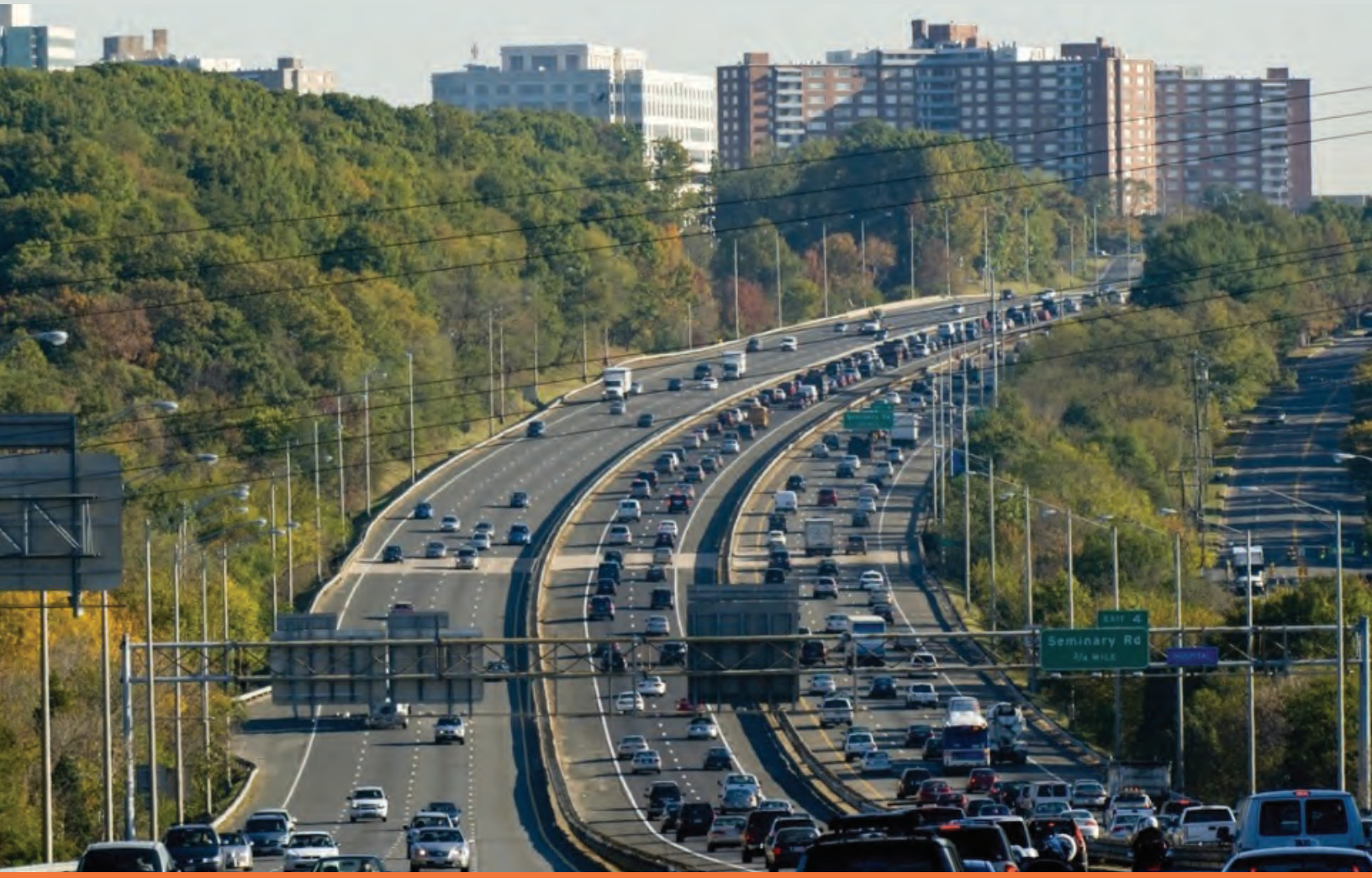
INTERSTATE 395 EXPRESS LANES NORTHERN EXTENSION

INTERCHANGE MODIFICATION REPORT

MAY 2017

VDOT

U.S. Department of Transportation Federal Highway Administration



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Interchange Modification Report

I-395 EXPRESS LANES NORTHERN EXTENSION

Commonwealth of Virginia

State Project Number: 0395-969-205
Federal Project Number: NHPP-395-4(189)
UPC: 108313

This document has been prepared and submitted pursuant to 23 U.S.C. 111 to obtain FHWA approval to modify existing interchange ramps on a fully-controlled interstate highway.

Submitted May 2017 to:

U.S. Department of Transportation
Federal Highway Administration

Submitted by:

VDOT Virginia Department of Transportation

The request for reconfiguration of the interstate access points is approved for a Finding of Engineering and Operational Acceptability. This approval is conditional upon compliance with applicable federal requirements, specifically with the National Environmental Policy Act (NEPA). Completion of the NEPA process is considered acceptance of the general project location and concepts denoted in the environmental documentation.

Federal Highway Administration, Virginia Division	Virginia Department of Transportation
Date of Approval	Date of Approval

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Interchange Modification Report

I-395 EXPRESS LANES NORTHERN EXTENSION

Commonwealth of Virginia

This document has been prepared to satisfy the requirements set forth by Federal and State Policy for changes in interstate access. It is consistent with the Virginia Department of Transportation's Location and Design Division Instructional and Informational Memorandum LD-200.9, and in accordance with the most recent update to FHWA's policy on *Access to the Interstate System* dated August 27, 2009.

Submitted May 2017 to:

U.S. Department of Transportation
Federal Highway Administration

Submitted by:

VDOT Virginia Department of Transportation

Prepared under the direction and review of:

NOVA District Virginia Department of Transportation	Date
Northern Virginia District Traffic Engineer Virginia Department of Transportation	Date
NOVA District Location and Design Engineer Virginia Department of Transportation	Date

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Interchange Modification Report

I-395 EXPRESS LANES NORTHERN EXTENSION

May 2017

Prepared for:

Virginia Department of Transportation

Prepared by:

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Acronym List

American Association of State Highway and Transportation Officials	AASHTO
Average annual weekday traffic volumes	AAWDT
American Community Survey	ACS
Average daily traffic	ADT
Closed circuit television cameras	CCTV
Code of Federal Regulations	CFR
Capital Improvement Program	CIP
Constrained Long Range Plan	CLRP
Crash Modification Factor	CMF
Corrosion Resistant Reinforcing Steel	CRR
Driving Alexandria Safely Home	DASH
District of Columbia Department of Transportation	DDOT
Design Exception	DE
Department of Defense	DoD
Design Waiver	DW
Dynamic Message Sign	DMS
Environmental Assessment	EA
Eastbound	EB
Eastern Federal Lands Highway Division	EFLHD
Environmental Impact Statement	EIS
Federal Emergency Management Agency	FEMA
Federal Highway Administration	FHWA
Finding of No Significant Impact	FONSI
Fiscal Year	FY
General Purpose	GP
Global Positioning System	GPS
Highway Capacity Manual	HCM
High Occupancy Toll	HOT
High Occupancy Vehicle	HOV
Highway Safety Manual	HSM

Horizontal stopping sight distance	HSSD
Interactive Highway Safety Design Model	IHSDM
Interchange Justification Report	IJR
Interchange Modification Report	IMR
Enhanced Interchange Safety Analysis Tool	ISATe
Intelligent Transportation System	ITS
Level of Service	LOS
Linear Referencing System	LRS
Lane Use Management System	LUMS
Measures of Effectiveness	MOEs
Mile Post	MP
Miles Per Hour	MPH
Manual on Uniform Traffic Control Devices	MUTCD
Multiple Vehicle Crashes	MV
Metropolitan Washington Council of Governments	MWCOG
Northbound	NB
National Capital Region Transportation Planning Board	NCRTPB
National Environmental Policy Act	NEPA
National Highway System	NHS
Origin and Destination	O-D
Property Damage Only	PDO
Pentagon Force Protection Agency	PFPA
Public-Private Transportation Act	PPTA
Potomac and Rappahannock Transportation Commission	PRTC
Pentagon Transit Center	PTC
Request for Proposal	RFP
Regional Integrated Transportation Information Systems	RITIS
Southbound	SB
Single Occupancy Vehicle	SOV
Safety Performance Function	SPF
Software Selection Tool	SST
Stakeholder Technical Advisory Group	STAG

Statewide Transportation Improvement Program	STIP
Strategic Highway Network	STRAHNET
Single Vehicle Crashes	SV
Stormwater Pollution Prevention Plan	SWPPP
Six-Year Improvement Plan	SYIP
Traffic Analysis Zone	TAZ
Tableau-Crash Analysis Tool	T-CAT
Transportation Demand Management	TDM
Transit Development Plan	TDP
Transportation Improvement Program	TIP
Traffic Management System	TMS
Traffic Operations and Safety Analysis Manual	TOSAM
Transportation Planning Board	TPB
Transportation Research Board	TRB
Transportation System Management	TSM
Technical Working Group	TWG
United States Army Corps of Engineers	USACE
United States Code	USC
Virginia Department of Environmental Quality	VDEQ
Virginia Department of Transportation	VDOT
Virginia Marine Resources Commission	VMRC
Vehicle Miles Traveled	VMT
Vehicle Occupancy Detection	VOD
Vehicles Per Hour	VPH
Virginia Railway Express	VRE
Variable speed limit signs	VSLs
Virginia State Police	VSP
Westbound	WB
Washington Headquarters Service	WHS
Washington Metropolitan Area Transit Authority	WMATA

EXECUTIVE SUMMARY

The Virginia Department of Transportation (VDOT), in cooperation with the Federal Highway Administration (FHWA), has initiated an Interchange Modification Report (IMR) for the Interstate 395 (I-395) Express Lanes Northern Extension (Northern High Occupancy Toll [HOT] Lanes) to extend the I-95 Express Lanes in the City of Alexandria, and Arlington and Fairfax Counties, Virginia. The I-395 corridor begins at the I-95 / I-495 Capital Beltway Interchange and ends at the New York Avenue NW (Route 50) intersection in northwest Washington, D.C., an approximate distance of 14 miles. I-395 is part of the National Highway System (NHS)[1] and the Strategic Highway Network (STRAHNET)[2]. The I-395 Express Lanes Northern Extension is included in the National Capital Region Transportation Planning Board's (TPB) 2016 Amendment to the Constrained Long Range Plan (CLRP).

The existing I-395 facility within the study limits generally includes four northbound and four southbound general purpose lanes and two reversible High Occupancy Vehicle (HOV) lanes between the northbound and southbound general purpose lanes. During weekdays, the HOV lanes operate in the northbound direction between 2:30 AM and 11:00 AM with HOV 3+ restrictions in effect from 6:00 AM to 9:00 AM and in the southbound direction from 1:00 PM to 12:00 AM with HOV 3+ restrictions in effect from 3:30 PM to 6:00 PM.

ES.1. PROJECT BACKGROUND

In 1995, the Public-Private Transportation Act (PPTA) was signed into law and was amended and re-enacted in 2005. PPTA allows for private entities to solicit VDOT to develop and/or operate and maintain transportation facilities that VDOT determines demonstrate a need. In November 2005, the conceptual proposal submitted by Fluor and Transurban was selected by the PPTA Advisory Panel. As proposed at that time, the project improvements would expand the HOV system in the I-95 / I-395 corridor and apply the HOT concept. The following improvements were proposed:

- Convert the existing two-lane HOV facility to three HOT lanes along I-395 from Eads Street to just south of Route 234 Interchange near Dumfries;
- Construct two new HOT lanes in the median from the existing terminus south of Route 234 to just north of Route 610 (Garrisonville Road);
- Add new entry/exit points between the general purpose lanes and the HOT lanes and modify existing entry/exit points; and

[1] NHS consists of major roadways important to the nation's economy, defense, and mobility. The NHS includes the interstate highway system as well as other roads connecting to major ports, airports, public transportation facilities, or other intermodal transportation services.

[2] STRAHNET is a system of highways important to the United States' strategic defense policy providing defense access, continuity and emergency capabilities for defense purposes.

- Build new structures associated with the Lorton Bus-rail transfer station, flyovers, and replace existing structures at Telegraph Road over I-95 and the Franconia-Springfield pedestrian bridge.

In February 2011, VDOT reduced the project scope by eliminating approximately six miles of HOT lanes on I-395 including modifications to the existing interchanges, instead, focusing traffic improvements along the I-95 corridor. VDOT then announced plans for a new I-95 HOT Lanes Project from Garrisonville Road in Stafford County to I-395 at Turkeycock Run (north of Edsall Road) in Fairfax County. These lanes would have access to the new I-495 HOT lanes already under construction. VDOT prepared an Interchange Justification Report (IJR) to demonstrate the regional need for the change in access. FHWA approved the IJR in December 2011. In 2012, VDOT and 95 Express Lanes, LLC (95 Express) entered into a Comprehensive Agreement for the development of the I-95 Express Lanes. The I-95 Express Lanes project was completed in December 2014.

The Comprehensive Agreement allows for the future development of the extension of the I-95 Express Lanes along the I-395 corridor similar to the limits originally proposed in 2005. In 2015, VDOT signed a Development Framework Agreement with 95 Express to extend the I-395 Express Lanes as a Concessionaire's Enhancement under the Comprehensive Agreement. The Development Framework Agreement outlines the responsibilities of both VDOT and the Concessionaire. The Agreement notes that improvements would be built largely within VDOT's existing right of way, VDOT and 95 Express would work together to finalize the scope, finance plan and agreement, and 95 Express would fund an annual transit payment.

ES.2. PURPOSE AND NEED

Based on the background information discussed above, information gathered during public and agency meetings, and the analysis of recent data collected for this study, the following transportation needs have been identified for the study area:

- Reduce congestion;
- Provide additional travel choices;
- Improve travel reliability; and
- Improve roadway safety.

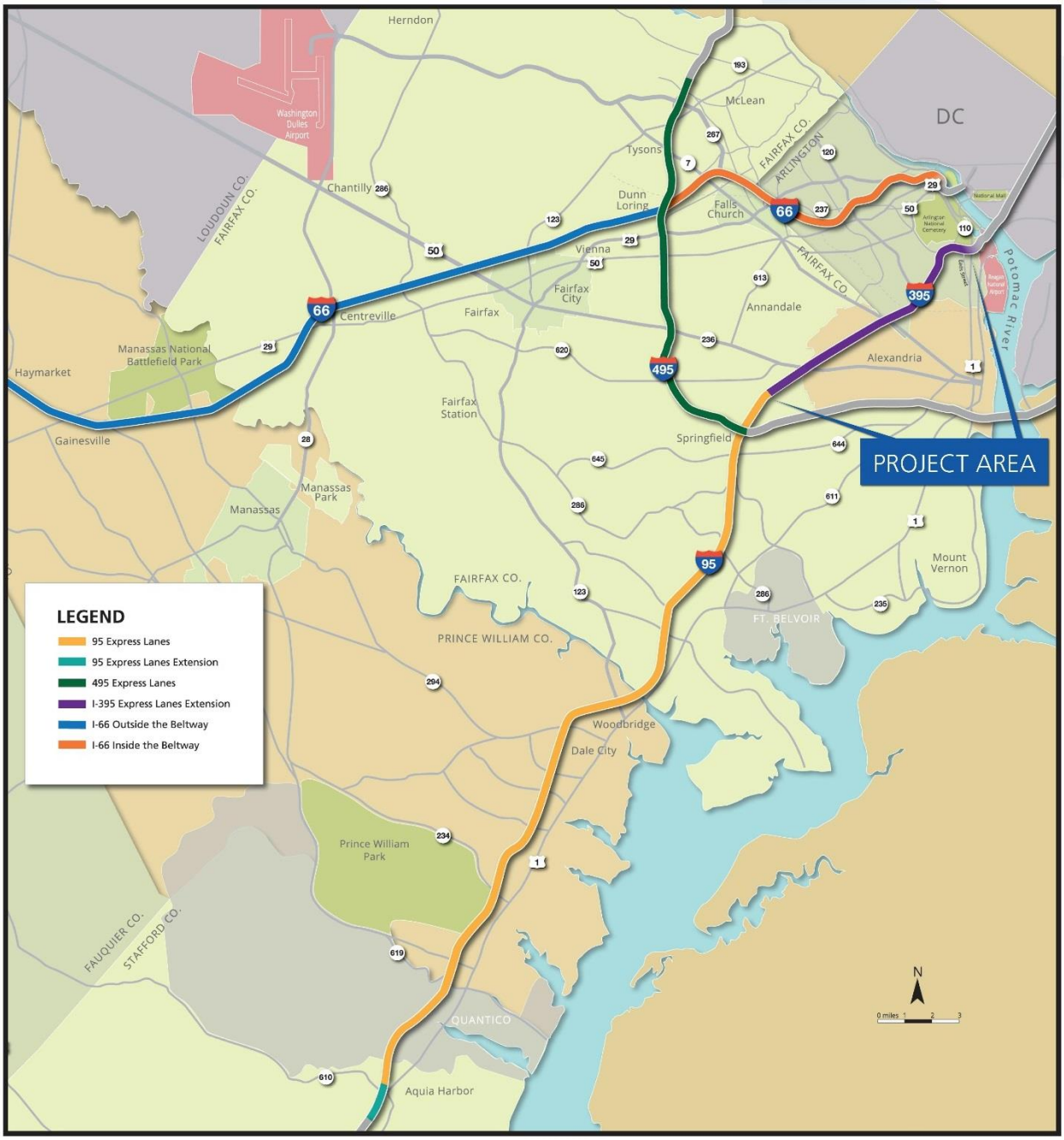
ES.3. SCREENING OF ALTERNATIVES

VDOT and 95 Express have been involved in discussions, reviews, and decisions related to HOT Lanes proposals in the I-95/I-395 corridor since 2004. While Express Lanes were recently implemented in December 2014 along I-95 from Garrisonville Road in Stafford County to Turkeycock Run in Fairfax County, congestion north of the Express Lanes has continued to increase along I-395. A conceptual alternative including several options in the vicinity of the Eads Street Interchange was developed that would address the identified purpose and need of the project. Public and agency coordination were then initiated to further inform the development and refinement of the conceptual alternative and selected a preferred option for the Eads Street Interchange.

Figure ES-1 illustrates the existing and planned Express Lanes (HOT lanes) network within Northern Virginia. The Express Lanes network is critical to the Northern Virginia region because the network provides additional travel choices and improves travel reliability for a variety of users. Due to the desire to address the needs of the project along the I-95 / I-395 corridor, converting the existing HOV facility to a HOT lanes facility was the only build alternative identified for evaluation along the corridor; however, several options at the northern terminus of the study area in the vicinity of the Eads Street Interchange were evaluated. The Dual Reversible Eads Street Ramps option was selected based on its ability to minimize the potential for congestion and queues along the northbound HOT lanes on the approach to the Eads Street Interchange and the northern terminus of the HOT lanes and compatibility with the Pentagon Master Plan improvements in the Pentagon South Parking Lot.

Since Express Lanes already exist within the median of I-95 from Garrisonville Road in Stafford County to I-395 at Turkeycock Run in Fairfax County, making the change from HOV to HOT lanes within the median of I-395 would minimize and reduce impacts by not requiring future improvements to the existing general purpose travel lanes beyond what has already been planned regionally. Furthermore, an additional build alternative that did not involve the conversion of the HOV lanes to HOT lanes was not considered as travel choices and reliability are dependent on connecting the existing HOV facility to the regional Express Lanes network. In order to provide a baseline for comparison, a No Build Alternative was also evaluated.

Figure ES-1: Express Lanes Network in Northern Virginia



ES.4. SUMMARY OF PROPOSED ACTION

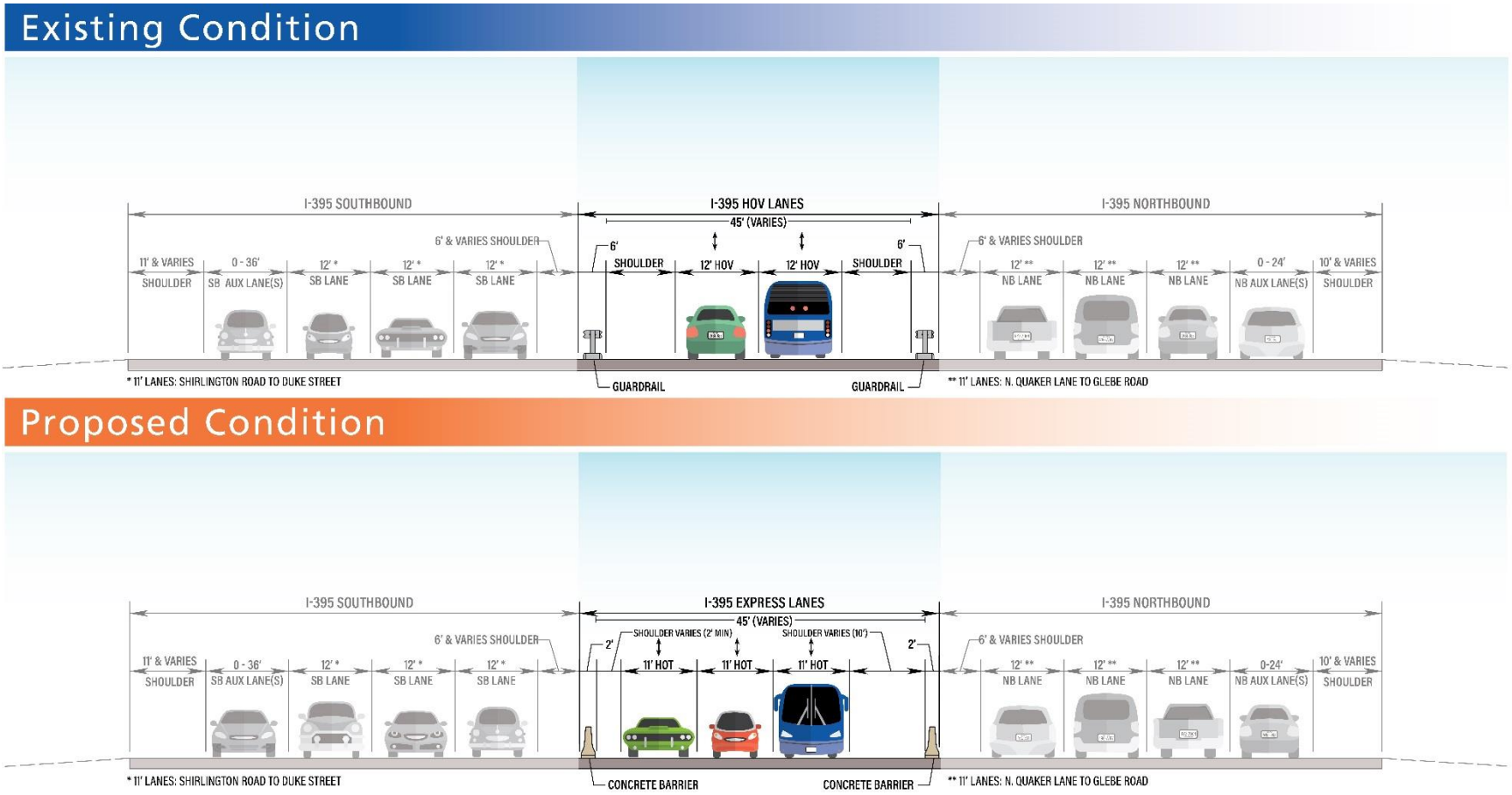
The Build Alternative converts the two existing reversible HOV lanes within the existing median along the I-395 corridor to three reversible HOT lanes within the existing footprint of the existing HOV facility from the current I-395 HOT lanes terminus at Turkeycock Run to north of Eads Street near the Pentagon. The expansion of the existing system of reversible HOV lanes located in the median of I-395 is an extension of the existing I-95 Express Lanes (HOT) to the south. For the majority of the project, the existing reversible HOV lanes are separated from the general purpose lanes by guardrail barriers mounted on a 4 to 6-foot

wide concrete island. The existing guardrail and the concrete island would be replaced with double face concrete barriers.

The proposed three HOT lanes would largely be accommodated within the footprint of the existing HOV facility. The typical available width for the three-lane HOT lanes facility is approximately 45 feet (variable). The Build Alternative provides a typical section of three 11-foot wide travel lanes with a minimum 2-foot shoulder on the west side and a minimum 10-foot shoulder on the east side. Disabled vehicles and emergency responders would use the east side of the corridor during emergency situations. The existing and proposed typical sections are shown in **Figure ES-2**.

Modifications are proposed to the Eads Street Interchange to address existing capacity deficiencies and improve transit access to the Pentagon Transit Center and Pentagon Reservation. These modifications include dual reversible ramps between the I-395 HOT lanes and Eads Street, installation of traffic signals at the two ramp terminals along Eads Street, improvements to the Pentagon South Parking Lot including two new traffic signals along Eads Street at North Rotary Road and South Rotary Road, and the removal of the southbound ramp from the HOV lanes to the general purpose lanes located south of the Eads Street Interchange. The five signalized intersections along Eads Street between Army Navy Drive and North Rotary Road would operate in a coordinated signal system to minimize the potential for delays and queues between these closely spaced intersections. All other access points to the proposed HOT lanes along the study corridor would remain in their current configuration, but would be converted to HOT access with the exception of the south facing Seminary Road ramp. The south facing Seminary Road ramp would remain an HOV ramp at all times.

Figure ES-2: Existing and Proposed Typical Section



ES.5. SUMMARY OF FINDINGS

ES.5.1 TRAFFIC OPERATIONAL ANALYSIS FINDINGS

VISSIM Version 7, Build 07 microsimulation software was used for the evaluation of traffic operations for the I-395 Express Lanes Northern Extension project. The capacity and operations analysis demonstrates that the Build Alternative would improve operations along I-395 within the limits of the proposed conversion of the two HOV lanes to three HOT lanes compared to No Build conditions under both 2020 and 2040 Build conditions based on a review of corridor travel times, speeds, densities, and person throughput results of the microsimulation analysis.

Northbound General Purpose Lanes (AM Peak Period): Under 2020 Build conditions, overall travel times along the northbound I-395 general purpose lanes decrease by 4 to 17 minutes with an average travel time decrease of 12 minutes over the four hour AM peak period resulting in a 29 percent reduction in travel times. Overall travel speeds increase by approximately 6 MPH. Under 2040 Build conditions, travel times along the northbound I-395 general purpose lanes decrease by an average of 6 minutes over the four hour AM peak period resulting in a 12 percent reduction in travel times. There is a 6 minute increase in travel times from 7 AM to 8 AM during the period when demand for the HOT lanes is highest and in order to maintain travel speeds in the HOT lanes, traffic would be shifted from the HOT lanes to the general purpose lanes, thereby increasing travel times. Overall travel speeds increase by 3 MPH.

Northbound HOV/HOT Lanes (AM Peak Period): Under 2020 Build conditions, travel times along the northbound I-395 HOV/HOT lanes decrease by 2.5 minutes. The largest travel time decrease (6 minutes) is observed from 9 AM to 10 AM when No Build travel times in the HOV lanes are highest entering D.C. Under 2040 Build conditions, travel times along the northbound I-395 HOV/HOT lanes decrease by an average of 2.5 minutes.

Southbound General Purpose Lanes (PM Peak Period): Under 2020 Build conditions, travel times along the southbound I-395 general purpose lanes decrease by 1 to 7 minutes with an average travel time decrease of 4 minutes over the four hour PM peak period resulting in an 18 percent reduction in travel time. Under 2040 Build conditions, overall travel times decrease by 3 to 13 minutes, with an average travel time decrease of 9 minutes over the four hour PM peak period resulting in a 29 percent reduction in travel times. Overall travel speeds increase by 8 MPH.

Southbound HOV/HOT Lanes (PM Peak Period): Under 2020 and 2040 Build conditions, travel times along the southbound I-395 HOV/HOT lanes decrease by approximately 15 to 20 seconds.

Under Build conditions, person trips would increase by up to 14 percent along the northbound I-395 general purpose and HOT lanes in the AM peak period and by up to 7 percent along the southbound I-395 general purpose lanes and HOT lanes in the PM peak period.

In addition to reducing congestion and overall travel times in both the I-395 general purpose and HOV lanes during peak periods described above, the I-395 Express Lanes Northern Extension would provide additional travel choices and improve travel reliability along the I-395 corridor. The I-395 Express Lanes would offer consistent and reliable travel times for all roadway users including HOV motorists and transit riders and provide an additional travel choice for vehicles with less than three occupants that want to continue north along the I-95 / I-395 Express Lanes facility north of the Turkeycock Run Interchange or

access the southbound Express Lanes facility exiting Washington, D.C. Although congestion would still exist during peak hours in the general purpose lanes as well as the I-395 Express Lanes approaching D.C., overall travel speeds would increase and travel times would decrease compared to the No Build Alternative.

Modifications to the Eads Street Interchange would improve operations for both HOT lane motorists and transit vehicles entering the Pentagon Reservation as well as motorists destined for Pentagon City. Northbound queues along the northbound I-395 HOV off-ramp to Eads Street would be reduced due to the implementation of dual reversible ramps from the northbound I-395 HOT lanes to Eads Street and the installation of traffic signals at the two ramp termini along Eads Street. Queuing along the northbound off-ramps to Eads Street that extends to the northbound I-395 HOV lanes under existing conditions would also be eliminated in the AM peak period. The Eads Street Interchange modifications include improvements to the Pentagon South Parking lot to create a smooth transition between the I-395 HOT ramp terminals along Eads Street and the South Rotary Road and North Rotary Road intersections. These modifications are consistent with the Pentagon Master Plan improvements to the Pentagon South Parking Lot.

Congestion levels for arterial intersections were categorized based on delay thresholds established in the Highway Capacity Manual 2010 with "light traffic" conditions corresponding to level of service (LOS) C, "moderate traffic" conditions corresponding to LOS D, "heavy congestion" corresponding to LOS E, and "severe congestion" corresponding to LOS F; however, in accordance with the *VDOT Traffic Operations and Safety Analysis Manual* (TOSAM), LOS was not used as a measure of effectiveness. The majority of the study intersections would not degrade under Build conditions. They operate under light or moderate traffic conditions under the No Build and Build scenarios; however, there are three intersections that would degrade to heavy or severe conditions under Build conditions compared to No Build conditions during either the AM or PM peak hour under 2020 or 2040 Build conditions.

ES.5.2 CRASH ANALYSIS FINDINGS

Recurring daily congestion due to heavy commuter traffic that extends for many hours during both the morning and evening peak periods creates the potential for crashes along the I-395 corridor in both the general purpose and HOV/HOT lanes. Crash data was reviewed along both the I-395 general purpose and HOV/HOT lanes from south of Edsall Road to the Potomac River as well as the intersecting arterials within the study area during the four-year period from January 1, 2012 through December 31, 2015. A total of 2,622 crashes were reported along I-395 including 1,461 (56 percent) rear end crashes which are frequently attributed to congestion.

The total crash rates in the northbound general purpose, southbound general purpose, and northbound HOV/HOT lanes are greater than the statewide average interstate crash rate, statewide average urban interstate crash rate, and Northern Virginia interstate average crash rate. The total crash rate for the southbound HOV/HOT lanes is lower than all three average crash rates; however, crash rates ranging from 134 to 198 crashes per 100 million vehicle-miles traveled (VMT) were reported just south of the Eads Street Interchange in the vicinity of the weave between the on-ramp from Eads Street and the off-ramp to the general purpose lanes, which are greater than all three average crash rates.

Overall, it can be concluded that the Build Alternative should not have a significant adverse impact on the safety of the I-395 study corridor. The Build Alternative would reduce recurring congestion during the AM and PM peak periods, thereby reducing the potential for congestion-related crashes and improving safety along the corridor as compared to the No Build Alternative. As part of the conversion of the two existing

HOV lanes to three HOT lanes, the lane widths within the HOV lanes would be reduced to 11 feet and the western shoulder would be reduced to 2 feet to accommodate the third HOT lane within the existing footprint of the HOV lanes facility. A quantitative crash analysis using Highway Safety Manual (HSM) methodologies was performed to document the safety impacts associated with the modifications to the typical section. The analysis indicates that the potential increase in crashes due to the reduction of typical section elements (i.e., lane width and shoulder width) may be offset by mitigating design features including the addition of a third lane and the installation of Traffic Management Systems (TMS) elements. Additionally, modifications to the Eads Street Interchange would have a positive safety benefit on congestion-related crashes reported south of the interchange along both the northbound and southbound HOV lanes by reducing the length of queues on the I-395 HOT lane ramps approaching Eads Street and due to the removal of the southbound ramp from the HOV lanes to the general purpose lanes located south of the Eads Street Interchange.

ES.6. RESPONSE TO FHWA INTERSTATE ACCESS POLICY REQUIREMENTS

FHWA has established Eight Policy Points as defined in FHWA's *Interstate System Access Informational Guide*. The FHWA's decision to approve a request for a modification to access is dependent on satisfying and documenting the following requirements. This section addresses each of the Eight Policy Points.

ES.6.1 POLICY REQUIREMENT 1: NEED FOR THE REVISED ACCESS

The need being addressed by the request cannot be adequately satisfied by existing interchanges to the Interstate, and/or local roads and streets in the corridor can neither provide the desired access, nor can they be reasonably improved (such as access control along surface streets, improving traffic control, modifying ramp terminals and intersections, adding turn bays or lengthening storage) to satisfactorily accommodate the design-year traffic demands (23 CFR 625.2(a)).

I-395, the primary north-south interstate highway into Washington, D.C. serving both local, commuter, and regional traffic, suffers from recurring congestion during peak commuter periods that extends for several hours during the morning and evening peak periods. Traffic demand along the I-395 general purpose lanes already exceeds capacity and forecasts for the 2040 design year indicated that demand would continue to increase, thereby increasing congestion and the duration of at-capacity conditions. Additionally, many of the local arterials in the study area also operate at or above capacity during peak periods and carry some diversion of traffic from I-395 due to recurring congestion.

Accommodating both existing and future traffic demands cannot be adequately addressed through improvements to adjacent corridors. With the exception of the Eads Street interchange area, no physical improvements are proposed to the existing access points along the corridor other than the provision of traffic control devices, Intelligent Transportation System (ITS), and tolling equipment serving the proposed HOT lanes.

Heavy congestion and the commuting patterns oriented toward Washington, DC have encouraged both carpooling and transit service along the I-395 corridor; however, unused capacity still remains in the HOV lanes. The proposed conversion of the two HOV lanes to three HOT lanes provides additional capacity for vehicles who choose to use the I-395 HOT lanes and improves reliability for existing and future HOV and transit users.

In addition to the proposed conversion from two HOV lanes to three HOT lanes, access modifications are proposed at the Eads Street Interchange. This interchange is a critical location in the I-395 HOV lanes system as Eads Street serves the Pentagon Reservation and the Pentagon Transit Center as well as serving as a primary origin and destination for informal ridesharing vehicles (slugs). The interchange is a traditional diamond configuration with unsignalized intersections at the ramp terminals along Eads Street. The northbound I-395 HOV off-ramp operates free flow onto Eads Street for both left and right turns. During the AM peak period, heavy left turn traffic volumes along the I-395 northbound HOV off ramp operate free flow on the approach to Eads Street but then encounter the police-controlled, four-way stop-control intersection at Eads Street and South Rotary Road. Although vehicles on the ramp from the northbound I-395 HOV lanes have the right of way, when there is downstream congestion on northbound Eads Street approaching South Rotary Road, motorists are not able to make a left turn from the ramp which creates queues on the northbound I-395 off ramp that extend into the mainline HOV lanes during the AM peak period. Modifications are required to the interchange to improve access to the Pentagon Transit Center and Pentagon Reservation and improve safety and operations along the northbound I-395 HOV lanes.

ES.6.2 POLICY POINT 2: REASONABLE ALTERNATIVES

The need being addressed by the request cannot be adequately satisfied by reasonable transportation system management (such as ramp metering, mass transit, and HOV facilities), geometric design, and alternative improvements to the Interstate without the proposed change(s) in access (23 CFR 625.2(a)).

Transportation System Management (TSM) strategies focus on improving the operational efficiency of the roadway transportation system without adding major system improvements, such as adding lanes or new ramps. Many TSM strategies currently exist along the I-395 corridor including HOV lanes between the northbound and southbound general purpose lanes, ramp metering along the northbound and southbound general purpose lanes that operates in the peak direction during peak periods, and extensive transit service along the corridor. Although the needs of the corridor cannot be adequately satisfied solely by TSM elements, additional TSM strategies would be implemented along the I-395 HOT lanes as part of the project including an active traffic management system that would improve the reliability and operation of the current HOV facility.

ES.6.3 POLICY POINT 3: OPERATIONAL AND COLLISION ANALYSES

An operational and safety analysis has concluded that the proposed change in access does not have a significant adverse impact on the safety and operation of the Interstate facility (which includes mainline lanes, existing, new, or modified ramps, ramp intersections with crossroad) or on the local street network based on both the current and the planned future traffic projections. The analysis shall, particularly in urbanized areas, include at least the first adjacent existing or proposed interchange on either side of the proposed change in access (23 CFR 625.2(a), 655.603(d) and 771.111(f)). The crossroads and the local street network, to at least the first major intersection on either side of the proposed change in access, shall be included in this analysis to the extent necessary to fully evaluate the safety and operational impacts that the proposed change in access and other transportation improvements may have on the local street network (23 CFR 625.2(a) and 655.603(d)). Requests for a proposed change in access must include a description and assessment of the impacts and ability of the proposed changes to safely and efficiently collect, distribute and accommodate traffic on the Interstate facility, ramps, intersection of ramps with crossroad, and local street network (23 CFR 625.2(a) and 655.603(d)). Each request must also include a conceptual plan of the type and location of the signs proposed to support each design alternative (23 U.S.C. 109(d) and 23 CFR 655.603(d)).

The operational and safety analyses includes approximately ten miles of existing I-395 from south of the Edsall Road interchange to the 12th Street Expressway in Washington, D.C. and includes one major signalized intersection on either side of the roadways with access to and from I-395.

The results of the microsimulation analysis for both 2020 and 2040 conditions indicate that the Build Alternative would result in an increase in overall travel speeds and travel times would decrease along both the I-395 general purpose lanes and the I-395 HOT lanes compared to No Build conditions and would not result in a significant adverse effect on the I-395 corridor or the local street network. The I-395 Express Lanes would offer consistent and reliable travel times for all roadway users including HOV motorists and transit riders and provide an additional travel choice for vehicles with less than three occupants that want to continue north along the I-95 / I-395 Express Lanes facility north of the Turkeycock Run Interchange or access the southbound Express Lanes facility exiting Washington, D.C.

Recurring daily congestion due to heavy commuter traffic that extends for many hours during both the morning and evening peak periods creates the potential for crashes along the I-395 corridor in both the general purpose and HOV/HOT lanes. Crash data was reviewed along both the I-395 general purpose and HOV/HOT lanes from south of Edsall Road to the Potomac River as well as the intersecting arterials within the study area during the four-year period from January 1, 2012 through December 31, 2015. A total of 2,622 crashes were reported along I-395 including 1,461 (56 percent) rear end crashes which are frequently attributed to congestion.

The potential for congestion-related crashes which account for the majority of reported crashes under existing conditions would decrease as a result of decreased congestion in the peak periods associated with the Build Alternative. The lane widths within the HOV lanes would be reduced to 11-foot lanes and the western shoulder would be reduced to 2 feet to accommodate the third HOT lane within the existing footprint of the HOV lanes facility. A quantitative crash analysis using HSM methodologies was performed to document the safety impacts associated with the modifications to the typical section. The analysis indicates that the potential increase in crashes due to the reduction of typical section elements may be offset by mitigating design features including the addition of a third lane and the installation of TMS elements. Additionally, modifications to the Eads Street Interchange would have a positive safety benefit on congestion-related crashes reported south of the interchange along both the northbound and southbound HOV lanes by reducing the length of queues on the I-395 HOT lane ramps approaching Eads Street and due to the removal of the southbound ramp from the HOV lanes to the general purpose lanes located south of the Eads Street Interchange.

A conceptual signing and pavement marking plan depicting all major guide signs is included in **Appendix H** and key design features of the Build Alternative signing are summarized in **Section 5.6**.

ES.6.4 POLICY POINT 4: ACCESS CONNECTIONS AND DESIGN

The proposed access connects to a public road only and will provide for all traffic movements. Less than "full interchanges" may be considered on a case-by-case basis for applications requiring special access for managed lanes (e.g., transit, HOVs, HOT lanes) or park and ride lots. The proposed access will be designed to meet or exceed current standards (23 CFR 625.2(a), 625.4(a)(2), and 655.603(d)).

The existing I-395 HOV facility includes several existing interchanges with partial access due to the nature of the reversible facility and commuter-oriented travel patterns toward Washington, D.C. With the

exception of the Eads Street interchange vicinity, traffic movements that are currently accommodated would be accommodated with the Build Alternative.

Several options were evaluated for the Eads Street interchange. The Dual Reversible Eads Street Ramps option was selected as the preferred option because this option significantly increases capacity on the two ramps serving Eads Street from the south (providing four ramp lanes at the Eads Street termini) and minimizes turning conflicts at the signalized intersections proposed along Eads Street. Compared to existing conditions, this option would accommodate one additional traffic movement from Army Navy Drive to the southbound I-395 HOT lanes during the PM peak period. This option also removes access from Eads Street to the southbound HOV lanes during the AM peak period.

Direct access from Eads Street to the northbound and southbound general purpose lanes is not currently provided today; however, the existing slip ramp from the southbound HOV lanes to the general purpose lanes located just south of Eads Street would be removed with the Build Alternative, thereby eliminating access from Eads Street to the southbound general purpose lanes. The safety and operational impacts associated with this ramp removal are documented in **Chapters 7 and 8**.

All elements of the project have been designed in accordance with American Association of State Highway and Transportation Officials (AASHTO) and VDOT standards to the extent practical. **Chapter 5** contains a summary of the design exceptions and waivers. The approved design exceptions and waivers are included in **Appendix G**.

ES.6.5 POLICY POINT 5: LAND USE AND TRANSPORTATION PLANS

The proposal considers and is consistent with local and regional land use and transportation plans. Prior to receiving final approval, all requests for new or revised access must be included in an adopted Metropolitan Transportation Plan, in the adopted Statewide or Metropolitan Transportation Improvement Program (STIP or TIP), and the Congestion Management Process within transportation management areas, as appropriate, and as specified in 23 CFR part 450, and the transportation conformity requirements of 40 CFR parts 51 and 93.

The proposed improvements to the I-395 corridor are consistent with the master plans for all of the localities. All three plans discuss the need to improve the transportation system either through restricting single-occupancy vehicle use through fees or other restrictions or by expanding the public transportation systems throughout the region. Additionally, Fairfax County and Arlington County master plans specifically include improvements to the I-395 corridor through HOV or HOT Lanes.

The proposed I-395 Express Lanes Extension project is included in the National Capital Region Transportation Planning Board's 2016 Amendment to the Constrained Long Range Plan (CLRP) and the FY 2017-2022 Transportation Improvement Program (TIP), adopted November 16, 2016.

VDOT has been coordinating with Arlington and Fairfax Counties, the City of Alexandria, and the District Department of Transportation (DDOT) through a series of meetings. Letters of support are included in **Appendix A**.

ES.6.6 POLICY POINT 6: FUTURE INTERCHANGES

In corridors where the potential exists for future multiple interchange additions, a comprehensive corridor or network study must accompany all requests for new or revised access with recommendations that address all of the proposed

and desired access changes within the context of a longer-range system or network plan (23 U.S.C. 09(d), 23 CFR 625.2(a), 655.603(d), and 771.111).

The CLRP for the National Capital Region comprehensively addresses transportation needs throughout the region, including the I-395 corridor. The traffic operational analysis considers as part of both the No Build and Build Alternatives all programmed projects included in the CLRP that would impact traffic operations along I-395. Additionally, no future interchanges are planned along the I-395 corridor, and due to the close spacing of the existing interchanges, there is minimal potential for additional future interchanges along I-395 in the vicinity of the study area.

ES.6.7 POLICY POINT 7: COORDINATION

When a new or revised access point is due to a new, expanded, or substantial change in current or planned future development or land use, requests must demonstrate appropriate coordination has occurred between the development and any proposed transportation system improvements (23 CFR 625.2(a) and 655.603(d)). The request must describe the commitments agreed upon to assure adequate collection and dispersion of the traffic resulting from the development with the adjoining local street network and Interstate access point (23 CFR 625.2(a) and 655.603(d)).

The request for revised access is not specifically related to changes to future development or land uses; however, significant coordination occurred through the Stakeholder Technical Advisory Group (STAG) meetings and Technical Working Group meetings with Arlington and Fairfax Counties, the City of Alexandria, DDOT, and the Pentagon.

Ongoing coordination with the Pentagon staff including the Washington Headquarters Service (WHS) and Pentagon Force Protection Agency (PFPA) will ensure that the proposed access changes in the vicinity of the Eads Street interchange are coordinated with improvements planned as part of the Master Plan for the Pentagon Reservation.

ES.6.8 POLICY POINT 8: ENVIRONMENTAL PROCESSES

The proposal can be expected to be included as an alternative in the required environmental evaluation, review and processing. The proposal should include supporting information and current status of the environmental processing (23 CFR 771.111).

Pursuant to the National Environmental Policy Act of 1969, as amended, (NEPA) and in accordance with FHWA regulations, an Environmental Assessment (EA) has been prepared to analyze and document the potential social, economic, and environmental effects associated with the proposed transportation improvements. The EA was approved for public availability in September 2016 and is available on the project website http://www.virginiadot.org/projects/northernvirginia/395_express.asp. Public Hearings were held on October 24, October 26, November 30, and December 1, 2016. A Finding of No Significant Impact (FONSI) is expected to be completed in February 2016 following the conclusion of the public involvement process.

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1. INTRODUCTION

The Virginia Department of Transportation (VDOT), in cooperation with the Federal Highway Administration (FHWA), has initiated an Interchange Modification Report (IMR) for the Interstate 395 (I-395) Express Lanes Project (Northern High Occupancy Toll [HOT] Lanes) to extend the I-95 Express Lanes in the City of Alexandria, and Arlington and Fairfax Counties, Virginia. The I-395 corridor begins at the I-95 / I-495 Capital Beltway Interchange and ends at the New York Avenue NW (Route 50) intersection in northwest Washington, D.C., an approximate distance of 14 miles. I-395 is part of the National Highway System (NHS)[1] and the Strategic Highway Network (STRAHNET)[2]. The I-395 Express Lanes Project is included in the National Capital Region Transportation Planning Board's (NCRTPB) 2016 Amendment to the Constrained Long Range Plan (CLRP).

I-395 is the primary north-south interstate into Washington, D.C. from Virginia serving local, commuter, and regional traffic. This corridor provides an important link between Washington, D.C. and Virginia and suffers from recurring congestion during peak commuter periods that extends for several hours during the morning and evening peak periods. The I-395 corridor is one of the most heavily traveled and congested freeways in the region and in the Commonwealth of Virginia. The existing I-395 facility within the study limits generally includes four northbound and four southbound general purpose lanes and two reversible High Occupancy Vehicle (HOV) lanes between the northbound and southbound general purpose lanes south of Eads Street. On weekdays, the HOV lanes operate in the northbound direction between 2:30 AM and 11:00 AM with HOV 3+ restrictions in effect from 6:00 AM to 9:00 AM. The HOV lanes operate in the southbound direction from 1:00 PM to 12:00 AM with HOV 3+ restrictions in effect from 3:30 PM to 6:00 PM. South of Eads Street, the reversible HOV lanes transition to barrier-separated lanes that operate in both the northbound and southbound directions and continue into Washington, D.C. to approximately 0.2-miles north of 14th Street SW where the lanes merge with the general purpose lanes. Although referred to as "HOV lanes" throughout this document, north of Eads Street and entering Washington, D.C., the barrier-separated lanes are not enforced as HOV lanes although in some locations the entry points and exit points are signed or marked as HOV lanes.

1.1 BACKGROUND

In 1995, the Public-Private Transportation Act (PPTA) was signed into law and was amended and re-enacted in 2005. PPTA allows for private entities to solicit VDOT to develop and/or operate and maintain transportation facilities that VDOT determines demonstrate a need. In November 2005, the conceptual proposal submitted by Fluor and Transurban was selected by the PPTA Advisory Panel. As proposed at that time, the project improvements would expand the High Occupancy Vehicle (HOV) system in the I-95 / I-395 corridor and apply the HOT concept. The following improvements were proposed:

[1] NHS consists of major roadways important to the nation's economy, defense, and mobility. The NHS includes the interstate highway system as well as other roads connecting to major ports, airports, public transportation facilities, or other intermodal transportation services.

[2] STRAHNET is a system of highways important to the United States' strategic defense policy providing defense access, continuity and emergency capabilities for defense purposes.

- Convert the existing two-lane HOV facility to three HOT lanes along I-395 from Eads Street to just south of the Route 234 Interchange near Dumfries;
- Construct two new HOT lanes in the median from the existing terminus south of Route 234 to just north of Route 610 (Garrisonville Road); and
- Add new entry/exit points between the general purpose lanes and the HOT lanes and modify existing entry/exit points.

In February 2011, VDOT reduced the project scope by eliminating approximately six miles of HOT lanes on I-395 including modifications to the existing interchanges, instead, focusing traffic improvements on the I-95 corridor. VDOT then announced plans for a new I-95 HOT Lanes Project from Garrisonville Road in Stafford County to I-395 north of Edsall Road in Fairfax County. These lanes would have access to the new I-495 HOT lanes already under construction. VDOT prepared an Interchange Justification Report (IJR) to demonstrate the regional need for the change in access. FHWA approved the IJR in December 2011. In 2012, VDOT and 95 Express Lanes, LLC (95 Express) entered into a Comprehensive Agreement for the development of the I-95 Express Lanes. The I-95 Express Lanes project was completed in December 2014.

The Comprehensive Agreement allows for the future development of the extension of the I-95 Express Lanes along the I-395 corridor similar to the limits originally proposed in 2005. In 2015, VDOT signed a Development Framework Agreement with 95 Express to extend the I-395 Express Lanes as a Concessionaire's Enhancement under the Comprehensive Agreement. The Development Framework Agreement outlines the responsibilities of both VDOT and the Concessionaire. The Agreement notes that improvements would be built largely within VDOT's existing right of way; VDOT and 95 Express would work together to finalize the scope, finance plan and agreement; and 95 Express would fund an annual transit payment.

1.2 RELATIONSHIP TO OTHER HIGHWAY IMPROVEMENT PLANS/PROGRAMS

The proposed project along I-395 overlaps with or is located adjacent to several recently completed improvements, planned improvements, and ongoing studies. **Section 4.2** provides a comprehensive list of planned projects included in the CLRP that would have the potential to impact operations along the corridor.

1.2.1 I-95/I-395 Express Lanes

As noted above in **Section 1.1**, Express Lanes were recently implemented in December 2014 along I-95 and I-395 from Garrisonville Road in Stafford County to north of Edsall Road at Turkeycock Run in Fairfax County. The project included the following elements:

- Two new reversible HOV/HOT lanes along the 9-mile segment within the median between Route 610 (Garrisonville Road) and the existing terminus south of Route 234 (Dumfries Road);
- Conversion of the existing two-lane directional HOV facility to a two-lane reversible HOT facility along the 6-mile segment between Route 234 (Dumfries Road) and Route 294 (Prince William Parkway);
- Conversion of the existing two-lane directional HOV facility to a three-lane reversible HOT facility along a 13.5-mile segment between Route 294 (Prince William Parkway) and the Turkeycock ramps north of Edsall Road; and

- Modifications and upgrades to existing access points and addition of new entry/exit points, between the general purpose lanes and the HOV/HOT lanes, and in a few isolated locations, to/from arterials.

1.2.2 I-95/I-395 Transit/Transportation Demand Management (TDM) Plan

The I-95/I-395 Transit/TDM Plan is currently under development to identify a range of transit and TDM recommendations for the I-95 and I-395 corridors with a focus on optimizing person throughput. The Plan will provide recommendations to the Commonwealth and regional decision-makers regarding how the Annual Transit Investment to be funded by Express Lanes toll revenues might be used. The Plan will also document relevant data for existing transit service providers in the corridor, approved Transit Development Plans (TDP), and transit and commuter patterns in the study area.

1.2.3 14th Street Bridge Corridor Draft Environmental Impact Statement (Draft EIS)

Eastern Federal Lands Highway Division (EFLHD) of FHWA conducted a Draft EIS to reduce congestion, enhance safety, and improve traffic operations in the 14th Street Bridge Corridor which is located at the northern terminus of the I-395 Express Lanes Project and extends from Eads Street in Arlington County to east of the Southeast Freeway in Washington, D.C. The study identified several highway, transit, bicycle/pedestrian, and management alternatives to be retained for further study in the Final EIS. The Draft EIS was completed in January 2012. To date, the Final EIS has not been initiated.

1.2.4 I-395 4th Lane South Widening – Duke Street to Edsall Road

This project involves the construction of a fourth lane along southbound I-395 to provide one additional through lane from north of Duke Street to south of Edsall Road. Work will include interchange modifications at both Edsall Road and Duke Street to accommodate the additional through lane and to reduce weaving issues along southbound I-395. At the Duke Street / Little River Turnpike Interchange, the loop ramp serving southbound I-395 to eastbound Duke Street traffic will be removed and replaced with a traffic signal. At the Edsall Road Interchange, the loop ramp serving westbound Edsall Road to southbound I-395 traffic will be removed and replaced with a traffic signal. The project is currently planned to be constructed concurrently with the I-395 Express Lanes project.

1.2.5 Pentagon Master Plan South Parking Lot Improvements

The 2015 Master Plan Update for the Pentagon Reservation establishes a long-term vision for the Pentagon and surrounding facilities and includes a reconfiguration of the Pentagon South Parking Lot. The Pentagon Reservation, including the Pentagon Transit Center, accommodates more than 23,000 employees and commuters using the transit center traveling to and from the site every day. Modifications to the Eads Street Interchange have the potential to affect traffic circulation at the Pentagon Reservation. The exact timing of the implementation of the proposed South Parking Lot Improvements is not known at this time and is dependent on federal approvals and funding availability. As such, VDOT and 95 Express have collaborated with Pentagon staff to develop an interim improvement for the South Parking Lot that is consistent with the longer term Master Plan improvements and would allow the Eads Street Interchange to operate effectively until the ultimate improvements are implemented.

1.2.6 I-395 HOV / Transit Ramp at Seminary Road

This project involved the construction of a south-facing ramp between the I-395 HOV lanes and the third level of the Seminary Road Interchange that provides access for HOV and transit vehicles along I-395 to the south of the interchange. The HOV ramp is reversible and permits northbound traffic to exit to Seminary Road in the morning hours and permits traffic from Seminary Road to access the southbound I-395 HOV lanes in the afternoon and evening hours. The ramp was opened to traffic in January 2016.

1.3 STUDY AREA / PROJECT LOCATION

The traffic study area encompasses approximately ten miles of existing I-395 from south of the Edsall Road interchange to the 12th Street Expressway in Washington, D.C. which is located just north of the entry and exit points of the existing HOV facility along I-395. The study area along the roadways with access to and from I-395 generally includes one major signalized intersection on either side of the interstate and all general purpose and HOV ramps serving I-395. **Figure 1-1** (*Volume 2*) depicts the traffic operations analysis study area and the sub-area model boundary.

1.4 PURPOSE AND NEED

Based on the background information discussed above, information gathered during public and agency meetings, and the analysis of recent data collected for this study, the following transportation needs have been identified for the study area:

- Reduce congestion;
- Provide additional travel choices;
- Improve travel reliability; and
- Improve roadway safety.

Each of these key needs is described in detail below.

1.4.1 Reduce Congestion

The I-395 corridor suffers from recurring congestion during peak commuter periods that extends for several hours during the morning and evening peak periods. The predominant travel direction in the AM peak period is northbound on I-395 toward Washington D.C., and southbound toward Stafford County during the PM peak period. **Chapters 6 and 7** further document traffic conditions for existing and future 2020 and 2040 No Build conditions in more detail.

Traffic Volumes

Existing (2015) and 2040 No Build peak hour traffic volumes for northbound and southbound I-395 for both the general purpose and HOV/HOT lanes are summarized in **Figures 1-2 and 1-3**, respectively.

Figure 1-2: Existing (2015) and 2040 No Build AM Peak Hour – Northbound I-395

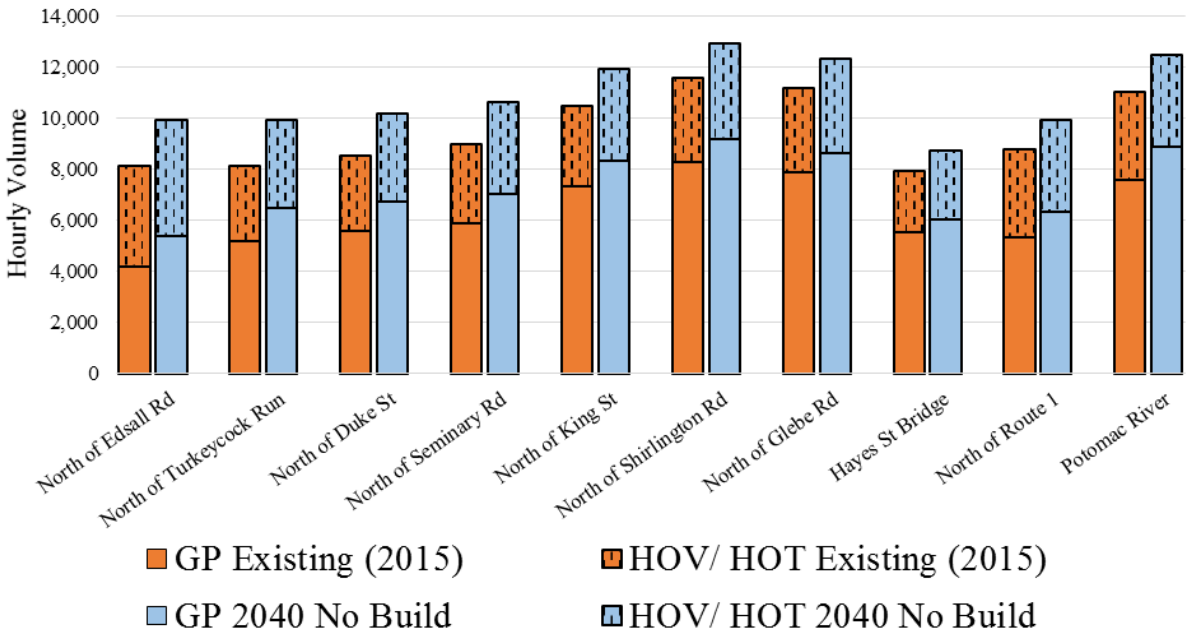
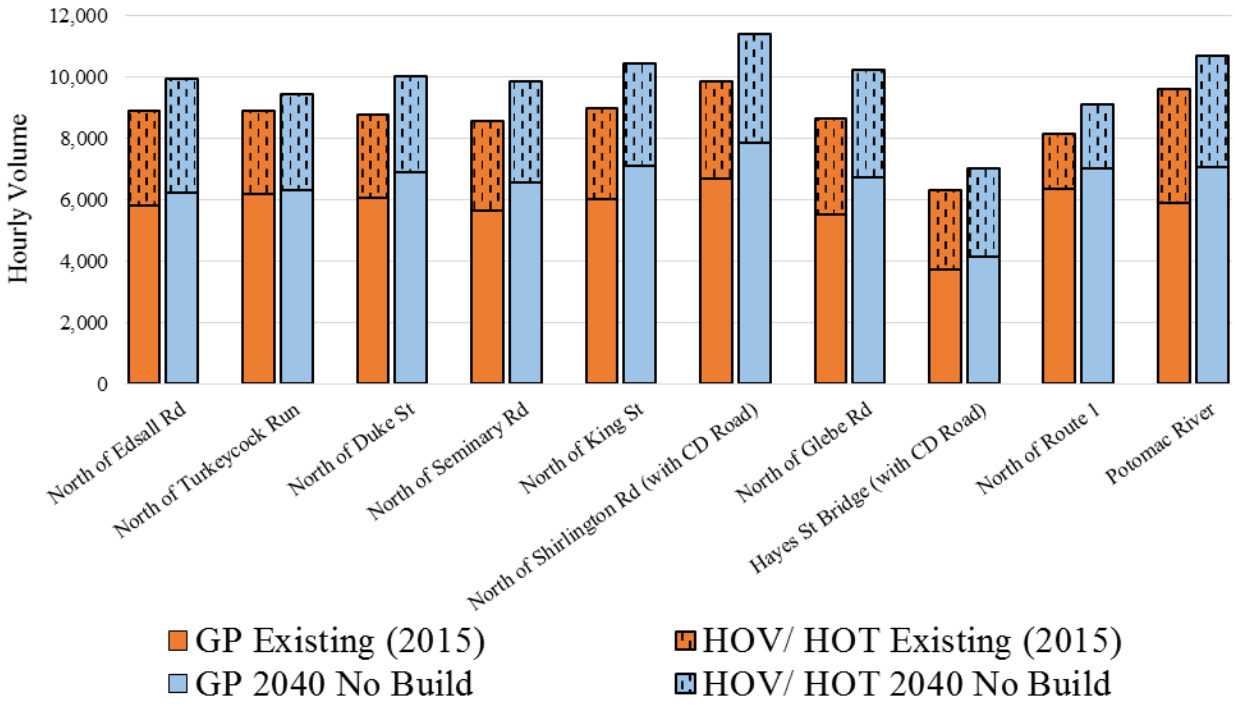


Figure 1-3: Existing (2015) and 2040 No Build PM Peak Hour – Southbound I-395



Northbound I-395 – AM Peak Hour: Under existing conditions, northbound AM peak hour traffic volumes in the I-395 general purpose lanes gradually increase from 4,200 to 8,300 between Edsall Road and Glebe Road. The traffic volumes reduce to 5,500 over the Hayes Street bridge due to the large amount of vehicles exiting the corridor and traveling to Washington Boulevard, Army Navy Drive, and other destinations in the Pentagon vicinity. General purpose traffic volumes increase to 7,600 over the Potomac River due to the traffic entering the corridor at George Washington Memorial Parkway. In the HOV/HOT lanes, traffic volumes decreases from 3,900 vehicles north of Edsall Road to 2,900 vehicles north of Turkeycock Run due to vehicles traveling from the HOT lanes to the general purpose lanes during the HOV-restricted period. Similar to the general purpose lanes, traffic volumes in the HOV lanes decrease to 2,400 over the Hayes Street bridge due to the traffic exiting the corridor to Washington Boulevard. At the Potomac River, the HOV volumes increase to 3,500 vehicles due to the traffic entering the HOV lanes from Eads Street and north of Eads Street (from the general purpose lanes) and traveling into Washington D.C.

Southbound I-395 – PM Peak Hour: In the southbound general purpose lanes, PM peak hour traffic volumes of 5,900 leaving Washington D.C. decrease at the Hayes Street bridge due to the traffic exiting the corridor at Route 1 and George Washington Memorial Parkway. PM peak hour volumes then gradually increase from 3,700 over the Hayes Street bridge to 6,700 at Shirlington Road due to the traffic entering the corridor at Washington Boulevard and Glebe Road. The general purpose lane volumes then stay relatively constant between Shirlington Road and Edsall Road averaging approximately 5,900 vehicles. Traffic volumes in the southbound HOV lanes leaving Washington D.C. are approximately 3,700 vehicles and decrease to 1,800 vehicles north of Route 1 due to traffic traveling from the HOV lanes to the general purpose lanes during the HOV-restricted period. Traffic volumes in the HOV lanes then gradually increase to 3,100 north of Shirlington Road due to traffic entering the corridor from Eads Street and Washington Boulevard. Traffic then remains relatively constant until south of Turkeycock Run where the HOT lanes begin and the volumes increase from 2,700 to 3,100 due to single occupancy vehicles being permitted to travel in the HOT lanes.

As shown in **Figures 1-2 and 1-3**, peak hour traffic volumes are forecasted to increase in the future which will lead to more severe and a longer duration of congestion during both the AM and PM peak periods as discussed below.

Travel Times and Speeds

A VISSIM microscopic model was prepared for both existing (2015) and 2040 No Build conditions to assess traffic operations along I-395 from south of Edsall Road to the 12th Street Expressway in Washington, D.C. in both the general purpose and HOV/HOT lanes. Due to over-capacity conditions along I-395 that are experienced for several hours during the morning and evening peak periods, the AM peak period was evaluated for four hours from 6:00 AM to 10:00 AM and the PM peak period was evaluated for four hours from 3:00 PM to 7:00 PM. A comparison of simulated travel times reported from VISSIM along I-395 from south of Edsall Road to the 10th Street bridge in Washington, D.C. for existing and 2040 No Build conditions is summarized in **Figures 1-4 and 1-5** for the peak travel direction (northbound in the AM peak period and southbound in the PM peak period) for each of the four analysis hours. **Figures 1-6 and 1-7** summarize the travel speeds by segment along I-395 for existing conditions and No Build conditions for the northbound I-395 and southbound I-395 travel directions, respectively.

Figure 1-4: Northbound Overall Travel Time Summary - AM Peak Period

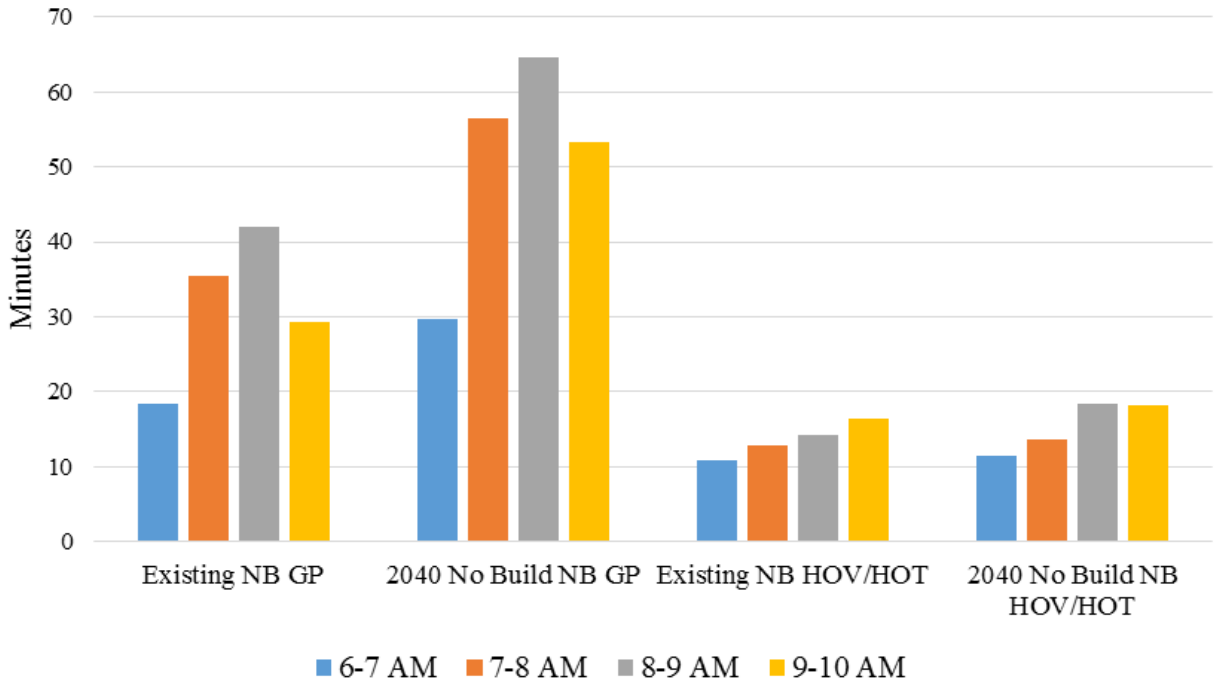


Figure 1-5: Southbound Overall Travel Time Summary - PM Peak Period

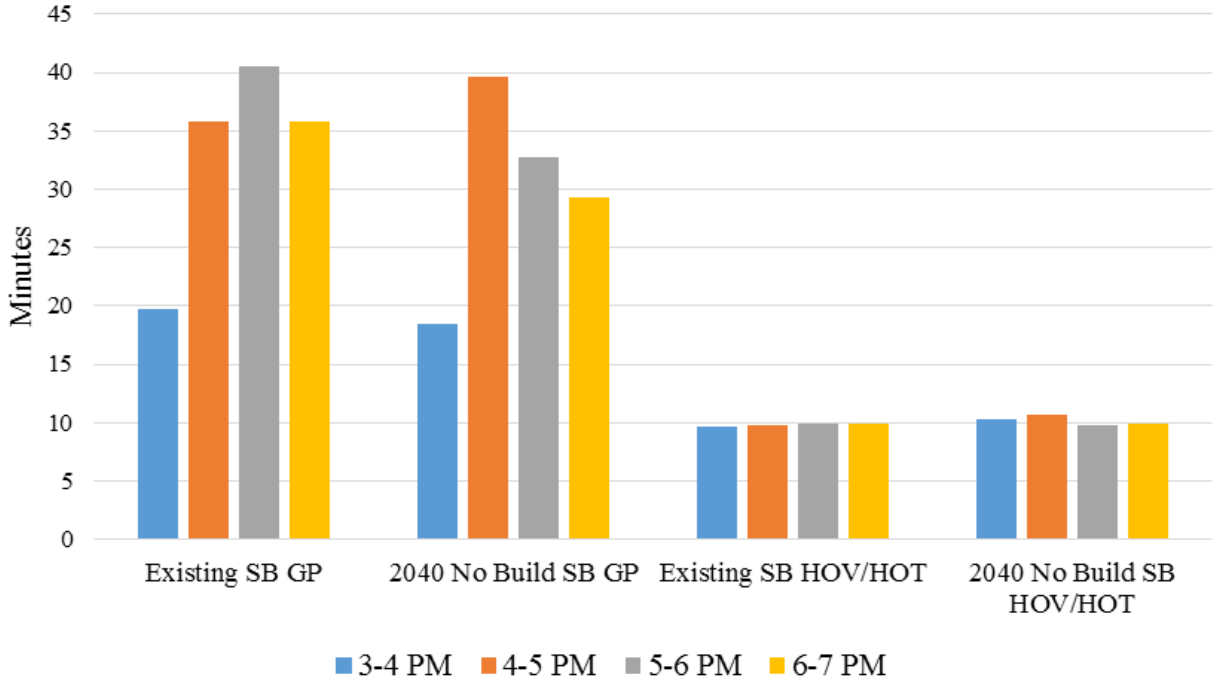


Figure 1-6: AM Peak Period Travel Speeds – Northbound I-395

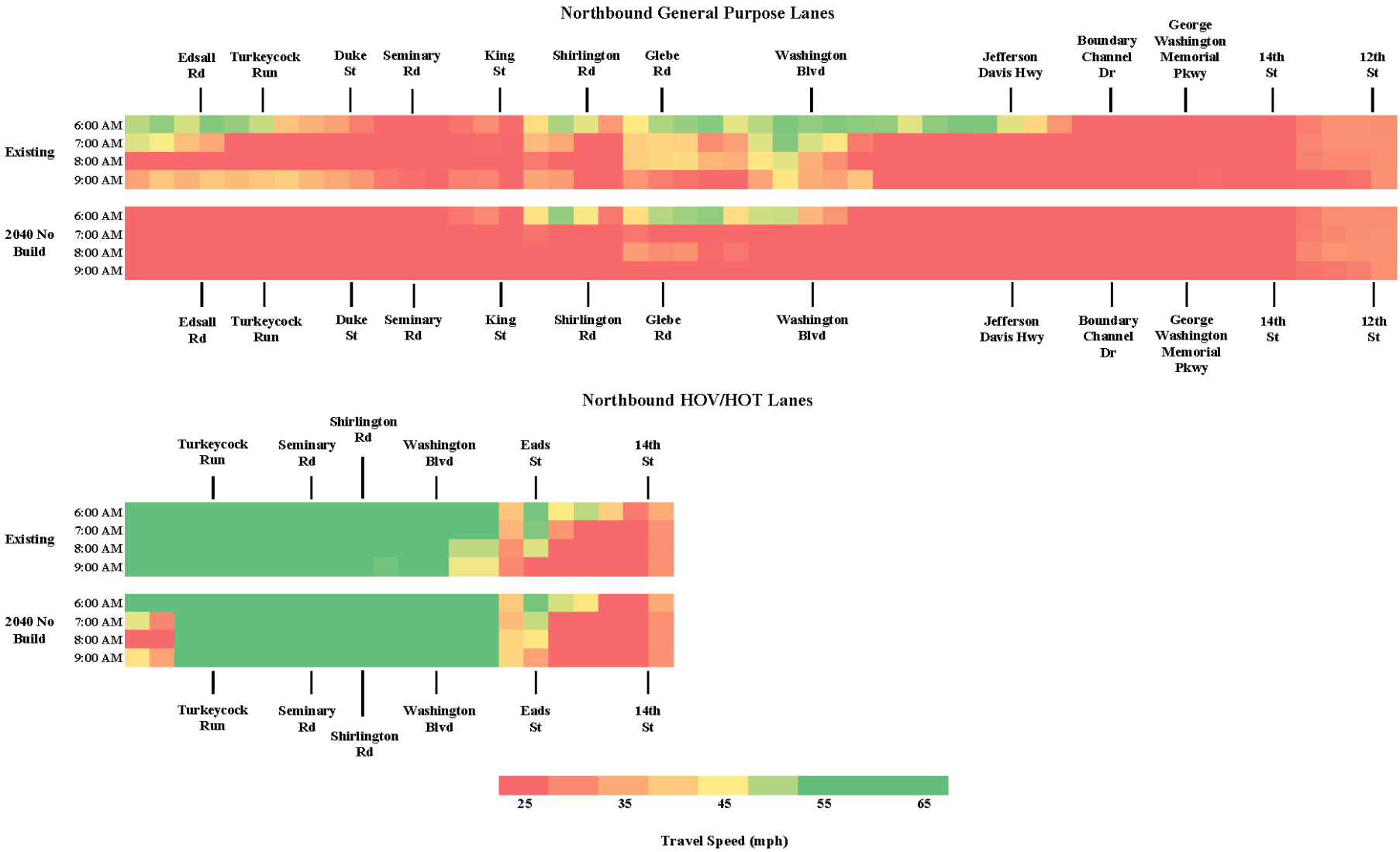
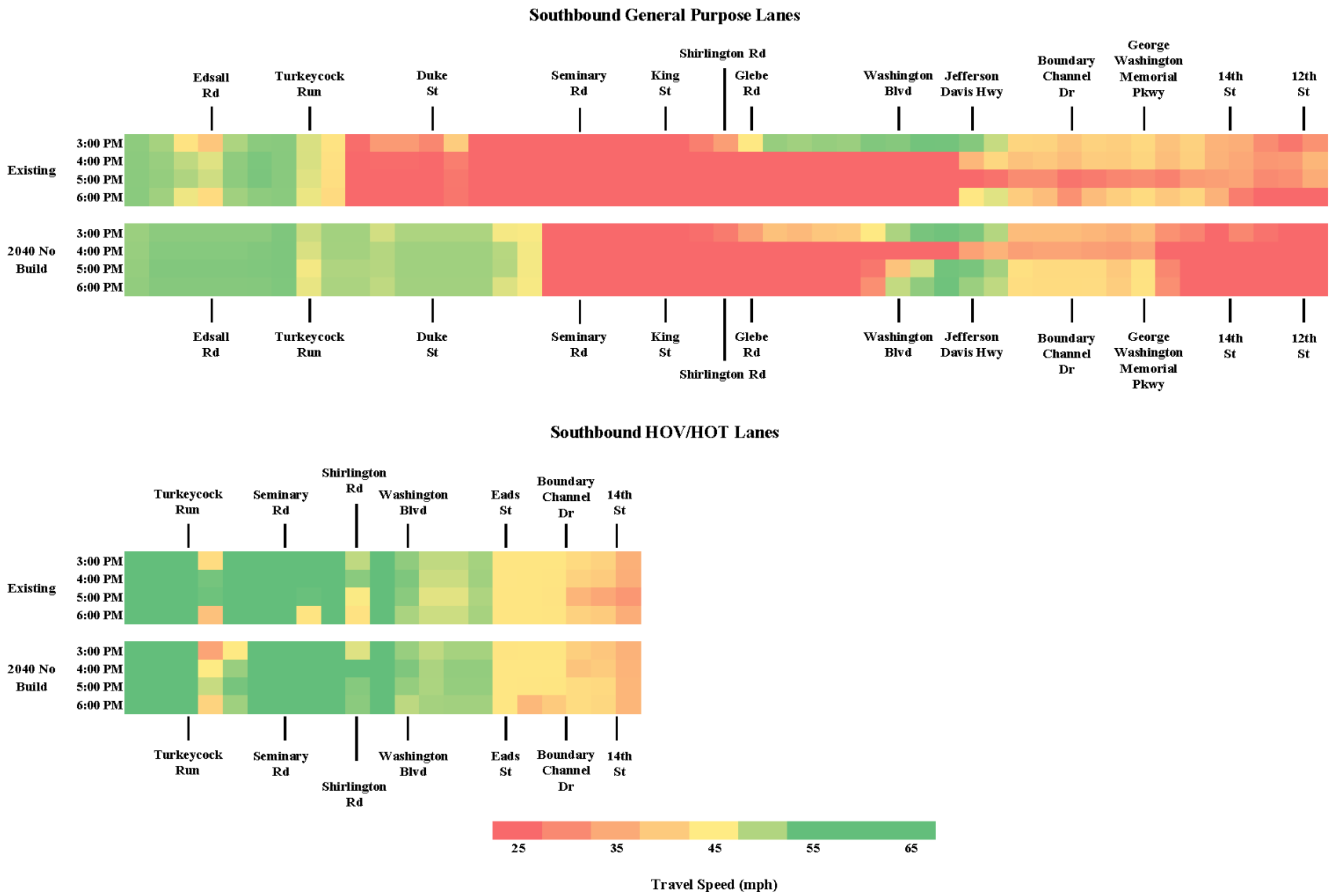


Figure 1-7: PM Peak Period Travel Speeds – Southbound I-395



AM Peak Period – Northbound General Purpose Lanes: Existing corridor travel times along the northbound I-395 general purpose lanes for the four hours during the AM peak period range from 18 to 42 minutes with an average travel time of 31 minutes and an average travel speed of 21 MPH. The 8 to 9 AM hour has the longest corridor travel time (42 minutes) of the four AM peak period hours due to higher congestion levels during this hour between Edsall Road and King Street.

Under 2040 No Build conditions, travel times along the northbound I-395 general purpose lanes increase by 11 to 24 minutes compared to existing conditions in the AM peak period. A large portion of the travel time increase occurs south of the Turkeycock Run Interchange as a result of the congestion and queuing along northbound I-395 extending farther to the south during peak hours. Average travel speeds decrease from approximately 21 MPH under existing conditions to 13 MPH under 2040 No Build conditions.

AM Peak Period – Northbound HOV/HOT Lanes: Existing corridor travel times along the northbound I-395 HOV/HOT lanes range from 11 to 16 minutes with an average travel time of 14 minutes. The 9 AM to 10 AM hour has the longest corridor travel time (16 minutes) of the four AM peak hours primarily due to higher levels of congestion and lower speeds during this hour between Eads Street and 14th Street. Travel times in the northbound HOV/HOT lanes between 7 AM and 10 AM are approximately two to three times shorter than travel times in the northbound general purpose lanes. Travel speeds in the HOV/HOT lanes generally operate under free-flow conditions south of the Eads Street Interchange area; however, outside of the designated HOV periods northbound motorists in the HOV lanes experience congestion and lower travel speeds due to downstream congestion approaching Washington, D.C., that occasionally extends farther to the south due to the use of the HOV lanes by single occupant vehicles.

Under 2040 No Build conditions, travel times along the northbound I-395 HOV/HOT lanes range from 11 to 19 minutes. From 8 AM to 9 AM, travel times increase by four minutes compared to existing conditions. Travel times increase south of Turkeycock Run as northbound motorists in the HOT lanes attempt to exit to the general purpose lanes at Turkeycock Run and encounter greater congestion in the general purpose lanes compared to existing conditions. Travel times also increase between Eads Street and 14th Street in Washington, D.C. as a result of higher traffic volumes and congestion levels in this section where the HOV lanes are open to travel by all motorists.

PM Peak Period – Southbound General Purpose Lanes: Existing travel times along the southbound I-395 general purpose lanes range from 20 to 41 minutes with an average travel time of 33 minutes and an average travel speed of 20 MPH. The longest corridor travel time occurs from 5 PM to 6 PM (41 minutes).

Under 2040 No Build conditions, travel times along the southbound I-395 general purpose lanes decrease by 1 to 8 minutes compared to existing conditions with the largest decrease of 6 to 8 minutes occurring between 5 PM and 7 PM. The travel time decreases can be attributed to the I-395 4th Lane South Widening – Duke Street to Edsall Road project that provides additional capacity south of the Duke Street interchange. Travel times decrease incrementally throughout the southern portion of the study limits south of Glebe Road; however, travel times increase in the northern portion of the study limits north of Boundary Channel Drive. Average travel speeds increase from 20 to 22 MPH between existing and 2040 No Build conditions.

PM Peak Period – Southbound HOV/HOT Lanes: Existing travel times along the southbound I-395 HOV/HOT lanes are approximately 10 minutes with average travel speeds of 61 MPH. Travel times in the

southbound HOV/HOT lanes are three to four times shorter than travel times in the southbound general purpose lanes from 4 PM to 7 PM.

Under 2040 No Build conditions, travel times from 3 PM to 7 PM remain approximately the same in the southbound HOV/HOT lanes when comparing existing to 2040 No Build conditions.

1.4.2 Provide Additional Travel Choices

I-395 is a multi-modal corridor that provides transportation services to a variety of users between Stafford County and Washington, D.C., in addition to regional travelers. The corridor provides access to the Pentagon which is a regional transit hub that serves the Metro system's Yellow and Blue lines, local and regional commuter buses, formal ridesharing, and informal ridesharing (also known as slugging). Slugging is an important component of travel in the I-395 corridor, which is a form of carpooling from designated pickup and drop off points located in close proximity to an HOV facility. The incentive to the driver and the passenger is the ability to use the HOV facility. Because of the proximity of the Pentagon Reservation and the Pentagon Transit Center (PTC) to the I-395 corridor, the Pentagon Reservation functions as a regional transit hub providing a linkage for commuters. The PTC accommodates eight transit bus services with nearly 850 buses per day and approximately 160 buses in the AM and PM peak hours. Over 19,000 bus passengers travel through the PTC daily from 6 AM to 9 AM and from 3 PM to 6 PM with over 5,600 peak period passengers using the Pentagon Metrorail Station (WHS, 2015). The I-395 corridor also serves many commuter and local bus lines serving local communities in northern Virginia and Washington, D.C. Although these transit services travel in the HOV lanes and therefore have a shorter travel times compared to vehicles in the general purpose lanes, they suffer from the same congestion deficiencies as other transportation users along the I-395 HOV lanes.

In addition, the existing Express Lanes network is critical because the network provides additional travel choices for a variety of users including motorists along I-95 / I-395/ and I-495. Travel choice is limited for vehicles with less than three occupants that want to continue north along the I-95 / I-395 Express Lanes facility north of the Turkeycock Run Interchange where these vehicles are required to exit the HOT lanes and enter the general purpose lanes. Similarly, vehicles with less than three occupants traveling southbound along I-395 within the project limits do not have an option to access the Express Lanes system until south of Turkeycock Run.

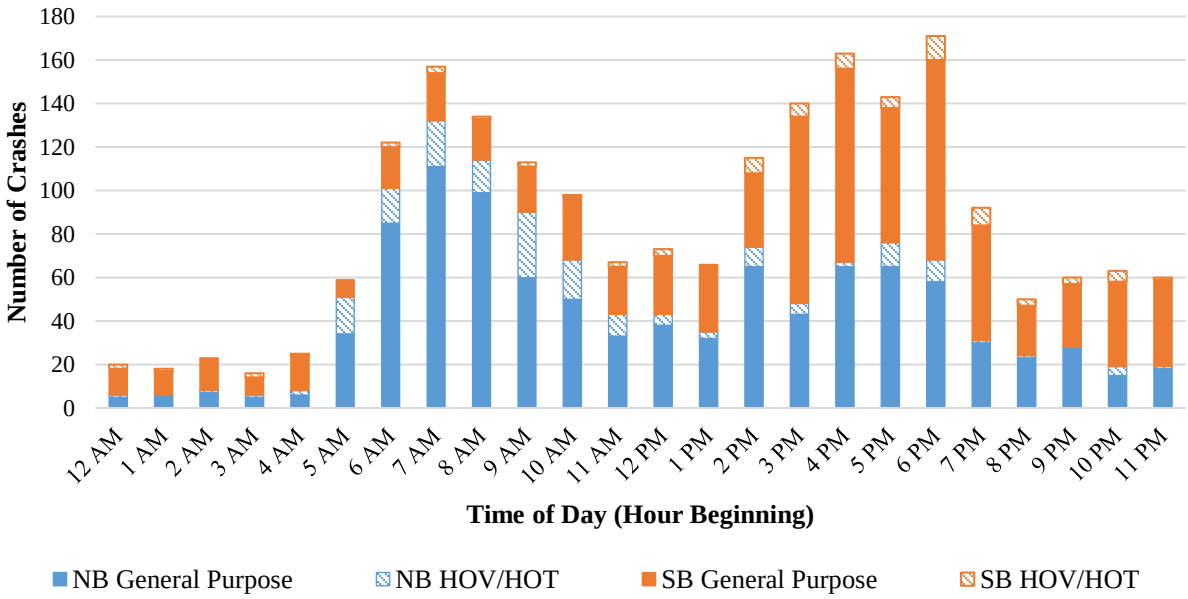
1.4.3 Improve Travel Reliability

Travel time reliability is a quality of life issue for travelers along I-395 including HOV motorists and those using bus transit services along the corridor. Based on travel speed data in both the I-395 general purpose lanes and HOV lanes, highly variable travel speeds and resulting travel times are experienced by motorists as a result of numerous factors including both recurring and non-recurring congestion, crash incidents, disabled vehicles, and weather events. Although there is a higher degree of travel time reliability in the HOV lanes compared to the general purpose lanes, high levels of congestion and reduced travel speeds are experienced in the northbound HOV lanes in the AM peak period approaching the Eads Street Interchange and entering Washington, D.C. As discussed in **Section 1.2.1**, the duration and extent of congestion within the HOV lanes in this area is expected to increase in the future as traffic volumes increase. There is a need to provide highly reliable travel times for motorists and transit services along the I-395 corridor throughout the day.

1.4.4 Improve Roadway Safety

Recurring daily congestion due to heavy commuter traffic that extends for many hours during both the morning and evening peak periods creates the potential for crashes along the I-395 corridor in both the general purpose and HOV/HOT lanes. Crash data was reviewed along both the I-395 general purpose and HOV/HOT lanes from approximately 0.45 mile south of Edsall Road to the Potomac River during the four-year period from January 1, 2012 through December 31, 2015. A total of 2,622 crashes were reported including 1,461 (56 percent) rear end crashes, which are frequently attributed to congestion. **Figure 1-8** summarizes weekday (Monday through Friday) crashes by time of day. Seventy-eight percent of all reported crashes occurred on weekdays from Monday through Friday. As shown, 30 percent of all weekday crashes occurred during the AM peak period from 6:00 AM to 11:00 AM and 40 percent of all weekday crashes occurred during the PM peak period between 2:00 PM and 8:00 PM. It should be noted that these time periods reflect the hours when the crash frequency increases compared to other hours and are not specifically related to the selected hours for the operational analysis. Fifty-six (70) percent of all weekday crashes occurred during these eleven hours indicating a higher proportion of crashes occurring when traffic volumes are highest and that congestion contributes to the potential for crashes.

Figure 1-8: Weekday (Monday – Friday) Crashes by Time of Day (2012 – 2015)



Crash rates per 100 million vehicle miles traveled (VMT) for the northbound and southbound I-395 general purpose and HOV/HOT lanes are summarized in **Table 1-1** for both total crashes and injuries. Calculated crash rates were compared to VDOT's annually-published statewide average interstate, statewide average urban interstate, and Northern Virginia average interstate rates for both total crashes and injuries.

The total crash rate in the northbound general purpose, southbound general purpose, and northbound HOV/HOT lanes is greater than the statewide average interstate crash rate, statewide average urban interstate crash rate, and Northern Virginia average crash rate. The total crash rate for the southbound HOV/HOT lanes is lower than all three average crash rates; however, crash rates ranging from 134 to 198 crashes per 100 million VMT were reported just south of the Eads Street Interchange in the vicinity of the

weave between the on-ramp from Eads Street and the off-ramp to the general purpose lanes, which are greater than all three average crash rates. Of the 68 crashes reported within the southbound HOV lanes from Turkeycock Run to Eads Street, 21 (31 percent) crashes occurred at this location.

Under future No Build conditions, with anticipated increases in travel demand, congestion in the peak periods will increase, thereby increasing the potential for congestion-related crashes which account for the majority of reported crashes under existing conditions.

Table 1-1: Crash and Injury Rate (per 100 million VMT) Compared to Average Statewide Rates

Crash Rate Type	I-395 Crash Rates by Facility (2012 – 2015 Crashes)				Statewide Average Rates[1]		
	NB GP	NB HOV/ HOT	SB GP	SB HOV/ HOT	Interstate	Urban Interstate	Northern Virginia Interstate
Total Crash Rate[2]	**119**	**109**	**113**	**39**	**68**	**81**	**97**
Injury Rate[3]	**29**	**44**	**37**	**39**	**30**	**37**	**41**

[1] *Average of the 2012, 2013, and 2014 crash rates published annually by VDOT's Traffic Engineering Division*
[2] *Crashes per 100 million VMT*
[3] *Injuries per 100 million VMT*

1.5 PROPOSED ACTION

The Build Alternative converts the two existing reversible HOV lanes within the existing median along the I-395 corridor to three HOT lanes within the footprint of the existing HOV facility from the current I-395 HOT lanes terminus at Turkeycock Run to Eads Street near the Pentagon. The expansion of the existing system of reversible HOV lanes located in the median of I-395 is an extension of the existing I-95 Express Lanes (HOT) to the south. For the majority of the project, the existing reversible HOV lanes are separated from the general purpose lanes by guardrail barriers mounted on a 4 to 6-foot wide concrete island. The existing guardrail and the concrete island would be replaced with double face concrete barriers. By maximizing the width between the general purpose lanes and reconstructing the existing paved shoulders, the proposed three HOT lanes would largely be accommodated within the footprint of the existing HOV facility. The typical available width for the three-lane HOT lanes facility is approximately 45 feet (variable). The proposed typical section includes three 11-foot wide travel lanes with a minimum 2-foot shoulder on the west side and a minimum 10-foot shoulder on the east side. Disabled vehicles and emergency responders would use the east side of the corridor during emergency situations.

The Build Alternative includes modifications to the Eads Street Interchange at the proposed northern terminus of the I-395 HOT lanes. This interchange is a critical location in the I-395 HOT lanes facility as Eads Street serves the Pentagon Reservation and the Pentagon Transit Center, a major transit hub for the Washington, D.C. region, and is a primary origin and destination for transit providers and motorists using the existing I-395 HOV lanes. As described in more detail in **Section 4.4.2** and as shown in **Figure 4-15**, the Build Alternative includes two reversible south-facing ramps that would increase capacity to and from Eads Street by dividing traffic between two reversible ramps, providing a total of four ramp lanes traveling to and from Eads Street. The northbound I-395 HOV off-ramp to Eads Street would operate northbound in the AM peak period and southbound in the PM peak period for traffic traveling to and from Army Navy Drive and the Pentagon City area. The existing ramp from Eads Street to the southbound I-395 HOV lanes

would be expanded to two lanes approaching the intersections at Eads Street and operate northbound in the AM peak period and southbound in the PM peak period for traffic traveling to and from the Pentagon Reservation.

With the exception of the Eads Street Interchange, access points to the proposed HOT lanes along the study corridor would remain in their current configuration, but would be converted to HOT access with the exception of the south facing Seminary Road ramp. The south facing Seminary Road ramp would remain a HOV ramp at all times. **Table 1-2** summarizes the proposed access modifications along the I-395 study corridor.

Table 1-2: Access Point Modifications

Access Point		Access	
		Existing	Proposed Action
Turkeycock Run	Ramp from NB HOT lanes to NB GP lanes	AM: NB access from HOT lanes PM: Closed	No change
	Ramp from NB GP lanes to NB HOV lanes	AM: NB access to HOV lanes PM: Closed	AM: NB access to HOT lanes PM: Closed
	Ramp from SB HOV lanes to SB GP lanes	AM: Closed PM: SB access from HOV lanes	AM: Closed PM: SB access from HOT lanes
	Ramp from SB GP lanes to SB HOT lanes	AM: Closed PM: SB access to HOT lanes	No change
Seminary Road – South Facing Ramp		AM: NB access from HOV lanes PM: SB access to HOV lanes (HOV at all times)	No change (would remain HOV at all times)
Seminary Road – North Facing Ramp		AM: NB access to HOV lanes PM: SB access from HOV lanes	AM: NB access to HOT lanes PM: SB access from HOT lanes
Shirlington Road – North Facing Ramp		AM: NB access to HOV lanes PM: SB access from HOV lanes	AM: NB access to HOT lanes PM: SB access from HOT lanes
Washington Boulevard – South Facing Ramp		AM: NB access from HOV lanes PM: SB access to HOV lanes	AM: NB access from HOT lanes PM: SB access to HOT lanes
Eads Street Interchange	Ramp from SB HOV lanes to SB GP Lanes (south of Eads Street)	AM & PM: SB access from HOV lanes	Ramp removed
	Eads Street – NB Off Ramp from HOV	AM: NB access from HOV lanes PM: Closed	AM: NB to Army Navy Drive from HOT lanes PM: SB from Army Navy Drive to HOT lanes
	Eads Street – SB On Ramp to HOV	AM & PM: SB access to HOV lanes	AM: NB to Pentagon from HOT lanes PM: SB from Pentagon to HOT lanes
	Eads Street – NB On Ramp to HOV	AM & PM: NB access to HOV lanes	AM & PM: NB access to HOT lanes
	Eads Street – SB Off Ramp from HOV	AM & PM: SB access from HOV lanes	No change
NB Ramp from GP Lanes to HOV Lanes north of Eads Street		AM & PM: NB access to HOV lanes	AM & PM: NB access to HOT lanes

Additionally, the Build Alternative would include interim improvements to the Pentagon South Parking Lot in order to create a smooth transition between the improvements planned at the Eads Street Interchange and within the Pentagon Reservation.

1.6 SUPPORT AND COMMITMENT FROM VDOT AND LOCAL JURISDICTIONS

The proposed I-395 Express Lanes Extension project is included in the National Capital Region Transportation Planning Board's 2016 Amendment to the Constrained Long Range Plan (CLRP) and the fiscal year (FY) 2017-2022 Transportation Improvement Program (TIP), adopted November 16, 2016.

The proposed improvements to the I-395 corridor are consistent with the master plans for all of the localities. All three plans discuss the need to improve the transportation system either through restricting single-occupancy vehicle use through fees or other restrictions or by expanding the public transportation systems throughout the region. Additionally, Fairfax County and Arlington County master plans specifically include improvements to the I-395 corridor through HOV or HOT Lanes.

VDOT has been coordinating with Arlington and Fairfax Counties and the City of Alexandria through a series of Stakeholder Technical Advisory Group (STAG) meetings and has presented a summary of the benefits and impacts of the project to the elected officials of each locality prior to widely advertised public meetings. A summary of these meetings is presented in **Table 1-3**. Letters of support are included in **Appendix A**. At the local level, VDOT has met with the local homeowners associations, as summarized in **Table 1-4**. In addition, VDOT has coordinated extensively though numerous one-on-one meetings with the District Department of Transportation (DDOT), the Pentagon, and the localities to develop a design that addresses the needs of the corridor. VDOT has also presented the information numerous times to local elected officials.

Table 1–3: Summary of Stakeholder and Public Engagement

Meeting	Attendees	Location	Date
STAG #1	VDOT, Alexandria, Arlington County, Fairfax County, Virginia Department of Rail and Public Transportation (DRPT), Metrorail	VDOT Northern Virginia District Office, Fairfax, VA	January 12, 2016
STAG #2	VDOT, Alexandria, Arlington County, Fairfax County, DRPT, Metrorail	VDOT Northern Virginia District Office, Fairfax, VA	March 2, 2016
STAG #3	VDOT, Alexandria, Arlington County, Fairfax County, DRPT, Metrorail	VDOT Northern Virginia District Office, Fairfax, VA	July 11, 2016
Public Information Meeting	VDOT, Arlington County, local citizens	Wakefield High School, Arlington, VA	April 11, 2016
Public Information Meeting	VDOT, Alexandria, local citizens	Francis C. Hammond Middle School, Alexandria, VA	April 13, 2016

Meeting	Attendees	Location	Date
Public Information Meeting	VDOT, Alexandria, Arlington County, Fairfax County, local citizens	Wakefield High School, Arlington, VA	October 24, 2016
Public Information Meeting	VDOT, Alexandria, Arlington County, Fairfax County, local citizens	Francis C. Hammond Middle School, Alexandria, VA	October 26, 2016
Design Public Hearing	VDOT, Alexandria, Arlington County, Fairfax County, local citizens	Bren Mar Park Elementary School, Alexandria, VA	November 30, 2016
Public Information Meeting	VDOT, Alexandria, Arlington County, Fairfax County, local citizens	Robert E. Lee High School, Springfield, VA	December 1, 2016

Table 1-4: Summary of Homeowners Association Meetings

Group	Winter meeting	Fall meeting
Alexandria		
Overlook Owners Association	2/25/16	9/22/16
Landmark Mews Owners Association	1/28/16	Provided presentation via email on 9/13/16; declined to meet in person
Brookville-Seminary Valley Civic Association	2/29/16	Provided presentation via email on 10/6/16; declined to meet in person
Seminary Hill Civic Association	1/15/16	10/13/16
North Ridge Civic Association	1/11/16	Provided presentation via email on 10/7/16; awaiting response to request to meet in-person
Arlington		
Aurora Highlands Civic Association	12/9/15	9/14/16
Columbia Heights Civic Association	1/11/16	10/5/16 with Columbia Pike Organization (Phone briefing on 9/26/16)
Crystal City Civic Association	1/20/16	9/21/16
Arlington County Civic Federation	3/1/16	N/A
Fairlington Civic Association	3/14/16 (joint meeting with Parkfairfax)	9/12/16 (joint meeting with Parkfairfax)
Parkfairfax Owners Association	3/14/16	9/12/16
Arlington Ridge Civic Association	1/21/16	9/15/16
Long Branch Creek Civic Association	4/21/16	Provided presentation via email on 10/24; awaiting response to request to meet in-person
Shirlington Civic Association	N/A	11/2/16
Columbia Pike Revitalization Organization	N/A	10/5/16
Arlington View Civic Association	N/A	Awaiting response on request to meet
Nauck Civic Association	N/A	Awaiting response on request to meet

2. METHODOLOGY

The IMR was developed following both federal and VDOT guidance contained in the documents listed below:

- Interstate, NHS Non-Interstate and Non-NHS (IJR / IMR Guidance) - VDOT Instructional and Informational Memorandum - IIM-LD-200.9 (January 2017)
- VDOT Traffic Operations and Safety Analysis Manual (TOSAM) - Version 1.0 (November 2015)
- FHWA Interstate System Access Informational Guide (August 2010)
- FHWA (Virginia Division) Standard Operating Procedure for New or Revised Interstate Access Points (September 2010).
- FHWA Interstate Access Policy (August 2009)

The approved IMR Framework Document (see **Appendix B**) outlines the understanding between FHWA and VDOT regarding the scope of work of the IMR including the study area, the traffic forecasting and analysis methodology, and study assumptions. The Framework Document also outlines the FHWA policy points to be utilized and level of detail for each point. The following summarizes the traffic forecasting methodology, the traffic operations methodology, and the safety analysis methodology as outlined in the IMR Framework Document.

2.1 TRAFFIC FORECASTING METHODOLOGY

2.1.1 Forecast Years

Forecasts were developed for the following scenarios:

- Existing conditions (2015)
- 2020
    - No Build Conditions (including all projects funded through construction based on the National Capital Region Transportation Planning Board's 2015 Constrained Long Range Plan (CLRP))
    - Build Alternative (including the CLRP projects and reflecting the proposed conversion of the two HOV lanes to three HOT lanes and improvements to the Eads Street interchange)
- 2040
    - No Build Conditions (including projects contained in the CLRP)
    - Build Alternative (including the CLRP projects and reflecting the proposed conversion of the two HOV lanes to three HOT lanes and improvements to the Eads Street interchange)

2.1.2 MWCOG Model

To provide consistency with the regional planning efforts, the Metropolitan Washington Council of Governments (MWCOG) Travel Demand Forecasting Model, Version 2.3 Build 57a (adopted on October 21, 2015), also known as the Version 2.3.57a Travel Model was used as the basis for the development traffic forecasts. Models exist for the following years: 2015, 2017, 2020, 2025, 2030, and 2040. The MWCOG Model utilizes a four step trip-based model framework with feedback between traffic assignment

and distribution. Memoranda summarizing the travel demand model methodology, calibration, and validation are contained in **Appendices C and D**, respectively.

Model Validation and Calibration: Prior to using the model for further analysis, the 2015 model network was reviewed for consistency with field conditions, including link coding and number of lanes. The model was validated to ensure reasonable volumes across a set of cutlines and corridors defined to capture the movements in the region.

Time of Day Assignment Model (MWCOG Post Processor): A review of the MWCOG Model periods and I-395 HOV lane operations showed an inconsistency that impacted the overall model calibration and use of the model for project-level forecasts and inputs into the operations models. Specifically, the time periods of operation of the I-395 HOV facility do not align well with the MWCOG Model Periods.

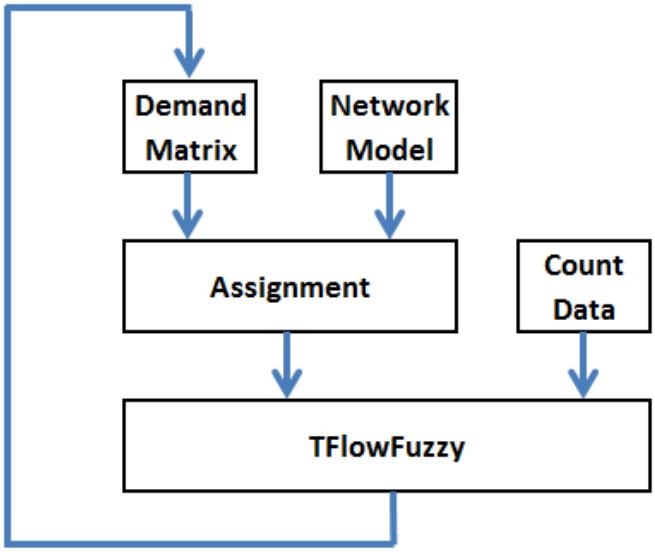
Based on the difference between the MWCOG Model periods and the actual I-395 HOV operations, a post process to the MWCOG Model was developed that further disaggregated the MWCOG trip tables to improve the alignment of periods between the model and actual operations. The Post Processor was used to develop the 2015 (existing conditions), 2020 (No Build and Build) and 2040 (No Build and Build) inputs to the VISUM models. The MWCOG Model was first run to provide consistency with regional forecasts. The output of the MWCOG Model was then input to the MWCOG Post Processor to develop the demand matrices used in the VISUM models.

2.1.3 VISUM Model

Model Development: A VISUM model was established to produce daily, AM, and PM peak period traffic volumes at a more detailed level than the MWCOG model and to produce the input files needed for VISSIM microscopic operations analysis. For the purposes of traffic forecasting, the VISUM study area was extended beyond the traffic analysis study area to account for potential shifts in traffic between competing roadways within the project area vicinity. The MWCOG model network was imported into VISUM and refined to include the detailed geometry of all roadway and intersections within the study area, including signalized intersections and key unsignalized intersections. Existing signal timing data provided by VDOT, Arlington County, and the City of Alexandria was coded into VISUM at signalized intersections. Traffic analysis zones (TAZs) that serve multiple driveways/developments were subdivided to ensure an accurate traffic assignment at the peak hour level. The MWCOG subarea origin and destination (O-D) matrices were exported as daily, AM, and PM peak period matrices and used as a seed matrix for the initial VISUM traffic assignment: the starting point of the VISUM model calibration and validation process. The MWCOG matrices were exported to align with the time periods of the HOV restrictions and then aggregated to produce Single Occupancy Vehicle (SOV)/HOV-2, HOV-3, and Truck matrices for assignment in VISUM.

Model Calibration and Validation Model calibration and validation refers to the process that confirms the model provides a reasonable approximation of reality (validation) and makes any adjustments to the model to bring it within desired validation targets (calibration). This ensures that the model accurately represents existing traffic conditions. VISUM was calibrated to match the existing link and turning movement demand volumes using its matrix estimation tool, TFlowFuzzy. This procedure adjusts the demand matrix so that its assignment results match observed traffic counts. An iterative process shown in **Figure 2-1** was utilized for the I-395 model to estimate the peak period O-D matrices using TFlowFuzzy for each of the five hours that were input into the VISSIM model for the AM and PM peak periods.

Figure 2-1: VISUM Trip Assignment Iterative Process



Future Year Model Development: The base year VISUM models were modified to reflect future CLRP projects (see **Section 4.2**) to generate the 2020 and 2040 No Build VISUM models. The future No Build models were then modified to incorporate the Build Alternative and generate the future 2020 and 2040 Build models. The outputs of the MWCOG Post Processor as described above were used to generate growth rates that were then applied to the base year VISUM matrices to generate the 2020 and 2040 No Build and Build scenario forecasts.

2.2 TRAFFIC OPERATIONS ANALYSIS METHODOLOGY

2.2.1 Analysis Tools

VDOT's TOSAM includes a *Software Selection Tool (SST)* used to select the most appropriate traffic analysis tool for any given analytical scenario. The Software Selection Tool was used to select the most appropriate tool for this study. VISSIM was determined to be the preferred tool to analyze the oversaturated I-395 transportation network. VISSIM Version 7, Build 07 was used for the evaluation of traffic operations.

Synchro Version 8 was used as the basis for signal timing inputs into the VISSIM models, but was not used to report measures of effectiveness for intersections. Existing signal timing data and existing Synchro networks for the study area were provided by VDOT, Arlington County, and the City of Alexandria.

2.2.2 VISSIM Model Development and Analysis Periods

Existing conditions VISSIM models were developed along the I-395 mainline freeway corridor and along the intersecting arterials for both the AM and PM peak periods and incorporate dynamic traffic assignment based on the VISUM trip tables established for each peak period. All necessary network object parameters were coded into the models in accordance with VDOT's TOSAM and *VISSIM User Guide* (VDOT, 2015b).

The base year VISSIM models were modified to reflect future CLRP projects (see **Section 4.2**) to generate the 2020 and 2040 No Build VISSIM models. The future No Build models were then modified to incorporate the Build Alternative and generate the future 2020 and 2040 Build VISSIM models.

Due to over-capacity conditions along I-395 that are experienced for several hours during the morning and evening peak periods, speed data in combination with diurnal traffic volume data along I-395 was used to establish morning and evening peak periods and hours corresponding to the most congested conditions along I-395 rather than when volumes are at their highest. During the highest-volume periods, downstream bottlenecks have not yet reached their capacity allowing for higher flow rates through the study area.

Based on a review of diurnal traffic volumes and speeds along the northbound and southbound I-395 general purpose lanes (see **Figures 2-2 and 2-3**) in combination with the time periods for the HOV restrictions (AM period: 6:00 AM – 9:00 AM; PM period: 3:30 PM – 6:00 PM), the AM peak period was evaluated for four hours from 6:00 AM to 10:00 AM and the PM peak period was evaluated for four hours from 3:00 PM to 7:00 PM. The identified peak hours for the traffic analysis are 7:00 AM to 8:00 AM and 5:00 PM to 6:00 PM.

The VISSIM analysis includes a seeding period of one hour to ensure that the model was properly loaded prior to producing measures of effectiveness. The AM peak period consists of five hours of simulation from 5 AM to 10 AM including a one-hour seeding period from 5 AM to 6 AM and a four-hour analysis period from 6 AM to 10 AM. Similarly, the PM peak period consists of five hours of simulation from 2 PM to 7 PM including a one-hour seeding period from 2 PM to 3 PM and a four-hour analysis period from 3 PM to 7 PM.

Figure 2-2: Northbound I-395 General Purpose Lanes – South of Seminary Road AM Peak Period - Traffic Flow Patterns

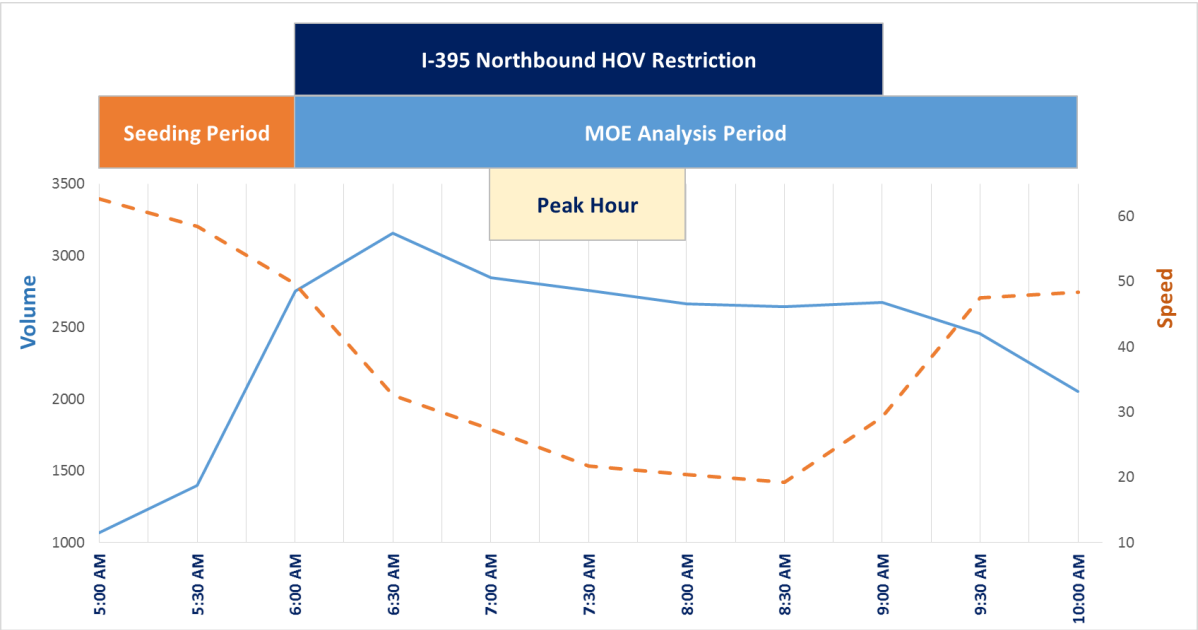
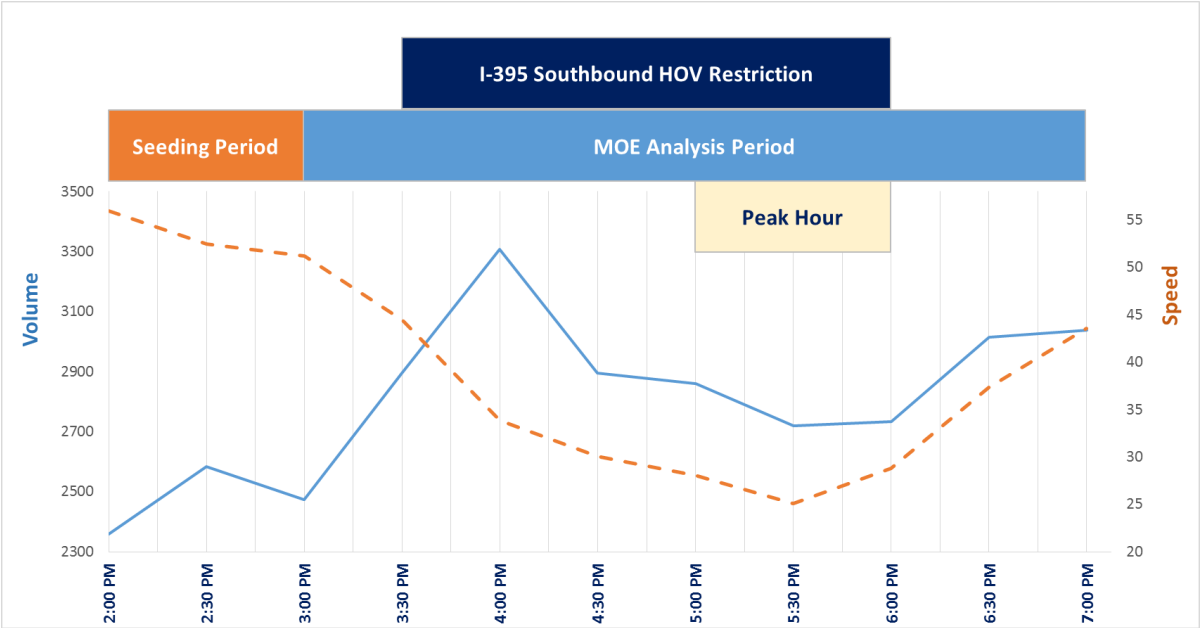


Figure 2-3: Southbound I-395 General Purpose Lanes – North of King Street PM Peak Period - Traffic Flow Patterns



2.2.3 VISSIM Model Number of Runs

VDOT's Sample Size Determination Tool included in the TOSAM, which is based on the FHWA 95th percentile confidence level sample size determination methodology, was used to determine the appropriate number of microsimulation runs. Overall corridor average speed, and volumes and speeds at three locations along both the I-395 general purpose and HOV lanes were the criteria selected for the sample size determination. The Sample Size Determination Tool indicated a passing sample size of 10 runs for both the AM and PM peak hours, respectively.

2.2.4 VISSIM Model Calibration and Validation

The existing conditions AM and PM peak period VISSIM models were calibrated and validated to ensure the models accurately depict existing field conditions in order to effectively evaluate future traffic operations along the I-395 corridor. I-395 operates in an oversaturated condition in the peak direction for most of the peak period. During the calibration process, priority was given to matching corridor travel speeds given the amount of congestion experienced along the I-395 corridor. The source of the calibration data came from two primary data collection efforts: volumes and travel times. The calibration criteria used for the VISSIM microscopic model is shown in **Table 2-1** and is based on the approved IMR Framework Document. Since improving operations along the I-395 corridor is a primary focus of the I-395 Express Lanes project and freeway congestion has a major impact on operations along the corridor, the travel time calibration was focused on the I-395 corridor. Volume calibration criteria were applied to all roadway links in the VISSIM network including freeways, arterials, and local roadways.

A detailed summary of the calibration and validation process and results is contained in **Appendix E**.

Table 2-1: VISSIM Model Calibration Criteria

Simulated Measure	Calibration Thresholds
Simulated Traffic Volume (vph) for the top 85% of the network links based on link traffic volumes	Within ± 20% for <100 vph Within ± 15% for ≥ 100 vph to <300 vph Within ± 10% for ≥ 300 vph to <1,000 vph Within ± 5% for ≥ 1,000 vph
Simulated Travel Time (seconds) for the entire I-395 corridor along both the general purpose and HOV/HOT lanes Simulated Travel Time (seconds) for 85% percent of the segments between interchanges along both the general purpose and HOV/HOT lanes	Within ± 20% of observed travel times
Simulated Queue Lengths for critical intersection approach links that affect I-395 freeway ramps and mainline operations	Average queue length within ± 30% Maximum queue length within ± 35%
Bottleneck locations along I-395	Visually acceptable to analyst and VDOT/FHWA's satisfaction

Tables 2-2 and 2-3 summarize the volume and travel time calibration criteria and resulting calibration data from the models, respectively.

Travel times from the VISSIM model were compared to the field-measured travel time runs. The calibration target of 85% of the simulated travel times being within 20% of the observed travel times for both the general purpose and HOV/HOT lanes is met for both the AM and PM VISSIM models. Forty-three of the 45 total segments included in the combined AM and PM peak hour models are within the 20% calibration threshold for travel time.

Calibration criteria and thresholds are presented for each of the four traffic volume groups. For volume groups 3 and 4 (≥300 vehicles per hour), 85 percent or more of the traffic volume links in the VISSIM model network meet the calibration thresholds for both the AM and PM peak hour models. These two volume groups include all of the roadway links along I-395 and the majority of the ramps entering and exiting the I-395 corridor. Less than 85 percent of the links within volume groups 1 and 2 (<300 vehicles per hour) meet the calibration thresholds. The majority of these links are located along the arterial roadway network and minor street approaches to arterials and are not located along I-395 or the ramp links that connect directly to the I-395 general purpose or HOV lanes and do not impact the overall calibration of the I-395 corridor. Additionally, the volume differences for the links not meeting the calibration thresholds represent a very small portion of the overall traffic volumes along the I-395 corridor which range from 3,700 to 8,300 vehicles per hour in the peak direction and will not impact the overall calibration of the I-395 corridor or the project outcomes related to the use of the model to document future operations of the I-395 Express Lanes project. The existing traffic volumes (including the links that do not meet the calibration criteria) produce calibrated travel times and bottleneck locations that are critical to the evaluation of the I-395 corridor; therefore, future forecasts and analysis would be accurate as well.

Table 2-2: AM and PM Peak Traffic Volume Calibration Summary

Simulated Measure	Volume Group	Calibration Thresholds	AM Peak			PM Peak		
			% Links Meeting Threshold	Total Links	Links Meeting Thresholds	% Links Meeting Threshold	Total Links	Links Meeting Thresholds
Simulated Traffic Volume (vph) for the top 85% of the network links based on link traffic volumes	1	Within ± 20% for < 100 vph	55%	71	39	69%	58	40
	2	Within ± 15% for ≥ 100 vph to < 300 vph	82%	92	75	78%	91	71
	3	Within ± 10% for ≥ 300 vph to < 1,000 vph	90%	163	147	88%	158	139
	4	Within ± 5% for ≥ 1,000 vph	86%	101	87	85%	120	102

Table 2-3: AM and PM Peak Travel Time Calibration Summary

Simulated Measure	Calibration Thresholds	% Segments Meeting Calibration Thresholds			
		AM – GP (%)	AM – HOV (%)	PM – GP (%)	PM – HOV (%)
Simulated Travel Time (seconds) for the entire I-395 corridor along both the general purpose and HOV/HOT lanes	Within ± 20% of observed travel times	100%	100%	100%	100%
Simulated Travel Time (seconds) for 85% of the segments between interchanges along the general purpose and HOV/HOT lanes		93%	100%	93%	100%

2.2.5 Measures of Effectiveness

Measures of effectiveness (MOEs) from the VISSIM outputs were used to document operations for existing conditions, no build conditions (2020 and 2040), and build conditions (2020 and 2040). The following is a summary of the MOEs documented for each scenario.

- Freeways performance measures including segments, merges, diverges and weaves
  - Average speed (MPH) for each lane and an average of all lanes
  - Average density (vehicles per mile per lane) for each lane and an average of all lanes
  - Volumes (vehicles per hour) for each lane and an total of all lanes
  - Travel times by facility for northbound and southbound I-395 general purpose and HOV/HOT lanes

  - Congestion heat maps depicting speeds (MPH) by time interval to document the duration of congested periods
- Arterials and intersections
  - Microsimulation delay for overall intersection (seconds / vehicle)
  - Microsimulation delay by intersection approach (seconds / vehicle)
  - Microsimulation delay by intersection movement (seconds / vehicle)
  - Maximum queue length by movement (feet)

Operational conditions for the I-395 freeway facility and arterial intersections were color-coded to reflect various congestion levels based on density and delay thresholds established in the Highway Capacity Manual 2010. **Tables 2-4 and 2-5** summarize the thresholds for freeways segments, signalized intersections, and unsignalized intersections. In accordance with the TOSAM, level of service (LOS) was not used as a measure of effectiveness.

Table 2-4: Freeway Measures of Effectiveness

Congestion Level	Freeways
	Average Density (veh/mi/ln)
Light Traffic	≤ 26
Moderate Traffic	>26 - 35
Heavy Congestion	>35 - 45
Severe Congestion	>45

Table 2-5: Intersection Measures of Effectiveness

Congestion Level	Intersections	
	Signalized	Unsignalized
	Average Delay (sec/veh)	Average Delay (sec/veh)
Light Traffic	>20 - 35	>15 - 25
Moderate Traffic	>35 - 55	>25 - 35
Heavy Congestion	>55 - 80	>35 - 50
Severe Congestion	>80	>50

2.3 SAFETY ANALYSIS METHODOLOGY

Crash data along northbound and southbound I-395 from approximately 0.45 mile south of Edsall Road to the 14th Street Bridges across the Potomac River was reviewed for a four-year period from January 1, 2012 through December 31, 2015. Crash data was obtained from the VDOT Tableau-Crash Analysis Tool (T-CAT). The crash data includes crashes that were reported in the general purpose and HOV/HOT lanes as

well as the ramps serving I-395. Using the latitude and longitude information from each crash, the crash data was converted to a shapefile to geospatially depict the location of each crash.

2.3.1 Qualitative Analysis

The crash data was summarized for both I-395 mainline general purpose and HOV lanes and ramps and arterials intersecting I-395. Crash data was summarized in both tabular format and on maps depicting crash characteristic including crash type and crash severity. High crash locations were identified based on both crash frequency and crash rate. The crash rates along I-395 were compared to statewide and regional crash rates. Based on a review of the crash data frequency and rates, a qualitative assessment was performed to document the safety impacts of the Build Alternative including the conversion of the two reversible HOV lanes to three HOT lanes and the proposed changes to access at the Eads Street interchange.

2.3.2 Quantitative Analysis

The quantitative safety analysis focused on the review of available crash modification factors (CMFs) and their application to the conversion of the two reversible HOV lanes to three HOT lanes and the proposed changes to access at the Eads Street interchange. Additionally, relevant CMFs (e.g., reduced shoulder width) were reviewed to assess the safety impacts associated with the reduction of the shoulder widths due to the conversion of the two reversible HOV lanes to three HOT lanes. Alternative treatment strategies were identified to mitigate any predicted increases in crashes associated with the build alternative. These strategies are further documented in the design exceptions and design waivers.

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3. EXISTING CONDITIONS

3.1 DEMOGRAPHICS

I-395 is the primary north-south interstate into Washington, D.C. from Virginia serving local, commuter, and regional traffic. This corridor provides an important link between Washington, D.C. and Virginia and passes through three localities: Fairfax County, the City of Alexandria, and Arlington County and then enters Washington, D.C. north of the project limits. For the purposes of quantifying population, the study area was defined as approximately 600 feet to either side of the I-395 corridor from Turkeycock Run in Fairfax County to the vicinity of Eads Street near the Pentagon in Arlington County. Population data was collected from the US Census Bureau. All Census block groups fully or partially within the study area were included in the study area population. This population is compared to the population for the localities as a whole in **Table 3-1**.

Table 3-1: Population for the Study Area and Localities

Locality	Study Area Population	Locality Total Population	Percentage of Population within Study Area
Fairfax	6,963	1,117,072	1%
Alexandria	39,123	146,422	27%
Arlington	27,164	220,173	12%
Study Area Total	73,250	1,483,667	5%

Source: U.S. Census Bureau, ACS 2010-2014, Population Totals, B01003.

The population totals for portions of the study area within each locality range from approximately 7,000 in Fairfax to 39,000 people in Alexandria. This population accounts for five percent of the total population of the localities. Alexandria and Arlington have a larger percentage of residents living within the study area (27% and 12%). Fairfax is the only locality to have a smaller percentage of residents living within the study area (1%), than the total of the study area population and locality totals.

3.2 EXISTING LAND USE

The land surrounding I-395 in the study area is comprised mainly of highly developed urban areas and communities interspersed with parks and recreational uses. Development in the study area primarily consists of commercial, industrial, governmental, and residential properties ranging from dense apartment complexes to single family homes.

Approximately 1,121 acres make up the study area. Of those acres, approximately 82 acres (or 7.3%) are classified as "forested or undeveloped" for recreational use in parks or land being preserved through easements. Of the remaining acres, approximately 44.2% of the study area is used for transportation facilities (including the I-395 roadway and ramps and the local roadways), 32.4% of the study area is used for residential development, 8.9% for commercial development, 4.6% for institutional development, 1.4% for industrial development, and 1.2% for other uses including city-owned, open, vacant, or other public land. **Figure 3-1** (*Volume 2*) shows the land uses within the study area.

3.3 EXISTING ROADWAY NETWORK

3.3.1 I-395 Corridor

The I-395 corridor begins at the I-95 / I-495 Capital Beltway Interchange and ends at the New York Avenue NW (Route 50) intersection in northwest Washington, D.C., an approximate distance of 14 miles. I-395 is part of the National Highway System (NHS)[1] and the Strategic Highway Network (STRAHNET)[2]. Additionally, I-395 is the primary north-south interstate highway into Washington, D.C. from Virginia serving both local, commuter, and regional traffic.

I-395 within the study limits generally includes three or four northbound and southbound general purpose lanes and auxiliary lanes between interchanges and two reversible HOV lanes between the northbound and southbound general purpose lanes that extend to south of the Eads Street Interchange. South of the Eads Street Interchange, the HOV lanes transition to barrier-separated lanes that operate in both the northbound and southbound directions and continue into Washington, D.C. **Figure 3-2** (*Volume 2*) depicts the existing I-395 speed limits and number of travel lanes along the study corridor including auxiliary lanes and collector-distributor roadways. **Figure 3-3** (*Volume 2*) depicts the number of lanes on both the general purpose and HOV facilities throughout the I-395 corridor under existing conditions.

- **South of Edsall Road:** Northbound I-395 includes three general purpose lanes and an auxiliary lane between I-495 and Edsall Road. Southbound I-395 includes three through lanes and two auxiliary lanes between Edsall Road and I-495. The two rightmost southbound travel lanes exit to northbound I-495. Three barrier-separated reversible Express Lanes are located between the northbound and southbound general purpose lanes.
- **Edsall Road to Turkeycock Run:** Northbound I-395 includes three general purpose lanes and an auxiliary lane between Turkeycock Run and Edsall Road. Southbound I-395 includes three general purpose lanes and an auxiliary lane between Turkeycock Run and Edsall Road. Three barrier-separated reversible Express Lanes are located between the northbound and southbound general purpose lanes.
- **Turkeycock Run to Duke Street / Little River Turnpike (Route 236):** Northbound I-395 includes three general purpose lanes and an auxiliary lane between Turkeycock Run and Duke Street / Little River Turnpike. Southbound I-395 includes three general purpose lanes. Two barrier-separated reversible HOV lanes are located between the northbound and southbound general purpose lanes.
- **Duke Street / Little River Turnpike (Route 236) to Seminary Road (Route 420):** Northbound I-395 includes three general purpose lanes and an auxiliary lane between Duke Street / Little River Turnpike and Seminary Road. Southbound I-395 includes four general purpose lanes. Two barrier-separated reversible HOV Lanes are located between the northbound and southbound general purpose lanes.

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[1] NHS consists of major roadways important to the nation's economy, defense, and mobility. The NHS includes the interstate highway system as well as other roads connecting to major ports, airports, public transportation facilities, or other intermodal transportation services (http://www.fhwa.dot.gov/planning/national_highway_system/).

[2] STRAHNET is a system of highways important to the United States' strategic defense policy providing defense access, continuity and emergency capabilities for defense purposes (http://www.fhwa.dot.gov/planning/national_highway_system/).

- **Seminary Road (Route 420) to King Street (Route 7):** Northbound I-395 includes three general purpose lanes and an auxiliary lane between Seminary Road and King Street. Southbound I-395 includes four southbound general purpose lanes and an auxiliary lane between King Street and Seminary Road. Two barrier-separated reversible HOV lanes are located between the northbound and southbound general purpose lanes.
- **King Street (Route 7) to Quaker Lane / Shirlington Road (Route 402):** Northbound I-395 includes four general purpose lanes with the fourth lane added from the King Street Interchange. Southbound I-395 includes four southbound general purpose lanes and an auxiliary lane between Shirlington Road and King Street. Two barrier-separated reversible HOV lanes are located between the northbound and southbound general purpose lanes.
- **Quaker Lane / Shirlington Road (Route 402) to Glebe Road (Route 120):** Northbound I-395 includes four general purpose lanes and an auxiliary lane between Quaker Lane/ Shirlington Road and Glebe Road. Southbound I-395 includes three general purpose lanes and a barrier-separated, two-lane collector-distributor roadway. Two barrier-separated reversible HOV lanes are located between the northbound and southbound general purpose lanes.
- **Glebe Road (Route 120) to Washington Boulevard (Route 27):** Northbound I-395 includes four general purpose lanes with the rightmost lane exiting onto the second Washington Boulevard ramp. Southbound I-395 includes three general purpose lanes and an auxiliary lane between Washington Boulevard and Glebe Road. Two barrier-separated reversible HOV lanes are located between the northbound and southbound general purpose lanes.
- **Washington Boulevard (Route 27) to Eads Street:** Northbound and southbound I-395 each include three general purpose lanes. Two barrier-separated reversible HOV lanes are located between the northbound and southbound general purpose lanes. Collector-distributor roadways with a varying number of lanes are located on the east and west sides of the general purpose lanes serving the Washington Boulevard Interchange, Army Navy Drive, and Arlington Ridge Road.
- **Eads Street to Jefferson Davis Highway (US Route 1):** Northbound I-395 includes three general purpose lanes. Southbound I-395 includes three general purpose lanes and an auxiliary lane that exits to the collector-distributor road serving Washington Boulevard. Four barrier-separated HOV lanes are located between the northbound and southbound purpose lanes, with two lanes serving each of the northbound and southbound directions.
- **Jefferson Davis Highway (US Route 1) to Boundary Channel Drive:** Northbound I-395 includes three general purpose lanes and an auxiliary lane that is reduced just north of the Boundary Channel Drive Interchange. Southbound I-395 includes four general purpose lanes, an auxiliary lane on the left-hand side of the roadway between the ramp from the HOV lanes and Jefferson Davis Highway, and an auxiliary lane on the right-hand side of the roadway between Boundary Channel Drive and the Jefferson Davis Highway ramps. Four barrier-separated HOV lanes are located between the northbound and southbound general purpose lanes, with two lanes serving each of the northbound and southbound directions.
- **Boundary Channel Drive to George Washington Memorial Parkway:** Northbound I-395 includes three general purpose lanes. Southbound I-395 includes three general purpose lanes and an auxiliary lane between George Washington Memorial Parkway and Boundary Channel Drive. Four barrier-separated HOV lanes are located between the northbound and southbound general purpose lanes, with two lanes serving each of the northbound and southbound directions.
- **George Washington Memorial Parkway to 14th Street SW:** This segment of I-395 includes three northbound general purpose lanes and three southbound general purpose lanes with auxiliary lanes on both northbound and southbound I-395. Four barrier-separated HOV lanes are located between

the northbound and southbound general purpose lanes, with two lanes serving each of the northbound and southbound directions.

- **North of 14th Street SW:** Northbound I-395 includes three general purpose lanes with one auxiliary lane between the ramp from Buckeye Drive and the 12th Street Expressway ramp. Southbound I-395 includes three general purpose lanes and one auxiliary lane.

The posted speed limit for the entire northbound I-395 general purpose lanes corridor is 55 MPH. The posted speed limit for the southbound I-395 general purpose lanes is 40 MPH north of the Potomac River and increases to 45 MPH at the George Washington Memorial Parkway Interchange. The southbound general purpose lanes speed limit then increases to 55 MPH south of the Boundary Channel Drive Interchange and continues through the southern study limits. The posted speed limits for the northbound HOT/HOV lanes are 65 MPH between the southern study limits and Washington Boulevard, 55 MPH between Washington Boulevard and 14th Street SW, and 45 MPH between 14th Street SW and the merge with the general purpose lanes. The posted speed limits for the southbound HOT/HOV lanes are 40 MPH between the diverge from general purpose lanes and 14th Street SW, 45 MPH between 14th Street SW and Eads Street, 55 MPH between Eads Street and Washington Boulevard, and 65 MPH between Washington Boulevard and the southern study limits.

3.3.2 HOV Operations and Access Points

The two-lane reversible, barrier-separated HOV lanes extend from the Turkeycock Run Interchange to south of Eads Street. South of Eads Street, the HOV lanes transition to barrier-separated lanes that operate in both the northbound and southbound directions and continue into Washington, D.C. to approximately 0.2-miles north of 14th Street SW where the lanes merge with the general purpose lanes. Although referred to as "HOV lanes" throughout this document, north of Eads Street and entering Washington, D.C., the barrier-separated lanes are not enforced as HOV lanes although in some locations the entry points and exit points are signed or marked as HOV lanes. South of Turkeycock Run, the HOV lanes transition to three-lane reversible Express Lanes that continue along I-395 to the I-95 Express Lanes extending to the Garrisonville Road (Route 610) Interchange in Stafford County.

Table 3-2 summarizes the operation of the reversible HOV lanes. In the two-lane reversible section, the HOV lanes operate in the northbound direction between 2:30 AM and 11:00 AM with HOV-3 restrictions in effect from 6:00 AM to 9:00 AM. The HOV lanes operate in the southbound direction from 1:00 PM to 12:00 AM with HOV-3 restrictions in effect from 3:30 PM to 6:00 PM. The following vehicle types are permitted in the lanes during the restricted periods:

- HOV-3
- Buses
- Motorcycles
- Hybrid vehicles (with clean fuel plates issued before July 1, 2006)
- Emergency vehicles
- Trucks (with 3 or more people)

Table 3-2: HOV Lane Operations

Time Period	Travel Direction	HOV Lane Operation
12 AM – 2:30 AM	Closed	
2:30 AM – 6 AM	Northbound	All Vehicles Permitted
6 AM – 9 AM		HOV-3 Only
9 AM – 11 AM		All Vehicles Permitted
11 AM – 1 PM	Closed	
1 PM – 3:30 PM	Southbound	All Vehicles Permitted
3:30 PM – 6 PM		HOV-3 Only
6 PM – 12 AM		All Vehicles Permitted

During periods when the HOV-3 restrictions are not in effect, all vehicles are permitted in the HOV lanes. Between approximately 11 AM and 1 PM and between 12 AM and 2:30 AM the HOV lanes are closed to accommodate the safe reversal of the travel direction. During the summer months, the midday closure of the reversible HOV lanes to reverse the lanes from northbound to southbound travel occurs one hour earlier, beginning at 10:00 AM to accommodate higher traffic demands in both the general purpose, HOV, and Express Lanes. Nighttime closures remain the same during the summer months.

Table 3-3 summarizes the existing access points to and from the HOV lanes including their operation during the AM and PM periods when the HOV lanes are open.

Table 3-3: HOV Lane Access Points

Access Point		Operation
Turkeycock Run (north of Edsall Road)		AM: NB access to and from HOV lanes PM: SB access to and from HOV lanes
Seminary Road – South Facing Ramp		AM: NB access from HOV lanes PM: SB access to HOV lanes (HOV at all times)
Seminary Road – North Facing Ramp		AM: NB access to HOV lanes PM: SB access from HOV lanes
Shirlington Road – North Facing Ramp		AM: NB access to HOV lanes PM: SB access from HOV lanes
Washington Boulevard – South Facing Ramp		AM: NB access from HOV lanes PM: SB access to HOV lanes
Eads Street Interchange	Ramp from SB HOV Lanes to SB GP Lanes (south of Eads Street)	AM & PM: SB access from HOV lanes
	Eads Street – NB Off Ramp from HOV	AM: NB access from HOV lanes PM: Closed
	Eads Street – SB On Ramp to HOV	AM & PM: SB access to HOV lanes (HOV restriction not enforced)
	Eads Street – NB On Ramp to HOV	AM & PM: NB access to HOV lanes (HOV restriction not enforced)
	Eads Street – SB Off Ramp from HOV	AM & PM: SB access from HOV lanes
NB Ramp from GP Lanes to HOV Lanes north of Eads Street		AM & PM: NB access to HOV lanes (HOV restriction not enforced)
SB Ramp from HOV Lanes to GP Lanes near Boundary Channel Drive		AM & PM: SB access to GP lanes

3.3.3 Ramp Metering

Ramp meters are provided at several entrance ramps along the I-395 general purpose lanes as shown in **Table 3-4** to regulate traffic entering the corridor. The ramp meters are activated in the peak travel direction only. During the morning peak period, the northbound ramp meters operate from 6:30 AM to 9:00 AM. During the evening peak period, the ramp meters operate from 3:30 PM to 6:30 PM. The cycle length for the metering signals is 4 seconds (2-second red and 2-second green).

Table 3-4: Ramp Meter Locations

Ramp Location		Number of Ramp Lanes
I-395 NB General Purpose	EB / WB Edsall Rd	2
	Little River Tnpk / Duke St	2
	EB / WB Seminary Rd	2
	EB King St	1
	WB King Street	2
	NB Quaker Lane	2
	EB Glebe Rd	1
	WB Glebe Rd	1
	NB Jefferson Davis Hwy	2
	EB / WB Boundary Channel Dr	1
I-395 SB General Purpose	SB Shirlington Rd	2
	WB King St	1
	EB King St	1
	EB / WB Seminary Rd	2
	WB Duke St	1
	EB Little River Tnpk	1
	WB Edsall Rd	1

3.4 ALTERNATIVE TRAVEL MODES: TRANSIT AND COMMUTER FACILITIES

The I-395 corridor is a heavily traveled commuter route with a high percentage of transit and HOV usage. The corridor provides direct access to the Pentagon Transit Center (PTC) which is a regional transit and commuter hub serving the Metrorail's Yellow and Blue lines, regional and local commuter buses, formal ridesharing, and informal ridesharing (also known as slugging). The PTC accommodates eight transit bus service providers, 27 bus lines, nearly 850 bus trips per day and approximately 160 bus trips in the AM and PM peak hours. Over 19,000 bus passengers travel through the PTC daily from 6 AM to 9 AM and from 3 PM to 6 PM with over 5,600 peak period passengers using the Pentagon Metrorail Station (WHS, 2015).

Table 3-5 summarizes existing bus routes that travel along the I-395 by the four transit agencies providing services along the corridor including Alexandria Transit Company (DASH), Fairfax Connector, Potomac and Rappahannock Transportation Commission (PRTC), Washington Metropolitan Area Transit Authority (WMATA). With the exception of a small portion of the transit lines that provide service to arterials that do not have access to the HOV lanes, these transit routes travel along the HOV lanes in the peak direction (i.e., northbound in the AM peak period and southbound in the PM peak period) and in the general purpose lanes in the off-peak direction.

Table 3-5: Existing Transit Service along I-395

Route Number/Name	Mode	Days of Service	Frequency (minutes)		Average Daily Ridership	
			Peak	Off Peak	Peak	Off Peak
Alexandria Transit Company (DASH)						
AT 3	Local	Weekdays	20	n/a	841	
AT 4	Local	Weekdays	20	n/a	872	
Fairfax Connector						
306	Local	Weekdays	n/a	60	78	118
393	Commuter	Weekdays	40	n/a	85	2
394	Commuter	Weekdays	40	n/a	162	9
395	Commuter	Weekdays	10 - 30	n/a	508	16
Potomac and Rappahannock Transportation Commission (PRTC)						
Capitol Hill	Commuter	Weekdays	1 trip	n/a	32	n/a
Dale City - Washington	Commuter	Weekdays	10	1 am/ 1 pm	1,501	23
Dale City - Crystal City	Commuter	Weekdays	25	n/a	380	n/a
Dale City - Navy Yard	Commuter	Weekdays	20	3 pm	427	81
Dale City - Lake Ridge	Commuter	Weekdays	n/a	20	n/a	48
Dale City - Lake Ridge Shuttle	Local Commuter	Weekdays	n/a	20	n/a	16
Lake Ridge - Washington	Commuter	Weekdays	15	n/a	668	n/a
Lake Ridge - Crystal City	Commuter	Weekdays	20	3 pm	340	57
Montclair - Washington	Commuter	Weekdays	25	3 pm	572	73
Montclair - Pentagon	Commuter	Weekdays	20	n/a	452	n/a
Rosslyn/Ballston	Commuter	Weekdays	45	n/a	279	n/a
South Route 1	Commuter	Weekdays	45	n/a	249	n/a
Washington Metropolitan Area Transit Authority (WMATA)						
7A	Local	Daily	0:15	0:40	476	794
7C	Local	Weekday	0:20	-	362	9
7F	Local	Wkdy, Sat	0:48	0:40	232	582
7M	Local	Weekday	0:10	0:15	938	797
7P	Local	Weekday	0:20	-	63	0
7W	Local	Weekday	0:05	0:25	647	0
7X	Local	Weekday	0:12	-	363	0
7Y	Local	Weekday	0:08	-	1,423	17
8S	Local	Weekday	0:30	-	25	0
8W	Local	Weekday	0:15	-	504	24
8Z	Local	Weekday	0:12		614	96
17A	Local	Weekday	1:00	1:05	67	65
17B	Local	Weekday	0:40	1:00	17	36
17F	Local	Weekday	0:30	-	37	0
17G	Express	Weekday	0:15	-	315	37

Route Number/Name	Mode	Days of Service	Frequency (minutes)		Average Daily Ridership	
			Peak	Off Peak	Peak	Off Peak
17H	Express	Weekday	0:18	-	323	62
17K	Express	Weekday	0:15	-	296	0
17L	Express	Weekday	0:15	-	154	26
17M	Local	Weekday	0:25	-	209	0
18E	Local	Weekday	0:30	-	153	0
18F	Local	Weekday	0:30	-	54	0
18G	Local	Weekday	0:20	-	293	33
18H	Local	Weekday	0:30	-	276	27
18J	Local	Weekday	0:35	-	19	0
18P	Local	Weekday	0:35	-	478	62
21A	Local	Weekday	0:17	-	310	27
21D	Local	Weekday	0:18		150	0
22A	Local	Daily	-	0:30	38	405
22C	Local	Weekday	0:20	-	856	107
22F	Local	Weekday	0:21	0:30	374	41
28F	Local	Weekday	0:30	-	138	12
28G	Local	Weekday	0:20	-	408	31
29C	Local	Weekday	0:30	-	157	5
29G	Local	Weekday	0:15	-	797	161
29W	Express	Weekday	0:30	-	222	29

Source: I-95/I-395 Transit/Transportation Demand Management (TDM) Plan

An important component of travel in the I-395 corridor is the informal ridesharing referred to as "slugging." Slugging is a form of carpooling from designated pickup and drop off points located in close proximity to the HOV facility. The incentive to the driver and the passenger is ability to the use the HOV facility. Because of the proximity of the Pentagon Reservation and the PTC to the I-395 corridor, it functions as a regional transit hub providing a linkage for commuters. Designated drop-off / pick-up locations are provided for eight origins / destinations:

- Burke / Springfield
- Horner Road / Potomac Mills
- Montclair / Route 234
- Rt. 17 Stafford
- Rt. 3 Fredericksburg Gordan Road
- Rt. 610 Mine Road
- Rt. 610 Stafford
- Tackett's Mill / Lorton / Virginia Railway Express (VRE)

In 2010, when a survey was conducted as part of data collection efforts for the preparation of the Pentagon Transportation Management Plan, approximately 2,455 riders were picked up at the designated locations during the PM peak period from 3 PM to 6 PM carried by 1,240 vehicles (see **Table 3-6**) (WHS, 2015).

Table 3-6: Informal Rideshare/Slugging Demand Survey

Location	Vehicles	Passengers
Burke / Springfield	130	275
Horner Road / Potomac Mills	315	600
Montclair / Route 234	245	480
Rt. 17 Stafford	95	195
Rt. 3 Fredericksburg Gordan Road	45	90
Rt. 610 Mine Road	130	250
Rt. 610 Stafford	165	320
Tackett's Mill / Lorton / VRE	115	245
Total	**1,240**	**2,455**

Source: Pentagon Transportation Master Plan, Table 2-1

3.5 INTERCHANGES

Within the study area, there are thirteen grade-separated interchanges that provide direct access to I-395, some of which are restricted to HOV use only during peak travel periods (see **Figure 3-2**). Eight additional roadways intersect the I-395 corridor but do not provide direct access to the interstate. The following are descriptions of the roadways that interchange with I-395, presented from south to north.

3.5.1 Edsall Road (Route 648)

Edsall Road (Route 648) is oriented in an east-west direction and is a four-lane divided roadway classified as a Minor Arterial. Its interchange with I-395 is located approximately 0.9 miles north of I-495 (Capital Beltway) and consists of a partial cloverleaf interchange with a single directional flyover ramp serving the eastbound Edsall Road to northbound I-395 movement. Edsall Road also provides access to northbound I-395 via a ramp originating from the traffic signal controlled intersection of Edsall Road and Bren Mar Drive. The remaining ramps at this interchange are free flow movements. The posted speed limit on Edsall Road is 35 MPH in the vicinity of I-395.

3.5.2 Turkeycock Run

Turkeycock Run is an interchange between the I-395 HOT, HOV, and I-395 general purpose lanes, is located approximately 0.9 miles north of the Edsall Road Interchange, and is the transition point between the three reversible HOT lanes south of Turkeycock Run and the two reversible HOV lanes north of Turkeycock Run. The interchange consists of single-lane directional ramps and flyovers to move vehicular traffic between the HOV/HOT lanes and general purpose lanes along I-395. The two northbound ramps are open to traffic during periods when the HOV/HOT lanes are operating in the northbound direction and the two southbound ramps are open to traffic during periods when the HOV/HOT lanes are operating in the southbound direction. The interchange does not provide access to other roadways.

3.5.3 Little River Turnpike/ Duke Street (Route 236)

Little River Turnpike / Duke Street (Route 236) is oriented in an east-west direction and is a four-lane divided roadway classified as an Other Principal Arterial. Its interchange with I-395 is located approximately 0.7 miles north of the Turkeycock Run Interchange and consists of a partial cloverleaf

interchange with a single directional flyover ramp serving eastbound Little River Turnpike to northbound I-395. All ramps at this interchange are free flow movements. The posted speed limit on Little River Turnpike / Duke Street is 35 MPH in the vicinity of I-395.

3.5.4 Seminary Road (Route 420)

Seminary Road (Route 420) is oriented in a northwest-southeast direction and is a four-lane divided roadway classified as a Minor Arterial. Its interchange with I-395 is located approximately 1.7 miles north of the Little River Turnpike / Duke Street Interchange and consists of a three-level interchange in a rotary arrangement. The second level of the interchange provides full access to and from the northbound and southbound general purpose lanes at four signalized intersections to distribute traffic to and from Seminary Road. In addition, the second level of the interchange accommodates traffic to and from the I-395 HOV lanes to and from the north via a north-facing reversible ramp. The third level of the interchange accommodates through traffic on Seminary Road in addition to the reversible I-395 HOV south-facing ramp on the south side of Seminary Road which opened to traffic in January 2016. The HOV ramp intersects Seminary Road at a traffic signal and is designated as HOV-3 at all times of the day. The posted speed limit on Seminary Road is 35 MPH in the vicinity of I-395.

3.5.5 King Street (Route 7)

King Street (Route 7) is oriented in a northwest-southeast direction and is a four-lane divided roadway classified as an Other Principal Arterial. Its interchange with I-395 is located approximately 0.9 miles north of the Seminary Road Interchange and consists of a partial cloverleaf interchange with a single directional flyover ramp serving the eastbound King Street to northbound I-395 movement and a single directional flyover ramp serving the westbound King Street to southbound I-395 movement. All ramps at this interchange are free flow movements. The posted speed limit on King Street is 35 MPH in the vicinity of I-395.

3.5.6 Quaker Lane/ Shirlington Road (Route 402)

Quaker Lane / Shirlington Road (Route 402) is oriented in a north-south direction and is a four-lane divided roadway classified as a Minor Arterial. Its interchange with I-395 is located approximately 0.8 miles north of the King Street Interchange and consists of a rotary interchange with all ramps at this interchange being free flow movements, except for southbound I-395 to Shirlington Road, which is controlled at a traffic signal. A north-facing ramp serving the HOV lanes is located at the north side of the rotary and provides access to and from the HOV lanes. The posted speed limit on Quaker Lane / Shirlington Road is 30 MPH in the vicinity of I-395.

3.5.7 Glebe Road (Route 120)

Glebe Road (Route 120) is oriented in a northwest-southeast direction and is a four-lane divided roadway classified as an Other Principal Arterial. Its interchange with I-395 is located approximately 0.5 miles north of the Quaker Lane/ Shirlington Road Interchange and consists of a partial cloverleaf interchange. The ramp from northbound I-395 to eastbound Glebe Road is signal controlled as well as the ramp from southbound I-395 to Glebe Road. All other ramps and loop ramps are free flow movements. Southbound general purpose traffic traveling to the Quaker Lane/ Shirlington Road Interchange exit at the Glebe Road interchange and

travel on a collector-distributor road between the two interchanges. The posted speed limit on Glebe Road is 35 MPH in the vicinity of I-395.

3.5.8 Washington Boulevard (Route 27)

Washington Boulevard (Route 27) is oriented in an east-west direction in the vicinity of I-395 and is a four-lane divided roadway classified as an Other Freeway or Expressway. Its interchange with I-395 is located approximately 1.5 miles north of the Glebe Road Interchange and consists of a directional ramp interchange with free flow ramp movements to and from I-395 and Washington Boulevard with collector-distributor roadways along both northbound and southbound I-395. The interchange and series of collector-distributor roadways also provide access to Army Navy Drive, South Rotary Road and Arlington Ridge Road. A north-facing reversible HOV ramp provide access to and from the north on Washington Boulevard. The posted speed limit on Washington Boulevard is 45 MPH in the vicinity of I-395.

3.5.9 Eads Street

Eads Street is oriented in a north-south direction and is a two-lane divided roadway classified as a Major Collector. Its interchange with the I-395 HOV lanes is located approximately 0.6 miles north of the Washington Boulevard Interchange and consists of a diamond interchange. The posted speed limit on Eads Street is 25 MPH in the vicinity of I-395. For the purposes of this study, I-395 and the corresponding on and off-ramps are referred to as north-south roadways, Eads Street is referred to as a north-south roadway, and North and South Rotary Roads are referred to as east-west roadways. The following is a summary of the configuration of the key intersections and roadways in the vicinity of the I-395 at Eads Street Interchange:

- **Eads Street at Northbound I-395 HOV ramps:** The northbound I-395 HOV off-ramp is free-flow onto Eads Street for both left and right turns and includes a left-turn lane and a shared through/right-turn lane. Northbound and southbound through traffic along Eads Street is stop-controlled at the ramp junction and only buses are permitted to travel northbound through the intersection via signing.
- **Eads Street at Southbound I-395 HOV ramps:** The southbound I-395 HOV Off-Ramp is stop-controlled at Eads Street with Eads Street operating free flow at the ramp junction in both the northbound and southbound directions. Northbound Eads Street left turns onto the on-ramp to the southbound I-395 HOV lanes are not accommodated at the intersection. Southbound Eads Street right turns to the southbound HOV lanes are channelized and operate freely.
- **Eads Street at South Rotary Road:** Eads Street at South Rotary Road is an all-way stop-controlled intersection with S. Rotary Road operating one-way eastbound. Eastbound South Rotary Road has three eastbound lanes at the intersection including a shared left/through, shared through/right, and a right-turn lane. Northbound Eads Street consists of a through and shared through/right-turn lane. Southbound Eads Street consists of a shared left/through lane and a through lane. Pedestrians are not accommodated at this intersection and are directed to Fern Street to cross under I-395.
- **Eads Street at North Rotary Road:** Eads Street at North Rotary Road is an all-way stop-controlled intersection with North Rotary Road operating one-way westbound. Westbound North Rotary Road has two lanes at the intersection including a left-turn lane and a shared left/through lane. Northbound Eads Street consists of a left-turn lane and shared left/through lane to the Pentagon Transit Center. Southbound Eads Street from the Pentagon Transit Center consists of a

shared through/right-turn lane. Pedestrian crosswalks are provided on the north, east, and west legs of the intersection.

- **Eads Street at Army Navy Drive:** This signalized intersection operates with protected/permissive left-turn phasing on the eastbound Army Navy Drive approach and concurrent phasing on northbound and southbound Eads Street. The eastbound approach includes a shared left/through lane and a shared through/right lane. The northbound Eads Street approach includes a left turn lane and a shared through/right-turn lane and the southbound Eads Street approach includes a single shared left/through/right-turn lane.

3.5.10 Jefferson Davis Highway (US Route 1)

Jefferson Davis Highway (US Route 1) is oriented in a north-south direction and is a six-lane divided roadway classified as an Other Freeway or Expressway. Its interchange with I-395 is located approximately 0.2 miles north of the Eads Street Interchange and consists of a partial cloverleaf interchange with partial access between Jefferson Davis Highway and I-395. There is no access provided between the I-395 northbound general purpose lanes and Jefferson Davis Highway and no access provided between Jefferson Davis Highway and the I-395 southbound general purpose lanes. Access from the southbound general purpose lanes to southbound Jefferson Davis Highway is provided by a directional flyover ramp that exits on the left-hand side of southbound I-395 and enters on the left-hand side of southbound Jefferson Davis Highway. The posted speed limit on Jefferson Davis Highway is 45 MPH in the vicinity of I-395.

3.5.11 Boundary Channel Drive/ Long Bridge Drive

Boundary Channel Drive is oriented in an east-west direction and is a four-lane divided roadway classified as a Minor Collector. Long Bridge Drive has a north-south orientation and is a two-lane undivided roadway in the vicinity of Boundary Channel Drive and classified as a Major Collector. Its interchange with I-395 is located approximately 0.4 miles north of the Jefferson Davis Highway Interchange and consists of a full cloverleaf interchange. All ramps and loop ramps are free flow except the ramp from southbound I-395 to Boundary Channel Drive that intersects Boundary Channel Drive at an unsignalized intersection. The posted speed limit on Boundary Channel Drive / Long Bridge Drive is 25 MPH in the vicinity of I-395.

3.5.12 George Washington Memorial Parkway

George Washington Memorial Parkway is oriented in a north-south direction and is a four-lane divided roadway classified as an Other Freeway or Expressway north of I-395 and an Other Principal Arterial south of I-395. Its interchange with I-395 is located approximately 0.2 miles north of the Boundary Channel Drive/ Long Bridge Drive Interchange and consists of a partial cloverleaf interchange with a directional ramp from northbound I-395 to westbound George Washington Memorial Parkway located in the median of I-395. All ramps and loop ramps at this interchange are free flow movements. The posted speed limit on George Washington Memorial Parkway is 40 MPH in the vicinity of I-395.

3.5.13 14th Street SW

14th Street SW is oriented in a north-south direction and is a six-lane divided roadway. Its interchange with I-395 is located approximately 0.6 miles north of the George Washington Memorial Parkway Interchange just north of the Potomac River and consists of directional ramps serving both the general purpose and

HOV lanes to and from the south. Access to and from I-395 to the north is not provided from 14th Street SW.

3.6 EXISTING DATA

Detailed information on existing traffic volumes is included in **Chapter 6** and detailed information regarding existing traffic speeds is included in **Chapter 7**.

3.7 OPERATIONAL PERFORMANCE

3.7.1 Speeds

INRIX® speed data was obtained from the Regional Integrated Transportation Information System (RITIS) database for the I-395 corridor. RITIS provides mean speed data for individual roadway segments established by INRIX® (generally between ramp terminals). Speed data was obtained in 15-minute intervals for weekdays (Tuesday, Wednesdays and Thursdays) during September and October 2015 (excluding holidays) and averaged. Mean speeds for each segment were tabulated based upon location and time of day to generate speed contour plots. Speed contour plots for northbound and southbound I-395 general purpose and HOV/HOT lanes are shown in **Figures 3-4 through 3-7**. It should be noted that due to the severely over-capacity conditions, on a daily basis there are frequently high variations in the speeds and travel times experienced by motorists along the corridor, especially traveling in the peak direction of the general purpose lanes. The following is a review of the average speed data and a summary of locations with recurring congestion during a typical weekday.

Northbound I-395 General Purpose Lanes (see Figure 3-4): During the morning peak period, heavy congestion and low travel speeds occur beginning at approximately 6:15 AM in the southern portion of the study area near Edsall Road and extend through approximately 11:00 AM through the northern end of the study area. Congestion is most severe and speeds are lowest for the longest duration in the northern portion of the corridor between Washington Boulevard and approaching the Potomac River where there are increases in traffic volumes as motorists enter the corridor from Washington Boulevard, Route 1, and George Washington Memorial Parkway.

During the evening peak period, there is heavy congestion and low travel speeds between Washington Boulevard and the northern study limits due to downstream congestion in Washington, D.C. that limits the flow of traffic entering the City.

Southbound I-395 General Purpose Lanes (see Figure 3-5): During the evening peak period, heavy congestion and low travel speeds occur beginning at approximately 3:00 PM exiting Washington, D.C. to the George Washington Memorial Parkway. Moderate congestion occurs between George Washington Memorial Parkway and Washington Boulevard due to the reduction in southbound traffic volumes as traffic exits the corridor at George Washington Memorial Parkway, Route 1, and Washington Boulevard. Heavy congestion continues along southbound I-395 from Washington Boulevard to Turkeycock Run beginning at approximately 4:00 PM and extending beyond 7:00 PM in some areas. South of Turkeycock Run within the limits of the existing Express Lanes, travel speeds drop to approximately 40 to 45 MPH from 3:00 to 4:00 PM and from 6:15 PM to 7:15 PM; however, travel speeds generally operate near free-flow conditions south of Turkeycock Run.

During the morning peak period, travel speeds are reduced to less than 45 MPH north of the George Washington Memorial Parkway, but exceed 45 MPH along southbound I-395 throughout the remainder of the study limits.

Northbound I-395 HOV/HOT Lanes (see Figure 3-6): During the morning peak period, heavy congestion and low travel speeds occur beginning at approximately 7:00 AM at Washington Boulevard and continue into Washington, D.C. until approximately 10:15 AM. From approximately 9:05 to 9:45 AM, low travel speeds and congestion within the northbound HOV lanes extend to approximately King Street due to downstream congestion approaching and within Washington, D.C. that limits the capacity of the HOV lanes.

During the evening peak period, travel speeds less than 45 mph are experienced along the northbound HOV lanes from Boundary Channel Drive and entering the District due to the high traffic volumes entering from Eads Street and the ramp from the general purpose lanes to the HOV lanes located north of Eads Street.

Southbound I-395 HOV/HOT Lanes (see Figure 3-7): During the evening peak period, travel speeds drop to approximately 45 to 50 MPH between 5:00 and 6:00 PM and 20 to 35 MPH between 6:00 and 7:15 PM along the southbound HOV lanes in the vicinity of the Eads Street on-ramp and the ramp from the HOV lanes to the general purpose lanes approaching Washington Boulevard.

Figure 3-4: Northbound I-395 General Purpose Lane Speeds

	I-495		Turkeycock Run			Seminary Rd		King St			Shirlington Rd	Glebe Rd			Washington Blvd					Boundary Channel Dr				Potomac River		14th St			12th St	
2:30	59	58	57	58	57	57	58	59	59	59	57	56	56	54	55	55	55	52	51	50	48	49	46	44	44	45	45	46		
2:45	59	58	57	58	56	57	59	58	61	61	59	56	57	54	56	54	54	52	51	51	49	49	47	45	45	45	45	46		
3:00	58	59	57	58	56	58	60	60	60	59	58	56	56	56	56	57	56	55	53	52	51	51	49	46	45	45	45	48		
3:15	60	60	58	58	56	57	59	60	60	60	58	57	58	56	56	56	56	54	53	52	50	51	47	45	43	44	43	44		
3:30	61	60	60	61	59	59	62	62	61	61	57	56	58	57	57	57	57	55	54	52	51	51	49	46	47	47	47	47		
3:45	61	62	60	61	60	58	62	62	62	63	60	58	60	58	57	58	57	55	53	52	51	51	48	45	45	47	46	47		
4:00	61	61	61	61	60	60	62	62	62	63	60	58	59	58	58	60	58	57	55	54	52	52	49	46	46	47	46	47		
4:15	62	62	62	63	60	60	62	61	60	62	59	58	59	58	57	58	57	58	55	53	52	53	49	47	46	48	47	48		
4:30	63	64	63	64	63	61	64	64	63	64	62	60	61	59	59	59	58	57	55	53	52	52	50	48	46	48	47	49		
4:45	63	64	64	65	62	61	64	65	65	65	63	61	62	60	61	60	60	58	56	55	54	52	50	48	47	49	48	49		
5:00	63	63	64	65	63	63	65	65	64	65	62	61	62	60	60	59	58	58	56	55	53	52	50	47	47	49	48	49	Seeding 5 - 6 AM	
5:15	62	62	62	63	62	62	65	65	64	65	63	60	61	60	60	59	58	57	55	54	52	52	50	47	46	48	47	48		
5:30	59	59	58	58	58	60	62	63	62	63	61	60	62	61	60	58	57	57	55	53	51	51	49	45	45	46	46	47		
5:45	57	55	55	57	55	56	59	60	60	61	59	57	60	58	58	56	56	54	52	51	49	50	48	44	44	45	43	44		
6:00	55	54	53	51	50	52	55	57	59	60	59	58	59	58	58	57	57	54	51	51	48	45	45	43	42	43	42	44		
6:15	51	44	39	37	38	46	50	53	55	55	56	54	56	55	56	54	51	48	41	39	36	35	39	38	38	37	37	39		
6:30	46	33	28	29	33	40	43	47	51	52	52	52	54	54	53	45	39	34	27	25	25	26	30	31	30	30	32	36		
6:45	42	27	25	25	29	33	34	38	47	48	51	51	51	52	43	32	29	25	20	20	21	24	25	28	28	28	30	36		
7:00	40	25	23	23	27	32	33	35	44	46	47	46	47	47	34	25	22	19	17	19	21	25	25	29	28	29	31	35	Peak Hour 7 - 8 AM	
7:15	37	23	21	22	25	27	28	32	37	38	36	35	36	43	31	22	21	19	19	20	22	26	26	30	30	30	31	34		
7:30	37	21	19	20	22	23	23	26	30	30	28	30	34	41	27	20	18	18	17	18	19	23	24	28	29	30	31	33		
7:45	31	20	19	20	22	23	23	25	28	28	26	29	33	36	23	20	17	17	17	18	20	23	25	28	29	29	31	35		
8:00	31	22	20	20	20	22	23	24	25	26	23	26	27	31	20	18	16	14	16	17	19	23	24	28	28	28	31	35		
8:15	32	25	20	19	19	20	21	23	25	25	22	23	24	28	18	20	18	16	17	18	19	23	24	27	27	29	31	35		
8:30	33	27	22	19	19	21	22	24	25	26	24	24	25	26	16	18	15	15	16	17	19	20	22	25	25	26	29	32	Peak Period 6 - 10 AM	
8:45	39	33	27	24	23	24	24	25	27	27	24	24	24	22	13	16	15	15	17	17	18	20	22	24	24	25	27	30		
9:00	45	46	41	35	29	32	32	31	30	30	25	24	24	23	14	18	16	16	17	17	18	19	20	23	22	23	25	29		
9:15	50	52	51	49	42	43	42	40	39	38	33	30	29	27	15	19	18	17	18	18	18	20	21	23	23	24	26	29		
9:30	50	52	54	50	48	49	50	47	47	47	44	41	38	36	17	19	18	18	19	20	19	19	21	25	24	26	27	31		
9:45	54	55	53	48	47	50	52	49	50	51	50	48	48	47	25	24	22	18	18	20	21	21	21	24	25	27	27	31		
10:00	55	56	53	48	48	51	55	53	53	54	53	51	51	50	41	33	29	25	22	23	23	25	23	26	26	28	30	34		
10:15	54	55	54	48	49	53	58	60	58	58	55	52	53	52	49	47	44	38	34	33	32	32	31	33	33	34	35	38		
10:30	54	54	52	47	48	53	59	60	60	58	55	54	53	52	51	47	45	42	39	40	37	36	37	37	36	37	36	38		
10:45	57	53	51	44	48	53	59	60	59	58	56	53	54	53	52	50	48	46	42	42	40	39	40	39	39	39	38	41		
11:00-13:00																														
13:00	59	57	56	53	52	55	59	60	59	59	57	57	58	57	59	57	56	54	52	51	47	45	44	42	42	42	41	43		
13:15	60	57	55	54	53	56	60	60	59	58	57	56	57	56	58	56	55	52	51	50	46	44	44	42	42	42	41	43		
13:30	60	58	54	52	52	55	60	61	59	59	58	57	58	57	57	55	52	51	50	49	45	44	43	42	41	42	40	42		
13:45	60	59	56	53	51	54	59	61	61	60	60	58	59	58	58	57	54	52	50	50	45	44	44	44	43	43	42	44		
14:00	59	59	56	54	51	55	59	59	59	59	58	57	58	56	56	54	52	51	49	49	44	43	44	43	42	42	40	42	Seeding 2 - 3 PM	
14:15	59	59	55	55	53	55	58	59	59	58	57	56	57	56	57	55	53	51	48	47	43	42	41	40	39	39	38	39		
14:30	59	58	58	55	53	56	58	60	60	59	59	58	58	57	58	56	56	52	48	44	42	41	42	41	40	40	38	39		
14:45	60	59	59	55	51	56	59	61	61	61	59	58	58	56	57	55	55	50	47	46	44	43	43	43	41	40	38	38		
15:00	59	60	57	55	52	56	60	60	61	61	60	58	59	58	58	55	54	49	47	46	44	43	43	43	42	41	40	41	Peak Period 3 - 7 PM	
15:15	59	59	57	56	54	57	60	60	60	60	59	57	58	56	57	55	51	48	44	43	40	38	39	40	39	36	36	37		
15:30	59	58	56	57	55	57	60	60	59	59	59	57	58	57	58	56	51	48	43	42	40	37	38	37	35	34	32	33		
15:45	59	57	57	57	55	57	58	59	60	59	58	56	58	56	57	55	51	49	44	43	40	38	38	37	34	33	31	32		
16:00	61	58	58	58	55	58	60	61	61	61	59	57	59	58	58	53	52	49	45	45	41	37	37	33	30	29	29	31		
16:15	58	57	57	59	57	57	60	60	60	59	58	56	57	57	58	53	52	48	42	39	36	34	35	34	32	30	29	32		
16:30	57	56	57	59	58	57	58	61	59	58	57	54	57	56	58	54	53	49	42	39	34	32	33	31	28	28	27	30		
16:45	55	54	55	56	54	56	58	59	58	57	56	54	56	56	57	51	49	44	41	40	34	32	32	30	27	27	26	29		
17:00	52	52	54	56	55	56	59	60	58	57	55	54	56	55	56	50	47	43	40	38	32	31	31	29	27	25	24	27	Peak Hour 5 - 6 PM	
17:15	47	47	52	56	54	54	57	57	54	54	52	51	54	52	55	48	46	41	34	32	28	27	26	24	23	21	21	23		
17:30	41	46	50	54	52	52	56	55	52	53	52	50	54	52	53	46	46	39	31	29	25	24	23	22	21	20	20	23		
17:45	41	46	50	54	51	52	57	56	54	55	54	53	55	54	51	46	45	41	34	33	28	26	26	25	23	22	22	25		
18:00	45	52	54	57	53	53	58	57	56	57	56	54	55	54	53	48	47	43	37	36	31	30	28	27	25	25	24	27		
18:15	52	54	56	59	55	55	59	57	57	58	57	54	56	55	54	49	47	44	37	35	30	29	28	28	27	27	26	29		
18:30	55	55	57	60	55	56	59	59	59	60	57	56	58	56	57	53	52	46	39	36	31	31	30	29	28	27	27	29		
18:45	56	55	55	59	53	55	59	59	58	59	57	55	56	55	57	55	53	48	43	41	36	34	35	33	32	31	30	32		
19:00	57	58	57	56	54	55	59	60	59	59	56	54	56	55	57	55	54	51	48	46	41	38	38	35	34	33	32	33		
19:15	59	59	58	58	56	56	59	59	59	60	57	55	56	55	56	54	54	52	49	48	45	43	41	37	36	37	35	35		
19:30	59	59	59	60	57	56	59	60	59	59	57	55	57	54	56	55	55	55	51	49	47	46	44	40	38	40	37	38		
19:45	58	59	58	59	57	56	60	61	60	61	58	56	57	55	56	56	55	52	51	50	47	47	43	41	40	40	39	40		
20:00	58	58	58	59	57	57	60	61	61	60	58	55	58	56	57	56	56	54	51	50	47	47	45	41	41	42	40	41		
20:15	57	60	59	60	58	58	61	61	60	60	58	56	59	57	57	56	56	54	52	50	49	47	46	42	42	44	42	42		
20:30	57	59	58	60	57	57	60	61	61	62	59	57	59	58	57	56	55	54	52	50	48	49	46	43	43	44	43	44		
20:45	57	58	59	61	58	57	60	60	60	61	59	56	58	57	56	56	56	54	52	51	50	48	47	44	44	44	43	45		
21:00	57	58	59	60	57	56	60	61	60	62	59	57	58	57	57	56	56	54	52	51	49	49	47	44	43	45	44	44		
21:15	56	57	57	59	58	57	61	61	60	61	58	55	58	55	55	56	54	53	51	49	48	48	46	43	42	45	44	44		
21:30	58	59	57	59	57	57	60	61	60	60	58	56	57	55	56	56	55	54	51	49	48	47	45	42	42	45	43	45		
21:45	59	58	59	58	56	57	61	61	61	61	59	57	58	56	57	57	56	54	53	51	49	49	46	44	43	44	43	45		
22:00	60	60	60	60	58	58	61	61	60	61	59	56	57	56	57	56	56	54	53	51	49	48	47	44	44	45	43	44		
22:15	58	59	59	59	58	58	61	61	60	61	59	57	59	57	58	57	56	56	54	54	50	49	47	44	43	45	44	45		
22:30	58	60	59	59	58	57	61	60	60	62	59	57	59	57	56	56	55	55	53	52	50	49	47	44	44	45	44	45		
22:45	59	60	59	59	57	57	60	61	60	61	59	56	59	56	57	57	56	54	52	50	49	50	47	45	44	46	44	46		
23:00	59	59	59	59	57	56	59	60	61	61	59	57	58	56	55	58	57	54	54	53	51	51	48	47	46	47	46	47		
23:15	59	58	58	58	57	56	59	59	59	60	58	57	57	55	56	56	56	54	53	51	50	50	46	44	44	46	46	47		
23:30	59	59	59	60	57	58	61	62	62	63	60	58	59	56	57	56	55	55	53	53	50	51	47	44	45	46	45	46		
23:45	60	61	60	60	58	57	61	62	61	62	59	58	58	55	57	58	57	55	54	52	51	51	48	45	45	46	45	47		

Speed Color Scale (mph)

25 35 45 55 65

Figure 3-5: Southbound I-395 General Purpose Lane Speeds

	I-495		Turkeycock Run			Seminary Rd		King St		Shirlington Rd		Glebe Rd			Washington Blvd					Boundary Channel Dr				Potomac River			14th St		12th St	
2:30	59	58	58	56	56	57	56	56	55	56	57	58	57	55	53	53	52	51	49	49	51	50	48	47	46	45	43	47	47	
2:45	59	58	58	56	57	57	56	57	56	57	59	59	59	57	53	52	52	51	50	50	50	50	49	48	46	46	47	48	49	
3:00	60	59	59	56	56	57	56	56	56	57	59	60	60	58	53	51	51	50	50	48	49	50	50	49	48	48	48	49	49	
3:15	59	58	59	57	56	58	56	56	56	56	58	59	59	59	54	54	53	53	50	49	49	49	50	50	50	50	50	50	51	
3:30	59	58	59	57	57	59	57	57	57	57	59	60	60	58	55	54	54	54	52	52	53	52	51	52	51	51	51	52	55	
3:45	60	58	59	56	56	57	55	56	55	56	58	59	59	57	53	53	52	52	49	50	52	52	52	51	49	49	50	50	52	
4:00	59	57	58	55	56	58	57	57	57	56	59	59	60	59	55	55	54	53	51	51	50	52	50	51	49	50	51	51	52	
4:15	59	56	57	55	56	58	57	57	56	56	58	58	57	57	53	54	53	53	50	51	51	51	50	50	48	49	49	50	52	
4:30	60	58	59	56	57	58	57	57	56	58	60	59	59	59	56	56	56	55	51	52	54	52	51	51	49	50	50	52	53	
4:45	59	59	59	57	58	59	57	57	57	58	60	60	61	59	56	53	54	55	53	54	55	54	53	52	51	51	52	52	55	
5:00	60	58	58	57	58	58	57	57	57	58	60	59	60	60	56	53	54	54	52	53	54	54	52	51	50	50	51	52	53	Seeding 5 - 6 AM
5:15	60	58	59	57	58	58	57	57	56	57	59	59	60	60	55	55	55	56	53	54	54	54	52	52	50	50	52	52	54	
5:30	61	59	59	58	59	60	58	57	56	57	60	61	60	60	56	55	55	55	52	53	54	53	52	51	49	49	49	51	53	
5:45	61	59	59	58	59	61	59	58	56	57	60	60	61	59	55	55	54	54	52	52	53	52	50	50	48	48	48	50	53	
6:00	61	61	61	59	60	61	59	58	57	57	60	61	60	59	55	54	55	54	51	52	52	53	51	50	48	48	48	48	51	
6:15	60	59	60	59	60	61	59	58	56	57	59	60	59	58	55	54	54	54	51	51	52	53	51	50	48	48	48	48	50	
6:30	60	60	61	59	60	60	56	57	56	57	59	59	59	58	55	55	54	54	52	51	52	53	51	49	47	47	45	45	47	
6:45	59	59	60	59	58	60	58	57	57	57	59	60	59	59	56	55	55	54	51	51	51	52	50	48	45	45	43	41	43	
7:00	60	60	60	58	58	59	58	58	56	57	59	60	59	59	55	54	54	53	51	51	52	52	50	48	45	44	40	37	40	Peak Hour 7 - 8 AM
7:15	61	60	61	59	58	59	57	58	57	57	59	60	59	59	55	54	54	54	52	52	53	52	49	46	44	42	35	30	27	
7:30	60	59	61	58	58	58	56	57	56	56	58	59	59	59	56	54	55	54	51	50	51	52	49	46	42	42	34	29	25	
7:45	60	58	61	59	59	57	56	56	56	57	59	60	58	58	56	56	55	53	51	51	50	51	48	45	43	42	35	30	26	
8:00	59	58	61	58	59	58	56	58	58	58	60	60	60	60	56	56	55	53	50	50	51	51	49	46	44	43	37	32	29	Peak Period 6 - 10 AM
8:15	60	60	61	59	61	62	60	59	59	58	60	60	60	60	55	55	54	54	50	51	52	52	49	46	43	42	35	30	28	
8:30	61	61	61	60	62	61	59	59	58	58	60	61	59	59	56	55	55	54	51	50	50	50	47	45	42	42	35	30	28	
8:45	61	61	62	60	62	61	59	59	57	58	60	60	60	60	56	56	55	53	50	50	50	49	46	43	41	41	36	32	32	
9:00	61	60	62	60	61	62	60	59	57	58	60	60	59	60	56	55	54	52	49	49	50	49	45	41	41	41	38	35	36	
9:15	61	60	62	61	63	62	60	59	57	58	60	61	60	60	56	55	54	51	49	49	50	50	45	42	42	43	39	38	39	
9:30	61	60	62	61	62	62	59	59	57	58	61	61	61	60	57	56	56	53	50	49	50	50	47	44	43	43	40	39	41	
9:45	61	61	62	60	61	61	59	59	57	58	60	60	60	60	57	56	55	54	49	50	50	51	49	47	44	44	41	40	42	
10:00	61	60	62	60	61	61	60	60	58	59	61	61	61	61	57	56	54	53	51	51	53	52	48	46	44	44	42	40	43	
10:15	60	59	61	59	59	59	57	57	56	58	60	60	60	60	56	55	54	53	50	50	50	50	47	47	44	44	42	41	44	
10:30	59	58	61	58	59	59	59	58	56	58	60	61	61	61	57	57	55	55	51	50	50	51	48	47	44	44	44	44	47	
10:45	57	59	60	58	60	60	59	58	57	58	60	61	61	60	56	55	54	54	49	50	50	51	49	48	45	45	44	44	46	
11:00-13:00																														
13:00	61	58	60	56	59	60	59	59	56	58	61	61	61	60	56	55	54	53	51	51	51	52	50	48	45	45	44	44	47	
13:15	60	58	59	54	58	60	59	58	57	58	60	61	61	61	56	55	54	53	51	51	51	52	49	48	46	45	43	43	45	
13:30	60	59	59	55	59	60	59	58	56	57	59	60	60	60	56	54	54	53	50	50	51	51	48	45	43	42	40	39	42	
13:45	59	57	59	55	58	60	58	57	55	57	59	60	60	61	56	55	54	53	50	50	51	51	48	45	42	42	40	40	42	
14:00	59	56	58	54	57	60	58	58	56	57	59	60	60	60	56	56	54	53	50	51	51	51	48	46	43	43	41	40	43	Seeding 2 - 3 PM
14:15	59	54	56	53	55	56	57	57	55	56	57	59	60	60	56	55	54	52	50	49	50	50	47	45	43	42	39	37	37	
14:30	57	48	51	50	49	50	52	53	52	54	56	58	60	60	56	55	53	52	50	50	51	51	48	46	42	41	37	34	33	
14:45	56	46	45	43	43	44	49	52	51	53	56	58	59	60	56	55	54	53	50	50	51	51	48	44	42	41	36	32	29	
15:00	54	43	39	38	41	43	46	51	51	52	55	56	56	57	54	55	55	52	49	50	51	51	47	43	41	39	36	30	25	Peak Period 3 - 7 PM
15:15	53	39	35	31	34	40	46	49	49	50	54	55	54	55	54	56	56	53	49	50	51	50	47	43	40	40	35	28	21	
15:30	54	42	37	30	29	35	41	45	44	45	47	48	47	48	49	55	54	51	48	50	49	49	45	40	37	37	31	25	20	
15:45	56	48	45	33	27	28	34	37	37	37	38	41	37	35	43	50	52	50	48	49	50	48	43	38	35	35	29	24	21	
16:00	59	54	53	37	29	28	32	35	34	33	33	34	30	25	34	48	49	48	47	49	51	49	44	40	36	35	30	25	22	
16:15	57	53	51	32	23	24	30	34	34	33	33	33	28	22	28	48	49	48	46	48	49	46	42	37	33	33	29	25	21	
16:30	59	55	52	32	22	21	26	30	30	29	31	34	29	22	26	47	48	48	47	48	48	46	39	36	32	32	26	22	18	
16:45	59	54	51	32	24	21	26	30	30	30	30	30	26	21	22	43	46	46	45	46	46	44	39	37	33	31	26	23	18	
17:00	59	55	52	32	24	21	24	27	28	27	27	28	25	21	22	39	45	46	44	45	45	44	41	36	33	32	27	23	19	Peak Hour 5 - 6 PM
17:15	58	55	51	29	21	21	24	27	27	25	22	23	23	19	20	36	42	45	43	45	45	44	40	34	30	30	26	21	18	
17:30	59	55	51	31	23	19	23	26	25	21	19	20	18	15	19	35	40	42	42	44	45	42	37	32	28	28	25	21	18	
17:45	60	55	51	31	24	22	24	26	25	23	21	22	20	15	16	32	38	40	41	44	44	42	38	31	27	26	24	21	18	
18:00	58	55	51	32	24	22	25	29	29	28	27	26	24	19	22	39	42	42	43	44	44	41	36	32	28	27	25	21	18	
18:15	56	45	43	31	26	25	29	33	32	30	29	31	29	26	31	46	48	47	45	46	47	43	39	33	29	29	27	23	19	
18:30	56	42	38	31	28	29	35	40	37	35	36	38	35	30	36	48	49	48	46	45	46	44	40	35	31	31	28	23	20	
18:45	57	43	39	32	31	37	41	45	42	40	40	42	40	37	40	50	50	48	46	46	46	45	42	37	32	31	29	25	21	
19:00	57	46	44	38	38	42	46	47	44	43	44	45	45	45	47	50	50	48	46	46	46	45	42	38	34	34	32	28	24	
19:15	56	48	48	40	37	42	46	48	45	44	47	51	53	53	52	52	51	50	47	47	47	47	43	41	38	37	34	32	30	
19:30	57	50	50	39	39	45	48	49	46	47	50	53	55	56	53	53	52	50	47	46	46	45	44	44	42	39	37	36	33	
19:45	58	53	54	43	45	50	52	52	50	51	55	57	57	57	53	51	50	49	47	47	46	46	44	43	41	41	40	40	39	
20:00	60	57	56	48	49	52	52	53	51	52	55	57	57	58	54	52	51	51	48	48	48	49	45	45	43	42	42	43	44	
20:15	60	57	57	51	50	52	51	52	52	53	56	57	58	58	54	52	52	51	49	49	50	50	48	46	44	43	44	45	46	
20:30	61	58	58	51	49	51	50	51	51	53	56	58	58	57	54	53	52	51	48	48	50	51	48	46	44	43	44	45	47	
20:45	60	57	57	51	49	51	51	52	52	54	57	58	58	57	52	53	52	52	48	49	50	50	48	47	45	45	45	46	48	
21:00	60	58	58	51	51	52	53	54	54	55	58	59	59	57	53	52	52	51	48	49	49	49	47	46	45	44	45	46	47	
21:15	60	57	56	53	56	58	57	55	54	55	58	58	58	57	53	53	52	51	49	49	48	49	47	47	45	45	46	46	48	
21:30	61	56	57	55	57	58	57	55	54	56	59	59	58	57	53	53	52	51	48	48	49	50	47	47	44	44	45	46	48	
21:45	60	55	58	56	57	58	57	56	54	55	57	57	58	58	55	54	53	51	49	49	48	47	45	45	44	43	44	46	48	
22:00	60	56	58	58	59	59	57	57	55	55	57	57	59	58	55	53	53	52	49	49	51	51	49	48	46	44	45	45	47	
22:15	59	58	59	58	59	59	57	55	52	53	54	55	58	58	54	52	52	51	48	49	49	49	47	47	45	44	45	45	47	
22:30	59	58	59	57	57	56	55	54	51	52	54	55	58	57	52	52	51	51	49	49	48	48	46	46	45	44	45	44	46	
22:45	59	58	59	58	58	55	54	53	52	53	55	56	59	57	52	51	51	51	49	48	49	48	46	46	45	44	45	45	47	
23:00	61	60	60	58	59	56	53	52	51	52	54	55	59	57	53	52	52	50	49	48	49	49	47	47	45	45	46	47	50	
23:15	61	60	60	58	58	58	53	52	51	52	54	57	60	58	53	53	52	51	49	50	50	51	48	48	45	46	46	47	49	
23:30	60	60	61	58	57	56	52	52	51	52	55	58	59	59	53	52	52	51	49	49	49	49	47	47	46	46	46	47	49	
23:45	59	59	60	59	59	56	54	53	51	53	56	59	60	59	54	52	52	51	49	51	53	52	52	50	48	48	49	49	50	

Speed Color Scale (mph)

25 35 45 55 65

Figure 3-6: Northbound I-395 HOT/HOV Lane Speeds

	I-495					Turkeycock Run				Seminary Rd		King St		Shirlington Rd		Glebe Rd		Washington Blvd	Eads St			Boundary Channel Dr				Potomac River	14th St	
2:30	51	50	52	53	54	54	60	61	56	57	60	63	63	63	65	65	62	58	57	56	55	54	54	54	54	50	48	
2:45	50	49	52	52	54	53	59	61	57	57	60	63	63	61	65	65	62	58	58	56	56	55	55	56	55	50	48	
3:00	65	66	65	65	65	65	63	64	62	59	64	66	66	65	66	65	63	59	58	56	56	56	55	56	56	50	49	
3:15	64	66	65	65	65	65	63	64	62	61	63	67	67	65	66	66	64	59	58	56	56	55	55	55	54	49	48	
3:30	64	65	65	64	65	65	63	64	63	61	65	67	66	65	65	64	64	60	60	58	58	56	55	55	54	52	51	
3:45	66	67	66	67	66	65	65	66	64	61	66	67	68	66	66	65	65	61	62	61	61	59	59	58	57	53	52	
4:00	66	67	66	66	66	66	66	68	65	66	68	68	68	67	67	66	66	61	62	61	60	59	58	58	56	54	50	
4:15	65	66	65	66	66	65	65	66	65	66	68	68	68	67	66	66	64	60	61	59	59	57	57	57	57	55	50	
4:30	66	67	66	67	66	66	66	67	66	67	69	68	69	68	68	67	66	60	61	59	59	56	56	56	56	53	50	
4:45	68	68	68	69	68	68	67	68	67	68	70	69	70	70	69	68	67	63	63	62	62	60	60	60	59	55	51	
5:00	69	69	70	70	69	71	68	70	70	70	71	71	72	72	70	70	68	64	65	64	64	62	62	61	59	56	52	Seeding 5 - 6 AM
5:15	70	69	69	70	69	69	67	68	68	70	70	70	71	70	69	69	68	62	63	62	62	61	60	60	59	55	51	
5:30	72	71	72	72	71	71	69	70	70	70	71	71	71	71	68	68	67	62	63	63	63	61	59	59	59	58	54	49
5:45	71	71	72	72	71	71	67	68	67	67	70	70	70	69	67	67	66	61	62	61	60	59	57	57	56	56	52	47
6:00	70	71	70	70	70	69	67	67	66	67	68	69	69	68	66	66	65	59	60	60	60	58	58	57	55	54	51	45
6:15	70	70	69	69	68	66	64	64	61	63	65	66	66	66	65	65	64	56	56	58	58	54	54	53	52	51	46	41
6:30	70	71	69	69	68	68	65	65	61	66	65	68	69	68	66	67	65	55	53	53	53	45	42	41	38	39	34	30
6:45	69	70	69	69	68	68	65	65	63	64	62	66	66	66	64	64	63	45	46	45	43	28	26	26	26	27	26	25
7:00	68	69	68	68	66	66	64	63	63	62	63	67	67	66	63	63	60	39	39	39	36	25	23	23	24	24	25	25
7:15	68	69	68	68	67	67	64	63	61	63	60	65	65	64	61	61	58	32	36	35	32	23	22	23	23	24	24	26
7:30	67	69	68	67	65	67	62	64	62	63	59	61	61	59	55	55	52	27	30	29	25	22	23	24	25	25	26	26
7:45	65	68	67	66	61	63	63	63	61	63	59	59	60	58	56	56	54	30	31	29	24	21	24	25	26	26	27	27
8:00	66	68	64	62	58	64	61	60	56	59	56	57	60	59	57	57	57	32	29	28	24	20	24	25	25	25	25	25
8:15	63	67	63	63	59	66	63	60	52	59	55	57	58	59	58	59	57	32	27	26	22	19	24	25	26	26	26	26
8:30	65	67	65	62	59	64	60	59	53	61	57	57	59	60	57	58	57	34	24	20	16	18	23	24	25	25	25	25
8:45	64	66	65	64	59	61	54	52	47	61	56	54	54	54	52	54	52	39	25	20	13	15	20	22	23	23	22	22
9:00	66	67	64	64	61	57	55	56	54	60	53	57	57	52	49	51	53	47	26	23	17	17	20	21	23	23	25	24
9:15	66	68	65	65	65	61	59	59	51	47	42	37	33	34	38	38	42	29	14	13	12	14	18	20	21	21	23	25
9:30	64	66	65	63	65	65	63	63	55	53	51	44	38	39	39	40	36	22	18	16	15	15	18	19	19	19	21	24
9:45	65	64	62	63	64	64	61	62	57	62	61	59	56	55	53	53	46	30	18	16	16	16	19	20	20	21	21	25
10:00	64	65	64	65	65	65	62	61	57	63	63	61	61	59	59	59	55	43	25	21	19	19	21	22	22	22	23	27
10:15	66	67	66	66	65	63	62	62	56	62	64	64	63	61	60	60	58	50	44	43	41	36	35	32	31	31	29	32
10:30	64	65	65	66	64	66	64	63	57	61	65	64	65	62	61	60	59	53	50	48	49	44	44	43	43	41	39	37
10:45	66	65	65	66	64	66	64	63	57	64	66	65	65	63	61	61	60	52	50	49	48	45	45	45	46	44	42	41
11:00-13:00	HOV/ HOT REVERSAL PERIOD																											
13:00																				55	55	50	54	54	53	52	50	44
13:15																				55	55	47	52	51	51	51	48	43
13:30																				56	56	50	53	53	53	53	49	45
13:45																				57	56	51	54	53	53	53	49	45
14:00																				55	55	49	54	53	54	53	49	44
14:15																				54	54	49	54	52	52	51	49	41
14:30																				54	54	49	55	53	53	54	50	41
14:45																				54	54	51	55	53	53	53	49	41
15:00																				55	56	53	57	57	56	55	50	42
15:15																				53	53	53	54	55	54	53	48	39
15:30																				53	53	52	53	52	52	50	44	36
15:45																				53	53	49	51	49	49	49	43	36
16:00																				50	52	51	52	51	50	50	45	33
16:15																				51	52	53	54	53	52	51	44	32
16:30																				52	52	51	52	51	49	48	42	28
16:45																				50	51	48	48	48	47	46	38	30
17:00																				47	49	47	47	44	45	44	35	28
17:15																				48	50	46	48	45	44	41	34	22
17:30																				49	49	43	44	43	42	41	31	20
17:45																				45	47	43	44	43	43	42	35	24
18:00																				46	47	43	42	41	41	40	35	28
18:15																				46	47	43	44	45	44	42	37	30
18:30																				47	49	45	46	45	45	44	39	30
18:45																				50	51	49	50	50	49	49	43	32
19:00																				51	51	52	52	53	52	51	48	37
19:15																				51	52	53	52	53	52	52	48	40
19:30																				51	52	53	52	52	52	52	49	41
19:45																				51	51	52	51	52	51	51	48	41
20:00																				51	51	53	52	53	52	52	49	44
20:15																				51	52	53	52	52	52	52	50	45
20:30																				51	52	53	53	54	54	54	50	47
20:45																				51	52	53	53	53	53	53	50	46
21:00																				51	52	53	53	53	53	53	50	47
21:15																				51	52	54	53	53	53	52	50	46
21:30																				51	52	52	52	53	53	52	49	46
21:45																				50	51	53	53	53	53	52	49	46
22:00																				53	53	54	55	54	55	54	51	47
22:15																				54	55	55	55	55	54	54	52	48
22:30																				52	53	54	54	55	55	55	52	48
22:45																				51	53	54	55	55	55	54	52	48
23:00																				51	51	54	54	54	54	53	51	48
23:15																				51	52	54	54	52	52	52	50	47
23:30																				49	50	53	54	53	53	53	50	48
23:45																				52	52	54	54	54	54	54	52	49

Seeding 5 - 6 AM

Peak Hour 7 - 8 AM

Peak Period 6 - 10 AM

Seeding 2 - 3 PM

Peak Period 3 - 7 PM

Peak Hour 5 - 6 PM

Speed Color Scale (mph)

25 35 45 55 65

Figure 3-7: Southbound I-395 HOT/HOV Lane Speeds

	I-495					Turkeycock Run					Seminary Rd					Shirlington Rd					Washington Blvd	Eads St				Boundary Channel Dr				14th St	
2:30																						54	53	52	52	51	51	51	50	49	
2:45																						53	53	51	51	51	51	52	50	49	
3:00																						55	54	53	53	52	52	52	51	50	
3:15																						55	53	53	53	53	53	53	53	50	
3:30																						56	54	54	54	54	54	55	53	51	
3:45																						56	55	55	54	53	53	53	52	50	
4:00																						57	56	55	54	54	54	54	53	51	
4:15																						56	54	54	54	53	52	53	52	50	
4:30																						56	54	54	54	53	54	54	53	52	
4:45																						57	56	55	55	54	54	54	53	52	
5:00																						57	55	55	55	55	55	55	54	52	Seeding 5 - 6 AM
5:15																						57	55	56	56	55	56	56	55	53	
5:30																						57	56	56	55	55	56	56	54	53	
5:45																						57	54	55	55	55	55	55	54	52	
6:00																						57	56	56	56	55	54	54	53	51	
6:15																						57	57	57	57	56	54	55	53	51	
6:30																						57	59	58	57	56	54	54	52	49	
6:45																						56	58	57	56	55	53	53	52	48	
7:00																						56	57	57	57	55	53	53	52	48	Peak Hour 7 - 8 AM
7:15																						54	54	55	58	56	53	53	51	44	
7:30																						56	56	56	56	55	53	53	51	43	
7:45																						57	57	57	56	55	53	53	51	43	
8:00																						56	56	56	57	55	52	52	50	43	Peak Period 6 - 10 AM
8:15																						56	56	56	55	54	53	52	49	42	
8:30																						56	57	57	57	55	53	53	50	41	
8:45																						58	59	58	57	55	51	51	49	42	
9:00																						58	56	55	55	52	51	50	49	43	
9:15																						58	55	54	53	51	51	51	49	45	
9:30																						57	54	53	52	51	51	51	49	46	
9:45																						57	54	54	54	52	52	52	51	47	
10:00																						58	56	54	53	52	52	52	50	47	
10:15																						57	56	54	52	52	52	52	50	47	
10:30																						57	56	54	52	52	53	52	51	49	
10:45																						58	55	54	53	52	52	52	50	48	
11:00-13:00	HOV/ HOT REVERSAL PERIOD																														
13:00	64	64	65	65	65	66	64	63	65	67	65	65	66	66	65	65	65	58	60	57	55	55	53	53	53	50	48				
13:15	65	66	66	65	65	68	65	63	66	68	66	65	66	66	65	65	65	58	59	57	56	55	53	52	51	49	47				
13:30	65	65	66	67	66	67	65	65	67	69	66	65	67	67	66	66	65	58	60	58	56	56	53	52	52	50	46				
13:45	64	61	64	65	66	67	64	64	65	68	65	64	67	67	66	66	65	58	59	57	55	54	52	51	51	49	46				
14:00	63	61	64	65	65	67	65	65	66	68	66	66	68	68	66	66	66	58	59	57	56	55	53	53	53	51	47				
14:15	65	64	66	65	65	67	65	64	65	64	64	66	68	67	66	66	66	58	60	59	58	58	55	54	54	51	46				
14:30	66	65	67	66	65	67	65	64	64	60	60	62	66	66	65	65	63	57	61	59	58	56	53	53	53	50	45				
14:45	67	68	68	69	67	68	66	65	64	62	60	61	64	64	64	64	65	58	60	58	58	58	56	54	54	50	44				
15:00	66	68	67	67	64	65	63	63	63	62	61	60	63	63	63	62	63	52	60	60	60	59	55	54	53	49	40				
15:15	65	67	66	64	63	66	60	60	63	61	58	56	58	59	60	59	60	50	61	62	61	59	57	55	54	49	40				
15:30	66	68	68	67	66	66	58	55	58	60	58	58	59	58	58	57	58	49	57	61	59	57	54	52	51	47	38				
15:45	68	70	70	69	68	69	68	67	66	65	59	61	61	63	64	64	63	50	59	60	59	58	55	53	52	48	38				
16:00	70	70	71	71	72	72	69	69	66	67	59	62	65	65	66	65	62	52	58	60	59	57	55	53	52	48	38				
16:15	67	69	68	68	69	69	67	67	65	66	63	62	65	65	66	66	63	51	59	61	60	59	55	53	52	48	37				
16:30	65	68	69	69	68	69	66	66	64	61	62	62	65	65	65	64	63	49	56	59	58	58	54	52	52	47	36				
16:45	65	67	67	68	68	68	66	65	66	63	62	63	67	67	65	64	62	49	56	58	57	56	53	50	50	46	35				
17:00	67	68	68	69	68	68	64	64	64	60	58	62	64	65	62	60	58	44	55	60	58	56	53	50	49	45	35				
17:15	67	68	68	68	67	65	64	64	61	60	58	60	62	62	57	58	57	49	55	58	57	56	53	50	49	44	34				
17:30	66	68	68	67	67	67	65	63	60	58	56	59	63	63	62	61	59	46	55	58	57	55	51	48	47	42	33				
17:45	66	67	67	67	67	66	64	62	60	60	58	59	62	62	62	61	60	45	53	56	55	54	50	47	46	41	32				
18:00	67	67	65	65	65	66	64	61	61	58	54	54	59	60	60	59	51	36	46	50	50	50	48	45	45	40	30				
18:15	64	65	64	62	62	64	60	59	59	59	54	50	51	52	50	50	36	22	36	41	43	47	47	46	45	40	31				
18:30	63	64	64	63	61	63	60	59	59	57	54	50	50	50	46	46	34	22	35	38	40	43	44	44	43	39	33				
18:45	64	64	64	64	64	65	59	57	60	58	56	54	55	54	50	50	36	25	41	45	47	49	48	47	46	42	35				
19:00	64	63	64	62	62	64	59	56	61	60	58	56	58	57	54	54	43	36	51	53	54	52	51	48	48	44	37				
19:15	63	62	63	61	61	63	60	57	60	61	60	58	59	59	58	58	54	48	57	56	56	54	52	49	49	45	37				
19:30	62	62	62	60	61	62	61	59	59	61	60	60	62	62	61	61	57	49	57	56	56	54	52	49	49	47	42				
19:45	63	64	64	62	61	63	61	61	62	62	61	61	64	64	64	63	60	50	57	57	56	54	52	49	50	48	43				
20:00	64	64	64	63	63	65	63	62	61	62	63	63	65	65	64	64	61	51	57	56	55	55	53	51	52	50	47				
20:15	63	64	64	64	63	64	61	60	56	56	55	59	62	62	62	63	58	49	56	56	56	55	53	51	51	49	46				
20:30	64	63	63	63	62	60	58	56	55	55	54	56	62	63	63	64	59	49	57	56	56	55	53	51	51	49	47				
20:45	63	62	62	62	62	63	60	59	56	59	56	56	61	62	64	65	60	50	57	56	56	55	53	51	52	50	47				
21:00	63	62	64	63	63	63	61	61	57	59	57	58	62	62	63	63	60	48	56	55	56	54	53	52	52	50	47				
21:15	62	61	62	61	61	61	59	59	58	59	59	59	62	61	62	62	58	49	57	57	57	56	54	53	54	51	47				
21:30	62	60	60	58	58	62	60	60	61	62	61	61	61	60	62	61	59	50	57	56	57	56	53	51	52	50	48				
21:45	62	61	60	59	59	62	61	60	61	62	61	59	59	59	62	62	59	50	57	57	56	55	54	52	52	51	48				
22:00	64	61	63	62	61	64	61	61	62	63	60	58	61	61	59	59	57	48	56	55	55	54	53	51	51	50	47				
22:15	62	61	62	63	62	64	62	62	62	62	60	57	58	58	58	59	57	49	56	55	56	55	52	49	50	49	46				
22:30	61	61	63	62	62	65	62	61	62	64	62	60	60	60	61	62	58	49	57	57	56	56	54	52	52	50	47				
22:45	62	62	62	61	61	64	62	61	61	63	58	58	60	60	61	61	59	49	57	56	56	55	53	51	51	49	47				
23:00	62	62	62	62	62	63	60	61	62	63	59	58	62	60	59	59	57	49	56	56	57	56	55	53	53	52	50				
23:15	62	62	62	64	61	62	59	61	62	64	57	56	61	60	60	61	57	49	58	58	58	57	55	53	52	50	49				
23:30	61	60	60	61	59	62	59	61	61	63	56	55	60	59	61	61	59	49	57	56	56	56	54	52	52	50	48				
23:45	60	61	61	62	60	63	59	60	62	64	59	58	61	61	61	62	60	49	57	56	56	55	54	51	52	51	49				

Speed Color Scale (mph)

25 35 45 55 65

3.7.1.1 Travel Time Runs

Travel time runs were performed along northbound and southbound I-395 in both the general purpose and HOV/HOT lanes during both the AM and PM peak hours. Travel time runs were completed during January, April and May 2016 and were performed on Tuesday, Wednesday, or Thursday using the floating car method where the drivers traveled with the average speed of traffic. GPS devices were used to record vehicle speeds. The speeds and travel times were generally segmented at each on-ramp and off-ramp along the corridor.

Table 3-7 depicts the average travel times, speeds and lengths for the overall corridor for the AM and PM peak hours for each facility. **Figures 3-8 through 3-11** depict the travel time runs by segment for the northbound and southbound I-395 general purpose and northbound and southbound I-395 HOV/HOT lanes in the peak direction (i.e., northbound in the AM peak hour and southbound in the PM peak hour).

The HOV/HOT lane peak direction travel times are approximately 2.5 times lower in the AM peak hour and about 3.5 times lower in the PM peak hour than the general purpose lanes. This is due to the high traffic volumes and congestion in the general purpose lanes traveling northbound in the AM peak period toward the Pentagon vicinity and the District and southbound in the PM peak period leaving the District and the Pentagon vicinity. The travel speeds in the off-peak direction of the general purpose lanes are significantly greater than the peak direction speeds (28 MPH greater in the AM and 36 MPH greater in the PM).

During the AM period, traffic in the southbound HOV lanes must exit the corridor south of Eads Street and merge into the general purpose lanes. During the PM period, the first opportunity to enter the northbound HOV lanes occurs at Eads Street. These shorter HOV lane travel distances are reflected in the **Table 3-7.**

Table 3-7: Existing Travel Time Summary

Period	Segment		Distance (miles)	Travel Time (minutes)	Average Speed (MPH)
AM	NB	General Purpose	10.2	33.1	19
		HOV/HOT	9.9	13.1	45
	SB	General Purpose	10.3	11.9	52
		HOV/HOT	2.0	2.3	52
PM	NB	General Purpose	10.2	13.0	47
		HOV/HOT	1.5	3.1	29
	SB	General Purpose	10.3	39.5	16
		HOV/HOT	9.9	10.7	55

Figure 3-8: Northbound I-395 General Purpose Lanes Travel Times – AM Peak Hour

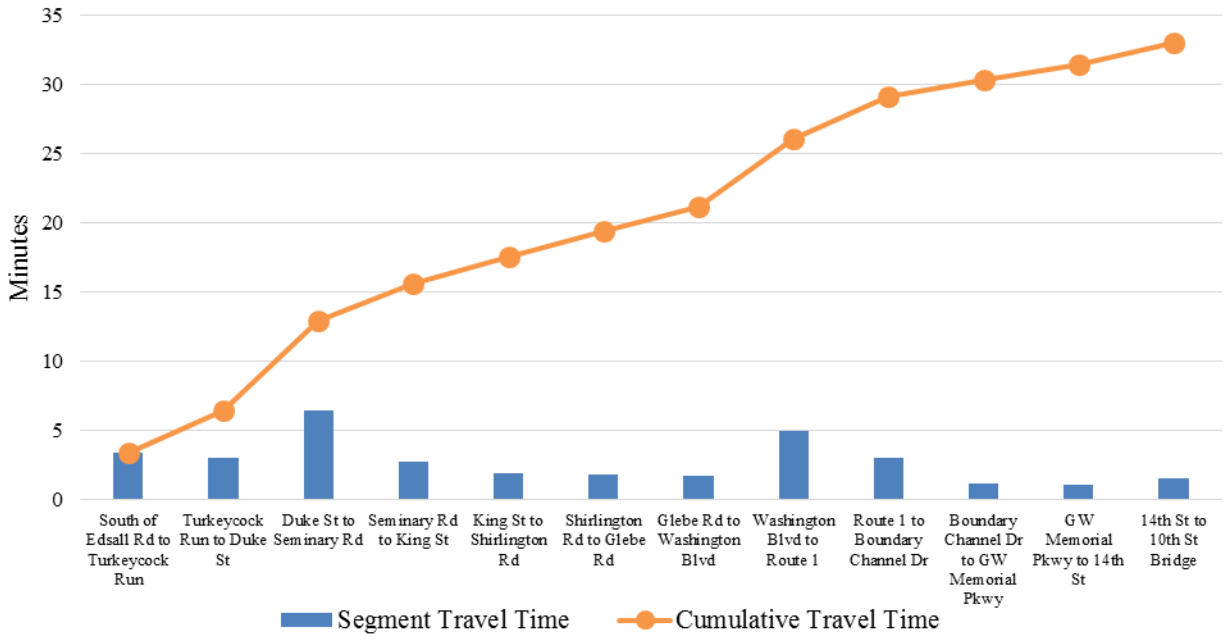


Figure 3-9: Northbound I-395 HOV/HOT Lanes Travel Times – AM Peak Hour

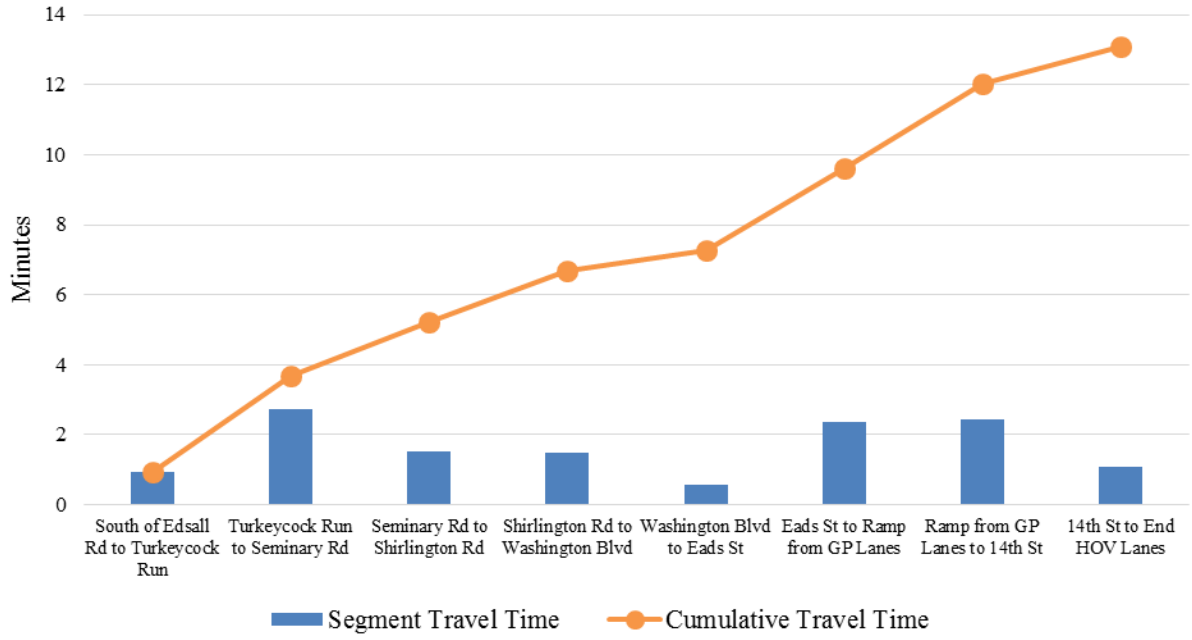


Figure 3-10: Southbound I-395 General Purpose Lanes Travel Times – PM Peak Hour

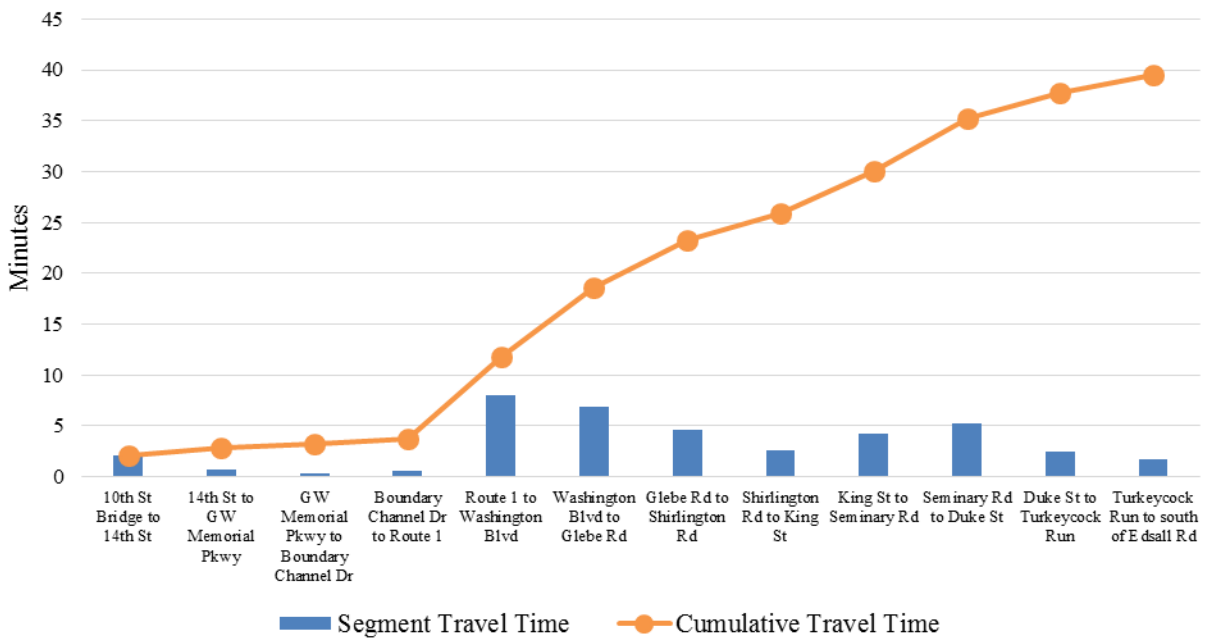
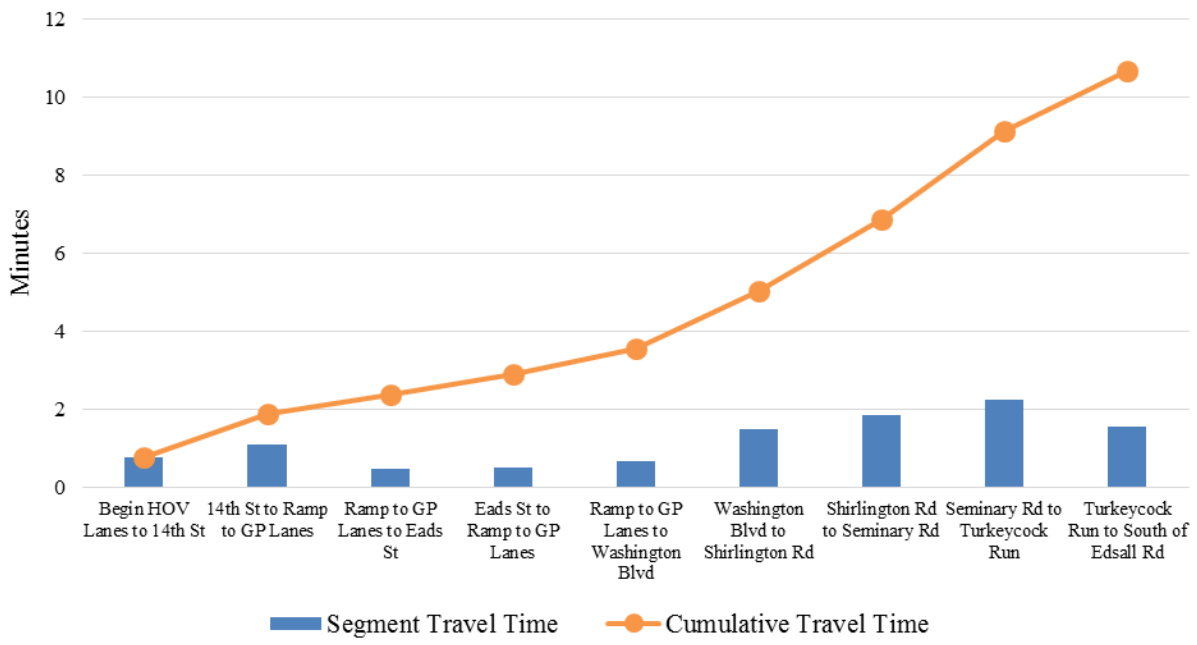


Figure 3-11: Southbound I-395 HOV/HOT Lanes Travel Times – PM Peak Hour



Detailed information on operational performance for existing conditions is included in **Chapter 7**.

3.8 EXISTING SAFETY CONDITIONS

Detailed information on existing safety conditions is included in **Chapter 8**.

3.9 EXISTING ENVIRONMENTAL CONSTRAINTS

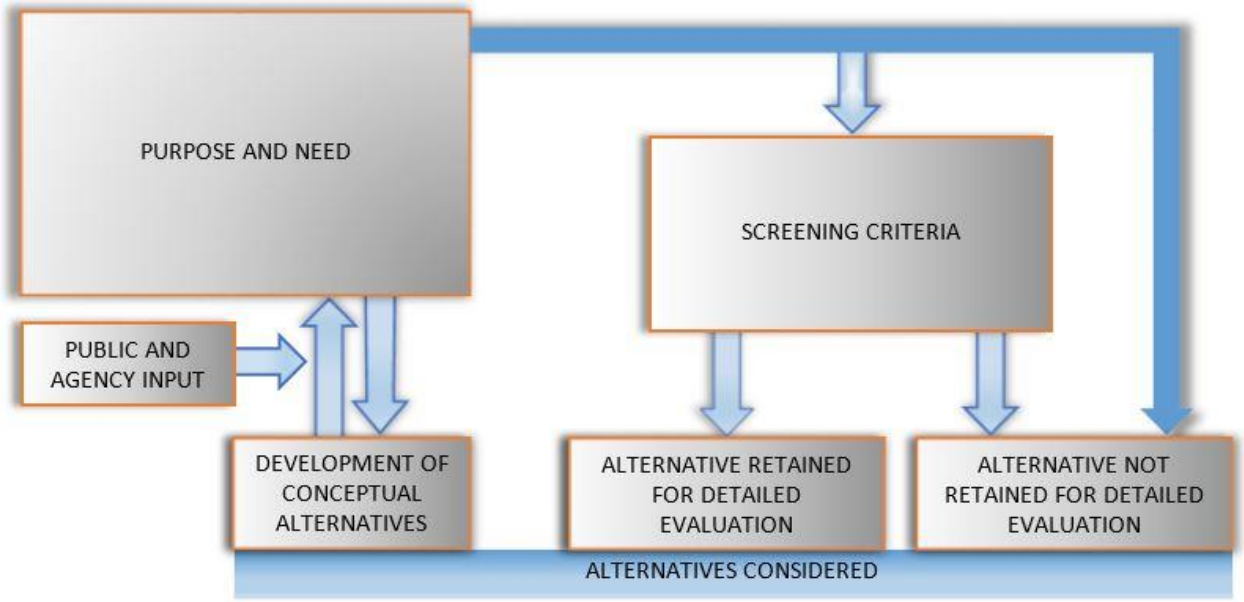
Pursuant to the National Environmental Policy Act of 1969, as amended, (NEPA) and in accordance with FHWA regulations, an Environmental Assessment (EA) has been prepared to identify existing environmental resources and to analyze and document the potential social, economic, and environmental effects associated with the proposed transportation improvements. Various named and unnamed streams exist in the study area. Four named perennial streams pass beneath I-395 along the project length: Four Mile Run, Turkeycock Run, Holmes Run, and Long Branch. Federal Emergency Management Agency (FEMA) regulated floodplains are associated with three of those streams: Four Mile Run, Turkeycock Run, and Holmes Run. Several historic resources and districts are located in close proximity to the proposed action and the boundaries of one historic district include a portion of VDOT right of way.

4. ALTERNATIVES CONSIDERED

4.1 ALTERNATIVES DEVELOPMENT AND SCREENING PROCESS

The alternatives development process typically involves developing conceptual alternatives that address the Purpose and Need of the project. Public and agency coordination is then conducted to receive input on the conceptual alternatives. **Figure 4-1** illustrates the general process used to identify and screen alternatives.

Figure 4-1: Alternatives Development and Screening Process



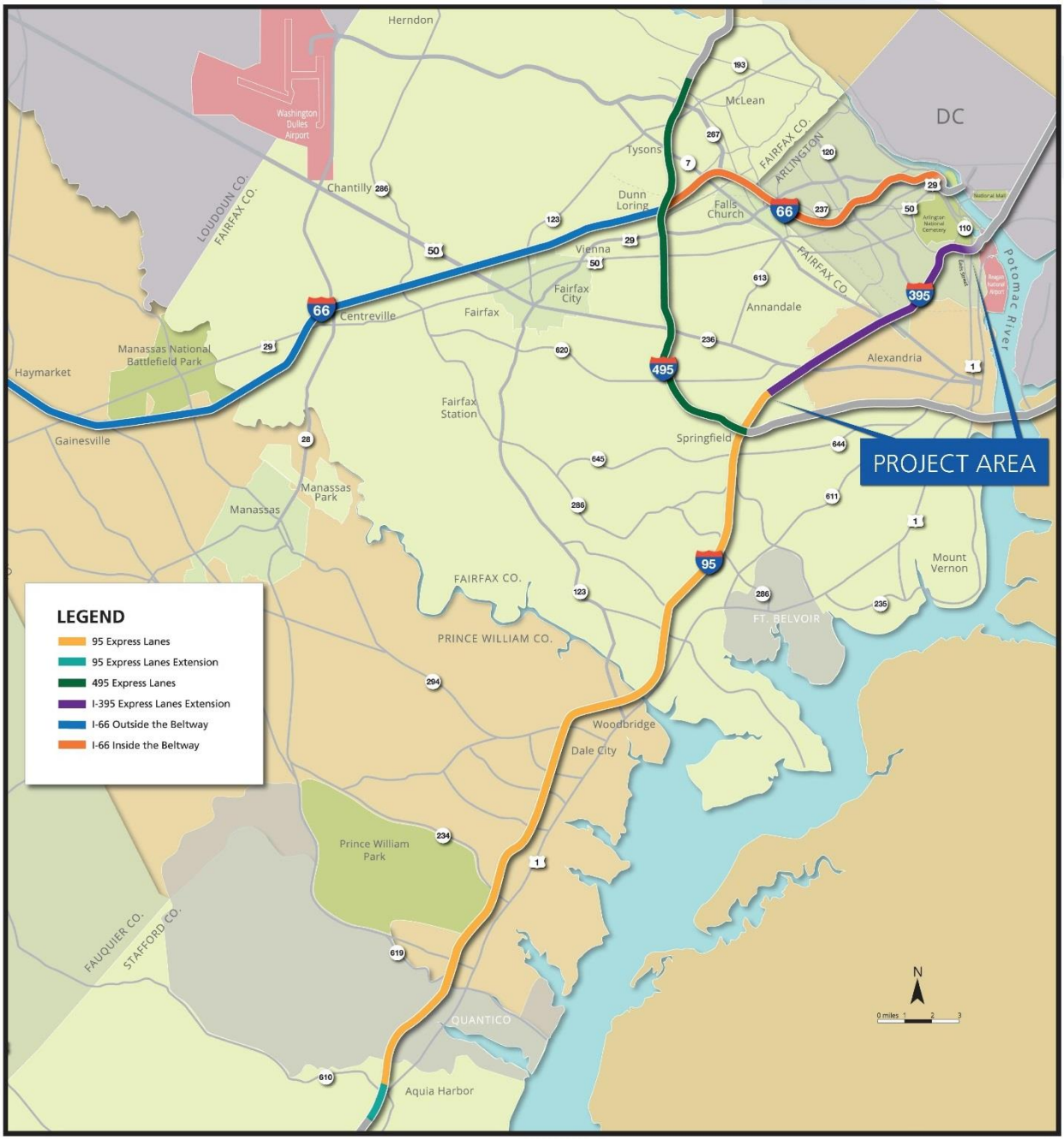
The process of developing alternatives to address the transportation needs along the I-395 corridor has been ongoing for several years as discussed in **Section 1.1**. While Express Lanes were recently implemented in December 2014 along I-95 from Garrisonville Road in Stafford County to Edsall Road in Fairfax County, congestion north of the Express Lanes has continued to increase along I-395. Consultation among VDOT, FHWA, District of Columbia Department of Transportation (DDOT), Department of Defense (DoD), Resource Agencies, Local Governments, and Stakeholders has resulted in the decision to evaluate alternatives that would address the identified needs along the I-395 corridor.

Similar to the process shown in **Figure 4-1**, a conceptual alternative was developed that would address the identified purpose and need of the project – which is to reduce congestion, provide additional travel choices, improve travel reliability, and improve roadway safety. Public and agency coordination were then initiated to further inform the development and refinement of the conceptual alternative.

Figure 4-2 illustrates the existing and planned Express Lanes (HOT lanes) network within Northern Virginia. The Express Lanes network is critical to the Northern Virginia region because the network provides additional travel choices and improves travel reliability for a variety of users. Due to the desire to address the needs of the project along the I-95 / I-395 corridor, converting the existing HOV facility to a HOT lanes facility was the only alternative identified for evaluation along the corridor; however, several

options at the northern terminus of the study area in the vicinity of the Eads Street Interchange were evaluated as discussed in **Section 4.4.2**.

Figure 4-2: Express Lanes Network in Northern Virginia



Since Express Lanes already exist within the median of I-95 from Garrisonville Road in Stafford County to I-395 at Edsall Road in Fairfax County, making the change from HOV to HOT lanes within the median of I-395 would minimize and reduce impacts by not requiring future improvements to the existing general purpose travel lanes beyond what has already been planned regionally. Furthermore, an additional build

alternative that did not involve the conversion of the HOV lanes to HOT lanes was not considered as travel choices and reliability are dependent on connecting the existing HOV facility to the regional Express Lanes network. In order to provide a baseline for comparison, a No Build Alternative is also being evaluated as described in **Section 4.2**.

4.2 NO BUILD ALTERNATIVE

The No Build Alternative has been included for evaluation as a benchmark for the comparison of future conditions and impacts. The No Build Alternative would retain the existing two reversible HOV lanes, existing general purpose lane configuration, and the associated interchanges, and allow for routine maintenance and safety upgrades. This alternative also assumes that the projects currently programmed and funded in VDOT's FY 2016-2021 Six-Year Improvement Program (SYIP) and the Metropolitan Washington Council of Governments (MWCOG) Constrained Long-Range Transportation Plan (CLRP) for the National Capital Region will be implemented as discussed. The projects listed in the SYIP and MWCOG CLRP within the study area are shown in **Table 4-1**. These No Build projects are discussed in more detail below.

4.2.1 I-395 HOV / Transit Ramp at Seminary Road

This project includes the construction of a south-facing ramp between the I-395 HOV lanes and the third level of the Seminary Road Interchange that provides access for HOV and transit vehicles along I-395 to the south of the interchange. The HOV ramp is reversible and permits northbound traffic to exit to Seminary Road in the morning hours and permits traffic from Seminary Road to access the southbound I-395 HOV lanes in the afternoon and evening hours. The ramp was opened to traffic in January 2016. Additional project information is located at: http://www.virginiadot.org/projects/northernvirginia/i-395_hovtransit-_ramp.asp (accessed 10/31/16).

4.2.2 12th Street Extension

This public-private project involves the construction of 12th Street between S. Eads Street and S. Fern Street to accommodate two-way traffic including traffic signal upgrades at the intersections of 12th Street with S. Eads Street and with S. Fern Street. The project was completed in summer 2016. Additional project information is located at: https://projects.arlingtonva.us/projects/12th-street-south-extension (accessed 10/31/16).

4.2.3 I-395 4th Lane South Widening – Duke Street to Edsall Road

This project involves the construction of a fourth lane along southbound I-395 to provide one additional through lane from north of Duke Street to south of Edsall Road. Work will include interchange modifications at both Edsall Road and Duke Street to accommodate the additional through lane and to reduce weaving issues along southbound I-395. At the Duke Street / Little River Turnpike Interchange, the loop ramp serving southbound I-395 to eastbound Duke Street traffic will be removed and replaced with a traffic signal. At the Edsall Road Interchange, the loop ramp serving westbound Edsall Road to southbound I-395 traffic will be removed and replaced with a traffic signal. The project is currently planned to be constructed concurrently with the I-395 Express Lanes project. Additional project information is located at: http://www.virginiadot.org/projects/northernvirginia/i-395_south_duke_to-_edsall.asp (accessed 10/31/16).

Table 4-1: No Build Improvements

Project/Study	Description	Completion Date
I-395 HOV / Transit Ramp at Seminary Road [1]	Construction of a south-facing ramp to and from the HOV lanes to the top level of the Seminary Road Interchange that provides additional access for HOV and transit	Jan 2016
12th Street Extension [2]	Construct 12th Street between S. Eads Street and S. Fern Street	Summer 2016
I-395 4th Lane South Widening – Duke Street to Edsall Road	Widening of southbound I-395 to provide one additional through lane from north of Duke Street to south of Edsall Road	2019
Seminary Road and Beauregard Street Ellipse	Modification of the intersection to an ellipse design to eliminate weaving issues on westbound Seminary Road and increase capacity	2020
Boundary Channel Drive Interchange	Interchange modifications to improve operations and reduce weaving along southbound I-395 including constructing two roundabouts, providing connections to Long Bridge Drive and US Route 1, and multi-modal improvements	Summer 2021
Army Navy Drive Complete Streets [3]	Multi-modal improvements along Army Navy Drive between South Joyce Street and 12th Street including constructing a dedicated bicycle facility and improving transit accommodations	2021
Arlington National Cemetery Southern Expansion Project and Associated Roadway Realignment	Interchange improvements to remove the NW and SW ramps and conversion to a diamond configuration to increase the contiguous area of Arlington National Cemetery	TBD [4]
Pentagon Master Plan South Parking Lot Improvements	Reconfiguration of the South Parking Lot as part of the Pentagon Master Plan	TBD [5]

[1] Not included in base year conditions due to recent opening of the HOV ramp and adjustment period required for full utilization of the ramp
[2] Not included in the CLRP, but recently completed
[3] Not included in the CLRP; however, funding for the project was included in the approved Arlington County 2015-2024 Capital Improvement Program (CIP)
[4] Sponsoring agencies are planning to incorporate this project into 2017 CLRP; anticipate completion between 2020 and 2040
[5] The South Parking Lot Improvements associated with the Pentagon Master Plan will be completed following construction of the interim improvements to the South Parking Lot that are incorporated into the I-395 Express Lanes Extension

4.2.4 Seminary Road and Beauregard Street Ellipse

This project involves modifications to the existing Seminary Road at Beauregard Street intersection to an ellipse design to eliminate weaving issues along westbound Seminary Road and to increase capacity of the intersection. The existing intersection will be shifted slightly to the south to accommodate eastbound Beauregard Street. A new signalized intersection with Seminary Road to the north will accommodate westbound Beauregard Street. Left-turning vehicles along Seminary Road will be directed into the ellipse to access Beauregard Street. Additional signalized access will be provided for the Southern Towers Apartments. The project is included in the CLRP and currently scheduled to be complete in 2020. Additional project information is located at:

https://www.alexandriava.gov/uploadedFiles/BeauregardPlanTransportation-AnalysisFinal.pdf (accessed 10/31/16).

4.2.5 Boundary Channel Drive Interchange

This project involves modifications to the existing I-395 and Boundary Channel Drive Interchange to improve operations and reduce weaving along southbound I-395. The project will include construction of two single-lane roundabouts at the I-395 ramp termini with Boundary Channel Drive. Additionally, connections to Long Bridge Park Drive and US Route 1 will be constructed and multi-modal improvements will be incorporated. An Interchange Modification Report (IMR) is currently being prepared by Arlington County and the project is scheduled to be completed in 2021. Additional project information is located at: https://projects.arlingtonva.us/projects/boundary-channel-drive-interchange/ (accessed 10/31/16).

4.2.6 Army Navy Drive Complete Streets

This project includes the construction of multi-modal improvements along Army Navy Drive between S. Joyce Street and 12th Street and will include a dedicated bicycle facility and improved transit accommodations. Funding for the project was included in the approved Arlington County 2015-2024 Capital Improvement Program (CIP). Preliminary engineering is underway with construction anticipated to begin in 2019 and project completion in 2021. Additional project information is located at: http://www.crystalcity.org/area/transformation/army-navy-drive-complete-streets-project (accessed 10/31/16).

4.2.7 Arlington National Cemetery Southern Expansion Project and Associated Roadway Realignment

This project includes modifications to the Washington Boulevard at Columbia Pike (East) Interchange and the realignment of Columbia Pike from S. Joyce Street to the west to increase the contiguous acreage of Arlington National Cemetery. The interchange modifications include the removal of the northwest and southwest loop ramps and converting the interchange to a partial diamond configuration. Southbound Washington Boulevard will access Columbia Pike at a new signalized intersection and access from Columbia Pike to southbound Washington Boulevard will also be provided at the new signal. Columbia Pike will be realigned to the south of its current location.

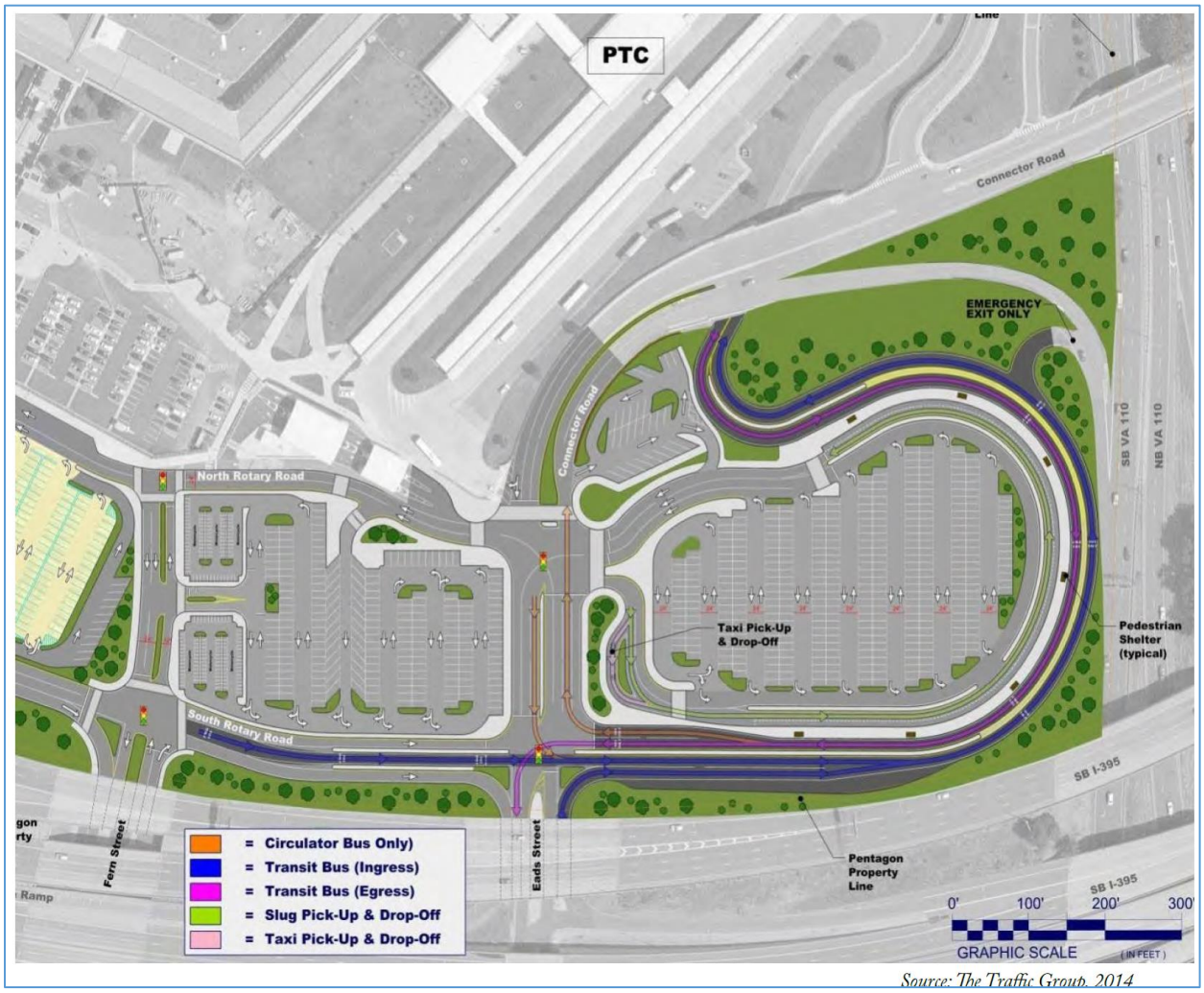
Arlington National Cemetery, the lead agency for the project, has been working with Arlington County and VDOT to pursue to the roadway modifications and land exchange agreement. The U.S. Army Corps of Engineers is preparing an Environmental Assessment for the project. The project is not included in the CLRP; however, sponsoring agencies are planning to incorporate this project into 2017 CLRP. Additional project information is located at: http://www.nao.usace.army.mil/Missions/Military-Construction/ANC-SouthernExpansion/ (accessed 10/31/16).

4.2.8 Pentagon Master Plan South Parking Lot Improvements

The 2015 Master Plan Update for the Pentagon Reservation establishes a long-term vision for the Pentagon and surrounding facilities and includes a reconfiguration of the Pentagon South Parking Lot as shown in **Figure 4-3** (WHS, 2015). The Pentagon Reservation, including the Pentagon Transit Center, accommodates more than 23,000 employees and commuters using the transit center traveling to and from the site every

day. Modifications to the Eads Street Interchange have the potential to affect traffic circulation at the Pentagon Reservation.

Figure 4-3: Pentagon Master Plan South Parking Lot Improvements



Source: The Traffic Group, 2014

The South Parking Lot improvements include the following major components:

- Direct access to the Pentagon Transit Center via a dedicated two-way bus loop that circulates on the eastern perimeter of the South Parking Lot. Transit vehicles will be separated from passenger vehicles and substantial pedestrian conflicts along North Rotary Road.
- Traffic signalization at the Eads Street at South Rotary Road and Eads Street at North Rotary Road intersections. These signals will be coordinated to provide smooth traffic flow and would be coordinated with the signals along Eads Street at the I-395 HOT ramps and Army Navy Drive.
- A dedicated ridesharing (slugging) area within the bus loop to accommodate the substantial ridesharing that occurs within this portion of the South Parking Lot.
- A fourth lane along eastbound South Rotary Road approaching Eads Street that will be used to access the future HOT lanes.

The exact timing of the implementation of the proposed South Parking Lot Improvements is not known at this time and is dependent on federal approvals and funding availability. As such, VDOT and 95 Express have collaborated with Pentagon staff to develop an interim improvement for the South Parking Lot (see **Section 4.4.2**) that is consistent with the longer term Master Plan improvements and would allow the Eads Street Interchange to operate effectively until the ultimate improvements are implemented.

4.3 TRANSPORTATION SYSTEM MANAGEMENT OPTION

A Transportation System Management (TSM) alternative was considered to address the needs of the corridor. TSM strategies focus on improving the operational efficiency of the roadway transportation system without adding major system improvements, such as adding lanes or new ramps. While many TSM strategies currently exist along the I-395 corridor including HOV lanes, ramp metering along the general purpose lanes during peak periods, and substantial transit service along the corridor and additional TSM strategies will be implemented along the I-395 HOT lanes as part of the project including an active traffic management system, the needs of the corridor cannot be adequately satisfied solely by a TSM alternative. Therefore, the TSM alternative was eliminated from detailed study.

4.4 BUILD ALTERNATIVE

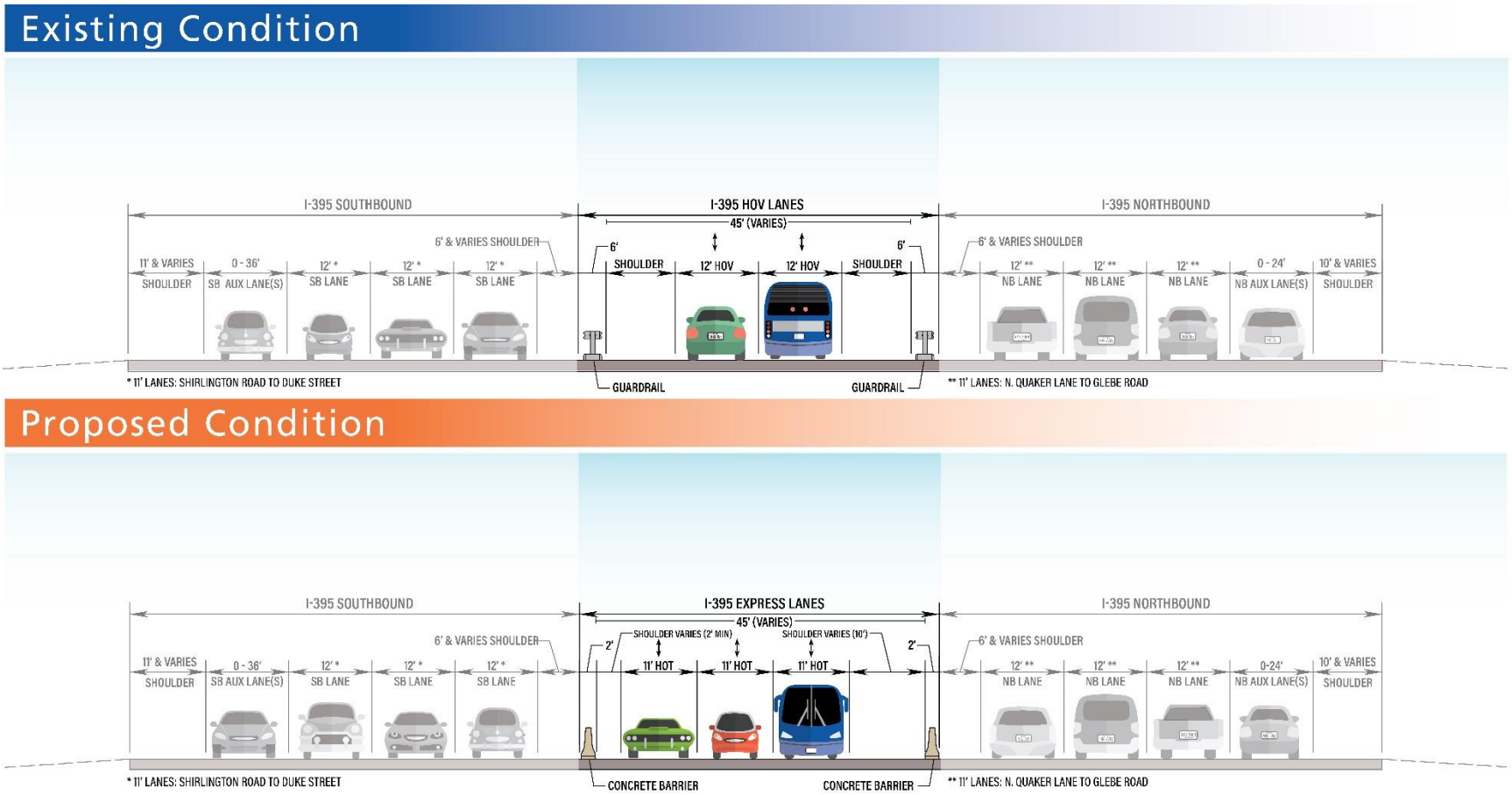
The Build Alternative, shown in **Figures 4-4 through 4-8** (*Volume 2*), converts the two existing reversible HOV lanes within the existing median along the I-395 corridor to three HOT lanes within the existing footprint of the existing HOV facility from the current I-395 HOT lanes terminus at Turkeycock Run to Eads Street near the Pentagon. The expansion of the existing system of reversible HOV lanes located in the median of I-395 is an extension of the existing I-95 Express Lanes (HOT) to the south. For the majority of the project, the existing reversible HOV lanes are separated from the general purpose lanes by guardrail barriers mounted on a 4 to 6-foot wide concrete island. The existing guardrail and the concrete island would be replaced with double face concrete barriers. The proposed concrete barriers would be installed generally with a 2-foot offset along the western edge of the existing concrete island (to be removed), which provides an additional 2-foot shoulder on the southbound general purpose lanes. The wider shoulder would improve the functionality of the inside shoulder of the southbound general purpose lanes. The remaining portion of the additional width gained from the removal of the concrete islands is allocated to the HOT facility to provide the space required for the three HOT lanes and shoulders.

By maximizing the width between the general purpose lanes and reconstructing the existing paved shoulders, the proposed three HOT lanes would largely be accommodated within the footprint of the existing HOV facility. The typical available width for the three-lane HOT lanes facility is approximately 45 feet (variable). The Build Alternative provides a typical section of three 11-foot wide travel lanes with a minimum 2-foot shoulder on the west side and a minimum 10-foot shoulder on the east side. Disabled vehicles and emergency responders would use the east side of the corridor during emergency situations. The easternmost travel lane (11 feet wide) along with the eastern shoulder (generally 10 feet) would provide a 21-foot wide travel way which would be sufficient for the emergency vehicles to access incidents along the corridor. Additionally, four enforcement/emergency pull-off areas have been proposed where space is available including one in the vicinity of the Seminary Road Interchange, on in the vicinity of the Shirlington Interchange and two in the vicinity of the King Street Interchange.

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, 2011* (Green Book) (AASHTO, 2011a) and the *VDOT Road Design Manual* (VDOT, 2016f). A Technical Working Group (TWG), comprised of VDOT, FHWA, 95 Express, and support staff, was formed to guide the development of the Build Alternative. The TWG met on a weekly basis to discuss design issues and constraints and to reach consensus on project design. Additional information regarding the development of the typical section is contained in the *Interstate 395 Express Lanes Environmental Assessment Alternatives Technical Report* (VDOT, 2016b) and the design exceptions and design waivers (see **Appendix G**).

The existing and proposed typical sections are shown below in **Figure 4-9**.

Figure 4-9: Existing and Proposed Typical Section



4.4.1 Proposed Access Points to the HOT Lanes

Table 4-2 summarizes the proposed access modifications along the I-395 study corridor associated with the Build Alternative. With the exception of the Eads Street Interchange, all existing access points would remain in their current geometric configuration. Traffic operations at the northern terminus of the proposed I-395 HOT lanes in the vicinity of the Eads Street Interchange are a critical component of the proposed improvements as discussed in **Section 4.4.2**.

Table 4-2: Access Point Modifications

Access Point		Access	
		Existing	Build Alternative
Turkeycock Run	Ramp from NB HOT lanes to NB GP lanes	AM: NB access from HOT lanes PM: Closed	No change
	Ramp from NB GP lanes to NB HOV lanes	AM: NB access to HOV lanes PM: Closed	AM: NB access to HOT lanes PM: Closed
	Ramp from SB HOV lanes to SB GP lanes	AM: Closed PM: SB access from HOV lanes	AM: Closed PM: SB access from HOT lanes
	Ramp from SB GP lanes to SB HOT lanes	AM: Closed PM: SB access to HOT lanes	No change
Seminary Road – South Facing Ramp		AM: NB access from HOV lanes PM: SB access to HOV lanes (HOV at all times)	No change (would remain HOV at all times)
Seminary Road – North Facing Ramp		AM: NB access to HOV lanes PM: SB access from HOV lanes	AM: NB access to HOT lanes PM: SB access from HOT lanes
Shirlington Road – North Facing Ramp		AM: NB access to HOV lanes PM: SB access from HOV lanes	AM: NB access to HOT lanes PM: SB access from HOT lanes
Washington Boulevard – South Facing Ramp		AM: NB access from HOV lanes PM: SB access to HOV lanes	AM: NB access from HOT lanes PM: SB access to HOT lanes
Eads Street Interchange	Ramp from SB HOV lanes to SB GP Lanes (south of Eads Street)	AM & PM: SB access from HOV lanes	Ramp removed
	Eads Street – NB Off Ramp from HOV	AM: NB access from HOV lanes PM: Closed	AM: NB to Army Navy Drive from HOT lanes PM: SB from Army Navy Drive to HOT lanes
	Eads Street – SB On Ramp to HOV	AM & PM: SB access to HOV lanes	AM: NB to Pentagon from HOT lanes PM: SB from Pentagon to HOT lanes
	Eads Street – NB On Ramp to HOV	AM & PM: NB access to HOV lanes	AM & PM: NB access to HOT lanes
	Eads Street – SB Off Ramp from HOV	AM & PM: SB access from HOV lanes	No change
NB Ramp from GP Lanes to HOV Lanes north of Eads Street		AM & PM: NB access to HOV lanes	AM & PM: NB access to HOT lanes

With the exception of the south facing ramp at the Seminary Road Interchange which would remain an HOV ramp at all times, all other access points to and from the proposed I-395 HOT lanes would be converted to HOT ramps.

4.4.2 Eads Street Interchange

The Build Alternative includes modifications to the Eads Street Interchange at the proposed northern terminus of the I-395 HOT lanes. This interchange is a critical location in the I-395 HOT lanes facility as Eads Street serves the Pentagon Reservation and the Pentagon Transit Center, a major transit hub for the Washington, D.C. region, and is a primary origin and destination for transit providers and motorists using the existing I-395 HOV lanes.

As discussed below, several options have been considered for the northern terminus of the project at the Eads Street Interchange. Accessibility and congestion reduction in this area are critical elements for future use of the I-395 HOT lanes. The Eads Street Interchange poses challenges in balancing the needs of all transportation users including transit vehicles, HOV motorists, and pedestrians. A key challenge at the Eads Street Interchange is managing traffic operations between the general purpose and HOT lanes in a congested and constrained area with limited opportunity for expansion. Maintaining free-flowing and safe traffic operations on the HOT lanes at the northern terminus and the Eads Street Interchange approach is imperative in order to ensure high quality service for transit vehicles, HOVs, and toll-paying customers.

Another key component of the Eads Street Interchange is the compatibility with improvements proposed on the Pentagon Reservation. The 2015 Master Plan Update for the Pentagon Reservation establishes a long-term vision for the Pentagon and surrounding facilities and includes a reconfiguration of the Pentagon South Parking Lot as shown above in **Figure 4-3** (WHS, 2015). The Pentagon Reservation, including the Pentagon Transit Center, accommodates more than 23,000 employees and commuters using the transit center traveling to and from the site every day. Modifications to the Eads Street Interchange have the potential to affect traffic circulation at the Pentagon Reservation.

The South Parking Lot improvements include the following major components:

- Direct access to the Pentagon Transit Center via a dedicated two-way bus loop that circulates on the eastern perimeter of the South Parking Lot. Transit vehicles would be separated from passenger vehicles and substantial pedestrian conflicts along North Rotary Road.
- Traffic signalization at the following four intersections within the South Parking Lot: Eads Street at South Rotary Road, Eads Street at North Rotary Road, Fern Street at South Rotary Road and Fern Street at North Rotary Road. These signals would be coordinated to provide smooth traffic flow within the parking lot and would include signalized pedestrian crossings.
- A dedicated ridesharing (slugging) area within the bus loop to accommodate the substantial ridesharing that occurs within the South Parking Lot.
- Other pedestrian amenities within the parking lot to accommodate the heavy pedestrian travel patterns between the parking lots, Pentagon Transit Center, and the ridesharing areas.

The exact timing of the implementation of the proposed South Parking Lot Improvements is not known at this time and is dependent on federal approvals and funding availability. As such, VDOT has worked closely

with Pentagon staff to develop an interim improvement for the South Parking Lot that is consistent with the longer term Master Plan improvements and would allow the Eads Street Interchange to operate effectively until the ultimate improvements are implemented.

Options Analyzed During Prior Studies (2004 – 2009): An initial range of twelve options for the Eads Street Interchange were considered as part of the original efforts to develop the I-395 Express Lanes project between 2004 and 2009. The initial range of Eads Street Interchange options generally consisted of two families of options:

- *Dedicated Entry and Exit Ramps To and From I-395 HOT Lanes:* Two options would maintain the current ramp configurations between the I-395 HOT lanes and Eads Street including a northbound I-395 HOT lanes off-ramp to Eads Street and a southbound on-ramp from Eads Street to the southbound I-395 HOT lanes.
- *Reversible Entry and Exit Ramps To and From I-395 HOT Lanes:* Ten options would include a reversible operation of one or both of the ramps between Eads Street and the I-395 HOT lanes south of Eads Street in addition to modifications to traffic flow and lane configurations along Eads Street and South Rotary Road.

The *Interstate 395 Express Lanes Environmental Assessment Alternatives Technical Report* (VDOT, 2016b) provides a detailed summary of each of the twelve options including a screening of the prior options and the reasons why the options were eliminated from further consideration or retained as part of the current study efforts. As a result of the screening, two refined options considered as part of the 2004 through 2009 studies and two new options were be considered as part of the current study efforts were identified that would best meet the project purpose and need and current constraints of the project including the proposed improvements associated with the Pentagon Master Plan. Following is a description of the four options.

Single Reversible Eads Street Ramp

The single reversible Eads Street ramp option would convert the existing I-395 NB HOV off-ramp to Eads Street into a widened three-lane, reversible ramp (see **Figure 4-10** and **Figure 4-11**). All existing traffic movements would be maintained at the Eads Street Interchange with additional capacity provided to and from Eads Street during the AM and PM peak hours. Traffic signals would be provided along Eads Street at both the NB and SB I-395 HOT ramps. Expansion of the existing NB I-395 HOV off-ramp to three lanes would require reconstruction of the I-395 HOV bridges over Fern Street and potentially Eads Street which would result in major access and maintenance of traffic challenges during construction and therefore, this option was not considered further.

Figure 4-10: Single Reversible Eads Street Ramp

Figure 4-11: Single Reversible Eads Street Ramp

Dedicated Bus Lane and Right-Turn Lane

This option would widen the NB I-395 HOV off-ramp to Eads Street and establish a bus-only left-turn lane and right-turn lane along the ramp. All traffic (excluding buses) would be directed to make a right-turn onto Eads Street toward the Army Navy Drive intersection (see **Figure 4-12** and **Figure 4-13**). Traffic would then continue to Fern Street to access the Pentagon Reservation. In this option, Eads Street through traffic would be limited to transit based vehicles by creating dedicated bus lanes from the HOT lanes to the Pentagon Reservation. Although the dedicated bus lanes create a more roundabout method of entering the Pentagon for non-transit traffic, this option simplifies the Eads Street intersection operations and prevents reconstruction of the existing I-395 bridges.

Directing all traffic entering the Pentagon Reservation from the I-395 NB HOT lanes (excluding transit vehicles) to use Army Navy Drive and Fern Street would increase traffic volumes along these streets and would require roadway improvement to mitigate the impacts. Additionally, the diverted traffic volumes would increase pedestrian and vehicle conflicts since Fern Street is the designated pedestrian route to the Pentagon (pedestrians are currently prohibited along Eads Street). Lastly, this option would provide a minimal increase to capacity on the Eads Street ramp compared to existing conditions. For these reasons, this option was not considered further.

Figure 4-12: Dedicated Bus Lane and Right Turn at Eads Street Ramp

Figure 4-13: Bus Lane and Right Turns at Eads Ramp

Diverging Diamond Interchange

A diverging diamond at the Eads Street Interchange would shift mainline traffic on Eads Street to the opposite side of the roadway in order to receive the I-395 HOT ramps beyond the two proposed signals (see **Figure 4-14**). All existing traffic movements would be retained with this option. The ramps would maintain their current operational functionality as exit/entrance ramps from the I-395 HOV (future HOT) lanes. The proposed diverging diamond configuration would simplify I-395 HOT egress and ingress movements, as well as reduce the number of signal phases at the ramp signals. Although this option would reduce the number of turning conflicts at the interchange, introducing a diverging diamond at this location is an unconventional intersection configuration considering the traffic volumes, emergency evacuation procedures at the Pentagon Reservation, and the dual General Purpose and proposed HOT facility.

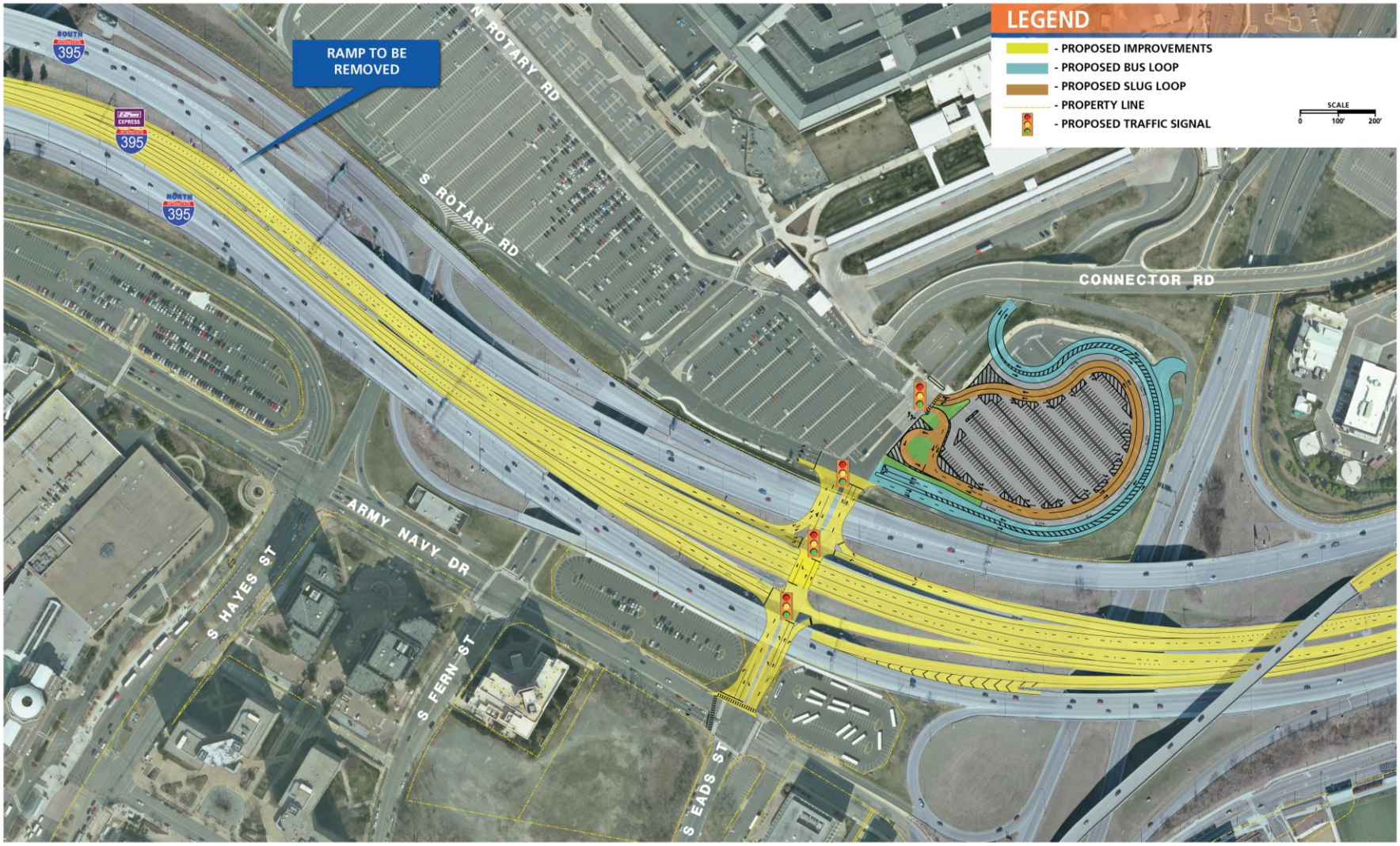
Based on the existing configuration of the Eads Street Interchange at the I-395 HOV ramps, the restricted width under the existing I-395 HOV bridge (future I-395 Express Lanes Bridge) does not accommodate an optimal diverging diamond interchange configuration. Diverging diamond interchanges rely on proper crossover intersection angles in order to minimize the potential for wrong way movements. In order to achieve the desired crossover intersection angles (i.e., as close as possible to 90 degrees), this option would likely require reconstruction of the I-395 HOV bridge over Eads Street. This would result in access and maintenance of traffic challenges during construction and therefore this option was not considered further.

Figure 4-14: Diverging Diamond at Eads Street

Dual Reversible Eads Street Ramps

The Dual Reversible Eads Street Ramps option would increase capacity to and from Eads Street by dividing traffic between two reversible ramps (see **Figure 4-15),** providing a total of four ramp lanes traveling to and from Eads Street. **Figures 4-16** and **4-17** (*Volume 2*) depict the operation of the interchange during both the AM and PM peak periods. The NB I-395 HOV off-ramp to Eads Street would operate NB in the AM peak period and SB in the PM peak period for traffic traveling to and from Army Navy Drive and the Pentagon City area. The existing ramp from Eads Street to the SB I-395 HOV lanes would be expanded to two lanes approaching the intersections at Eads Street and operate NB in the AM peak period and SB in the PM peak period for traffic traveling to and from the Pentagon Reservation. The use of existing ramp and bridge infrastructure would not require reconstruction of the interchange and comparatively reduced maintenance of traffic impacts.

Figure 4-15: Dual Reversible Eads Ramps



As part of this option, the access to the SB I-395 general purpose lanes from the existing SB I-395 HOV lanes would be removed. Access to the SB I-395 general purpose lanes would be provided via Hayes Street/Army Navy Drive, Washington Boulevard/Columbia Pike, and Boundary Channel Drive instead of the current ramp. This would eliminate a weave condition along the SB I-395 HOV lanes and eliminate a merge condition along the SB I-395 general purpose lanes in an area with a high density of access points.

This option would retain the current circulation patterns within the Pentagon Reservation and is consistent with the Pentagon Master Plan improvements in the Pentagon South Parking Lot. Four traffic signals would be constructed along Eads Street at the two I-395 HOT ramp intersections, at South Rotary Road, and at North Rotary Road.

The Dual Reversible Eads Street Ramps option was selected as the preferred option for detailed study as part of the Build Alternative because this option significantly increases capacity on the two ramps serving Eads Street from the south (providing four ramp lanes) and minimizes turning conflicts at the signalized intersections proposed along Eads Street. This option also minimizes disruption to the Pentagon South Parking Lot compared to other previously considered options.

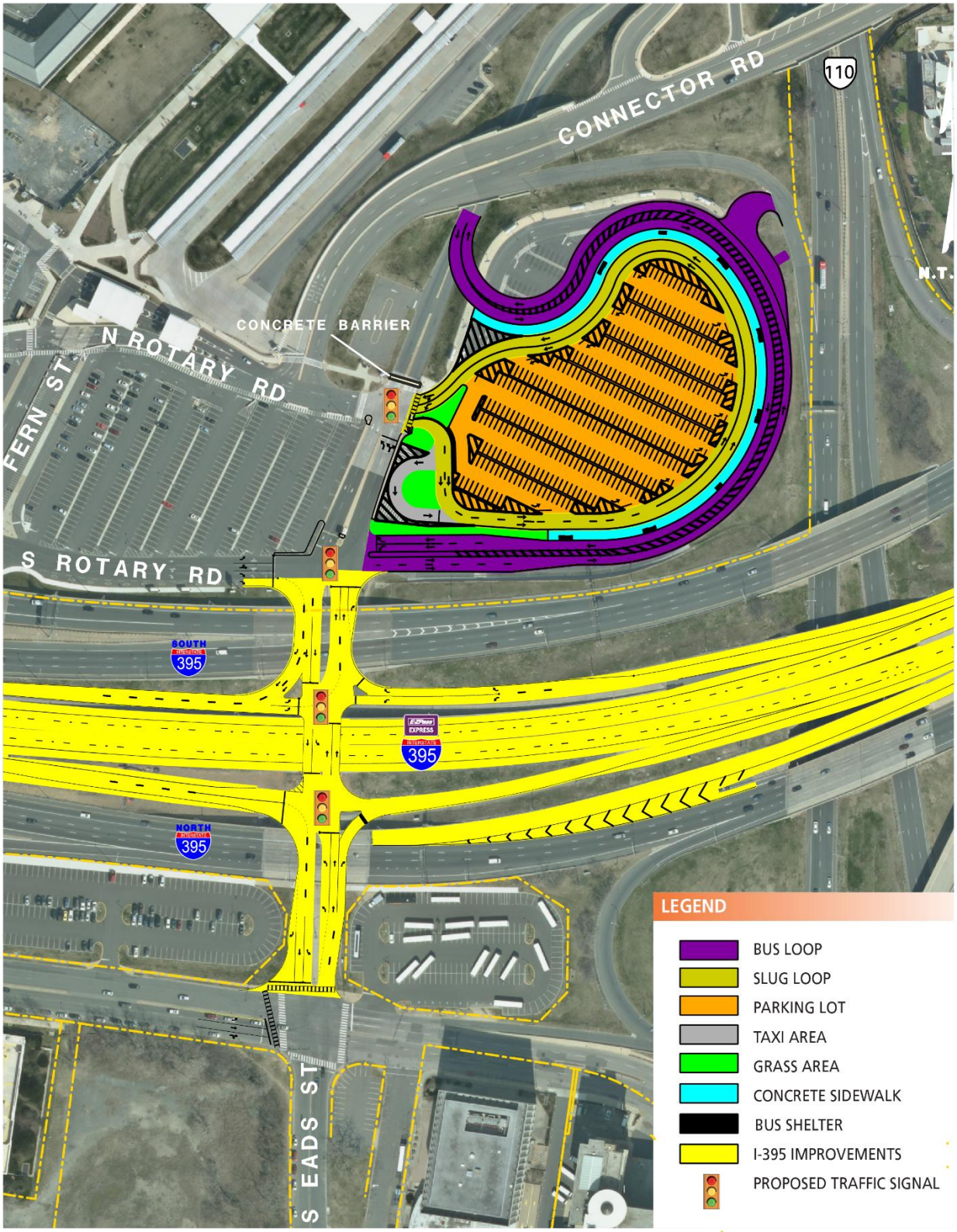
4.4.3 Pentagon Interim Improvements

As noted above, the timing of the improvements to the Pentagon South Parking Lot is unknown at this time; however, some improvements to the South Parking Lot are required in order to create a smooth transition between the improvements planned at the Eads Street Interchange and within the Pentagon Reservation.

During the development of the interchange alternatives at Eads Street, VDOT worked very closely with Pentagon staff to develop an interim solution for the Pentagon South Parking Lot that is consistent with the long-term plans proposed as part of the Pentagon Master Plan and also meets the operational needs of the I-395 Express Lanes project. **Figure 4-18** depicts the planned improvements within the South Parking Lot that would be constructed as part of the Eads Street Interchange improvements associated with the I-395 Express Lanes project. The interim improvements incorporate the following components:

- Direct access to the Pentagon Transit Center via a dedicated two-way bus loop that circulates on the eastern perimeter of the South Parking Lot. Transit vehicles would be separated from passenger vehicles and substantial pedestrian conflicts along North Rotary Road.
- Traffic signalization at the Eads Street at South Rotary Road and Eads Street at North Rotary Road intersections. These signals would be coordinated to provide smooth traffic flow and would be coordinated with the signals along Eads Street at the I-395 HOT ramps and Army Navy Drive.
- A dedicated ridesharing (slugging) area within the bus loop to accommodate the substantial ridesharing that occurs within this portion of the South Parking Lot.
- A fourth lane along EB South Rotary Road approaching Eads Street that would be used to access the future HOT lanes. The lane would be open to traffic during the PM period when the I-395 HOT lanes are operating in a southbound direction.

Figure 4-18: Pentagon South Parking Lot Interim Improvements



5. ROADWAY GEOMETRY

5.1 DESIGN CRITERIA

The proposed project design was established in accordance with AASHTO, FHWA, and VDOT design guidelines. The following documents were used in the development of the design criteria table provided in **Appendix F**:

- FHWA, Price Managed Lane Guide, 2012
- AASHTO, Green Book, 2011
- AASHTO, A Policy on Design Standards – Interstate System, 5th Edition, 2005
- AASHTO, Roadside Design Guide, 4th Edition, 2011
- AASHTO, Guide for High-Occupancy Vehicle Facilities, 2004
- VDOT, Road Design Manual, August 2016
- VDOT, Manual of the Structure and Bridge Division, Volume V, Part 2, 2011
- VDOT, Drainage Manual, July 2016
- VDOT, Guardrail Installation Training Manual, February 2015
- VDOT, Instructional and Informational Memoranda

These documents were used to develop the proposed design within the project limits. Where the design standards could not be met, appropriate design exceptions or waivers have been obtained. An overview of the criteria shown in **Table 5-1** reflects the selected standards for each roadway classification. Along the I-395 Express Lanes, Segment 1 refers to the area between Turkeycock Run and the Memorial Drive underpass and Segment 2 refers the area from the Memorial Drive underpass to the Potomac River.

Table 5-1: Design Criteria

	I-395 Express Lanes	Eads Street	One Lane Ramps
Functional Classification	Urban Freeway GS-5	Urban Collector GS-7	Ramp GS-R
Average Daily Traffic (ADT)	55,000	21,000	5,000 - 21,000
Design Speed	Segment 1: 65 MPH Segment 2: 55 MPH	35 MPH	30 - 50 MPH
Lane Width	Segment 1: 11 ft Segment 2: 12 ft	12 ft	17 ft (Pavement)
Shoulder Width	2 ft – 10 ft	Curb and Gutter	8 ft Right – 4 ft Left
Superelevation Standard	TC-5.11R, 8% Max	TC-5.11U, 4% Max	TC-5.11R, 8% Max
Min. Vertical Clearance	16.5 ft	16.5 ft	16.5 ft
Max. Vertical Grade	5%	5%	7% at 30 MPH 5% at 50 MPH
Min. Vertical Grade	0.5%	0.5%	0.5%

The design vehicle for the proposed roadway improvements is assumed to be an Intercity Bus (Motor Coach) BUS-45. In general, intercity buses may be used for the design of state highways that are designated bus routes and have relatively low numbers of trucks, such as the Express Lanes, which prohibit vehicles

with 3 or more axles. The use of buses as a design vehicle requires wider pavement areas at intersections to provide adequate room for turning movements.

5.2 DESIGN CONSTRAINTS

The I-395 corridor is a heavily developed area with limited opportunities for widening to expand the highway infrastructure. Any widening to the existing footprint of the existing HOV facility would require an extensive redesign of the I-395 general purpose lanes. Impacts would include, but not be limited to, interchange redesign, bridge expansion, retaining and sound wall relocations, drainage redesign, Intelligent Transportation System (ITS)/Traffic Management System (TMS) relocation, right of way impacts, and major disruptions to traffic operations during construction. The individual design waivers and design exceptions required for the Build Alternative are summarized in **Section 5.5**. Safety and mitigation strategies pertaining to the usage of design waivers and exceptions throughout the corridor are discussed in their respective reports.

The Build Alternative converts the two existing reversible HOV lanes within the existing median along the I-395 corridor to three HOT lanes within the existing footprint of the HOV facility from the current I-395 HOT lanes terminus at Turkeycock Run to Eads Street near the Pentagon. The expansion of the existing system of reversible HOV lanes located in the median of I-395 is an extension of the existing I-95 Express Lanes (HOT) to the south along I-95. For the majority of the project, the existing reversible HOV lanes are separated from the general purpose lanes by guardrail barriers mounted on a 4 to 6-foot wide concrete island.

5.3 RIGHT-OF-WAY AND LIMITED ACCESS REQUIREMENTS

Under the current Build Alternative, no changes to the limited access are anticipated. It is anticipated that the project will require right of way acquisitions and / or easements for the following proposed elements: signage, power facilities, noise barriers, and temporary construction areas to accommodate signal installation. Signage easements would require approximately 0.02 acres, power easements would require approximately 0.2 acres, noise barriers would require approximately 5.06 acres, and temporary construction to install signal easements would require approximately 0.02 acres. The following is a summary of the easements anticipated for each design element.

5.3.1 Signage Easements

There is a potential need for permanent easements for areas where new signage is proposed to be installed on the arterial roads interchanging with I-395. Approximately 37 new sign structures are proposed along the project corridor. Twenty-eight of these structures are estimated to be fully within VDOT right of way, while nine structures would be partially or fully outside of VDOT right of way, requiring easements totaling approximately 0.02 acres.

5.3.2 Power Easements

Four service panels are anticipated to require new service for power, with one anticipated to require a new easement consisting of approximately 0.2 acres.

5.3.3 Noise Barrier Right of Way or Easements

Noise barrier requirements and locations have not been finalized; however, minor right of way and/or easements may be necessary. Based upon preliminary design, approximately 5.06 acres may be required. This estimate is based on a conservative estimate of the right of way width required to construct and maintain the barriers (approximately 30 feet). During the final design noise analysis, barrier locations would be refined and may be shifted to be fully located within the VDOT right of way. Of the 5.06 acres of potential right of way/easements potentially required for noise barriers, approximately 2.41 acres have been estimated to be within historic resource properties.

5.3.4 Signal Easements

A temporary construction easement of approximately 0.02 acres is anticipated to be required to allow for construction of a proposed signal installation in the southwest corner of the Army Navy Drive and South Eads Street Intersection. While the signal would be within VDOT right of way, the construction easement is anticipated to be required to install the traffic signal.

5.4 GEOMETRIC CONFIGURATION

The alternatives considered during the design process and details of the preferred alternative are discussed in detail in **Chapter 4.**

5.5 DESIGN EXCEPTIONS AND WAIVERS

The Build Alternative requires approval of several design exceptions and design waivers as summarized in **Tables 5-2 and 5-3**. The Build Alternative was developed using current design guidelines including the AASHTO *A Policy on the Geometric Design of Highways and Streets, 2011* (Green Book) (AASHTO, 2011a) and the VDOT *Road Design Manual* (VDOT, 2016f). A Technical Working Group (TWG), comprised of VDOT, FHWA, 95 Express, and support staff, was formed to guide the development of the Build Alternative. The TWG met on a weekly basis to discuss design issues and constraints and to reach a consensus on the project design. Tables summarizing the Design Criteria that were used to develop the design concept are included in **Appendix F**. The design criteria was reviewed and approved by VDOT and FHWA. Overall, the design criteria are based on the functional classification of the roadway as an urban freeway. Based on these requirements, design exceptions and waivers were developed in situations where the Build Alternative failed to meet the specific design standards. The Design Exceptions (DE) and Design Waivers (DW) are included in **Appendix G** including maps depicting the location of the DEs and DWs.

Table 5-2: Summary of Design Exceptions

Design Exception Number	Design Exception	Required Value	Value Provided
DE-10	Stopping Sight Distance on I-395 Express Lanes	645 ft (VDOT)	570 ft
		645 ft (AASHTO)	
DE-11	Reduced Lane and Shoulder Widths on I-395 Express Lanes	12 ft Lane 4 ft LT/10 ft RT Shoulder (VDOT)	11 ft Lane 2 ft LT/10 ft RT Shoulder
		12 ft Lane 4 ft LT/10 ft RT Shoulder (AASHTO)	
DE-12	Reduced Superelevation Rate	7.0% (Curve 1) 6.5% (Curve 2)	5.7-6.4% (Curve 1) 6.2% (Curve 2)
DE-13	Reduced Shoulder Width – Spot Reduction	4 ft LT/10 ft RT (VDOT)	2 ft LT/10 ft RT
		4 ft LT/10 ft RT (AASHTO)	
DE-14	In-fill Walls	BPPS-1 BPPS-3	In-fill walls

Table 5-3: Summary of Design Waivers

Design Waiver Number	Design Waiver	Required Value	Value Provided
DW-19	Total Shoulder Width on I-395 Express Lanes One-Lane Ramps	10 ft	Varies
DW-20	Posted Speed Same as Design Speed on I-395 Express Lanes	60 MPH (Segment 1) 50 MPH (Segment 2)	65 MPH (Segment 1) 55 MPH (Segment 2)
DW-21	Use of Class I CRR for Bridge Repairs	Class III CRR	Class I CRR
DW-22	GS-11 Shoulder Restoration	ST'D GS-11	Slope away from barrier
DW-23	Reduced Turn Lane Taper Lengths	100 ft	50 ft
DW-24	Vertical Clearance	16.5 ft	16.0 ft

5.5.1 Stopping Sight Distances (DE-10)

The proposed design speed of the curve at Shirlington South Rotary flyover bridge is 65 MPH and it requires a minimum horizontal stopping sight distance (HSSD) of 645 feet. The clear face to face width between existing barriers under the Shirlington South Rotary Bridge is 42.83 feet and the clear with between piers at this location is 46.83 feet. In order to provide the minimum HSSD, a horizontal sight offset of 14.12 feet from the face of the west barrier is required, which will provide an 8.62 feet wide west shoulder, three 11-foot lanes, and a 3.2-foot wide east shoulder. However if the proposed design speed is reduced to 60 MPH, the required HSSD will be 570 feet. In order to provide the 570 feet of HSSD, a horizontal sight distance offset of 11.03 feet is required, which will provide a 5.5-foot wide west shoulder, three 11-foot lanes, and a 3.3-foot wide east shoulder between the barriers under the bridge. Alternatively, the replacement of bridge pier protection barriers with infill walls could provide an additional 4 feet that would increase the width of the east shoulder to 7.33 feet.

Since the sight distance restriction under the bridge is for a short distance, the TWG decided that it would be more desirable to maintain the corridor Design Speed of 65 MPH throughout Segment 1, provide advisory signs for a 60 MPH speed on both sides of the curve at Shirlington South Rotary bridge, and request a design exception for horizontal sight distance at this location instead of lowering the design speed.

5.5.2 Reduced Lane and Shoulder Widths (DE-11)

The purpose of this Design Exception is to request reductions of lane and shoulder widths below the minimum width required for the at-grade pavement portion of the facility throughout the length of the project.

The project will provide three 11-foot wide HOV/HOT travel lanes from Turkeycock Run to the Memorial Drive underpass. The three-lane configuration maintains continuity with the 95 Express Lanes project which currently ends near Turkeycock Run. North of the Memorial Drive underpass, the 11-foot lanes transition back to 12-foot lanes, south of the Washington Boulevard interchange. The 12-foot lanes are within Segment 2 of the corridor which is a hot-spot location based on VDOT's highway safety criteria. The 12-foot lanes are provided because of the horizontal curve requirements and the wider lanes (from 11 feet to 12 feet) will enhance safety within Segment 2. Non-continuous auxiliary lanes and acceleration/deceleration lanes will also be 12 feet wide. A Design Exception Request for lane and shoulder width reduction was previously approved for Segments 3N and 4 of the I-95 Express Lanes project, which is located immediately south of the I-395 Express Lanes project.

The proposed HOV/HOT shoulder widths through this area vary to conform to the remaining space between the HOV/HOT median barriers. The west shoulder width will generally vary between 2 to 4 feet and the east shoulder will generally be 10 feet wide, unless governed by horizontal stopping sight distance requirements. This arrangement provides one functional HOV/HOT shoulder, allowing space for enforcement, maintenance, disabled vehicles, emergency responder access, snow removal, etc.

5.5.3 Reduced Superelevation Rate at Bridges (DE-12)

Due to the tight constraints of the corridor, there are two horizontal curves within the project that cannot achieve the required superelevation rate in some locations. These locations are on existing bridges and would require extensive reconstruction of the bridges in order to achieve the required superelevation rate. At the bridge over Washington Boulevard the required superelevation rate for the 1,492-foot radius horizontal curve is 7%; however, the existing bridge has a varying cross slope between 6.4% and 5.7%. At the bridge over Joyce Street, the required superelevation rate for the 1,712-foot radius horizontal curve is 6.5%; however, the existing bridge cross slope is 6.2%.

5.5.4 Reduced Shoulder Width – Spot Reduction (DE-13)

The purpose of this Design Exception is to request reductions of shoulder widths at multiple locations where localized shoulder width reductions are present or proposed within the project limits due to the presence of existing bridge piers and signs, gantries, light poles, etc.

Reduced shoulders are required to accommodate widened barriers (blisters) for integral structural supports. It is not desirable to reduce the HOV/HOT shoulder to less than two feet, so widening of the west side of the barrier may occasionally impact the adjacent southbound general purpose shoulder. Moreover, the width

of the east side shoulder may also be reduced to less than 10 feet under existing bridges due to presence of existing bridge piers. The narrow shoulder under bridges will transition to 10 feet upstream and downstream of the bridge over a short distance. Additionally, blisters are primarily located within the wide shoulder on the east side of the Express Lanes.

5.5.5 In-Fill Walls (DE-14)

The minimum HSSD clear widths and shoulder widths along the I-395 Express Lanes are constrained beneath the existing bridge piers**.** In order to provide enough space for the three Express Lanes within the existing footprint of the I-395 HOV lanes, the existing roadway alignment must be shifted and shoulder widths reduced.

VDOT's Manual of the Structure and Bridge Division, Volume V, Part 2 (VDOT, 2016e) requires that bridge piers within 30 feet of the edge of travel lane must be protected with an approved pier protection barrier if not designed for collisions. The only standard pier protection systems provided in the Manual are BPPS-1 thru BPPS-3, which require a minimum two-foot barrier width encroachment into the shoulder**.** In several locations, installing these protection systems is not feasible due to the required roadway realignment and bridge reconstruction.

A vertical face, solid, reinforced, cast-in-place in-fill wall/barrier with a top elevation 7.5 feet above proposed finished grade has been proposed as mitigation to the potential shoulder impedance. The wall/barrier will be in line with the piers and not project from the face of pier. The infill walls will be anchored to the existing bridge columns by dowels and special design connections that will effectively isolate the infill from the bridge pier and not significantly modify the pier structural behavior or loading. The proposed wall will transition to standard VDOT median barrier at both terminations of the wall**.**

5.5.6 Total Shoulder Width at One-Lane Ramps (DW-19)

The purpose of this Design Wavier is to request reductions of total shoulder widths below the minimum width required by VDOT standards for One-Lane Ramps.

The total shoulder widths along the existing ramps serving the I-395 HOV lanes are less than the 16 feet as required by VDOT standards with the exception of the Turkeycock Run ramps. The proposed minimum total shoulder width on One-Lane Ramps of the HOV/HOT lanes will be 10 feet or less throughout the project limits, but the total pavement widths will be 18 feet or more for all One-Lane Ramps except for the slip ramp from the southbound HOV lanes to the southbound general purpose lanes located in the vicinity of the Boundary Channel Drive interchange. It is recognized that total shoulder widths have a significant effect on both safety and traffic operations. The proposal to maintain the existing minimum total shoulder widths on One-Lane Ramps to less than or equal to 10 feet minimizes impacts to the existing general purpose lanes. This approach is consistent with adjacent projects and the total pavement widths are similar to ramps in the adjacent Express Lanes facilities. A Design Waiver Request for substandard HOV/HOT Ramp Shoulder Widths was approved for Segments 3N and 4 of the I-95 Express Lanes project, which is located immediately south of the I-395 Express Lanes project.

5.5.7 Posted Speed Same as Design Speed (DW-20)

The purpose of this waiver is to request approval for posting the speed limit the same as the design speed within the corridor. A noted above, Segment 1 refers to the HOV/Express Lanes between Turkeycock Run and the Memorial Drive underpass and Segment 2 refers the area from the Memorial Drive underpass to the Potomac River.

The existing posted speed limit in Segment 1 is currently 65 MPH, which adheres to both VDOT and AASHTO standards for this particular type of roadway. The posted speed limit in Segment 2 is currently 55 MPH to accommodate the tight horizontal curve radii and HSSD restrictions, which also adheres to both VDOT and AASHTO requirements. North of Segment 2, on the 14th Street Bridge, the posted speed decreases to 45 mph. In order to accommodate projected design year traffic volumes and operational requirements, the posted speed limit for Segments 1 and 2 are proposed to be 65 MPH and 55 MPH, respectively.

In order for the projected design year traffic volume to move efficiently through the Express Lanes corridor, the posted speed limits in the corridor should be the highest without compromising the safety of motorists. The topography and existing roadway geometric design permit 65 MPH and higher vehicle speeds in Segment 1. For Segment 2 (already posted at a lower speed limit), ball-bank indicator tests show that the existing roadway curvature is rated for 55 MPH. Hence, the TWG recommended the posted speed limit to be same as the design speed.

5.5.8 Use of Class I CRR for Bridge Repairs (DW-21)

Major bridge repairs that were identified during the field condition assessments generally consist of reconstruction and replacement of existing deck expansion joints, repair of existing bridge decks including patching and milling/overlay deck repairs, surface repairs of existing bridge barriers, widening of existing approach slabs and associated reconstruction of the abutment backwalls to accommodate the proposed widened roadway due to the addition of the third HOT lane.

The purpose and need for this waiver is to reduce the overall material cost for the project by using Class I Corrosion Resistant Reinforcing Steel (CRR) for the bridge repairs in lieu of Class III Corrosion Resistant Reinforcement required per VDOT IIM-S&B-81.6. The proposed type of steel is adequate for the expected service life of the bridge deck. The existing reinforcing is black steel and the bridge deck is expected to be replaced within the next 50 years.

5.5.9 GS-11 Shoulder Restoration (DW-22)

The project will add an additional HOT lane to the existing HOV lanes without adding any additional right of way. In order to accommodate the additional lane, the lanes have been reduced from 12 feet to 11 feet and the existing shoulder widths will be reduced to a 10-foot east shoulder (63% of the corridor) and a 2-foot minimum west shoulder. Approximately 90% of the corridor will have an 8-foot wide or greater shoulder on the east side. Similarly, 50% of the project corridor will have a 4-foot wide or greater shoulder on the west side. The east shoulder will maintain the VDOT standard GS-11 for shoulder slope. However, the west shoulder will not comply with the GS-11 standard for shoulder slope along the entire corridor. In order to maintain GS-11 for the narrow shoulder (west side), the shoulder would be sloped toward the barrier. Rolling the narrow shoulder toward the barrier would be a concern for driver comfort. If a vehicle

tire runs over the shoulder break and the shoulder is sloped toward the barrier, the driver could be pulled toward the barrier. Furthermore, it would also be difficult to pave a narrow shoulder sloped toward the barrier utilizing normal paving equipment which could potentially require more manual work and longer construction durations.

Additionally, maintaining the GS-11 standard for the narrow shoulder (west side) causes concerns with drainage implementation and maintenance along the median barrier. Therefore, the west shoulder will not follow the GS-11 standards and the shoulder will be sloped toward the travel lanes.

5.5.10 Reduced Turn Lane Taper Lengths (DW-23)

The purpose of this Design Wavier is to request the use of a 50-foot turn lane taper length along Eads Street between the I-395 Express Lanes ramps and South Rotary Road. VDOT's standard for taper length for a single turn lane is 100 feet for roads with a 45 MPH or less design speed and an urban classification. There is no posted speed limit along the Eads Street segment under consideration between Army Navy Drive and South Rotary Road; however, a 30 MPH speed limit sign is located on southbound Eads Street south of Army Navy Drive. The taper lengths provided for the turn lanes between the ramps to the I-395 Express Lanes and Army Navy Drive meet the requirements for the design speed of 35 MPH. The right-turn lane from northbound Eads Street to eastbound South Rotary Road (future bus loop) is proposed to prohibit the right turn from the ramp from the southbound I-395 Express Lanes from blocking access to the northbound Eads Street right-turn lane to South Rotary Road and to reduce conflicts with the movements from the northbound I-395 Express Lane ramp.

The proposed turn lane taper lengths along Eads Street between the I-395 Express Lanes ramp and Army Navy Drive are 100 feet, which meet the design standard. However, a 50-foot turn lane taper is proposed for the northbound right-turn lane from Eads Street to South Rotary Road due to safety and site constraints.

5.5.11 Vertical Clearance (DW-24)

The purpose of this design waiver is for substandard vertical clearance at four existing overpass bridges within the corridor: Seminary Road Ramp B (Structure No. 100-2801), Seminary Road Ramp A (Structure No. 100-2802), King Street (Structure No. 100-1821), and Shirlington Circle South Rotary (Structure No. 000-2019). The current VDOT Structure and Bridge Manual requires a minimum vertical clearance of 16 feet and 6 inches and AASHTO requires a minimum vertical clearance of 16 feet. The proposed vertical clearances at the four overpass bridges are listed in **Table 5.4** (rounded down to nearest inch). Due to the geometric constraints with the exiting I-395 HOV lanes being confined within the northbound and southbound general purpose lanes, the roadway cannot be realigned and the bridges cannot be reconstructed at a reasonable cost to achieve the VDOT vertical clearance requirements.

The Seminary Road Ramp B Bridge is located at the eastbound Seminary Road crossing of the proposed I-395 Express Lanes and has an existing vertical clearance of 16 feet and 10 inches. The existing roadway is in a reverse crown and the proposed configuration is similar; however, the location of the crown for the proposed roadway has shifted. The proposed vertical clearance is 16 feet and 5 inches on the west side of the roadway at the face of curb for the proposed pier protection barrier.

The Seminary Road Ramp A Bridge is located at the westbound Seminary Road crossing of the proposed I-395 Express Lanes and has an existing vertical clearance of 16 feet and 9 inches. The roadway cross slope

at this location is similar to the Seminary Road Ramp B Bridge (see above). The proposed vertical clearance is 16 feet and 3 inches on the west side of the roadway at the face of curb for the proposed pier protection barrier.

The King Street Bridge has an existing vertical clearance of 17 feet and 5 inches. The existing and proposed roadway has a normal crown of 2 percent; however, the existing roadway is crowned in the middle and the proposed roadway crown location has shifted. The proposed vertical clearance is 16 feet and 3 inches on the west side of the roadway at the face of curb for the proposed pier protection barrier.

The Shirlington Circle South Rotary Bridge has an existing vertical clearance of 16 feet and 7 inches. Due to the horizontal curvature of the roadway at this location, the existing and proposed roadway cross slope is superelevated to the east; however, additional pavement build-up is required for the proposed condition. The proposed vertical clearance is 16 feet and 0 inches at the edge of travel lane for the east shoulder.

Table 5-4: Existing and Proposed Vertical Clearances

Overpass Bridge Name	Existing Vertical Clearance	Proposed Vertical Clearance at Barrier Edge	Proposed Vertical Clearance at Lane Edge
Seminary Road Ramp B	16’-10”	16’-5”	16’-6”
Seminary Road Ramp A	16’-9”	16’-3”	16’-4”
King Street	17’-5”	16’-3”	16’-4”
Shirlington South Rotary	16’-7”	16’-0”	16’-0”

5.6 CONCEPTUAL SIGNING PLAN AND PAVEMENT MARKING PLAN

Appendix H contains a conceptual signing and pavement marking plan for the Build Alternative. The conceptual signing and pavement marking plan was developed using current design standards and guidelines including the *2009 Manual on Uniform Traffic Control Devices (MUTCD)* (FHWA, 2012a) and the *2011 Virginia Supplement to the MUTCD, Revision 1* (VDOT, 2016i). Existing signing along the I-95 and I-495 Express Lanes facilities was also considered to provide consistent signing with the existing adjacent Express Lanes facilities. The TWG met five times to guide the development of the Conceptual Signing Plan and develop an optimal plan given various physical and operational constraints and challenges along the corridor. The following is a brief summary of some key design features of the Build Alternative signing:

- Due to existing sign clutter within the project corridor, every effort to collocate proposed signage on existing sign structures was made.
- Sign panels were designed in accordance with the latest edition of the MUTCD and 2011 Virginia Supplement to the MUTCD, Revision 1 except for some specific sign panels as identified in the concept plans. Some sign panels were reduced in size to avoid potential structural re-use issues.
- Cursory structural review and analysis of existing sign structures proposed for re-use was performed. If the sign square footage was kept the same or reduced, it was generally recommended that the sign structures could be reused. If the sign square footage increased or loadings varied, it was generally recommended to re-use the sign structure provided an in-depth structural analysis determined the adequacy of re-use.

- Lane use management signs are placed at approximately 1600-foot spacing with additional lane use management signs installed in the vicinity of the Eads Street interchange to control access to the reversible south-facing Eads Street ramps.
- Variable speed limit signs (VSLs) are located with an 800-foot minimum spacing and a 1,400-foot desirable spacing.
- The E-ZPass EXPRESS ONLY "top cap" design is consistent with the branding used on the I-495 and I-95 Express Lanes corridors.

The conceptual signing plan has been issued by Transurban (USA) Inc., on behalf of 395 Express Lanes LLC as part of the Request for Proposals (RFP) to three short-listed offerors. The technical requirements document issued to the offerors prohibits the Design-Build teams from deviating from the concept plan unless previously approved by Transurban and VDOT.

5.7 ENFORCEMENT AT THE NORTHERN TERMINUS

Due to the currently unenforced portion of the HOV lanes north of Eads Street, there are concerns regarding toll violators and HOV-3 enforcement at the northern terminus of the Express Lanes. One of the primary concerns is that without proper enforcement, some non-HOV drivers may switch their E-ZPass transponders to the "HOV 3+ mode" prior to traveling through the northernmost toll gantry located north of Eads Street (Toll Gantry 4) to avoid toll payment. This could potentially increase vehicular demand thereby affecting travel speeds in this section of the Express Lanes north of Eads Street and approaching Washington, DC.

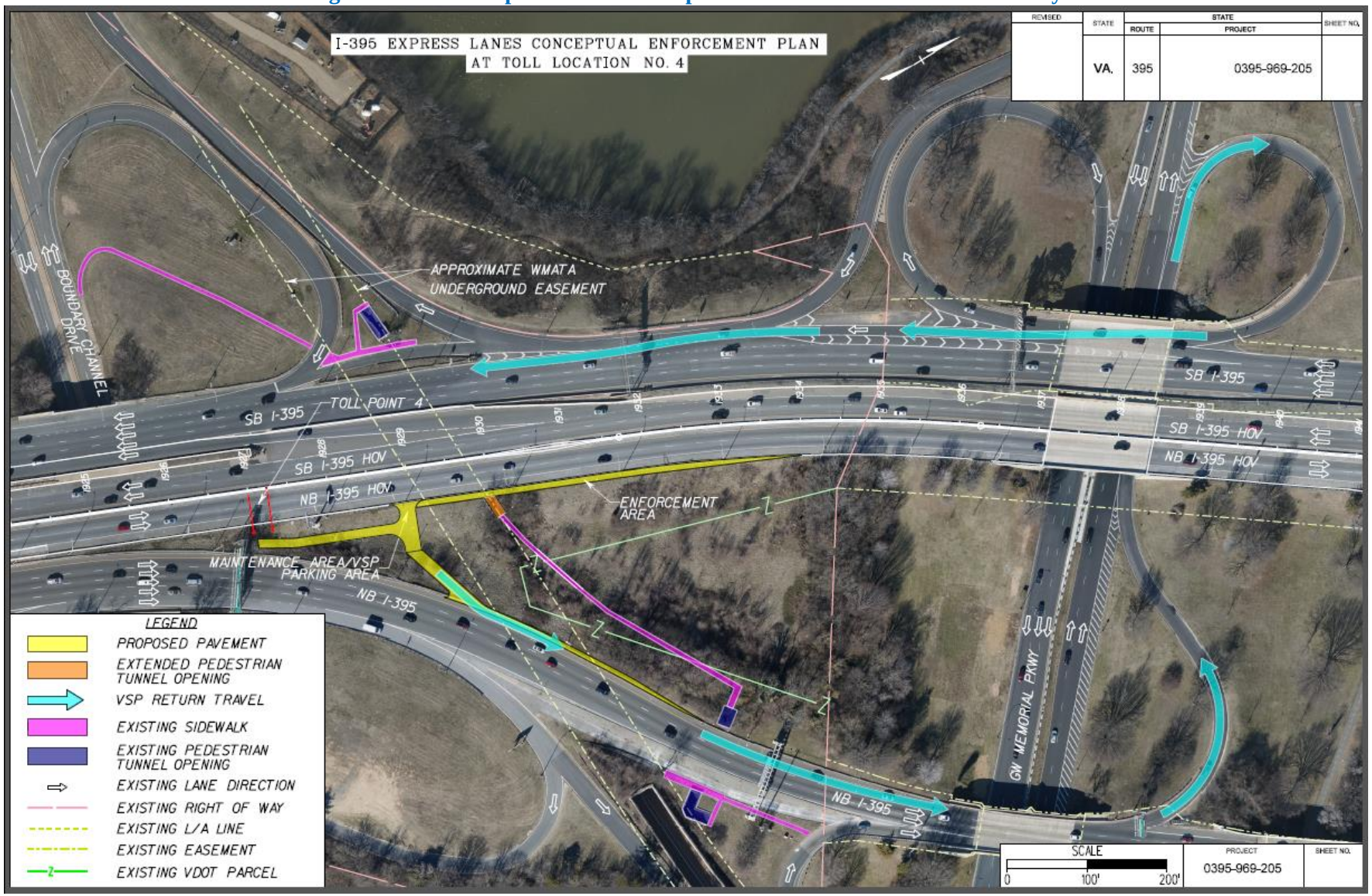
To address concerns regarding toll violators and HOV-3 enforcement at Toll Gantry 4 (located north of Eads Street), 95 Express is pursuing the following phased enforcement approach:

A. Construction of an enforcement area in the vicinity of Toll Gantry 4 that consists of a widened shoulder and emergency cross-over. This will allow Virginia State Police (VSP) vehicles to use visual enforcement at the gantry (similar to the current approach on the I-495 and I-95 Express Lanes) and provide an opportunity to turn around without crossing the Potomac River and entering Washington, DC. The enforcement area is shown in yellow in **Figure 5-1** and the path that the VSP vehicles can follow to avoid crossing into Washington, DC is shown with blue arrows. These improvements would be constructed within existing VDOT right-of-way and provide a new connection between the Express Lanes and the northbound I-395 general purpose lanes and will be signed "For Authorized Vehicle Use Only." VSP vehicles would use the existing George Washington Memorial Parkway interchange ramps to turn around and resume enforcement activities.

B. Implementation of an automated Vehicle Occupancy Detection (VOD) system which will identify vehicles in violation of the minimum vehicle occupancy requirements while traveling within the Express Lanes with a transponder in "HOV 3+ mode." This system would be implemented at two locations along I-395 (at Toll Point 3 and Toll Point 4). A pilot program to test and refine the proposed VOD system – including issuing warning notices to violators – will be initiated on the I-95 Express Lanes in the summer of 2017. 95 Express also intends to explore the ability to issue fines to HOV-3 violators in the future. The issuance of fines using the VOD system is likely to require enabling legislation. However, implementation and application of the VOD system is not dependent on the future ability to assess fines.

95 Express intends to implement both elements of this enforcement approach. The enforcement area and emergency cross-over will be in place at Service Commencement. The schedule for implementing the automated VOD system will be determined following the completion of the pending pilot program. The enforcement area and emergency crossover would remain and be available for use after the implementation of the automated VOD system.

Figure 5-1: I-395 Express Lanes Conceptual Enforcement Plan at Toll Gantry No. 4



6. TRAFFIC VOLUMES

6.1 ANALYSIS YEARS

Traffic volumes were developed for the following scenarios:

- Existing conditions (2015)
- 2020
  - No Build Conditions (including all projects funded through construction based on the National Capital Region Transportation Planning Board's 2015 Constrained Long Range Plan (CLRP))
  - Build Alternative (including the CLRP projects and reflecting the proposed conversion of the two HOV lanes to three HOT lanes and improvements to the Eads Street interchange)
- 2040
  - No Build Conditions (including projects contained in the CLRP)
  - Build Alternative (including the CLRP projects and reflecting the proposed conversion of the two HOV lanes to three HOT lanes and improvements to the Eads Street interchange)

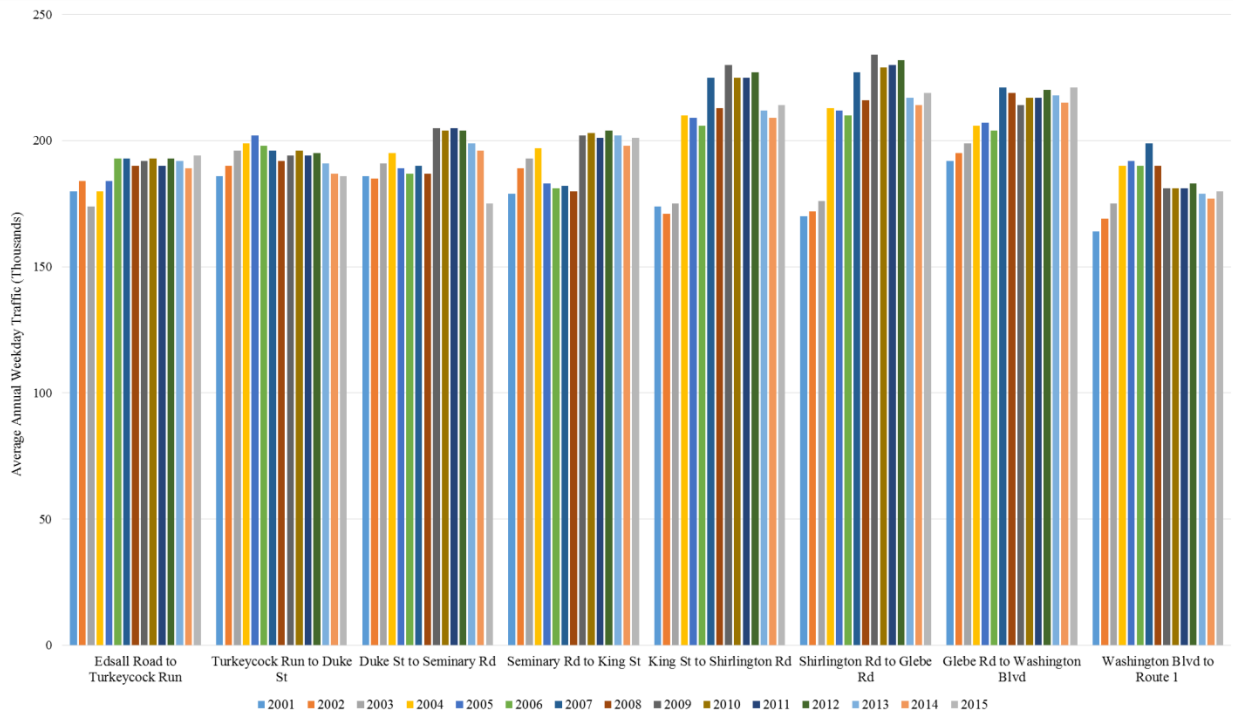
6.2 EXISTING TRAFFIC VOLUMES AND PATTERNS

6.2.1 Travel Patterns

I-395 serves primarily as a commuter route that connects the southern suburban areas of Northern Virginia to the urbanized regional employment core of Washington, D.C. at the northern end of the study area. I-395 also connects to several regional corridors including Washington Boulevard (Route 27), US Route 1 (Jefferson Davis Highway) and George Washington Memorial Parkway at the northern portion of the study area before entering Washington, D.C. The corridor also serves as a local travel route for residents of Fairfax and Arlington Counties and the City of Alexandria. The I-395 corridor provides access to the Pentagon which is a regional transit hub serving the Metro system's Yellow and Blue lines, regional commuter and local buses, formal ridesharing, and informal ridesharing.

Figure 6-1 depicts historic average annual weekday traffic volumes (AAWDT) obtained from the VDOT Traffic Data publications (VDOT, 2016h). AAWDT traffic volumes are shown for 2001 through 2015 along I-395 within the study area. As shown, daily traffic volumes in the general purpose lanes remained relatively unchanged between 2001 and 2015 in the southern portion of the study area between Edsall Road and King Street. Moderate growth has occurred between King Street and Washington Boulevard with a 15 to 30% increase (1% to 2% annually) in daily traffic volumes between 2001 and 2015. From north of Washington Boulevard to Jefferson Davis Highway, traffic volumes have grown by 7 to 10% between 2001 and 2015 (less than 1% annually).

Figure 6-1: I-395 Historical Average Weekday Traffic Volumes



The origin and destination of trips along the I-395 corridor at three locations was obtained from the Metropolitan Washington Council of Governments (MWCOG) Travel Demand Forecasting Model, Version 2.3 Build 57a used to produce the forecasts for the project:

- North of Turkeycock Run
- North of the Glebe Road Interchange
- South of George Washington Memorial Parkway

The distribution of traffic at each location was summarized by direction to understand the points of entry to and exit from the corridor. The following entry / exit regions were defined:

- I-95 (south of I-495)
- I-495 (west and east of I-395)
- Edsall Road
- Little River Turnpike / Duke Street to Seminary Road
- King Street to Glebe Road
- Washington Boulevard to Boundary Channel Drive
- George Washington Memorial Parkway
- Washington, D.C. line (Potomac River)

The following tables provide the distribution of traffic in the northbound and southbound directions for the points of entry to the specific location along the corridor and the destination or exit points from the corridor.

At the southern end of the corridor at Turkeycock Run, in the northbound direction, nearly 70% of the traffic on the corridor is entering from I-95 south of I-495 with 25% entering from I-495 (see **Table 6-1**). The destination of those trips that exit within the corridor is split relatively evenly among the Duke Street to Seminary Road area, the King Street to Glebe Road area, and the Pentagon area between Washington Boulevard and Boundary Channel Drive. Of the traffic at Turkeycock Run, 31%, continues through the entire corridor crossing into the District. The pattern of traffic in the southbound direction at Turkeycock Run is very similar with the same percentage entering from the District, but a higher proportion entering the corridor in the Pentagon area between Washington Boulevard and Boundary Channel Drive. Destinations in the southbound direction are similar to the northbound direction with 71% traveling to I-95, 21% traveling to I-495 and 7% traveling to Edsall Road.

Table 6-1: I-395 @ Turkeycock Run:
Daily Origins and Destinations on I-395 at Southern End of Corridor

Entry / Exit Region		Northbound
Points of Entry	I-95	68%
	I-495	25%
	Edsall Road	7%
I-395 @ Turkeycock Run		**100%**
Points of Exit	Duke Street to Seminary Road	25%
	King Street to Glebe Road	19%
	Washington Boulevard to Boundary Channel Drive	25%
	George Washington Memorial Parkway	0%
	Washington, D.C.	31%

Entry / Exit Region		Southbound
Points of Exit	I-95	71%
	I-495	21%
	Edsall Road	8%
I-395 @ Turkeycock Run		**100%**
Points of Entry	Duke Street to Seminary Road	22%
	King Street to Glebe Road	18%
	Washington Boulevard to Boundary Channel Drive	29%
	George Washington Memorial Parkway	0%
	Washington, D.C.	31%

At the middle portion of the corridor, the distribution of traffic origins in the northbound direction is 40% from I-95, but the majority is from locations along the corridor including over 40% from Duke Street to Glebe Road suggesting a high proportion of local movements on the corridor (see **Table 6-2**). Destinations are nearly evenly split between the Washington Boulevard to Boundary Channel Drive area (Pentagon area) and those traveling across the Potomac River into Washington, D.C. The southbound flow of traffic is very similar with a split of entries to the corridor entering from the Pentagon area and those from the District. Destinations are similarly distributed to locations along the corridor with 40% continuing south to I-95.

Table 6-2: I-395 North of Glebe Road:
Daily Origins and Destinations on I-395 at Mid-Point of Corridor

Entry / Exit Region		Northbound
Points of Entry	I-95	42%
	I-495	13%
	Edsall Road	4%
	Duke Street to Seminary Road	22%
	King Street to Glebe Road	19%
I-395 North of Glebe Road		**100%**
Points of Exit	Washington Boulevard to Boundary Channel Drive	45%
	George Washington Memorial Parkway	0%
	Washington, D.C.	54%

Entry / Exit Region		Southbound
Points of Exit	I-95	43%
	I-495	12%
	Edsall Road	4%
	Duke Street to Seminary Road	24%
	King Street to Glebe Road	17%
I-395 North of Glebe Road		**100%**
Points of Entry	Washington Boulevard to Boundary Channel Drive	50%
	George Washington Memorial Parkway	0%
	Washington, D.C.	50%

At the northern end of the corridor, nearly 100% of the traffic is entering from the District in the southbound direction (see **Table 6-3**). The distribution pattern shows the importance of local destinations along the corridor with only a combined 31% of the traffic going beyond Edsall Road to I-95 and I-495. Nearly half of the trips in the southbound direction exit the corridor in the Pentagon area. The points of entry to the corridor in the northbound direction are very similar with almost half of the traffic entering the corridor in the Pentagon area and approximately 30% entering from points south of Edsall Road.

Table 6-3: I-395 South of George Washington Memorial Parkway: Daily Origins and Destinations on I-395 at Northern End of Corridor

Entry / Exit Region		Northbound
Points of Entry	I-95	22%
	I-495	8%
	Edsall Road	2%
	Duke Street to Seminary Road	12%
	King Street to Glebe Road	9%
	Washington Boulevard to Boundary Channel Drive	46%
I-395 South of George Washington Memorial Parkway		**100%**
Points of Exit	George Washington Memorial Parkway	2%
	Washington, D.C.	98%

Entry / Exit Region		Southbound
Points of Exit	I-95	23%
	I-495	8%
	Edsall Road	2%
	Duke Street to Seminary Road	13%
	King Street to Glebe Road	8%
	Washington Boulevard to Boundary Channel Drive	47%
I-395 South of George Washington Memorial Parkway		**100%**
Points of Entry	George Washington Memorial Parkway	0%
	Washington, D.C.	100%

This origin-destination data indicates that traffic along the corridor is serving local destinations for both trips coming from south of I-495 along I-95 and those coming from the District. As expected, the Pentagon area between Washington Boulevard and Boundary Channel Drive is a significant origin and destination for trips along the corridor because of the many employment opportunities and linkages to surrounding areas served by Washington Boulevard, Jefferson Davis Highway, and Boundary Channel Drive.

The origin-destination data was also aggregated to the County and City boundaries for both the origins and destinations of trips using the corridor at the same three locations. **Tables 6-4 and 6-5** show the percent of origins and destinations within each County and City along the corridor for the three locations (I-395 at Turkeycock Run, I-395 north of Glebe Road, and I-395 south of George Washington Memorial Parkway).

At the southernmost end of the corridor (Turkeycock Run), over 90% of both the origins and destinations are within the defined counties and cities with the largest source of trips coming from Fairfax followed by Prince William and the remainder from Stafford and Spotsylvania (see **Table 6-4**). As anticipated, and consistent with the traffic in the corridor, the largest destinations are Arlington, the District of Columbia, and Alexandria. At the midpoint of the corridor (north of Glebe Road), more local trips are observed with a decrease in origins from points south of I-495. Arlington and the District represent the major destinations with approximately 20% of the trips destined for locations outside the listed destinations in the table. At the northernmost end of the corridor (George Washington Memorial Parkway), over 50% of the trips have destinations within the District of Columbia coming from Alexandria, Arlington and Fairfax.

Table 6-4: Daily Destination and Origin of Trips by County / City on Northbound I-395

Location	Turkeycock Run		North of Glebe Rd		George Wash. Mem Pkwy	
	Origin	Destination	Origin	Destination	Origin	Destination
Alexandria	0.1%	22.0%	25.0%	0.3%	16.1%	0.5%
Arlington	0.0%	35.4%	4.7%	34.6%	36.2%	1.7%
District of Columbia	0.0%	28.8%	0.0%	45.3%	0.0%	55.4%
Fairfax	61.1%	5.9%	47.0%	0.8%	33.8%	0.2%
Falls Church	0.0%	0.0%	0.0%	0.0%	0.6%	0.0%
Prince William	20.0%	0.0%	12.4%	0.0%	6.0%	0.0%
Stafford VA	4.2%	0.0%	3.0%	0.0%	1.4%	0.0%
Fredericksburg	0.5%	0.0%	0.0%	0.0%	0.1%	0.0%
Spotsylvania	8.0%	0.0%	5.6%	0.0%	3.5%	0.0%
Total	**93.9%**	**92.3%**	**97.6%**	**81.1%**	**97.8%**	**57.8%**

In the southbound direction, origins for trips at the southernmost end of the corridor are predominantly from Arlington, the District of Columbia, and Fairfax (see **Table 6-5**). The highest destination area is Fairfax followed by points along I-95 south of the corridor including Prince William, Stafford, and Spotsylvania. The middle portion of the corridor has the majority of origins from Arlington and the District with destinations in Fairfax and Alexandria consistent with the local nature of trips. Trips entering the corridor in the southbound direction are destined for points along the corridor with the majority traveling to Arlington, Fairfax and Alexandria.

Table 6-5: Daily Origin and Destination of Trips by County / City of Southbound I-395

Location	Turkeycock Run		North of Glebe Rd		George Wash. Mem Pkwy	
	Origin	Destination	Origin	Destination	Origin	Destination
Alexandria	0.4%	0.0%	0.0%	23.3%	0.0%	13.6%
Arlington	43.0%	0.0%	36.4%	5.0%	3.8%	36.3%
District of Columbia	35.3%	0.0%	43.8%	0.0%	52.9%	0.2%
Fairfax	10.2%	58.6%	1.0%	47.2%	0.7%	34.3%
Falls Church	0.0%	0.0%	0.0%	0.0%	0.0%	0.7%
Prince William	0.0%	21.5%	0.0%	12.4%	0.0%	6.3%
Stafford	0.0%	4.9%	0.0%	3.0%	0.0%	1.5%
Fredericksburg	0.0%	0.5%	0.0%	0.3%	0.0%	0.2%
Spotsylvania	0.0%	9.9%	0.0%	6.3%	0.0%	4.3%
Total	**88.9%**	**95.5%**	**81.1%**	**97.4%**	**57.4%**	**97.3%**

Figures 6-2 through 6-5 visually depict the origins and destinations of motorists traveling along I-195 north of Glebe Road for the AM and PM peak periods. The distribution of origins and destinations is consistent with the traffic patterns along the corridor and shows that the corridor is serving a large number of local trips along the corridor while also providing a route to the District of Columbia for areas along the corridor and serving trips from areas south of I-495 to destinations along the corridor.

Figure 6-2: Northbound I-395 – North of Glebe Road AM Peak Period Origins

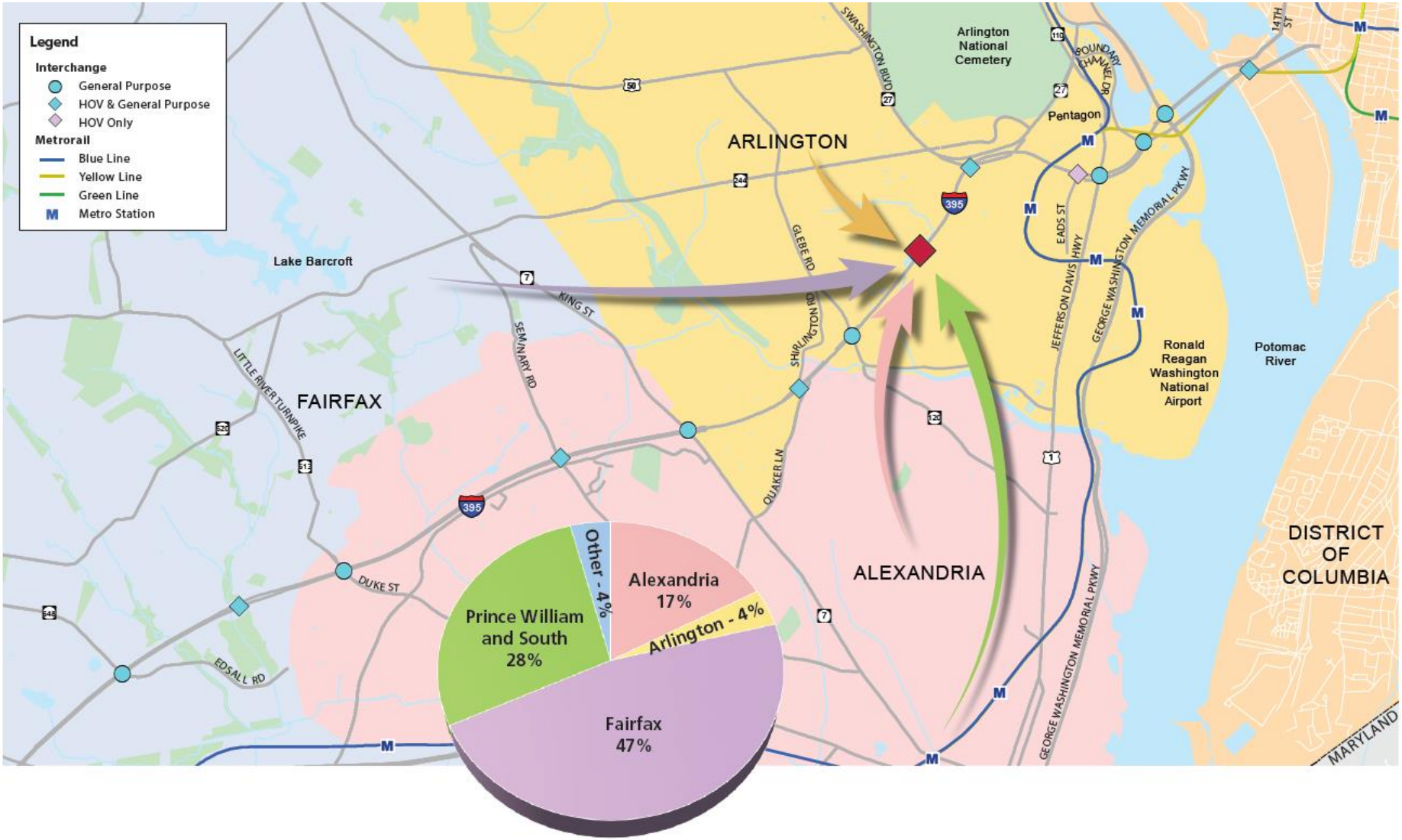


Figure 6-3: Northbound I-395 – North of Glebe Road AM Peak Period Destinations

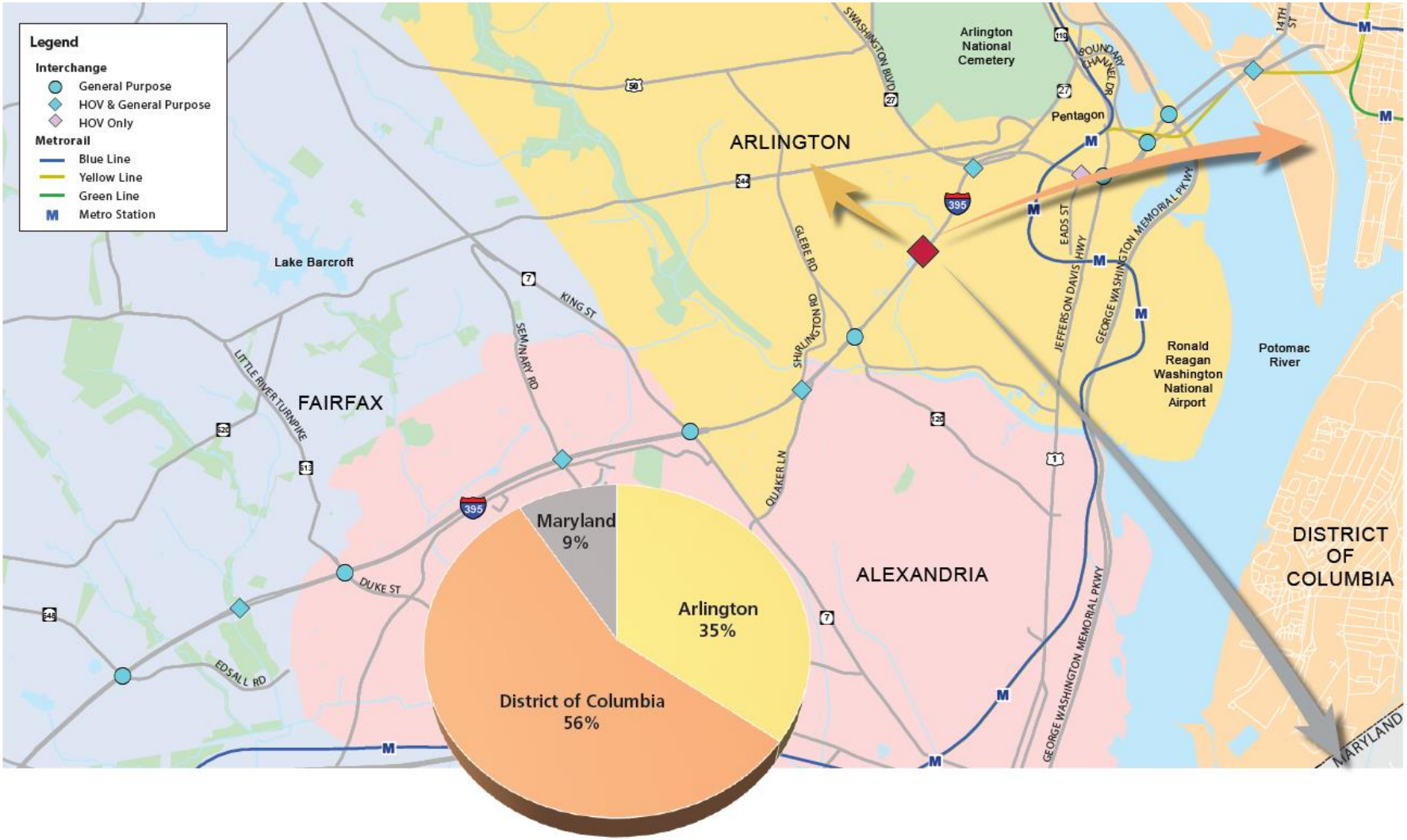


Figure 6-4: Southbound I-395 – North of Glebe Road PM Peak Period Origins

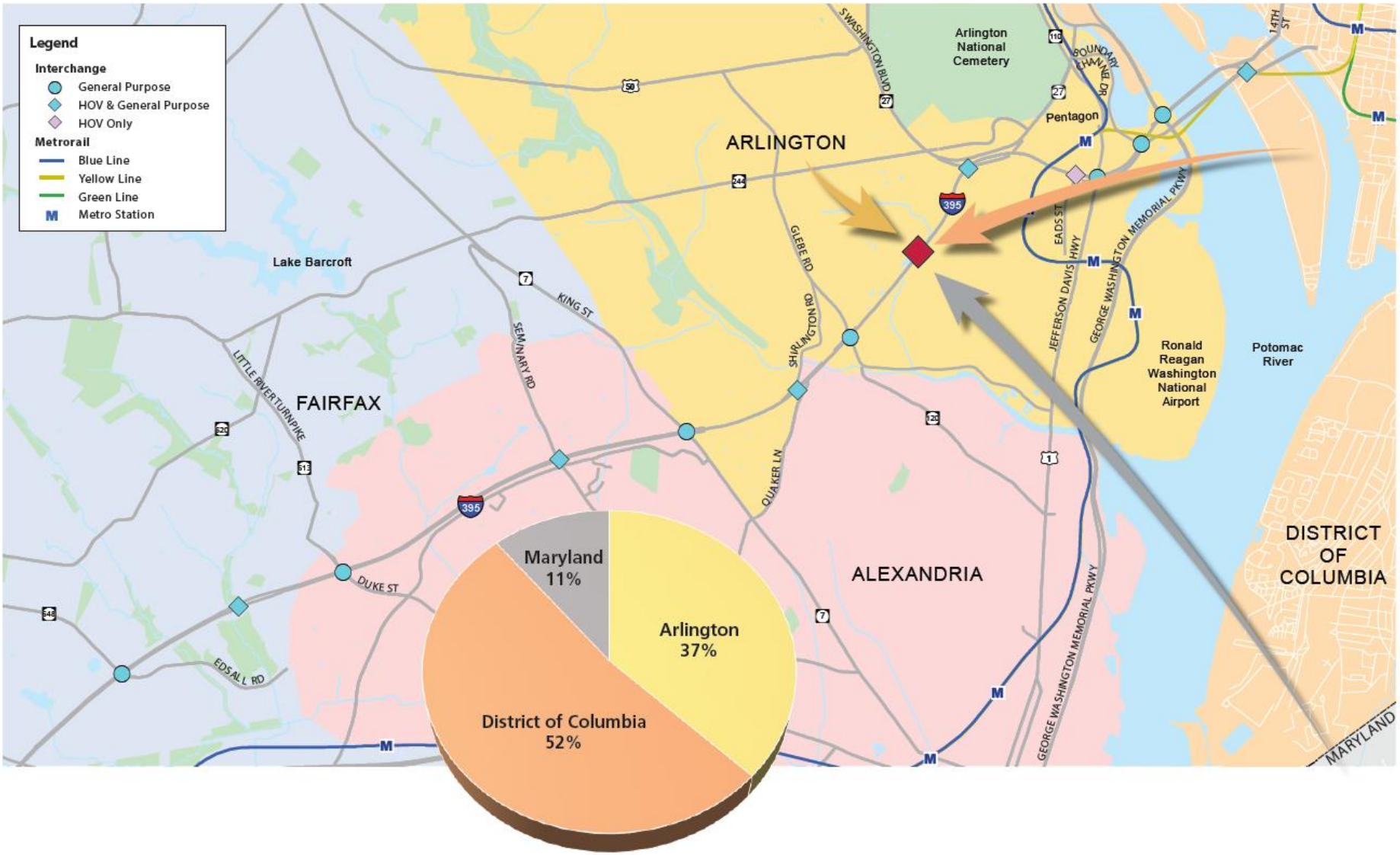
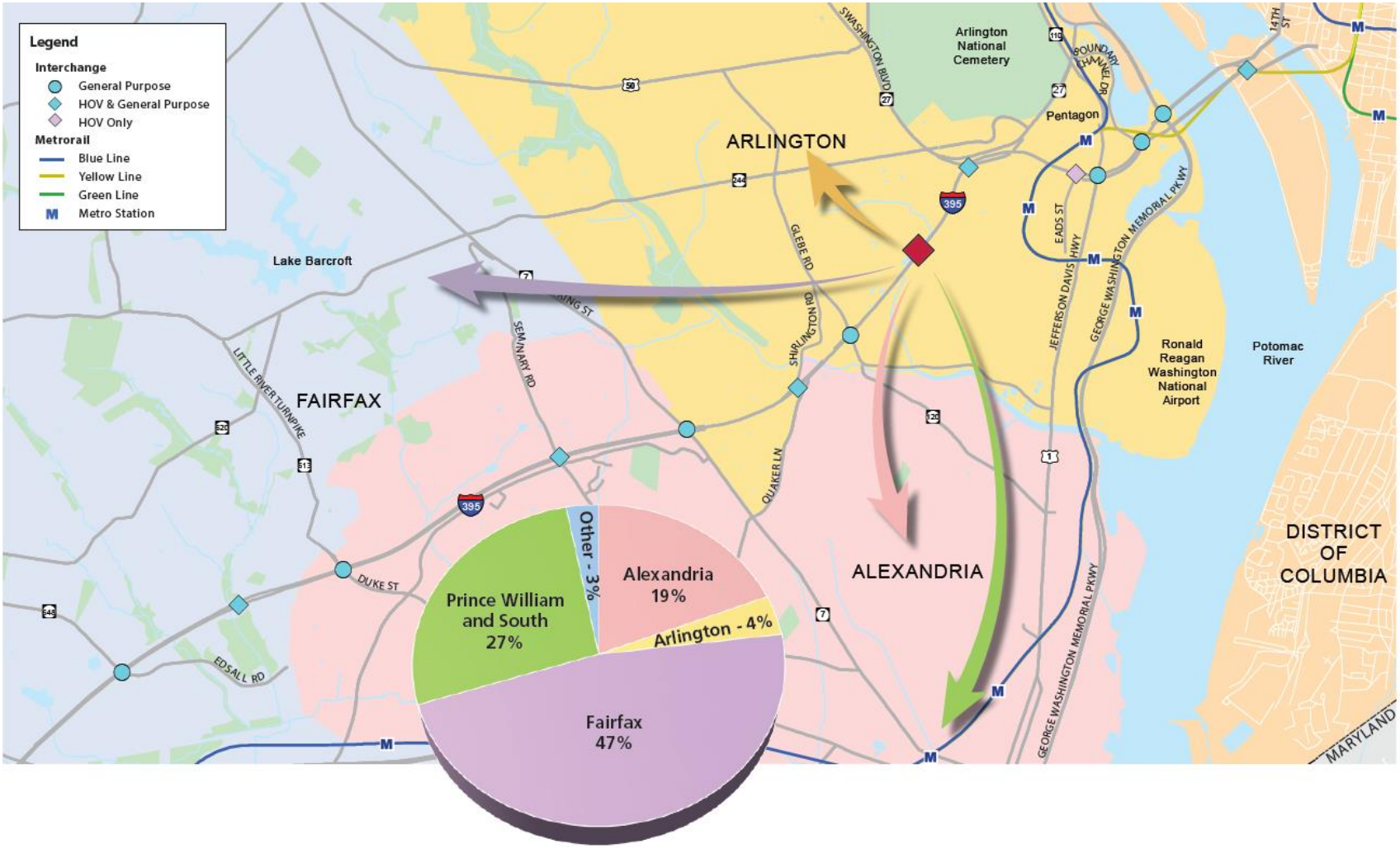


Figure 6-5: Southbound I-395 – North of Glebe Road PM Peak Period Destinations



6.2.2 Vehicle Occupancy

Vehicle occupancy and classification counts were conducted as part of the *DRAFT 2016 Performance of High-Occupancy Vehicle Facilities on Freeway in the Washington Region* (NCRTPB, 2016) report. The data was collected along northbound I-395 north of the Glebe Road Interchange in spring 2016. All vehicles were classified by vehicle type and vehicle occupancy was recorded for automobiles. Classification and occupancy data were recorded within both the general purpose and HOV lanes during the AM peak period.

Figure 6-6 depicts AM peak period (6 AM – 9 AM) vehicle trips by vehicle type in both the HOV lanes and the general purpose lanes during the period when HOV restrictions are in effect. As shown, 68% of vehicles in the HOV lanes carry three or more person; however, almost all vehicle trips (99%) in the general purpose lanes are motorcycles, single, and two-person vehicles.

Figure 6-6: AM Peak Period (6 AM – 9 AM) Vehicle Trips
Northbound I-395 North of Glebe Road

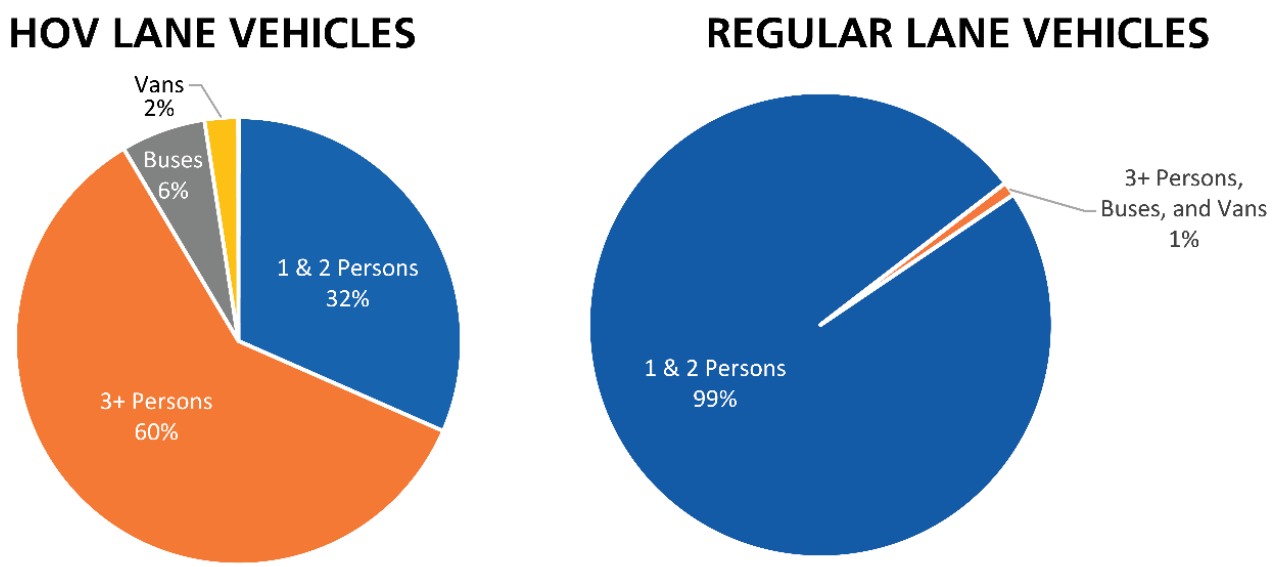
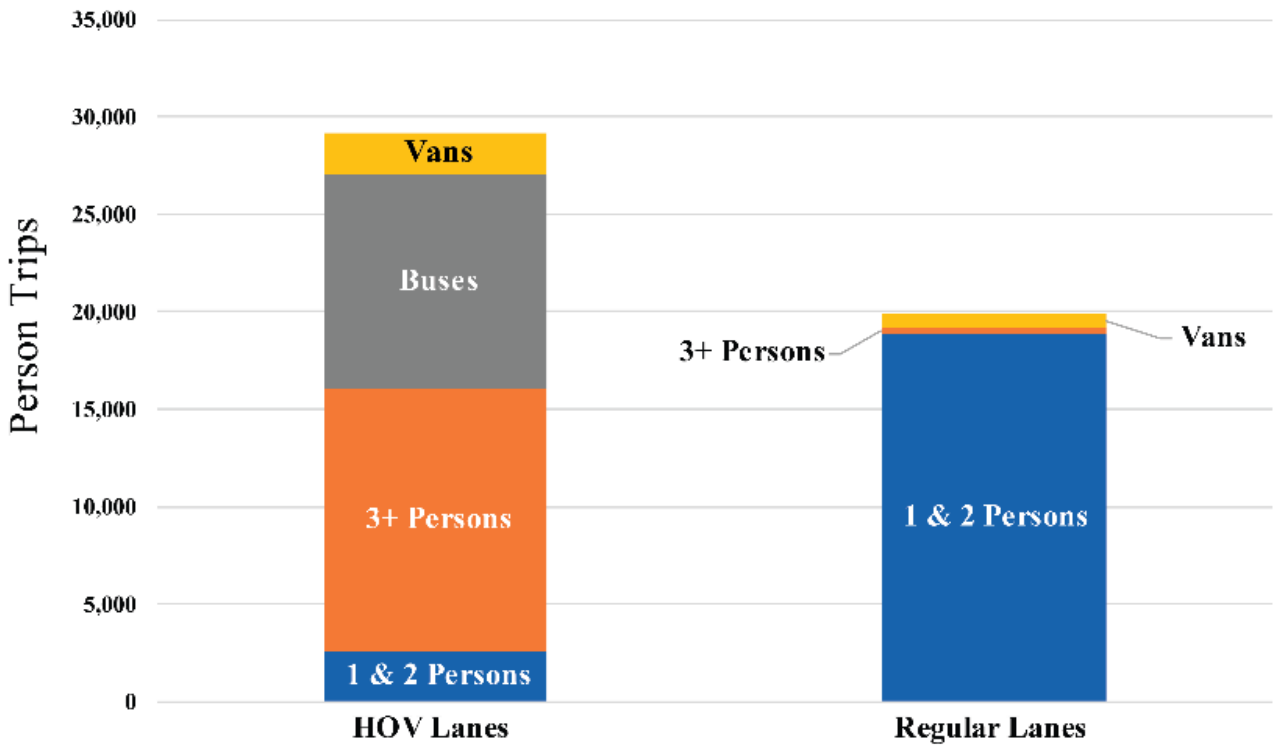


Figure 6-7 depicts person trips by vehicle type for both the HOV lanes and the general purpose lanes. Although there are more than two times as many vehicles in the general purpose lanes compared to the HOV lanes and four general purpose lanes compared to two HOV lanes, there are 47% more person trips in the HOV lanes compared to the general purpose lanes. When considering the number of person-trips per lane, approximately 14,600 persons per lane travel in the HOV lanes compared to 5,000 persons per lane in the general purpose lanes during the three hour period between 6 AM and 9 AM. The average auto occupancy in the HOV lanes is 3.9 persons per vehicle and the average auto occupancy in the general purpose lanes is 1.2 persons per vehicle.

Figure 6-7: AM Peak Period (6 AM – 9 AM) Person Trips
Northbound I-395 North of Glebe Road



6.2.3 Traffic Data Collection

Traffic volume data was collected throughout the study area network during October and November 2015. Additional data collection efforts occurred in February, March, and April 2016 following the opening of the I-395 HOV / Transit Ramp at Seminary Road and following the expansion of the study area to include the Pentagon South Parking Lot. Hourly counts were collected for a minimum of 48 hours on a Tuesday, Wednesday, or Thursday. Turning movement counts were collected for a 12-hour period from 5:00 AM to 11:00 AM and 2:00 PM to 8:00 PM.

Appendix I contains a summary of the turning movement count locations and 48-hour classification count locations.

6.2.4 Development of Existing Traffic Volumes

Due to over-capacity conditions along I-395 that are experienced for several hours during the morning and evening peak periods, speed data in combination with diurnal traffic volume data along I-395 was used to establish morning and evening peak periods and hours corresponding to the most congested conditions along I-395 rather than when volumes are highest. During the highest-volume periods, downstream bottlenecks have not yet reached their capacity allowing for higher flow rates through the study area.

Based on a review of the traffic volumes in combination with speeds along northbound and southbound I-395, the AM peak period was evaluated for four hours from 6:00 AM to 10:00 AM and the PM peak period was evaluated for four hours from 3:00 PM to 7:00 PM. The identified peak hours for the traffic analysis are 7:00 AM to 8:00 AM and 5:00 PM to 6:00 PM.

Existing peak hour traffic volumes were developed for the five-hour AM and PM peak period analysis periods based on a review of the traffic data collected in 2015 and 2016. Diurnal curves were reviewed at each count location to eliminate data for days and/or hours with atypical volume patterns. Traffic volumes were balanced along the I-395 corridor and then balanced along the arterials intersecting I-395. **Figure 6-8** (*Volume 2*) summarizes the existing peak hour traffic volumes along the corridor, ramps, and intersecting roadways within the study area. Peak hour traffic volumes at the intersections within the study area are contained in **Figure 6-9** (*Volume 2*).

Existing weekday daily traffic volumes are summarized in **Figure 6-10** (*Volume 2*). The daily volumes were developed based on a review of the traffic data collected in 2015 and 2016. Daily traffic volumes were balanced along the corridor and rounded to the nearest 100 vehicles.

6.2.5 Summary of Daily Traffic Volumes

Figures 6-11 and 6-12 depict existing (2015) daily traffic volumes along northbound and southbound I-395 including both the general purpose and HOV/HOT lanes, respectively. Daily traffic volumes gradually increase from 195,000 to 227,000 between Edsall Road and Glebe Road where there is a reduction in traffic volumes due to a large portion of motorists that enter (traveling southbound) and exit (traveling northbound) the corridor at that interchange. Traffic volumes along the general purpose lanes at the Hayes Street bridge within Washington Boulevard Interchange are the lowest in the corridor (58,700 northbound and 51,800 southbound) due to the high volume of traffic on the parallel collector-distributor roadways. The highest daily traffic volumes are at the Potomac River with an average weekday daily traffic volume of 261,900.

Figure 6-11: Existing (2015) Average Weekday Daily Traffic Volumes – Northbound I-395

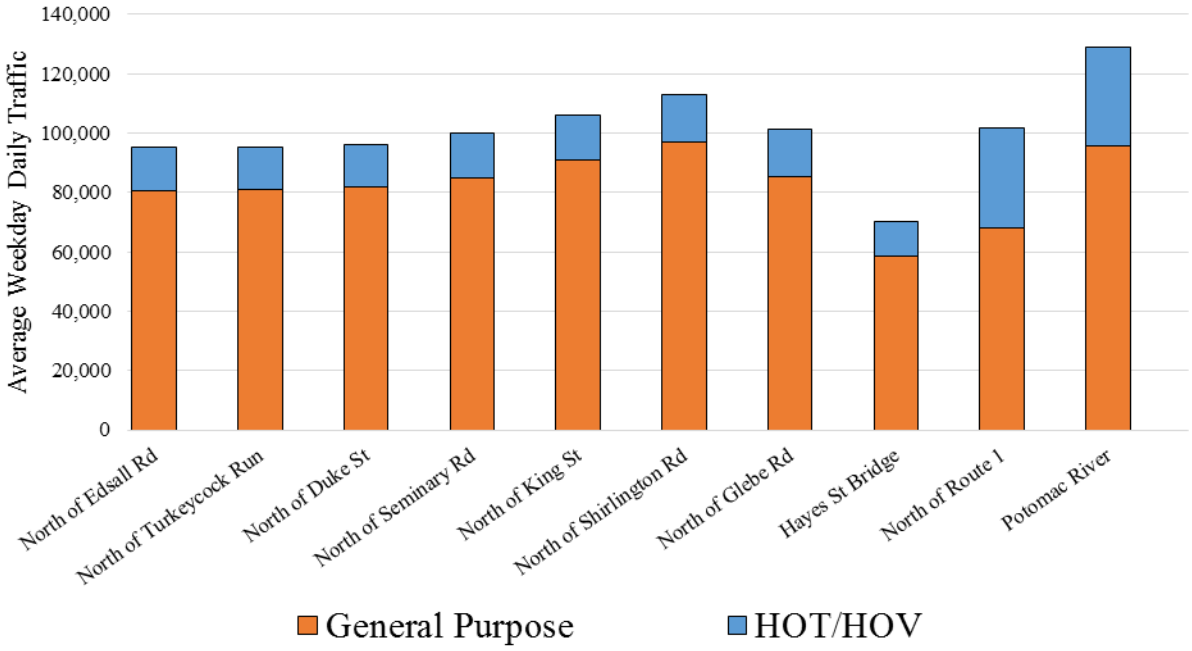
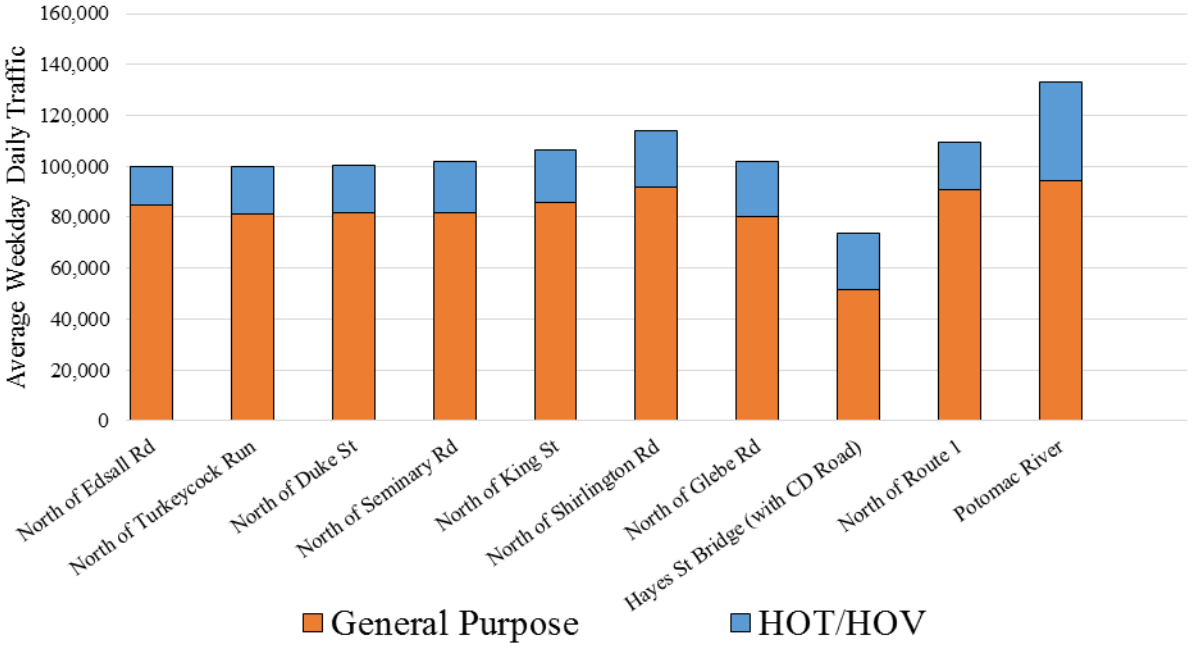


Figure 6-12: Existing (2015) Average Weekday Daily Traffic Volumes – Southbound I-395

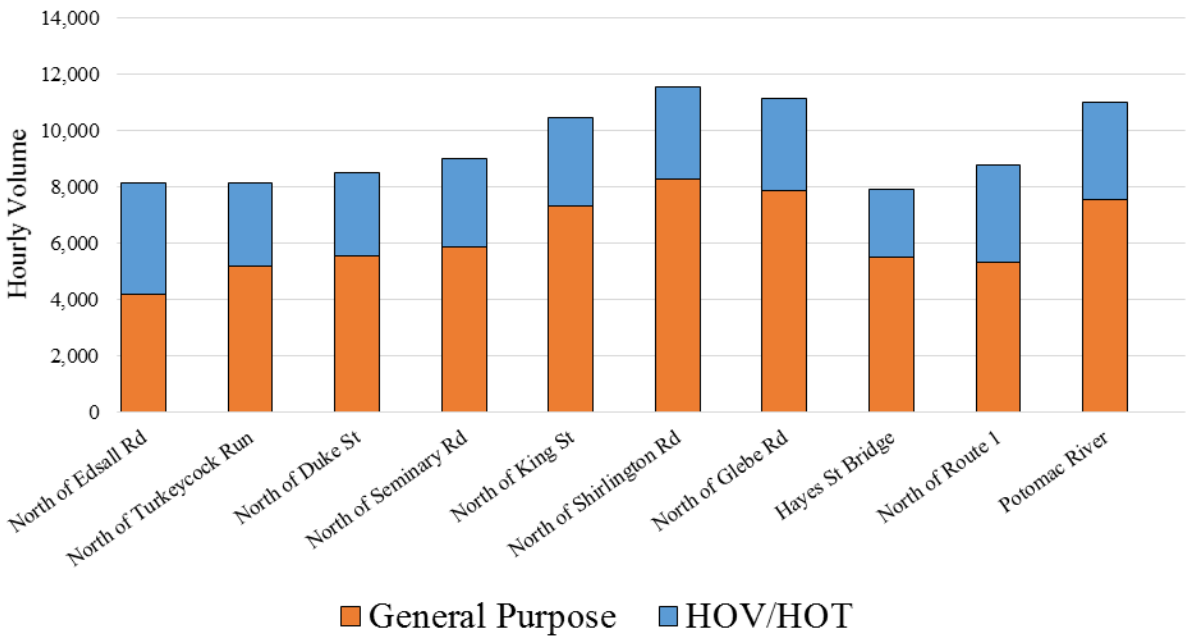


6.2.6 Summary of Peak Hour Traffic Volumes

Figures 6-13 and 6-14 depict existing (2015) peak hour traffic volumes along northbound and southbound I-395 including both the general purpose and HOV/HOT lanes, respectively.

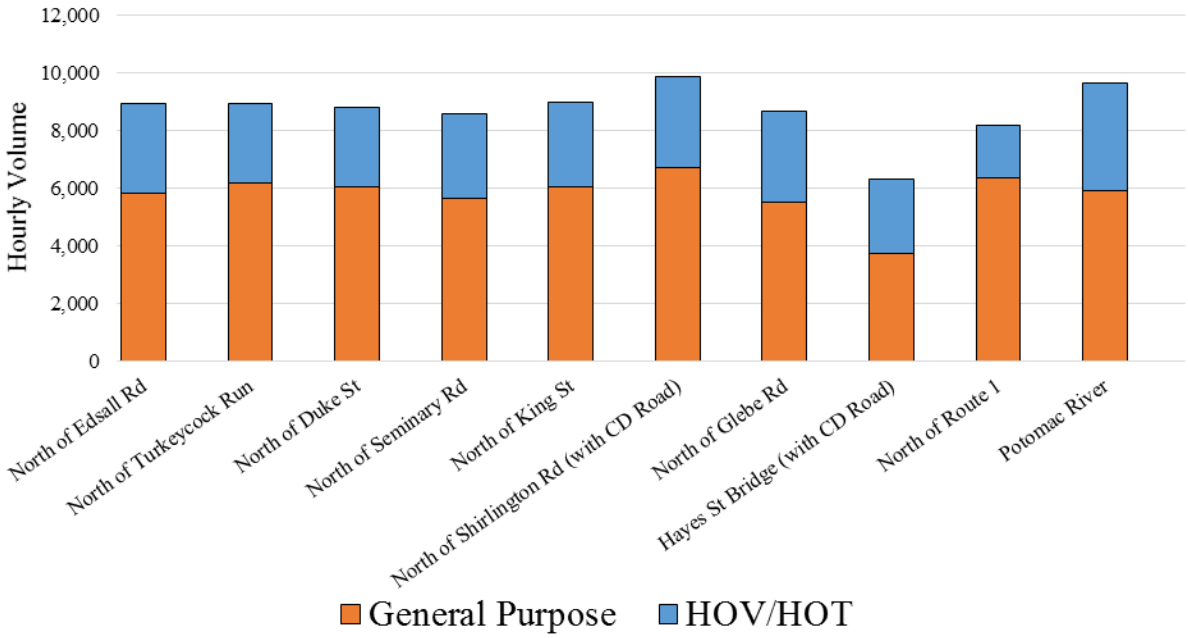
Northbound AM peak hour traffic volumes in the I-395 general purpose lanes gradually increase from 4,200 to 8,300 between Edsall Road and Glebe Road (see **Figure 6-13**). The traffic volumes reduce to 5,500 over the Hayes Street bridge due to the large amount of vehicles exiting the corridor and traveling to Washington Boulevard, Army Navy Drive, and other destinations in the Pentagon vicinity. General purpose traffic volumes increase to 7,600 over the Potomac River due to the traffic entering the corridor at George Washington Memorial Parkway. In the HOV/HOT lanes, traffic volumes decreases from 3,900 vehicles north of Edsall Road to 2,900 vehicles north of Turkeycock Run due to vehicles traveling from the HOT lanes to the general purpose lanes during the HOV-restricted period. Similar to the general purpose lanes, the HOV volumes decrease to 2,400 over the Hayes Street bridge due to the traffic exiting the corridor to Washington Boulevard. At the Potomac River, the HOV volumes increase to 3,500 vehicles due to the traffic entering the HOV lanes from Eads Street and north of Eads Street (from the general purpose lanes) and traveling into the District.

Figure 6-13: Existing (2015) Northbound AM Peak Hour Traffic Volumes



Southbound PM peak hour traffic volumes in the general purpose lanes leaving the District decreases at the Hayes Street bridge due to the traffic exiting the corridor at Route 1 and George Washington Memorial Parkway (see **Figure 6-14**). PM peak hour volumes then gradually increase from 3,700 over the Hayes Street bridge to 6,700 at Shirlington Road due to the traffic entering the corridor at Washington Boulevard and Glebe Road. The volume then stays relatively consistent between Shirlington Road and Edsall Road averaging approximately 5,900 vehicles. Traffic volumes in the HOV lanes leaving the District southbound are approximately 3,700 vehicles and decrease to 1,800 vehicles north of Route 1 due to traffic traveling from the HOV lanes to general purpose lanes during the HOV-restricted period. Traffic volumes in the HOV lanes then gradually increases to 3,100 north of Shirlington Road due to traffic entering the corridor from Eads Street and Washington Boulevard. Traffic then remains relatively constant until south of Turkeycock Run where the HOT lanes begin and the volumes increase from 2,700 to 3,100 due to single occupancy vehicles being permitted to travel in the HOT lanes.

Figure 6-14: Existing (2015) Southbound PM Peak Hour Traffic Volumes



6.3 FUTURE TRAFFIC VOLUMES

6.3.1 Land Use and Socioeconomic Trends

Between 2015 and 2040, the region is expected to increase the number of households by three quarters of a million people and increase the total employment by 1.4 million (see **Table 6-6**). More specific to the I-395 study corridor, the localities within the traffic study area include the District of Columbia, Arlington, Fairfax and Alexandria. Within this portion of the region, the growth in population, households and employment is nearly one third of the regional growth between 2015 and 2040.

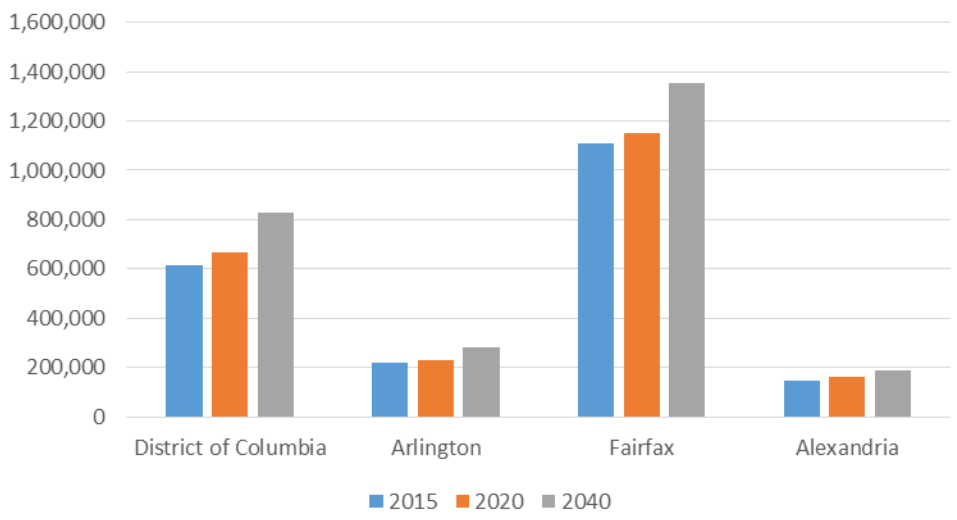
Table 6-6: MWCOG Demographic Inputs

Year	Households	Population	Total Employment	Industrial	Retail	Office	Other
2015	2,632,300	6,910,868	4,095,480	454,363	750,599	2,039,077	851,441
2020	2,807,126	7,331,949	4,397,669	482,531	803,002	2,213,105	899,031
2040	3,357,575	8,598,702	5,504,157	604,039	994,432	2,810,914	1,094,772

Source: MWCOG version 2.3.57a

The change in population among the four areas that are included in the traffic study area is shown in **Figure 6-15**. Within the study area, Fairfax has the largest population with nearly 53% of the total 2.1 million in 2015. The total population growth among the four areas is 550,000, increasing it to over 2.6 million by 2040. The District of Columbia is expected to have the largest growth as a percentage of the 2015 population, increasing 35% from 616,000 to 830,000 by 2040.

Figure 6-15: Population Growth by County / City within Traffic Study Area



Household changes between 2015 and 2040 are shown below in **Figure 6-16**. As with population, Fairfax has the most households within the area with a total number of households in 2015 of just over 400,000. All areas within the study area increase in number of households by roughly 30% over the 2015 to 2040 period.

Figure 6-16: Household Growth by County / City within Traffic Study Area

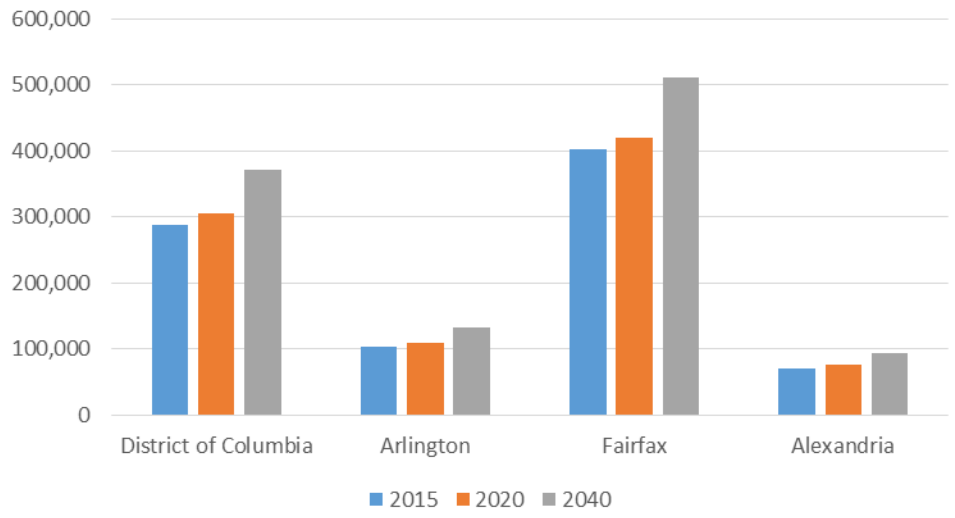
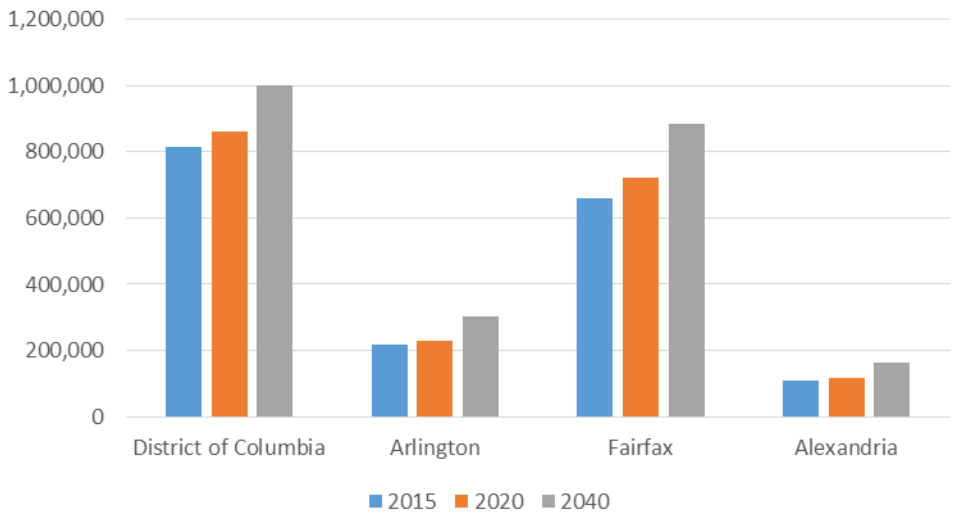


Figure 6-17 displays the growth in total employment in the traffic study area. With respect to employment, the District of Columbia has the highest employment followed by Fairfax. By 2040, the largest growth in employment is within Fairfax, but as a percentage growth, Alexandria is expected to have a 50% increase in employment.

Figure 6-17: Employment Growth by County / City within Traffic Study Area



In the broader scope, looking at all likely users of the corridor, nine localities are identified. The total population, household and employment for 2015, 2020 and 2040 are shown in **Tables 6-7 through 6-9.** The relative size of each jurisdiction relative to the entire region stays consistent through the forecast years as Fairfax is the largest population area and the majority of the employment is in the District and Fairfax areas.

Table 6-7: Forecasted Population by Jurisdiction

Jurisdiction	2015	2020	2040
Alexandria	145,761	160,668	188,961
Arlington	219,030	229,367	279,715
District of Columbia	616,552	667,271	830,387
Fairfax	1,111,263	1,149,129	1,351,416
Falls Church	13,069	14,169	17,269
Prince William	425,930	468,523	551,501
Stafford	145,519	165,644	246,651
Fredericksburg	22,978	24,260	30,019
Spotsylvania	107,132	118,738	154,521
Total	**2,807,234**	**2,997,769**	**3,650,440**

Table 6-8: Forecasted Households by Jurisdiction

Jurisdiction	2015	2020	2040
Alexandria	71,202	77,352	93,188
Arlington	104,317	109,394	133,319
District of Columbia	287,112	305,550	370,758
Fairfax	402,885	420,328	510,212
Falls Church	5,504	6,204	7,904
Prince William	140,046	156,008	186,086
Stafford	49,673	57,533	87,670
Fredericksburg	10,239	10,969	13,739
Spotsylvania	37,503	42,153	55,567
Total	**1,108,481**	**1,185,491**	**1,458,443**

Table 6-9: Forecasted Employment by Jurisdiction

Jurisdiction	2015	2020	2040
Alexandria	108,712	115,060	163,401
Arlington	219,152	228,897	301,281
District of Columbia	814,952	861,809	1,001,809
Fairfax	661,038	722,083	886,765
Falls Church	12,000	14,300	18,300
Prince William	132,664	151,486	235,360
Stafford	52,681	58,399	84,159
Fredericksburg	35,586	39,662	54,819
Spotsylvania	43,173	46,219	61,356
Total	**2,079,958**	**2,237,915**	**2,807,250**

6.3.2 Future Year Forecasts

An overview of the methodology used to develop the future year forecasts is included in **Section 2.1** and **Appendix C.** The 2040 Build and 2040 No Build forecasts were compared to assess the impacts of the project on the study area network during the peak period. As expected, the HOV/HOT lanes in the corridor show an increase in traffic consistent with the increase in capacity of the two HOV lanes to three HOT lanes from Turkeycock Run to Eads Street. The benefit to the general purpose lanes with the reassignment of traffic to the Express Lanes is mitigated by new traffic entering the I-395 corridor as a preferred route and thus maintaining traffic levels near those of the no build scenario.

A review of volume differences between 2040 No Build and Build conditions along the arterial system serving I-395 does not show evidence of systematic diversion from the corridor in response to the conversion of the two existing HOV lanes to three HOT lanes. Additionally, the arterial network benefits from increased traffic being drawn to the I-395 facility with some arterials showing improved conditions with lower daily volumes. At the north end of the study area in the vicinity of the Eads Street Interchange, there is some localized reallocation of traffic observed with alternative routes being taken as a result of the revised access points associated with the modifications to the Eads Street Interchange. This is discussed in more detail in **Sections 7.2 and 7.3**.

Figures 6-18 and 6-19 (*Volume 2*) depict traffic volume changes in the peak direction during the AM peak period (6 AM to 9 AM) and PM peak period (3 PM – 6 PM) along a series of screen lines intersecting the I-395 corridor. Traffic volume increases and decreases of 200 vehicles or more during the three hour period are depicted in addition to locations with no significant change (less than a 200 vehicle difference). The model results indicate that in general, with the exception of increases in overall volume along the I-395 corridor in the peak direction, there are relatively minor traffic volume changes in the peak direction during the AM and PM peak periods along the parallel arterials.

The following figures, located in Volume 2, depict the forecasted peak hour and daily traffic volumes for the future 2020 and 2040 No Build and Build conditions.

- Figure 6-20: 2020 No Build Peak Hour Volumes (Mainline)
- Figure 6-21: 2020 No Build Peak Hour Volumes (Intersections)
- Figure 6-22: 2020 No Build Average Daily Traffic Volumes

- Figure 6-23: 2020 Build Peak Hour Volumes (Mainline)
- Figure 6-24: 2020 Build Peak Hour Volumes (Intersections)
- Figure 6-25: 2020 Build Average Daily Traffic Volumes

- Figure 6-26: 2040 No Build Peak Hour Volumes (Mainline)
- Figure 6-27: 2040 No Build Peak Hour Volumes (Intersections)
- Figure 6-28: 2040 No Build Average Daily Traffic Volumes

- Figure 6-29: 2040 Build Peak Hour Volumes (Mainline)
- Figure 6-30: 2040 Build Peak Hour Volumes (Intersections)
- Figure 6-31: 2040 Build Average Daily Traffic Volumes

The following sections describe the daily and peak hour traffic volume changes for both No Build and Build conditions in more detail.

6.3.3 Summary of Daily Traffic Volumes

Existing (2015), 2040 No Build, and 2040 Build weekday daily traffic volumes for northbound and southbound I-395 for both the general purpose and HOV/HOT lanes are summarized in **Figures 6-32 and 6-33**, respectively.

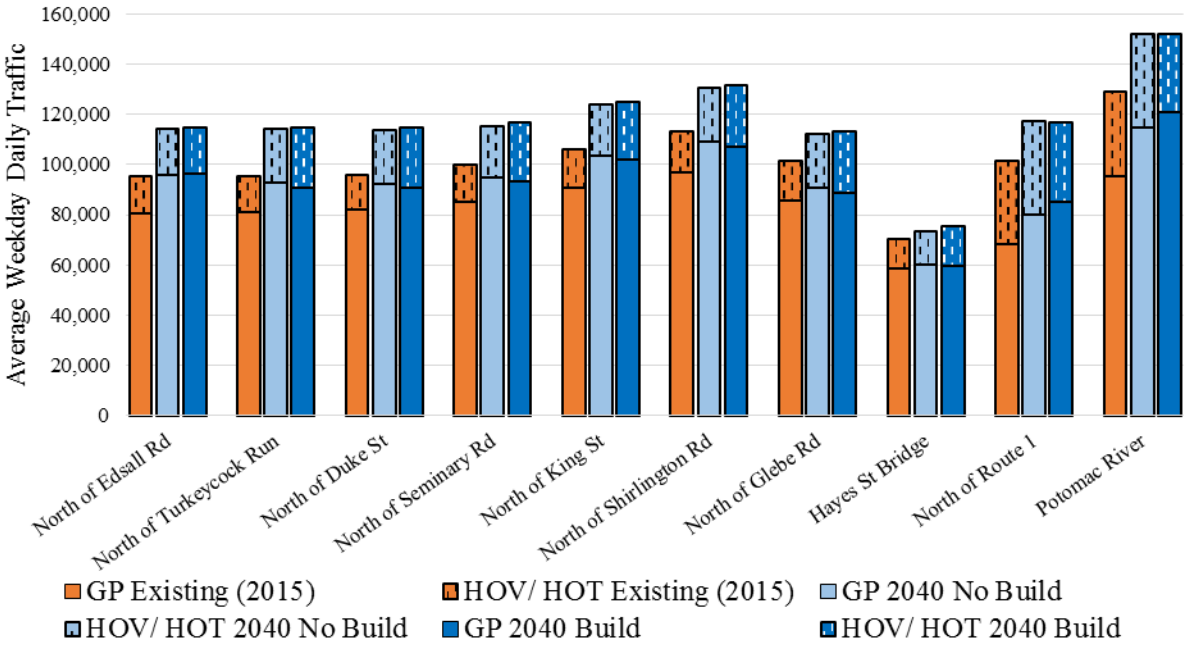
2040 No Build Daily Traffic Volumes: Northbound I-395 general purpose weekday daily traffic volumes increase by approximately 10,000 to 15,000 vehicles (12% to 19% increase) between existing and 2040 No Build conditions from north of Edsall Road to north of Shirlington Road. From north of Glebe Road to the Hayes Street bridge (located between Washington Boulevard and Eads Street), traffic volumes increase by 1,000 to 5,000 vehicles (2% to 6% increase). North of Route 1 and at the Potomac River crossing, traffic volumes increase by 12,000 to 19,000 vehicles (17% to 20% increase).

Northbound weekday daily traffic volumes in the HOV/HOT lanes increase by approximately 3,500 vehicles between Edsall Road and Turkeycock Run (24% increase) and by 5,000 to 7,000 vehicles between Turkeycock Run and north of Glebe Road (36% to 51% increase). North of Route 1, traffic volumes in the HOV lanes increase by approximately 4,000 vehicles (11% increase). The higher growth rates within the HOV/HOT lanes compared to the general purpose lanes can be attributed to the available capacity in the HOV/HOT lanes compared to the general purpose lanes.

Southbound I-395 general purpose weekday daily traffic volumes increase by approximately 11,000 to 14,000 vehicles (13% to 16% increase) between existing and 2040 No Build conditions from north of Edsall Road to north of Shirlington Road with one exception. Between Turkeycock Run and Duke Street, traffic volume increases are 3,000 vehicles (approximately 4%) due to the I-395 4th Lane South Widening – Duke Street to Edsall Road project which relocates southbound traffic entering from Little River Turnpike and Duke Street to a collector-distributor road. From north of Glebe Road to the Hayes Street bridge (located between Washington Boulevard and Eads Street), traffic volumes increase by 3,000 to 8,000 vehicles (6% to 10% increase). North of Route 1 and at the Potomac River crossing, traffic volumes increase by 14,000 to 16,000 vehicles (15 to 17% increase).

Southbound weekday daily traffic volumes in the HOV/HOT lanes increase by approximately 3,500 vehicles between Edsall Road and Turkeycock Run (23% increase) and by 3,000 to 5,000 vehicles between Turkeycock Run and Hayes Street (16% to 29% increase). From north of Route 1 to the Potomac River, traffic volumes in the HOV lanes increase by 2,000 to 5,000 vehicles (12% to 14% increase). The higher growth rates within the HOV/HOT lanes compared to the general purpose lanes at the south end of the corridor can be attributed to the available capacity in the HOV/HOT lanes compared to the general purpose lanes.

Figure 6-32: Existing (2015), 2040 No Build and 2040 Build Daily Traffic Volumes – Northbound I-395

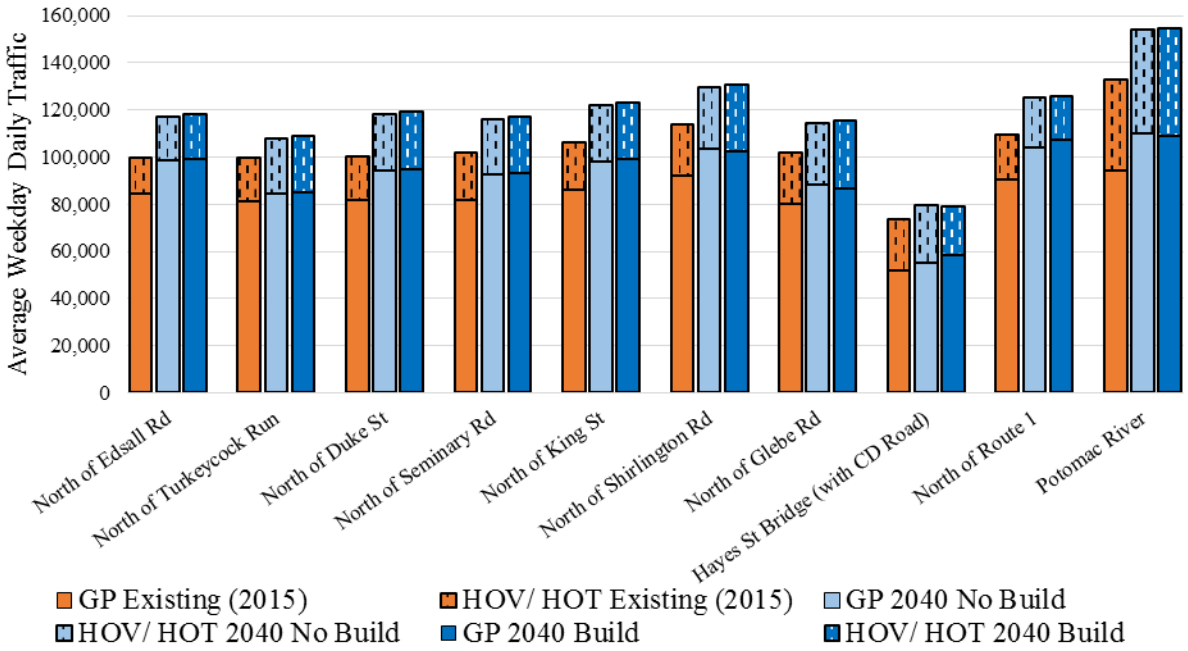


2040 Build Daily Traffic Volumes: Overall daily traffic volume changes between the combined general purpose lanes and HOV/HOT lanes are less than 2% along northbound I-395 between No Build and Build conditions. Northbound I-395 general purpose traffic volumes decrease by 1,500 to 2,200 vehicles between No Build and Build conditions from north of Turkeycock Run to north of Glebe Road. Traffic volumes on the Hayes Street bridge decrease by 500 vehicles. From north of Route 1 to the Potomac River and crossing the Potomac River, traffic volumes increase by 5,300 vehicles and 5,900 vehicles, respectively due to the shifting of traffic from the HOV lanes to the general purpose lanes in this area.

Northbound traffic volumes in the HOV/HOT lanes increase by 2,000 to 3,000 vehicles between Turkeycock Run and the Hayes Street bridge. North of Route 1, traffic volumes in the HOV lanes decrease by approximately 6,000 vehicles primarily due to the reduction in volumes entering the HOV lanes at the ramp from the general purpose lanes and HOV lanes located north of Eads Street.

Overall daily traffic volumes changes between the combined general purpose lanes and HOV/HOT lanes are less than 2% along southbound I-395 between No Build and Build conditions, similar to the northbound trends. Combined general purpose and HOV/HOT lane traffic volumes increase by 700 to 1,300 vehicles between No Build conditions and Build conditions from north of Turkeycock Run to north of Glebe Road. From the Hayes Street bridge to the Potomac River, daily traffic volume changes are less than 300 vehicles.

Figure 6-33: Existing (2015), 2040 No Build Weekday and 2040 Build Daily Traffic Volumes – Southbound I-395



6.3.4 Summary of Peak Hour Traffic Volumes

Existing (2015), 2040 No Build, and 2040 Build peak hour traffic volumes for northbound and southbound I-395 for both the general purpose and HOV/HOT lanes are summarized in **Figures 6-34 and 6-35,** respectively.

2040 No Build Peak Hour Traffic Volumes: In the AM peak hour, northbound I-395 general purpose traffic volumes increase by 900 to 1,300 vehicles per hour between existing and 2040 No Build conditions from north of Edsall Road to north of Shirlington Road. From north of Glebe Road to the Hayes Street bridge (located between Washington Boulevard and Eads Street), traffic volumes increase by 500 to 700 vehicles. North of Route 1 and at the Potomac River crossing, traffic volumes increase by 1,000 to 1,300 vehicles.

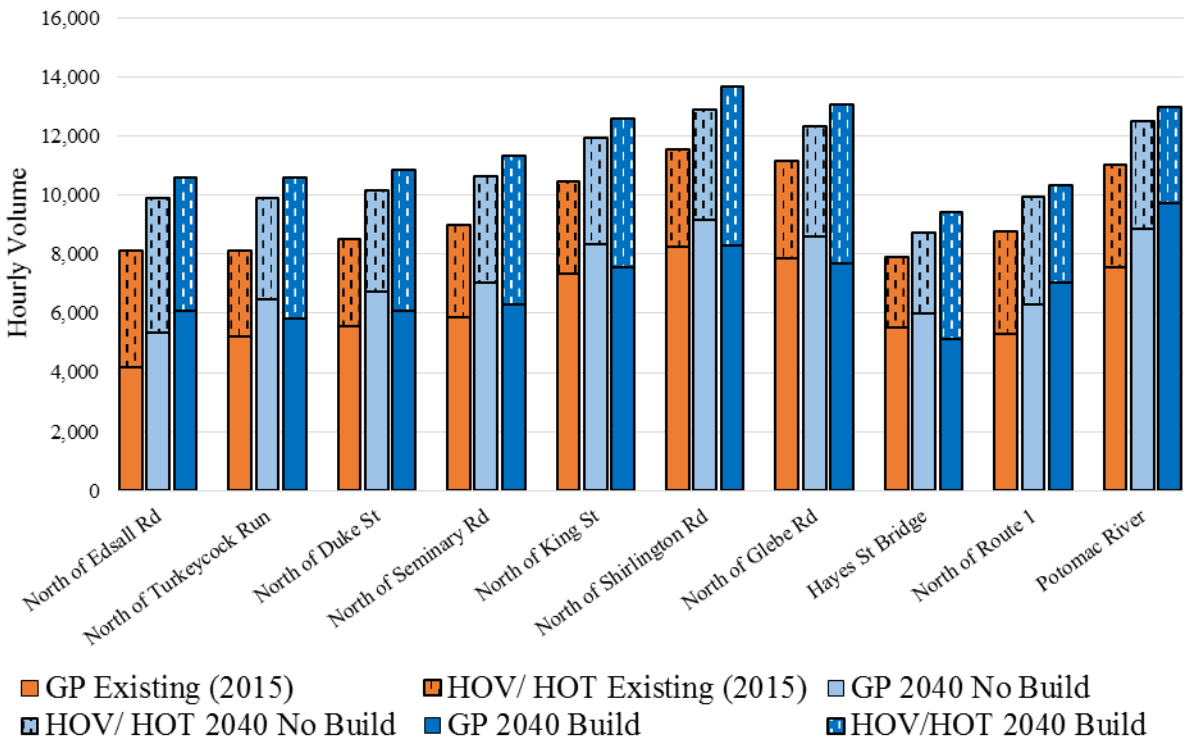
Northbound traffic volumes in the HOV/HOT lanes increase by approximately 600 vehicles between Edsall Road and Turkeycock Run and by 300 to 500 vehicles between Turkeycock Run and Hayes Street (located south of Eads Street). North of Route 1, traffic volumes in the HOV lanes increase by approximately 150 vehicles.

In the PM peak hour, southbound I-395 general purpose traffic volumes increase by 850 to 1,200 vehicles between existing and 2040 No Build conditions from north of Duke Street to north of Glebe Road. Between Turkeycock Run and Duke Street, traffic volume increases are less (approximately 150 vehicles) due to the I-395 4th Lane South Widening – Duke Street to Edsall Road project which relocates southbound traffic entering from Little River Turnpike and Duke Street to a collector-distributor road. From the Hayes Street

bridge to north of Route 1, traffic volumes increase by approximately 400 to 700 vehicles. At the Potomac River crossing, traffic volumes increase by approximately 1,100 vehicles.

Southbound traffic volumes in the HOV/HOT lanes increase by approximately 600 vehicles between Edsall Road and Turkeycock Run and by 350 to 400 vehicles from Turkeycock Run to north of Glebe Road. Between Hayes Street (located south of Eads Street) and north of Route 1, traffic volumes in the HOV lanes increase by 250 to 300 vehicles.

Figure 6-34: Existing (2015), 2040 No Build and 2040 Build AM Peak Hour - Northbound I-395



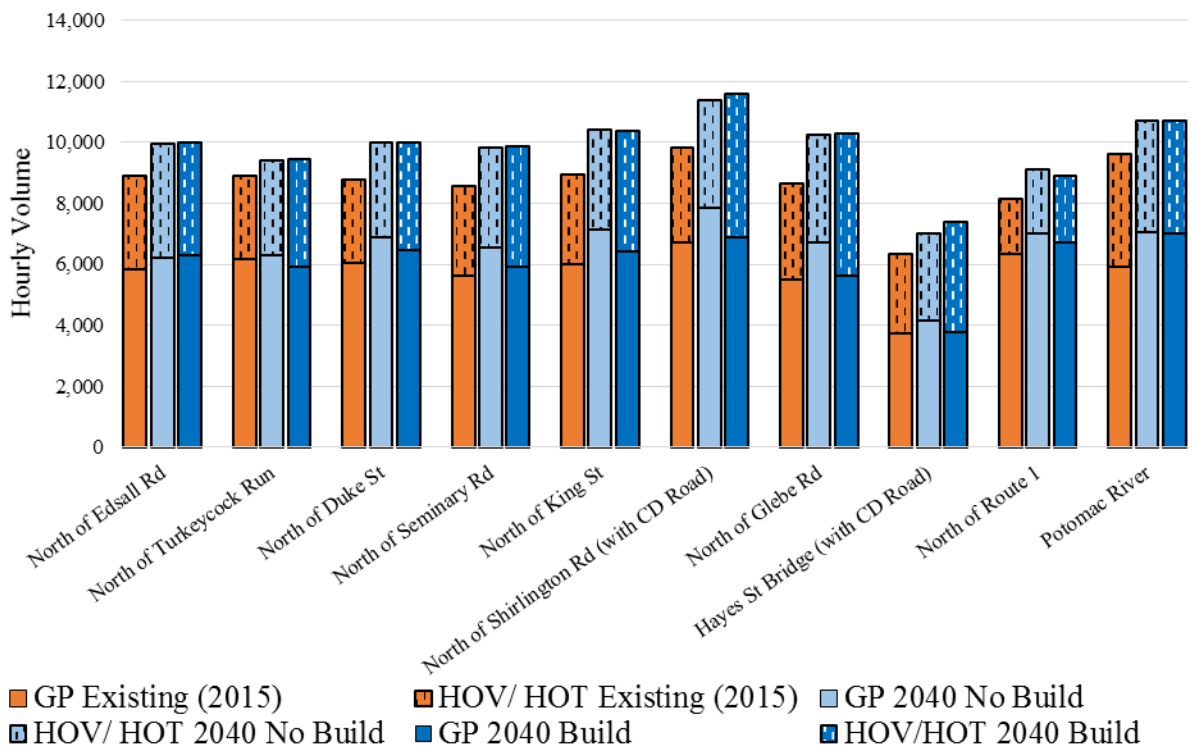
2040 Build Peak Hour Traffic Volumes: In the AM peak hour, northbound I-395 general purpose traffic volumes decrease by 600 to 900 vehicles per hour between 2040 No Build and 2040 Build conditions from north of Turkeycock Run to the Hayes Street bridge. From north of Route 1 to the Potomac River, traffic volumes increase by 700 to 800 vehicles due to the shifting of traffic from the HOV/HOT lanes to the general purpose lanes in this area.

Northbound traffic volumes in the HOV/HOT lanes increase by 1,400 to 1,700 vehicles between Turkeycock Run and the Hayes Street bridge. North of Route 1, traffic volumes in the HOV lanes decrease by approximately 350 vehicles primarily due to the reduction in volumes entering the HOV lanes at the ramp from the general purpose lanes located north of Eads Street. The decrease in northbound HOV volumes and increase in general purpose lanes volumes is due to the conversion to HOT lanes north of Eads Street in the currently unrestricted portion of the HOV lanes entering Washington, D.C.

Southbound I-395 general purpose traffic volumes decrease by 400 to 1,100 vehicles per hour between 2040 No Build and 2040 Build conditions from north of Turkeycock Run to the Hayes Street bridge. North of Route 1 traffic volumes decrease by approximately 300 vehicles and there is no change in volumes between no build and build conditions at the Potomac River.

Southbound traffic volumes in the HOV/HOT lanes increase by 400 and 1,200 vehicles from Turkeycock Run to north of Glebe Road with higher increases at the northern end of this segment. At the Hayes Street bridge, traffic volumes increase by approximately 700 vehicles, and from North of Route 1 to the Potomac River, traffic volumes increase by 100 vehicles or less.

Figure 6-35: Existing (2015), 2040 No Build and 2040 Build PM Peak Hour - Southbound I-395



7. TRAFFIC ANALYSIS

As discussed in **Section 2.2,** operational conditions for the I-395 freeway facility and arterial intersections were color-coded to reflect various congestion levels based on density and delay thresholds established in the *Highway Capacity Manual 2010* (TRB, 2010). **Tables 7-1 and 7-2** summarize the thresholds for freeways segments, signalized intersections, and unsignalized intersections. In accordance with the TOSAM, level of service (LOS) was not used as a measure of effectiveness.

Table 7-1: Freeway Measures of Effectiveness

Congestion Level	Freeways
	Average Density (veh/mi/ln)
Light Traffic	≤ 26
Moderate Traffic	>26 - 35
Heavy Congestion	>35 - 45
Severe Congestion	>45

Table 7-2: Intersection Measures of Effectiveness

Congestion Level	Intersections	
	Signalized	Unsignalized
	Average Delay (sec/veh)	Average Delay (sec/veh)
Light Traffic	>20 - 35	>15 - 25
Moderate Traffic	>35 - 55	>25 - 35
Heavy Congestion	>55 - 80	>35 - 50
Severe Congestion	>80	>50

Speed profiles from the VISSIM model for the northbound and southbound I-395 general purpose and HOV/HOT lanes are provided for each of the four analysis hours during the AM and PM peak periods. The travel speeds by freeway segment depicted in the speed profiles are color coded from red to dark green with red representing 25 MPH or lower average travel speeds and dark green representing 55 MPH or greater average travel speeds.

7.1 EXISTING CONDITIONS TRAFFIC OPERATIONS

7.1.1 Freeway Travel Time Analysis

7.1.1.1 AM Peak Period

A comparison of overall corridor travel times for existing conditions during the AM peak period is summarized in **Figure 7-1** for the northbound peak travel direction for each of the four analysis hours. **Figures 7-2 through 7-5** summarize cumulative travel times for the northbound and southbound I-395 general purpose and HOV/HOT lanes for each of the four analysis hours during the AM peak period between interchanges along the corridor. **Table 7-3** presents existing overall travel times and segment travel times for the northbound and southbound I-395 general purpose and HOV/HOT lanes for each of the four analysis hours during the AM peak period between interchanges along the corridor.

AM Peak Period – Northbound General Purpose Lanes (Peak Direction)

Existing corridor travel times along the northbound I-395 general purpose lanes for the four hours during the AM peak period range from 18 to 42 minutes with an average travel time of 31 minutes. The 8 to 9 AM hour has the longest corridor travel time (42 minutes) of the four AM peak period hours due to higher congestion levels during this hour between Edsall Road and King Street.

AM Peak Period – Northbound HOV/HOT Lanes (Peak Direction)

Existing corridor travel times along the northbound I-395 HOV/HOT lanes range from 11 to 16 minutes with an average travel time of 14 minutes. The 9 AM to 10 AM hour has the longest corridor travel time (16 minutes) of the four AM peak hours primarily due to higher levels of congestion and lower speeds during this hour between Eads Street and 14th Street. Travel times in the northbound HOV/HOT lanes between 6 AM and 10 AM are approximately 2 to 3 times shorter than travel times in the northbound general purpose lanes.

AM Peak Period – Southbound General Purpose Lanes (Off-Peak Direction)

Existing corridor travel times along the southbound I-395 general purpose lanes are approximately 12 minutes during the four AM peak period hours.

AM Peak Period – Southbound HOV Lanes (Off-Peak Direction)

Existing corridor travel times along the southbound I-395 HOV/HOT lanes are approximately 2.5 minutes. Each of the four AM peak period hours have similar corridor travel times due to the relatively short southbound I-395 HOV corridor distance during the AM peak period.

Figure 7-1: AM Peak Period - Northbound Overall Travel Time Summary (Existing)

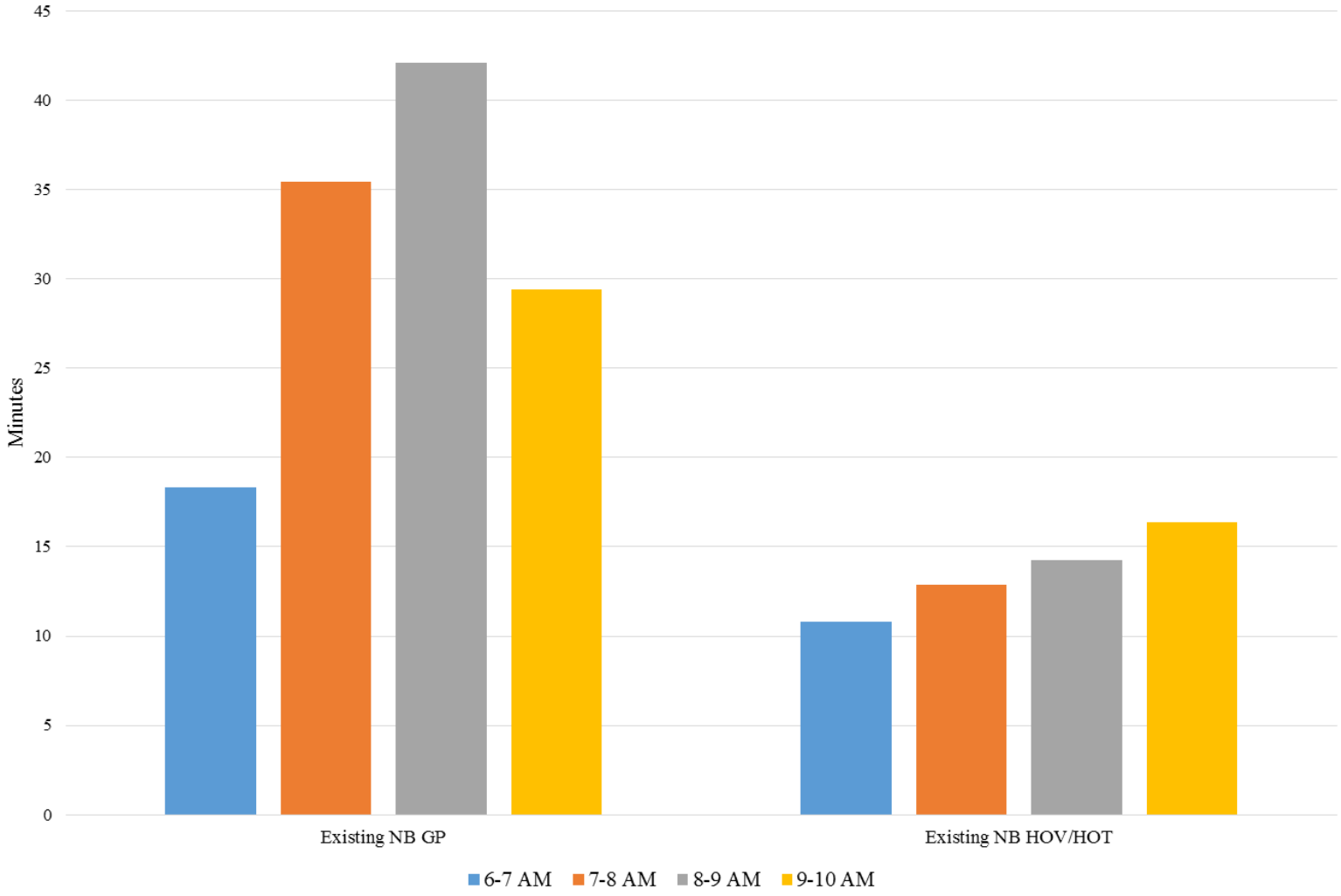


Figure 7-2: AM Peak Period - Northbound General Purpose Lanes Cumulative Travel Times (Existing)

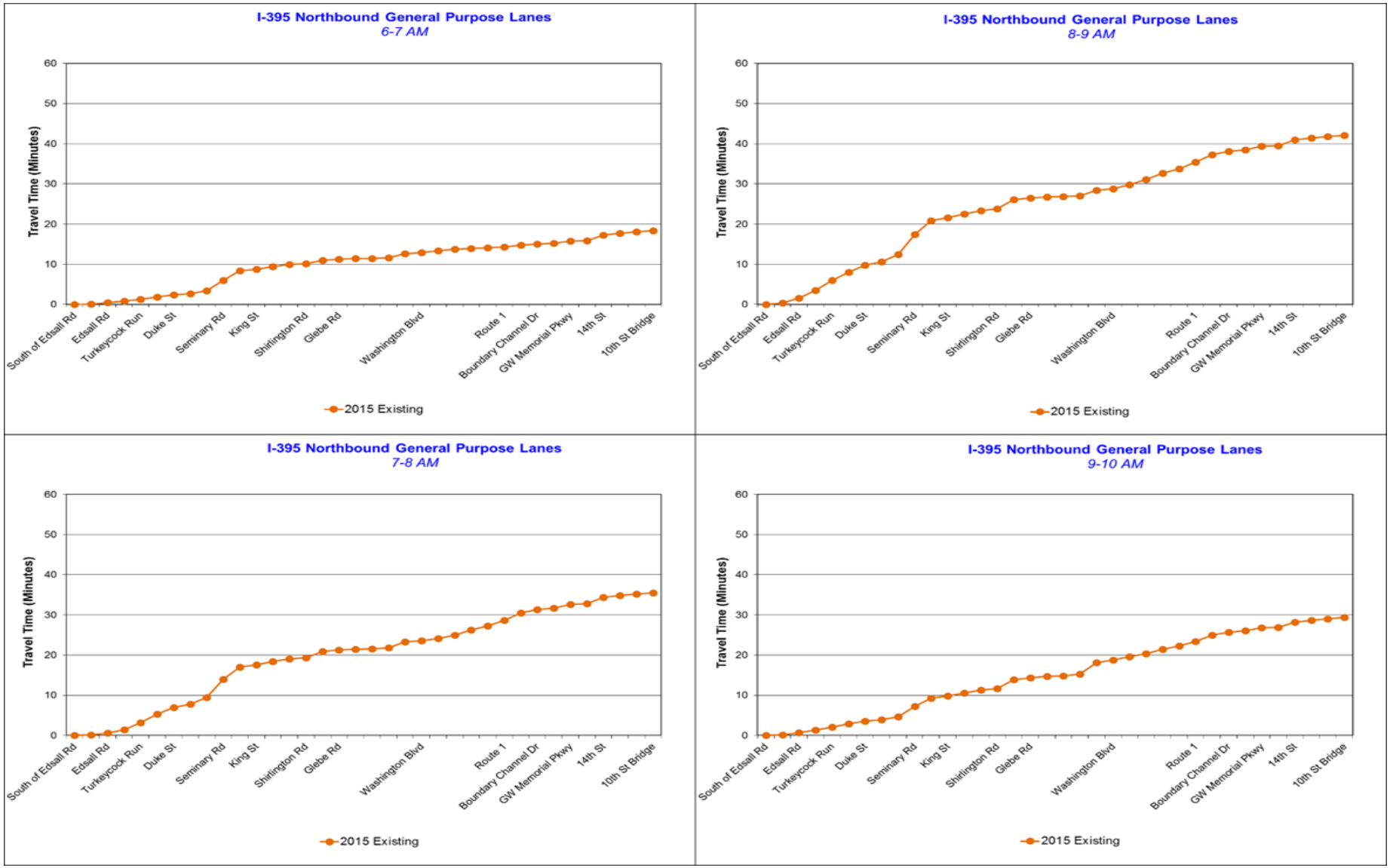


Figure 7-3: AM Peak Period - Northbound HOV/HOT Lanes Cumulative Travel Times (Existing)

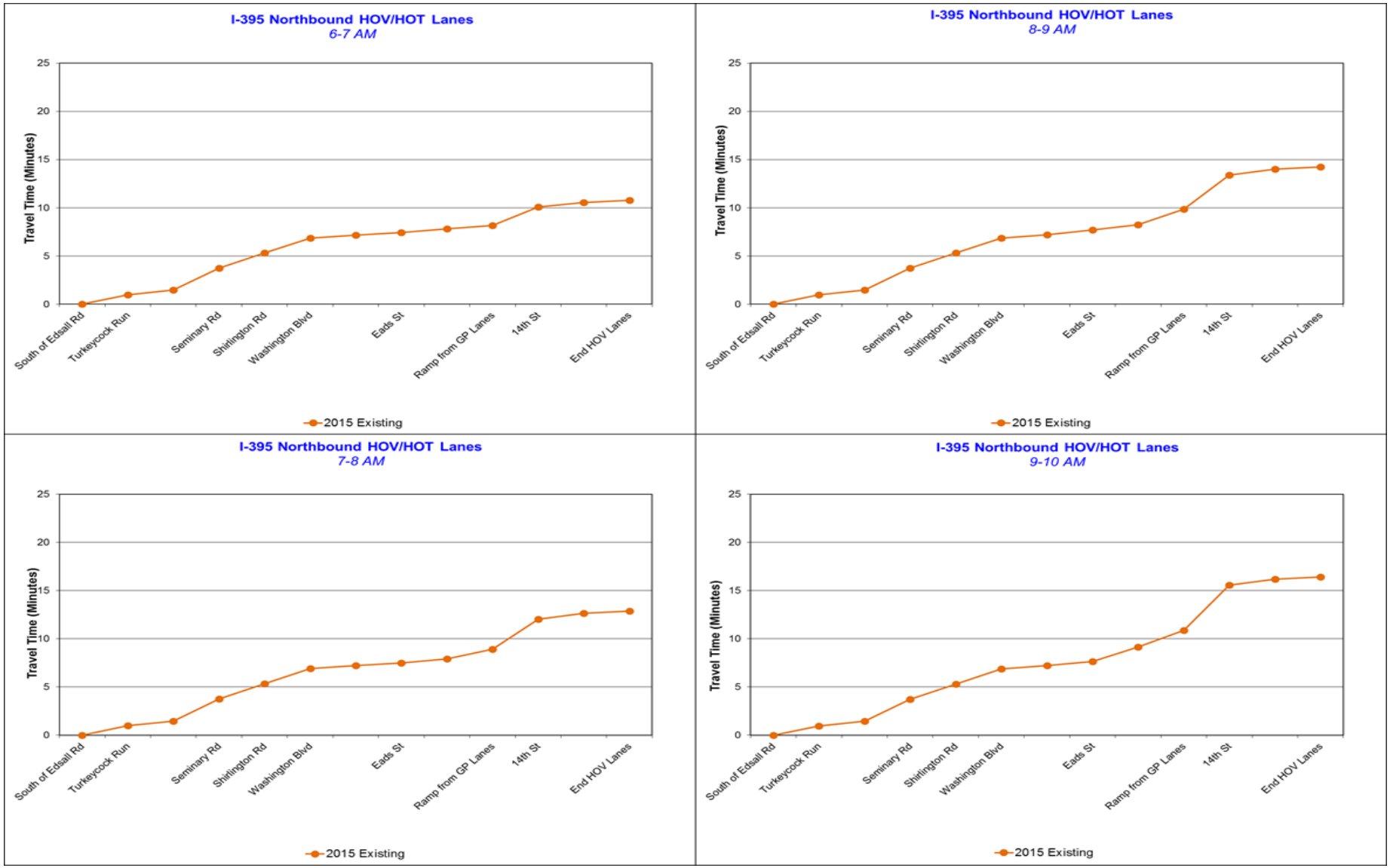


Figure 7-4: AM Peak Period – Southbound General Purpose Lanes Cumulative Travel Times (Existing)

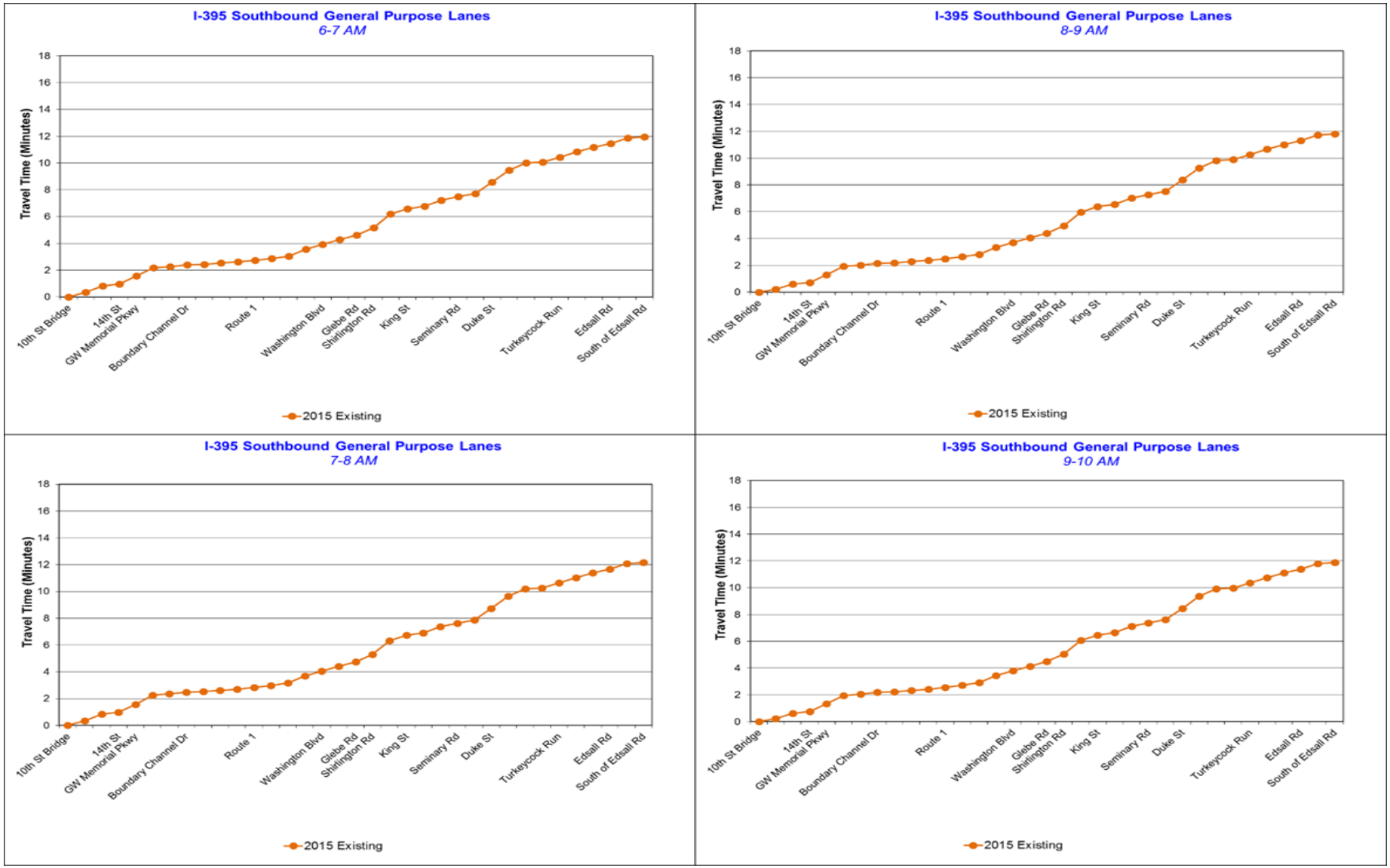


Figure 7-5: AM Peak Period – Southbound HOV/HOT Lanes Cumulative Travel Times (Existing)

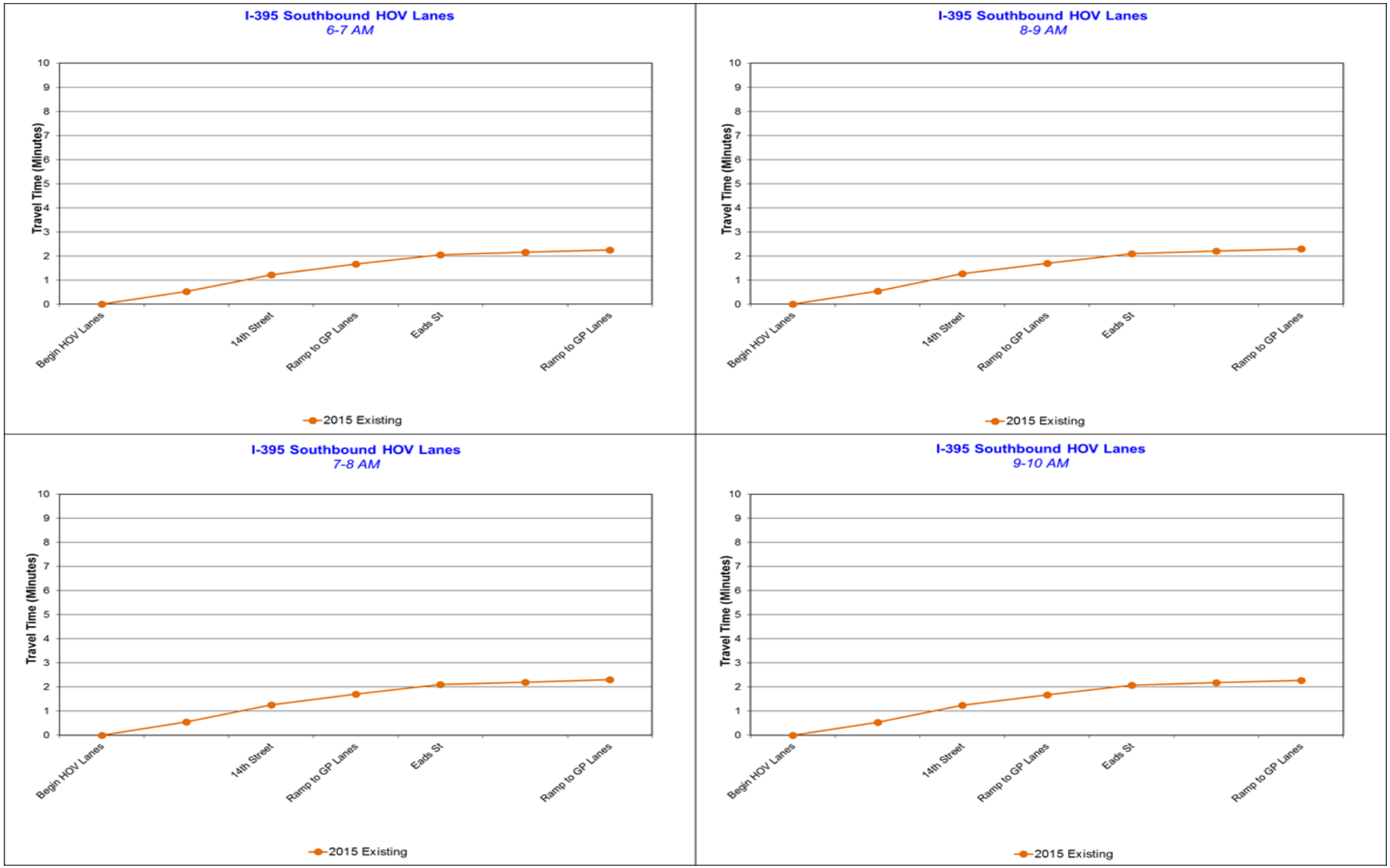


Table 7-3: AM Peak Period – Travel Time Summary (Existing)

Segment	Existing Travel Time (Min)			
	6-7 AM	7-8 AM	8-9 AM	9-10 AM
Northbound General Purpose Lanes				
South of Edsall Rd to Turkeycock Run	1.3	3.2	6.0	2.1
Tukeycock Run to Duke St	1.0	3.8	3.8	1.4
Duke St to Seminary Rd	3.6	7.0	7.7	3.7
Seminary Rd to King St	2.8	3.6	4.1	2.5
King St to Shirtlington Rd	1.4	1.7	2.2	1.9
Shirlington Rd to Glebe Rd	1.1	2.0	2.8	2.7
Glebe Rd to Washington Blvd	2.5	3.6	4.6	6.0
Washington Blvd to Route 1	0.6	3.8	4.3	3.0
Route 1 to Boundary Channel Dr	0.7	2.6	2.7	2.2
Boundary Channel Drive to GW Memorial Pkwy	0.8	1.4	1.3	1.1
GW Memorial Pkwy to 14th St	1.4	1.7	1.6	1.4
14th St to 12th St Exp Ramp	1.1	1.1	1.1	1.2
Total	**18.3**	**35.5**	**42.1**	**29.4**
Average	**31.3**			
Southbound General Purpose Lanes				
Ramp from 9th St Expy	1.0	1.0	0.7	0.7
14th St to GW Memorial Pkwy	0.6	0.6	0.6	0.6
GW Memorial Pkwy to Boundary Channel Dr	0.8	0.9	0.8	0.8
Boundary Channel Dr to Route 1	0.3	0.3	0.3	0.4
Route 1 to Washington Blvd	1.2	1.2	1.2	1.3
Washington Blvd to Glebe Rd	0.7	0.7	0.7	0.7
Glebe Rd to Shirlington Rd	0.5	0.6	0.6	0.6
Shirlington Rd to King St	1.4	1.4	1.4	1.4
King St to Seminary Rd	0.9	0.9	0.9	0.9
Seminary Road to Duke St	1.1	1.1	1.1	1.1
Duke St to Turkeycock Run	1.9	1.9	1.9	1.9
Turkeycock Run to South of Edsall Rd	1.1	1.5	1.5	1.5
Total	**11.6**	**12.2**	**11.8**	**11.9**
Average	**11.9**			
Northbound HOV/HOT Lanes				
South of Edsall Rd to Turkeycock Run	1.0	1.0	1.0	1.0
Turkeycock Run to Seminary Road	2.8	2.8	2.8	2.8
Seminary Rd to Shirlington Rd	1.6	1.6	1.6	1.6
Shirlington Rd to Washington Blvd	1.6	1.6	1.6	1.6
Washington Blvd to Eads St	0.6	0.6	0.8	0.7
Eads St to Ramp from GP Lanes	0.7	1.4	2.2	3.2
Ramp from GP Lanes to 14th St	1.9	3.1	3.5	4.7
14th St to End HOV Lanes	0.7	0.8	0.8	0.8
Total	**10.8**	**12.9**	**14.2**	**16.4**
Average	**13.6**			
Southbound HOV Lanes				
Begin HOV Lanes to 14th St	1.2	1.3	1.3	1.2
14th St to Ramp to GP Lanes	0.4	0.4	0.4	0.4
Ramp to GP Lanes to Eads St	0.4	0.4	0.4	0.4
Eads St to Ramp to GP Lanes	0.2	0.2	0.2	0.2
Total	**2.3**	**2.3**	**2.3**	**2.3**
Average	**2.3**			

7.1.1.2 PM Peak Period

A comparison of overall corridor travel times for existing conditions during the PM peak period is summarized in **Figure 7-6** for the southbound peak travel direction for each of the four analysis hours. **Figures 7-7 through 7-10** summarize cumulative and segment travel times for the northbound and southbound I-395 general purpose and HOV/HOT lanes for each of the four analysis hours during the PM peak period between interchanges along the corridor. **Table 7-4** presents existing overall travel times and segment travel times for the northbound and southbound I-395 general purpose and HOV/HOT lanes for each of the four analysis hours during the PM peak period between interchanges along the corridor.

PM Peak Period – Southbound General Purpose Lanes (Peak Direction)

Existing corridor travel times along the southbound I-395 general purpose lanes range from 20 to 41 minutes with an average travel time of 33 minutes. The 5 PM - 6 PM hour has the longest corridor travel time (41 minutes) of the four PM peak period hours due to higher congestion levels during this hour between south of Route 1 and Duke Street

PM Peak Period – Southbound HOV/HOT Lanes (Peak Direction)

Existing corridor travel times along the southbound I-395 HOV/HOT lanes are approximately 10 minutes. Travel times in the southbound I-395 HOV/HOT lanes are 3 to 4 times shorter than travel times in the southbound general purpose lanes from 4 PM to 7 PM.

PM Peak Period – Northbound General Purpose Lanes (Off-Peak Direction)

Existing corridor travel times along the northbound I-395 general purpose lanes range from 11 to 12 minutes. The longest corridor travel time occurs from 5 PM to 6 PM (12 minutes).

PM Peak Period – Northbound HOV Lanes (Off-Peak Direction)

Existing corridor travel times along the northbound I-395 HOV/HOT lanes are 2 to 3 minutes. Each of the four PM peak period hours have similar corridor travel times due to the relatively short northbound HOV corridor distance during the PM period.

Figure 7-6: PM Peak Period - Southbound Overall Travel Time Summary (Existing)

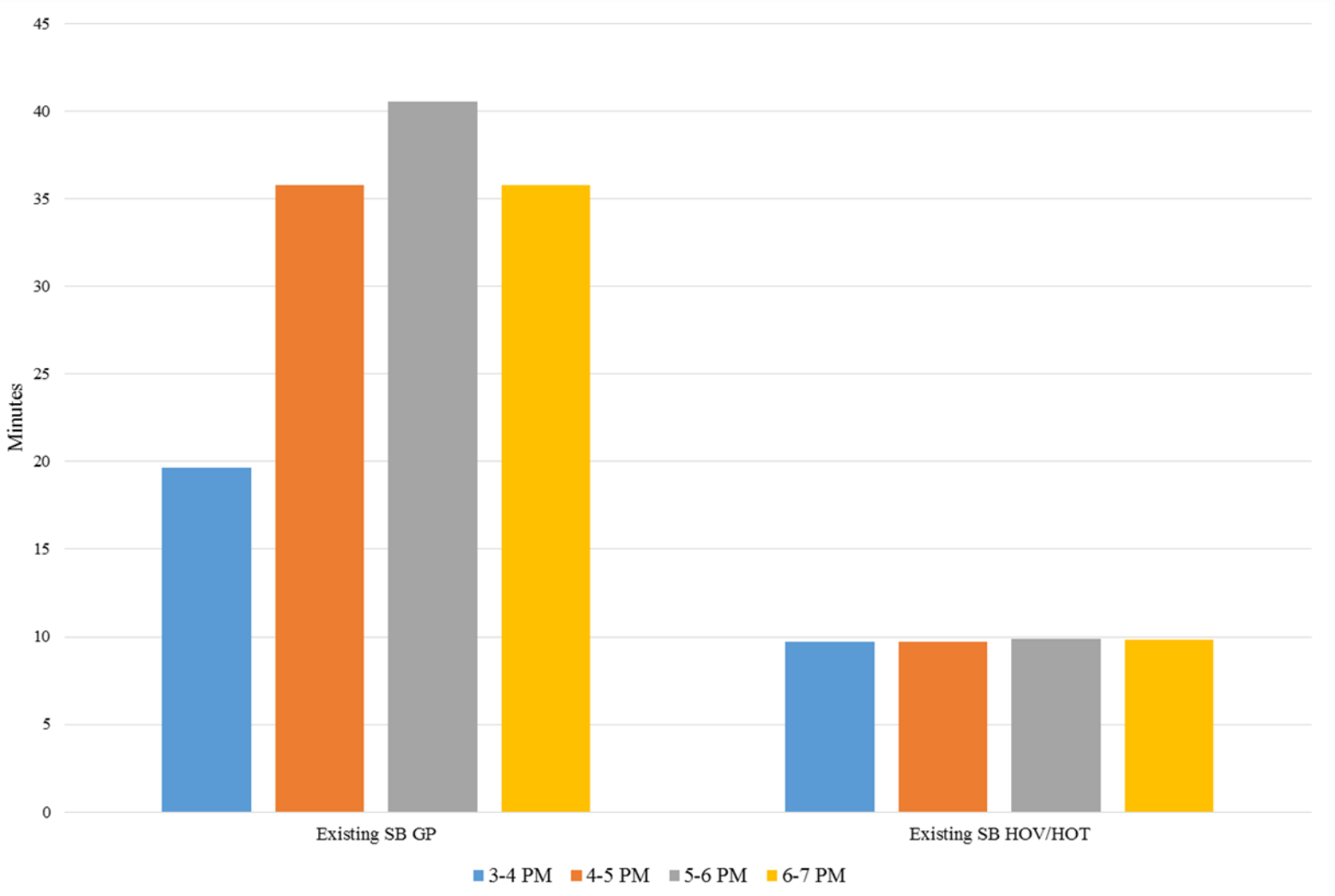


Figure 7-7: PM Peak Period – Southbound General Purpose Lanes Cumulative Travel Times (Existing)

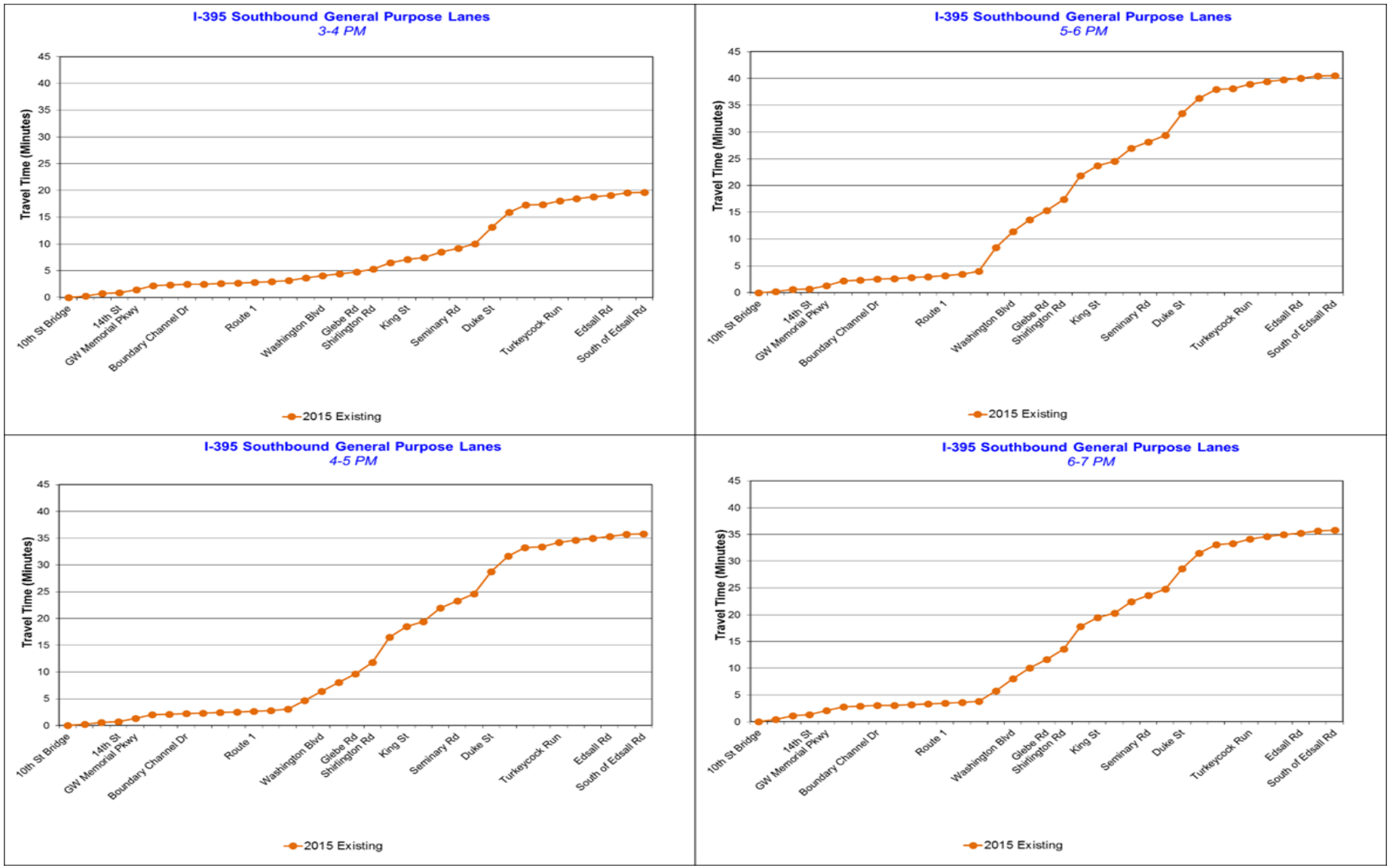


Figure 7-8: PM Peak Period – Southbound HOV/HOT Lanes Cumulative Travel Times (Existing)

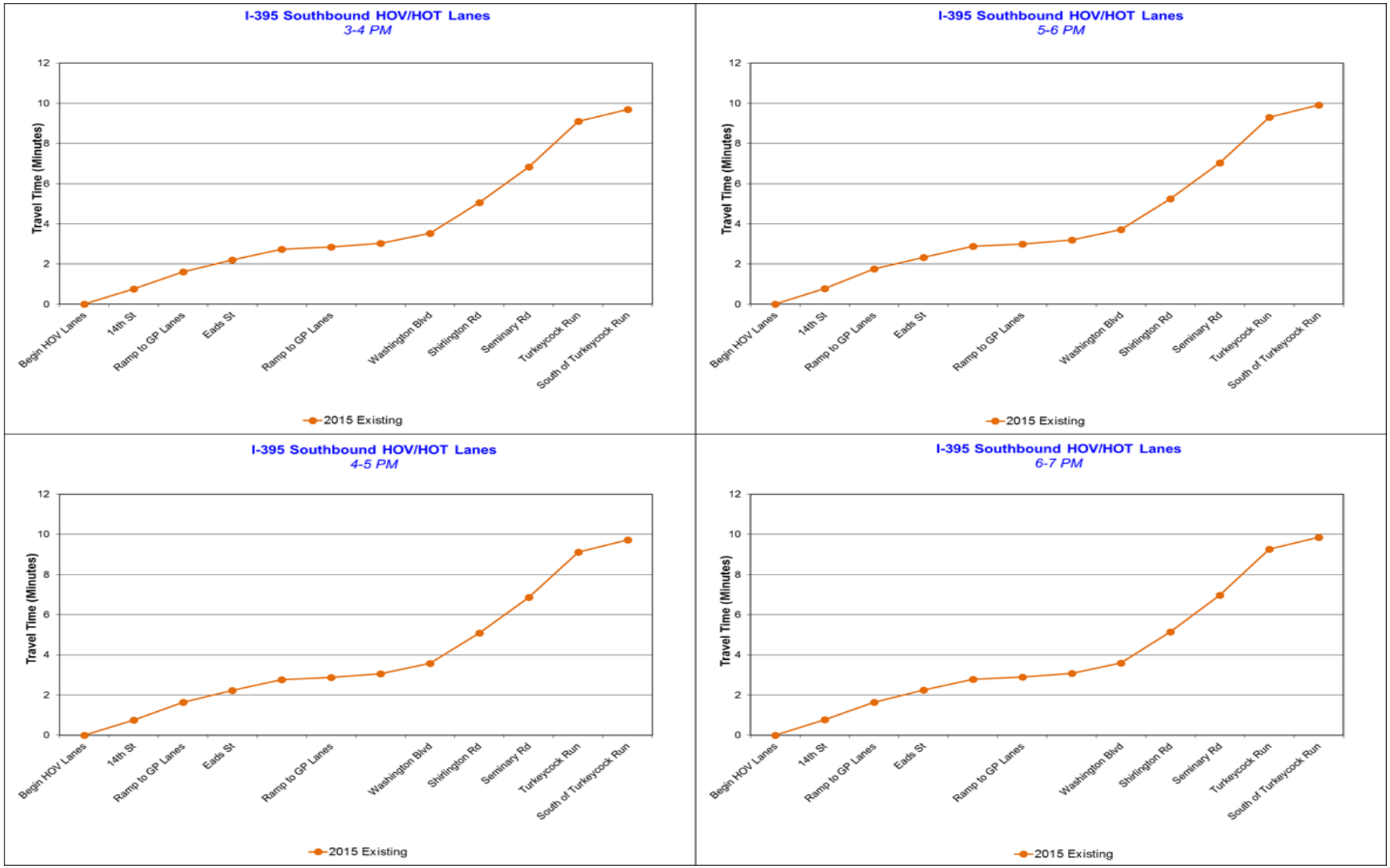


Figure 7-9: PM Peak Period - Northbound General Purpose Lanes Cumulative Travel Times (Existing)

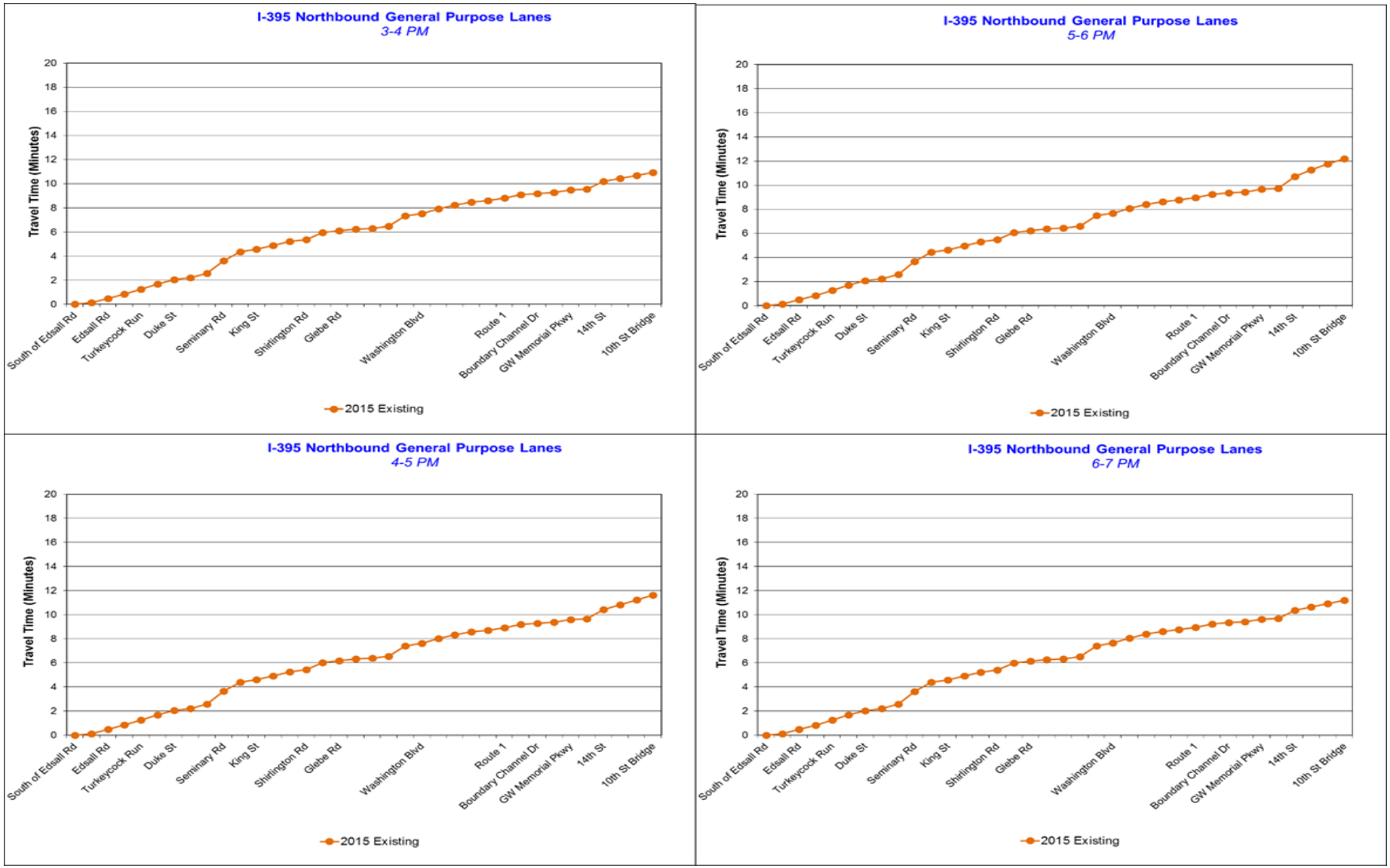


Figure 7-10: PM Peak Period - Northbound HOV/HOT Lanes Cumulative Travel Times (Existing)

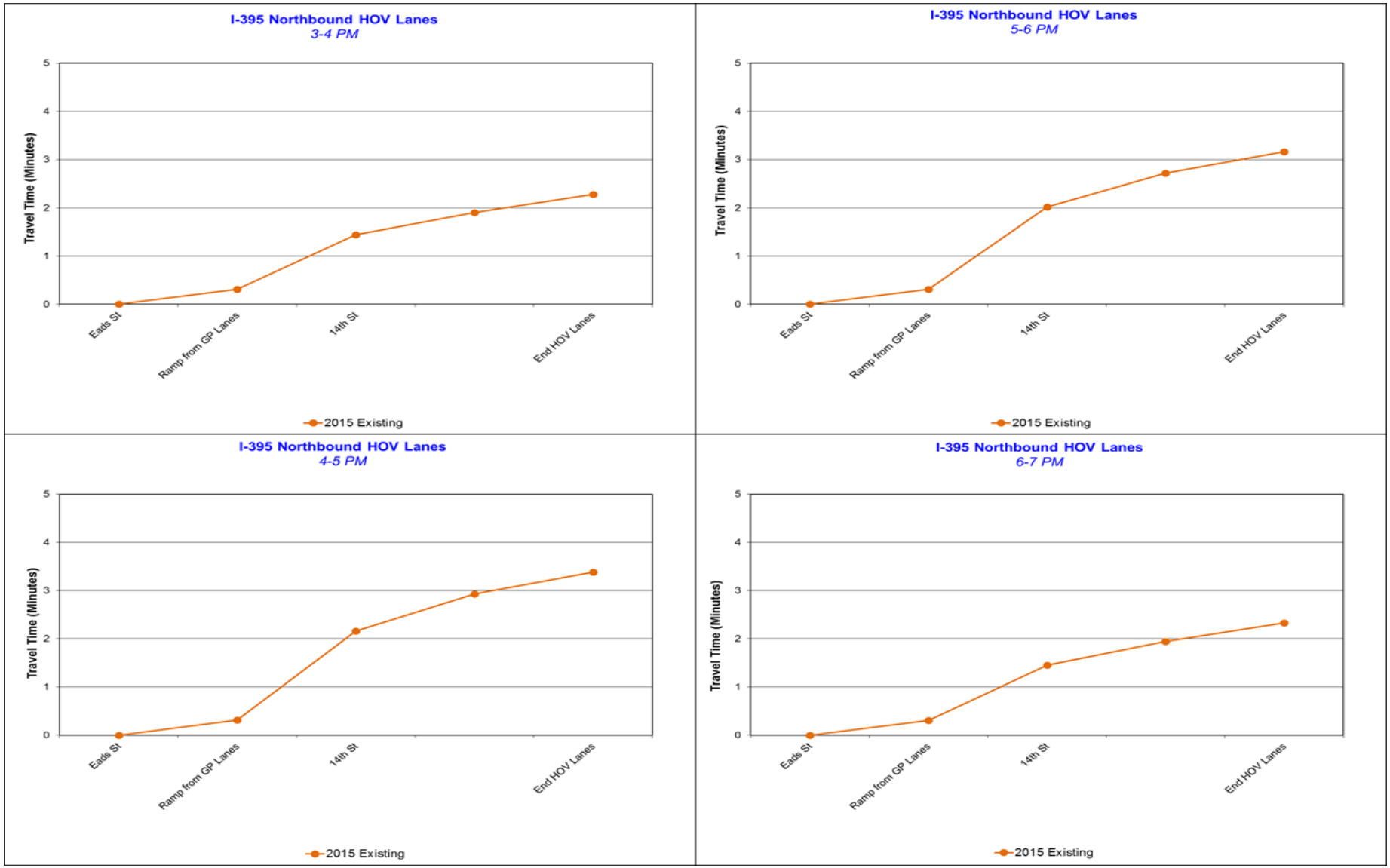


Table 7-4: PM Peak Period – Travel Time Summary (Existing)

Segment	Existing Travel Time (Min)			
	3-4 PM	4-5 PM	5-6 PM	6-7 PM
Northbound General Purpose Lanes				
South of Edsall Rd to Turkeycock Run	1.2	1.3	1.3	1.3
Turkeycock Run to Duke St	0.8	0.8	0.8	0.8
Duke St to Seminary Rd	1.6	1.6	1.6	1.6
Seminary Rd to King St	0.9	1.0	1.0	0.9
King St to Shirlington Rd	0.8	0.8	0.8	0.8
Shirlington Rd to Glebe Rd	0.7	0.7	0.7	0.7
Glebe Rd to Washington Blvd	2.1	2.2	2.2	2.3
Washington Blvd to Route 1	0.6	0.6	0.6	0.6
Route 1 to Boundary Channel Dr	0.4	0.4	0.4	0.4
Boundary Channel Drive to GW Memorial Pkwy	0.3	0.3	0.3	0.3
GW Memorial Pkwy to 14th St	0.7	0.8	1.0	0.7
14th St to 12th St Exp Ramp	0.7	1.2	1.5	0.8
Total	**10.9**	**11.6**	**12.2**	**11.2**
Average	**11.5**			
Southbound General Purpose Lanes				
Ramp from 9th St Expy	0.9	0.7	0.7	1.3
14th St to GW Memorial Pkwy	0.6	0.6	0.6	0.8
GW Memorial Pkwy to Boundary Channel Dr	1.0	1.0	1.2	1.0
Boundary Channel Dr to Route 1	0.4	0.4	0.6	0.4
Route 1 to Washington Blvd	1.2	3.7	8.3	4.6
Washington Blvd to Glebe Rd	0.7	3.2	3.9	3.6
Glebe Rd to Shirlington Rd	0.6	2.2	2.1	1.9
Shirlington Rd to King St	1.8	6.7	6.3	5.9
King St to Seminary Rd	2.1	4.8	4.5	4.1
Seminary Road to Duke St	4.0	5.5	5.3	5.0
Duke St to Turkeycock Run	4.9	5.4	5.5	5.5
Turkeycock Run to South of Edsall Rd	1.7	1.6	1.6	1.7
Total	**19.7**	**35.8**	**40.5**	**35.8**
Average	**32.9**			
Northbound HOV Lanes				
Eads St to Ramp from GP Lanes	0.3	0.3	0.3	0.3
Ramp from GP Lanes to 14th St	1.1	1.9	1.7	1.1
14th St to End HOV Lanes	0.8	1.2	1.2	0.9
Total	**2.3**	**3.4**	**3.2**	**2.3**
Average	**2.8**			
Southbound HOV/HOT Lanes				
Begin HOV Lanes to 14th St	0.8	0.8	0.8	0.8
14th St to Ramp to GP Lanes	0.9	0.9	1.0	0.9
Ramp to GP Lanes to Washington Blvd	0.6	0.6	0.6	0.6
Eads St to Ramp to GP Lanes	0.7	0.7	0.7	0.7
Ramp to GP Lanes to Washington Blvd	0.7	0.7	0.7	0.7
Washington Blvd to Shirlington Rd	1.5	1.5	1.5	1.5
Shirlington Rd to Seminary Rd	1.8	1.8	1.8	1.8
Seminary Rd to Turkeycock Run	2.3	2.3	2.3	2.3
Turkeycock Run to South of Edsall Rd	0.6	0.6	0.6	0.6
Total	**9.7**	**9.7**	**9.9**	**9.9**
Average	**9.8**			

7.1.2 Freeway Density and Speed Analysis

7.1.2.1 AM Peak Period

Figure 7-11 summarizes existing traffic operations based on the freeway segment density measured in vehicles per mile per lane for the northbound and southbound I-395 general purpose and HOV/HOT lanes for each of the four analysis hours from 6 AM through 10 AM. Under existing conditions, there are a total of 125 segments including 52 freeway segments, 23 weave segments, and 50 merge/diverge junctions.

Figures 7-12 (*Volume 2*) **and 7-13** (*Volume 2*) **and Table 7-5** depict existing travel speeds (MPH) and densities (vehicles per mile per lane) along the northbound and southbound I-395 general purpose and HOV/HOT lanes for each of the four analysis hours during the AM peak period. **Appendix J** contains a summary of throughput volumes, travel speeds, and densities by lane for existing conditions.

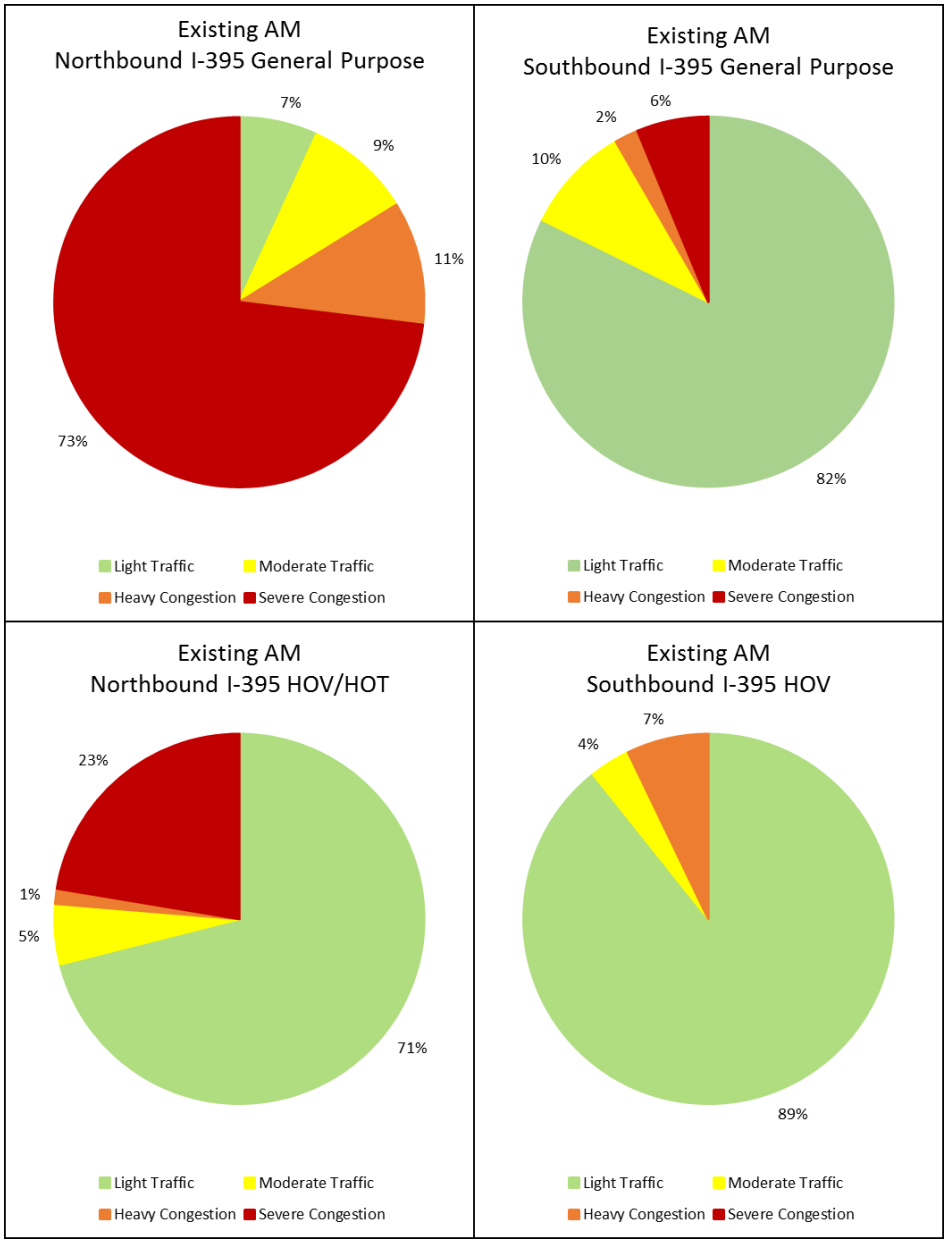
As shown in **Figure 7-11 and Table 7-5** under existing AM conditions, 73 percent of the 51 northbound I-395 general purpose segments operate with severe congestion and 11 percent operate with heavy congestion. The remaining 16 percent operate with light or moderate traffic conditions. Twenty-four percent of the 19 northbound I-395 HOV/HOT segments operate with severe or heavy congestion and 5 percent operate with moderate traffic conditions. The remaining 71 percent operate with light traffic conditions.

Freeway Segments: Under existing conditions in the AM peak period, there are a total of 22 freeway segments in the northbound I-395 general purpose lanes. Of these segments, 76 percent operate with severe congestion, 11 percent operate with heavy congestion, and the remaining 13 percent operate with light or moderate traffic conditions. There are a total of eight freeway segments in the northbound I-395 HOV/HOT lanes. Of these segments, 25 percent operate with severe congestion and 75 percent operate with light or moderate traffic conditions.

Ramp Junctions: Under existing conditions in the AM peak period, there are a total of 16 ramp junctions in the northbound I-395 general purpose lanes. Of these segments, 62 percent operate with severe congestion, 12 percent operate with heavy congestion, and the remaining 26 percent operate with light or moderate traffic conditions. There are a total of 11 ramp junctions in the northbound I-395 HOV/HOT lanes. Of these segments, 22 percent operate with severe or heavy congestion and 78 percent operate with light or moderate traffic conditions.

Weave Segments: Under existing conditions in the AM peak period, there are a total of 13 weave segments in the northbound I-395 general purpose lanes. Of these segments, 81 percent operate with severe congestion, 8 percent operate with heavy congestion, and the remaining 11 percent operate with light or moderate traffic conditions. There are no weave segments in the northbound I-395 HOV/HOT lanes.

Figure 7-11: AM Peak Period Freeway Density Summary (Existing Conditions)



Figures 7-14 through 7-16 depict existing speed profiles from the VISSIM model for the northbound and southbound I-395 general purpose and HOV/HOT lanes for each of the four analysis hours during the AM peak period. The following is a summary of the travel speeds for existing conditions in the peak travel direction.

AM Peak Period – Northbound General Purpose Lanes (Peak Direction): Existing average corridor travel speeds along the northbound I-395 general purpose lanes for the four hours during the AM peak period range from 14 MPH to 33 MPH with an overall average travel speed of 21 MPH during the four hour period. The lowest corridor speeds occur between 7 AM and 9 AM with speeds under 10 MPH observed between Washington Boulevard and Route 1 due to higher levels of congestion approaching Washington, D.C. and the increase on volumes generated by Washington Boulevard, Jefferson Davis Highway, and George Washington Memorial Parkway. Travel speeds increase north of Glebe Road compared to south of Glebe Road due to a high volume of traffic exiting to Glebe Road compared to the entering volume from Glebe Road.

AM Peak Period – Northbound HOV/HOT Lanes (Peak Direction): Existing corridor travel speeds along the northbound I-395 HOV/HOT lanes range from 36 MPH to 55 MPH with average travel speeds of 45 MPH. The lowest travel speeds occur from 9 AM to 10 AM due to non-HOV motorists entering the northbound I-395 HOV lanes during this hour when the HOV restrictions are not in effect. During the 8 AM to 9 AM and 9 AM to 10 AM hours, reduced travel speeds are experienced in the HOV lanes south of Eads Street to the northern study limits with speeds of approximately 10 MPH observed north of Eads Street to 14th Street.

Table 7-5: AM Peak Period Freeway Speed and Density by Segment (Existing)

Existing Conditions									
Location	Type	Average Speed (mph)				Average Density (veh/mi/ln)			
		6-7 AM	7-8 AM	8-9 AM	9-10 AM	6-7 AM	7-8 AM	8-9 AM	9-10 AM
I-395 Northbound General Purpose Lanes									
I-395 NB south of Edsall Rd ramps	Diverge	50	47	19	34	25	29	75	49
I-395 NB between Edsall Rd off-ramps	Freeway	52	45	18	39	29	36	90	50
I-395 NB at Edsall Rd WB off-ramp	Diverge	48	38	17	36	24	33	74	41
I-395 NB between Edsall Rd off-ramp and on-ramp	Freeway	53	35	12	40	26	47	112	44
I-395 NB between Edsall Rd and Turkeycock Run	Weave	52	14	11	38	23	79	107	42
I-395 NB between Turkeycock Run ramps	Freeway	49	12	13	39	31	112	112	46
I-395 NB between Turkeycock Run and Duke St	Weave	39	13	14	40	35	103	100	37
I-395 NB at Duke St EB off-ramp	Diverge	36	15	15	37	38	98	101	41
I-395 NB between Duke St off-ramps	Diverge	34	14	14	35	38	90	94	40
I-395 NB between Duke St off-ramp and on-ramp	Freeway	28	13	12	32	55	114	116	52
I-395 NB between Duke St and Seminary Rd	Weave	23	15	13	27	63	100	104	57
I-395 NB between Seminary Rd ramps	Freeway	19	14	13	26	87	111	115	66
I-395 NB at Seminary Rd on-ramp	Merge	19	16	15	24	67	78	82	49
I-395 NB between Seminary Rd and King St	Weave	27	23	19	29	56	68	77	54
I-395 NB between King St off-ramp and on-ramp	Freeway	31	25	21	29	62	74	83	62
I-395 NB at King St EB on-ramp	Merge	25	22	18	24	62	74	80	60
I-395 NB between King St on-ramps	Freeway	43	38	28	34	49	55	68	57
I-395 NB between King St and Shirlington Rd	Weave	50	35	23	33	31	50	70	55
I-395 NB between Shirlington Rd ramps	Freeway	47	24	17	21	36	76	102	82
I-395 NB between Shirlington Rd and Glebe Rd	Weave	32	22	20	18	49	80	91	84
I-395 NB between Glebe Rd EB off-ramp and on-ramp	Freeway	45	41	40	32	37	42	39	49
I-395 NB between Glebe Rd EB on-ramp and WB off-ramp	Weave	50	42	42	28	28	36	32	49
I-395 NB between Glebe Rd WB off-ramp and on-ramp	Freeway	52	41	43	26	32	43	37	61
I-395 NB at Glebe Rd WB on-ramp	Merge	53	30	37	18	26	55	42	90
I-395 NB north of Glebe Rd ramps	Freeway	47	34	36	24	37	58	47	75
I-395 NB at Washington Blvd WB off-ramp	Diverge	50	47	44	34	28	30	29	41
I-395 NB at Washington Blvd EB off-ramp	Diverge	53	53	47	44	28	28	28	36
I-395 NB between Washington Blvd EB off-ramp and Army Navy Dr off-ramp	Freeway	52	47	36	36	26	29	47	49
I-395 NB at Army Navy Dr off-ramp	Diverge	53	44	31	34	19	24	46	51

Existing Conditions									
Location	Type	Average Speed (mph)				Average Density (veh/mi/ln)			
		6-7 AM	7-8 AM	8-9 AM	9-10 AM	6-7 AM	7-8 AM	8-9 AM	9-10 AM
I-395 NB between Army Navy Dr off-ramp and Washington Blvd EB on-ramp	Freeway	52	27	22	39	23	43	53	22
I-395 NB at Washington Blvd EB on-ramp	Weave	52	13	8	18	22	107	121	62
I-395 NB at ramp to HOV lanes	Weave	47	12	9	16	24	98	119	69
I-395 NB between ramp to HOV lanes and S Rotary Rd on-ramp	Freeway	52	9	8	15	23	127	125	79
I-395 NB at S Rotary Rd on-ramp	Merge	53	9	8	15	17	103	107	65
I-395 NB between S Rotary Rd on-ramp and Rte 1 SB on-ramp	Freeway	53	8	8	14	22	148	152	94
I-395 NB at Rte 1 SB on-ramp	Merge	47	9	9	14	22	109	114	87
I-395 NB between Rte 1 ramps	Freeway	42	9	9	14	33	149	149	109
I-395 NB at Rte 1 NB on-ramp	Merge	32	10	9	12	29	100	132	121
I-395 NB between Rte 1 and Boundary Channel Dr	Freeway	23	10	10	14	51	130	133	113
I-395 NB between Boundary Channel Dr ramps	Weave	21	11	10	13	46	102	123	108
I-395 NB at lane reduction north of Boundary Channel Dr	Merge	20	11	12	15	57	118	118	102
I-395 NB south of GW Memorial Pkwy	Freeway	20	13	15	17	72	116	111	99
I-395 NB between GW Memorial Pkwy EB on-ramp and WB off-ramp	Weave	20	15	17	19	83	101	95	90
I-395 NB between GW Memorial Pkwy WB off-ramp and WB on-ramp	Freeway	25	19	22	25	67	92	84	73
I-395 NB between GW Memorial Pkwy and 14th St	Weave	21	18	20	23	73	93	88	75
I-395 NB at 14th St off-ramp	Diverge	20	20	20	22	75	87	86	79
I-395 NB between 14th St off-ramp and off-ramp to Buckeye Dr	Freeway	20	19	19	20	83	95	95	89
I-395 NB between Buckeye Dr ramps	Freeway	28	29	29	25	58	60	61	68
I-395 NB at on-ramp from Buckeye Dr	Merge	31	31	30	25	48	52	55	64
I-395 NB between HOV merge and 12th St Expy off-ramp	Weave	31	31	30	26	56	58	61	67
I-395 NB north of 12th St Expy off-ramp	Freeway	31	31	31	31	65	64	61	53
I-395 Southbound General Purpose Lanes									
I-395 SB north of 9th St Expy on-ramp	Freeway	21	22	36	35	83	75	45	45
I-395 SB on Francis Case Memorial Bridge	Weave	28	25	32	31	51	60	45	43
I-395 SB between HOV diverge and off-ramp to Ohio Dr	Diverge	32	30	32	32	57	66	57	55
I-395 SB between 14th St on-ramp and HOV diverge	Freeway	35	36	37	36	60	54	51	53
I-395 SB on 14th St Bridge	Merge	43	39	43	43	28	34	27	27
I-395 SB at GW Memorial Pkwy WB off-ramp	Diverge	43	36	42	42	23	31	22	22
I-395 SB between GW Memorial Pkwy EB off-ramp and WB off-ramp	Diverge	45	40	44	42	21	33	23	24

Existing Conditions									
Location	Type	Average Speed (mph)				Average Density (veh/mi/ln)			
		6-7 AM	7-8 AM	8-9 AM	9-10 AM	6-7 AM	7-8 AM	8-9 AM	9-10 AM
I-395 SB between GW Memorial Pkwy EB on-ramp and EB off-ramp	Freeway	48	48	48	48	22	22	22	21
I-395 SB between Boundary Channel Dr and GW Memorial Pkwy	Weave	43	43	45	45	18	19	17	17
I-395 SB between ramp from HOV lanes and Boundary Channel Dr WB off-ramp	Merge	48	47	47	46	18	19	20	19
I-395 SB between Boundary Channel Dr EB off-ramp and ramp from HOV lanes	Weave	48	47	46	39	18	23	23	26
I-395 SB between Rte 1 SB off-ramp and Boundary Channel Dr EB off-ramp	Freeway	48	46	46	44	22	28	29	28
I-395 SB between Boundary Channel Dr EB on-ramp and Rte 1 SB off-ramp	Diverge	47	44	42	43	18	24	25	23
I-395 SB between Rte 1 NB off-ramp and SB off-ramp	Weave	50	45	45	37	14	17	17	22
I-395 SB between S Rotary Rd off-ramp and Rte 1 NB off-ramp	Diverge	53	50	51	51	11	14	12	12
I-395 SB between ramp from HOV lanes and S Rotary Rd off-ramp	Freeway	54	55	55	54	8	6	5	7
I-395 SB between Army Navy Dr on-ramp and ramp from HOV lanes	Merge	55	55	55	55	7	7	7	7
I-395 SB at Army Navy Dr on-ramp	Merge	54	53	53	53	9	9	8	9
I-395 SB between Washington Blvd WB on-ramp and Army Navy Dr on-ramp	Freeway	54	54	54	54	12	12	11	11
I-395 SB at Washington Blvd WB on-ramp	Merge	54	53	53	53	9	11	10	10
I-395 SB between Washington Blvd EB on-ramp and WB on-ramp	Freeway	54	54	54	54	11	14	13	13
I-395 SB at Washington Blvd EB on-ramp	Merge	53	51	52	51	11	15	13	14
I-395 SB north of Glebe Rd ramps	Diverge	54	54	54	54	13	17	16	16
I-395 SB between Shirlington Rd and Glebe Rd	Freeway	54	53	54	53	15	19	17	17
I-395 SB between Shirlington Rd on-ramps	Merge	53	52	52	52	14	19	17	16
I-395 SB between King St and Shirlington Rd	Weave	53	52	52	52	12	17	16	15
I-395 SB between King St WB on-ramp and off-ramp	Freeway	54	54	54	54	13	18	16	15
I-395 SB at King St WB on-ramp	Merge	54	53	53	53	11	15	14	13
I-395 SB between King St EB on-ramp and WB on-ramp	Freeway	54	53	54	54	14	19	18	16
I-395 SB between Seminary Rd and King St	Weave	54	53	54	54	12	17	16	14
I-395 SB between Seminary Rd ramps	Freeway	54	54	54	54	13	17	16	15
I-395 SB at Seminary Rd on-ramp	Merge	53	52	52	52	13	17	16	15
I-395 SB between Little River Tnpk and Seminary Rd	Freeway	54	53	53	53	15	20	20	18

Existing Conditions									
Location	Type	Average Speed (mph)				Average Density (veh/mi/ln)			
		6-7 AM	7-8 AM	8-9 AM	9-10 AM	6-7 AM	7-8 AM	8-9 AM	9-10 AM
I-395 SB at Little River Tnpk WB off-ramp	Diverge	52	50	51	51	13	17	17	15
I-395 SB between lane reduction and Little River Tnpk WB off-ramp	Merge	53	51	52	51	15	19	18	17
I-395 SB between Little River Tnpk WB on-ramp and lane reduction	Freeway	53	51	51	52	19	25	24	22
I-395 SB between Little River Tnpk EB off-ramp and WB on-ramp	Weave	47	43	43	45	19	27	26	22
I-395 SB between Little River Tnpk EB on-ramp and EB off-ramp	Freeway	53	52	52	52	20	25	24	21
I-395 SB at Little River Tnpk EB on-ramp	Merge	51	49	50	51	18	23	22	19
I-395 SB between Turkeycock Run and Little River Tnpk	Freeway	53	52	53	53	23	28	27	23
I-395 SB at Turkeycock Run off-ramp to HOT	Diverge	53	53	53	53	22	28	27	23
I-395 SB between Turkeycock Run ramps	Freeway	53	53	53	53	22	28	27	23
I-395 SB between Edsall Rd and Turkeycock Run	Weave	54	54	54	54	17	21	20	17
I-395 SB between Edsall Rd WB on-ramp and WB off-ramp	Freeway	53	53	53	53	21	26	24	21
I-395 SB between Edsall Rd EB off-ramp and WB on-ramp	Weave	51	49	48	49	19	24	23	20
I-395 SB between Edsall Rd EB off-ramp and lane addition	Freeway	52	51	51	52	24	29	27	24
I-395 SB at lane addition south of Edsall Rd	Freeway	53	52	52	53	18	21	20	17
I-395 SB south of Edsall Rd ramps	Merge	53	53	53	53	15	18	18	16
I-395 Northbound HOV/HOT Lanes									
I-395 HOT NB south of Turkeycock Run ramps	Freeway	67	67	67	67	16	20	14	8
I-395 HOT NB at Turkeycock Run off-ramp	Diverge	60	59	60	63	13	17	12	7
I-395 HOV NB between Turkeycock Run off-ramp and lane reduction	Merge	66	65	66	67	11	14	9	7
I-395 HOV NB between lane reduction and Turkeycock Run on-ramp	Freeway	67	66	67	67	17	21	14	10
I-395 HOV NB at Turkeycock Run on-ramp	Merge	65	65	65	59	12	15	10	13
I-395 HOV NB between Turkeycock Run and Seminary Rd	Merge	67	66	67	67	18	22	15	17
I-395 HOV NB at Seminary Rd on-ramp	Merge	64	62	62	61	13	17	12	14
I-395 HOV NB between Seminary Rd at Shirlington Rd	Freeway	66	66	66	66	19	24	17	19
I-395 HOV NB at Shirlington Rd on-ramp	Merge	62	60	57	54	15	22	19	27
I-395 HOV NB between Shirlington Rd and Washington Blvd	Freeway	62	62	62	62	21	26	21	23

Existing Conditions									
Location	Type	Average Speed (mph)				Average Density (veh/mi/ln)			
		6-7 AM	7-8 AM	8-9 AM	9-10 AM	6-7 AM	7-8 AM	8-9 AM	9-10 AM
I-395 HOV NB at Washington Blvd off-ramp	Diverge	63	62	63	61	14	17	14	16
I-395 HOV NB between Washington Blvd and Eads St	Freeway	57	57	49	46	18	21	22	25
I-395 HOV NB at Eads St off-ramp	Diverge	39	37	31	30	19	23	36	34
I-395 HOV NB between Eads St ramps	Freeway	54	53	47	23	11	13	12	47
I-395 HOV NB at Eads St on-ramp	Merge	45	32	9	11	12	22	80	84
I-395 HOV NB between Eads St on-ramp and on-ramp from GP lanes	Freeway	49	17	9	10	16	60	128	107
I-395 HOV NB at on-ramp from GP lanes	Merge	40	12	9	8	29	103	134	124
I-395 HOV NB between on-ramp from GP lanes and 14th St	Diverge	28	16	14	11	59	102	110	120
I-395 HOV NB north of 14th St	Freeway	36	31	31	31	53	56	56	56
I-395 Southbound HOV Lanes									
I-395 HOV SB north of 14th St	Freeway	51	50	50	51	24	39	38	30
I-395 HOV SB between off-ramp to GP lanes and 14th St	Merge	53	51	51	52	12	23	22	17
I-395 HOV SB at off-ramp to GP lanes	Diverge	39	36	37	36	12	23	22	17
I-395 HOV SB between Eads St off-ramp and off-ramp to GP lanes	Freeway	59	59	59	59	3	6	6	3
I-395 HOV SB at Eads St off-ramp	Diverge	57	58	58	58	2	4	4	2
I-395 HOV SB between Eads St ramps	Freeway	60	60	60	60	2	5	5	3
I-395 HOV SB between off-ramp to GP lanes and Eads St	Weave	56	57	58	57	2	3	3	2

Figure 7-14: Freeway Speeds – Northbound General Purpose Lanes – AM Peak Period (Existing)

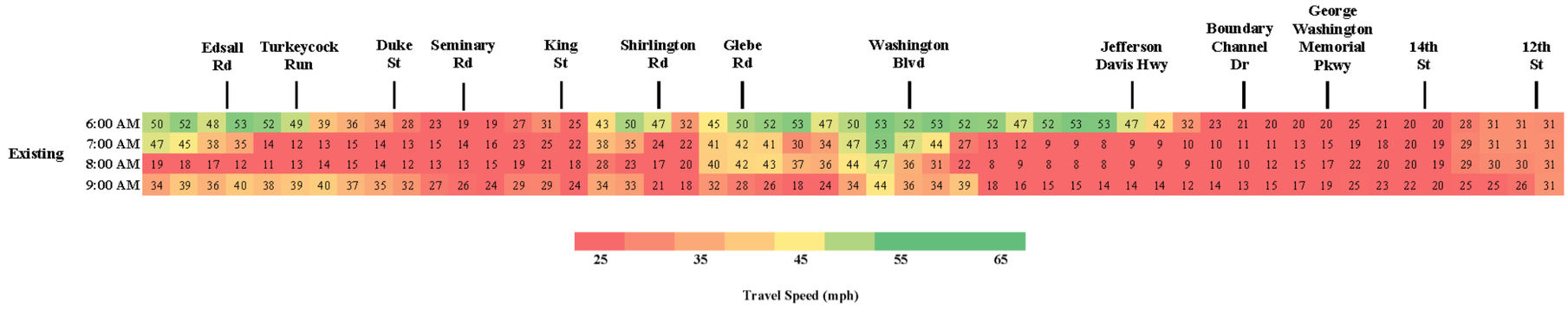


Figure 7-15: Freeway Speeds – Southbound General Purpose Lanes – AM Peak Period (Existing)

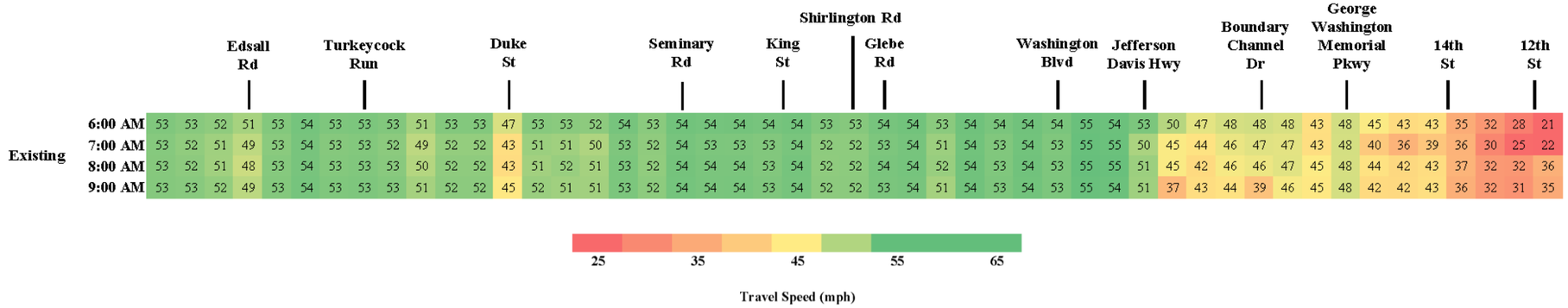
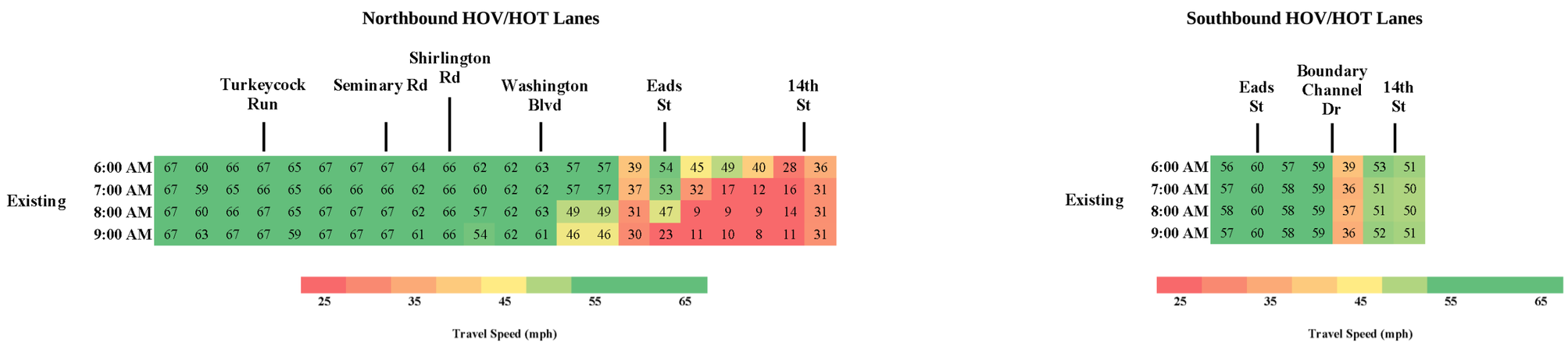


Figure 7-16: Freeway Speeds – HOV/HOT Lanes – AM Peak Period (Existing)



7.1.2.2 PM Peak Period

Figure 7-17 summarizes existing traffic operations based on the freeway segment density measured in vehicles per mile per lane for the northbound and southbound I-395 general purpose and HOV/HOT lanes for each of the four analysis hours from 3 PM through 7 PM. Under existing conditions, there are a total of 122 segments including 53 freeway segments, 23 weave segments, and 46 merge/diverge junctions.

Figures 7-18 (*Volume 2*) **and 7-19** (*Volume 2*) **and Table 7-6** depict existing travel speeds (MPH) and densities (vehicles per mile per lane) along the northbound and southbound I-395 general purpose and HOV/HOT lanes for each of the four analysis hours during the PM peak period. **Appendix J** contains a summary of throughput volumes, travel speeds, and densities by lane for existing conditions.

As shown in **Figure 7-17 and Table 7-6**, 58 percent of the 48 southbound I-395 general purpose segments operate with severe congestion and 13 percent operate with heavy congestion. The remaining 29 percent operate with light or moderate traffic conditions. Seven percent of the 18 southbound I-395 HOV/HOT segments operate with severe congestion and 4 percent operate with heavy congestion. The remaining 89 percent operate with light or moderate traffic conditions.

Figure 7-17: PM Peak Period Freeway Density and Speed Summary (Existing Conditions)

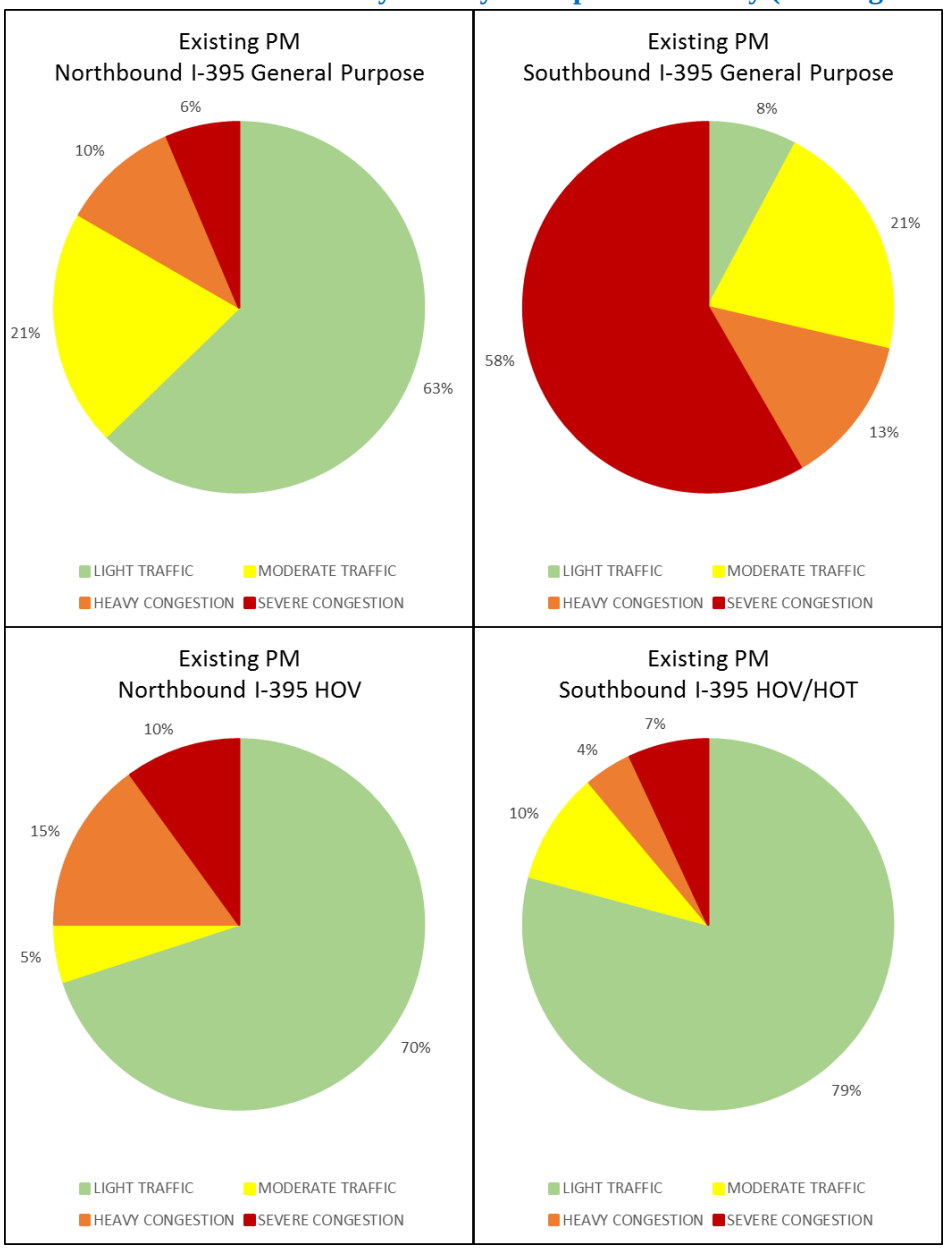


Table 7-6: PM Peak Period Freeway Speed and Density by Segment (Existing)

Existing Conditions									
Location	Type	Average Speed (mph)				Average Density (veh/mi/ln)			
		3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM
I-395 Northbound General Purpose Lanes									
I-395 NB south of Edsall Rd ramps	Diverge	50	48	48	49	25	32	34	29
I-395 NB between Edsall Rd off-ramps	Freeway	52	52	52	52	29	36	38	33
I-395 NB at Edsall Rd WB off-ramp	Diverge	48	46	47	48	24	31	32	28
I-395 NB between Edsall Rd off-ramp and on-ramp	Freeway	58	57	57	57	23	29	32	27
I-395 NB between Edsall Rd and Turkeycock Run	Weave	58	57	56	57	20	25	27	23
I-395 NB between Turkeycock Run ramps	Freeway	58	57	56	57	26	33	36	31
I-395 NB between Turkeycock Run and Duke St	Weave	58	57	57	58	20	24	27	23
I-395 NB at Duke St EB off-ramp	Diverge	58	57	57	57	20	24	27	23
I-395 NB between Duke St off-ramps	Diverge	58	58	58	58	18	22	24	20
I-395 NB between Duke St off-ramp and on-ramp	Freeway	58	57	57	58	20	26	29	24
I-395 NB between Duke St and Seminary Rd	Weave	58	57	57	57	20	24	27	23
I-395 NB between Seminary Rd ramps	Freeway	58	57	57	57	22	28	31	26
I-395 NB at Seminary Rd on-ramp	Merge	53	52	51	53	18	22	25	20
I-395 NB between Seminary Rd and King St	Weave	58	57	57	58	21	25	27	23
I-395 NB between King St off-ramp and on-ramp	Freeway	58	57	56	57	24	29	32	27
I-395 NB at King St EB on-ramp	Merge	55	54	52	54	21	26	30	24
I-395 NB between King St on-ramps	Freeway	57	56	55	56	27	33	37	31
I-395 NB between King St and Shirlington Rd	Weave	57	56	56	56	21	25	27	23
I-395 NB between Shirlington Rd ramps	Freeway	58	58	58	58	19	23	25	20
I-395 NB between Shirlington Rd and Glebe Rd	Weave	52	46	48	52	21	32	31	22
I-395 NB between Glebe Rd EB off-ramp and on-ramp	Freeway	58	57	57	58	20	24	26	22
I-395 NB between Glebe Rd EB on-ramp and WB off-ramp	Weave	55	54	54	54	18	21	24	20
I-395 NB between Glebe Rd WB off-ramp and on-ramp	Freeway	58	57	57	57	19	22	25	21
I-395 NB at Glebe Rd WB on-ramp	Merge	58	58	58	58	16	18	20	17
I-395 NB north of Glebe Rd ramps	Freeway	58	58	57	58	20	23	25	22
I-395 NB at Washington Blvd WB off-ramp	Diverge	54	53	51	53	17	20	23	19
I-395 NB at Washington Blvd EB off-ramp	Diverge	58	58	57	58	16	18	21	17
I-395 NB between Washington Blvd EB off-ramp and Army Navy Dr off-ramp	Freeway	59	58	58	58	14	16	19	15
I-395 NB at Army Navy Dr off-ramp	Diverge	57	57	57	57	11	13	14	12
I-395 NB between Army Navy Dr off-ramp and Washington Blvd EB on-ramp	Freeway	59	59	58	59	12	14	15	12
I-395 NB at Washington Blvd EB on-ramp	Weave	54	53	53	54	13	16	17	14
I-395 NB at ramp to HOV lanes	Weave	53	49	48	52	13	18	19	14

Existing Conditions									
Location	Type	Average Speed (mph)				Average Density (veh/mi/ln)			
		3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM
I-395 NB between ramp to HOV lanes and S Rotary Rd on-ramp	Freeway	54	53	53	54	16	15	17	16
I-395 NB at S Rotary Rd on-ramp	Merge	53	53	54	54	12	12	13	12
I-395 NB between S Rotary Rd on-ramp and Rte 1 SB on-ramp	Freeway	54	54	54	54	16	15	17	16
I-395 NB at Rte 1 SB on-ramp	Merge	52	52	52	52	16	16	16	16
I-395 NB between Rte 1 ramps	Freeway	53	53	53	54	21	20	21	20
I-395 NB at Rte 1 NB on-ramp	Merge	49	49	49	50	18	18	18	16
I-395 NB between Rte 1 and Boundary Channel Dr	Freeway	54	54	54	54	20	20	20	19
I-395 NB between Boundary Channel Dr ramps	Weave	50	49	50	50	19	19	19	18
I-395 NB at lane reduction north of Boundary Channel Dr	Merge	52	52	52	52	20	19	20	18
I-395 NB south of GW Memorial Pkwy	Freeway	53	53	53	53	26	25	26	24
I-395 NB between GW Memorial Pkwy EB on-ramp and WB off-ramp	Weave	41	41	42	42	42	39	35	36
I-395 NB between GW Memorial Pkwy WB off-ramp and WB on-ramp	Freeway	44	44	44	45	36	34	36	33
I-395 NB between GW Memorial Pkwy and 14th St	Weave	42	39	37	42	35	37	42	33
I-395 NB at 14th St off-ramp	Diverge	43	35	33	41	35	44	51	34
I-395 NB between 14th St off-ramp and off-ramp to Buckeye Dr	Freeway	42	28	23	39	38	59	75	38
I-395 NB between Buckeye Dr ramps	Freeway	39	26	23	38	41	61	73	39
I-395 NB at on-ramp from Buckeye Dr	Merge	40	27	24	38	37	53	60	34
I-395 NB between HOV merge and 12th St Expy off-ramp	Weave	35	25	23	34	41	63	70	41
I-395 NB north of 12th St Expy off-ramp	Freeway	23	23	23	23	72	77	79	68
I-395 Southbound General Purpose Lanes									
I-395 SB north of 9th St Expy on-ramp	Freeway	31	37	35	19	46	38	39	84
I-395 SB on Francis Case Memorial Bridge	Weave	27	33	31	18	53	43	44	82
I-395 SB between HOV diverge and off-ramp to Ohio Dr	Diverge	30	32	30	24	60	57	59	81
I-395 SB between 14th St on-ramp and HOV diverge	Freeway	36	35	34	28	55	54	50	64
I-395 SB on 14th St Bridge	Merge	36	36	33	36	45	45	50	45
I-395 SB at GW Memorial Pkwy WB off-ramp	Diverge	41	41	33	42	31	32	42	31
I-395 SB between GW Memorial Pkwy EB off-ramp and WB off-ramp	Diverge	39	38	29	40	34	36	51	34
I-395 SB between GW Memorial Pkwy EB on-ramp and EB off-ramp	Freeway	42	42	30	43	30	31	48	31
I-395 SB between Boundary Channel Dr and GW Memorial Pkwy	Weave	41	40	30	41	22	23	36	23
I-395 SB between ramp from HOV lanes and Boundary Channel Dr WB off-ramp	Merge	41	40	28	38	26	28	46	31

Existing Conditions									
Location	Type	Average Speed (mph)				Average Density (veh/mi/ln)			
		3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM
I-395 SB between Boundary Channel Dr EB off-ramp and ramp from HOV lanes	Weave	39	38	27	31	28	34	51	40
I-395 SB between Rte 1 SB off-ramp and Boundary Channel Dr EB off-ramp	Freeway	41	40	30	38	33	40	55	40
I-395 SB between Boundary Channel Dr EB on-ramp and Rte 1 SB off-ramp	Diverge	42	39	30	40	26	33	44	30
I-395 SB between Rte 1 NB off-ramp and SB off-ramp	Weave	49	42	26	47	19	26	45	21
I-395 SB between S Rotary Rd off-ramp and Rte 1 NB off-ramp	Diverge	53	37	23	44	19	36	62	30
I-395 SB between ramp from HOV lanes and S Rotary Rd off-ramp	Freeway	54	17	7	22	16	60	121	76
I-395 SB between Army Navy Dr on-ramp and ramp from HOV lanes	Merge	54	12	7	11	13	67	112	99
I-395 SB at Army Navy Dr on-ramp	Merge	53	12	10	11	16	74	103	95
I-395 SB between Washington Blvd WB on-ramp and Army Navy Dr on-ramp	Freeway	53	14	14	14	22	100	123	117
I-395 SB at Washington Blvd WB on-ramp	Merge	51	13	13	13	20	101	117	117
I-395 SB between Washington Blvd EB on-ramp and WB on-ramp	Freeway	52	14	15	16	25	100	107	106
I-395 SB at Washington Blvd EB on-ramp	Merge	51	14	14	16	24	97	100	100
I-395 SB north of Glebe Rd ramps	Diverge	52	14	15	17	30	105	103	98
I-395 SB between Shirlington Rd and Glebe Rd	Freeway	45	12	13	15	37	123	118	110
I-395 SB between Shirlington Rd on-ramps	Merge	33	11	12	15	44	125	120	113
I-395 SB between King St and Shirlington Rd	Weave	28	12	12	14	46	113	109	103
I-395 SB between King St WB on-ramp and off-ramp	Freeway	25	10	11	12	58	131	128	120
I-395 SB at King St WB on-ramp	Merge	22	11	11	12	54	106	103	101
I-395 SB between King St EB on-ramp and WB on-ramp	Freeway	21	12	13	13	71	119	116	113
I-395 SB between Seminary Rd and King St	Weave	17	11	11	12	76	116	111	109
I-395 SB between Seminary Rd ramps	Freeway	16	13	13	13	88	111	109	106
I-395 SB at Seminary Rd on-ramp	Merge	13	11	12	12	107	118	116	112
I-395 SB between Little River Tnpk and Seminary Rd	Freeway	21	19	20	20	85	88	87	88
I-395 SB at Little River Tnpk WB off-ramp	Diverge	17	17	17	17	83	84	83	84
I-395 SB between lane reduction and Little River Tnpk WB off-ramp	Merge	19	18	17	17	95	98	99	100
I-395 SB between Little River Tnpk WB on-ramp and lane reduction	Freeway	40	28	27	27	46	64	66	66
I-395 SB between Little River Tnpk EB off-ramp and WB on-ramp	Weave	30	19	18	18	53	77	80	80
I-395 SB between Little River Tnpk EB on-ramp and EB off-ramp	Freeway	33	26	25	25	58	72	73	74
I-395 SB at Little River Tnpk EB on-ramp	Merge	26	22	22	22	61	69	70	69

Existing Conditions									
Location	Type	Average Speed (mph)				Average Density (veh/mi/ln)			
		3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM
I-395 SB between Turkeycock Run and Little River Tnpk	Freeway	44	43	43	43	46	47	47	48
I-395 SB at Turkeycock Run off-ramp to HOT	Diverge	47	48	47	46	35	35	35	37
I-395 SB between Turkeycock Run ramps	Freeway	53	53	53	53	35	34	34	33
I-395 SB between Edsall Rd and Turkeycock Run	Weave	52	53	53	52	31	27	26	31
I-395 SB between Edsall Rd WB on-ramp and WB off-ramp	Freeway	50	52	52	51	40	34	33	39
I-395 SB between Edsall Rd EB off-ramp and WB on-ramp	Weave	39	47	48	43	43	32	31	39
I-395 SB between Edsall Rd EB off-ramp and lane addition	Freeway	44	49	50	46	49	39	37	45
I-395 SB at lane addition south of Edsall Rd	Freeway	51	52	52	51	32	28	27	31
I-395 SB south of Edsall Rd ramps	Merge	52	52	52	53	28	25	24	26
I-395 Northbound HOV/HOT Lanes									
I-395 HOV NB at Eads St on-ramp	Merge	28	28	28	28	7	11	12	8
I-395 HOV NB between Eads St on-ramp and on-ramp from GP lanes	Freeway	43	43	43	43	7	10	11	8
I-395 HOV NB at on-ramp from GP lanes	Merge	44	43	42	44	9	18	19	11
I-395 HOV NB between on-ramp from GP lanes and 14th St	Freeway	43	28	31	43	14	42	39	18
I-395 HOV NB north of 14th St	Freeway	31	21	23	29	28	69	65	36
I-395 Southbound HOV/HOT Lanes									
I-395 HOV SB north of 14th St	Freeway	36	36	32	36	44	51	61	63
I-395 HOV SB between off-ramp to GP lanes and 14th St	Merge	41	40	35	40	33	43	53	45
I-395 HOV SB at off-ramp to GP lanes	Diverge	43	41	37	41	21	28	34	30
I-395 HOV SB between Eads St off-ramp and off-ramp to GP lanes	Freeway	44	44	44	44	18	18	21	24
I-395 HOV SB at Eads St off-ramp	Diverge	44	44	44	44	12	12	14	16
I-395 HOV SB between Eads St ramps	Freeway	44	44	44	44	16	15	17	21
I-395 HOV SB between Eads St on-ramp and ramp to GP lanes	Weave	51	51	50	51	14	15	17	17
I-395 HOV SB between ramp to GP lanes and Washington Blvd on-ramp	Freeway	49	48	47	48	17	20	23	21
I-395 HOV SB at Washington Blvd on-ramp	Merge	52	53	53	51	17	17	19	22
I-395 HOV SB between Washington Blvd on-ramp and Shirlington Rd off-ramp	Freeway	58	58	57	57	22	23	26	29
I-395 HOV SB at Shirlington Rd off-ramp	Diverge	49	53	45	44	17	17	22	25
I-395 HOV SB between Shirlington Rd off-ramp and Seminary Rd off-ramp	Freeway	63	63	62	62	20	20	23	25
I-395 HOV SB at Seminary Rd off-ramp	Diverge	58	57	55	44	14	15	17	23
I-395 HOV SB between Seminary Rd and Turkeycock Run	Freeway	62	62	62	61	18	19	21	22
I-395 HOV SB at Turkeycock Run off-ramp	Diverge	43	54	54	39	19	14	16	25
I-395 HOV SB between Turkeycock Run ramps	Freeway	63	63	63	63	10	32	37	23

Existing Conditions									
Location	Type	Average Speed (mph)				Average Density (veh/mi/ln)			
		3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM
I-395 HOT SB at Turkeycock Run on-ramp	Merge	60	60	60	59	11	15	17	13
I-395 HOT SB south of Turkeycock Run ramps	Freeway	64	64	64	64	10	14	16	12

Freeway Segments: Under existing conditions in the PM peak period, there are a total of 19 freeway segments in the southbound I-395 general purpose lanes. Of these segments, 66 percent operate with severe congestion, 12 percent operate with heavy congestion, and the remaining 22 percent operate with light or moderate traffic conditions. There are a total of nine freeway segments in the southbound I-395 HOV/HOT lanes. Of these segments, 14 percent operate with severe or heavy congestion and 86 percent operate with light or moderate traffic conditions.

Ramp Junctions: Under existing conditions in the PM peak period, there are a total of 20 ramp junctions in the southbound I-395 general purpose lanes. Of these segments, 59 percent operate with severe congestion, 11 percent operate with heavy congestion, and the remaining 30 percent operate with light or moderate traffic conditions. There are a total of eight ramp junctions in the southbound I-395 HOV/HOT lanes. Of these segments, 9 percent operate with severe or heavy congestion and 91 percent operate with light or moderate traffic conditions.

Weave Segments: Under existing conditions in the PM peak period, there are a total of nine weave segments in the southbound I-395 general purpose lanes. Of these segments, 42 percent operate with severe congestion, 19 percent operate with heavy congestion, and the remaining 39 percent operate with light or moderate traffic conditions.

Figures 7-20 through 7-22 depict existing speed profiles from the VISSIM model for the northbound and southbound I-395 general purpose and HOV/HOT lanes for each of the four analysis hours during the PM peak period. The following is a summary of the travel speeds for existing conditions in the peak travel direction.

PM Peak Period – Southbound General Purpose Lanes (Peak Direction): Existing corridor travel speeds along the southbound I-395 general purpose lanes range from 15 to 31 MPH with average travel speeds of 20 MPH. Travel speeds are lowest along the southbound I-395 travel lanes from approximately Washington Boulevard to Duke Street where there is a lane reduction from four lanes to three lanes. Travel speeds in the section range from 10 MPH to 20 MPH from 4 PM to 6 PM with higher travel speeds observed between 3 PM and 4 PM. Travel speeds increase south of the Duke Street Interchange to the southern study limits to 40 MPH to 55 MPH due to increased capacity in the adjacent HOT lanes and the bottleneck to the north of this segment at the Duke Street Interchange.

PM Peak Period – Southbound HOV/HOT Lanes (Peak Direction)

Existing corridor travel speeds along the southbound I-395 HOV/HOT lanes are approximately 60 MPH to 61 MPH. Travel speeds in the southbound I-395 HOV/HOT lanes are approximately 3 times greater than travel speeds in the southbound I-395 general purpose lanes. Southbound I-395 HOV lane travel speeds generally range from 35 to 50 MPH north of Washington Boulevard and increase to 55 MPH to 65 MPH

south of Washington Boulevard where the HOV restrictions are enforced from 3:30 PM to 6:00 PM. Travel speeds approaching the Turkeycock Run Interchange decrease to approximately 40 MPH from 3 PM to 4 PM and 6 PM to 7 PM due to motorists exiting the HOV lanes and encountering congestion in the southbound I-395 general purpose lanes.

Figure 7-20: Freeway Speeds – Northbound General Purpose Lanes – PM Peak Period (Existing)

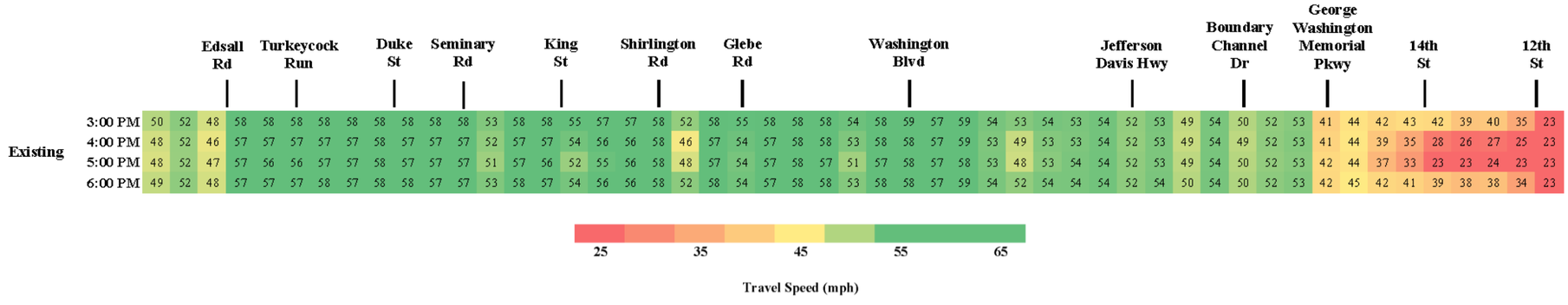


Figure 7-21: Freeway Speeds – Southbound General Purpose Lanes – PM Peak Period (Existing)

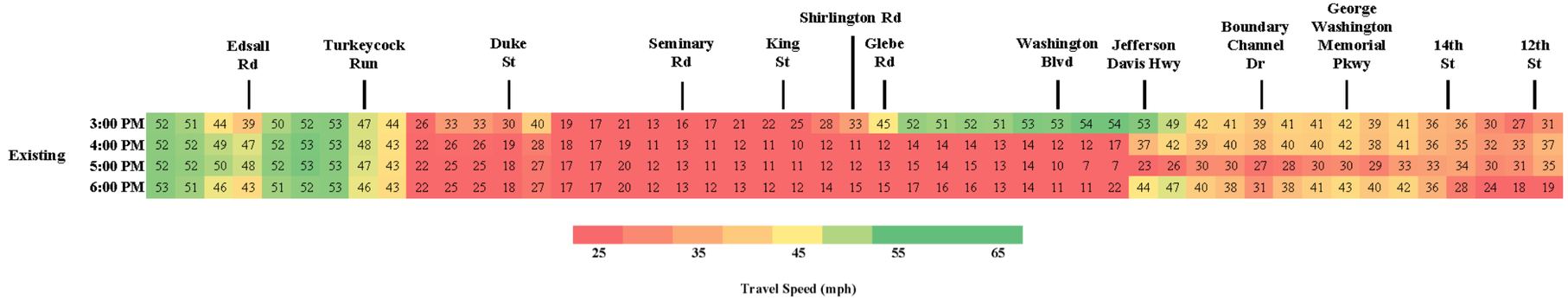
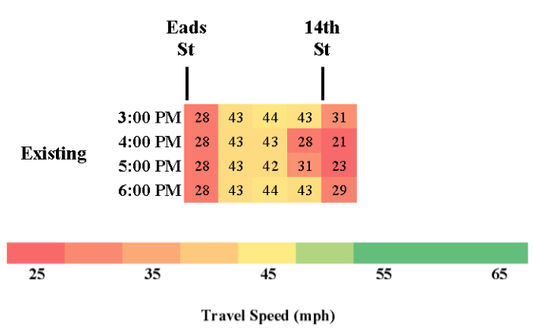
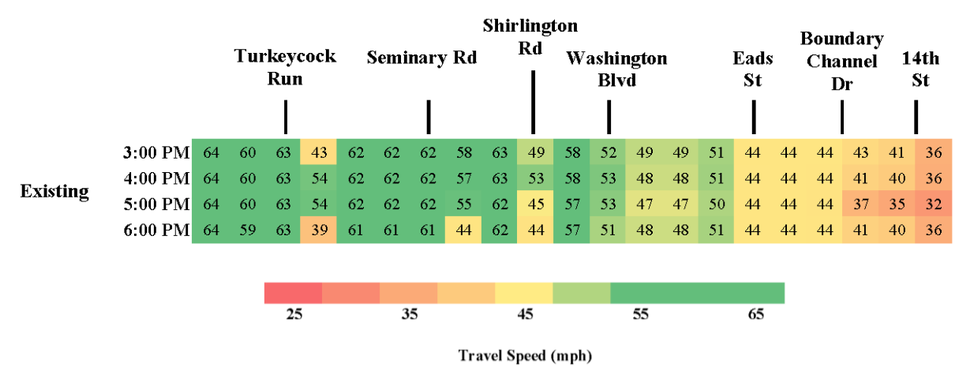


Figure 7-22: Freeway Speeds – HOV/HOT Lanes – PM Peak Period (Existing)

Northbound HOV/HOT Lanes



Southbound HOV/HOT Lanes



7.1.3 Arterial Intersection Operations

Measures of effectiveness (MOEs) from the VISSIM outputs were used to document operations for existing conditions at the signalized and unsignalized intersections along the I-395 study corridor. Average delay by movement, average delay by approach, and overall intersection delay was reported for each intersection. Maximum queue lengths by movement in feet were also reported. Overall average delay values are color-coded to reflect various congestion levels based on delay thresholds established in the *Highway Capacity Manual 2010* (TRB, 2010) as shown in **Table 7-2**. **Appendix J** also contains a summary of travel speeds and travel times by link for the arterials throughout the study area.

Figure 7-23 presents a summary of existing intersection operations for both signalized and unsignalized intersections for the AM and PM peak hours. Operations at the Eads Street Interchange are discussed in more detail in **Section 7.1.4** and operations at the Shirlington Interchange are discussed in more detail in **Section 7.1.5**. **Table 7-7** depicts overall intersection delay for both signalized and unsignalized intersections for the AM and PM peak hours for existing conditions. **Appendix J** contains a tabular summary of average delays by movement, intersection approach, and overall delay as well as maximum queue lengths and storage lengths. **Figure 7-23a** *(Volume 2)* depicts the average delays by movement and for the overall intersections. **Figure 7-23b** *(Volume 2)* depicts the maximum queue lengths by movement.

During the AM peak hour, 44 (94 percent) of the 47 intersections operate with light traffic conditions and three intersections (6 percent) operate with moderate traffic conditions. During the PM peak hour, 41 (86 percent) of the 48 intersections operate with light traffic conditions, four (8 percent) operate with moderate traffic conditions, two intersections operate with heavy traffic congestion, and one intersection operates with severe traffic congestion. The high percentage of intersections that operate with light to moderate traffic conditions can be primarily attributed to congestion along I-395 during peak periods that meters traffic flow entering the arterials intersecting the corridor.

Figure 7-23: Intersection Operations Summary (Existing Conditions)

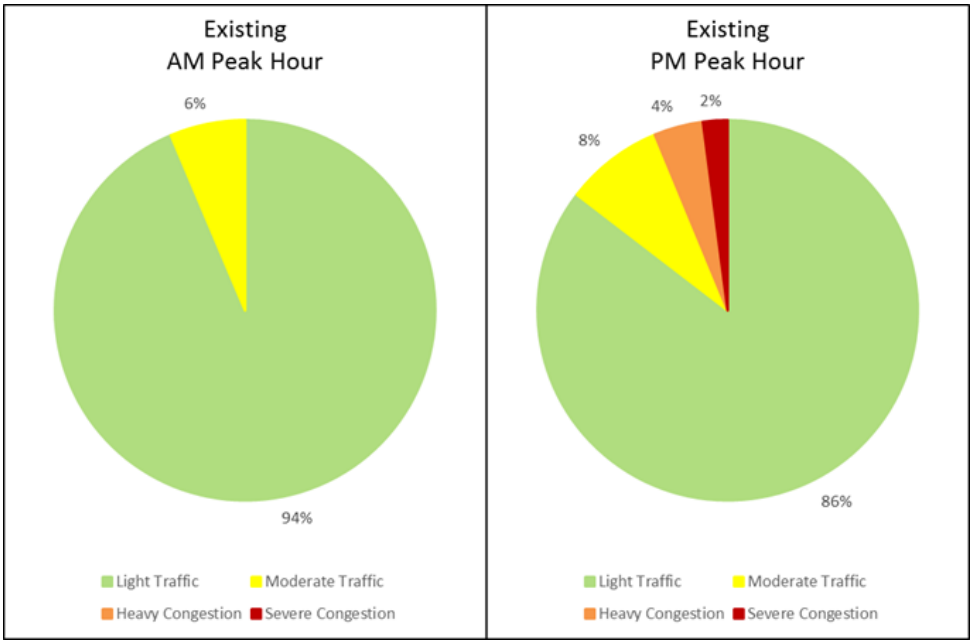


Table 7-7: Intersection Delay Summary (Existing Conditions)

Intersection		Existing Conditions		
		Intersection Control	Average Delay (sec)	
			AM Peak Hour (7-8 AM)	PM Peak Hour (5-6 PM)
1	Edsall Rd at Cherokee Ave	Signalized	12.0	16.9
2	Edsall Rd at Bren Mar Dr	Signalized	24.7	33.6
3	Edsall Rd at Bloomfield Dr	Signalized	9.0	7.8
4	Little River Turnpike at Beauregard St	Signalized	50.0	62.3
5	Little River Turnpike at Oasis Dr	Signalized	10.4	12.0
6	Duke St at Walker St	Signalized	17.0	22.8
7	Seminary Rd at N Beauregard St	Signalized	32.1	38.8
8	Seminary Rd at Mark Center Ave	Signalized	31.1	24.8
9	EB Seminary Rd at SB I-395 ramps	Signalized	36.8	31.9
10	WB Seminary Rd at SB I-395 ramps	Signalized	14.9	19.4
11	EB Seminary Rd at NB I-395 ramps	Signalized	31.4	23.1
12	WB Seminary Rd at NB I-395 ramps	Signalized	24.6	21.5
13	Seminary at HOV Ramp (North Facing)	Unsignalized	--[1]	4.4
14	Seminary Rd at Kenmore Ave	Unsignalized	12.3	21.5
15	Seminary Rd at Library Ln	Signalized	21.8	25.1
16	King St at Park Center Dr	Signalized	9.9	12.5
17	King St at 30th St S	Unsignalized	1.2	1.7
18	King St at Menokin Dr	Signalized	20.2	13.4
19	S Shirlington Rd at S Arlington Mill Dr	Signalized	26.2	51.2
22	S Shirlington Rd at Campbell Ave	Signalized	23.3	28.8
23	Shirlington Rotary at HOV Ramp	Unsignalized	2.4	2.2
26	N Quaker Ln at Gunston Rd	Unsignalized	7.4	4.6
27	Martha Custis Dr at Gunston Rd	Unsignalized	23.8	11.4
30	N Quaker Ln at Preston Rd	Signalized	9.5	14.3
31	S Glebe Rd at 24th Rd S (north of Glebe Rd)	Signalized	17.8	33.4
32	S Glebe Rd at 24th Rd S (south of Glebe Rd)	Signalized	13.8	18.6
33	S Glebe Rd at SB I-395 off-ramp	Signalized	7.0	15.3
34	S Glebe Rd at NB I-395 off-ramp	Signalized	20.9	114.0
35	S Arlington Ridge Rd at I-395 Ramps	Unsignalized	3.4	7.4
36	Columbia Pike at Southgate Rd/ S Joyce St	Signalized	12.9	27.0
37	Columbia Pike at N/S Rotary Rd	Unsignalized	7.2	8.3
38	Army Navy Dr at S Joyce St	Signalized	18.1	23.3
39	Army Navy Dr at Parking Lot/ Garage	Signalized	14.0	12.8
40	Army Navy Dr at S Hayes St	Signalized	18.9	29.9

Intersection		Existing Conditions		
		Intersection Control	Average Delay (sec)	
			AM Peak Hour (7-8 AM)	PM Peak Hour (5-6 PM)
41	Army Navy Dr at S Fern St	Signalized	24.7	29.2
42	I-395 SB HOV Ramps at Eads St	Unsignalized	5.7	5.3
43	I-395 NB HOV Ramps at Eads St	Unsignalized	18.0	6.5
44	Army Navy Dr at S Eads St	Signalized	23.3	73.8
45	12th St at S Eads St	Signalized	12.6	15.1
46	Army Navy Dr at 12th St S	Unsignalized	7.2	9.3
47	12th St S at Long Bridge Dr	Signalized	11.1	20.3
50	N Rotary Rd at Connector Rd	Unsignalized	3.7	22.4
51	N Rotary Rd at Fern St	Unsignalized	31.2	21.9
52	S Rotary Rd at Fern St	Unsignalized	13.0	14.8
53	N Rotary Rd at Eads St	Unsignalized	10.6	32.0
54	S Rotary Rd at Eads St	Unsignalized	21.3	29.3
55	Boundary Channel Dr at Connector Rd	Unsignalized	3.7	3.4
56	Boundary Channel Dr at Long Bridge Dr	Unsignalized	3.7	2.9

[1] Intersection does not utilize signal, stop, or yield control during this time period, therefore no results given

7.1.4 Eads Street Interchange

The Eads Street Interchange is a critical location in the I-395 HOV lanes system as Eads Street serves the Pentagon Reservation and the Pentagon Transit Center, as well as serving as a primary origin and destination for informal ridesharing vehicles (slugs). The interchange is a traditional diamond configuration with unsignalized intersections at the ramp terminals along Eads Street. For the purposes of this study, I-395 and the corresponding on and off-ramps are referred to as north-south roadways, Eads Street is referred to as a north-south roadway, and North and South Rotary Roads are referred to as east-west roadways. The following is a summary of the configuration of the key intersections in the vicinity of the I-395 at Eads Street Interchange:

- **Eads Street at Northbound I-395 HOV ramps:** The northbound I-395 HOV off-ramp is free-flow onto Eads Street for both left and right turns and includes a left-turn lane and a shared through/right-turn lane. Northbound and southbound through traffic along Eads Street is stop-controlled at the ramp junction and only buses are permitted to travel northbound through the intersection via signing.

- **Eads Street at Southbound I-395 HOV ramps:** The southbound I-395 HOV Off-Ramp is stop-controlled at Eads Street with Eads Street operating free flow at the ramp junction in both the northbound and southbound directions. Northbound Eads Street left turns to the on-ramp to the southbound I-395 HOV lanes are not accommodated at the intersection. Southbound Eads Street right turns to the southbound HOV lanes are channelized and operate freely.

- **Eads Street at South Rotary Road:** Eads Street at South Rotary Road is an all-way stop-controlled intersection with South Rotary Road operating one-way eastbound. Eastbound South Rotary Road has three eastbound lanes at the intersection including a shared left/through, shared through/right,

and a right-turn lane. Northbound Eads Street consists of a through and shared through/right-turn lane. Southbound Eads Street consists of a shared left/through lane and a through lane. Pedestrians are not accommodated at this intersection and are directed to Fern Street to cross under I-395.

- **Eads Street at North Rotary Road:** Eads Street at North Rotary Road is an all-way stop-controlled intersection with North Rotary Road operating one-way westbound. Westbound North Rotary Road has two lanes at the intersection including a left-turn lane and a shared left/through lane. Northbound Eads Street consists of a left-turn lane and shared left/through lane to the Pentagon Transit Center. Southbound Eads Street from the Pentagon Transit Center consists of a shared through/right-turn lane. Pedestrian crosswalks are provided on the north, east, and west legs of the intersection.
- **Eads Street at Army Navy Drive:** This signalized intersection operates with protected/permissive left-turn phasing on the eastbound Army Navy Drive approach and concurrent phasing on northbound and southbound Eads Street. The eastbound approach includes a shared left/through lane and a shared through/right lane. The northbound Eads Street approach includes a left turn lane and a shared through/right-turn lane and the southbound Eads Street approach includes a single shared left/through/right-turn lane.

As shown in **Table 7-8**, the intersection of Eads Street at the ramp from the northbound I-395 HOV lanes operates with mild congestion; however, calculated queue lengths over 1,100 feet are reported on the northbound I-395 HOV lanes off-ramp approach to Eads Street from 7 AM to 8 AM with queues up to 2,700 feet reported between 9 AM and 10 AM and delays on the ramp of up to 92 seconds. The distance between the intersection and the upstream ramp gore is approximately 900 feet resulting in queues from the ramp extending onto the HOV lanes during the AM peak period. As noted above, this intersection approach operates free flow onto northbound and southbound Eads Street.

Table 7-8: Existing (2015) Intersection Delay Summary – Eads Street Interchange

Intersection		Existing Conditions		
		Intersection Control	Average Delay (sec)	
			AM Peak Hour (7-8 AM)	PM Peak Hour (5-6 PM)
38	Army Navy Dr at S Joyce St	Signalized	18.1	23.3
39	Army Navy Dr at Parking Lot/ Garage	Signalized	14.0	12.8
40	Army Navy Dr at S Hayes St	Signalized	18.9	29.9
41	Army Navy Dr at S Fern St	Signalized	24.7	29.2
42	I-395 SB HOV Ramps at Eads St	Unsignalized	5.7	5.3
43	I-395 NB HOV Ramps at Eads St	Unsignalized	18.0	6.5
44	Army Navy Dr at S Eads St	Signalized	23.3	73.8
45	12th St at S Eads St	Signalized	12.6	15.1
46	Army Navy Dr at 12th St S	Unsignalized	7.2	9.3
47	12th St S at Long Bridge Dr	Signalized	11.1	20.3
50	N Rotary Rd at Connector Rd	Unsignalized	3.7	22.4
51	N Rotary Rd at Fern St	Unsignalized	31.2	21.9
52	S Rotary Rd at Fern St	Unsignalized	13.0	14.8
53	N Rotary Rd at Eads St	Unsignalized	10.6	32.0
54	S Rotary Rd at Eads St	Unsignalized	21.3	29.3

The operational deficiencies at the interchange can be further illustrated based on a summary of key observations and operational issues observed within the vicinity of the Eads Street Interchange and the Pentagon South Parking Lot during several peak periods during the AM and PM peaks.

AM Peak Period

- Heavy left turn traffic volumes along the I-395 northbound HOV off-ramp operate free flow on the approach to Eads Street but then encounter the police-controlled, four-way stop-controlled intersection at Eads Street and South Rotary Road as discussed below. Although vehicles on the ramp from the northbound I-395 HOV lanes have the right of way, when there is downstream congestion on northbound Eads Street approaching South Rotary Road and motorists are not able to make a left turn, motorists on the ramp often leave a gap for southbound Eads Street motorists to continue to Army Navy Drive or to make a left-turn onto the ramp to the northbound HOV lanes.

- Pentagon Force Protection Agency (PFPA) officers control intersection operations at four locations during the AM peak period: South Rotary at Eads Street, North Rotary at Eads Street, North Rotary at Connector Road, and the Pentagon Transit Center Emergency Bus Access at Connector Road. At the Eads Street and South Rotary Road Intersection, the officer alternates the right of way between eastbound South Rotary Road and northbound and southbound Eads Street; however, due to heavy demands on both the northbound and eastbound approaches, queues build on both approaches with northbound Eads Street queues extending onto the HOV ramp from northbound I-395 and eastbound South Rotary Road queues extending beyond Fern Street.

- Northbound queues along Eads Street extend through the Army Navy Drive due to congestion on the ramp from Eads Street to the northbound I-395 HOV lanes resulting from downstream congestion in the HOV lanes approaching the District.

- During the AM peak period from 7:00 AM to 9:00 PM, the majority of bus traffic exiting the Pentagon Transit Center is directed out through the bollard-controlled exit onto northbound Connector Road, as a result of a Pilot Program that began on January 4, 2016. Three bus routes are approved to exit the Pentagon Transit Center onto Eads Street including WMATA Routes 9A, 10A, and 7Y. This reduces the amount of bus traffic along Eads Street south of North Rotary Road during the AM peak period.

- On multiple occasions, it was observed that incidents along either the northbound I-395 HOV or northbound I-395 general purpose lanes north of the interchange caused severe congestion and gridlock on the surface streets in the vicinity of the Eads Street Interchange including Army Navy Drive.

- Police officers controlling the intersection of North Rotary Road at Eads Street frequently stopped vehicular traffic on the north and east legs of the intersection to allow pedestrians to safely cross the intersection.

- The drop off area for informal ridesharing (slugging) is located in the parking lot between Eads Street and Fern Street on the south side of North Rotary Road. During the AM peak period, westbound North Rotary Road motorists dropping off slugs enter the drop off area just west of Fern Street in a gap in the barrier just west of Connector Road.

- There is heavy pedestrian activity crossing North Rotary Road west of Fern Street. Although the pedestrians have the right of way at this location due to the stop control on westbound North Rotary Road, based on observations, pedestrians and motorists alternate the right of way.

PM Peak Period

- Heavy traffic volumes exiting the Pentagon South Parking lot along eastbound South Rotary Road and southbound Eads Street destined for the ramp to southbound I-395 HOV lanes create queues that regularly extend along eastbound South Rotary Road to Fern Street. Motorists exiting the slug pick up area along the east side of Fern Street often weave through queues along eastbound South Rotary Road to access the ramp to the southbound I-395 HOV lanes.

- Along the southbound I-395 HOV lanes, southbound motorists entering from the ramp from Eads Street encounter congestion within the weave between the entrance ramp from Eads Street and the exit ramp to the general purpose lanes which is further degraded due to downstream congestion in the general purpose lanes.

- Slug passengers are staged for eight specific destinations along the north side of North Rotary Road east of Eads Street and in the parking lot between Eads Street and Fern Street along the east side of Fern Street.

- Police officers control intersection operations at two locations during the PM peak period: South Rotary at Eads Street and North Rotary at Eads Street. Police control at the two Eads Street intersections helps to facilitate outbound traffic from both the Pentagon Transit Center and the slug lines along North Rotary Road.

- HOV motorists from Pentagon City and Crystal City must use Fern Street and South Rotary Road to access the southbound I-395 HOV lanes causing additional conflict with vehicles exiting the Pentagon along Eads Street at the South Rotary Road Intersection.

7.1.5 Shirlington Interchange

The Shirlington Interchange is a non-traditional Rotary interchange that provides access to I-395 from several local roadways including North Quaker Lane, Shirlington Road, Gunston Road, Campbell Avenue, and Arlington Mill Drive, as well as providing direct access to the HOV lanes to and from the north. The north facing ramp located at the north side of the Rotary currently operates in a northbound direction in the AM peak period and in a southbound direction during the PM peak period. This ramp would be converted to a HOT ramp under Build Conditions which would have an impact on traffic patterns within the Rotary.

Traditional intersection measures of effectiveness cannot be used to adequately assess the operation of a Rotary due to the series of merges and diverges that occur within the circulatory portion of the Rotary. In order to assess the impact of the Build Alternative on operations within the circulatory portion of the Rotary and on the approaches to the Rotary, average travel speeds for each link coded in the VISSIM model were established for existing conditions. **Figure 7-24** depicts the various links within the Rotary Interchange corresponding to the subsequent discussion of operations at the Rotary Interchange under future No Build and Build conditions.

7.1.5.1 AM Peak Hour

Table 7-9 depicts speeds within the Rotary Interchange and on the approaches and departure legs of the Rotary for existing conditions for the AM peak period. Also shown are the average speeds for all vehicles traversing the Rotary for each hour and the average speed for the four hour period for all vehicles traversing the Rotary. As shown, the average travel speed is approximately 23 miles per hour for all vehicles during the four hour analysis period. The lowest travel speeds are observed along the west side of the Rotary on the southbound Rotary approach to the signalized intersection at Campbell Avenue (segment 453), as well as on the westbound Gunston Road approach to the Rotary (segment 483). As shown in **Table 7-11**, the six study intersections located in the vicinity of the Shirlington Rotary operate under light traffic conditions.

7.1.5.2 PM Peak Hour

Table 7-10 depicts speeds within the Rotary Interchange and on the approaches and departure legs of the Rotary for existing conditions for the PM peak period. Also shown are the average speeds for all vehicles traversing the Rotary for each hour and the average speed for the four hour period for all vehicles traversing the Rotary. As shown, the average travel speed is approximately 22 miles per hour for all vehicles during the four hour analysis period. The lowest travel speeds are observed along southbound I-395 collector-distributor roadway approaching the diverge to the Rotary (segment 443) and along the west side of the Rotary on the southbound Rotary approach to the signalized intersection at Campbell Avenue (segment 453). As shown in **Table 7-11**, the five of the study intersections located in the vicinity of the Shirlington Rotary operate under light traffic conditions and the Shirlington Road at South Arlington Mill Drive Intersection operates under moderate traffic conditions.

Figure 7-24: Shirlington Rotary Interchange Link Identifiers

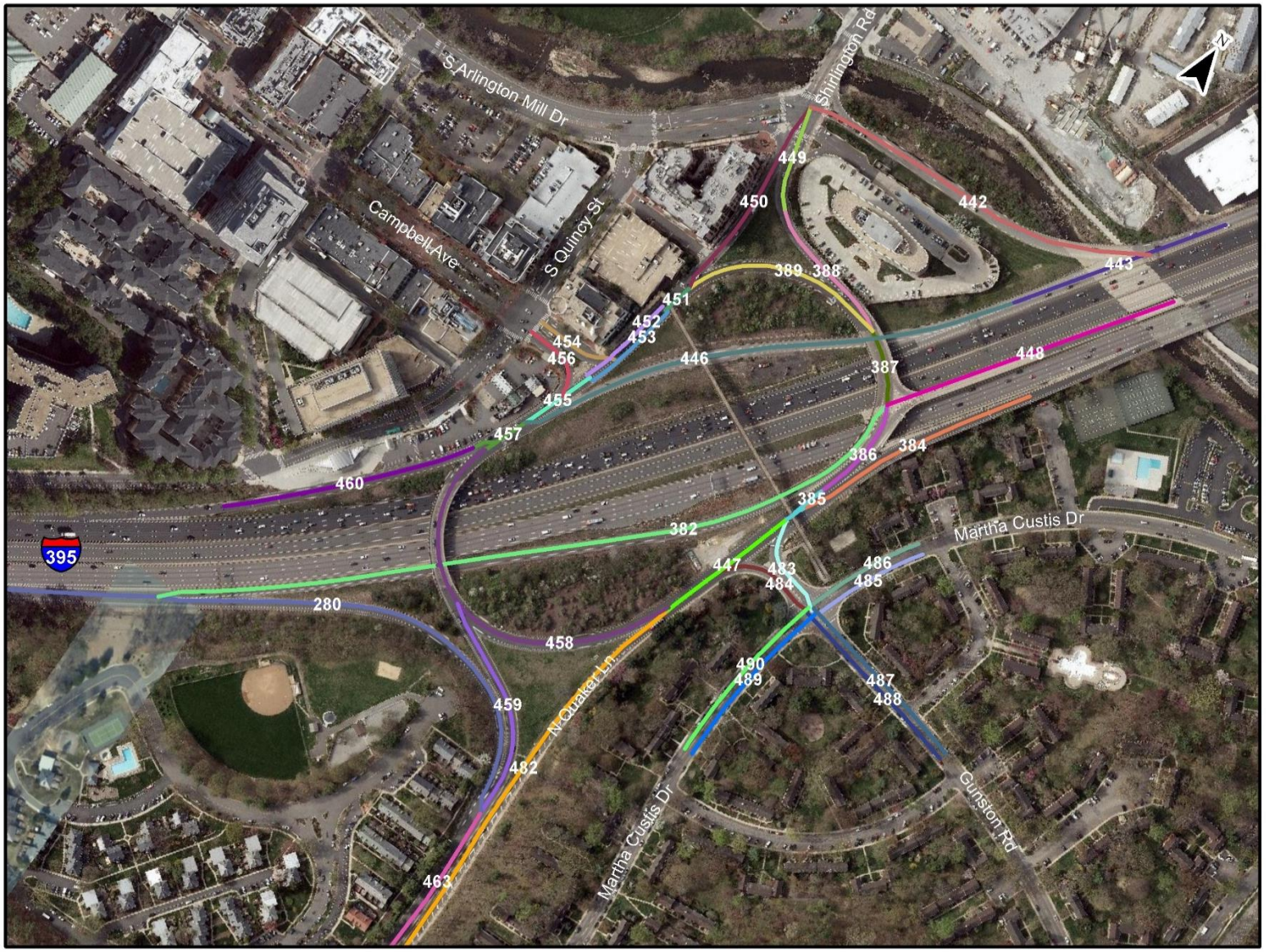


Table 7-9: AM Peak Period Speed by Segment (Existing Conditions)
Shirlington Rotary Interchange

Segment		Existing Conditions			
		Avg Speed (mph)			
		6-7 AM	7-8 AM	8-9 AM	9-10 AM
WB Rotary	387	25	25	23	25
SB Rotary	389	28	27	27	27
WB Shirlington Rd approaching Arlington Mill Dr	388	27	25	21	24
EB Shirlington Rd approach Rotary	450	21	15	14	16
SB Rotary approaching Campbell Ave	451	20	15	17	17
SB Rotary approaching Campbell Ave	453	5	6	6	6
SB Rotary approaching Campbell Ave	452	21	21	21	20
WB Campbell Ave	454	24	24	24	24
EB Shirlington Rd approach Rotary	456	13	10	10	11
SB Rotary	455	24	23	23	23
SB I-395 C-D Road approaching Rotary	446	28	28	28	28
SB Rotary	457	26	25	24	25
SB from Rotary to SB I-395 on ramp	460	28	27	28	27
NB Rotary approaching Quaker Ln	458	28	27	27	27
EB Exit from Rotary to Quaker Ln	459	29	29	29	29
NB I-395 off-ramp to Quaker Ln	280	24	25	24	24
SB Quaker Ln approaching Preston Rd	463	29	28	28	28
NB Quaker Ln approaching Rotary	482	27	25	25	25
NB Rotary approaching Gunston Rd	447	26	22	22	25
EB Gunston Rd approaching Martha Custis Dr	484	9	8	6	9
WB Gunston Rd approaching Rotary	483	9	6	6	7
NB Rotary north of Gunston Rd	385	22	18	20	21
NB I-395 off-ramp to Rotary	382	24	24	23	23
NB Rotary approaching HOV/HOT ramp	386	29	28	27	28
NB from Rotary to NB I-395 on ramp	384	19	15	11	19
NB/SB HOV/HOT ramp to/from I-395 HOV/HOT	448	34	33	34	32
SB I-395 C-D Road approaching Rotary	443	25	24	24	24
SB I-395 C-D Road off-ramp to Shirlington Rd	442	9	8	8	8
WB approaching Arlington Mill Dr	449	7	6	5	6
NB Martha Custis Dr approaching Gunston Rd	489	15	13	12	14
SB Martha Custis Dr	490	19	20	21	20
WB Gunson Rd approaching Martha Custis Dr	487	12	5	8	11
EB Gunston Rd	488	24	25	24	25
NB Martha Custis Dr	485	23	24	24	23
SB Martha Custis Dr approaching Gunston Rd	486	20	18	19	19
Average Speed		23.5	22.4	22.1	22.5
4 Hour Average Speed		22.5			

Table 7-10: PM Peak Period Speed by Segment (Existing Conditions)
Shirlington Rotary Interchange

Segment		Existing Conditions			
		Avg Speed (mph)			
		3-4 PM	4-5 PM	5-6 PM	6-7 PM
WB Rotary	387	24	26	24	24
SB Rotary	389	28	27	27	27
WB Shirlington Rd approaching Arlington Mill Dr	388	26	24	20	21
EB Shirlington Rd approach Rotary	450	13	14	10	9
SB Rotary approaching Campbell Ave	451	13	14	13	14
SB Rotary approaching Campbell Ave	453	6	6	7	7
SB Rotary approaching Campbell Ave	452	20	20	19	19
WB Campbell Ave	454	24	24	24	24
EB Shirlington Rd approach Rotary	456	9	10	9	9
SB Rotary	455	23	24	22	22
SB I-395 C-D Road approaching Rotary	446	28	27	26	26
SB Rotary	457	25	25	22	22
SB from Rotary to SB I-395 on ramp	460	21	16	12	19
NB Rotary approaching Quaker Ln	458	27	27	26	25
EB Exit from Rotary to Quaker Ln	459	29	29	29	29
NB I-395 off-ramp to Quaker Ln	280	24	24	24	24
SB Quaker Ln approaching Preston Rd	463	28	27	26	26
NB Quaker Ln approaching Rotary	482	27	25	26	26
NB Rotary approaching Gunston Rd	447	26	25	24	24
EB Gunston Rd approaching Martha Custis Dr	484	9	8	8	8
WB Gunston Rd approaching Rotary	483	9	8	8	8
NB Rotary north of Gunston Rd	385	24	22	21	21
NB I-395 off-ramp to Rotary	382	23	24	23	23
NB Rotary approaching HOV/HOT ramp	386	28	28	28	28
NB from Rotary to NB I-395 on ramp	384	22	20	20	22
NB/SB HOV/HOT ramp to/from I-395 HOV/HOT	448	35	34	34	34
SB I-395 C-D Road approaching Rotary	443	22	9	11	12
SB I-395 C-D Road off-ramp to Shirlington Rd	442	8	8	8	8
WB approaching Arlington Mill Dr	449	5	5	4	4
NB Martha Custis Dr approaching Gunston Rd	489	16	15	15	15
SB Martha Custis Dr	490	23	23	22	22
WB Gunson Rd approaching Martha Custis Dr	487	13	13	12	12
EB Gunston Rd	488	25	25	25	25
NB Martha Custis Dr	485	24	24	24	24
SB Martha Custis Dr approaching Gunston Rd	486	20	20	19	19
Average Speed		23.1	22.4	21.7	22.0
4 Hour Average Speed		22.2			

Table 7-11: Intersection Delay Summary (Existing Conditions)
Shirlington Rotary Interchange

Intersection		Existing Conditions		
		Intersection Control	Average Delay (sec)	
			AM Peak Hour (7-8 AM)	PM Peak Hour (5-6 PM)
19	S Shirlington Rd at S Arlington Mill Dr	Signalized	26.2	51.2
22	S Shirlington Rd at Campbell Ave	Signalized	23.3	28.8
23	Shirlington Rotary at HOV Ramp	Unsignalized	2.4	2.2
26	N Quaker Ln at Gunston Rd	Unsignalized	7.4	4.6
27	Martha Custis Dr at Gunston Rd	Unsignalized	23.8	11.4
30	N Quaker Ln at Preston Rd	Signalized	9.5	14.3

7.2 2020 NO BUILD AND BUILD CONDITIONS TRAFFIC OPERATIONS

The base year (2015) VISSIM microscopic models for both the AM and PM peak periods were modified to reflect the committed No Build projects as discussed in **Section 2.2** to create a 2020 No Build conditions model. The 2020 Build conditions model was then created by incorporating the proposed Build Alternative for the I-395 Express Lanes Northern Extension project as discussed in **Section 4.4**.

7.2.1 Freeway Travel Time Analysis

7.2.1.1 AM Peak Period

A comparison of overall corridor travel times for existing conditions, 2020 No Build conditions, and 2020 Build conditions is summarized in **Figure 7-25** for the northbound peak travel direction for each of the four analysis hours. **Figures 7-26 through 7-29** summarize cumulative and segment travel times for the northbound and southbound I-395 general purpose and HOV/HOT lanes for each of the four analysis hours during the AM peak period between interchanges along the corridor. **Table 7-12** presents 2020 No Build and Build overall travel times and segment travel times for the northbound and southbound I-395 general purpose and HOV/HOT lanes for each of the four analysis hours during the AM peak period between interchanges along the corridor.

AM Peak Period – Northbound General Purpose Lanes (Peak Direction)

Under 2020 No Build conditions, travel times along the northbound I-395 general purpose lanes range from 24 to 49 minutes with the longest travel times observed between 7 AM and 9 AM. The average travel time during the four hour AM peak period is 40 minutes. Travel times increase by 6 to 11 minutes compared to existing conditions in the AM peak period. A large portion of the travel time increase (5 minutes from 7 AM to 8 AM) occurs south of the Turkeycock Run Interchange. This is a result of the congestion and queuing along northbound I-395 extending farther to the south during peak hours. The average travel time increase of 3 minutes over the four peak hours between Glebe Road and Washington Boulevard is due to further increases in traffic volumes in this portion of the corridor which is already operating over capacity during peak hours.

Under 2020 Build conditions, travel times along the northbound I-395 general purpose lanes range from 20 to 35 minutes. The average travel time during the four hour AM peak period is 28 minutes. Overall travel times between No Build and Build conditions decrease by 4 to 17 minutes with an average travel time decrease of 12 minutes over the four hour AM peak period. The largest travel time benefits are observed in the southern portion of the corridor from south of Edsall Road to Shirlington Road with travel time reductions ranging from 8 to 18 minutes and averaging approximately 13 minutes. Over the four hours, average travel times from Shirlington Road to the northern study limits increase by approximately 1 minute due to higher traffic volumes in the general purpose lanes north of Eads Street compared to No Build conditions. However, from 8 AM to 10 AM, there is a reduction in the travel time in this segment of 1 minute from 8 AM to 9 AM and 7 minutes from 9 AM to 10 AM.

AM Peak Period – Northbound HOV/HOT Lanes (Peak Direction)

Under 2020 No Build conditions, travel times along the northbound I-395 HOV/HOT lanes range from 12 to 16 minutes with the longest travel times observed between 9 AM and 10 AM. The average travel time

during the four hour AM peak period is 14 minutes. Travel times from 9 AM to 10 AM remain approximately the same in the northbound HOV/HOT lanes when comparing existing to 2020 No Build conditions. From 6 AM to 9 AM, travel times increase by approximately 40 seconds. Travel times primarily increase between Eads Street and 14th Street in D.C. as a result of higher traffic volumes and congestion levels in this section where the HOV lanes are open to travel by all motorists.

Under 2020 Build conditions, travel times along the northbound I-395 HOV/HOT lanes range from 10 to 13 minutes. The average travel time during the four hour AM peak period is 11 minutes. Overall travel times decrease by 0.5 to 6 minutes with an average travel time decrease of 2.5 minutes. The largest travel time decrease (6 minutes) is observed from 9 AM to 10 AM when No Build travel times in the HOV lanes are highest entering D.C. The benefits from 9 AM to 10 AM can be primarily attributed to enforcing the HOV/HOT restriction north of Eads Street and lower traffic volumes under Build conditions compared to No Build conditions. The travel time reductions are observed north of Washington Boulevard to the northern study limits as a result of lower traffic volumes in this section compared to No Build conditions. South of Washington Boulevard, travel times remain approximately the same between No Build and Build conditions.

AM Peak Period – Southbound General Purpose Lanes (Off-Peak Direction)

Under 2020 No Build conditions, travel times along the southbound I-395 general purpose lanes range from 12 to 13 minutes. Travel times along the southbound I-395 general purpose lanes increase by less than 1 minute between existing conditions and 2020 No Build Conditions with the largest increases in delays and reductions in speeds occurring exiting D.C. and approaching George Washington Memorial Parkway and Boundary Channel Drive.

Under 2020 Build conditions, travel times along the southbound I-395 general purpose lanes range from 12 to 13 minutes and remain approximately the same when comparing 2020 No Build to Build conditions.

AM Peak Period – Southbound HOV Lanes (Off-Peak Direction)

Under 2020 No Build conditions, travel times along the southbound I-395 HOV lanes are approximately 2.5 minutes. Travel times remain approximately the same in the southbound I-395 HOV lanes between existing conditions and 2020 No Build Conditions.

Under 2020 Build conditions, the southbound I-395 HOV lanes terminate north of the Eads Street Interchange and motorists are required to exit to the general purpose lane in the vicinity of the Boundary Channel Drive Interchange or at the Eads Street Interchange. Under 2020 Build conditions, travel times along the southbound I-395 HOV/HOT lanes range from 1.5 to 2 minutes. Travel times along the portion of the southbound I-395 HOV lanes that would remain open increase by approximately 20 seconds from 8 AM to 9 AM, but on average increase by less than 10 seconds when comparing 2020 No Build to Build conditions over the four hour AM peak period.

Figure 7-25: AM Peak Period - Northbound Overall Travel Time Summary (Existing and 2020)

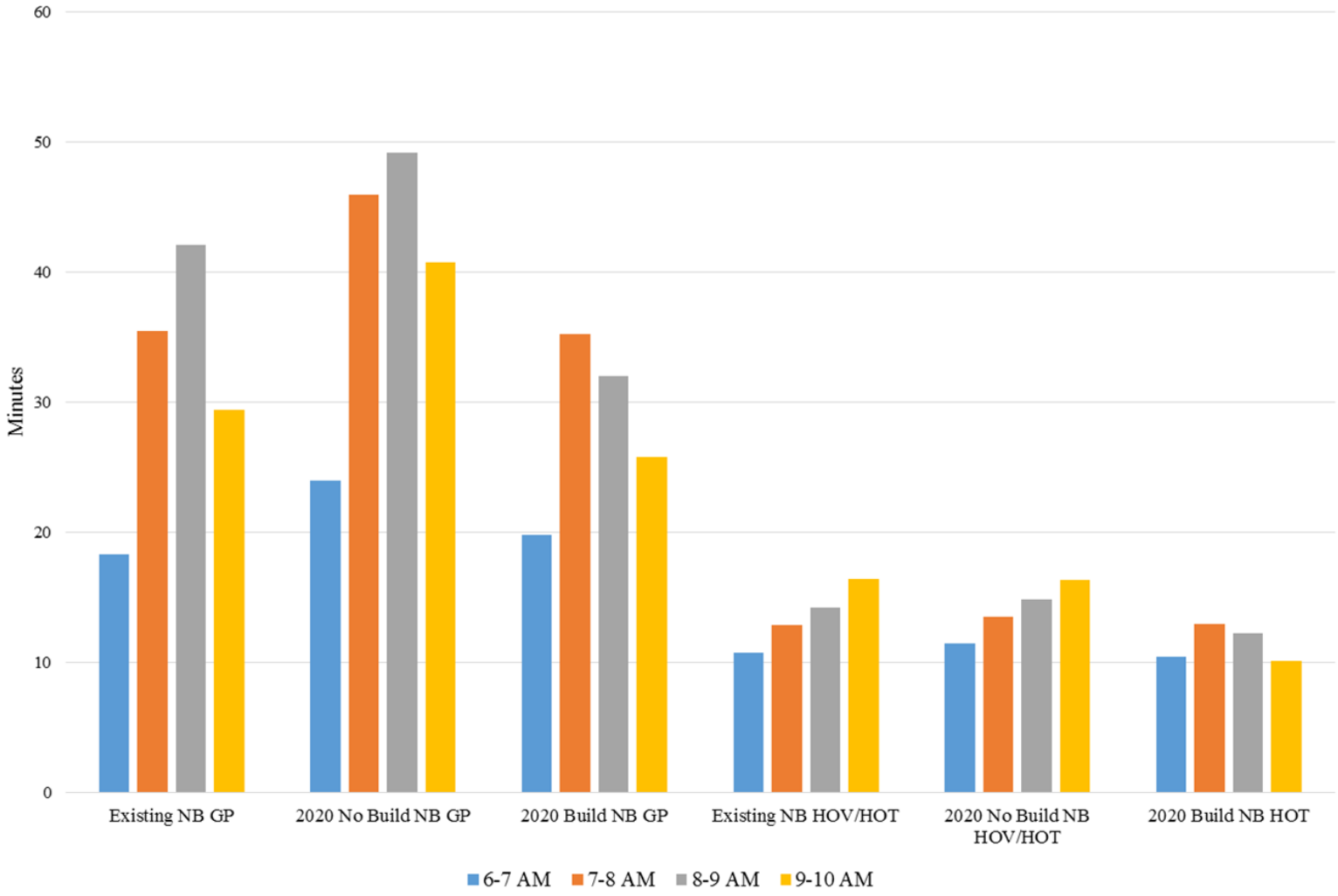


Figure 7-26: AM Peak Period - Northbound General Purpose Lanes Cumulative Travel Times (Existing and 2020)

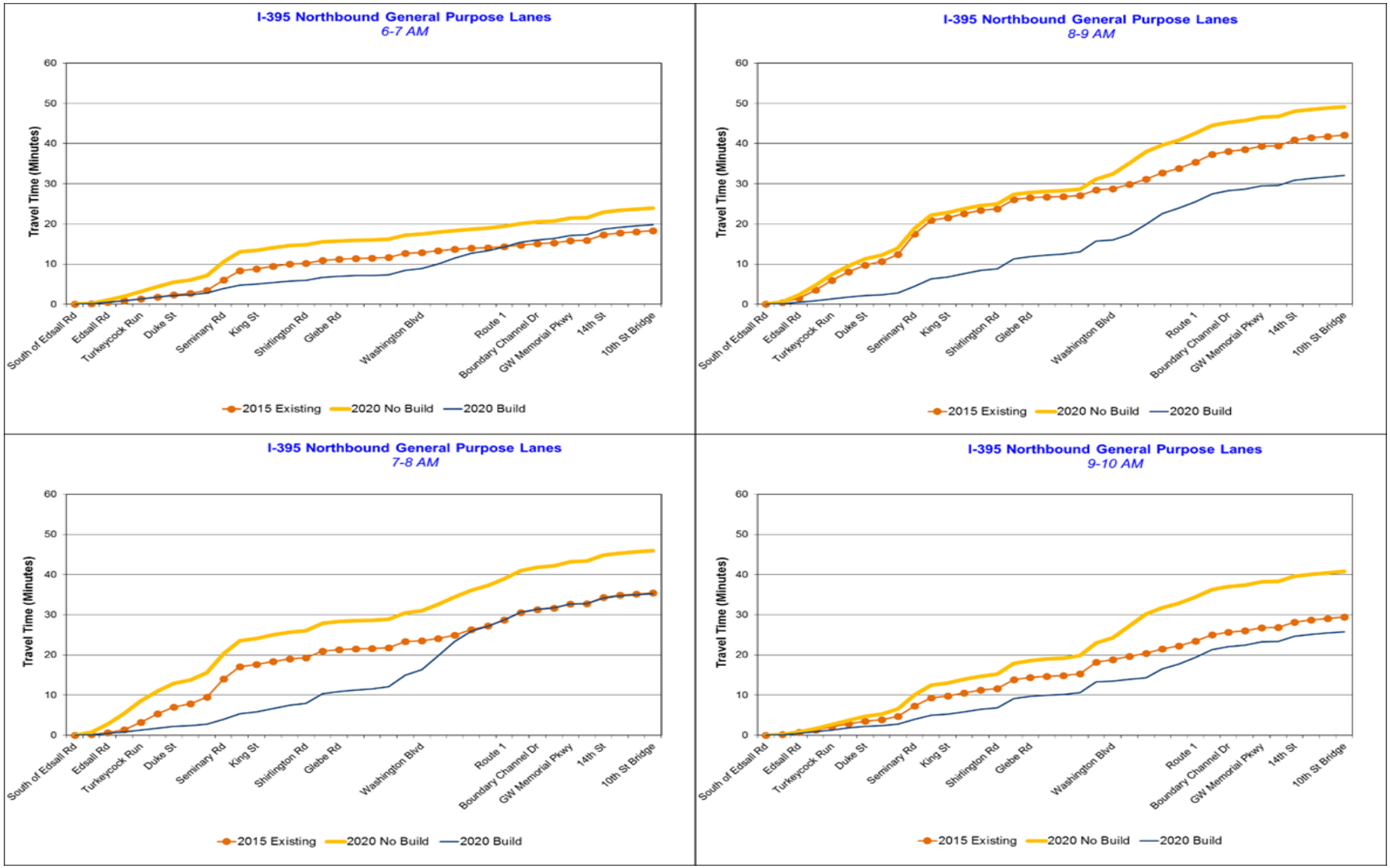


Figure 7-27: AM Peak Period - Northbound HOV/HOT Lanes Cumulative Travel Times (Existing and 2020)

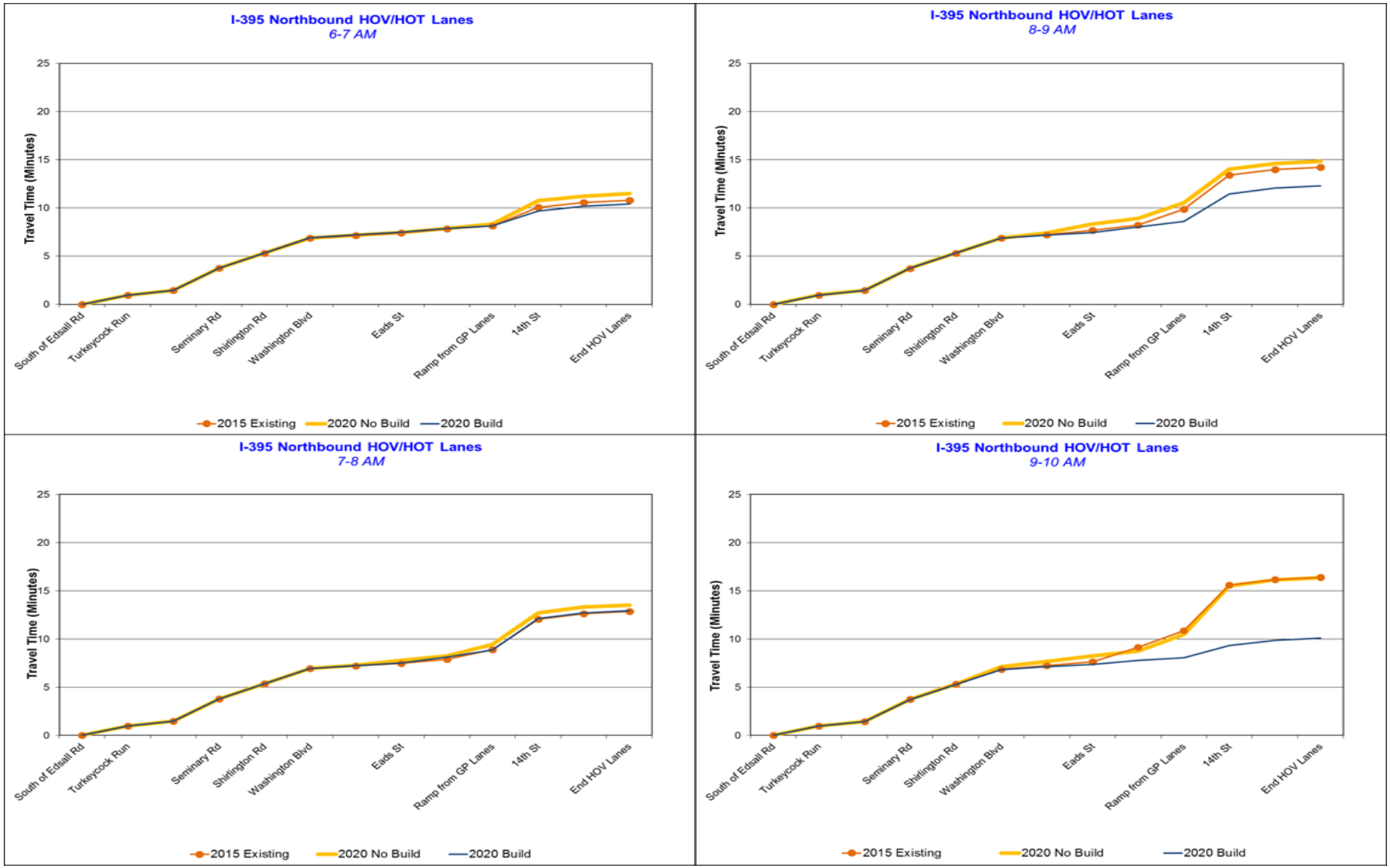


Figure 7-28: AM Peak Period – Southbound General Purpose Lanes Cumulative Travel Times (Existing and 2020)

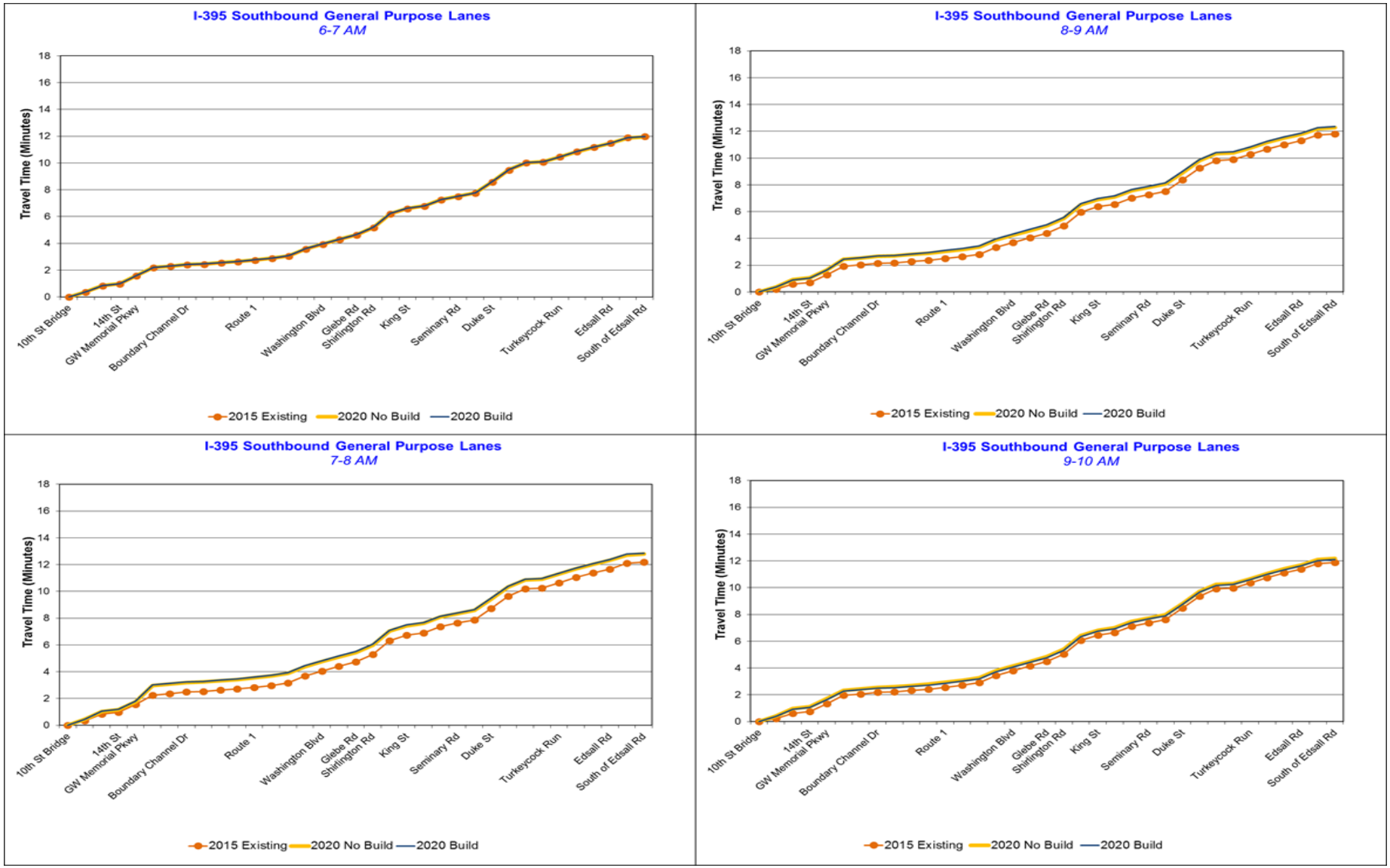


Figure 7-29: AM Peak Period – Southbound HOV/HOT Lanes Cumulative Travel Times (Existing and 2020)

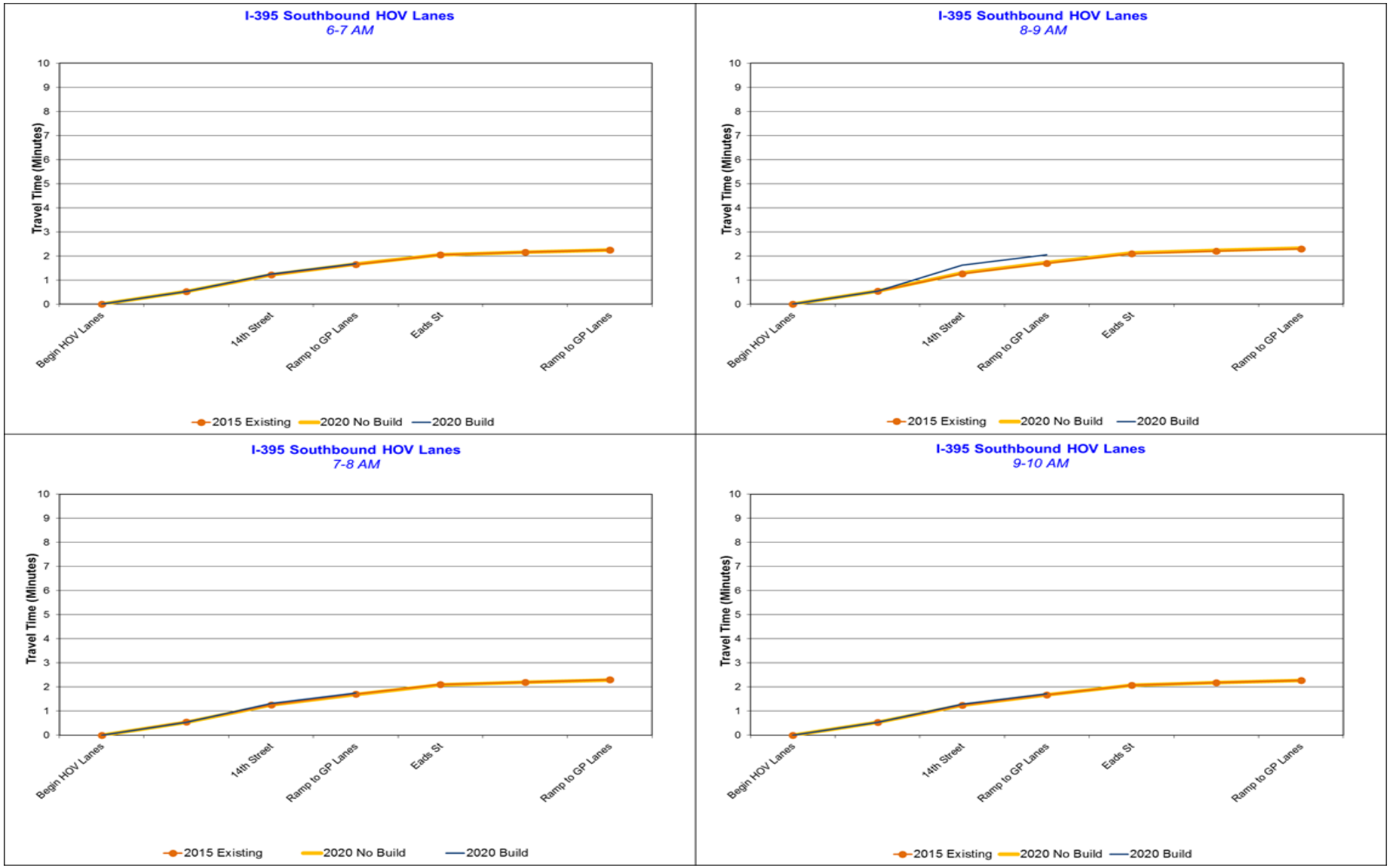


Table 7-12: AM Peak Period – Travel Time Summary (2020 No Build and Build Conditions)

Segment	2020 No Build Travel Time (Min)				2020 Build Travel Time (Min)			
	6-7 AM	7-8 AM	8-9 AM	9-10 AM	6-7 AM	7-8 AM	8-9 AM	9-10 AM
Northbound General Purpose Lanes								
South of Edsall Rd to Turkeycock Run	3.2	8.5	7.4	2.7	1.3	1.3	1.3	1.3
Tukeycock Run to Duke St	2.3	4.3	3.9	2.0	0.9	0.9	0.9	0.9
Duke St to Seminary Rd	5.0	7.5	7.5	5.4	1.8	1.8	2.2	1.7
Seminary Rd to King St	2.9	3.8	4.0	2.9	1.1	1.9	2.4	1.3
King St to Shirtlington Rd	1.4	1.9	2.2	2.2	1.0	2.1	2.0	1.5
Shirlington Rd to Glebe Rd	1.0	2.3	2.9	3.3	1.0	3.0	3.0	2.9
Glebe Rd to Washington Blvd	2.6	6.1	10.1	11.7	4.5	12.5	8.0	4.7
Washington Blvd to Route 1	1.0	4.6	4.6	4.3	2.8	5.3	5.7	5.1
Route 1 to Boundary Channel Dr	1.1	2.8	2.8	2.5	1.8	2.6	2.7	2.6
Boundary Channel Drive to GW Memorial Pkwy	0.9	1.4	1.3	1.2	1.1	1.3	1.2	1.2
GW Memorial Pkwy to 14th St	1.5	1.6	1.5	1.4	1.5	1.5	1.4	1.4
14th St to 12th St Exp Ramp	1.1	1.1	1.1	1.2	1.1	1.1	1.2	1.2
Total	**24.0**	**45.9**	**49.1**	**40.7**	**19.8**	**35.3**	**32.0**	**25.8**
Average	**39.9**				**28.2**			
Southbound General Purpose Lanes								
Ramp from 9th St Expy	1.0	1.2	1.1	1.1	1.0	1.2	1.0	1.0
14th St to GW Memorial Pkwy	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
GW Memorial Pkwy to Boundary Channel Dr	0.8	1.4	1.0	0.9	0.8	1.4	1.0	0.8
Boundary Channel Dr to Route 1	0.3	0.3	0.4	0.4	0.3	0.4	0.4	0.4
Route 1 to Washington Blvd	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Washington Blvd to Glebe Rd	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Glebe Rd to Shirlington Rd	0.5	0.6	0.6	0.6	0.5	0.6	0.6	0.6
Shirlington Rd to King St	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
King St to Seminary Rd	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Seminary Road to Duke St	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Duke St to Turkeycock Run	1.8	1.9	1.9	1.9	1.8	1.9	1.9	1.9
Turkeycock Run to South of Edsall Rd	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Total	**12.0**	**12.8**	**12.3**	**12.2**	**12.0**	**12.9**	**12.4**	**12.1**
Average	**12.3**				**12.3**			
Northbound HOV/HOT Lanes								
South of Edsall Rd to Turkeycock Run	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Turkeycock Run to Seminary Road	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
Seminary Rd to Shirlington Rd	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
Shirlington Rd to Washington Blvd	1.6	1.6	1.6	1.8	1.6	1.6	1.6	1.5
Washington Blvd to Eads St	0.6	0.8	1.4	1.1	0.5	0.6	0.6	0.5
Eads St to Ramp from GP Lanes	0.9	1.7	2.2	2.2	0.7	1.4	1.2	0.7
Ramp from GP Lanes to 14th St	2.4	3.3	3.5	5.1	1.5	3.2	2.8	1.3
14th St to End HOV Lanes	0.7	0.8	0.8	0.8	0.7	0.8	0.8	0.8
Total	**11.5**	**13.5**	**14.9**	**16.3**	**10.4**	**12.9**	**12.3**	**10.1**
Average	**14.1**				**11.4**			
Southbound HOV/HOT Lanes								
Begin HOV Lanes to 14th St	1.2	1.3	1.3	1.2	1.2	1.3	1.6	1.3
14th St to Ramp to GP Lanes	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Ramp to GP Lanes to Eads St	0.4	0.4	0.4	0.4	0.0	0.0	0.0	0.0
Eads St to Ramp to GP Lanes	0.2	0.2	0.2	0.2	0.0	0.0	0.0	0.0
Total	**2.3**	**2.3**	**2.3**	**2.3**	**1.7**	**1.8**	**2.1**	**1.7**
Average	**2.3**				**1.8**			

7.2.1.2 PM Peak Period

A comparison of overall corridor travel times for existing conditions, 2020 No Build conditions, and 2020 Build conditions is summarized in **Figure 7-30** for the southbound peak travel direction for each of the four analysis hours. **Figures 7-31 through 7-34** summarize cumulative travel times for the northbound and southbound I-395 general purpose and HOV/HOT lanes for each of the four analysis hours during the PM peak period between interchanges along the corridor. **Table 7-13** presents 2020 No Build and Build overall travel times and segment travel times for the northbound and southbound I-395 general purpose and HOV/HOT lanes for each of the four analysis hours during the PM peak period between interchanges along the corridor.

PM Peak Period – Southbound General Purpose Lanes (Peak Direction)

Under 2020 No Build conditions, travel times along the southbound I-395 general purpose lanes range from 15 to 31 minutes with the longest travel times observed between 4 PM and 6 PM. The average travel time during the four hour PM peak period is 24 minutes. Under 2020 No Build conditions, travel times along the southbound I-395 general purpose lanes decrease by 5 to 13 minutes compared to exiting conditions in the PM peak period with an average decrease of 9 minutes. This can be attributed to the I-395 4th Lane Southbound – Duke Street to Edsall Road widening project which is included in the No Build conditions. Travel times from the northern study limits to Boundary Channel Drive increase by an average of 2 minutes with increases of up to 4 minutes occurring between 5 PM and 6 PM.

Under 2020 Build conditions, travel times along the southbound I-395 general purpose lanes range from 14 to 27 minutes with an average travel time of 20 minutes. Overall travel times decrease by 1 to 7 minutes with an average travel time decrease of 4 minutes over the four hour PM peak period. The highest travel time reductions occur from 4 to 5 PM (7 minutes). Travel times decrease incrementally throughout the study limits when comparing No Build to Build conditions.

PM Peak Period – Southbound HOV/HOT Lanes (Peak Direction)

Under 2020 No Build conditions, travel times along the southbound I-395 HOV/HOT lanes are approximately 10 minutes. Travel times remain approximately the same in the southbound HOV/HOT lanes when comparing existing to No Build conditions with average increases of approximately 15 seconds. Delay increases of approximately 15 seconds occur in the southbound HOV lanes approaching Turkeycock Run as motorists exiting the HOV lanes encounter congestion in the general purpose lanes.

Under 2020 Build conditions, travel times along the southbound I-395 HOV/HOT lanes are approximately 10 minutes with average travel time reductions of approximately 20 seconds when comparing No Build to Build conditions. Travel times from 4 PM to 5 PM increase by approximately 15 seconds north of the Boundary Channel Drive Interchange due to motorists exiting the HOV lanes to the general purpose lanes. This is caused by the downstream removal of the ramp from the HOV lanes to the general purpose lanes south of Eads Street. This small increase in delay is offset by a reduction in travel times of approximately 20 seconds between Seminary Road and Turkeycock Run where there is less congestion at the Turkeycock Run Interchange where HOT motorists are no longer required to exit from the HOV lanes to the general purpose lanes under Build conditions.

PM Peak Period – Northbound General Purpose Lanes (Off-Peak Direction)

Under 2020 No Build conditions, travel times along the northbound I-395 general purpose lanes range from 11 to 20 minutes with the longest travel times observed between 5 PM and 7 PM. The average travel time during the four hour PM peak period is 15 minutes. Travel times along the southbound I-395 general purpose lanes increase by an average of 4 minutes between existing conditions and 2020 No Build conditions with the majority of the travel time increases occurring between Washington Boulevard and the northern study limits. This is due to lack of available capacity in D.C. to accommodate any increase in the reverse commute pattern in the PM peak period.

Under 2020 Build conditions, travel times along the northbound I-395 general purpose lanes range from 11 to 19 minutes with average travel times of approximately 15 minutes, similar to 2020 No Build conditions.

PM Peak Period – Northbound HOV Lanes (Off-Peak Direction)

Under 2020 No Build conditions, travel times along the northbound I-395 HOV/HOT lanes range from 2.5 to 4 minutes with average travel times of approximately 3 minutes. Travel times increase by approximately 30 seconds due to higher traffic volumes in the unenforced portion of the HOV lanes.

Under 2020 Build conditions, travel times along the northbound I-395 HOV/HOT lanes range from 2.5 to 3 minutes. Overall travel times decrease by an average of 30 seconds due to reduced volumes in the HOT lanes compared to No Build conditions with delay reductions of approximately 1.5 minutes from 5 PM to 6 PM.

Figure 7-30: PM Peak Period - Southbound Overall Travel Time Summary (Existing and 2020)

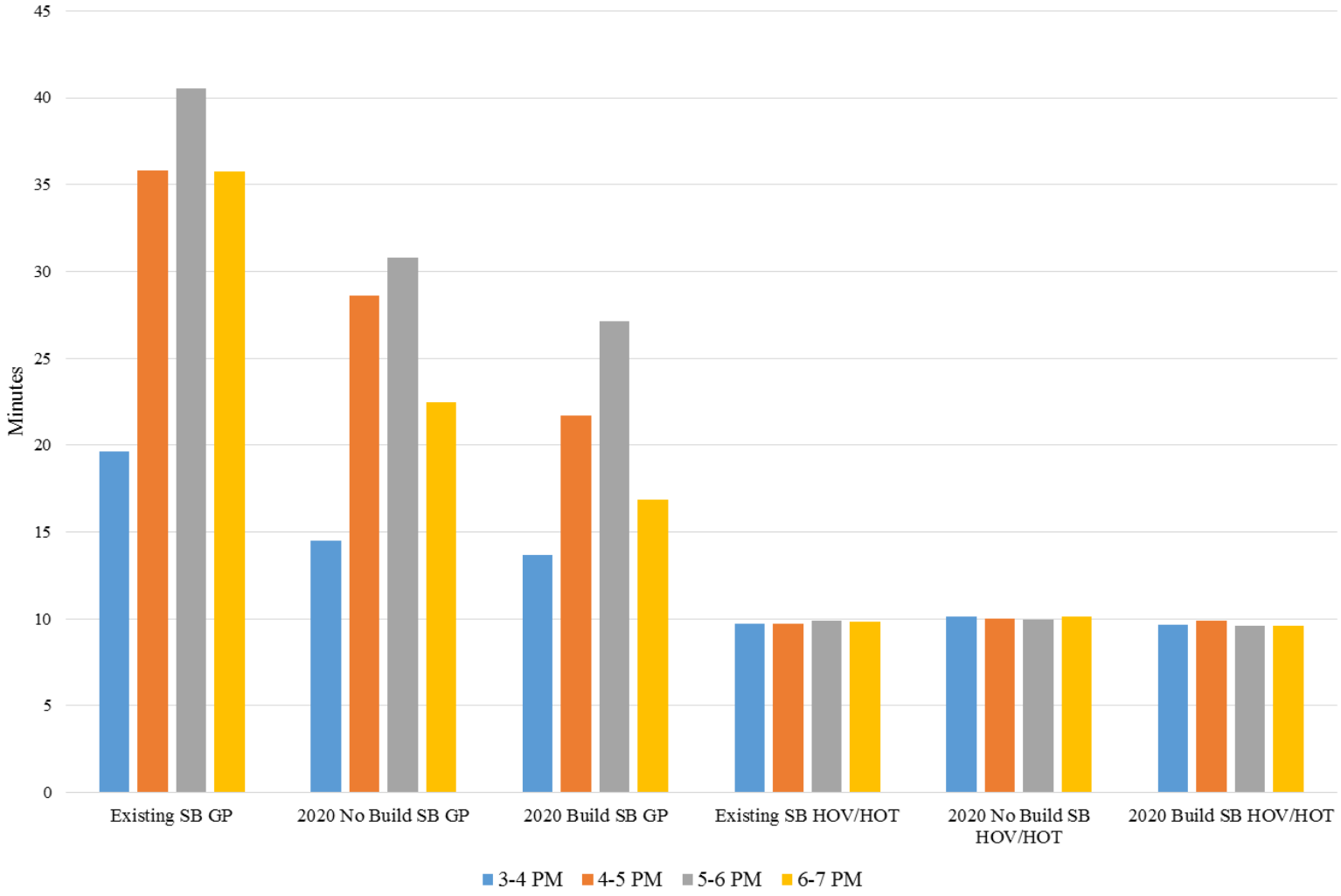


Figure 7-31: PM Peak Period – Southbound General Purpose Lanes Cumulative Travel Times (Existing and 2020)

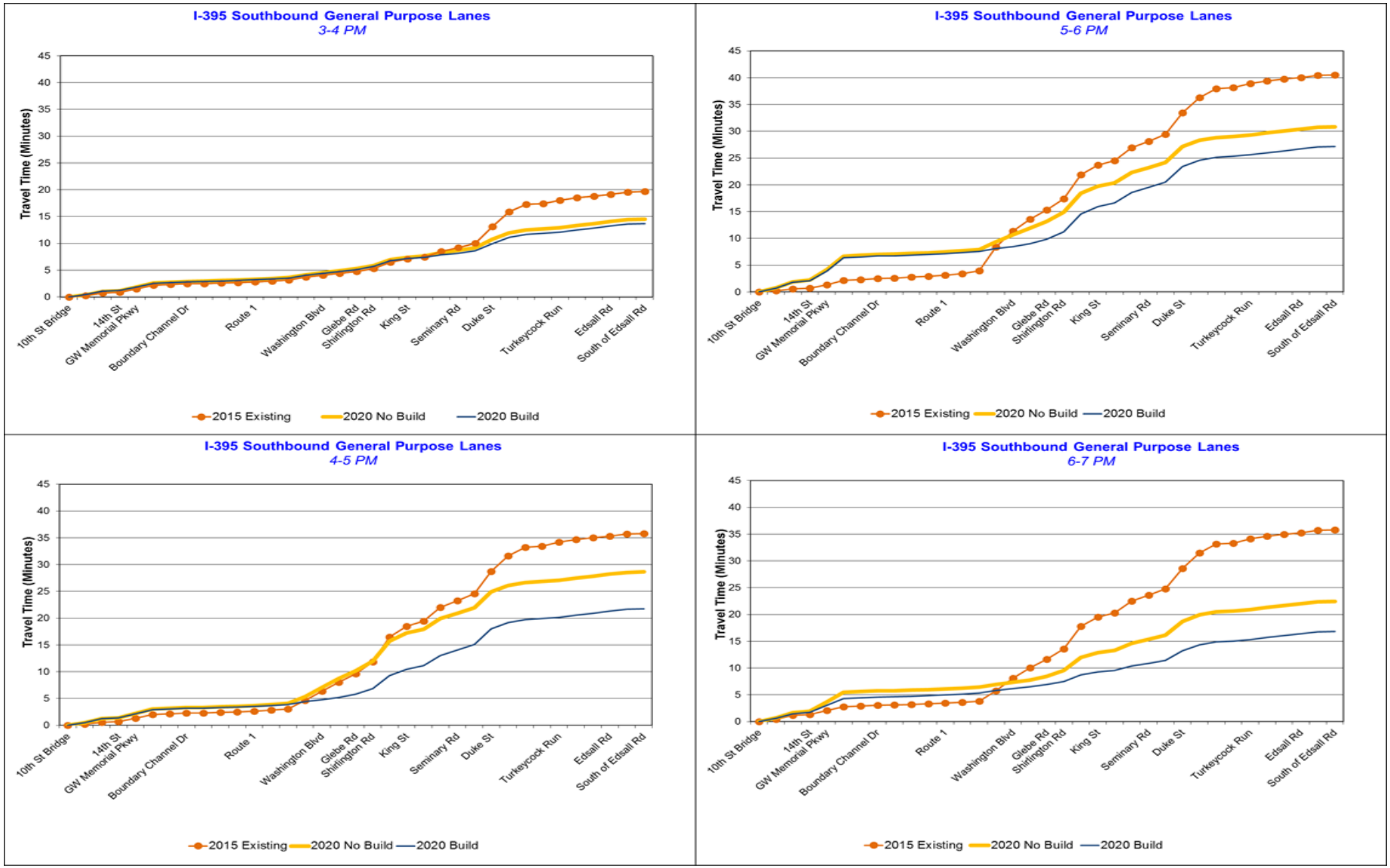


Figure 7-32: PM Peak Period – Southbound HOV/HOT Lanes Cumulative Travel Times (Existing and 2020)

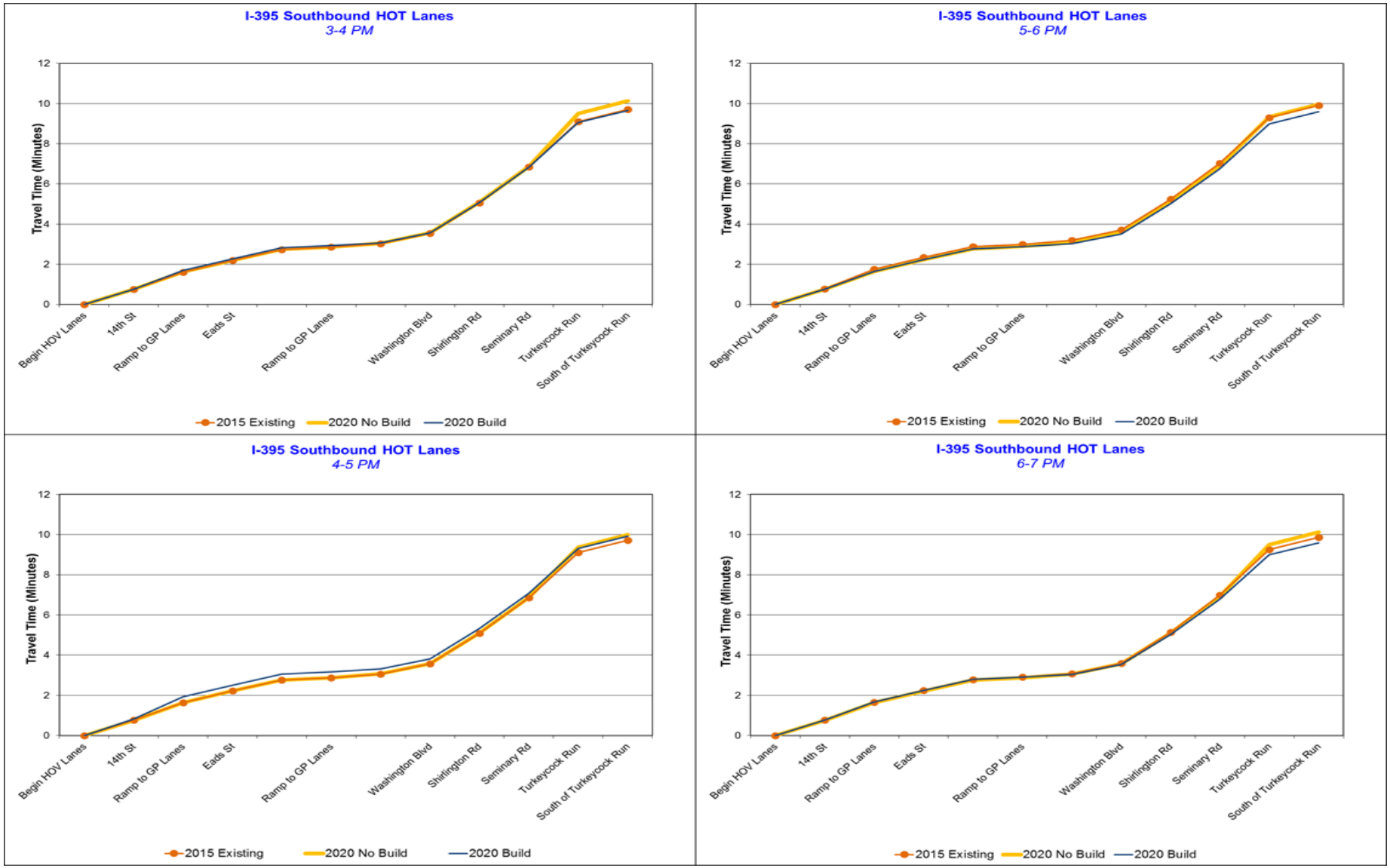


Figure 7-33: PM Peak Period - Northbound General Purpose Lanes Cumulative Travel Times (Existing and 2020)

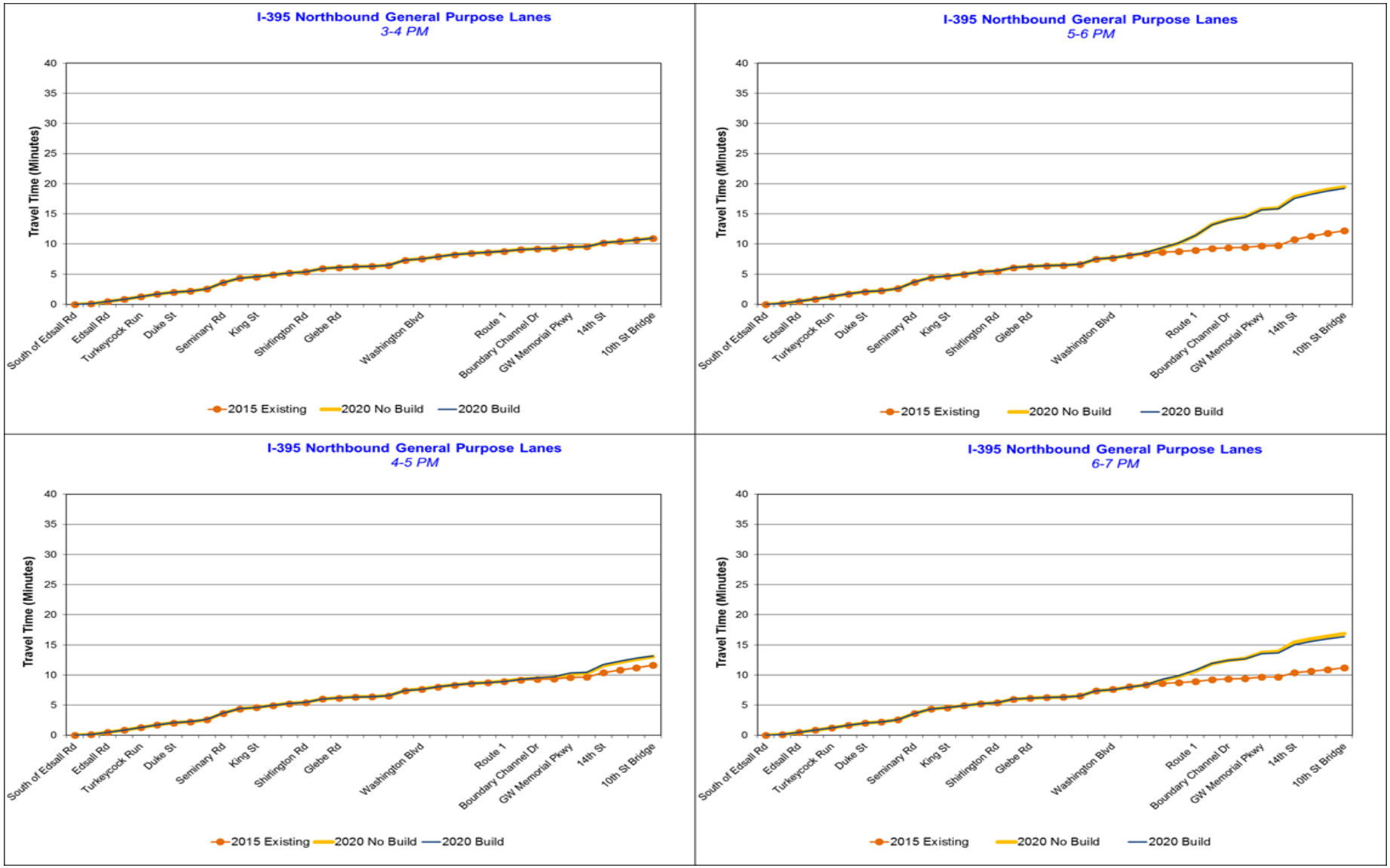


Figure 7-34: PM Peak Period - Northbound HOV/HOT Lanes Cumulative Travel Times (Existing and 2020)

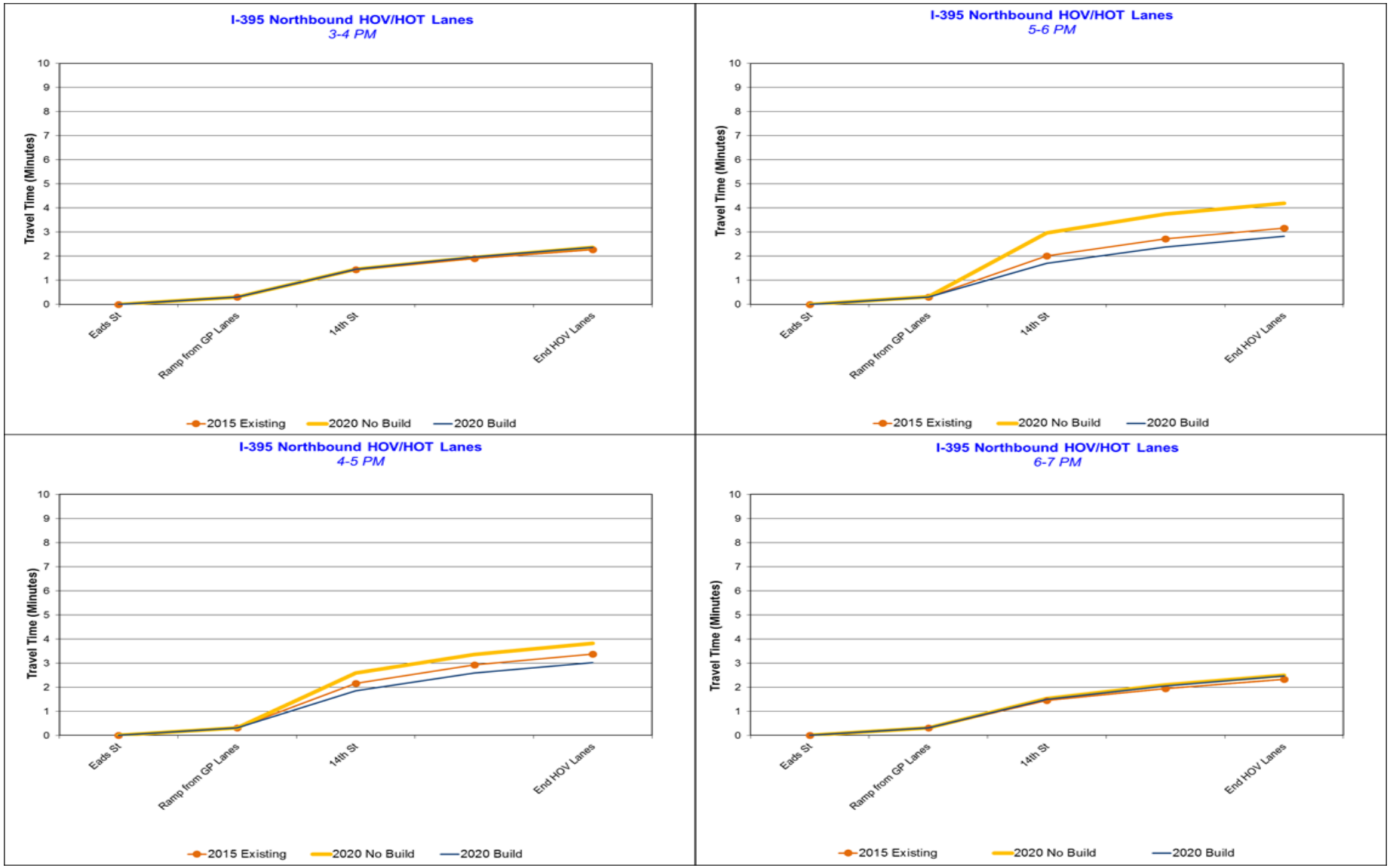


Table 7-13: PM Peak Period – Travel Time Summary (2020 No Build and Build Conditions)

Segment	2020 No Build Travel Time (Min)				2020 Build Travel Time (Min)			
	3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM
Northbound General Purpose Lanes								
South of Edsall Rd to Turkeycock Run	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Turkeycock Run to Duke St	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Duke St to Seminary Rd	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
Seminary Rd to King St	0.9	1.0	1.0	1.0	0.9	1.0	1.0	1.0
King St to Shirlington Rd	0.8	0.8	0.9	0.8	0.8	0.8	0.9	0.8
Shirlington Rd to Glebe Rd	0.7	0.8	0.7	0.7	0.7	0.7	0.7	0.7
Glebe Rd to Washington Blvd	2.1	2.2	2.3	2.2	2.1	2.2	2.3	2.2
Washington Blvd to Route 1	0.6	0.6	2.9	2.3	0.6	0.6	2.9	2.4
Route 1 to Boundary Channel Dr	0.4	0.5	2.6	1.7	0.4	0.6	2.6	1.6
Boundary Channel Drive to GW Memorial Pkwy	0.3	0.7	1.7	1.3	0.3	0.8	1.7	1.1
GW Memorial Pkwy to 14th St	0.7	1.4	2.0	1.7	0.7	1.4	1.9	1.5
14th St to 12th St Exp Ramp	0.8	1.4	1.7	1.4	0.8	1.4	1.6	1.3
Total	**11.0**	**13.0**	**19.5**	**16.8**	**11.0**	**13.2**	**19.2**	**16.4**
Average	**15.1**				**14.9**			
Southbound General Purpose Lanes								
Ramp from 9th St Expy	1.1	1.4	2.2	2.0	1.2	1.4	2.1	1.7
14th St to GW Memorial Pkwy	0.7	0.8	2.0	1.7	0.6	0.8	1.8	1.4
GW Memorial Pkwy to Boundary Channel Dr	1.1	1.1	2.8	2.1	1.0	1.0	2.8	1.5
Boundary Channel Dr to Route 1	0.4	0.4	0.5	0.4	0.4	0.4	0.5	0.4
Route 1 to Washington Blvd	1.2	3.3	3.2	1.2	1.2	1.2	1.3	1.2
Washington Blvd to Glebe Rd	0.7	3.2	2.5	1.1	0.7	1.1	1.4	0.7
Glebe Rd to Shirlington Rd	0.6	1.8	1.7	1.1	0.6	1.0	1.4	0.6
Shirlington Rd to King St	1.5	5.2	4.8	3.3	1.5	3.6	4.7	1.8
King St to Seminary Rd	1.3	3.7	3.5	2.5	1.0	3.5	3.6	1.6
Seminary Road to Duke St	2.1	4.0	3.9	3.3	1.8	4.0	3.9	2.4
Duke St to Turkeycock Run	2.2	2.1	2.2	2.2	2.1	2.2	2.2	2.1
Turkeycock Run to South of Edsall Rd	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Total	**14.5**	**28.6**	**30.8**	**22.5**	**13.7**	**21.7**	**27.1**	**16.8**
Average	**24.1**				**19.8**			
Northbound HOV/HOT Lanes								
Eads St to Ramp from GP Lanes	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Ramp from GP Lanes to 14th St	1.2	2.3	2.6	1.2	1.2	1.5	1.4	1.2
14th St to End HOV Lanes	0.9	1.2	1.2	1.0	0.9	1.2	1.1	1.0
Total	**2.4**	**3.8**	**4.2**	**2.5**	**2.4**	**3.0**	**2.8**	**2.5**
Average	**3.2**				**2.7**			
Southbound HOV/HOT Lanes								
Begin HOV Lanes to 14th St	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
14th St to Ramp to GP Lanes	0.9	0.9	0.9	0.9	0.9	1.1	0.9	0.9
Ramp to GP Lanes to Washington Blvd	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Eads St to Ramp to GP Lanes	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Ramp to GP Lanes to Washington Blvd	0.7	0.7	0.7	0.7	0.6	0.6	0.6	0.6
Washington Blvd to Shirlington Rd	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Shirlington Rd to Seminary Rd	1.8	1.8	1.8	1.8	1.7	1.8	1.7	1.7
Seminary Rd to Turkeycock Run	2.6	2.5	2.4	2.6	2.2	2.2	2.2	2.2
Turkeycock Run to South of Edsall Rd	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Total	**10.1**	**10.0**	**10.0**	**10.1**	**9.7**	**9.9**	**9.6**	**9.6**
Average	**10.1**				**9.7**			

7.2.2 Freeway Density, Speeds, and Queues

7.2.2.1 AM Peak Period

Figures 7-35 and 7-36 summarize 2020 No Build and Build traffic operations based on the freeway segment density measured in vehicles per mile per lane for the northbound and southbound I-395 general purpose and HOV/HOT lanes for each of the four analysis hours from 6 AM through 10 AM. In the 2020 No Build scenario, there are a total of 121 segments including 51 freeway segments, 21 weave segments, and 49 merge/diverge junctions, with minor differences in the segmentation in the Build scenario due to modifications in the vicinity of the Eads Street Interchange.

Figures 7-37 (*Volume 2*) **and 7-38** (*Volume 2*) **and Table 7-14** depict 2020 No Build travel speeds (MPH) and densities (vehicles per mile per lane) along the northbound and southbound I-395 general purpose and HOV/HOT lanes for each of the four analysis hours during the AM peak period. **Figures 7-39** (*Volume 2*) **and 7-40** (*Volume 2*) **and Table 7-15** depict 2020 Build travel speeds and densities. **Appendix J** contains a summary of throughput volumes, travel speeds and densities by lane for both 2020 No Build and Build Conditions.

As shown in **Figure 7-35,** under 2020 No Build conditions in the AM peak period, 90 percent of the 51 northbound I-395 general purpose segments operate with severe congestion and 5 percent operate with heavy congestion. The remaining 5 percent operate with moderate traffic conditions. Twenty-three percent of the 21 northbound I-395 HOV/HOT segments operate with severe congestion and 2 percent operate with heavy congestion. The remaining 75 percent operate with light or moderate traffic conditions.

Under 2020 Build conditions in the AM peak period, the number of northbound general purpose segments that operate with severe congestion is reduced from 90 percent to 63 percent with 6 percent of the segments operating with heavy congestion. The number of segments operating with light or moderate traffic conditions increases from 5 percent to 31 percent. The number of segments along the northbound I-395 HOV/HOT lanes that operate with severe or heavy congestion is reduced from 25 percent to 17 percent with the remaining 83 percent operating with light or moderate traffic conditions.

As shown in **Figure 7-36**, under 2020 No Build conditions in the AM peak period, 12 percent of the 42 southbound I-395 general purpose segments operate with severe or heavy congestion and 88 percent operate with light or moderate traffic conditions. Seven percent of the seven southbound I-395 HOV segments operate with heavy congestion. Under 2020 Build conditions in the AM peak period, there are minor changes in the operations along the southbound general purpose lanes. The number of segments in the southbound I-395 HOV lanes that operate with moderate or heavy congestion increases from 11 percent under 2020 No Build conditions to 20 percent under 2020 Build conditions due to the removal of the ramp from the HOV lanes to the general purpose lanes south of the Eads Street Interchange. Under 2020 Build conditions, motorists would be required to exit the HOV lanes in the vicinity of the Boundary Channel Drive Interchange or at the Eads Street Interchange. No I-395 southbound HOV segments would operate with severe congestion under 2020 No Build or Build conditions.

Figure 7-35: AM Peak Period Freeway Density Summary (2020 No Build and Build Conditions) Northbound I-395

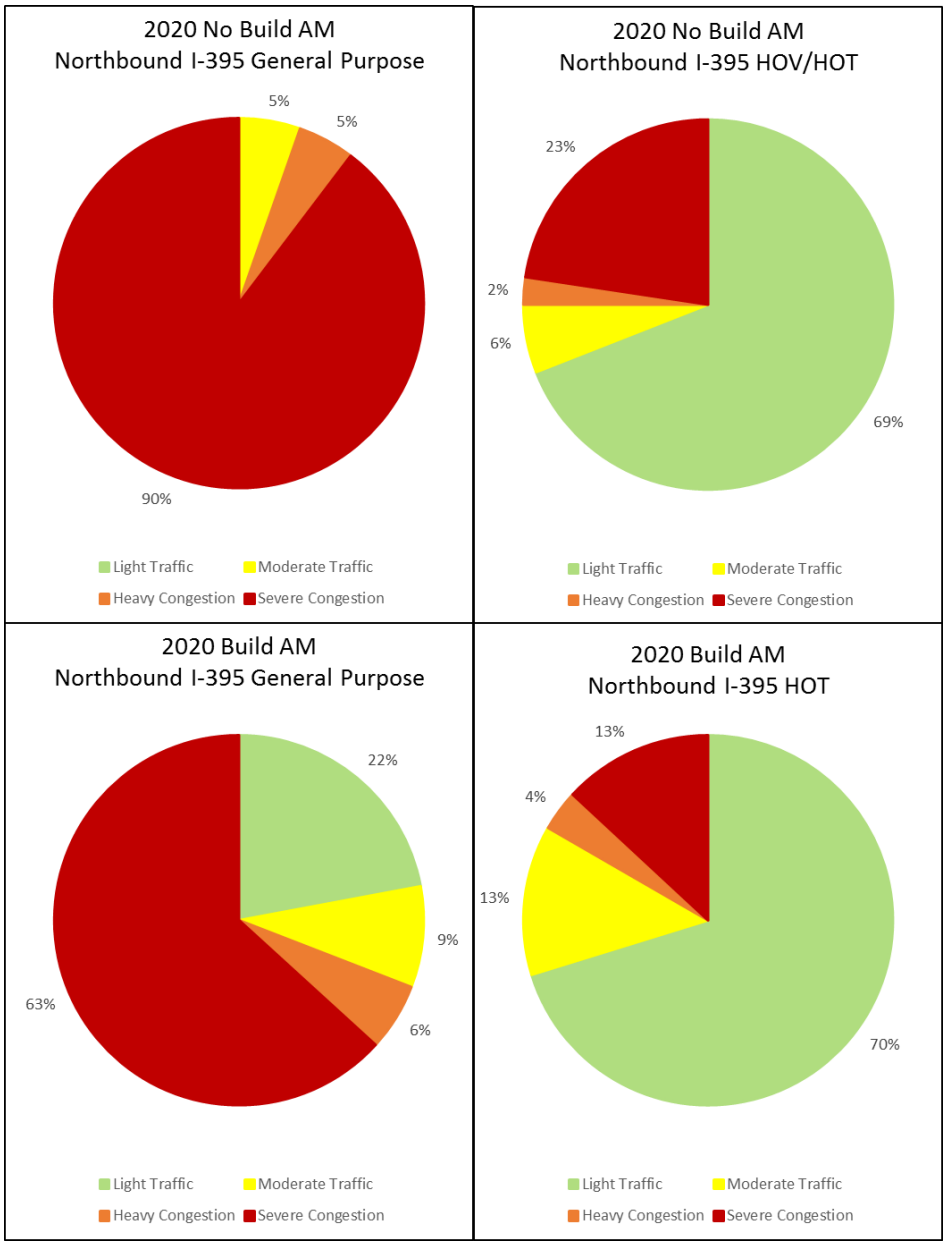
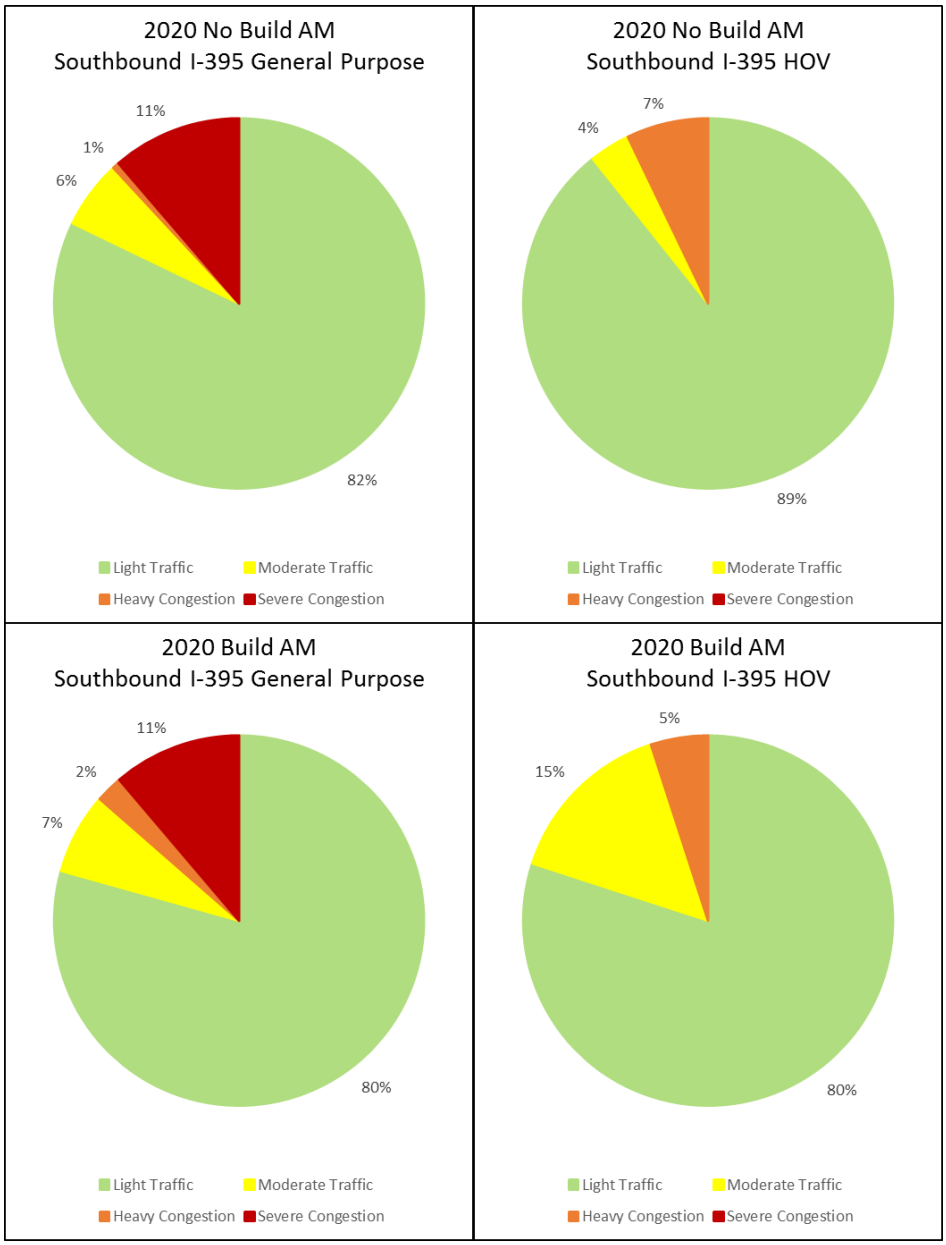


Figure 7-36: AM Peak Period Freeway Density Summary (2020 No Build and Build Conditions) Southbound I-395



Freeway Segments: Under 2020 No Build conditions in the AM peak period, there are a total of 22 freeway segments in the northbound I-395 general purpose lanes. Of these segments, 92 percent operate with severe congestion, 3 percent operate with heavy congestion, and the remaining 5 percent operate with moderate traffic conditions. There are a total of nine freeway segments in the northbound I-395 HOV/HOT lanes. Of these segments, 25 percent operate with severe or heavy congestion and 75 percent operate with light or moderate traffic conditions.

Under 2020 Build conditions in the AM peak period, the number of freeway segments along the northbound I-395 general purpose lanes that operate with severe congestion is reduced from 92 percent to 66 percent with 7 percent of the segments operating with heavy congestion. The number of segments operating with

light or moderate traffic conditions increases from 5 percent to 27 percent. The number of freeway segments along the northbound I-395 HOV/HOT lanes that operate with severe or heavy congestion is reduced from 25 percent to 17 percent with the remaining 83 percent operating with light or moderate traffic conditions.

Ramp Junctions: Under 2020 No Build conditions in the AM peak period, there are a total of 16 ramp junctions in the northbound I-395 general purpose lanes. Of these segments, 87 percent operate with severe congestion, 5 percent operate with heavy congestion, and the remaining 8 percent operate with light or moderate traffic conditions. There are a total of 12 ramp junctions in the northbound I-395 HOV/HOT lanes. Of these segments, 25 percent operate with severe congestion and 75 percent operate with light or moderate traffic conditions.

Under 2020 Build conditions in the AM peak period, the number of ramp junctions along the northbound I-395 general purpose lanes that operate with severe congestion is reduced from 87 percent to 55 percent with 9 percent of the segments operating with heavy congestion. The number of segments operating with light or moderate traffic conditions increases from 8 percent to 36 percent. The number of ramp junctions along the northbound I-395 HOV/HOT lanes that operate with severe or heavy congestion is reduced from 25 percent to 16 percent with the remaining 84 percent operating with light or moderate traffic conditions.

Weave Segments: Under 2020 No Build conditions in the AM peak period, there are a total of 13 weave segments in the northbound I-395 general purpose lanes. Of these segments, 90 percent operate with severe congestion, 4 percent operate with heavy congestion, and the remaining 6 percent operate with light or moderate traffic conditions. There are no weave segments in the northbound HOV/HOT lanes.

Under 2020 Build conditions in the AM peak period, the number of weave segments along the northbound I-395 general purpose lanes that operate with severe congestion is reduced from 90 percent to 69 percent. The number of segments operating with light or moderate traffic conditions increases from 6 percent to 31 percent.

Figures 7-41 through 7-43 depict 2020 No Build and Build speed profiles from the VISSIM model for the northbound and southbound I-395 general purpose and HOV/HOT lanes for each of the four analysis hours during the AM peak period. The following is a summary of the travel speeds when comparing existing, 2020 No Build and 2020 Build conditions in the peak travel direction.

AM Peak Period – Northbound General Purpose Lanes (Peak Direction): 2020 No Build corridor travel speeds along the northbound I-395 general purpose lanes for the four hours during the AM peak period range from 12 MPH to 25 MPH with an overall average travel speed of 16 MPH. Compared to existing conditions, overall travel speeds decrease by approximately 5 MPH under 2020 No Build conditions and the duration of travel speeds under 25 MPH increases in the 6 AM to 7 AM hour with lower travel speeds from south of Edsall Road to King Street and north of Washington Boulevard.

Under 2020 Build conditions, travel speeds along the northbound I-395 general purpose lanes range from 17 MPH to 30 MPH. Overall travel speeds increase by approximately 6 MPH over the four hour AM peak period compared to No Build conditions. The largest increases in speeds are observed in the southern portion of the corridor from south of Edsall Road to Shirlington Road in the 6 AM to 7 AM and 9 AM to 10 AM hours.

AM Peak Period – Northbound HOV/HOT Lanes (Peak Direction): 2020 No Build corridor travel speeds along the northbound I-395 HOV/HOT lanes range from 36 MPH to 52 MPH with average travel speeds of 43 MPH. The lowest travel speeds occur from 9 AM to 10 AM due to non-HOV motorists entering the northbound I-395 HOV lanes during this hour when the HOV restrictions are not in effect. Travel speeds decrease by approximately 4 percent overall during the four hours with lower travel speeds (less than 50 MPH) extending for a longer duration south of the Eads Street Interchange.

Under 2020 Build conditions, travel speeds along the northbound I-395 HOT lanes range from 46 MPH to 59 MPH. Overall travel speeds increase by approximately 10 MPH over the four hour AM peak period compared to No Build conditions with travel speed increases up to 23 MPH observed from 9 AM to 10 AM when the HOV lanes are most congested under No Build conditions due to the removal of the HOV restriction during this hour.

Table 7-14: AM Peak Period Freeway Speed and Density by Segment (2020 No Build)

2020 No Build Conditions									
Location	Type	Average Speed (mph)				Average Density (veh/mi/ln)			
		6-7 AM	7-8 AM	8-9 AM	9-10 AM	6-7 AM	7-8 AM	8-9 AM	9-10 AM
I-395 Northbound General Purpose Lanes									
I-395 NB south of Edsall Rd ramps	Diverge	24	10	11	25	56	114	106	67
I-395 NB between Edsall Rd off-ramps	Freeway	25	10	12	31	66	127	118	65
I-395 NB at Edsall Rd WB off-ramp	Diverge	23	10	12	30	53	98	91	52
I-395 NB between Edsall Rd off-ramp and on-ramp	Freeway	22	8	9	29	69	136	129	61
I-395 NB between Edsall Rd and Turkeycock Run	Weave	20	9	10	26	65	121	115	60
I-395 NB between Turkeycock Run ramps	Freeway	20	10	12	27	77	121	113	70
I-395 NB between Turkeycock Run and Duke St	Weave	19	12	13	26	72	110	102	61
I-395 NB at Duke St EB off-ramp	Diverge	20	13	14	24	71	103	101	72
I-395 NB between Duke St off-ramps	Diverge	20	13	13	21	67	94	94	71
I-395 NB between Duke St off-ramp and on-ramp	Freeway	18	12	12	17	85	118	116	96
I-395 NB between Duke St and Seminary Rd	Weave	18	14	13	17	80	103	103	99
I-395 NB between Seminary Rd ramps	Freeway	18	14	14	21	95	114	114	81
I-395 NB at Seminary Rd on-ramp	Merge	19	16	15	20	67	80	80	61
I-395 NB between Seminary Rd and King St	Weave	27	21	20	23	55	72	75	63
I-395 NB between King St off-ramp and on-ramp	Freeway	31	24	22	23	62	78	81	76
I-395 NB at King St EB on-ramp	Merge	25	20	19	20	62	78	78	73
I-395 NB between King St on-ramps	Freeway	44	33	29	27	48	60	66	69
I-395 NB between King St and Shirlington Rd	Weave	52	29	24	21	30	59	70	77
I-395 NB between Shirlington Rd ramps	Freeway	50	20	17	17	33	88	106	108
I-395 NB between Shirlington Rd and Glebe Rd	Weave	33	20	19	16	49	86	92	98
I-395 NB between Glebe Rd EB off-ramp and on-ramp	Freeway	44	37	33	20	39	47	50	89
I-395 NB between Glebe Rd EB on-ramp and WB off-ramp	Weave	50	38	31	17	28	41	50	85
I-395 NB between Glebe Rd WB off-ramp and on-ramp	Freeway	52	39	31	19	33	47	59	93
I-395 NB at Glebe Rd WB on-ramp	Merge	53	33	26	15	27	55	80	120
I-395 NB north of Glebe Rd ramps	Freeway	46	34	27	21	40	57	70	82
I-395 NB at Washington Blvd WB off-ramp	Diverge	49	39	25	25	29	37	67	58
I-395 NB at Washington Blvd EB off-ramp	Diverge	53	34	25	24	28	54	93	87
I-395 NB between Washington Blvd EB off-ramp and Army Navy Dr off-ramp	Freeway	51	22	18	16	27	77	110	110
I-395 NB at Army Navy Dr off-ramp	Diverge	50	25	25	17	21	60	80	85

2020 No Build Conditions									
Location	Type	Average Speed (mph)				Average Density (veh/mi/ln)			
		6-7 AM	7-8 AM	8-9 AM	9-10 AM	6-7 AM	7-8 AM	8-9 AM	9-10 AM
I-395 NB between Army Navy Dr off-ramp and Washington Blvd EB on-ramp	Freeway	46	11	9	7	28	99	123	131
I-395 NB at Washington Blvd EB on-ramp	Weave	39	9	7	7	32	136	137	138
I-395 NB at ramp to HOV lanes	Weave	30	9	9	9	43	124	128	128
I-395 NB between ramp to HOV lanes and S Rotary Rd on-ramp	Freeway	34	8	8	9	38	136	131	125
I-395 NB at S Rotary Rd on-ramp	Merge	32	8	8	9	31	113	112	110
I-395 NB between S Rotary Rd on-ramp and Rte 1 SB on-ramp	Freeway	27	8	8	9	48	159	159	156
I-395 NB at Rte 1 SB on-ramp	Merge	25	8	8	9	43	118	122	130
I-395 NB between Rte 1 ramps	Freeway	23	9	9	9	61	153	153	151
I-395 NB at Rte 1 NB on-ramp	Merge	21	8	8	9	44	129	146	149
I-395 NB between Rte 1 and Boundary Channel Dr	Freeway	17	10	10	11	69	134	134	128
I-395 NB between Boundary Channel Dr ramps	Weave	17	10	10	10	58	111	126	119
I-395 NB at lane reduction north of Boundary Channel Dr	Merge	17	11	12	12	71	125	118	114
I-395 NB south of GW Memorial Pkwy	Freeway	18	13	15	16	83	118	111	108
I-395 NB between GW Memorial Pkwy EB on-ramp and WB off-ramp	Weave	18	15	18	19	90	104	95	93
I-395 NB between GW Memorial Pkwy WB off-ramp and WB on-ramp	Freeway	23	19	23	25	74	90	81	74
I-395 NB between GW Memorial Pkwy and 14th St	Weave	21	20	22	22	77	90	83	78
I-395 NB at 14th St off-ramp	Diverge	21	20	21	22	76	86	83	82
I-395 NB between 14th St off-ramp and off-ramp to Buckeye Dr	Freeway	20	19	19	20	84	95	94	92
I-395 NB between Buckeye Dr ramps	Freeway	29	29	29	27	59	62	61	66
I-395 NB at on-ramp from Buckeye Dr	Merge	32	30	31	27	48	54	54	64
I-395 NB between HOV merge and 12th St Expy off-ramp	Weave	31	31	31	28	56	58	60	67
I-395 NB north of 12th St Expy off-ramp	Freeway	31	31	31	31	66	64	62	57
I-395 Southbound General Purpose Lanes									
I-395 SB north of 9th St Expy on-ramp	Freeway	19	16	19	17	88	98	92	95
I-395 SB on Francis Case Memorial Bridge	Weave	28	23	25	25	52	67	63	61
I-395 SB between HOV diverge and off-ramp to Ohio Dr	Diverge	32	29	29	29	58	67	67	63
I-395 SB between 14th St on-ramp and HOV diverge	Freeway	35	36	36	36	60	54	57	55
I-395 SB on 14th St Bridge	Merge	43	29	37	43	28	65	38	28
I-395 SB at GW Memorial Pkwy WB off-ramp	Diverge	42	27	36	41	23	55	32	24
I-395 SB between GW Memorial Pkwy EB off-ramp and WB off-ramp	Diverge	45	36	40	42	22	47	30	25

2020 No Build Conditions									
Location	Type	Average Speed (mph)				Average Density (veh/mi/ln)			
		6-7 AM	7-8 AM	8-9 AM	9-10 AM	6-7 AM	7-8 AM	8-9 AM	9-10 AM
I-395 SB between GW Memorial Pkwy EB on-ramp and EB off-ramp	Freeway	48	48	47	48	21	21	24	22
I-395 SB between Boundary Channel Dr and GW Memorial Pkwy	Weave	43	43	45	45	18	19	19	18
I-395 SB between ramp from HOV lanes and Boundary Channel Dr WB off-ramp	Merge	47	47	46	45	18	19	21	21
I-395 SB between Boundary Channel Dr EB off-ramp and ramp from HOV lanes	Weave	48	48	44	34	18	21	26	30
I-395 SB between Rte 1 SB off-ramp and Boundary Channel Dr EB off-ramp	Freeway	48	47	42	42	22	27	33	30
I-395 SB between Boundary Channel Dr EB on-ramp and Rte 1 SB off-ramp	Diverge	47	44	37	41	18	23	33	24
I-395 SB between Rte 1 NB off-ramp and SB off-ramp	Weave	49	47	44	44	14	16	18	17
I-395 SB between S Rotary Rd off-ramp and Rte 1 NB off-ramp	Diverge	54	51	51	52	11	13	13	12
I-395 SB between ramp from HOV lanes and S Rotary Rd off-ramp	Freeway	54	55	55	54	9	6	6	8
I-395 SB between Army Navy Dr on-ramp and ramp from HOV lanes	Merge	55	55	55	55	8	7	7	8
I-395 SB at Army Navy Dr on-ramp	Merge	54	53	53	53	9	9	9	9
I-395 SB between Washington Blvd WB on-ramp and Army Navy Dr on-ramp	Freeway	54	54	54	54	12	12	11	12
I-395 SB at Washington Blvd WB on-ramp	Merge	53	53	53	53	10	12	11	11
I-395 SB between Washington Blvd EB on-ramp and WB on-ramp	Freeway	54	54	54	54	12	15	13	13
I-395 SB at Washington Blvd EB on-ramp	Merge	52	52	52	51	12	14	13	14
I-395 SB north of Glebe Rd ramps	Diverge	54	54	54	54	14	17	16	16
I-395 SB between Shirlington Rd and Glebe Rd	Freeway	54	53	54	53	16	19	17	17
I-395 SB between Shirlington Rd on-ramps	Merge	53	52	52	52	15	18	17	16
I-395 SB between King St and Shirlington Rd	Weave	53	52	52	52	13	17	16	15
I-395 SB between King St WB on-ramp and off-ramp	Freeway	54	54	54	54	14	18	17	16
I-395 SB at King St WB on-ramp	Merge	54	53	53	53	12	16	15	13
I-395 SB between King St EB on-ramp and WB on-ramp	Freeway	54	53	53	54	15	19	18	17
I-395 SB between Seminary Rd and King St	Weave	54	53	53	54	13	17	16	15
I-395 SB between Seminary Rd ramps	Freeway	54	54	54	54	14	18	17	15
I-395 SB at Seminary Rd on-ramp	Merge	52	52	52	52	14	17	17	15
I-395 SB between Little River Tnpk and Seminary Rd	Freeway	54	53	53	53	17	21	20	18
I-395 SB at Little River Tnpk off-ramp	Diverge	54	53	53	54	13	17	16	14

2020 No Build Conditions									
Location	Type	Average Speed (mph)				Average Density (veh/mi/ln)			
		6-7 AM	7-8 AM	8-9 AM	9-10 AM	6-7 AM	7-8 AM	8-9 AM	9-10 AM
I-395 SB between Little River Tnpk ramps	Freeway	54	53	54	53	14	17	16	14
I-395 SB at Little River Tnpk WB on-ramp	Freeway	50	48	49	50	15	19	18	14
I-395 SB between Turkeycock Run and Little River Tnpk	Freeway	54	53	53	54	16	20	19	16
I-395 SB at Turkeycock Run off-ramp	Diverge	54	54	54	54	16	20	18	16
I-395 SB between Turkeycock Run ramps	Freeway	54	53	54	54	16	20	18	16
I-395 SB between Edsall Rd and Turkeycock Run	Weave	54	53	54	54	14	17	17	14
I-395 SB between Edsall Rd EB on-ramp and off-ramp	Freeway	54	53	54	54	17	19	18	15
I-395 SB south of Edsall Rd ramps	Merge	53	52	52	52	16	20	19	17
I-395 Northbound HOV/HOT Lanes									
I-395 HOT NB south of Turkeycock Run ramps	Freeway	67	66	67	67	17	21	14	9
I-395 HOT NB at Turkeycock Run off-ramp	Diverge	62	60	57	64	14	17	15	7
I-395 HOV NB between Turkeycock Run off-ramp and lane reduction	Merge	66	66	66	67	12	15	10	7
I-395 HOV NB between lane reduction and Turkeycock Run on-ramp	Freeway	67	66	67	67	18	22	15	11
I-395 HOV NB at Turkeycock Run on-ramp	Merge	65	65	65	62	13	16	11	11
I-395 HOV NB between Turkeycock Run on-ramp and Seminary Rd off-ramp	Merge	67	66	67	67	20	23	16	15
I-395 HOV NB at Seminary Rd off-ramp	Diverge	66	64	66	66	13	16	11	10
I-395 HOV NB between Seminary Rd ramps	Freeway	66	66	67	67	19	23	16	14
I-395 HOV NB at Seminary Rd on-ramp	Merge	64	61	62	61	14	18	13	13
I-395 HOV NB between Seminary Rd on-ramp and Shirlington Rd on-ramp	Freeway	66	66	66	63	21	25	18	18
I-395 HOV NB at Shirlington Rd on-ramp	Merge	62	57	56	51	16	21	17	21
I-395 HOV NB between Shirlington Rd on-ramp and Washington Blvd off-ramp	Freeway	62	62	62	56	23	27	21	27
I-395 HOV NB at Washington Blvd off-ramp	Diverge	63	62	62	53	15	18	15	23
I-395 HOV NB between Washington Blvd off-ramp and Eads St off-ramp	Freeway	56	43	33	39	20	31	42	41
I-395 HOV NB at Eads St off-ramp	Diverge	35	28	26	25	24	50	68	47
I-395 HOV NB between Eads St ramps	Freeway	54	52	47	47	11	13	12	12
I-395 HOV NB at Eads St on-ramp	Merge	47	25	10	21	11	30	77	33
I-395 HOV NB between Eads St on-ramp and on-ramp from GP lanes	Freeway	44	13	9	11	17	78	126	77
I-395 HOV NB at on-ramp from GP lanes	Merge	24	10	9	6	54	122	133	144
I-395 HOV NB between on-ramp from GP lanes and 14th St	Diverge	21	15	14	10	76	106	109	123
I-395 HOV NB north of 14th St	Freeway	35	31	31	32	55	56	56	55

2020 No Build Conditions									
Location	Type	Average Speed (mph)				Average Density (veh/mi/ln)			
		6-7 AM	7-8 AM	8-9 AM	9-10 AM	6-7 AM	7-8 AM	8-9 AM	9-10 AM
I-395 Southbound HOV Lanes									
I-395 HOV SB north of 14th St	Freeway	51	50	50	51	25	37	37	32
I-395 HOV SB between off-ramp to GP lanes and 14th St	Merge	53	51	49	52	13	21	24	18
I-395 HOV SB at off-ramp to GP lanes	Diverge	39	37	35	37	12	21	23	18
I-395 HOV SB between Eads St off-ramp and off-ramp to GP lanes	Freeway	59	59	59	55	4	6	6	5
I-395 HOV SB at Eads St off-ramp	Diverge	57	58	58	52	3	4	4	8
I-395 HOV SB between Eads St ramps	Freeway	60	60	60	60	2	4	5	3
I-395 HOV SB between off-ramp to GP lanes and Eads St	Weave	56	57	58	56	2	3	3	2

Table 7-15: AM Peak Period Freeway Speed and Density by Segment (2020 Build)

2020 Build Conditions									
Location	Type	Average Speed (mph)				Average Density (veh/mi/ln)			
		6-7 AM	7-8 AM	8-9 AM	9-10 AM	6-7 AM	7-8 AM	8-9 AM	9-10 AM
I-395 Northbound General Purpose Lanes									
I-395 NB south of Edsall Rd ramps	Diverge	50	50	49	50	23	24	28	25
I-395 NB between Edsall Rd off-ramps	Freeway	52	52	50	52	26	26	31	28
I-395 NB at Edsall Rd WB off-ramp	Diverge	48	46	43	46	22	23	29	25
I-395 NB between Edsall Rd off-ramp and on-ramp	Freeway	53	53	53	53	23	20	23	23
I-395 NB between Edsall Rd and Turkeycock Run	Weave	53	53	52	52	20	19	21	21
I-395 NB between Turkeycock Run ramps	Freeway	52	53	52	52	26	24	27	27
I-395 NB north of Turkeycock Run ramps	Weave	51	50	51	51	23	24	25	23
I-395 NB at Duke St EB off-ramp	Diverge	52	52	52	52	23	23	24	23
I-395 NB between Duke St off-ramps	Diverge	52	52	51	52	21	21	22	20
I-395 NB between Duke St off-ramp and on-ramp	Freeway	53	53	50	53	26	25	28	24
I-395 NB between Duke St and Seminary Rd	Weave	52	51	44	52	26	26	33	23
I-395 NB between Seminary Rd ramps	Freeway	52	37	31	48	29	43	53	30
I-395 NB at Seminary Rd on-ramp	Merge	50	27	23	45	22	43	49	25
I-395 NB between Seminary Rd and King St	Weave	48	26	25	43	29	52	55	31
I-395 NB between King St off-ramp and on-ramp	Freeway	50	24	25	39	35	64	64	41
I-395 NB at King St EB on-ramp	Merge	42	21	21	35	35	67	66	40
I-395 NB between King St on-ramps	Freeway	46	26	28	37	43	66	63	48
I-395 NB between King St and Shirlington Rd	Weave	52	21	24	33	29	75	66	49
I-395 NB between Shirlington Rd ramps	Freeway	50	16	16	19	31	100	99	81
I-395 NB between Shirlington Rd and Glebe Rd	Weave	33	17	16	16	45	95	96	83
I-395 NB between Glebe Rd EB off-ramp and on-ramp	Freeway	46	24	23	29	33	65	66	45
I-395 NB between Glebe Rd EB on-ramp and WB off-ramp	Weave	50	19	19	24	25	78	70	48
I-395 NB between Glebe Rd WB off-ramp and on-ramp	Freeway	52	20	20	24	29	85	79	56
I-395 NB at Glebe Rd WB on-ramp	Merge	52	16	16	19	25	114	101	76
I-395 NB north of Glebe Rd ramps	Freeway	43	23	23	24	39	80	74	66
I-395 NB at Washington Blvd WB off-ramp	Diverge	40	26	32	33	31	51	43	40
I-395 NB at Washington Blvd EB off-ramp	Diverge	37	25	46	53	37	80	19	15
I-395 NB between Washington Blvd EB off-ramp and Army Navy Dr off-ramp	Freeway	21	7	22	54	53	143	42	14
I-395 NB at Army Navy Dr off-ramp	Diverge	18	10	18	52	51	120	48	11

2020 Build Conditions									
Location	Type	Average Speed (mph)				Average Density (veh/mi/ln)			
		6-7 AM	7-8 AM	8-9 AM	9-10 AM	6-7 AM	7-8 AM	8-9 AM	9-10 AM
I-395 NB between Army Navy Dr off-ramp and Washington Blvd EB on-ramp	Freeway	13	8	12	52	79	156	80	9
I-395 NB at Washington Blvd EB on-ramp	Weave	11	7	8	9	97	163	149	113
I-395 NB at ramp to HOT lanes	Weave	12	8	8	10	75	118	120	111
I-395 NB between ramp to HOT lanes and S Rotary Rd on-ramp	Freeway	12	7	7	8	105	159	163	159
I-395 NB at S Rotary Rd on-ramp	Merge	12	8	8	8	77	114	129	116
I-395 NB between S Rotary Rd on-ramp and Rte 1 SB on-ramp	Freeway	11	8	8	8	109	159	160	159
I-395 NB at Rte 1 SB on-ramp	Merge	12	8	8	9	88	116	120	125
I-395 NB between Rte 1 ramps	Freeway	12	9	9	9	110	152	153	153
I-395 NB at Rte 1 NB on-ramp	Merge	14	9	9	8	69	122	144	150
I-395 NB between Rte 1 and Boundary Channel Dr	Freeway	12	10	10	10	105	131	133	129
I-395 NB between Boundary Channel Dr ramps	Weave	13	11	10	10	86	105	125	120
I-395 NB at lane reduction north of Boundary Channel Dr	Merge	13	12	12	12	101	117	117	114
I-395 NB south of GW Memorial Pkwy	Freeway	15	14	16	16	104	113	108	108
I-395 NB between GW Memorial Pkwy EB on-ramp and WB off-ramp	Weave	17	17	18	19	95	97	92	93
I-395 NB between GW Memorial Pkwy WB off-ramp and WB on-ramp	Freeway	22	22	24	25	79	84	77	74
I-395 NB between GW Memorial Pkwy and 14th St	Weave	20	21	22	23	83	86	80	78
I-395 NB at 14th St off-ramp	Diverge	20	21	21	21	81	85	84	83
I-395 NB between 14th St off-ramp and off-ramp to Buckeye Dr	Freeway	20	19	19	19	88	94	94	93
I-395 NB between Buckeye Dr ramps	Freeway	29	29	28	28	59	60	63	64
I-395 NB at on-ramp from Buckeye Dr	Merge	32	31	28	28	47	53	60	59
I-395 NB between HOT merge and 12th St Expy off-ramp	Weave	32	31	28	28	56	58	65	62
I-395 NB north of 12th St Expy off-ramp	Freeway	31	31	31	31	66	64	56	55
I-395 Southbound General Purpose Lanes									
I-395 SB north of 9th St Expy on-ramp	Freeway	19	16	19	18	89	99	91	92
I-395 SB on Francis Case Memorial Bridge	Weave	28	23	25	26	52	66	63	58
I-395 SB between HOT diverge and off-ramp to Ohio Dr	Diverge	32	28	29	30	57	67	67	63
I-395 SB between 14th St on-ramp and HOV diverge	Freeway	35	35	35	35	59	56	57	57
I-395 SB on 14th St Bridge	Merge	43	28	35	43	28	68	42	30
I-395 SB at GW Memorial Pkwy WB off-ramp	Diverge	43	27	35	42	23	58	35	25
I-395 SB between GW Memorial Pkwy EB off-ramp and WB off-ramp	Diverge	45	36	39	42	22	51	34	27

2020 Build Conditions									
Location	Type	Average Speed (mph)				Average Density (veh/mi/ln)			
		6-7 AM	7-8 AM	8-9 AM	9-10 AM	6-7 AM	7-8 AM	8-9 AM	9-10 AM
I-395 SB between GW Memorial Pkwy EB on-ramp and EB off-ramp	Freeway	48	48	46	47	22	23	27	24
I-395 SB between Boundary Channel Dr and GW Memorial Pkwy	Weave	43	43	43	45	19	20	21	19
I-395 SB between ramp from HOT lanes and Boundary Channel Dr WB off-ramp	Merge	47	46	41	46	18	20	27	22
I-395 SB between Boundary Channel Dr EB off-ramp and ramp from HOV lanes	Weave	45	40	36	40	21	27	35	28
I-395 SB between Rte 1 SB off-ramp and Boundary Channel Dr EB off-ramp	Freeway	47	44	38	43	24	30	40	32
I-395 SB between Boundary Channel Dr EB on-ramp and Rte 1 SB off-ramp	Diverge	46	43	34	39	20	25	38	29
I-395 SB between Rte 1 NB off-ramp and SB off-ramp	Weave	49	46	41	42	15	18	22	20
I-395 SB between S Rotary Rd off-ramp and Rte 1 NB off-ramp	Diverge	53	51	51	52	13	15	16	14
I-395 SB south of S Rotary Rd off-ramp	Freeway	54	54	54	54	10	9	9	10
I-395 SB north of Army Navy Dr on-ramp	Freeway	54	54	54	54	10	9	9	10
I-395 SB at Army Navy Dr on-ramp	Merge	53	53	53	53	9	10	9	9
I-395 SB between Washington Blvd WB on-ramp and Army Navy Dr on-ramp	Freeway	54	54	54	54	12	12	11	12
I-395 SB at Washington Blvd WB on-ramp	Merge	53	53	53	53	10	12	11	11
I-395 SB between Washington Blvd EB on-ramp and WB on-ramp	Freeway	54	54	54	54	12	15	13	13
I-395 SB at Washington Blvd EB on-ramp	Merge	53	53	53	52	12	12	12	13
I-395 SB north of Glebe Rd ramps	Diverge	54	54	54	54	14	15	14	16
I-395 SB between Shirlington Rd and Glebe Rd	Freeway	54	54	54	54	16	17	15	17
I-395 SB between Shirlington Rd on-ramps	Merge	53	52	52	52	15	17	16	16
I-395 SB between King St and Shirlington Rd	Weave	53	52	52	52	13	16	16	15
I-395 SB between King St WB on-ramp and off-ramp	Freeway	54	54	54	54	15	17	16	15
I-395 SB at King St WB on-ramp	Merge	54	53	53	53	12	15	14	13
I-395 SB between King St EB on-ramp and WB on-ramp	Freeway	54	53	54	54	15	18	18	16
I-395 SB between Seminary Rd and King St	Weave	54	53	54	54	13	16	15	14
I-395 SB between Seminary Rd ramps	Freeway	54	54	54	54	14	17	16	15
I-395 SB at Seminary Rd on-ramp	Merge	52	52	52	52	14	17	16	15
I-395 SB between Little River Tnpk and Seminary Rd	Freeway	54	53	53	54	17	20	20	18
I-395 SB at Little River Tnpk off-ramp	Diverge	54	53	54	54	13	16	16	14

2020 Build Conditions									
Location	Type	Average Speed (mph)				Average Density (veh/mi/ln)			
		6-7 AM	7-8 AM	8-9 AM	9-10 AM	6-7 AM	7-8 AM	8-9 AM	9-10 AM
I-395 SB between Little River Tnpk ramps	Freeway	54	54	54	54	14	16	16	14
I-395 SB at Little River Tnpk WB on-ramp	Merge	49	48	49	50	15	19	17	14
I-395 SB between Turkeycock Run and Little River Tnpk	Freeway	53	53	53	54	16	19	18	16
I-395 SB at Turkeycock Run off-ramp	Diverge	54	54	54	54	16	19	18	16
I-395 SB between Turkeycock Run ramps	Freeway	54	54	54	54	16	19	18	16
I-395 SB between Edsall Rd and Turkeycock Run	Weave	54	54	54	54	15	17	16	14
I-395 SB between Edsall Rd EB on-ramp and off-ramp	Freeway	54	54	54	54	17	19	17	15
I-395 SB south of Edsall Rd ramps	Merge	53	52	52	52	16	19	19	17
I-395 Northbound HOT Lanes									
I-395 HOT NB south of Turkeycock Run ramps	Freeway	66	66	66	67	26	29	23	14
I-395 HOT NB at Turkeycock Run off-ramp	Diverge	63	61	62	65	21	23	18	11
I-395 HOT NB between Turkeycock Run ramps	Freeway	66	66	67	67	23	23	19	12
I-395 HOT NB at Turkeycock Run on-ramp	Merge	65	66	66	66	18	18	15	10
I-395 HOT NB between Turkeycock Run on-ramp and Seminary Rd off-ramp	Freeway	66	66	67	67	24	24	20	13
I-395 HOT NB at Seminary Rd off-ramp	Diverge	66	66	66	67	18	18	15	10
I-395 HOT NB between Seminary Rd ramps	Freeway	66	66	66	67	24	24	20	13
I-395 HOT NB at Seminary Rd on-ramp	Merge	62	62	63	63	21	22	17	12
I-395 HOT NB between Seminary Rd on-ramp and Shirlington Rd on-ramp	Freeway	66	66	66	67	25	26	21	15
I-395 HOT NB at Shirlington Rd on-ramp	Merge	55	52	54	57	26	30	25	17
I-395 HOT NB between Shirlington Rd on-ramp and Washington Blvd off-ramp	Freeway	61	61	62	63	29	31	26	19
I-395 HOT NB at Washington Blvd off-ramp	Diverge	58	55	59	62	23	26	20	14
I-395 HOT NB between Washington Blvd off-ramp and diverge to Eads St NB	Diverge	62	62	62	63	21	21	18	13
I-395 HOT NB between diverge to Eads St NB and Eads St SB off-ramp	Freeway	54	54	54	55	28	29	26	20
I-395 HOT NB at Eads St off-ramp	Diverge	47	44	45	46	22	24	21	16
I-395 HOT NB between Eads St ramps	Freeway	53	39	41	54	25	39	30	16
I-395 HOT NB at Eads St on-ramp	Merge	48	26	29	47	21	54	37	15
I-395 HOT NB between Eads St on-ramp and on-ramp from GP lanes	Freeway	51	30	32	51	28	61	46	19
I-395 HOT NB at on-ramp from GP lanes	Merge	44	17	21	44	22	82	54	17

2020 Build Conditions									
Location	Type	Average Speed (mph)				Average Density (veh/mi/ln)			
		6-7 AM	7-8 AM	8-9 AM	9-10 AM	6-7 AM	7-8 AM	8-9 AM	9-10 AM
I-395 HOT NB between on-ramp from GP lanes and 14th St	Diverge	33	16	18	39	45	98	80	29
I-395 HOT NB north of 14th St	Freeway	36	31	31	32	52	55	55	46
I-395 Southbound HOV Lanes									
I-395 HOV SB north of 14th St	Freeway	51	50	50	51	25	35	38	31
I-395 HOV SB between off-ramp to GP lanes and 14th St	Merge	52	47	38	49	12	19	28	16
I-395 HOV SB at off-ramp to GP lanes	Diverge	34	30	26	29	13	21	26	19
I-395 HOV SB between Eads St off-ramp and off-ramp to GP lanes	Freeway	59	59	59	59	1	1	1	0
I-395 HOV SB at Eads St off-ramp	Diverge	59	60	60	60	1	1	1	0

Figure 7-41: Freeway Speed Comparison – Northbound General Purpose Lanes
2020 No Build and Build – AM Peak Period

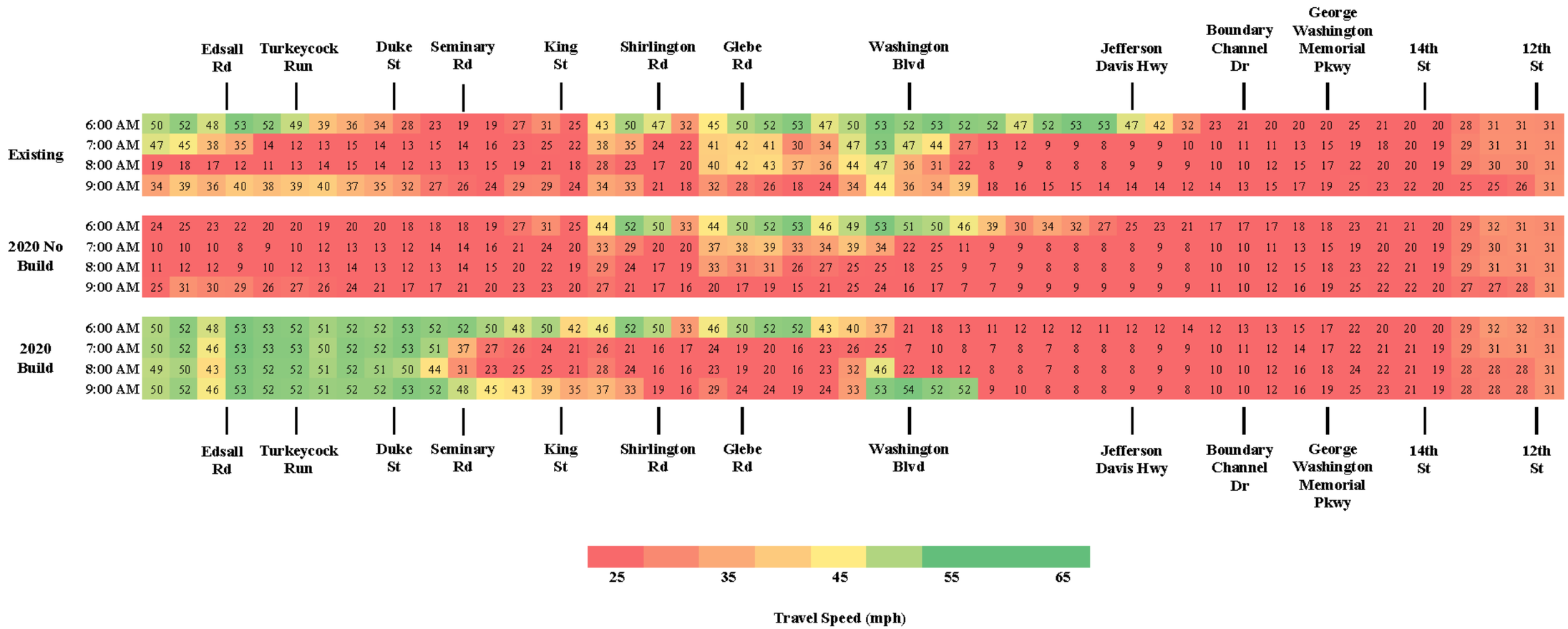


Figure 7-42: Freeway Speed Comparison – Southbound General Purpose Lanes
2020 No Build and Build – AM Peak Period

		Edsall Rd				Turkeycock Run					Duke St						Seminary Rd				King St		Shirlington Rd		Glebe Rd				Washington Blvd				Jefferson Davis Hwy			Boundary Channel Dr			George Washington Memorial Pkwy				14th St			12th St	
Existing	6:00 AM	53	53	52	51	53	54	53	53	53	51	53	53	47	53	53	52	54	53	54	54	54	54	54	53	53	54	54	53	54	54	54	54	55	54	53	50	47	48	48	48	43	48	45	43	43	35	32	28	21
	7:00 AM	53	52	51	49	53	54	53	53	52	49	52	52	43	51	51	50	53	52	54	53	53	53	54	52	52	53	54	51	54	53	54	53	55	55	50	45	44	46	47	47	43	48	40	36	39	36	30	25	22
	8:00 AM	53	52	51	48	53	54	53	53	53	50	52	52	43	51	52	51	53	52	54	54	54	53	54	52	52	54	54	52	54	53	54	53	55	55	51	45	42	46	46	47	45	48	44	42	43	37	32	32	36
	9:00 AM	53	53	52	49	53	54	53	53	53	51	52	52	45	52	51	51	53	52	54	54	54	53	54	52	52	53	54	51	54	53	54	53	55	54	51	37	43	44	39	46	45	48	42	42	43	36	32	31	35
2020 No Build	6:00 AM	53	54	54	54	54	54	54	54	54	54	50	54	54	54	54	54	54	52	54	54	54	54	54	53	53	54	54	52	54	53	54	54	55	54	54	49	47	48	48	47	43	48	45	42	43	35	32	28	19
	7:00 AM	52	53	53	53	53	53	53	54	53	53	48	53	53	53	53	53	53	52	54	53	53	53	54	52	52	53	54	52	54	53	54	53	55	55	51	47	44	47	48	47	43	48	36	27	29	36	29	23	16
	8:00 AM	52	54	54	54	54	54	54	54	53	53	49	54	54	54	54	53	53	52	54	53	53	53	54	52	52	54	54	52	54	53	54	53	55	55	51	44	37	42	44	46	45	47	40	36	37	36	29	25	19
	9:00 AM	52	54	54	54	54	54	54	54	54	54	50	53	53	53	53	54	53	52	54	54	54	53	54	52	52	53	54	51	54	53	54	53	55	54	52	44	41	42	34	45	45	48	42	41	43	36	29	25	17
2020 Build	6:00 AM	53	54	54	54	54	54	54	54	53	53	49	54	54	54	54	54	54	52	54	54	54	54	54	53	53	54	54	53	54	53	54	53	54	54	53	49	46	47	45	47	43	48	45	43	43	35	32	28	19
	7:00 AM	52	54	54	54	54	54	54	54	53	53	48	54	54	54	54	53	53	52	54	53	53	53	54	52	52	54	54	53	54	53	54	53	54	54	51	46	43	44	40	46	43	48	36	27	28	35	28	23	16
	8:00 AM	52	54	54	54	54	54	54	54	53	53	49	54	54	54	54	54	53	52	54	54	54	53	54	52	52	54	54	53	54	53	54	53	54	54	51	41	34	38	36	41	43	46	39	35	35	35	29	25	19
	9:00 AM	52	54	54	54	54	54	54	54	54	54	50	54	54	54	54	54	54	52	54	54	54	53	54	52	52	54	54	52	54	53	54	53	54	54	52	42	39	43	40	46	45	47	42	42	43	35	30	26	18

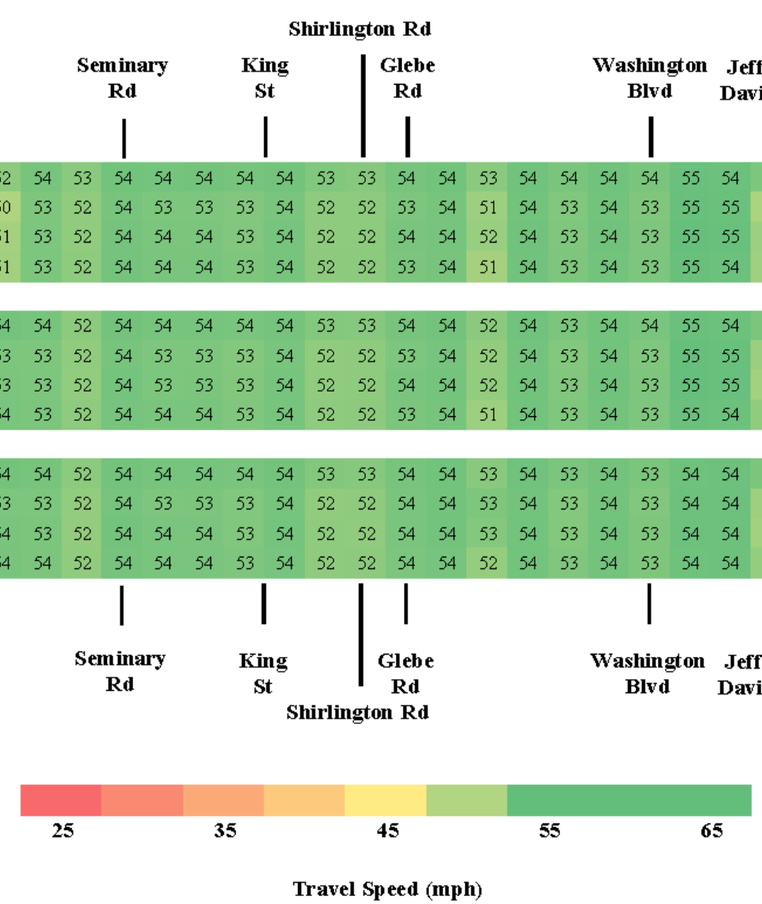


Figure 7-43: Freeway Speed Comparison – HOV/HOT Lanes
2020 No Build and Build – AM Peak Period

Northbound HOV/HOT Lanes

		Turkeycock Run				Seminary Rd			Shirlington Rd			Washington Blvd				Eads St				14th St	
Existing	6:00 AM	67	60	66	67	65	67	67	67	64	66	62	62	63	57	57	39	54	45	49	40	28	36
	7:00 AM	67	59	65	66	65	66	66	66	62	66	60	62	62	57	57	37	53	32	17	12	16	31
	8:00 AM	67	60	66	67	65	67	67	67	62	66	57	62	63	49	49	31	47	9	9	9	14	31
	9:00 AM	67	63	67	67	59	67	67	67	61	66	54	62	61	46	46	30	23	11	10	8	11	31
2020 No Build	6:00 AM	67	62	66	67	65	67	66	66	64	66	62	62	63	56	56	35	54	47	44	24	21	35
	7:00 AM	66	60	66	66	65	66	64	66	61	66	57	62	62	43	43	28	52	25	13	10	15	31
	8:00 AM	67	57	66	67	65	67	66	67	62	66	56	62	62	33	33	26	47	10	9	9	14	31
	9:00 AM	67	64	67	67	62	67	66	67	61	63	51	56	53	39	39	25	47	21	11	6	10	32
2020 Build	6:00 AM	66	63	66	66	65	66	66	66	62	66	55	61	58	62	54	47	53	48	51	44	33	36
	7:00 AM	66	61	66	66	66	66	66	66	62	66	52	61	55	62	54	44	39	26	30	17	16	31
	8:00 AM	66	62	67	67	66	67	66	66	63	66	54	62	59	62	54	45	41	29	32	21	18	31
	9:00 AM	67	65	67	67	66	67	67	67	63	67	57	63	62	63	55	46	54	47	51	44	39	32

Southbound HOV/HOT Lanes

		Eads St		Boundary Channel Dr			14th St	
Existing	6:00 AM	56	60	57	59	39	53	51
	7:00 AM	57	60	58	59	36	51	50
	8:00 AM	58	60	58	59	37	51	50
	9:00 AM	57	60	58	59	36	52	51
2020 No Build	6:00 AM	56	60	57	59	39	53	51
	7:00 AM	57	60	58	59	37	51	50
	8:00 AM	58	60	58	59	35	49	50
	9:00 AM	56	60	52	55	37	52	51
2020 Build	6:00 AM		59	59	34	52	51	
	7:00 AM		60	59	30	47	50	
	8:00 AM		60	59	26	38	50	
	9:00 AM		60	59	29	49	51	

25 35 45 55 65

Travel Speed (mph)

HOV/HOT Lane Queues: Queues along freeway off-ramps from the I-395 HOV/HOT lanes during the AM peak period were compared between No Build and Build conditions to identify locations where there would be queue spillback onto the freeway lanes. **Table 7-15a** summarizes average and maximum queue lengths and available storage lengths for the northbound and southbound I-395 HOV/HOT lanes for each of the four analysis hours from 6 AM through 10 AM. The following is a summary of the two locations where either average or maximum queues exceed available storage under No Build or Build conditions:

- **Northbound I-395 HOV/HOT to Eads Street:** Under No Build conditions, northbound maximum queue lengths on the off-ramp from the I-395 HOV lanes to Eads Street exceed available storage during all four analysis hours and average queue lengths exceed available storage between 8 AM and 10 AM. Under Build conditions with the improvements to the Eads Street Interchange (see **Section 7.2.4**), the two existing lanes (one left-turn lane and one right-turn lane) on the I-395 HOV ramp approaching Eads Street would be modified to provide two ramps including four lanes (two left-turn lanes and two right-turn lanes) doubling the turning capacity approaching Eads Street and reducing the potential for queues extending to the northbound I-395 HOT lanes. The maximum queue lengths on the northbound I-395 HOV ramp to Eads Street would reduce from 3,630 feet under No Build conditions during the four hour analysis period on the single ramp to a maximum of 540 feet on the ramp to northbound Eads Street (Pentagon traffic) and a maximum of 280 feet on the ramp to southbound Eads Street (to Army Navy Drive) and not exceed the ramp storage lengths under Build conditions.

- **Southbound I-395 HOV to Southbound General Purpose at Boundary Channel Drive:** Under Build conditions, motorists would be required to exit the HOV lanes in the vicinity of the Boundary Channel Drive Interchange or at the Eads Street Interchange due to the removal of the ramp from the southbound HOV lanes to the southbound general purpose lanes south of Eads Street. Southbound queues on the ramp from the I-395 HOV lanes to the general purpose lanes increase under Build condition and will extend beyond the storage area due to the removal of the downstream ramp and due to congestion in the general purpose lanes from 8 AM to 9 AM. Motorists exiting the southbound HOV lanes to the southbound general purpose lanes encounter a left-hand weave between the ramp from the HOV lanes and the ramp to southbound Route 1 which causes queues to extend into the southbound HOV lanes.

  To reduce the potential for queues under Build conditions, modifying the lane configuration along the southbound I-395 general purpose lanes to provide a choice lane for motorists destined for southbound Route 1 is proposed as part of the Build conditions. This will result in two off-ramp lanes to southbound Route 1 (one exclusive lane and one choice lane) and reduce weaving along the southbound I-395 general purpose lanes. Motorists traveling from the southbound general purpose lanes to southbound Route 1 will only be required to make one lane change compared to two lane changes under No Build conditions. The conceptual signing and marking plan shown in **Appendix H – Roll 8 and Figure 4-8** *(Volume 2)* depict the revised lane configuration along southbound I-395.

Table 7-15a depicts the queue lengths along the southbound I-395 HOV lanes under conditions with the proposed choice lane along the southbound I-395 general purpose lanes which indicate that the maximum queue length (393 feet) does not exceed the available storage (700 feet). Additionally, based on a review of travel speeds along both the southbound I-395 HOV and general purpose lanes, the proposed choice lane will increase average travel speeds. Along the southbound HOV lanes approaching the off ramp to the general purpose lanes, average travel speeds will increase from 38 MPH to 44 MPH from 8 AM to 9 AM when projected queues are greatest. Average travel speeds in the weave along the southbound I-395 general purpose lanes will increase from 35 MPH to 44 MPH.

Table 7-15a: AM Peak Period I-395 HOV/HOT Ramp Queues (2020 No Build and Build)

HOV/HOT Lane Ramp Location	Available Storage (feet)	2020 No Build		2020 Build		2020 No Build		2020 Build		2020 No Build		2020 Build		2020 No Build		2020 Build	
		Avg. (feet)	Max. (feet)	Avg. (feet)	Max. (feet)	Avg. (feet)	Max. (feet)	Avg. (feet)	Max. (feet)	Avg. (feet)	Max. (feet)	Avg. (feet)	Max. (feet)	Avg. (feet)	Max. (feet)	Avg. (feet)	Max. (feet)
		6 - 7 AM				7 - 8 AM				8 - 9 AM				9 - 10 AM			
NB to NB GP at Turkeycock Run	2,780	4	301	0	0	198	1,462	0	0	548	2,262	0	0	13	285	0	0
NB to Seminary Rd	2,750	5	48	4	47	9	62	9	62	8	53	8	54	5	53	6	49
NB to Washington Blvd	1,580	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SB to SB GP (south of Eads St)	410	0	0	-	-	0	0	-	-	0	0	-	-	0	0	-	-
NB to Eads St (to Army Navy Dr) [1]	1,000	134	1,389	18	216	828	2,508	27	240	1,586	3,083	26	265	1,413	3,574	23	280
NB to Eads St (to Pentagon) [2]	1,000 No Build 2,000 Build	151	1,453	39	345	878	2,572	57	405	1,647	3,148	45	337	1,449	3,632	103	541
SB to Eads St	1,260	6	113	26	147	7	111	20	139	26	205	13	99	114	475	6	68
SB to SB GP at Boundary Channel Dr	700	0	0	0	8	0	0	2	235	23	697	239	1,453	147	760	4	375
SB to SB GP at Boundary Channel Dr (with improvements)	700	-	-	0	7	-	-	2	295	-	-	1	255	-	-	4	393
NB to 14th St SW	1,350	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NB to NB GP into D.C.	2,400	91	740	0	7	715	859	0	11	951	1,017	0	108	989	1,179	0	83

[1] Storage and queue values for the right turn from the Eads Street ramp to Army Navy Drive

[2] Storage and queue values for the left turn from the Eads Street ramp to the Pentagon

Highlighted cells indicate locations where average or maximum queue lengths exceed available storage

7.2.2.2 PM Peak Period

Figures 7-44 and **7-45** summarize 2020 No Build and Build traffic operations based on the freeway segment density measured in vehicles per mile per lane for the northbound and southbound I-395 general purpose and HOV/HOT lanes for each of the four analysis hours from 3 PM through 7 PM. In the 2020 No Build scenario, there are a total of 118 segments including 52 freeway segments, 21 weave segments, and 45 merge/diverge junctions, with minor differences in the segmentation in the Build scenario due to modifications in the vicinity of the Eads Street Interchange.

Figures 7-46 (*Volume 2*) **and 7-47** (*Volume 2*) **and Table 7-16** depict 2020 No Build travel speeds (MPH) and densities (vehicles per mile per lane) along the southbound and northbound I-395 general purpose and HOV/HOT lanes for each of the four analysis hours during the PM peak period. **Figures 7-48** (*Volume 2*) **and 7-49** (*Volume 2*) **and Table 7-17** depict 2020 Build travel speeds and densities. **Appendix J** contains a summary of throughput volumes, travel speeds, and densities by lane for both 2020 No Build and Build Conditions.

As shown in **Figure 7-44,** under 2020 No Build conditions in the PM peak period, 43 percent of the 42 southbound I-395 general purpose segments operate with severe congestion and 11 percent operate with heavy congestion. The remaining 46 percent operate with light or moderate traffic conditions. Seven percent of the 20 southbound I-395 HOV/HOT segments operate with severe congestion or heavy congestion. The remaining 93 percent operate with light or moderate traffic conditions.

Under 2020 Build conditions in the PM peak period, the number of southbound general purpose segments that operate with severe congestion is reduced from 43 percent to 31 percent with 11 percent of the segments operating with heavy congestion. The number of segments operating with light or moderate traffic conditions increases from 46 percent to 58 percent. The number of segments along the southbound I-395 HOV/HOT lanes that operate with heavy congestion is approximately the same as No Build conditions. The number of segments along the southbound I-395 HOV/HOT lanes that operate with light traffic conditions increases from 80 percent to 85 percent due to the reduction in congestion at the Turkeycock Run ramps and the reduction in congestion during the 6 PM to 7 PM hour when there are no HOV restrictions under 2020 No Build conditions.

As shown in **Figure 7-45**, under 2020 No Build conditions in the PM peak period, 34 percent of the 51 northbound I-395 general purpose segments operate with severe or heavy congestion and 66 percent operate with light or moderate traffic conditions. Thirty percent of the five northbound I-395 HOV/HOT segments operate with severe or heavy congestion. Under 2020 Build conditions in the PM peak period, there are minor changes in the operations along the northbound general purpose lanes. The number of northbound I-395 HOV/HOT segments that operate with severe traffic conditions decreases from 25 percent to 15 percent and the number of northbound I-395 HOV/HOT segments that operate with light or moderate traffic conditions increases from 70 percent to 80 percent.

Figure 7-44: PM Peak Period Freeway Density Summary (2020 No Build and Build Conditions) Southbound I-395

Figure 7-45: PM Peak Period Freeway Density Summary (2020 No Build and Build Conditions) Northbound I-395

Freeway Segments: Under 2020 No Build conditions in the PM peak period, there are a total of 17 freeway segments in the southbound I-395 general purpose lanes. Of these segments, 41 percent operate with severe congestion, 12 percent operate with heavy congestion, 38 percent operate with moderate traffic conditions, and the remaining 9 percent operate with light traffic conditions. There are a total of ten freeway segments in the southbound I-395 HOV/HOT lanes. Of these segments, 10 percent operate with severe or heavy congestion and 90 percent operate with light or moderate traffic conditions.

Under 2020 Build conditions in the PM peak period, the number of freeway segments along the southbound I-395 general purpose lanes that operate with severe congestion is reduced from 41 percent to 29 percent with 12 percent of the segments operating with heavy congestion. The number of segments operating with

light or moderate traffic conditions increases from 47 percent to 59 percent. The number of freeway segments along the southbound I-395 HOV/HOT lanes that operate with severe or heavy congestion is reduced from ten percent to 9 percent.

Ramp Junctions: Under 2020 No Build conditions in the PM peak period, there are a total of 18 ramp junctions in the southbound I-395 general purpose lanes. Of these segments, 46 percent operate with severe congestion, 11 percent operate with heavy congestion, and the remaining 43 percent operate with light or moderate traffic conditions. There are a total of nine ramp junctions in the southbound I-395 HOV/HOT lanes. Of these segments, 6 percent operate with heavy congestion and 94 percent operate with light or moderate traffic conditions.

Under 2020 Build conditions in the PM peak period, the number of ramp junctions along the southbound I-395 general purpose lanes that operate with severe congestion is reduced from 46 percent to 32 percent with 11 percent of the segments operating with heavy congestion. The number of segments operating with light or moderate traffic conditions increases from 43 percent to 57 percent. The number of ramp junctions along the southbound I-395 HOV/HOT lanes that operate with severe or heavy congestion increases from 6 percent to 8 percent due to a higher utilization of the HOV lanes in the northern portion of the corridor prior to the beginning of the tolled portion of the southbound lanes in addition to removal of the ramp south of Eads Street. The number of ramp junctions along the southbound I-395 HOV/HOT lanes that operate with light traffic conditions increases from 83 percent to 88 percent.

Weave Segments: Under 2020 No Build conditions in the PM peak period, there are a total of seven weave segments in the southbound I-395 general purpose lanes. Of these segments, 39 percent operate with severe congestion, 7 percent operate with heavy congestion, and the remaining 54 percent operate with light or moderate traffic conditions.

Under 2020 Build conditions in the PM peak period, the number of weave segments along the southbound I-395 general purpose lanes that operate with severe congestion is reduced from 39 percent to 32 percent. The number of segments operating with light or moderate traffic conditions increases from 54 percent to 61 percent.

Figures 7-50 through 7-52 depict 2020 No Build and Build speed profiles from the VISSIM model for the northbound and southbound I-395 general purpose and HOV/HOT lanes for each of the four analysis hours during the PM peak period. The following is a summary of the travel speeds when comparing existing, 2020 No Build, and 2020 Build conditions in the peak travel direction.

PM Peak Period – Southbound General Purpose Lanes (Peak Direction): 2020 No Build corridor travel speeds along the southbound I-395 general purpose lanes range from 20 to 41 MPH with average travel speeds of 27 MPH. Under 2020 No Build conditions, travel speeds along the southbound I-395 general purpose lanes increase by 4 to 11 MPH compared to existing conditions in the PM peak period with an average increase of 7 MPH. This can be attributed to the I-395 4th Lane Southbound – Duke Street to Edsall Road widening project which is included in the No Build conditions. Travel speeds increase south of Glebe Road to approximately Turkeycock Run with the largest speed increases observed south of Seminary Road to Turkeycock Run, immediately approaching and within the I-395 4th Lane Southbound project limits. Travel speeds from the northern study limits to George Washington Memorial Parkway decrease compared to existing conditions due to higher traffic demands in this portion of the study area.

Under 2020 Build conditions, travel speeds along the southbound I-395 general purpose lanes range from 22 to 44 MPH with an average travel speed of 32 MPH. Overall travel speeds increase by 3 MPH to 9 MPH with an average travel speed increase of 5 MPH over the four hour PM peak period. The highest travel speed increases occur from 6 PM to 7 PM with a travel speed increase of 9 MPH. Travel speed increases are greatest along the southbound I-395 general purpose lanes from north of the Washington Boulevard Interchange to south of Seminary Road where there is a higher utilization of the HOT lanes compared to No Build conditions.

PM Peak Period – Southbound HOV/HOT Lanes (Peak Direction)

2020 No Build corridor travel speeds along the southbound I-395 HOV/HOT lanes are approximately 59 MPH to 60 MPH. Travel speeds in the southbound I-395 HOV/HOT lanes are approximately two times greater than travel speeds in the southbound I-395 general purpose lanes from 4 PM to 7 PM. Southbound I-395 HOV lane travel speeds generally range from 35 to 50 MPH north of Washington Boulevard. Travel speeds approaching the Turkeycock Run Interchange decrease to 35 to 50 MPH from 3 PM to 7 PM due to motorists exiting the HOV lanes and encountering congestion in the southbound I-395 general purpose lanes impacting corridor overall travel speeds.

Under 2020 Build conditions, travel speeds along the southbound I-395 HOV/HOT lanes are approximately 60 MPH to 62 MPH. Overall travel speeds increase by 2 MPH compared to 2020 No Build conditions. Travel speeds increase on the approach to the Turkeycock Run Interchange as non-HOV motorists would no longer be required to exit the southbound I-395 HOT lanes to the heavily congested I-395 southbound general purpose lanes. Travel speeds from 4 PM to 5 PM decrease by 3 MPH to 8 MPH north of the Boundary Channel Drive Interchange due to motorists exiting the HOV lanes to the general purpose lanes. This is caused by the downstream removal of the ramp from the HOV lanes to the general purpose lanes south of Eads Street.

Table 7-16: PM Peak Period Freeway Speed and Density by Segment (2020 No Build)

2020 No Build Conditions									
Location	Type	Average Speed (mph)				Average Density (veh/mi/ln)			
		3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM
I-395 Northbound General Purpose Lanes									
I-395 NB south of Edsall Rd ramps	Diverge	49	45	44	49	27	36	40	29
I-395 NB between Edsall Rd off-ramps	Freeway	52	51	50	52	31	40	43	34
I-395 NB at Edsall Rd WB off-ramp	Diverge	47	45	45	47	26	35	36	28
I-395 NB between Edsall Rd off-ramp and on-ramp	Freeway	57	57	56	57	24	32	35	28
I-395 NB between Edsall Rd and Turkeycock Run	Weave	57	57	56	57	21	27	29	24
I-395 NB between Turkeycock Run ramps	Freeway	57	57	56	57	28	35	39	32
I-395 NB between Turkeycock Run and Duke St	Weave	58	57	57	58	21	26	29	24
I-395 NB at Duke St EB off-ramp	Diverge	57	57	57	57	21	26	29	24
I-395 NB between Duke St off-ramps	Diverge	58	58	58	58	18	23	25	21
I-395 NB between Duke St off-ramp and on-ramp	Freeway	58	57	57	58	22	28	32	26
I-395 NB between Duke St and Seminary Rd	Weave	58	57	57	57	21	26	29	24
I-395 NB between Seminary Rd ramps	Freeway	58	57	56	57	23	30	34	27
I-395 NB at Seminary Rd on-ramp	Merge	53	51	51	53	19	24	27	21
I-395 NB between Seminary Rd and King St	Weave	58	57	57	57	21	26	30	24
I-395 NB between King St off-ramp and on-ramp	Freeway	57	56	55	57	25	31	35	27
I-395 NB at King St EB on-ramp	Merge	55	53	50	53	22	28	32	25
I-395 NB between King St on-ramps	Freeway	57	55	54	56	29	35	39	32
I-395 NB between King St and Shirlington Rd	Weave	57	56	56	56	22	26	29	24
I-395 NB between Shirlington Rd ramps	Freeway	58	58	58	58	20	24	25	21
I-395 NB between Shirlington Rd and Glebe Rd	Weave	51	45	51	52	22	32	27	22
I-395 NB between Glebe Rd EB off-ramp and on-ramp	Freeway	58	56	57	58	20	25	27	22
I-395 NB between Glebe Rd EB on-ramp and WB off-ramp	Weave	55	54	54	54	18	22	24	20
I-395 NB between Glebe Rd WB off-ramp and on-ramp	Freeway	57	57	57	57	20	23	26	21
I-395 NB at Glebe Rd WB on-ramp	Merge	58	58	58	58	16	19	20	17
I-395 NB north of Glebe Rd ramps	Freeway	58	58	57	58	20	24	26	22
I-395 NB at Washington Blvd WB off-ramp	Diverge	54	54	53	53	17	20	22	19
I-395 NB at Washington Blvd EB off-ramp	Diverge	58	58	57	58	16	19	22	17
I-395 NB between Washington Blvd EB off-ramp and Army Navy Dr off-ramp	Freeway	59	58	58	58	14	17	19	15
I-395 NB at Army Navy Dr off-ramp	Diverge	57	57	57	57	11	13	15	12
I-395 NB between Army Navy Dr off-ramp and Washington Blvd EB on-ramp	Freeway	59	58	50	53	12	14	20	14
I-395 NB at Washington Blvd EB on-ramp	Weave	54	53	27	28	14	17	44	36
I-395 NB at ramp to HOV lanes	Weave	52	47	22	23	14	19	53	44

2020 No Build Conditions									
Location	Type	Average Speed (mph)				Average Density (veh/mi/ln)			
		3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM
I-395 NB between ramp to HOV lanes and S Rotary Rd on-ramp	Freeway	54	53	12	14	14	15	79	62
I-395 NB at S Rotary Rd on-ramp	Merge	54	53	10	13	10	12	74	53
I-395 NB between S Rotary Rd on-ramp and Rte 1 SB on-ramp	Freeway	54	54	9	12	14	16	112	74
I-395 NB at Rte 1 SB on-ramp	Merge	52	51	8	12	15	17	120	79
I-395 NB between Rte 1 ramps	Freeway	53	52	9	14	19	22	125	83
I-395 NB at Rte 1 NB on-ramp	Merge	48	44	8	12	17	21	116	77
I-395 NB between Rte 1 and Boundary Channel Dr	Freeway	54	36	9	12	19	33	137	95
I-395 NB between Boundary Channel Dr ramps	Weave	50	28	9	14	18	39	112	79
I-395 NB at lane reduction north of Boundary Channel Dr	Merge	52	28	10	14	19	46	122	91
I-395 NB south of GW Memorial Pkwy	Freeway	53	23	11	14	25	68	148	116
I-395 NB between GW Memorial Pkwy EB on-ramp and WB off-ramp	Weave	41	19	10	13	38	88	148	121
I-395 NB between GW Memorial Pkwy WB off-ramp and WB on-ramp	Freeway	44	19	11	14	33	83	142	115
I-395 NB between GW Memorial Pkwy and 14th St	Weave	42	22	16	18	34	70	98	85
I-395 NB at 14th St off-ramp	Diverge	43	23	20	21	33	72	92	82
I-395 NB between 14th St off-ramp and off-ramp to Buckeye Dr	Freeway	42	17	14	17	37	93	115	103
I-395 NB between Buckeye Dr ramps	Freeway	37	21	18	23	42	79	90	75
I-395 NB at on-ramp from Buckeye Dr	Merge	36	23	21	26	39	63	70	59
I-395 NB between HOV merge and 12th St Expy off-ramp	Weave	31	23	21	24	49	71	76	68
I-395 NB north of 12th St Expy off-ramp	Freeway	23	23	23	23	75	77	78	79
I-395 Southbound General Purpose Lanes									
I-395 SB north of 9th St Expy on-ramp	Freeway	25	21	19	18	63	84	100	107
I-395 SB on Francis Case Memorial Bridge	Weave	22	19	16	16	69	79	101	101
I-395 SB between HOV diverge and off-ramp to Ohio Dr	Diverge	28	25	18	20	67	75	91	90
I-395 SB between 14th St on-ramp and HOV diverge	Freeway	32	27	13	15	63	70	123	113
I-395 SB on 14th St Bridge	Merge	33	31	14	21	54	59	114	88
I-395 SB at GW Memorial Pkwy WB off-ramp	Diverge	40	37	19	27	33	39	85	63
I-395 SB between GW Memorial Pkwy EB off-ramp and WB off-ramp	Diverge	37	37	28	33	38	43	56	46
I-395 SB between GW Memorial Pkwy EB on-ramp and EB off-ramp	Freeway	40	42	38	43	34	34	28	24
I-395 SB between Boundary Channel Dr and GW Memorial Pkwy	Weave	38	40	36	41	26	25	23	19
I-395 SB between ramp from HOV lanes and Boundary Channel Dr WB off-ramp	Merge	38	40	37	40	32	31	28	24

2020 No Build Conditions									
Location	Type	Average Speed (mph)				Average Density (veh/mi/ln)			
		3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM
I-395 SB between Boundary Channel Dr EB off-ramp and ramp from HOV lanes	Weave	38	38	36	37	31	36	29	27
I-395 SB between Rte 1 SB off-ramp and Boundary Channel Dr EB off-ramp	Freeway	40	40	38	41	37	42	32	30
I-395 SB between Boundary Channel Dr EB on-ramp and Rte 1 SB off-ramp	Diverge	40	39	39	42	29	35	26	24
I-395 SB between Rte 1 NB off-ramp and SB off-ramp	Weave	48	45	41	49	20	26	24	16
I-395 SB between S Rotary Rd off-ramp and Rte 1 NB off-ramp	Diverge	52	46	41	53	20	30	24	16
I-395 SB between ramp from HOV lanes and S Rotary Rd off-ramp	Freeway	54	26	28	54	16	49	31	13
I-395 SB between Army Navy Dr on-ramp and ramp from HOV lanes	Merge	54	13	23	54	13	63	33	12
I-395 SB at Army Navy Dr on-ramp	Merge	53	12	20	53	16	78	40	15
I-395 SB between Washington Blvd WB on-ramp and Army Navy Dr on-ramp	Freeway	53	14	19	45	22	105	57	26
I-395 SB at Washington Blvd WB on-ramp	Merge	48	13	16	28	23	104	82	46
I-395 SB between Washington Blvd EB on-ramp and WB on-ramp	Freeway	48	16	17	29	29	100	94	51
I-395 SB at Washington Blvd EB on-ramp	Merge	47	15	16	27	29	94	91	52
I-395 SB north of Glebe Rd ramps	Diverge	49	17	19	29	34	96	93	59
I-395 SB between Shirlington Rd and Glebe Rd	Freeway	51	15	16	24	35	111	106	70
I-395 SB between Shirlington Rd on-ramps	Merge	45	15	17	26	36	109	99	64
I-395 SB between King St and Shirlington Rd	Weave	41	15	16	23	36	101	96	66
I-395 SB between King St WB on-ramp and off-ramp	Freeway	38	13	14	20	42	119	115	78
I-395 SB at King St WB on-ramp	Merge	35	14	14	19	38	96	93	71
I-395 SB between King St EB on-ramp and WB on-ramp	Freeway	35	15	16	21	47	108	105	80
I-395 SB between Seminary Rd and King St	Weave	28	14	14	18	51	102	99	78
I-395 SB between Seminary Rd ramps	Freeway	30	16	16	19	51	96	94	81
I-395 SB at Seminary Rd on-ramp	Merge	20	16	16	17	74	94	92	84
I-395 SB between Little River Tnpk and Seminary Rd	Freeway	46	46	46	45	39	39	39	39
I-395 SB at Little River Tnpk off-ramp	Diverge	44	50	50	43	38	33	34	39
I-395 SB between Little River Tnpk ramps	Freeway	51	51	51	51	29	29	29	28
I-395 SB at Little River Tnpk WB on-ramp	Freeway	49	50	50	50	27	27	27	26
I-395 SB between Turkeycock Run and Little River Tnpk	Freeway	51	51	51	51	31	32	32	31
I-395 SB at Turkeycock Run off-ramp	Diverge	49	49	48	48	27	33	32	32
I-395 SB between Turkeycock Run ramps	Freeway	53	53	53	53	28	28	27	26
I-395 SB between Edsall Rd and Turkeycock Run	Weave	52	53	53	53	28	26	25	27
I-395 SB between Edsall Rd EB on-ramp and off-ramp	Freeway	52	53	53	53	32	29	27	30

2020 No Build Conditions									
Location	Type	Average Speed (mph)				Average Density (veh/mi/ln)			
		3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM
I-395 SB south of Edsall Rd ramps	Merge	52	52	52	52	32	30	28	29
I-395 Northbound HOV/HOT Lanes									
I-395 HOV NB at Eads St on-ramp	Merge	28	28	28	28	8	10	10	8
I-395 HOV NB between Eads St on-ramp and on-ramp from GP lanes	Freeway	43	43	43	43	8	10	10	8
I-395 HOV NB at on-ramp from GP lanes	Merge	44	42	36	44	14	18	22	14
I-395 HOV NB between on-ramp from GP lanes and 14th St	Freeway	43	22	20	41	21	54	61	23
I-395 HOV NB north of 14th St	Freeway	28	21	21	26	43	70	72	47
I-395 Southbound HOV/HOT Lanes									
I-395 HOV SB north of 14th St	Freeway	36	36	36	36	43	49	39	49
I-395 HOV SB between off-ramp to GP lanes and 14th St	Merge	41	40	40	40	34	42	30	35
I-395 HOV SB at off-ramp to GP lanes	Diverge	42	41	41	42	21	27	20	23
I-395 HOV SB between Eads St off-ramp and off-ramp to GP lanes	Freeway	44	44	44	44	18	18	15	20
I-395 HOV SB at Eads St off-ramp	Diverge	44	44	44	44	12	12	10	14
I-395 HOV SB between Eads St ramps	Freeway	44	44	44	44	18	16	12	18
I-395 HOV SB between Eads St on-ramp and ramp to GP lanes	Weave	50	50	51	51	14	15	13	15
I-395 HOV SB between ramp to GP lanes and Washington Blvd on-ramp	Freeway	48	48	48	48	19	22	20	18
I-395 HOV SB at Washington Blvd on-ramp	Merge	52	54	52	50	18	17	18	21
I-395 HOV SB between Washington Blvd on-ramp and Shirlington Rd off-ramp	Freeway	57	58	57	57	24	24	24	27
I-395 HOV SB at Shirlington Rd off-ramp	Diverge	47	48	45	47	19	19	21	22
I-395 HOV SB between Shirlington Rd off-ramp and Seminary Rd off-ramp	Freeway	62	62	62	62	21	21	21	23
I-395 HOV SB at Seminary Rd off-ramp	Diverge	56	58	55	51	16	15	16	19
I-395 HOV SB between Seminary Rd ramps	Freeway	62	62	62	62	20	19	19	20
I-395 HOV SB at Seminary Rd on-ramp	Merge	58	59	60	59	15	14	14	16
I-395 HOV SB between Seminary Rd on-ramp and Turkeycock Run off-ramp	Freeway	47	51	54	48	28	24	23	28
I-395 HOV SB at Turkeycock Run off-ramp	Diverge	36	46	48	36	25	18	17	26
I-395 HOV SB between Turkeycock Run ramps	Freeway	61	61	62	61	12	34	34	28
I-395 HOT SB at Turkeycock Run on-ramp	Merge	61	61	60	60	12	15	16	14
I-395 HOT SB south of Turkeycock Run ramps	Freeway	64	64	64	64	11	14	15	13

Table 7-17: PM Peak Period Freeway Speed and Density by Segment (2020 Build)

2020 Build Conditions									
Location	Type	Average Speed (mph)				Average Density (veh/mi/ln)			
		3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM
I-395 Northbound General Purpose Lanes									
I-395 NB south of Edsall Rd ramps	Diverge	49	44	41	49	27	39	43	29
I-395 NB between Edsall Rd off-ramps	Freeway	52	50	50	52	31	42	44	34
I-395 NB at Edsall Rd WB off-ramp	Diverge	47	43	44	48	26	37	38	28
I-395 NB between Edsall Rd off-ramp and on-ramp	Freeway	57	56	56	57	25	33	36	28
I-395 NB between Edsall Rd and Turkeycock Run	Weave	57	57	56	57	21	27	30	24
I-395 NB between Turkeycock Run ramps	Freeway	57	57	56	57	28	36	40	32
I-395 NB north of Turkeycock Run ramps	Weave	58	57	57	58	21	27	30	24
I-395 NB at Duke St EB off-ramp	Diverge	57	57	57	57	21	27	29	24
I-395 NB between Duke St off-ramps	Diverge	58	58	58	58	19	24	26	21
I-395 NB between Duke St off-ramp and on-ramp	Freeway	58	57	57	57	22	29	32	26
I-395 NB between Duke St and Seminary Rd	Weave	58	57	57	56	21	26	29	25
I-395 NB between Seminary Rd ramps	Freeway	58	57	56	57	23	30	34	27
I-395 NB at Seminary Rd on-ramp	Merge	53	52	50	53	19	24	28	21
I-395 NB between Seminary Rd and King St	Weave	58	57	56	58	22	27	30	24
I-395 NB between King St off-ramp and on-ramp	Freeway	57	56	55	57	25	32	36	27
I-395 NB at King St EB on-ramp	Merge	55	53	49	53	23	28	34	25
I-395 NB between King St on-ramps	Freeway	57	55	54	56	29	36	40	32
I-395 NB between King St and Shirlington Rd	Weave	56	56	56	56	22	26	29	24
I-395 NB between Shirlington Rd ramps	Freeway	58	58	58	58	20	24	26	21
I-395 NB between Shirlington Rd and Glebe Rd	Weave	53	52	52	52	21	25	27	23
I-395 NB between Glebe Rd EB off-ramp and on-ramp	Freeway	58	57	57	58	20	25	27	22
I-395 NB between Glebe Rd EB on-ramp and WB off-ramp	Weave	55	54	53	53	18	22	25	21
I-395 NB between Glebe Rd WB off-ramp and on-ramp	Freeway	58	57	57	57	20	24	26	21
I-395 NB at Glebe Rd WB on-ramp	Merge	58	58	58	58	16	19	21	17
I-395 NB north of Glebe Rd ramps	Freeway	58	58	57	58	20	24	26	22
I-395 NB at Washington Blvd WB off-ramp	Diverge	54	53	53	54	17	21	23	19
I-395 NB at Washington Blvd EB off-ramp	Diverge	58	57	57	58	17	20	22	17
I-395 NB between Washington Blvd EB off-ramp and Army Navy Dr off-ramp	Freeway	59	58	58	58	14	18	20	15
I-395 NB at Army Navy Dr off-ramp	Diverge	57	57	57	57	11	13	15	12
I-395 NB between Army Navy Dr off-ramp and Washington Blvd EB on-ramp	Freeway	59	59	49	52	12	15	20	14
I-395 NB at Washington Blvd EB on-ramp	Weave	54	53	23	22	14	17	51	46
I-395 NB at ramp to HOT lanes	Weave	52	48	20	21	14	19	59	50
I-395 NB between ramp to HOT lanes and S Rotary Rd on-ramp	Freeway	53	53	12	13	14	16	83	67

2020 Build Conditions									
Location	Type	Average Speed (mph)				Average Density (veh/mi/ln)			
		3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM
I-395 NB at S Rotary Rd on-ramp	Merge	54	53	10	12	11	13	74	56
I-395 NB between S Rotary Rd on-ramp and Rte 1 SB on-ramp	Freeway	54	54	9	12	15	17	109	77
I-395 NB at Rte 1 SB on-ramp	Merge	52	49	9	12	15	18	112	76
I-395 NB between Rte 1 ramps	Freeway	53	48	9	15	20	25	122	77
I-395 NB at Rte 1 NB on-ramp	Merge	48	38	8	12	17	27	115	71
I-395 NB between Rte 1 and Boundary Channel Dr	Freeway	53	34	9	13	19	37	135	86
I-395 NB between Boundary Channel Dr ramps	Weave	50	24	10	14	19	44	111	71
I-395 NB at lane reduction north of Boundary Channel Dr	Merge	52	24	11	16	19	54	121	80
I-395 NB south of GW Memorial Pkwy	Freeway	53	21	11	16	25	74	147	100
I-395 NB between GW Memorial Pkwy EB on-ramp and WB off-ramp	Weave	41	18	11	15	40	93	147	106
I-395 NB between GW Memorial Pkwy WB off-ramp and WB on-ramp	Freeway	44	19	12	17	35	88	140	99
I-395 NB between GW Memorial Pkwy and 14th St	Weave	42	22	16	21	35	72	96	75
I-395 NB at 14th St off-ramp	Diverge	43	23	20	23	34	74	91	75
I-395 NB between 14th St off-ramp and off-ramp to Buckeye Dr	Freeway	42	17	15	18	37	94	113	94
I-395 NB between Buckeye Dr ramps	Freeway	38	21	19	24	41	79	86	70
I-395 NB at on-ramp from Buckeye Dr	Merge	37	23	22	27	37	63	67	55
I-395 NB between HOT merge and 12th St Expy off-ramp	Weave	31	23	22	25	48	70	74	65
I-395 NB north of 12th St Expy off-ramp	Freeway	23	23	23	23	75	78	79	78
I-395 Southbound General Purpose Lanes									
I-395 SB north of 9th St Expy on-ramp	Freeway	23	21	19	20	70	83	102	104
I-395 SB on Francis Case Memorial Bridge	Weave	22	19	16	18	71	81	101	95
I-395 SB between HOT diverge and off-ramp to Ohio Dr	Diverge	28	25	18	22	67	76	88	84
I-395 SB between 14th St on-ramp and HOV diverge	Freeway	34	29	14	18	59	64	118	103
I-395 SB on 14th St Bridge	Merge	36	33	15	27	47	56	114	72
I-395 SB at GW Memorial Pkwy WB off-ramp	Diverge	41	38	21	34	32	38	85	47
I-395 SB between GW Memorial Pkwy EB off-ramp and WB off-ramp	Diverge	40	38	30	38	34	41	53	39
I-395 SB between GW Memorial Pkwy EB on-ramp and EB off-ramp	Freeway	41	42	41	42	34	35	26	29
I-395 SB between Boundary Channel Dr and GW Memorial Pkwy	Weave	40	41	37	40	24	25	22	22
I-395 SB between ramp from HOT lanes and Boundary Channel Dr WB off-ramp	Merge	39	41	38	38	30	30	28	29
I-395 SB between Boundary Channel Dr EB off-ramp and ramp from HOV lanes	Weave	39	40	37	35	28	32	29	34

2020 Build Conditions									
Location	Type	Average Speed (mph)				Average Density (veh/mi/ln)			
		3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM
I-395 SB between Rte 1 SB off-ramp and Boundary Channel Dr EB off-ramp	Freeway	41	41	39	40	33	38	32	36
I-395 SB between Boundary Channel Dr EB on-ramp and Rte 1 SB off-ramp	Diverge	41	41	40	41	27	31	25	27
I-395 SB between Rte 1 NB off-ramp and SB off-ramp	Weave	48	48	43	48	18	22	21	19
I-395 SB between S Rotary Rd off-ramp and Rte 1 NB off-ramp	Diverge	51	51	47	52	18	22	20	19
I-395 SB south of S Rotary Rd off-ramp	Freeway	54	54	54	54	13	17	10	14
I-395 SB north of Army Navy Dr on-ramp	Freeway	54	54	54	54	13	17	10	14
I-395 SB at Army Navy Dr on-ramp	Merge	53	53	51	53	13	15	10	13
I-395 SB between Washington Blvd WB on-ramp and Army Navy Dr on-ramp	Freeway	54	43	41	53	17	26	20	17
I-395 SB at Washington Blvd WB on-ramp	Merge	51	32	28	51	19	39	42	19
I-395 SB between Washington Blvd EB on-ramp and WB on-ramp	Freeway	52	31	24	52	23	48	57	24
I-395 SB at Washington Blvd EB on-ramp	Merge	51	29	22	51	24	51	60	23
I-395 SB north of Glebe Rd ramps	Diverge	52	29	23	51	29	60	69	29
I-395 SB between Shirlington Rd and Glebe Rd	Freeway	52	23	18	47	32	77	92	32
I-395 SB between Shirlington Rd on-ramps	Merge	51	18	16	41	31	91	103	37
I-395 SB between King St and Shirlington Rd	Weave	50	17	16	38	29	89	95	37
I-395 SB between King St WB on-ramp and off-ramp	Freeway	50	14	13	34	31	115	115	44
I-395 SB at King St WB on-ramp	Merge	45	13	14	30	29	96	95	42
I-395 SB between King St EB on-ramp and WB on-ramp	Freeway	42	14	15	30	39	110	108	51
I-395 SB between Seminary Rd and King St	Weave	33	14	14	26	44	102	100	51
I-395 SB between Seminary Rd ramps	Freeway	33	16	16	27	45	95	94	52
I-395 SB at Seminary Rd on-ramp	Merge	25	16	16	23	58	92	91	59
I-395 SB between Little River Tnpk and Seminary Rd	Freeway	47	46	46	48	37	39	39	35
I-395 SB at Little River Tnpk off-ramp	Diverge	45	50	49	47	37	34	34	34
I-395 SB between Little River Tnpk ramps	Freeway	51	51	51	51	28	29	29	27
I-395 SB at Little River Tnpk WB on-ramp	Merge	49	50	50	50	26	27	27	25
I-395 SB between Turkeycock Run and Little River Tnpk	Freeway	51	51	51	51	30	32	32	30
I-395 SB at Turkeycock Run off-ramp	Diverge	49	49	48	48	26	28	28	26
I-395 SB between Turkeycock Run ramps	Freeway	53	53	53	53	27	28	27	25
I-395 SB between Edsall Rd and Turkeycock Run	Weave	52	53	53	53	29	29	26	26
I-395 SB between Edsall Rd EB on-ramp and off-ramp	Freeway	52	52	53	53	34	33	29	29
I-395 SB south of Edsall Rd ramps	Merge	51	52	52	52	33	33	30	28
I-395 Northbound HOT Lanes									
I-395 HOT NB at Eads St on-ramp	Freeway	28	28	28	28	7	9	9	8

2020 Build Conditions									
Location	Type	Average Speed (mph)				Average Density (veh/mi/ln)			
		3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM
I-395 HOT NB between Eads St on-ramp and on-ramp from GP lanes	Freeway	43	43	43	43	7	9	9	8
I-395 HOT NB at on-ramp from GP lanes	Merge	44	44	44	44	12	16	16	13
I-395 HOT NB between on-ramp from GP lanes and 14th St	Freeway	43	32	36	41	19	34	31	22
I-395 HOT NB north of 14th St	Freeway	28	22	23	27	42	67	63	48
I-395 Southbound HOT Lanes									
I-395 HOT SB north of 14th St	Freeway	36	33	36	36	44	56	40	50
I-395 HOT SB between off-ramp to GP lanes and 14th St	Merge	38	32	40	39	39	58	30	39
I-395 HOT SB at off-ramp to GP lanes	Diverge	43	42	42	41	22	29	19	25
I-395 HOT SB between Eads St off-ramp and off-ramp to GP lanes	Freeway	44	44	44	44	24	27	16	22
I-395 HOT SB at Eads St off-ramp	Diverge	44	44	44	44	16	18	11	14
I-395 HOT SB between Eads St ramps	Freeway	44	44	44	44	24	25	14	20
I-395 HOT SB at Eads St on-ramp	Merge	51	50	51	50	18	21	15	14
I-395 HOT SB between HOT merge and Washington Blvd on-ramp	Freeway	54	53	54	54	21	24	17	16
I-395 HOT SB at Washington Blvd on-ramp	Merge	47	48	47	48	21	23	19	18
I-395 HOT SB between Washington Blvd on-ramp and Shirlington Rd off-ramp	Freeway	58	58	58	58	23	25	20	19
I-395 HOT SB at Shirlington Rd off-ramp	Diverge	49	48	50	53	20	23	18	16
I-395 HOT SB between Shirlington Rd off-ramp and Seminary Rd off-ramp	Freeway	63	63	63	63	18	20	16	16
I-395 HOT SB at Seminary Rd off-ramp	Diverge	63	62	63	63	14	15	12	12
I-395 HOT SB between Seminary Rd ramps	Freeway	63	63	64	64	17	18	14	14
I-395 HOT SB at Seminary Rd on-ramp	Merge	61	61	62	62	14	15	11	12
I-395 HOT SB between Seminary Rd on-ramp and Turkeycock Run off-ramp	Freeway	62	62	63	63	18	19	15	15
I-395 HOT SB at Turkeycock Run off-ramp	Diverge	43	48	55	50	23	21	13	16
I-395 HOT SB between Turkeycock Run ramps	Freeway	64	63	63	64	10	28	26	22
I-395 HOT SB at Turkeycock Run on-ramp	Merge	60	58	57	59	10	13	13	11
I-395 HOT SB south of Turkeycock Run ramps	Freeway	64	64	64	64	12	15	16	14

Figure 7-50: Freeway Speed Comparison – Southbound General Purpose Lanes
2020 No Build and Build – PM Peak Period

				Edsall Rd			Turkeycock Run					Duke St						Seminary Rd				King St			Shirlington Rd / Glebe Rd						Washington Blvd			Jefferson Davis Hwy			Boundary Channel Dr			George Washington Memorial Pkwy			14th St		12th St	
Existing	3:00 PM	52	51	44	39	50	52	53	47	44	26	33	33	30	40	19	17	21	13	16	17	21	22	25	28	33	45	52	51	52	51	53	53	54	54	53	49	42	41	39	41	41	42	39	41	36	36	30	27	31
	4:00 PM	52	52	49	47	52	53	53	48	43	22	26	26	19	28	18	17	19	11	13	11	12	11	10	12	11	12	14	14	14	13	14	12	12	17	37	42	39	40	38	40	40	42	38	41	36	35	32	33	37
	5:00 PM	52	52	50	48	52	53	53	47	43	22	25	25	18	27	17	17	20	12	13	11	13	11	11	12	12	13	15	14	15	13	14	10	7	7	23	26	30	30	27	28	30	30	29	33	33	34	30	31	35
	6:00 PM	53	51	46	43	51	52	53	46	43	22	25	25	18	27	17	17	20	12	13	12	13	12	12	14	15	15	17	16	16	13	14	11	11	22	44	47	40	38	31	38	41	43	40	42	36	28	24	18	19
2020 No Build	3:00 PM	52	52	52	52	52	52	53	49	51	51	49	51	51	51	51	44	46	20	30	28	35	35	38	41	45	51	49	47	48	48	53	53	54	54	52	48	40	40	38	38	38	40	37	40	33	32	28	22	25
	4:00 PM	52	53	53	53	53	53	53	49	51	51	50	51	51	51	51	50	46	16	16	14	15	14	13	15	15	15	17	15	16	13	14	12	13	26	46	45	39	40	38	40	40	42	37	37	31	27	25	19	21
	5:00 PM	52	53	53	53	53	53	53	48	51	51	50	51	51	51	51	50	46	16	16	14	16	14	14	16	17	16	19	16	17	16	19	20	23	28	41	41	39	38	36	37	36	38	28	19	14	13	18	16	19
	6:00 PM	52	53	53	53	53	53	53	48	51	51	50	51	51	51	51	43	45	17	19	18	21	19	20	23	26	24	29	27	29	28	45	53	54	54	53	49	42	41	37	40	41	43	33	27	21	15	20	16	18
2020 Build	3:00 PM	51	52	52	52	52	52	53	49	51	51	49	51	51	51	51	45	47	25	33	33	42	45	50	50	51	52	52	51	52	51	54	53	54	54	51	48	41	41	39	39	40	41	40	41	36	34	28	22	23
	4:00 PM	52	52	52	52	52	53	53	49	51	51	50	51	51	51	51	50	46	16	16	14	14	13	14	17	18	23	29	29	31	32	43	53	54	54	51	48	41	41	40	41	41	42	38	38	33	29	25	19	21
	5:00 PM	52	53	53	53	53	53	53	48	51	51	50	51	51	51	51	49	46	16	16	14	15	14	13	16	16	18	23	22	24	28	41	51	54	54	47	43	40	39	37	38	37	41	30	21	15	14	18	16	19
	6:00 PM	52	53	53	53	53	53	53	48	51	51	50	51	51	51	51	47	48	23	27	26	30	30	34	38	41	47	51	51	52	51	53	53	54	54	52	48	41	40	35	38	40	42	38	34	27	18	22	18	20

Edsall Rd | Turkeycock Run | Duke St | Seminary Rd | King St | Shirlington Rd / Glebe Rd | Washington Blvd | Jefferson Davis Hwy | Boundary Channel Dr | George Washington Memorial Pkwy | 14th St | 12th St

25 35 45 55 65

Travel Speed (mph)

Figure 7-51: Freeway Speed Comparison – Northbound General Purpose Lanes
2020 No Build and Build – PM Peak Period

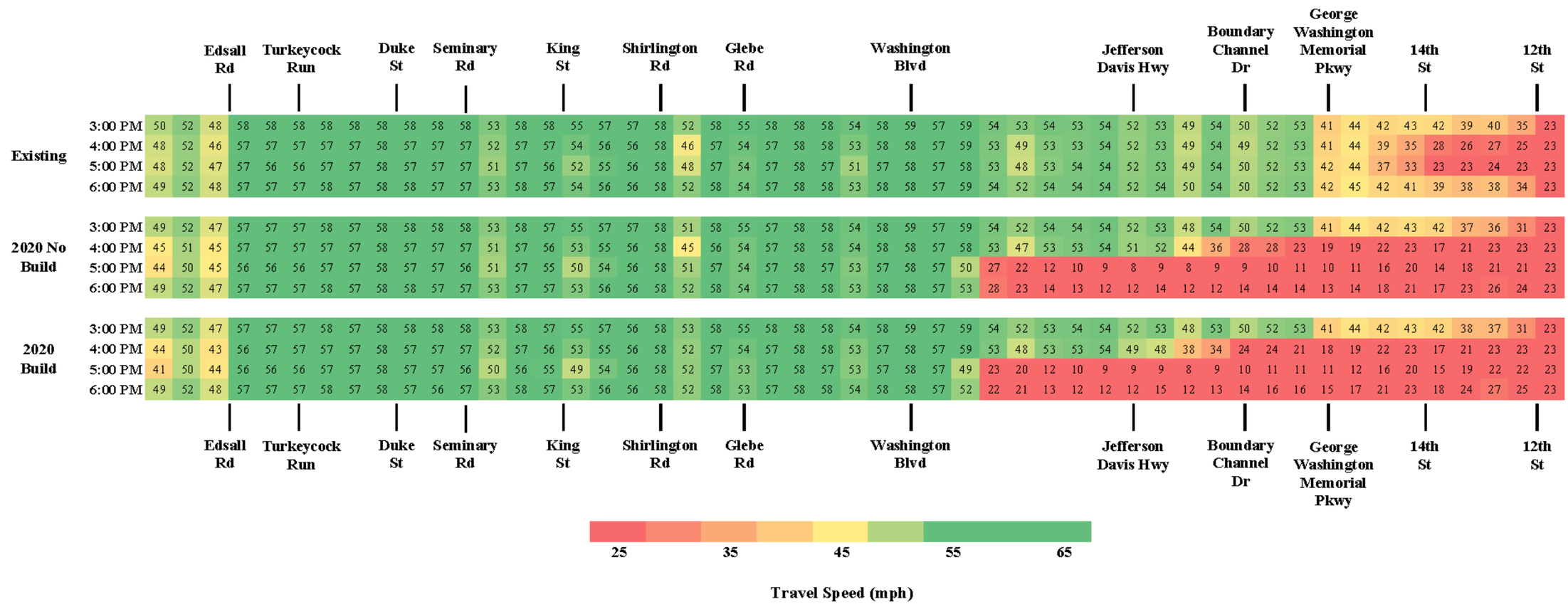


Figure 7-52: Freeway Speed Comparison – HOV/HOT Lanes
2020 No Build and Build – PM Peak Period

Northbound HOV/HOT Lanes

		Eads St			14th St
Existing	3:00 PM	28	43	44	43	31
	4:00 PM	28	43	43	28	21
	5:00 PM	28	43	42	31	23
	6:00 PM	28	43	44	43	29
2020 No Build	3:00 PM	28	43	44	43	28
	4:00 PM	28	43	42	22	21
	5:00 PM	28	43	36	20	21
	6:00 PM	28	43	44	41	26
2020 Build	3:00 PM	28	43	44	43	28
	4:00 PM	28	43	44	32	22
	5:00 PM	28	43	44	36	23
	6:00 PM	28	43	44	41	27

Eads St | 14th St

25 35 45 55 65

Travel Speed (mph)

Southbound HOV/HOT Lanes

		Turkeycock Run			Seminary Rd				Shirlington Rd		Washington Blvd				Eads St			Boundary Channel Dr		14th St
Existing	3:00 PM	64	60	63	43	62	62	62	58	63	49	58	52	49	49	51	44	44	44	43	41	36
	4:00 PM	64	60	63	54	62	62	62	57	63	53	58	53	48	48	51	44	44	44	41	40	36
	5:00 PM	64	60	63	54	62	62	62	55	62	45	57	53	47	47	50	44	44	44	37	35	32
	6:00 PM	64	59	63	39	61	61	61	44	62	44	57	51	48	48	51	44	44	44	41	40	36
2020 No Build	3:00 PM	64	61	61	36	47	58	62	56	62	47	57	52	48	50	50	44	44	44	42	41	36
	4:00 PM	64	61	61	46	51	59	62	58	62	48	58	54	48	50	50	44	44	44	41	40	36
	5:00 PM	64	60	62	48	54	60	62	55	62	45	57	52	48	51	51	44	44	44	41	40	36
	6:00 PM	64	60	61	36	48	59	62	51	62	47	57	50	48	51	51	44	44	44	42	40	36
2020 Build	3:00 PM	64	60	64	43	62	61	63	63	63	49	58	47	54	51	51	44	44	44	43	38	36
	4:00 PM	64	58	63	48	62	61	63	62	63	48	58	48	53	50	50	44	44	44	42	32	33
	5:00 PM	64	57	63	55	63	62	64	63	63	50	58	47	54	51	51	44	44	44	42	40	36
	6:00 PM	64	59	64	50	63	62	64	63	63	53	58	48	54	50	50	44	44	44	41	39	36

Turkeycock Run | Seminary Rd | Shirlington Rd | Washington Blvd | Eads St | Boundary Channel Dr | 14th St

25 35 45 55 65

Travel Speed (mph)

HOV/HOT Lane Queues: Queues along freeway off-ramps from the I-395 HOV/HOT lanes during the PM peak period were compared between No Build and Build conditions to identify locations where there would be queue spillback onto the freeway lanes. **Table 7-15a** summarizes average and maximum queue lengths and available storage lengths for the northbound and southbound I-395 HOV/HOT lanes for each of the four analysis hours from 3 PM through 7 PM.

As shown, the maximum queue length for the ramp from the southbound I-395 HOV lanes to the southbound general purpose lanes at Boundary Channel Drive exceeds the available storage under No Build conditions from 4 PM to 5 PM; however, under Build conditions queues will not exceed available storage due to the ability for all motorists (including non-HOV motorists) to continue in the southbound HOT lanes.

Table 7-17a: PM Peak Period I-395 HOV/HOT Ramp Queues (2020 No Build and Build)

HOV/HOT Lane Ramp Location	Available Storage (feet)	2020 No Build		2020 Build		2020 No Build		2020 Build		2020 No Build		2020 Build		2020 No Build		2020 Build	
		Avg. (feet)	Max. (feet)	Avg. (feet)	Max. (feet)	Avg. (feet)	Max. (feet)	Avg. (feet)	Max. (feet)	Avg. (feet)	Max. (feet)	Avg. (feet)	Max. (feet)	Avg. (feet)	Max. (feet)	Avg. (feet)	Max. (feet)
		3 - 4 PM				4 - 5 PM				5 - 6 PM				6 - 7 PM			
SB to SB GP at Turkeycock Run	2,780	1	133	7	662	0	0	34	1,183	0	0	0	0	23	465	0	18
SB to Seminary Rd	2,750	1	104	5	219	2	123	21	360	1	92	14	325	3	172	4	191
SB to Shirlington Rd	1,580	0	48	2	144	0	58	5	221	1	91	6	203	1	92	3	167
SB to SB GP (south of Eads St)	410	0	0	-	-	0	0	-	-	0	0	-	-	0	0	-	-
SB to Eads St	1,260	2	71	8	92	1	92	40	210	8	134	34	179	9	145	17	162
SB to SB GP at Boundary Channel Dr	700	1	190	0	0	17	935	1	174	1	149	49	526	2	171	12	338
NB to 14th St SW	1,350	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NB to NB GP into D.C.	2,400	0	0	0	0	248	1,291	0	55	716	2,138	0	68	0	0	0	26

Highlighted cells indicate locations where average or maximum queue lengths exceed available storage

7.2.3 Arterial Intersection Operations

Similar to existing conditions, measures of effectiveness (MOEs) from the VISSIM outputs were used to document operations for 2020 No Build and Build conditions at the signalized and unsignalized intersections along the I-395 study corridor. Average delay by movement, average delay by approach, and overall intersection delay was reported for each intersection. Maximum queue lengths by movement in feet were also reported. Overall average delay values are color-coded to reflect various congestion levels based on delay thresholds established in the *Highway Capacity Manual 2010* (TRB, 2010) as shown in **Table 7-2**. **Appendix J** also contains a summary of travel speeds and travel times by link for the arterials throughout the study area.

Figure 7-53 presents a summary of 2020 No Build and Build intersection operations for both signalized and unsignalized intersections for the AM and PM peak hours. Operations at the Eads Street Interchange are discussed in more detail in **Section 7.2.4** and operations at the Shirlington Interchange are discussed in more detail in **Section 7.2.5**. **Table 7-18** depicts overall intersection delay for both signalized and unsignalized intersections for the AM and PM peak hours for 2020 No Build and Build conditions. **Appendix J** contains a tabular summary of average delays by movement, intersection approach, and overall delay as well as maximum queue lengths and storage lengths. **Figures 7-53a** (*Volume 2*) **and 53c** *(Volume 2)* depict the average delays by movement and for the overall intersections for 2020 No Build and Build conditions, respectively. **Figures 7-53b** (*Volume 2*) **and 7-53d** *(Volume 2)* depict the maximum queue lengths by movement for 2020 No Build and Build conditions, respectively.

AM Peak Hour: Under 2020 No Build conditions during the AM peak hour, 47 (87 percent) of the 54 intersections operate with light traffic conditions, three (6 percent) intersections operate with moderate traffic conditions, three (6 percent) intersections operate with heavy congestion, and one intersection operates with severe congestion. Under 2020 Build condition, 47 (87 percent) of the 54 intersections operate with light traffic conditions, four (7 percent) intersections operate with moderate traffic conditions, two (4 percent) intersections operate with heavy congestion, and one intersection operates with severe congestion. The congestion level at two intersections change under 2020 Build conditions in the AM peak hour. Operations at one intersection would improve and operations at one intersection would degrade when comparing 2020 No Build and Build conditions.

- **Eastbound Seminary Road at Northbound I-395 ramps**: The congestion level at this intersection would increase from light traffic conditions to moderate traffic conditions with overall intersection delays increasing by approximately 6 seconds from 32 seconds to 38 seconds. This can be attributed to a higher volume of motorists exiting the northbound I-395 general purpose lanes and utilizing this ramp to access the north facing HOT ramp to the northbound I-395 HOT lanes under Build conditions. Approach delays for any movement at the intersection do not increase by more than 4 seconds between No Build and Build conditions.

- **I-395 Northbound HOV Ramps at Eads Street** (see discussion in **Section 7.2.4**): The congestion level at this intersection would improve from heavy traffic conditions to light traffic conditions.

PM Peak Hour: Under 2020 No Build conditions during the PM peak hour, 48 (87 percent) of the 55 intersections operate with light traffic conditions, four (7 percent) operate with moderate traffic conditions, and three (6 percent) operate with heavy congestion. Under 2020 Build conditions, 49 (89 percent) of the 55 intersections operate with light traffic conditions, four (7 percent) operate with moderate traffic

conditions, two (4 percent) operate with heavy congestion. The congestion level at two intersections in the vicinity of the Eads Street Interchange improve under 2020 Build conditions in the PM peak hour. These two intersections, North Rotary Road at Eads Street and South Rotary Road at Eads Street, are discussed further in **Section 7.2.4**.

Figure 7-53: Intersection Operations Summary (2020 No Build and Build Conditions)

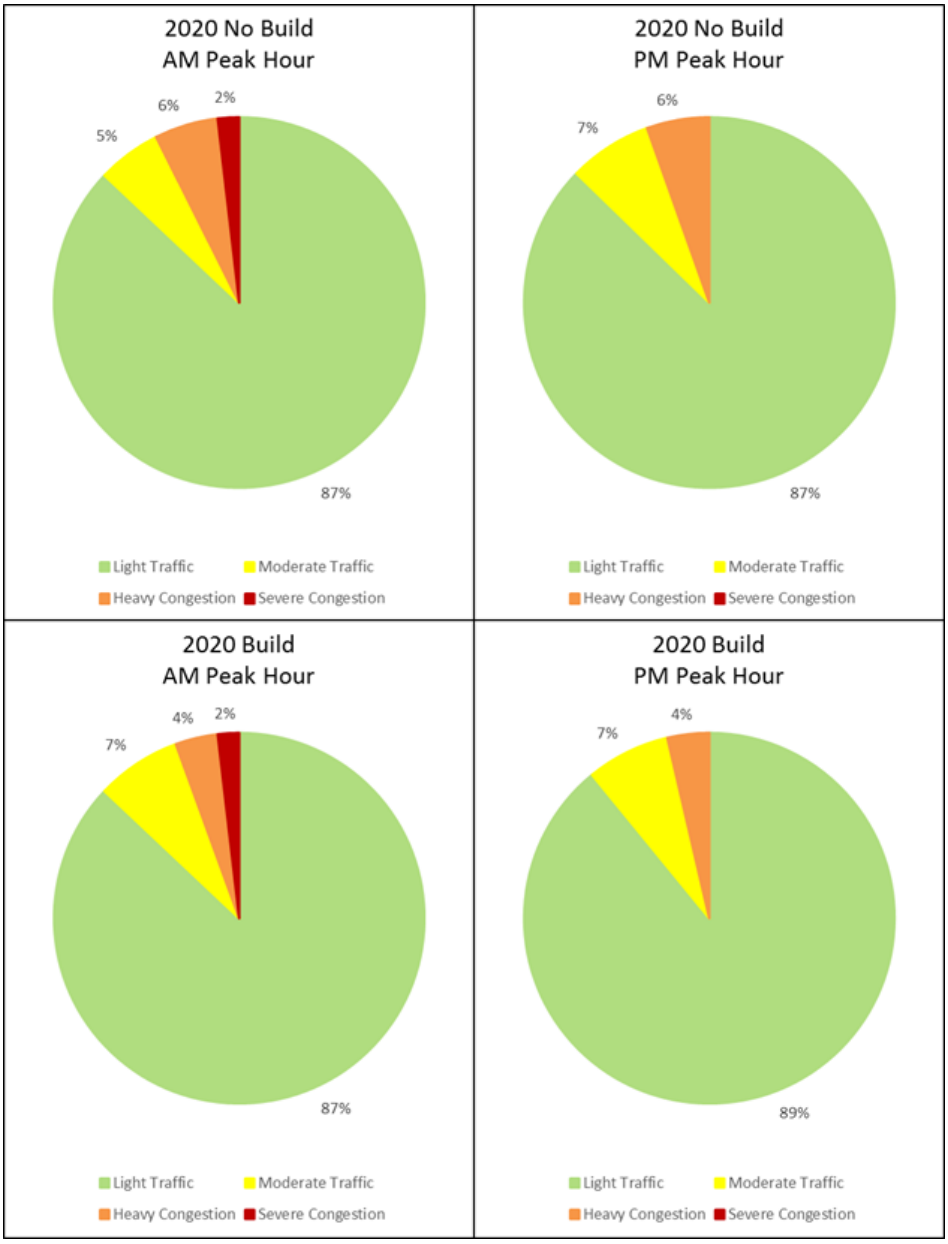


Table 7-18: Intersection Delay Summary (2020 No Build and Build Conditions)

Intersection		2020 No Build Conditions			2020 Build Conditions		
		Intersection Control	Average Delay (sec)		Intersection Control	Average Delay (sec)	
			AM Peak (7-8 AM)	PM Peak (5-6 PM)		AM Peak (7-8 AM)	PM Peak (5-6 PM)
1	Edsall Rd at Cherokee Ave	Signalized	9.8	15.1	Signalized	9.5	14.9
2	Edsall Rd at Bren Mar Dr	Signalized	23.9	32.2	Signalized	29.2	30.7
3	Edsall Rd at Bloomfield Dr	Signalized	9.7	7.8	Signalized	9.2	8.0
4	Little River Turnpike at Beauregard St	Signalized	60.3	64.2	Signalized	58.1	62.1
5	Little River Turnpike at Oasis Dr	Signalized	11.8	12.5	Signalized	11.8	12.5
6	Duke St at Walker St	Signalized	17.9	23.2	Signalized	17.3	23.6
8	Seminary Rd at Mark Center Ave	Signalized	36.4	30.2	Signalized	36.5	33.0
9	EB Seminary Rd at SB I-395 ramps	Signalized	40.8	31.7	Signalized	40.8	33.8
10	WB Seminary Rd at SB I-395 ramps	Signalized	14.9	20.9	Signalized	12.8	14.4
11	EB Seminary Rd at NB I-395 ramps	Signalized	31.5	23.1	Signalized	37.9	24.1
12	WB Seminary Rd at NB I-395 ramps	Signalized	22.0	19.3	Signalized	32.3	19.2
13	Seminary at HOV Ramp (North Facing)	Unsignalized	--[1]	4.5	Unsignalized	--[1]	10.9
14	Seminary Rd at Kenmore Ave	Unsignalized	6.7	22.1	Unsignalized	23.7	21.0
15	Seminary Rd at Library Ln	Signalized	20.9	24.9	Signalized	24.7	25.2
16	King St at Park Center Dr	Signalized	10.6	13.8	Signalized	10.3	13.3
17	King St at 30th St S	Unsignalized	1.2	2.0	Unsignalized	1.2	1.9
18	King St at Menokin Dr	Signalized	22.5	13.2	Signalized	21.9	13.7
19	S Shirlington Rd at S Arlington Mill Dr	Signalized	26.1	53.1	Signalized	25.7	50.2
22	S Shirlington Rd at Campbell Ave	Signalized	22.8	31.3	Signalized	22.8	31.7
23	Shirlington Rotary at HOV Ramp	Unsignalized	2.7	2.6	Unsignalized	2.4	2.9
26	N Quaker Ln at Gunston Rd	Unsignalized	11.8	5.0	Unsignalized	8.0	5.6
27	Martha Custis Dr at Gunston Rd	Unsignalized	60.1	15.0	Unsignalized	58.5	14.5
30	N Quaker Ln at Preston Rd	Signalized	11.6	16.0	Signalized	10.5	15.7
31	S Glebe Rd at 24th Rd S (north of Glebe Rd)	Signalized	18.0	21.9	Signalized	18.2	23.1
32	S Glebe Rd at 24th Rd S (south of Glebe Rd)	Signalized	13.6	14.5	Signalized	14.0	14.5
33	S Glebe Rd at SB I-395 off-ramp	Signalized	7.1	14.9	Signalized	7.3	15.0
34	S Glebe Rd at NB I-395 off-ramp	Signalized	20.5	63.7	Signalized	22.3	64.4
35	S Arlington Ridge Rd at I-395 Ramps	Unsignalized	2.9	7.7	Unsignalized	8.3	7.3
36	Columbia Pike at Southgate Rd/ S Joyce St	Signalized	12.3	28.1	Signalized	12.1	27.4
37	Columbia Pike at N/S Rotary Rd	Unsignalized	7.6	10.9	Unsignalized	7.6	9.5
38	Army Navy Dr at S Joyce St	Signalized	19.2	24.8	Signalized	18.8	23.7
39	Army Navy Dr at Parking Lot/ Garage	Signalized	13.2	15.1	Signalized	12.8	14.7
40	Army Navy Dr at S Hayes St	Signalized	18.0	28.8	Signalized	18.2	28.8
41	Army Navy Dr at S Fern St	Signalized	27.0	28.5	Signalized	26.8	28.8

Intersection		2020 No Build Conditions			2020 Build Conditions		
		Intersection Control	Average Delay (sec)		Intersection Control	Average Delay (sec)	
			AM Peak (7-8 AM)	PM Peak (5-6 PM)		AM Peak (7-8 AM)	PM Peak (5-6 PM)
42	I-395 SB HOV Ramps at Eads St	Unsignalized	8.5	3.5	Signalized	26.7	8.9
43	I-395 NB HOV Ramps at Eads St	Unsignalized	39.8	5.8	Signalized	10.9	8.1
44	Army Navy Dr at S Eads St	Signalized	26.5	38.9	Signalized	24.8	48.4
45	12th St at S Eads St	Signalized	27.9	19.6	Signalized	16.5	25.4
46	Army Navy Dr at 12th St S	Unsignalized	6.0	5.0	Unsignalized	6.1	4.5
47	12th St S at Long Bridge Dr	Signalized	12.6	12.0	Signalized	12.0	12.2
50	N Rotary Rd at Connector Rd	Unsignalized	6.9	13.7	Unsignalized	7.7	15.3
51	N Rotary Rd at Fern St	Unsignalized	45.0	19.0	Unsignalized	44.5	20.4
52	S Rotary Rd at Fern St	Unsignalized	13.1	18.1	Unsignalized	12.3	18.1
53	N Rotary Rd at Eads St	Unsignalized	13.6	33.1	Signalized	6.9	30.8
54	S Rotary Rd at Eads St	Unsignalized	23.6	35.6	Signalized	23.5	52.3
55	Boundary Channel Dr at Connector Rd	Unsignalized	4.0	4.1	Unsignalized	3.6	3.8
56	Boundary Channel Dr at Long Bridge Dr	Unsignalized	3.9	5.4	Unsignalized	4.3	5.5
101	Edsall Rd at I-395 SB on-ramp	Signalized	6.7	3.8	Signalized	6.3	3.7
102	Little River Turnpike at I-395 SB off-ramp	Signalized	15.5	17.2	Signalized	14.9	19.3
103	Seminary Rd at SB Beauregard St	Signalized	13.1	25.5	Signalized	13.4	26.1
105	SB Beauregard St at Seminary Rd (East)	Signalized	44.2	42.9	Signalized	40.5	41.2
106	NB Beauregard St at Seminary Rd (East)	Signalized	11.8	14.9	Signalized	12.1	14.8
107	NB Beauregard St at Seminary Rd (West)	Signalized	15.0	20.6	Signalized	14.2	20.7
108	Seminary Rd at NB Beauregard St	Signalized	24.8	23.2	Signalized	27.0	23.5
109	Seminary Rd at HOV ramp (South Facing)	Signalized	4.0	0.8	Signalized	4.4	2.2

[1] Intersection does not utilize signal, stop, or yield control during this time period, therefore no results given

Peak Hour Queues: Tables 7-18a and 7-18b depict turn lanes throughout the study area where maximum queue lengths exceed available storage during the AM and PM peak hours and where the maximum queue length increases by 100 feet or more between 2020 No Build and Build conditions. The table depicts the available storage length, average queue length, and maximum queue length for both 2020 No Build and Build conditions. It should be noted that at most locations, the maximum queue lengths are significantly greater than the average queue lengths since the maximum queue lengths reported by VISSIM may occur only one time or infrequently during the reporting period.

Following the table is a discussion of each location and potential mitigation measures to reduce the potential for queues that extend beyond the turn lanes. For the locations where mitigation is discussed, **Appendix J** contains a tabular summary of average delays by movement and intersection approach, overall delay, maximum queue lengths, and storage lengths for the mitigated conditions.

Table 7-18a: AM Peak Hour Queue Summary (2020 No Build and Build Conditions)

Intersection / Movement			No Build			Build			Avg. Queue Increase (feet)	Max. Queue Increase (feet)
			Available Storage (feet)	Avg. Queue (feet)	Max. Queue (feet)	Available Storage (feet)	Avg. Queue (feet)	Max. Queue (feet)		
15	Seminary Rd at Library Ln	WBL	40	12	308	40	28	452	16	144
34	S Glebe Rd at NB I-395 off-ramp	NBR	730	116	570	730	295	1,219	179	649

- **Seminary Road at Library Lane:** During the AM peak hour, the westbound Seminary Road left-turn lane maximum queue length approaching Library Lane increases from 308 feet under No Build conditions to 452 feet under Build conditions compared to an available storage length of 40 feet. However, this queue is not caused by the left-turn volume (15 vehicles), but rather represents a left-turning vehicle that is unable to access the left-turn lane due to a queue from the adjacent westbound Seminary Road through movement. The average queue length under Build conditions is 28 feet which is less than the available storage length. The increase in the maximum queue length can be attributed to a shift in vehicles along westbound Seminary Road that were previously using the downstream channelized right turn to access the northbound general purpose lanes that are now traveling westbound on Seminary Road through the signal at the northbound I-395 ramps to access the northbound I-395 HOT lanes.

  To mitigate this condition, signal timings were adjusted to provide additional green time for the westbound Seminary Road approach and the resulting queue length is only 88 feet longer (less than 4 vehicles) than No Build conditions. The average queue is a low percentage (6%) of the maximum queue, an indication that the maximum queue occurs infrequently.

- **S Glebe Road at Northbound I-395 Off-Ramp**: During the AM peak hour, the northbound right-turn maximum queue length on the off-ramp from northbound I-395 to Glebe Road increases from 570 feet under No Build conditions to 1,219 feet under Build conditions compared to an available storage length of 730 feet (measured to the gore along northbound I-395). This can be attributed to reduced congestion along the northbound I-395 general purpose lanes in the AM peak hour and more vehicles gaining access to the northbound off-ramp to Glebe Road. Average queue lengths for both No Build (116 feet) and Build (295 feet) conditions do not exceed the storage length.

  To mitigate this condition, signal timings were adjusted to provide additional green time for the northbound I-395 off-ramp approach to the intersection and the resulting queue length (348 feet) is less than queues lengths under No Build conditions and can be accommodated within the 730-foot storage length. Additionally, average queue lengths are less than the storage length under both unmitigated and mitigated conditions.

Table 7-18b: PM Peak Hour Queue Summary (2020 No Build and Build Conditions)

Intersection / Movement			No Build			Build			Avg. Queue Increase (feet)	Max. Queue Increase (feet)
			Available Storage (feet)	Avg. Queue (feet)	Max. Queue (feet)	Available Storage (feet)	Avg. Queue (feet)	Max. Queue (feet)		
44	Army Navy Dr at S Eads St	SBR	20	2	80	140	3	183	1	103

- **Army Navy Drive at Eads Street (see PM peak hour discussion in Section 7.2.4.2)**

7.2.4 Eads Street Interchange

Traffic operations at the Eads Street Interchange were evaluated for both 2020 No Build and Build conditions. Under 2020 No Build conditions, no changes are planned at the Eads Street Interchange. Under 2020 Build conditions, as discussed in **Section 4.4.2**, the two HOT ramp terminals would be signalized at their intersections with Eads Street.

- **Eads Street at South I-395 HOT ramps (southern intersection):** In the AM peak hour, the northbound I-395 HOT off-ramp would include two right-turn lanes onto Eads Street southbound serving Army Navy Drive and the Pentagon City area. In the PM peak hour, the traffic direction for the northbound I-395 HOT off-ramp would be reversed to permit traffic to enter the HOT lanes in the southbound direction. The southbound Eads Street approach would be widened into the median to accommodate a left-turn and through lane. The northbound Eads Street approach would be widened to provide a left-turn lane, a through lane, and a right-turn lane. The northbound left-turn from Eads Street would provide a new access point to the HOT lanes and would be accommodated only during the PM peak period due to the reversible nature of the ramp. Access would be prohibited by gates during other periods. The configuration of the on-ramp from Eads Street to the northbound HOV lanes would not be changed.

- **Eads Street at North I-395 HOT ramps (northern intersection):** In the AM peak hour, the on-ramp that currently accommodates traffic from Eads Street to the southbound I-395 HOV lanes would be reversed to accommodate northbound I-395 HOT traffic destined for the Pentagon. The ramp would include two left-turn lanes onto northbound Eads Street. In the PM peak hour, the traffic direction for the ramp would be reversed to permit traffic to enter the I-395 southbound HOT lanes. The southbound I-395 HOV off-ramp would be widened to provide a dedicated left-turn lane and right turn lane approaching Eads Street. The southbound Eads Street approach would be modified to provide a right-turn lane, a shared through/right-turn lane, and a right-turn lane. The two right-turn lanes would be channelized and become free-flowing right turns to the ramp to the southbound I-395 HOT lanes. The northbound Eads Street approach would be widened to accommodate two through lanes.

The timing of the improvements to the Pentagon South Parking Lot is unknown at this time; however, some improvements to the South Parking Lot are required in order to provide a smooth transition between the improvements planned at the Eads Street Interchange and within the Pentagon Reservation. The 2020 Build improvements include the following key features:

- Direct access to the Pentagon Transit Center via a dedicated two-way bus loop that circulates on the eastern perimeter of the South Parking Lot. Access to the bus loop would be provided on the east leg of the Eads Street at South Rotary Road Intersection. Transit vehicles would be separated from passenger vehicles and substantial pedestrian conflicts along North Rotary Road.

- Traffic signalization at the Eads Street at South Rotary Road Intersection. The eastbound South Rotary Road Intersection would be widened to provide a second eastbound right-turn lane providing four total lanes approaching the Eads Street Intersection. The second right-turn lane would be open to traffic during the PM period when the I-395 HOT lanes are operating in a southbound direction. During other periods, gates would prohibit traffic from entering the rightmost right-turn lane. The northbound Eads Street approach to South Rotary Road would be widened to provide two through lanes and a separate right-turn lane serving buses entering the new bus loop discussed above.

- Traffic signalization at the Eads Street at North Rotary Road Intersection and removal of the north leg of the intersection serving the Pentagon Transit Center. The South and North Rotary signals would be coordinated with the signals along Eads Street at the I-395 HOT ramps and Army Navy Drive. A signalized pedestrian crossing would be provided on the east leg of the intersection.

- A dedicated ridesharing (slugging) area within the bus loop to accommodate the substantial ridesharing that occurs within this portion of the South Parking Lot. The existing slug area along Fern Street would remain in its current location under the interim conditions.

Table 7-19 depicts overall intersection delay for both signalized and unsignalized intersections for the AM and PM peak hours for existing conditions. **Appendix J** contains a tabular summary of average delays by movement, intersection approach, and overall delay as well as maximum queue lengths and storage lengths. **Figures 7-53a** (*Volume 2*) **and 53c** *(Volume 2)* depict the average delays by movement and for the overall intersections for 2020 No Build and Build conditions, respectively. **Figures 7-53b** (*Volume 2*) **and 7-53d** *(Volume 2)* depict the maximum queue lengths by movement for 2020 No Build and Build conditions, respectively.

Table 7-19: 2020 No Build and Build Intersection Delay Summary – Eads Street Interchange

Intersection		2020 No Build Conditions			2020 Build Conditions		
		Intersection Control	Avg Delay (sec)		Intersection Control	Avg Delay (sec)	
			AM Peak Hour (7-8 AM)	PM Peak Hour (5-6 PM)		AM Peak Hour (7-8 AM)	PM Peak Hour (5-6 PM)
38	Army Navy Dr at S Joyce St	Signalized	19.2	24.8	Signalized	18.8	23.7
39	Army Navy Dr at Parking Lot/ Garage	Signalized	13.2	15.1	Signalized	12.8	14.7
40	Army Navy Dr at S Hayes St	Signalized	18.0	28.8	Signalized	18.2	28.8
41	Army Navy Dr at S Fern St	Signalized	27.0	28.5	Signalized	26.8	28.8
42	I-395 SB HOV Ramps at Eads St	Unsignalized	8.5	3.5	Signalized	26.7	8.9
43	I-395 NB HOV Ramps at Eads St	Unsignalized	39.8	5.8	Signalized	10.9	8.1
44	Army Navy Dr at S Eads St	Signalized	26.5	38.9	Signalized	24.8	48.4
45	12th St at S Eads St	Signalized	27.9	19.6	Signalized	16.5	25.4
46	Army Navy Dr at 12th St S	Unsignalized	6.0	5.0	Unsignalized	6.1	4.5
47	12th St S at Long Bridge Dr	Signalized	12.6	12.0	Signalized	12.0	12.2
50	N Rotary Rd at Connector Rd	Unsignalized	6.9	13.7	Unsignalized	7.7	15.3
51	N Rotary Rd at Fern St	Unsignalized	45.0	19.0	Unsignalized	44.5	20.4

Intersection		2020 No Build Conditions			2020 Build Conditions		
		Intersection Control	Avg Delay (sec)		Intersection Control	Avg Delay (sec)	
			AM Peak Hour (7-8 AM)	PM Peak Hour (5-6 PM)		AM Peak Hour (7-8 AM)	PM Peak Hour (5-6 PM)
52	S Rotary Rd at Fern St	Unsignalized	13.1	18.1	Unsignalized	12.3	18.1
53	N Rotary Rd at Eads St	Unsignalized	13.6	33.1	Signalized	6.9	30.8
54	S Rotary Rd at Eads St	Unsignalized	23.6	35.6	Signalized	23.5	52.3

7.2.4.1 AM Peak Hour Operations

The following are key observations when comparing 2020 No Build and Build conditions during the AM peak hour:

- Fourteen of the 15 intersections in the vicinity of the Eads Street Interchange are expected to operate with light traffic conditions during the AM peak hour under Build conditions.
- Traffic operations at the two I-395 HOT ramp terminals would improve due to the added capacity on the ramp approaches to Eads Street and the reduction of conflict points at the two intersections. Separating traffic destined for the Pentagon and Army Navy Drive reduces the number of conflict points at the two ramp signals and greatly simplifies traffic signal operations by reducing the number of signal phases. The two existing lanes (one left-turn lane and one right-turn lane) on the I-395 HOV ramp approaching Eads Street would be increased to four lanes (two left-turn lanes and two right-turn lanes) under Build Conditions doubling the turning capacity approaching Eads Street and reducing the potential for queues extending to the northbound I-395 HOT lanes.
- Traffic signal timings along Eads Street were modified to progress traffic from the reversible ramps. The double left turn from the northbound I-395 HOT ramp toward the Pentagon would be coordinated with the northbound Eads Street approach to South Rotary Road and subsequently the northbound Eads Street approach to North Rotary Road allowing for a free-flowing operation of this heavy movement during the AM peak period. Similarly, the heavy right turn from the northbound I-395 HOT ramp toward Army Navy Drive would be coordinated with the southbound Eads Street approach to Army Navy Drive to minimize the potential for queuing between these two intersections.
- The northbound I-395 HOV ramp approach operates free flow onto northbound and southbound Eads Street under 2020 No Build conditions but is degraded due to downstream congestion at the South Rotary Road and Eads Street Intersection. The maximum queue lengths on the northbound I-395 HOV ramp to Eads Street would reduce from 3,630 feet under No Build conditions during the four hour analysis period on the single ramp to a maximum of 540 feet on the ramp to northbound Eads Street (Pentagon traffic) and a maximum of 280 feet on the ramp to southbound Eads Street (to Army Navy Drive) and not impact traffic operations along the northbound I-395 HOT lanes under Build conditions.
- Under Build conditions, southbound and northbound vehicles (including transit vehicles) traveling along Eads Street would no longer have to rely on a courtesy gap from motorists on the uncontrolled northbound I-395 HOT lanes ramp due to the installation of the traffic signal, creating a safer crossing for these vehicles.

- Within the Pentagon South Parking Lot, traffic operations would improve by providing predictable traffic flow and signal progression between the I-395 HOT lanes ramp signals and the North and South Rotary Road signals. Pedestrian operations and safety would be improved at the Eads Street at North Rotary Road intersection by eliminating the north leg of the intersection and conflicts between buses exiting the PTC and pedestrians currently crossing on the north leg of the intersection.

- The North Rotary Road at Fern Street Intersection would operate with heavy congestion along North Rotary Road under both No Build and Build conditions due to the heavy pedestrian traffic crossing North Rotary Road at this location.

I-395 Southbound HOV Ramp Removal: Another key feature of the Eads Street Interchange is the removal of the ramp from the southbound I-395 HOV lanes to the southbound I-395 general purpose lanes (see **Figure 4-15**). This would eliminate a weave condition along the southbound I-395 HOV lanes and eliminate a merge condition along the southbound I-395 general purpose lanes in an area with a high density of access points. The removal of this ramp is required in order to accommodate the proposed reversible ramps serving the Eads Street Interchange that would operate in a northbound direction in the AM peak period and in a southbound direction in the PM peak period. Access to the southbound I-395 general purpose lanes would be provided via Hayes Street/Army Navy Drive, Washington Boulevard/Columbia Pike, and Boundary Channel Drive instead of the current ramp. Based on a review of overall intersection delay changes at these other locations, the revised access would not result in a degradation of intersection operations due to the ramp removal.

In the AM peak period, when the HOV lanes are operating in a northbound direction south of Eads Street, this ramp is the last opportunity for southbound vehicles to exit the HOV lanes via the slip ramp including motorists that have entered the HOV lanes from Washington, D.C. or Eads Street/Pentagon. There is another opportunity to exit the HOV lanes to the southbound I-395 general purpose lanes in the vicinity of the Boundary Channel Drive Interchange, which would remain open as part of the Build Alternative. In terms of impacts to traffic and transit operations in Pentagon City and Crystal City, the removal of this ramp has the potential to impact any vehicles that are currently using the ramp to be removed that have entered the southbound I-395 HOV lanes from the Eads Street ramp.

During the original data collection efforts in November 2015, in the AM peak hour when the primary travel direction is northbound I-395 toward Washington, D.C., traffic volumes on the ramp from Eads Street to the southbound HOV lanes were approximately 115 vehicles per hour including approximately 30 passenger cars and 80 buses. Many of these buses are “dead head buses” making a return trip to the south along the I-395 general purpose lanes after discharging passengers at the Pentagon Transit Center. However, on January 4, 2016, the Pentagon implemented the “Pentagon Transit Center (PTC) Traffic Operations Improvement Pilot Program” on weekdays from 7 AM to 9 AM. During this two-hour period, with the exception of a limited number of approved bus routes, all buses exit the PTC via the emergency exit and make a left turn onto northbound Connector Road. After entering Connector Road, buses are then directed to travel north to Boundary Channel Drive to access northbound I-395 to Washington, DC or take the ramp to southbound Route 1 to westbound Army Navy Drive and then make a subsequent right turn onto the southbound I-395 general purpose lanes via the Hayes Street ramp. WMATA bus routes 7Y, 9A, and 10A are exempted from the Pilot Program and are still permitted to exit the PTC onto Eads Street. Per the WMATA bus route schedules, these buses do not use the ramp that would be removed and therefore

would not be diverted as a result of the ramp removal associated with the Build Alternative. The Pilot Program has reduced the number of buses exiting the PTC during the 7 AM to 8 AM peak hour from approximately 160 buses to approximately 20 to 30 buses (including some violators) per data provided by the Pentagon Police Department (PPD); however, as noted above, the "approved" buses using Eads Street rather than the emergency exit are not currently using the ramp to be removed and would therefore not be impacted by the Build Alternative.

Based on conversations with Pentagon staff, they have received positive feedback from both the PPD and transit providers regarding the Pilot Program and currently plan to continue implementation of the Pilot Program.

As noted above, approximately 30 passenger vehicles per hour (i.e., non-transit vehicles) are using the ramp from Eads Street to the southbound HOV lanes in the AM peak hour and would be diverted to alternate routes, but would not result in a substantial impact to operations at surrounding intersections.

7.2.4.2 PM Peak Hour Operations

The following are key observations when comparing 2020 No Build and Build conditions during the PM peak hour:

- Thirteen of the 15 intersections in the vicinity of the Eads Street Interchange are expected to operate with light traffic conditions during the PM peak hour under Build conditions. Two of the 15 intersections are expected to operate with moderate traffic conditions during the PM peak hour under Build conditions including Army Navy Drive at Eads Street and South Rotary Road at Eads Street.

- During the PM peak period, the high traffic volumes along eastbound South Rotary Road and southbound Eads Street would be signal-controlled as motorists exit the Pentagon Reservation toward the southbound I-395 HOT lanes and make a double right turn to the southbound on-ramp to the southbound I-395 HOT lanes. Under Build conditions, the east leg of the intersection serves as the access point to and from the Pentagon Transit Center as part of the Pentagon South Parking Lot interim improvements. Under No Build conditions, the east leg only serves vehicles entering the eastern portion of the South Parking Lot, while vehicles exit this portion of the South Parking Lot at the North Rotary Road at Eads Street Intersection. This additional approach to the intersection creates a fourth leg of the intersection and results in an increase to overall intersection delay of approximately 16 seconds when compared to 2020 No Build conditions.

- At the southern I-395 HOT ramps intersection, the new northbound Eads Street left-turn movement to the southbound I-395 HOT lanes ramp would be signalized and operate as part of a two-phase signal accommodating northbound and southbound Eads Street left turns concurrently and northbound and southbound Eads Street through traffic. It should be noted that under current conditions, based on a review of the travel patterns within the Pentagon South Parking lot, motorists in the Pentagon City area and points along Army Navy Drive travel north along Fern Street and make a right turn onto eastbound South Rotary Road to access the southbound I-395 HOV lanes. Providing this ramp would eliminate this traffic from entering the Pentagon Reservation during the heavy traffic periods and reduce traffic along Fern Street which is the designated pedestrian route crossing I-395 and entering the Pentagon Reservation. This new access point would also reduce traffic on the eastbound South Rotary Road approach to Eads Street.

- Traffic volumes at the Eads Street and Army Navy Drive intersection would increase as a result of the I-395 Express Lanes project. This is due to the inclusion of the new access point to the southbound I-395 HOT lanes in the PM peak period discussed above. This new access point would improve accessibility to the southbound I-395 HOT lanes for both HOV motorists and toll-paying customers from the Pentagon City and Crystal City areas.

  In the PM peak hour, traffic volumes for the eastbound left turn from Army Navy Drive to Eads Street increase by approximately 8 percent, the northbound through volume along Eads Street increases by approximately 85 percent, and the westbound right turn from Army Navy Drive to Eads Street increases by approximately 92 percent in the 2020 Build scenario compared to the 2020 No Build scenario.

  Motorists using this new access point from Eads Street to enter the southbound I-395 HOT lanes would be removed from the Hayes Street ramp to the southbound I-395 general purpose lanes. This would result in some changes to traffic patterns along Army Navy Drive between Hayes Street and Eads Street. Westbound Army Navy Drive motorists destined for the southbound I-395 HOT lanes who were previously using the southbound general purpose lanes would turn right from Army Navy Drive onto Eads Street, two blocks earlier than their prior route. This would result in a reduction in traffic volumes along westbound Army Navy Drive between Hayes Street and Eads Street of approximately 90 vehicles per hour. Similarly, eastbound Army Navy Drive motorists destined for the southbound Express Lanes who were previously using the southbound general purpose lanes via the Hayes Street ramp would drive two blocks farther along Army Navy Drive and turn left onto Eads Street. This would result in an increase in traffic volumes along eastbound Army Navy Drive between Hayes Street and Eads Street of approximately 70 vehicles per hour.

  Based on a comparison of forecasted traffic volumes for 2020 No Build versus Build conditions for the PM peak hour, there is an overall increase in traffic volumes of 7 percent at the Eads Street and Army Navy Drive intersection, a reduction in traffic volumes of 10 percent at the Army Navy Drive and Hayes Street intersection, and a reduction in traffic volumes of 7 percent at the Army Navy Drive at Fern Street intersection. Additionally, there is an 8 to 25 percent decrease in westbound traffic volumes and a 3 to 10 percent increase in eastbound traffic volumes along Army Navy Drive between Eads Street and Hayes Street due to the additional access point from Eads Street to the southbound I-395 HOT Lanes during the PM peak hour. This results in an overall reduction in two-way traffic volumes of approximately 9 percent along Army Navy Drive in this segment. Along northbound Eads Street approaching Army Navy Drive, there is a 150 vehicle per hour increase due to the attractiveness of the new access point to the I-395 southbound HOT lanes.

  The increase in traffic volume at the Eads Street and Army Navy Drive intersection results in an increase to overall intersection delay by approximately 9 seconds when comparing the No Build to Build conditions. The northbound and westbound approach delays are expected to increase by approximately 20 seconds and 6 seconds, respectively. Eastbound approach delays are expected to increase by approximately 3 seconds. Delays on the southbound Eads Street approach to the intersection are reduced by approximately 7 seconds due to the installation of an additional southbound left-turn lane and southbound right-turn lane on the approach to Army Navy Drive.

As discussed in **Section 7.2.3** and as shown in **Table 7.18b**, one location in the vicinity of the Eads Street Interchange was observed as having maximum queue lengths during the PM peak hour that exceed available storage and where the maximum queue length increases by 100 feet or more between 2040 No Build and Build conditions.

- **Army Navy Drive at Eads Street:** The right-turn maximum queue length on the southbound Eads Street approach to Army Navy Drive increases from 80 feet under No Build conditions to 183 feet under Build conditions. The southbound right-turn from Eads Street to Army Navy Drive is flared with a very short storage area (approximately 20 feet). The improvements associated with the Eads Street Interchange include the construction of separate left-turn and right-turn lanes on the southbound Eads Street approach to Army Navy Drive increasing the available storage for turning traffic and accommodating increased traffic volumes resulting from the I-395 Express Lanes project. The southbound right-turn lane is 140 feet under Build conditions and has been extended the maximum extent practical while maintaining separation between the northbound I-395 HOT off-ramp and the right-turn lane. Additionally, average right-turn queues are 3 feet under Build conditions and significantly less than the 140-foot available storage length. It should also be noted that the southbound right-turn volume (less than 100 vehicles) is very low when compared to the other movements at this intersection during the PM peak hour and therefore providing additional green time for this movement would degrade the operation of other movements at this intersection.

I-395 Southbound HOV Ramp Removal: As discussed in the summary of AM peak hour operations, the ramp from the southbound I-395 HOV lanes to the southbound I-395 general purpose lanes located south of Eads Street would be removed as part of the Build Alternative. Access to the southbound I-395 general purpose lanes would be provided via Hayes Street/Army Navy Drive, Washington Boulevard/Columbia Pike, and Boundary Channel Drive instead of the current ramp. Based on a review of overall intersection delay changes at these other locations, the revised access would not result in a degradation of operations under Build conditions.

During the PM peak hour, the ramp to be removed as part of the Build Alternative currently serves as the last opportunity for motorists exiting the unenforced portion of the HOV lanes north of Eads Street to exit from the HOV lanes to the southbound I-395 general purpose lanes. The ramp is composed of both traffic that has entered from Eads Street and traffic that has entered the HOV lanes in Washington, DC. The PM peak hour volume on the ramp to be removed is approximately 350 vehicles per hour with only one bus recorded during the peak hour. Transit usage of the ramp to be removed is negligible since it can be assumed that all buses would continue in the HOV lanes during the PM peak hour.

Although detailed origin-destination data for users of the ramp to be removed is not available, it can be assumed that the motorists that use the ramp that have entered from Eads Street have origins on the north side of I-395 (Pentagon area) since there is an access point to the southbound I-395 general purpose lanes on the south side of I-395 at the Hayes Street ramp that provides an entrance point farther to the south along the southbound I-395 general purpose lanes.

With the removal of the ramp associated with the Build Alternative, motorists that are currently entering the HOV lanes in D.C. would have the option to either exit the HOV lanes at the ramp to the southbound I-395 general purpose lanes in the vicinity of the Boundary Channel Drive Interchange, or not enter the HOV lanes at all.

Motorists exiting the Pentagon Reservation that are currently using the ramp to be removed would have the opportunity to pay a toll to use the Express Lanes facility or be diverted to alternative travel routes to access the southbound I-395 general purpose lanes. There are three primary ways to access the southbound I-395 general purpose lanes from the Pentagon South Parking Lot area and the decision regarding which route to take likely depends on a driver's proximity to the various access points and congestion levels along the southbound I-395 general purpose lanes as discussed below:

- **Hayes Street Ramp:** Pentagon motorists parking in the eastern portions of the Pentagon South Parking lot (east of Eads Street) are the most likely motorists exiting the Pentagon Reservation to use the "ramp to be removed" to access the southbound I-395 general purpose lanes due to their proximity to the Eads Street access point to the HOV lanes. These motorists would have the option to continue to take the Eads Street ramp and pay a toll to use the Express Lanes or may be diverted to the Hayes Street ramp to access the southbound I-395 general purpose lanes. As discussed above, there would be a reduction in traffic on the Hayes Street ramp to access the southbound I-395 general purpose lanes due to the new ramp to the southbound Express Lanes from Eads Street, north of Army Navy Drive, which would offset any increases in traffic volumes on the Hayes Street ramp associated with the ramp removal.

- **Washington Boulevard / Columbia Pike Interchange:** Pentagon motorists parking in the western portion of the Pentagon South Parking lot (west of Fern Street) destined for the southbound I-395 general purpose lanes are likely already using the Washington Boulevard / Columbia Pike Interchange to access the ramp to the southbound I-395 general purpose lanes. Because the Washington Boulevard entrance ramp is located farther downstream along the southbound I-395 general purpose lanes compared to the ramp to be removed, it is not likely that motorists leaving the western portion of the Pentagon South Parking lot are currently backtracking to the east to access the ramp to be removed.

  Some motorists in the eastern and central portions of the Pentagon South Parking lot (east of Fern Street) may divert to the Washington Boulevard / Columbia Pike Interchange to access the southbound I-395 general purpose lanes; however, some Pentagon motorists would be relocated from this interchange since non-HOV motorists would now have the option to pay to use the Express Lanes via the Eads Street ramp. Based on a review of traffic volumes between 2020 No Build and Build conditions at the Washington Boulevard / Columbia Pike Interchange, roadway segment and ramp traffic volumes during the PM peak hour do not change by more than approximately 50 vehicles per hour due to the revisions to access associated with the I-395 Express Lanes project.

- **Boundary Channel Drive Interchange:** Pentagon Reservation motorists that have work places or parking spaces at the north end of the Pentagon Reservation that are using the ramp to be removed would potentially use the Boundary Channel Drive Interchange to access the southbound I-395 general purpose lanes. However, it is unlikely that motorists in the Pentagon South Parking lot would use the Boundary Channel Drive Interchange to access the southbound I-395 general purpose lanes because they would be "backtracking" against the very congested flow of the southbound I-395 general purpose lanes during the PM peak hour. Based on a review of traffic volumes between 2020 No Build and Build conditions along Boundary Channel Drive, traffic volumes during the PM peak hour do not change by more than approximately 50 vehicles per hour due to revisions to access associated with the I-395 Express Lanes project.

Based on a survey of Pentagon staff performed as part of the Pentagon Master Plan, a very low percentage (16 percent) of Pentagon employees drive to work alone due to limited parking at the Pentagon Reservation and incentives offered to Pentagon employees to encourage transit and demand management programs. Most employees participate in carpools (both formal and informal) and/or take transit including both commuter buses and Metrorail. Additionally, the Build Alternative would eliminate approximately 373 of the existing 749 parking spaces (50 percent reduction) from the eastern portion of the Pentagon South Parking lot creating an increase in carpools/slugging and transit usage as a result of the Build Alternative and a reduction in the number of motorists exiting the Pentagon Reservation and entering the southbound I-395 general purpose lanes from alternative access points. As discussed above, this parking area within the Pentagon South Parking Lot is the primary origin of Pentagon employees currently using the ramp to be removed.

7.2.5 Shirlington Interchange

The Shirlington Interchange is a non-traditional Rotary interchange that provides access to I-395 from several local roadways including North Quaker Lane, Shirlington Road, Gunston Road, Campbell Avenue, Arlington Mill Drive as well as providing direct access to the HOV lanes to and from the north. The north facing ramp located at the north side of the Rotary currently operates in a northbound direction in the AM peak period and in a southbound direction during the PM peak period. This ramp would be converted to a HOT ramp under Build Conditions which would have an impact on traffic patterns within the Rotary. During the AM peak period when the HOV ramp (future HOT ramp) is operating in a northbound direction, motorists destined for the northbound HOT lanes that previously traveled in the northbound general purpose lanes would travel approximately 250 feet farther around the Rotary to access the northbound HOT ramp. During the PM peak period, motorists exiting the general purpose lanes at the Shirlington Interchange have the option to take the ramp to the Shirlington Road at Arlington Mill Drive intersection or the ramp that enters the Rotary in the southwest quadrant. Motorists from the general purpose lanes that divert to the HOT lanes under Build conditions would enter the Rotary at the north side of the Rotary, changing the traffic patterns on the west side of the Rotary.

Traditional intersection measures of effectiveness cannot be used to adequately assess the operation of a Rotary due to the series of merges and diverges that occur within the circulatory portion of the Rotary. In order to assess the impact of the Build Alternative on operations within the circulatory portion of the Rotary and on the approaches to the Rotary, average travel speeds for each link coded in the VISSIM model were established for existing conditions. **Figure 7-54** depicts the various links within the Rotary Interchange corresponding to the subsequent discussion of operations at the Rotary Interchange under 2020 No Build and Build conditions.

7.2.5.1 AM Peak Hour

Table 7-20 depicts speeds within the Rotary Interchange and on the approaches and departure legs of the Rotary for 2020 No Build and Build conditions for the AM peak period. Also shown are the average speeds for all vehicles traversing the Rotary for each hour and the average speed for the four hour period for all vehicles traversing the Rotary. As shown, the average travel speed is approximately 22 miles per hour for all vehicles during the four hour analysis period under both No Build and Build conditions indicating overall minor changes to the operation of the Rotary under 2020 Build conditions.

As shown in **Table 7-11**, the six study intersections located in the vicinity of the Shirlington Rotary operate under light traffic conditions with the exception of the Martha Custis Drive at Gunston Road intersection that operates under heavy traffic conditions under both 2020 No Build and Build conditions. This increase in delay can be attributed to an increase in traffic volumes weaving across the Rotary from Gunston Road to access Shirlington Road to the west or southbound I-395. Additionally, there is less than a 5 second change in overall intersection delay at all six study intersections when comparing 2020 No Build and Build conditions.

7.2.5.2 PM Peak Hour

Table 7-21 depicts speeds within the Rotary Interchange and on the approaches and departure legs of the Rotary for 2020 No Build and Build conditions for the PM peak period. Also shown are the average speeds for all vehicles traversing the Rotary for each hour and the average speed for the four hour period for all

vehicles traversing the Rotary. As shown, the average travel speed is approximately 22 miles per hour for all vehicles during the four hour analysis period under both No Build and Build conditions indicating overall minor changes to the operation of the Rotary under 2020 Build conditions.

Due to the reassignment of traffic entering the Rotary from the general purpose lanes to the HOT lanes, there is some change in speeds on the west side of the Rotary. Vehicles utilizing the off-ramp from the southbound I-395 HOT lanes to Shirlington Road must travel along more sections of the Rotary compared to vehicles using the off-ramp from the southbound general purpose lanes. As a result, there would be minor decreases in speed along the Rotary segments from the HOT lanes access point around the west side of the Rotary to the southbound I-395 general purpose lane access point. The largest speed decrease occurs on the eastbound Shirlington Road approach to the Rotary (segment 450) with a speed reduction of 3 MPH from 13 MPH to 10 MPH.

The queue length on the southbound I-395 HOT lane off-ramp approaching the Shirlington Rotary would increase from approximately 90 feet under No Build conditions to 200 feet under Build conditions, which less than the storage length of 1650 feet to the gore point along the southbound I-395 HOT lanes.

As shown in **Table 7-22**, the six study intersections located in the vicinity of the Shirlington Rotary operate under light traffic conditions with the exception of the Shirlington Road at Arlington Mill Drive Intersection that operates under moderate traffic conditions under both 2020 No Build and Build conditions. Additionally, there is less than a 3 second change in overall intersection delay at all six study intersections when comparing 2020 No Build and Build conditions.

Figure 7-54: Shirlington Rotary Interchange Link Identifiers

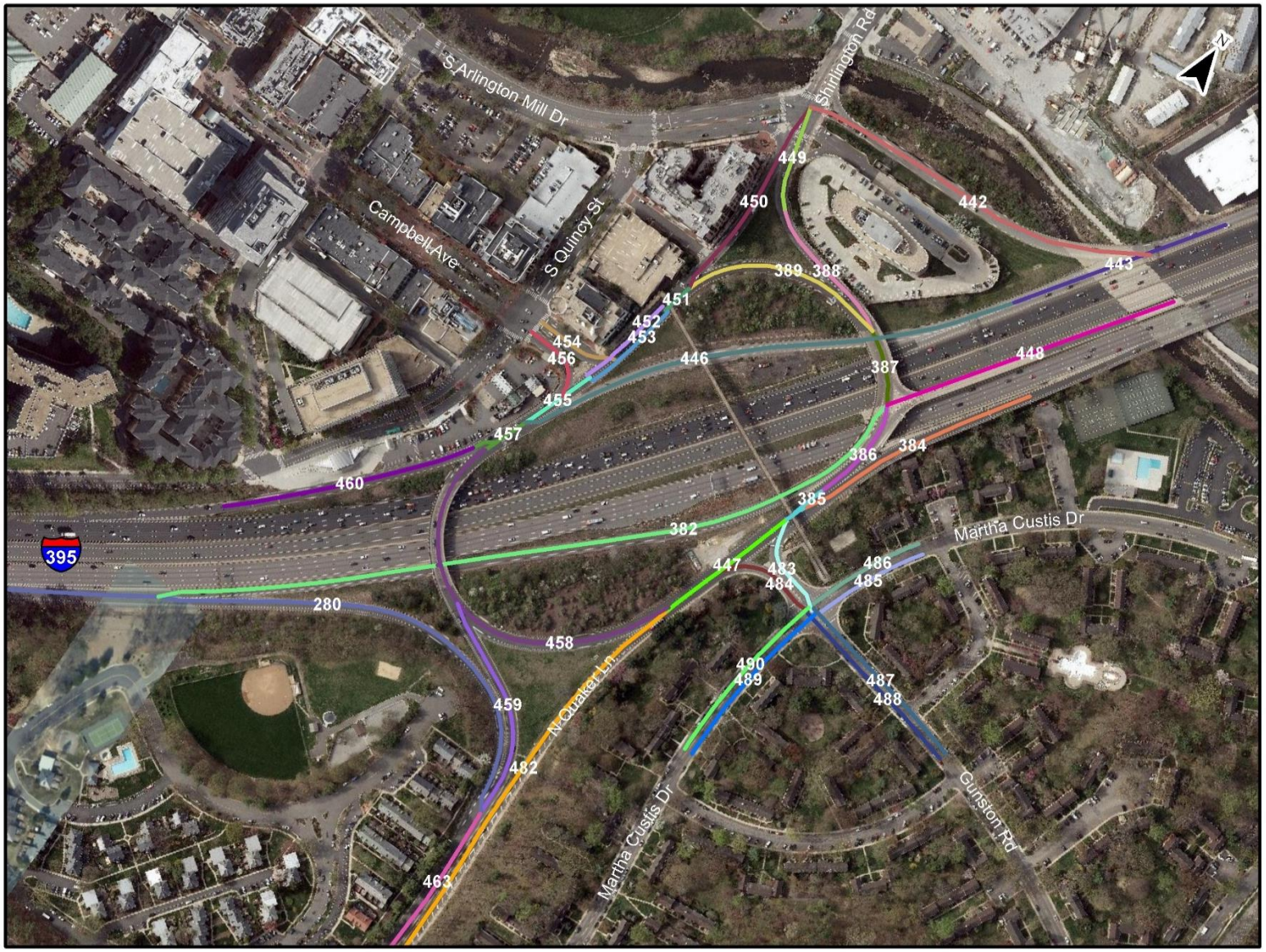


Table 7-20: AM Peak Period Speed by Segment (2020 No Build and Build Conditions) Shirlington Rotary Interchange

Segment		2020 No Build Conditions				2020 Build Conditions			
		Avg Speed (mph)				Avg Speed (mph)			
		6-7 AM	7-8 AM	8-9 AM	9-10 AM	6-7 AM	7-8 AM	8-9 AM	9-10 AM
WB Rotary	387	26	25	21	25	25	25	22	24
SB Rotary	389	28	27	27	27	28	27	26	27
WB Shirlington Rd approaching Arlington Mill Dr	388	27	24	19	25	27	24	20	24
EB Shirlington Rd approach Rotary	450	20	15	14	17	20	16	14	16
SB Rotary approaching Campbell Ave	451	19	16	17	16	19	16	17	17
SB Rotary approaching Campbell Ave	453	5	6	6	6	5	6	6	6
SB Rotary approaching Campbell Ave	452	21	21	21	21	21	21	21	21
WB Campbell Ave	454	24	24	24	24	24	24	24	24
EB Shirlington Rd approach Rotary	456	13	10	10	11	13	10	10	11
SB Rotary	455	23	22	22	23	23	23	23	23
SB I-395 C-D Road approaching Rotary	446	28	28	28	27	28	28	28	28
SB Rotary	457	25	23	23	24	25	24	24	25
SB from Rotary to SB I-395 on ramp	460	28	27	28	27	28	27	28	27
NB Rotary approaching Quaker Ln	458	28	27	26	27	28	28	27	28
EB Exit from Rotary to Quaker Ln	459	29	29	29	29	29	29	29	29
NB I-395 off-ramp to Quaker Ln	280	24	25	24	24	25	24	24	24
SB Quaker Ln approaching Preston Rd	463	29	28	28	28	29	28	28	28
NB Quaker Ln approaching Rotary	482	26	23	24	26	27	26	24	27
NB Rotary approaching Gunston Rd	447	24	20	22	25	26	23	23	26
EB Gunston Rd approaching Martha Custis Dr	484	9	6	6	9	9	7	5	9
WB Gunston Rd approaching Rotary	483	8	4	5	7	8	4	5	8
NB Rotary north of Gunston Rd	385	21	16	19	21	23	18	19	22
NB I-395 off-ramp to Rotary	382	24	24	23	24	24	24	23	23
NB Rotary approaching HOV/HOT ramp	386	29	28	27	28	28	27	26	27
NB from Rotary to NB I-395 on ramp	384	20	13	16	18	21	12	16	22
NB/SB HOV/HOT ramp to/from I-395 HOV/HOT	448	34	34	34	31	33	33	33	33
SB I-395 C-D Road approaching Rotary	443	25	24	24	24	25	24	23	24
SB I-395 C-D Road off-ramp to Shirlington Rd	442	8	8	8	8	8	8	8	8
WB approaching Arlington Mill Dr	449	7	6	5	5	7	6	6	6
NB Martha Custis Dr approaching Gunston Rd	489	15	10	12	14	15	10	12	14
SB Martha Custis Dr	490	18	20	20	20	18	20	20	21
WB Gunson Rd approaching Martha Custis Dr	487	12	2	4	10	12	2	2	11
EB Gunston Rd	488	25	25	24	25	25	25	24	25
NB Martha Custis Dr	485	24	24	24	24	23	24	24	23
SB Martha Custis Dr approaching Gunston Rd	486	20	9	14	19	20	11	15	20
Average Speed		23.4	21.3	21.6	22.6	23.4	21.6	21.7	23.0
4 Hour Average Speed		22.1				22.3			

Table 7-21: PM Peak Period Speed by Segment (2020 No Build and Build Conditions) Shirlington Rotary Interchange

Segment		2020 No Build Conditions				2020 Build Conditions			
		Avg Speed (mph)				Avg Speed (mph)			
		3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM
WB Rotary	387	24	25	22	23	24	24	21	22
SB Rotary	389	28	28	27	27	28	28	27	27
WB Shirlington Rd approaching Arlington Mill Dr	388	25	24	16	18	25	21	17	18
EB Shirlington Rd approach Rotary	450	11	13	9	8	10	10	8	8
SB Rotary approaching Campbell Ave	451	13	14	13	13	13	15	13	13
SB Rotary approaching Campbell Ave	453	7	7	7	7	7	7	7	7
SB Rotary approaching Campbell Ave	452	20	20	19	18	19	19	18	18
WB Campbell Ave	454	24	24	24	24	24	24	24	24
EB Shirlington Rd approach Rotary	456	9	10	8	9	9	10	8	9
SB Rotary	455	23	23	18	21	23	23	20	22
SB I-395 C-D Road approaching Rotary	446	27	25	24	25	27	25	24	26
SB Rotary	457	24	23	19	21	24	24	21	22
SB from Rotary to SB I-395 on ramp	460	19	13	10	16	22	16	11	18
NB Rotary approaching Quaker Ln	458	28	28	26	27	28	27	26	27
EB Exit from Rotary to Quaker Ln	459	29	29	29	29	29	29	29	28
NB I-395 off-ramp to Quaker Ln	280	24	24	24	24	24	24	24	23
SB Quaker Ln approaching Preston Rd	463	27	27	25	26	27	27	25	25
NB Quaker Ln approaching Rotary	482	27	26	26	25	27	25	25	25
NB Rotary approaching Gunston Rd	447	26	24	24	22	26	21	23	23
EB Gunston Rd approaching Martha Custis Dr	484	9	7	8	7	9	6	7	7
WB Gunston Rd approaching Rotary	483	9	8	7	5	9	8	7	6
NB Rotary north of Gunston Rd	385	23	22	20	19	23	22	20	20
NB I-395 off-ramp to Rotary	382	24	23	23	23	23	23	23	23
NB Rotary approaching HOV/HOT ramp	386	28	28	27	27	28	28	27	27
NB from Rotary to NB I-395 on ramp	384	22	22	22	22	22	22	22	22
NB/SB HOV/HOT ramp to/from I-395 HOV/HOT	448	34	34	34	34	34	33	33	34
SB I-395 C-D Road approaching Rotary	443	22	17	20	21	21	16	14	22
SB I-395 C-D Road off-ramp to Shirlington Rd	442	8	8	8	8	9	8	8	8
WB approaching Arlington Mill Dr	449	5	4	4	4	6	5	4	4
NB Martha Custis Dr approaching Gunston Rd	489	16	15	14	15	16	15	14	15
SB Martha Custis Dr	490	23	23	22	22	23	23	22	22
WB Gunson Rd approaching Martha Custis Dr	487	13	13	12	9	13	12	12	10
EB Gunston Rd	488	25	25	25	25	25	25	25	25
NB Martha Custis Dr	485	24	24	24	24	24	24	24	24
SB Martha Custis Dr approaching Gunston Rd	486	20	18	17	12	20	18	17	16
Average Speed		22.9	22.3	21.3	21.2	22.9	21.9	21.2	21.6
4 Hour Average Speed		21.8				21.9			

Table 7-22: Intersection Delay Summary (2020 No Build and Build Conditions)
Shirlington Rotary Interchange

Intersection		2020 No Build Conditions			2020 Build Conditions		
		Intersection Control	Average Delay (sec)		Intersection Control	Average Delay (sec)	
			AM Peak (7-8 AM)	PM Peak (5-6 PM)		AM Peak (7-8 AM)	PM Peak (5-6 PM)
19	S Shirlington Rd at S Arlington Mill Dr	Signalized	26.1	53.1	Signalized	25.7	50.2
22	S Shirlington Rd at Campbell Ave	Signalized	22.8	31.3	Signalized	22.8	31.7
23	Shirlington Rotary at HOV Ramp	Unsignalized	2.7	2.6	Unsignalized	2.4	2.9
26	N Quaker Ln at Gunston Rd	Unsignalized	11.8	5.0	Unsignalized	8.0	5.6
27	Martha Custis Dr at Gunston Rd	Unsignalized	60.1	15.0	Unsignalized	58.5	14.5
30	N Quaker Ln at Preston Rd	Signalized	11.6	16.0	Signalized	10.5	15.7

7.3 2040 NO BUILD AND BUILD CONDITIONS TRAFFIC OPERATIONS

7.3.1 Freeway Travel Time Analysis

7.3.1.1 AM Peak Period

A comparison of overall corridor travel times for existing conditions, 2040 No Build conditions, and 2040 Build conditions is summarized in **Figure 7-55** for the northbound peak travel direction for each of the four analysis hours. **Figures 7-56 through 7-59** summarize cumulative and segment travel times for the northbound and southbound I-395 general purpose and HOV/HOT lanes for each of the four analysis hours during the AM peak period between interchanges along the corridor. **Table 7-23** presents 2040 No Build and Build overall travel times and segment travel times for the northbound and southbound I-395 general purpose and HOV/HOT lanes for each of the four analysis hours during the AM peak period between interchanges along the corridor.

AM Peak Period – Northbound General Purpose Lanes (Peak Direction)

Under 2040 No Build conditions, travel times along the northbound I-395 general purpose lanes range from 30 to 65 minutes with the longest travel times observed between 8 AM and 9 AM. The average travel time during the four hour AM peak period is 51 minutes. Travel times increase by 11 to 24 minutes compared to existing conditions in the AM peak period. A large portion of the travel time increase (average of 6 minutes) occurs south of the Turkeycock Run Interchange. This is a result of the congestion and queuing along northbound I-395 extending farther to the south during peak hours. The average travel time increase of 5 minutes over the four peak hours between Glebe Road and Washington Boulevard is due to further increases in traffic volumes in this portion of the corridor which is already operating over capacity during peak hours.

Under 2040 Build conditions, travel times along the northbound I-395 general purpose lanes range from 25 to 63 minutes. Overall travel times decrease by an average of 6 minutes over the four hours with a 6 minute increase from 7 AM to 8 AM and a 22 minute decrease from 9 AM to 10 AM. The largest travel time benefits are observed in the southern portion of the corridor from south of Edsall Road to Seminary Road with travel time reductions averaging approximately 5 minutes. Average travel times from Shirlington Road to the northern study limits decrease by approximately 1 minute over the four hours. The increases in travel times from 7 AM to 8 AM are during the period when demand for the HOT lanes is highest, and in order to maintain travel speeds in the HOT lanes, traffic would be shifted from the HOT lanes to the general purpose lanes at points north of Eads Street where no improvement to the HOV lanes or general purpose lanes would occur. Additionally, due to reduced congestion in the southern portion of the study area in the 6 AM to 7 AM hour south of King Street, northbound I-395 general purpose traffic would arrive at the northern portion of the study area more quickly, degrading traffic operations from Shirlington Road to Boundary Channel Drive.

AM Peak Period – Northbound HOV/HOT Lanes (Peak Direction)

Under 2040 No Build conditions, travel times along the northbound I-395 HOV/HOT lanes range from 11 to 19 minutes. From 8 AM to 9 AM, travel times increase by 4 minutes compared to existing conditions and travel times increase by an average of 2 minutes over the four hour period. Travel times increase south of Turkeycock Run as northbound motorists in the HOT lanes attempt to exit to the general purpose lanes

at Turkeycock Run and encounter greater congestion in the general purpose lanes compared to existing conditions. Travel times also increase between Eads Street and 14th Street in Washington, D.C. as a result of higher traffic volumes and congestion levels in this section where the HOV lanes are open to travel by all motorists.

Under 2040 Build conditions, travel times along the northbound I-395 HOT lanes range from 11 to 15 minutes. Overall travel times decrease by an average of 2.5 minutes. The largest travel time decreases (6 minutes) are observed from 8 AM to 9 AM. Travel times decrease south of Turkeycock Run as northbound motorists in the HOT lanes have the option to continue in the HOT lanes rather than exit to the general purpose lanes if they are not HOV motorists. Travel times are also reduced by approximately 1 minute between Eads Street and 14th Street as a result of lower traffic volumes in this section compared to No Build conditions.

AM Peak Period – Southbound General Purpose Lanes (Off-Peak Direction)

Under 2040 No Build conditions, travel times along the southbound I-395 general purpose lanes range from 12 to 15 minutes. Travel times along the southbound I-395 general purpose lanes increase by approximately 2 minutes between existing conditions and 2040 No Build Conditions with the largest increases in delays and reductions in speeds occurring exiting D.C. and approaching George Washington Memorial Parkway and Boundary Channel Drive.

Under 2040 Build conditions, travel times along the southbound I-395 general purpose lanes range from 12 to 15 minutes and remain approximately the same when comparing 2040 No Build to Build conditions.

AM Peak Period – Southbound HOV Lanes (Off-Peak Direction)

Under 2040 No Build conditions, travel times along the southbound I-395 HOV lanes range from 2 to 6 minutes with an average travel time of 3 minutes. Travel times increase by an average of 1 minute between existing conditions and 2040 No Build Conditions with the highest delay increases from 8 AM to 9 AM.

Under 2040 Build conditions, the southbound I-395 HOV lanes terminate north of the Eads Street Interchange and motorists are required to exit to the general purpose lanes in the vicinity of the Boundary Channel Drive Interchange or at the Eads Street Interchange. Under 2040 Build conditions, travel times along the southbound I-395 HOV lanes range from 2 to 4 minutes. Travel times along the portion of the southbound I-395 HOV lanes that would remain open increase by approximately 1.5 minutes from 9 AM to 10 AM and decrease by approximately 1.5 minutes from 8 to 9 AM. Travel times increase by less than 5 seconds when comparing 2040 No Build to Build conditions over the four hour AM peak period.

Figure 7-55: AM Peak Period - Northbound Overall Travel Time Summary (Existing and 2040)

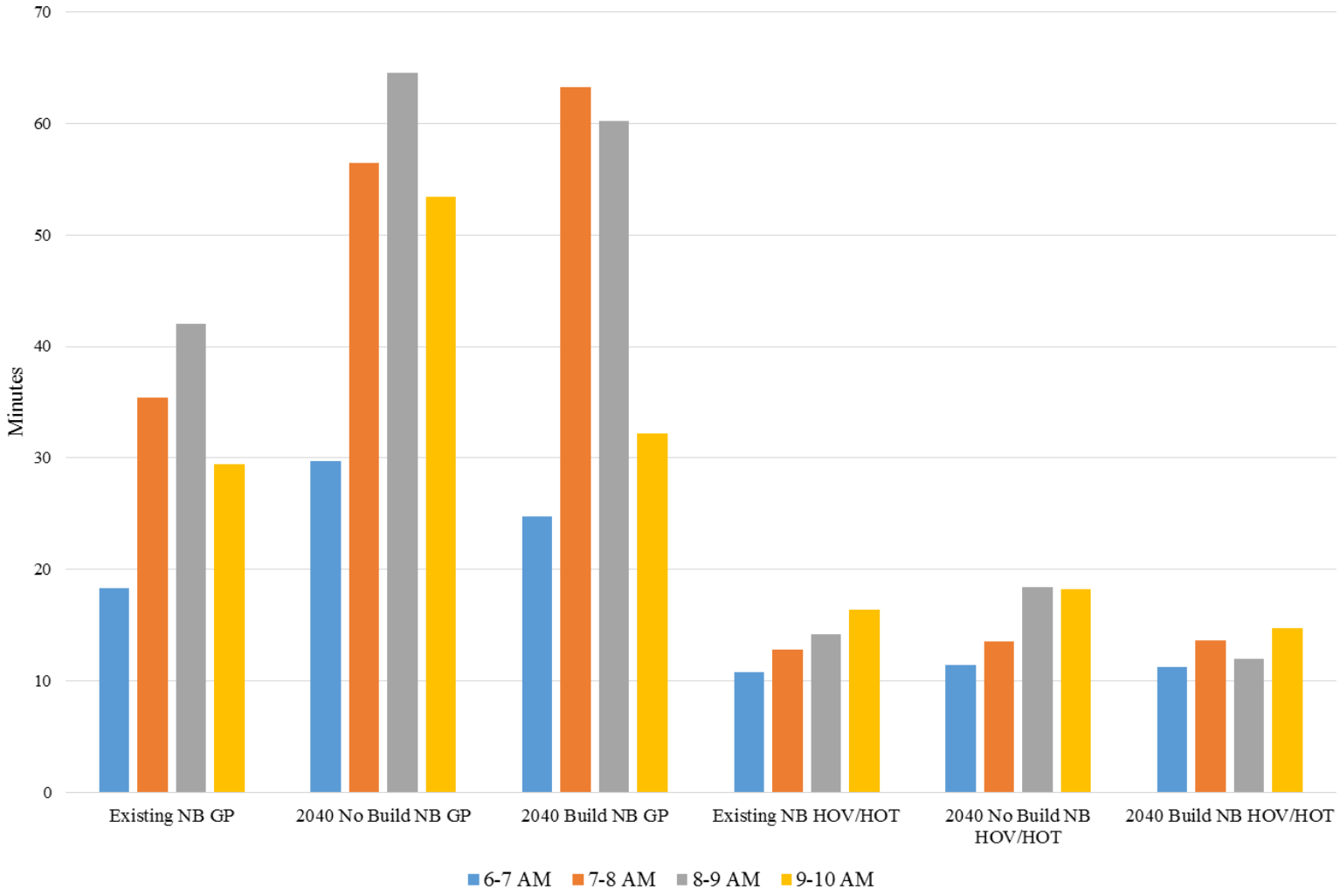


Figure 7-56: AM Peak Period - Northbound General Purpose Lanes Cumulative Travel Times (Existing and 2040)

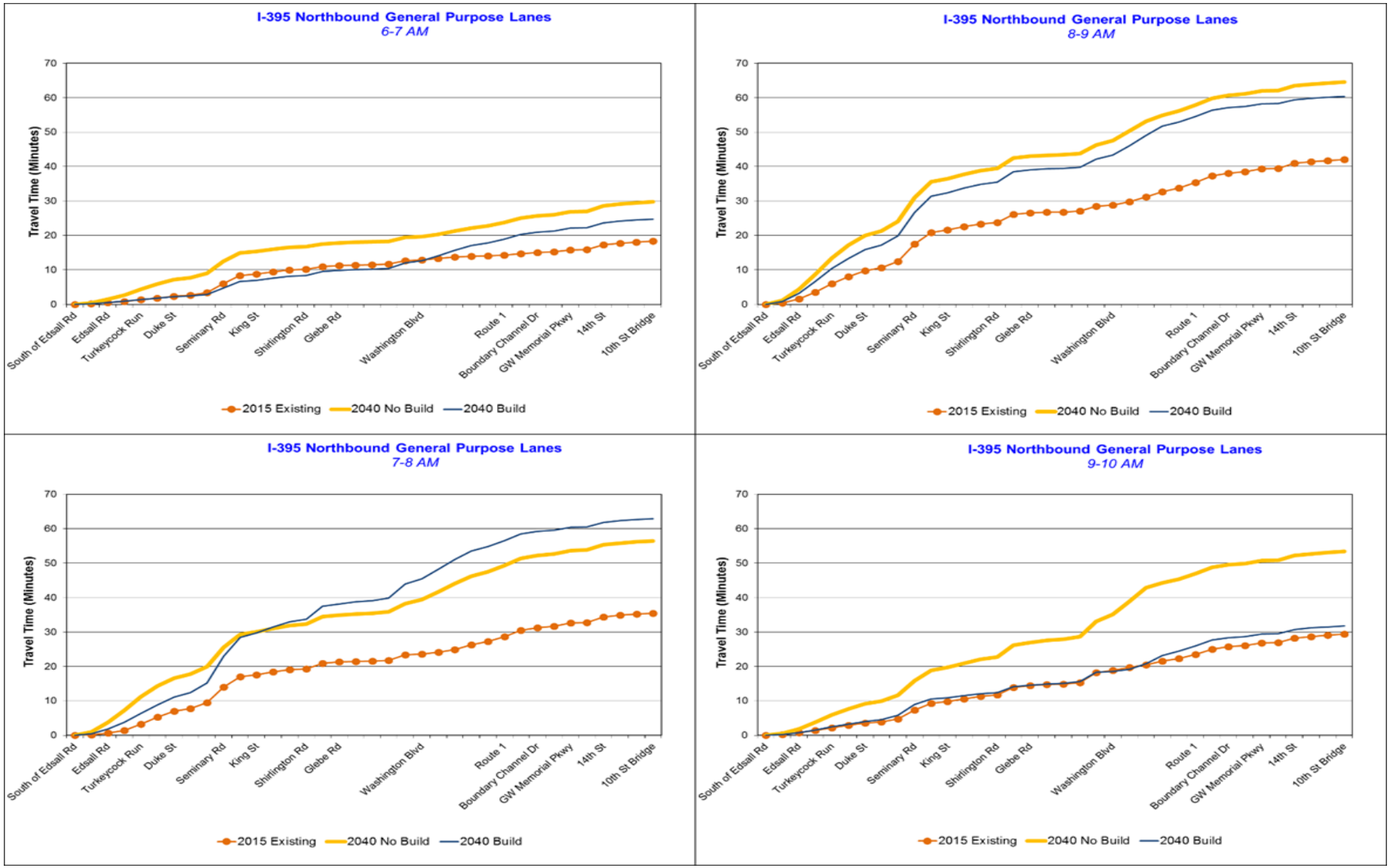


Figure 7-57: AM Peak Period - Northbound HOV/HOT Lanes Cumulative Travel Times (Existing and 2040)

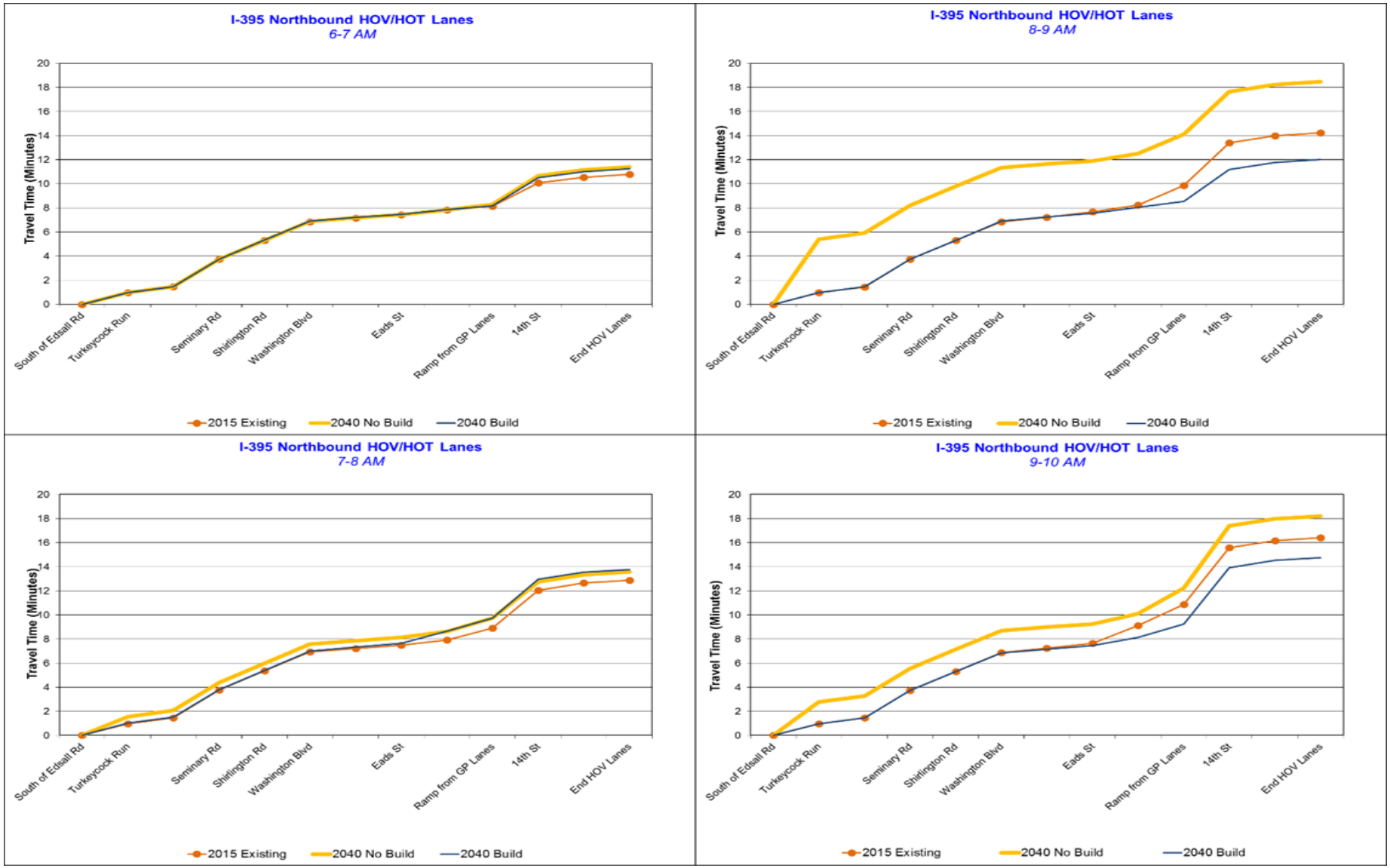


Figure 7-58: AM Peak Period – Southbound General Purpose Lanes Cumulative Travel Times (Existing and 2040)

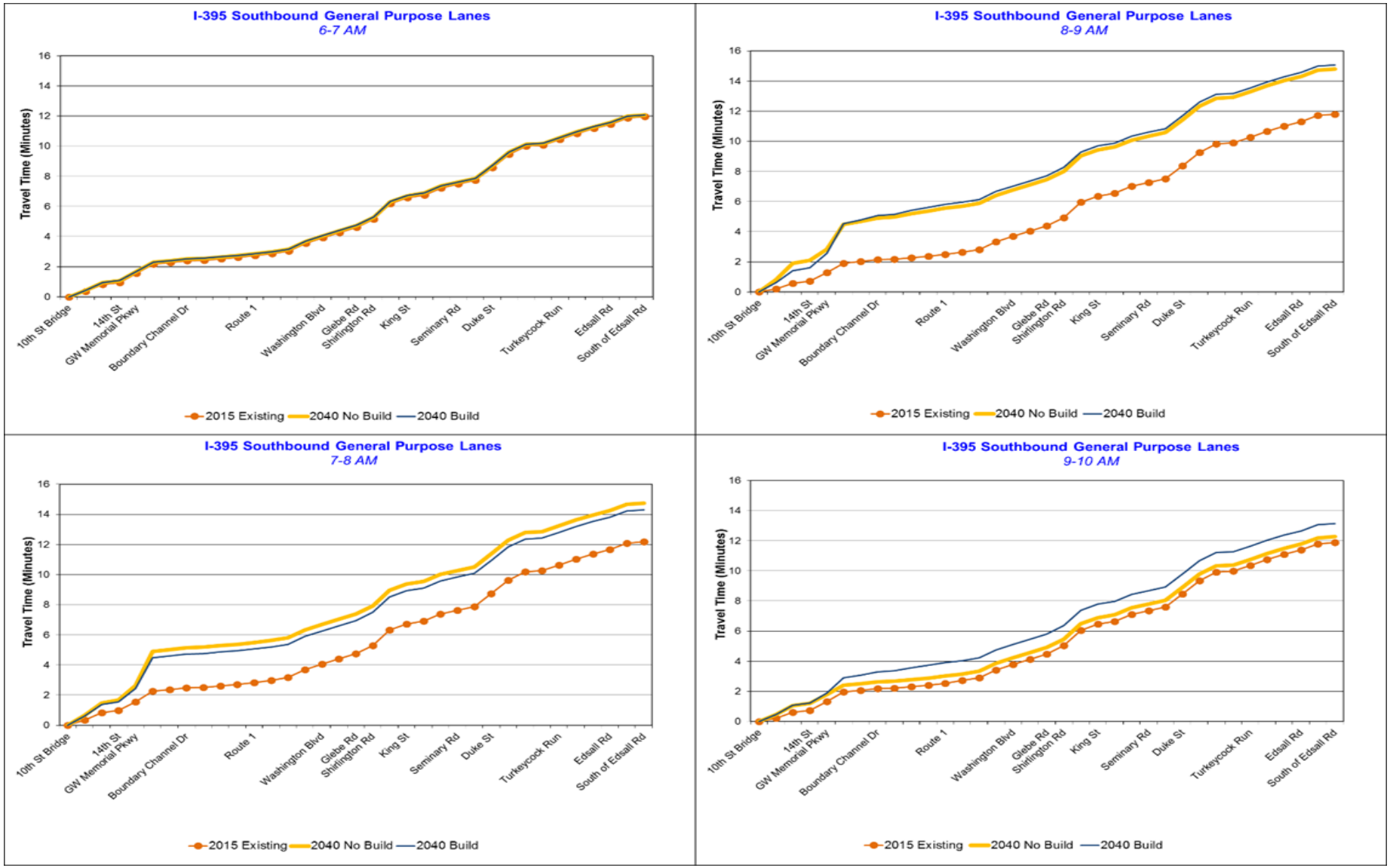


Figure 7-59: AM Peak Period – Southbound HOV Lanes Cumulative Travel Times (Existing and 2040)

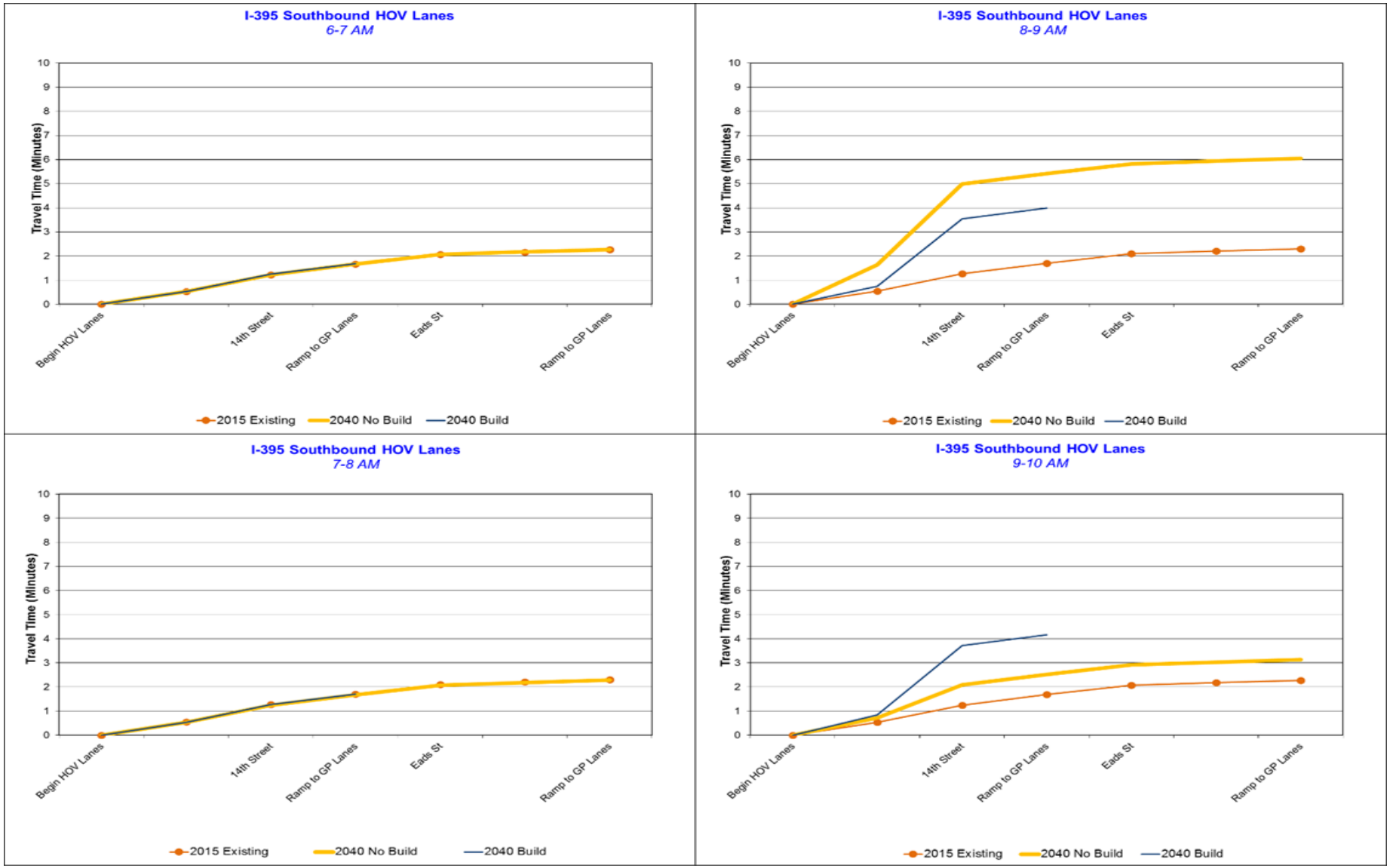


Table 7-23: AM Peak Period – Travel Time Summary (2040 No Build and Build Conditions)

Segment	2040 No Build Travel Time (Min)				2040 Build Travel Time (Min)			
	6-7 AM	7-8 AM	8-9 AM	9-10 AM	6-7 AM	7-8 AM	8-9 AM	9-10 AM
Northbound General Purpose Lanes								
South of Edsall Rd to Turkeycock Run	4.4	11.2	13.5	5.9	1.3	6.4	10.2	2.6
Tukeycock Run to Duke St	2.8	5.5	6.5	3.2	0.9	4.8	5.4	1.7
Duke St to Seminary Rd	5.3	8.9	11.0	6.7	2.4	11.9	10.7	5.0
Seminary Rd to King St	2.9	4.4	5.5	3.9	2.3	6.9	5.6	2.1
King St to Shirtlington Rd	1.4	2.3	3.0	3.1	1.4	4.0	3.0	1.5
Shirlington Rd to Glebe Rd	1.1	2.6	3.5	4.2	1.5	4.4	3.6	2.1
Glebe Rd to Washington Blvd	3.4	9.1	10.1	15.9	5.8	12.8	10.2	6.1
Washington Blvd to Route 1	2.5	5.3	4.8	4.1	3.3	5.5	5.5	5.2
Route 1 to Boundary Channel Dr	1.9	2.9	2.8	2.6	2.0	2.7	2.5	2.4
Boundary Channel Drive to GW Memorial Pkwy	1.2	1.5	1.3	1.2	1.2	1.2	1.1	1.1
GW Memorial Pkwy to 14th St	1.7	1.6	1.5	1.5	1.5	1.4	1.2	1.3
14th St to 12th St Exp Ramp	1.1	1.1	1.1	1.2	1.1	1.0	1.0	1.1
Total	**29.7**	**56.4**	**64.5**	**53.4**	**24.7**	**63.2**	**60.2**	**32.2**
Average	**51.0**				**45.1**			
Southbound General Purpose Lanes								
Ramp from 9th St Expy	1.1	1.7	2.1	1.2	1.1	1.5	1.6	1.2
14th St to GW Memorial Pkwy	0.6	1.0	0.8	0.6	0.6	0.9	1.0	0.7
GW Memorial Pkwy to Boundary Channel Dr	0.8	2.5	2.1	0.9	0.8	2.3	2.5	1.4
Boundary Channel Dr to Route 1	0.3	0.3	0.6	0.4	0.3	0.3	0.7	0.6
Route 1 to Washington Blvd	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Washington Blvd to Glebe Rd	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Glebe Rd to Shirlington Rd	0.5	0.6	0.6	0.6	0.5	0.6	0.6	0.6
Shirlington Rd to King St	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
King St to Seminary Rd	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Seminary Road to Duke St	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Duke St to Turkeycock Run	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
Turkeycock Run to South of Edsall Rd	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Total	**12.1**	**14.7**	**14.8**	**12.3**	**12.1**	**14.3**	**15.0**	**13.2**
Average	**13.5**				**13.6**			
Northbound HOV/HOT Lanes								
South of Edsall Rd to Turkeycock Run	1.0	1.6	5.4	2.8	1.0	1.0	1.0	1.0
Turkeycock Run to Seminary Road	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
Seminary Rd to Shirlington Rd	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
Shirlington Rd to Washington Blvd	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
Washington Blvd to Eads St	0.6	0.6	0.6	0.6	0.5	0.6	0.6	0.6
Eads St to Ramp from GP Lanes	0.9	1.6	2.2	3.0	0.7	2.0	1.0	1.8
Ramp from GP Lanes to 14th St	2.4	3.0	3.5	5.2	2.3	3.2	2.7	4.7
14th St to End HOV Lanes	0.7	0.8	0.8	0.8	0.7	0.8	0.8	0.8
Total	**11.4**	**13.6**	**18.5**	**18.2**	**11.2**	**13.6**	**12.0**	**14.7**
Average	**15.4**				**12.9**			
Southbound HOV/HOT Lanes								
Begin HOV Lanes to 14th St	1.2	1.2	5.0	2.1	1.2	1.3	3.4	3.7
14th St to Ramp to GP Lanes	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Ramp to GP Lanes to Eads St	0.4	0.4	0.4	0.4	0.0	0.0	0.0	0.0
Eads St to Ramp to GP Lanes	0.2	0.2	0.2	0.2	0.0	0.0	0.0	0.0
Total	**2.3**	**2.3**	**6.0**	**3.1**	**1.7**	**1.7**	**3.9**	**4.1**
Average	**3.4**				**2.8**			

7.3.1.2 PM Peak Period

A comparison of overall corridor travel times for existing conditions, 2040 No Build conditions, and 2040 Build conditions is summarized in **Figure 7-60** for the southbound peak travel direction for each of the four analysis hours. **Figures 7-61 through 7-64** summarize cumulative travel times for the northbound and southbound I-395 general purpose and HOV/HOT lanes for each of the four analysis hours during the PM peak period between interchanges along the corridor. **Table 7-24** presents 2040 No Build and Build overall travel times and segment travel times for the northbound and southbound I-395 general purpose and HOV/HOT lanes for each of the four analysis hours during the PM peak period between interchanges along the corridor.

PM Peak Period – Southbound General Purpose Lanes (Peak Direction)

Under 2040 No Build conditions, travel times along the southbound I-395 general purpose lanes range from 18 to 40 minutes with the longest travel times observed between 4 PM and 6 PM. The average travel time during the four hour PM peak period is 30 minutes. Under 2040 No Build conditions, travel times along the southbound I-395 general purpose lanes decrease by 1 to 8 minutes compared to exiting conditions in the PM peak period with an average decrease of 3 minutes. This can be attributed to the I-395 4th Lane Southbound – Duke Street to Edsall Road widening project which is included in the No Build conditions. Travel times from the northern study limits to Boundary Channel Drive increase by an average of 5 minutes with increases of up to 7 minutes occurring between 5 PM and 6 PM.

Under 2040 Build conditions, travel times along the southbound I-395 general purpose lanes range from 16 to 27 minutes with an average travel time of 21 minutes. Overall travel times decrease by 3 to 13 minutes with an average travel time decrease of 9 minutes over the four hour PM peak period. The highest travel time reductions occur from 4 to 5 PM (13 minutes). Travel times decrease incrementally throughout the study limits when comparing 2040 No Build to Build conditions.

PM Peak Period – Southbound HOV/HOT Lanes (Peak Direction)

Under 2040 No Build conditions, travel times along the southbound I-395 HOV/HOT lanes are approximately 10 minutes. Travel times remain approximately the same in the southbound HOV/HOT lanes when comparing existing to No Build conditions with average increases of approximately 10 seconds. Delay increases of approximately 15 seconds occur in the southbound HOV lanes approaching Turkeycock Run as motorists exiting the HOV lanes encounter congestion in the general purpose lanes.

Under 2040 Build conditions, travel times along the southbound I-395 HOV/HOT lanes are approximately 10 minutes with average travel time reductions of approximately 15 seconds when comparing No Build to Build conditions. There is an average travel time reduction between 2040 No Build and Build conditions of approximately 15 seconds between Seminary Road and Turkeycock Run where there is less congestion at the Turkeycock Run Interchange where HOT motorists are no longer required to exit from the HOV lanes to the general purpose lanes under Build conditions.

PM Peak Period – Northbound General Purpose Lanes (Off-Peak Direction)

Under 2040 No Build conditions, travel times along the northbound I-395 general purpose lanes range from 13 to 25 minutes with the longest travel times observed between 5 PM and 7 PM. The average travel time during the four hour PM peak period is 20 minutes. Travel times along the northbound I-395 general purpose lanes increase by an average of 8 minutes between existing conditions and 2040 No Build conditions with the majority of the travel time increases occurring between Washington Boulevard and the northern study limits. This is due to a lack of available capacity in D.C. to accommodate any increase in the reverse commute pattern in the PM peak period.

Under 2040 Build conditions, travel times along the northbound I-395 general purpose lanes range from 13 to 25 minutes similar to 2040 No Build conditions with some increases in delay between Glebe Road and Boundary Channel Drive (approximately 1 minute) due to higher volumes in the general purpose lanes compared to the HOV lanes under Build conditions.

PM Peak Period – Northbound HOV/HOT Lanes (Off-Peak Direction)

Under 2040 No Build conditions, travel times along the northbound I-395 HOV lanes range from 2.5 to 4 minutes with average travel times of approximately 3 minutes. Travel times increase by approximately 30 seconds due to higher traffic volumes in the unenforced portion of the HOV lanes.

Under 2040 Build conditions, travel times along the northbound I-395 HOT lanes range from 2.5 to 3 minutes. Overall travel times decrease by an average of 40 seconds due to reduced volumes in the HOT lanes compared to No Build conditions with delay reductions of approximately 2 minutes from 5 PM to 6 PM.

Figure 7-60: PM Peak Period - Southbound Overall Travel Time Summary (Existing and 2040)

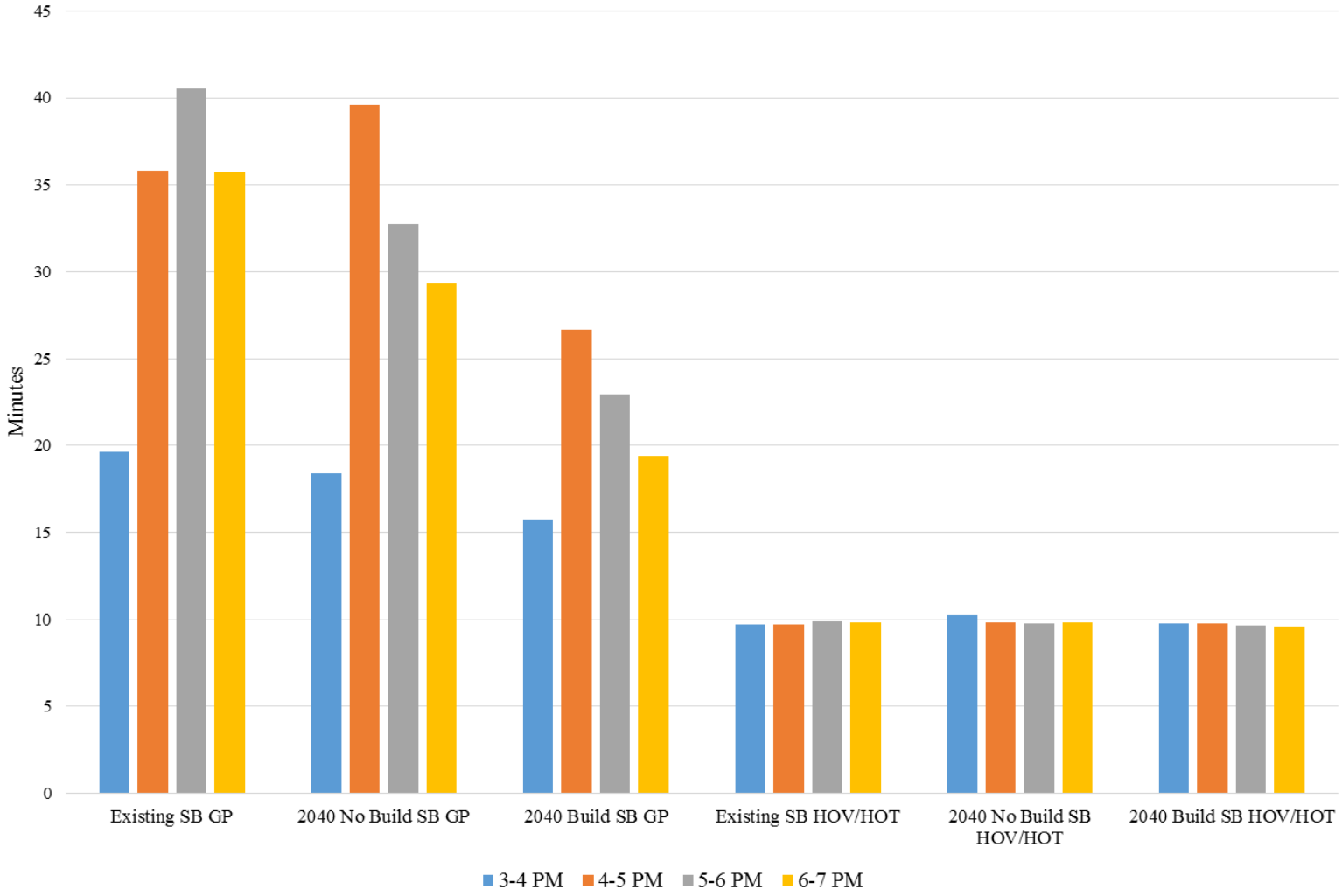


Figure 7-61: PM Peak Period – Southbound General Purpose Lanes Cumulative Travel Times (Existing and 2040)

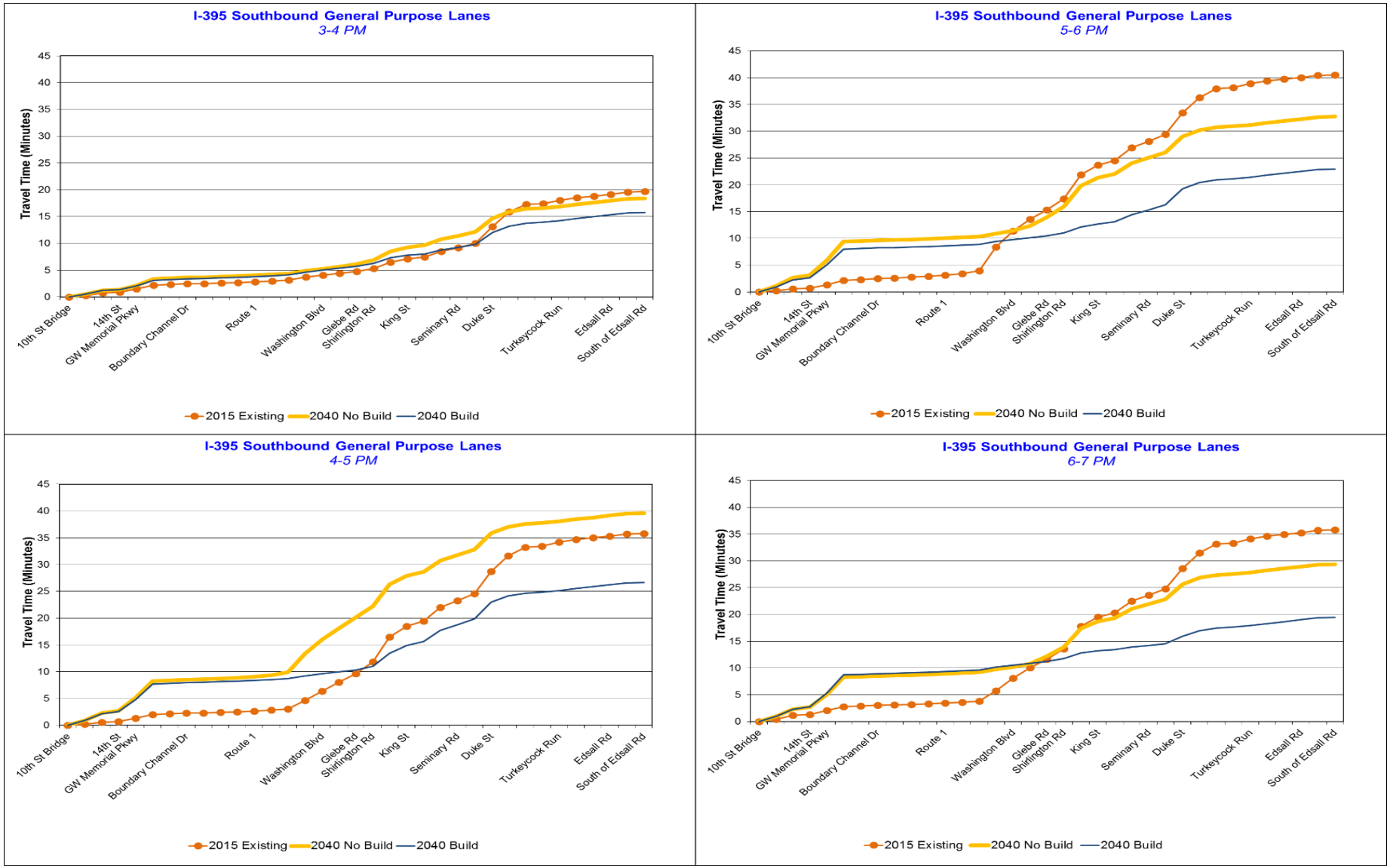


Figure 7-62: PM Peak Period – Southbound HOV/HOT Lanes Cumulative Travel Times (Existing and 2040)

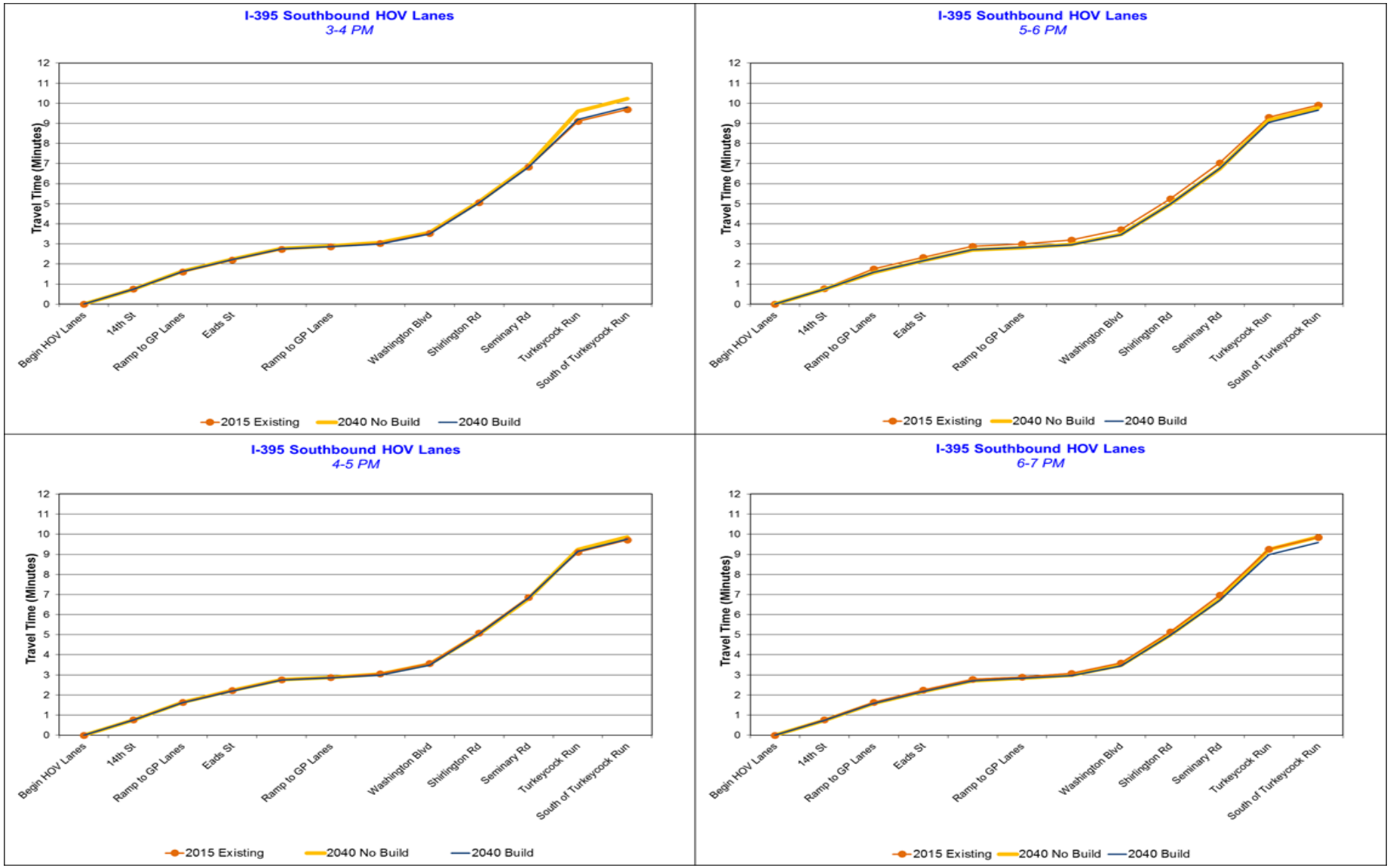


Figure 7-63: PM Peak Period - Northbound General Purpose Lanes Cumulative Travel Times (Existing and 2040)

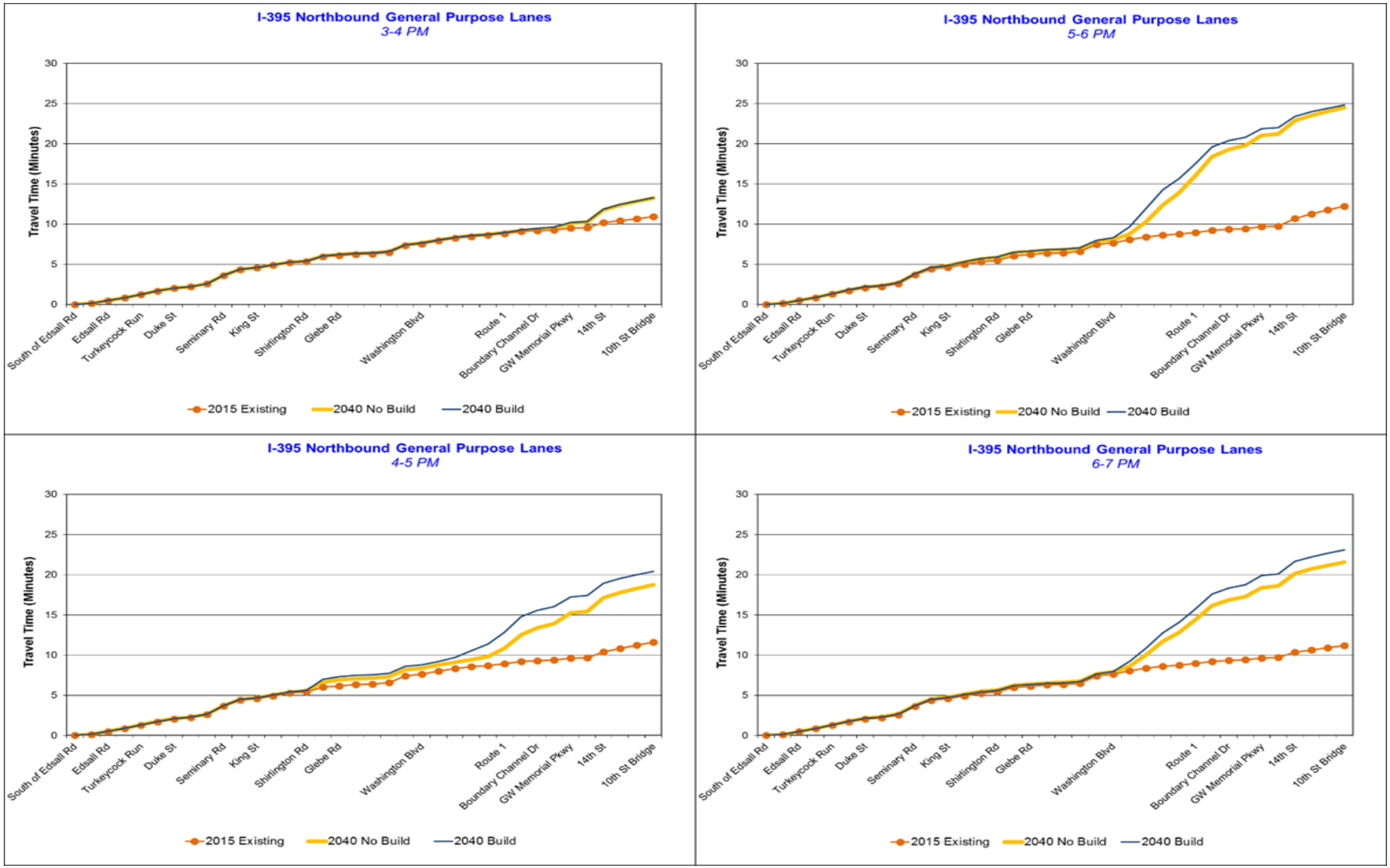


Figure 7-64: PM Peak Period - Northbound HOV/HOT Lanes Cumulative Travel Times (Existing and 2040)

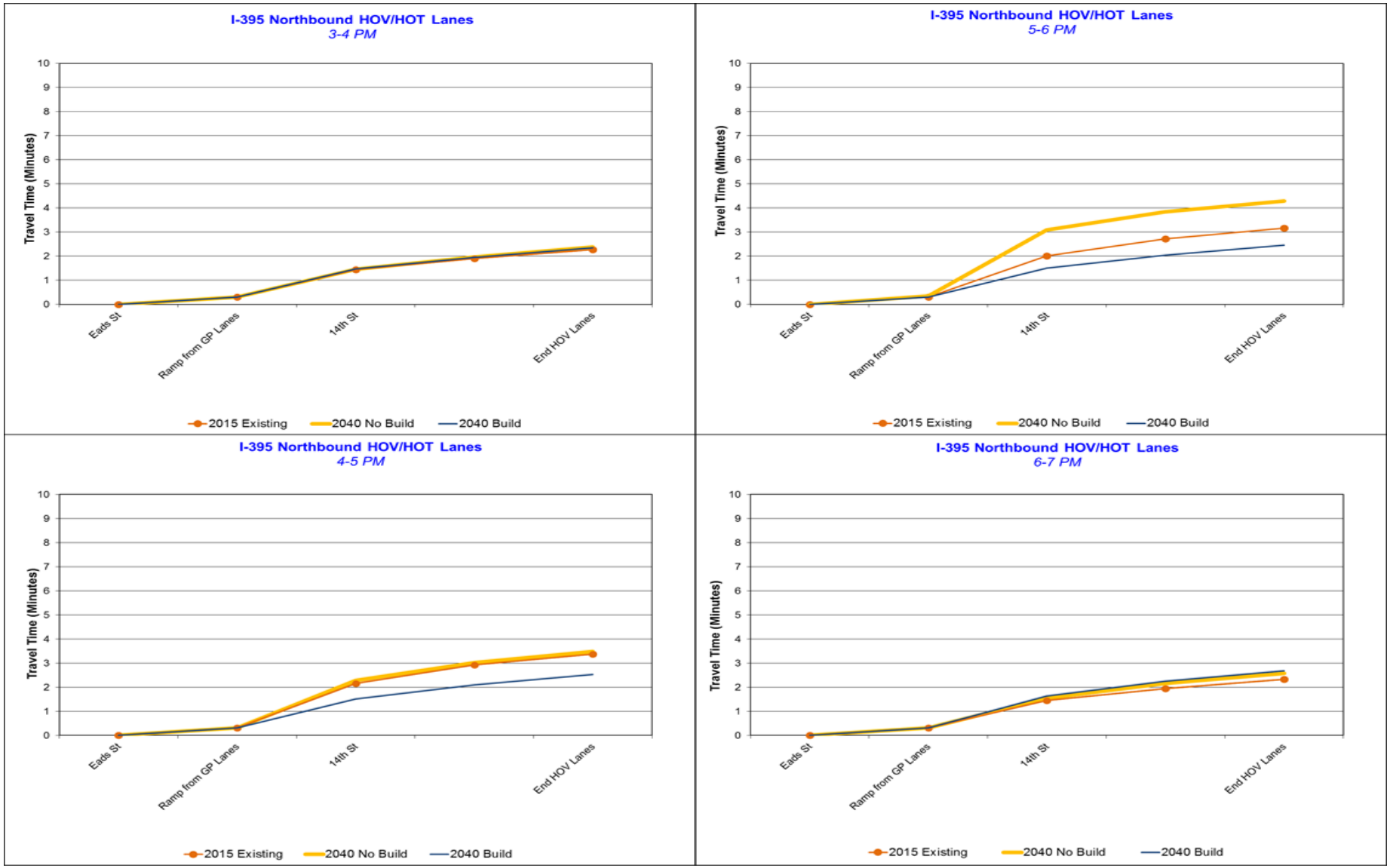


Table 7-24: PM Peak Period – Travel Time Summary (2040 No Build and Build Conditions)

Segment	2040 No Build Travel Time (Min)				2040 Build Travel Time (Min)			
	3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM
Northbound General Purpose Lanes								
South of Edsall Rd to Turkeycock Run	1.3	1.3	1.3	1.3	1.3	1.3	1.4	1.3
Turkeycock Run to Duke St	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Duke St to Seminary Rd	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
Seminary Rd to King St	0.9	1.0	1.0	1.0	1.0	1.0	1.0	1.0
King St to Shirlington Rd	0.8	0.9	1.0	0.9	0.8	0.9	1.0	0.9
Shirlington Rd to Glebe Rd	0.8	1.4	0.7	0.7	0.8	1.7	0.8	0.7
Glebe Rd to Washington Blvd	2.2	2.2	3.7	3.6	2.2	2.4	5.3	4.5
Washington Blvd to Route 1	0.6	1.8	5.8	4.4	0.6	3.1	5.6	4.9
Route 1 to Boundary Channel Dr	0.4	2.5	3.2	2.5	0.5	2.8	2.9	2.6
Boundary Channel Drive to GW Memorial Pkwy	0.7	1.8	1.7	1.5	0.7	1.6	1.5	1.6
GW Memorial Pkwy to 14th St	1.7	1.9	1.8	1.7	1.7	1.7	1.6	1.7
14th St to 12th St Exp Ramp	1.5	1.6	1.6	1.4	1.5	1.5	1.4	1.5
Total	**13.2**	**18.7**	**24.5**	**21.6**	**13.3**	**20.4**	**24.8**	**23.1**
Average	**19.5**				**20.4**			
Southbound General Purpose Lanes								
Ramp from 9th St Expy	1.4	2.7	3.1	2.7	1.4	2.6	2.7	2.7
14th St to GW Memorial Pkwy	0.7	2.4	2.8	2.4	0.7	2.2	2.4	2.6
GW Memorial Pkwy to Boundary Channel Dr	1.5	3.4	3.8	3.5	1.3	3.2	3.2	3.6
Boundary Channel Dr to Route 1	0.4	0.5	0.4	0.4	0.4	0.4	0.4	0.4
Route 1 to Washington Blvd	1.2	7.0	1.4	1.2	1.2	1.2	1.2	1.2
Washington Blvd to Glebe Rd	0.9	4.2	2.5	2.0	0.7	0.7	0.7	0.7
Glebe Rd to Shirlington Rd	0.8	2.1	2.0	1.8	0.6	0.7	0.6	0.6
Shirlington Rd to King St	2.4	5.7	5.4	4.8	1.5	3.8	1.7	1.4
King St to Seminary Rd	2.2	3.8	3.7	3.2	1.4	3.9	2.6	0.9
Seminary Road to Duke St	3.3	4.1	4.0	3.7	2.8	4.2	3.9	1.7
Duke St to Turkeycock Run	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.0
Turkeycock Run to South of Edsall Rd	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Total	**18.4**	**39.6**	**32.7**	**29.3**	**15.8**	**26.7**	**22.9**	**19.4**
Average	**30.0**				**21.2**			
Northbound HOV/HOT Lanes								
Eads St to Ramp from GP Lanes	0.3	0.3	0.4	0.3	0.3	0.3	0.3	0.3
Ramp from GP Lanes to 14th St	1.2	2.0	2.7	1.2	1.2	1.2	1.2	1.3
14th St to End HOV Lanes	0.9	1.2	1.2	1.0	0.9	1.0	1.0	1.0
Total	**2.4**	**3.5**	**4.3**	**2.6**	**2.4**	**2.5**	**2.5**	**2.7**
Average	**3.2**				**2.5**			
Southbound HOV/HOT Lanes								
Begin HOV Lanes to 14th St	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
14th St to Ramp to GP Lanes	0.9	0.9	0.8	0.8	0.9	0.9	0.8	0.8
Ramp to GP Lanes to Washington Blvd	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Eads St to Ramp to GP Lanes	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Ramp to GP Lanes to Washington Blvd	0.7	0.7	0.7	0.7	0.6	0.6	0.6	0.6
Washington Blvd to Shirlington Rd	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Shirlington Rd to Seminary Rd	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.7
Seminary Rd to Turkeycock Run	2.7	2.5	2.4	2.5	2.4	2.3	2.3	2.3
Turkeycock Run to South of Edsall Rd	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Total	**10.2**	**9.9**	**9.8**	**9.9**	**9.8**	**9.8**	**9.6**	**9.6**
Average	**9.9**				**9.7**			

7.3.2 Freeway Density, Speeds, and Queues

7.3.2.1 AM Peak Period

Figures 7-65 and 7-66 summarize 2040 No Build and Build traffic operations based on the freeway segment density measured in vehicles per mile per lane for the northbound and southbound I-395 general purpose and HOV/HOT lanes for each of the four analysis hours from 6 AM through 10 AM. In the 2040 No Build scenario, there are a total of 120 segments including 49 freeway segments, 21 weave segments, and 50 merge/diverge junctions, with minor differences in the segmentation in the Build scenario due to modifications in the vicinity of the Eads Street Interchange.

Figures 7-67 (*Volume* 2) **and 7-68** (*Volume 2*) **and Table 7-25** depict 2040 No Build travel speeds (MPH) and densities (vehicles per mile per lane) along the northbound and southbound I-395 general purpose and HOV/HOT lanes for each of the four analysis hours during the AM peak period. **Figures 7-69** (*Volume 2*) **and 7-70** (*Volume 2*) **and Table 7-26** depict 2040 Build travel speeds and densities. **Appendix J** contains a summary of throughput volumes, travel speeds and densities by lane for both 2040 No Build and Build Conditions.

As shown in **Figure 7-65**, under 2040 No Build conditions in the AM peak period, 94 percent of the 51 northbound I-395 general purpose segments operate with severe congestion and 2 percent operate with heavy congestion. The remaining 4 percent operate with light or moderate traffic conditions. Twenty-four percent of the 21 northbound I-395 HOV/HOT segments operate with severe congestion and 2 percent operate with heavy congestion. The remaining 74 percent operate with light or moderate traffic conditions.

Under 2040 Build conditions in the AM peak period, the number of northbound general purpose segments that operate with severe congestion is reduced from 94 percent to 89 percent with 4 percent of the segments operating with heavy congestion. The number of segments operating with light or moderate traffic conditions increases from 4 percent to 7 percent. The number of segments along the northbound I-395 HOV/HOT lanes that operate with severe or heavy congestion is reduced from 26 percent to 20 percent with the remaining 80 percent operating with light or moderate traffic conditions.

As shown in **Figure 7-66**, under 2040 No Build conditions in the AM peak period, 17 percent of the 41 southbound I-395 general purpose segments operate with severe or heavy congestion and 83 percent operate with light or moderate traffic conditions. Under 2040 Build conditions in the AM peak period, there are minor changes in the operations along the southbound general purpose lanes. The number of segments in the southbound I-395 HOV lanes that operate with severe congestion increases from 11 percent under 2040 No Build conditions to 20 percent under 2040 Build conditions due to the removal of the ramp from the HOV lanes to the general purpose lanes south of the Eads Street Interchange. Under 2040 Build conditions, motorists would be required to exit the HOV lanes in the vicinity of the Boundary Channel Drive Interchange or at the Eads Street Interchange.

Figure 7-65: AM Peak Period Freeway Density Summary (2040 No Build and Build Conditions) Northbound I-395

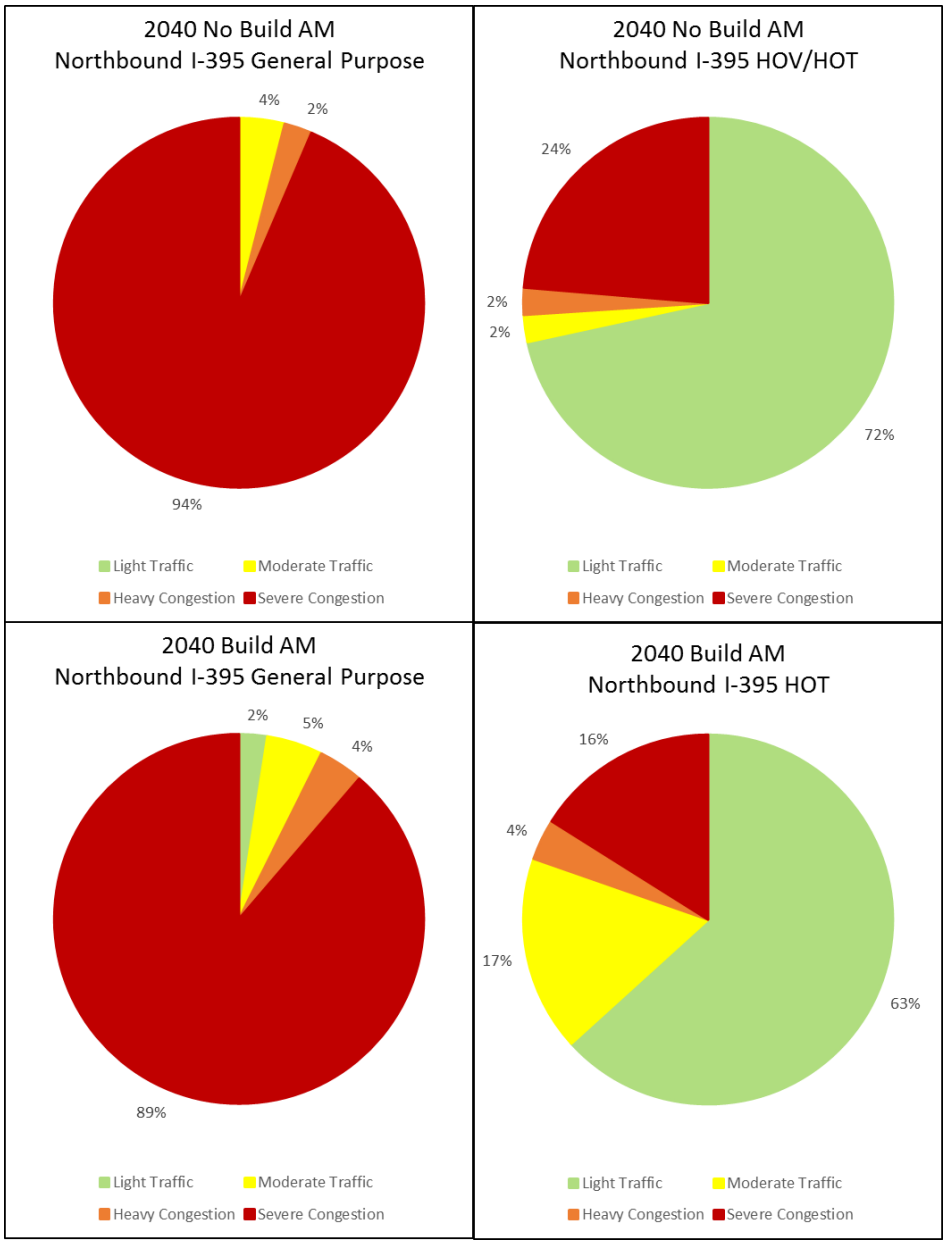


Figure 7-66: AM Peak Period Freeway Density Summary (2040 No Build and Build Conditions) Southbound I-395

Freeway Segments: Under 2040 No Build conditions in the AM peak period, there are a total of 22 freeway segments in the northbound I-395 general purpose lanes. Of these segments, 94 percent operate with severe congestion and 6 percent operate with heavy congestion or moderate traffic conditions. There are a total of ten freeway segments in the northbound I-395 HOV/HOT lanes. Of these segments, 23 percent operate with severe or heavy congestion and 77 percent operate with light or moderate traffic conditions.

Under 2040 Build conditions in the AM peak period, the number of freeway segments along the northbound I-395 general purpose lanes that operate with severe congestion is reduced from 94 percent to 89 percent with 5 percent of the segments operating with heavy congestion. The number of segments operating with light or moderate traffic conditions increases from 4 percent to 6 percent. The number of freeway segments

along the northbound I-395 HOV/HOT lanes that operate with severe congestion is reduced from 20 percent to 15 percent.

Ramp Junctions: Under 2040 No Build conditions in the AM peak period, there are a total of 16 ramp junctions in the northbound I-395 general purpose lanes. Of these segments, 94 percent operate with severe congestion and 6 percent operate with moderate traffic conditions. There are a total of 11 ramp junctions in the northbound I-395 HOV/HOT lanes. Of these segments, 30 percent operate with severe or heavy congestion and 70 percent operate with light or moderate traffic conditions.

Under 2040 Build conditions in the AM peak period, the number of ramp junctions along the northbound I-395 general purpose lanes that operate with severe congestion is reduced from 94 percent to 88 percent. The number of ramp junctions along the northbound I-395 HOV/HOT lanes that operate with severe or heavy congestion is reduced from 30 percent to 20 percent with the remaining 80 percent operating with light or moderate traffic conditions.

Weave Segments: Under 2040 No Build conditions in the AM peak period, there are a total of 13 weave segments in the northbound I-395 general purpose lanes. Of these segments, 94 percent operate with severe congestion, 2 percent operate with heavy congestion, and the remaining 4 percent operate with moderate traffic conditions. There are no weave segments in the northbound HOV/HOT lanes.

Under 2040 Build conditions in the AM peak period, the number of weave segments along the northbound I-395 general purpose lanes that operate with severe congestion is reduced from 94 percent to 88 percent. The number of segments operating with light or moderate traffic conditions increases from 4 percent to 8 percent.

Figures 7-71 through **7-73** depict 2040 No Build and Build speed profiles from the VISSIM model for the northbound and southbound I-395 general purpose and HOV/HOT lanes for each of the four analysis hours during the AM peak period. The following is a summary of the travel speeds when comparing existing, 2040 No Build, and 2040 Build conditions in the peak travel direction.

AM Peak Period – Northbound General Purpose Lanes (Peak Direction): 2040 No Build corridor travel speeds along the northbound I-395 general purpose lanes for the four hours during the AM peak period range from 9 MPH to 20 MPH with an overall average travel speed of 13 MPH. Compared to existing conditions, overall travel speeds decrease by approximately 8 MPH under 2040 No Build conditions and the duration of travel speeds under 25 MPH increases in the 6 AM to 7 AM hour with the entire corridor south of 14th Street operating at 25 MPH or less during all four hours except for between King Street and Washington Boulevard from 6 AM to 7 AM.

Under 2040 Build conditions, travel speeds along the northbound I-395 general purpose lanes range from 10 MPH to 24 MPH with an overall average travel speeds of 16 MPH. Overall travel speeds increase by approximately 3 MPH over the four hour AM peak period compared to No Build conditions. The largest increases in speeds are observed in the 6 AM to 7 AM hour south of Duke Street and in the 9 AM to 10 AM hour south of Washington Boulevard.

AM Peak Period – Northbound HOV/HOT Lanes (Peak Direction): 2040 No Build corridor travel speeds along the northbound I-395 HOV/HOT lanes range from 32 MPH to 52 MPH with average travel speeds of 40 MPH. The lowest travel speeds occur from 8 AM to 10 AM due to non-HOV motorists entering the

northbound I-395 HOV lanes during the 9 AM to 10 AM hour when the HOV restrictions are not in effect and due to high demand for the HOV lanes from 8 AM to 9 AM. Travel speeds decrease by approximately 5 MPH overall during the four hours compared to existing conditions. Travel speeds along the northbound I-395 HOT lanes approaching Turkeycock Run decrease from free flow conditions to 25 to 45 MPH between 7 AM and 10 AM due to congestion caused by non-HOV motorists attempting to exit the northbound I-395 HOT lanes and enter the northbound I-395 general purpose lanes.

Under 2040 Build conditions, travel speeds along the northbound I-395 HOT lanes range from 40 MPH to 53 MPH with an average travel speeds of 47 MPH. Overall travel speeds increase by approximately 6 MPH over the four hour AM peak period compared to No Build conditions with travel speed increases up to 8 to 17 MPH observed from 8 AM to 10 AM when the HOV lanes are most congested under No Build conditions at the northern portion of the study area. Travel speeds in the northbound I-395 HOT lanes approaching Turkeycock Run would operate under free flow conditions during the four hour period compared to the lower travel speeds (25 MPH to 45 MPH) observed under 2040 No Build conditions. There is some reduction in travel speeds in the vicinity of Shirlington Road and the Washington Boulevard access points to the northbound I-395 HOT lanes due to high demand for the HOT lanes under 2040 Build conditions; however, travel speeds are not predicted to reduce below 47 MPH in this area.

Table 7-25: AM Peak Period Freeway Speed and Density by Segment (2040 No Build)

2040 No Build Conditions									
Location	Type	Average Speed (mph)				Average Density (veh/mi/ln)			
		6-7 AM	7-8 AM	8-9 AM	9-10 AM	6-7 AM	7-8 AM	8-9 AM	9-10 AM
I-395 Northbound General Purpose Lanes									
I-395 NB south of Edsall Rd ramps	Diverge	17	7	6	14	76	129	134	94
I-395 NB between Edsall Rd off-ramps	Freeway	18	7	6	15	86	141	148	103
I-395 NB at Edsall Rd WB off-ramp	Diverge	17	8	8	16	68	108	114	79
I-395 NB between Edsall Rd off-ramp and on-ramp	Freeway	16	7	6	12	89	147	156	113
I-395 NB between Edsall Rd and Turkeycock Run	Weave	15	7	6	12	84	138	146	105
I-395 NB between Turkeycock Run ramps	Freeway	16	8	7	15	91	133	138	101
I-395 NB between Turkeycock Run and Duke St	Weave	16	9	8	16	85	122	127	88
I-395 NB at Duke St EB off-ramp	Diverge	17	10	9	17	81	116	121	95
I-395 NB between Duke St off-ramps	Diverge	17	10	8	15	75	109	116	90
I-395 NB between Duke St off-ramp and on-ramp	Freeway	17	10	8	13	93	127	136	114
I-395 NB between Duke St and Seminary Rd	Weave	18	11	10	14	84	112	120	108
I-395 NB between Seminary Rd ramps	Freeway	18	12	10	15	96	121	129	100
I-395 NB at Seminary Rd on-ramp	Merge	19	13	12	14	65	92	98	76
I-395 NB between Seminary Rd and King St	Weave	27	18	15	16	55	83	95	85
I-395 NB between King St off-ramp and on-ramp	Freeway	30	20	17	17	63	86	96	93
I-395 NB at King St EB on-ramp	Merge	25	17	15	14	63	85	92	92
I-395 NB between King St on-ramps	Freeway	44	27	21	19	48	69	83	87
I-395 NB between King St and Shirlington Rd	Weave	52	23	16	15	31	72	96	95
I-395 NB between Shirlington Rd ramps	Freeway	46	18	14	11	37	96	121	126
I-395 NB between Shirlington Rd and Glebe Rd	Weave	27	18	17	12	63	92	98	116
I-395 NB between Glebe Rd EB off-ramp and on-ramp	Freeway	43	27	33	15	40	64	45	96
I-395 NB between Glebe Rd EB on-ramp and WB off-ramp	Weave	50	24	31	14	29	65	44	92
I-395 NB between Glebe Rd WB off-ramp and on-ramp	Freeway	51	25	31	14	34	72	51	101
I-395 NB at Glebe Rd WB on-ramp	Merge	52	19	25	12	28	96	67	120
I-395 NB north of Glebe Rd ramps	Freeway	43	25	27	13	43	75	64	104
I-395 NB at Washington Blvd WB off-ramp	Diverge	48	24	25	21	30	61	65	88
I-395 NB at Washington Blvd EB off-ramp	Diverge	48	25	23	21	32	94	95	112
I-395 NB between Washington Blvd EB off-ramp and Army Navy Dr off-ramp	Freeway	37	15	18	12	39	107	111	126
I-395 NB at Army Navy Dr off-ramp	Diverge	32	15	25	14	35	86	80	98
I-395 NB between Army Navy Dr off-ramp and Washington Blvd EB on-ramp	Freeway	22	8	8	6	59	130	122	144
I-395 NB at Washington Blvd EB on-ramp	Weave	19	9	7	7	77	143	139	135
I-395 NB at ramp to HOV lanes	Weave	17	9	8	9	72	122	130	123
I-395 NB between ramp to HOV lanes and S Rotary Rd on-ramp	Freeway	12	7	8	10	92	147	134	102
I-395 NB at S Rotary Rd on-ramp	Merge	12	8	8	9	70	115	114	100
I-395 NB between S Rotary Rd on-ramp and Rte 1 SB on-ramp	Freeway	11	7	7	8	102	160	160	151

2040 No Build Conditions									
Location	Type	Average Speed (mph)				Average Density (veh/mi/ln)			
		6-7 AM	7-8 AM	8-9 AM	9-10 AM	6-7 AM	7-8 AM	8-9 AM	9-10 AM
I-395 NB at Rte 1 SB on-ramp	Merge	11	8	8	9	90	130	121	135
I-395 NB between Rte 1 ramps	Freeway	12	8	9	9	108	154	151	148
I-395 NB at Rte 1 NB on-ramp	Merge	12	8	8	8	76	143	148	149
I-395 NB between Rte 1 and Boundary Channel Dr	Freeway	12	9	10	10	105	135	133	129
I-395 NB between Boundary Channel Dr ramps	Weave	12	10	10	10	83	109	125	115
I-395 NB at lane reduction north of Boundary Channel Dr	Merge	13	11	12	12	99	121	118	111
I-395 NB south of GW Memorial Pkwy	Freeway	14	12	14	15	108	119	113	111
I-395 NB between GW Memorial Pkwy EB on-ramp and WB off-ramp	Weave	15	15	17	18	103	106	97	97
I-395 NB between GW Memorial Pkwy WB off-ramp and WB on-ramp	Freeway	19	18	22	23	88	92	83	78
I-395 NB between GW Memorial Pkwy and 14th St	Weave	18	19	22	21	90	91	83	83
I-395 NB at 14th St off-ramp	Diverge	19	20	22	21	86	87	82	85
I-395 NB between 14th St off-ramp and off-ramp to Buckeye Dr	Freeway	19	19	20	19	93	96	92	95
I-395 NB between Buckeye Dr ramps	Freeway	28	28	30	27	61	63	60	66
I-395 NB at on-ramp from Buckeye Dr	Merge	31	30	32	27	50	55	53	61
I-395 NB between HOV merge and 12th St Expy off-ramp	Weave	30	31	31	28	58	58	59	64
I-395 NB north of 12th St Expy off-ramp	Freeway	31	31	31	31	67	64	62	59
I-395 Southbound General Purpose Lanes									
I-395 SB north of 9th St Expy on-ramp	Freeway	17	11	9	16	96	117	128	99
I-395 SB on Francis Case Memorial Bridge	Weave	26	18	12	22	56	77	96	67
I-395 SB between HOV diverge and off-ramp to Ohio Dr	Diverge	31	23	17	28	58	71	92	68
I-395 SB between 14th St on-ramp and HOV diverge	Freeway	36	23	29	36	58	77	54	55
I-395 SB on 14th St Bridge	Merge	43	17	20	43	28	110	78	29
I-395 SB at GW Memorial Pkwy WB off-ramp	Diverge	42	20	18	42	23	84	65	23
I-395 SB between GW Memorial Pkwy EB off-ramp and WB off-ramp	Diverge	44	31	22	44	23	59	58	24
I-395 SB between GW Memorial Pkwy EB on-ramp and EB off-ramp	Freeway	48	47	27	47	22	18	41	27
I-395 SB between Boundary Channel Dr and GW Memorial Pkwy	Weave	43	40	26	44	19	18	33	21
I-395 SB between ramp from HOV lanes and Boundary Channel Dr WB off-ramp	Merge	47	47	24	45	19	16	41	24
I-395 SB between Rte 1 SB off-ramp and ramp from HOV lanes	Weave	48	48	22	38	21	20	55	34
I-395 SB at Rte 1 SB off-ramp	Diverge	46	45	24	33	19	19	58	39
I-395 SB between Rte 1 NB off-ramp and SB off-ramp	Weave	50	50	47	47	14	12	13	17
I-395 SB between S Rotary Rd off-ramp and Rte 1 NB off-ramp	Diverge	54	53	53	53	12	10	11	13

2040 No Build Conditions									
Location	Type	Average Speed (mph)				Average Density (veh/mi/ln)			
		6-7 AM	7-8 AM	8-9 AM	9-10 AM	6-7 AM	7-8 AM	8-9 AM	9-10 AM
I-395 SB between ramp from HOV lanes and S Rotary Rd off-ramp	Freeway	54	55	55	54	9	6	6	8
I-395 SB between Army Navy Dr on-ramp and ramp from HOV lanes	Merge	54	54	54	54	9	7	6	9
I-395 SB at Army Navy Dr on-ramp	Merge	54	53	53	53	9	9	7	11
I-395 SB between Washington Blvd WB on-ramp and Army Navy Dr on-ramp	Freeway	54	54	54	54	12	11	10	14
I-395 SB at Washington Blvd WB on-ramp	Merge	53	53	53	53	11	12	10	12
I-395 SB between Washington Blvd EB on-ramp and WB on-ramp	Merge	54	54	54	54	13	14	13	15
I-395 SB at Washington Blvd EB on-ramp	Merge	52	53	52	51	13	13	12	16
I-395 SB north of Glebe Rd ramps	Diverge	54	54	54	54	15	16	15	19
I-395 SB between Shirlington Rd and Glebe Rd	Freeway	54	54	54	53	17	17	16	20
I-395 SB between Shirlington Rd on-ramps	Merge	53	52	52	52	16	18	17	18
I-395 SB between King St and Shirlington Rd	Weave	53	52	52	52	14	17	17	17
I-395 SB between King St WB on-ramp and off-ramp	Freeway	54	54	54	54	16	18	17	17
I-395 SB at King St WB on-ramp	Merge	54	53	53	53	13	15	15	15
I-395 SB between King St EB on-ramp and WB on-ramp	Freeway	54	53	53	53	17	19	19	19
I-395 SB between Seminary Rd and King St	Weave	54	53	53	54	14	17	17	16
I-395 SB between Seminary Rd ramps	Freeway	54	54	54	54	15	18	18	17
I-395 SB at Seminary Rd on-ramp	Merge	52	52	52	52	15	18	18	16
I-395 SB between Little River Tnpk and Seminary Rd	Freeway	54	53	53	53	18	22	22	20
I-395 SB at Little River Tnpk off-ramp	Diverge	54	53	53	53	15	17	17	16
I-395 SB between Little River Tnpk ramps	Freeway	54	53	53	53	16	18	17	16
I-395 SB at Little River Tnpk WB on-ramp	Merge	49	47	48	50	17	21	20	16
I-395 SB between Turkeycock Run and Little River Tnpk	Freeway	53	53	53	53	18	21	20	18
I-395 SB at Turkeycock Run off-ramp	Diverge	54	54	54	54	18	20	20	18
I-395 SB between Turkeycock Run ramps	Freeway	54	53	54	54	18	21	20	18
I-395 SB between Edsall Rd and Turkeycock Run	Weave	54	54	54	54	16	18	18	16
I-395 SB between Edsall Rd EB on-ramp and off-ramp	Freeway	53	53	54	54	19	20	19	17
I-395 SB south of Edsall Rd ramps	Merge	53	52	52	52	18	21	20	19
I-395 Northbound HOV/HOT Lanes									
I-395 HOT NB south of Turkeycock Run ramps	Freeway	67	47	24	44	19	36	80	24
I-395 HOT NB at Turkeycock Run off-ramp	Diverge	60	30	25	34	16	67	115	32
I-395 HOV NB between Turkeycock Run off-ramp and lane reduction	Merge	66	58	58	65	13	18	12	9
I-395 HOV NB between lane reduction and Turkeycock Run on-ramp	Freeway	67	66	67	67	19	24	16	13
I-395 HOV NB at Turkeycock Run on-ramp	Merge	65	65	66	64	14	17	11	11

2040 No Build Conditions									
Location	Type	Average Speed (mph)				Average Density (veh/mi/ln)			
		6-7 AM	7-8 AM	8-9 AM	9-10 AM	6-7 AM	7-8 AM	8-9 AM	9-10 AM
I-395 HOV NB between Turkeycock Run on-ramp and Seminary Rd off-ramp	Freeway	67	66	67	67	20	24	17	15
I-395 HOV NB at Seminary Rd off-ramp	Diverge	66	64	65	66	14	17	11	10
I-395 HOV NB between Seminary Rd ramps	Freeway	66	66	67	67	20	24	17	15
I-395 HOV NB at Seminary Rd on-ramp	Merge	63	61	63	61	15	20	13	14
I-395 HOV NB between Seminary Rd on-ramp and Shirlington Rd on-ramp	Freeway	66	65	66	66	22	26	18	18
I-395 HOV NB at Shirlington Rd on-ramp	Merge	61	56	56	55	16	22	17	17
I-395 HOV NB between Shirlington Rd on-ramp and Washington Blvd off-ramp	Freeway	62	61	62	62	24	28	21	21
I-395 HOV NB at Washington Blvd off-ramp	Diverge	63	62	63	62	16	19	14	14
I-395 HOV NB between Washington Blvd off-ramp and Eads St off-ramp	Freeway	57	56	58	58	20	23	15	16
I-395 HOV NB at Eads St off-ramp	Diverge	40	38	42	42	20	25	15	15
I-395 HOV NB between Eads St ramps	Freeway	54	49	44	34	13	16	14	19
I-395 HOV NB at Eads St on-ramp	Merge	48	21	9	9	12	39	89	93
I-395 HOV NB between Eads St on-ramp and on-ramp from GP lanes	Freeway	44	14	9	7	18	79	127	125
I-395 HOV NB at on-ramp from GP lanes	Merge	23	12	9	6	53	105	133	151
I-395 HOV NB between on-ramp from GP lanes and 14th St	Diverge	21	17	14	10	76	100	110	125
I-395 HOV NB north of 14th St	Freeway	35	31	31	32	55	55	56	55
I-395 Southbound HOV Lanes									
I-395 HOV SB north of 14th St	Freeway	51	51	16	42	25	27	80	42
I-395 HOV SB between off-ramp to GP lanes and 14th St	Merge	53	52	10	31	13	16	79	33
I-395 HOV SB at off-ramp to GP lanes	Diverge	39	38	9	31	12	15	58	26
I-395 HOV SB between Eads St off-ramp and off-ramp to GP lanes	Freeway	59	59	58	59	4	5	3	6
I-395 HOV SB at Eads St off-ramp	Diverge	57	58	58	58	3	3	2	4
I-395 HOV SB between Eads St ramps	Freeway	60	60	60	60	2	4	2	5
I-395 HOV SB between off-ramp to GP lanes and Eads St	Weave	52	52	51	54	2	4	2	4

Table 7-26: AM Peak Period Freeway Speed and Density by Segment (2040 Build)

2040 Build Conditions									
Location	Type	Average Speed (mph)				Average Density (veh/mi/ln)			
		6-7 AM	7-8 AM	8-9 AM	9-10 AM	6-7 AM	7-8 AM	8-9 AM	9-10 AM
I-395 Northbound General Purpose Lanes									
I-395 NB south of Edsall Rd ramps	Diverge	49	14	9	25	29	82	116	66
I-395 NB between Edsall Rd off-ramps	Freeway	51	14	9	32	33	94	129	63
I-395 NB at Edsall Rd WB off-ramp	Diverge	46	14	10	29	28	77	101	52
I-395 NB between Edsall Rd off-ramp and on-ramp	Freeway	53	11	7	31	30	102	144	56
I-395 NB between Edsall Rd and Turkeycock Run	Weave	52	10	8	29	26	100	131	53
I-395 NB between Turkeycock Run ramps	Freeway	52	10	9	31	31	109	126	59
I-395 NB north of Turkeycock Run ramps	Weave	50	10	10	30	27	108	116	50
I-395 NB at Duke St EB off-ramp	Diverge	51	10	11	27	26	109	117	59
I-395 NB between Duke St off-ramps	Diverge	51	8	9	24	25	111	112	62
I-395 NB between Duke St off-ramp and on-ramp	Freeway	49	8	9	18	33	137	132	93
I-395 NB between Duke St and Seminary Rd	Weave	32	8	10	19	47	128	117	95
I-395 NB between Seminary Rd ramps	Freeway	23	8	11	29	72	140	127	57
I-395 NB at Seminary Rd on-ramp	Merge	22	9	11	26	55	117	99	43
I-395 NB between Seminary Rd and King St	Weave	28	11	15	31	52	115	96	46
I-395 NB between King St off-ramp and on-ramp	Freeway	31	13	17	31	61	112	96	54
I-395 NB at King St EB on-ramp	Merge	25	11	15	27	61	113	94	53
I-395 NB between King St on-ramps	Freeway	43	15	21	37	48	99	82	50
I-395 NB between King St and Shirlington Rd	Weave	50	12	17	36	32	113	92	44
I-395 NB between Shirlington Rd ramps	Freeway	34	11	13	27	51	132	121	65
I-395 NB between Shirlington Rd and Glebe Rd	Weave	23	13	16	24	71	112	98	66
I-395 NB between Glebe Rd EB off-ramp and on-ramp	Freeway	38	18	36	29	41	89	37	56
I-395 NB between Glebe Rd EB on-ramp and WB off-ramp	Weave	39	15	34	25	34	99	35	58
I-395 NB between Glebe Rd WB off-ramp and on-ramp	Freeway	39	17	35	24	39	101	39	67
I-395 NB at Glebe Rd WB on-ramp	Merge	33	14	27	18	42	126	50	90
I-395 NB north of Glebe Rd ramps	Freeway	30	16	24	25	51	98	59	71
I-395 NB at Washington Blvd WB off-ramp	Diverge	30	21	22	34	46	88	62	47
I-395 NB at Washington Blvd EB off-ramp	Diverge	26	19	19	52	57	112	83	16
I-395 NB between Washington Blvd EB off-ramp and Army Navy Dr off-ramp	Freeway	17	9	10	43	74	135	121	23
I-395 NB at Army Navy Dr off-ramp	Diverge	16	11	12	36	66	113	106	24
I-395 NB between Army Navy Dr off-ramp and Washington Blvd EB on-ramp	Freeway	14	10	10	19	94	145	143	53
I-395 NB at Washington Blvd EB on-ramp	Weave	13	10	9	9	108	155	160	143
I-395 NB at ramp to HOT lanes	Weave	15	13	11	10	86	116	119	114
I-395 NB between ramp to HOT lanes and S Rotary Rd on-ramp	Freeway	10	7	8	8	121	160	162	157
I-395 NB at S Rotary Rd on-ramp	Merge	10	8	8	8	90	115	127	115
I-395 NB between S Rotary Rd on-ramp and Rte 1 SB on-ramp	Freeway	10	8	8	8	124	160	159	156

2040 Build Conditions									
Location	Type	Average Speed (mph)				Average Density (veh/mi/ln)			
		6-7 AM	7-8 AM	8-9 AM	9-10 AM	6-7 AM	7-8 AM	8-9 AM	9-10 AM
I-395 NB at Rte 1 SB on-ramp	Merge	10	8	9	9	106	128	122	132
I-395 NB between Rte 1 ramps	Freeway	11	9	9	9	124	154	152	148
I-395 NB at Rte 1 NB on-ramp	Merge	13	9	9	9	79	133	140	145
I-395 NB between Rte 1 and Boundary Channel Dr	Freeway	11	10	11	11	115	130	129	123
I-395 NB between Boundary Channel Dr ramps	Weave	12	11	11	12	89	100	111	99
I-395 NB at lane reduction north of Boundary Channel Dr	Merge	13	12	14	13	102	111	108	103
I-395 NB south of GW Memorial Pkwy	Freeway	15	14	16	16	109	112	106	106
I-395 NB between GW Memorial Pkwy EB on-ramp and WB off-ramp	Weave	17	17	20	20	98	98	90	92
I-395 NB between GW Memorial Pkwy WB off-ramp and WB on-ramp	Freeway	22	22	26	27	82	82	73	70
I-395 NB between GW Memorial Pkwy and 14th St	Weave	20	22	26	24	85	81	73	76
I-395 NB at 14th St off-ramp	Diverge	21	23	24	23	83	81	77	80
I-395 NB between 14th St off-ramp and off-ramp to Buckeye Dr	Freeway	20	20	21	21	90	92	88	90
I-395 NB between Buckeye Dr ramps	Freeway	30	32	34	32	58	56	54	57
I-395 NB at on-ramp from Buckeye Dr	Merge	33	34	37	30	48	50	48	59
I-395 NB between HOT merge and 12th St Expy off-ramp	Weave	32	33	35	30	57	54	53	62
I-395 NB north of 12th St Expy off-ramp	Freeway	30	31	31	31	69	66	64	56
I-395 Southbound General Purpose Lanes									
I-395 SB north of 9th St Expy on-ramp	Freeway	17	11	12	16	97	114	114	100
I-395 SB on Francis Case Memorial Bridge	Weave	26	19	18	22	55	73	77	68
I-395 SB between HOT diverge and off-ramp to Ohio Dr	Diverge	31	25	23	26	58	68	75	70
I-395 SB between 14th St on-ramp and HOV diverge	Freeway	35	25	23	33	58	74	77	60
I-395 SB on 14th St Bridge	Merge	43	18	14	32	28	105	103	44
I-395 SB at GW Memorial Pkwy WB off-ramp	Diverge	43	20	14	30	23	81	82	40
I-395 SB between GW Memorial Pkwy EB off-ramp and WB off-ramp	Diverge	44	32	17	29	22	60	78	45
I-395 SB between GW Memorial Pkwy EB on-ramp and EB off-ramp	Freeway	48	47	22	28	22	20	58	52
I-395 SB between Boundary Channel Dr and GW Memorial Pkwy	Weave	43	41	22	27	19	19	43	40
I-395 SB between ramp from HOT lanes and Boundary Channel Dr WB off-ramp	Merge	47	47	20	26	19	18	53	51
I-395 SB between Rte 1 SB off-ramp and ramp from HOV lanes	Merge	48	48	20	30	22	22	62	53
I-395 SB at Rte 1 SB off-ramp	Diverge	46	45	23	30	21	21	60	47
I-395 SB between Rte 1 NB off-ramp and SB off-ramp	Weave	50	50	46	45	15	14	16	22
I-395 SB between S Rotary Rd off-ramp and Rte 1 NB off-ramp	Diverge	54	53	53	52	13	13	13	17
I-395 SB south of S Rotary Rd off-ramp	Freeway	54	54	54	54	11	8	8	12

2040 Build Conditions									
Location	Type	Average Speed (mph)				Average Density (veh/mi/ln)			
		6-7 AM	7-8 AM	8-9 AM	9-10 AM	6-7 AM	7-8 AM	8-9 AM	9-10 AM
I-395 SB north of Army Navy Dr on-ramp	Freeway	54	54	54	54	11	8	8	12
I-395 SB at Army Navy Dr on-ramp	Merge	54	53	53	53	9	9	8	11
I-395 SB between Washington Blvd WB on-ramp and Army Navy Dr on-ramp	Freeway	54	54	54	54	13	11	10	15
I-395 SB at Washington Blvd WB on-ramp	Merge	53	53	53	53	11	12	11	13
I-395 SB between Washington Blvd EB on-ramp and WB on-ramp	Freeway	54	54	54	54	13	14	13	15
I-395 SB at Washington Blvd EB on-ramp	Merge	53	53	53	53	12	12	11	14
I-395 SB north of Glebe Rd ramps	Diverge	54	54	54	54	15	15	14	17
I-395 SB between Shirlington Rd and Glebe Rd	Freeway	54	54	54	53	17	16	15	17
I-395 SB between Shirlington Rd on-ramps	Merge	53	52	52	52	16	17	16	17
I-395 SB between King St and Shirlington Rd	Weave	53	52	52	52	14	17	16	16
I-395 SB between King St WB on-ramp and off-ramp	Freeway	54	54	54	54	16	17	16	16
I-395 SB at King St WB on-ramp	Merge	54	53	53	53	13	15	14	14
I-395 SB between King St EB on-ramp and WB on-ramp	Freeway	54	53	54	54	16	19	18	17
I-395 SB between Seminary Rd and King St	Weave	54	53	54	54	14	17	16	15
I-395 SB between Seminary Rd ramps	Freeway	54	54	54	54	15	17	17	15
I-395 SB at Seminary Rd on-ramp	Merge	52	52	52	52	15	18	17	16
I-395 SB between Little River Tnpk and Seminary Rd	Freeway	54	53	53	53	18	21	21	19
I-395 SB at Little River Tnpk off-ramp	Diverge	54	53	53	54	14	17	17	15
I-395 SB between Little River Tnpk ramps	Freeway	54	53	54	54	16	17	17	15
I-395 SB at Little River Tnpk WB on-ramp	Merge	49	47	48	50	17	21	19	15
I-395 SB between Turkeycock Run and Little River Tnpk	Freeway	53	53	53	54	18	20	20	16
I-395 SB at Turkeycock Run off-ramp	Diverge	54	54	54	54	18	20	19	16
I-395 SB between Turkeycock Run ramps	Freeway	54	54	54	54	18	20	20	16
I-395 SB between Edsall Rd and Turkeycock Run	Weave	54	54	54	54	16	18	17	15
I-395 SB between Edsall Rd EB on-ramp and off-ramp	Freeway	53	53	54	54	18	20	18	16
I-395 SB south of Edsall Rd ramps	Merge	53	52	52	52	18	20	20	18
I-395 Northbound HOT Lanes									
I-395 HOT NB south of Turkeycock Run ramps	Freeway	66	65	66	67	24	25	23	13
I-395 HOT NB at Turkeycock Run off-ramp	Diverge	63	53	62	65	19	29	19	11
I-395 HOT NB between Turkeycock Run ramps	Freeway	67	66	67	67	20	21	19	12
I-395 HOT NB at Turkeycock Run on-ramp	Merge	64	66	65	64	18	16	16	11
I-395 HOT NB between Turkeycock Run on-ramp and Seminary Rd off-ramp	Freeway	66	66	67	67	23	21	20	14
I-395 HOT NB at Seminary Rd off-ramp	Diverge	65	62	65	66	17	17	16	11
I-395 HOT NB between Seminary Rd ramps	Freeway	66	66	66	67	23	21	20	14
I-395 HOT NB at Seminary Rd on-ramp	Merge	62	61	62	62	20	21	18	13
I-395 HOT NB between Seminary Rd on-ramp and Shirlington Rd on-ramp	Freeway	66	66	66	67	25	24	23	16

2040 Build Conditions									
Location	Type	Average Speed (mph)				Average Density (veh/mi/ln)			
		6-7 AM	7-8 AM	8-9 AM	9-10 AM	6-7 AM	7-8 AM	8-9 AM	9-10 AM
I-395 HOT NB at Shirlington Rd on-ramp	Merge	55	49	47	51	27	32	34	23
I-395 HOT NB between Shirlington Rd on-ramp and Washington Blvd off-ramp	Freeway	62	61	61	62	28	29	28	22
I-395 HOT NB at Washington Blvd off-ramp	Diverge	53	47	55	61	25	30	24	17
I-395 HOT NB between Washington Blvd off-ramp and diverge to Eads St NB	Diverge	62	58	59	61	18	20	21	16
I-395 HOT NB between diverge to Eads St NB and Eads St SB off-ramp	Freeway	55	51	50	51	24	29	33	25
I-395 HOT NB at Eads St off-ramp	Diverge	46	41	40	41	20	25	29	21
I-395 HOT NB between Eads St ramps	Freeway	53	37	48	40	20	40	24	27
I-395 HOT NB at Eads St on-ramp	Merge	51	24	35	24	15	59	33	41
I-395 HOT NB between Eads St on-ramp and on-ramp from GP lanes	Freeway	52	22	38	22	21	75	37	61
I-395 HOT NB at on-ramp from GP lanes	Merge	34	15	24	9	31	94	50	107
I-395 HOT NB between on-ramp from GP lanes and 14th St	Diverge	21	17	19	11	71	94	80	115
I-395 HOT NB north of 14th St	Freeway	36	31	32	31	54	52	53	55
I-395 Southbound HOV Lanes									
I-395 HOV SB north of 14th St	Freeway	51	51	38	36	25	28	42	48
I-395 HOV SB between off-ramp to GP lanes and 14th St	Merge	51	51	11	16	12	15	67	57
I-395 HOV SB at off-ramp to GP lanes	Diverge	33	32	9	19	13	16	59	36
I-395 HOV SB between Eads St off-ramp and off-ramp to GP lanes	Freeway	59	59	58	58	1	1	1	1
I-395 HOV SB at Eads St off-ramp	Diverge	60	60	60	59	1	0	0	1

Figure 7-71: Freeway Speed Comparison – Northbound General Purpose Lanes
2040 No Build and Build – AM Peak Period

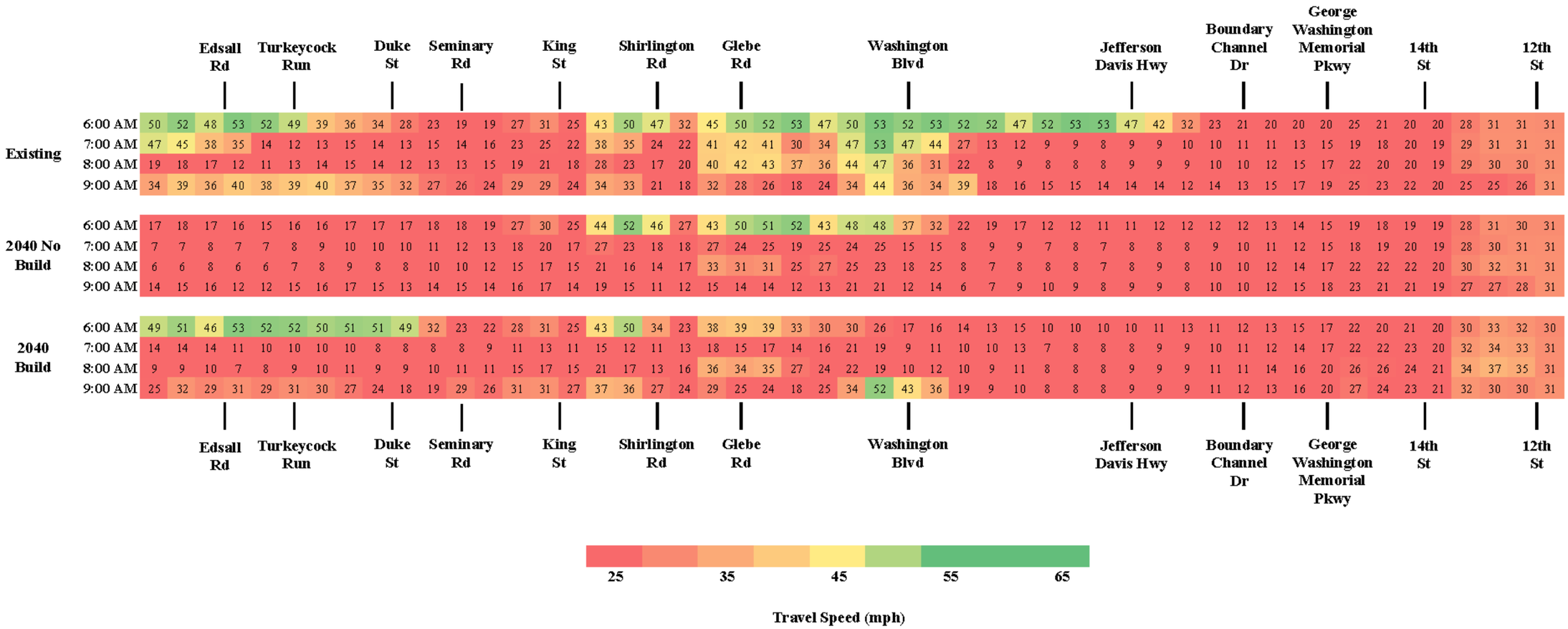


Figure 7-72: Freeway Speed Comparison – Southbound General Purpose Lanes
2040 No Build and Build – AM Peak Period

		Edsall Rd				Turkeycock Run					Duke St						Seminary Rd				King St			Shirlington Rd / Glebe Rd						Washington Blvd			Jefferson Davis Hwy			Boundary Channel Dr			George Washington Memorial Pkwy			14th St			12th St	
Existing	6:00 AM	53	53	52	51	53	54	53	53	53	51	53	53	47	53	53	52	54	53	54	54	54	54	54	53	53	54	54	53	54	54	54	54	55	54	53	50	47	48	48	48	43	48	45	43	43	35	32	28	21
	7:00 AM	53	52	51	49	53	54	53	53	52	49	52	52	43	51	51	50	53	52	54	53	53	53	54	52	52	53	54	51	54	53	54	53	55	55	50	45	44	46	47	47	43	48	40	36	39	36	30	25	22
	8:00 AM	53	52	51	48	53	54	53	53	53	50	52	52	43	51	52	51	53	52	54	54	54	53	54	52	52	54	54	52	54	53	54	53	55	55	51	45	42	46	46	47	45	48	44	42	43	37	32	32	36
	9:00 AM	53	53	52	49	53	54	53	53	53	51	52	52	45	52	51	51	53	52	54	54	54	53	54	52	52	53	54	51	54	53	54	53	55	54	51	37	43	44	39	46	45	48	42	42	43	36	32	31	35
2040 No Build	6:00 AM	53	53	53	53	53	54	54	54	53	53	49	54	54	54	54	54	54	52	54	54	54	54	54	53	53	54	54	52	54	53	54	54	54	54	54	50	46	48	48	47	43	48	44	42	43	36	31	26	17
	7:00 AM	52	53	53	53	53	54	53	54	53	53	47	53	53	53	53	53	53	52	54	53	53	53	54	52	52	54	54	53	54	53	54	53	54	55	53	50	45	48	48	47	40	47	31	20	17	23	23	18	11
	8:00 AM	52	54	54	54	54	54	54	54	53	53	48	53	53	53	53	53	53	52	54	53	53	53	54	52	52	54	54	52	54	53	54	53	54	55	53	47	24	22	22	24	26	27	22	18	20	29	17	12	9
	9:00 AM	52	54	54	54	54	54	54	54	53	53	50	53	53	53	53	53	53	52	54	54	53	53	54	52	52	53	54	51	54	53	54	53	54	54	53	47	33	38	38	45	44	47	44	42	43	36	28	22	16
2040 Build	6:00 AM	53	53	53	53	53	54	54	54	53	53	49	54	54	54	54	54	54	52	54	54	54	54	54	53	53	54	54	53	54	53	54	54	54	54	54	50	46	48	48	47	43	48	44	43	43	35	31	26	17
	7:00 AM	52	53	53	53	53	54	54	54	53	53	47	53	53	53	53	53	53	52	54	53	53	53	54	52	52	54	54	53	54	53	54	53	54	54	53	50	45	48	48	47	41	47	32	20	18	25	25	19	11
	8:00 AM	52	54	54	54	54	54	54	54	53	53	48	54	54	54	54	53	53	52	54	54	54	53	54	52	52	54	54	53	54	53	54	53	54	54	53	46	23	20	20	20	22	22	17	14	14	23	23	18	12
	9:00 AM	52	54	54	54	54	54	54	54	54	54	50	54	54	54	54	54	53	52	54	54	54	53	54	52	52	53	54	53	54	53	54	53	54	54	52	45	30	30	30	26	27	28	29	30	32	33	26	22	16

Travel Speed (mph): 25 – 35 – 45 – 55 – 65

Figure 7-73: Freeway Speed Comparison – HOV/HOT Lanes
2040 No Build and Build – AM Peak Period

Northbound HOV/HOT Lanes

				Turkeycock Run				Seminary Rd			Shirlington Rd			Washington Blvd			Eads St				14th St	
Existing	6:00 AM	67	60	66	67	65	67	67	67	64	66	62	62	63	57	57	39	54	45	49	40	28	36
	7:00 AM	67	59	65	66	65	66	66	66	62	66	60	62	62	57	57	37	53	32	17	12	16	31
	8:00 AM	67	60	66	67	65	67	67	67	62	66	57	62	63	49	49	31	47	9	9	9	14	31
	9:00 AM	67	63	67	67	59	67	67	67	61	66	54	62	61	46	46	30	23	11	10	8	11	31
2040 No Build	6:00 AM	67	60	66	67	65	67	66	66	63	66	61	62	63	57	57	40	54	48	44	23	21	35
	7:00 AM	47	30	58	66	65	66	64	66	61	65	56	61	62	56	56	38	49	21	14	12	17	31
	8:00 AM	24	25	58	67	66	67	65	67	63	66	56	62	63	58	58	42	44	9	9	9	14	31
	9:00 AM	44	34	65	67	64	67	66	67	61	66	55	62	62	58	58	42	34	9	7	6	10	32
2040 Build	6:00 AM	66	63	67	67	64	66	65	66	62	66	55	62	53	62	55	46	53	51	52	34	21	36
	7:00 AM	65	53	66	66	66	66	62	66	61	66	49	61	47	58	51	41	37	24	22	15	17	31
	8:00 AM	66	62	67	67	65	67	65	66	62	66	47	61	55	59	50	40	48	35	38	24	19	32
	9:00 AM	67	65	67	67	64	67	66	67	62	67	51	62	61	61	51	41	40	24	22	9	11	31

Southbound HOV/HOT Lanes

			Eads St		Boundary Channel Dr		14th St	
Existing	6:00 AM	56	60	57	59	39	53	51
	7:00 AM	57	60	58	59	36	51	50
	8:00 AM	58	60	58	59	37	51	50
	9:00 AM	57	60	58	59	36	52	51
2040 No Build	6:00 AM	52	60	57	59	39	53	51
	7:00 AM	52	60	58	59	38	52	51
	8:00 AM	51	60	58	58	9	10	16
	9:00 AM	54	60	58	59	31	31	42
2040 Build	6:00 AM		60	59	33	51	51	
	7:00 AM		60	59	32	51	51	
	8:00 AM		60	58	9	11	38	
	9:00 AM		59	58	19	16	36	

Eads St | Boundary Channel Dr | 14th St

25 35 45 55 65

Travel Speed (mph)

HOV/HOT Lane Queues: Queues along freeway off-ramps from the I-395 HOV/HOT lanes during the AM peak period were compared between No Build and Build conditions to identify locations where there would be queue spillback onto the freeway lanes. **Table 7-26a** summarizes average and maximum queue lengths and available storage lengths for the northbound and southbound I-395 HOV/HOT lanes for each of the four analysis hours from 6 AM through 10 AM. The following is a summary of the three locations where either average or maximum queues exceed available storage under No Build or Build conditions:

- **Northbound I-395 HOT to Northbound General Purpose at Turkeycock Run:** Under No Build conditions, the maximum queues lengths for the ramp from the northbound I-395 HOT lanes to the northbound general purpose lanes at Turkeycock Run exceed the available storage from 7 AM to 10 AM and the average queue lengths exceed the available storage from 7 AM to 9 AM. This can be attributed to non-HOV motorists being required to exit the northbound I-395 HOT lanes during the HOV-enforced period. Under Build conditions, with the exception of the maximum queue length from 7 AM to 8 AM, the average and maximum queue lengths do not exceed the storage length along the ramp (2,780 feet). From 7 AM to 8 AM the maximum queue length of 3,336 feet exceeds the ramp storage length (2,780 feet); however, the maximum queue length is reduced by 54% compared to No Build conditions (7,264 feet) and the average queue (835 feet) is less than one third of the available storage length.

- **Northbound I-395 HOV/HOT to Eads Street:** Under No Build conditions, northbound maximum queue lengths on the off-ramp from the I-395 HOV lanes to Eads Street exceed available storage from 7 AM to 8 AM. Under Build conditions with the improvements to the Eads Street Interchange (see **Section 7.2.4**), the two existing lanes (one left-turn lane and one right-turn lane) on the I-395 HOV ramp approaching Eads Street would be modified to provide two ramps including four lanes (two left-turn lanes and two right-turn lanes) doubling the turning capacity approaching Eads Street and reducing the potential for queues extending to the northbound I-395 HOT lanes. Under Build conditions, the maximum queue lengths on the northbound I-395 HOV ramps to Eads Street would not exceed the ramp storage lengths under Build conditions.

- **Southbound I-395 HOV to Southbound General Purpose at Boundary Channel Drive:** Under Build conditions, motorists would be required to exit the HOV lanes in the vicinity of the Boundary Channel Drive Interchange or at the Eads Street Interchange due to the removal of the ramp from the southbound HOV lanes to the southbound general purpose lanes south of Eads Street. Southbound maximum queue lengths on the ramp from the I-395 HOV lanes to the general purpose lanes extend beyond the beyond the storage area from 8 AM to 10 AM. Motorists exiting the southbound HOV lanes to the southbound general purpose lanes encounter a left-hand weave between the ramp from the HOV lanes and the ramp to southbound Route 1 which causes queues to extend into the southbound HOV lanes. As discussed in Section 7.2.2, to reduce the potential for queues under Build conditions, modifying the lane configuration along the southbound I-395 general purpose lanes to provide a choice lane for motorists destined for southbound Route 1 is proposed as part of the Build conditions. The conceptual signing and marking plan shown in **Appendix H – Roll 8 and Figure 4-8** *(Volume 2)* depict the revised lane configuration along southbound I-395.

Table 7-26a depicts the queue lengths along the southbound I-395 HOV lanes under conditions with the proposed choice lane along the southbound I-395 general purpose lanes which indicate that the queue lengths do not exceed the available storage (700 feet). Additionally, based on a review of travel speeds along both the southbound I-395 HOV and general purpose lanes, the proposed choice lane will increase average travel speeds. Along the southbound HOV lanes approaching the off ramp to the general purpose lanes, average travel speeds will increase from 11 MPH to 48 MPH from 8 AM to 9 AM when projected queues are greatest. Average travel speeds in the weave along the southbound I-395 general purpose lanes will increase from 21 MPH to 46 MPH.

Table 7-26a: AM Peak Period I-395 HOV/HOT Ramp Queues (2040 No Build and Build)

HOV/HOT Lane Ramp Location	Available Storage (feet)	2040 No Build		2040 Build		2040 No Build		2040 Build		2040 No Build		2040 Build		2040 No Build		2040 Build	
		Avg. (feet)	Max. (feet)	Avg. (feet)	Max. (feet)	Avg. (feet)	Max. (feet)	Avg. (feet)	Max. (feet)	Avg. (feet)	Max. (feet)	Avg. (feet)	Max. (feet)	Avg. (feet)	Max. (feet)	Avg. (feet)	Max. (feet)
		6 - 7 AM				7 - 8 AM				8 - 9 AM				9 - 10 AM			
NB to NB GP at Turkeycock Run	2,780	204	1,683	0	0	2,997	7,264	835	3,336	6,833	8,216	285	1,732	1,252	7,062	9	171
NB to Seminary Rd	2,750	5	50	5	47	10	62	10	63	8	55	8	53	7	54	6	53
NB to Washington Blvd	1,580	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0
SB to SB GP (south of Eads St)	410	0	0	-	-	0	0	-	-	0	0	-	-	0	0	-	-
NB to Eads St (to Army Navy Drive) [1]	1,000	10	422	28	291	91	973	70	517	40	860	122	854	14	279	58	634
NB to Eads St (to Pentagon) [2]	1,000 No Build 2,000 Build	16	484	31	292	108	1,036	51	396	48	922	65	425	13	301	23	200
SB to Eads St	1,260	4	88	15	115	2	56	11	97	3	75	11	101	36	258	17	118
SB to SB GP at Boundary Channel Dr	700	0	0	0	0	0	0	0	0	1,636	3,749	1,634	3,693	594	3,732	1,301	3,727
SB to SB GP at Boundary Channel Dr (with improvements)	700	-	-	0	0	-	-	0	0	-	-	0	0	-	-	0	0
NB to 14th St SW	1,350	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NB to NB GP into D.C.	2,400	1	124	0	0	0	12	0	0	0	25	0	12	2	268	2	236

[1] Storage and queue values for the right turn from the Eads Street ramp to Army Navy Drive

[2] Storage and queue values for the left turn from the Eads Street ramp to the Pentagon

Highlighted cells indicate locations where average or maximum queue lengths exceed available storage

7.3.2.2 PM Peak Period

Figures 7-74 and 7-75 summarize 2040 No Build and Build traffic operations based on the freeway segment density measured in vehicles per mile per lane for the northbound and southbound I-395 general purpose and HOV/HOT lanes for each of the four analysis hours from 3 PM through 7 PM. In the 2040 No Build scenario, there are a total of 117 segments including 49 freeway segments, 21 weave segments, and 47 merge/diverge junctions, with minor differences in the segmentation in the Build scenario due to modifications in the vicinity of the Eads Street Interchange.

Figures 7-76 (*Volume 2*) **and 7-77** (*Volume 2*) **and Table 7-27** depict 2040 No Build travel speeds (MPH) and densities (vehicles per mile per lane) along the southbound and northbound I-395 general purpose and HOV/HOT lanes for each of the four analysis hours during the PM peak period. **Figures 7-78** (*Volume 2*) **and 7-79** (*Volume 2*) **and Table 7-28** depict 2040 Build travel speeds and densities. **Appendix J** contains a summary of throughput volumes, travel speeds, and densities by lane for both 2040 No Build and Build Conditions.

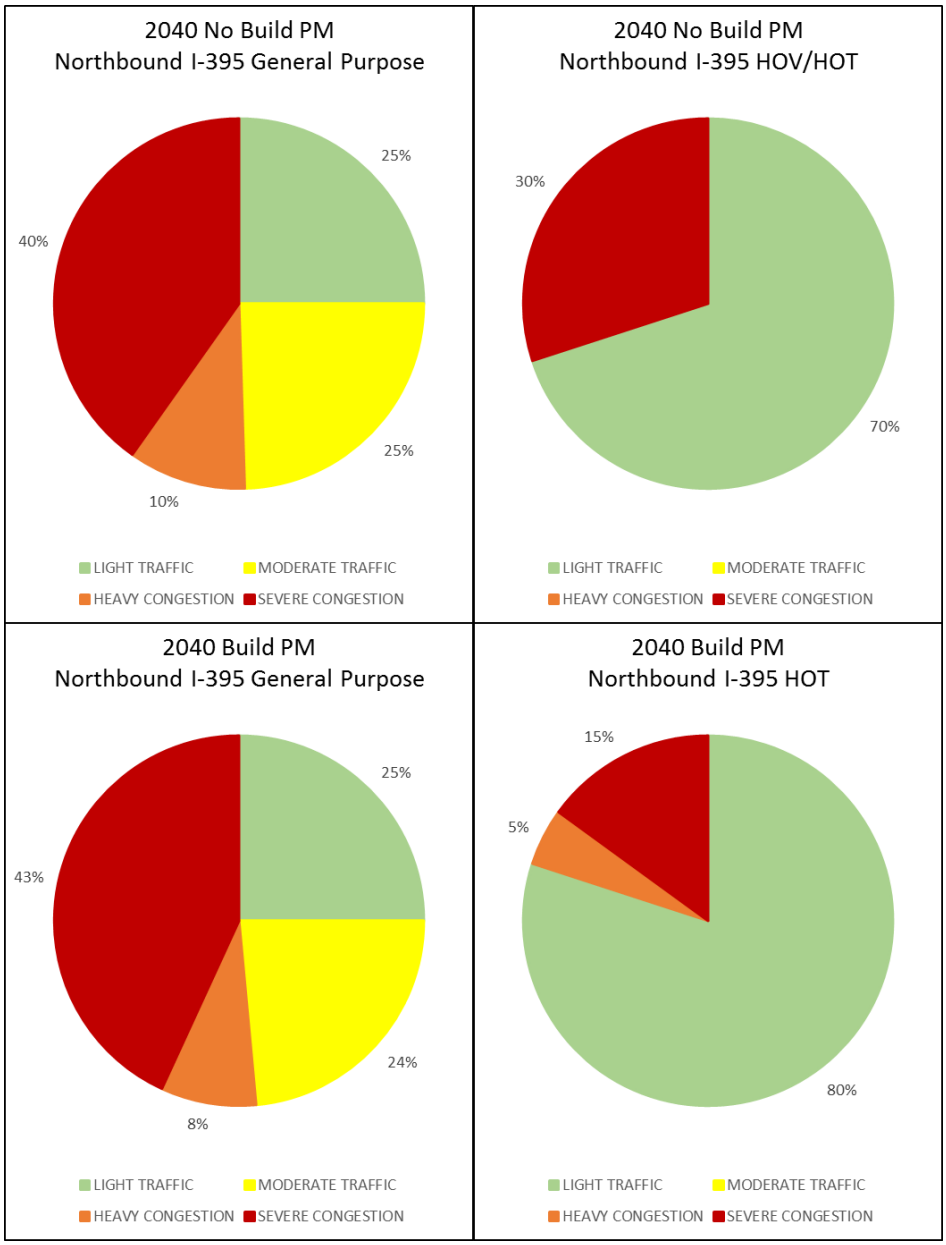
As shown in **Figure 7-74,** under 2040 No Build conditions in the PM peak period, 49 percent of the 41 southbound I-395 general purpose segments operate with severe congestion and 7 percent operate with heavy congestion. The remaining 44 percent operate with light or moderate traffic conditions. Ten percent of the 20 southbound I-395 HOV/HOT segments operate with heavy or moderate congestion. The remaining 90 percent operate with light traffic conditions.

Under 2040 Build conditions in the PM peak period, the number of southbound general purpose segments that operate with severe congestion is reduced from 49 percent to 29 percent with 9 percent of the segments operating with heavy congestion. The number of segments operating with light or moderate traffic conditions increases from 44 percent to 62 percent. The number of segments along the southbound I-395 HOV/HOT lanes that operate with moderate or heavy congestion decreases from 10 percent under No Build conditions to 6 percent under Build conditions. The number of segments along the southbound I-395 HOV/HOT lanes that operate with light traffic conditions increases from 90 percent to 94 percent due to the reduction in congestion at the Turkeycock Run ramps.

As shown in **Figure 7-45**, under 2040 No Build conditions in the PM peak period, 50 percent of the 51 northbound I-395 general purpose segments operate with severe or heavy congestion and 50 percent operate with light or moderate traffic conditions. Thirty percent of the five northbound I-395 HOV/HOT segments operate with severe congestion. Under 2040 Build conditions in the PM peak period, there are minor changes in the operations along the northbound general purpose lanes. The number of northbound I-395 HOV/HOT segments that operate with severe traffic conditions decreases from 30 percent to 15 percent and the number of northbound I-395 HOV/HOT segments that operate under light traffic conditions increases from 70 percent to 80 percent.

Figure 7-74: PM Peak Period Freeway Density Summary (2040 No Build and Build Conditions) Southbound I-395

Figure 7-75: PM Peak Period Freeway Density Summary (2040 No Build and Build Conditions) Northbound I-395



Freeway Segments: Under 2040 No Build conditions in the PM peak period, there are a total of 14 freeway segments in the southbound I-395 general purpose lanes. Of these segments, 46 percent operate with severe congestion, 11 percent operate with heavy congestion, 32 percent operate with moderate traffic conditions, and the remaining 11 percent operate with light traffic conditions. There are a total of 10 freeway segments in the southbound I-395 HOV/HOT lanes. Of these segments, 3 percent operate with heavy congestion and 97 percent operate with light or moderate traffic conditions.

Under 2040 Build conditions in the PM peak period, the number of freeway segments along the southbound I-395 general purpose lanes that operate with severe congestion is reduced from 46 percent to 28 percent with 8 percent of the segments operating with heavy congestion. The number of segments operating with

light or moderate traffic conditions increases from 43 percent to 64 percent. The number of freeway segments along the southbound I-395 HOV/HOT lanes that operate with light traffic conditions is increased from 86 percent to 90 percent.

Ramp Junctions: Under 2040 No Build conditions in the PM peak period, there are a total of 20 ramp junctions in the southbound I-395 general purpose lanes. Of these segments, 53 percent operate with severe congestion, 6 percent operate with heavy congestion, and the remaining 41 percent operate with light or moderate traffic conditions. There are a total of nine ramp junctions in the southbound I-395 HOV/HOT lanes. Of these segments, 6 percent operate with moderate congestion and 94 percent operate with light traffic conditions.

Under 2040 Build conditions in the PM peak period, the number of ramp junctions along the southbound I-395 general purpose lanes that operate with severe congestion is reduced from 53 percent to 26 percent with 11 percent of the segments operating with heavy congestion. The number of segments operating with light or moderate traffic conditions increases from 41 percent to 63 percent. The number of ramp junctions along the southbound I-395 HOV/HOT lanes that operate with light traffic conditions increases from 94 percent to 98 percent.

Weave Segments: Under 2040 No Build conditions in the PM peak period, there are a total of 7 weave segments in the southbound I-395 general purpose lanes. Of these segments, 43 percent operate with severe congestion and the 57 percent operate with light or moderate traffic conditions.

Under 2040 Build conditions in the PM peak period, the number of weave segments along the southbound I-395 general purpose lanes that operate with severe congestion is reduced from 43 percent to 38 percent.

Figures 7-80 through 7-82 depict 2040 No Build and Build speed profiles from the VISSIM model for the northbound and southbound I-395 general purpose and HOV/HOT lanes for each of the four analysis hours during the PM peak period. The following is a summary of the travel speeds when comparing existing, 2040 No Build, and 2040 Build conditions in the peak travel direction.

PM Peak Period – Southbound General Purpose Lanes (Peak Direction): 2040 No Build corridor travel speeds along the southbound I-395 general purpose lanes range from 15 to 33 MPH with average travel speeds of 22 MPH. Under 2040 No Build conditions, travel speeds along the southbound I-395 general purpose lanes increase by an average of 2 MPH compared to existing conditions. This can be attributed to the I-395 4th Lane Southbound – Duke Street to Edsall Road widening project which is included in the No Build conditions. Travel speeds increase south of Glebe Road to approximately Turkeycock Run with the largest speed increases observed south of Seminary Road to Turkeycock Run, immediately approaching and within the I-395 4th Lane Southbound project limits. Travel speeds from the northern study limits to George Washington Memorial Parkway decrease compared to existing conditions due to higher traffic demands in this portion of the study area.

Under 2040 Build conditions, travel speeds along the southbound I-395 general purpose lanes range from 23 to 38 MPH with an average travel speed of 29 MPH. Overall travel speeds increase by 6 MPH to 11 MPH with an average travel speed increase of 8 MPH over the four hour PM peak period. Travel speed increases are greatest along the southbound I-395 general purpose lanes from north of the Washington Boulevard Interchange to south of Seminary Road where there is a higher utilization of the HOT lanes compared to No Build conditions.

PM Peak Period – Southbound HOV/HOT Lanes (Peak Direction)

2040 No Build corridor travel speeds along the southbound I-395 HOV/HOT lanes are approximately 58 MPH to 61 MPH. Travel speeds in the southbound I-395 HOV/HOT lanes are approximately 2 to 3 times greater than travel speeds in the southbound I-395 general purpose lanes. Southbound I-395 HOV lane travel speeds generally range from 35 to 50 MPH north of Washington Boulevard. Travel speeds approaching the Turkeycock Run Interchange decrease to 35 to 50 MPH from 3 PM to 7 PM due to motorists exiting the HOV lanes and encountering congestion in the southbound I-395 general purpose lanes impacting corridor overall travel speeds.

Under 2040 Build conditions, travel speeds along the southbound I-395 HOV/HOT lanes are approximately 61 MPH to 62 MPH. Overall travel speeds increase by 2 MPH compared to 2040 No Build conditions. Travel speeds increase on the approach to the Turkeycock Run Interchange as non-HOV motorists would no longer be required to exit the southbound I-395 HOT lanes to the heavily congested I-395 southbound general purpose lanes and the increase from two lanes to three lanes reduces the potential for congestion at the diverge to the southbound I-395 general purpose lanes; however, there are some travel speed reductions due to the high level of congestion in the southbound I-395 general purpose lanes that motorists exiting the HOT lanes encounter thereby creating congestion in the southbound I-395 HOT lanes. There is some reduction in travel speeds along the southbound I-395 HOT lanes in the vicinity of the Washington Boulevard, Shirlington Road, and Seminary Road Interchanges due to overall higher demand for the HOT lanes under 2040 Build conditions; however, travel speeds are not anticipated to drop below 42 MPH at Washington Boulevard and exceed 45 MPH at the Shirlington Road and Seminary Road Interchanges.

Table 7-27: PM Peak Period Freeway Speed and Density by Segment (2040 No Build)

2040 No Build Conditions									
Location	Type	Average Speed (mph)				Average Density (veh/mi/ln)			
		3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM
I-395 Northbound General Purpose Lanes									
I-395 NB south of Edsall Rd ramps	Diverge	49	37	33	43	30	49	57	37
I-395 NB between Edsall Rd off-ramps	Freeway	52	49	50	51	34	46	46	39
I-395 NB at Edsall Rd WB off-ramp	Diverge	47	43	45	46	29	40	39	33
I-395 NB between Edsall Rd off-ramp and on-ramp	Freeway	57	56	55	55	27	36	38	33
I-395 NB between Edsall Rd and Turkeycock Run	Weave	57	56	53	53	23	30	34	28
I-395 NB between Turkeycock Run ramps	Freeway	57	56	52	53	30	39	46	38
I-395 NB between Turkeycock Run and Duke St	Weave	57	57	56	57	23	29	32	27
I-395 NB at Duke St EB off-ramp	Diverge	57	57	57	57	23	29	31	27
I-395 NB between Duke St off-ramps	Diverge	58	58	58	58	20	26	27	23
I-395 NB between Duke St off-ramp and on-ramp	Freeway	58	57	57	57	24	32	34	29
I-395 NB between Duke St and Seminary Rd	Weave	57	57	56	57	23	29	31	27
I-395 NB between Seminary Rd ramps	Freeway	57	56	55	56	26	34	37	31
I-395 NB at Seminary Rd on-ramp	Merge	52	51	48	50	21	27	31	25
I-395 NB between Seminary Rd and King St	Weave	58	57	48	53	23	29	38	29
I-395 NB between King St off-ramp and on-ramp	Freeway	57	55	42	50	28	35	51	35
I-395 NB at King St EB on-ramp	Merge	54	50	39	47	25	33	45	31
I-395 NB between King St on-ramps	Freeway	56	53	52	54	31	40	44	36
I-395 NB between King St and Shirlington Rd	Weave	56	53	55	55	24	31	32	27
I-395 NB between Shirlington Rd ramps	Freeway	56	40	58	55	23	45	26	24
I-395 NB between Shirlington Rd and Glebe Rd	Weave	39	28	49	47	37	81	30	28
I-395 NB between Glebe Rd EB off-ramp and on-ramp	Freeway	56	54	57	52	22	28	28	29
I-395 NB between Glebe Rd EB on-ramp and WB off-ramp	Weave	55	53	54	48	19	25	26	27
I-395 NB between Glebe Rd WB off-ramp and on-ramp	Freeway	57	56	56	50	21	26	27	29
I-395 NB at Glebe Rd WB on-ramp	Merge	58	58	58	50	17	20	22	26
I-395 NB north of Glebe Rd ramps	Freeway	41	38	37	33	45	59	60	64
I-395 NB at Washington Blvd WB off-ramp	Diverge	54	53	50	46	19	22	26	27
I-395 NB at Washington Blvd EB off-ramp	Diverge	58	57	55	49	17	21	24	25
I-395 NB between Washington Blvd EB off-ramp and Army Navy Dr off-ramp	Freeway	59	58	46	46	15	19	32	24
I-395 NB at Army Navy Dr off-ramp	Diverge	57	57	33	27	11	14	36	35
I-395 NB between Army Navy Dr off-ramp and Washington Blvd EB on-ramp	Freeway	59	58	14	15	13	16	73	54
I-395 NB at Washington Blvd EB on-ramp	Weave	54	49	9	10	14	18	118	99
I-395 NB at ramp to HOV lanes	Weave	51	39	13	14	15	25	110	91

2040 No Build Conditions									
Location	Type	Average Speed (mph)				Average Density (veh/mi/ln)			
		3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM
I-395 NB between ramp to HOV lanes and S Rotary Rd on-ramp	Freeway	53	34	6	8	13	31	153	122
I-395 NB at S Rotary Rd on-ramp	Merge	54	25	6	8	10	32	124	101
I-395 NB between S Rotary Rd on-ramp and Rte 1 SB on-ramp	Freeway	54	13	6	8	13	65	167	136
I-395 NB at Rte 1 SB on-ramp	Merge	52	10	6	8	14	88	163	131
I-395 NB between Rte 1 ramps	Freeway	54	10	7	9	18	101	157	127
I-395 NB at Rte 1 NB on-ramp	Merge	47	8	6	8	18	118	156	122
I-395 NB between Rte 1 and Boundary Channel Dr	Freeway	43	9	9	10	26	133	143	122
I-395 NB between Boundary Channel Dr ramps	Weave	30	9	9	11	34	125	123	100
I-395 NB at lane reduction north of Boundary Channel Dr	Merge	28	11	11	12	43	132	127	113
I-395 NB south of GW Memorial Pkwy	Freeway	22	11	11	12	68	150	149	135
I-395 NB between GW Memorial Pkwy EB on-ramp and WB off-ramp	Weave	16	10	10	11	100	150	148	135
I-395 NB between GW Memorial Pkwy WB off-ramp and WB on-ramp	Freeway	16	11	12	13	99	145	141	128
I-395 NB between GW Memorial Pkwy and 14th St	Weave	19	17	17	18	84	95	93	87
I-395 NB at 14th St off-ramp	Diverge	21	20	21	22	86	91	92	83
I-395 NB between 14th St off-ramp and off-ramp to Buckeye Dr	Freeway	16	15	15	17	109	112	112	103
I-395 NB between Buckeye Dr ramps	Freeway	22	19	19	22	80	86	87	77
I-395 NB at on-ramp from Buckeye Dr	Merge	25	22	22	25	63	68	68	61
I-395 NB between HOV merge and 12th St Expy off-ramp	Weave	23	22	22	24	71	75	74	68
I-395 NB north of 12th St Expy off-ramp	Freeway	23	23	23	23	80	77	78	78
I-395 Southbound General Purpose Lanes									
I-395 SB north of 9th St Expy on-ramp	Freeway	20	15	14	14	83	112	112	115
I-395 SB on Francis Case Memorial Bridge	Weave	20	13	13	14	75	112	113	111
I-395 SB between HOV diverge and off-ramp to Ohio Dr	Diverge	27	15	15	15	68	97	96	95
I-395 SB between 14th St on-ramp and HOV diverge	Freeway	30	9	9	10	67	142	142	138
I-395 SB on 14th St Bridge	Merge	25	10	11	12	76	133	130	133
I-395 SB at GW Memorial Pkwy WB off-ramp	Diverge	29	16	18	20	49	103	99	103
I-395 SB between GW Memorial Pkwy EB off-ramp and WB off-ramp	Diverge	31	24	30	31	48	65	56	55
I-395 SB between GW Memorial Pkwy EB on-ramp and EB off-ramp	Freeway	38	34	44	44	34	23	16	16
I-395 SB between Boundary Channel Dr and GW Memorial Pkwy	Weave	36	33	40	40	26	19	15	14
I-395 SB between ramp from HOV lanes and Boundary Channel Dr WB off-ramp	Merge	37	33	42	43	30	23	17	17

2040 No Build Conditions									
Location	Type	Average Speed (mph)				Average Density (veh/mi/ln)			
		3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM
I-395 SB between Rte 1 SB off-ramp and ramp from HOV lanes	Weave	38	34	43	43	32	29	20	19
I-395 SB at Rte 1 SB off-ramp	Diverge	38	33	43	43	29	29	18	18
I-395 SB between Rte 1 NB off-ramp and SB off-ramp	Weave	50	37	51	49	17	27	13	14
I-395 SB between S Rotary Rd off-ramp and Rte 1 NB off-ramp	Diverge	53	34	54	51	16	43	13	15
I-395 SB between ramp from HOV lanes and S Rotary Rd off-ramp	Freeway	54	19	54	54	14	83	11	11
I-395 SB between Army Navy Dr on-ramp and ramp from HOV lanes	Merge	54	16	48	52	12	89	12	11
I-395 SB at Army Navy Dr on-ramp	Merge	50	15	39	49	17	91	21	17
I-395 SB between Washington Blvd WB on-ramp and Army Navy Dr on-ramp	Freeway	45	15	27	31	26	112	44	37
I-395 SB at Washington Blvd WB on-ramp	Merge	40	11	13	15	28	124	99	89
I-395 SB between Washington Blvd EB on-ramp and WB on-ramp	Merge	39	13	14	17	34	117	106	94
I-395 SB at Washington Blvd EB on-ramp	Merge	37	13	14	16	38	111	99	90
I-395 SB north of Glebe Rd ramps	Diverge	39	15	16	18	44	104	100	93
I-395 SB between Shirlington Rd and Glebe Rd	Freeway	34	14	15	17	53	115	112	103
I-395 SB between Shirlington Rd on-ramps	Merge	28	14	14	17	59	116	112	101
I-395 SB between King St and Shirlington Rd	Weave	26	14	15	17	57	102	100	90
I-395 SB between King St WB on-ramp and off-ramp	Freeway	24	13	13	15	69	121	119	107
I-395 SB at King St WB on-ramp	Merge	21	13	13	15	64	98	97	93
I-395 SB between King St EB on-ramp and WB on-ramp	Freeway	21	14	15	17	77	110	109	103
I-395 SB between Seminary Rd and King St	Weave	18	13	14	15	80	104	103	97
I-395 SB between Seminary Rd ramps	Freeway	19	16	16	17	80	97	95	90
I-395 SB at Seminary Rd on-ramp	Merge	17	16	16	16	86	94	92	89
I-395 SB between Little River Tnpk and Seminary Rd	Freeway	45	46	46	46	39	39	39	39
I-395 SB at Little River Tnpk off-ramp	Diverge	46	50	50	47	37	34	34	36
I-395 SB between Little River Tnpk ramps	Freeway	50	51	51	51	29	29	29	30
I-395 SB at Little River Tnpk WB on-ramp	Merge	48	50	50	49	28	27	27	28
I-395 SB between Turkeycock Run and Little River Tnpk	Freeway	51	51	50	50	32	32	33	33
I-395 SB at Turkeycock Run off-ramp	Diverge	48	47	46	46	27	28	31	30
I-395 SB between Turkeycock Run ramps	Freeway	53	53	53	53	28	27	26	27
I-395 SB between Edsall Rd and Turkeycock Run	Weave	52	53	53	53	29	25	24	26
I-395 SB between Edsall Rd EB on-ramp and off-ramp	Freeway	52	53	53	53	33	28	27	29
I-395 SB south of Edsall Rd ramps	Merge	51	52	52	52	33	30	28	29
I-395 Northbound HOV/HOT Lanes									
I-395 HOV NB at Eads St on-ramp	Merge	28	28	28	28	8	10	10	6

2040 No Build Conditions									
Location	Type	Average Speed (mph)				Average Density (veh/mi/ln)			
		3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM
I-395 HOV NB between Eads St on-ramp and on-ramp from GP lanes	Freeway	43	43	42	43	7	10	9	6
I-395 HOV NB at on-ramp from GP lanes	Merge	44	42	31	43	14	18	25	14
I-395 HOV NB between on-ramp from GP lanes and 14th St	Freeway	43	25	19	40	22	47	60	23
I-395 HOV NB north of 14th St	Freeway	28	22	22	25	46	68	67	52
I-395 Southbound HOV/HOT Lanes									
I-395 HOV SB north of 14th St	Freeway	36	37	37	37	41	30	26	32
I-395 HOV SB between off-ramp to GP lanes and 14th St	Merge	39	40	42	42	33	23	18	21
I-395 HOV SB at off-ramp to GP lanes	Diverge	41	39	43	43	21	17	12	14
I-395 HOV SB between Eads St off-ramp and off-ramp to GP lanes	Freeway	44	44	44	40	19	10	9	15
I-395 HOV SB at Eads St off-ramp	Diverge	44	44	44	37	13	7	6	23
I-395 HOV SB between Eads St ramps	Freeway	44	44	44	44	18	9	8	11
I-395 HOV SB between Eads St on-ramp and ramp to GP lanes	Weave	51	52	52	51	14	11	11	9
I-395 HOV SB between ramp to GP lanes and Washington Blvd on-ramp	Freeway	49	50	50	51	18	13	12	9
I-395 HOV SB at Washington Blvd on-ramp	Merge	52	53	52	49	18	12	13	16
I-395 HOV SB between Washington Blvd on-ramp and Shirlington Rd off-ramp	Freeway	57	58	58	58	24	17	18	19
I-395 HOV SB at Shirlington Rd off-ramp	Diverge	47	57	53	52	20	11	13	14
I-395 HOV SB between Shirlington Rd off-ramp and Seminary Rd off-ramp	Freeway	62	63	63	63	22	15	15	17
I-395 HOV SB at Seminary Rd off-ramp	Diverge	59	60	59	58	15	11	11	12
I-395 HOV SB between Seminary Rd ramps	Freeway	62	63	63	63	20	14	14	15
I-395 HOV SB at Seminary Rd on-ramp	Merge	57	58	59	58	17	11	11	12
I-395 HOV SB between Seminary Rd on-ramp and Turkeycock Run off-ramp	Freeway	45	52	54	51	30	18	17	20
I-395 HOV SB at Turkeycock Run off-ramp	Diverge	34	45	49	41	27	14	13	17
I-395 HOV SB between Turkeycock Run ramps	Freeway	60	61	61	60	12	25	27	24
I-395 HOT SB at Turkeycock Run on-ramp	Merge	61	60	59	59	12	13	15	13
I-395 HOT SB south of Turkeycock Run ramps	Freeway	64	64	64	64	11	12	14	12

Table 7-28: PM Peak Period Freeway Speed and Density by Segment (2040 Build)

2040 Build Conditions									
Location	Type	Average Speed (mph)				Average Density (veh/mi/ln)			
		3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM
I-395 Northbound General Purpose Lanes									
I-395 NB south of Edsall Rd ramps	Diverge	49	35	32	41	30	53	58	40
I-395 NB between Edsall Rd off-ramps	Freeway	52	49	50	51	34	46	46	39
I-395 NB at Edsall Rd WB off-ramp	Diverge	47	43	45	46	29	40	39	34
I-395 NB between Edsall Rd off-ramp and on-ramp	Freeway	57	56	55	56	27	36	38	33
I-395 NB between Edsall Rd and Turkeycock Run	Weave	57	56	52	54	23	30	35	28
I-395 NB between Turkeycock Run ramps	Freeway	57	56	51	54	31	40	46	38
I-395 NB north of Turkeycock Run ramps	Weave	57	57	56	57	23	29	32	27
I-395 NB at Duke St EB off-ramp	Diverge	57	57	57	57	23	29	31	27
I-395 NB between Duke St off-ramps	Diverge	58	58	58	58	21	26	27	24
I-395 NB between Duke St off-ramp and on-ramp	Freeway	58	57	57	57	25	32	34	29
I-395 NB between Duke St and Seminary Rd	Weave	57	57	56	57	23	29	31	27
I-395 NB between Seminary Rd ramps	Freeway	57	56	55	56	26	34	38	31
I-395 NB at Seminary Rd on-ramp	Merge	53	51	48	51	21	27	31	25
I-395 NB between Seminary Rd and King St	Weave	58	57	51	55	24	29	36	29
I-395 NB between King St off-ramp and on-ramp	Freeway	57	54	41	52	28	36	53	34
I-395 NB at King St EB on-ramp	Merge	54	48	37	48	25	34	48	31
I-395 NB between King St on-ramps	Freeway	56	51	52	55	32	42	44	36
I-395 NB between King St and Shirlington Rd	Weave	56	50	55	56	24	34	32	27
I-395 NB between Shirlington Rd ramps	Freeway	56	32	57	58	23	60	27	23
I-395 NB between Shirlington Rd and Glebe Rd	Weave	40	26	46	52	36	89	34	25
I-395 NB between Glebe Rd EB off-ramp and on-ramp	Freeway	56	53	56	57	22	28	30	24
I-395 NB between Glebe Rd EB on-ramp and WB off-ramp	Weave	55	53	53	53	19	25	27	23
I-395 NB between Glebe Rd WB off-ramp and on-ramp	Freeway	57	57	56	57	21	25	28	23
I-395 NB at Glebe Rd WB on-ramp	Merge	58	58	58	58	17	20	22	19
I-395 NB north of Glebe Rd ramps	Freeway	58	57	54	55	21	25	31	25
I-395 NB at Washington Blvd WB off-ramp	Diverge	53	52	47	48	19	22	29	24
I-395 NB at Washington Blvd EB off-ramp	Diverge	58	57	49	47	17	21	32	25
I-395 NB between Washington Blvd EB off-ramp and Army Navy Dr off-ramp	Freeway	59	58	29	29	14	18	56	43
I-395 NB at Army Navy Dr off-ramp	Diverge	58	57	18	20	11	14	70	47
I-395 NB between Army Navy Dr off-ramp and Washington Blvd EB on-ramp	Freeway	59	43	9	13	13	23	117	69
I-395 NB at Washington Blvd EB on-ramp	Weave	54	23	8	9	14	48	150	123
I-395 NB at ramp to HOT lanes	Weave	51	21	12	12	15	56	121	111
I-395 NB between ramp to HOT lanes and S Rotary Rd on-ramp	Freeway	53	11	6	7	14	82	157	147

2040 Build Conditions									
Location	Type	Average Speed (mph)				Average Density (veh/mi/ln)			
		3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM
I-395 NB at S Rotary Rd on-ramp	Merge	54	9	7	7	11	74	124	119
I-395 NB between S Rotary Rd on-ramp and Rte 1 SB on-ramp	Freeway	54	8	7	7	14	115	162	158
I-395 NB at Rte 1 SB on-ramp	Merge	50	8	7	7	16	127	156	150
I-395 NB between Rte 1 ramps	Freeway	50	8	8	9	22	133	149	141
I-395 NB at Rte 1 NB on-ramp	Merge	42	7	7	8	23	142	134	127
I-395 NB between Rte 1 and Boundary Channel Dr	Freeway	37	9	9	10	32	137	138	135
I-395 NB between Boundary Channel Dr ramps	Weave	28	10	10	11	38	120	119	109
I-395 NB at lane reduction north of Boundary Channel Dr	Merge	28	12	12	12	45	125	118	121
I-395 NB south of GW Memorial Pkwy	Freeway	22	12	12	12	70	145	139	143
I-395 NB between GW Memorial Pkwy EB on-ramp and WB off-ramp	Weave	17	11	12	11	98	145	141	143
I-395 NB between GW Memorial Pkwy WB off-ramp and WB on-ramp	Freeway	17	12	14	13	97	138	131	134
I-395 NB between GW Memorial Pkwy and 14th St	Weave	19	18	20	18	84	90	85	90
I-395 NB at 14th St off-ramp	Diverge	21	22	23	21	86	87	87	87
I-395 NB between 14th St off-ramp and off-ramp to Buckeye Dr	Freeway	16	16	17	16	108	108	106	108
I-395 NB between Buckeye Dr ramps	Freeway	22	22	23	22	78	81	78	80
I-395 NB at on-ramp from Buckeye Dr	Merge	25	24	26	25	61	64	61	63
I-395 NB between HOT merge and 12th St Expy off-ramp	Weave	23	23	24	23	70	72	70	72
I-395 NB north of 12th St Expy off-ramp	Freeway	23	23	23	23	79	80	81	80
I-395 Southbound General Purpose Lanes									
I-395 SB north of 9th St Expy on-ramp	Freeway	20	16	17	15	86	106	104	110
I-395 SB on Francis Case Memorial Bridge	Weave	20	14	14	14	76	110	107	111
I-395 SB between HOT diverge and off-ramp to Ohio Dr	Diverge	27	16	16	16	68	96	91	95
I-395 SB between 14th St on-ramp and HOV diverge	Freeway	32	10	10	9	62	134	135	142
I-395 SB on 14th St Bridge	Merge	29	11	13	10	64	126	119	133
I-395 SB at GW Memorial Pkwy WB off-ramp	Diverge	32	17	19	18	44	98	89	101
I-395 SB between GW Memorial Pkwy EB off-ramp and WB off-ramp	Diverge	34	27	30	30	43	60	52	55
I-395 SB between GW Memorial Pkwy EB on-ramp and EB off-ramp	Freeway	38	39	44	44	36	20	17	15
I-395 SB between Boundary Channel Dr and GW Memorial Pkwy	Weave	37	37	40	41	25	16	15	12
I-395 SB between ramp from HOT lanes and Boundary Channel Dr WB off-ramp	Merge	37	38	43	43	31	19	17	14
I-395 SB between Rte 1 SB off-ramp and ramp from HOV lanes	Merge	36	38	43	43	33	22	19	16
I-395 SB at Rte 1 SB off-ramp	Diverge	34	37	43	44	34	21	17	15

2040 Build Conditions									
Location	Type	Average Speed (mph)				Average Density (veh/mi/ln)			
		3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM
I-395 SB between Rte 1 NB off-ramp and SB off-ramp	Weave	50	50	51	51	16	12	12	11
I-395 SB between S Rotary Rd off-ramp and Rte 1 NB off-ramp	Diverge	53	52	53	53	15	12	13	11
I-395 SB south of S Rotary Rd off-ramp	Freeway	54	54	54	55	12	9	9	8
I-395 SB north of Army Navy Dr on-ramp	Freeway	54	54	54	55	12	9	9	8
I-395 SB at Army Navy Dr on-ramp	Merge	53	53	53	53	12	9	10	10
I-395 SB between Washington Blvd WB on-ramp and Army Navy Dr on-ramp	Freeway	54	54	54	54	16	12	12	13
I-395 SB at Washington Blvd WB on-ramp	Merge	52	51	51	51	16	17	18	16
I-395 SB between Washington Blvd EB on-ramp and WB on-ramp	Freeway	53	52	53	53	20	20	21	20
I-395 SB at Washington Blvd EB on-ramp	Merge	50	44	51	51	24	30	21	21
I-395 SB north of Glebe Rd ramps	Diverge	52	42	53	53	29	40	25	25
I-395 SB between Shirlington Rd and Glebe Rd	Freeway	52	28	52	53	32	67	26	25
I-395 SB between Shirlington Rd on-ramps	Merge	45	16	38	51	36	103	40	27
I-395 SB between King St and Shirlington Rd	Weave	40	14	30	49	37	99	48	26
I-395 SB between King St WB on-ramp and off-ramp	Freeway	35	12	23	53	46	121	71	25
I-395 SB at King St WB on-ramp	Merge	30	13	18	51	43	99	73	21
I-395 SB between King St EB on-ramp and WB on-ramp	Freeway	29	14	17	49	55	112	93	28
I-395 SB between Seminary Rd and King St	Weave	24	13	15	39	61	105	96	33
I-395 SB between Seminary Rd ramps	Freeway	22	16	16	37	69	97	94	35
I-395 SB at Seminary Rd on-ramp	Merge	18	16	16	32	82	94	92	40
I-395 SB between Little River Tnpk and Seminary Rd	Freeway	45	46	46	50	39	39	39	31
I-395 SB at Little River Tnpk off-ramp	Diverge	44	50	49	49	39	34	34	30
I-395 SB between Little River Tnpk ramps	Freeway	50	51	51	52	29	29	28	24
I-395 SB at Little River Tnpk WB on-ramp	Merge	48	50	49	50	28	27	27	24
I-395 SB between Turkeycock Run and Little River Tnpk	Freeway	51	51	51	52	32	32	32	28
I-395 SB at Turkeycock Run off-ramp	Diverge	49	49	47	49	27	27	28	24
I-395 SB between Turkeycock Run ramps	Freeway	53	53	53	53	28	28	27	24
I-395 SB between Edsall Rd and Turkeycock Run	Weave	52	53	53	53	31	28	25	25
I-395 SB between Edsall Rd EB on-ramp and off-ramp	Freeway	52	53	53	53	35	31	28	27
I-395 SB south of Edsall Rd ramps	Merge	51	51	52	52	35	32	29	27
I-395 Northbound HOT Lanes									
I-395 HOT NB at Eads St on-ramp	Freeway	28	28	28	28	7	9	8	7
I-395 HOT NB between Eads St on-ramp and on-ramp from GP lanes	Freeway	43	43	43	43	6	8	8	7
I-395 HOT NB at on-ramp from GP lanes	Merge	44	44	44	44	13	15	15	14
I-395 HOT NB between on-ramp from GP lanes and 14th St	Freeway	42	41	41	37	20	25	24	26

2040 Build Conditions									
Location	Type	Average Speed (mph)				Average Density (veh/mi/ln)			
		3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM
I-395 HOT NB north of 14th St	Freeway	29	25	27	25	41	55	47	55
I-395 Southbound HOT Lanes									
I-395 HOT SB north of 14th St	Freeway	36	37	37	37	41	32	31	31
I-395 HOT SB between off-ramp to GP lanes and 14th St	Merge	40	41	42	42	34	26	22	21
I-395 HOT SB at off-ramp to GP lanes	Diverge	43	43	43	43	21	17	14	14
I-395 HOT SB between Eads St off-ramp and off-ramp to GP lanes	Freeway	44	44	44	44	22	15	13	13
I-395 HOT SB at Eads St off-ramp	Diverge	44	44	44	44	15	10	9	9
I-395 HOT SB between Eads St ramps	Freeway	44	44	44	44	22	15	12	12
I-395 HOT SB at Eads St on-ramp	Merge	51	51	51	50	14	14	13	8
I-395 HOT SB between HOT merge and Washington Blvd on-ramp	Freeway	54	54	54	55	19	17	15	11
I-395 HOT SB at Washington Blvd on-ramp	Merge	43	44	42	42	24	22	21	17
I-395 HOT SB between Washington Blvd on-ramp and Shirlington Rd off-ramp	Freeway	57	57	57	58	23	21	20	16
I-395 HOT SB at Shirlington Rd off-ramp	Diverge	47	46	47	52	21	20	18	13
I-395 HOT SB between Shirlington Rd off-ramp and Seminary Rd off-ramp	Freeway	63	63	63	64	18	16	15	12
I-395 HOT SB at Seminary Rd off-ramp	Diverge	51	46	50	58	17	17	14	10
I-395 HOT SB between Seminary Rd ramps	Freeway	63	63	63	64	17	15	13	11
I-395 HOT SB at Seminary Rd on-ramp	Merge	60	60	61	60	14	12	11	10
I-395 HOT SB between Seminary Rd on-ramp and Turkeycock Run off-ramp	Freeway	54	55	58	58	21	18	15	13
I-395 HOT SB at Turkeycock Run off-ramp	Diverge	38	44	52	47	25	18	13	13
I-395 HOT SB between Turkeycock Run ramps	Freeway	62	63	63	63	10	24	25	18
I-395 HOT SB at Turkeycock Run on-ramp	Merge	62	61	60	61	9	11	12	8
I-395 HOT SB south of Turkeycock Run ramps	Freeway	64	64	64	64	12	13	15	11

Figure 7-80: Freeway Speed Comparison – Southbound General Purpose Lanes
2040 No Build and Build – PM Peak Period

					Edsall Rd				Turkeycock Run					Duke St					Seminary Rd				King St			Shirlington Rd	Glebe Rd					Washington Blvd			Jefferson Davis Hwy			Boundary Channel Dr			George Washington Memorial Pkwy			14th St			12th St	
Existing	3:00 PM	52	51	44	39	50	52	53	47	44	26	33	33	30	40	19	17	21	13	16	17	21	22	25	28	33	45	52	51	52	51	53	53	54	54	53	49	42	41	39	41	41	42	39	41	36	36	30	27	31
	4:00 PM	52	52	49	47	52	53	53	48	43	22	26	26	19	28	18	17	19	11	13	11	12	11	10	12	11	12	14	14	14	13	14	12	12	17	37	42	39	40	38	40	40	42	38	41	36	35	32	33	37
	5:00 PM	52	52	50	48	52	53	53	47	43	22	25	25	18	27	17	17	20	12	13	11	13	11	11	12	12	13	15	14	15	13	14	10	7	7	23	26	30	30	27	28	30	30	29	33	33	34	30	31	35
	6:00 PM	53	51	46	43	51	52	53	46	43	22	25	25	18	27	17	17	20	12	13	12	13	12	12	14	15	15	17	16	16	13	14	11	11	22	44	47	40	38	31	38	41	43	40	42	36	28	24	18	19
2040 No Build	3:00 PM	51	52	52	52	52	52	53	48	51	51	48	50	50	50	50	46	45	17	19	18	21	21	24	26	28	34	39	37	39	40	45	50	54	54	53	50	38	38	38	37	36	38	31	29	25	30	27	20	20
	4:00 PM	52	53	53	53	53	53	53	47	51	51	50	51	51	51	51	50	46	16	16	13	14	13	13	14	14	14	15	13	13	11	15	15	16	19	34	37	33	34	34	33	33	34	24	16	10	9	15	13	15
	5:00 PM	52	53	53	53	53	53	53	46	50	50	50	51	51	51	51	50	46	16	16	14	15	13	13	15	14	15	16	14	14	13	27	39	48	54	54	51	43	43	43	42	40	44	30	18	11	9	15	13	14
	6:00 PM	52	53	53	53	53	53	53	46	50	50	49	51	51	51	51	47	46	16	17	15	17	15	15	17	17	17	18	16	17	15	31	49	52	54	51	49	43	43	43	43	40	44	31	20	12	10	15	14	14
2040 Build	3:00 PM	51	52	52	52	52	52	53	49	51	51	48	50	50	50	50	44	45	18	22	24	29	30	35	40	45	52	52	50	53	52	54	53	54	54	53	50	34	36	36	37	37	38	34	32	29	32	27	20	20
	4:00 PM	51	53	53	53	53	53	53	49	51	51	50	51	51	51	51	50	46	16	16	13	14	13	12	14	16	28	42	44	52	51	54	53	54	54	52	50	37	38	38	38	37	39	27	17	11	10	16	14	16
	5:00 PM	52	53	53	53	53	53	53	47	51	51	49	51	51	51	51	49	46	16	16	15	17	18	23	30	38	52	53	51	53	51	54	53	54	54	53	51	43	43	43	43	40	44	30	19	13	10	16	14	17
	6:00 PM	52	53	53	53	53	53	53	49	52	52	50	52	52	52	52	49	50	32	37	39	49	51	53	49	51	53	53	51	53	51	54	53	55	55	53	51	44	43	43	43	41	44	30	18	10	9	16	14	15

25 35 45 55 65

Travel Speed (mph)

Figure 7-81: Freeway Speed Comparison – Northbound General Purpose Lanes
2040 No Build and Build – PM Peak Period

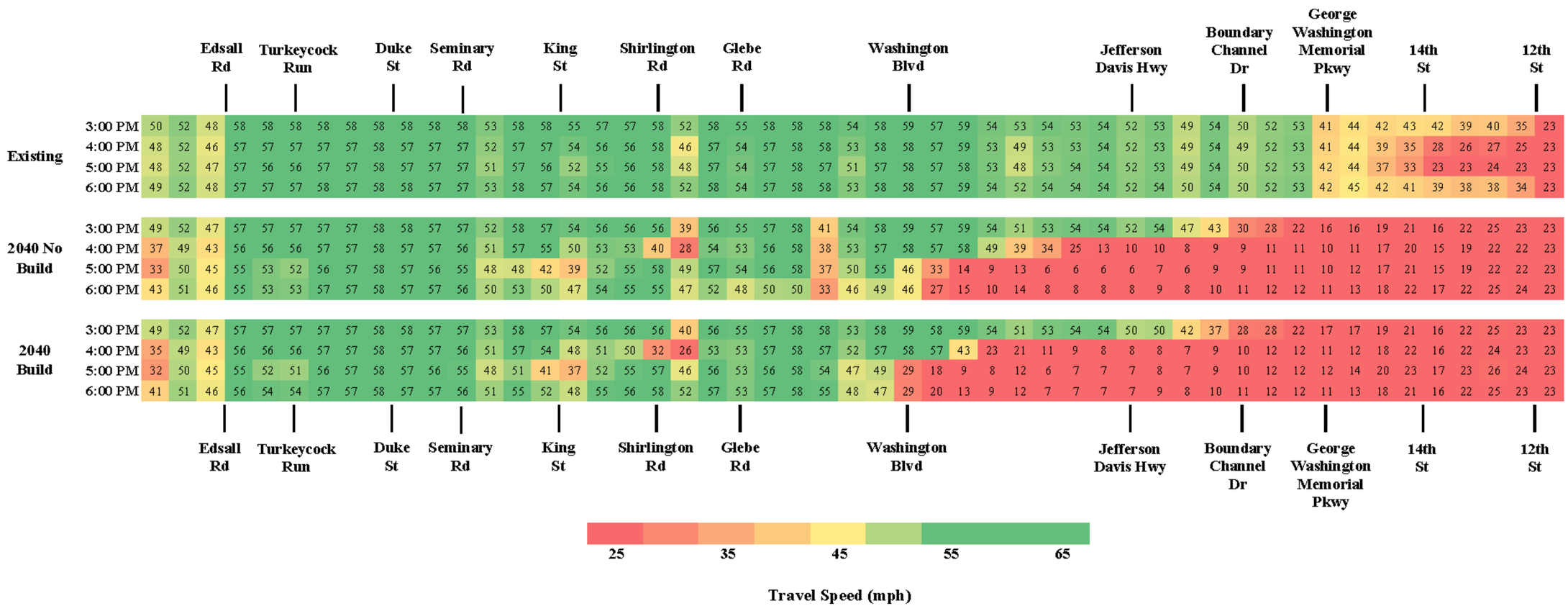


Figure 7-82: Freeway Speed Comparison – HOV/HOT Lanes
2040 No Build and Build – PM Peak Period

Northbound HOV/HOT Lanes

		Eads St			14th St
Existing	3:00 PM	28	43	44	43	31
	4:00 PM	28	43	43	28	21
	5:00 PM	28	43	42	31	23
	6:00 PM	28	43	44	43	29
2040 No Build	3:00 PM	28	43	44	43	28
	4:00 PM	28	43	42	25	22
	5:00 PM	28	42	31	19	22
	6:00 PM	28	43	43	40	25
2040 Build	3:00 PM	28	43	44	42	29
	4:00 PM	28	43	44	41	25
	5:00 PM	28	43	44	41	27
	6:00 PM	28	43	44	37	25
		Eads St			14th St

25 35 45 55 65

Travel Speed (mph)

Southbound HOV/HOT Lanes

		Turkeycock Run				Seminary Rd				Shirlington Rd		Washington Blvd				Eads St		Boundary Channel Dr		14th St
Existing	3:00 PM	64	60	63	43	62	62	62	58	63	49	58	52	49	49	51	44	44	44	43	41	36
	4:00 PM	64	60	63	54	62	62	62	57	63	53	58	53	48	48	51	44	44	44	41	40	36
	5:00 PM	64	60	63	54	62	62	62	55	62	45	57	53	47	47	50	44	44	44	37	35	32
	6:00 PM	64	59	63	39	61	61	61	44	62	44	57	51	48	48	51	44	44	44	41	40	36
2040 No Build	3:00 PM	64	61	60	34	45	57	62	59	62	47	57	52	49	51	51	44	44	44	41	39	36
	4:00 PM	64	60	61	45	52	58	63	60	63	57	58	53	50	52	52	44	44	44	39	40	37
	5:00 PM	64	59	61	49	54	59	63	59	63	53	58	52	50	52	52	44	44	44	43	42	37
	6:00 PM	64	59	60	41	51	58	63	58	63	52	58	49	51	51	51	44	37	40	43	42	37
2040 Build	3:00 PM	64	62	62	38	54	60	63	51	63	47	57	43	54	51	51	44	44	44	43	40	36
	4:00 PM	64	61	63	44	55	60	63	46	63	46	57	44	54	51	51	44	44	44	43	41	37
	5:00 PM	64	60	63	52	58	61	63	50	63	47	57	42	54	51	51	44	44	44	43	42	37
	6:00 PM	64	61	63	47	58	60	64	58	64	52	58	42	55	50	50	44	44	44	43	42	37
		Turkeycock Run				Seminary Rd				Shirlington Rd		Washington Blvd				Eads St		Boundary Channel Dr		14th St

25 35 45 55 65

Travel Speed (mph)

HOV/HOT Lane Queues: Queues along freeway off-ramps from the I-395 HOV/HOT lanes during the PM peak period were compared between No Build and Build conditions to identify locations where there would be queue spillback onto the freeway lanes. **Table 7-28a** summarizes average and maximum queue lengths and available storage lengths for the northbound and southbound I-395 HOV/HOT lanes for each of the four analysis hours from 3 PM through 7 PM.

As shown, the maximum queue length for the ramp from the southbound I-395 HOV lanes to the southbound general purpose lanes at Boundary Channel Drive exceeds the available storage under No Build conditions from 4 PM to 5 PM; however, under Build conditions queues will not exceed available storage due to the ability for all motorists (including non-HOV motorists) to continue in the southbound HOT lanes.

Table 7-28a: PM Peak Period I-395 HOV/HOT Ramp Queues (2040 No Build and Build)

HOV/HOT Ramp Location	Available Storage (feet)	2040 No Build		2040 Build		2040 No Build		2040 Build		2040 No Build		2040 Build		2040 No Build		2040 Build	
		Avg. (feet)	Max. (feet)	Avg. (feet)	Max. (feet)	Avg. (feet)	Max. (feet)	Avg. (feet)	Max. (feet)	Avg. (feet)	Max. (feet)	Avg. (feet)	Max. (feet)	Avg. (feet)	Max. (feet)	Avg. (feet)	Max. (feet)
		3 - 4 PM				4 - 5 PM				5 - 6 PM				6 - 7 PM			
SB to SB GP at Turkeycock Run	2,780	7	568	19	876	0	0	2	297	0	0	0	0	0	67	0	6
SB to Seminary Rd	2,750	0	19	5	205	0	60	20	336	0	54	13	313	1	96	1	106
SB to Shirlington Rd	1,580	0	53	2	152	0	60	7	237	1	78	53	479	1	98	8	221
SB to SB GP (south of Eads St)	410	0	0			0	0			0	0			0	0		
SB to Eads St	1,260	2	76	4	71	1	72	2	70	4	107	5	87	224	489	5	85
SB to SB GP at Boundary Channel Dr	700	25	661	1	91	85	1,571	2	167	0	0	0	0	0	0	0	0
NB to 14th St SW	1,350	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NB to NB GP into D.C.	2,400	1	81	0	49	274	1,252	0	5	778	1,595	0	0	0	9	0	0

Highlighted cells indicate locations where average or maximum queue lengths exceed available storage

7.3.3 Arterial Intersection Operations

Similar to existing conditions, measures of effectiveness (MOEs) from the VISSIM outputs were used to document operations for 2040 No Build and Build conditions at the signalized and unsignalized intersections along the I-395 study corridor. Average delay by movement, average delay by approach, and overall intersection delay was reported for each intersection. Maximum queue lengths by movement in feet were also reported. Overall average delay values are color-coded to reflect various congestion levels based on delay thresholds established in the *Highway Capacity Manual 2010* (TRB, 2010) as shown in **Table 7-2**. **Appendix J** also contains a summary of travel speeds and travel times by link for the arterials throughout the study area.

Figure 7-83 presents a summary of 2040 No Build and Build intersection operations for both signalized and unsignalized intersections for the AM and PM peak hours. Operations at the Eads Street Interchange are discussed in more detail in **Section 7.3.4** and operations at the Shirlington Interchange are discussed in more detail in **Section 7.3.5**. **Table 7-29** depicts overall intersection delay for both signalized and unsignalized intersections for the AM and PM peak hours for 2040 No Build and Build conditions. **Appendix J** contains a tabular summary of average delays by movement, intersection approach, and overall delay as well as maximum queue lengths and storage lengths. **Figures 7-83a** (*Volume 2*) **and 83c** *(Volume 2)* depict the average delays by movement and for the overall intersections for 2040 No Build and Build conditions, respectively. **Figures 7-83b** (*Volume 2*) **and 7-83d** *(Volume 2)* depict the maximum queue lengths by movement for 2040 No Build and Build conditions, respectively.

AM Peak Hour: Under 2040 No Build conditions during the AM peak hour, 49 (87 percent) of the 56 intersections operate with light traffic conditions, four (7 percent) intersections operate with moderate traffic conditions, 2 (4 percent) intersections operate with heavy congestion, and one intersection operates with severe congestion. Under 2040 Build condition, 49 (88 percent) of the 56 intersections operate with light traffic conditions, four (7 percent) intersections operate with moderate traffic conditions, and three (5 percent) intersections operate with severe congestion. The congestion level at five intersections change under 2040 Build conditions in the AM peak hour. Operations at two intersections would improve and operations at three intersections would degrade when comparing 2040 No Build and Build conditions.

- **Little River Turnpike at Beauregard Street:** The congestion level at this intersection would increase from heavy congestion to severe congestion with overall intersection delays increasing by approximately 17 seconds from 70 seconds to 87 seconds. This can be attributed to higher congestion levels in the northbound I-395 general purpose lanes during the 7 AM to 8 AM hour when demand for the HOT lanes is highest and in order to maintain travel speeds in the HOT lanes, traffic would be shifted from the HOT lanes to the general purpose lanes. This causes the northbound on-ramp from eastbound Little River Turnpike to the northbound general purpose lanes to become more congested resulting in longer delays along eastbound Little River Turnpike approaching the northbound flyover ramp. Average delays on the eastbound Little River Turnpike approach increase by approximately 43 seconds from 72 seconds to 115 seconds between 2040 No Build and Build conditions. Average approach delays on the remaining three intersection approaches do not increase by more than 20 seconds.

  To address the increase in congestion levels at this intersection, mitigation measures including widening to provide additional lanes and increasing capacity at this intersection could potentially reduce delays at the intersection; however, widening this intersection would be very impactive to

adjacent commercial properties on all four corners of the intersection and the additional lanes would result in limited congestion benefits due to the downstream capacity constraints at the ramp to the northbound I-395 general purpose lanes located 500 feet to the east of the intersection. Additionally, increased delays are not predicted under 2020 Build conditions due to the lower congestion levels in the northbound general purpose lanes compared to 2040 Build conditions.

- **Duke Street at Walker Street:** The congestion level at this intersection would increase from light traffic conditions to moderate traffic conditions with overall intersection delays increasing by approximately 24 seconds from 19 seconds to 43 seconds. Similar to the Little River Turnpike at Beauregard Street Intersection, this can be attributed to a higher congestion levels in the northbound I-395 general purpose lanes during the 7 AM to 8 AM hour when demand for the HOT lanes is highest and in order to maintain travel speeds in the HOT lanes, traffic would be shifted from the HOT lanes to the general purpose lanes. This causes the northbound on-ramp from westbound Duke Street to the northbound general purpose lanes to become more congested resulting in longer delays along westbound Duke Street approaching the northbound on-ramp.

  Similar to the Little River Turnpike at Beauregard Street intersection, to address the increase in congestion levels at this intersection, mitigation measures including widening to provide additional lanes and increasing capacity at this intersection could potentially reduce delays at the intersection; however, the additional lanes would result in limited congestion benefits due to the downstream capacity constraints at the ramp to the northbound I-395 general purpose lanes located 300 feet to the west of the intersection. Additionally, increased delays are not predicted under 2020 Build conditions due to the lower congestion levels in the northbound general purpose lanes compared to 2040 Build conditions.

- **Quaker Lane at Gunston Road** (see discussion in **Section 7.3.5**): The congestion level at this intersection would improve from heavy congestion to light traffic conditions.

- **Quaker Lane at Preston Road** (see discussing in **Section 7.3.5**): The congestion level at this intersection would improve from moderate traffic conditions to light traffic conditions.

- **Arlington Ridge Road at I-395 Ramps**: The congestion level at this intersection would increase from light to severe traffic conditions with overall intersection delays increasing from less than 5 seconds to approximately 3 minutes. This three-legged intersection currently operates under stop control on the southbound Arlington Ridge Road and eastbound I-395 ramp approaches with the northbound left-turn movement to the northbound I-395 collector-distributor roadway and the northbound through movements operating free flow. The northbound and southbound Arlington Ridge Road approaches both include a single lane and the eastbound approach from I-395 includes a left-turn lane and a right-turn lane.

  The increase in delays can be attributed to higher congestion levels in the northbound I-395 general purpose lanes in the northern portion of the corridor during the 7 AM to 8 AM hour when demand for the HOT lanes is highest and in order to maintain travel speeds in the HOT lanes, traffic would be shifted from the HOT lanes to the general purpose lanes. Due to proximity of the intersection to the northbound I-395 collector-distributor roadway (approximately 1,000 feet between the gore point along the collector-distributor and the intersection), increased congestion along the collector-distributor roadway under Build conditions makes it more difficult for the heavy left-turn movement (over 500 vehicles per hour) from northbound Arlington Ridge Road to enter the collector-distributor roadway creating queues that extend to Arlington Ridge Road and creating

delays at the intersection. The congestion along the northbound I-395 collector-distributor road is present in the 2040 Build conditions since the collector-distributor road ultimately merges with the general purpose lanes in the vicinity of Eads Street which are more congested under Build conditions compared to No Build conditions. The general purpose lanes are more congested in this area under Build conditions compared to No Build conditions due to the increased volumes in this area in order to maintain free-flowing conditions at the terminus of the northbound I-395 HOT lanes.

Northbound Arlington Ridge Road in this area serves the residential communities between Pentagon City/Crystal City and Glebe Road but also serves as an alternate route to westbound Glebe Road and northbound I-395 during the heavily congested AM peak period. It is likely that as a result of increased delays at this intersection, the Arlington Ridge Road access point to northbound I-395 would become a less desirable route and some motorists would no longer choose to take this route in the future, reducing the likelihood of delays at this intersection under 2040 Build conditions. Additionally, increased delays are not predicted under 2020 Build conditions due to the lower congestion levels in the northbound general purpose lanes compared to 2040 Build conditions. Therefore, in lieu of specific mitigation measures, it is recommended that traffic conditions at this location be monitored to determine if traffic patterns change in the future and if mitigation would be beneficial to reduce the potential for increased delays at this intersection.

PM Peak Hour: Under 2040 No Build conditions during the PM peak hour, 48 (84 percent) of the 57 intersections operate with light traffic conditions, four (7 percent) intersections operate with moderate traffic conditions, four (7 percent) intersections operate with heavy congestion, and one intersection operates with severe congestion. Under 2040 Build conditions, 50 (88 percent) of the 57 intersections operate with light traffic conditions, three (5 percent) operate with moderate traffic conditions, two (4 percent) operate with heavy congestion, and two (3 percent) operate with severe congestion. The congestion level at four intersections change under 2040 Build conditions in the PM peak hour. Operations at three intersections would improve and operations at one intersection would degrade when comparing 2040 No Build and Build conditions.

- **Martha Custis Drive at Gunston Road** (see discussion in **Section 7.3.5**): The congestion level at this intersection would increase from heavy congestion to severe congestion with overall average delay increases of 5 seconds.
- **Army Navy Drive at Hayes Street** (see discussion in **Section 7.3.4**): The congestion level at this intersection would improve from moderate traffic conditions to light traffic conditions with overall average delay decreases of 7 seconds.
- **Army Navy Drive at Fern Street** (see discussion in **Section 7.3.4**): The congestion level at this intersection would improve from heavy congestion to moderate traffic conditions with overall average delay decreases of 27 seconds.
- **North Rotary Road at Connector Road / Eads Stree**t (see discussion in **Section 7.3.4**): The congestion level at this intersection would improve from moderate traffic conditions to light traffic conditions with overall average delay decreases of 12 seconds.

Figure 7-83: Intersection Operations Summary (2040 No Build and Build Conditions)

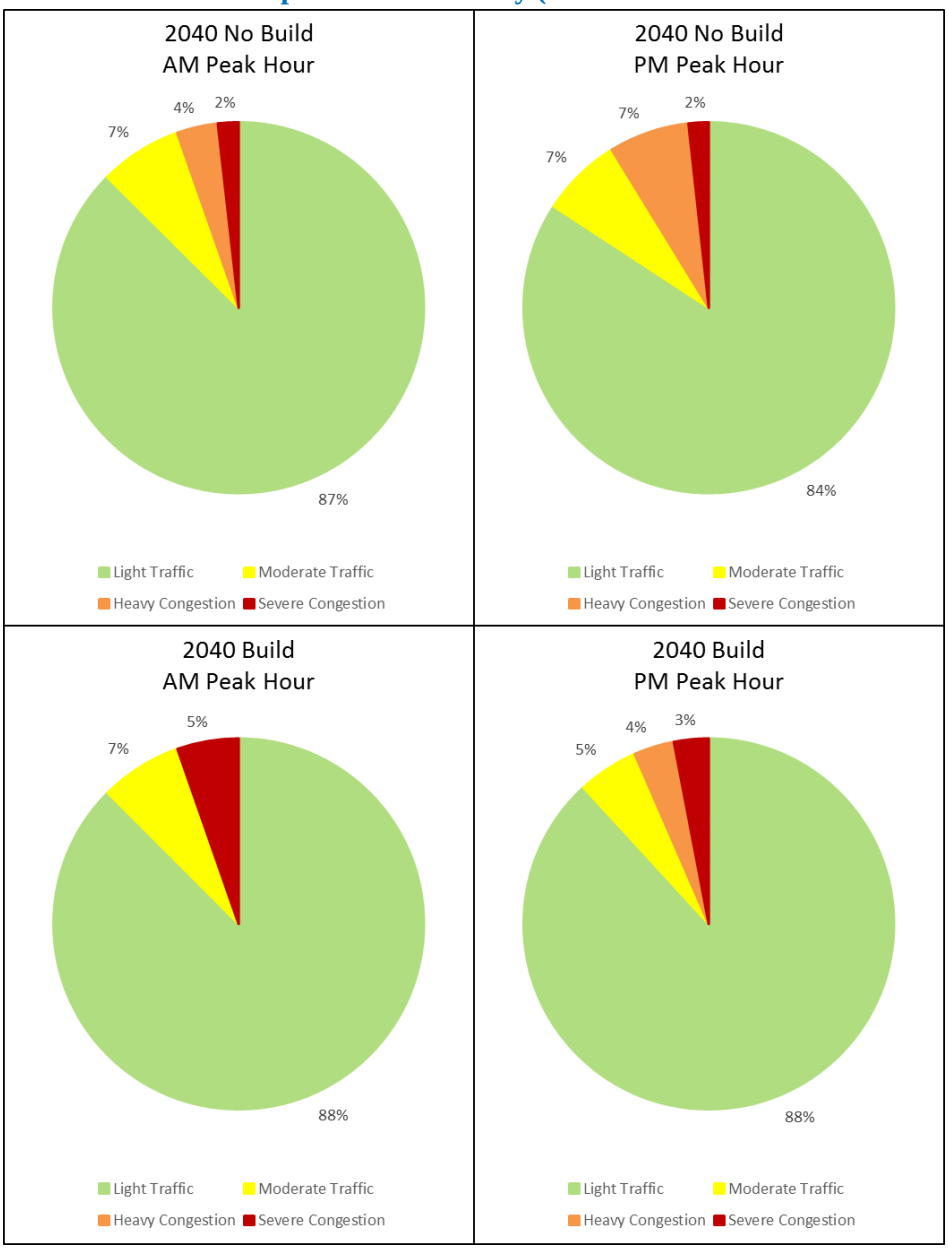


Table 7-29: Intersection Delay Summary (2040 No Build and Build Conditions)

Intersection		2040 No Build Conditions			2040 Build Conditions		
		Intersection Control	Average Delay (sec)		Intersection Control	Average Delay (sec)	
			AM Peak (7-8 AM)	PM Peak (5-6 PM)		AM Peak (7-8 AM)	PM Peak (5-6 PM)
1	Edsall Rd at Cherokee Ave	Signalized	9.9	16.1	Signalized	11.5	15.7
2	Edsall Rd at Bren Mar Dr	Signalized	23.1	32.9	Signalized	28.3	32.2
3	Edsall Rd at Bloomfield Dr	Signalized	10.2	8.1	Signalized	11.9	7.9
4	Little River Turnpike at Beauregard St	Signalized	69.7	65.9	Signalized	86.6	68.4
5	Little River Turnpike at Oasis Dr	Signalized	13.0	13.8	Signalized	17.4	18.6
6	Duke St at Walker St	Signalized	19.3	24.7	Signalized	43.0	24.8
8	Seminary Rd at Mark Center Ave	Signalized	35.5	31.5	Signalized	35.8	33.9
9	EB Seminary Rd at SB I-395 ramps	Signalized	47.2	33.0	Signalized	42.2	33.3
10	WB Seminary Rd at SB I-395 ramps	Signalized	15.1	18.4	Signalized	15.8	14.8
11	EB Seminary Rd at NB I-395 ramps	Signalized	24.9	21.4	Signalized	30.1	22.1
12	WB Seminary Rd at NB I-395 ramps	Signalized	23.3	19.1	Signalized	24.9	19.4
13	Seminary at HOV Ramp (North Facing)	Unsignalized	--[1]	3.4	Unsignalized	--[1]	11.1
14	Seminary Rd at Kenmore Ave	Unsignalized	7.0	16.8	Unsignalized	13.2	19.6
15	Seminary Rd at Library Ln	Signalized	20.2	24.9	Signalized	21.6	25.2
16	King St at Park Center Dr	Signalized	10.7	17.9	Signalized	10.1	18.4
17	King St at 30th St S	Unsignalized	1.2	2.2	Unsignalized	1.1	2.1
18	King St at Menokin Dr	Signalized	27.2	14.4	Signalized	34.1	14.6
19	S Shirlington Rd at S Arlington Mill Dr	Signalized	28.2	50.0	Signalized	26.0	48.0
22	S Shirlington Rd at Campbell Ave	Signalized	33.6	30.0	Signalized	24.3	30.6
23	Shirlington Rotary at HOV Ramp	Unsignalized	3.4	3.6	Unsignalized	3.1	7.6
26	N Quaker Ln at Gunston Rd	Unsignalized	46.3	9.9	Unsignalized	14.2	13.9
27	Martha Custis Dr at Gunston Rd	Unsignalized	87.7	47.2	Unsignalized	51.4	52.2
30	N Quaker Ln at Preston Rd	Signalized	47.0	18.7	Signalized	15.4	25.3
31	S Glebe Rd at 24th Rd S (north of Glebe Rd)	Signalized	19.1	22.5	Signalized	18.9	22.1
32	S Glebe Rd at 24th Rd S (south of Glebe Rd)	Signalized	13.9	14.7	Signalized	14.2	14.9
33	S Glebe Rd at SB I-395 off-ramp	Signalized	6.8	12.6	Signalized	7.2	13.7
34	S Glebe Rd at NB I-395 off-ramp	Signalized	20.6	90.1	Signalized	22.5	87.2
35	S Arlington Ridge Rd at I-395 Ramps	Unsignalized	3.8	6.4	Unsignalized	182.0	5.7
37	Columbia Pike at N/S Rotary Rd	Unsignalized	9.7	13.1	Unsignalized	10.7	14.1
38	Army Navy Dr at S Joyce St	Signalized	20.3	28.8	Signalized	23.0	28.2
39	Army Navy Dr at Parking Lot/ Garage	Signalized	12.2	16.2	Signalized	9.0	16.7
40	Army Navy Dr at S Hayes St	Signalized	17.7	39.7	Signalized	27.0	32.9
41	Army Navy Dr at S Fern St	Signalized	26.9	71.4	Signalized	28.1	44.1
42	I-395 SB HOV Ramps at Eads St	Unsignalized	9.5	6.2	Signalized	24.1	5.0
43	I-395 NB HOV Ramps at Eads St	Unsignalized	20.4	7.4	Signalized	18.6	8.2

Intersection		2040 No Build Conditions			2040 Build Conditions		
		Intersection Control	Average Delay (sec)		Intersection Control	Average Delay (sec)	
			AM Peak (7-8 AM)	PM Peak (5-6 PM)		AM Peak (7-8 AM)	PM Peak (5-6 PM)
44	Army Navy Dr at S Eads St	Signalized	24.2	42.0	Signalized	21.3	46.8
45	12th St at S Eads St	Signalized	26.2	28.9	Signalized	24.9	24.8
46	Army Navy Dr at 12th St S	Unsignalized	4.1	5.6	Unsignalized	5.7	17.0
47	12th St S at Long Bridge Dr	Signalized	11.9	9.9	Signalized	11.3	15.8
51	N Rotary Rd at Fern St	Signalized	19.8	10.5	Signalized	19.0	13.1
52	S Rotary Rd at Fern St	Signalized	20.4	21.2	Signalized	17.9	29.6
54	S Rotary Rd at Eads St	Signalized	27.0	31.8	Signalized	22.4	30.9
55	Boundary Channel Dr at Connector Rd	Unsignalized	3.8	3.1	Unsignalized	2.4	2.7
101	Edsall Rd at I-395 SB on-ramp	Signalized	7.4	5.1	Signalized	6.8	5.2
102	Little River Turnpike at I-395 SB off-ramp	Signalized	15.7	20.3	Signalized	15.5	24.3
103	Seminary Rd at SB Beauregard St	Signalized	14.4	29.0	Signalized	14.3	28.9
105	SB Beauregard St at Seminary Rd (East)	Signalized	37.1	61.6	Signalized	36.5	69.5
106	NB Beauregard St at Seminary Rd (East)	Signalized	11.4	14.6	Signalized	11.5	14.4
107	NB Beauregard St at Seminary Rd (West)	Signalized	14.9	21.0	Signalized	14.6	21.0
108	Seminary Rd at NB Beauregard St	Signalized	20.0	20.2	Signalized	20.2	20.8
109	Seminary Rd at HOV ramp (South Facing)	Signalized	4.2	1.8	Signalized	4.0	1.5
110	Columbia Pike at Joyce St	Signalized	14.9	14.1	Signalized	13.7	14.9
111	Columbia Pike at Washington Blvd SB ramps	Signalized	19.1	24.9	Signalized	15.9	22.1
112	N Rotary Rd at Connector Rd/Eads St	Signalized	13.7	38.3	Signalized	10.4	26.8
113	Boundary Channel Dr at I-395 SB Ramps (Roundabout)	Unsignalized	3.7	1.6	Unsignalized	3.9	1.7
114	Boundary Channel Dr at I-395 NB Ramps (Roundabout)	Unsignalized	2.2	1.9	Unsignalized	1.5	2.1
115	Long Bridge Dr at NB I-395 ramp	Unsignalized	2.5	0.5	Unsignalized	2.6	3.7

[1] Intersection does not utilize signal, stop, or yield control during this time period, therefore no results given

Peak Hour Queues: **Table 7-29a and 29b** depict turn lanes throughout the study area where maximum queue lengths exceed available storage during the AM and PM peak hours and where the maximum queue length increases by 100 feet or more between 2040 No Build and Build conditions. The table depicts the available storage length, average queue length, and maximum queue length for both 2040 No Build and Build conditions. It should be noted that at most locations, the maximum queue lengths are significantly greater than the average queue lengths since the maximum queue lengths reported by VISSIM may occur only one time or infrequently during the reporting period.

Following the table is a discussion of each location and potential mitigation measures to reduce the potential for queues that extend beyond the turn lanes. For the locations where mitigation is discussed, **Appendix J** contains a tabular summary of average delays by movement and intersection approach, overall delay, maximum queue lengths, and storage lengths for the mitigated conditions.

Table 7-29a: AM Peak Hour Queue Summary (2040 No Build and Build Conditions)

Intersection / Movement			No Build			Build			Avg. Queue Increase (feet)	Max. Queue Increase (feet)
			Available Storage (feet)	Avg. Queue (feet)	Max. Queue (feet)	Available Storage (feet)	Avg. Queue (feet)	Max. Queue (feet)		
38	Army Navy Dr at S Joyce St	SBL	130	49	319	130	70	439	21	120

Table 7-29b: PM Peak Hour Queue Summary (2040 No Build and Build Conditions)

Intersection / Movement			No Build			Build			Avg. Queue Increase (feet)	Max. Queue Increase (feet)
			Available Storage (feet)	Avg. Queue (feet)	Max. Queue (feet)	Available Storage (feet)	Avg. Queue (feet)	Max. Queue (feet)		
4	Little River Turnpike at Beauregard St	WBL	225	61	323	225	66	472	5	149
34	S Glebe Rd at NB I-395 off-ramp	NBR	730	282	1,616	730	418	2,054	136	438
36	Columbia Pike at S Joyce St	WBL	220	15	215	220	28	337	13	122
39	Army Navy Dr at Parking Lot/ Garage	WBL	160	2	92	160	10	260	8	168
43	I-395 NB HOV/HOT Ramps at Eads St	NBL	-	-	-	170	20	373	20	373
44	Army Navy Dr at S Eads St	EBL	320	84	578	320	166	915	82	337
44	Army Navy Dr at S Eads St	WBR	--	116	679	--	1151	1,376	1,035	697
103	Seminary Rd at SB Beauregard St	SBL	140	185	930	140	351	1,428	166	498

- **Army Navy Drive at S Joyce Street:** During the AM peak hour, the southbound left-turn maximum queue length on the Joyce Street approach to Army Navy Drive increases from 319 feet under No Build conditions to 439 feet under Build conditions compared to an available storage length of 130 feet. Average queue lengths for both No Build (49 feet) and Build (70 feet) conditions do not exceed the storage length.

Lengthening the southbound left-turn lane is not practical due to impacts to the piers for the bridges serving the Washington Boulevard collector-distributor road. To mitigate the southbound left-turn queues, signal timings were adjusted to provide additional green time for the southbound left-turn phase without impacting other turning movements and the resulting queue length (400 feet) is within 81 feet (approximately 3 vehicles) of queues lengths under No Build conditions. Average queue lengths are approximately half the length of the available storage length under both unmitigated (70 feet) and mitigated (57 feet) conditions.

- **Little River Turnpike at Beauregard Street:** During the PM peak hour, the left-turn maximum queue length on the westbound Little River Turnpike approach to Beauregard Street increases from 323 feet under No Build conditions to 472 feet under Build conditions compared to an available storage length of 225 feet. Average queue lengths for both No Build (61 feet) and Build (66 feet) conditions do not exceed the storage length and the Build conditions average queue length increases by only 5 feet.

  To mitigate this condition, signal timings were adjusted to provide additional green time for the westbound left-turn phase and the resulting maximum queue length (391 feet) is within 68 feet of maximum queues lengths under No Build conditions (323 feet). Additionally, average queue lengths are less than the storage length under both unmitigated and mitigated conditions. Lengthening the westbound left-turn lane is not feasible due to the proximity to the upstream Oasis Drive signalized intersection.

- **S Glebe Road at Northbound I-395 Off-Ramp**: During the PM peak hour, the right-turn maximum queue length on the off-ramp from northbound I-395 to Glebe Road increases from 1,616 feet under No Build conditions to 2,054 feet under Build conditions compared to an available storage length of 730 feet (measured to the gore along northbound I-395). Average queue lengths for both No Build (282 feet) and Build (418 feet) conditions do not exceed the 730-foot storage length.

  To mitigate this condition, signal timings were adjusted to provide additional green time for the northbound I-395 off-ramp approach to the intersection and the resulting queue length (573 feet) is less than the queue length under No Build conditions and can be accommodated within the 730-foot storage length.

- **Columbia Pike at South Joyce Street:** As part of No Build conditions, the Columbia Pike at South Joyce Street intersection Road is planned to be modified as part of the Arlington National Cemetery Southern Expansion Project and Associated Roadway Realignment (see **Section 4.2.7**). Columbia Pike will be realigned to the south of its current alignment and will form a three-legged intersection with South Joyce Street. The existing Southgate Road northern leg of the intersection will be eliminated.

  During the PM peak hour, the westbound left-turn maximum queue length from Columbia Pike to South Joyce Street increases from 215 feet under No Build conditions to 337 feet under Build conditions compared to an available storage length of 220 feet (based on the VISSIM files for the project). Average queue lengths for both No Build (15 feet) and Build (28 feet) conditions do not exceed the storage length.

  To mitigate this condition, signal timings were adjusted to provide additional green time for the westbound Columbia Pike left-turn phase and the resulting maximum queue length (293 feet) is

within 73 feet of the 220-foot storage length. Additionally, average queue lengths are less than the storage length under both unmitigated and mitigated conditions.

- **Army Navy Drive at Parking Lot / Garage:** During the PM peak hour, the left-turn maximum queue length on the westbound Army Navy Drive approach to the parking garage serving the Fashion Centre at Pentagon City (located between Joyce Street and Hayes Street) increases from 92 feet under No Build conditions to 260 feet under Build conditions compared to an available storage length of 160 feet. Average queue lengths for both No Build (2 feet) and Build (10 feet) conditions do not exceed the available storage length. Extending the westbound left-turn lane to provide additional storage is not feasible due to the upstream eastbound left-turn lane at the Army Navy Drive at Hayes Street intersection. Additionally, the average queue is a low percentage (4%) of the maximum queue under Build conditions, an indication that the maximum queue occurs infrequently.

- **I-395 Northbound HOV/HOT Ramps at Eads Street (see PM peak hour discussion in Section 7.3.4.2)**

- **Army Navy Drive at Eads Street (see PM peak hour discussion in Section 7.3.4.2)**

- **Seminary Road at Southbound Beauregard Street:** As part of No Build conditions, the Seminary Road at Beauregard Street intersection is planned to be modified to an ellipse design to eliminate weaving issues along westbound Seminary Road and to increase capacity of the intersection (see **Section 4.2.4**). A new signalized intersection with Seminary Road to the northwest of the existing Seminary Road and Beauregard Street intersection will accommodate southbound Beauregard Street traffic. During the PM peak hour, the southbound left-turn maximum queue length from Beauregard Street to eastbound Seminary Road increases from 930 feet under No Build conditions to 1,428 feet under Build conditions compared to an available storage length of 140 feet. Average queue lengths for both No Build (185 feet) and Build (351 feet) conditions also exceed the storage length.

  To mitigate this condition, signal timings were adjusted to provide additional green time for the southbound Beauregard Street approach to the intersection and the resulting queue length (752 feet) is less than queue lengths under No Build conditions. Additionally, the average queue length with the revised signal timings is 100 feet and does not exceed the storage length. Although Build condition queue lengths are less than No Build condition queue lengths, as part of the future planning for the Seminary Road and Beauregard Street Ellipse, consideration should be given to extending the length of the southbound left-turn lane to the extent practical to accommodate forecasted queue lengths.

7.3.4 Eads Street Interchange

Under 2040 Build conditions, as noted in the 2020 No Build and Build discussion of the Eads Street interchange (**Section 7.2.4)**, the two HOT ramp terminals would be signalized at their intersections with Eads Street. The installation of traffic signals and expansion of capacity on the I-395 HOT ramps under Build conditions would improve traffic operations and allow for the smooth progression of traffic between the intersections proposed within the Pentagon South Parking Lot and the two new signals at the I-395 HOT ramp terminals. These signals would operate within the same coordinated signal system as the existing traffic signal at the Eads Street at Army Navy Drive intersection.

It is assumed that improvements to the Pentagon South Parking Lot associated with the Pentagon Master Plan would be implemented prior to the 2040 design year, and therefore, these improvements are assumed to be in place for both 2040 No Build and Build Conditions. The Pentagon South Parking lot improvements include the following key features under both 2040 No Build and Build conditions.

- Realign Eads Street to intersect with Connector Road at North Rotary Road creating a four-legged intersection. It should be noted that the planned configuration does not accommodate left turns from the emergency exit onto Connector Road that buses are using to exit the PTC during the AM peak hour. Per the current design concept, all transit buses would ingress / egress the PTC via the bus loop at the South Rotary Road and Eads Street intersection.

- Signalization of the North Rotary Road at Fern Street and South Rotary Road at Fern Street intersections and conversion of Fern Street to two-way operations between North Rotary Road and South Rotary Road.

The Army Navy Drive Complete Streets project is assumed to be completed prior to the 2040 design year and therefore is assumed to be in place for both 2040 No Build and Build conditions. Based on the concept plan provided by Arlington County, this project includes the construction of multi-modal improvements along Army Navy Drive between S. Joyce Street and 12th Street and would include a dedicated bicycle facility and improved transit accommodations. The project would reduce the number of through lanes along Army Navy Drive, but would provide dedicated eastbound and westbound left-turn lanes at the Eads Street intersection. The concept plan proposes a reduction of two westbound through lanes at the Army Navy Drive and Joyce Street intersection and a reduction of one westbound Army Navy Drive through lane for the remainder of the project limits. Along eastbound Army Navy Drive, there is a reduction of one of the through lane at the Hayes Street and Eads Street intersections.

Table 7-30 depicts overall intersection delay for both signalized and unsignalized intersections for the AM and PM peak hours for existing conditions. **Appendix J** contains a tabular summary of average delays by movement, intersection approach, and overall delay as well as maximum queue lengths and storage lengths. **Figures 7-83a** *(Volume 2)* **and 83c** *(Volume 2)* depict the average delays by movement and for the overall intersections for 2040 No Build and Build conditions, respectively. **Figures 7-83b** *(Volume 2)* **and 7-83d** *(Volume 2)* depict the maximum queue lengths by movement for 2040 No Build and Build conditions, respectively.

Table 7-30: 2040 No Build and Build Intersection Delay Summary – Eads Street Interchange

Intersection		2040 No Build Conditions			2040 Build Conditions		
		Intersection Control	Average Delay (sec)		Intersection Control	Average Delay (sec)	
			AM Peak (7-8 AM)	PM Peak (5-6 PM)		AM Peak (7-8 AM)	PM Peak (5-6 PM)
38	Army Navy Dr at S Joyce St	Signalized	20.3	28.8	Signalized	23.0	28.2
39	Army Navy Dr at Parking Lot/ Garage	Signalized	12.2	16.2	Signalized	9.0	16.7
40	Army Navy Dr at S Hayes St	Signalized	17.7	39.7	Signalized	27.0	32.9
41	Army Navy Dr at S Fern St	Signalized	26.9	71.4	Signalized	28.1	44.1
42	I-395 SB HOV Ramps at Eads St	Unsignalized	9.5	6.2	Signalized	24.1	5.0
43	I-395 NB HOV Ramps at Eads St	Unsignalized	20.4	7.4	Signalized	18.6	8.2
44	Army Navy Dr at S Eads St	Signalized	24.2	42.0	Signalized	21.3	46.8
45	12th St at S Eads St	Signalized	26.2	28.9	Signalized	24.9	24.8
46	Army Navy Dr at 12th St S	Unsignalized	4.1	5.6	Unsignalized	5.7	17.0
47	12th St S at Long Bridge Dr	Signalized	11.9	9.9	Signalized	11.3	15.8
51	N Rotary Rd at Fern St	Signalized	19.8	10.5	Signalized	19.0	13.1
52	S Rotary Rd at Fern St	Signalized	20.4	21.2	Signalized	17.9	29.6
54	S Rotary Rd at Eads St	Signalized	27.0	31.8	Signalized	22.4	30.9
55	Boundary Channel Dr at Connector Rd	Unsignalized	3.8	3.1	Unsignalized	2.4	2.7
112	N Rotary Rd at Connector Rd/Eads St	Signalized	13.7	38.3	Signalized	10.4	26.8

7.3.4.1 AM Peak Period Operations

The following are key observations when comparing 2040 No Build and Build conditions during the AM peak hour:

- All 15 intersections in the vicinity of the Eads Street Interchange are expected to operate with light traffic conditions during the AM peak hour under Build conditions.
- Under 2040 No Build conditions, overall delays and congestion along Eads Street at the two I-395 ramp intersections are expected to increase moderately compared to existing conditions; however, due to the conversion of Fern Street to two-way operations between North Rotary Road and South Rotary Road associated with the South Parking Lot improvements, traffic volumes are reduced along Eads Street providing some relief to traffic operations at the two I-395 HOV ramp terminals.
- Traffic operations at the two I-395 HOT ramp terminals would improve due to the added capacity on the ramp approaches to Eads Street and the reduction of conflict points at the two intersections. Separating traffic destined for the Pentagon and Army Navy Drive reduces the number of conflict points at the two ramp signals and greatly simplifies traffic signal operations by reducing the number of signal phases. The two existing lanes (one left-turn lane and one right-turn lane) on the I-395 HOV ramp approaching Eads Street would be increased to four lanes (two left-turn lanes and

two right-turn lanes) under Build Conditions doubling the turning capacity approaching Eads Street and reducing the potential for queues extending to the northbound I-395 HOT lanes.

- Traffic signal timings along Eads Street were modified to progress traffic from the reversible ramps. The double left turn from the northbound I-395 HOT ramp toward the Pentagon would be coordinated with the northbound Eads Street approach to South Rotary Road and subsequently the northbound Eads Street approach to North Rotary Road allowing for a free-flowing operation of this heavy movement during the AM peak period. Similarly, the heavy right turn from the northbound I-395 HOT ramp toward Army Navy Drive would be coordinated with the southbound Eads Street approach to Army Navy Drive to minimize the potential for queuing between these two intersections.

- The maximum queue lengths during the AM peak hour on the northbound I-395 HOV ramp to Eads Street would reduce from 1,040 feet under No Build conditions on the single ramp to a maximum of 400 feet on the ramp to northbound Eads Street (Pentagon traffic) and a maximum of 520 feet on the ramp to southbound Eads Street (to Army Navy Drive) and not impact traffic operations along the northbound I-395 HOT lanes under Build conditions.

- Under Build conditions, southbound and northbound vehicles (including transit vehicles) traveling along Eads Street would no longer have to rely on a courtesy gap from motorists on the uncontrolled northbound I-395 HOT lanes ramp due to the installation of the traffic signal, creating a safer crossing for these vehicles.

- Within the Pentagon South Parking Lot, traffic operations would improve by providing predictable traffic flow and signal progression between the I-395 HOT lanes ramp signals and the North and South Rotary Road signals. The Pentagon Master Plan, which is planned to be implemented following the opening of the I-395 Express Lanes Northern Extension project, realigns Eads Street to intersect with Connector Road at North Rotary Road and does not currently accommodate left turns from the emergency exit onto Connector Road that buses are using to exit the PTC. Per the current design concept, all transit buses would ingress / egress the PTC via the bus loop at the South Rotary Road and Eads Street intersection.

- Both traffic and pedestrian operations would be improved by installing signals at the North Rotary at Fern Street and South Rotary Road at Fern Street intersections under both 2040 No Build and Build conditions. This would improve operations at the North Rotary at Fern Street intersection from heavy congestion in 2020 to light traffic conditions in 2040 and consolidate pedestrian crossings of both North Rotary Road and South Rotary Road during the AM peak period when there are very high volumes of pedestrians crossing these roadway to access the Pentagon.

I-395 Southbound HOV Ramp Removal: As noted in the 2020 No Build and Build discussion of the Eads Street Interchange (**Section 7.2.4)**, a key feature of the Eads Street Interchange concept is the removal of the ramp from the southbound I-395 HOV lanes to the southbound I-395 general purpose lanes. This would eliminate a weave condition along the southbound I-395 HOV lanes and eliminate a merge condition along the southbound I-395 general purpose lanes in an area with a high density of access points. Access to the southbound I-395 general purpose lanes would be provided via Hayes Street/Army Navy Drive, Washington Boulevard/Columbia Pike, and Boundary Channel Drive instead of the current ramp. Similar to 2020 conditions, very few passenger vehicles use the ramp from Eads Street to the southbound HOV lanes in the AM peak hour, resulting in minimal impact to operations at surrounding intersections.

As noted in the discussion of 2020 operations at the Eads Street Interchange, due to the Pentagon's Pilot Program directing buses to Connector Road rather than Eads Street during the AM peak period, the removal of the ramp associated with the Build Alternative would not impact existing bus operations since buses are not currently utilizing the ramp to be removed. However, the Pentagon Master Plan does not accommodate the Pilot Program due to the realignment of Eads Street to intersect Connector Road at North Rotary Road. As such, if the Pentagon South Parking Lot improvements associated with the Pentagon Master Plan are implemented, buses egressing the Pentagon Transit Center in the AM peak period would use southbound Eads Street to westbound Army Navy Drive to access the Hayes Street ramp to the southbound I-395 general purpose lanes. Based on conversations with Pentagon staff, they have received positive feedback from both the PPD and transit providers regarding the Pilot Program and plan to continue implementation of the Pilot Program. As noted above, Pentagon staff intend to investigate the feasibility of incorporating the Pilot Program into the Master Plan which would minimize impacts to current bus operations in the future.

7.3.4.2 PM Peak Period Operations

The following are key observations when comparing 2040 No Build and Build conditions during the PM peak hour:

- Thirteen of the 15 intersections in the vicinity of the Eads Street interchange are expected to operate with light traffic conditions during the PM peak hour under Build conditions. Two of the 15 intersections are expected to operate with moderate traffic conditions during the PM peak hour under Build conditions including the Army Navy Drive at Eads Street and South Rotary Road at Eads Street intersections.

- During the PM peak period, the high traffic volumes along eastbound South Rotary Road and southbound Eads Street would be signal-controlled as motorists exit the Pentagon Reservation toward the southbound I-395 HOT lanes and make a double right turn to the southbound on-ramp. At the southern I-395 HOT ramps intersection, the new northbound Eads Street left-turn movement to southbound I-395 ramp would be signalized and operate as part of a two-phase signal accommodating northbound and southbound Eads Street left turns concurrently and northbound and southbound Eads Street through traffic. It should be noted that under current conditions, based on a review of the travel patterns within the Pentagon South Parking lot, motorists in the Pentagon City area and points along Army Navy Drive travel north along Fern Street and make a right turn onto eastbound South Rotary Road to access the southbound I-395 HOV lanes. Providing this ramp would eliminate this traffic from entering the Pentagon Reservation during the heavy traffic periods and reduce traffic along Fern Street which is the designated pedestrian route crossing I-395 and entering the Pentagon Reservation. This new access point would also reduce traffic on the eastbound South Rotary Road approach to Eads Street.

- Similar to 2020 Build conditions, traffic volumes at the Eads Street and Army Navy Drive intersection would increase as a result of the I-395 Express Lanes project. In the PM peak hour, traffic volumes for the eastbound left turn from Army Navy Drive to Eads Street increase by approximately 12 percent, the northbound through volume along Eads Street increases by approximately 53 percent, and the westbound right turn from Army Navy Drive to Eads Street more than double under 2040 Build conditions compared to 2040 No Build conditions.

- Motorists using this new access point from Eads Street to enter the southbound I-395 HOT lanes would be removed from the Hayes Street ramp to the southbound I-395 general purpose lanes. This would result in some changes to traffic patterns along Army Navy Drive between Hayes Street and Eads Street. Westbound Army Navy Drive motorists destined for the southbound I-395 HOT lanes who were previously using the southbound general purpose lanes would turn right from Army Navy Drive onto Eads Street, two blocks earlier than their prior route. This would result in a reduction in traffic volumes along westbound Army Navy Drive between Hayes Street and Eads Street of approximately 300 vehicles per hour. Similarly, eastbound Army Navy Drive motorists destined for the southbound Express Lanes who were previously using the southbound general purpose lanes via the Hayes Street ramp would drive two blocks farther along Army Navy Drive and turn left onto Eads Street. This would result in an increase in traffic volumes along eastbound Army Navy Drive between Hayes Street and Eads Street of approximately 25 vehicles per hour.

  Based on a comparison of forecasted traffic volumes for 2040 No Build versus Build conditions for the PM peak hour, there is an overall increase in traffic volumes of 4 percent at the Eads Street and Army Navy Drive intersection, a reduction in traffic volumes of 7 percent at the Army Navy Drive and Hayes Street intersection, and a reduction in traffic volumes of 9 percent at the Army Navy Drive at Fern Street intersection. Additionally, there is a 25 to 35 percent decrease in westbound traffic volumes and a 5 to 7 percent increase in eastbound traffic volumes along Army Navy Drive between Eads Street and Hayes Street due to the additional access point from Eads Street to the Express Lanes during the PM peak hour. This results in an overall reduction in two-way traffic volumes of approximately 15 percent along Army Navy Drive in this segment. Along northbound Eads Street approaching Army Navy Drive, there is a 100 vehicle per hour increase due to the attractiveness of the new access point to the Express Lanes.

  The increase in traffic volume at the Eads Street and Army Navy Drive intersection result in an increase to overall intersection delay of less than 5 seconds when comparing No Build to Build conditions. The northbound and eastbound approach delays are expected to increase by approximately 15 seconds and 9 seconds, respectively. The eastbound left-turn queues increase by approximately 60 percent and the westbound right-turn queue approximately doubles. Delays on the southbound Eads Street approach to the intersection are reduced by approximately 32 seconds due to the installation of an addition southbound left-turn lane and southbound right-turn lane on the approach to Army Navy Drive. Delays on the westbound approach remain approximately the same.

- The congestion level at the Army Navy Drive at Hayes Street intersection would improve from moderate traffic conditions to light traffic conditions with overall average delay decreases of 7 seconds. This can be attributed to a reduction in the utilization of the Hayes Street ramp to access the southbound I-395 general purpose lanes with the implementation of the access point from Eads Street to the southbound I-395 HOT lanes.

- The congestion level at the Army Navy Drive at Fern Street intersection would improve from heavy congestion to moderate traffic conditions with overall average delay decreases of 27 seconds. This can be attributed to a relocation of vehicles that used to utilize this intersection to access the I-395 southbound general purpose lanes at the Army Navy Drive at Hayes Street intersection to Eads Street to access the southbound I-395 HOT lanes.

- The congestion level at the North Rotary Road at Connector Road / Eads Street intersection would improve from moderate traffic conditions to light traffic conditions with overall average delay

decreases of 12 seconds. This can be attributed to the downstream capacity increases associated with the southbound double right turn from Eads Street to the southbound I-395 HOT lanes under Build conditions.

As discussed in **Section 7.3.3** and as shown in **Table 7.29b**, two locations in the vicinity of the Eads Street Interchange were observed as having maximum queue lengths during the PM peak hour that exceed available storage and where the maximum queue length increases by 100 feet or more between 2040 No Build and Build conditions.

- **I-395 Northbound HOV/HOT Ramps at Eads Street:** The northbound Eads Street left-turn maximum queue length approaching the northbound HOT ramps intersection under Build conditions is 373 feet and exceeds the available storage of 170 feet.

  The improvements associated with the Eads Street Interchange (see **Figure 4-15**) include the construction of separate left-turn and right-turn lanes on the northbound Eads Street approach to the northbound I-395 HOT ramps intersection, increasing the available storage for turning traffic and accommodating increased traffic volumes resulting from the new access point to the southbound I-395 HOT lanes. The northbound left-turn lane has been extended the maximum extent practical under Build conditions without encroaching into the Army Navy Drive intersection. The average left-turn queue length is 20 feet and significantly less than the 170-foot available storage length. Additionally, the average queue is a low percentage (5%) of the maximum queue, an indication that the maximum queue occurs infrequently. Lastly, the average delay for the northbound left-turn movement is 8 seconds indicating relatively low delays for the left-turn movement.

- **Army Navy Drive at Eads Street**: The Army Navy Drive Complete Streets project (see **Section 4.2.6**) includes the construction of multi-modal improvements along Army Navy Drive in the vicinity of Eads Street including an exclusive left-turn lane, through lane, and right-turn lane on the eastbound Army Navy Drive approach (currently the approach operates with a shared left-turn/through lane and a shared through/right-turn lane. Modifications to the westbound approach include converting the existing shared left-turn/through lane, through lane, and shared through/right-turn lanes to a left-turn lane, a through lane, and a shared through/right-turn lane. During the PM peak hour, the maximum queue length for the eastbound Army Navy Drive left turn and westbound Army Navy Drive right turn exceed available storage.

  The assumed eastbound left-turn lane length is 320 feet in conjunction with the Army Navy Drive Complete Streets project. Extending this turn lane is not practical without impacting the westbound left-turn lane for Fern Street. The maximum queue length under No Build conditions is 578 feet compared to 915 feet under Build conditions with an average queue length of 84 feet under No Build conditions and 166 feet under Build conditions. The longer queue lengths under Build conditions are due to increased traffic volumes resulting from the new access point to the southbound I-395 HOT lanes along Eads Street north of the intersection.

  The westbound Army Navy Drive right turn to northbound Eads Street operates in a shared through/right-turn lane and is located in close proximity (140 feet) to the upstream loop ramp from southbound Route 1. The maximum queue length under No Build conditions is 679 feet compared to 1,376 feet under Build conditions with an average queue length of 116 feet under No Build conditions and 1,151 feet under Build conditions. Similar to the eastbound left-turn lane, the longer westbound right-turn queue lengths under Build conditions are due to increased traffic volumes

resulting from the new access point to the southbound I-395 HOT lanes along Eads Street north of the intersection.

To mitigate this condition, signal timings were adjusted to provide additional green time for the eastbound left turn and improve coordination between the Army Navy Drive and I-395 Northbound HOT Ramps intersections. The resulting maximum queue for the eastbound left-turn lane is 469 feet, which is less than No Build conditions and an average of 76 feet which is less than the available storage length. The resulting maximum queue for the westbound right-turn is 305 feet, which is less than No Build conditions and an average of 67 feet which will not extend to the upstream loop ramp from southbound Route 1.

I-395 Southbound HOV Ramp Removal: As discussed in the summary of 2020 conditions for the PM peak hour, the ramp from the southbound I-395 HOV lanes to the southbound I-395 general purpose lanes located south of Eads Street would be removed as part of the Build Alternative. Access to the southbound I-395 general purpose lanes would be provided via Hayes Street/Army Navy Drive, Washington Boulevard/Columbia Pike, and Boundary Channel Drive instead of the current ramp. Based on a review of overall intersection delay changes at these other locations, the revised access would not result in a degradation of operations under Build conditions. Based on a review of link traffic volumes in the Eads Street Interchange area that would be impacted by the removal of this ramp, PM peak hour traffic volumes do not change by more than approximately 50 vehicles per hour between No Build and Build conditions due to the revisions to access associated with the I-395 Express Lanes project.

7.3.5 Shirlington Interchange

The Shirlington Interchange is a non-traditional Rotary interchange that provides access to I-395 from several local roadways including North Quaker Lane, Shirlington Road, Gunston Road, Campbell Avenue, Arlington Mill Drive as well as providing direct access to the HOV lanes to and from the north. The north facing ramp located at the north side of the Rotary currently operates in a northbound direction in the AM peak period and in a southbound direction during the PM peak period. This ramp would be converted to a HOT ramp under Build Conditions which would have an impact on traffic patterns within the Rotary. During the AM peak period when the HOV ramp (future HOT ramp) is operating in a northbound direction, motorists destined for the northbound HOT lanes that previously traveled in the northbound general purpose lanes would travel approximately 250 feet farther around the Rotary to access the northbound HOT ramp. During the PM peak period, motorists exiting the general purpose lanes at the Shirlington Interchange have the option to take the ramp to the Shirlington Road at Arlington Mill Drive Intersection or the ramp that enters the Rotary in the southwest quadrant. Motorists from the general purpose lanes that divert to the HOT lanes under Build conditions would enter the Rotary at the north side of the Rotary changing the traffic patterns on the west side of the Rotary.

Traditional intersection measures of effectiveness cannot be used to adequately assess the operation of a Rotary due to the series of merges and diverges that occur within the circulatory portion of the Rotary. In order to assess the impact of the Build Alternative on operations within the circulatory portion of the Rotary and on the approaches to the Rotary, average travel speeds and density for each link coded in the VISSIM model were established for existing conditions. **Figure 7-84** depicts the various links within the Rotary Interchange corresponding to the subsequent discussion of operations at the Rotary Interchange under 2040 No Build and Build conditions.

7.3.5.1 AM Peak Hour

Table 7-31 depicts speeds and densities within the Rotary Interchange and on the approaches and departure legs of the Rotary for 2040 No Build and Build conditions for the AM peak period. Also shown are the average speeds for all vehicles traversing the Rotary for each hour and the average speed for the four hour period for all vehicles traversing the Rotary. As shown, the average travel speed is approximately 20 miles per hour for all vehicles during the four hour analysis period under No Build conditions and 22 miles per hour under Build conditions, indicating a small improvement to the overall the operation of the Rotary under 2040 Build conditions. Based on a review of density and speeds by link, there are reductions in density and increases in speeds primarily on the east side of the Rotary where motorists are now able to access the northbound I-395 HOT lanes rather than entering the heavily congestion northbound I-395 general purpose lanes.

As shown in **Table 7-33**, three of the study intersections located in the vicinity of the Shirlington Rotary operate under light traffic conditions. The Quaker Lane at Preston Road intersection operates under moderate traffic conditions, the Quaker Lane at Gunston Road intersection operates with heavy congestion, and the Martha Custis Drive at Gunston Road intersection operates under severe traffic conditions under 2040 No Build conditions. The increase in delays at these intersections can be primarily attributed to increased congestion along northbound I-395 general purpose lanes in the weave segment between Shirlington Road and the Glebe Road off ramp under 2040 No Build conditions that spills back onto the Rotary. Under Build conditions, the three intersection that operate under moderate congestion levels or worse under No Build conditions have delay reductions of 30 seconds or more due to the increased usage of the HOT lanes to access northbound I-395 rather than the general purpose lanes. The diversion of approximately 400 vehicles from the northbound I-395 general purpose lanes to the northbound I-395 general purpose lanes reduces the queue length that spills into the Rotary in the 2040 No Build scenario.

7.3.5.2 PM Peak Hour

Table 7-32 depicts speeds and densities within the Rotary Interchange and on the approaches and departure legs of the Rotary for 2040 No Build and Build conditions for the PM peak period. Also shown are the average speeds for all vehicles traversing the Rotary for each hour and the average speed for the four hour period for all vehicles traversing the Rotary. As shown, the average travel speed is approximately 20 miles per hour for all vehicles during the four hour analysis period under both No Build and Build conditions indicating overall minor changes to the operation of the Rotary under 2040 Build conditions.

Due to the reassignment of traffic entering the Rotary from the general purpose lanes to the HOT lanes, there is some change in speeds on the west side of the Rotary. Vehicles utilizing the off-ramp from the southbound I-395 HOT lanes to Shirlington Road must travel along more sections of the Rotary compared to vehicles using the off-ramp from the southbound general purpose lanes. As a result, there would be minor decreases in speed along the Rotary segments from the HOT lanes access point around the west side of the Rotary to the southbound I-395 general purpose lane access point. The largest speed decrease occurs on the southbound Shirlington Rotary merge with I-395 southbound general purpose lane off-ramp (segment 455) with a speed reduction of 8 MPH from 22 MPH to 14 MPH.

The queue length on the southbound I-395 HOT lane off-ramp approaching the Shirlington Rotary would increase from approximately 80 feet under 2040 No Build conditions to 480 feet under 2040 Build

conditions, which less than the storage length of 1650 feet to the gore point along the southbound I-395 HOT lanes.

As shown in **Table 7-33**, the six study intersections located in the vicinity of the Shirlington Rotary operate under light traffic conditions with the exception of the Martha Custis Drive at Gunston Drive intersection that operates under heavy congestion under 2040 No Build conditions and severe congestion during 2040 Build conditions (5 second overall delay increase) and the intersection of Shirlington Road at Arlington Mill Drive that operates under moderate traffic conditions during both 2040 No Build and 2040 Build conditions. Additionally, there is less than a 7 second change in overall intersection delay at all six study intersections when comparing 2040 No Build and Build conditions.

Figure 7-84: Shirlington Rotary Interchange Link Identifiers

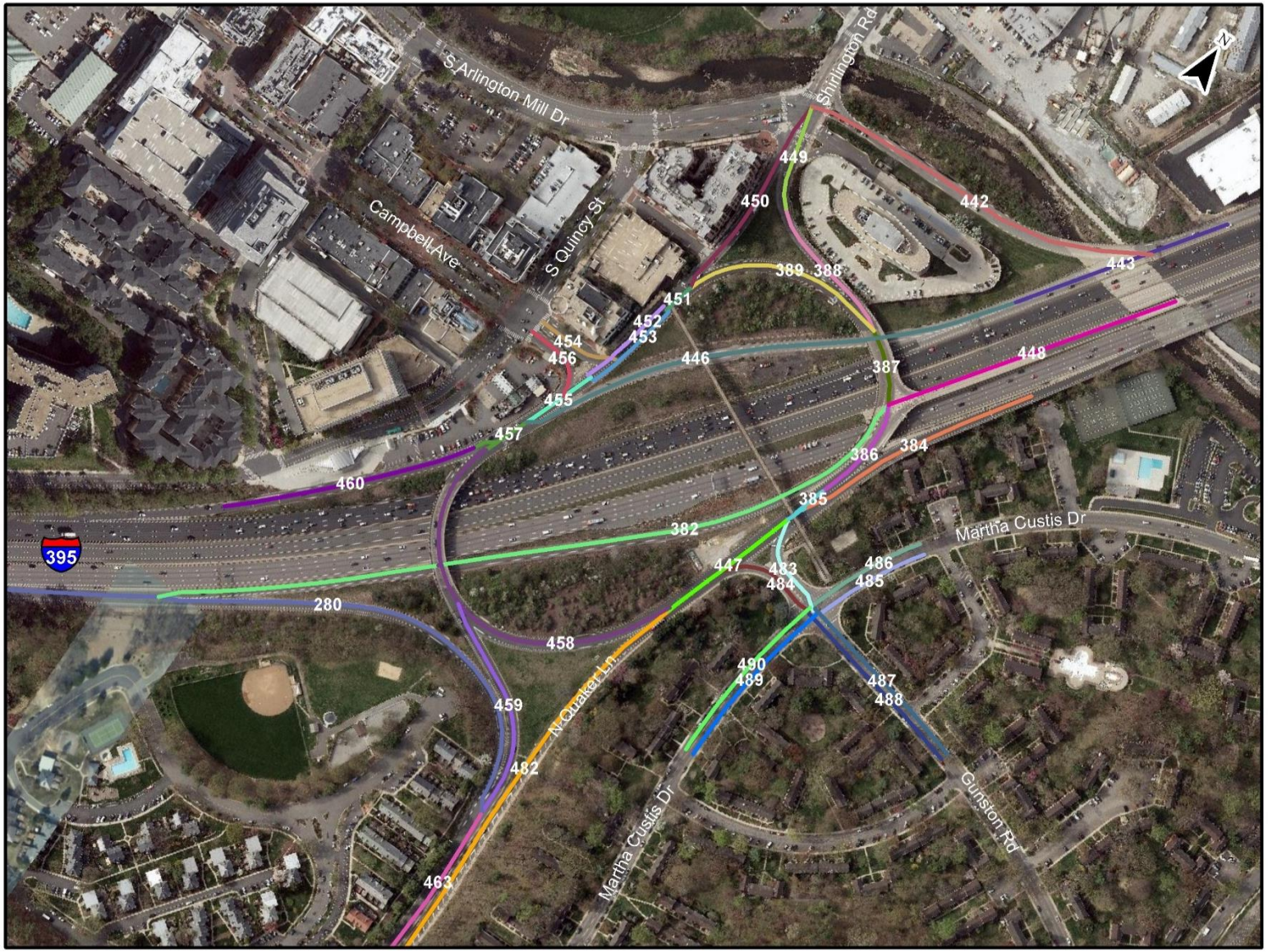


Table 7-31: AM Peak Period Speed by Segment (2040 No Build and Build Conditions) Shirlington Rotary Interchange

Segment		2040 No Build Conditions				2040 Build Conditions			
		Avg Speed (mph)				Avg Speed (mph)			
		6-7 AM	7-8 AM	8-9 AM	9-10 AM	6-7 AM	7-8 AM	8-9 AM	9-10 AM
WB Rotary	387	25	25	21	24	26	26	21	23
SB Rotary	389	28	25	25	26	28	27	26	27
WB Shirlington Rd approaching Arlington Mill Dr	388	27	24	19	22	28	24	19	21
EB Shirlington Rd approach Rotary	450	19	11	12	15	18	14	14	14
SB Rotary approaching Campbell Ave	451	18	12	14	15	18	15	17	15
SB Rotary approaching Campbell Ave	453	5	6	6	6	5	7	6	6
SB Rotary approaching Campbell Ave	452	21	21	21	21	21	21	21	21
WB Campbell Ave	454	24	24	24	24	24	24	24	24
EB Shirlington Rd approach Rotary	456	12	8	9	11	12	10	10	11
SB Rotary	455	23	16	19	22	23	22	23	23
SB I-395 C-D Road approaching Rotary	446	28	26	26	27	28	28	28	28
SB Rotary	457	25	17	20	23	25	24	24	24
SB from Rotary to SB I-395 on ramp	460	28	27	27	27	28	27	28	27
NB Rotary approaching Quaker Ln	458	27	15	17	23	28	26	27	28
EB Exit from Rotary to Quaker Ln	459	29	29	29	29	29	29	29	29
NB I-395 off-ramp to Quaker Ln	280	25	25	24	24	25	24	24	24
SB Quaker Ln approaching Preston Rd	463	29	28	28	28	29	28	28	27
NB Quaker Ln approaching Rotary	482	27	9	10	16	27	21	23	26
NB Rotary approaching Gunston Rd	447	24	10	11	15	25	19	23	26
EB Gunston Rd approaching Martha Custis Dr	484	9	4	3	8	9	5	4	8
WB Gunston Rd approaching Rotary	483	8	4	4	5	8	4	5	6
NB Rotary north of Gunston Rd	385	22	13	15	13	23	18	20	24
NB I-395 off-ramp to Rotary	382	24	23	23	23	24	23	23	23
NB Rotary approaching HOV/HOT ramp	386	28	27	26	27	28	25	21	22
NB from Rotary to NB I-395 on ramp	384	20	8	7	5	21	6	16	23
NB/SB HOV/HOT ramp to/from I-395 HOV/HOT	448	34	34	34	34	33	33	32	32
SB I-395 C-D Road approaching Rotary	443	24	23	23	24	24	23	23	24
SB I-395 C-D Road off-ramp to Shirlington Rd	442	8	8	8	8	9	8	9	8
WB approaching Arlington Mill Dr	449	7	6	6	6	7	6	6	6
NB Martha Custis Dr approaching Gunston Rd	489	15	8	10	14	15	11	12	14
SB Martha Custis Dr	490	18	20	20	21	19	20	20	20
WB Gunson Rd approaching Martha Custis Dr	487	12	1	1	4	12	1	2	4
EB Gunston Rd	488	25	25	24	25	25	25	24	25
NB Martha Custis Dr	485	24	24	23	24	24	23	24	24
SB Martha Custis Dr approaching Gunston Rd	486	20	6	8	16	20	16	18	19
Average Speed		23.3	18.9	19.1	21.0	23.4	21.2	21.7	22.6
4 Hour Average Speed		20.3				22.1			

Table 7-32: PM Peak Period Speed by Segment (2040 No Build and Build Conditions) Shirlington Rotary Interchange

Segment		2040 No Build Conditions				2040 Build Conditions			
		Avg Speed (mph)				Avg Speed (mph)			
		3-4 PM	4-5 PM	5-6 PM	6-7 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM
WB Rotary	387	24	25	18	22	23	23	17	19
SB Rotary	389	28	27	26	26	28	23	27	26
WB Shirlington Rd approaching Arlington Mill Dr	388	25	21	14	17	23	20	15	16
EB Shirlington Rd approach Rotary	450	11	12	9	8	10	7	8	7
SB Rotary approaching Campbell Ave	451	13	13	13	13	13	12	14	13
SB Rotary approaching Campbell Ave	453	7	6	7	7	7	6	7	7
SB Rotary approaching Campbell Ave	452	20	20	19	18	20	19	18	17
WB Campbell Ave	454	24	24	24	24	24	24	24	24
EB Shirlington Rd approach Rotary	456	9	10	8	8	8	7	8	8
SB Rotary	455	23	22	19	22	23	14	21	23
SB I-395 C-D Road approaching Rotary	446	26	24	24	25	27	17	26	26
SB Rotary	457	24	22	20	22	24	15	22	23
SB from Rotary to SB I-395 on ramp	460	20	14	11	18	20	14	13	19
NB Rotary approaching Quaker Ln	458	28	17	26	26	27	10	25	27
EB Exit from Rotary to Quaker Ln	459	29	29	29	29	29	28	29	29
NB I-395 off-ramp to Quaker Ln	280	24	24	23	23	24	23	23	24
SB Quaker Ln approaching Preston Rd	463	27	25	23	25	27	23	23	26
NB Quaker Ln approaching Rotary	482	27	9	23	24	26	5	20	25
NB Rotary approaching Gunston Rd	447	26	7	20	21	25	5	19	22
EB Gunston Rd approaching Martha Custis Dr	484	9	6	7	6	9	6	6	7
WB Gunston Rd approaching Rotary	483	9	4	5	5	8	3	5	5
NB Rotary north of Gunston Rd	385	23	8	17	18	22	6	17	18
NB I-395 off-ramp to Rotary	382	23	23	23	23	23	23	22	23
NB Rotary approaching HOV/HOT ramp	386	28	27	26	27	28	26	24	26
NB from Rotary to NB I-395 on ramp	384	19	4	20	21	19	3	16	22
NB/SB HOV/HOT ramp to/from I-395 HOV/HOT	448	34	34	34	34	34	33	29	33
SB I-395 C-D Road approaching Rotary	443	16	10	12	13	21	13	20	21
SB I-395 C-D Road off-ramp to Shirlington Rd	442	8	8	8	8	9	9	9	8
WB approaching Arlington Mill Dr	449	5	5	4	4	6	5	5	5
NB Martha Custis Dr approaching Gunston Rd	489	16	14	14	14	16	14	14	14
SB Martha Custis Dr	490	24	23	22	23	23	23	22	23
WB Gunson Rd approaching Martha Custis Dr	487	13	5	10	6	13	4	9	6
EB Gunston Rd	488	25	25	25	25	25	25	25	25
NB Martha Custis Dr	485	24	24	24	24	24	24	24	24
SB Martha Custis Dr approaching Gunston Rd	486	20	5	9	3	20	4	8	5
Average Speed		22.6	18.3	20.1	20.2	22.5	16.6	19.5	20.6
4 Hour Average Speed		20.3				19.8			

Table 7-33: Intersection Delay Summary (2040 No Build and Build Conditions)

Intersection		2040 No Build Conditions			2040 Build Conditions		
		Intersection Control	Average Delay (sec)		Intersection Control	Average Delay (sec)	
			AM Peak (7-8 AM)	PM Peak (5-6 PM)		AM Peak (7-8 AM)	PM Peak (5-6 PM)
19	S Shirlington Rd at S Arlington Mill Dr	Signalized	28.2	50.0	Signalized	26.0	48.0
22	S Shirlington Rd at Campbell Ave	Signalized	33.6	30.0	Signalized	24.3	30.6
23	Shirlington Rotary at HOV Ramp	Unsignalized	3.4	3.6	Unsignalized	3.1	7.6
26	N Quaker Ln at Gunston Rd	Unsignalized	46.3	9.9	Unsignalized	14.2	13.9
27	Martha Custis Dr at Gunston Rd	Unsignalized	87.7	47.2	Unsignalized	51.4	52.2
30	N Quaker Ln at Preston Rd	Signalized	47.0	18.7	Signalized	15.4	25.3

7.4 PERSON THROUGHPUT

In addition to traditional measures of effectiveness typically used to measure the benefits of a project including traffic volumes, travel times, speeds, and density, person throughput is a valuable measure that can be used to document the effectiveness of the I-395 Express Lanes Northern Extension project. Person throughput is the number of travelers passing through a corridor at a given point for all modes of travel.

To calculate person throughput, the vehicle class matrices (i.e., SOV, HOV2, HOV3, and Truck) from the MWCOG travel demand model outputs were used as inputs to VISUM to produce hourly traffic flows and future year forecasts by vehicle class. The percentage of each vehicle class from the VISUM models were then applied to the simulated volume outputs from VISSIM for each hour during the peak periods in both the general purpose and HOV/HOT lanes. Once the number of vehicles in each vehicle class was calculated, vehicle occupancy factors for each vehicle class were applied to the volumes to calculate person throughput by hour. The vehicle occupancy factors were based on data collected as part of the 2014 *Performance of High-Occupancy Vehicle Facilities on Freeway in the Washington Region* (NCRTPB, 2015) report as follows.

- Single occupant vehicles and HOV-2 = 1.1 persons per vehicle
- HOV 3+ = 4 persons per vehicle
- Buses = 25 persons per vehicle
- Trucks = 1 person per vehicle

7.4.1 2020 No Build and Build Conditions

Figures 7-85 and 7-86 summarize the person throughput along the corridor for existing conditions and 2020 No Build and Build conditions in the peak direction at two locations along the corridor – north of Turkeycock Run and north of Glebe Road for the four-hour analysis periods during the AM peak (6 AM to 10 AM) and PM peak (3 PM to 7 PM) periods.

As shown in **Figure 7-85**, there is a 1 percent increase in person trips between existing conditions and 2020 No Build conditions along I-395 in the northbound AM peak travel direction. When comparing No Build to Build conditions, there is an 11 to 13 percent increase in person trips north of Glebe Road and north of Turkeycock Run, respectively, equating to moving 7,000 to 7,400 more persons during the morning peak period. Although the person trips in the northbound general purpose lanes north of Glebe Road decrease by 12 percent (3,900 persons) between 2020 No Build and Build conditions, the number of person trips in the HOT lanes would increase by 32 percent (11,300 persons).

As shown in **Figure 7-86**, there is a 3 percent increase in person trips between existing conditions and 2020 No Build conditions along I-395 in the southbound PM peak travel direction, which equates to moving about 2,000 more persons. This is due to the increased travel demand in 2020 as well as the increased capacity in the southbound I-395 general purpose lanes as a result of the I-395 4th Lane South Widening – Duke Street to Edsall Road project (see **Section 4.2.3**) that is included in the 2020 No Build conditions. When comparing 2020 No Build to Build conditions, there is a 5 to 6 percent increase in person trips equating to moving 3,400 to 3,700 more persons during the evening peak period north of Glebe Road and north of Turkeycock Run, respectively. Although the persons trips in the southbound general purpose lanes decrease by 2 percent (800 persons), the number of person trips in the HOT lanes increases by 17 percent

(4,500 persons) during the PM peak travel direction north of Turkeycock Run. North of Glebe Road, the person trips in the southbound general purpose lanes decrease by 6 percent (2,100 persons) and the person trips in the southbound HOT lanes increase by 17 percent (5,500 more persons).

Figure 7-85: Northbound AM Peak Period Person Throughput Comparison (Existing and 2020)

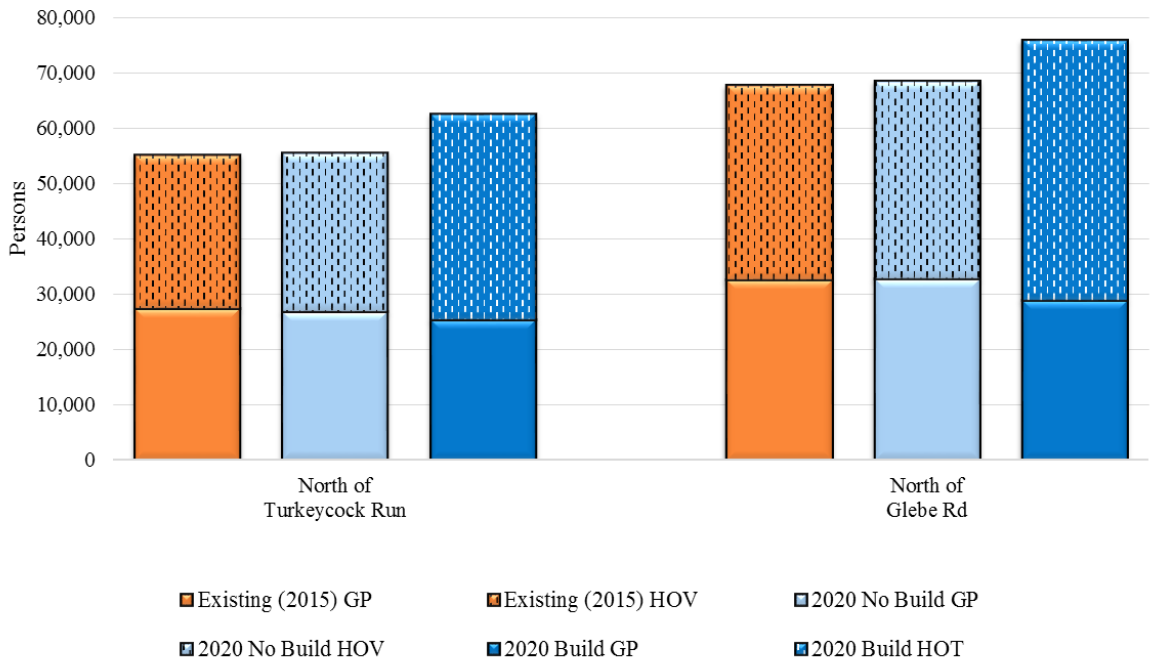
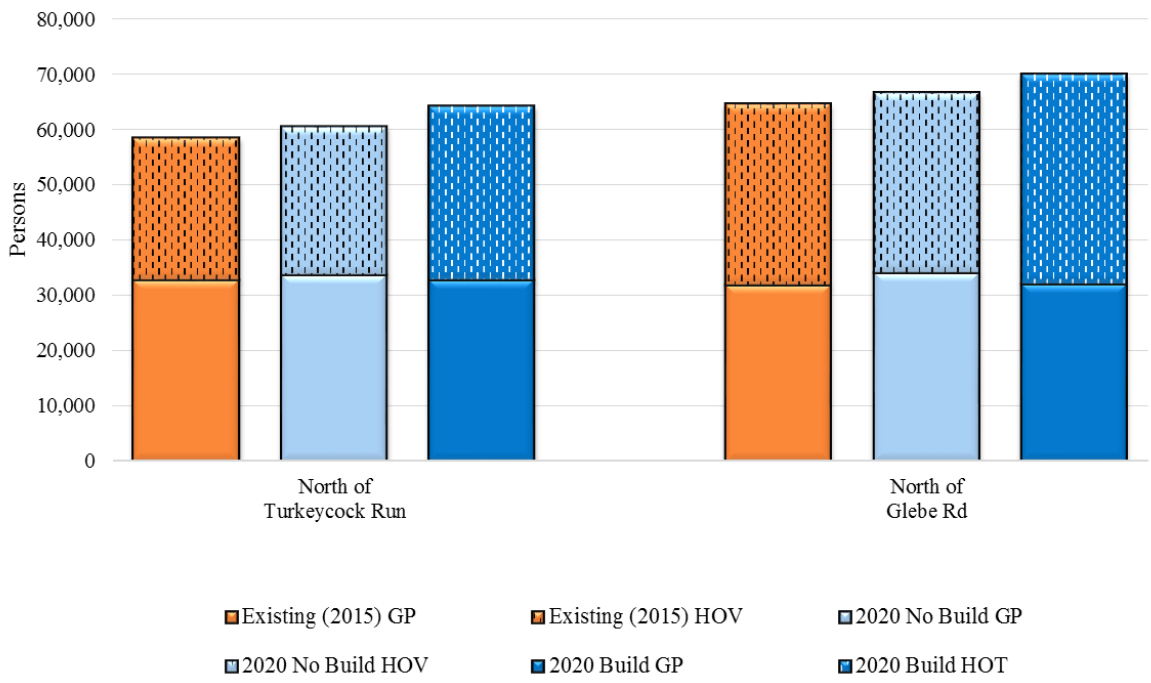


Figure 7-86: Southbound PM Peak Period Person Throughput Comparison (Existing and 2020)



7.4.2 2040 No Build and Build Conditions

Figures 7-87 and 7-88 summarize the person throughput along the corridor for existing conditions and 2040 No Build and Build conditions in the peak direction at two locations along the corridor – north of Turkeycock Run and north of Glebe Road for the four-hour analysis periods during the AM peak (6 AM to 10 AM) and PM peak (3 PM to 7 PM) periods.

As shown in **Figure 7-87**, there is a two percent (900 persons) decrease to 1 percent (800 persons) increase in person trips between existing conditions and 2040 No Build conditions along I-395 in the northbound AM peak travel direction north of Turkeycock Run and north of Glebe Road, respectively. When comparing No Build to Build conditions, there is a 12 to 14 percent increase in person trips north of Glebe Road and north of Turkeycock Run, respectively, equating to moving 7,500 to 8,400 more persons during the morning peak period. Although the person trips in the northbound general purpose lanes decrease by 10 percent (3,100 persons), the HOT lanes move 31 percent (11,500 persons) more persons during the PM peak travel direction north of Glebe Road due to the increase in HOT lane capacity in the Build scenario.

As shown in **Figure 7-88**, there is a 1 to 8 percent decrease in person trips between existing conditions and 2040 No Build conditions along I-395 in the southbound PM peak travel direction north of Turkeycock Run and north of Glebe Road, respectively. This is due to the northern portion of the study area being severely over capacity and approaching "jam density" throughout the duration of the four-hour peak period which causes a decrease in both traffic flow rates and person throughput. Jam density refers to high traffic densities with stopped traffic flow. When comparing 2040 No Build to Build conditions, there is a 4 to 7 percent increase in person trips equating to moving 2,100 to 4,300 more persons during the evening peak

period north of Turkeycock Run and north of Glebe Road, respectively. Although the person trips in the general purpose lanes decrease by 8 to 12 percent (2,900 to 4,100 persons), the HOT lanes move 23 to 32 percent (5,100 to 8,400 persons) more persons during the PM peak travel direction north of Turkeycock Run and north of Glebe Road, respectively, due to the increase in HOT lane capacity in the Build scenario.

Figure 7-87: Northbound AM Peak Period Person Throughput Comparison (Existing and 2040)

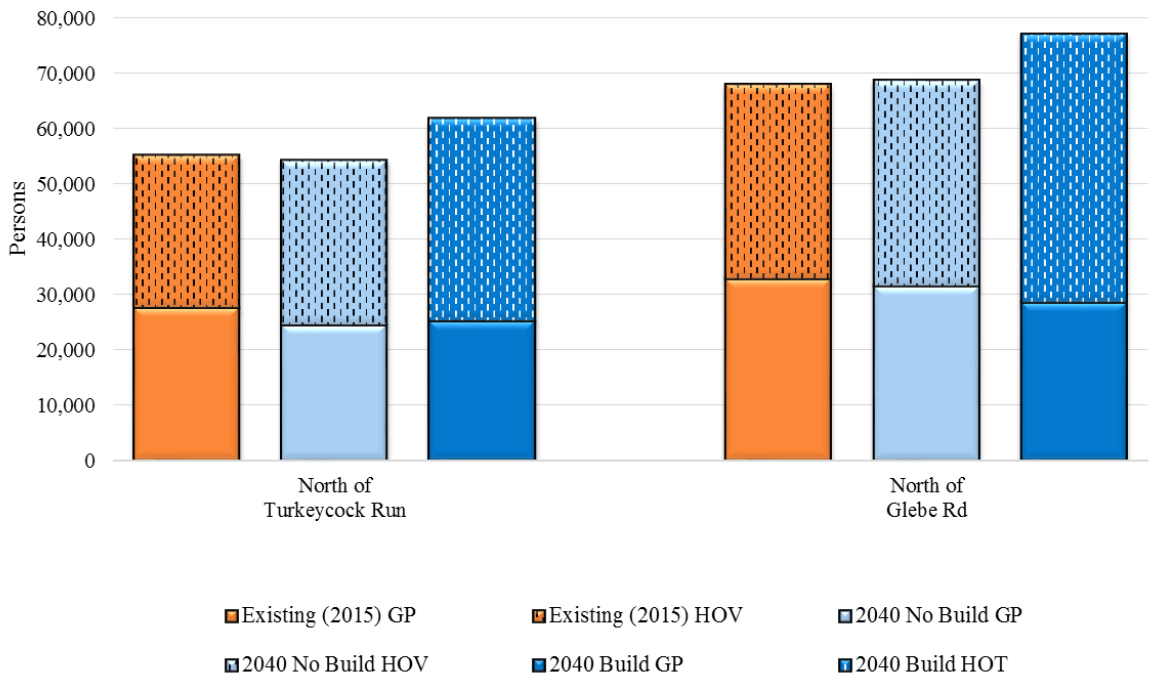
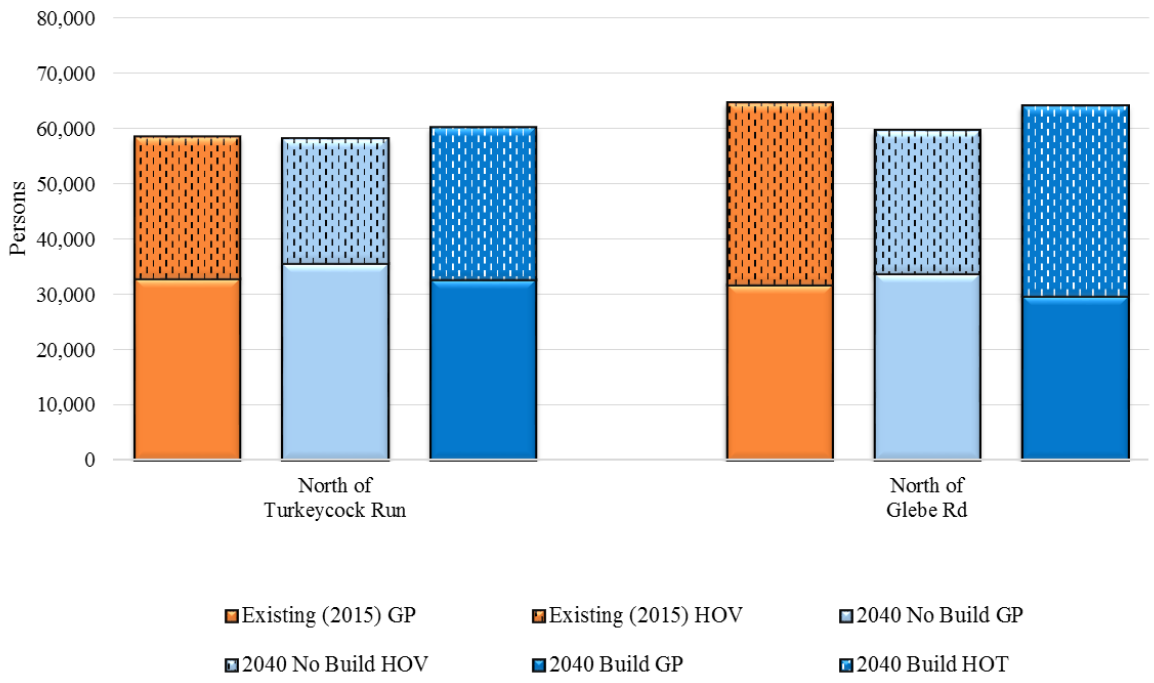


Figure 7-88: Southbound PM Peak Period Person Throughput Comparison (Existing and 2040)



7.5 TRAFFIC ANALYSIS FINDINGS

The traffic analysis for the I-395 Express Lanes Northern Extension demonstrates that the Build Alternative would improve operations along the I-395 corridor within the limits of the proposed conversion of the two HOV lanes to three HOT lanes compared to No Build conditions under both 2020 and 2040 Build conditions based on a review of corridor travel times, speeds, densities, and person throughput results of the microsimulation analysis.

Northbound General Purpose Lanes (AM Peak Period): Under 2020 Build conditions, overall travel times along the northbound I-395 general purpose lanes decrease by 4 to 17 minutes with an average travel time decrease of 12 minutes over the four hour AM peak period resulting in a 29 percent reduction in travel times. Overall travel speeds increase by approximately 6 MPH. Under 2040 Build conditions, travel times along the northbound I-395 general purpose lanes decrease by an average of 6 minutes over the four hour AM peak period resulting in a 12 percent reduction in travel times. There is a 6 minute increase in travel times from 7 AM to 8 AM during the period when demand for the HOT lanes is highest and in order to maintain travel speeds in the HOT lanes, traffic would be shifted from the HOT lanes to the general purpose lanes, thereby increasing travel times. Overall travel speeds increase by 3 MPH.

Northbound HOV/HOT Lanes (AM Peak Period): Under 2020 Build conditions, travel times along the northbound I-395 HOV/HOT lanes decrease by 2.5 minutes. The largest travel time decrease (6 minutes) is observed from 9 AM to 10 AM when No Build travel times in the HOV lanes are highest entering D.C. Under 2040 Build conditions, travel times along the northbound I-395 HOV/HOT lanes decrease by an average of 2.5 minutes.

Southbound General Purpose Lanes (PM Peak Period): Under 2020 Build conditions, travel times along the southbound I-395 general purpose lanes decrease by 1 to 7 minutes with an average travel time decrease of 4 minutes over the four hour PM peak period resulting in an 18 percent reduction in travel time. Under 2040 Build conditions, overall travel times decrease by 3 to 13 minutes, with an average travel time decrease of 9 minutes over the four hour PM peak period resulting in a 29 percent reduction in travel times. Overall travel speeds increase by 8 MPH.

Southbound HOV/HOT Lanes (PM Peak Period): Under 2020 and 2040 Build conditions, travel times along the southbound I-395 HOV/HOT lanes decrease by approximately 15 to 20 seconds.

Under Build conditions, person trips would increase by up to 14 percent along the northbound I-395 general purpose and HOT lanes in the AM peak period and by up to 7 percent along the southbound I-395 general purpose lanes and HOT lanes in the PM peak period.

In addition to reducing congestion and overall travel times in both the I-395 general purpose and HOV lanes during peak periods described above, the I-395 Express Lanes Northern Extension would provide additional travel choices and improve travel reliability along the I-395 corridor. The I-395 Express Lanes would offer consistent and reliable travel times for all roadway users including HOV motorists and transit riders and provide an additional travel choice for vehicles with less than three occupants that want to continue north along the I-95 / I-395 Express Lanes facility north of the Turkeycock Run Interchange or access the southbound Express Lanes facility exiting Washington, D.C. Although congestion would still exist during peak hours in the general purpose lanes as well as the I-395 Express Lanes approaching D.C., overall travel speeds would increase and travel times would decrease compared to the No Build Alternative.

Modifications to the Eads Street Interchange would improve operations for both HOT lane motorists and transit vehicles entering the Pentagon Reservation as well as motorists destined for Pentagon City. Northbound queues along the northbound I-395 HOV off-ramp to Eads Street would be reduced due to the implementation of dual reversible ramps from the northbound I-395 HOT lanes to Eads Street and the installation of traffic signals at the two ramp termini along Eads Street. Queuing along the northbound off-ramps to Eads Street that extends to the northbound I-395 HOV lanes under existing conditions would also be eliminated in the AM peak period. The Eads Street Interchange modifications include improvements to the Pentagon South Parking lot to create a smooth transition between the I-395 HOT ramp terminals along Eads Street and the South Rotary Road and North Rotary Road intersections. These modifications are consistent with the Pentagon Master Plan improvements to the Pentagon South Parking Lot.

The majority of the study intersections would not degrade under Build conditions. They operate under light or moderate traffic conditions under the No Build and Build scenarios; however, there are three intersections that would degrade to heavy or severe conditions under Build conditions compared to No Build conditions during either the AM or PM peak hour under 2020 or 2040 Build conditions, as discussed below:

- Little River Turnpike at Beauregard Street – Under 2040 Build conditions in the AM peak hour, the congestion level at this intersection would increase from heavy congestion to severe congestion with overall intersection delays increasing by approximately 17 seconds.
- Arlington Ridge Road at I-395 Ramps – Under 2040 Build conditions, the congestion level at this intersection would increase from light to severe traffic conditions with overall intersection delays increasing by approximately 3 minutes.
- Martha Custis Drive at Gunston Road – Under 2040 Build conditions in the PM peak hour, the congestion level at this intersection would increase from heavy congestion to severe congestion with overall average delay increases of 5 seconds.

8. SAFETY AND CRASH ANALYSIS

I-395 within the study area is characterized by recurring congestion during peak commuter periods that extends for several hours during the morning and evening peak periods. This congestion creates the potential for crashes, especially rear end and sideswipe crashes.

The available methods and tools for evaluating roadway safety can be separated into two categories: qualitative and quantitative. Qualitative methods for evaluating roadway safety typically include an evaluation of historical crash data and traffic volumes to review crash trends and rates. Quantitative methods for evaluating roadway safety are based not only on historic crash data and traffic volumes, but also take into account the geometric features of a roadway. The *Highway Safety Manual* (HSM), published in 2010, introduced a quantitative approach to evaluating roadway safety. Prior to the development of the HSM, safety analysis techniques largely focused on a review of crash history and qualitative assessments of the historic data. It should be noted that the predictive crash methods detailed in the HSM are not applicable to reversible lane facilities such as the I-395 HOV lanes; therefore, the quantitative safety analysis focuses on a review of available crash modification factors (CMFs) and state-specific Safety Performance Functions (SPFs) developed for Virginia.

8.1 QUALITATIVE SAFETY ANALYSIS

Crash data along northbound (NB) and southbound (SB) I-395 from approximately 0.45 mile south of Edsall Road to the Potomac River was reviewed for a four-year period from January 1, 2012 through December 31, 2015. Crash data was obtained from the VDOT Tableau-Crash Analysis Tool (T-CAT). The crash data includes crashes that were reported in the general purpose and HOV/HOT lanes as well as the ramps and arterials serving I-395. Using the latitude and longitude information from each crash, the crash data was converted to a shapefile to geospatially depict the location of each crash.

8.1.1 I-395 General Purpose and HOV/HOT Lane Crashes

A total of 2,622 crashes were reported along both the I-395 general purpose and HOV/HOT lanes within the crash study area during the four-year crash study period including 1,461 (56 percent) rear end crashes, 413 (16 percent) fixed object crashes, 382 (15 percent) sideswipe crashes, and 290 (11 percent) angle crashes. For the purposes of this study, crashes reported in the northbound and southbound travel directions in the HOV/HOT lanes are summarized separately although they occur within the same roadway facility for the majority of the study limits.

Table 8-1 summarizes the crashes by collision type, severity, surface condition, weather condition, year, and time interval. As shown, 657 crashes (25 percent) resulted in a total of 960 personal injuries and two crashes resulted in three fatalities. One fatal crash occurred on Wednesday, December 19, 2012 at 4:45 AM within the northbound I-395 general purpose lanes in the vicinity of the on-ramp from eastbound Little River Turnpike/Duke Street. This crash resulted in one fatality. Another fatal crash occurred on Thursday, April 9, 2015 at 10:00 PM within the HOV/HOT lanes approximately 450 feet north of Little River Turnpike/Duke Street and involved a vehicle traveling northbound in the HOV lanes when the lanes were operating in a southbound direction. This crash resulted in two fatalities. Of the 2,622 total crashes, 416 (16 percent) crashes occurred on wet/ice/snow-covered roadways and 397 (15 percent) crashes occurred during adverse weather conditions (i.e., rain, snow, etc.).

Table 8-1: I-395 Crash Summary

Crash Type		Number of Crashes[2]				Total Crashes	% of Total Crashes
		NB General Purpose Lanes	NB HOV/HOT[1] Lanes	SB General Purpose Lanes	SB HOV/HOT[1] Lanes		
Collision Type	Rear End	722	128	579	32	**1,461**	**55.7%**
	Sideswipe	186	30	147	19	**382**	**14.6%**
	Angle	146	26	112	6	**290**	**11.1%**
	Fixed Object	131	40	208	34	**413**	**15.7%**
	Other	22	11	35	8	**76**	**2.9%**
Crash Severity	Fatal Injury	0	0	1	1	**2**	**0.1%**
	Ambulatory Injury	26	5	33	3	**67**	**2.5%**
	Visible Injury	208	43	196	19	**466**	**17.8%**
	Non-Visible Injury	65	11	42	6	**124**	**4.7%**
	Property Damage Only	908	176	809	70	**1,963**	**74.9%**
Surface Condition	Dry	1,042	201	888	75	**2,206**	**84.1%**
	Wet	139	25	178	19	**361**	**13.8%**
	Snowy/Icy/Slush	25	9	15	5	**54**	**2.1%**
	Other	1	0	0	0	**1**	**0.0%**
Weather Condition	No Adverse Conditions (Clear/Cloudy)	1,053	200	897	75	**2,225**	**84.9%**
	Rain/Mist	124	26	170	19	**339**	**12.9%**
	Snow/Sleet/Hail	28	9	13	4	**54**	**2.1%**
	Fog	2	0	1	0	**3**	**0.1%**
	Other	0	0	0	1	**1**	**0.0%**
Year of Crash	2012	284	33	230	34	**581**	**22.2%**
	2013	318	51	266	16	**651**	**24.8%**
	2014	275	85	270	20	**650**	**24.8%**
	2015	330	66	315	29	**740**	**28.2%**
Time	12 AM - 3 AM	46	8	79	6	**139**	**5.3%**
	3 AM - 6 AM	62	28	82	4	**176**	**6.7%**
	6 AM - 9 AM	316	54	83	9	**462**	**17.6%**
	9 AM - 12 PM	167	61	93	8	**329**	**12.6%**
	12 PM - 3 PM	173	29	126	14	**342**	**13.0%**
	3 PM - 6 PM	221	28	280	23	**552**	**21.1%**
	6 PM - 9 PM	140	18	194	26	**378**	**14.4%**
	9 PM - 12 AM	82	9	144	9	**244**	**9.3%**
Total Crashes by Facility		**1,207**	**235**	**1,081**	**99**	**2,622**	**-**
Crashes per Mile (9.25 total miles)		**130.5**	**25.4**	**116.9**	**10.7**	**283.5**	**-**

[1] HOV/HOT = High Occupancy Vehicle/High Occupancy Toll lanes which include both the reversible I-395 HOV/HOT lanes and the northern section of the I-395 HOV lanes with dedicated travel lanes for each direction

[2] Crash study period consists of January 1, 2012 through December 31, 2015

During the study period, there were approximately 131, 117, 25, and 11 crashes per mile reported in the northbound general purpose, southbound general purpose, northbound HOV/HOT, and southbound HOV/HOT lanes, respectively. The number of crashes per year by facility is shown in **Figure 8-1.** As shown, the number of crashes per year increased approximately 12 percent in 2013 compared to 2012, remained approximately the same in 2014 (compared to 2013), and increased by approximately 14 percent in 2015 compared to 2013 or 2014, which suggests an upward trend in reported crashes. Further review of the crash data indicates that there was a high number of crashes (22 crashes) reported on snow-covered roadways during 2014, including 9 crashes that occurred on March 17, 2014 (St. Patrick's Day), 4 crashes that occurred on February 13, 2014, and 4 crashes that occurred on February 25, 2014. Of these 22 reported crashes, 14 occurred in the northbound HOV/HOT lanes. The number of crashes reported between 12 PM and 3 PM increased by approximately 38 percent in 2013 (compared to 2012), by approximately 29 percent in 2014 (compared to 2013), and by approximately 15 percent in 2015 (compared to 2014).

Figure 8-2 summarizes weekday (i.e., Monday - Friday) crashes by time of day. Seventy-eight percent of all reported crashes occurred on weekdays. As shown, 30 percent of all weekday crashes occurred during the AM peak period from 6:00 AM to 11:00 AM and 40 percent of all weekday crashes occurred during the PM peak period between 2:00 PM and 8:00 PM. The HOV lanes operate in the northbound direction between 2:30 AM and 11:00 AM with HOV-3 restrictions from 6:00 AM to 9:00 AM. The HOV lanes operate in the southbound direction from 1:00 PM to 12:00 AM with HOV-3 restrictions from 3:30 PM to 6:00 PM. During time periods without HOV-3 restrictions, all vehicles are permitted to use the HOV lanes. During time periods immediately preceding and following the HOV-3 restrictions, traffic volumes in the HOV lanes increase, creating the potential for congestion-related crashes. Crashes were reviewed for the 15-minute intervals during the one-hour preceding the HOV-3 restriction time periods through the two hours following the HOV-3 restriction period (see **Figures 8-3 and 8-4**) to determine the impact on the number of reported crashes. Northbound I-395 crashes were reviewed for the morning peak period and southbound I-395 crashes were reviewed for the evening peak period.

As shown, there is an increase in the number of crashes in the northbound HOV/HOT lanes from 5:30 – 6:00 AM (i.e., the time period preceding the AM peak HOV-3 restriction period), which is followed by a decrease in crashes from 6:15 – 6:30 AM. Following the HOV-3 restriction period, there is an increase in crashes in the northbound HOV/HOT lanes from 9:15 – 9:30 AM and 9:45 – 10:00 AM. A total of 34 crashes were reported in the northbound HOV/HOT lanes from 9:15 - 10:15 AM, which represents the highest number of crashes during a one-hour interval throughout the day and is 113 percent greater than the number of crashes reported in the northbound HOV/HOT lanes from 8:00 – 9:00 AM (i.e., the last hour of the AM peak HOV-3 restriction period).

A total of 14 crashes were reported in the southbound HOV/HOT lanes from 6:30 – 7:30 PM, which represents the highest number of crashes during a one-hour interval throughout the day and is 75 percent greater than the number of crashes reported in the southbound HOV/HOT lanes from 5:00 – 6:00 PM (i.e., the last hour of the PM peak HOV-3 restriction period). Furthermore, five crashes were reported in the southbound HOV/HOT lanes from 3:15 – 3:30 PM during the 15-minute period immediately preceding the PM peak HOV-3 restriction period. Three of these five crashes occurred south of Eads Street near the ramp from the southbound HOV lanes to the general purpose lanes. These historical crash trends suggest that there is a degradation of safety within the HOV lanes during the time period preceding and following the AM and PM peak HOV-3 restriction periods.

Figure 8-1: Crashes by Year by Facility

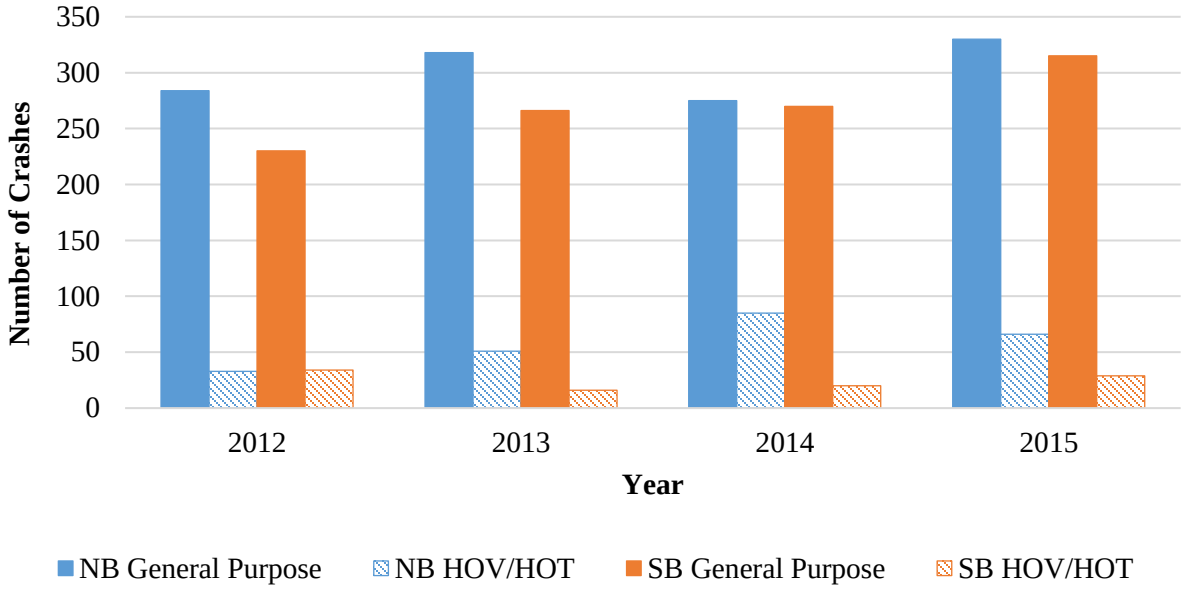


Figure 8-2: Weekday (Monday – Friday) Crashes by Time of Day (2012 – 2015)

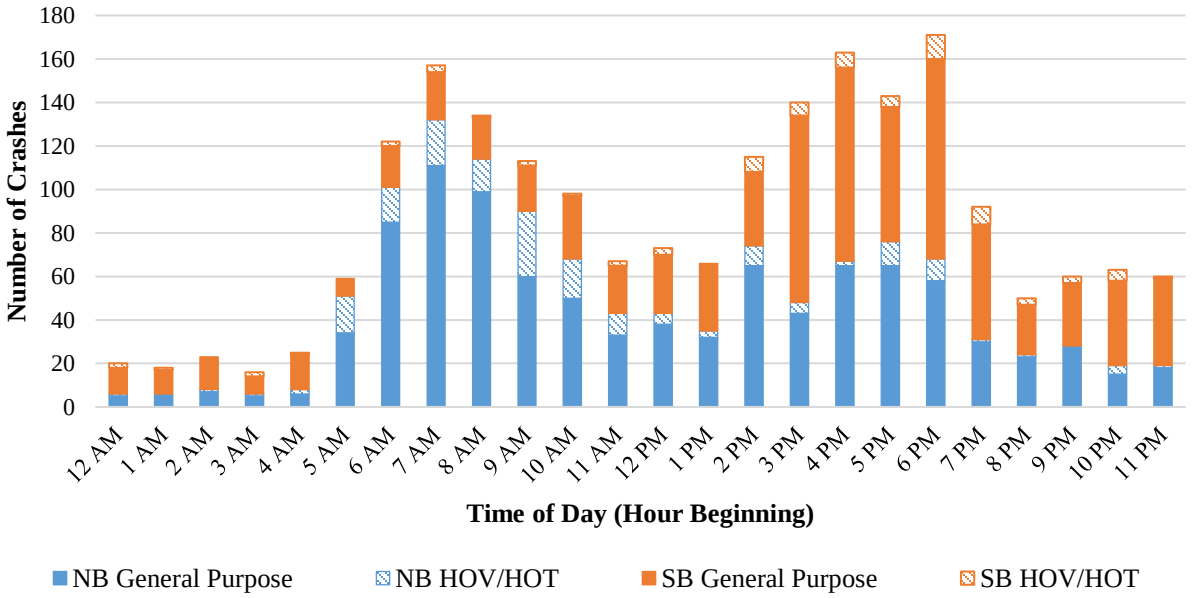


Figure 8-3: Crashes by 15-Minute Time Period Intervals (2012 – 2015) – 5:00 AM to 11:00 AM Northbound I-395 Crashes

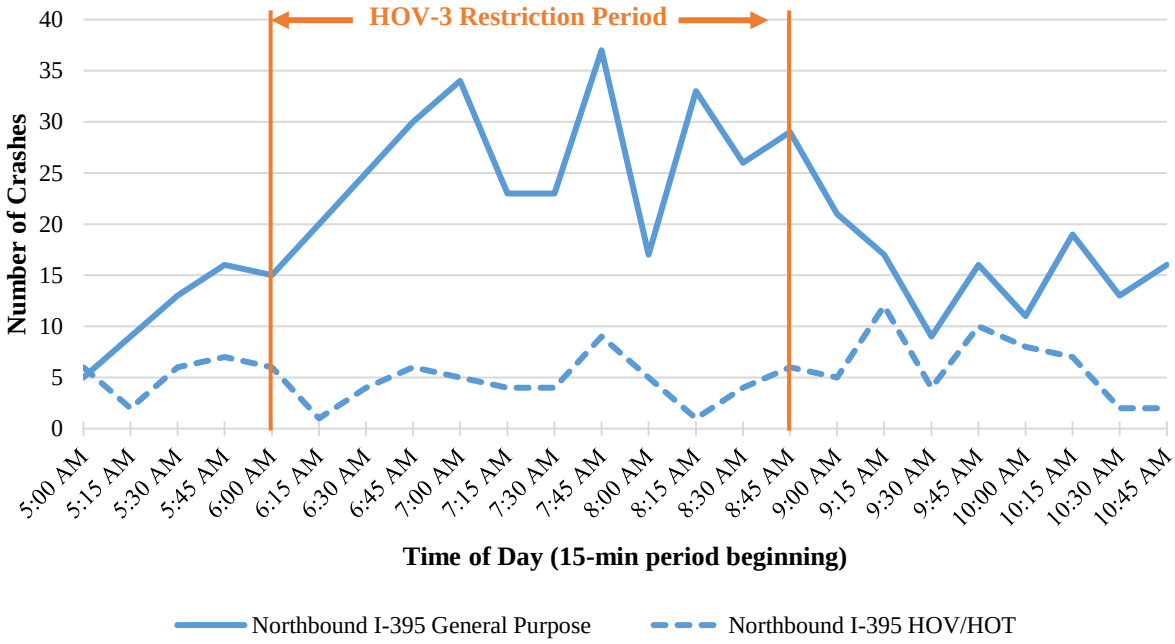
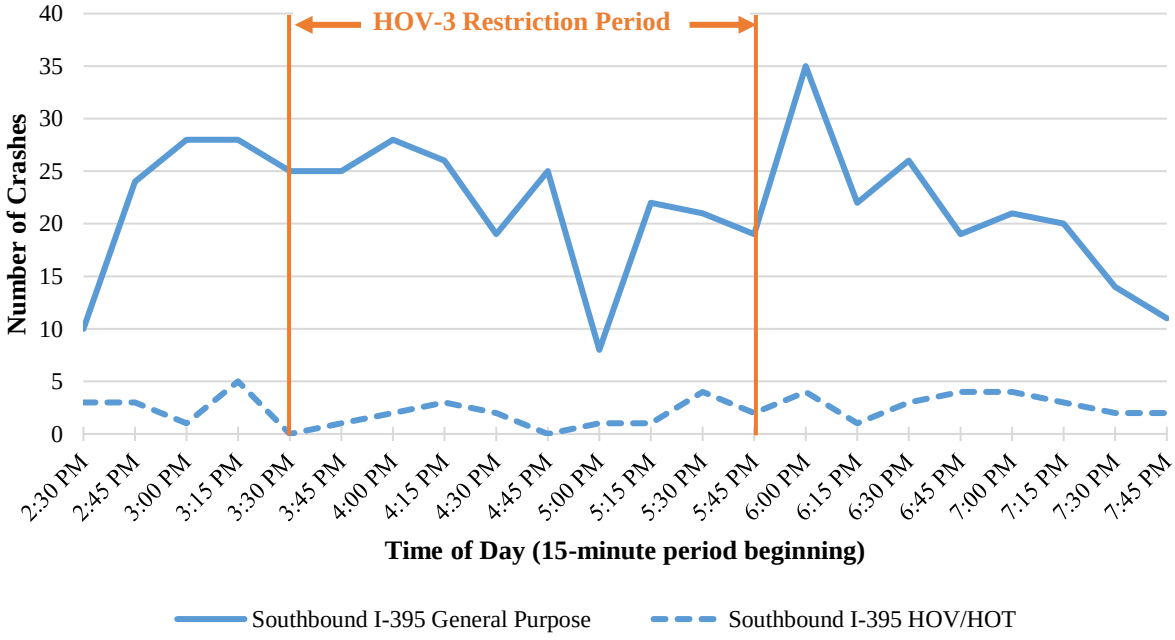


Figure 8-4: Crashes by 15-Minute Time Period Intervals (2012 – 2015) – 2:30 PM to 8:00 PM Southbound I-395 Crashes



To further analyze the crash data and identify crash trends, the study corridor was separated into 37 segments, each covering a 0.25-mile roadway segment. Quarter-mile points were established at consistent locations along all four I-395 facilities (northbound general purpose, southbound general purpose, northbound HOV/HOT, southbound HOV/HOT) and are generally based on the VDOT-published Linear Referencing System (LRS), Release 14.1. All crashes reported along I-395 were associated with a specific 0.25-mile point based on geospatial data. For example, crashes associated with mile point 3.25 represent the roadway segment from mile point 3.125 to 3.375. Crashes within the general purpose and HOV/HOT travel lanes are summarized using crash frequency histograms in 0.25-mile segments by crash type in **Figures 8-5 and 8-6** (*Volume 2*), respectively. **Figures 8-7 through 8-10** (*Volume 2*) show the crash frequency by crash severity and by time of day for crashes within the general purpose and HOV/HOT travel lanes.

Crash rates per 100 million vehicle miles traveled were calculated for the four I-395 facilities for each 0.25-mile segment and are summarized in **Table 8-2 and Figures 8-11 and 8-12** for both total crashes and injuries.

Calculated crash rates were compared to VDOT's annually-published statewide average interstate, statewide average urban interstate, and Northern Virginia interstate crash rates. At the time of this study, statewide crash, injury, and fatality rates for calendar year 2015 were not available; therefore, the calculated rates were compared to the average of the 2012 through 2014 crash rates, which represent three of the four years included in the crash study period. Of the 148 total 0.25-mile segments analyzed (37 per facility), 63 (43 percent) segments have a total crash rate greater than the statewide average interstate crash rate, statewide average urban interstate crash rate, and Northern Virginia interstate crash rate. Eleven (7 percent) segments have a total crash rate greater than both the statewide average urban interstate and statewide average interstate crash rates, but have a rate lower than the Northern Virginia interstate average crash rate. Eight (5 percent) segments have a total crash rate greater than the statewide interstate average crash rate, but have a rate lower than both the Northern Virginia interstate average and statewide average interstate crash rates.

Calculated injury rates were compared to VDOT's annually-published statewide average interstate, statewide average urban interstate, and Northern Virginia interstate injury rates. Of the 148 total quarter-mile segments analyzed (37 per facility), 48 (32 percent) segments have an injury rate greater than the statewide average interstate injury rate, statewide average urban interstate injury rate, and Northern Virginia interstate injury rate. Twelve (8 percent) segments have an injury rate greater than both the statewide average interstate and statewide average urban interstate, but have a rate lower than the Northern Virginia interstate average injury rate. Ten (7 percent) segments have an injury rate greater than the statewide average interstate injury rate, but have a rate lower than both the Northern Virginia interstate average and statewide average interstate injury rates.

The overall crash rate in the northbound general purpose, southbound general purpose, and northbound HOV/HOT facilities is greater than the statewide average interstate crash rate, statewide average urban interstate crash rate, and Northern Virginia crash rate. The overall corridor crash rate for the southbound HOV/HOT lanes is lower than all three average crash rates.

Fatality rates were not calculated for each segment due to the relatively low number of reported fatal crashes during the study period (three fatalities were reported during the four-year study period).

Table 8-2: Crash and Injury Rate (per 100 million Vehicle Miles Traveled [VMT]) Comparison by Quarter-Mile Segment

MP	Reference Interchange / Cross Street	I-395 Total Crash Rate by Facility[1] (2012 – 2015 Crashes) [Statewide Average Total Crash Rates[2]: Interstate = 68; Urban Interstate = 81; Northern Virginia Interstate = 97]				I-395 Injury Rate by Facility (2012 – 2015 Crashes) [Statewide Average Injury Rates[2]: Interstate = 30; Urban Interstate = 37; Northern Virginia Interstate = 41]			
		NB GP	NB HOV/ HOT	SB GP	SB HOV/ HOT	NB GP	NB HOV/ HOT	SB GP	SB HOV/ HOT
1.75		146	131	65	36	64	75	27	0
2.00	Edsall Road	192	206	80	36	76	56	80	0
2.25		166	169	149	0	39	94	43	0
2.50		146	188	117	54	68	113	55	18
2.75		143	123	93	72	41	0	21	72
3.00	Turkeycock Run Interchange	85	104	59	24	39	0	31	0
3.25		95	78	54	102	41	59	27	26
3.50		132	235	109	44	74	59	51	44
3.75	Duke Street	234	157	263	59	102	39	93	59
4.00		250	117	188	44	42	39	38	15
4.25		154	98	161	15	63	39	30	0
4.50		63	59	167	0	20	0	60	0
4.75	Sanger Avenue	40	20	94	0	23	20	20	0
5.00		114	157	100	0	60	0	30	0
5.25	Seminary Road	122	196	152	15	35	59	88	0
5.50		39	18	72	27	20	18	28	0
5.75	W. Braddock Road	35	73	94	0	0	0	18	0
6.00	King Street Interchange	58	109	59	0	19	36	38	0
6.25		73	18	41	14	18	0	22	0
6.50		109	36	77	14	16	0	35	0
6.75		60	91	137	27	6	0	41	0
7.00		95	18	36	27	49	0	7	41
7.25		39	54	61	14	20	36	16	14
7.50	Glebe Road Interchange	175	171	229	13	78	0	67	13
7.75		94	120	130	88	33	17	45	63
8.00		48	17	107	38	19	34	48	0
8.25		42	68	106	63	10	17	10	100
8.50		67	51	96	0	19	17	34	0
8.75		91	17	161	38	49	0	37	0
9.00	Washington Boulevard	60	137	247	13	8	103	84	0
9.25		64	152	102	15	19	65	20	0
9.50		85	211	115	198	30	94	23	17
9.75	Fern Street	128	90	79	134	52	30	18	30
10.00	Jefferson Davis Highway	181	130	114	48	45	52	36	0
10.25		217	57	118	43	84	49	38	0
10.50		284	164	133	88	104	25	47	79
10.75	Potomac River	270	188	34	35	130	114	34	21
Overall Corridor		**119**	**109**	**113**	**39**	**29**	**44**	**37**	**39**

[1] Critical crash locations identified based on the crash rate (i.e., crashes per 100 million vehicle miles traveled) are indicated with shading
[2] Average of the 2012, 2013, and 2014 crash rates published annually by VDOT's Traffic Engineering Division

Figure 8-11: Total Crash Rate Summary by Mile Point

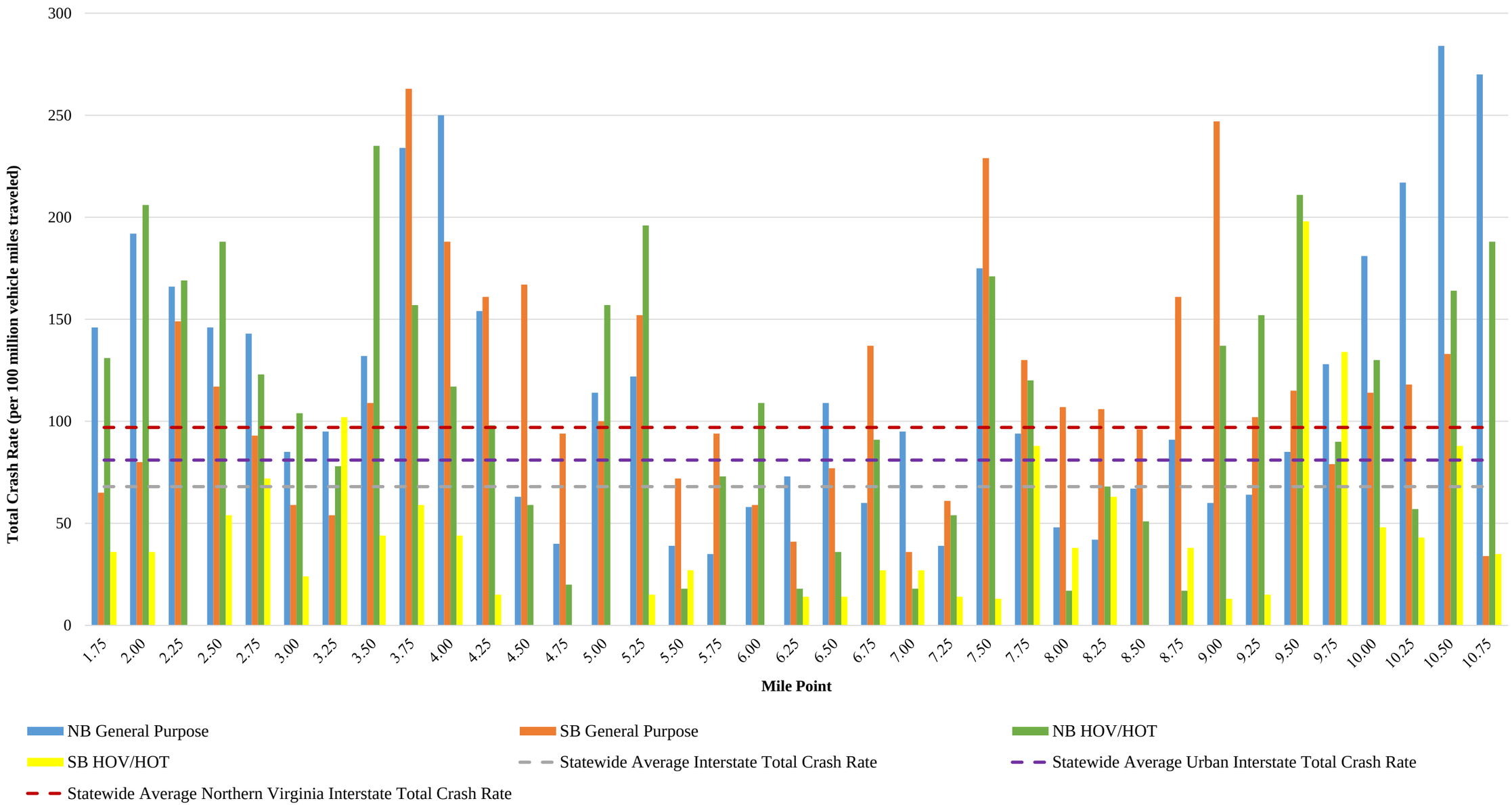
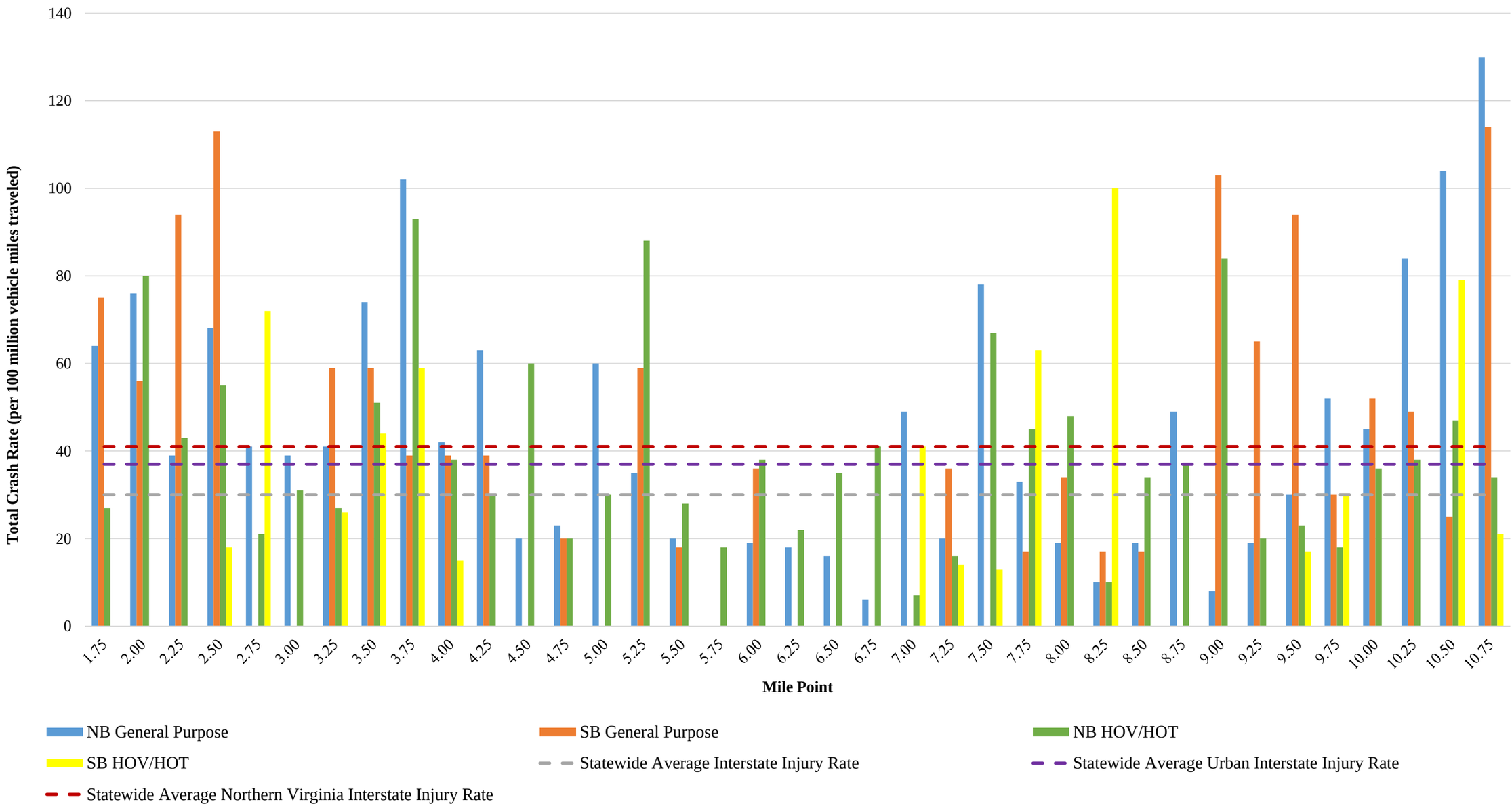


Figure 8-12: Total Injury Rate Summary by Mile Point



Critical crash locations (or crash "hot spots") were identified along the corridor using two different methods, both of which used an 85th-percentile measurement to define the critical crash threshold. Separate thresholds were calculated for each of the four facilities (i.e., northbound general purpose, southbound general purpose, northbound HOV/HOT, and southbound HOV/HOT). The first method reviewed the crash frequency (i.e., number of crashes) and the second method reviewed the total crash rates (i.e., crashes per 100 million vehicle miles traveled) as described below:

- **Crash Frequency** - The critical crash locations identified using the crash frequency methodology are summarized in **Table 8-3 and Figures 8-11 and 8-12**. As shown, the 85th-percentile crash frequency for the northbound general purpose, southbound general purpose, northbound HOV/HOT, and southbound HOV/HOT facilities are 55, 44, 10, and 5 crashes per 0.25-mile segment, respectively.

- **Crash Rate per 100 Million VMT** – The critical crash locations identified using the crash rate are summarized in **Table 8-4** and are indicated with shading in **Table 8-2**. As show, the 85th-percentile crash rates for the northbound general purpose, southbound general purpose, northbound HOV/HOT, and southbound HOV/HOT facilities are 188, 161, 181, and 68 crashes per 100 million vehicle miles traveled, respectively.

A comparison of the critical crash locations identified through both the crash frequency and crash rate methodologies indicates similar results. The northbound general purpose lanes have critical crash locations near the Edsall Road Interchange, Little River Turnpike/Duke Street Interchange, Glebe Road Interchange, and approaching the Potomac River in the vicinity of Boundary Channel Drive and George Washington Memorial Parkway. The southbound general purpose lanes have critical crash locations near the Edsall Road Interchange, approaching the Little River Turnpike/Duke Street Interchange, near the Glebe Road Interchange, and near the Washington Boulevard (south) Interchange. Critical crash locations within the northbound HOV/HOT lanes were identified south of and north of Edsall Road, between the Turkeycock Run Interchange and Little River Turnpike/Duke Street, south of Seminary Road, south of Glebe Road, near the northern terminus of the reversible HOV lanes, and north and south of George Washington Memorial Parkway. Critical crash locations within the southbound HOV/HOT lanes were identified south of and north of the Turkeycock Run Interchange, north of Glebe Road, in the vicinity of the Eads Street on-ramp and approaching the ramp from the HOV lanes to the southbound general purpose lanes, near Boundary Channel Drive (approaching the exit from the HOV lanes to the southbound general purpose lanes), and at George Washington Memorial Parkway. Critical crash locations were identified for both the northbound and southbound HOV/HOT lanes near the northern terminus of the reversible HOV lanes (i.e., mile point 9.5). Heavy congestion approaching the off-ramp to Eads Street during the morning peak period is likely a leading contributor to the northbound crashes. During the evening peak period, heavy congestion in the southbound direction and vehicles exiting the HOV/HOT lanes are likely a leading contributors to southbound crashes.

Table 8-3: I-395 Critical Crash Locations based on Crash Frequency

I-395 Facility	Average Crash Frequency (crashes per 0.25-mile segment)	85th-Percentile Critical Crash Frequency (crashes per 0.25-mile segment)	Locations with Crash Frequency ≥ 85th-Percentile Critical Crash Frequency
NB General Purpose	32.6	55.2	• MP 2.00: South of Edsall Rd • MP 3.75: Duke St • MP 4.00: North of Duke St • MP 7.5: South of Glebe Rd • MP 10.50: Boundary Channel Drive to George Washington Memorial Pkwy • MP 10.75: George Washington Memorial Pkwy to Potomac River
SB General Purpose	29.2	44.2	• MP 2.25: North of Edsall Rd • MP 3.75: Duke St • MP 4.00: North of Duke St • MP 4.25: In Vicinity of Off-Ramp to Duke St • MP 4.50: South of Sanger Ave • MP 7.50: South of Glebe Rd
NB HOV/ HOT	6.4	10.0	• MP 2.00: South of Edsall Rd • MP 2.50: Between Edsall Rd and Turkeycock Run • MP 3.50: South of Duke St • MP 5.25: South of Seminary Rd • MP 7.50: South of Glebe Road • MP 10.50: Boundary Channel Drive to George Washington Memorial Pkwy • MP 10.75: George Washington Memorial Pkwy to Potomac River
SB HOV/ HOT	3.3	5.0	• MP 7.75: North of Glebe Rd • MP 8.25: Between Glebe Rd and Arlington Ridge Rd • MP 9.50: Joyce St to Hayes St • MP 9.75: Hayes St to Eads St • MP 10.50: Boundary Channel Drive to George Washington Memorial Pkwy • MP 10.75: George Washington Memorial Pkwy to Potomac River

Table 8-4: I-395 Critical Crash Locations based on Crash Rate

I-395 Facility	Average Crash Rate (crashes per 100 million VMT per 0.25-mile segment)	85th-Percentile Critical Crash Rate (crashes per 100 million VMT per 0.25-mile segment)	Locations with Crash Frequency ≥ 85th-Percentile Critical Crash Rate
NB General Purpose	118.9	187.9	• MP 2.00: South of Edsall Rd • MP 3.75: Duke St • MP 4.00: North of Duke St • MP 10.25: South of Boundary Channel Drive • MP 10.50: Boundary Channel Drive to George Washington Memorial Pkwy • MP 10.75: George Washington Memorial Pkwy to Potomac River
SB General Purpose	113.5	161.0	• MP 3.75: Duke St • MP 4.00: North of Duke St • MP 4.25: In Vicinity of Off-Ramp to Duke St • MP 4.50: South of Richenbacher Ave • MP 7.50: South of Glebe Rd • MP 8.75: South of Arlington Ridge Rd • MP 9.00: South of Washington Blvd
NB HOV/ HOT	108.9	181.1	• MP 2.00: South of Edsall Rd • MP 2.50: Between Edsall Rd and Turkeycock Run • MP 3.50: South of Duke St • MP 5.25: South of Seminary Rd • MP 9.50: Joyce St to Hayes St • MP 10.75: George Washington Memorial Pkwy to Potomac River
SB HOV/ HOT	38.8	68.3	• MP 2.75: South of Turkeycock Run • MP 3.25: North of Turkeycock Run • MP 7.75: North of Glebe Rd • MP 9.50: Joyce St to Hayes St • MP 9.75: Hayes St to Eads St • MP 10.50: Boundary Channel Drive to George Washington Memorial Pkwy

It should be noted that the I-395 HOV lanes south of the Turkeycock Run Interchange were expanded from two to three lanes and converted to HOT lanes during the crash study period and operations were impacted by construction activities. The HOV lanes were officially converted to HOT lanes on December 14, 2014 and tolling began on December 29, 2014. A review of the total number of crashes from the southern crash study limits to the Turkeycock Run Interchange does not suggest there was a significant change in the number of reported crashes following the conversion of the HOV lanes to HOT lanes (14 crashes per year were reported during 2012 through 2014 and 17 crashes were reported during 2015). Although there was an increase in the number of crashes during the "after" period, typically a minimum of two years of crash data (and preferably five years) should be reviewed before conclusions regarding safety conditions are made. Therefore, this study does not further compare crashes before and after the conversion to HOT lanes from the southern study limit to the Turkeycock Run Interchange.

8.1.2 I-395 General Purpose Ramp Crashes

Crashes reported along the I-395 ramps and collector-distributor roadways within the study area were analyzed separately from crashes reported within the general purpose lanes. Ramp crashes were identified based on the roadway data fields included in VDOT's crash data, specifically the route number, and a visual inspection of geospatial crash locations. A summary of the number of crashes by crash severity for each ramp along the northbound and southbound I-395 general purpose lanes is shown in **Tables 8-5 and 8-6**, respectively. A total of 225 crashes were reported on the ramps serving the northbound I-395 general purpose lanes and a total of 223 crashes were reported on the ramps serving the I-395 southbound general purpose lanes. Twenty-nine percent of the crashes resulted in personal injuries and one crash resulted in a fatality. The fatal crash occurred on Thursday, August 16, 2012 at approximately 2:30 AM along the southbound off-ramp to westbound Duke Street (Exit 3B). The fatal crash involved an impaired driver. The locations of ramp crashes are depicted in **Figure 8-13** (*Volume 2*) including the crash type and crash severity.

As shown, the highest number of crashes occurred along the southbound I-395 collector-distributor road between Glebe Road and Shirlington Road. Fifty-seven (84 percent) of these crashes occurred in the vicinity of the merge between the southbound Glebe Road on ramp and the collector-distributor road located approximately 700 feet south of Glebe Road. In addition to this ramp, at least 20 crashes (5 crashes per year) were reported on four other ramps. These locations include:

- Northbound I-395 general purpose lanes to eastbound Edsall Road
- Northbound I-395 general purpose lanes to Seminary Road
- Seminary Road to northbound I-395 general purpose lanes
- Southbound I-395 general purpose lanes to westbound Duke Street

Table 8-5: I-395 Northbound General Purpose Ramp Crash Summary (January 2012 – December 2015)

Ramp	Fatal Crashes	Injury Crashes	Property Damage Only Crashes	Total
NB I-395 GP to EB Edsall Rd	0	11	12	23
NB I-395 GP to WB Edsall Rd	0	1	2	3
Edsall Rd to NB I-395 GP	0	0	0	0
NB I-395 GP to NB I-395 HOV (at Turkeycock Run)	0	0	2	2
NB I-395 HOV to NB I-395 GP (at Turkeycock Run)	0	0	0	0
NB I-395 GP to EB Duke St	0	1	4	5
NB I-395 GP to WB Duke St	0	3	5	8
Duke St to NB I-395 GP	0	6	19	25
NB I-395 GP to Seminary Rd	0	13	17	30
Seminary Rd to NB I-395 GP	0	0	0	0
NB I-395 GP to King St	0	0	2	2
NB I-395 GP to WB King St	0	3	1	4
NB I-395 GP to EB King St	0	0	0	0
EB King St to NB I-395 GP	0	1	5	6
WB King St to NB I-395 GP	0	0	0	0
NB I-395 GP to SB Quaker Ln	0	4	4	8
NB I-395 GP to NB Quaker Ln	0	1	2	3
Quaker Ln to NB I-395 GP	0	0	0	0
NB I-395 GP to Glebe Rd	0	10	22	32
EB Glebe Rd to NB I-395 GP	0	0	0	0
NB I-395 GP to WB Glebe Rd	0	8	4	12
WB Glebe Rd to NB I-395 GP	0	0	0	0
NB I-395 GP to Exit 8A (Wash Blvd; Columbia Pike)	0	2	8	10
NB I-395 GP to Exit 8B (Wash Blvd; Pentagon; Arlington Cemetery)	0	3	7	10
NB I-395 GP to Exit 8C (To Route 1 North)	0	2	7	9
Wash Blvd to NB I-395 GP	0	2	0	2
SB Hayes St to NB I-395 GP	0	0	0	0
NB I-395 GP to NB I-395 HOV (at Eads)	0	0	0	0
SB Route 1 to NB I-395 GP	0	1	1	2
NB Route 1 to NB I-395 GP	0	1	3	4
Boundary Channel Dr to NB I-395 GP	0	0	0	0
NB I-395 GP to Boundary Channel Dr	0	2	2	4
NB I-395 GP to SB GW Pkwy	0	1	0	1
SB GW Pkwy to NB I-395 GP	0	0	2	2
NB GW Pkwy to NB I-395 GP	0	1	2	3
NB I-395 GP to NB GW Pkwy	0	4	11	15

Table 8-6: I-395 Southbound General Purpose Ramp Crash Summary (January 2012 – December 2015)

Ramp	Fatal Crashes	Injury Crashes	Property Damage Only Crashes	Total
SB I-395 GP to NB GW Pkwy	0	0	3	3
NB GW Pkwy to SB I-395 GP	0	1	1	2
SB I-395 GP to SB GW Pkwy	0	0	0	0
SB GW Pkwy to SB I-395 GP	0	0	3	3
WB Boundary Channel Dr to SB I-395 GP	0	1	1	2
SB I-395 GP to EB Boundary Channel Dr	0	0	2	2
EB Boundary Channel Dr to SB I-395 GP	0	0	0	0
SB I-395 GP to Route 1 North	0	1	5	6
SB I-395 GP to Route 1 South	0	0	2	2
SB I-395 GP to Exit 8A (Pentagon South Parking; Wash Blvd)	0	0	5	5
SB I-395 HOV to SB I-395 GP (at Hayes St)	0	0	3	3
Hayes St to SB I-395 GP	0	0	0	0
WB Wash Blvd to SB I-395 GP	0	0	1	1
EB Wash Blvd to SB I-395 GP	0	0	0	0
SB I-395 to Glebe Rd	0	4	9	13
SB I-395 GP C-D Road, Glebe Rd to Shirlington Rd	0	25	43	68
Glebe Rd to SB I-395 GP	0	2	9	11
Shirlington/Quaker to SB I-395 GP	0	0	0	0
SB I-395 GP to NB King St	0	1	2	3
SB I-395 GP to SB King St	0	1	5	6
NB King St to SB I-395 GP	0	0	3	3
SB King St to SB I-395 GP	0	1	5	6
SB I-395 GP to WB Duke St	0	8	20	28
Seminary Rd to SB I-395 GP	0	0	1	1
SB I-395 GP to WB Duke St	1	1	17	19
WB Duke St to SB I-395 GP	0	1	10	11
SB I-395 GP to EB Duke St	0	2	3	5
EB Duke St to SB I-395 GP	0	0	4	4
SB I-395 GP to SB I-395 HOV (at Turkeycock Run)	0	0	4	4
SB I-395 HOV to SB I-395 GP (at Turkeycock Run)	0	0	0	0
SB I-395 GP to WB Edsall Rd	0	0	1	1
WB Edsall Rd to SB I-395 GP	0	0	8	8
SB I-395 GP to EB Edsall Rd	0	0	2	2
EB Edsall Rd to SB I-395 GP	0	0	1	1

8.1.3 I-395 HOV/HOT Lane Ramp Crashes

Crashes reported along the I-395 HOV/HOT ramps, within the limits of the ramp merge and diverge areas, and at the ramp termini were analyzed to identify trends associated with the HOV access points. Crashes were identified based on the roadway data fields included in VDOT's crash data, specifically the route

number, and a visual inspection of geospatial crash locations. A summary of the number of crashes for each ramp along the northbound and southbound HOV/HOT lanes is shown in **Table 8-7**. As shown, the majority of the I-395 HOV/HOT lane ramps had less than two reported crashes during the four-year study period with the exception of the southbound HOV to southbound general purpose lane ramp at Turkeycock Run and the southbound HOV to southbound general purpose lane ramp located south of Eads Street, which would be eliminated as part of the Build Alternative.

Northbound HOV/HOT lane ramps with two or more reported crashes along the HOV/HOT lanes are all located within merge areas with the exception of the northbound HOV diverge to Washington Boulevard. Along the southbound HOV/HOT lanes, ramp locations with two or more crashes are located in the vicinity of the Eads Street interchange with the highest crash cluster (12 crashes) reported within the weave between the Eads Street on ramp and the off ramp to the general purpose lanes. Many of these crashes are likely the result of recurring congestion along the I-395 HOV/HOT lanes. The reduced frequency and intensity of recurring congestion with the additional travel lane proposed by the project has the potential to mitigate crash patterns at these locations.

Table 8-7: I-395 HOV/HOT Lane Ramp Crash Summary (January 2012 – December 2015)

Direction	Ramp	Operation	Ramp Crashes	Crashes along HOV/HOT Lanes	Ramp Terminal Crashes
Northbound HOV/HOT Lanes	NB HOT to GP (Turkeycock Run)	AM only	0	0	N/A[1]
	NB GP to HOV (Turkeycock Run)	AM only	2	2	N/A[1]
	NB HOV to Seminary Road	AM only	0	1	N/A[2]
	Seminary Road to NB HOV	AM only	0	4	4
	Shirlington Road to NB HOV	AM only	0	6	0
	NB HOV to Washington Boulevard	AM only	1	6	N/A[1]
	NB HOV to Eads Street	AM only	1	1	1
	Eads Street to NB HOV	Open at all times	0	2	
	NB GP to NB HOV (north of Eads Street)	Open at all times	0	6	N/A[1]
Southbound HOV/HOT Lanes	SB HOV to GP (Turkeycock Run)	PM only	0	1	N/A[1]
	SB GP to HOT (Turkeycock Run)	PM only	4	1	N/A[1]
	Seminary Road to SB HOV	PM only	0	0	N/A[2]
	SB HOV to Seminary Road	PM only	0	0	1
	SB HOV to Shirlington Road	PM only	0	0	3
	Washington Boulevard to SB HOV	PM only	1	0	N/A[1]
	SB HOV to SB GP (south of Eads Street)	Open at all times	3	10	N/A[1]
	Eads Street to SB HOV	Open at all times	1	2	1
	SB HOV to Eads Street	Open at all times	1	2	
	SB HOV to SB GP (Boundary Channel Drive)	Open at all times	0	2	N/A[1]

[1] Ramp terminal does not exist
[2] Ramp terminal did not exist during study period

8.1.4 Arterial Crashes

Crashes reported along major roadways intersecting I-395 and/or within the study area (i.e., arterial crashes) were analyzed separately from crashes reported within the I-395 general purpose, HOV/HOT lanes, and ramps. Arterial crashes were identified geospatially using the latitude and longitude information for each crash. A total of 1,308 crashes were identified during the four year study period. Crash rates for these roadways were calculated and compared to VDOT's annually-published statewide average crash rates by functional classification. As shown in **Table 8-8**, the majority of roadways had crash rates greater than the statewide average crash rates for the four-year study period from January 1, 2015 through December 31, 2015. It can be expected that crash rates are higher along roadways at interstate interchanges due to the higher traffic volumes at these locations compared to other segments along the arterials. In addition, interchange areas typically have a greater frequency of conflict points and turning movements compared to other locations along a roadway. Arterial crash locations including the crash severity and crash types are depicted in **Figure 8-13** *(Volume 2)*.

It should be noted that crash data is not available through VDOT's Tableau-Crash Analysis Tool for roadways on the Pentagon Reservation; therefore, these federally-maintained roadways (i.e., South Rotary Road and North Rotary Road) are not included in the safety assessment.

Table 8-8: Arterial Crash Analysis Summary (January 2012 – December 2015)

Roadway	Fatal Crashes	Injury Crashes	Property Damage Only Crashes	Total	Crash Rate[1]	Statewide Average Crash Rate[2]
Edsall Road	0	53	48	101	297	231
Duke Street / Little River Turnpike	1	79	136	216	303	191
Seminary Road	0	54	158	212	441	231
King Street	0	18	39	57	135	191
Shirlington Road	0	20	47	67	619	231
Quaker Lane	0	15	40	55	365	231
Glebe Road	0	38	60	98	544	191
Washington Boulevard	1	26	85	112	115	61
Army Navy Drive	0	39	93	132	669	225
Hayes Street	0	29	69	98	1,269	231
Eads Street	0	9	20	29	510	225
Route 1	0	2	11	13	24	191
Long Bridge Drive	0	2	12	14	540	225
Boundary Channel Drive	0	0	2	2	70	225
GW Memorial Parkway	0	2	3	5	14	61

[1] Crash rates greater than the average crash rate are indicated with shading
[2] Average of the 2012, 2013, and 2014 crash rates by functional classification published annually by VDOT's Traffic Engineering Division

8.2 QUANTITATIVE SAFETY ANALYSIS

AASHTO's *Highway Safety Manual* (HSM), published in 2010, presents a variety of quantitative methods for estimating crash frequency or severity for various facility types. In 2014, a supplement for the HSM

was released which includes two new chapters to estimate crash frequency for both freeways and ramps. There are two tools available for implementing the predictive method of the HSM for freeway facilities - the Interactive Highway Safety Design Model (IHSDM) and Enhanced Interchange Safety Analysis Tool (ISATe). The Traffic Operations Analysis Tool Selection Matrix included in Appendix D of the Traffic Operations and Safety Analysis Manual (TOSAM), Version 1.0 (VDOT TOSAM, 2015) specifies the use of the IHSDM or ISATe; however, according to Chapter 18 of the HSM and the ISATe Users Manual, "the predictive method for freeways does not account for the influence of reversible lanes." Also, a freeway segment is defined as "a length of freeway consisting of several through lanes with a constant cross section providing two directions of travel in which the opposing travel lanes are physically separated by a median." These statements indicate that the IHSDM and ISATe tools are not applicable to the reversible HOV facility located between the I-395 northbound and southbound general purpose lanes where the majority of physical improvements are located. A quantitative HSM analysis of the I-395 general purpose lanes could be performed using the IHSDM or ISATe; however, since minimal physical modifications are proposed to the general purpose lanes, the analysis would provide little benefit in terms of informing decision making and selection of the Build Alternative.

Therefore, the quantitative safety analysis focuses on the review of available CMFs and state-specific SPFs developed for Virginia and their application to the conversion from two HOV lanes to three HOT lanes and improvements to the Eads Street Interchange.

8.2.1 HOV Lane Conversion from Two to Three Lanes

The Build Alternative would convert the two existing reversible HOV lanes to HOT lanes and construct an additional HOT lane between Turkeycock Run and Eads Street near the Pentagon. The additional HOT lane would be constructed along the existing roadway alignment of the existing HOV lanes between the northbound and southbound I-395 general purpose lanes by reducing the travel lane width from 12-feet to 11-feet and reducing the shoulder widths. The additional travel lane has the potential to increase safety by increasing capacity and thus reducing congestion, which is frequently a contributing factor in crashes. However, the Build Alternative also requires Design Exceptions and Design Waivers that have the potential to decrease safety and increase the potential for crashes.

The Design Exception and Design Waiver approval process considers the safety implications of a proposed exception or waiver and mitigation measures that would have the potential to address degradation of safety as a result of the Build Alternative. **Chapter 5** includes a summary of Design Exceptions and Design Waivers associated with the Build Alternative and a more detailed discussion of the factors considered during the approval process.

The Crash Modification Factors Clearinghouse is a web-based comprehensive listing of available crash modification factors (CMF) including both those included and not included in the HSM. A CMF is a multiplicative factor used to compute the expected number of crashes after implementing a given countermeasure at a specific site. CMFs with higher reliability are typically included in the HSM. The Crash Modification Factors Clearinghouse and the HSM do not provide a CMF for converting a two-lane reversible HOV facility to a three-lane reversible HOV/HOT facility. As part of the development of the Smart Scale prioritization process, VDOT developed planning-level CMFs to calculate the safety consequences of various improvement alternatives under consideration. A CMF of 0.90 is provided for directional widening of an urban freeway from two to three lanes. Based on this, the predicted crash

frequency for all crashes along I-395 from Turkeycock Run to Eads Street may decrease by approximately 10 percent or approximately 7 crashes per year in 2040 (see **Table 8-9**).

A summary of individual design elements associated with the proposed Build Alternative that may contribute to safety along I-395 within the study limits is discussed below. Many of the design elements are not quantifiable in terms of their impacts on safety. Where quantifiable benefits cannot be documented, a qualitative discussion of the safety impacts is provided. CMFs discussed below are primarily outlined in Chapter 18 of the HSM which does not account for reversible lanes and are based on two-direction freeway segments (see discussion above). Furthermore, CMFs are developed assuming a facility operates in the same direction at all times. The proposed I-395 Express Lanes would be reversible, single-direction travel lanes; therefore, the CMFs are applied with the intention of identifying the relative safety of various design elements and are not intended to predict the frequency of future crashes. For these reasons, caution should be used when applying the methodologies of the HSM (including CMFs) to the Build Alternative.

- The two existing 12-foot HOV lanes would be reduced to three 11-foot HOT lanes from the Turkeycock Run interchange to approximately the Memorial Drive overpass. Chapter 18 of the HSM, provides a CMF to describe the relationship between lane width and predicted crash frequency for freeway segments. Based on this, the predicted crash frequency for multi-vehicle and single-vehicle crashes of all severities may increase by approximately 4 percent or less than one crash per year in 2040.

- The inside shoulder width for travel in the northbound direction of the HOV lanes would be decreased to 2 feet to accommodate the additional HOT lane. Currently, a 10-foot inside shoulder (minimum) is provided on both sides of the HOV lanes. Chapter 18 of the HSM provides a CMF to describe the relationship between inside shoulder width and predicted crash frequency for freeway segments. The CMF is applicable to all crash types of all severities. Based on this, reducing the inside shoulder may increase crash frequency for northbound fatal and injury crashes by approximately 15 percent or 1.5 crashes per year in 2040 and increase crash frequency for northbound property damage only crashes by approximately 13 percent or approximately 5 crashes per year in 2040.

- The outside shoulder width for travel in the southbound direction of the HOV lanes would be decreased to 2 feet to accommodate the additional HOT lane. Currently, a 10-foot outside shoulder (minimum) is provided on both sides of the HOV lanes. Chapter 18 of the HSM provides a CMF to describe the relationship between outside shoulder width and predicted crash frequency for freeway segments. The CMF is applicable to single-vehicle crashes only of all severities. Based on this, reducing the outside shoulder may increase the frequency of single-vehicle, southbound fatal and injury crashes by approximately 2.2 crashes per year in 2040 and increase the frequency of single-vehicle, southbound property damage only crashes by approximately 3.6 crashes per year in 2040.

- Currently, a double-faced guardrail is generally provided on both sides of the HOV lanes between Turkeycock Run and approximately Shirlington Road to separate the HOV lanes from the general purpose lanes. As part of the proposed improvements, the existing double-faced guardrail would be replaced with concrete barrier. Per Section 18.10 of the HSM (1st Edition), "the predictive method does not distinguish between barrier types (i.e., cable barrier, concrete barrier, guardrail, and bridge rail in terms of their possible different influence on crash severity." FHWA identifies three basic categories of median barriers: rigid barrier systems (e.g., concrete barrier), semi-rigid

barrier systems (e.g., guardrail), and flexible barrier systems (e.g., high-tension cable). Per FHWA, concrete barriers "have proven to be highly effective in locations with high traffic volumes and high speeds" (USDOT FHWA, 2015). Additionally, the need for little to no maintenance following a crash with a concrete barrier as compared to guardrail is likely to reduce the vulnerability of subsequent crashes that could occur prior to addressing the maintenance need. It should be noted that the HSM includes a CMF for the presence of a median barrier; however, it is not applicable to the Build Alternative.

- Traffic Management System (TMS) elements would include a suite of closed circuit television cameras (CCTV) providing full video coverage of the Express Lanes to the Express Lanes Operations Center, microwave vehicle detectors to monitor traffic flow, and a Lane Use Management System (LUMS) consisting of lane use arrows above each lane. The LUMS would provide advance notice of any closures or breakdowns to approaching motorists and would include variable speed limit signs, advising motorists of the desired speed based on downstream traffic conditions. Per the CMF Clearinghouse, installing variable speed limit signs has a CMF of 0.92. Based on this, installing variable speed limit signs may decrease all crashes by 8 percent or approximately 6 crashes per year in 2040. No CMFs are available for the other TMS elements; however, installation of these devices would improve the Express Lanes operators' ability to remotely detect and visually verify reported incidents and congestions levels. This would lead to more rapid response to and clearing of incidents. The TMS including the LUMS would enable the Express Lanes operators to provide more reliable information to motorists in the Express Lanes, which reduces the potential for secondary crashes.

Table 8-9 summarizes the relevant CMFs (directional widening, lane width, inside shoulder width, outside shoulder width, and variable speed limit signs) discussed above. The CMFs were applied to the northbound and southbound HOV/HOT lanes from Turkeycock Run to Eads Street and the existing four-year crash study period to calculate the predicted crash frequency per year for each element. However, as previously noted, the results are intended to identify relationships between design elements and safety but are not intended to predict the frequency of future crashes due to the limitations of the HSM for this situation.

Table 8-9: Crash Modification Factor Summary of Design Elements for I-395 HOV/HOT Lanes Turkeycock Run to Eads Street

Design Element	Crash Type[1] (Severity)	CMF[2]	CMF Star Rating[3]	Applicable Direction	Historical Crash Frequency[4] (crashes per year)	2040 Crash Frequency[5] (crashes per year)	2040 Build Predicted Crash Frequency[2] (crashes per year)	Future Change in Crashes per Year
Directional Widening from 2 to 3 Lanes[6]	MV; SV (all severities)	0.900	N/A	NB & SB	51.3	72.0	64.8	-7.2
Lane Width[7] Reduce from 12 to 11 feet	MV; SV (fatal + injury)	1.038	N/A	NB & SB	9.5	13.3	13.9	+0.6
Inside Shoulder Width[8] Reduce from 10 to 2 feet	MV; SV (fatal + injury)	1.148	N/A	NB	7.3	10.2	11.7	+1.5
	MV; SV (PDO)	1.130	N/A		27.0	37.9	42.8	+4.9
Outside Shoulder Width[9] Reduce from 10 to 2 feet	SV (fatal + injury)	1.924	N/A	SB	1.8	2.5	4.7	+2.2
	SV (PDO)	1.635	N/A		4.0	5.6	9.2	+3.6
Install Variable Speed Limit Signs[10]	MV; SV (all severities)	0.920	★★★★	NB & SB	51.3	72.0	66.2	-5.8

[1] MV = Multiple Vehicle Crashes; SV = Single Vehicle Crashes; PDO = Property Damage Only
[2] CMFs found in Chapter 18 of the HSM do not account for reversible, one-directional lanes (e.g., I-395 Express Lanes); therefore, the results are intended to identify relationships between design elements and safety and are not indented to predict the frequency of future crashes
[3] The star quality rating indicates the quality or confidence in the results of the study that produced the CMF and is based on a scale of 1 to 5, where 5 indicates the highest rating. CMFs for lane width, inside shoulder width, and outside shoulder width were calculated based on equations provided in the HSM, 1st Edition, 2014 Supplement and the CMF for widening was provided by VDOT, neither of which includes star ratings
[4] Four-year crash study period from January 1, 2012 through December 31, 2015
[5] 2040 crash frequency calculated based on the ratio of 2040 Build traffic volumes to existing traffic volumes
[6] Source: VDOT *Expected Roadway Project Crash Reductions for HB2 Safety Factor Evaluation*, August 2015; Turkeycock Run to Eads Street
[7] Source: *Highway Safety Manual* Equation 18-25; Turkeycock Run interchange to Memorial Drive overpass
[8] Source: *Highway Safety Manual* Equation 18-26; Turkeycock Run to Eads Street
[9] Source: *Highway Safety Manual* Equation 18-35; Turkeycock Run to Eads Street
[10] Source: CMF Clearinghouse – CMF ID 3340; Turkeycock Run to Eads Street

According to Chapter 3 of the HSM, there is limited understanding of the interrelationships between various countermeasures; therefore, it is difficult to quantify the impacts of multiple CMFs. One proposed method of quantifying multiple CMFs is to multiply the CMFs together; however, this assumes that the countermeasures are independent of each other. Many of the CMFs shown in **Table 8-9** address similar crash types and could be considered dependent; therefore, quantifying the combined impact of all the project elements was not pursued. As noted above, although many of the elements of the project that would provide safety benefits including the additional of a third travel lane, the TMS, and the installation of concrete median barrier are likely to reduce the potential for crashes, their benefits are not quantifiable with CMFs. Therefore, the potential increase in crashes due to the reduction of typical section elements (i.e., lane width and shoulder width) may be offset by these other design elements in addition to the improvements at the Eads Street Interchange as discussed in **Section 4.2.2.**

In addition to CMFs, Part C (Predictive Method) of the HSM includes safety performance functions (SPFs), which can be used to estimate the expected crash frequency of a facility. Although the HSM does not account for the influence of reversible lanes, the Virginia Center for Transportation Innovation and Research's *Development of Safety Performance Functions for Multilane Highway and Freeway Segments Maintained by the Virginia Department of Transportation* (published May 2014) includes an SPF for use on freeway segments that are applicable to one direction of travel. The document includes separate roadway types for an urban freeway segment within and outside of an interchange area. As such, I-395 from Turkeycock Run to Eads Street was segmented into these two different roadway types. Interchange areas were assumed to begin/end at the approximate location of the entrance or exit ramps to/from the I-395 HOV lanes. It should be noted that the SPF used for these calculations does not explicitly account for the design elements discussed above in the summary of the application of CMFs.

A summary of the predicted total crashes per year and predicted fatal and/or injury crashes per year are shown in **Tables 8-10 and 8-11**, respectively, for existing conditions, future 2040 No Build conditions with two lanes, and future 2040 Build conditions considering existing and future forecasted traffic volumes. As shown, the calculations suggest a reduction of approximately 21 percent of all crashes and a reduction of approximately 11 percent of fatal and/or injury crashes when comparing 2040 Build conditions to 2040 No Build conditions.

Table 8-10: I-395 HOV/HOT Lanes, Turkeycock Run to Eads Street Predicted Crash Frequency (Total Crashes)

Segment	Length[2] (miles)	Predicted Total Crashes per Year[1]		
		Existing[3]	2040 No Build[3]	2040 Build[4]
Turkeycock Run Interchange Area	0.61	10.1	16.1	15.4
Turkeycock Run to Seminary Road	1.49	18.5	35.3	24.2
Seminary Road Interchange Area	0.92	16.2	23.9	22.9
Seminary Road to Shirlington Road	1.56	22.8	35.3	24.5
Shirlington Road Interchange Area	0.2	3.9	5.4	5.3
Shirlington Road to Washington Blvd	1.31	22.1	34.7	24.3
Washington Blvd Interchange Area	0.24	4.0	5.3	5.4
Washington Blvd to Eads Street	0.47	4.1	5.7	5.1
Eads Street Interchange Area	0.23	3.0	3.8	3.9
Total	**7.03**	**104.7**	**165.5**	**131.0**
Change from 2040 No-Build to 2040 Build		**- 34.5 crashes/year (-21%)**		

[1] Predicted crash frequency based on Equation 3 and Table 2 of the Virginia Center for Transportation Innovation & Research's *Development of Safety Performance Functions for Multilane Highway and Freeway Segments Maintained by the Virginia Department of Transportation* (published May 2014)
[2] Segment length measurements are approximate and based on Google aerial imagery
[3] Calculated using the Safety Performance Function for an Urban Freeway Segment – 4 lanes for one direction of travel
[4] Calculated using the Safety Performance Function for an Urban Freeway Segment – 6 lanes for one direction of travel

Table 8-11: I-395 HOV/HOT Lanes, Turkeycock Run to Eads Street Predicted Crash Frequency (Fatal + Injury Crashes)

Segment	Length[2] (miles)	Predicted Fatal + Injury Crashes per Year[1]		
		Existing[3]	2040 No Build[3]	2040 Build[4]
Turkeycock Run Interchange Area	0.61	2.7	4.2	4.6
Turkeycock Run to Seminary Road	1.49	5.3	9.7	7.5
Seminary Road Interchange Area	0.92	4.3	6.3	6.8
Seminary Road to Shirlington Road	1.56	6.4	9.7	7.6
Shirlington Road Interchange Area	0.2	1.0	1.4	1.6
Shirlington Road to Washington Blvd	1.31	6.2	9.5	7.6
Washington Blvd Interchange Area	0.24	1.1	1.4	1.6
Washington Blvd to Eads Street	0.47	1.2	1.6	1.5
Eads Street Interchange Area	0.23	0.8	1.0	1.2
Total	**7.03**	**29.0**	**44.8**	**40.0**
Change from 2040 No-Build to 2040 Build		**- 4.8 crashes/year (-11%)**		

[1] Predicted crash frequency based on Equation 3 and Table 3 of the Virginia Center for Transportation Innovation & Research's *Development of Safety Performance Functions for Multilane Highway and Freeway Segments Maintained by the Virginia Department of Transportation* (published May 2014)
[2] Segment length measurements are approximate and based on Google aerial imagery
[3] Calculated using the Safety Performance Function for an Urban Freeway Segment – 4 lanes for one direction of travel
[4] Calculated using the Safety Performance Function for an Urban Freeway Segment – 6 lanes for one direction of travel

During 2013 and 2014, the reversible HOV lanes along I-95/I-395 from Garrisonville Road to the Turkeycock Run interchange, located immediately south of the I-395 Express Lanes study limits, were converted from HOV lanes to Express Lanes as part of the I-95 Express Lanes project, and tolling began on December 29, 2014. The section of I-95/I-395 from Prince William Parkway to the Turkeycock Run interchange was converted from two HOV lanes to three Express Lanes and has a typical section similar to the typical section for the Build Alternative along I-395 from Turkeycock Run to Eads Street (i.e., I-395 Express Lanes Northern Extension). Before and after crash rates along this section of I-95/I-395 were compared to evaluate the relative frequency of crashes reported within the two-lane HOV typical section before construction of the Express Lanes to the three-lane Express Lanes typical section after construction of the Express Lanes. For the purposes of this comparison, the "before" period is a one-year period from January 1, 2012 through December 31, 2012 and the "after" period is an approximately 1.75 year period from January 1, 2015 through September 30, 2016. As shown in **Table 8-12**, crash rates per 100 million VMT decreased from 53.5 during the "before" period to 47 during the "after" period, or by approximately 12 percent. Additionally, the fatality rate per 100 million VMT decreased from 0.67 during the "before" period to 0.00 during the "after" period as there were no reported fatalities in the Express Lanes during the "after" study period. This indicates that there has not been an increase in crashes as a result of the reduced lane widths and reduced shoulder widths in the I-95/I-395 Express Lanes and that mitigation measures that have been implemented in conjunction with the Express Lanes project have compensated for any potential increases in crashes as a result of the lane and shoulder width reductions.

Table 8-12: I-95/I-395 Express Lanes, Prince William Parkway to Turkeycock Run Interchange Crash Rate Comparison for Conversion from Two Lanes to Three Lanes

I-95/I-395 Express Lanes Prince William Parkway to Turkeycock Run Interchange	"Before" Study Period (1/1/12 – 12/31/12)	"After" Study Period (1/1/2015 – 9/30/2016)[1]
Crashes per 100 Million VMT	53.5	47
Fatalities per 100 Million VMT	0.67	0.00

[1] Crash rates calculated and provided by Transurban

8.2.2 Eads Street Interchange

Several alternatives were considered at the Eads Street Interchange as discussed in **Section 4** of the IMR and the ***Alternatives Technical Report*** (VDOT, 2016b). The Dual Reversible Ramps concept would increase capacity to and from Eads Street by dividing traffic between two ramps - one for traffic traveling to and from the Pentagon and one for traffic traveling to and from Army Navy Drive and installing traffic signals at the two ramp termini along Eads Street. Increasing the capacity of the ramps serving the Eads Street Interchange and installing traffic signals at the ramp termini would reduce the potential for congestion-related crashes at the Eads Street Interchange. Based on a review of the crash data, a total of three crashes were reported on the Eads Street ramps to/from the HOV lanes (one ramp crash was reported on each of the northbound HOV off-ramp to Eads Street, the southbound HOV off-ramp to Eads Street, and the southbound HOV on-ramp from Eads Street. At the two intersections along Eads Street formed by the northbound and southbound HOV ramp termini, a relatively low number of crashes were reported. One angle crash was reported at the Eads Street at southbound HOV ramps intersection and three crashes (one

angle crash; two rear end crashes) were reported at the Eads Street at northbound HOV ramps intersection. During the AM peak period, there is recurring congestion within the northbound HOV lanes on the approach to Eads Street. A total of two crashes were reported near the diverge point of the northbound HOV to Eads Street ramp; however, an additional five crashes were reported along the northbound HOV lanes within approximately 1,000 feet of the diverge point. Recurring congestion along the northbound HOV lanes approaching D.C. is likely a contributing circumstance to these crashes.

Another key element of the Eads Street Interchange improvements is the removal of the ramp from the southbound I-395 HOV lanes to the southbound I-395 general purpose lanes located just south of the Eads Street Interchange. Currently, there is a weave condition between the on-ramp from Eads Street and the off-ramp to the general purpose lanes. Based on a review of crash data, this location has the highest crash rate reported during the four-year study period with a crash rate of 134 to 198 crashes per 100 million VMT compared to the average corridor-wide rate of 39 crashes per 100 million VMT within the southbound HOV/HOT lanes. Of the 68 crashes reported within the southbound HOV lanes from Turkeycock Run to Eads Street, 21 (31 percent) crashes occurred at this location (i.e., approximately Eads Street to approximately Joyce Street). Three additional crashes were reported on this ramp. Removal of this ramp would eliminate the weave condition and reduce the potential for crashes in this area.

There are no available CMFs that are applicable to the overall interchange configuration proposed at Eads Street due to the atypical configuration of the reversible ramps; however, available CMFs applicable to specific elements of the interchange are summarized in **Table 8-13**.

Several CMFs are available on the CMF Clearinghouse for the conversion of an unsignalized intersection to a signalized intersection; however, in virtually all cases, the CMFs were developed based on data from traditional intersections (i.e., intersections with permanent configurations and operations that do not change by time of day) unlike the Eads Street at I-395 HOV/HOT lane ramp terminals intersections. As such, selecting the most appropriate CMF is very subjective and the CMF is most likely not directly applicable to this situation. As noted previously, VDOT developed planning-level CMFs to calculate the safety consequences of various improvement alternatives under consideration as part of the development of the Smart Scale prioritization process. A CMF of 0.65 is provided for installing a traffic signal. By applying this CMF, the predicted crash frequency for all crashes at Eads Street at the I-395 HOV/HOT lane ramp termini may decrease by approximately 35 percent or approximately 0.5 crashes per year.

There are no CMFs for converting from a weave condition to a single merge condition along the southbound I-395 HOV/HOT lanes between Eads Street and the off-ramp to the southbound general purpose lanes. However, the removal of the short weave section and the elimination of conflict points along the freeway are anticipated to have a positive safety benefit by reducing the number of merging and weaving vehicles in this area. The removal of the southbound weave allows for the separation and lengthening of the northbound HOV diverge ramp to Eads Street in the AM peak period when the HOT lanes are operating in a northbound direction. It should be noted that the removal of the ramp from the southbound I-395 HOV lanes to the southbound general purpose lanes will change current driver expectations for motorists that currently use the ramp to be removed. To improve motorist awareness of this changed condition, as part of the conceptual signing plan (see **Appendix H – Roll 8**), flashing beacons are proposed with the dynamic message sign (DMS) located along the southbound I-395 HOV lanes at the entrance to the I-395 Express Lanes.

Today, northbound HOV motorists destined for both the Pentagon and Army Navy Drive use a single right side off-ramp that has a deceleration length of approximately 1,000 feet. Under proposed conditions, northbound motorists in the HOT lanes destined for the Pentagon will use a left side exit approaching Eads Street that will operate as a lane drop with approximately 2,000 feet of storage between Eads Street and the gore along the northbound HOT lanes. Northbound HOV motorists destined for Army Navy Drive will continue to use the existing right side exit. The CMF Clearinghouse provides a function to calculate a CMF for changing the length of a deceleration lane on a one-lane freeway exit ramp. Per the function, increasing a deceleration length from 1,000 feet to 2,000 feet is anticipated to reduce all crash types and severities by approximately 34 percent. It should be noted that this CMF does not account for the separation of traffic to the left and right anticipated due to the proposed ramp configuration; therefore, the anticipated safety benefits are intended to identify the relationship between the design elements (i.e., lengthening of the deceleration lane for northbound HOV motorists destined to the Pentagon) and may not explicitly predict future crash frequency.

Table 8-13: Crash Modification Factor Summary for Eads Street Interchange

Location - Design Element	Crash Type[1] (Severity)	CMF[2]	CMF Star Rating[3]	Historical Crash Frequency[4]	Predicted Crash Frequency[2]	Change in Crashes per Year
				Crashes per Year		
Eads Street at NB I-395 HOV Ramps - Conversion from stop control to signal control[5]	MV; SV (all severities)	0.65	N/A	1.0	0.65	-0.35
Eads Street at SB I-395 HOV Ramps - Conversion from stop control to signal control[5]	MV; SV (all severities)	0.65	N/A	0.25	0.16	-0.11
SB I-395 HOV Lanes – Weave between Eads Street and Off Ramp to GP Lanes - Ramp removal	N/A	N/A	N/A	4.5	N/A	N/A
NB I-395 HOV Diverge to Eads Street - Increase capacity and storage lengths[6]	MV; SV (all severities)	0.66	N/A	0.5	0.33	-0.17

[1] MV = Multiple Vehicle Crashes; SV = Single Vehicle Crashes; PDO = Property Damage Only
[2] CMFs typically do not account for daily changes in operations and configurations such as those required due to the reversible lanes along the I-395 HOV/HOT lanes; therefore, the results are intended to identify relationships between design elements and safety and are not indented to predict the frequency of future crashes
[3] The star quality rating indicates the quality or confidence in the results of the study that produced the CMF and is based on a scale of 1 to 5, where 5 indicates the highest rating. The CMF for installing a traffic signal was provided by VDOT, which does not include a star rating
[4] Four-year crash study period from January 1, 2012 through December 31, 2015
[5] Source: VDOT *Expected Roadway Project Crash Reductions for HB2 Safety Factor Evaluation*, August 2015
[6] Source: CMF Clearinghouse, CMF ID 3042

8.3 SAFETY AND CRASH ANALYSIS FINDINGS

Overall it can be concluded that the Build Alternative should not have a significant adverse impact on the safety of the I-395 study corridor. Recurring daily congestion due to heavy commuter traffic that extends for many hours during both the morning and evening peak periods creates the potential for crashes along the I-395 corridor in both the general purpose and HOV/HOT lanes. The predominant crash type is rear end crashes, which account for 56 percent of all crashes and are frequently attributed to congestion. The Build Alternative would reduce recurring congestion during the AM and PM peak periods thereby reducing the potential for congestion-related crashes and improve safety along the corridor as compared to the No Build Alternative.

As part of the conversion of the two existing HOV lanes to three HOT lanes, the lane widths within the HOV lanes would be reduced to 11 feet and the western shoulder would be reduced to 2 feet to accommodate the third HOT lane within the existing footprint of the HOV lanes facility. A quantitative crash analysis using Highway Safety Manual (HSM) methodologies was performed to document the safety impacts associated with the modifications to the typical section. The analysis indicates that the potential increase in crashes due to the reduction of typical section elements (i.e., lane width and shoulder width) may be offset by mitigating design features including the addition of a third lane and the installation of TMS elements. Additionally, modifications to the Eads Street Interchange would have a positive safety benefit on congestion-related crashes reported south of the interchange along both the northbound and southbound HOV lanes.

9. LAND USE

9.1 EXISTING LAND USE

Existing land use is discussed in **Section 3.2**. **Figure 3-1** (*Volume 2*) shows the land uses within the study area.

9.2 FUTURE LAND USE PLANS

The following is a brief description of each locality's master plan for future land use and transportation goals.

9.2.1 Fairfax County

Fairfax County's Concept for Future Development Map, adopted June 2012, depicts the study area region of Fairfax as having suburban neighborhood development (Fairfax County, 2012). The Fairfax County Comprehensive Plan, 2013 Edition lists the Franconia-Springfield Transit Station Area region inside of the study area as mixed-use development, industrialization (outside of the study area but along the I-395 corridor and north of I-495), and prioritizes the creation of urban patterns that support mass transit (Fairfax County, 2015b). The Fairfax County Transportation Plan, amended September 2, 2015, depicts the study area within Fairfax as having an HOV road (Fairfax County, 2015a). Therefore Fairfax has included an I-395 expansion / HOT lanes consideration in their future transportation plans.

9.2.2 City of Alexandria

The Alexandria Master Plan & Citywide Chapters (City of Alexandria, 2016a), Alexandria's goals and objectives are to "promote mixed use development in major development and redevelop areas," offering a wide variety of transportation options which encourage uses other than single-occupancy vehicle use. The City of Alexandria's Comprehensive Transportation Master Plan, with an updated transit section dated January 12, 2013, stresses the need to expand and improve public transportation systems to provide an alternative to private vehicle use throughout the locality (City of Alexandria, 2013).

9.2.3 Arlington County

Arlington plans to maintain current residential areas and open spaces while creating high-density, mixed-use development for future growth. Arlington's Master Transportation Plan, updated April 2016, depicts the I-395 corridor as a High-Occupancy-Incentive Corridor (Arlington County, 2016). The document further states the need to encourage high-occupancy travel through the use of "facilities, restrictions, fees, and other measures" which can include HOV lanes, HOT lanes, congestion fees, and ramp metering (Arlington County, 2016).

9.3 ACTIVITY CENTERS

The Metropolitan Washing Council of Governments (MWCOG) published a Regional Activity Centers Map (2013) that lists five activity centers within the study area: Landmark / Van Dorn, Beauregard, Shirlington, Pentagon, and Pentagon City. MWCOG's 2014 report, *Place + Opportunity: Strategies for Creating Great Communities and a Stronger Region,* states that a major redevelopment plan has been put into place for the Landmark / Van Dorn and Beauregard activity centers (MWCOG, 2014). Redevelopment

plans in these areas will lead to "urban neighborhoods containing a mix of uses, open space, a variety of housing opportunities, and integrated transit." The Shirlington activity center is described an example of a community that is internally and externally well-connected with its own strong market. Development of this activity center includes infill development with an emphasis on adding parks and recreational areas. Pentagon and Pentagon City currently do not have development plans in place.

9.4 CONSISTENCY WITH PLANS AND POLICY

The proposed improvements to the I-395 corridor are consistent with the master plans for all of the localities, as discussed in **Section 9.2**. All three plans discuss the need to improve the transportation system either through restricting single-occupancy vehicle use through fees or other restrictions or by expanding the public transportation systems throughout the region. Additionally, the Fairfax County and Arlington County master plans specifically include improvements to the I-395 corridor through HOV or HOT Lanes.

10. ENVIRONMENTAL COMPLIANCE

Pursuant to the National Environmental Policy Act of 1969, as amended (NEPA), and in accordance with FHWA regulations[1], an Environmental Assessment (EA) has been prepared to analyze and document the potential social, economic, and environmental effects associated with the proposed transportation improvements. The EA, dated September 2016, identifies and further explains the environmental resources that are within the study area and discusses the potential impact that the project would have on those resources. A summary of the EA is included in **Appendix K**.

Permits identified by the EA that are likely needed include: the Section 404 permit from the USACE, a Virginia Water Protection Individual Permit from the Virginia Department of Environmental Quality (VDEQ) (which serves as the Section 401 certification), a subaqueous bottomland permit from Virginia Marine Resources Commission (VMRC), and registration under the VDEQ General Permit for Discharges of Stormwater from Construction Activities with a project specific Stormwater Pollution Prevention Plan (SWPPP). Compensatory mitigation would be required for permanent impacts to streams and wetlands resulting from the project. All areas with temporary impacts would be required to be restored to the areas' original contours and re-vegetated with the same or similar species, per existing regulations and standard permit conditions.

[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.

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INTERSTATE 395 EXPRESS LANES NORTHERN EXTENSION

VDOT

U.S. Department of Transportation
Federal Highway Administration