greatest increase in the segments between Route 267 and GWMP where the new Express Lanes significantly add capacity.
- In the southbound direction, the highest person throughputs are again across the ALMB. Increases in throughput from No Build to Build range from 10 to 47 percent, with the greatest increases again in the segments between GWMP and Route 267 where the new Express Lanes significantly add capacity.

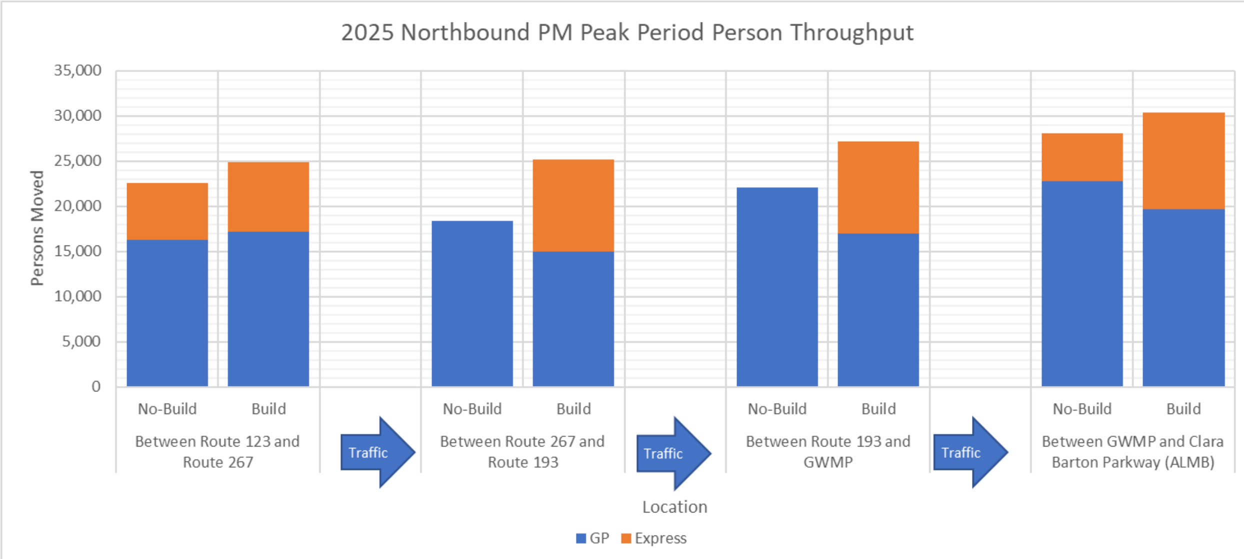


Figure 7-17. 2025 No Build and Build – PM Peak Period Person Throughput, I-495 Northbound

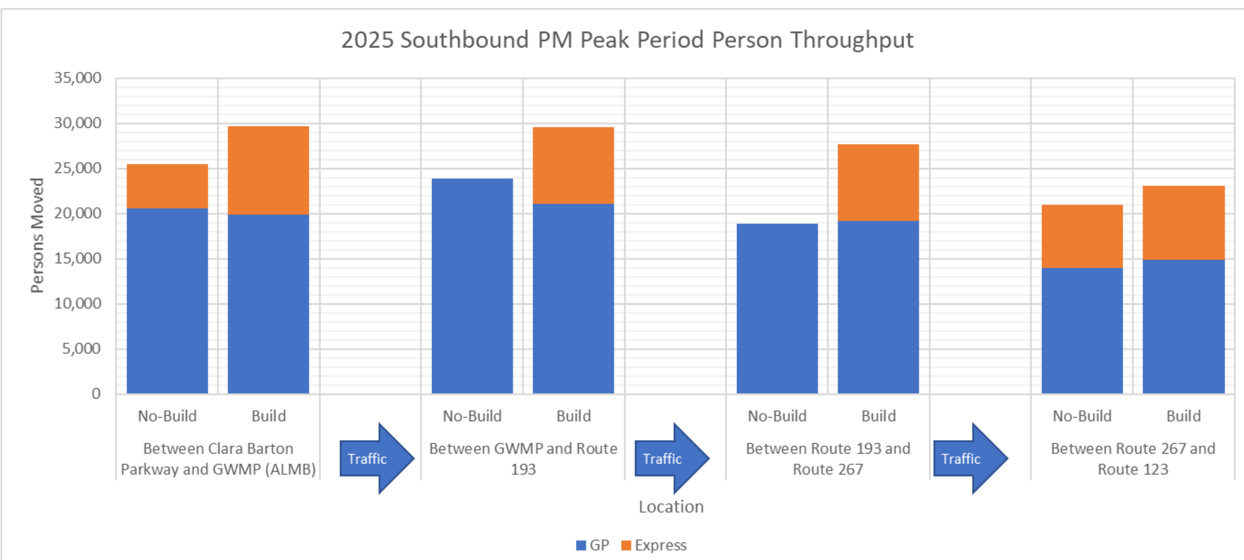


Figure 7-18. 2025 No Build and Build – PM Peak Period Person Throughput, I-495 Southbound

7.2.4 2025 No Build vs. Build Arterial Operations

AM Arterial Operations

Intersections Evaluated in VISSIM

Intersections in the Traffic Operations Study Area evaluated in VISSIM generally see similar operations in the 2025 AM peak hour under both No Build and Build conditions. **Figure 7-19** provides pie charts of overall intersection HCM-analogous LOS for No Build and Build conditions. The figure shows that both scenarios see the same percentage of intersections operating under failing conditions (19 percent).

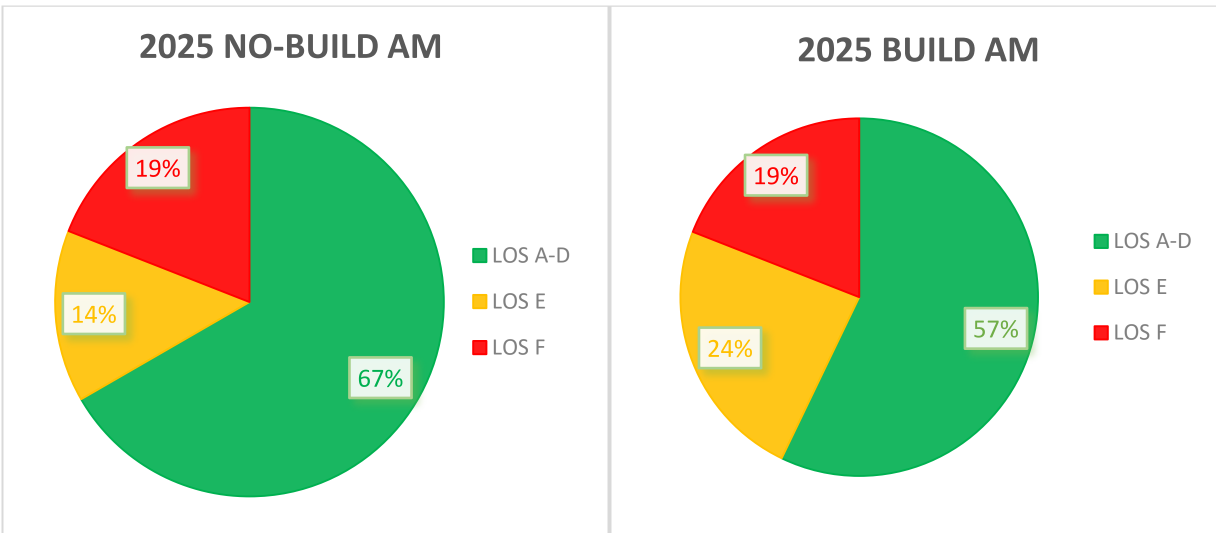


Figure 7-19. Summary of Arterial HCM-Analogous LOS, 2025 AM No Build vs. Build Conditions

Table 7-3 compares the overall intersection HCM-analogous LOS between the two scenarios for each intersection. A detailed breakdown of intersection delay and LOS, including delay and LOS by approach, is provided in **Appendix H.**

The following intersections operate under failing conditions under both 2025 No Build and Build conditions:

- Route 123 and Route 267 eastbound off-ramp/Anderson Road
- Route 123 and Lewinsville Road/Great Falls Street
- Spring Hill Road and Dulles Toll Road eastbound ramps

All three of these intersections are in the Tysons area and see continued growth in demand tied to commercial and residential growth in Tysons.

The unsignalized intersection of Route 193 and Helga Place/Linganore Drive is failing under 2025 No Build conditions due to heavy delays on the southbound approach; this stop-controlled approach sees few gaps for traffic to enter the mainline Route 193 traffic stream due to heavy congestion in along eastbound Route 193 (spilling back from the northbound on-ramp to I-495). In the Build scenario, this eastbound congestion along Route 193 is relieved due to improved operations along northbound I-495, which reduces queue spillback on the on-ramp from Route 193.

The signalized intersection of Route 123 and Capital One Tower Drive / Old Meadow Road is failing under 2025 Build conditions with an overall intersection delay of approximately 83 seconds; under No Build conditions, this intersection operates with a delay of approximately 78 seconds. This minor increase in delay is attributable to increased throughput along I-495, allowing more vehicles to access Route 123 in Tysons.

Table 7-3. VISSIM Intersection Microsimulation Delay and HCM-Analogous LOS – 2025 No Build vs. Build AM Peak Hour

Intersection Control	Intersection	2025 No-Build		2025 Build	
		Intersection Microsimulation Delay (s/veh)	Intersection HCM-Analogous LOS	Intersection Microsimulation Delay (s/veh)	Intersection HCM-Analogous LOS
Signalized	Route 123 and Tysons Boulevard	32.6	C	33.3	C
Signalized	Westpark Drive and Tysons Connector	21.4	C	22.7	C
Signalized	Tysons Connector and Express Lanes Ramps	13.9	B	14.1	B
Signalized	Route 123 and Capital One Tower Drive/ Old Meadow Road	77.9	E	83.0	F
Signalized	Route 123 and Scotts Crossing Boulevard/ Colshire Drive	74.6	E	78.4	E
Signalized	Route 123 and Route 267 Eastbound Off-Ramp/ Anderson Road	106.8	F	86.8	F
Signalized	Route 123 and Lewinsville Road/ Great Falls Street	136.3	F	155.0	F
Signalized	Lewinsville Road and Balls Hill Road	22.5	C	22.0	C
Signalized	Jones Branch Drive and Jones Branch Connector	17.6	B	18.0	B
Signalized	Jones Branch Connector and Express Lanes Ramps	64.7	E	65.0	E
Signalized	Jones Branch Drive and Capital One (West)	17.0	B	17.6	B
Signalized	Jones Branch Drive and Capital One (East)	5.4	A	5.3	A
Signalized	International Drive and Spring Hill Road/ Jones Branch Drive	48.3	D	49.1	D
Signalized	Spring Hill Road and Dulles Toll Road Eastbound Ramps	159.8	F	150.7	F
Signalized	Spring Hill Road and Dulles Toll Road Westbound Ramps	31.9	C	77.1	E

Intersection Control	Intersection	2025 No-Build		2025 Build	
		Intersection Microsimulation Delay (s/veh)	Intersection HCM-Analogous LOS	Intersection Microsimulation Delay (s/veh)	Intersection HCM-Analogous LOS
Signalized	Spring Hill Road and Lewinsville Road	54.1	D	57.6	E
Unsignalized	Route 193 and Helga Place/ Linganore Drive	139.6	F	39.5	E
Signalized	Route 193 and I-495 Southbound Ramps	25.4	C	23.9	C
Signalized	Route 193 and I-495 Northbound Ramps	20.5	C	20.7	C
Signalized	Route 193 and Balls Hill Road	21.1	C	23.0	C
Unsignalized	Route 193 and Dead Run Drive	9.6	A	9.5	A

Intersections Evaluated in Synchro

The expanded arterial network beyond intersections immediately adjacent to freeway interchanges in the corridor was evaluated solely through Synchro. **Table 7-4** compares the overall intersection delay and LOS between the two scenarios for each intersection.

Under both No Build and Build conditions, the following intersections are failing:

- Old Dominion Drive and Balls Hill Road (signalized)
- Route 193 and Swinks Mill Road (unsignalized)
- Route 193 and Douglass Drive (unsignalized)

Note that under Build conditions, while the two unsignalized intersections along Route 193 are experiencing failing conditions due to significant delays on stop-controlled approaches, a significant reduction in delay is achieved as compared to No Build conditions.

Table 7-4. 2025 Synchro Intersection Delay and LOS – 2025 No Build vs. Build AM Peak Hour

Intersection Control	Intersection Name	2025 No-Build AM		2025 Build AM	
		Intersection Delay (Sec/veh)	LOS	Intersection Delay (Sec/veh)	LOS
Signalized	Old Dominion Drive at Spring Hill Road	10.9	B	10.9	B
Signalized	Old Dominion Drive at Swinks Mill Road	16.2	B	16.2	B
Signalized	Old Dominion Drive at Balls Hill Road	101.5	F	101.5	F
Signalized	Route 123 at Old Dominion Drive	43.7	D	43.7	D
Unsignalized	Route 193 at Swinks Mill Road	221.4	F	101.9	F
Unsignalized	Route 193 at Spring Hill Road	18.0	C	16.7	C
Unsignalized	Lewinsville Road at Swinks Mill Road	46.7	E	47.6	E

Intersection Control	Intersection Name	2025 No-Build AM		2025 Build AM	
		Intersection Delay (Sec/veh)	LOS	Intersection Delay (Sec/veh)	LOS
Unsignalized	Route 123 at Ingleside Avenue	20.2	C	19.9	C
Unsignalized	Douglass Drive at Route 193	153.7	F	115.3	F

Figure 7-20 provides a summary comparison of overall intersection delay for Build conditions as compared to No Build conditions at each intersection in the Traffic Operations Study Area for the 2025 AM scenario. The figure shows whether an intersection shows an improvement in operations (increase in LOS in Build conditions if below LOS D for No Build conditions, or a significant reduction in delay if still operating at LOS F in Build conditions), a degradation in operations (decrease in LOS in Build conditions or significant increase in delay if operating at LOS F already in No Build conditions), or if operations remain generally consistent between the two scenarios.

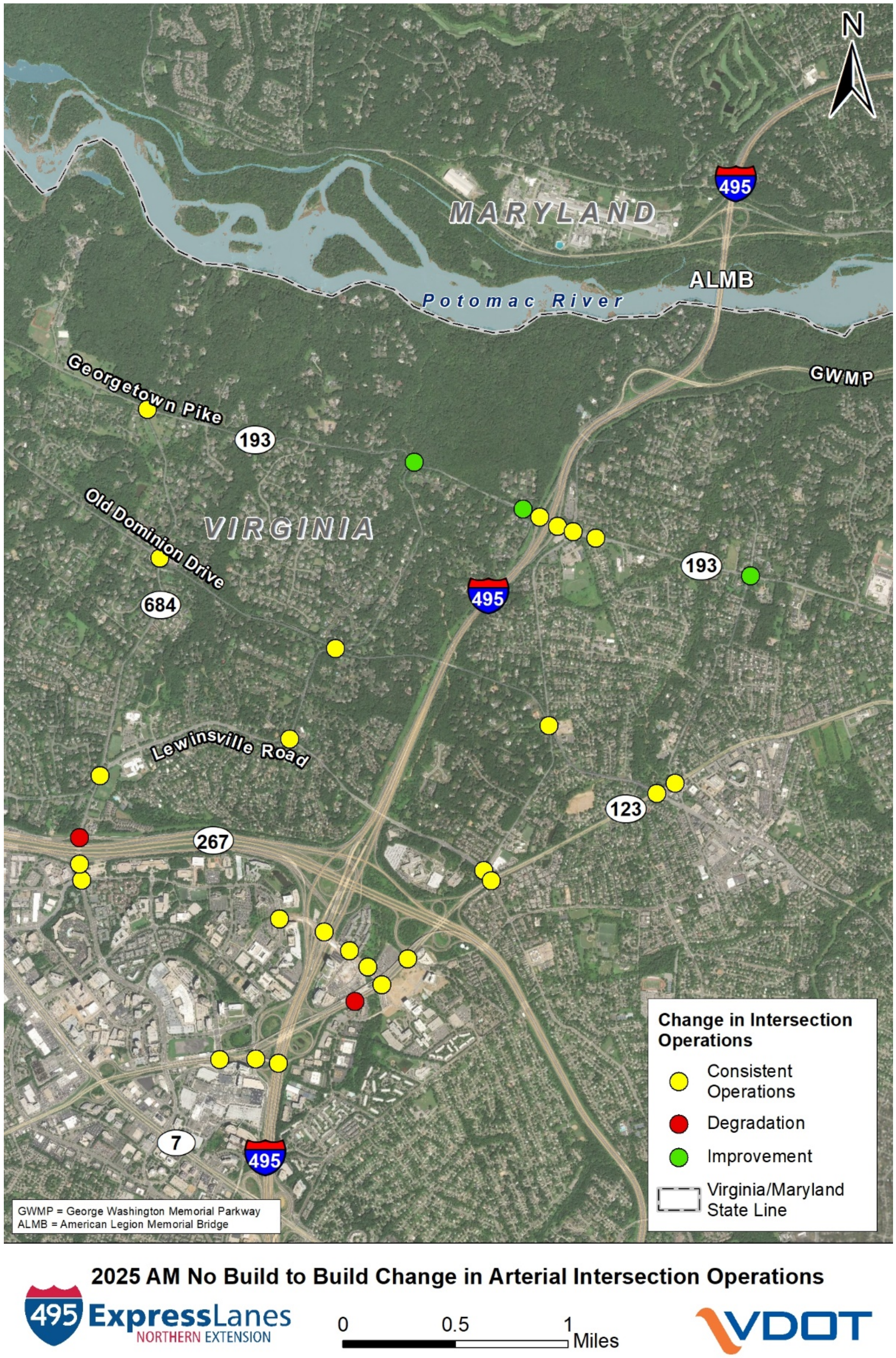


Figure 7-20. 2025 AM No Build to Build Change in Arterial Intersection Operations

PM Arterial Operations

Intersections Evaluated in VISSIM

Intersections in the Traffic Operations Study Area evaluated in VISSIM generally see improved operations in the 2025 PM peak hour in the Build condition as compared to No Build conditions. **Figure 7-21** provides pie charts of overall intersection HCM-analogous LOS for No Build and Build conditions. The figure shows under Build conditions, 33 percent of intersections are at LOS F while 43 percent are at LOS F under No Build conditions. Additionally, more than half of all intersections are LOS D or better in the Build condition, while only 33 percent are at LOS D or better in the No Build condition.

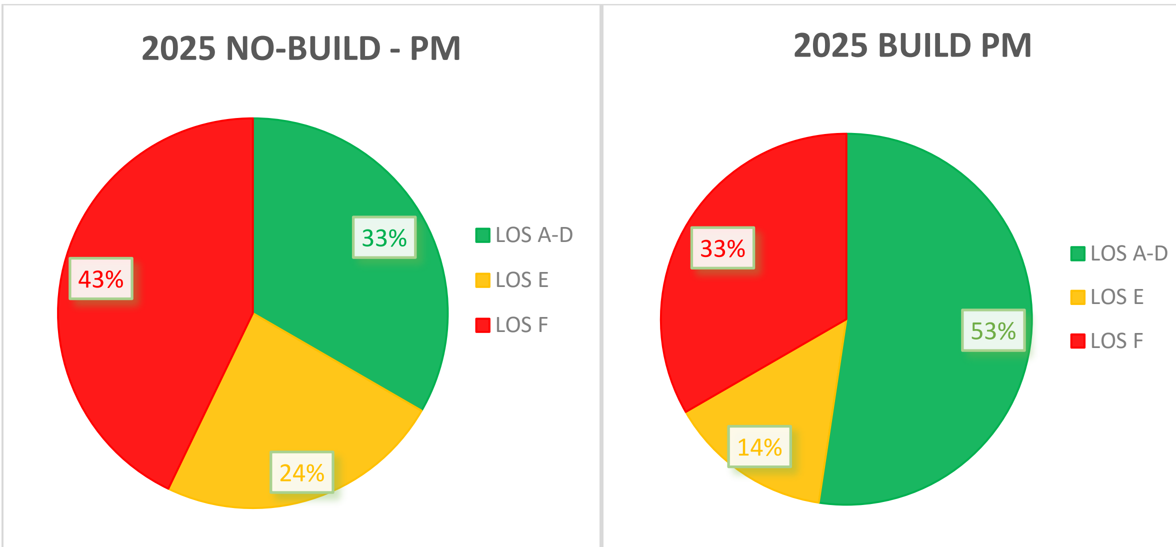


Figure 7-21. Summary of Arterial HCM-Analogous LOS, 2025 PM No Build vs. Build Conditions

Table 7-5 compares the overall intersection HCM-analogous LOS between the two scenarios for each intersection. A detailed breakdown of intersection delay and LOS, including delay and LOS by approach, is provided in **Appendix H.**

The following intersections operate under failing conditions under both 2025 No Build and Build conditions:

- Route 123 and Tysons Boulevard
- Route 123 and Capital One Tower Drive / Old Meadow Road
- Route 123 and Lewinsville Road/Great Falls Street
- Lewinsville Road and Balls Hill Road
- Jones Branch Connector and I-495 Express Lanes ramps
- International Drive and Spring Hill Road / Jones Branch Drive
- Route 193 and Dead Run Drive (unsignalized)

Most of these intersections are in the Tysons area and see continued growth in demand tied to commercial and residential growth in Tysons.

The signalized intersection of Route 123 and the Route 267 eastbound off-ramp / Anderson Road is failing under 2025 No Build conditions but improves to LOS E under 2025 Build conditions. However, the overall delay improves from approximately 86 seconds to approximately 79 seconds, representing a fairly minor improvement in operations.

The unsignalized intersection of Route 193 and Helga Place/Linganore Drive is failing under 2025 No Build conditions due to heavy delays on the southbound approach; this stop-controlled approach sees few gaps for traffic to enter the mainline Route 193 traffic stream due to heavy congestion in along eastbound Route 193 (spilling back from the northbound on-ramp to I-495). In the Build scenario, this eastbound congestion along Route 193 is relieved due to improved operations along northbound I-495, which reduces queue spillback on the on-ramp from Route 193.

Table 7-5. VISSIM Intersection Microsimulation Delay and HCM-Analogous LOS – 2025 No Build vs. Build PM Peak Hour

Intersection Control	Intersection	2025 No-Build		2025 Build	
		Intersection Microsimulation Delay (s/veh)	Intersection HCM-Analogous LOS	Intersection Microsimulation Delay (s/veh)	Intersection HCM-Analogous LOS
Signalized	Route 123 and Tysons Boulevard	174.5	F	177.1	F
Signalized	Westpark Drive and Tysons Connector	11.4	B	10.4	B
Signalized	Tysons Connector and Express Lanes Ramps	7.6	A	7.4	A
Signalized	Route 123 and Capital One Tower Drive/ Old Meadow Road	177.1	F	178.7	F
Signalized	Route 123 and Scotts Crossing Boulevard/ Colshire Drive	76.9	E	71.9	E
Signalized	Route 123 and Route 267 Eastbound Off-Ramp/ Anderson Road	85.9	F	78.7	E
Signalized	Route 123 and Lewinsville Road/ Great Falls Street	116.3	F	113.9	F
Signalized	Lewinsville Road and Balls Hill Road	116.6	F	117.1	F
Signalized	Jones Branch Drive and Jones Branch Connector	16.2	B	16.6	B
Signalized	Jones Branch Connector and Express Lanes Ramps	149.3	F	144.7	F
Signalized	Jones Branch Drive and Capital One (West)	21.0	C	20.5	C
Signalized	Jones Branch Drive and Capital One (East)	8.3	A	7.2	A
Signalized	International Drive and Spring Hill Road/ Jones Branch Drive	89.0	F	99.8	F
Signalized	Spring Hill Road and Dulles Toll Road Eastbound Ramps	20.2	C	20.1	C

Intersection Control	Intersection	2025 No-Build		2025 Build	
		Intersection Microsimulation Delay (s/veh)	Intersection HCM-Analogous LOS	Intersection Microsimulation Delay (s/veh)	Intersection HCM-Analogous LOS
Signalized	Spring Hill Road and Dulles Toll Road Westbound Ramps	61.8	E	39.8	D
Signalized	Spring Hill Road and Lewinsville Road	75.0	E	76.5	E
Unsignalized	Route 193 and Helga Place/ Linganore Drive	157.9	F	28.0	D
Signalized	Route 193 and I-495 Southbound Ramps	61.7	E	42.5	D
Signalized	Route 193 and I-495 Northbound Ramps	19.9	B	21.5	C
Signalized	Route 193 and Balls Hill Road	65.0	E	35.5	D
Unsignalized	Route 193 and Dead Run Drive	58.6	F	71.5	F

Intersections Evaluated in Synchro

The expanded arterial network beyond intersections immediately adjacent to freeway interchanges in the corridor was evaluated solely through Synchro. **Table 7-6** compares the overall intersection delay and LOS between the two scenarios for each intersection.

Under both No Build and Build conditions, the following intersections are failing:

- Old Dominion Drive and Balls Hill Road (signalized)
- Lewinsville Road and Swinks Mill Road (unsignalized)
- Route 193 and Douglass Drive (unsignalized)

Two of these three intersections are also failing in the 2025 AM peak hour under both No Build and Build conditions. Note that under Build conditions, while the intersection of Route 193 and Douglass Drive is still failing, a significant reduction in delay is achieved as compared to No Build conditions.

Table 7-6. 2025 Synchro Intersection Delay and LOS – 2025 No Build vs. Build PM Peak Hour

Intersection Control	Intersection Name	2025 No Build PM		2025 Build PM	
		Intersection Delay (Sec/veh)	LOS	Intersection Delay (Sec/veh)	LOS
Signalized	Old Dominion Drive at Spring Hill Road	10.8	B	10.8	B
Signalized	Old Dominion Drive at Swinks Mill Road	12.1	B	12.1	B
Signalized	Old Dominion Drive at Balls Hill Road	189.4	F	181.5	F

Intersection Control	Intersection Name	2025 No Build PM		2025 Build PM	
		Intersection Delay (Sec/veh)	LOS	Intersection Delay (Sec/veh)	LOS
Signalized	Route 123 at Old Dominion Drive	41.9	D	41.7	D
Unsignalized	Route 193 at Swinks Mill Road	23.4	C	15.8	C
Unsignalized	Georgetown Pike at Spring Hill Road	13.3	B	12.7	B
Unsignalized	Lewinsville Road at Swinks Mill Road	85.8	F	87.9	F
Unsignalized	Route 123 at Ingleside Avenue	24.9	C	24.9	C
Unsignalized	Douglass Drive at Route 193	280.2	F	144.2	F

Figure 7-22 provides a summary comparison of overall intersection delay for Build conditions as compared to No Build conditions at each intersection in the Traffic Operations Study Area for the 2025 PM scenario. The figure shows whether an intersection shows an improvement in operations (increase in LOS in Build conditions if below LOS D for No Build conditions, or a significant reduction in delay if still operating at LOS F in Build conditions), a degradation in operations (decrease in LOS in Build conditions or significant increase in delay if operating at LOS F already in No Build conditions), or if operations remain generally consistent between the two scenarios.

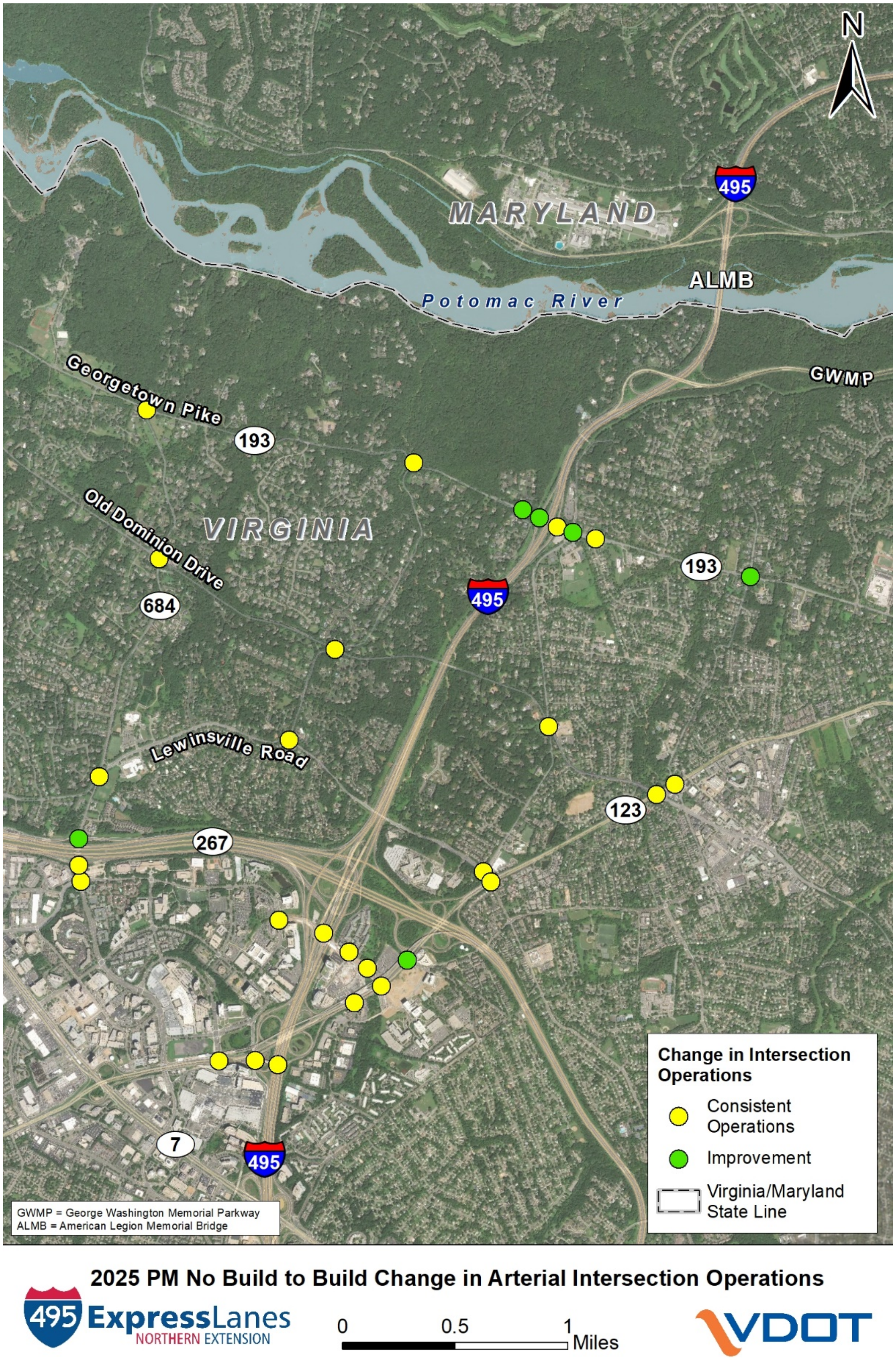


Figure 7-22. 2025 PM No Build to Build Change in Arterial Intersection Operations

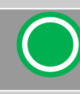
7.2.5 Summary of 2025 Operations

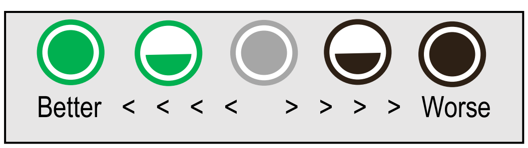
2025 AM Peak Period Summary

- Total demand along I-495 (GP plus Express) is forecasted to increase in the Build scenario along the length of the I-495 corridor. The greatest increases in demand are in the segments between Route 267 and GWMP, where Express Lanes are only present in the Build scenario and thus represent a substantial capacity increase from No Build conditions. Peak hour volumes are forecasted to increase in the Build scenario by between 2 to 9 percent in the northbound direction and between 2 to 6 percent in the southbound direction.
- In the northbound direction along the I-495 GP lanes, congestion is observed under No Build conditions between Route 267 and Clara Barton Parkway (across the ALMB) due to heavy merging and weaving volumes on and near the bridge. Under Build conditions, a significant reduction in congestion is observed due to the additional capacity provided by the Express Lanes and the reduced weaving due to the continuity of the Express Lanes. The average travel time in the northbound GP lanes improves by approximately 3 minutes (a 24 percent improvement) in the Build condition.
- In the southbound direction along the I-495 GP lanes, congestion is observed under No Build conditions south of the ALMB and north of Route 267 due to weaving approaching the entrance to the Express Lanes system as well as merging from vehicles exiting the Maryland managed lanes system south of the ALMB. This congestion is largely mitigated under Build conditions. The average travel time in the southbound GP lanes improves by approximately 1.5 minutes (an 11 percent improvement).
- Both directions of the Express Lanes operate at or near the posted speed limit. To travel the length of the corridor via Express Lanes under No Build conditions, vehicles must utilize the congested GP lanes between Route 267 and GWMP as Express Lanes are not present.
- Along eastbound Route 267 (DTR) there is 47 percent improvement in travel time. With the improved operations along northbound I-495, the ramp from eastbound DTR to northbound I-495 does not spill back to eastbound DTR, improving operations along eastbound DTR. Travel times along the westbound DTR remain unchanged.
- Over the course of the AM peak period, total persons moved along I-495 are forecasted to increase from No Build to Build conditions by between 4 and 17 percent in the northbound direction and between 6 and 21 percent in the southbound direction, depending upon location along the corridor.
- Arterial intersection operations are largely consistent between No Build and Build conditions, as both scenarios see the same percentage of intersections operating under failing conditions. These failing intersections are in the Tysons area and see continue growth in demand tied to commercial and residential growth in Tysons.

Table 7-7 presents an overall performance comparison table for the Build alternative versus the No Build alternative for 2025 AM conditions. The table shows that the Build alternative improves overall operations along the I-495 corridor given the improvement in travel times, reduction in congestion, and increase in persons moved.

Table 7-7. Overall Performance Comparison for 2025 AM No Build and Build Alternative

Measure of Effectiveness	Description	Facility	2025 AM No Build Value	2025 AM Build Value	Build Performance Compared to No Build
Travel Times	End-to-end travel time along the facility through the Traffic Operations Study Area, measured in Minutes	I-495 NB GP	10	7	
		I-495 NB Express	8	6	
		I-495 SB GP	8	7	
		I-495 SB Express	7	6	
		Dulles Toll Road EB	3	2	
		Dulles Toll Road WB	2	2	
Extent and Duration of Congestion	Visual assessment of freeway mainline queue length and duration of congestion	I-495 NB GP			
		I-495 SB GP			
Person Throughput	Additional persons moved during peak period of Build condition and percentage increase	I-495 NB (All)	+4,500 (17%)		
		I-495 SB (All)	+5,000 (21%)		
Arterial Operations	Number of intersections operating at LOS F	Entire Study Area	7	7	
	Number of intersections operating at LOS D or better		19	17	



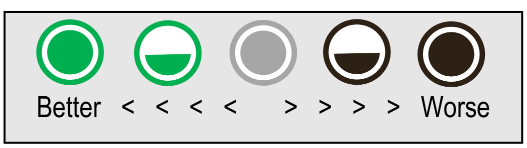
2025 PM Peak Period Summary

- Total demand along I-495 (GP plus Express) is forecasted to increase in the Build scenario along the length of the I-495 corridor. The greatest increases in demand are in the segments between Route 267 and GWMP, where Express Lanes are only present in the Build scenario and thus represent a substantial capacity increase from No Build conditions. Peak hour volumes are forecasted to increase in the Build scenario by between 10 to 29 percent in the northbound direction and between 7 to 12 percent in the southbound direction.
- In the northbound direction along the I-495 GP lanes, congestion is observed under No Build conditions between Route 267 and Clara Barton Parkway (across the ALMB) due to heavy merging and weaving volumes on and near the bridge, especially early in the peak period. Under Build conditions, a significant reduction in congestion is observed due to the additional capacity provided by the Express Lanes and the reduced weaving due to the continuity of the Express Lanes. The average travel time in the northbound GP lanes improves by approximately 4 minutes (a 36 percent improvement) in the Build condition.
- In the southbound direction along the I-495 GP lanes, congestion is observed under No Build conditions south of the ALMB and north of Route 267 due to weaving approaching the left-side entrance to the southbound Express Lanes (between Route 193 and Route 267) and downstream right-side exit to westbound DTR, as both of these movements have heavy volumes. This congestion is also worsened in the No Build scenario due to the southbound Maryland managed lanes system terminating near the GWMP interchange, creating a merge that spills back upstream in the GP lanes across the ALMB. This congestion is largely mitigated under Build conditions. The average travel time in the southbound GP lanes improves by nearly 8 minutes (a 49 percent improvement).
- Both directions of the Express Lanes operate at or near the posted speed limit. To travel the length of the corridor via Express Lanes under No Build conditions, vehicles must utilize the congested GP lanes between Route 267 and GWMP as Express Lanes are not present.
- Along eastbound and westbound Route 267 (DTR), travel times are essentially identical between No Build and Build.
- Over the course of the PM peak period, total persons moved along I-495 are forecasted to increase from No Build to Build conditions by between 8 and 37 percent in the northbound direction and between 10 and 47 percent in the southbound direction, depending upon location along the corridor.
- Arterial intersection operations see an improvement under Build conditions, as the percentage of intersections operating at failing conditions drops from 43 percent (No Build) to 33 percent (Build), and more than half of all intersections are LOS D or better in the Build condition, while only 33 percent are at LOS D or better in the No Build condition. Most of the failing intersections are in the Tysons area and see continue growth in demand tied to commercial and residential growth in Tysons.

Table 7-8 presents an overall performance comparison table for the Build alternative versus the No Build alternative for 2025 PM conditions. The table shows that the Build alternative improves overall operations along the I-495 corridor given the improvement in travel times, reduction in congestion, and increase in persons moved. Arterial operations are also shown to improve in the PM peak hour under the Build alternative.

Table 7-8. Overall Performance Comparison for 2025 PM No Build and Build Alternative

Measure of Effectiveness	Description	Facility	2025 AM No Build Value	2025 AM Build Value	Build Performance Compared to No Build
Travel Times	End-to-end travel time along the facility through the Traffic Operations Study Area, measured in Minutes	I-495 NB GP	11	7	
		I-495 NB Express	8	6	
		I-495 SB GP	16	8	
		I-495 SB Express	8	6	
		Dulles Toll Road EB	2	2	
		Dulles Toll Road WB	2	2	
Extent and Duration of Congestion	Visual assessment of freeway mainline queue length and duration of congestion	I-495 NB GP			
		I-495 SB GP			
Person Throughput	Additional persons moved during peak period of Build condition and percentage increase	I-495 NB (All)	+6,800 (37%)		
		I-495 SB (All)	+8,800 (47%)		
Arterial Operations	Number of intersections operating at LOS F	Entire Study Area	12	10	
	Number of intersections operating at LOS D or better		13	17	



7.3 2045 DESIGN YEAR ANALYSIS

7.3.1 2045 Traffic Volumes

This section describes forecasted traffic volumes for the study area for 2045 No Build and Build conditions; the following sections detail the differences in traffic operations analysis results between the two conditions.

Peak hour freeway forecast volumes for 2045 conditions are provided in the following exhibits:

- **Exhibits 7-17a** and **7-17b** show 2045 No Build AM peak hour freeway volumes for the I-495 and Route 267 corridors, respectively.
- **Exhibits 7-18a** and **7-18b** show 2045 Build AM peak hour freeway volumes for the I-495 and Route 267 corridors, respectively.
- **Exhibits 7-19a** and **7-19b** show 2045 No Build PM peak hour freeway volumes for the I-495 and Route 267 corridors, respectively.
- **Exhibits 7-20a** and **7-20b** show 2045 Build PM peak hour freeway volumes for the I-495 and Route 267 corridors, respectively.

Arterial turning movement volumes for 2045 conditions are provided in the following exhibits:

- **Exhibits 7-21a** through **7-21e** show 2045 No Build AM and PM peak hour arterial turning movement volumes.
- **Exhibits 7-22a** through **7-22e** show 2045 Build AM and PM peak hour arterial turning movement volumes.

Average daily traffic forecast volumes for 2045 conditions are provided in the following exhibits:

- **Exhibits 7-23a** and **7-23b** show 2045 No Build ADT freeway volumes for the I-495 and Route 267 corridors, respectively.
- **Exhibits 7-24a** and **7-24b** show 2045 Build ADT freeway volumes for the I-495 and Route 267 corridors, respectively.

Peak Hour Traffic Volumes and Peaking Patterns

Figure 7-23 and **Figure 7-24** compare 2045 No Build and Build AM forecast peak hour mainline volumes with existing conditions along northbound and southbound I-495 (GP and Express combined), respectively.

- In the northbound direction, the highest traffic volumes in all scenarios are between the GWMP and Clara Barton Parkway (across the ALMB). The increases in volume from No Build to Build range from 280 vph to 1,080 vph (3 percent to 11 percent) across the four segments, with the largest increases in the segments between Route 267 and GWMP where the Build Alternative adds capacity from the Express Lanes.
- In the southbound direction, the highest traffic volumes in all scenarios are again between the Clara Barton Parkway and GWMP (across the ALMB). The increases in volume from No Build to Build range from 410 vph to 690 vph (4 percent to 6 percent) across the four segments, with the largest increase in the segments between GWMP and Route 267 where the Build Alternative adds capacity from the Express Lanes.

Figure 7-25 and **Figure 7-26** compare 2045 No Build and Build PM forecast peak hour mainline volumes with existing conditions along northbound and southbound I-495 (GP and Express combined), respectively.

- In the northbound direction, the highest traffic volumes in all scenarios are between the GWMP and Clara Barton Parkway (across the ALMB). The increases in volume from No Build to Build range from 260 vph to 1,400 vph (3 percent to 20 percent) across the four segments, with the largest increases in the segments between Route 267 and GWMP where the Build Alternative adds capacity from the Express Lanes.
- In the southbound direction, the highest traffic volumes in all scenarios are again between the Clara Barton Parkway and GWMP (across the ALMB). The increases in volume from No Build to Build range from 660 vph to 1,020 vph (7 percent to 12 percent) across the four segments, with the largest increase in the segments between GWMP and Route 267 where the Build Alternative adds capacity from the Express Lanes.

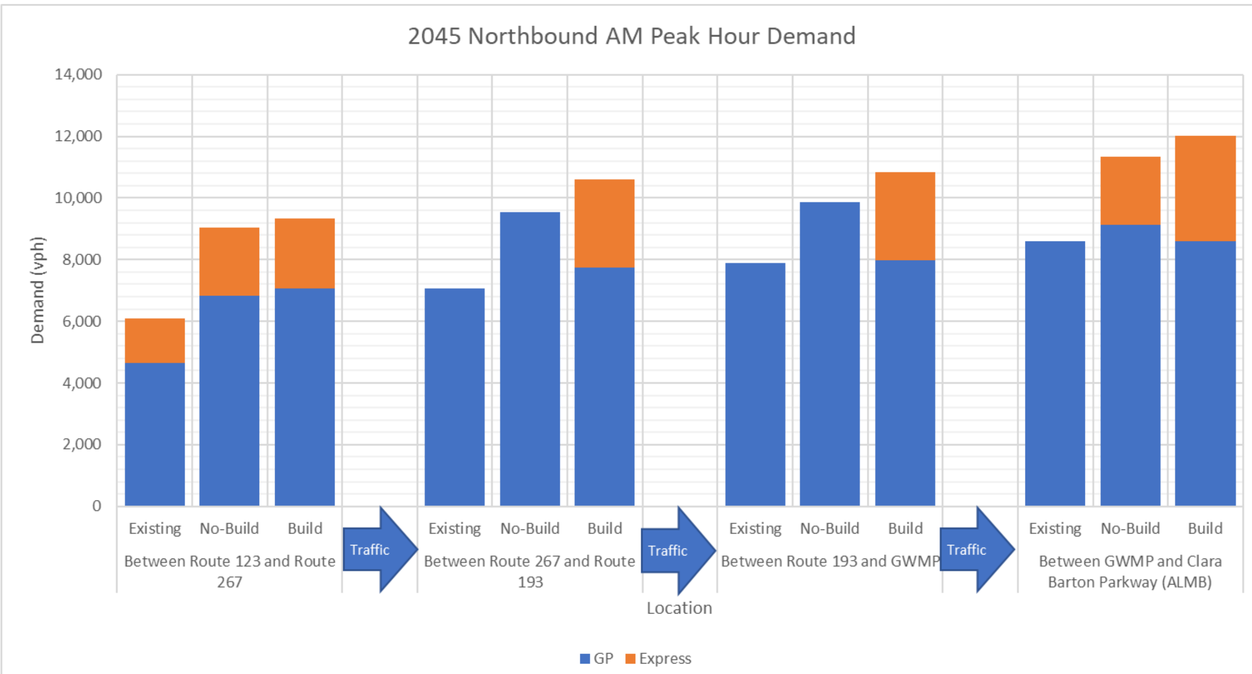


Figure 7-23: Existing and 2045 No Build AM Peak Hour Volumes - Northbound I-495

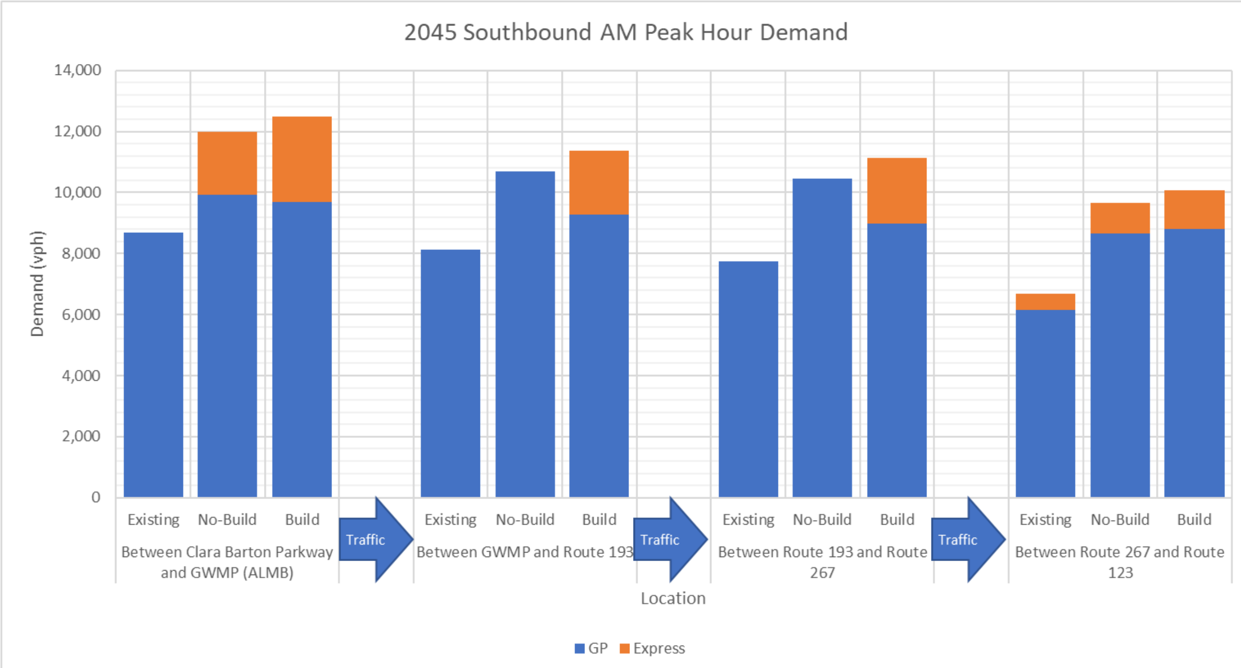


Figure 7-24: Existing and 2045 No Build AM Peak Hour Volumes - Southbound I-495

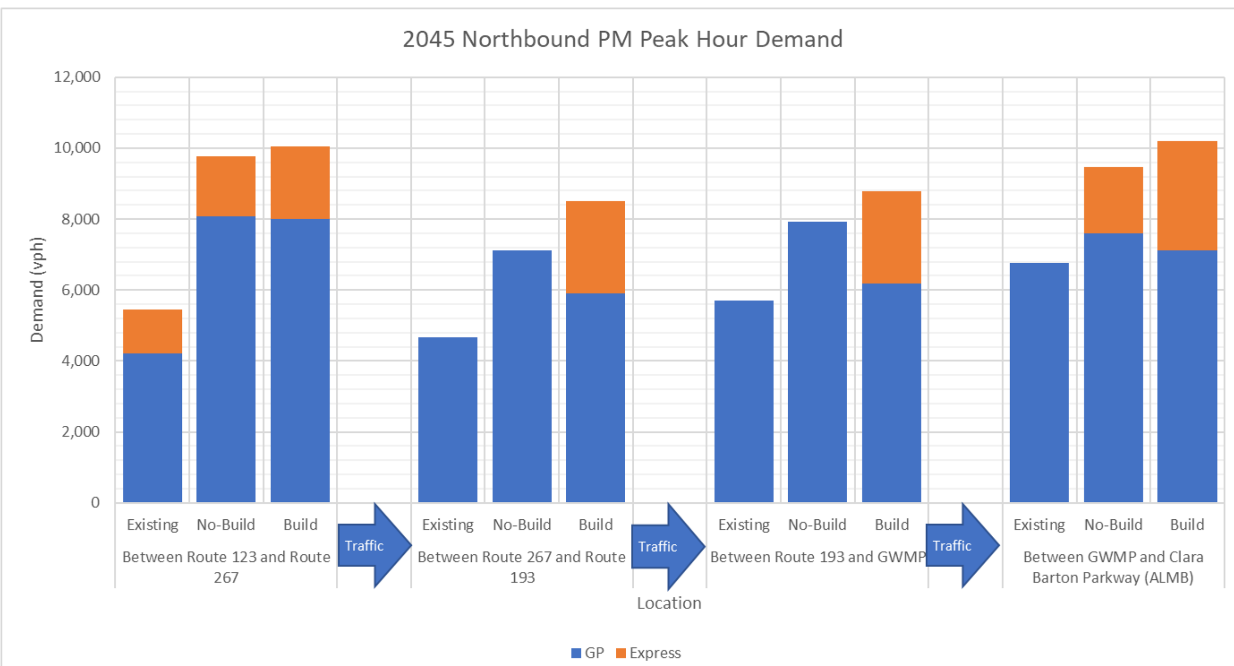


Figure 7-25: Existing and 2045 No Build PM Peak Hour Volumes - Northbound I-495

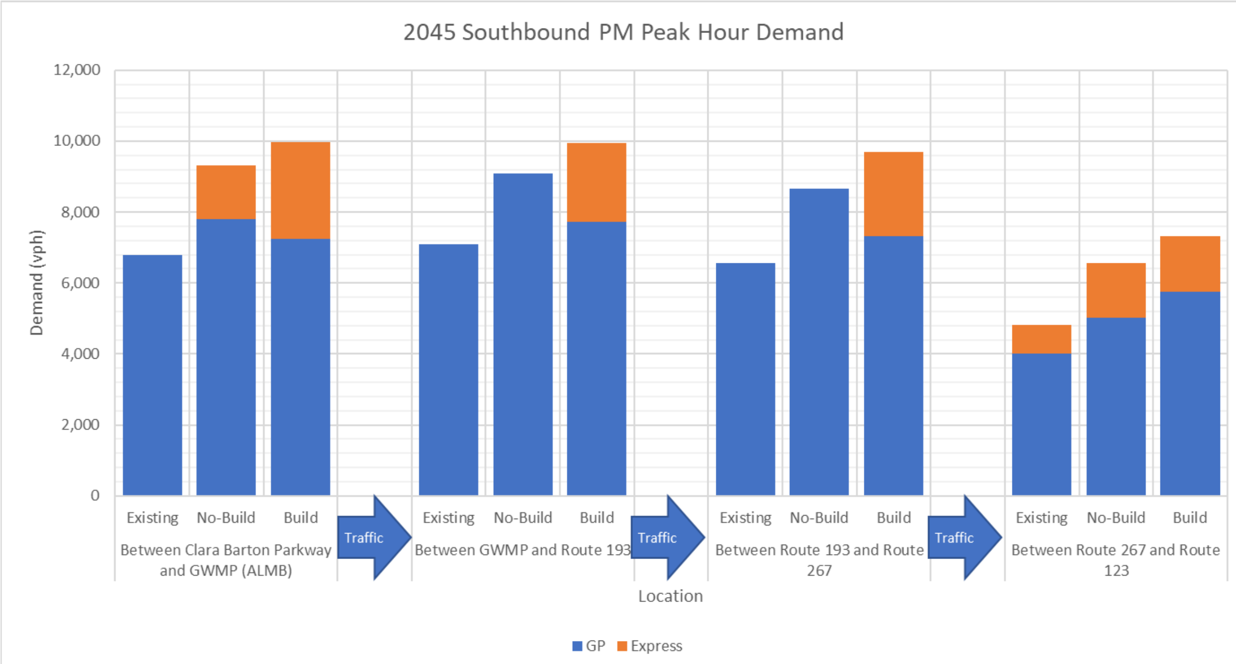


Figure 7-26: Existing and 2045 No Build PM Peak Hour Volumes - Southbound I-495

7.3.2 2045 No Build vs. Build AM Freeway Operations

Exhibits 7-25 through **7-28** illustrate the density and speed results from the VISSIM models for the I-495 and Route 267 mainline segments in the study area for the AM peak period:

- **Exhibits 7-25a** through **7-25c** show 2045 No Build AM peak period freeway densities.
- **Exhibits 7-26a** through **7-26c** show 2045 Build AM peak period freeway densities.
- **Exhibits 7-27a** through **7-27c** show 2045 No Build AM peak period freeway speeds.
- **Exhibits 7-28a** through **7-28c** show 2045 Build AM peak period freeway speeds.

In each figure, the centerline diagram laid over the aerial depicts the average densities or speeds during the peak hour from 7:45 a.m. to 8:45 a.m. in both directions along the mainline segments. The average densities and speeds are color-coded based on the congestion levels and ranges of speeds as depicted in the legend. The boxes on the top and bottom depict the densities and speeds in each direction for the entire peak period from 6:45 a.m. to 9:45 a.m., including the shoulder periods before and after the peak hour. Detailed tabular results can be found in **Appendix G.**

Density

In the AM peak period, it can be seen from the exhibits that in the northbound direction, more than half of the segments operate under congested to severe densities in both the No Build and Build conditions. **Figure 7-27** summarizes various densities along northbound I-495 GP lanes. As can be seen in the figure, 65 percent of the freeway segments operate under congested to severe congestion in the No Build condition compared to 72 percent in the Build condition. Although the Build condition has a slight increase in the number of congested segments compared to No Build, the volume processed increases significantly in the Build condition (thus increasing density); additionally, as shown in the following sections, speeds and travel times improve in the Build condition. The Build condition also sees a higher percentage of segments operating under light to moderate densities in the northbound direction (22 percent versus 12 percent).

As seen in **Figure 7-28**, 52 percent of the segments operate under congested to severe congestion along the southbound I-495 GP lanes in the No Build condition as compared to 47 percent operating under congested to severe congested densities in the Build condition. In the No Build condition, the segment between Georgetown Pike and River Road operates under severe congestion due to the merge from the terminus of the southbound Maryland managed lanes system; this severe congestion meters traffic from getting downstream, artificially improving operations in the downstream southbound segments. The proposed project (Build condition) significantly alleviates this congestion, and as a result, more demand is processed which results in slightly higher density levels compared to No Build conditions.

All the segments along the northbound and southbound Express Lanes operate under light to moderate traffic congestion in both the scenarios with the exceptions of the segments approaching the Express Lanes termini in the No Build condition.

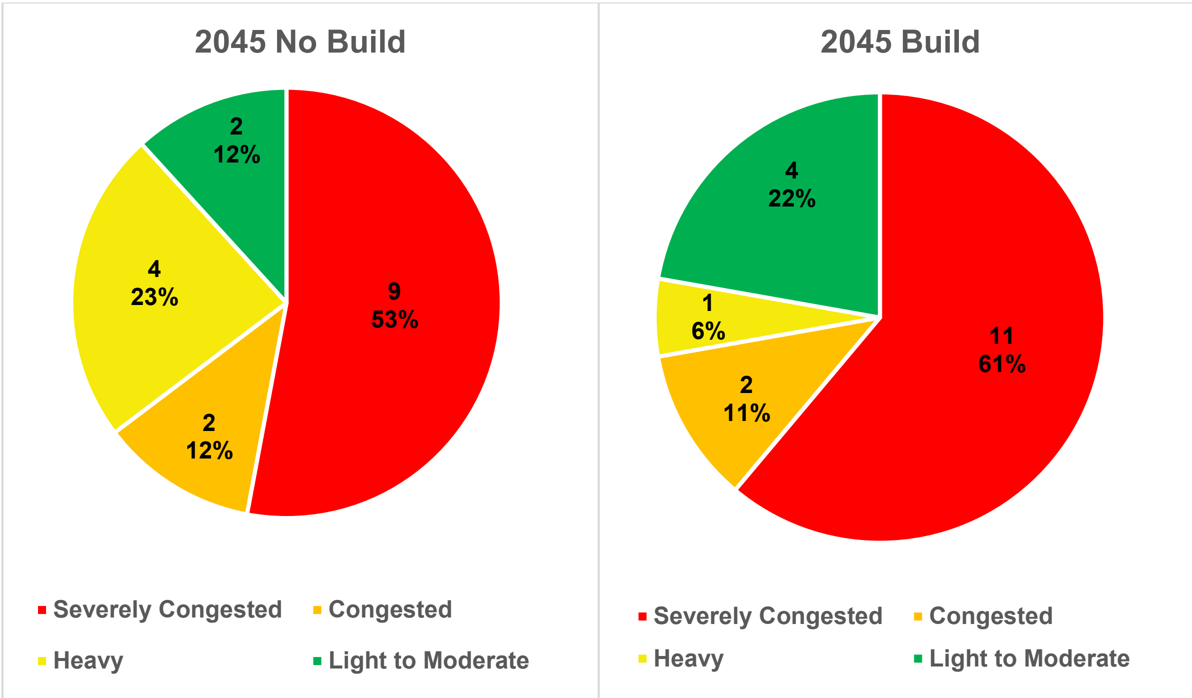


Figure 7-27: 2045 AM Freeway Segment Densities for I-495 Northbound

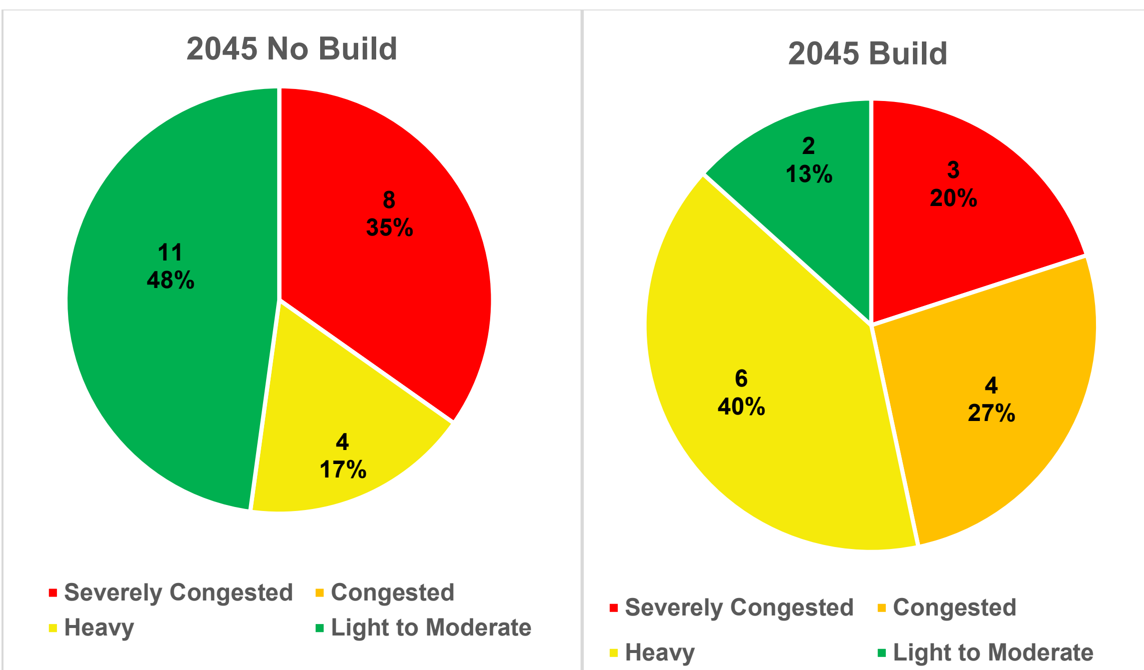


Figure 7-28: 2045 AM Freeway Segment Densities for I-495 Southbound

Speeds

As illustrated in **Exhibits 7-27** and **7-28**, the diagrams for average speeds in the AM peak period generally show similar patterns as seen in the density diagrams. In the northbound GP lanes, in the No Build condition, the corridor is severely congested from south of Route 193 (Georgetown Pike) to the Clara Barton Parkway across the ALMB. In the Build condition, some of this congestion remains, but it is significantly alleviated as compared to No Build, and higher speeds are observed. In both the No Build and Build conditions, speeds are much higher north of the ALMB due to congestion relief provided by the Maryland managed lanes system.

In the southbound GP lanes, in the No Build condition, severe congestion is observed between the entrance to the network and Route 193. As noted in the previous section, this congestion is due to the merge from the terminus of the southbound Maryland managed lanes system, as all traffic must rejoin the GP lanes at this point. This creates significant queue spillback in the southbound GP lanes and meters traffic at this point, resulting in artificially high speeds and limited congestion south of Route 193. In the Build condition, the continuous Express Lanes system significantly relieves congestion along the southbound GP lanes as that merge point is eliminated; some congestion across the ALMB remains, with low speeds observed spilling back into Maryland during the peak hour.

Both directions of the Express Lanes operate at or near the posted speed limit.

Figure 7-29 provides a "heat map" comparison of average speeds between 2045 No Build and Build conditions for the AM peak period along the I-495 GP lanes. Time of day during the peak period is provided on the horizontal axis while location along the corridor is provided along the vertical axis; the colors signify average speeds for each scenario. The figure is consistent with the speed Exhibits and indicates a more significant presence of congestion in the No Build scenario in both directions of the I-495 GP lanes.

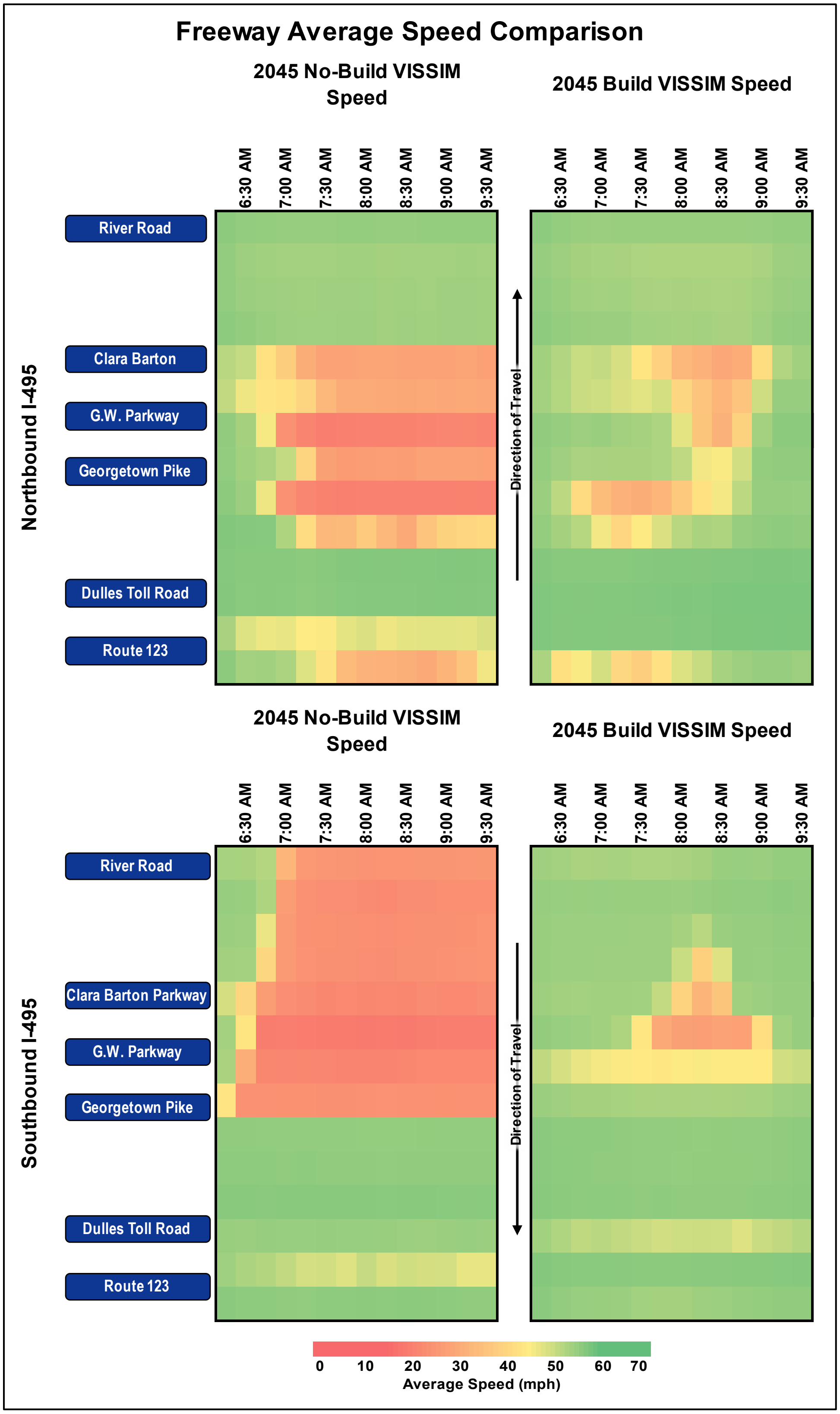


Figure 7-29: 2045 No Build and Build – AM Peak Period Average Speeds, I-495 GP Lanes

Travel Time

A comparison of AM peak period travel times for 2045 No Build and 2045 Build scenarios is shown in **Table 7-9**. Travel time measurements have been aggregated by direction of travel and facility type.

Table 7-9. 2045 AM Peak Period Travel Time Comparison

Route	GP Travel Times (Minutes: Seconds)		Express Lanes Travel Times (Minutes: Seconds)	
	2045 No Build	2045 Build	2045 No Build	2045 Build
Northbound I-495 (Route 123 to River Road)	11:59	8:03	9:37	5:43
Southbound I-495 (River Road to Route 123)	16:15	7:32	8:04	5:41
Eastbound Route 267 (Spring Hill Road to Route 123)	7:21	1:51	-	-
Westbound Route 267 (Route 123 to Spring Hill Road)	1:56	2:01	-	-

2045 Build AM peak period travel times improve or remain consistent as compared to No Build across all freeway facilities in the Traffic Operations Study Area

- The average travel time in the northbound GP lanes improves by approximately 4 minutes (a 33 percent improvement) in the Build condition. The majority of the travel time savings are between Old Dominion Drive and Clara Barton Parkway, which is consistent with the speed results shown in the previous section.
- Vehicles traveling in the northbound Express Lanes see a nearly 4-minute improvement (41 percent) in the Build condition. The travel time improvement in the Build condition is between Lewinsville Road and GWMP, where in the No Build condition, vehicles need to travel on the congested GP lanes.
- In the southbound direction, GP travel times in the Build improve by nearly 9 minutes (54 percent) and Express Lanes travel time improve by approximately 2.5 minutes (30 percent). Similar to northbound, providing a continuous Express Lanes system helps with the traffic operations.
- Along eastbound Route 267 (DTR) there is a 5.5-minute (75 percent) improvement in travel time. With the improved operations along northbound I-495, the ramp from eastbound DTR to northbound I-495 does not spill back to eastbound DTR, significantly improving operations along eastbound DTR.
- In the westbound direction, travel times along Route 267 (DTR) are generally consistent between No Build and Build.

Simulated Volumes and Demand Served

Figure 7-30 shows the comparison of unserved demand (vehicular throughput as compared to vehicular demand) between No Build and Build conditions for the AM peak hour in the northbound direction. As can be seen in the figure, nearly all demand is served in the Build condition during the AM peak hour except for a small percentage over the ALMB. In the No Build condition, the unserved demand exceeds 10 percent north of the Route 267 interchange due to the heavy congestion. The improved throughput in the Build condition can be attributed to the continuous Express Lanes system, which alleviates congestion and allows demand to be processed more quickly.

Figure 7-31 shows the comparison of unserved demand between No Build and Build conditions for the AM peak hour in the southbound direction. As can be seen in the figure, the unserved demand is generally within 5 percent in the Build compared to more than 20 percent in the No Build for the length of the corridor. The increased in the throughput in the Build condition can be attributed to the reduced congestion between Route 193 and Route 267 due to the new Express Lanes system being in place; in the No Build condition, the severe congestion at the terminus of the Maryland managed lanes system constrains demand from reaching points south of this point. The proposed project alleviates congestion in this segment, thus reducing the unserved demand.

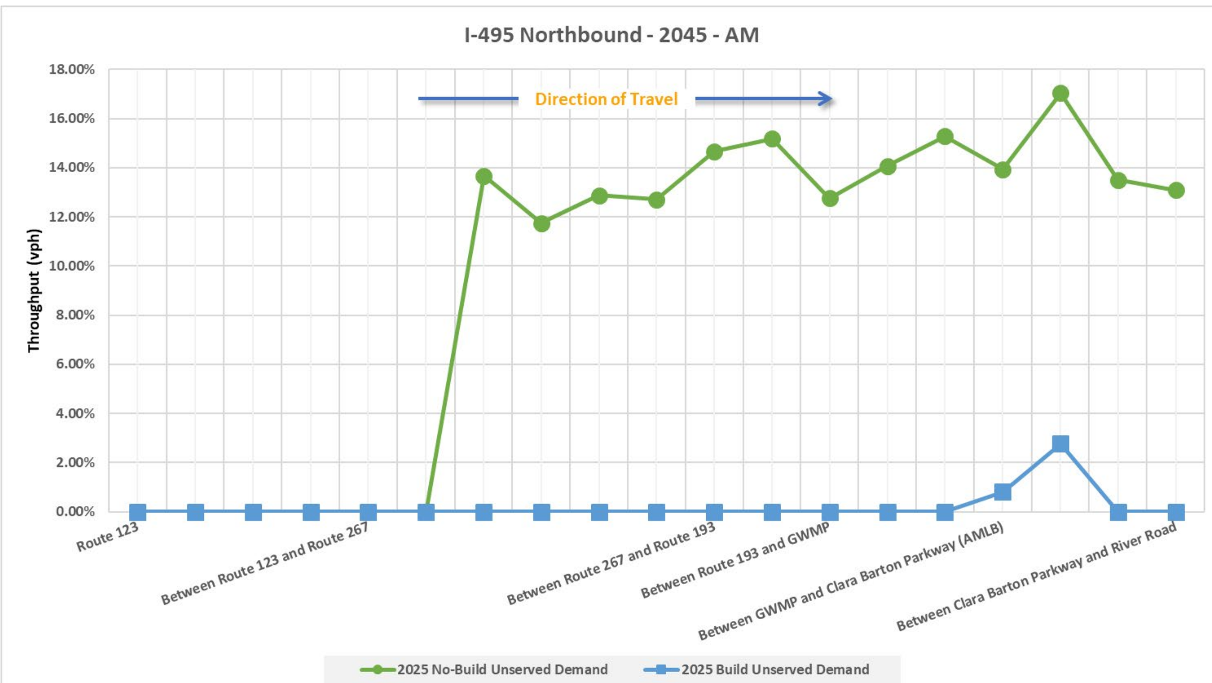


Figure 7-30. 2045 No Build and Build – AM Peak Hour Unserved Demand, I-495 Northbound

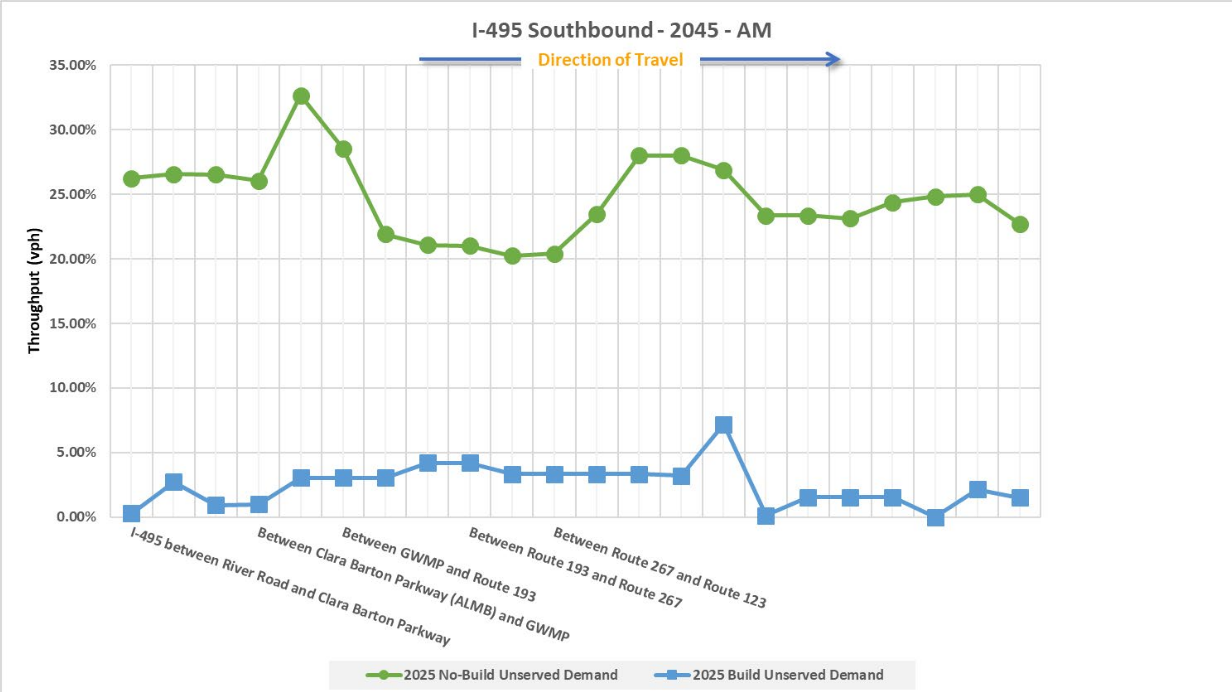


Figure 7-31. 2045 No Build and Build – AM Peak Hour Unserved Demand, I-495 Southbound

Person Throughput

Figure 7-32 and **Figure 7-33** display AM peak period person throughput along I-495 northbound and southbound, respectively (GP and Express combined). These figures show the estimated number of persons moved across a three-hour period based on simulated vehicle throughput and assumed vehicle occupancies for GP and Express Lanes. GP lanes are assumed to carry 1.1 persons per vehicle, based on the estimated non-HOV lane auto occupancy MWCOG has estimated across various interstate facilities in Northern Virginia (MWCOG, 2014). Express Lanes are assumed to carry 1.44 person per vehicle, based on a historic 18 percent HOV-3 utilization in the existing I-495 Express Lanes and assuming the remaining 82 percent of vehicles take on the non-HOV lane auto occupancy. These figures show that person throughput increases in the Build scenario across the length of the I-495 corridor in both directions due to the added capacity from the Express Lanes and increased occupancy of vehicles in those lanes.

- In the northbound direction, the highest person throughputs are across the ALMB. Increases in throughput from No Build to Build range from 6 to 33 percent, with the greatest increase in the segments between Route 267 and GWMP where the new Express Lanes significantly add capacity.
- In the southbound direction, the highest person throughputs are again across the ALMB. Increases in throughput from No Build to Build range from 29 to 35 percent, with the greatest increases again in the segments between GWMP and Route 267 where the new Express Lanes significantly add capacity. Note that the southbound throughput in the No Build scenario is heavily constrained due to the merge with the southbound Maryland managed lanes terminus; this reduces throughput along the length of the corridor.

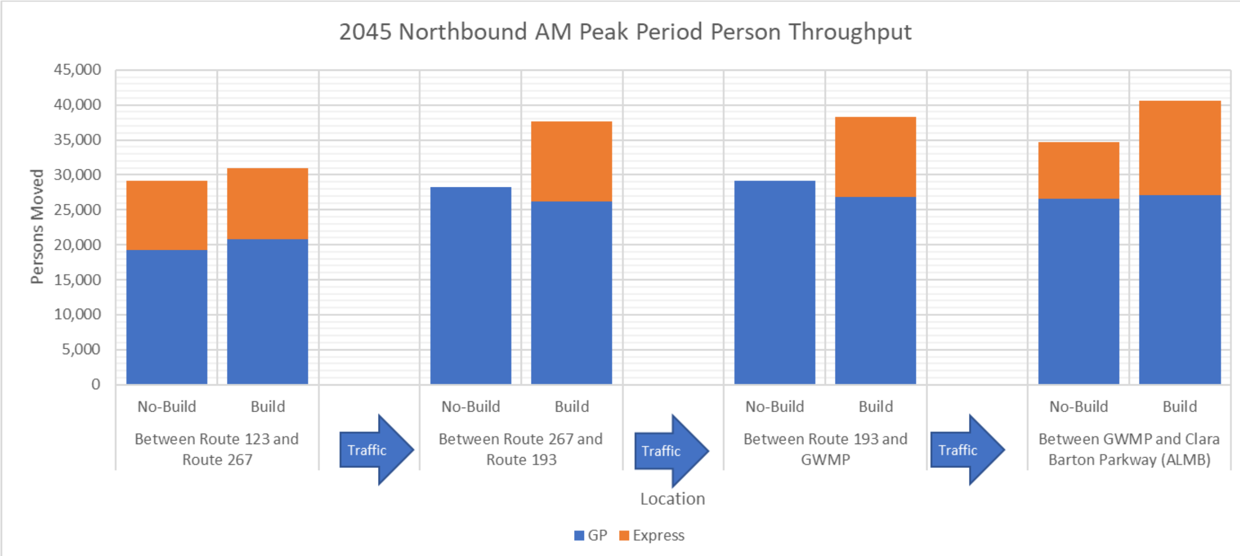


Figure 7-32. 2045 No Build and Build – AM Peak Period Person Throughput, I-495 Northbound

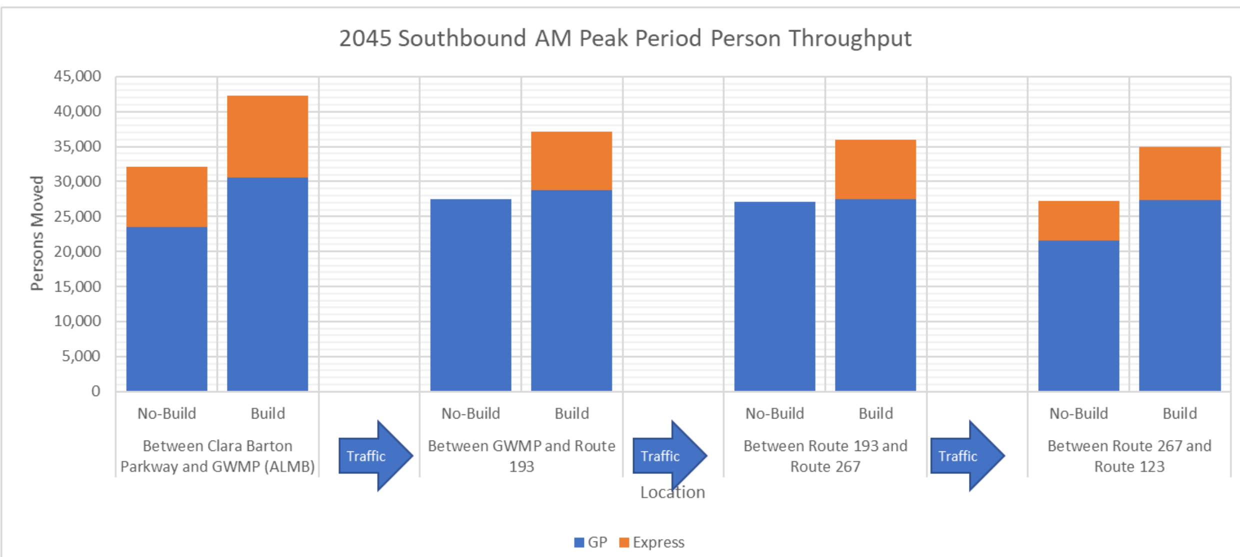


Figure 7-33. 2045 No Build and Build – AM Peak Period Person Throughput, I-495 Southbound

7.3.3 2045 No Build vs. Build PM Freeway Operations

Exhibits 7-29 through **7-32** illustrate the density and speed results from the VISSIM models for the I-495 and Route 267 mainline segments in the study area for the PM peak period:

- **Exhibits 7-29a** through **7-29c** show 2045 No Build PM peak period freeway densities.
- **Exhibits 7-30a** through **7-30c** show 2045 Build PM peak period freeway densities.
- **Exhibits 7-31a** through **7-31c** show 2045 No Build PM peak period freeway speeds.
- **Exhibits 7-32a** through **7-32c** show 2045 Build PM peak period freeway speeds.

In each figure, the centerline diagram laid over the aerial depicts the average densities or speeds during the peak hour from 3:45 p.m. to 4:45 p.m. in both directions along the mainline segments. The average densities and speeds are color-coded based on the congestion levels and ranges of speeds as depicted in the legend. The boxes on the top and bottom depict the densities and speeds in each direction for the entire peak period from 2:45 p.m. to 5:45 p.m., including the shoulder periods before and after the peak hour. Detailed tabular results can be found in **Appendix G.**

Density

In the PM peak period, it can be seen from the exhibits that in the northbound GP lanes, all of the segments in the No Build condition are severely congested. As seen in **Figure 7-34**, 100 percent of the segments in the No Build condition are severely congested, whereas 67 percent are severely congested in the Build condition. In the Build condition, 22 percent of northbound GP segments operate under light to moderate freeway densities, a significant improvement from No Build conditions.

In the southbound GP lanes, as shown in **Figure 7-35**, the Build condition shows a slight improvement as compared to the No Build condition in terms of an increase in segments operating under light to moderate densities and a decrease in segments operating under severely congested freeway segment densities. The locations of the south congested segments vary somewhat between the two scenarios, however. In the No Build condition, due to the merge from the southbound Maryland managed lanes, severe congestion is observed north of the ALMB while downstream segments are artificially metered. In the Build condition, downstream segments such as those near Route 123 in Tysons see higher freeway densities due to increased throughput from the improved upstream capacity.

Northbound and southbound Express Lanes segments operate under light to moderate traffic conditions in both the No Build and Build conditions, with the exceptions of the segments approaching the Express Lanes termini in the No Build condition.

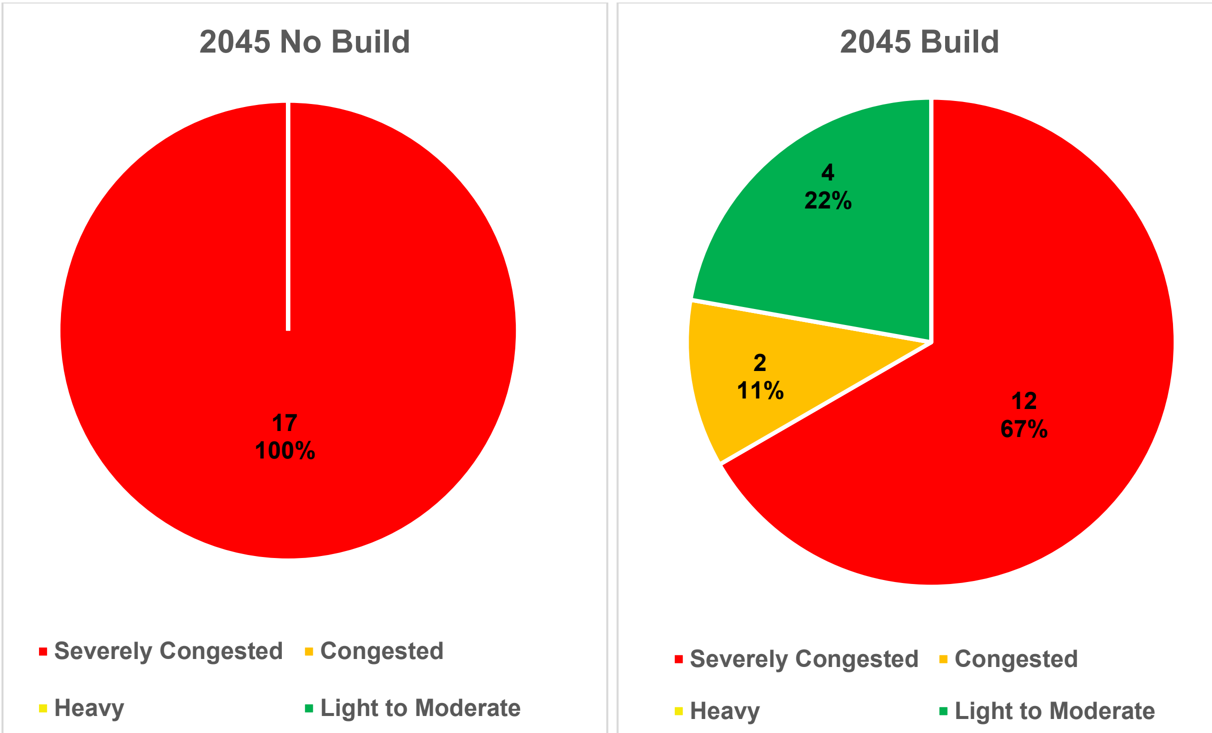


Figure 7-34: 2045 PM Freeway Segment Densities for I-495 Northbound

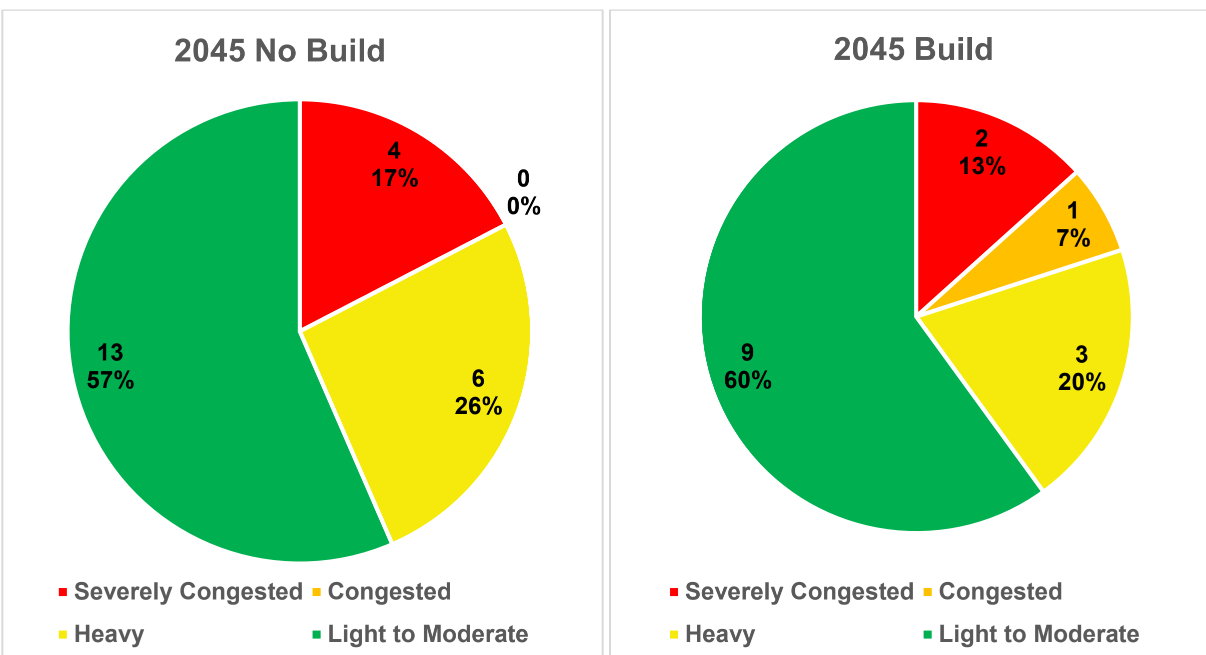


Figure 7-35: 2045 PM Freeway Segment Densities for I-495 Southbound

Speeds

As illustrated in **Exhibits 7-31** and **7-32**, the diagrams for average speeds in the PM peak period show similar patterns as seen in the density diagrams. In the northbound GP lanes, in the No Build condition, severe congestion is observed spilling back from the ALMB through the Route 267 interchange and essentially through the extents of the Traffic Operations Study Area; this congestion is worsened by spillback from the northbound GP lanes in Maryland later in the peak period, creating a single continuous area of congestion through the corridor. In the Build condition, the congestion in Maryland remains generally unchanged, but the extent of the queue spillback and duration on the Virginia side, especially south of Route 193, is not as significant as the No Build condition.

In the southbound GP lanes, in the No Build condition, severe congestion is observed north of the ALMB due to spillback from the merge with the terminus of the southbound Maryland managed lanes system and weaving on the bridge itself; higher speeds are observed south of this point. In the Build condition, the queue spillback into Maryland is essentially eliminated due to the continuity of the Express Lanes system and elimination of the merge from the No Build condition. In the Build condition, given that more throughput is able to reach downstream locations, lower speeds are observed at the southern extents of the Traffic Operations Study Area in Tysons.

Both directions of the Express Lanes operate at or near the posted speed limit.

Figure 7-36 provides a “heat map” comparison of average speeds between 2045 No Build and Build conditions for the PM peak period along the I-495 GP lanes. Time of day during the peak period is provided on the horizontal axis while location along the corridor is provided along the vertical axis; the colors signify average speeds for each scenario. The figure is consistent with the speed Exhibits and indicates a more significant presence of congestion in the No Build scenario in both directions of the I-495 GP lanes.

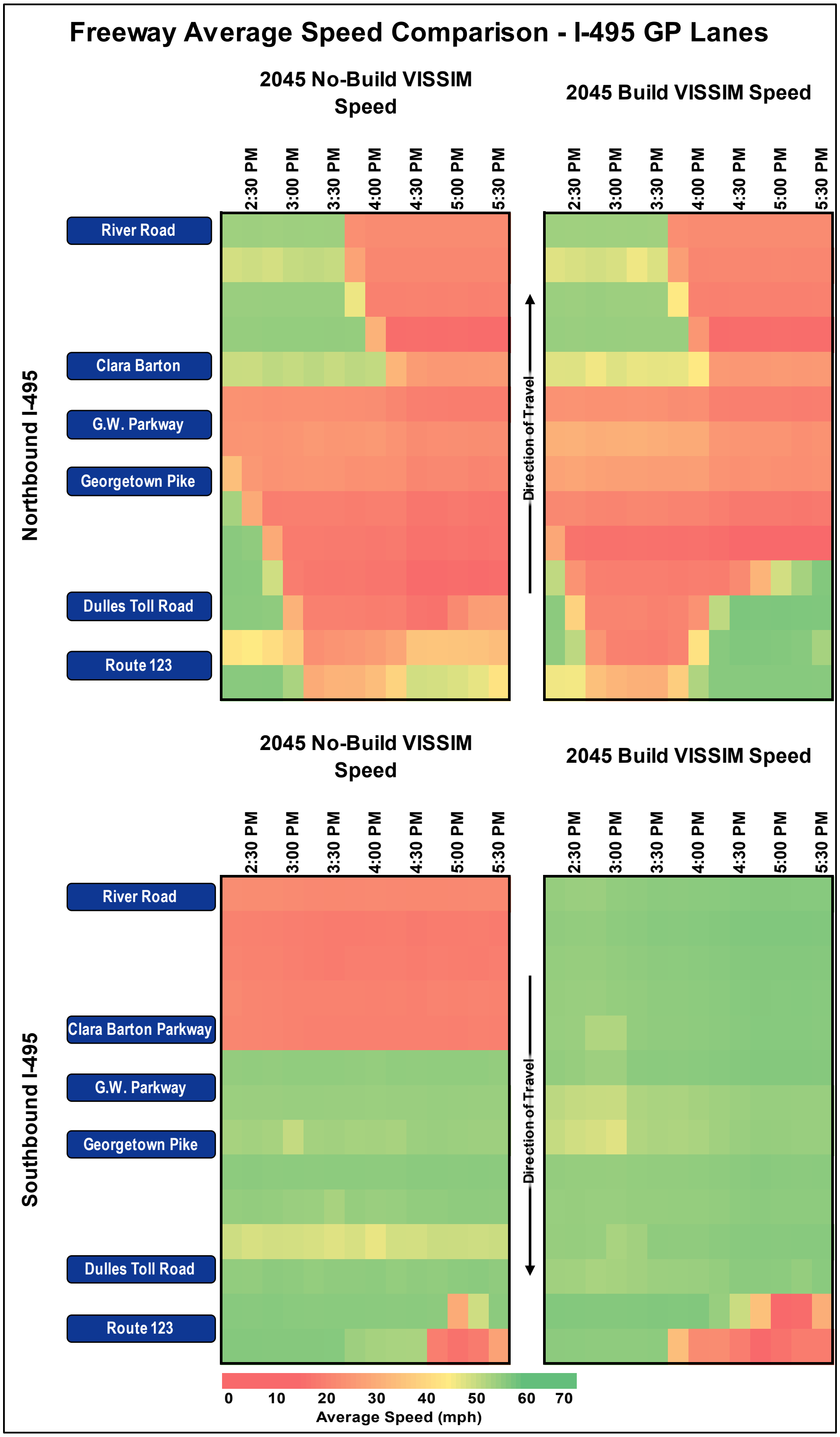


Figure 7-36: 2045 No Build and Build – PM Peak Period Average Speeds, I-495 GP Lanes

Travel Time

A comparison of PM peak period travel times for 2045 No Build and 2045 Build scenarios is shown in **Table 7-10**. Travel time measurements have been aggregated by direction of travel and facility type.

Table 7-10. 2045 PM Peak Period Travel Time Comparison

Route	GP Travel Times (Minutes: Seconds)		Express Lanes Travel Times (Minutes: Seconds)	
	2045 No Build	2045 Build	2045 No Build	2045 Build
Northbound I-495 (Route 123 to River Road)	28:18	23:42	15:59	5:39
Southbound I-495 (River Road to Route 123)	15:16	7:46	6:42	5:49
Eastbound Route 267 (Spring Hill Road to Route 123)	1:48	1:52	-	-
Westbound Route 267 (Route 123 to Spring Hill Road)	1:50	1:52	-	-

2045 Build PM peak period travel times improve or remain consistent as compared to No Build across all freeway facilities in the Traffic Operations Study Area.

- The average travel time in the northbound GP lanes improves by approximately 4.5 minutes (a 16 percent improvement). The majority of the travel time savings are south of GWMP, which is consistent with the speed results shown in the previous section.
- Vehicles traveling on the northbound Express Lanes see a 10-minute (65 percent) travel time improvement. The travel time improvement in the Build condition is between Lewisville Road and GWMP, where in the No Build condition, vehicles need to travel on the congested GP lanes.
- In the southbound direction, GP travel times in the Build improve by 7.5 minutes (49 percent improvement) and Express Lanes travel times improve by 1 minute (13 percent). Providing a continuous Express Lanes system, eliminating the merge from the terminus of the southbound Maryland managed lanes system, helps relieve the congestion.
- Along eastbound and westbound Route 267 (DTR), travel times are essentially identical between No Build and Build.

Simulated Volumes and Demand Served

Figure 7-37 shows the comparison of unserved demand (vehicular throughput as compared to vehicular demand) between No Build and Build conditions for the PM peak hour in the northbound direction. As can be seen in the figure, nearly all demand is served in the Build condition during the PM peak hour except for a small percentage near the Route 123, which likely represents demand from arterials being metered within the arterial network. In the No Build condition, the unserved demand is between 4 and 8 percent north of the Route 267 interchange due to the heavy congestion. The improved throughput in the Build condition can be attributed to the continuous Express Lanes system, which alleviates congestion and allows demand to be processed more quickly.

Figure 7-38 shows the comparison of unserved demand between No Build and Build conditions for the PM peak hour in the southbound direction. As can be seen in the figure, the percentage of unserved demand is lower in the Build scenario along the length of the corridor. The increased throughput in the Build condition can be attributed to the reduced congestion between Route 193 and Route 267 due to the new Express Lanes system being in place. The proposed project alleviates congestion in this segment, thus reducing the unserved demand. South of Route 267, congestion along I-495 and along arterials in Tysons constrains demand in both the No Build and Build condition, thus increasing the percentage of unserved demand.

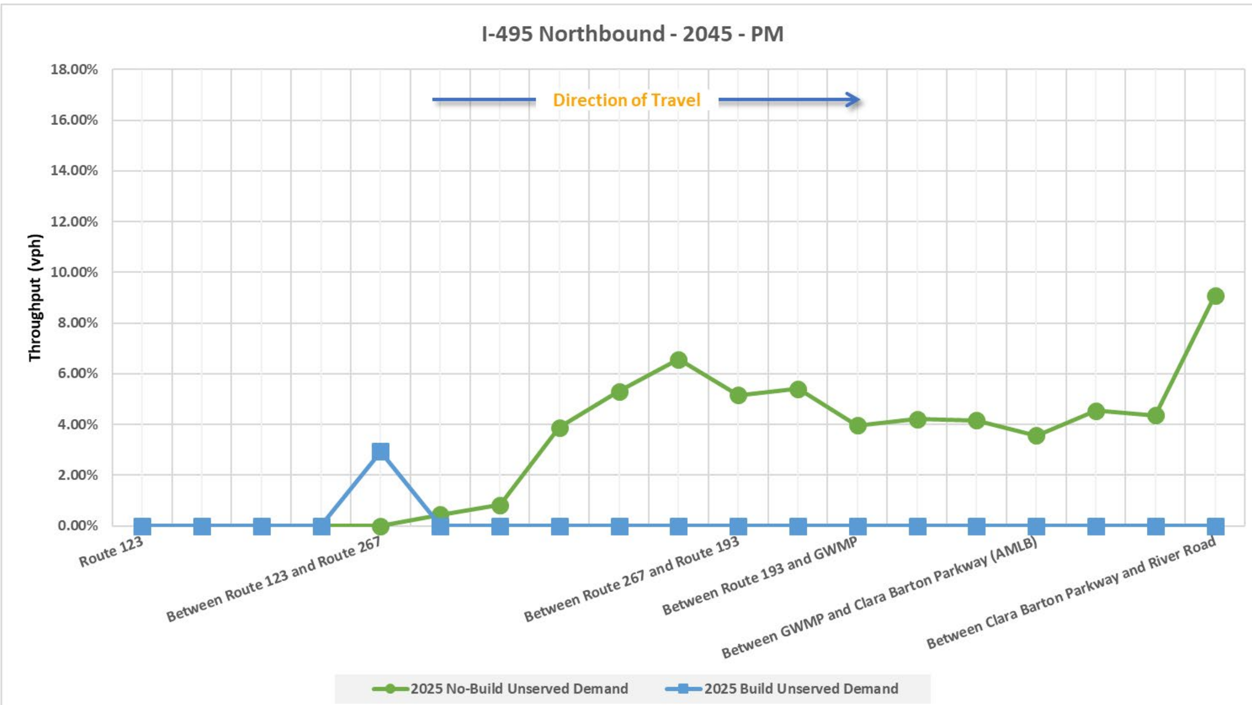


Figure 7-37. 2045 No Build and Build – PM Peak Hour Unserved Demand, I-495 Northbound

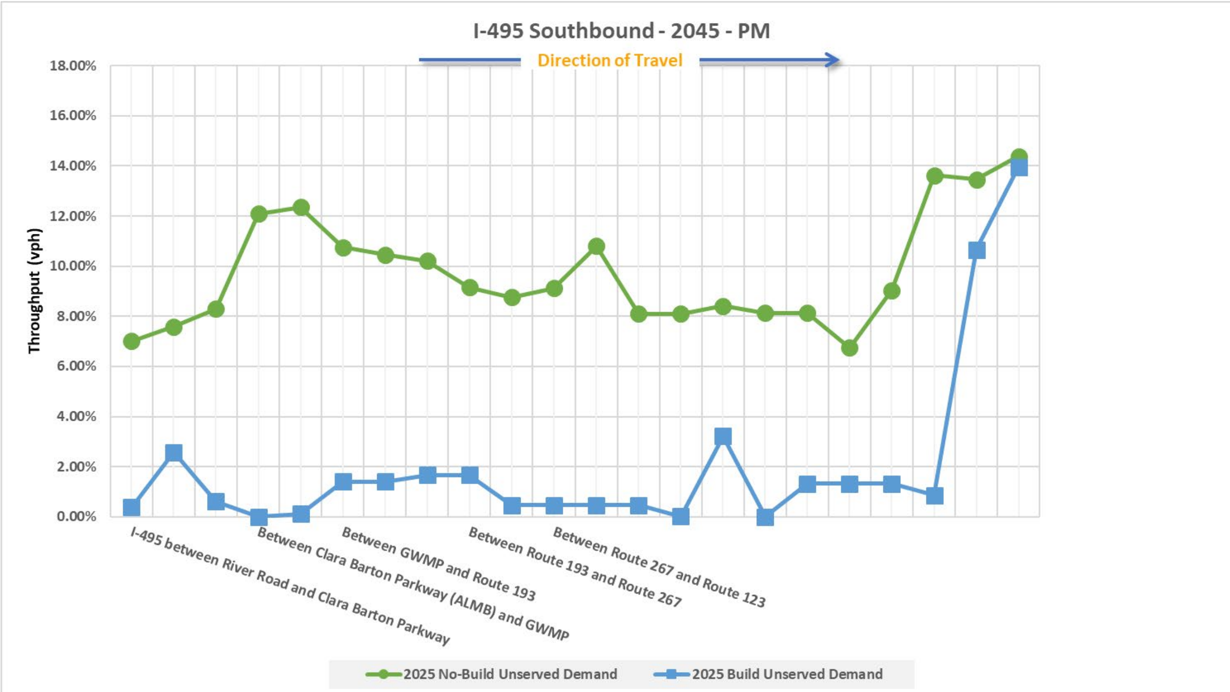


Figure 7-38. 2045 No Build and Build – PM Peak Hour Unserved Demand, I-495 Southbound

Person Throughput

Figure 7-39 and **Figure 7-40** display PM peak period person throughput along I-495 northbound and southbound, respectively (GP and Express combined). These figures show the estimated number of persons moved across a three-hour period based on simulated vehicle throughput and assumed vehicle occupancies for GP and Express Lanes. GP lanes are assumed to carry 1.1 persons per vehicle, based on the estimated non-HOV lane auto occupancy MWCOG has estimated across various interstate facilities in Northern Virginia (MWCOG, 2014). Express Lanes are assumed to carry 1.44 person per vehicle, based on a historic 18 percent HOV-3 utilization in the existing I-495 Express Lanes and assuming the remaining 82 percent of vehicles take on the non-HOV lane auto occupancy. These figures show that person throughput increases in the Build scenario across the length of the I-495 corridor in both directions due to the added capacity from the Express Lanes and increased occupancy of vehicles in those lanes.

- In the northbound direction, the highest person throughputs are across the ALMB. Increases in throughput from No Build to Build range from 10 to 35 percent, with the greatest increase in the segments between Route 267 and GWMP where the new Express Lanes significantly add capacity.
- In the southbound direction, the highest person throughputs are again across the ALMB. Increases in throughput from No Build to Build range from 16 to 32 percent, with the greatest increases again in the segments between GWMP and Route 267 where the new Express Lanes significantly add capacity.

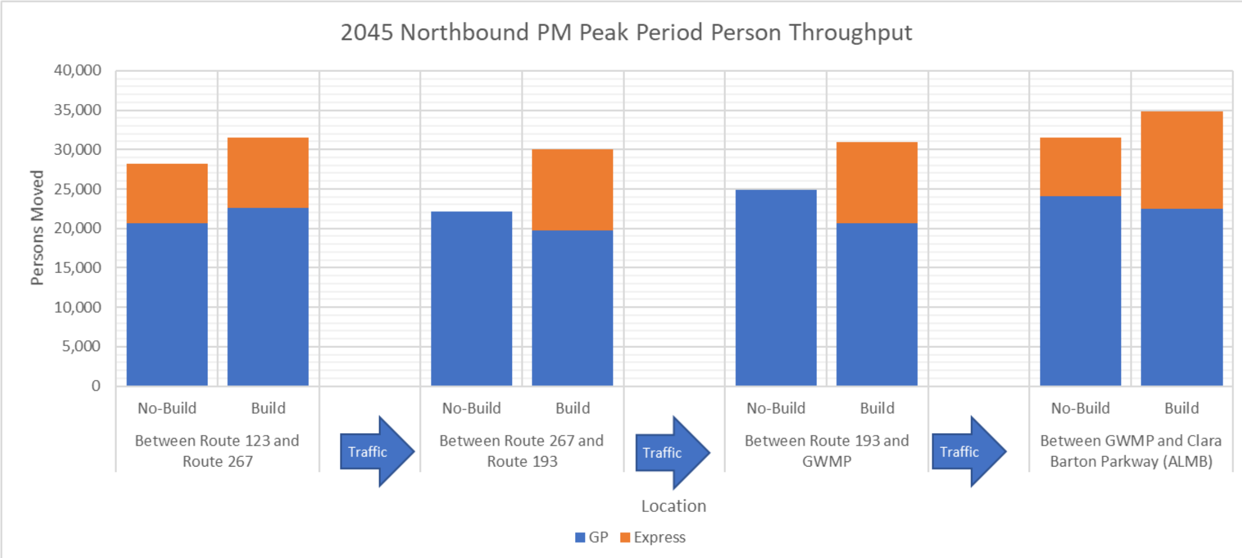


Figure 7-39. 2045 No Build and Build – PM Peak Period Person Throughput, I-495 Northbound

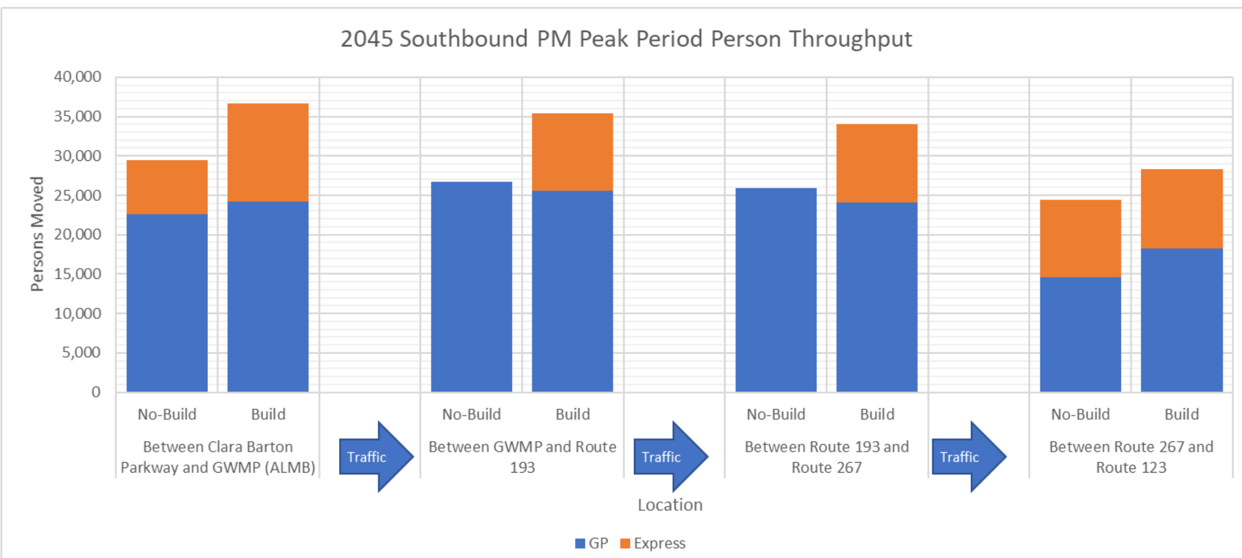


Figure 7-40. 2045 No Build and Build – PM Peak Period Person Throughput, I-495 Southbound

7.3.4 2045 No Build vs. Build Arterial Operations

AM Arterial Operations

Intersections Evaluated in VISSIM

Intersections in the Traffic Operations Study Area evaluated in VISSIM generally see improved operations in the 2045 AM peak hour under Build conditions as compared to No Build conditions. **Figure 7-41** provides pie charts of overall intersection HCM-analogous LOS for No Build and Build conditions. The figure shows that, in the Build condition, a lower percentage of intersections are failing (29 percent versus 33 percent) and a higher percentage of intersections are operating at an acceptable LOS (A to D; 58 percent versus 48 percent).

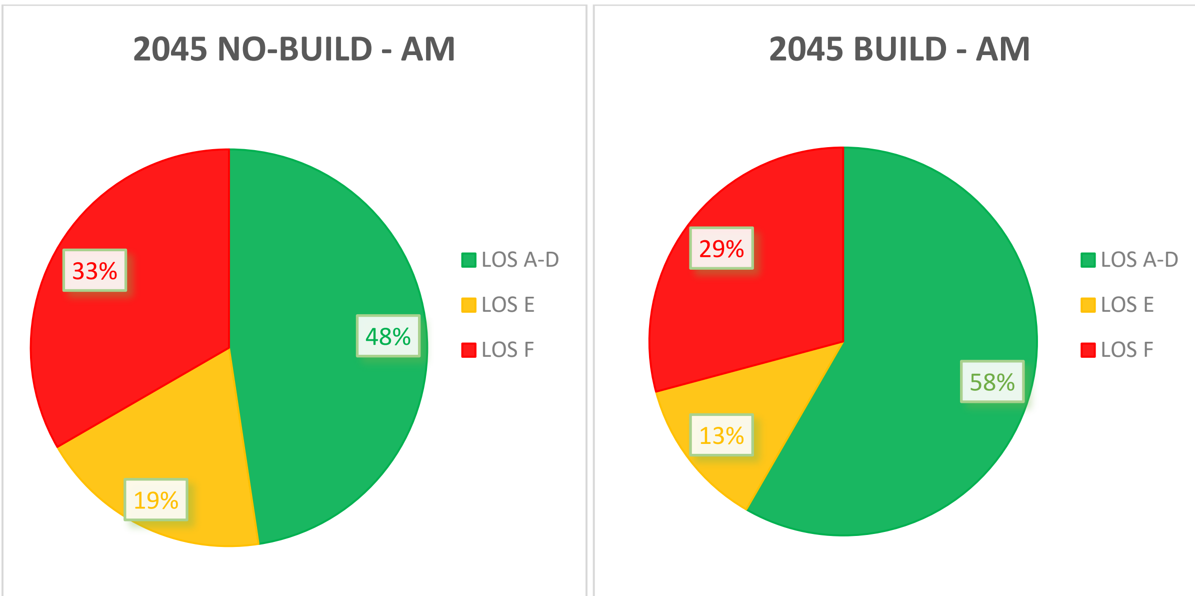


Figure 7-41. Summary of Arterial HCM-Analogous LOS, 2045 AM No Build vs. Build Conditions

Table 7-11 compares the overall intersection HCM-analogous LOS between the two scenarios for each intersection. A detailed breakdown of intersection delay and LOS, including delay and LOS by approach, is provided in **Appendix H.**

The following signalized intersections operate under failing conditions under both 2045 No Build and Build conditions:

- Route 123 and Lewinsville Road/Great Falls Street
- Lewinsville Road and Balls Hil. Road
- Spring Hill Road and Dulles Toll Road eastbound ramps

All three of these intersections are in the Tysons area and see continued growth in demand tied to commercial and residential growth in Tysons.

The following intersections are failing under No Build conditions but see improved operations (LOS E or better) under Build conditions:

- Route 123 and Capital One Tower Drive / Old Meadow Road
- Route 123 and Route 267 eastbound off-ramp / Anderson Road
- Jones Branch Connector and Express Lanes ramps

These improvements are likely attributable to improved operations along Route 123. New traffic signals are proposed in the Build condition with the off-ramps from I-495; coordination among these signals improves operations in the Build condition. Note that heavy arterial congestion is still observed along arterials in Tysons in the Build condition, including along several side street approaches.

In the Build condition, some arterial locations experience a deterioration in operations due to improved throughput from freeways that were previously metered in the No Build condition. This is most prevalent along Spring Hill Road near its interchange with Route 267, where the intersections of Spring Hill Road with the Dulles Toll Road westbound ramps and with Lewinsville Road are both failing in the Build condition. While demand for these intersections is not forecasted to change significantly between the No Build and Build conditions, throughput from upstream locations (such as I-495 southbound) is not constrained upstream in the Build condition.

The unsignalized intersection of Route 193 and Helga Place/Linganore Drive is failing under both 2045 No Build and Build conditions due to heavy delays on the southbound approach; this stop-controlled approach sees few gaps for traffic to enter the mainline Route 193 traffic stream due to heavy congestion in along eastbound Route 193 (spilling back from the northbound on-ramp to I-495). In the Build scenario, this eastbound congestion along Route 193 is relieved due to improved operations along northbound I-495, which reduces queue spillback on the on-ramp from Route 193. This is also reflected in the improved operations in the Build condition at all three signalized intersections along Route 193, most notably at the intersection with Balls Hill Road, where the northbound approach sees a significant improvement in operations.

Table 7-11. VISSIM Intersection Microsimulation Delay and HCM-Analogous LOS – 2045 No Build vs. Build AM Peak Hour

Intersection Control	Intersection	2045 No-Build		2045 Build	
		Intersection Microsimulation Delay (s/veh)	Intersection HCM-Analogous LOS	Intersection Microsimulation Delay (s/veh)	Intersection HCM-Analogous LOS
Signalized	Route 123 and Tysons Boulevard	45.4	D	29.5	C
Signalized	Westpark Drive and Tysons Connector	31.8	C	35.2	D
Signalized	Tysons Connector and Express Lanes Ramps	24.0	C	26.5	C
Signalized	Route 123 and EB DTR/SB I-495 C-D Road	*	*	14.6	B
Signalized	Route 123 and NB I-495 Ramp	*	*	43.2	D
Signalized	Route 123 and Capital One Tower Drive/ Old Meadow Road	105.9	F	69.8	E
Signalized	Route 123 and Scotts Crossing Boulevard/ Colshire Drive	55.4	E	71.3	E
Signalized	Route 123 and Route 267 Eastbound Off-Ramp/ Anderson Road	145.6	F	79.3	E

Intersection Control	Intersection	2045 No-Build		2045 Build	
		Intersection Microsimulation Delay (s/veh)	Intersection HCM-Analogous LOS	Intersection Microsimulation Delay (s/veh)	Intersection HCM-Analogous LOS
Signalized	Route 123 & Route 267 Eastbound On-Ramp	*	*	155.7	F
Signalized	Route 123 and Lewinsville Road/ Great Falls Street	211.0	F	234.3	F
Signalized	Lewinsville Road and Balls Hill Road	102.8	F	90.6	F
Signalized	Jones Branch Drive and Jones Branch Connector	19.3	B	18.9	B
Signalized	Jones Branch Connector and Express Lanes Ramps	100.2	F	33.5	C
Signalized	Jones Branch Drive and Capital One (West)	36.1	D	35.6	D
Signalized	Jones Branch Drive and Capital One (East)	26.0	C	26.5	C
Signalized	International Drive and Spring Hill Road/ Jones Branch Drive	45.7	D	45.8	D
Signalized	Spring Hill Road and Dulles Toll Road Eastbound Ramps	123.0	F	217.9	F
Signalized	Spring Hill Road and Dulles Toll Road Westbound Ramps	26.2	C	85.7	F
Signalized	Spring Hill Road and Lewinsville Road	57.2	E	138.7	F
Unsignalized	Route 193 and Helga Place/ Linganore Drive	231.7	F	72.7	F
Signalized	Route 193 and I-495 Southbound Ramps	40.2	D	39.1	D
Signalized	Route 193 and I-495 Northbound Ramps	69.1	E	54.8	D
Signalized	Route 193 and Balls Hill Road	59.7	E	25.1	C
Unsignalized	Route 193 and Dead Run Drive	14.3	B	14.3	B

*This intersection is not provided under the No Build conditions.

<u>Intersections Evaluated in Synchro</u>

The expanded arterial network beyond intersections immediately adjacent to freeway interchanges in the corridor was evaluated solely through Synchro. **Table 7-12** compares the overall intersection delay and LOS between the two scenarios for each intersection.

Under both No Build and Build conditions, the following intersections are failing:

- Old Dominion Drive and Balls Hill Road (signalized)
- Route 193 and Swinks Mill Road (unsignalized)
- Route 193 and Douglass Drive (unsignalized)

Note that under Build conditions, while the two unsignalized intersections along Route 193 are experiencing failing conditions due to significant delays on stop-controlled approaches, a significant reduction in delay is achieved as compared to No Build conditions. This is consistent with the VISSIM findings at adjacent intersections along the Route 193 corridor, where operations improve significantly in the Build condition.

Table 7-12. 2045 Synchro Intersection Delay and LOS – 2045 No Build vs. Build AM Peak Hour

Intersection Control	Intersection Name	2045 No-Build AM		2045 Build AM	
		Intersection Delay (Sec/veh)	LOS	Intersection Delay (Sec/veh)	LOS
Signalized	Old Dominion Drive at Spring Hill Road	11.3	B	11.2	B
Signalized	Old Dominion Drive at Swinks Mill Road	15.6	B	14.6	B
Signalized	Old Dominion Drive at Balls Hill Road	97.1	F	87.0	F
Signalized	Route 123 at Old Dominion Drive	48.8	D	45.0	D
Unsignalized	Route 193 at Swinks Mill Road	187.8	F	59.3	F
Unsignalized	Route 193 at Spring Hill Road	23.9	C	23.5	C
Unsignalized	Lewinsville Road at Swinks Mill Road	2.6	A	2.6	A
Unsignalized	Route 123 at Ingleside Avenue	22.8	C	23.2	C
Unsignalized	Douglass Drive at Route 193	478.6	F	236.7	F

Figure 7-42 provides a summary comparison of overall intersection delay for Build conditions as compared to No Build conditions at each intersection in the Traffic Operations Study Area for the 2045 AM scenario. The figure shows whether an intersection shows an improvement in operations (increase in LOS in Build conditions if below LOS D for No Build conditions, or a significant reduction in delay if still operating at LOS F in Build conditions), a degradation in operations (decrease in LOS in Build conditions or significant increase in delay if operating at LOS F already in No Build conditions), or if operations remain generally consistent between the two scenarios.

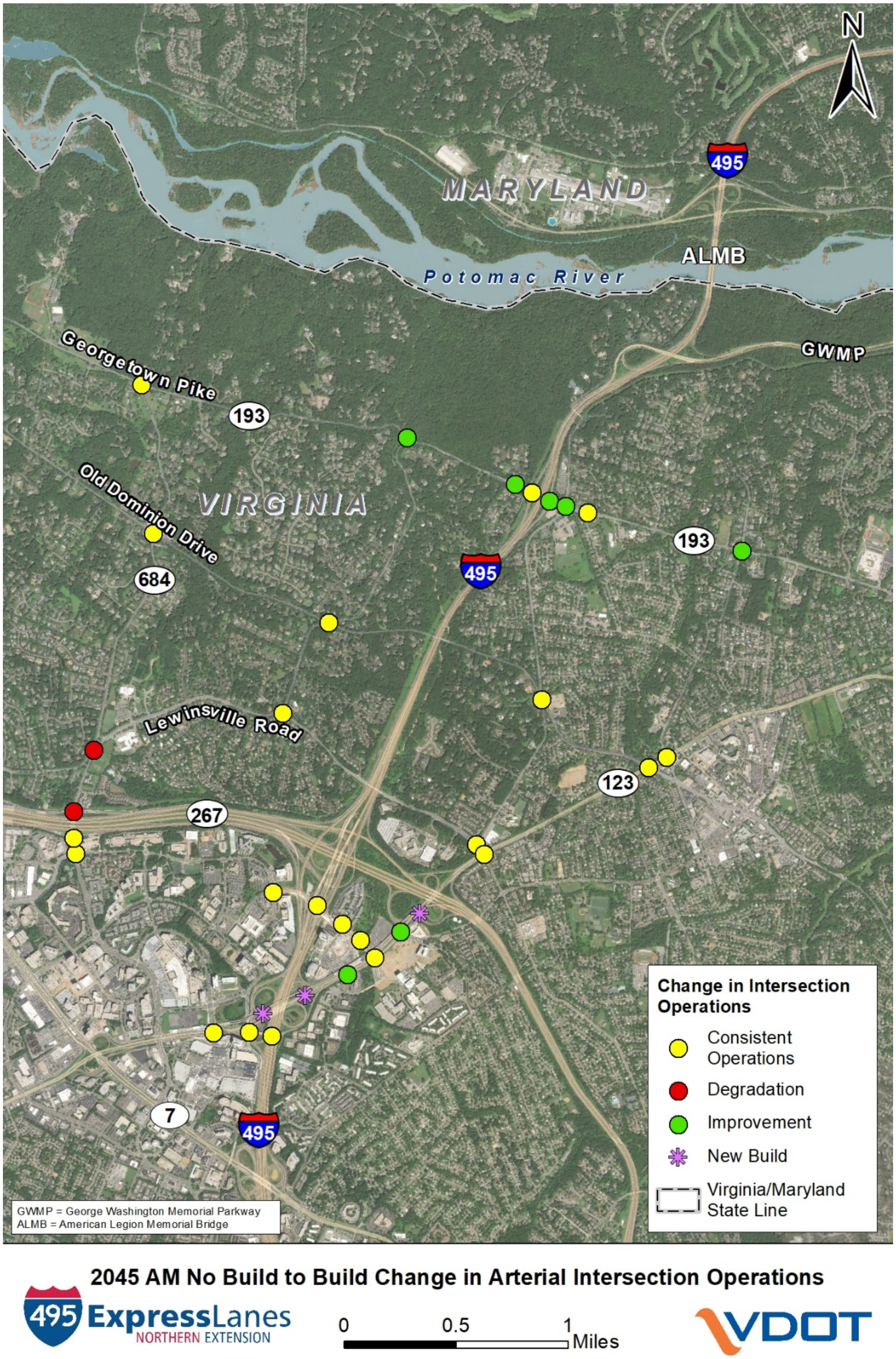


Figure 7-42. 2045 AM No Build to Build Change in Arterial Intersection Operations

PM Arterial Operations

Intersections Evaluated in VISSIM

Intersections in the Traffic Operations Study Area evaluated in VISSIM generally see improved operations in the 2045 PM peak hour under Build conditions as compared to No Build conditions. **Figure 7-43** provides pie charts of overall intersection HCM-analogous LOS for No Build and Build conditions. The figure shows that, in the Build condition, a lower percentage of intersections are failing (33 percent versus 43 percent) and a higher percentage of intersections are operating at an acceptable LOS (A to D; 46 percent versus 33 percent).

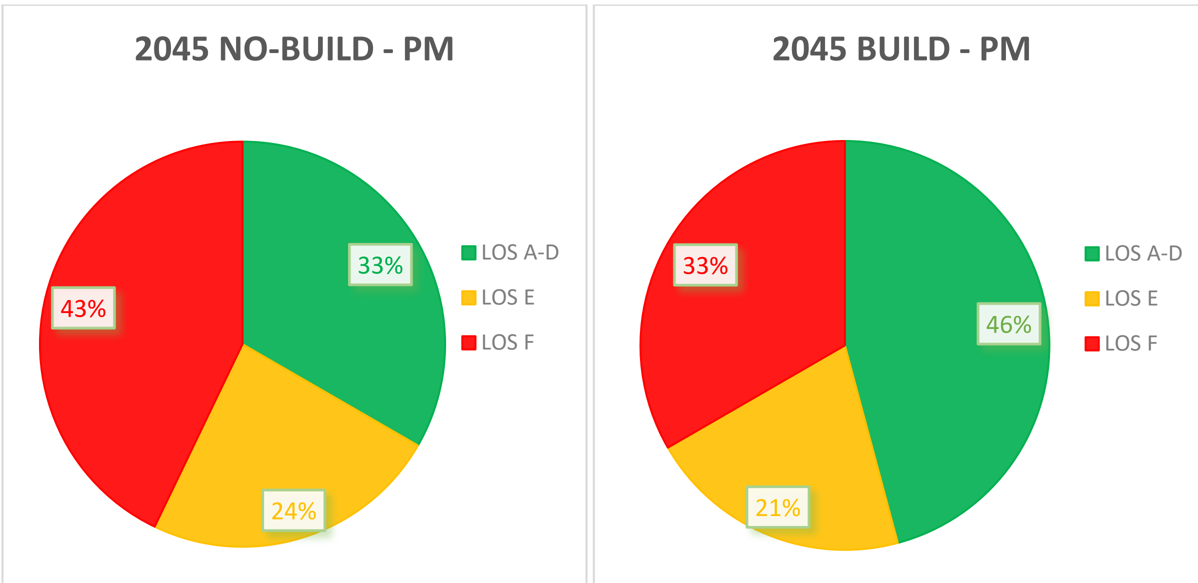


Figure 7-43. Summary of Arterial HCM-Analogous LOS, 2045 PM No Build vs. Build Conditions

Table 7-13 compares the overall intersection HCM-analogous LOS between the two scenarios for each intersection. A detailed breakdown of intersection delay and LOS, including delay and LOS by approach, is provided in **Appendix H.**

The following signalized intersections operate under failing conditions under both 2045 No Build and Build conditions:

- Route 123 and Tysons Boulevard
- Route 123 and Route 267 eastbound off-ramp / Anderson Road
- Route 123 and Lewinsville Road/Great Falls Street
- Lewinsville Road and Balls Hill Road
- Jones Branch Connector and I-495 Express Lanes ramps
- Jones Branch Connector and Capital One driveway (West)

All of these intersections are in the Tysons area and see continued growth in demand tied to commercial and residential growth in Tysons.

The following signalized intersections are failing under No Build conditions but see improved operations (LOS E or better) under Build conditions:

- Route 123 and Capital One Tower Drive / Old Meadow Road

- Route 123 and Scotts Crossing Boulevard / Colshire Drive
- Jones Branch Connector and Express Lanes ramps

These improvements are likely attributable to improved operations along Route 123. New traffic signals are proposed in the Build condition with the off-ramps from I-495; coordination among these signals improves operations in the Build condition. Note that heavy arterial congestion is still observed along arterials in Tysons in the Build condition, including along several side street approaches.

In the Build condition, some arterial locations experience a deterioration in operations due to improved throughput from freeways that were previously metered in the No Build condition. This is most prevalent along the Jones Branch Connector / Scotts Crossing Boulevard, where three intersections are failing in the Build condition. While demand for these intersections is not forecasted to change significantly between the No Build and Build conditions, throughput from upstream locations (such as I-495 southbound) is not constrained upstream in the Build condition.

The unsignalized intersection of Route 193 and Helga Place/Linganore Drive is failing under 2045 No Build conditions due to heavy delays on the southbound approach; this stop-controlled approach sees few gaps for traffic to enter the mainline Route 193 traffic stream due to heavy congestion in along eastbound Route 193 (spilling back from the northbound on-ramp to I-495). In the Build scenario, this eastbound congestion along Route 193 is relieved due to improved operations along northbound I-495, which reduces queue spillback on the on-ramp from Route 193. Along Route 193, the signalized intersections all operate at LOS E or better under No Build and Build conditions; in the Build condition, a significant improvement in operations is realized along the northbound approach from Balls Hill Road at Route 193, which is failing under No Build conditions.

Table 7-13. VISSIM Intersection Microsimulation Delay and HCM-Analogous LOS – 2045 No Build vs. Build PM Peak Hour

Intersection Control	Intersection	2045 No-Build		2045 Build	
		Intersection Microsimulation Delay (s/veh)	Intersection HCM-Analogous LOS	Intersection Microsimulation Delay (s/veh)	Intersection HCM-Analogous LOS
Signalized	Route 123 and Tysons Boulevard	206.0	F	209.9	F
Signalized	Westpark Drive and Tysons Connector	15.8	B	18.8	B
Signalized	Tysons Connector and Express Lanes Ramps	13.8	B	13.7	B
Signalized	Route 123 and EB DTR/SB I-495 C-D Road	*	*	6.9	A
Signalized	Route 123 and NB I-495 Ramp	*	*	23.7	C
Signalized	Route 123 and Capital One Tower Drive/ Old Meadow Road	80.2	F	77.5	E
Signalized	Route 123 and Scotts Crossing Boulevard/ Colshire Drive	80.3	F	71.4	E

Intersection Control	Intersection	2045 No-Build		2045 Build	
		Intersection Microsimulation Delay (s/veh)	Intersection HCM-Analogous LOS	Intersection Microsimulation Delay (s/veh)	Intersection HCM-Analogous LOS
Signalized	Route 123 and Route 267 Eastbound Off-Ramp/ Anderson Road	192.9	F	89.3	F
Signalized	Route 123 & EB DTR Ramps	*	*	198.6	F
Signalized	Route 123 and Lewinsville Road/ Great Falls Street	230.1	F	260.2	F
Signalized	Lewinsville Road and Balls Hill Road	168.7	F	212.1	F
Signalized	Jones Branch Drive and Jones Branch Connector	76.6	E	143.9	F
Signalized	Jones Branch Connector and Express Lanes Ramps	132.6	F	138.0	F
Signalized	Jones Branch Drive and Capital One (West)	93.5	F	99.5	F
Signalized	Jones Branch Drive and Capital One (East)	72.3	E	70.7	E
Signalized	International Drive and Spring Hill Road/ Jones Branch Drive	47.6	D	51.4	D
Signalized	Spring Hill Road and Dulles Toll Road Eastbound Ramps	21.6	C	23.6	C
Signalized	Spring Hill Road and Dulles Toll Road Westbound Ramps	31.6	C	38.1	D
Signalized	Spring Hill Road and Lewinsville Road	67.2	E	69.1	E
Unsignalized	Route 193 and Helga Place/ Linganore Drive	125.6	F	15.9	C
Signalized	Route 193 and I-495 Southbound Ramps	24.5	C	21.6	C
Signalized	Route 193 and I-495 Northbound Ramps	60.3	E	63.6	E
Signalized	Route 193 and Balls Hill Road	40.7	D	18.4	B
Unsignalized	Route 193 and Dead Run Drive	40.6	E	13.8	B

*This intersection is not provided under the No Build conditions.

Intersections Evaluated in Synchro

The expanded arterial network beyond intersections immediately adjacent to freeway interchanges in the corridor was evaluated solely through Synchro. **Table 7-14** compares the overall intersection delay and LOS between the two scenarios for each intersection.

Under both No Build and Build conditions, the following intersections are failing:

- Old Dominion Drive and Balls Hill Road (signalized)
- Route 193 and Douglass Drive (unsignalized)

These same two intersections are failing in the 2045 AM peak hour under both No Build and Build conditions. Note that under Build conditions, while the intersection of Route 193 and Douglass Drive is still failing, a significant reduction in delay is achieved as compared to No Build conditions.

Table 7-14. 2045 Synchro Intersection Delay and LOS – 2045 No Build vs. Build PM Peak Hour

Intersection Control	Intersection Name	2045 No-Build PM		2045 Build PM	
		Intersection Delay (Sec/veh)	LOS	Intersection Delay (Sec/veh)	LOS
Signalized	Old Dominion Drive at Spring Hill Road	11.0	B	9.9	A
Signalized	Old Dominion Drive at Swinks Mill Road	11.7	B	10.1	B
Signalized	Old Dominion Drive at Balls Hill Road	209.9	F	174.6	F
Signalized	Route 123 at Old Dominion Drive	35.2	D	36.4	D
Unsignalized	Route 193 at Swinks Mill Road	25.8	D	18.1	C
Unsignalized	Route 193 at Spring Hill Road	20.1	C	19.6	C
Unsignalized	Lewinsville Road at Swinks Mill Road	2.6	A	2.6	A
Unsignalized	Route 123 at Ingleside Avenue	28.5	D	26.1	D
Unsignalized	Douglass Drive at Route 193	898.5	F	513.1	F

Figure 7-44 provides a summary comparison of overall intersection delay for Build conditions as compared to No Build conditions at each intersection in the Traffic Operations Study Area for the 2045 AM scenario. The figure shows whether an intersection shows an improvement in operations (increase in LOS in Build conditions if below LOS D for No Build conditions, or a significant reduction in delay if still operating at LOS F in Build conditions), a degradation in operations (decrease in LOS in Build conditions or significant increase in delay if operating at LOS F already in No Build conditions), or if operations remain generally consistent between the two scenarios.

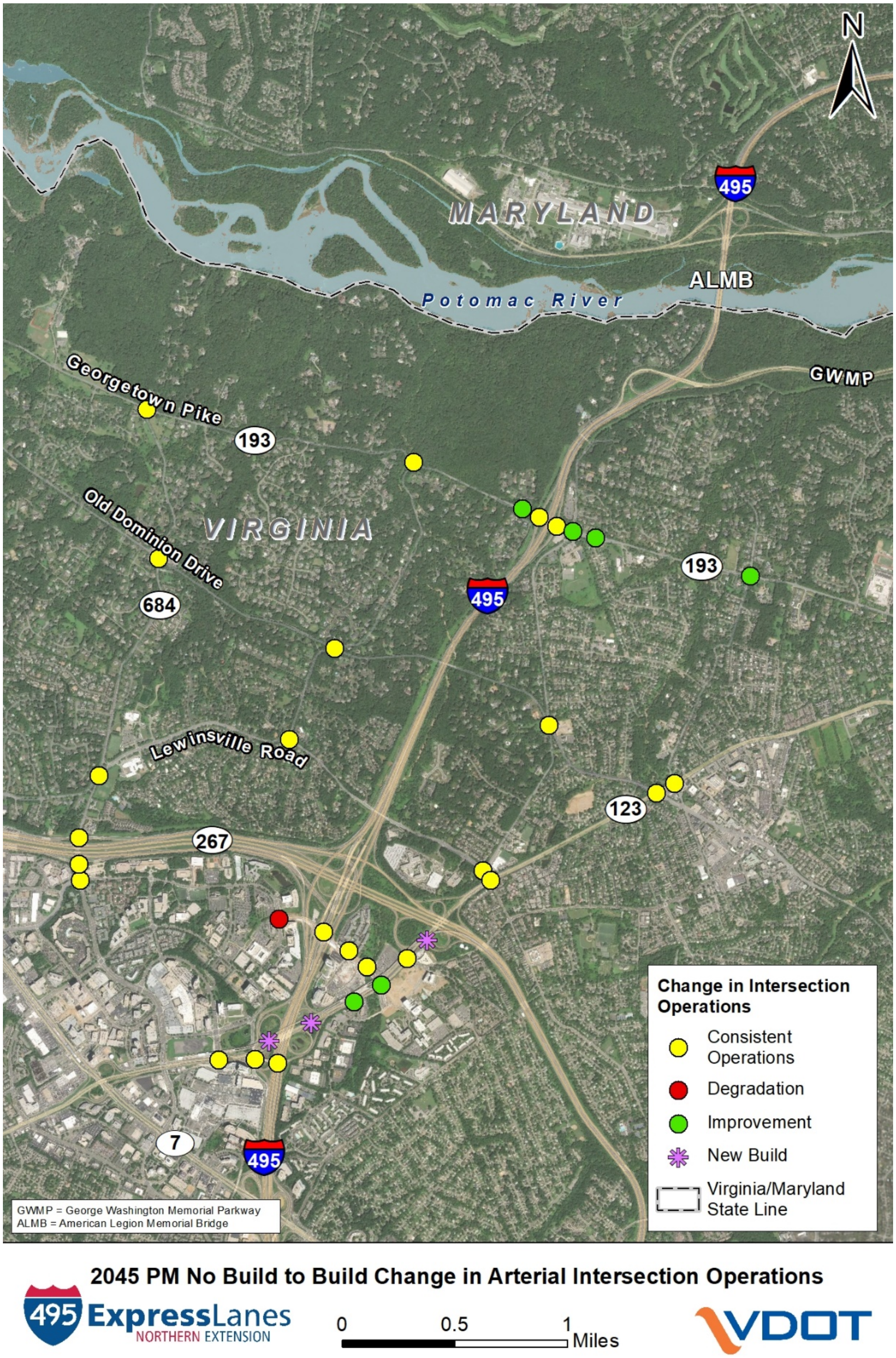


Figure 7-44. 2045 PM No Build to Build Change in Arterial Intersection Operations

7.3.5 Summary of 2045 Operations

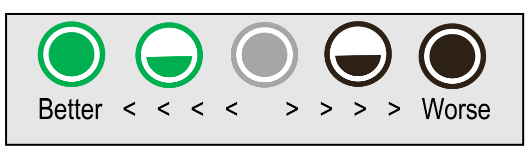
2045 AM Peak Period Summary

- Total demand along I-495 (GP plus Express) is forecasted to increase in the Build scenario along the length of the I-495 corridor. The greatest increases in demand are in the segments between Route 267 and GWMP, where Express Lanes are only present in the Build scenario and thus represent a substantial capacity increase from No Build conditions. Peak hour volumes are forecasted to increase in the Build scenario by between 3 to 11 percent in the northbound direction and between 4 to 6 percent in the southbound direction.
- In the northbound direction along the I-495 GP lanes, congestion is observed under No Build conditions between Route 267 and Clara Barton Parkway (across the ALMB) due to heavy merging and weaving volumes on and near the bridge. Under Build conditions, a significant reduction in congestion is observed due to the additional capacity provided by the Express Lanes and the reduced weaving due to the continuity of the Express Lanes. The average travel time in the northbound GP lanes improves by approximately 4 minutes (a 33 percent improvement) in the Build condition.
- In the southbound direction along the I-495 GP lanes, severe congestion is observed under No Build conditions north of Route 193 through the northern extents of the Traffic Operations Study Area due to queue spillback from the merge at the southern Terminus of the Maryland managed lanes system. This congestion is significantly alleviated under Build conditions. The average travel time in the southbound GP lanes improves by nearly 9 minutes (a 54 percent improvement).
- Both directions of the Express Lanes operate at or near the posted speed limit, with the exceptions of the termini segments in the No Build conditions which much merge into the GP lanes. To travel the length of the corridor via Express Lanes under No Build conditions, vehicles must utilize the congested GP lanes between Route 267 and GWMP, as Express Lanes are not present.
- Along eastbound Route 267 (DTR) there is 75 percent improvement in travel time. With the improved operations along northbound I-495, the ramp from eastbound DTR to northbound I-495 does not spill back to eastbound DTR, improving operations along eastbound DTR. Travel times along the westbound DTR remain unchanged.
- Over the course of the AM peak period, total persons moved along I-495 are forecasted to increase from No Build to Build conditions by between 6 and 33 percent in the northbound direction and between 29 and 35 percent in the southbound direction, depending upon location along the corridor.
- Arterial intersection operations see an improvement under Build conditions, as the percentage of intersections operating at failing conditions drops from 33 percent (No Build) to 29 percent (Build), and more than half of all intersections are LOS D or better in the Build condition, while only 48 percent are at LOS D or better in the No Build condition. Most of the failing intersections are in the Tysons area and see continue growth in demand tied to commercial and residential growth in Tysons. Improved arterial operations are observed along Route 193, most notably at the intersection with Balls Hill Road, where the northbound approach sees a significant improvement in operations.

Table 7-15 presents an overall performance comparison table for the Build alternative versus the No Build alternative for 2045 AM conditions. The table shows that the Build alternative improves overall operations along the I-495 corridor given the improvement in travel times, reduction in congestion, and increase in persons moved.

Table 7-15. Overall Performance Comparison for 2045 AM No Build and Build Alternative

Measure of Effectiveness	Description	Facility	2025 AM No Build Value	2025 AM Build Value	Build Performance Compared to No Build
Travel Times	End-to-end travel time along the facility through the Traffic Operations Study Area, measured in Minutes	I-495 NB GP	12	8	● (green)
		I-495 NB Express	10	6	● (green)
		I-495 SB GP	16	8	● (green)
		I-495 SB Express	8	6	● (green)
		Dulles Toll Road EB	7	2	● (green)
		Dulles Toll Road WB	2	2	● (gray)
Extent and Duration of Congestion	Visual assessment of freeway mainline queue length and duration of congestion	I-495 NB GP			● (green)
		I-495 SB GP			● (green)
Person Throughput	Additional persons moved during peak period of Build condition and percentage increase	I-495 NB (All)	+9,300 (33%)		● (green)
		I-495 SB (All)	+9,600 (35%)		● (green)
Arterial Operations	Number of intersections operating at LOS F	Entire Study Area	10	10	● (gray)
	Number of intersections operating at LOS D or better		16	20	● (green)

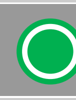
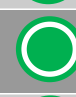


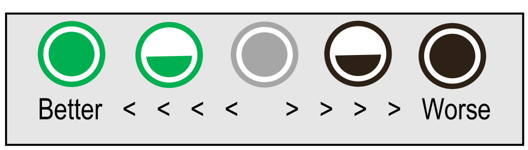
2045 PM Peak Period Summary

- Total demand along I-495 (GP plus Express) is forecasted to increase in the Build scenario along the length of the I-495 corridor. The greatest increases in demand are in the segments between Route 267 and GWMP, where Express Lanes are only present in the Build scenario and thus represent a substantial capacity increase from No Build conditions. Peak hour volumes are forecasted to increase in the Build scenario by between 3 to 20 percent in the northbound direction and between 7 to 12 percent in the southbound direction.
- In the northbound direction along the I-495 GP lanes, severe congestion is observed under No Build conditions spilling back from the ALMB through the Route 267 interchange and essentially through the extents of the Traffic Operations Study Area; this congestion is worsened by spillback from the northbound GP lanes in Maryland later in the peak period, creating a single continuous area of congestion through the corridor. In the Build condition, the congestion in Maryland remains generally unchanged, but the extent of the queue spillback and duration on the Virginia side, especially south of Route 193, is not as significant as the No Build condition. This is attributable to the additional capacity provided by the Express Lanes and reduced weaving due to the continuity of the Express Lanes system. The average travel time in the northbound GP lanes improves by approximately 4.5 minutes (a 16 percent improvement) in the Build condition.
- In the southbound direction along the I-495 GP lanes, severe congestion is observed under No Build conditions north of Route 193 through the northern extents of the Traffic Operations Study Area due to queue spillback from the merge at the southern Terminus of the Maryland managed lanes system. This congestion is significantly alleviated under Build conditions. The average travel time in the southbound GP lanes improves by approximately 7.5 minutes (a 49 percent improvement).
- Both directions of the Express Lanes operate at or near the posted speed limit, with the exceptions of the termini segments in the No Build conditions which much merge into the GP lanes. To travel the length of the corridor via Express Lanes under No Build conditions, vehicles must utilize the congested GP lanes between Route 267 and GWMP as Express Lanes are not present.
- Along eastbound and westbound Route 267 (DTR), travel times are essentially identical between No Build and Build.
- Over the course of the PM peak period, total persons moved along I-495 are forecasted to increase from No Build to Build conditions by between 10 and 35 percent in the northbound direction and between 16 and 32 percent in the southbound direction, depending upon location along the corridor.
- Arterial intersection operations see an improvement under Build conditions, as the percentage of intersections operating at failing conditions drops from 43 percent (No Build) to 33 percent (Build), and 46 percent of intersections are LOS D or better in the Build condition, while only 33 percent are at LOS D or better in the No Build condition. Most of the failing intersections are in the Tysons area and see continue growth in demand tied to commercial and residential growth in Tysons. Along Route 193, the signalized intersections all operate at LOS E or better under No Build and Build conditions; in the Build condition, a significant improvement in operations is realized along the northbound approach from Balls Hill Road at Route 193, which is failing under No Build conditions.

Table 7-16 presents an overall performance comparison table for the Build alternative versus the No Build alternative for 2045 PM conditions. The table shows that the Build alternative improves overall operations along the I-495 corridor given the improvement in travel times, reduction in congestion, and increase in persons moved. Arterial operations are also shown to improve in the PM peak hour under the Build alternative.

Table 7-16. Overall Performance Comparison for 2045 PM No Build and Build Alternative

Measure of Effectiveness	Description	Facility	2025 AM No Build Value	2025 AM Build Value	Build Performance Compared to No Build
Travel Times	End-to-end travel time along the facility through the Traffic Operations Study Area, measured in Minutes	I-495 NB GP	28	24	
		I-495 NB Express	16	6	
		I-495 SB GP	15	8	
		I-495 SB Express	7	6	
		Dulles Toll Road EB	2	2	
		Dulles Toll Road WB	2	2	
Extent and Duration of Congestion	Visual assessment of freeway mainline queue length and duration of congestion	I-495 NB GP			
		I-495 SB GP			
Person Throughput	Additional persons moved during peak period of Build condition and percentage increase	I-495 NB (All)	+7,800 (35%)		
		I-495 SB (All)	+8,700 (32%)		
Arterial Operations	Number of intersections operating at LOS F	Entire Study Area	11	10	
	Number of intersections operating at LOS D or better		14	18	



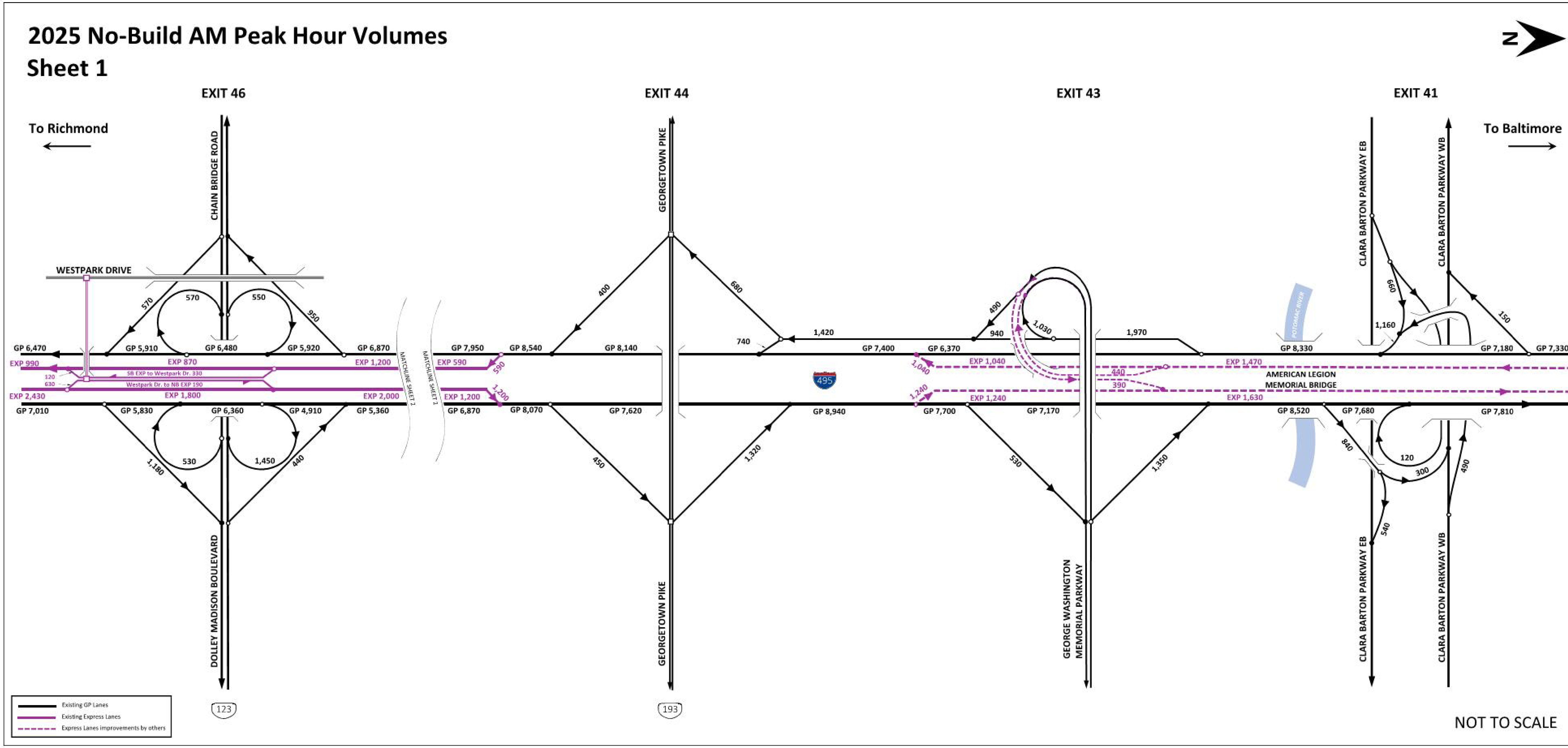


Exhibit 7-1a. Freeway 2025 No Build AM Peak Hour Volume – I-495

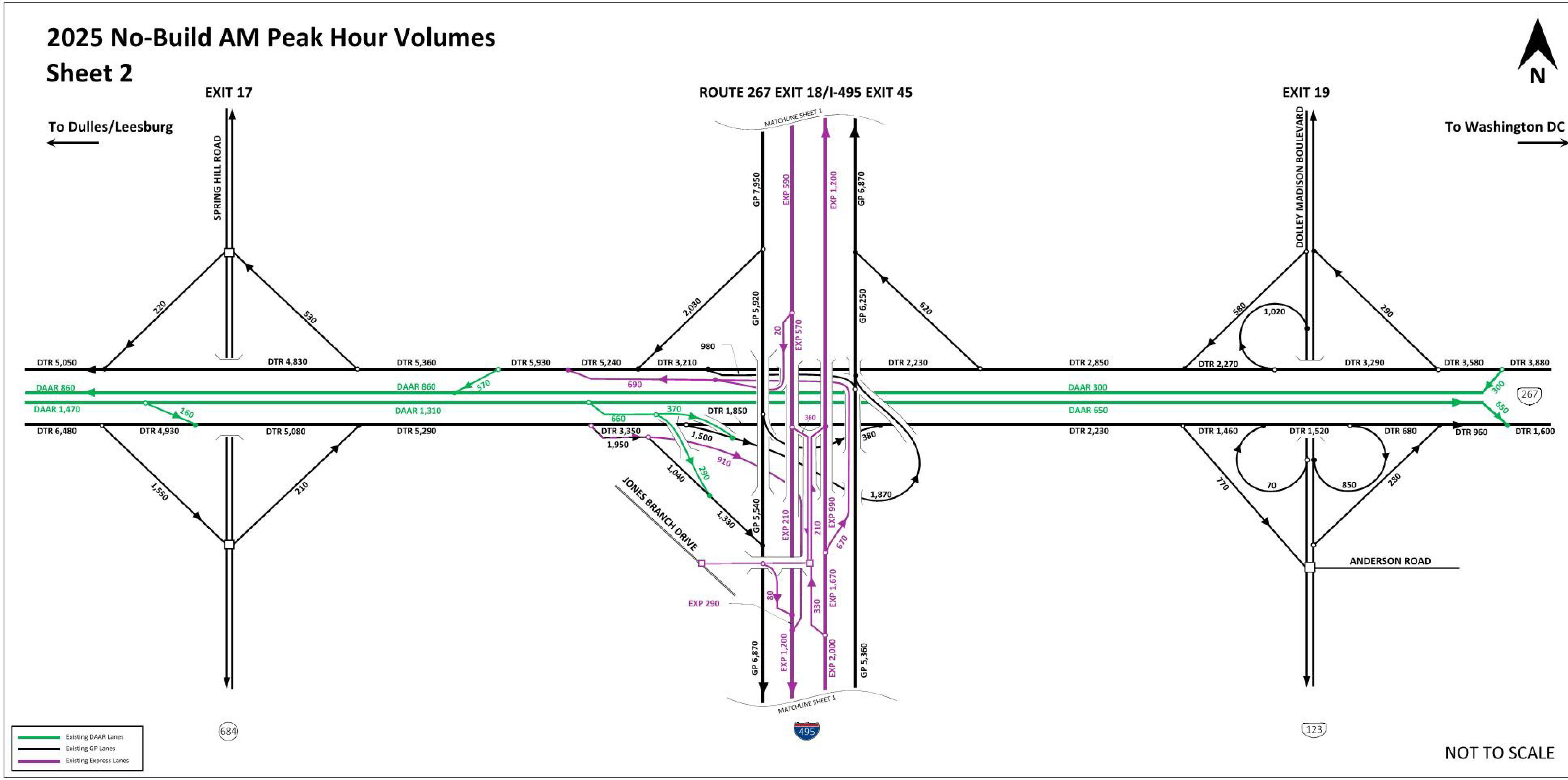


Exhibit 7-1b. Freeway 2025 No Build AM Peak Hour Volume – Route 267

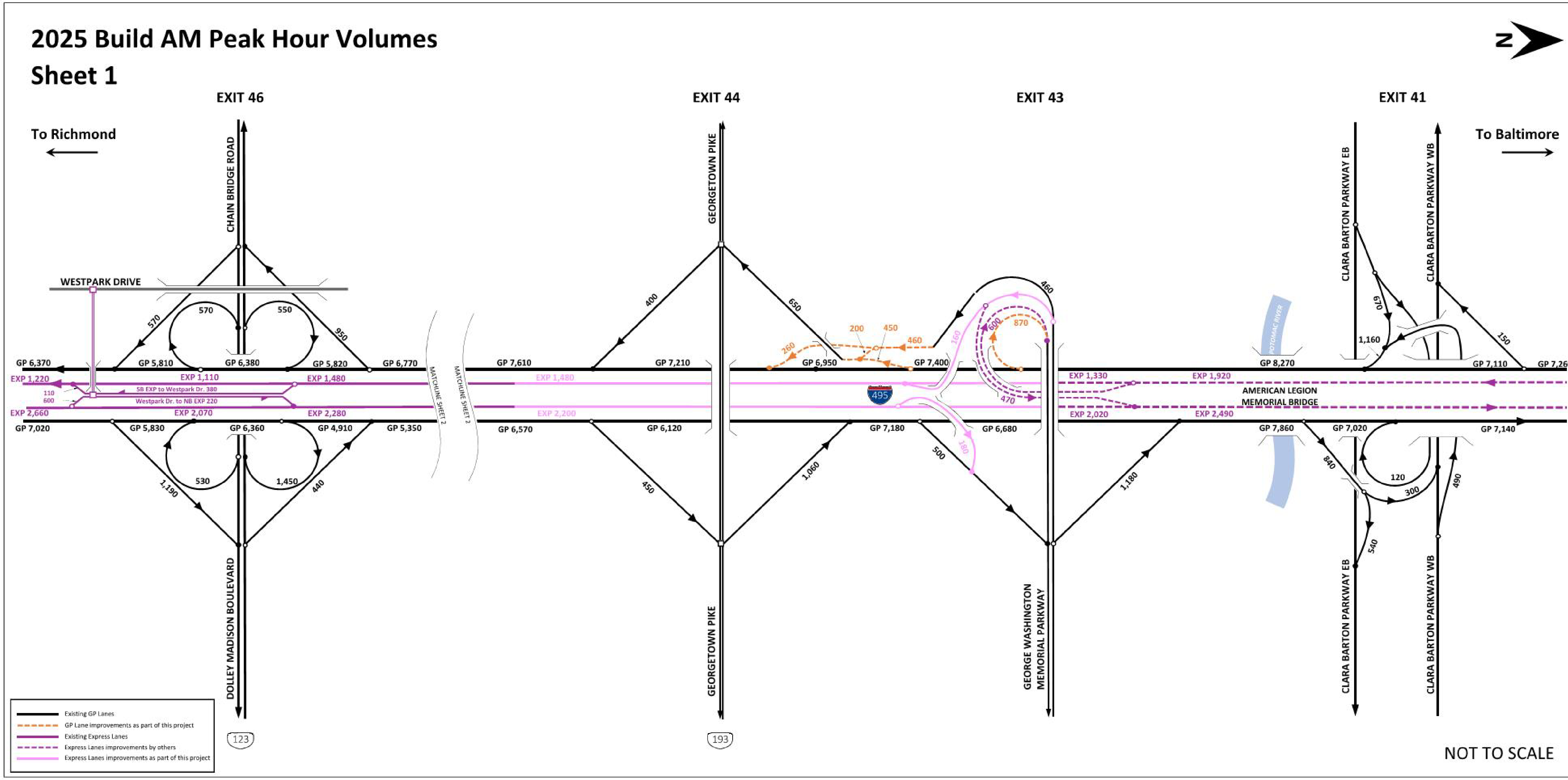


Exhibit 7-2a. Freeway 2025 Build AM Peak Hour Volume – I-495

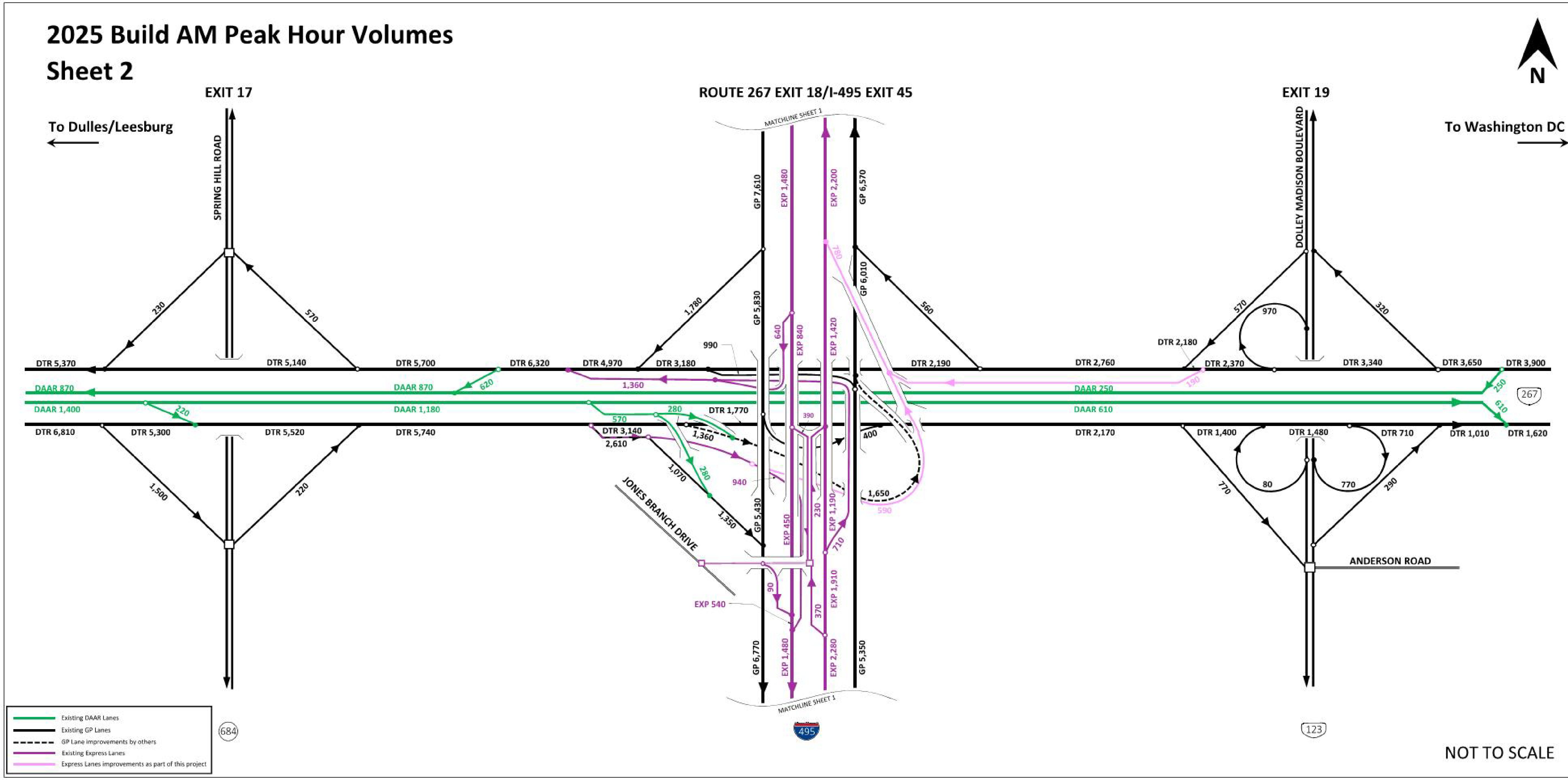


Exhibit 7-2b. Freeway 2025 Build AM Peak Hour Volume – Route 267

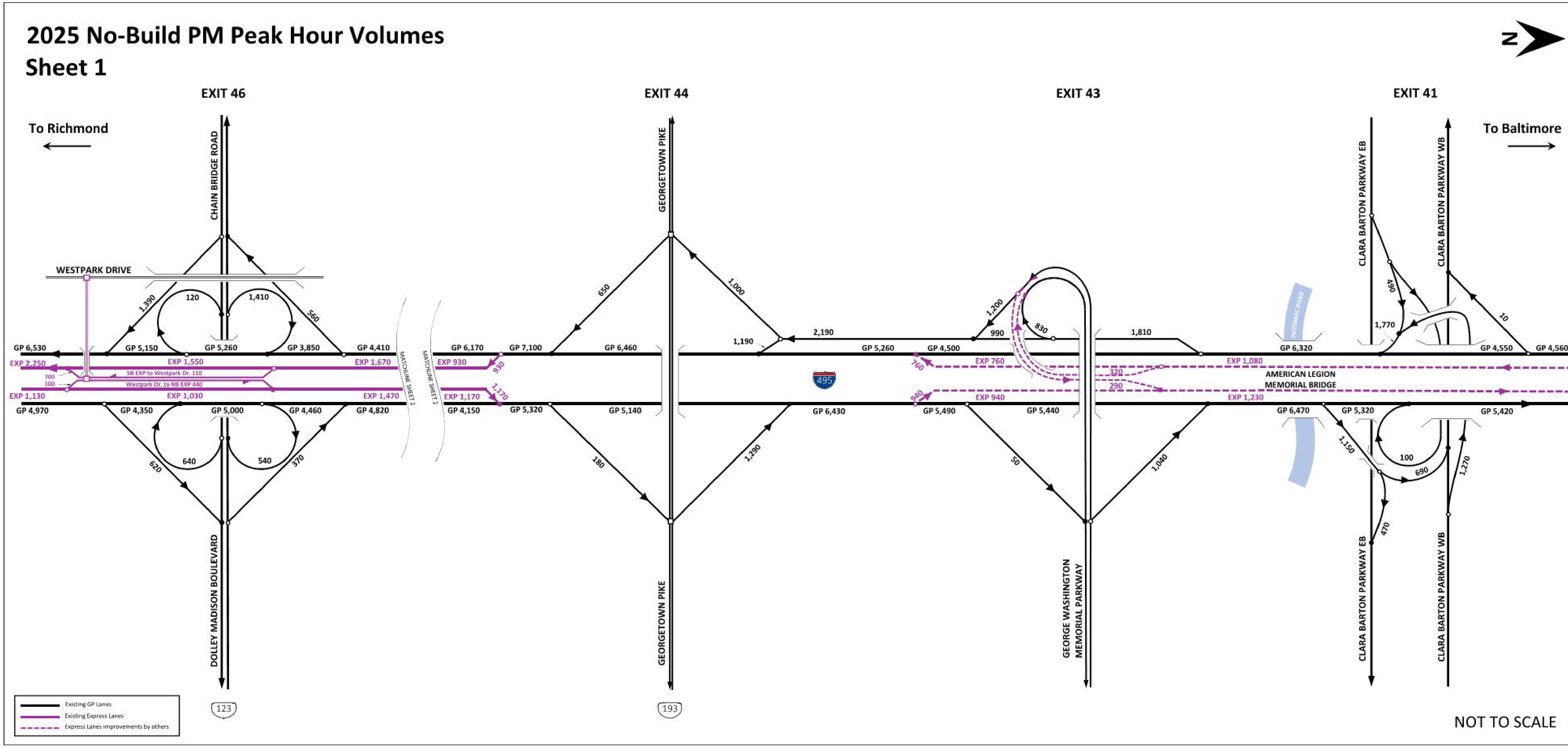


Exhibit 7-3a. Freeway No Build PM Peak Hour Volume – I-495

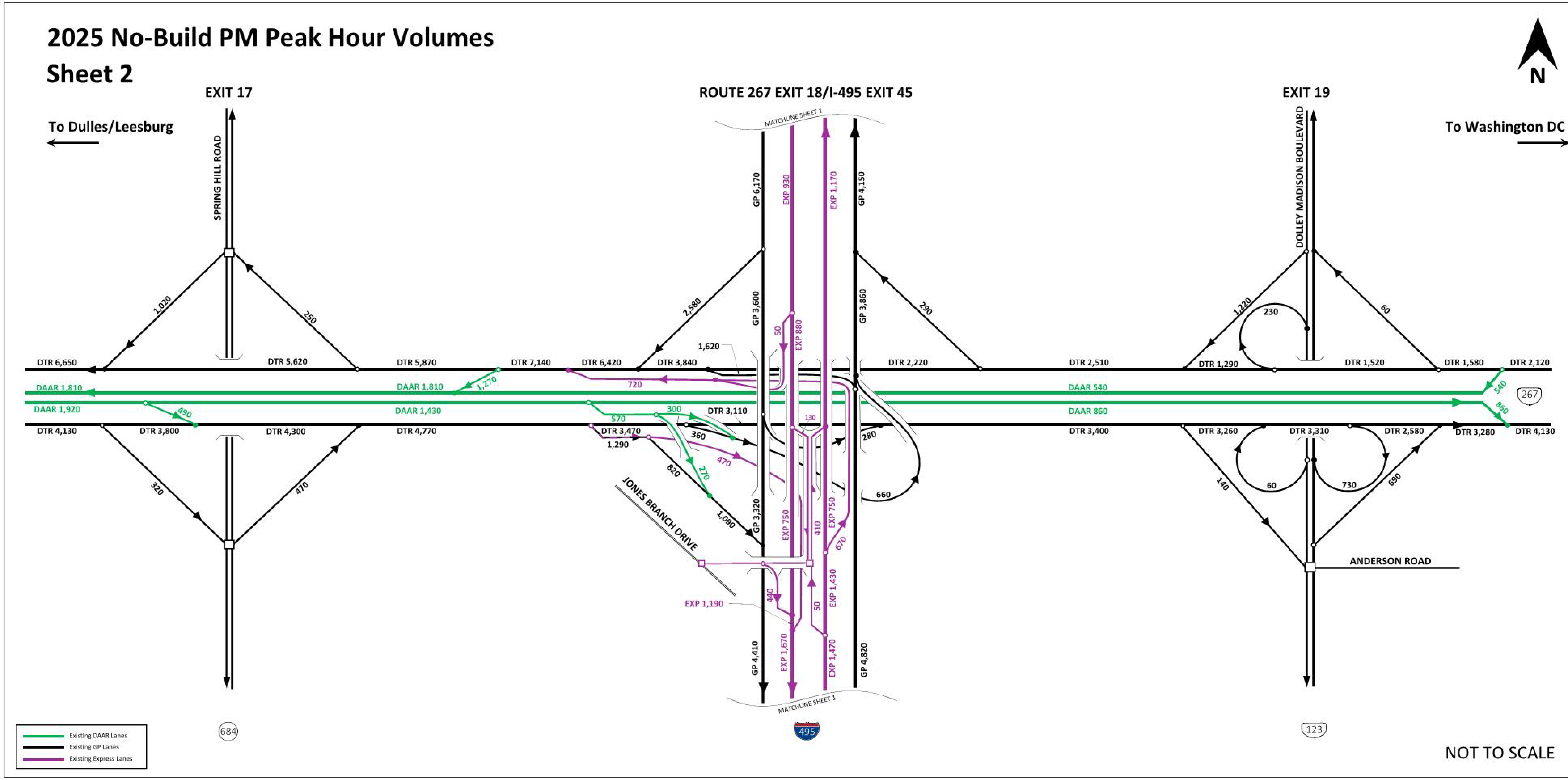


Exhibit 7-3b. Freeway No Build PM Peak Hour Volume – Route 267

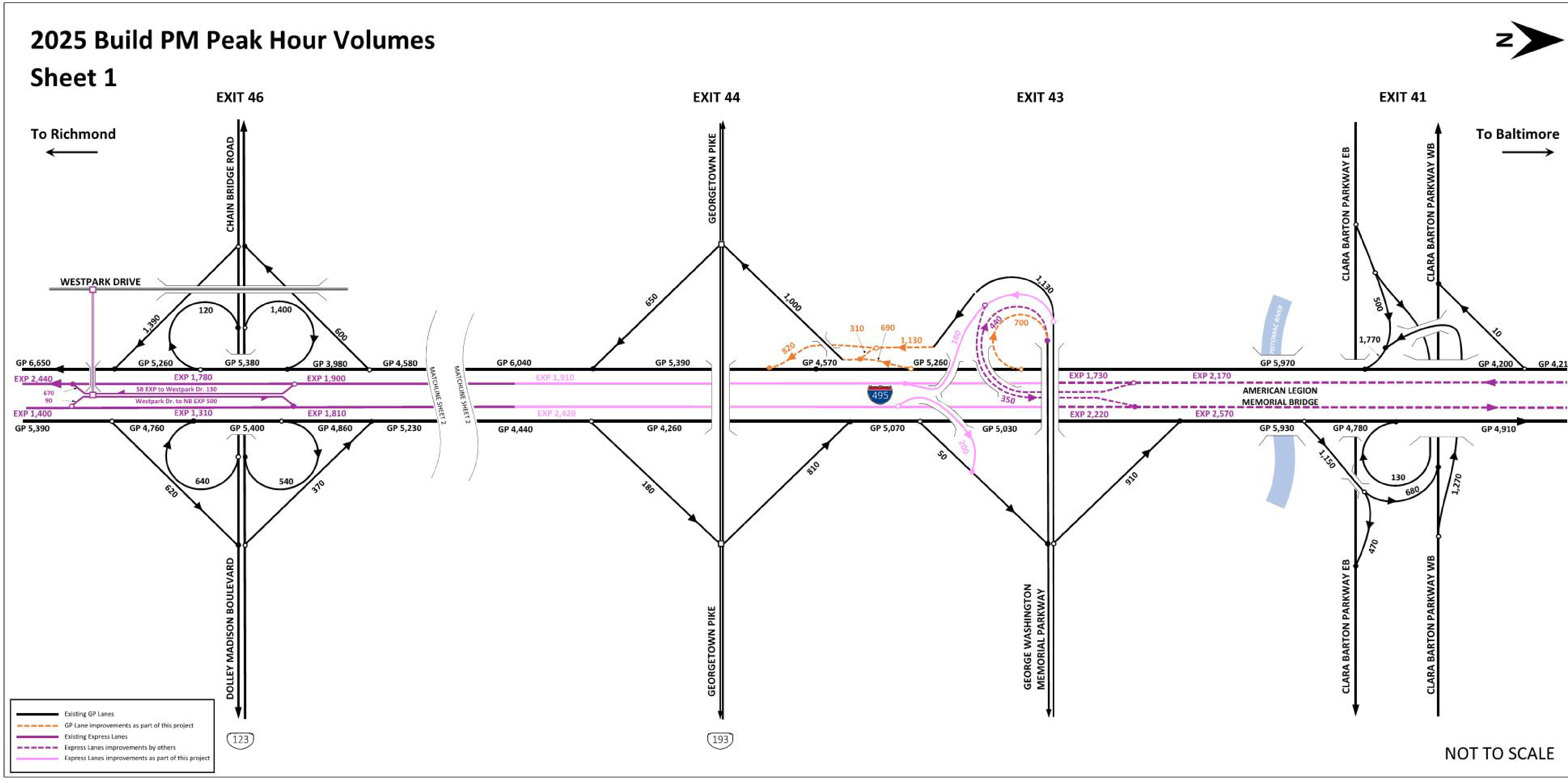


Exhibit 7-4a. Freeway Build PM Peak Hour Volume – I-495

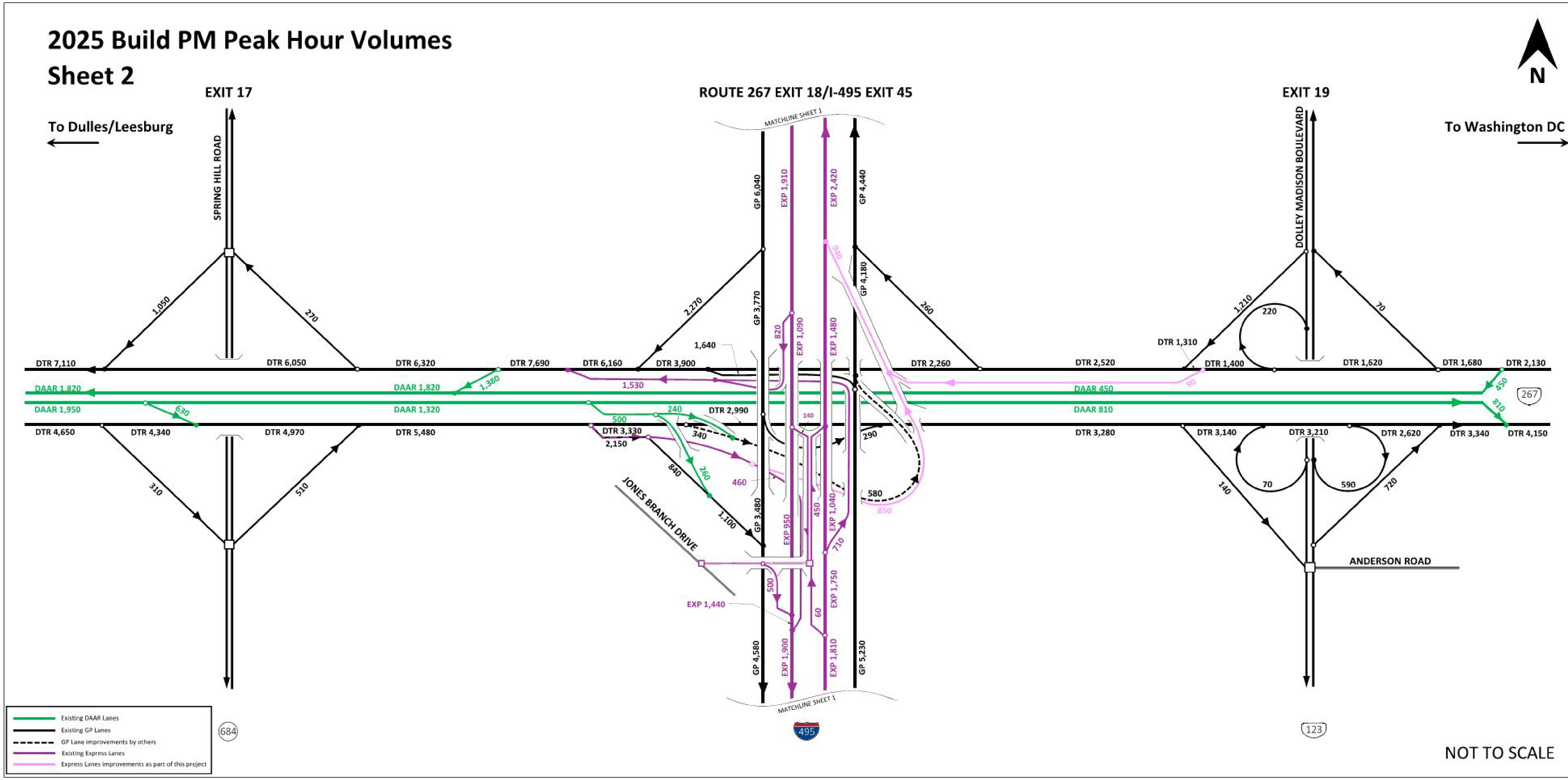


Exhibit 7-4b. Freeway Build PM Peak Hour Volume – Route 267

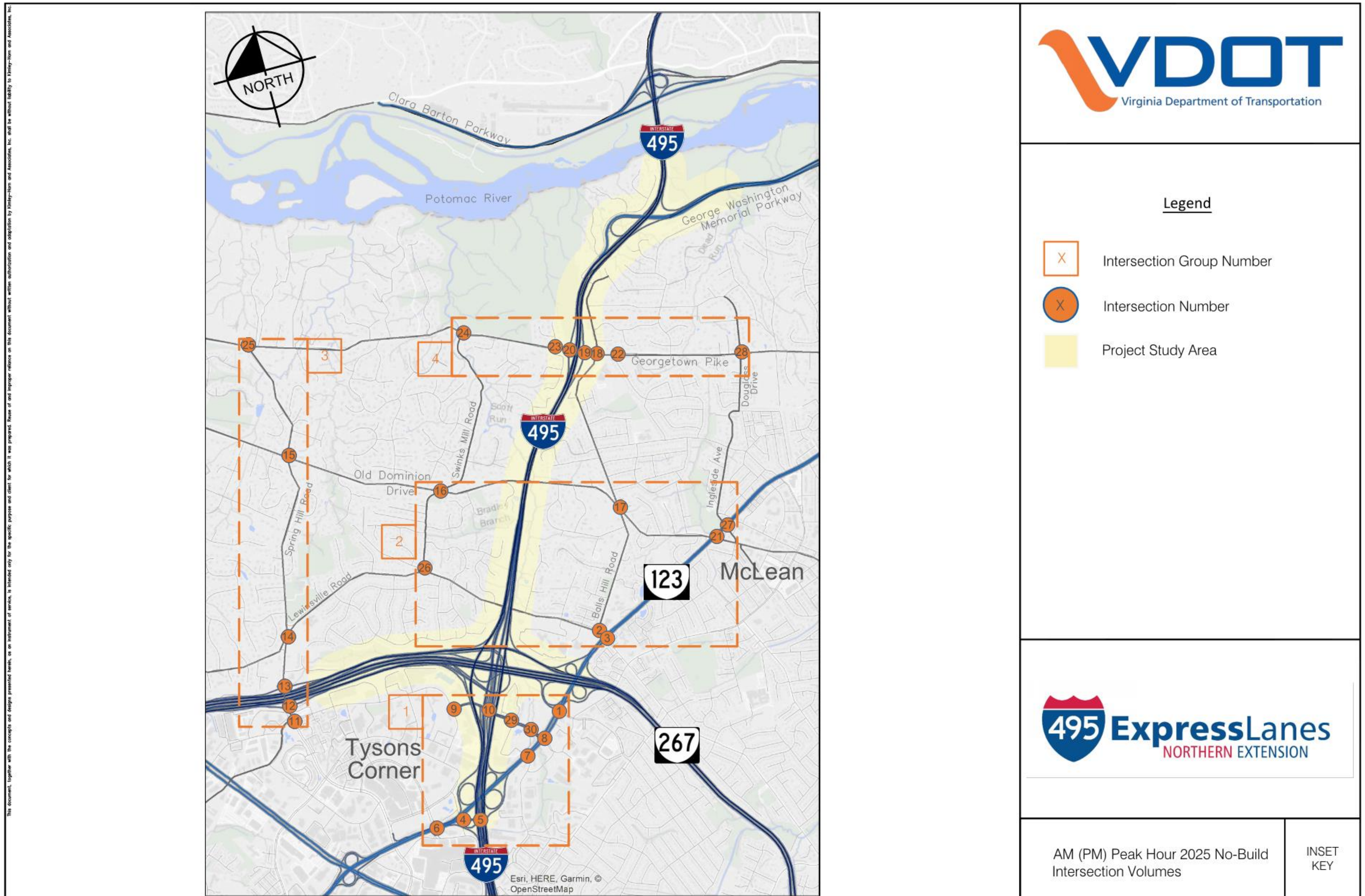


Exhibit 7-5a. Arterial 2025 No Build Peak Hour Turning Movement Volumes – Figure Key

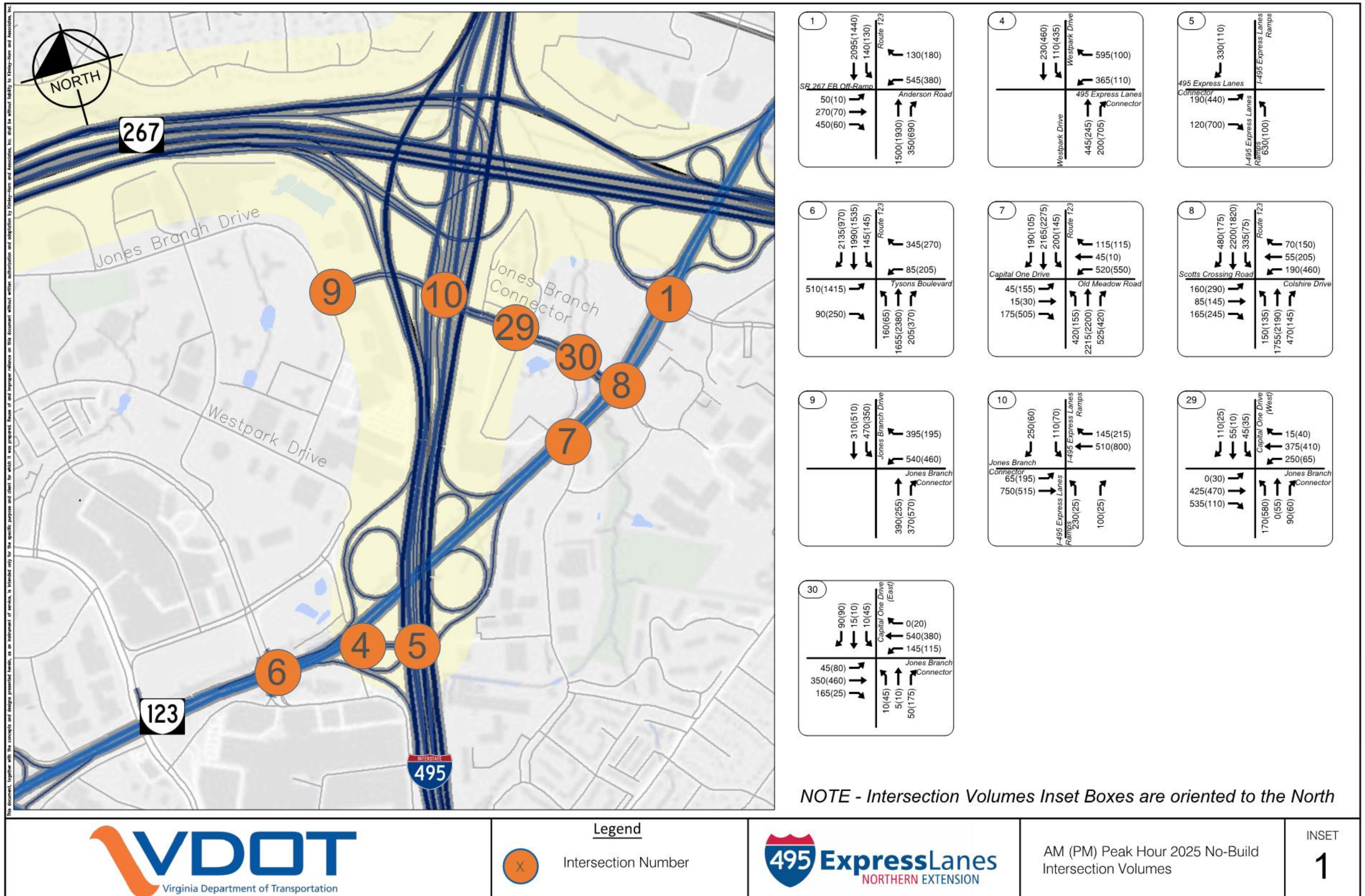


Exhibit 7-5b. Arterial 2025 No Build Peak Hour Turning Movement Volumes – Location 1

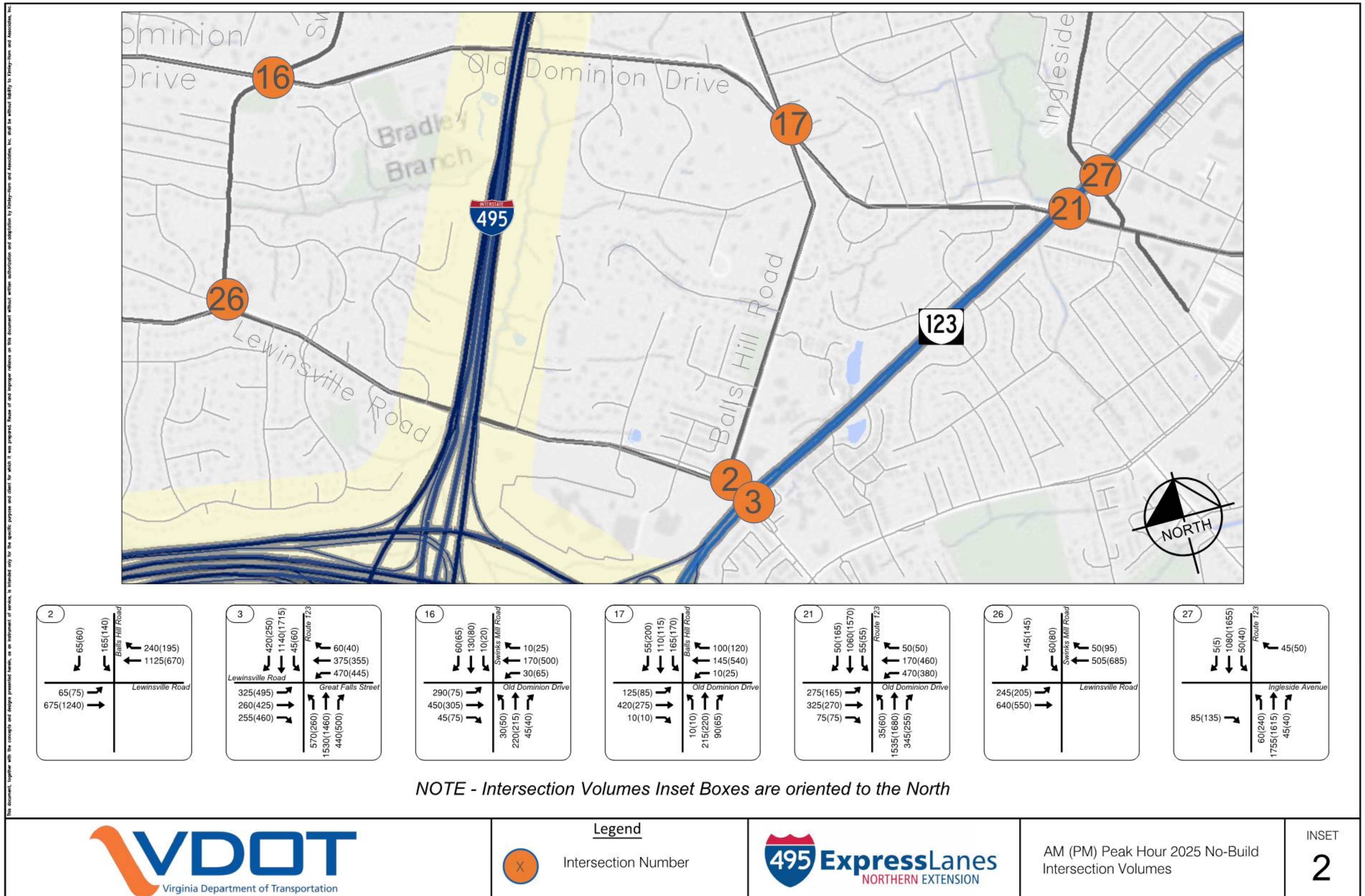


Exhibit 7-5c. Arterial 2025 No Build Peak Hour Turning Movement Volumes – Location 2

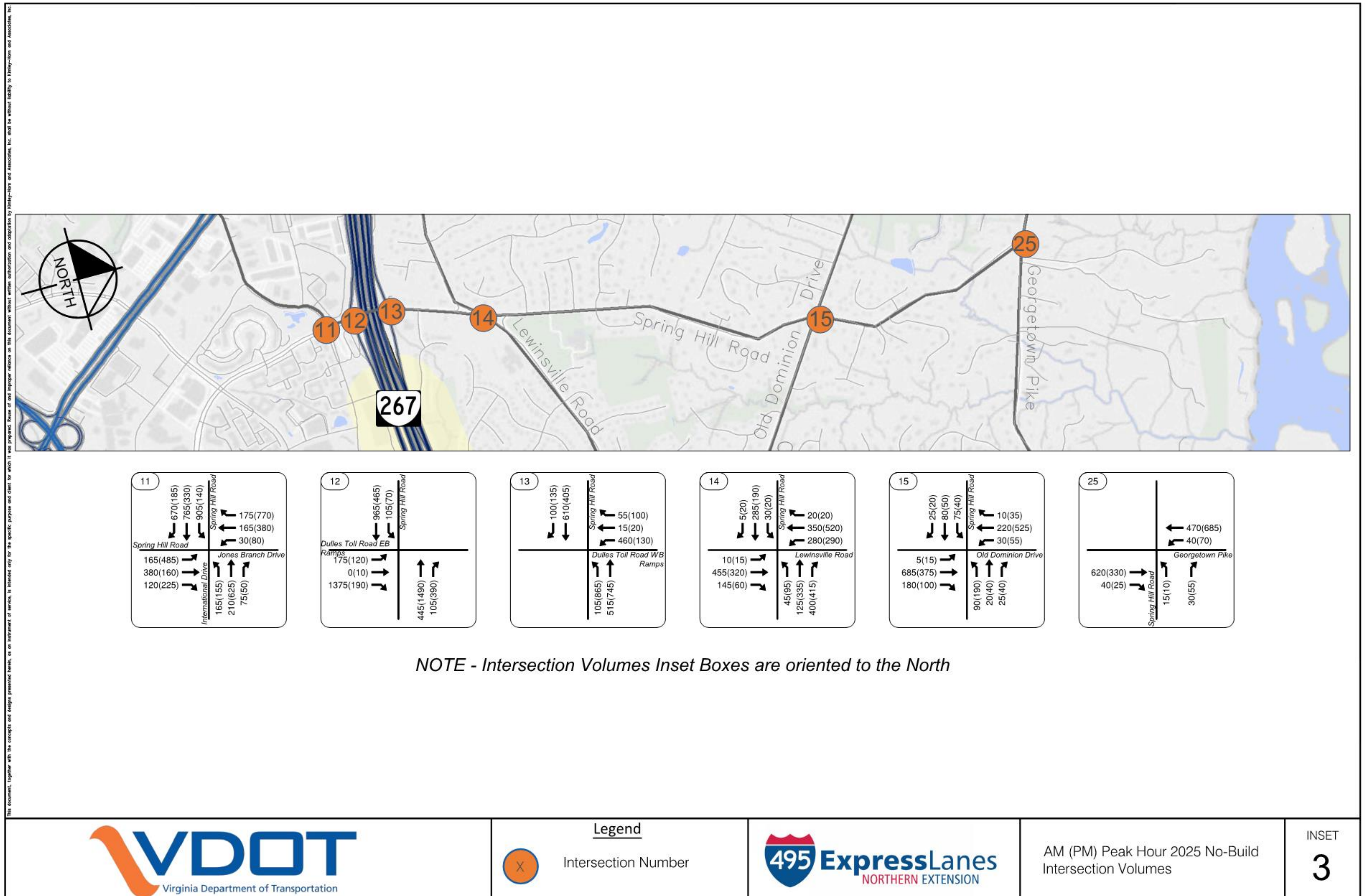


Exhibit 7-5d. Arterial 2025 No Build Peak Hour Turning Movement Volumes – Location 3

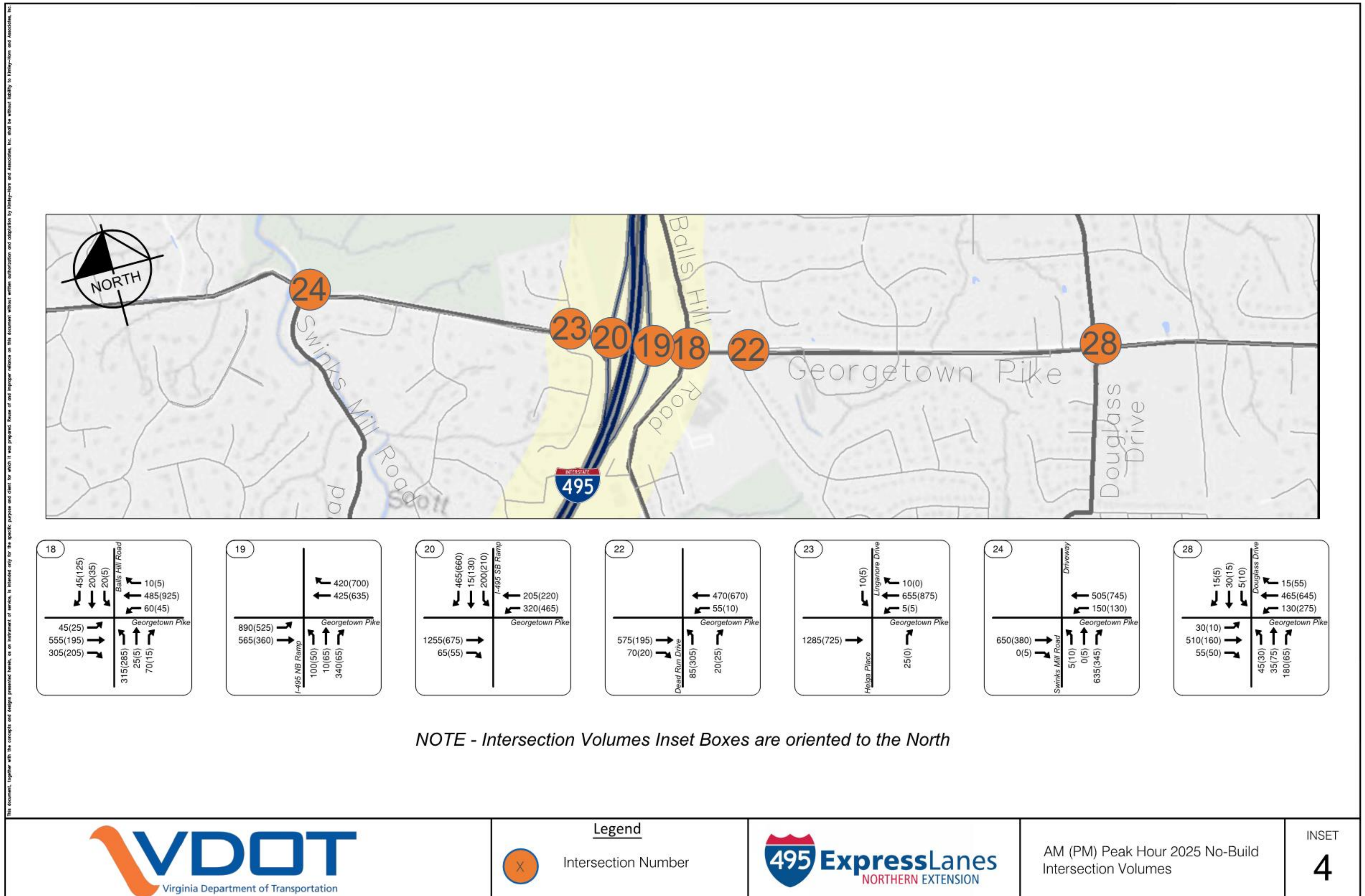


Exhibit 7-5e. Arterial 2025 No Build Peak Hour Turning Movement Volumes – Location 4

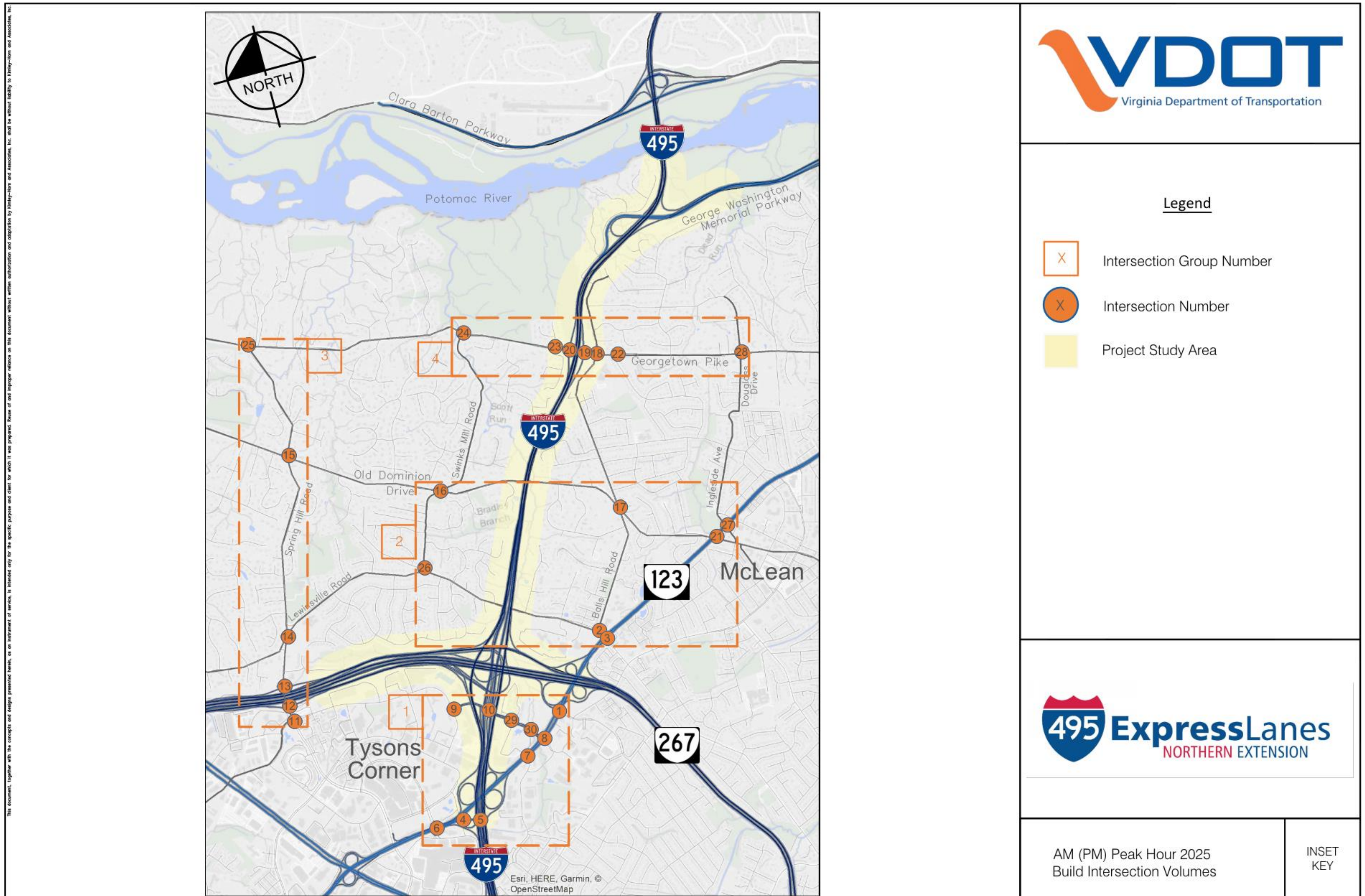


Exhibit 7-6a. Arterial 2025 Build Peak Hour Turning Movement Volumes – Figure Key

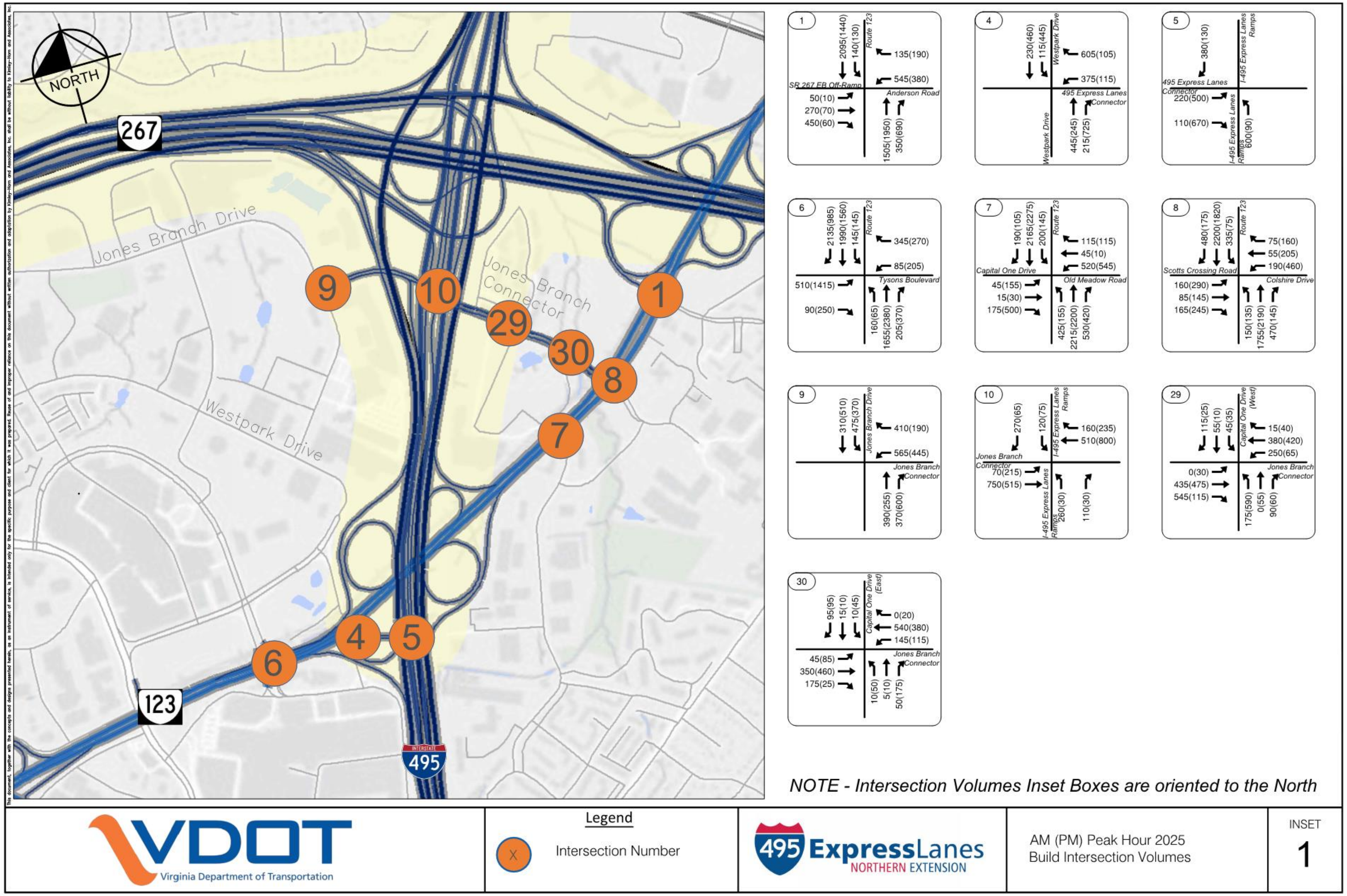


Exhibit 7-6b. Arterial 2025 Build Peak Hour Turning Movement Volumes – Location 1

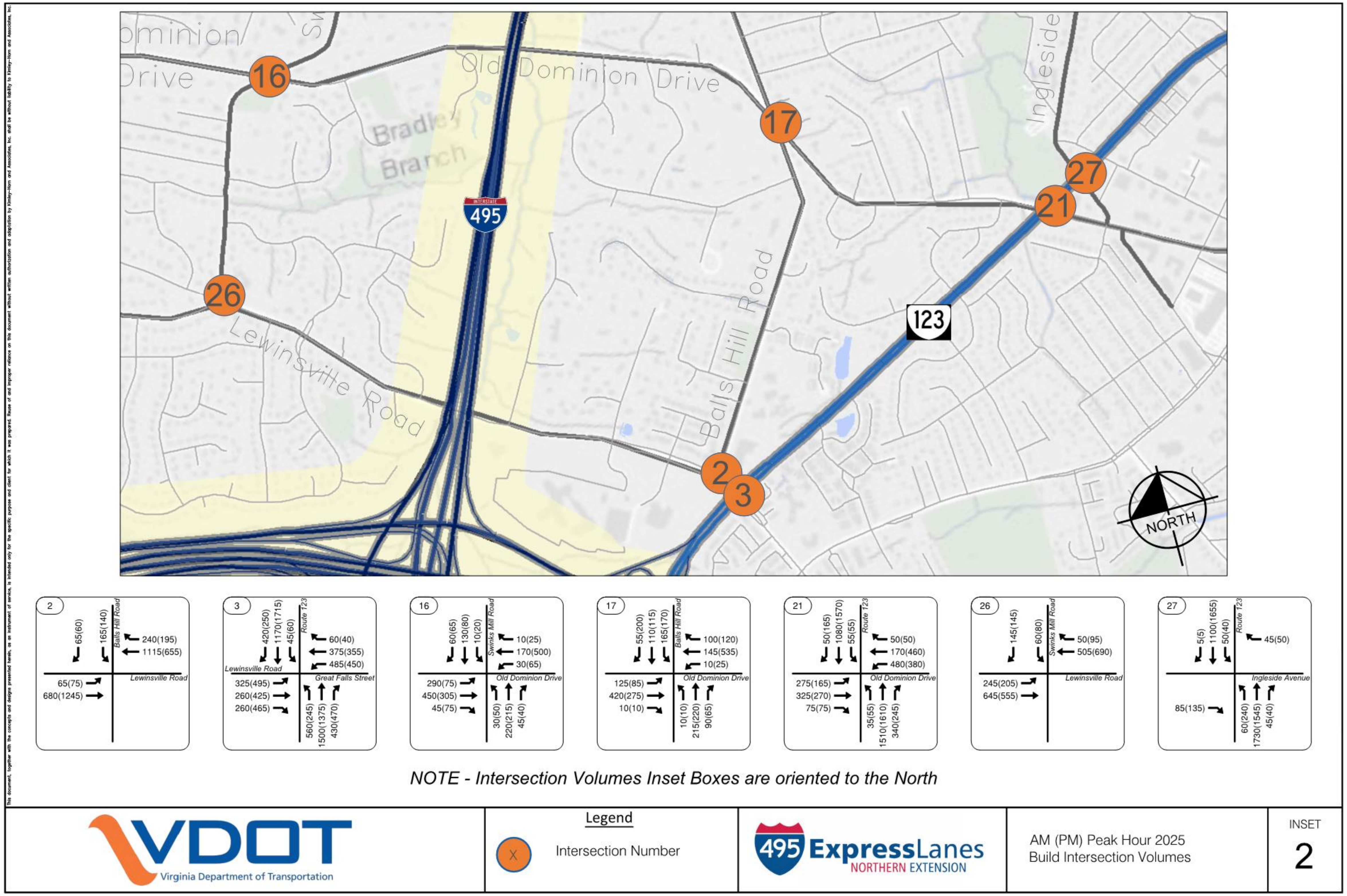


Exhibit 7-6c. Arterial 2025 Build Peak Hour Turning Movement Volumes – Location 2

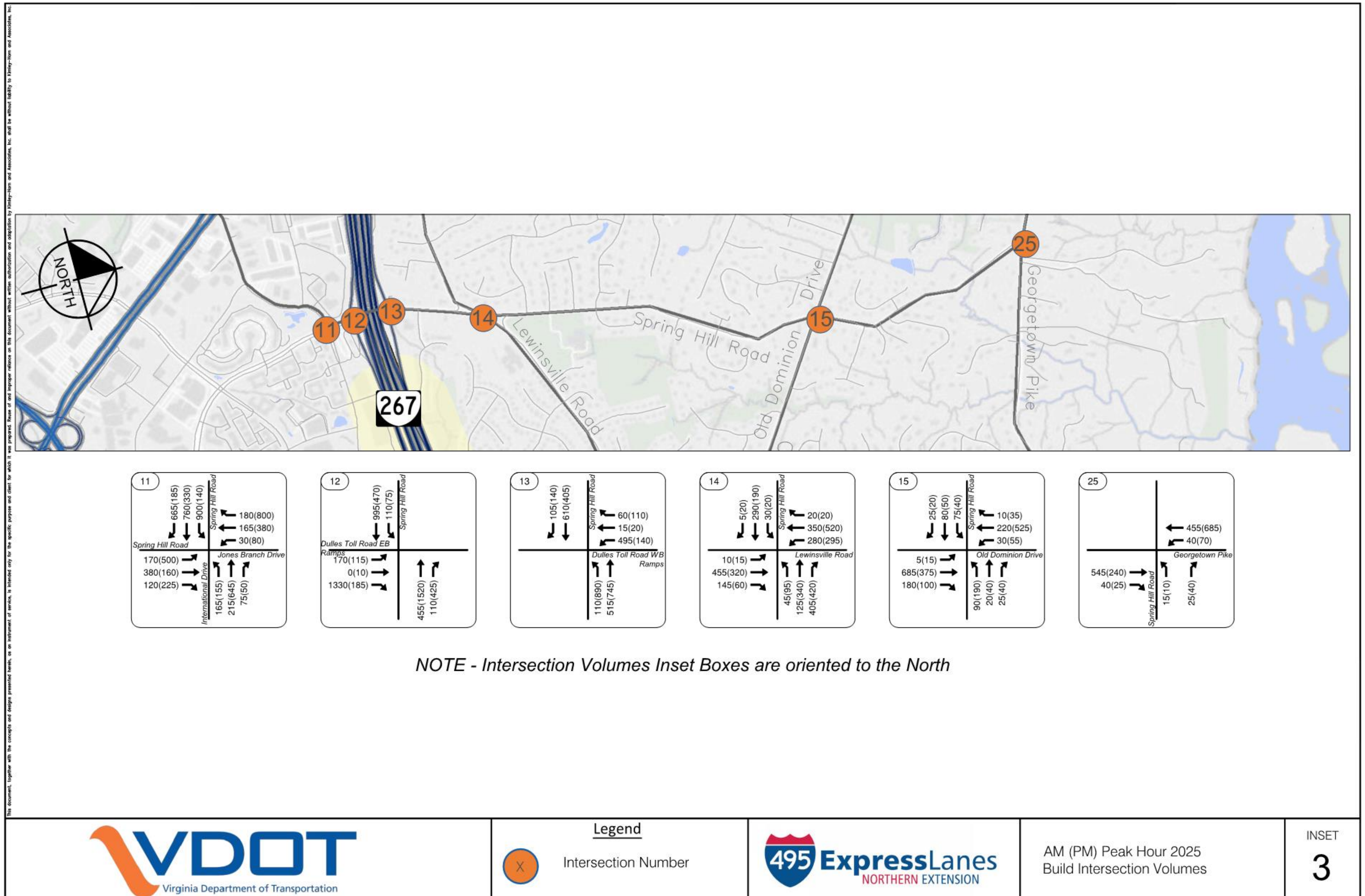


Exhibit 7-6d. Arterial 2025 Build Peak Hour Turning Movement Volumes – Location 3

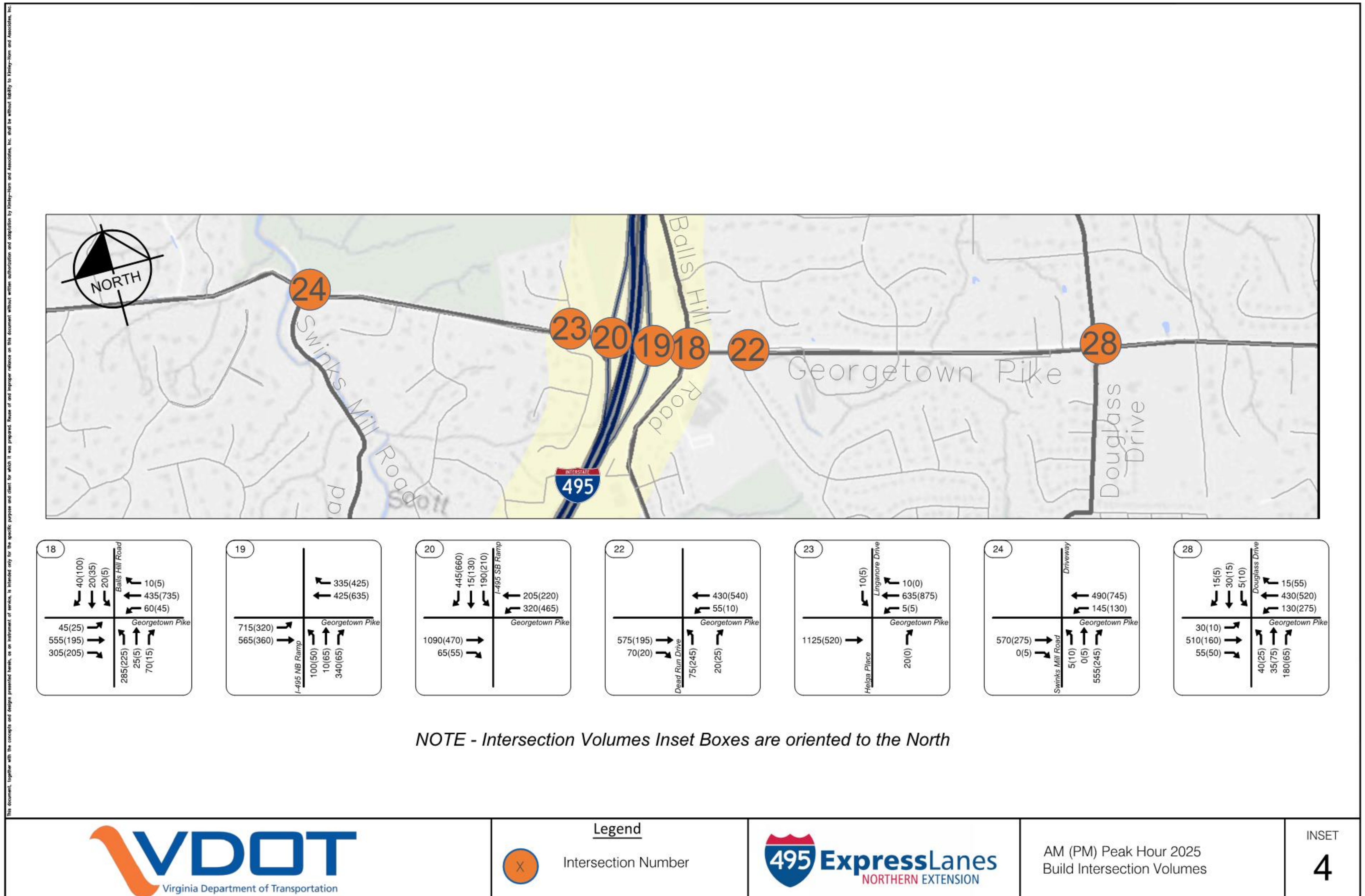


Exhibit 7-6e. Arterial 2025 Build Peak Hour Turning Movement Volumes – Location 4

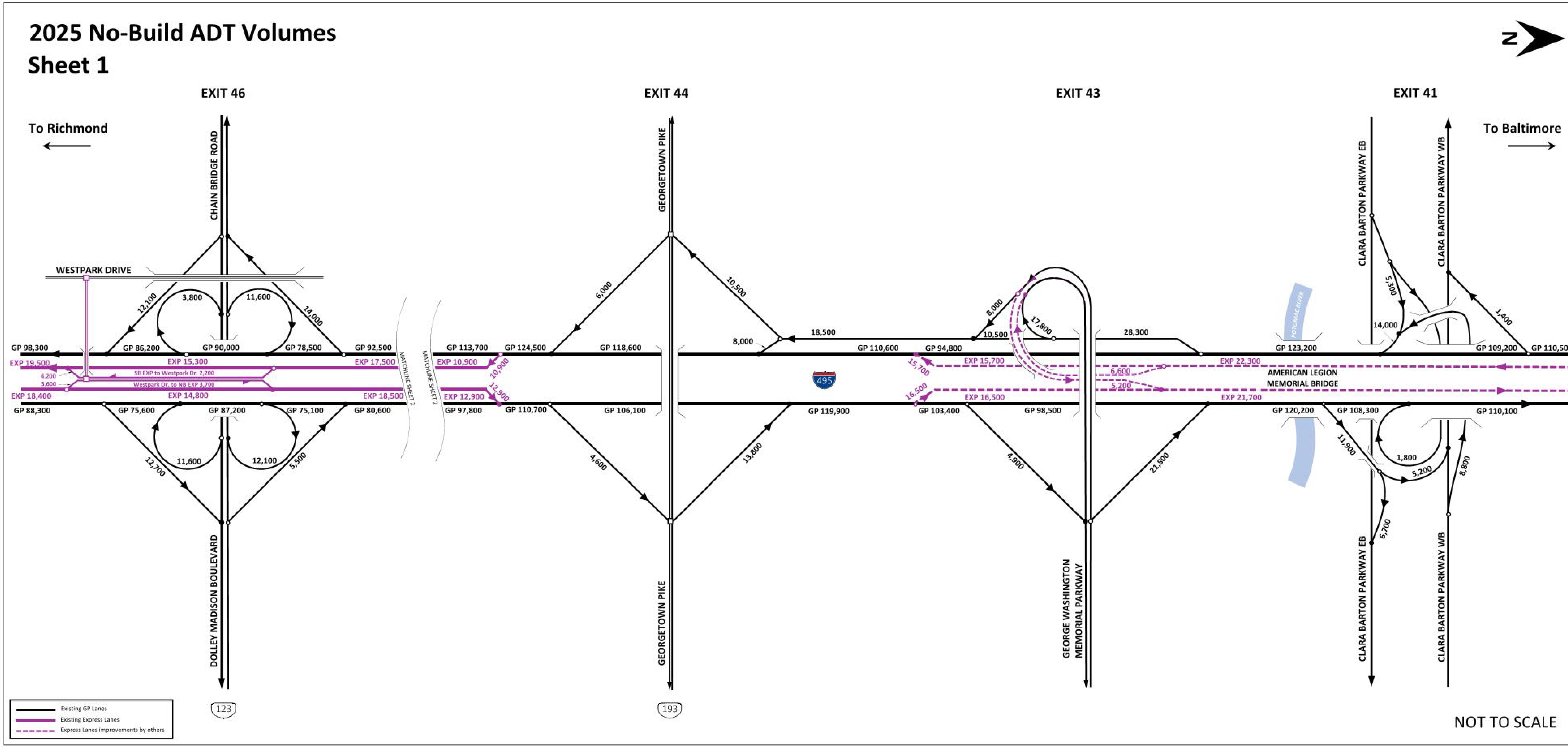


Exhibit 7-7a. Freeway No Build ADT – I-495

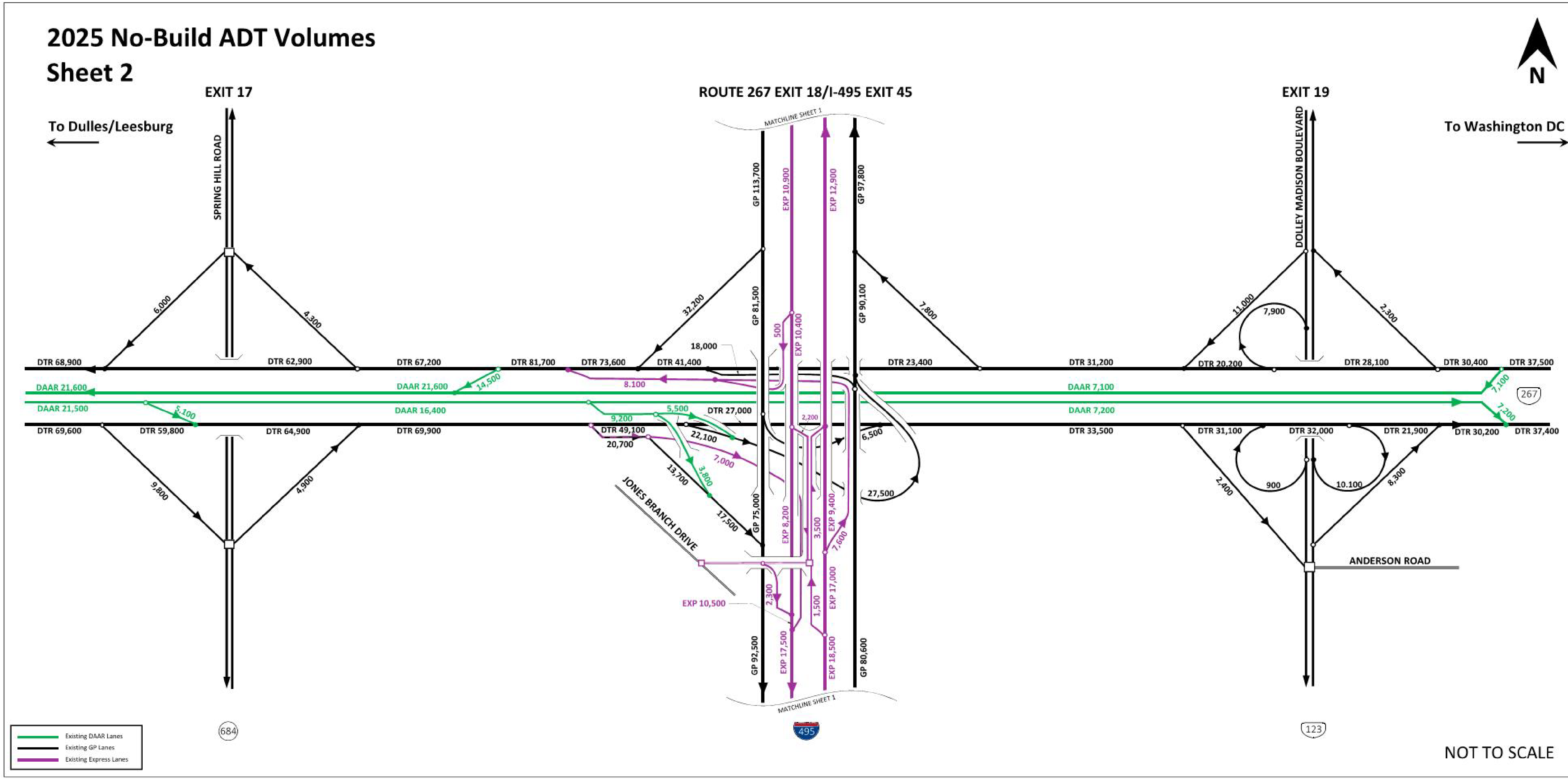


Exhibit 7-7b. Freeway No Build ADT – Route 267

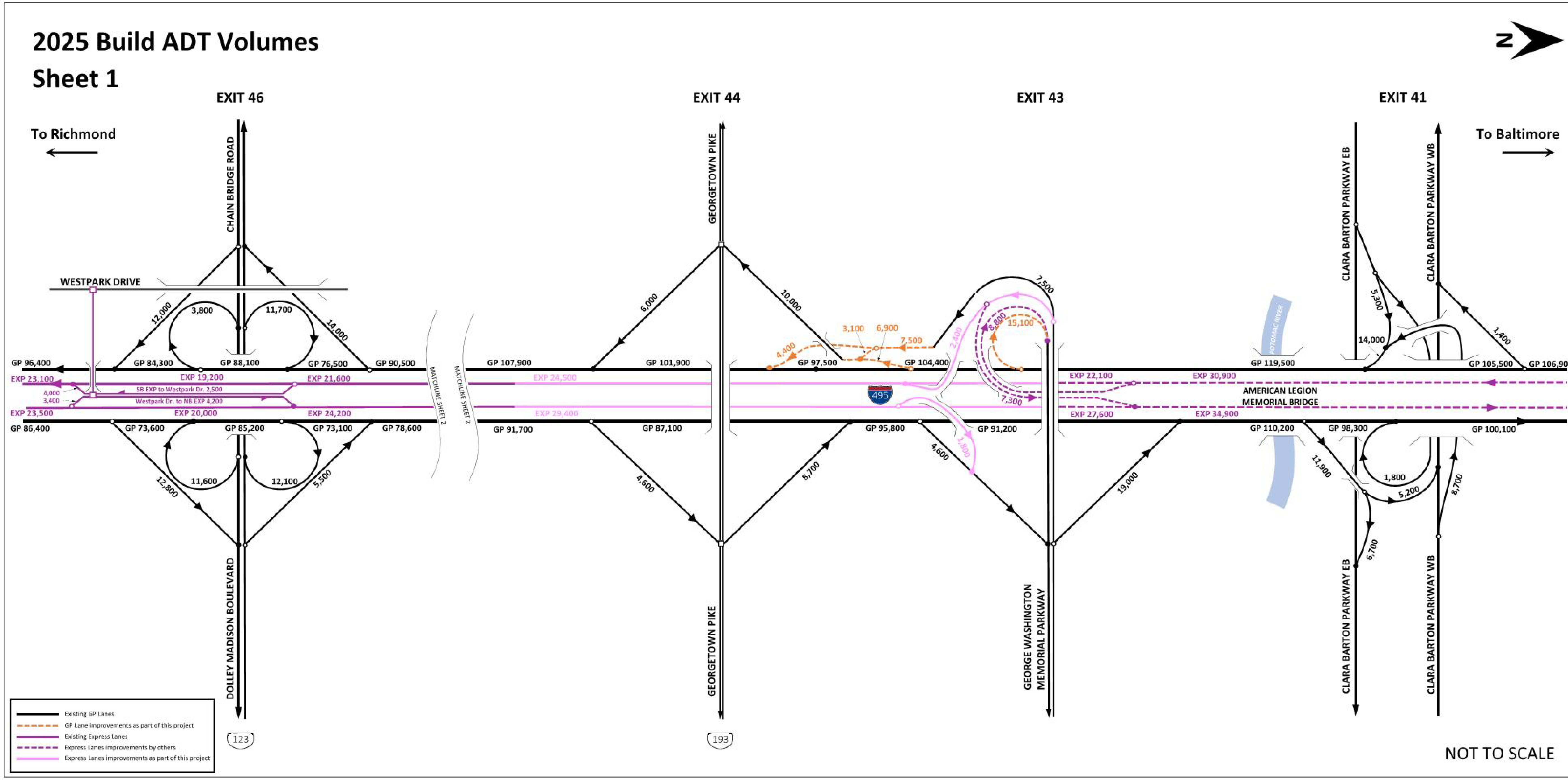


Exhibit 7-8a. Freeway Build ADT – I-495

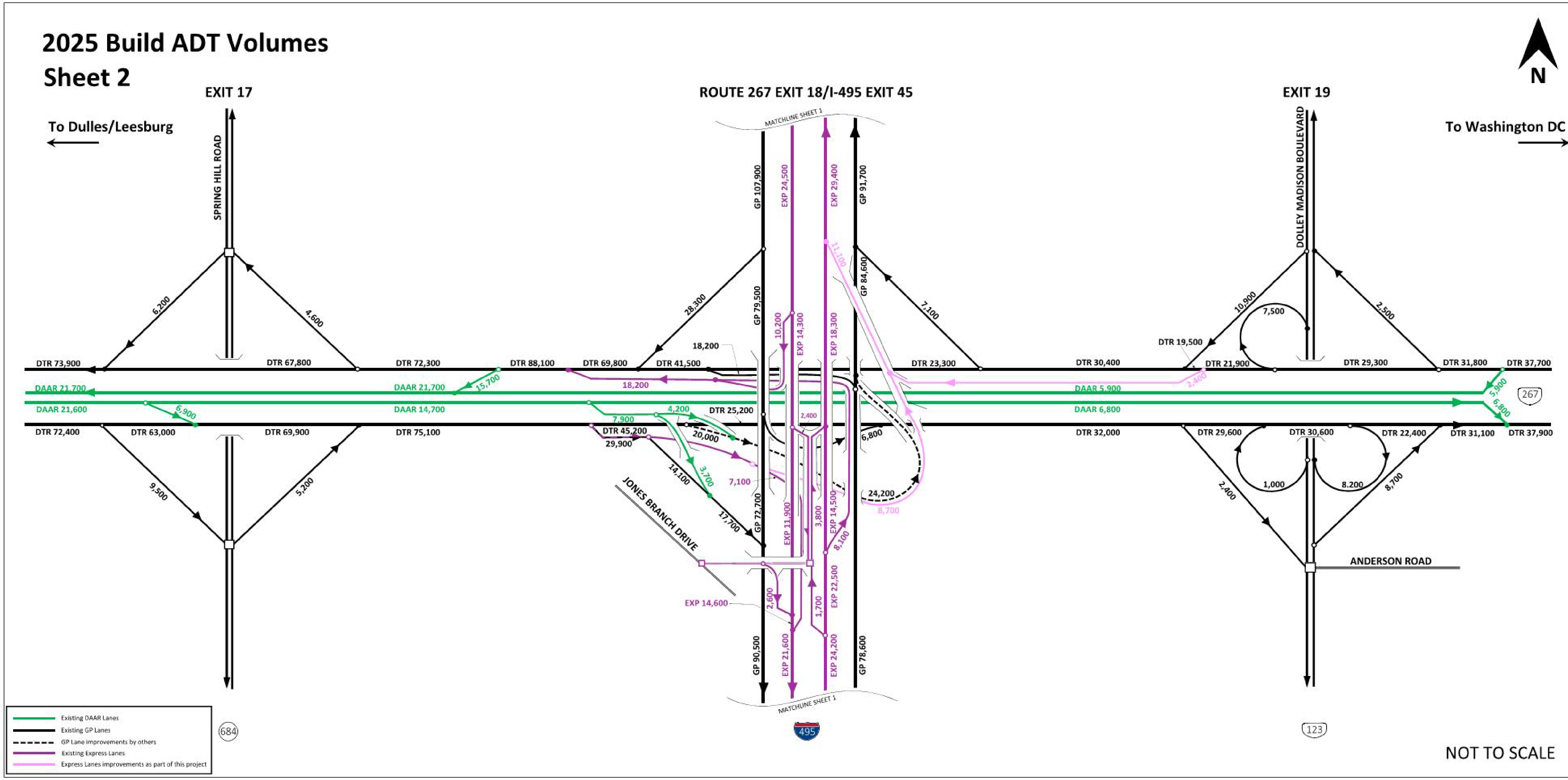


Exhibit 7-8b. Freeway Build ADT – Route 267

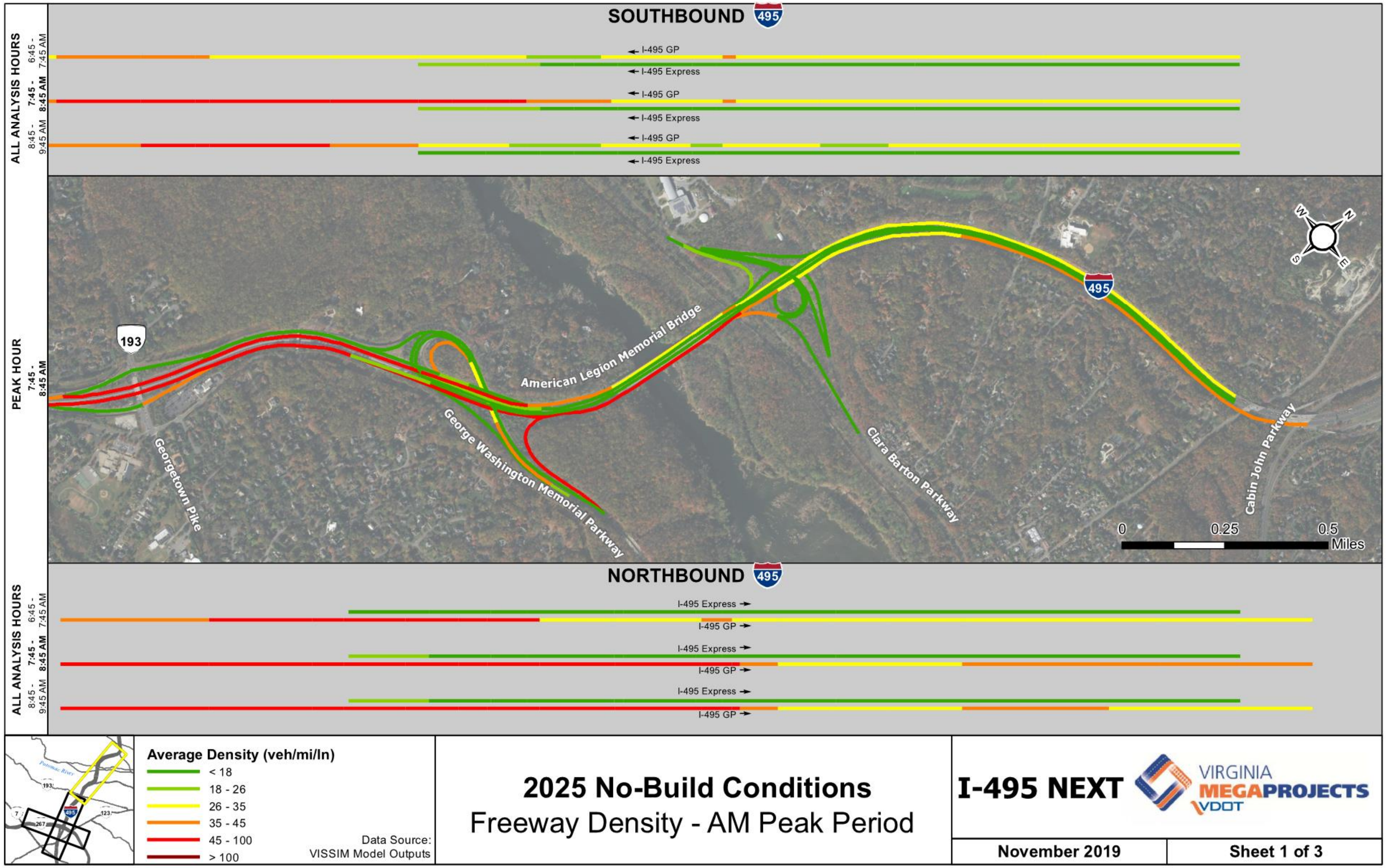


Exhibit 7-9a. 2025 No Build I-495 AM Peak Period Average Densities – Georgetown Pike to Cabin John Parkway

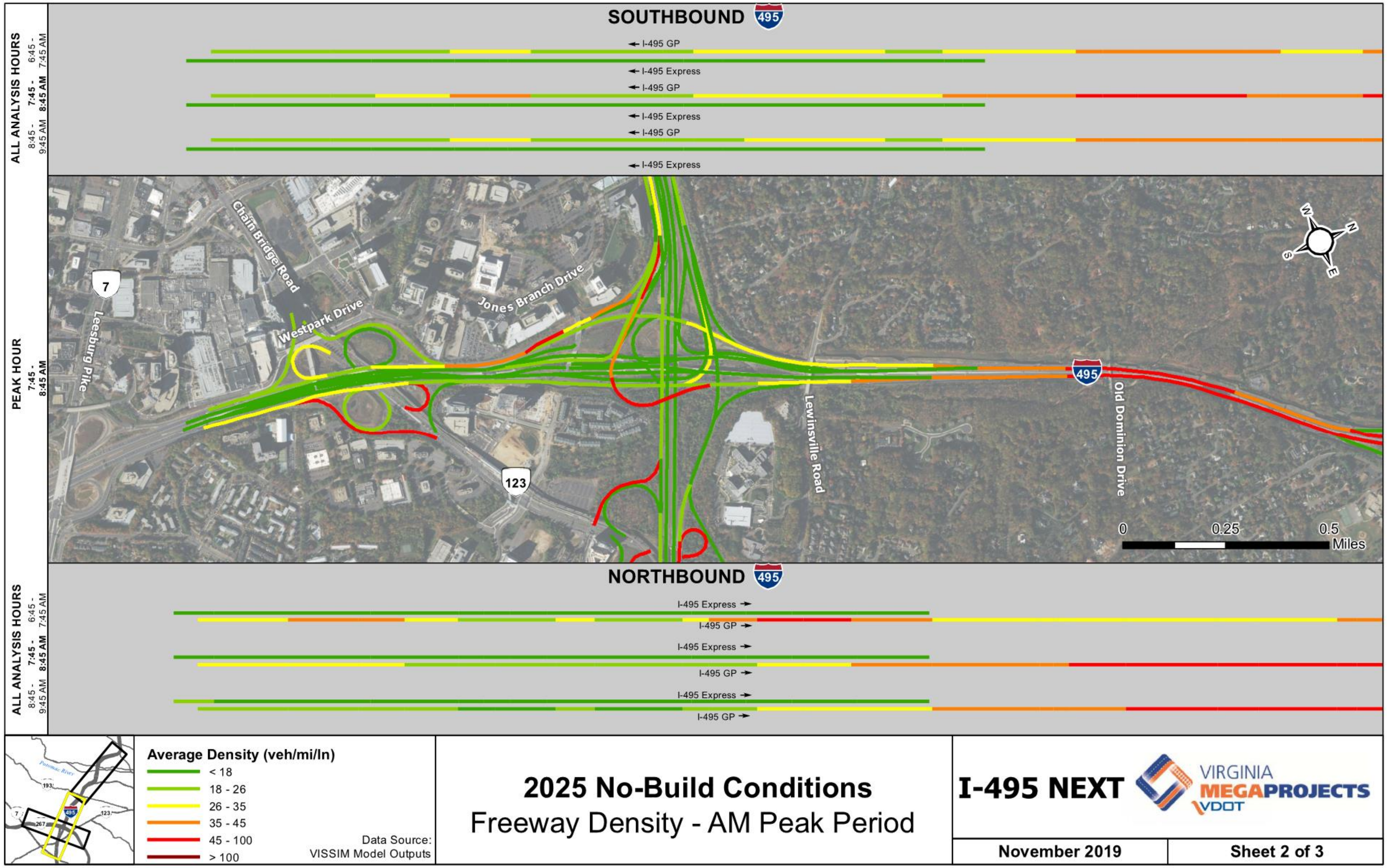


Exhibit 7-9b. 2025 No Build I-495 AM Peak Period Average Densities – Route 123 through Old Dominion Drive

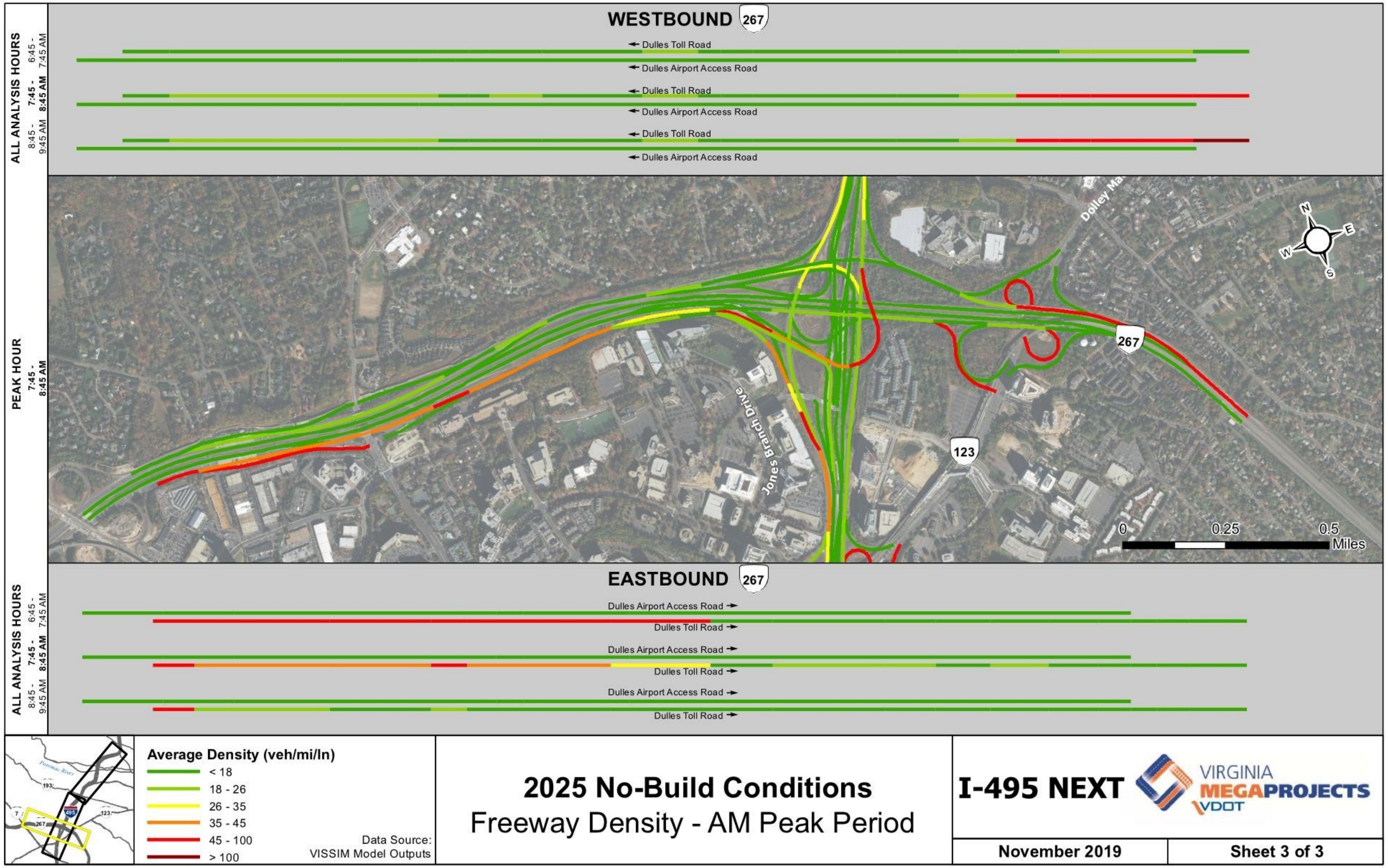


Exhibit 7-9c. 2025 No Build Route 267 AM Peak Period Average Densities

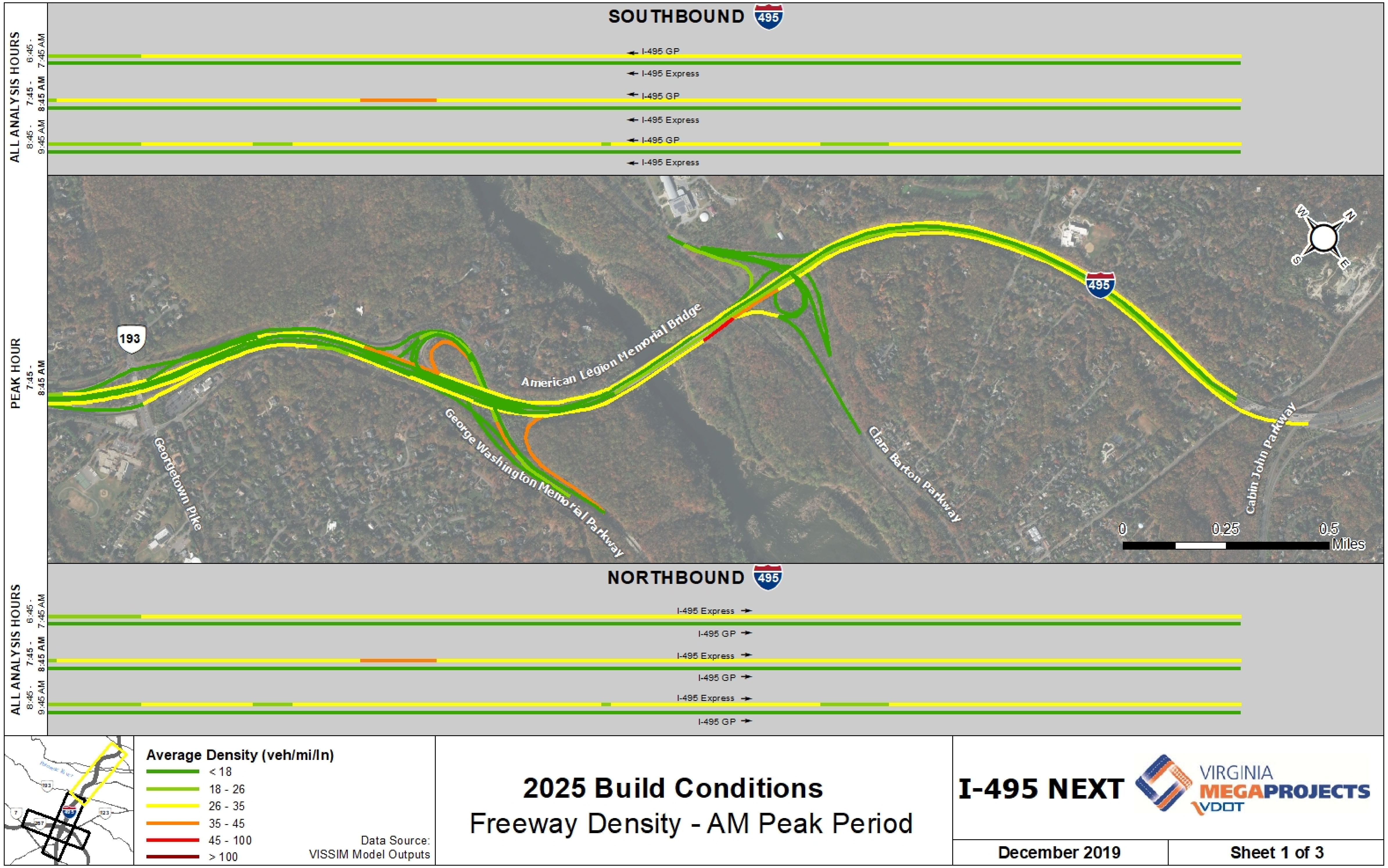


Exhibit 7-10a. 2025 Build I-495 AM Peak Period Average Densities – Georgetown Pike to Cabin John Parkway

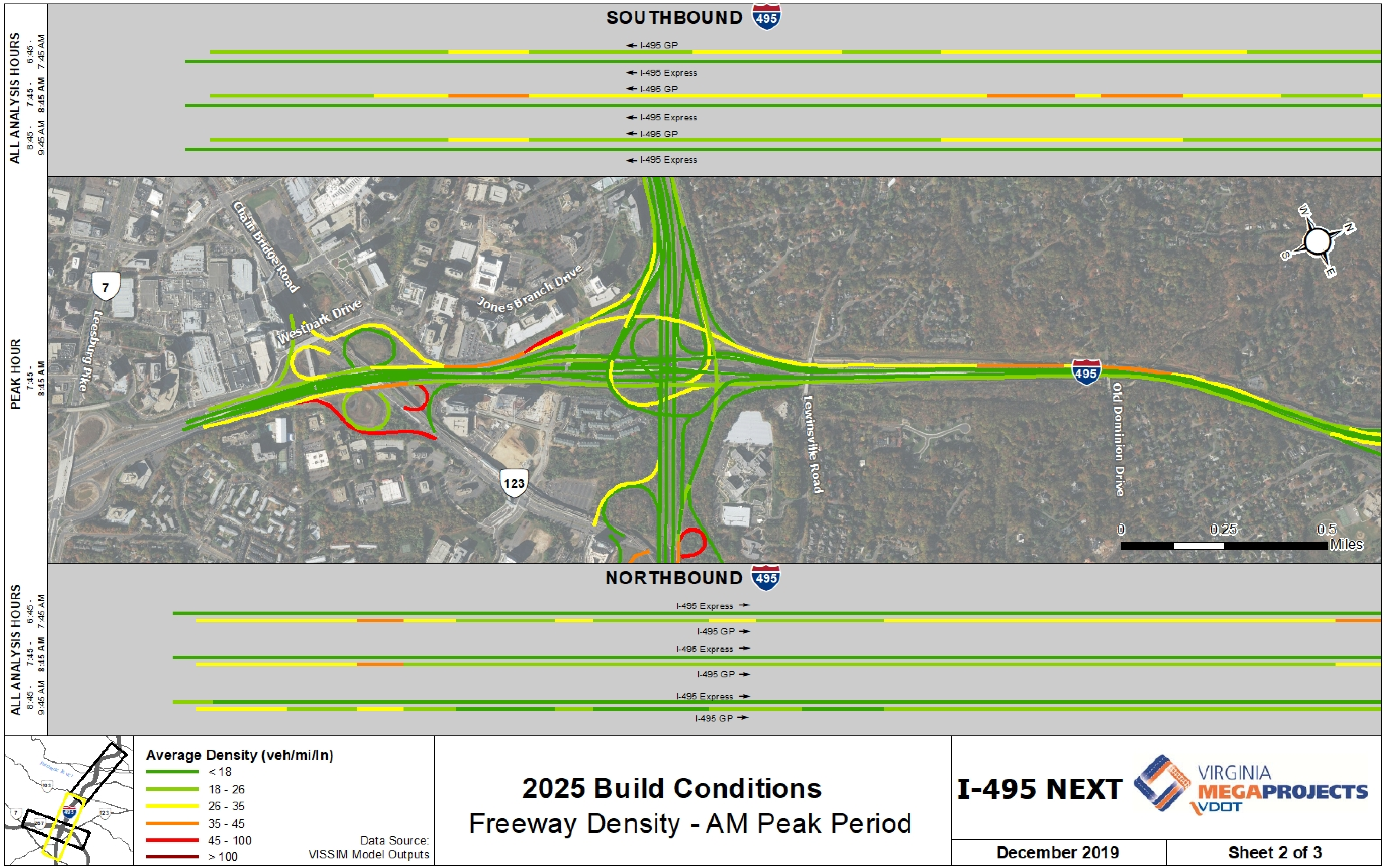


Exhibit 7-10b. 2025 Build I-495 AM Peak Period Average Densities – Route 123 through Old Dominion Drive

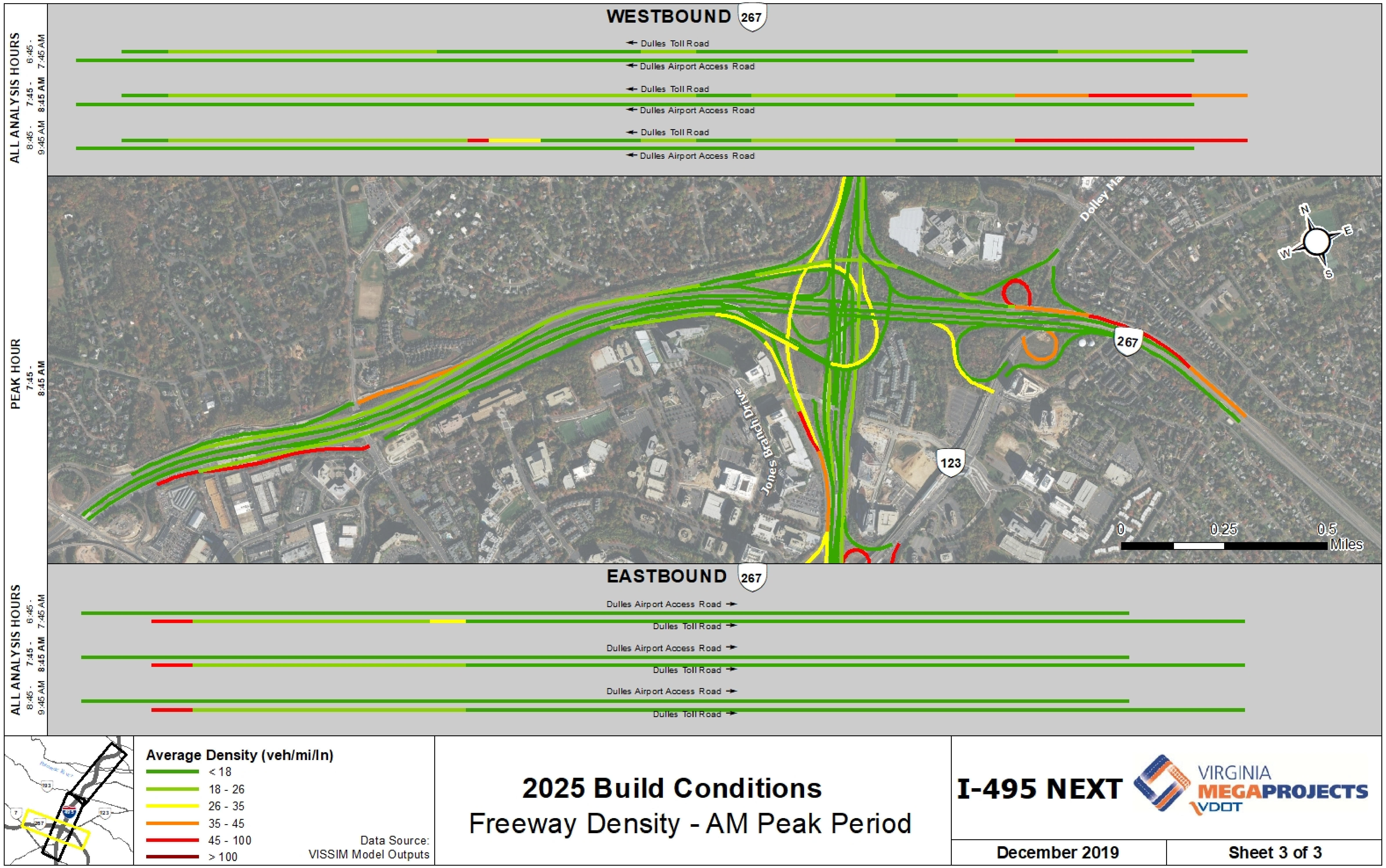


Exhibit 7-10c. 2025 Build Route 267 AM Peak Period Average Densities

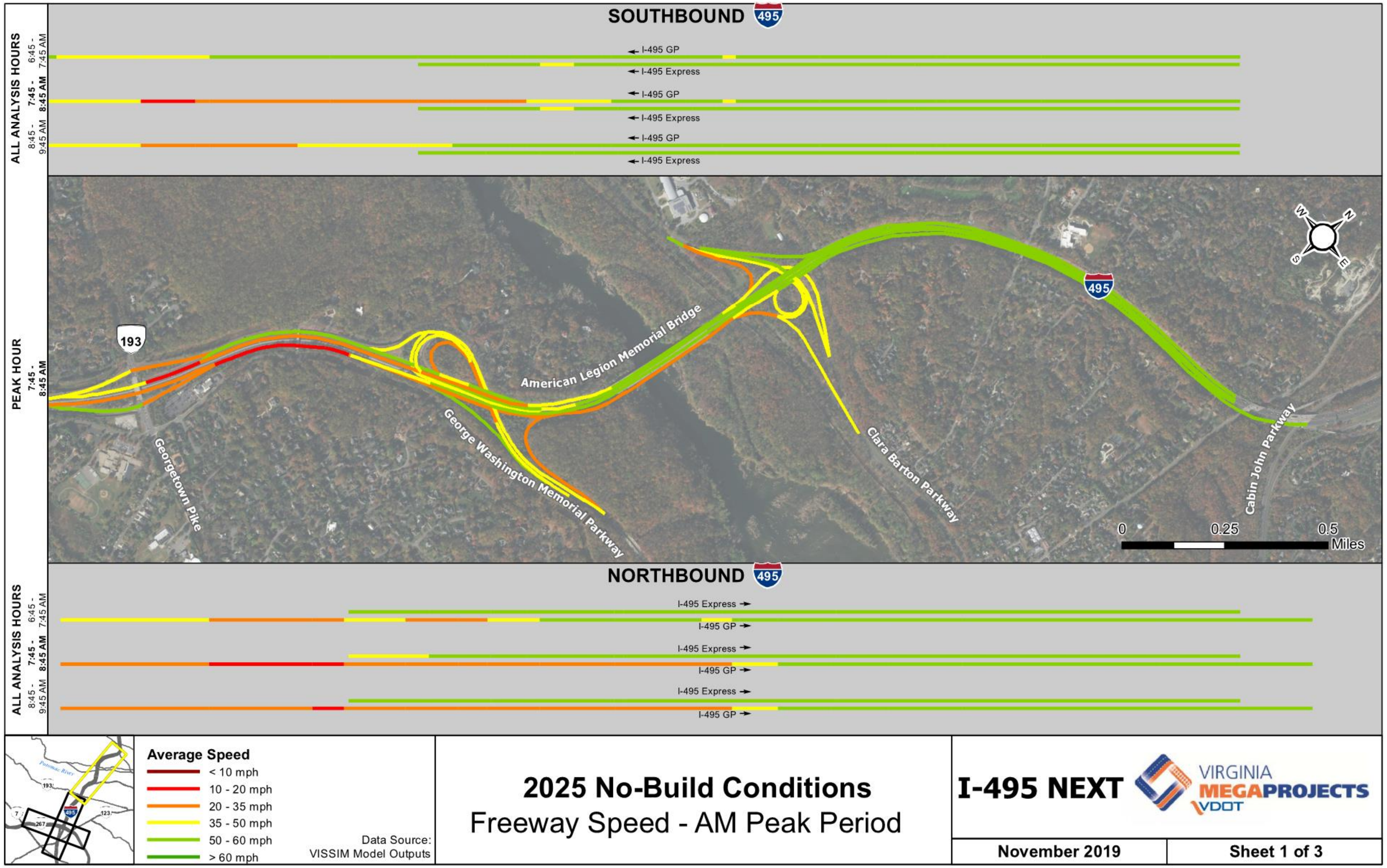


Exhibit 7-11a. 2025 No Build I-495 AM Peak Period Average Speeds – Georgetown Pike to Cabin John Parkway

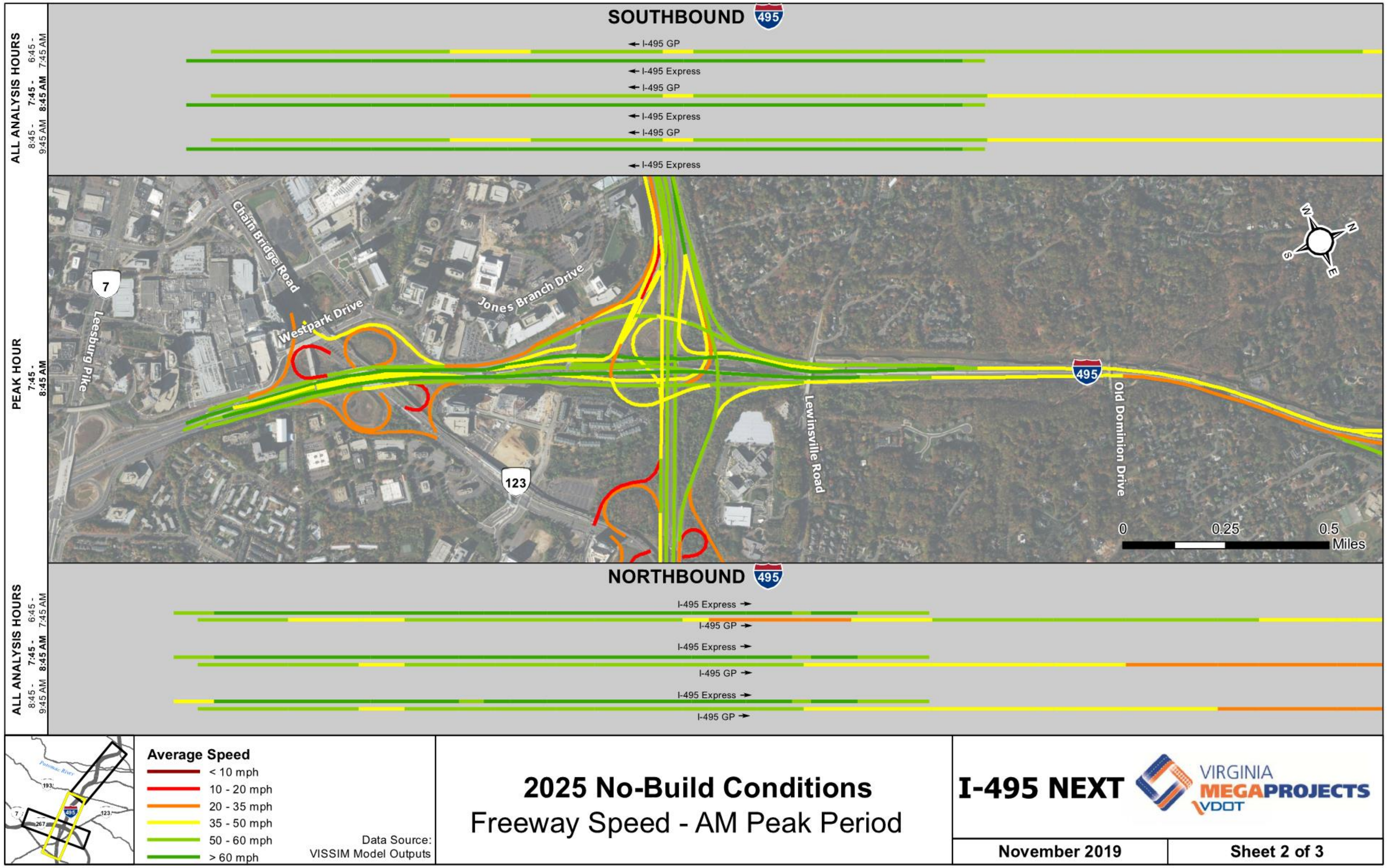


Exhibit 7-11b. 2025 No Build I-495 AM Peak Period Average Speeds – Route 123 through Old Dominion Drive

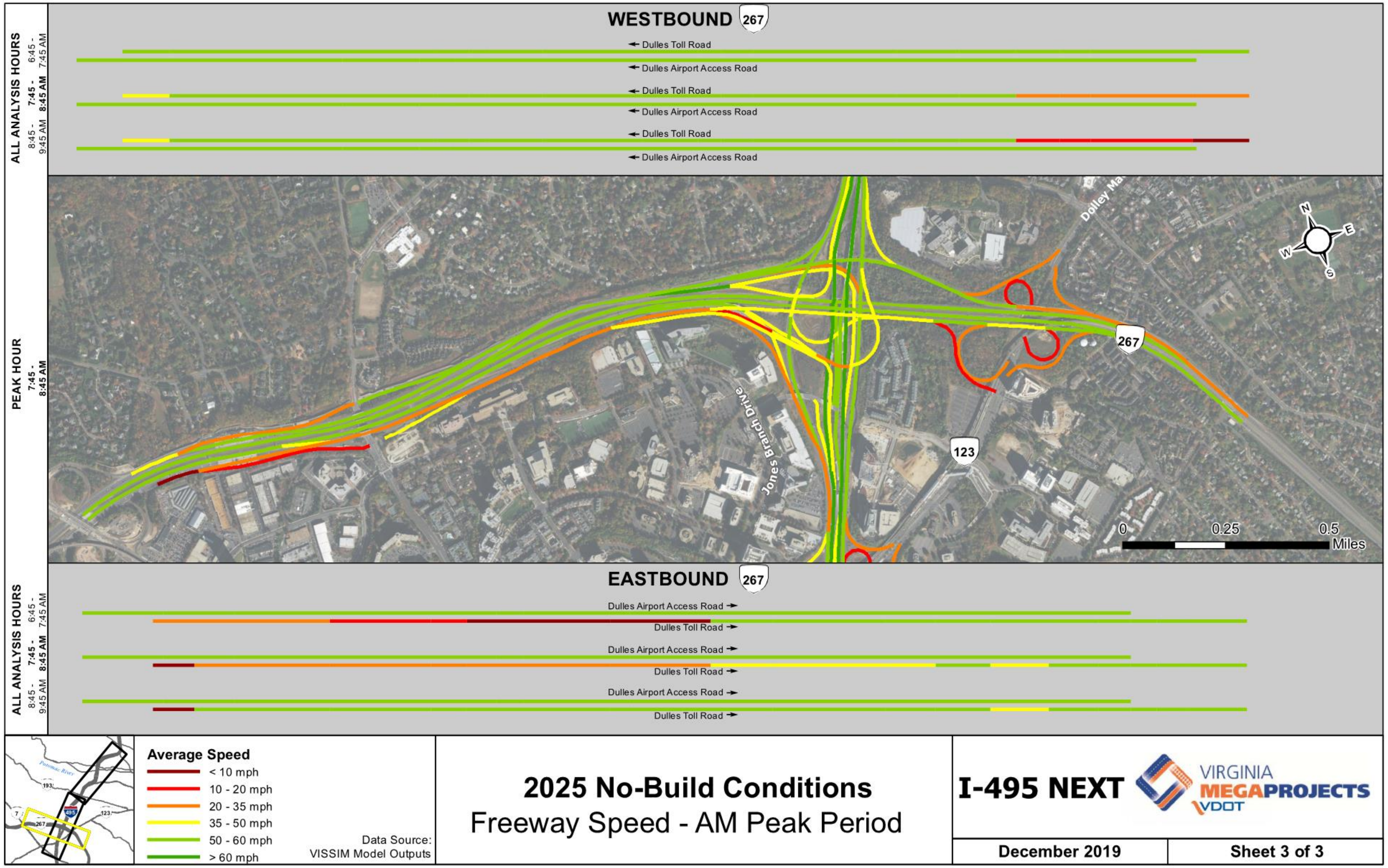


Exhibit 7-11c. 2025 No Build Route 267 AM Peak Period Average Speeds

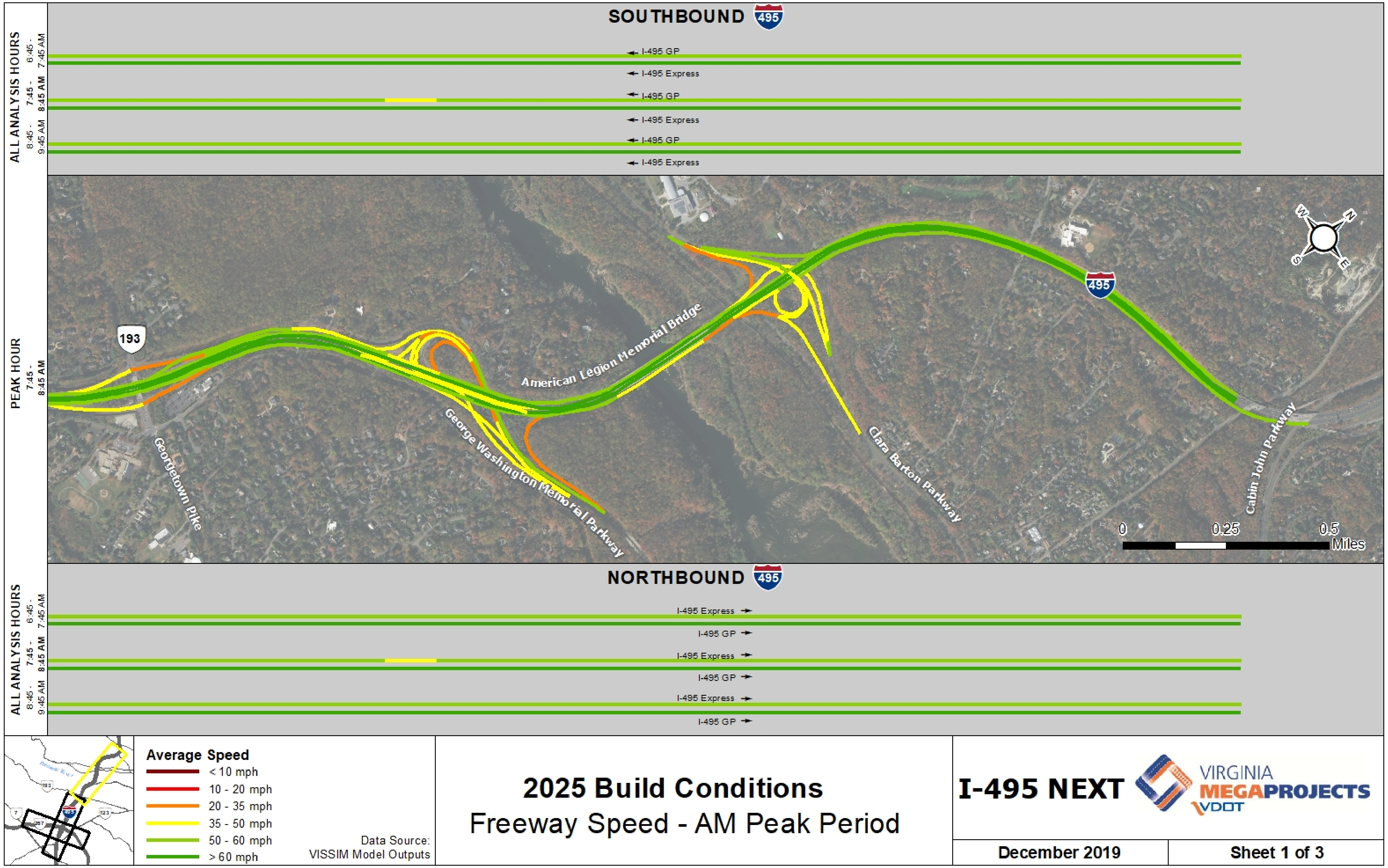


Exhibit 7-12a. 2025 Build I-495 AM Peak Period Average Speeds – Georgetown Pike to Cabin John Parkway

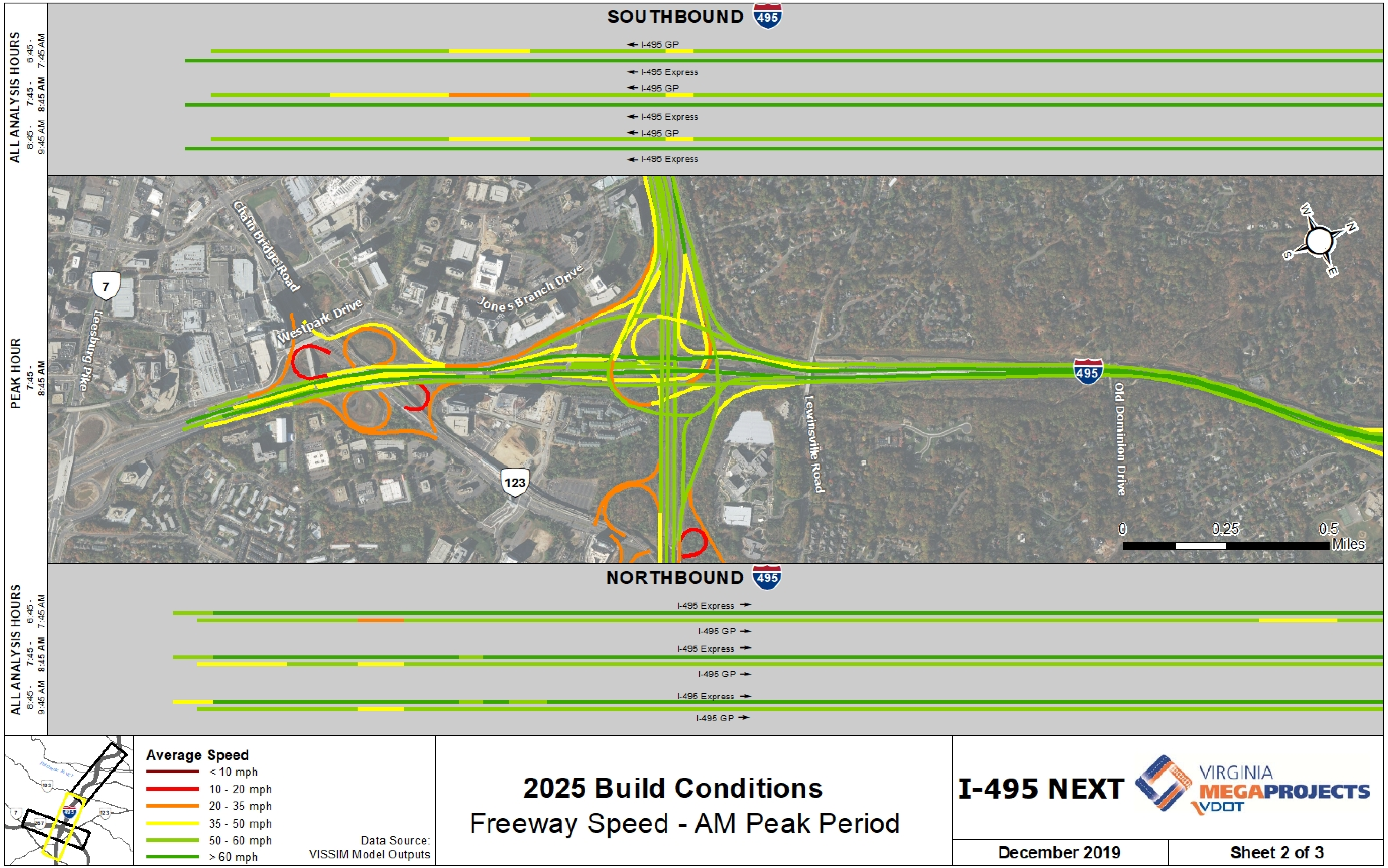


Exhibit 7-12b. 2025 Build I-495 AM Peak Period Average Speeds – Route 123 through Old Dominion Drive

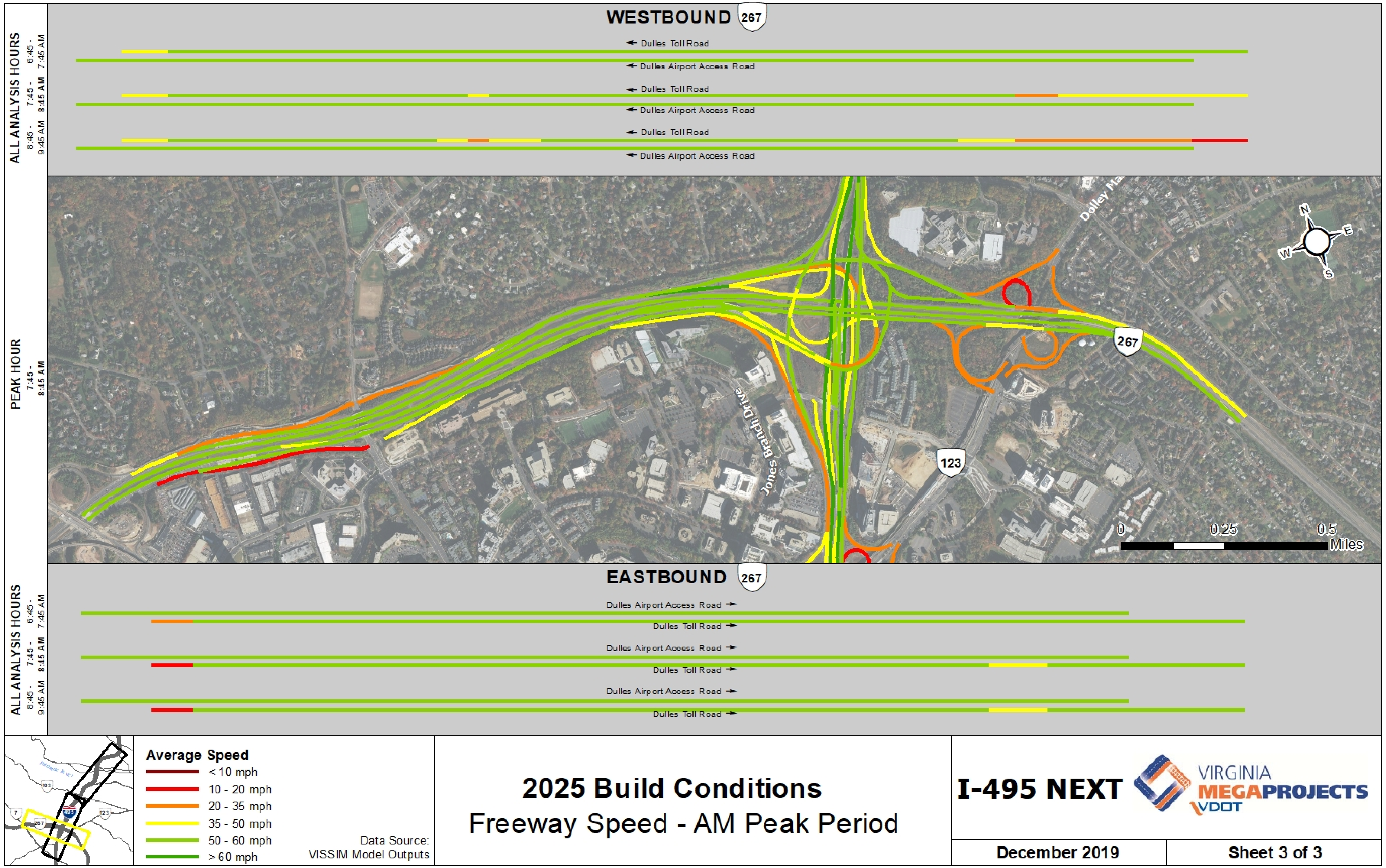


Exhibit 7-12c. 2025 Build Route 267 AM Peak Period Average Speeds

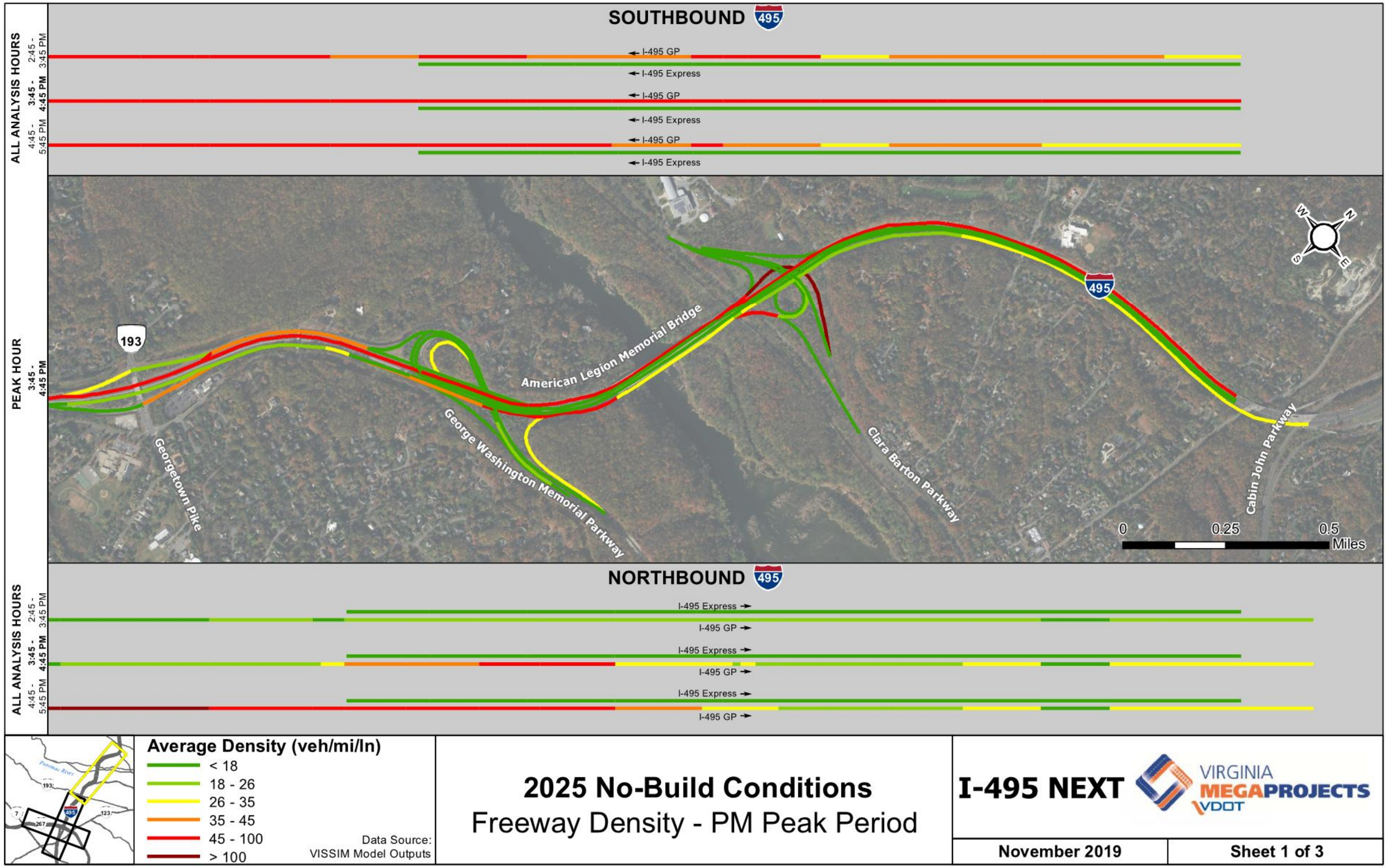


Exhibit 7-13a. 2025 No Build I-495 PM Peak Period Average Densities – Georgetown Pike to Cabin John Parkway

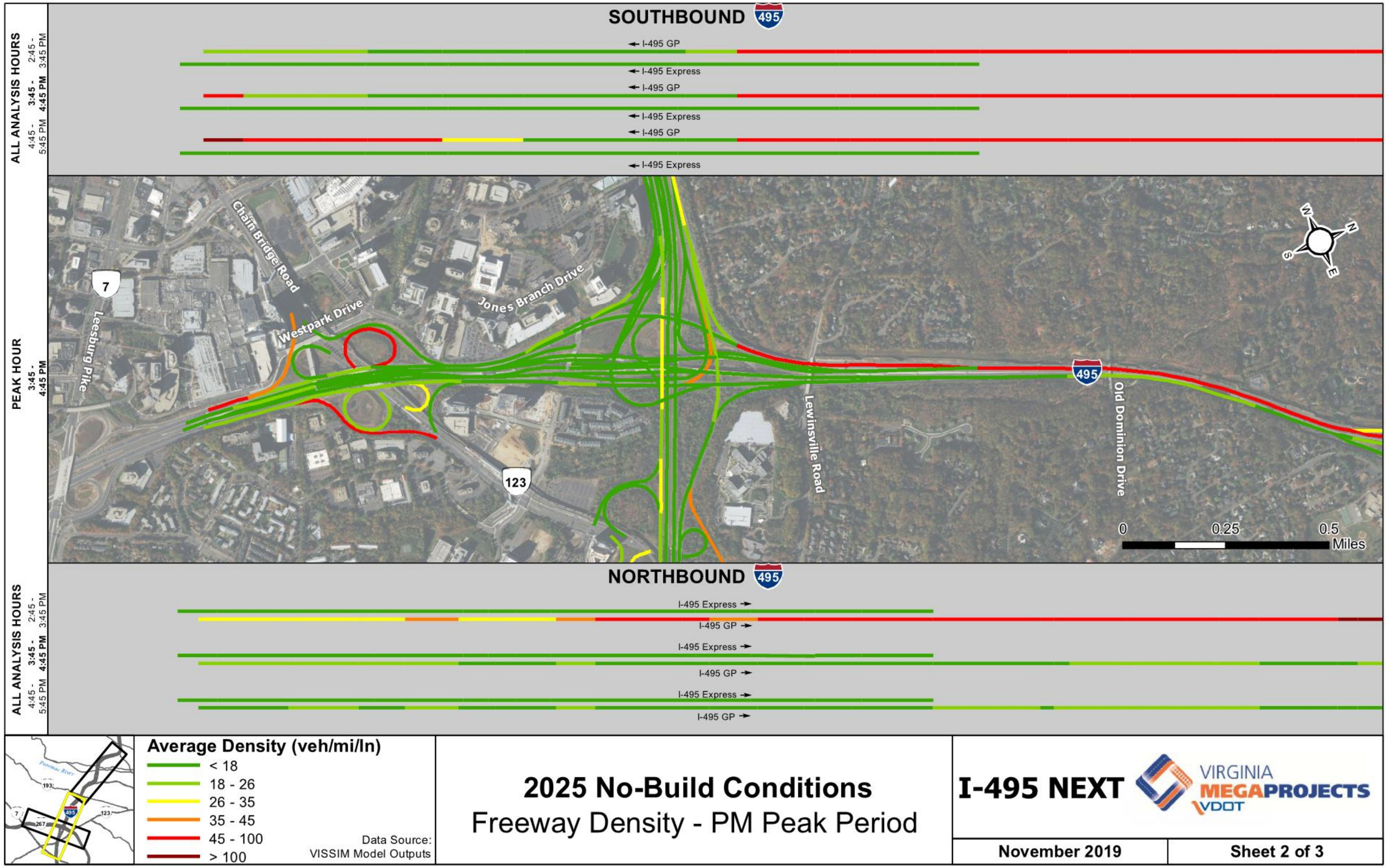


Exhibit 7-13b. 2025 No Build I-495 PM Peak Period Average Densities – Route 123 through Old Dominion Drive

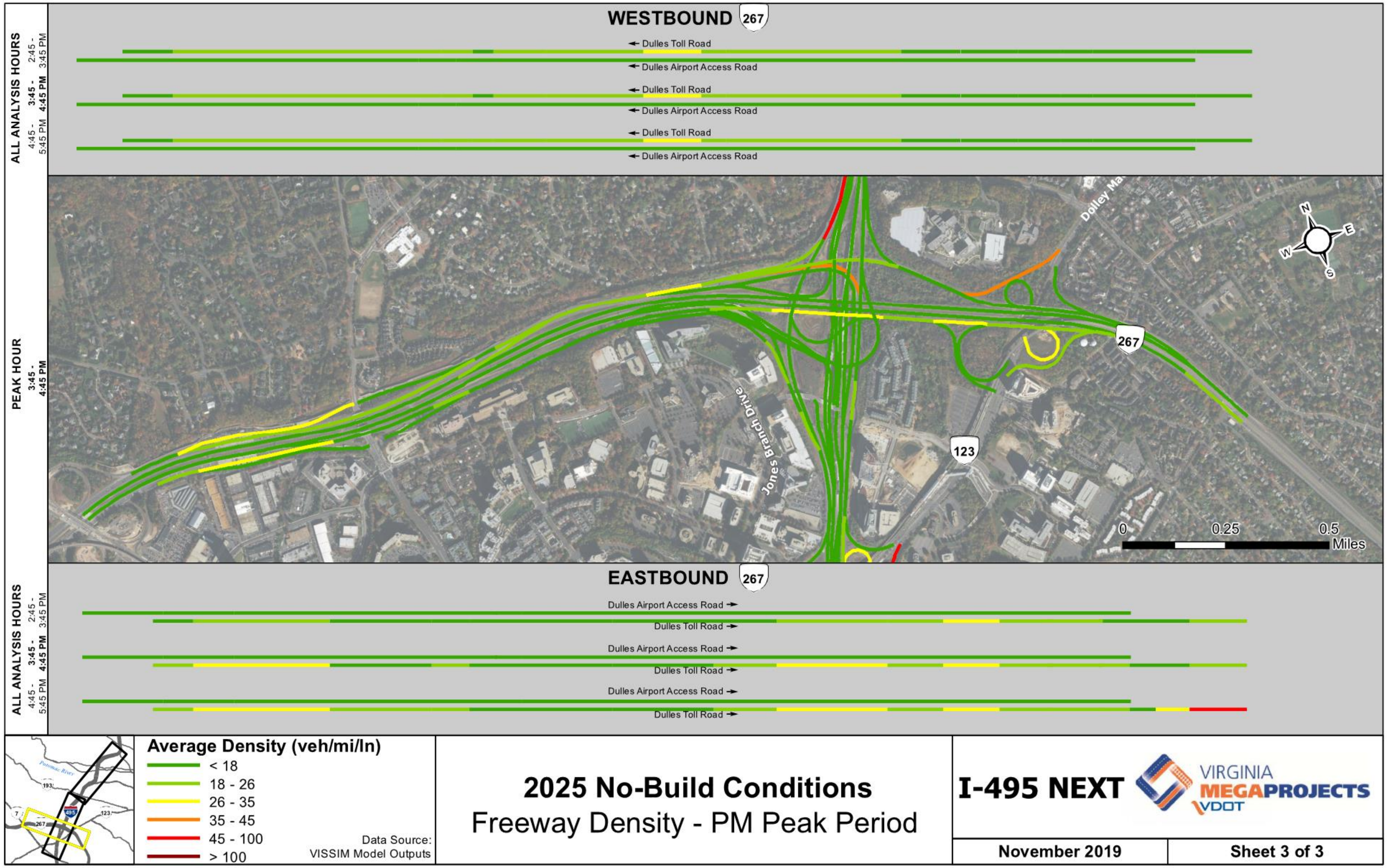


Exhibit 7-13c. 2025 No Build Route 267 PM Peak Period Average Densities

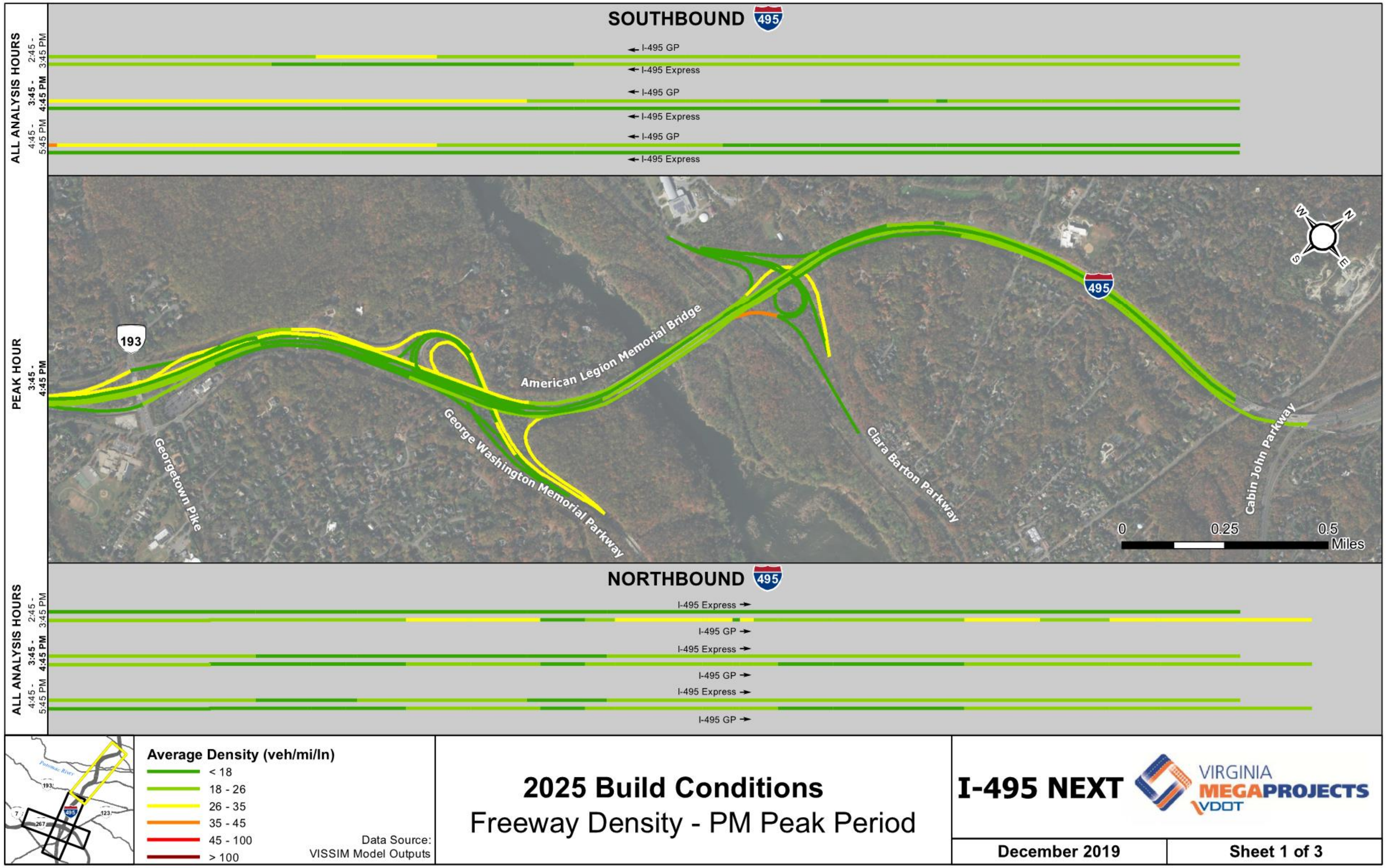


Exhibit 7-14a. 2025 Build I-495 PM Peak Period Average Densities – Georgetown Pike to Cabin John Parkway

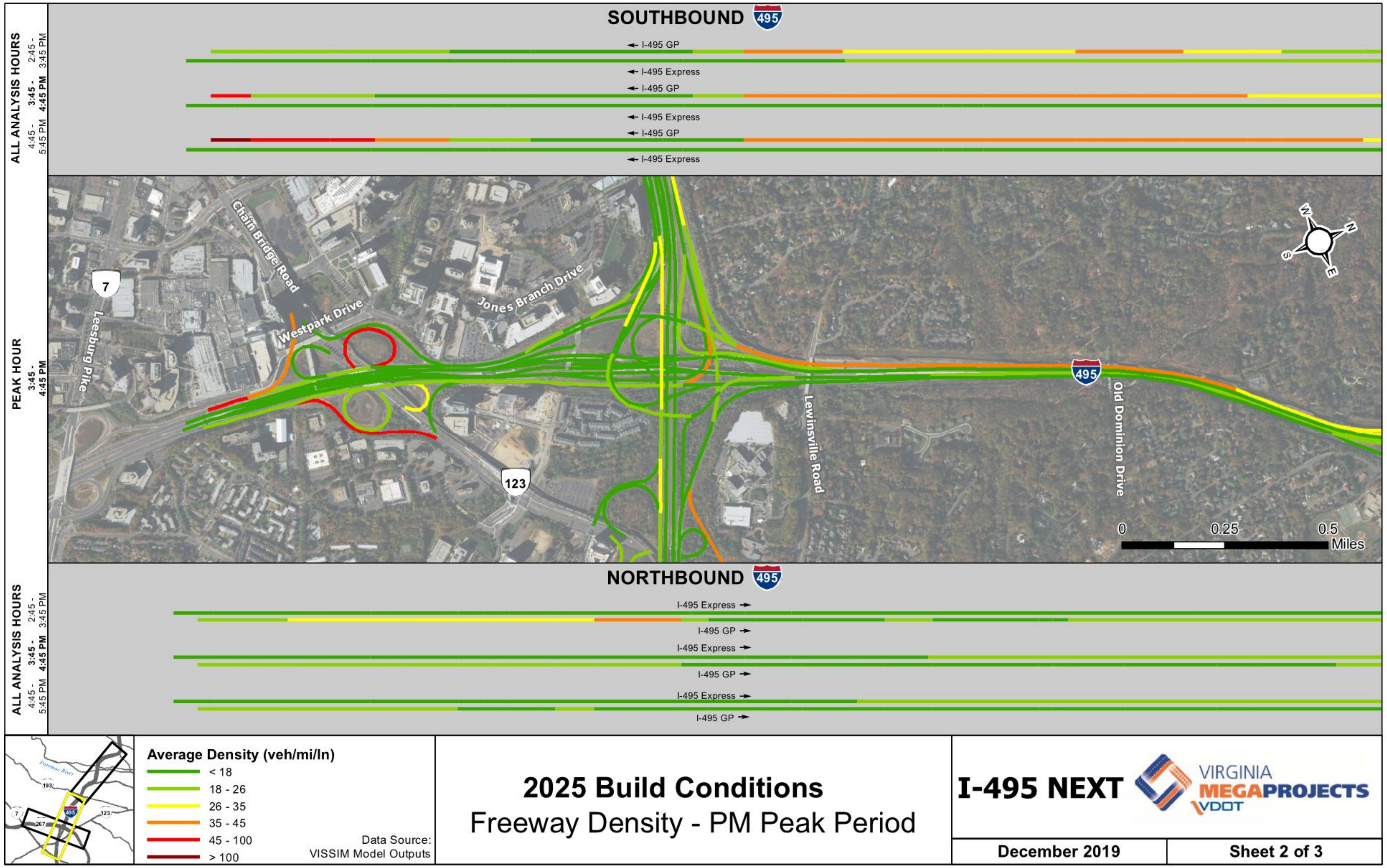


Exhibit 7-14b. 2025 Build I-495 PM Peak Period Average Densities – Route 123 through Old Dominion Drive

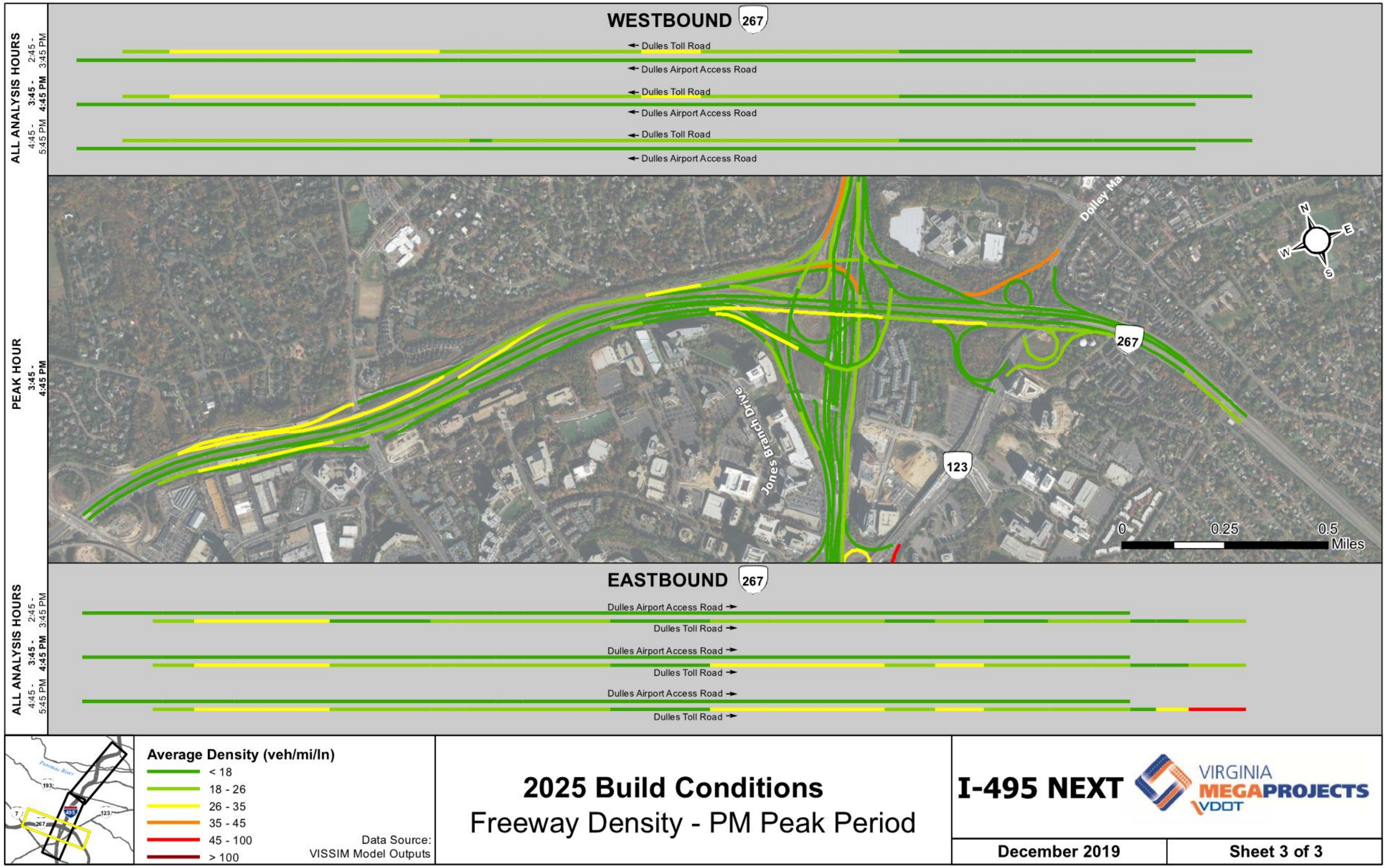


Exhibit 7-14c. 2025 Build Route 267 PM Peak Period Average Densities

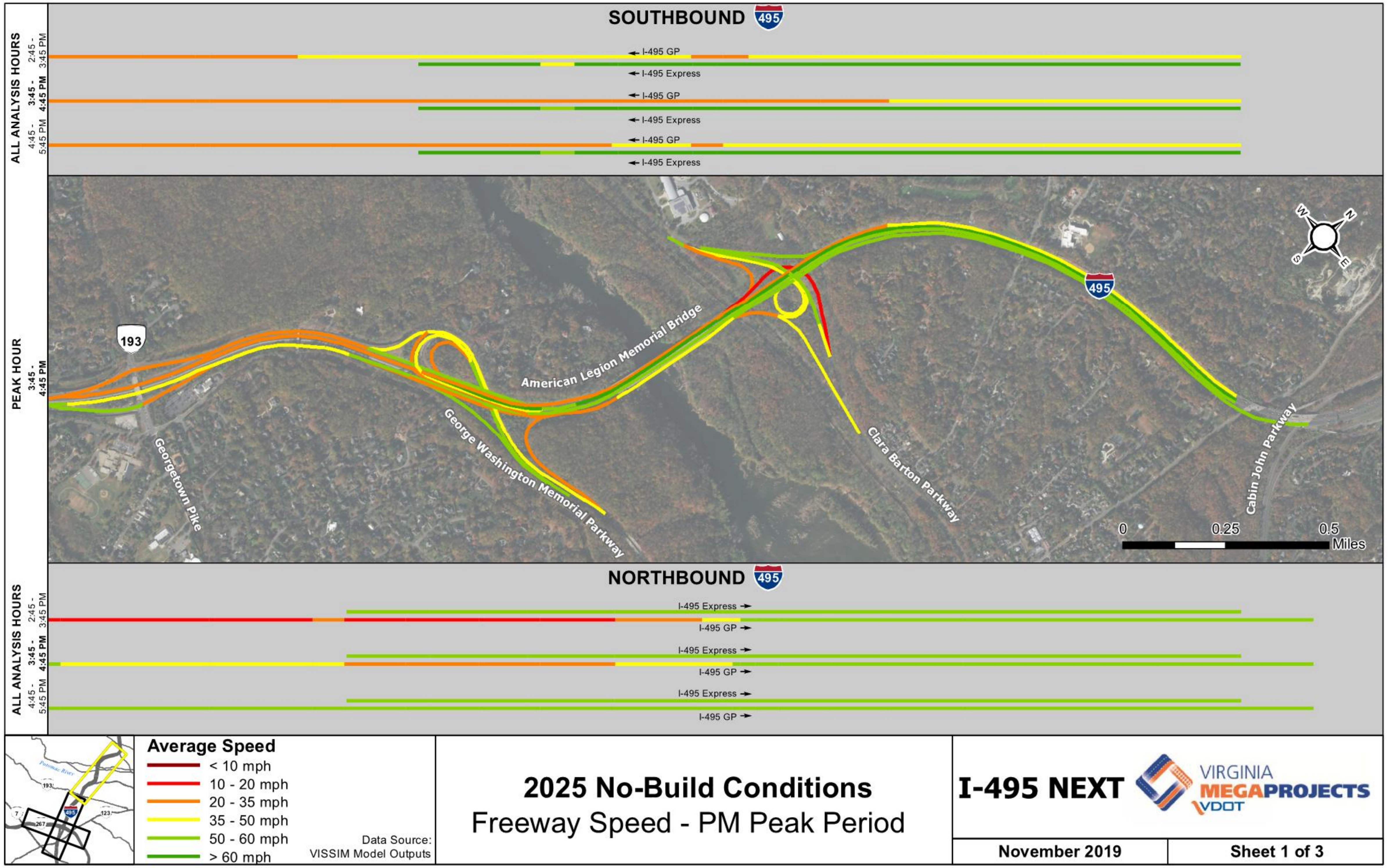


Exhibit 7-15a. 2025 No Build I-495 PM Peak Period Average Speeds – Georgetown Pike to Cabin John Parkway

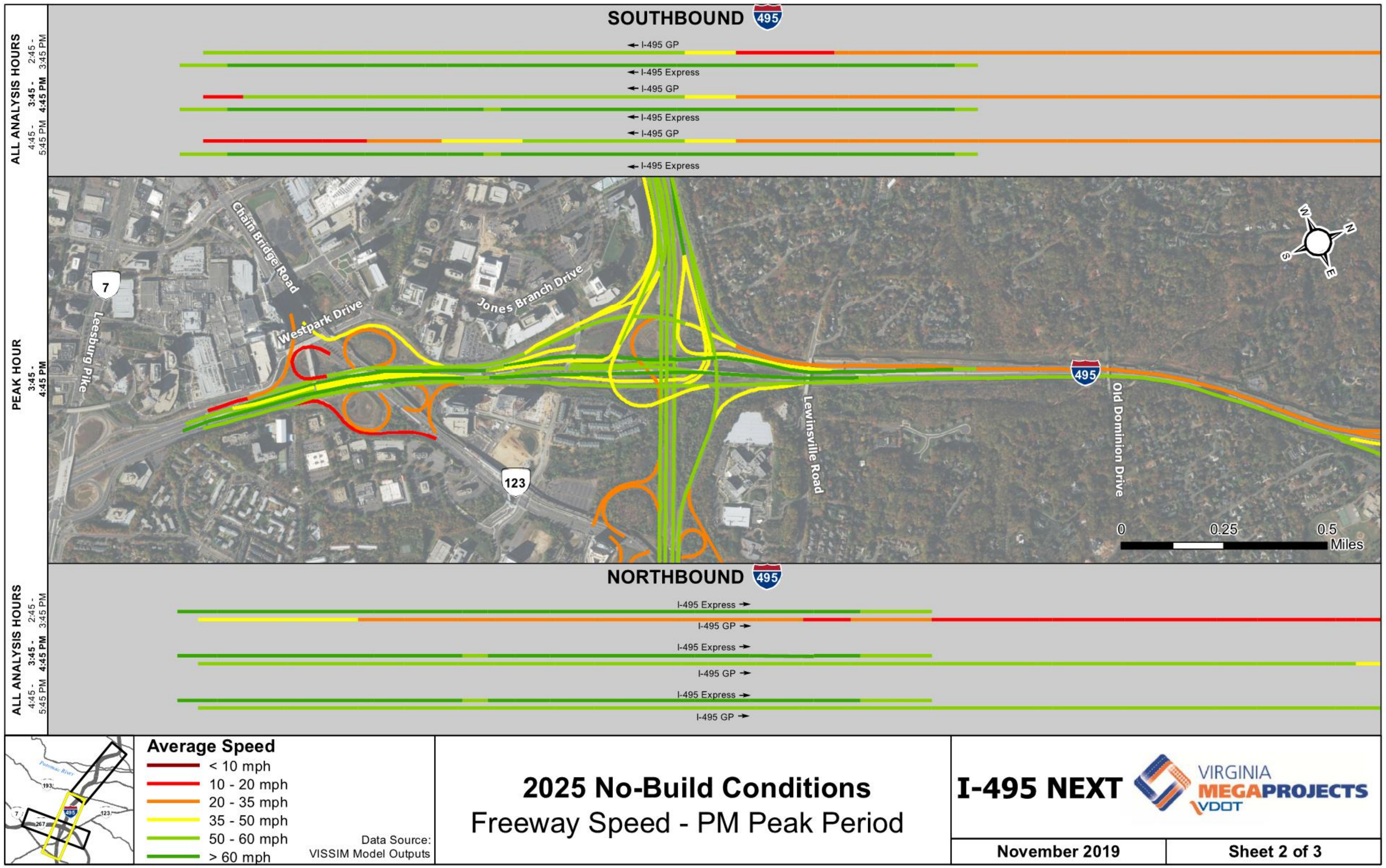


Exhibit 7-15b. 2025 No Build I-495 PM Peak Period Average Speeds – Route 123 through Old Dominion Drive

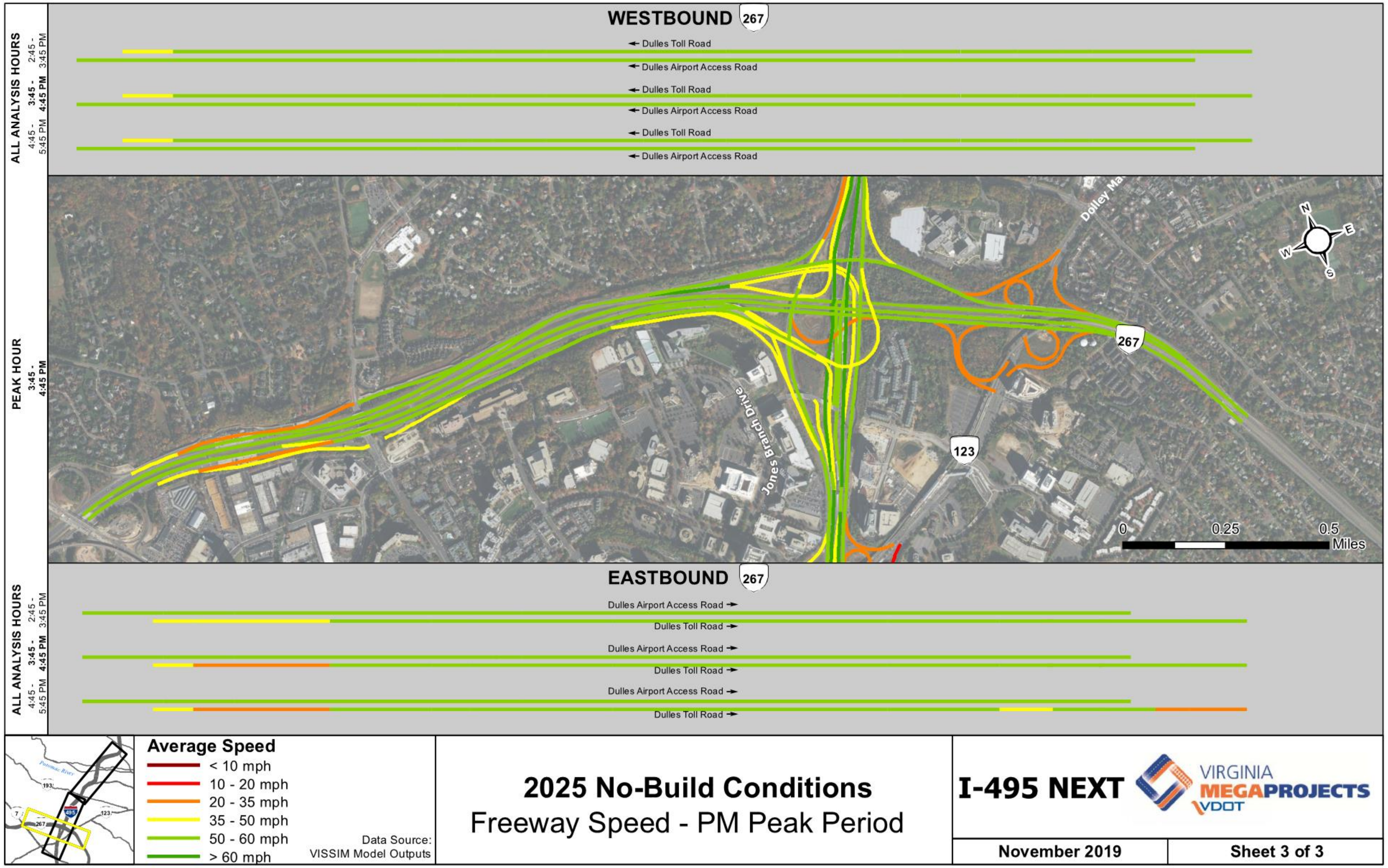


Exhibit 7-15c. 2025 No Build Route 267 PM Peak Period Average Speeds

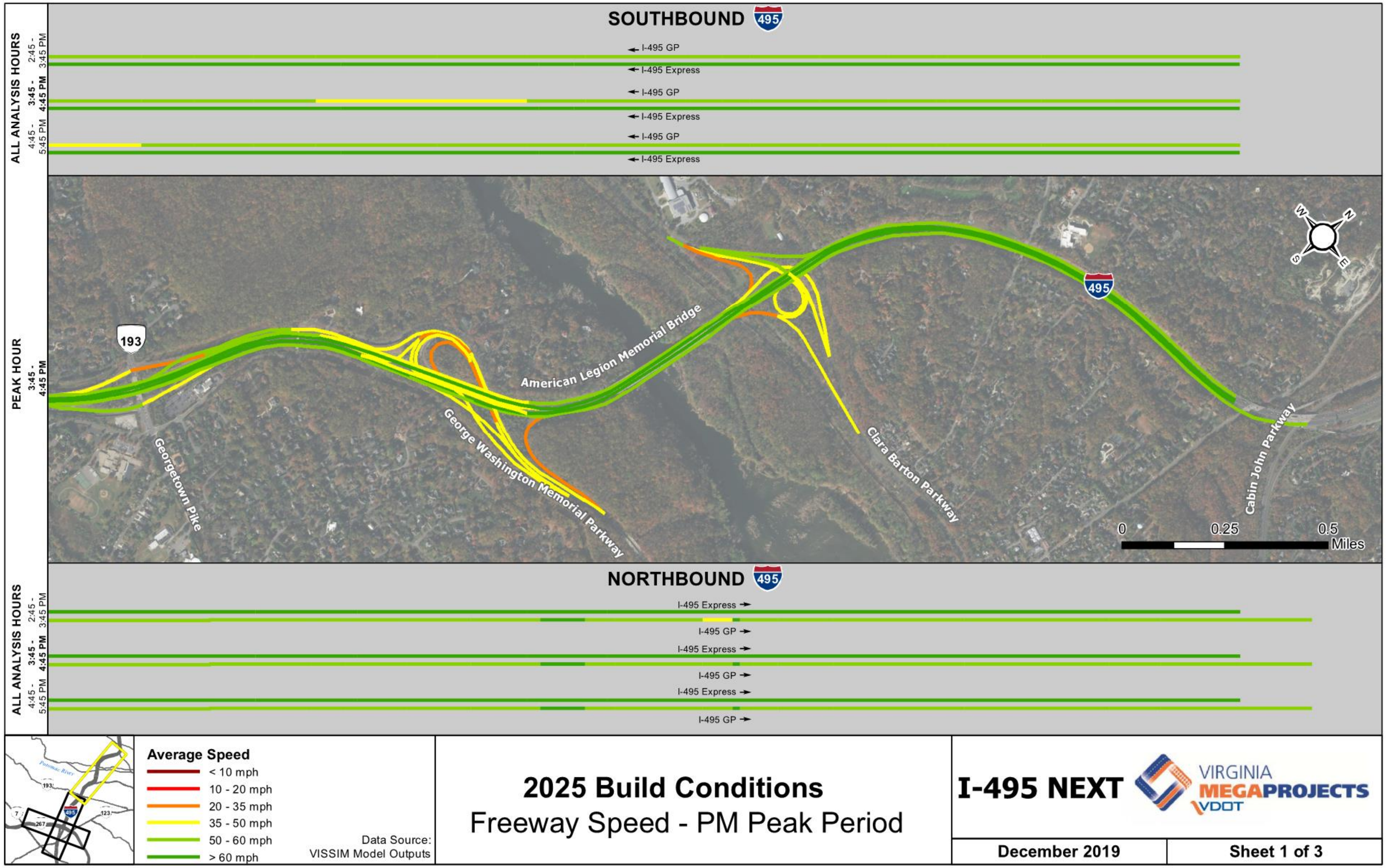


Exhibit 7-16a. 2025 Build I-495 PM Peak Period Average Speeds – Georgetown Pike to Cabin John Parkway

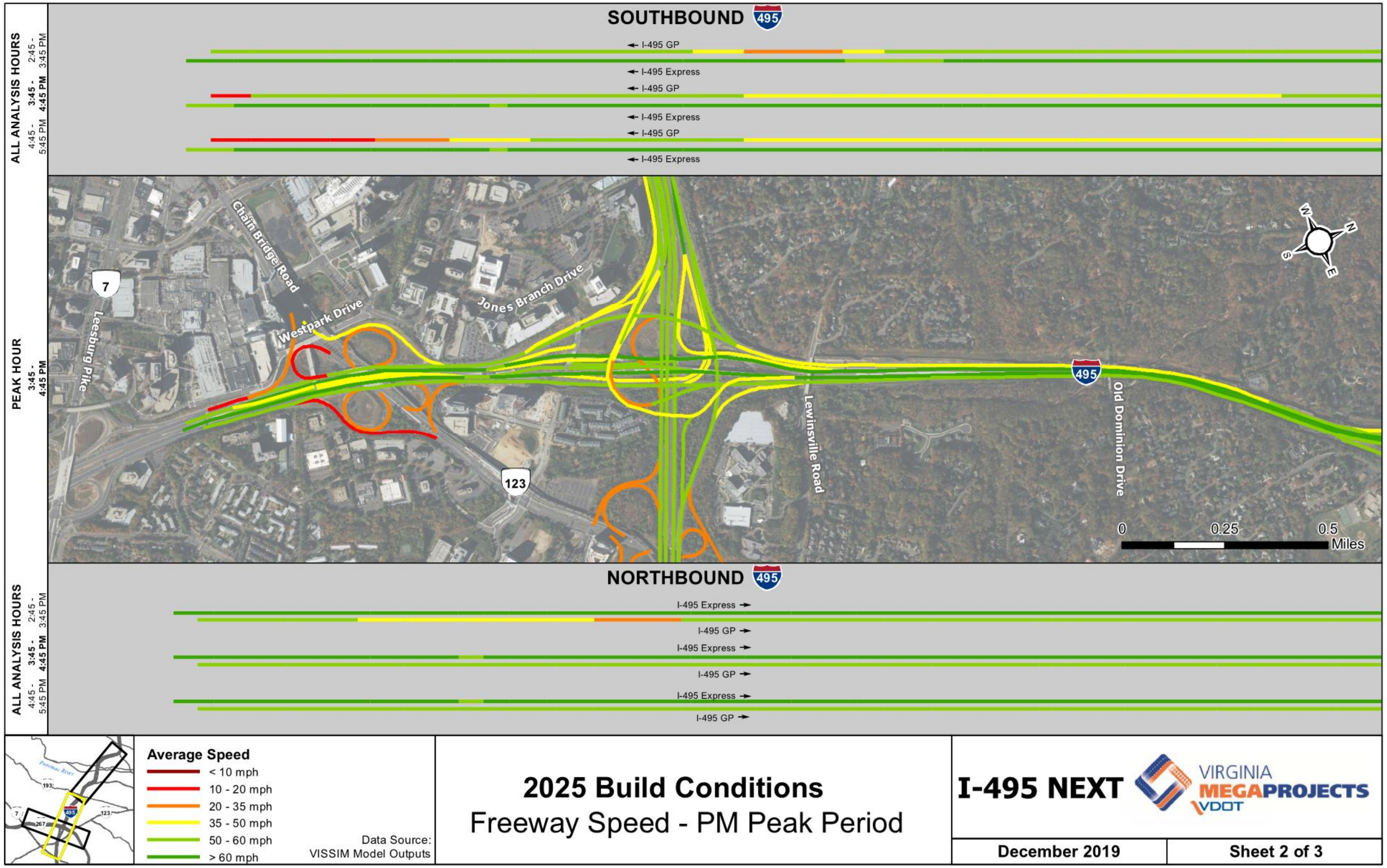


Exhibit 7-16b. 2025 Build I-495 PM Peak Period Average Speeds – Route 123 through Old Dominion Drive

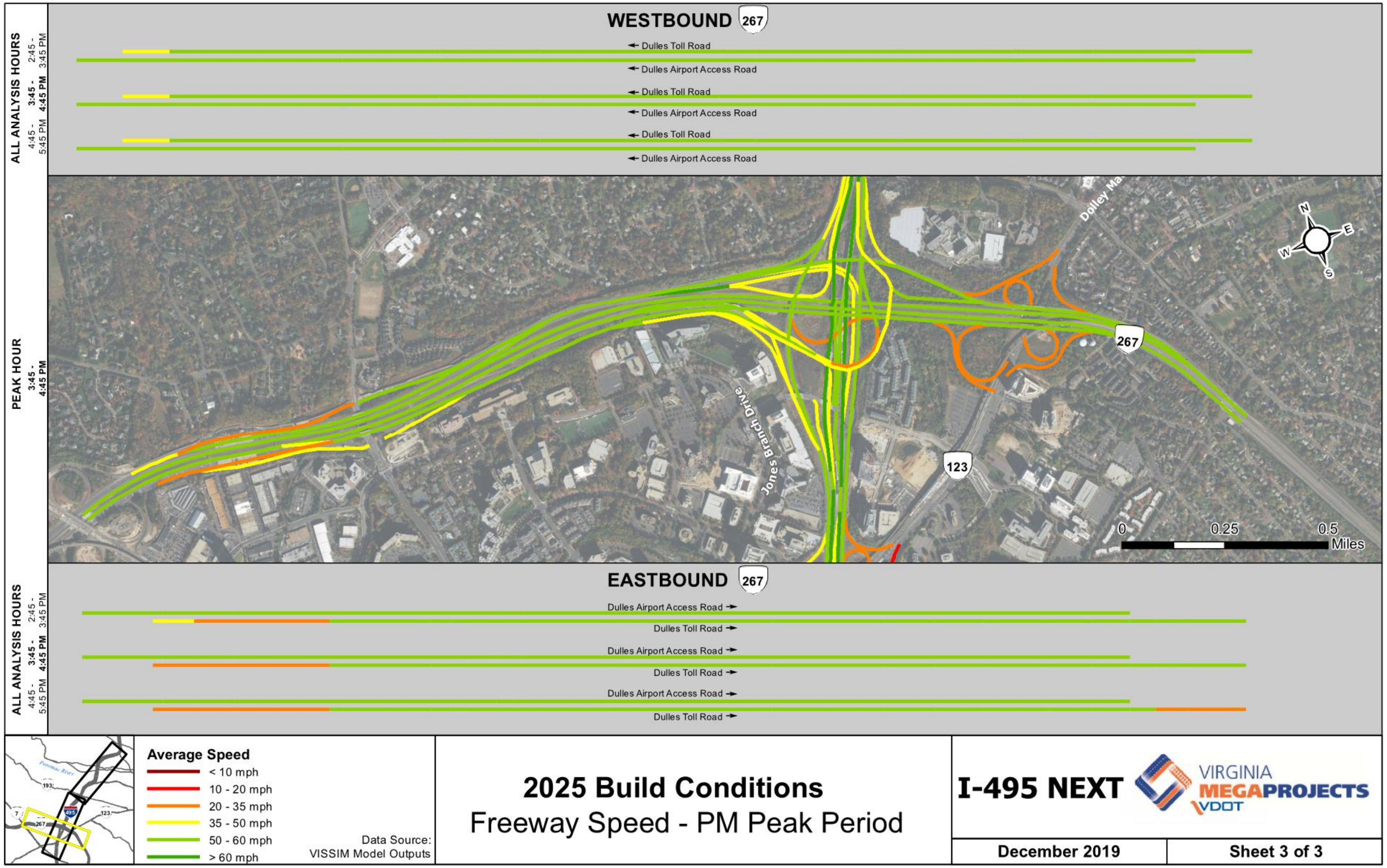


Exhibit 7-16c. 2025 Build Route 267 PM Peak Period Average Speeds

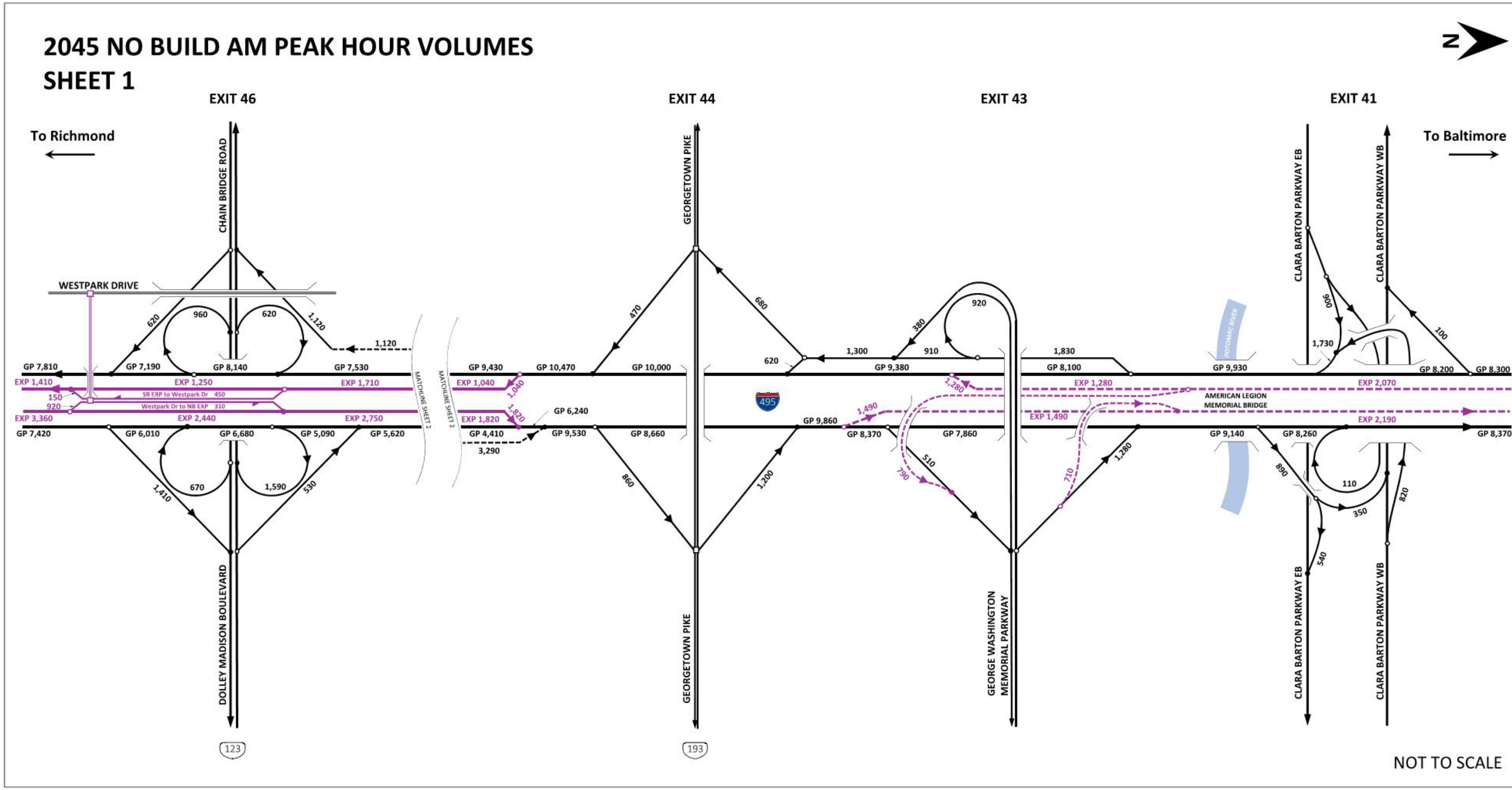


Exhibit 7-17a. Freeway 2045 No Build AM Peak Hour Volume – I-495

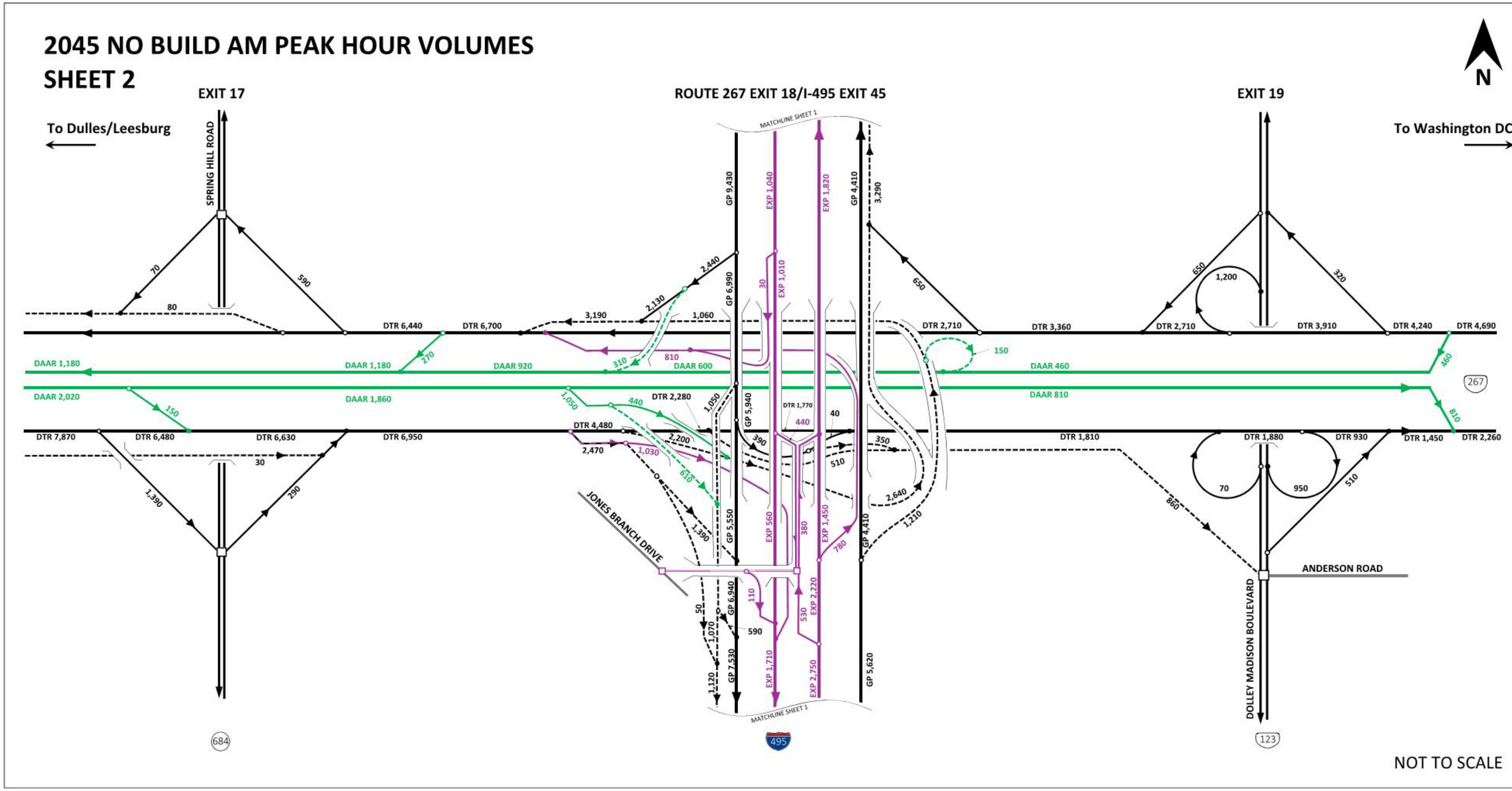


Exhibit 7-17b. Freeway 2045 No Build AM Peak Hour Volume – Route 267

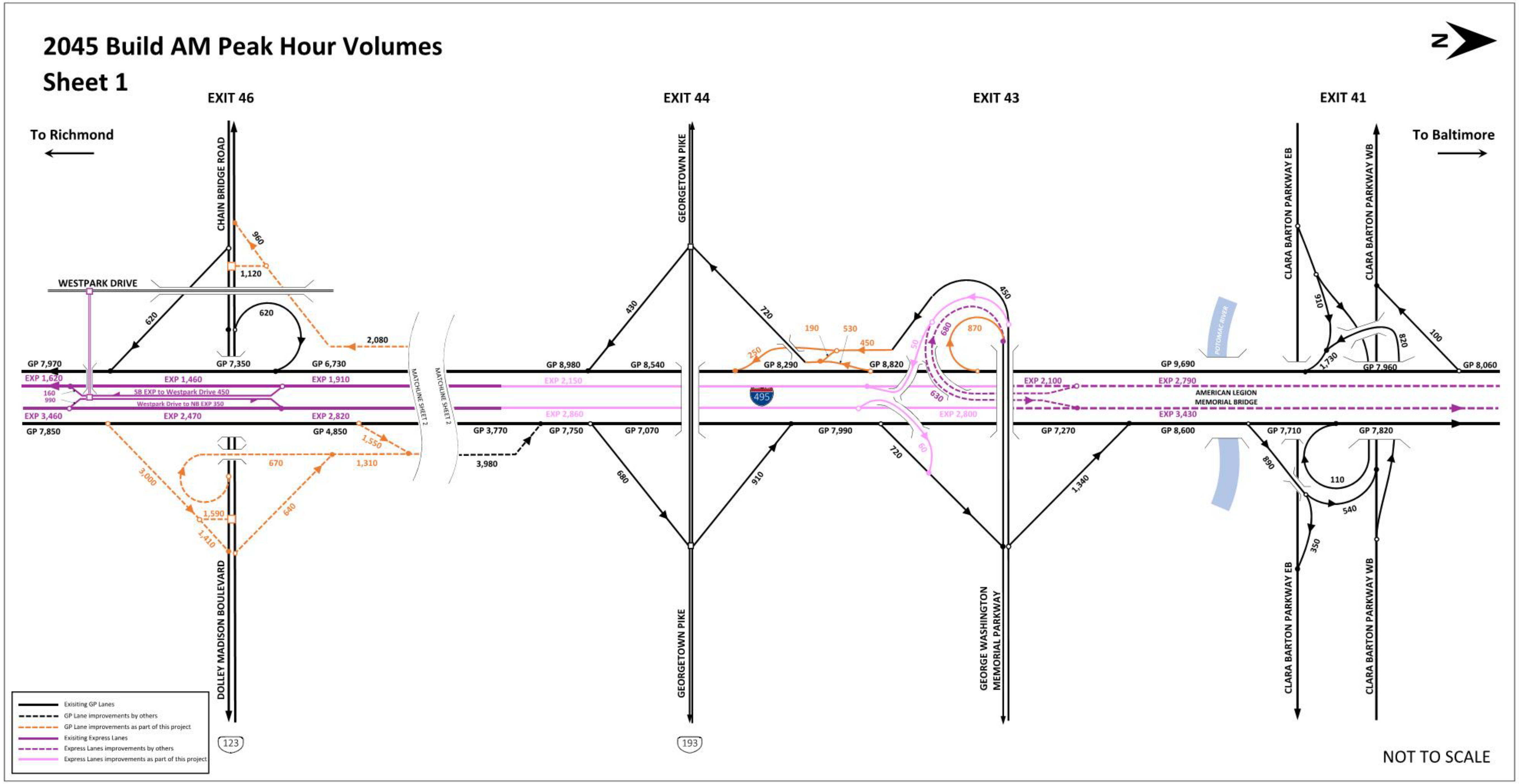


Exhibit 7-18a. Freeway 2045 Build AM Peak Hour Volume – I-495

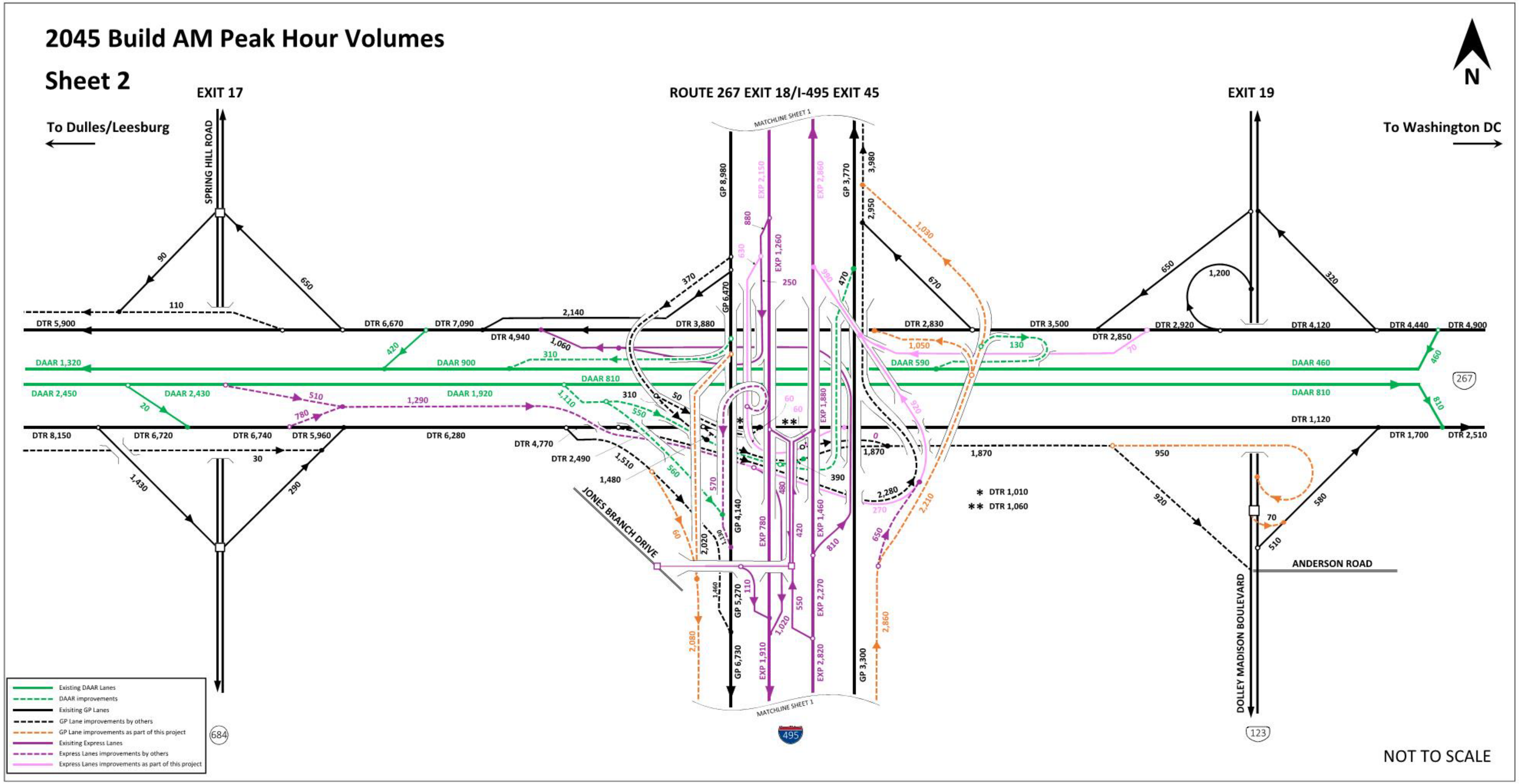


Exhibit 7-18b. Freeway 2045 Build AM Peak Hour Volume – Route 267

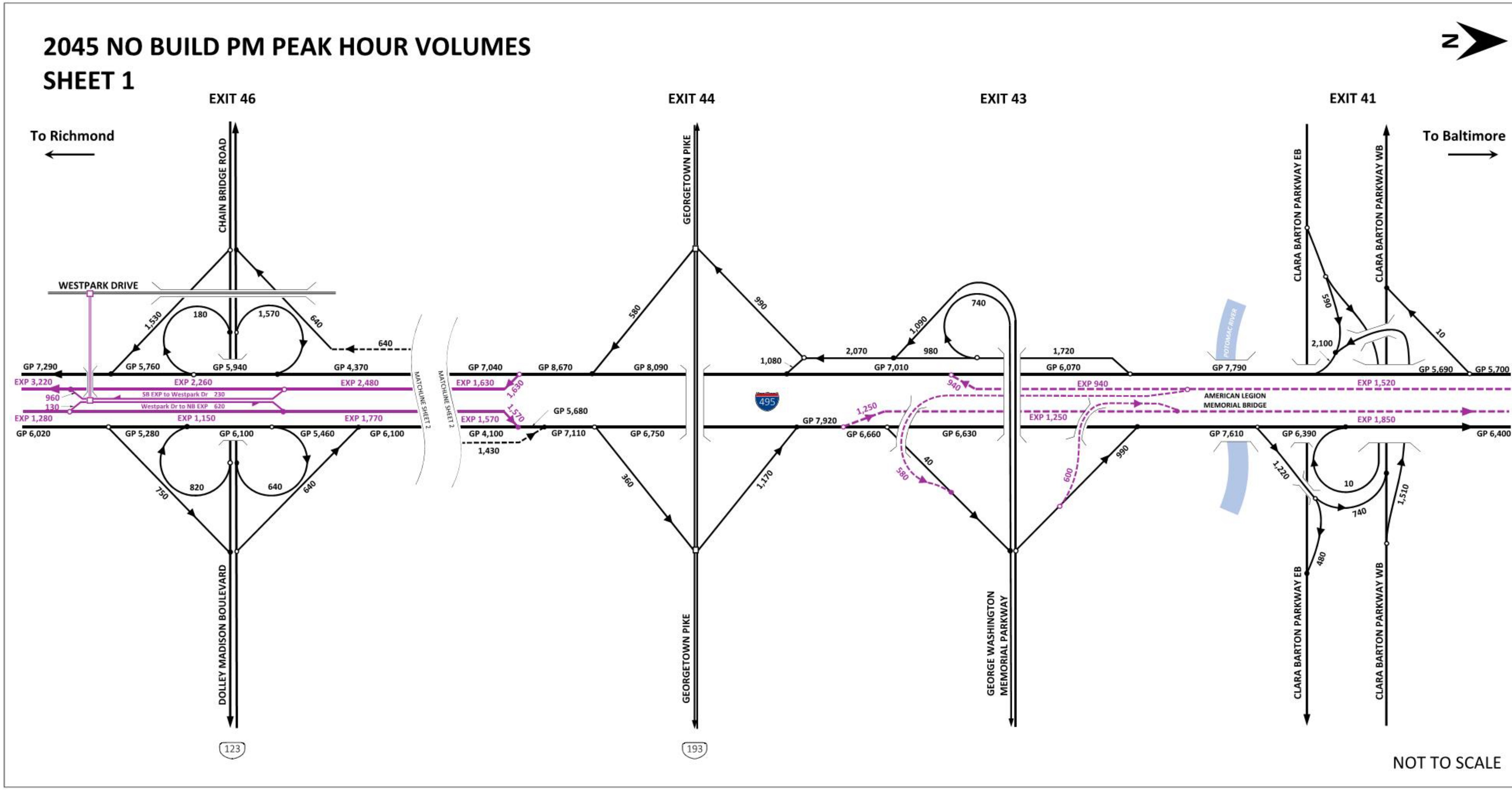


Exhibit 7-19a. Freeway 2045 No Build PM Peak Hour Volume – I-495

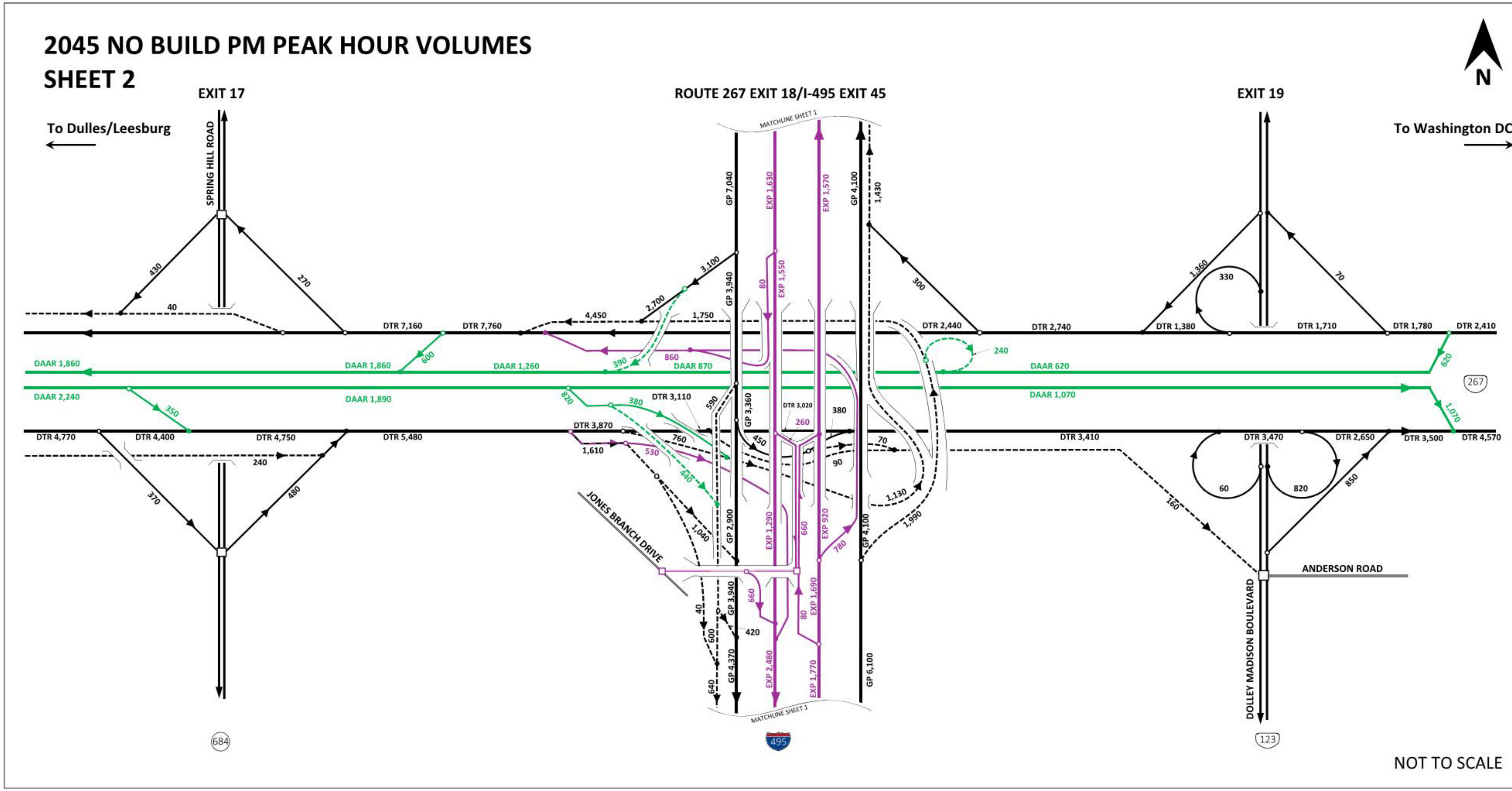


Exhibit 7-19b. Freeway 2045 No Build PM Peak Hour Volume – Route 267

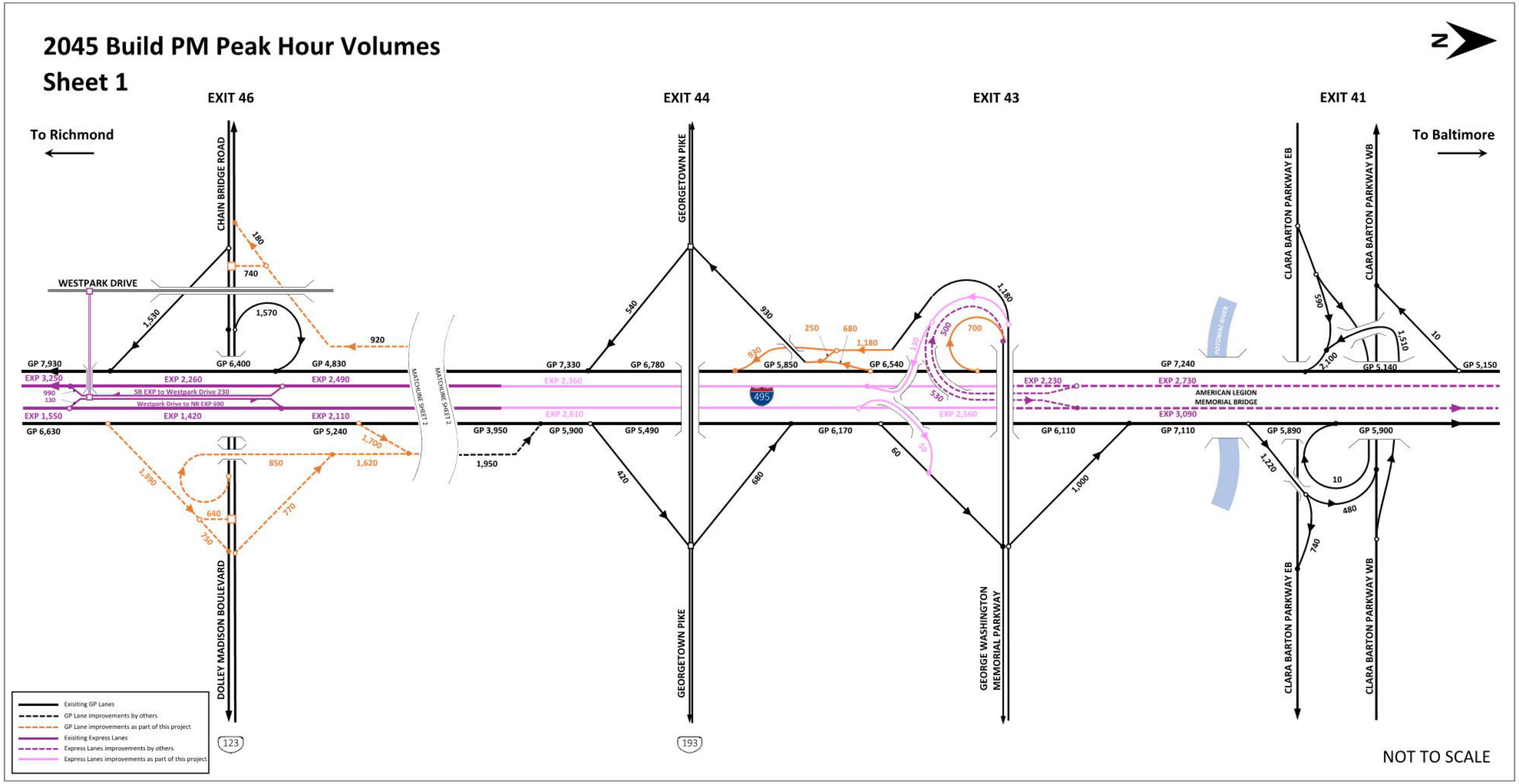


Exhibit 7-20a. Freeway 2045 Build PM Peak Hour Volume – I-495

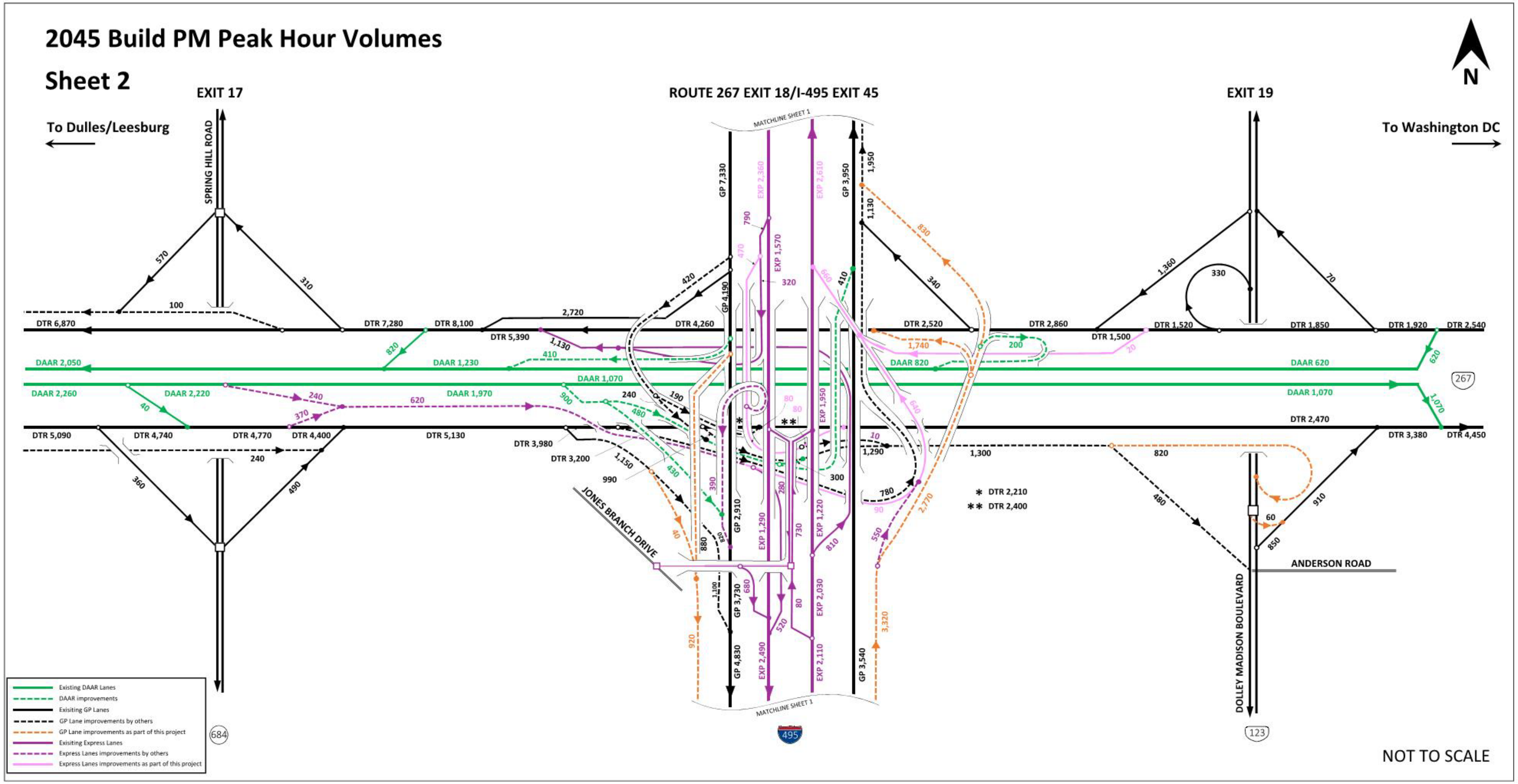


Exhibit 7-20b. Freeway 2045 Build PM Peak Hour Volume – Route 267

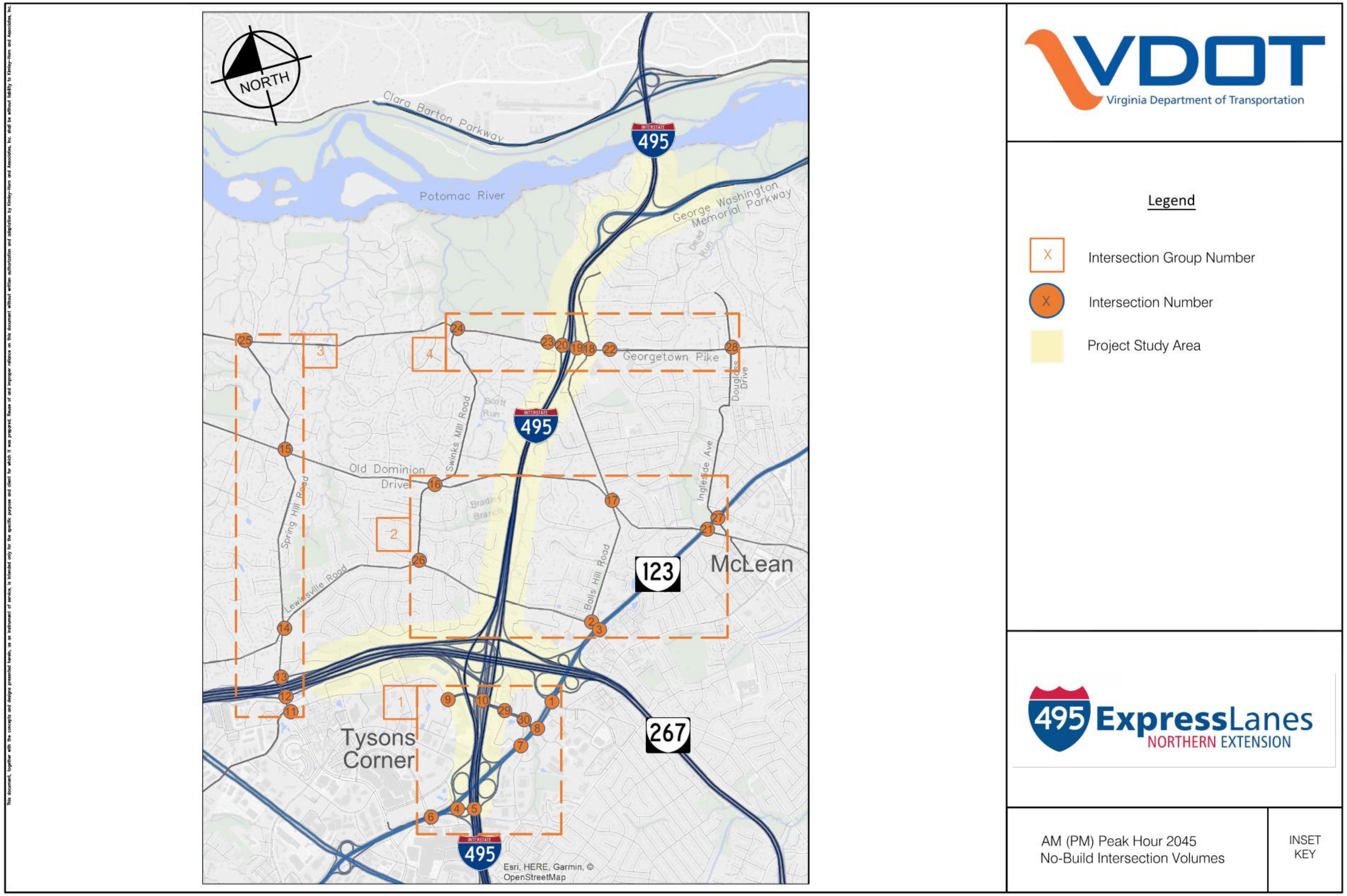


Exhibit 7-21a. Arterial 2045 No Build Peak Hour Turning Movement Volumes – Figure Key

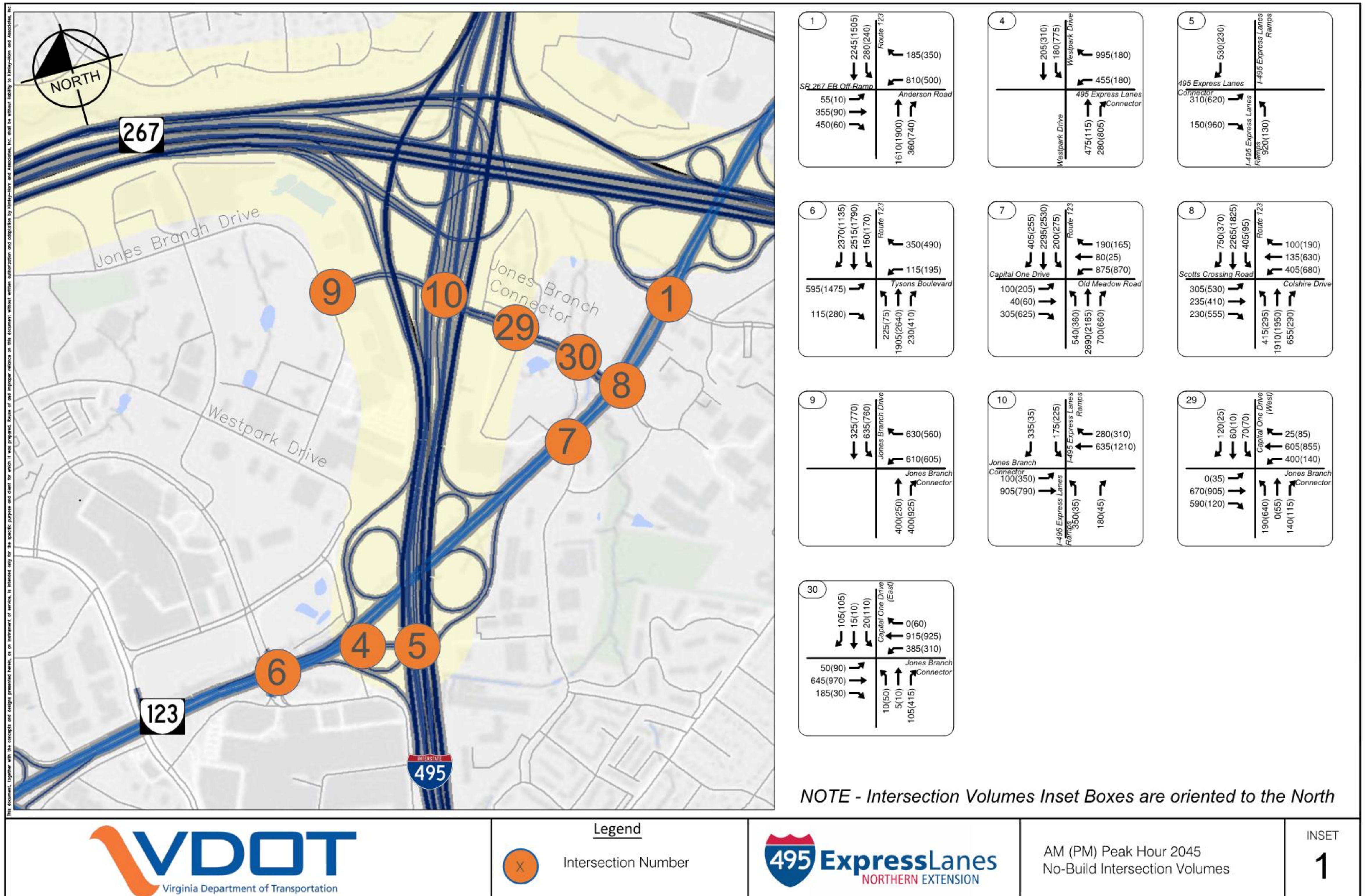


Exhibit 7-21b. Arterial 2045 No Build Peak Hour Turning Movement Volumes – Location 1

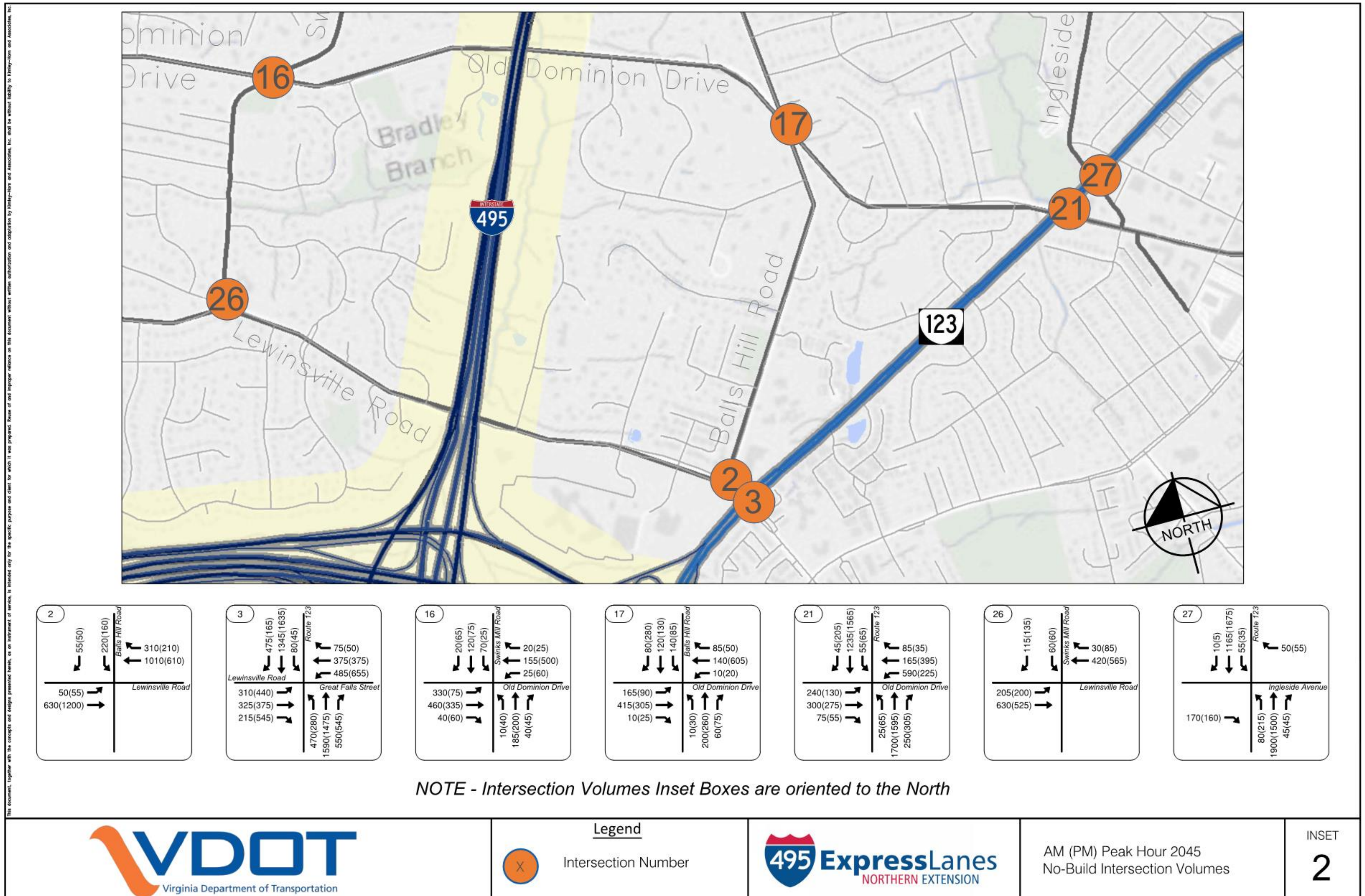


Exhibit 7-21c. Arterial 2045 No Build Peak Hour Turning Movement Volumes – Location 2

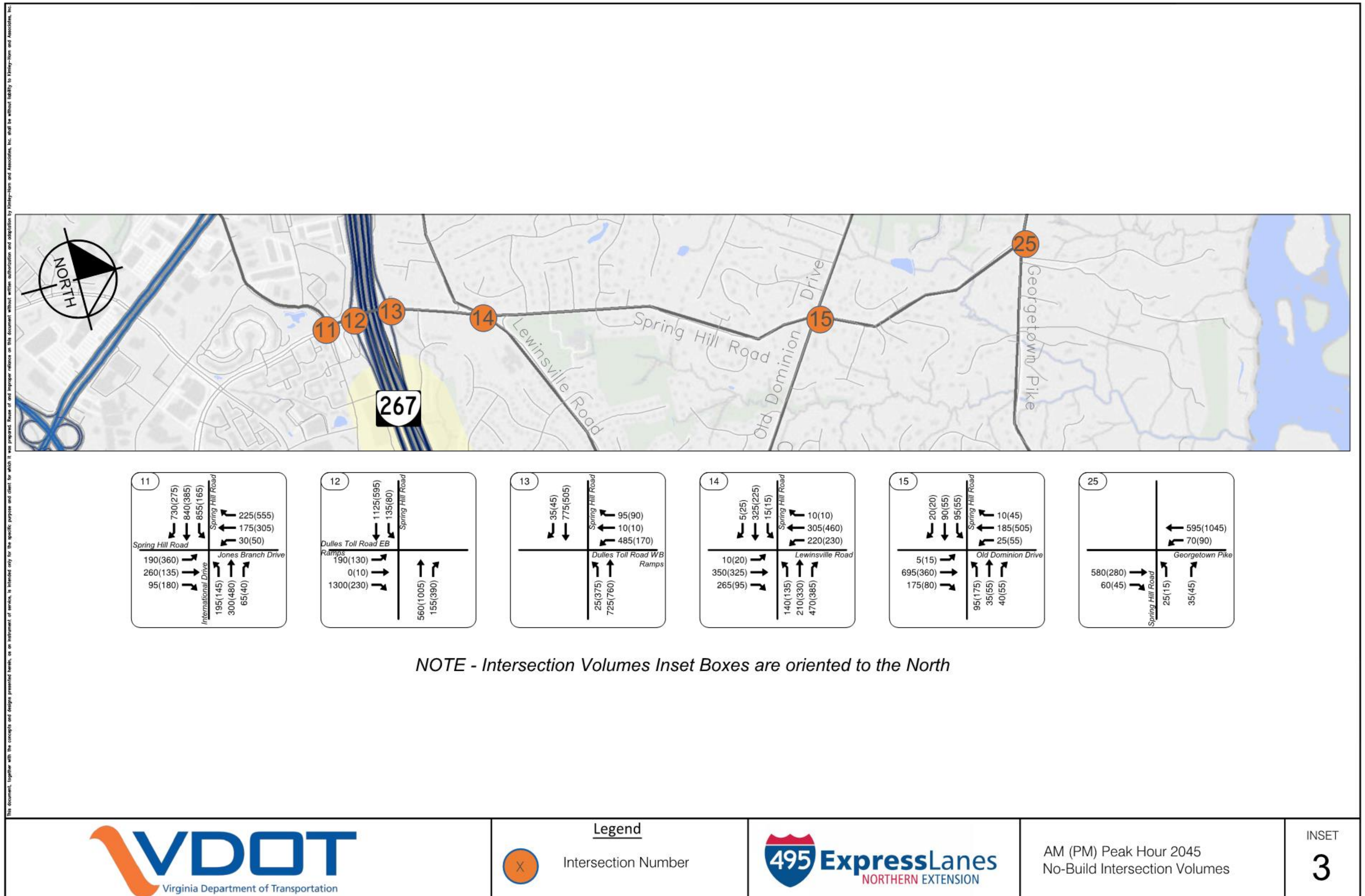


Exhibit 7-21d. Arterial 2045 No Build Peak Hour Turning Movement Volumes – Location 3

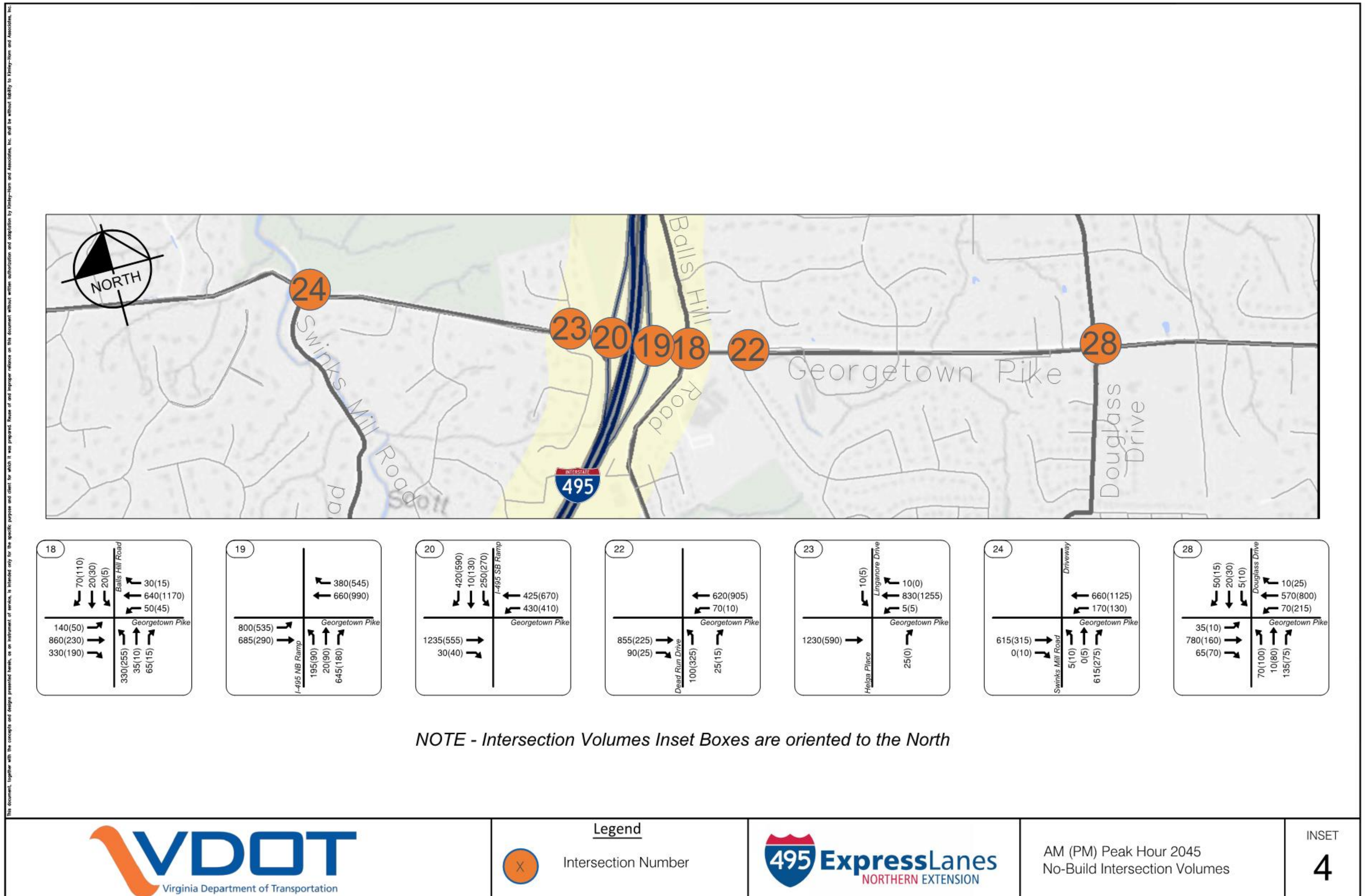


Exhibit 7-21e. Arterial 2045 No Build Peak Hour Turning Movement Volumes – Location 4

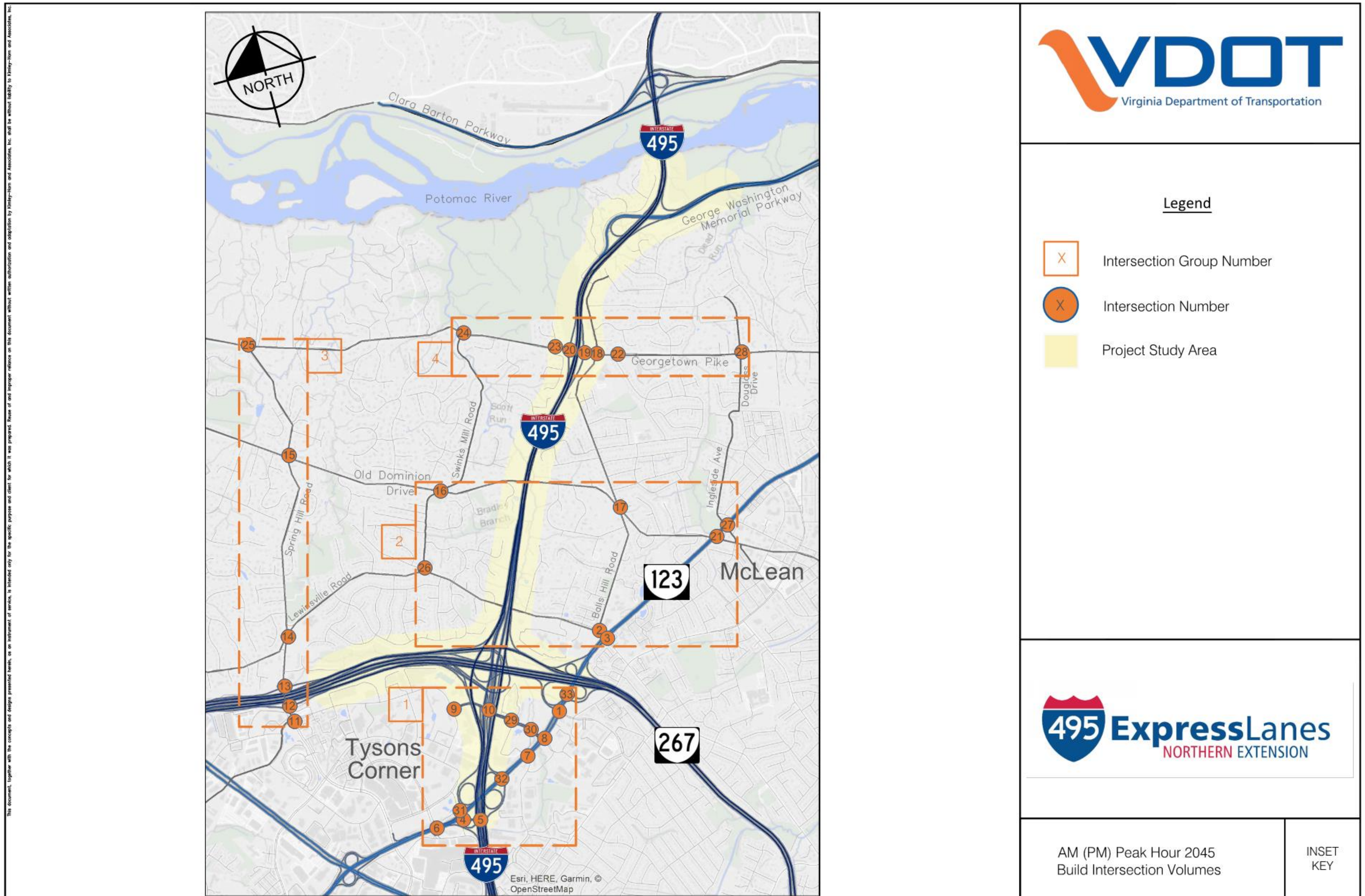


Exhibit 7-22a. Arterial 2045 Build Peak Hour Turning Movement Volumes – Figure Key

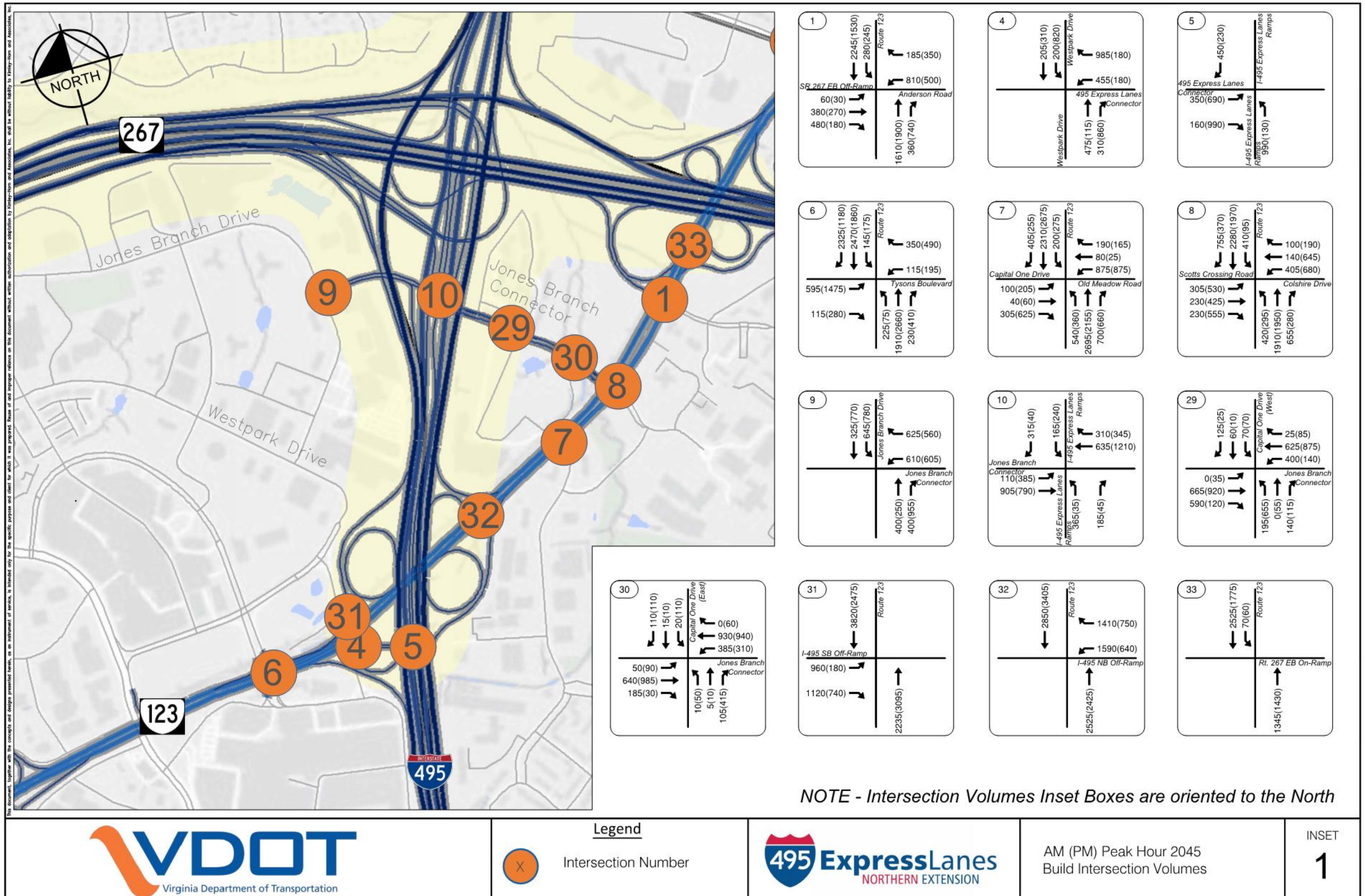


Exhibit 7-22b. Arterial 2045 Build Peak Hour Turning Movement Volumes – Location 1

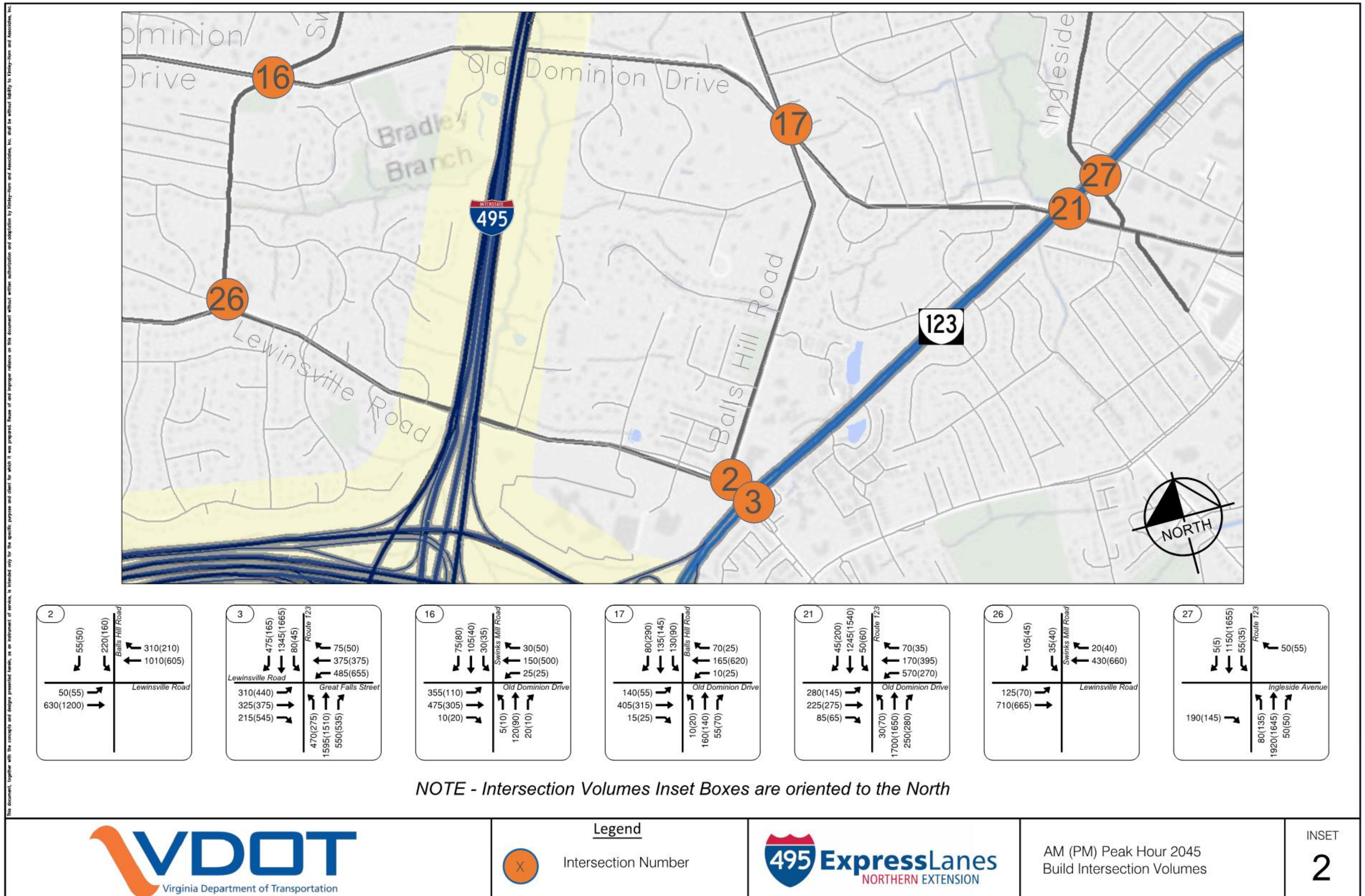


Exhibit 7-22c. Arterial 2045 Build Peak Hour Turning Movement Volumes – Location 2

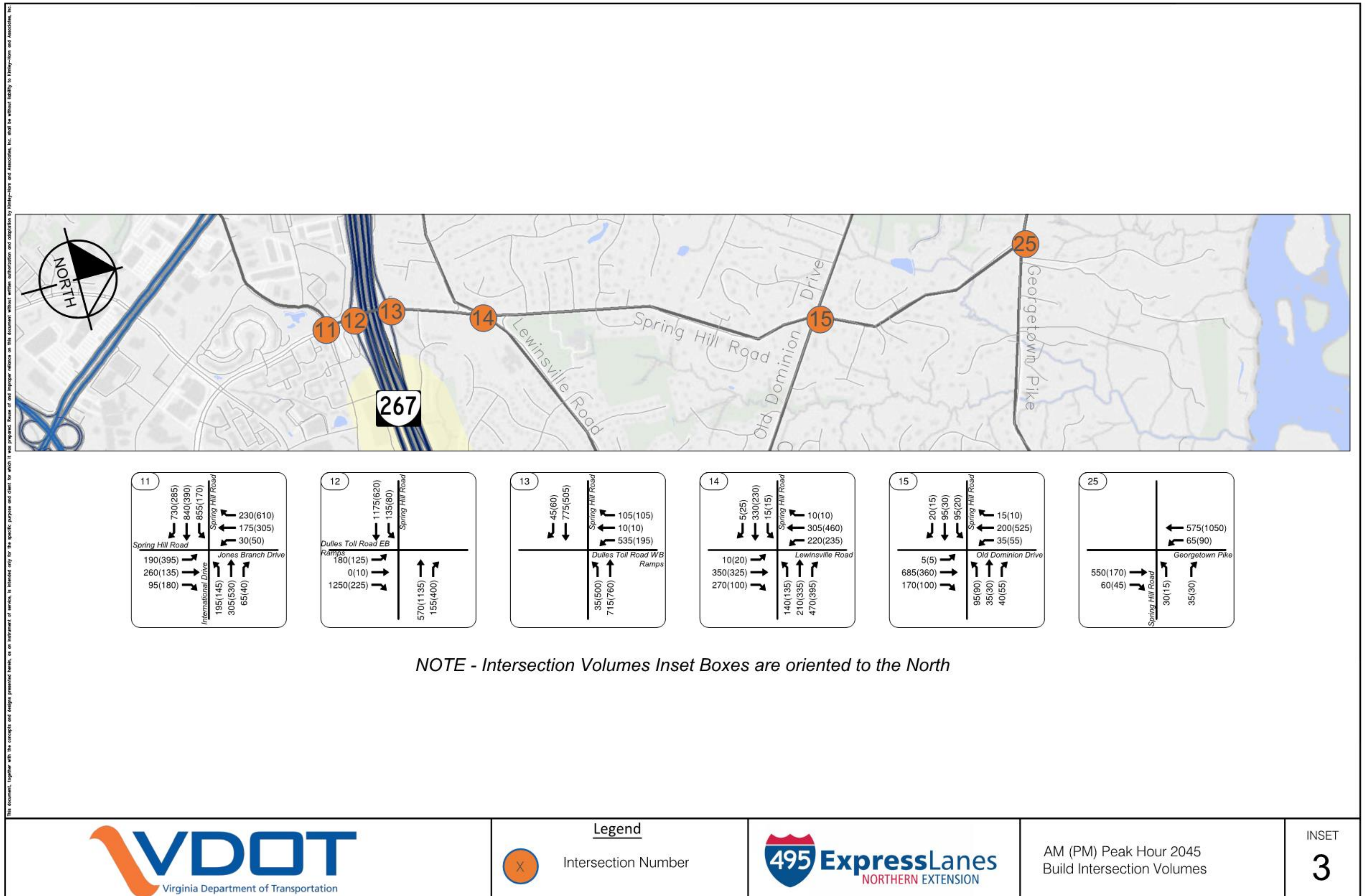


Exhibit 7-22d. Arterial 2045 Build Peak Hour Turning Movement Volumes – Location 3

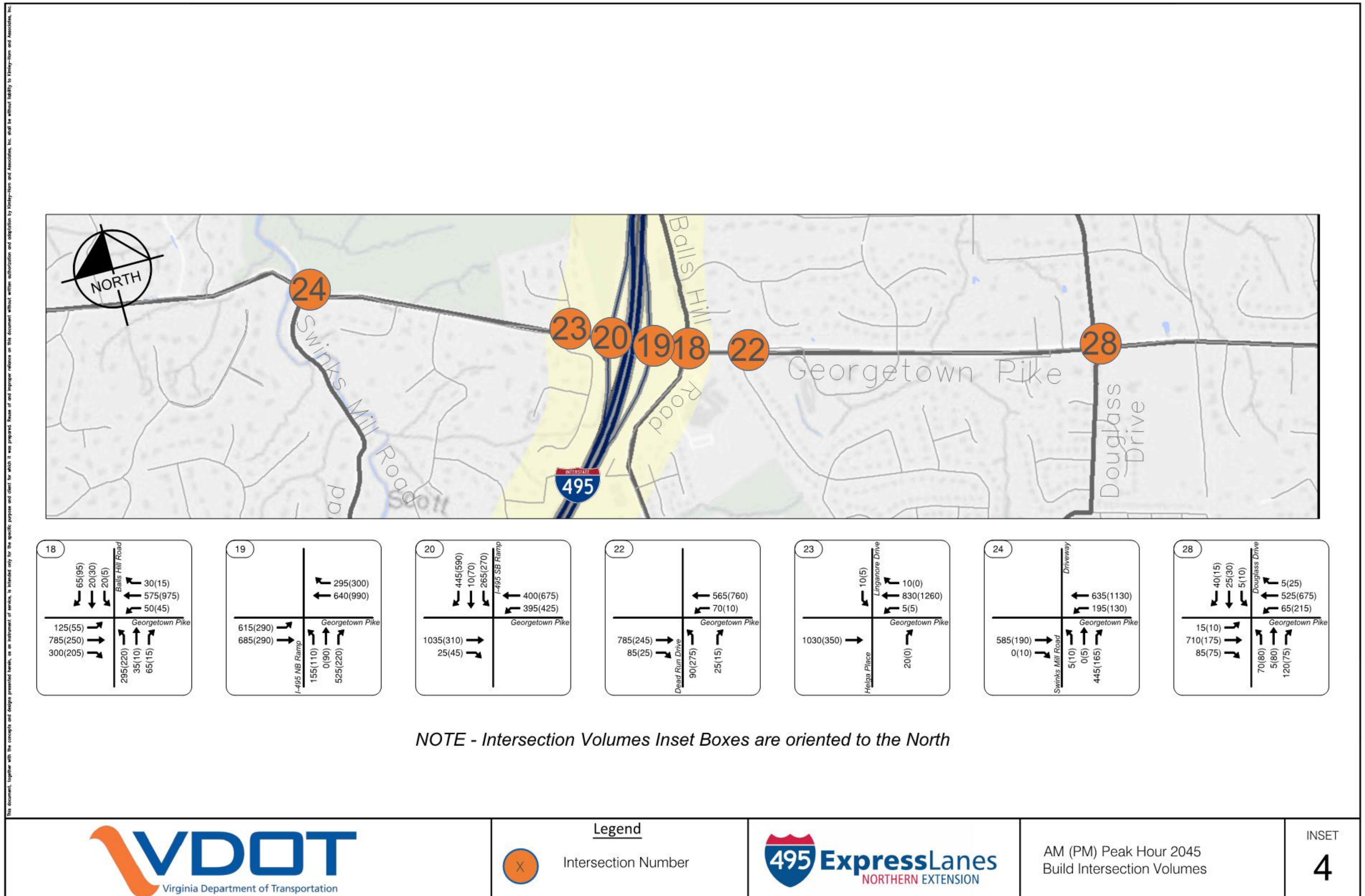


Exhibit 7-22e. Arterial 2045 Build Peak Hour Turning Movement Volumes – Location 4

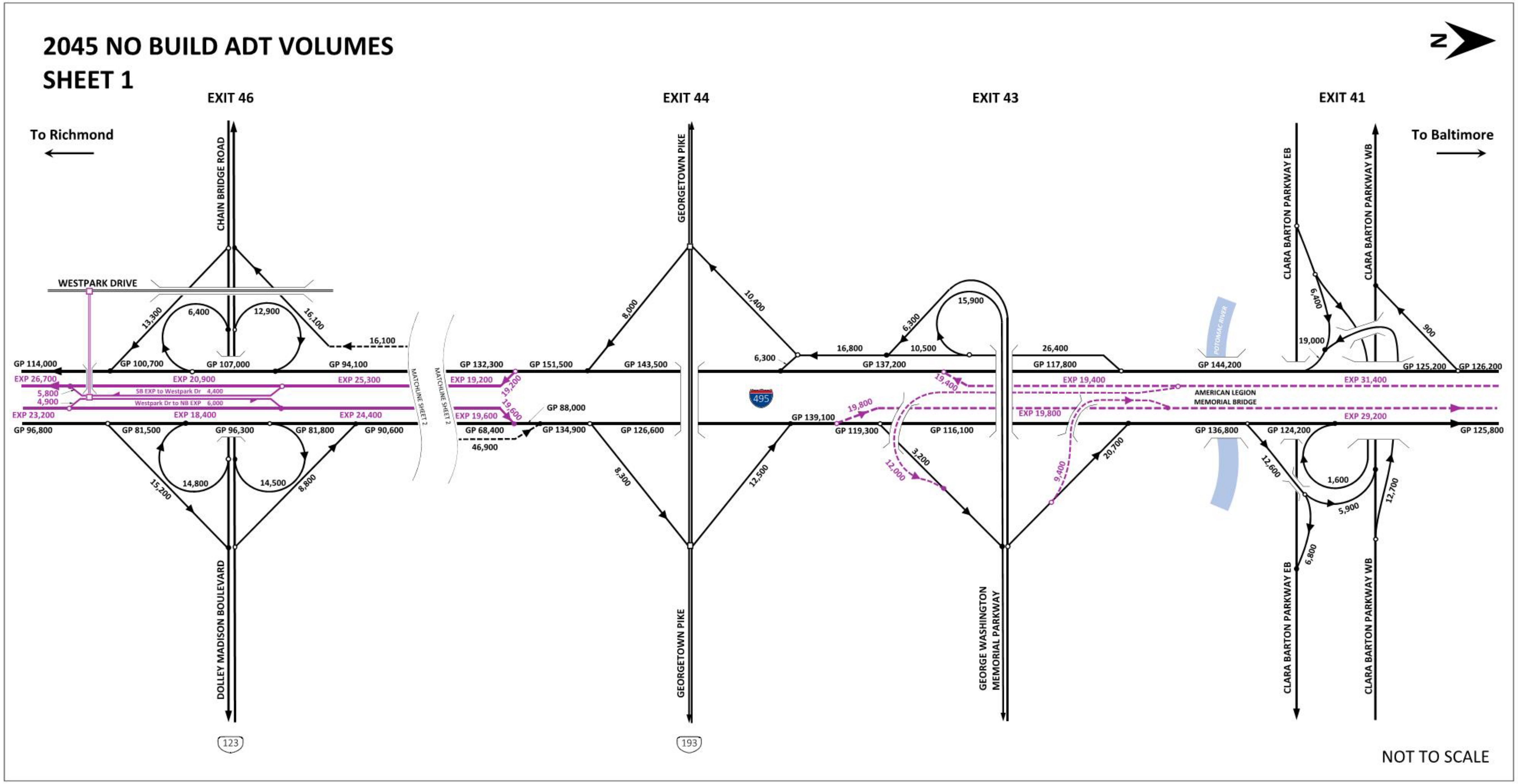


Exhibit 7-23a. Freeway 2045 No Build ADT – I-495

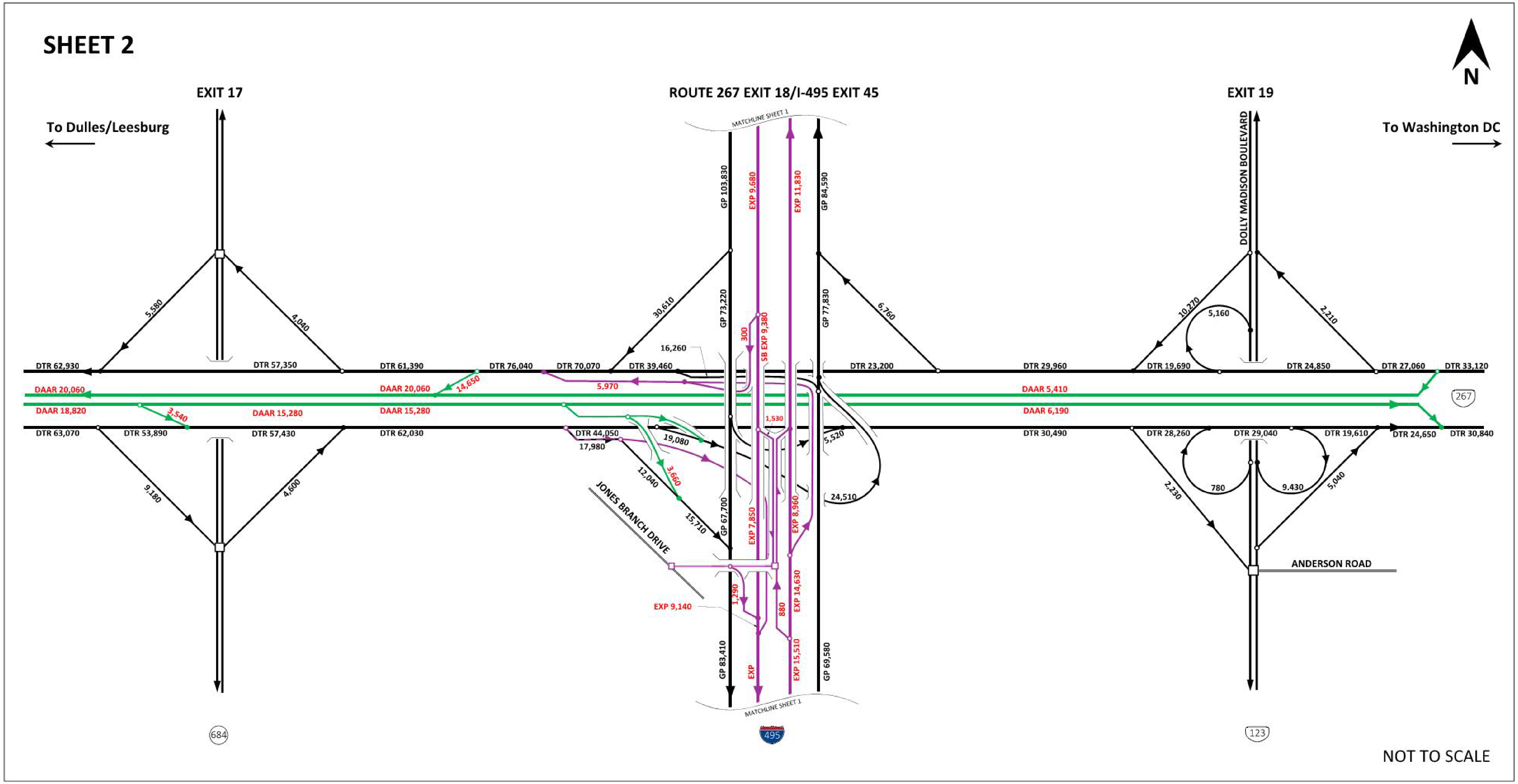


Exhibit 7-23b. Freeway 2045 No Build ADT – Route 267

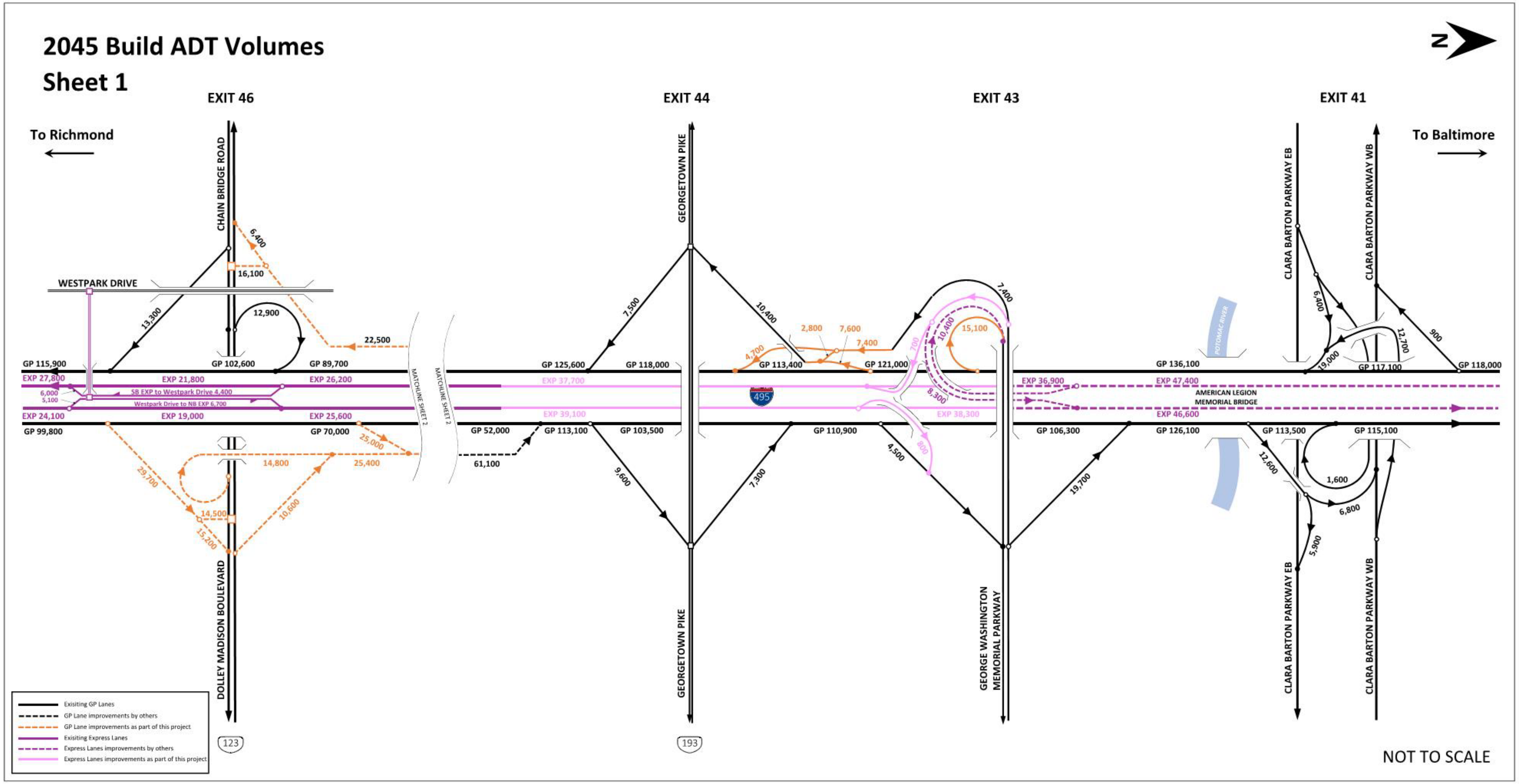


Exhibit 7-24a. Freeway 2045 Build ADT – I-495

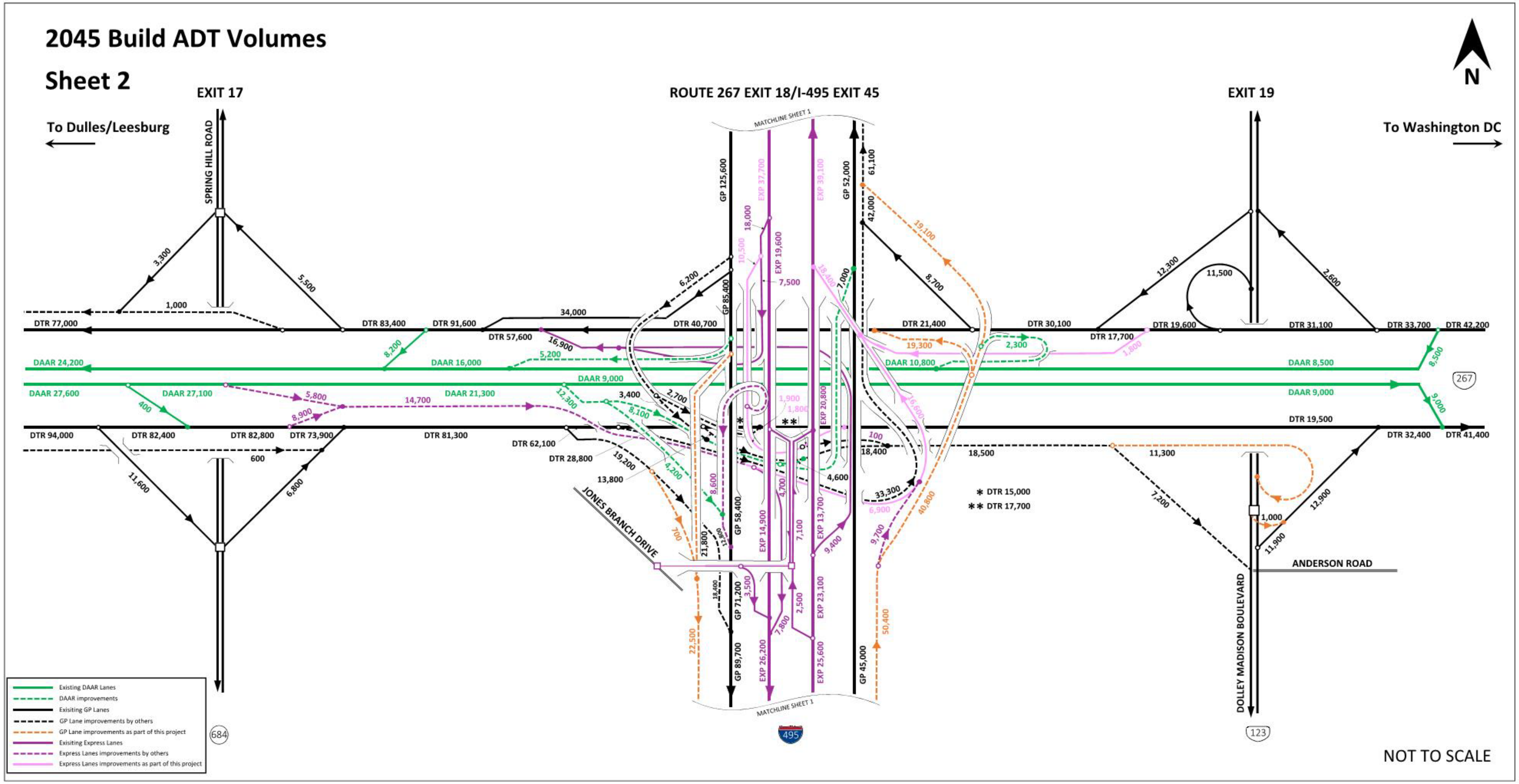


Exhibit 7-24b. Freeway 2045 Build ADT – Route 267

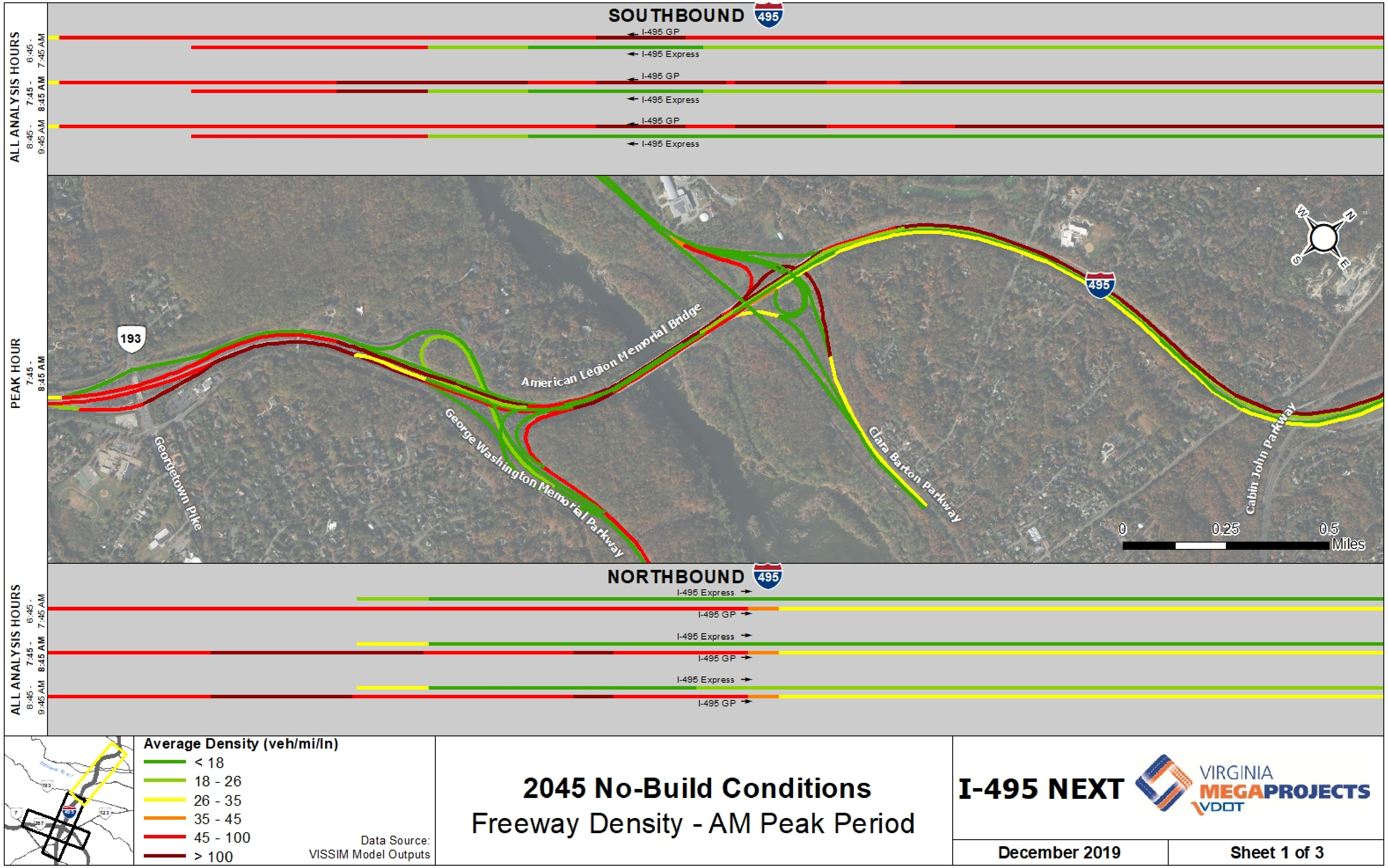


Exhibit 7-25a. 2045 No Build I-495 AM Peak Period Average Densities – Georgetown Pike to Cabin John Parkway

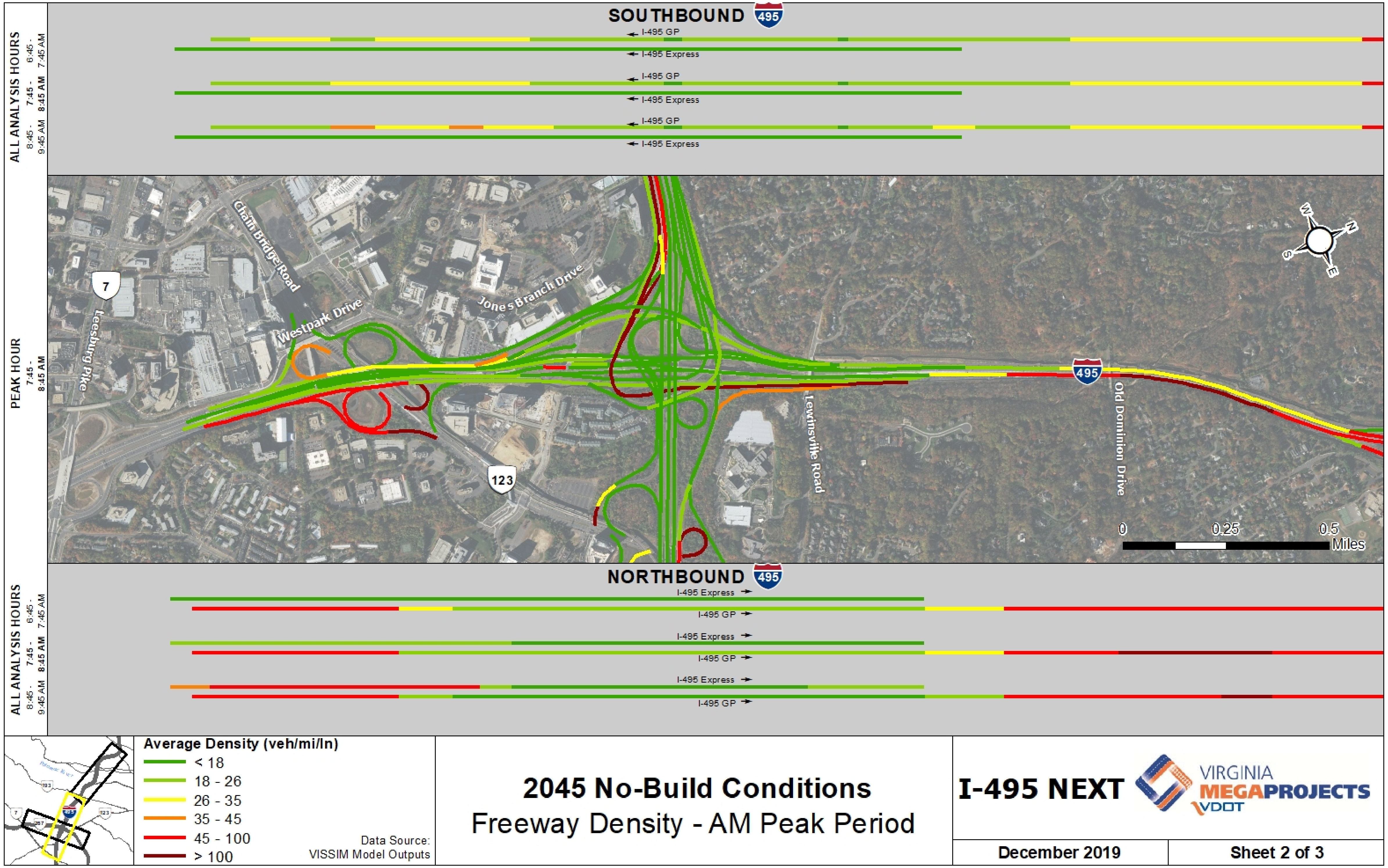


Exhibit 7-25b. 2045 No Build I-495 AM Peak Period Average Densities – Route 123 through Old Dominion Drive

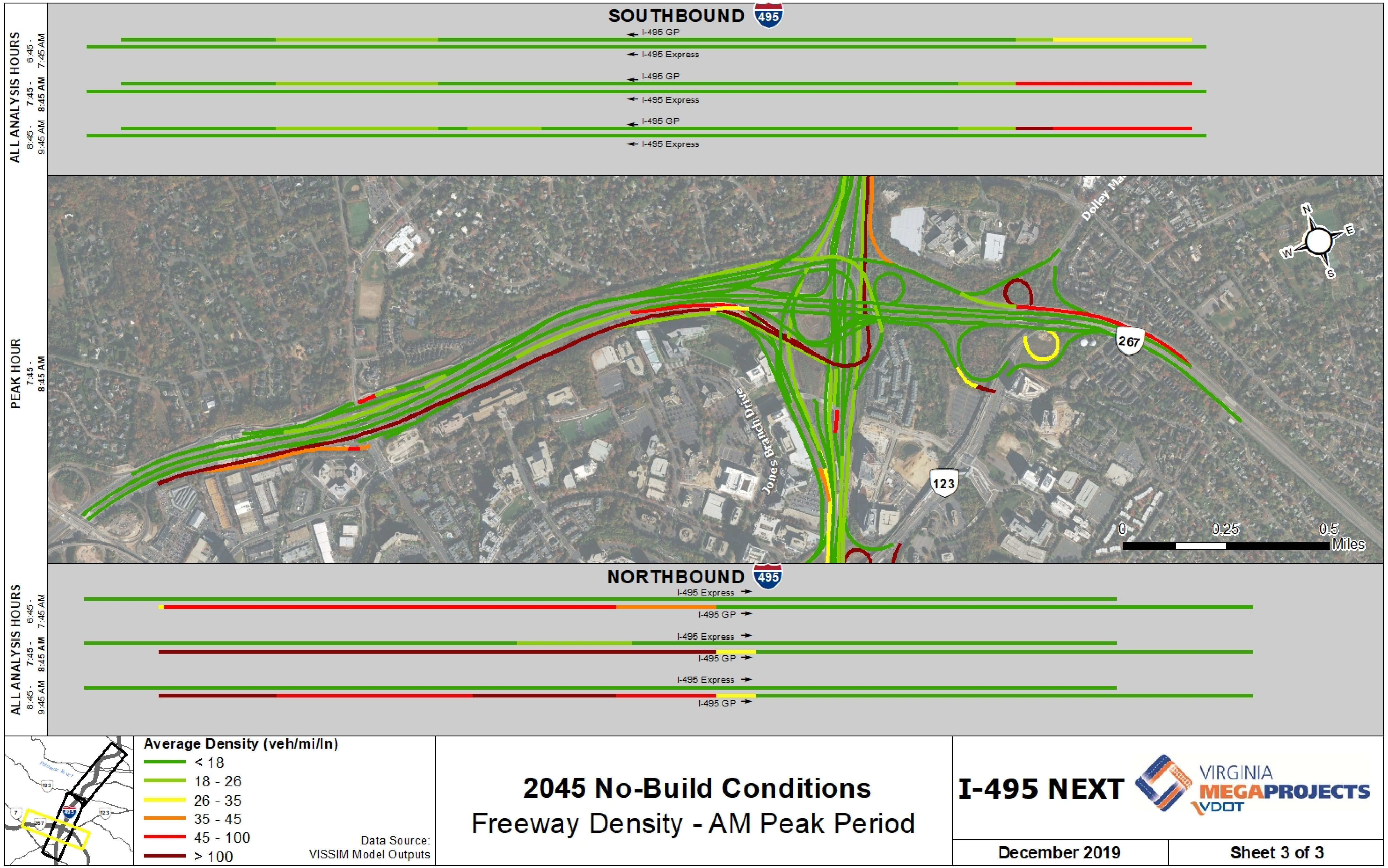


Exhibit 7-25c. 2045 No Build Route 267 AM Peak Period Average Densities

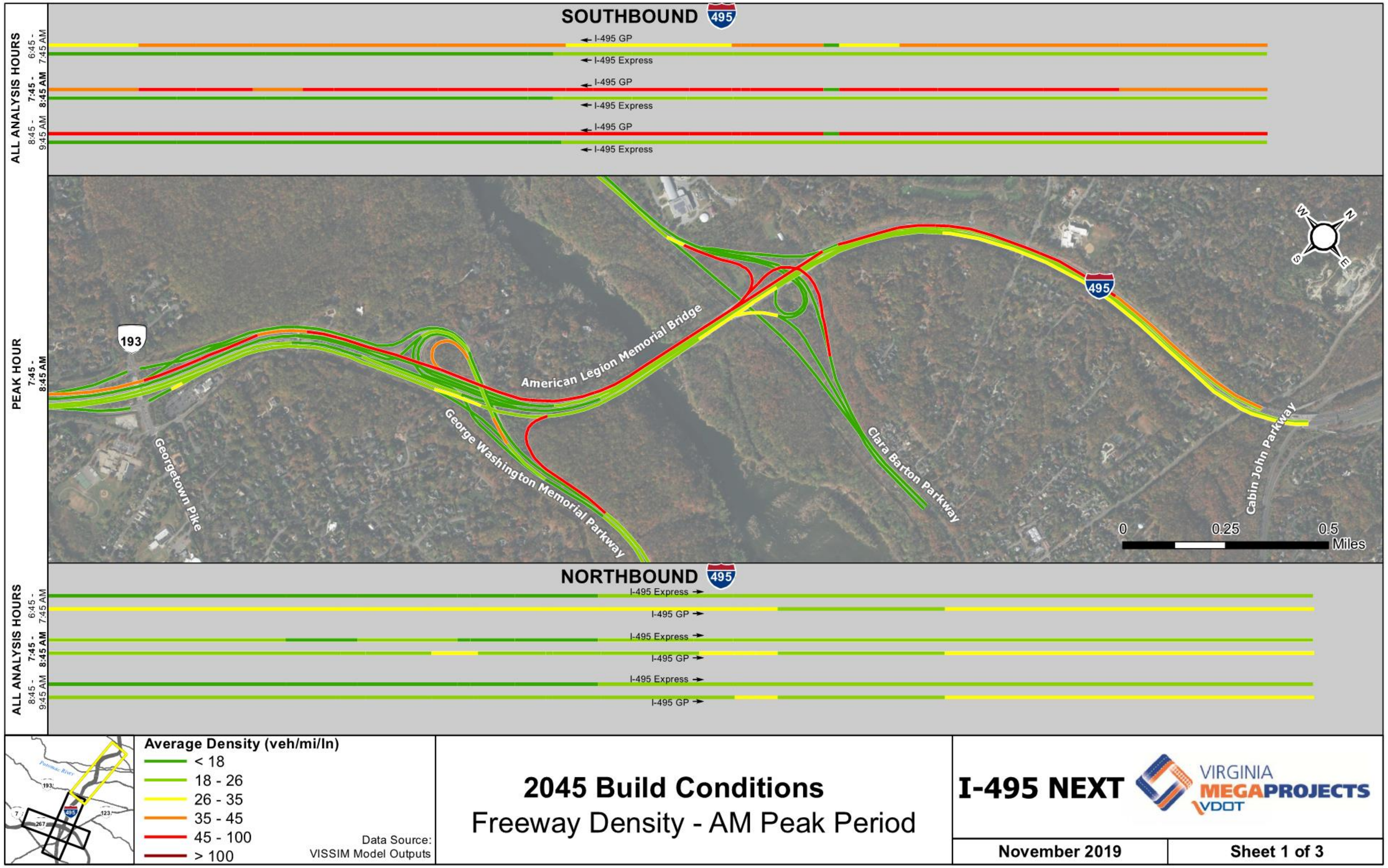


Exhibit 7-26a. 2045 Build I-495 AM Peak Period Average Densities – Georgetown Pike to Cabin John Parkway

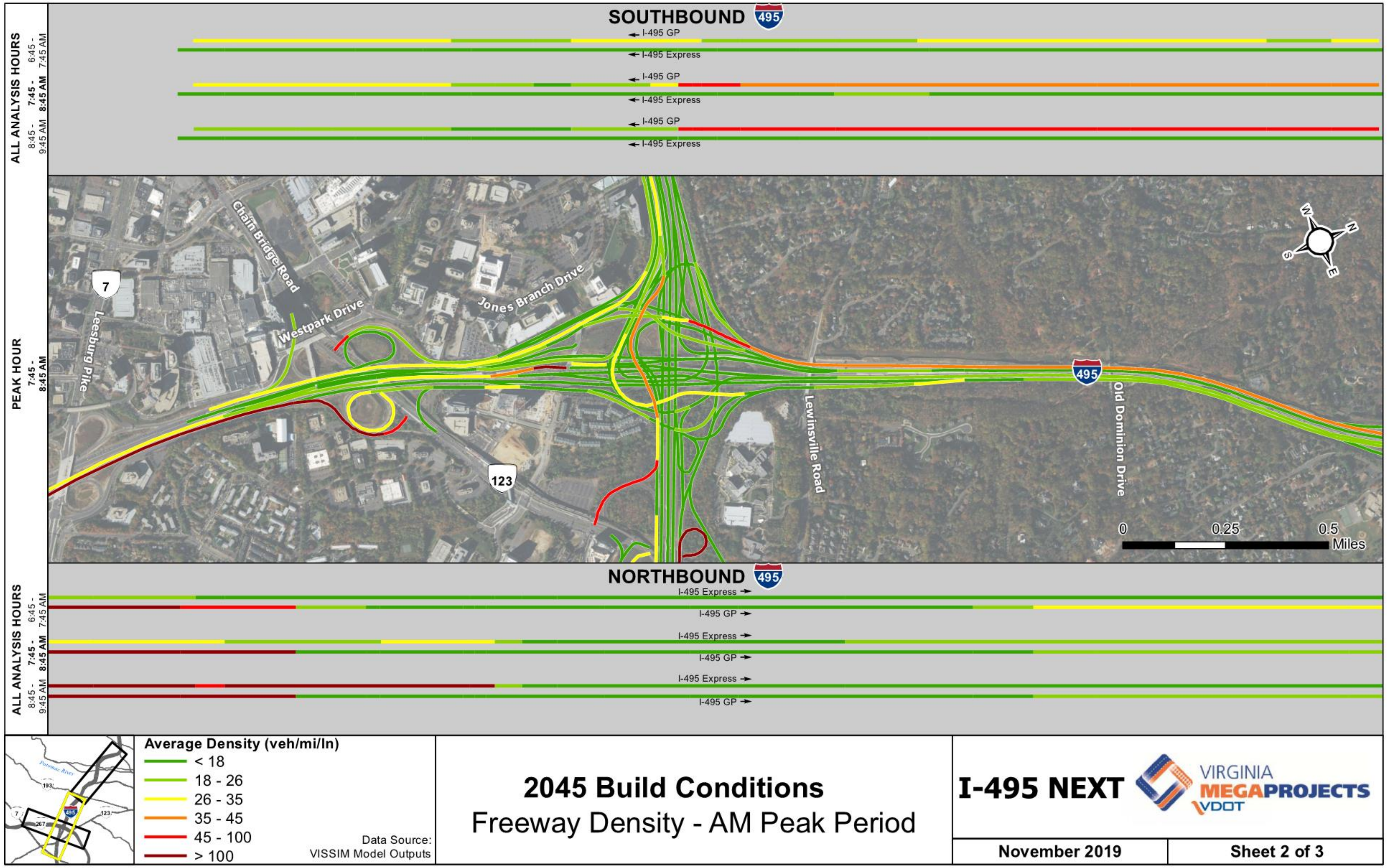


Exhibit 7-26b. 2045 Build I-495 AM Peak Period Average Densities – Route 123 through Old Dominion Drive

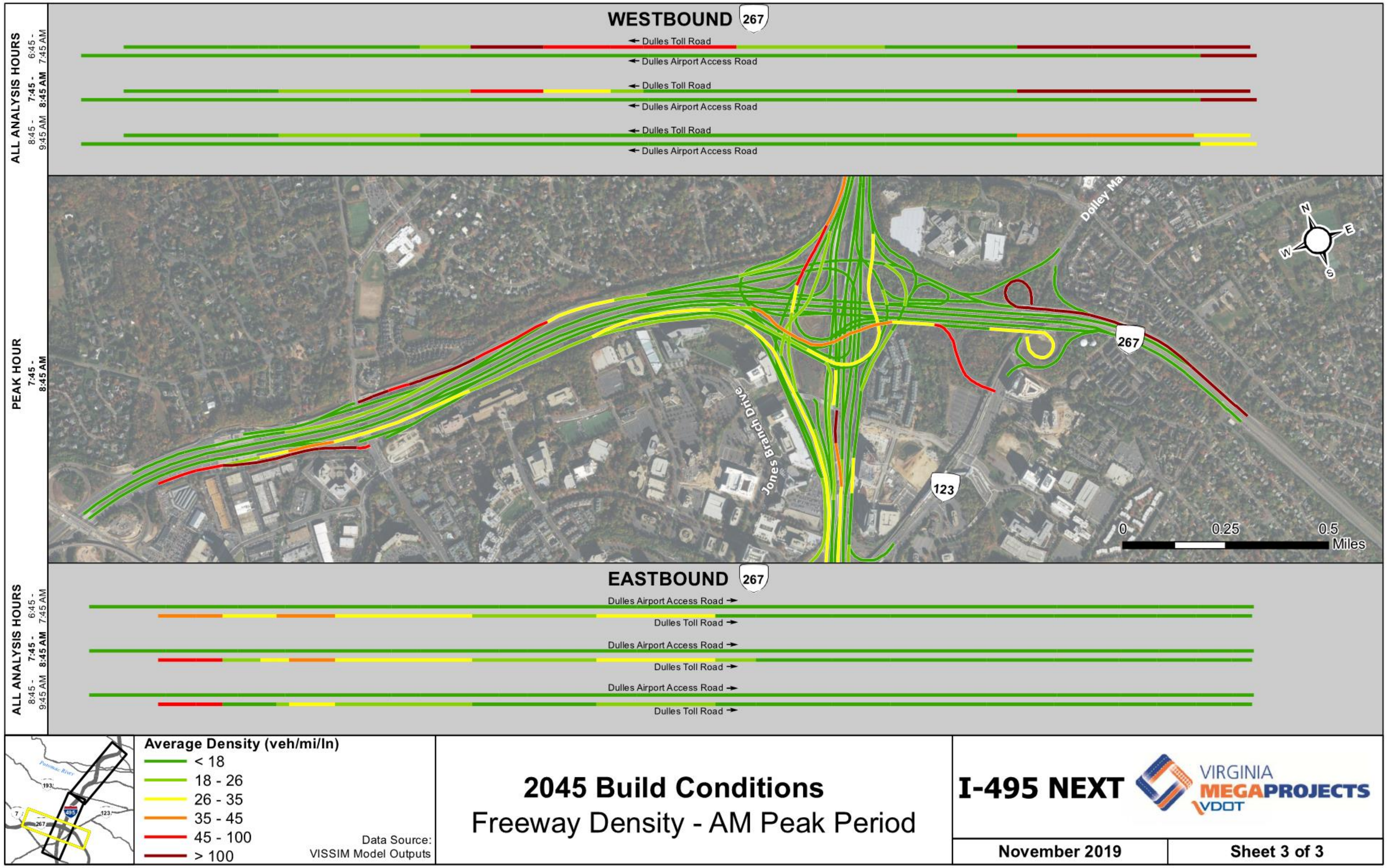


Exhibit 7-26c. 2045 Build Route 267 AM Peak Period Average Densities

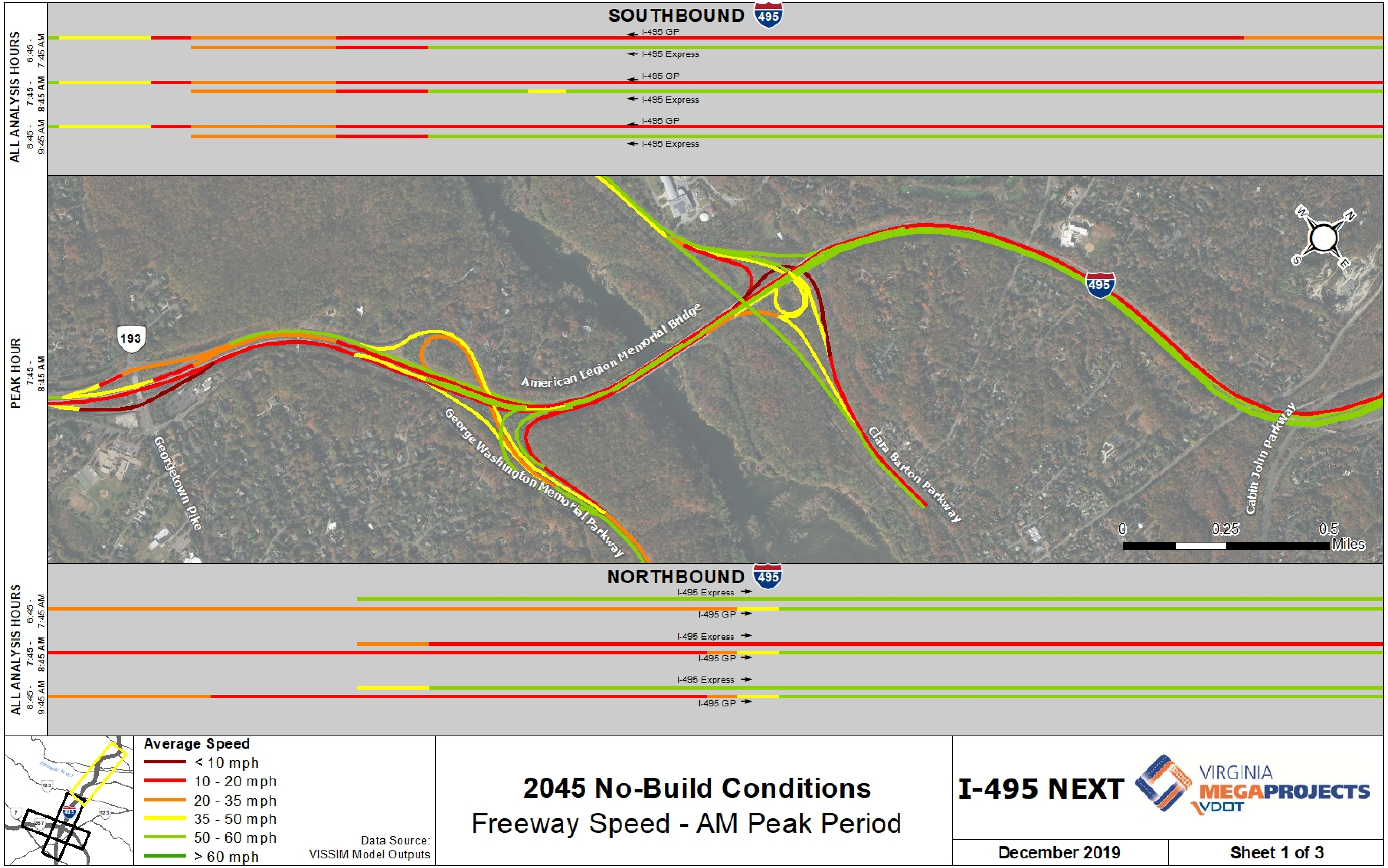


Exhibit 7-27a. 2045 No Build I-495 AM Peak Period Average Speeds – Georgetown Pike to Cabin John Parkway

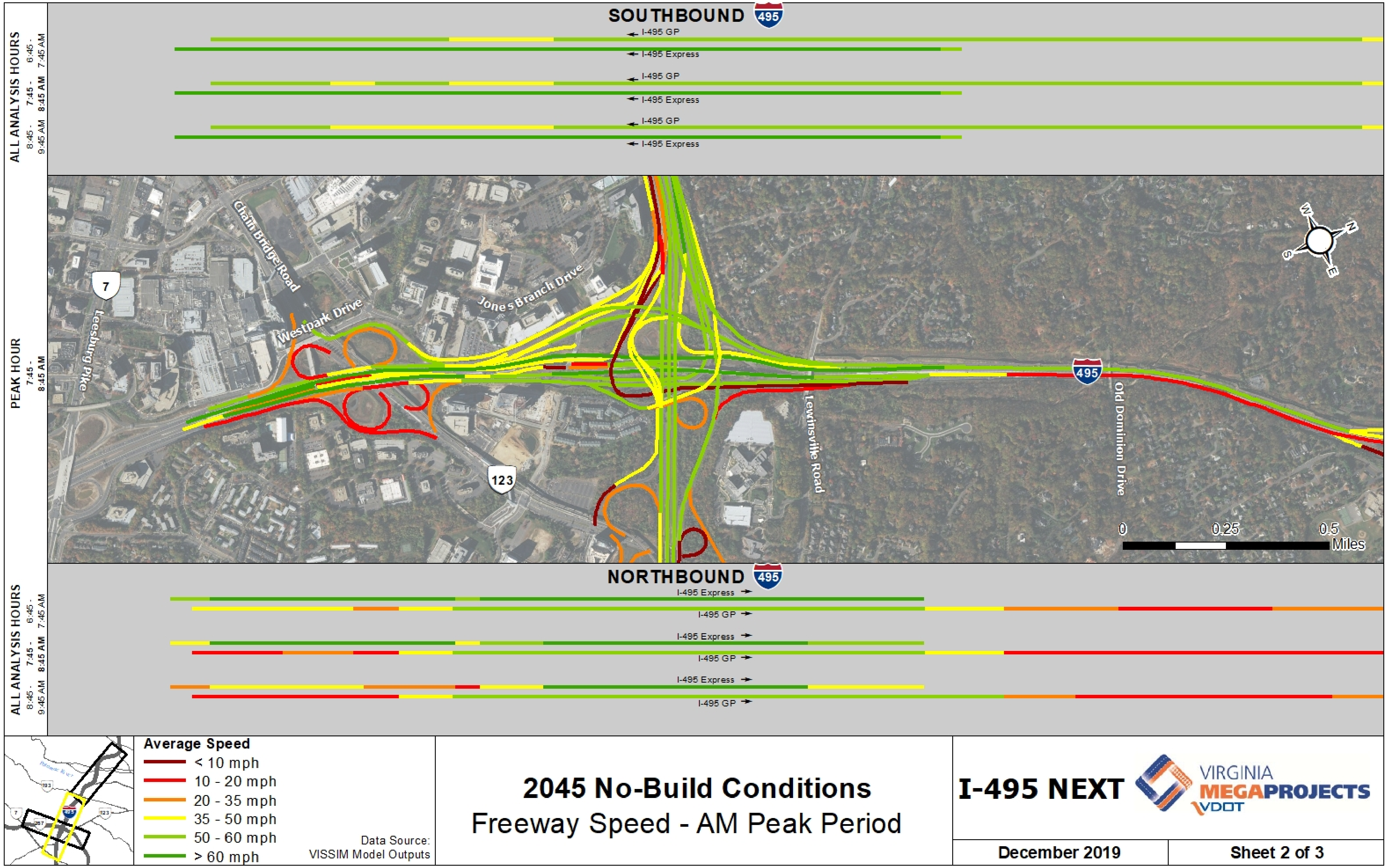


Exhibit 7-27b. 2045 No Build I-495 AM Peak Period Average Speeds – Route 123 through Old Dominion Drive

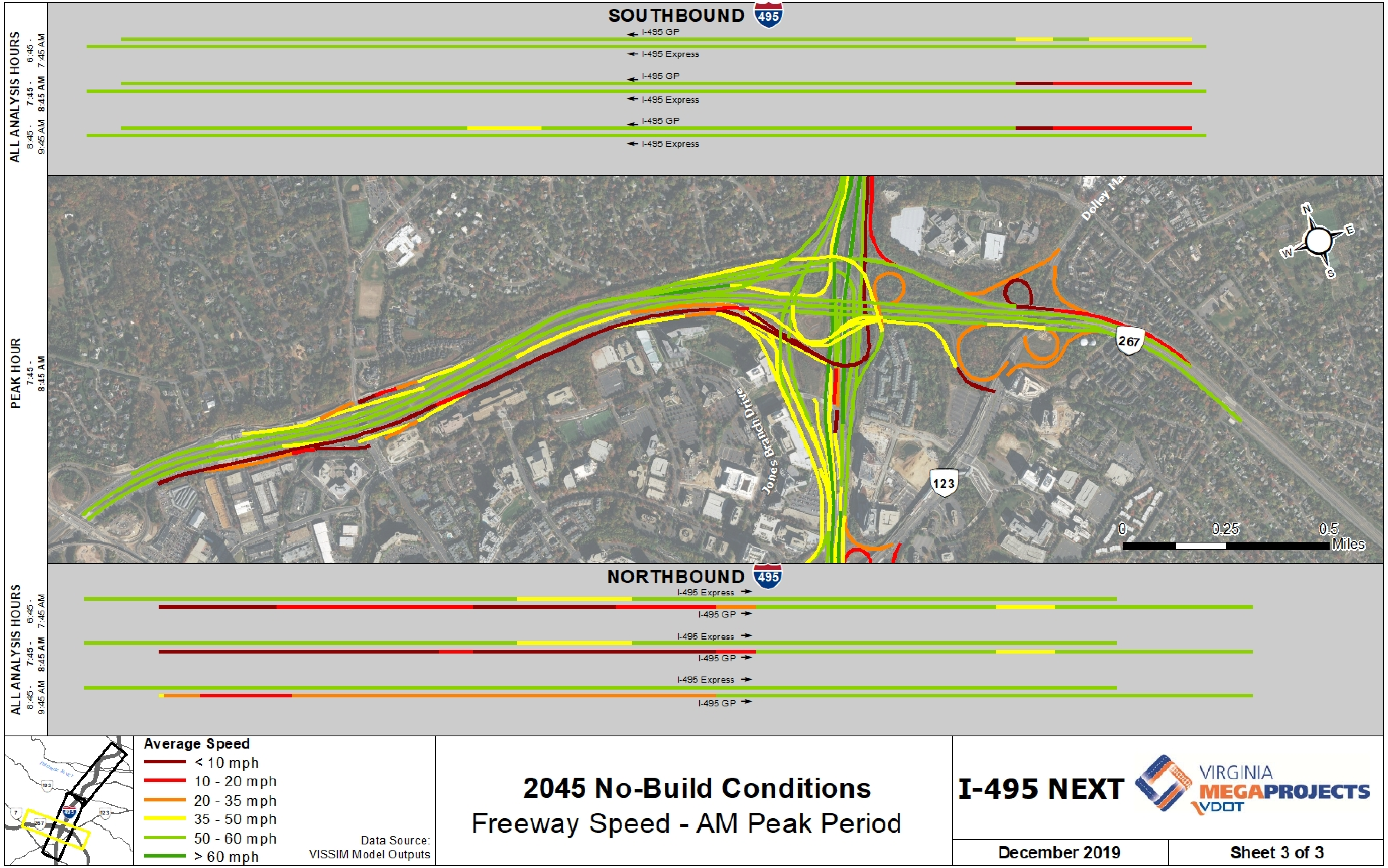


Exhibit 7-27c. 2045 No Build Route 267 AM Peak Period Average Speeds

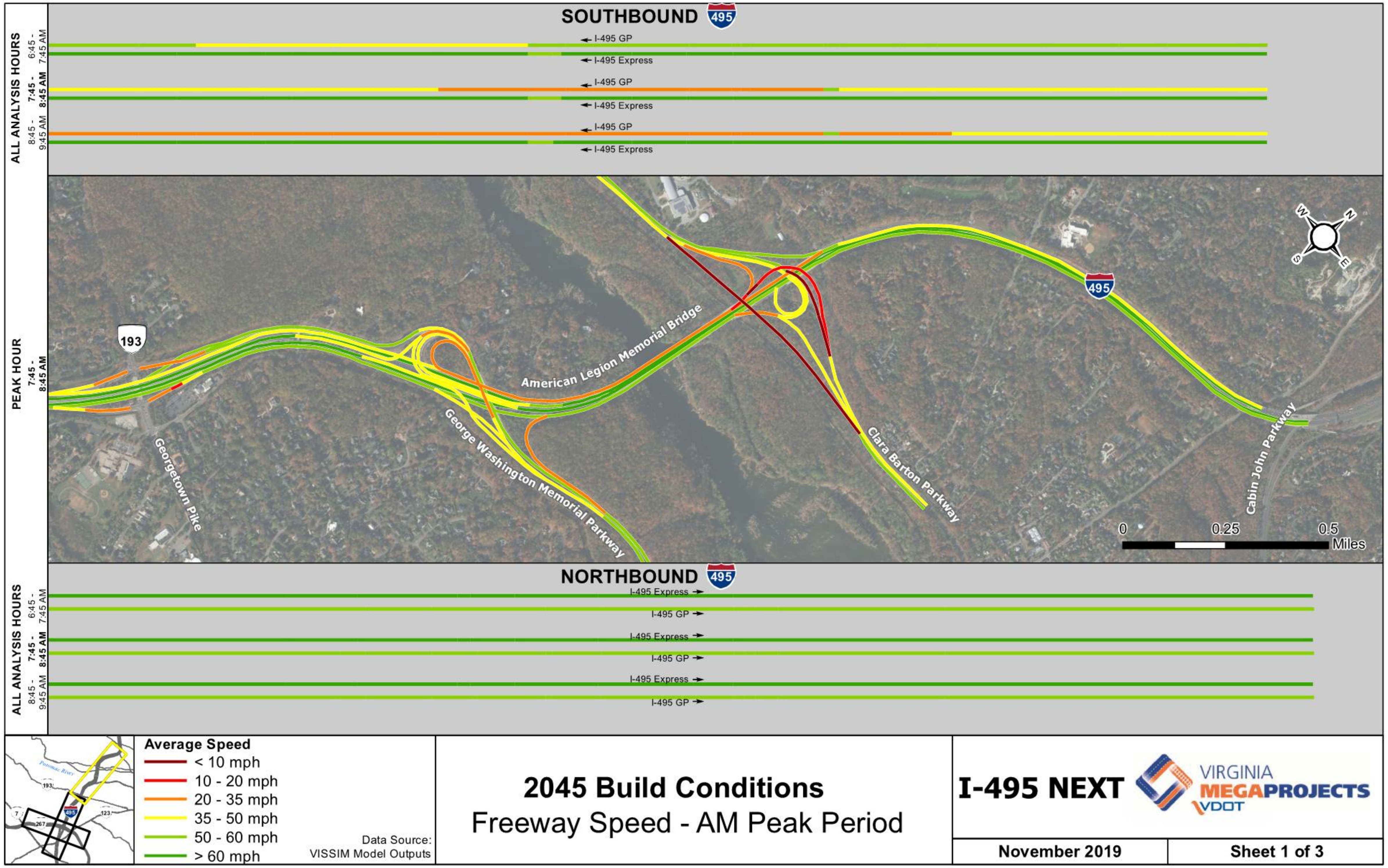


Exhibit 7-28a. 2045 Build I-495 AM Peak Period Average Speeds – Georgetown Pike to Cabin John Parkway

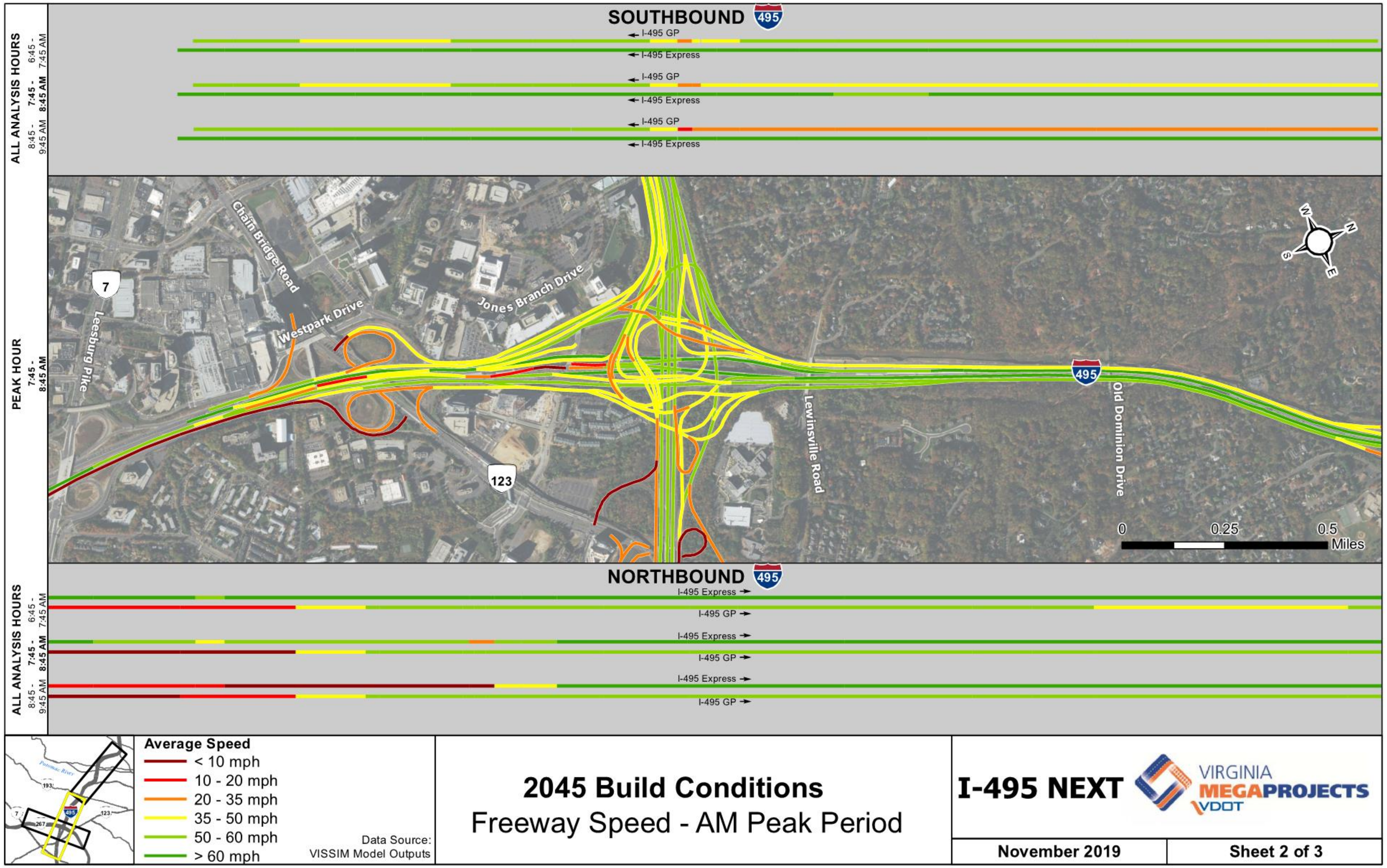


Exhibit 7-28b. 2045 Build I-495 AM Peak Period Average Speeds – Route 123 through Old Dominion Drive

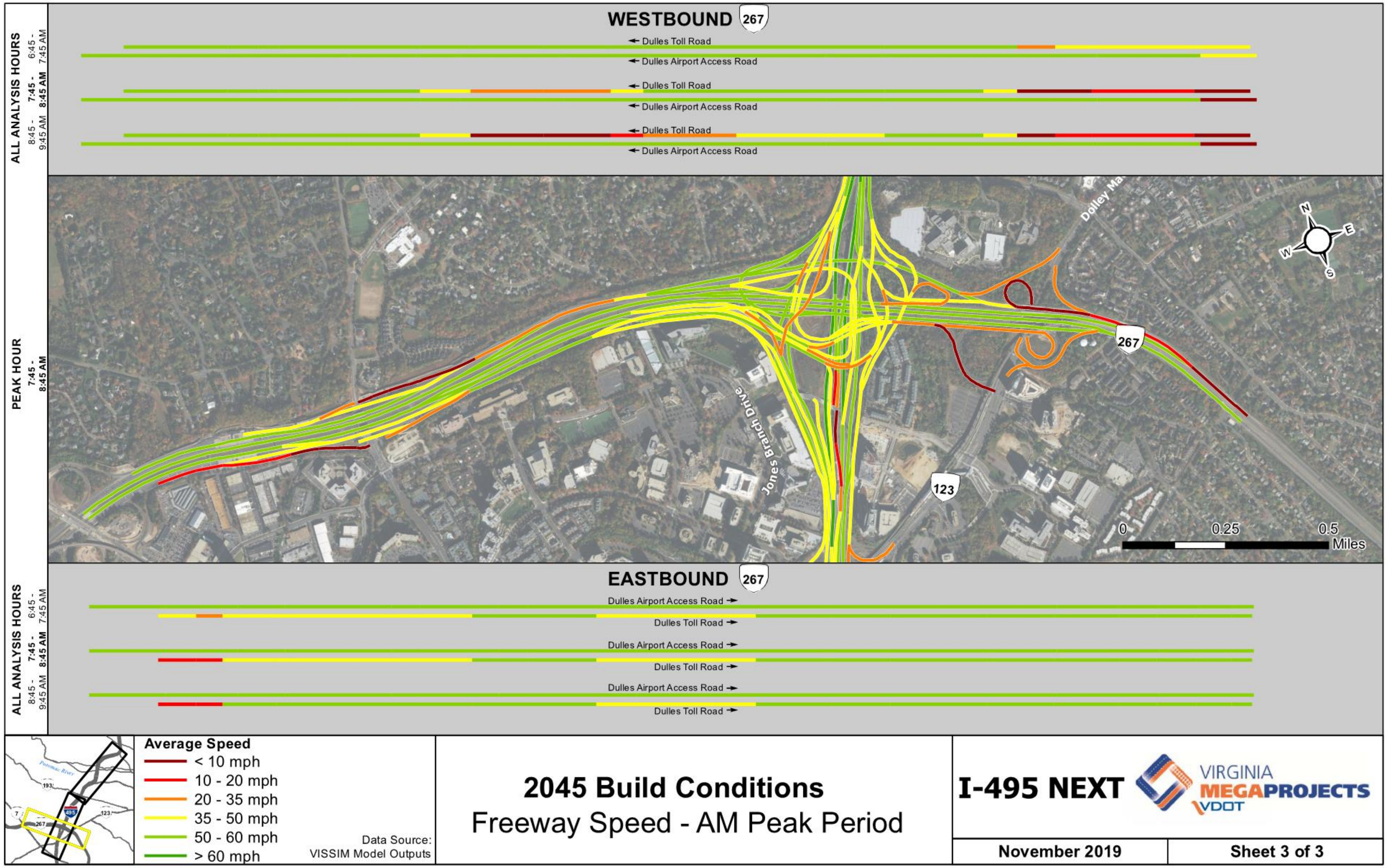


Exhibit 7-28c. 2045 Build Route 267 AM Peak Period Average Speeds

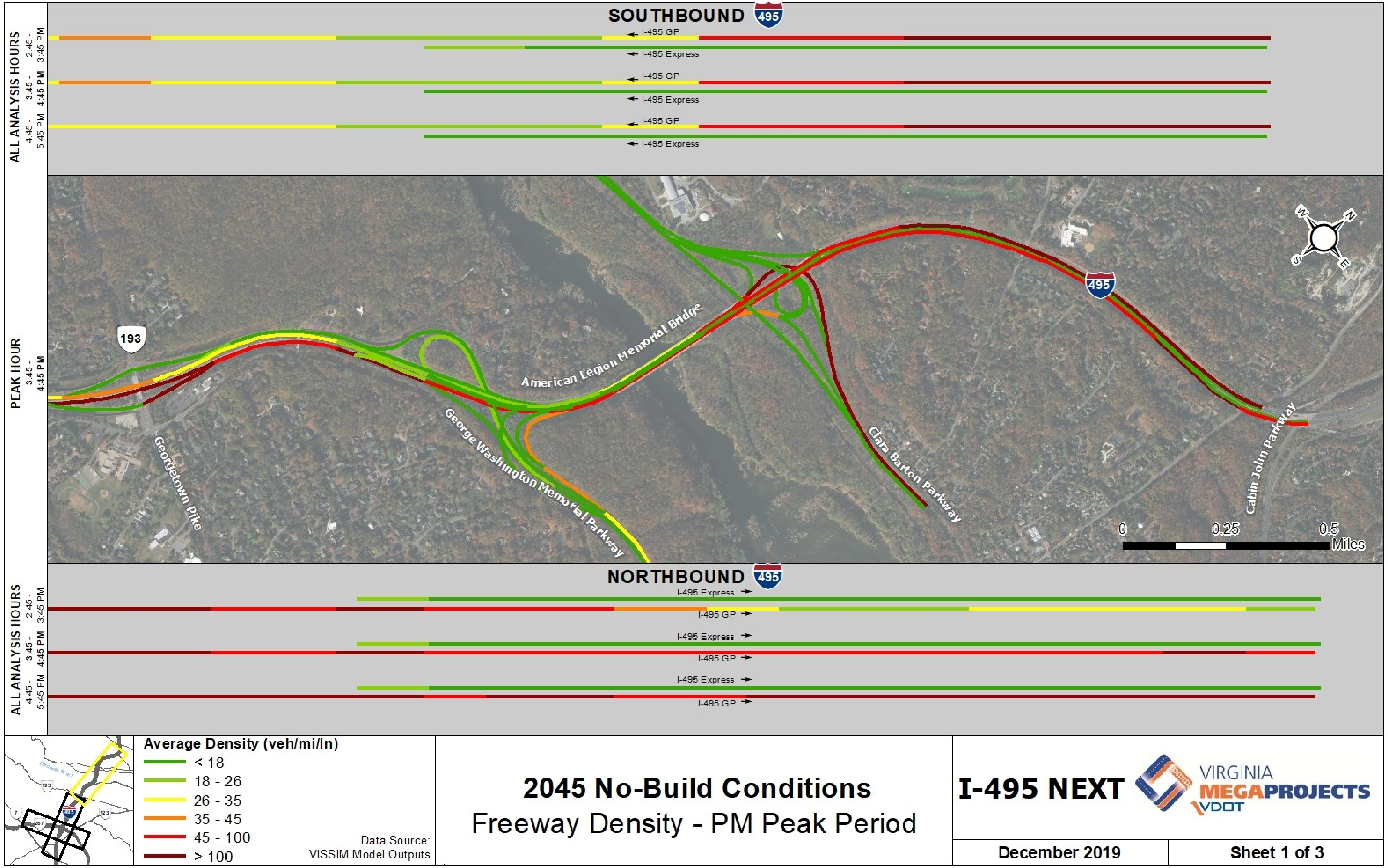


Exhibit 7-29a. 2045 No Build I-495 PM Peak Period Average Densities – Georgetown Pike to Cabin John Parkway

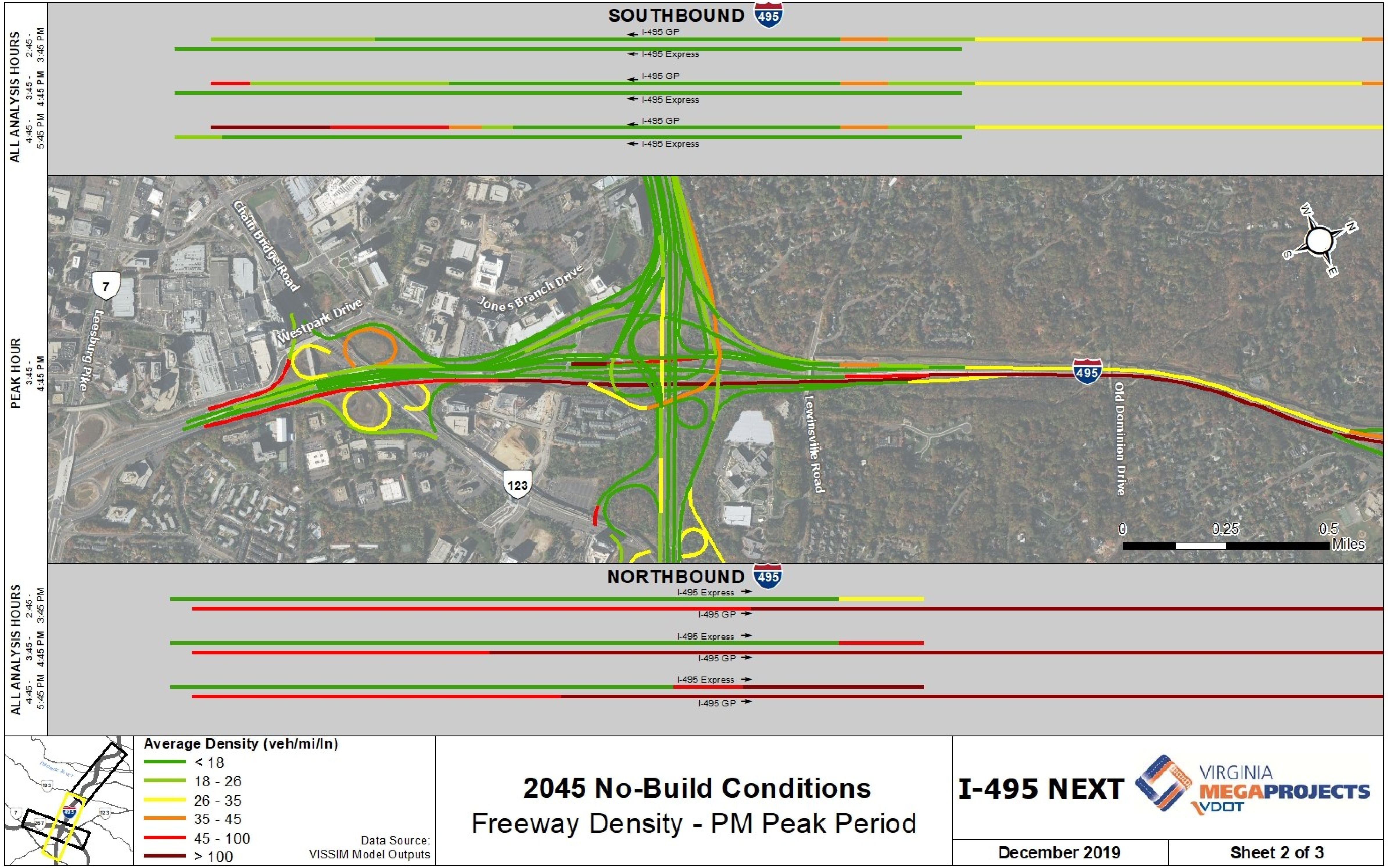


Exhibit 7-29b. 2045 No Build I-495 PM Peak Period Average Densities – Route 123 through Old Dominion Drive

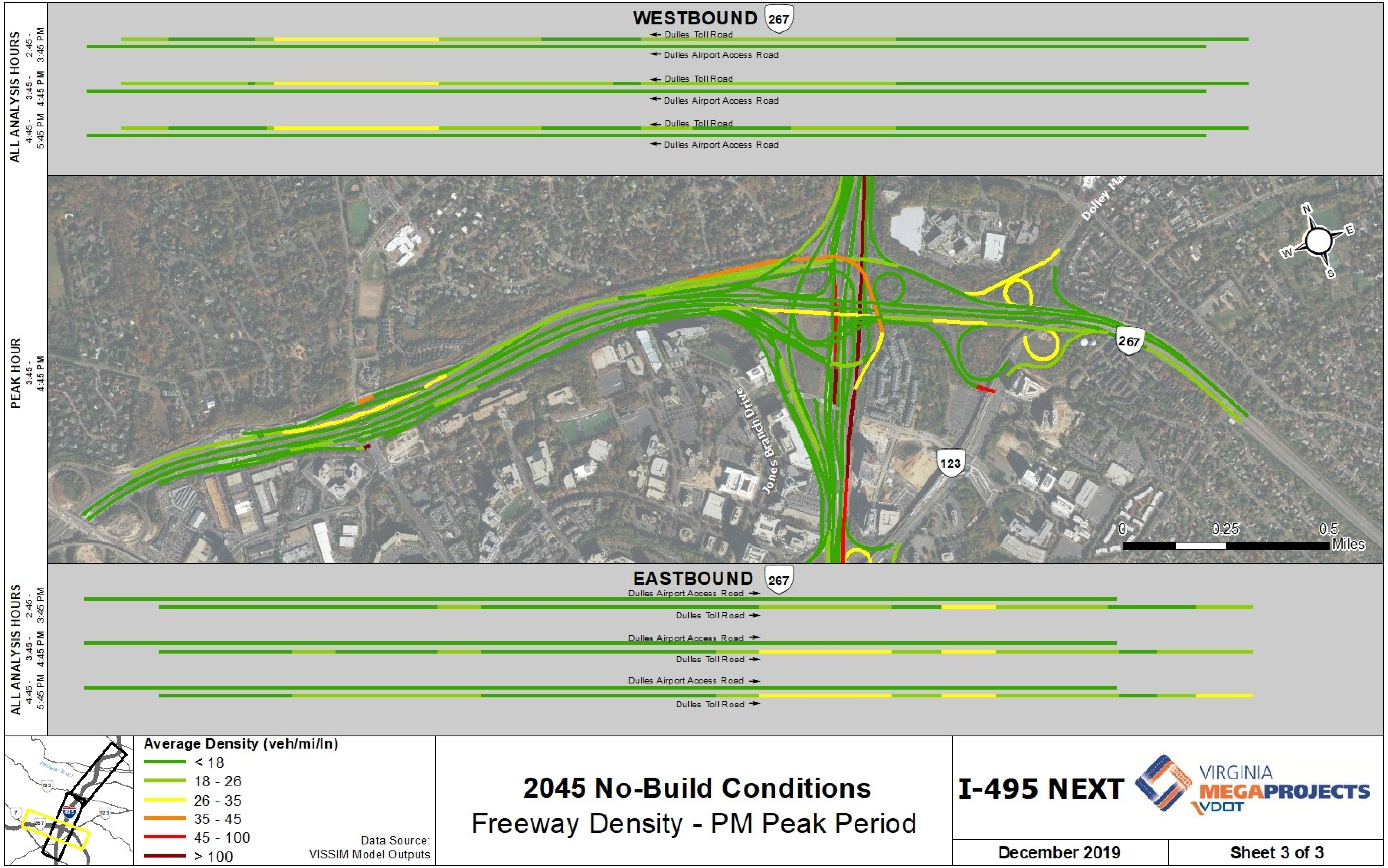


Exhibit 7-29c. 2045 No Build Route 267 PM Peak Period Average Densities

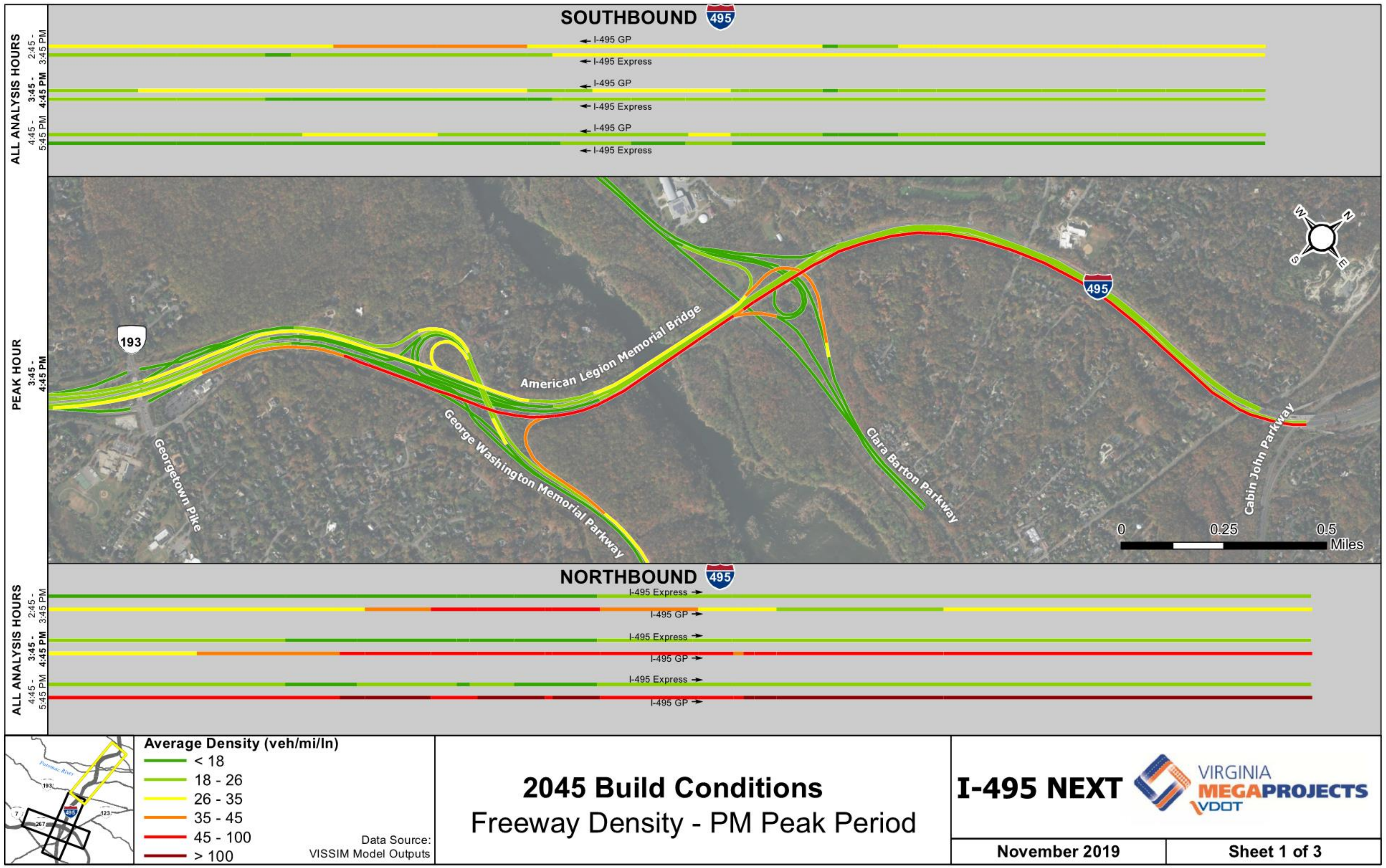


Exhibit 7-30a. 2045 Build I-495 PM Peak Period Average Densities – Georgetown Pike to Cabin John Parkway

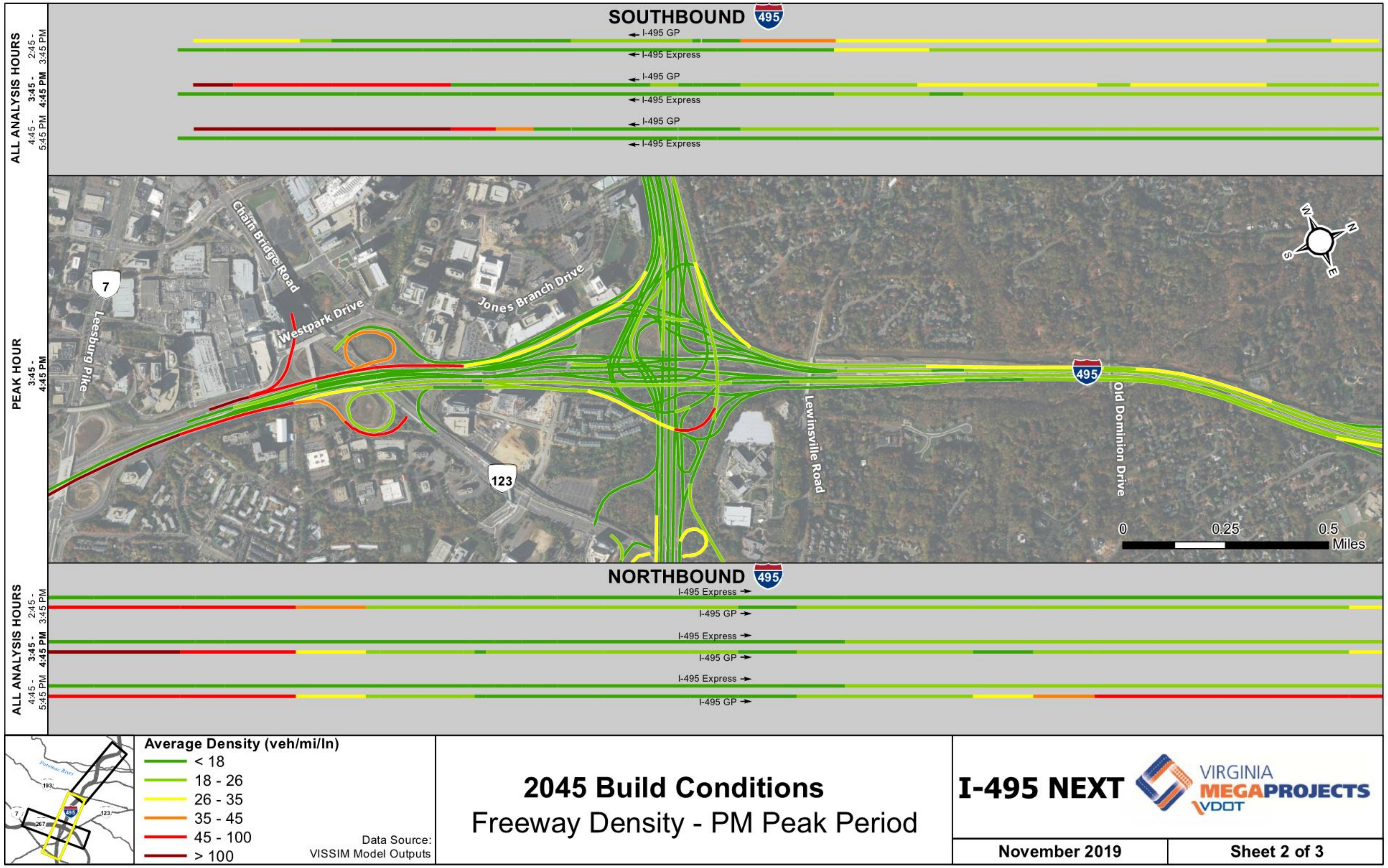


Exhibit 7-30b. 2045 Build I-495 PM Peak Period Average Densities – Route 123 through Old Dominion Drive

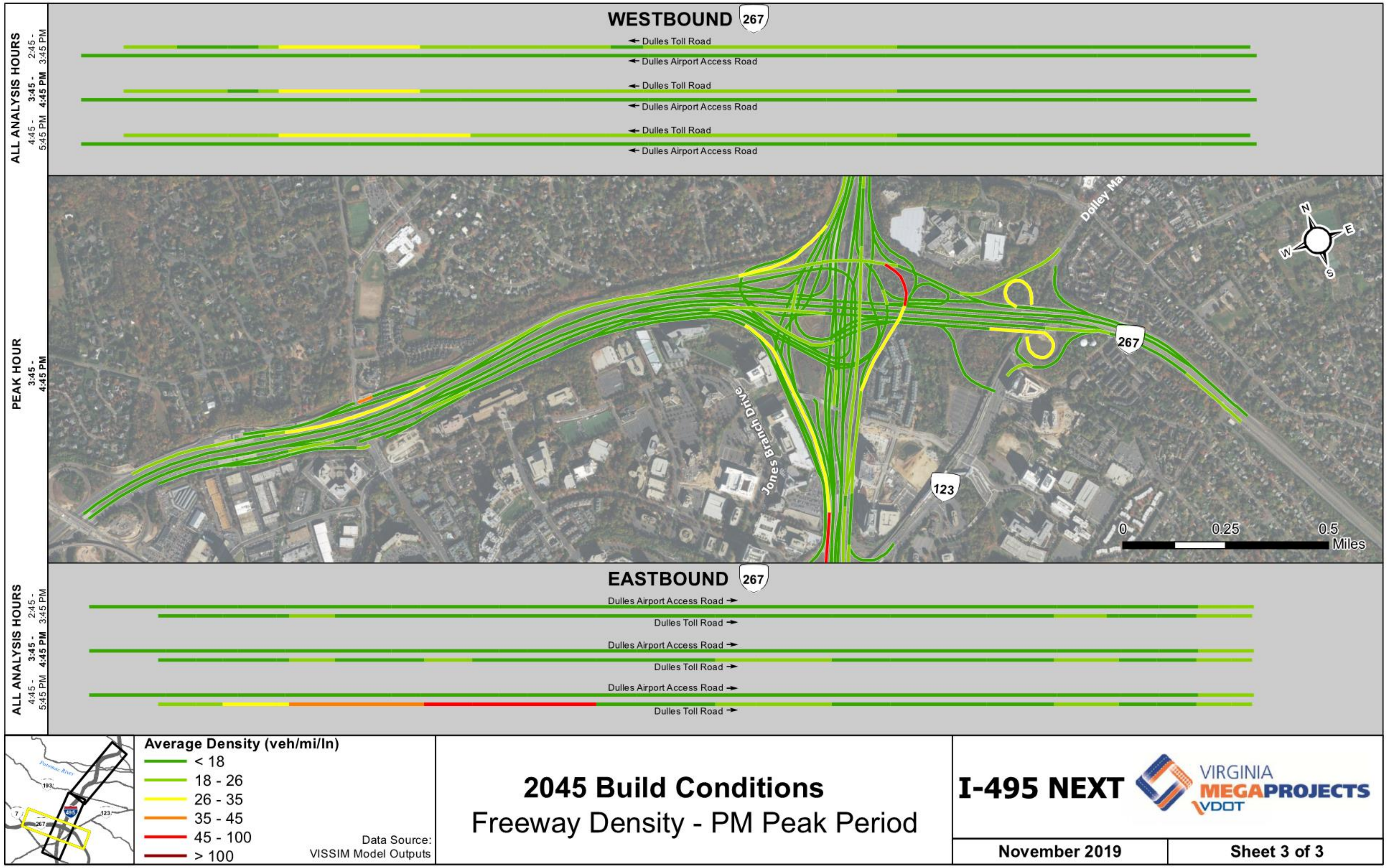


Exhibit 7-30c. 2045 Build Route 267 PM Peak Period Average Densities

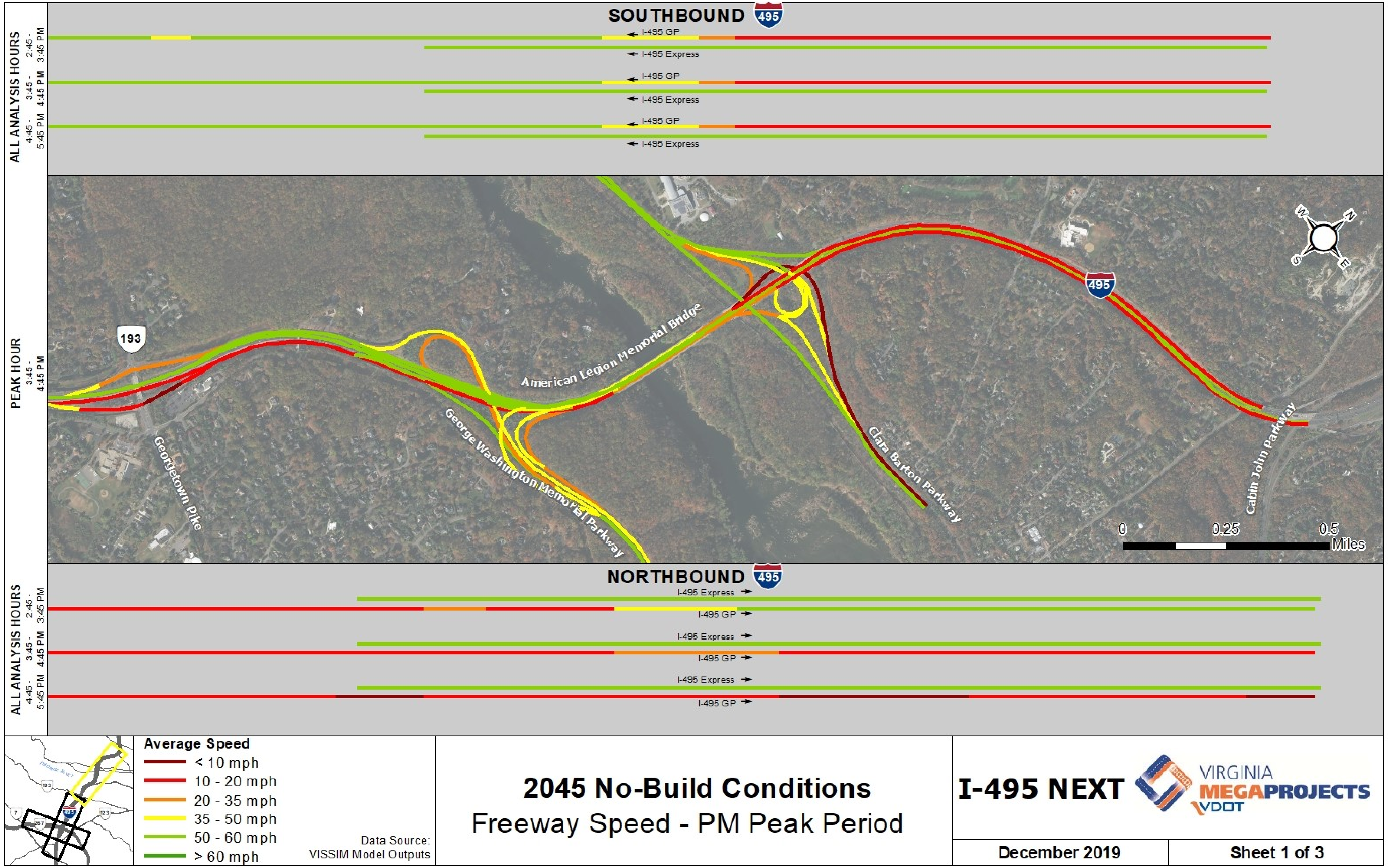


Exhibit 7-31a. 2045 No Build I-495 PM Peak Period Average Speeds – Georgetown Pike to Cabin John Parkway

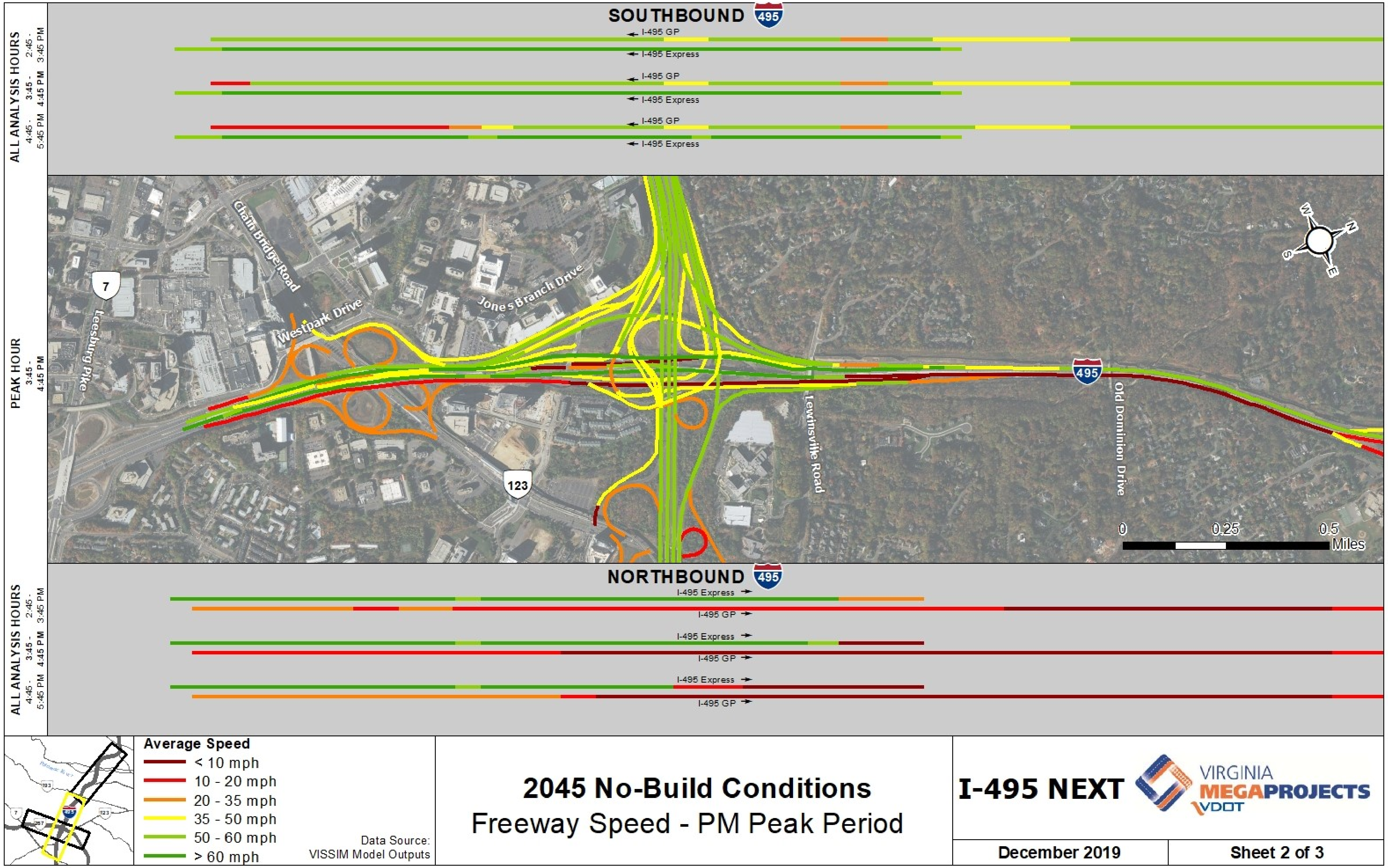


Exhibit 7-31b. 2045 No Build I-495 PM Peak Period Average Speeds – Route 123 through Old Dominion Drive

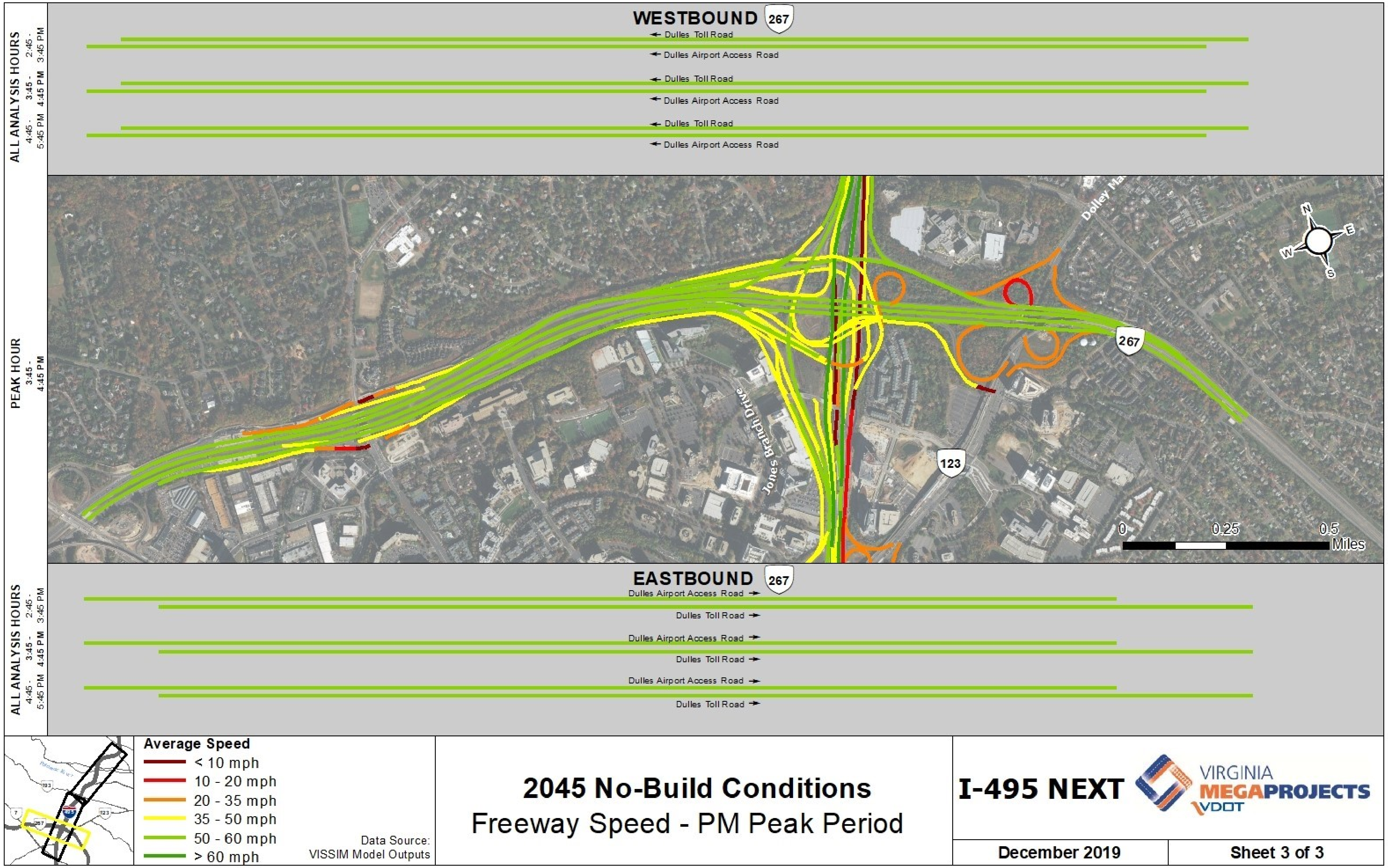


Exhibit 7-31c. 2045 No Build Route 267 PM Peak Period Average Speeds

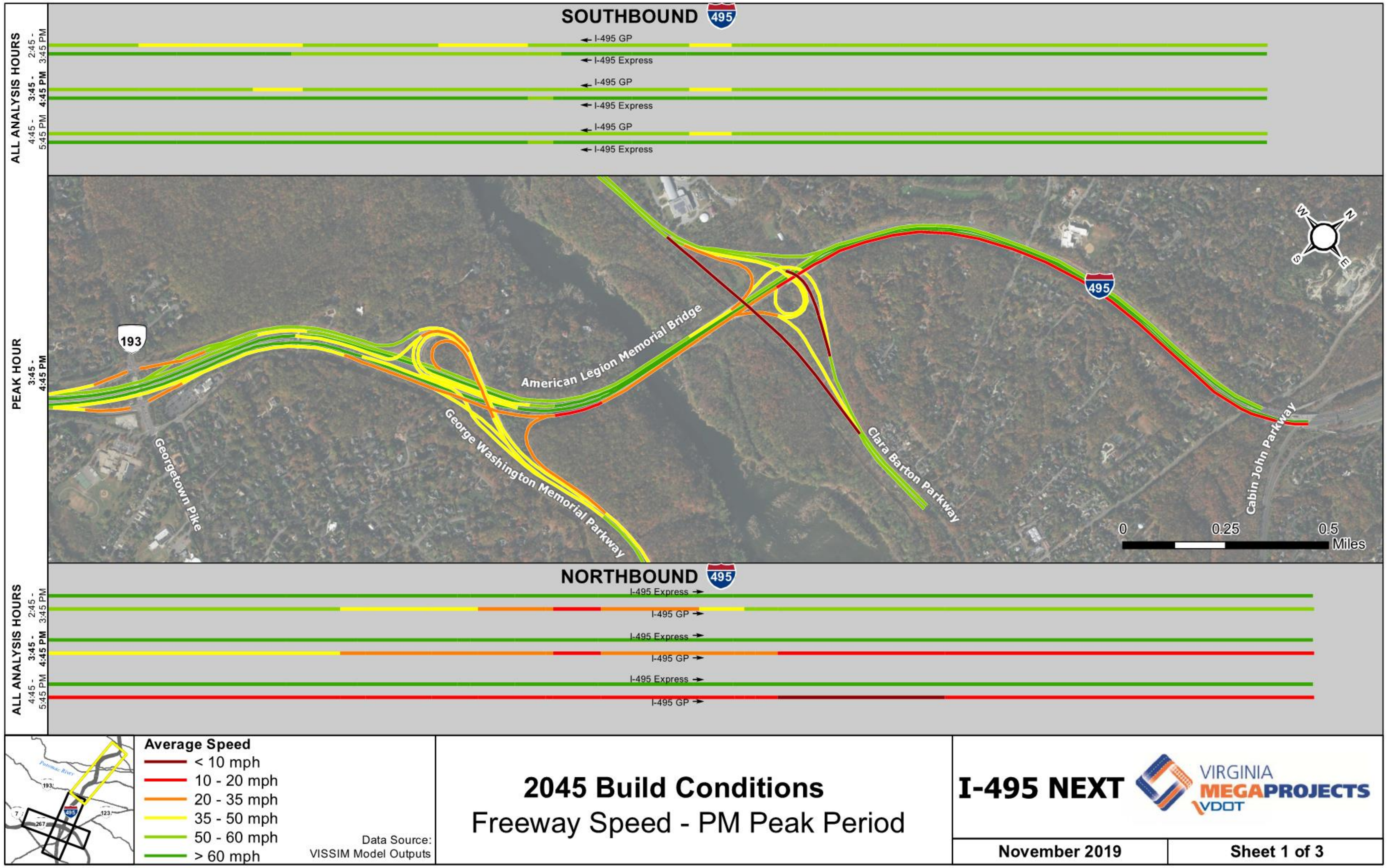


Exhibit 7-32a. 2045 Build I-495 PM Peak Period Average Speeds – Georgetown Pike to Cabin John Parkway

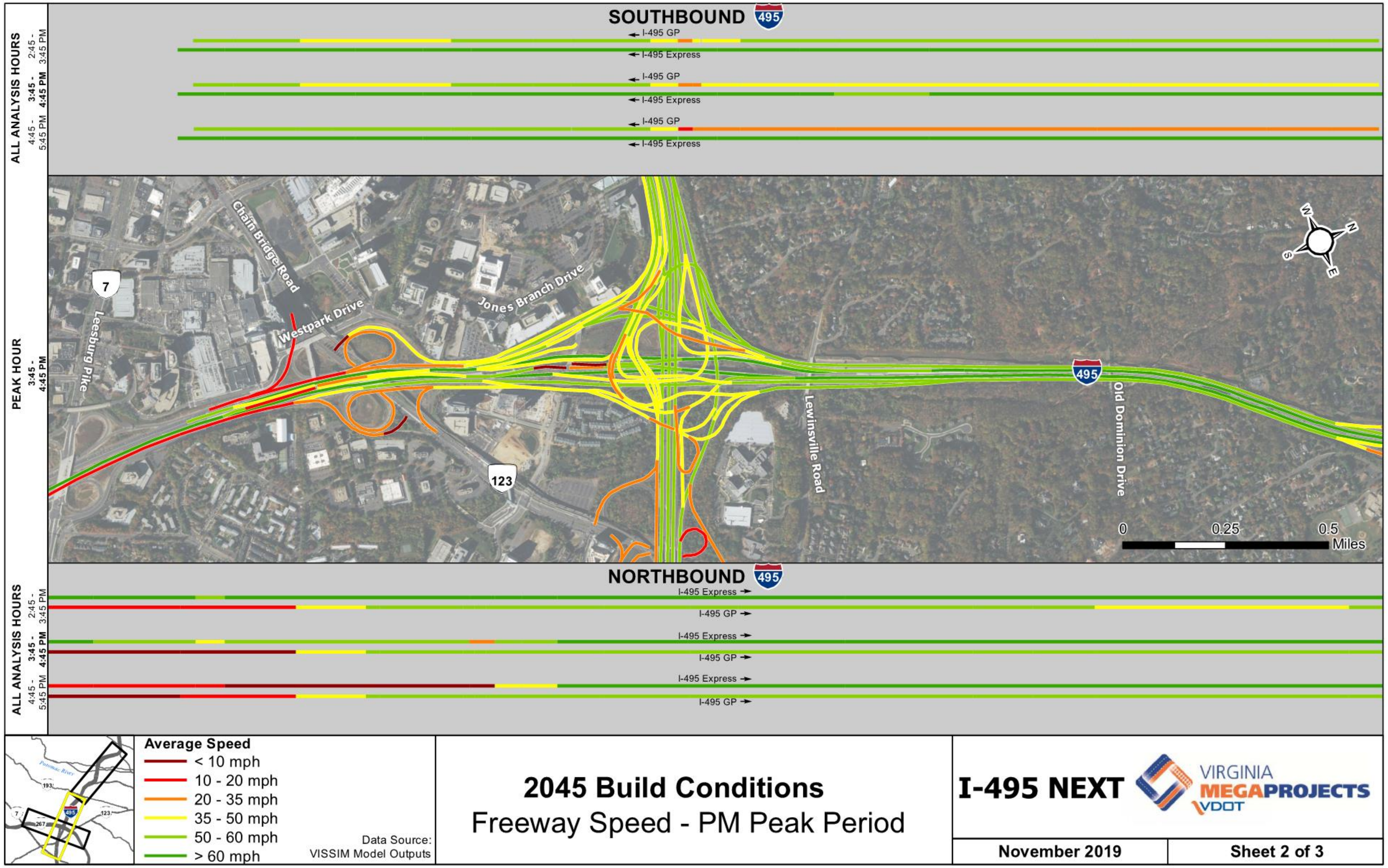


Exhibit 7-32b. 2045 Build I-495 PM Peak Period Average Speeds – Route 123 through Old Dominion Drive

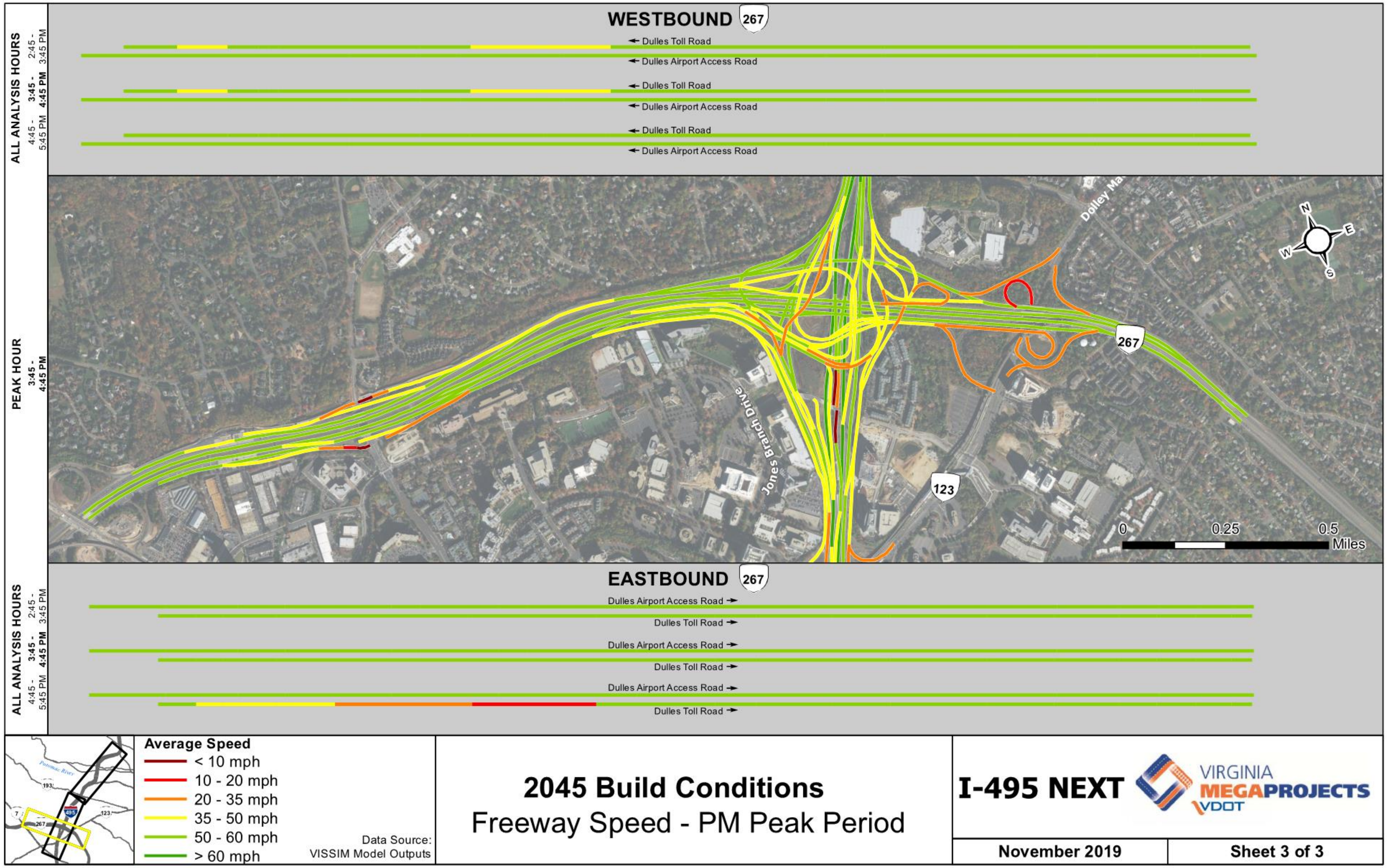


Exhibit 7-32c. 2045 Build Route 267 PM Peak Period Average Speeds

CHAPTER 8.0 EXISTING AND FUTURE SAFETY ANALYSIS

8.1 INTRODUCTION AND OVERVIEW

The project Traffic Operations Study Area is regularly characterized by heavy congestion, most especially in the area of the GWMP interchange and the ALMB on the northern portion of the corridor and the Route 267 interchange on the southern end. This congestion, most prevalent during the morning and evening peak periods, creates strong potential for crashes, especially multi-vehicle crashes such as rear end and sideswipe collisions. This congestion also regularly causes drivers to seek alternate routes on surrounding arterials, collectors, and residential streets in an attempt to reduce or avoid delay. This re-routing creates increased safety risks on those diversion routes that can also have negative safety impacts.

This chapter summarizes the following assessments of Traffic Operations Study Area safety:

- Existing conditions – crash frequencies (expressed in number of crashes per year) and crash rates (expressed in number of crashes per 100 million VMT for freeway segments or per million entering vehicles for intersections) based on historic crash data for the corridor
- Future No Build and Build conditions – predicted future crash probabilities, expressed in crash frequencies and crash rates, using HSM-based tools including:
  - ISATe for GP freeway segments and interchanges
  - Project-specific SPFs for Express Lanes segments
  - HSM spreadsheets for arterial intersections

The methodology applied for the existing and future safety analyses is documented in **Chapter 2**.

8.2 EXISTING CONDITIONS CRASH HISTORY AND SAFETY ANALYSIS

This section provides a summary of existing conditions total crashes along I-495, crash frequencies and rates for individual freeway sections of I-495, and trends for crash severity and type for individual freeway sections of I-495. It also contains a summary of crash history data for the Route 267 and GWMP corridors as well as arterial intersections. A detailed review of crash history throughout the entire Traffic Operations Study Area, including point maps of individual crash locations, is provided in the *Existing Conditions Technical Report* (VDOT, 2019a).

8.2.1 I-495 Corridor Crash History Summary

Existing Conditions Crash History Totals

Over the five-year period analysis period, there were a total of 1,736 crashes reported on the 4.6-mile section of I-495 (northbound and southbound) between the Route 7 interchange and the ALMB over the Potomac River. This section of I-495 includes the I-495 GP lanes, approximately 2.85 miles of the I-495 Express Lanes between Route 7 and the current northern terminus north of the Dulles Toll Road interchange, and approximately 22 ramps to and from I-495. During this five-year period, there were no fatal crashes, 455 injury crashes, and 1,281 property damage only (PDO) crashes reported in the freeway corridor.

Of the 1,736 of crashes reported within the study area between 2013 and 2017, the predominant crash type along the I-495 corridor is Rear-End-type crashes. Approximately 59 percent of all crashes were Rear-End collisions, compared to 22 percent Side-Swipe (same direction) crashes, 8 percent Angle crashes, 8 percent Run-Off-Road crashes, and 3 percent Other crashes.

Existing Conditions Crash Frequencies by Freeway Facility

The following summarizes crash frequencies along the I-495 corridor in terms of total crashes per mile per year.

- Crash frequencies are much lower in the Express Lanes than the GP lanes, with reported crash frequencies in the northbound direction ranging between 0 and 1.8 crashes per year per quarter-mile section and in the southbound direction ranging from 0 to 1.6 crashes per year per quarter-mile section.
- In the northbound GP lanes, nearly all segments analyzed average at least 10 crashes per year per quarter-mile section. The highest crash frequencies were near the Route 193 interchange, where one quarter-mile segment experiences more than 17 crashes per year, and near the merge from the GWMP on-ramp, which experiences nearly 20 crashes per year in a single quarter-mile segment.
- In the southbound GP lanes, crash frequencies are lower than in the northbound direction, likely due to less severe congestion experienced. Crash frequencies range from approximately 3 to 12 crashes per year per quarter-mile segment, with the highest crash rates near the southbound off-ramps to Route 267 (9.8 crashes per year) and near the southbound off-ramps to Route 123 (12.0 crashes per year).
- The southbound I-495 GP lanes within the study area included only two quarter-mile sections that had 9 or more crashes per year. By comparison, the northbound I-495 GP lanes within the study area had 15 quarter-mile sections that had 9 or more crashes per year. There were 594 reported crashes on the southbound GP lanes within the study area and 1,106 reported crashes on the northbound GP lanes.

Existing Conditions Crash Rates by Freeway Facility

The following summarizes crash rates along the I-495 corridor in terms of total crashes per 100 million vehicle miles traveled (VMT). Crash rates consider the influence of vehicular flows on crash occurrence and can be considered a normalization accounting for traffic volumes. **Figure 8-1** shows the crash rates for the northbound and southbound Express Lanes, while **Figure 8-2** provides the crash rates for the northbound and southbound GP lanes.

- In the northbound Express Lanes, one section exceeds a crash rate of 150 crashes per 100 million VMT; in the southbound Express Lanes, six sections exceed this rate. Within the Traffic Operations Study Area, there are more merges, diverges and weaving areas associated with the southbound Express Lanes compared to the northbound Express Lanes. Notably, there is one section of the southbound Express Lanes where two ramps merge in close proximity followed by a downstream off-ramp. This section had the highest crash rate of all the Express Lanes sections. The southbound Express Lanes also have more frequent changes in horizontal and vertical alignment, in addition to more access points.
- In the northbound GP lanes, there were eight sections that had reported crash rates exceeding 150 crashes per 100 million VMT. One northbound GP section had a crash rate of over 500 crashes per 100 million VMT: the section including the left-hand exit ramp to westbound Route 267 and the merge of the on-ramp from eastbound Route 267. Frequently queueing from downstream in the northbound GP lanes extends into this area. Consequently, the geometric conditions, coupled with the heavy traffic flows (for both of these ramp movements) and congestion all contribute to this location's very high crash rate.

- In the southbound GP lanes, there were no sections that have reported crash rates exceeding 150 crashes per million VMT.

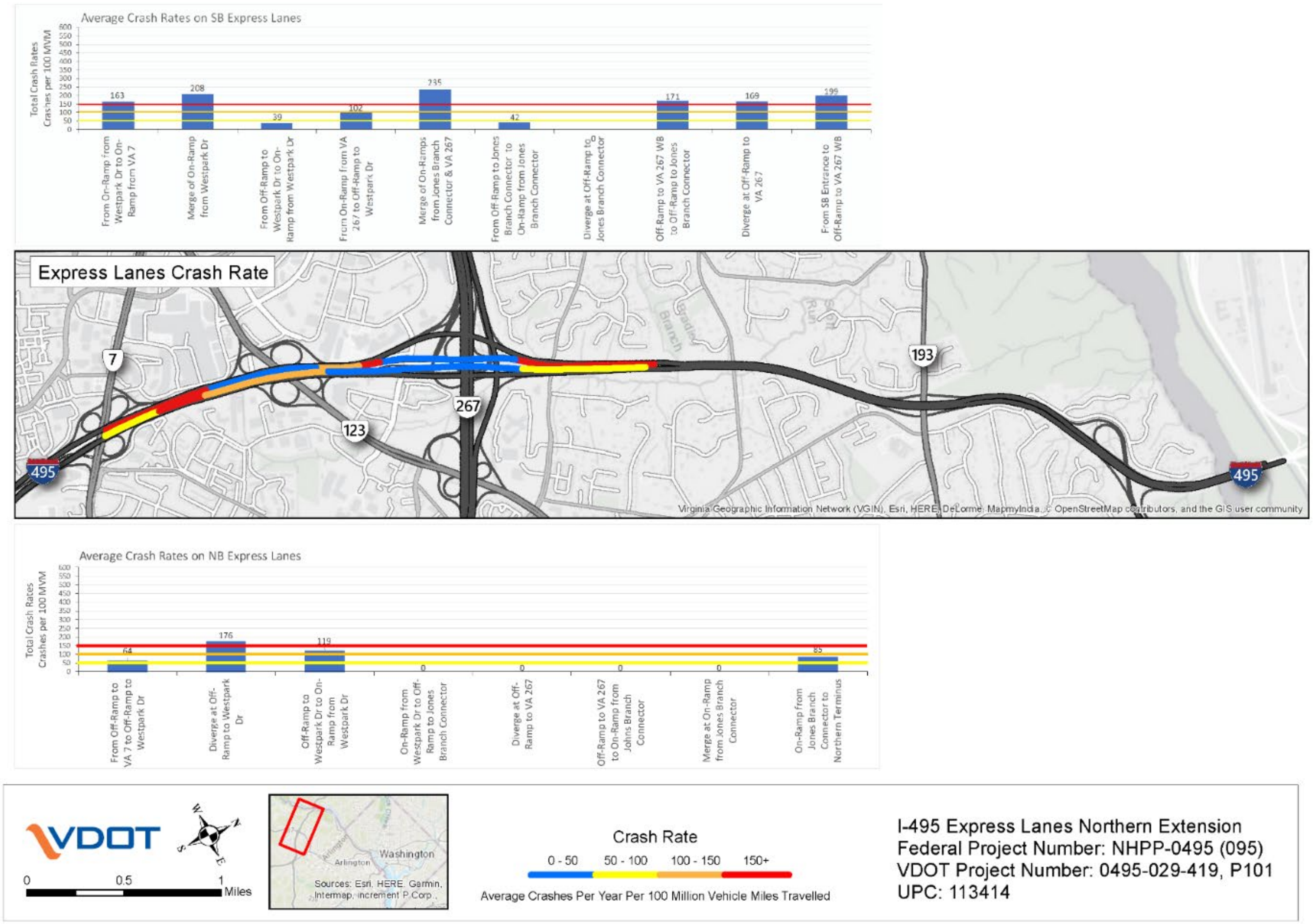


Figure 8-1. Crash Rates per Million VMT for I-495 Northbound and Southbound Express Lanes (2013-2017)

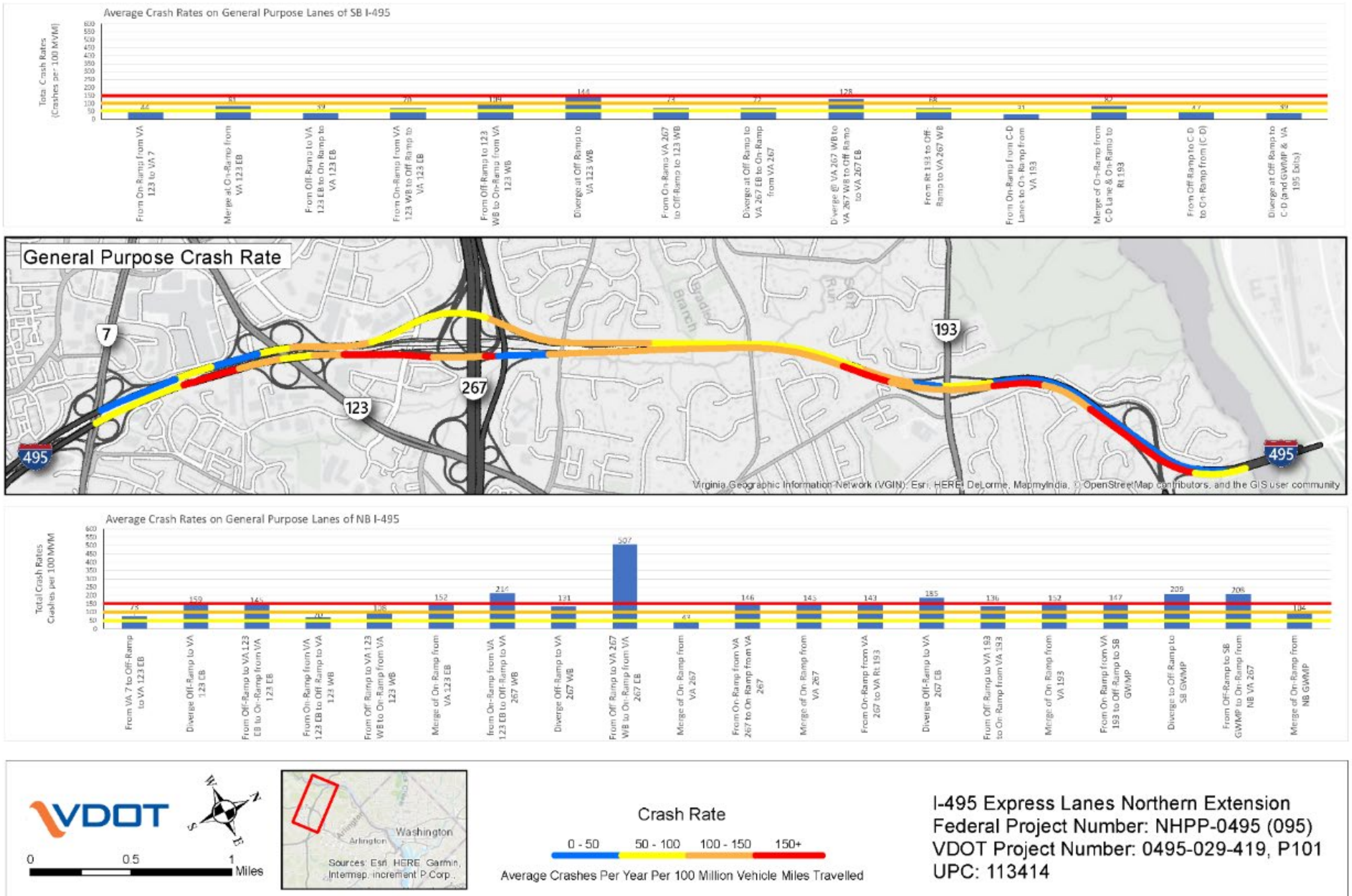


Figure 8-2. Crash Rates per Million VMT for I-495 Northbound and Southbound GP Lanes (2013-2017)

Summary of I-495 Crash History and Safety Issues

Northbound I-495 GP Lanes

The crash rate for northbound I-495 from Route 7 to the ALMB is worse than the southbound crash rate between the same termini. Moreover, the crash rate for this northbound section is approximately 100 percent higher than the statewide crash rate. The injury crash rate is 25 percent higher than the statewide injury crash rate. There were no fatalities reported. The northbound section includes the current northern terminus of the I-495 Express Lanes, 5 merges, 4 diverges, and a dynamic shoulder use lane. Over 70 percent of the crashes in all basic, diverge, and merge segments are PDO crashes in the northbound direction. The predominant type of crashes in all basic, diverge, and merge segments are Rear-End and Same-Direction Side-Swipe crashes. Traffic congestion in the study area influences the safety conditions. Rear-End and Side-Swipe crashes tend to typically be prominent in congested corridors.

The following three segments of I-495 experience the highest number of Rear-End crashes:

- Northbound I-495 from Route 267 to Route 193, with 145 crashes;
- Northbound I-495 from the off-ramp to Route 193 to the on-ramp from Route 193, with 67 crashes
- Northbound I-495 from the off-ramp to GWMP to the on-ramp from GWMP, with 60 crashes.

Each of these segments is located on northbound I-495 from the Route 267 interchange to near the GWMP where the northbound part-time shoulder lane currently terminates. A dynamic shoulder running lane was added in 2015, with a majority of the construction occurring from 2014 to 2015. This shoulder use lane drop contributes to increased turbulence in the traffic stream, creating the higher potential for Rear-End crashes to occur due to the stop-and-go nature of traffic operations in this area. This is further exacerbated by the long upgrade section north of the ALMB, which continues to the River Road interchange.

Northbound I-495 Express Lanes

Compared to the statewide average crash rates from 2013 through 2017 for interstate facilities within Virginia, the crash rate for the northbound Express Lanes section of I-495, exclusive of the existing northern terminus and the transition section to the GP lanes, was approximately 17 percent lower. The injury crash rate is 71 percent lower than the statewide injury crash rate. There were no fatalities reported. This can be attributed to the reduced congestion and improved LOS offered to commuters using the Express Lanes.

Southbound I-495 GP Lanes

Compared with the statewide average crash rates from 2013 through 2017 for interstate facilities within Virginia, the southbound section of I-495 between the ALMB and Route 7 exhibited an approximately 11 percent lower crash rate. The injury crash rate is 42 percent lower than the statewide injury crash rate. Over the five-year period, there were no fatal crashes reported. The southbound section includes the separated C-D roadway that provides access to the GWMP, which is operated and maintained by the NPS, and Route 193. The predominant type of crashes in all basic, diverge, and merge segments are Rear-End and Same-Direction Side-Swipe crashes. It is observed that diverge segments have an almost equal number of Rear-End and Side-Swipe crashes. This implies that in addition to the congestion, the merging and lane-changing maneuvers executed influence traffic safety in the study area.

Southbound I-495 Express Lanes

Compared with the statewide average crash rates from 2013 through 2017 for interstate facilities within Virginia, the southbound Express Lanes section of I-495 exhibited an approximately 27 percent lower crash rate. The injury crash rate is 55 percent lower than the statewide injury crash rate. There were no fatalities reported. This can be attributed to the reduced congestion and improved LOS offered to commuters using the Express Lanes.

8.2.2 Route 267 Crash History Summary

Further analysis was conducted on the section of the Dulles Toll Road/Dulles Connector Road (DTR/DCR) for the 2.5-mile mainline segment in the area of the I-495 Interchange (Exit 18). The analysis was broken up into the DTR/DCR mainline and Exit 18 off-ramps to I-495. The analysis included a six-year period from 2013-2018 which are the most complete years available at the time of analysis. During this period, there were 181 reported crashes on the DTR/DCR mainline, 61 crashes reported on the eastbound ramps to I-495, and 10 crashes reported on the westbound off-ramp to I-495 northbound.

From the analysis, five "Hot Spots", shown in **Figure 8-3**, were identified which in total account for 44 percent of all crashes along the DTR/DCR study area:

- Hot Spot 1 coincides with the westbound approach to the mainline toll plaza. Rear-End and Side-Swipe crashes combined comprise 85 percent of overall crashes at this location.
- Hot Spot 2 coincides with the westbound weave area between the I-495 and Spring Hill Road interchanges. Traffic is entering from the right from the heavy movement from I-495 southbound and is exiting to the right to access Spring Hill Road. Additionally, traffic is exiting to the left to access the Dulles Airport Access Road, and additional traffic is merging to the left to access the higher-speed EZ-Pass lanes at the downstream toll plaza. Notably, Rear-End and Side-Swipe crashes comprise 87 percent of overall crashes at this location.
- Hot Spot 3 coincides with the diverge area of the eastbound DTR and Exit 18 ramps to I-495, which represents a major decision point for drivers. Rear-End and Side-Swipe collisions are common, especially during congested periods. Approximately 91 percent of the collisions in this location are Rear-End and Side-Swipe type collisions.
- Hot Spot 4 coincides the eastbound weave area between the merge from southbound I-495 to eastbound DTR and the diverge to Exit 19 (Route 123). Exit 19 frequently sees significant congestion during peak periods due to spillback from the heavy loop ramp to Route 123 northbound. Rear-End and Side-Swipe type collisions comprise 79 percent of total crashes.
- Hot Spot 5 is just downstream from Hot Spot 3 and coincides with the diverge area of the Exit 18 ramps where drivers must properly lane position for the exit onto either northbound or southbound I-495. It has a similar pattern of Rear-End and Side-Swipe collisions; however, it does have additional presence of Fixed Object – Off Road collisions associated with the horizontal curvature of the segment. Overall, 68 percent of the total crash activity is Read-End and Side-Swipe type collisions, while 28 percent of the crashes are Fixed Object - Off Road.

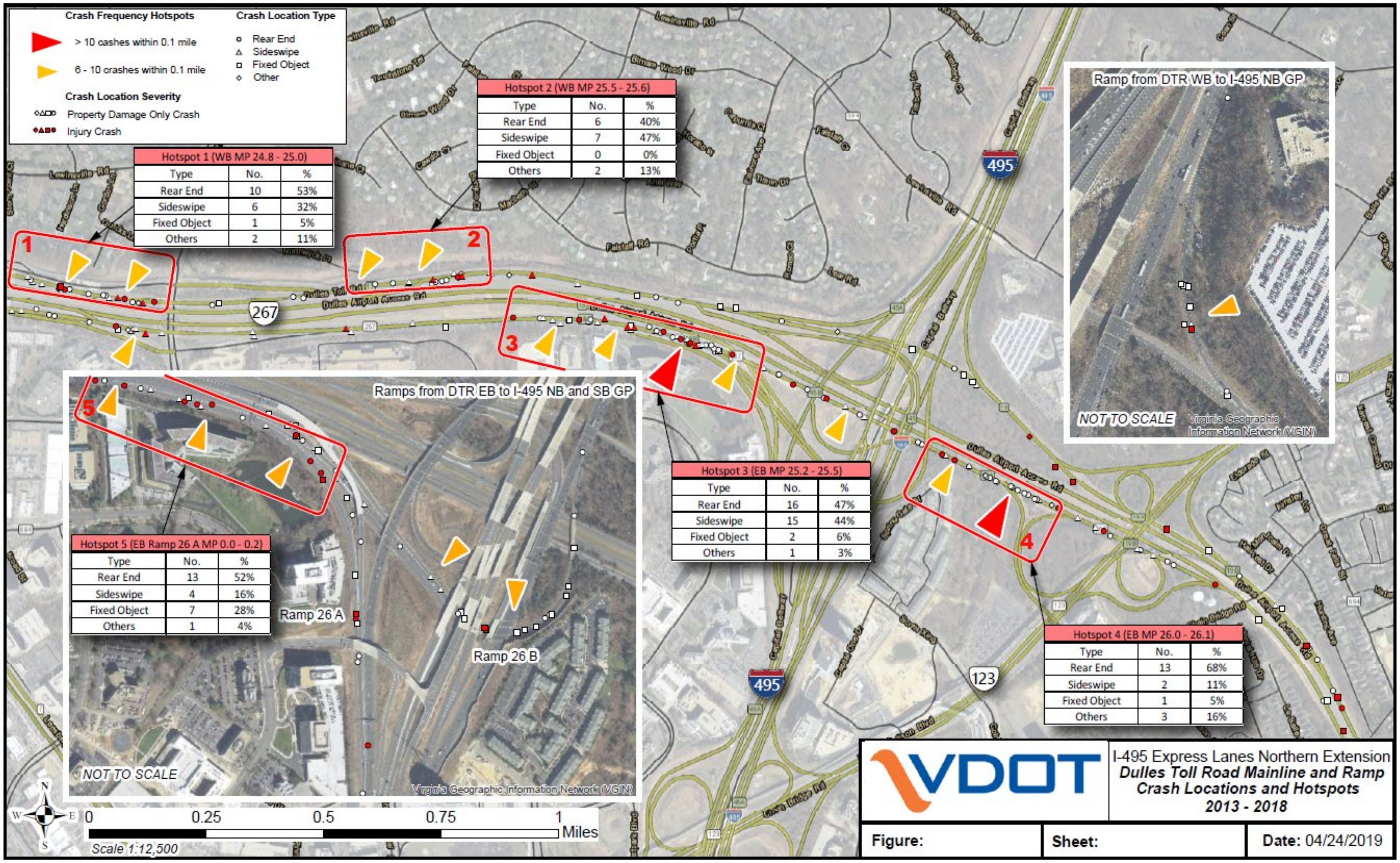


Figure 8-3. Detailed DTR/DCR Hot Spot Locations (2013-2018)

8.2.3 George Washington Memorial Parkway Crash History Summary

For thorough analysis of the entire project area, crash data was requested from the National Park Service (NPS) for the George Washington Memorial Parkway (GWMP) from the I-495 interchange to the Turkey Run Turnaround Ramps. Complete NPS data was provided for calendar years 2014-2017 which were the most recent full years available. NPS crash data include date/time, severity, and GPS locations of investigated incidents. Details, such as type of collision or diagrams of the crash, were not available from the data received. A summary of crashes by year and severity is shown in **Table 8-1**.

Table 8-1. Summary of NPS Crash Data for GWMP between I-495 and Turkey Run Interchange (2014-2017)

George Washington Mem Pkwy Crashes			
	PDO	Injury	Total
2014	76	5	81
2015	78	13	91
2016	70	5	75
2017	86	5	91

The data indicate the two primary areas of significant activity are the ramps to and from the Turkey Run turnaround and the gore area for westbound GWMP to the I-495 ramps. The crash frequency of the Turkey Run Ramps is likely due to limited geometrics and very short acceleration and deceleration lanes. The crash activity at the gore area may be due to late lane changes or unsafe diverging maneuvers by motorists.

Based on the number of crashes, calculations were performed to determine the segment crash rate. The rate was calculated on the segment from I-495 to the eastern most ramps for the Turkey Run Turnaround and utilized existing traffic volumes. The segment crash rate is 2.13 crashes per million VMT and 0.18 injuries per million VMT.

8.2.4 Arterial Intersections Crash History Summary

As traffic continues to encounter increasing levels of congestion, some drivers seek alternative routes to avoid the congestion. As a result, there are several intersections on the arterial streets within the vicinity of the interstate freeway that have experienced high annual crash frequencies and intersection crash rates. At several of these intersections, the intersection crash rate is significantly higher than the statewide intersection average crash rates for similar intersections. A total of 28 intersections were identified and assessed in terms of safety. A total of 1 fatal crash, 205 injury crashes, and 306 property damage only (PDO) crashes were reported over the five-year period at these 28 intersections. The average annual number of crashes per year per intersection varied from 1 to 16 intersection crashes per year. The associated intersection crash rates varied from 0.07 to 1.18 intersection crashes per million entering vehicles.

Additionally, the following existing conditions trends were observed along arterials:

- **Figure 8-4** and **Figure 8-5** show that the intersections of Route 123 (Chain Bridge Road) with Tysons Boulevard and Old Meadow Road have high crash rates and crash frequencies. Both intersections are adjacent to I-495 with several high traffic volume generators nearby. Both intersections experience heavy traffic congestion, leading to increased crashes.

- Across all intersections in the Traffic Operations Study area, approximately 40 percent of intersection crashes are injury crashes, which is notably high.
- Most of the crashes are either Rear-End crashes or angle crashes. Therefore, it can be inferred that heavy congestion primarily contributes to the intersection crashes in the study area.
- Based on the analysis of the reported crash data for this five-year period, environmental factors as lighting, weather, and pavement condition did not significantly affect the safety performance of the intersections.

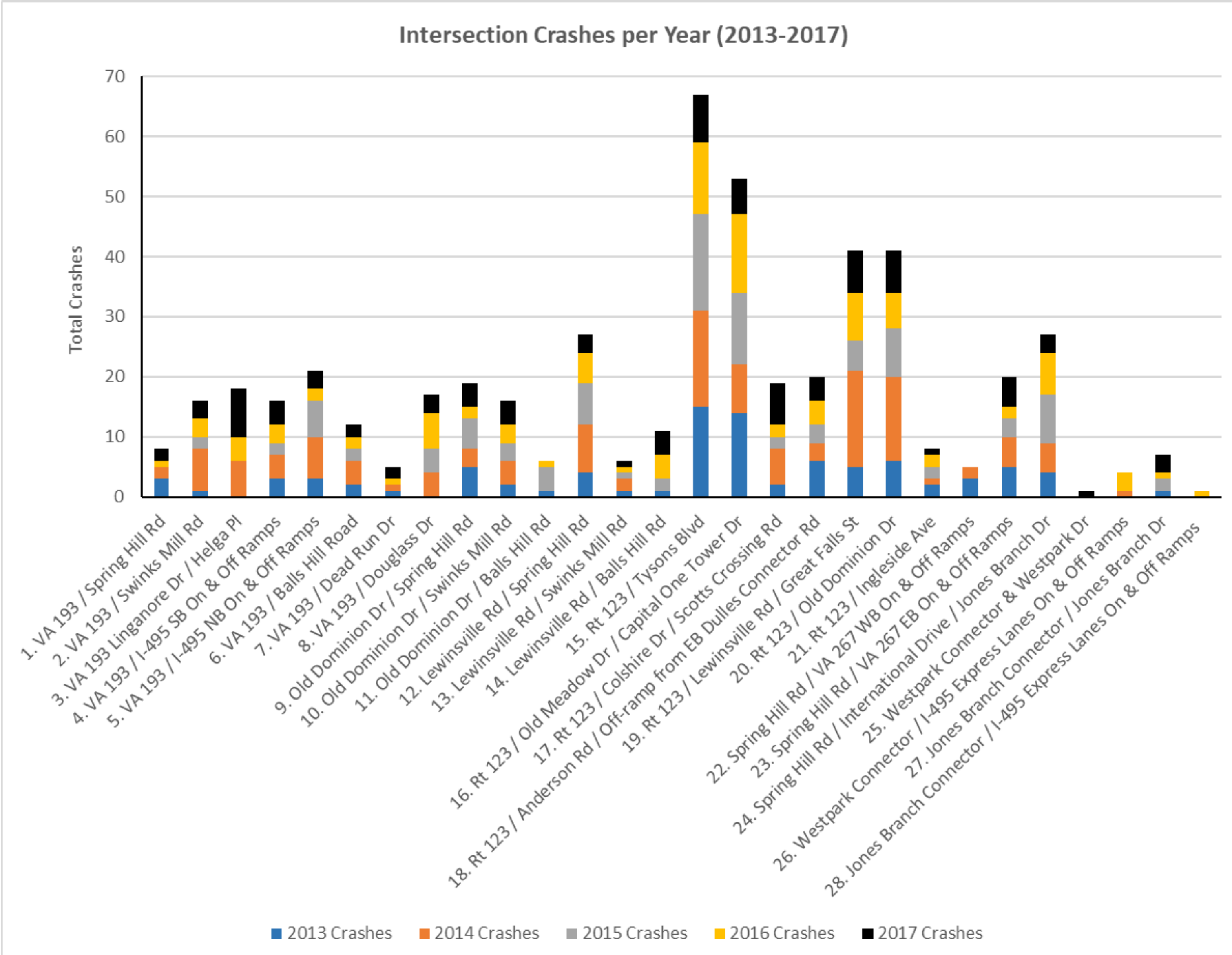


Figure 8-4. Arterial Intersection Crashes Reported by Year (2013-2017)

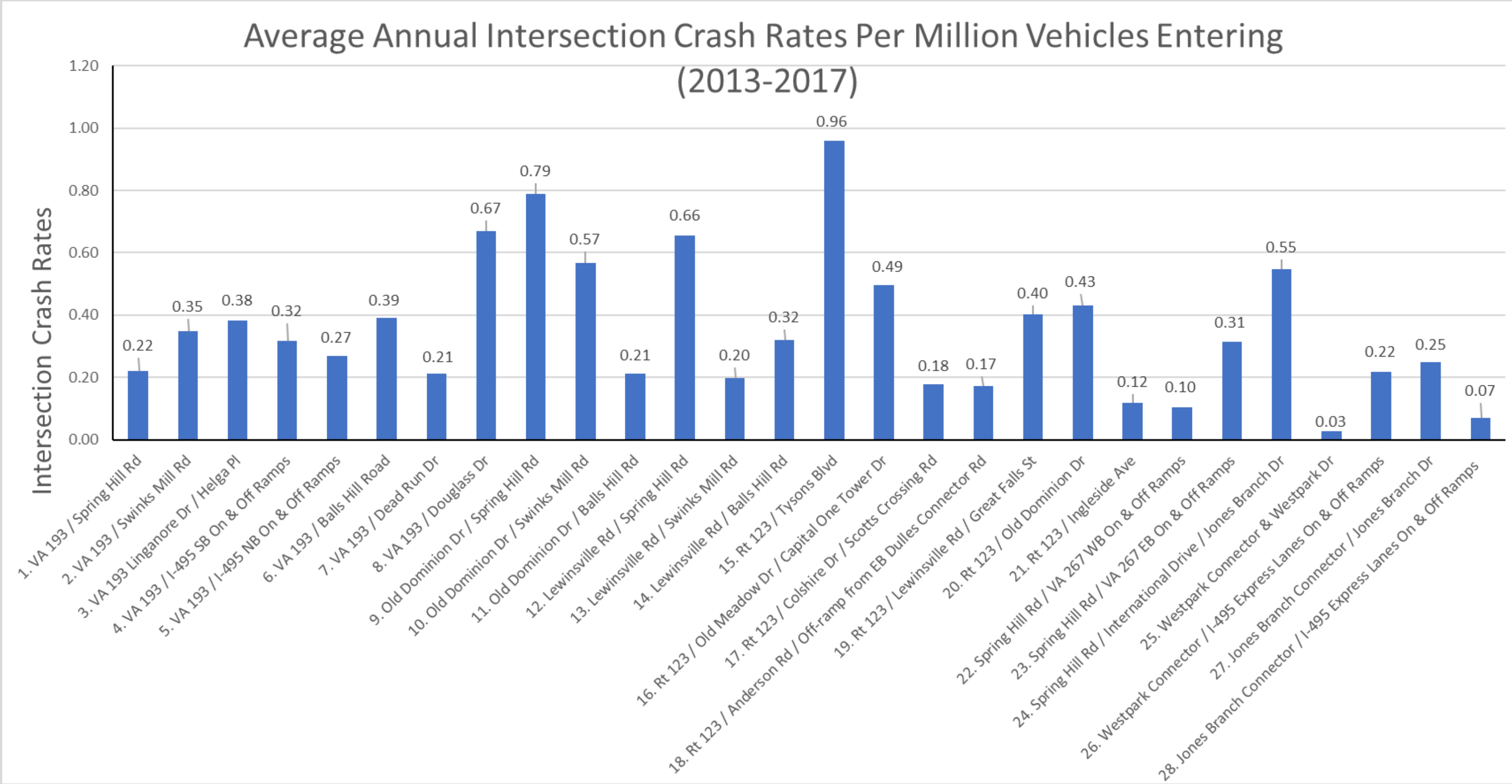


Figure 8-5. Arterial Intersection Crash Rates per Million Vehicles Entering (2013-2017)

8.3 FUTURE CONDITIONS SAFETY ANALYSIS

The operations and design elements of a proposed freeway system or interchange design project affect safety performance. Through the use of the principles and concepts in the HSM and safety analysis tools including ISATe, a project-specific SPF, and Extended HSM Spreadsheets, the project study team evaluated the safety impact of changes to the design. HSM methods and tools were used to predict the safety performance of design alternatives.

Section 8.2 summarized the results of the existing conditions safety evaluation and determination of potential for safety improvement at locations within the Traffic Operations Analysis Study Area. Additionally, the intent of the safety analysis is to provide insight into detailed design elements and aid in refining the Preferred Alternative during the design phase of project development. To address this second item, future conditions safety analysis was performed for the No Build and proposed Build conditions for both 2025 and 2045 analysis years for four configurations: 2025 No Build, 2025 Build, 2045 No Build, and 2045 Build. Note that, as discussed in **Chapter 5** (for No Build conditions) and **Chapter 6** (for Build conditions), various elements proposed to be in place by 2045 are not assumed to be in place by 2025. Additionally, for the 2025 No Build and Build scenarios only, it was determined upon consultation with VDOT that crash predictions would be based on a scenario in which the Maryland managed lanes system is not yet constructed. This assumes a conservative "worst case" condition for safety analysis for 2025.

8.3.1 Evaluation Approach and Process

Crash Prediction on Freeway and Ramp Segments Using ISATe

The Interchange Safety Analysis Tool–Enhanced (ISATe) was used to evaluate and compare the expected safety performance of freeway and ramp segments. ISATe enables prediction of interchange safety performance (including mainline segments, ramp segments, and ramp terminal intersections). It was adopted for use in the HSM as a crash prediction method for predictive safety performance of freeways and interchanges. (It should be noted that this specific tool is cited by FHWA as an example, and not as an endorsement over others).

To align with the national emphasis on addressing fatal and severe injury crashes, the I-495 NEXT safety performance evaluation focused on predicting the number of KAB crashes (K is a fatal crash, A is an incapacitating injury crash, and B is a non-incapacitating injury crash) expected for each alternative (No Build and Build) for 2025 and 2045. The project study team did not calculate the societal costs associated with the number of predicted crashes over the study periods; however, it may be performed at a later date.

Crash Prediction on the Express Lanes Using Safety Performance Functions (SPFs)

For evaluating Express Lanes freeway segments, a project-specific SPF was developed. In developing the SPF, it is important to recognize the underlying assumptions on which the new relationships were based. These included the following:

- Because I-495 Express Lanes operate within an uncongested regime, SPFs would be directly related to AADT as a dependent variable within certain thresholds.
- Traffic volumes and crash history for the existing I-495 Express Lane sections for the most recently available 5 years (January 1, 2013 through December 31, 2017) were deemed adequate from a historical perspective and used to develop new SPFs for the Express Lanes directional segments consisting of two lanes.

The salient features of the crash data, from which the SPF were developed, are described as follows:

- A total of 396 crashes were reported over a period of 5 years on the I-495 Express Lanes.
- Of those 396 reported crashes, 49 reported crashes occurred within the Diverge Segments and 45 reported crashes occurred within the Merge Segments. The remaining 302 reported crashes occurred on the Basic and Weave Segments.

A series of statistical models were developed to predict crashes. The primary independent variables used in the regression analyses were AADT, segment length and segment type (Merge, Diverge or Basic/Weave). The number of predicted crashes per year was the dependent variable in each model. The following functional forms for SPFs were tested:

Group 1 (Each model included segment length as one of the independent variables):

1. All reported crashes as a function of AADT, segment length and segment type
2. All reported crashes as a function of AADT and segment length
3. Basic and weave segment crashes as a function of AADT and segment length
4. Merge segment crashes as a function of AADT and segment length
5. Diverge segment crashes as a function of AADT and segment length

Group 2 (None of the models included section length as an independent variable)

1. All reported crashes as a function of AADT and segment type
2. All reported crashes as a function of AADT
3. Basic and weave Segment Crashes as a function of AADT
4. Merge segment crashes as a function of AADT
5. Diverge segment crashes as a function of AADT

The results of the statistical regression modelling were as follows:

Group 1:

1. All Crashes as a function of AADT, segment length and segment type: Segment type was insignificant.
2. All Crashes as a function of AADT and segment length: All variables were significant.
3. Basic and Weave Segment Crashes as a function of AADT and segment length: All variables were significant.
4. Merge Segment Crashes as a function of AADT and segment length: All variables were insignificant.
5. Diverge Segment Crashes as a function of AADT and segment length: AADT was insignificant.

Group 2:

1. All Crashes as a function of AADT and segment type: AADT and segment type variables were insignificant.
2. All Crashes as a function of AADT: All variables were significant.
3. Basic and Weave Segment Crashes as a function of AADT: All variables were insignificant.
4. Merge Segment Crashes as a function of AADT: All variables were insignificant.
5. Diverge Segment Crashes as a function of AADT: All variables were insignificant.

The results of the statistical modeling results and the statistical model forms were included a previous technical memorandum titled *Development of Safety Performance Functions (SPFs) for I-495 Express Lanes*. This memorandum is provided as **Appendix J.** The results show that SFP2 in Group 1 and SPF7 in Group 2 were the only models in which all of their independent variables were found to be statistically significant. Of the two, SFP2 in Group 1 had a much higher R-squared value, which reflects a better "goodness of fit," compared to SPF7 in Group 2. Intuitively, predicted crashes should have a direct correlation to AADT and roadway segment length. The models in the Highway Safety Manual for crash prediction are also very similar in form but with different coefficients.

On the basis of the analysis conducted, the proposed SPF for Express Lanes on I-495 is given below for the non-linear and linear regression models.

Regression: Expectation ($Crashes_{i,t}$) = exponential (0.011022579 + 0.987113593 * ln(Segment $Length_{i,t}$) + 0.141283034 * ln($AADT_{i,t}$)

Linear Regression: Expectation ($Crashes_{i,t}$) = 0.550840245 + 4.130999289 * Segment Length $_{i,t}$) - 0.000121228 * AADT $_{i,t}$)

Where:

$Crashes_{i,t}$ = Crashes/year on Segment i for Time period t,

Segment $Length_{i,t}$ = Segment Length on Segment i for Time period t and

$AADT_{i,t}$ = Average Annual Daily Traffic on Segment i for Time period t.

The non-linear regression form had an R-squared value of 0.51 and the linear regression form had an R-squared value of 0.564; therefore, the linear regression model form was chosen due to the better R-squared value. There was a challenge with linear regression model for a limited number of cases where the model had a negative prediction of crashes. To fix that challenge, the form of the linear regression model was modified to be the max value of 0 and linear regression predicted crashes; this change in the model form solved the challenge by replacing negative prediction of crashes with zero. The R-squared for the modified form continued to be 0.564.

On the basis of the analysis conducted, the proposed SPF for Express Lanes on I-495 is given below:

Expectation ($Crashes_{i,t}$) = Max[0.550840245 + 4.130999289 * Segment $Length_{i,t}$) -0.000121228 * $AADT_{i,t}$), 0]

Where:

$Crashes_{i,t}$ = Crashes/year on Segment i for Time period t,

Segment $Length_{i,t}$ = Segment Length on Segment i for Time period t and

$AADT_{i,t}$ = Average Annual Daily Traffic on Segment i for Time period t.

This equation applies to all Freeway sections: Merge, Diverge, Basic, and Weave.

Appendix J includes a comparison of the actual crashes and predicted crashes for all segments of the Express Lanes in the existing conditions. The comparison shows the difference in the total crashes predicted using linear regression model versus actual crash performance is less than 1 crash in five years for existing conditions. The proposed SPF for I-495 Express Lanes can be used for the prediction of crashes for future No Build and Build alternatives for the I-495 NEXT project.

Crash Prediction on Arterials using Extended HSM Spreadsheets
Extended HSM Spreadsheets were used to conduct safety analysis for arterial intersections within the Traffic Operations Study Area. The HSM spreadsheets are applicable for Rural Two-Lane, Two-Way Roads (HSM Chapter 10); Rural Multilane Highways (HSM Chapter 11); and Urban and Suburban Arterials (HSM Chapter 12). The tool predicts crashes by roadway segment and intersection.

8.3.2 Total Crash Prediction

In **Table 8-2**, the crash frequency results from the 2025 No Build and Build conditions are compared with the crash frequency results from the 2045 No Build and Build conditions. These numbers represent the total predicted crashes in the Traffic Operations Study Area, including GP lanes, Express Lanes, and arterials. The total number of predicted crashes per year is anticipated to decrease in the 2045 No Build case compared to the 2025 No Build case due to CLRP improvements included within the study area (including the Maryland Traffic Relief Plan). Similarly, the total number of predicted crashes per year is anticipated to decrease in the 2045 Build case compared to the 2025 Build case. The improvements to I-495 on the Maryland side of the river were assumed to be in place for both No Build and Build conditions for 2045 only.

Table 8-2. Total I-495 Traffic Operations Study Area Predicted Crash Frequency Summary

Year	Scenario	Total General Purpose, Express, and Arterial Intersection Predicted Crash Frequency (crashes/year)		
		KABC	PDO	Total
2025	No Build	278.1	583.3	861.4
	Build	280.2	588.2	868.4
2045	No Build	254.9	563.2	818.1
	Build	226.8	426.1	652.9

8.3.3 Freeway Crash Prediction by Segment

Crash Analysis Zones Overview
Predicted crash frequencies and crash rates were calculated for individual freeway segments. For reporting purposes, these metrics were aggregated into interchange zones and/or segment zones within the Traffic Operations Study Area. Below is a description of limits for the various crash analysis zones.

- I-495 Interchanges
    - I-495/Route 123 and I-495/Route 267 interchanges were combined as one zone. These two interchanges were grouped together because of their close proximity and interconnectedness, especially in the 2045 scenarios in which C-D roads provide connectivity between the interchanges. See **Figure 8-6** for limits of I-495 Interchange Zone: Route 123 and Route 267 Combined.

    - I-495/Route 193 and I-495/GWMP interchanges were also combined as one zone for similar reasons. The interchanges currently share a C-D road in the southbound direction. See **Figure 8-7** for limits of Interchange Zone: Route 193 and GWMP Combined.
- Northbound I-495 GP Lane segments
    - From Route 7 to Route 123
    - From Route 267 to Route 193
- Southbound I-495 GP Lane segments
    - From Route 193 to Route 267
    - From Route 123 to Route 7
- Northbound I-495 Express Lanes segments
    - From Route 7 to I-495/Route 123/Route 267 interchanges
    - Within the I-495/Route 123/Route 267 interchanges[1]
    - From I-495/Route 123/Route 267 interchange to GWMP interchange
    - From GWMP interchange to the state line
- Southbound I-495 Express Lanes segments
    - From the state line to GWMP interchange
    - From to GWMP interchange to I-495/Route 123/Route 267 interchanges[1]
    - Within the I-495/Route 123/Route 267 interchanges
    - From I-495/Route 123/Route 267 interchanges to Route 7
- Route 267 (Dulles Toll Road) interchanges and segments
    - Spring Hill Road and Route 267 (Dulles Toll Road) interchange. See **Figure 8-8** for limits of the Route 267 Interchange Zone at Spring Hill Road and Dulles Toll Road.
    - I-495 and Route 267 (Dulles Toll Road) interchange (mainline only; all ramps for the I-495/Route 267 interchange are included in the I-495/Route 267 interchange zone). See **Figure 8-9** for limits of the Route 267 Interchange Zone at I-495.
    - Route 123 and Route 267 (Dulles Toll Road) interchange. See **Figure 8-10** for limits of the Route 267 Interchange Zone at Route 123.
    - Route 267 eastbound from Route 123 interchange to 0.03 miles east of the bridge over Route 650
    - Route 267 westbound from 0.03 miles east of the bridge over Route 650 to the Route 123 interchange
- Route 267 (Dulles Airport Access Road) segments
    - Eastbound Route 267 (DAAR) from Spring Hill Road to the eastern terminus
    - Westbound Route 267 (DAAR) from the eastern terminus to Spring Hill Road

[1] For the 2045 Build Alternative, it should be noted that because Ramp E1 from Route 267 (DTR & DAAR) eastbound is nearly 1 mile in length and serves both the northbound and southbound Express Lanes, and therefore accounts for a significant portion of the 2045 Build Express Lanes ramp crashes, the crash predictions for Ramp E1 were distributed to the northbound Express Lanes within the I-495/Route 123/Route 267 interchanges and to the southbound Express Lanes within the I-495/Route 123/Route 267 interchanges by percentage of ADT volume destined to each. See **Figure 8-11**.

Figure 8-6. I-495 Interchange Zone: Route 123 and Route 267 Combined

Figure 8-7. I-495 Interchange Zone: Route 193 and GWMP Combined

Figure 8-8. Route 267 Interchange Zone: Spring Hill Road and Dulles Toll Road

Figure 8-9. Route 267 Interchange Zone: I-495 (Dulles Toll Road Mainline Only)

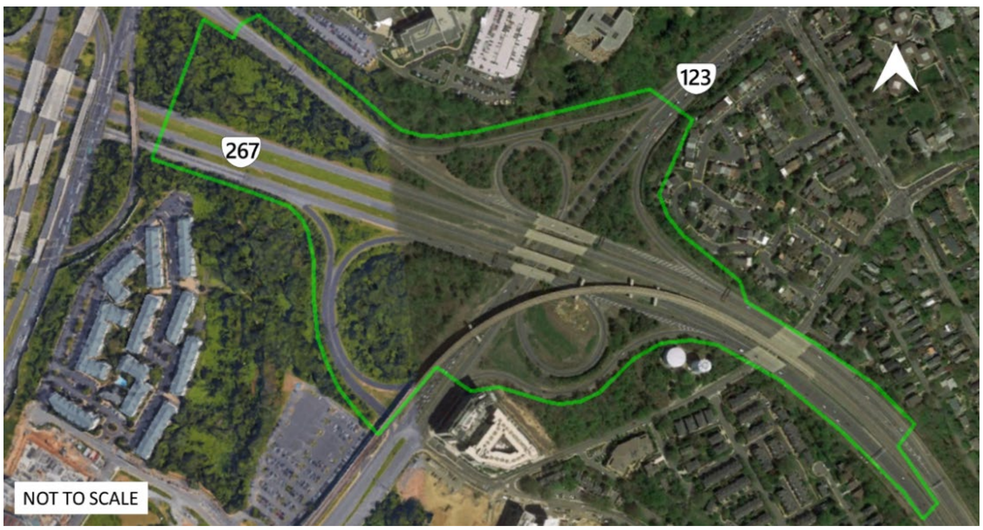


Figure 8-10. Route 267 Interchange Zone: Route 123

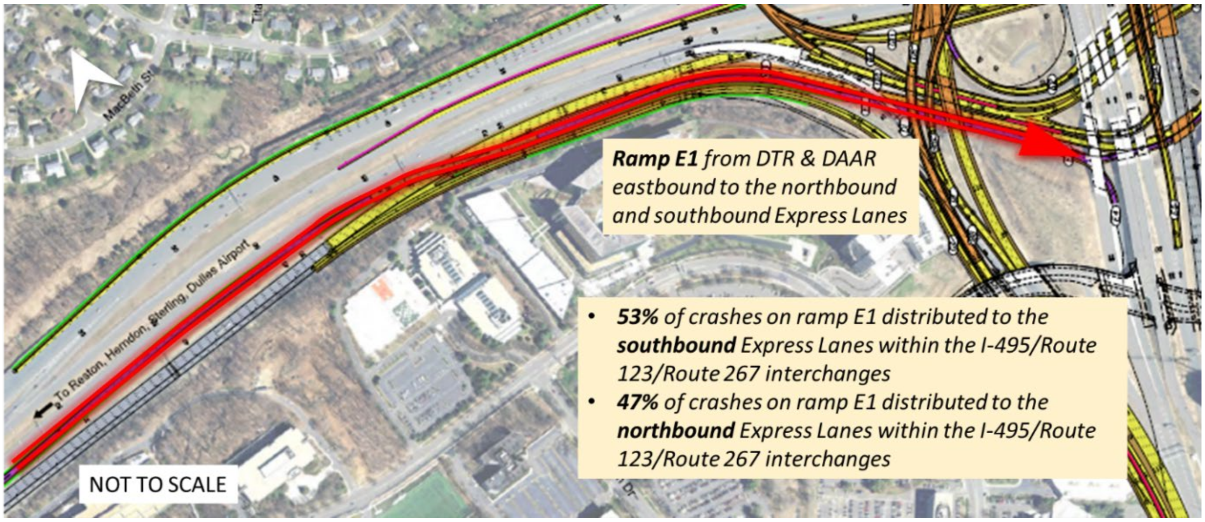


Figure 8-11. Ramp E1 from eastbound DTR and DAAR to northbound and southbound I-495 Express Lanes

2025 No Build and Build Crash Rate Predictions

I-495 Interchanges

The predicted crash rate per 100 million entering vehicles (MEV) for the two I-495 interchange areas for 2025 No Build and Build conditions are summarized **Figure 8-12**. The following summarize the comparative crash rates for the I-495 interchanges under 2025 conditions**:**

- The predicted crash rate for the I-495 GP interchanges with Route 123 and Route 267 slightly decreases between the No Build and Build conditions. Under 2025 Build conditions, the Express Lanes northern terminus is removed from the I-495 and Route 267 interchange area; therefore, the merge and diverge conflicts associated with the northern terminus are no longer present which yield a lower predicted crash rate.
- The predicted crash rate for the I-495 GP interchanges with Route 193 and the GWMP increases by nearly 23 more crashes per 100 MEV from No Build to Build conditions. This change in predicted crashes is the result of (1) the additional ramp terminals associated with the GWMP which increases the potential for conflict and crashes and (2) the terminus for the I-495 Express Lanes assumed for 2025 Build conditions for this safety analysis, which is assumed to be located at the GWMP interchange. This terminus creates a heavy merge in the northbound direction and diverge in the southbound direction.

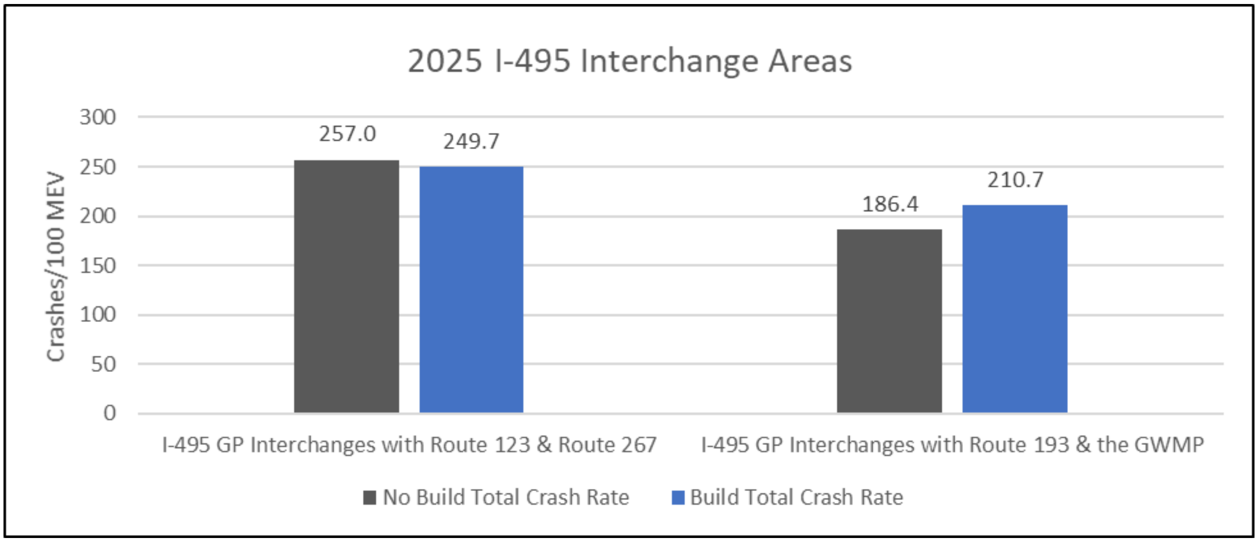


Figure 8-12. 2025 No Build and Build Predicted Crash Rates: I-495 Interchange Areas

I-495 GP Lanes

Figure 8-13 shows the predicted crash rate per 100 million vehicle miles traveled (MVMT) for two segments of the northbound I-495 GP lanes between 2025 No Build and Build conditions. The following summarize the comparative crash rates for the northbound I-495 GP lanes under 2025 conditions**:**

- The predicted crash rate for the northbound GP lanes from the Route 7 bridge to the interchanges with Route 123 and Route 267 shows a nominal increase between 2025 No Build and Build conditions.
- The predicted crash rate for the northbound GP lanes from Route 267 to the interchanges with Route 193 and the GWMP decreases significantly by nearly 20 crashes per 100 MVMT from No Build to Build conditions. The extension of the Express Lanes to the Maryland border diverts traffic volume from the GP lanes to the Express Lanes through this segment, reducing congestion and therefore lowering the potential for crashes to occur.

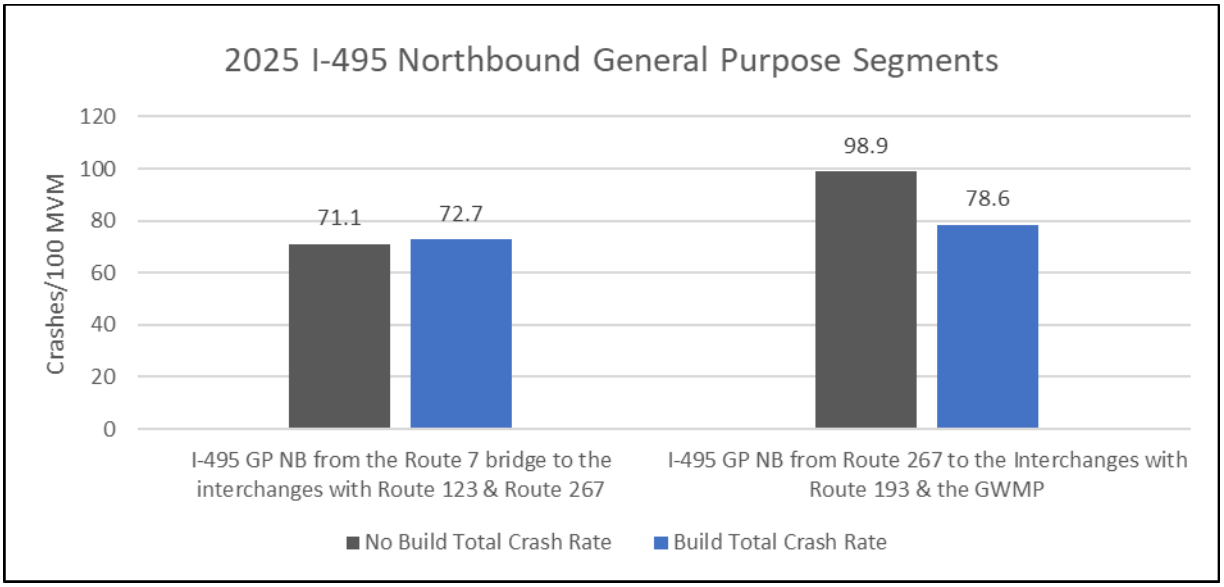


Figure 8-13. 2025 No Build and Build Predicted Crash Rates: Northbound I-495 GP Lanes

Figure 8-14 provides a summary of predicted crash rates for two segments of the southbound I-495 GP lanes under 2025 No Build and Build conditions. The following summarize the comparative crash rates for the southbound I-495 GP lanes under 2025 conditions**:**

- The predicted crash rate for the southbound I-495 GP lanes from Route 267 to the interchanges with Route 193 and the GWMP decreases by nearly 20 crashes per MVMT between No Build and Build conditions. The extension of the Express Lanes to the GWMP diverts volume from the GP lanes to the Express Lanes through this segment, reducing congestion and therefore lowering the potential for crashes to occur.
- The predicted crash rate for the southbound I-495 GP lanes from the Route 7 bridge to the interchanges with Route 123 and Route 267 shows a nominal increase between No Build and Build.

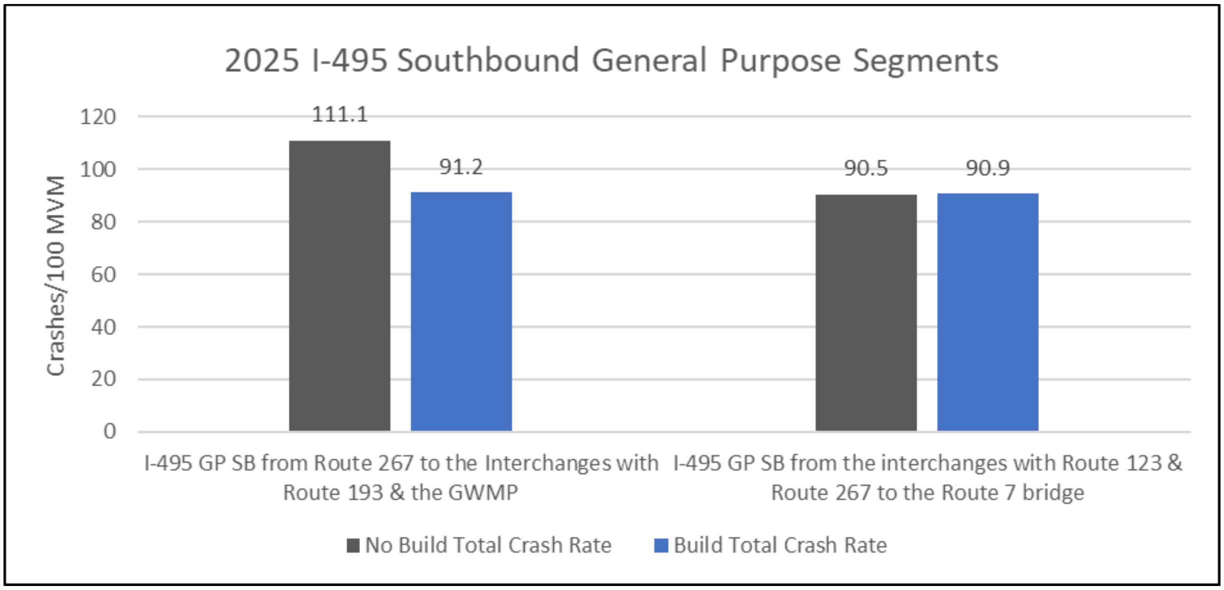


Figure 8-14. 2025 No Build and Build Predicted Crash Rates: Southbound I-495 GP Lanes

I-495 Express Lanes

Figure 8-15 shows the predicted crash rate at four locations on the northbound Express Lanes under 2025 No Build and Build conditions. The following summarize the comparative crash rates for the northbound I-495 Express Lanes under 2025 conditions**:**

- The Express Lanes predicted crash rate from the existing northern terminus to the state line is shown only for the Build condition. Express Lanes are not present in the No Build condition for this section.
- The predicted crash rate the northbound Express Lanes from the Route 7 bridge to the interchanges with Route 123 and Route 267 decreases by approximately 17 crashes per 100 MVMT from No Build to Build conditions.
- The predicted crash rate for the northbound Express Lanes within the Route 123 and Route 267 interchanges decreases by 22 crashes per 100 MVMT from No Build to Build conditions.

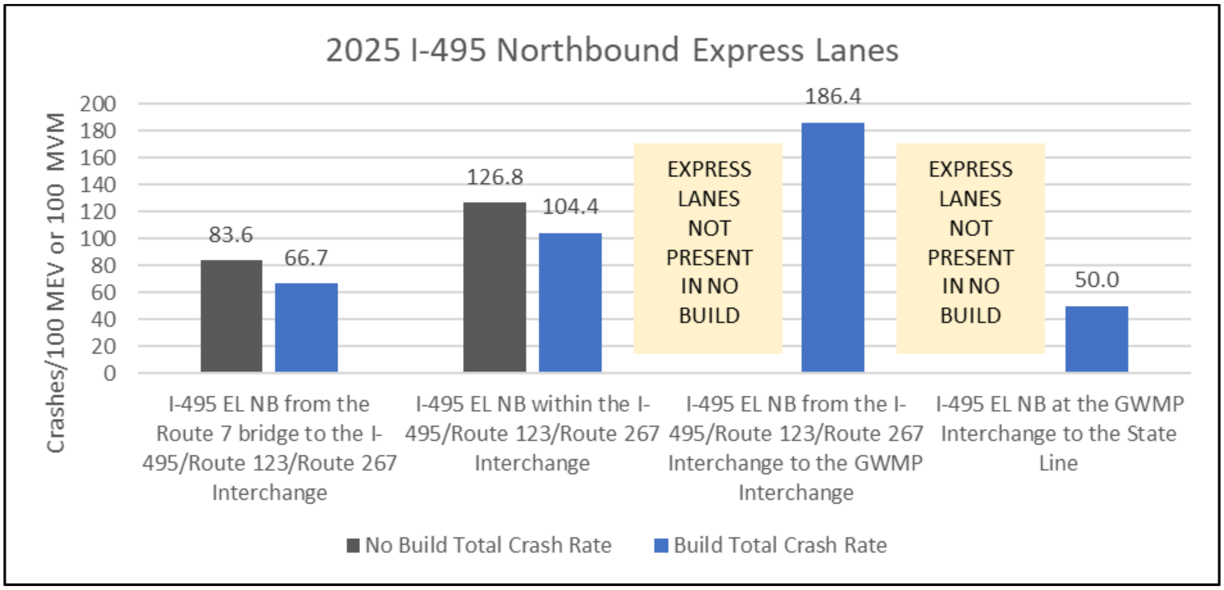


Figure 8-15. 2025 No Build and Build Predicted Crash Rates: Northbound I-495 Express Lanes

Figure 8-16 shows the predicted crash rate for four segments on the southbound Express Lanes between 2025 No Build and Build conditions. The following summarize the comparative crash rates for the southbound I-495 Express Lanes under 2025 conditions**:**

- The Express Lanes predicted crash rate from the existing northern terminus to the state line is shown only for the Build condition. Express Lanes are not present in the No Build condition for this section.
- The predicted crash rate for the southbound Express Lanes within the Route 123 and Route 267 interchanges decrease by 24 crashes per 100 MVMT from No Build to Build.
- The predicted crash rate for the southbound Express Lanes from the interchanges with Route 123 and Route 267 to the Route 7 bridge decrease by approximately 18 crashes per 100 MVMT from No Build to Build.

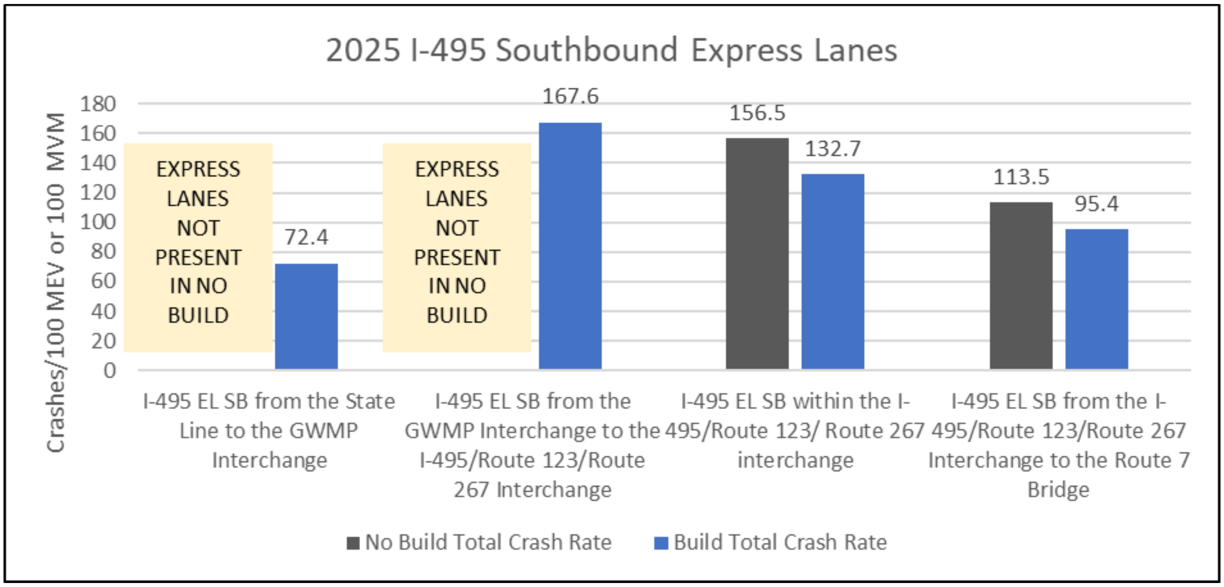


Figure 8-16. 2025 No Build and Build SPFs Developed for Express Lanes Predicted Crash Rate Summary (Southbound Express Lanes)

Route 267

Figure 8-17 shows the predicted crash rate for five segments of Route 267 (DTR) between 2025 No Build and Build conditions. The following summarize the comparative crash rates for the DTR under 2025 conditions**:**

- The predicted crash rate for the DTR interchange with Spring Hill Road increases by 16 crashes per 100 MVMT from No Build to Build conditions. This zone includes the mainline weave on eastbound DTR and the mainline weave on westbound DTR between Spring Hill Road and I-495. Due to the Express Lanes extension and the new access from eastbound DTR to the northbound Express Lanes, volume increases through the mainline weave sections. This causes an increase in friction and conflicts between vehicles, which increases predicted crash rate for the Build conditions compared to the No Build.
- The predicted crash rate for the DTR interchange with I-495 (crash rate along the DTR segments only) slightly decrease from No Build to Build.
- The predicted crash rate for the DTR interchange with the Route 123 decrease by 18 crashes per MVMT from No Build to Build conditions. It should be noted that the higher crash frequency at the DTR/Route 123 interchange as compared to other segments of the DTR is due to (1) the two mainline weaving sections between the interchange with I-495 and Route 123 are included in the DTR/Route 123 interchange zone and (2) while the length of the DTR/Route 123 interchange zone is similar to the length of the DTR/I-495 interchange zone, all ramps to and from Route 123 are accounted for in the DTR/Route 123 interchange zone. The ramps for the DTR/I-495 interchange are accounted for in the "I-495 GP Interchange with Route 267 & Route 123" zone and are not shown with the DTR results to avoid double-counting evaluation results.
- The predicted crash rate for eastbound DTR from the Route 123 interchange to the eastern terminus of the study area (0.03 miles past the Route 650 bridge) slightly increase from No Build to Build.

- The predicted crash rate for westbound DTR from the eastern terminus to the Route 123 interchange slightly decrease from No Build to Build.

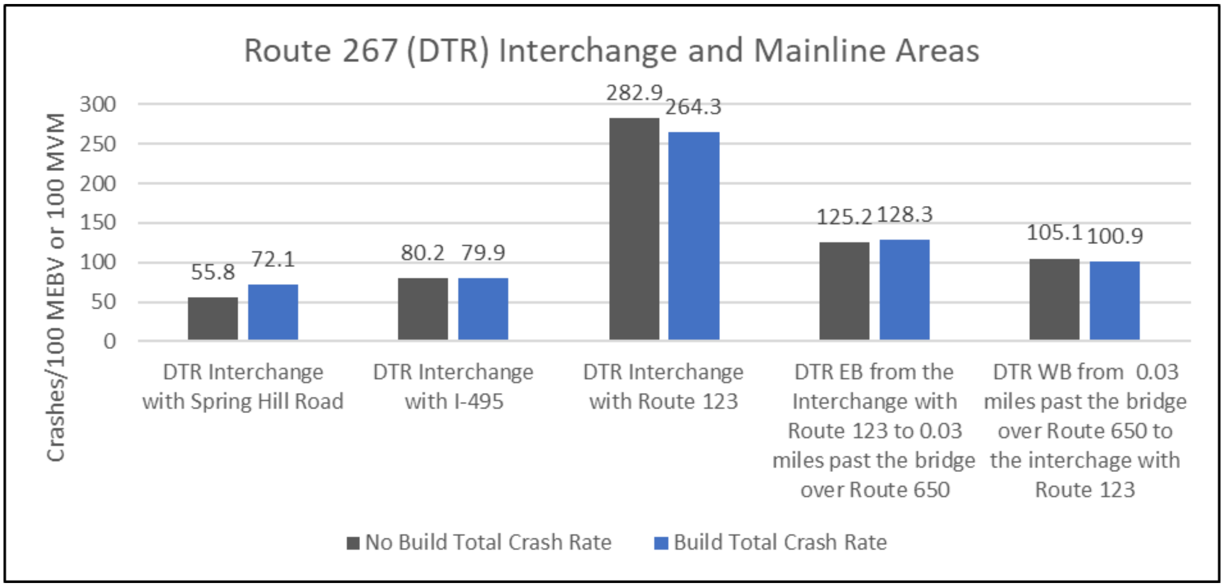


Figure 8-17. 2025 No Build and Build ISATe Predicted Crash Rate Summary for Route 267 (DTR)

Figure 8-18 shows the predicted crash rate for eastbound and westbound Route 267 (DAAR) under 2025 No Build and Build conditions. The following summarize the comparative crash rates for the DAAR under 2025 conditions**:**

- The predicted crash rate for eastbound DAAR slightly decreases by 3 crashes per 100 MVMT from No Build to Build conditions due to traffic volume fluctuations. There are no changes to eastbound DAAR geometry under the 2025 Build condition.
- The predicted crash rate for westbound DAAR slightly increases by 4 crashes per 100 MVMT from No Build to Build conditions. There are no changes to the DAAR westbound geometry in the 2025 Build condition.

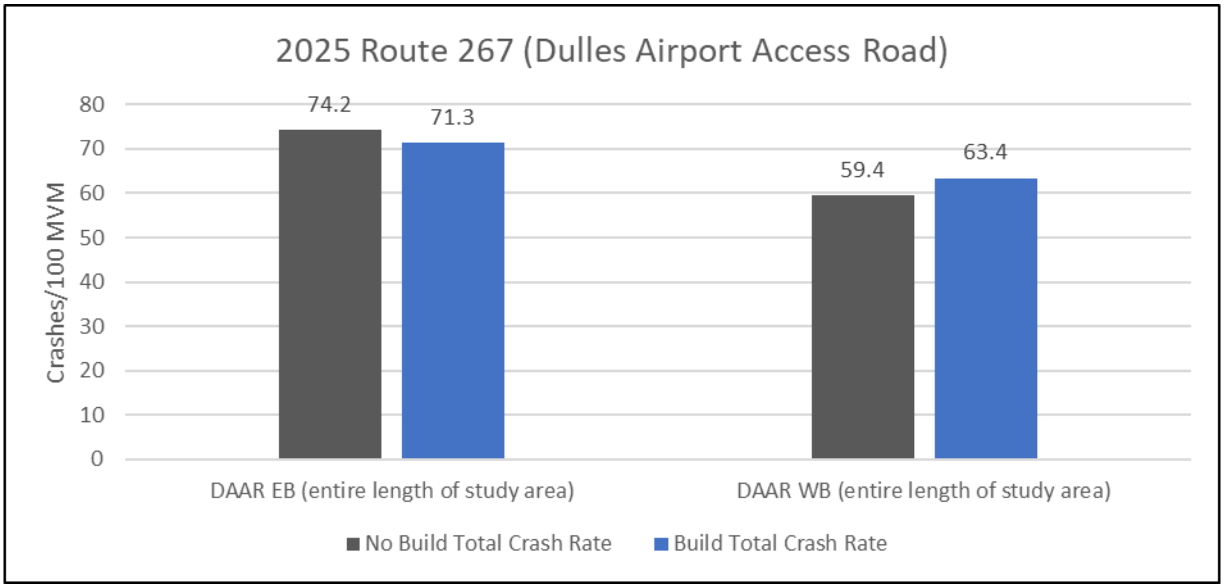


Figure 8-18. 2025 No Build and Build ISATe Predicted Crash Rate Summary for Route 267 (DAAR)

2025 No Build and Build Crash Frequency Predictions

I-495 Interchanges

Figure 8-19 shows the predicted crash frequency (crashes/year) for two segments of the I-495 interchanges between 2025 No Build and Build conditions. The following summarize the comparative crash frequencies for the I-495 interchanges under 2025 conditions**:**

- The predicted annual crash frequency for the I-495 GP interchanges with Route 123 and Route 267 slightly decrease by 13 crashes per year from No Build to Build conditions. In the 2025 Build alternative, the Express Lanes northern terminus is removed from the I-495 and Route 267 interchange area; therefore, the merge and diverge conflicts associated with the northern terminus are no longer present.
- The predicted annual crash frequency for the I-495 GP interchanges with Route 193 and the George Washington Memorial Parkway significantly increases by 7 crashes per year from No Build to Build, due to (1) the additional ramp terminals associated with the GWMP which increases the potential for conflict and crashes and (2) the terminus for the I-495 Express Lanes assumed for 2025 Build conditions for this safety analysis, which is assumed to be located at the GWMP interchange. This terminus creates a heavy merge in the northbound direction and diverge in the southbound direction.

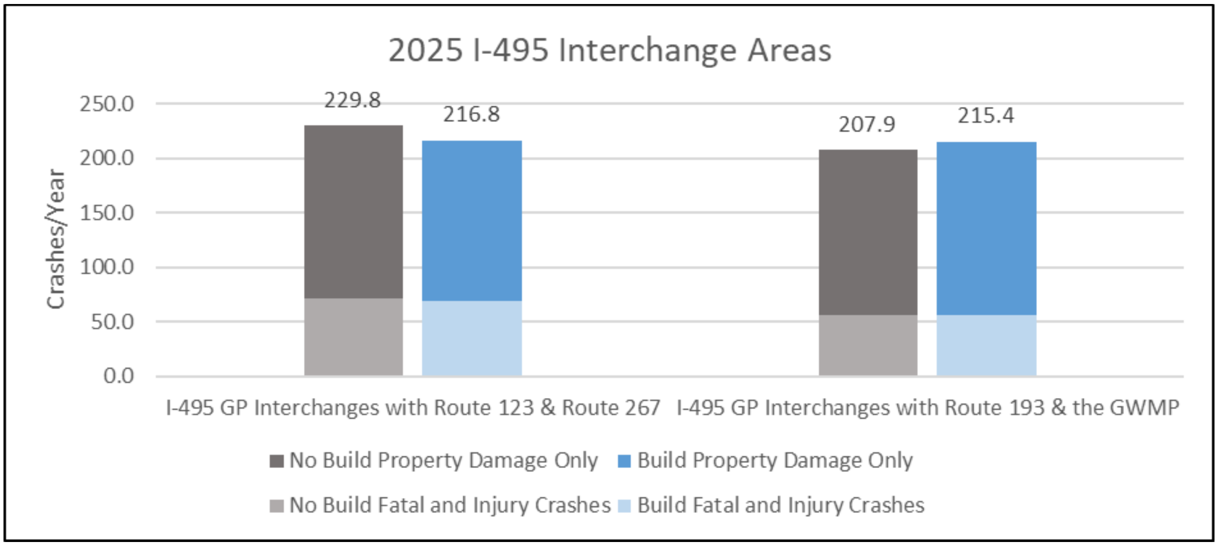


Figure 8-19. 2025 No Build and Build ISATe Predicted Crash Frequency Summary for I-495 Interchange

<u>I-495 GP Lanes</u>

Figure 8-20 shows the predicted annual crash frequency for two segments of the northbound GP lanes between 2025 No Build and Build conditions. The following summarize the comparative annual crash frequencies for the northbound I-495 GP lanes under 2025 conditions**:**

- The predicted annual crash frequency for the northbound GP lanes from the Route 7 bridge to the interchanges with Route 123 and Route 267 increases nominally from No Build to Build due to a slight increase in predicted volume and therefore in predicted crash frequency.
- The predicted annual crash frequency for the northbound GP lanes from Route 267 to the interchanges with Route 193 and the GWMP significantly decreases by approximately 6 crashes per year from No Build to Build conditions. The extension of the Express Lanes to the Maryland state line diverts volume from the GP Lanes to the Express Lanes through this segment; therefore, lowering the potential for crashes to occur.

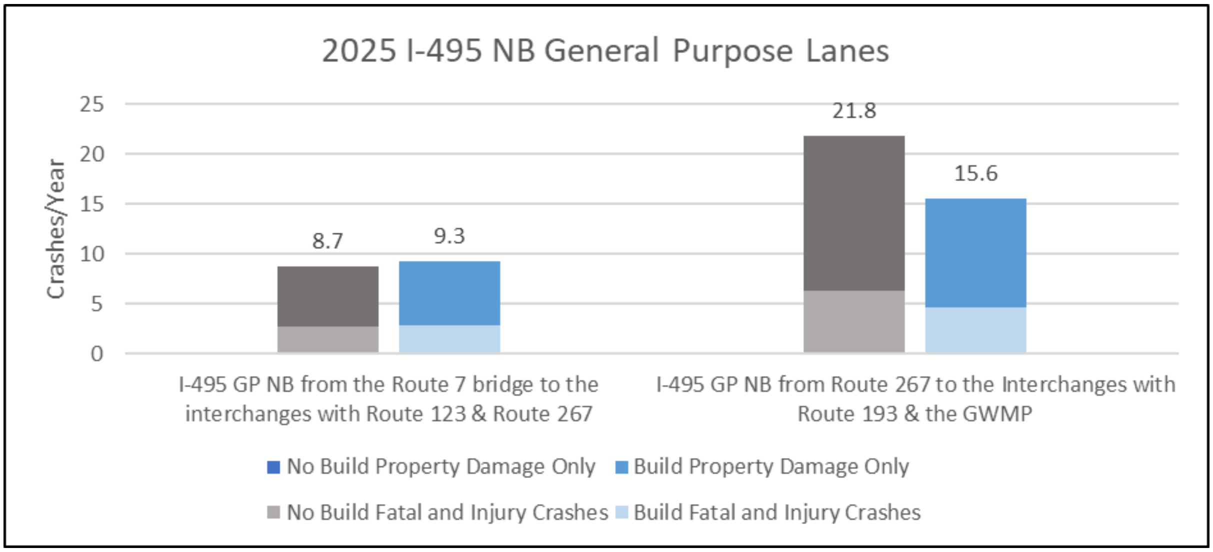


Figure 8-20. 2025 No Build and Build ISATe Predicted Crash Frequency Summary for Northbound I-495 GP Lanes

Figure 8-21 shows the predicted crash frequency (crashes/year) for two segments of the southbound GP lanes between 2025 No Build and Build conditions. The following summarize the comparative annual crash frequencies for the southbound I-495 GP lanes under 2025 conditions**:**

- The predicted annual crash frequency for the southbound I-495 GP lanes from Route 267 to the interchanges with Route 193 and the GWMP significantly decreases by approximately 5 crashes per year from No Build to Build conditions. The extension of the Express Lanes from the Maryland state line diverts traffic volume from the GP Lanes to the Express Lanes through this segment; therefore, lowering the potential for crashes to occur.
- The predicted annual crash frequency for the southbound GP lanes from the Route 7 bridge to the interchanges with Route 123 and Route 267 show a nominal increase and is effectively stable.

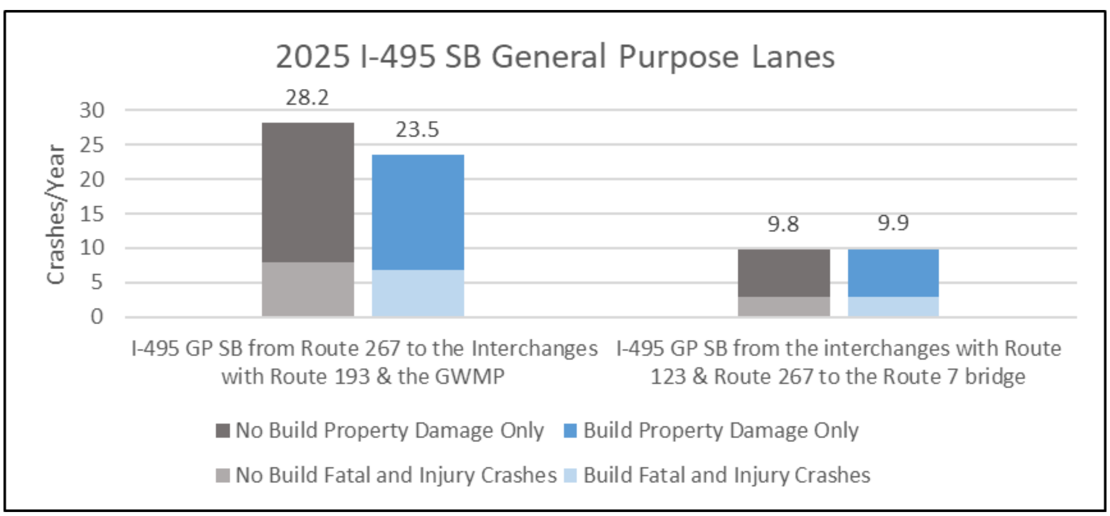


Figure 8-21. 2025 No Build and Build ISATe Predicted Crash Frequency Summary for Southbound I-495 GP Lanes

<u>I-495 Express Lanes</u>

Figure 8-22 shows the predicted crash frequency (crashes/year) for four segments of the northbound Express Lanes between 2025 No Build and Build conditions. The following summarize the comparative annual crash frequencies for the northbound I-495 Express Lanes under 2025 conditions**:**

- The Express Lanes predicted annual crash frequency from the existing northern terminus to the state line is shown only for the Build condition. Express Lanes are not present in the No Build condition for this section.
- The predicted annual crash frequency for the northbound Express Lanes from the Route 7 bridge to the interchanges with Route 123 and Route 267 is expected have nominal change between the No Build to Build conditions.
- While the predicted crash rate for the northbound Express Lanes within the Route 123 and Route 267 interchanges decreases from No Build to Build, the crash frequency increases slightly. The Express Lanes extension and additional access from Route 267 eastbound increases demand on the existing and future mainline and ramps through these two interchanges, therefore increasing the predicted overall number of crashes.

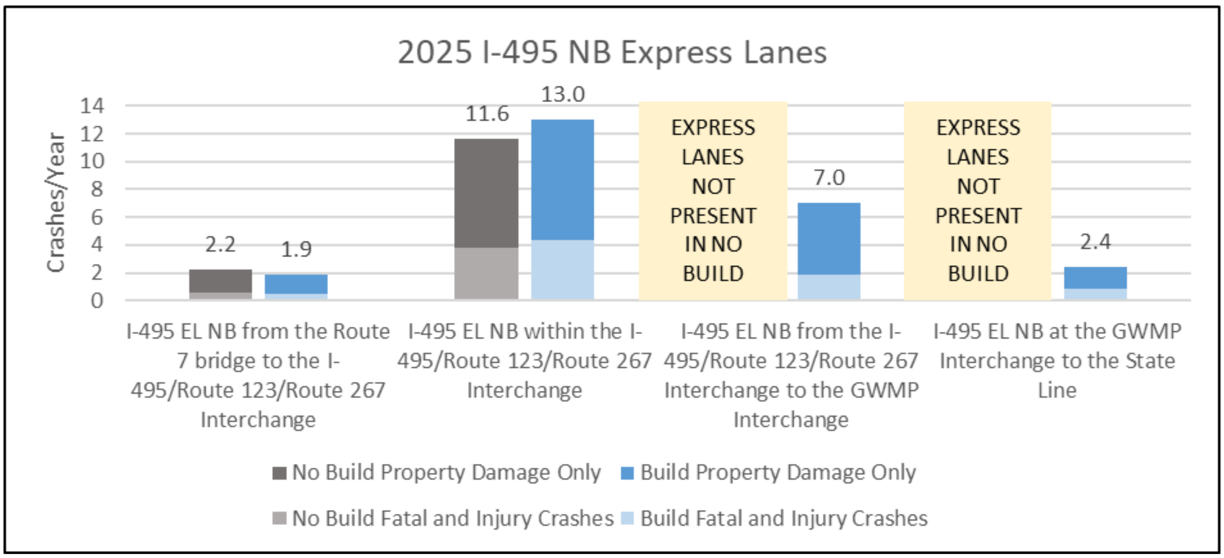


Figure 8-22. 2025 No Build and Build SPFs Developed for Express Lanes Predicted Crash Frequency Summary for Northbound I-495 Express Lanes

Figure 8-23 shows the predicted crash frequency (crashes/year) for four segments of the southbound Express lanes between 2025 No Build and Build conditions. The following summarize the comparative annual crash frequencies for the southbound I-495 Express Lanes under 2025 conditions**:**

- The Express Lanes predicted annual crash frequency from the existing northern terminus to the state line is shown only for the Build condition. Express Lanes are not present in the No Build condition for this section.
- The predicted annual crash frequency for the southbound Express Lanes within the Route 123 and Route 267 interchanges increases slightly from No Build to Build conditions.

- The predicted annual crash frequency for the southbound Express Lanes from the interchanges with Route 123 and Route 267 to the Route 7 bridge experience a nominal decrease from No Build to Build conditions.

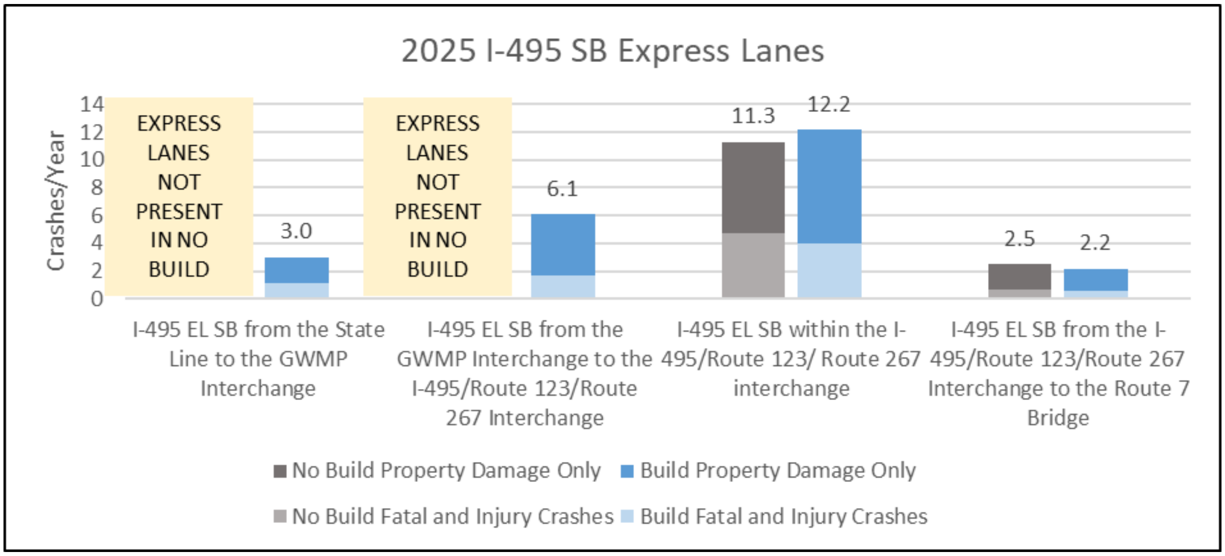


Figure 8-23. 2025 No Build and Build SPFs Developed for Express Lanes Predicted Crash Frequency Summary for Southbound I-495 Express Lanes

Route 267

Figure 8-24 shows the predicted crash frequency (crashes/year) for five segments of Route 267 (DTR) between 2025 No Build and Build conditions. The following summarize the comparative annual crash frequencies for the DTR under 2025 conditions**:**

- The predicted annual crash frequency for the DTR interchange with Spring Hill Road significantly increases by 10 crashes per year from No Build to Build conditions. The Express Lanes extension and additional access from DTR eastbound to the northbound Express Lanes increases demand on the DTR mainline and on the ramps through the Spring Hill Road interchange. This zone includes the mainline weave on eastbound DTR and the mainline weave on westbound DTR between Spring Hill Road and I-495. Due to the Express Lanes extension and the new access from eastbound DTR to the northbound Express Lanes, volume increases through the mainline weave sections. This causes an increase in friction and conflicts, which increases the total number of predicted crashes for the Build conditions compared to the No Build.
- While the predicted crash rate for the DTR interchange with I-495 (crash rate along the DTR segments only) slightly decreases from No Build to Build, the crash frequency slightly increases. The Express Lanes extension and additional access from DTR eastbound to the northbound Express Lanes will increase volume on the DTR mainline. While the overall number of crashes could potentially increase due to the increase in volume, the reduced crash rate does not indicate a potential safety issue.
- The predicted annual crash frequency for the DTR interchange with the Route 123 decreases from No Build to Build conditions. It should be noted that the higher crash frequency at the DTR/Route 123 interchange compared to the rest of the DTR is due to (1) the two mainline weaving sections between the interchange with I-495 and Route 123 that are included in the DTR/Route 123

interchange zone and (2) while the length of the DTR/Route 123 zone is similar to the length of the DTR/I-495 zone, all ramps to and from Route 123 are accounted for in the DTR/Route 123 interchange zone. The ramps for the DTR/I-495 interchange are only included in the "I-495 GP Interchange with Route 267 & Route 123" zone and are not shown with the DTR results to avoid double counting evaluation results.

- The predicted crash frequency on eastbound DTR from the Route 123 interchange to the eastern terminus of the study area (0.03 miles past the Route 650 bridge) shows a nominal change from 2025 No Build to 2025 Build.
- The predicted crashes frequency for westbound DTR from the eastern terminus to the Route 123 interchange is effectively stable across both alternatives.

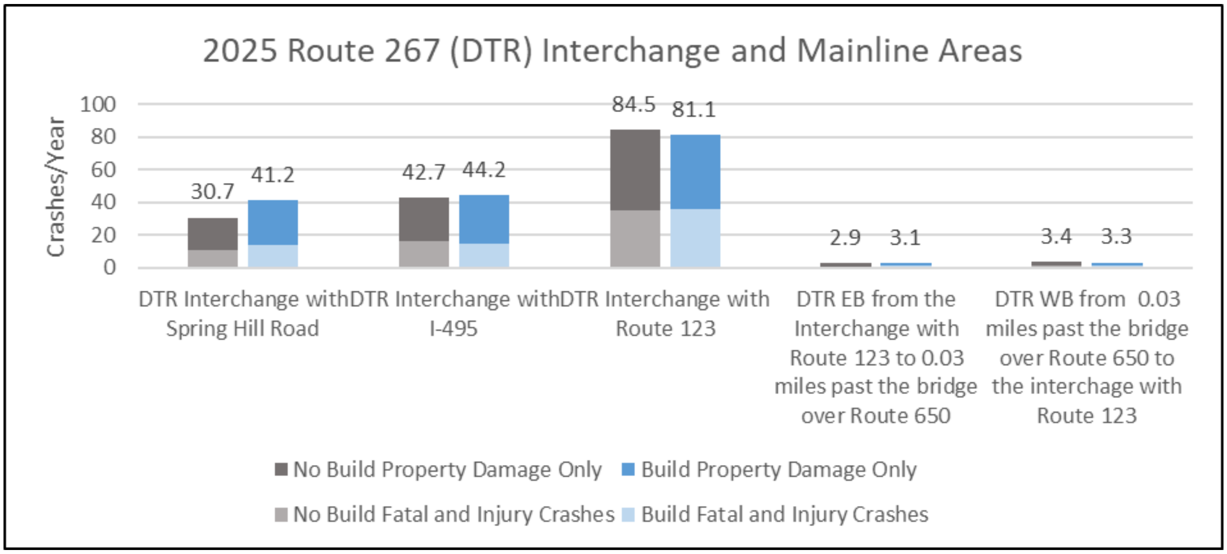


Figure 8-24. 2025 No Build and Build ISATe Predicted Crash Frequency Summary for Route 267 (DTR)

Figure 8-25 shows the predicted crash frequency (crashes/year) for each direction of Route 267 (DAAR) between 2025 No Build and Build conditions. The following summarize the comparative annual crash frequencies for the DAAR under 2025 conditions**:**

- The predicted annual crash frequency change for eastbound DAAR from No Build to Build conditions is nominal.
- The predicted annual crash frequency change for westbound DAAR from No Build to Build conditions is nominal.

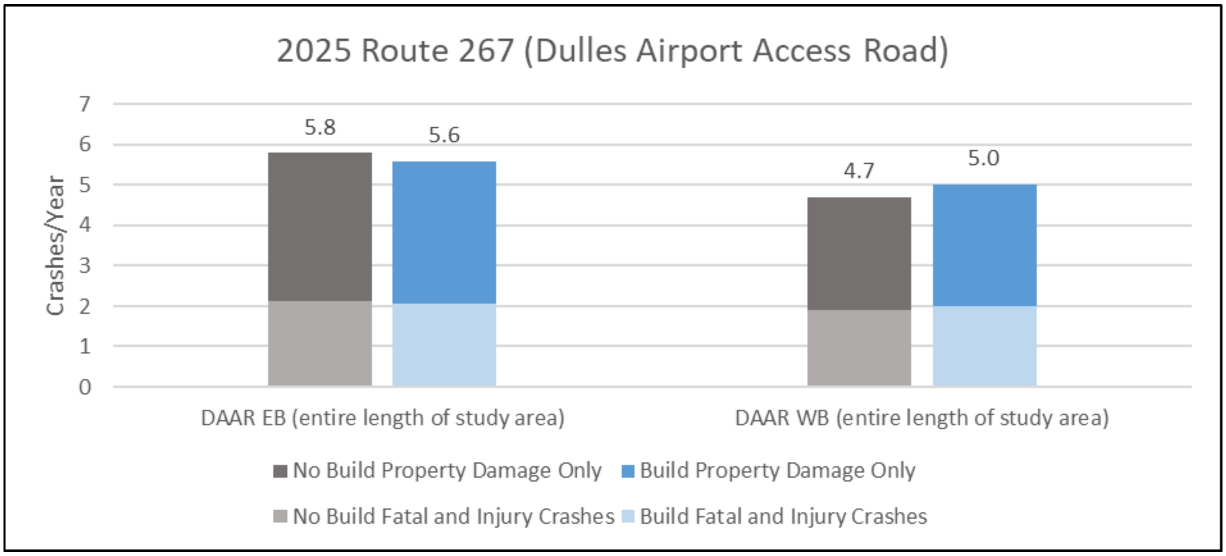


Figure 8-25. 2025 No Build and Build ISATe Predicted Crash Frequency Summary for Route 267 (DAAR)

2045 No Build and Build Crash Rate Predictions

I-495 Interchanges

Figure 8-26 shows the predicted crash rate per 100 MEV for the two major interchange areas of the I-495 GP Lanes between 2045 No Build and Build conditions. The following summarize the comparative crash rates for the I-495 interchanges under 2045 conditions**:**

- The predicted crash rate for the I-495 GP interchanges with Route 123 and Route 267 shows a negligible change from No Build to Build conditions.
- The predicted crash rate decreases significantly by 132 crashes per 100 MEV for the Route 193 and GWMP interchange analysis zone when comparing the No Build and Build conditions. There are multiple contributing factors:
  - (1) In the 2045 No Build condition, it is assumed that the Maryland managed lanes terminate within this zone. A merge from the southbound Maryland managed lanes and a diverge to the northbound Maryland managed lanes at this location will result in conflicts between vehicles continuing on the GP lanes and traffic merging from and diverging to the Maryland managed lanes.
  - (2) There is a decrease in approximately 35,000 ADT for vehicles entering this zone on the GP lanes in the 2045 Build conditions compared to the 2045 No Build conditions. This is due to vehicles choosing to either enter and exit the Express Lanes directly from the new GWMP access to and from the south and through trips traveling north and south on the Express Lanes bypassing the GP lanes all together.
  - (3) In the Build condition, the southbound ramp and C-D lane geometric re-configuration between GWMP and Route 193 removes weaving conflicts between vehicles destined for southbound I-495 and vehicles destined to Route 193. Additionally, the ability for "queue jumpers" to use the southbound C-D lanes and cause additional unnecessary weaving and merging conflicts is eliminated in the Build condition.

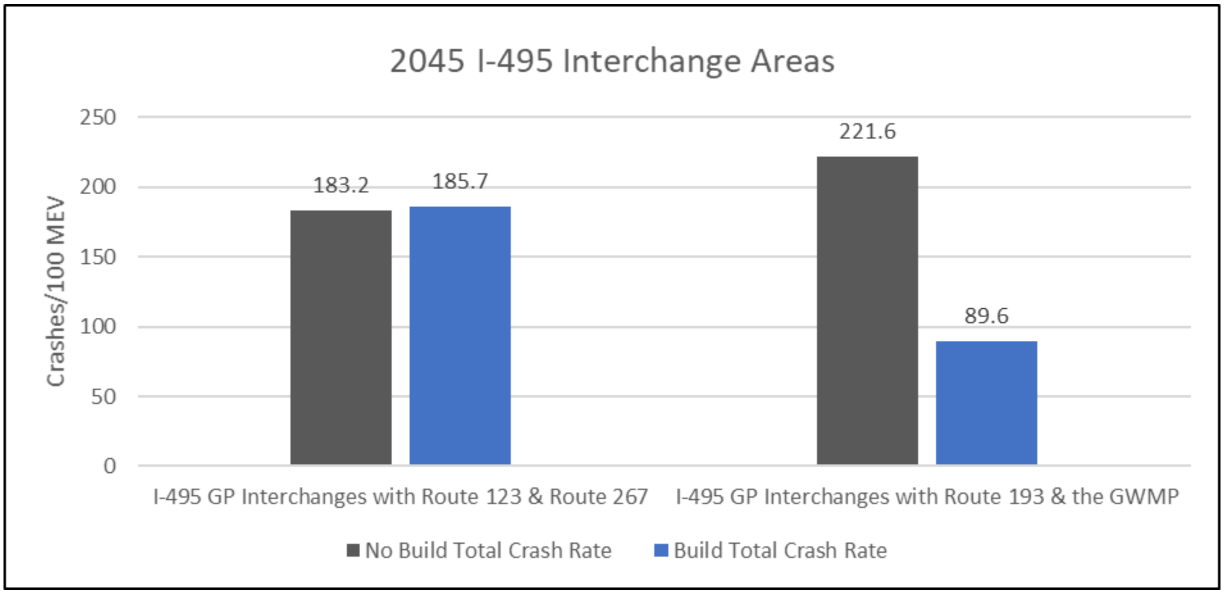


Figure 8-26. 2045 No Build and Build ISATe Predicted Crash Rate Summary for I-495 GP Interchange Areas

<u>I-495 GP Lanes</u>

Figure 8-27 shows the predicted crash rate per 100 MVMT for two segments of the northbound GP lanes between 2045 No Build and Build conditions. The following summarize the comparative crash rates for the northbound I-495 GP lanes under 2045 conditions**:**

- The predicted crash rate for the northbound GP lanes from the Route 7 bridge to the interchanges with Route 123 and Route 267 decreases by 21 crashes per 100 MVMT from No Build to Build conditions due to the C-D road system in both directions separating interchange traffic from through traffic and reducing weaving conflicts.
- The predicted crash rate for the northbound GP lanes from Route 267 to the interchanges with Route 193 and the GWMP decreases by nearly 10 crashes per 100 MVMT from No Build to Build conditions. The extension of the Express Lanes to the Maryland state line diverts volume from the GP Lanes to the Express Lanes through this segment, reducing congestion and there therefore lowering the potential for crashes to occur.

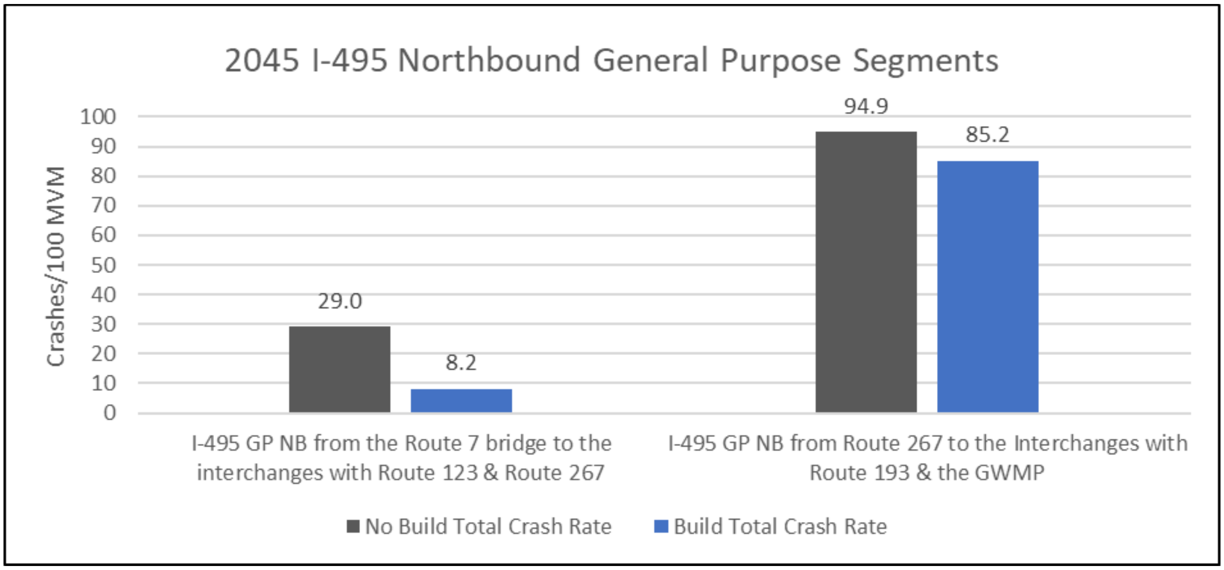


Figure 8-27. 2045 No Build and Build ISATe Predicted Crash Rate Summary for Northbound I-495 GP Lanes

Figure 8-28 shows the predicted crash rate for two segments of the southbound GP lanes between 2045 No Build and Build conditions. The following summarize the comparative crash rates for the southbound I-495 GP lanes under 2045 conditions**:**

- The predicted crash rate for the southbound I-495 GP lanes from Route 267 to the interchanges with Route 193 and the GWMP decrease from No Build to Build conditions. The extension of the Express Lanes from the northern terminus to the state line diverts volume from the GP Lanes to the Express Lanes through this segment; therefore, lowering projected crashes.
- The predicted crash rate for the southbound GP lanes from the Route 7 bridge to the interchanges with Route 123 and Route 267 show a nominal increase from No Build to Build conditions.

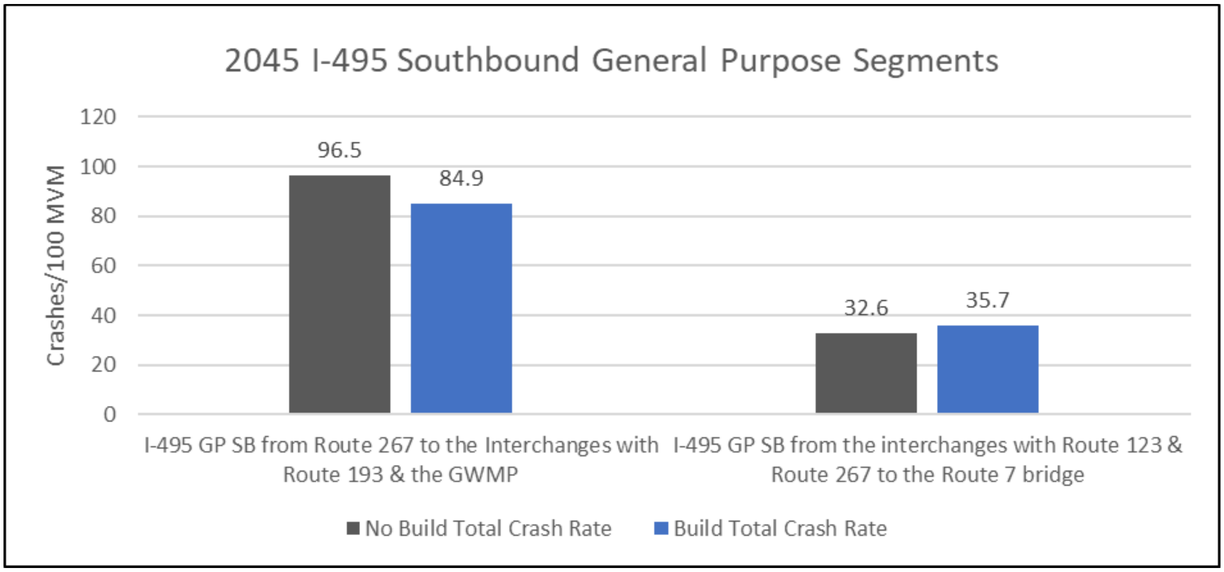


Figure 8-28. 2045 No Build and Build ISATe Predicted Crash Rate Summary for Southbound I-495 GP Lanes

I-495 Express Lanes

Figure 8-29 shows the predicted crash rate for four segments of the northbound Express Lanes between 2045 No Build and Build conditions. The following summarize the comparative crash rates for the northbound I-495 Express Lanes under 2045 conditions**:**

- The Express Lanes predicted crash rate from the existing northern terminus to the GWMP interchange is shown only for the Build condition. Express Lanes are not present in the No Build condition for this section.
- The predicted crash rate for the northbound Express Lanes from the Route 7 bridge to the interchanges with Route 123 and Route 267 decreases by nearly 14 crashes per 100 MVMT from No Build to Build conditions largely due to the increase in volume without introducing any new access for this segment.
- The predicted crash rate for the northbound Express Lanes within the Route 123 and Route 267 interchanges increases in the Build condition by 18 crashes per 100 MVMT due to the introduction of connecting ramps from Route 267 and an increase in volume on existing Express Lanes ramps. Note that in 2045 Build conditions, ramp-related crashes account for approximately 75 percent of all Express Lanes crashes in the I-495/Route 267/Route 123 interchange zone.
- The predicted crash rate for the northbound Express Lanes from the GWMP to the state line decreases by 7 crashes per MVMT from 2045 No Build conditions to 2045 Build conditions, as the Build condition provides a continuous Express Lanes system whereas the No Build condition assumes the southern terminus of the Maryland managed lanes system, featuring a southbound merge and northbound diverge.

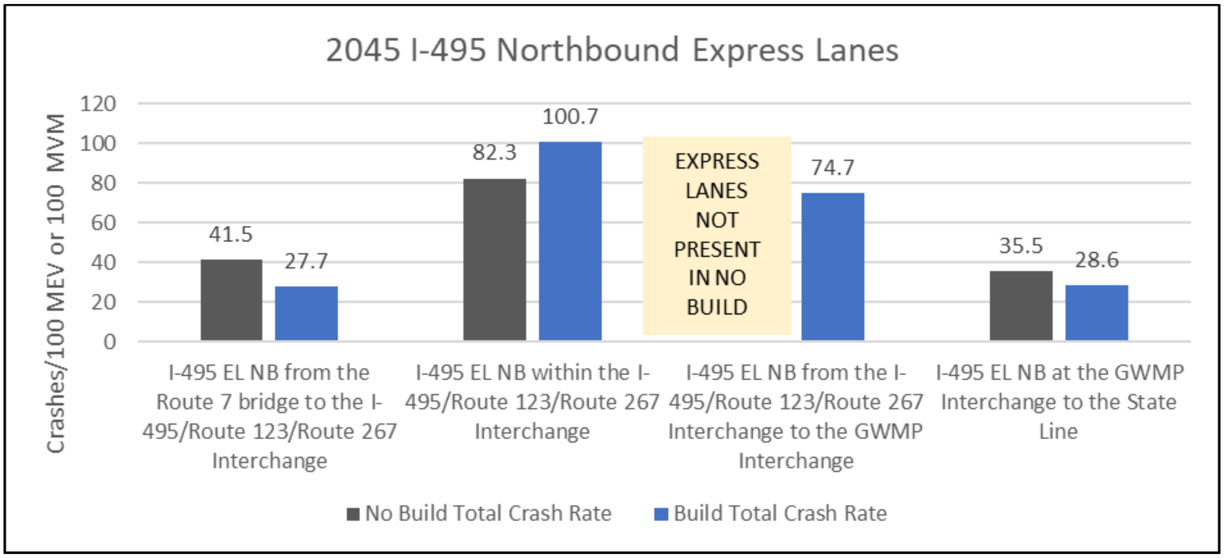


Figure 8-29. 2045 No Build and Build SPFs Developed for Express Lanes Predicted Crash Rate Summary for I-495 Northbound Express Lanes

Figure 8-30 shows the predicted crash rate for four segments of the southbound Express lanes between 2045 No Build and Build conditions. The following summarize the comparative crash rates for the southbound I-495 Express Lanes under 2045 conditions**:**

- The Express Lanes predicted crash rate from the GWMP interchange to the existing northern terminus is shown only for the Build condition. Express Lanes are not present in the No Build condition for this section.
- The predicted crash rate for the southbound Express Lanes from the GWMP to the state lines decrease by nearly 14 crashes per 100 MVMT from 2045 No Build conditions to 2045 Build conditions, as the Build condition provides a continuous Express Lanes system whereas the No Build condition assumes the southern terminus of the Maryland managed lanes system, featuring a southbound merge and northbound diverge.
- The predicted crash rate for the southbound Express Lanes within the Route 123 and Route 267 interchanges increases by nearly 22 crashes per 100 MVMT. Similar to the northbound Express Lanes, this is due to the introduction of connecting ramps from and to Route 267 and increases in volume on existing Express Lanes ramps. In 2045 Build conditions, ramp related crashes account for approximately 70 percent of all Express Lanes crashes in the I-495/Route 267/Route 123 interchange zone.
- The predicted crash rate for the southbound Express Lanes from the interchanges with Route 123 and Route 267 to the Route 7 bridge decreases from No Build to Build largely due to the increase in volume without introducing any new access for this segment.

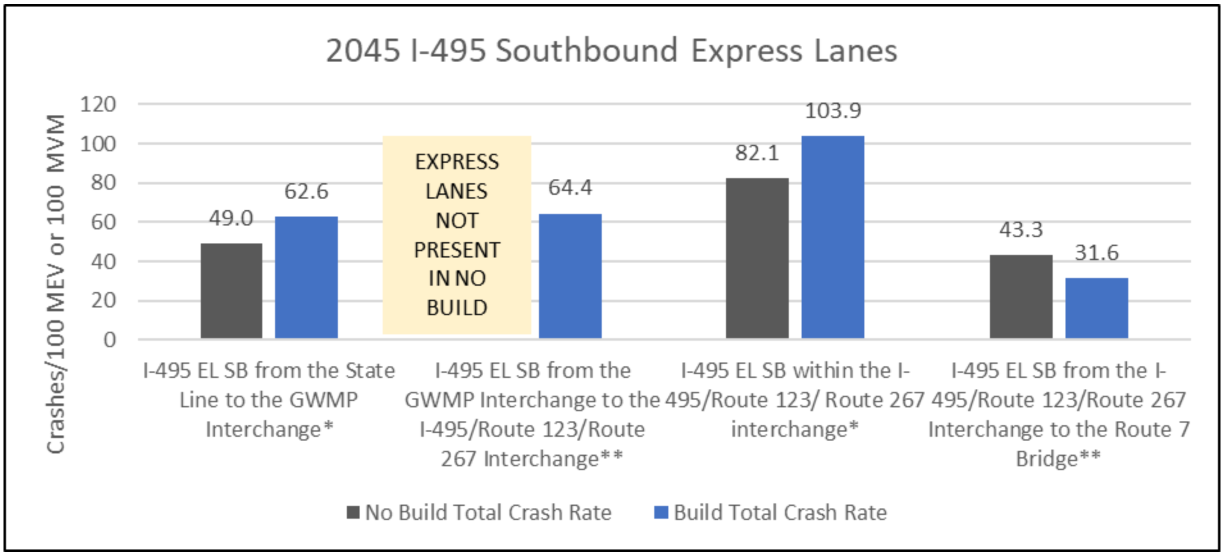


Figure 8-30. 2045 No Build and Build SPFs Developed for Express Lanes Predicted Crash Rate Summary for I-495 Southbound Express Lanes

<u>Route 267</u>

Figure 8-31 shows the predicted crash rate for five segments of Route 267 (DTR) between 2045 No Build and Build conditions. The following summarize the comparative crash rates for the DTR under 2045 conditions:

- The DTR crash rates decrease slightly in the Build condition as compared to the No Build condition at the interchange of Spring Hill Road and at the interchange with Route 123.
- The DTR crash rates increase slightly in the Build condition as compared to the No Build condition at the interchange with I-495; this is attributable to the increased demand from the Express Lanes extension and additional ramp connections to and from the Express Lanes.
- The DTR crash rates for the eastbound and westbound between the Route 123 interchange and the eastern terminus (0.03 miles past the Route 650 bridge) are significantly higher that segments to the west; however, these segments are quite short in length and overall annual crash frequencies are quite low. In both directions of the DTR along these segments, a decrease is predicted in Build conditions as compared to No Build conditions.

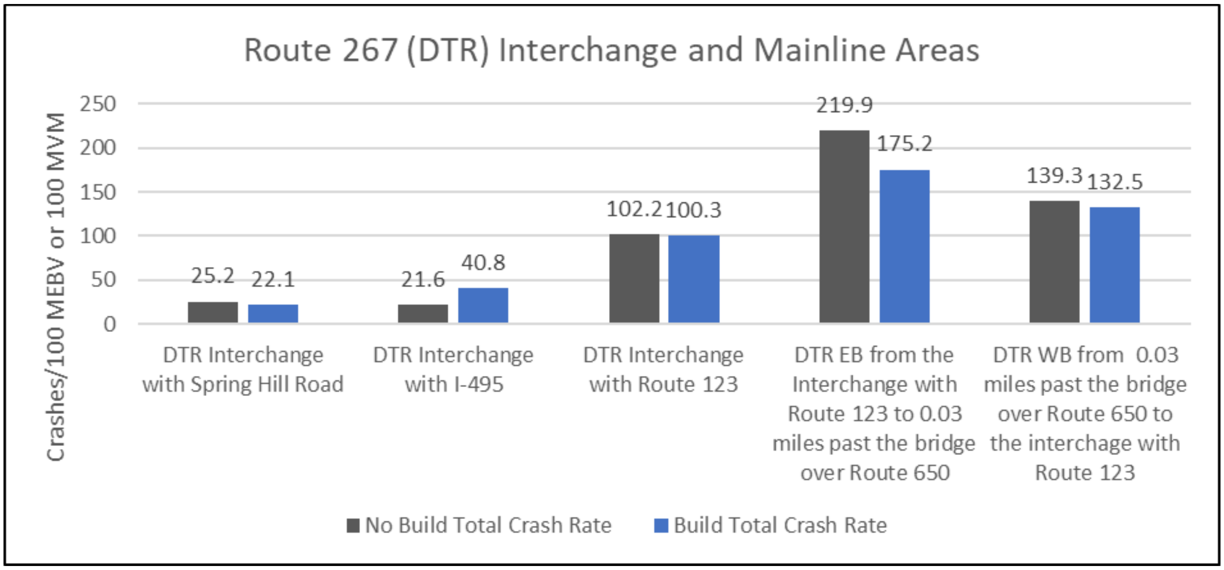


Figure 8-31. 2045 No Build and Build ISATe Predicted Crash Rate Summary for Route 267 (DTR)

Figure 8-32 shows the predicted crash crate for each direction of Route 267 (DAAR) between 2045 No Build and Build conditions. The following summarize the comparative crash rates for the DAAR under 2045 conditions:

- The predicted crash rate for eastbound DAAR decreases from No Build to Build conditions due to new direct access to the I-495 Express Lanes.
- The predicted crash rate for westbound DAAR shows a nominal decrease from No Build to Build conditions.

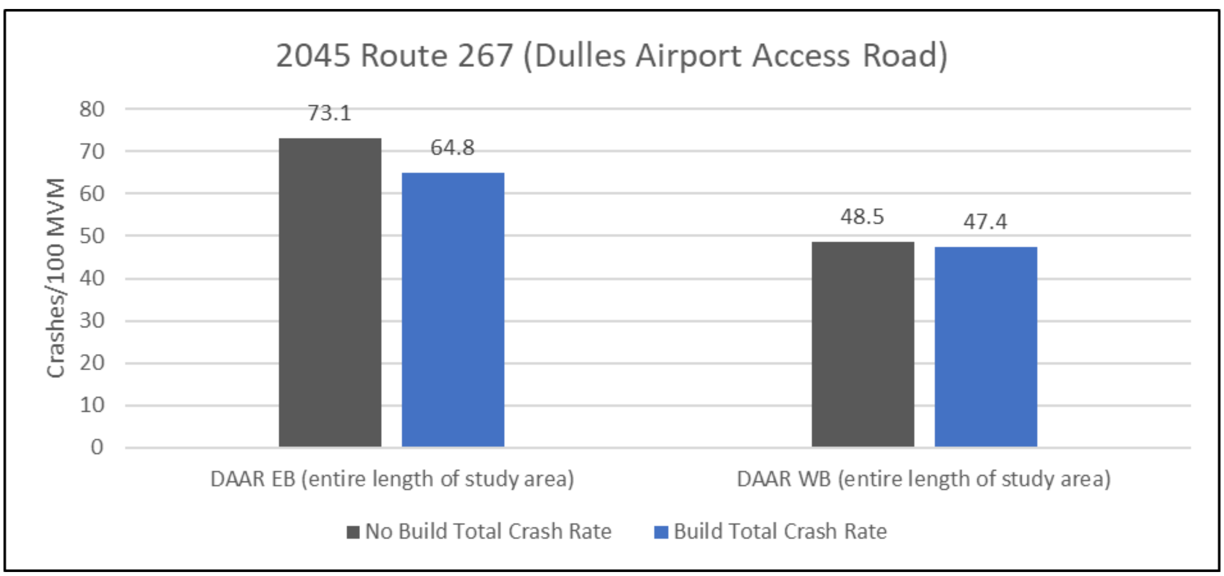


Figure 8-32. 2045 No Build and Build ISATe Predicted Crash Rate Summary for Route 267 (DAAR)

2045 No Build and Build Crash Frequency Predictions

I-495 Interchanges

Figure 8-33 shows the predicted crash frequency (crashes/year) for two segments of the I-495 interchanges between 2045 No Build and Build conditions. The following summarize the comparative crash frequencies for the I-495 interchanges under 2045 conditions:

- The predicted annual crash frequency decreases for the I-495 GP interchanges with Route 123 and Route 267 due to geometric improvements and a C-D system that separates interchange movements from mainline through movements.
- The predicted annual crash frequency decreases significantly by nearly 168 crashes per year for the Route 193 and GWMP interchange analysis zone when comparing the No Build and Build conditions. There are multiple contributing factors:
  - (1) In the 2045 No Build condition, it is assumed that the Maryland managed lanes terminate within this zone. A merge from the southbound Maryland managed lanes and a diverge to the northbound Maryland managed lanes at this location will result in conflicts between vehicles continuing on the GP lanes and traffic merging from and diverging to the Maryland managed lanes.
  - (2) There is a decrease in approximately 35,000 ADT for vehicles entering this zone on the GP lanes in the 2045 Build conditions compared to the 2045 No Build conditions. This is due to vehicles choosing to either enter and exit the Express Lanes directly from the new GWMP access to and from the south and through trips traveling north and south on the Express Lanes bypassing the GP lanes all together.
  - (3) In the Build condition, the southbound ramp and C-D lane geometric re-configuration between GWMP and Route 193 removes weaving conflicts between vehicles destined for southbound I-495 and vehicles destined to Route 193. Additionally, the ability for "queue jumpers" to use the southbound C-D lanes and cause additional unnecessary weaving and merging conflicts is eliminated in the Build condition.

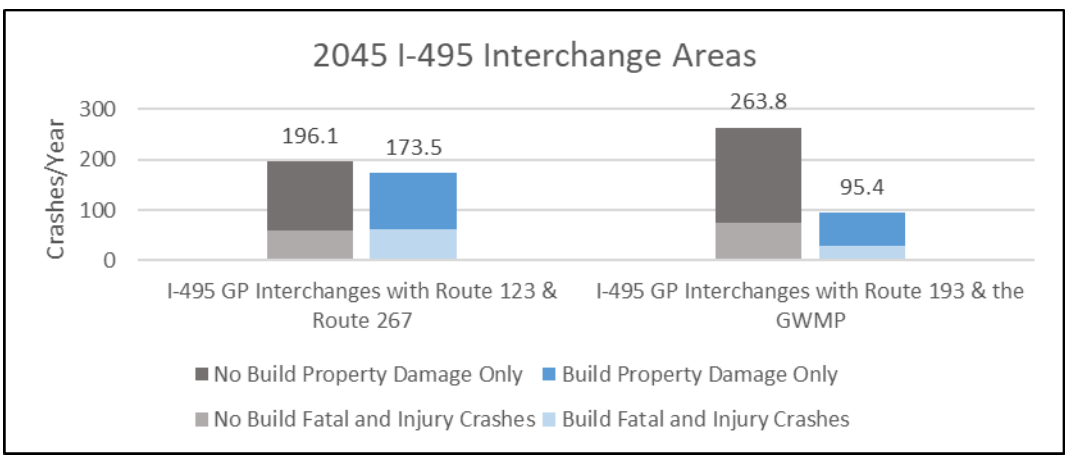


Figure 8-33. 2045 No Build and Build ISATe Predicted Crash Frequency Summary for I-495 GP Interchange Areas

<u>I-495 GP Lanes</u>

Figure 8-34 shows the predicted annual crash frequency for two segments of the northbound GP lanes between 2045 No Build and Build conditions. The following summarize the comparative annual crash frequencies for the northbound I-495 GP lanes under 2045 conditions**:**

- The predicted annual crash frequency for the northbound GP lanes from the Route 7 bridge to the interchanges with Route 123 and Route 267 decreases from No Build to Build conditions due to the C-D road system in both directions separating interchange traffic from through traffic and reducing weaving conflicts.
- The predicted annual crash frequency for the northbound GP lanes from Route 267 to the interchanges with Route 193 and the GWMP decreases from No Build to Build conditions. The extension of the Express Lanes to the Maryland state line diverts volume from the GP Lanes to the Express Lanes through this segment, reducing congestion and there therefore lowering the potential for crashes to occur.

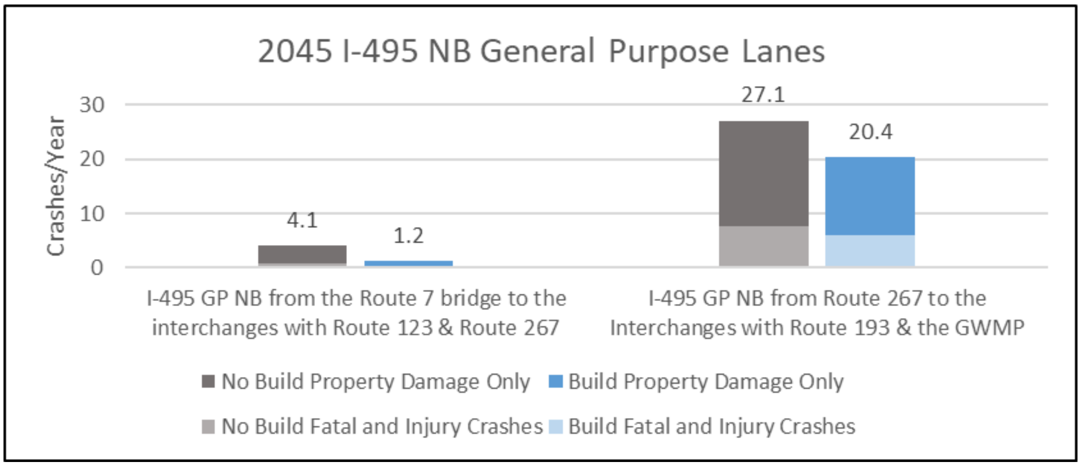


Figure 8-34. 2045 No Build and Build ISATe Predicted Crash Frequency Summary for I-495 Northbound GP Lanes

Figure 8-35 shows the predicted annual crash frequency for two segments of the southbound GP lanes between 2045 No Build and Build conditions. The following summarize the comparative annual crash frequencies for the southbound I-495 GP lanes under 2045 conditions**:**

- The predicted annual crash frequency for the I-495 southbound GP lanes from Route 267 to the interchanges with Route 193 and the GWMP decreases by 9 crashes per year from No Build to Build. The extension of the Express Lanes from the northern terminus to the state line diverts volume from the GP Lanes to the Express Lanes through this segment; therefore, lowering the projected number of crashes.
- The predicted annual crash frequency for the southbound GP lanes from the Route 7 bridge to the interchanges with Route 123 and Route 267 shows a nominal increase from No Build to Build conditions.

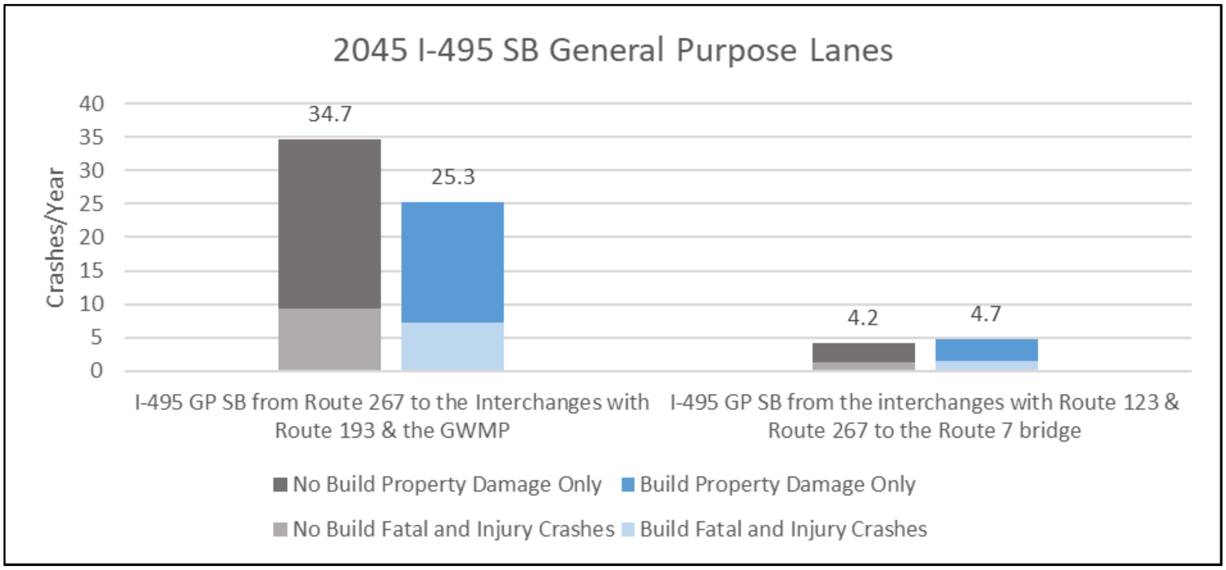


Figure 8-35. 2045 No Build and Build ISATe Predicted Crash Frequency Summary for I-495 Southbound GP Lanes

<u>I-495 Express Lanes</u>

Figure 8-36 shows the predicted annual crash frequency for four segments of the northbound Express Lanes between 2045 No Build and Build conditions. The following summarize the comparative annual crash frequencies for the northbound I-495 Express Lanes under 2045 conditions**:**

- The Express Lanes predicted crash frequency from the existing northern terminus to the GWMP interchange is shown only for the Build condition. Express Lanes are not present in the No Build condition for this section.
- The predicted crash frequency for the northbound Express Lanes from the Route 7 bridge to the interchanges with Route 123 and Route 267 decreases nominally from No Build to Build conditions.
- The predicted crash rate for the northbound Express Lanes within the Route 123 and Route 267 interchanges increases in the Build condition due to the introduction of connecting ramps from Route 267 and an increase in volume on existing Express Lanes ramps. Note that in 2045 Build conditions, ramp-related crashes account for approximately 75 percent of all Express Lanes crashes in the I-495/Route 267/Route 123 interchange zone.
- Given the increase in volume and connections to the south on I-495 and to the GWMP, the predicted annual crash frequency for the northbound Express Lanes from the GWMP interchange to the state line increase nominally from 2045 No Build to 2045 Build conditions.

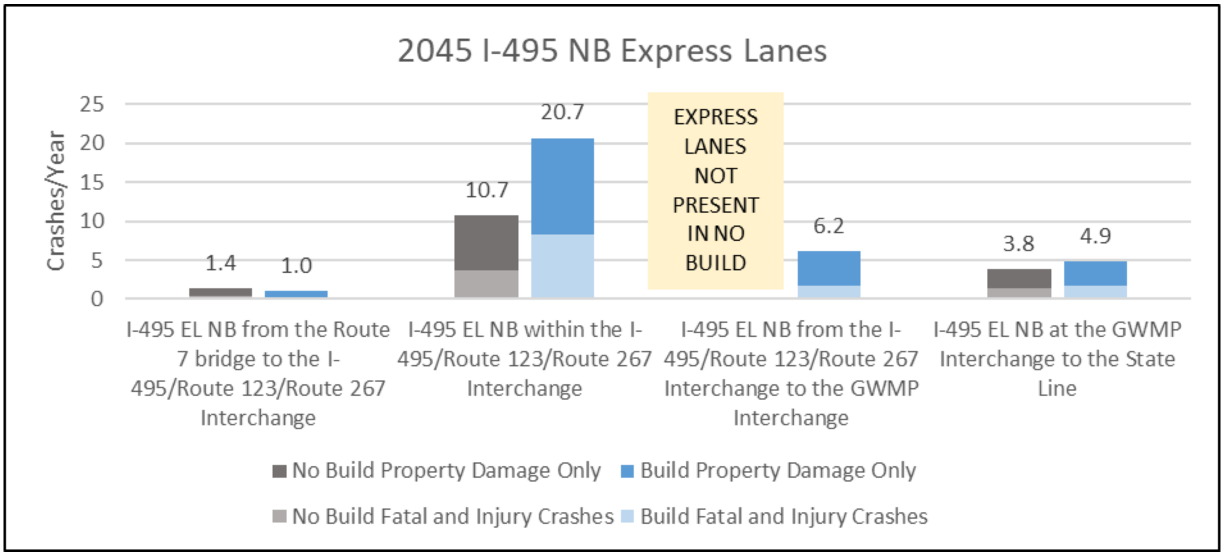


Figure 8-36. 2045 No Build and Build SPFs Developed for Express Lanes Predicted Crash Frequency Summary for I-495 Northbound Express Lanes

Figure 8-37 shows the predicted crash frequency (crashes/year) for four segments of the southbound Express lanes between 2045 No Build and Build conditions. The following summarize the comparative annual crash frequencies for the southbound I-495 Express Lanes under 2045 conditions**:**

- The Express Lanes predicted annual crash frequency from the existing northern terminus to the GWMP interchange is shown only for the Build condition. Express Lanes are not present in the No Build condition for this section.
- The predicted annual crash frequency for the southbound Express Lanes from the GWMP to the state line decreases from 2045 No Build to 2045 Build conditions, as the Build condition provides a continuous Express Lanes system whereas the No Build condition assumes the southern terminus of the Maryland managed lanes system, featuring a southbound merge and northbound diverge.
- The predicted annual crash frequency for the southbound Express Lanes within the Route 123 and Route 267 interchanges increases. Similar to the northbound Express Lanes, this is due to the introduction of connecting ramps from and to Route 267 and increases in volume on existing Express Lanes ramps. In 2045 Build conditions, ramp related crashes account for approximately 70 percent of all Express Lanes crashes in the I-495/Route 267/Route 123 interchange zone.
- The predicted annual crash frequency for the southbound Express Lanes from the interchanges with Route 123 and Route 267 to the Route 7 bridge decreases nominally.

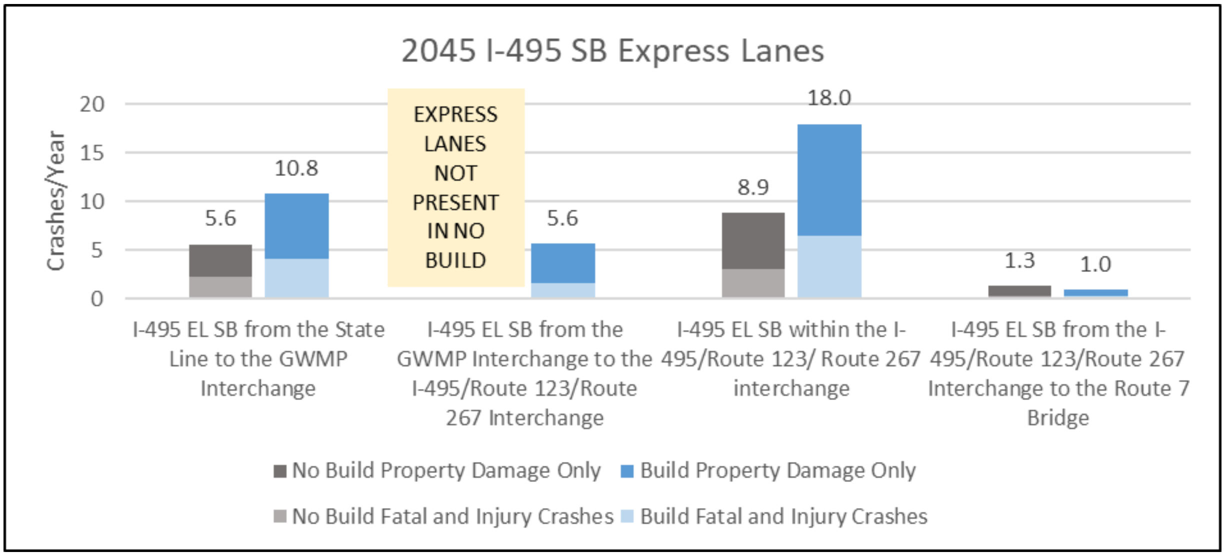


Figure 8-37. 2045 No Build and Build SPFs Developed for Express Lanes Predicted Crash Frequency Summary for I-495 Southbound Express Lanes

Route 267

Figure 8-38 shows the predicted crash frequency for five segments of Route 267 (DTR) between 2045 No Build and Build conditions. The following summarize the comparative annual crash frequencies for the DTR under 2045 conditions:

- The annual crash frequency along the DTR increases in the Build condition through the interchange with I-495 due to the increased demand from the Express Lanes extension and additional ramp connections to the Express Lanes.
- Annual crash frequencies at other locations along the DTR are predicted to decrease slightly or remain stable.

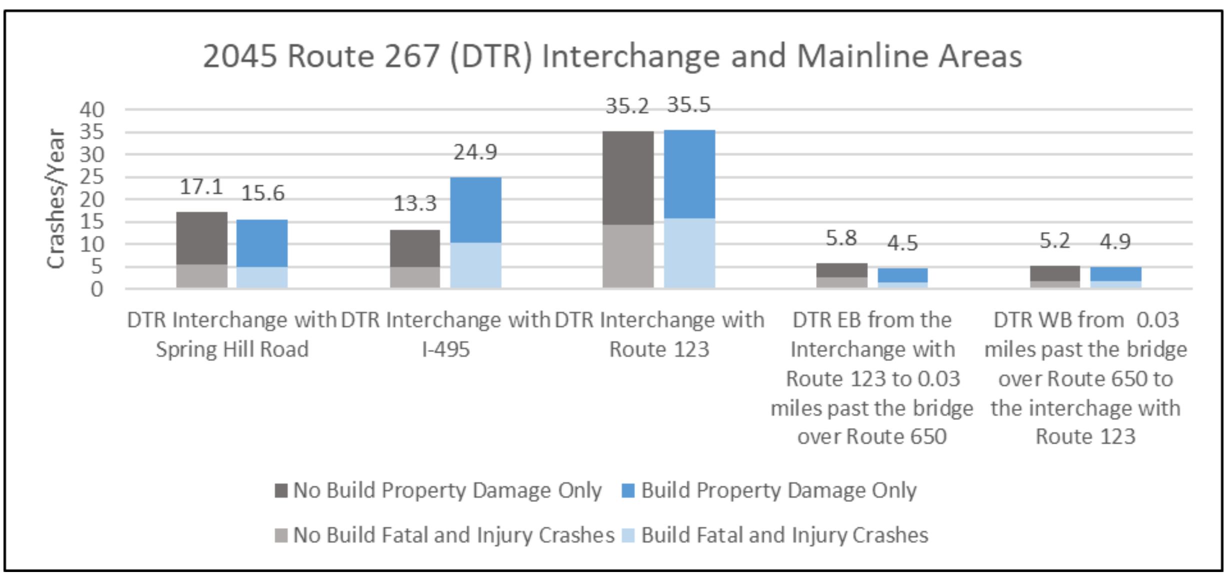


Figure 8-38. 2045 No Build and Build ISATe Predicted Crash Frequency Summary for Route 267 (DTR)

Figure 8-39 shows the predicted crash frequency for each direction of Route 267 (DAAR) between 2045 No Build and Build conditions. The following summarize the comparative annual crash frequencies for the DAAR under 2045 conditions:

- The predicted annual crash frequency for eastbound DAAR shows a nominal change from 2045 No Build to Build conditions.
- The predicted annual crash frequency for westbound DAAR shows a nominal change from 2045 No Build to 2045 Build conditions.

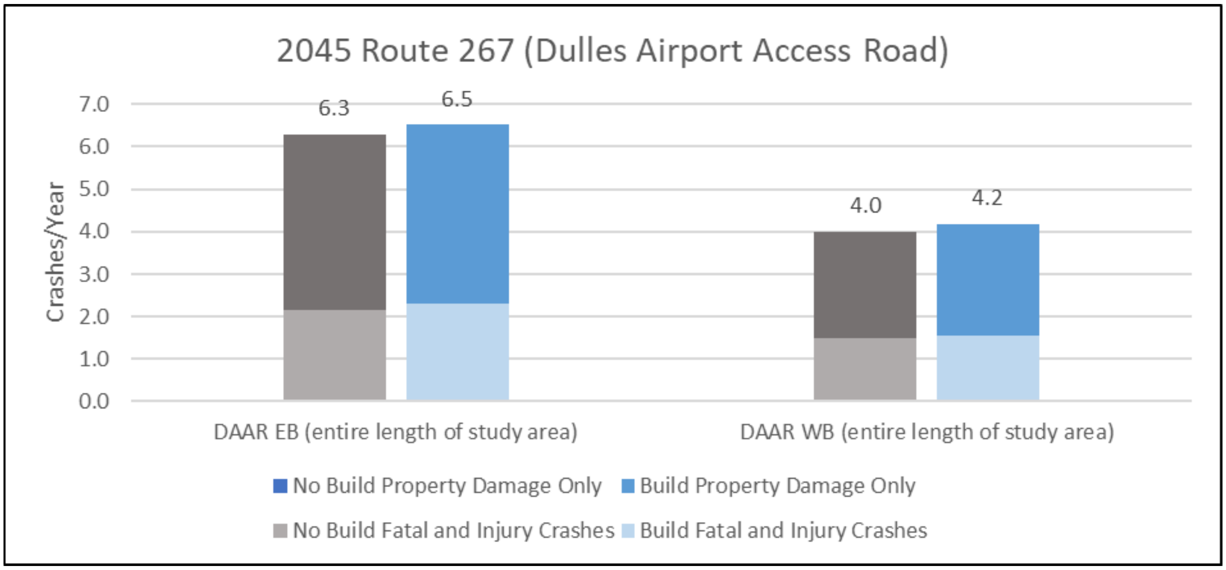


Figure 8-39. 2045 No Build and Build ISATe Predicted Crash Frequency Summary for Route 267 (DAAR)

8.3.4 Arterial Crash Prediction

Predicted crash frequencies were calculated for each of the 33 arterial intersections in the Traffic Operations Study Area. Predicted annual number of fatal, injury, and property damage only crashes were identified by location for future No Build and Build conditions.

Table 8-3 provides a summary of predicted crash frequencies for 2025 No Build and Build conditions. In 2025, all intersections have a nominal decrease or no change in crash frequencies from No Build to Build conditions. The predicted annual number crashes is forecasted to reduce by approximately 4 percent (2 fatal or injury crashes and 4 PDO crashes per year) when comparing 2025 No Build and Build conditions for the entire Traffic Operations Study Area.

Table 8-4 provides a summary of predicted crash frequencies for 2045 No Build and Build conditions. In 2045, all intersections have a nominal decrease or no change in crash frequencies from No Build to Build conditions. The predicted annual number of crashes is estimated to reduce by approximately 1 percent (1 PDO crash per year) when comparing arterial intersections under 2045 No Build and Build conditions for the entire Traffic Operations Study Area.

Table 8-3. 2025 Arterial Intersection Predicted Crash Frequencies

Intersection	Predicted Annual Number of Fatal & Injury Crashes			Predicted Annual Number of Property Damage Only (PDO) Crashes			Predicted Annual Number of Total Crashes		
	2025 No Build	2025 Build	Difference	2025 No Build	2025 Build	Difference	2025 No Build	2025 Build	Difference
Intersection #1 - Anderson Rd/267 EB Off-ramp & Dolley Madison Blvd	2.9	2.8	-0.1	5.2	4.9	-0.3	8.1	7.7	-0.4
Intersection #2 - Lewsinsville Rd & Balls Hill Rd	0.6	0.6	0.0	1.1	1.1	0.0	1.7	1.7	0.0
Intersection #3 - Dolley Madison Blvd & Lewinsville Rd/Great Falls St	2.7	2.6	-0.1	4.9	4.7	-0.2	7.6	7.3	-0.3
Intersection #4 - Westpark Dr & 495 Exp. Lanes Connector	1.0	1.0	0.0	1.9	1.9	0.0	2.9	2.9	0.0
Intersection #5 - 495 Exp. Lanes Ramps & 495 Exp. Lanes Connector	0.5	0.5	0.0	0.9	0.8	-0.1	1.4	1.3	-0.1
Intersection #6 - Tysons Blvd & Chain Bridge Rd	3.8	3.7	-0.1	6.3	6.3	0.0	10.1	10.0	-0.1
Intersection #7 - Capital One Dr/Old Meadow Rd & Dolley Madison Blvd	3.7	3.6	-0.1	6.2	6.1	-0.1	9.9	9.7	-0.2
Intersection #8 - Dolley Madison Blvd & Scotts Crossing Rd/Colshire Dr	3.1	3.0	-0.1	5.3	5.2	-0.1	8.4	8.2	-0.2
Intersection #9 - Jones Branch Dr/Jones Branch Connector	1.2	1.2	0.0	2.4	2.4	0.0	3.6	3.6	0.0
Intersection #10 - 495 Exp. Lanes Ramps & Jones Branch Connector	0.4	0.4	0.0	0.7	0.7	0.0	1.1	1.1	0.0
Intersection #11 - Spring Hill Rd/International Dr & Jones Branch Dr	0.9	1.0	0.1	1.8	1.9	0.1	2.7	2.9	0.2
Intersection #12 - Spring Hill Rd & DTR EB Ramps	1.3	1.3	0.0	2.6	2.6	0.0	3.9	3.9	0.0
Intersection #13 - Spring Hill Rd & DTR WB Ramps	1.3	1.3	0.0	2.6	2.6	0.0	3.9	3.9	0.0
Intersection #14 - Spring Hill Rd & Lewinsville Rd	1.8	1.8	0.0	3.6	3.6	0.0	5.4	5.4	0.0
Intersection #15 - Spring Hill Rd & Old Dominion Dr	0.7	0.7	0.0	1.4	1.4	0.0	2.1	2.1	0.0
Intersection #16 - Old Dominion Dr & Swinks Mill Rd	0.7	0.7	0.0	1.6	1.6	0.0	2.3	2.3	0.0
Intersection #17 - Old Dominion Dr & Balls Hill Rd	0.7	0.7	0.0	1.5	1.5	0.0	2.2	2.2	0.0
Intersection #18 - Georgetown Pike & Balls Hill Rd	1.1	0.9	-0.2	2.1	1.7	-0.4	3.2	2.6	-0.6
Intersection #19 - Georgetown Pike & 495 NB Ramp	1.5	1.2	-0.3	3.2	2.6	-0.6	4.7	3.8	-0.9
Intersection #20 - Georgetown Pike & 495 SB Ramp	3.2	3.0	-0.2	7.6	7.0	-0.6	10.8	10.0	-0.8
Intersection #21 - Dolley Madison Blvd & Old Dominion Dr	2.0	1.8	-0.2	3.6	3.4	-0.2	5.6	5.2	-0.4
Intersection #22 - Georgetown Pike and Dead Run Dr	1.2	1.0	-0.2	1.8	1.5	-0.3	3.0	2.5	-0.5
Intersection #23 - Georgetown Pike & Helga Place/Linganore Dr	0.8	0.7	-0.1	1.3	1.1	-0.2	2.1	1.8	-0.3
Intersection #24 - Georgetown Pike & Swinks Mill Rd	0.9	0.7	-0.2	1.6	1.3	-0.3	2.5	2.0	-0.5
Intersection #25 - Georgetown Pike & Spring Hill Rd	0.5	0.4	-0.1	0.6	0.5	-0.1	1.1	0.9	-0.2
Intersection #26 - Lewinsville Rd & Swinks Mill Rd	0.5	0.5	0.0	0.7	0.7	0.0	1.2	1.2	0.0
Intersection #27 - Dolley Madison Blvd & Ingleside Ave	1.8	1.7	-0.1	2.4	2.3	-0.1	4.2	4.0	-0.2
Intersection #28 - Georgetown Pike & Douglass Dr	1.2	1.0	-0.2	1.8	1.5	-0.3	3.0	2.5	-0.5
Intersection #29 - Jones Branch Connector & Capital One Dr (West)	1.5	1.5	0.0	2.9	2.9	0.0	4.4	4.4	0.0
Intersection #30 - Jones Branch Connector & Capital One Dr (East)	0.6	0.6	0.0	1.1	1.1	0.0	1.7	1.7	0.0
Intersection #31 - Chain Bridge Rd & 495 SB Off-Ramp	3.3	3.3	0.0	8.1	8.1	0.0	11.4	11.4	0.0
Intersection #32 - Dolley Madison Blvd & 495 NB Off-ramp	3.2	3.2	0.0	7.6	7.7	0.1	10.8	10.9	0.1
Intersection #33 - Dolley Madison Blvd & 267 EB On-Ramp	1.8	1.8	0.0	4.0	3.8	-0.2	5.8	5.6	-0.2
Total	52.4	50.2	-2.2	100.4	96.5	-3.9	152.8	146.7	-6.1

Table 8-4. 2045 Arterial Intersection Predicted Crash Frequencies

Intersection	Predicted Annual Number of Fatal & Injury Crashes			Predicted Annual Number of Property Damage Only (PDO) Crashes			Predicted Annual Number of Total Crashes		
	2045 No Build	2045 Build	Difference	2045 No Build	2045 Build	Difference	2045 No Build	2045 Build	Difference
Intersection #1 - Anderson Rd/267 EB Off-ramp & Dolley Madison Blvd	5.8	5.9	0.1	9.9	10.0	0.1	15.7	15.9	0.2
Intersection #2 - Lewsinsville Rd & Balls Hill Rd	0.8	0.8	0.0	1.4	1.4	0.0	2.2	2.2	0.0
Intersection #3 - Dolley Madison Blvd & Lewinsville Rd/Great Falls St	4.0	4.0	0.0	6.7	6.8	0.1	10.7	10.8	0.1
Intersection #4 - Westpark Dr & 495 Exp. Lanes Connector	1.5	1.5	0.0	3.3	3.3	0.0	4.8	4.8	0.0
Intersection #5 - 495 Exp. Lanes Ramps & 495 Exp. Lanes Connector	0.9	1.0	0.1	1.8	1.9	0.1	2.7	2.9	0.2
Intersection #6 - Tysons Blvd & Chain Bridge Rd	3.4	3.5	0.1	6.0	6.1	0.1	9.4	9.6	0.2
Intersection #7 - Capital One Dr/Old Meadow Rd & Dolley Madison Blvd	3.1	3.1	0.0	5.5	5.4	-0.1	8.6	8.5	-0.1
Intersection #8 - Dolley Madison Blvd & Scotts Crossing Rd/Colshire Dr	3.4	3.4	0.0	6.0	6.0	0.0	9.4	9.4	0.0
Intersection #9 - Jones Branch Dr/Jones Branch Connector	1.1	1.1	0.0	2.1	2.1	0.0	3.2	3.2	0.0
Intersection #10 - 495 Exp. Lanes Ramps & Jones Branch Connector	0.4	0.4	0.0	0.8	0.8	0.0	1.2	1.2	0.0
Intersection #11 - Spring Hill Rd/International Dr & Jones Branch Dr	0.4	0.4	0.0	0.9	0.9	0.0	1.3	1.3	0.0
Intersection #12 - Spring Hill Rd & DTR EB Ramps	1.3	1.3	0.0	2.8	2.8	0.0	4.1	4.1	0.0
Intersection #13 - Spring Hill Rd & DTR WB Ramps	1.1	1.1	0.0	2.2	2.3	0.1	3.3	3.4	0.1
Intersection #14 - Spring Hill Rd & Lewinsville Rd	1.8	1.8	0.0	3.6	3.6	0.0	5.4	5.4	0.0
Intersection #15 - Spring Hill Rd & Old Dominion Dr	0.9	0.9	0.0	2.0	2.0	0.0	2.9	2.9	0.0
Intersection #16 - Old Dominion Dr & Swinks Mill Rd	0.9	0.9	0.0	1.9	1.8	-0.1	2.8	2.7	-0.1
Intersection #17 - Old Dominion Dr & Balls Hill Rd	0.8	0.9	0.1	1.8	1.9	0.1	2.6	2.8	0.2
Intersection #18 - Georgetown Pike & Balls Hill Rd	1.0	1.0	0.0	2.1	2.0	-0.1	3.1	3.0	-0.1
Intersection #19 - Georgetown Pike & 495 NB Ramp	1.2	1.0	-0.2	2.6	2.1	-0.5	3.8	3.1	-0.7
Intersection #20 - Georgetown Pike & 495 SB Ramp	3.1	2.8	-0.3	7.4	6.6	-0.8	10.5	9.4	-1.1
Intersection #21 - Dolley Madison Blvd & Old Dominion Dr	1.7	1.7	0.0	3.2	3.1	-0.1	4.9	4.8	-0.1
Intersection #22 - Georgetown Pike and Dead Run Dr	1.5	1.6	0.1	2.2	2.2	0.0	3.7	3.8	0.1
Intersection #23 - Georgetown Pike & Helga Place/Linganore Dr	0.8	0.8	0.0	1.3	1.2	-0.1	2.1	2.0	-0.1
Intersection #24 - Georgetown Pike & Swinks Mill Rd	1.0	0.9	-0.1	1.9	1.8	-0.1	2.9	2.7	-0.2
Intersection #25 - Georgetown Pike & Spring Hill Rd	0.6	0.6	0.0	0.8	0.7	-0.1	1.4	1.3	-0.1
Intersection #26 - Lewinsville Rd & Swinks Mill Rd	0.7	0.7	0.0	1.1	1.1	0.0	1.8	1.8	0.0
Intersection #27 - Dolley Madison Blvd & Ingleside Ave	2.8	2.8	0.0	3.6	3.6	0.0	6.4	6.4	0.0
Intersection #28 - Georgetown Pike & Douglass Dr	1.5	1.6	0.1	2.1	2.2	0.1	3.6	3.8	0.2
Intersection #29 - Jones Branch Connector & Capital One Dr (West)	1.5	1.5	0.0	2.9	2.9	0.0	4.4	4.4	0.0
Intersection #30 - Jones Branch Connector & Capital One Dr (East)	0.6	0.6	0.0	1.2	1.2	0.0	1.8	1.8	0.0
Intersection #31 - Chain Bridge Rd & 495 SB Off-Ramp	3.7	3.7	0.0	9.0	8.8	-0.2	12.7	12.5	-0.2
Intersection #32 - Dolley Madison Blvd & 495 NB Off-ramp	1.5	1.5	0.0	3.3	3.2	-0.1	4.8	4.7	-0.1
Intersection #33 - Dolley Madison Blvd & 267 EB On-Ramp	3.5	3.4	-0.1	8.2	8.2	0.0	11.7	11.6	-0.1
Total	***58.3***	***58.2***	***-0.1***	***111.6***	***110.0***	***-1.6***	***169.9***	***168.2***	***-1.7***

8.3.5 Future Safety Analysis Conclusions

Planning-level crash prediction analysis was performed using industry-standard practices and highway safety analysis tools. This analysis evaluated the safety performance of the differences between the 2025 No Build and Build conditions and the 2045 No Build and Build conditions. This evaluation considered all locations within the I-495 NEXT Traffic Operations Study Area affected by changes in geometry or forecasted volumes: interchanges, freeway segments, ramp segments, and key arterial intersections. Both qualitative and quantitative analyses were conducted to evaluate No Build and Build conditions in the I-495 NEXT corridor between Route 7 and the ALMB.

Under analyzed 2025 conditions, the Build condition has positive safety impacts on the I-495 corridor as well as the surrounding arterial network as compared to No Build conditions by improving throughput and reducing congestion in both directions of the I-495 corridor. However, if no improvements are constructed or undertaken in Maryland at the Express Lanes northern terminus of the I-495 NEXT project, it is anticipated there will be some potential safety concerns by introducing additional merge and diverge conflicts into the currently congested area of the GWMP and ALMB.

For 2045 conditions, the Build condition produces significant overall safety benefits as compared to No Build conditions by efficiently moving a greater volume of traffic with significantly reduced congestion in both directions of the I-495 corridor. With the full Express Lanes network extended into Maryland, it is anticipated that the corridor will operate at a much-improved level of safety as compared to No Build conditions. Comprehensively, the project is a significant improvement in overall safety.

In both 2025 and 2045 analysis scenarios, the I-495 NEXT Project is anticipated to have a positive impact on the safety of the corridor within the EA project study area. Based on analysis of both scenarios, it is projected that the safety benefits of the project will improve into future years and have an increasing reduction in overall crash activity and crash rates along the corridor.

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